Cospas Sarsat satellite system

HANDBOOK ON DISTRESS ALERT MESSAGES FOR RESCUE COORDINATION CENTRES (RCCs), SEARCH AND RESCUE POINTS OF CONTACT (SPOCs) AND IMO SHIP SECURITY COMPETENT AUTHORITIES

C/S G.007
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COSPAS SARSAT

1. INTRODUCTION

1.1 Overview

Cospas-Sarsat is a satellite system designed to provide distress alert and location data to assist search and rescue (SAR) authorities, using spacecraft and ground facilities to detect and locate the signals of distress beacons operating on 406 megahertz (MHz). The position of the distress and related information is forwarded by the responsible Cospas-Sarsat Mission Control Centre (MCC) to the appropriate national SAR authorities. Cospas-Sarsat's objective is to support search and rescue authorities worldwide, whether at sea, in the air, or on land.

The purpose of this document is to provide Rescue Coordination Centre (RCC) personnel and SAR Point of Contact (SPOC) personnel with an overview of the Cospas-Sarsat System, its evolution and an understanding of the contents and types of Cospas-Sarsat distress alert messages. This will allow RCCs to prosecute SAR incidents involving Cospas-Sarsat distress alerts in an informed manner. Furthermore, the document also provides information on 406 MHz interference which can impact 406 MHz distress alerting.

1.2 Document Organisation

Section 1 provides information on the concept of the Cospas-Sarsat System and its vision. In addition, the section includes several topics of relevance to RCCs which are Doppler location processing procedures, 406 MHz interference, 406 MHz direction finding, future implementation of the medium-altitude earth orbit SAR system (MEOSAR), the International Beacon Registration Database (IBRD), etc.

Section 2 provides information on Cospas-Sarsat distress alert data distribution principles.

Section 3 gives a brief overview of Cospas-Sarsat beacon coding.

Section 4 provides detailed information on the content and types of Cospas-Sarsat 406 MHz distress alert messages.

Section 5 is a standard form for RCCs to provide reports on 406 MHz beacon SAR incidents.

Section 6 gives real world examples of 406 MHz distress alert messages.

Section 7 lists some frequently asked questions by RCC personnel.

Annexes A, B, C and D provide a Glossary, MCC address and contact numbers, data distribution regions and a suggested RCC personnel Cospas-Sarsat course.

1.3 Reference Documents

The Cospas-Sarsat documents listed below are available free-of-charge from the Cospas-Sarsat web site at **www.cospas-sarsat.org**:

C/S G.003 - Introduction to the Cospas-Sarsat System.
This document provides detailed information of the System history, Programme Management, concept of operation and a description of the various components. This is the ideal document to read to obtain a general understanding of the of the Cospas-Sarsat System.

C/S G.005 – Cospas-Sarsat Guidelines on 406 MHz Beacon Coding, Registration and Type Approval.

This document was developed as an aide to help in understanding beacon coding, registration and type approval. It also assists in the understanding of the more complex beacon technical specification document, C/S T.001 and complements it.

C/S P.011 – Cospas-Sarsat Programme Management Policy.

As the name suggests this is a high level document that provides information on all aspects of the System and its management and, in the main, is intended for senior Managers.

C/S A.001- Cospas-Sarsat Data Distribution Plan (DDP)

This document provides operational guidance to MCCs for the exchange of alert and system data between MCCs and to RCCs.

C/S A.002 – Cospas-Sarsat Mission Control Centre Standard Interface Description (SID)

This document provides information on message content and formats for the automatic exchange of data between MCCs and to RCCs.

C/S T.001 – Specifications for Cospas-Sarsat 406 MHz Distress Beacons

This document defines the specifications for the development and manufacture of 406 MHz distress beacons and the beacon message content.

C/S S.007 – Handbook of Regulations on 406 MHz Beacons

This document provides a summary of regulations issued by Cospas-Sarsat participants regarding the carriage of 406 MHz beacons and includes information on the coding and registration of 406 MHz beacons in each country.

The document listed below is available from the International Maritime Organization (www.imo.org) or the International Civil Aviation Organization (www.icao.int) for a fee:

Doc 9731 –AN/958 – IAMSAR Manual (International Aeronautical and Maritime Search and Rescue Manual).

1.4 Cospas-Sarsat Mission and Vision

Mission Statement:
The International Cospas-Sarsat Programme provides accurate, timely and reliable distress alert and location data to help search and rescue authorities assist persons in distress.

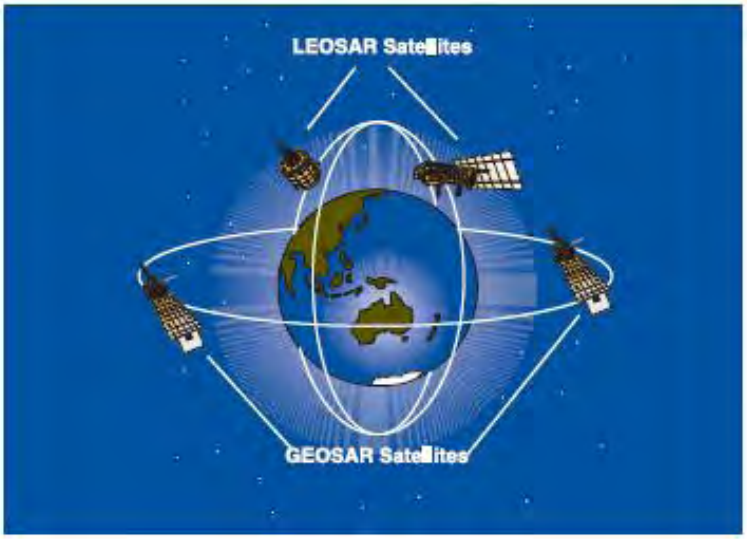
Objective:
The objective of the Cospas-Sarsat System is to reduce as far as possible, delays in the provision of distress alerts to SAR services, and the time required to locate a distress and provide assistance, which have a direct impact on the probability of survival of the person in distress at sea or on land.

1.5 Basic Concept of the Cospas-Sarsat System

The System is comprised of:

- satellites in low-altitude Earth orbit (LEOSAR) and geostationary orbit (GEOSAR) that process and / or relay signals transmitted by distress beacons;
- ground receiving stations called local user terminals (LUTs) which process the satellite signals to locate the beacon; and
- MCCs that provide the distress alert information to SAR services.

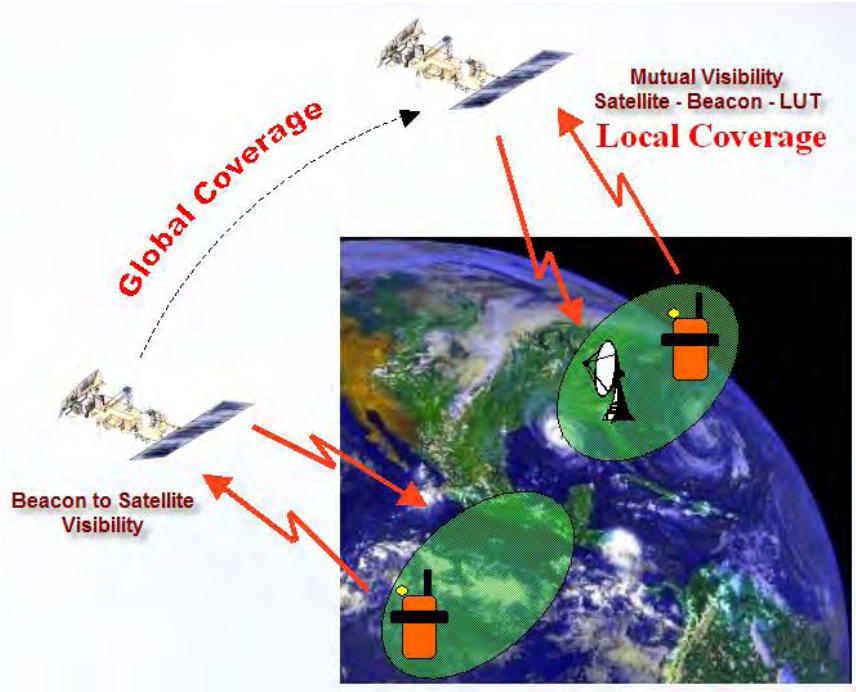
Figure 1.1: Cospas-Sarsat Space Segment



In contrast to older generation 121.5 MHz analogue beacons, both LEOSAR and GEOSAR satellites support 406 MHz digital beacons. Additionally, each LEOSAR satellite includes a 406 MHz processor/memory module that stores the digital messages received from 406 MHz beacons. The contents of the satellite memory are

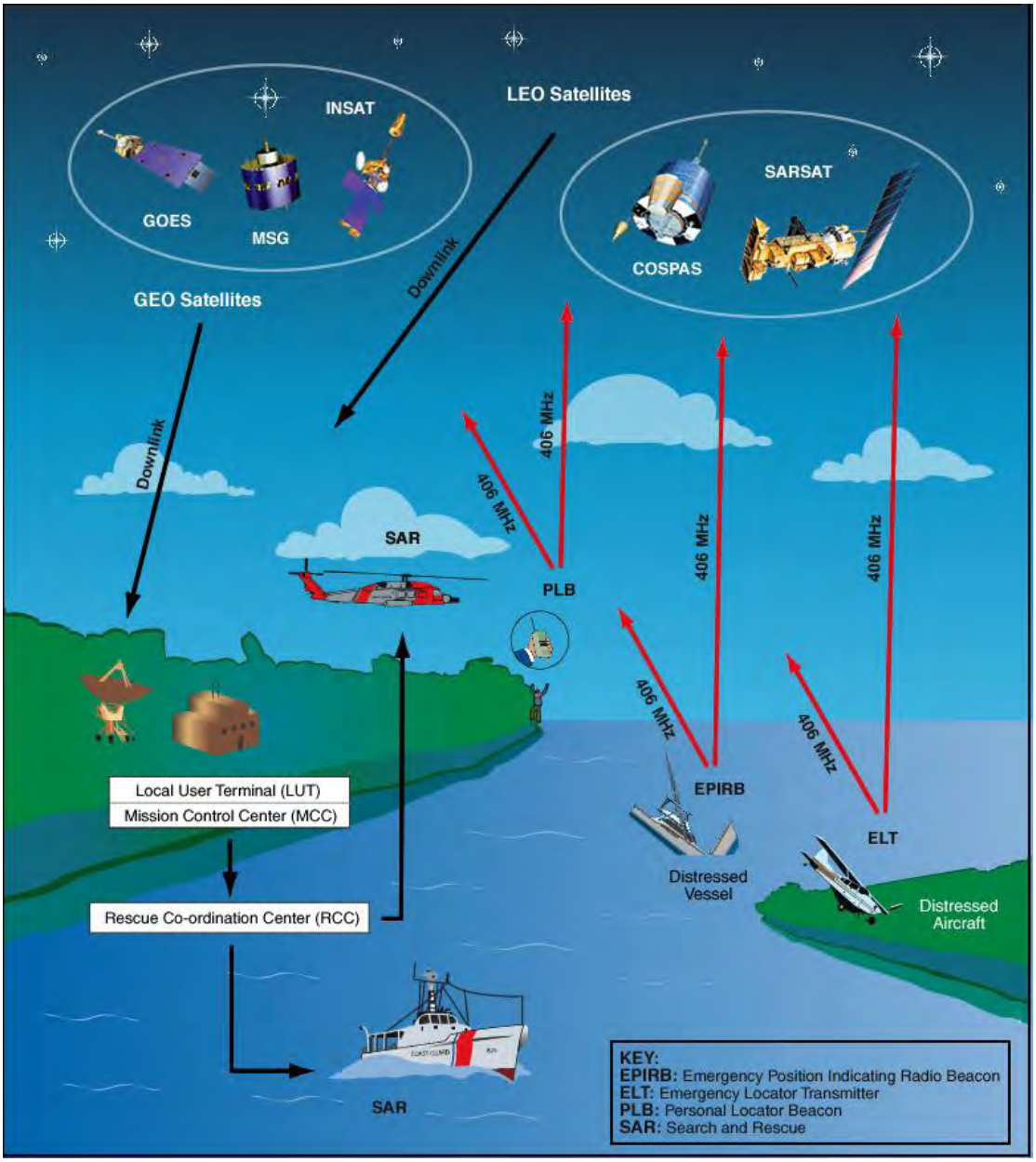
continually transmitted to Earth, thereby eliminating the need for the satellite to have simultaneous visibility of the beacon and a LUT for detecting and locating the beacon. In effect, after a satellite has received the 406 MHz beacon transmissions, the signals stored in the satellite memory are made available to every LUT in the Cospas-Sarsat System, thereby providing complete global coverage. Local mode coverage is when there is mutual visibility between the LUT, satellite and beacon.

Figure 1.2: Local and Global Mode Coverage



Users in distress may have to wait for a LEOSAR satellite to pass into view of their location. To address this limitation, in 1998 Cospas-Sarsat incorporated GEOSAR satellites to complement the service already provided by LEOSAR satellites. GEOSAR satellites are at a fixed position relative to the earth, and provide continuous coverage of a specific geographic region. Since geostationary satellites do not move with respect to the earth, the GEOSAR system cannot determine beacon location unless this information is transmitted in the beacon's digital message. Many 406 MHz beacon models incorporate a satellite navigation receiver to determine their own position and transmit this information in the distress message.

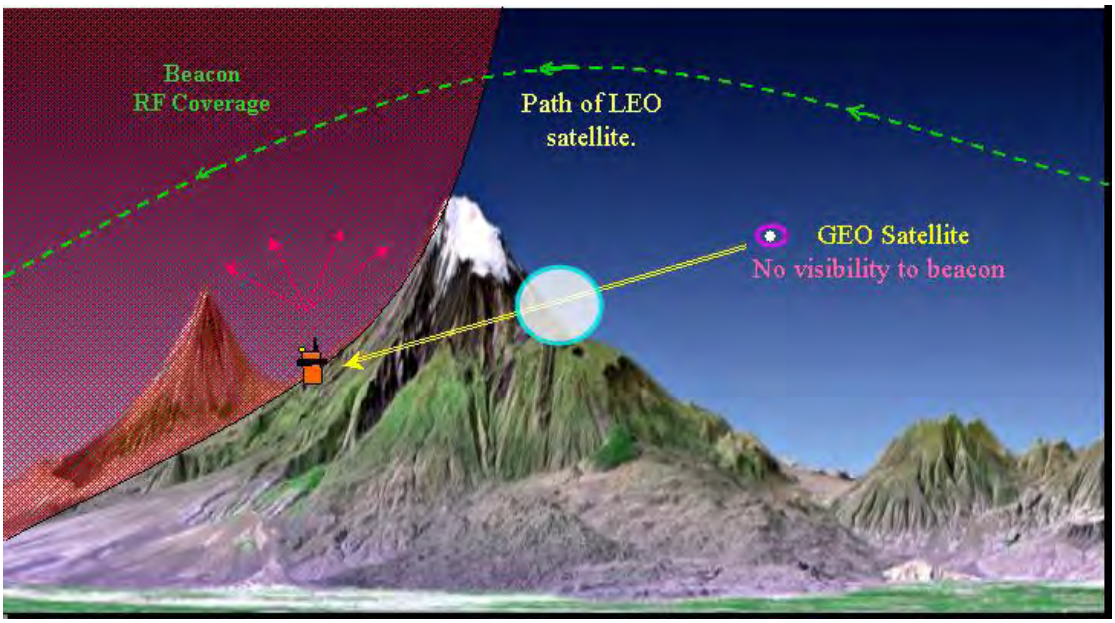
Figure 1.3: Basic Concept of the Cospas-Sarsat System



Notes:
COSPAS - Space system for the search of vessels in distress (Russia)
SARSAT - Search and rescue satellite-aided tracking system (USA)
MSG - Meteosat second generation satellite (EUMETSAT)
GOES - Geostationary operational environmental satellite
INSAT - Indian geostationary satellite
GEOLUT - Local user terminal in a GEOSAR system
GEOSAR - Geostationary satellite system for SAR
LEOLUT - Local user terminal in a LEOSAR system
LEOSAR - Low Earth Orbit satellite system for SAR

There are occasions when the beacon may be blocked from view of the stationary GEOSAR satellite but is visible to a polar orbiting LEOSAR satellite. This is depicted in Figure 1.4 below.

Figure 1.4: GEOSAR and LEOSAR Complementary Service



1.6 Doppler Location Processing

The Cospas–Sarsat System employs Doppler principles, using the relative motion between a satellite and an activated beacon to calculate the location of that beacon. This technique produces a position line, upon which are two positions, one either side of the satellite's track over the ground. One is the actual position, and the other is the "mirror image" on the other side of the satellite's track (see Figures 6.3 and 6.4). This ambiguity is resolved when a subsequent satellite pass detects the same beacon.

The frequency time plot in Figure 1.5 is representative of a 406 MHz signal heard by a LEO satellite passing over a stationary transmitter on the surface of the Earth. Each dot represents one digital burst from the beacon. The point of inflection of the curve represents the point in time where the satellite was closest to the transmitter (TCA – Time of Closest Approach). The actual shape of the curve can be used to determine the distance the transmitter was from the satellite track. A minimum of three bursts is required to calculate a Doppler location. However, under some circumstances a combination of LEO and GEO processing can provide a location from very limited beacon bursts.

Using this information, and by knowing where the satellite was at all times during the pass, it is possible to plot two lines which represent the distance from the satellite track to the transmitter. Then, knowing the time of closest approach of the satellite, it is a simple matter of drawing perpendicular lines from the point on the satellite track at TCA to the lines representing the distance between the transmitter and the satellite

track. The intersection of these lines represents two possible locations for the transmitter, one the actual location and the other its mirror image.

RCCs should be aware that each location has a probability of error associated with it and this is processed as an error ellipse around each position with a 50% probability that the beacon is within the error ellipse. Error ellipse information is not provided to RCCs in the normal course of events however RCCs should be aware that the Doppler location provided is not flawless.

An error ellipse analogy can be considered to a wise navigator who thinks of a dead reckoning position as a circle, with a radial error appropriate to the situation. If his estimate of speed is believed to be less reliable than his estimate of direction of travel, he may think of the area of uncertainty as being an ellipse, with the long axis along his course line. If the speed is more accurate, the long axis is perpendicular to the course line.

Ambiguity resolution is the process of determining which of the two computed Doppler solutions of the transmitting beacon is the real position and which is the image , or "mirror" position. A subsequent satellite pass can be used to resolve the ambiguity between the actual location and its mirror (see Figure 6.4).

An estimate of the true and image location can also be calculated by taking into account the Doppler frequency change caused by the earth's rotation when computing the Doppler solutions. This ambiguity resolution technique is dependent upon the stability of the transmitted frequency of 406 MHz distress beacons.

If the LUT cannot calculate a Doppler location then the beacon identity information contained within the signal will be processed and transmitted to an RCC. With location protocol beacons an encoded position may also be included.

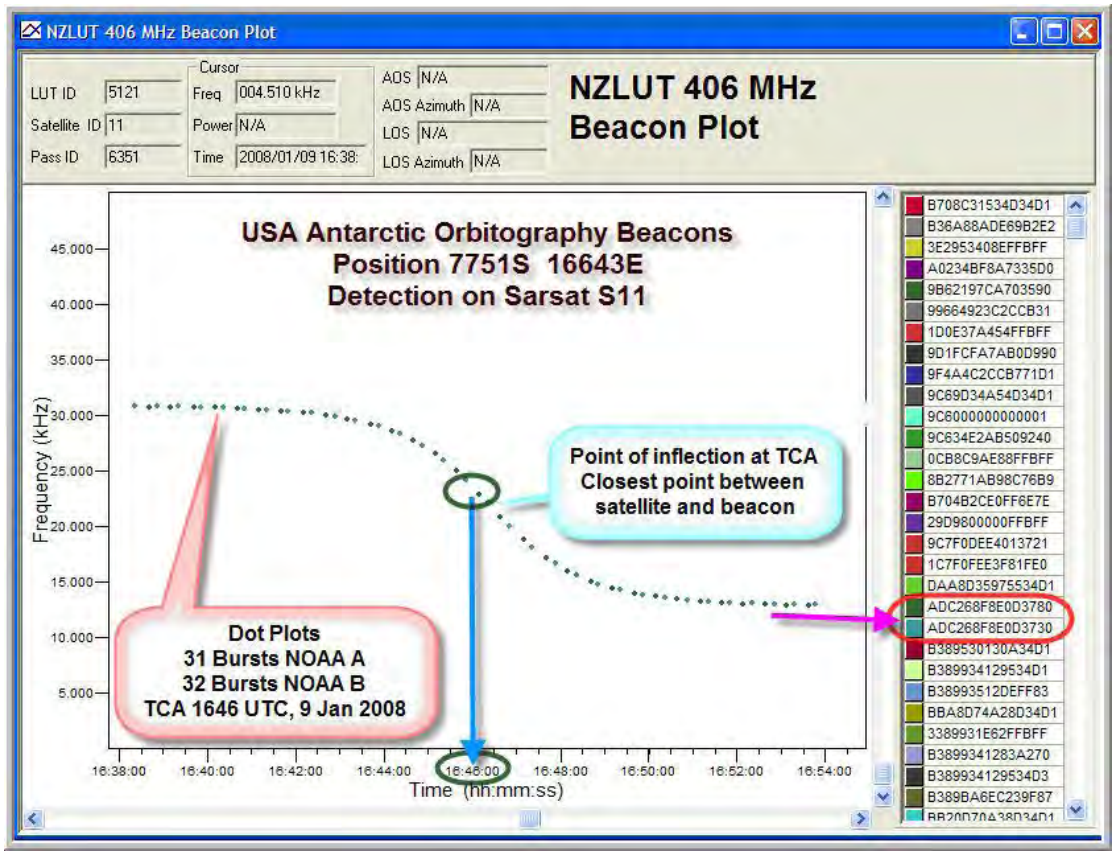
Figure 1.5 depicts a real world detection by the New Zealand Wellington LEOLUT and Sarsat-11 satellite of two USA Antarctic orbitography beacons. These special beacons transmit a burst every 30 seconds and are used to update the satellite orbit parameters in a LEOLUT. Note the Doppler curve from which the location of the beacon is determined.

The location obtained from the Wellington LEOLUT for this detection was:

HEX ID: ADC268F8E0D3730 - USA/ORB NOAA00B
TCA 9 Jan 2008 16:46:24.16 UTC, Bursts - 32
Position A - 77.8468S 166.7149E, Probability 98%
Position B - 84.3815S 173.2486E

HEX ID: ADC268F8E0D3780 - USA/ORB NOAA00A
TCA 9 Jan 2008 16:46:24.16 UTC, Bursts – 31
Position A - 77.8479S 166.7159E, Probability 99%
Position B - 84.3851S 173.2607E

Figure 1.5: Representative Doppler Curve



1.7 Interference on 406 MHz

The International Telecommunication Union (ITU) has allocated the 406 MHz band for low distress power beacons. Nevertheless there are unauthorised signal sources in various areas of the world radiating in the 406.0 – 406.1 MHz band. Interferers degrade the performance of the Cospas-Sarsat System and reduce the probability of detecting real beacon messages. The Cospas-Sarsat System itself can be used to detect and locate the source of some of these interferers from suitably equipped LUTs. Unlike the processing of 406 MHz digital beacon signals, no identification code is available from an interferer. An interfering source can only be identified by determining its location.

Persistent interferers are reported by MCCs to ITU through the Cospas-Sarsat Secretariat or their national spectrum management agencies. In addition, some MCCs also transmit 406 MHz interferer alerts to RCCs using the SIT 185 sixteen paragraph message format which is discussed in section 4.

Figures 1.6 and 1.7 provide graphical information on a typical 406 MHz interferer detection.

European Maritime Safety Agency’s IMDatE database

European Maritime Safety Agency

MARITIME SURVEILLANCE IN PRACTICE

USING INTEGRATED MARITIME SERVICES

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GETTING AN OVERVIEW OF MARITIME ACTIVITIES

Getting a comprehensive overview of activity at sea is a challenge for most countries. To implement maritime policies effectively, governments and authorities need detailed, reliable knowledge about what happens at sea, in real time.

At EMSA, we have the flexibility to tailor maritime information according to unique operational requirements. Precise services can be provided responding directly to the specific needs of diverse maritime users across Europe.

INTEGRATED MARITIME SERVICES

The integrated maritime services offered are based on advanced maritime data processing, combining information from all the agency's maritime applications as well as other external sources.

As part of a tailor-made maritime traffic picture, users can choose which information they want to receive, such as specific data sets and maritime activities in defined areas of interest. Users are now able to access vessel behaviour patterns as well as meteorological and oceanographic data, for example. Based on user feedback, EMSA refines and implements the individual services, ensuring that each one is focused on the key objectives specified.

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Services are offered directly to EU Member States and organisations, sparing them the cost and complexity of buying and managing the underlying hardware and software, and hosting separate data integration systems.

Users have full operational support, 24 hours a day, 7 days a week, through EMSA's Maritime Support Services (MSS).

Met Office, Marine weather hindcast

Met Office

Marine weather hindcast for Vessel: Trawler: OCEAN WAY

For: Marine Accident Investigation Branch

Date: 1st and 2nd November 2014

Author:

Senior Scientist: Marine Legal

Met Office reference: msc/11/14/052

Contents

1.0 Terms of engagement

1.1 To provide a marine weather hindcast giving marine weather, wind and sea states for the trawler **OCEAN WAY i**n the North Sea from the 1st to the 2nd November 2014. The hindcast was requested by M.A.I.B in his email of 4h November 2014.

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2.0 Data and information sources

2.1 Hindcast data from the Met Office's ReMap third generation wave model archive are tabulated in Section 4.

2.2 Available VOS ship / platform data from the Met Office marine data-base are given in Section 5

2.3 Tidal current model data is presented in Table 4.2 and is held in the Met Office Atlantic Margin Model.

3.0 Points to note

3.1 The hindcast is a data hindcast and is a tabulation of model data closest to the UTC locations along the route of interest. The Met Office 3rd generation ReMap model holds archived wind and waves at 1 hourly UTC intervals. The tables presented in Section 4 include daily wind and waves at those 1 hourly UTC time steps. The model has an 8 KM resolution. Although significant wave height (Hs) is archived, wind wave and swell are not explicitly rendered. Instead, wave components (height, period and direction) making up the total sea are listed. In many instances, if direction aligns itself broadly with wind direction then height of Hs0 can be considered as wind wave. Remaining swells are identified by the components Hs1, Hs2, Hs3.

3.2 The wave heights (crest to trough) given in the assessment are defined as the average of the highest third of all waves within the wave train, also known as the significant wave height and in this case the resultant wave height. The resultant wave height is the total obtained from the individual wave and swell components. It is considered to be the equivalent of the significant wave height that would be measured by a wave recorder, to which it is also accepted that visual observations of wave height approximate. **Naturally individual wave heights will vary around these average conditions and the maximum wave height may be around two times the quoted significant wave height.** There may be further variations in these heights close to the coast due to tidal and shallow water effects.

3.3 When the significant wave height is discussed using descriptive terminology, the term sea state is often used. Refer to appendix A to see the WMO Sea State scale (WMO stands for the World Meteorological Organisation).

3.4 Wind waves, often called “sea”, are generated by the local winds blowing over the surface of the ocean.

3.5 Swell (identified by wave components H1,2,3 and on some occasions H0) represents wind waves that have either travelled out of the area in which they were generated, or can no longer be sustained by the winds in the generating area. The direction is that from which the swell is running. It is possible that there may be swells from one or more than one direction.

3.8 The Atlantic Margin Model (AMM) has been used for tidal currents. The operational Shelf Seas model is a three-dimensional model capable of representing the effects of temperature and salinity and able to resolve vertical current structure both on the shelf and at the shelf break and beyond. It operates on a 7 km grid.

3.9 Details of the route of Trawler Ocean Way as presented by M.A.I.B.

Log Time UTC	Position	knots	Course
02/11/2014 10:51	55°48.491'N 1°08.602'E	7	51
02/11/2014 08:51	55°42.301'N 0°48.682'E	7	40
02/11/2014 06:51	55°35.996'N 0°27.719'E	7	70
02/11/2014 04:51	55°29.497'N 0°05.936'E	8	51
02/11/2014 02:51	55°22.810'N 0°16.850'W	7	50
02/11/2014 00:51	55°15.108'N 0°39.125'W	7	54
01/11/2014 22:51	55°07.867'N 1°01.782'W	8	95
01/11/2014 20:51	55°01.034'N 1°23.217'W	8	59

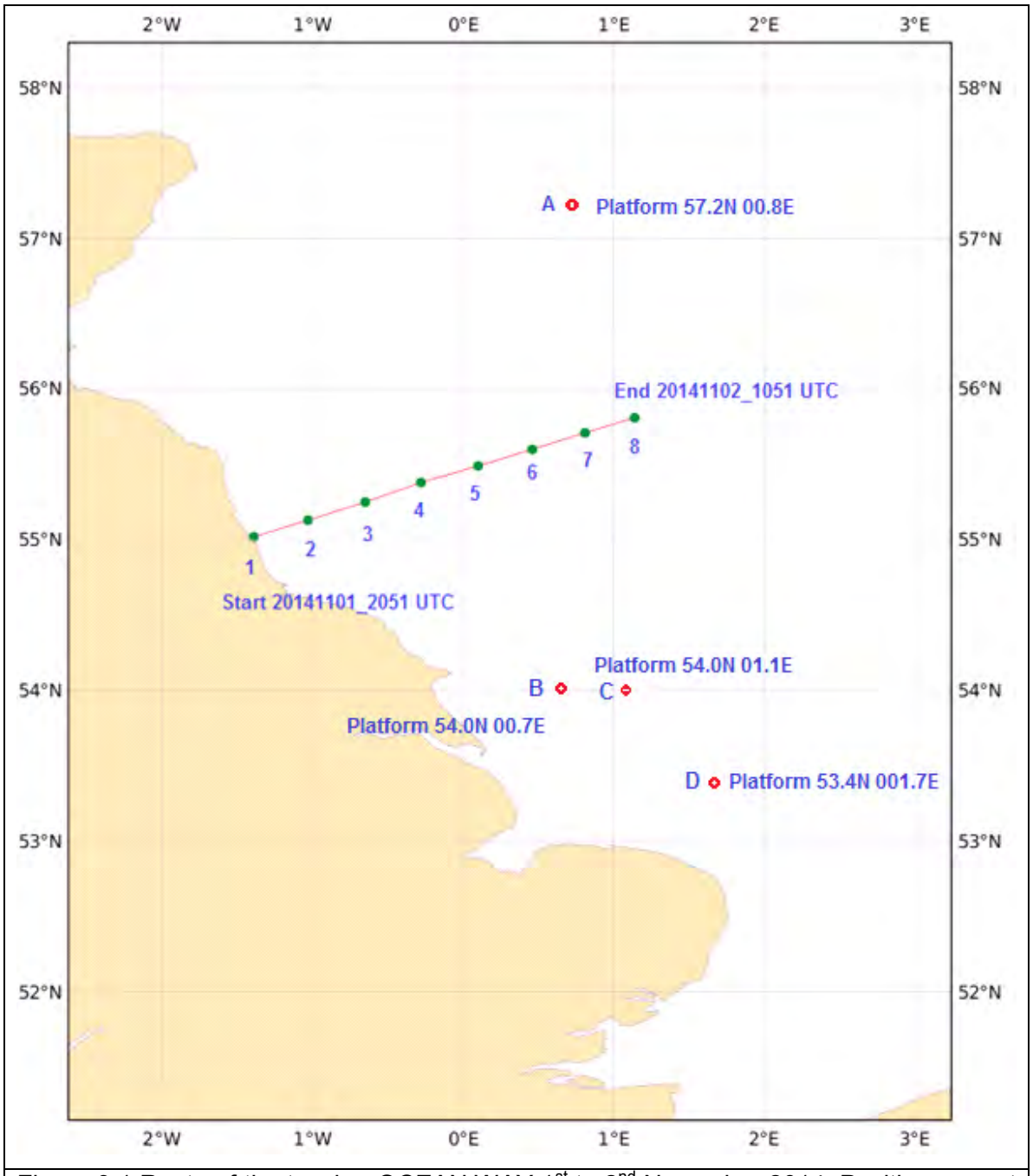


Figure 3.1 Route of the trawler: OCEAN WAY 1st to 2nd November 2014. Positions are at 2 hourly UTC time intervals

Platform A north of route: north

Platforms B / C: mid

Platform D: south

4.0 Marine Data Tables

Model and observational data are presented in the following tables

Date	Time		Location		Wind			Sig wave (model)			Wave Comp 0				Wave Comp 1				Wave Comp 2				Wave Comp 3		
2014			°N	°W	Dir	10 metres	BF	Hs	Tp	Tz	Hs0	Tp	dir		Hs1	Tp	dir		Hs2	Tp	dir		Hs3	Tp	dir
	UTC				°true	knots		m	sec	sec	m	s	°true		m	s	°true		m	s	°true		m	s	°true
1 Nov	21	1	55.03	-1.36	173	22	6	1.3	5	3	1.1	5	145		0.5	6	99		0.2	11	12		0.1	13	15
	22		55.08	-1.18	176	26	6	1.7	5	4	1.6	5	154		0.6	6	101		0.2	10	12		0.1	13	15
	23	2	55.14	-1.00	180	28	7	2.2	6	4	2.0	6	159		0.7	7	102		0.2	10	11		0.1	13	15
2 Nov	0		55.2	-0.81	183	31	7	2.6	6	5	2.5	6	165		0.6	8	106		0.2	12	12		0.0	0	0
	1	3	55.26	-0.62	190	30	7	2.8	7	5	2.6	7	171		0.9	8	115		0.2	10	11		0.1	13	13
	2		55.32	-0.44	195	27	6	2.8	7	5	2.6	7	175		1.1	8	123		0.2	12	11		0.0	0	0
	3	4	55.39	-0.25	197	24	6	2.8	7	5	2.5	7	180		1.2	8	129		0.2	12	11		0.0	0	0
	4		55.44	-0.06	198	23	6	2.8	8	5	2.6	8	181		1.2	9	134		0.2	12	11		0.0	0	0
	5	5	55.50	0.13	199	23	6	2.8	8	6	2.6	8	182		1.2	9	138		0.2	12	11		0.0	0	0
2 Nov	6		55.55	0.31	198	23	6	2.8	8	6	2.6	8	181		0.9	10	135		0.1	12	11		0.0	0	0
	7	6	55.61	0.49	201	24	6	2.8	8	5	2.6	8	185		0.9	10	141		0.1	12	11		0.0	0	0
	8		55.66	0.66	206	24	6	2.7	8	5	2.6	8	188		0.9	9	143		0.1	12	11		0.0	0	0
	9	7	55.72	0.83	215	23	6	2.6	8	5	2.4	8	194		1.2	9	149		0.1	12	10		0.0	0	0
	10		55.77	1.00	225	22	6	2.6	8	5	2.2	8	201		1.3	8	154		0.1	12	9		0.0	0	0
	11	8	55.81	1.14	235	21	5	2.5	8	5	2.0	8	211		1.6	9	160		0.1	12	9		0.0	0	0

Table 4.1 **Marine Weather table of wind and seas**

Refer to Appendix A for Beaufort Force (BF) and qualitative wave ranges and definitions

Date	Time		Location		Wind			Sig wave (model)				Wave comp 0			Current	
2014			°N	°W/°E	Dir	10 metres	BF	height	Tp	Tz		Hs	Tp	dir	Direction Going to	speed
	UTC	I			°true	knots		m	s	s		m	s	°true	°true	knots
1 Nov	**21**		55.03	-1.36	173	22	6	1.3	5	3		1.1	5	145	131	0.42
	22		55.08	-1.18	176	26	6	1.7	5	4		1.6	5	154	137	0.51
	23		55.14	-1.00	180	28	7	2.2	6	4		2.0	6	159	141	0.34
2 Nov	**00**		55.20	-0.81	183	31	7	2.6	6	5		2.5	6	165	098	0.19
	01		55.26	-0.62	190	30	7	2.8	7	5		2.6	7	171	027	0.30
	02		55.32	-0.44	195	27	6	2.8	7	5		2.6	7	175	005	0.61
	03		55.39	-0.25	197	24	6	2.8	7	5		2.5	7	180	001	0.77
	04		55.44	-0.06	198	23	6	2.8	8	5		2.6	8	181	357	0.76
	05		55.50	0.13	199	23	6	2.8	8	6		2.6	8	182	353	0.61
2 Nov	**06**		55.55	0.31	198	23	6	2.8	8	6		2.6	8	181	350	0.27
	07		55.61	0.49	201	24	6	2.8	8	5		2.6	8	185	232	0.09
	08		55.66	0.66	206	24	6	2.7	8	5		2.6	8	188	227	0.32
	09		55.72	0.83	215	23	6	2.6	8	5		2.4	8	194	214	0.40
	10		55.77	1.00	225	22	6	2.6	8	5		2.2	8	201	203	0.34
	11		55.81	1.14	235	21	5	2.5	8	5		2.0	8	211	188	0.26

Table 4.2 **Marine Weather table of tidal current ,wind, significant wave height and major wave component (wind wave)**
Refer to Appendix A for Beaufort Force (BF) and qualitative wave ranges and definitions

5.0 Ship Observations VOS

Key
DD = wind direction ° true: (230=230° =SW: the wind is coming from the southwest
FF = wind speed (knots) (25= 25 knots = force 6)
WW= present weather (0 indicates no precipitation, 4 = smoke, 10 = mist, 61 = continuous slight rain, 62 = intermittent moderate rain, 63 = moderate continuous rain)
WP = wind wave period in half seconds 8 = 4 seconds
WH = wind wave height in half metres 2 = 1.0 metres
SDD = swell direction in degrees 230 = 230° (coming from the SW)
SP = swell period in half seconds 12 =6 seconds
SH = swell height in half metres 4 = 2.0 metres
SHIPS DATA: RES = resultant wave in 1/10ths metres (equivalent to significant wave height): 22 = 2.2 metres
BUOY DATA: MP= measured wave period in 1/10ths seconds 80 = 8.0 seconds MH = measured wave height in 1/10ths metres 12 = 1.2 metres
VIS= visibility in dm (1000 DM = 10 km, 2000 = 20 km , 400 = 4 km)

Table 5.01
OBSERVATIONS: SHIPS 201411_01
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	1	21	534	17	190	22	0	1000	143	84	68	***	10114	**	**	***	**	**	***	**	**	***	30	7
2014	11	1	21	535	2	***	***	*	****	135	101	80	***	10078	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	21	536	-2	***	***	*	****	123	78	74	***	10075	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	21	536	1	180	***	*	****	125	81	75	***	10077	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	21	536	7	190	25	0	2000	135	85	72	***	10102	**	**	***	**	**	***	**	**	***	70	10
2014	11	1	21	536	15	190	22	*	****	136	75	67	***	10110	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	21	537	-4	***	***	*	****	123	79	74	***	10068	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	21	537	11	180	24	0	5000	136	105	82	***	10102	**	**	***	**	**	***	**	**	***	70	9
2014	11	1	21	538	4	200	***	0	5000	130	85	74	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	21	539	12	180	18	*	****	135	93	76	***	10100	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	21	540	7	190	27	0	2000	134	74	67	***	10087	**	**	***	**	**	***	**	**	***	70	10
2014	11	1	21	540	11	210	15	0	2000	133	95	78	***	10092	**	**	***	**	**	***	**	**	***	70	10
2014	11	1	21	542	16	180	***	*	****	138	100	78	***	10092	**	**	***	**	**	***	**	**	***	***	***

Table 5.02
OBSERVATIONS: SHIPS 201411_01
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	1	21	564	20	190	17	*	****	118	92	84	***	10066	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	21	568	11	***	***	*	****	****	92	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	21	570	18	180	***	0	1000	116	82	80	***	10049	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	21	570	18	160	21	0	2000	119	83	79	***	10057	**	**	***	**	**	***	**	**	***	50	15
2014	11	1	21	570	18	180	***	0	2000	118	114	97	***	10049	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	21	570	19	190	18	0	1000	118	83	79	***	10054	**	**	***	**	**	***	**	**	***	40	14
2014	11	1	21	570	19	***	***	*	****	****	83	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	21	571	9	190	24	*	****	****	83	***	***	10044	**	**	***	**	**	***	**	**	***	50	17
2014	11	1	21	571	16	***	***	0	1000	117	83	80	***	10047	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	21	572	8	180	20	0	1000	126	93	80	116	10029	**	**	***	**	**	***	**	**	***	50	18
2014	11	1	21	572	16	190	***	0	1000	116	74	75	***	*****	**	**	***	**	**	***	**	**	***	***	14
2014	11	1	21	573	13	190	18	*	****	117	88	82	***	10045	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	21	573	16	180	18	0	2000	116	84	81	***	10048	**	**	***	**	**	***	**	**	***	50	15
2014	11	1	21	573	20	180	19	0	1000	****	84	***	***	10054	**	**	***	**	**	***	**	**	***	50	14
2014	11	1	21	574	5	180	***	*	1000	120	84	***	***	10027	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	21	574	11	170	***	0	1000	116	82	80	***	10034	**	**	***	**	**	***	**	**	***	***	16
2014	11	1	21	574	13	***	***	*	****	****	82	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	22	534	17	190	19	0	1000	139	91	73	***	10108	**	**	***	**	**	***	**	**	***	30	8
2014	11	1	22	536	-2	***	***	*	****	121	83	78	***	10063	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	22	536	1	180	***	*	****	125	86	77	***	10063	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	22	536	7	190	28	0	2000	134	90	75	***	10089	**	**	***	**	**	***	**	**	***	80	13
2014	11	1	22	536	15	190	23	*	****	133	75	68	***	10102	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	22	537	-4	***	***	*	****	124	85	77	***	10057	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	22	537	11	180	26	0	2000	136	103	80	***	10090	**	**	***	**	**	***	**	**	***	70	11
2014	11	1	22	538	4	200	***	0	5000	127	89	78	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	22	539	12	180	21	*	****	133	91	76	***	10090	**	**	***	**	**	***	**	**	***	***	***

Table 5.03
OBSERVATIONS: SHIPS 201411_01
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	1	22	540	7	190	29	0	2000	132	78	70	***	10073	**	**	***	**	**	***	**	**	***	80	13
2014	11	1	22	540	11	210	17	0	2000	133	92	76	***	10079	**	**	***	**	**	***	**	**	***	80	12
2014	11	1	22	542	16	190	***	*	****	136	97	77	***	10084	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	22	564	20	200	21	*	****	122	85	78	***	10053	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	22	568	11	***	***	*	****	****	85	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	22	570	18	170	***	0	1000	114	87	83	***	10037	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	22	570	18	160	22	0	1000	117	87	82	***	10044	**	**	***	**	**	***	**	**	***	40	16
2014	11	1	22	570	18	170	***	0	1000	117	117	100	***	10036	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	22	570	19	180	20	0	1000	115	88	83	***	10041	**	**	***	**	**	***	**	**	***	40	15
2014	11	1	22	570	19	***	***	*	****	****	88	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	22	571	9	180	26	*	****	****	88	***	***	10030	**	**	***	**	**	***	**	**	***	50	16
2014	11	1	22	571	16	***	***	0	1000	117	86	81	***	10033	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	22	572	8	170	22	0	1000	127	92	79	116	10014	**	**	***	**	**	***	**	**	***	50	18
2014	11	1	22	572	16	170	***	0	2000	118	75	75	***	*****	**	**	***	**	**	***	**	**	***	***	15
2014	11	1	22	573	13	190	22	*	****	118	85	80	***	10032	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	22	573	16	180	24	0	2000	118	86	81	***	10032	**	**	***	**	**	***	**	**	***	50	16
2014	11	1	22	573	20	170	20	0	1000	****	86	***	***	10040	**	**	***	**	**	***	**	**	***	50	15
2014	11	1	22	574	5	180	***	*	1000	121	86	***	***	10008	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	22	574	11	170	***	0	1000	118	81	78	***	10018	**	**	***	**	**	***	**	**	***	***	18
2014	11	1	22	574	13	***	***	*	****	****	81	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	23	534	17	190	25	0	1000	137	90	73	***	10096	**	**	***	**	**	***	**	**	***	40	10
2014	11	1	23	536	-2	***	***	*	****	122	86	79	***	10056	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	23	536	1	190	***	*	****	124	89	79	***	10058	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	23	536	7	190	30	0	2000	133	91	76	***	10080	**	**	***	**	**	***	**	**	***	90	15
2014	11	1	23	536	15	190	26	*	****	132	81	71	***	10091	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	23	537	-4	***	***	*	****	127	89	78	***	10048	**	**	***	**	**	***	**	**	***	***	***

Table 5.04
OBSERVATIONS: SHIPS 201411_01
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	1	23	537	11	180	30	0	2000	134	110	85	***	10076	**	**	***	**	**	***	**	**	***	80	13
2014	11	1	23	538	4	200	***	0	2000	125	94	81	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	23	539	12	180	22	*	****	133	92	76	***	10079	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	23	540	7	190	30	0	2000	130	82	73	***	10063	**	**	***	**	**	***	**	**	***	100	18
2014	11	1	23	540	11	210	19	0	1000	132	96	79	***	10067	**	**	***	**	**	***	**	**	***	80	15
2014	11	1	23	542	16	180	***	*	****	134	93	76	***	10074	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	23	564	20	170	20	*	****	123	80	75	***	10038	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	23	568	11	***	***	*	****	****	80	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	23	570	18	170	***	0	1000	117	82	79	***	10019	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	23	570	18	160	25	0	1000	119	84	79	***	10028	**	**	***	**	**	***	**	**	***	50	18
2014	11	1	23	570	18	170	***	0	2000	119	116	98	***	10022	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	23	570	19	170	22	0	1000	117	86	81	***	10026	**	**	***	**	**	***	**	**	***	40	16
2014	11	1	23	570	19	***	***	*	****	****	86	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	23	571	9	180	27	*	****	****	86	***	***	10015	**	**	***	**	**	***	**	**	***	50	19
2014	11	1	23	571	16	***	***	0	1000	118	83	79	***	10017	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	23	572	8	170	19	0	1000	126	92	80	116	9999	**	**	***	**	**	***	**	**	***	50	20
2014	11	1	23	572	16	180	***	0	1000	119	74	74	***	*****	**	**	***	**	**	***	**	**	***	***	16
2014	11	1	23	573	13	190	23	*	****	119	87	81	***	10018	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	23	573	16	170	23	0	1000	118	87	81	***	10019	**	**	***	**	**	***	**	**	***	50	17
2014	11	1	23	573	20	170	25	0	1000	****	87	***	***	10024	**	**	***	**	**	***	**	**	***	50	16
2014	11	1	23	574	5	170	***	*	1000	120	87	***	***	9991	**	**	***	**	**	***	**	**	***	***	***
2014	11	1	23	574	11	160	***	0	1000	119	84	79	***	10003	**	**	***	**	**	***	**	**	***	***	19
2014	11	1	23	574	13	***	***	*	****	****	84	***	***	*****	**	**	***	**	**	***	**	**	***	***	***

Table 5.05
OBSERVATIONS: SHIPS 201411_02
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	2	0	534	17	190	26	0	1000	136	93	75	***	10090	**	**	***	**	**	***	**	**	***	40	14
2014	11	2	0	536	-2	***	***	*	****	123	89	80	***	10049	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	0	536	1	190	***	*	****	127	92	79	***	10050	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	0	536	7	190	28	0	2000	132	93	77	***	10076	**	**	***	**	**	***	**	**	***	90	18
2014	11	2	0	536	15	190	27	*	****	132	84	73	***	10084	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	0	537	11	190	28	0	2000	133	112	87	***	10073	**	**	***	**	**	***	**	**	***	90	19
2014	11	2	0	538	4	200	***	0	2000	126	96	82	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	0	539	12	190	26	*	****	133	95	78	***	10069	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	0	540	7	200	34	0	1000	129	85	75	***	10050	**	**	***	**	**	***	**	**	***	100	21
2014	11	2	0	540	11	220	25	0	1000	133	98	79	***	10055	**	**	***	**	**	***	**	**	***	90	20
2014	11	2	0	542	16	180	***	*	****	134	96	78	***	10067	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	0	564	20	190	21	*	****	123	84	77	***	10026	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	0	568	11	***	***	*	****	****	84	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	0	570	18	170	***	0	1000	118	78	76	***	10005	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	0	570	18	160	26	0	1000	120	81	77	***	10013	**	**	***	**	**	***	**	**	***	50	17
2014	11	2	0	570	18	170	***	0	1000	120	113	95	***	10007	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	0	570	19	170	23	0	1000	119	83	79	***	10012	**	**	***	**	**	***	**	**	***	40	17
2014	11	2	0	570	19	***	***	*	****	****	83	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	0	571	9	180	31	*	****	****	83	***	***	10001	**	**	***	**	**	***	**	**	***	50	22
2014	11	2	0	571	16	***	***	61	1000	118	82	79	***	10001	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	0	572	8	180	21	61	400	125	92	80	116	9982	**	**	***	**	**	***	**	**	***	50	24
2014	11	2	0	572	16	170	***	0	1000	120	72	72	***	*****	**	**	***	**	**	***	**	**	***	***	18
2014	11	2	0	573	13	180	25	*	****	119	83	79	***	10001	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	0	573	16	170	25	0	1000	119	85	80	***	10002	**	**	***	**	**	***	**	**	***	50	17
2014	11	2	0	573	20	170	26	61	1000	****	85	***	***	10010	**	**	***	**	**	***	**	**	***	50	17
2014	11	2	0	574	5	180	***	*	400	118	85	***	***	9973	**	**	***	**	**	***	**	**	***	***	***

Table 5.06
OBSERVATIONS: SHIPS 201411_02
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	2	0	574	11	160	***	0	1000	119	80	77	***	9985	**	**	***	**	**	***	**	**	***	***	20
2014	11	2	0	574	13	***	***	*	****	****	80	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	534	17	190	28	0	1000	142	92	72	***	10081	**	**	***	**	**	***	**	**	***	50	17
2014	11	2	1	536	-2	***	***	*	****	130	93	78	***	10040	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	536	1	200	***	*	****	133	93	77	***	10042	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	536	7	200	28	0	2000	132	96	79	***	10065	**	**	***	**	**	***	**	**	***	100	17
2014	11	2	1	536	15	190	27	*	****	132	85	73	***	10076	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	537	-4	***	***	*	****	133	95	78	***	10033	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	537	11	190	30	0	2000	135	115	88	***	10062	**	**	***	**	**	***	**	**	***	100	22
2014	11	2	1	538	4	200	***	0	2000	128	96	81	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	538	18	***	***	*	****	135	96	***	***	10065	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	539	12	180	27	*	****	134	98	79	***	10059	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	540	7	200	33	62	1000	128	85	75	***	10043	**	**	***	**	**	***	**	**	***	100	23
2014	11	2	1	540	11	220	25	0	1000	134	100	80	***	10045	**	**	***	**	**	***	**	**	***	100	24
2014	11	2	1	542	16	190	***	*	****	133	99	80	***	10057	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	564	20	220	29	*	****	124	86	78	***	10014	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	568	11	***	***	*	****	****	86	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	570	18	180	***	10	400	114	87	83	***	9992	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	570	18	160	30	0	400	118	86	81	***	10000	**	**	***	**	**	***	**	**	***	50	21
2014	11	2	1	570	18	180	***	10	400	119	117	99	***	9992	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	570	19	180	25	0	1000	117	87	82	***	9998	**	**	***	**	**	***	**	**	***	50	20
2014	11	2	1	570	19	***	***	*	****	****	87	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	571	9	190	34	*	****	****	87	***	***	9988	**	**	***	**	**	***	**	**	***	50	24
2014	11	2	1	571	16	***	***	61	400	116	87	82	***	9985	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	572	8	180	23	61	400	120	95	85	116	9967	**	**	***	**	**	***	**	**	***	50	28
2014	11	2	1	572	16	180	***	0	1000	117	79	77	***	*****	**	**	***	**	**	***	**	**	***	***	20

Table 5.07
OBSERVATIONS: SHIPS 201411_02
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	2	1	573	13	190	28	*	****	115	86	82	***	9987	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	573	16	180	28	62	1000	118	84	80	***	9987	**	**	***	**	**	***	**	**	***	50	21
2014	11	2	1	573	20	170	29	62	400	****	84	***	***	9993	**	**	***	**	**	***	**	**	***	50	19
2014	11	2	1	574	5	190	***	*	200	115	84	***	***	9956	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	1	574	11	170	***	10	400	114	87	83	***	9966	**	**	***	**	**	***	**	**	***	***	23
2014	11	2	1	574	13	***	***	*	****	****	87	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	2	534	17	190	25	0	1000	140	94	74	***	10070	**	**	***	**	**	***	**	**	***	50	20
2014	11	2	2	536	-2	***	***	*	****	132	96	79	***	10034	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	2	536	1	190	***	*	****	136	96	77	***	10031	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	2	536	7	190	29	0	2000	134	100	80	***	10055	**	**	***	**	**	***	**	**	***	100	19
2014	11	2	2	536	15	190	28	*	****	134	86	73	***	10065	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	2	537	-4	***	***	*	****	134	98	79	***	10027	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	2	537	11	190	29	0	2000	135	117	89	***	10053	**	**	***	**	**	***	**	**	***	100	20
2014	11	2	2	538	4	200	***	0	5000	130	99	81	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	2	539	12	190	26	*	****	134	100	80	***	10051	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	2	539	14	***	***	*	****	133	100	***	***	10040	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	2	540	7	200	32	62	2000	129	88	76	***	10035	**	**	***	**	**	***	**	**	***	100	22
2014	11	2	2	540	11	220	26	0	1000	132	101	81	***	10038	**	**	***	**	**	***	**	**	***	110	25
2014	11	2	2	542	16	190	***	*	****	134	102	81	***	10048	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	2	564	20	220	28	*	****	121	92	82	***	10006	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	2	568	11	***	***	*	****	****	92	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	2	570	18	190	***	10	400	113	92	87	***	9978	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	2	570	18	180	27	0	400	116	91	85	***	9992	**	**	***	**	**	***	**	**	***	50	22
2014	11	2	2	570	18	190	***	10	400	117	117	100	***	9983	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	2	570	19	210	29	61	400	110	96	91	***	9986	**	**	***	**	**	***	**	**	***	50	22
2014	11	2	2	570	19	***	***	*	****	****	96	***	***	*****	**	**	***	**	**	***	**	**	***	***	***

Table 5.08
OBSERVATIONS: SHIPS 201411_02
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	2	2	571	9	190	34	*	****	****	96	***	***	9977	**	**	***	**	**	***	**	**	***	60	27
2014	11	2	2	571	16	***	***	61	400	117	94	86	***	9973	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	2	572	8	190	30	0	400	121	101	88	***	9956	**	**	***	**	**	***	**	**	***	60	32
2014	11	2	2	572	16	190	***	61	400	115	85	82	***	*****	**	**	***	**	**	***	**	**	***	***	24
2014	11	2	2	573	13	200	30	*	****	110	95	90	***	9977	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	2	573	16	190	30	62	400	119	91	83	***	9976	**	**	***	**	**	***	**	**	***	50	23
2014	11	2	2	573	20	180	31	63	200	****	91	***	***	9981	**	**	***	**	**	***	**	**	***	50	22
2014	11	2	2	574	5	200	***	*	400	123	91	***	***	9942	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	2	574	11	180	***	10	400	115	93	86	***	9951	**	**	***	**	**	***	**	**	***	***	26
2014	11	2	2	574	13	***	***	*	****	****	93	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	3	534	17	190	28	0	1000	141	96	74	***	10063	**	**	***	**	**	***	**	**	***	50	21
2014	11	2	3	536	-2	***	***	*	****	137	104	80	***	10027	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	3	536	1	200	***	*	****	137	103	80	***	10028	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	3	536	7	200	29	0	2000	136	102	80	***	10051	**	**	***	**	**	***	**	**	***	90	19
2014	11	2	3	536	15	200	28	*	****	136	89	73	***	10058	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	3	537	-4	***	***	*	****	139	107	81	***	10019	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	3	537	11	190	31	0	2000	138	121	89	***	10046	**	**	***	**	**	***	**	**	***	110	22
2014	11	2	3	538	4	200	***	0	5000	134	105	83	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	3	539	12	190	29	*	****	136	104	81	***	10044	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	3	540	7	200	33	0	2000	135	93	76	***	10029	**	**	***	**	**	***	**	**	***	100	24
2014	11	2	3	540	11	220	27	0	1000	134	106	83	***	10031	**	**	***	**	**	***	**	**	***	110	27
2014	11	2	3	541	10	***	***	*	****	133	106	***	***	10022	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	3	542	16	190	***	*	****	134	104	82	***	10039	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	3	564	20	230	28	*	****	120	95	85	***	9999	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	3	568	11	***	***	*	****	****	95	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	3	570	18	190	***	10	400	115	94	87	***	9971	**	**	***	**	**	***	**	**	***	***	***

Table 5.09
OBSERVATIONS: SHIPS 201411_02
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	2	3	570	18	180	27	0	400	117	94	86	***	9986	**	**	***	**	**	***	**	**	***	50	26
2014	11	2	3	570	18	190	***	10	400	118	118	100	***	9976	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	3	570	19	210	30	61	400	110	103	95	***	9980	**	**	***	**	**	***	**	**	***	50	26
2014	11	2	3	570	19	***	***	*	****	****	103	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	3	571	9	200	32	*	****	****	103	***	***	9969	**	**	***	**	**	***	**	**	***	60	32
2014	11	2	3	571	16	***	***	10	400	118	95	86	***	9969	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	3	572	8	200	28	0	400	126	103	86	116	9956	**	**	***	**	**	***	**	**	***	60	38
2014	11	2	3	572	16	200	***	10	400	117	86	81	***	*****	**	**	***	**	**	***	**	**	***	***	25
2014	11	2	3	573	13	210	27	*	****	119	106	92	***	9972	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	3	573	16	200	28	61	400	126	99	84	***	9972	**	**	***	**	**	***	**	**	***	60	27
2014	11	2	3	573	20	190	31	62	400	****	99	***	***	9973	**	**	***	**	**	***	**	**	***	60	26
2014	11	2	3	574	5	210	***	*	400	127	99	***	***	9941	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	3	574	11	190	***	10	400	120	94	84	***	9950	**	**	***	**	**	***	**	**	***	***	31
2014	11	2	3	574	13	***	***	*	****	****	94	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	4	534	17	190	27	0	1000	141	99	76	***	10057	**	**	***	**	**	***	**	**	***	50	21
2014	11	2	4	536	-2	***	***	*	****	138	108	82	***	10021	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	4	536	1	190	***	*	****	137	108	83	***	10024	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	4	536	7	190	26	0	2000	135	107	83	***	10046	**	**	***	**	**	***	**	**	***	90	18
2014	11	2	4	536	15	190	25	*	****	136	92	75	***	10054	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	4	537	-4	***	***	*	****	140	109	82	***	10015	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	4	537	11	190	29	0	2000	139	124	91	***	10043	**	**	***	**	**	***	**	**	***	100	21
2014	11	2	4	538	4	200	***	0	2000	132	108	85	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	4	539	12	190	27	*	****	137	106	82	***	10040	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	4	540	7	200	30	0	2000	132	96	79	***	10028	**	**	***	**	**	***	**	**	***	100	24
2014	11	2	4	540	11	220	26	0	1000	136	109	84	***	10027	**	**	***	**	**	***	**	**	***	110	25
2014	11	2	4	542	16	200	***	*	****	138	109	83	***	10033	**	**	***	**	**	***	**	**	***	***	***

Table 5.10
OBSERVATIONS: SHIPS 201411_02
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	2	4	543	6	***	***	*	****	133	109	***	***	10010	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	4	564	20	230	27	*	****	121	97	85	***	9993	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	4	568	11	***	***	*	****	****	97	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	4	570	18	200	***	10	400	117	95	86	***	9968	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	4	570	18	190	24	0	400	120	95	85	***	9982	**	**	***	**	**	***	**	**	***	60	30
2014	11	2	4	570	18	200	***	10	400	120	120	100	***	9972	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	4	570	19	200	27	0	400	114	104	94	***	9978	**	**	***	**	**	***	**	**	***	60	28
2014	11	2	4	570	19	***	***	*	****	****	104	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	4	571	9	200	31	*	****	****	104	***	***	9965	**	**	***	**	**	***	**	**	***	70	34
2014	11	2	4	571	16	***	***	10	400	120	95	85	***	9964	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	4	572	8	200	24	0	400	125	103	86	116	9955	**	**	***	**	**	***	**	**	***	70	38
2014	11	2	4	572	16	200	***	0	1000	119	86	80	***	*****	**	**	***	**	**	***	**	**	***	***	29
2014	11	2	4	573	13	220	21	*	****	120	102	89	***	9970	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	4	573	16	200	28	0	400	128	99	83	***	9967	**	**	***	**	**	***	**	**	***	60	31
2014	11	2	4	573	20	200	30	0	400	****	99	***	***	9969	**	**	***	**	**	***	**	**	***	60	30
2014	11	2	4	574	5	210	***	*	400	126	99	***	***	9948	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	4	574	11	190	***	10	400	121	95	84	***	9952	**	**	***	**	**	***	**	**	***	***	37
2014	11	2	4	574	13	***	***	*	****	****	95	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	5	534	17	190	24	0	1000	142	102	77	***	10053	**	**	***	**	**	***	**	**	***	50	18
2014	11	2	5	536	-2	***	***	*	****	141	112	83	***	10020	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	5	536	1	200	***	*	****	138	111	84	***	10021	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	5	536	7	200	27	0	2000	139	112	84	***	10041	**	**	***	**	**	***	**	**	***	80	16
2014	11	2	5	536	15	190	23	*	****	133	95	78	***	10051	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	5	537	-4	***	***	*	****	140	113	84	***	10012	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	5	537	11	190	27	0	2000	139	127	92	***	10039	**	**	***	**	**	***	**	**	***	100	21
2014	11	2	5	538	4	200	***	0	5000	134	113	87	***	*****	**	**	***	**	**	***	**	**	***	***	***

Table 5.11
OBSERVATIONS: SHIPS 201411_02
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	2	5	539	12	180	24	*	****	137	109	83	***	10037	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	5	540	7	200	29	0	2000	132	100	81	***	10026	**	**	***	**	**	***	**	**	***	100	23
2014	11	2	5	540	11	220	21	0	1000	136	112	85	***	10024	**	**	***	**	**	***	**	**	***	110	26
2014	11	2	5	542	16	200	***	*	****	137	110	84	***	10031	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	5	544	2	***	***	*	****	130	110	***	***	10004	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	5	564	20	230	27	*	****	121	97	85	***	9989	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	5	568	11	***	***	*	****	****	97	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	5	570	18	200	***	4	400	118	96	86	***	9967	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	5	570	18	190	22	0	400	120	96	85	***	9982	**	**	***	**	**	***	**	**	***	60	32
2014	11	2	5	570	18	200	***	10	400	120	120	100	***	9971	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	5	570	19	200	26	0	400	116	101	90	***	9977	**	**	***	**	**	***	**	**	***	60	31
2014	11	2	5	570	19	***	***	*	****	****	101	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	5	571	9	210	28	*	****	****	101	***	***	9962	**	**	***	**	**	***	**	**	***	60	34
2014	11	2	5	571	16	***	***	10	400	122	96	84	***	9967	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	5	572	8	200	22	0	400	126	105	87	116	9958	**	**	***	**	**	***	**	**	***	70	38
2014	11	2	5	572	16	200	***	0	1000	121	87	80	***	*****	**	**	***	**	**	***	**	**	***	***	30
2014	11	2	5	573	13	230	20	*	****	121	100	87	***	9970	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	5	573	16	200	24	0	400	133	102	81	***	9969	**	**	***	**	**	***	**	**	***	60	32
2014	11	2	5	573	20	200	25	4	400	****	102	***	***	9971	**	**	***	**	**	***	**	**	***	60	31
2014	11	2	5	574	5	210	***	*	400	126	102	***	***	9951	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	5	574	11	200	***	10	400	120	97	86	***	9954	**	**	***	**	**	***	**	**	***	***	38
2014	11	2	5	574	13	***	***	*	****	****	97	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	534	17	190	23	0	1000	143	106	78	***	10050	**	**	***	**	**	***	**	**	***	50	16
2014	11	2	6	536	-2	***	***	*	****	141	115	84	***	10017	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	536	1	200	***	*	****	138	115	86	***	10018	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	536	7	200	26	0	1000	138	115	86	***	10037	**	**	***	**	**	***	**	**	***	90	17

Table 5.12
OBSERVATIONS: SHIPS 201411_02
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	2	6	536	15	190	26	*	****	136	97	77	***	10044	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	537	-4	***	***	*	****	138	114	85	***	10012	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	537	11	180	26	0	2000	139	131	95	***	10036	**	**	***	**	**	***	**	**	***	90	18
2014	11	2	6	538	4	210	***	0	5000	135	116	88	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	539	12	180	20	*	****	135	111	85	***	10035	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	540	7	200	26	0	2000	133	104	83	***	10024	**	**	***	**	**	***	**	**	***	100	21
2014	11	2	6	540	11	220	21	0	1000	136	116	88	***	10024	**	**	***	**	**	***	**	**	***	100	20
2014	11	2	6	542	16	190	***	*	****	136	111	85	***	10028	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	546	-2	***	***	*	****	133	111	***	***	9994	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	564	20	230	23	*	****	122	97	85	***	9988	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	568	11	***	***	*	****	****	97	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	570	18	200	***	4	400	117	97	88	***	9972	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	570	18	190	20	0	400	122	97	85	***	9984	**	**	***	**	**	***	**	**	***	60	33
2014	11	2	6	570	18	200	***	0	1000	122	122	100	***	9973	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	570	19	210	23	0	400	118	100	89	***	9978	**	**	***	**	**	***	**	**	***	60	33
2014	11	2	6	570	19	***	***	*	****	****	100	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	571	9	210	26	*	****	****	100	***	***	9965	**	**	***	**	**	***	**	**	***	60	32
2014	11	2	6	571	16	***	***	10	400	119	97	86	***	9969	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	572	8	200	19	0	400	126	106	88	116	9958	**	**	***	**	**	***	**	**	***	60	33
2014	11	2	6	572	16	200	***	0	400	120	88	81	***	*****	**	**	***	**	**	***	**	**	***	***	32
2014	11	2	6	573	13	230	19	*	****	120	100	88	***	9971	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	573	16	210	22	0	400	133	99	80	***	9969	**	**	***	**	**	***	**	**	***	60	31
2014	11	2	6	573	20	200	26	*	****	****	99	***	***	9970	**	**	***	**	**	***	**	**	***	60	32
2014	11	2	6	574	5	210	***	*	1000	125	99	***	***	9951	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	6	574	11	200	***	10	400	120	97	86	***	9956	**	**	***	**	**	***	**	**	***	***	36
2014	11	2	6	574	13	***	***	*	****	****	97	***	***	*****	**	**	***	**	**	***	**	**	***	***	***

Table 5.13
OBSERVATIONS: SHIPS 201411_02
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	2	7	534	17	180	19	0	1000	144	110	80	***	10047	**	**	***	**	**	***	**	**	***	40	15
2014	11	2	7	536	-2	***	***	*	****	138	119	88	***	10018	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	7	536	7	200	29	0	1000	140	117	86	***	10035	**	**	***	**	**	***	**	**	***	80	15
2014	11	2	7	536	15	190	24	*	****	136	100	79	***	10041	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	7	537	-4	***	***	*	****	135	116	88	***	10012	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	7	537	11	180	24	0	2000	138	132	96	***	10036	**	**	***	**	**	***	**	**	***	90	17
2014	11	2	7	538	4	210	***	0	5000	135	119	90	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	7	539	12	180	20	*	****	136	115	87	***	10033	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	7	540	7	200	25	0	1000	132	108	85	***	10025	**	**	***	**	**	***	**	**	***	100	19
2014	11	2	7	540	11	220	23	0	1000	136	119	89	***	10022	**	**	***	**	**	***	**	**	***	100	21
2014	11	2	7	542	16	180	***	*	****	135	113	87	***	10026	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	7	547	-6	***	***	*	****	133	113	***	***	9987	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	7	564	20	230	21	*	****	122	100	86	***	9989	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	7	568	11	***	***	*	****	****	100	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	7	570	18	190	***	10	400	118	98	88	***	9970	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	7	570	18	190	21	0	400	124	98	84	***	9982	**	**	***	**	**	***	**	**	***	60	31
2014	11	2	7	570	18	200	***	0	1000	123	123	100	***	9972	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	7	570	19	210	21	0	400	118	101	89	***	9978	**	**	***	**	**	***	**	**	***	70	35
2014	11	2	7	570	19	***	***	*	****	****	101	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	7	571	9	200	23	*	****	****	101	***	***	9966	**	**	***	**	**	***	**	**	***	70	32
2014	11	2	7	571	16	***	***	10	400	120	99	87	***	9970	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	7	572	8	200	15	0	400	125	106	88	116	9960	**	**	***	**	**	***	**	**	***	60	33
2014	11	2	7	572	16	200	***	0	1000	119	90	82	***	*****	**	**	***	**	**	***	**	**	***	***	33
2014	11	2	7	573	13	220	14	*	****	119	100	88	***	9969	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	7	573	16	200	19	0	400	134	101	80	***	9972	**	**	***	**	**	***	**	**	***	70	34
2014	11	2	7	573	20	200	23	*	****	****	101	***	***	9972	**	**	***	**	**	***	**	**	***	60	31

Table 5.14
OBSERVATIONS: SHIPS 201411_02
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	2	7	574	5	210	***	*	1000	122	101	***	***	9952	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	7	574	11	190	***	0	1000	121	96	85	***	9958	**	**	***	**	**	***	**	**	***	***	35
2014	11	2	7	574	13	***	***	*	****	****	96	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	8	534	17	190	21	0	1000	145	112	81	***	10046	**	**	***	**	**	***	**	**	***	40	15
2014	11	2	8	536	-2	***	***	*	****	136	120	90	***	10017	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	8	536	7	190	24	0	1000	135	120	91	***	10036	**	**	***	**	**	***	**	**	***	70	13
2014	11	2	8	536	15	190	24	*	****	138	103	79	***	10042	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	8	537	-4	***	***	*	****	132	119	92	***	10014	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	8	537	11	180	23	0	2000	140	136	97	***	10034	**	**	***	**	**	***	**	**	***	90	15
2014	11	2	8	538	4	210	***	0	2000	134	121	92	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	8	539	12	190	19	*	****	137	118	88	***	10031	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	8	540	7	200	26	62	1000	133	110	86	***	10022	**	**	***	**	**	***	**	**	***	90	17
2014	11	2	8	540	11	220	19	62	400	136	120	90	***	10023	**	**	***	**	**	***	**	**	***	100	21
2014	11	2	8	542	16	190	***	*	****	137	116	87	***	10027	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	8	549	-10	***	***	*	****	128	116	***	***	9977	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	8	564	20	230	22	*	****	123	102	87	***	9989	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	8	568	11	***	***	*	****	****	102	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	8	570	18	200	***	10	400	116	99	89	***	9970	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	8	570	18	190	19	0	400	121	99	86	***	9981	**	**	***	**	**	***	**	**	***	60	29
2014	11	2	8	570	18	200	***	0	1000	121	121	100	***	9971	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	8	570	19	200	19	0	1000	118	103	91	***	9978	**	**	***	**	**	***	**	**	***	60	30
2014	11	2	8	571	9	200	21	*	****	****	103	***	***	9967	**	**	***	**	**	***	**	**	***	70	31
2014	11	2	8	571	16	***	***	10	1000	121	100	87	***	9969	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	8	572	8	200	14	0	400	127	108	88	116	9959	**	**	***	**	**	***	**	**	***	70	33
2014	11	2	8	572	16	200	***	0	1000	121	91	82	***	*****	**	**	***	**	**	***	**	**	***	***	32
2014	11	2	8	573	13	220	16	*	****	119	101	89	***	9970	**	**	***	**	**	***	**	**	***	***	***

Table 5.15
OBSERVATIONS: SHIPS 201411_02
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	2	8	573	16	210	17	0	1000	132	101	81	***	9971	**	**	***	**	**	***	**	**	***	60	30
2014	11	2	8	573	20	200	19	*	****	****	101	***	***	9974	**	**	***	**	**	***	**	**	***	70	32
2014	11	2	8	574	5	210	***	*	400	124	101	***	***	9955	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	8	574	11	190	***	4	400	118	99	88	***	9959	**	**	***	**	**	***	**	**	***	***	31
2014	11	2	8	574	13	***	***	*	****	****	99	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	534	17	180	21	0	1000	144	114	82	***	10041	**	**	***	**	**	***	**	**	***	40	15
2014	11	2	9	536	-2	***	***	*	****	135	122	92	***	10015	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	536	1	200	***	*	****	137	121	90	***	10016	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	536	7	200	23	0	1000	135	121	91	***	10034	**	**	***	**	**	***	**	**	***	80	14
2014	11	2	9	536	15	180	21	*	****	135	110	85	***	10037	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	537	-4	***	***	*	****	131	119	92	***	10013	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	537	11	180	23	0	1000	139	138	99	***	10031	**	**	***	**	**	***	**	**	***	80	15
2014	11	2	9	538	4	200	***	0	2000	133	122	93	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	539	12	180	20	*	****	135	118	89	***	10029	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	540	7	200	25	0	1000	132	111	87	***	10021	**	**	***	**	**	***	**	**	***	100	18
2014	11	2	9	540	11	220	17	0	1000	134	122	92	***	10023	**	**	***	**	**	***	**	**	***	100	20
2014	11	2	9	542	16	190	***	*	****	136	117	88	***	10027	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	550	-13	***	***	*	****	118	117	***	***	9980	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	564	20	230	21	*	****	123	102	87	***	9991	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	568	11	***	***	*	****	****	102	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	570	18	200	***	10	400	118	101	89	***	9969	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	570	18	190	21	0	1000	122	101	87	***	9981	**	**	***	**	**	***	**	**	***	60	31
2014	11	2	9	570	18	210	***	0	1000	122	122	100	***	9971	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	570	19	210	21	0	1000	118	104	91	***	9978	**	**	***	**	**	***	**	**	***	60	30
2014	11	2	9	570	19	***	***	*	****	****	104	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	571	9	210	22	*	****	****	104	***	***	9965	**	**	***	**	**	***	**	**	***	60	28

Table 5.16
OBSERVATIONS: SHIPS 201411_02
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	2	9	571	16	***	***	0	1000	123	99	85	***	9969	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	572	8	200	18	0	1000	126	106	88	116	9958	**	**	***	**	**	***	**	**	***	70	32
2014	11	2	9	572	16	200	***	0	1000	122	91	81	***	*****	**	**	***	**	**	***	**	**	***	***	31
2014	11	2	9	573	13	220	15	*	****	121	103	89	***	9969	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	573	16	210	21	0	1000	135	104	82	***	9969	**	**	***	**	**	***	**	**	***	70	31
2014	11	2	9	573	20	200	22	*	****	****	104	***	***	9971	**	**	***	**	**	***	**	**	***	70	33
2014	11	2	9	574	5	220	***	*	1000	127	104	***	***	9951	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	9	574	11	190	***	10	400	118	99	88	***	9956	**	**	***	**	**	***	**	**	***	***	33
2014	11	2	9	574	13	***	***	*	****	****	99	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	534	17	190	24	0	1000	147	115	81	***	10038	**	**	***	**	**	***	**	**	***	40	16
2014	11	2	10	536	-2	***	***	*	****	132	114	89	***	10014	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	536	1	210	***	*	****	139	122	89	***	10012	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	536	7	200	21	0	2000	137	121	90	***	10030	**	**	***	**	**	***	**	**	***	80	14
2014	11	2	10	536	15	190	25	*	****	140	108	81	***	10036	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	537	-4	***	***	*	****	123	95	83	***	10013	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	537	11	190	22	0	2000	140	140	100	***	10028	**	**	***	**	**	***	**	**	***	80	14
2014	11	2	10	538	4	210	***	0	5000	133	124	94	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	539	12	190	20	*	****	136	122	91	***	10023	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	540	7	210	25	0	1000	130	113	89	***	10015	**	**	***	**	**	***	**	**	***	100	16
2014	11	2	10	540	11	220	18	0	1000	134	124	94	***	10016	**	**	***	**	**	***	**	**	***	90	18
2014	11	2	10	542	16	190	***	*	****	137	120	89	***	10020	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	550	-15	***	***	*	****	120	120	***	***	9983	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	564	20	230	19	*	****	123	102	87	***	9989	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	568	11	***	***	*	****	****	102	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	570	18	200	***	0	1000	120	98	86	***	9967	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	570	18	190	22	0	1000	129	99	82	***	9980	**	**	***	**	**	***	**	**	***	60	28

Table 5.17
OBSERVATIONS: SHIPS 201411_02
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	2	10	570	18	210	***	0	1000	125	125	100	***	9969	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	570	19	210	22	0	1000	122	105	89	***	9976	**	**	***	**	**	***	**	**	***	60	29
2014	11	2	10	570	19	***	***	*	****	****	105	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	571	9	210	21	*	****	****	105	***	***	9963	**	**	***	**	**	***	**	**	***	60	25
2014	11	2	10	571	16	***	***	0	1000	122	98	85	***	9965	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	572	8	200	16	0	1000	125	104	87	116	9958	**	**	***	**	**	***	**	**	***	70	30
2014	11	2	10	572	16	200	***	0	1000	122	89	80	***	*****	**	**	***	**	**	***	**	**	***	***	26
2014	11	2	10	573	13	210	17	*	****	118	100	89	***	9968	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	573	16	210	21	0	1000	138	104	80	***	9966	**	**	***	**	**	***	**	**	***	70	29
2014	11	2	10	573	20	200	22	*	****	****	104	***	***	9968	**	**	***	**	**	***	**	**	***	70	32
2014	11	2	10	574	5	220	***	*	1000	128	104	***	***	9951	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	10	574	11	190	***	0	1000	119	94	85	***	9955	**	**	***	**	**	***	**	**	***	***	29
2014	11	2	10	574	13	***	***	*	****	****	94	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	11	534	17	190	22	0	1000	150	116	80	***	10033	**	**	***	**	**	***	**	**	***	50	16
2014	11	2	11	536	-2	***	***	*	****	134	105	83	***	10016	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	11	536	1	220	***	*	****	132	102	82	***	10013	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	11	536	7	210	22	0	2000	140	119	87	***	10026	**	**	***	**	**	***	**	**	***	80	13
2014	11	2	11	536	15	190	22	*	****	142	110	81	***	10030	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	11	537	-4	***	***	*	****	128	91	78	***	10013	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	11	537	11	190	22	0	5000	149	144	97	***	10022	**	**	***	**	**	***	**	**	***	90	15
2014	11	2	11	538	4	220	***	0	2000	133	124	94	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	11	539	12	190	19	*	****	137	123	91	***	10019	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	11	540	7	210	21	0	2000	132	113	88	***	10015	**	**	***	**	**	***	**	**	***	90	14
2014	11	2	11	540	11	220	19	0	1000	134	125	94	***	10015	**	**	***	**	**	***	**	**	***	90	18
2014	11	2	11	542	16	200	***	*	****	138	122	90	***	10015	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	11	550	-15	***	***	*	****	130	122	***	***	9982	**	**	***	**	**	***	**	**	***	***	***

Table 5.18
OBSERVATIONS: SHIPS 201411_02
AREA RECTANGLE: 57.5N 53.4N 002.0W 002.0E

YEAR	MN	DY	HR	LAT	LON	DD	FF	WW	VIS	AIR	DEW	REL	SEA	MSLP	WP	WH	SDD	SP	SH	SDD	SP	SH	RES	MP	MH
2014	11	2	11	564	20	230	17	*	****	123	101	86	***	9988	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	11	568	11	***	***	*	****	****	101	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	11	570	18	200	***	0	1000	117	95	86	***	9965	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	11	570	18	190	21	0	1000	122	96	84	***	9978	**	**	***	**	**	***	**	**	***	60	28
2014	11	2	11	570	18	210	***	0	1000	123	123	100	***	9967	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	11	570	19	210	22	0	1000	119	99	88	***	9973	**	**	***	**	**	***	**	**	***	60	28
2014	11	2	11	570	19	***	***	*	****	****	99	***	***	*****	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	11	571	9	220	23	*	****	****	99	***	***	9958	**	**	***	**	**	***	**	**	***	60	26
2014	11	2	11	571	16	***	***	0	1000	121	95	84	***	9964	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	11	572	8	210	19	0	1000	128	98	82	116	9955	**	**	***	**	**	***	**	**	***	60	28
2014	11	2	11	572	16	200	***	0	1000	120	86	80	***	*****	**	**	***	**	**	***	**	**	***	***	23
2014	11	2	11	573	13	220	16	*	****	118	99	88	***	9965	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	11	573	16	210	20	0	1000	135	99	79	***	9965	**	**	***	**	**	***	**	**	***	60	27
2014	11	2	11	573	20	200	23	*	****	****	99	***	***	9966	**	**	***	**	**	***	**	**	***	70	28
2014	11	2	11	574	5	220	***	*	1000	121	99	***	***	9949	**	**	***	**	**	***	**	**	***	***	***
2014	11	2	11	574	11	200	***	0	1000	118	87	81	***	9953	**	**	***	**	**	***	**	**	***	***	30
2014	11	2	11	574	13	***	***	*	****	****	87	***	***	*****	**	**	***	**	**	***	**	**	***	***	***

Platform	Date / time	Wind speed offset (obs-model)	Wind speed Standard deviation	2 X SD (95%confidence limit)	Wave height offset (obs-model)	Wave height SD Standard deviation	2 X SD (95%confidence limit)
	UTC	knots	+/-knots	+/- knots	metres	+/-metres	+/- metres
North A	01/2100-02/1100	-5.8	2.5	5.0	-0.2	0.3	0.6
Mid B	01/2100-02/1100	1.8	2.6	4.2	-0.4	0.2	0.4
Mid C	01/2100-02/1100	-5.5	3.1	6.1	-0.4	0.2	0.4
South D	01/2100-02/1100	-1.3	2.0	4.0	-0.3	0.2	0.4
A **negative** offset means that the model has over-predicted wind / wave							

Table 5.19 Analysis from selected platforms, see Figure 3.1 (Observed – model)

5.0 **Weather radar charts** from 2100 UTC on 1 November to 1100 UTC on 2nd November 2014. Plots of hourly radar charts are shown in Figures 6.01 to 6.15 below

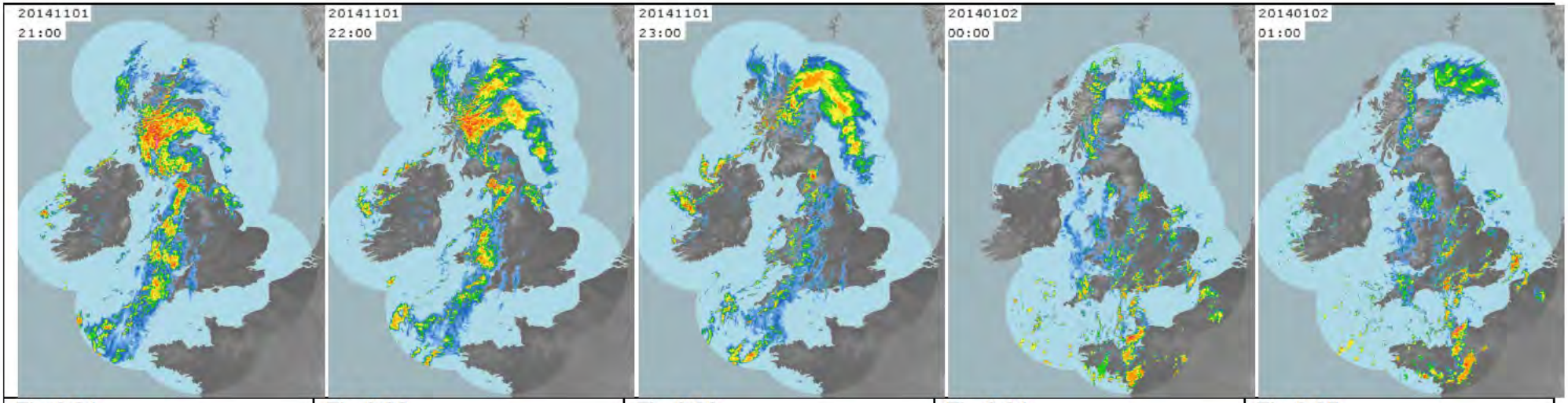


Fig 6.01	Fig 6.02	Fig 6.03	Fig 6.04	Fig 6.05

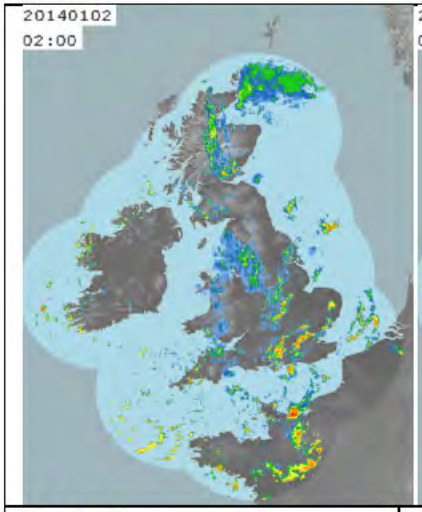


Fig 6.06

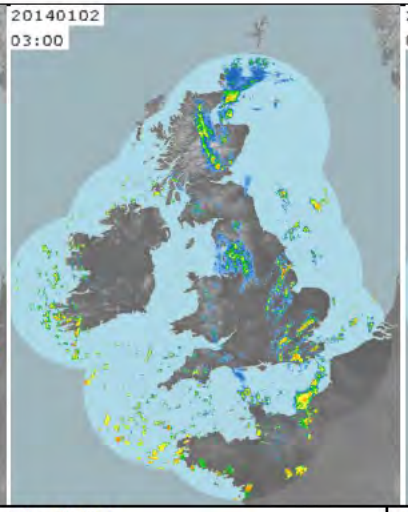


Fig 6.07

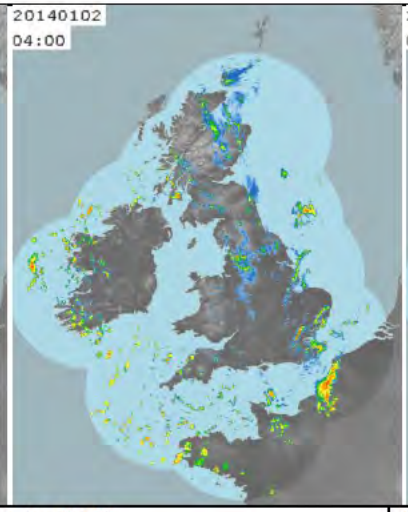


Fig 6.08

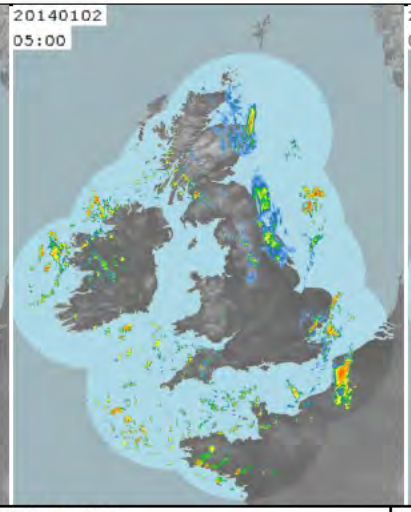


Fig 6.09

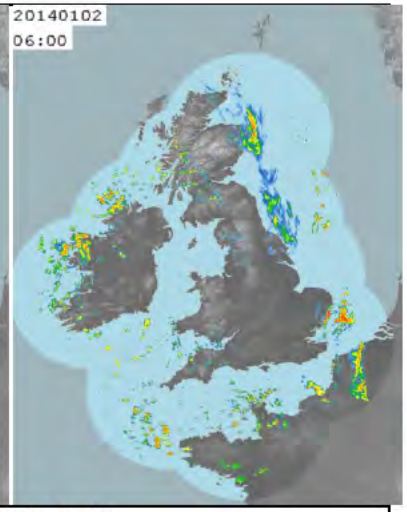


Fig 6.10

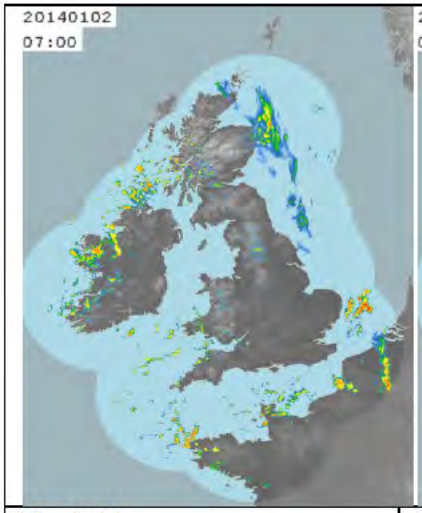


Fig 6.11

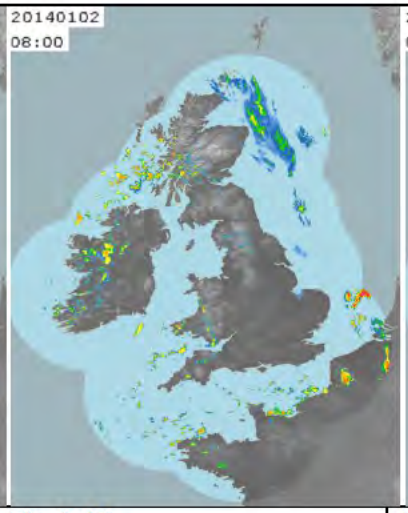


Fig 6.12

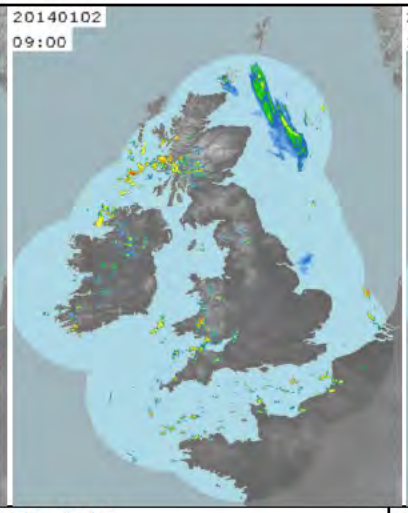


Fig 6.13

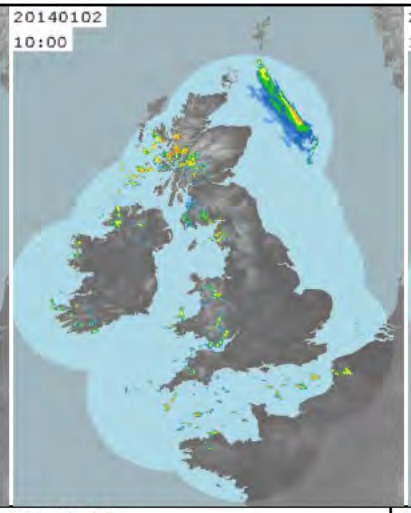


Fig 6.14

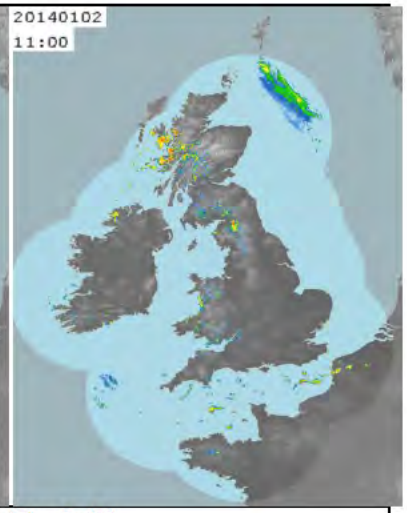
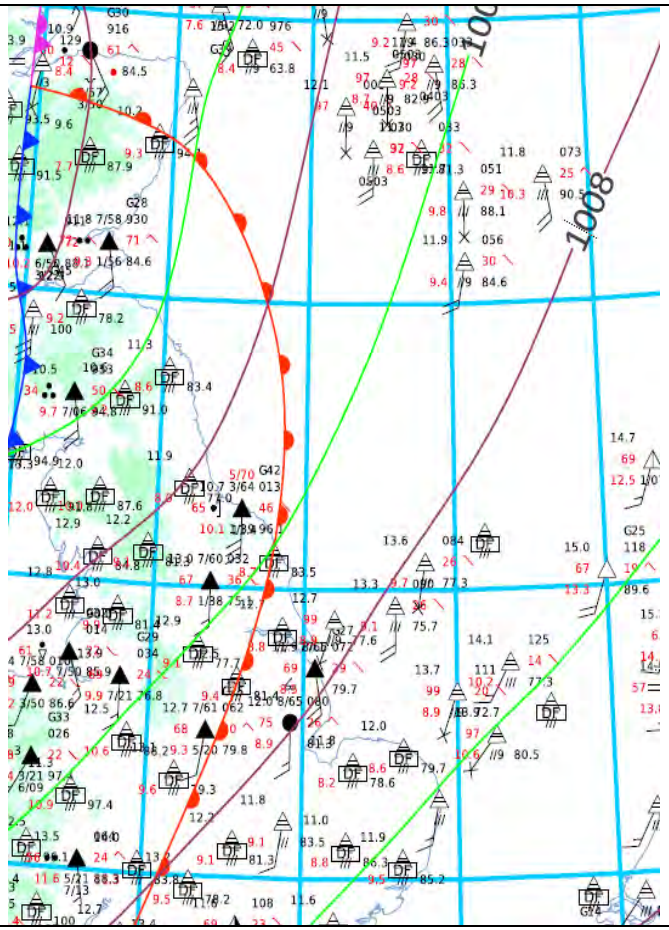
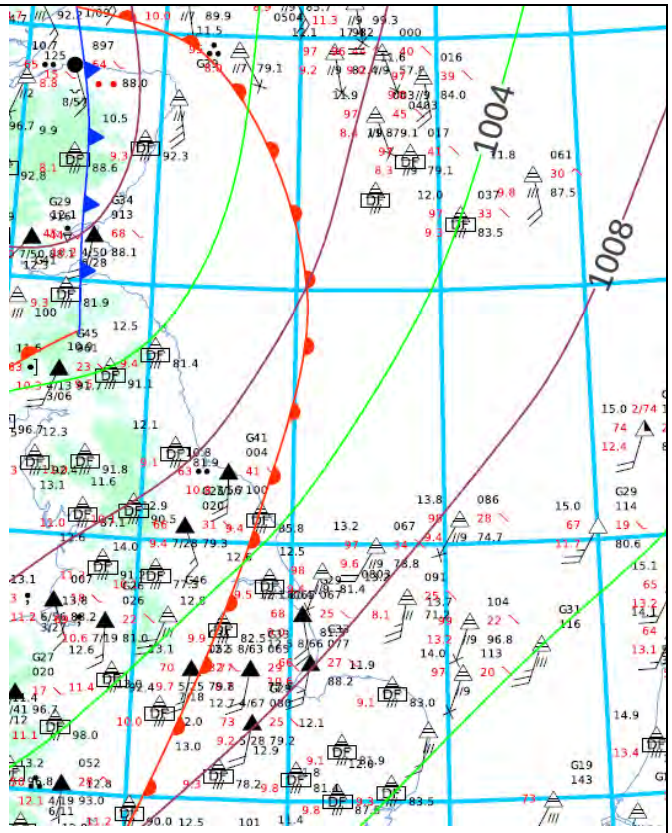


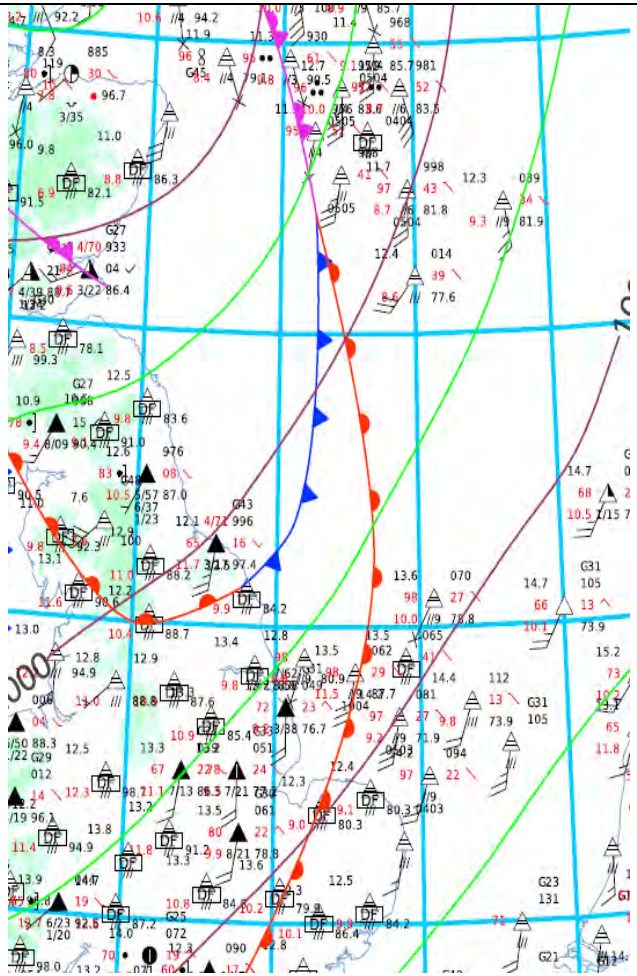
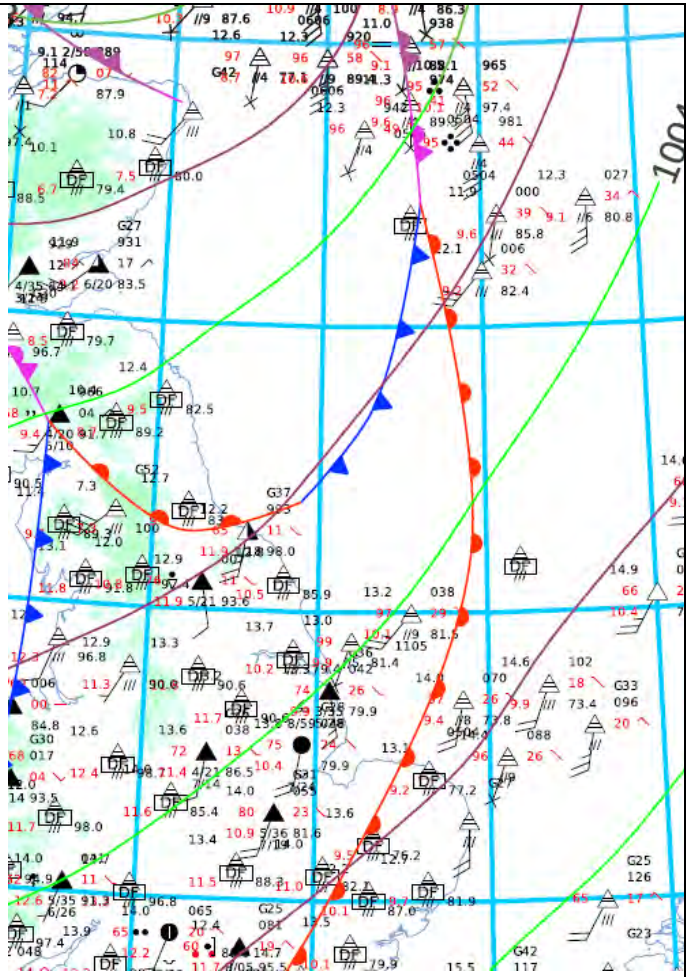
Fig 6.15

7.0 Synoptic Weather Charts

Plots of synoptic weather charts from 2100 1/11/2014 to 1100 2/11/2014 are shown in Figures 7.01 to 7.15 below.

There were no charts for 2100 on the 1st and 0000 on the 2nd (all times UTC)

		
Fig 7.01 20141101_21 UTC Missing	Fig 7.02 20141101_22 UTC	Fig 7.03 20141101_23 UTC

		
Fig 7.04 20141102_00 UTC Missing	Fig 7.05 20141102_01 UTC	Fig 7.06 20141102_02 UTC

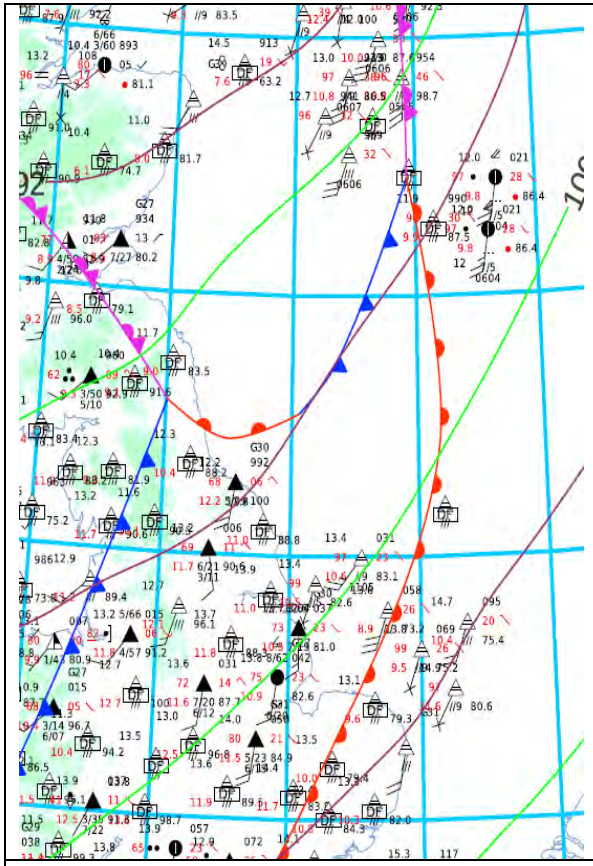


Fig 7.07 20141102_03 UTC

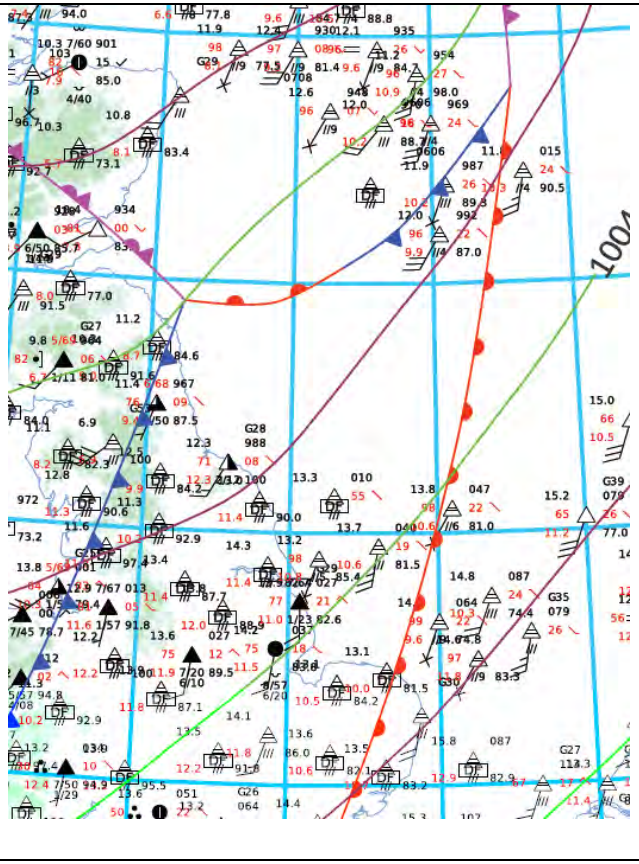


Fig 7.08 20141102_04 UTC

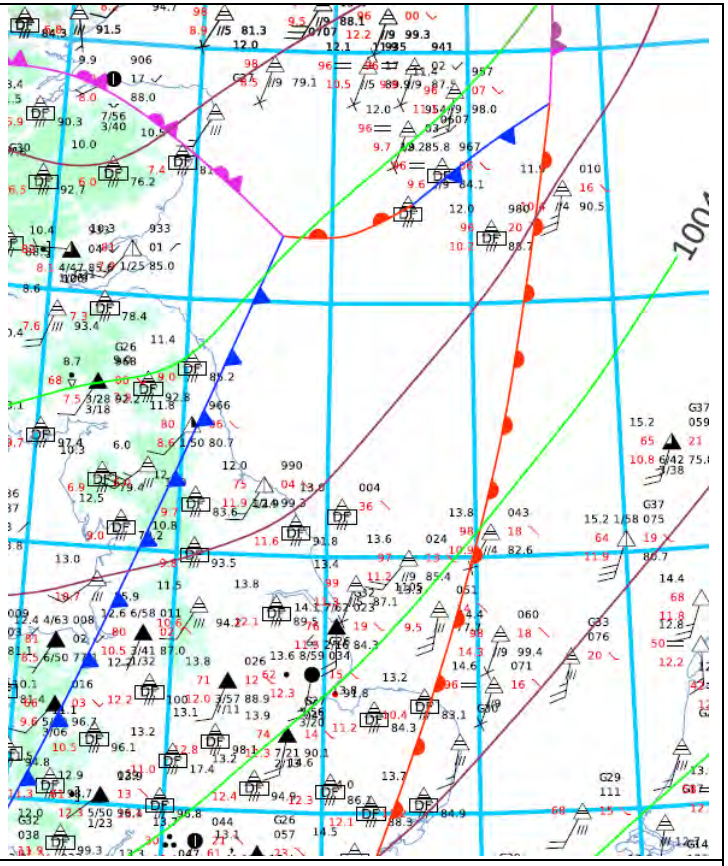


Fig 7.09 20141102_05 UTC

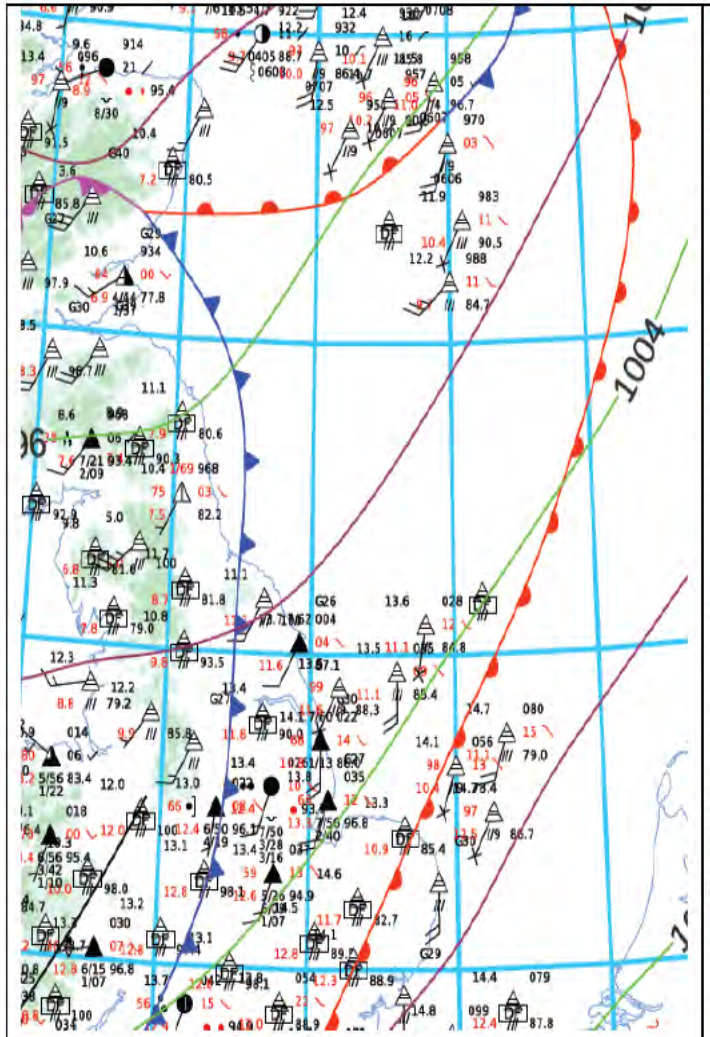


Fig 7.10 20141102_06 UTC

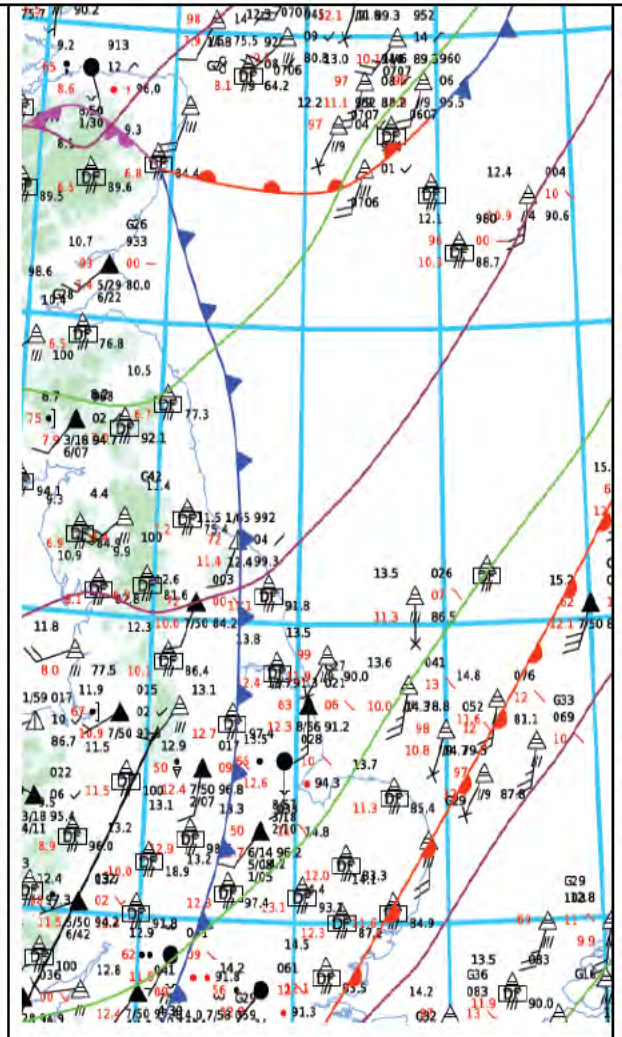


Fig 7.11 20141102_07 UTC

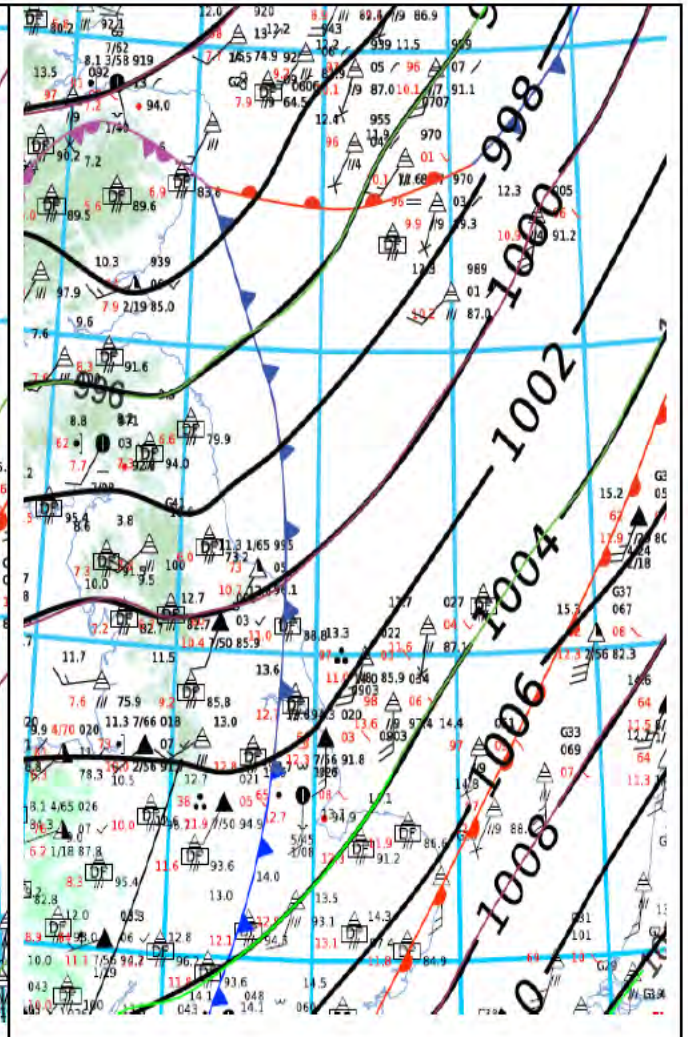


Fig 7.12 20141102_08 UTC

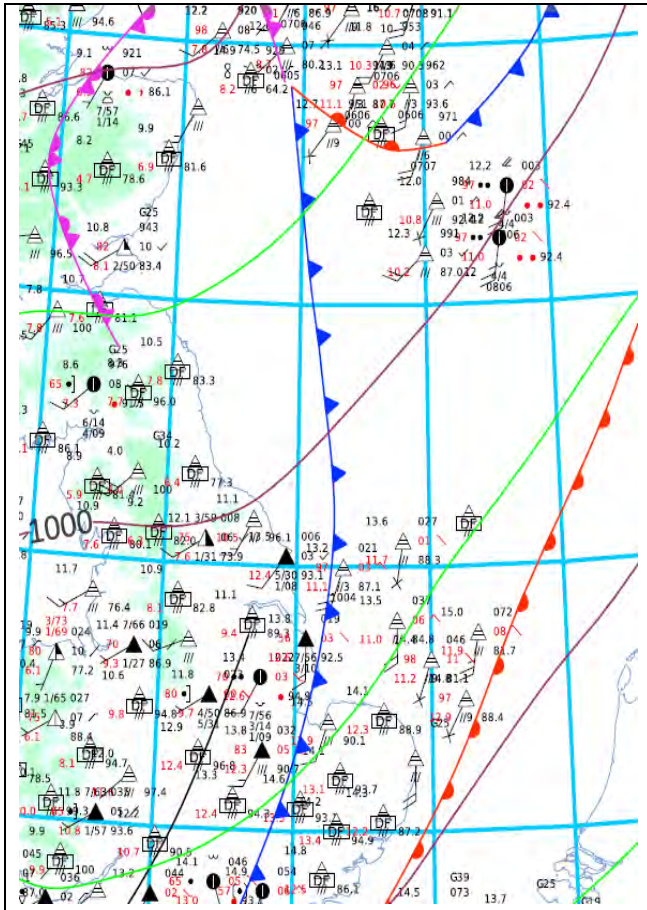


Fig 7.13 20141102_09 UTC

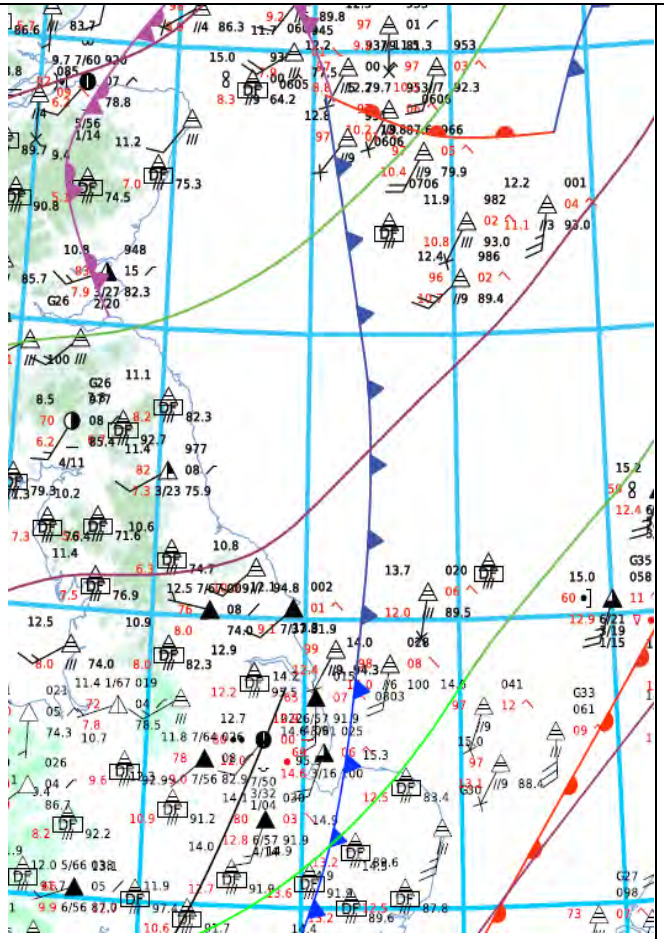


Fig 7.14 20141102_10 UTC

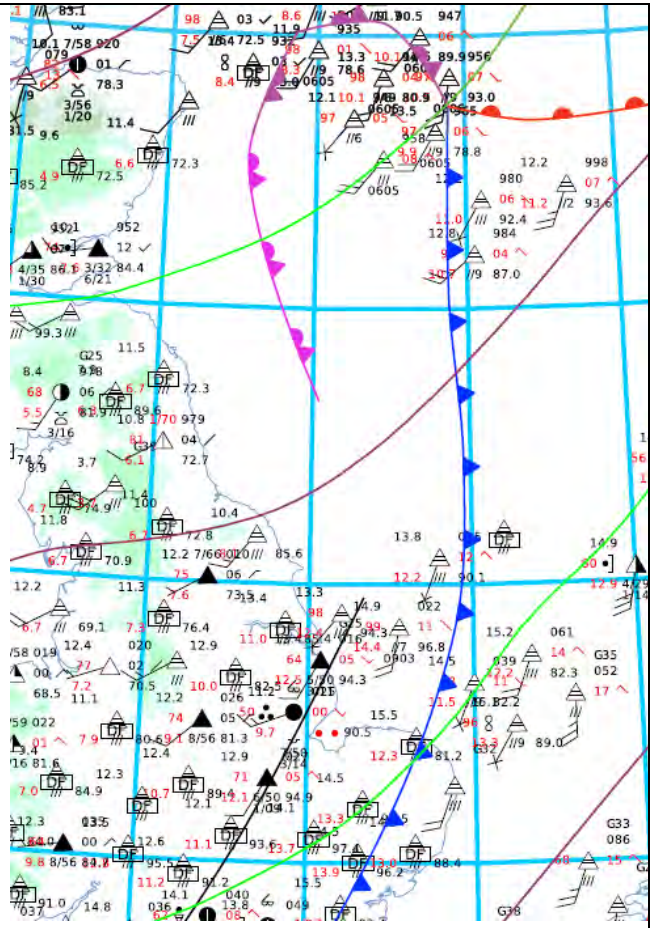


Fig 7.15 20141102_11 UTC

8.0 Discussion

8.1 **General situation**: refer to synoptic weather charts in section 7 and analysis charts in appendix B

At 01/1800 UTC a deep low, 974 hPa lay in SE Iceland. A secondary low 991 hPa was centred to the north of Malin Head at the same time. By 02/0600 UTC the secondary low had travelled northeast to lie north of Shetland, 981 hPa. Associated frontal troughs crossed the route of interest during the early hours of the 2nd. The cold front finally cleared the route between 1000 and 1100 UTC as it moved east on 2nd November 2014.

8.2 **Weather**

From a visual appraisal of the radar images in section 6, Ocean Way probably engaged with rain or showers from approximately 2300 UTC till 0400 UTC. Showers may have been present in the vicinity from 0700 to 0800 UTC. Rain or showers were not observed near the route of interest as seen from the images in the latter stages of the voyage i.e.1000 to 1100 UTC. With reference to Tables 5.01 to 5.18, fog was not reported at any of the platforms. Visibilities were generally good; 10 or 20 km. However, 4 km visibility was reported in mist on occasions throughout the night and during the daylight hours. Rain also affected visibility. 2 km was reported in moderate continuous rain at 0200 UTC at Platform 57.3N 02.0 E, Table 5.08. Otherwise, the lowest visibility reported in rain was 4 km.

Observations of sea surface temperatures were sparse. However, a sea surface temperature of 11.6 deg C was recorded at Platform A (57 deg N 000.80 deg E) at 1100 UTC on 2nd November 2014. The air temperature at that time was 12.8 deg C.

8.3 **Comparisons of model with observations, refer to Table 5.19**

There was good correlation between observed wind speeds and model at Platform B nearer to the route (Mid) and well south of the route, Platform D. There was good correlation between measured wave height (=significant wave height) at platforms A (North) and D (South).

The larger offset in wind speed at Platform A may have been due to anemometer exposure at the platform in a southerly wind, since waves agreed well at this location, and noting that within the model, wave height is driven by modelled winds. At Platform C the model over-predicted winds and waves, of approximately 5 knots and 0.4 metres respectively. As a result, it was inferred that the wave model provided reasonably good

guidance to the marine environment on the 1st and 2nd November 2014, with wind speeds accurate to within +/- 1 Beaufort force and wave height accurate to +/-0.4 metres, perhaps +/- 0.6 metres to the north of the route.

8.4 **Winds** Refer to Tables 4.1 and 4.2

As Ocean Way left port, she engaged with a southerly wind modelled at force 6. Towards midnight and through the early hours the southerlies increased force 7 with 10 metre wind speeds of around 30 knots. Gusts can be as much as 1.4 times this amount which indicates that Ocean Way could have experienced gusts of 43 knots. Southerly winds decreased to a modelled force 6 during the early hours of the 2nd, and veered slowly to the SSW at a fairly steady force 6 through the latter stages of the night and into the morning with a veer into the SW sector by approximately 0900 UTC. As the cold front cleared between 1000 and 1100 UTC the winds veered further, still within the SW sector and decreased force 5. Gusts around this time could have reached 31 knots.

8.5 **Seas** Refer to Tables 4.1 and 4.2

From these tables; it can be inferred that Wave Comp 0 refers in the main to wind wave. Wave comp 2, 3, 4 can be regarded as primary, secondary and tertiary swells.

Significant wave height increased from slight to moderate within the first hour of the voyage. As she headed into open waters of the North Sea, significant wave height increased into the rough category, by midnight beginning the 2nd of November. Wave height was modelled at a steady height of around 2.8 metres through the early hours and into the daylight hours of the 2nd of November. As winds decreased and veered a commensurate decrease was modelled in significant wave height to approximately 2.5 metres, just into the moderate category. However, with reference to Table 5.19, significant wave height may have been 0.2 to 0.4 metres below these modelled values.

Taking the figures as they stand, with a maximum significant wave height of 2.8 metres and a zero upcrossing period of 5 seconds an individual maximum wave height trough to crest, could have reached 5.6 metres over a 6 hour sampling period.

Of note is the primary swell (Wave Comp 1 in Table 4.0 and 4.1) at an angle of approximately 50° to the wind wave direction, throughout most of the voyage. Wave heights of both wind wave and primary swell converged commensurately and peak periods were very similar towards the latter stages of the voyage. During this time, 1000-1100 UTC, Ocean Way would have been impacted by wind wave astern (to starboard), and abeam to starboard by primary swell (approximately 1.6 metres by 1100 UTC). An individual maximum wave could have reached 4.7 metres trough to crest within a 60 minute sampling time. In addition a SSW then S going current between 1000 and 1100

(modelled at 0.34 reducing 0.26 knots UTC) would have opposed the SSW to SW wind wave, causing steeper waves than normal.

The author is not an expert on the impacts of wave trains against seagoing vessels.

9.0 Conclusion

Ocean Way endured a rough passage as she headed north eastwards into the North Sea. Southerly or south-southwest winds blew strong force 6 or 7 with gusts of 43 knots possible during the early hours of the 2nd of November and gusts of 31 knots towards the end of the voyage. Wind direction veered to the southwest from 0900 UTC.

Significant wave height was in the moderate or rough category throughout the voyage. Individual maximum waves, measured from trough to crest could have reached 5.6 metres during the period 0100 to 0700 UTC. Towards the end of the voyage, 1000-1100, UTC, an individual maximum wave could have reached 4.7 metres within a 60 minute sampling time.

In addition, Ocean Way would have been impacted by a wind wave astern (to starboard) of peak period 8 seconds, and abeam (to starboard) by an increasing primary swell of peak period 8 or 9 seconds. Also during the latter stages, 1000 to 1100 UTC, a SSW then S going current would have opposed the SSW to SW wind wave, causing steeper waves than normal.

10.0 Experience and Qualifications of the Author

10.1 The Met Office is the national meteorological service for the United Kingdom and is a leading member of the World Meteorological Organisation (WMO), which is an agency of the United Nations. In addition to national responsibilities (such as the issue of Shipping Forecasts for waters around UK), the Met Office also has a wide range of global weather analysis and forecasting commitments, for land applications, aviation and the maritime community.

10.2 The author is currently employed as a Senior Scientist in Weather Analytics within Weather Science at the UK Met Office. He became a forecaster in the organisation in 1978 after completion of the Applied Meteorology Course (post grad) at the Met Office College. From 1982-1985 and 1986 to 1988 he was employed by IAL in the Gulf. In the United Kingdom, his forecasting career was spent in the Met Office, specialising in marine forecasting at Aberdeen & London for North Sea Oil operations 1985-86. From 1988-1998, whilst forecasting at Southampton, he provided international team briefings for the Admiral's and Commodore's cup at Cowes IOW. From 1999-2004 he acted as a forecaster at the International Forecast Unit in Bracknell and Exeter, providing forecasting services to the global marine market. Between 2001 and 2004 he specialised in compiling the United Kingdom Shipping Forecast and the Atlantic High Seas Forecast. He is also a Fellow of the Royal Meteorological Society.

10.3 I confirm that I have made clear which facts and matters referred to in this report are within my knowledge and which are not. Those that are within my own knowledge I confirm to be true. The opinions I have expressed represents my true and complete professional opinions on the matters to which they refer.

14th November 2014

APPENDIX A: GLOSSARY OF TERMS

Table A1 WAVE DEFINITIONS

SEA STATE – WMO Code 3700

Code	Description	Height in metres
0	Calm – glassy	0
1	Calm – rippled	0.1 or less
2	Smooth – wavelets	Over 0.1 to 0.5
3	Slight	Over 0.5 to 1.25
4	Moderate	Over 1.25 to 2.5
5	Rough	Over 2.5 to 4.0
6	Very rough	Over 4.0 to 6.0
7	High	Over 6.0 to 9.0
8	Very high	Over 9.0 to 14.0
9	Phenomenal	Over 14.0

SWELL WAVES

Description	Height in metres
Very low	1 or less
Low	Over 1 to 2
Moderate	Over 2 to 4
Heavy	Over 4

FURTHER COMMENT ON THE DEFINITIONS

In relation to the **state of sea (sea state)** code above, the following guidance is provided is provided within the WMO Manual on Codes (Volume I.1, Part A):

> "These values refer to well-developed wind waves of the open sea. While priority shall be given to the descriptive terms, these height values may be used for guidance by the observer when reporting the total state of agitation of the sea resulting from various factors such as wind, swell, currents and angle between swell and wind, etc"

While sentence one states that the sea state code relates to wind waves, the remainder of the paragraph suggests that it can be used to describe the resultant wave heights associated with both wind waves and swell. As such the above description of **state of sea (sea state)** is considered to be the same as the **significant wave height** and indicates the wave height resulting from the combined effect of wind waves and swell waves. Further information can be found in section 2.

Table A3	BEAUFORT SCALE OF WIND: EQUIVALENT SPEEDS

FORCE	DESCRIPTION	EQUIVALENT SPEED (KNOTS)	
		MEAN	LIMITS
0	CALM	0	Less than 1
1	LIGHT AIR	2	1 – 3
2	LIGHT BREEZE	5	4 – 6
3	GENTLE BREEZE	9	7 – 10
4	MODERATE BREEZE	13	11 – 16
5	FRESH BREEZE	19	17 – 21
6	STRONG BREEZE	24	22 – 27
7	NEAR GALE	30	28 – 33
8	GALE	37	34 – 40
9	STRONG GALE	44	41 – 47
10	STORM	52	48 – 55
11	VIOLENT STORM	60	56 – 63
12	HURRICANE	--	64 and over

FURTHER COMMENT ON THE DEFINITIONS

1 knot = 0.515 metres/sec = 1.85 km/hour = 1.16 statute miles/hour

A **Gale (Force 8)** is a mean wind speed in the range 34 to 40 knots. In general, the term 'gale' implies a mean wind speed of 34 knots or above over a period of at least 10 consecutive minutes. The term **Strong Gale (Force 9)** is used when the mean wind speed lies in the range 41 to 47 knots, over a period of at least 10 consecutive minutes.

APPENDIX B: ANALYSIS CHARTS

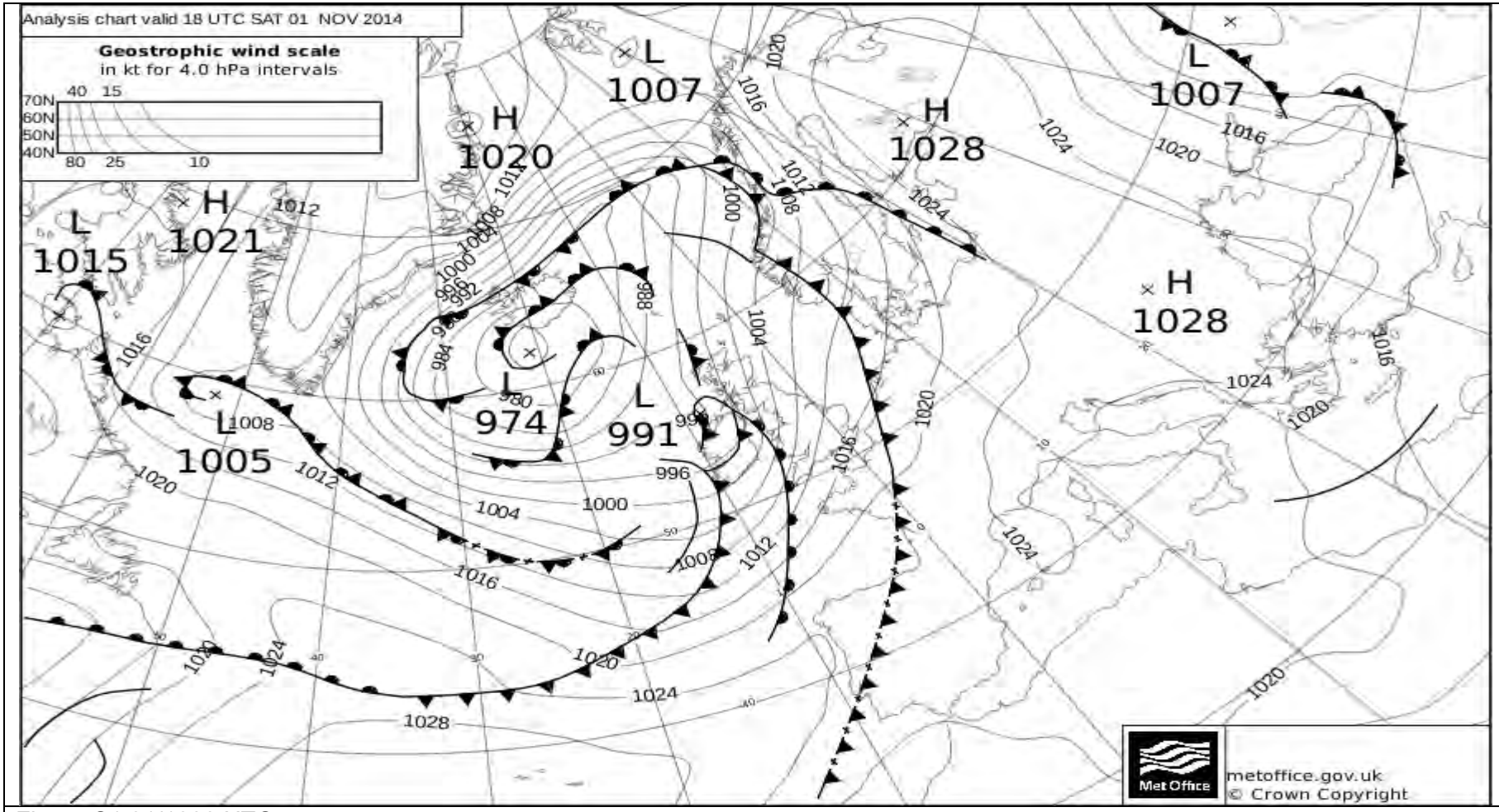


Figure C1 01/1800 UTC

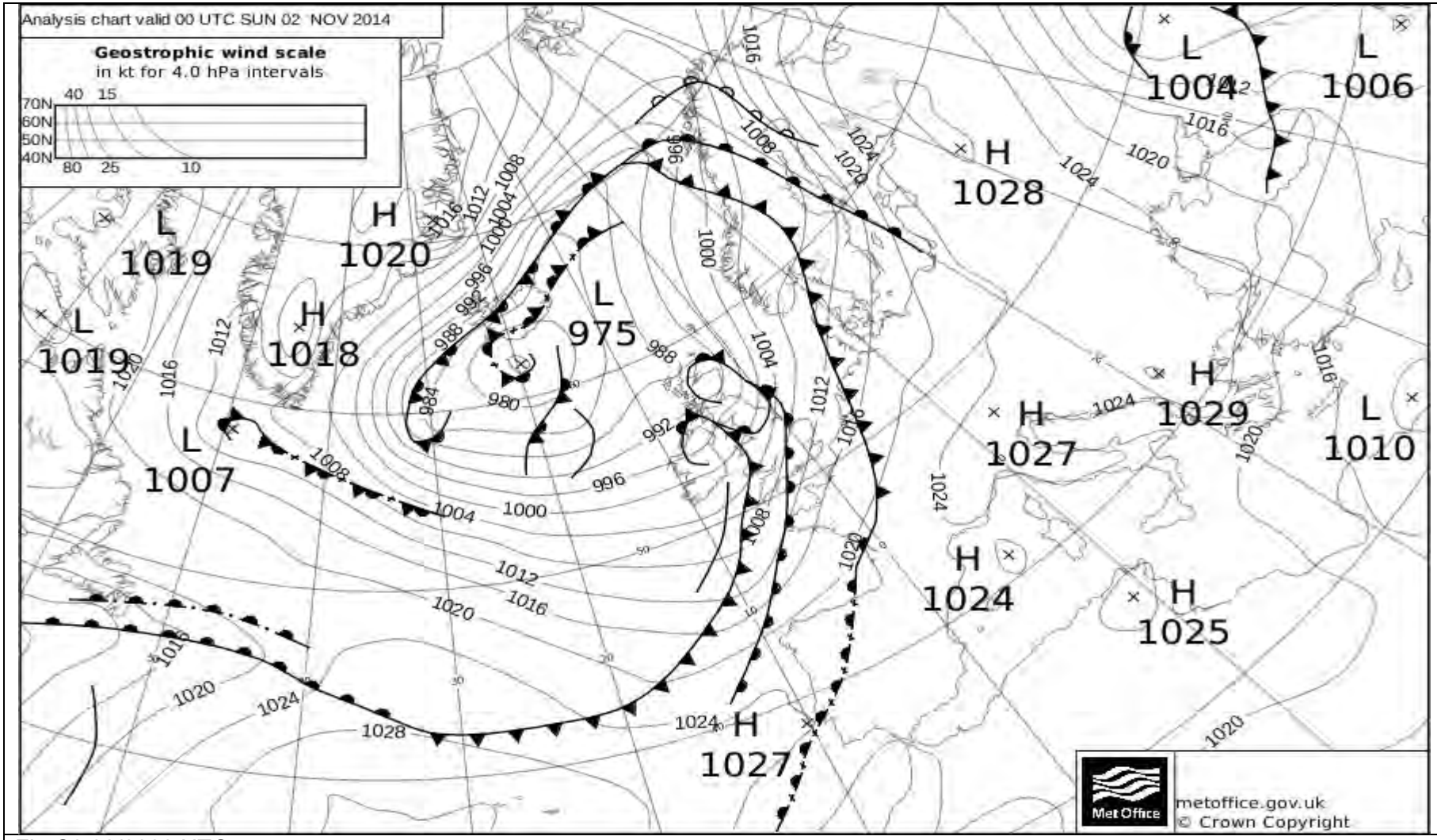


Fig C2 02/0000 UTC

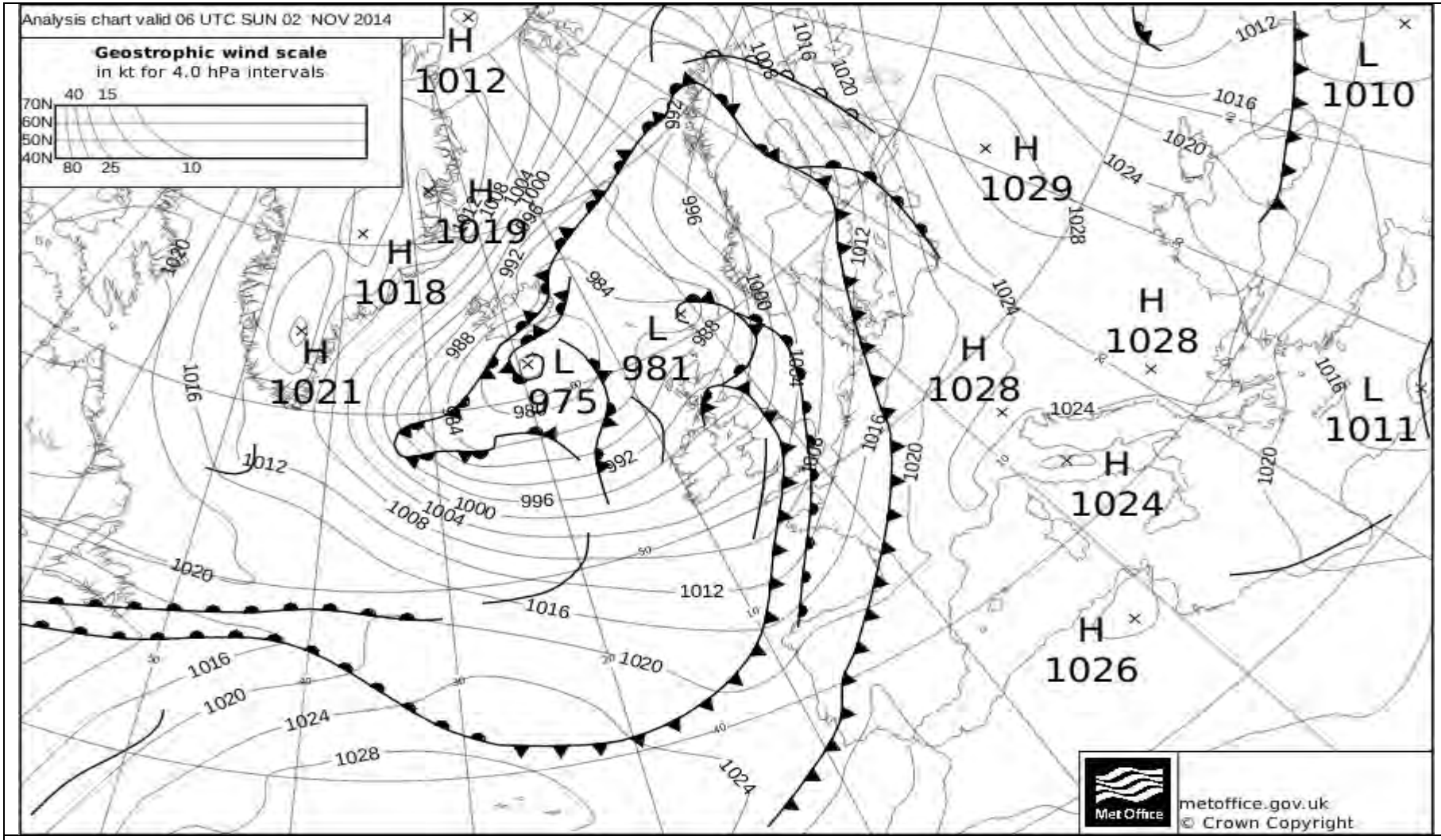


Fig C3 02/0600 UTC

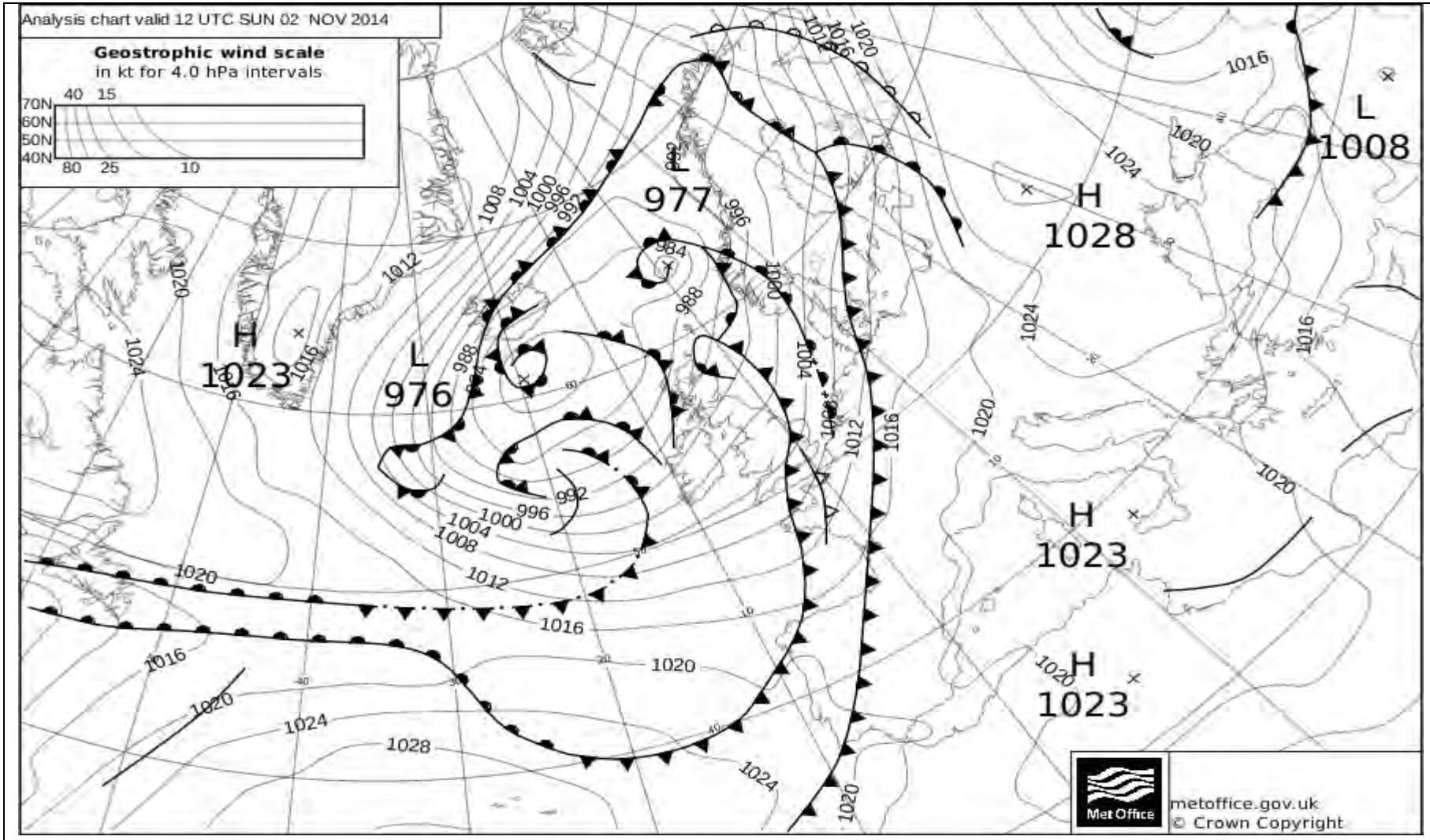


Fig C4 02/1200 UTC

Ocean Way, Record of Particulars (extract)

PORTHOLES AND WINDOWS

Position	Type	Size	Blank / Deadlight

SKYLIGHTS

Position	Type	Size	Blank / Deadlight Material

Guard Rails to Rule Height	3 Tier 0.94 high around shelter top
Portable Wires / Rails	
Safety Harnesses	2 carried ✓
Lifelines	d/cssd not rigged

WATER FREEING ARRANGEMENTS

Deck	Length of Bulwark	Height of Bulwark	Size of Freeing Ports	Number on each Side	Means of Closure
Shelter	7.85	2m	310 x 460	3	Flap
Aft Deck	3.5	0.76	310 x 460	1	Flap

Actual area each side	0.57m2	Rule area each side	0.88

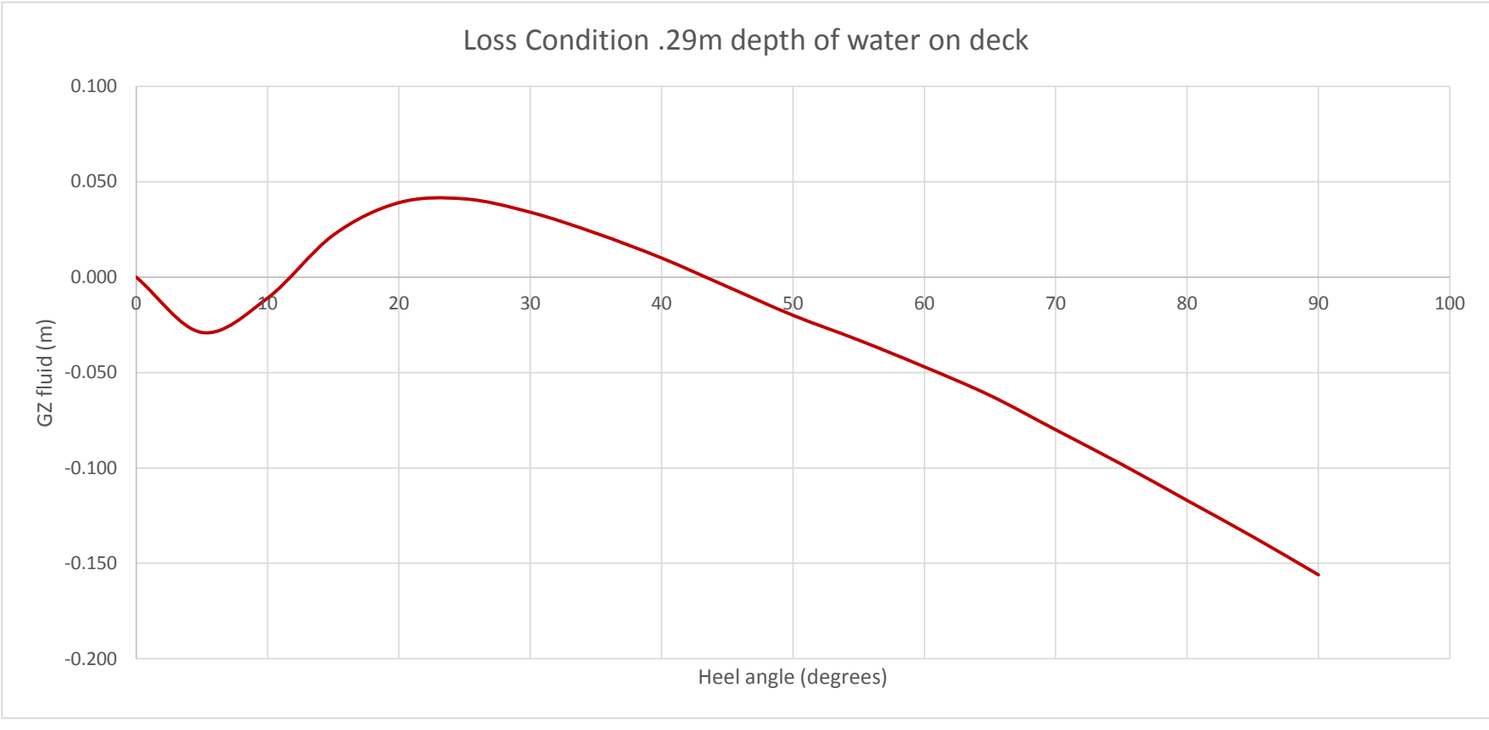
PUMP DRAINAGE SYSTEM

Space	Type	Capacity	Backup Arrangements

Ocean Way stability calculations for loss condition

STABILITY SUMMARY	Minimum	Actual
Angle of immersion of ENGINE ROOM VENTS (degrees).....	-	45.89
Area under GZ curve between 11.66 and 30.00 degrees (metre.radians)....	0.06	0.00
Area under GZ curve between 11.66 and 40.00 degrees (metre.radians)....	0.09	0.00
Area under GZ curve between 30.00 and 40.00 degrees (metre.radians)....	0.03	0.00
Maximum GZ (metres).....	0.20	0.04
Angle of heel at which maximum GZ occurs (degrees).....	25.00	23.77
Maximum GZ between 29 and 90 degrees (metres).....	0.20	0.04
Positive GZ heel range (degrees).....	-	0.00
GM solid (metres) (at angle of equilibrium).....	-	1.27
Free Surface correction (metres).....	-	0.88
GM fluid (metres) (at angle of equilibrium).....	0.35	0.40

STABILITY SUMMARY (CONTINUED)	Maximum	Actual
Angle of equilibrium (degrees).....	-	11.66



SAILING STATE
Loss condition

DRAFT SUMMARY (DIMENSIONS IN METRES)	Maximum	Actual
Draft forward to usk at FP.....	4.033	2.027
Draft amidships to usk.....	2.716	2.521
Draft aft to usk at AP.....	3.246	3.016

FREEBOARD SUMMARY (DIMENSIONS IN METRES)	Minimum	Actual
Freeboard forward to focsle top at FP.....	1.177	2.908
Freeboard amidships to main deck.....	0.388	-0.054
Freeboard aft to main deck at AP.....	0.654	0.342

STABILITY DATA

Heel angle degrees	Trim about Base L metres on LBP	Draft at midships LBP about Base Line	KN metres	KGxSIN(Heel) metres	Righting moment tonne.metres	GZ fluid metres
0	0.173	2.567	0.000	0.000	0.000	0.000
5	0.150	2.568	0.270	0.298	-3.411	-0.029
10	0.163	2.535	0.583	0.595	-1.338	-0.011
15	0.192	2.487	0.908	0.886	2.565	0.022
20	0.240	2.434	1.210	1.171	4.587	0.039
25	0.312	2.375	1.488	1.447	4.852	0.041
30	0.410	2.306	1.746	1.712	4.071	0.034
35	0.533	2.224	1.987	1.964	2.711	0.023
40	0.679	2.127	2.210	2.201	1.156	0.010
45	0.848	2.012	2.416	2.421	-0.559	-0.005
50	1.004	1.877	2.603	2.623	-2.372	-0.020
55	1.206	1.731	2.771	2.805	-3.942	-0.033
60	1.412	1.571	2.918	2.965	-5.552	-0.047
65	1.611	1.401	3.041	3.103	-7.378	-0.062
70	1.796	1.223	3.137	3.217	-9.498	-0.080
75	1.974	1.036	3.209	3.307	-11.654	-0.098
80	2.141	0.843	3.255	3.372	-13.856	-0.117
85	2.300	0.645	3.275	3.411	-16.156	-0.136
90	2.458	0.442	3.268	3.424	-18.535	-0.156
	by stern					

Loss condition

DEADWEIGHT TABLE
Loss condition

Vessel....: OCEAN WAY FR 349
Condition.: 2:Loss condition 05% deck flooding
State.....: Hull without added appendages
Water SG..: 1.025
Compliance: Vessel fails requirements in this condition

Longitudinal dimensions about AFT PERPENDICULAR (-ve aft, forward)
Vertical dimensions about BASE LINE (above, -ve below)

	Deadweight Item	Weight tonnes	LCG metres	Longitudinal moment t.m	VCG metres	Vertical moment t.m	Free Surface moment t.m
1	OIL FUEL AFT PORT	3.183	2.231	7.101	2.403	7.649	0.334
2	OIL FUEL AFT STBD	3.183	2.231	7.101	2.403	7.649	0.334
3	OIL FUEL FORE PEAK	0.930	15.639	14.544	2.737	2.545	0.129
4	FRESHWATER PORT	0.970	9.653	9.363	0.747	0.725	0.725
5	FRESHWATER STBD	0.970	9.653	9.363	0.747	0.725	0.722
6	CREW & STORES	0.500	11.000	5.500	3.500	1.750	-
7	FISHING GEAR	7.100	4.924	34.960	3.777	26.817	-
8	ICE IN LOCKERS	4.000	5.700	22.800	2.300	9.200	-
9	120 EMPTY PLASTIC BOXES	0.540	5.500	2.970	2.400	1.296	-
10	Deck tank	6.444	5.930	38.213	3.236	20.853	102.127
	DEADWEIGHT TOTAL	27.820	5.461	151.917	2.847	79.208	104.371
	LIGHTSHIP	91.000	8.208	746.928	2.453	223.223	-
	DISPLACEMENT	118.820	7.565	898.845	2.545	302.431	104.371

Free Surface Correction (Total Free Surface Moment/Displacement)	0.88
VCG fluid	3.42

Coastguard procedure for transferring incident co-ordination

Extracts from OmS

SOP Extract – “Satellite Distress Beacon Alerts (GMDSS)”

(http://oms.mcga.gov.uk/oms_procedures/satellite_distress_beacon_alerts_gmdss.htm)

406 Detect Only Alerts

In the event of a detect only (no position) 406 alert, MRCC Falmouth will assume coordination until the position is confirmed

If information is gained that the vessel is registered to a UK port or uses a certain area, then Falmouth will contact the relevant MRCC and may ask them to undertake local information gathering

Falmouth remains the coordinating station and the other MRCC becomes an action station until such time as the position is confirmed

406 Unresolved Alerts

If an unresolved alert is received with one position in the UKSRR and the other outside the UKSRR, MRCC Falmouth will assume initial coordination. Falmouth will discuss the alert with the other RCC and agree the action to be taken

If the alert subsequently resolves to the UKSRR then Falmouth will formally pass coordination to the appropriate MRCC, with Falmouth acting as a supporting station thereafter

If both positions are in the UKSRR, Falmouth will assume initial coordination until such time as the position resolves or information is gathered proving the actual position. At this point, coordination will be formally handed to the appropriate MRCC

Op Detail Extract – “Incident Coordination”

(http://oms.mcga.gov.uk/oms_operational_detail/incident_coordination.htm**)**

Transfer of Co-ordination

It is not normally desirable to change responsibility for the overall co-ordination of an incident that is in progress. Technology allows us to co-ordinate incidents in the partner MRCC's AoR and future technology will almost certainly give us easy access to the non partner flank station

The circumstances under which co-ordination of an incident is transferred will depend largely on the length of time an incident has been running and its severity

If transfer of co-ordination between MRCCs is deemed necessary, it must be effected in an orderly manner

A fully completed SAR Sitrep should be sent from the old to the new co-ordinating station, copied to the Duty Area Officer(s). If out of hours then the DAOs should be paged. The Co-ordination Transfer Form format should be used as a guide to the information required in the SAR Sitrep.

Before any transfer is finalised, the respective SMCs are to discuss any outstanding issues, satisfy themselves that all relevant information has been transferred and ensure that there is no doubt about asset tasking

Information to be Passed

To ensure a comprehensive and transfer, the Co-ordination Transfer Form should be used. This should form the basis of an orderly transfer of responsibilities. Before any transfer is finalised, the SMCs are to discuss any outstanding issues.

In the case of a major incident involving a large number of SRUs and/or complex plans, a more comprehensive approach to the handover is necessary

Other Considerations

SAR units and any other participants are to be fully briefed before the changeover and an agreed communications policy established

A SAR SITREP should be sent and an amendment to any broadcast action already taken made by the outgoing MRCC to advise of the transfer of co-ordination

Once the transfer has been affected, a confirming message by GD92 or fax is to be sent from the MRCC assuming co-ordination to the previous co-ordinating MRCC. It must be logged into the incident narrative at both stations so that there is no subsequent doubt as to when co-ordination transferred

There may well be further action required of the initial co-ordinating station and full use should be made of their resources and local contacts. Care should be taken to avoid duplication of effort particularly when dealing with outside agencies. Any significant devolvement of responsibility should when practical be backed up by a GD92 message or fax for reference

Safety Flyer to the fishing industry

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

FLYER TO FISHING VESSELS

Capsize and sinking of the fishing vessel *Ocean Way* with the loss of three lives, 2 November 2014

Image courtesy of SY. Photos and Trawler Photos

Figure 1: Fishing vessel *Ocean Way*

Narrative

At 1058 on 2 November 2014, the 17m, twin rig fishing vessel *Ocean Way* **(Figure 1)** capsized and subsequently sank about 100 miles off the north-east coast of England while on passage to its fishing grounds. Two of the crew were rescued about 3 hours later when the body of the skipper was also recovered; the other two crew have not been found.

Ocean Way had left North Shields the previous evening and was heading north-easterly towards the Gut fishing grounds, about 120 miles offshore. The wind was south-south-west Force 6 with a heavy southerly swell and very rough sea.

At about 1056 the skipper, who was in the wheelhouse, shouted down to the four crewmen in the cabin to get out, as the vessel was going down. Two of the crew, wearing tee shirts and shorts, managed to climb up and out of the accommodation and over the rails as the vessel capsized. The men then managed to climb onto the upturned hull from where they saw the skipper and another crewman, unresponsive, in the water.

At 1058 a signal from the vessel's EPIRB was received at the UK's search and rescue satellite receiving centre and this information was passed to the MCA at 1101. The EPIRB was not fitted with integral Global Navigation Satellite System and so the signal identified the vessel, but not its position. A number of satellite passes were necessary before the EPIRB's position could be confirmed, which took about 50 minutes.

The two crewmen remained on the upturned hull for about 30 minutes until the vessel sank under them. Two lifebuoys floated to the surface and the men used these to keep themselves afloat.

The coastguard issued a “Mayday Relay” broadcast for the vessel and, once they had an accurate position about an hour after the accident, tasked a rescue helicopter. This helicopter arrived at the scene about 3 hours after the capsize.

Wreck survey

An underwater ROV survey of the wreck found the vessel upright and intact with no visible signs of damage. The rudder was hard to port. Some of the freeing ports were found jammed, and others had been reduced in size. The shelter deck behind the wheelhouse opened on to the aft deck and was not weathertight.

Ocean Way’s two liferafts had not floated to the surface after the accident. The ROV survey found that the hydrostatic releases on both liferaft canisters had activated correctly, but their painters led into the accommodation. It was concluded that once out of their cradles the liferaft canisters had floated into the inverted vessel’s shelter deck area, where they had become trapped.

Analysis

It is probable that *Ocean Way* broached and capsized in high following seas. The vessel’s stability, which would have been reduced while surf riding, was probably further reduced due to entrapped water on deck as, unlike its sister vessels, its shelter deck area was not weathertight. It was calculated that with around 6 tonnes of water on deck (about a foot of water), the vessel would have become unstable.

Ocean Way was 40 years old and was well regarded for its seakeeping qualities, yet its survey records showed a history of marginal stability compliance. No inclining test had been carried out since 2004.

Safety Lessons

- If *Ocean Way*’s EPIRB had been fitted with an integral GNSS receiver the rescue services would have arrived sooner.
- The water trapped on deck had an adverse effect on stability. Had the freeing ports been of the correct size and functioning this water would have been able to drain more quickly. Further, the amount of trapped water could have been significantly reduced had the shelter deck been made weathertight.
- Quartering seas create a broaching risk for well-found vessels, and can be exceptionally hazardous to vessels with marginal stability.

This flyer and the MAIB’s investigation report are posted on our website: www.gov.uk/maib

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Marine Accident Investigation Branch
November 2015

MCA Surveyor Advice Note re Fishing Vessel Freeing Ports

	Maritime and Coastguard Agency SURVEYOR ADVICE NOTE	Document number: SAN 72
Revision: 01	**FISHING VESSEL FREEING PORTS**	Date: 02 March 2015
Target document:	MSIS 27 - Fishing Vessels Chapter 2 /Rev 2/Page 25 of 35 Paragraph 2.12.14 Freeing ports	
Distribution	HQ and Marine Offices Class Societies, Recognised Organisations, Red Ensign Group	
Expiry date:	When included in Instructions	

Key Changes

As a result of an MAIB Investigation, more detailed information and survey instructions have been identified as a necessary amendment to the Instruction to Surveyors for Fishing Vessels with respect to Freeing Ports.

All amendments are highlighted in yellow.

Sections 2.12.14 and 2.16 of MSIS 27 are amended as follows:

2.12.14 Freeing ports

2.12.14.1

Freeing ports are openings in the bulwarks on open deck to allow water to drain directly overboard.

Water on deck is a factor which is to be avoided in the day to day operation of a fishing vessel. Where the weather deck is enclosed by bulwarks it must have freeing ports, to allow rapid clearing of water under all weather and sea conditions.

As constructional precautions against capsizing, at each survey it is to be verified that the vessel has an adequate number of freeing ports in proper locations for getting rid of water rapidly. Reference is to be made to details with respect to freeing ports in the Record of Particulars MSF 1301.

If an emergency exit is located in the well formed by the bulwarks, then freeing ports should be located nearby. The arrangement of the freeing ports shall be carefully considered to ensure the most effective drainage of water trapped on the weather deck.

Rule requirements have been based upon past experience and removal of water trapped on deck makes a significant contribution to the vessels safety. **Existing areas which are deficient should be increased.** Freeing ports are to be completely

free of any obstructions such as pots, nets or debris of any kind. Lower edges of freeing ports shall be as near to the deck as is practicable.

Where shutters are fitted to freeing ports the surveyor should ensure that these shutters can operate freely, comply with the requirements, and any safety bars are securely attached.

Before vessels depart for areas subject to icing the shutters should be kept in the open position or removed.

2.12.14.2 When assessing freeing port arrangements, surveyors should ensure that water is removed from the deck as quickly as possible and that freeing ports are disposed in such a way that they will achieve this. Freeing port areas should be calculated using the following formulae:

2.16 Shelters open only at the after end

[Insert: Diagram from MSIS 27 2.16 refers]

2.16.1 With the arrangement in the diagram, the probability of water entering the shelter space is much reduced. Thus, whilst for the open deck aft the freeing port area should be determined in accordance with the applicable formulae and located in that section, for the shelter space the required freeing port area may be determined in accordance with the following formula:

As = 0,04 x a x ls (m2)

Where 'a' = width of opening in the after end of the shelter (m). (Where the port and starboard openings differ in width the greater value is to be used).

'ls'= length of shelter assumed (m) = L – la – lwf and

lwf = 0,1L or the length of an intact forecastle whichever is the greater where

L = la + ls + lwf, i.e the length of the deck.

2.16.2 Where the length of the shelter is reduced on one side due to the inclusion of an intact space, the freeing port area may be proportionately reduced on that side.

2.16.3 If the deck area is asymmetric the reduction in freeing port area should be added to that required on the opposite side. 80% of the area of any scupper within the shelter space may be included in the freeing port area for the side on which it is located.

2.16.4 Where superstructure is fitted forward of a partial / non-weather-tight shelter, 'a' the width of opening in the after end of the shelter is taken as half of the beam.

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