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SHIP OBSERVATIONS TEAM

ITEM III-1.1

FIFTH SESSION

GENEVA, SWITZERLAND, 18-22 MAY 2009

Original: ENGLISH

REPORT BY THE CHAIRPERSON OF THE VOS PANEL

(Submitted by Julie Fletcher, Chairperson, VOSP)

Summary and purpose of the document

This document describes the activities undertaken by the VOS Panel Chairperson during the last intersessional period and highlights the significant issues for the VOSP-VI.

ACTION PROPOSED

The Team will review the information contained in this report and comment and make decisions or recommendations as appropriate.

Appendices: A. Review of Action Items
B. Review of WMO Pub 47 Entries
C. Seaways Article - "Meteorological Observations from Ships"
D. VOSP TOR

- A - DRAFT TEXT FOR INCLUSION IN THE FINAL REPORT

III.1.1.1 The VOS Panel Chairperson, Ms Julie Fletcher (Met Service, New Zealand), opened the sixth Session of the VOS Panel. She reported on activities undertaken during the last intersessional period (April 2007 – May 2009). There has been considerable activity in the period with a number of significant tasks being completed. The work has mostly been undertaken by email, but meetings with the SOT Chair, WMO Secretariat and some Task Team members occurred at DBCP-23, Jeju, Republic of Korea, October 2007 and VOS actions were progressed with the SOT Chair at the Bureau's Port Met Agents' workshop in Melbourne in November 2007.

III.1.1.2 Ms Fletcher reported that much work has been done to advertise the VOS Programme, from the creation of the new PowerPoint presentation to the issuing of the new IMO MSC Circular No 1293. However, at the time of writing (March 2009) global shipping is in a state of dire retrenchment with 10% of the world's container vessels unemployed as owners and operators cannot find cargo to fill them. VOS operators are facing changes to their fleet composition, as ships are laid up and withdrawn from regular liner service. Against this background, the number of ships reporting per month rose from around 2000 per month in mid 2007, to 2150 per month in mid 2008, but by February 2009 had dropped to around 1900 per month. The count of reporting ships is done by JCOMMOPS and the callsign SHIP is counted only once, when in fact many ships are reporting as SHIP. The actual number of observations per month has risen, due to an increased number of automated systems being installed. The MeteoFrance observation-counting tool shows some 1,415,000, ship observations were made by global VOS in 2008, which around 275,000 more than in 2007. Within the last two years the Danish VOS programme has finished, and another major European VOS programme is under review. However, it is pleasing to note that Brazil has re-activated their VOS programme in 2008.

III.1.1.3 To address security concerns, the JMA commenced their Callsign Masking scheme in December 2007, by replacing the callsigns on all Japanese observations with the generic SHIP identifier. There is concern about how this Masking scheme impacts on the real time monitoring, and how data sets will be matched up in the future, for archiving and research purposes.

III.1.1.4 The dedicated work of the global PMO network underpins the programmes co-ordinated under SOT, in particular the VOS programme, and work is ongoing to provide PMOs with more tools and support. PMOs are working hard to retain ships and attract new recruits, but this is difficult in the current economic climate. There is consensus that, an international PMO Meeting in 2010 would benefit the PMOs and strengthen relationships in a role, which relies heavily on international co-operation.

III.1.1.5 The VOS Monitoring tools have further improved over the last two years with MeteoFrance recently developing tools to compare extra variables e.g. humidity, wind wave, etc. with outputs from both the MeteoFrance and ECMWF models. The tools although widely used, are still not being utilised by all NMS and PMOs, so opportunities to improve observation quality, by the routine use of the tools and feedback to ships are being lost.

III.1.1.6 The new metadata for Pub 47 version 3 was introduced in July 2007. New tools were developed to assist countries without a suitable database, to collect and submit the new variables in XML output format. There is major frustration that the WMO Pub 47 is still not up to date. (At March 2009, Q2 2008 is the latest published).

III.1.1.7 Ms Fletcher explained that the future of the VOSclim project, a new proposal to identify SOT ships, new technology challenges, and a proposal to introduce new sub-classes for AWS, were all issues that will be addressed within this VOSP-VI Session.

- B - BACKGROUND INFORMATION

1. Review of Action Items undertaken by VOSP Chair since SOT-IV

The status of Action Items undertaken by the VOS Panel Chairperson since SOT-IV is detailed in **Appendix A**.

2. Significant Tasks Undertaken by VOSP Chair

2.1 Review of WMO Pub 47 Historical Entries. At VOSP-V, I expressed the need to review the Pub 47 to identify and delete historical records from countries, which no longer operate VOS, and to remove ships, which were no longer active. In December 2006, some 50 countries had entries in Pub 47. . The VOSP Chairperson prepared a list showing that the entries of 25 countries had remained unchanged since 1998, and that the entries for another 6 countries required review because the numbers of ships contained in Pub47 differed greatly from the number of ships providing real-time reports for those countries. Refer to **Appendix B**. WMO sent letters to the 31 countries identified in the report, and subsequent action has resulted in the 'historical' entries from 24 countries being deleted from Pub 47. As at March 2009, the latest Pub47 data on the WMO site is for Q2 2008, (which is old) but significant progress has been made in culling historical material.

2.2 Annual Automation Report – The AWS and the electronic logbook entries were, extracted from the countries annual SOT reports for 2007 and 2008 to update the Automation report and to gather trends on the increased use of automation.

2.3 MSC Circ 1017 – The VOSP Chairperson updated this circular memorandum in September 2007, in time for WMO to present it at MSC-83 in Copenhagen in October 2007. The resultant new MSC.1/Circ.1293 was issued by IMO on 10 December 2008.

2.4 E-Logbook Inter-Comparison - On behalf of the TT Instruments Standards, The VOSP Chairperson prepared and circulated the raw data and guidelines for the E-logbook Inter-Comparison study in February 2008. A report on the Inter-Comparison of the completed observations was, compiled in August 2008 and sent to the Three E-Logbook manufacturers. The subsequent discussion was summarized and recommendations prepared on the Inter Comparison for the TT.

2.5 Article for UK SEAWAYS magazine – Ms Fletcher prepared an article entitled “Meteorological Observations from Ships” and this was published in the April 2008 edition of the magazine. Refer to **Appendix C**.

3. Other Tasks

3.1 The VOSP Chairperson used the group email lists to announce to VOS FPS and PMOS details of:

- Pub 47 spreadsheet software tool to enable countries without a database to compile and submit metadata in version 3 XML output format – June 2007
- VOSP002 metadata collection form and new excel Pub47 XML Generator tools - May 2008

3.2 In consultation with SOT Chairperson and WMO Secretariat, Ms Fletcher prepared the agenda and documents for SOT-V and VOSP-VI.

4. SOT Task Team Activities

4.1 The VOSP Chairperson participated in several Task Teams as described below:

- (i.) VOS Recruitment and Programme Promotion
 - a. Provided input to the revised SOT Recruitment presentation.

- b. Tested the VOS Form VOSP002, Metadata collection form.
- c. Provided the revised MSC Circ 1017 to WMO (as described above)
- d. As Chairperson of the TT compiled the report for SOT-V

(ii.) Instrument Standards

- a. Completed the E-Logbook Inter-Comparison report (as above)
- b. Sent the review of WMO No.8, Chapter 4, Marine Observations to Chairperson of TT for submission to WMO

(iii.) Metadata for WMO No. 47

- a. Provided input to and tested the xml output generator tool

(iv.) VOSCLim

- a. Discussion with TT Chairperson concerning the way forward for the VOSCLim project and its implications on the wider VOS.

5. Document Review

5.1 With the SOT Chairperson reviewed and made input to the following documents:

- (i.) Shaun Smith's Guide to Met and Flux Measurements – Nov 2007
- (ii.) VOS Framework document – Feb 2008
- (iii.) WMO No.8, Chapter 4, Marine Observations – Feb 2008
- (iv.) *The Case for Maintaining Surface Meteorological Data Collection from Voluntary Observing Ships*, AOPC-XXIV, Geneva, April 2008.

5.2 Terms of Reference (TOR) for VOSP refer to **Appendix D**

Appendices: 4

APPENDIX A

REVIEW OF ACTION ITEMS FROM VOSP-V UNDERTAKEN BY VOSP CHAIRPERSON

Para	Action	Responsible
IV-1.1.12	<p>To work with WMO in order to identify active ships and remove the historical records from the WMO Pub.47 for ships which are not active anymore</p> <p>Status: Significant progress. Q1 2008 Pub 47 Listing reduced to entries from 24 countries. The 'historical' records from some 24 countries have been removed.</p>	VOS Panel Chairperson and Secretariat (WMO)
IV-5.2.2	<p>To liaise with WMO Secretariat regarding updating the MSC Circular 1017 to include ships owners and masters concerns regarding VOS data exchange</p> <p>Status: Completed. New MSC Circular 1293 issued 10 December 2008.</p>	VOS Panel Chairperson and Secretariat (WMO)
I-6.3.5	<p>To review the list of JCOMM Publications that are of interest to the SOT or its sub-Panels.</p> <p>Status: Ongoing. With SOT Chairperson reviewed:</p> <ul style="list-style-type: none"> • VOS Framework document. • WMO No.8, Chapter 4, Marine Observations. 	SOT, VOSP, SOOPIP & TT/ASAP Chairpersons

APPENDIX B

REVIEW OF WMO PUB 47 ENTRIES

1. Background

The International List of Selected, Supplementary and Auxiliary Ships, WMO Pub No. 47, gives the list of ships for each country participating in the WMO Voluntary Observing Ship Scheme (VOS). This publication contains the metadata of ships participating in VOS and as such is the primary reference for VOS Programme Managers, Port Meteorological Officers (PMOs), Modelling and Monitoring Centres, Climatologists and Researchers.

2. Current Status

NMS are requested to submit their Pub 47 list, quarterly to WMO. The data contained in Pub 47 are only as good as the submissions, and in recent years many countries have not made any submissions, with the result that many of the entries in the current Pub 47 are now seemingly out of date because the current status cannot be confirmed and therefore of historical interest only.

3. Review Requirement

At VOSP-V (Geneva April 2007), the panel noted that whilst Pub 47 contains the entries of some 50 countries, only about 30 countries operate ships which are actively participating in VOS. The panel asked the VOSP Chairperson to work with WMO to identify and remove ships, which are no longer active.

4. Objective

To get the historical ships removed so Pub 47 lists only the active or current VOS ships.

4.1. The Comparison

The entries in the December 2006 on-line Pub 47 fall into 3 categories:

1. Lists of ships which are submitted regularly by countries with active, operational VOS programmes
2. Lists of ships which have remained unchanged for years and which can be considered historical
3. Lists of ships from countries which operate VOS programmes but which have not been recently updated

Historical Entries

The entries in the December 2006 on-line Pub 47 list were compared with the 1998 hard copy of Pub 47. The entries for the 25 countries listed below are unchanged from the 1998 list, i.e. the number and names of the ships are identical, and so these data are all historical.

Azerbaijan 3
Bangladesh 3
Bulgaria 34
Chile 2
China 47
Cuba 5
Dem People's Rep of Korea 13

Finland 13
Indonesia 31
Israel 38
Italy 13
Jamaica 1
Kenya 14
Latvia 35
Lithuania 26
Pakistan 16
Philippines 49
Portugal 15
Saudi Arabia 101
Singapore 48
South Africa 34
Sri Lanka 7
Thailand 2
United Rep of Tanzania 21
Yugoslavia 125

Notes

1. It would appear that the above countries have either continued to submit the same list over the years, or have not made a submission since 1998 (the records held by WMO would show when countries last made submissions).
2. 14 of the ships in the Tanzanian entry are the same ships as listed in the entry for Kenya. Approval was given by both countries at SOT III to remove all the entries as none of the ships are active.
3. With the exception of Singapore and the United Republic of Tanzania, none of the above countries submitted Annual SOT Reports for 2006, which indicates that they probably have no active VOS programmes.
4. The United Republic of Tanzania, SOT report listed zero VOS ships.
5. The Singapore SOT report listed 15 VOS ships, so maybe 15 of the 48 are active, but Singapore should be asked to make an updated Pub 47 submission.
6. The Yugoslavian list is historical. Croatia now provides input to Pub 47.

Incomplete or Out of Date Entries

A lesser number of countries have entries in Pub 47 that require reviewing to remove any historical entries from their list of active ships. The countries are:

- ❖ Brazil – 345 ships listed, many of which are the same as listed in the 1998 list. Brazil did not submit a SOT report so the number of active ships is unknown.
- ❖ India – 165 ships listed. India listed 185 VOS ships in their 2006 SOT report. India should be encouraged to update their Pub 47 list to remove any historical ships, and list only the active ships.
- ❖ Malaysia – 105 ships listed. Only a few ship entries contain any metadata. Malaysia listed 93 VOS ships in their 2006 SOT report. Malaysia should be encouraged to update their Pub 47 list to remove any historical ships, and list only the active ships.
- ❖ Poland – 61 ships listed. No SOT annual report. Seek confirmation that ships listed are active.
- ❖ Russian Federation – 291 ships listed. No SOT annual report. Russia should be encouraged to update their Pub 47 list to remove any historical ships, and list only the active ships.
- ❖ Switzerland – 1 ship listed. Check MV Nyon is still active.

4.2 Actions required for dealing with the Historical entries

- WMO to extract the list of ships for each of the 25 countries in the 'historical' list above from the December 2006 Pub 47.
- WMO to send the individual Pub 47 list plus a letter to each of the 25 countries advising that the ships in these entries are considered to be historical and will be deleted from the next edition of Pub 47 unless the countries concerned indicate otherwise.
- WMO to request any country that has 'active' VOS ships to supply new Pub 47 details as per the instructions on the WMO Pub 47 website page <http://www.wmo.int/pages/prog/www/ois/pub47/pub47-home.htm>
- WMO to advise countries that their historical entries will only be deleted from the next Pub 47, but that entries will remain in the Pub 47 records prior to and including December 2006, so no historical data will be lost.

4.3 Actions required for dealing with Countries with Incomplete or out of Date Entries

- WMO to extract the list of ships from the December 2006 Pub 47 for Brazil, India, Malaysia, Poland, Russian Federation and Switzerland.
- WMO to send the individual ship lists to each of the countries above, with a letter requesting each country review their lists to remove any historical ships, or to add any active ships and return to WMO.
- WMO to advise countries that any historical entries they remove will remain in the Pub 47 records prior to and including December 2006, so no historical data will be lost.
- WMO to advise these countries that the aim is to have only 'active' or current vessels listed in Pub 47
- WMO to remind countries of the need to make regular Pub 47 submissions in future as per the instructions on the WMO Pub 47 website page <http://www.wmo.int/pages/prog/www/ois/pub47/pub47-home.htm>

Julie Fletcher
Chairperson VOS Panel
5 June 2007

Meteorological observations from ships

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The World Meteorological Organisation (WMO) Voluntary Observing Ships (VOS) scheme is the international programme by which ships plying the oceans and seas of the world are recruited by national meteorological services (NMSs) for taking and transmitting meteorological observations.

The forerunner of the scheme dates back as far as 1853 – from the very beginning, ships' meteorological observations were recognised as essential for the provision of safety-related meteorological services for ships at sea, as well as for climatological purposes.

Currently the contribution that VOS meteorological reports make to operational meteorology, to marine meteorological services and to global climate studies, is unique and irreplaceable. During the past few decades, the increasing recognition of the role of the oceans in the global climate system has placed even greater emphasis on the importance of marine meteorological and oceanographical observing systems.

During the past two decades, the need for improved knowledge of the ocean weather and climate has been further reinforced by the threat of global warming, and the requirement for high quality marine observations has increased.

Four times a day, ships of all sizes and types across the global oceans, compile and send coded weather observations under the VOS scheme. These ships have been recruited by the meteorological

services of some 30 countries to make observations of marine meteorological conditions and transmit them to shore in real-time.

Weather forecasting, operational planning for maritime activities, the design of vessels, coastal and offshore facilities, marine and sea-bed exploration, oil spill response, and climate change research: all require a knowledge of weather conditions over the oceans. The observations from VOS play a vital role in addressing these information requirements.

Ship observations continue to provide an essential ingredient of the WMO's World Weather Watch programme. Furthermore, ship observations contribute greatly to the computer generated models, from which marine forecast products are derived, and the maritime safety information which is called for by the Global Maritime Distress and Safety System (GMDSS). Without timely, high-quality ship observations the accuracy of marine forecasts like the high seas forecast, Navtex forecasts, inshore waters forecasts and the shipping forecast would inevitably diminish.

With increasing concerns over climate change, the importance of in-situ ship observations is as great as ever. Observations received in ships' logbooks, or downloaded from ships' electronic logbooks, undergo thorough quality control procedures before being archived for climate research purposes.

Ship observations are also the mainstay of a number of key international global climate datasets, including the Hadley Centre HadSST, and HadISST (sea surface temperature and ice) datasets which extend back to 1870, and HadMAT (night-time marine air temperature) which goes back to 1856. Indeed, voluntary ship observations have provided the majority of the historical climate record of conditions at the marine surface, where night-time air temperatures (not being influenced by daytime heating of the ship's deck) provide a valuable cross-check for sea surface temperatures. By providing observations

of air temperature, sea surface temperature and wind speed, ship observations also give vital information on surface fluxes which are essential for the validation of climate models.

Mariners face many hazards: storms, rough seas, ice and icebergs. As early as 1853, the reality of this led seafaring nations to organise the first formal international meteorological meeting to coordinate weather observing at sea. Since that time, ships' meteorological observations have provided essential inputs to weather warnings and forecasts, which have progressively become more accurate. During the past two decades, the need for improved knowledge of the ocean weather and climate has been further reinforced by the threat of global warming and the requirement for high quality marine observations has increased.

VOS scheme

The VOS scheme is a core observing programme of the Ship Observations Team (SOT) which is coordinated by the Joint WMO/International Oceanographic Commission of UNESCO (WMO/IOC) Technical Commission for Oceanography and Marine Meteorology (JCOMM). The VOS panel under SOT provides guidance on observing practices, standards and issues related to all areas of VOS operation.

Today, some 5,000 ships are registered in the VOS scheme, but in reality only about 4,000 ships actively participate in the programme. When a ship joins the VOS, a Port Met Officer (PMO) from the recruiting country installs calibrated meteorological instruments and provides training on how to make the weather reports. The coded observations contain a mix of readings from instruments, such as pressure and temperature, and visually observed elements like visibility, cloud type, sea and swell. On completion of the report, the ship's officer transmits it to the nearest meteorological centre, typically using Inmarsat communications with a special access code so there is no cost to the ship.

The observations are distributed between

met services and global modelling centres using the global telecommunications system (GTS) established and operated by the WMO. The data are ingested into numerical weather prediction (NWP) models, along with global land and upper air observations which have all been made at the same synoptic hour. Using these data the models output a snapshot of the conditions existing now, called the analysis. Prognosis maps of what the future weather patterns are expected to look like are then produced. The accuracy of NWP model forecasts depend on the accuracy of the initial conditions used to start the model runs. Ship observations are vitally important in establishing accurate initial conditions over vast oceanic areas of the globe.

Increased automation

Over the last decade there has been a steady increase in the use of automated shipboard observing systems. By December 2007, about 2,000 VOS ships were using electronic logbook software to compile their observations. There are three major e-logbook software packages in use: TurboWin as developed by the Royal Dutch Meteorological Institute (KNMI) and used globally; SEAS developed by the National Oceanographic and Atmospheric Administration (NOAA), USA, and used on US VOS; and OBSJMA developed by the Japanese Meteorological Agency (JMA) and used on Japanese VOS.

The electronic logbook software prompts the observer to enter the required weather elements, it provides help in text and pictorial form, and contains many inbuilt quality control checks. The observer no longer has to understand how to code – he or she merely enters the required parameters and the software produces the required output in SHIP code. Depending on the software type, observations are either sent directly or transferred to the Inmarsat terminal by floppy disk, which prevents typing transcription errors. Use of the software has improved observation quality and in many cases has increased the number of reports prepared because observers like the software and find it easy to use.

Automatic weather stations

In addition to the manually produced observations, 14 countries now use some form of automatic weather station (AWS) in their VOS fleet. The type and complexity of these AWS varies greatly from simple to sophisticated installations. Some of the simplest ship-board AWS are based on the



▲ Figure 1: Batos II instrument layout schematic

technology used in meteorological buoys, and consists basically of a barometer package with satellite communications.

MetService New Zealand has recently installed a low cost AWS called mStar-Ship on a coastal ship. Originally the mSTAR model of AWS was designed by MetService for land applications and is currently used at 46 sites throughout New Zealand. All mSTAR AWS report data at one minute intervals using GPRS cellular communications. The mSTAR AWS was adapted for shipboard use by the inclusion of a GPS unit which enables computation of station location, course and speed, and 'true' wind speed and direction for a moving station. In addition to the wind data, the mStar-Ship also reports air temperature, relative humidity and atmospheric pressure data. The prototype unit on MV *Spirit of Competition*, has proved successful so another mSTAR-SHIP AWS is planned for installation this year.

At the top end of the range, a ship AWS may have a full suite of met sensors and include the facility for manual entry of the visual parameters. Some AWS are completely self-contained, while others require ship's power and may be connected to the ship's navigation system.

The UK VOS uses several different types of AWS. These include the Meteo-France developed BATOS and MINOS systems, the Canadian AVOS developed by Axyx Technologies and the Automet system by Christian Michelson in Norway.

Of the eleven vessels in the UK VOS fleet fitted with AWS, the BATOS system is installed on three vessels (two of which are funded under the E-SURFMAR programme – see box, below), the MINOS system installed on six vessels, and the AVOS and Automet on one vessel each.

BATOS gathers data from digital weather sensors (pressure, air temperature, sea temp, wind speed and direction) and

E-SURFMAR

E-SURFMAR (Surface Marine Observations) is a sub programme within the EUCOS (EUMETNET [Network of European Meteorological Services] Composite Observing System) ground-based observing system designed to coordinate, optimise and progressively integrate the activities for surface marine observations within the EUCOS operational framework.

Data is provided from several networks in EUMETNET and EUCOS participating countries within the EUCOS area 10°N -

90°N, 70°W - 40°E. Funding is provided from this sub-programme to seed projects designed to improve the quality of observations in the EUCOS area. This includes funding for installing AWS on board VOS.

E-SURFMAR also hosts the *Marine Observer's Log*, an online site to disseminate marine observations of special interest and scientific value, previously published in *The Marine Observer*.

Go to http://esurfmar.meteo.fr/wikilog/index.php/Main_Page

allows the input of manually observed elements (visibility, sea state, cloud type and height, present/past weather, ice, etc). The BATOS unit then codes this data into a complete weather observation and transmits it ashore using satellite communications. Meteo-France has some 45 BATOS installations within their VOS fleet.

MINOS consists of a Vaisala PTB 210 barometer, a GPS unit and an Argos transmitter, all located together beneath an antenna dome. An air temperature probe is located inside a small screen below the dome. The MINOS system on board the round the world, container ship CMA/CGM *Matisse* was installed in December 2002 and has worked flawlessly over the last five years producing hourly weather reports.

The AVOS system collects the data similar to the BATOS, but all the instruments are situated on one mast. All Canadian Coastguard vessels are fitted with AVOS. The Automet system is similar to MINOS, measuring temperature and pressure.

At the end of 2007, there were approximately 240 ship AWS systems installed on VOS globally, with numbers expected to increase during 2008.

Special project VOSclim

The VOS climate project (VOSclim) was set up with the goal of providing a high-quality subset of marine meteorological data, with extensive associated metadata, to be available in both real-time and delayed mode to support global climate studies. VOSclim is a follow-up to the earlier VOS special observing project North Atlantic (VSOP-NA) which was conducted on behalf of the World Climate Research Project (WCRP) from 1988 to 1990.

VOSclim has a target of 250 ships

participating in the project. In addition to the usual parameters recorded in the SHIP observation, VOSclim ships record the relative wind speed and direction, and ship's speed and heading in their e-logbooks. The PMO collects metadata for each ship; this is data relating to instrument type and location, details about the ship's dimensions and layout, and includes digital photographs and schematic drawings.

In future research studies, the real-time observation, the co-located model data, the metadata and the extra VOSclim groups will be collected together to give a complete picture of how, where and when the observation was made.

Data from the VOSclim project will be invaluable for climate change studies and research. In particular it will be used to input directly into air-sea flux computations, as part of coupled atmosphere-ocean climate models; it will provide ground truth for calibrating satellite observations; and it will provide a high quality reference data set for possible re-calibration of observations from the entire VOS fleet. In terms of benefits to the marine industry, VOSclim will help in the development of future marine meteorological systems which are expected to assist forecasters in producing more accurate marine weather forecasts, and which will also give ships much more comprehensive real-time weather information for operational purposes.

More information

■ To learn more about how your ship could participate in the VOS Scheme, visit the VOS panel website www.bom.gov.au/jcomm/vos/index.html and to learn more about the VOS-Clim project go to www.ncdc.noaa.gov/oa/climate/vosclim/about.html



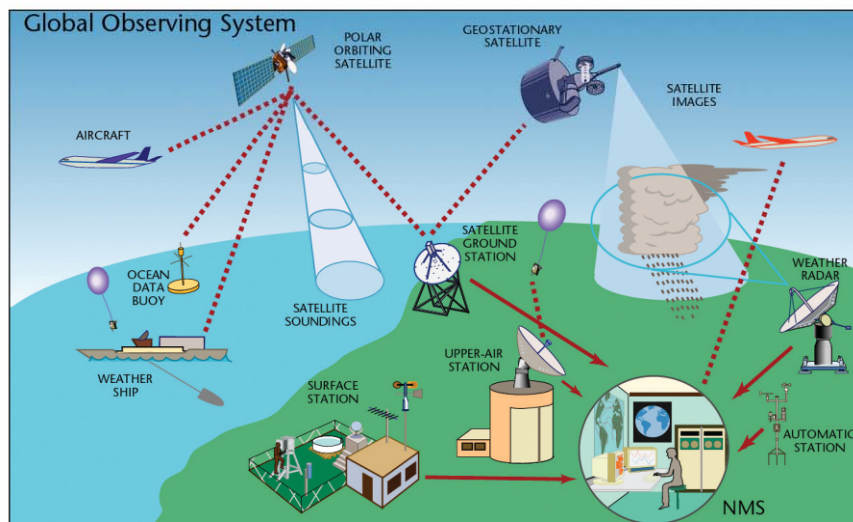
▲ Figure 2: Meteo-France's Minos on CMA/CGM *Matisse*



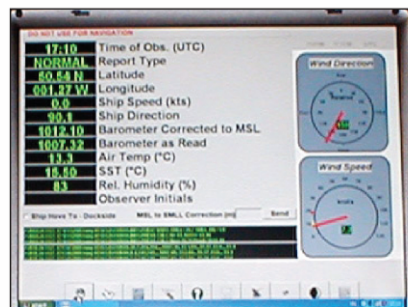
▲ Figure 3: mStar-Ship AWS console and temperature screen on board *Spirit of Competition*



▲ Figure 4: AVOS mast and sensors
Crown copyright (2007) The Met Office



▲ Figure 6: Global Observing System



▲ Figure 5: AVOS display
Crown copyright (2007) The Met Office

APPENDIX D

TERMS OF REFERENCE FOR VOS PANEL

- TOR 1. Review, recommend, co-ordinate the implementation of new and improved specialised shipboard meteorological instrumentation, siting and observing practices, as well as of associated software

 - TOR 2. Support the development and maintenance of new pilot projects

 - TOR 3. Oversee the efficient performance and operation of the VOSclim Project

 - TOR 4. Develop and implement activities to enhance ship recruitment, including promotional brochures, training videos, etc.

 - TOR 5. Annually prepare a report on the status of VOS operations, data availability and data quality
-