

# **Sea state and temperature statistics for MHP operational limits**

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**Defence R&D Canada – Atlantic**

Technical Memorandum

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## **Abstract**

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In response to a request by the Project Management Office for the Maritime Helicopter Project (MHP), DRDC Atlantic has evaluated the frequency of occurrence of combinations of significant wave height and temperature in ocean areas of interest. A set of tables showing these frequencies, both annually and seasonally, has been provided for eight ocean regions.

## **Résumé**

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En réponse à une demande du Bureau de gestion de projet (BGP) du Projet d'hélicoptère maritime (PHM), RDDC Atlantique a évalué la fréquence d'occurrence simultanée de grandes hauteurs de vague et de températures extrêmes dans des secteurs océaniques d'intérêt. Un ensemble de tables montrant ces fréquences sur une base annuelle et sur une base saisonnière a été fourni pour huit régions océaniques du monde.

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## Executive summary

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### Sea state and temperature statistics for MHP operational limits

**Sean Pecknold; DRDC Atlantic TM 2012-235; Defence R&D Canada – Atlantic; November 2012.**

**Background:** The Project Management Office for the Maritime Helicopter Project has a requirement to know how often extreme temperature conditions occur at the same time as high sea states. DRDC Atlantic was requested to provide an evaluation of the frequency of occurrence of weather conditions (sea state and temperature) to assist in determining the requirements for operational limits of the CH148 Maritime Helicopter. Because of the anticipated global extent of possible operations for the CH148, such information was required in all maritime areas of the world.

**Results:** Sets of temperature and significant wave height data were acquired from the US National Oceanic and Atmospheric Administration (NOAA) that allow for estimation of joint probabilities of given temperature and wave height conditions. A set of tables of annual and seasonal joint probabilities was generated for eight ocean regions. Processing in this report was improved from that performed in a previous report [1].

**Significance:** The joint frequency of occurrence tables provided here should assist the PMO MHP in assessing the requirements for operational capabilities of the CH148. Maps of the areas where extreme temperature and wave height conditions occur most frequently also provide a useful tool for assessing where and how often the limits of the operating envelope of the CH148 might potentially be reached.

**Future plans:** The current data set is based on six years of data covering the years 2006 to 2011 inclusive. Follow-on analyses, if desired by the client, could improve the temporal or spatial resolution of the data set, or broaden the temporal extent to include meteorological and oceanographic conditions that might not be evidenced in the current data. Joint frequency of occurrence with other wave parameters such as wave period could also be generated.

# Sommaire

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## Sea state and temperature statistics for MHP operational limits

**Sean Pecknold; DRDC Atlantic TM 2012-235; R & D pour la défense Canada – Atlantique; novembre 2012.**

**Contexte :** Le Bureau de gestion de projet (BGP) du Projet d'hélicoptère maritime (PHM) a besoin de connaître la fréquence à laquelle des conditions de température extrêmes se produisent en même temps que la mer est agitée. On a demandé à RDDC Atlantique de fournir une évaluation de la fréquence d'occurrence simultanée des mauvaises conditions météorologiques (état de la mer et température) pour aider à déterminer les exigences relatives aux limites opérationnelles de l'hélicoptère maritime CH148. En raison de l'étendue mondiale anticipée du domaine d'exploitation du CH148, cette information était nécessaire pour toutes les zones maritimes du monde.

**Résultats :** Des jeux de données sur la température et les vagues de grande amplitude ont été acquis auprès de la US National Oceanic and Atmospheric Administration (NOAA) et ils permettent l'estimation des probabilités d'occurrence conjointe de conditions de température et de hauteur des vagues. Un ensemble de tables annuelles et saisonnières de probabilités conjointes a été généré pour huit régions océaniques. Le traitement couvert par ce rapport a été amélioré comparativement à celui réalisé pour un précédent rapport [1].

**Importance :** Les tables de fréquences d'occurrence conjointe présentées dans le présent rapport devraient aider le BGP du PHM à évaluer les capacités opérationnelles requises du CH148. Les cartes des zones où les températures extrêmes et les fortes hauteurs de vague se produisent le plus souvent constituent aussi un outil utile pour évaluer les endroits où les limites de l'enveloppe de fonctionnement du CH148 pourraient potentiellement être atteintes ainsi que la fréquence de telles occurrences.

**Perspectives :** Le jeu de données actuel est basé sur six ans de données couvrant les années 2006 à 2011 inclusivement. Des analyses de suivi pourraient, si le client le souhaite, améliorer la résolution temporelle ou spatiale du jeu de données. Par ailleurs, un allongement de l'étendue temporelle pourrait inclure des conditions météorologiques et océanographiques qui pourraient ne pas être mises en évidence dans les données actuelles. Il serait aussi possible de calculer la fréquence d'occurrence conjointe d'autres paramètres relatifs aux vagues, comme leur période.

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# 1 Background

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## 1.1 Maritime Helicopter Project

The objective of the Maritime Helicopter Project (MHP) is to replace the current maritime helicopter fleet, composed of CH124 Sea Kings, with a new fleet of 28 CH148 Cyclone helicopters. The Cyclones are based on the Sikorsky H-92 helicopter, with a mission system from General Dynamics Canada. The project also includes a long-term in-service support program and training facility, and will require modifications to the RCN's Halifax class (HFX) frigates. The project will address the operational deficiencies and increasing difficulties involved in supporting the current CH124.

## 1.2 Environmental requirements

The CH124 Sea King was originally designed as a single-role anti-submarine warfare (ASW) helicopter. The 1994 Defence White Paper [2] called for multi-purpose, combat-capable armed forces; the CH124 replacement therefore requires a multi-role capability. The 1999 Maritime Helicopter (MH) Statement of Requirements (SOR) [3] stated that:

The MH will normally be operated from flight decks on Canadian navy DDHs, FFHs and AORs, and from shore facilities that will include both airfields and unprepared landing areas. The MH and aircrew must be prepared to operate in a harsh maritime environment, in tropical, temperate, and sub-Arctic conditions and, potentially, in a nuclear, biological and/or, chemical warfare environment.

and

The MH and associated equipment will be subjected to extremes of temperature, wind, humidity, icing, salt spray, and turbulence typical of operations ranging from Canada's sub-Arctic to tropical locations throughout the world. The MH will be expected to operate from sea level to 10,000 feet above sea level (ASL), in inclement weather and heavy seas, day and night, from both embarked and austere shore-based locations.

In order to determine where, when, and to what extent extreme environmental conditions that could impact the operation limits of the CH148 might be encountered, DRDC was requested by Mr. T. J. Caron, DGMPD PMO MHP SEM 8-3 to perform an evaluation of the frequency of occurrence of extreme weather conditions (sea state and temperature). An initial report on sea state and temperature statistics was provided on 3 October 2012 [1]. An extension of that information was requested to provide more detailed tabular values for potential operational areas. This report provides the requested information.

## 2 Global sea state and temperature data

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To meet the requirements of estimating the frequency of occurrence of various temperature and sea state conditions at the same time, a dataset with contemporaneous wave and temperature data was required. For the purposes of this request, global gridded databases were chosen, both to provide sufficient geographic extent for the analysis and to eliminate bias caused by sampling density that might occur with point-source data such as buoys.

### 2.1 Temperature data

Marine temperature data can be acquired from a number of sources. These include buoy and ship data, data from sonde observations and aircraft, and temperatures derived from satellite observations. The temperature datasets selected for the purposes of this report were obtained from the U.S. National Oceanic and Atmospheric Administration (NOAA) Earth Sciences Research Laboratory Physical Sciences Division. Two immediately applicable sources of data were found here, each of which was obtained from the NCEP/NCAR (National Centers for Environmental Prediction/National Center for Atmospheric Research) Reanalysis 1 Project [4]. This project assimilates data from all the above-mentioned sources, and provides a set of gridded outputs based on the observed data and the NCEP global spectral model. These outputs include temperature and wind profiles, humidity, precipitation, and surface fluxes.

The first dataset (used in the initial report [1]) is a set of four-times-daily gridded near-surface temperatures. The temperatures provided are air temperature at a 995 sigma level, i.e. a pressure level corresponding to 38 m above mean sea level (see Figure 1 for an example). The temperatures are instantaneous values provided on a global grid with a spatial resolution of 2.5° in both latitude and longitude. This data is classified as category A by the NCEP/NCAR Reanalysis Project, indicating that it is strongly influenced by observed data and is thus the most reliable class of data.

The second dataset is similar to the first – it is gridded temperature data with a frequency of four times per day. The provided temperatures are air temperatures at a height of 2 m. The main differences are that the temperatures here are 6 hour forecast temperatures, and that they are classified as category B, rather than category A. This indicates that the 2 m height temperature data is not as reliable as the first dataset – although the temperature values are directly affected by observed temperatures, they also have a strong dependence on the NCEP model. It should also be noted that these data are provided on a Gaussian latitude-longitude grid rather than a uniform grid. Figure 2 shows an example of this temperature data, corresponding to the date and time of the data in Figure 1. The 2 m height temperature data show very similar spatial characteristics, but cover a slightly broader range of values.

4xDaily Air temperature at sigma level 995

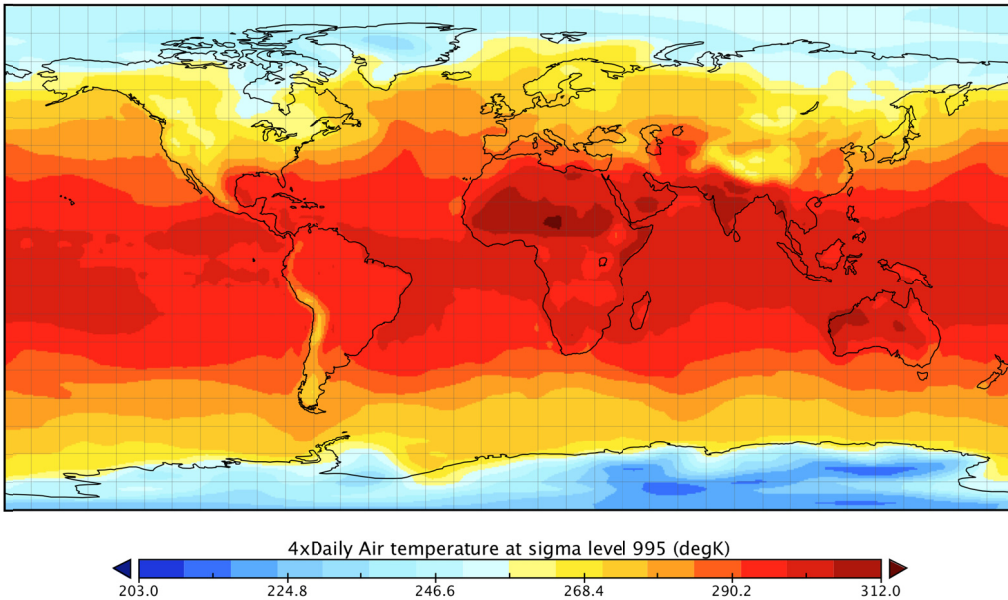


Figure 1: Sigma level 995 global temperature data from NCEP/NCAR Reanalysis 1, for 12:00 UTC on 20 March 2006.

4xDaily Air temperature at 2 m

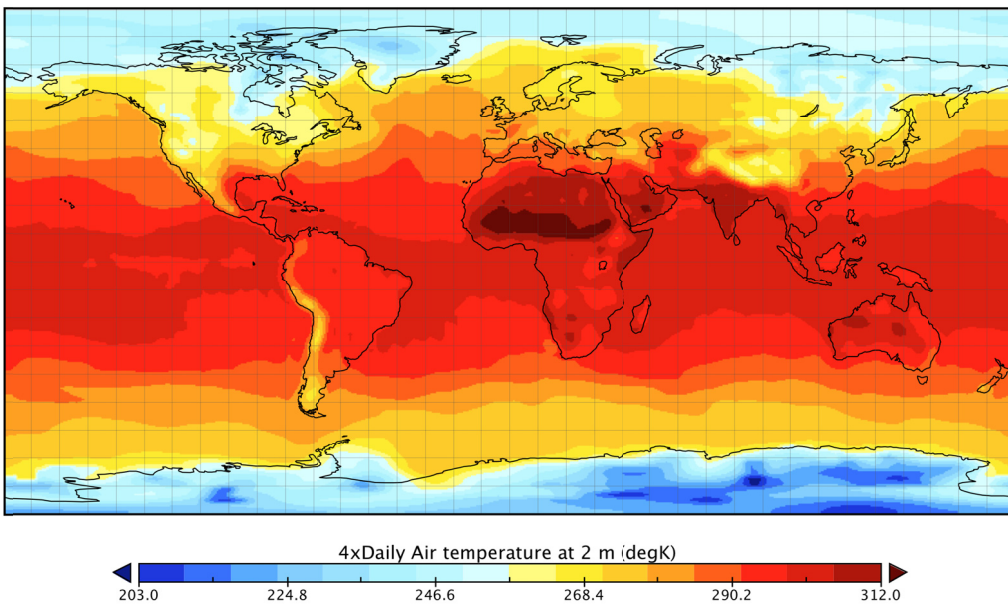


Figure 2: 2-m height global temperature forecast from NCEP/NCAR Reanalysis 1, for 12:00 UTC on 20 March 2006.

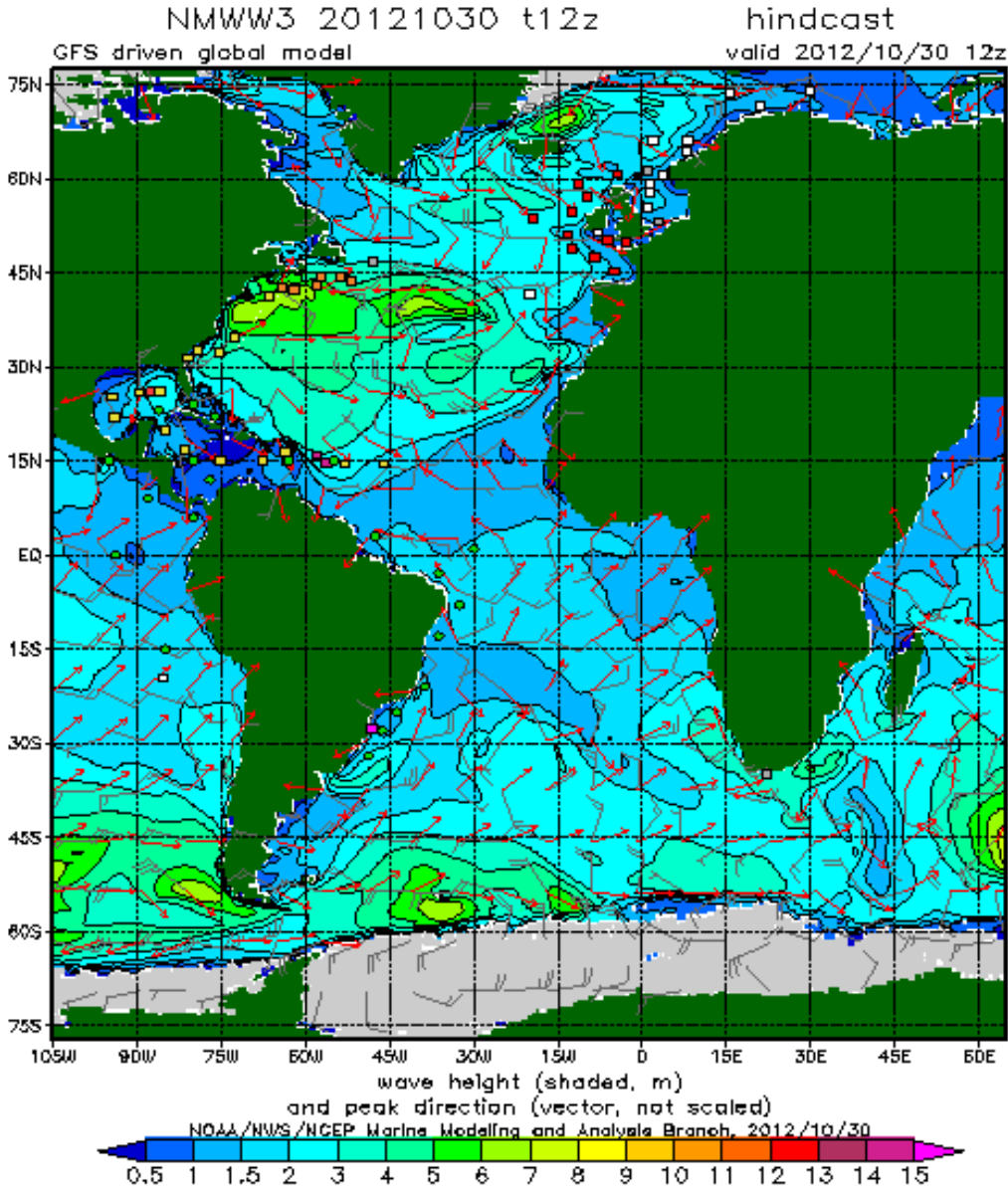
Temperature data were acquired for 2006 through 2011 for the purposes of this statistical analysis. Further data are available from 1948 to the present, but time constraints did not allow the analysis to be extended over a longer period. It is possible that the analysis undertaken here will therefore fail to capture examples of meteorological and oceanographic conditions that change or oscillate over longer time scales. For example, the Pacific Decadal Oscillation (PDO) generates sea-surface temperature anomalies, primarily in the North Pacific Ocean (north of 20° latitude). The PDO index was negative for 53 of the 72 months of this analysis, yielding cooler tropical temperatures and warmer temperatures in the North Pacific. Conversely, the Atlantic Multidecadal Oscillation (AMO) index was strongly positive for almost all (67 of 72 months) of the time period of this analysis, indicating warmer than average North Atlantic temperatures. Finally, climate change is highly likely to cause a long-term warming trend, particularly in Arctic and sub-Arctic regions.

## 2.2 Wave height data

The significant wave height data was obtained from the NOAA National Weather Service Environmental Modeling Center. Significant wave heights (the mean wave height of the highest one-third of waves) were computed using the WAVEWATCH III<sup>TM</sup> wave model [5], which uses operational NCEP products as input. Model forecasts are available every three hours, on a 0.25° global grid between 77.5° S and 77.5° N. An example is shown in Figure 3. Significant wave height data are available for the period of August 1999 to the present. For the current analysis, data was acquired for 2006 through 2011.

The WAVEWATCH III<sup>TM</sup> model is a physics-based model that uses observationally-influenced oceanographic and meteorological fields for input, but it does not currently assimilate observed ocean wave data. Although NOAA does not provide a direct comparison to the classification of data category as provided for the temperature data, the significant wave height data from the WAVEWATCH III<sup>TM</sup> model should therefore not be assumed to be as reliable as the category A data (which is strongly influenced by direct observations). Nevertheless, in comparisons to both other wave models and to ground-truthed data, the WAVEWATCH III<sup>TM</sup> model has been shown to perform well [7]. Data are also available from the wave model for peak and mean wave periods and directions, wind speed and direction, and wind sea direction and period. Joint frequencies could be generated with these variables in addition to the joint temperature-wave height frequencies.





*Figure 3: 0-hour hindcast wave height and direction model output for 12:00Z for 30 October 2012, from NOAA NWS/EMC WAVEWATCH III model [6].*

## 3 Analysis and results

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### 3.1 Processing

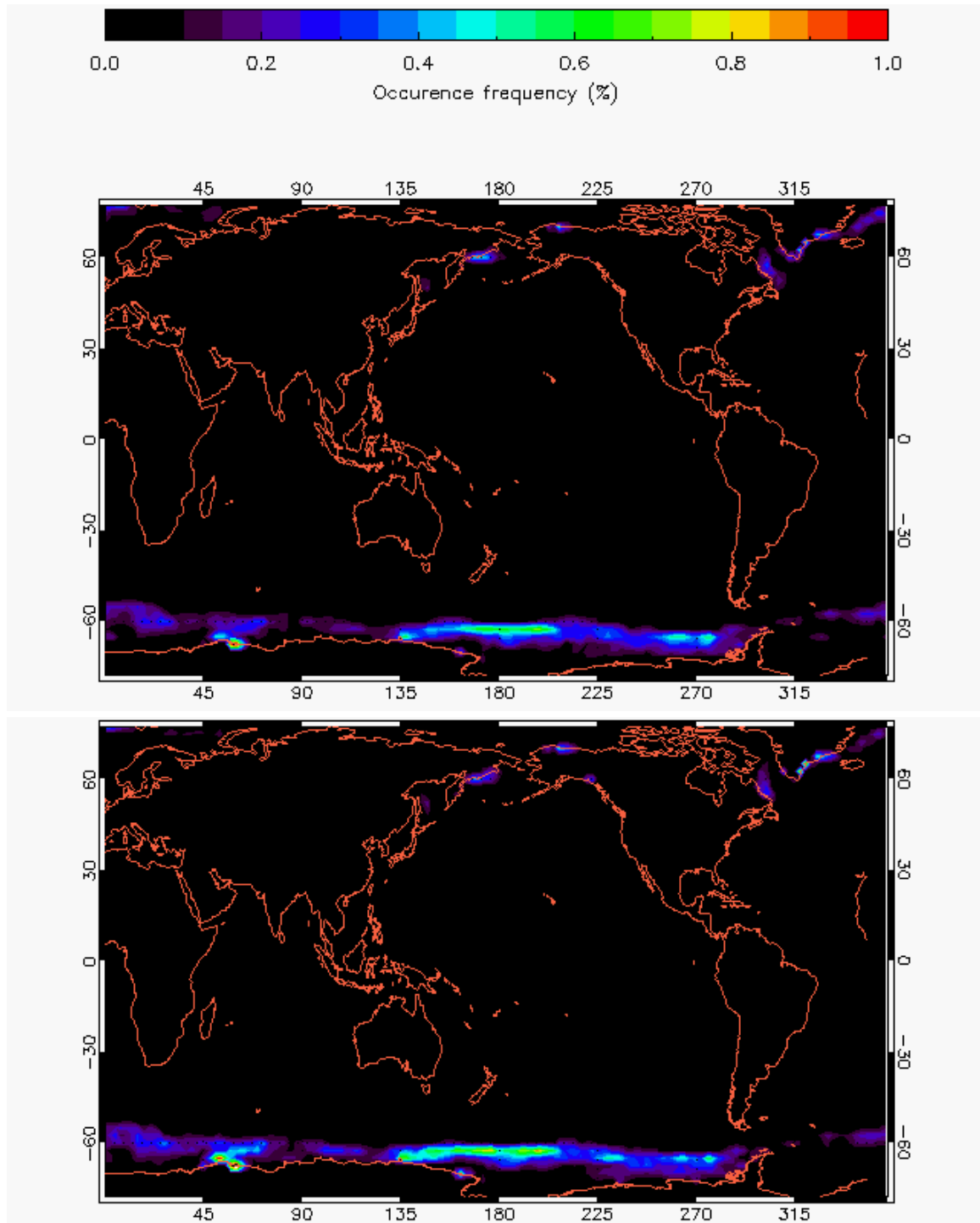
The joint occurrence dataset was created on a 2.5° global grid between latitudes 77.5° S and 77.5° N, matching the temperature data. The 995 sigma level temperature data were already gridded on an evenly spaced–longitude grid. The 2 m height air temperature data were re-gridded from the Gaussian-spaced grid to the evenly spaced grid before being further processed. Eighteen temperature bins (less than -40 °C; from -40 °C to +40 °C in 5 °C intervals; and greater than +40 °C) and eleven wave height bins (for significant wave heights below 1 m; from 1 m to 10 m in steps of 1 m; and over 10 m) were defined. For each set of daily wave height data at 00Z, 06Z, 12Z, and 18Z, the matching temperature data set was determined, and the number of occurrences of each wave height at each temperature was totalled at each latitude and longitude grid point for every month. This results in an array of size 144×63×12×11×18 (longitude, latitude, month, wave height bin, and temperature bin). A second array gives the total number of modeled wave heights for each longitude, latitude, and month, to eliminate the effect of land grid points.

Some changes were made in the data processing from the previous analysis [1]. An error in the centering of wave height data bins was corrected. Of more concern, particularly near the poles, a weighting term (based on the cosine of the latitude) was introduced to eliminate bias caused by the spacing density. Both of these changes will reduce the frequency of occurrence of extreme events near the Arctic.

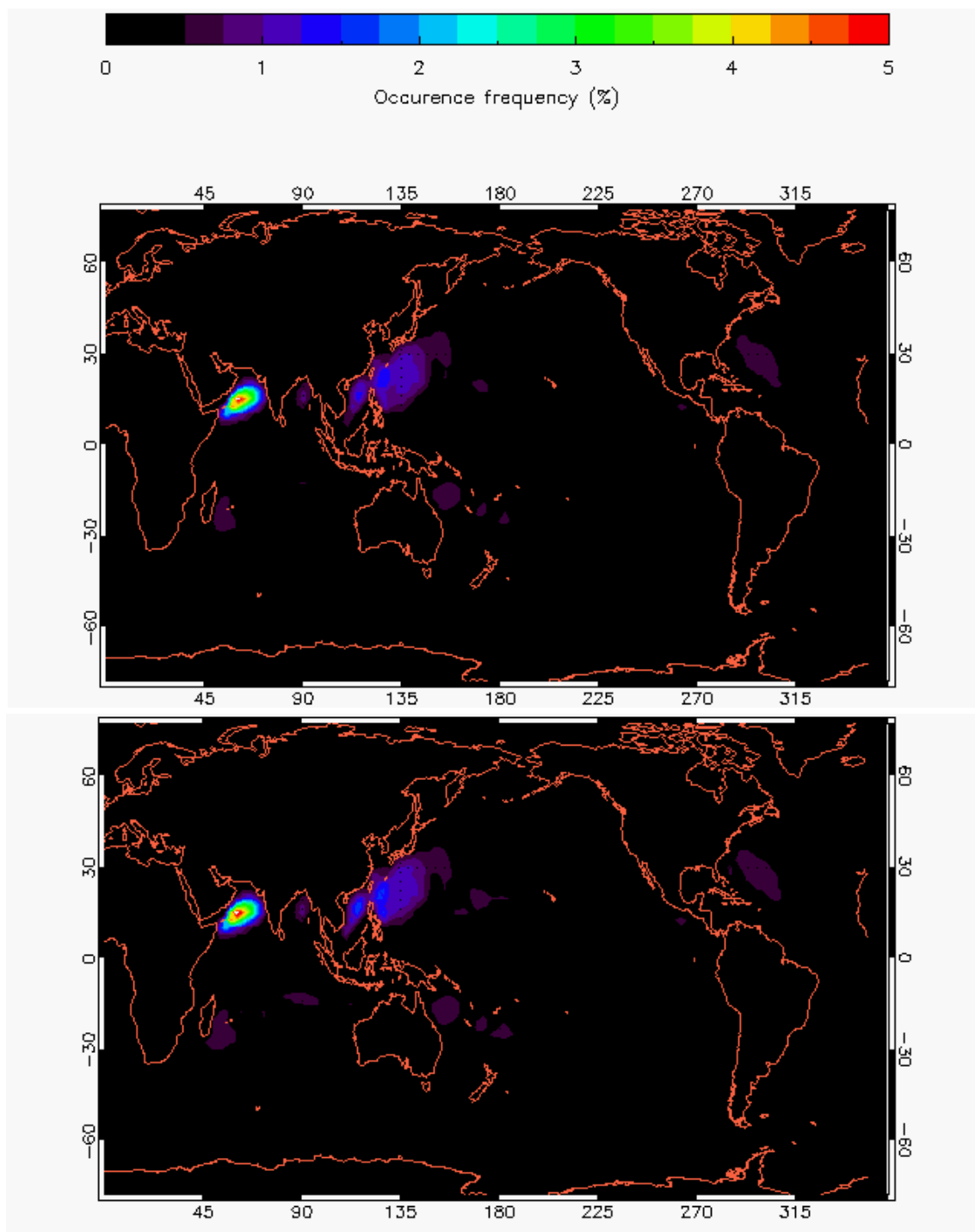
### 3.2 Temperature-wave statistics

The temperature-wave height statistics can be viewed in a number of ways. Figure 4 shows the frequency of occurrence of high significant wave heights (greater than or equal to 5 m) and cold weather (-10 °C and below) over the course of a year, for the whole globe, for both the 995 sigma level temperature dataset and the 2 m height temperature dataset. These occurrences are found near the Antarctic, and the Greenland, Siberia, Alaska, and Labrador coasts, and are quite uncommon (they are also likely to be limited mostly to the winter seasons). It is also evident that the differences between the two temperature datasets are small.

Figure 5 shows the frequency of occurrence for high waves (again greater than or equal to 5 m) for warm weather (30 °C and above). Again, statistics are nearly identical for the two temperature datasets. The frequency of occurrence is overall a bit higher than for the cold temperatures, with most high wave/high temperature conditions occurring in the Northern Indian Ocean, the South China Sea, and some occurrences in and around the Eastern Caribbean.

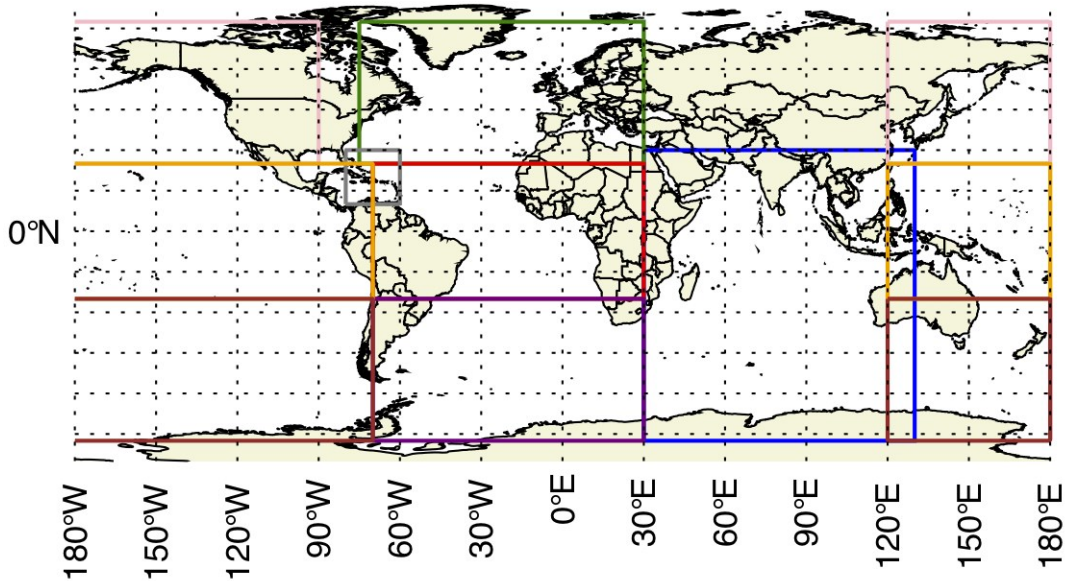


*Figure 4: Maps showing frequency of occurrence of 5 m or greater significant wave height with temperatures less than or equal to -10 °C at 995 sigma height (top) and 2 m height (bottom) throughout the year. Frequency scale is from 0% to 1%.*



*Figure 5: Maps showing frequency of occurrence of 5 m or greater significant wave height with temperatures greater than or equal to 30 °C at 995 sigma height (top) and 2 m height (bottom) throughout the year. Frequency scale is from 0% to 5%.*

To express these frequencies more quantitatively, the ocean basins were subdivided into eight regions: the Indian Ocean (30° N to 77.5° S, 30° E to 130° E); the North Atlantic (77.5° N to 25° N, 75° W to 30° E); tropical Atlantic (25° N to 25° S, 70° W to 30° E); South Atlantic (25° S to 77.5° S, 70° W to 30° E); Caribbean (10° N to 30° N, 80° W to 60° W); North Pacific (77.5° N to 25° N, 120° E to 90° W); tropical Pacific (25° N to 25° S, 120° E to 70° W); South Pacific (25° S to 77.5° S, 120° E to 70° W). The regions are shown in Figure 6.



*Figure 6: Regions for wave-temperature statistics tables. Blue – Indian Ocean; green – North Atlantic; red – tropical Atlantic; purple – South Atlantic; grey – Caribbean; pink – North Pacific; orange – tropical Pacific; brown – South Pacific.*

For each region, the annual frequencies of occurrence for joint wave heights and temperatures have been tabulated, along with the cumulative statistics. The same has been done for each season (i.e., January–March, April–June, July–September, and October–December). Because the statistics are quite similar, only the tables for the 2 m height temperature dataset are compiled here.

### 3.2.1 Indian Ocean

Table 1: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the Indian Ocean on an annual basis. Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.000	0.000	0.000	-	-	-	-	-	-	-	-
-40 to -35	0.001	0.000	0.000	0.000	-	-	-	-	-	-	-
-35 to -30	0.004	0.001	0.000	0.000	0.000	0.000	-	-	-	-	-
-30 to -25	0.010	0.002	0.000	0.000	0.000	0.000	0.000	0.000	-	-	-
-25 to -20	0.019	0.007	0.002	0.001	0.000	0.000	0.000	0.000	0.000	0.000	-
-20 to -15	0.032	0.019	0.008	0.004	0.001	0.000	0.000	0.000	0.000	0.000	-
-15 to -10	0.054	0.046	0.029	0.017	0.008	0.003	0.001	0.001	0.000	0.000	0.000
-10 to -5	0.093	0.102	0.095	0.070	0.038	0.019	0.009	0.004	0.001	0.001	0.000
-5 to 0	0.271	0.451	0.731	0.732	0.513	0.291	0.154	0.075	0.036	0.017	0.012
0 to 5	0.036	0.212	1.290	2.424	2.273	1.484	0.801	0.386	0.172	0.075	0.049
5 to 10	0.013	0.074	0.757	1.675	1.706	1.141	0.610	0.288	0.131	0.056	0.030
10 to 15	0.042	0.235	1.637	2.527	1.962	1.080	0.502	0.214	0.088	0.035	0.016
15 to 20	0.141	0.851	3.647	3.374	1.504	0.524	0.167	0.052	0.017	0.005	0.003
20 to 25	1.356	2.593	6.510	4.351	1.207	0.168	0.021	0.004	0.001	0.000	0.000
25 to 30	10.883	17.125	12.285	3.762	0.673	0.108	0.019	0.004	0.002	0.001	0.001
30 to 35	0.213	0.253	0.092	0.026	0.007	0.002	0.001	0.000	0.000	0.000	0.000
35 to 40	0.014	0.013	0.006	0.002	0.000	0.000	0.000	0.000	0.000	-	-
> 40	0.003	0.002	0.001	0.000	0.000	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
-35 to -30	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
-30 to -25	0.010	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
-25 to -20	0.019	0.026	0.028	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029
-20 to -15	0.032	0.051	0.059	0.063	0.064	0.064	0.064	0.064	0.064	0.064	0.064
-15 to -10	0.054	0.100	0.129	0.146	0.154	0.157	0.158	0.159	0.159	0.159	0.159
-10 to -5	0.093	0.195	0.290	0.360	0.398	0.417	0.426	0.430	0.431	0.432	0.432
-5 to 0	0.271	0.722	1.453	2.185	2.698	2.989	3.143	3.218	3.254	3.271	3.283
0 to 5	0.036	0.248	1.538	3.962	6.235	7.719	8.520	8.906	9.078	9.153	9.202
5 to 10	0.013	0.087	0.844	2.519	4.225	5.366	5.976	6.264	6.395	6.451	6.481
10 to 15	0.042	0.277	1.914	4.441	6.403	7.483	7.985	8.199	8.287	8.322	8.338
15 to 20	0.141	0.992	4.639	8.013	9.517	10.041	10.208	10.260	10.277	10.282	10.285
20 to 25	1.356	3.949	10.459	14.810	16.017	16.185	16.206	16.210	16.211	16.211	16.211
25 to 30	10.883	28.008	40.293	44.055	44.728	44.836	44.855	44.859	44.861	44.862	44.863
30 to 35	0.213	0.466	0.558	0.584	0.591	0.593	0.594	0.594	0.594	0.594	0.594
35 to 40	0.014	0.027	0.033	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035
> 40	0.003	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006

Table 2: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the Indian Ocean (January–March). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.000	-	-	-	-	-	-	-	-	-	-
-40 to -35	0.000	0.000	-	-	-	-	-	-	-	-	-
-35 to -30	0.000	0.000	0.000	-	-	-	-	-	-	-	-
-30 to -25	0.002	0.001	0.000	0.000	0.000	0.000	-	-	-	-	-
-25 to -20	0.007	0.003	0.001	0.000	0.000	0.000	0.000	-	-	-	-
-20 to -15	0.017	0.008	0.002	0.001	0.000	0.000	0.000	0.000	-	-	-
-15 to -10	0.034	0.022	0.009	0.002	0.001	0.000	0.000	0.000	0.000	-	-
-10 to -5	0.063	0.064	0.042	0.016	0.006	0.002	0.001	0.000	0.000	0.000	-
-5 to 0	0.203	0.622	0.791	0.494	0.204	0.071	0.025	0.007	0.002	0.001	0.000
0 to 5	0.049	0.464	2.216	3.226	2.325	1.126	0.462	0.195	0.075	0.029	0.014
5 to 10	0.037	0.117	1.045	2.136	1.798	0.839	0.321	0.116	0.042	0.016	0.007
10 to 15	0.087	0.270	1.698	2.248	1.272	0.480	0.153	0.048	0.015	0.005	0.002
15 to 20	0.234	1.074	3.856	2.614	0.821	0.207	0.058	0.016	0.003	0.001	0.000
20 to 25	2.305	3.606	7.424	3.264	0.674	0.107	0.019	0.004	0.001	0.000	0.000
25 to 30	11.508	22.064	11.269	2.330	0.389	0.071	0.018	0.005	0.002	0.001	0.001
30 to 35	0.220	0.124	0.023	0.004	0.001	0.000	0.000	0.000	-	-	-
35 to 40	0.015	0.006	0.001	0.000	-	-	-	-	-	-	-
> 40	0.004	0.002	0.000	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
-25 to -20	0.007	0.010	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
-20 to -15	0.017	0.025	0.027	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
-15 to -10	0.034	0.056	0.065	0.067	0.068	0.068	0.068	0.068	0.068	0.068	0.068
-10 to -5	0.063	0.127	0.169	0.185	0.191	0.193	0.194	0.194	0.194	0.194	0.194
-5 to 0	0.203	0.825	1.616	2.110	2.314	2.385	2.410	2.417	2.419	2.420	2.420
0 to 5	0.049	0.513	2.729	5.955	8.280	9.406	9.868	10.063	10.138	10.167	10.181
5 to 10	0.037	0.154	1.199	3.335	5.133	5.972	6.293	6.409	6.451	6.467	6.474
10 to 15	0.087	0.357	2.055	4.303	5.575	6.055	6.208	6.256	6.271	6.276	6.278
15 to 20	0.234	1.308	5.164	7.778	8.599	8.806	8.864	8.880	8.883	8.884	8.884
20 to 25	2.305	5.911	13.335	16.599	17.273	17.380	17.399	17.403	17.404	17.404	17.404
25 to 30	11.508	33.572	44.841	47.171	47.560	47.631	47.649	47.654	47.656	47.657	47.658
30 to 35	0.220	0.344	0.367	0.371	0.372	0.372	0.372	0.372	0.372	0.372	0.372
35 to 40	0.015	0.021	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022
> 40	0.004	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006

Table 3: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the Indian Ocean (April–June). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.000	0.000	0.000	-	-	-	-	-	-	-	-
-40 to -35	0.002	0.000	0.000	0.000	-	-	-	-	-	-	-
-35 to -30	0.007	0.001	0.000	0.000	0.000	-	-	-	-	-	-
-30 to -25	0.020	0.005	0.001	0.000	0.000	0.000	-	0.000	-	-	-
-25 to -20	0.036	0.013	0.004	0.001	0.000	0.000	0.000	0.000	-	-	-
-20 to -15	0.052	0.033	0.016	0.008	0.003	0.001	0.000	0.000	0.000	0.000	-
-15 to -10	0.070	0.079	0.060	0.035	0.015	0.006	0.002	0.001	0.000	0.000	0.000
-10 to -5	0.078	0.146	0.172	0.134	0.064	0.029	0.012	0.005	0.002	0.001	0.000
-5 to 0	0.043	0.190	0.632	0.868	0.676	0.369	0.178	0.083	0.039	0.019	0.016
0 to 5	0.004	0.049	0.785	2.179	2.445	1.788	1.007	0.493	0.221	0.103	0.075
5 to 10	0.003	0.024	0.439	1.424	1.770	1.330	0.754	0.368	0.154	0.062	0.034
10 to 15	0.027	0.093	0.912	2.142	2.117	1.330	0.652	0.274	0.101	0.037	0.021
15 to 20	0.125	0.440	2.840	3.666	2.075	0.798	0.264	0.080	0.027	0.009	0.006
20 to 25	0.944	1.620	5.520	4.928	1.407	0.222	0.031	0.008	0.002	0.000	0.000
25 to 30	11.734	15.345	13.660	4.500	0.712	0.105	0.018	0.003	0.001	0.001	0.001
30 to 35	0.365	0.668	0.249	0.073	0.022	0.006	0.002	0.000	0.000	0.000	0.000
35 to 40	0.024	0.034	0.011	0.002	0.000	0.000	0.000	0.000	0.000	-	-
> 40	0.002	0.003	0.001	0.000	0.000	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
-35 to -30	0.007	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
-30 to -25	0.020	0.025	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
-25 to -20	0.036	0.049	0.053	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054
-20 to -15	0.052	0.085	0.101	0.109	0.112	0.113	0.113	0.113	0.113	0.113	0.113
-15 to -10	0.070	0.149	0.209	0.244	0.259	0.265	0.267	0.268	0.268	0.268	0.268
-10 to -5	0.078	0.224	0.396	0.530	0.594	0.623	0.635	0.640	0.642	0.643	0.643
-5 to 0	0.043	0.233	0.865	1.733	2.409	2.778	2.956	3.039	3.078	3.097	3.113
0 to 5	0.004	0.053	0.838	3.017	5.462	7.250	8.257	8.750	8.971	9.074	9.149
5 to 10	0.003	0.027	0.466	1.890	3.660	4.990	5.744	6.112	6.266	6.328	6.362
10 to 15	0.027	0.120	1.032	3.174	5.291	6.621	7.273	7.547	7.648	7.685	7.706
15 to 20	0.125	0.565	3.405	7.071	9.146	9.944	10.208	10.288	10.315	10.324	10.330
20 to 25	0.944	2.564	8.084	13.012	14.419	14.641	14.672	14.680	14.682	14.682	14.682
25 to 30	11.734	27.079	40.739	45.239	45.951	46.056	46.074	46.077	46.078	46.079	46.080
30 to 35	0.365	1.033	1.282	1.355	1.377	1.383	1.385	1.385	1.385	1.385	1.385
35 to 40	0.024	0.058	0.069	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071
> 40	0.002	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006



Table 4: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the Indian Ocean (July–September). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.000	0.000	0.000	-	-	-	-	-	-	-	-
-40 to -35	0.001	0.000	0.000	-	-	-	-	-	-	-	-
-35 to -30	0.006	0.001	0.000	0.000	0.000	0.000	-	-	-	-	-
-30 to -25	0.015	0.005	0.001	0.000	0.000	0.000	0.000	-	-	-	-
-25 to -20	0.027	0.013	0.004	0.001	0.001	0.000	0.000	0.000	0.000	0.000	-
-20 to -15	0.041	0.032	0.014	0.006	0.003	0.001	0.000	0.000	0.000	0.000	-
-15 to -10	0.062	0.069	0.044	0.026	0.014	0.005	0.002	0.001	0.000	0.000	0.000
-10 to -5	0.091	0.138	0.132	0.111	0.073	0.042	0.020	0.009	0.004	0.001	0.001
-5 to 0	0.100	0.250	0.545	0.769	0.712	0.506	0.313	0.169	0.083	0.039	0.028
0 to 5	0.011	0.077	0.639	1.627	2.134	1.844	1.202	0.627	0.297	0.132	0.090
5 to 10	0.002	0.019	0.372	1.194	1.720	1.531	0.974	0.506	0.268	0.123	0.068
10 to 15	0.013	0.126	1.221	2.783	2.786	1.846	0.973	0.465	0.216	0.089	0.040
15 to 20	0.058	0.349	3.001	4.415	2.380	0.928	0.312	0.105	0.034	0.009	0.005
20 to 25	0.969	1.705	5.397	6.351	2.347	0.303	0.030	0.001	0.000	0.000	-
25 to 30	8.821	9.755	13.886	6.373	1.334	0.202	0.027	0.005	0.002	0.001	0.000
30 to 35	0.069	0.123	0.088	0.027	0.003	0.001	0.000	-	-	-	-
35 to 40	0.005	0.011	0.011	0.005	0.000	-	-	-	-	-	-
> 40	0.000	0.002	0.002	0.000	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
-35 to -30	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
-30 to -25	0.015	0.020	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
-25 to -20	0.027	0.040	0.044	0.045	0.046	0.046	0.046	0.046	0.046	0.046	0.046
-20 to -15	0.041	0.073	0.087	0.093	0.096	0.097	0.097	0.097	0.097	0.097	0.097
-15 to -10	0.062	0.131	0.175	0.201	0.215	0.220	0.222	0.223	0.223	0.223	0.223
-10 to -5	0.091	0.229	0.361	0.472	0.545	0.587	0.607	0.616	0.620	0.621	0.622
-5 to 0	0.100	0.350	0.895	1.664	2.376	2.882	3.195	3.364	3.447	3.486	3.514
0 to 5	0.011	0.088	0.727	2.354	4.488	6.332	7.534	8.161	8.458	8.590	8.680
5 to 10	0.002	0.021	0.393	1.587	3.307	4.838	5.812	6.318	6.586	6.709	6.777
10 to 15	0.013	0.139	1.360	4.143	6.929	8.775	9.748	10.213	10.429	10.518	10.558
15 to 20	0.058	0.407	3.408	7.823	10.203	11.131	11.443	11.548	11.582	11.591	11.596
20 to 25	0.969	2.674	8.071	14.422	16.769	17.072	17.102	17.103	17.103	17.103	17.103
25 to 30	8.821	18.576	32.462	38.835	40.169	40.371	40.398	40.403	40.405	40.406	40.406
30 to 35	0.069	0.192	0.280	0.307	0.310	0.311	0.311	0.311	0.311	0.311	0.311
35 to 40	0.005	0.016	0.027	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032
> 40	0.000	0.002	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004

Table 5: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the Indian Ocean (October–December). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.000	0.000	-	-	-	-	-	-	-	-	-
-40 to -35	0.000	0.000	-	-	-	-	-	-	-	-	-
-35 to -30	0.001	0.000	-	-	-	-	-	-	-	-	-
-30 to -25	0.002	0.000	0.000	0.000	-	-	-	-	-	-	-
-25 to -20	0.008	0.001	0.000	0.000	0.000	0.000	0.000	-	-	-	-
-20 to -15	0.020	0.004	0.001	0.000	0.000	0.000	0.000	0.000	-	-	-
-15 to -10	0.050	0.015	0.006	0.002	0.001	0.000	0.000	0.000	0.000	0.000	-
-10 to -5	0.140	0.062	0.035	0.022	0.012	0.005	0.002	0.001	0.000	0.000	0.000
-5 to 0	0.735	0.739	0.953	0.796	0.463	0.222	0.102	0.043	0.019	0.009	0.005
0 to 5	0.079	0.255	1.509	2.652	2.185	1.186	0.540	0.232	0.099	0.036	0.019
5 to 10	0.009	0.135	1.165	1.940	1.535	0.872	0.396	0.164	0.063	0.022	0.010
10 to 15	0.042	0.451	2.713	2.939	1.687	0.674	0.237	0.073	0.023	0.007	0.002
15 to 20	0.145	1.533	4.883	2.818	0.754	0.171	0.037	0.008	0.002	0.000	0.000
20 to 25	1.199	3.429	7.681	2.892	0.416	0.041	0.005	0.000	0.000	0.000	-
25 to 30	11.437	21.223	10.348	1.884	0.268	0.055	0.013	0.004	0.001	0.001	0.000
30 to 35	0.197	0.094	0.008	0.001	0.000	0.000	-	-	-	-	-
35 to 40	0.013	0.004	0.000	0.000	-	-	-	-	-	-	-
> 40	0.005	0.001	0.000	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
-30 to -25	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
-25 to -20	0.008	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
-20 to -15	0.020	0.024	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
-15 to -10	0.050	0.065	0.071	0.073	0.074	0.074	0.074	0.074	0.074	0.074	0.074
-10 to -5	0.140	0.202	0.237	0.259	0.271	0.276	0.278	0.279	0.279	0.279	0.279
-5 to 0	0.735	1.474	2.427	3.223	3.686	3.908	4.010	4.053	4.072	4.081	4.086
0 to 5	0.079	0.334	1.843	4.495	6.680	7.866	8.406	8.638	8.737	8.773	8.792
5 to 10	0.009	0.144	1.309	3.249	4.784	5.656	6.052	6.216	6.279	6.301	6.311
10 to 15	0.042	0.493	3.206	6.145	7.832	8.506	8.743	8.816	8.839	8.846	8.848
15 to 20	0.145	1.678	6.561	9.379	10.133	10.304	10.341	10.349	10.351	10.351	10.351
20 to 25	1.199	4.628	12.309	15.201	15.617	15.658	15.663	15.663	15.663	15.663	15.663
25 to 30	11.437	32.660	43.008	44.892	45.160	45.215	45.228	45.232	45.233	45.234	45.234
30 to 35	0.197	0.291	0.299	0.300	0.300	0.300	0.300	0.300	0.300	0.300	0.300
35 to 40	0.013	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
> 40	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006

### 3.2.2 North Atlantic

Table 6: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the North Atlantic on an annual basis. Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.001	0.000	0.000	-	-	-	-	-	-	-	-
-40 to -35	0.004	0.000	0.000	-	-	-	-	-	-	-	-
-35 to -30	0.012	0.002	0.000	0.000	0.000	-	-	-	-	-	-
-30 to -25	0.029	0.007	0.001	0.000	0.000	0.000	0.000	0.000	-	-	-
-25 to -20	0.059	0.019	0.005	0.001	0.000	0.000	0.000	0.000	0.000	0.000	-
-20 to -15	0.112	0.057	0.022	0.007	0.002	0.001	0.000	0.000	0.000	0.000	-
-15 to -10	0.193	0.147	0.075	0.031	0.011	0.004	0.001	0.000	0.000	0.000	0.000
-10 to -5	0.336	0.366	0.254	0.140	0.063	0.026	0.009	0.003	0.001	0.000	0.000
-5 to 0	0.812	1.019	0.872	0.591	0.324	0.152	0.066	0.027	0.009	0.004	0.002
0 to 5	1.795	2.467	2.255	1.738	1.086	0.585	0.284	0.132	0.060	0.027	0.021
5 to 10	1.350	3.481	3.394	2.688	1.776	1.037	0.545	0.271	0.128	0.062	0.052
10 to 15	1.120	3.958	4.666	3.492	2.111	1.158	0.588	0.275	0.125	0.061	0.047
15 to 20	0.916	6.278	7.164	3.912	1.749	0.741	0.300	0.121	0.048	0.020	0.014
20 to 25	1.080	10.987	6.919	2.197	0.595	0.169	0.055	0.017	0.006	0.002	0.001
25 to 30	0.706	5.445	1.438	0.265	0.061	0.020	0.009	0.005	0.003	0.002	0.002
30 to 35	0.008	0.014	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35 to 40	0.002	0.002	0.001	0.000	-	-	-	-	-	-	-
> 40	0.000	0.000	0.000	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
-40 to -35	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
-35 to -30	0.012	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
-30 to -25	0.029	0.036	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037	0.037
-25 to -20	0.059	0.078	0.083	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084
-20 to -15	0.112	0.169	0.191	0.198	0.200	0.201	0.201	0.201	0.201	0.201	0.201
-15 to -10	0.193	0.340	0.415	0.446	0.457	0.461	0.462	0.462	0.462	0.462	0.462
-10 to -5	0.336	0.702	0.956	1.096	1.159	1.185	1.194	1.197	1.198	1.198	1.198
-5 to 0	0.812	1.831	2.703	3.294	3.618	3.770	3.836	3.863	3.872	3.876	3.878
0 to 5	1.795	4.262	6.517	8.255	9.341	9.926	10.210	10.342	10.402	10.429	10.450
5 to 10	1.350	4.831	8.225	10.913	12.689	13.726	14.271	14.542	14.670	14.732	14.784
10 to 15	1.120	5.078	9.744	13.236	15.347	16.505	17.093	17.368	17.493	17.554	17.601
15 to 20	0.916	7.194	14.358	18.270	20.019	20.760	21.060	21.181	21.229	21.249	21.263
20 to 25	1.080	12.067	18.986	21.183	21.778	21.947	22.002	22.019	22.025	22.027	22.028
25 to 30	0.706	6.151	7.589	7.854	7.915	7.935	7.944	7.949	7.952	7.954	7.956
30 to 35	0.008	0.022	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027
35 to 40	0.002	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
> 40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 7: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the North Atlantic (January–March). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.002	0.000	0.000	-	-	-	-	-	-	-	-
-40 to -35	0.009	0.001	0.000	-	-	-	-	-	-	-	-
-35 to -30	0.029	0.005	0.001	0.000	0.000	-	-	-	-	-	-
-30 to -25	0.073	0.019	0.003	0.001	0.000	0.000	0.000	0.000	-	-	-
-25 to -20	0.135	0.055	0.015	0.003	0.001	0.000	0.000	0.000	0.000	0.000	-
-20 to -15	0.227	0.142	0.060	0.020	0.007	0.002	0.000	0.000	0.000	0.000	-
-15 to -10	0.350	0.341	0.195	0.090	0.035	0.012	0.004	0.001	0.000	0.000	0.000
-10 to -5	0.514	0.738	0.597	0.359	0.175	0.076	0.029	0.009	0.002	0.001	0.000
-5 to 0	0.767	1.544	1.734	1.345	0.796	0.398	0.183	0.081	0.030	0.013	0.008
0 to 5	0.684	1.961	3.097	3.222	2.311	1.338	0.688	0.342	0.164	0.078	0.062
5 to 10	0.588	1.771	3.155	3.689	3.137	2.069	1.183	0.624	0.309	0.156	0.134
10 to 15	0.149	1.446	3.920	4.525	3.574	2.324	1.274	0.608	0.280	0.139	0.112
15 to 20	0.220	4.382	9.200	6.525	3.330	1.549	0.636	0.244	0.090	0.038	0.027
20 to 25	0.141	3.790	6.092	2.515	0.626	0.155	0.047	0.014	0.003	0.000	-
25 to 30	0.002	0.016	0.006	0.002	0.000	-	-	-	-	-	-
30 to 35	-	0.000	0.000	0.000	0.000	-	-	-	-	-	-
35 to 40	-	-	-	-	-	-	-	-	-	-	-
> 40	-	-	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
-40 to -35	0.009	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
-35 to -30	0.029	0.034	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035
-30 to -25	0.073	0.092	0.095	0.096	0.096	0.096	0.096	0.096	0.096	0.096	0.096
-25 to -20	0.135	0.190	0.205	0.208	0.209	0.209	0.209	0.209	0.209	0.209	0.209
-20 to -15	0.227	0.369	0.429	0.449	0.456	0.458	0.458	0.458	0.458	0.458	0.458
-15 to -10	0.350	0.691	0.886	0.976	1.011	1.023	1.027	1.028	1.028	1.028	1.028
-10 to -5	0.514	1.252	1.849	2.208	2.383	2.459	2.488	2.497	2.499	2.500	2.500
-5 to 0	0.767	2.311	4.045	5.390	6.186	6.584	6.767	6.848	6.878	6.891	6.899
0 to 5	0.684	2.645	5.742	8.964	11.275	12.613	13.301	13.643	13.807	13.885	13.947
5 to 10	0.588	2.359	5.514	9.203	12.340	14.409	15.592	16.216	16.525	16.681	16.815
10 to 15	0.149	1.595	5.515	10.040	13.614	15.938	17.212	17.820	18.100	18.239	18.351
15 to 20	0.220	4.602	13.802	20.327	23.657	25.206	25.842	26.086	26.176	26.214	26.241
20 to 25	0.141	3.931	10.023	12.538	13.164	13.319	13.366	13.380	13.383	13.383	13.383
25 to 30	0.002	0.018	0.024	0.026	0.026	0.026	0.026	0.026	0.026	0.026	0.026
30 to 35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35 to 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
> 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 8: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the North Atlantic (April–June). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.000	0.000	-	-	-	-	-	-	-	-	-
-40 to -35	0.000	0.000	0.000	-	-	-	-	-	-	-	-
-35 to -30	0.001	0.000	0.000	-	-	-	-	-	-	-	-
-30 to -25	0.005	0.000	0.000	0.000	-	-	-	-	-	-	-
-25 to -20	0.016	0.002	0.000	0.000	-	-	-	-	-	-	-
-20 to -15	0.041	0.010	0.002	0.000	0.000	0.000	0.000	0.000	-	-	-
-15 to -10	0.100	0.043	0.014	0.004	0.001	0.000	0.000	-	-	-	-
-10 to -5	0.265	0.176	0.080	0.028	0.010	0.003	0.001	0.000	0.000	-	-
-5 to 0	1.233	1.013	0.576	0.271	0.106	0.034	0.011	0.002	0.000	0.000	-
0 to 5	2.720	3.972	2.765	1.420	0.594	0.210	0.067	0.021	0.006	0.001	0.000
5 to 10	1.898	5.360	4.547	2.618	1.081	0.414	0.157	0.063	0.022	0.006	0.001
10 to 15	1.611	5.328	5.799	3.372	1.400	0.445	0.117	0.030	0.006	0.002	0.000
15 to 20	1.065	10.694	8.801	2.980	0.804	0.181	0.036	0.008	0.002	0.000	-
20 to 25	1.744	14.734	4.934	0.711	0.104	0.010	0.001	0.000	0.000	-	-
25 to 30	0.576	2.264	0.202	0.019	0.001	0.000	-	-	-	-	-
30 to 35	0.007	0.011	0.003	0.000	-	-	-	-	-	-	-
35 to 40	0.001	0.002	0.000	0.000	-	-	-	-	-	-	-
> 40	0.000	0.000	0.000	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
-30 to -25	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
-25 to -20	0.016	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018	0.018
-20 to -15	0.041	0.051	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053	0.053
-15 to -10	0.100	0.143	0.157	0.161	0.162	0.162	0.162	0.162	0.162	0.162	0.162
-10 to -5	0.265	0.441	0.521	0.549	0.559	0.562	0.563	0.563	0.563	0.563	0.563
-5 to 0	1.233	2.246	2.822	3.093	3.199	3.233	3.244	3.246	3.246	3.246	3.246
0 to 5	2.720	6.692	9.457	10.877	11.471	11.681	11.748	11.769	11.775	11.776	11.776
5 to 10	1.898	7.258	11.805	14.423	15.504	15.918	16.075	16.138	16.160	16.166	16.167
10 to 15	1.611	6.939	12.738	16.110	17.510	17.955	18.072	18.102	18.108	18.110	18.110
15 to 20	1.065	11.759	20.560	23.540	24.344	24.525	24.561	24.569	24.571	24.571	24.571
20 to 25	1.744	16.478	21.412	22.123	22.227	22.237	22.238	22.238	22.238	22.238	22.238
25 to 30	0.576	2.840	3.042	3.061	3.062	3.062	3.062	3.062	3.062	3.062	3.062
30 to 35	0.007	0.018	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
35 to 40	0.001	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
> 40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 9: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the North Atlantic (July–September). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	0.000	-	-	-	-	-	-	-	-	-	-
-30 to -25	0.000	0.000	0.000	-	-	-	-	-	-	-	-
-25 to -20	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-
-20 to -15	0.003	0.001	0.000	0.000	-	-	-	-	-	-	-
-15 to -10	0.019	0.005	0.001	0.000	0.000	-	-	-	-	-	-
-10 to -5	0.079	0.028	0.006	0.001	0.000	0.000	0.000	-	-	-	-
-5 to 0	0.510	0.247	0.075	0.019	0.004	0.001	0.000	0.000	0.000	-	-
0 to 5	2.987	1.896	0.651	0.206	0.061	0.016	0.003	0.000	0.000	0.000	-
5 to 10	2.194	4.636	2.342	0.912	0.347	0.126	0.039	0.012	0.004	0.001	0.000
10 to 15	2.071	6.967	5.443	2.437	0.862	0.308	0.122	0.044	0.012	0.003	0.001
15 to 20	1.986	6.686	4.836	1.689	0.459	0.154	0.054	0.016	0.004	0.001	0.000
20 to 25	1.902	16.614	6.331	1.089	0.249	0.073	0.027	0.011	0.006	0.003	0.002
25 to 30	1.971	15.818	3.339	0.584	0.155	0.063	0.032	0.017	0.011	0.007	0.007
30 to 35	0.025	0.042	0.017	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35 to 40	0.006	0.007	0.003	0.000	-	-	-	-	-	-	-
> 40	0.000	0.000	0.000	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20 to -15	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
-15 to -10	0.019	0.024	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
-10 to -5	0.079	0.107	0.113	0.114	0.114	0.114	0.114	0.114	0.114	0.114	0.114
-5 to 0	0.510	0.757	0.832	0.851	0.855	0.856	0.856	0.856	0.856	0.856	0.856
0 to 5	2.987	4.883	5.534	5.740	5.801	5.817	5.820	5.820	5.820	5.820	5.820
5 to 10	2.194	6.830	9.172	10.084	10.431	10.557	10.596	10.608	10.612	10.613	10.613
10 to 15	2.071	9.038	14.481	16.918	17.780	18.088	18.210	18.254	18.266	18.269	18.270
15 to 20	1.986	8.672	13.508	15.197	15.656	15.810	15.864	15.880	15.884	15.885	15.885
20 to 25	1.902	18.516	24.847	25.936	26.185	26.258	26.285	26.296	26.302	26.305	26.307
25 to 30	1.971	17.789	21.128	21.712	21.867	21.930	21.962	21.979	21.990	21.997	22.004
30 to 35	0.025	0.067	0.084	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085
35 to 40	0.006	0.013	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016
> 40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 10: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the North Atlantic (October–December). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.004	0.000	-	-	-	-	-	-	-	-	-
-40 to -35	0.006	0.001	0.000	-	-	-	-	-	-	-	-
-35 to -30	0.017	0.003	0.000	0.000	-	-	-	-	-	-	-
-30 to -25	0.040	0.008	0.001	0.000	0.000	0.000	-	-	-	-	-
-25 to -20	0.090	0.022	0.007	0.002	0.000	0.000	0.000	0.000	-	-	-
-20 to -15	0.181	0.077	0.026	0.008	0.002	0.001	0.000	0.000	0.000	-	-
-15 to -10	0.312	0.206	0.093	0.034	0.011	0.003	0.001	0.000	0.000	0.000	0.000
-10 to -5	0.498	0.539	0.350	0.181	0.073	0.025	0.009	0.003	0.001	0.000	0.000
-5 to 0	0.750	1.308	1.150	0.766	0.412	0.187	0.076	0.027	0.008	0.002	0.001
0 to 5	0.740	2.065	2.585	2.191	1.437	0.809	0.396	0.172	0.073	0.032	0.024
5 to 10	0.685	2.110	3.568	3.606	2.609	1.586	0.828	0.399	0.184	0.090	0.078
10 to 15	0.599	1.960	3.484	3.696	2.680	1.605	0.867	0.429	0.210	0.104	0.076
15 to 20	0.348	3.371	5.996	4.589	2.474	1.112	0.488	0.222	0.097	0.043	0.031
20 to 25	0.494	8.482	10.238	4.468	1.395	0.436	0.144	0.043	0.013	0.006	0.003
25 to 30	0.219	3.173	2.073	0.432	0.083	0.014	0.004	0.002	0.001	0.000	0.000
30 to 35	0.001	0.002	0.001	0.000	-	-	-	-	-	-	-
35 to 40	-	-	-	-	-	-	-	-	-	-	-
> 40	-	-	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
-40 to -35	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
-35 to -30	0.017	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
-30 to -25	0.040	0.048	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049
-25 to -20	0.090	0.112	0.119	0.121	0.121	0.121	0.121	0.121	0.121	0.121	0.121
-20 to -15	0.181	0.258	0.284	0.292	0.294	0.295	0.295	0.295	0.295	0.295	0.295
-15 to -10	0.312	0.518	0.611	0.645	0.656	0.659	0.660	0.660	0.660	0.660	0.660
-10 to -5	0.498	1.037	1.387	1.568	1.641	1.666	1.675	1.678	1.679	1.679	1.679
-5 to 0	0.750	2.058	3.208	3.974	4.386	4.573	4.649	4.676	4.684	4.686	4.687
0 to 5	0.740	2.805	5.390	7.581	9.018	9.827	10.223	10.395	10.468	10.500	10.524
5 to 10	0.685	2.795	6.363	9.969	12.578	14.164	14.992	15.391	15.575	15.665	15.743
10 to 15	0.599	2.559	6.043	9.739	12.419	14.024	14.891	15.320	15.530	15.634	15.710
15 to 20	0.348	3.719	9.715	14.304	16.778	17.890	18.378	18.600	18.697	18.740	18.771
20 to 25	0.494	8.976	19.214	23.682	25.077	25.513	25.657	25.700	25.713	25.719	25.722
25 to 30	0.219	3.392	5.465	5.897	5.980	5.994	5.998	6.000	6.001	6.001	6.001
30 to 35	0.001	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
35 to 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
> 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

### 3.2.3 Tropical Atlantic

Table 11: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the tropical Atlantic on an annual basis. Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	-	-	-	-	-	-	-	-	-	-	-
-30 to -25	-	-	-	-	-	-	-	-	-	-	-
-25 to -20	-	-	-	-	-	-	-	-	-	-	-
-20 to -15	-	0.000	0.000	-	-	-	-	-	-	-	-
-15 to -10	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-
-10 to -5	0.000	0.001	0.001	0.000	0.000	-	-	-	-	-	-
-5 to 0	0.000	0.002	0.002	0.000	0.000	-	-	-	-	-	-
0 to 5	0.000	0.013	0.015	0.003	0.000	0.000	-	-	-	-	-
5 to 10	0.000	0.033	0.040	0.008	0.001	0.000	0.000	-	-	-	-
10 to 15	0.004	0.065	0.068	0.022	0.005	0.002	0.000	0.000	-	-	-
15 to 20	0.044	1.529	2.993	1.318	0.321	0.043	0.003	0.000	0.000	-	-
20 to 25	0.573	15.739	16.670	3.571	0.450	0.052	0.007	0.001	0.000	-	-
25 to 30	1.863	33.618	19.146	1.498	0.082	0.012	0.004	0.002	0.001	0.001	0.001
30 to 35	0.043	0.093	0.021	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35 to 40	0.004	0.004	0.002	0.000	0.000	-	-	-	-	-	-
> 40	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20 to -15	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-15 to -10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-10 to -5	0.000	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
-5 to 0	0.000	0.002	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
0 to 5	0.000	0.013	0.028	0.031	0.031	0.031	0.031	0.031	0.031	0.031	0.031
5 to 10	0.000	0.033	0.073	0.081	0.082	0.082	0.082	0.082	0.082	0.082	0.082
10 to 15	0.004	0.069	0.137	0.159	0.164	0.166	0.166	0.166	0.166	0.166	0.166
15 to 20	0.044	1.573	4.566	5.884	6.205	6.248	6.251	6.251	6.251	6.251	6.251
20 to 25	0.573	16.312	32.982	36.553	37.003	37.055	37.062	37.063	37.063	37.063	37.063
25 to 30	1.863	35.481	54.627	56.125	56.207	56.219	56.223	56.225	56.226	56.227	56.228
30 to 35	0.043	0.136	0.157	0.159	0.159	0.159	0.159	0.159	0.159	0.159	0.159
35 to 40	0.004	0.008	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
> 40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Table 12: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the tropical Atlantic (January–March). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	-	-	-	-	-	-	-	-	-	-	-
-30 to -25	-	-	-	-	-	-	-	-	-	-	-
-25 to -20	-	-	-	-	-	-	-	-	-	-	-
-20 to -15	-	-	-	-	-	-	-	-	-	-	-
-15 to -10	-	0.000	-	-	-	-	-	-	-	-	-
-10 to -5	-	0.000	0.000	-	-	-	-	-	-	-	-
-5 to 0	-	0.001	0.000	-	-	-	-	-	-	-	-
0 to 5	0.000	0.014	0.006	0.000	-	-	-	-	-	-	-
5 to 10	0.000	0.023	0.019	0.001	0.000	-	-	-	-	-	-
10 to 15	0.002	0.050	0.030	0.001	0.000	-	-	-	-	-	-
15 to 20	0.031	0.581	0.941	0.354	0.065	0.005	0.001	0.000	0.000	-	-
20 to 25	0.652	15.014	18.520	4.650	0.537	0.064	0.013	0.002	0.000	-	-
25 to 30	2.091	35.189	18.902	1.957	0.059	0.002	0.000	-	-	-	-
30 to 35	0.054	0.123	0.023	0.002	0.000	-	-	-	-	-	-
35 to 40	0.006	0.005	0.005	0.001	0.000	-	-	-	-	-	-
> 40	0.000	0.000	0.000	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20 to -15	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-15 to -10	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-10 to -5	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-5 to 0	-	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
0 to 5	0.000	0.014	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
5 to 10	0.000	0.023	0.042	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043
10 to 15	0.002	0.052	0.082	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
15 to 20	0.031	0.612	1.553	1.907	1.972	1.977	1.978	1.978	1.978	1.978	1.978
20 to 25	0.652	15.666	34.186	38.836	39.373	39.437	39.450	39.452	39.452	39.452	39.452
25 to 30	2.091	37.280	56.182	58.139	58.198	58.200	58.200	58.200	58.200	58.200	58.200
30 to 35	0.054	0.177	0.200	0.202	0.202	0.202	0.202	0.202	0.202	0.202	0.202
35 to 40	0.006	0.011	0.016	0.017	0.017	0.017	0.017	0.017	0.017	0.017	0.017
> 40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 13: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the tropical Atlantic (April–June). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	-	-	-	-	-	-	-	-	-	-	-
-30 to -25	-	-	-	-	-	-	-	-	-	-	-
-25 to -20	-	-	-	-	-	-	-	-	-	-	-
-20 to -15	-	0.000	-	-	-	-	-	-	-	-	-
-15 to -10	-	0.000	0.000	0.000	-	-	-	-	-	-	-
-10 to -5	0.000	0.001	0.001	0.000	-	-	-	-	-	-	-
-5 to 0	-	0.003	0.003	0.000	-	-	-	-	-	-	-
0 to 5	0.000	0.012	0.019	0.003	0.000	-	-	-	-	-	-
5 to 10	0.000	0.035	0.048	0.011	0.001	0.000	-	-	-	-	-
10 to 15	0.004	0.066	0.079	0.018	0.002	0.000	-	-	-	-	-
15 to 20	0.045	0.782	1.617	0.781	0.212	0.027	0.001	0.000	0.000	-	-
20 to 25	0.549	15.047	17.421	3.471	0.461	0.050	0.003	0.000	0.000	-	-
25 to 30	1.601	34.147	22.136	1.170	0.040	0.001	0.000	-	-	-	-
30 to 35	0.032	0.078	0.012	0.001	0.000	-	-	-	-	-	-
35 to 40	0.005	0.002	0.000	0.000	-	-	-	-	-	-	-
> 40	0.000	0.000	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20 to -15	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-15 to -10	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-10 to -5	0.000	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
-5 to 0	-	0.003	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
0 to 5	0.000	0.012	0.031	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034
5 to 10	0.000	0.035	0.083	0.094	0.095	0.095	0.095	0.095	0.095	0.095	0.095
10 to 15	0.004	0.070	0.149	0.167	0.169	0.169	0.169	0.169	0.169	0.169	0.169
15 to 20	0.045	0.827	2.444	3.225	3.437	3.464	3.465	3.465	3.465	3.465	3.465
20 to 25	0.549	15.596	33.017	36.488	36.949	36.999	37.002	37.002	37.002	37.002	37.002
25 to 30	1.601	35.748	57.884	59.054	59.094	59.095	59.095	59.095	59.095	59.095	59.095
30 to 35	0.032	0.110	0.122	0.123	0.123	0.123	0.123	0.123	0.123	0.123	0.123
35 to 40	0.005	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
> 40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 14: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the tropical Atlantic (July–September). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	-	-	-	-	-	-	-	-	-	-	-
-30 to -25	-	-	-	-	-	-	-	-	-	-	-
-25 to -20	-	-	-	-	-	-	-	-	-	-	-
-20 to -15	-	0.000	0.000	-	-	-	-	-	-	-	-
-15 to -10	0.000	0.000	0.001	0.000	-	-	-	-	-	-	-
-10 to -5	-	0.002	0.002	0.000	0.000	-	-	-	-	-	-
-5 to 0	0.000	0.004	0.005	0.001	0.000	-	-	-	-	-	-
0 to 5	0.000	0.013	0.024	0.007	0.001	0.000	-	-	-	-	-
5 to 10	0.001	0.040	0.059	0.019	0.003	0.000	0.000	-	-	-	-
10 to 15	0.006	0.076	0.106	0.057	0.015	0.007	0.001	0.000	-	-	-
15 to 20	0.062	2.036	5.314	3.013	0.815	0.106	0.008	0.001	0.000	-	-
20 to 25	0.446	14.464	17.402	3.870	0.388	0.015	-	-	-	-	-
25 to 30	1.722	32.375	16.063	1.146	0.104	0.036	0.015	0.008	0.004	0.003	0.003
30 to 35	0.033	0.068	0.021	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35 to 40	0.001	0.002	0.001	0.000	0.000	-	-	-	-	-	-
> 40	0.000	0.001	0.000	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20 to -15	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-15 to -10	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
-10 to -5	-	0.002	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
-5 to 0	0.000	0.004	0.009	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
0 to 5	0.000	0.013	0.037	0.044	0.045	0.045	0.045	0.045	0.045	0.045	0.045
5 to 10	0.001	0.041	0.100	0.119	0.122	0.122	0.122	0.122	0.122	0.122	0.122
10 to 15	0.006	0.082	0.188	0.245	0.260	0.267	0.268	0.268	0.268	0.268	0.268
15 to 20	0.062	2.098	7.412	10.425	11.240	11.346	11.354	11.355	11.355	11.355	11.355
20 to 25	0.446	14.910	32.312	36.182	36.570	36.585	36.585	36.585	36.585	36.585	36.585
25 to 30	1.722	34.097	50.160	51.306	51.410	51.446	51.461	51.469	51.473	51.476	51.479
30 to 35	0.033	0.101	0.122	0.125	0.125	0.125	0.125	0.125	0.125	0.125	0.125
35 to 40	0.001	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
> 40	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Table 15: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the tropical Atlantic (October–December). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	-	-	-	-	-	-	-	-	-	-	-
-30 to -25	-	-	-	-	-	-	-	-	-	-	-
-25 to -20	-	-	-	-	-	-	-	-	-	-	-
-20 to -15	-	-	-	-	-	-	-	-	-	-	-
-15 to -10	-	0.000	-	-	-	-	-	-	-	-	-
-10 to -5	-	0.000	0.000	-	-	-	-	-	-	-	-
-5 to 0	0.000	0.002	0.001	0.000	-	-	-	-	-	-	-
0 to 5	0.000	0.015	0.013	0.001	0.000	-	-	-	-	-	-
5 to 10	0.000	0.036	0.035	0.002	0.000	0.000	-	-	-	-	-
10 to 15	0.002	0.069	0.058	0.012	0.003	0.002	0.000	-	-	-	-
15 to 20	0.036	2.691	4.042	1.098	0.186	0.033	0.003	0.000	-	-	-
20 to 25	0.646	18.409	13.381	2.312	0.415	0.078	0.012	0.000	-	-	-
25 to 30	2.041	32.798	19.509	1.726	0.124	0.008	0.001	0.000	0.000	0.000	0.000
30 to 35	0.051	0.103	0.027	0.003	0.000	0.000	-	-	-	-	-
35 to 40	0.003	0.005	0.003	0.001	0.000	-	-	-	-	-	-
> 40	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20 to -15	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-15 to -10	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-10 to -5	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-5 to 0	0.000	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
0 to 5	0.000	0.015	0.028	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029
5 to 10	0.000	0.036	0.071	0.073	0.073	0.073	0.073	0.073	0.073	0.073	0.073
10 to 15	0.002	0.071	0.129	0.141	0.144	0.146	0.146	0.146	0.146	0.146	0.146
15 to 20	0.036	2.727	6.769	7.867	8.053	8.086	8.089	8.089	8.089	8.089	8.089
20 to 25	0.646	19.055	32.436	34.748	35.163	35.241	35.253	35.253	35.253	35.253	35.253
25 to 30	2.041	34.839	54.348	56.074	56.198	56.206	56.207	56.207	56.207	56.207	56.207
30 to 35	0.051	0.154	0.181	0.184	0.184	0.184	0.184	0.184	0.184	0.184	0.184
35 to 40	0.003	0.008	0.011	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
> 40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

### 3.2.4 South Atlantic

Table 16: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the South Atlantic on an annual basis. Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.002	0.000	0.000	0.000	0.000	-	-	-	-	-	-
-40 to -35	0.003	0.001	0.000	0.000	0.000	0.000	0.000	-	-	-	-
-35 to -30	0.008	0.003	0.001	0.000	0.000	0.000	0.000	0.000	-	-	-
-30 to -25	0.018	0.008	0.002	0.001	0.000	0.000	0.000	0.000	0.000	-	-
-25 to -20	0.037	0.022	0.008	0.003	0.001	0.000	0.000	0.000	0.000	0.000	-
-20 to -15	0.068	0.048	0.023	0.010	0.004	0.001	0.000	0.000	0.000	0.000	0.000
-15 to -10	0.120	0.103	0.064	0.035	0.016	0.007	0.002	0.001	0.000	0.000	0.000
-10 to -5	0.256	0.253	0.216	0.151	0.086	0.042	0.018	0.007	0.003	0.001	0.001
-5 to 0	1.184	1.902	2.489	2.045	1.221	0.608	0.271	0.111	0.044	0.016	0.011
0 to 5	0.294	1.454	4.700	5.657	3.887	2.019	0.906	0.370	0.146	0.057	0.027
5 to 10	0.248	1.687	3.907	4.358	2.923	1.455	0.632	0.263	0.111	0.042	0.021
10 to 15	0.245	2.147	4.967	4.756	2.818	1.295	0.553	0.220	0.084	0.030	0.013
15 to 20	0.232	4.315	9.147	5.580	2.186	0.755	0.244	0.070	0.021	0.006	0.002
20 to 25	0.207	4.401	5.338	1.780	0.362	0.068	0.014	0.003	0.001	0.000	-
25 to 30	0.049	0.813	0.459	0.070	0.011	0.002	0.000	0.000	-	-	-
30 to 35	0.005	0.004	0.004	0.001	0.000	0.000	-	-	-	-	-
35 to 40	0.000	0.001	0.001	0.000	0.000	-	-	-	-	-	-
> 40	0.000	0.000	0.000	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
-40 to -35	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
-35 to -30	0.008	0.011	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
-30 to -25	0.018	0.026	0.028	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029
-25 to -20	0.037	0.059	0.067	0.070	0.071	0.071	0.071	0.071	0.071	0.071	0.071
-20 to -15	0.068	0.116	0.139	0.149	0.153	0.154	0.154	0.154	0.154	0.154	0.154
-15 to -10	0.120	0.223	0.287	0.322	0.338	0.345	0.347	0.348	0.348	0.348	0.348
-10 to -5	0.256	0.509	0.725	0.876	0.962	1.004	1.022	1.029	1.032	1.033	1.034
-5 to 0	1.184	3.086	5.575	7.620	8.841	9.449	9.720	9.831	9.875	9.891	9.902
0 to 5	0.294	1.748	6.448	12.105	15.992	18.011	18.917	19.287	19.433	19.490	19.517
5 to 10	0.248	1.935	5.842	10.200	13.123	14.578	15.210	15.473	15.584	15.626	15.647
10 to 15	0.245	2.392	7.359	12.115	14.933	16.228	16.781	17.001	17.085	17.115	17.128
15 to 20	0.232	4.547	13.694	19.274	21.460	22.215	22.459	22.529	22.550	22.556	22.558
20 to 25	0.207	4.608	9.946	11.726	12.088	12.156	12.170	12.173	12.174	12.174	12.174
25 to 30	0.049	0.862	1.321	1.391	1.402	1.404	1.404	1.404	1.404	1.404	1.404
30 to 35	0.005	0.009	0.013	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
35 to 40	0.000	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
> 40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 17: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the South Atlantic (January–March). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.000	0.000	-	-	-	-	-	-	-	-	-
-40 to -35	0.001	0.000	-	-	-	-	-	-	-	-	-
-35 to -30	0.003	0.000	0.000	-	-	-	-	-	-	-	-
-30 to -25	0.006	0.000	0.000	-	-	-	-	-	-	-	-
-25 to -20	0.013	0.002	0.000	0.000	0.000	-	-	-	-	-	-
-20 to -15	0.036	0.008	0.001	0.000	0.000	0.000	-	-	-	-	-
-15 to -10	0.092	0.044	0.013	0.002	0.001	0.000	0.000	0.000	-	-	-
-10 to -5	0.245	0.178	0.078	0.022	0.008	0.003	0.001	0.000	0.000	-	-
-5 to 0	1.530	3.116	3.185	1.694	0.604	0.192	0.058	0.014	0.004	0.002	0.000
0 to 5	0.238	1.975	6.190	6.398	3.603	1.538	0.572	0.213	0.081	0.028	0.012
5 to 10	0.136	1.076	3.425	4.121	2.490	1.003	0.355	0.135	0.046	0.014	0.007
10 to 15	0.206	1.932	4.120	3.514	1.694	0.634	0.211	0.062	0.019	0.007	0.001
15 to 20	0.285	3.873	7.482	4.094	1.314	0.356	0.102	0.027	0.006	0.000	-
20 to 25	0.461	8.194	9.052	2.698	0.432	0.061	0.010	0.001	-	-	-
25 to 30	0.138	2.537	1.390	0.203	0.032	0.005	0.001	0.000	-	-	-
30 to 35	0.011	0.008	0.007	0.001	0.000	-	-	-	-	-	-
35 to 40	0.001	0.002	0.003	0.001	0.000	-	-	-	-	-	-
> 40	0.000	0.000	0.000	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
-35 to -30	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
-30 to -25	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
-25 to -20	0.013	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
-20 to -15	0.036	0.044	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045
-15 to -10	0.092	0.136	0.149	0.151	0.152	0.152	0.152	0.152	0.152	0.152	0.152
-10 to -5	0.245	0.423	0.501	0.523	0.531	0.534	0.535	0.535	0.535	0.535	0.535
-5 to 0	1.530	4.646	7.831	9.525	10.129	10.321	10.379	10.393	10.397	10.399	10.399
0 to 5	0.238	2.213	8.403	14.801	18.404	19.942	20.514	20.727	20.808	20.836	20.848
5 to 10	0.136	1.212	4.637	8.758	11.248	12.251	12.606	12.741	12.787	12.801	12.808
10 to 15	0.206	2.138	6.258	9.772	11.466	12.100	12.311	12.373	12.392	12.399	12.400
15 to 20	0.285	4.158	11.640	15.734	17.048	17.404	17.506	17.533	17.539	17.539	17.539
20 to 25	0.461	8.655	17.707	20.405	20.837	20.898	20.908	20.909	20.909	20.909	20.909
25 to 30	0.138	2.675	4.065	4.268	4.300	4.305	4.306	4.306	4.306	4.306	4.306
30 to 35	0.011	0.019	0.026	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027
35 to 40	0.001	0.003	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
> 40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 18: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the South Atlantic (April–June). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.002	0.000	0.000	0.000	-	-	-	-	-	-	-
-40 to -35	0.005	0.001	0.000	0.000	-	-	-	-	-	-	-
-35 to -30	0.015	0.005	0.001	0.000	0.000	0.000	-	-	-	-	-
-30 to -25	0.036	0.015	0.004	0.001	0.000	0.000	0.000	0.000	0.000	-	-
-25 to -20	0.072	0.038	0.013	0.005	0.001	0.000	0.000	0.000	0.000	-	-
-20 to -15	0.119	0.083	0.039	0.017	0.004	0.001	0.000	0.000	0.000	0.000	-
-15 to -10	0.163	0.166	0.104	0.057	0.023	0.008	0.002	0.001	0.000	0.000	0.000
-10 to -5	0.239	0.397	0.378	0.239	0.121	0.047	0.016	0.006	0.002	0.000	0.000
-5 to 0	0.252	1.133	2.646	2.778	1.812	0.913	0.387	0.149	0.057	0.021	0.014
0 to 5	0.120	0.815	3.737	5.816	4.473	2.422	1.152	0.462	0.179	0.071	0.038
5 to 10	0.219	1.197	3.252	4.376	3.296	1.678	0.759	0.303	0.121	0.042	0.017
10 to 15	0.227	1.383	3.767	4.728	3.207	1.645	0.714	0.288	0.108	0.045	0.020
15 to 20	0.192	2.411	8.231	6.922	3.420	1.409	0.507	0.154	0.051	0.015	0.005
20 to 25	0.089	2.883	6.013	2.797	0.742	0.180	0.043	0.010	0.002	0.000	-
25 to 30	0.010	0.335	0.237	0.040	0.005	0.000	0.000	-	-	-	-
30 to 35	0.000	0.002	0.002	0.000	0.000	-	-	-	-	-	-
35 to 40	-	0.000	0.000	-	-	-	-	-	-	-	-
> 40	-	-	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
-40 to -35	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
-35 to -30	0.015	0.020	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021	0.021
-30 to -25	0.036	0.051	0.055	0.056	0.056	0.056	0.056	0.056	0.056	0.056	0.056
-25 to -20	0.072	0.110	0.123	0.128	0.129	0.129	0.129	0.129	0.129	0.129	0.129
-20 to -15	0.119	0.202	0.241	0.258	0.262	0.263	0.263	0.263	0.263	0.263	0.263
-15 to -10	0.163	0.329	0.433	0.490	0.513	0.521	0.523	0.524	0.524	0.524	0.524
-10 to -5	0.239	0.636	1.014	1.253	1.374	1.421	1.437	1.443	1.445	1.445	1.445
-5 to 0	0.252	1.385	4.031	6.809	8.621	9.534	9.921	10.070	10.127	10.148	10.162
0 to 5	0.120	0.935	4.672	10.488	14.961	17.383	18.535	18.997	19.176	19.247	19.285
5 to 10	0.219	1.416	4.668	9.044	12.340	14.018	14.777	15.080	15.201	15.243	15.260
10 to 15	0.227	1.610	5.377	10.105	13.312	14.957	15.671	15.959	16.067	16.112	16.132
15 to 20	0.192	2.603	10.834	17.756	21.176	22.585	23.092	23.246	23.297	23.312	23.317
20 to 25	0.089	2.972	8.985	11.782	12.524	12.704	12.747	12.757	12.759	12.759	12.759
25 to 30	0.010	0.345	0.582	0.622	0.627	0.627	0.627	0.627	0.627	0.627	0.627
30 to 35	0.000	0.002	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
35 to 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
> 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 19: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the South Atlantic (July–September). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.005	0.001	0.000	0.000	0.000	-	-	-	-	-	-
-40 to -35	0.006	0.002	0.000	0.000	0.000	0.000	0.000	-	-	-	-
-35 to -30	0.014	0.005	0.001	0.000	0.000	0.000	0.000	0.000	-	-	-
-30 to -25	0.029	0.019	0.005	0.001	0.000	0.000	0.000	0.000	-	-	-
-25 to -20	0.057	0.047	0.020	0.007	0.002	0.001	0.000	0.000	0.000	0.000	-
-20 to -15	0.095	0.101	0.054	0.025	0.010	0.004	0.001	0.000	0.000	0.000	0.000
-15 to -10	0.147	0.187	0.139	0.082	0.041	0.019	0.007	0.002	0.001	0.000	0.000
-10 to -5	0.247	0.356	0.370	0.331	0.215	0.118	0.054	0.022	0.009	0.003	0.002
-5 to 0	0.446	1.125	1.798	2.038	1.592	0.973	0.514	0.234	0.097	0.038	0.027
0 to 5	0.284	1.575	3.884	4.752	3.899	2.573	1.352	0.631	0.274	0.113	0.051
5 to 10	0.365	2.313	3.913	4.307	3.463	2.268	1.155	0.534	0.243	0.097	0.056
10 to 15	0.232	1.752	5.100	6.112	4.533	2.384	1.115	0.464	0.188	0.061	0.029
15 to 20	0.118	3.533	9.561	6.881	2.929	0.963	0.278	0.073	0.021	0.006	0.003
20 to 25	0.037	1.160	1.844	0.624	0.111	0.011	0.001	0.000	-	-	-
25 to 30	0.003	0.008	0.007	0.003	0.001	0.000	0.000	-	-	-	-
30 to 35	0.000	0.001	0.002	0.001	0.000	0.000	-	-	-	-	-
35 to 40	-	-	0.000	0.000	-	-	-	-	-	-	-
> 40	-	-	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
-40 to -35	0.006	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
-35 to -30	0.014	0.019	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020
-30 to -25	0.029	0.048	0.053	0.054	0.054	0.054	0.054	0.054	0.054	0.054	0.054
-25 to -20	0.057	0.104	0.124	0.131	0.133	0.134	0.134	0.134	0.134	0.134	0.134
-20 to -15	0.095	0.196	0.250	0.275	0.285	0.289	0.290	0.290	0.290	0.290	0.290
-15 to -10	0.147	0.334	0.473	0.555	0.596	0.615	0.622	0.624	0.625	0.625	0.625
-10 to -5	0.247	0.603	0.973	1.304	1.519	1.637	1.691	1.713	1.722	1.725	1.727
-5 to 0	0.446	1.571	3.369	5.407	6.999	7.972	8.486	8.720	8.817	8.855	8.882
0 to 5	0.284	1.859	5.743	10.495	14.394	16.967	18.319	18.950	19.224	19.337	19.388
5 to 10	0.365	2.678	6.591	10.898	14.361	16.629	17.784	18.318	18.561	18.658	18.714
10 to 15	0.232	1.984	7.084	13.196	17.729	20.113	21.228	21.692	21.880	21.941	21.970
15 to 20	0.118	3.651	13.212	20.093	23.022	23.985	24.263	24.336	24.357	24.363	24.366
20 to 25	0.037	1.197	3.041	3.665	3.776	3.787	3.788	3.788	3.788	3.788	3.788
25 to 30	0.003	0.011	0.018	0.021	0.022	0.022	0.022	0.022	0.022	0.022	0.022
30 to 35	0.000	0.001	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
35 to 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
> 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Table 20: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the South Atlantic (October–December). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.000	0.000	-	-	-	-	-	-	-	-	-
-40 to -35	0.000	0.000	-	-	-	-	-	-	-	-	-
-35 to -30	0.001	0.000	0.000	-	-	-	-	-	-	-	-
-30 to -25	0.002	0.000	0.000	-	-	-	-	-	-	-	-
-25 to -20	0.007	0.001	0.000	0.000	0.000	0.000	-	-	-	-	-
-20 to -15	0.023	0.007	0.002	0.001	0.001	0.000	0.000	-	-	-	-
-15 to -10	0.081	0.021	0.009	0.005	0.002	0.001	0.000	0.000	-	-	-
-10 to -5	0.296	0.087	0.052	0.030	0.015	0.007	0.003	0.001	0.000	0.000	0.000
-5 to 0	2.479	2.099	2.211	1.673	0.933	0.403	0.153	0.061	0.023	0.007	0.003
0 to 5	0.547	1.430	4.830	5.531	3.579	1.604	0.593	0.201	0.063	0.019	0.010
5 to 10	0.292	2.282	5.123	4.649	2.500	0.950	0.306	0.104	0.047	0.019	0.007
10 to 15	0.319	3.561	7.038	4.873	2.024	0.625	0.228	0.092	0.033	0.011	0.002
15 to 20	0.324	7.546	11.562	4.582	1.154	0.316	0.094	0.027	0.006	0.002	0.001
20 to 25	0.212	4.867	3.839	0.799	0.125	0.011	0.002	0.000	-	-	-
25 to 30	0.033	0.167	0.090	0.018	0.003	0.001	0.000	-	-	-	-
30 to 35	0.007	0.004	0.006	0.002	0.000	-	-	-	-	-	-
35 to 40	0.000	0.001	0.001	0.000	0.000	-	-	-	-	-	-
> 40	0.000	0.000	0.000	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
-30 to -25	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
-25 to -20	0.007	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
-20 to -15	0.023	0.030	0.032	0.033	0.034	0.034	0.034	0.034	0.034	0.034	0.034
-15 to -10	0.081	0.102	0.111	0.116	0.118	0.119	0.119	0.119	0.119	0.119	0.119
-10 to -5	0.296	0.383	0.435	0.465	0.480	0.487	0.490	0.491	0.491	0.491	0.491
-5 to 0	2.479	4.578	6.789	8.462	9.395	9.798	9.951	10.012	10.035	10.042	10.045
0 to 5	0.547	1.977	6.807	12.338	15.917	17.521	18.114	18.315	18.378	18.397	18.407
5 to 10	0.292	2.574	7.697	12.346	14.846	15.796	16.102	16.206	16.253	16.272	16.279
10 to 15	0.319	3.880	10.918	15.791	17.815	18.440	18.668	18.760	18.793	18.804	18.806
15 to 20	0.324	7.870	19.432	24.014	25.168	25.484	25.578	25.605	25.611	25.613	25.614
20 to 25	0.212	5.079	8.918	9.717	9.842	9.853	9.855	9.855	9.855	9.855	9.855
25 to 30	0.033	0.200	0.290	0.308	0.311	0.312	0.312	0.312	0.312	0.312	0.312
30 to 35	0.007	0.011	0.017	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
35 to 40	0.000	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
> 40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

### 3.2.5 Caribbean

Table 21: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the Caribbean on an annual basis. Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	-	-	-	-	-	-	-	-	-	-	-
-30 to -25	-	-	-	-	-	-	-	-	-	-	-
-25 to -20	-	-	-	-	-	-	-	-	-	-	-
-20 to -15	-	-	-	-	-	-	-	-	-	-	-
-15 to -10	-	-	-	-	-	-	-	-	-	-	-
-10 to -5	-	-	-	-	-	-	-	-	-	-	-
-5 to 0	-	-	-	-	-	-	-	-	-	-	-
0 to 5	0.000	0.000	0.000	-	-	-	-	-	-	-	-
5 to 10	0.003	0.007	0.004	0.001	0.000	-	-	-	-	-	-
10 to 15	0.039	0.074	0.059	0.032	0.017	0.009	0.003	0.001	0.000	-	-
15 to 20	0.485	1.232	1.091	0.613	0.256	0.104	0.037	0.014	0.005	0.001	0.000
20 to 25	4.330	12.430	6.789	1.834	0.344	0.059	0.014	0.003	0.001	0.000	0.000
25 to 30	15.298	39.734	12.419	2.123	0.256	0.053	0.022	0.011	0.007	0.004	0.005
30 to 35	0.092	0.066	0.012	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000
35 to 40	0.001	0.001	0.001	0.000	-	-	-	-	-	-	-
> 40	-	-	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20 to -15	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-15 to -10	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-10 to -5	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-5 to 0	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0 to 5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5 to 10	0.003	0.010	0.014	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
10 to 15	0.039	0.113	0.172	0.204	0.221	0.230	0.233	0.234	0.234	0.234	0.234
15 to 20	0.485	1.717	2.808	3.421	3.677	3.781	3.818	3.832	3.837	3.838	3.838
20 to 25	4.330	16.760	23.549	25.383	25.727	25.786	25.800	25.803	25.804	25.804	25.804
25 to 30	15.298	55.032	67.451	69.574	69.830	69.883	69.905	69.916	69.923	69.927	69.932
30 to 35	0.092	0.158	0.170	0.173	0.174	0.174	0.174	0.174	0.174	0.174	0.174
35 to 40	0.001	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
> 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 22: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the Caribbean (January–March). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	-	-	-	-	-	-	-	-	-	-	-
-30 to -25	-	-	-	-	-	-	-	-	-	-	-
-25 to -20	-	-	-	-	-	-	-	-	-	-	-
-20 to -15	-	-	-	-	-	-	-	-	-	-	-
-15 to -10	-	-	-	-	-	-	-	-	-	-	-
-10 to -5	-	-	-	-	-	-	-	-	-	-	-
-5 to 0	-	-	-	-	-	-	-	-	-	-	-
0 to 5	0.000	0.001	0.000	-	-	-	-	-	-	-	-
5 to 10	0.010	0.023	0.012	0.002	0.000	-	-	-	-	-	-
10 to 15	0.128	0.233	0.189	0.109	0.058	0.029	0.004	0.000	-	-	-
15 to 20	0.991	2.991	3.125	1.892	0.753	0.285	0.099	0.033	0.011	0.004	0.001
20 to 25	6.746	20.862	14.467	3.581	0.555	0.092	0.024	0.006	0.002	0.000	-
25 to 30	4.207	21.887	13.472	2.716	0.203	0.005	0.000	-	-	-	-
30 to 35	0.049	0.102	0.027	0.006	0.001	-	-	-	-	-	-
35 to 40	0.002	0.004	0.002	0.000	-	-	-	-	-	-	-
> 40	-	-	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20 to -15	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-15 to -10	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-10 to -5	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-5 to 0	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0 to 5	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
5 to 10	0.010	0.033	0.045	0.047	0.047	0.047	0.047	0.047	0.047	0.047	0.047
10 to 15	0.128	0.361	0.550	0.659	0.717	0.746	0.750	0.750	0.750	0.750	0.750
15 to 20	0.991	3.982	7.107	8.999	9.752	10.037	10.136	10.169	10.180	10.184	10.185
20 to 25	6.746	27.608	42.075	45.656	46.211	46.303	46.327	46.333	46.335	46.335	46.335
25 to 30	4.207	26.094	39.566	42.282	42.485	42.490	42.490	42.490	42.490	42.490	42.490
30 to 35	0.049	0.151	0.178	0.184	0.185	0.185	0.185	0.185	0.185	0.185	0.185
35 to 40	0.002	0.006	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
> 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 23: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the Caribbean (April–June). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	-	-	-	-	-	-	-	-	-	-	-
-30 to -25	-	-	-	-	-	-	-	-	-	-	-
-25 to -20	-	-	-	-	-	-	-	-	-	-	-
-20 to -15	-	-	-	-	-	-	-	-	-	-	-
-15 to -10	-	-	-	-	-	-	-	-	-	-	-
-10 to -5	-	-	-	-	-	-	-	-	-	-	-
-5 to 0	-	-	-	-	-	-	-	-	-	-	-
0 to 5	-	-	-	-	-	-	-	-	-	-	-
5 to 10	-	-	-	-	-	-	-	-	-	-	-
10 to 15	0.003	0.005	0.003	0.001	0.000	-	-	-	-	-	-
15 to 20	0.328	0.940	0.709	0.194	0.061	0.020	0.001	0.000	-	-	-
20 to 25	5.963	16.642	5.107	0.803	0.150	0.016	0.002	0.000	-	-	-
25 to 30	18.020	41.287	8.829	0.694	0.011	0.001	-	-	-	-	-
30 to 35	0.125	0.072	0.007	0.002	-	-	-	-	-	-	-
35 to 40	0.002	0.001	0.000	-	-	-	-	-	-	-	-
> 40	-	-	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20 to -15	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-15 to -10	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-10 to -5	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-5 to 0	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0 to 5	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5 to 10	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10 to 15	0.003	0.008	0.011	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
15 to 20	0.328	1.268	1.977	2.171	2.232	2.252	2.253	2.253	2.253	2.253	2.253
20 to 25	5.963	22.605	27.712	28.515	28.665	28.681	28.683	28.683	28.683	28.683	28.683
25 to 30	18.020	59.307	68.136	68.830	68.841	68.842	68.842	68.842	68.842	68.842	68.842
30 to 35	0.125	0.197	0.204	0.206	0.206	0.206	0.206	0.206	0.206	0.206	0.206
35 to 40	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
> 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 24: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the Caribbean (July–September). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	-	-	-	-	-	-	-	-	-	-	-
-30 to -25	-	-	-	-	-	-	-	-	-	-	-
-25 to -20	-	-	-	-	-	-	-	-	-	-	-
-20 to -15	-	-	-	-	-	-	-	-	-	-	-
-15 to -10	-	-	-	-	-	-	-	-	-	-	-
-10 to -5	-	-	-	-	-	-	-	-	-	-	-
-5 to 0	-	-	-	-	-	-	-	-	-	-	-
0 to 5	-	-	-	-	-	-	-	-	-	-	-
5 to 10	-	-	-	-	-	-	-	-	-	-	-
10 to 15	-	-	-	-	-	-	-	-	-	-	-
15 to 20	0.178	0.214	0.017	0.000	-	-	-	-	-	-	-
20 to 25	1.309	2.121	0.255	0.013	0.003	-	-	-	-	-	-
25 to 30	24.110	57.228	11.752	1.817	0.410	0.162	0.077	0.040	0.026	0.016	0.021
30 to 35	0.146	0.060	0.012	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001
35 to 40	0.001	-	-	-	-	-	-	-	-	-	-
> 40	-	-	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20 to -15	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-15 to -10	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-10 to -5	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-5 to 0	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0 to 5	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5 to 10	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10 to 15	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15 to 20	0.178	0.392	0.409	0.409	0.409	0.409	0.409	0.409	0.409	0.409	0.409
20 to 25	1.309	3.430	3.685	3.698	3.701	3.701	3.701	3.701	3.701	3.701	3.701
25 to 30	24.110	81.338	93.090	94.907	95.317	95.479	95.556	95.596	95.622	95.638	95.659
30 to 35	0.146	0.206	0.218	0.221	0.223	0.225	0.226	0.227	0.228	0.229	0.230
35 to 40	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
> 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 25: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the Caribbean (October–December). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	-	-	-	-	-	-	-	-	-	-	-
-30 to -25	-	-	-	-	-	-	-	-	-	-	-
-25 to -20	-	-	-	-	-	-	-	-	-	-	-
-20 to -15	-	-	-	-	-	-	-	-	-	-	-
-15 to -10	-	-	-	-	-	-	-	-	-	-	-
-10 to -5	-	-	-	-	-	-	-	-	-	-	-
-5 to 0	-	-	-	-	-	-	-	-	-	-	-
0 to 5	-	-	-	-	-	-	-	-	-	-	-
5 to 10	0.001	0.005	0.004	0.002	0.000	-	-	-	-	-	-
10 to 15	0.024	0.062	0.047	0.017	0.008	0.006	0.006	0.002	0.000	-	-
15 to 20	0.453	0.814	0.550	0.387	0.217	0.116	0.050	0.022	0.010	0.002	0.000
20 to 25	3.367	10.312	7.465	2.963	0.670	0.127	0.030	0.006	0.002	0.001	0.000
25 to 30	14.659	38.189	15.606	3.261	0.397	0.042	0.009	0.003	0.001	0.000	0.001
30 to 35	0.049	0.029	0.004	0.001	-	-	-	-	-	-	-
35 to 40	-	-	-	-	-	-	-	-	-	-	-
> 40	-	-	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20 to -15	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-15 to -10	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-10 to -5	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-5 to 0	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0 to 5	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
5 to 10	0.001	0.006	0.010	0.012	0.012	0.012	0.012	0.012	0.012	0.012	0.012
10 to 15	0.024	0.086	0.133	0.150	0.158	0.164	0.170	0.172	0.172	0.172	0.172
15 to 20	0.453	1.267	1.817	2.204	2.421	2.537	2.587	2.609	2.619	2.621	2.621
20 to 25	3.367	13.679	21.144	24.107	24.777	24.904	24.934	24.940	24.942	24.943	24.943
25 to 30	14.659	52.848	68.454	71.715	72.112	72.154	72.163	72.166	72.167	72.167	72.168
30 to 35	0.049	0.078	0.082	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
35 to 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
> 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

### 3.2.6 North Pacific

Table 26: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the North Pacific on an annual basis. Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.000	0.000	-	-	-	-	-	-	-	-	-
-40 to -35	0.004	0.000	0.000	-	-	-	-	-	-	-	-
-35 to -30	0.014	0.001	0.000	0.000	0.000	-	-	-	-	-	-
-30 to -25	0.038	0.005	0.000	0.000	0.000	-	-	-	-	-	-
-25 to -20	0.074	0.016	0.002	0.000	0.000	0.000	0.000	-	-	-	-
-20 to -15	0.121	0.041	0.010	0.002	0.001	0.000	0.000	0.000	0.000	0.000	-
-15 to -10	0.210	0.116	0.043	0.013	0.004	0.001	0.001	0.000	0.000	0.000	0.000
-10 to -5	0.390	0.322	0.181	0.078	0.029	0.010	0.004	0.001	0.000	0.000	0.000
-5 to 0	1.220	1.099	0.769	0.450	0.220	0.095	0.039	0.014	0.005	0.002	0.008
0 to 5	1.994	2.403	2.339	1.833	1.155	0.595	0.271	0.121	0.052	0.022	0.029
5 to 10	1.653	3.671	3.393	2.766	1.857	1.028	0.503	0.231	0.101	0.046	0.036
10 to 15	1.540	4.701	4.808	3.385	1.917	0.949	0.432	0.197	0.092	0.044	0.033
15 to 20	1.128	6.733	7.376	3.868	1.574	0.619	0.254	0.103	0.044	0.019	0.010
20 to 25	1.086	7.991	6.781	2.509	0.681	0.191	0.063	0.020	0.005	0.001	0.001
25 to 30	0.848	5.235	2.292	0.462	0.112	0.033	0.014	0.007	0.003	0.002	0.002
30 to 35	0.041	0.009	0.001	0.000	0.000	0.000	-	-	-	-	-
35 to 40	0.016	0.003	0.000	0.000	-	-	-	-	-	-	-
> 40	0.005	0.000	0.000	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
-35 to -30	0.014	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
-30 to -25	0.038	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043	0.043
-25 to -20	0.074	0.090	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092
-20 to -15	0.121	0.162	0.172	0.174	0.175	0.175	0.175	0.175	0.175	0.175	0.175
-15 to -10	0.210	0.326	0.369	0.382	0.386	0.387	0.388	0.388	0.388	0.388	0.388
-10 to -5	0.390	0.712	0.893	0.971	1.000	1.010	1.014	1.015	1.015	1.015	1.015
-5 to 0	1.220	2.319	3.088	3.538	3.758	3.853	3.892	3.906	3.911	3.913	3.921
0 to 5	1.994	4.397	6.736	8.569	9.724	10.319	10.590	10.711	10.763	10.785	10.814
5 to 10	1.653	5.324	8.717	11.483	13.340	14.368	14.871	15.102	15.203	15.249	15.285
10 to 15	1.540	6.241	11.049	14.434	16.351	17.300	17.732	17.929	18.021	18.065	18.098
15 to 20	1.128	7.861	15.237	19.105	20.679	21.298	21.552	21.655	21.699	21.718	21.728
20 to 25	1.086	9.077	15.858	18.367	19.048	19.239	19.302	19.322	19.327	19.328	19.329
25 to 30	0.848	6.083	8.375	8.837	8.949	8.982	8.996	9.003	9.006	9.008	9.010
30 to 35	0.041	0.050	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051
35 to 40	0.016	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
> 40	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005

Table 27: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the North Pacific (January–March). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.001	0.000	-	-	-	-	-	-	-	-	-
-40 to -35	0.007	0.000	0.000	-	-	-	-	-	-	-	-
-35 to -30	0.036	0.003	0.000	0.000	-	-	-	-	-	-	-
-30 to -25	0.099	0.011	0.001	0.000	0.000	-	-	-	-	-	-
-25 to -20	0.179	0.036	0.006	0.001	0.000	0.000	0.000	-	-	-	-
-20 to -15	0.260	0.102	0.027	0.008	0.002	0.001	0.000	0.000	0.000	0.000	-
-15 to -10	0.410	0.282	0.115	0.039	0.013	0.005	0.002	0.001	0.000	0.000	0.000
-10 to -5	0.665	0.730	0.460	0.215	0.089	0.032	0.013	0.004	0.001	0.000	0.000
-5 to 0	1.061	1.896	1.749	1.160	0.619	0.278	0.114	0.043	0.016	0.006	0.002
0 to 5	0.931	2.518	4.063	3.936	2.758	1.509	0.705	0.324	0.144	0.064	0.045
5 to 10	0.772	1.258	2.954	4.145	3.572	2.152	1.120	0.532	0.236	0.106	0.085
10 to 15	0.505	1.442	4.319	5.314	3.793	2.076	1.020	0.493	0.233	0.111	0.086
15 to 20	0.440	3.179	8.696	6.782	3.260	1.397	0.600	0.256	0.116	0.050	0.027
20 to 25	0.171	1.628	4.607	3.099	1.013	0.329	0.116	0.033	0.008	0.001	0.000
25 to 30	0.024	0.009	0.016	0.015	0.002	0.000	-	-	-	-	-
30 to 35	0.005	0.001	0.000	0.000	-	-	-	-	-	-	-
35 to 40	0.000	0.000	-	-	-	-	-	-	-	-	-
> 40	-	-	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
-40 to -35	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
-35 to -30	0.036	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
-30 to -25	0.099	0.110	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111	0.111
-25 to -20	0.179	0.215	0.221	0.222	0.222	0.222	0.222	0.222	0.222	0.222	0.222
-20 to -15	0.260	0.362	0.389	0.397	0.399	0.400	0.400	0.400	0.400	0.400	0.400
-15 to -10	0.410	0.692	0.807	0.846	0.859	0.864	0.866	0.867	0.867	0.867	0.867
-10 to -5	0.665	1.395	1.855	2.070	2.159	2.191	2.204	2.208	2.209	2.209	2.209
-5 to 0	1.061	2.957	4.706	5.866	6.485	6.763	6.877	6.920	6.936	6.942	6.944
0 to 5	0.931	3.449	7.512	11.448	14.206	15.715	16.420	16.744	16.888	16.952	16.997
5 to 10	0.772	2.030	4.984	9.129	12.701	14.853	15.973	16.505	16.741	16.847	16.932
10 to 15	0.505	1.947	6.266	11.580	15.373	17.449	18.469	18.962	19.195	19.306	19.392
15 to 20	0.440	3.619	12.315	19.097	22.357	23.754	24.354	24.610	24.726	24.776	24.803
20 to 25	0.171	1.799	6.406	9.505	10.518	10.847	10.963	10.996	11.004	11.005	11.005
25 to 30	0.024	0.033	0.049	0.064	0.066	0.066	0.066	0.066	0.066	0.066	0.066
30 to 35	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
35 to 40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
> 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Table 28: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the North Pacific (April–June). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	0.000	-	-	-	-	-	-	-	-	-	-
-35 to -30	0.000	-	-	-	-	-	-	-	-	-	-
-30 to -25	0.002	0.000	0.000	-	-	-	-	-	-	-	-
-25 to -20	0.009	0.000	0.000	-	-	-	-	-	-	-	-
-20 to -15	0.028	0.002	0.000	0.000	0.000	0.000	-	-	-	-	-
-15 to -10	0.078	0.011	0.002	0.001	0.000	0.000	0.000	-	-	-	-
-10 to -5	0.215	0.061	0.023	0.008	0.003	0.001	0.000	0.000	-	-	-
-5 to 0	1.362	0.748	0.324	0.146	0.055	0.021	0.009	0.004	0.001	0.000	0.000
0 to 5	3.408	4.281	2.854	1.603	0.776	0.296	0.111	0.047	0.019	0.006	0.002
5 to 10	2.387	6.756	5.311	2.888	1.258	0.459	0.163	0.061	0.024	0.008	0.002
10 to 15	1.454	6.011	6.119	2.803	0.918	0.275	0.080	0.026	0.011	0.005	0.002
15 to 20	1.509	10.108	8.631	2.368	0.492	0.099	0.022	0.005	0.002	0.000	0.000
20 to 25	1.279	10.254	6.184	1.043	0.150	0.023	0.003	0.001	0.000	0.000	0.000
25 to 30	0.497	2.962	0.678	0.054	0.009	0.003	0.001	0.001	0.000	0.000	0.000
30 to 35	0.045	0.008	0.002	0.000	-	-	-	-	-	-	-
35 to 40	0.019	0.003	0.000	-	-	-	-	-	-	-	-
> 40	0.005	0.000	0.000	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
-25 to -20	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.009
-20 to -15	0.028	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030
-15 to -10	0.078	0.089	0.091	0.092	0.092	0.092	0.092	0.092	0.092	0.092	0.092
-10 to -5	0.215	0.276	0.299	0.307	0.310	0.311	0.311	0.311	0.311	0.311	0.311
-5 to 0	1.362	2.110	2.434	2.580	2.635	2.656	2.665	2.669	2.670	2.670	2.670
0 to 5	3.408	7.689	10.543	12.146	12.922	13.218	13.329	13.376	13.395	13.401	13.403
5 to 10	2.387	9.143	14.454	17.342	18.600	19.059	19.222	19.283	19.307	19.315	19.317
10 to 15	1.454	7.465	13.584	16.387	17.305	17.580	17.660	17.686	17.697	17.702	17.704
15 to 20	1.509	11.617	20.248	22.616	23.108	23.207	23.229	23.234	23.236	23.236	23.236
20 to 25	1.279	11.533	17.717	18.760	18.910	18.933	18.936	18.937	18.937	18.937	18.937
25 to 30	0.497	3.459	4.137	4.191	4.200	4.203	4.204	4.205	4.205	4.205	4.205
30 to 35	0.045	0.053	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055
35 to 40	0.019	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022
> 40	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005

Table 29: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the North Pacific (July–September). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	-	-	-	-	-	-	-	-	-	-	-
-30 to -25	0.000	-	-	-	-	-	-	-	-	-	-
-25 to -20	0.001	0.000	-	-	-	-	-	-	-	-	-
-20 to -15	0.004	0.000	0.000	0.000	0.000	-	-	-	-	-	-
-15 to -10	0.014	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-	-
-10 to -5	0.077	0.009	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-5 to 0	1.389	0.377	0.050	0.008	0.002	0.002	0.002	0.002	0.002	0.001	0.011
0 to 5	2.786	0.861	0.152	0.032	0.010	0.006	0.005	0.004	0.004	0.004	0.044
5 to 10	2.605	4.004	1.505	0.487	0.158	0.055	0.017	0.008	0.004	0.002	0.005
10 to 15	3.278	8.985	5.058	1.765	0.592	0.200	0.069	0.024	0.009	0.004	0.002
15 to 20	1.617	9.728	5.183	1.322	0.315	0.091	0.031	0.012	0.006	0.002	0.001
20 to 25	2.184	14.593	6.062	0.983	0.181	0.048	0.016	0.005	0.002	0.001	0.001
25 to 30	2.543	13.967	4.858	0.917	0.265	0.099	0.045	0.023	0.011	0.006	0.006
30 to 35	0.091	0.021	0.003	0.001	0.000	0.000	-	-	-	-	-
35 to 40	0.041	0.008	0.000	-	-	-	-	-	-	-	-
> 40	0.013	0.001	0.000	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
-20 to -15	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
-15 to -10	0.014	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
-10 to -5	0.077	0.086	0.087	0.087	0.087	0.087	0.087	0.087	0.087	0.087	0.087
-5 to 0	1.389	1.766	1.816	1.824	1.826	1.828	1.830	1.832	1.834	1.835	1.846
0 to 5	2.786	3.647	3.799	3.831	3.841	3.847	3.852	3.856	3.860	3.864	3.908
5 to 10	2.605	6.609	8.114	8.601	8.759	8.814	8.831	8.839	8.843	8.845	8.850
10 to 15	3.278	12.263	17.321	19.086	19.678	19.878	19.947	19.971	19.980	19.984	19.986
15 to 20	1.617	11.345	16.528	17.850	18.165	18.256	18.287	18.299	18.305	18.307	18.308
20 to 25	2.184	16.777	22.839	23.822	24.003	24.051	24.067	24.072	24.074	24.075	24.076
25 to 30	2.543	16.510	21.368	22.285	22.550	22.649	22.694	22.717	22.728	22.734	22.740
30 to 35	0.091	0.112	0.115	0.116	0.116	0.116	0.116	0.116	0.116	0.116	0.116
35 to 40	0.041	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049	0.049
> 40	0.013	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014

Table 30: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the North Pacific (October–December). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.001	0.000	-	-	-	-	-	-	-	-	-
-40 to -35	0.007	0.000	-	-	-	-	-	-	-	-	-
-35 to -30	0.023	0.002	0.000	0.000	0.000	-	-	-	-	-	-
-30 to -25	0.055	0.008	0.000	0.000	0.000	-	-	-	-	-	-
-25 to -20	0.115	0.029	0.003	0.001	0.000	0.000	-	-	-	-	-
-20 to -15	0.203	0.067	0.013	0.002	0.000	0.000	0.000	0.000	0.000	0.000	-
-15 to -10	0.356	0.181	0.060	0.016	0.004	0.001	0.000	0.000	0.000	0.000	0.000
-10 to -5	0.630	0.521	0.262	0.100	0.030	0.009	0.003	0.001	0.000	0.000	0.000
-5 to 0	1.055	1.450	1.034	0.542	0.234	0.095	0.039	0.011	0.004	0.003	0.020
0 to 5	0.792	2.092	2.516	1.974	1.223	0.646	0.299	0.126	0.047	0.019	0.025
5 to 10	0.771	2.592	3.924	3.741	2.612	1.545	0.764	0.346	0.152	0.072	0.057
10 to 15	0.770	1.998	3.736	3.839	2.515	1.332	0.604	0.267	0.127	0.061	0.045
15 to 20	0.892	3.659	7.224	5.259	2.362	0.946	0.387	0.151	0.059	0.024	0.014
20 to 25	0.605	4.842	10.141	4.969	1.407	0.375	0.121	0.040	0.011	0.004	0.002
25 to 30	0.185	3.183	3.297	0.799	0.154	0.025	0.006	0.002	0.001	0.000	0.000
30 to 35	0.021	0.004	0.000	0.000	0.000	-	-	-	-	-	-
35 to 40	0.003	0.000	0.000	0.000	-	-	-	-	-	-	-
> 40	-	-	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
-40 to -35	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
-35 to -30	0.023	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
-30 to -25	0.055	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063	0.063
-25 to -20	0.115	0.144	0.147	0.148	0.148	0.148	0.148	0.148	0.148	0.148	0.148
-20 to -15	0.203	0.270	0.283	0.285	0.285	0.285	0.285	0.285	0.285	0.285	0.285
-15 to -10	0.356	0.537	0.597	0.613	0.617	0.618	0.618	0.618	0.618	0.618	0.618
-10 to -5	0.630	1.151	1.413	1.513	1.543	1.552	1.555	1.556	1.556	1.556	1.556
-5 to 0	1.055	2.505	3.539	4.081	4.315	4.410	4.449	4.460	4.464	4.467	4.487
0 to 5	0.792	2.884	5.400	7.374	8.597	9.243	9.542	9.668	9.715	9.734	9.759
5 to 10	0.771	3.363	7.287	11.028	13.640	15.185	15.949	16.295	16.447	16.519	16.576
10 to 15	0.770	2.768	6.504	10.343	12.858	14.190	14.794	15.061	15.188	15.249	15.294
15 to 20	0.892	4.551	11.775	17.034	19.396	20.342	20.729	20.880	20.939	20.963	20.977
20 to 25	0.605	5.447	15.588	20.557	21.964	22.339	22.460	22.500	22.511	22.515	22.517
25 to 30	0.185	3.368	6.665	7.464	7.618	7.643	7.649	7.651	7.652	7.652	7.652
30 to 35	0.021	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
35 to 40	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
> 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

### 3.2.7 Tropical Pacific

Table 31: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the tropical Pacific on an annual basis. Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	-	-	-	-	-	-	-	-	-	-	-
-30 to -25	-	-	-	-	-	-	-	-	-	-	-
-25 to -20	-	-	-	-	-	-	-	-	-	-	-
-20 to -15	-	0.000	0.000	-	-	-	-	-	-	-	-
-15 to -10	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-
-10 to -5	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-
-5 to 0	0.000	0.001	0.001	0.000	0.000	-	-	-	-	-	-
0 to 5	0.000	0.005	0.005	0.001	0.000	0.000	-	-	-	-	-
5 to 10	0.001	0.018	0.017	0.003	0.000	0.000	-	-	-	-	-
10 to 15	0.012	0.067	0.092	0.034	0.007	0.000	0.000	-	-	-	-
15 to 20	0.105	1.081	2.409	1.092	0.228	0.033	0.006	0.001	0.001	0.000	0.000
20 to 25	0.926	7.186	14.264	4.562	0.694	0.095	0.015	0.003	0.001	0.000	0.000
25 to 30	7.588	29.502	25.418	3.862	0.401	0.049	0.012	0.005	0.002	0.001	0.001
30 to 35	0.109	0.053	0.011	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000
35 to 40	0.010	0.001	0.000	0.000	-	-	-	-	-	-	-
> 40	0.002	0.000	0.000	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20 to -15	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-15 to -10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-10 to -5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-5 to 0	0.000	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
0 to 5	0.000	0.005	0.010	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
5 to 10	0.001	0.019	0.036	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
10 to 15	0.012	0.079	0.171	0.205	0.212	0.212	0.212	0.212	0.212	0.212	0.212
15 to 20	0.105	1.186	3.595	4.687	4.915	4.948	4.954	4.955	4.956	4.956	4.956
20 to 25	0.926	8.112	22.376	26.938	27.632	27.727	27.742	27.745	27.746	27.746	27.746
25 to 30	7.588	37.090	62.508	66.370	66.771	66.820	66.832	66.837	66.839	66.840	66.841
30 to 35	0.109	0.162	0.173	0.176	0.177	0.177	0.177	0.177	0.177	0.177	0.177
35 to 40	0.010	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
> 40	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002

Table 32: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the tropical Pacific (January–March). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	-	-	-	-	-	-	-	-	-	-	-
-30 to -25	-	-	-	-	-	-	-	-	-	-	-
-25 to -20	-	-	-	-	-	-	-	-	-	-	-
-20 to -15	-	-	-	-	-	-	-	-	-	-	-
-15 to -10	-	0.000	-	-	-	-	-	-	-	-	-
-10 to -5	-	0.000	0.000	-	-	-	-	-	-	-	-
-5 to 0	-	0.000	0.000	-	-	-	-	-	-	-	-
0 to 5	0.000	0.005	0.002	0.000	-	-	-	-	-	-	-
5 to 10	0.003	0.021	0.009	0.001	0.000	0.000	-	-	-	-	-
10 to 15	0.017	0.049	0.037	0.011	0.002	0.000	0.000	-	-	-	-
15 to 20	0.142	0.807	1.758	0.725	0.157	0.043	0.011	0.004	0.002	0.000	0.000
20 to 25	1.035	6.277	15.879	5.459	0.947	0.155	0.031	0.007	0.001	0.000	0.000
25 to 30	5.367	23.783	29.637	6.566	0.776	0.081	0.015	0.006	0.003	0.002	0.002
30 to 35	0.075	0.056	0.017	0.005	0.001	0.000	0.000	0.000	-	-	-
35 to 40	0.006	0.002	0.000	0.000	-	-	-	-	-	-	-
> 40	0.003	0.001	0.000	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20 to -15	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-15 to -10	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-10 to -5	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-5 to 0	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0 to 5	0.000	0.005	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
5 to 10	0.003	0.024	0.033	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034
10 to 15	0.017	0.066	0.103	0.114	0.116	0.116	0.116	0.116	0.116	0.116	0.116
15 to 20	0.142	0.949	2.707	3.432	3.589	3.632	3.643	3.647	3.649	3.649	3.649
20 to 25	1.035	7.312	23.191	28.650	29.597	29.752	29.783	29.790	29.791	29.791	29.791
25 to 30	5.367	29.150	58.787	65.353	66.129	66.210	66.225	66.231	66.234	66.236	66.238
30 to 35	0.075	0.131	0.148	0.153	0.154	0.154	0.154	0.154	0.154	0.154	0.154
35 to 40	0.006	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
> 40	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004

Table 33: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the tropical Pacific (April–June). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	-	-	-	-	-	-	-	-	-	-	-
-30 to -25	-	-	-	-	-	-	-	-	-	-	-
-25 to -20	-	-	-	-	-	-	-	-	-	-	-
-20 to -15	-	0.000	-	-	-	-	-	-	-	-	-
-15 to -10	-	0.000	0.000	0.000	-	-	-	-	-	-	-
-10 to -5	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-
-5 to 0	-	0.001	0.001	0.000	-	-	-	-	-	-	-
0 to 5	0.000	0.004	0.006	0.001	0.000	-	-	-	-	-	-
5 to 10	0.001	0.015	0.021	0.004	0.000	-	-	-	-	-	-
10 to 15	0.010	0.046	0.067	0.017	0.002	0.000	-	-	-	-	-
15 to 20	0.091	1.070	1.728	0.694	0.165	0.028	0.003	0.000	0.000	-	-
20 to 25	0.894	6.123	12.181	4.215	0.727	0.086	0.008	0.001	0.000	0.000	0.000
25 to 30	8.259	33.181	26.668	3.274	0.223	0.018	0.003	0.002	0.001	0.000	0.000
30 to 35	0.085	0.058	0.008	0.001	0.000	0.000	0.000	0.000	0.000	-	-
35 to 40	0.005	0.000	0.000	-	-	-	-	-	-	-	-
> 40	0.000	-	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20 to -15	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-15 to -10	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-10 to -5	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-5 to 0	-	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
0 to 5	0.000	0.004	0.010	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
5 to 10	0.001	0.016	0.037	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041
10 to 15	0.010	0.056	0.123	0.140	0.142	0.142	0.142	0.142	0.142	0.142	0.142
15 to 20	0.091	1.161	2.889	3.583	3.748	3.776	3.779	3.779	3.779	3.779	3.779
20 to 25	0.894	7.017	19.198	23.413	24.140	24.226	24.234	24.235	24.235	24.235	24.235
25 to 30	8.259	41.440	68.108	71.382	71.605	71.623	71.626	71.628	71.629	71.629	71.629
30 to 35	0.085	0.143	0.151	0.152	0.152	0.152	0.152	0.152	0.152	0.152	0.152
35 to 40	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
> 40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 34: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the tropical Pacific (July–September). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	-	-	-	-	-	-	-	-	-	-	-
-30 to -25	-	-	-	-	-	-	-	-	-	-	-
-25 to -20	-	-	-	-	-	-	-	-	-	-	-
-20 to -15	-	0.000	0.000	-	-	-	-	-	-	-	-
-15 to -10	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-
-10 to -5	-	0.001	0.001	0.000	0.000	-	-	-	-	-	-
-5 to 0	0.000	0.001	0.002	0.000	0.000	-	-	-	-	-	-
0 to 5	0.000	0.004	0.008	0.002	0.000	0.000	-	-	-	-	-
5 to 10	0.001	0.017	0.026	0.007	0.000	0.000	-	-	-	-	-
10 to 15	0.013	0.067	0.157	0.084	0.022	0.001	0.000	-	-	-	-
15 to 20	0.102	0.924	2.820	2.050	0.507	0.056	0.007	0.001	0.000	0.000	-
20 to 25	0.941	7.413	12.913	5.013	0.642	0.067	0.007	0.001	0.000	0.000	-
25 to 30	8.902	32.334	22.480	1.941	0.191	0.046	0.020	0.010	0.005	0.003	0.002
30 to 35	0.111	0.050	0.011	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000
35 to 40	0.007	0.000	-	-	-	-	-	-	-	-	-
> 40	0.000	-	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20 to -15	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-15 to -10	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-10 to -5	-	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
-5 to 0	0.000	0.001	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
0 to 5	0.000	0.004	0.012	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014
5 to 10	0.001	0.018	0.044	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051
10 to 15	0.013	0.080	0.237	0.321	0.343	0.344	0.344	0.344	0.344	0.344	0.344
15 to 20	0.102	1.026	3.846	5.896	6.403	6.459	6.466	6.467	6.467	6.467	6.467
20 to 25	0.941	8.354	21.267	26.280	26.922	26.989	26.996	26.997	26.997	26.997	26.997
25 to 30	8.902	41.236	63.716	65.657	65.848	65.894	65.914	65.924	65.929	65.932	65.934
30 to 35	0.111	0.161	0.172	0.176	0.177	0.177	0.177	0.177	0.177	0.177	0.177
35 to 40	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
> 40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 35: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the tropical Pacific (October–December). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	-	-	-	-	-	-	-	-	-	-	-
-40 to -35	-	-	-	-	-	-	-	-	-	-	-
-35 to -30	-	-	-	-	-	-	-	-	-	-	-
-30 to -25	-	-	-	-	-	-	-	-	-	-	-
-25 to -20	-	-	-	-	-	-	-	-	-	-	-
-20 to -15	-	-	-	-	-	-	-	-	-	-	-
-15 to -10	-	0.000	-	-	-	-	-	-	-	-	-
-10 to -5	-	0.000	0.000	-	-	-	-	-	-	-	-
-5 to 0	0.000	0.001	0.000	0.000	-	-	-	-	-	-	-
0 to 5	0.000	0.005	0.005	0.000	0.000	-	-	-	-	-	-
5 to 10	0.001	0.018	0.014	0.001	0.000	0.000	-	-	-	-	-
10 to 15	0.010	0.103	0.106	0.022	0.002	0.000	-	-	-	-	-
15 to 20	0.087	1.517	3.307	0.889	0.083	0.005	0.001	0.000	0.000	-	-
20 to 25	0.836	8.903	16.095	3.574	0.467	0.071	0.016	0.004	0.001	0.000	0.000
25 to 30	7.788	28.634	22.984	3.715	0.419	0.053	0.011	0.003	0.001	0.000	0.000
30 to 35	0.163	0.047	0.006	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35 to 40	0.023	0.001	0.000	0.000	-	-	-	-	-	-	-
> 40	0.005	0.001	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-30 to -25	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-25 to -20	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-20 to -15	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-15 to -10	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-10 to -5	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-5 to 0	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
0 to 5	0.000	0.005	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
5 to 10	0.001	0.019	0.033	0.034	0.034	0.034	0.034	0.034	0.034	0.034	0.034
10 to 15	0.010	0.113	0.219	0.241	0.243	0.243	0.243	0.243	0.243	0.243	0.243
15 to 20	0.087	1.604	4.911	5.800	5.883	5.888	5.889	5.889	5.889	5.889	5.889
20 to 25	0.836	9.739	25.834	29.408	29.875	29.946	29.962	29.966	29.967	29.967	29.967
25 to 30	7.788	36.422	59.406	63.121	63.540	63.593	63.604	63.607	63.608	63.608	63.608
30 to 35	0.163	0.210	0.216	0.216	0.216	0.216	0.216	0.216	0.216	0.216	0.216
35 to 40	0.023	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
> 40	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006



### 3.2.8 South Pacific

Table 36: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the South Pacific on an annual basis. Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.002	0.000	0.000	0.000	-	-	-	-	-	-	-
-40 to -35	0.003	0.001	0.000	0.000	0.000	0.000	-	-	-	-	-
-35 to -30	0.009	0.003	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-
-30 to -25	0.020	0.009	0.003	0.001	0.000	0.000	0.000	0.000	0.000	-	-
-25 to -20	0.033	0.019	0.008	0.004	0.002	0.001	0.000	0.000	0.000	0.000	0.000
-20 to -15	0.053	0.041	0.023	0.013	0.006	0.002	0.001	0.000	0.000	0.000	0.000
-15 to -10	0.086	0.081	0.061	0.040	0.021	0.010	0.004	0.002	0.001	0.000	0.000
-10 to -5	0.161	0.165	0.166	0.132	0.079	0.043	0.020	0.008	0.003	0.001	0.001
-5 to 0	0.740	0.887	1.259	1.162	0.783	0.437	0.221	0.099	0.042	0.017	0.010
0 to 5	0.167	0.531	2.519	3.944	3.350	2.121	1.114	0.518	0.224	0.093	0.054
5 to 10	0.081	0.392	2.943	5.590	5.224	3.284	1.649	0.755	0.314	0.122	0.067
10 to 15	0.143	1.181	5.452	6.822	4.466	2.118	0.857	0.318	0.110	0.039	0.019
15 to 20	0.141	2.854	8.428	6.246	2.502	0.787	0.237	0.065	0.018	0.004	0.001
20 to 25	0.062	2.791	6.780	3.101	0.751	0.145	0.025	0.005	0.001	0.000	0.000
25 to 30	0.012	0.420	0.774	0.213	0.033	0.006	0.001	0.001	0.000	0.000	0.000
30 to 35	0.002	0.004	0.002	0.000	0.000	-	-	-	-	-	-
35 to 40	0.000	0.001	0.000	0.000	0.000	-	-	-	-	-	-
> 40	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
-40 to -35	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
-35 to -30	0.009	0.012	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
-30 to -25	0.020	0.029	0.032	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033
-25 to -20	0.033	0.052	0.060	0.064	0.066	0.067	0.067	0.067	0.067	0.067	0.067
-20 to -15	0.053	0.094	0.117	0.130	0.136	0.138	0.139	0.139	0.139	0.139	0.139
-15 to -10	0.086	0.167	0.228	0.268	0.289	0.299	0.303	0.305	0.306	0.306	0.306
-10 to -5	0.161	0.326	0.492	0.624	0.703	0.746	0.766	0.774	0.777	0.778	0.779
-5 to 0	0.740	1.627	2.886	4.048	4.831	5.268	5.489	5.588	5.630	5.647	5.657
0 to 5	0.167	0.698	3.217	7.161	10.511	12.632	13.746	14.264	14.488	14.581	14.635
5 to 10	0.081	0.473	3.416	9.006	14.230	17.514	19.163	19.918	20.232	20.354	20.421
10 to 15	0.143	1.324	6.776	13.598	18.064	20.182	21.039	21.357	21.467	21.506	21.525
15 to 20	0.141	2.995	11.423	17.669	20.171	20.958	21.195	21.260	21.278	21.282	21.283
20 to 25	0.062	2.853	9.633	12.734	13.485	13.630	13.655	13.660	13.661	13.661	13.661
25 to 30	0.012	0.432	1.206	1.419	1.452	1.458	1.459	1.460	1.460	1.460	1.460
30 to 35	0.002	0.006	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008	0.008
35 to 40	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
> 40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 37: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the South Pacific (January–March). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.000	0.000	-	-	-	-	-	-	-	-	-
-40 to -35	0.001	0.000	-	-	-	-	-	-	-	-	-
-35 to -30	0.003	0.000	0.000	-	-	-	-	-	-	-	-
-30 to -25	0.008	0.002	0.000	0.000	-	-	-	-	-	-	-
-25 to -20	0.018	0.006	0.001	0.000	0.000	-	-	-	-	-	-
-20 to -15	0.040	0.018	0.006	0.002	0.000	0.000	0.000	0.000	-	-	-
-15 to -10	0.083	0.045	0.018	0.007	0.002	0.001	0.000	0.000	0.000	-	-
-10 to -5	0.187	0.140	0.086	0.036	0.012	0.004	0.001	0.000	0.000	0.000	-
-5 to 0	1.163	1.506	1.726	0.983	0.379	0.125	0.043	0.015	0.006	0.002	0.001
0 to 5	0.185	0.855	3.851	4.634	2.825	1.283	0.526	0.223	0.087	0.031	0.016
5 to 10	0.063	0.275	2.504	4.726	4.174	2.379	1.056	0.458	0.187	0.071	0.033
10 to 15	0.083	0.708	4.406	5.691	3.674	1.670	0.650	0.226	0.068	0.018	0.010
15 to 20	0.169	2.601	7.926	5.465	1.923	0.548	0.148	0.032	0.007	0.002	0.002
20 to 25	0.095	4.715	11.721	4.645	0.869	0.157	0.033	0.009	0.003	0.001	0.001
25 to 30	0.027	1.272	2.524	0.647	0.085	0.016	0.005	0.002	0.001	0.000	0.000
30 to 35	0.004	0.011	0.006	0.001	0.000	-	-	-	-	-	-
35 to 40	0.001	0.001	0.001	0.000	0.000	-	-	-	-	-	-
> 40	0.000	0.000	0.000	0.000	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
-35 to -30	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
-30 to -25	0.008	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
-25 to -20	0.018	0.024	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
-20 to -15	0.040	0.058	0.064	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066
-15 to -10	0.083	0.128	0.146	0.153	0.155	0.156	0.156	0.156	0.156	0.156	0.156
-10 to -5	0.187	0.327	0.413	0.449	0.461	0.465	0.466	0.466	0.466	0.466	0.466
-5 to 0	1.163	2.669	4.395	5.378	5.757	5.882	5.925	5.940	5.946	5.948	5.949
0 to 5	0.185	1.040	4.891	9.525	12.350	13.633	14.159	14.382	14.469	14.500	14.516
5 to 10	0.063	0.338	2.842	7.568	11.742	14.121	15.177	15.635	15.822	15.893	15.926
10 to 15	0.083	0.791	5.197	10.888	14.562	16.232	16.882	17.108	17.176	17.194	17.204
15 to 20	0.169	2.770	10.696	16.161	18.084	18.632	18.780	18.812	18.819	18.821	18.823
20 to 25	0.095	4.810	16.531	21.176	22.045	22.202	22.235	22.244	22.247	22.248	22.249
25 to 30	0.027	1.299	3.823	4.470	4.555	4.571	4.576	4.578	4.579	4.579	4.579
30 to 35	0.004	0.015	0.021	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022
35 to 40	0.001	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
> 40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 38: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the South Pacific (April–June). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.004	0.001	0.000	-	-	-	-	-	-	-	-
-40 to -35	0.008	0.002	0.000	0.000	0.000	0.000	-	-	-	-	-
-35 to -30	0.021	0.006	0.001	0.001	0.000	0.000	0.000	-	-	-	-
-30 to -25	0.039	0.015	0.004	0.002	0.001	0.000	0.000	0.000	-	-	-
-25 to -20	0.060	0.033	0.015	0.007	0.003	0.001	0.000	0.000	0.000	0.000	-
-20 to -15	0.082	0.072	0.046	0.026	0.010	0.004	0.002	0.001	0.000	0.000	0.000
-15 to -10	0.101	0.127	0.113	0.079	0.039	0.016	0.007	0.003	0.001	0.000	0.000
-10 to -5	0.119	0.208	0.277	0.237	0.139	0.070	0.032	0.012	0.004	0.002	0.001
-5 to 0	0.116	0.343	0.966	1.366	1.083	0.626	0.329	0.150	0.063	0.026	0.014
0 to 5	0.054	0.218	1.494	3.529	3.701	2.615	1.468	0.722	0.318	0.135	0.077
5 to 10	0.080	0.326	2.210	4.812	5.115	3.553	1.966	0.968	0.411	0.169	0.109
10 to 15	0.152	0.814	4.023	6.403	4.984	2.735	1.251	0.520	0.197	0.078	0.038
15 to 20	0.127	1.792	6.879	7.400	3.877	1.445	0.483	0.136	0.037	0.007	0.001
20 to 25	0.037	1.703	6.440	4.542	1.547	0.317	0.053	0.007	0.000	0.000	-
25 to 30	0.002	0.208	0.372	0.163	0.040	0.006	0.001	0.000	-	-	-
30 to 35	0.000	0.000	0.000	-	-	-	-	-	-	-	-
35 to 40	-	0.000	-	-	-	-	-	-	-	-	-
> 40	-	-	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.004	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
-40 to -35	0.008	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
-35 to -30	0.021	0.027	0.028	0.029	0.029	0.029	0.029	0.029	0.029	0.029	0.029
-30 to -25	0.039	0.054	0.058	0.060	0.061	0.061	0.061	0.061	0.061	0.061	0.061
-25 to -20	0.060	0.093	0.108	0.115	0.118	0.119	0.119	0.119	0.119	0.119	0.119
-20 to -15	0.082	0.154	0.200	0.226	0.236	0.240	0.242	0.243	0.243	0.243	0.243
-15 to -10	0.101	0.228	0.341	0.420	0.459	0.475	0.482	0.485	0.486	0.486	0.486
-10 to -5	0.119	0.327	0.604	0.841	0.980	1.050	1.082	1.094	1.098	1.100	1.101
-5 to 0	0.116	0.459	1.425	2.791	3.874	4.500	4.829	4.979	5.042	5.068	5.082
0 to 5	0.054	0.272	1.766	5.295	8.996	11.611	13.079	13.801	14.119	14.254	14.331
5 to 10	0.080	0.406	2.616	7.428	12.543	16.096	18.062	19.030	19.441	19.610	19.719
10 to 15	0.152	0.966	4.989	11.392	16.376	19.111	20.362	20.882	21.079	21.157	21.195
15 to 20	0.127	1.919	8.798	16.198	20.075	21.520	22.003	22.139	22.176	22.183	22.184
20 to 25	0.037	1.740	8.180	12.722	14.269	14.586	14.639	14.646	14.646	14.646	14.646
25 to 30	0.002	0.210	0.582	0.745	0.785	0.791	0.792	0.792	0.792	0.792	0.792
30 to 35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35 to 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
> 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 39: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the South Pacific (July–September). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.002	0.001	0.000	0.000	-	-	-	-	-	-	-
-40 to -35	0.005	0.002	0.000	0.000	0.000	0.000	-	-	-	-	-
-35 to -30	0.013	0.007	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-
-30 to -25	0.028	0.018	0.006	0.002	0.001	0.000	0.000	0.000	0.000	-	-
-25 to -20	0.045	0.037	0.015	0.007	0.004	0.002	0.001	0.000	0.000	0.000	0.000
-20 to -15	0.066	0.069	0.042	0.023	0.013	0.006	0.002	0.001	0.000	0.000	0.000
-15 to -10	0.098	0.127	0.104	0.070	0.042	0.023	0.010	0.004	0.001	0.000	0.000
-10 to -5	0.134	0.208	0.240	0.216	0.148	0.090	0.045	0.019	0.007	0.003	0.002
-5 to 0	0.214	0.494	0.923	1.161	0.985	0.648	0.367	0.176	0.078	0.033	0.021
0 to 5	0.111	0.453	2.132	3.691	3.597	2.667	1.519	0.733	0.328	0.138	0.091
5 to 10	0.100	0.516	3.569	6.536	6.322	4.268	2.267	1.039	0.444	0.172	0.098
10 to 15	0.189	1.433	5.751	7.957	5.547	2.750	1.130	0.415	0.150	0.054	0.026
15 to 20	0.084	2.309	8.107	6.867	2.923	0.931	0.273	0.084	0.026	0.008	0.003
20 to 25	0.034	0.720	2.391	1.487	0.357	0.072	0.011	0.002	0.000	0.000	-
25 to 30	0.001	0.002	0.001	0.000	0.000	0.000	-	-	-	-	-
30 to 35	0.000	0.000	0.000	0.000	0.000	-	-	-	-	-	-
35 to 40	-	-	-	-	-	-	-	-	-	-	-
> 40	-	-	-	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.002	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
-40 to -35	0.005	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
-35 to -30	0.013	0.020	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022
-30 to -25	0.028	0.046	0.052	0.054	0.055	0.055	0.055	0.055	0.055	0.055	0.055
-25 to -20	0.045	0.082	0.097	0.104	0.108	0.110	0.111	0.111	0.111	0.111	0.111
-20 to -15	0.066	0.135	0.177	0.200	0.213	0.219	0.221	0.222	0.222	0.222	0.222
-15 to -10	0.098	0.225	0.329	0.399	0.441	0.464	0.474	0.478	0.479	0.479	0.479
-10 to -5	0.134	0.342	0.582	0.798	0.946	1.036	1.081	1.100	1.107	1.110	1.112
-5 to 0	0.214	0.708	1.631	2.792	3.777	4.425	4.792	4.968	5.046	5.079	5.100
0 to 5	0.111	0.564	2.696	6.387	9.984	12.651	14.170	14.903	15.231	15.369	15.460
5 to 10	0.100	0.616	4.185	10.721	17.043	21.311	23.578	24.617	25.061	25.233	25.331
10 to 15	0.189	1.622	7.373	15.330	20.877	23.627	24.757	25.172	25.322	25.376	25.402
15 to 20	0.084	2.393	10.500	17.367	20.290	21.221	21.494	21.578	21.604	21.612	21.615
20 to 25	0.034	0.754	3.145	4.632	4.989	5.061	5.072	5.074	5.074	5.074	5.074
25 to 30	0.001	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
30 to 35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
35 to 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
> 40	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 40: Percentage frequency of occurrence (top) and cumulative frequency with respect to wave height (bottom) for temperature and significant wave height observations in the South Pacific (October–December). Dashes indicate where no such conditions were observed (zero observations are those eliminated due to round-off).

Frequency of occurrence (%) Temperature (°C)	Significant wave height (m)										
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
< -40	0.000	-	-	-	-	-	-	-	-	-	-
-40 to -35	0.000	0.000	-	-	-	-	-	-	-	-	-
-35 to -30	0.001	0.000	0.000	-	-	-	-	-	-	-	-
-30 to -25	0.003	0.001	0.000	0.000	-	-	-	-	-	-	-
-25 to -20	0.011	0.002	0.000	0.000	0.000	0.000	0.000	-	-	-	-
-20 to -15	0.026	0.007	0.002	0.001	0.000	0.000	0.000	-	-	-	-
-15 to -10	0.064	0.026	0.011	0.006	0.004	0.001	0.000	0.000	0.000	0.000	0.000
-10 to -5	0.200	0.106	0.068	0.047	0.024	0.011	0.005	0.003	0.001	0.000	0.000
-5 to 0	1.436	1.168	1.393	1.145	0.710	0.367	0.157	0.061	0.024	0.010	0.005
0 to 5	0.316	0.584	2.532	3.885	3.309	1.968	0.978	0.414	0.172	0.071	0.035
5 to 10	0.084	0.459	3.528	6.355	5.361	3.004	1.347	0.573	0.225	0.079	0.032
10 to 15	0.151	1.798	7.693	7.320	3.719	1.351	0.413	0.117	0.030	0.008	0.003
15 to 20	0.179	4.716	10.822	5.299	1.314	0.237	0.047	0.009	0.001	0.000	0.000
20 to 25	0.081	3.891	6.231	1.611	0.212	0.029	0.004	0.000	-	-	-
25 to 30	0.019	0.150	0.099	0.015	0.002	0.000	0.000	-	-	-	-
30 to 35	0.002	0.006	0.003	0.000	0.000	-	-	-	-	-	-
35 to 40	0.000	0.001	0.000	0.000	0.000	-	-	-	-	-	-
> 40	0.000	0.000	0.000	-	-	-	-	-	-	-	-

Cumulative frequency (%) Temperature (°C)	Up to significant wave height (m)										
	1	2	3	4	5	6	7	8	9	10	all
< -40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-40 to -35	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-35 to -30	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
-30 to -25	0.003	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004
-25 to -20	0.011	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
-20 to -15	0.026	0.033	0.035	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036
-15 to -10	0.064	0.090	0.101	0.107	0.111	0.112	0.112	0.112	0.112	0.112	0.112
-10 to -5	0.200	0.306	0.374	0.421	0.445	0.456	0.461	0.464	0.465	0.465	0.465
-5 to 0	1.436	2.604	3.997	5.142	5.852	6.219	6.376	6.437	6.461	6.471	6.476
0 to 5	0.316	0.900	3.432	7.317	10.626	12.594	13.572	13.986	14.158	14.229	14.264
5 to 10	0.084	0.543	4.071	10.426	15.787	18.791	20.138	20.711	20.936	21.015	21.047
10 to 15	0.151	1.949	9.642	16.962	20.681	22.032	22.445	22.562	22.592	22.600	22.603
15 to 20	0.179	4.895	15.717	21.016	22.330	22.567	22.614	22.623	22.624	22.624	22.624
20 to 25	0.081	3.972	10.203	11.814	12.026	12.055	12.059	12.059	12.059	12.059	12.059
25 to 30	0.019	0.169	0.268	0.283	0.285	0.285	0.285	0.285	0.285	0.285	0.285
30 to 35	0.002	0.008	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011	0.011
35 to 40	0.000	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
> 40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

## 4 Conclusions

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Tables of joint frequency of occurrence for significant wave height and temperature have been generated for various areas of the world's oceans. Unsurprisingly, extreme combinations of temperature and wave height are rare – nevertheless, they do occur. Hopefully this data will assist in determining when, where, and how often these extreme events occur, and provide valuable information for determining the requirements for operating the CH148 Maritime Helicopter in all environments.

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In response to a request by the Project Management Office for the Maritime Helicopter Project (MHP), DRDC Atlantic has evaluated the frequency of occurrence of combinations of significant wave height and temperature in ocean areas of interest. A set of tables showing these frequencies, both annually and seasonally, has been provided for eight ocean regions.

En réponse à une demande du Bureau de gestion de projet (BGP) du Projet d'hélicoptère maritime (PHM), RDDC Atlantique a évalué la fréquence d'occurrence simultanée de grandes hauteurs de vague et de températures extrêmes dans des secteurs océaniques d'intérêt. Un ensemble de tables montrant ces fréquences sur une base annuelle et sur une base saisonnière a été fourni pour huit régions océaniques du monde.

14. **KEYWORDS, DESCRIPTORS or IDENTIFIERS** (Technically meaningful terms or short phrases that characterize a document and could be helpful in cataloguing the document. They should be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location may also be included. If possible keywords should be selected from a published thesaurus, e.g. Thesaurus of Engineering and Scientific Terms (TEST) and that thesaurus identified. If it is not possible to select indexing terms which are Unclassified, the classification of each should be indicated as with the title.)

Temperature-wave height statistics