The importance of including satellite remotely-sensed ocean colour analyses in the planning of airborne LiDAR bathymetry detection

César Fuentes-Yaco, Stephen Parsons, Melanie Hardy, Stephanie Clay, Edward Horne, Brent Law, Carla Caverhill, Tim Perry, Shauna Neary, Christopher LeBlanc, René Chénier, Marc-André Faucher, Michel Breton, Danial Mariampillai

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Canadian Technical Report of Fisheries and Aquatic Sciences

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The importance of including satellite remotely-sensed ocean colour analyses to the planning of airborne LiDAR bathymetry detection

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ABSTRACT

Fuentes-Yaco, C., Parsons, S., Hardy, M., Clay, S., Horne, E., Law, B., Caverhill, C., Perry, T., Neary, S., LeBlanc, C., Chénier, R., Faucher, M-A, Breton, M., Mariampillai, D. 2020. The importance of including satellite remotely sensed ocean colour analyses to the planning of airborne LiDAR bathymetry detection. Can. Tech. Rep. Fish. Aquat. Sci. 3366 : xli + 299 p.

This document summarizes the results of a collaboration between the Canadian Hydrographic Service (CHS) and the Science Branch of Ecosystem and Ocean Science Division within the Department of Fisheries and Oceans Canada (DFO). The study concerns CHS's use of Airborne LiDAR Bathymetry (ALB) in obtaining data to produce hydrographic charts, where the primary challenge is to time LiDAR flights to coincide with when the water is clear, so that the bottom can be detected. This report briefly discusses the issues of water clarity and proposes a solution to the problem, demonstrating how water clarity estimates derived from remotely sensed data can impact the ALB data collection.

The report includes *in situ* physical, chemical, and biological data collected from various research sites in Lobster Bay (southwestern Nova Scotia in 2012), along the Northumberland Strait in the southern Gulf of St. Lawrence (2015 to 2017), and the Pacific Ocean around the Haida Gwaii archipelago in 2018. Historical ocean-colour remotely sensed Total Suspended Matter (TSM) data from MERIS, as well as specifically-developed information on water clarity (Secchi Disk Depth –SDD) and TSM computed at full $\text{MODIS}_{\textit{Aqua}}$ spatial resolution (250 m/pixel), became fundamental in planning airborne LiDAR bathymetry missions. NASA's products of chlorophyll *a*, Diffuse Attenuation Coefficients for Downwelling Irradiance at 490 nm and 532 nm, and Sea Surface Temperature (SST) at the same spatial resolution were also helpful in interpreting the final maps constructed by LiDAR's approach.

In areas where were water clarity and meteorological conditions are highly variable, the use of remote sensing data for water clarity analysis was especially valuable. The high resolution and large spatial coverage of data also allowed for alternate planning of ALB survey sites in near real-time. Prior to using the $\text{MODIS}_{\text{aqua}}$ SDD models, local variations were very hard to understand. The extension of this ocean colour approach to sensors such as OLCI and VIIRS would be advantageous in the future to allow continuity of this work as the MODIS sensors age and degrade.

The cost of deep water ALB surveys is very high, but given the proper water clarity conditions it can be very productive and extremely cost-effective. The availability of $\text{MODIS}_{\text{aqua}}$ based SDD and TSM dramatically increased ALB mission productivity, improved the overall quality of data by optimizing surveys with the best available water clarity, significantly improved cost benefits by reducing unnecessary (and costly) ALB reconnaissance flights and assisted with planning scheduled downtime during periods of less than ideal water clarity conditions.

RÉSUMÉ

Fuentes-Yaco, C., Parsons, S., Hardy, M., Clay, S., Horne, E., Law, B., Caverhill, C., Perry, T., Neary, S., LeBlanc, C., Chénier, R., Faucher, M-A, Breton, M., Mariampillai, D. 2020. The importance of including satellite remotely-sensed ocean colour analyses to the planning of airborne LiDAR bathymetry detection. Can. Tech. Rep. Fish. Aquat. Sci. 3366 : xli + 299 p.

Ce document résume les résultats d'une collaboration entre le Service hydrographique du Canada (SHC) et la Direction des sciences de la Division des écosystèmes et des océans au sein du ministère des Pêches et des Océans Canada (MPO). L'étude porte sur l'utilisation par le SHC de la bathymétrie LiDAR aéroportée (BLA) pour obtenir des données afin de produire des cartes hydrographiques, où le principal défi est de synchroniser les vols LiDAR avec le moment où l'eau est claire afin que le fond puisse être repéré. Ce rapport examine brièvement les problèmes de clarté de l'eau et propose une solution au problème, démontrant comment les estimations de clarté de l'eau dérivées de données télédétectées peuvent avoir un impact sur la collecte de données BLA.

Le rapport comprend des données physiques, chimiques et biologiques recueillies *in situ* provenant de divers sites de recherche dans Lobster Bay (sud-ouest de la Nouvelle-Écosse en 2012), le long du détroit de Northumberland dans le sud du golfe du Saint-Laurent (2015 à 2017) et dans l'archipel de Haida Gwaii au large des côtes de la Colombie-Britanique dans l'océan Pacifique (2018). Les données historiques des matières en suspension (TSM) télédétectées par MERIS, ainsi que des informations spécifiquement développées sur la clarté de l'eau telle la profondeur de pénétration verticale de la lumière dans l'eau par la méthode du disque de Secchi (SDD) et TSM calculées à pleine résolution spatiale du $MODIS_{Aqua}$ (250 m / pixel), sont devenues fondamentales dans la planification des missions de bathymétrie LiDAR aéroportée. Des produits de la NASA tel que la chlorophylle *a*, les coefficients d'atténuation diffuse pour l`éclairement descendant à 490 nm et 532 nm et la température de la surface de la mer (SST) à la même résolution spatiale ont également été utiles pour interpréter les cartes finales construites par l'approche LiDAR.

Dans les zones où la clarté de l'eau et les conditions météorologiques sont très variables, l'utilisation de données de télédétection pour l'analyse de la clarté de l'eau était particulièrement utile. La haute résolution et la grande couverture spatiale des données ont également permis une planification alternative des sites d'évaluation par BLA en temps quasi réel. Avant d'utiliser les modèles SDD dérivés du $MODIS_{Aqua}$, les variations locales étaient très difficiles à comprendre. Dans le future, l'extension de cette approche de la couleur de l'océan à des capteurs tels que OLCI et VIIRS serait avantageuse et permettrait la continuité de ce travail à mesure que le capteur MODIS vieilli et se dégrade.

Le coût des levés BLA en eau profonde est très élevé, mais compte tenu des conditions de la clarté de l'eau, il peut être très productif et extrêmement rentable. La disponibilité des SDD et TSM basés sur $MODIS_{Aqua}$ a considérablement augmenté la productivité des missions BLA, amélioré la qualité globale des données en optimisant les recherches avec la meilleure clarté de l'eau disponible, considérablement amélioré les coûts en réduisant les vols de reconnaissance BLA inutiles (et coûteux) et aidé à planifier les temps d'arrêt programmés pendant des périodes de conditions de clarté de l'eau moins qu'idéales.

1. INTRODUCTION

1.1 PURPOSE AND OBJECTIVE

This project is part of a collaboration between the Canadian Hydrographic Service (CHS) and the Science Branch of Ecosystem and Ocean Science Division within the Department of Fisheries and Oceans Canada (DFO). As part of a large survey program within CHS, the use of Airborne LiDAR Bathymetry (ALB) is useful in obtaining data to produce hydrographic charts. The principal challenge in this large program lies in planning the LiDAR flights to coincide with times when the water is clear, so the bottom can be detected. This report briefly discusses the issues of water clarity and proposes a solution to the problem, illustrating how water clarity estimated by remotely-sensed data can positively impact the ALB data collection. Data from Medium Resolution Imaging Spectrometer (MERIS) and Moderate Resolution Imaging Spectrometer (MODIS*Aqua*) are briefly assessed and a corresponding methodology developed to examine water clarity using this satellite-derived information.

It is well known that the main constituent affecting water clarity in open waters is the chlorophyll *a* pigment from phyto and zooplankton, which often occurs as a bloom. This large concentration of living material dissipates slowly, conferring mostly a green colour. Coastal areas are dominated by Total Suspended Matter (TSM), typically composed of sediment and particulate of various size and composition, which usually “settles out” rapidly after resuspension. Another predominant constituent is Coloured Dissolved Organic Matter (CDOM) composed of tannins, humic, and yellow substances, usually from decaying detritus which takes longer to settle down. In general, as the amount of organic matter increases it causes the water to appear greener, which fades to yellow-green, and then brown as the matter decays.

Bathymetric LiDAR uses specific spectral wavelengths which can be isolated for a detailed analysis of the impact on the LiDAR signal, allowing for an overall spatial analysis of light depth extinction and data quality that is not available from other methodologies. Successful Airborne LiDAR Bathymetry detection requires high transparency of the water column, however this information has not always been available before flying the survey. Satellite derived ocean colour data can be used to model water clarity with synoptic spatial and temporal coverage by the use of sensitive radiometers on board the satellites. The near real-time satellite water colour analysis is vitally important in the session planning of bathymetric LiDAR projects. It results in significant economic benefits and project planning efficiencies that have direct cost savings and immediate positive impacts on data quality.

In addition, both satellite remote sensing and ALB can be used to acquire spatial and temporal information in coastal waters that would be difficult to collect by physical methodology, thus these are effective alternative tools for obtaining information about coastal waters. It is worth mentioning that Case II waters dominate coastal regions, where land drainage, suspended matter and sediments influence the optical properties of the water, posing a challenge to satellite water colour analysis (Morel and Maritorena, 2001). In particular, suspended organic and inorganic matter and colored dissolved organic matter (CDOM) may interfere with the accuracy of water clarity models.

This report includes *in situ* physical, chemical, and biological data collected from various research sites in Lobster Bay (southwestern Nova Scotia in 2012), along Northumberland Strait in the southern Gulf of St. Lawrence (2015 to 2017), and the Pacific Ocean around the Haida Gwaii archipelago in 2018, which used the same methodology developed to study the eastern Canada sites. The document also accounts historical ocean-colour remotely sensed TSM data from MERIS, as well as specifically-developed information on water clarity (Secchi Disk Depth – SDD) and TSM computed at full $\text{MODIS}_{\textit{Aqua}}$ spatial resolution (250 m/pixel). This information became fundamental in planning airborne LiDAR bathymetry missions. NASA's products of chlorophyll *a*, Diffuse Attenuation Coefficients for Downwelling Irradiance at 490 nm and 532 nm, and Sea Surface Temperature (SST) at the same spatial resolution were also helpful in interpreting the final maps constructed by LiDAR's approach.

The data are summarized to illustrate the seasonal variation of water clarity and its applications in the planning of Airborne LiDAR Bathymetry activities by CHS. The study is concluded with a discussion of the potential use of these products in other fields.

1.2 STUDY AREAS

1.2.1 Lobster Bay

Lobster Bay is located in southwestern Nova Scotia (Figure 1). The region has a unique topography consisting of a shallow (<15 m) shoreline with a number of small islands and substrate dominated by mud, sand, and gravel. The area is characterized by a very large tidal range that begins in this region and extends into the Bay of Fundy (Greenlaw *et al.* 2013).

1.2.2 Northumberland Strait

The Northumberland Strait is located between mainland Nova Scotia and Prince Edward Island (Figure 1). The average depth of the strait ranges from 5 to 40 m in the central and western areas, and beyond 40 m in the eastern region (Fuentes-Yaco *et al.* 1998). Our study area is located in a large shallow region (average depth 50 m) based on de Lafontaine *et al.* (1991), which is described as an area where wind and bottom stresses are mixing agents for the water column.

Lauzier (1965) studied the non-tidal drift of the Northumberland Strait and described the movement of the surface water from west to east. His results also indicated that the predominant drift from the mainland to Prince Edward Island is stronger in the summer than in the autumn.

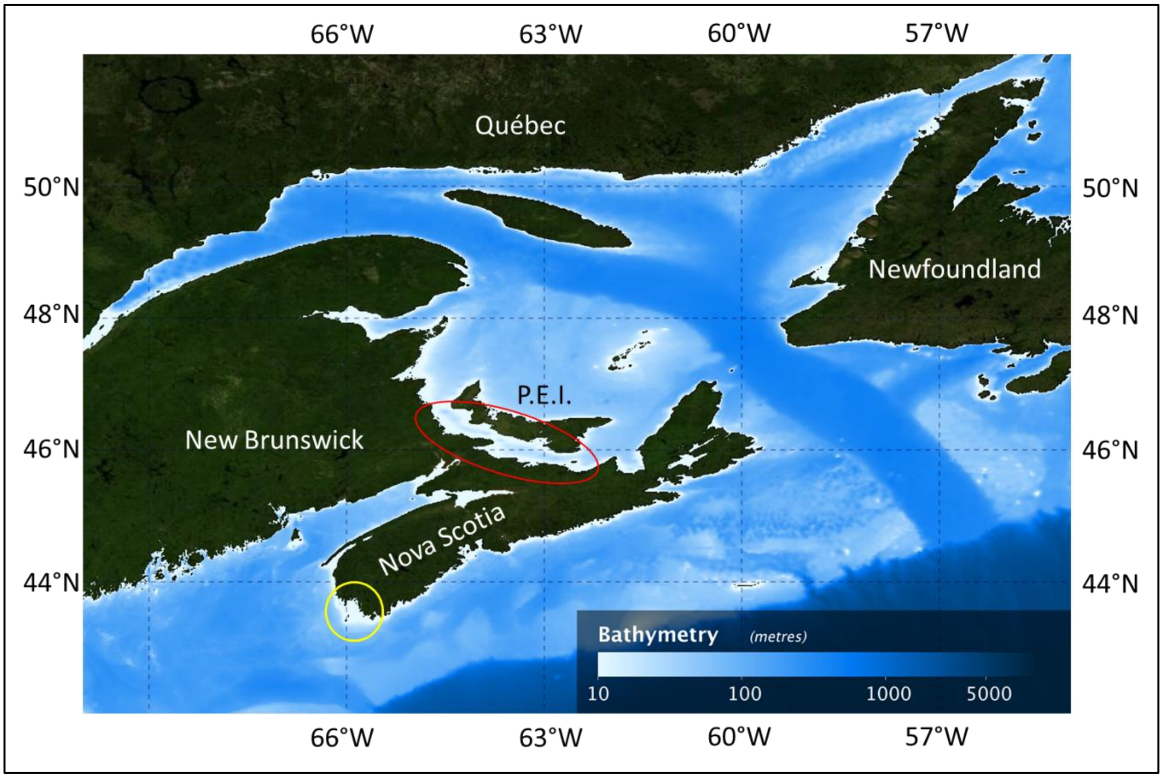


Figure 1. Eastern Canada study area: Québec, Newfoundland, New Brunswick, Prince Edward Island (P.E.I), and Nova Scotia. The Lobster Bay region is circled in yellow and the Northumberland Strait is in red.

In situ sampling was conducted in all the mentioned areas. There were a total of 21 locations in the Northumberland Strait in 2016. Figure 2 displays the location of each sample station. The station name, geographical coordinates and the date they were sampled are provided in Table 1. Stations PH-1, 2, 3 are located in Pictou Harbor (PH), PM-1, 2, 3, 4 are located near the Papermill (PM), and MG-1, 2, 3, 4 are located near Merigomish (MG). These three groups of stations are circled in red. These stations are located in inlets which are difficult to view on the map (Figure 2) due to the low spatial resolution.

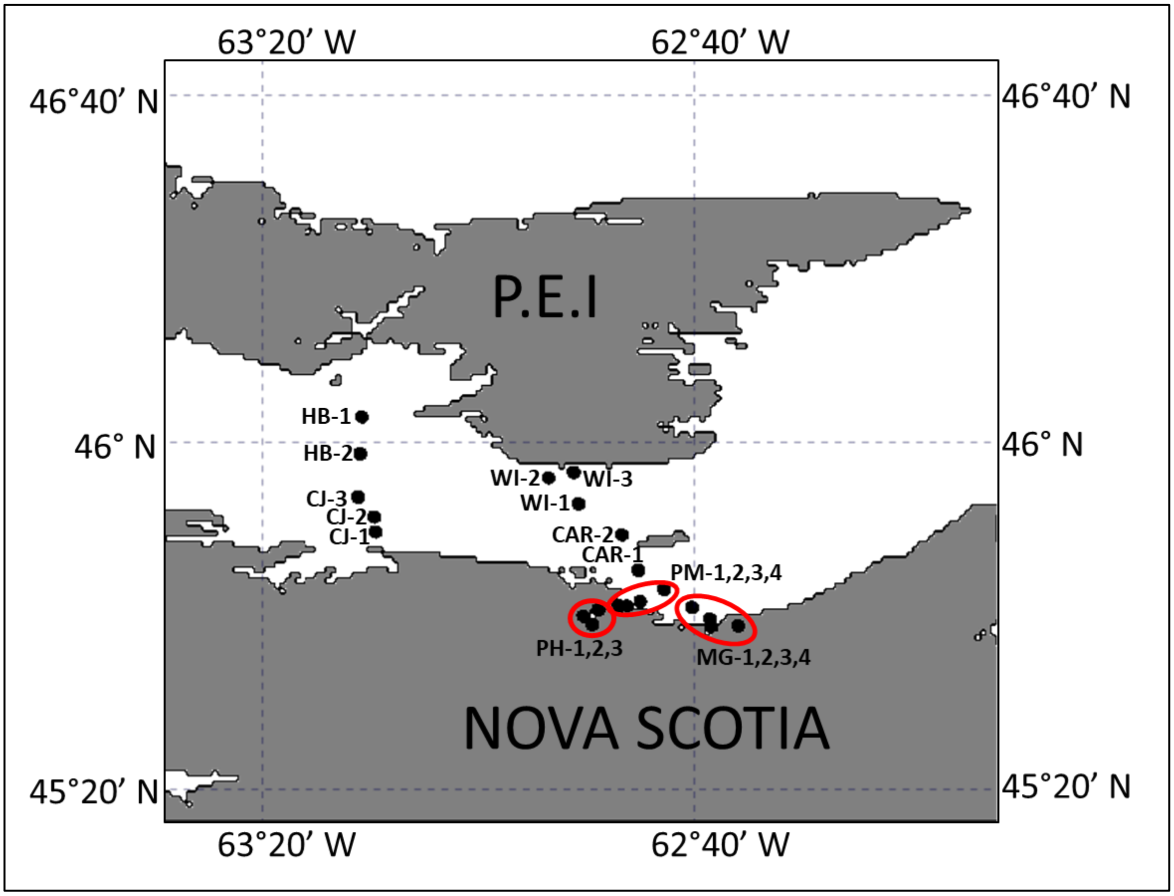


Figure 2. Northumberland Strait sampling stations in 2016

There were a total of ten stations in the Northumberland Strait in 2017. Figure 3 illustrates the location of each sample station and the associated station name. The corresponding geographical coordinates and the date of sampling are provided in Table 2.

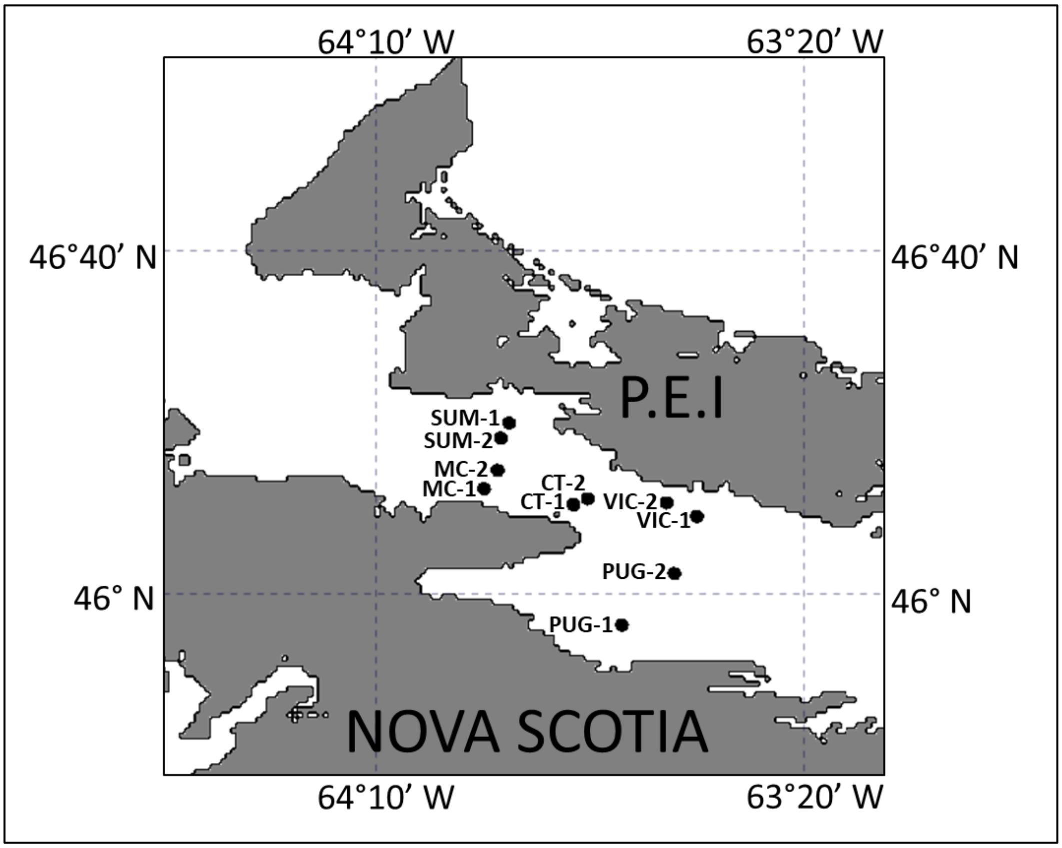


Figure 3. Northumberland Strait sampling stations in 2017.

1.2.3 Haida Gwaii

Haida Gwaii or the Queen Charlotte Islands is an archipelago separated from the northern coast of British Columbia (BC) mainland by the Hecate Strait in the east and from the Alaska (AK, USA) coast by the Dixon Entrance to the north. The area used in the remotely-sensed maps in this study is circumscribed between the 51°N and 55°N, and the 130°W and 134°W. The field work was focused on the northeastern zone, including the Naikoon Provincial Park located in the northeastern point of Graham Island. A total of 12 field stations were sampled, as shown in Figure 4. The corresponding geographical coordinates and dates of sampling are summarized in Table 3.

A description of the regional physiography and physical oceanography is summarized in Juliet (2004). In relation to the nature of this study, a compilation of data from satellite derived water leaving radiance and reflectance to survey phytoplankton pigments and sea surface temperature in the area has been presented by Robinson *et al* (2004).

Briefly, the eastern region is characterized by Hecate Strait, a shallow submarine valley that extends for 220 km along the eastern BC coast. A shoal on the northeastern archipelago is mostly shallower than 50 m; the strait encloses a channel with depths ranging from 50 m in the north to 300 m in the south. The western archipelago has a narrow continental shelf (< 5 km) and is exposed to seasonal Pacific Ocean dynamics, in particular the upwelling of cool, nutrient-rich waters in the summer, and the “Haida Eddies” associated with high nutrient concentrations and phytoplankton-rich surface waters in winter (Juliet 2004; Robinson et al 2004). The Dixon entrance to the north shows a relatively deep channel (300 m) that moves gradually upward to Graham Island coast (Cream, 1967), Figure 4.

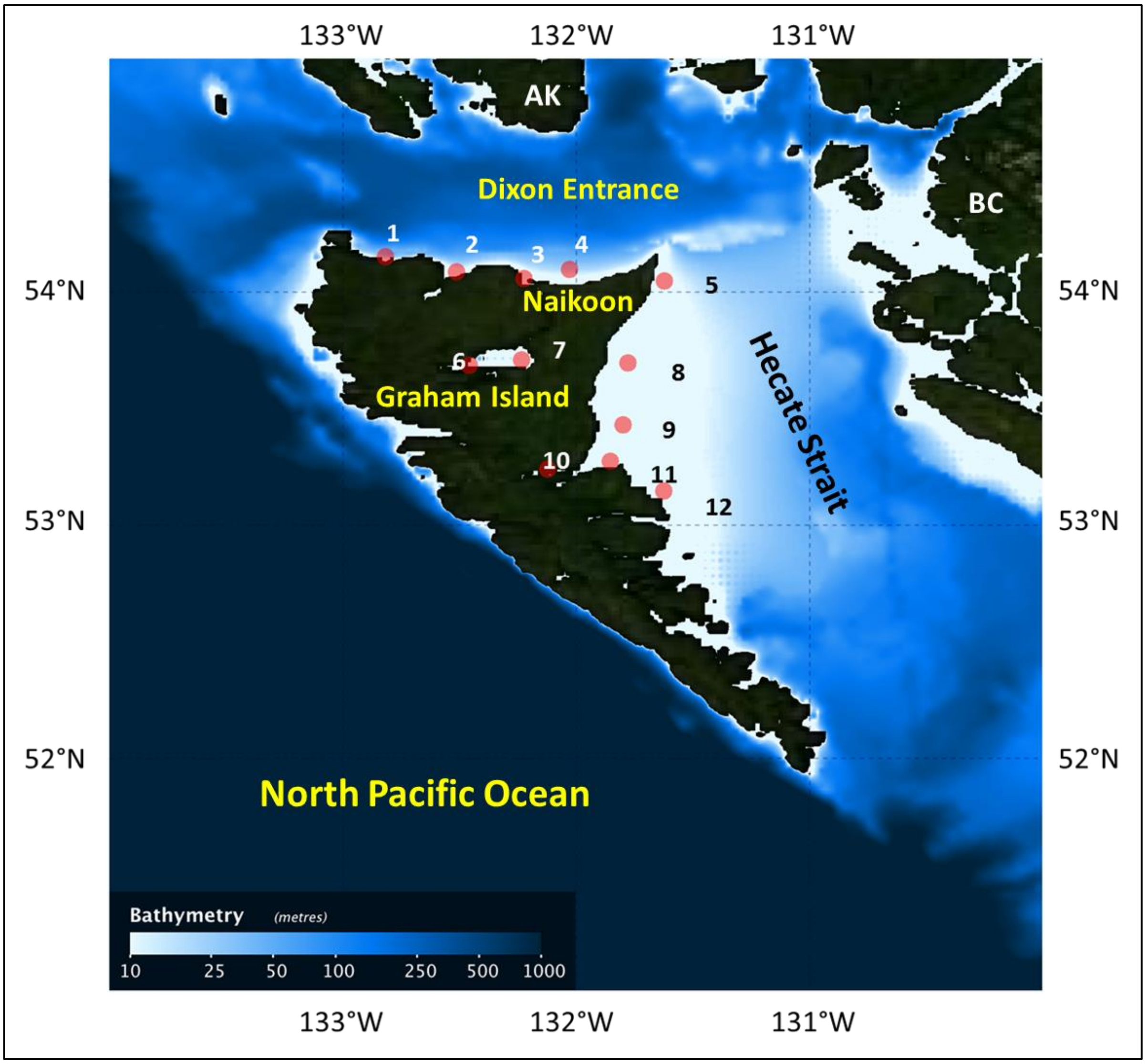


Figure 4. Haida Gwaii archipelago sampling stations in 2018, and bathymetry (m).

2. METHODS

2.1 *GENERALITIES*

Visual observation has been a traditional, objective method of assessing and measuring depth of water and is still commonly used. Visibility in the aquatic environment is a direct function of water clarity or, inversely, its attenuation properties. Some of the most standard methods of measuring the water clarity and colour are mentioned in the following paragraphs.

The Secchi disk (a simple white, circular disk of ~30 cm in diameter, Figure 5a), was created by Pietro Angelo Secchi in 1865 to measure water transparency or turbidity of natural waters (https://blog.limnology.wisc.edu/the-secchi-disk-celebrates-150-years-of-clarity/). The Secchi depth or the depth at which the disk disappears from view (*d*, in m) is reached when the reflectance equals the intensity of light backscattered from the water. The attenuation coefficient *k* (also known as extinction coefficient) is calculated using the following relationship: $k = 1.7/ d$. This coefficient is also used as a variable for water turbidity. The Secchi disk is easy to use with low cost and has long been a conventional approach with well established procedures. Another method to assess water clarity, typically used in conjunction with the Secchi depth, is the Forel-Ule Scale developed by François-Alphonse Forel and Willhelm Ule (http://www.citclops.eu/water-colour/measuring-water-colour) (Figure 5a).

Turbidity, another concept used to measure the relative clarity of water, is an optical characteristic expressing the amount of light that is scattered by material in the water (http://www.waterontheweb.org/under/waterquality/turbidity.html). Turbidity sensors (nephelometers) are comprised of a light emitter (LED or LASER diode) and a light detector (a photodiode). The instrument is widely used because of its reasonable cost; however it requires deployment and frequent calibration to maintain the international standards (Figure 5b).

Finally, radiometers are among the more recently developed instruments to quantify the water clarity by measuring radiance and irradiance. While more expensive than other options, they are highly accurate and distinguish many ocean water constituents. In this study we used the Satlantic Hyperspectral Ocean Colour Radiometer (HyperOCR) (https://www.seabird.com/hyperspectral-radiometers/hyperocr-radiometer/family?productCategoryId=54627869935), mounted on a real-time free-falling optical profiler (Figure 5c).

a) b) c)

Figure 5. a) Forel-Ule Scale (top left) and Secchi disk, b) moored (left) and free fall turbidimeters, c) Satlantic hyperspectral radiometers (HyperOCR) mounted on a real-time free-falling optical profiler.

2.2 *IN SITU* DATABASE

Historical works by the Canada Hydrographic Service (CHS) in the Lobster Bay area (southern Nova Scotia) in 2012 were the foundational material used in the development of Secchi disk depth field satellite matching assessments. Further details are provided in this document (2.3.3 *Secchi Disk Depth Algorithm*).

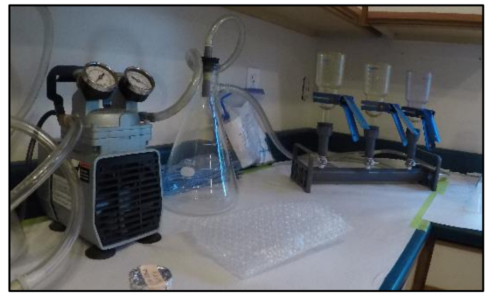
The protocols for analyses of different water components followed those of the Atlantic Zone Monitoring Program (AZMP), described in Mitchell *et al.* 2002. In particular: chlorophyll *a* concentrations were measured using the Turner fluorometer method (Holm-Hansen *et al.*, 1965) as well as High Performance Liquid Chromatography (HPLC) corresponding to Mitchell (1990) as modified by Stuart and Head (2005). Particulate Organic Carbon (POC) and Particulate Organic Nitrogen (PON) are based on that described by Head and Harris (1992). Total Suspended Matter (TSM) was measured as described later in the manuscript.

In the Northumberland Strait, 21 stations were visited in August 2016 and a total of 25 discrete water samples were collected at the surface (Table 1) and stored in plastic containers that were rinsed with the sample and then placed in a cooler with ice packs until ready for filtering. Due to bad weather, some sites were resampled later for higher light levels and better data quality (CAR-1 and CAR-2). Other sites were resampled to gather water data at various depths (PM-1, 2, 3). Samples were analyzed to determine their concentrations of chlorophyll *a* and TSM. In July of 2017, ten discrete surface water samples were collected from ten stations (Table 2), stored using the same procedure as in 2016, and analyzed to obtain chlorophyll *a*, TSM, HPLC, POC, and PON data. In June 2018, samples were collected from 12 stations in the Haida Gwaii archipelago, at the surface and at the depth of maximum fluorescence. Some stations were resampled due to bad weather, resulting in 15 *in situ* measurements (Table 3). Samples were analyzed to collect the same data as in 2017.

To filter the water samples, a glass filtration tower was set up (Figure 6a). For chlorophyll *a*, two 100 ml replicates were filtered through a GFF filter. The filter was collected and placed in a glass vial containing 10 ml of 90% acetone then stored in a freezer/cooler. Chlorophyll *a* was measured using a fluorimeter. An initial reading of the acetone sample was taken, then 2-3 drops of hydrochloric acid (10% HCl) was added to remove any phaeophytin from the sample, while leaving chlorophyll *a*for the second reading. The values of chlorophyll and phaeophytin were then calculated using these measurements. A similar procedure was performed for HPLC; 250 ml of sample was filtered through GFF filters and the filters were stored in plastic vials, which were then stored in liquid nitrogen. POC/PON required two 250 ml replicates filtered through baked GFF filters. These filters were then folded in half and both replicates were placed in one small plastic Petri dish, then stored in a freezer.

TSM had an individual filtration tower, where a MF-Millipore membrane filter was used (Figure 6b). Water was passed through a filter that was weighed in advance, until colour appeared on the filter. It was then folded into quarters and air-dried before storing it at room temperature in a small bag, then weighed in order to use the difference between pre-filter and post-filter weight to calculate the weight of sediment. The weight was then divided by the quantity of sample water filtered to get the final measurement in units of mg/L.

a) 

b) 

c) 

Figure 6. a) Example of filtration tower set up for chlorophyll a*, HPLC, and POC/PON. b) Example of TSM filtration tower, c) HyperOCR profiler modified with a foam cap to slow down the falling velocity in shallow waters.*

Light data was collected with a Satlantic Hyperspectral Ocean Colour Radiometer (HyperOCR) mounted on a real-time free-falling optical profiler (Figure 6c). The HyperOCR (PRO-ID: MPR0145) has a fully digital optical sensor package, providing up to 255 channels of optical data with wavelengths ranging from 300 to 1200 nm. In order to use the profiler in shallow waters (<20 m depth), it was modified with a foam cap to slow down the falling velocity. The instrument was dropped until it was 1-2 m from the bottom in shallow depths or when the signal became noisy (no light penetration). This procedure was repeated five times to obtain five replicates of light data. The HyperOCR is operated onboard with the software package Satlantic SatView (version 2.95_7). Further, the Satlantic ProSoft data analysis package (version 7.7.19) was used for processing the measurements from raw data to a Level 4 format.

The measurements of light retrieved from the HyperOCR for the objectives of this study were the Remote Sensing Reflectance (*RSR-LU_hyperspectral/ED_hyperspectral_downcast (/sr)*), and the Attenuation Coefficient for downwelling irradiance (*K_ED_hyperspectral_downcast (/m*) at 490 nm, and at 532 nm (*Kd_490, and Kd_532*). In addition, the downcast of temperature (*°C*) and salinity (*psu*) were also used to characterize the water column at the sampling locations.

The light attenuation was also estimated using the Secchi disk depth (SDD). A Secchi disk is a disk with black and white quarters that was lowered into the water and a measurement of depth (in meters) taken once the disk was no longer visible.

In the Northumberland Strait in 2017, a turbidimeter provided information on the relative clarity of the water column. The instrument was an AML Minos-X water column profiler (Serial # 30413), equipped with an AML turbidity sensor (serial # 300418). The instrument was lowered to cast depth using a Teledyne winch in manual mode; after the cast the instrument was brought onboard, connected to a computer and the information downloaded. The raw data were processed with the Seacast software (version 4.3.1) and the results expressed in Nephelometer Turbidity Units (NTU).

2.3 SATELLITE-DERIVED DATA

2.3.1 *Medium Resolution Imaging Spectrometer (MERIS)*

In this study we used BIO/DFO's existing archive of Total Suspended Matter (TSM) data provided from the European Space Agency (ESA)'s Level 3 Medium Resolution Imaging Spectrometer (MERIS) at 300 m/pixel. This information was initially used to visually examine the water clarity in different locations in the Northumberland Strait, southern Gulf of St. Lawrence (SGSL), and northwestern Atlantic Ocean (Figure 7).

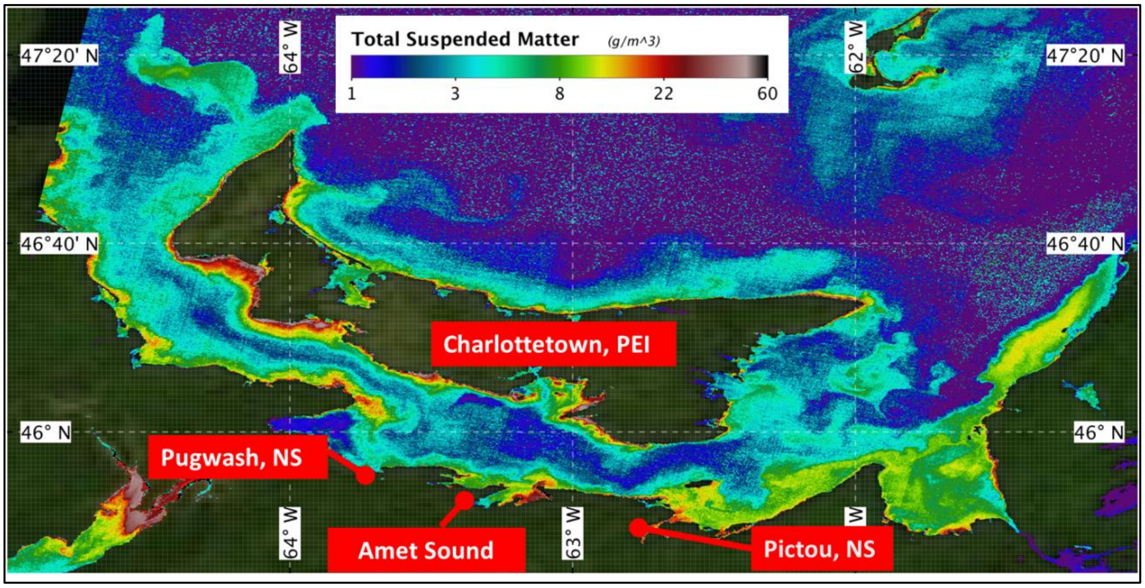


Figure 7. Total Suspended Matter (g m^{-3}) from MERIS at 300 m per pixel, in the Northumberland Strait, southern Gulf of St. Lawrence, on October 8th, 2011.

A TSM weekly climatology report from MERIS (reduced resolution spatial at 1.5 km/pixel) for the period between 2002 and 2012 was computed with the aim of finding the minima TSM concentration and the corresponding timing values. An optimization of parameters of a split Gaussian curve was applied to the weekly mean TSM in the region of interest as a statistical reduction method (Fuentes-Yaco *et al*, 2020). The TSM minima values and timings defined a preliminary index of water clarity in four areas in the SGSL: Hillsborough Bay, PEI Eastern Coast, Pictou, and Pugwash (Figures 8a, b, c, d, and e, respectively). This approach showed that the most transparent period in these areas is between June and August, with an expected TSM minimum between 0.41 and 1.01 (g m^{-3}) in the second week of July.

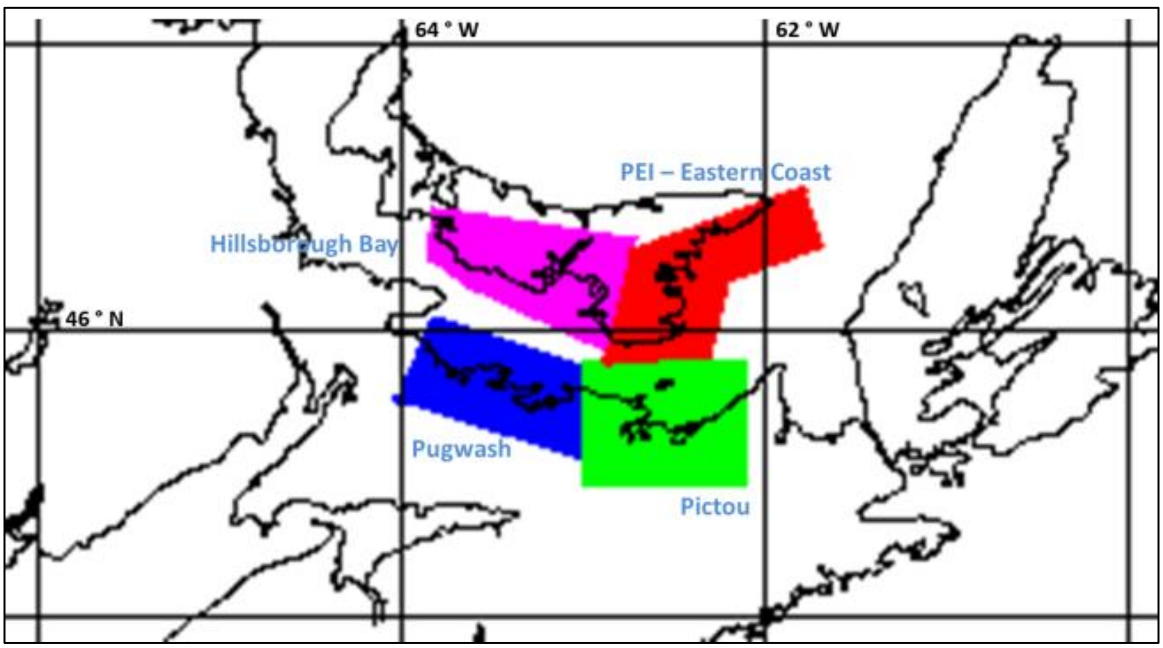
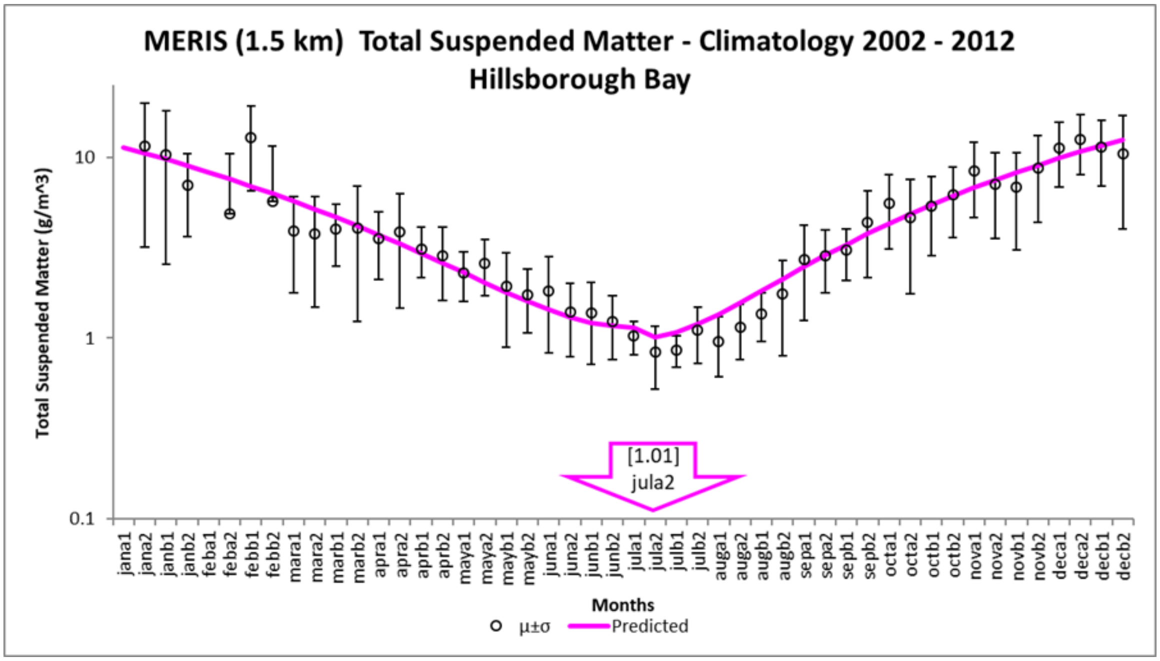
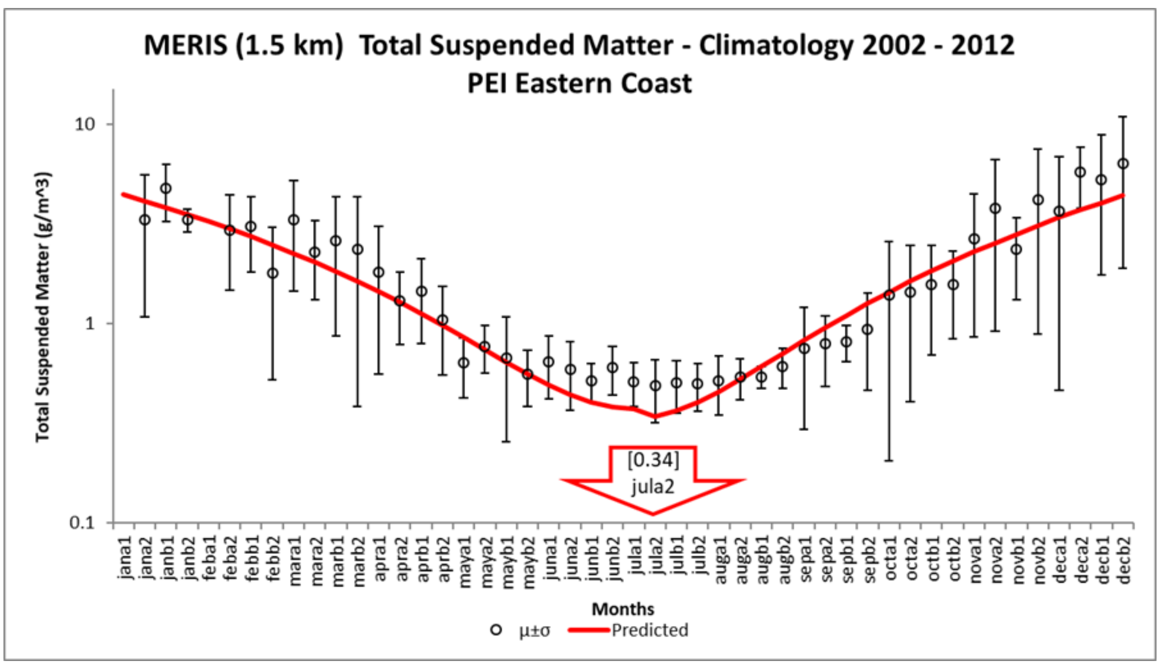


Figure 8. MERIS (1.5 km/pixel) climatology (2002 to 2012) of Total Suspended Matter (g m^{-3}) (± standard deviation σ) in Northumberland Strait, GSL: Hillsborough Bay (a), PEI Eastern Coast (b), Pugwash (c), and Pictou (d). See continuation of this figure below.

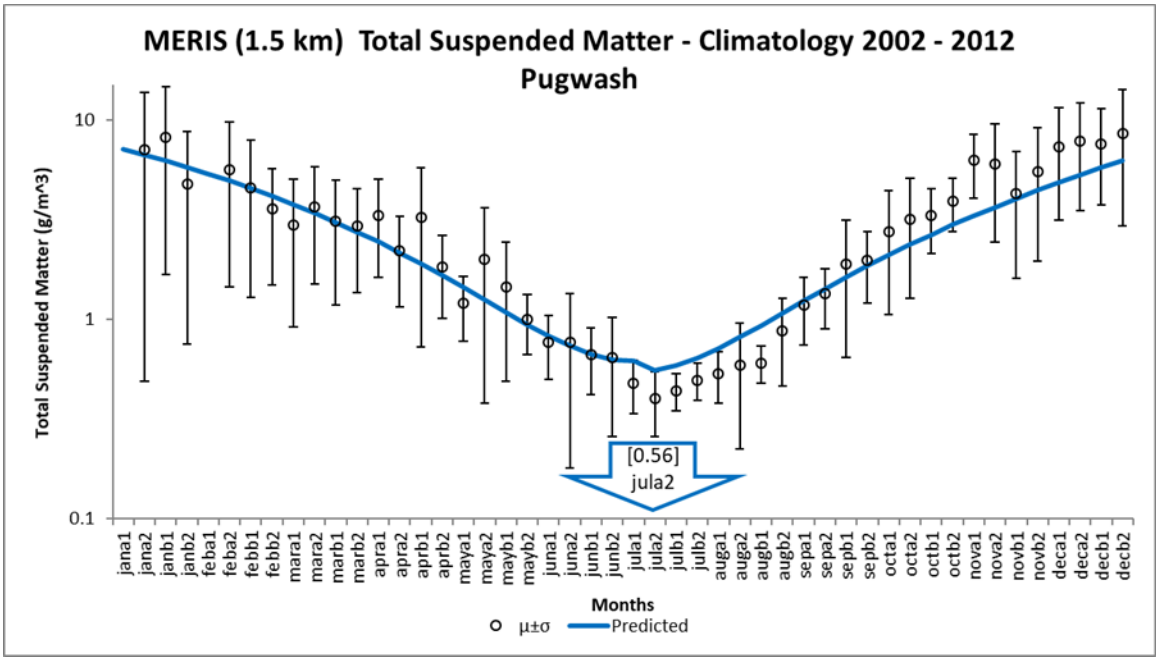


a)

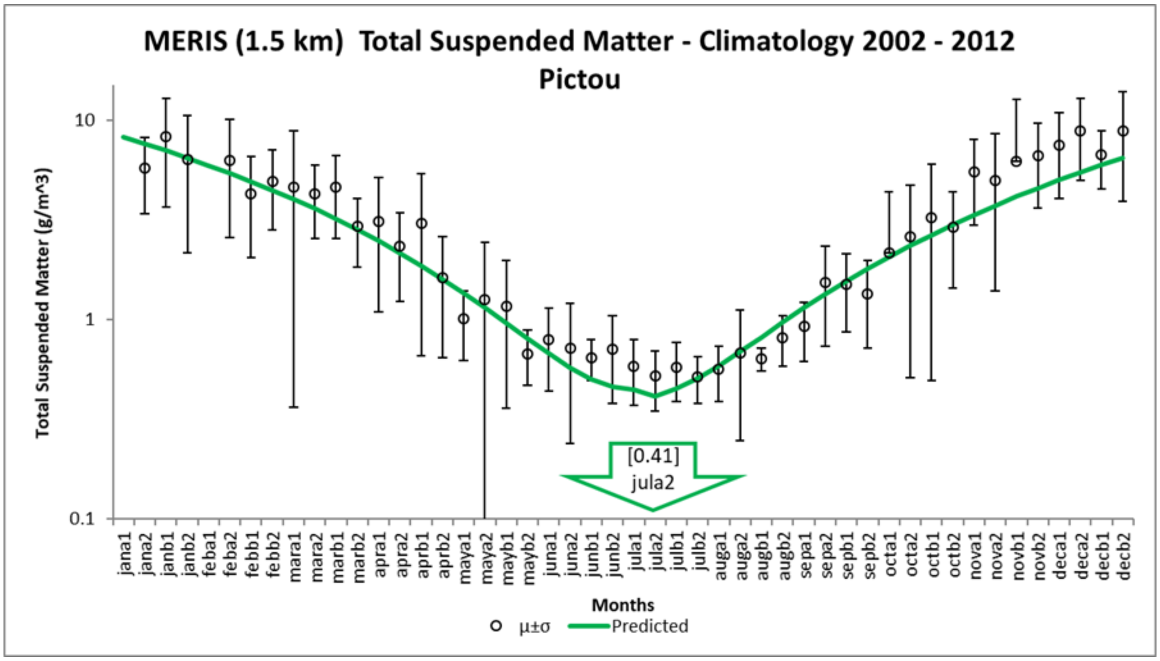


b)

Continuation of Figure 8. MERIS (1.5 km/pixel) climatology (2002 to 2012) of Total Suspended Matter (g m^{-3}) (± standard deviation, σ) in Hillsborough Bay (a), PEI eastern coast (b).



c)



d)

Continuation of Figure 8. MERIS (1.5 km/pixel) climatology (2002 to 2012) of Total Suspended Matter (g m^{-3}) (± standard deviation, σ) in Pugwash (c), and Pictou (d).

A similar approach was applied to Jeddore and Medway regions on Canada's Scotian Shelf, as well for the Rimouski region in the lower St. Lawrence Estuary (Figures 9a, b, and c, respectively). Again, the second week of July was the most transparent period in the Scotian Shelf, with minimum TSM values of 0.24 and 0.3 (g m^{-3}). However, Rimouski showed a later temporal window, between July and September with an estimated minimum in the third week of August with 1.03 (g m^{-3}), which is not unexpected given the low river discharge at that time of year.

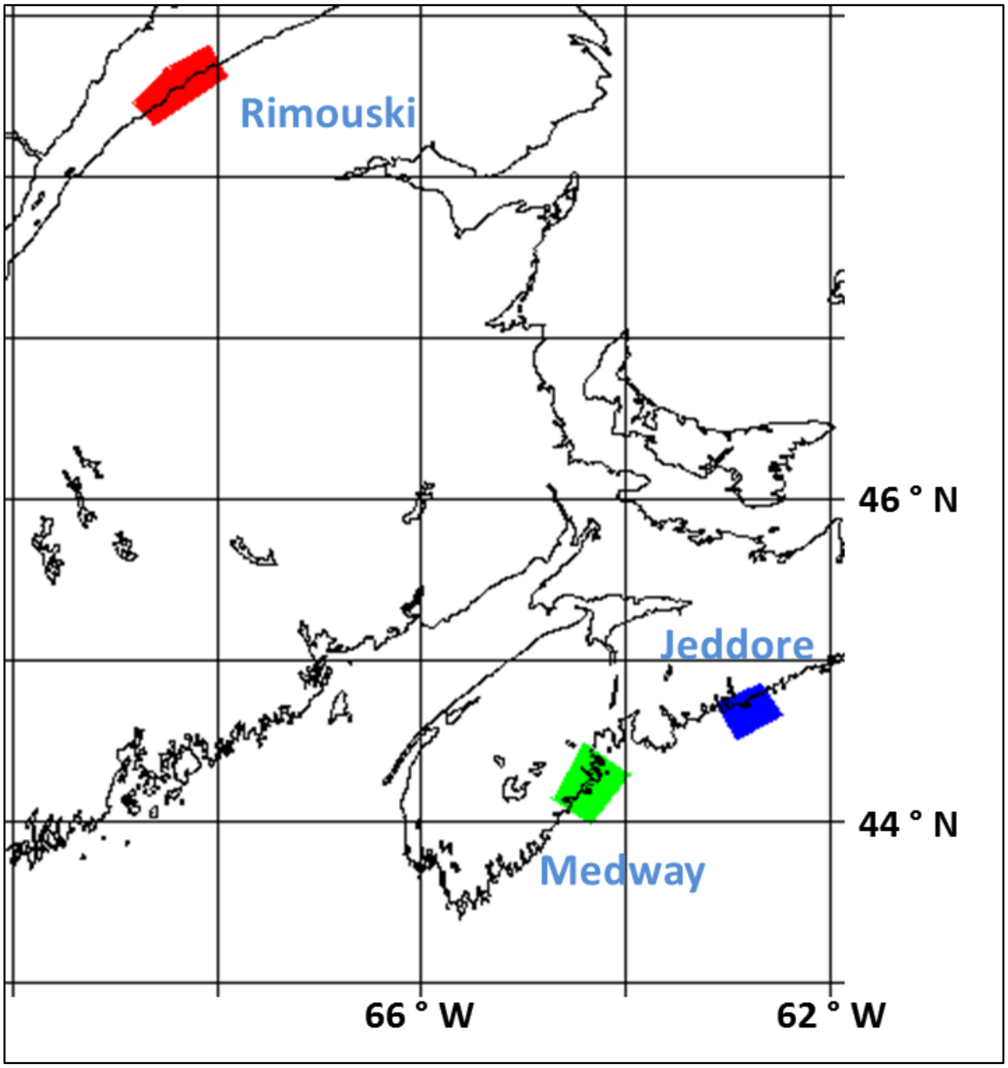
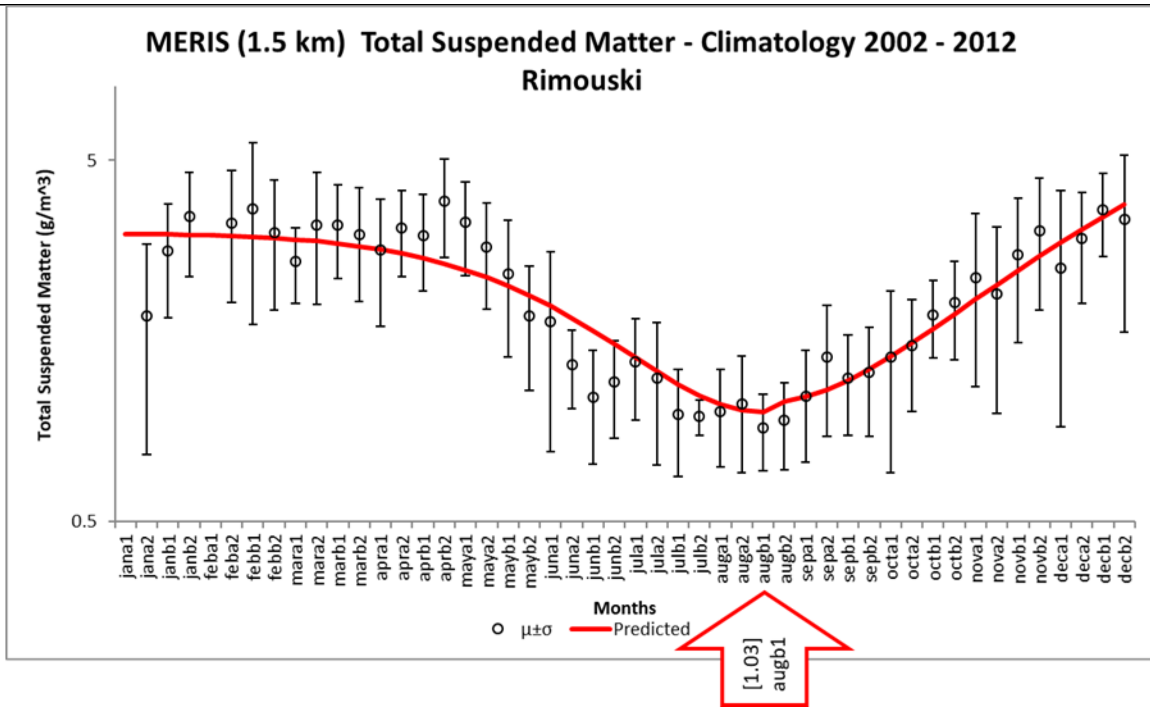
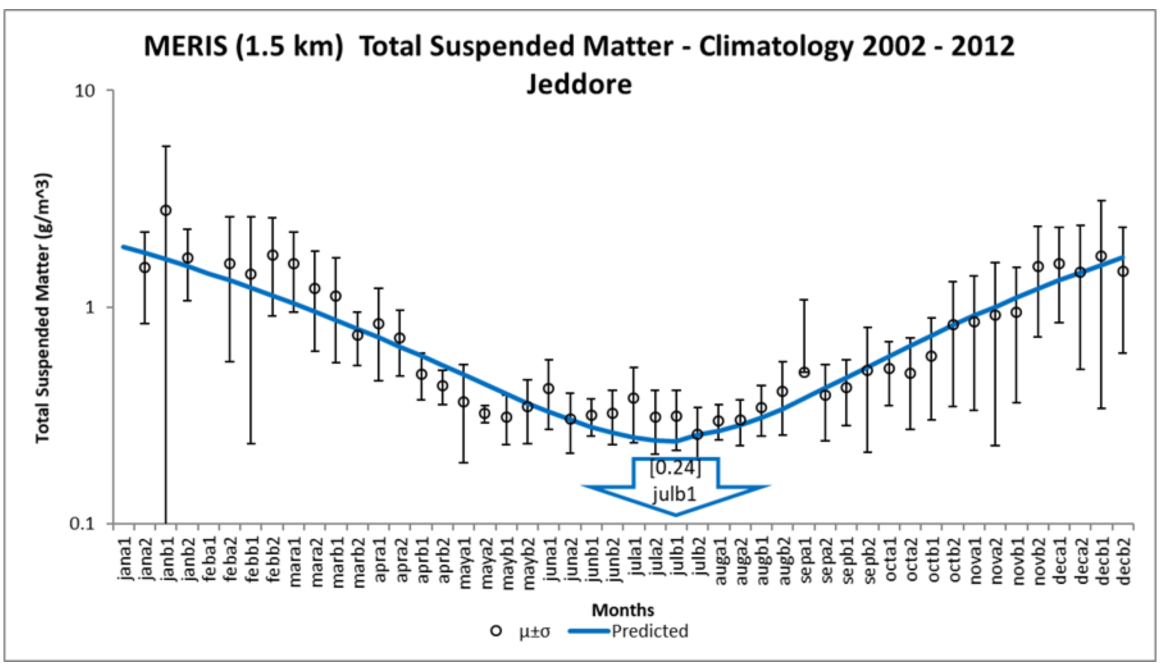


Figure 9. MERIS (1.5 km/pixel) climatology (2002 to 2012) of Total Suspended Matter (± σ, g m^{-3}) in Rimouski, lower St. Lawrence Estuary (a), Jeddore (b) and Medway (c). See continuation of this figure below.

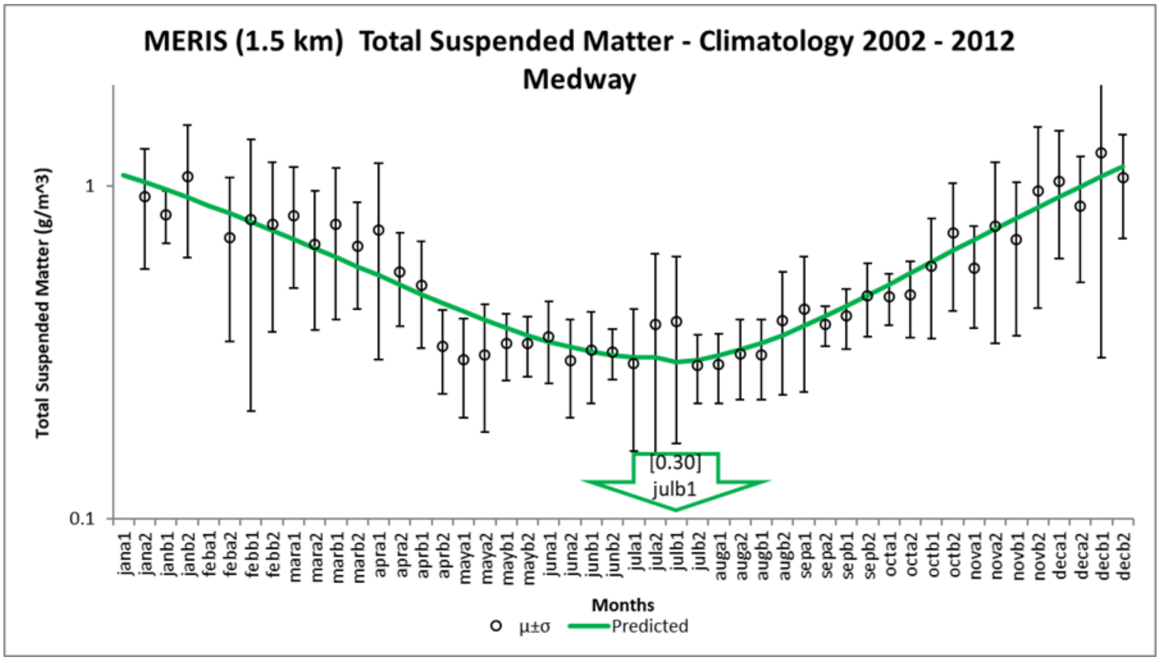


a)



b)

Continuation of Figure 9. MERIS (1.5 km/pixel) climatology (2002 to 2012) of Total Suspended Matter (± σ, g m^{-3}) in Rimouski, lower St. Lawrence Estuary (a) and Jeddore (b).



Continuation of Figure 9. MERIS (1.5 km/pixel) climatology (2002 to 2012) of Total Suspended Matter (± σ, g m^{-3}) in Medway.

2.3.2 *Moderate Resolution Imaging Spectroradiometer (MODIS$_{Aqua}$)*

The flowchart in Figure 10 shows the sequence of steps followed in processing the MODIS$_{Aqua}$ images, from the Level 1A LAC data downloaded from NASA, to the computation of target geophysical variables processed at the Bedford Institute of Oceanograpy (BIO).

The main data was processed using NASA's free software SEADAS (https://seadas.gsfc.nasa.gov/). The process began by retrieving MODIS$_{Aqua}$ Level 1A LAC data (digitated raw and detector count) from NASA's website (https://oceancolor.gsfc.nasa.gov/). These were reconstructed but unprocessed full resolution data, calculated for each 1 km MODIS Instantaneous Fields of Views (IFOV), and used to create geolocation files. The most recent near real-time ancillary data used in the following step were also requested from NASA, and contained meteorological information to properly remove atmospheric and surface effects from the radiances, as well as ozone, which affects the visible light absorption. These data were used to compute the water-leaving radiances in the Level-1 and Level-2 processing. The atmospheric correction method used in this study was the aerosol model multi-scattering with Management Unit of the Mathematical Model (MUMM) correction and MUMM Near Infrared (NIR) calculation (Ruddick *et al.* 2000, Goyens *et al.* 2013), at a spatial resolution of 250 m/pixel. Level 2 flags used in these products wee: CLDICE (probable cloud or ice contamination), HILT (observed radiance very high or saturated), STRAYLIGHT (probable stray light contamination), and ATMWARN (atmospheric correction is suspect).

The geophysical variables of interest were generated in the Level 2 products from SeaDAS algorithms for the ocean color (OC) suite and SST. They were applied using the information provided on NASA's website: https://oceancolor.gsfc.nasa.gov/atbd/. The processed products are: *i*) surface spectral Remote Sensing Reflectance (*Rrs; sr^{-1}*) after atmospheric correction, *ii*) chlorophyll *a* (*chlor_a; mg m^{-3}*), the concentration of the photosynthetic pigment chlorophyll a, *iii*) the diffuse attenuation coefficient for downwelling irradiance over the first optical layer at 490 nm, and at 532 nm (*Kd_490, Kd_532; m^{-1}*), and *iv*) Sea Surface Temperature (SST; °C) derived from long-wave (11-12 µm) thermal radiation. In addition, this study uses specific BIO developed algorithms for Secchi Disk Depth and Total Suspended Matter (as explained in sections 2.3.3 and 2.3.4).

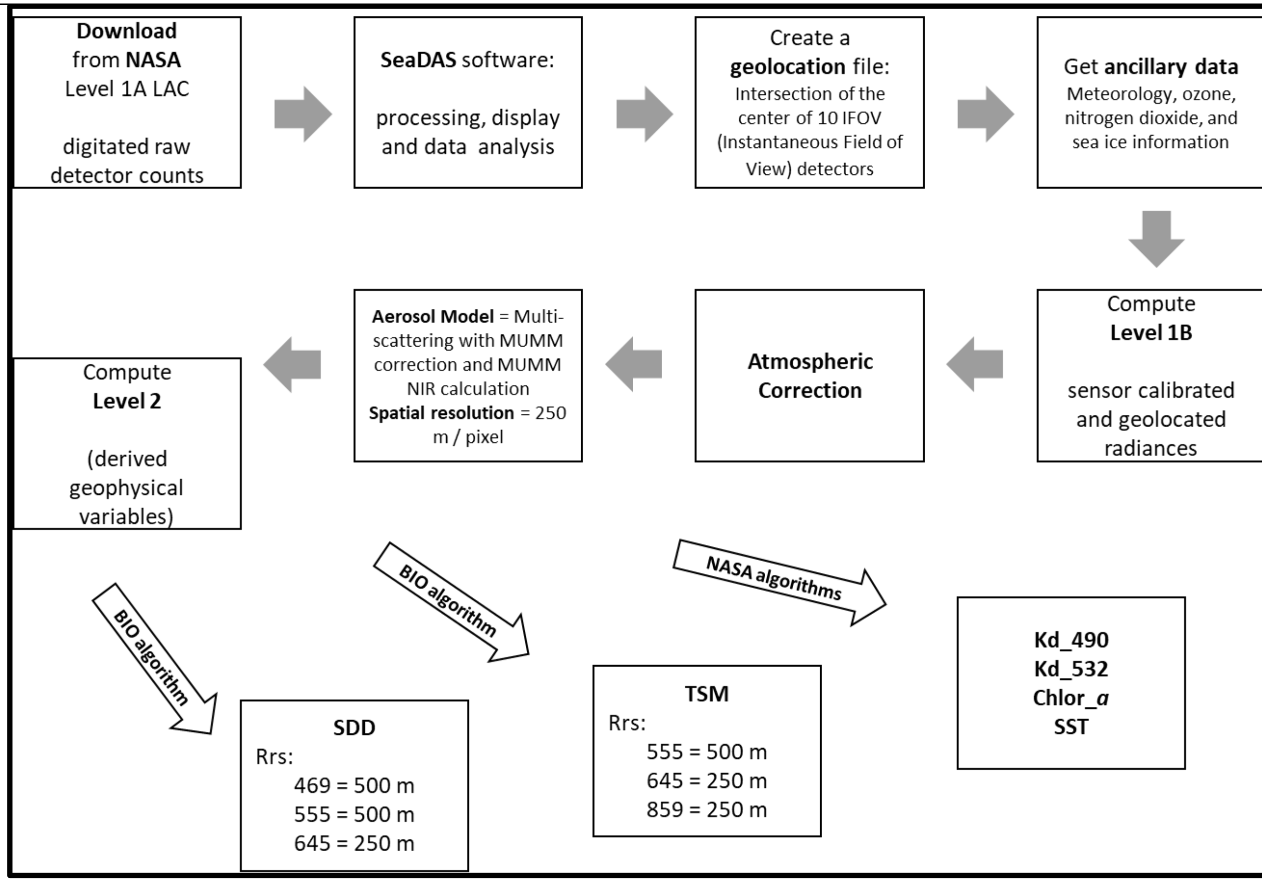


Figure 10. Flowchart showing the sequence of steps followed in processing the MODIS images, from the Level 1A LAC data downloaded from NASA to the computation of target geophysical variables computed at BIO. Acronyms are: MUMM = the Management Unit of the Mathematical Model, Belgium, SDD = Secchi Disk Depth, TSM = Total Suspended Matter, Kd_490 and Kd_532 = Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm respectively, Chlor_a = concentration of phytoplankton pigment chlorophyll a*, SST = sea surface temperature.*

2.3.3 *Secchi Disk Depth Algorithm*

Water clarity can be expressed as a function of the depth at which a Secchi disk can no longer be seen, also known as the “Secchi depth”. The Secchi depth is reached when the reflectance equals the intensity of light backscattered from the water. Water transparency decreases as the abundance of algae and/or suspended sediments increases, affecting the colour of the water. The clarity of water impacts light penetration, and consequently photosynthesis and the distribution of organisms. In our case, the LiDAR signal may be obstructed and fail to reach the bottom.

Determination of Secchi Disk depth using remotely-sensed signals for specific regions requires the development of an explicit algorithm. For the objectives of this study various data sets have been provided from different locations and dates. The Canadian Hydrographic Service (CHS) provided 26 *in situ* measurements from Lobster Bay (southern Nova Scotia) on February 8th 2012, corresponding to 22 satellite *in situ* matching locations. The present project’s field work in Northumberland Strait (SGSL) in 2015 provided *in situ* samples that matched to satellite data from two stations in July, 11 stations in August, and three stations in September, as well as seven stations in August, 2016. The locations are shown in Figures 11a and b, respectively. CHS provided SDD data from Vancouver Island during 2017 , and the Haida Gwaii archipelago surrounding areas were sampled between the 7th and 11th of June, 2018. The geographical locations of the west coast field measurements are shown in Figure 12c.

In order to develop an algorithm, a 5x5 matrix of un-flagged satellite-derived Remote Sensing Reflectance (Rrs) values was extracted from $MODIS_{Aqua}$ Level 2 products (before map projection), centered around the location of the *in situ* sample site, and the mean value of the 25 pixels was computed to use in the algorithm.

The *in situ* data were then regressed against $\log_{10}(Rrs_{average})$ at 469 nm (500 m/pixel spatial resolution), 555 nm (500 m), and 645 nm (250 m). The regression model was a Robust MM (maximum likelihood type) Linear Regression (Equation 1), performed using TIBCO S+ 8.2 software:

$$Log_{10}SDD \sim a + b\ Log_{10}(Rrs.469) + c\ Log_{10}(Rrs.555) + d\ Log_{10}(Rrs.645)$$

Equation (1)

where SDD is the Secchi Disk Depth, and the coefficients for the east coast of Canada were *a* = -1.0867, *b* = 0.6417, *c* = -1.4111, and *d* = -0.0289. The coefficients for the combined east and west coast datasets were *a* = -1.076358, *b* = 0.6116638, *c* = -1.375102, and *d* = -0.02957308.

The Pearson product-moment correlation coefficients (*r*, Equation 2) of the east coast model and the combined east/western coast model were 0.85 and 0.61 respectively, suggesting the models are moderately to strongly correlated with the *in situ* data and therefore appropriate for use. The residual scales estimated for the east coast model was 0.08785 on 854 degrees of freedom, and 0.1038 on 1112 degrees of freedom for the combined east/west coast model.

$$r = \sum (x - \acute{x})\,(y - \acute{y}) \Big/ \sqrt{\sum (x - \acute{x})^2 \sum (y - \acute{y})^2}$$

Equation (2)

Figure 12 shows (a) a scatterplot of the RMM linear regression of the combined east and west coast regions, (b) a comparison of model-derived and *in situ* Secchi disk depth for all pixels, and (c) the geographical locations of field sampling during this study.

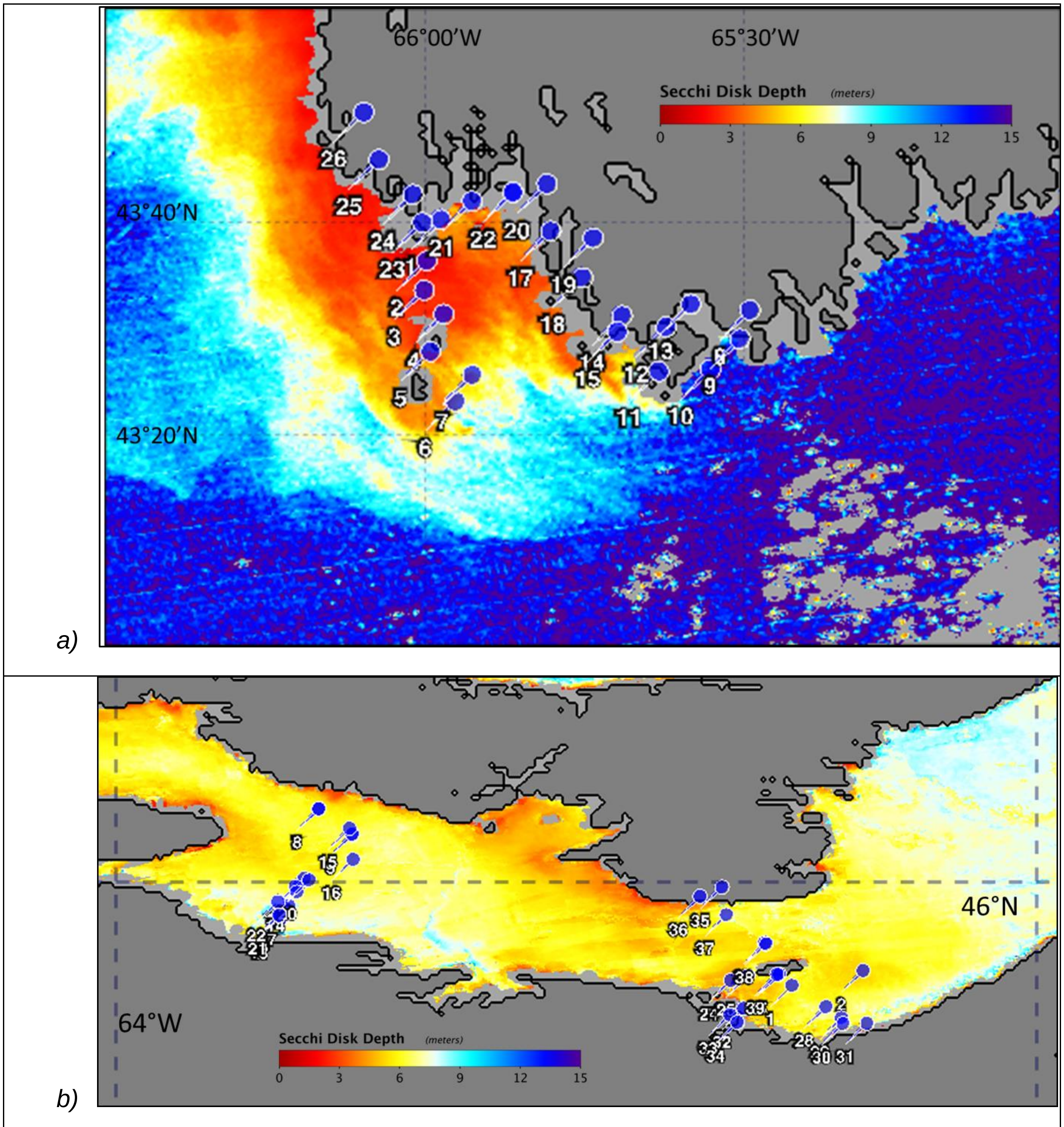
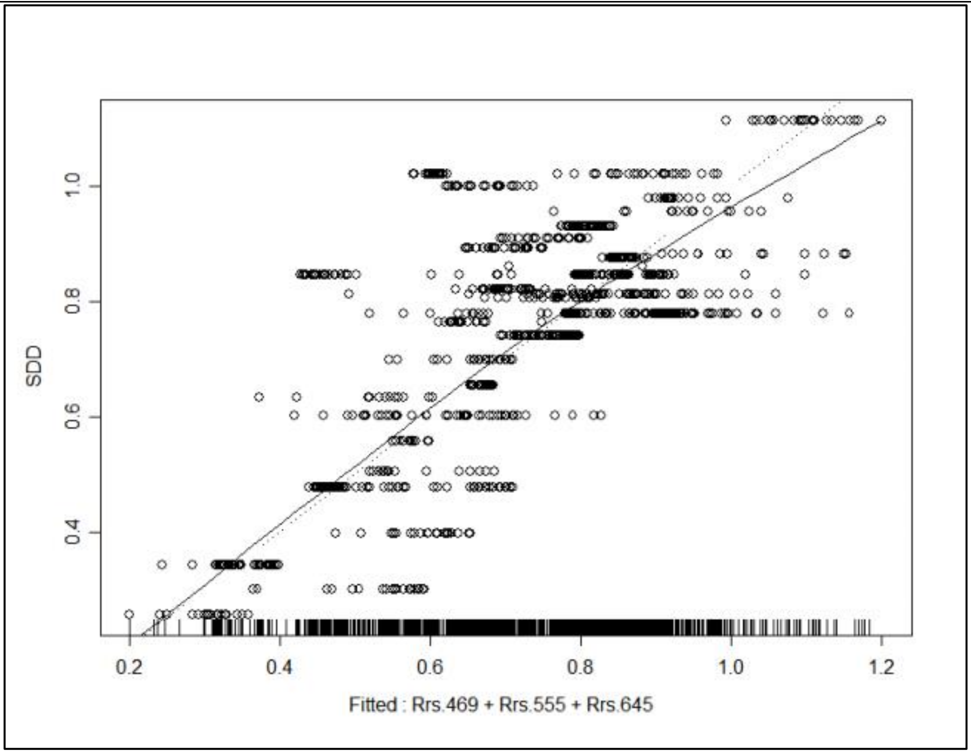
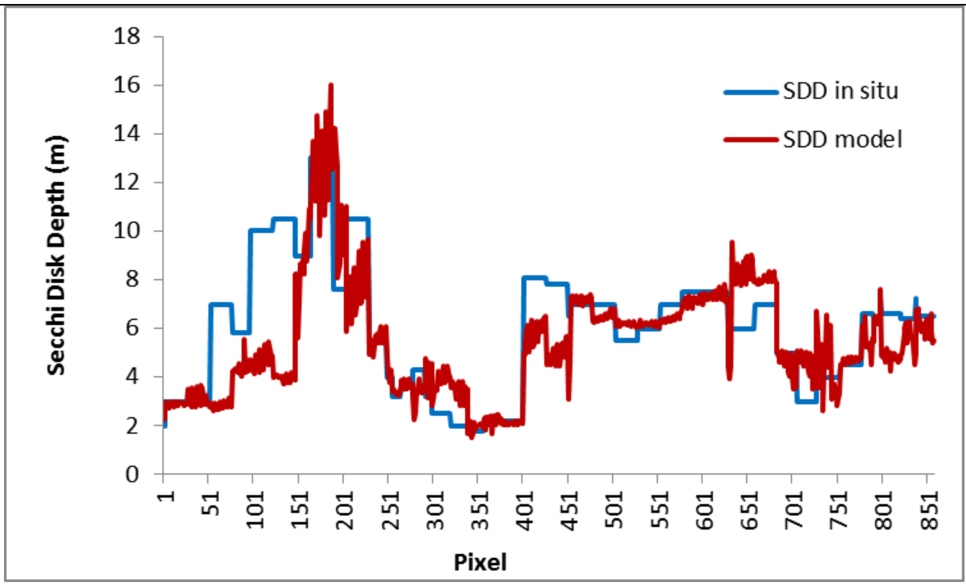


Figure 11. Maps of SDD (m) showing the geographical locations of in situ *measurements (blue circles) used in the development of the algorithm, a) in Lobster Bay, Southern Nova Scotia on February 8th, 2012, and b) in the Northumberland Strait, southern Gulf of St. Lawrence during 2015 and 2016.*

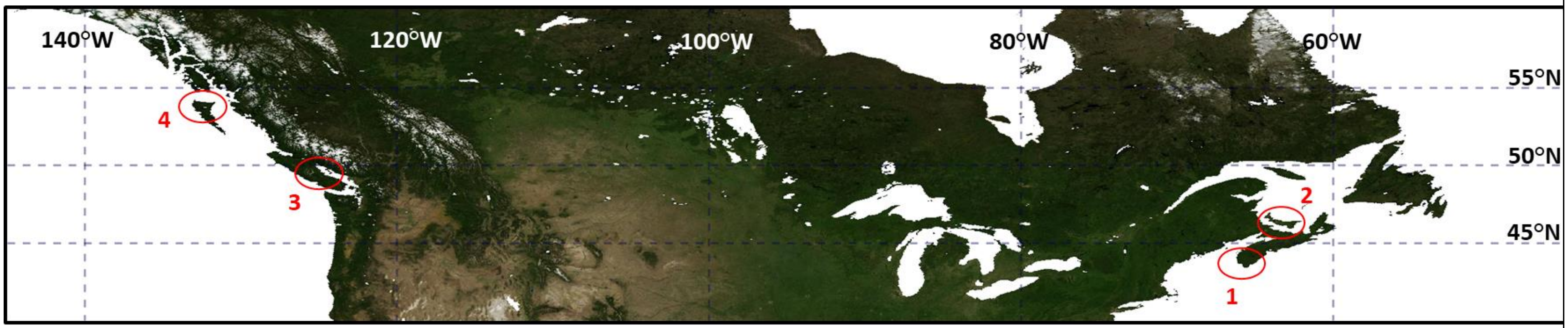


a)



b)

Figure 12. a) Scatterplot of $MODIS_{Aqua}$ fitted and in situ *measured SDD through the RMM linear regression from the eastern (2012, 2015 to 2017) and western (2017 and 2018) coasts of Canada, resulting in a correlation coefficient of 0.61. b) Comparison of* in situ *SDD and the RMM linear model including all data.*



Continuation of Figure 12. c) Geographical locations of field sampling in all locations and years. 1 – Lobster Bay, NS – February 8th, 2012; 2 – Northumberland Strait – 2015 to 2017; 3 – Vancouver Island – 2017; 4 – Haida Gwaii Island – 2018.

2.3.4 *Total Suspended Matter Algorithm*

A regional algorithm for Total Suspended Matter was developed for this study using *in situ* measurements provided by the Laboratory of Sedimentology at BIO/DFO (2006), in addition to data obtained during field missions for this study in 2016. The majority of field data were from 2006: August (19 stations), September (32), and October (40). Only 14 stations were sampled during August 2016. Their geographical locations are shown in Figures 2 and 3 (2016) and 13a (2006).

Similar to the Secchi Disk Depth algorithm (see section 2.3.3), the *in situ* data were regressed against band ratios of $MODIS_{Aqua}$ (Level 2) $\log_{10}(Rrs_{average})$ at 555nm (500 m/pixel of spatial resolution), 645 nm (250 m) and 859 nm (250 m) (see Equation 3). The model was a second order polynomial regression, again performed using TIBCO S+ 8.2 software:

$$Log_{10}\, TSM = a\, x^2 + b\, x + c$$

(Equation 3)

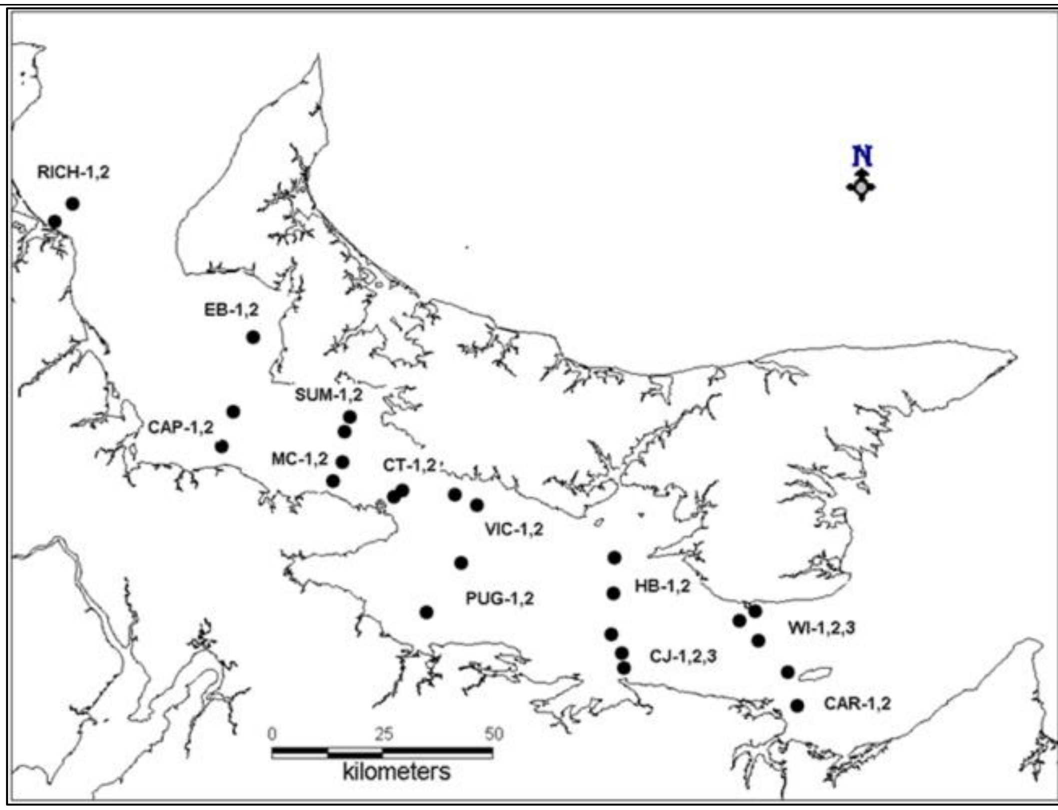
where *TSM* is Total Suspended Matter, the coefficients were a = 40.70320, b = 57.79984, and c = 21.88387, and x is defined as follows (Equation 4):

$$x = (Log_{10}\, Rrs555 \,/\, Log_{10}\, Rrs645) + (Log_{10}\, Rrs859 \,/\, Log_{10}\, Rrs645) \,/\, Log_{10}\, Rrs645$$

(Equation 4)

The model explained a large portion of the variance, as evidenced by a high correlation coefficient of 0.85. Figure 13a shows the corresponding scatterplot of *TSM* satellite-derived versus *in situ* values ($g\ m^{-3}$). Finally, Figure 13c illustrates a satellite–derived composite map of *TSM* from the period of field work in 2006 and 2016.

a)



b)

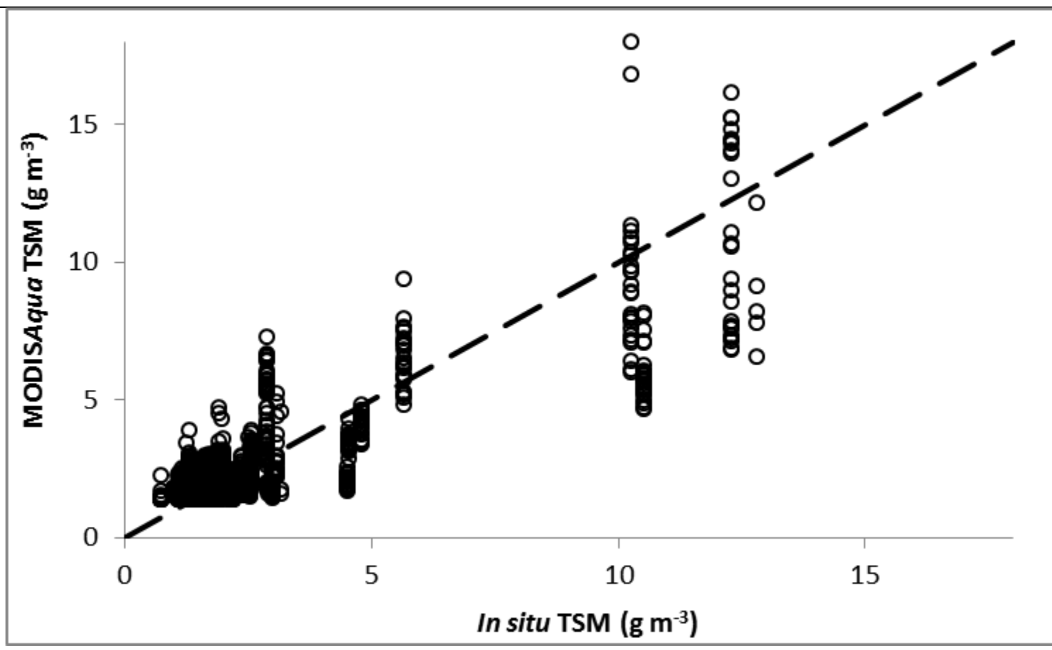
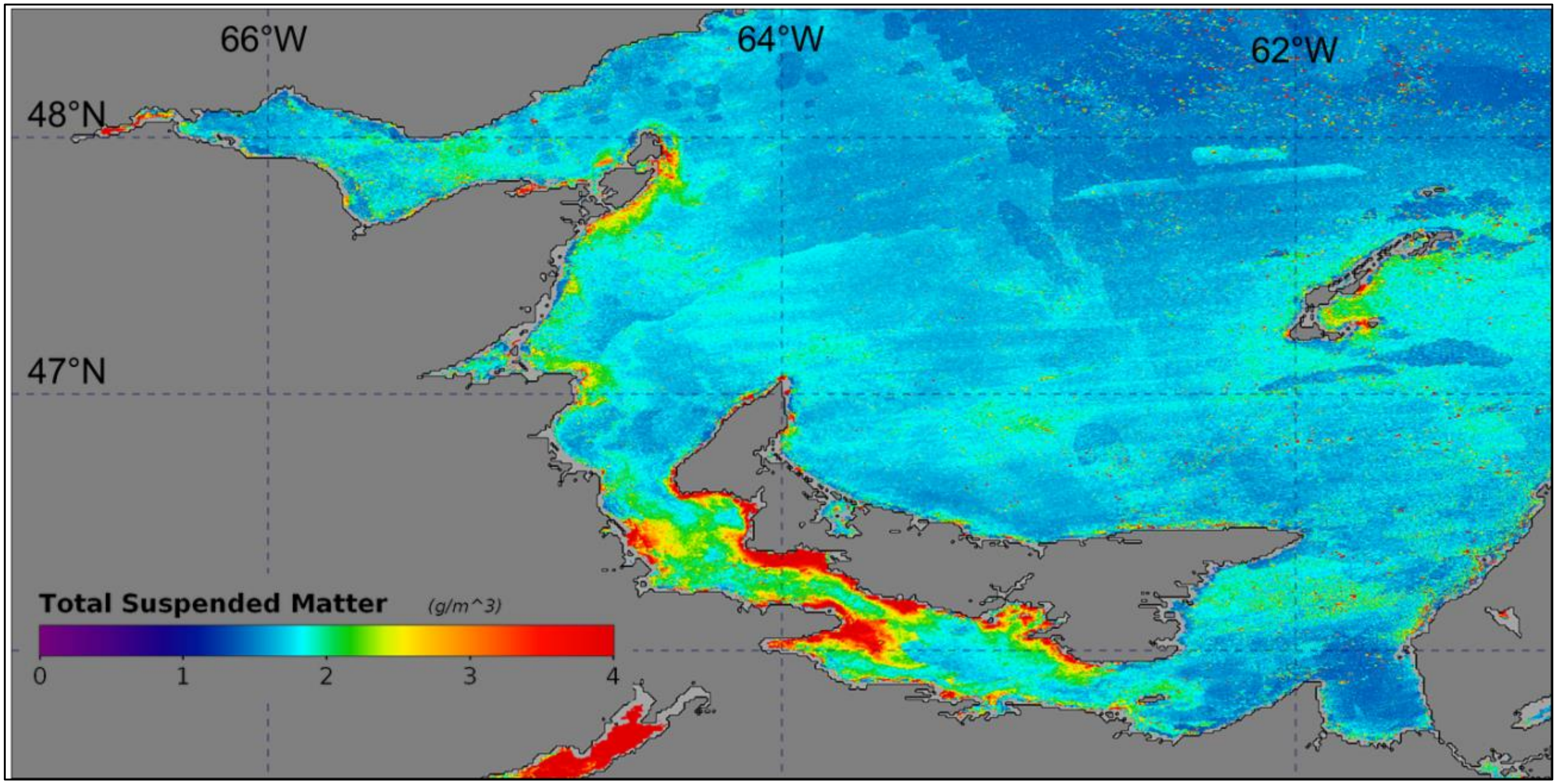


Figure 13 a) The geographical locations of Total Suspended Matter field measurements in 2006, b) Scatterplot of TSM in situ *and MODIS$_{Aqua}$ –derived values (g m^{-3}) including data from 2006 and 2016, the hatched line is a one to one relationship.*



Continuation of Figure 13 c) Composite image of TSM from MODIS$_{Aqua}$ (250m/pixel) from the period of field work in 2006 and 2016.

3. RESULTS

3.1 *IN SITU* DATABASE

The ground works in Northumberland Strait produced 21 sampling stations in 2016 and ten locations in 2017. The field activities around Haida Gwaii archipelago in 2018 resulted in fifteen sampling events. A detailed description of these results follows.

Environmental conditions in the Northumberland Strait during 2016 are summarized in Table 1 (SDD, Chlorophyll concentration and TSM). The vertical profiles (0.5 m steps) from 24 stations of temperature, salinity, Kd_490 and Kd_532, their averages and their associated standard deviations, are in Tables 4 to 27. The corresponding graphs, including surface remote-sensing reflectances spectra are compiled in the Appendix 1, from Figures APX1.1 to APX1.23.

The water analyses in Northumberland Strait for 2017 are shown in Table 2 (SDD, Chlorophyll concentration, TSM, POC and PON). Vertical profiles (0.5 m steps) of these ten stations (temperature, salinity, Kd_490 and Kd_532), average and their associated standard deviations, are in Tables 28 to 37. The matching graphs, and surface remote sensing reflectances spectra are shown in Figures APX1.24 to APX1.33.

Haida Gwaii's *in situ* measurement values in 2018 are shown in Table 3 (SDD, Chlorophyll concentration and TSM). The vertical profiles at 0.5 m steps for fifteen stations (temperature, salinity, Kd_490 and Kd_532), average and their associated standard deviations, are in Tables 38 to 52. The corresponding graphs as well as surface remote-sensing reflectances spectra are illustrated in Figures APX1.34 to APX1.48.

3.2 SATELLITE-DERIVED DATA

3.2.1 *MERIS*

Results on the first approach, inspecting the ten years of archived MERIS-derived TSM for each of CHS planned ALB project showed positive outcomes. A summary of the TSM analyses performed on the weekly MERIS (1 km/pixel) from 2002 to 2012 is shown in Figure 14. Seasonal and site specific trends are evident. The period with higher water clarity in the SGSL is between June and August for Hillsborough Bay, PEI eastern coast, Pictou and Pugwash, with a specific TSM minimum in the second week of July, and values between 0.41 and 1.01 (g m^{-3}). For the regions in Canada's Scotian Shelf, Jeddore and Medway, a similar temporal pattern is shown with TSM minima of 0.24 and 0.3 (g m^{-3}). Nevertheless, Rimouski region in the lower St. Lawrence Estuary, revealed a later temporal window, between July and September with an estimated minimum in the third week of August with 1.03 (g m^{-3}), associated with low river discharges this time of the year.

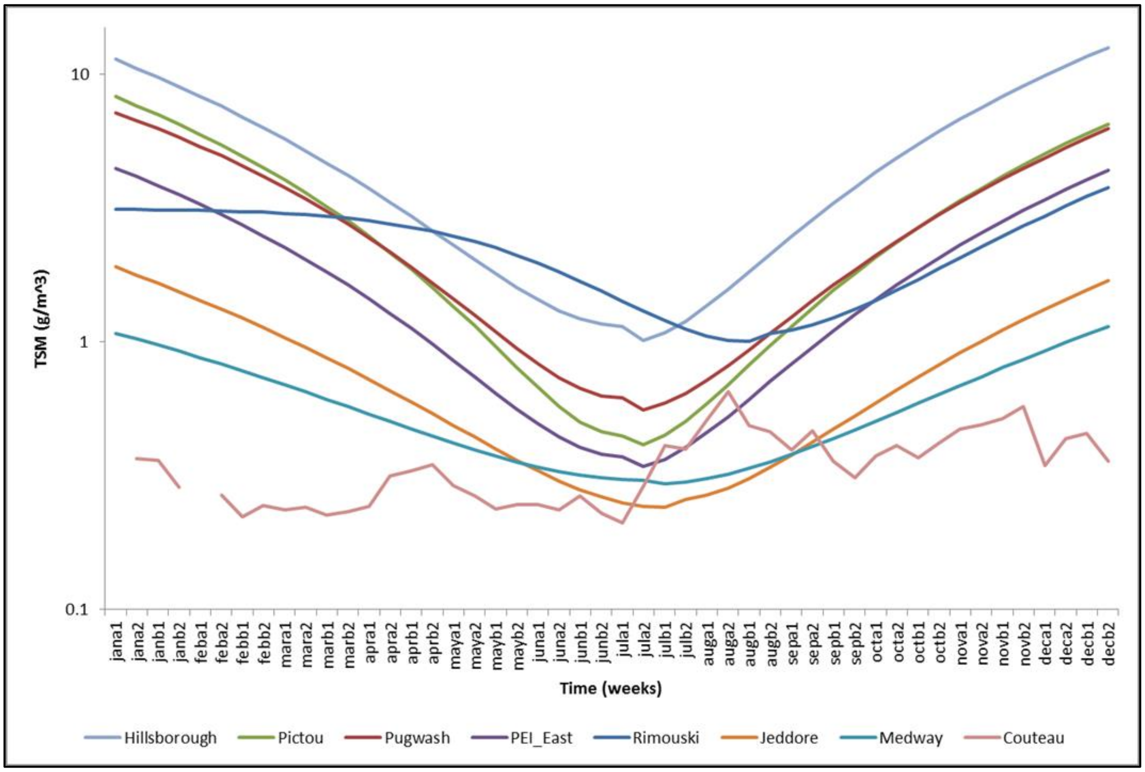


Figure 14. Summary of the weekly TSM (g/m^3) climatology derived from MERIS (1km/pixel) between 2002 and 2012. The regions are from the SGSL: Hillsborough Bay, Pictou, Pugwash, PEI Eastern Coast,. It also shows the Rimouski region in the lower St. Lawrence Estuary, as well as Jeddore, Medway and Couteau from Canada's Scotian Shelf. The lines represent a split Gaussian curve (Fuentes-Yaco et al, 2020).

3.2.2 *MODIS*

As previously described, a functional relationship was found between $MODIS_{Aqua}$ remote sensing reflectance and *in situ* observations of Secchi depths taken in Lobster Bay, NS and the Northumberland Strait. The resulting coefficients were used to compute Secchi depth maps to represent the water clarity spatial and temporal variations, extending the available information to earlier and later periods than the field measurements.

3.2.2.1 *Northumberland Strait 2015*

The Canadian Hydrographic Service (CHS) had originally scheduled their ALB field work in the Northumberland Strait for December, 2015. The results on water clarity from this study provided information for the planned flights. The corresponding maps did not support ALB activities in the area during the scheduled time, because the water clarity was not deep enough to ensure appropriate penetration of the LiDAR signal in the water column (white ellipse in Figure 15). Nevertheless, the analyzed area was large enough and showed the southern Newfoundland area (Burgeo) with very clear waters, as can be observed in the red circle in Figure 15 for December 26th, 2015. The Burgeo ALB resulted in one of the deepest areas surveyed throughout this project, approximately 30-35 m of LiDAR penetration. A set of daily maps of variables included physical and biological information (SST, SDD, TMS, Kd_490, Kd_532 and Chlorophyll *a*) for December 26th, 2015 is shown in Figure APX2.1, which depicts a larger area than the GSL (42° to 52°N and 55° to 70°W).

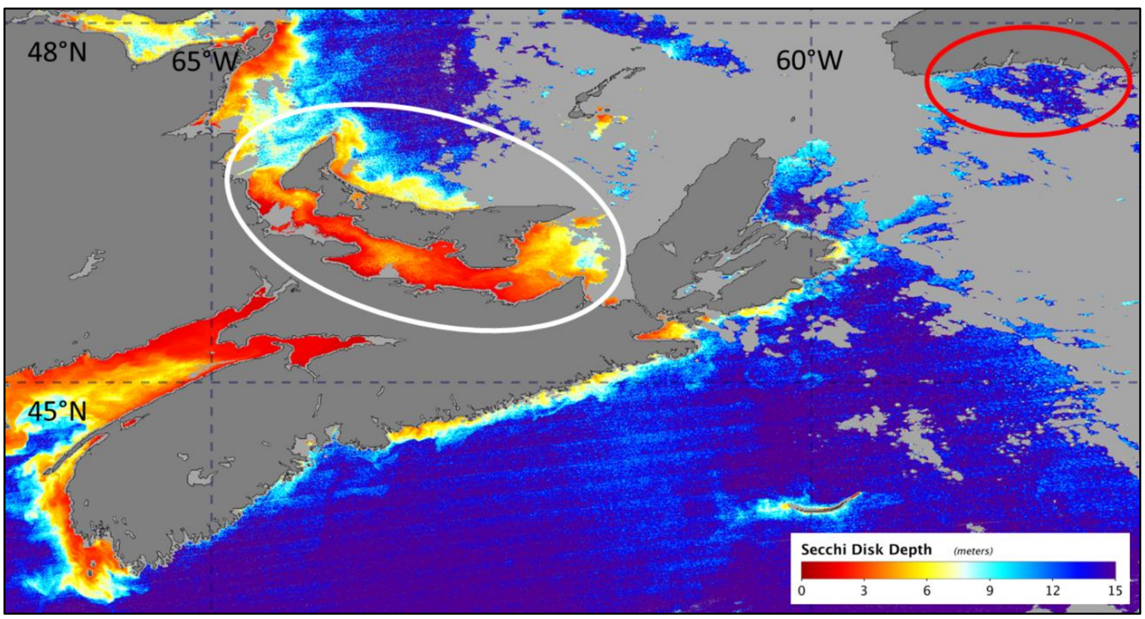


Figure 15. MODIS$_{Aqua}$ (250m)-derived Secchi Disk Depth (m) on December 26th, 2015 showing the Northumberland Strait, Southern Gulf of St. Lawrence (white ellipse), and Burgeo, Southern Newfoundland (red ellipse).

3.2.2.2 *Northumberland Strait 2016*

The encouraging results obtained for planning ALB in the Northumberland Strait and southern Newfoundland coasts in 2015, stimulated the application of this approach for the organization of field works in the coming year. In 2016, the first attempt of flights was scheduled for July and August 2016. As a consequence, some images were processed from late June until mid-August, as seen in Figures 16, 17 and 18. As expected, the daily time-series of SDD results showed the best possible conditions to fly the LiDAR sensor.

The period of field work in the Northumberland Strait during 2016 was within the acceptable range of water transparency predicted by the TSM MERIS climatology. In addition, the sequence of daily MODIS SDD images confirmed the forecasted good water clarity conditions. As projected, the ALB results were of high quality. The set of daily maps of variables corresponding with the field sampling period included physical and biological information (SST, SDD, TMS, Kd_490, Kd_532 and Chlorophyll *a*). The ninety resulting maps show data for July (five days) and August (ten days) in Appendix 2 (Figures APX 2.2 to APX 2.16). The 48 weekly composite images summarizing all available variables and pixels during the period of July and August are shown in Appendix 3, Figures APX 3.1 to APX 3.8.

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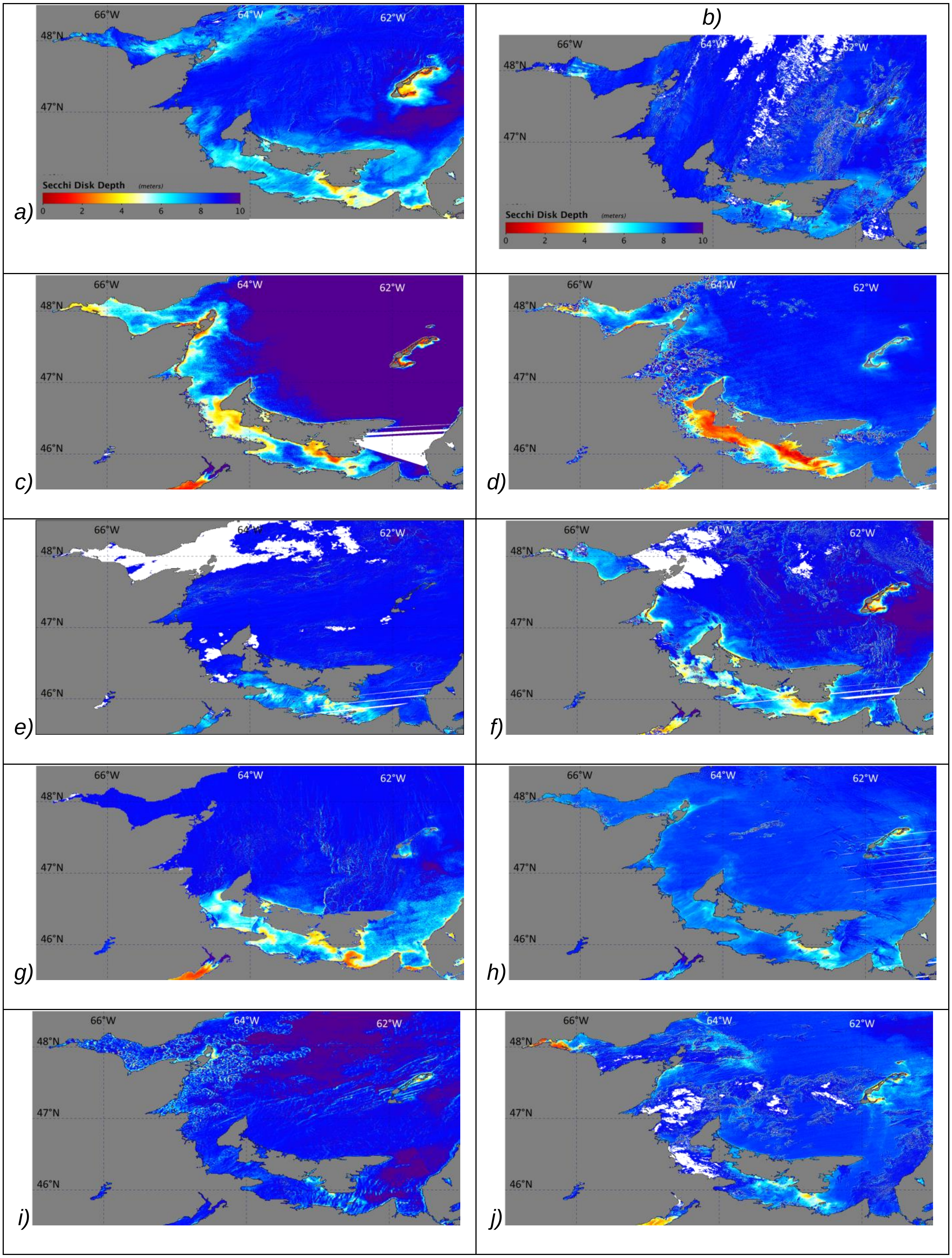
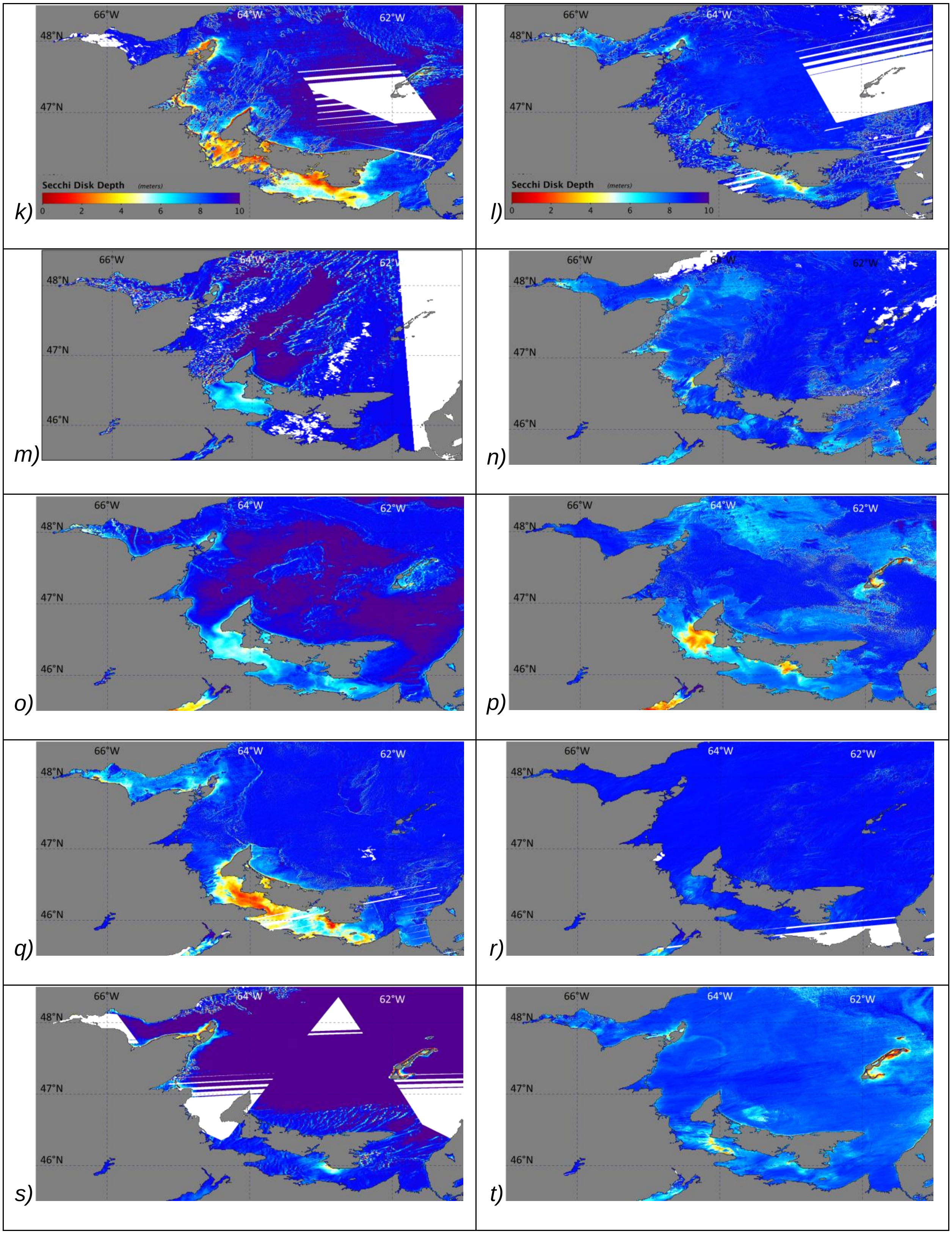
Next two pages:

Figure 16. MODIS$_{Aqua}$ (250 m)-derived Secchi Disk Depth (m) showing the Northumberland Strait, southern Gulf of St. Lawrence in 2016: a) June 19th, b) June 21st,c) July 1st, d) July 4th, e) July 5th, f) July 12th, g) July 13th, h) July 14th, i) July 15th,and j) July 16th.

Figure 17. MODIS$_{Aqua}$ (250 m)-derived Secchi Disk Depth (m) showing Northumberland Strait, Southern Gulf of St. Lawrence in 2016: k) July 19th, l) July 20th, m) July 22nd, n) July 23rd, o) July 24th, p) July 25th, q) July 27th, r) July 28th, s) July 31st, and t) August 1st.


a)
b)
c)
d)
e)
f)
g)
h)
i)
j)
66°W
64°W
62°W
48°N
47°N
46°N
Secchi Disk Depth (meters)
0 2 4 6 8 10


k)
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r)
s)
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66°W
64°W
62°W
48°N
47°N
46°N
Secchi Disk Depth (meters)
0 2 4 6 8 10

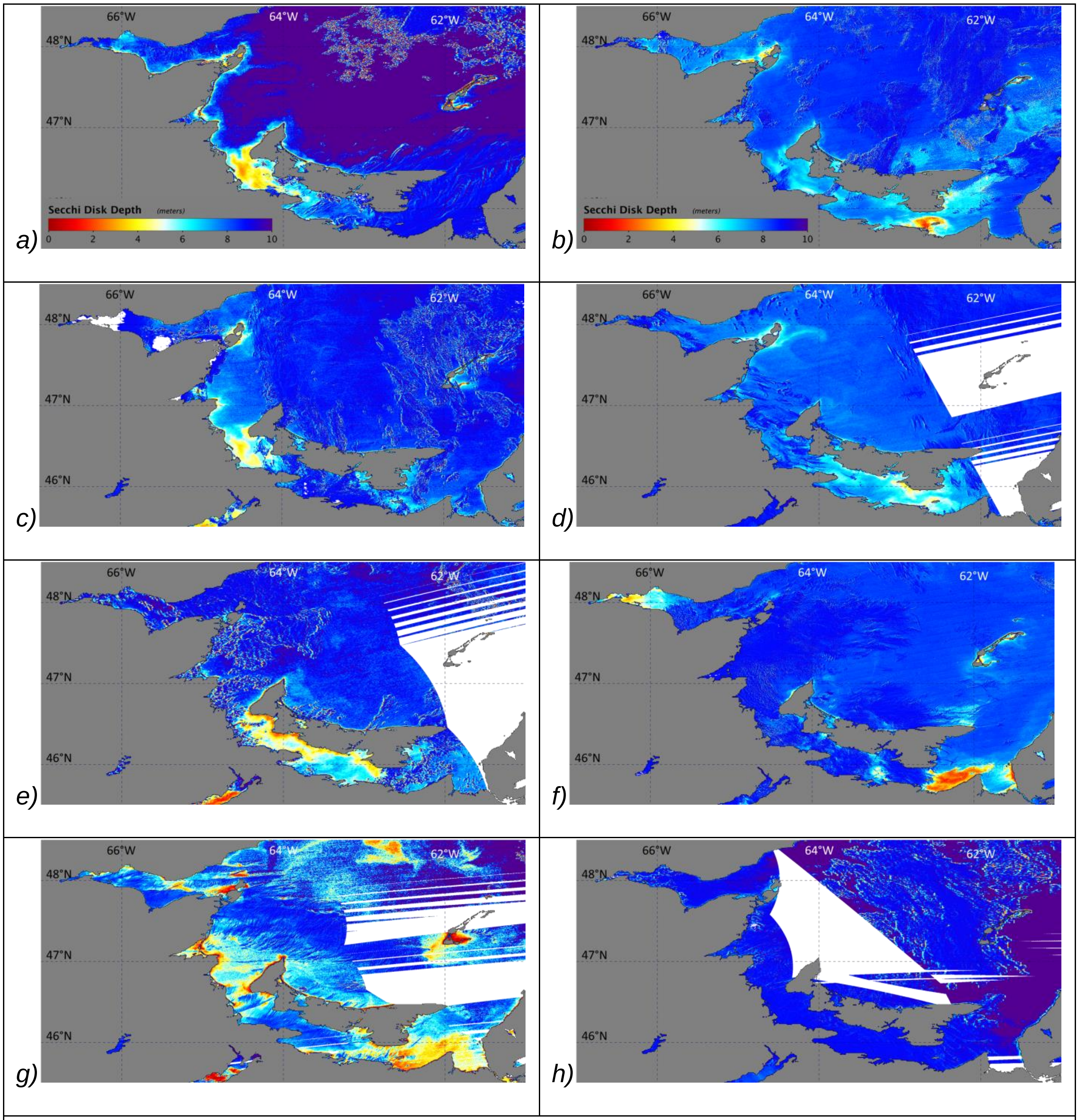


Figure 18. MODIS$_{Aqua}$ (250 m)-derived Secchi Disk Depth (m) showing Northumberland Strait, southern Gulf of St. Lawrence in 2016: a) August 2nd, b) August 3rd, c) August 4th, d) August 5th, e) August 7th, f) August 10th, g) August 13th, and h) August 16th.

The ALB activities were still operative in October, 2016, and an attempt was made to continue charting the Northumberland Strait. According to the MERIS TSM climatologies, by this late in the year the water in this region is not clear enough to chart the bottom. The water clarity conditions measured by MODIS did not support ALB activities in the region (Figure 19a and b). Fortunately, the Scotian Shelf and Northumberland coasts did show some promising areas (Figure 19c, d, e and f, respectively). Logistical inconveniences prevented the flying of LiDAR this time of the year, despite some places being detected with the potential for positive results.

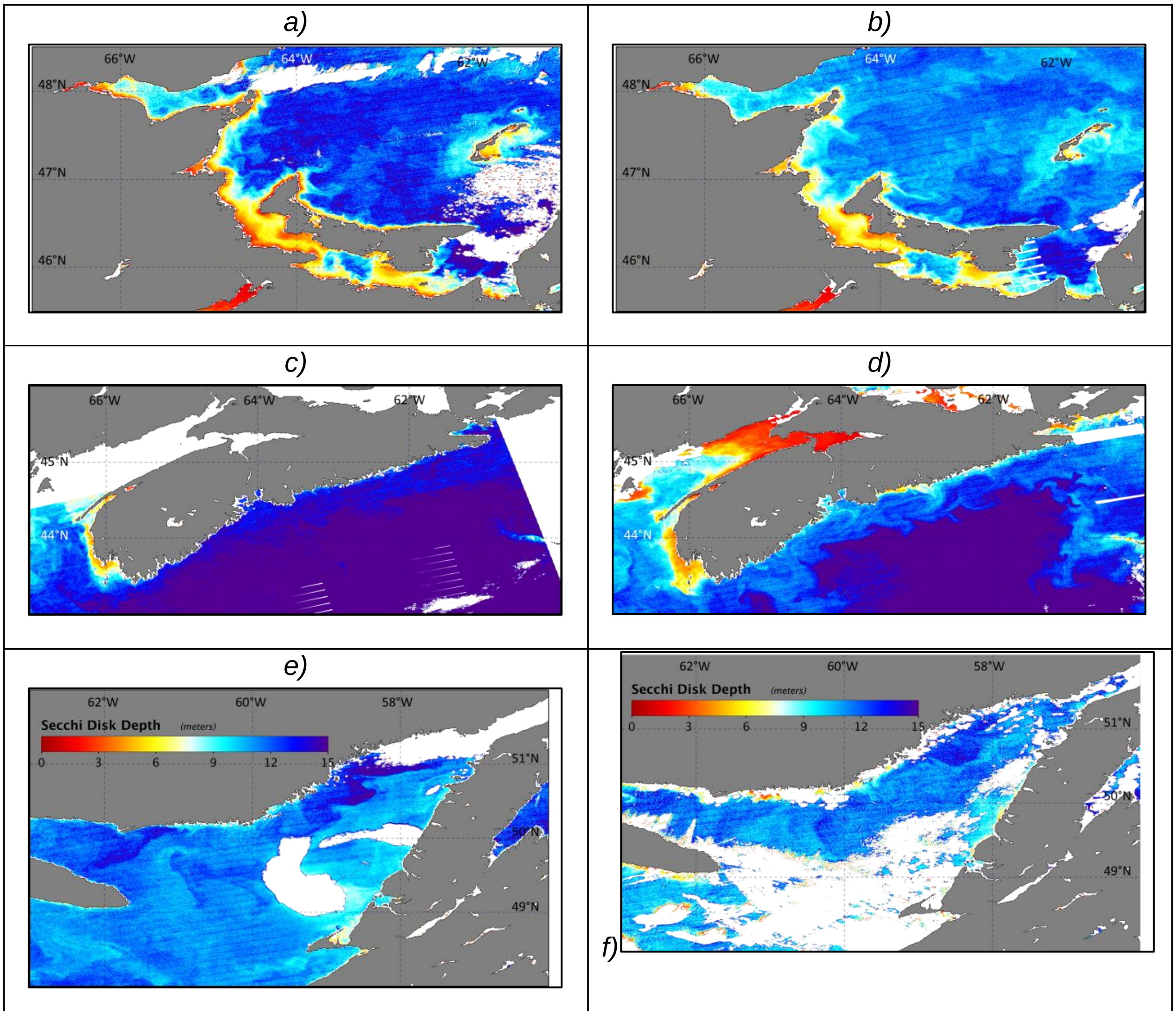
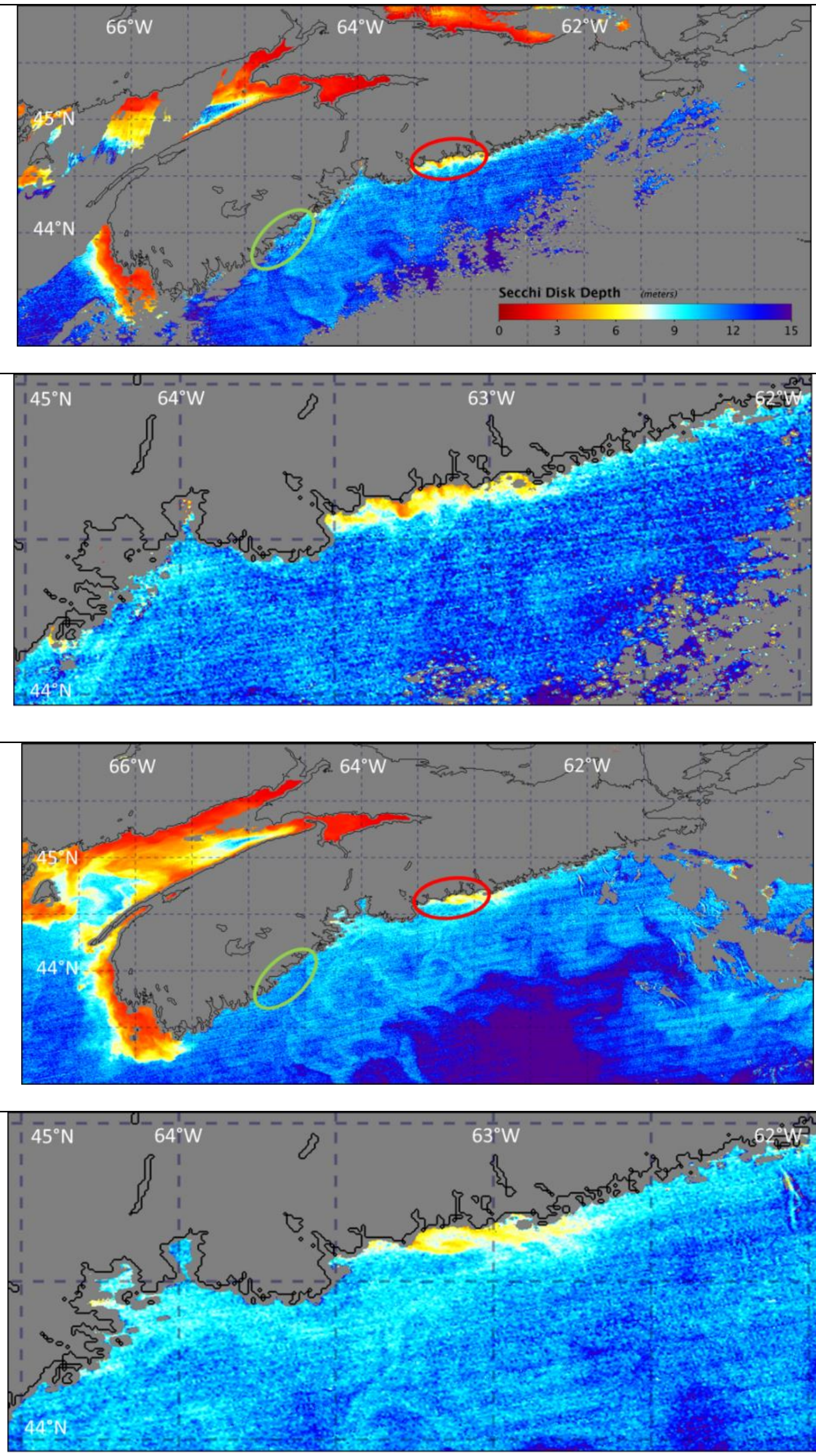


Figure 19. Daily images of MODIS$_{Aqua}$-derived Secchi Disk Depth (m) in October 2016. southern Gulf of St. Lawrence on October 4th and 6th: a) and b) respectively. Scotian Shelf and the northeastern Gulf of St. Lawrence on October 6th and 20th: c), d), e) and f), respectively.

Fortunately, the opportunity to continue ALB work on the eastern and south shores of Nova Scotia became available in mid-November, 2016. High resolution observations on the corresponding MODIS maps of water clarity (SDD) for November 12th and 14th, 2016, showed the area near Jeddore Harbour (as outlined in red) had relatively poor transparency (Figure 20). ALB operations were delayed based on this analysis and moved initially further to the east near Sheet Harbour, NS and then to the south shore as shown circled in green (Figure 20) An alternative ALB survey region with clearer conditions was proposed, between LaHave and Port Mouton Islands, NS. This late season ALB survey continued into the winter with relatively stable (although not ideal) water clarity in the south shore, NS survey areas. Based on experience gathered from near-time $MODIS_{aqua}$ and the known impacts of meteorlogical conditions on the water clarity, it was possible to reasonably predict whether conditions would be conducive to ALB surveys. This prevented costly, unnecessary flight sorties and allowed the ALB survey program to continue well beyond the expected end date.



a)

b)

c)

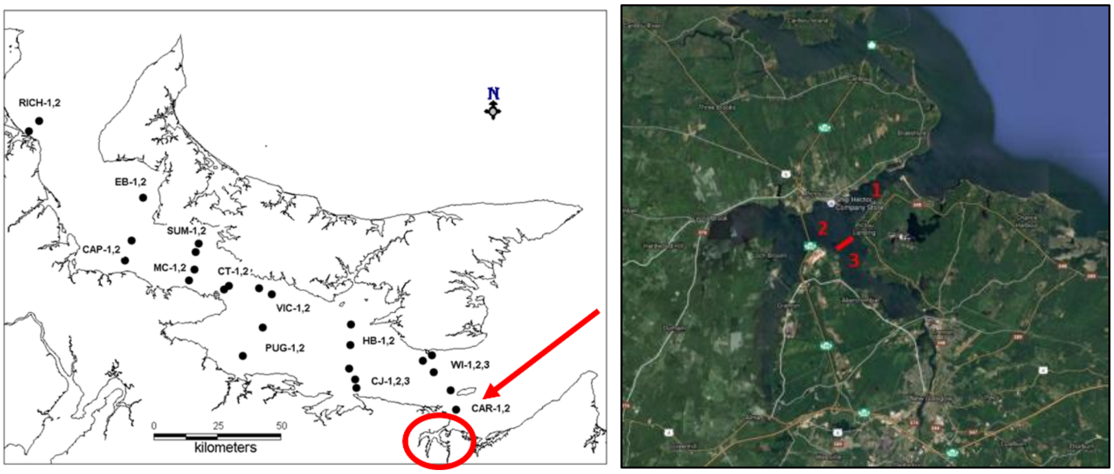
d)

Figure 20. MODIS$_{Aqua}$-derived SDD (m) on November 12th (a) and 14th (c) 2016; Jeddore (b) and the coast between LaHave and Port Mouton (d) Islands (red and green ellipses, respectively).

3.2.2.3 *Pictou Landing*

Pictou Landing area in the Northumberland Strait is of particular interest because of its optical characteristics derived from the water column constituents. At the time of the present study, there was a paper mill sending treated effluents into the adjacent waters which may have some impact on the water features. The *in situ* measurements of Secchi Disk Depth, Chlorophyll *a* and Total Suspended Matter at three stations and three depths sampled on August 16th, 2016, showed the middle and bottom layers with higher values than the surface (Figure 21a, b). Results of an ALB transect on the site revealed a marked difference between the signal penetration on the Abercrombie (left side) and Pictou Landing (right side), with the data showing broad areas of noisy values around the 2 m depth. Winds were light during the flight, thus not a serious inconvenience. The LiDAR signal returns from other regions in Northumberland Strait were satisfactory, but the Pictou region did not produce good reflection from the bottom (Figure 21 continuation). These results were not assessed in detail during this study, however they suggest a further examination of the area's characteristics and their temporal evolution may prove useful.

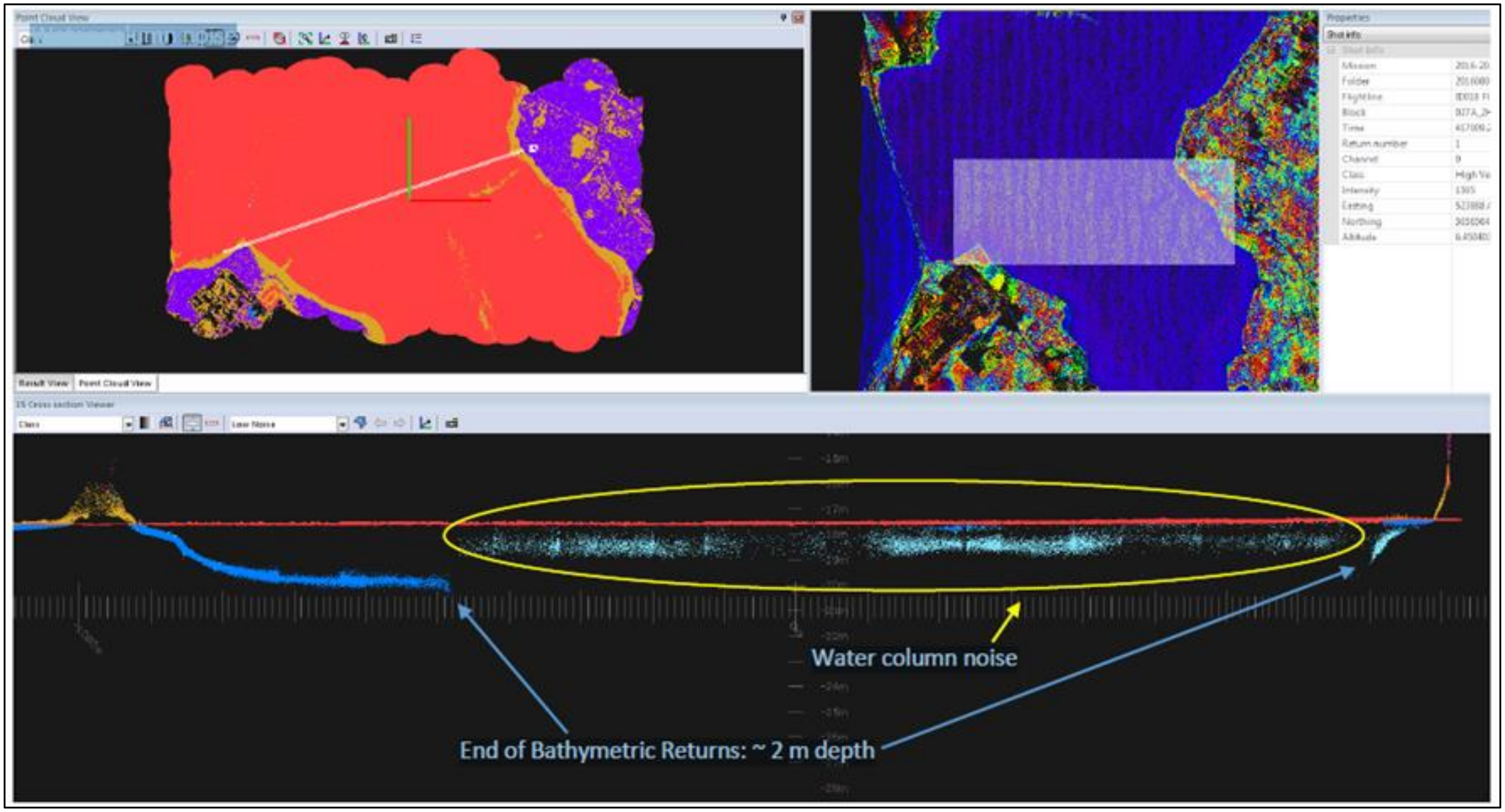
a)



b)

STATION	Sounding Depth (m)	Secchi D. Depth (m)	Sample Depth (m)	Surface CHL (mg m^{-3})	Surface TSM (g m^{-3})
1	12.0	2.6	0	3.34	4.02
			5	10.17	4.38
			8	6.53	3.93
2	12.0	3.0	0	3.86	3.04
			2	8.29	3.63
			5	7.72	4.27
			8	4.97	3.19
3	7.5	2.6	0	3.29	2.68
			2	7.07	7.20
			5	8.75	10.63

Figure 21. Pictou Landing region in the southern Northumberland Strait. a) location and b) data at three stations in the area: sounding depth, SDD, Chl_a and TSM.



Continuation of Figure 21. LiDAR transects from Abercrombie (left side) to Pictou Landing (right side) showing noisy returns at approximately 2 m depth.

3.2.2.4 *Northumberland Strait 2017*

Field work in 2017 was divided in two main regions and periods: i) the Northumberland Strait from May until July, and ii) the western Newfoundland coast in October. The former area is presented below and the latter in the next section.

Planning of ALB for 2017 started by examining the water clarity conditions since the end of May (28^{th} to 30^{th}), to track the evolution of water quality conditions. Figure 22 shows Secchi disk penetration depth values at consistently less than 5 m in large areas, meaning that for this time of the year, the water was still too turbid for LiDAR penetration in the region.

A second attempt for ALB was scheduled for July, 2017, thus preliminary analyses were developed for the end of June (25^{th}) until early July (9^{th}), as illustrated in Figure 23a to h. This exploratory study showed clearer waters in the Northumberland Strait, thus the decision to fly the LiDAR sensor during this time was made.

Finally, ALB was performed between June 25^{th} and August 10th, 2017; the field sampling was executed on July 10^{th} and 11^{th}. The meteorological conditions did not allow cloud free $MODIS_{\textit{Aqua}}$ images for the entire Northumberland Strait on both days, however the water column was calm thus the airplane sorties were successful. Figures 24a and b show the water clarity maps (SDD) for each date. July 9^{th} shows large areas of the central and western Strait with good water transparency, whereas the July 10^{th} image shows only a small portion free of clouds on the eastern side of the Strait. The weekly satellite composite (9^{th} to 15^{th} July, Figure 24c) provided a summary of the water clarity conditions with average SDD values deeper than 5 m and highlighted the best possible conditions for ALB in the region.

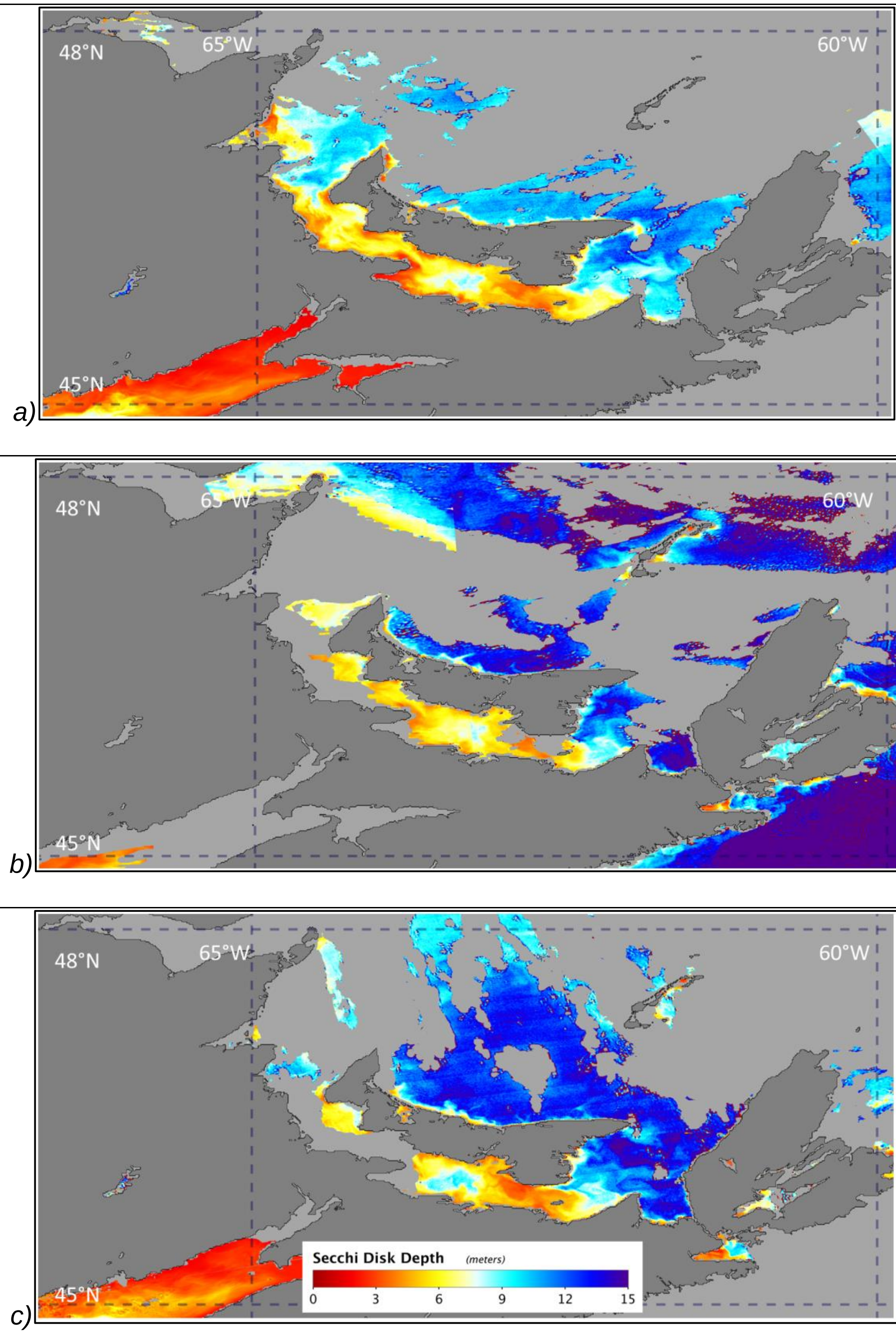


Figure 22. Water clarity maps as MODIS$_{Aqua}$ Secchi Disk Depth (m) from the Northumberland Strait in 2017. a) May 28^{th} (doy =148), b) May 29^{th} (doy =149), c) May 30^{th} (doy =150).

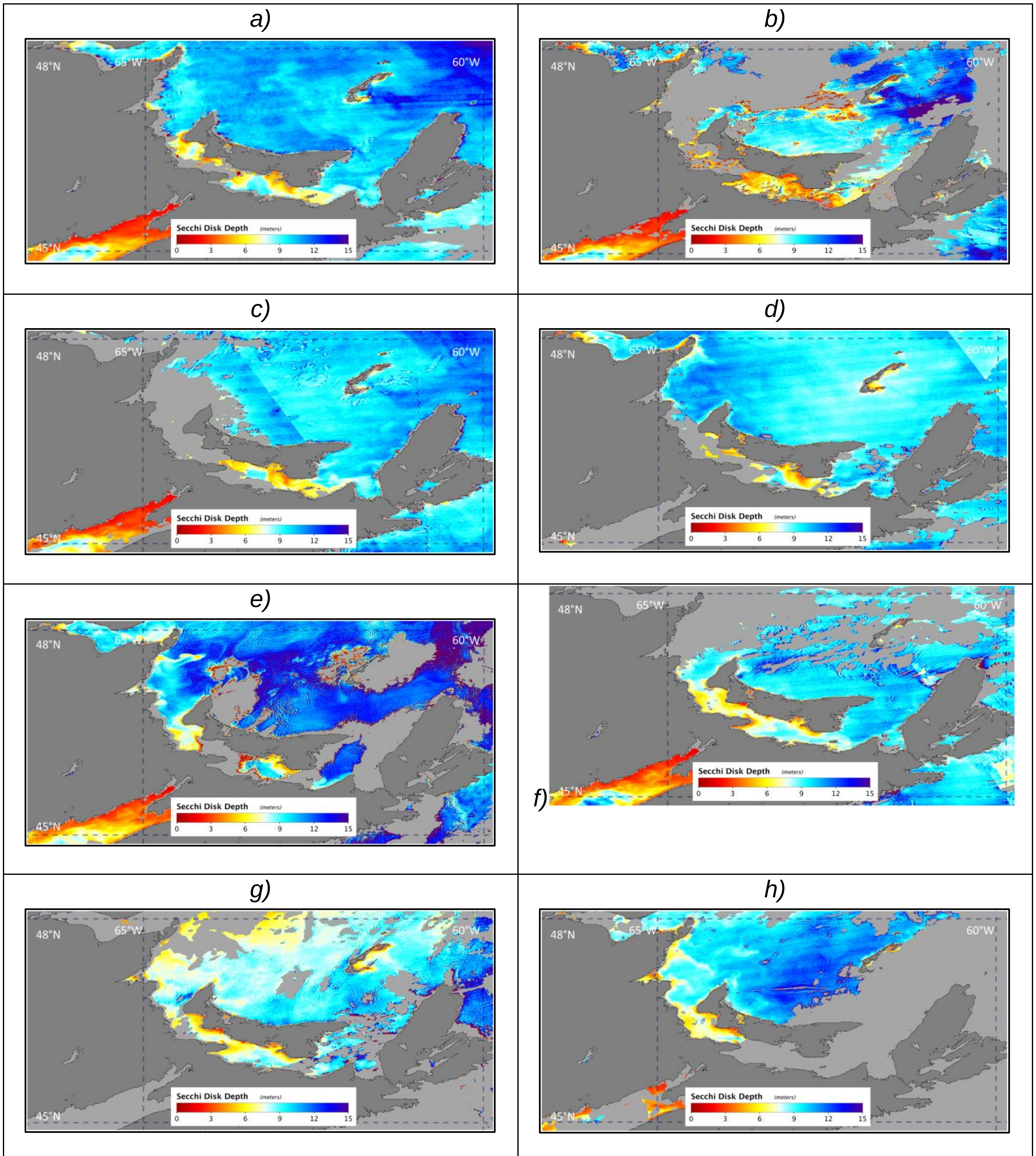
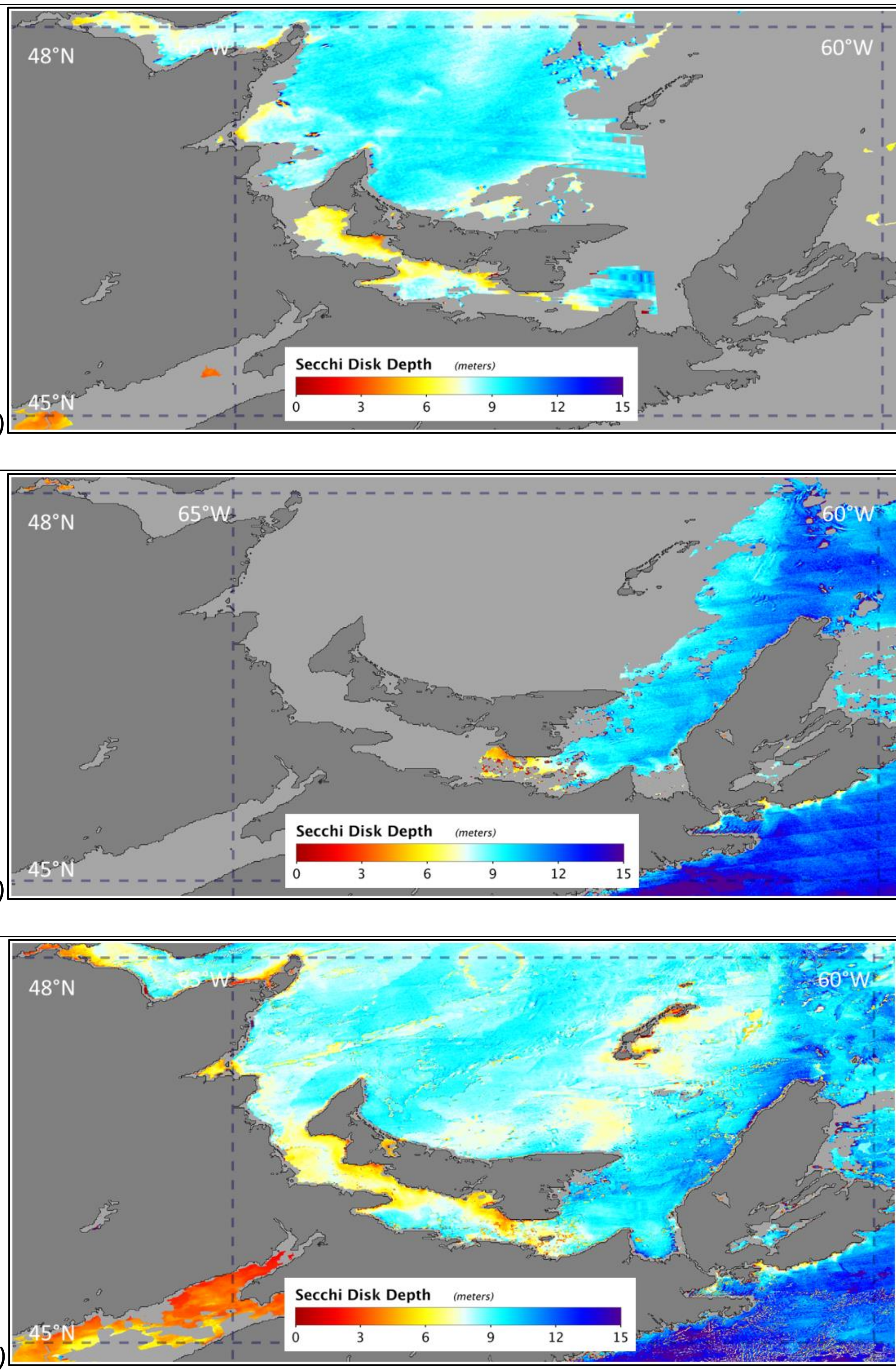


Figure 23. Water clarity maps as MODIS$_{Aqua}$ Secchi Disk Depth (m) from the Northumberland Strait in 2017. a) June 25th (doy =176), b) June 26th (doy =177), c) June 27th (doy =178), d) June 29th (doy =180), e) July 5th (doy =186), f) July 6th (doy =187), g) July 7th (doy =188), h) July 9th (doy =189).



a)

b)

c)

Figure 24. Water clarity maps as MODIS$_{Aqua}$ Secchi Disk Depth (m) from the Northumberland Strait in 2017. a) July 9th (doy =190), b) July 10th (doy =191), and c) weekly composite of July 9th to 15th (doy =190 to 196).

A third attempt to perform ALB in Northumberland Strait was projected for later in the year, in October, 2017. As with the first attempt, preliminary SDD maps of MODIS$_{Aqua}$ were processed for late September (Figure 25). It is important to mention here that historical MERIS data did not predict acceptable water clarity for this time of the year in the Strait. In fact, the images in Figure 25 confirmed the forecasts.

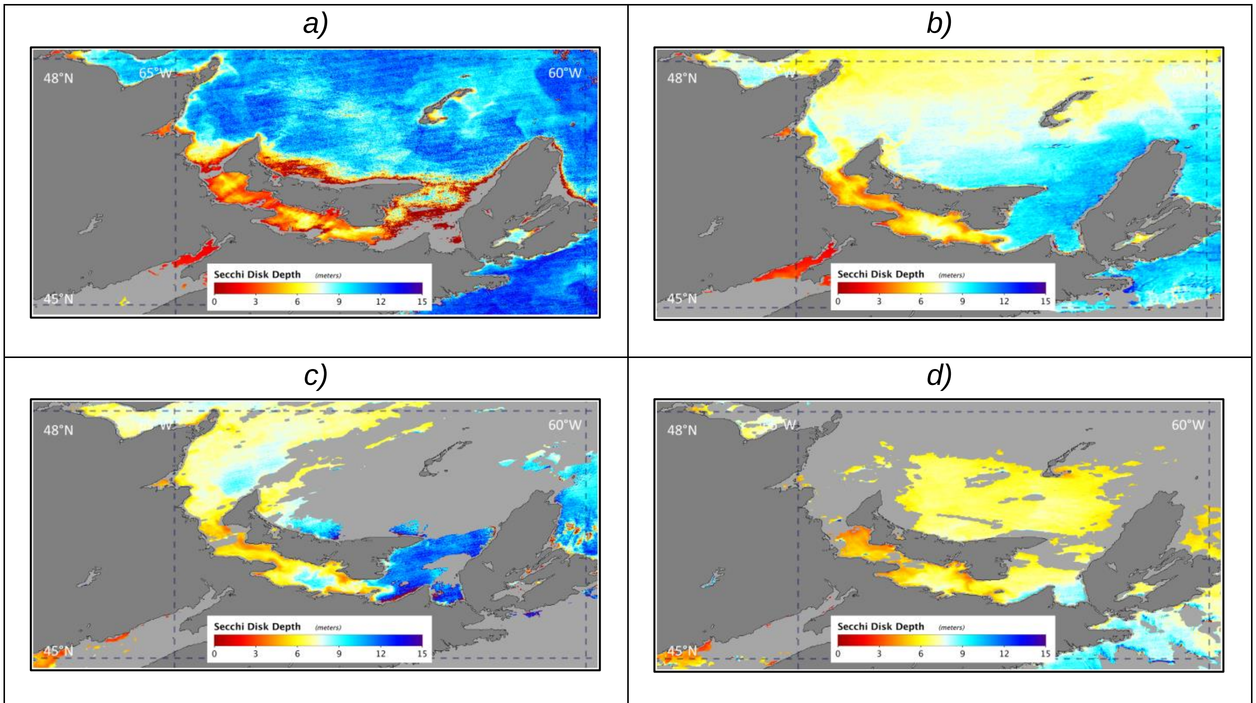


Figure 25. Water clarity maps as MODIS$_{Aqua}$ Secchi Disk Depth (m) from the Northumberland Strait in 2017. a) September 21st, (doy =264), b) September 22nd, (doy =265), c) September 23rd, (doy =266), d) September 26th, (doy =269).

3.2.2.5 *West Coast Newfoundland*

As part of the Ocean Protection Plan, CHS planned to perform ALB activities in Newfoundland: on the southwest coast between Rose Blanche and Port aux Basques; on the west coast: Bonne Bay (chart under construction), Port aux Choix north to Cape Bauld (old charts), Port au Port (old charts), and Bay of Islands (new charts); and other areas still in planning stages: the south and west coasts of the island are noted for being compiled with large areas of primarily French and British Admiralty data sources dating to the 1800's, as shown in Figure 26.

Successful ALB was completed in October, 2017, when the water clarity conditions were good and the flights provided excellent results. Figures 27a to d show the SDD maps for selected days between September 30th and October 31st . Figures APX 2.17 to APX 2.43 show daily images for the set of variables used in 2017, as follows: May (three days), June (four days), July (six days), September (five days), and October (nine days) for a total of 162 daily maps. Figures APX 3.9 to APX 3.18 show 60 weekly composites of all the environmental variables.

In this case, the monitoring of water clarity was of vital importance as it directly impacted the project's overall flight and mission planning. The initial plan for the survey was to proceed first with the southern Labrador project area near the Strait of Belle Isle on the northern tip of Newfoundland. It was expected that weather conditions would cause problems further north so these would be completed first, but SDD water clarity indications were far better in the southern areas of the west coast of Newfoundland. From this SDD data, the decision was made to begin the project in the southern survey areas instead. The ALB results were very good, closely reflecting the indications derived from the $MODIS_{aqua}$ SDD model data. As the survey progressed, the water clarity conditions improved to the north and survey operations were gradually shifted to these survey areas. Once again, the depth results of the ALB were corresponded with the $MODIS_{aqua}$ SDD models, and very good quality ALB data was acquired during this segment of the project.

The western Newfoundland and southern Labrador survey was an excellent example of an exceptional improvement in data quality achieved as a result of having the ability to analyze *in situ* water clarity information and provide Secchi depth estimations in near-time. This knowledge allowed the mission plans to be advantageously altered, resulted in very significant cost savings relating to survey mobilization and wholly improved the overall quality of the ALB data collected.

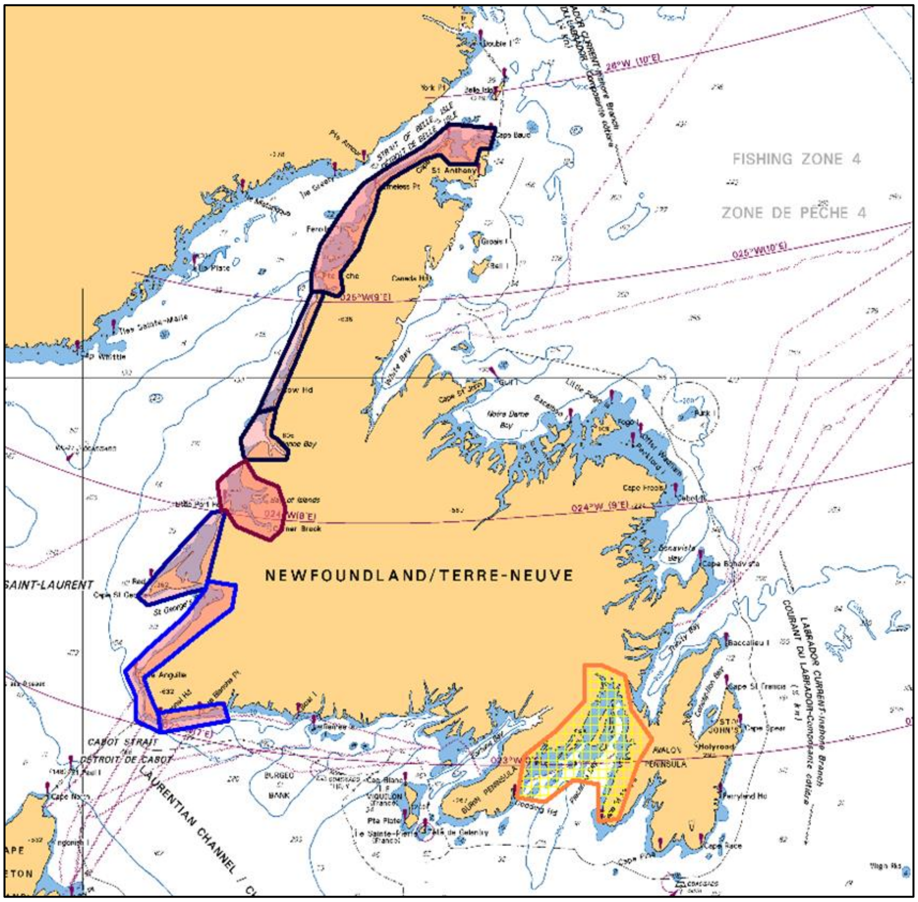


Figure 26. Eastern Northumberland coast ALB surveys planned for between 2017 and 2019.

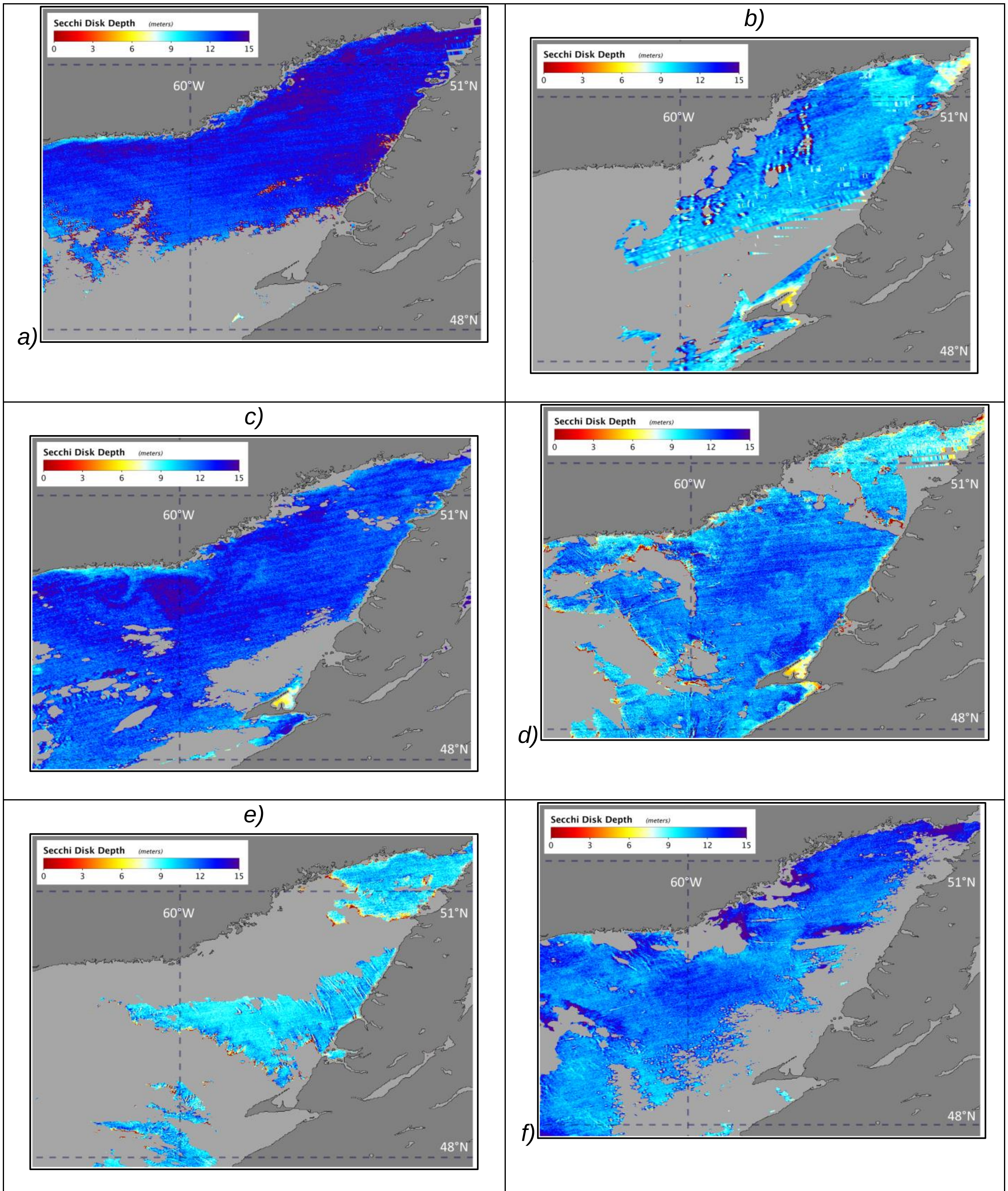


Figure 27. Water clarity maps as MODIS$_{Aqua}$ Secchi Disk Depth (m) from Newfoundland western coast in 2017. a) September 30th (doy=273), b) October 3rd (276), c) October 6th (279), d) October 7th (280), e) October 9th (282), f) October 13th (286).

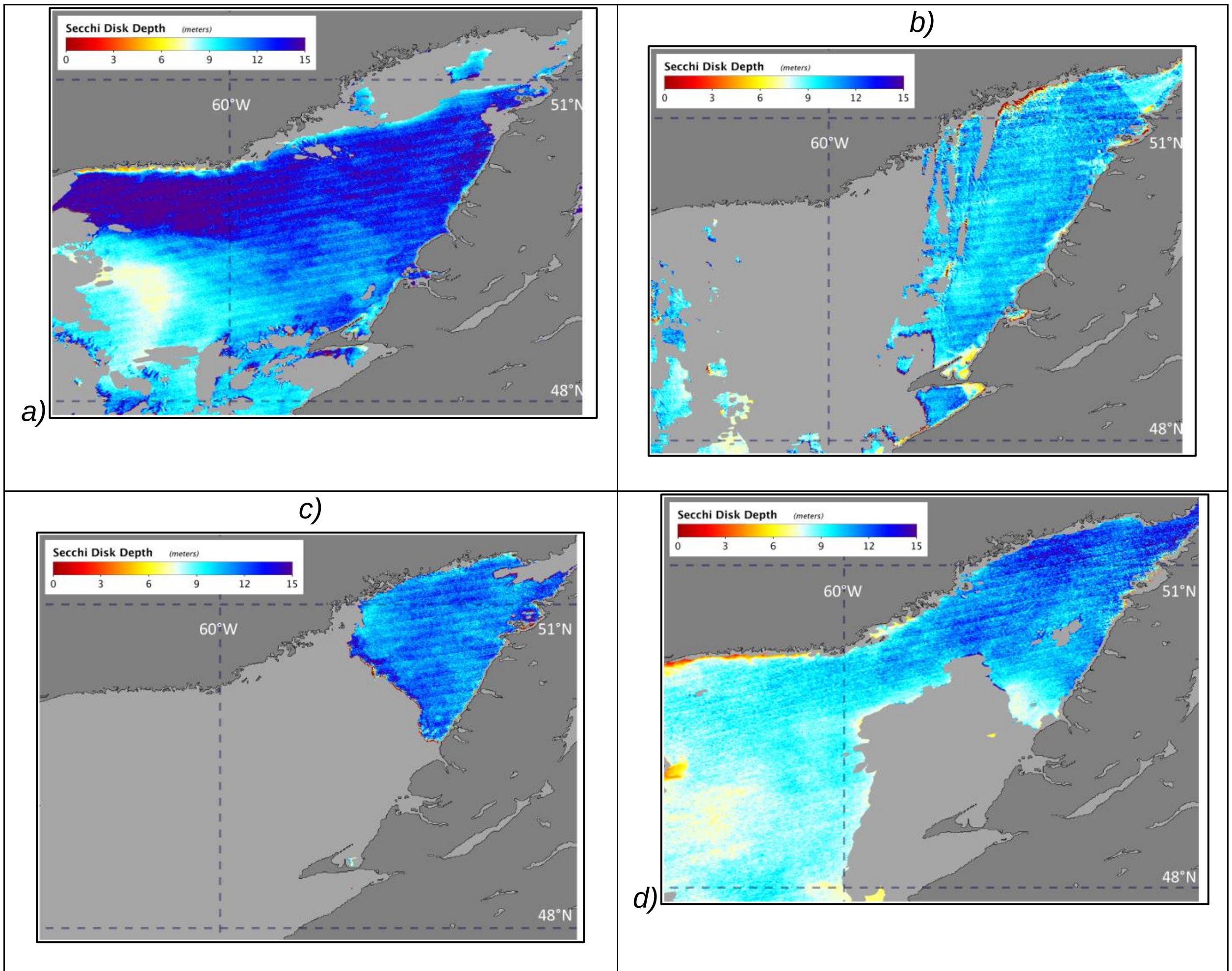


Figure 28. Water clarity maps as MODIS$_{Aqua}$ Secchi Disk Depth (m) from Newfoundland western coast in 2017. a) October 20th (doy=293), b) October 23rd (296), c) October 27th (300), d) October 31st (304).

3.2.2.6 *Haida Gwaii*

The expertise developed for the eastern coasts was applied in the Haida Gwaii archipelago, thus preparatory work to plan ALB started in 2017 by producing and analyzing a time series of Total Suspended Matter (TSM). MERIS–derived weekly climatological data were computed for the period between 2002 and 2012, at a spatial resolution of 4 km/pixel. The results showed strong variability of suspended material concentration throughout the year, however they also suggested a potential period of better water transparency in June and July, as seen in Figure 29. Consequently, this time of the year was used to do the field work in 2018, in particular the northern region of the study area.

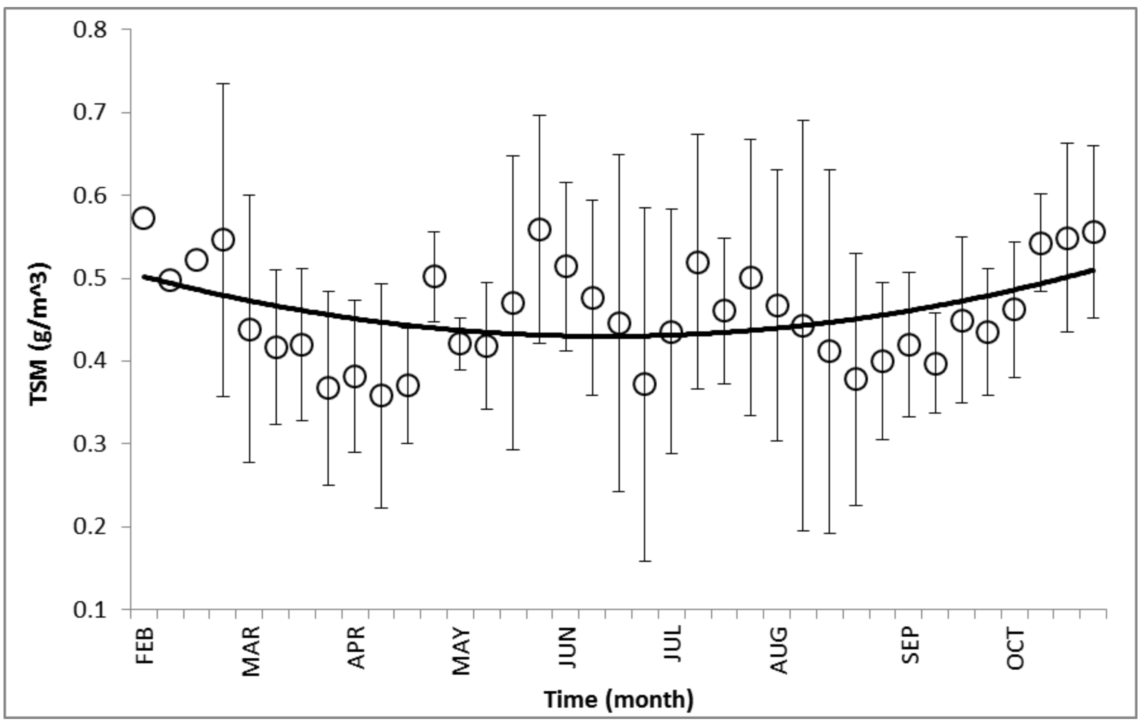


Figure 29. Climatology (2002-2012) of Total Suspended Matter (g/m^3) derived from MERIS (4 km/pixel) for the surrounding region of Haida Gwaii's archipelago. The circles refer to the long-term average, the bars are a standard deviation and the thick line is a second order polynomial fit.

Planning of the LiDAR flights for 2018 in the west coast area was approached with the method tested in Atlantic Canada using specifically produced maps of $MODIS_{Aqua}$ oceanographic variables: SDD, Chlor_a, TSM, Kd at 490 nm and 532 nm, and SST. In April, four daily sets of maps were computed and in May, there were 15 daily collections. During field work in June, 13 days of maps were produced. The exercise concluded in July with 24 days of data. Figures 30 to 32 show some examples of water clarity (SDD).

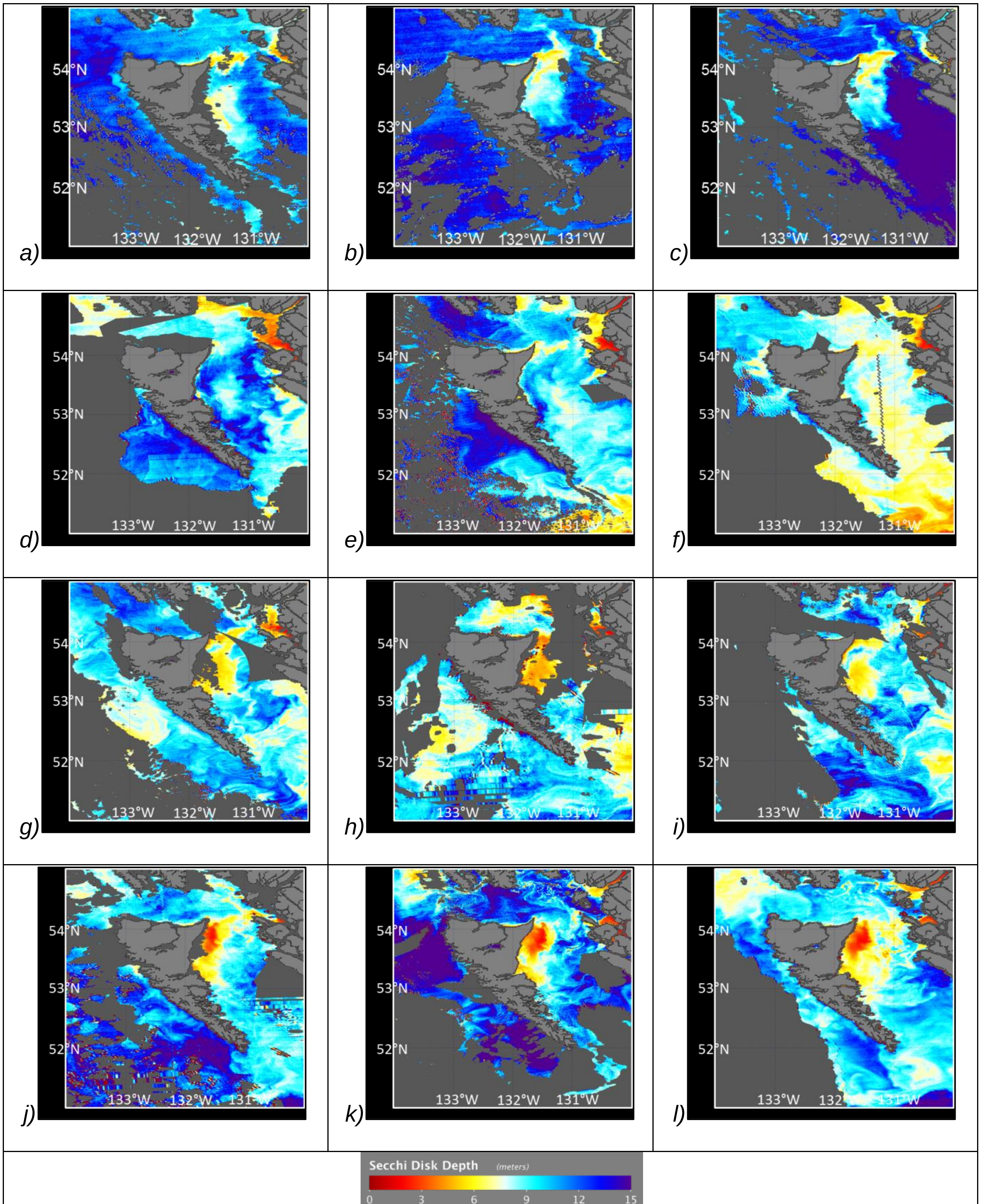


Figure 30. MODIS$_{Aqua}$ SDD (m) from Haida Gwaii in 2018. a) April 1st (doy=91), b) April 15th (105), c) April 16th (106), d) May 6th (126), e) May 16th (136), f) May 17th (137), g) June 15th (166), h) June 16th (167), i) June 17th (168), j) July 2nd (183), k) July 3rd (184), l) July 4th (185).

During the field work in June, only five days of MODIS data were available due to meteorological conditions; Figure 31 shows four maps of SDD (June 8th to 11th). The *in situ* measurements of water clarity matched the general pattern of water transparency shown in the images. The values oscillated between 6.5 m and 10.5 m of SDD in the northern sites, while in the western area they fluctuated between 3 m and 8 m.

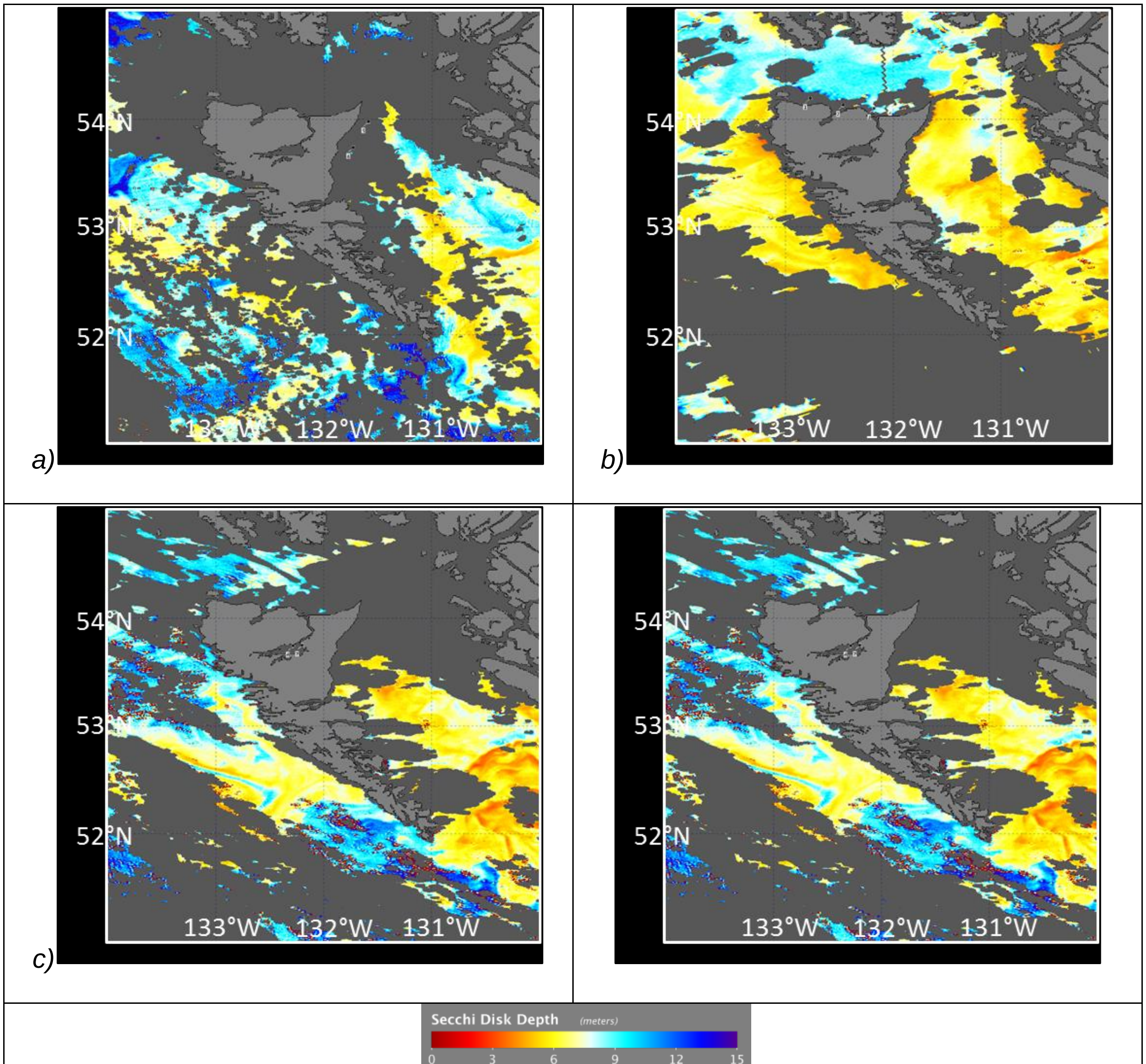


Figure 31. MODIS$_{Aqua}$ SDD (m) from Haida Gwaii in 2018. a) June 8th (doy=159), b) June 9th (doy=160), c) June 10th (doy=161),and d) June11th (doy=162).

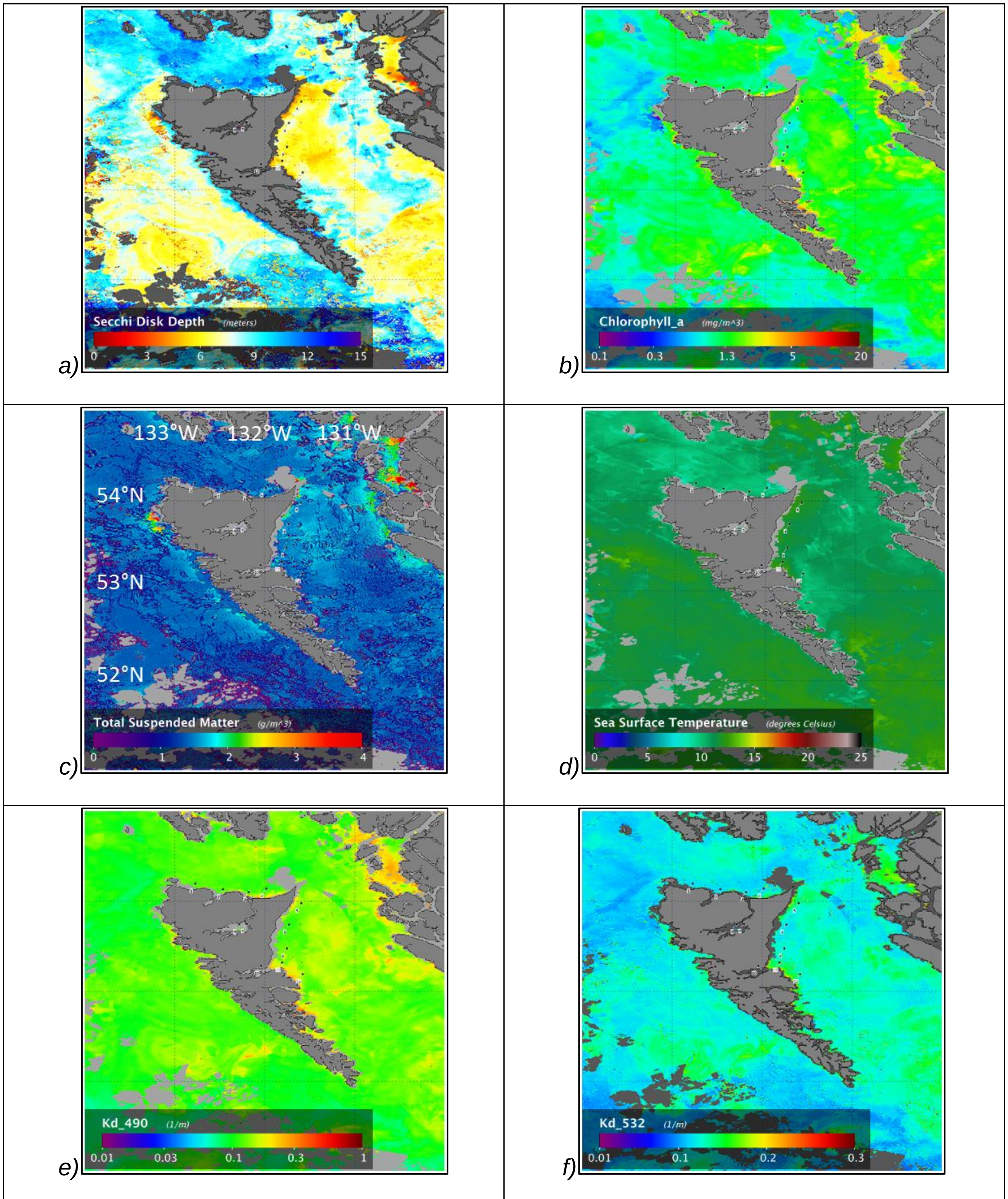


Figure 32. MODIS$_{Aqua}$ weekly composites (June 9th to 15th) of environmental variables in Haida Gwaii archipelago: a) SDD, b) Chlor_a, c) TSM, d) SST, e) Kd_490 and f) Kd_532.

As final examples of remotely sensed data, Figure 32 shows the weekly composites of six oceanographic variables. These maps summarize the daily variability allowing a general understanding of the physical and biological conditions during the field work between June 9th and 15th, 2018.

Overall, a total of 336 daily maps were computed for 2018 in the Haida Gwaii region; these images are shown in Figures APX 2.44 to APX 2.82. This daily available information was composited to produce 54 weekly maps shown in Figures APX 3.19 to APX 3.27.

3.3 COEFFICIENT OF ATTENUATION (Kd) IN THE BEDFORD BASIN

A specific project was implemented in the Bedford Basin, Halifax Harbour, NS on December 6th, 2016, with the main goal of determining the water column attenuation coefficient (Kd) from different approaches (Figure 33). The observational activities were conducted by simultaneously collecting data from multiple sensors: i) airplane transported bathymetry LiDAR using the CZMIL (Teledyne Optech), ii) light motorboat transported hyperspectral radiometer (Satlantic), and iii) turbidity, pressure and temperature were observed with the AML Minos-X. A four-hour time window was planned around MODIS and OLCI satellite passes. 11 of 13 proposed stations were sampled using the hyperspectral radiometer with four casts at each station (Figure 33a). Sampling stations 1 and 8 were used to compare results from the hyperspectral radiometer, the CZMIL LiDAR and satellite measurements.

Results from the hyperspectral Kd at the 11 stations varied between 0.2 and 0.3 (1/m) depending on depth (Figures 34a and b).

Independent estimation of Kd using the CZMIL LiDAR return signal was performed by Dr. Viktor Feygels (Teledyne Optech). These data were based on the computation of (*a*+*bb*) where: *a* is the absorption coefficient, and *bb* is the backscatter coefficient. The relationship of (*a*+*bb*) to Kd was determined using Equation 5:

$$K/D_0 = 1.30395\ (a + bb),$$

(Equation 5)

where D_0 (downwelling distribution function) is estimated based on the sun angle and a lookup table (Gordon, 1989).

Individual results of Kd from this CZMIL approach fluctuated between 0.21 and 0.23 (1/m). The averaged Kd at stations 1 and 8 (at 8 m depth) was 0.25 (1/m), but the average at station 8 (11m depth) was 0.21 (1/m) (Figures 34c and d). The last value is close to the average Kd from the hyperspectral [approximately 0.22 (1/m)]. The collaboration with Optech continues on the analysis of this data, nevertheless the initial results indicate a very close Kd comparison using both methodologies.

Clear skies were rare during the satellite passes, thus no MODIS satellite pixels were collected in the Bedford Basin. However, OLCI provided matching pixels on five of ten stations (Figure 33b). OLCI derived Kd values ranged between 0.18 and 0.28 (1/m) in the basin, which was within the expected range and very acceptable given the proximity to the coastline. In conclusion, CZMIL LiDAR-derived and hyperspectral radiometer Kd *in situ* measured values compared very closely. In addition, OLCI's Kd was within range, in spite of the data being affected by the sensor's low sun angle, proximity to shoreline and partial cloud cover.

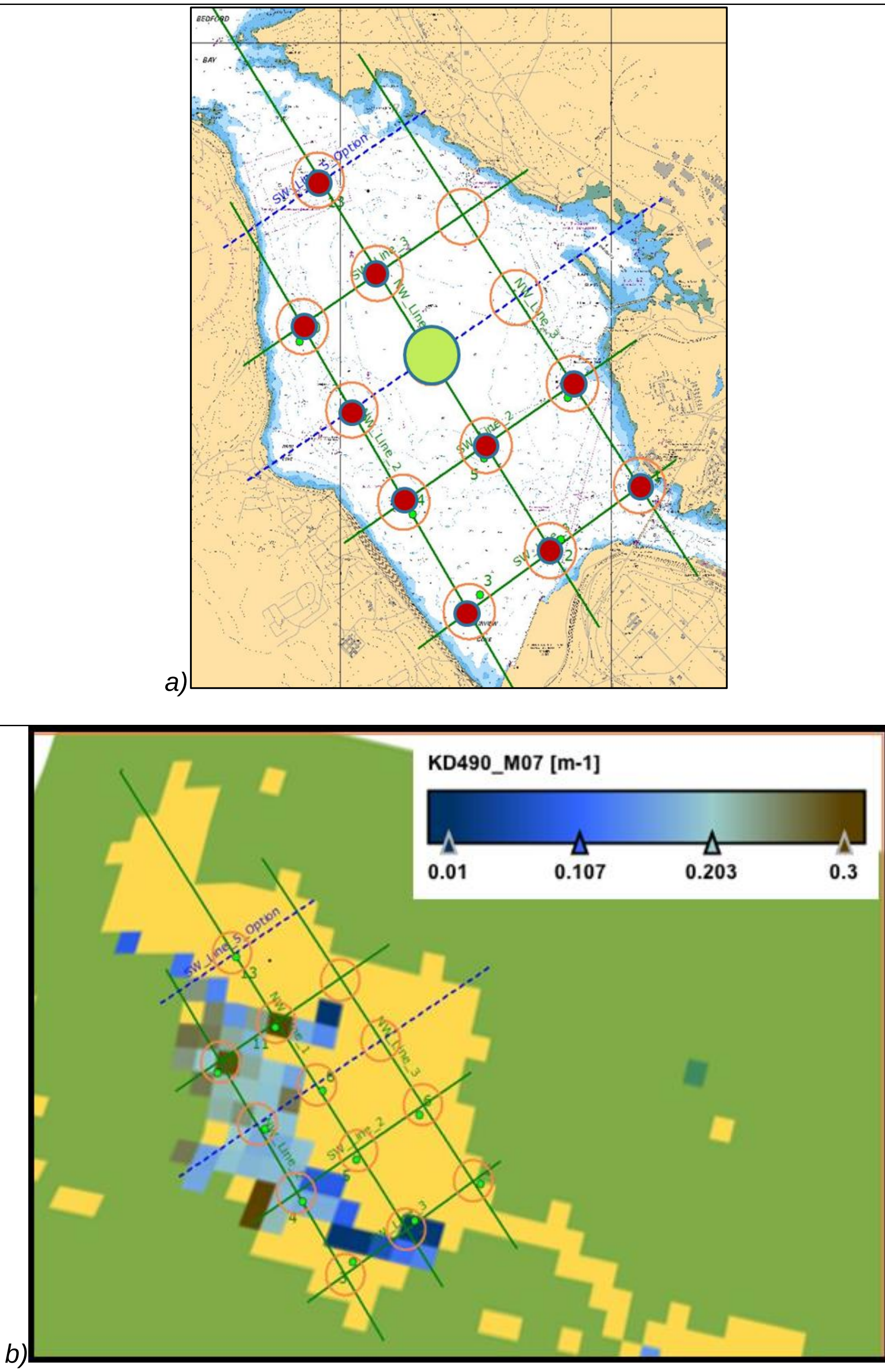
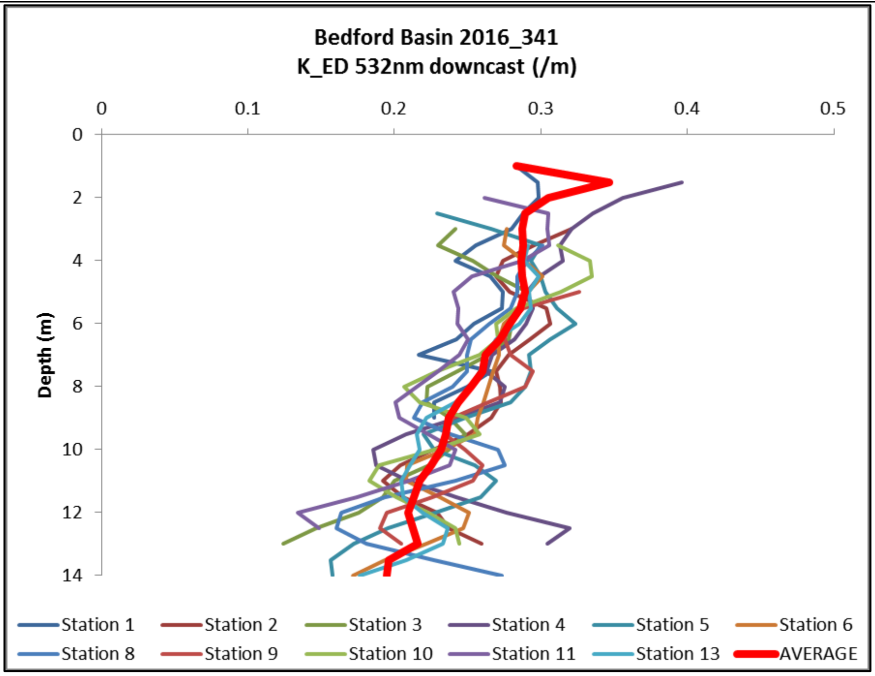


Figure 33. a) Thirteen station locations in the Bedford Basin. b) Kd_490 values derived from OLCI matching in situ *stations 2, 4, 9, 10, and 11.*

a)



b)

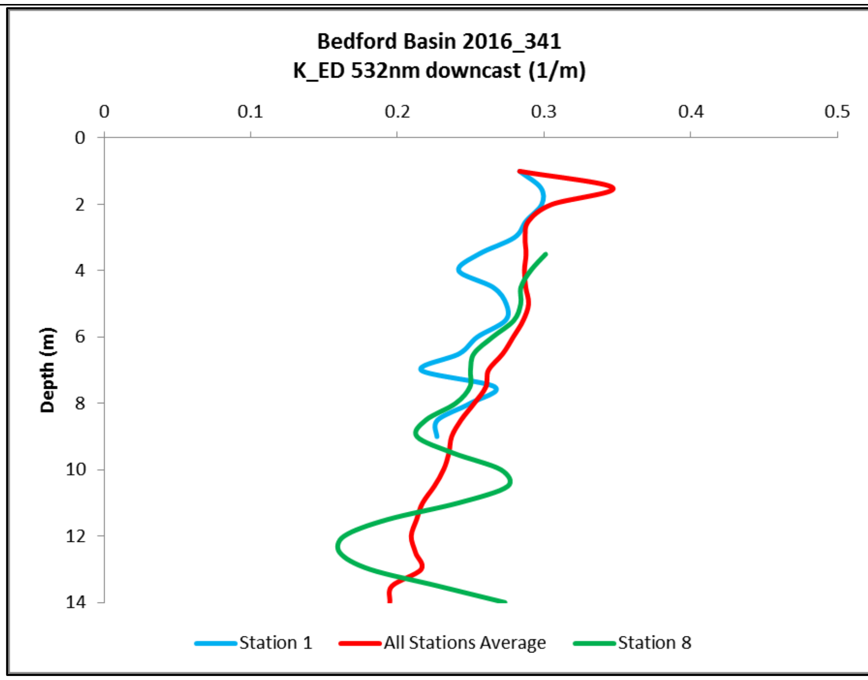
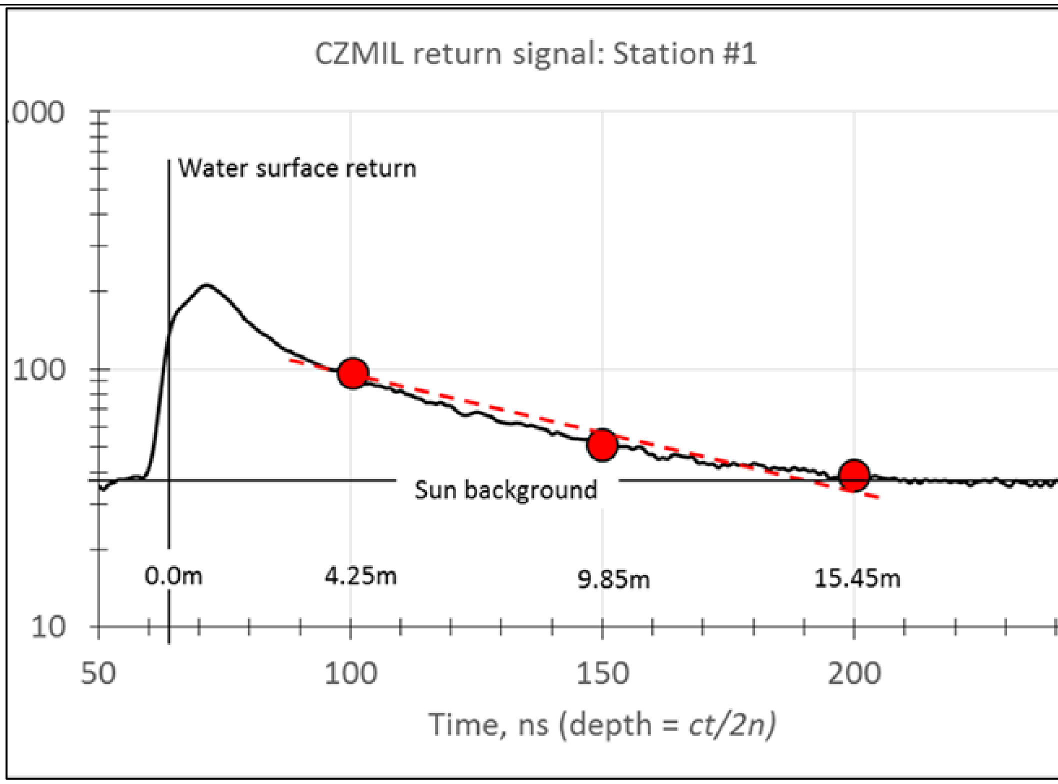


Figure 34. a) Profiles of Kd_532 at 11 stations (Satlantic radiometer).b) Profiles of Kd_532 measured at stations 1 (green line), 8 (blue), and the average of all stations (red).



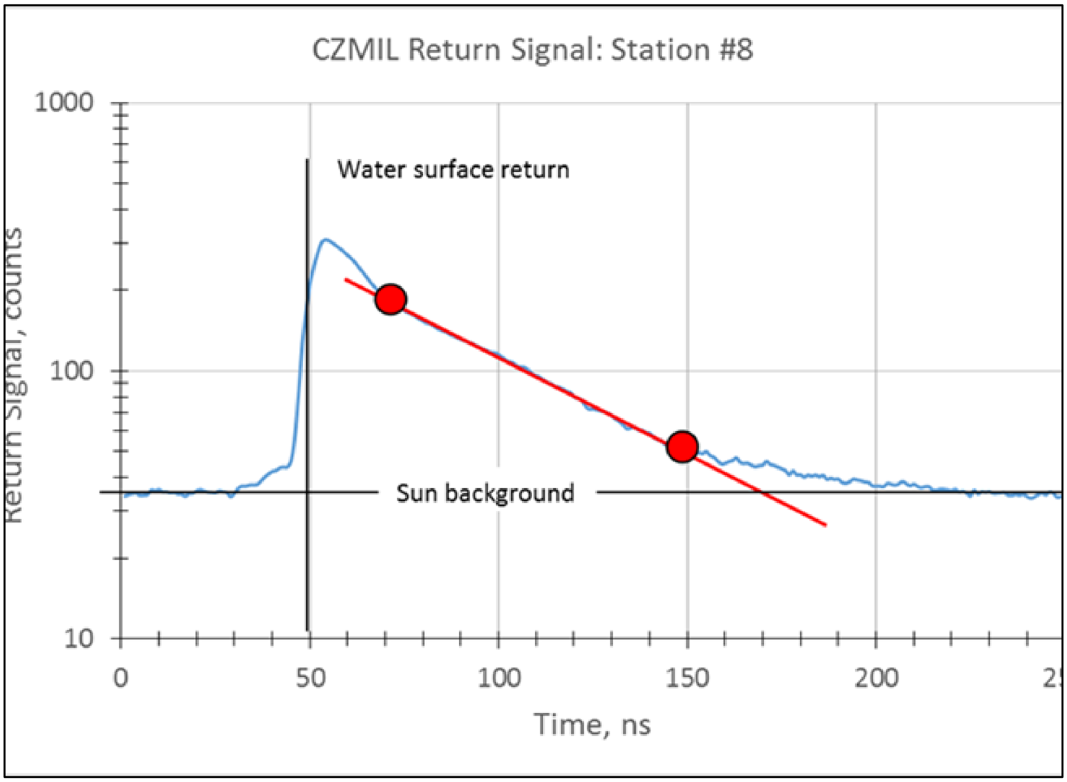
c)

Time interval, ns	$(a+b_b)$, 1/m
100-150	0.139
150-200	0.142
100-200	0.136

Time interval, ns	K_d, 1/m
100-150	**0.208**
150-200	**0.213**
100-200	**0.205**

d)

Continuation of Figure 34. c) CZMIL LiDAR water surface return at station 1 (left), and (a+b), and d) Kd calculations at different time intervals (right), d) similar as previous but for station 8.



e)

Time interval, ns	$(a+b_b)$, 1/m
70-150	0.132

Time interval, ns	K_d, 1/m
70-150	**0.189**

f)

Continuation of Figure 34. e) and f) similar as previous but for station 8.

3.4 OCEAN AND LAND COLOUR INSTRUMENT (OLCI)

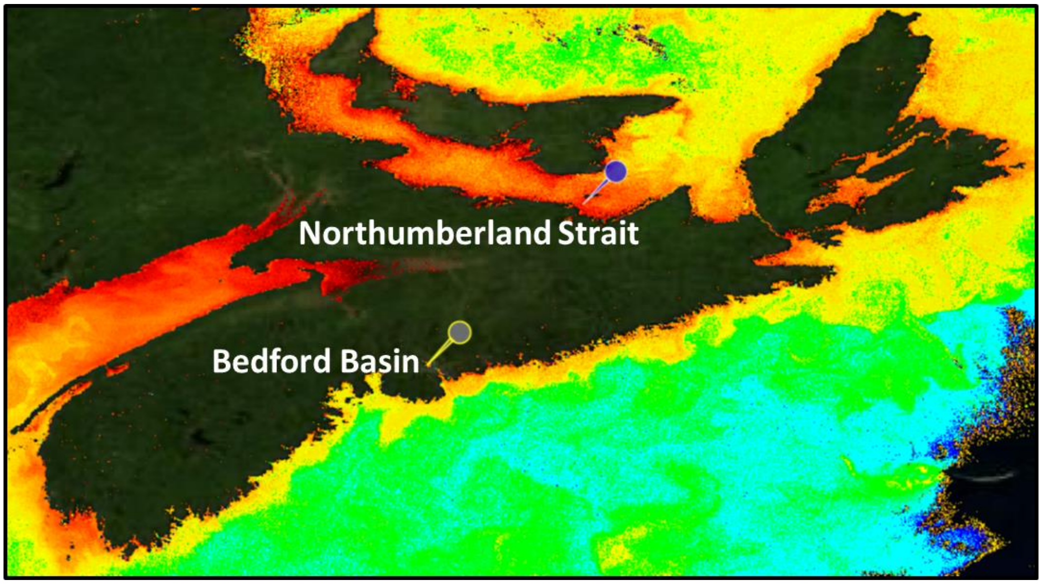
3.4.1. *Northumberland Strait*

The 2016 field activities under this project also provided radiometric and environmental data helping the validation of the Ocean and Land Colour Instrument (OLCI) sensor onboard the European Space Agency's (ESA) Sentinel-3A satellite.

Preliminary assessments of the performance of OLCI Level 2 products were achieved at two different coastal locations off the coast of Nova Scotia: the Bedford Basin and the Northumberland Strait (Figure 35a). The phytoplankton pigment analyses used *in situ* HPLC and Turner (Figure 35b) chlorophyll *a* measurements to compare with OLCI's CHL_OC4ME and CHL_NN products. In addition, reflectance measurements at these locations were compared to OLCI's remote sensing reflectance (Rrs) values (Figure 35c).

Preliminary results showed that the OLCI band-ratio algorithm CHL_OC4ME performed better than CHL_NN in the Bedford Basin because the band-ratio method reduced the large differences between OLCI and *in situ* Rrs (Figure 35b). The results also revealed that OLCI overestimates Rrs, especially in bluegreen bands, leading to overestimation of chlorophyll. Nevertheless, the shapes of Rrs spectra are well represented by OLCI data, but magnitudes in blue-green bands are generally higher. The agreement is better for the Northumberland Strait, which is sediment-dominated, than for Bedford Basin, which is surrounded by land and suffers from the adjacency effect (Figure 35c).

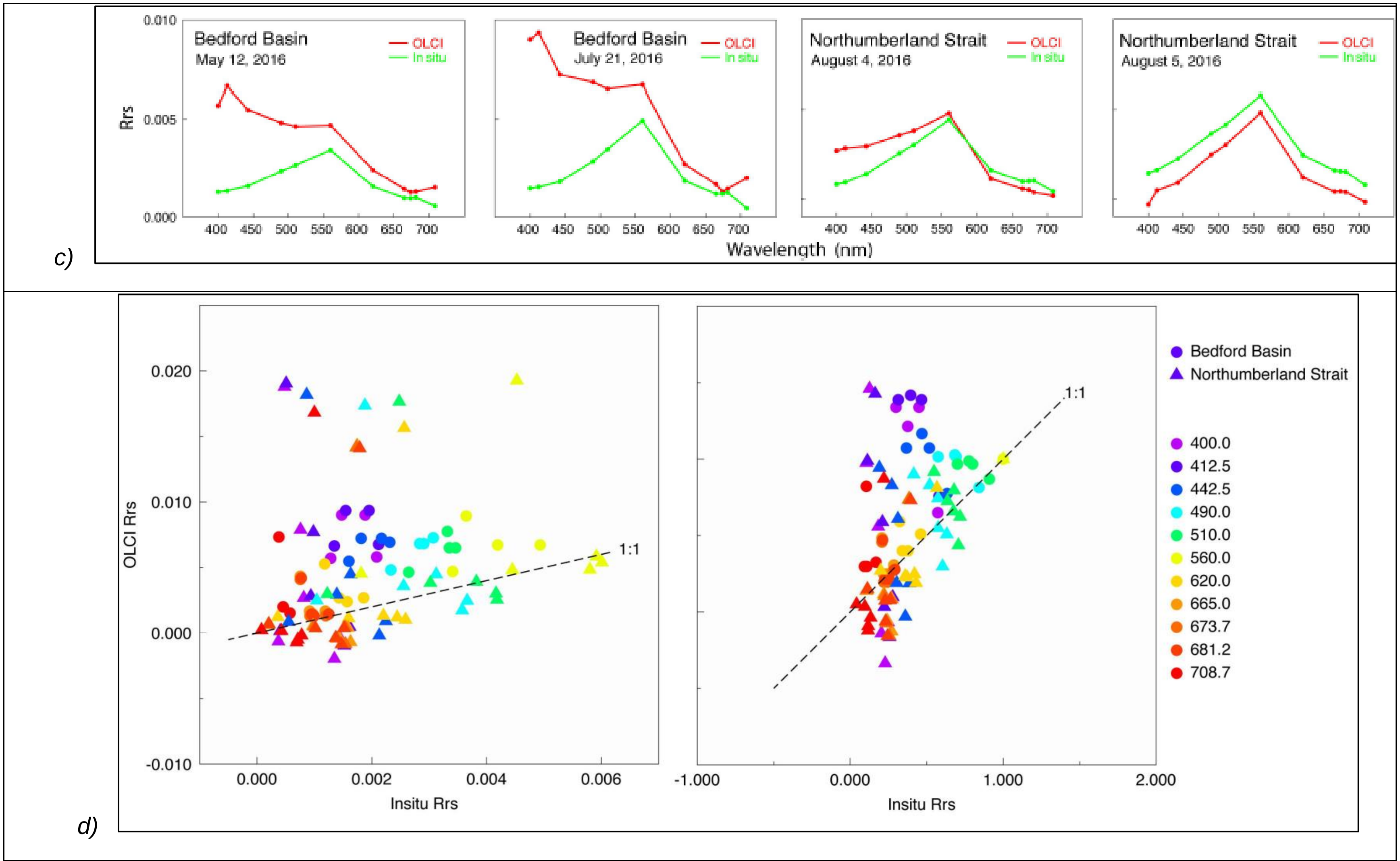
In conclusion, comparison between OLCI and *in situ* Rrs revealed an overestimation of OLCI's remote sensing reflectance, especially in the blue-green bands (Figure 35d). In the Bedford Basin, the adjacency effects seem to accentuate the issue. Overestimation of Rrs leads to an overestimation of chlorophyll *a* products, especially in coastal and shelf waters. As expected, CHLNN performs better in coastal environments (less overestimation) than OC4ME, although use of absolute Rrs in CHLNN leads to large errors close to the coast when adjacency effects are present.

a) 

b)

Region	Date	In situ Chl Turner (mg/m^3)	OLCI Chl (mg/m^3) CHL_OC4ME	CHL_NN	% over/underestimate CHL_OC4ME	CHL_NN
Bedford Basin	12-May-16	5.39	8.78	18.37	63	241
Bedford Basin	21-Jul-16	4.19	14.98	47.56	257	1035
North. Strait	04-Aug-16	1.39	10.75	0.36	674	-74
North. Strait	05-Aug-16	1.18	5.55	1.77	370	50

Figure 35. a) Location of sampling sites, the OLCI FR image is from April 27, 2016. b) Table of in situ *and OLCI chlorophyll measurements at two coastal stations.*



Continuation of Figure 35. c) Spectra graphs of in situ *Rrs and OLCI Rrs at both sampled stations, and d) Scatterplot comparing* in situ *and OLCI Rrs at the studied locations. Figure on the right shows each value normalized to the value at 560 nm.*

3.4.2. *Haida Gwaii*

During the field work in Haida Gwaii, two of five stations were covered by the OLCI pass on June 10th, 2018. Figure 36a shows a map of phytoplankton pigment chlorophyll *a* (Neural Network algorithm) at the northeastern tip of Graham Island, near the Naikoon Provincial Park, British Columbia. The hyperspectral remotely sensed reflectance data measured in Station 5 of the grid (Figure 4) allowed the computation of an averaged (8 casts) spectra. This curve closely compares with the filtered mean of 11 pixels surrounding the *in situ* Station 5 location, as shown on Figure 36b.

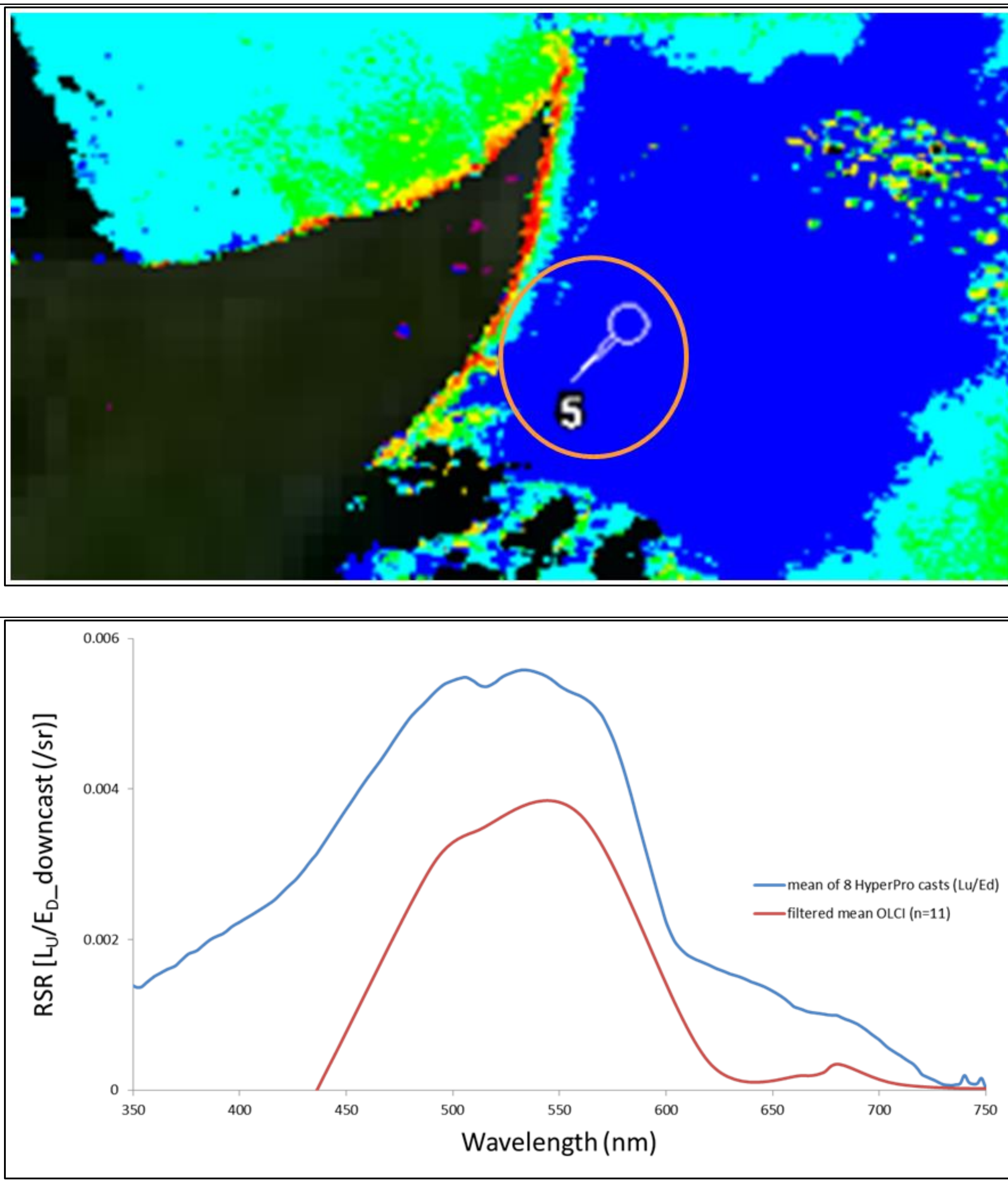


Figure 36. a) Map of chlorophyll a *showing the Station 5 at the northeastern tip of Graham Island, b) Remotely sensed reflectance* in situ *data (blue line) and OLCI derived spectra at Station 5.*

4. DISCUSSION

4.1 *IN SITU AND SATELLITE-DERIVED INFORMATION*

The historic and specifically-designed field work in this study provided *in situ* databases from both eastern and western Canadian coasts, allowing for the development of two regional algorithms of satellite derived products required for this study: Secchi Disk Depth (SDD) and Total Suspended Matter (TSM). The measurements had enough accuracy to produce sets of remotely sensed maps in support of the main goals of this study: evaluation of water column clarity to enable successful ALB activities. The set of associated maps derived from NASA's Ocean Color suite: Chlorophyll *a*, Kd_490, Kd_532 and the water surface temperature (SST) are valuable in understanding the holistic conditions of the areas under study.

Conventionally, the phytoplankton biomass indicated by the concentration of chlorophyll *a* pigment has been the standard available information to associate with water clarity; eventually the Kd_490 was incorporated to supplement this information. However, both products are typically computed using atmospheric corrections for relatively clear waters and projected on spatial resolution at 4 km/pixel. Contrasting with these standard products, the information generated in this study is computed using regional *in situ* measurements, the MUMM's atmospheric correction and at 250 m/pixel of spatial resolution; consequently, the products are closer to the ALB working conditions. Further, a correct interpretation of the full set of remotely sensed information derived using BIO and NASA's algorithms represent an important source of information to compare and validate the ALB products.

In parallel to the information of water clarity computed from satellites in this study, recent investigations on the improvement of ALB-derived data to measure water turbidity in the river Elbe have been published by Maas and collaborators (2019). These results were derived from LiDAR bathymetry using a full LiDAR waveform analysis on the water column, in particular the decay of the signal intensity (Maas *et al.*, 2019). There is additional literature on the impact of turbidity on satellite-derived bathymetry (Caballero *et al.*, 2019), using the Sentinel-2A sensor and the moderate-resolution Ocean and Land Colour instrument (OLCI) onboard Sentinel-3A, the latter with spatial resolution (300 m/pixel) comparable to MODIS' data reported in the present study (250 m/pixel).

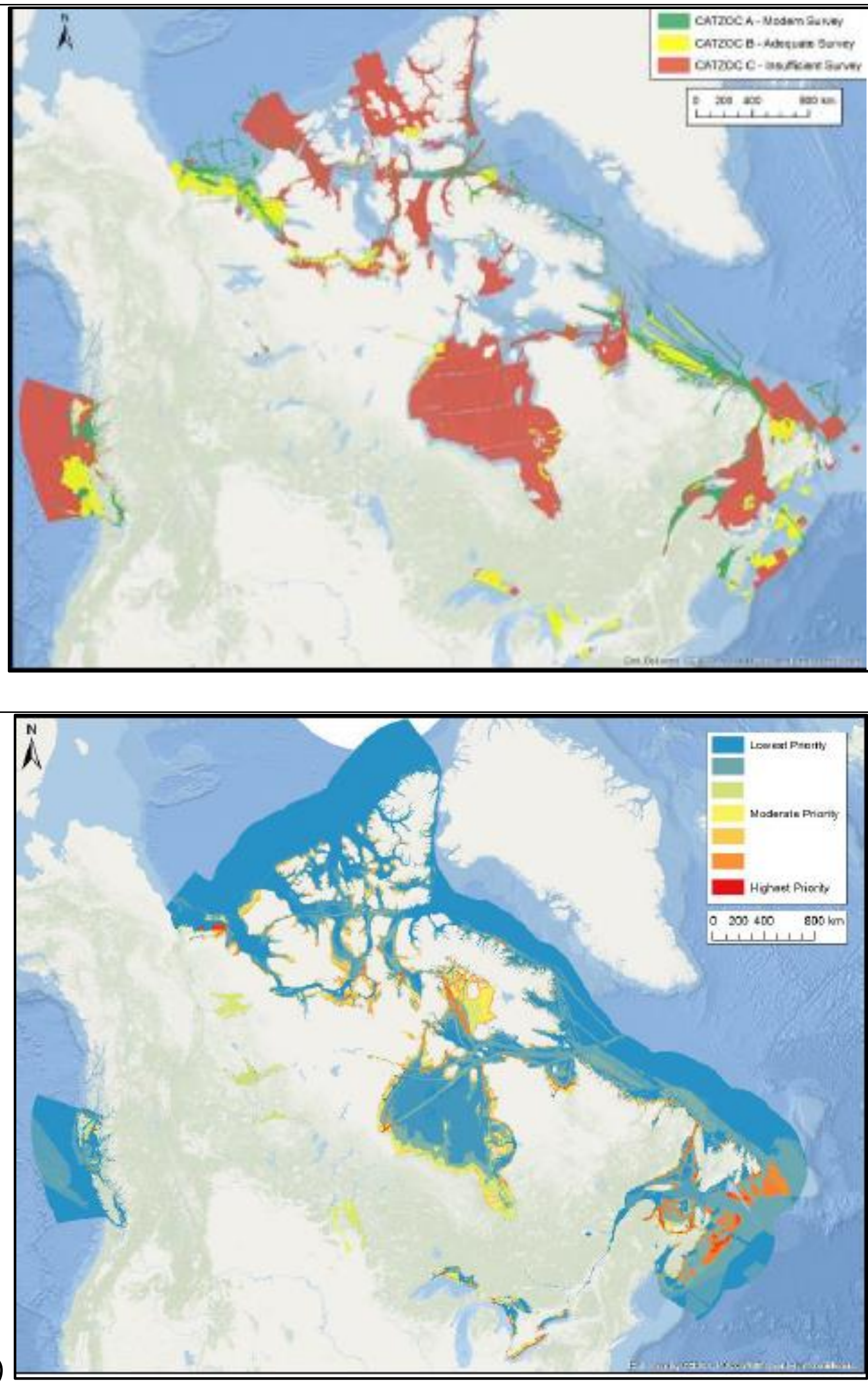
Unfortunately, it has been noticied by NASA's staff that the $MODIS_{Aqua}$ sensor has aged (2002 to present), and maintenance of data quality has grown increasingly challenging, with the mission potentially ending soon. In particular, the images produced since mid-2019 seem to have calibration problems in the bands required for computations of SDD and TSM. On the positive side, VIIRS (Son and Wang, 2019), and recent sensors such as Sentinel-2A and 3A (Caballero *et al.*, 2019), are potential candidates to carry on the approach used in this study.

4.2 *FUTURE ACTIVITIES*

The positive results obtained using remotely sensed ocean colour data to help planning ALB studies during three years and along two Canadian seaboards strongly suggest their use in other regions of the long Canadian coastline. Figure 12c shows the limited number of sites where satellite-derived data have been used to plan ALB missions, compared to the remaining Canadian coastlines to be charted.

The next regions where ocean colour derived information can be used to plan ALBs should be some Arctic areas, following the survey of the coastlines shown in the Category Zones of Confidence (CATZOC) for navigation (Figure 37a), as reported by Chénier *et al*. (2018). The suggestions outlined in the CHS Priority Planning Plan Tool (CPPT - Chénier *et al*. 2018) are fundamental (Figure 37b).

Certainly, the shorter timeframe for field work makes these areas more challenging than the regions already tested. However, the experience developed on the eastern and western Canadian coasts should be taken into account to plan and execute the sampling in the northern latitudes. In conclusion, the addition of more and new data will extend and validate the ocean colour approach as an invaluable tool for ALB planning.



a)

b)

Figure 37. a) Category Zone of Confidence (CATZOC) data for Canada. b) The Canadian Priority Planning Tool (CPPT) output, with priority zones present in all navigable waterways. Both images from Chénier et al 2018, Figures 2 and 6.

5. CONCLUSION

Specifically-developed, remotely sensed information on water clarity (SDD and TSM) at full $MODIS_{Aqua}$ spatial resolution (250 m/pixel) is fundamental to planning Airborne LiDAR Bathymetry missions. In addition, the set of associated maps produced in this study such as Chlorophyll *a*, Kd_490, Kd_532 and SST at the same spatial resolution complement the ALB measurements. These maps can be helpful in interpreting the final maps constructed using the LiDAR approach.

The high resolution and large spatial coverage of the data also allowed for alternate planning of ALB survey sites in near real-time. If one survey site indicated worsening water clarity conditions, then an alternate survey site could be evaluated to continue production work until localized conditions improved.

In areas prone to significant seasonal variations in water clarity and short term factors such as meteorological conditions, the use of remote sensing data for water clarity analysis was especially valuable. The Northumberland Strait between Nova Scotia and Prince Edward Island has notably high variations in water clarity and the windows of opportunity for ALB survey were known to be short lived. Local variations were very hard to understand prior to using the $MODIS_{aqua}$ SDD models. The SDD proved to be very accurate based on local observations taken during the study. Similar advantages were noted in the ALB surveys in near Haida Gwaii, Queen Charlotte Islands, British Columbia where water clarity conditions also presented a higher than normal challenge for ALB survey work. The extension of this approach to other water color remote sensing sensors such as OLCI and VIIRS would be advantageous in the future to allow continuity of this work as the MODIS sensors age and degrade. Incorporation of these additional sources of data would also allow temporal continuity of water clarity trends from sensor to sensor, allow more seamless historical comparison of archival data and further help in the analysis of longer term, seasonal trends like those presented using MERIS archival data.

The ability to have high resolution data relating to both SDD and TSM during the extensive ALB projects described in this report was extremely valuable from an ALB operational perspective. The cost of deep water ALB surveys is very high but with the proper water clarity conditions can be very productive and extremely cost-effective. The availability of $MODIS_{aqua}$ based SDD and TSM dramatically increased ALB mission productivity, improved the overall quality of data by optimizing surveys to the best available water clarity, significantly improved cost benefits by reducing unnecessary (and costly) ALB reconnaissance flights and greatly improved scheduled downtime planning during periods of less than ideal water clarity conditions.

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Tables

Table 1. Sampling stations in Northumberland Strait in 2016. Site name, Date, Day of Year, Latitude (°N), Longitude (°W), Sounding depth (m), Secchi Disk Depth (SDD, m), Station Depth (m), Chlorophyll concentration (mg m^{-3}), and Total Suspended Matter (TSM) (g m^{-3}).

SITE NAME	DATE	DAY OF YEAR	LATITUDE (°N)	LONGITUDE (°w)	Sounding (m)	SDD (m)	DEPTH (m)	Chlorophyll (mg m^{-3})	TSM (g m^{-3})
PM 1	4-Aug-16	217	45.68727	-62.64750	5.6	3.0	surface	3.05	3.14
PM 2	4-Aug-16	217	45.68628	-62.62968	4.8	4.0	surface	1.73	2.28
PM 3	4-Aug-16	217	45.69383	-62.60623	9.2	4.2	surface	1.62	2.41
PM 4	4-Aug-16	217	45.71700	-62.56077	14.0	5.0	surface	1.39	7.25
CAR 2	5-Aug-16	218	45.82160	-62.63993	24.0	NA	surface	1.18	2.17
CAR Lidar 1	5-Aug-16	218	45.74015	-62.71357	9.5	3.6	surface	1.12	2.57
CAR Lidar 2	5-Aug-16	218	45.74960	-62.67675	8.0	4.0	surface	1.24	1.41
CAR 1	5-Aug-16	218	45.75303	-62.60815	12.0	4.5	surface	1.59	1.73
CAR 1	9-Aug-16	222	45.75303	-62.60815	12.0	6.6	surface	1.28	1.77
MG 1	9-Aug-16	222	45.68273	-62.50638	17.0	6.4	surface	2.14	1.71
MG 2	9-Aug-16	222	45.65833	-62.47277	8.0	7.3	surface	1.43	1.81
MG 3	9-Aug-16	222	45.64613	-62.46910	8.0	4.8	surface	1.92	2.01
MG 4	9-Aug-16	222	45.64712	-62.41732	7.9	3.4	surface	3.26	2.84
PH 1	9-Aug-16	222	45.67928	-62.68580	12.0	**2.6**	surface	3.34	4.02
PH 2	9-Aug-16	222	45.66543	-62.71513	12.0	3.0	surface	3.86	3.04
PH 3	9-Aug-16	222	45.64882	-62.69927	7.5	2.6	surface	3.29	2.68
WI 1	10-Aug-16	223	45.94270	-62.73238	13.0	5.5	surface	2.02	2.54
WI 2	10-Aug-16	223	45.92308	-62.78012	21.0	5.1	surface	1.74	2.49
WI 3	10-Aug-16	223	45.88248	-62.72247	35.0	6.2	surface	1.21	2.28
CAR 2	10-Aug-16	223	45.81943	-62.63673	18.0	7.2	surface	0.74	0.84
HB 1	16-Aug-16	229	46.04907	-63.14010	17.0	7.0	surface	1.27	1.19
HB 2	16-Aug-16	229	45.97790	-63.14317	23.0	9.2	surface	1.11	2.37
CJ 3	16-Aug-16	229	45.89492	-63.14732	26.0	7.9	surface	1.11	0.93
CJ 2	16-Aug-16	229	45.85628	-63.11622	18.0	8.4	surface	0.75	1.32
CJ 1	16-Aug-16	229	45.82843	-63.11390	11.0	6.1	surface	1.38	2.24

Table 2. Sampling stations in Northumberland Strait in 2017. Site name, Date, Day of Year, Latitude (°N), Longitude (°W), Sounding depth (m), Secchi Disk Depth (SDD, m), Station Depth (m), Chlorophyll concentration (mg m^{-3}), HPLC Chlorophyll a concentration (mg m^{-3}), Total Suspended Matter (TSM) (g m^{-3}), Particulate Organic Carbon (POC) (µg L^{-1}) , and Particulate Organic Nitrogen (PON) (µg L^{-1}).

SITE NAME	DATE	DAY OF YEAR	LATITUDE (°N)	LONGITUDE (°w)	Sounding (m)	SDD (m)	DEPTH (m)	Chlorophyll (mg m^{-3})	HPLCHLA (mg m^{-3})	TSM (g m^{-3})	POC (µg L^{-1})	PON (µg L^{-1})
PUG 1	10-Jul-17	191	45.9392	63.6879	14.0	11.0	surface	0.40	0.41	3.69	659	46
PUG 2	10-Jul-17	191	46.0382	63.5865	18.0	8.0	surface	0.94	0.46	1.02	402	36
VIC 1	10-Jul-17	191	46.1558	63.5385	14.0	8.0	surface	0.45	0.41	0.79	260	30
VIC 2	10-Jul-17	191	46.1765	63.6027	15.2	7.0	surface	0.42	0.45	0.16	235	26
SUM 1	11-Jul-17	192	46.3317	63.9085	12.0	6.0	surface	1.93	1.20	1.22	342	46
SUM 2	11-Jul-17	192	46.3027	63.9238	19.0	6.0	surface	2.13	1.39	0.70	371	47
MC 2	11-Jul-17	192	46.2408	63.9307	24.1	7.0	surface	1.84	0.81	0.50	268	37
MC 1	11-Jul-17	192	46.2040	63.9583	14.1	6.0	surface	1.91	1.51	0.44	265	37
CT 2	11-Jul-17	192	46.1845	63.7564	25.3	6.0	surface	2.04	1.49	1.12	265	39
CT 1	11-Jul-17	192	46.1723	63.7826	14.8	6.0	surface	1.93	1.40	0.33	236	32

Table 3. Sampling stations in Haida Gwaii archipelago in 2018. Site name, Date, Day of Year, Latitude (°N), Longitude (°W), Sounding depth (m), Secchi Disk Depth (SDD, m), Station Depth (m), Chlorophyll concentration (mg m^{-3}), HPLC Chlorophyll a concentration (mg m^{-3}), , Particulate Organic Carbon (POC) (µg L^{-1}) , and Particulate Organic Nitrogen (PON) (µg L^{-1})..

SITE NAME	DATE	DAY OF YEAR	LATITUDE (°N)	LONGITUDE (°w)	Sounding (m)	SDD (m)	DEPTH (m)	Chlorophyll (mg m^{-3})	HPLCHLA (mg m^{-3})	POC (µg L^{-1})	PON (µg L^{-1})
10	7-Jun-18	158	53.23799	-132.0892	12.0	5.0	0.0	2.01	1.45	400	60
							5.5	2.87	3.47	465	58
11	7-Jun-18	158	53.273349	-131.85454	50.0	3.0	0.0	2.30	2.40	287	49
							5.0	1.99	2.74	357	51
5	8-Jun-18	159	53.932267	-131.6395	14.5	5	0.0	1.14	1.18	286	45
							5.0	1.45	1.43	354	61
8	8-Jun-18	159	53.23799	-131.7801	18	5	0.0	1.25	1.53	292	50
							5.0	1.59	2.11	406	60
1	9-Jun-18	160	54.151617	-132.8189	34	10.5	0.0	1.58	1.40	353	40
							10.0	2.57	2.74	326	61
2	9-Jun-18	160	54.08600	-132.5132	14	9.5	0.0	3.36	3.79	456	73
							7.0	3.01	2.89	359	58
4	9-Jun-18	160	54.09603	-132.0298	18	6.5	0.0	6.37	5.82	722	85
							6.0	6.85	6.62	575	95
3	9-Jun-18	160	54.05728	-132.2246	10	7	0.0	3.71	4.12	395	52
							7.5	3.14	3.25	328	47
5	10-Jun-18	161	53.932283	-131.6403	14	5.5	0.0	0.61	0.69	390	63
							9.0	1.61	1.50	369	46
8	10-Jun-18	161	53.69510	-131.7785	19	8.5	0.0	1.81	1.95	471	63
							10.0	4.95	5.69	533	89
9	10-Jun-18	161	53.430417	-131.8007	19	8.5	0.0	3.01	2.76	587	84
							9.0	9.02	7.02	714	96
12	10-Jun-18	161	53.14575	-131.6249	20	6	0.0	6.32	8.04	479	84
							8.0	6.41	3.09	456	80
11	10-Jun-18	161	53.273167	-131.8539	50	6	0.0	1.91	1.69	349	40
							10.0	1.99	NA	375	53
6	11-Jun-18	162	53.69845	-132.3326	51.0	2.0	0.0	1.77	2.05	271	38
							1.0	1.90	2.07	267	39
7	11-Jun-18	162	53.70512	-132.2481	19.0	2.5	0.0	1.86	2.40	310	47
							2.5	2.48	2.88	294	59

Table 4. Profile measurements at Station PM 1 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
1.0	20.36	0.02	28.33	0.01	0.7261	0.0724	0.5304	0.0732
1.5	20.24	0.05	28.36	0.01	0.7269	0.0530	0.5360	0.0495
2.0	20.07	0.08	28.39	0.02	0.7171	0.0350	0.5372	0.0335
2.5	19.92	0.06	28.42	0.02	0.7078	0.0401	0.5363	0.0385

Table 5. Profile measurements at Station PM 2 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
0.5	19.62	0.02	28.53	0.00	0.5158	0.0748	0.3835	0.0750
1.0	19.63	0.04	28.54	0.01	0.5294	0.0390	0.3952	0.0404
1.5	19.62	0.04	28.54	0.01	0.5293	0.0544	0.3943	0.0555
2.0	19.61	0.04	28.54	0.02	0.5443	0.0395	0.4079	0.0400
2.5	19.60	0.04	28.54	0.02	0.5590	0.0361	0.4214	0.0313

Table 6. Profile measurements at Station PM 3 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	**Temp. (°C)**	**Stdev**	**Salinity (psu)**	**Stdev**	**Kd(490)**	**Stdev**	**Kd(532)**	**Stdev**
					K_ED_hyperspectral_downcast (/m)			
0.5	19.09	0.01	28.67	0.00	0.4106	0.0011	0.3099	0.0039
1.0	19.07	0.02	28.67	0.00	0.4045	0.0255	0.3082	0.0269
1.5	19.07	0.02	28.67	0.00	0.4160	0.0255	0.3199	0.0237
2.0	19.07	0.02	28.68	0.00	0.4346	0.0273	0.3388	0.0260
2.5	19.06	0.03	28.68	0.00	0.4361	0.0280	0.3418	0.0293
3.0	19.05	0.04	28.68	0.00	0.4285	0.0186	0.3362	0.0197
3.5	19.03	0.04	28.68	0.00	0.4333	0.0160	0.3407	0.0142
4.0	19.03	0.04	28.67	0.00	0.4284	0.0459	0.3388	0.0368
4.5	19.02	0.04	28.67	0.00	0.4240	0.0396	0.3358	0.0300
5.0	19.00	0.05	28.67	0.00	0.4374	0.0740	0.3442	0.0583
5.5	18.94	0.08	28.67	0.01	0.4246	0.0638	0.3361	0.0533
6.0	18.81	0.16	28.68	0.01	0.4005	0.0844	0.3221	0.0683
6.5	18.55	0.31	28.71	0.03	0.3820	0.1270	0.3109	0.1007
7.0	18.11	0.44	28.73	0.06	0.3826	0.0986	0.3135	0.0783
7.5	17.74	0.66	28.75	0.08	0.3510	0.1056	0.2878	0.0893

Table 7. Profile measurements at Station PM 4 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
1.0	18.41	0.01	28.80	0.0020	0.3225	0.0372	0.2643	0.0388
1.5	18.41	0.02	28.80	0.0021	0.3217	0.0140	0.2604	0.0154
2.0	18.39	0.02	28.80	0.0016	0.3226	0.0126	0.2596	0.0128
2.5	18.36	0.02	28.81	0.0018	0.3443	0.0105	0.2832	0.0114
3.0	18.33	0.02	28.81	0.0019	0.3579	0.0134	0.2948	0.0099
3.5	18.30	0.03	28.80	0.0020	0.3602	0.0168	0.2939	0.0150
4.0	18.28	0.03	28.80	0.0019	0.3647	0.0029	0.3005	0.0053
4.5	18.26	0.02	28.80	0.0016	0.3453	0.0269	0.2867	0.0230
5.0	18.23	0.03	28.80	0.0026	0.3452	0.0351	0.2855	0.0300
5.5	18.16	0.05	28.80	0.0047	0.3755	0.0386	0.3096	0.0310
6.0	18.01	0.05	28.81	0.0045	0.3632	0.0568	0.3003	0.0446
6.5	17.81	0.02	28.82	0.0065	0.3195	0.0385	0.2653	0.0295
7.0	17.61	0.03	28.83	0.0129	0.3137	0.0702	0.2640	0.0622
7.5	17.40	0.03	28.86	0.0119	0.3452	0.0489	0.2961	0.0434
8.0	17.23	0.02	28.88	0.0100	0.3668	0.0473	0.3178	0.0383
8.5	17.11	0.01	28.89	0.0063	0.3378	0.0723	0.2921	0.0596
9.0	17.00	0.01	28.90	0.0039	0.2841	0.0740	0.2446	0.0598
9.5	16.88	0.02	28.91	0.0041	0.2616	0.0791	0.2257	0.0669
10.0	16.73	0.03	28.91	0.0103	0.2751	0.1625	0.2383	0.1444
10.5	16.57	0.08	28.91	0.0186	0.2487	0.1644	0.2166	0.1473

Table 8. Profile measurements at Station CAR 2 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
0.5	17.27	0.02	28.90	0.00	0.2632	0.0326	0.2167	0.0376
1.0	17.28	0.03	28.91	0.01	0.2060	0.0692	0.1574	0.0729
1.5	17.27	0.03	28.91	0.01	0.2572	0.0403	0.2122	0.0415
2.0	17.26	0.04	28.91	0.01	0.3329	0.0781	0.2912	0.0833
2.5	17.23	0.04	28.91	0.01	0.3494	0.0285	0.3054	0.0287
3.0	17.21	0.05	28.91	0.01	0.3384	0.0858	0.2926	0.0866
3.5	17.18	0.05	28.90	0.00	0.3233	0.0554	0.2778	0.0586
4.0	17.15	0.06	28.90	0.01	0.3748	0.0288	0.3288	0.0292
4.5	17.12	0.07	28.90	0.00	0.4042	0.0443	0.3598	0.0447
5.0	17.09	0.08	28.89	0.00	0.3876	0.0164	0.3422	0.0153
5.5	17.05	0.08	28.89	0.01	0.3954	0.0328	0.3415	0.0308
6.0	17.02	0.07	28.89	0.01	0.3802	0.0488	0.3243	0.0431
6.5	16.99	0.06	28.89	0.01	0.3235	0.0354	0.2756	0.0406
7.0	16.96	0.05	28.89	0.00	0.3516	0.0946	0.3035	0.0850
7.5	16.93	0.06	28.90	0.01	0.4322	0.0747	0.3776	0.0657
8.0	16.91	0.06	28.90	0.01	0.4341	0.0802	0.3781	0.0674
8.5	16.89	0.06	28.90	0.01	0.3674	0.0756	0.3185	0.0629
9.0	16.87	0.07	28.91	0.01	0.2856	0.1052	0.2499	0.0899
9.5	16.85	0.07	28.91	0.01	0.2610	0.0616	0.2323	0.0525
10.0	16.84	0.08	28.91	0.02	0.3290	0.1248	0.2934	0.1134
10.5	16.83	0.08	28.92	0.02	0.4357	0.1249	0.3873	0.1100
11.0	16.81	0.08	28.92	0.02	0.4763	0.0750	0.4235	0.0622
11.5	16.81	0.07	28.92	0.01	0.4166	0.0978	0.3728	0.0887
12.0	16.79	0.06	28.92	0.01	0.3439	0.0651	0.3106	0.0576
12.5	16.78	0.05	28.92	0.01	0.3158	0.0709	0.2863	0.0583
13.0	16.77	0.04	28.92	0.01	0.3052	0.0827	0.2774	0.0732
13.5	16.77	0.04	28.92	0.01	0.2962	0.1077	0.2699	0.0966
14.0	16.78	0.04	28.92	0.01	0.2684	0.0842	0.2444	0.0774
14.5	16.78	0.05	28.92	0.01	0.2103	0.0367	0.1905	0.0408
15.0	16.77	0.05	28.92	0.02	0.1704	0.0446	0.1519	0.0470
15.5	16.76	0.04	28.93	0.01	0.1705	0.0605	0.1499	0.0605
16.0	16.75	0.03	28.93	0.01	0.1928	0.0751	0.1699	0.0736
16.5	16.75	0.03	28.93	0.01	0.2272	0.1088	0.2017	0.1064
17.0	16.74	0.03	28.93	0.01	0.2813	0.1518	0.2505	0.1448
17.5	16.73	0.03	28.93	0.01	0.3650	0.2228	0.3234	0.2017
18.0	16.73	0.03	28.94	0.01	0.4603	0.3287	0.3986	0.2894
18.5	16.72	0.02	28.94	0.01	0.4922	0.3220	0.4183	0.2848
19.0	16.72	0.02	28.94	0.01	0.4676	0.3262	0.3918	0.2789
19.5	16.71	0.02	28.94	0.01	0.4279	0.2776	0.3512	0.2122
20.0	16.71	0.02	28.94	0.01	0.4180	0.2189	0.3282	0.1356
20.5	16.70	0.02	28.95	0.01	0.4154	0.1835	0.3207	0.1036
21.0	16.68	0.01	28.95	0.00	0.3654	0.1531	0.3063	0.0917

Table 9. Profile measurements at Station CAR LiDAR 1 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
0.5	19.49	0.05	28.88	0.01	0.3155	0.1070	0.2282	0.1054
1.0	19.48	0.04	28.89	0.01	0.3801	0.0470	0.2904	0.0522
1.5	19.45	0.03	28.89	0.01	0.4337	0.0564	0.3467	0.0609
2.0	19.39	0.06	28.89	0.01	0.4071	0.0592	0.3217	0.0568
2.5	19.29	0.09	28.88	0.01	0.4288	0.0267	0.3406	0.0250
3.0	19.16	0.09	28.88	0.01	0.4510	0.0197	0.3652	0.0213
3.5	19.01	0.11	28.86	0.01	0.4158	0.0123	0.3351	0.0148
4.0	18.81	0.12	28.84	0.03	0.3894	0.0326	0.3148	0.0320
4.5	18.58	0.20	28.84	0.04	0.4017	0.0241	0.3331	0.0259
5.0	18.38	0.27	28.85	0.03	0.4232	0.0164	0.3529	0.0157
5.5	18.24	0.27	28.87	0.02	0.4473	0.0437	0.3696	0.0384
6.0	18.08	0.20	28.88	0.03	0.4172	0.0261	0.3449	0.0249
6.5	17.97	0.18	28.89	0.01	0.3897	0.0383	0.3257	0.0321
7.0	18.06	0.11	28.90	0.00	0.4407	0.0037	0.3749	0.0090

Table 10. Profile measurements at Station CAR LiDAR 2 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
1.0	18.38	0.02	28.92	0.00	0.2844	0.0891	0.2322	0.0891
1.5	18.37	0.01	28.92	0.00	0.2462	0.0295	0.1917	0.0276
2.0	18.36	0.01	28.92	0.00	0.2531	0.0349	0.1984	0.0374
2.5	18.34	0.01	28.92	0.00	0.3114	0.0455	0.2586	0.0455
3.0	18.33	0.01	28.92	0.00	0.3476	0.0330	0.2938	0.0335
3.5	18.32	0.01	28.92	0.00	0.3433	0.0520	0.2891	0.0551
4.0	18.30	0.02	28.92	0.00	0.3385	0.0383	0.2864	0.0382
4.5	18.27	0.02	28.92	0.00	0.3639	0.0288	0.3109	0.0309
5.0	18.26	0.02	28.91	0.00	0.4051	0.0480	0.3484	0.0506
5.5	18.24	0.01	28.91	0.00				

Table 11. Profile measurements at Station CAR 1 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
0.5	18.48	0.00	28.80	0.01				
1.0	18.48	0.00	28.80	0.01				
1.5	18.48	0.01	28.80	0.01				
2.0	18.48	0.01	28.80	0.01	0.0683	0.0098		
2.5	18.48	0.01	28.80	0.01	0.2451	0.0151	0.1943	0.0171
3.0	18.48	0.00	28.80	0.01	0.2949	0.0747	0.2401	0.0852
3.5	18.48	0.00	28.79	0.01	0.3075	0.1172	0.2588	0.1167
4.0	18.48	0.00	28.79	0.00	0.3002	0.1522	0.2578	0.1586
4.5	18.48	0.00	28.79	0.00	0.3495	0.0626	0.2546	0.1345
5.0	18.48	0.01	28.78	0.00	0.4073	0.1216	0.3643	0.1214
5.5	18.47	0.01	28.78	0.00	0.4342	0.1395	0.3903	0.1369
6.0	18.47	0.00	28.78	0.00	0.3386	0.0745	0.2712	0.0845
6.5	18.47	0.00	28.79	0.00	0.2068	0.1552	0.2027	0.1589
7.0	18.47	0.00	28.79	0.00	0.2235	0.0913	0.1907	0.0856
7.5	18.47	0.00	28.79	0.00	0.3316	0.1126	0.2362	0.1299
8.0	18.47	0.00	28.79	0.00	0.3554	0.0689	0.2524	0.1170
8.5	18.47	0.00	28.79	0.00	0.2716	0.1390	0.2032	0.1198
9.0	18.47	0.00	28.79	0.00	0.2318	0.1437	0.1841	0.1136
9.5	18.47	0.00	28.79	0.00	0.1846	0.0849	0.1566	0.0598

Table 12. Profile measurements at Station MG 1 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
0.5	18.09	0.02	28.89	0.00	0.3763	0.2552	0.3305	0.2611
1.0	18.10	0.02	28.89	0.01	0.2993	0.1388	0.2551	0.1439
1.5	18.10	0.02	28.89	0.00	0.2606	0.0738	0.2153	0.0770
2.0	18.10	0.03	28.89	0.01	0.2333	0.0862	0.1868	0.0895
2.5	18.09	0.03	28.89	0.01	0.2178	0.0407	0.1690	0.0445
3.0	18.09	0.03	28.88	0.01	0.2686	0.0751	0.2169	0.0809
3.5	18.09	0.03	28.88	0.00	0.3145	0.1238	0.2636	0.1227
4.0	18.09	0.03	28.88	0.00	0.3548	0.1435	0.3073	0.1467
4.5	18.09	0.03	28.88	0.00	0.3250	0.0490	0.2789	0.0539
5.0	18.08	0.03	28.87	0.00	0.2800	0.0447	0.2306	0.0409
5.5	18.08	0.03	28.87	0.00	0.2833	0.0412	0.2312	0.0412
6.0	18.08	0.03	28.87	0.00	0.3093	0.0582	0.2593	0.0560
6.5	18.08	0.03	28.87	0.00	0.3349	0.0376	0.2817	0.0293
7.0	18.08	0.03	28.88	0.00	0.3576	0.0803	0.2979	0.0779
7.5	18.07	0.02	28.88	0.00	0.3358	0.0665	0.2795	0.0615
8.0	18.06	0.02	28.88	0.00	0.2998	0.0623	0.2527	0.0559
8.5	18.05	0.01	28.88	0.00	0.2985	0.1017	0.2537	0.0947
9.0	18.05	0.01	28.88	0.00	0.3170	0.0585	0.2678	0.0510
9.5	18.04	0.01	28.88	0.00	0.3204	0.0860	0.2674	0.0718
10.0	18.04	0.01	28.88	0.00	0.3080	0.1271	0.2552	0.1081
10.5	18.04	0.01	28.88	0.00	0.2917	0.0902	0.2437	0.0790
11.0	18.04	0.01	28.88	0.00	0.2787	0.1149	0.2359	0.1032
11.5	18.03	0.01	28.88	0.00	0.2810	0.1318	0.2371	0.1131
12.0	18.03	0.01	28.88	0.00	0.3095	0.1094	0.2581	0.0890
12.5	18.03	0.01	28.88	0.00	0.3385	0.1173	0.2798	0.0983
13.0	18.03	0.01	28.88	0.00	0.3430	0.1070	0.2815	0.0914
13.5	18.03	0.01	28.88	0.00	0.3198	0.1475	0.2611	0.1233
14.0	18.02	0.01	28.88	0.00	0.2842	0.1038	0.2351	0.0861
14.5	18.02	0.02	28.88	0.00	0.2736	0.1374	0.2336	0.1156
15.0	18.02	0.02	28.88	0.00	0.2791	0.1721	0.2419	0.1442

Table 13. Profile measurements at Station MG 2 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
1.0	18.49	0.01	28.85	0.02	0.1490	0.0636	0.0936	0.0588
1.5	18.49	0.01	28.85	0.02	0.2166	0.0657	0.1658	0.0654
2.0	18.49	0.00	28.85	0.02	0.2940	0.0632	0.2433	0.0661
2.5	18.49	0.01	28.86	0.02	0.3212	0.0801	0.2639	0.0816
3.0	18.49	0.01	28.86	0.02	0.3157	0.0778	0.2580	0.0800
3.5	18.49	0.01	28.85	0.01	0.2856	0.0340	0.2307	0.0333
4.0	18.48	0.01	28.85	0.01	0.2753	0.0657	0.2211	0.0724
4.5	18.48	0.01	28.85	0.01	0.2821	0.0520	0.2230	0.0548
5.0	18.48	0.01	28.85	0.01	0.2903	0.0278	0.2282	0.0339
5.5	18.48	0.00	28.85	0.00	0.2920	0.0361	0.2346	0.0316

Table 14. Profile measurements at Station MG 3 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
1.0	20.03	0.05	28.69	0.0090	0.3161	0.0966	0.2249	0.0973
1.5	19.98	0.07	28.70	0.0088	0.3407	0.0215	0.2515	0.0241
2.0	19.91	0.08	28.70	0.0110	0.2947	0.1651	0.2763	0.0372
2.5	19.86	0.07	28.70	0.0108	0.3962	0.0532	0.3072	0.0543
3.0	19.79	0.06	28.71	0.0089	0.4022	0.0681	0.3104	0.0697
3.5	19.70	0.07	28.71	0.0104	0.3727	0.0358	0.2854	0.0396
4.0	19.59	0.06	28.73	0.0103	0.3734	0.0678	0.2960	0.0746
4.5	19.46	0.03	28.74	0.0066	0.3498	0.0513	0.2813	0.0585
5.0	19.31	0.03	28.75	0.0057	0.3026	0.0436	0.2390	0.0406
5.5	19.21	0.02	28.77	0.0013	0.3235	0.0057	0.2568	0.0056

Table 15. Profile measurements at Station MG 4 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
0.5	21.05	0.03	28.53	0.0005				
1.0	21.02	0.03	28.54	0.0080	0.5881	0.0746	0.4393	0.0727
1.5	20.99	0.05	28.54	0.0091	0.5165	0.1582	0.3598	0.1670
2.0	20.95	0.05	28.54	0.0119	0.5607	0.0492	0.4043	0.0414
2.5	20.92	0.05	28.54	0.0120	0.6023	0.0914	0.4462	0.0871
3.0	20.89	0.04	28.54	0.0104	0.6360	0.0592	0.4912	0.0594
3.5	20.87	0.02	28.54	0.0101	0.6078	0.0476	0.4743	0.0454
4.0	20.85	0.02	28.54	0.0079	0.6187	0.0361	0.4749	0.0261
4.5	20.84	0.02	28.54	0.0075	0.6357	0.0285	0.4783	0.0167
5.0	20.83	0.03	28.54	0.0058	0.6047	0.0272	0.4561	0.0328
5.5	20.82	0.03	28.54	0.0038	0.5604	0.0914	0.4280	0.0748
6.0	20.79	0.01	28.54	0.0022	0.5425	0.1395	0.4212	0.1335

Table 16. Profile measurements at Station PH 1 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
0.5	21.31	0.09	28.24	0.0162	0.7893	0.0986	0.5507	0.1006
1.0	21.20	0.08	28.26	0.0179	0.8298	0.1176	0.5973	0.1283
1.5	21.05	0.05	28.29	0.0136	0.8306	0.0840	0.6011	0.0848
2.0	20.97	0.03	28.32	0.0068	0.8262	0.0292	0.5988	0.0276
2.5	20.91	0.05	28.33	0.0083	0.8078	0.0139	0.5823	0.0117
3.0	20.83	0.08	28.34	0.0099	0.7785	0.0254	0.5616	0.0221
3.5	20.70	0.08	28.35	0.0201	0.7116	0.0468	0.5193	0.0380
4.0	20.49	0.07	28.38	0.0277	0.7127	0.0460	0.5256	0.0361
4.5	20.26	0.04	28.42	0.0164	0.7276	0.1112	0.5387	0.0763
5.0	20.07	0.02	28.46	0.0039	0.5961	0.1225	0.4503	0.0926
5.5	19.88	0.03	28.51	0.0089	0.4939	0.1190	0.3821	0.0960
6.0	19.74	0.04	28.55	0.0147	0.5407	0.2190	0.4151	0.1634
6.5	19.61	0.03	28.57	0.0146	0.6411	0.1603	0.4909	0.1156
7.0	19.50	0.01	28.58	0.0103	0.6687	0.1861	0.5241	0.1482
7.5	19.43	0.01	28.60	0.0061	0.5726	0.1874	0.4650	0.1701
8.0	19.38	0.01	28.61	0.0053	0.5035	0.0928	0.4178	0.0998
8.5	19.35	0.01	28.62	0.0034	0.5418	0.0952	0.4697	0.0703
9.0	19.32	0.01	28.62	0.0031	0.5967	0.2112	0.5504	0.1560
9.5	19.30	0.00	28.63	0.0014	0.6596	0.3621	0.6141	0.2635

Table 17. Profile measurements at Station PH 2 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
1.00	20.71	0.03	28.3666	0.0077	0.5454	0.2415	0.4617	0.0099
1.50	20.71	0.03	28.3661	0.0075	0.6219	0.1168	0.3953	0.1616
2.00	20.70	0.04	28.3653	0.0068	0.6886	0.0394	0.4894	0.0395
2.50	20.69	0.04	28.3643	0.0062	0.7123	0.0192	0.5152	0.0164
3.00	20.67	0.04	28.3616	0.0062	0.7289	0.0222	0.5324	0.0211
3.50	20.63	0.05	28.3477	0.0134	0.7010	0.0370	0.5208	0.0297
4.00	20.47	0.15	28.3353	0.0178	0.7604	0.0799	0.5774	0.0676
4.50	20.11	0.26	28.3591	0.0292	0.7432	0.0511	0.5769	0.0359
5.00	19.64	0.26	28.4423	0.0479	0.5357	0.1535	0.4307	0.1219
5.50	19.29	0.14	28.5251	0.0404	0.4670	0.0854	0.3853	0.0701
6.00	19.14	0.05	28.5599	0.0146	0.5930	0.1710	0.4875	0.1453
6.50	19.07	0.02	28.5792	0.0095	0.6224	0.2304	0.5147	0.1948
7.00	19.03	0.02	28.5906	0.0048	0.5153	0.1831	0.4383	0.1555
7.50	18.99	0.02	28.5964	0.0041	0.4605	0.0658	0.4054	0.0553
8.00	18.97	0.02	28.5988	0.0060	0.4833	0.0305	0.4283	0.0300
8.50	18.95	0.02	28.6016	0.0056	0.4779	0.0762	0.4244	0.0725
9.00	18.94	0.01	28.6043	0.0013	0.3396	0.1106	0.3079	0.1173
9.50	18.93	0.00	28.6068	0.0011	0.1869		0.1625	

Table 18. Profile measurements at Station PH 3 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
1	22.49953321	0.136863	27.89984	0.016997	0.775063	0.201344	0.512253	0.194925
1.5	22.39294771	0.199675	27.91309	0.022816	0.810414	0.089314	0.55333	0.087819
2	22.24152755	0.253296	27.92123	0.039753	0.868664	0.054687	0.616227	0.056293
2.5	22.07274742	0.25477	27.93036	0.045365	0.873635	0.042628	0.633044	0.041703
3	21.87715188	0.213322	27.95304	0.038114	0.811599	0.017778	0.59769	0.010412
3.5	21.72557988	0.153022	27.97349	0.041747	0.787861	0.035238	0.584473	0.022463
4	21.6127963	0.105578	27.99192	0.036876	0.865092	0.058295	0.649677	0.03744
4.5	21.51549501	0.073639	28.0115	0.02765	0.907995	0.02995	0.688881	0.013543
5	21.37013912	0.136459	28.03384	0.044404	0.888872	0.040109	0.672869	0.039574

Table 19. Profile measurements at Station WI 1 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
1.0	14.71	0.05	29.28	0.01	0.3203	0.0330	0.2686	0.0360
1.5	14.67	0.04	29.27	0.01	0.3083	0.0375	0.2556	0.0384
2.0	14.64	0.03	29.27	0.01	0.2958	0.0194	0.2403	0.0189
2.5	14.63	0.02	29.27	0.01	0.2762	0.0459	0.2194	0.0467
3.0	14.62	0.03	29.27	0.01	0.2961	0.0189	0.2377	0.0199
3.5	14.60	0.03	29.27	0.00	0.3078	0.0171	0.2488	0.0164
4.0	14.59	0.03	29.26	0.00	0.3074	0.0149	0.2519	0.0144
4.5	14.57	0.02	29.26	0.00	0.3173	0.0106	0.2618	0.0080
5.0	14.56	0.02	29.26	0.00	0.3211	0.0156	0.2640	0.0121
5.5	14.55	0.02	29.27	0.00	0.3446	0.0259	0.2836	0.0220
6.0	14.54	0.02	29.27	0.00	0.3624	0.0153	0.2981	0.0138
6.5	14.53	0.02	29.27	0.00	0.3114	0.0264	0.2566	0.0200
7.0	14.53	0.02	29.27	0.00	0.3054	0.0561	0.2564	0.0526
7.5	14.52	0.02	29.27	0.00	0.3735	0.0455	0.3159	0.0428
8.0	14.51	0.02	29.27	0.00	0.3790	0.0605	0.3171	0.0504
8.5	14.51	0.02	29.27	0.00	0.3165	0.0553	0.2612	0.0435
9.0	14.49	0.02	29.26	0.00	0.3118	0.0663	0.2586	0.0597
9.5	14.46	0.02	29.26	0.00	0.3657	0.0967	0.3077	0.0856
10.0	14.41	0.01	29.27	0.00	0.4091	0.0910	0.3462	0.0792

Table 20. Profile measurements at Station WI 2 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
0.5	14.45	0.19	29.29	0.01	0.2698	0.1279	0.2187	0.1313
1.0	14.30	0.15	29.31	0.01	0.2956	0.0808	0.2420	0.0833
1.5	14.14	0.09	29.31	0.01	0.3184	0.0695	0.2617	0.0713
2.0	14.02	0.09	29.31	0.01	0.3110	0.0360	0.2542	0.0329
2.5	13.93	0.07	29.31	0.01	0.3070	0.0312	0.2487	0.0310
3.0	13.87	0.07	29.31	0.01	0.3020	0.0272	0.2429	0.0246
3.5	13.81	0.05	29.30	0.01	0.2998	0.0251	0.2421	0.0240
4.0	13.74	0.03	29.30	0.01	0.3114	0.0193	0.2531	0.0188
4.5	13.66	0.03	29.31	0.01	0.3244	0.0200	0.2632	0.0166
5.0	13.56	0.06	29.31	0.01	0.3284	0.0195	0.2685	0.0177
5.5	13.45	0.06	29.32	0.01	0.3530	0.0284	0.2950	0.0235
6.0	13.35	0.04	29.33	0.01	0.3719	0.0201	0.3135	0.0153
6.5	13.28	0.02	29.34	0.01	0.3326	0.0620	0.2813	0.0536
7.0	13.24	0.02	29.34	0.00	0.3171	0.0304	0.2698	0.0289
7.5	13.19	0.02	29.34	0.01	0.3727	0.0664	0.3174	0.0532
8.0	13.13	0.02	29.35	0.01	0.4119	0.0721	0.3504	0.0608
8.5	13.07	0.02	29.35	0.00	0.3817	0.0980	0.3255	0.0910
9.0	13.02	0.02	29.36	0.00	0.3255	0.0909	0.2789	0.0827
9.5	12.97	0.02	29.36	0.01	0.3032	0.0733	0.2602	0.0629
10.0	12.90	0.02	29.36	0.00	0.3234	0.1169	0.2768	0.1030
10.5	12.83	0.02	29.37	0.00	0.3524	0.1133	0.3004	0.0983
11.0	12.77	0.02	29.38	0.01	0.3803	0.0945	0.3254	0.0814
11.5	12.73	0.01	29.38	0.00	0.3734	0.1271	0.3237	0.1110
12.0	12.70	0.01	29.38	0.00	0.3310	0.0999	0.2898	0.0846
12.5	12.67	0.01	29.39	0.00	0.3070	0.1252	0.2690	0.1069
13.0	12.65	0.01	29.39	0.00	0.2930	0.1043	0.2574	0.0914
13.5	12.64	0.01	29.38	0.00	0.2944	0.0794	0.2612	0.0662
14.0	12.61	0.02	29.38	0.00	0.3174	0.1156	0.2845	0.0993
14.5	12.56	0.03	29.38	0.00	0.3057	0.1504	0.2766	0.1281
15.0	12.51	0.03	29.38	0.00	0.2602	0.1081	0.2396	0.0902
15.5	12.45	0.02	29.38	0.01	0.2497	0.1429	0.2347	0.1348
16.0	12.40	0.02	29.38	0.01	0.2593	0.1775	0.2451	0.1681
16.5	12.36	0.03	29.39	0.01	0.2400	0.1229	0.2275	0.1123
17.0	12.30	0.04	29.39	0.01	0.2176	0.0894	0.2082	0.0770
17.5	12.22	0.06	29.38	0.01	0.2215	0.0904	0.2118	0.0776
18.0	12.05	0.08	29.37	0.01	0.2516	0.1206	0.2259	0.0885
18.5	11.82	0.11	29.38	0.02	0.2763	0.1381	0.2448	0.0959

Table 21. Profile measurements at Station WI 3 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
0.5	16.61	0.08	29.13	0.01	0.4856	0.2107	0.8216	0.6169
1.0	16.51	0.08	29.15	0.02	0.4234	0.0605	0.7337	0.7013
1.5	16.38	0.10	29.15	0.02	0.2496	0.1220	0.3401	0.2893
2.0	16.28	0.10	29.14	0.02	0.1694	0.0622	0.1221	0.0608
2.5	16.21	0.08	29.13	0.02	0.2079	0.0877	0.1591	0.0870
3.0	16.12	0.06	29.14	0.01	0.2574	0.0182	0.2061	0.0160
3.5	16.03	0.05	29.14	0.01	0.2219	0.1174	0.2193	0.0168
4.0	15.96	0.05	29.14	0.01	0.2579	0.0330	0.2003	0.0336
4.5	15.89	0.05	29.15	0.01	0.2633	0.0180	0.2052	0.0175
5.0	15.80	0.07	29.14	0.01	0.2708	0.0364	0.2153	0.0335
5.5	15.70	0.08	29.14	0.02	0.2814	0.0365	0.2238	0.0383
6.0	15.59	0.10	29.15	0.02	0.2967	0.0281	0.2344	0.0283
6.5	15.45	0.12	29.17	0.02	0.3081	0.0071	0.2495	0.0071
7.0	15.32	0.13	29.18	0.01	0.3223	0.0183	0.2669	0.0172
7.5	15.19	0.12	29.19	0.02	0.3172	0.0267	0.2587	0.0240
8.0	15.09	0.10	29.20	0.02	0.2950	0.0280	0.2394	0.0238
8.5	15.01	0.11	29.21	0.02	0.3090	0.0427	0.2530	0.0352
9.0	14.93	0.13	29.21	0.02	0.3372	0.0470	0.2775	0.0386
9.5	14.85	0.18	29.21	0.02	0.3165	0.0582	0.2657	0.0458
10.0	14.74	0.25	29.22	0.02	0.2779	0.0397	0.2392	0.0324
10.5	14.58	0.36	29.22	0.03	0.2918	0.0619	0.2519	0.0585
11.0	14.38	0.48	29.23	0.03	0.3482	0.0581	0.2989	0.0508
11.5	14.20	0.57	29.23	0.02	0.3628	0.0877	0.3100	0.0735
12.0	14.01	0.60	29.24	0.05	0.2965	0.0895	0.2525	0.0757
12.5	13.83	0.56	29.24	0.07	0.2192	0.0465	0.1898	0.0380
13.0	13.64	0.45	29.26	0.06	0.2002	0.0801	0.1782	0.0693
13.5	13.46	0.33	29.29	0.04	0.2421	0.1006	0.2165	0.0898
14.0	13.29	0.26	29.30	0.03	0.3072	0.1074	0.2732	0.0970
14.5	13.15	0.23	29.31	0.03	0.3439	0.0551	0.3039	0.0489
15.0	13.02	0.20	29.32	0.02	0.3300	0.0710	0.2902	0.0608
15.5	12.91	0.18	29.33	0.01	0.2649	0.0737	0.2352	0.0636
16.0	12.82	0.19	29.34	0.01	0.1997	0.0505	0.1839	0.0465
16.5	12.73	0.21	29.35	0.00	0.1741	0.0439	0.1648	0.0422
17.0	12.66	0.23	29.36	0.01	0.1694	0.0486	0.1589	0.0476
17.5	12.59	0.27	29.36	0.01	0.1800	0.0519	0.1655	0.0516
18.0	12.49	0.32	29.37	0.01	0.1998	0.0731	0.1810	0.0706
18.5	12.39	0.35	29.37	0.01	0.2092	0.1453	0.1869	0.1353
19.0	12.29	0.37	29.38	0.01	0.2150	0.1440	0.1917	0.1338
19.5	12.19	0.41	29.39	0.03	0.2415	0.1427	0.2174	0.1334
20.0	12.09	0.47	29.39	0.03	0.2700	0.2004	0.2435	0.1837
20.5	11.98	0.50	29.41	0.03	0.2457	0.1646	0.2212	0.1518
21.0	11.87	0.52	29.42	0.04	0.1885	0.0783	0.1711	0.0787
21.5	11.78	0.53	29.43	0.03	0.1818	0.0240	0.1675	0.0295
22.0	11.69	0.56	29.43	0.03	0.2287	0.0334	0.2125	0.0247
22.5	11.59	0.59	29.44	0.04	0.2806	0.0832	0.2604	0.0711
23.0	11.48	0.59	29.45	0.04	0.3298	0.1348	0.3019	0.1141
23.5	11.38	0.57	29.46	0.04	0.3677	0.1769	0.3305	0.1446
24.0	11.29	0.55	29.46	0.05	0.3556	0.1480	0.3159	0.1139
24.5	11.19	0.53	29.47	0.04	0.3017	0.0623	0.2678	0.0394
25.0	11.10	0.52	29.48	0.04	0.2754	0.0262	0.2432	0.0039
25.5	11.01	0.51	29.49	0.05	0.2852	0.0546	0.2486	0.0209
26.0	10.93	0.49	29.50	0.04	0.2865	0.0608	0.2512	0.0279
26.5	10.84	0.48	29.51	0.04	0.2662	0.0473	0.2422	0.0256
27.0	10.73	0.50	29.51	0.04	0.2452	0.0442	0.2313	0.0179
27.5	10.63	0.53	29.51	0.04	0.2390	0.0496	0.2274	0.0137
28.0	10.59	0.58	29.51	0.05	0.2478	0.0839	0.2314	0.0333
28.5	10.13	0.03	29.55	0.02	0.2674	0.0847	0.2343	0.0340
29.0	9.98	0.07	29.58	0.01	0.2354	0.0375	0.2213	0.0029

Table 22. Profile measurements at Station CAR 2 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
1.0	19.99	0.09	28.78	0.0101	0.2124	0.1045	0.1823	0.1107
1.5	19.74	0.04	28.77	0.0075	0.1804	0.1366	0.1479	0.1432
2.0	19.57	0.04	28.76	0.0071	0.1653	0.0997	0.1286	0.1057
2.5	19.46	0.06	28.75	0.0077	0.2183	0.0905	0.1821	0.0930
3.0	19.38	0.07	28.75	0.0082	0.2188	0.1005	0.1839	0.1046
3.5	19.30	0.06	28.75	0.0062	0.2010	0.0754	0.1660	0.0761
4.0	19.25	0.04	28.76	0.0079	0.2241	0.0601	0.1894	0.0623
4.5	19.21	0.02	28.77	0.0064	0.2151	0.0404	0.1787	0.0412
5.0	19.19	0.01	28.77	0.0049	0.2079	0.0408	0.1676	0.0415
5.5	19.18	0.01	28.78	0.0032	0.2128	0.0312	0.1715	0.0306
6.0	19.18	0.01	28.78	0.0023	0.2279	0.0532	0.1881	0.0559
6.5	19.17	0.01	28.78	0.0020	0.2542	0.0349	0.2121	0.0334
7.0	19.17	0.01	28.79	0.0025	0.2346	0.0340	0.1916	0.0333
7.5	19.17	0.01	28.79	0.0025	0.2110	0.0386	0.1688	0.0409
8.0	19.16	0.01	28.79	0.0021	0.2319	0.0335	0.1871	0.0382
8.5	19.15	0.01	28.79	0.0020	0.2298	0.0414	0.1879	0.0409
9.0	19.14	0.01	28.79	0.0013	0.2223	0.0234	0.1829	0.0229
9.5	19.14	0.01	28.79	0.0013	0.2602	0.0529	0.2120	0.0469
10.0	19.12	0.02	28.79	0.0018	0.2609	0.0379	0.2099	0.0358
10.5	19.09	0.05	28.79	0.0045	0.2217	0.0598	0.1788	0.0540
11.0	19.04	0.07	28.78	0.0063	0.2169	0.0296	0.1768	0.0263
11.5	18.97	0.09	28.79	0.0088	0.2406	0.0317	0.1966	0.0268
12.0	18.90	0.08	28.79	0.0074	0.2340	0.0254	0.1925	0.0209
12.5	18.85	0.06	28.80	0.0081	0.1852	0.0465	0.1539	0.0386
13.0	18.82	0.04	28.81	0.0060	0.1771	0.0145	0.1471	0.0147
13.5	18.80	0.03	28.81	0.0044	0.2426	0.0630	0.2007	0.0517
14.0	18.79	0.02	28.81	0.0048	0.3017	0.0297	0.2491	0.0234
14.5	18.78	0.02	28.81	0.0038	0.2920	0.0488	0.2404	0.0412
15.0	18.77	0.01	28.81	0.0028	0.2341	0.0620	0.1932	0.0502
15.5	18.77	0.01	28.81	0.0030	0.1876	0.0438	0.1555	0.0338
16.0	18.76	0.01	28.81	0.0023	0.1695	0.0849	0.1412	0.0689
16.5	18.76	0.01	28.81	0.0015	0.1801	0.0700	0.1517	0.0598
17.0	18.75	0.01	28.81	0.0021	0.2531	0.0526	0.2159	0.0476
17.5	18.75	0.01	28.81	0.0001	0.3232	0.1554	0.2751	0.1392

Table 23. Profile measurements at Station HB 1 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
0.5	19.16	0.01	28.73	0.01	0.2947		0.2598	
1.0	19.16	0.02	28.74	0.01	0.2114		0.1774	
1.5	19.16	0.04	28.74	0.01	0.0709		0.0286	
2.0	19.10	0.09	28.73	0.01	0.1507	0.0753	0.0961	0.0703
2.5	18.99	0.13	28.73	0.01	0.1953	0.0936	0.1448	0.0866
3.0	18.84	0.12	28.72	0.01	0.1940	0.1074	0.1479	0.1013
3.5	18.69	0.08	28.73	0.01	0.2183	0.0847	0.1707	0.0752
4.0	18.56	0.08	28.75	0.01	0.2672	0.0714	0.2137	0.0723
4.5	18.44	0.07	28.75	0.02	0.2872	0.0438	0.2251	0.0413
5.0	18.35	0.04	28.77	0.01	0.2715	0.0880	0.2064	0.0685
5.5	18.29	0.02	28.78	0.01	0.2621	0.0899	0.2012	0.0717
6.0	18.25	0.01	28.79	0.00	0.2474	0.0693	0.1941	0.0528
6.5	18.22	0.01	28.79	0.00	0.2415	0.0681	0.1906	0.0555
7.0	18.19	0.01	28.80	0.00	0.2616	0.1094	0.2088	0.0922
7.5	18.17	0.01	28.80	0.01	0.2814	0.0695	0.2258	0.0589
8.0	18.15	0.01	28.81	0.01	0.3127	0.0474	0.2510	0.0398
8.5	18.14	0.00	28.81	0.00	0.3373	0.0853	0.2728	0.0713
9.0	18.13	0.01	28.81	0.00	0.3252	0.1095	0.2630	0.0867
9.5	18.08	0.04	28.81	0.00	0.3119	0.0809	0.2498	0.0617
10.0	17.97	0.06	28.81	0.01	0.2970	0.0588	0.2404	0.0491
10.5	17.85	0.05	28.83	0.01	0.2455	0.0723	0.1980	0.0590
11.0	17.77	0.02	28.85	0.01	0.2105	0.0734	0.1676	0.0539
11.5	17.73	0.01	28.86	0.00	0.2420	0.0989	0.1966	0.0808
12.0	17.70	0.00	28.87	0.00	0.2875	0.1351	0.2378	0.1125
12.5	17.69	0.00	28.87	0.00	0.2733	0.1195	0.2250	0.1000
13.0	17.68	0.00	28.87	0.00	0.2221	0.0688	0.1799	0.0545
13.5	17.66	0.01	28.87	0.00	0.1804	0.0291	0.1449	0.0218
14.0	17.61	0.04	28.86	0.01	0.1706	0.0322	0.1378	0.0219
14.5	17.50	0.06	28.86	0.01	0.1770	0.0431	0.1435	0.0301

Table 24. Profile measurements at Station HB 2 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
0.5	19.51	0.06	28.72	0.00				
1.0	19.43	0.15	28.73	0.01	0.0887	0.0989	0.0170	0.0147
1.5	19.40	0.15	28.73	0.00	0.0443	0.0370	0.0229	0.0285
2.0	19.36	0.12	28.73	0.00	0.0621	0.0601	0.0580	0.0471
2.5	19.33	0.08	28.72	0.01	0.1330	0.1177	0.0642	0.0902
3.0	19.29	0.04	28.71	0.01	0.1749	0.1374	0.1135	0.1263
3.5	19.22	0.04	28.70	0.01	0.1880	0.1231	0.1560	0.1094
4.0	19.16	0.05	28.70	0.01	0.1915	0.1352	0.1578	0.1244
4.5	19.09	0.03	28.70	0.01	0.1919	0.1158	0.1557	0.0968
5.0	19.03	0.01	28.70	0.00	0.1939	0.1272	0.1575	0.1109
5.5	18.98	0.02	28.70	0.01	0.2029	0.1276	0.1647	0.1102
6.0	18.92	0.02	28.70	0.01	0.1967	0.1110	0.1552	0.0883
6.5	18.86	0.02	28.70	0.00	0.1782	0.1009	0.1385	0.0786
7.0	18.79	0.04	28.71	0.00	0.1903	0.1138	0.1516	0.0932
7.5	18.64	0.05	28.72	0.01	0.2148	0.1231	0.1751	0.1011
8.0	18.41	0.08	28.74	0.02	0.1979	0.1141	0.1592	0.0920
8.5	18.13	0.12	28.76	0.03	0.2005	0.1123	0.1595	0.0899
9.0	17.88	0.12	28.79	0.04	0.2352	0.1343	0.1890	0.1082
9.5	17.64	0.10	28.80	0.03	0.2217	0.1226	0.1762	0.0964
10.0	17.36	0.09	28.84	0.03	0.1970	0.1151	0.1544	0.0901
10.5	17.14	0.05	28.89	0.02	0.2294	0.1301	0.1861	0.1042
11.0	17.02	0.03	28.92	0.02	0.2572	0.1443	0.2154	0.1196
11.5	16.92	0.05	28.94	0.01	0.2237	0.1351	0.1895	0.1143
12.0	16.81	0.08	28.94	0.01	0.1839	0.1085	0.1552	0.0913
12.5	16.66	0.09	28.93	0.01	0.1967	0.1241	0.1652	0.1011
13.0	16.43	0.10	28.94	0.02	0.2421	0.1567	0.2042	0.1302
13.5	16.23	0.08	28.96	0.03	0.2743	0.1552	0.2333	0.1307
14.0	16.10	0.05	28.99	0.01	0.2617	0.1595	0.2259	0.1373
14.5	15.99	0.04	29.00	0.01	0.2115	0.1371	0.1865	0.1199
15.0	15.88	0.04	29.01	0.01	0.1951	0.1144	0.1728	0.0995
15.5	15.76	0.03	29.02	0.01	0.2259	0.1625	0.1974	0.1411
16.0	15.64	0.02	29.03	0.01	0.2693	0.1894	0.2345	0.1653
16.5	15.53	0.02	29.04	0.00	0.3232	0.2165	0.2832	0.1907
17.0	15.44	0.03	29.06	0.01	0.3524	0.2157	0.3106	0.1877
17.5	15.36	0.03	29.06	0.01	0.3340	0.2101	0.2969	0.1817
18.0	15.28	0.02	29.07	0.01	0.2914	0.2008	0.2609	0.1741
18.5	15.20	0.02	29.08	0.01	0.2521	0.1624	0.2257	0.1420
19.0	15.11	0.02	29.09	0.01	0.2394	0.1613	0.2144	0.1438
19.5	15.03	0.03	29.09	0.01	0.2462	0.1742	0.2236	0.1593
20.0	14.90	0.06	29.09	0.02	0.2501	0.1833	0.2299	0.1689

Table 25. Profile measurements at Station CJ 3 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
0.5	19.10	0.06	28.72	0.00	0.3141	0.0649	0.2685	0.0943
1.0	19.01	0.14	28.73	0.01	0.2369	0.0930	0.1943	0.0983
1.5	18.91	0.13	28.72	0.01	0.2170	0.1147	0.1749	0.1244
2.0	18.82	0.09	28.71	0.02	0.1972	0.0757	0.1608	0.0740
2.5	18.72	0.06	28.71	0.02	0.1620	0.1149	0.1595	0.1034
3.0	18.62	0.05	28.71	0.02	0.1631	0.0552	0.1225	0.0524
3.5	18.54	0.05	28.72	0.01	0.1984	0.0136	0.1579	0.0125
4.0	18.46	0.05	28.72	0.01	0.2509	0.0185	0.2097	0.0187
4.5	18.39	0.04	28.72	0.01	0.2422	0.0276	0.1979	0.0306
5.0	18.31	0.05	28.72	0.01	0.2299	0.0251	0.1820	0.0267
5.5	18.25	0.06	28.72	0.01	0.2317	0.0327	0.1833	0.0344
6.0	18.17	0.09	28.71	0.01	0.2368	0.0339	0.1877	0.0323
6.5	18.05	0.10	28.70	0.01	0.2526	0.0123	0.2016	0.0132
7.0	17.93	0.10	28.69	0.01	0.2608	0.0252	0.2102	0.0244
7.5	17.79	0.13	28.70	0.01	0.2710	0.0286	0.2199	0.0244
8.0	17.62	0.16	28.73	0.03	0.2784	0.0295	0.2228	0.0289
8.5	17.42	0.17	28.77	0.05	0.3004	0.0354	0.2355	0.0310
9.0	17.24	0.13	28.81	0.04	0.3171	0.0403	0.2508	0.0319
9.5	17.06	0.12	28.84	0.02	0.2914	0.0399	0.2349	0.0317
10.0	16.82	0.18	28.87	0.05	0.3017	0.0487	0.2478	0.0415
10.5	16.54	0.23	28.92	0.06	0.3342	0.0385	0.2780	0.0346
11.0	16.27	0.24	28.97	0.04	0.3023	0.0362	0.2543	0.0321
11.5	16.01	0.26	29.00	0.03	0.2317	0.0467	0.1974	0.0450
12.0	15.74	0.26	29.03	0.04	0.2258	0.0275	0.1928	0.0267
12.5	15.52	0.22	29.06	0.06	0.3020	0.0599	0.2597	0.0531
13.0	15.37	0.15	29.09	0.04	0.3402	0.0257	0.2982	0.0232
13.5	15.23	0.11	29.11	0.01	0.2988	0.0357	0.2668	0.0319
14.0	15.13	0.13	29.11	0.00	0.2565	0.0294	0.2284	0.0282
14.5	15.02	0.13	29.11	0.02	0.2282	0.0417	0.1993	0.0364
15.0	14.92	0.10	29.12	0.02	0.1863	0.0520	0.1598	0.0416
15.5	14.83	0.08	29.14	0.02	0.1779	0.0296	0.1522	0.0216
16.0	14.76	0.07	29.15	0.01	0.2560	0.0916	0.2229	0.0853
16.5	14.70	0.06	29.15	0.00	0.3510	0.0684	0.3091	0.0688
17.0	14.65	0.06	29.15	0.00	0.3453	0.0499	0.3064	0.0390
17.5	14.60	0.06	29.16	0.01	0.2712	0.0682	0.2433	0.0558
18.0	14.54	0.06	29.16	0.01	0.2337	0.0217	0.2112	0.0153
18.5	14.48	0.06	29.17	0.01	0.2401	0.0207	0.2156	0.0165
19.0	14.40	0.07	29.17	0.01	0.2471	0.0190	0.2207	0.0133
19.5	14.32	0.08	29.17	0.01	0.2397	0.0324	0.2166	0.0246
20.0	14.23	0.07	29.17	0.01	0.2380	0.0384	0.2214	0.0334
20.5	14.13	0.05	29.17	0.01	0.2399	0.0450	0.2278	0.0441
21.0	14.00	0.04	29.17	0.01	0.1923	0.0768	0.1850	0.0771
21.5	13.86	0.00	29.17	0.01	0.1084	0.0387	0.1028	0.0287
22.0	13.63	0.01	29.17	0.01	0.0978	0.0299	0.0920	0.0170
22.5	13.37	0.01	29.19	0.01	0.1109	0.0326	0.1037	0.0167
23.0	13.17	0.00	29.22	0.00	0.1217	0.0375	0.1133	0.0195

Table 26. Profile measurements at Station CJ 2 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
0.5	20.17	0.13	28.58	0.0975	0.2253	0.0581	0.1923	0.0600
1.0	19.67	0.16	28.56	0.0440	0.1621	0.0449	0.1314	0.0475
1.5	19.35	0.09	28.55	0.0342	0.0876	0.0511	0.0766	0.0321
2.0	19.14	0.07	28.55	0.0217	0.0803	0.0662	0.0582	0.0555
2.5	18.98	0.03	28.55	0.0135	0.1591	0.0922	0.1517	0.0389
3.0	18.84	0.05	28.56	0.0208	0.1970	0.1313	0.2009	0.0985
3.5	18.73	0.04	28.58	0.0209	0.1646	0.1108	0.1539	0.0915
4.0	18.66	0.03	28.60	0.0170	0.1438	0.0874	0.1267	0.0503
4.5	18.61	0.02	28.61	0.0111	0.1586	0.0983	0.1460	0.0546
5.0	18.57	0.02	28.62	0.0079	0.1594	0.0876	0.1372	0.0648
5.5	18.52	0.03	28.63	0.0105	0.1688	0.0857	0.1496	0.0569
6.0	18.46	0.03	28.64	0.0099	0.1683	0.0919	0.1503	0.0495
6.5	18.42	0.01	28.65	0.0068	0.1849	0.0844	0.1631	0.0444
7.0	18.39	0.01	28.66	0.0080	0.2068	0.0611	0.1527	0.0686
7.5	18.38	0.01	28.66	0.0084	0.2199	0.0467	0.1652	0.0521
8.0	18.36	0.01	28.66	0.0082	0.2188	0.0397	0.1670	0.0412
8.5	18.31	0.03	28.64	0.0169	0.2376	0.0447	0.1839	0.0414
9.0	18.17	0.09	28.63	0.0157	0.2862	0.0592	0.2229	0.0501
9.5	17.90	0.17	28.65	0.0235	0.2860	0.0517	0.2221	0.0387
10.0	17.54	0.23	28.69	0.0378	0.2798	0.0513	0.2216	0.0446
10.5	17.05	0.34	28.75	0.0244	0.2931	0.0618	0.2406	0.0545
11.0	16.47	0.37	28.83	0.0437	0.2859	0.0586	0.2404	0.0470
11.5	15.96	0.33	28.92	0.0678	0.2745	0.0454	0.2332	0.0431
12.0	15.65	0.19	28.98	0.0504	0.2511	0.0996	0.2149	0.0882
12.5	15.47	0.08	29.01	0.0242	0.2666	0.0729	0.2309	0.0648
13.0	15.32	0.03	29.04	0.0115	0.3318	0.0675	0.2883	0.0613
13.5	15.21	0.03	29.06	0.0113	0.3557	0.0639	0.3102	0.0564
14.0	15.16	0.03	29.06	0.0070	0.3372	0.0116	0.3012	0.0131
14.5	15.08	0.02	29.08	0.0054	0.3350	0.0473	0.3030	0.0450
15.0	15.01		29.09		0.3578		0.3267	

Table 27. Profile measurements at Station CJ 1 of Northumberland Strait in 2016. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
1.0	19.52	0.03	28.70	0.0067	0.3547	0.0523	0.3004	0.0509
1.5	19.37	0.05	28.71	0.0054	0.3044	0.0598	0.2453	0.0574
2.0	19.17	0.07	28.71	0.0100	0.2719	0.0317	0.2082	0.0318
2.5	18.97	0.05	28.71	0.0084	0.2916	0.0390	0.2293	0.0392
3.0	18.81	0.04	28.73	0.0037	0.2719	0.0371	0.2092	0.0379
3.5	18.70	0.04	28.74	0.0066	0.2598	0.0316	0.1936	0.0324
4.0	18.63	0.03	28.75	0.0093	0.2727	0.0407	0.2068	0.0411
4.5	18.59	0.01	28.75	0.0075	0.2847	0.0175	0.2203	0.0192
5.0	18.55	0.02	28.75	0.0057	0.3164	0.0169	0.2479	0.0217
5.5	18.49	0.02	28.75	0.0065	0.3044	0.0276	0.2413	0.0262
6.0	18.41	0.03	28.76	0.0082	0.2718	0.0184	0.2173	0.0163
6.5	18.33	0.02	28.77	0.0036	0.3152	0.0457	0.2524	0.0407
7.0	18.26	0.02	28.77	0.0056	0.3319	0.0196	0.2650	0.0151
7.5	18.19	0.02	28.78	0.0054	0.2718	0.0467	0.2146	0.0352
8.0	18.12	0.02	28.79	0.0052	0.2691	0.0187	0.2111	0.0162
8.5	18.07	0.02	28.80	0.0018	0.3022	0.0664	0.2376	0.0552

Table 28. Profile measurements at Station PUG 1 of Northumberland Strait in 2017. Depth (m), Temperature (°C), Salinity (psu), Kd_490, Kd_532; and Turbidity (NTU), standard deviations are also included for each variable.

Depth (m)	**Temp. (°C)**	**Stdev**	**Salinity (psu)**	**Stdev**	**Kd(490)**	**Stdev**	**Kd(532)**	**Stdev**	**Depth (m)**	**Turbidity (NTU)**	**Depth (m)**	**Turbidit (NTU)**
					K_ED_hyperspectral_downcast (/m)							
0.5	18.76	0.07	27.11	0.01					1.4	0.79	6.2	0.84
1.0	18.55	0.07	27.12	0.01	0.1669	0.1351	0.1653	0.1263	1.7	0.80	6.4	0.85
1.5	18.41	0.04	27.11	0.01	0.2084	0.0631	0.1666	0.0687	2.0	0.80	6.7	0.86
2.0	18.33	0.03	27.11	0.00	0.2040	0.0561	0.1604	0.0591	2.2	0.81	7.0	0.86
2.5	18.32	0.02	27.11	0.00	0.2042	0.0816	0.1604	0.0877	2.5	0.81	7.3	0.88
3.0	18.32	0.01	27.11	0.00	0.2293	0.0838	0.1857	0.0905	2.7	0.81	7.5	0.88
3.5	18.32	0.02	27.11	0.00	0.2033	0.0237	0.1576	0.0241	3.0	0.81	7.8	0.89
4.0	18.31	0.03	27.11	0.00	0.2217	0.0280	0.1747	0.0309	3.3	0.81	8.1	0.89
4.5	18.28	0.03	27.11	0.00	0.1999	0.0464	0.1497	0.0491	3.5	0.82	8.3	0.90
5.0	18.25	0.02	27.11	0.00	0.1741	0.0496	0.1199	0.0516	3.8	0.82	8.6	0.90
5.5	18.22	0.01	27.11	0.00	0.1875	0.0519	0.1351	0.0522	4.1	0.82	8.9	0.91
6.0	18.20	0.01	27.11	0.00	0.1944	0.0402	0.1435	0.0419	4.3	0.83	9.1	0.91
6.5	18.19	0.01	27.11	0.00	0.2250	0.0618	0.1733	0.0657	4.6	0.83	9.4	0.92
7.0	18.17	0.01	27.11	0.00	0.2267	0.0459	0.1765	0.0479	4.8	0.83	9.7	0.92
7.5	18.16	0.01	27.11	0.00	0.2612	0.0715	0.2118	0.0768	5.1	0.83	9.9	0.93
8.0	18.13	0.02	27.11	0.01	0.2639	0.0419	0.2153	0.0459	5.4	0.84	9.7	0.96
8.5	18.07	0.05	27.13	0.02	0.2505	0.0202	0.2005	0.0241	5.7	0.84		
9.0	17.95	0.07	27.16	0.02	0.2526	0.0226	0.2004	0.0183	5.9	0.84		
9.5	17.59	0.25	27.24	0.07	0.2105	0.0393	0.1548	0.0412				
10.0	16.85	0.17	27.37	0.03	0.2210	0.0808	0.1708	0.0694				

Table 29. Profile measurements at Station PUG 2 of Northumberland Strait in 2017. Depth (m), Temperature (°C), Salinity (psu), Kd_490, Kd_532; and Turbidity (NTU), standard deviations are also included for each variable.

Depth	**Temp.**	**Stdev**	**Salinity**	**Stdev**	**Kd(490)**	**Stdev**	**Kd(532)**	**Stdev**	**Depth**	**Turbidity**	**Depth**	**Turbidit**
(m)	**(°C)**		**(psu)**		**K_ED_hyperspectral_downcast (/m)**				**(m)**	**(NTU)**	**(m)**	**(NTU)**
0.5	17.76	0.17	27.46	0.04	0.2719	0.0302	0.2222	0.0341	5.5	0.93	12.0	0.96
1.0	17.55	0.18	27.47	0.02	0.2509	0.0252	0.1987	0.0258	5.7	0.93	12.3	0.97
1.5	17.44	0.04	27.47	0.00	0.2545	0.0289	0.2014	0.0313	6.0	0.93	12.5	0.97
2.0	17.38	0.11	27.47	0.01	0.2512	0.0226	0.1957	0.0255	6.2	0.93	12.8	0.98
2.5	17.28	0.16	27.49	0.02	0.2414	0.0156	0.1851	0.0191	6.5	0.93	13.0	0.98
3.0	17.17	0.21	27.49	0.02	0.2572	0.0343	0.1994	0.0364	6.8	0.93	13.3	0.98
3.5	17.07	0.15	27.51	0.01	0.2539	0.0547	0.1963	0.0563	7.1	0.94	13.6	0.98
4.0	16.97	0.06	27.52	0.01	0.2675	0.0308	0.2084	0.0297	7.3	0.94	13.9	0.98
4.5	16.91	0.03	27.52	0.01	0.2804	0.0196	0.2217	0.0210	7.6	0.94	14.1	0.98
5.0	16.84	0.02	27.53	0.00	0.2813	0.0247	0.2228	0.0243	7.9	0.94		
5.5	16.77	0.02	27.54	0.00	0.2889	0.0236	0.2263	0.0224	8.1	0.94		
6.0	16.72	0.02	27.54	0.01	0.2704	0.0184	0.2106	0.0182	8.4	0.94		
6.5	16.65	0.02	27.53	0.01	0.2638	0.0170	0.2046	0.0155	8.7	0.94		
7.0	16.58	0.02	27.53	0.01	0.2796	0.0178	0.2209	0.0145	9.0	0.94		
7.5	16.51	0.03	27.53	0.01	0.2765	0.0105	0.2169	0.0089	9.2	0.94		
8.0	16.44	0.02	27.53	0.00	0.2957	0.0219	0.2308	0.0190	9.5	0.95		
8.5	16.37	0.02	27.51	0.00	0.2964	0.0069	0.2322	0.0047	9.8	0.95		
9.0	16.25	0.05	27.49	0.01	0.2802	0.0131	0.2214	0.0109	10.0	0.95		
9.5	16.12	0.05	27.49	0.01	0.2645	0.0125	0.2122	0.0113	10.3	0.95		
10.0	16.02	0.04	27.49	0.01	0.2436	0.0161	0.1984	0.0138	10.6	0.96		
10.5	15.96	0.02	27.49	0.01	0.2499	0.0220	0.2041	0.0164	10.9	0.96		
11.0	15.93	0.01	27.50	0.00	0.2677	0.0348	0.2145	0.0226	11.1	0.96		
11.5	15.90	0.00	27.50	0.00	0.2838	0.0302	0.2211	0.0221	11.4	0.96		
12.0	15.89	0.01	27.51	0.00	0.2858	0.0250	0.2165	0.0232	11.7	0.96		
12.5	15.88	0.01	27.51	0.00	0.2905	0.0321	0.2210	0.0246				
13.0	15.85	0.01	27.51	0.01	0.3114	0.0716	0.2400	0.0533				
13.5	15.62	0.01	27.60	0.01	0.2891	0.0749	0.2305	0.0624				

Table 30. Profile measurements at Station VIC 1 of Northumberland Strait in 2017. Depth (m), Temperature (°C), Salinity (psu), Kd_490, Kd_532; and Turbidity (NTU), standard deviations are also included for each variable.

Depth	Temp.	Stdev	Salinity	Stdev	Kd(490)	Stdev	Kd(532)	Stdev	Depth	Turbidity	Depth	Turbidit
(m)	(°C)		(psu)		K_ED_hyperspectral_downcast (/m)				(m)	(NTU)	(m)	(NTU)
0.5	17.65	0.17	27.55	0.01	0.1006	0.0736			1.0	1.07	6.1	1.23
1.0	17.34	0.10	27.57	0.02	0.1747	0.0934	0.1294	0.0983	1.3	1.10	6.3	1.25
1.5	17.21	0.07	27.57	0.01	0.2010	0.0390	0.1548	0.0393	1.6	1.10	6.6	1.25
2.0	17.16	0.03	27.58	0.01	0.2279	0.0279	0.1817	0.0294	1.8	1.11	6.9	1.28
2.5	17.12	0.02	27.59	0.01	0.2217	0.0434	0.1715	0.0452	2.1	1.11	7.2	1.28
3.0	17.05	0.09	27.62	0.03	0.2251	0.0315	0.1728	0.0344	2.4	1.13	7.4	1.28
3.5	16.97	0.10	27.64	0.03	0.2392	0.0187	0.1834	0.0198	2.6	1.13	7.7	1.32
4.0	16.85	0.06	27.65	0.02	0.2785	0.0302	0.2224	0.0337	2.9	1.16	8.0	1.32
4.5	16.50	0.10	27.65	0.04	0.2879	0.0113	0.2344	0.0125	3.1	1.16	8.3	1.36
5.0	15.66	0.21	27.69	0.07	0.2830	0.0256	0.2316	0.0255	3.4	1.18	8.5	1.36
5.5	14.24	0.31	27.92	0.15	0.2667	0.0397	0.2177	0.0420	3.7	1.18	8.8	1.36
6.0	12.93	0.41	28.14	0.14	0.2614	0.0217	0.2149	0.0240	3.9	1.20	9.0	1.44
6.5	12.18	0.33	28.28	0.14	0.2846	0.0338	0.2393	0.0307	4.2	1.20	9.3	1.44
7.0	11.29	0.21	28.60	0.09	0.3028	0.0245	0.2575	0.0164	4.5	1.21	9.6	1.50
7.5	10.85	0.11	28.74	0.06	0.3294	0.0115	0.2806	0.0096	4.7	1.21		
8.0	10.71	0.05	28.78	0.04	0.3381	0.0159	0.2853	0.0142	5.0	1.21		
8.5	10.67	0.02	28.80	0.01	0.3438	0.0298	0.2922	0.0227	5.3	1.22		
9.0	10.64	0.01	28.81	0.01	0.3573	0.0536	0.3052	0.0462	5.6	1.22		
9.5	10.63	0.01	28.81	0.00	0.3342	0.0530	0.2958	0.0492	5.8	1.23		

Table 31. Profile measurements at Station VIC 2 of Northumberland Strait in 2017. Depth (m), Temperature (°C), Salinity (psu), Kd_490, Kd_532; and Turbidity (NTU), standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev	Depth (m)	Turbidity (NTU)	Depth (m)	Turbidit (NTU)
					K_ED_hyperspectral_downcast (/m)							
1.0	16.91	0.15	27.51	0.03	0.2250	0.0349	0.1762	0.0386	1.2	0.58	6.1	0.65
1.5	16.71	0.06	27.52	0.03	0.2312	0.0281	0.1835	0.0294	1.5	0.58	6.4	0.65
2.0	16.63	0.07	27.53	0.03	0.2333	0.0177	0.1843	0.0181	1.7	0.58	6.7	0.65
2.5	16.60	0.07	27.54	0.03	0.2394	0.0150	0.1900	0.0159	2.0	0.59	6.9	0.66
3.0	16.60	0.05	27.53	0.02	0.2441	0.0121	0.1927	0.0128	2.3	0.59	7.2	0.66
3.5	16.56	0.05	27.54	0.02	0.2482	0.0175	0.1968	0.0198	2.6	0.60	7.5	0.66
4.0	16.48	0.09	27.55	0.03	0.2522	0.0232	0.2020	0.0241	2.9	0.60	7.7	0.66
4.5	16.25	0.18	27.58	0.06	0.2499	0.0181	0.2017	0.0189	3.1	0.60	8.0	0.67
5.0	15.93	0.26	27.64	0.08	0.2467	0.0062	0.1986	0.0062	3.4	0.62	8.3	0.67
5.5	15.42	0.29	27.76	0.10	0.2579	0.0117	0.2074	0.0099	3.7	0.62	8.6	0.70
6.0	14.89	0.24	27.86	0.07	0.2692	0.0212	0.2162	0.0181	3.9	0.62	8.8	0.70
6.5	14.39	0.28	27.98	0.11	0.2875	0.0210	0.2320	0.0190	4.2	0.62	9.1	0.70
7.0	13.56	0.43	28.16	0.22	0.2829	0.0144	0.2305	0.0142	4.5	0.63	9.4	0.75
7.5	12.36	0.52	28.44	0.19	0.2909	0.0124	0.2410	0.0148	4.8	0.63	9.6	0.75
8.0	11.49	0.42	28.62	0.14	0.2902	0.0231	0.2454	0.0214	5.0	0.63	9.9	0.75
8.5	10.98	0.33	28.73	0.10	0.2840	0.0242	0.2433	0.0232	5.3	0.64	10.2	0.81
9.0	10.68	0.24	28.81	0.10	0.3043	0.0303	0.2630	0.0300	5.6	0.64	10.5	0.81
9.5	10.46	0.10	28.89	0.01	0.2861	0.0141	0.2453	0.0048	5.8	0.64	10.7	0.81
10.0	10.41	0.07	28.89	0.01	0.3047	0.0546	0.2628	0.0321			11.0	0.88

Table 32. Profile measurements at Station SUM 1 of Northumberland Strait in 2017. Depth (m), Temperature (°C), Salinity (psu), Kd_490, Kd_532; and Turbidity (NTU), standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev	Depth (m)	Turbidity (NTU)	Depth (m)	Turbidit (NTU)
0.5	17.90	0.00	27.27	0.00	0.3167	0.0167	0.2598	0.0163	1.1	1.16	6.2	1.26
1.0	17.91	0.01	27.27	0.00	0.3197	0.0167	0.2575	0.0164	1.3	1.17	6.4	1.29
1.5	17.90	0.01	27.27	0.00	0.3169	0.0071	0.2544	0.0074	1.6	1.20	6.7	1.29
2.0	17.91	0.01	27.27	0.00	0.3290	0.0208	0.2640	0.0165	1.9	1.20	7.0	1.29
2.5	17.91	0.01	27.27	0.00	0.3255	0.0141	0.2616	0.0107	2.1	1.20	7.3	1.30
3.0	17.91	0.00	27.27	0.00	0.3289	0.0122	0.2648	0.0076	2.4	1.21	7.5	1.30
3.5	17.91	0.00	27.27	0.00	0.3341	0.0130	0.2696	0.0094	2.7	1.21	7.8	1.30
4.0	17.91	0.01	27.27	0.00	0.3307	0.0054	0.2670	0.0048	3.0	1.22	8.1	1.31
4.5	17.91	0.00	27.27	0.00	0.3265	0.0198	0.2640	0.0158	3.2	1.22	8.3	1.31
5.0	17.91	0.00	27.27	0.00	0.3178	0.0191	0.2583	0.0159	3.5	1.22	8.6	1.31
5.5	17.91	0.00	27.27	0.00	0.3169	0.0035	0.2591	0.0045	3.8	1.22	8.8	1.31
6.0	17.91	0.00	27.27	0.00	0.3075	0.0454	0.2508	0.0349	4.0	1.22	9.1	1.31
6.5	17.91	0.00	27.27	0.00	0.3157	0.0605	0.2562	0.0454	4.3	1.22	9.4	1.32
7.0	17.91	0.01	27.27	0.00	0.3302	0.0203	0.2663	0.0168	4.6	1.23	9.6	1.32
7.5	17.91	0.01	27.27	0.00	0.3424	0.0592	0.2767	0.0491	4.8	1.23	9.9	1.32
8.0	17.91	0.01	27.27	0.00	0.3580	0.0420	0.2922	0.0336	5.1	1.25	10.2	1.33
8.5	17.91	0.01	27.27	0.00	0.3451	0.0137	0.2834	0.0116	5.4	1.25	10.4	1.33
9.0	17.91	0.01	27.27	0.00	0.3386	0.0647	0.2789	0.0518	5.6	1.26	10.7	1.33
9.5	17.91	0.01	27.27	0.00	0.3399	0.0623	0.2852	0.0540	5.9	1.26	11.0	1.34
											11.3	1.34

Table 33. Profile measurements at Station SUM 2 of Northumberland Strait in 2017. Depth (m), Temperature (°C), Salinity (psu), Kd_490, Kd_532; and Turbidity (NTU), standard deviations are also included for each variable.

Depth	Temp.	Stdev	Salinity	Stdev	Kd(490)	Stdev	Kd(532)	Stdev	Depth	Turbidity	Depth	Turbidity
(m)	(°C)		(psu)		K_ED_hyperspectral_downcast (/m)				(m)	(NTU)	(m)	(NTU)
0.5	16.72	0.02	27.38	0.01	0.2920	0.0305	0.2329	0.0281	1.0	0.95	9.0	1.04
1.0	16.73	0.02	27.38	0.01	0.2962	0.0170	0.2347	0.0150	1.2	0.95	9.2	1.04
1.5	16.72	0.02	27.38	0.01	0.2974	0.0129	0.2375	0.0100	1.0	0.99	9.5	1.04
2.0	16.72	0.02	27.38	0.01	0.3016	0.0078	0.2402	0.0055	0.7	0.99	9.8	1.04
2.5	16.72	0.02	27.38	0.01	0.2996	0.0135	0.2385	0.0133	1.0	1.03	10.0	1.04
3.0	16.72	0.02	27.38	0.01	0.2983	0.0127	0.2394	0.0125	1.2	1.02	10.3	1.04
3.5	16.73	0.02	27.38	0.01	0.2960	0.0075	0.2377	0.0077	1.5	1.02	10.6	1.04
4.0	16.73	0.02	27.38	0.01	0.2913	0.0202	0.2355	0.0183	1.7	1.02	10.9	1.04
4.5	16.72	0.02	27.38	0.01	0.2887	0.0132	0.2334	0.0103	2.0	1.02	11.1	1.04
5.0	16.72	0.02	27.38	0.01	0.3036	0.0125	0.2446	0.0080	2.3	1.02	11.4	1.05
5.5	16.72	0.02	27.38	0.00	0.3172	0.0030	0.2553	0.0026	2.6	1.00	11.7	1.05
6.0	16.71	0.03	27.38	0.00	0.3161	0.0150	0.2545	0.0108	2.9	1.00	11.9	1.06
6.5	16.71	0.03	27.38	0.00	0.3019	0.0169	0.2445	0.0145	3.1	1.00	12.2	1.06
7.0	16.70	0.04	27.38	0.00	0.2806	0.0286	0.2300	0.0237	3.4	1.00	12.5	1.07
7.5	16.68	0.04	27.39	0.00	0.2868	0.0480	0.2359	0.0392	3.7	1.00	12.7	1.07
8.0	16.65	0.05	27.39	0.00	0.3116	0.0326	0.2551	0.0236	4.0	1.00	13.0	1.07
8.5	16.64	0.05	27.39	0.01	0.3097	0.0651	0.2523	0.0519	4.2	1.00	13.3	1.07
9.0	16.62	0.05	27.39	0.00	0.2956	0.0874	0.2403	0.0707	4.5	1.02	13.5	1.07
9.5	16.60	0.06	27.40	0.01	0.2946	0.0457	0.2404	0.0364	4.8	1.02	13.8	1.08
10.0	16.59	0.05	27.40	0.01	0.2955	0.0462	0.2430	0.0379	5.1	1.02	14.1	1.08
10.5	16.58	0.04	27.40	0.00	0.2885	0.0925	0.2399	0.0765	5.4	1.02	14.3	1.08
11.0	16.57	0.03	27.40	0.00	0.2661	0.1035	0.2232	0.0852	5.6	1.02	14.6	1.08
11.5	16.56	0.03	27.40	0.00	0.2514	0.0633	0.2110	0.0529	5.9	1.02		
12.0	16.56	0.03	27.40	0.00	0.2883	0.0621	0.2398	0.0534	6.2	1.02		
12.5	16.55	0.03	27.40	0.00	0.3391	0.0740	0.2800	0.0617	6.4	1.02		
13.0	16.54	0.02	27.40	0.00	0.3522	0.0984	0.2894	0.0807	6.7	1.03		
13.5	16.54	0.02	27.41	0.00	0.3227	0.1031	0.2649	0.0864	7.0	1.03		
14.0	16.53	0.02	27.41	0.01	0.2625	0.1007	0.2150	0.0852	7.3	1.03		
14.5	16.52	0.02	27.41	0.01	0.2357	0.0794	0.1951	0.0647	7.6	1.03		
15.0	16.51	0.01	27.41	0.00	0.2453	0.0929	0.2049	0.0745	7.8	1.04		
15.5	16.49	0.01	27.41	0.00	0.2675	0.1040	0.2241	0.0852	8.1	1.04		
16.0	16.48	0.00	27.41	0.00	0.2868	0.1232	0.2406	0.1014	8.4	1.04		
16.5	16.48	0.00	27.41	0.00	0.2460	0.0930	0.2089	0.0816	8.7	1.04		

Table 34. Profile measurements at Station MC 2 of Northumberland Strait in 2017. Depth (m), Temperature (°C), Salinity (psu), Kd_490, Kd_532; and Turbidity (NTU), standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev	Depth (m)	Turbidity (NTU)	Depth (m)	Turbidit (NTU)
0.5	17.20	0.02	26.94	0.02	0.2704	0.0550	0.2099	0.0519	0.8	0.69	12.2	0.70
1.0	17.20	0.02	26.95	0.02	0.2778	0.0392	0.2162	0.0409	1.1	0.68	12.5	0.71
1.5	17.19	0.02	26.95	0.02	0.2807	0.0262	0.2180	0.0254	1.3	0.67	12.8	0.71
2.0	17.19	0.02	26.95	0.02	0.2881	0.0174	0.2240	0.0177	1.6	0.67	13.1	0.71
2.5	17.19	0.02	26.95	0.02	0.2838	0.0125	0.2166	0.0137	1.8	0.67	13.3	0.73
3.0	17.19	0.02	26.95	0.02	0.2870	0.0142	0.2202	0.0147	2.1	0.67	13.6	0.73
3.5	17.19	0.02	26.95	0.02	0.2814	0.0106	0.2152	0.0087	2.4	0.67	13.9	0.73
4.0	17.20	0.02	26.95	0.02	0.2853	0.0077	0.2191	0.0059	2.7	0.67	14.2	0.73
4.5	17.19	0.01	26.95	0.01	0.2864	0.0106	0.2225	0.0105	2.9	0.67	14.4	0.75
5.0	17.18	0.03	26.95	0.01	0.2829	0.0121	0.2197	0.0086	3.2	0.67	14.7	0.75
5.5	17.16	0.03	26.96	0.01	0.2895	0.0155	0.2262	0.0100	3.5	0.67	15.0	0.75
6.0	17.14	0.04	26.97	0.01	0.2830	0.0110	0.2196	0.0102	3.8	0.67	15.3	0.76
6.5	17.12	0.04	26.97	0.01	0.2914	0.0188	0.2264	0.0138	4.1	0.67	15.6	0.76
7.0	17.09	0.07	26.98	0.02	0.3007	0.0118	0.2354	0.0065	4.4	0.68	15.9	0.76
7.5	17.06	0.07	26.99	0.03	0.2979	0.0099	0.2328	0.0089	4.7	0.68	16.2	0.76
8.0	17.01	0.07	27.00	0.02	0.2882	0.0150	0.2244	0.0078	4.9	0.68	16.5	0.78
8.5	16.93	0.11	27.03	0.03	0.2756	0.0345	0.2167	0.0249	5.2	0.68	16.7	0.78
9.0	16.82	0.18	27.06	0.05	0.2829	0.0270	0.2276	0.0205	5.5	0.68	17.0	0.78
9.5	16.70	0.16	27.09	0.05	0.2890	0.0169	0.2369	0.0144	5.8	0.68	17.3	0.78
10.0	16.58	0.12	27.13	0.04	0.2790	0.0678	0.2289	0.0544	6.1	0.68	17.6	0.80
10.5	16.47	0.10	27.16	0.02	0.2566	0.0670	0.2089	0.0539	6.3	0.68	17.8	0.80
11.0	16.26	0.10	27.22	0.02	0.2511	0.0211	0.2044	0.0154	6.6	0.68	18.1	0.80
11.5	16.07	0.11	27.27	0.04	0.2661	0.0632	0.2181	0.0515	6.9	0.68	18.4	0.80
12.0	15.89	0.11	27.32	0.05	0.2767	0.0903	0.2292	0.0753	7.2	0.68	18.7	0.80
12.5	15.76	0.09	27.37	0.04	0.2777	0.0816	0.2325	0.0708	7.4	0.68	18.9	0.82
13.0	15.69	0.07	27.39	0.03	0.2762	0.0425	0.2332	0.0405	7.7	0.68	19.2	0.82
13.5	15.65	0.05	27.40	0.02	0.2976	0.0439	0.2503	0.0347	8.0	0.68	19.5	0.82
14.0	15.59	0.04	27.42	0.02	0.3090	0.0795	0.2576	0.0612	8.2	0.68	19.8	0.82
14.5	15.56	0.04	27.43	0.01	0.2891	0.0924	0.2392	0.0742	8.5	0.68	20.1	0.84
15.0	15.55	0.03	27.43	0.01	0.2430	0.0753	0.2000	0.0658	8.8	0.68	20.4	0.84
15.5	15.51	0.03	27.44	0.01	0.1920	0.0711	0.1579	0.0648	9.0	0.69	20.6	0.84
16.0	15.48	0.02	27.45	0.01	0.1595	0.0621	0.1308	0.0587	9.3	0.69		
16.5	15.45	0.01	27.46	0.00	0.1456	0.0440	0.1187	0.0475	9.6	0.69		
17.0	15.43	0.01	27.46	0.00	0.1486	0.0362	0.1217	0.0427	9.9	0.69		
17.5	15.42	0.01	27.47	0.00	0.1791	0.0462	0.1502	0.0465	10.2	0.69		
18.0	15.41	0.01	27.47	0.00	0.2379	0.0756	0.2036	0.0680	10.5	0.69		
18.5	15.40	0.02	27.47	0.00	0.3169	0.1306	0.2708	0.1124	10.8	0.69		
19.0	15.39	0.02	27.47	0.01	0.3837	0.1778	0.3229	0.1500	11.0	0.69		
19.5	15.38	0.02	27.48	0.01	0.3905	0.1761	0.3239	0.1475	11.3	0.70		
20.0	15.36	0.01	27.48	0.00	0.3539	0.1394	0.2921	0.1157	11.6	0.70		
20.5	15.35	0.01	27.48	0.00	0.3091	0.0920	0.2560	0.0745	11.9	0.70		
21.0	15.35	0.01	27.48	0.00	0.2746	0.0625	0.2301	0.0479				
21.5	15.34	0.01	27.48	0.01	0.2720	0.0638	0.2272	0.0463				

Table 35. Profile measurements at Station MC 1 of Northumberland Strait in 2017. Depth (m), Temperature (°C), Salinity (psu), Kd_490, Kd_532; and Turbidity (NTU), standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev	Depth (m)	Turbidity (NTU)	Depth (m)	Turbidit (NTU)
0.5	17.66	0.02	26.86	0.00	0.2970	0.0111	0.2276	0.0122	0.6	1.04	6.0	1.00
1.0	17.66	0.01	26.86	0.00	0.2953	0.0230	0.2235	0.0202	0.9	1.02	6.3	1.00
1.5	17.66	0.01	26.86	0.00	0.2970	0.0183	0.2264	0.0158	1.1	0.99	6.6	1.00
2.0	17.66	0.01	26.86	0.00	0.3017	0.0116	0.2323	0.0114	1.4	0.99	6.8	1.00
2.5	17.66	0.01	26.86	0.00	0.3070	0.0099	0.2361	0.0076	1.1	0.98	7.1	1.00
3.0	17.66	0.01	26.86	0.00	0.3193	0.0086	0.2474	0.0061	0.9	0.99	7.4	1.00
3.5	17.66	0.01	26.86	0.00	0.3147	0.0087	0.2425	0.0068	1.2	0.99	7.6	1.02
4.0	17.66	0.01	26.86	0.00	0.3180	0.0083	0.2448	0.0051	1.4	0.99	7.9	1.02
4.5	17.65	0.01	26.86	0.00	0.3169	0.0116	0.2453	0.0086	1.7	0.99	8.2	1.02
5.0	17.65	0.01	26.86	0.00	0.3057	0.0142	0.2365	0.0117	2.0	0.99	8.4	1.03
5.5	17.64	0.02	26.86	0.00	0.3100	0.0188	0.2410	0.0136	2.2	0.99	8.7	1.03
6.0	17.63	0.04	26.86	0.00	0.3171	0.0121	0.2477	0.0102	2.5	0.99	9.0	1.03
6.5	17.62	0.05	26.86	0.01	0.3235	0.0181	0.2525	0.0144	2.8	0.99	9.2	1.03
7.0	17.60	0.05	26.87	0.01	0.3189	0.0309	0.2482	0.0235	3.0	0.99	9.5	1.04
7.5	17.58	0.05	26.87	0.01	0.3130	0.0238	0.2431	0.0180	3.3	0.99	9.7	1.04
8.0	17.56	0.04	26.87	0.01	0.3140	0.0180	0.2461	0.0129	3.6	0.99	10.0	1.04
8.5	17.55	0.04	26.88	0.01	0.3195	0.0203	0.2543	0.0138	3.9	0.99	10.3	1.05
9.0	17.54	0.04	26.88	0.01	0.3113	0.0385	0.2500	0.0317	4.1	0.99	10.6	1.05
9.5	17.53	0.05	26.88	0.01	0.2840	0.0493	0.2284	0.0406	4.4	0.99	10.8	1.05
10.0	17.52	0.05	26.88	0.01	0.2710	0.0526	0.2144	0.0400	4.6	0.99	11.1	1.06
10.5	17.51	0.06	26.88	0.01	0.2613	0.0791	0.2034	0.0597	4.9	0.99	11.4	1.06
11.0	17.49	0.04	26.88	0.01	0.2543	0.1158	0.1964	0.0887	5.2	0.99	11.6	1.06
11.5	17.48	0.03	26.89	0.01	0.2510	0.1379	0.1931	0.1062	5.5	0.99	11.9	1.06

Table 36. Profile measurements at Station CT 2 of Northumberland Strait in 2017. Depth (m), Temperature (°C), Salinity (psu), Kd_490, Kd_532; and Turbidity (NTU), standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev	Depth (m)	Turbidity (NTU)	Depth (m)	Turbidit (NTU)
0.5	16.29	0.02	27.26	0.01	0.3197	0.0382	0.2512	0.0378	1.5	1.15	12.0	1.12
1.0	16.29	0.02	27.26	0.00	0.3149	0.0259	0.2507	0.0253	1.7	1.15	12.3	1.12
1.5	16.28	0.01	27.26	0.00	0.3211	0.0282	0.2552	0.0272	1.5	1.11	12.6	1.12
2.0	16.28	0.01	27.26	0.00	0.3336	0.0283	0.2662	0.0279	1.2	1.10	12.9	1.12
2.5	16.27	0.01	27.26	0.00	0.3207	0.0209	0.2543	0.0202	0.9	1.08	13.1	1.12
3.0	16.27	0.01	27.26	0.00	0.3241	0.0093	0.2551	0.0065	1.2	1.08	13.4	1.13
3.5	16.27	0.02	27.26	0.00	0.3129	0.0179	0.2473	0.0175	1.5	1.08	13.7	1.13
4.0	16.27	0.02	27.26	0.00	0.3152	0.0095	0.2480	0.0102	1.8	1.08	14.0	1.13
4.5	16.27	0.01	27.26	0.00	0.3406	0.0150	0.2694	0.0135	2.0	1.07	14.3	1.13
5.0	16.26	0.02	27.26	0.00	0.3292	0.0139	0.2620	0.0118	2.3	1.07	14.5	1.16
5.5	16.25	0.02	27.26	0.00	0.3292	0.0322	0.2636	0.0249	2.6	1.07	14.8	1.16
6.0	16.24	0.01	27.26	0.00	0.3281	0.0194	0.2652	0.0161	2.9	1.07	15.1	1.16
6.5	16.23	0.01	27.26	0.00	0.3209	0.0168	0.2593	0.0122	3.1	1.07	15.4	1.16
7.0	16.21	0.02	27.27	0.01	0.3221	0.0330	0.2589	0.0225	3.4	1.07	15.6	1.16
7.5	16.17	0.03	27.28	0.01	0.3210	0.0180	0.2572	0.0121	3.7	1.07	15.9	1.16
8.0	16.14	0.04	27.29	0.01	0.3280	0.0420	0.2623	0.0333	4.0	1.07	16.1	1.16
8.5	16.09	0.05	27.30	0.02	0.3400	0.0272	0.2735	0.0208	4.2	1.07	16.4	1.16
9.0	16.02	0.04	27.32	0.02	0.3241	0.0474	0.2632	0.0417	4.5	1.07	16.7	1.17
9.5	15.94	0.05	27.35	0.02	0.2919	0.0715	0.2387	0.0605	4.8	1.08	17.0	1.17
10.0	15.87	0.06	27.37	0.02	0.2813	0.0698	0.2298	0.0554	5.1	1.08	17.3	1.17
10.5	15.80	0.06	27.40	0.02	0.3090	0.0680	0.2502	0.0535	5.3	1.08	17.5	1.17
11.0	15.72	0.10	27.42	0.05	0.3412	0.0944	0.2756	0.0755	5.6	1.08	17.8	1.17
11.5	15.63	0.10	27.45	0.05	0.3396	0.1089	0.2772	0.0879	5.9	1.08	18.1	1.17
12.0	15.53	0.10	27.49	0.05	0.3105	0.0862	0.2597	0.0708	6.1	1.08	18.3	1.17
12.5	15.44	0.10	27.52	0.05	0.2862	0.0454	0.2455	0.0390	6.4	1.08	18.6	1.17
13.0	15.34	0.09	27.54	0.04	0.2750	0.0912	0.2382	0.0716	6.7	1.08	18.9	1.18
13.5	15.20	0.09	27.58	0.03	0.2644	0.1234	0.2271	0.0980	7.0	1.08	19.1	1.18
14.0	15.02	0.08	27.64	0.03	0.2425	0.1131	0.2061	0.0920	7.2	1.08	19.4	1.18
14.5	14.81	0.09	27.70	0.03	0.2144	0.0769	0.1828	0.0662	7.5	1.08	19.7	1.19
15.0	14.65	0.11	27.71	0.05	0.2193	0.0782	0.1890	0.0700	7.8	1.09	20.0	1.19
15.5	14.51	0.19	27.73	0.08	0.2536	0.1315	0.2193	0.1142	8.1	1.09	20.3	1.19
16.0	14.36	0.20	27.79	0.09	0.2819	0.1636	0.2434	0.1419	8.4	1.09	20.5	1.19
16.5	14.20	0.19	27.85	0.08	0.2912	0.1399	0.2508	0.1228	8.6	1.09	20.8	1.20
17.0	14.04	0.16	27.90	0.06	0.2874	0.0976	0.2465	0.0896	8.9	1.10	21.1	1.20
17.5	13.96	0.16	27.91	0.07	0.2935	0.1191	0.2491	0.1060	9.2	1.10	21.3	1.20
18.0	13.86	0.14	27.95	0.05	0.3040	0.1524	0.2547	0.1285	9.5	1.10	21.6	1.20
18.5	13.80	0.13	27.96	0.05	0.3078	0.1343	0.2553	0.1061	9.8	1.10	21.8	1.21
19.0	13.74	0.11	27.97	0.05	0.3141	0.1111	0.2583	0.0803	10.0	1.11	22.1	1.21
19.5	13.62	0.11	28.01	0.04	0.3365	0.1377	0.2750	0.1084	10.3	1.11	22.4	1.21
20.0	13.52	0.07	28.04	0.02	0.3604	0.1893	0.2964	0.1528	10.6	1.11	22.7	1.21
20.5	13.46	0.07	28.06	0.02	0.3459	0.1916	0.2919	0.1490	10.9	1.11	22.9	1.22
21.0	13.40	0.07	28.08	0.02	0.3043	0.1462	0.2672	0.1084	11.2	1.12	23.2	1.22
21.5	13.34	0.08	28.08	0.02	0.2669	0.1065	0.2456	0.0736	11.4	1.12	23.5	1.22
22.0	13.19	0.14	28.12	0.03	0.2428	0.0511	0.2223	0.0402	11.7	1.12	23.8	1.26

Table 37. Profile measurements at Station CT 1 of Northumberland Strait in 2017. Depth (m), Temperature (°C), Salinity (psu), Kd_490, Kd_532; and Turbidity (NTU), standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev	Depth (m)	Turbidity (NTU)	Depth (m)	Turbidit (NTU)
0.5	16.72	0.07	27.21	0.01	0.3377	0.0199	0.2667	0.0182	0.4	1.39	6.0	1.29
1.0	16.67	0.13	27.22	0.02	0.3361	0.0170	0.2635	0.0153	0.7	1.32	6.3	1.28
1.5	16.67	0.12	27.21	0.03	0.3348	0.0099	0.2626	0.0071	0.9	1.33	6.6	1.28
2.0	16.63	0.11	27.22	0.03	0.3402	0.0101	0.2662	0.0090	1.2	1.33	6.8	1.28
2.5	16.61	0.10	27.22	0.02	0.3304	0.0108	0.2592	0.0079	1.5	1.33	7.1	1.26
3.0	16.60	0.10	27.22	0.03	0.3342	0.0045	0.2639	0.0033	1.8	1.31	7.4	1.26
3.5	16.58	0.11	27.22	0.02	0.3448	0.0145	0.2719	0.0130	2.0	1.31	7.7	1.26
4.0	16.53	0.15	27.23	0.03	0.3404	0.0114	0.2684	0.0100	2.3	1.30	7.9	1.26
4.5	16.45	0.25	27.26	0.06	0.3448	0.0141	0.2716	0.0125	2.6	1.30	8.2	1.25
5.0	16.40	0.29	27.27	0.07	0.3494	0.0012	0.2765	0.0029	2.8	1.30	8.5	1.25
5.5	16.35	0.30	27.28	0.08	0.3552	0.0075	0.2845	0.0047	3.1	1.30	8.7	1.25
6.0	16.27	0.31	27.29	0.08	0.3582	0.0175	0.2904	0.0137	3.4	1.30	9.0	1.25
6.5	16.18	0.30	27.31	0.08	0.3219	0.0255	0.2631	0.0210	3.6	1.29	9.2	1.25
7.0	16.07	0.35	27.34	0.10	0.2738	0.0443	0.2251	0.0352	3.9	1.29	9.5	1.25
7.5	15.96	0.31	27.38	0.09	0.2965	0.0274	0.2438	0.0233	4.2	1.29	9.8	1.25
8.0	15.80	0.21	27.43	0.07	0.3547	0.0687	0.2926	0.0582	4.4	1.29	10.1	1.25
8.5	15.67	0.12	27.48	0.05	0.4173	0.0569	0.3467	0.0491	4.7	1.29	10.3	1.25
9.0	15.63	0.08	27.49	0.04	0.4387	0.0277	0.3668	0.0234	5.0	1.29	10.6	1.26
9.5	15.62	0.09	27.49	0.05	0.4137	0.0408	0.3475	0.0326	5.2	1.29	10.9	1.26
10.0	15.59	0.08	27.50	0.05	0.4121	0.0454	0.3480	0.0383	5.5	1.29	11.2	1.31
10.5	15.55	0.05	27.52	0.02	0.3996	0.0379	0.3386	0.0319	5.8	1.29	11.4	1.31
11.0	15.53	0.02	27.53	0.01	0.4271	0.0425	0.3617	0.0421			11.7	1.36
											11.9	1.36
											12.2	1.36

Table 38. Profile measurements at Station 10 of Haida Gwaii archipelago in 2018. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
1	11.93295096	0.02414	31.135883	0.14768	0.290109	0.048676	0.23209	0.04512
1.5	11.91886206	0.030268	31.230243	0.078988	0.290073	0.035305	0.233931	0.033299
2	11.89671634	0.030269	31.304909	0.054815	0.289397	0.026673	0.23519	0.026022
2.5	11.87055664	0.026716	31.369956	0.04252	0.285769	0.012442	0.235393	0.012787
3	11.84224701	0.023779	31.41617	0.034007	0.282727	0.01366	0.235267	0.008113
3.5	11.81509037	0.016682	31.44773	0.021456	0.280372	0.012804	0.235042	0.007459
4	11.79395738	0.009494	31.466163	0.011488	0.278289	0.012702	0.234691	0.011614
4.5	11.78210423	0.004797	31.475723	0.006174	0.27362	0.018349	0.231634	0.018393
5	11.77794816	0.002977	31.479904	0.004446	0.26134	0.024955	0.222	0.024615
5.5	11.77689267	0.003017	31.482154	0.004284	0.255575	0.028193	0.218067	0.027458
6	11.7762369	0.002531	31.484831	0.003127	0.258538	0.023506	0.221501	0.023605
6.5	11.77647203	0.002329	31.488461	0.0038	0.259724	0.025682	0.223782	0.025095
7	11.77691672	0.002346	31.493482	0.007154	0.261608	0.020685	0.225952	0.017544
7.5	11.77594403	0.002275	31.498807	0.009394	0.247348	0.02576	0.216421	0.020303
8	11.77110931	0.003784	31.506387	0.017737	0.242958	0.01385	0.214675	0.009447
8.5	11.7633946	0.00922	31.51996	0.015448	0.266821	0.001921	0.236641	0.005648

Table 39. Profile measurements at Station 11 of Haida Gwaii archipelago in 2018. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
1	11.93387821	0.004844	31.65671	0.013541	0.29696	0.073186	0.26257	0.070626
1.5	11.92979866	0.007432	31.6516	0.011613	0.255955	0.068605	0.220886	0.067834
2	11.9291363	0.00782	31.65059	0.006491	0.252174	0.059944	0.217192	0.059098
2.5	11.92873018	0.007976	31.65036	0.004918	0.248117	0.044278	0.213404	0.043792
3	11.92831901	0.008127	31.65112	0.004356	0.250243	0.030301	0.216341	0.029902
3.5	11.9279606	0.00822	31.65142	0.003707	0.255063	0.014509	0.221972	0.014021
4	11.92792397	0.007845	31.65187	0.003341	0.257298	0.010678	0.224185	0.009451
4.5	11.92782116	0.007441	31.6521	0.002792	0.258117	0.016409	0.224502	0.015138
5	11.92723616	0.00743	31.65222	0.00234	0.253901	0.022836	0.220703	0.021102
5.5	11.92647867	0.007423	31.65266	0.002074	0.250805	0.015244	0.218872	0.013287
6	11.92602307	0.007256	31.65254	0.001955	0.254541	0.011911	0.223147	0.010207
6.5	11.92583953	0.007032	31.65229	0.001991	0.257507	0.010996	0.226041	0.010594
7	11.92550398	0.006689	31.65236	0.001569	0.264155	0.016474	0.231604	0.014744
7.5	11.92386591	0.006584	31.65231	0.002278	0.254872	0.015601	0.223169	0.013394
8	11.92347314	0.006554	31.65202	0.002204	0.254702	0.011534	0.222856	0.011771
8.5	11.92242868	0.006661	31.65181	0.001678	0.264592	0.01476	0.231246	0.014764
9	11.92106591	0.006599	31.65171	0.001606	0.278433	0.016862	0.243139	0.014371
9.5	11.91969347	0.007233	31.65192	0.001461	0.281185	0.024164	0.245391	0.019835
10	11.91980554	0.009204	31.65185	0.000867	0.25751	0.018108	0.224894	0.015005
10.5	11.92318602	0.005933	31.65175	0.000856	0.237116	0.021068	0.207592	0.017105

Table 40. Profile measurements at Station 5 of Haida Gwaii archipelago in 2018. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
1.5	11.91280148	0.005208	31.8919	0.005426				
2	11.92335406	0.008751	31.88824	0.004297	0.214848	0.036	0.191122	0.037499
2.5	11.92258826	0.011428	31.88774	0.003189	0.211432	0.0517	0.186378	0.055036
3	11.91998439	0.015367	31.88737	0.001427	0.204128	0.0546	0.178363	0.058217
3.5	11.91577746	0.014598	31.88763	0.001781	0.173546	0.0644	0.14578	0.068195
4	11.90518281	0.013749	31.88832	0.003625	0.165293	0.0748	0.138806	0.079667
4.5	11.88178308	0.019302	31.89121	0.007948	0.122476	0.0585	0.094786	0.063153
5	11.84561195	0.014888	31.89902	0.006048	0.154003	0.0601	0.1279	0.064155
5.5	11.8088589	0.018818	31.91041	0.002225	0.143135	0.0778	0.145542	0.049218
6	11.78602439	0.026116	31.91899	0.00525	0.165381	0.0504	0.134502	0.054809
6.5	11.77169101	0.024688	31.92298	0.007386	0.174627	0.0304	0.144521	0.032454
7	11.74851315	0.013868	31.92744	0.004095	0.179679	0.0305	0.151905	0.032176
7.5	11.72080275	0.023687	31.9358	0.005841	0.188881	0.0413	0.162366	0.042477
8	11.70453279	0.03145	31.94331	0.010149	0.193424	0.0404	0.166893	0.040649
8.5	11.71056803	0.025099	31.93867	0.010696	0.203822	0.0675	0.176499	0.064887

Table 41. Profile measurements at Station 8 of Haida Gwaii archipelago in 2018. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
0	11.7980841	0.003917	31.81843	0.002188	0.178399	0.054869	0.15426	0.059249
0.5	11.79203798	0.003205	31.81998	0.000874	0.187662	0.06526	0.162932	0.069854
1	11.78504916	0.004687	31.82137	0.001672	0.197	0.059094	0.172234	0.061729
1.5	11.77222625	0.020766	31.82313	0.005121	0.200077	0.046448	0.174252	0.047019
2	11.73910891	0.048585	31.82911	0.013312	0.191663	0.035517	0.164612	0.036389
2.5	11.66957025	0.070077	31.84991	0.023121	0.184562	0.028114	0.157505	0.029473
3	11.5840854	0.062334	31.88165	0.026269	0.19397	0.030519	0.167054	0.030675
3.5	11.52387407	0.034544	31.90826	0.018404	0.20863	0.027051	0.18019	0.026218
4	11.49313447	0.019564	31.92381	0.013091	0.218021	0.022128	0.187169	0.021247
4.5	11.47293273	0.012432	31.93613	0.008941	0.217219	0.031736	0.185546	0.030593
5	11.45841242	0.009367	31.94575	0.007313	0.208456	0.035651	0.178339	0.033387
5.5	11.44690435	0.009109	31.95353	0.006228	0.198247	0.018404	0.171155	0.016812
6	11.43566478	0.007613	31.95926	0.004241	0.191104	0.018036	0.165718	0.017508
6.5	11.42451327	0.005611	31.96426	0.003399	0.189214	0.020979	0.163814	0.01857
7	11.41416591	0.004768	31.96958	0.003282	0.18848	0.014951	0.163306	0.014211
7.5	11.40294434	0.004639	31.97368	0.003759	0.187569	0.024314	0.162443	0.028167
8	11.39160451	0.004186	31.97692	0.004161	0.190072	0.044831	0.163706	0.045661
8.5	11.38076665	0.004568	31.97945	0.00357	0.187169	0.05908	0.160237	0.057772
9	11.37402246	0.003273	31.98058	0.002302	0.212451	0.027926	0.183486	0.017907

Table 42. Profile measurements at Station 1 of Haida Gwaii archipelago in 2018. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
0	10.34681556	0.112915	31.99584	0.075861				
0.5	10.28096105	0.09325	32.05806	0.071889				
1	10.26325839	0.106927	32.07254	0.080673				
1.5	10.21616221	0.111668	32.08833	0.068547	0.136611	0.0967	0.122545	0.097118
2	10.18311705	0.096181	32.1026	0.046579	0.147506	0.0724	0.129474	0.070899
2.5	10.1519908	0.064392	32.11933	0.020173	0.16717	0.0453	0.148315	0.042191
3	10.13309133	0.040974	32.12852	0.008465	0.143552	0.0234	0.121038	0.019241
3.5	10.12231928	0.028555	32.1327	0.006064	0.131178	0.0154	0.106654	0.014154
4	10.11401436	0.023726	32.13502	0.003211	0.142901	0.0257	0.116929	0.024201
4.5	10.10582004	0.023198	32.13626	0.001086	0.173577	0.0074	0.143439	0.005197
5	10.09707892	0.022937	32.13675	0.000862	0.163377	0.0683	0.133231	0.060298
5.5	10.08766988	0.021871	32.13722	0.001614	0.183356	0.0498	0.151788	0.043904
6	10.07816145	0.020926	32.13871	0.001844	0.195248	0.0479	0.163242	0.04482
6.5	10.06738818	0.022525	32.14047	0.002213	0.188314	0.0239	0.158264	0.02272
7	10.05485558	0.027506	32.14009	0.004496	0.170783	0.0125	0.143217	0.011743
7.5	10.04088341	0.035262	32.13856	0.005553	0.160314	0.0097	0.134668	0.007702
8	10.02626881	0.044092	32.13912	0.004792	0.162475	0.0136	0.137659	0.011665
8.5	10.01062449	0.052967	32.13567	0.009271	0.17264	0.0232	0.147739	0.018833
9	9.987841436	0.065217	32.12858	0.015763	0.184619	0.0224	0.15965	0.0164
9.5	9.95675049	0.083109	32.12653	0.01672	0.182566	0.0105	0.158686	0.007033
10	9.928520386	0.095415	32.13351	0.011824	0.176163	0.0069	0.153319	0.008281
10.5	9.912360796	0.097195	32.14289	0.009434	0.175755	0.0132	0.15382	0.013191
11	9.903135812	0.092539	32.14714	0.010666	0.17637	0.0206	0.156065	0.017661
11.5	9.894975708	0.083349	32.15027	0.008058	0.178885	0.0235	0.160108	0.018661
12	9.88752061	0.071969	32.15379	0.004488	0.17524	0.014	0.157873	0.011264
12.5	9.881994446	0.062866	32.15481	0.005411	0.164168	0.0168	0.148429	0.015867
13	9.877027516	0.058368	32.15558	0.006811	0.146042	0.0145	0.132602	0.011994
13.5	9.870052678	0.051904	32.15465	0.010784	0.138929	0.025	0.127111	0.021603
14	9.860269352	0.042003	32.15533	0.010831	0.147532	0.0293	0.136215	0.026596
14.5	9.853132252	0.035375	32.15839	0.00588	0.172899	0.04	0.160746	0.037823
15	9.838441165	0.025044	32.16154	0.002175	0.170756	0.0164	0.158947	0.017744
15.5	9.835181518	0.021465	32.16251	0.001725	0.168014	0.0289	0.156214	0.027589
16	9.832564973	0.018531	32.16373	0.001392	0.156285	0.0389	0.144896	0.034422
16.5	9.8192737	0.005882	32.16395	0.001689	0.109104	0.0161	0.102637	0.014634
17	9.81910528	0.005403	32.16444	0.001586	0.10315	0.0198	0.096299	0.018728

Table 43. Profile measurements at Station 2 of Haida Gwaii archipelago in 2018. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
0.5	10.25421961	0.011273	32.07784	0.006135	0.136276	0.007622	0.119	0.006231
1	10.24791861	0.011532	32.07824	0.00656	0.140031	0.003851	0.122	0.003456
1.5	10.23879545	0.022365	32.07941	0.006082	0.140567	0.005588	0.1223	0.00477
2	10.22592578	0.034406	32.08061	0.005497	0.143026	0.007265	0.1239	0.004798
2.5	10.21796349	0.036267	32.08105	0.004233	0.149806	0.009333	0.1302	0.007894
3	10.20980061	0.034842	32.07907	0.004001	0.154239	0.008137	0.1343	0.006762
3.5	10.19708727	0.035791	32.0761	0.006982	0.157255	0.0048	0.1369	0.004209
4	10.18332278	0.040737	32.07342	0.006324	0.158585	0.003463	0.1373	0.002007
4.5	10.16789898	0.049097	32.07218	0.005375	0.160305	0.006064	0.1378	0.004241
5	10.14411637	0.067604	32.07101	0.008989	0.16269	0.009123	0.1395	0.006397
5.5	10.11164263	0.088444	32.06919	0.022301	0.161558	0.013191	0.1386	0.009075
6	10.04891203	0.081857	32.0773	0.02656	0.153802	0.014352	0.1331	0.011728
6.5	9.961216028	0.060878	32.09654	0.022795	0.144557	0.016906	0.1271	0.014468
7	9.88907283	0.04002	32.1211	0.013909	0.140733	0.023674	0.1261	0.020782
7.5	9.849427648	0.02293	32.13743	0.005475	0.143493	0.026661	0.13	0.023898
8	9.828532986	0.013398	32.14351	0.002561	0.138741	0.014055	0.1259	0.012567
8.5	9.816011523	0.007652	32.14568	0.000889	0.139169	0.033796	0.1256	0.029922
9	9.807504798	0.006186	32.14713	0.001083	0.116671	0.000909	0.1049	0.000422
9.5	9.80260455	0.006612	32.14752	0.000749	0.130953	0.045101	0.1162	0.037803
10	9.79702108	0.007375	32.14723	0.001883				
10.5	9.78000926	0.026915	32.13664	0.017034				
11	9.745470295	0.069997	32.12488	0.033112				

Table 44. Profile measurements at Station 4 of Haida Gwaii archipelago in 2018. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
1	9.851770925	0.155211	31.54958	0.024409	0.468131	0.104545	0.378721	0.102946
1.5	9.735003284	0.150695	31.57094	0.034794	0.391023	0.114056	0.304353	0.109356
2	9.647824654	0.08359	31.59059	0.026568	0.375809	0.082551	0.289759	0.079666
2.5	9.57749034	0.026917	31.60951	0.012722	0.338985	0.079121	0.25447	0.076138
3	9.533878768	0.027054	31.62196	0.008879	0.331404	0.042816	0.248928	0.040923
3.5	9.484005434	0.033058	31.63089	0.009348	0.313733	0.025982	0.235897	0.024699
4	9.419520264	0.038276	31.65002	0.015206	0.301348	0.036813	0.228492	0.035621
4.5	9.354393102	0.032529	31.68049	0.016544	0.316899	0.039697	0.247003	0.038295
5	9.305123872	0.019655	31.70678	0.011924	0.327563	0.020785	0.261202	0.020099
5.5	9.271540278	0.016851	31.72522	0.01166	0.325963	0.013306	0.263107	0.013529
6	9.251344094	0.018139	31.73661	0.012272	0.322469	0.012574	0.261197	0.010852
6.5	9.239696984	0.017982	31.74307	0.012098	0.304973	0.014396	0.246207	0.011842
7	9.22839075	0.016532	31.7478	0.010471	0.296085	0.010597	0.238866	0.009273
7.5	9.20963444	0.024573	31.75387	0.012959	0.296847	0.007473	0.240035	0.006494
8	9.179219842	0.043604	31.76377	0.021118	0.299992	0.007376	0.243467	0.006449
8.5	9.138792128	0.056932	31.77964	0.026923	0.295519	0.009394	0.240592	0.005728
9	9.092192722	0.0672	31.80237	0.033302	0.273399	0.021194	0.223402	0.015431
9.5	9.049839966	0.074625	31.82521	0.041618	0.257436	0.030868	0.21183	0.023988
10	9.014929926	0.072888	31.84538	0.044414				
10.5	8.983827126	0.062403	31.86417	0.041104				
11	8.94627332	0.049695	31.89016	0.034711				

Table 45. Profile measurements at Station 3 of Haida Gwaii archipelago in 2018. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
0.5	9.573862543	0.050035	31.66797	0.041635				
1	9.517808742	0.018702	31.66934	0.033942	0.137096	0.010762	0.073725	0.014071
1.5	9.485237566	0.019418	31.68989	0.024551	0.201507	0.063005	0.143732	0.067298
2	9.471104624	0.02026	31.71131	0.016061	0.200209	0.06649	0.145899	0.06456
2.5	9.465851822	0.022009	31.73432	0.009001	0.225995	0.061892	0.172028	0.061372
3	9.4713719	0.022832	31.75375	0.010602	0.256393	0.030119	0.204491	0.031706
3.5	9.479483144	0.023364	31.76865	0.010917	0.275831	0.032451	0.225385	0.034655
4	9.48573304	0.022243	31.78201	0.009416	0.265761	0.039998	0.215588	0.038658
4.5	9.490117176	0.018037	31.79608	0.011466	0.249024	0.021399	0.198634	0.022763
5	9.491750326	0.013044	31.8112	0.013444	0.253815	0.021269	0.202363	0.023334
5.5	9.487307854	0.009733	31.83153	0.018581	0.247269	0.017933	0.196784	0.016601
6	9.47770011	0.008339	31.85525	0.021438	0.256436	0.022512	0.207089	0.023219
6.5	9.46410572	0.008329	31.88261	0.020582	0.256339	0.025398	0.20997	0.027466
7	9.447462133	0.010272	31.91183	0.02112	0.244308	0.015107	0.202782	0.015677
7.5	9.43924125	0.006267	31.92651	0.011703	0.227674	0.020673	0.186271	0.017844
8	9.424024555	0.005696	31.94916	0.009631	0.181661	0.0036	0.149911	0.003822

Table 46. Profile measurements at Station 5 of Haida Gwaii archipelago in 2018. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
0.5	12.85627952	0.01553	31.822175	0.004671	0.153388	0.0329	0.126742	0.034851
1	12.83996965	0.029361	31.825185	0.005545	0.118024	0.0022	0.089706	0.000451
1.5	12.8345968	0.035375	31.825981	0.004398	0.140957	0.0244	0.113939	0.025767
2	12.82568115	0.042426	31.826914	0.004917	0.145235	0.0494	0.119241	0.053638
2.5	12.8003876	0.047575	31.826973	0.006375	0.186977	0.0538	0.163893	0.059386
3	12.75501544	0.052656	31.828141	0.008058	0.185955	0.0383	0.16213	0.04297
3.5	12.69150079	0.060422	31.831255	0.006305	0.182071	0.0268	0.157874	0.031659
4	12.61826202	0.076628	31.836653	0.007597	0.209927	0.0231	0.18819	0.027142
4.5	12.52579281	0.075887	31.839967	0.010868	0.220865	0.0266	0.200914	0.029292
5	12.40175262	0.06328	31.842323	0.013414	0.216395	0.0225	0.197744	0.023615
5.5	12.25940133	0.038832	31.8592	0.007562	0.217001	0.0157	0.199599	0.016544
6	12.12630986	0.060961	31.88031	0.006226	0.204688	0.0086	0.186433	0.012369
6.5	12.00608211	0.076092	31.898591	0.005952	0.194711	0.0129	0.175284	0.014783
7	11.8965496	0.073501	31.911922	0.00946	0.19974	0.0147	0.179842	0.015536
7.5	11.80066567	0.056312	31.927123	0.011519	0.200763	0.0154	0.1808	0.01573
8	11.73379862	0.039396	31.943173	0.01016	0.210045	0.011	0.191136	0.011468
8.5	11.70564319	0.027172	31.952646	0.004409	0.214071	0.0094	0.19596	0.00913
9	11.68642576	0.017905	31.957802	0.004622	0.202138	0.0048	0.184	0.005854
9.5	11.67356151	0.010638	31.960757	0.004232	0.196674	0.021	0.178774	0.020453
10	11.66549269	0.005479	31.96271	0.001756	0.202317	0.0145	0.184787	0.015046
10.5	11.66042965	0.003852	31.964033	0.000699	0.212687	0.0229	0.194258	0.021589
11	11.65830454	0.00313	31.964415	0.000669	0.206792	0.0587	0.188658	0.054864

Table 47. Profile measurements at Station 8 of Haida Gwaii archipelago in 2018. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
0	12.1470706	0.001546	31.974253	0.000333				
0.5	12.13260952	0.030976	31.972267	0.001103	0.059954	0.002671	0.04214	0.006122
1	12.10592909	0.057333	31.971563	0.003073	0.104289	0.098585	0.12167	0.097669
1.5	12.0827169	0.081372	31.97254	0.003446	0.116093	0.08233	0.09636	0.089134
2	12.06268216	0.085488	31.972174	0.004358	0.166855	0.091038	0.14713	0.096647
2.5	12.03341783	0.079231	31.969778	0.004891	0.179153	0.049684	0.15878	0.053165
3	11.99560278	0.075865	31.966926	0.006557	0.174333	0.029457	0.15316	0.028574
3.5	11.95280399	0.072333	31.96354	0.009452	0.179144	0.060843	0.15758	0.063567
4	11.90162994	0.062551	31.961046	0.006852	0.188286	0.04736	0.16657	0.048214
4.5	11.84611396	0.067384	31.960793	0.005346	0.191125	0.027034	0.16791	0.026299
5	11.79496978	0.091843	31.960514	0.002389	0.185859	0.044818	0.15954	0.045266
5.5	11.74976164	0.122277	31.962211	0.00314	0.182406	0.038032	0.15401	0.036605
6	11.71480364	0.146987	31.960939	0.007679	0.199755	0.03406	0.16998	0.029787
6.5	11.66833849	0.160521	31.953739	0.011056	0.221596	0.031973	0.18928	0.028787
7	11.59179473	0.158902	31.95085	0.016997	0.237436	0.024625	0.20183	0.020409
7.5	11.51140379	0.135303	31.957014	0.019348	0.255497	0.025055	0.21705	0.020653
8	11.44389195	0.099195	31.964711	0.018311	0.268204	0.012228	0.22798	0.008355
8.5	11.38801185	0.066777	31.969402	0.018123	0.272175	0.018603	0.23013	0.019247
9	11.34671376	0.042184	31.976065	0.01398	0.278965	0.018779	0.23586	0.018166
9.5	11.31350043	0.020752	31.982458	0.006756	0.283296	0.016669	0.24079	0.01584
10	11.28637968	0.0133	31.984392	0.003868	0.277012	0.024016	0.2363	0.02225
10.5	11.26110643	0.014183	31.987308	0.003232	0.271813	0.022078	0.2311	0.018817
11	11.24094776	0.017518	31.991514	0.002481	0.277788	0.018811	0.23486	0.015438
11.5	11.22919245	0.017546	31.993694	0.003805	0.263726	0.05341	0.22195	0.046137
12	11.22069517	0.013487	31.994972	0.003746	0.23113	0.061022	0.19541	0.056356
12.5	11.21415263	0.009592	31.995765	0.003561	0.209673	0.076432	0.17781	0.072162

Table 48. Profile measurements at Station 9 of Haida Gwaii archipelago in 2018. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
1	11.29012407	0.1103	31.98759	0.004706	0.184804	0.113196	0.147362	0.114186
1.5	11.24854258	0.0926	31.98539	0.009726	0.198079	0.084785	0.160692	0.087513
2	11.1798688	0.0619	31.98301	0.011459	0.211751	0.046223	0.171052	0.048253
2.5	11.12174576	0.0346	31.98664	0.008327	0.219467	0.036287	0.175313	0.03864
3	11.08008479	0.0238	31.98809	0.005593	0.236927	0.031035	0.189136	0.031032
3.5	11.03414948	0.0256	31.98467	0.004878	0.243032	0.018216	0.19382	0.016475
4	10.96916377	0.0315	31.97728	0.004162	0.248584	0.030093	0.198416	0.029117
4.5	10.88063152	0.0235	31.9733	0.000935	0.266248	0.015075	0.213646	0.014647
5	10.78111039	0.027	31.97453	0.00528	0.274893	0.014842	0.219943	0.013879
5.5	10.69588803	0.0308	31.97799	0.00563	0.289955	0.015053	0.231186	0.014783
6	10.62189392	0.0269	31.97842	0.005583	0.314265	0.019518	0.252002	0.01908
6.5	10.55157169	0.0181	31.98392	0.003906	0.326679	0.027672	0.263673	0.026203
7	10.49277387	0.0178	31.98734	0.004335	0.326669	0.019822	0.263535	0.017981
7.5	10.44642798	0.0156	31.98964	0.002852	0.320979	0.012304	0.258883	0.012272
8	10.41213896	0.0118	31.99415	0.002728	0.320973	0.015079	0.26008	0.015108
8.5	10.38755536	0.0058	31.99691	0.001806	0.322663	0.008865	0.26359	0.007525
9	10.36671888	0.0046	31.99824	0.001182	0.315991	0.010584	0.259971	0.006552
9.5	10.34947878	0.0058	31.99979	0.000562	0.312088	0.010085	0.257968	0.006594
10	10.33453342	0.0031	32.00099	0.001158	0.313587	0.025316	0.2594	0.02065
10.5	10.32248125	0.0021	32.00177	0.001017	0.308837	0.037221	0.255707	0.030857
11	10.3139921	0.0038	32.00288	0.000491	0.292459	0.037421	0.243037	0.033108
11.5	10.30849361	0.0032	32.00381	0.001053	0.277604	0.057391	0.231868	0.05089
12	10.30526246	0.0027	32.00496	0.000966	0.28973	0.066074	0.244995	0.055627
12.5	10.30197986	5E-05	32.00516	0.000443	0.330493	0.052308	0.279862	0.044207

Table 49. Profile measurements at Station 12 of Haida Gwaii archipelago in 2018. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490) K_ED_hyperspectral_downcast (/m)	Stdev	Kd(532)	Stdev
0.5	10.59381003	0.02396	32.033493	0.002549	0.25345	0.032716	0.203897	0.03093
1	10.56346414	0.017178	32.033448	0.00353	0.27093	0.10032	0.216676	0.09639
1.5	10.45230852	0.159147	32.029431	0.004518	0.250344	0.086133	0.190781	0.087656
2	10.39160062	0.167185	32.021247	0.012755	0.268309	0.057116	0.205456	0.058595
2.5	10.32336806	0.153151	32.013328	0.014301	0.280135	0.029643	0.213046	0.031052
3	10.22990821	0.119343	32.016848	0.011388	0.301152	0.033144	0.232375	0.034134
3.5	10.14086753	0.086736	32.030159	0.019953	0.299184	0.032377	0.228399	0.03306
4	10.08601444	0.066614	32.035728	0.016109	0.300644	0.027321	0.227792	0.028376
4.5	10.04038113	0.056128	32.044189	0.011712	0.306871	0.01908	0.233703	0.020004
5	10.00106346	0.054448	32.050933	0.010653	0.312881	0.022207	0.240777	0.019545
5.5	9.962247406	0.061354	32.056796	0.010963	0.31679	0.017436	0.246282	0.016714
6	9.926643072	0.06241	32.059455	0.011841	0.304959	0.029327	0.238563	0.028697
6.5	9.893193032	0.054934	32.061491	0.011075	0.295069	0.032469	0.23295	0.030881
7	9.861564212	0.0477	32.066057	0.01044	0.296489	0.025529	0.237412	0.022992
7.5	9.835441744	0.040436	32.069424	0.009655	0.291092	0.019631	0.235739	0.018215
8	9.811254158	0.033908	32.073262	0.007956	0.281661	0.016574	0.229746	0.016475
8.5	9.791376782	0.027727	32.076806	0.005104	0.267329	0.017433	0.219256	0.015716
9	9.774308964	0.02814	32.079327	0.00483	0.268212	0.016695	0.222082	0.014826
9.5	9.75898312	0.030029	32.081923	0.00611	0.279565	0.012845	0.232721	0.012137
10	9.74756541	0.027596	32.083579	0.006059	0.269762	0.018469	0.224458	0.012157
10.5	9.738708562	0.023918	32.084179	0.005859	0.247319	0.029962	0.205522	0.02317
11	9.730540664	0.017617	32.085018	0.005159	0.229024	0.012368	0.190204	0.010457
11.5	9.727782388	0.008167	32.085486	0.002258	0.254694	0.025433	0.21279	0.020354
12	9.72228402	0.004152	32.086736	0.000705	0.280324	0.026813	0.235049	0.021907
12.5	9.718477155	0.003378	32.08705	0.000607	0.284834	0.039774	0.239751	0.034514
13	9.7156012	0.003942	32.08731	0.001165	0.229652	0.053329	0.193871	0.045049
13.5	9.713104643	0.004061	32.088128	0.001235	0.201458	0.052024	0.171753	0.043904
14	9.710838367	0.00392	32.088865	0.000712	0.186516	0.053796	0.161022	0.045778
14.5	9.709271627	0.003984	32.08921	0.000915	0.183077	0.075503	0.159104	0.064573
15	9.708791765	0.005362	32.089869	0.001684				

Table 50. Profile measurements at Station 11 of Haida Gwaii archipelago in 2018. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
1	12.33554452	0.15602	31.5353	0.014438	0.200079	0.001358	0.173707	0.002257
1.5	12.25232236	0.081318	31.54465	0.013799	0.198604	0.003908	0.171622	0.004255
2	12.21397003	0.023185	31.55937	0.014554	0.199284	0.007363	0.172804	0.00583
2.5	12.22013161	0.013927	31.58067	0.017534	0.202665	0.006503	0.175824	0.00529
3	12.23946634	0.01626	31.59912	0.013121	0.20172	0.008271	0.175107	0.006716
3.5	12.24237057	0.015433	31.61097	0.007349	0.203037	0.006263	0.176143	0.00582
4	12.22187763	0.012302	31.61736	0.004892	0.207079	0.003772	0.179776	0.002779
4.5	12.19905749	0.01095	31.62186	0.003008	0.208326	0.003228	0.181219	0.002678
5	12.17989188	0.008733	31.62817	0.003104	0.210166	0.002359	0.183149	0.00158
5.5	12.16964273	0.005491	31.63465	0.002326	0.212048	0.001957	0.184722	0.001445
6	12.16633864	0.003164	31.63771	0.001562	0.2117	0.008529	0.184615	0.006875
6.5	12.16275352	0.003032	31.63889	0.00124	0.205303	0.012391	0.179727	0.010947
7	12.15463312	0.011258	31.63874	0.001893	0.197046	0.004485	0.173385	0.004391
7.5	12.14007167	0.019668	31.63878	0.001695	0.200629	0.018329	0.177386	0.015128
8	12.12166274	0.020939	31.63843	0.001613	0.21854	0.01766	0.193727	0.014452
8.5	12.10110027	0.014224	31.63858	0.002852	0.230088	0.01373	0.204097	0.012279
9	12.07997473	0.007305	31.64151	0.002062	0.223474	0.032283	0.19837	0.028741
9.5	12.06303231	0.006131	31.64434	0.001314	0.209557	0.0143	0.186224	0.013675
10	12.05136775	0.007529	31.64634	0.000986	0.210001	0.023243	0.187039	0.020254
10.5	12.04382136	0.006823	31.64789	0.00162	0.218059	0.036296	0.195042	0.031061
11	12.03504539	0.005301	31.64912	0.00127	0.244776	0.009701	0.219025	0.008113
11.5	12.02666588	0.007156	31.64933	0.001143	0.235834	0.017594	0.211724	0.015205
12	12.02144155	0.008438	31.64982	0.002226	0.21949	0.041301	0.197428	0.036216
12.5	12.01099344	0.008907	31.64954	0.00133	0.206306	0.037089	0.185696	0.033146
13	12.00013405	0.008582	31.65046	0.003259	0.194733	0.048473	0.175082	0.044347

Table 51. Profile measurements at Station 6 of Haida Gwaii archipelago in 2018. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

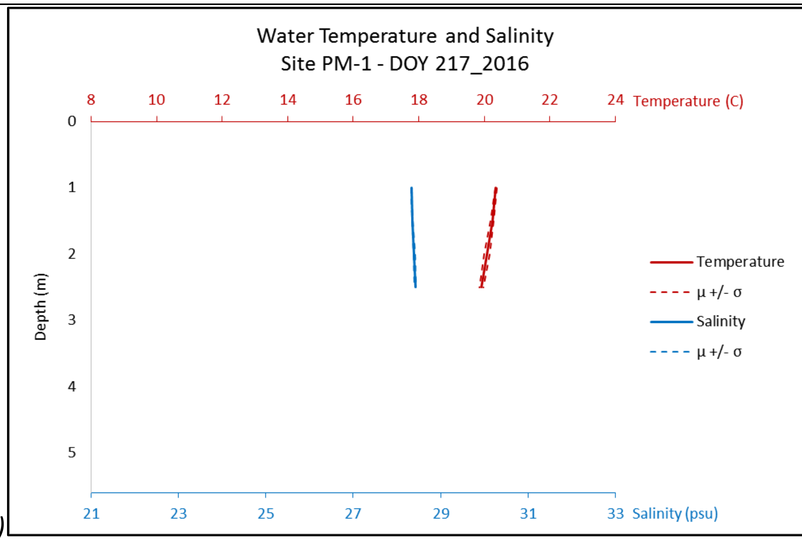
Depth (m)	Temp. (°C)	Stdev	Salinity (psu)	Stdev	Kd(490)	Stdev	Kd(532)	Stdev
					K_ED_hyperspectral_downcast (/m)			
0.5	11.13980873	0.043736	21.6538	0.032352	1.168336	0.052704	0.807784	0.036708
1	10.9665347	0.211866	21.75712	0.125867	1.148935	0.042391	0.796786	0.030405
1.5	10.81849769	0.192242	21.83515	0.108153	1.116482	0.056484	0.775925	0.039642
2	10.71673306	0.098013	21.88985	0.052694	1.071443	0.094785	0.746844	0.064363
2.5	10.6507706	0.034115	21.93455	0.021585	1.078012	0.113604	0.753046	0.077412
3	10.62543681	0.01941	21.96434	0.015858	1.127069	0.08902	0.789227	0.06249
3.5	10.61406198	0.009481	21.98302	0.006298	1.15501	0.046905	0.810797	0.044733
4	10.61070119	0.00724	21.99016	0.003828	1.148827	0.108815	0.809286	0.087257
4.5	10.60757391	0.008041	21.99418	0.006731	1.116427	0.157417	0.789583	0.114876
5	10.61287445	0.008958	21.9907	0.004005	1.004898	0.020764	0.732327	0.064652

Table 52. Profile measurements at Station 7 of Haida Gwaii archipelago in 2018. Depth (m), Temperature (°C), Salinity (psu), Kd_490, and Kd_532; standard deviations are also included for each variable.

Depth (m)	**Temp. (°C)**	**Stdev**	**Salinity (psu)**	**Stdev**	**Kd(490)**	**Stdev**	**Kd(532)**	**Stdev**
					K_ED_hyperspectral_downcast (/m)			
1	11.29144245	0.052655	21.79811	0.0207877	1.163939	0.06593	0.796788	0.057858
1.5	11.23468655	0.02337	21.83253	0.0075617	1.175003	0.061433	0.811983	0.050361
2	11.19337198	0.009668	21.87562	0.0125125	1.164339	0.073989	0.810135	0.060574
2.5	11.13483431	0.024496	21.91505	0.0165994	1.144625	0.055242	0.802943	0.046345
3	11.04683465	0.041586	21.94385	0.0131851	1.131962	0.062744	0.794428	0.046782
3.5	10.96611975	0.042412	21.96204	0.0093376	1.126098	0.086935	0.787542	0.066772
4	10.90536481	0.036599	21.97432	0.0101183	1.165426	0.150618	0.815916	0.098224
4.5	10.86515643	0.023057	21.98098	0.0092039	1.184946	0.149836	0.835689	0.106912

APPENDICES

APPENDIX 1



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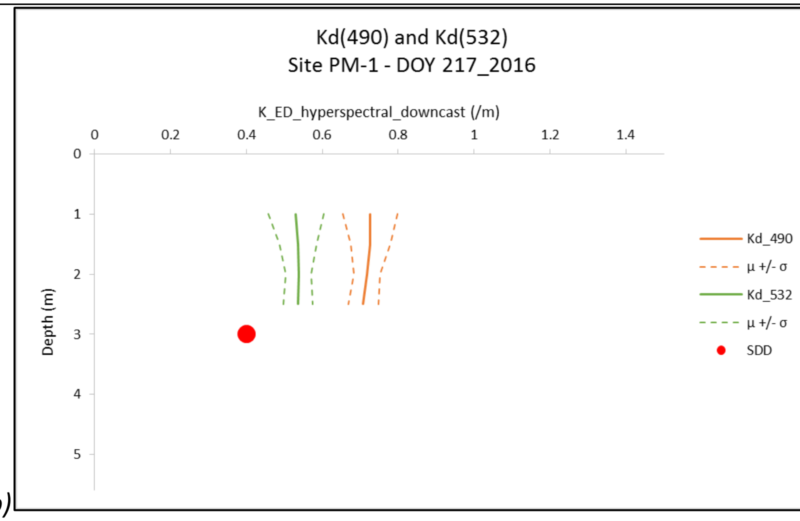
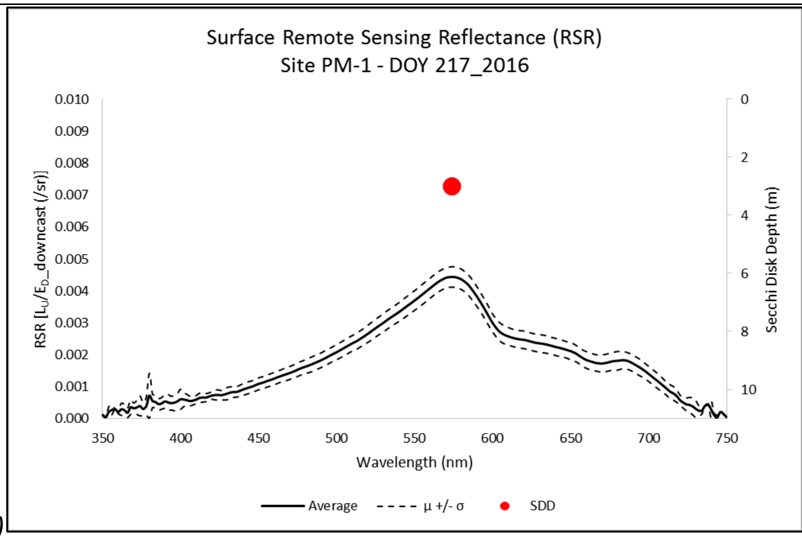
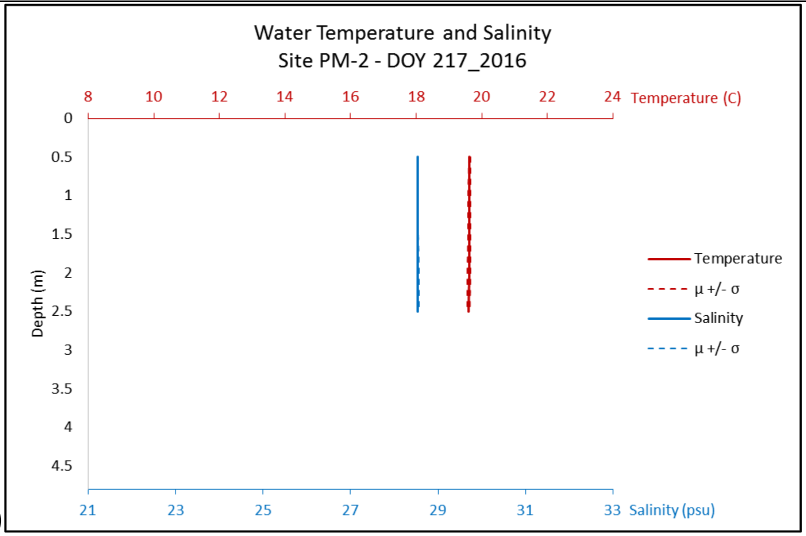


b)

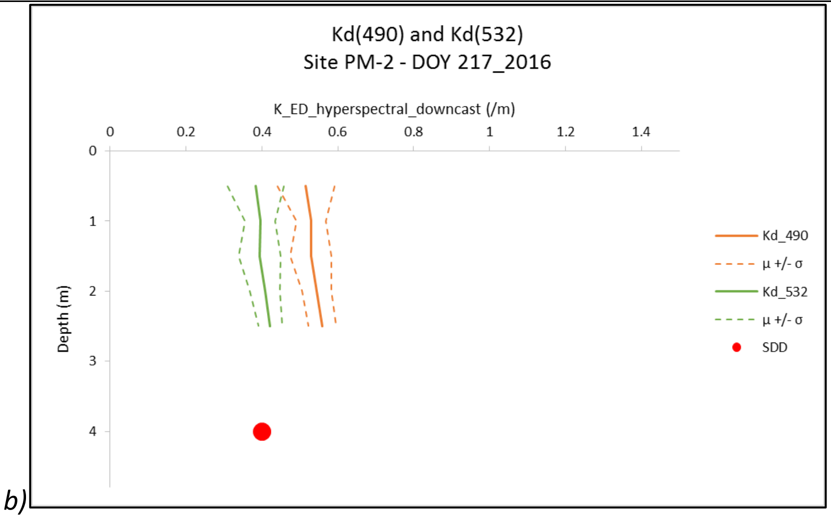


c)

Figure APX 1.1
Northumberland Strait on August 4th 2016 (doy = 217), site PM-1.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)



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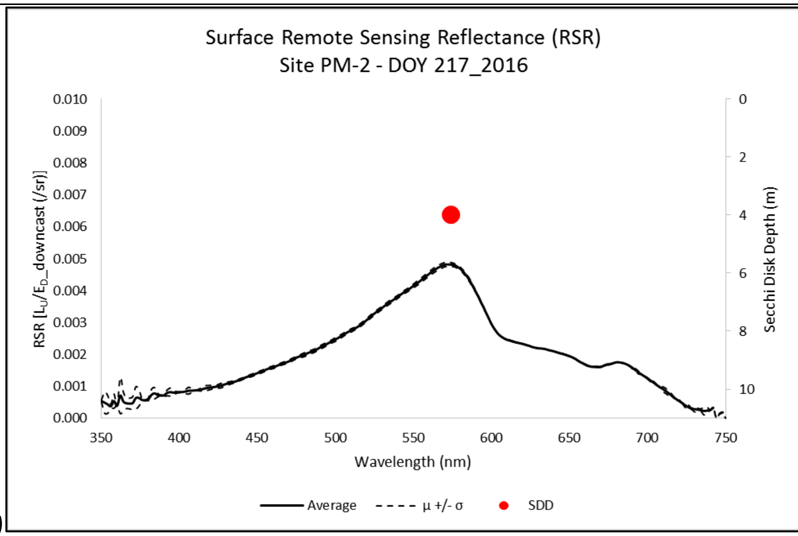
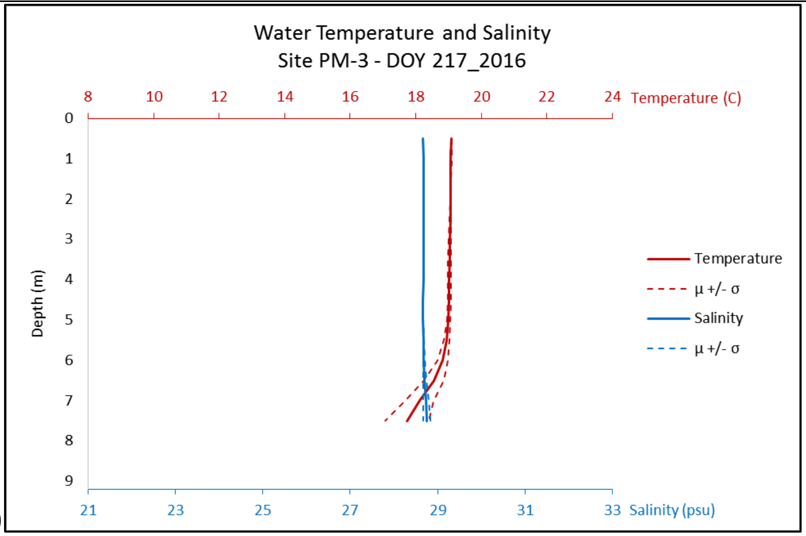


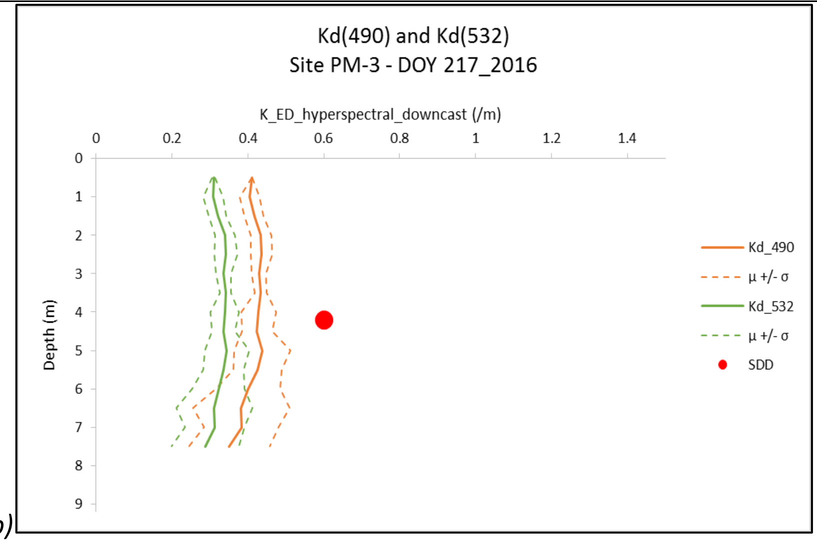
c)

Figure APX 1.2
Northumberland Strait on August 4th 2016 (doy = 217), site PM-2.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.

a)



b)



c)

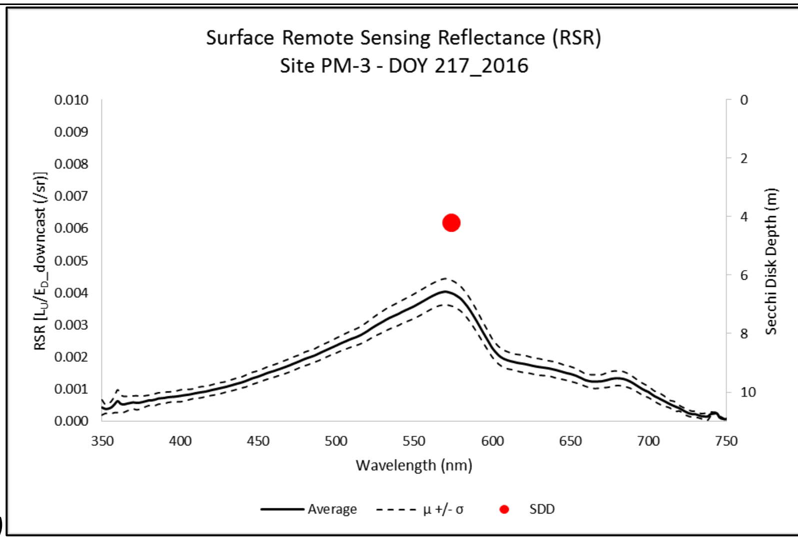
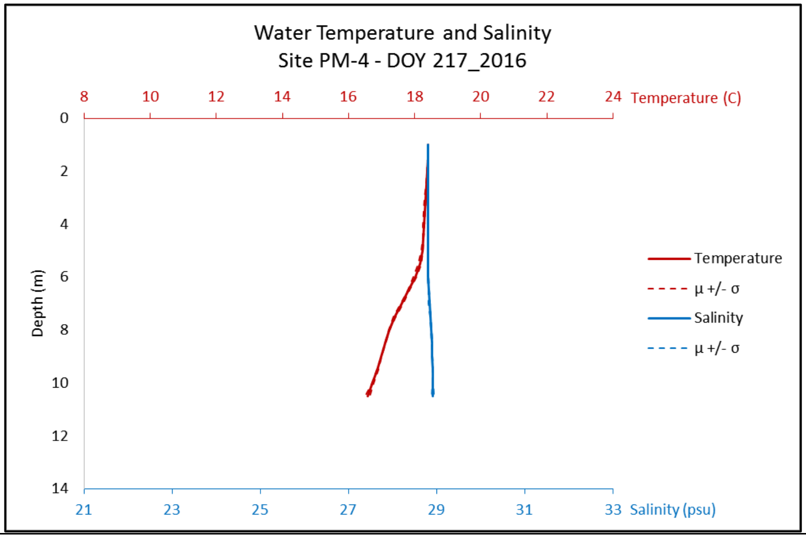
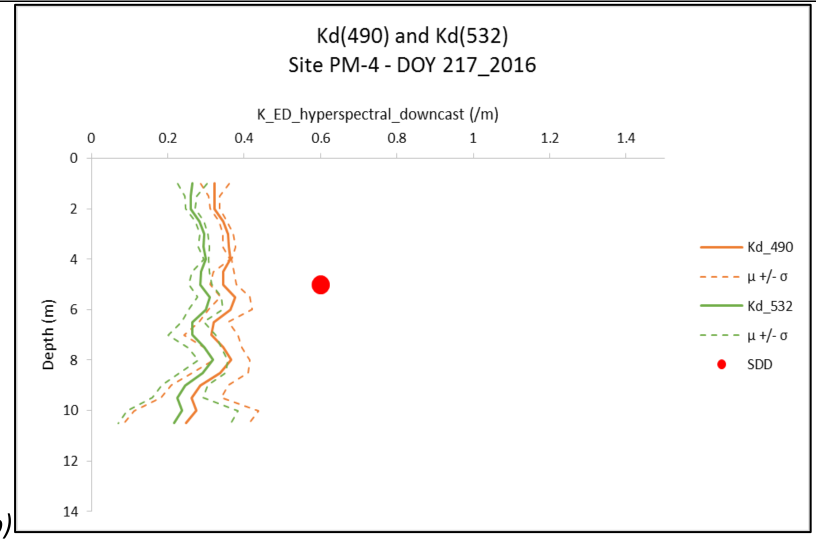


Figure APX 1.3
Northumberland Strait on August 4th 2016 (doy = 217), site PM-3.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.

a)



b)



c)

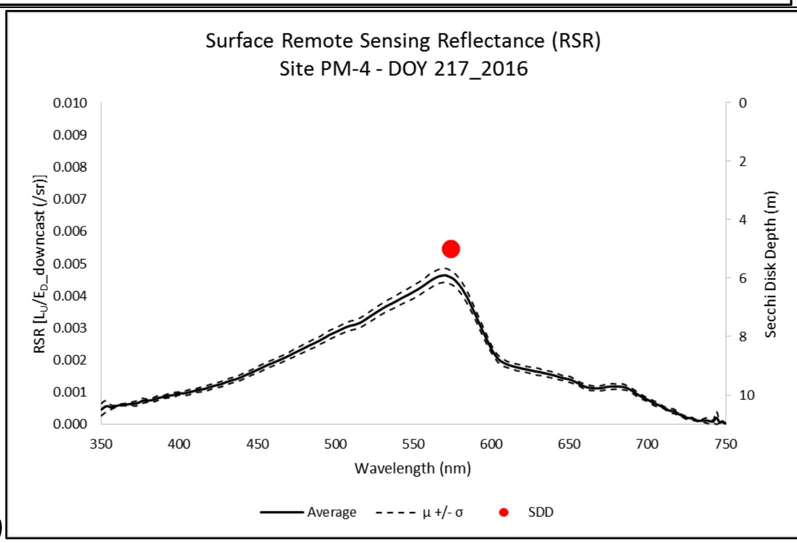
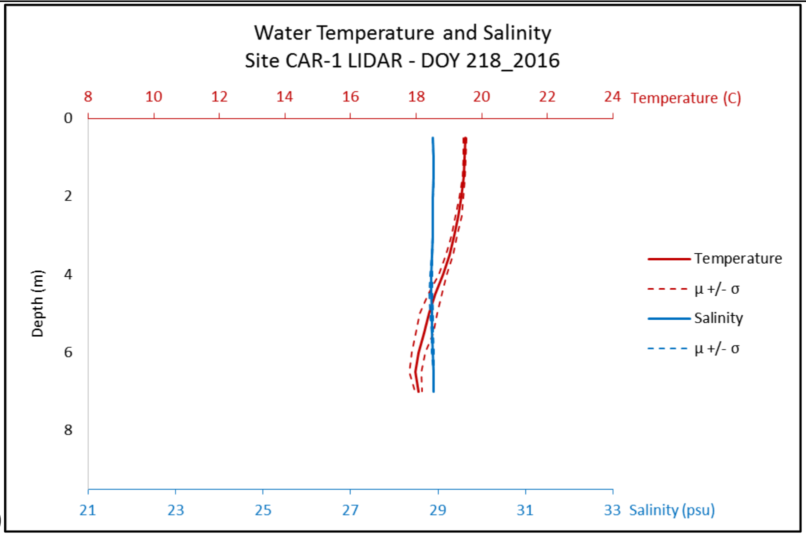
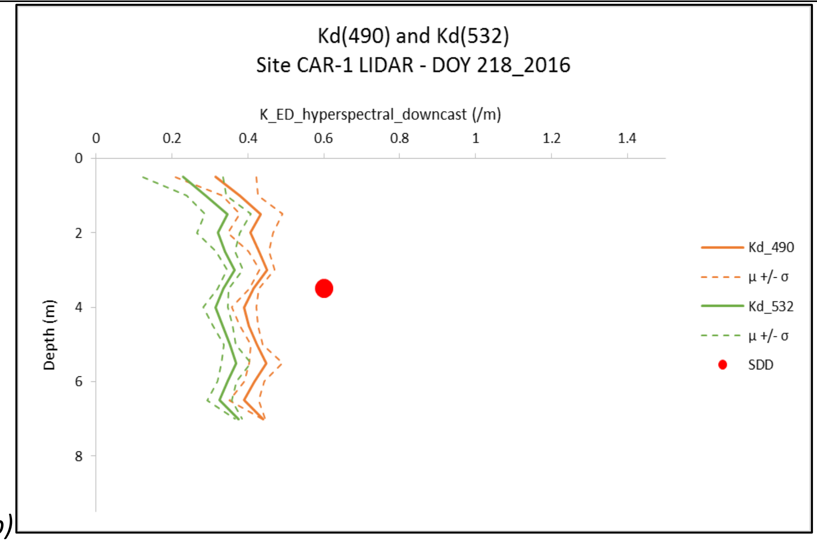


Figure APX 1.4
Northumberland Strait on August 4th 2016 (doy = 217), site PM-4.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.

a)


b)


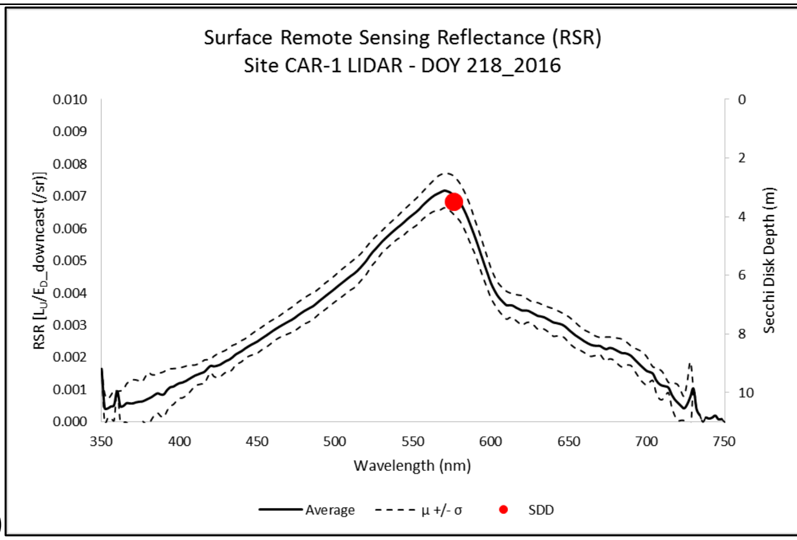
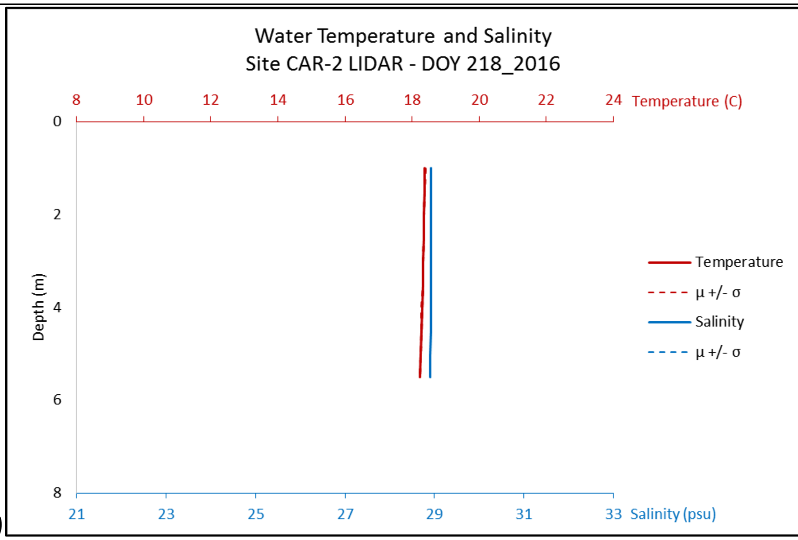
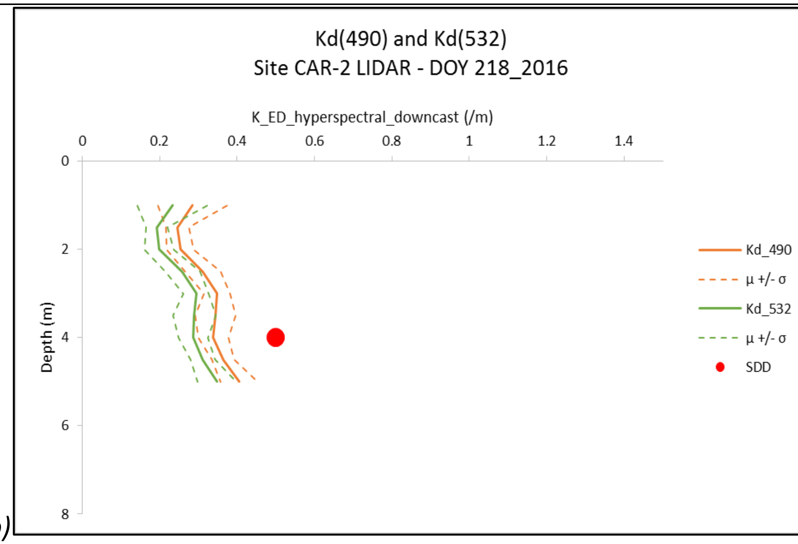
c)


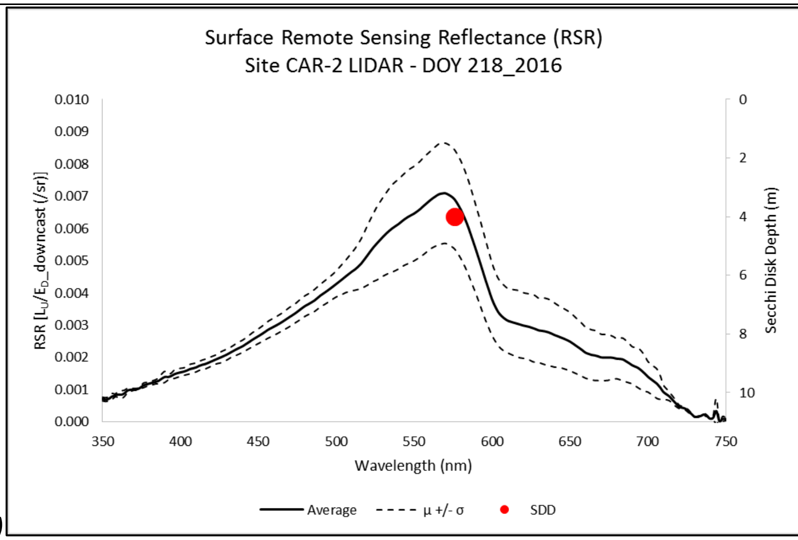
Figure APX 1.5
Northumberland Strait on August 5th 2016 (doy = 218), site CAR-1 LIDAR.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)



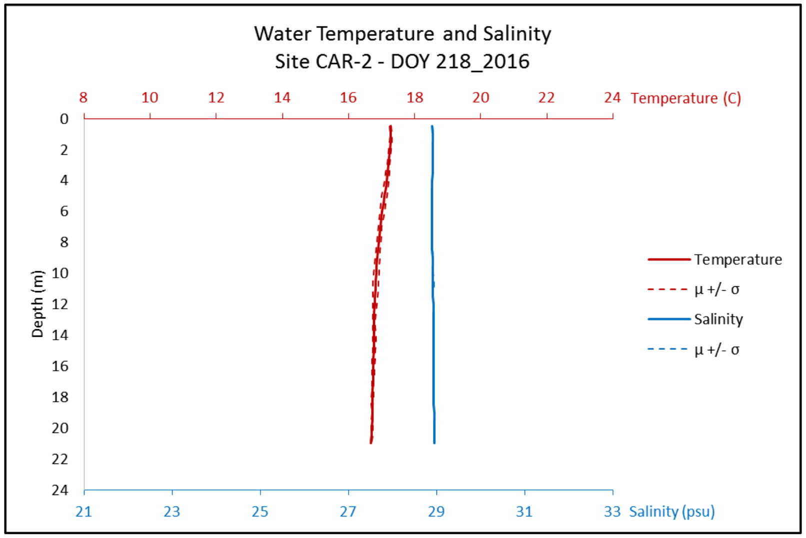
b)



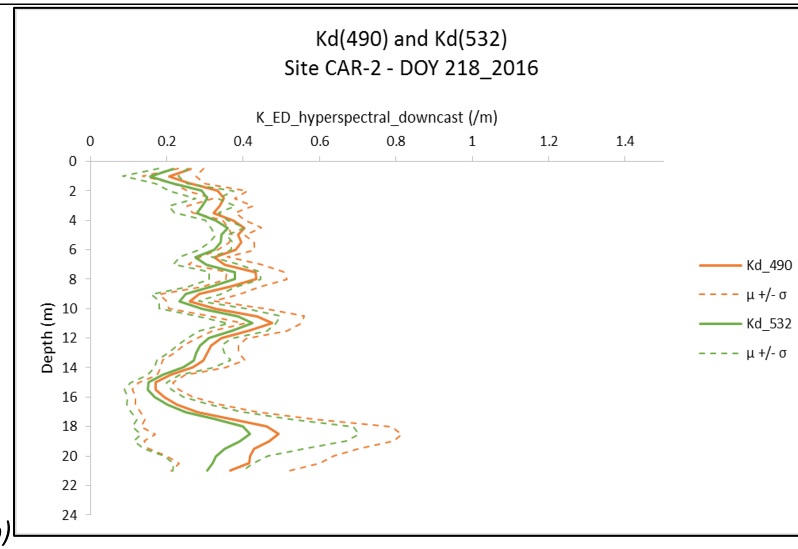
c)

Figure APX 1.6
Northumberland Strait on August 5th 2016 (doy = 218), site CAR-2 LIDAR.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.

a)



b)



c)

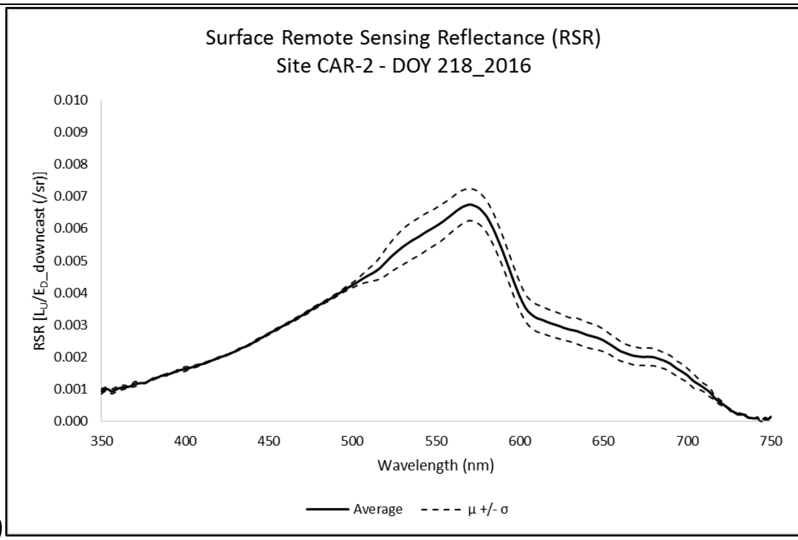
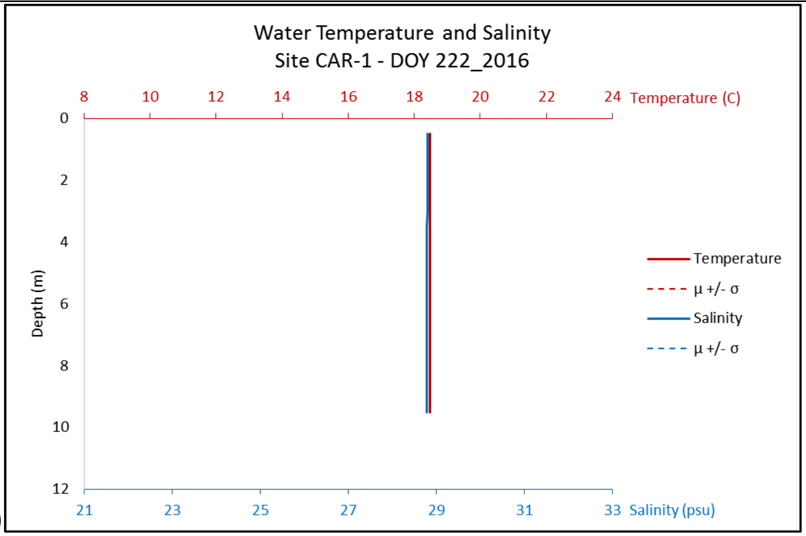
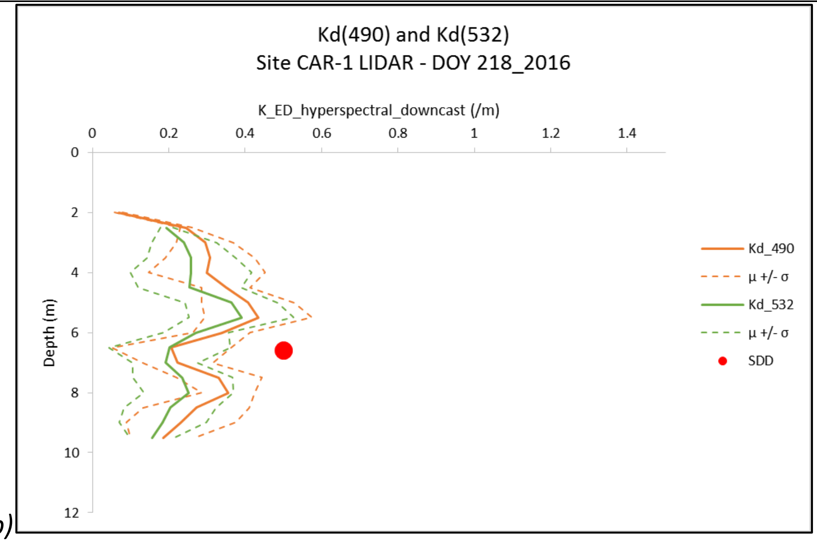


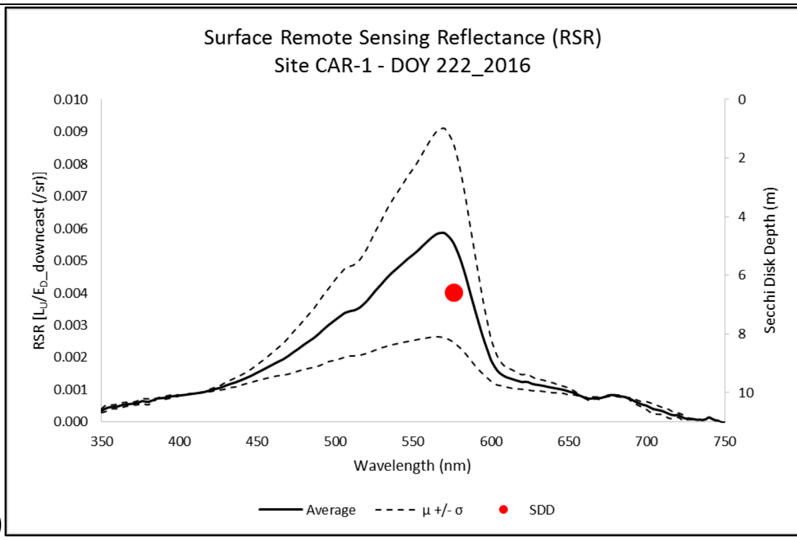
Figure APX 1.7
Northumberland Strait on August 5th 2016 (doy = 218), site CAR-2.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)]. Hatched lines are ± one standard deviation.



a)

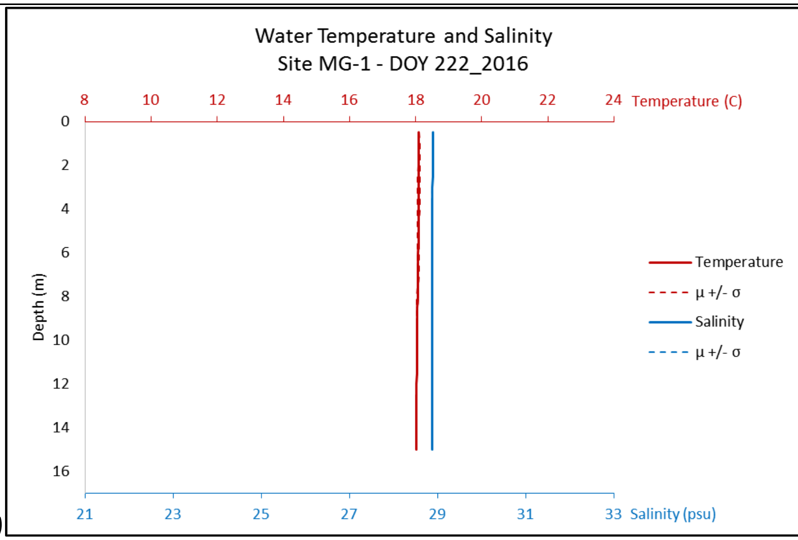


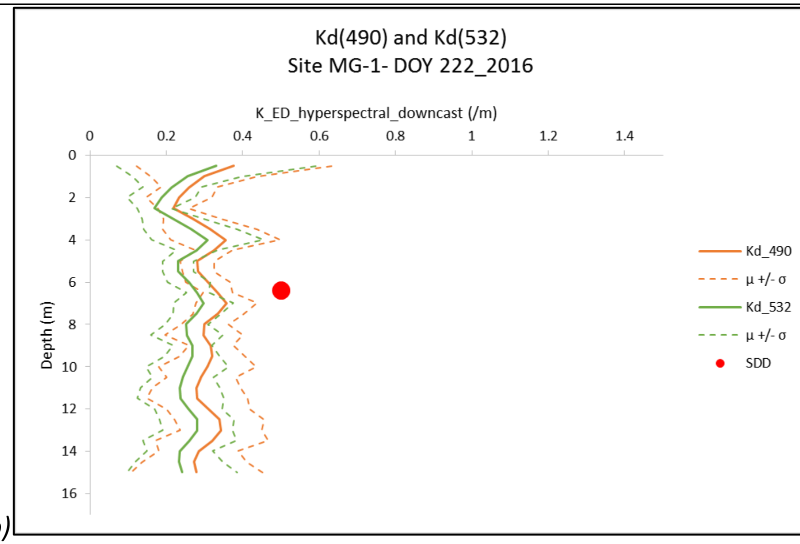
b)



c)

Figure APX 1.8
Northumberland Strait on August 9th 2016 (doy = 222), site CAR-1.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.

a)


b)


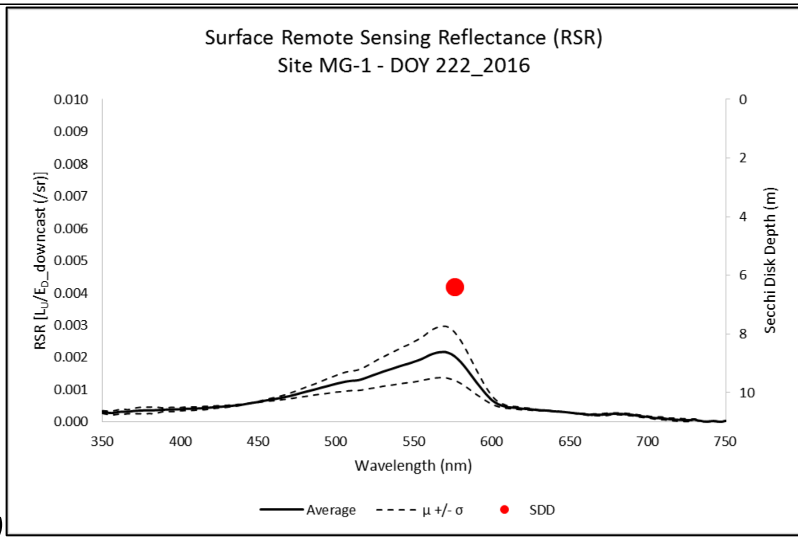
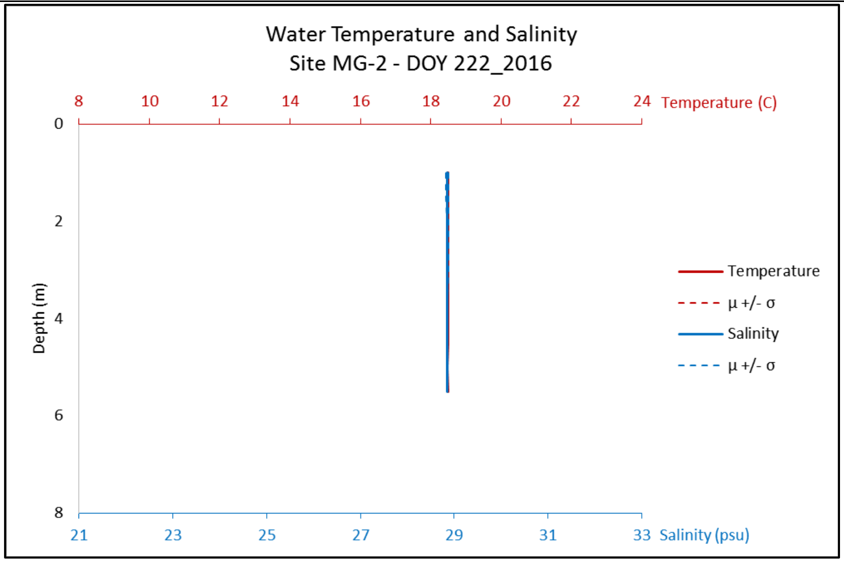
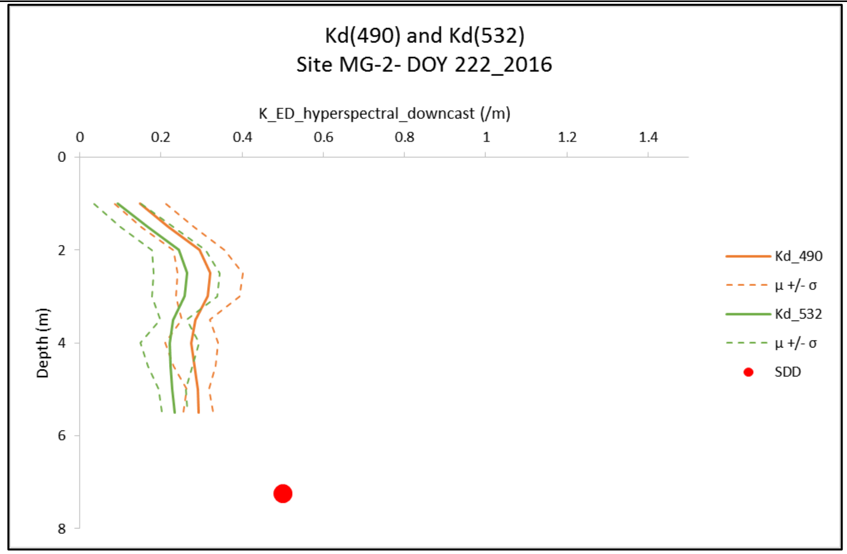
c)


Figure APX 1.9
Northumberland Strait on August 9th 2016 (doy = 222), site MG-1.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.





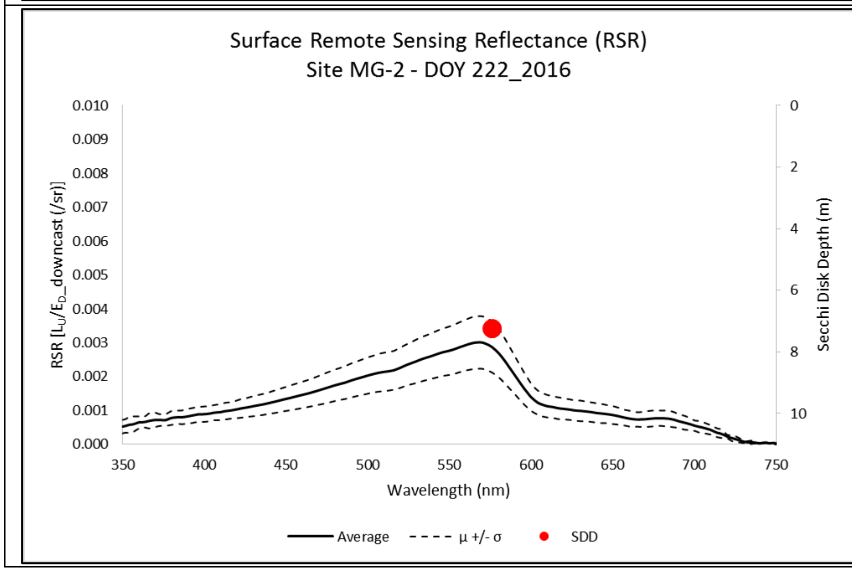


Figure APX 1.10

Northumberland Strait on August 9th 2016 (doy = 222), site MG-2.

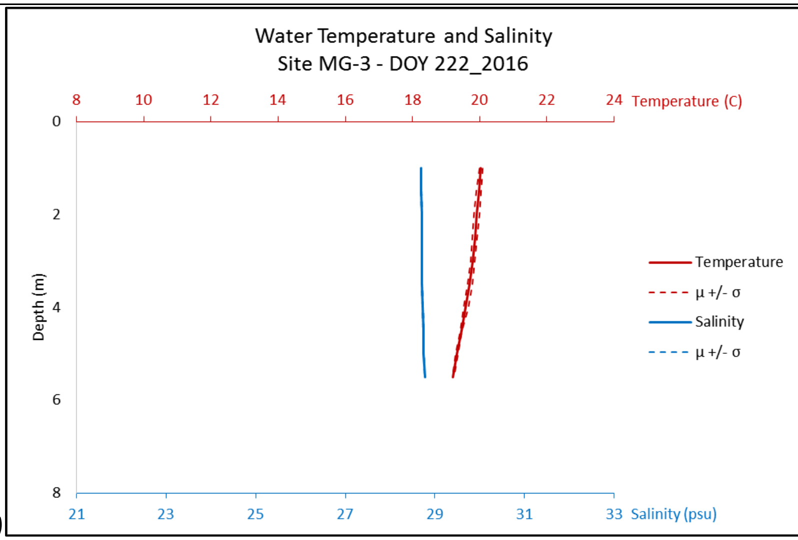
a) Temperature (°C) and salinity (psu), .

b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and

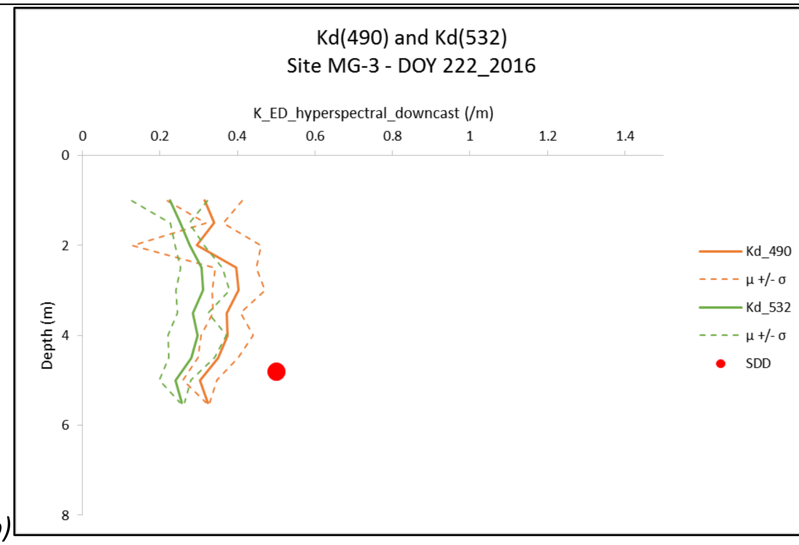
c) Surface Remote Sensing Reflectance [Rrs (/sr)].

Secchi Disk Depth (m) is shown as a red dot on b) and c).

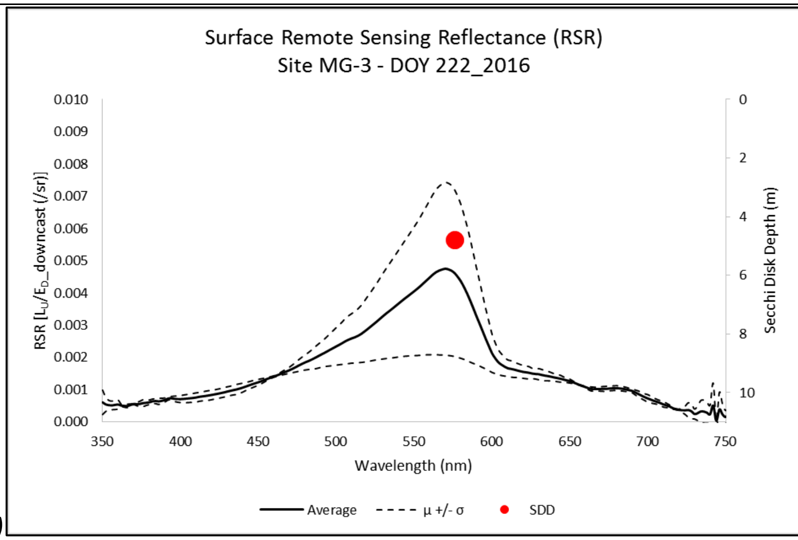
Hatched lines are ± one standard deviation.



a)



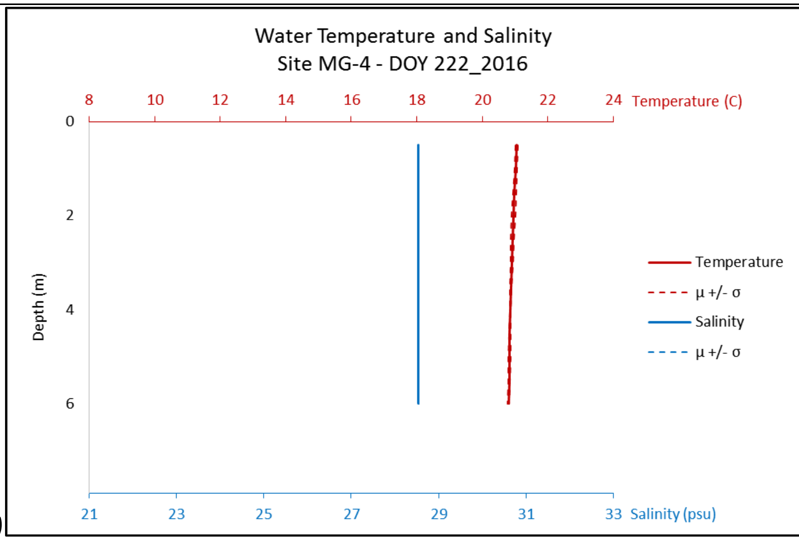
b)



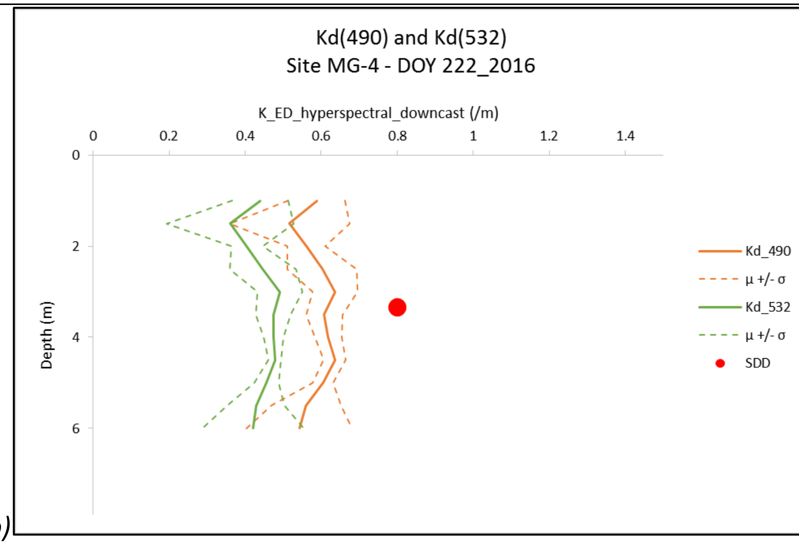
c)

Figure APX 1.11
Northumberland Strait on August 9th 2016 (doy = 222), site MG-3.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.

a)



b)



c)

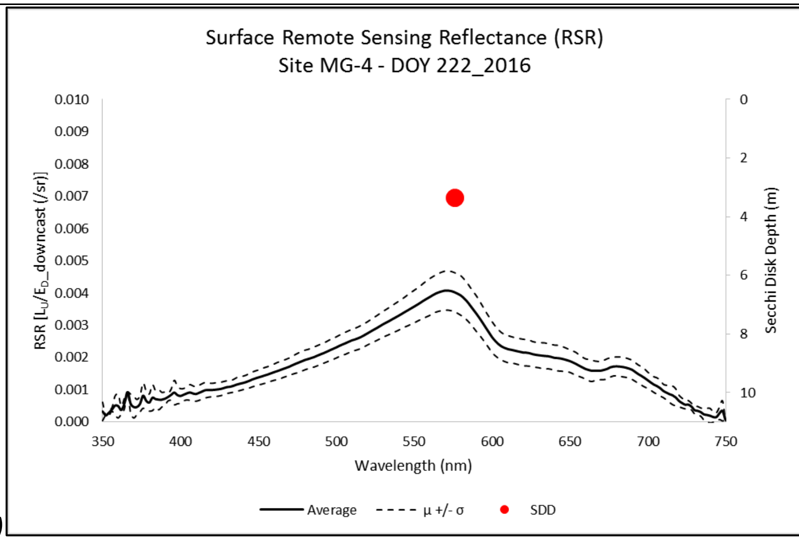
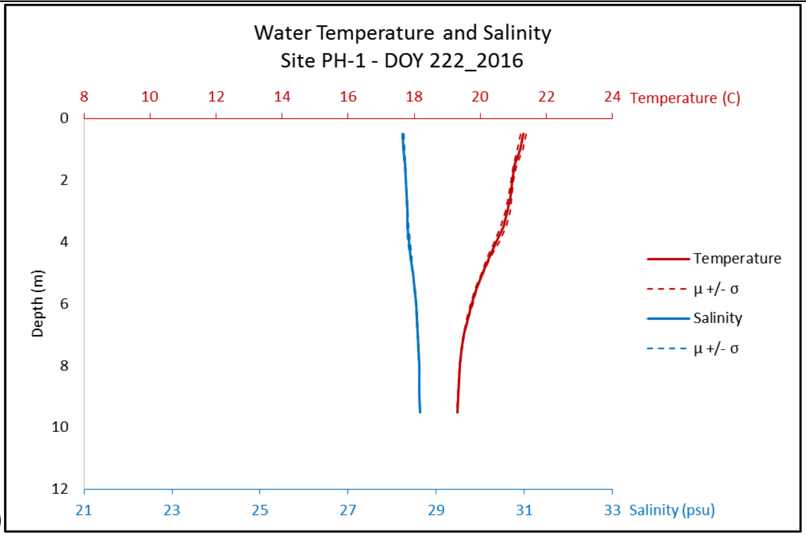
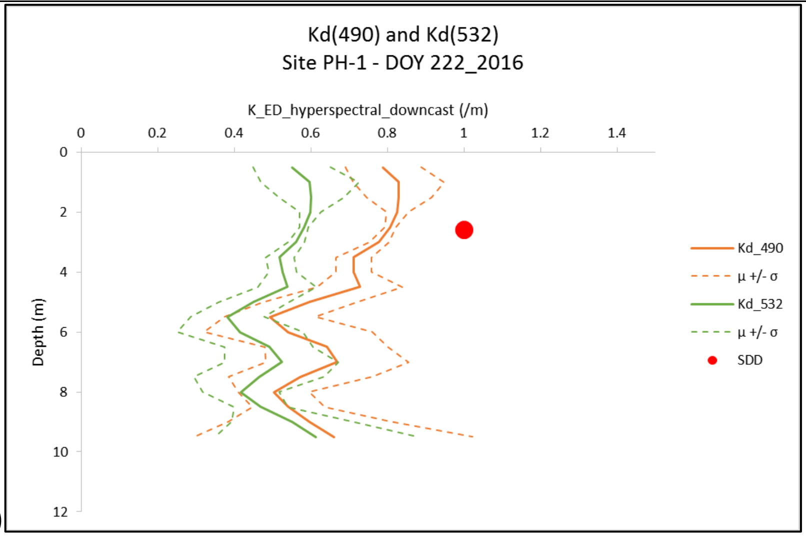


Figure APX 1.12
Northumberland Strait on August 9th 2016 (doy = 222), site MG-4.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)



b)

Figure APX 1.13
Northumberland Strait on August 9th 2016 (doy = 222), site PH-1.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
Secchi Disk Depth (m) is shown as a red dot.
Hatched lines are ± one standard deviation.

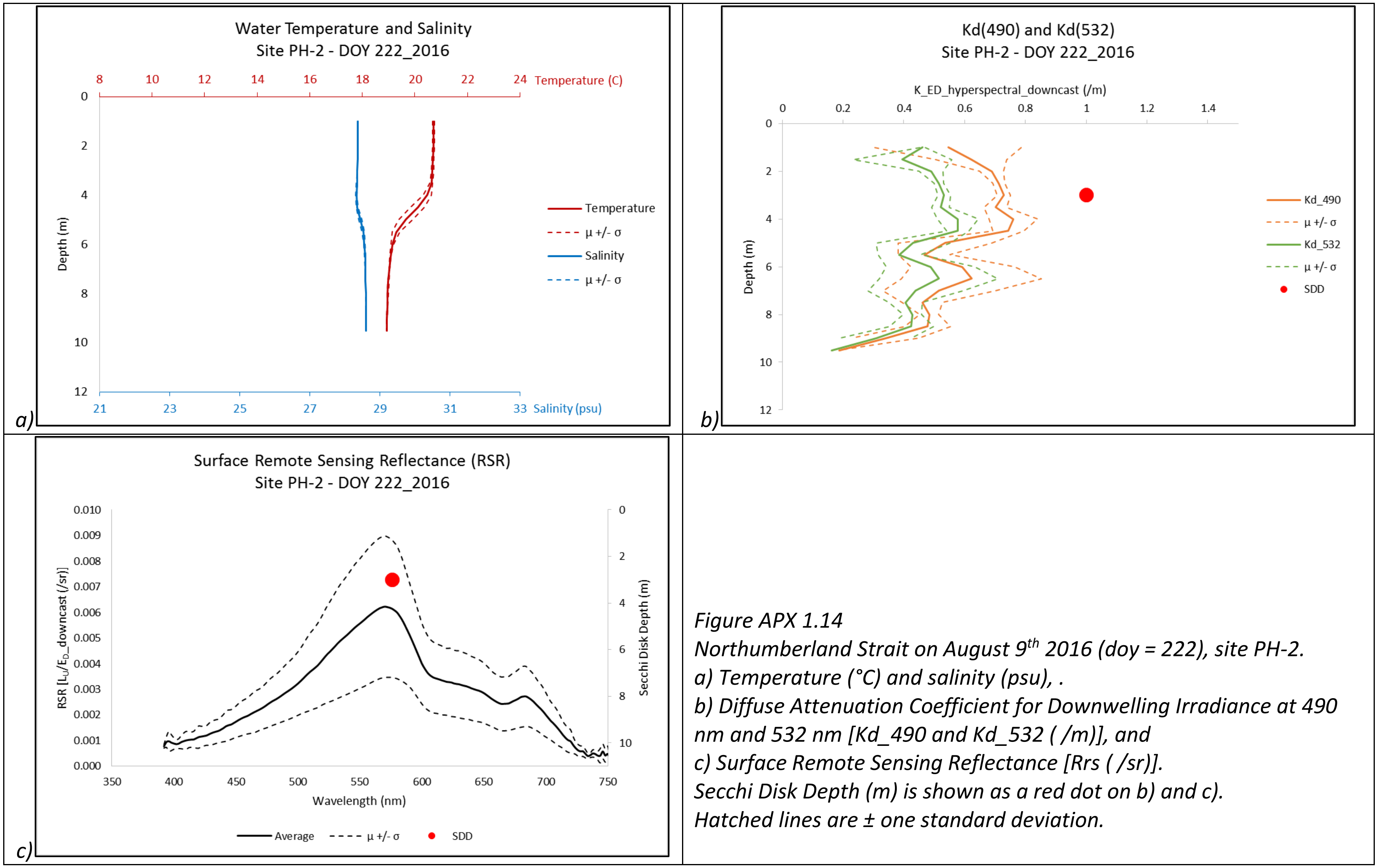
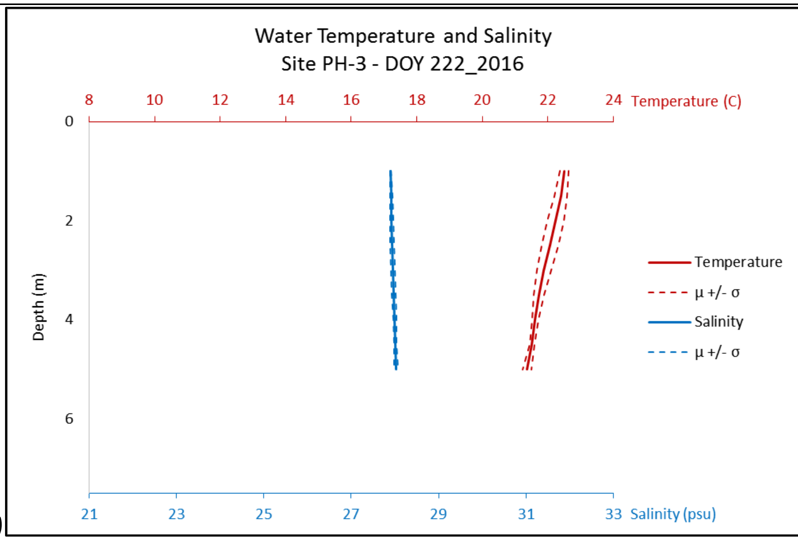
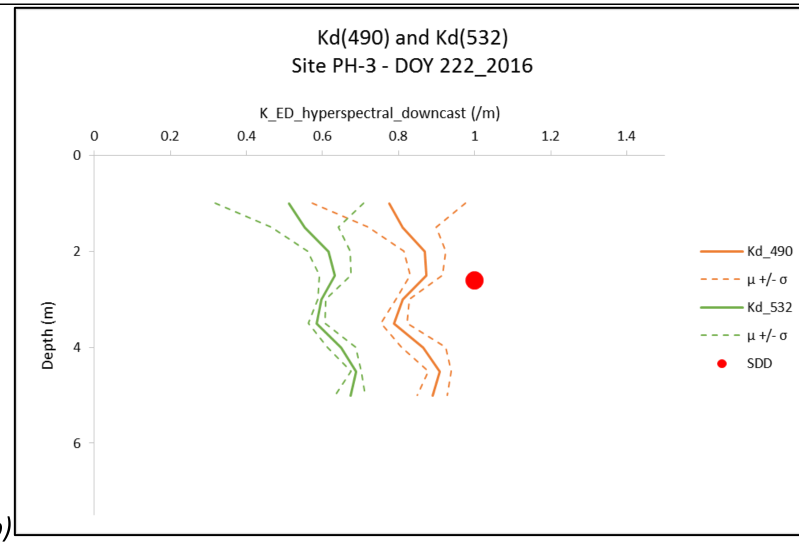


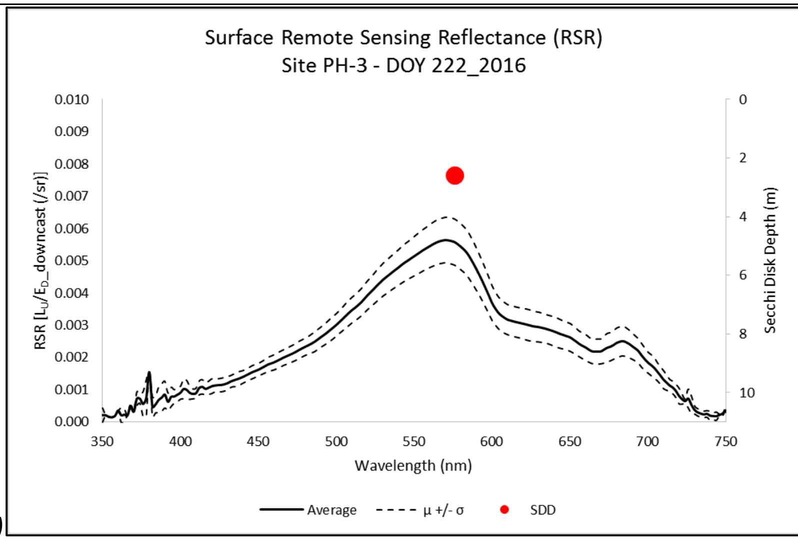
Figure APX 1.14
Northumberland Strait on August 9th 2016 (doy = 222), site PH-2.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)

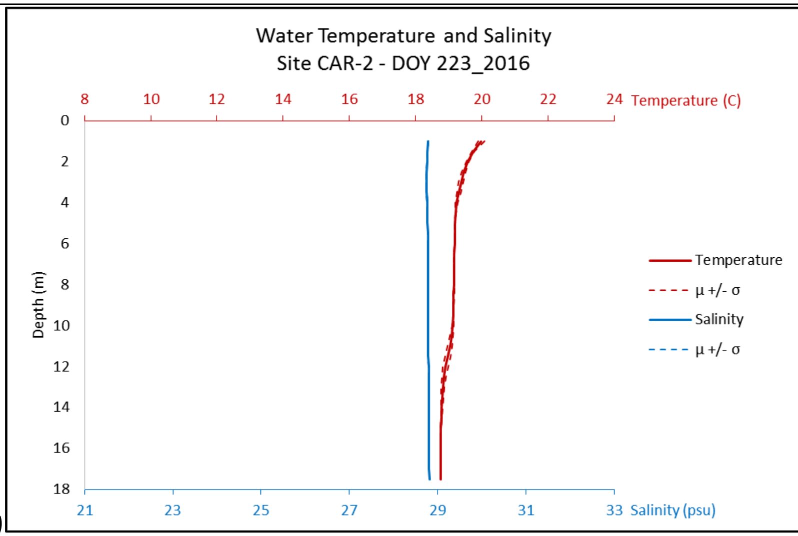


b)

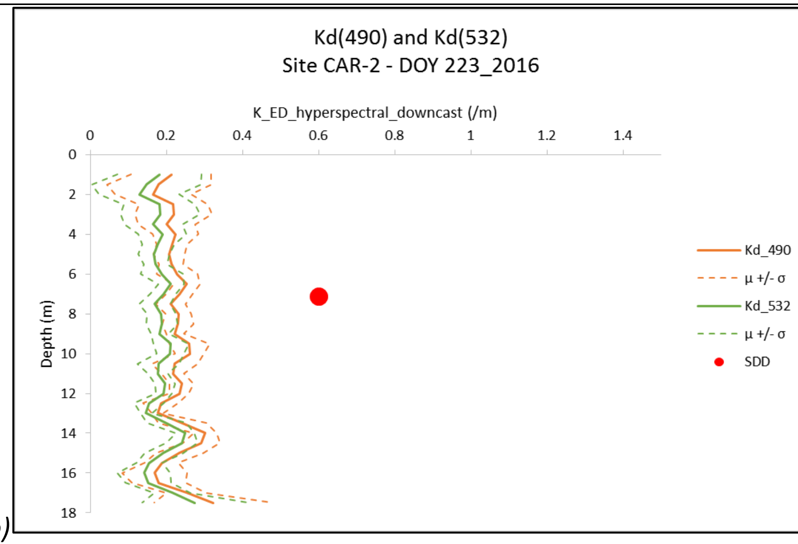


c)

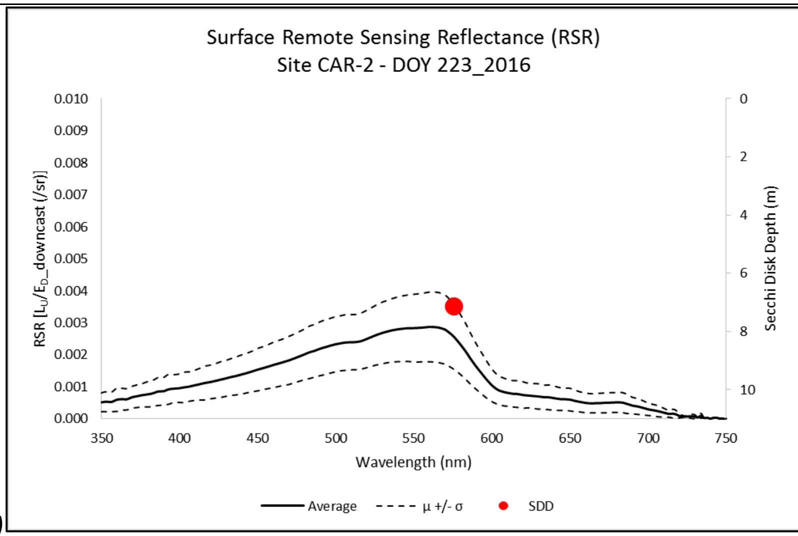
Figure APX 1.15
Northumberland Strait on August 9th 2016 (doy = 222), site PH-3.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)

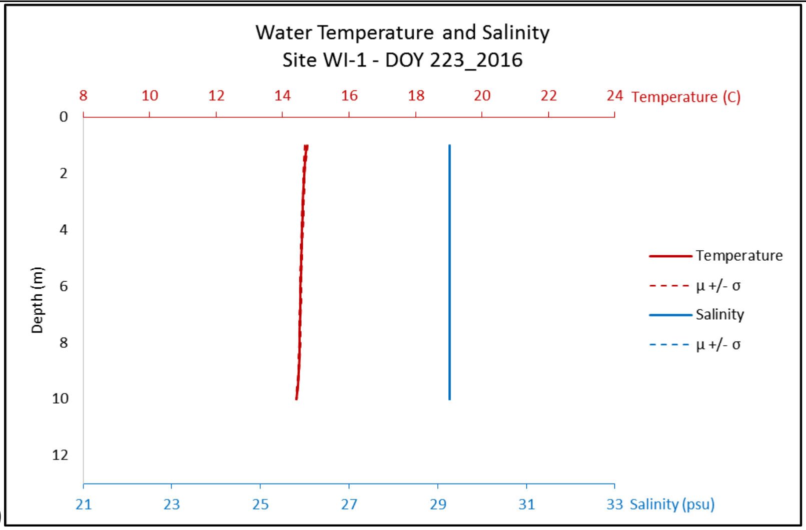


b)

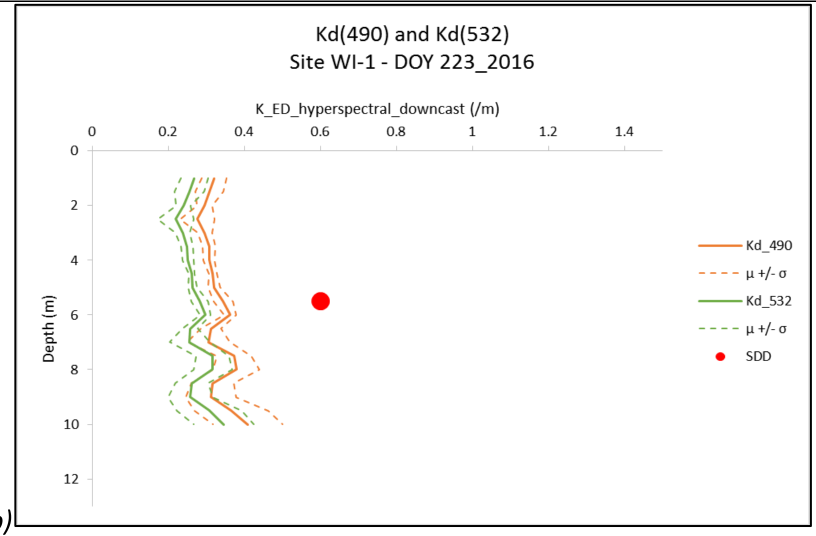


c)

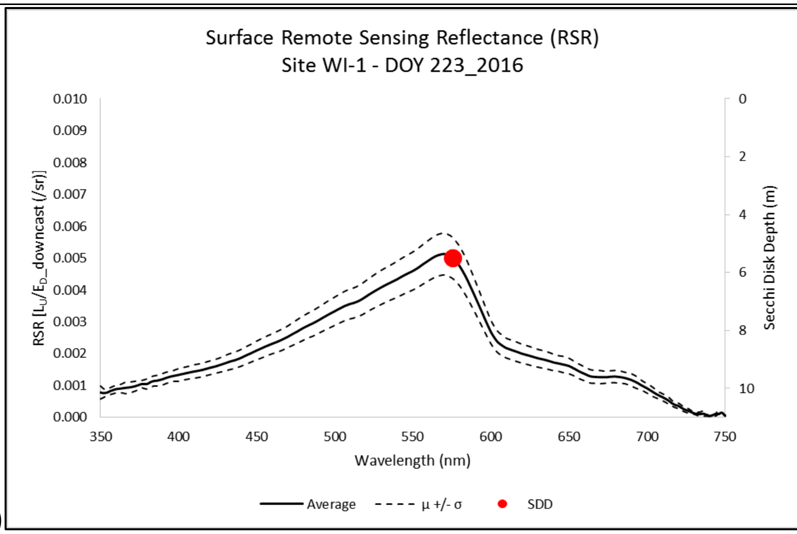
Figure APX 1.16
Northumberland Strait on August 10th 2016 (doy = 223), site CAR-2.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)

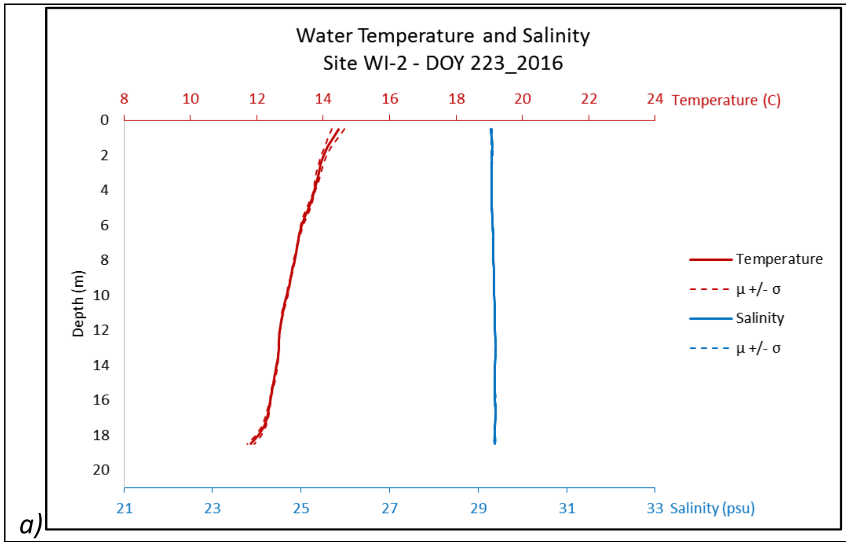


b)



c)

Figure APX 1.17
Northumberland Strait on August 10th 2016 (doy = 223), site WI-1.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



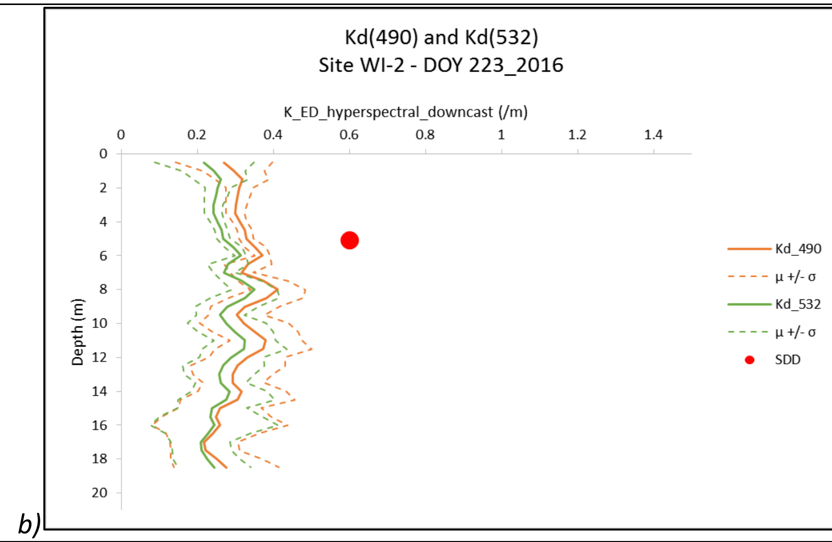
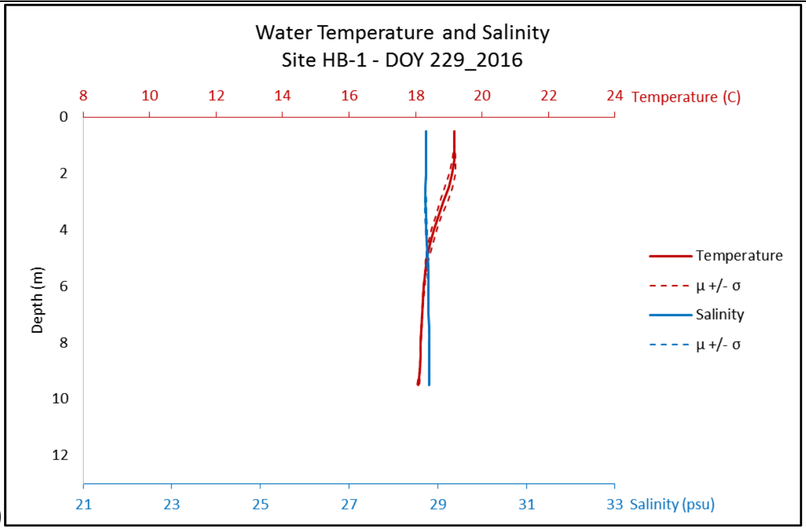
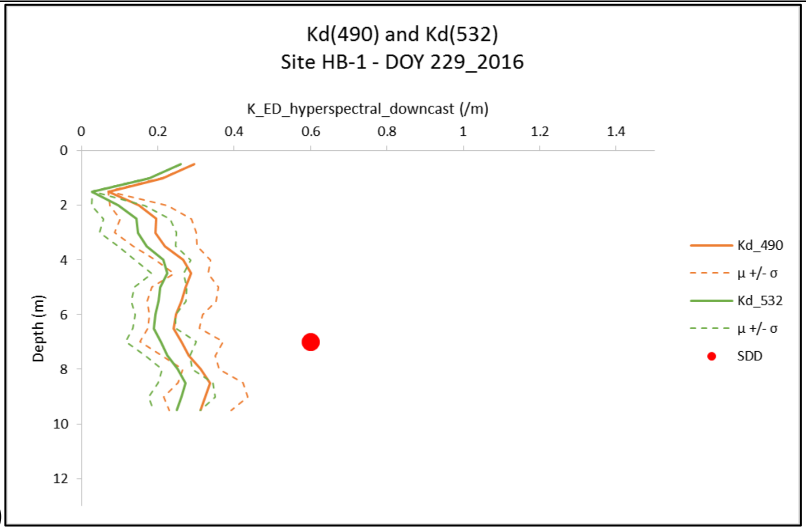


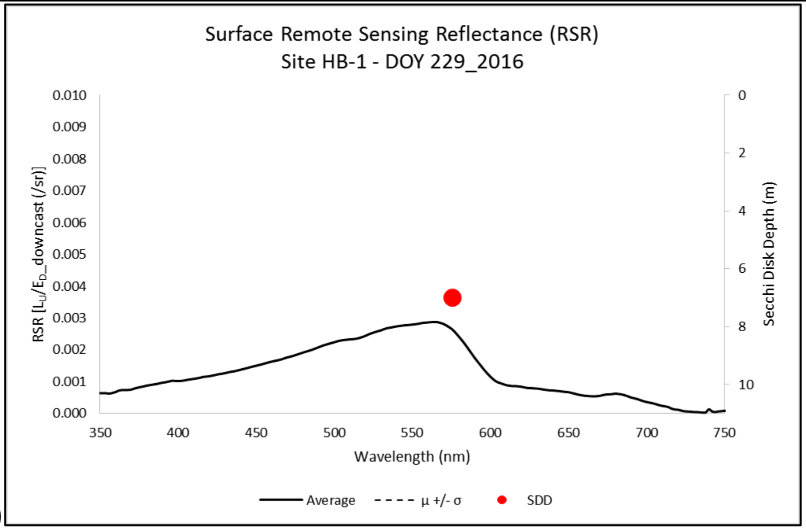
Figure APX 1.18
Northumberland Strait on August 10th 2016 (doy = 223), site WI-2.
a) Temperature (°C) and salinity (psu), and b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)]. Secchi Disk Depth (m) is shown as a red dot. Hatched lines are ± one standard deviation.



a)

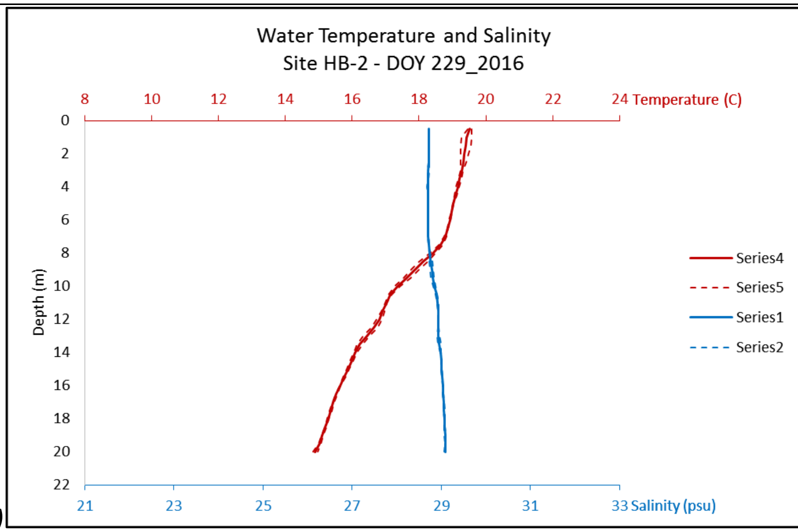


b)

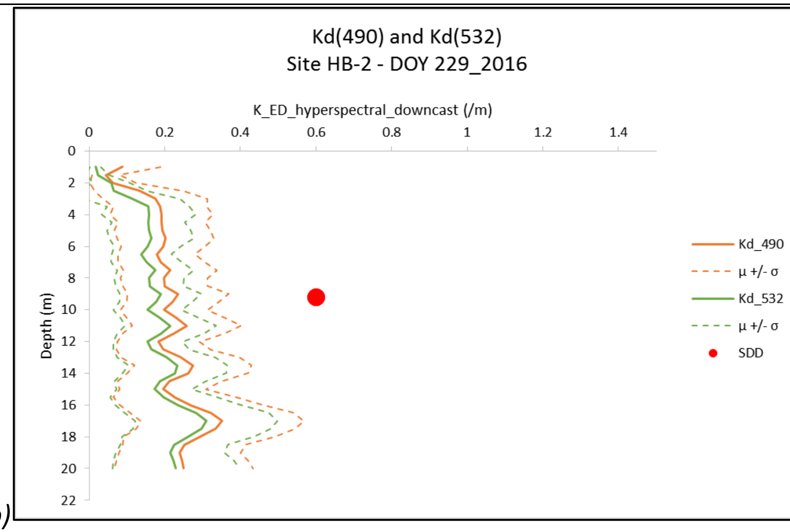


c)

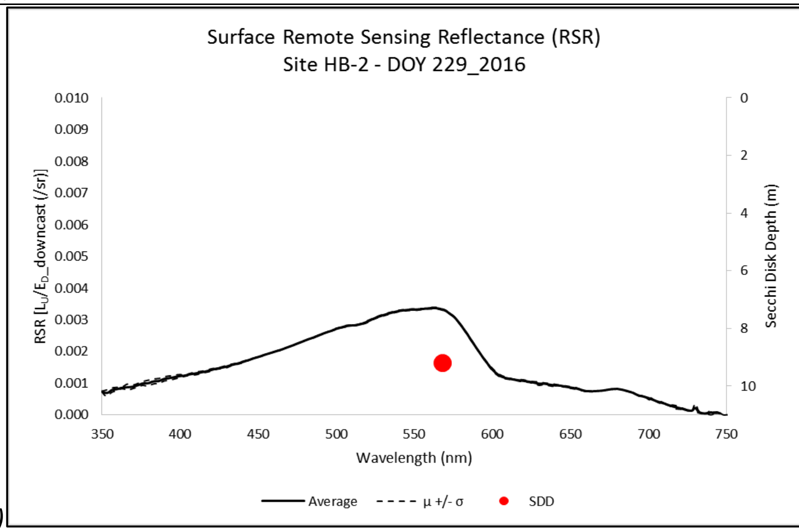
Figure APX 1.19
Northumberland Strait on August 16th 2016 (doy = 229), site HB-1.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)

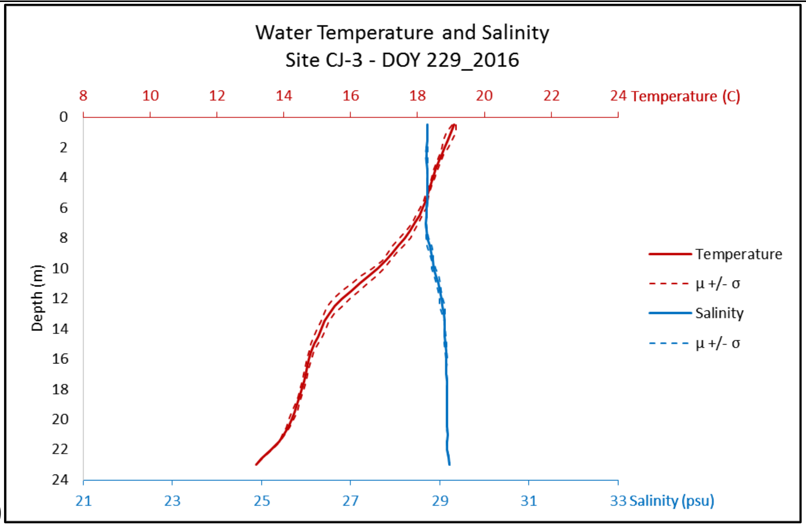


b)

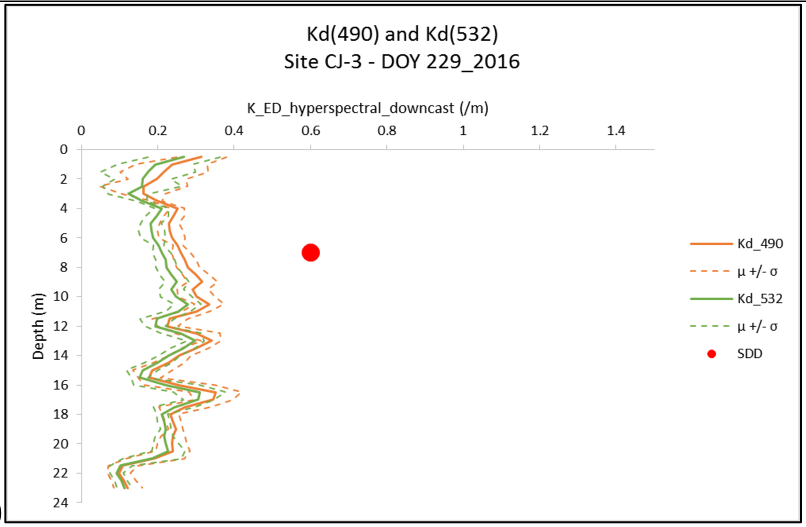


c)

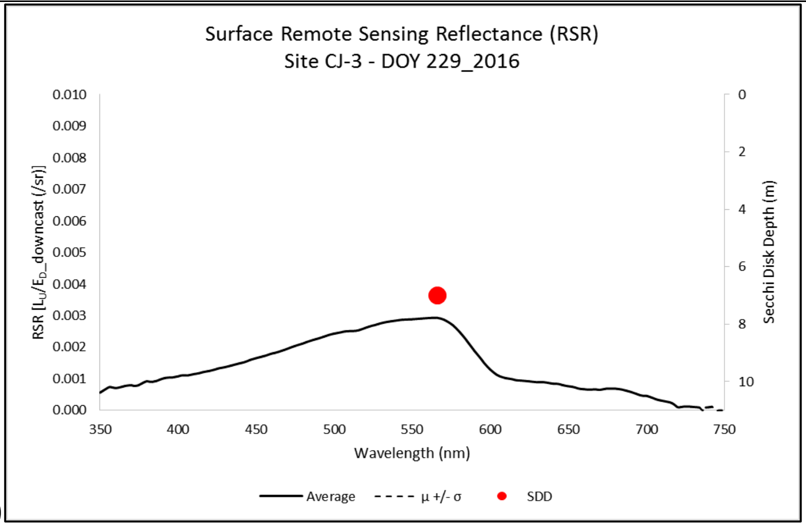
Figure APX 1.20
Northumberland Strait on August 16^{th} 2016 (doy = 229), site HB-2.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)

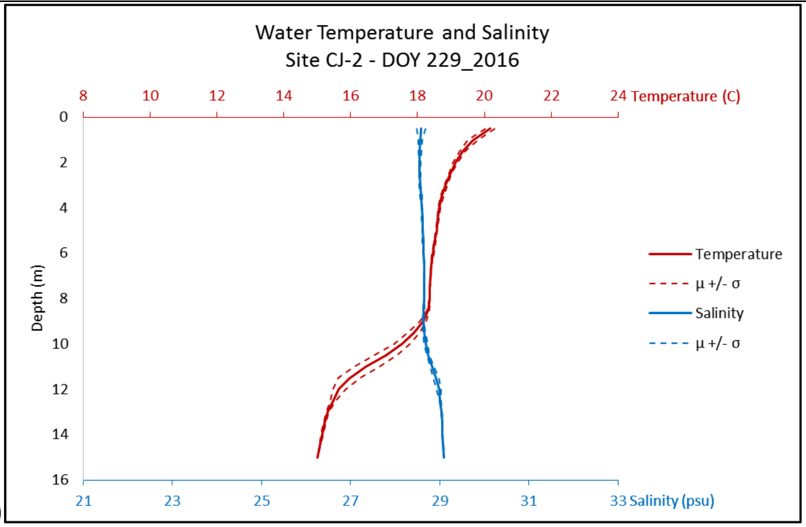


b)

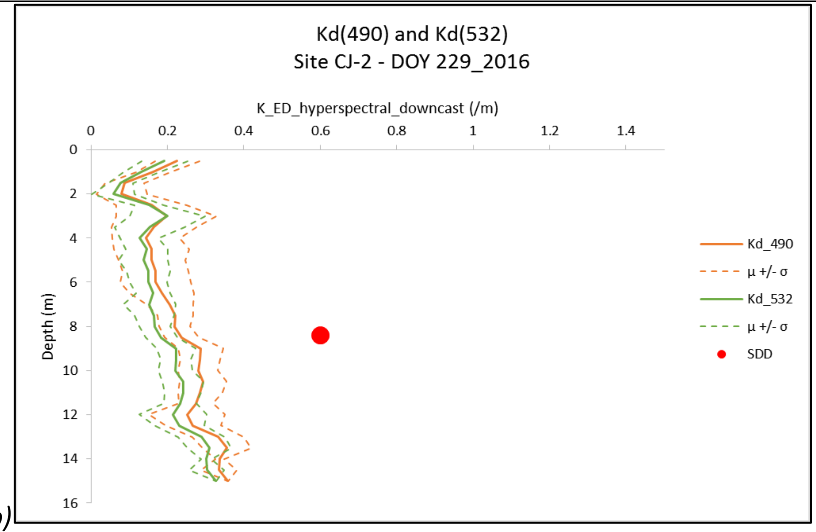


c)

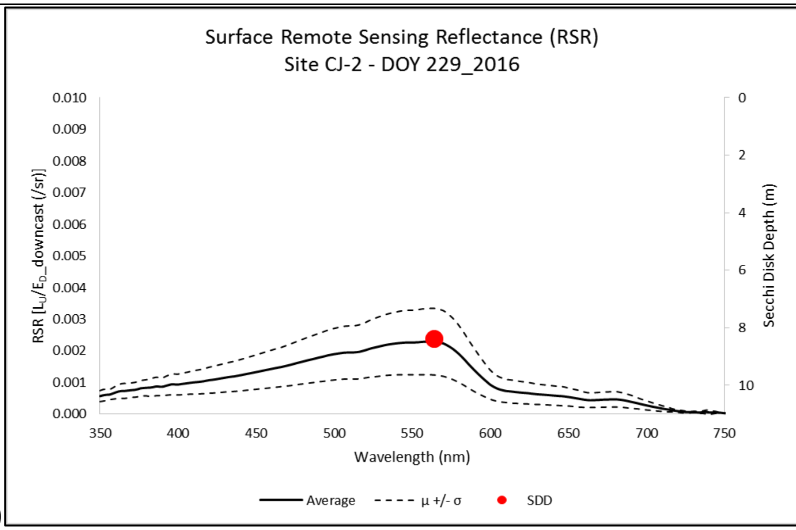
Figure APX 1.21
Northumberland Strait on August 16th 2016 (doy = 229), site CJ-3.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)



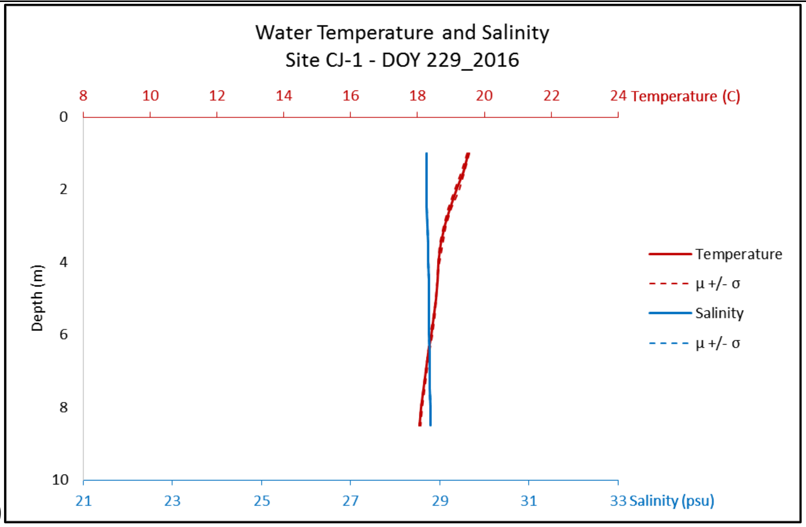
b)



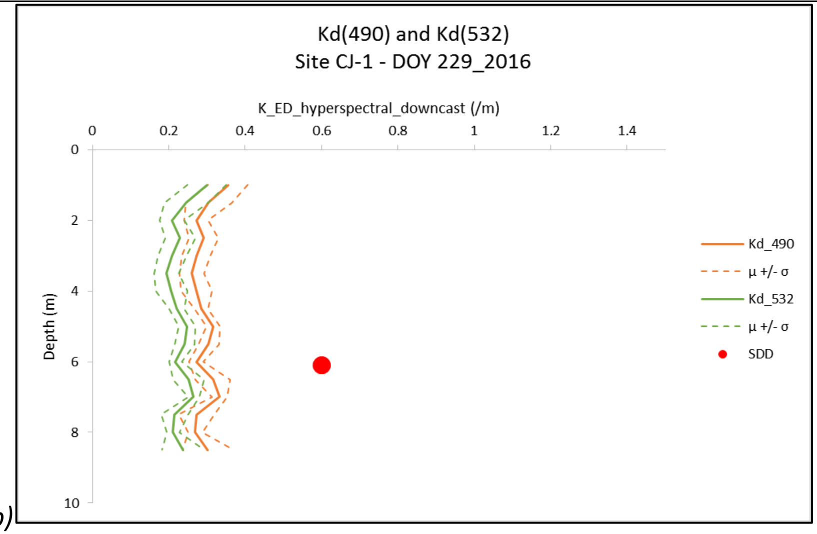
c)

Figure APX 1.22
Northumberland Strait on August 16th 2016 (doy = 229), site CJ-2.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.

a)



b)



c)

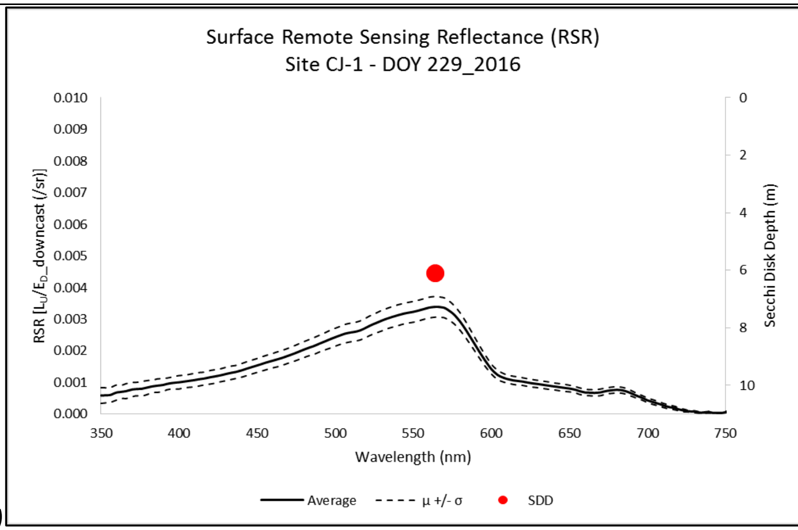
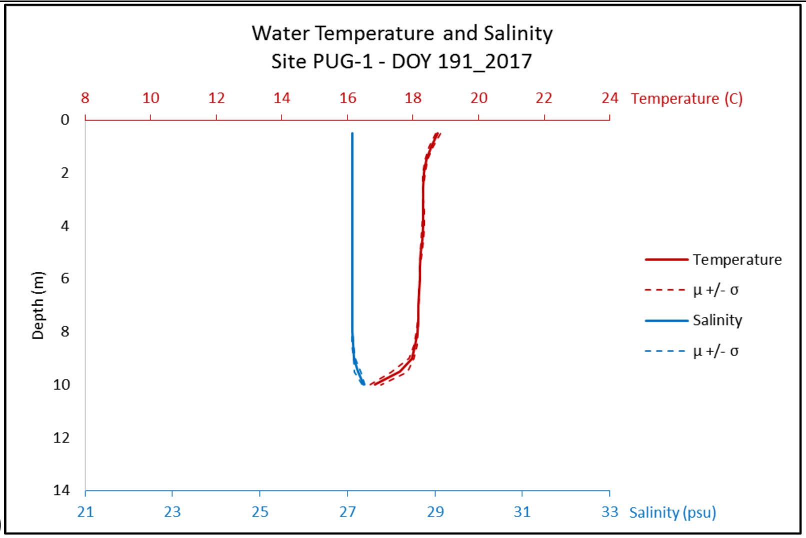
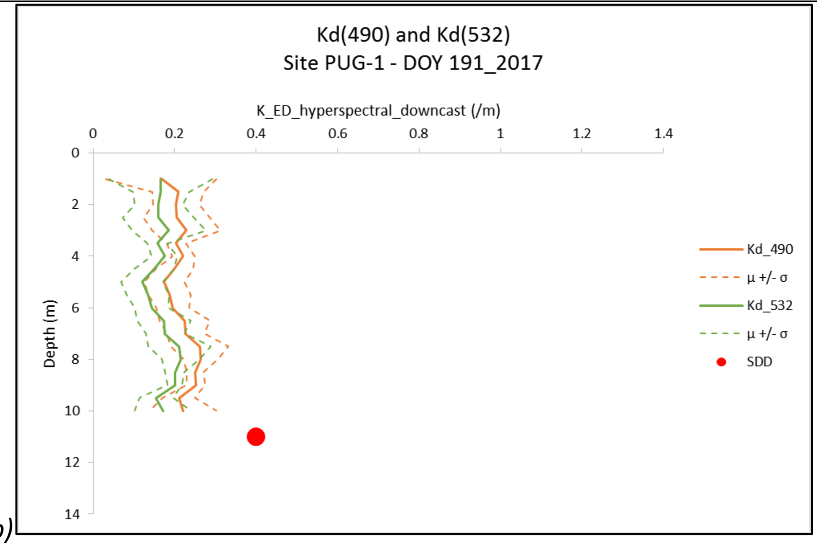


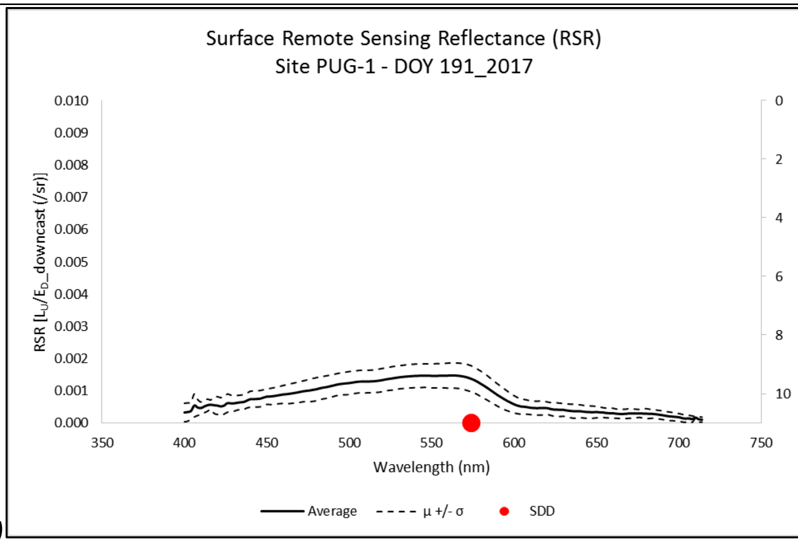
Figure APX 1.23
Northumberland Strait on August 16th 2016 (doy = 229), site CJ-1.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)

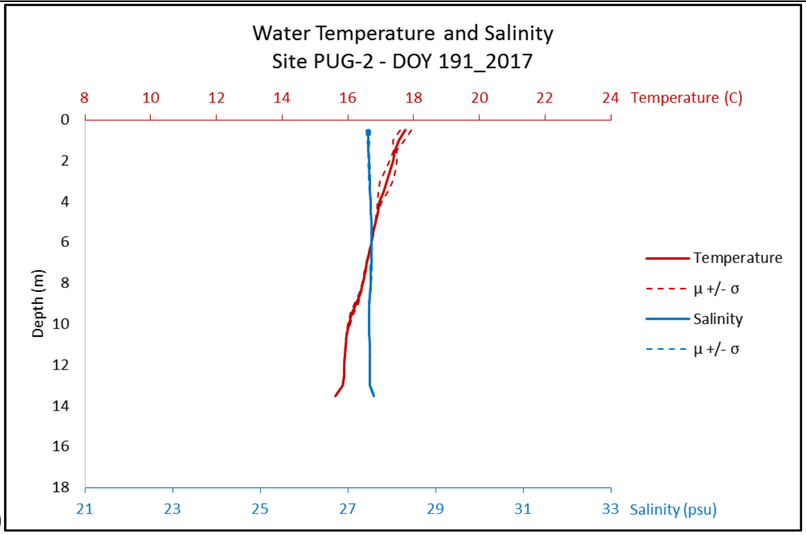


b)

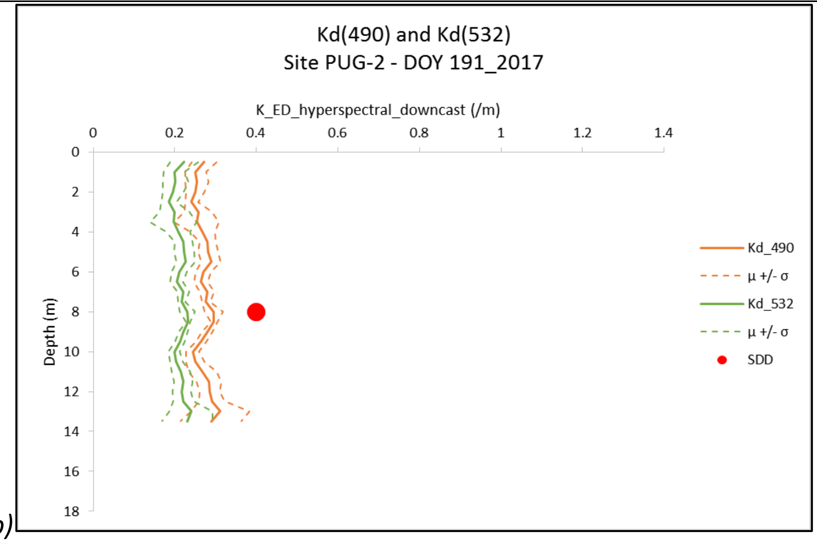


c)

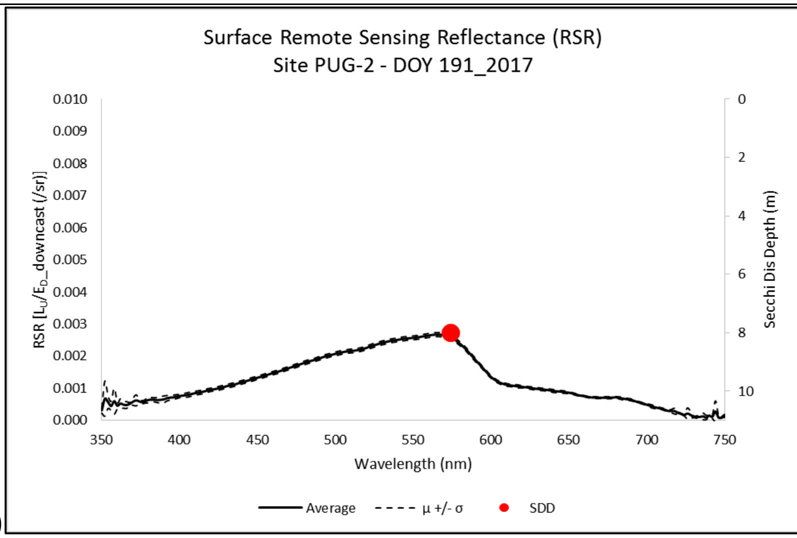
Figure APX 1.24
Northumberland Strait on July 10th 2017 (doy = 191), site PUG-1.
a) Temperature (°C) and salinity (psu),
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)

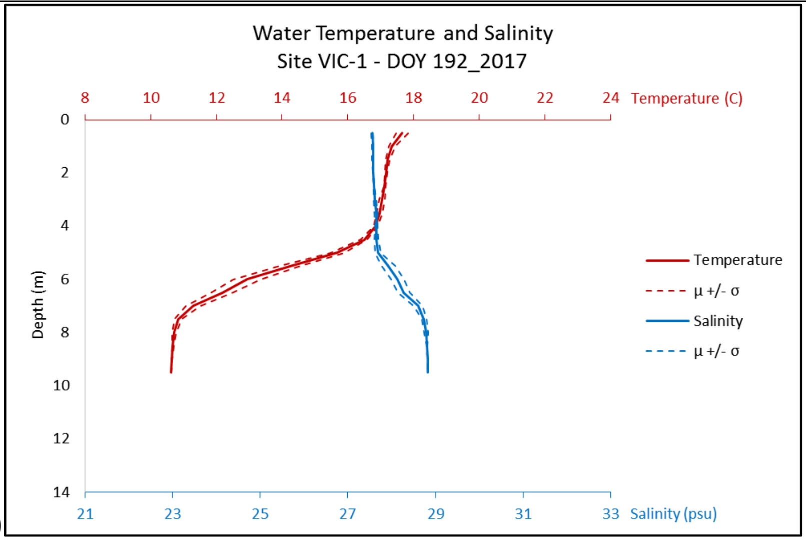


b)

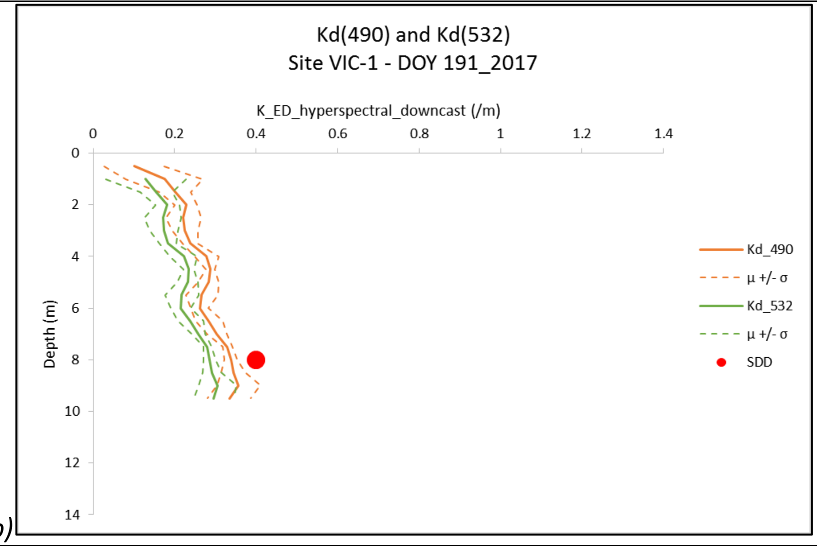


c)

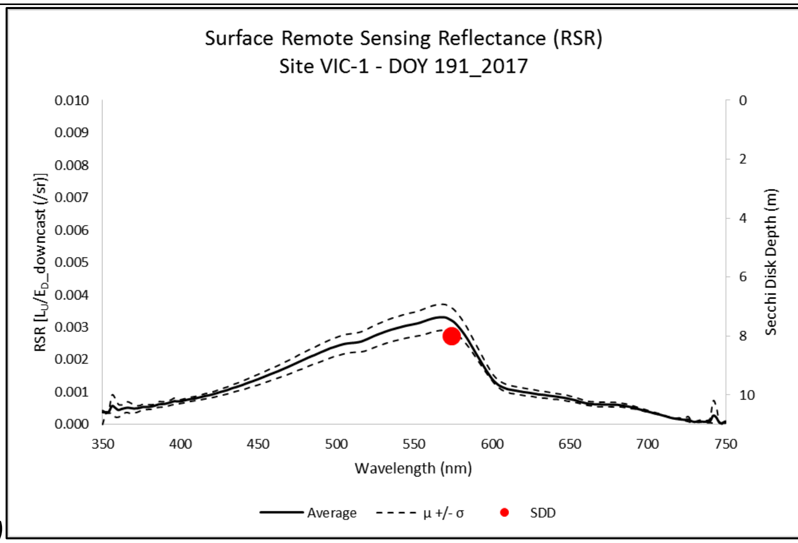
Figure APX 1.25
Northumberland Strait on July 10th 2017 (doy = 191), site PUG-2.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)

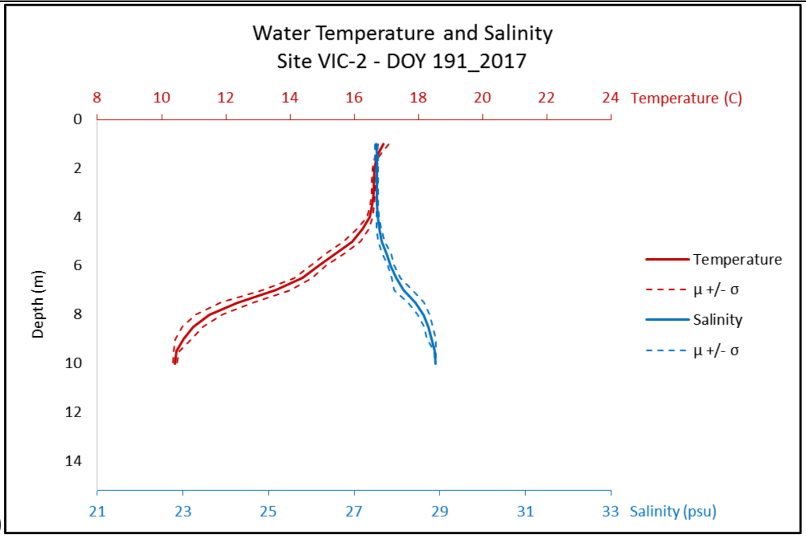


b)

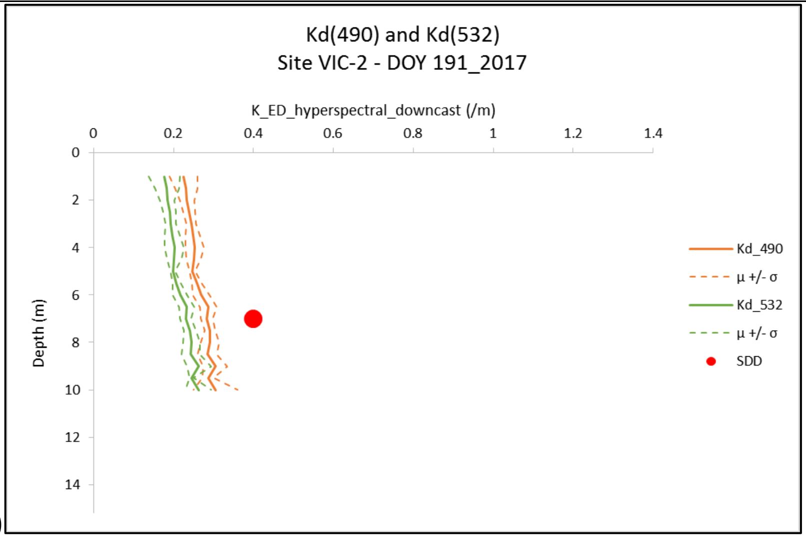


c)

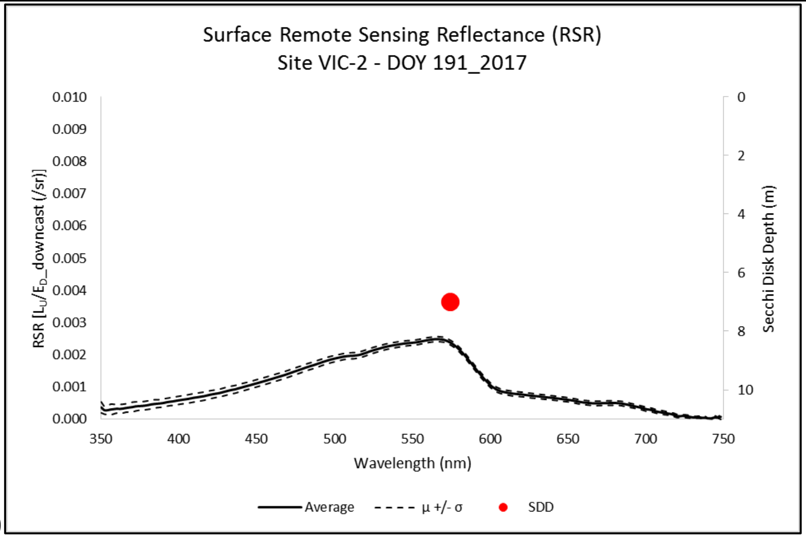
Figure APX 1.26
Northumberland Strait on July 10th 2017 (doy = 191), site VIC-1.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)

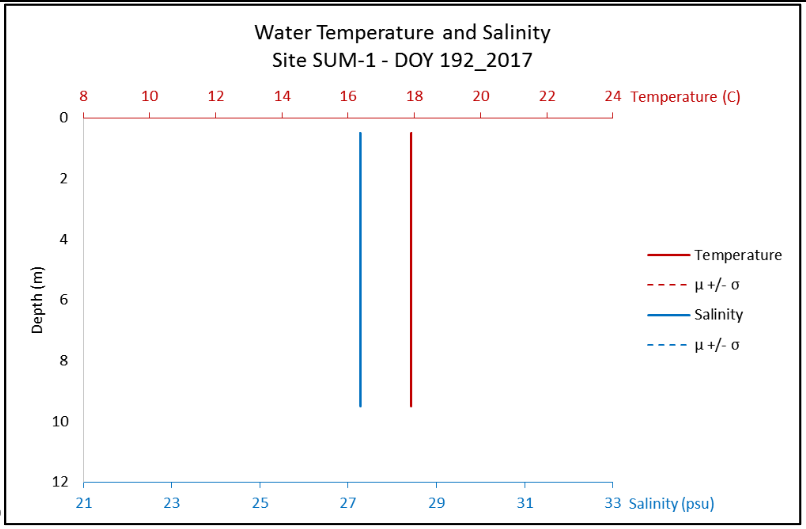


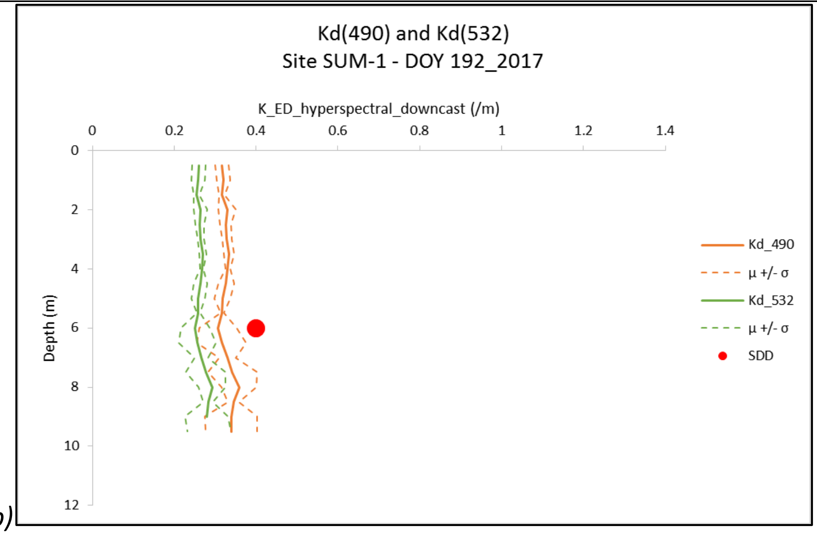
b)



c)

Figure APX 1.27
Northumberland Strait on July 10th 2017 (doy = 191), site VIC-2.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.

a) 

b) 

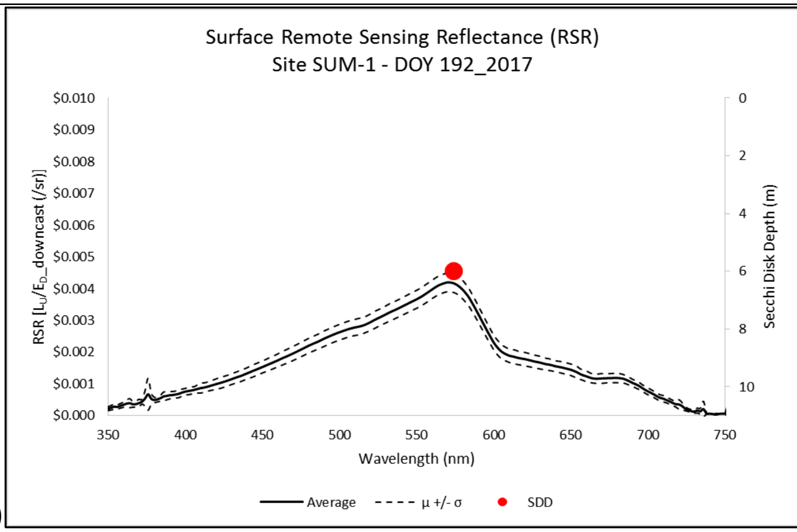
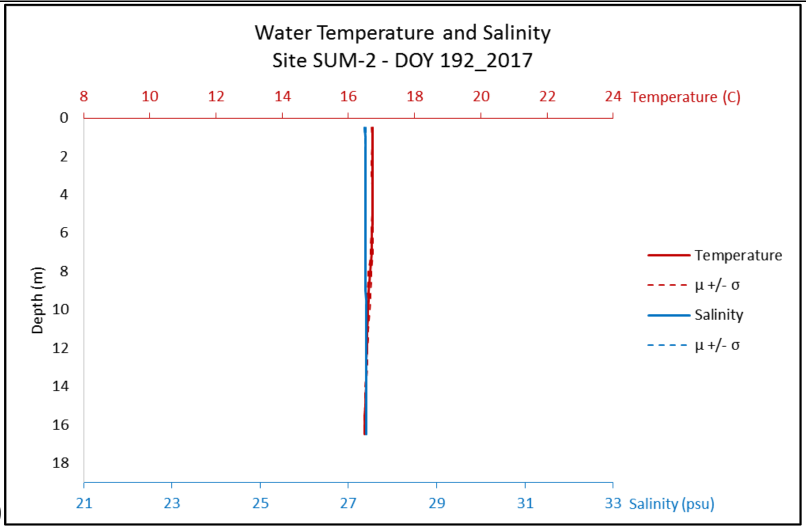
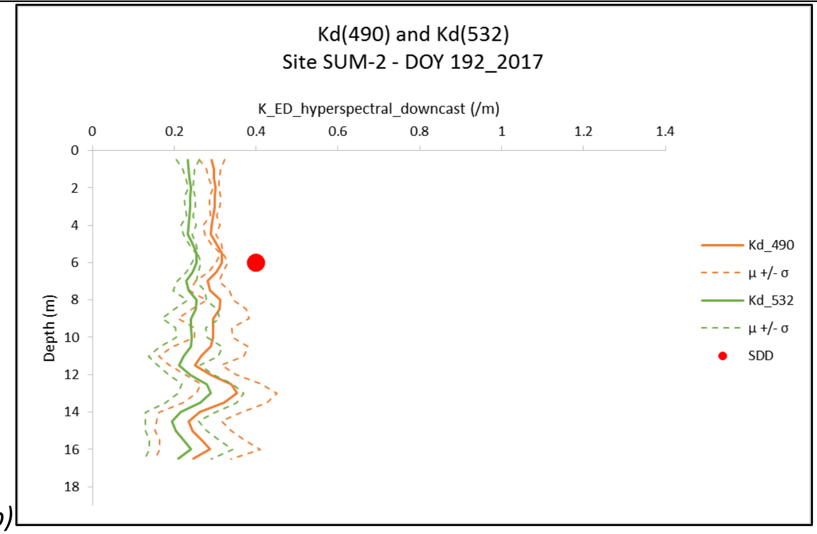
c) 

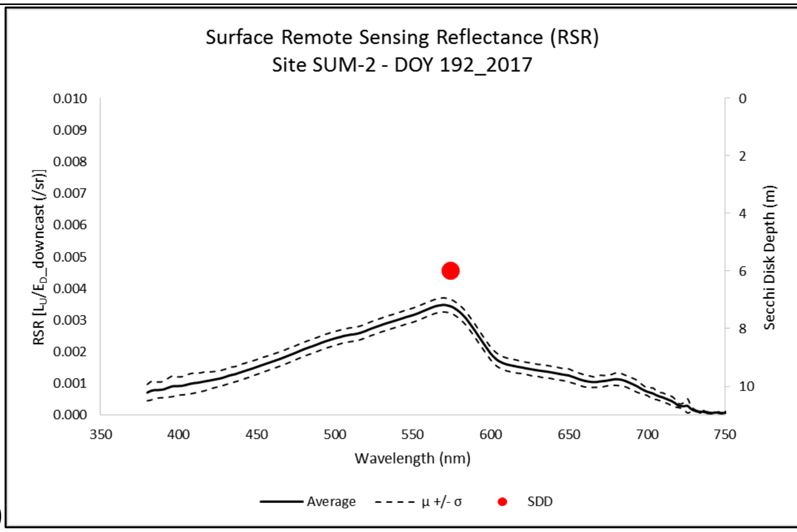
Figure APX 1.28
Northumberland Strait on July 11th 2017 (doy = 192), site SUM-1.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)



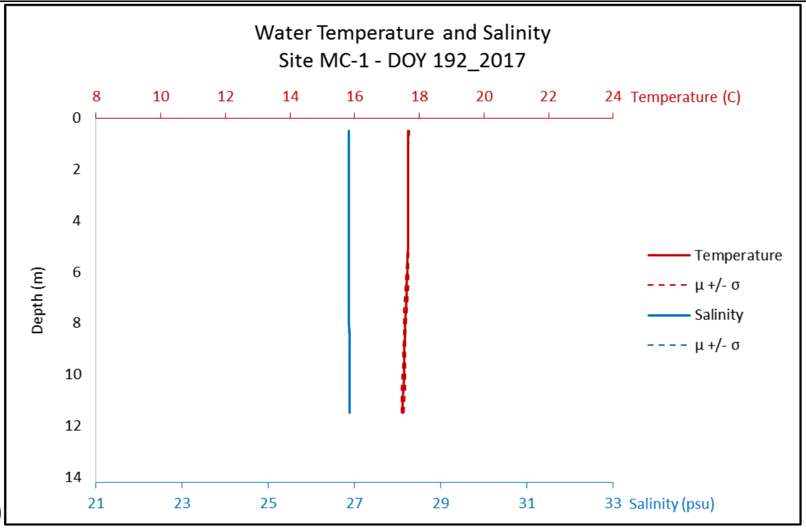
b)



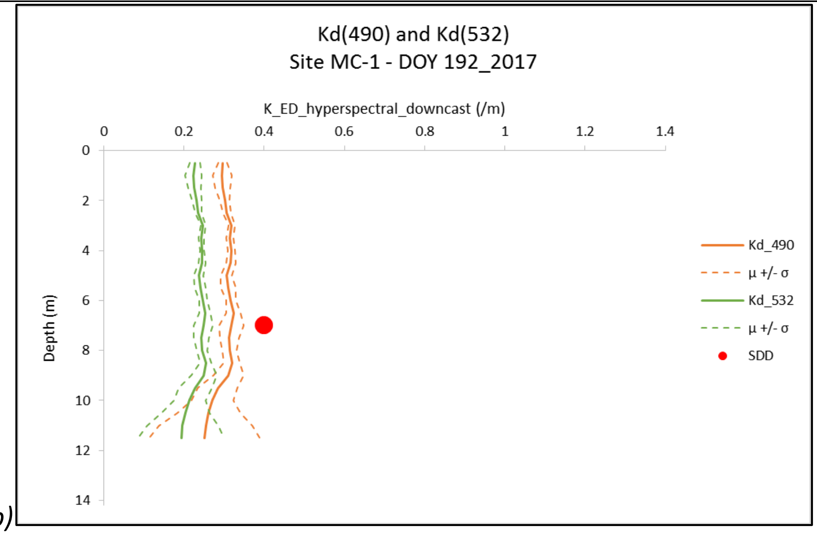
c)

Figure APX 1.29
Northumberland Strait on July 11^{th} 2017 (doy = 192), site SUM-2.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.

a)



b)



c)

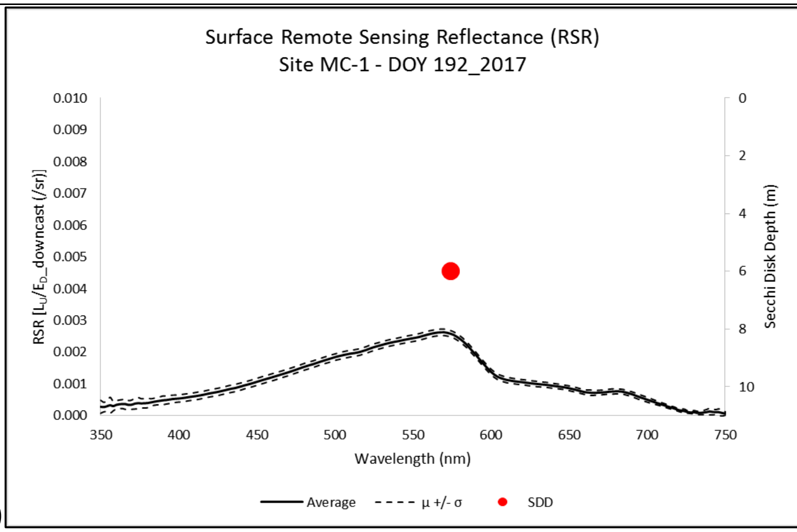
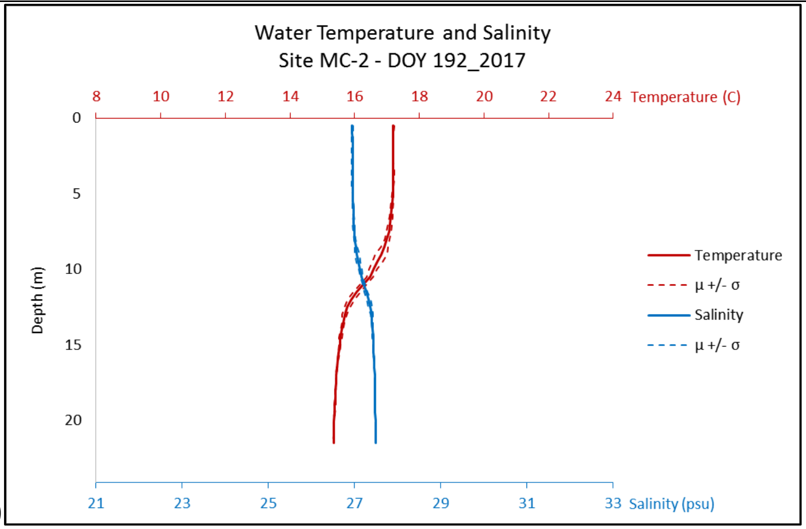
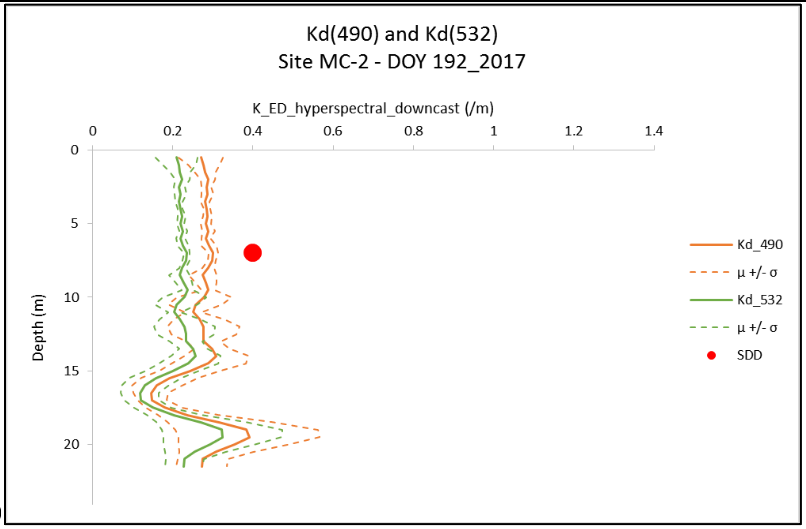


Figure APX 1.30
Northumberland Strait on July 11th 2017 (doy = 192), site MC-1.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.





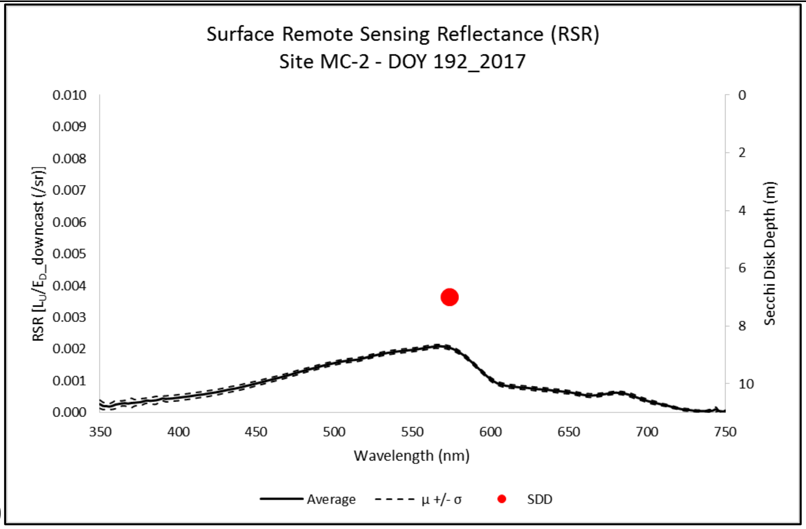
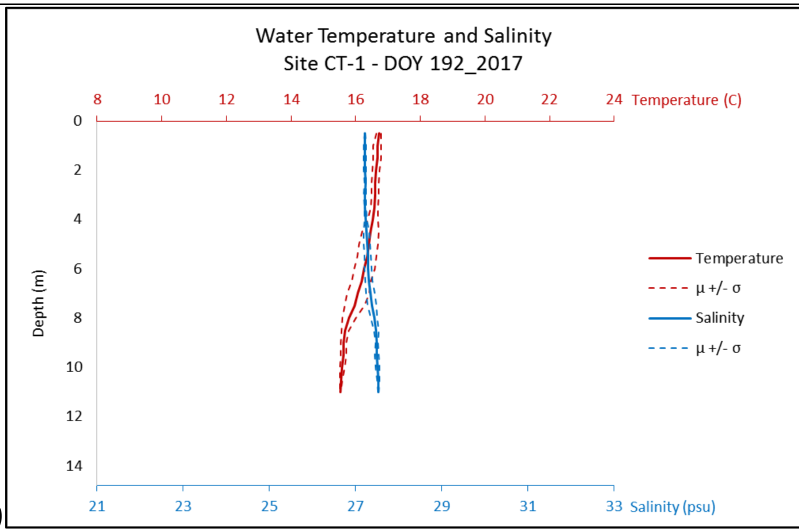
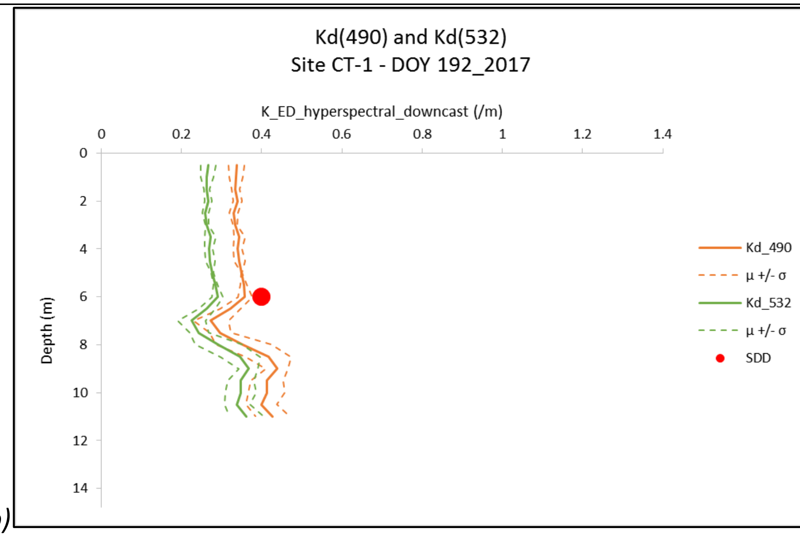


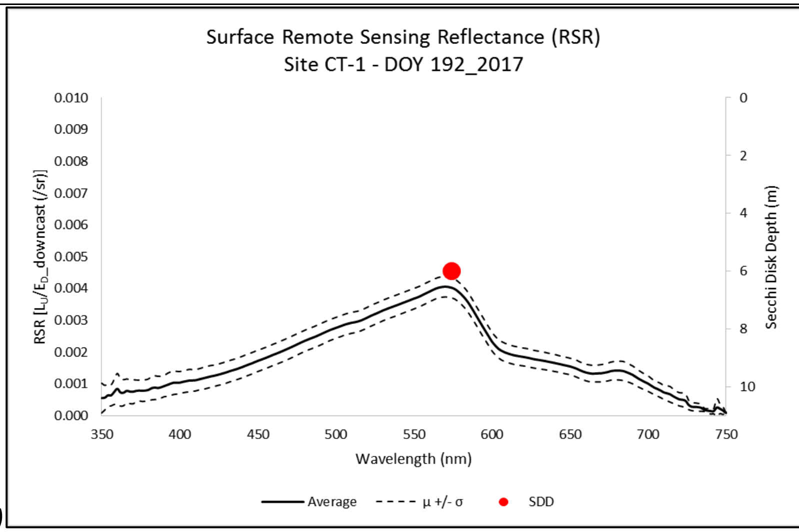
Figure APX 1.31
Northumberland Strait on July 11th 2017 (doy = 192), site MC-2.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)

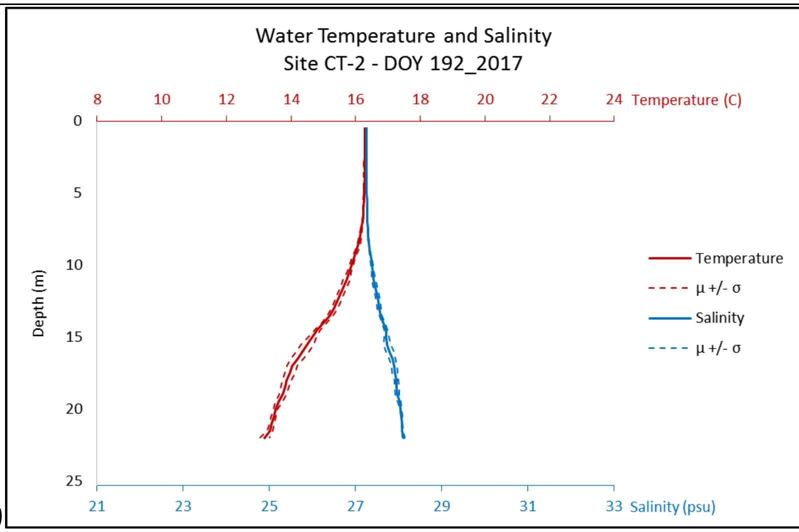


b)

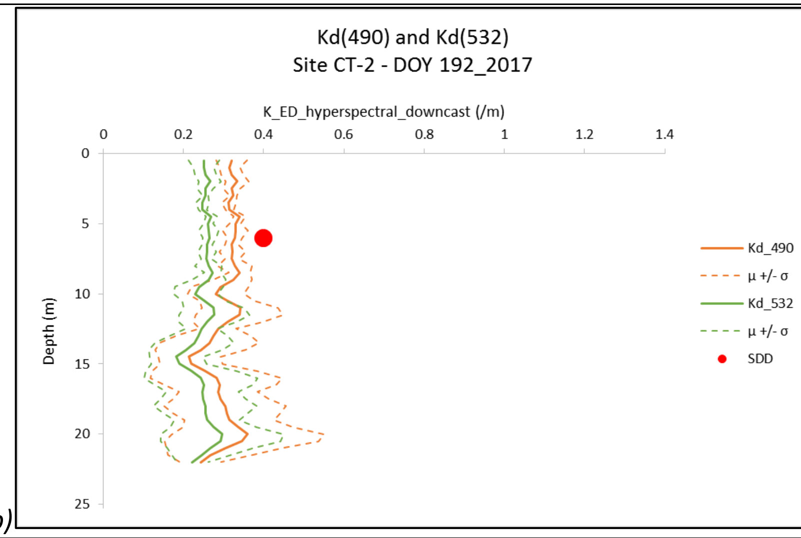


c)

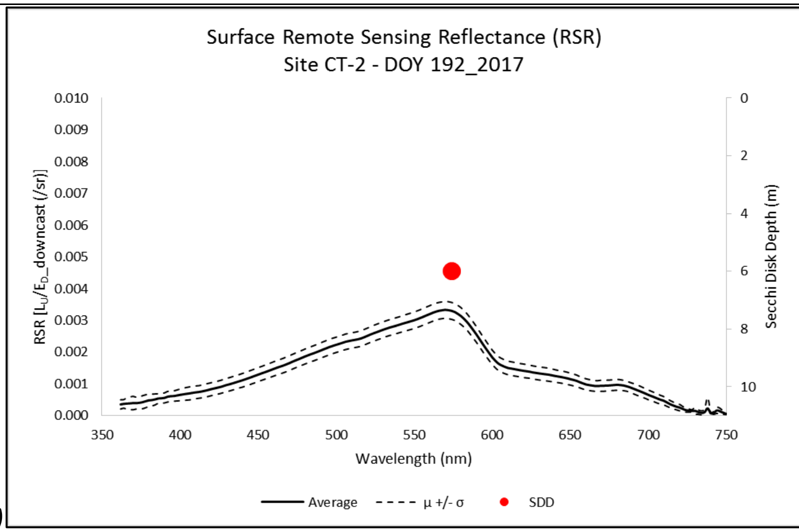
Figure APX 1.32
Northumberland Strait on July 11th 2017 (doy = 192), site CT-1.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)

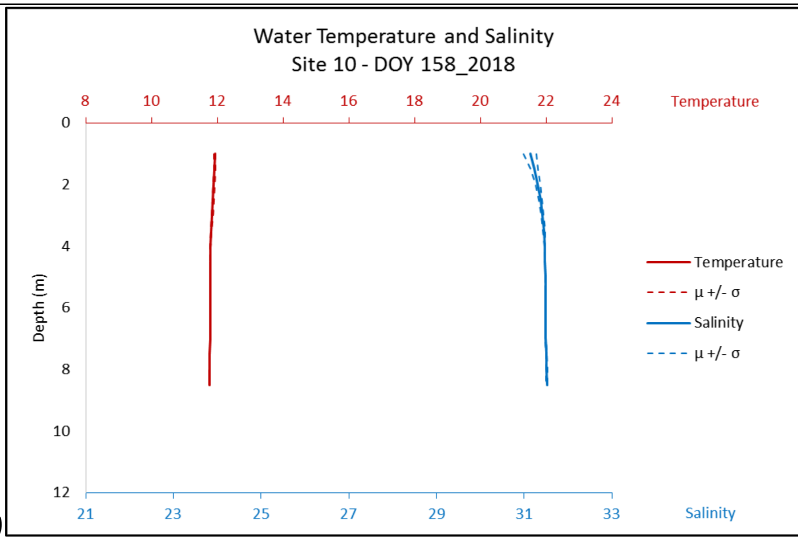


b)

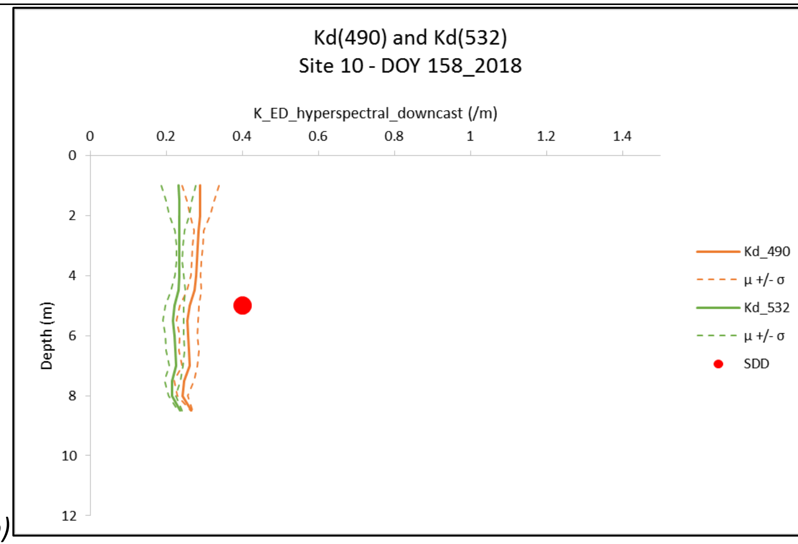


c)

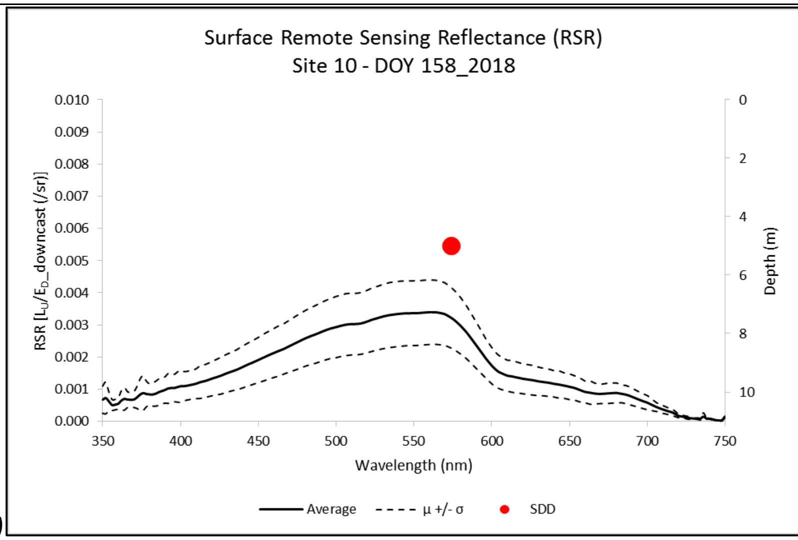
Figure APX 1.33
Northumberland Strait on July 11th 2017 (doy = 192), site CT-2.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)

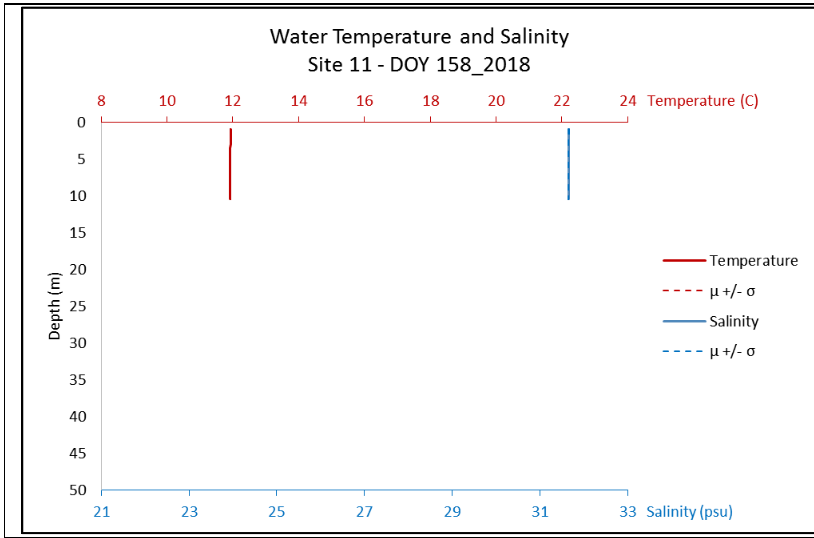


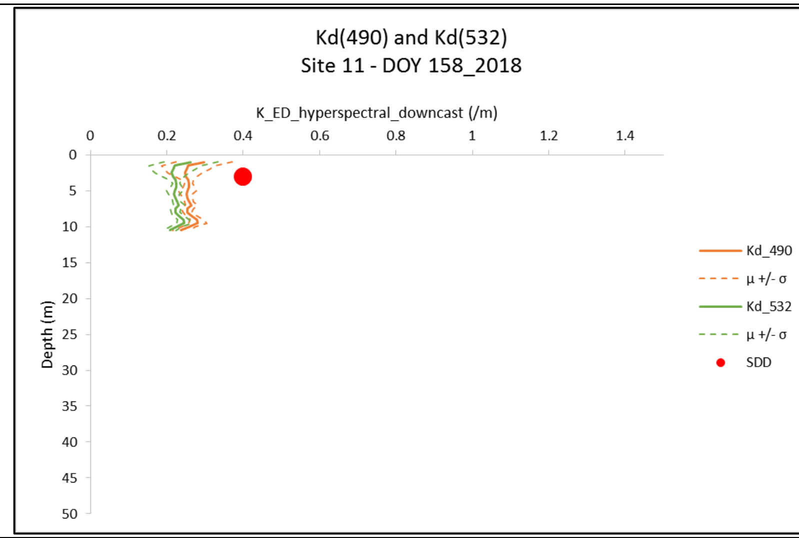
b)



c)

Figure APX 1.34
Haida Gwaii on June 7th 2018 (doy = 158), site 10.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.





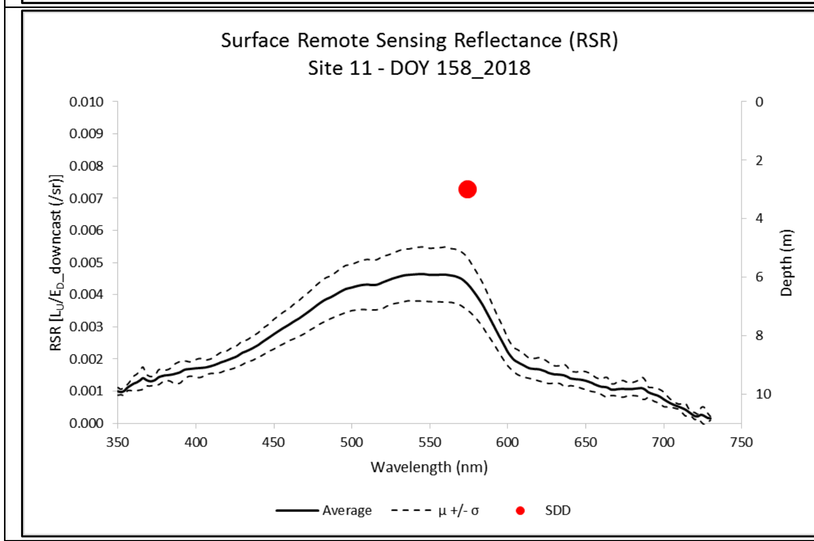
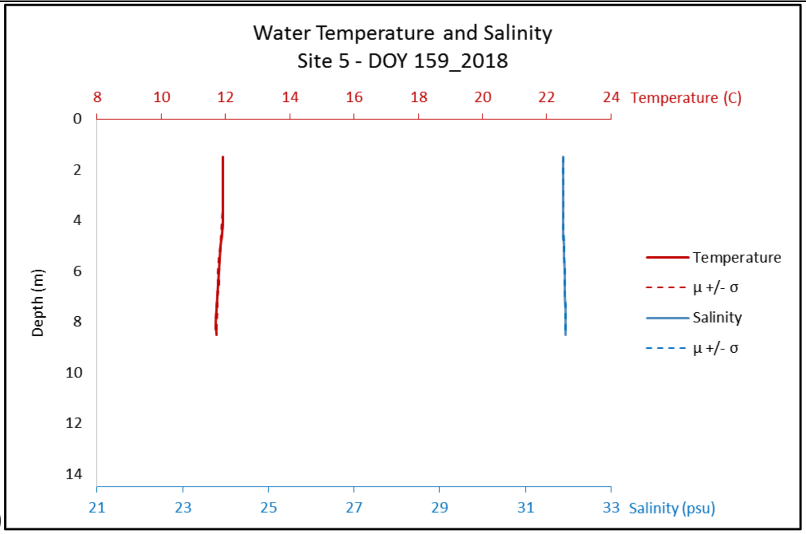
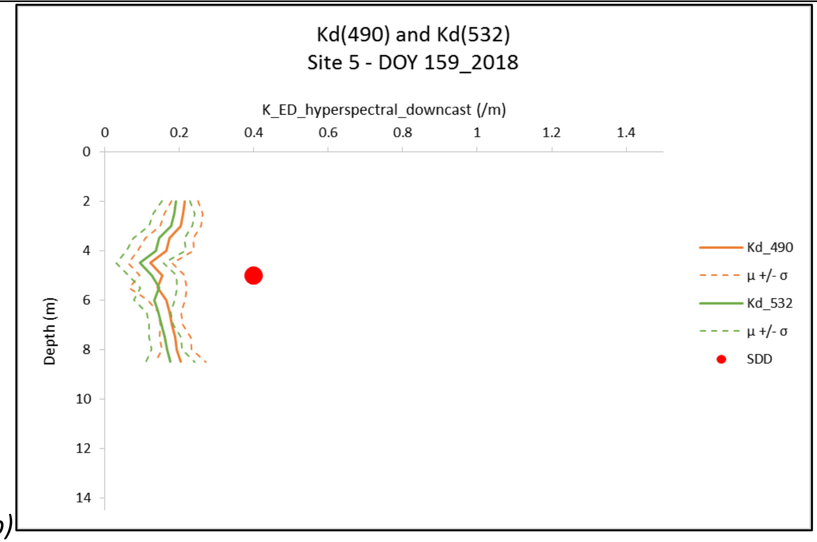


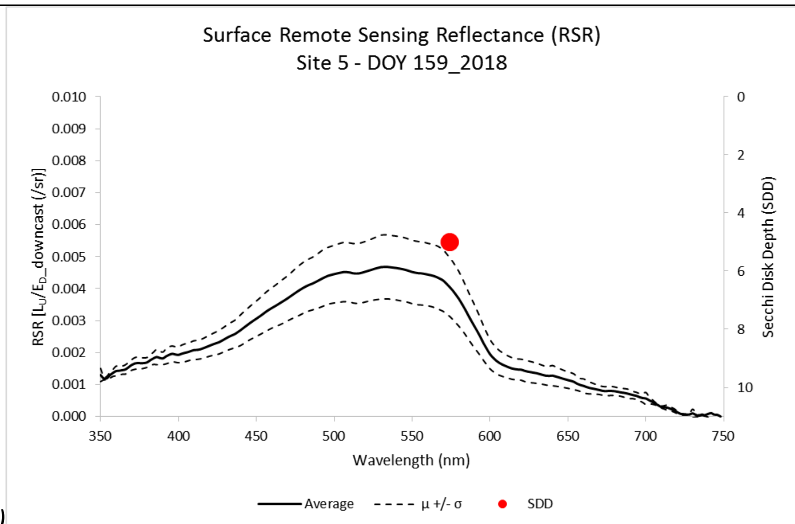
Figure APX 1.35
Haida Gwaii on June 7th 2018 (doy = 158), site 11.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)



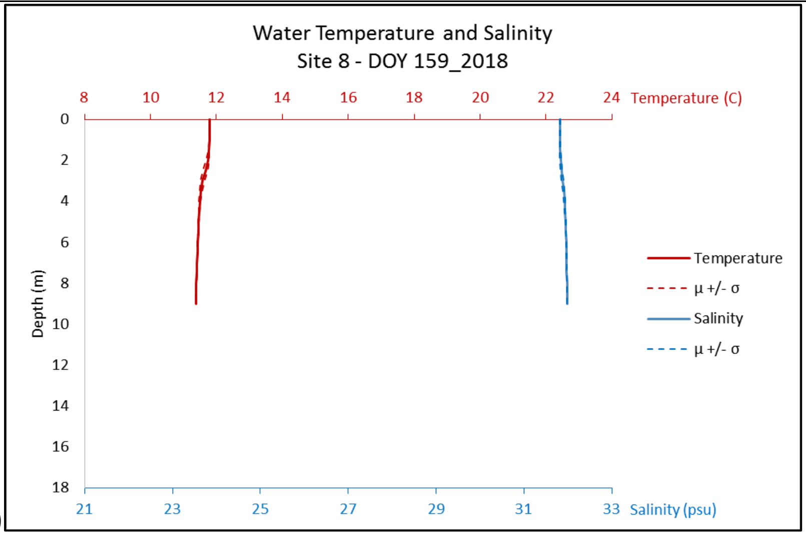
b)



c)

Figure APX 1.36
Haida Gwaii on June 8th 2018 (doy = 159), site 5.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.

a)



b)

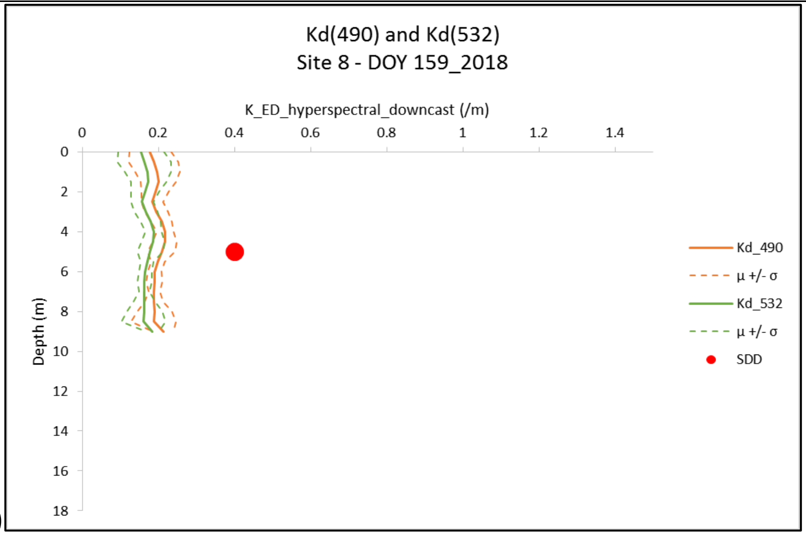
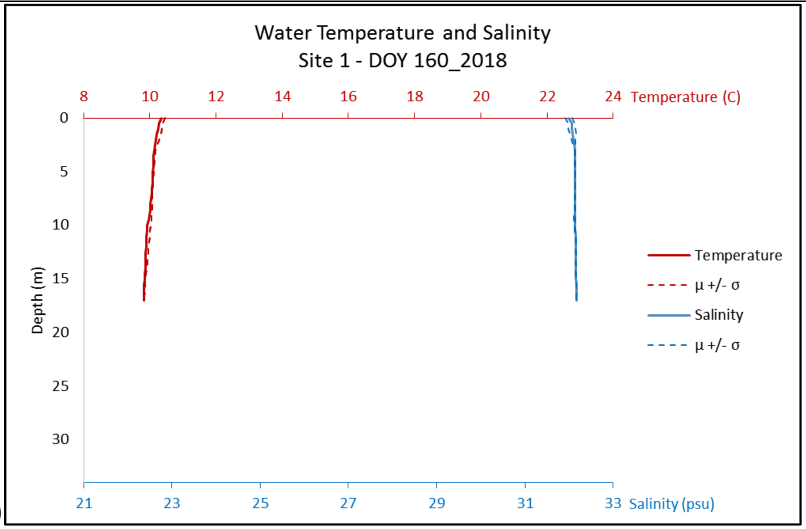
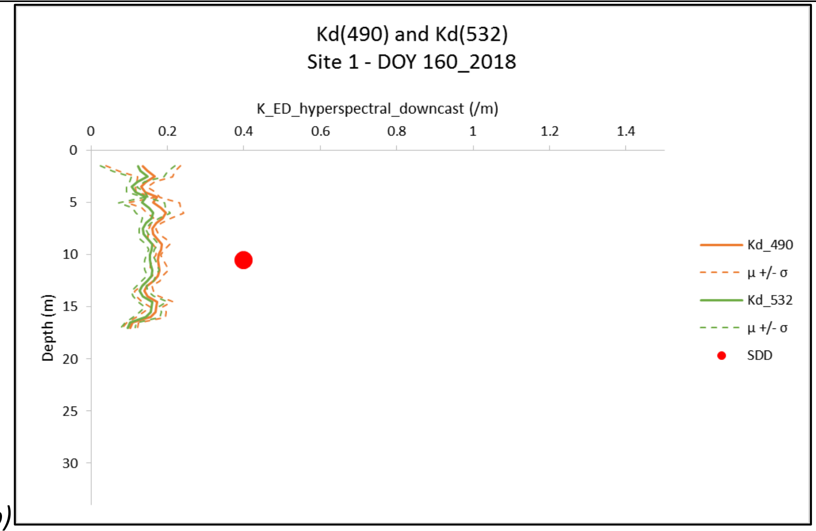


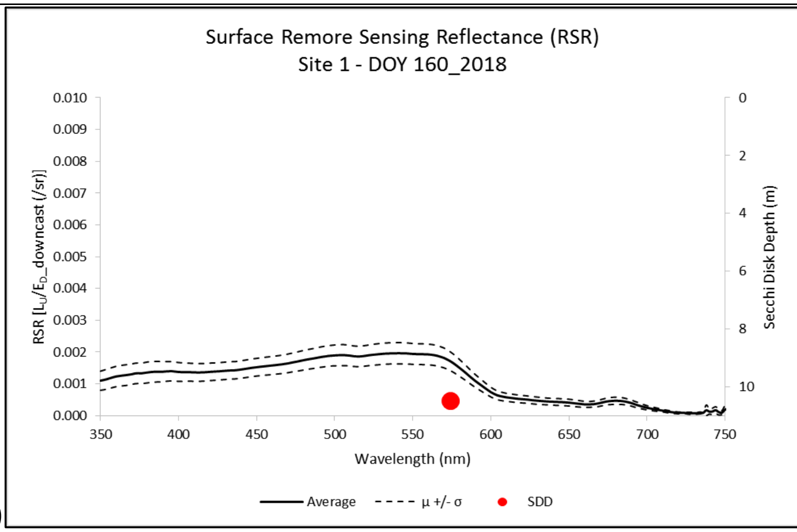
Figure APX 1.37
Haida Gwaii on June 8th 2018 (doy = 159), site 8.
a) Temperature (°C) and salinity (psu), and b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)]. Secchi Disk Depth (m) is shown as a red dot. Hatched lines are ± one standard deviation.



a)

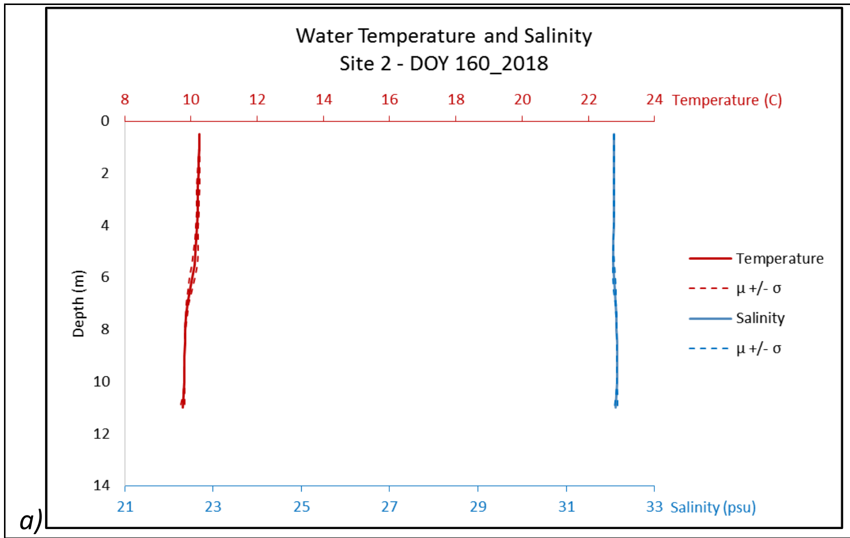


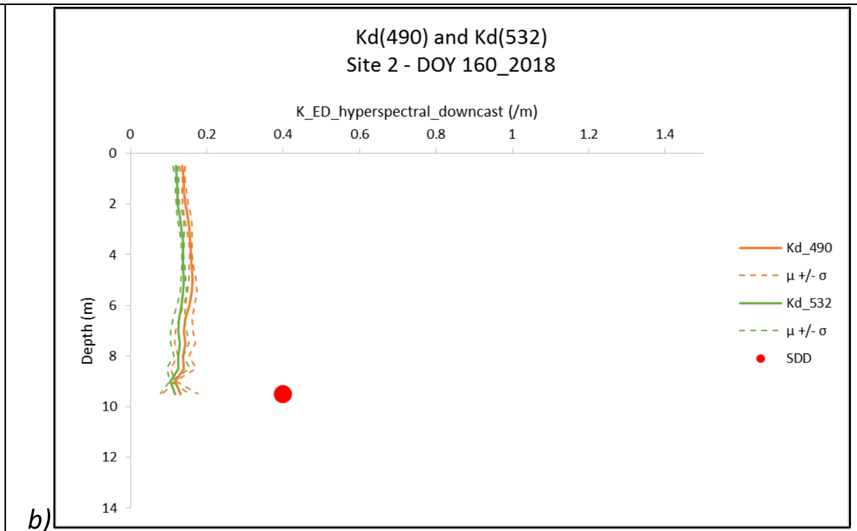
b)



c)

Figure APX 1.38
Haida Gwaii on June 9th 2018 (doy = 160), site 1.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.





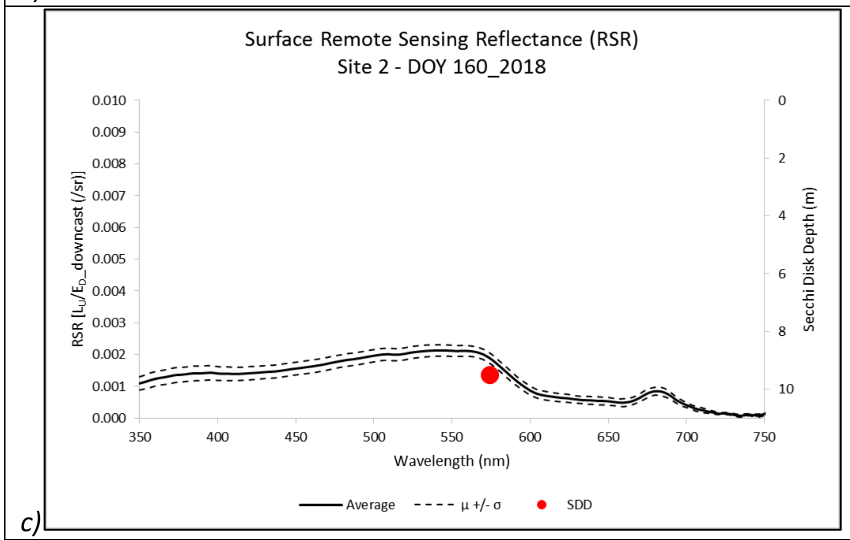
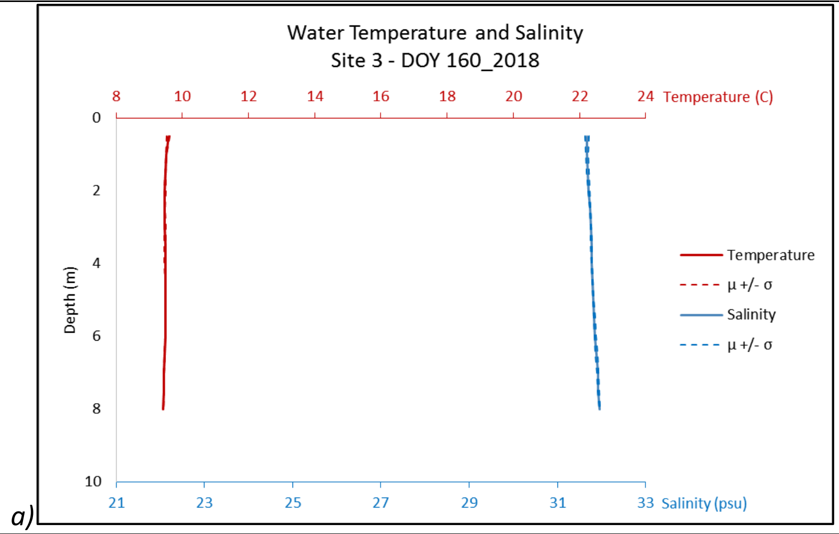
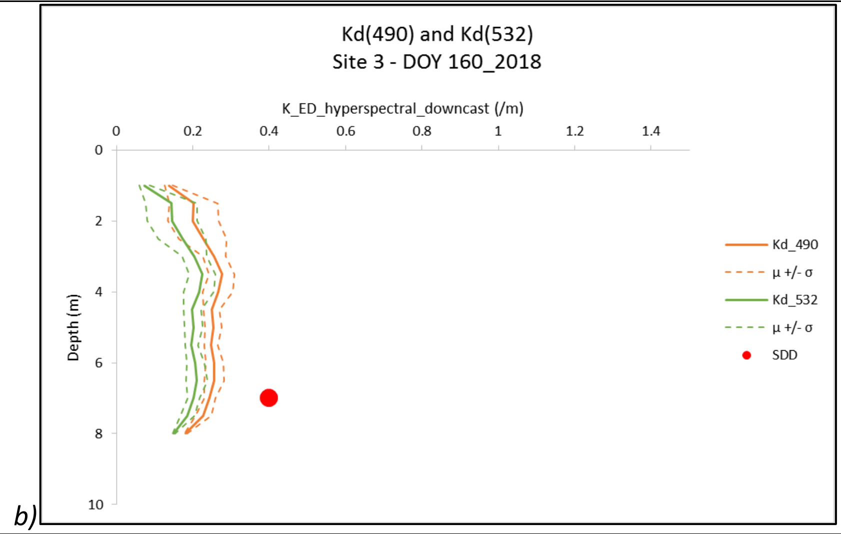


Figure APX 1.39
Haida Gwaii on June 9th 2018 (doy = 160), site 2.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.





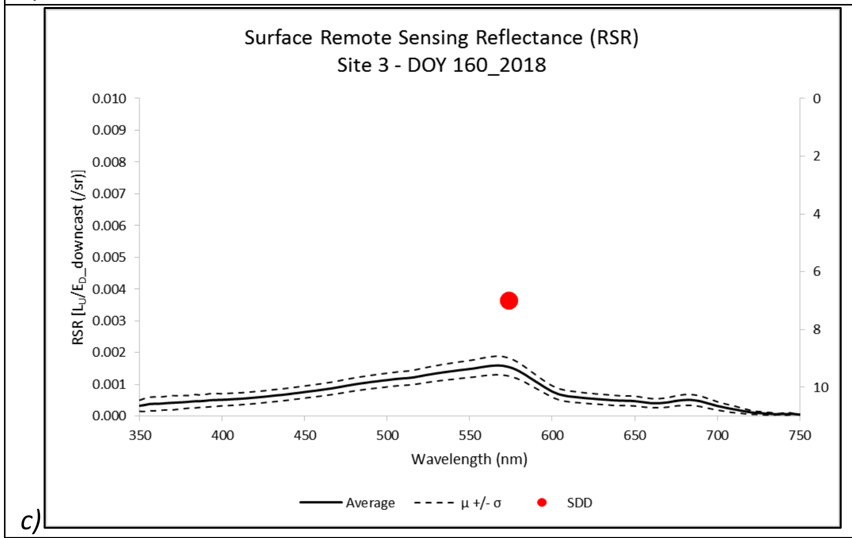


Figure APX 1.40
Haida Gwaii on June 9th 2018 (doy = 160), site 3.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.

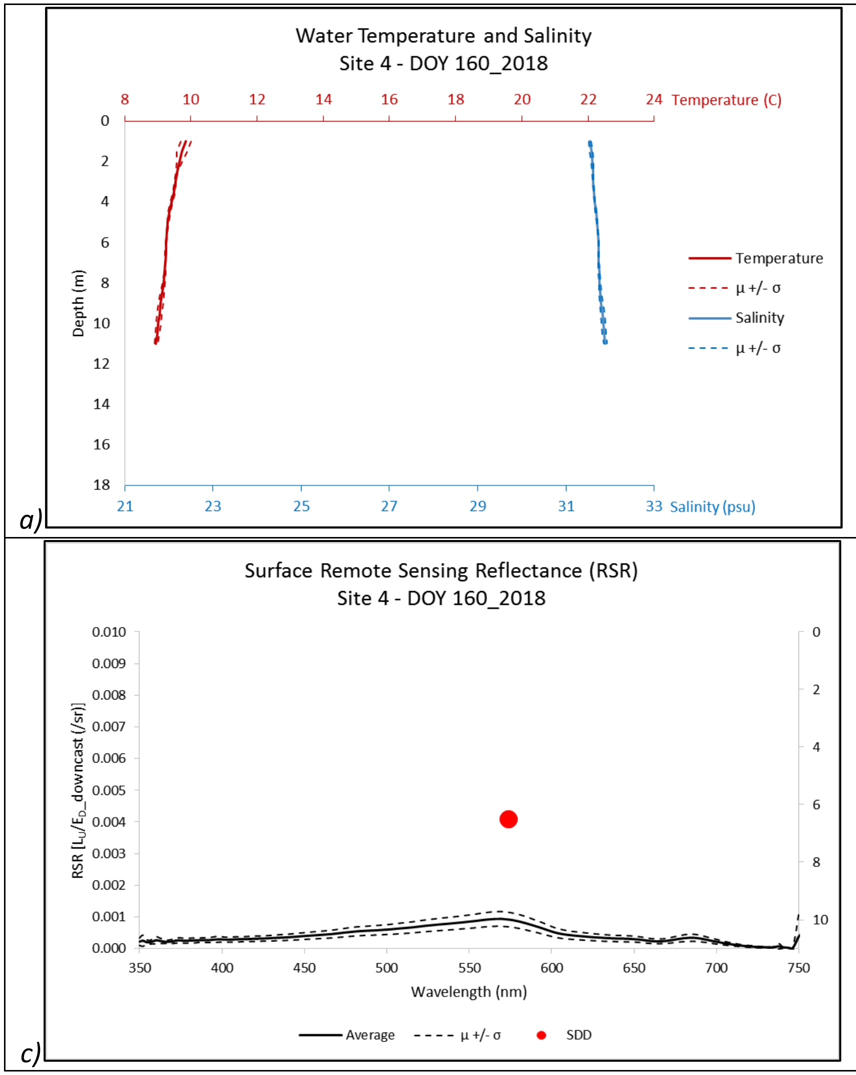
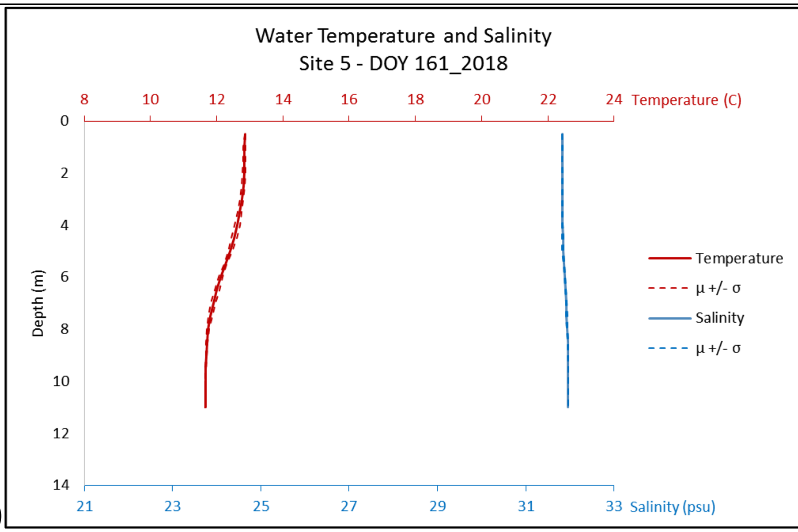
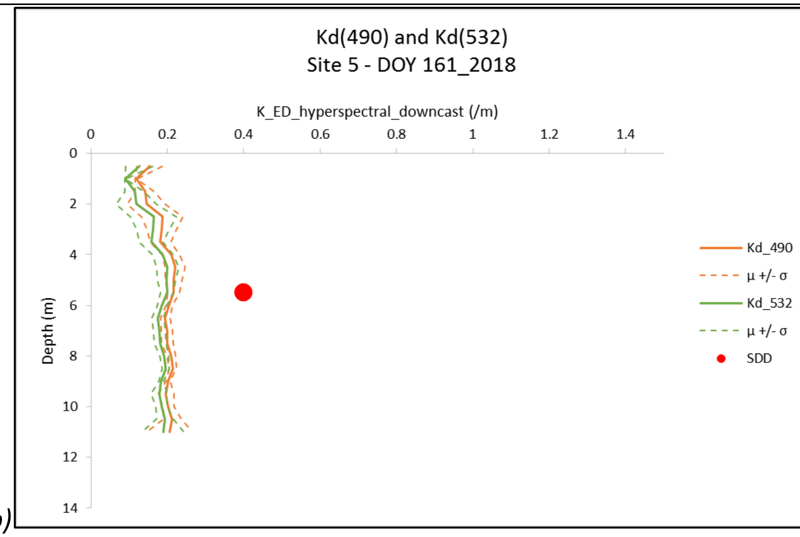


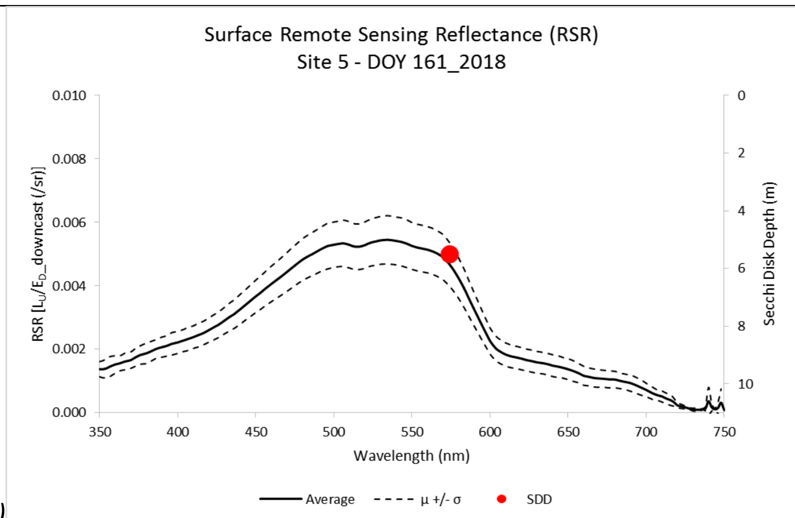
Figure APX 1.41
Haida Gwaii on June 9th 2018 (doy = 160), site 4.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)

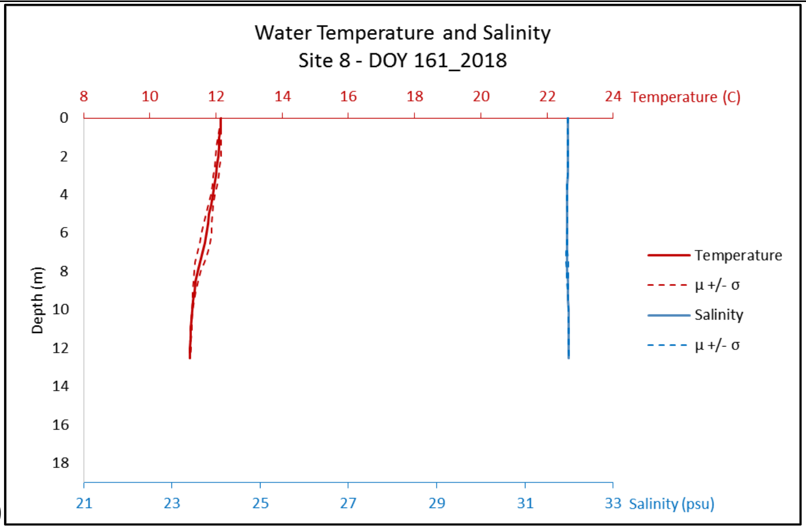


b)

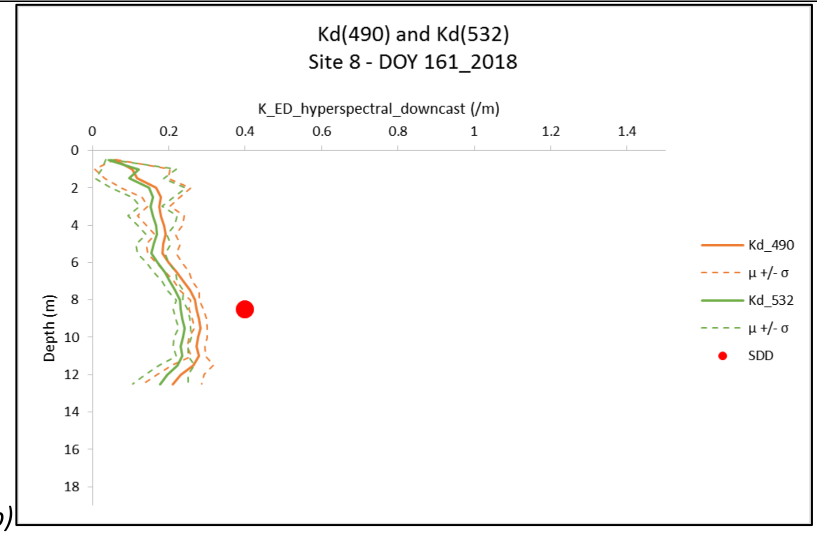


c)

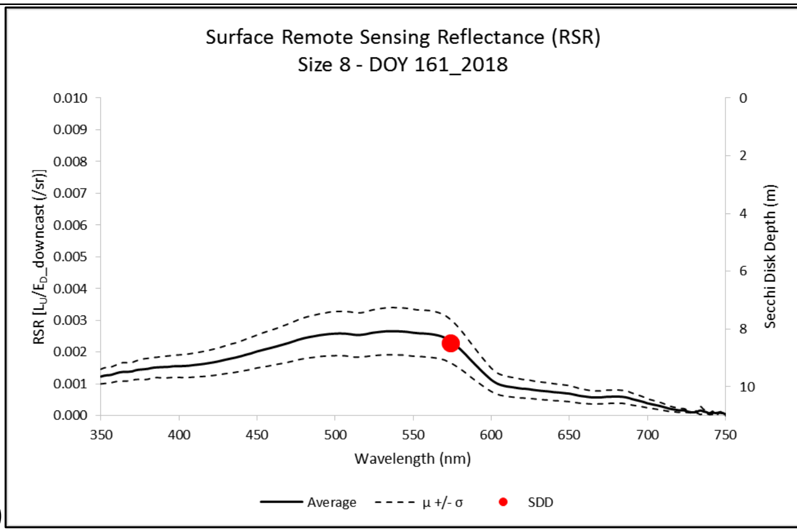
Figure APX 1.42
Haida Gwaii on June 10th 2018 (doy = 161), site 5.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)

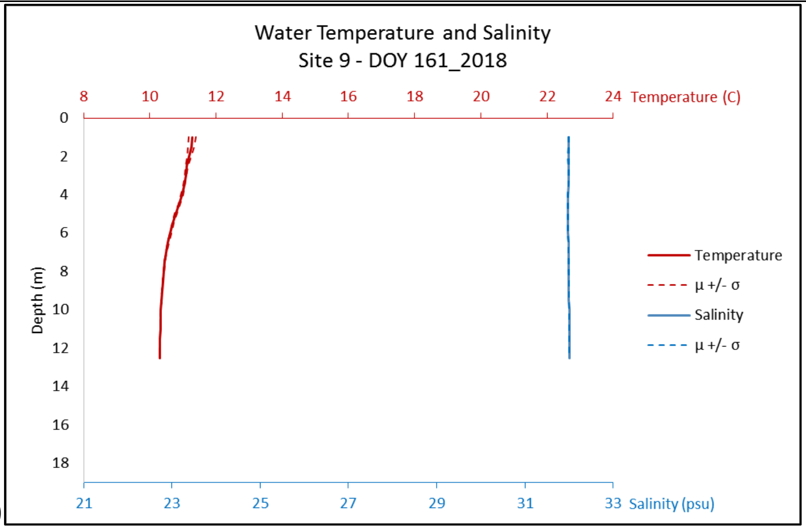


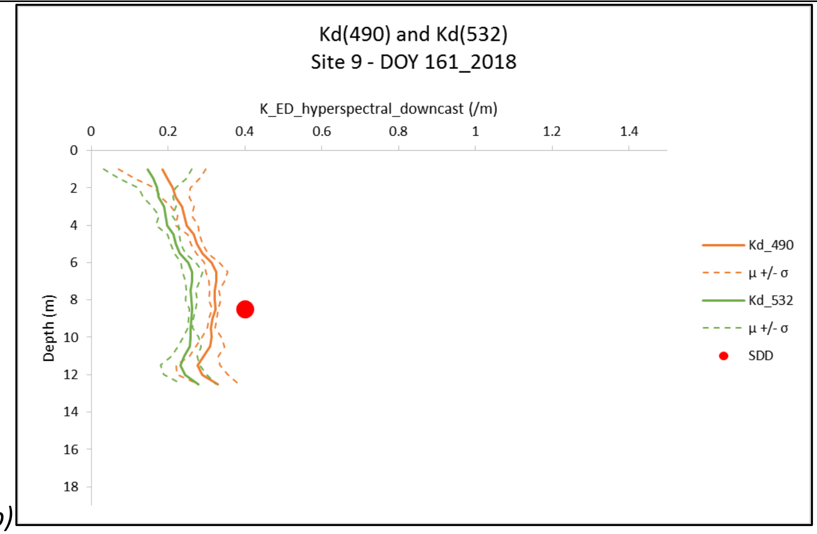
b)



c)

Figure APX 1.43
Haida Gwaii on June 10th 2018 (doy = 161), site 8.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.

a)


b)


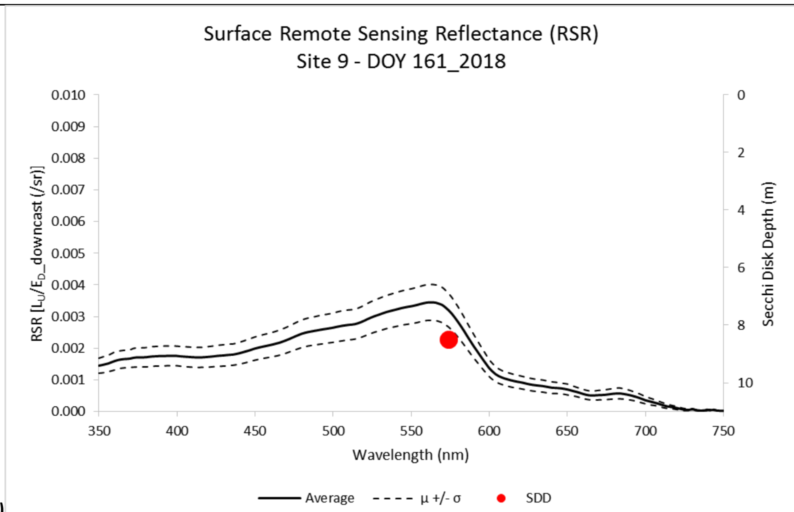
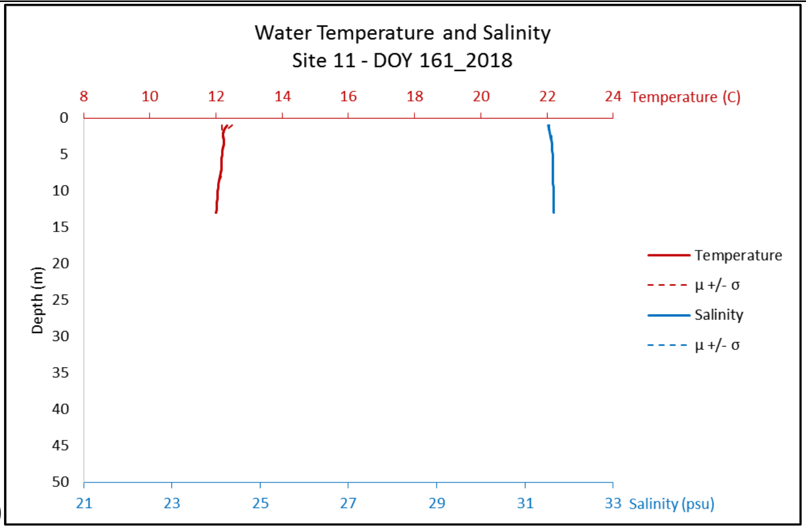
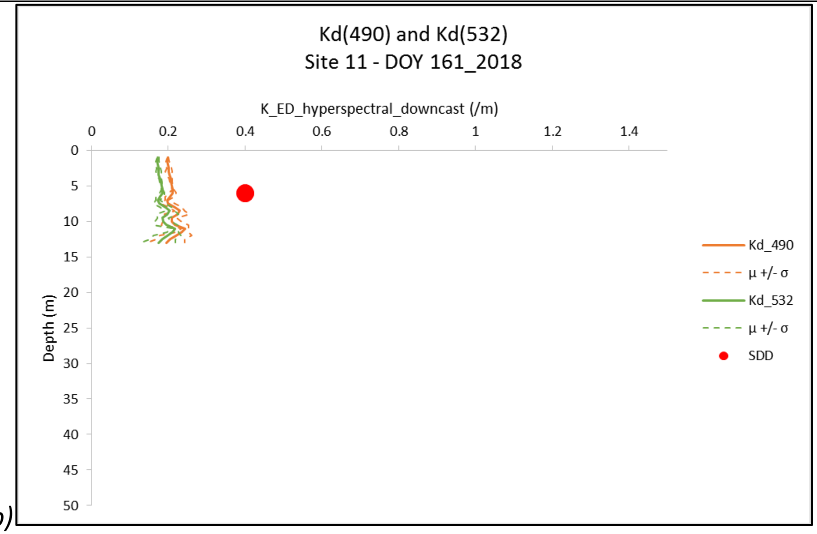
c)


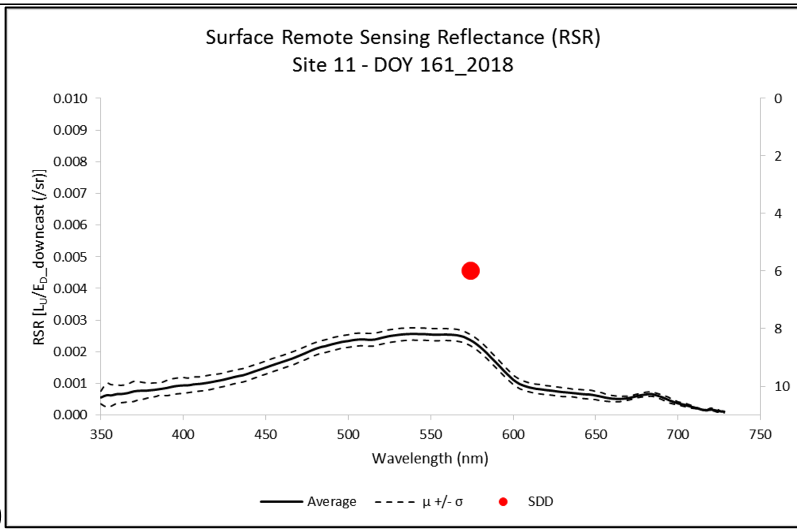
Figure APX 1.44
Haida Gwaii on June 10th 2018 (doy = 161), site 9.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.



a)

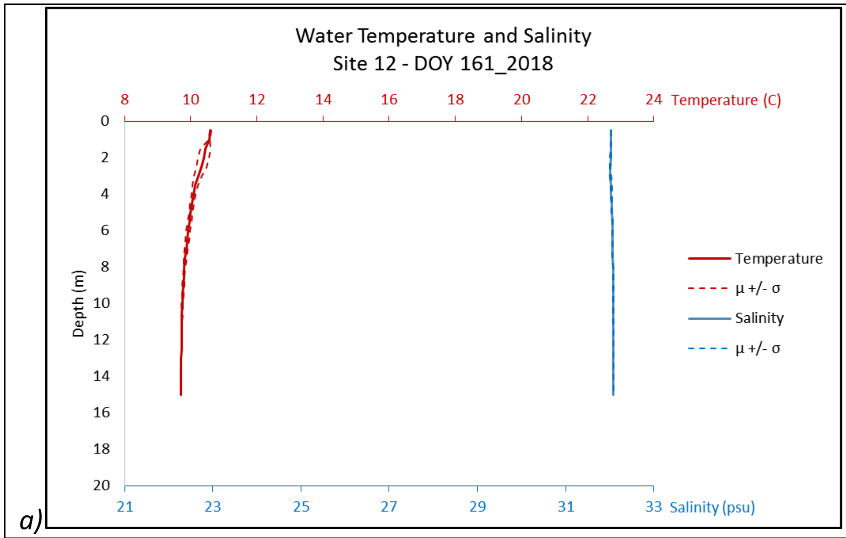


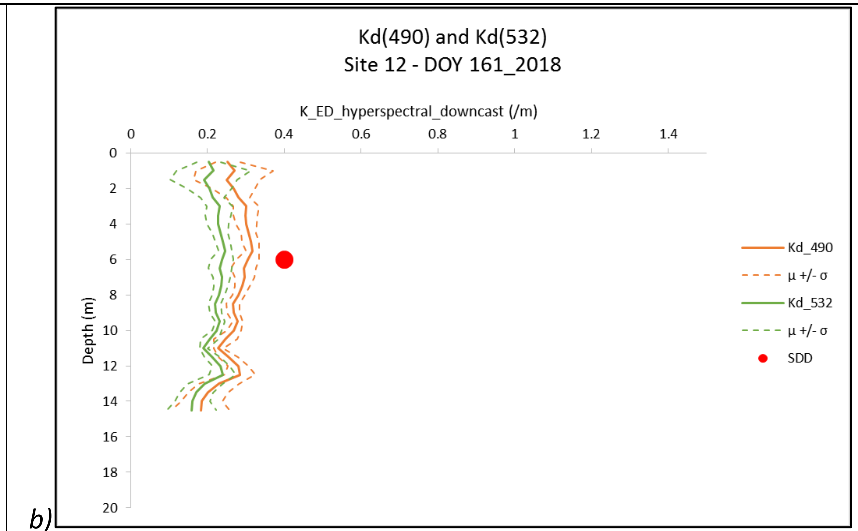
b)



c)

Figure APX 1.45
Haida Gwaii on June 10th 2018 (doy = 161), site 11.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.





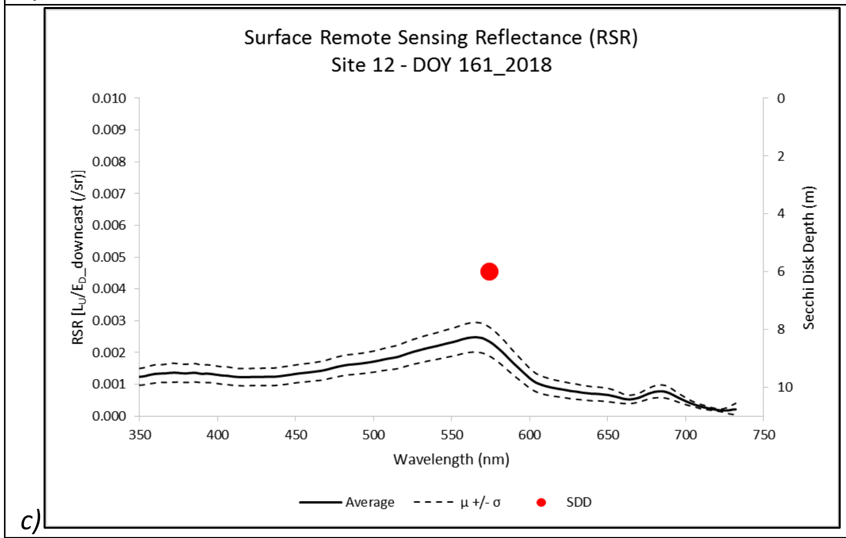
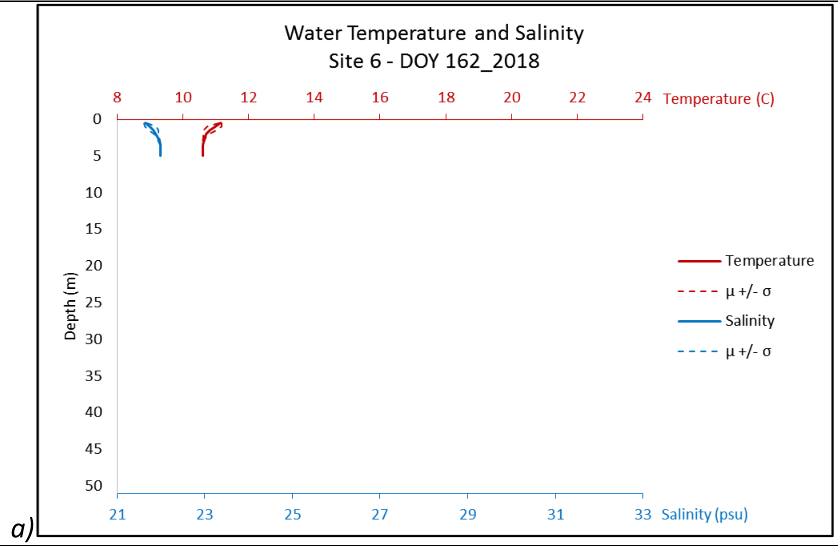
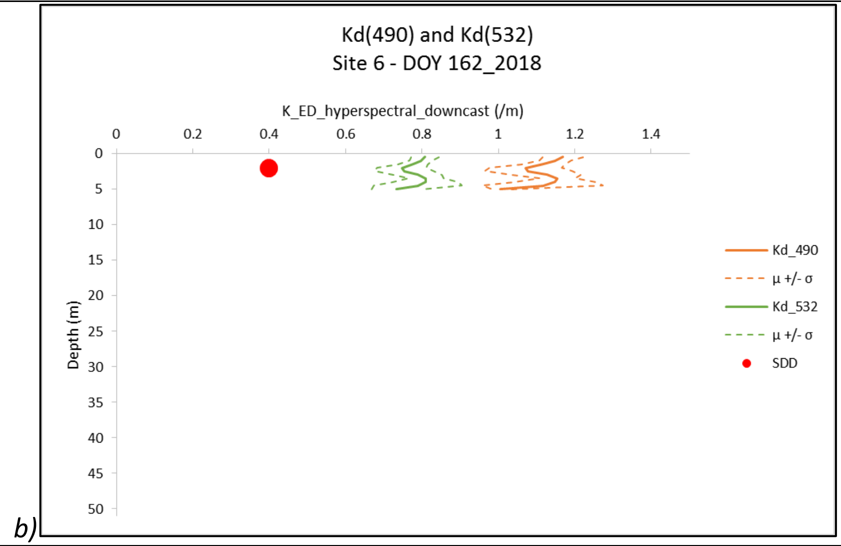


Figure APX 1.46
Haida Gwaii on June 10^{th} 2018 (doy = 161), site 12.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.





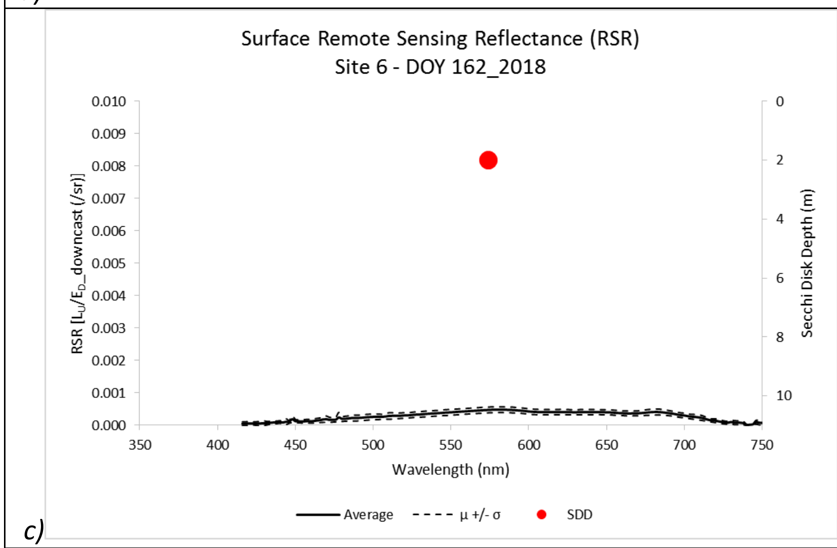
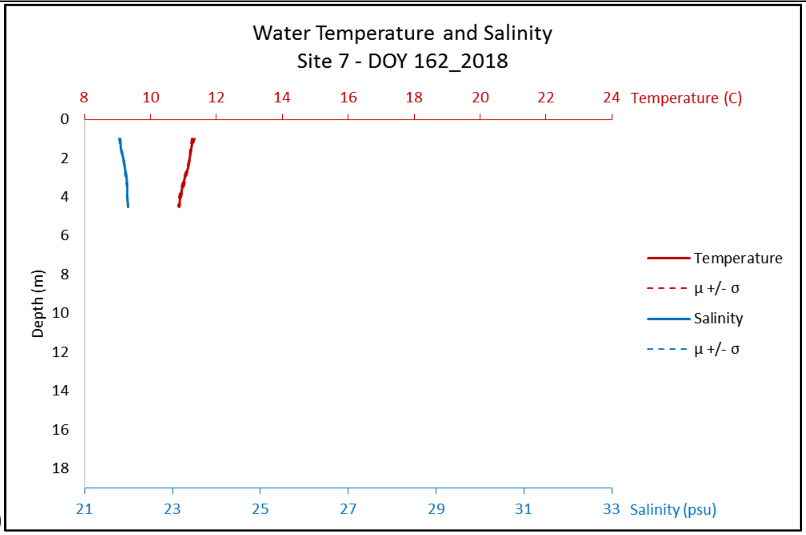
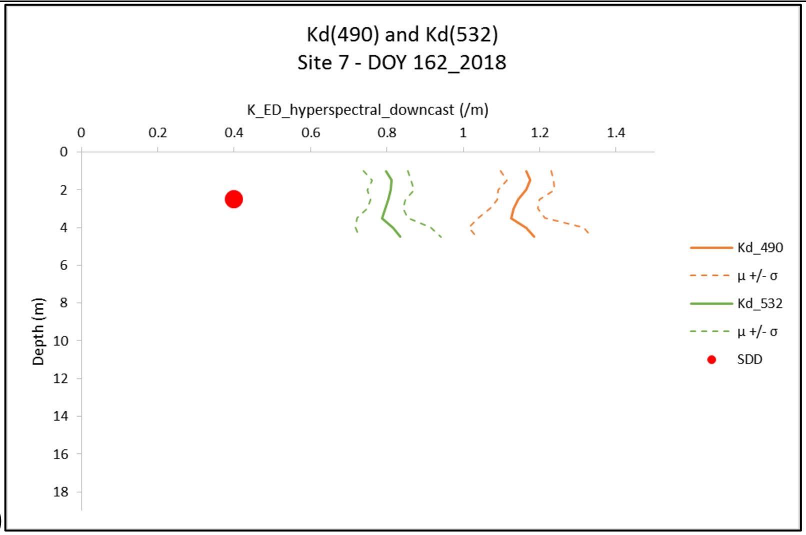


Figure APX 1.47
Haida Gwaii on June 11th 2018 (doy = 162), site 6.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.

a)


b)


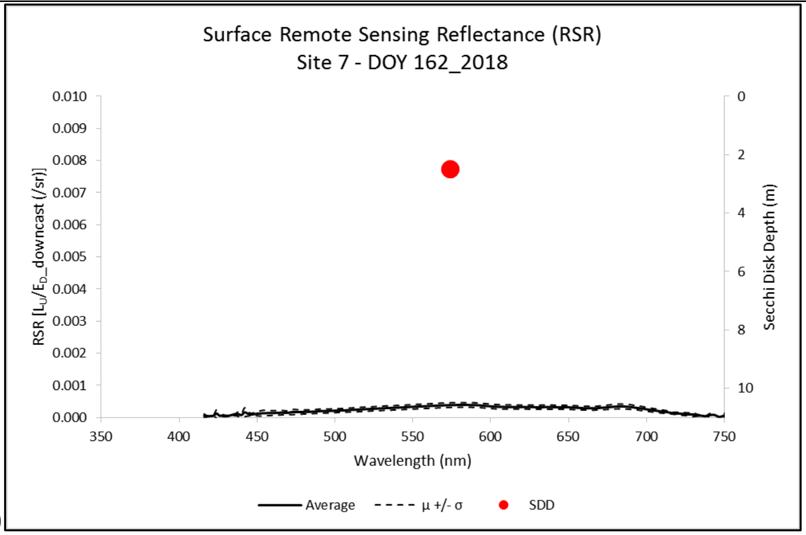
c)


Figure APX 1.48
Haida Gwaii on June 11th 2018 (doy = 162), site 7.
a) Temperature (°C) and salinity (psu), .
b) Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm and 532 nm [Kd_490 and Kd_532 (/m)], and
c) Surface Remote Sensing Reflectance [Rrs (/sr)].
Secchi Disk Depth (m) is shown as a red dot on b) and c).
Hatched lines are ± one standard deviation.

APPENDIX 2

Daily composites corresponding to days with enough available information for the study area.

i) December 26th (doy = 360) 2015
ii) 2016
iii) 2017
iv) April until July 2018,

The images are for the following variables: Water Transparency (Secchi Disk Depth, meters), Chlorophyll a (Chl_a, mg m^3), Total Suspended Matter (TSM, g m^3), Sea Surface Temperature (° C), Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm (Kd490, 1/m), and Kd at 532 nanometers (Kd532, 1/m).

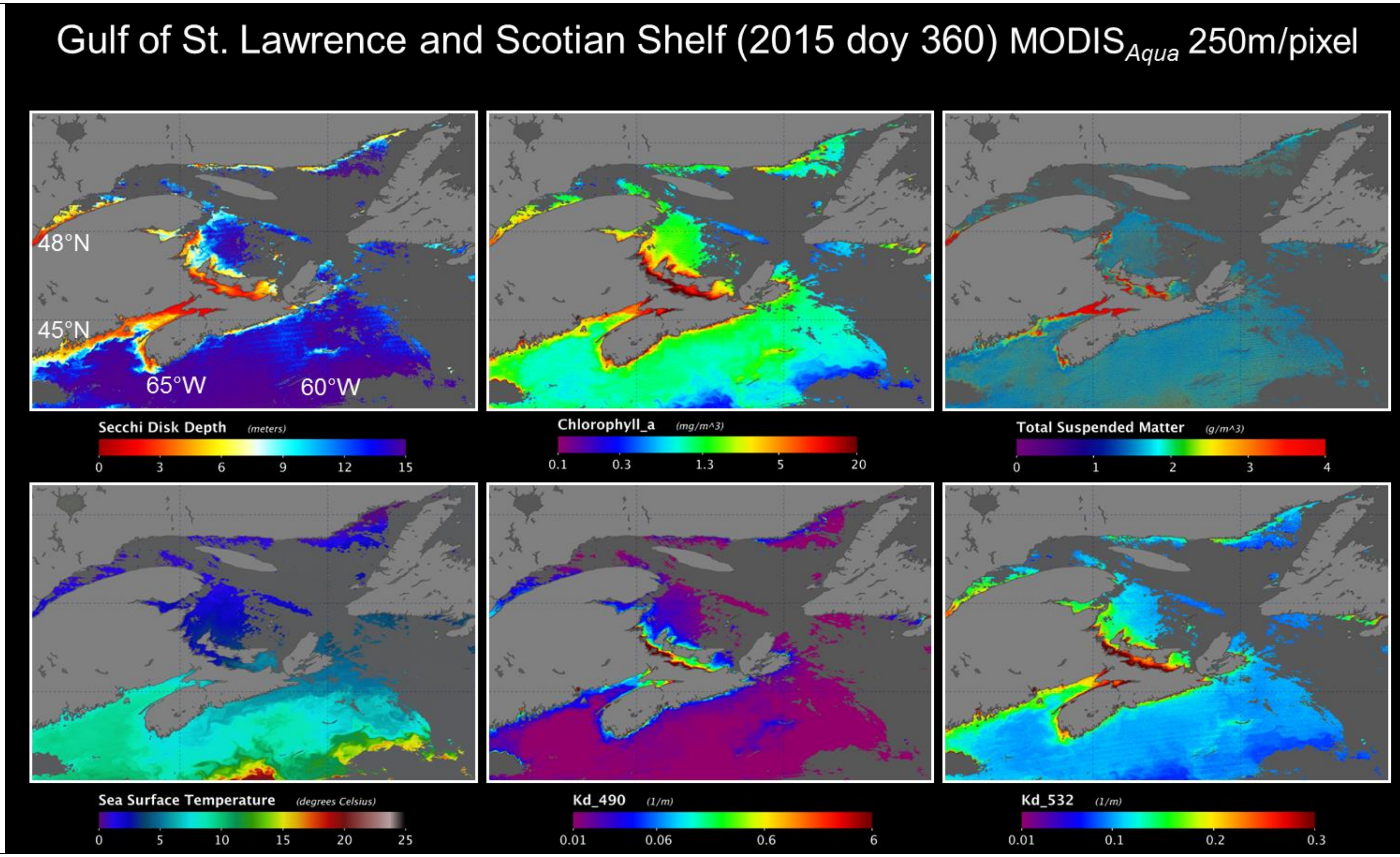


Figure APX 2.1. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on December 26th 2015 (doy = 360). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

2016

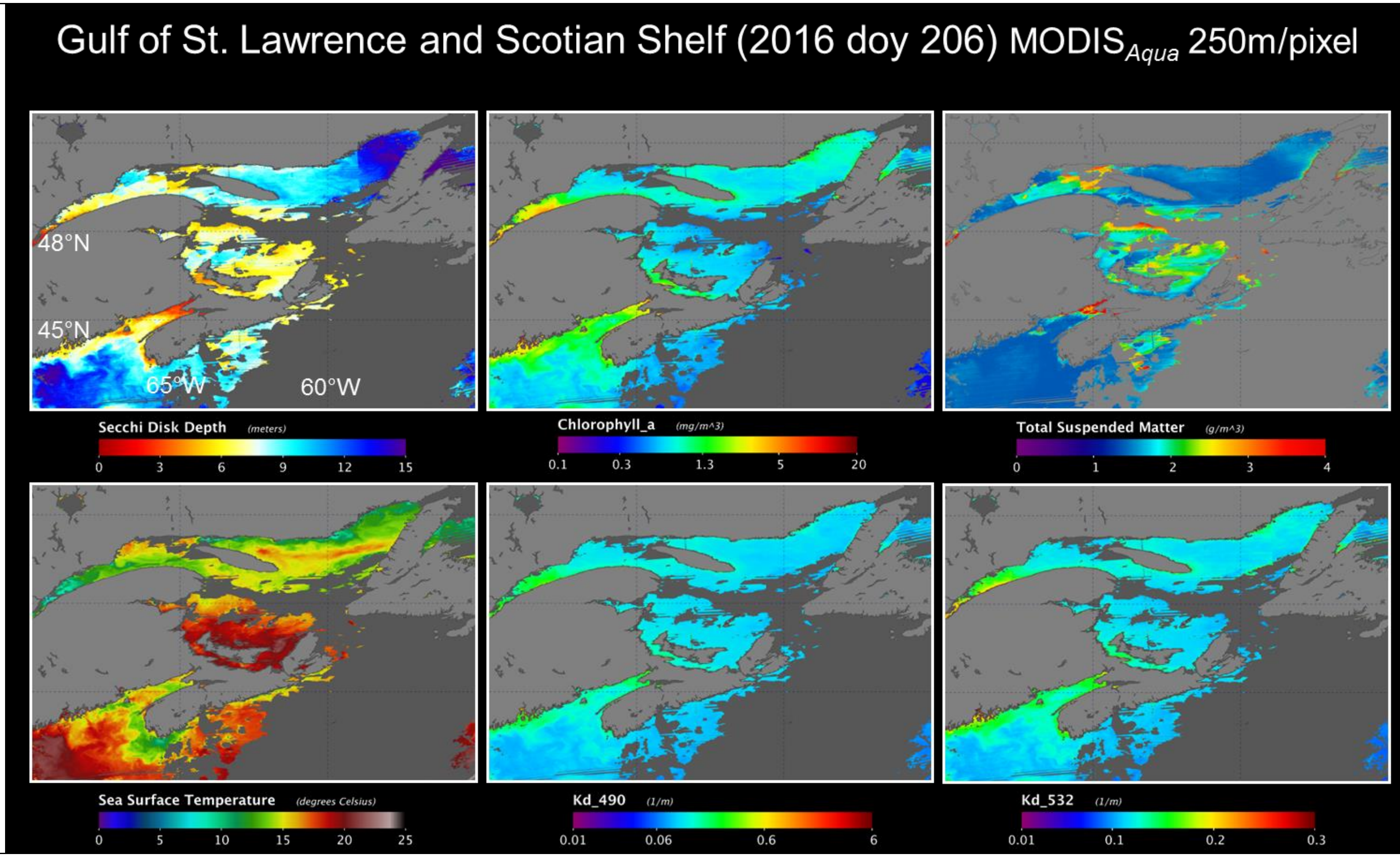


Figure APX 2.2. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on July 24th 2016 (doy = 206). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

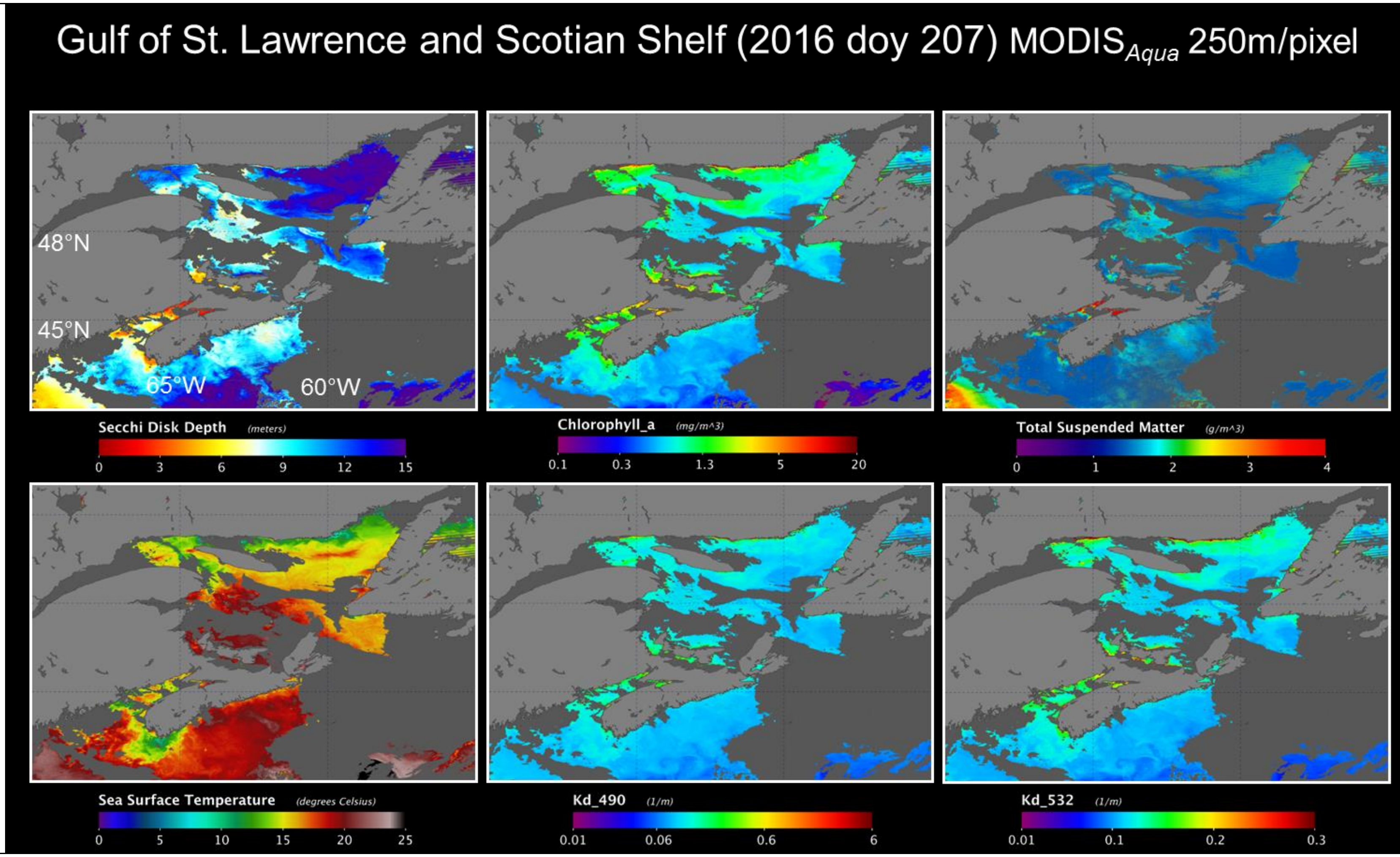


Figure APX 2.3. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on July 25th 2016 (doy = 207). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

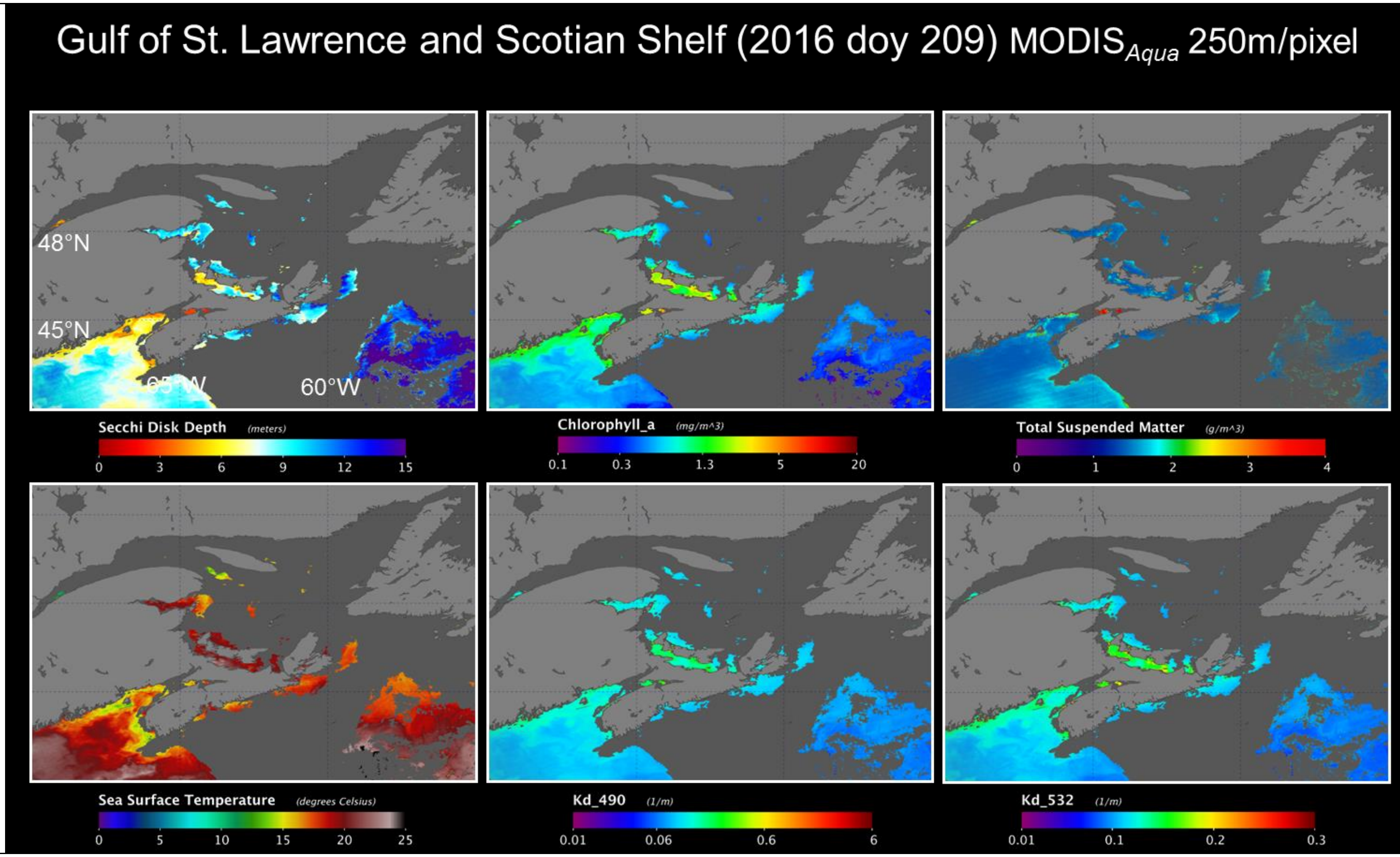


Figure APX 2.4. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on July 27th 2016 (doy = 209). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

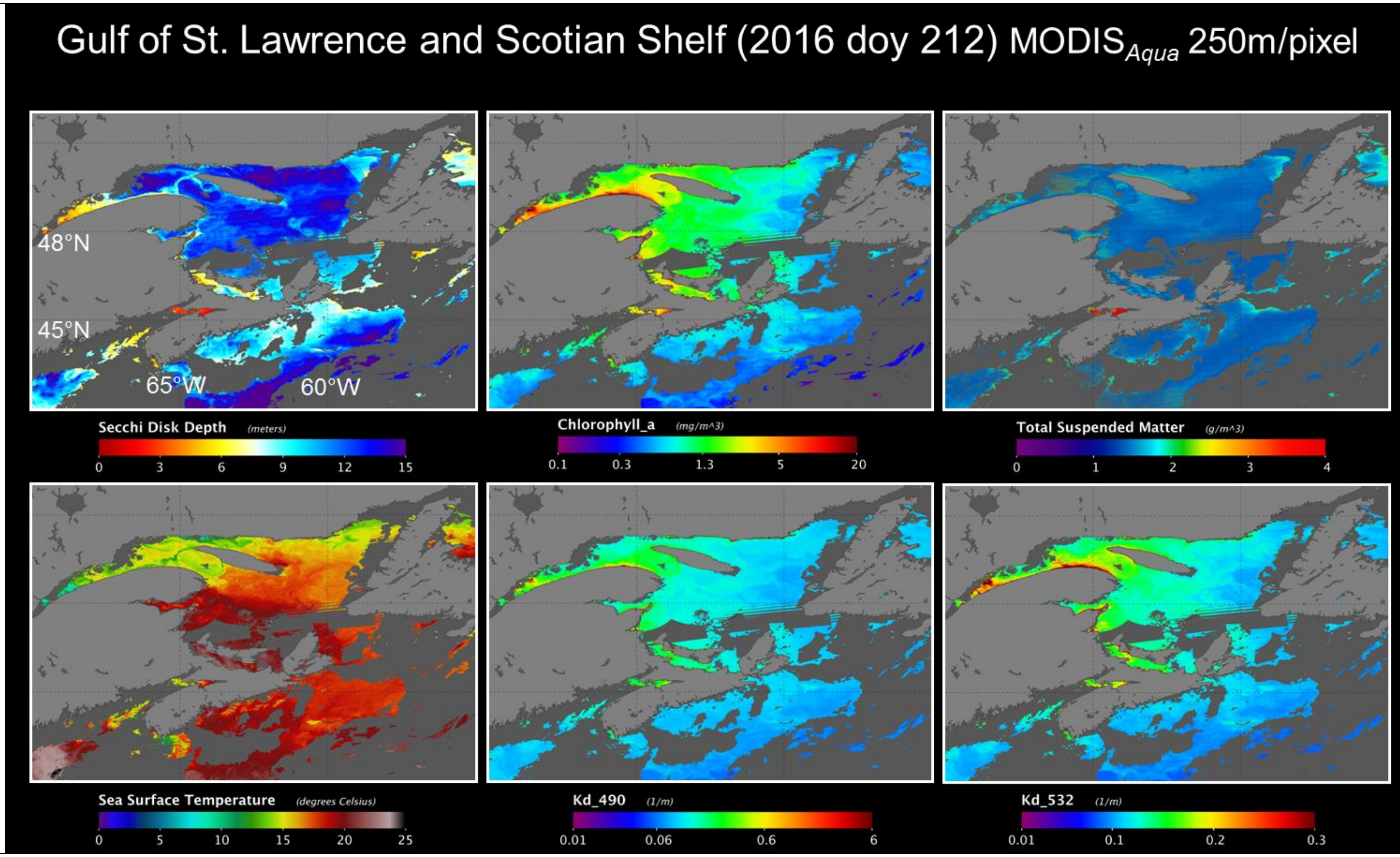


Figure APX 2.5. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on July 30th 2016 (doy = 212). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

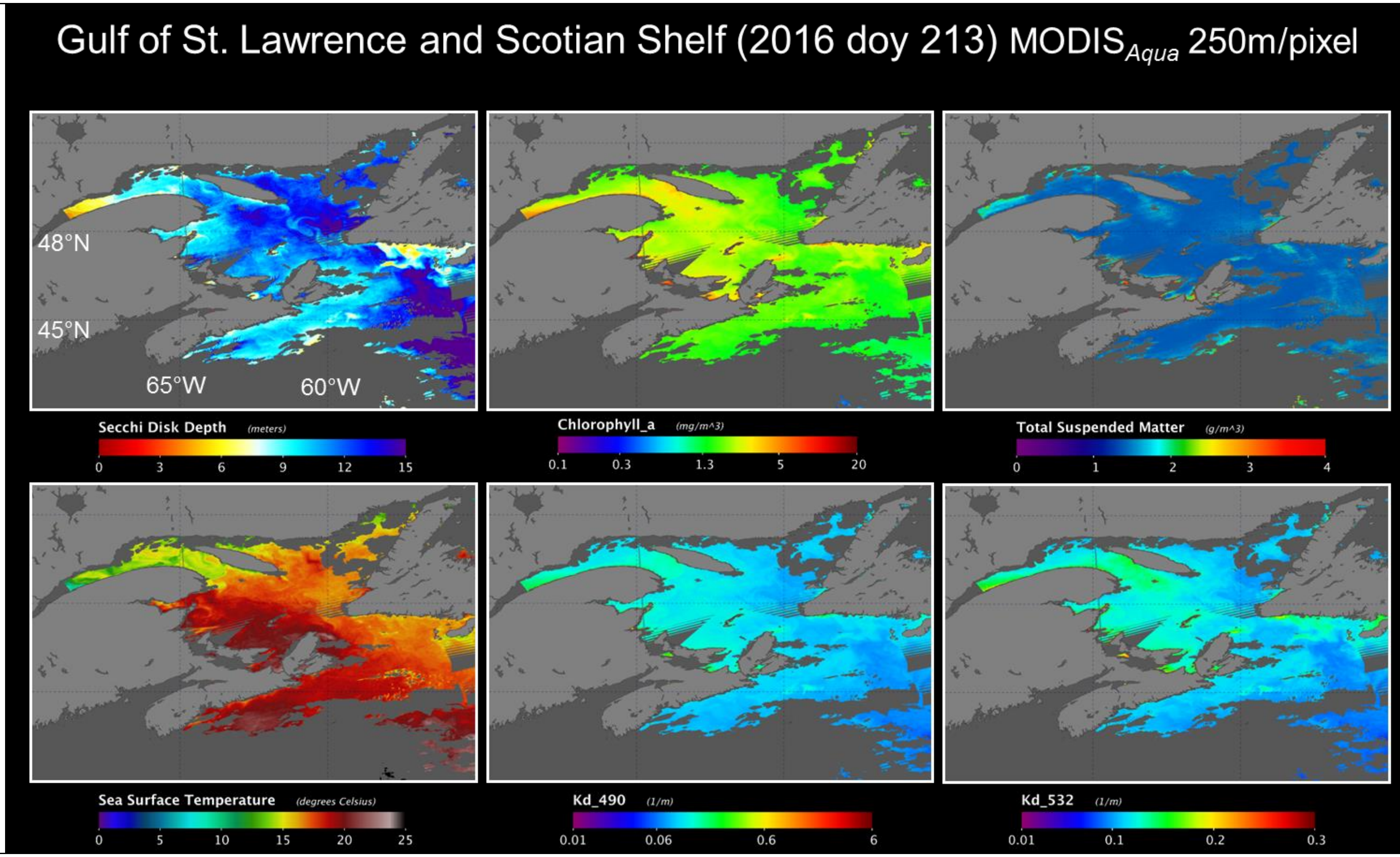


Figure APX 2.6. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on July 31st 2016 (doy = 213). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

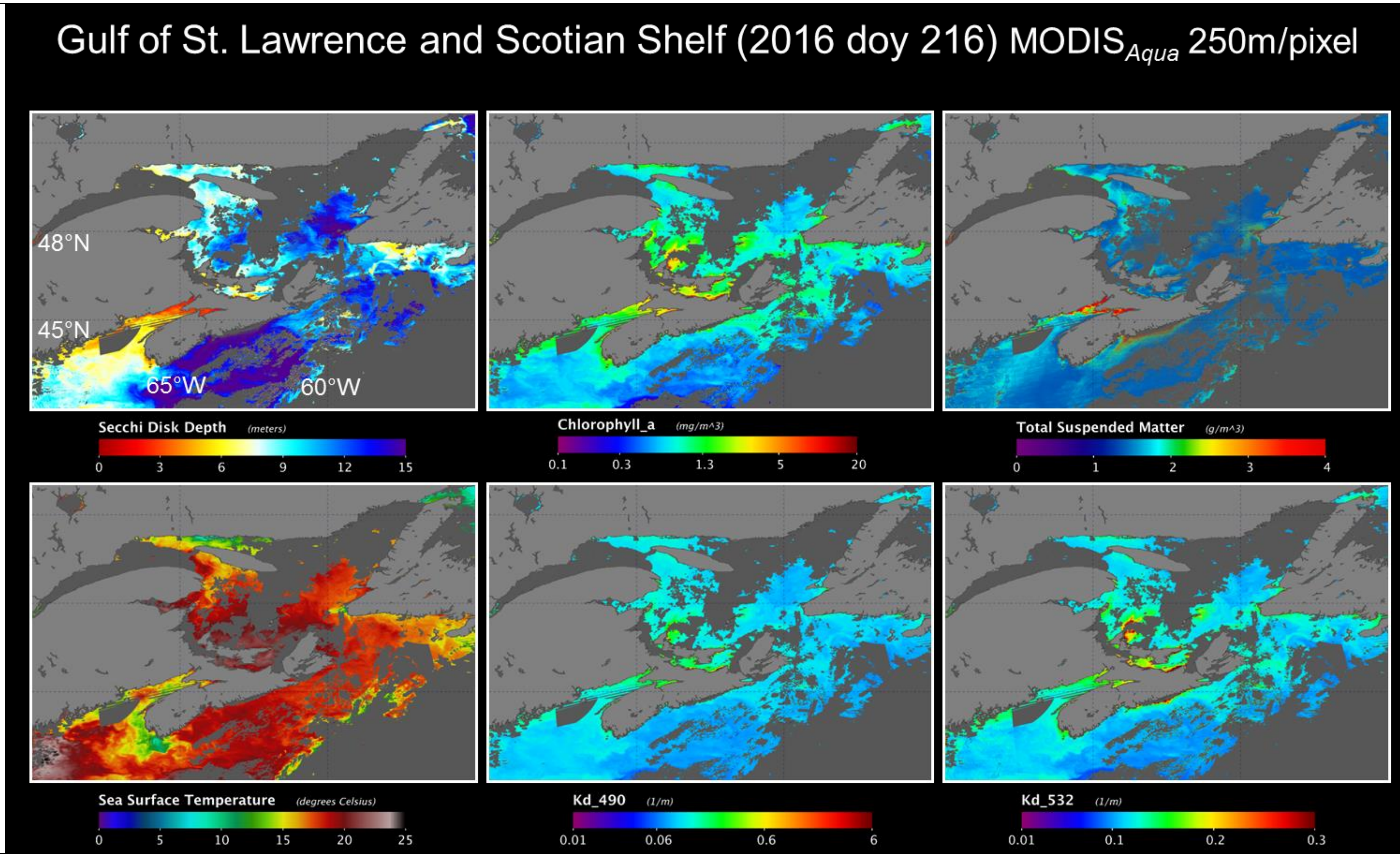


Figure APX 2.7. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on August 3rd 2016 (doy = 216). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

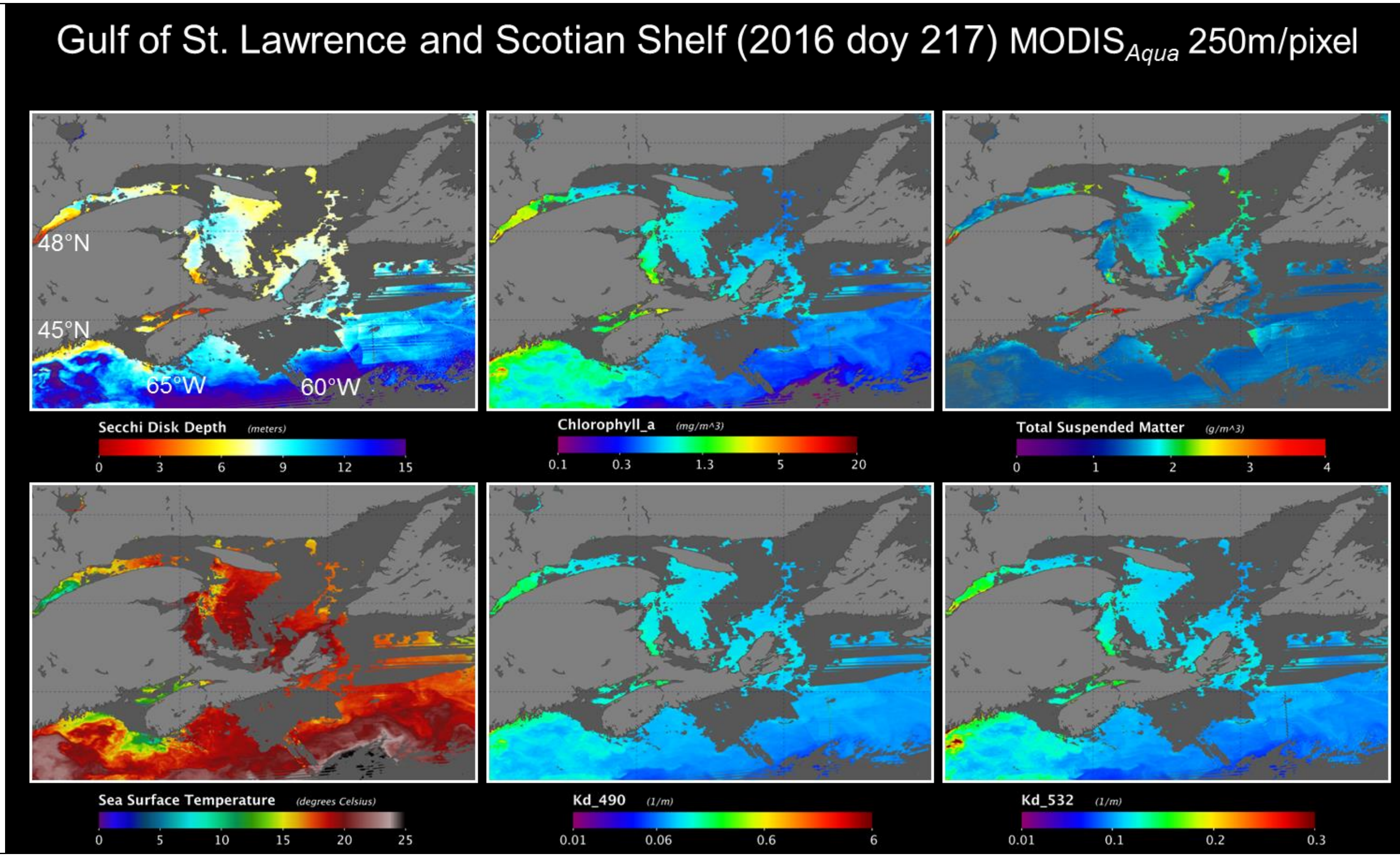


Figure APX 2.8. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on August 4th 2016 (doy = 217). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

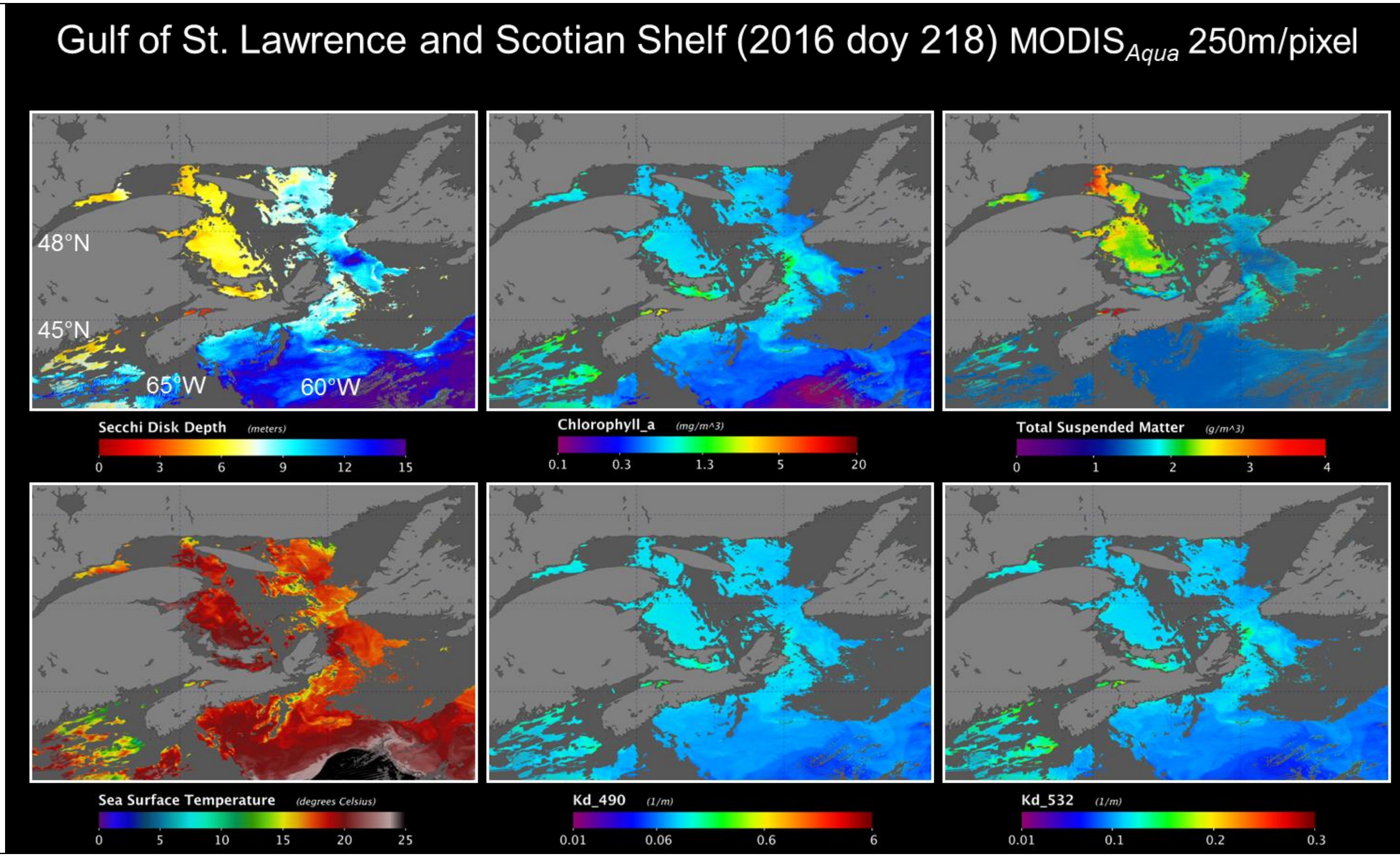


Figure APX 2.9. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on August 5th 2016 (doy = 218). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

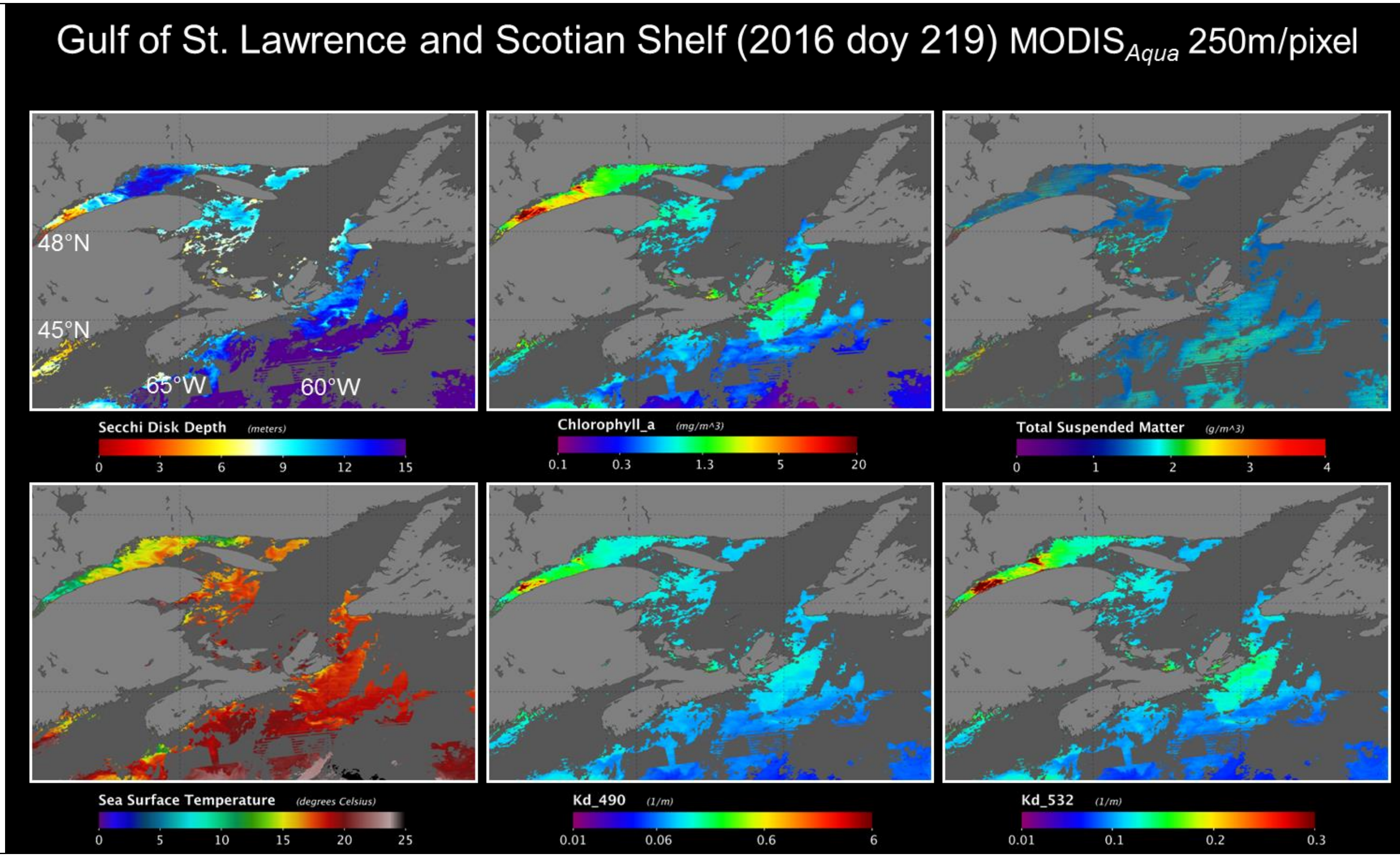


Figure APX 2.10. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on August 6th 2016 (doy = 219). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

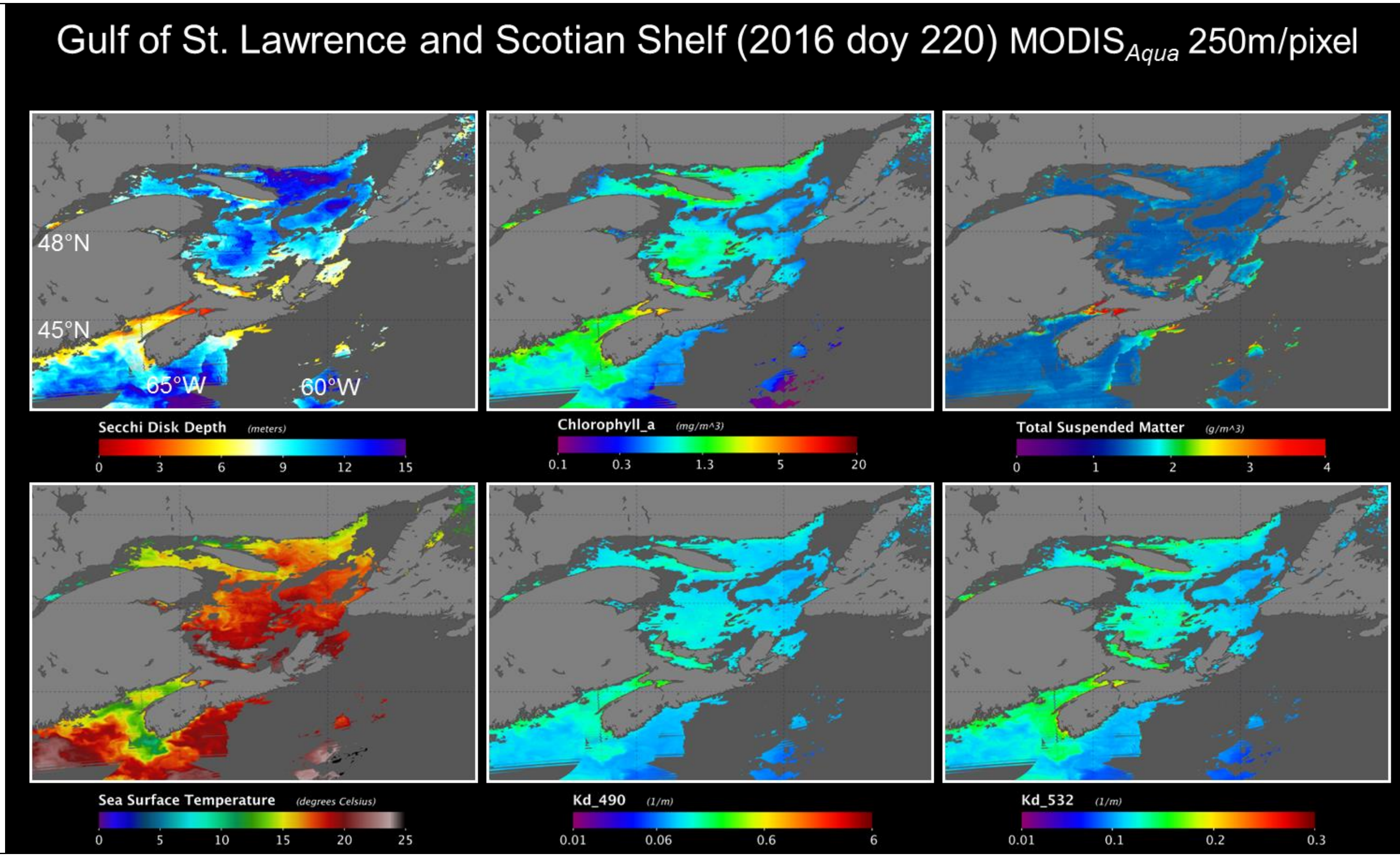


Figure APX 2.11. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on August 7th 2016 (doy = 220). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

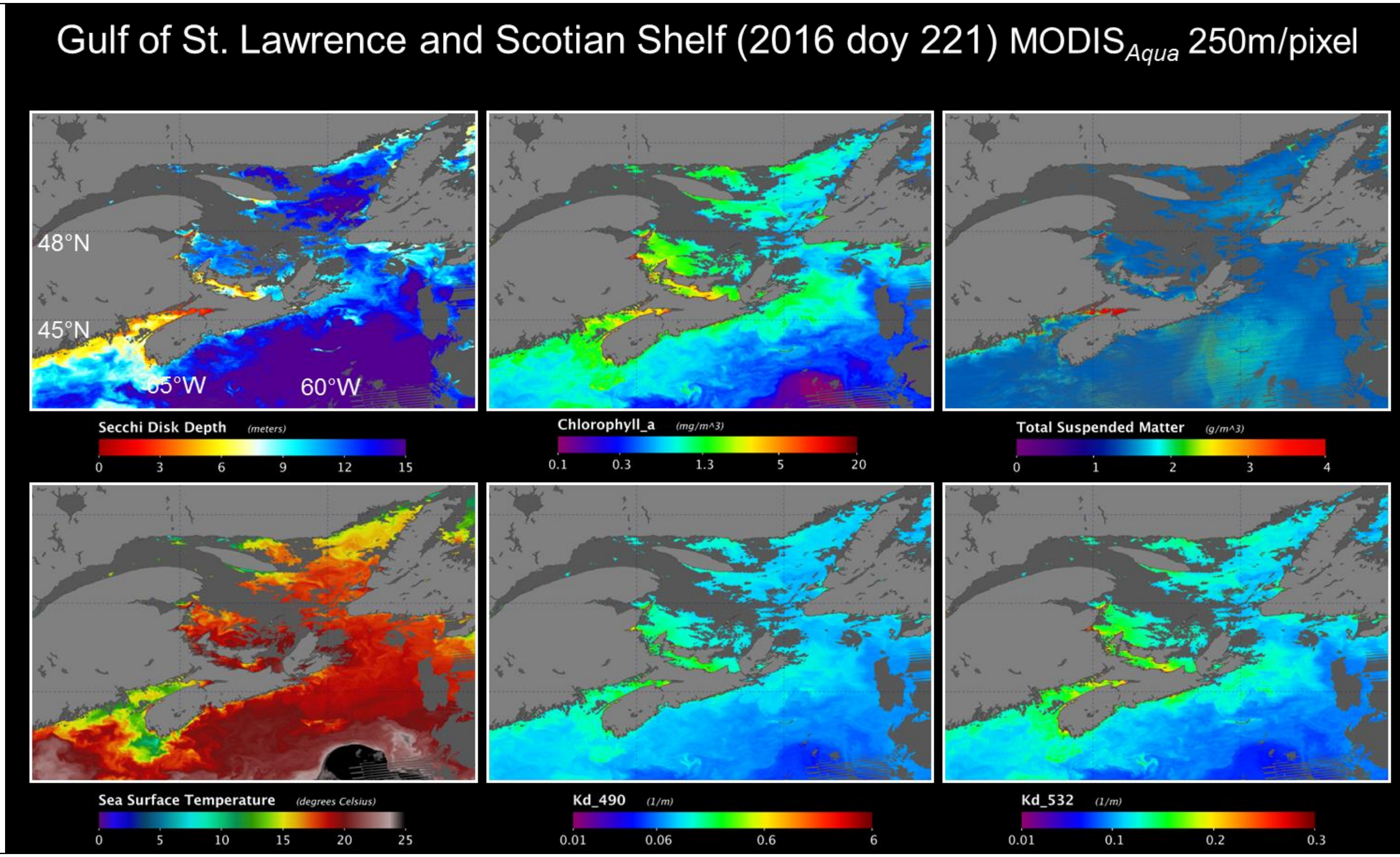


Figure APX 2.12. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on August 8th 2016 (doy = 221). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

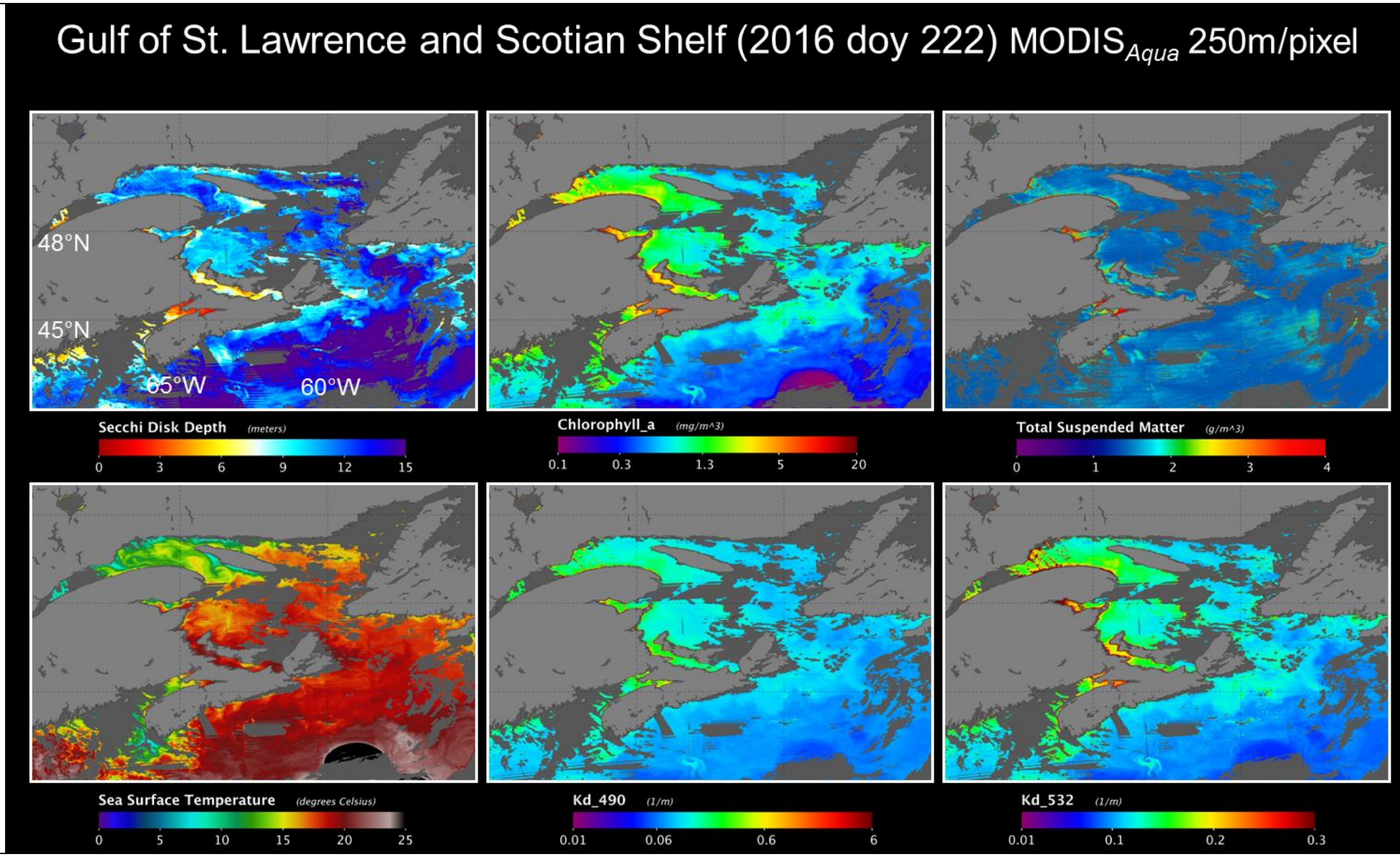


Figure APX 2.13. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on August 9th 2016 (doy = 222). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

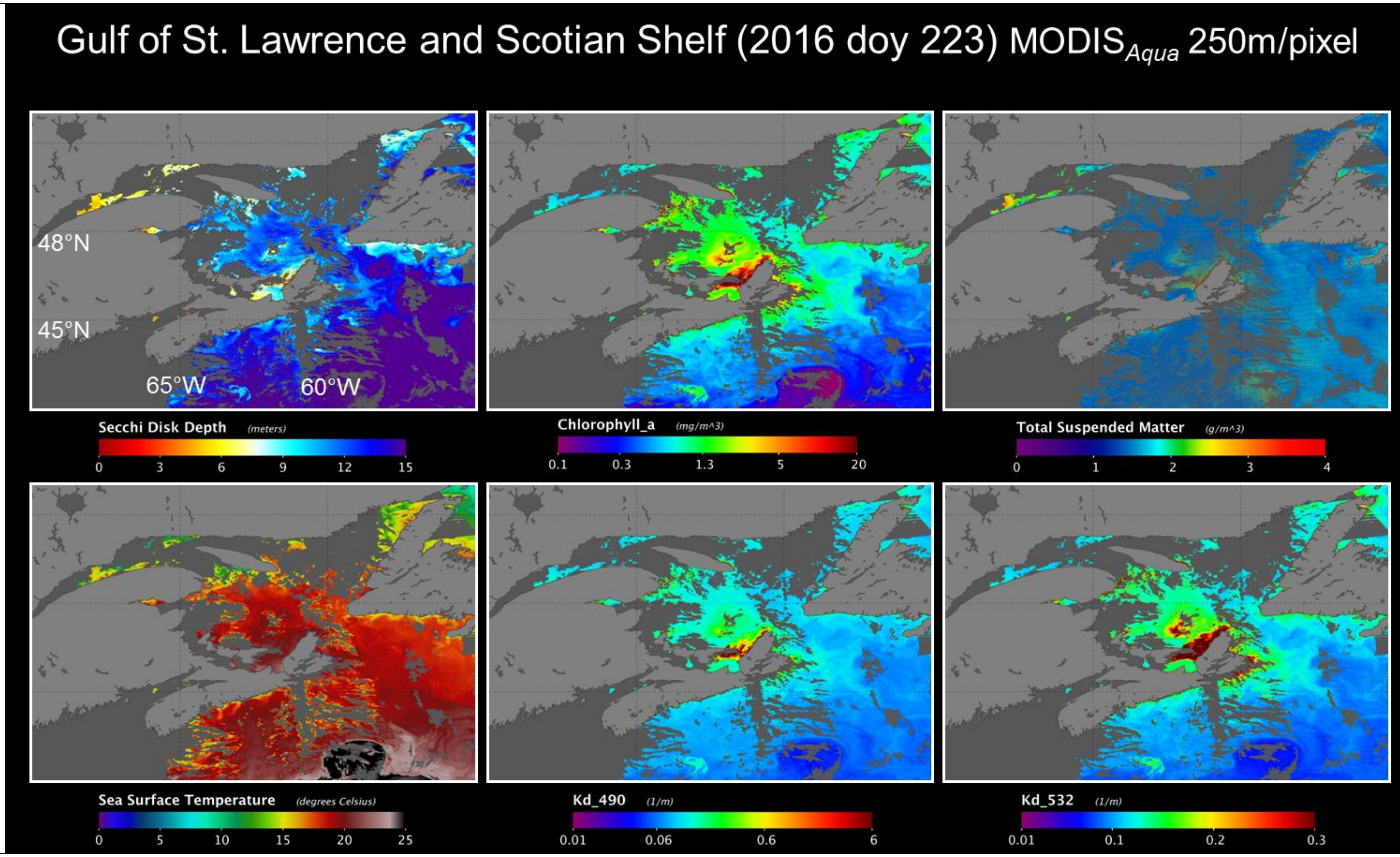


Figure APX 2.14. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on August 10th 2016 (doy = 223). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

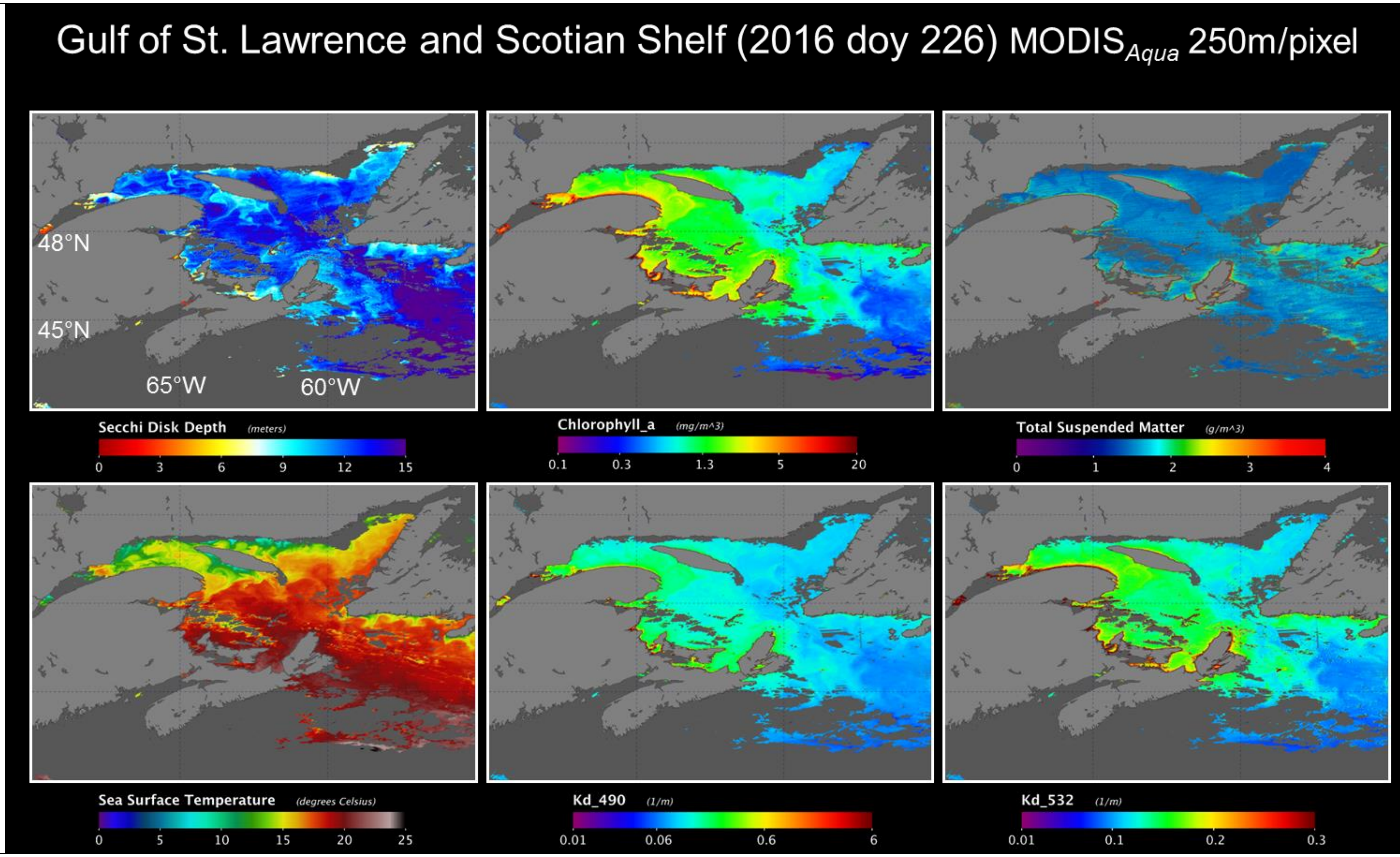


Figure APX 2.15. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on August 13th 2016 (doy = 226). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

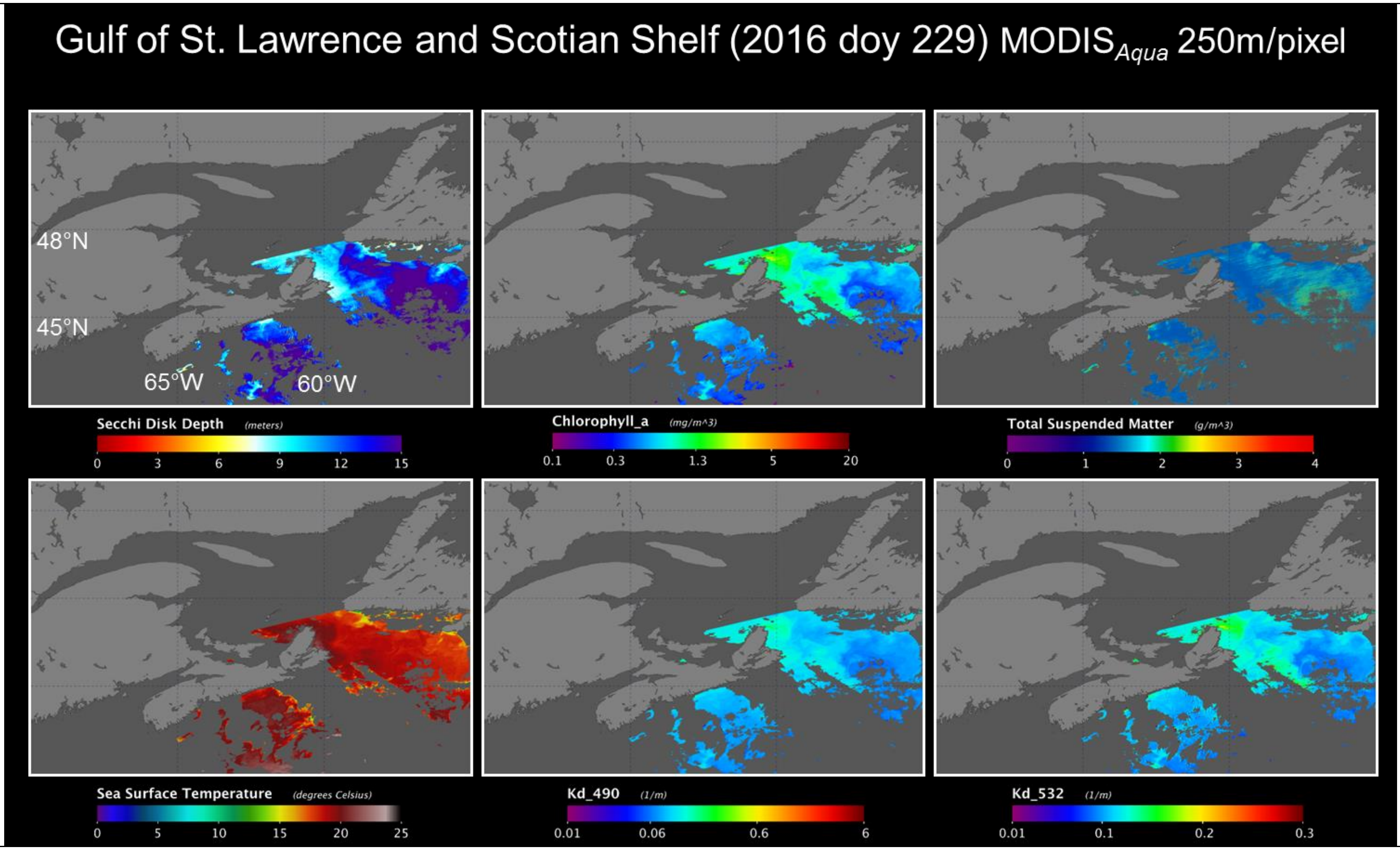


Figure APX 2.16. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on August 16th 2016 (doy = 229). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

201

2017

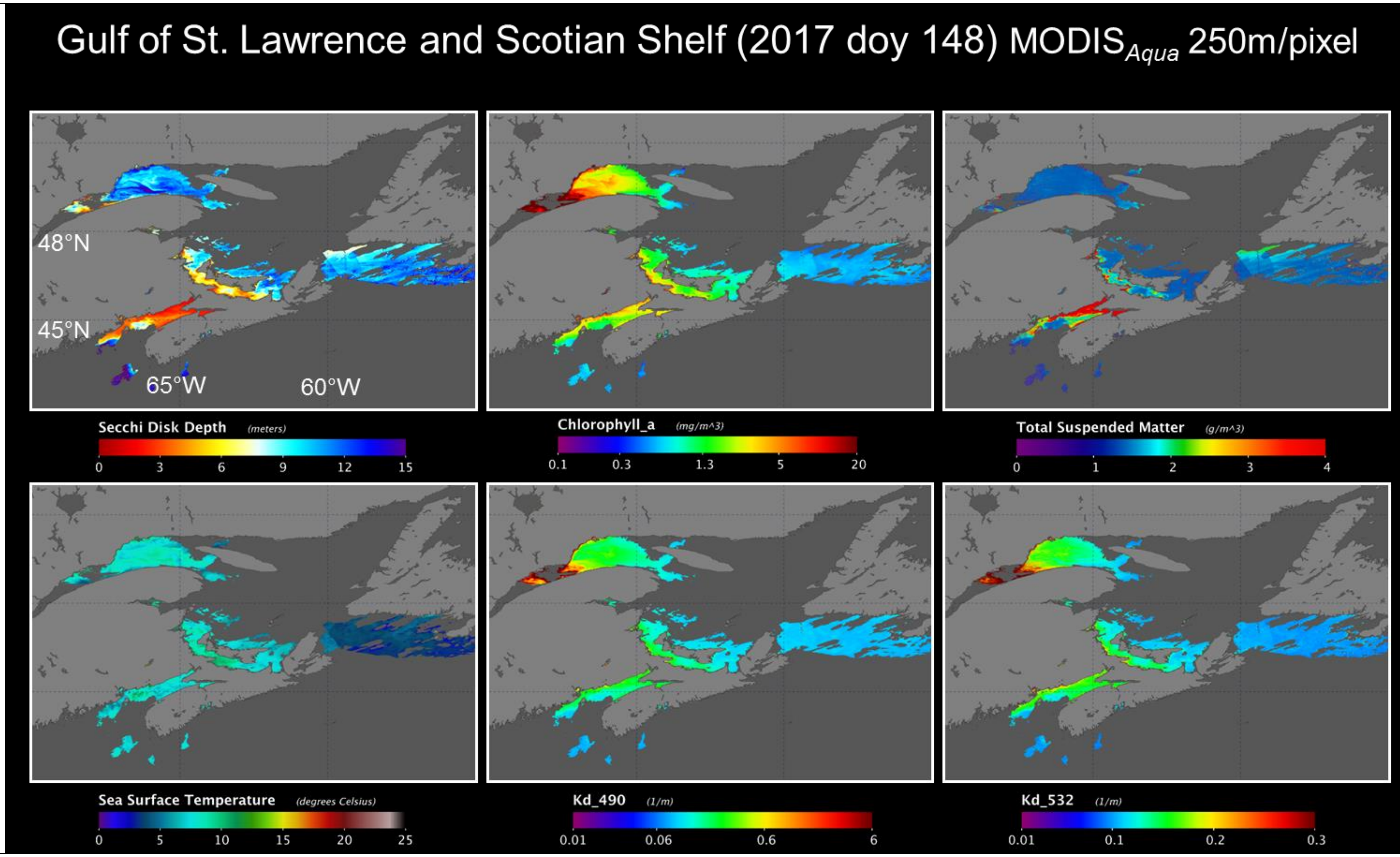


Figure APX 2.17. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on May 28th 2017 (doy =148). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

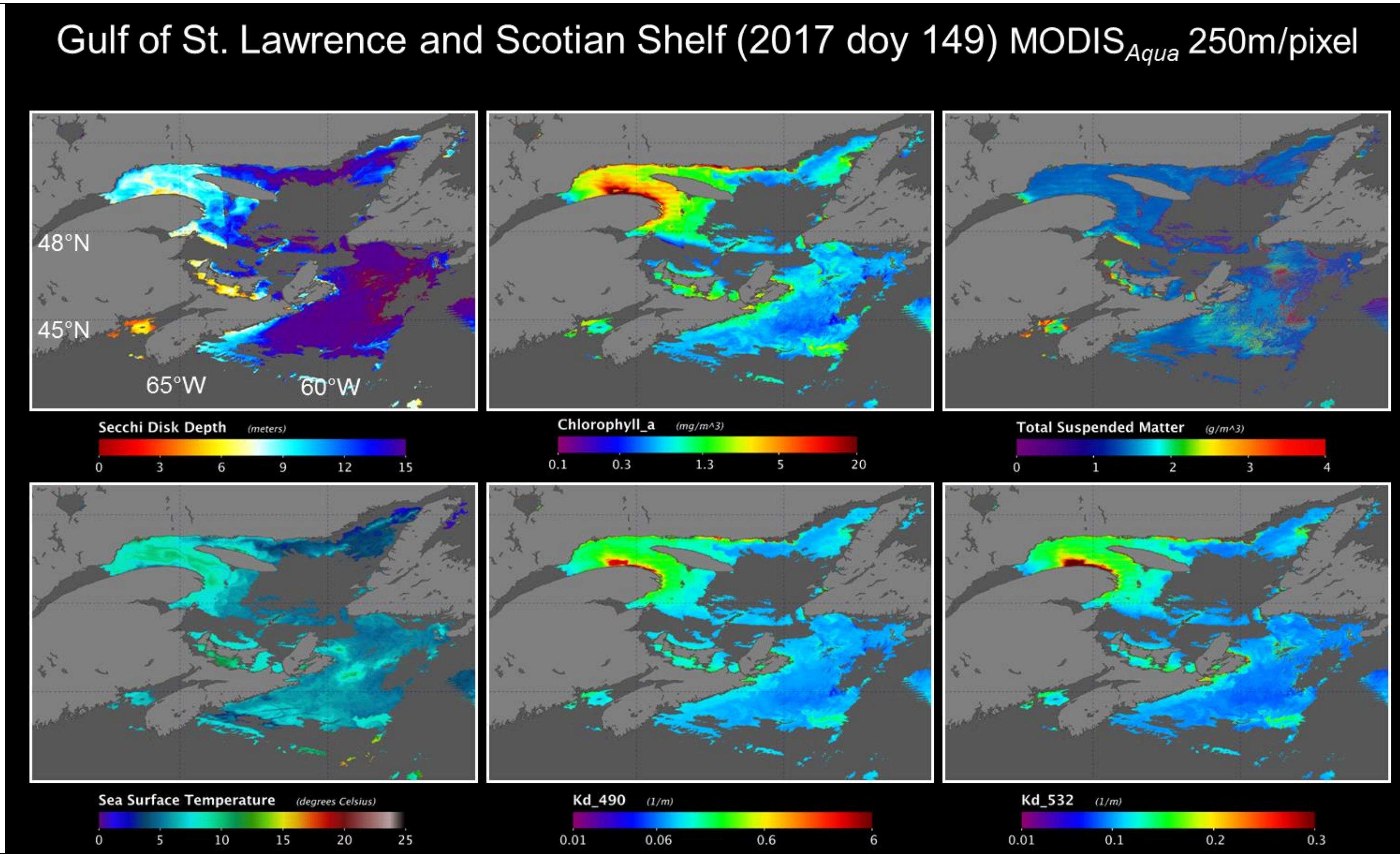


Figure APX 2.18. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on May 29th 2017 (doy =149). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

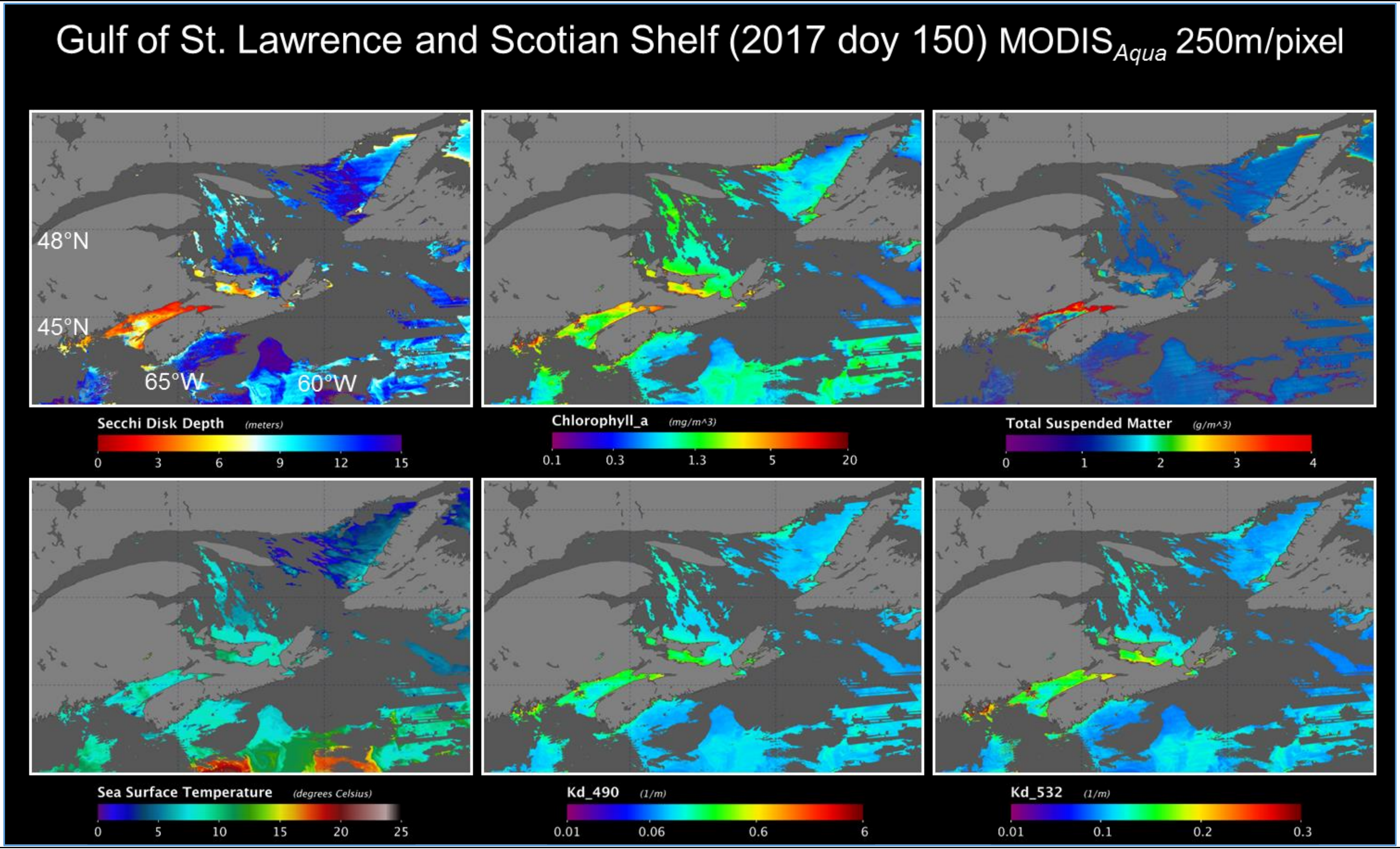


Figure APX 2.19. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on May 30th 2017 (doy =150). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

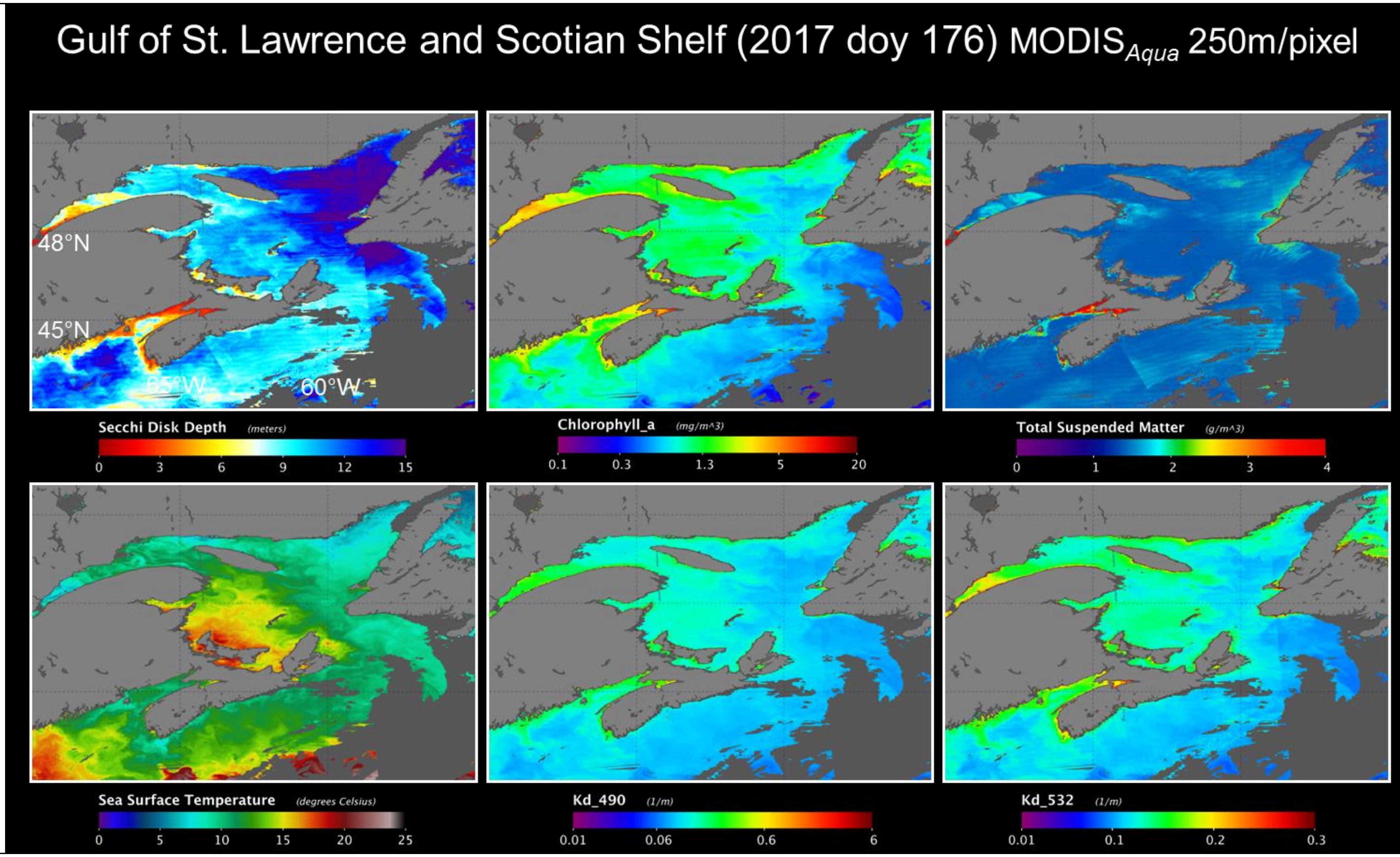


Figure APX 2.20. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on June 25th 2017 (doy =176). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

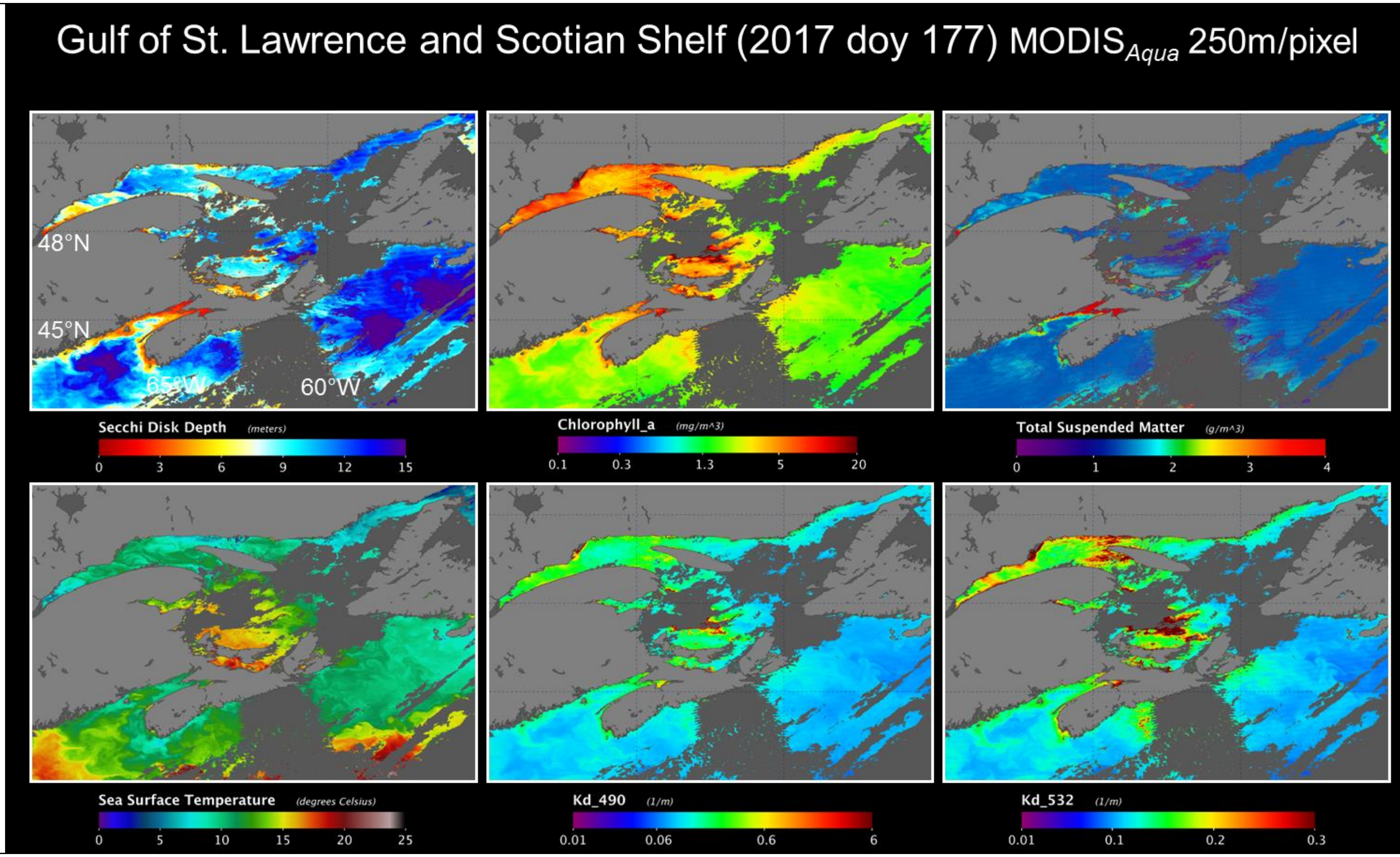


Figure APX 2.21. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on June 26th 2017 (doy =177). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

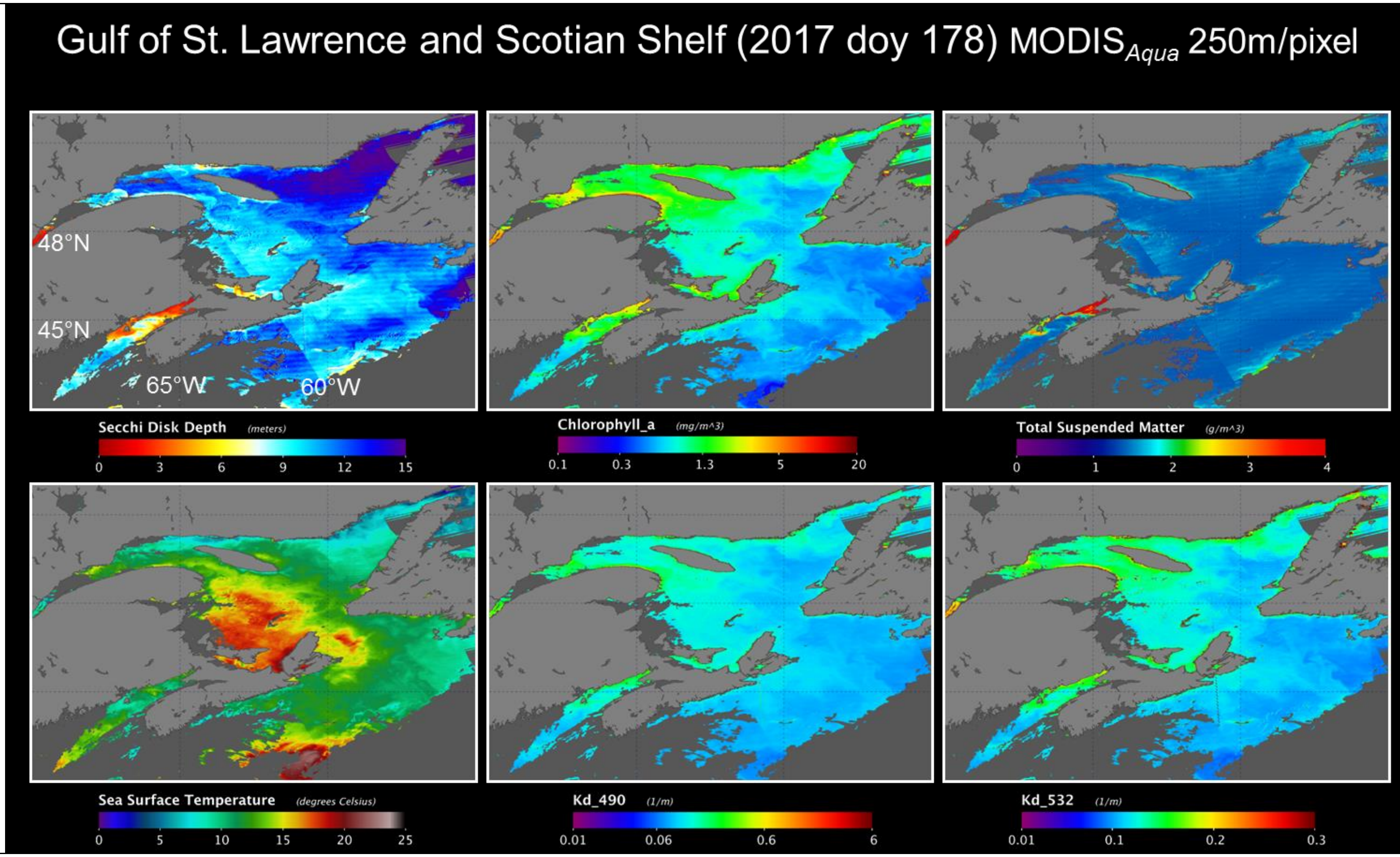


Figure APX 2.22. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on June 27th 2017 (doy =178). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

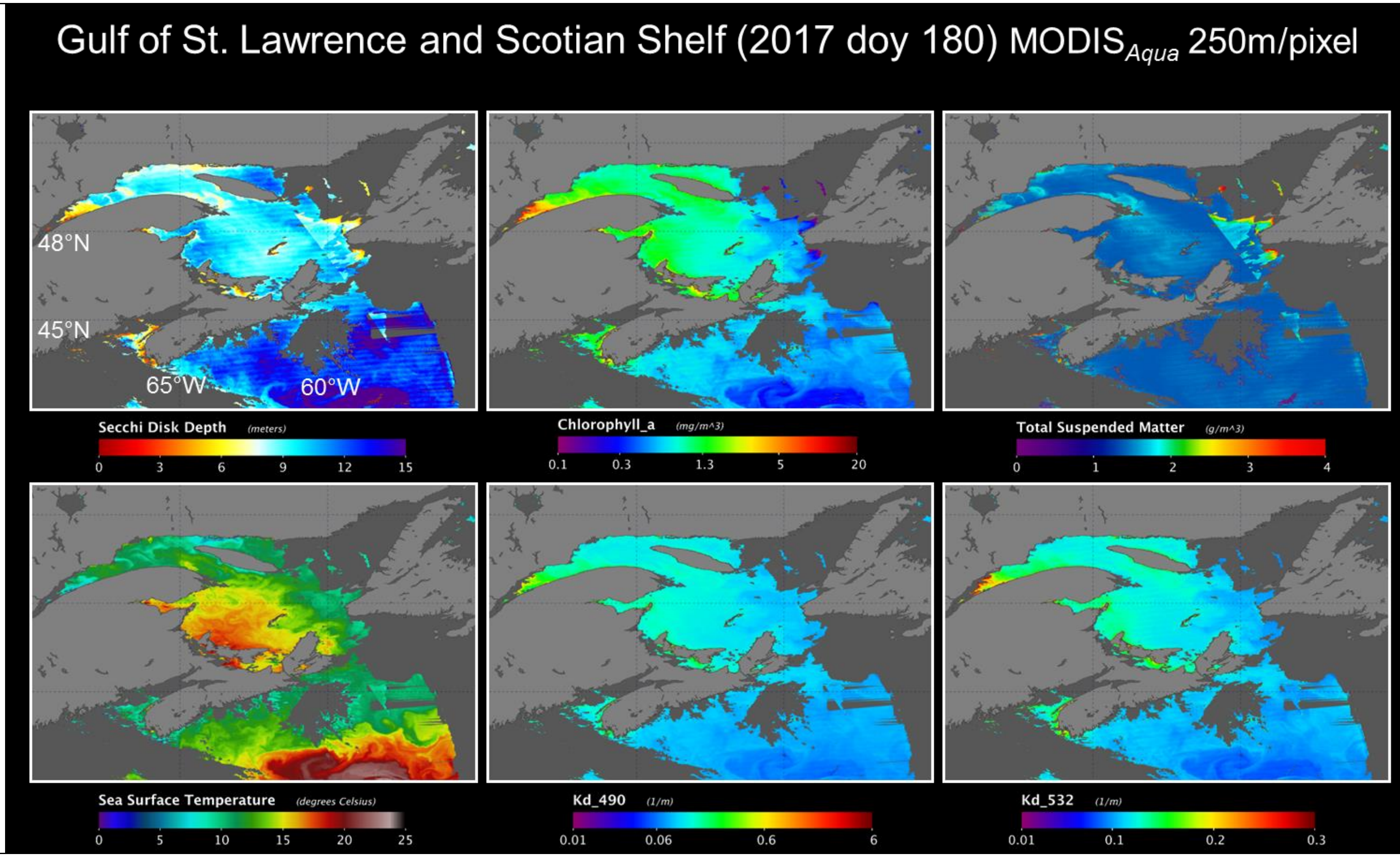


Figure APX 2.23. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on June 29th 2017 (doy =180). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

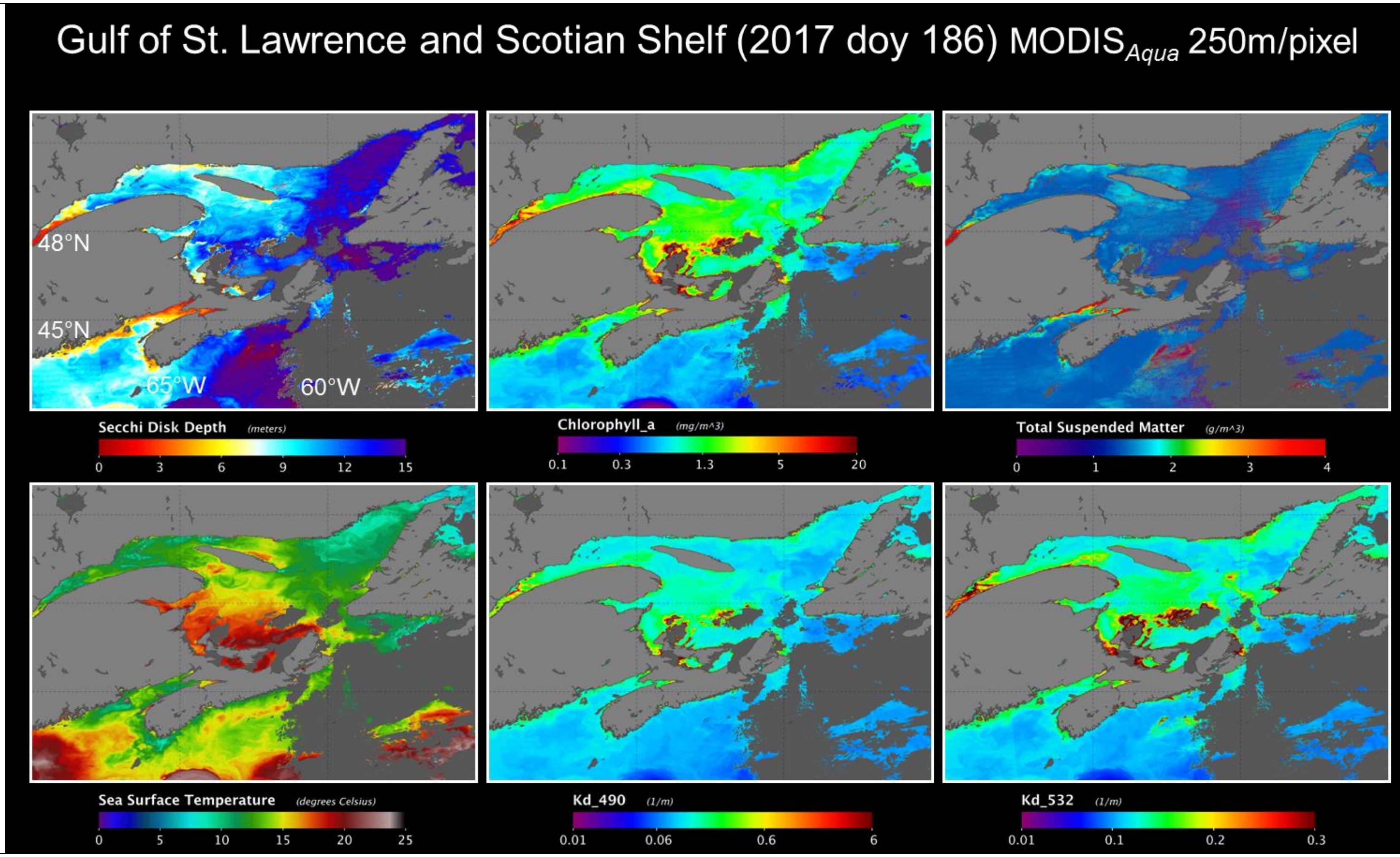


Figure APX 2.24. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on July 5th 2017 (doy =186). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

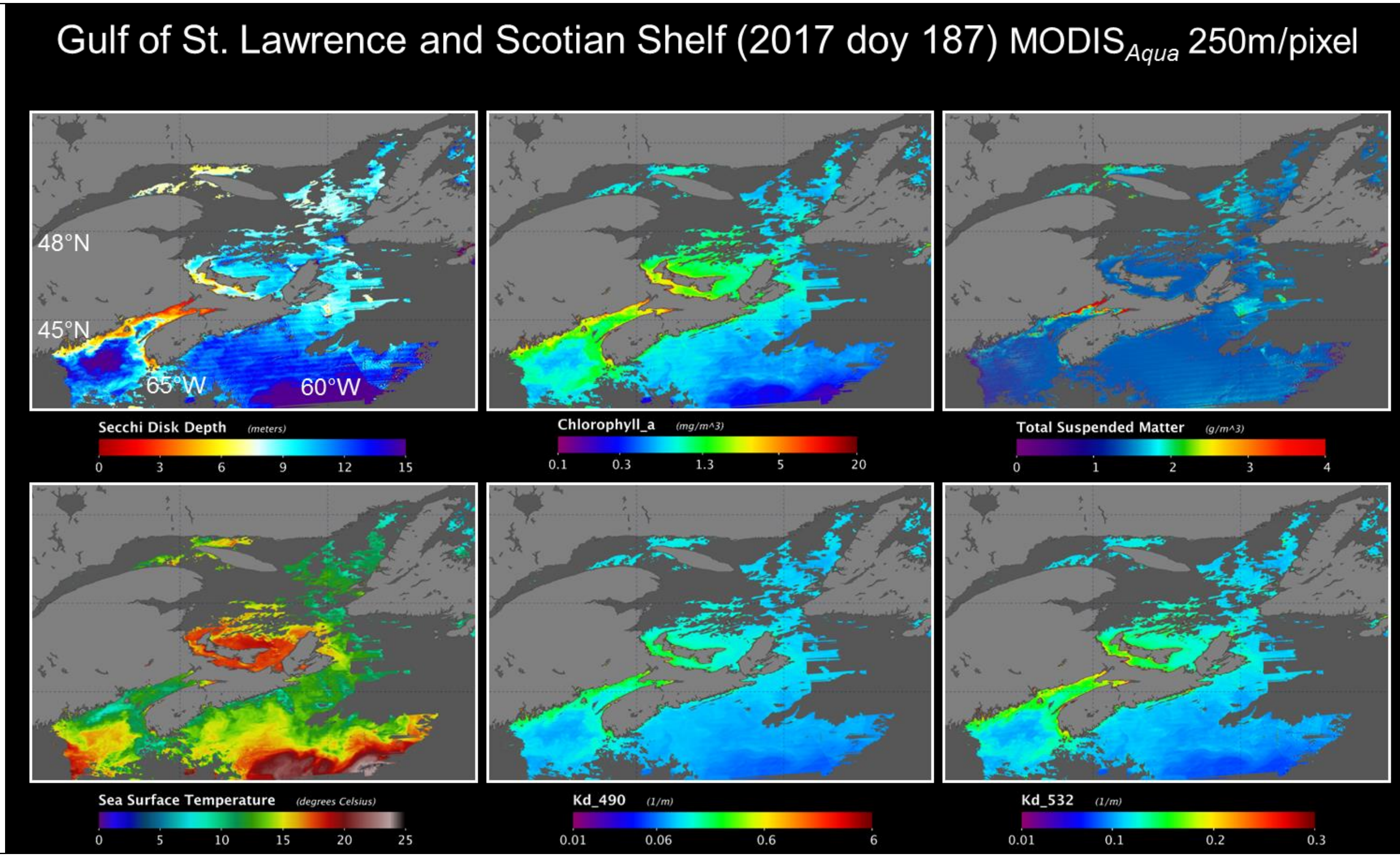


Figure APX 2.25. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on July 6th 2017 (doy =187). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

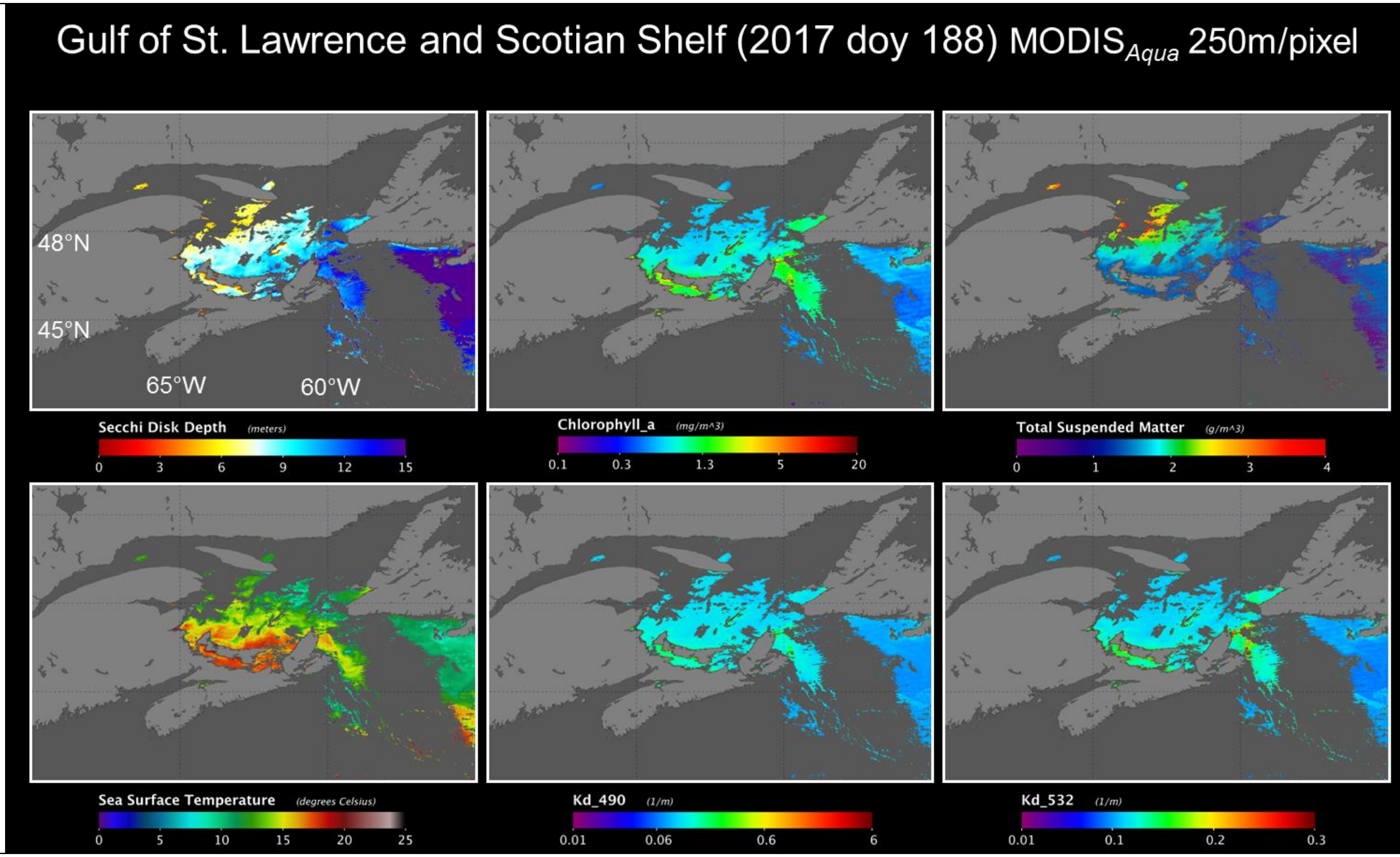


Figure APX 2.26. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on July 7th 2017 (doy =188). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

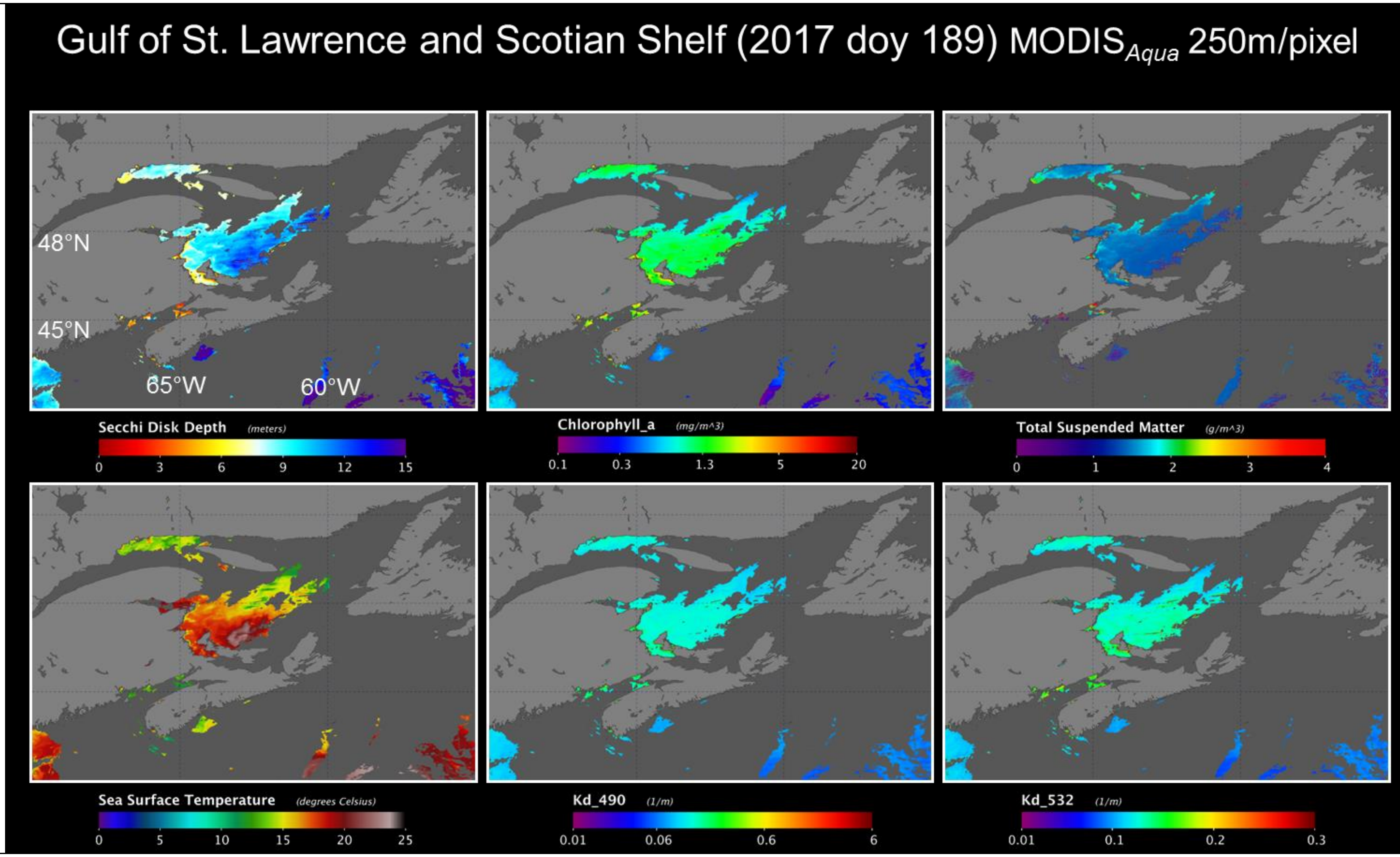


Figure APX 2.27. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on July 8th 2017 (doy =189). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

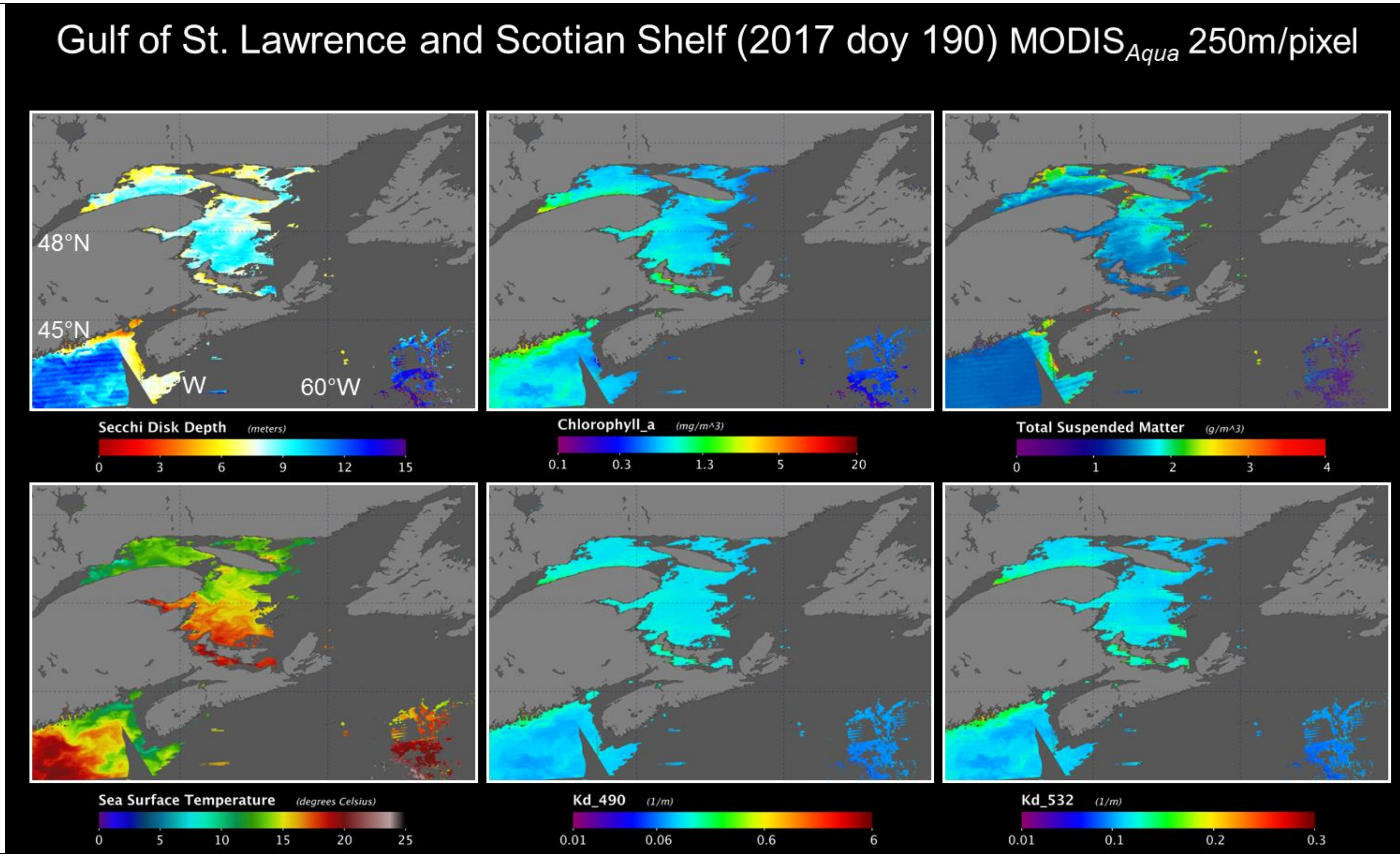


Figure APX 2.28. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on July 9th 2017 (doy =190). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

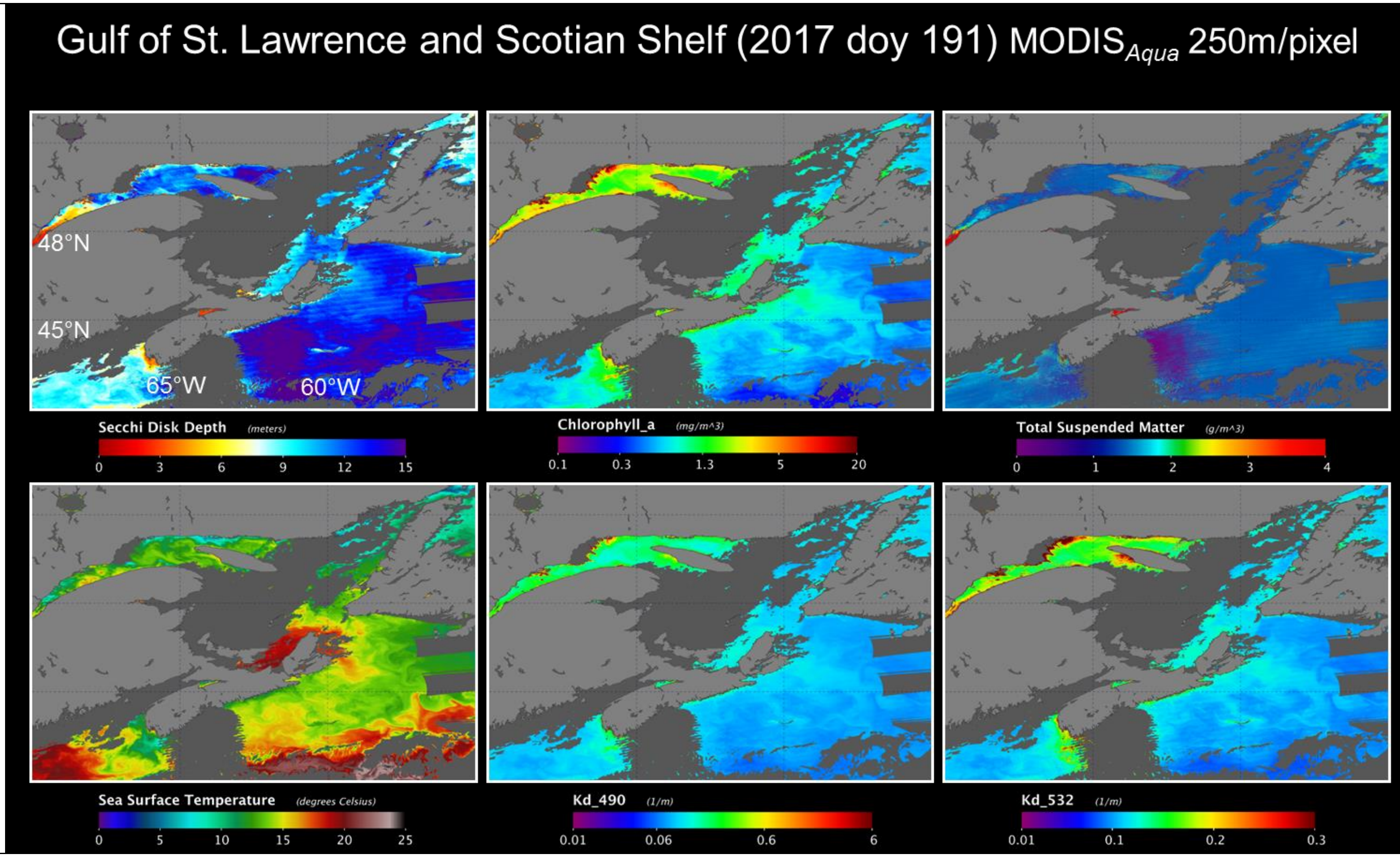


Figure APX 2.29. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on July 10th 2017 (doy =191). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

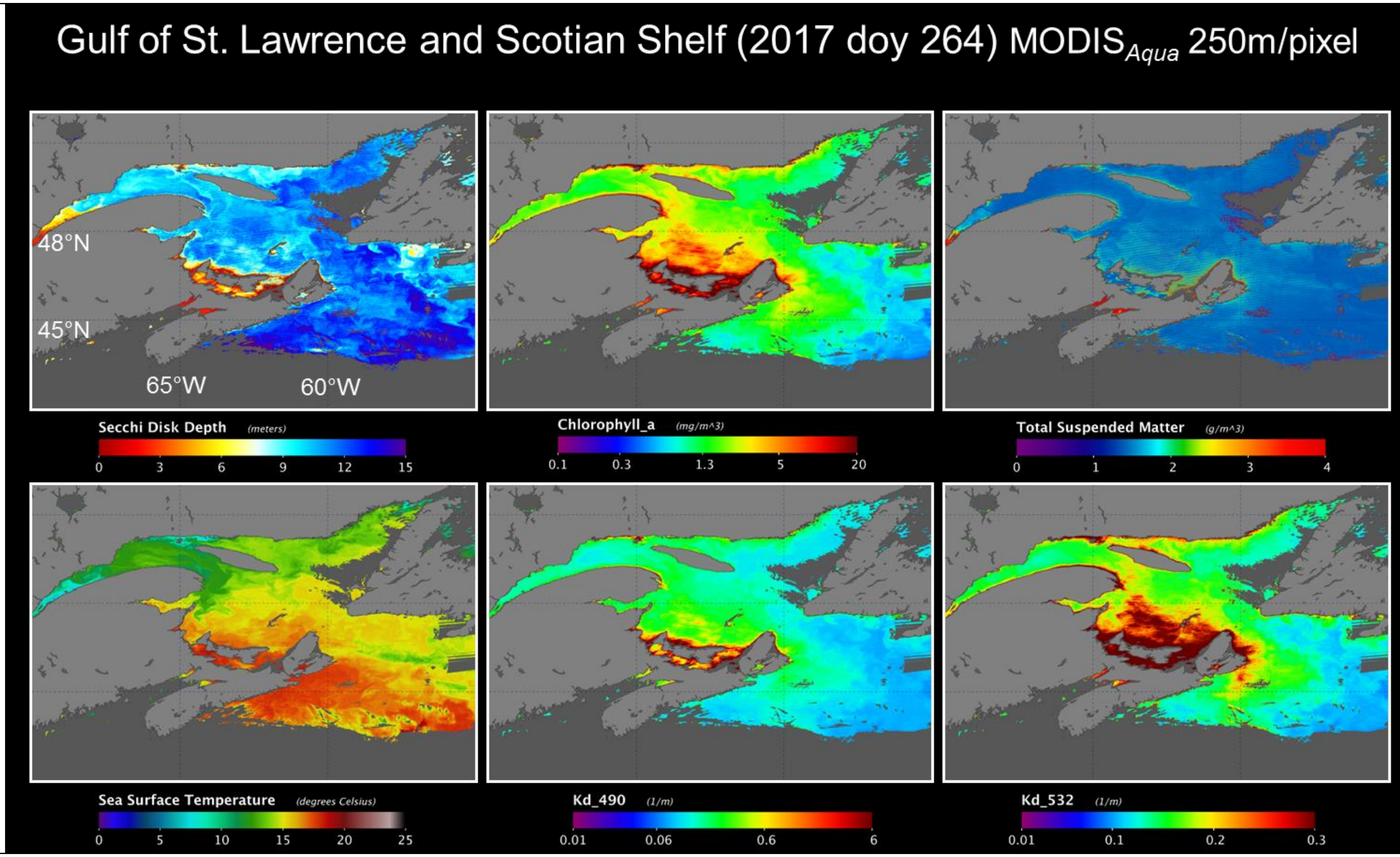


Figure APX 2.30. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on September 21st 2017 (doy =264). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

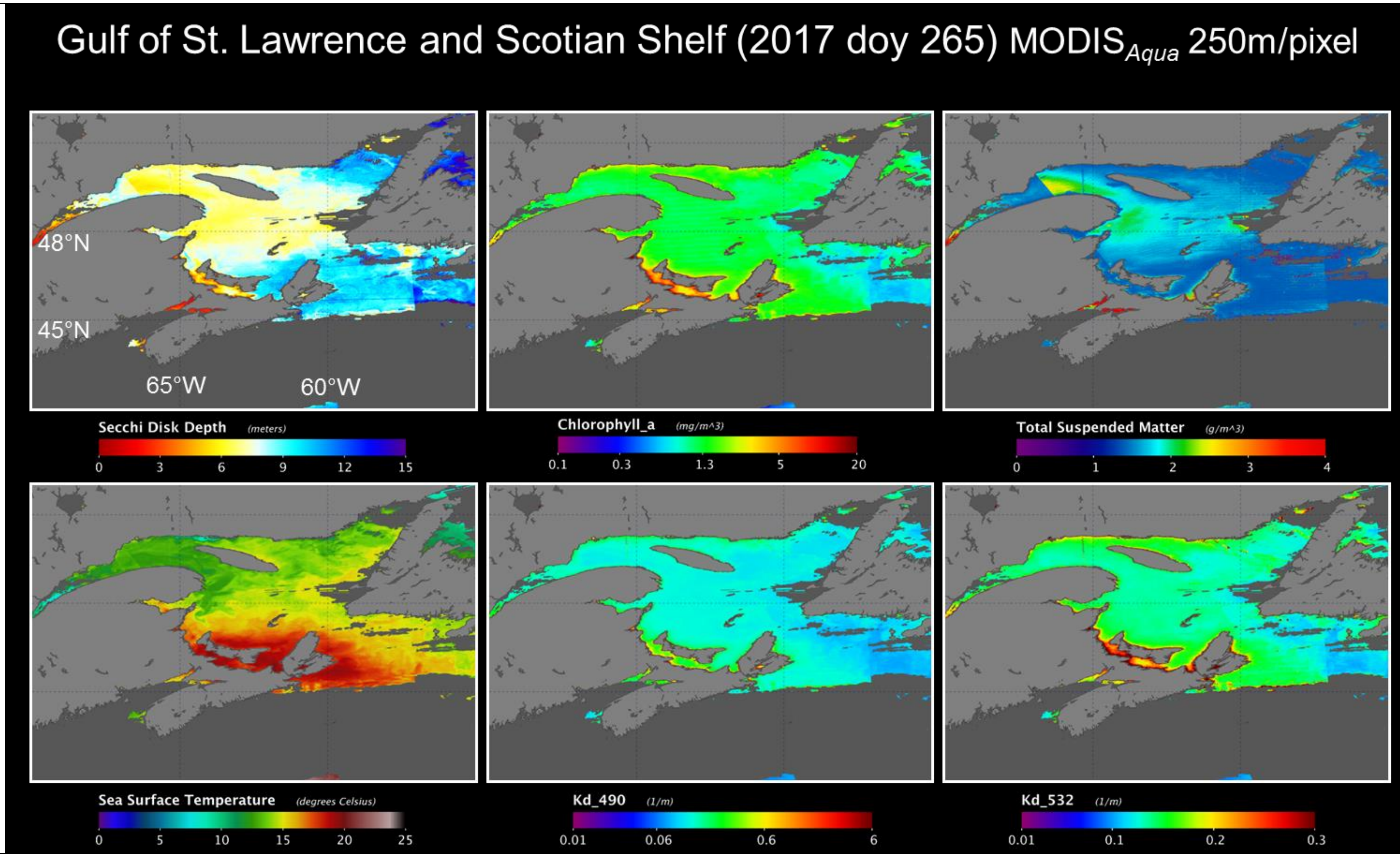


Figure APX 2.31. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on September 22nd 2017 (doy =265). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

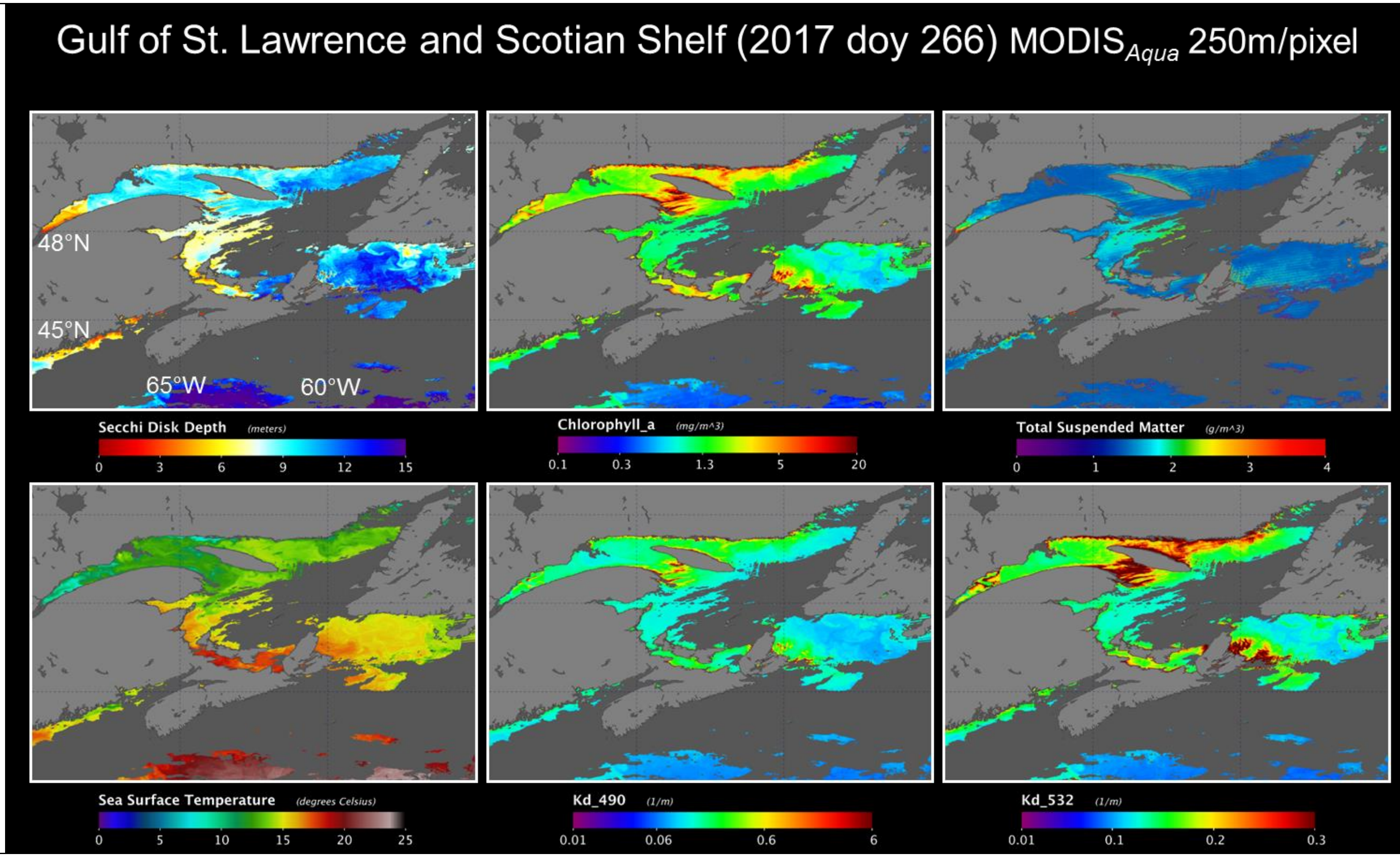


Figure APX 2.32. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on September 23rd 2017 (doy =266). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

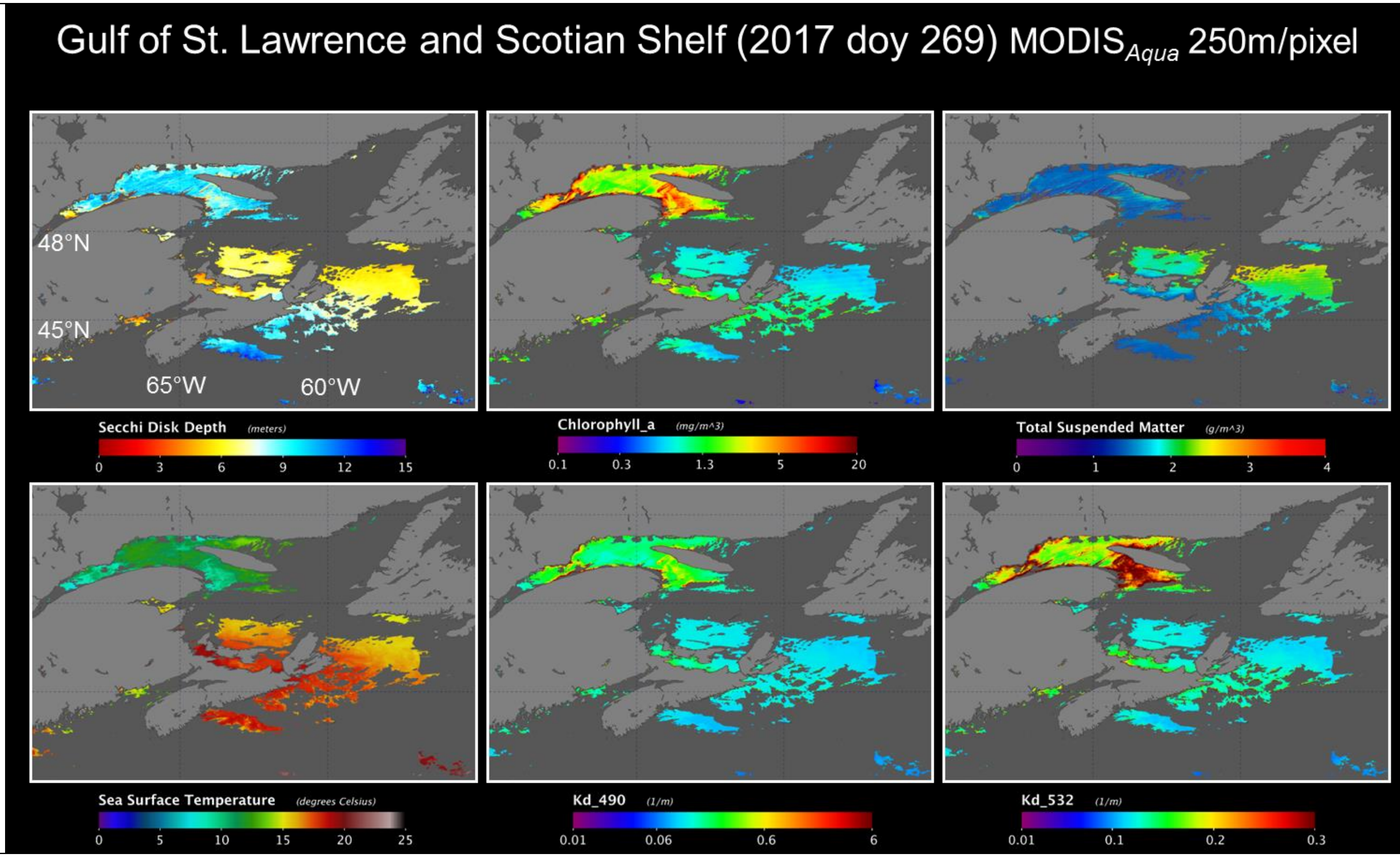


Figure APX 2.33. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on September 26th 2017 (doy =269). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

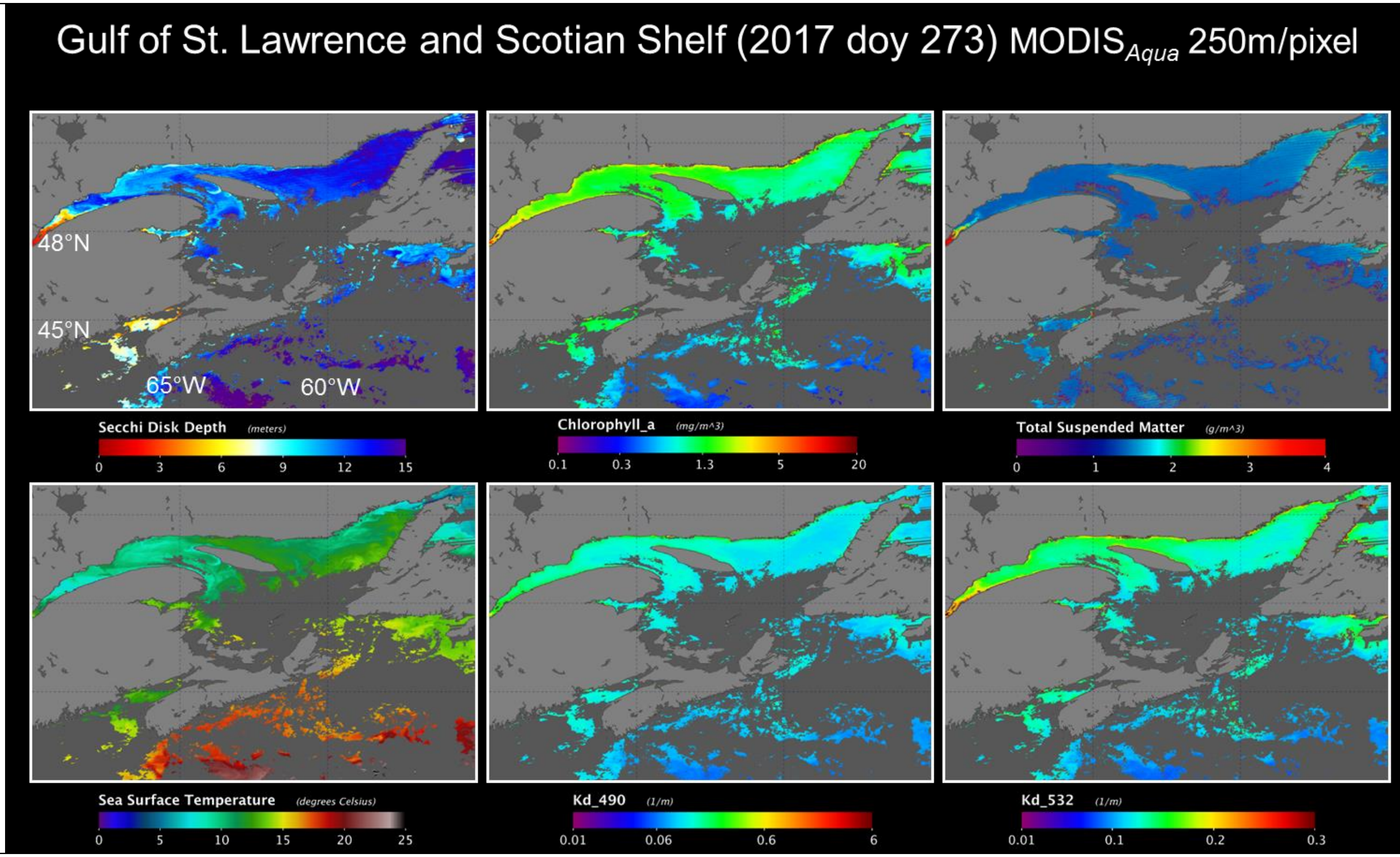


Figure APX 2.34. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on September 30th 2017 (doy =273). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

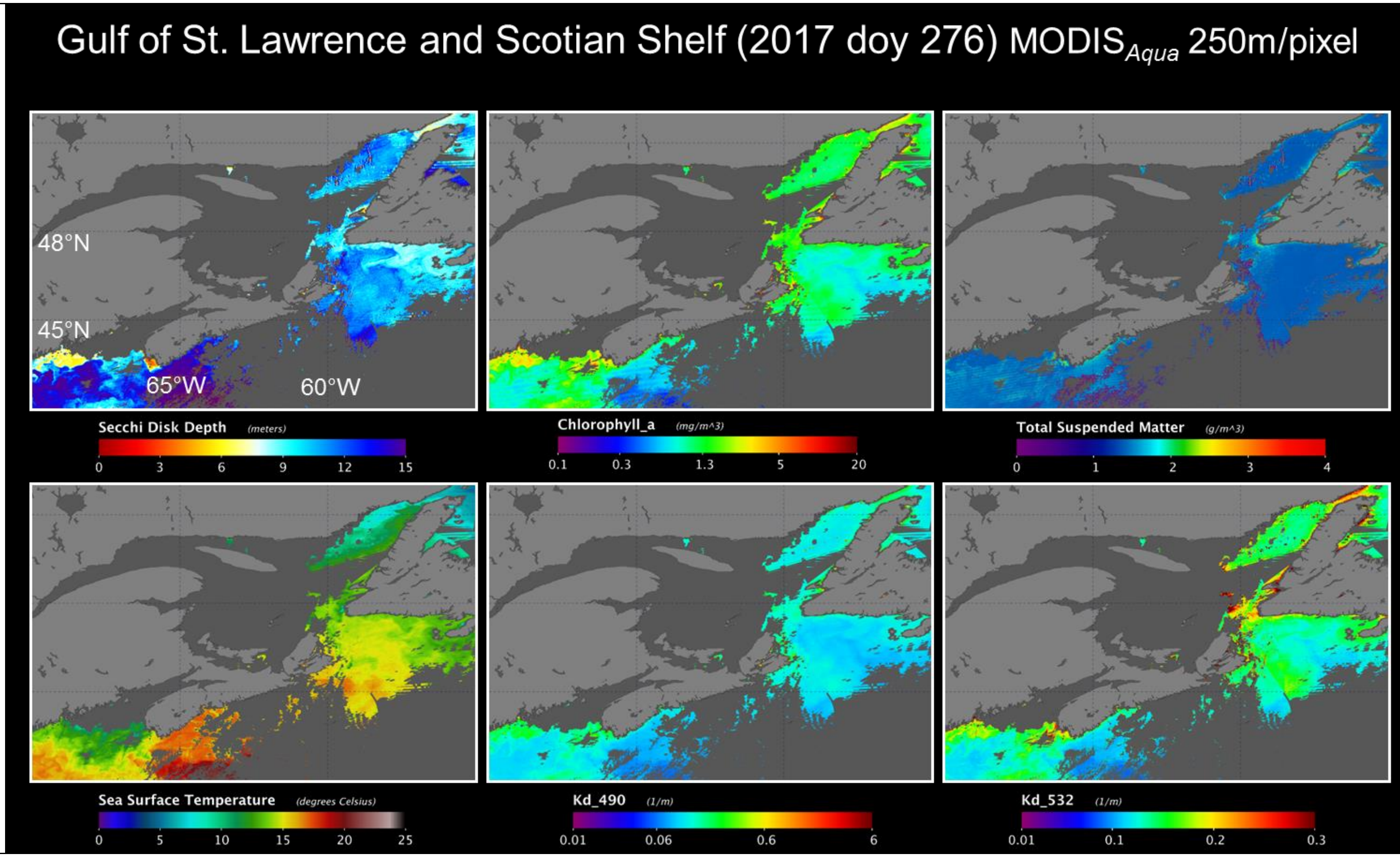


Figure APX 2.35. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on October 3rd 2017 (doy =276). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

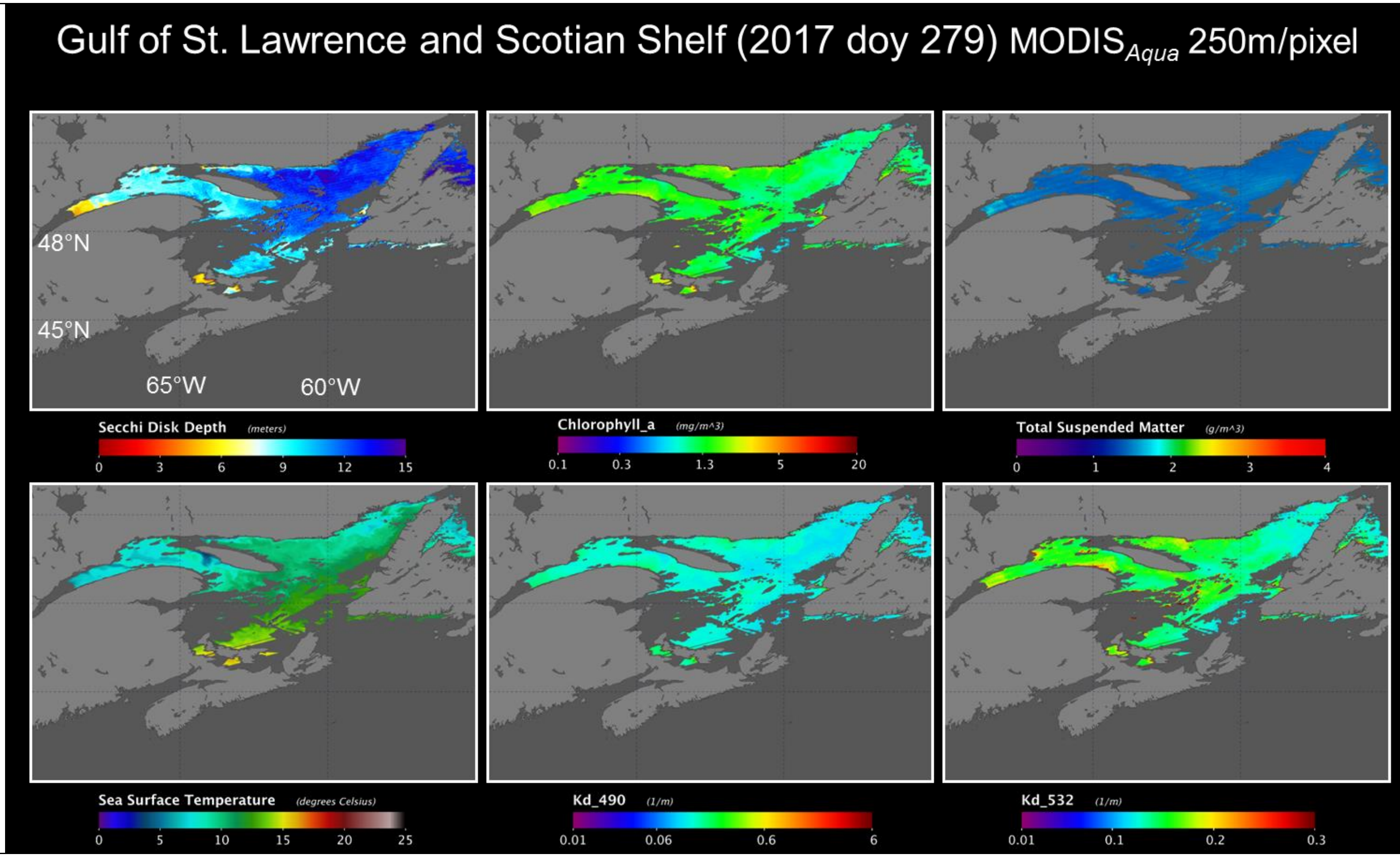


Figure APX 2.36. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on October 6th 2017 (doy =279). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

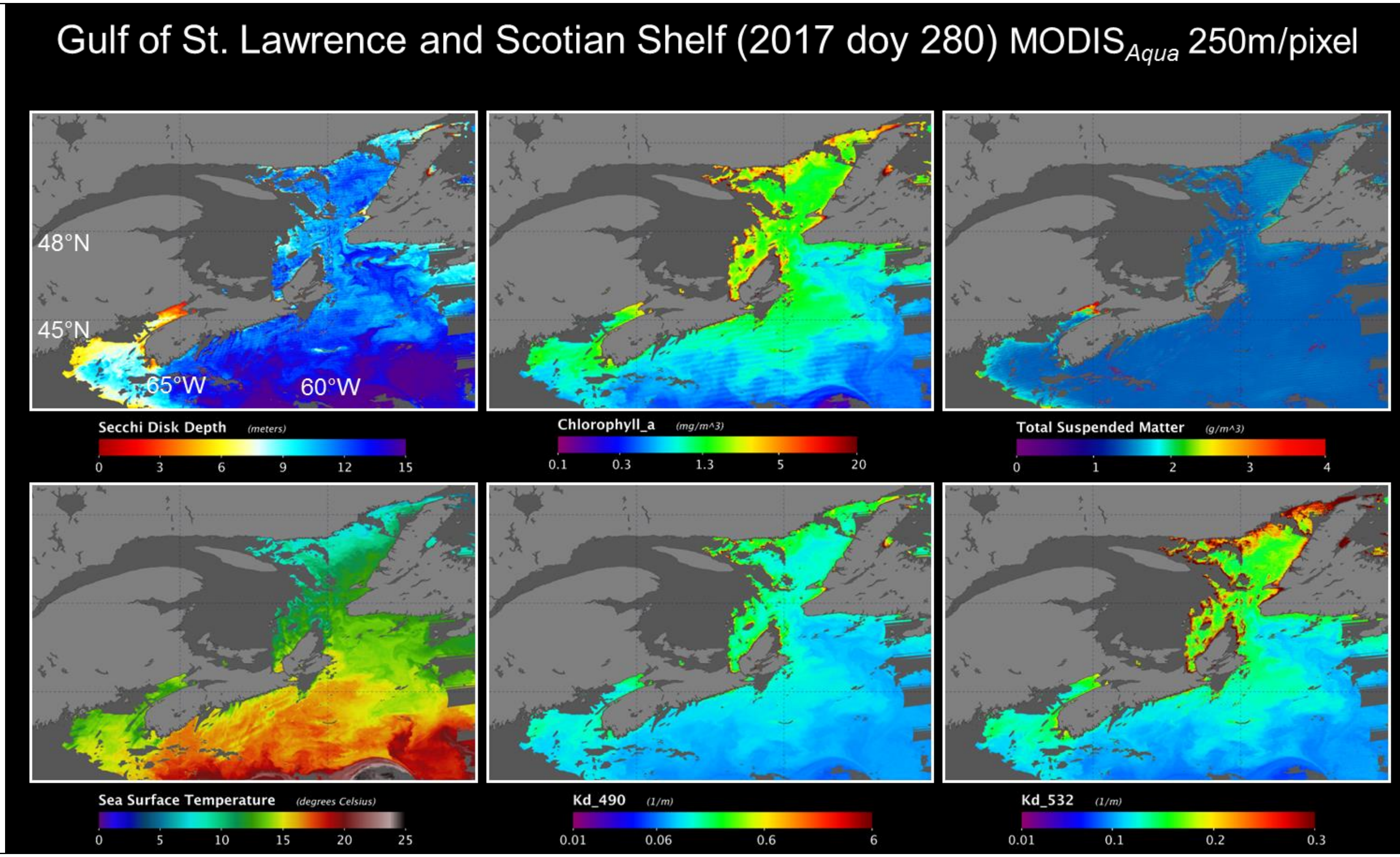


Figure APX 2.37. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on October 7th 2017 (doy =280). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

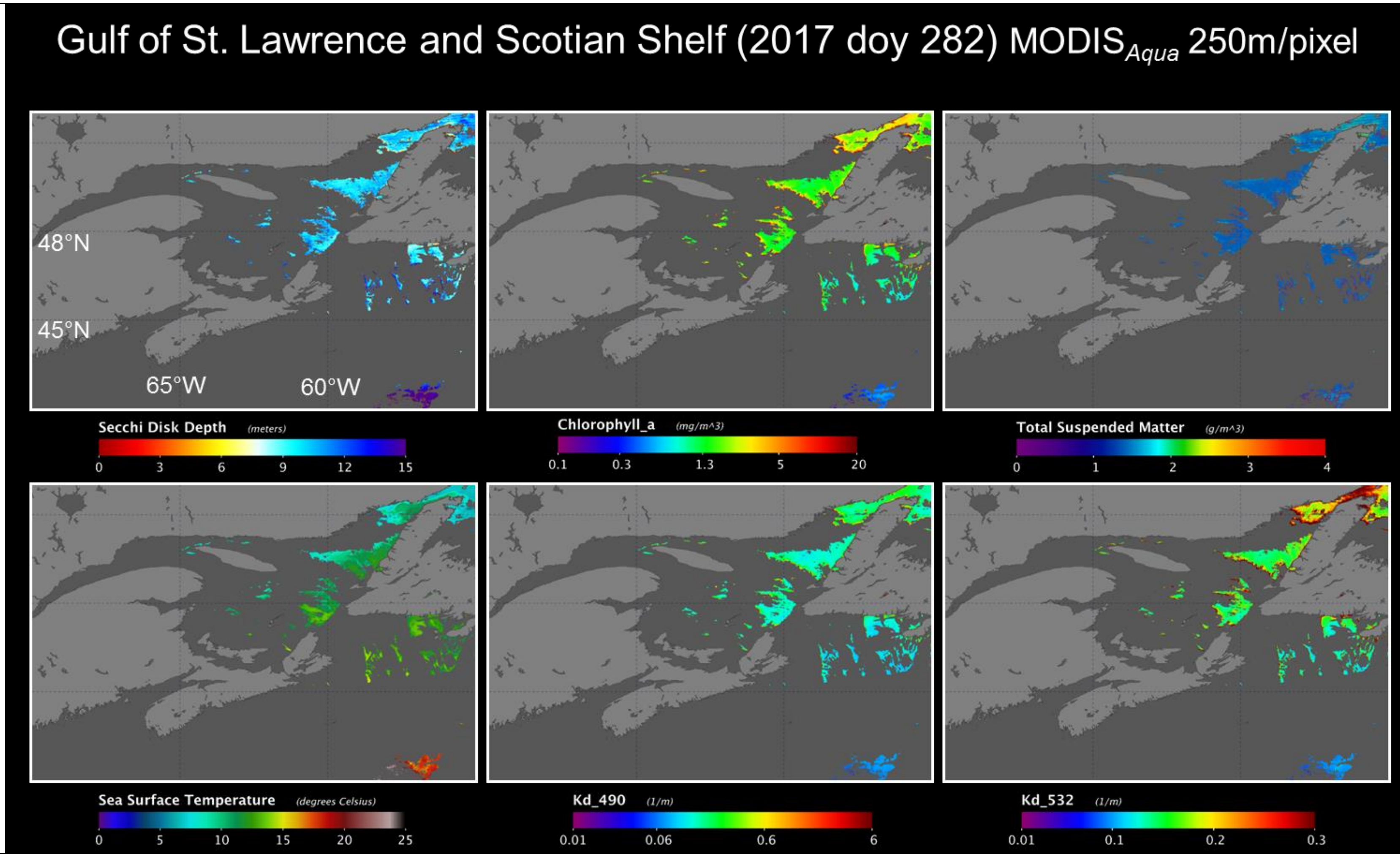


Figure APX 2.38. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on October 9th 2017 (doy =282). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

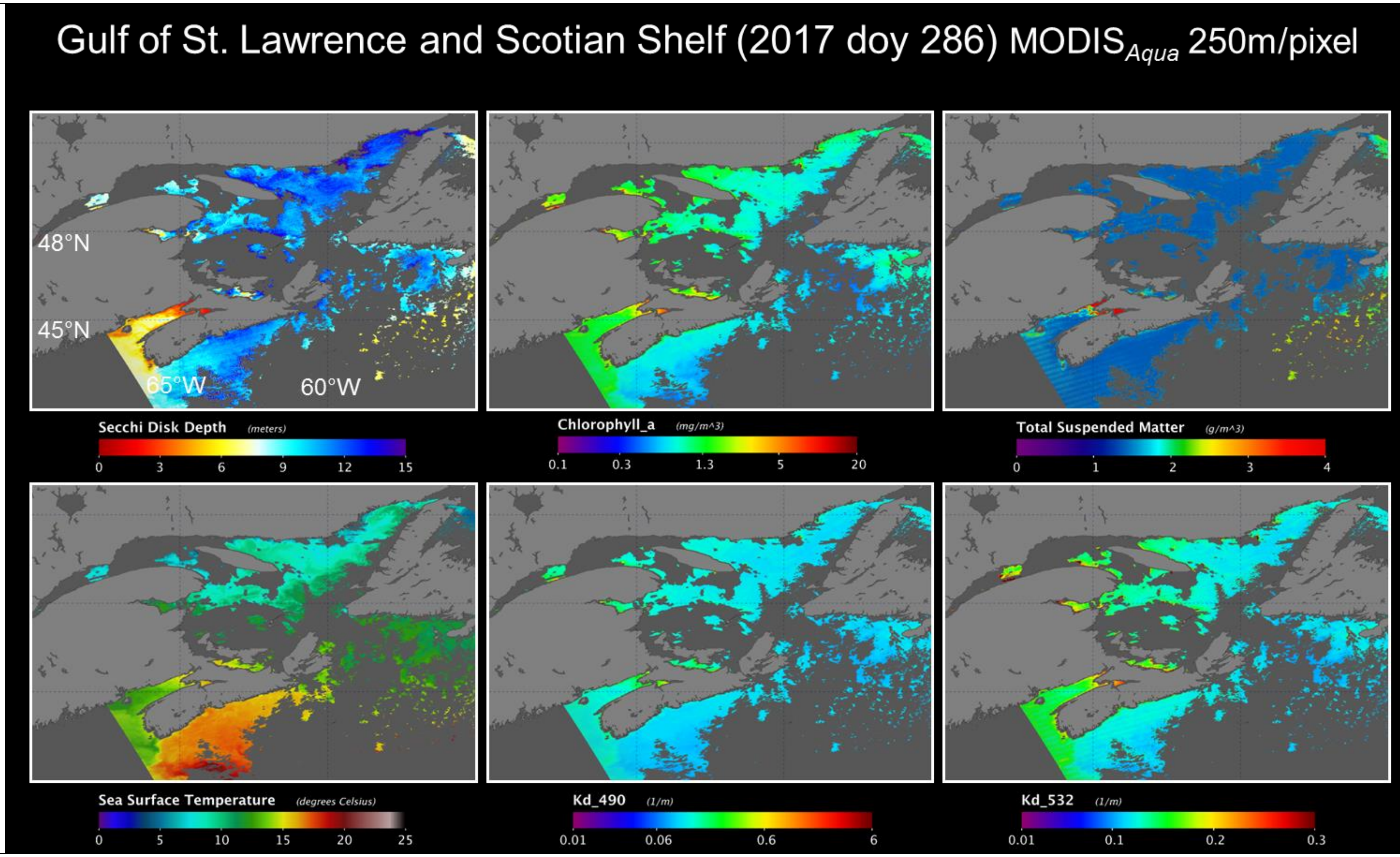


Figure APX 2.39. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on October 13th 2017 (doy =286). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

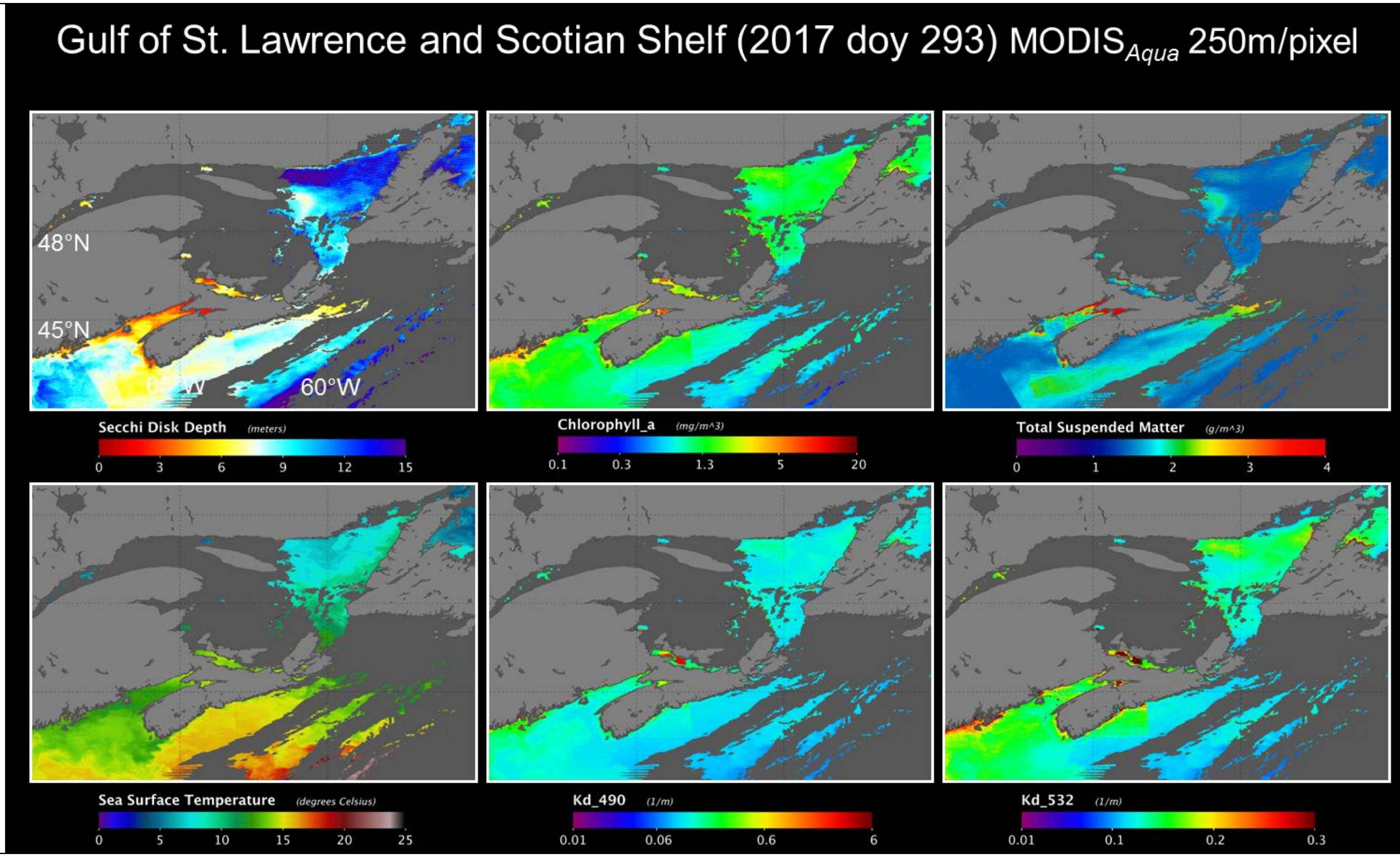


Figure APX 2.40. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on October 20th 2017 (doy =293). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

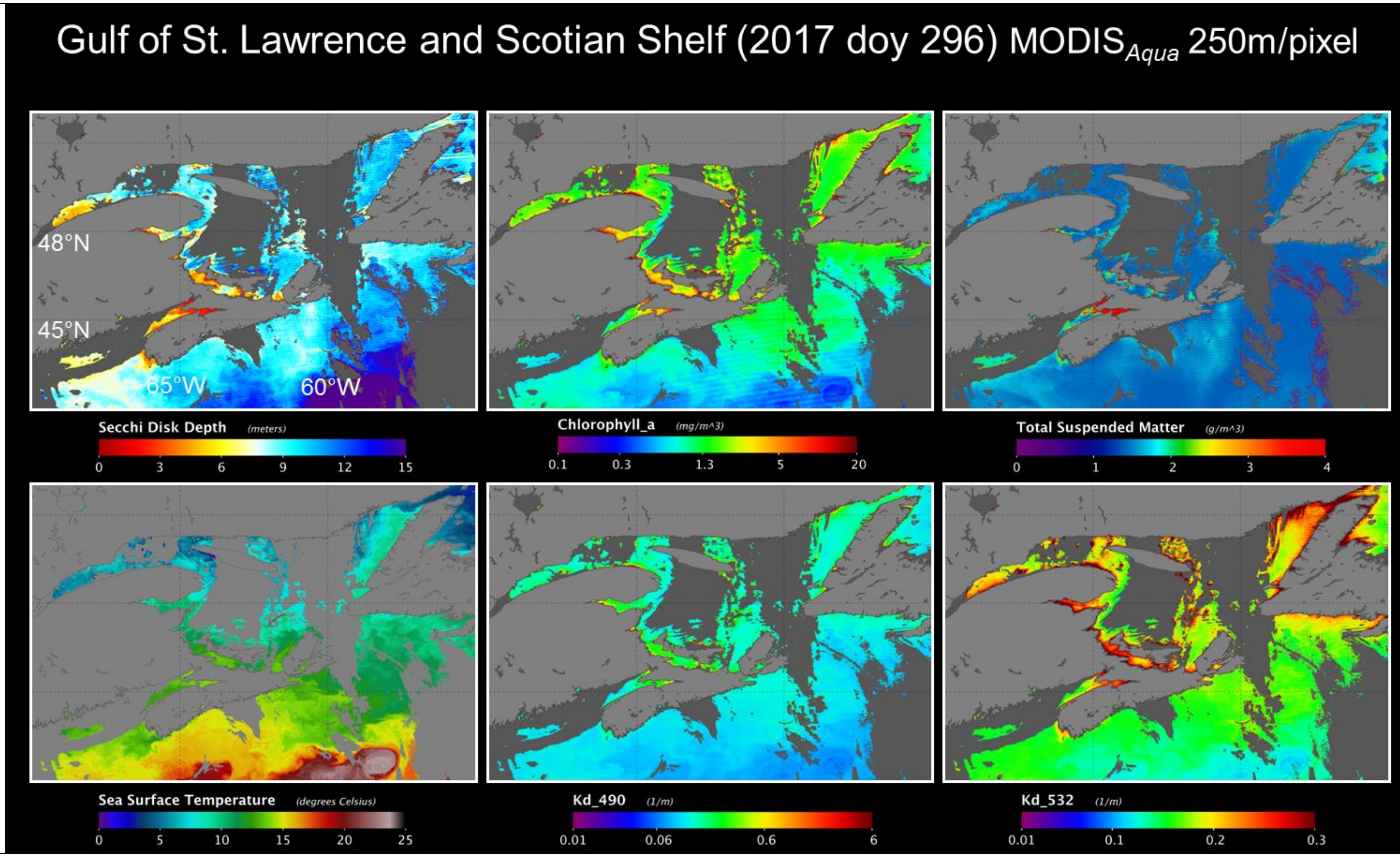


Figure APX 2.41. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on October 23rd 2017 (doy =296). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

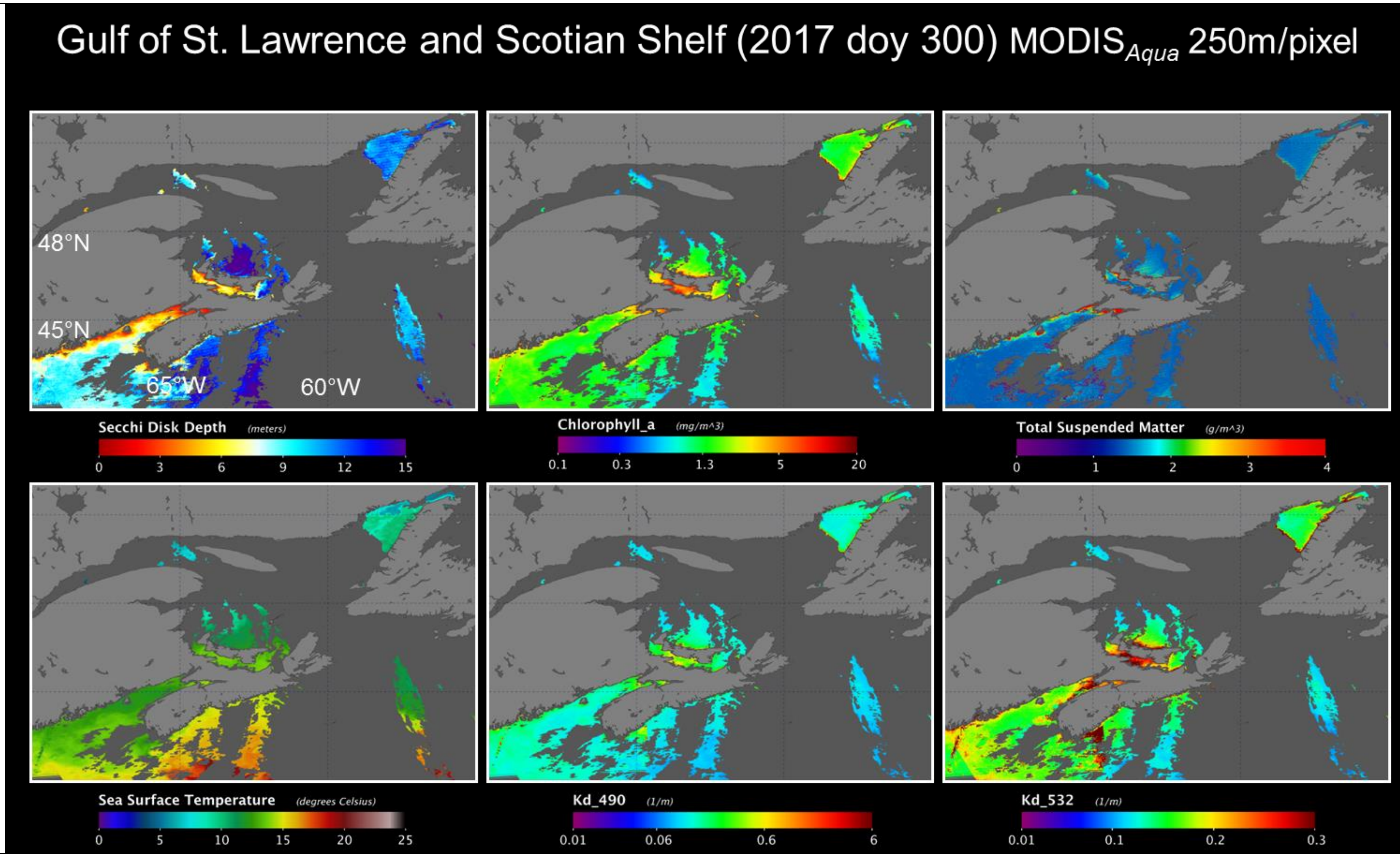


Figure APX 2.42. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on October 27th 2017 (doy =300). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

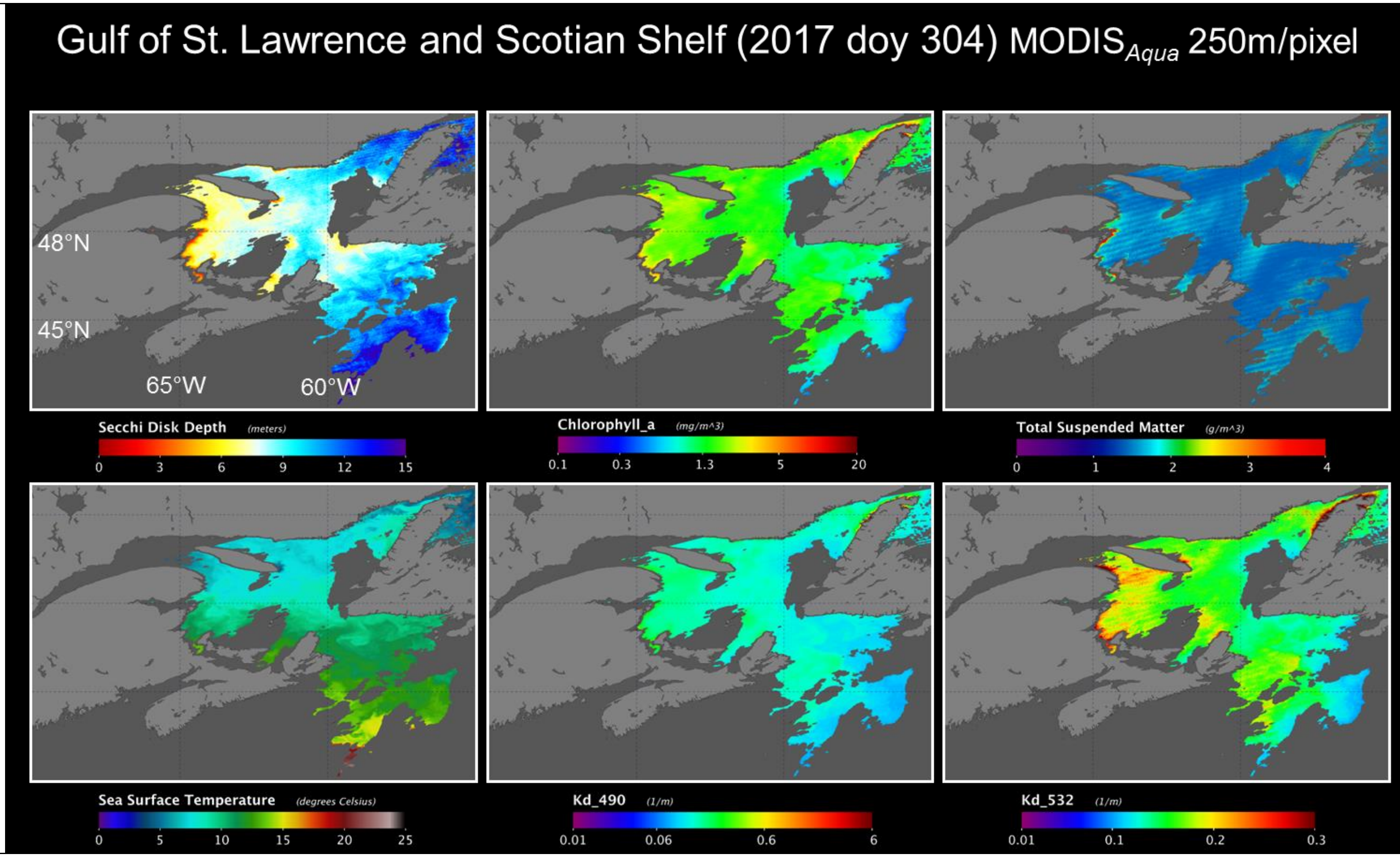


Figure APX 2.43. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf on October 31st 2017 (doy =304). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

2018

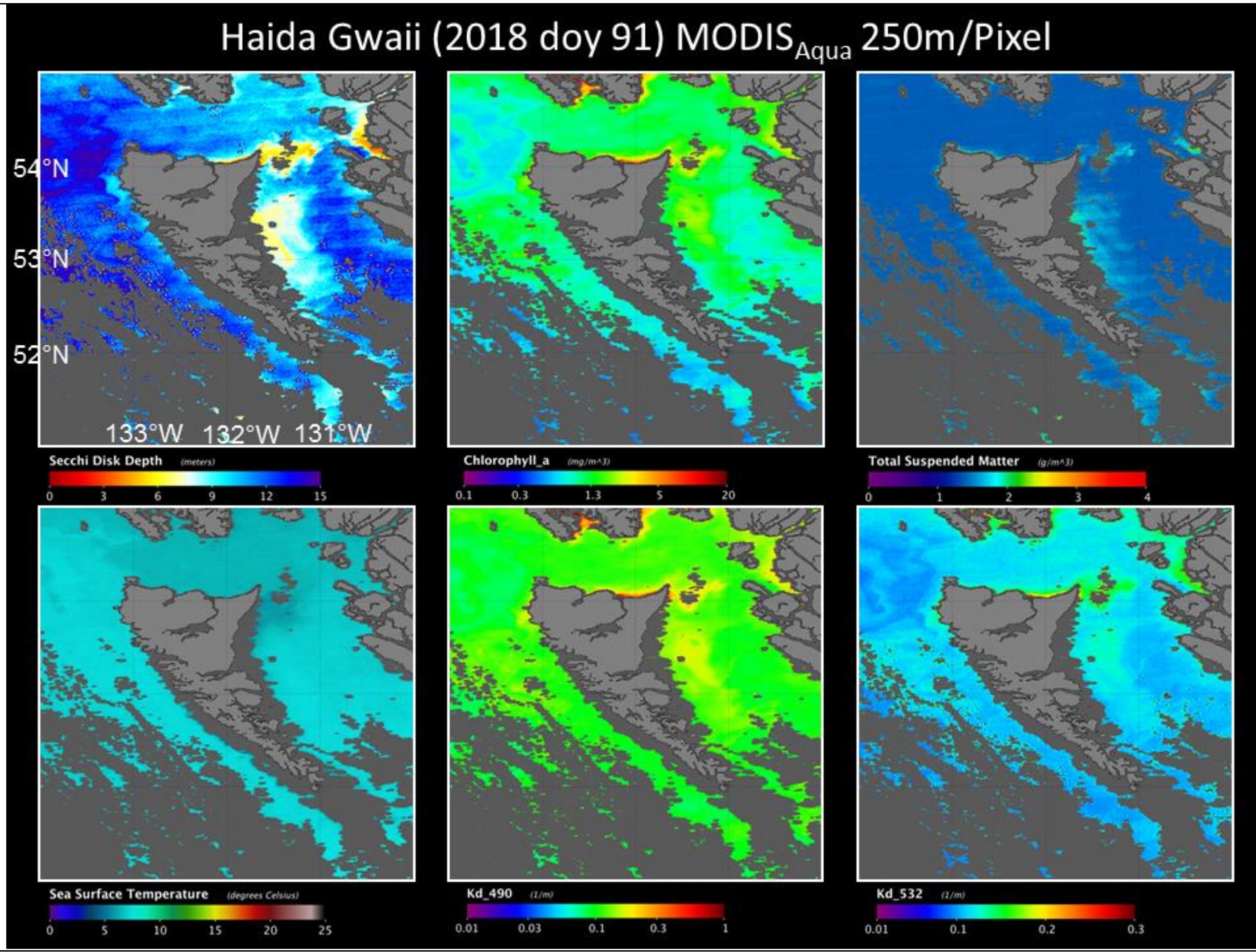


Figure APX 2.44. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on April 1st 2018 (doy = 91). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

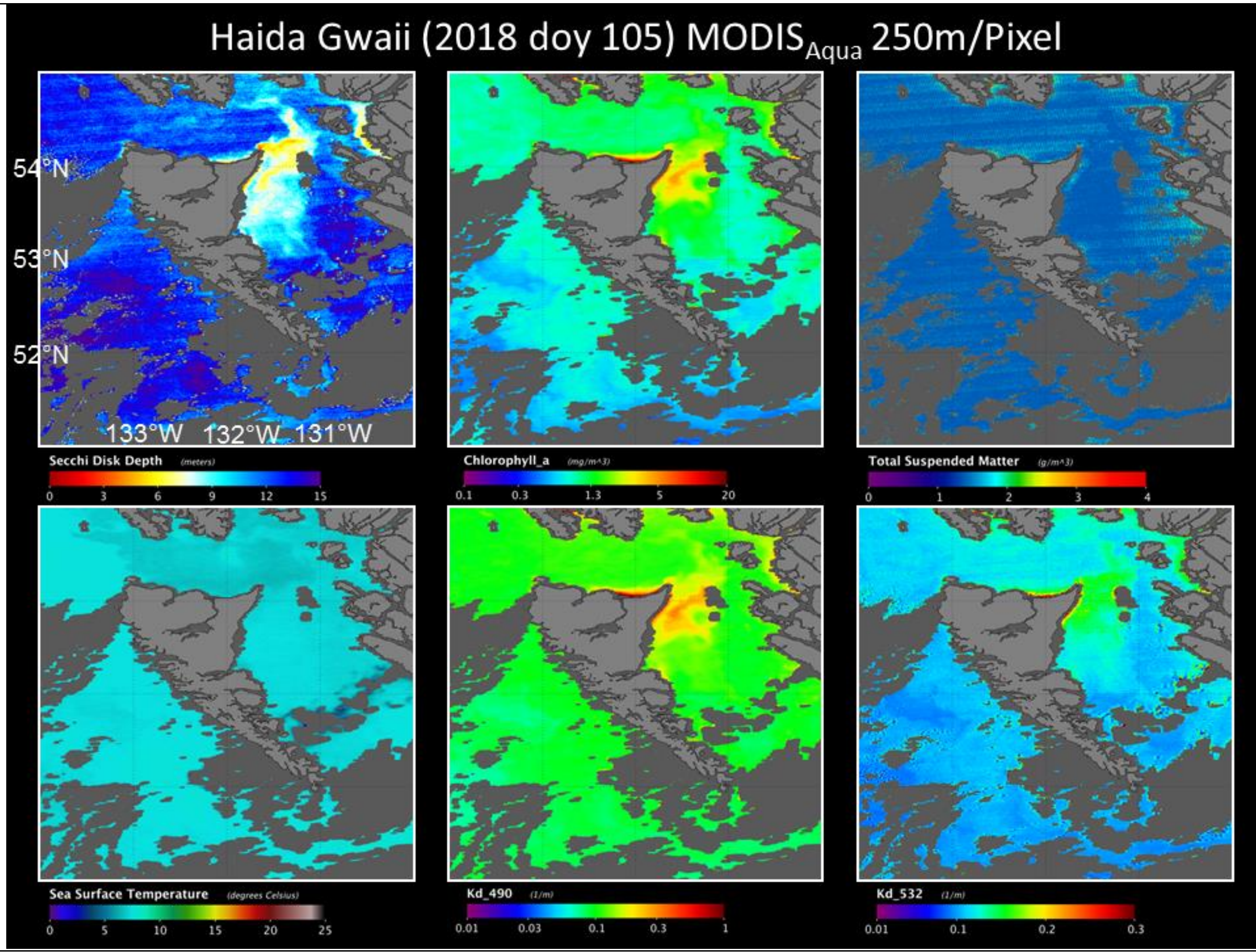


Figure APX 2.45. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on April 15th 2018 (doy = 105). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

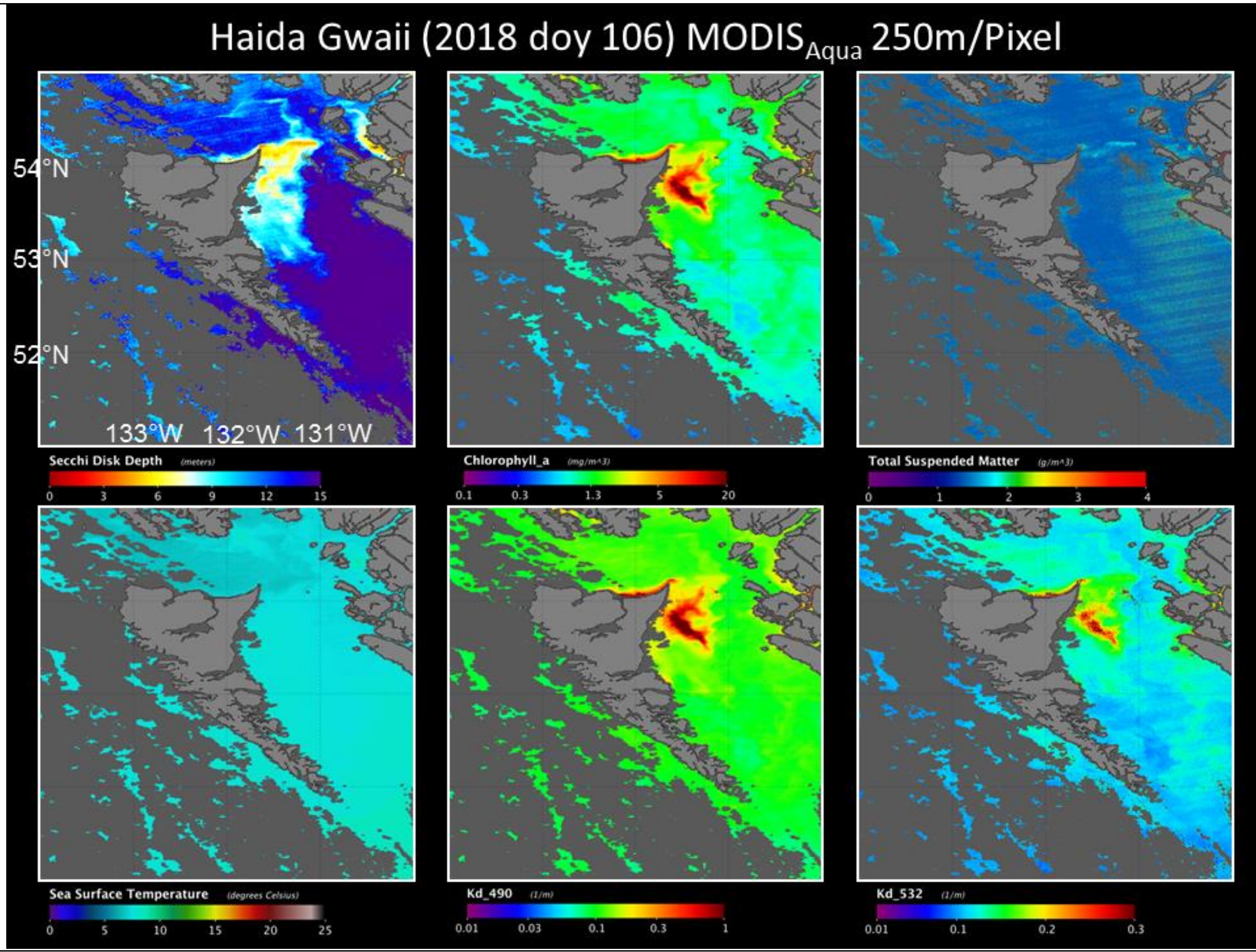


Figure APX 2.46. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on April 16th 2018 (doy = 106). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

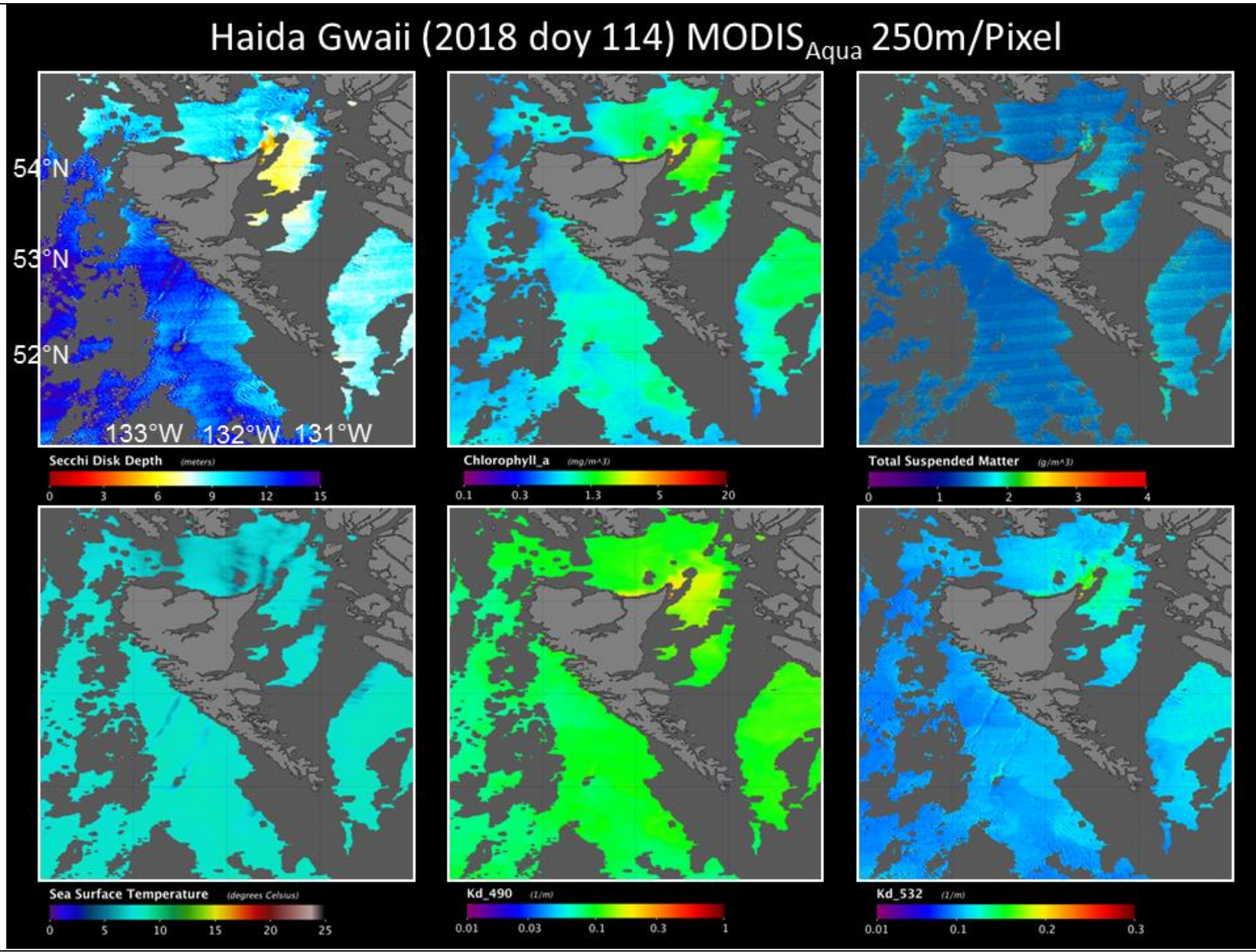


Figure APX 2.47. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on April 24th 2018 (doy = 114). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

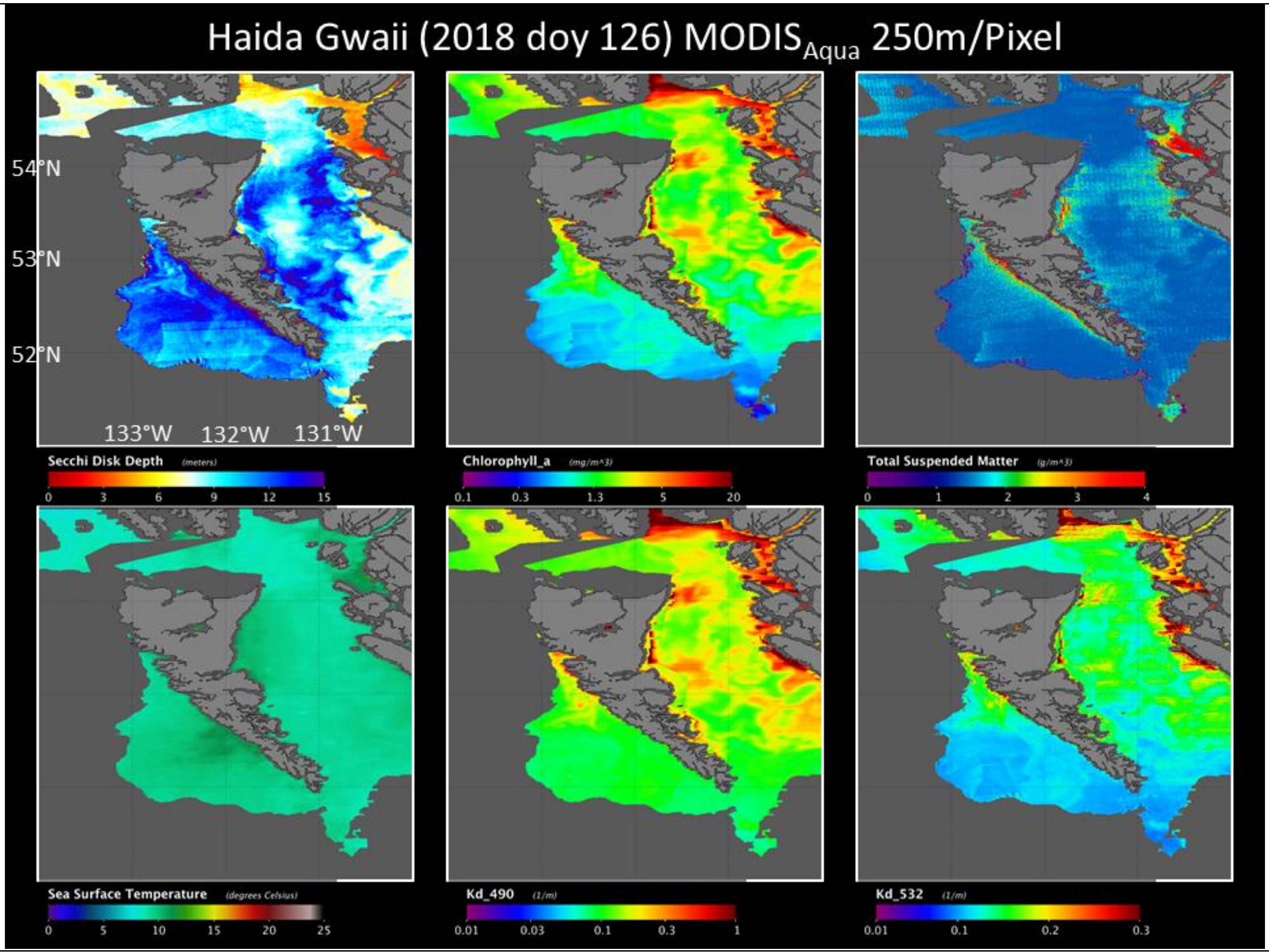


Figure APX 2.48. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on May 6th 2018 (doy = 126). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

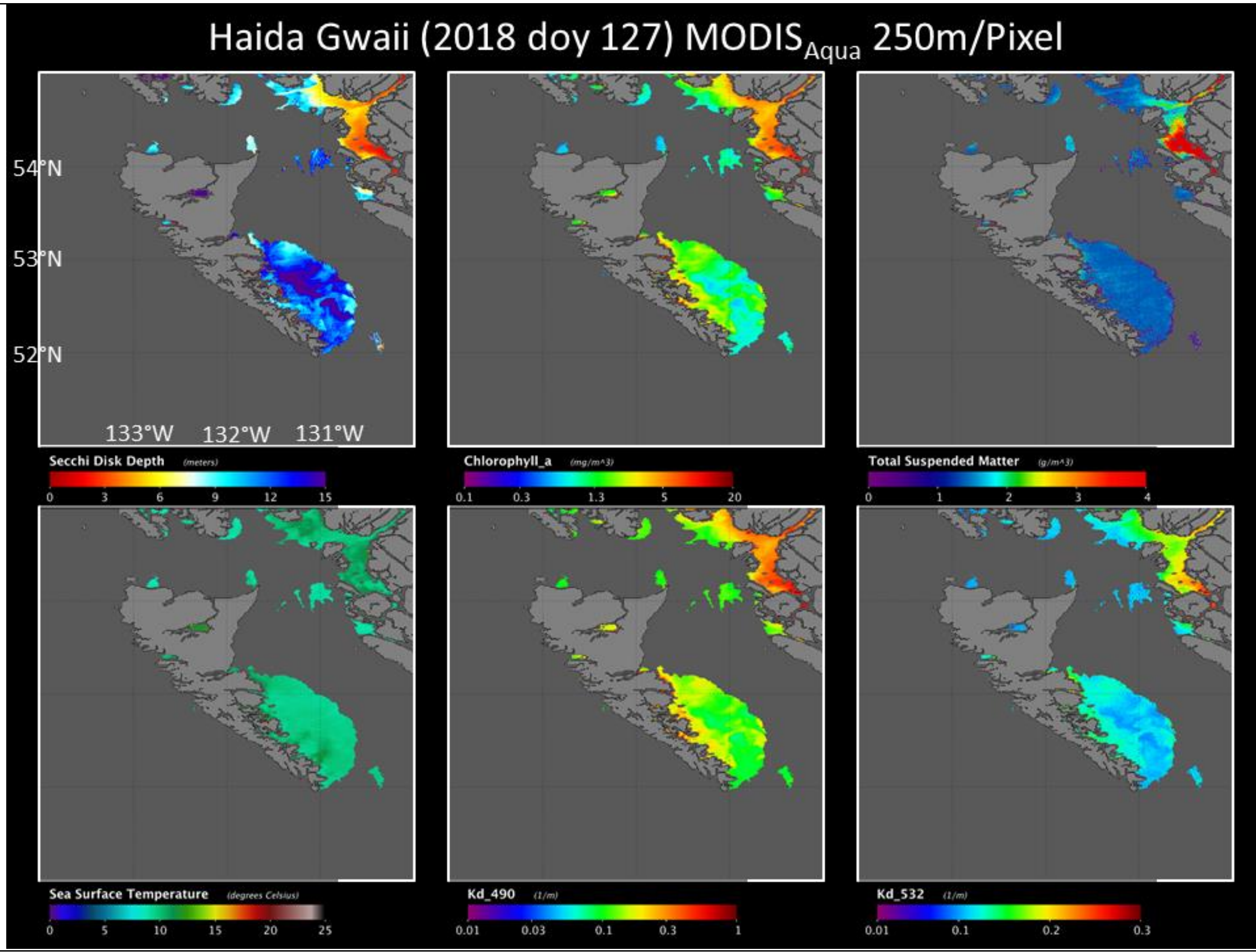


Figure APX 2.49. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on May 7th 2018 (doy = 127). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

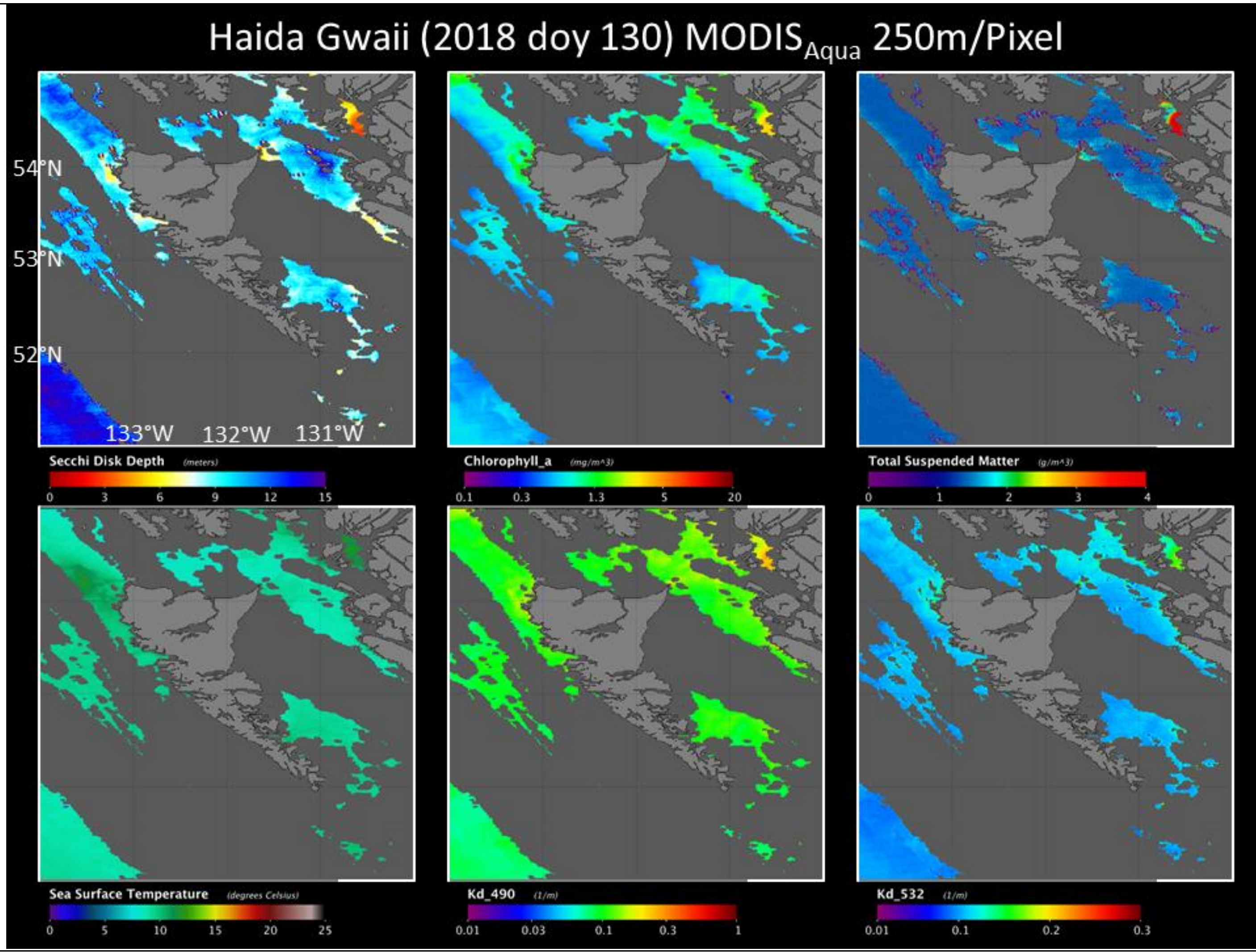


Figure APX 2.50. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on May 10th 2018 (doy = 130). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

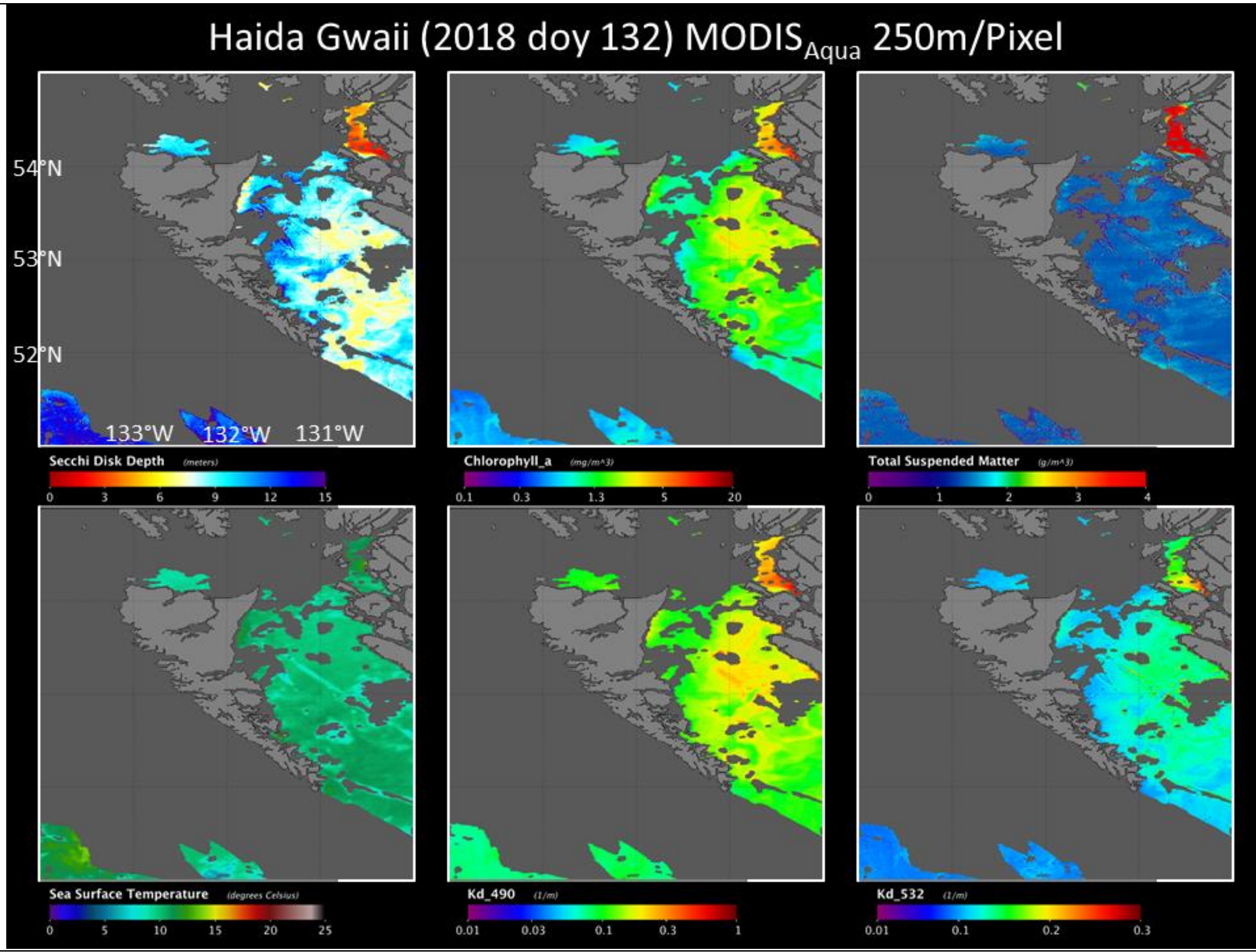


Figure APX 2.51. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on May 12th 2018 (doy = 132). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

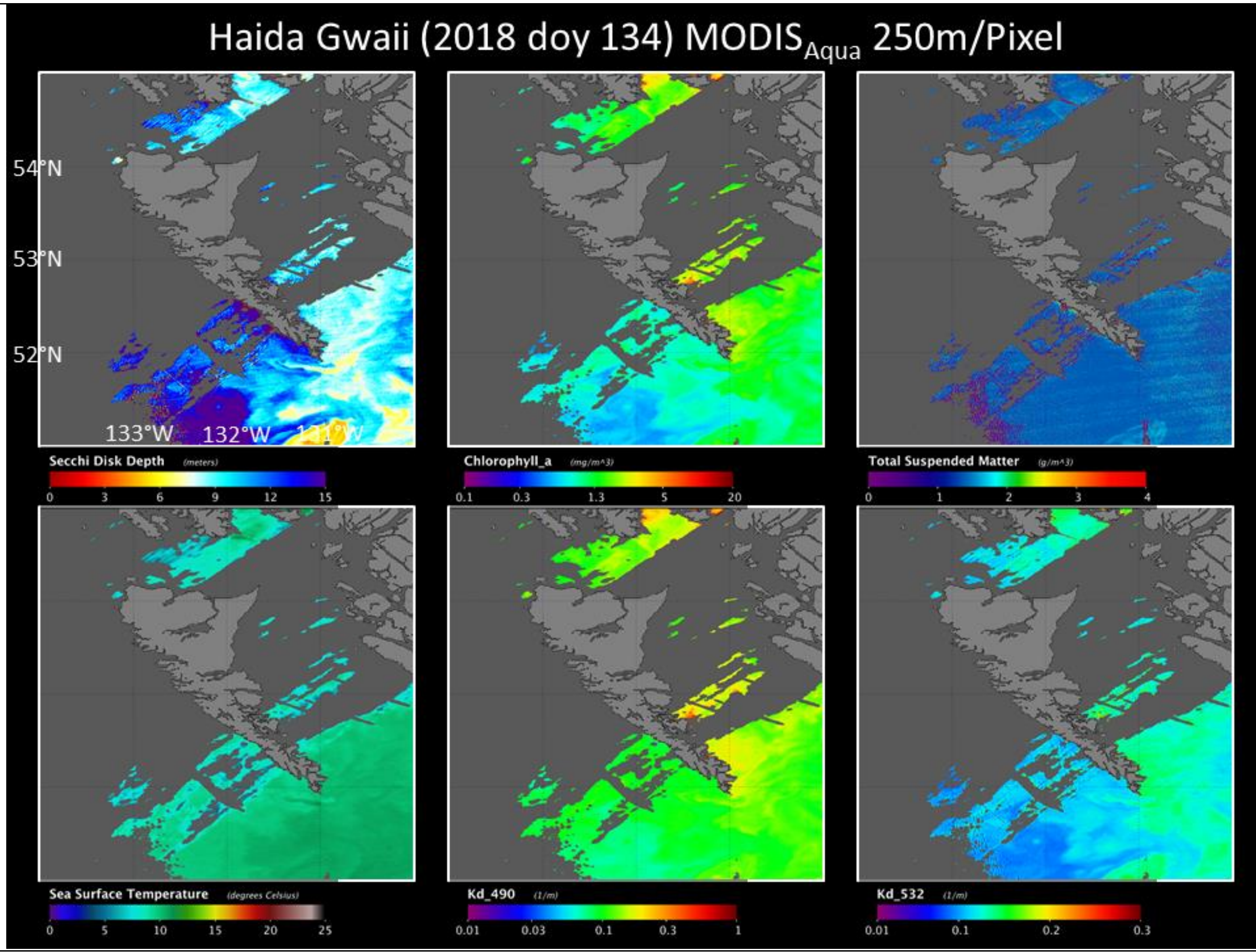


Figure APX 2.52. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on May 14th 2018 (doy = 134). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

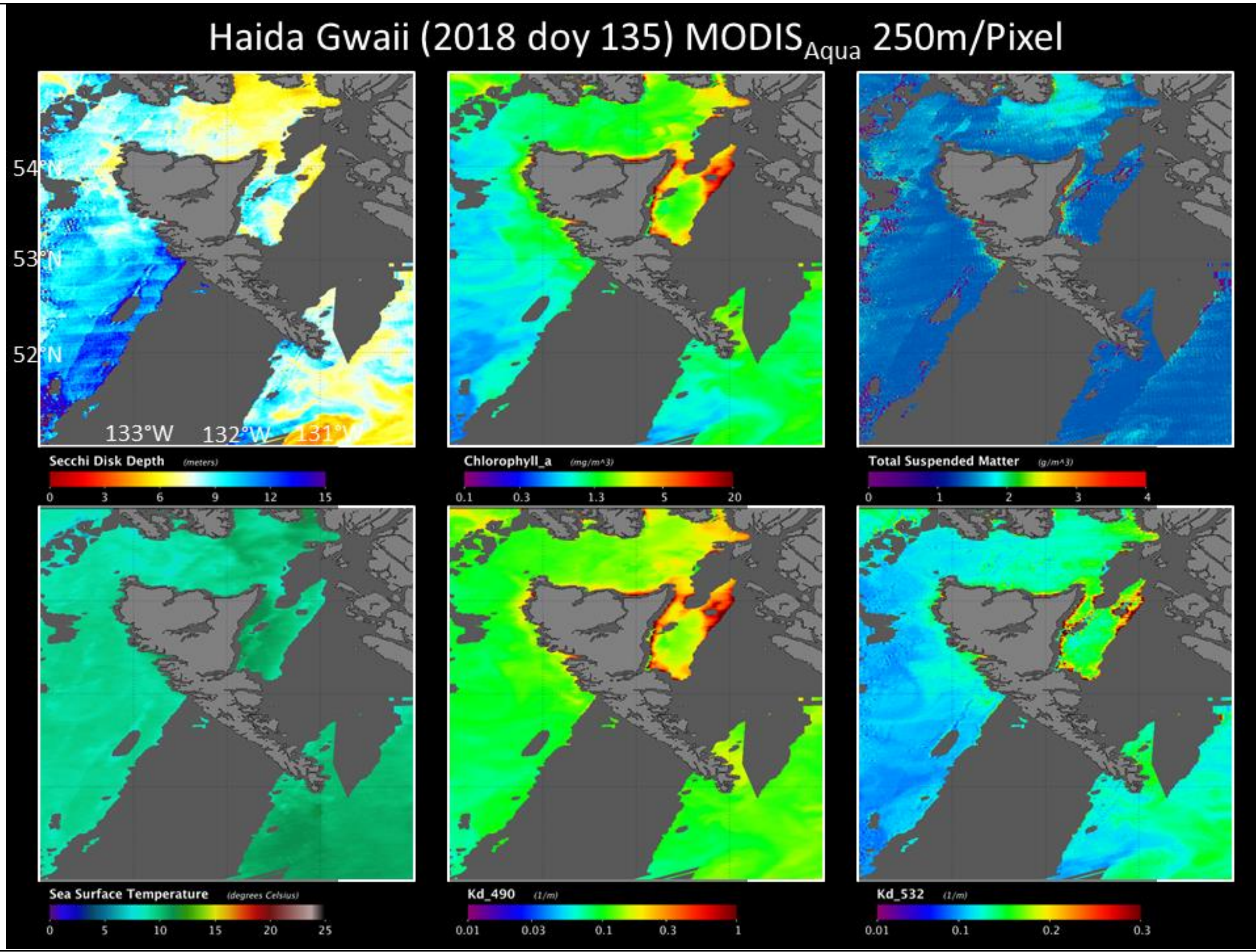


Figure APX 2.53. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on May 15th 2018 (doy = 135). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

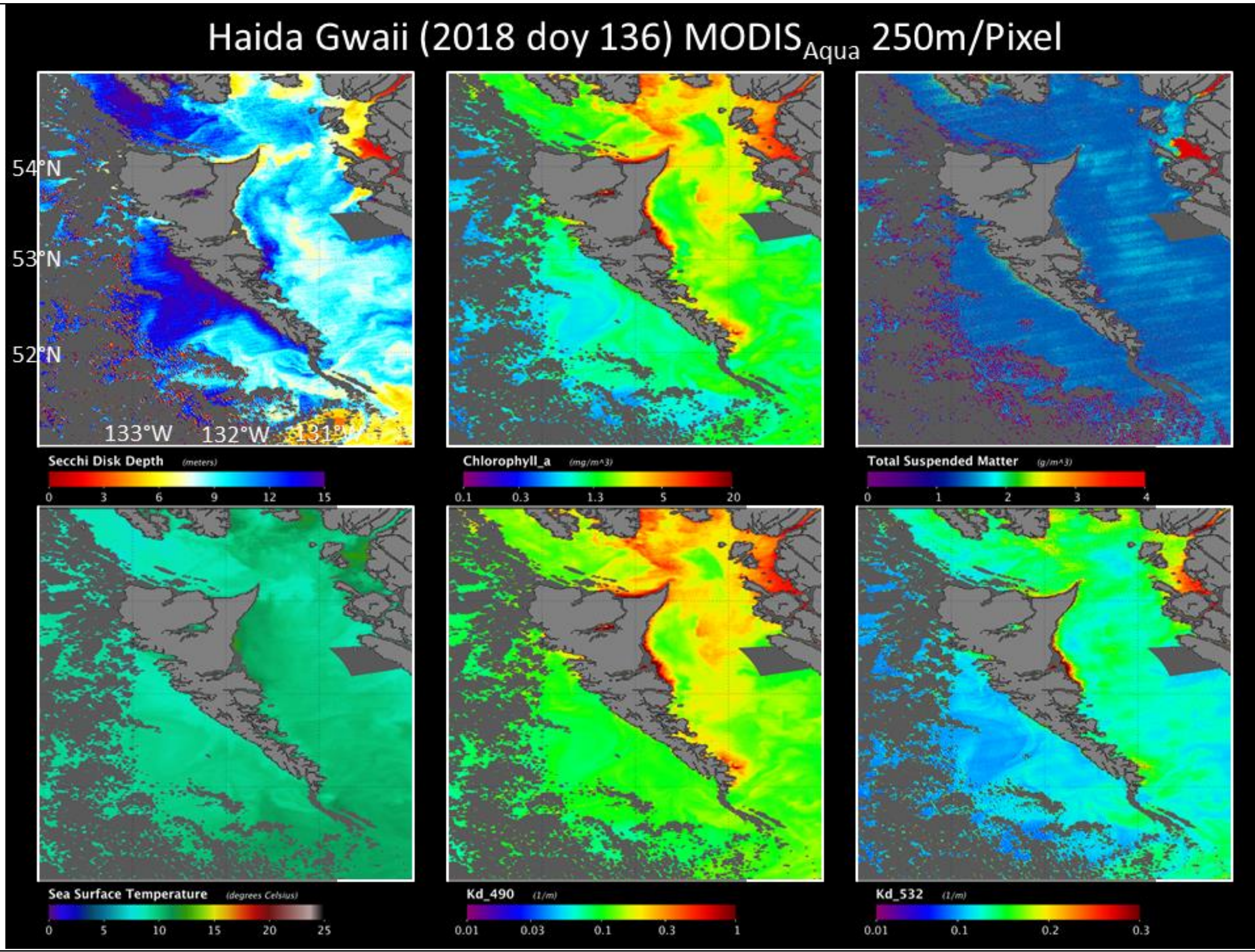


Figure APX 2.54. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on May 16th 2018 (doy = 136). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

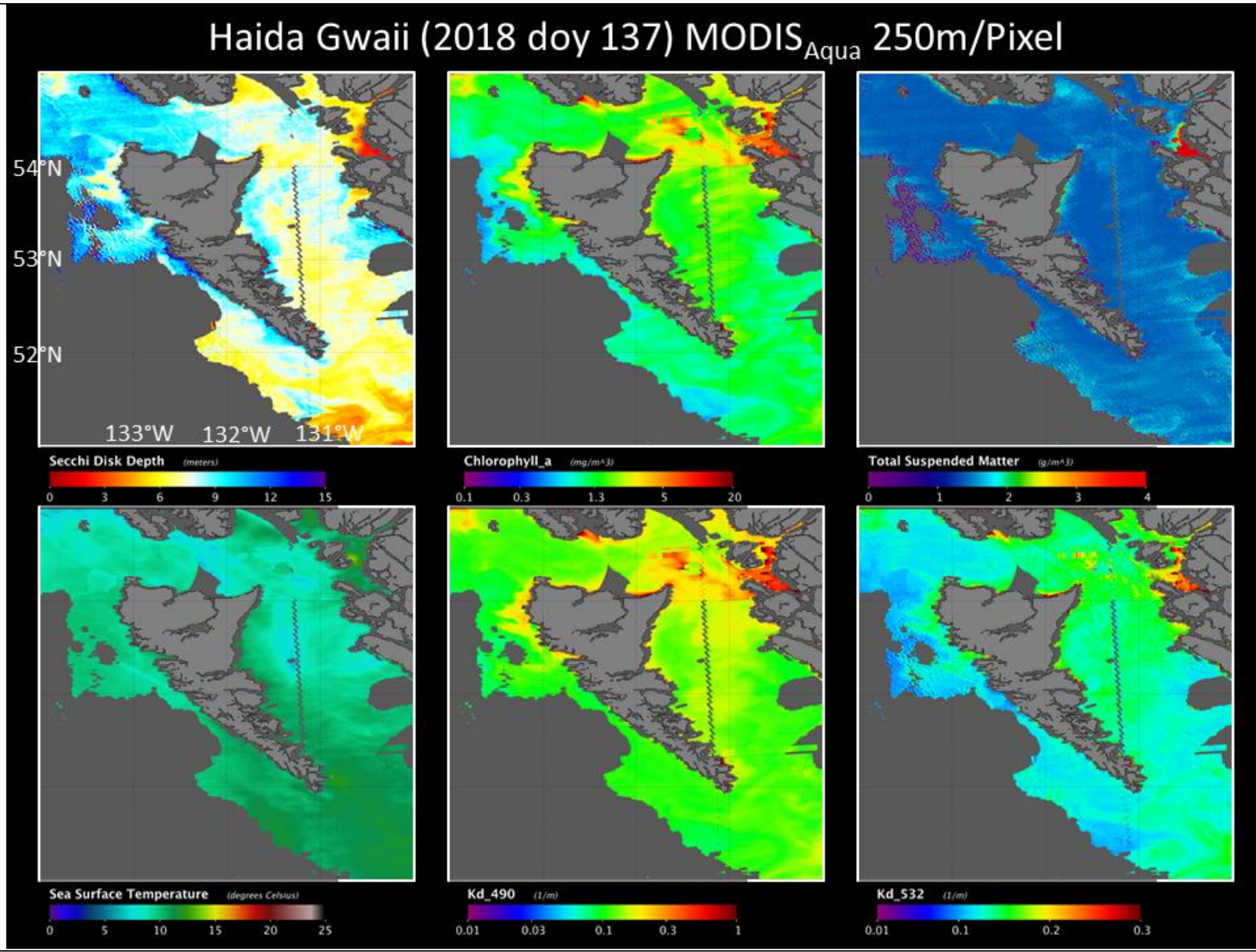


Figure APX 2.55. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on May 17th 2018 (doy = 137). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

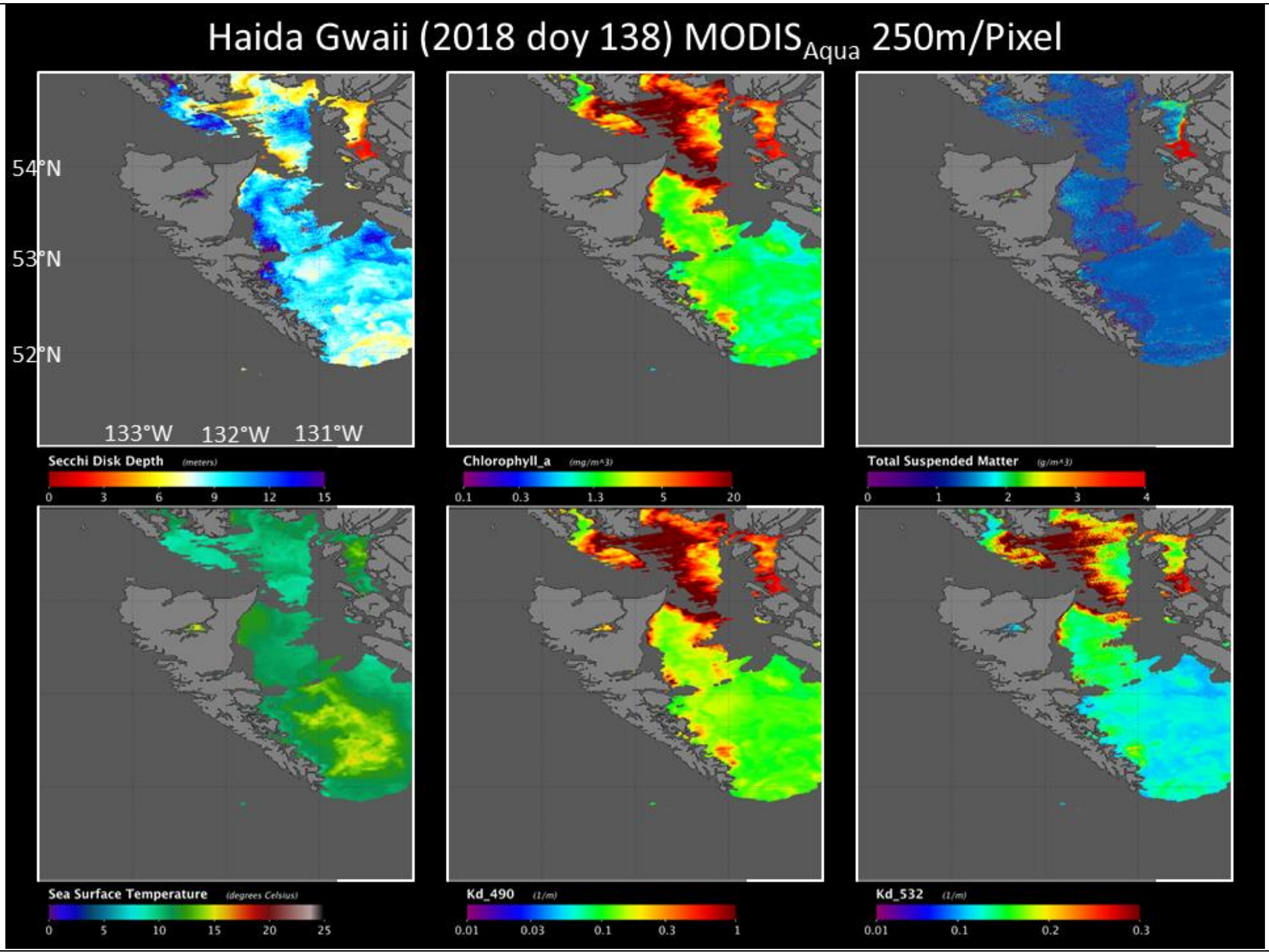


Figure APX 2.56. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on May 18th 2018 (doy = 138). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

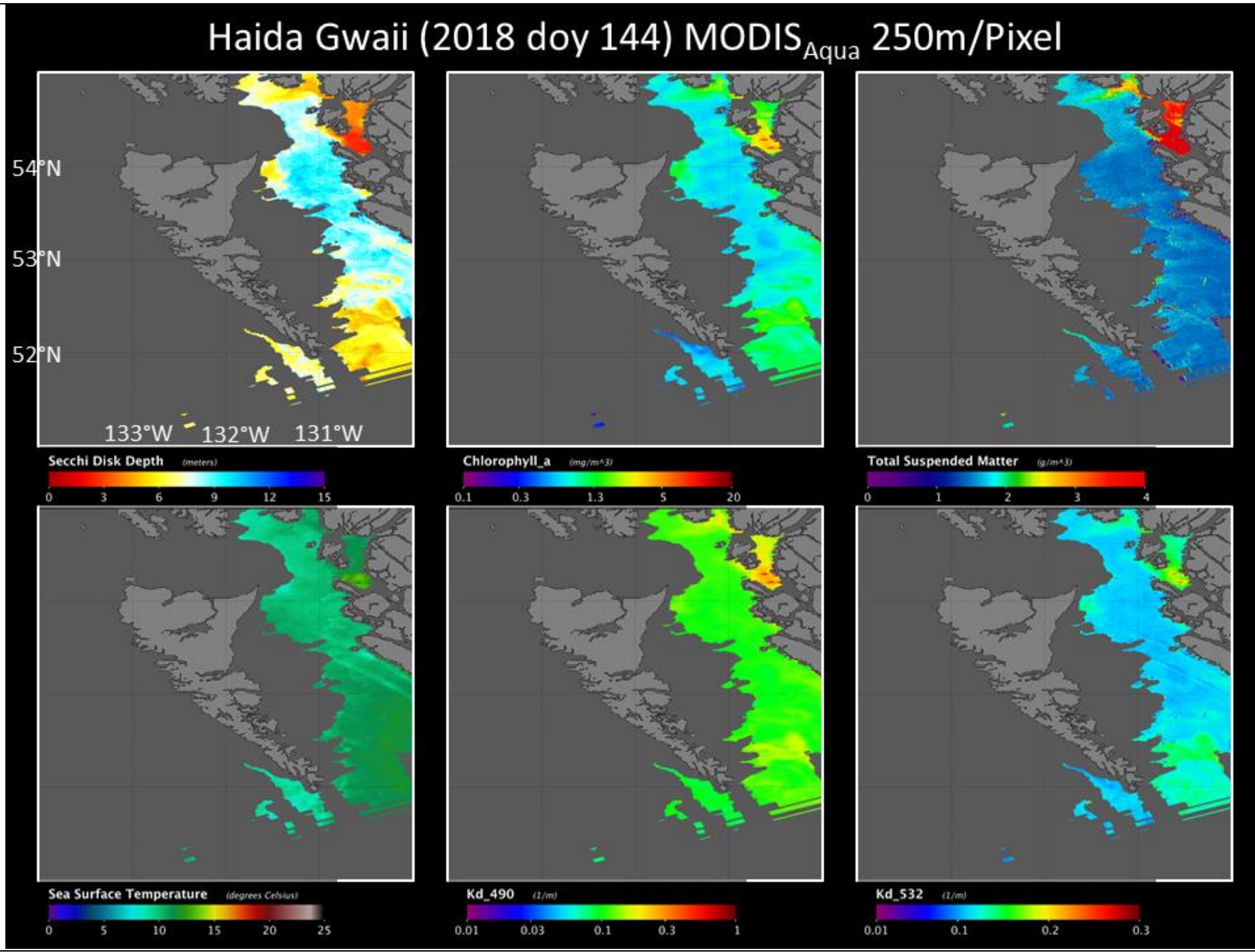


Figure APX 2.57. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on May 24th 2018 (doy = 144). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

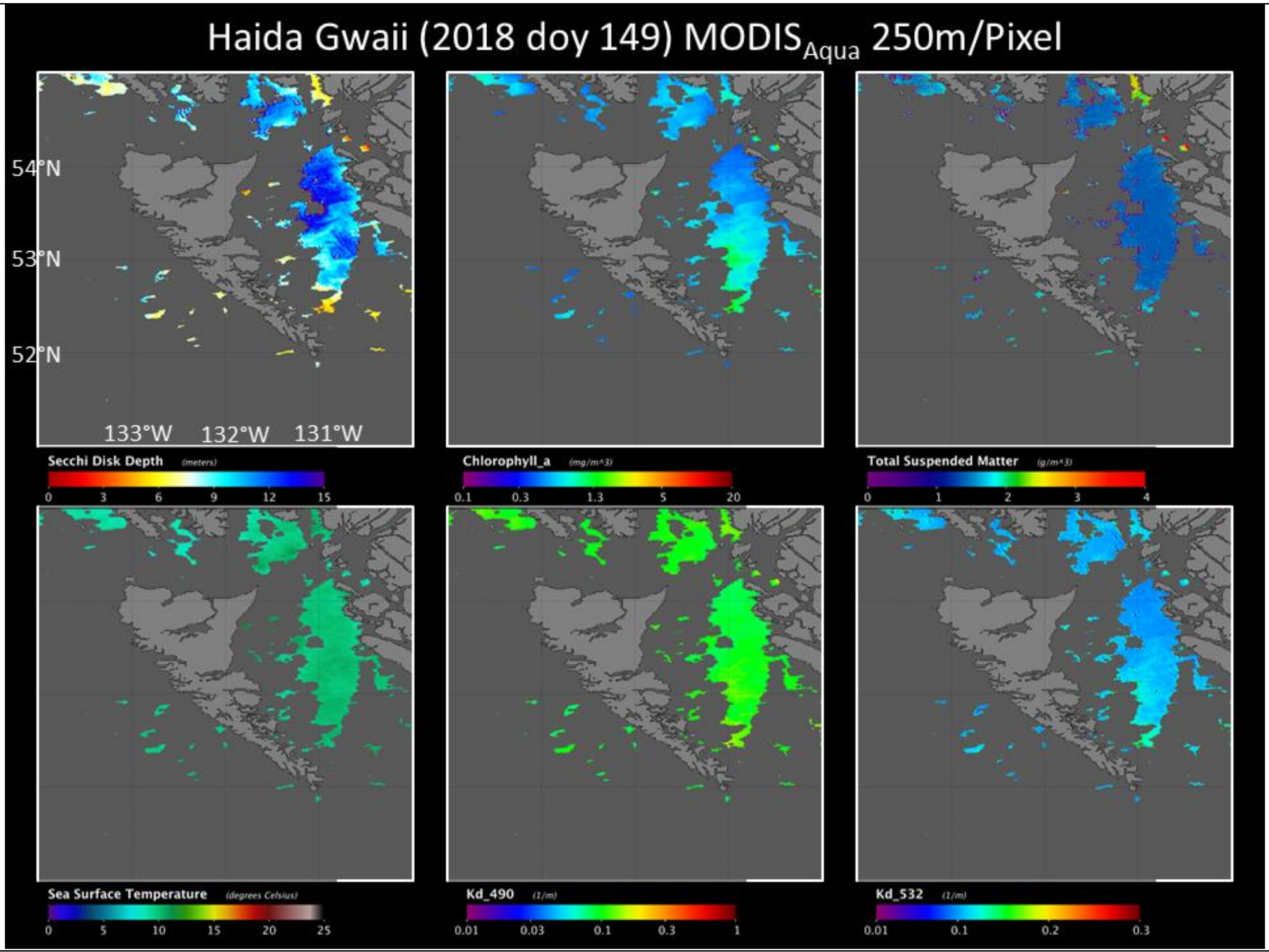


Figure APX 2.58. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on May 29th 2018 (doy = 149). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

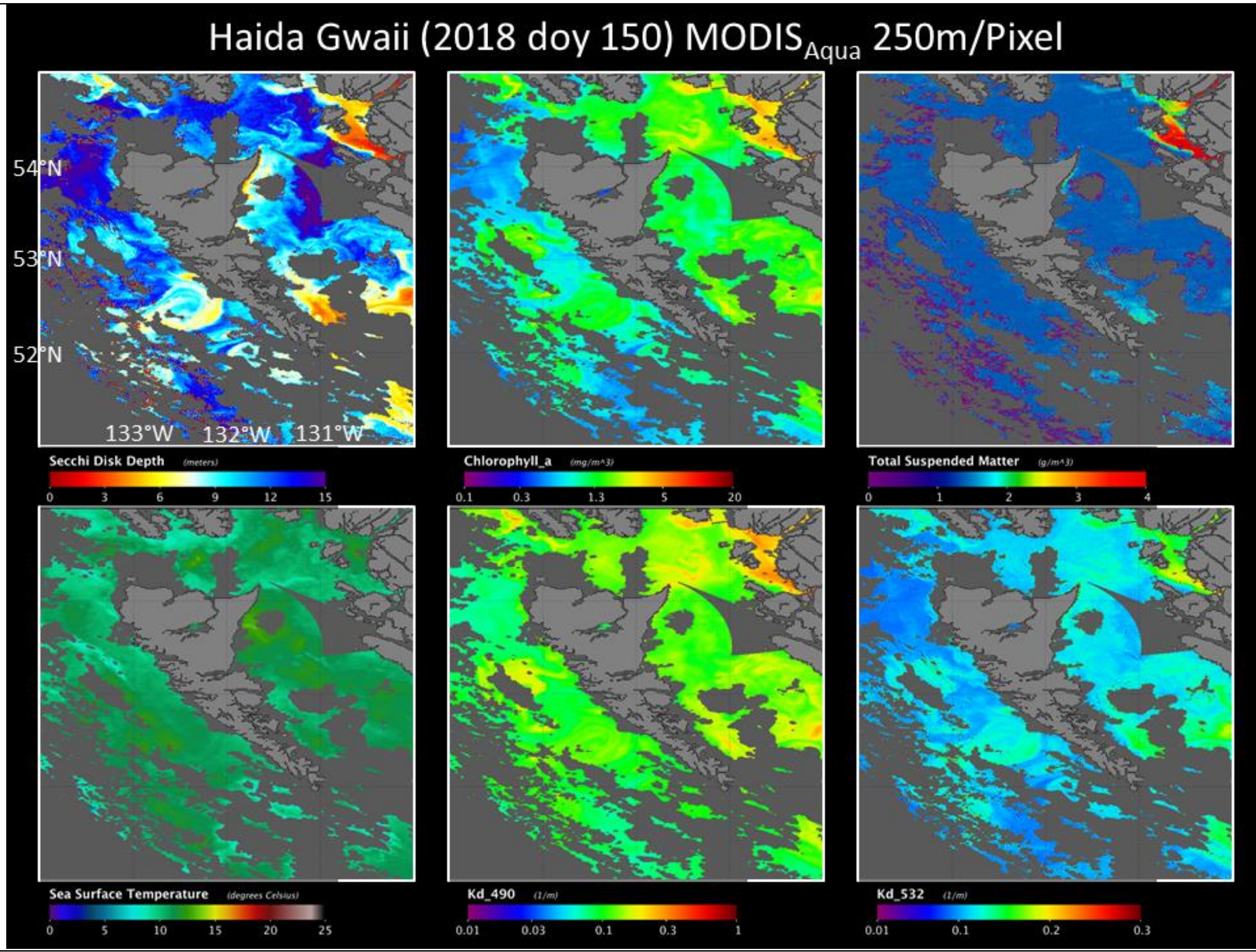


Figure APX 2.59. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on May 30th 2018 (doy = 150). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

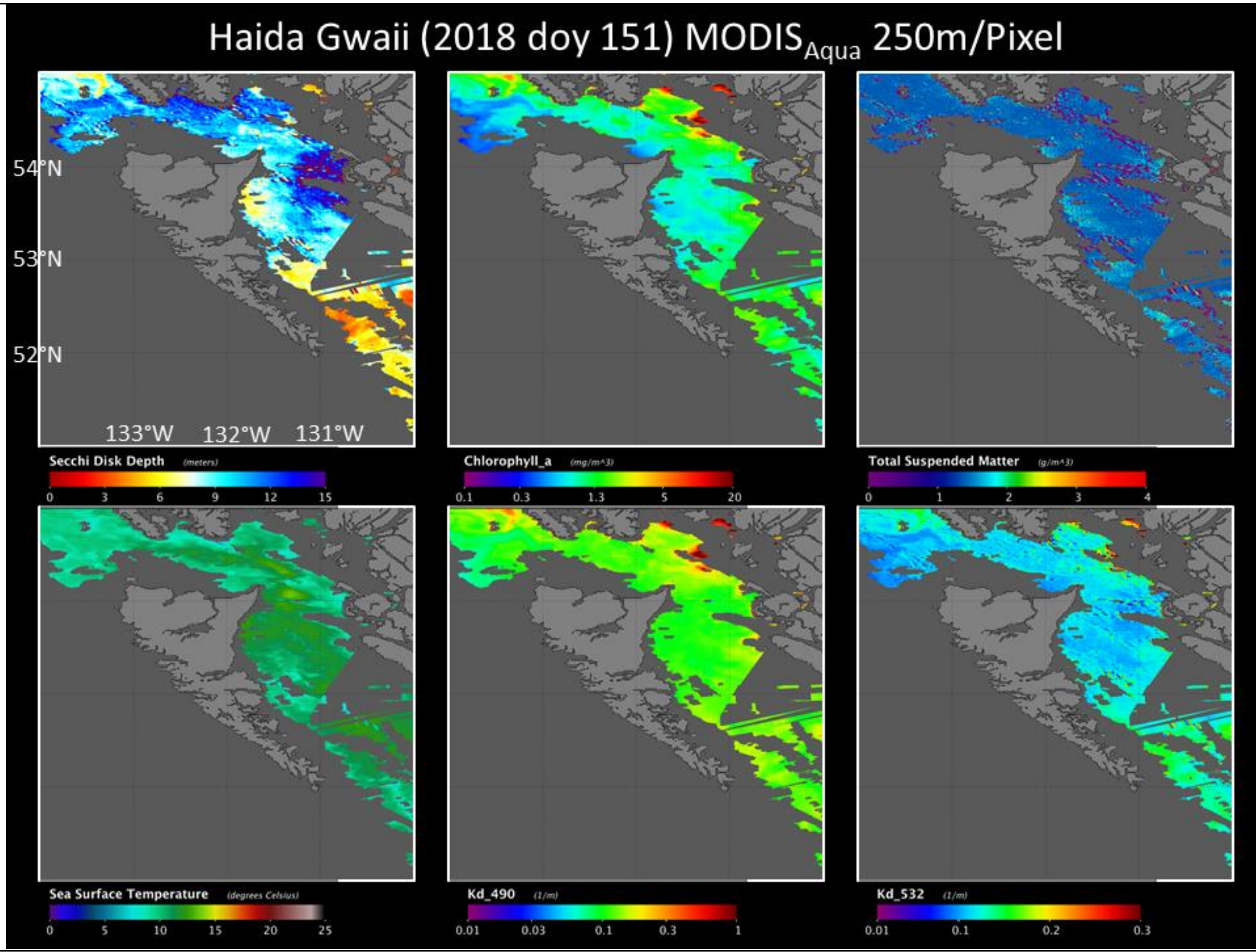


Figure APX 2.60. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on May 31st 2018 (doy = 151). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

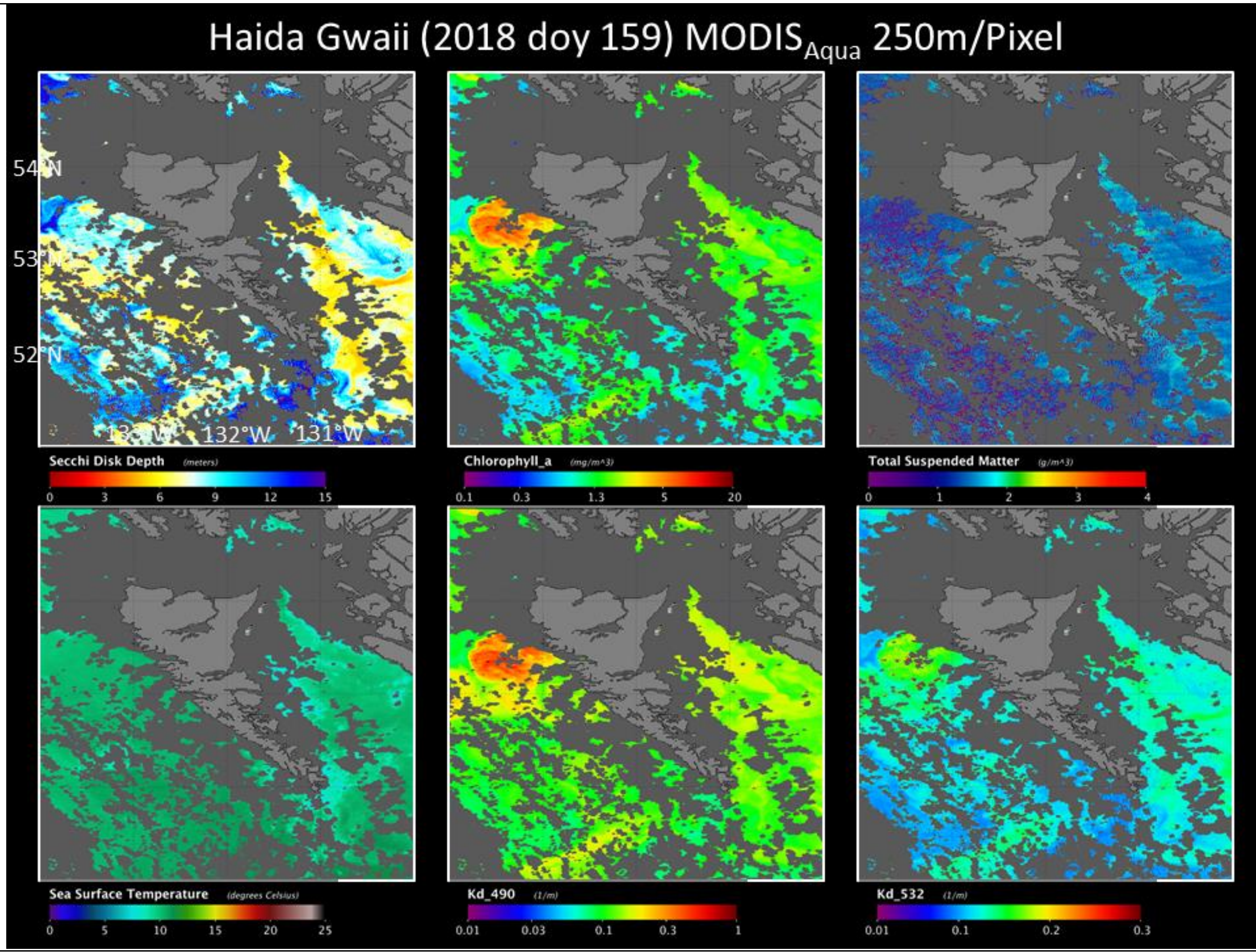


Figure APX 2.61. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on June 8th 2018 (doy = 159). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

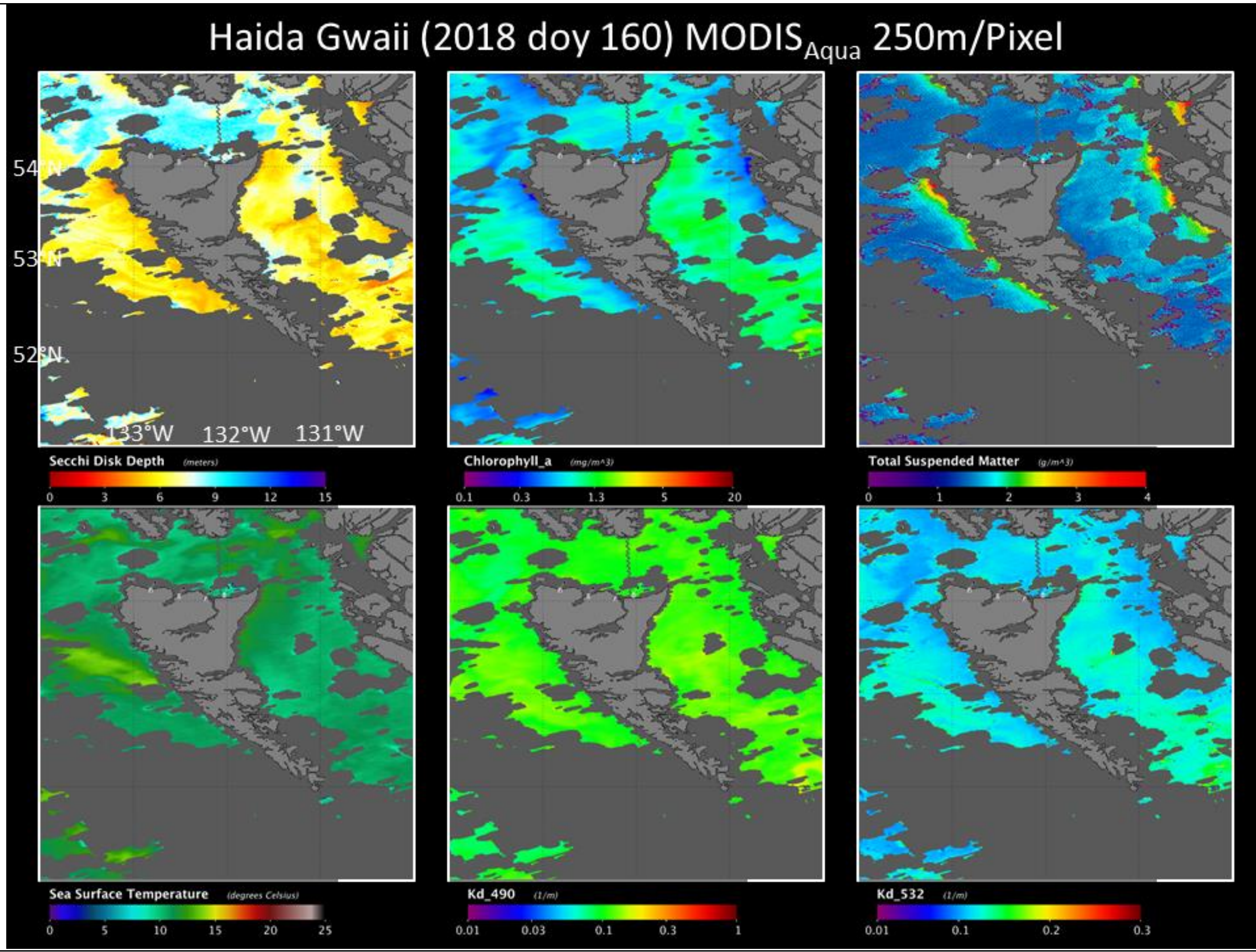


Figure APX 2.62. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on June 9th 2018 (doy = 160). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

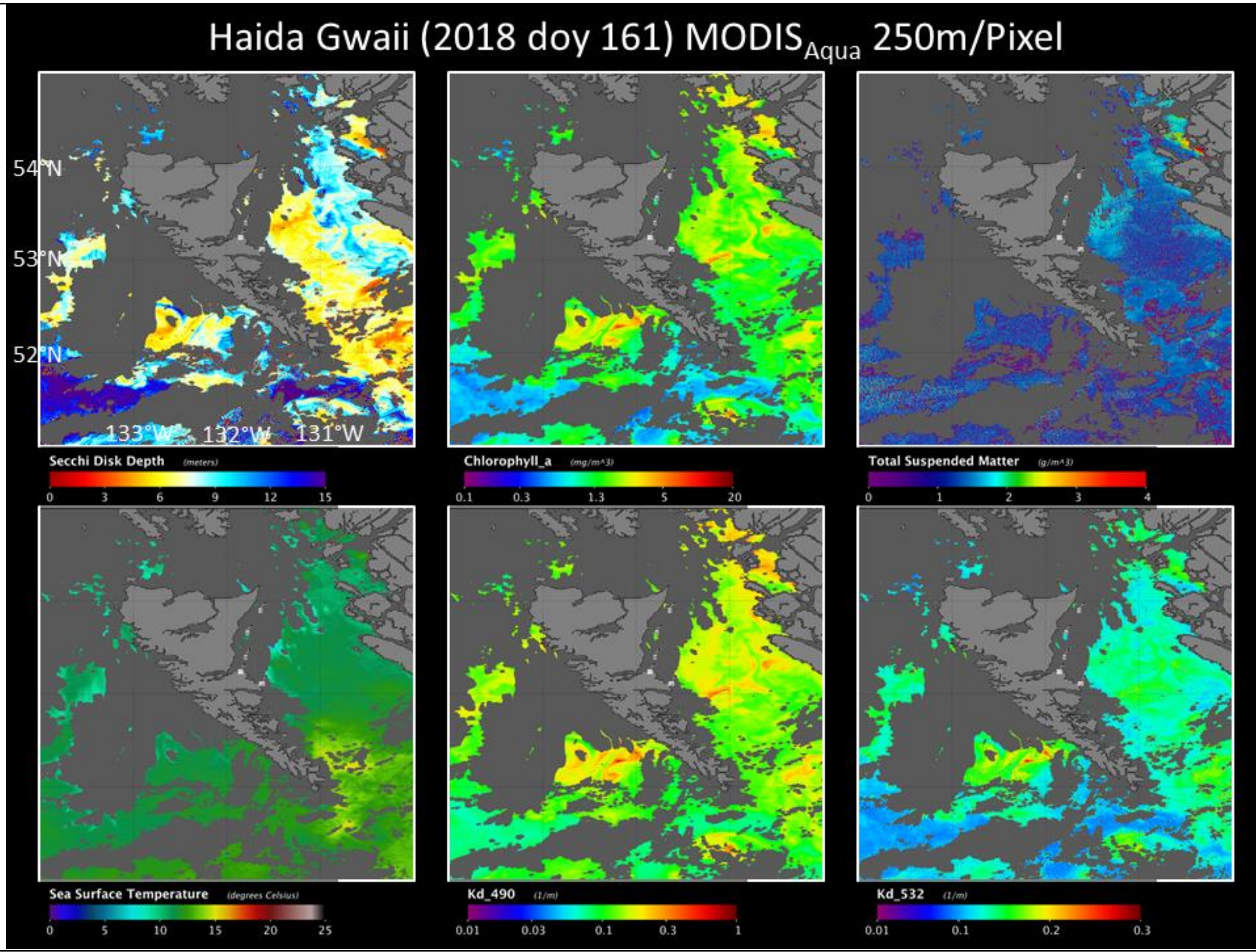


Figure APX 2.63. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on June 10th 2018 (doy = 161). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

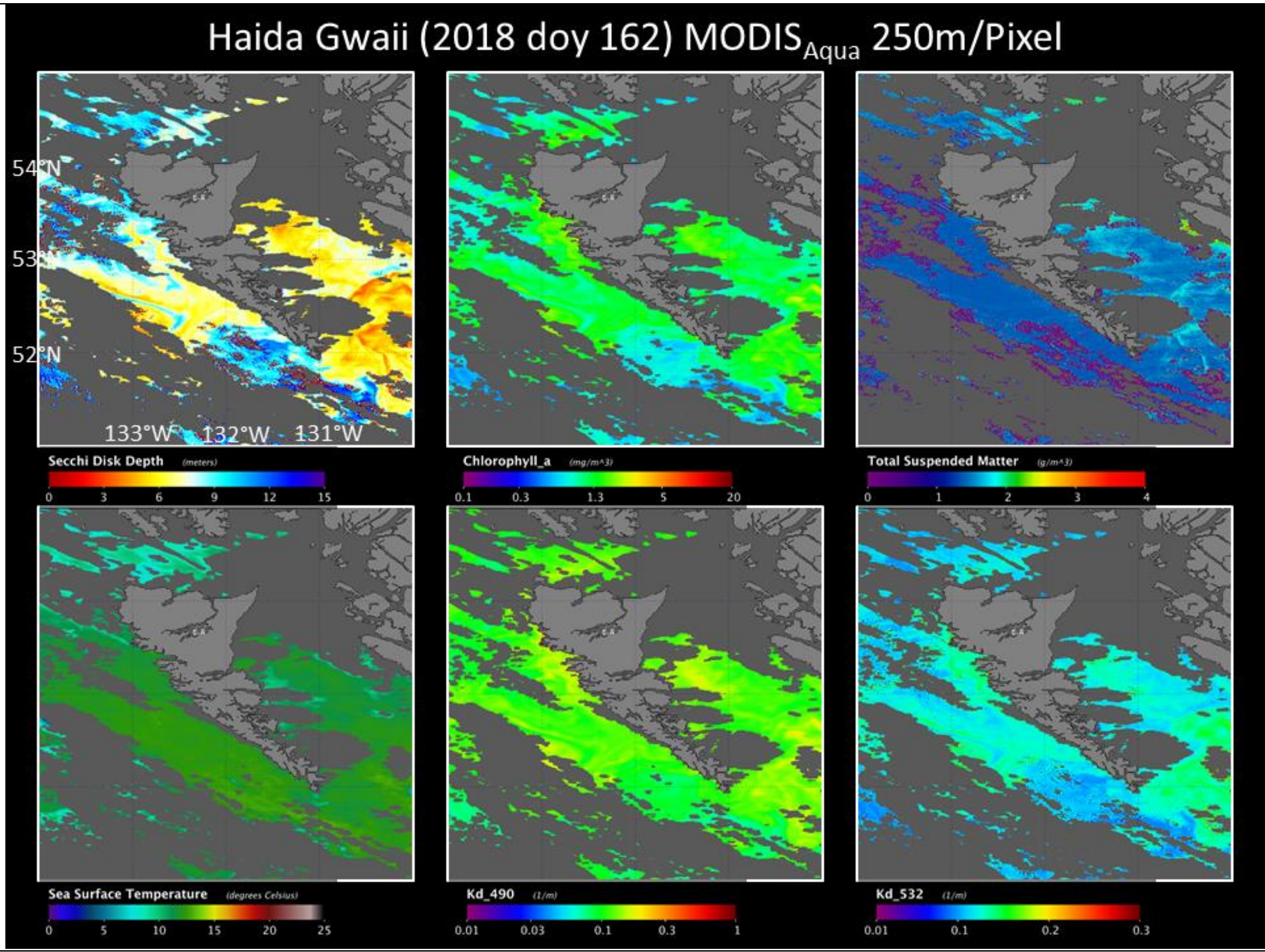


Figure APX 2.64. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on June 11th 2018 (doy = 162). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

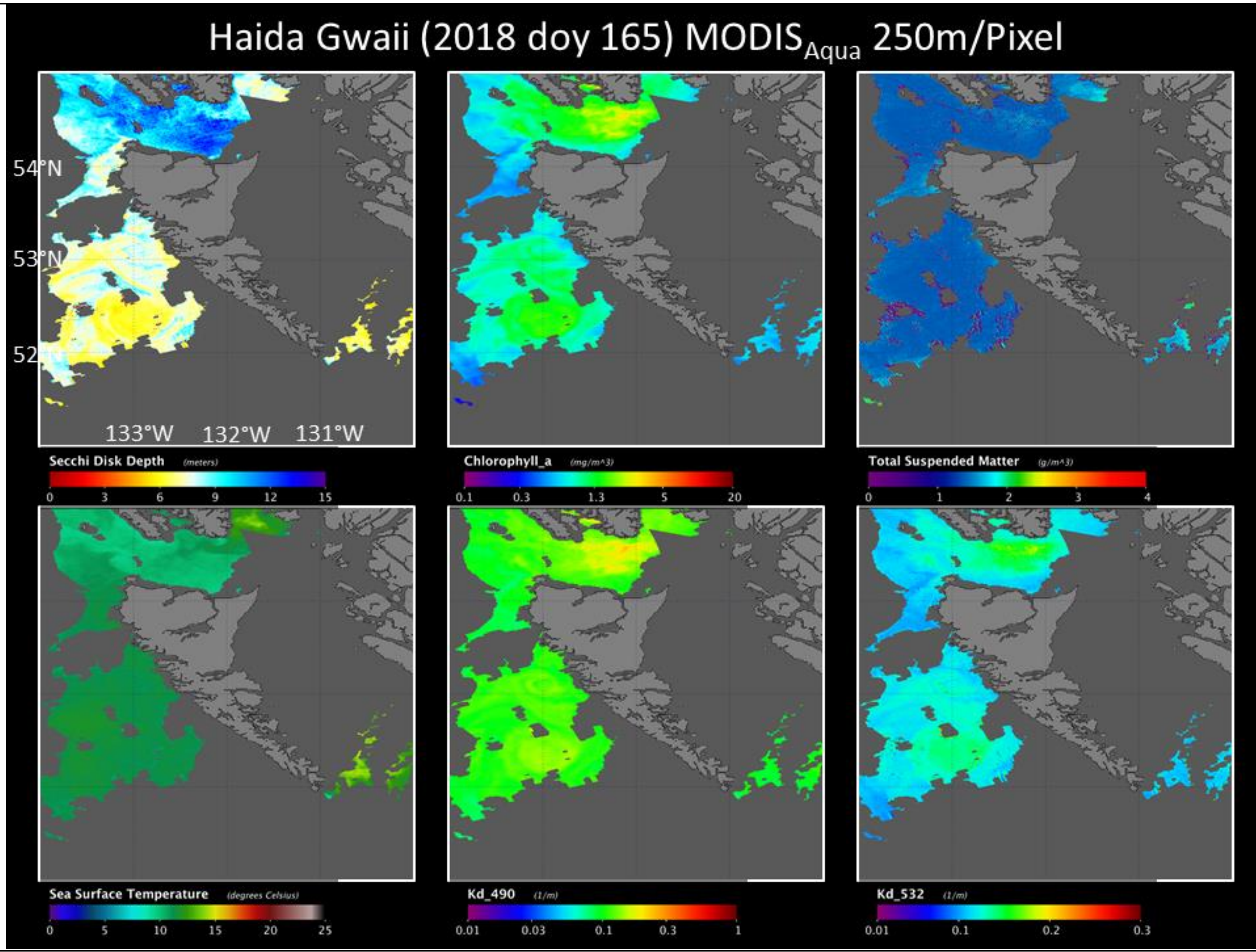


Figure APX 2.65. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on June 14th 2018 (doy = 165). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

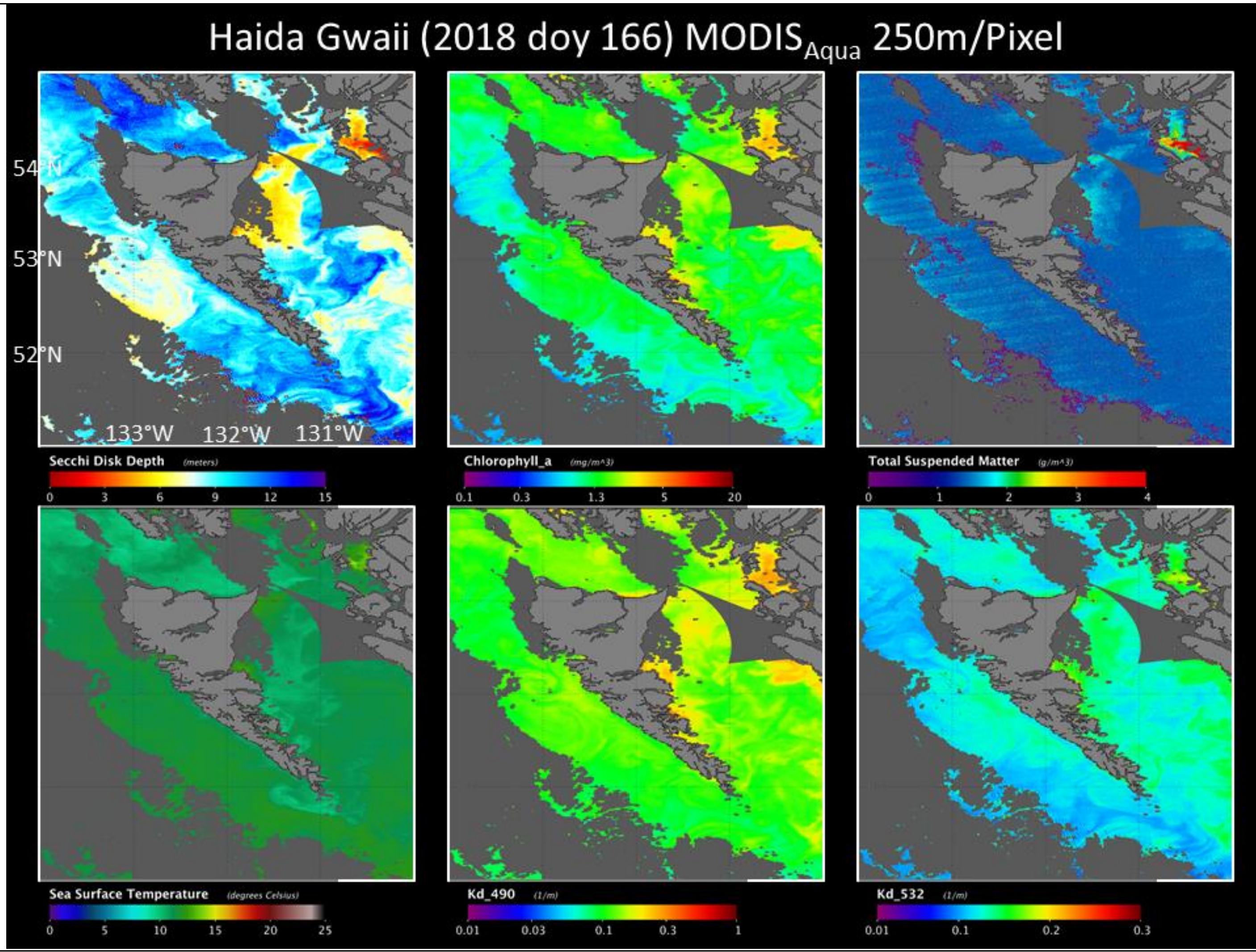


Figure APX 2.66. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on June 15th 2018 (doy = 166). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

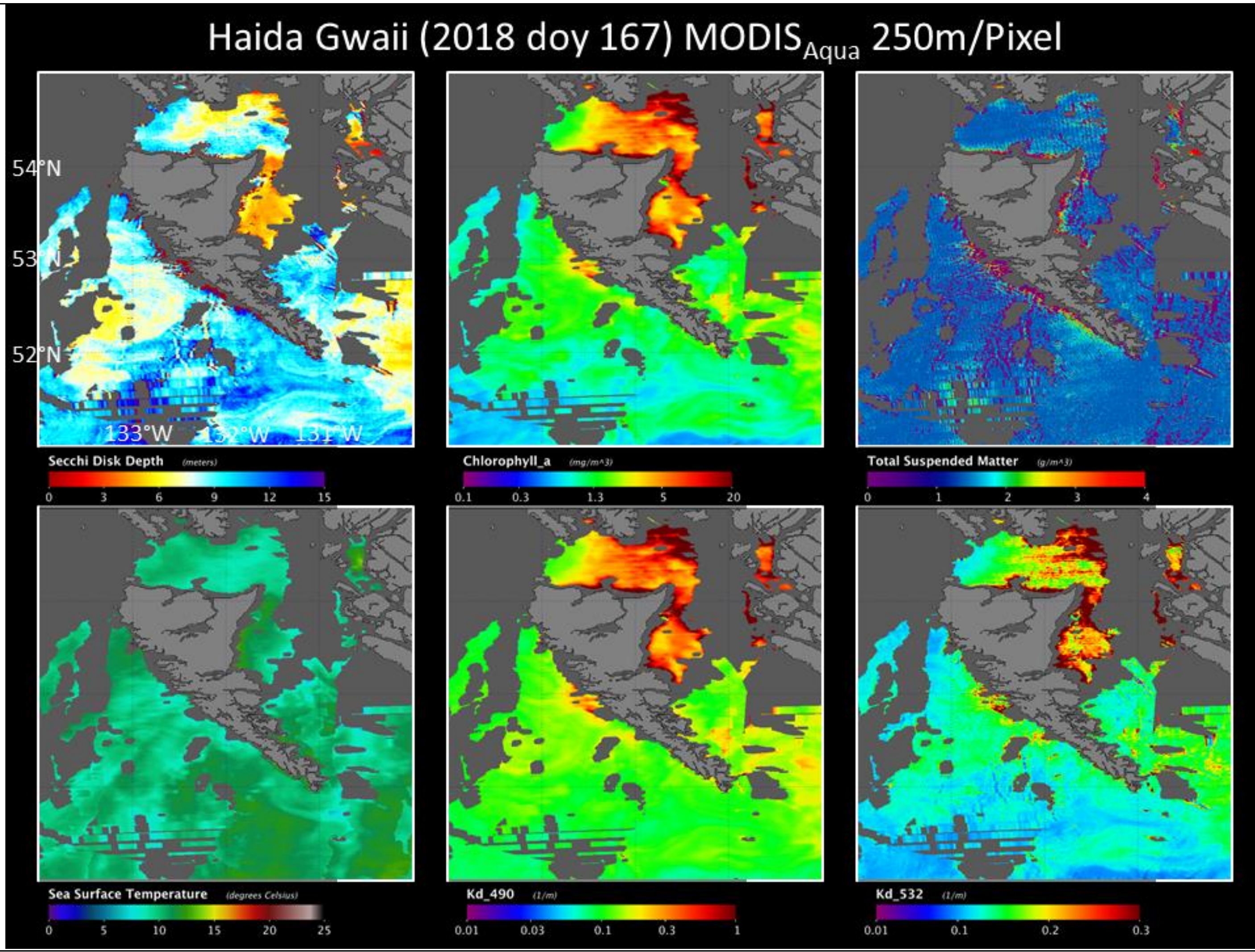


Figure APX 2.67. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on June 16th 2018 (doy = 167). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

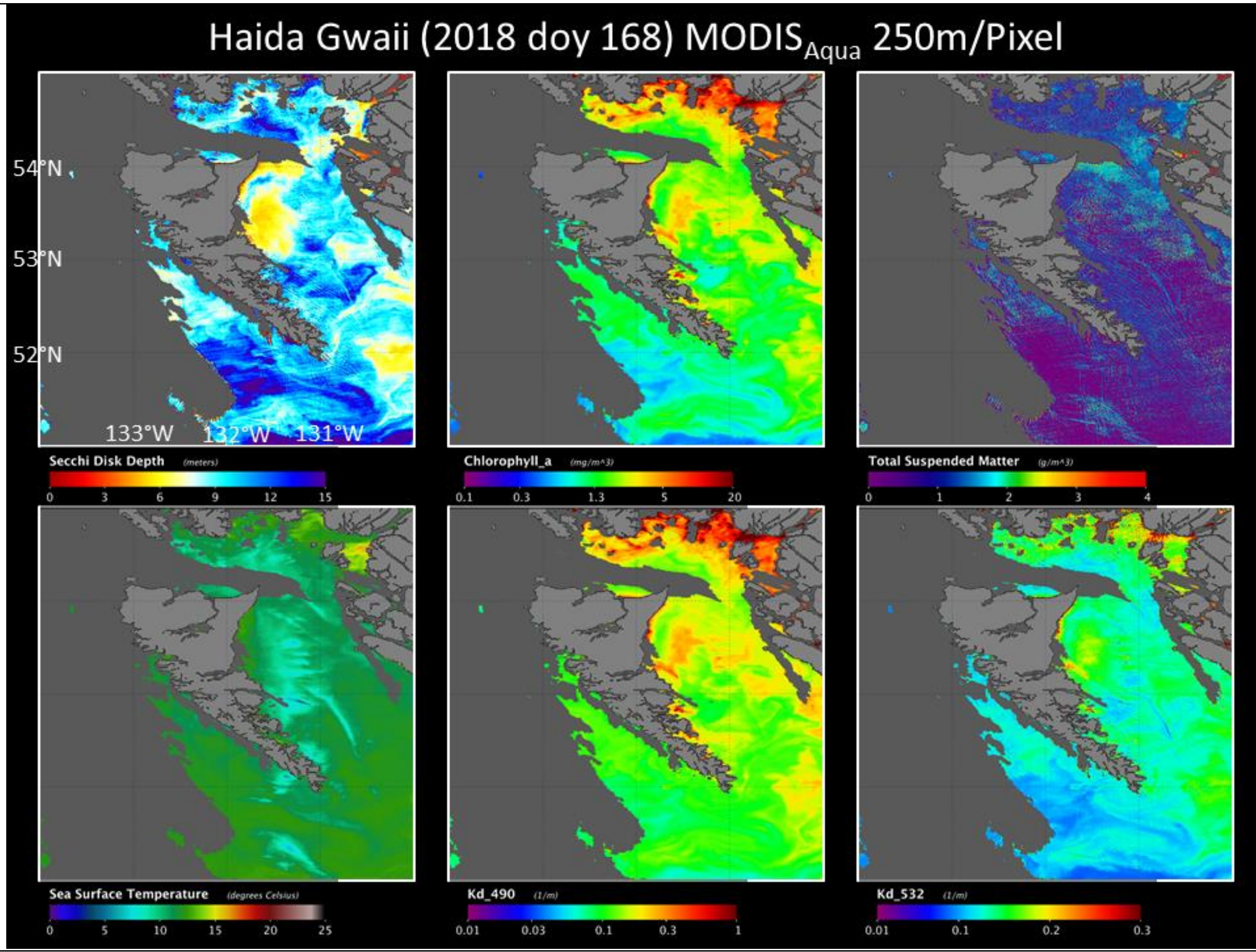


Figure APX 2.68. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on June 17th 2018 (doy = 168). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

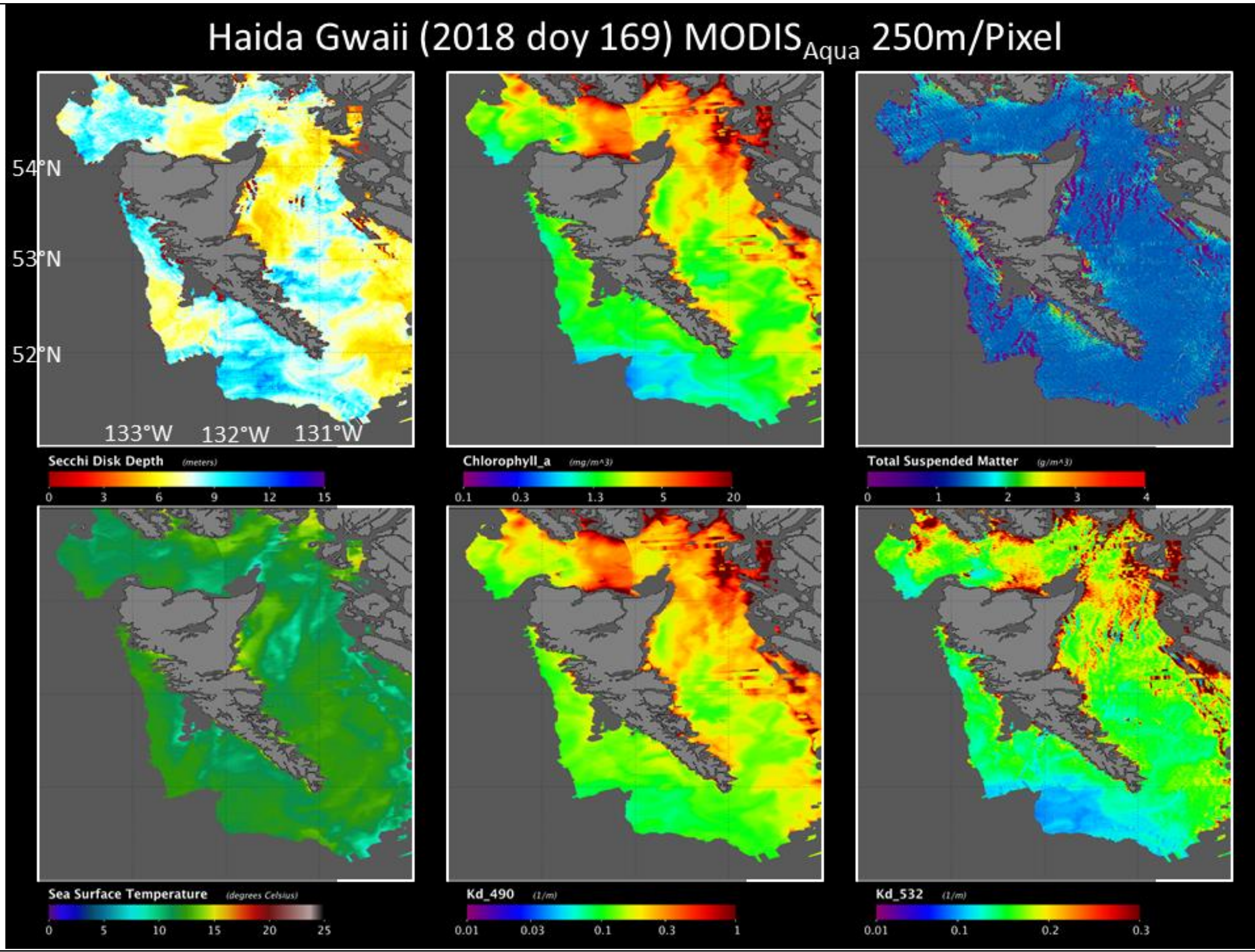


Figure APX 2.69. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on June 18th 2018 (doy = 169). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

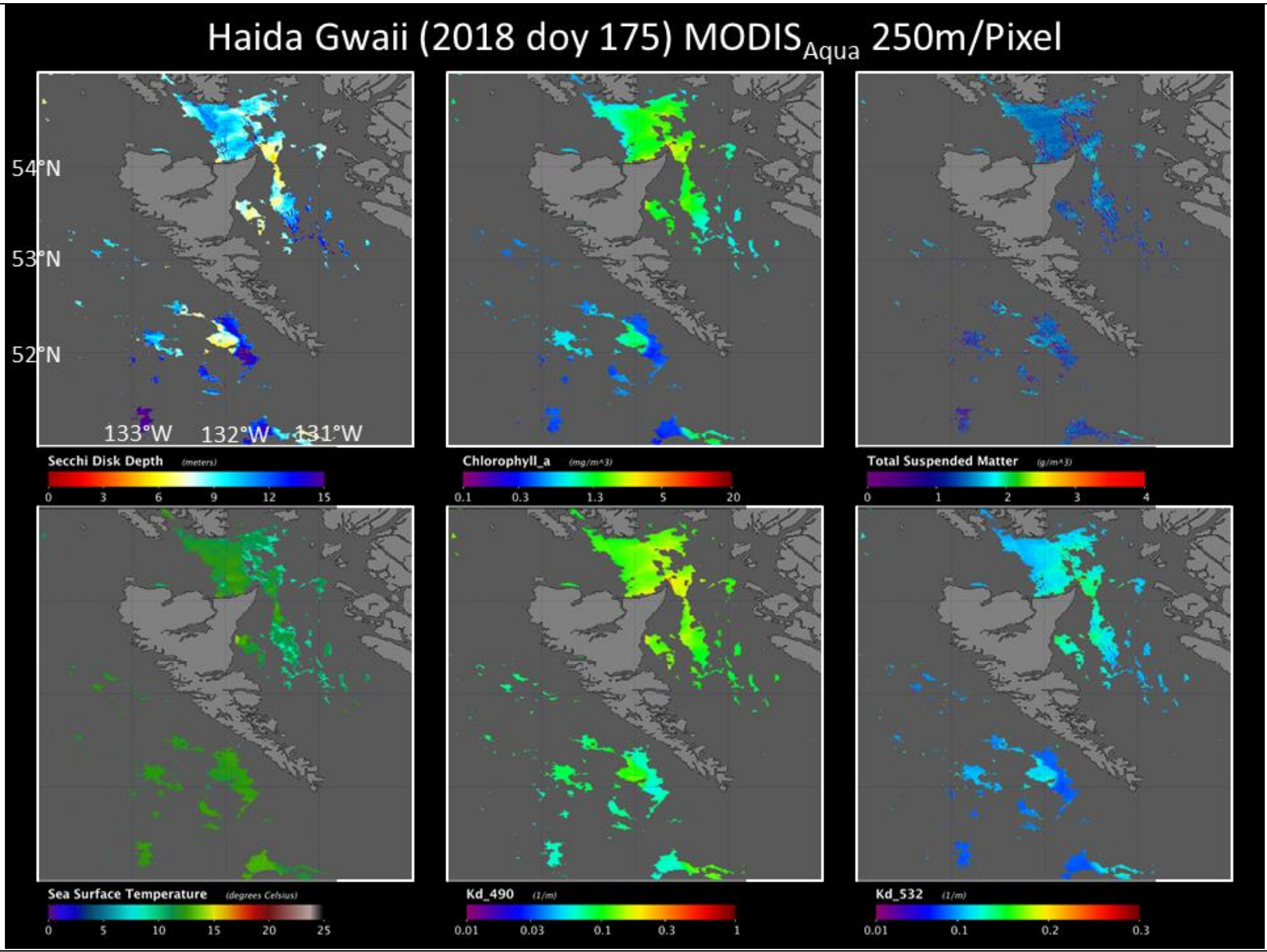


Figure APX 2.70. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on June 24th 2018 (doy = 175). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

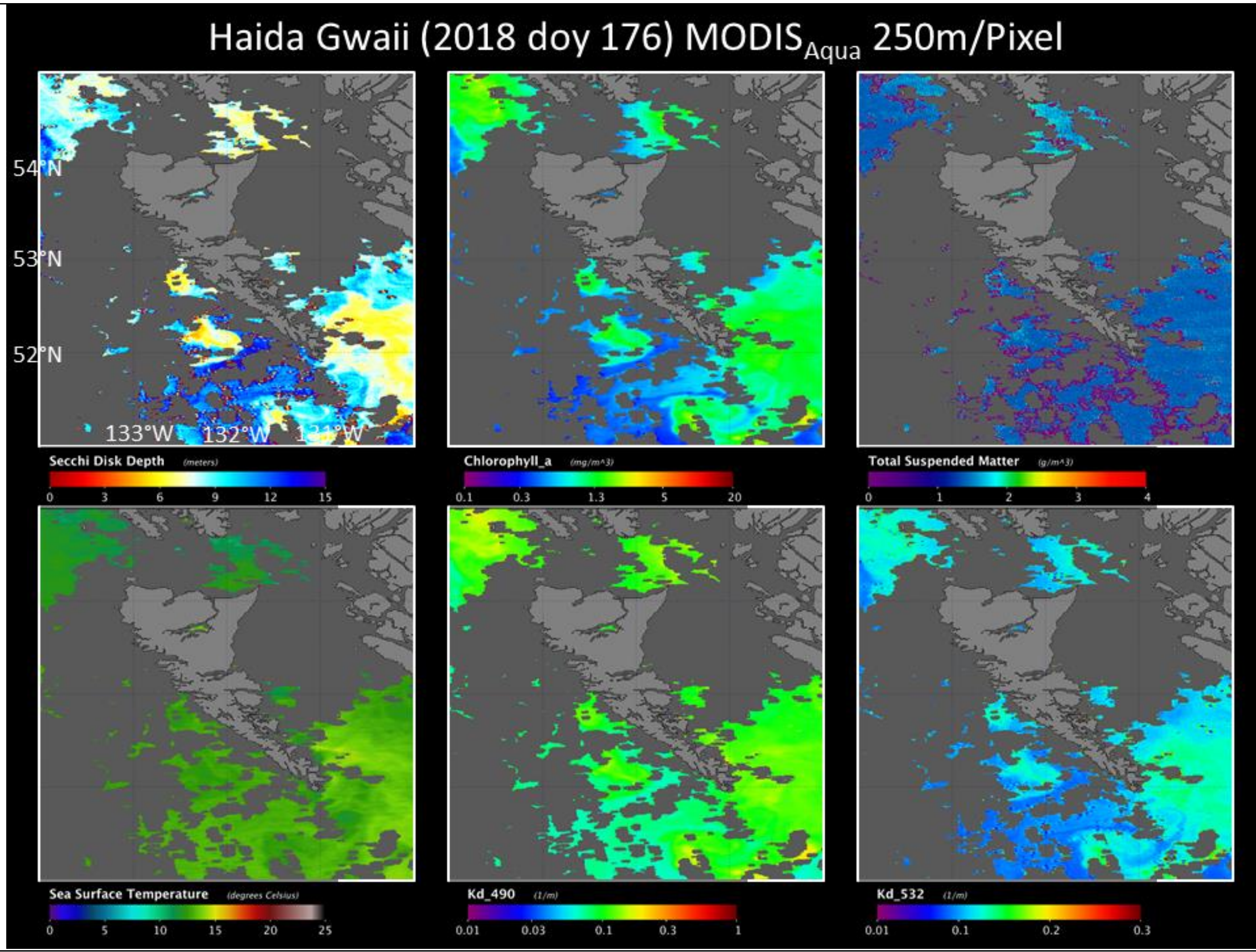


Figure APX 2.71. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on June 25th 2018 (doy = 176). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

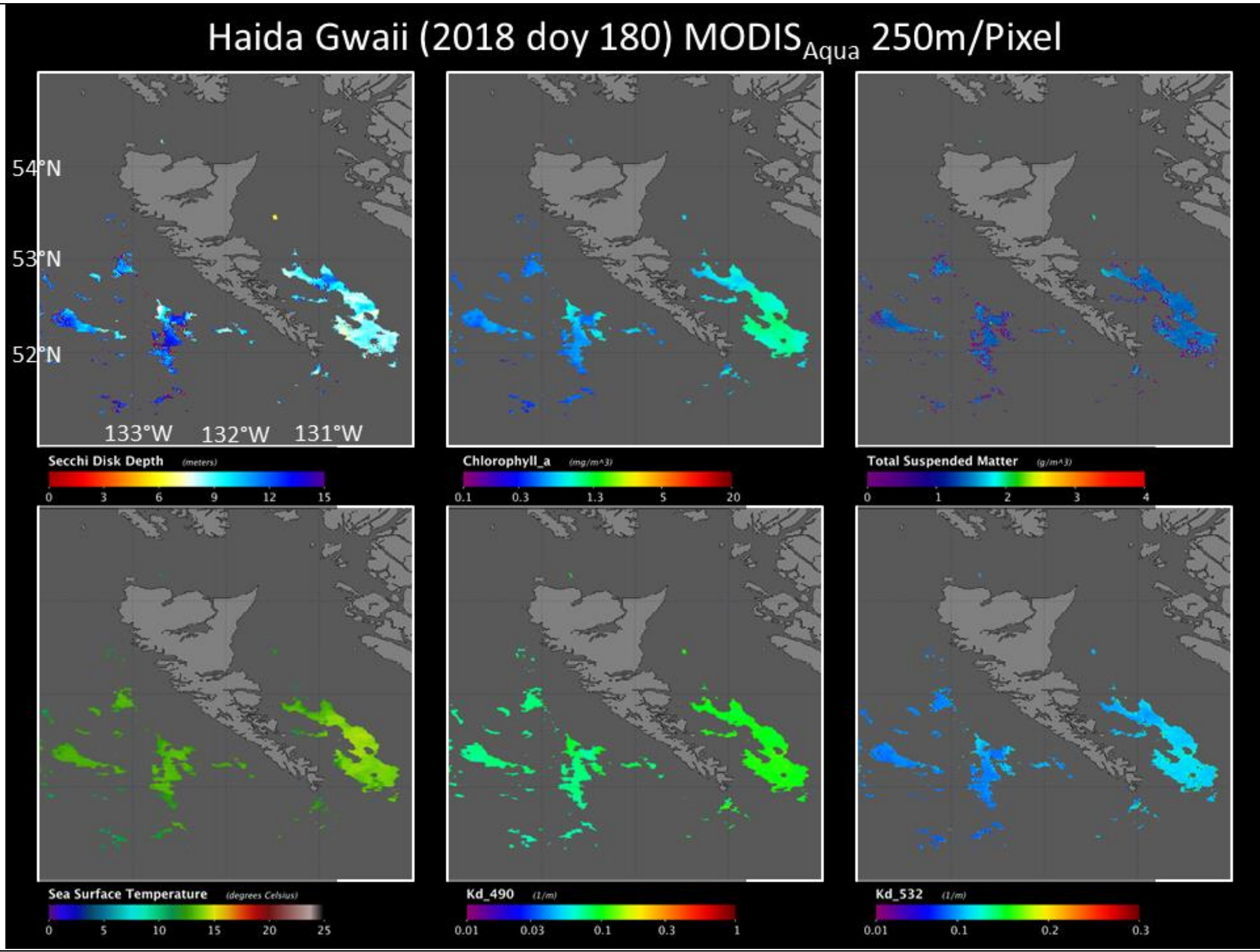


Figure APX 2.72. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on June 29th 2018 (doy = 180). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

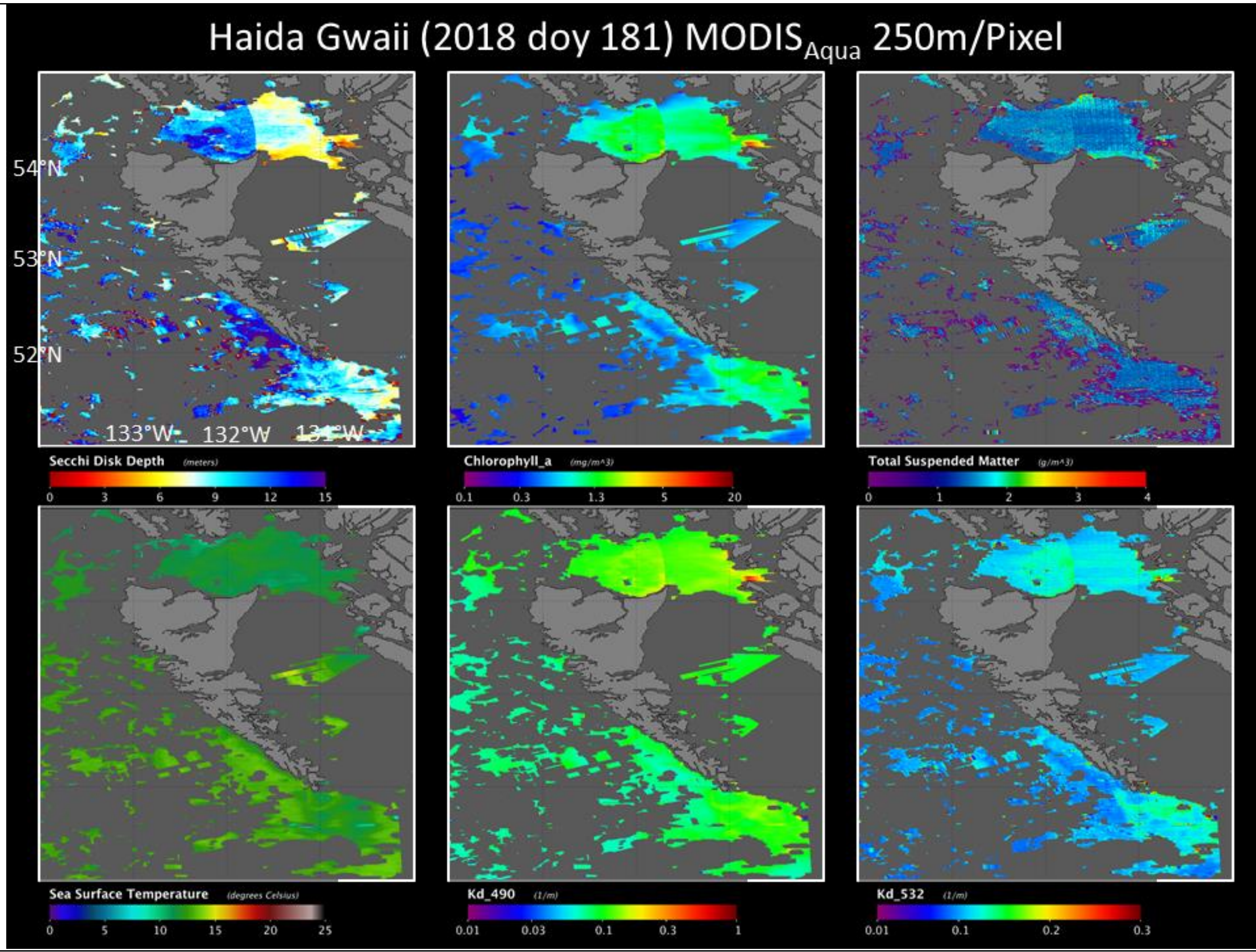


Figure APX 2.73. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on June 30th 2018 (doy = 181). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

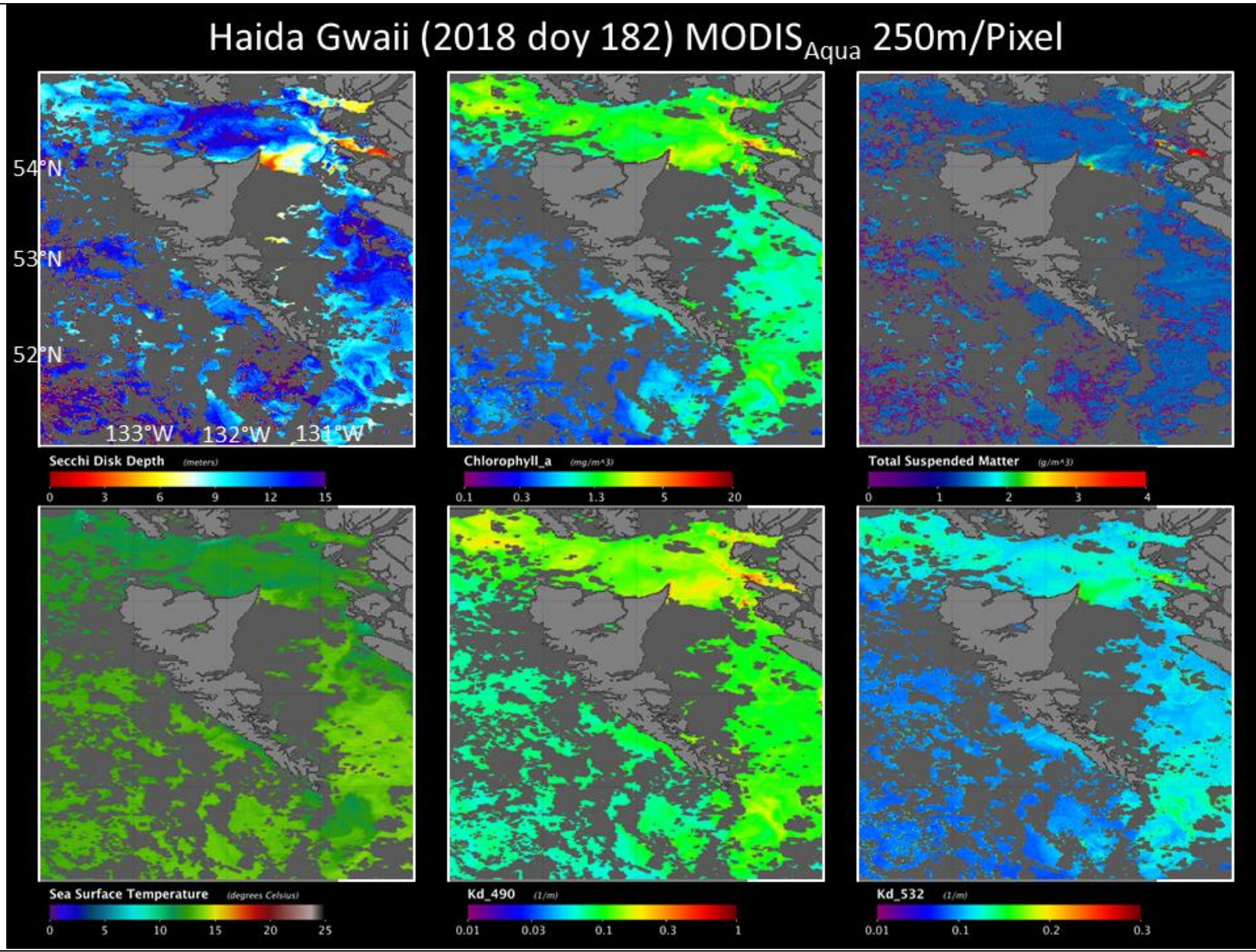


Figure APX 2.74. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on July 1st 2018 (doy = 182). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

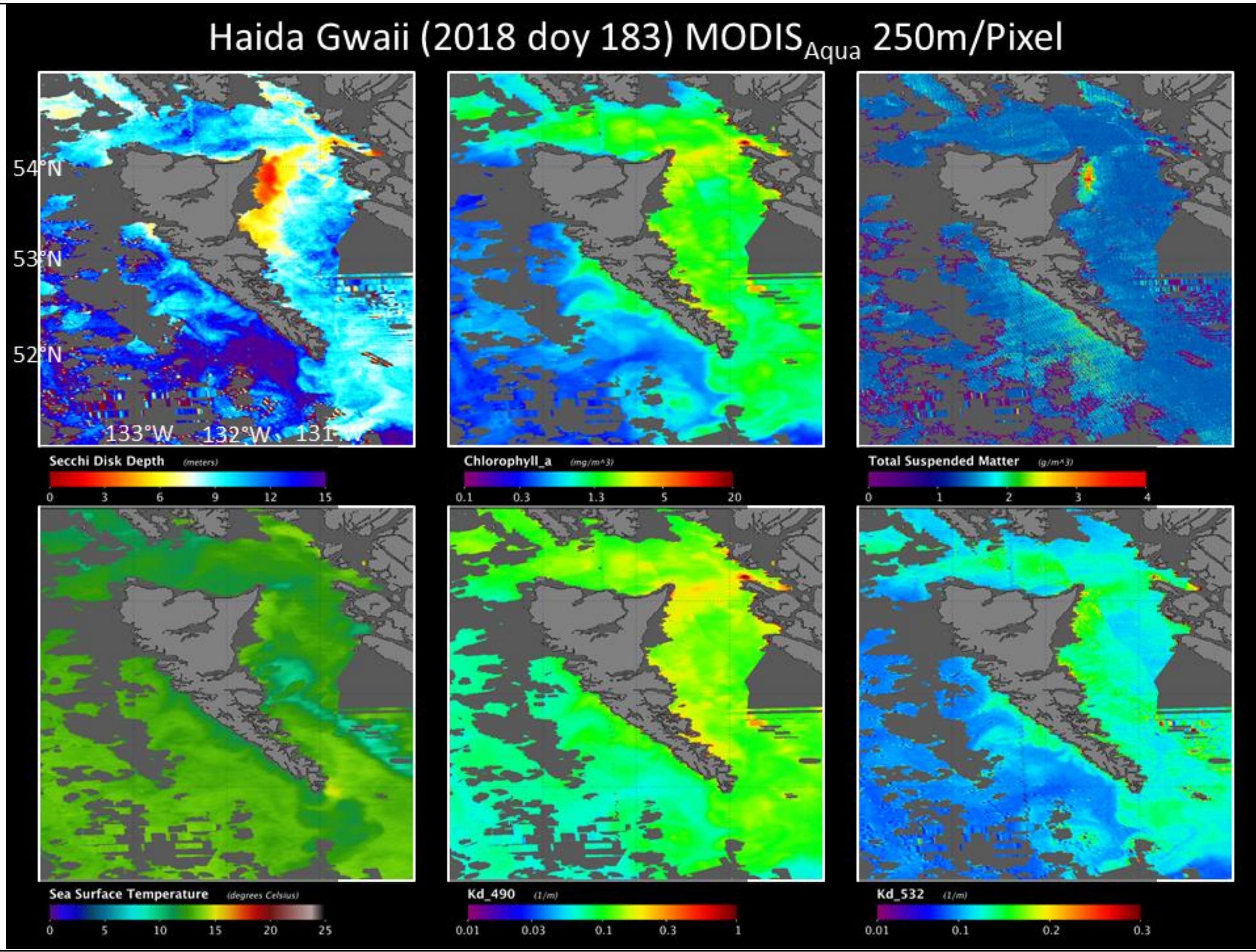


Figure APX 2.75. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on July 2nd 2018 (doy = 183). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

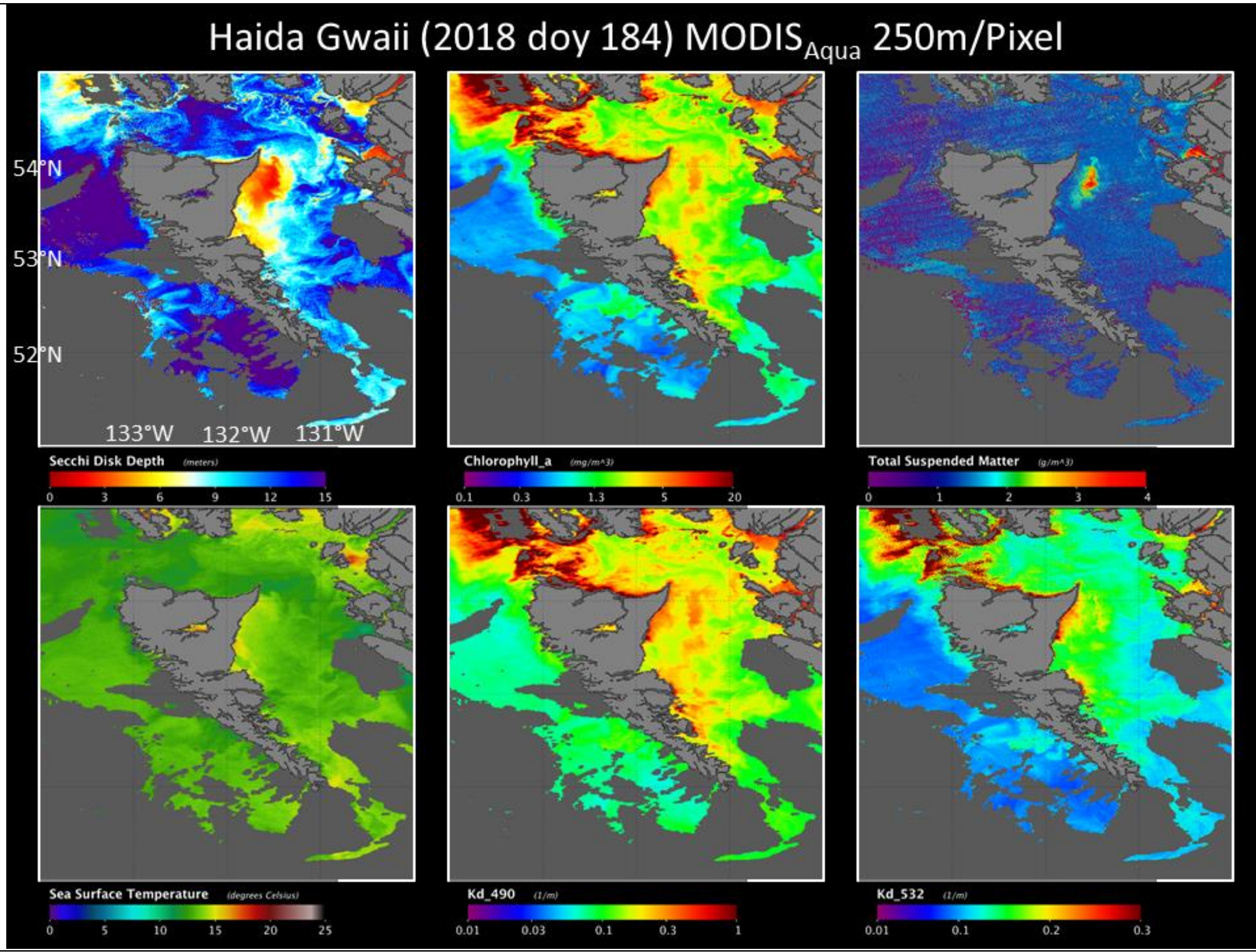


Figure APX 2.76. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on July 3rd 2018 (doy = 184). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

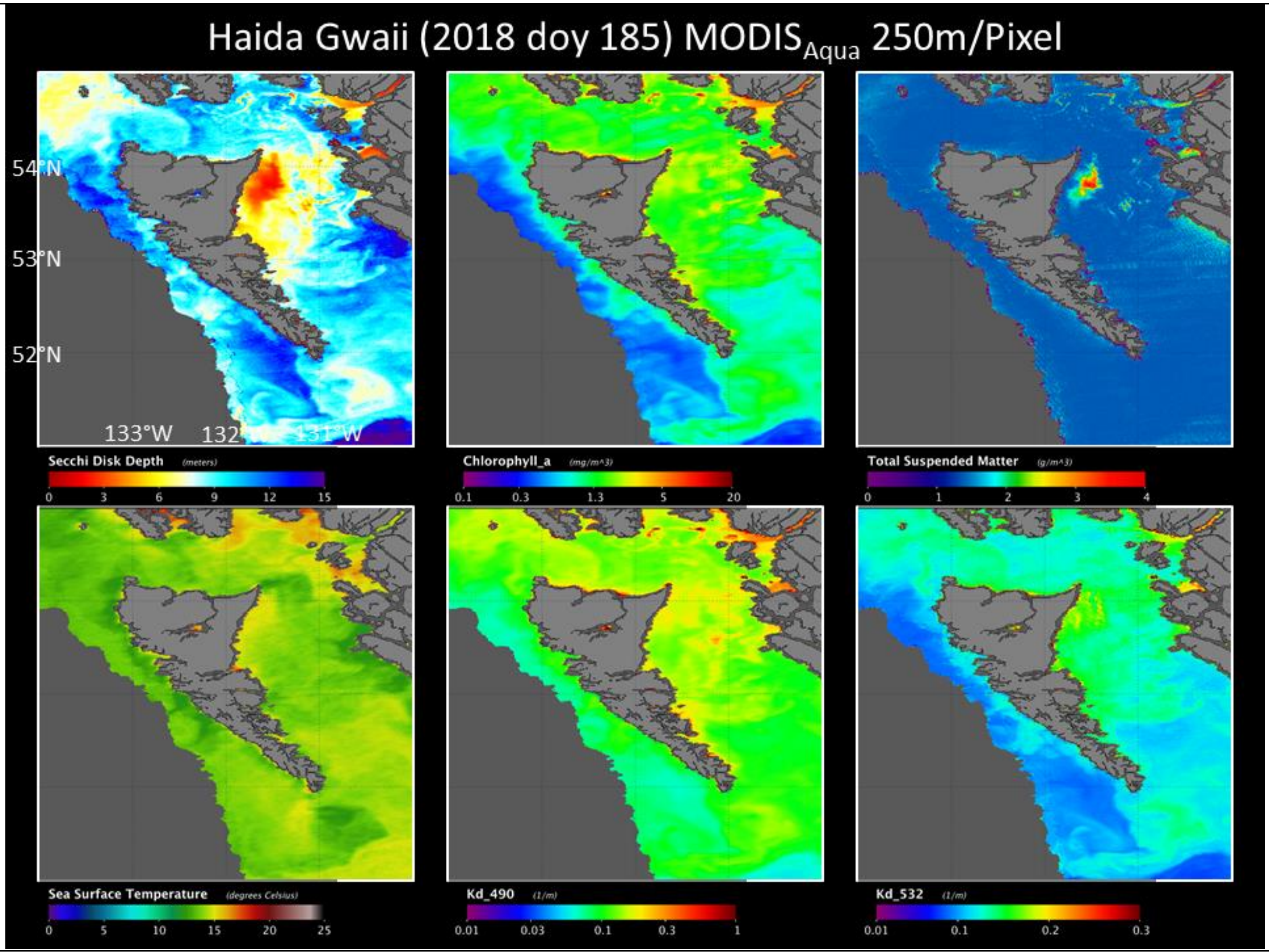


Figure APX 2.77. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on July 4th 2018 (doy = 185). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

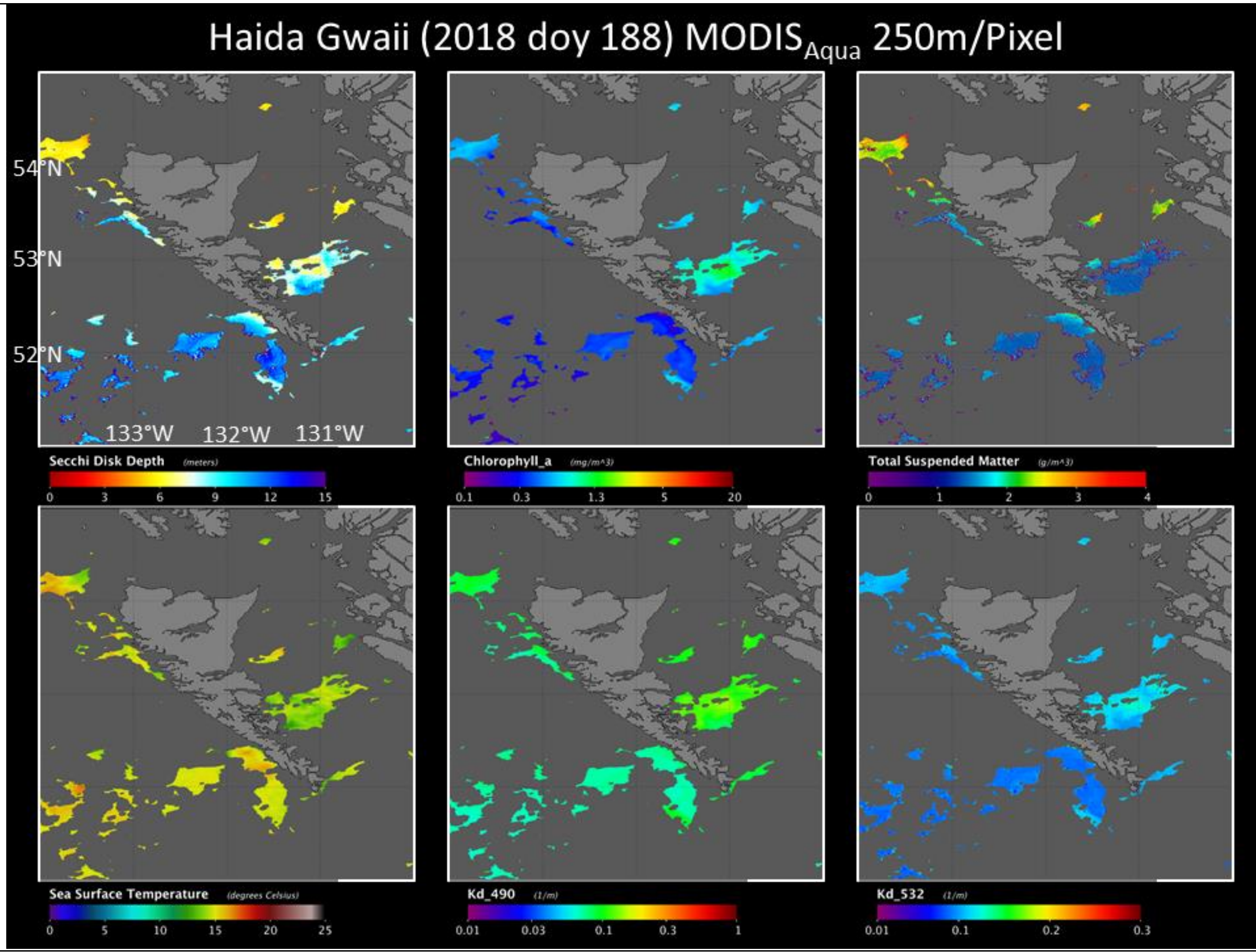


Figure APX 2.78. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on July 7th 2018 (doy = 188). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

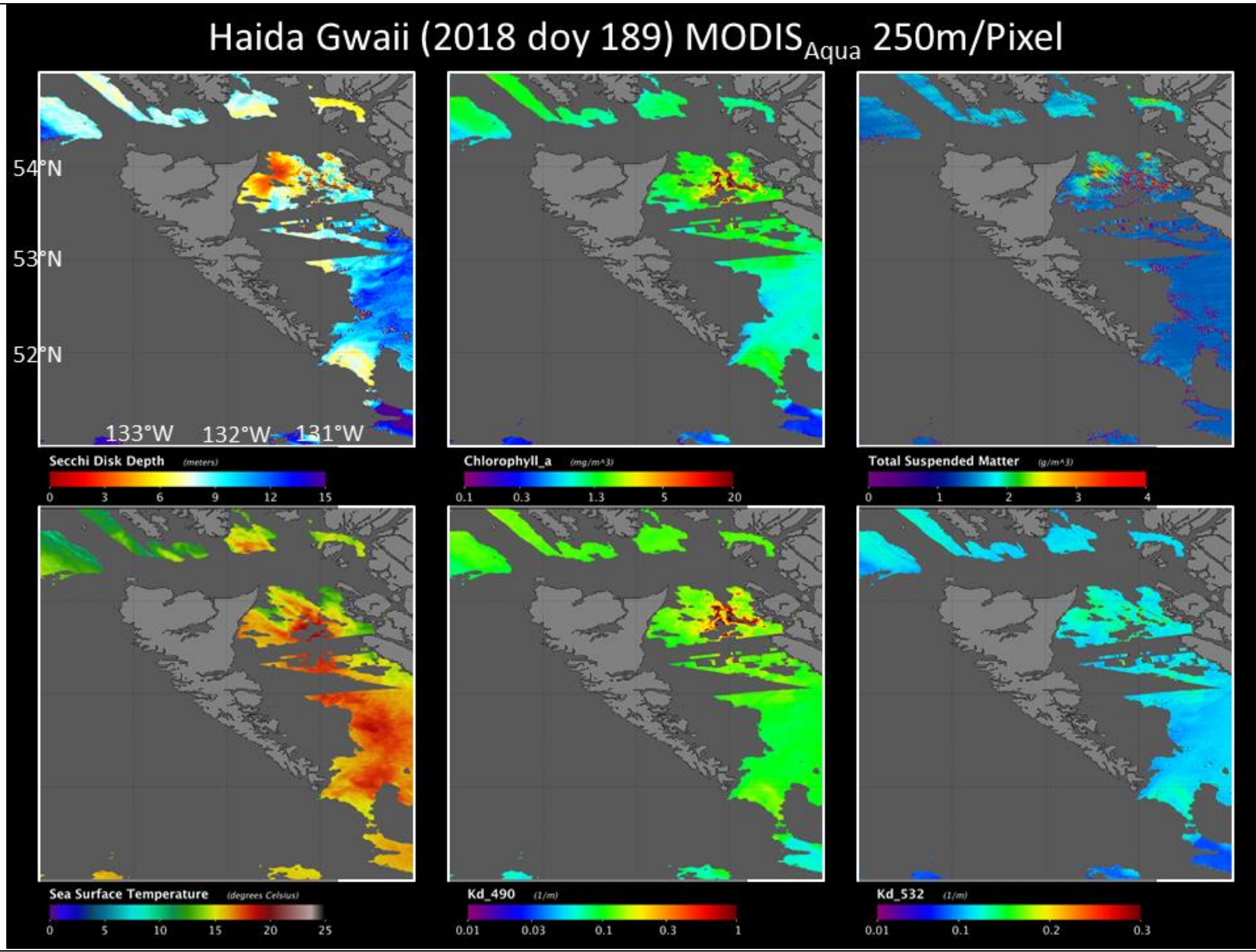


Figure APX 2.79. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on July 8th 2018 (doy = 189). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

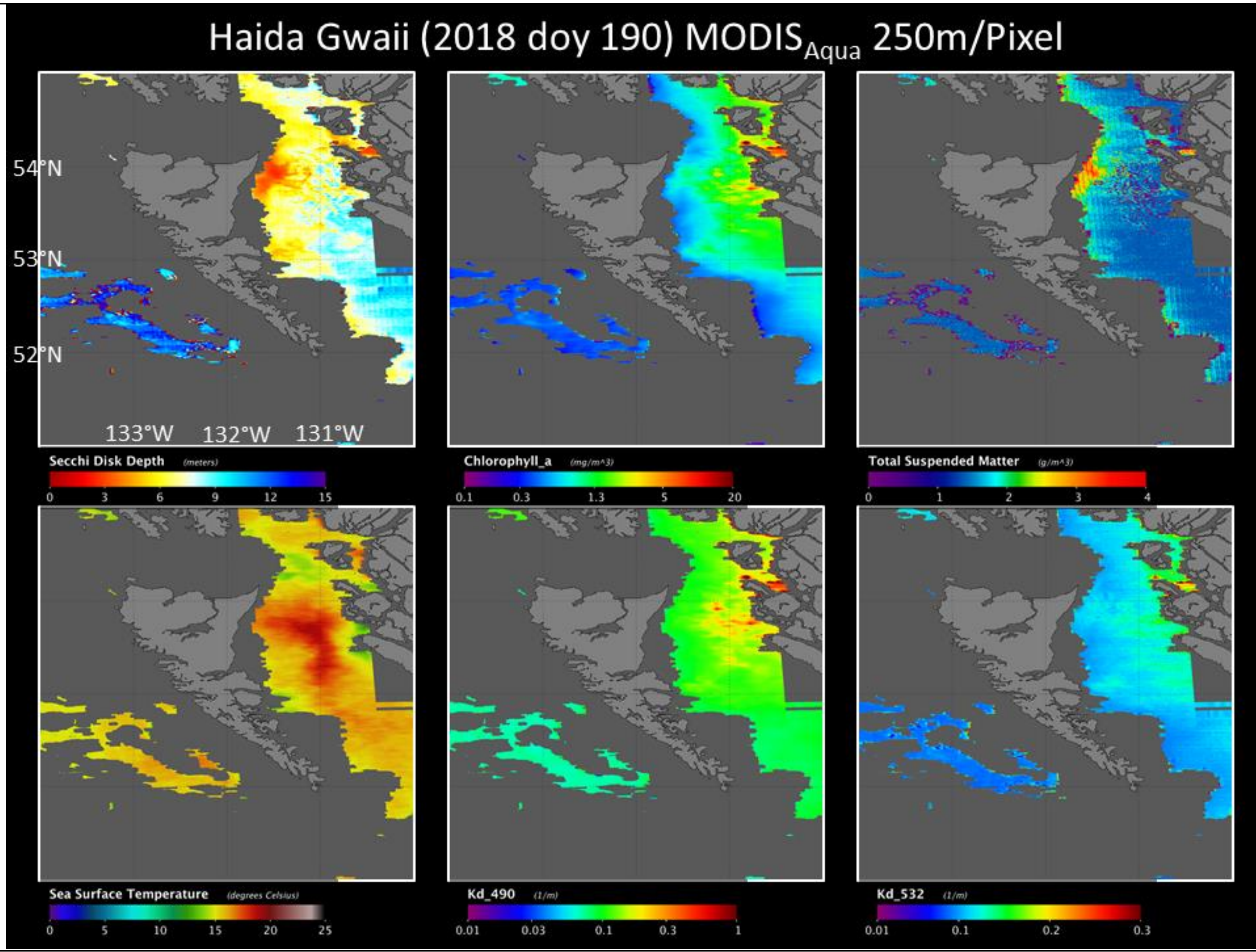


Figure APX 2.80. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on July 9th 2018 (doy = 190). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

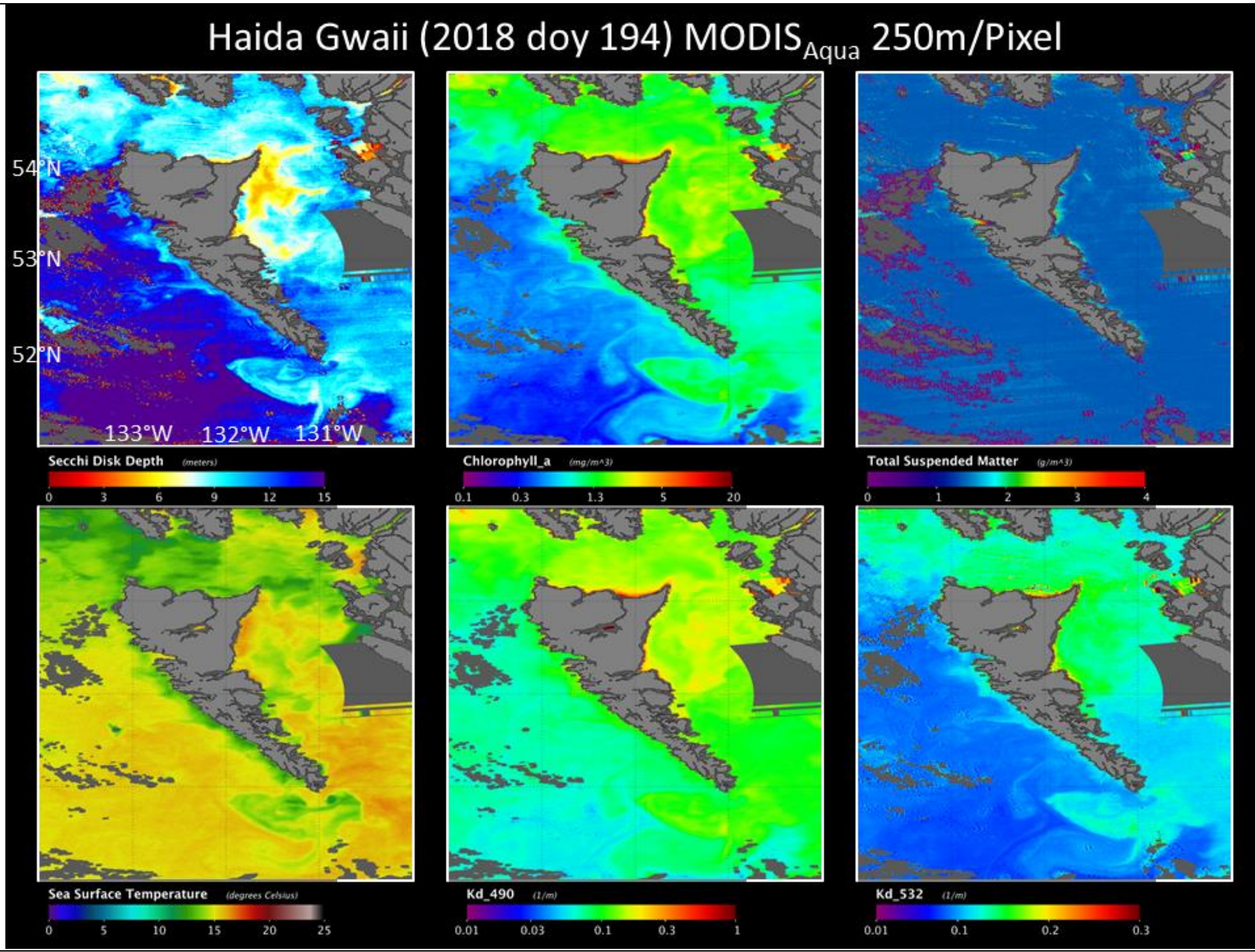


Figure APX 2.81. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on July 13th 2018 (doy = 194). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

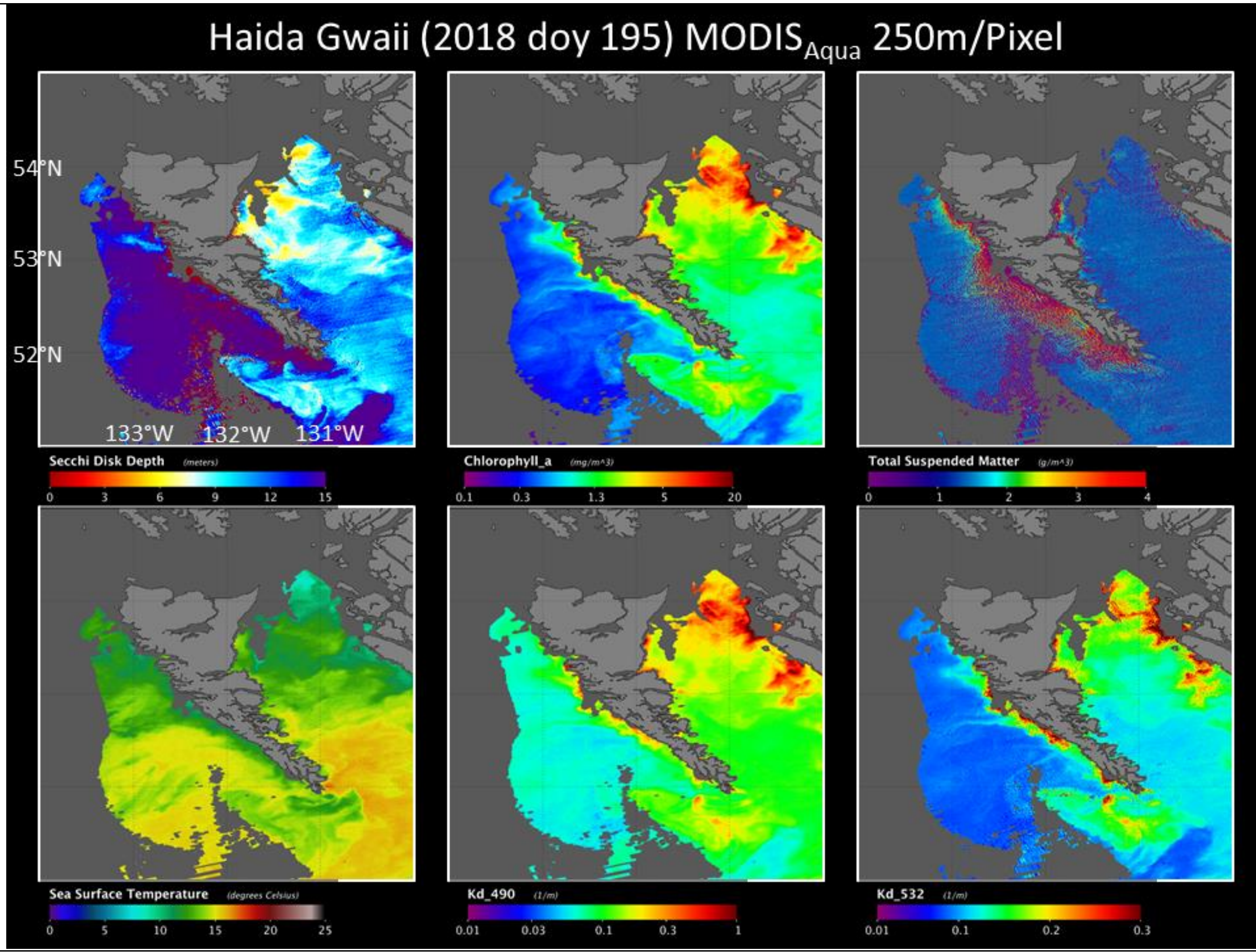


Figure APX 2.82. MODIS$_{Aqua}$ (250m/pixel) daily composite of oceanographic variables in Haida Gwaii on July 14th 2018 (doy = 195). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

APPENDIX 3

Weekly composites corresponding to days with enough available information for the study area.

i) July and August 2016
ii) 2017
iii) April until July 2018,

The images are for the following variables: Water Transparency (Secchi Disk Depth, meters), Chlorophyll a (Chl_a, mg m^3), Total Suspended Matter (TSM, g m^3), Sea Surface Temperature (° C), Diffuse Attenuation Coefficient for Downwelling Irradiance at 490 nm (Kd490, 1/m), and Kd at 532 nanometers (Kd532, 1/m).

2016

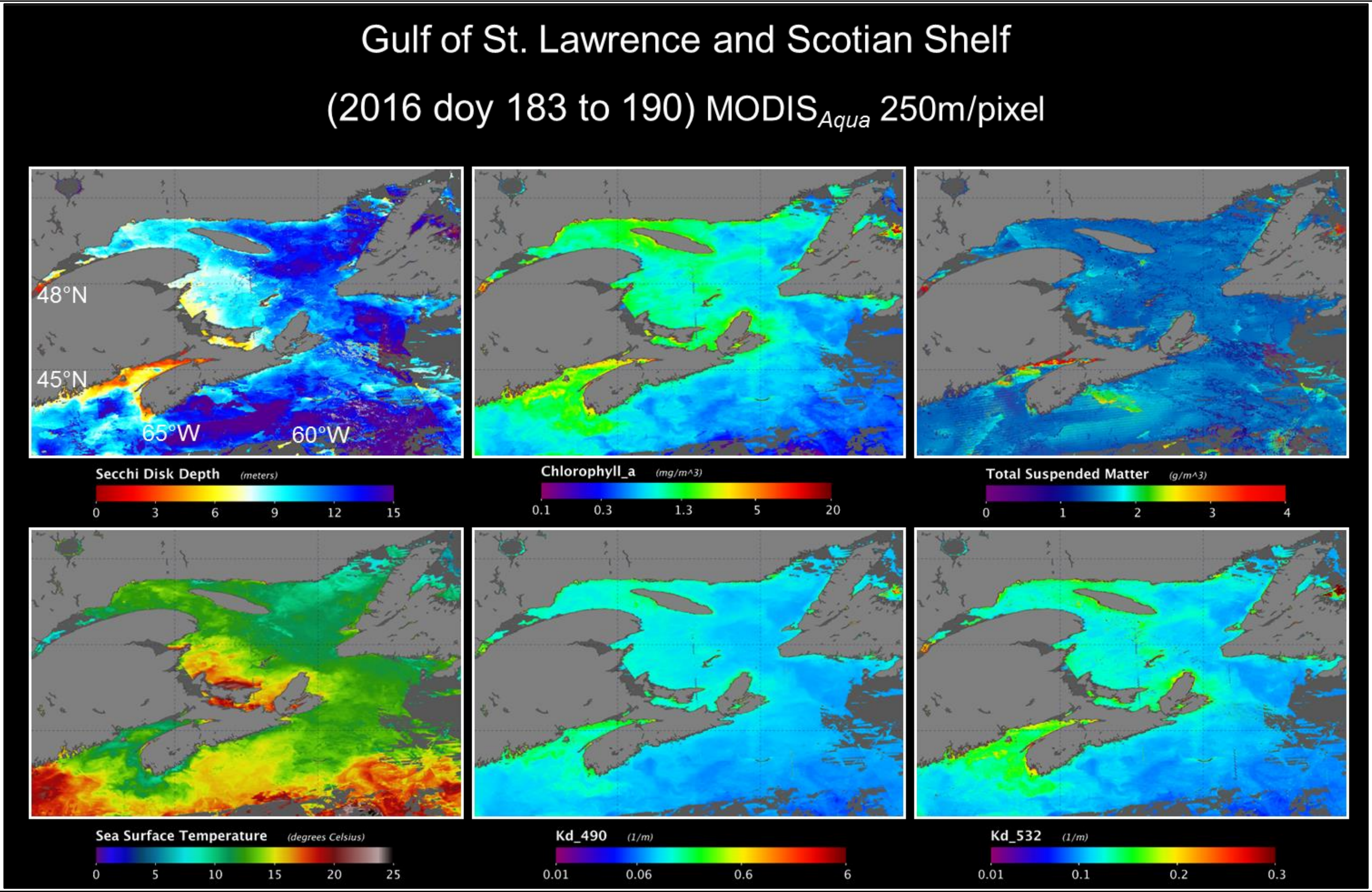


Figure APX 3.1. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from July 1st to 8th 2016 (doys = 183 to 190). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

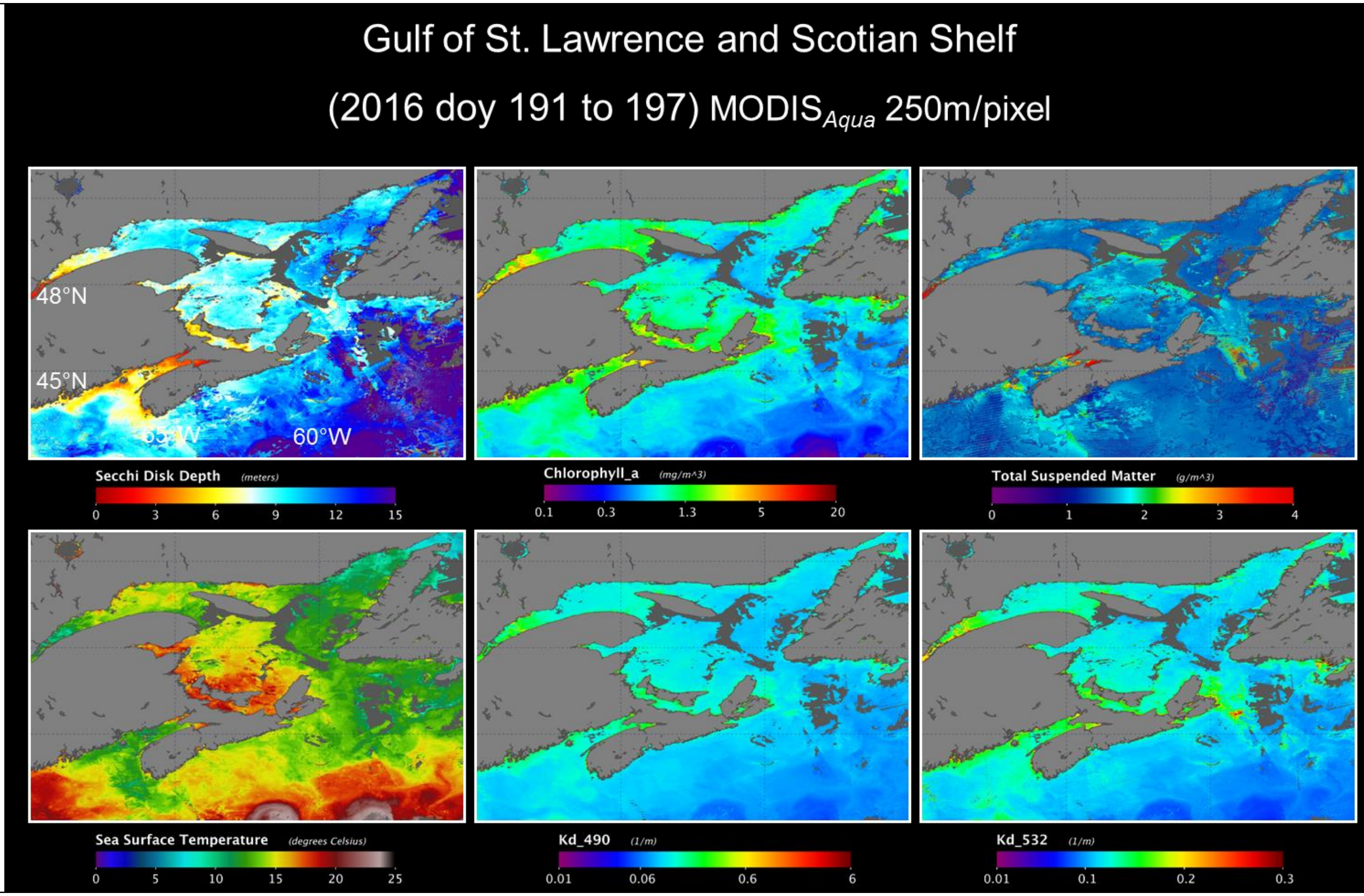


Figure APX 3.2. $MODIS_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from July 9th to 15th 2016 (doys = 191 to 197). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

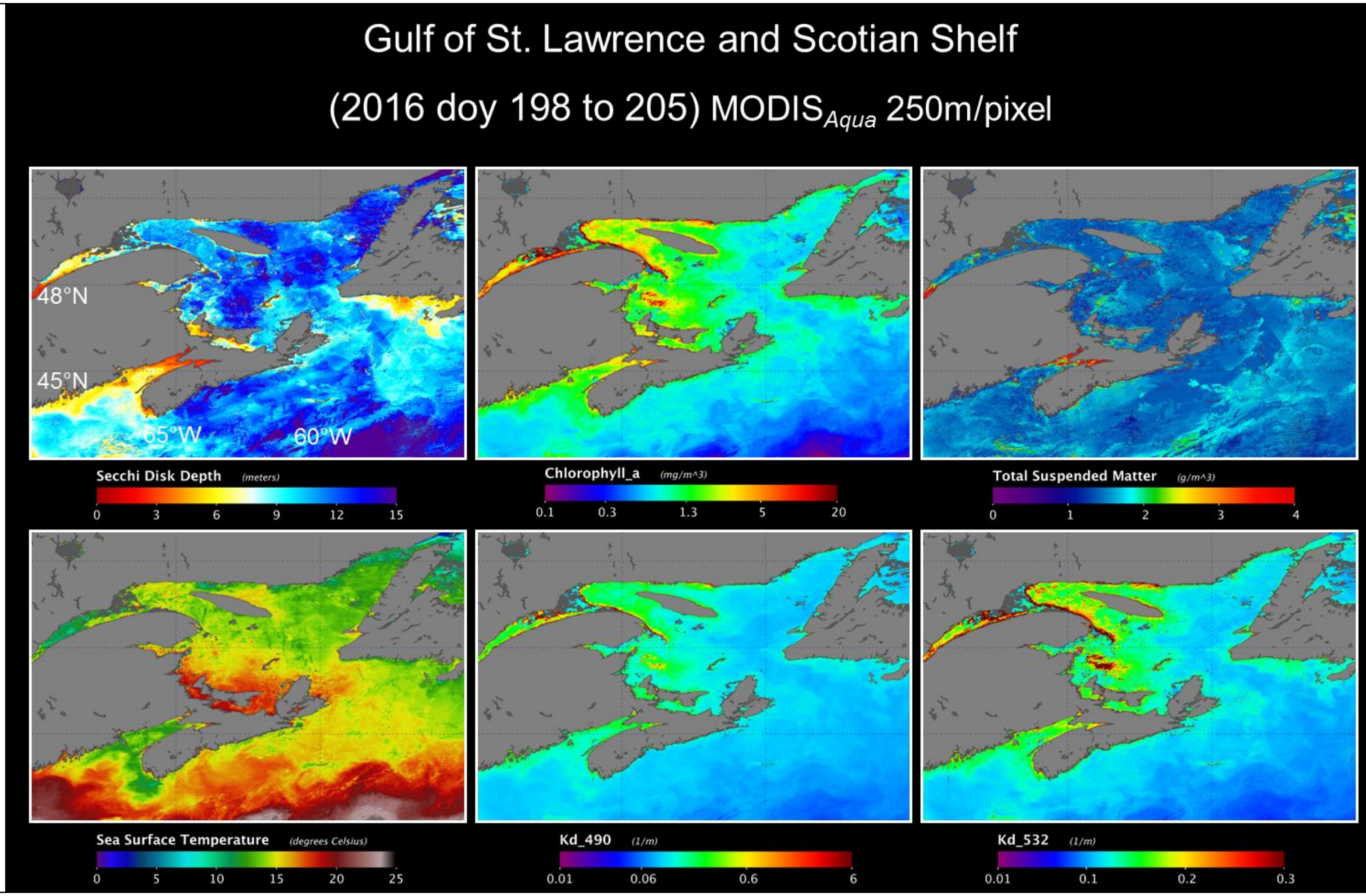


Figure APX 3.3. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from July 16th to 23rd 2016 (doys = 198 to 205). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

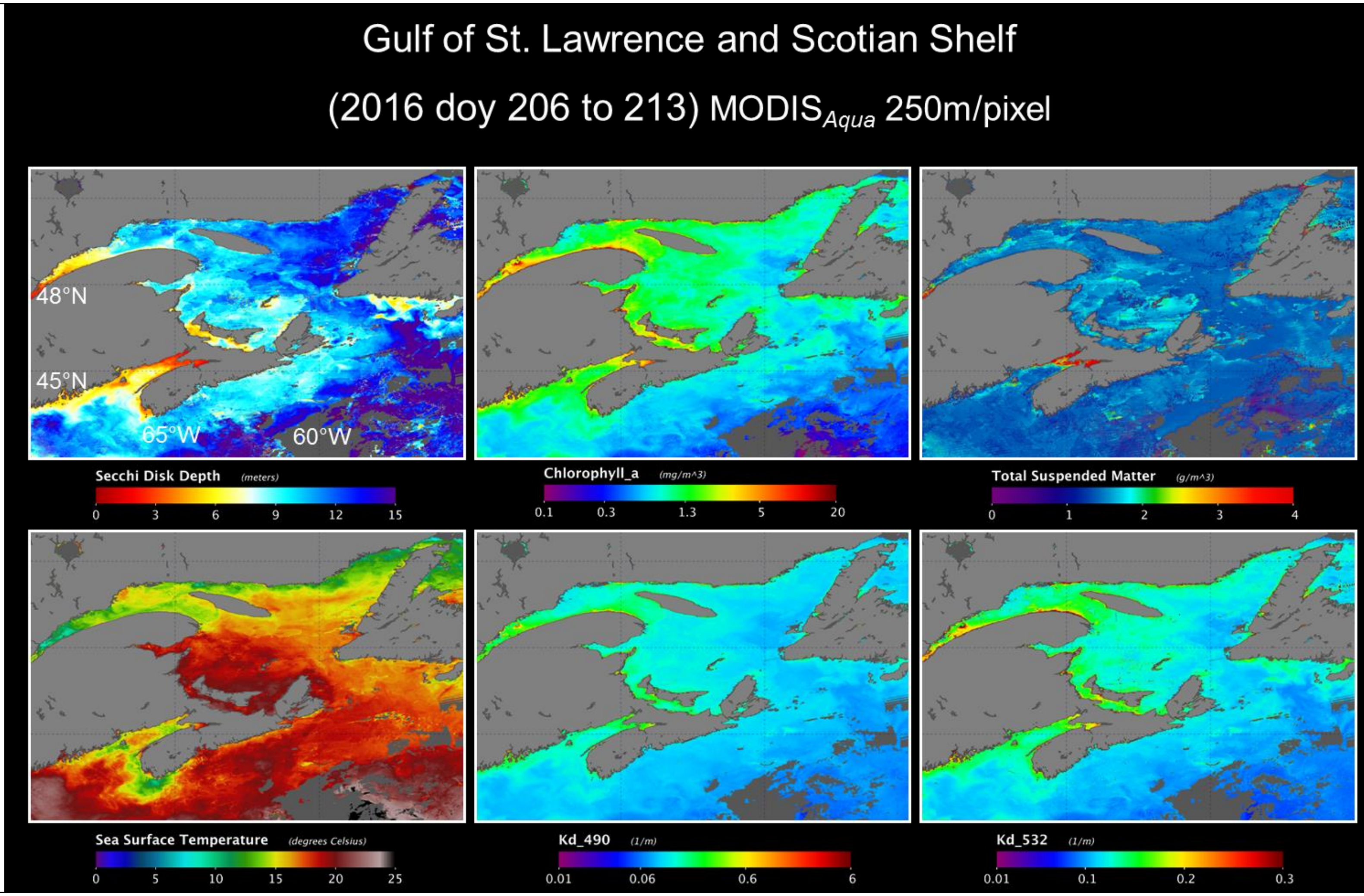


Figure APX 3.4. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from July 24th to 31st 2016 (doys = 206 to 213). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

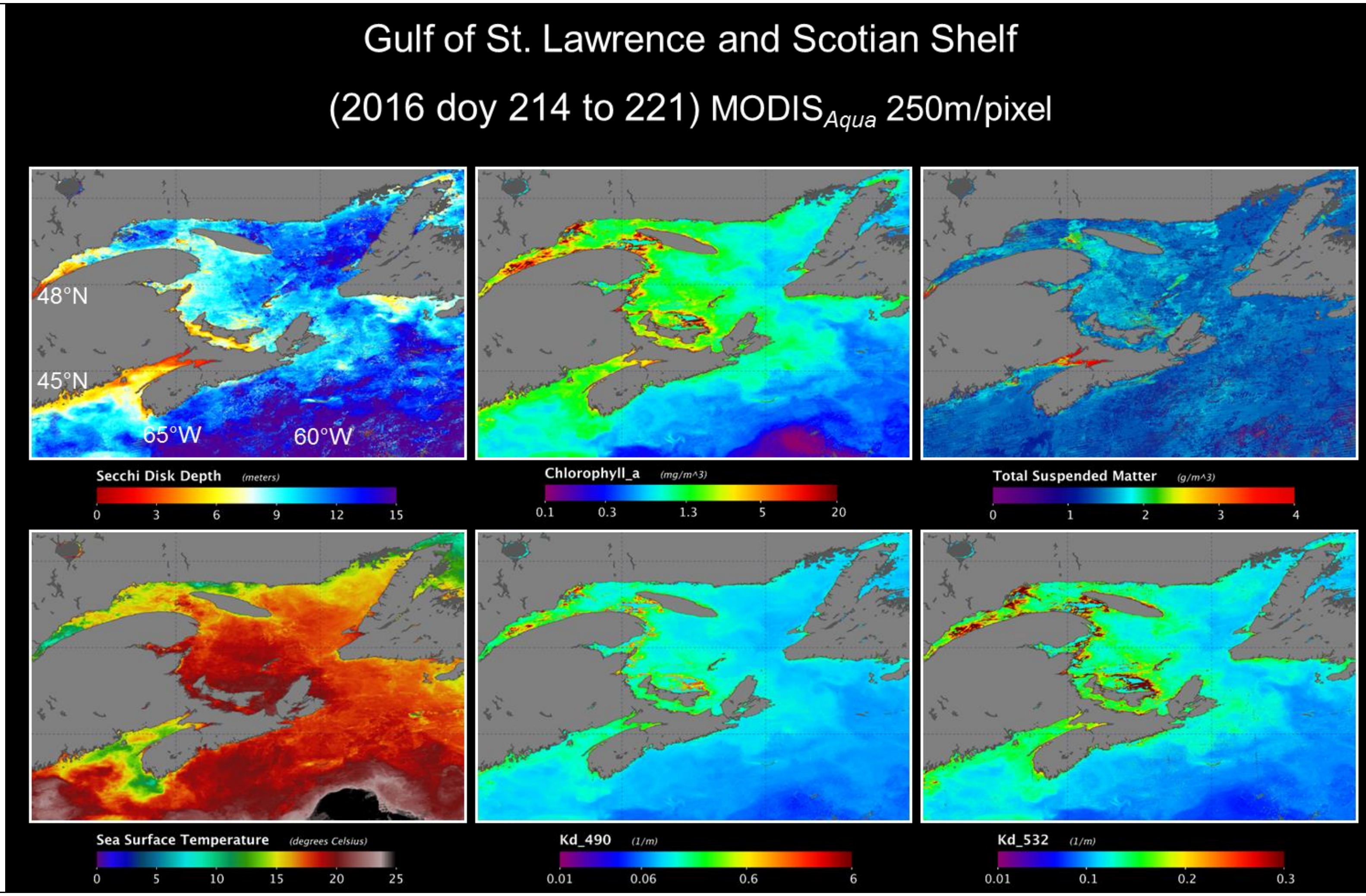


Figure APX 3.5. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from August 1st to 8th 2016 (doys = 214 to 221). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

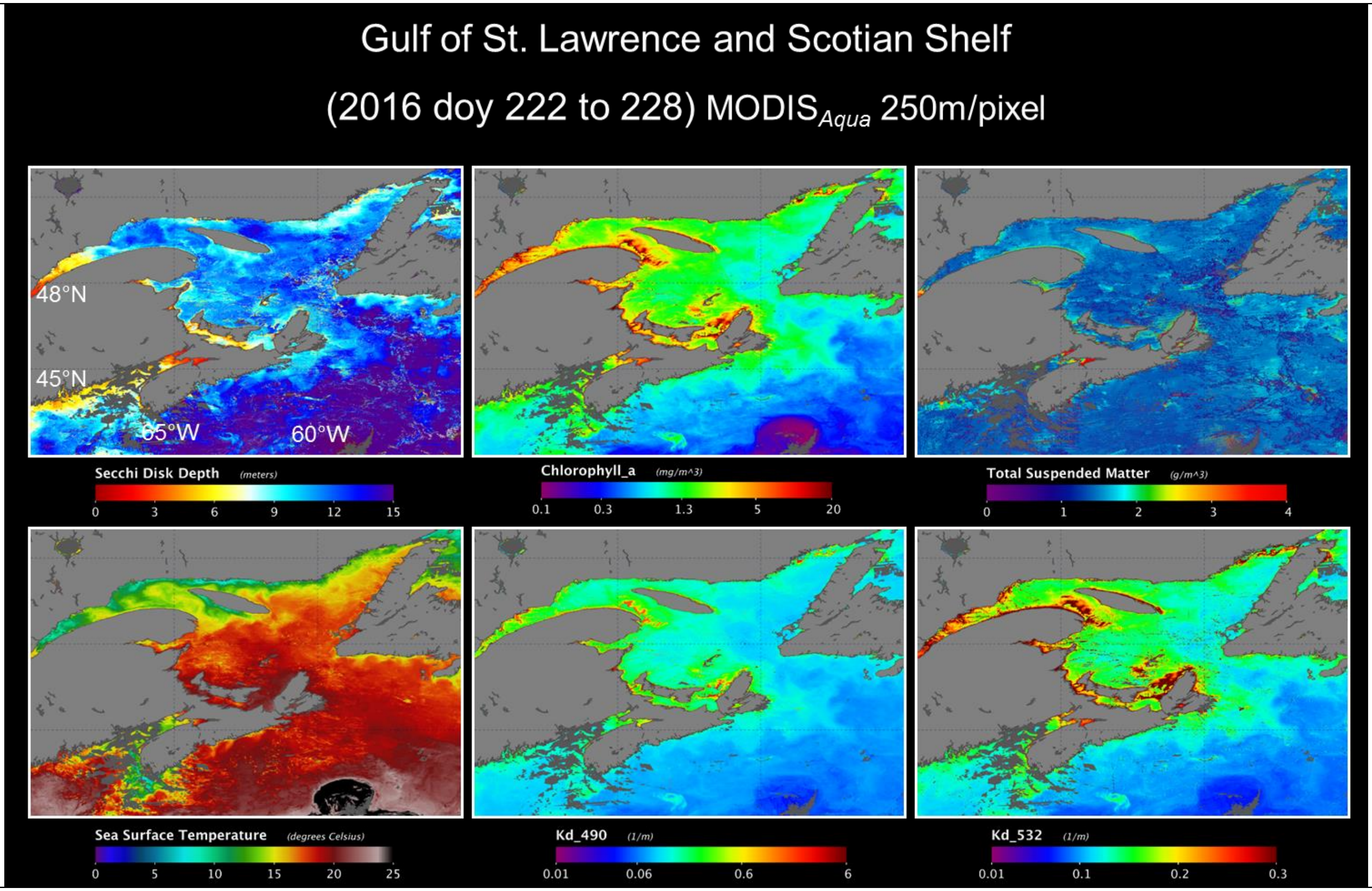


Figure APX 3.6. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from August 9th to 15th 2016 (doys = 222 to 228). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

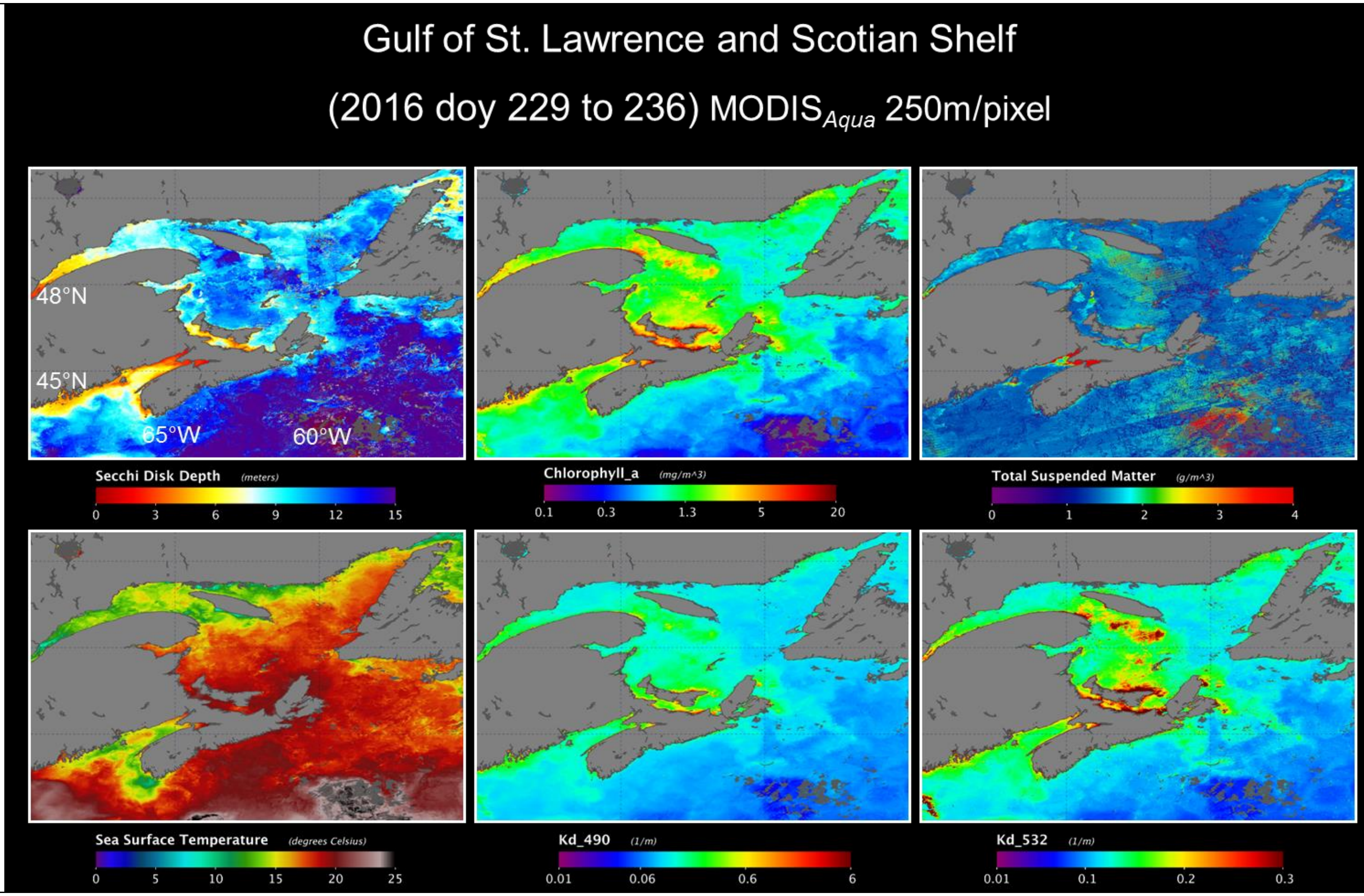


Figure APX 3.7. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from August 16th to 23rd 2016 (doys = 229 to 236). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

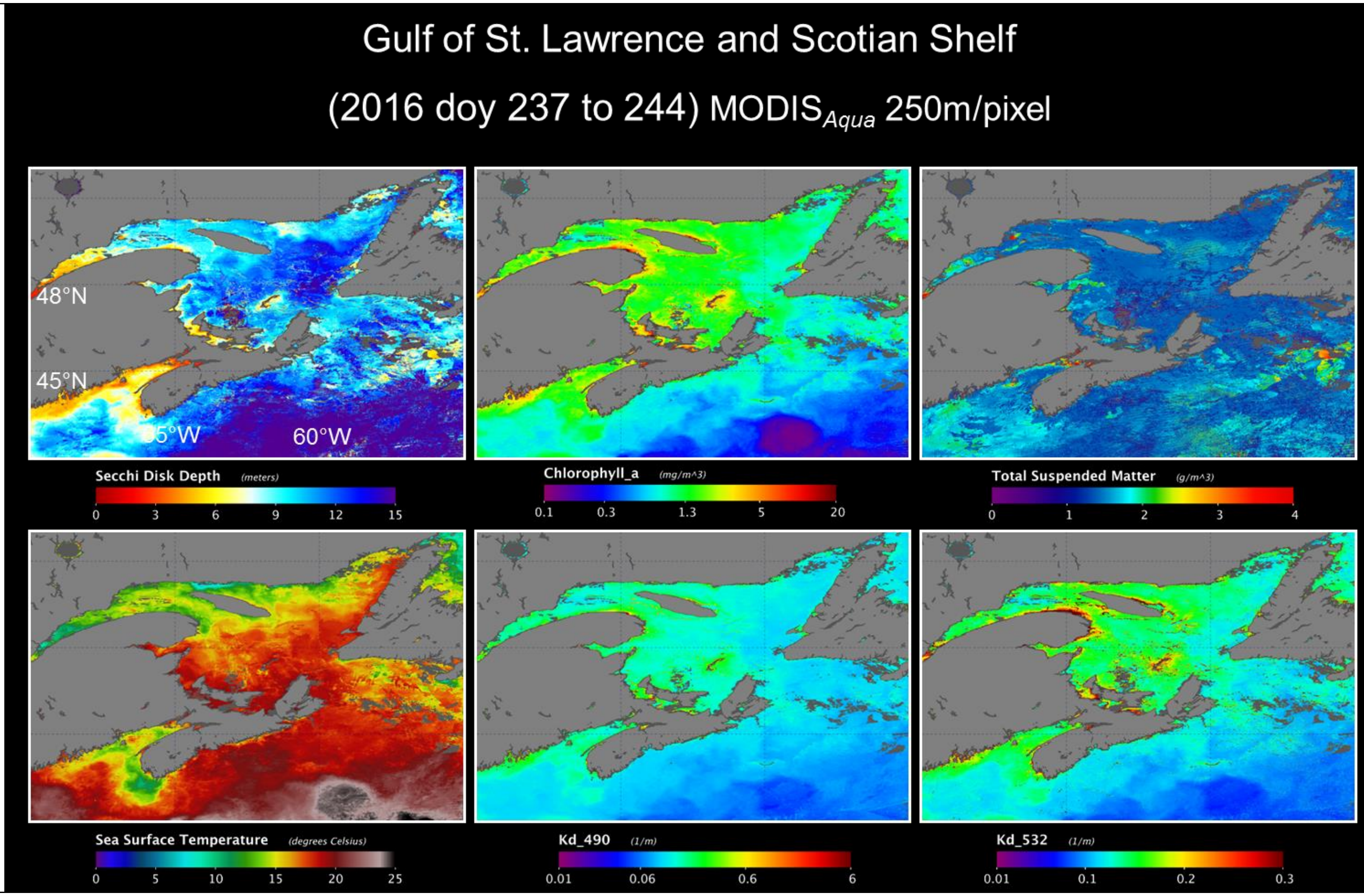


Figure APX 3.8. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from August 24th to 31st 2016 (doys = 237 to 244). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

2017

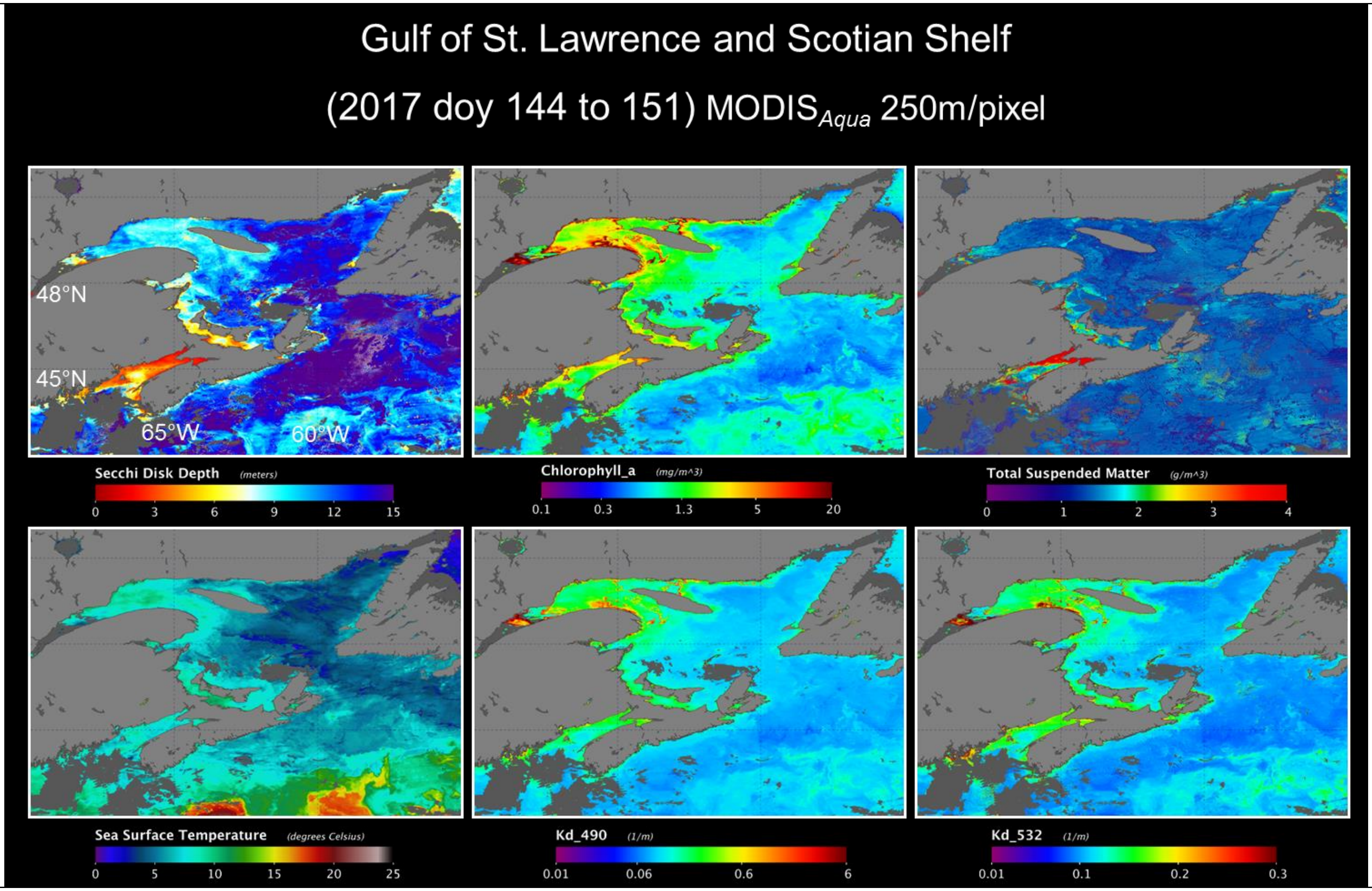


Figure APX 3.9. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from April 24th to 31st 2017 (doys = 144 to 151). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

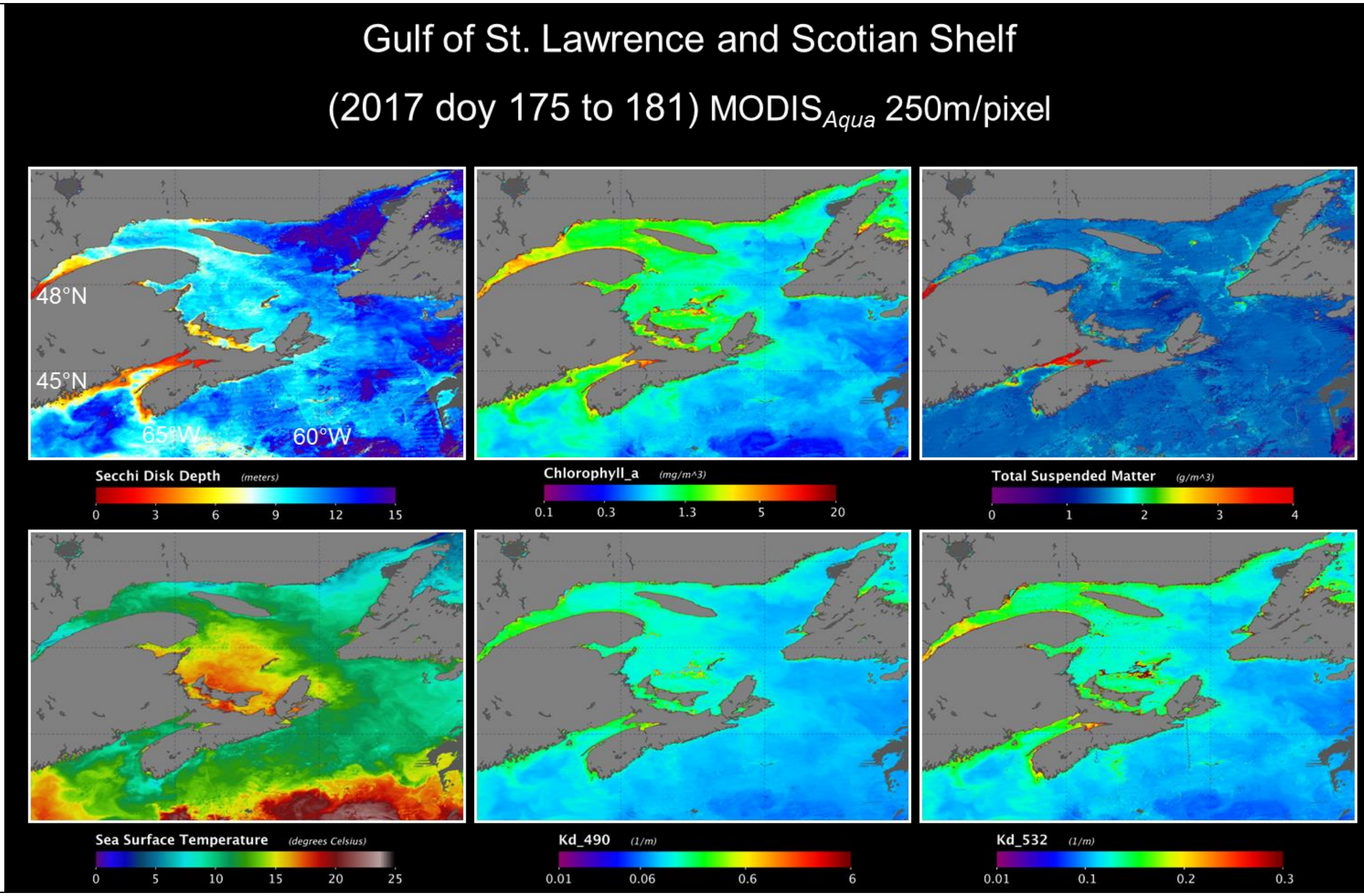


Figure APX 3.10. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from June 24th to 30st 2017 (doys = 175 to 181). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

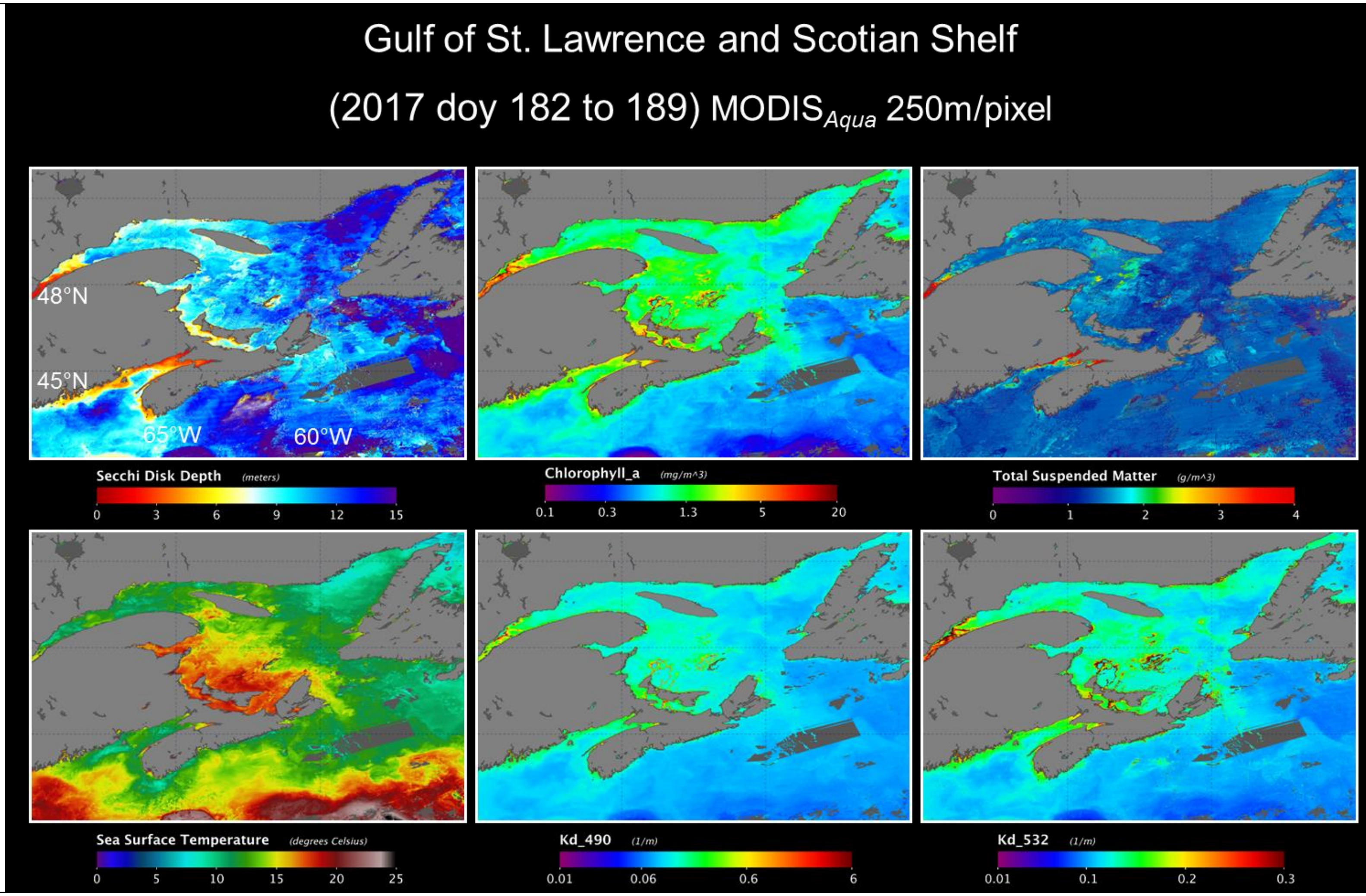


Figure APX 3.11. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from July 1st to 8th 2017 (doys = 182 to 189). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

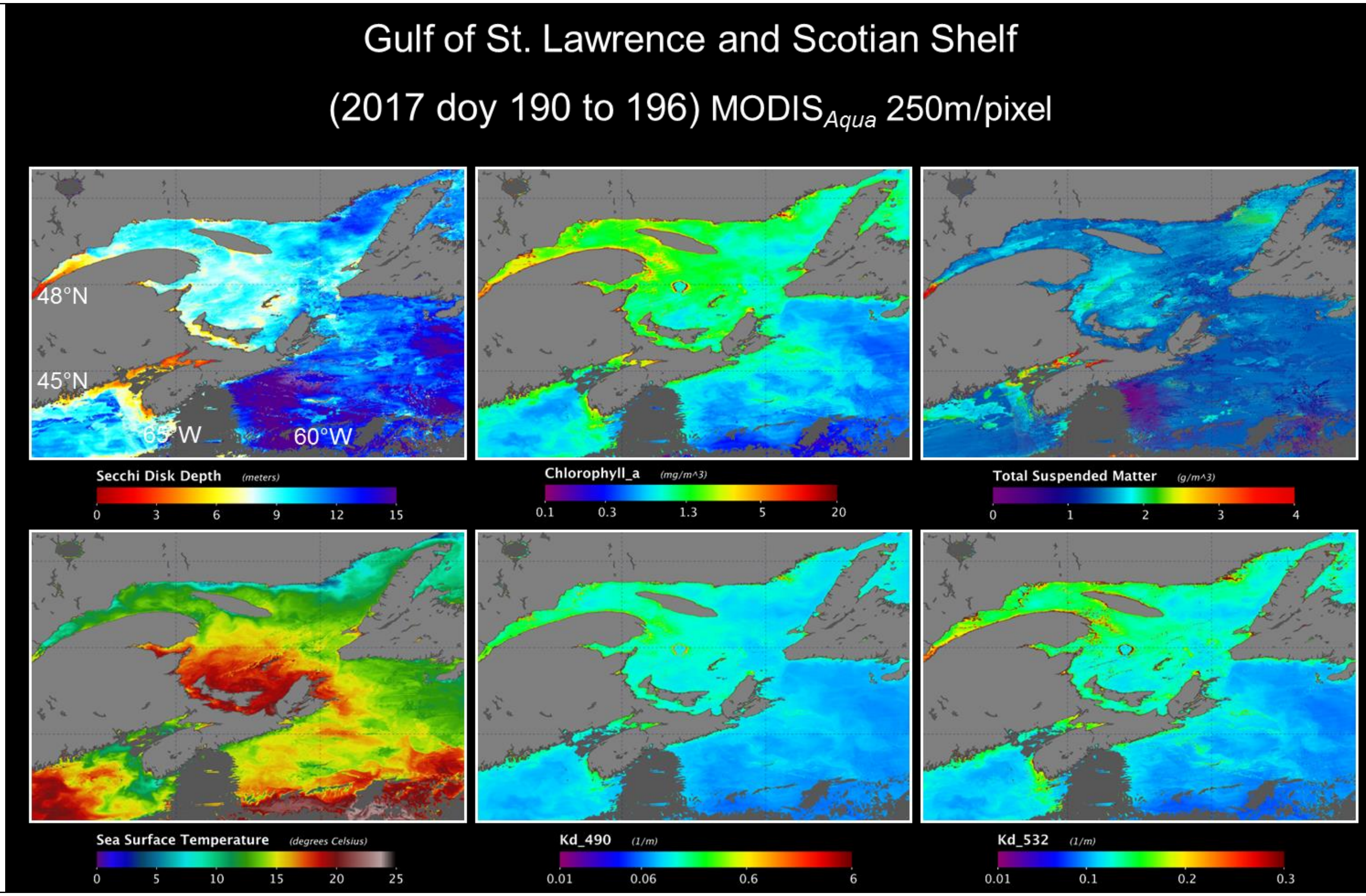


Figure APX 3.12. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from July 9th to 15th 2017 (doys = 190 to 196). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

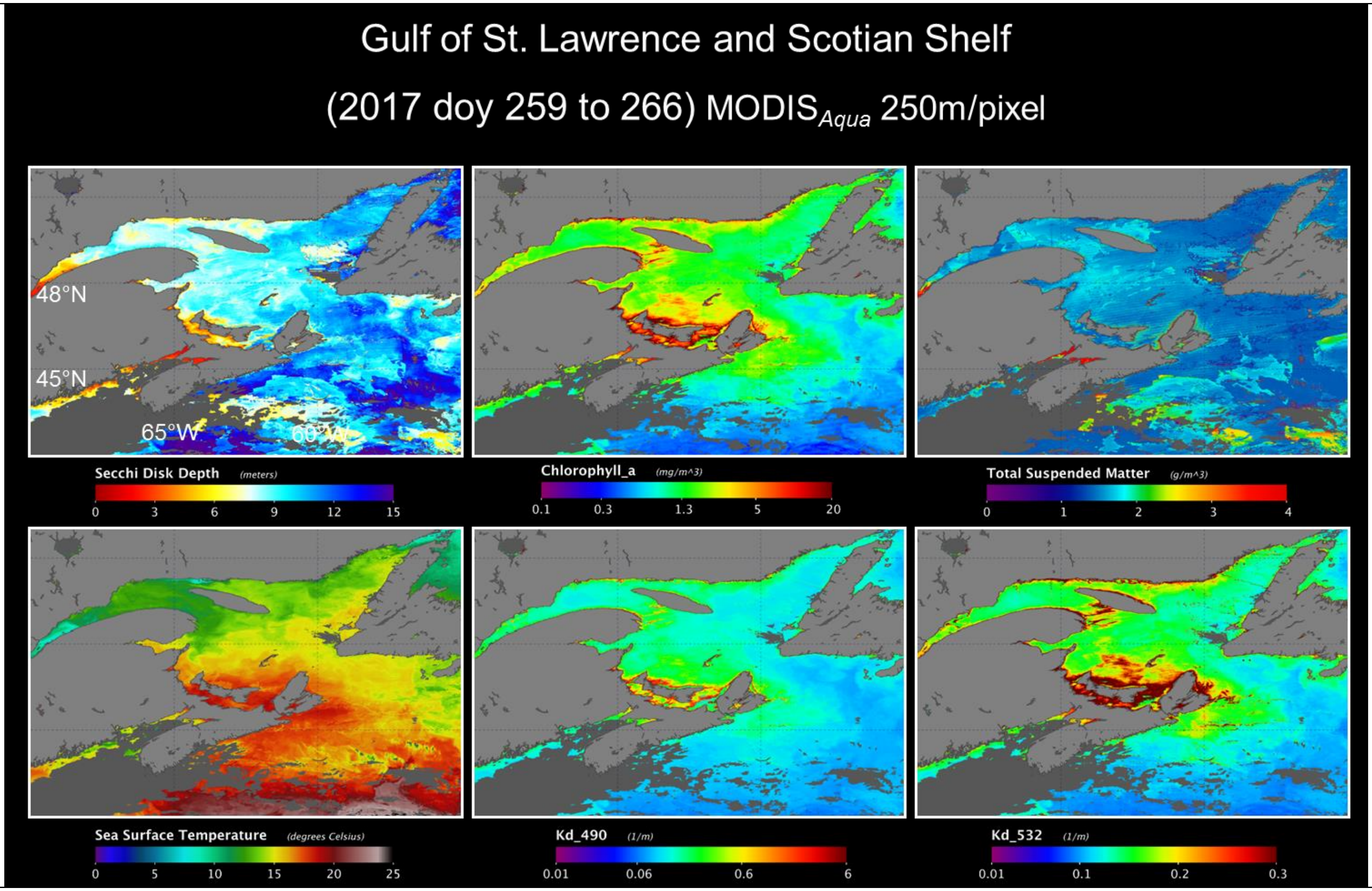


Figure APX 3.13. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from September 16th to 23rd 2017 (doys = 259 to 266). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

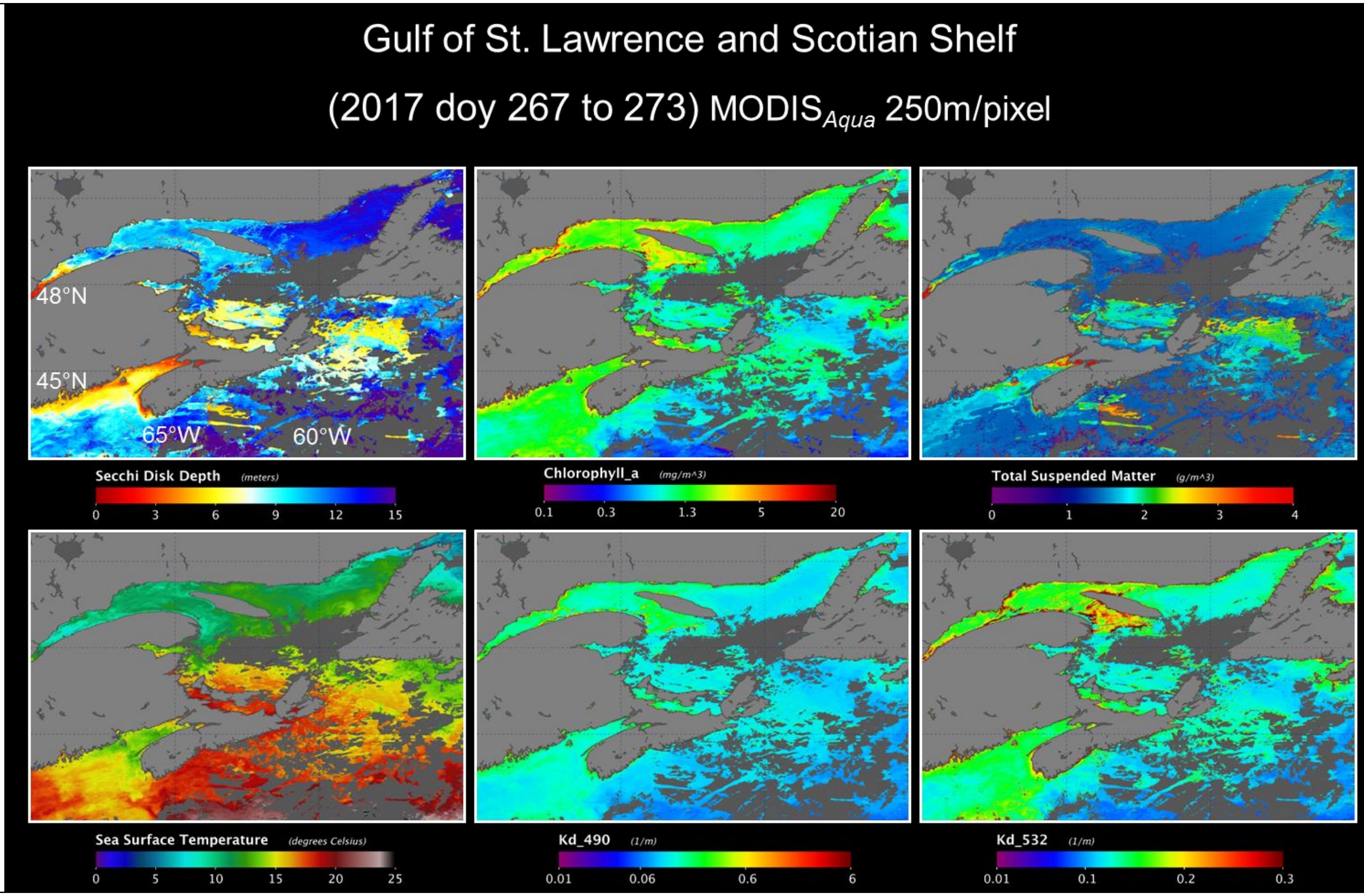


Figure APX 3.14. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from September 24th to 30th 2017 (doys = 267 to 273). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

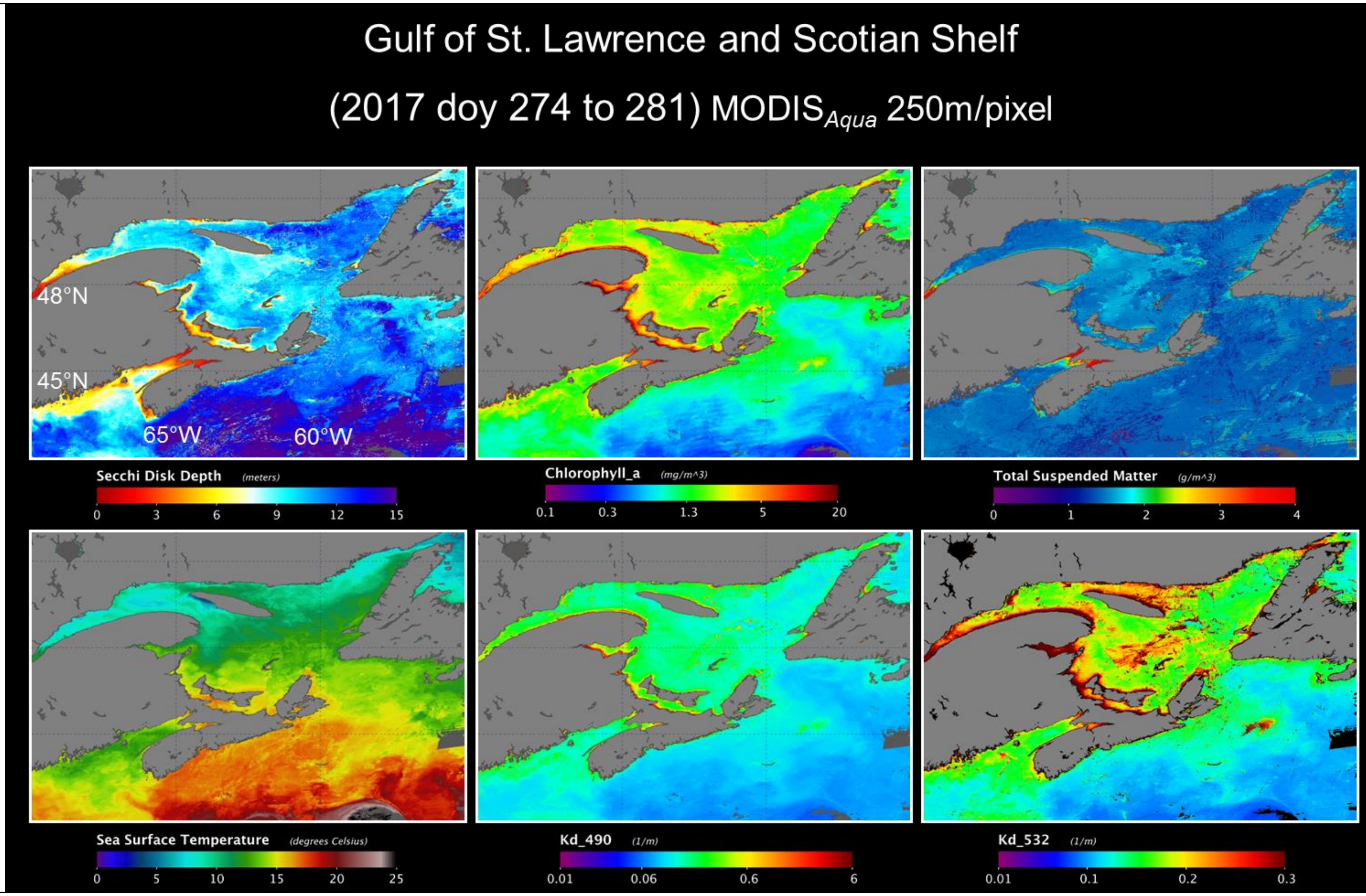


Figure APX 3.15. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from October 1st to 8th 2017 (doys = 274 to 281). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

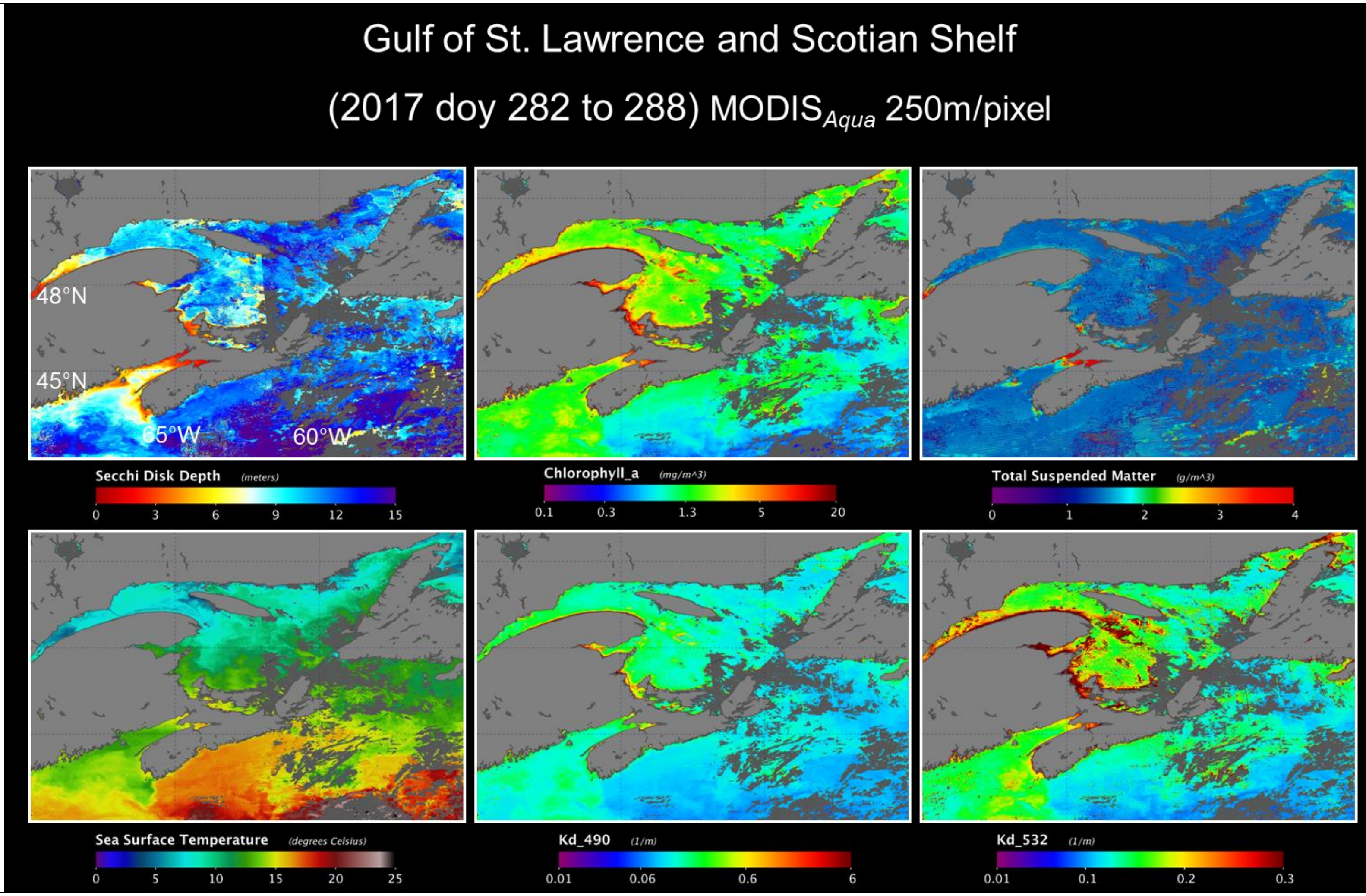


Figure APX 3.16. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from October 9th to 15th 2017 (doys = 282 to 288). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

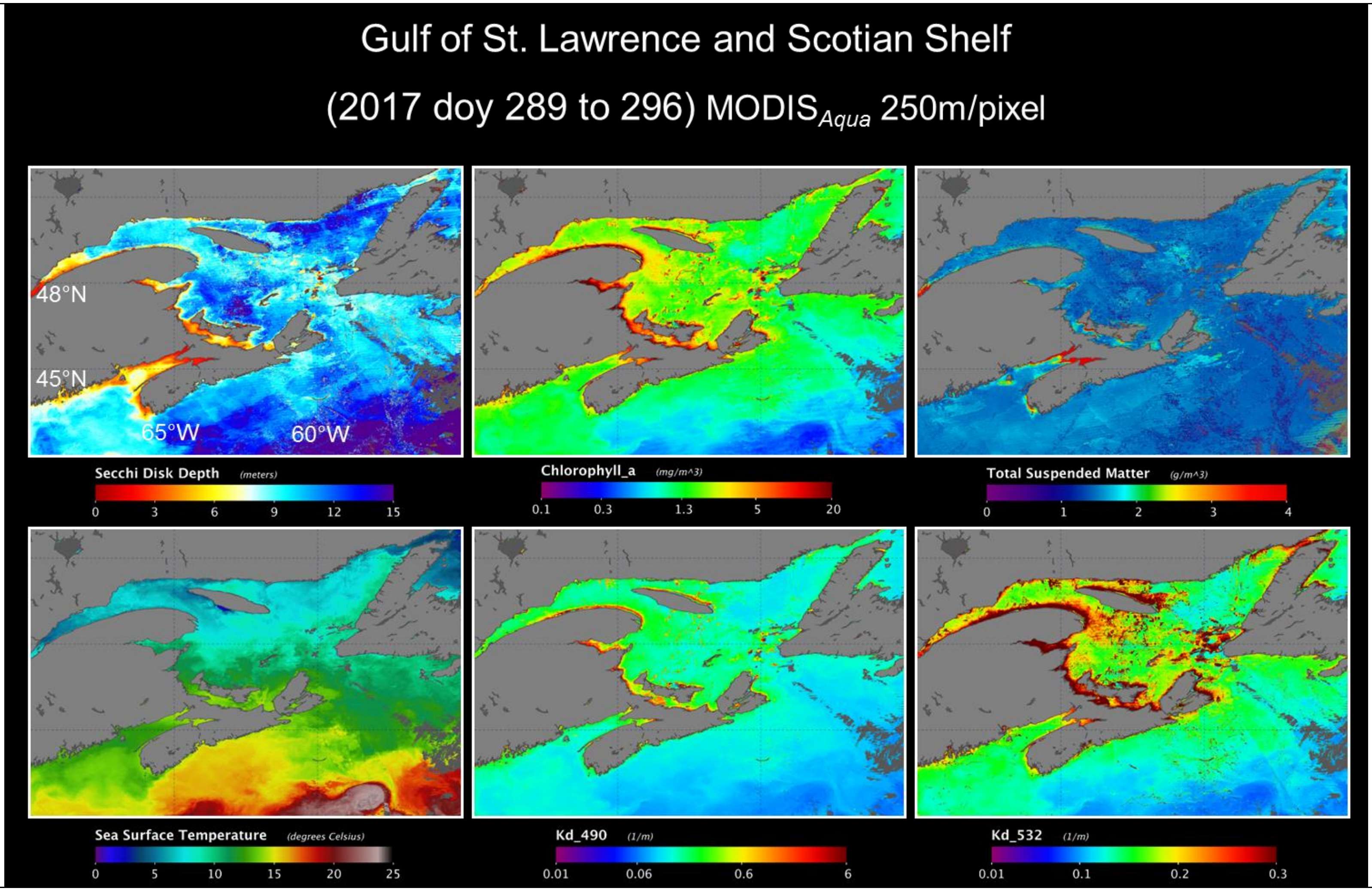


Figure APX 3.17. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from October 16th to 23rd 2017 (doys = 289 to 296). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

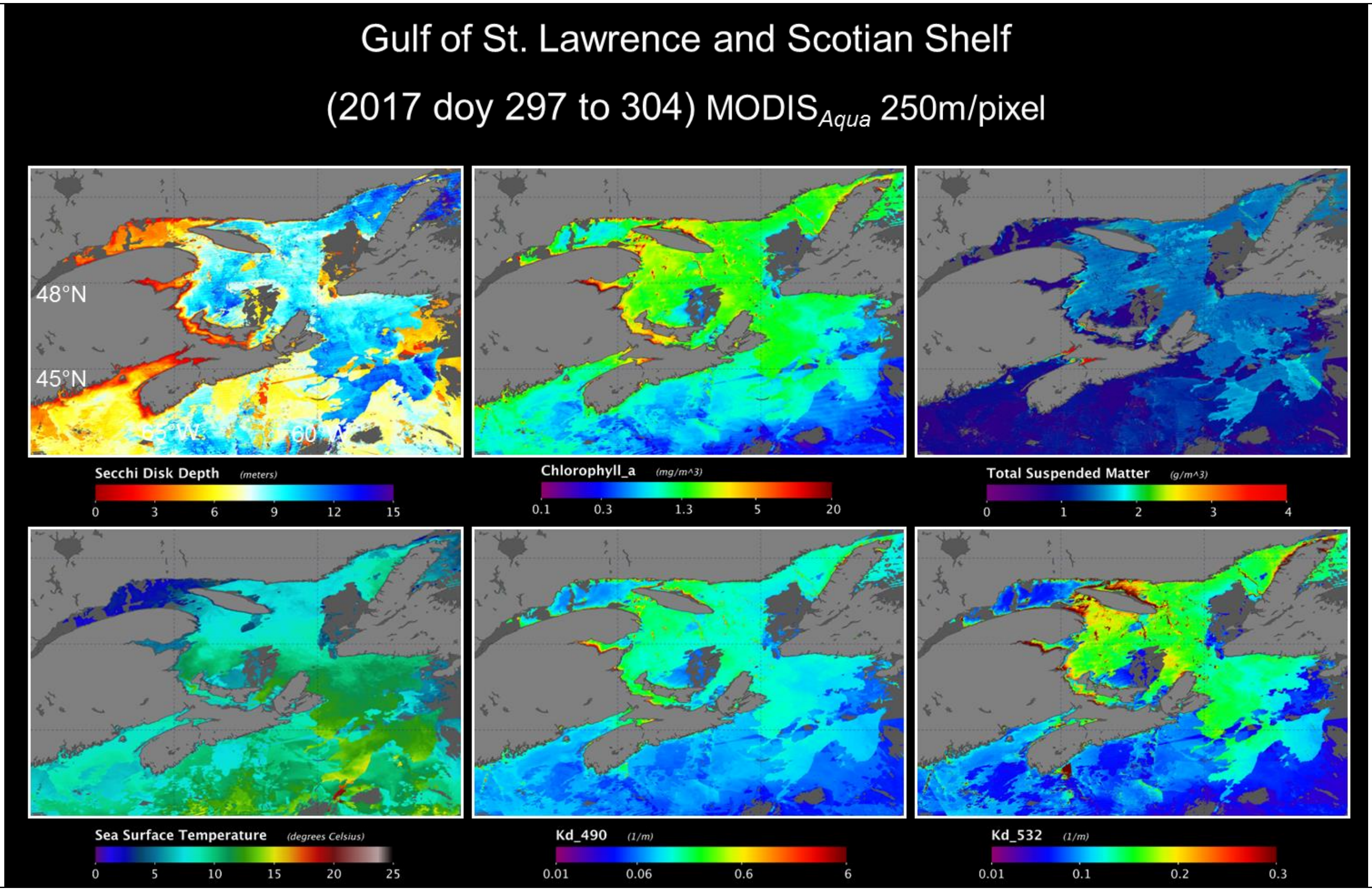


Figure APX 3.18. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in the Gulf of St. Lawrence and Scotian Shelf from October 24th to 31st 2017 (doys = 297 to 304). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

2018

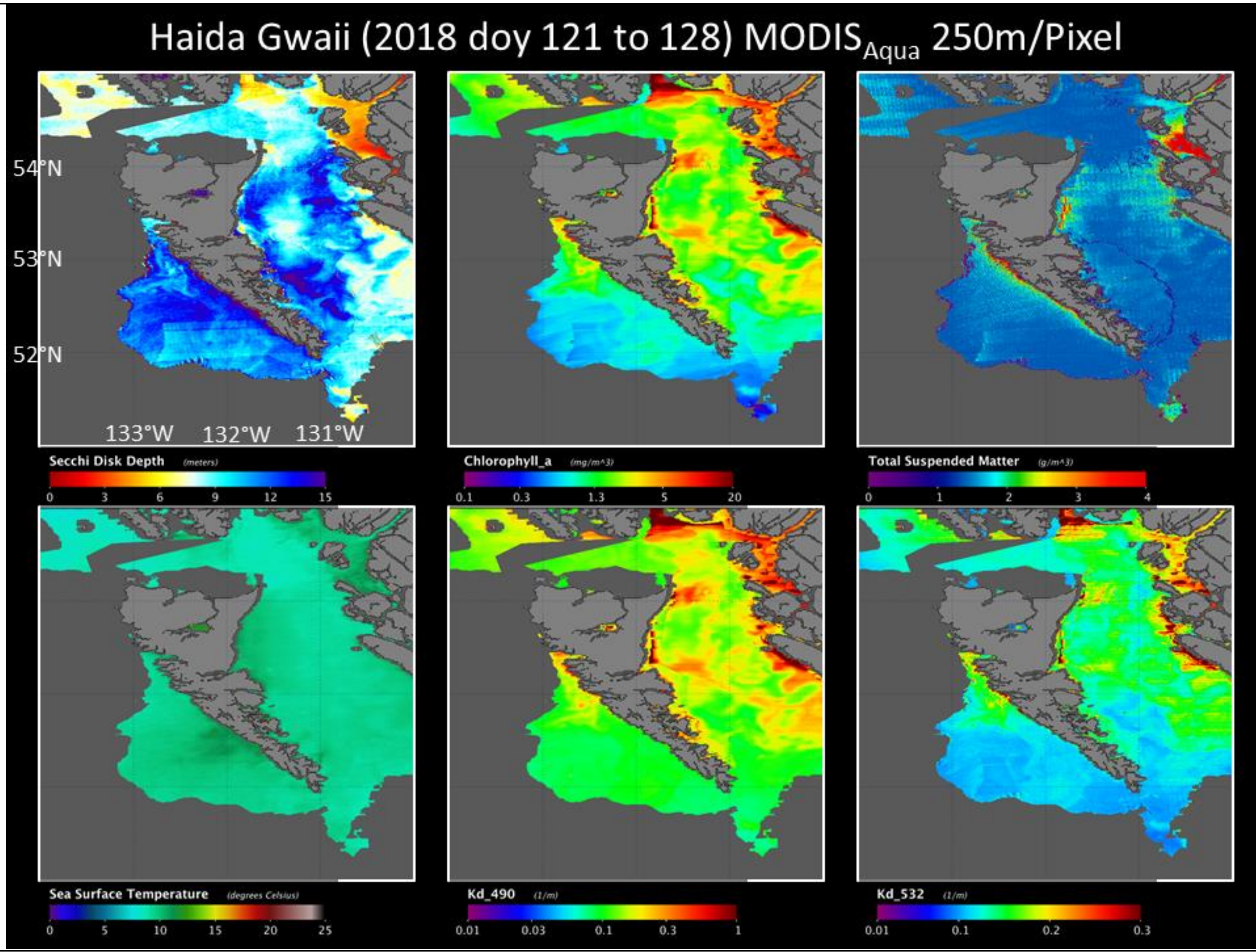


Figure APX 3.19. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in Haida Gwaii from May 1st to 8th 2018 (doys = 121 to 128). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

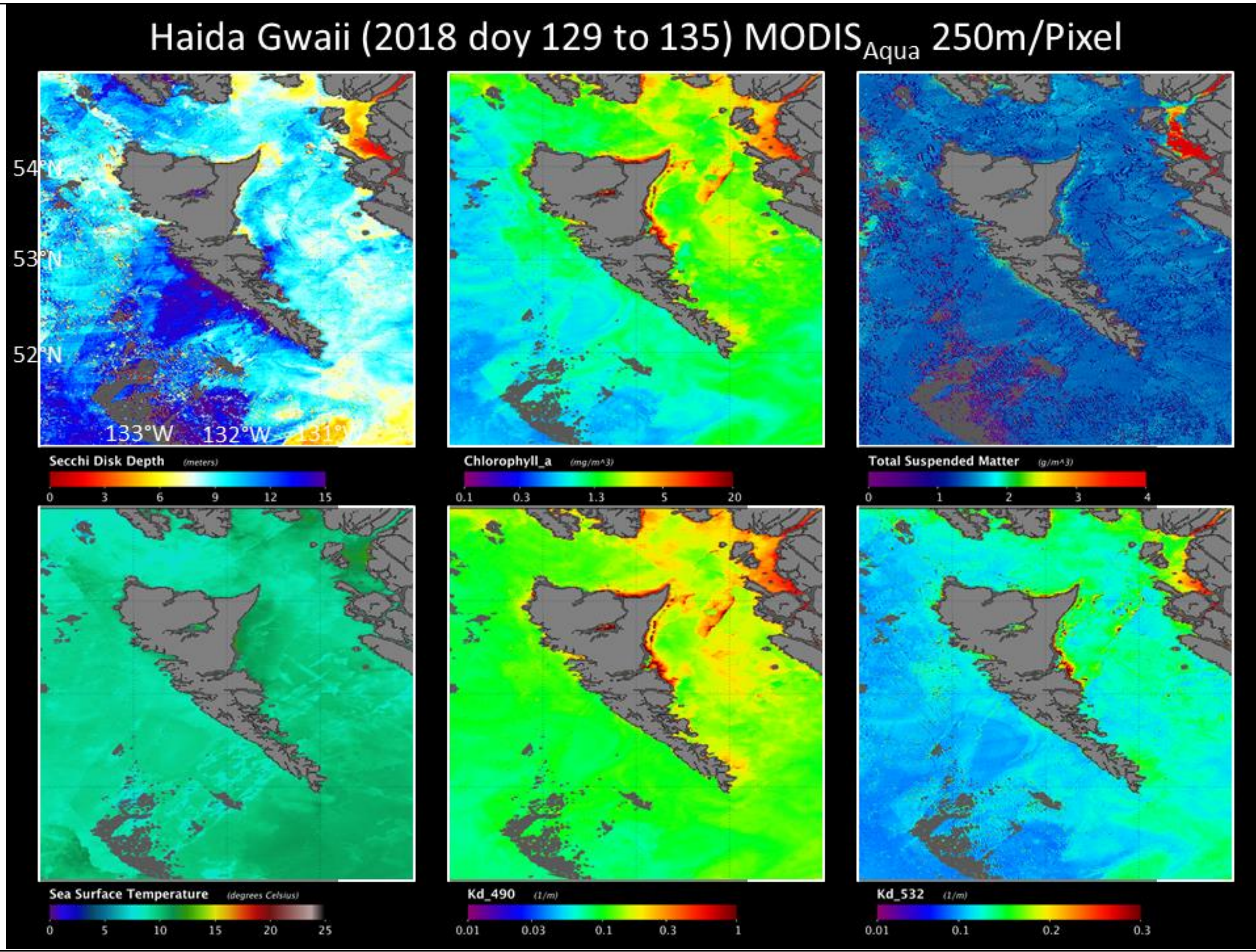


Figure APX 3.20. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in Haida Gwaii from May 9th to 15th 2018 (doys = 129 to 135). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

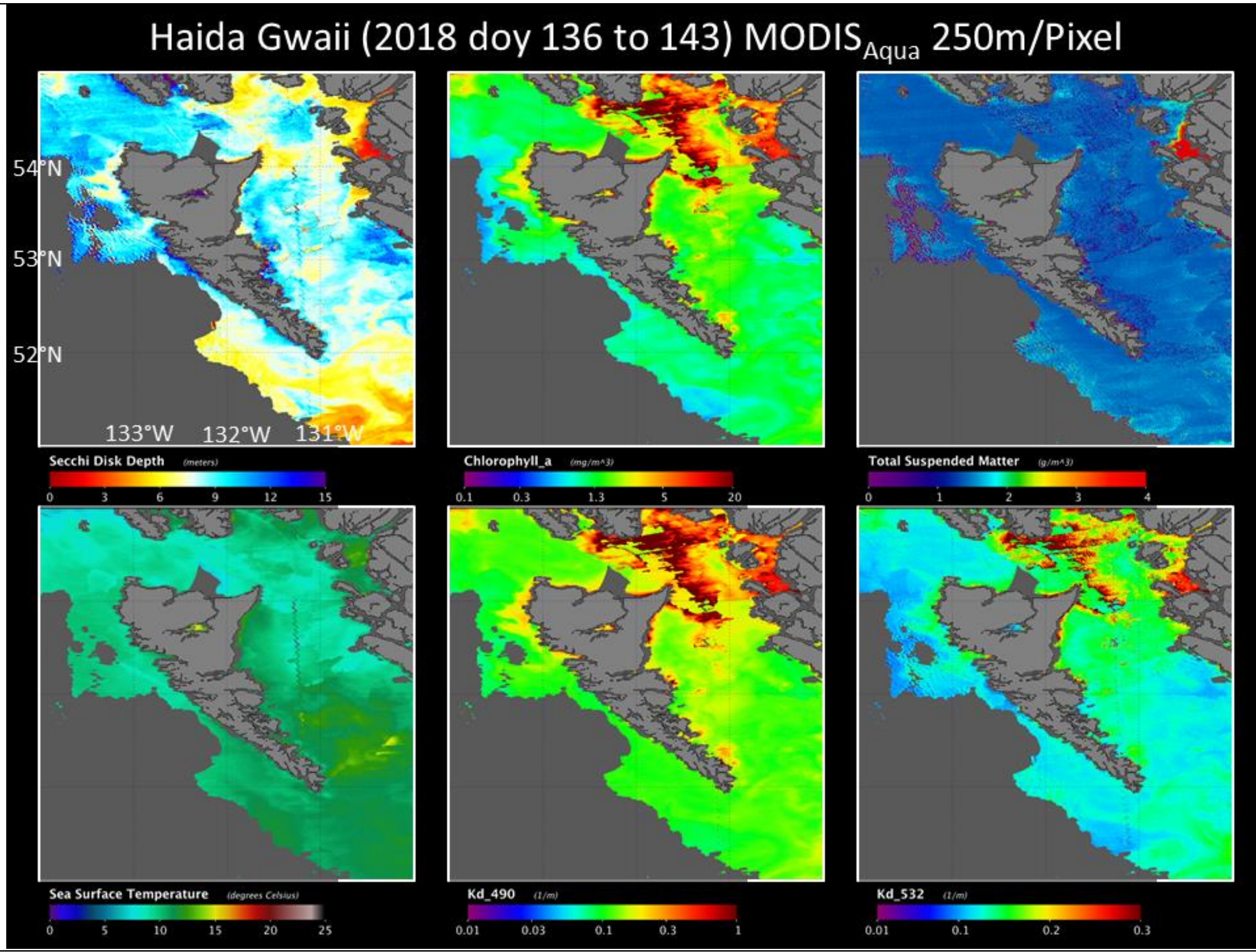


Figure APX 3.21. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in Haida Gwaii from May 16th to 23rd 2018 (doys = 136 to 143). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

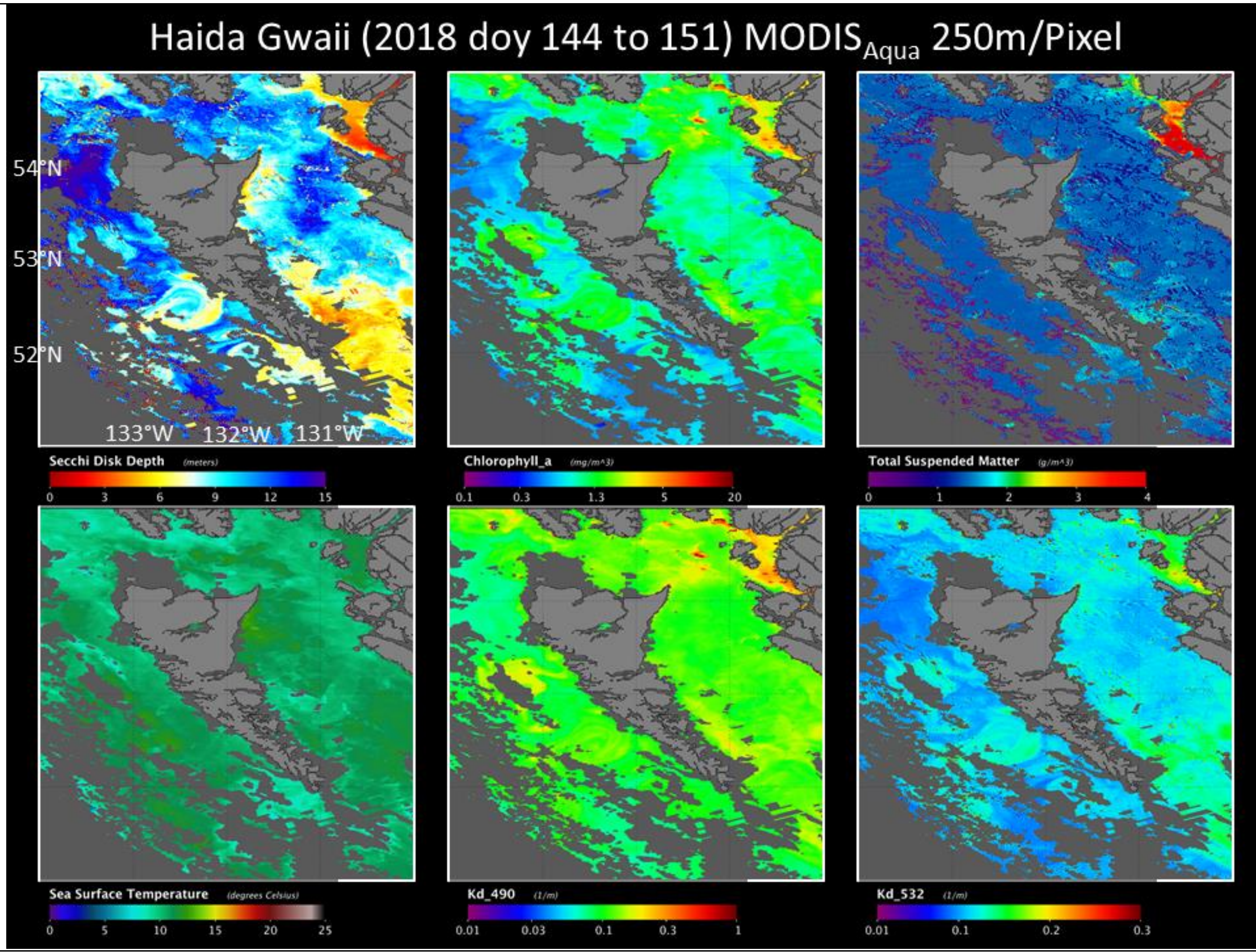


Figure APX 3.22. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in Haida Gwaii from May 24th to 31st 2018 (doys = 144 to 151). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

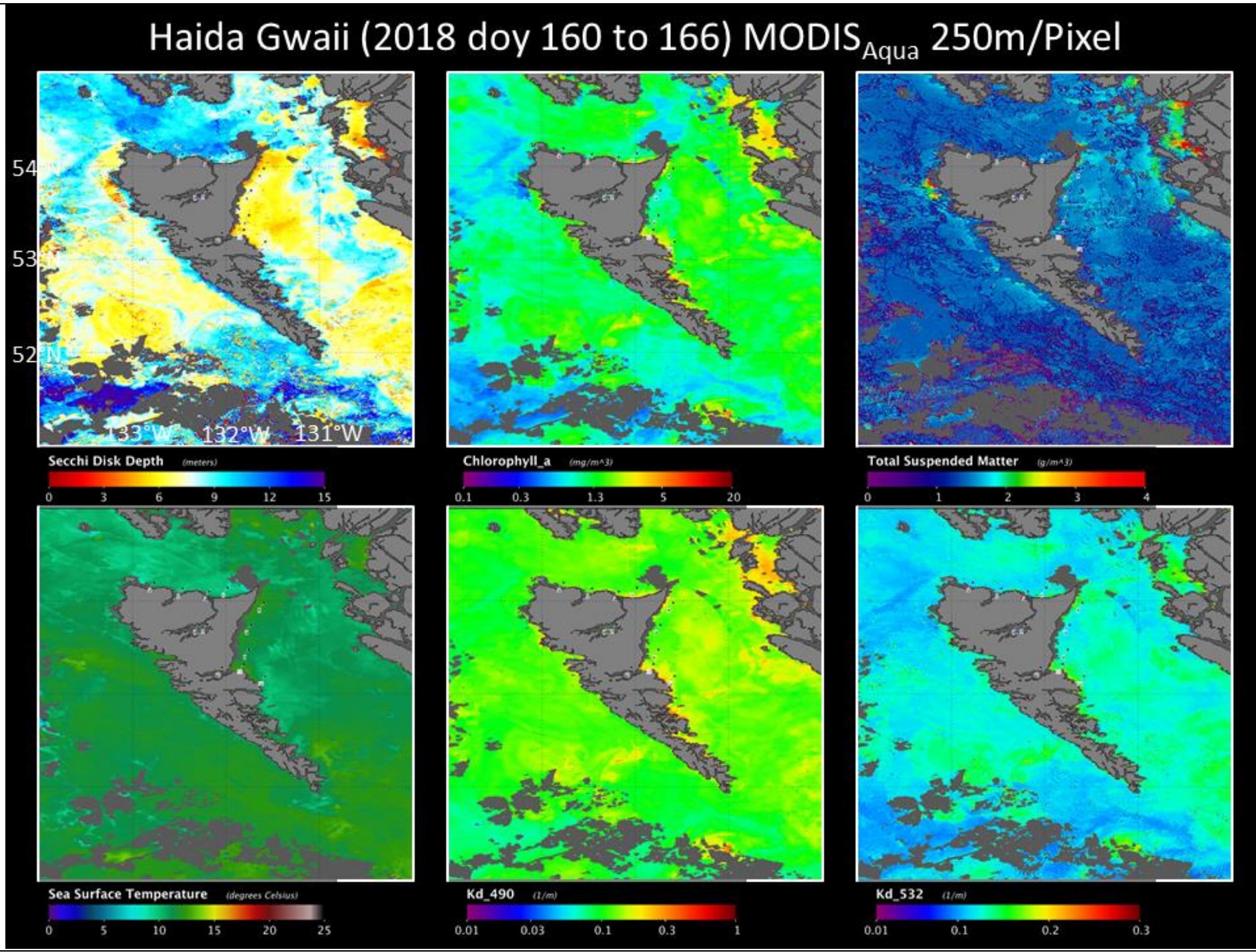


Figure APX 3.23. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in Haida Gwaii from June 9th to 15th 2018 (doys = 160 to 166). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

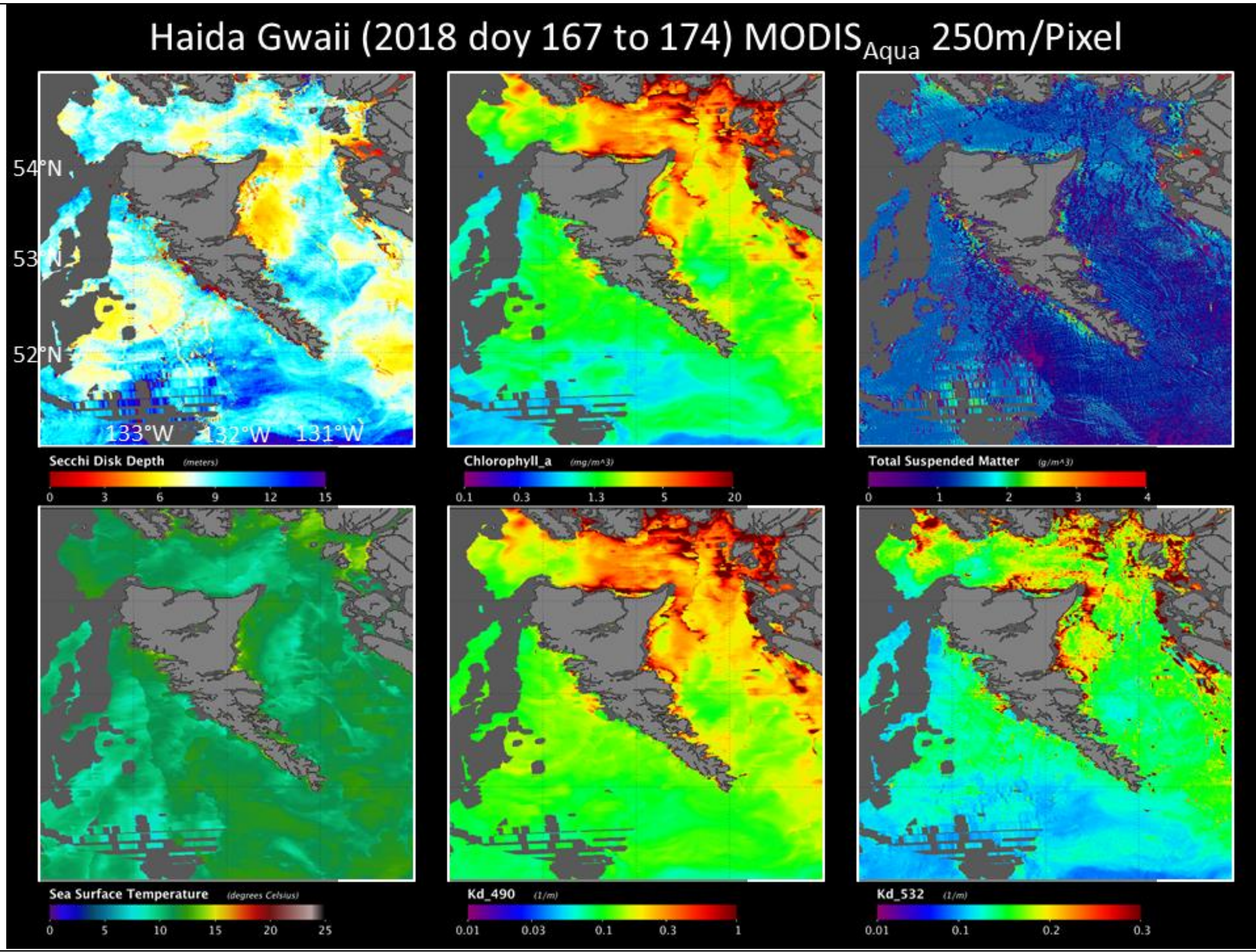


Figure APX 3.24. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in Haida Gwaii from June 16th to 23rd 2018 (doys = 167 to 174). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

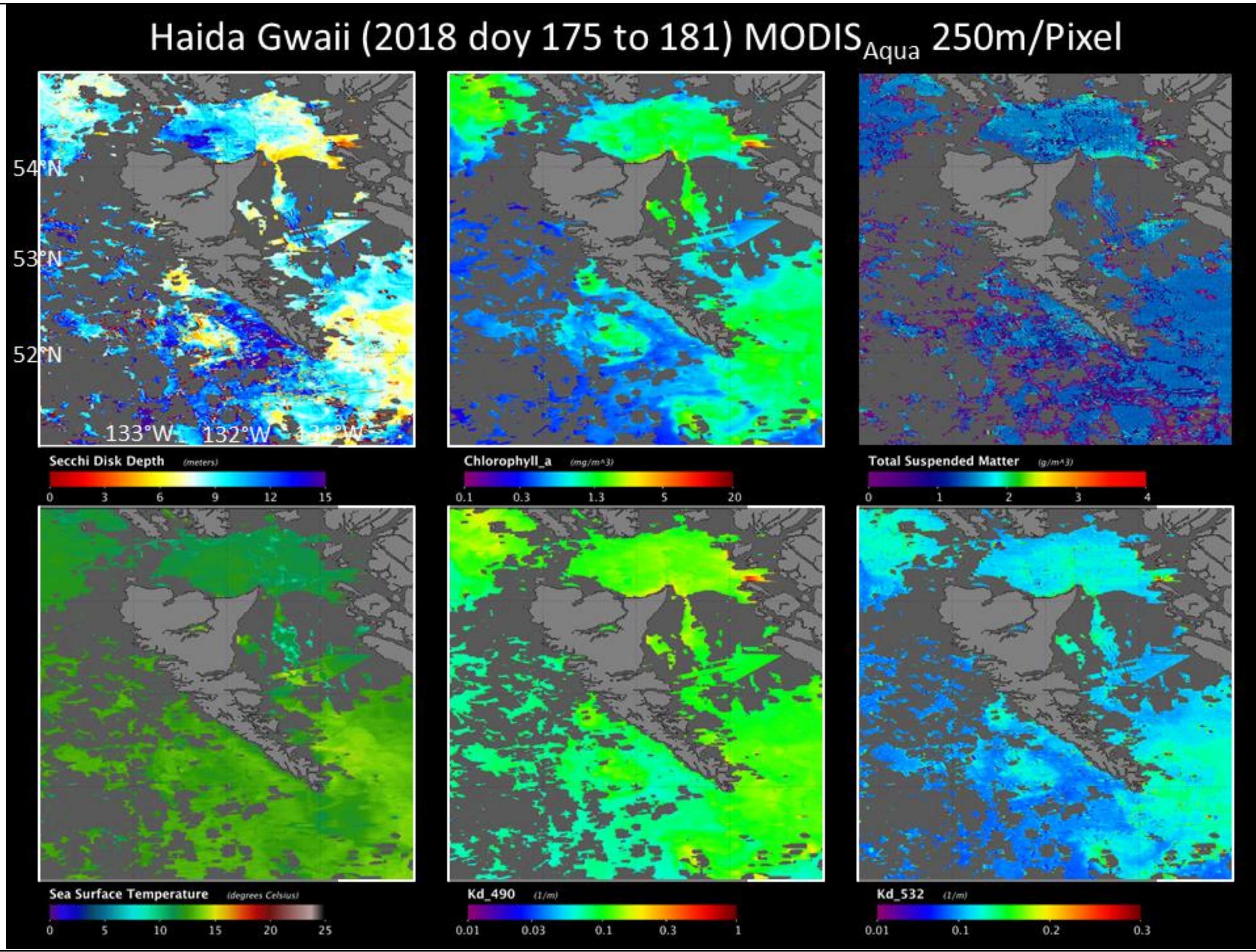


Figure APX 3.25. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in Haida Gwaii from June 24th to 30th 2018 (doys = 175 to 181). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

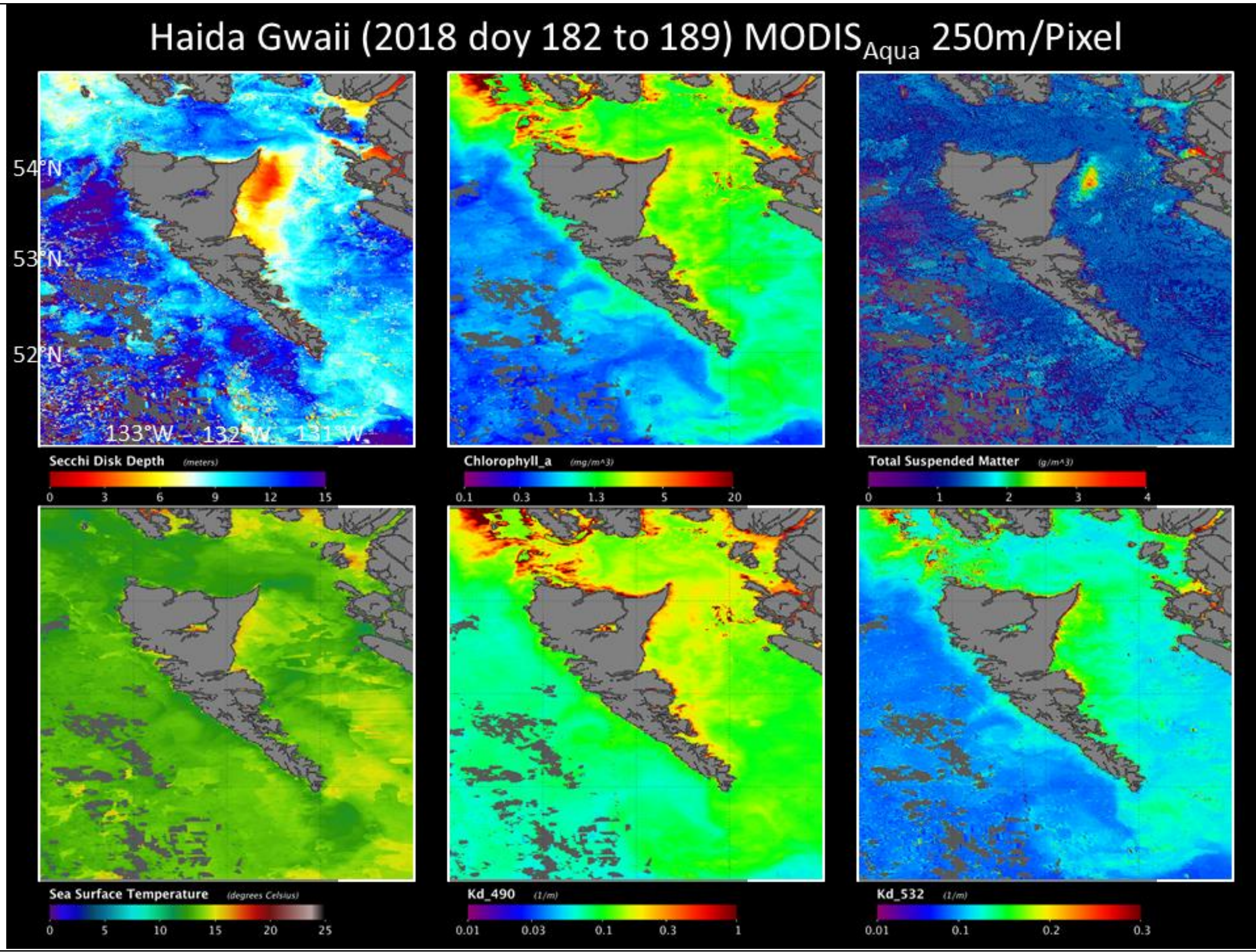


Figure APX 3.26. $MODIS_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in Haida Gwaii from July 1st to 8th 2018 (doys = 182 to 189). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).

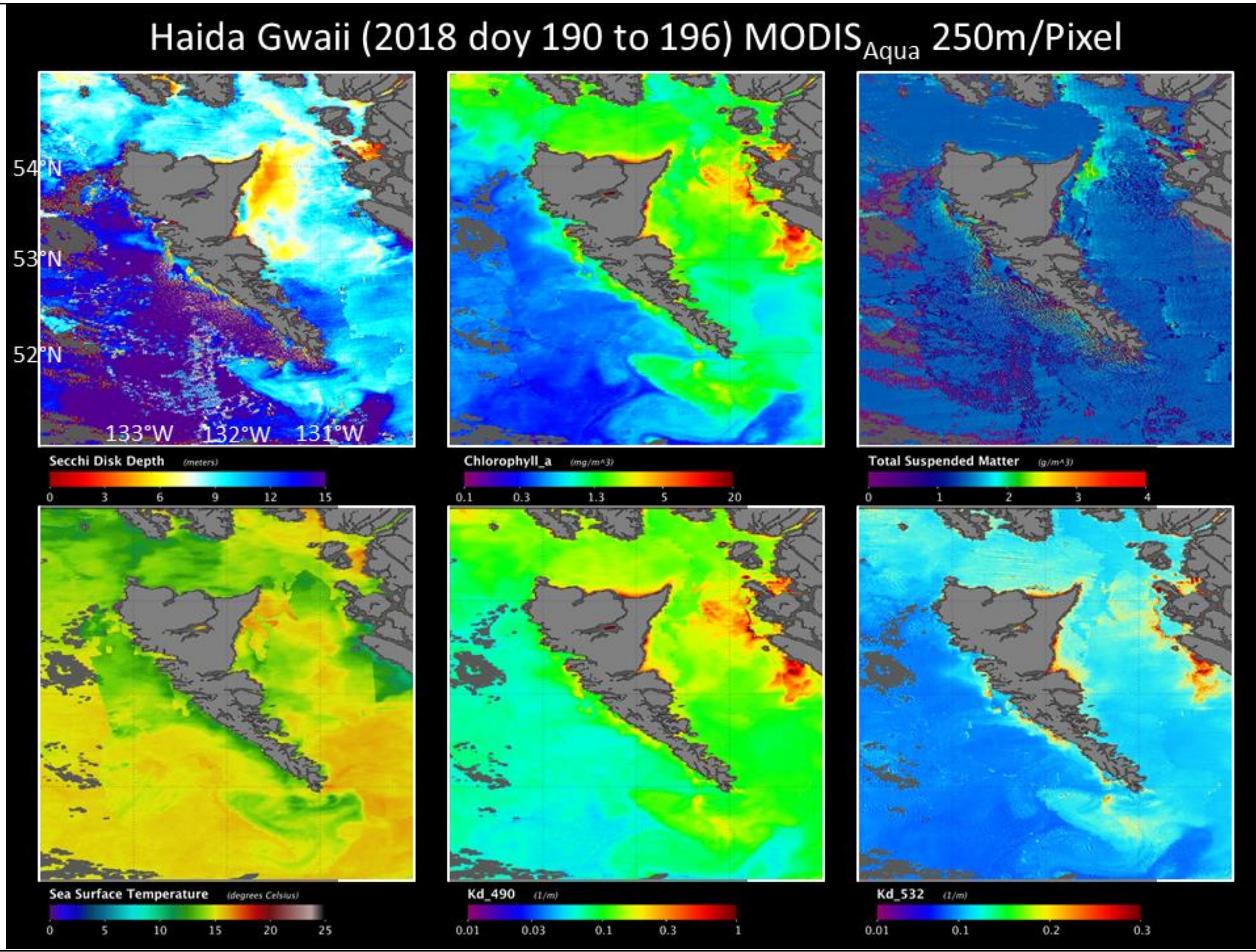


Figure APX 3.27. MODIS$_{Aqua}$ (250m/pixel) weekly composite of oceanographic variables in Haida Gwaii from July 9th to 15th 2018 (doys = 190 to 196). Starting from the top left panel clockwise direction: Secchi Disk Depth (m), Chlorophyll a (mg/m^3), Total Suspended Matter (g/m^3), Diffuse Attenuation Coefficient for Downwelling Irradiance at 532 nm [Kd_532 (/m)], Kd_490 (/m), and Sea Surface Temperature (°C).