United Nations
Educational, Scientific and
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Intergovernmental
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Organization
Weather • Climate • Water

THE JCOMM

VOLUNTARY OBSERVING SHIP SCHEME

SHIP OBSERVATIONS TEAM
JCOMM
VOS
Voluntary Observing Ship Scheme

AN ENDURING PARTNERSHIP

The VOS and other ocean observing programmes described in this pamphlet represent a highly cost-effective approach to marine data collection. At a time when demands for observations from the oceans are increasing, they also possess significant potential for expansion in climatically important, data sparse, regions. Realization of this potential will, however, require investments in capacity building, in vessel recruitment, in software development and in automated observing systems. It will also require the continuation of the long tradition of voluntary ocean data collection by the world's seamen which has made the VOS Scheme such a classic example of enlightened cooperation and enduring partnership.

GET INVOLVED NOW!

Contact:
sot.jcommops.org/vos
support@jcommops.org
+33 2 29 00 85 85

THE VOLUNTARY OBSERVING SHIP SCHEME

Weather forecasting, operational planning for maritime activities, the design of vessels and coastal and offshore facilities, the exploitation of marine and sea-bed resources, the response to oil spills at sea and climate research all require a knowledge of weather conditions over the oceans. This pamphlet highlights the continuing importance of meteorological observations from **Voluntary Observing Ships (VOS)** in addressing these information requirements and in illustrating the vital nature of the data provided by this highly cost-effective scheme.

Mariners face many hazards - including storms, rough seas, ice and icebergs. As early as 1853, this reality led seafaring nations to organize 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 become progressively more accurate.

Severe weather conditions will always pose a hazard to ships at sea.

During the past two decades, however, the need for improved knowledge of ocean, weather and climate has been further reinforced by the threat of global warming and by the prospect that weather forecasts can be made on time-scales of months to years by using information on oceanic conditions. In response to these expanded requirements, the World Meteorological Organization (WMO) and the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO), under the Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) have been working with the maritime community to enhance voluntary observational programmes carried out by ships at sea.

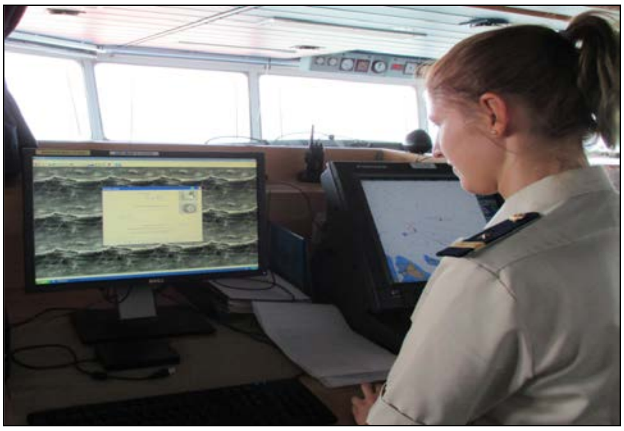
At the global level, the WMO World Weather Watch Programme is the international cooperative programme which arranges for the gathering and distribution, in real time and on a worldwide scale, of meteorological information including marine weather and oceanographic observations, forecasts and other bulletins

The VOS Scheme is a core observing programme of the Ship Observations Team (SOT) in the Observations Programme Area of JCOMM.

Under the JCOMM VOS Scheme, ships are recruited by National Meteorological Services (NMSs) to record and transmit meteorological observations (the most critical data being air pressure, wind speed and direction, sea state, humidity, visibility, air and sea-surface temperature), to shore stations in real-time to assist in the provision of more accurate marine forecasts and warnings.

VOS observer collecting meteorological data

The same observations are also used for a host of climatological and research activities. Meteorological observations made by officers onboard vessels participating in the programme are traditionally compiled every six hours, although models can now also assimilate observations sent at intermediate hours. Electronic logbook software is now used to compile the observation reports. The officer enters data read from instruments and observed visually, and the software codes this information into a recognized format for immediate transmission to shore. Many observations are sent via INMARSAT C using a Special Access Code, which relays the report free of charge to the ship. Increasingly email is being used with the cost of the small text message being borne by the ship. Once ashore, the observations are then routed around the world on WMO's Global Telecommunication System (GTS) for use by meteorologists, numerical weather prediction models, ship routing services, and other clients.



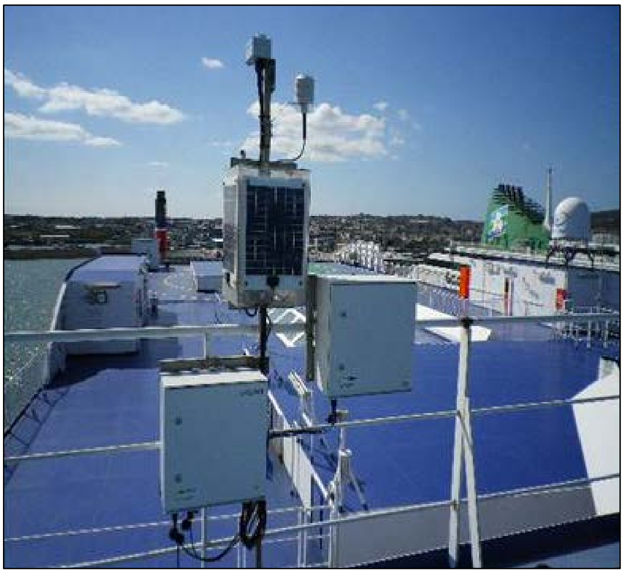
VOS observer compiling and sending a weather report

Vessels participating in the VOS Scheme are currently classified into one of four major categories. So-called "selected" ships carry out a complete suite of meteorological observations while VOS Climate ("VOSClim") ships are recruited to provide higher climate quality data, and are therefore monitored against more stringent criteria; "supplementary" ships report a slightly reduced set of observational parameters whilst a vessel travelling through a data-sparse region may be recruited into a fourth category, known as "auxiliary" class ships, and requested to supply limited observations.

Over 450 VOSClim ships now provide higher quality VOS data for climate applications.

Worldwide VOS numbers reached a peak of about 7700 ships in 1984-85 but have declined since that time with about 3300 vessels recruited from 25 countries participating today. This decline reflects the continuing trend towards fewer but larger ships but has been balanced, to some extent, by the fact that vessels, in general, now spend reduced time in port. This fact, in addition to improved communications via satellite, has actually led to enhancements in both the quantity and the quality of meteorological reports received from the VOS.

Increasingly many National Meteorological Services (NMSs) are equipping ships with an Automatic Weather Station (AWS) that may either operate in a totally stand–alone mode, or accept manual input of the visual parameters e.g. cloud, weather, sea and swell, via a computer.



Observations from Automatic Weather Stations (AWS) allow for more frequent data transmissions. Supplementary manual observations by the crew are possible.

The VOS Scheme operates at no direct cost to participating vessels. Port Meteorological Officers (PMOs) provide free training both in weather observing practices and the use of electronic logbook software, while essential meteorological supplies are also provided by participating NMSs.

ARE OBSERVATIONS FROM VOLUNTARY OBSERVING SHIPS REALLY NECESSARY TODAY?

The question "Do we really need observations from ships now that we have weather satellites?" is still frequently asked, even though the need for enhanced observational coverage of the world's oceans is increasingly accepted.

The answer is most emphatically "YES"!

Observations from VOS significantly complement the bird's eye view of the global distribution of clouds, weather systems and ocean variables obtained from satellites, as well as provide a long-term observational record.

They supply information on variables and phenomena which cannot, as yet, be accurately, reliably and consistently observed from space. Perhaps the most critical of these variables is surface air pressure. Along with measurements from buoys and other surface platforms, they are essential for the calibration or "ground-truthing" of satellite observations.

Damage from sea ice and icebergs is also an ongoing threat to shipping in high latitudes

Furthermore, reports from VOS continue to be used routinely in the preparation of weather forecasts, thus supplying a constant "reality check" on actual weather conditions, contributing directly to short-range prediction and providing important inputs to numerical weather prediction (NWP) models[1]. Both observations from VOS and satellite data are, today, indispensable and complementary meteorological tools. Without VOS observations, the provision of timely and accurate weather forecasts and warnings for mariners would be seriously compromised.

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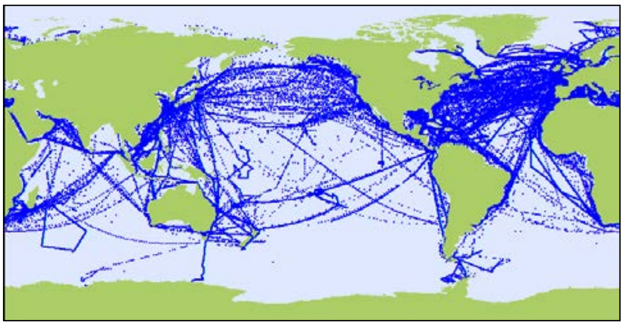
[1] Modern weather forecasting relies heavily on computerized NWP models. The accuracy of NWP model forecasts, however, depends on the accuracy of the initial conditions used to start the model runs. VOS observations are vitally important in establishing accurate initial conditions over the vast oceanic areas of the globe.

It is less widely appreciated that historical records of observations from VOS also find ever-increasing practical applications, in this way contributing design statistics used in ship and oil rig construction and in coastal engineering, facilitating the selection of seasonal “weather windows” for vulnerable marine operations and underpinning the analysis of climatic variations. Reflecting the importance of these historical records, observations recorded in ships’ electronic logbook software are extracted, quality controlled, archived, processed by Global Collecting Centers into climatological summaries and exchanged in a globally coordinated and consistent manner.



Map of VOS data received during November 2014 (total 181 264 observations): The need for more VOS in the southern hemisphere and polar regions is clear.

In addition, historical marine meteorological observations recorded in hardcopy ships’ logbooks since the nineteenth century form one of the longest continuous climate records in existence and are essential to the assessment of natural and anthropological climate changes. It is vital that this record be continued.

Sailing yachts operating in remote areas, away from the main shipping routes, can also contribute data of high value for marine forecasting. Photo: Garcia

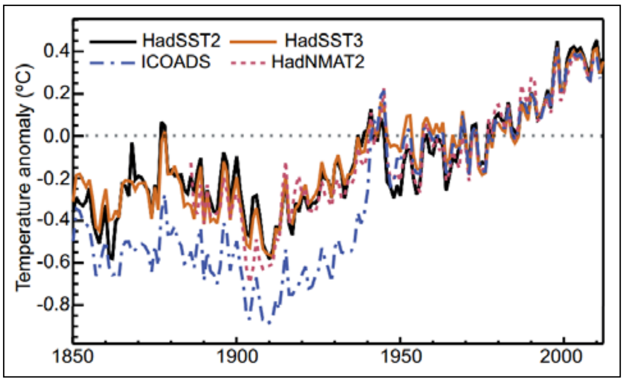
THE EXPANDING REQUIREMENTS FOR OCEAN OBSERVATIONS

For several decades, three major factors have combined to increase the need for observations from the world’s oceans:

a) The growth in the demand for specialized marine meteorological services;

b) El Niño/Southern Oscillation (ENSO) and the potential for useful long-range forecasts; and

c) The spectre of global warming.



Global annual average Sea Surface Temperature (SST) and Night Marine Air Temperature (NMAT)

(Intergovernmental Panel on Climate Change, AR5)

Specialized marine meteorological services

Since the end of the Second World War, marine meteorology has expanded to include a variety of specialized or tailored services. Weather routing has become a highly valued service for vessels engaged in trans-ocean voyages. The commercial fishing industry has become increasingly reliant on up-to-date meteorological and oceanographic observations and forecasts to optimize their fishing effort.

Tailored products support increased traffic volumes and ship sizes in coastal regions and harbors as well as the operations of specialized vessels such as hovercraft, hydrofoils and high-speed ferries. Site-specific meteorological support has become critically important to sensitive offshore oil and gas operations such as drilling, pipe laying and re-supply, as well as to responding to oil spills at sea. All of these services have generated an increasing need for more detailed and accurate observational data from the open ocean, coastal waters and harbor approaches. Observations from the oceans are essential to understanding the Earth’s climate system.

The promise of accurate long-range forecasts

Climate is subject to variations on all time-scales, from seasons to decades and beyond. The best known of these variations is associated with the ENSO phenomenon. This shift or seesaw of atmospheric pressure across the equatorial Pacific Ocean occurs irregularly, roughly every two to seven years and is linked to changes in tropical sea-surface temperature patterns, with the eastern Pacific tending to be unusually warm during El Niño years.

Unusual weather conditions are often experienced during the El Niño years.

Around the globe, droughts, floods, the collapse of important fisheries and other unusual phenomena are often associated with El Niño. The existence of a connection between tropical sea-surface temperatures and weather in distant regions for months ahead has raised hopes that useful monthly to seasonal weather forecasts can be developed. This has stimulated efforts to develop such products, bringing increased requirements for observations from ocean areas.

The spectre of global warming

During the past two decades, concern regarding the potential impacts of global warming has intensified efforts to understand the functioning of the global climate system. In addressing this challenge, the Second World Climate Conference (Geneva, 1990) identified the need for a comprehensive ocean observing system as a vital component of the Global Climate Observing System (GCOS). Subsequently, in 1998, the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) called on the world's governments to enhance substantially systematic monitoring and data collection activities over and within the oceans. This need was reinforced during the Third World Climate Conference (Geneva, 2009). The provision of specialized services, the development of long-range forecasts, climate change research, and climate services require oceanic observations with increased accuracy and coverage.

There is a need for a long-term observing system to monitor, describe and understand the physical and biogeochemical processes that determine the ocean circulation, the seasonal-to-century climate changes in the ocean, and to provide observations needed for climate predictions. Most ocean measurements are not made on adequate temporal and spatial scales, and data coverage is very poor, particularly in high latitudes and in the deep ocean.

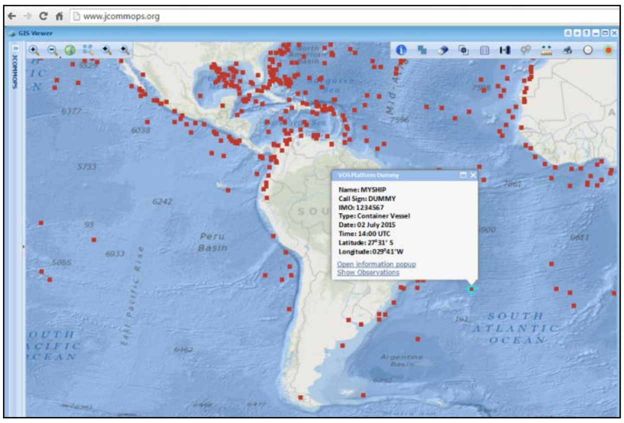
VOS CLIMATE FLEET (VOSClim)

The aim of the VOS Climate Fleet (VOSClim) is to provide a high quality subset of VOS data in both real-time and delayed mode, supplemented by an extensive array of metadata to support global climate studies and research.

The Contracting Governments undertake to encourage the collection of meteorological data by ships at sea and to arrange for their examination, dissemination and exchange in the manner most suitable for the purpose of aiding navigation.

International Convention for Safety of Life at Sea (SOLAS), 1974, and its Protocol of 1988, Regulation 5 Chapter V.

Like other VOS ships, VOSClim class ships use electronic logbook software to prepare their real-time observations, but they also input extra variables such as; ship's ground course and speed, ship's heading, maximum height of the cargo above summer load line and the difference between summer load line and the waterline. PMOs take photographs of VOSClim ships and provide schematics showing the location of the instruments so that future researchers can visualize the ship's layout and model the wind flow over a vessel. More than 450 VOSClim ships are reporting observations from the world oceans.



Latest positions and query tools are also available on public websites. It is possible to mask true ship identities.

CONCLUSION

Meteorological observations from VOS continue to make a vital contribution to marine safety and efficiency, providing real-time reports needed for weather forecasting, and historical data needed for planning and design. They contribute substantially to increasing our understanding of the atmosphere/ ocean linkages, essential in addressing the issue of global warming and for the development of accurate long-range weather forecasts. They also provide vital ground truth measurements for the calibration and validation of satellite observations. These realities will remain unchanged in the foreseeable future.

VOS observer Thomasz Bartoszek receiving an award from German PMO Horst von Bargen

Get involved now - Join the VOS fleet!

OTHER OCEAN OBSERVING PROGRAMMES REQUIRING SHIP ASSISTANCE

In addition to VOS, ships are sought for a range of other scientific ocean applications, the most common of which are listed below.

Automated Shipboard Aerological Programme

The JCOMM Automated Shipboard Aerological Programme (ASAP) provides vertical profiles of temperature, humidity, wind speed and wind direction from data sparse ocean areas. The ASAP uses radiosondes tethered to helium filled balloons to sample the atmosphere from the sea surface to a height of up to 30km.Such upper air profiles are mostly performed on VOS ships in the North Atlantic, but also on some research and naval vessels in other global regions. More than 20 ships are actively involved in ASAP, producing approximately 5000 profiles of the atmosphere per year. This data significantly enhances the accuracy of the meteorological analyses over the oceans.

Temperature and humidity profiles over the oceans are vital to weather and climate forecasting.

Ship of Opportunity Programme

The JCOMM Ship of Opportunity Programme (SOOP) collects a range of predominantly oceanographic data, most notably Upper Ocean Thermal (UOT) data, but also at times atmospheric and ocean carbon, fluorescence and pigments, sub-surface temperature and salinity data.

Expendable bathythermographs sample the structure of the upper layers of the ocean.

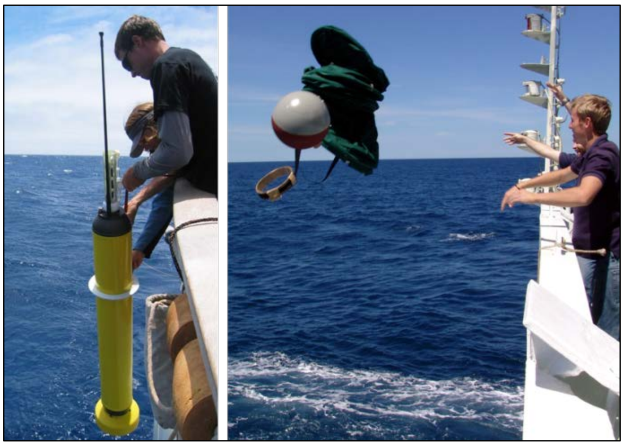
The UOT data are collected on the top 1000m of the oceans by probes, known as expendable bathythermographs (XBTs).
The probes are dropped at regular intervals along repeat XBT sampling lines from mostly volunteer ships (merchant, research and naval vessels).

The data collected by the SOOP supports a range of operational and research applications including:

- Tropical ocean variability and prediction
- Global and regional heat storage
- Ocean transport and circulation
- Sea state estimation and model evaluation
- Climate change

Data Buoy Cooperation Panel

The JCOMM Data Buoy Cooperation Panel (DBCP) is an international programme coordinating the use of autonomous data buoys to observe atmospheric and ocean conditions in data sparse areas. Globally the DBCP seeks to maintain an array of 1250 buoys, most of which are deployed due to the willing cooperation of merchant and research vessels. Typically a buoy deployment requires only the removal of plastic wrapping, and dropping at a pre-arranged location along a ship's normal route.



Deployment of autonomous instruments:
Argo float (left) and surface drifter (right)

Argo: International Profiling Float Programme

Argo is an international programme to collect temperature and salinity profiles of the upper part of the world's oceans. Argo uses robotic floats that spend most of their life drifting far below the surface. Almost 4000 floats are active in the ocean.

The floats record temperature and salinity measurements as they ascend to the surface, where the data are then transmitted to shore by satellites. The floats then descend to between 1000m and 2000m and drift for 10 days before ascending and recording new temperature and salinity profiles. This cycle is continually repeated over the 4-5 years expected life of the float.

Argo floats are deployed from a wide range of ships, and opportunities to deploy floats away from the main shipping routes are keenly sought.