

## WORLD METEOROLOGICAL ORGANISATION VOLUNTARY OBSERVING SHIPS SCHEME(VOS): AN OVERVIEW

*Raja Acharya*



*The Voluntary Observing Ship (VOS) Scheme is an international program comprising member countries of the World Meteorological Organization (WMO) that recruit ships to take, record and transmit marine meteorological and oceanographic observations while at sea. This marine meteorological data is of great use to ocean scientists, weather forecasters etc. The effective operation of the VoS ships are maintained by the Port Meteorological Officers of each member countries of WMO. This paper makes an attempt to highlight the marine meteorological observational activities of the VoS ships and their smooth dissemination to various stakeholders.*

### INTRODUCTION

It is an international scheme, first developed almost 150 years ago, by which ships plying the various oceans and seas of the world are recruited for taking and transmitting meteorological observations. VOS ships make a highly important contribution to the Global Observing System (GOS) of the World Weather Watch (WWW), and increasingly to global climate studies.

Port Meteorological Officers (PMOs) having experience in marine meteorology are appointed for recruiting voluntary observing ships and assisting them in their meteorological work. (<https://www.wmo.int/pages/prog/amp/mmop/JCOMM/OPA/SOT/vos.html>)

Lieutenant Matthew Fontaine Maury of the U.S. Navy was the first man to realise the scientific and commercial value of weather information collected from ships. Owing to his initiative, the first International Meteorological Conference was held in Brussels in 1853 to consider international cooperation and a uniform system of observation. With the advent of radio communications early in the twentieth century it became possible for observations from ships to be transmitted to meteorological offices ashore, and warnings of dangerous conditions to be transmitted to ships. At the 1929 meeting of the International Convention for the Safety of Life at Sea (SOLAS), provision was made for the international encouragement of meteorological work at sea. The current Solas Convention was adopted in 1974.

Meteorological services of most maritime countries made arrangements with ships regularly visiting their shores to take marine meteorological observations and transmit them to shore at no cost to the ship. The observations themselves are usually provided free of charge by shipping companies in return for the instrumentation and the forecasting and warning service. Hence, the name of the scheme--Voluntary Observing Ship (VOS). (<http://sot.jcommops.org/vos/vos.html>)

## IMPORTANCE OF VOS PROGRAM

The VOS program provides Marine Meteorological data which are required for a number of purposes:

- For the preparation of marine forecasts and warnings;
- For the preparation of forecasts and warnings for offshore industries;
- For marine consultancy;
- For global computer models of the future state of the atmosphere;
- To monitor the state of the oceans using delayed-mode data in weekly and monthly analyses;
- For climatological data banks for many purposes, e.g. design of ships and structures at sea, determination of economic shipping routes; and
- To build long-term records to monitor changes in the climate of the earth.

### Classification of VOS:

There are eight classes of ships in the international **VOS** Scheme as follows:

A **Selected** ship is equipped with sufficient certified meteorological instruments for making observations, transmits regular weather reports and enters the observations in meteorological logbooks. It should have at least a barometer, a thermometer for sea-surface temperature, a psychrometer and a barograph. Most of the **VOS** are selected ships.

A **Selected AWS** ship is a mobile ship station equipped with an Automatic Weather Station (AWS) system comprising certified meteorological instruments to measure at least air pressure, pressure change, temperature and humidity. Optional sensors would include wind speed and direction and sea temperature measurement. The AWS may or may not have the facility for manual input of the visual elements, and transmit reports at least three hourly or more frequently. The AWS should have the facility to log the data.

A **VOSClim** ship is a mobile ship station equipped with sufficient certified meteorological instruments for making observations, transmits regular and timely weather reports, enters the observations in an International Maritime Meteorological Tape (IMMT) compliant electronic logbook including the extra **VOSClim** delayed-mode groups, and has a proven record of providing high quality observations. A **VOSClim** ship should have at least a barometer, a thermometer to measure SST, a psychrometer (for air temperature and humidity), a barograph and possibly an anemometer. The full range of metadata must be maintained in WMO No. 47<sub>2</sub>, the full suite of digital images, sketches and drawings must be available, and the delayed-mode IMMT data must be submitted to the Global Collecting Centres (GCCs) according to recommended WMO procedures. It is highly desirable for a **VOSClim** ship to be inspected at less than six monthly intervals.

A **VOSClim AWS** ship is a mobile ship station equipped with an AWS system comprising certified meteorological instruments to measure at least air pressure, pressure change,

temperature and humidity. Optional sensors would include wind speed and direction and sea temperature measurement. The AWS may have a facility for manual input of the visual elements, and transmit reports at least three hourly or more frequently. The AWS must have the facility to log the data including the additional IMMT delayed-mode **VOSClim** groups. The full range of metadata must be maintained in WMO No. 47, the full suite of digital images, sketches and drawings must be available, and the delayed-mode IMMT data must be submitted to the GCCs according to the recommended WMO procedures. It is highly desirable for a **VOSClim** AWS ship to be inspected at less than six monthly intervals.

A **Supplementary** ship is a mobile ship station equipped with a limited number of certified meteorological instruments for making observations. It transmits regular weather reports and enters the observations in a meteorological logbook.

A **Supplementary AWS** ship is a mobile ship station equipped with an AWS system comprising a limited number of certified meteorological instruments and reporting regularly. The AWS should at least measure air pressure.

An **Auxiliary** ship is a mobile ship station normally without certified meteorological instruments, which transmits in a reduced code form or in plain language, either on a routine basis or on request, in certain data sparse areas and under certain conditions.

An **Auxiliary AWS** ship is a mobile ship station equipped with an AWS system comprising non-certified meteorological instruments and reporting regularly. The AWS should at least measure air pressure. (<http://sot.jcommops.org/vos/vos.html>)

## VOS CLIM PROJECT

VOSClim is an ongoing project within JCOMM's Voluntary Observing Ships' Scheme. It aims to provide 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. The aim of Voluntary Observing Ship Climate (VOSClim) Fleet is to provide a high-quality subset of VOS data in both real time and in delayed mode, supplemented by an extensive array of metadata, to support global climate studies and research.

The VOSClim Fleet builds on the strong foundation of the VOS Climate Project that ran between 2001 and 2009. The **VOSClim Project** followed the successful VOS Special Observing Project North Atlantic (VSOP-NA) that was conducted on behalf of the World Climate Research Project (WCRP) between May 1988 and September 1990. The aim of VSOP-NA was to establish the effects on the quality of VOS data of different ship instrumentation and observing practices.

A review of the VOSClim Project was initiated in 2008 and concluded that the operational project goals had been achieved and that there were many positive results that should be applied across the entire VOS Fleet. It was proposed and agreed at the Ship Observations

Team Fifth Session (SOT-V) in 2009 to end the VOSCLIM Project but to create a new VOSCLIM class of VOS reporting vessel.

## **RECRUITMENT OF VOLUNTARY OBSERVING SHIPS**

As per manual of GOOS (Global Ocean Observing System) each member country has the obligation to arrange for recruitment of ships that are on the register of the member country as mobile sea stations. In this way each member country contributes to the common objective of obtaining sufficient coverage of meteorological observations over the oceans. Efforts should be given to achieve a uniform coverage with emphasis on low shipping lines density.

### **Criteria of Recruitment of VOS:**

Several criteria can be used in deciding whether a particular ship should be recruited as a selected, supplementary or auxiliary ship, to satisfy both national and international needs. Questions which should be examined are whether all the necessary instruments can be installed, whether the ship's officers will have the time available for recording and transmitting the observations and whether the necessary regular contact can be established for the receipt of meteorological logbooks. Generally, ship owners and masters are very cooperative in these matters; however, it is advisable that these questions be thoroughly discussed at the recruiting stage.

Countries may recruit ships of foreign registry which visit the ports of the recruiting country sufficiently often to permit regular contact. This recruitment is sometimes done by arrangement between the Meteorological Services of two countries concerned. In order to avoid the entry of duplicate data into the international archiving system, meteorological logbooks from ships of foreign registry should be procured and stored through appropriate arrangements with the Meteorological Service of the country of registry. When a ship of foreign registry is recruited, the Member in whose country the ship is registered should be notified, unless a port in the country of the Member which recruits the ship is considered to be its home port. For the recruitment of an auxiliary ship, no prior arrangements are required with the Meteorological Service of the country of registry. Members should establish a suitable organizational unit for the recruitment of voluntary observing ships. This unit should contact shipping agencies to enlist their cooperation, arrange for the provision of instruments, instructive material and other necessary documents to ships, arrange for the collection and examination of the ships' meteorological logbooks, arrange for visits to ships, and to look after the various financial questions involved. Port meteorological officers can play a large role in the recruitment of ships. Complaints about meteorological observations from a particular observing ship should be directed to the Member with which the ship is registered. If the ship was recruited by another Member, the Member receiving the complaint should forward it to the Member concerned. ([https://mcanet.mcga.gov.uk/public/c4/solas/solas\\_v/Annexes/Annex04.htm#3](https://mcanet.mcga.gov.uk/public/c4/solas/solas_v/Annexes/Annex04.htm#3))

## PORT METEOROLOGICAL OFFICES, ROLES AND FUNCTIONS

The Port Meteorological Officer (PMO) is a representative of the national meteorological service (NMS) and is the primary contact with local maritime authorities and the maritime community at large. The position is important because it contributes directly to the effectiveness and efficiency of the Voluntary Observing Ship (VOS) scheme.

Without the dedication and enthusiasm of the PMO to maintain an active national VOS Fleet (VOF), the quality and quantity of recorded and reported meteorological and oceanographic data from ships would be adversely affected. This has serious implications for national meteorological services that; Provide an operational marine forecasting and warning service; Undertake climate monitoring and research; and supply data to end users.

### Location of the PMO

The **PMO** office should preferably be located at the main port. This provides the opportunity for more visits to voluntary weather observing ships and quicker access to replace equipment and instruments if necessary.

An office at the port will help to facilitate close contact with marine authorities and shipping companies, as well as passing ships' officers and crew. It also provides increased opportunities to recruit ships into the national **VOS** Fleet (VOF).

### Functions of the PMO

The specific functions provided by the **PMO** are dependent on the area or the port being serviced and the type and volume of marine traffic. The complete range of **PMO** functions are:

- To maintain a national VOF by; Recruiting ships of any nationality (if not already recruited by another NMHS) to take, record and transmit weather observations whilst at sea; and
- De-recruiting ships as deemed necessary.
2. To maintain accurate records of the ships recruited into the national VOF, including:
  - Full ship details, as required for WMO No. 47;
  - All instrumentation supplied and recovered; and
  - All instrument checks and calibrations dates.
3. To regularly visit ships recruited into the national VOF to:
  - Maintain contact with the Observers;
  - Provide ongoing training to Observers;
  - Maintain and inspect the meteorological and selected oceanographic instruments;
  - Check the presence and condition of supplied handbooks, meteorological tables and charts;
  - Maintain the ship's supply of logbooks, autographic charts, muslin, wicks and other mandatory consumables;
  - Recover and inspect completed logbooks and autographic charts; and
  - Recover electronic logbook data.

4. Provide the following services, regardless of the ship's nationality and country of recruitment:
  - Perform a barometer check;
  - Check meteorological code tables;
  - Check instructions for Observers; and
  - Provide advice on bulletins, including a list of areas for which forecasts are issued and to update the relevant facsimile broadcast schedules.
5. At the request of the Master of any ship, regardless of country of recruitment, perform the following services:
  - Check the meteorological and selected oceanographic instruments; and
  - Provide advice or assistance on meteorological matters.
6. Promote and maintain liaison with:
  - National Meteorological Service (NMS);
  - Neighbouring **PMOs**;
  - Harbour authorities and shipping companies; and
  - Merchant marine schools and yacht clubs.
7. Enquire about problems that may be experienced with:
  - The transmission of meteorological and oceanographic observations to a Land Earth Stations or other communications facility.
  - The reception and adequacy of forecasts, bulletins and facsimile broadcasts, and to bring this information to the attention of the national meteorological service.
8. To support complementary national, regional and international marine meteorological and oceanographic programs:
  - The deployment of meteorological drifting buoys;
  - The deployment of profiling floats;
  - The Ship-of-Opportunity Programme (SOOP); and
  - The Automated Shipboard Aerological Programme (ASAP).

### **ROLE OF PORT METEOROLOGICAL OFFICES IN MAINTAINING THE NATIONAL VOS**

The Port Meteorological Office is the nodal unit of the National Meteorological Administration of any country, entrusted with the task of recruitment of voluntary observing ships. This unit contacts shipping agencies to enlist their cooperation, arranging for provision of instruments, instruction material and other necessary documents to ships, arrange for inspection calibration of onboard ship instruments, examination of ship meteorological data and log books.

As per WMO publication no. 47 Annex V, VOS CLIM Recruitment/Update/Derecruitment advice(F-001) has to be filled up. This form is intended to be used as a record of recruitment of a vessel into the VOSCLIM Program as well as to advice and its derecruitment from VOS CLIM. Whenever any instrument is installed or removed from the vessel or a calibration of a meteorological instrument is performed, a new copy of the Form is used. The updated form is intended to be attached to the Master Form for the purpose of furnishing a complete record of instruments used on board. The Port Meteorological Officer for his/her own record need only collect installation dates and serial numbers and also update the

same in case of any change and append the same in the Master Form. If any vessel is decommissioned by one country and recruited by other the original country's F-001 form should be marked to show the derecruitment and new recruitment form to be filled by the new recruiting country.

Port Met Offices are required to follow the guidelines issued by the WMO (World Meteorological Observation) as RIDER RULES while visiting the ships.

### RIDER RULES

- Always make your presence known to the captain and chief Officer while visiting the ship.
- Be cognizant of the ship customs and protocol.
- Carry your own tools and do not borrow ships tools.
- Wear appropriate clothing and shoes.
- When there is lot of activity on the bridge, limit your questions and conversations.

### Specimen Form F-001 Recruitment/inspection form:



**VOSCLIM**  
**RECRUITMENT / UPDATE/ DERECRUITMENT**  
**ADVICE**

**Form 001**  
February 2002

Vessel Information							
Vessel Name		Call sign	IMO Number	Recruiting Country	VOS Type	Auto-mation	Baseline check
1		2	3	4	9	10	11
Flag	Home Port	Year of Construct.	Date of Recruitment /Derecruitment		Routes	3hr/6hr/1reg	
					12		

Details of Ship's Manager				Details of Ship's Agent			
Name				Name			
Address				Address			
Email				Email			
Phone		Fax		Phone		Fax	

Vessel Layout		Digital Image	6
Vessel Type	5	Location of observation points	
Gross Tonnage	t	Height of barometer*	15 . m.
Dist of bridge from bow	B	7 (a) Length	. m
		7 (b) Breadth	. m
		7 (c) Freeboard	. m
		7 (d) Draught	. m
		7 (e) Cargo ht.*	. m
		Height of thermometers*	23 . m.
		Height of anemometer*	30 . m.
		Height of anemometer**	31 . m.
		Height of visual wind/wave observation point*	38 . m.
		Dist of anemometer (from bow) :	33 . m.
		Dist of anemometer (from centre line) :	34 . m.
		Depth of sea surface temperature#:	28 . m.

\* above maximum summer load line # below maximum summer load line  
 \*\* above deck on which it is installed

Communications	
Inmarsat	A B C ...
Radio Telephone	
Mobile Telephone	

Email	
Facsimile	
Telex	
SEATEX	
Argos	

Equipment			Vessel Name		Location		Date in last calibrated	Date Removed	National Use
Instrument	Make	Owner	Type	Serial no.	Exposure	Location	Date in last calibrated	Date Removed	National Use
Barometer	14		13			16	17 Units	18	
Barograph			29						
Screen							Power/Wobly		
Air Temperature	20		19	21		22	24 Units		
Wet Bulb/Humidity			25	26					
Sea Temperature			27						
Wind Speed			35			32	36 Usage	37	
Wind Direction			35						
Weather Radar			39						
Sea and Swell			39						
Sub Surface			39						
Upper Air Winds			39						
Upper Air Temps			39						
Rain Gauge			39						
Data Entry Terminal			39						
Data Entry Software				Version:					
Other									

<b>Publications supplied to ship</b> <input type="checkbox"/> Marine Observers Handbook <input type="checkbox"/> Meteorology for Mariners <input type="checkbox"/> Cloud types for Observers <input type="checkbox"/> Cloud Chart <input type="checkbox"/> State of Sea Charts/Booklet	<input type="checkbox"/> NWS H/Book No 1 <input type="checkbox"/> Ice Handbook <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	Footnotes:  Comments/Remedial Action:
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42 - dddmmmyyy

Port Meteorological Officer (Printed): _____	(Signed): _____	Date: _____	Port: _____
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Source: WMO/TD-No. 1122 JCOMM Technical Report No. 5, Revision 2 (Pg 17-18)

## METEOROLOGICAL OBSERVATION FROM THE VOS AND TRANSMISSION OF OBSERVATIONS

Meteorological Observations onboard VOS, do have a significant role in operational forecasting as well as marine meteorological research. The ultimate objective is to forewarn the public regarding marine weather related natural disasters and minimise the losses as far as possible.

### Types of Observations undertaken on board VOS:

1. Synoptic Observations
2. Special Observations.

#### Synoptic Observations:

a. Surface observations should be made at the following main standard times: 0000,0600,1200 & 1800 UTC. when additional observations are required they should be made at one or more of the Intermediate Standard times: 0300,0900,1500 & 2100 UTC.

b. The atmospheric pressure should be read at the exact standard time, while observations of the remaining weather parameters have to be made within ten minutes preceding the standard time.

c. Due to operational difficulties it is practicable to make synoptic observation at main standard time, the actual time of observation should be made as near as possible to the main standard time. In special cases the observations may be taken one full hour earlier than the main standard time.

d. If there is sudden or dangerous weather developments, then observations should be made for immediate transmission without regard to the standard time of observation.

**Special Observation:** In connection with international programs of scientific or economic importance, observations of special nature are required from ships at sea. For Example: Request for observations on locust swarms in these as around Africa, Arabia, Pakistan and India, as this program has significance related to the agricultural economy in these countries.

Another example is the logbook report of freak waves. A freak wave is defined as a wave of very considerable height ahead of which there is a deep trough. It is the unusual steepness of the wave, which makes it dangerous to shipping. Favorable conditions for the development of freak waves seem to be strong current flows in the opposite direction to a heavy sea and especially when this occurs near the edge of the continental shelf. The reports may contribute to a mapping of these particularly dangerous areas and to a better understanding of the phenomenon.

### **Coding of Ship based meteorological Observations**

Onboard observations are coded as per the international meteorological codes published in the Manual on Codes, Volume I (WMO -No. 306).

## **METEOROLOGICAL INSTRUMENTATION ON BOARD SHIPS**

A Guide to Meteorological Instruments and Methods of Observation (WMO-No. 8) Part II, Chapter 4, Marine observations. provides detailed guidance regarding the basic meteorological instruments suitable for use on board ships making observations under the Voluntary Observing Ships Scheme,

The following basic instruments are generally installed onboard VoSships

### **a. Instruments measuring atmospheric pressure**

In practice the proper installation and operation of mercury barometers at sea has proved very difficult, and mercury barometers are now rarely installed on board ships. The use of precision aneroid barometers on the other hand does not give rise to similar problems. However, because of the zero drift to which these instruments are liable, frequent checking against standing barometers is necessary in order to ensure proper continuous operation. This checking should be carried out by a Port Meteorological Officer whenever possible, preferably at intervals not exceeding three months.

On board small vessels the reduction of the pressure reading to MSL may be carried out by the addition of a given reduction constant, or simply by correcting the reading of the scale to give pressure at MSL directly. If the barometer elevation is great, air temperature may also have to be taken into consideration when preparing reduction tables. At all times the limit of accuracy of the applied reduction should be kept within 0.2 hPa.

### **b. Barographs:**

A **barograph** is a barometer that records the barometric pressure over time in graphical form. This instrument is also used to make a continuous recording of atmospheric pressure. The pressure-sensitive element, a partially evacuated metal cylinder, is linked to a pen arm in such a

way that the vertical displacement of the pen is proportional to the changes in the atmospheric pressure. and it should be supplied with an efficient built-in damping device and the instrument should be mounted on shock-absorbing material in a position where it is least likely to be affected by concussion, vibration or movement of the ship.

#### **c. Wind Vane Anemometer:**

These are instruments mounted on the ship for measuring wind speed and direction. In order that wind reports from ships equipped with instruments are comparable with estimated winds and wind reports from land stations, anemometer readings should be averaged over 10 minutes. It is difficult to estimate 10-minute means by watching the dial of an anemometer. Due to the flow distortion caused by superstructure, masts and spars, the site of the anemometer sensor has to be carefully selected, preferably as far forward and as high as possible. The wind speed needs to be corrected for effective height (**Marine Meteorology and Related Oceanographic Activities Report No. 22, Reduction of wind measurements at sea to a standard level by R. J. Shearman and A. A. Zelenko (WMO/TD-No. 311).**)

#### **d. Instruments measuring temperature and humidity**

Temperature and humidity observations should be made by means of a psychrometer with good ventilation, exposed in the fresh airstream on the windward side of the bridge. The use of a louvered screen is not as satisfactory. If it is used, two should be provided, one secured on each side of the vessel, so that the observation can be made on the windward side. The muslin and wick fitted to a wet-bulb thermometer in a louvered screen should be changed at least once a week, and more often in stormy weather.

#### **e. Instruments measuring sea temperature**

The temperature of the uppermost thin film of water (Sea Surface Temperature) are measured by infra-red radiometers. The temperature of the underlying mixed layer below the sea surface is the representative temperature of the mixed layer which should be reported by voluntary observing ships. The "bucket" instrument method is the simplest and probably the most effective method of sampling this mixed layer, but unfortunately the method can only be used on board small vessels moving slowly. Other methods are:

1. Intake and tank thermometers, preferably with distant reading display and used only when the ship is moving;
2. Hull-attached thermometers located forward of all discharges;
3. Trailing thermometers; and

[Part II, Chapter 4 of the Guide to Meteorological Instrument and Observing Practices (WMO-No.8)]

## **TRANSMISSION OF SHIP OBSERVATIONS TO THE SHORE**

#### **a. IMMARSAT**

Ship reports can be transmitted readily to a Coast Earth Station (CES) which has been authorised to accept these reports at no cost to the ship. The national Meteorological Service of the country operating the CES pays the cost, which is usually less than the cost of a report

received via coastal radio. There are a number of such CESs in each satellite footprint and they are listed, together with the area from which they will accept reports, in **WMO-No. 9, volume D, Part B**. Code 41 is the INMARSAT address which automatically routes the report to the Meteorological Service concerned. To place a limit on the costs incurred by a national Meteorological Service, a CES may be authorised to accept reports only from ships within a designated area of ocean. These limits should be drawn to the attention of the relevant ship's officers when recruiting a ship under the Voluntary Observing Ships Scheme. A radio operator is not needed to transmit the report, and hence transmission is not restricted to the operator's hours of duty.

#### **b. Through Radio telegraphy to Coastal Radio Stations**

Ship reports can be transmitted by radio telegraphy to a coastal radio station which has been authorised to accept these reports at no cost to the ship. (The costs are met by the country operating the coastal radio station, in many cases by the national Meteorological Service).

The global plan for the collection of ship reports, and the procedures for the transmission of weather reports to coastal radio stations are described in the **Manual on the Global Telecommunications System, Volume 1, Part 1, Section 2.6 and Attachment I-1 (WMO-No 386)**.

Weather reports from mobile ship stations should (without special request) be transmitted from the ship to the nearest coastal radio station situated in the zone in which the ship is navigating. If it is difficult, due to radio propagation conditions or other circumstances, to contact promptly the nearest radio station in the zone in which the ship is navigating, the weather messages should be cleared by applying the following procedures in the order given below:

- a) Transmission to any other coastal radio station in the zone in which the ship is navigating;
- b) Transmission to any coastal radio station in an adjacent zone within the same Region;
- c) Transmission to any coastal radio station in any other zone within the same Region;
- d) Transmission to a coastal radio station in an adjacent zone in a neighbouring Region, or, failing that, to any other station in neighbouring Region;
- e) Transmission to another ship or an ocean weather station with the function or willing to act as a relay station.

In zones situated along the borderline between two Regions, the order of the procedures for the transmission of ships' weather reports to coastal radio stations, as laid down in subparagraphs (a), (b), (c), (d) and (e) above, may be interchanged subject to agreement between the two Regional Associations involved. Any agreement reached on this matter should specify the limits of the area concerned.

Members may issue instructions to their mobile ship stations to the effect that their weather reports may be transmitted via one of their home coastal radio stations designated for the collection of reports from the zone, if the application of such procedures may facilitate the efficient contact with coastal radio stations and the clearing of weather messages.

On most voluntary observing ships there is only one radio officer, whose watch-keeping hours total eight per day, hence he/she is not always available at the time when a weather report is ready for transmission. Watch-keeping hours are based on local standard time where the ship happens to be, and these times do not always synchronize with coordinated Universal Time (UTC) used for meteorological observations. It is desirable that watch keeping hours are chosen so that as many ships' observations at the main standard times (0000, 0600, 1200, 1800 UTC) as possible can be transmitted immediately after the observations are taken.

Observations taken while the radio officer is off duty should be sent at the first opportunity even with a delay of up to 12 hours. In the southern hemisphere and other areas where few ships' weather reports are available they should be sent up to 24 hours after the time of observation.

In transmitting meteorological reports to coastal radio stations, ships' radio officers follow the regulations which are valid for Maritime Mobile Services, as defined in the ITU Radio Regulations.

- a) Keep a continuous 24-hour watch; or
- b) Keep a watch for at least 30 minutes beginning at 0000, 0600, 1200 and 1800 UTC daily; watch should also be kept for a similar minimum time at the beginning of the nearest "single-operator period" following those standard synoptic hours;
- c) Keep watch for shorter periods (stations with limited hours of operation) than those mentioned under (b) above when these stations are considered of particular value.

The list of coastal radio stations accepting ships' weather reports, free of charge to the ship, together with their radio addresses and other relevant particulars, is contained in **WMO-No. 9, Volume D, Part B**. Members responsible for the reception of meteorological reports from ships need to advise the Secretariat of changes to their coastal radio stations so that this publication can be kept up to date.

The ship weather report must be addressed to the telegraphic address of the relevant National Meteorological Centre. The addresses are included in the information published in **WMO-No. 9, Volume D, Part B**. The address should be preceded by the abbreviation "OBS" to ensure appropriate handling of the message at the coastal radio station. The coastal radio station must forward the report to the National Meteorological Centre with minimum delay (by telex, landline or other means of electronic communication).

Members whose ships repeatedly encounter difficulties in clearing ships' weather reports with coastal radio stations should communicate promptly with the Member(s) concerned giving full particulars as to dates and times; the presidents of the Commission for Basic Systems and the Commission for Marine Meteorology and the Secretary-General of WMO should also be informed.

### **Service Argos**

Service Argos is a system for receipt of data from automatic weather stations by orbiting satellites. It has been used for many years to collect data from drifting buoys, but is also used to collect data from Marine Data Collection Platforms (MDCPs) on board ships. The data are read out from the satellite at one of three ground stations, and are then distributed on the GTS.

### **Distribution of ships' weather reports over the GTS**

Ship weather reports received at a National Meteorological Centre from INMARSAT Coast Earth Stations and coastal radio stations should be assembled into meteorological bulletins and transmitted over the GTS. This should be done with minimum delay, and some Centres transmit a bulletin of available ship weather reports every 15 minutes. The speed of transmission over the GTS has become more important with the advent of INMARSAT, as ship reports which were received at a local coastal radio station and arrived quickly may now be received by a CES in a distant country and have to arrive over the GTS. The ship weather reports are also a vital input to global models run at a number of centres, and there should be minimum delay in receipt of data from all over the world.

[\[https://mcanet.mcga.gov.uk/public/c4/solas/solas\\_v/Annexes/Annex04.htm#10 \]](https://mcanet.mcga.gov.uk/public/c4/solas/solas_v/Annexes/Annex04.htm#10)

## **AUTOMATION OF ON BOARD SHIP OBSERVATIONS**

Automation of ship board observation has been advanced by the advent of computer systems and satellite communication technology.

### **TurboWin Software:**

In one form the observations are taken manually in the traditional way and then entered into a personal computer, which may be in the form of a laptop or notebook. TurboWin has been developed by the Royal Netherlands Meteorological Institute (KNMI) and endorsed by the World Meteorological Organization (WMO) for use on Voluntary Observing Ships. The Bureau of Meteorology (Australia), Deutscher Wetterdienst (Germany), Met Office (United Kingdom) and Environment Canada also contributed to the development of TurboWin+. TurboWin is the most used marine observing software in use today throughout the Voluntary Observing Ship (VOS) program today. TurboWin contains observation-checking routines, which are applied on the observations before they are transmitted. Turbo Win is a user-friendly system with over 200 built-in quality checks. It allows the automated compilation of observations on board ships and fixed sea stations, their downloading to disk and their subsequent transmission ashore and thence to a Meteorological Center, by using Inmarsat, ftp, Email or other specific communication facilities and the Global Telecommunications Network. The program assists the observer with many menus, pictures, photos, forms, helps pages, output possibilities, automated calculations etc. The computer programme recommended by WMO and developed by KNMI, Netherlands,

### **This computer programme can provide the following benefits:**

- (a) Provide screen prompts to assist with data entry;
- (b) Calculates the true wind, MSL pressure and dew point;
- (c) Checks validity of some data, e.g. month in range 1–12

- (d) Stores the observation in SHIP code on disc and prints it out for transmission;
- (e) Formats the observation in IMMT format and stores it on disc or transmits the data to a shore station via a satellite system. If the ship is equipped with INMARSAT-C, the computer diskette can be placed in the INMARSAT terminal and transmitted without re-keying. In addition to filling in a meteorological logbook the diskette of observations in IMMT format is sent periodically to the Meteorological Office.

### **MDCP**

Another form of automation is the Marine Data Collection Platform (MDCP), which consists of a hand-held computer, air temperature and air pressure sensor, transmitter and antenna. The coded SHIP observations are entered into the computer and collected by Service Argos satellite.

## **UTILITY OF VOS OBSERVATIONS**

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. 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.

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. 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.

<http://sot.jcommops.org/vos/documents/VOS-Brochure-2015.pdf>

## **INCENTIVE PROGRAMME FOR VOLUNTARY OBSERVING SHIPS**

In recognition of the valuable work done by ships' officers in taking and transmitting meteorological observations and as an incentive to maintain the high standard of the observations many maritime countries have established a national award or certificate system. These systems vary greatly from country to country; in some countries the ships receive the awards, while in other countries awards are made to the masters or navigation and radio officers individually. Sometimes recognition for the meteorological work done on board ships is given in the form of books, charts and other documents presented to the ship. Members are encouraged to continue the practice of issuing national awards or certificates to selected, supplementary and auxiliary ships recruited by them, or to the ships' personnel, as a sign of their participation in the WMO Voluntary Observing Ships' Scheme.

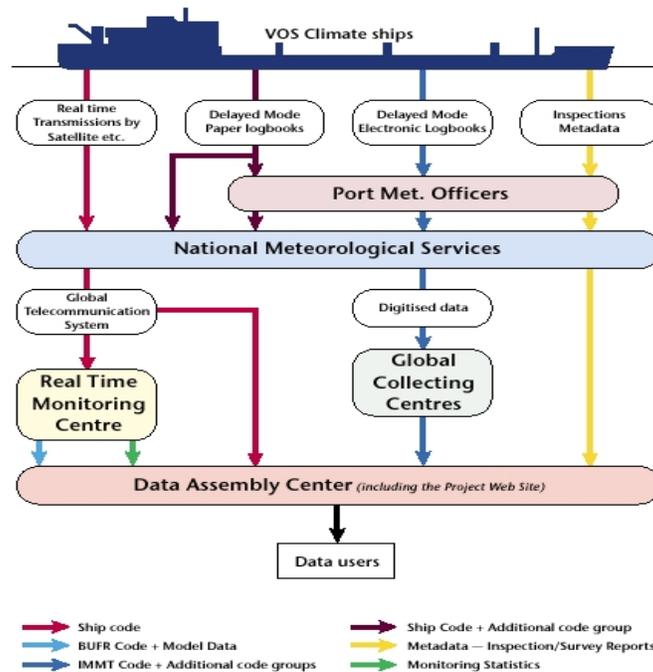
## **FUTURE PERSPECTIVES OF VOS SCHEME**

The Voluntary Observing Ships (VOS) Scheme is an observing program for marine meteorology, continuing a record extending back centuries. VOS are an important component of the surface observing system, providing air and sea surface temperatures, humidity, pressure, wind speed and direction, cloud cover, waves, ice and weather data. Observational metadata allow biases to be diagnosed and corrected. Despite its importance, the Scheme faces challenges. Observation numbers have declined as more data from satellites and buoys becomes available.

However, buoys and satellites do not replace the full multivariate VOS record, which is needed for applications including climate monitoring, air-sea interaction and satellite validation. Other issues include changes to the transmission system and the security and commercial concerns of ship operators whose ships are identified in the data stream. Current initiatives are aimed at improving data quality, real time metadata availability and archival of data for climate applications. VOS provide observations that maintain a surface marine climate record of over 300 years. Although VOS are now only one part of the surface marine observing system, their ongoing role is increasingly being recognised.

It is clear that VOS data will remain widely used in datasets essential to monitor and understand climate change, for the validation, calibration and analysis of satellite observations of SST, precipitation, wind, cloud, air temperature and humidity, providing information on air-sea interaction and atmospheric stability and modelling applications including reanalysis, NWP and forcing fields for ocean models. New initiatives to improve data quality and integration with other observing programs should ensure that the VOS remain an important contributor to the Global Climate Observing System in decades to come. (Ref THE VOLUNTARY OBSERVING SHIP (VOS) SCHEME Elizabeth C. Kent (1) et al.)

## Schematic Diagram of VoS, PMOs, National Meteorological Services and Data Assembly Centers



Source: WMO/TD-No. 1122 JCOMM Technical Report No. 5, Revision 2, p. 34.

**Acknowledgment:** I must also submit here that this article is not exhaustive, but provides only important issues related to WMO Voluntary Observing ships. I am hopeful that this article would be of some help for many students, and other professionals in their scientific pursuits and applications. I am indebted to the Office of the Climate Research & Research Services, India Meteorological Department Pune [erstwhile Office of the DDGM(WF), IMD Pune] for providing useful online resources /lecture notes which have helped a long way in preparation of this article. I am also grateful to the Head Regional Meteorological Centre Kolkata and Director, Regional Weather Forecasting Centre (Formerly Area Cyclone Warning Centre) Kolkata for providing me an opportunity to work as a Port Meteorological Officer at international River Port at Kolkata and undertake VoS inspections and other PMO activities under their guidance. I declare that the views expressed by me in this article are my own and not of my employing organisation and there is no conflict of interest involved.

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### About the Author

**Mr. Raja Acharya** is Meteorologist A, India Meteorological Department, Regional Meteorological Centre, Ministry of Earth Sciences, 4, Duel Avenue, Alipore, Kolkata-700027  
Email: [raja.acharya2011@gmail.com](mailto:raja.acharya2011@gmail.com)