

# 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.

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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



▲ Figure 1: Batos II instrument layout schematic

(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.

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## 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 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 Axys 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 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.

## 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](http://esurfmar.meteo.fr/wikilog/index.php/Main_Page)



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



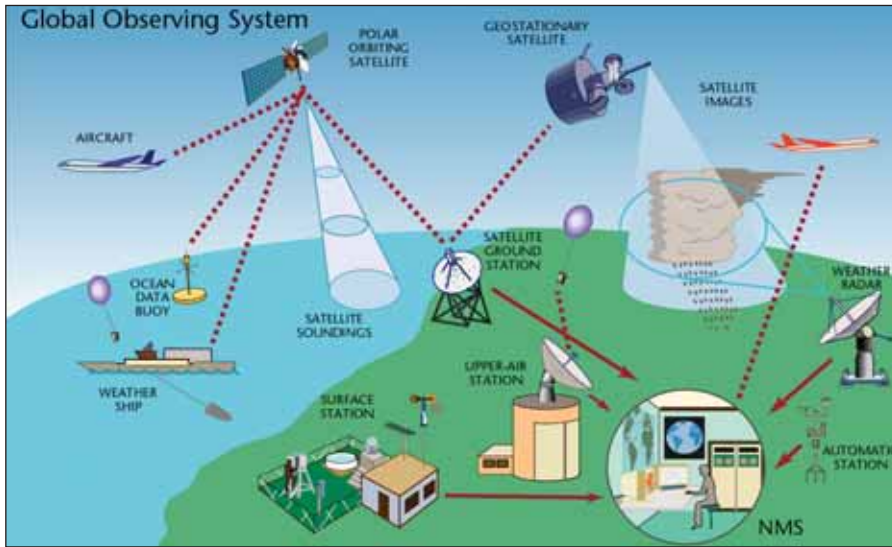
▲ Figure 3: mStar-Ship AWS console and temperature screen on board *Spirit of Competition*



▲ Figure 4: AVOS mast and sensors  
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▲ Figure 5: AVOS display  
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▲ Figure 6: Global Observing System

## 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](http://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](http://www.ncdc.noaa.gov/oa/climate/vosclim/about.html)

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