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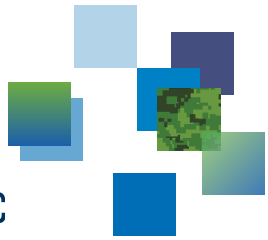

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CFMETR2018 TRIAL PLAN: Electro-optical Ship Wakes Signatures and Background Clutter Measurement

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1 Introduction

In support of the WBE04 of the Naval Platform Signature Management (01ec), Electro-Optical measurements (EO) of the ship wake are required.

In this upcoming trial, we will focus our efforts on simultaneous measurement of temperature relaxation within the turbulent wake with infrared sensor and the thermal array.

The range area, the TSRV Naval Platform, Bell206L Helicopter, MX15 or MX20 with the Bell206L, IR sensor on land for the clutter measurement, DRDC and CFMETR thermal arrays and the operational teams are the core of this trial.

2 Objectives of the Trial

- Simultaneous measurement of IR radiance and temperature relaxation of the turbulent wake.
- Background clutter measurement.
- Collection of EO ship wake signature data in order to extend the SSRS to wider range of wavelengths.

3 Classification

The existence of this trial and the full contents of this trial plan are all UNCLASSIFIED.

4 Requirements

Our measurements require a range facility with naval platform and a helicopter. Instrumentation as Infrared sensors, motion sensors, weather station, and sea surface and depth water profiling are required on-board the helicopter and/or the Naval platform.

4.1 Range Facility

Following are the parameters expected to be measured by the range:

- Meteorological data on-board the ship if possible
- Ship GPS position
- Helicopter GPS position or relative position to the ship

4.2 Helicopter

A Bell206L is required to fly the sensors in order to cover the needed receiver positions. MX15 or MX20 is required to be installed on board the Bell206L. Two DRDC operators need to be on-board the helicopter to operate the sensor and to collect the data.

4.3 Naval Platform

The TSRV CFNAV STIKINE is required. Following are the parameters required to be registered from the CFNAV STIKINE for each run:

- GPS position
- Shaft and speed
- Meteorological data on-board the ship

4.4 Thermal Array

Two (2) SOSI arrays will be deployed in the background for the full two days of measurement. Two (2) SOSI array and two CFMETR arrays will be deployed in the within the ship turbulent wake in the dedicated runs.

4.5 Data Collection from Land

Ship wake radiative imaging will also be performed from the HELO landing pad on the Winchelsea Island, 78 ft. above the water surface (49 17 40.097 / -124 05 08.0966). As a complement, radiance of the background sea surface will be collected from the same site throughout the duration of the experiment. IR images will be captured in the Mid-wave and Long-wave IR. In conjunction with these measurements, a tripod will be installed outside for the collection of:

- Standard meteorological measurements (air temperature and humidity, and wind speed)
- Solar irradiance
- Pictures of cloud coverage

For these measurements, a shelter (tent) shall be erected on the HELO pad, with a large opening (the size of a patio door) toward the sea. In the shelter, a large table (or two medium size tables) and three chairs shall be provided to install three laptop computers and provide rooms for documentations and note/log books of two scientists and one technician. In addition, another mid-size table is required to install reference sources (blackbodies) outside, near the shelter. A standard 120v/15A outlet shall be available at reasonable distance from the shelter (25 ft.). Standard access to Internet would also be more than useful.

5 Description of Experiments

MX15 should be installed to the helicopter prior to the trial. Two (2) SOSI Background array should be deployed in the background before Run 1 and will be recovered at the end of the trial. GPS position monitoring of these buoys can be done in real time.

The experiment Ship and Helo headings and initial positions are dependent on the sun position and wind orientation. We provide in here the most likely plan, a slight modification can occurs according to the wind orientation or a delay in the run time.

Table 1: *Outline of IR wake signature measurement.*

Day 0: Tuesday 31 of July 2018	
Time	Task or test
08:30	Setup and Installation
17:00	adjourn
Day 1: Wednesday 1st of August 2018	
Time	Task or test
07:30	Set up and TA Bck deployment
08:30	Run 1
11:00	Run W1
13:00	Run 2
17:00	adjourn
Day 2: Thursday 2nd of August 2018	
08:30	Run 3
11:30	Run W2
13:00	Run 4
17:00	adjourn
Day 3: Friday 3rd of August 2018	
8:30	Spare
17:00	End of the trial

5.1 Run 1

We show in Figure 1 a description of the Run 1 and the required heading relative to the sun position in Figure 2. We present in Table 2 the coordinates of the points S1,S2, H1 and H2 and their location on the map in Figure 3.

Time stamp	initialization	Start run 1	+ 3 minutes (1.4Km)	+ 8 minutes (3.7 km)	+ 13minutes (6 km)	+ 18minutes (8.3 km)	End run 1
Ship	Ship positioning at S1	Constant heading at 15 kts until end of the run					Recovery of 4 TA
Bell206	Positioning at H1, heading toward H2 @300m elevation	Stationary	Stationary Until ship within ¾ of FOV (11 min) run toward ship top down heading toward Downstream for 3 min followed by TD run.				
TA			Deployment TA SOSI 1	Deployment TA SOSI 2	Deployment CFMERT 1	Deployment CFMETR 2	
MX15	Sensor heading toward S2	Start data collection	Continuous data collection				End of data collection
Note for the SC	Amendment H1, H2, S1, S2 in case of delay in schedule or wind different from expected	Clutter ship outside the frame Data: Clutter1 RUN1Clutter		Ship within the MX15 frame CS DATA: RUN1CTR	Stationary on the TOP, DATA: Run1WWW	TD Data: Run1Turb	
Weather station And BCK TA	BCK TA already deployed	Start record					End record

Figure 1: *Run 1.*

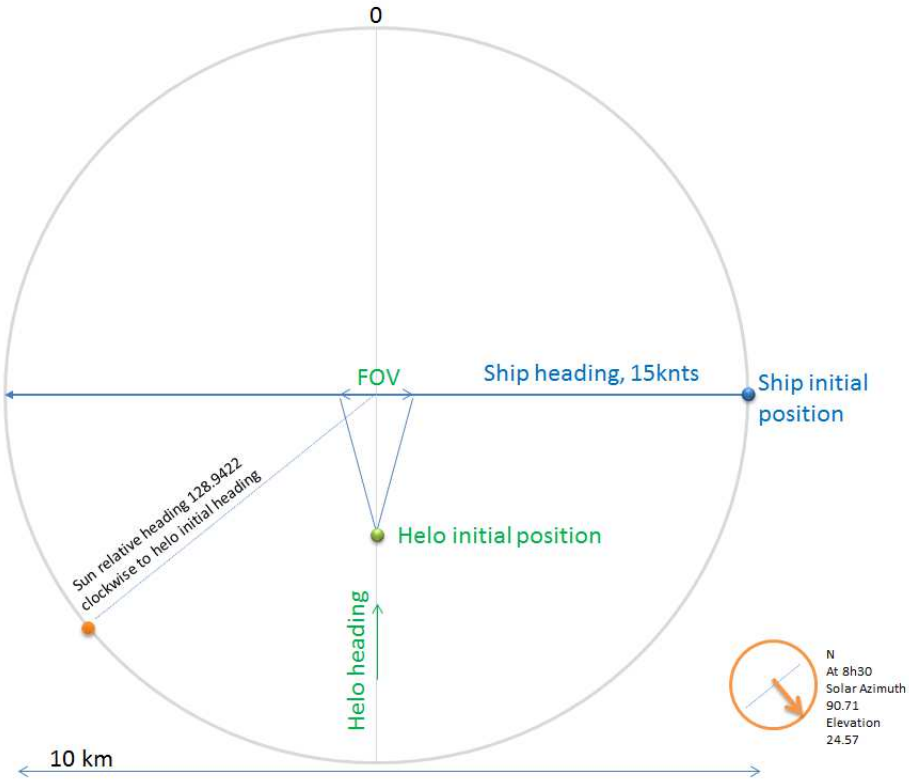

Figure 2: *Run 1 geometry.*

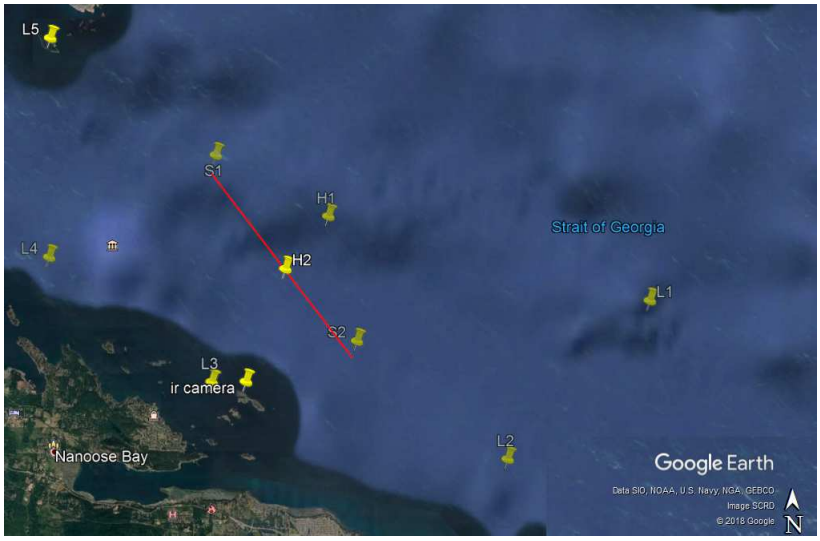

Figure 3: *Geographical map pf the Run 1 from Google Earth.*

Table 2: *Ship waypoints for ship Run 1 and Helo initial position.*

Waypoints	Latitude	Longitude
S1	N49;20;50.41	W124;6;14.10
S2	N49;18;35.48	W124;1;15.41
H1	N49;21;26.33	W124;2;16.89
H2	N49;20;14.33	W124;3.43;52

5.2 Run 2

Similar to Run 1 With replacing the Helo TD by Elliptical run followed by Reverse CS run. Adjustment for the sun position is required.

5.3 Run 3

Similar to Run 1 but for ship at 10kts.

5.4 Run 4

Similar to Run 2 but for ship at 10kts.

5.5 Run W

W runs allow collection of white water wake data. In the Run W the Helo and the Ship have the same track and speed at the binging of each track for three minutes. The Helo slow its speed for the same coarse until 80 metre downstream distance. We show in Figure 4 the W run. Run W1 is at ship speed 15 kts and run W2 is at 12kts.

Table 3: *W run.*

Zenith	h	R	CS distance
80	150	864	851
70	150	438	412
50	282	438	336
30	380	438	219
20	412	438	150
0	438	438	0
-20	412	438	-150
-50	282	438	-336

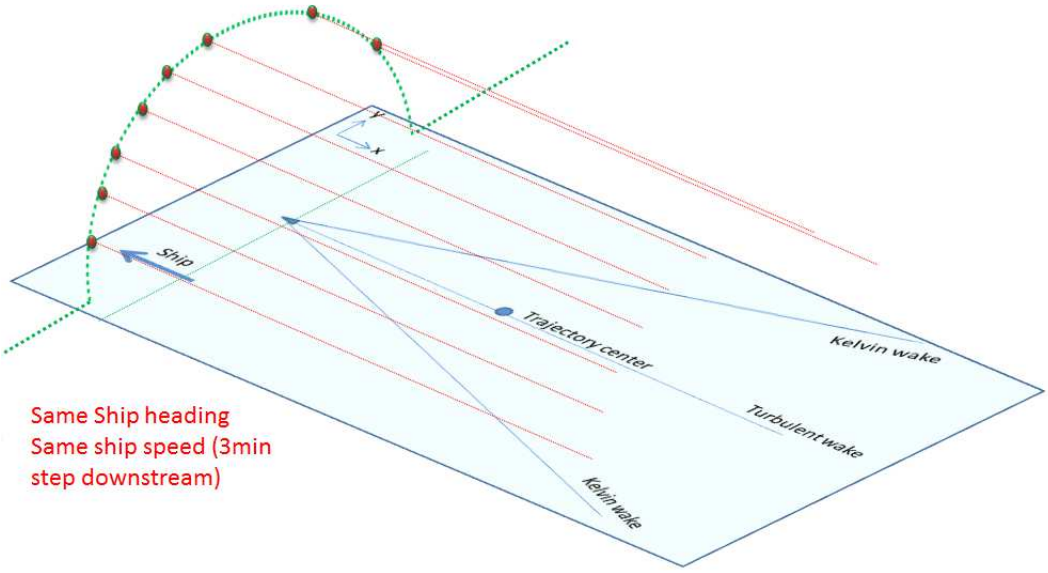

Figure 4: *The W run tracks.*

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13. ABSTRACT/RÉSUMÉ (When available in the document, the French version of the abstract must be included here.)

This document presents the CFMETR2018 ship wake and clutter measurement trial plan in support of the WBE04 of the Naval Platform Signature Management (01ec). The trial objective is to collect simultaneously electro-optical measurements and thermal measurements of the ship wakes and the background. The electro-optical measurements are collected with an MX15 sensor from a helicopter at a multiple viewing angles for the middle wave infrared and the visible bands and with a FLIR camera from land within the middle wave and long wave band. At the same time, the thermal relaxation of the sea temperature and the sea stratification are measured with thermal array buoys. The trial plan shows the requirements and the details of the experience including ship tracks and helicopter tracks synchronization and run descriptions.

Ce document présente le plan d'essai CFMETR2018 de mesure du sillage de navire à l'appui de la WBE04 de la du projet 01ec. L'objectif de l'essai est de collecter simultanément des mesures électro-optiques et thermiques du sillage du navire et de l'arrière plan. Les mesures électro-optiques sont collectées avec un capteur MX15 depuis un hélicoptère sous plusieurs angles de vision pour l'infrarouge et les bandes visibles, ainsi qu'avec une caméra FLIR depuis la terre, pour l'infrarouge MW et LW et les ondes longues infrarouge. En même temps, la relaxation thermique dans le sillage de navire et la stratification de la mer ambiante sont mesurées à l'aide de bouées thermiques. Le plan d'essai montre les exigences et les détails de l'expérience, y compris la synchronisation des parcours de navires et ceux de l'hélicoptère, ainsi que des descriptions de test.