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WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC
COMMISSION (OF UNESCO)

THE VOLUNTARY OBSERVING SHIPS SCHEME

A FRAMEWORK DOCUMENT

WMO/TD-NO. 1009

JCOMM Technical Report No. 4

2015

REVISION 3

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NOTES

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Chairperson, Publications Board
World Meteorological Organization (WMO)
7 bis, avenue de la Paix
P.O. Box No. 2300
CH-1211 Geneva 2, Switzerland

Tel.: +41 (0) 22 730 84 03
Fax: +41 (0) 22 730 80 40
E-mail: Publications@wmo.int

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FOREWORD

Ships of the World Meteorological Organization (WMO) Voluntary Observing Ship (VOS) scheme have always been an important component of the global observing system of the WMO, providing meteorological and oceanographic data essential to operational meteorology, maritime safety services, and a range of marine climatological applications. More recently, it has become clear that their observations can also be of critical importance to global climate studies.

In view of this importance, and at the same time of the ongoing and increasing difficulties in VOS recruitment and maintenance, the WMO Commission for Marine Meteorology (CMM, now the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology - JCOMM) Subgroup on the VOS recognized the value of adopting a guiding strategy or framework document for the VOS. This document would provide VOS operators with a global framework in which to develop and maintain their national VOS programmes, and at the same time help to sensitize user groups and organizations to the VOS scheme in general, its structure, operations and value. A first draft of this framework document was prepared by Mr Don Linforth (Australia), and reviewed by the first session of the subgroup (Athens, March 1999). The document was revised, on the basis of comments received from participants, by Capt. Gordon Mackie (U.K.), and reviewed a final time by subgroup members.

The document was again revised in early 2008 by Mr G. Ball (Australia), Chair of the JCOMM Ship Observations Team (SOT), and Ms J. Fletcher (New Zealand), the Chair of the Voluntary Observing Ship Panel (VOSP), a sub-group of the SOT, and is now published herewith as a report in the JCOMM Technical Report series. Another revision was made in 2010 to reflect the SOT proposal, approved by JCOMM-III (November 2009) to integrate the VOSclim as part of the wider VOS Scheme through the use of a new VOSclim class. A further revision was made in March 2015 to update the annual VOS Fleet figures and provide a more recent monthly map of VOS observations. As noted above, it is hoped that this document will prove of interest and value to VOS operators and data users alike. The appreciation of WMO is extended to Mr Linforth, Capt. Mackie, Mr Ball and Ms Fletcher for their valuable contributions to its preparation.

THE VOLUNTARY OBSERVING SHIPS SCHEME

A FRAMEWORK DOCUMENT

1. INTRODUCTION

In 1853 a conference was held in Brussels to discuss the establishment of a uniform system for the collection of meteorological and oceanographic data from the oceans and the use of these data for the benefit of shipping in return. The aim was to ascertain the climatology of the oceans, or at least of the trade routes, to reduce the hazards and increase the efficiency of marine navigation.

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. The International Convention for the Safety of Life at Sea specified that “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”.

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 provided free of charge by shipping companies in return for the instrumentation and the forecasting and warning services. Hence, the name of the scheme – Voluntary Observing Ship (VOS) – which is coordinated by the VOS Panel, a sub-group of the JCOMM Ship Observations Team.

2. RATIONALE

Meteorological data are required from the seas and oceans for a number of purposes:

- they are required very quickly for the preparation of forecasts and warnings, and for the global computer models of the future state of the atmosphere;
- they are required in a delayed mode for the preparation of weekly and monthly analyses for monitoring the state of the oceans;
- they are required for climatological data banks for many purposes, e.g. design of ships and structures at sea and determination of economic shipping routes;
- they are required on a long-term basis for monitoring changes in the climate of the earth.

The data required pertain to the atmosphere above the sea (temperature, dew point, cloud, weather, visibility and pressure) and the surface of the sea (temperature, waves, currents and ice).

The requirements for forecasts and warnings are specified by the World Weather Watch of WMO, which is managed by the Commission for Basic Systems (CBS), which is also responsible for systems for management of the data (distribution on the Global Telecommunication System – GTS - and processing by the Global Data-Processing and Forecasting System - GDPFS).

The requirements for monitoring change in climate have been specified by the Ocean Observations Panel for Climate (of GOOS/GCOS/WCRP), within the context of the Climate Module of the WMO-IOC-UNEP-ICSU Global Ocean Observing System (GOOS). GOOS is also the Ocean Module of the WMO-IOC-UNEP-ICSU Global Climate Observing System (GCOS).

The desirable observational network for climate monitoring purposes was specified in the Final Report of the Ocean Observing Systems Development Panel (OOSDP) in 1995, and revised in the Action Plan for Global Ocean Observations for the GOOS/GCOS in 1998. Observational user requirements for WMO Application Areas, including for example those for Global Numerical Weather Prediction (GNWP), Global Climate Observing System (GCOS), and Ocean Applications are collected and recorded quantitatively in the WMO Observing System Capability Analysis and Review Tool (OSCAR, see website¹). In OSCAR, each requirement is expressed in terms of horizontal resolution, vertical resolution, observing cycle, delay of availability, uncertainty, and stability with each parameter described in terms of goal, breakthrough (B/T) and threshold (T/H)². The spatial and temporal resolution of observations required for climate is coarser than for weather forecasting.

The oceans cover about two-thirds of the surface of the earth, and for decades ships were the only means of obtaining meteorological data from them. Although there are now several other means – satellites, drifting buoys and floats, radar – ships still play a very important part. They provide ground truth for the calibration of satellite observations and make measurements not yet obtainable by other means, such as air temperature and dew point.

3. THE EXISTING SCHEME

There are eight types of ships in the VOS:

- (i) Selected ships;
- (ii) Selected AWS ships;
- (iii) VOSCLim (VOS Climate) ships;
- (iv) VOSCLim AWS ships;
- (v) Supplementary ships;
- (vi) Supplementary AWS ships;
- (vii) Auxiliary ships;
- (viii) Auxiliary AWS ships.

A Selected ship is a mobile ship station equipped with sufficient certified meteorological instruments for making observations, transmits regular weather reports and enters the observations in a meteorological logbook. It should have at least a barometer, a thermometer to measure SST, a psychrometer (for air temperature and humidity), a barograph and possibly an anemometer. 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 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.

¹ www.wmo.int/oscar/requirements

² The “threshold” is the absolute minimum requirement, i.e. the requirement level below which data have no significant impact on the application; the “goal” is the ideal requirement above which data do not bring any additional value to the application; the “breakthrough” level is an intermediate value between “threshold” and “goal” which, if achieved, would result in a significant improvement for the targeted application. The breakthrough level is expected to be more appropriate than the “goal” from a cost-benefit point of view.

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, 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 the procedures described in Chapter 3 of the WMO Guide to Marine Meteorological Services (WMO No. 471). 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 procedures described in Chapter 3 of the WMO No. 471. It is highly desirable for a VOSClim 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.

TABLE 1: THE ELEMENTS OBSERVED BY THE VARIOUS TYPES OF VOS

	<i>Selected</i> ³	<i>VOS</i> <i>Clim</i> ³	<i>Supplementary</i> ³	<i>Auxiliary</i> ³
Present and past weather	x	x	x	x
Wind direction and speed	x	x	x	x
Cloud amount	x	x	x	x
Cloud type and height of base	x	x	x	
Visibility	x	x	x	x
Temperature	x	x	x	x
Humidity (dew point)	x	x		
Atmospheric pressure	x	x	x	x
Pressure Tendency	x	x		
Ship's course and speed	x	x		
Sea surface temperature	x	x		
Period and heights of wind waves	x	x		
Direction, period and height of swell	x	x		
Sea ice and/or icing (if appropriate)	x	x	x	x
Special phenomena (if appropriate)	x	x		
Max height of deck cargo above the SLL		x		
Height difference from the SLL to the water line		x		
Course of ship over ground		x		
Ship's ground speed		x		
Ship's heading		x		

Ships are recruited by Members of WMO, usually through Port Meteorological Officers (PMO), who recruit if possible into their VOS fleets ships of all flags, not just those on their national register. Ships are recruited on the basis of the willingness of the ships' officers to perform the observations and the regular route followed by the ship. A Member will generally recruit ships which regularly visit ports in the country concerned. Recruited ships are usually on the national register of the Member, but may be on a foreign register, in which case the meteorological service of the country of registry is informed. Ships' observations are generally made at the standard synoptic hours of 0000, 0600, 1200 and 1800 UTC and are sent to a meteorological service as by INMARSAT-C or email communication. In the case of INMARSAT C, the cost of transmission is paid by the meteorological service of the receiving country. Observations at the intermediate reporting times of 0300, 0900, 1500 and 2100 UTC are also welcomed, and observers are urged to report at any UTC hour if they missed the standard or intermediate reporting times or if weather conditions varied markedly from that forecast.

A list of VOS and their instrumentation is kept up to date by the Secretariat of WMO, and included in the WMO Publication No. 47, on the basis of information supplied by Members. Pub47 is available at <http://www.wmo.int/pages/prog/www/ois/pub47/pub47-home.htm> Metadata, including full details of the observational site (e.g. height and exposure of the instrument), are absolutely essential to a correct interpretation and use of the observations.

³ Are indicated in bold the elements required by both automated (i.e. AWS sub-class) and non-automated systems; otherwise the element is only required for non-automated systems.

TABLE 2: THE NUMBER OF SHIPS BELONGING TO THE VOS⁴

Number of ships in the international VOS Scheme

Year	Selected		VOS _{Clim}				Supplementary		Auxiliary		Other		Total
	Manual	AWS	Manual	AWS	Manual	AWS	Manual	AWS	Manual	AWS	Manual	AWS	
1987	4642												7384
1988	4438												7202
1989	4664												7539
1990	4645												7491
1991	4647												7450
1992	4608												7362
1993	4512												7316
1994	4092												6675
1995	4124												6726
1996	4171												6752
1997	4187												6759
1998	4230												7062
1999	4244												7092
2000	4185												6966
2001	4179												6938
2002	4133												6896
2003	4006												6605
2004	3963												6605
2005	3482										112		5859
2006	3444										151		5429
2007	3441										132		5046
2008	2510										50		4833
2009	3321										1266		4278
											192		4254
2010	2663	109	136	47	473	48	239	0					3910
2011	2225	114	191	45	655	67	235	0					3696
2012	2090	80	315	109	714	62	270	0	8	0			3820
2013	1797	63	372	114	593	69	289	0	14	1			3471
2014	1654	62	403	115	592	75	333	4	18	2			3557

4. DATA MANAGEMENT

Marine meteorological observations have traditionally been recorded on board most ships in special meteorological registers (logbooks) provided by national Meteorological Services. The logbooks are collected by the Port Meteorological Officer of the recruiting country and the observations are transferred from the logbooks to magnetic media, in a standard, internationally agreed, format. Increasing numbers of ships are now using Electronic Logbook Software, eg TurboWin, OBSJMA, SEAS, to compile and record their observations in the internationally agreed format. These data are periodically collected by the Port Meteorological Officer on diskette or USB stick.

The data are then sent, at approximately three-month intervals, to global collecting centres in Germany and the United Kingdom in support of the Marine Climatological Summaries Scheme (MCSS). These centres ensure that minimum quality control has been applied to the data, and then, every three months, supply data to eight Members, each with a specific area of responsibility for the preparation of climatological summaries.

⁴ The VOS_{Clim} class, and the AWS sub-class didn't exist prior to 2010 and their numbers are therefore not indicated in this table for this period.

5. REAL-TIME DATA QUALITY

PMOs visit VOS calling at their ports to check the instrumentation, calibrate the barometer, supply stationery such as barograph charts or logbooks as required, and discuss any observational problems with the Master and officers.

The quality of VOS reports is monitored by several major meteorological centres, primarily the U.K. Meteorological Office. Results of this monitoring are compiled and distributed monthly to VOS operators and PMOs, who are expected to take follow-up actions to correct deficiencies.

6. COORDINATION

The Scheme is coordinated by the Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) through the VOS Panel. The Terms of Reference of the VOSP are:

1. Review, recommend and coordinate the implementation of new and improved specialized shipboard meteorological instrumentation, siting and observing practices, as well as of associated software;
2. Support the development and maintenance of pilot projects such as VOSclim⁵;
3. Develop and implement activities to enhance ship recruitment, including promotional brochures, training videos, etc.; and
4. Prepare annually a report on the status of VOS operations, data availability and data quality.

7. CURRENT PROBLEMS

7.1 Number of Ships

As can be seen from Table 2, the number of VOS is decreasing. This is due in part to cargo ships becoming larger but fewer in numbers, increased changes of routes and ships' personnel which make recruitment difficult, as well as the removal of non-performing ships from the VOS.

7.2 Reduced Crews

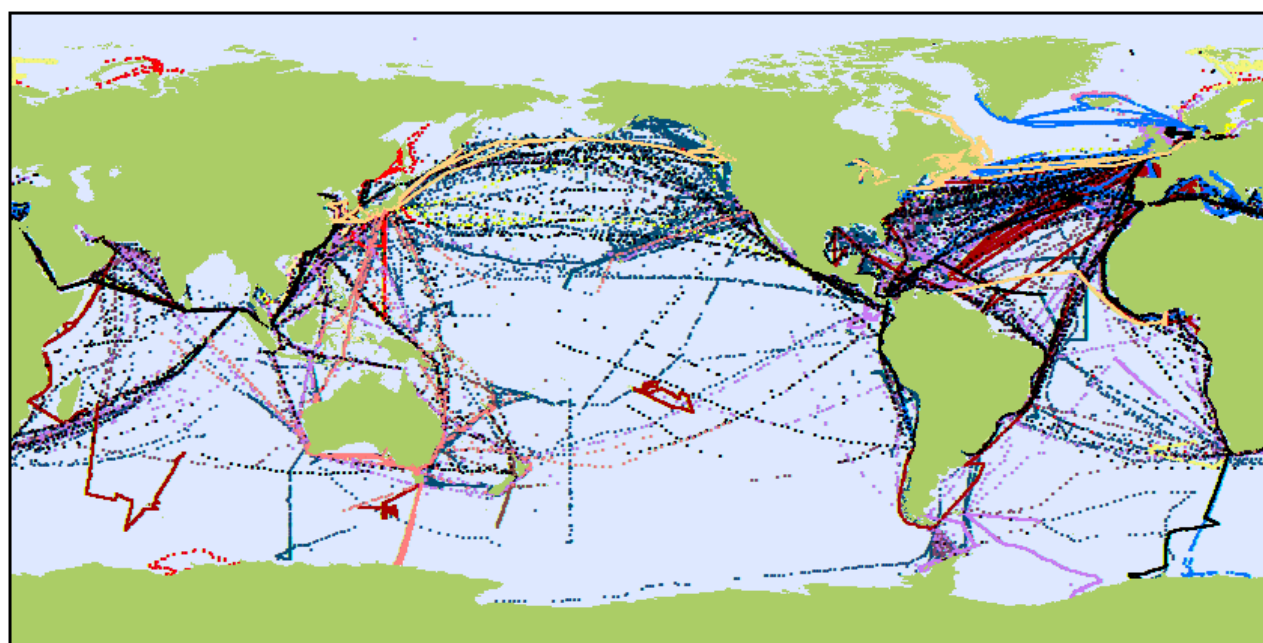
Although ships have become larger, the crews have become smaller. Ships' officers have less time in which to make observations, e.g. under the IMO Global Maritime Distress and Safety System (GMDSS) the requirement to carry a ship's radio officer no longer exists and the ship's deck officers (observing officers) now have to carry out communications work. This is being overcome to some extent by automation of the observations.

7.3 Spatial Coverage

The geographical distribution of ships' weather observations in a typical month is shown in Figure 1. The location of the major trade routes of the world is obvious, as is the heavy concentration of observations in the Northern Hemisphere and the large data sparse areas in the Southern Hemisphere.

⁵ VOSclim: VOS Climate Project. VOSclim is a project within JCOMM's Voluntary Observing Ships' Scheme that ceased in 2010 but which has then been integrated as an ongoing activity as part of the wider VOS through the use of the VOSclim class of vessel. 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.

FIGURE 1: CURRENT STATUS OF GLOBAL VOS NETWORK (JANUARY 2015)



Ship Observations Team	VOS by recruiting Country	January 2015
	(N° of active IDs / N° of observations in period, without generic call sign SHIP)	
• AU (38/2870)	• ES (1,620)	• GB (236/29243)
• CA (45/30500)	• EU (26/9790)	• GR (1/44)
• DE (353/20981)	• FR (47/16668)	• HK (43/1599)
		• IE (2/24)
		• IL (4/60)
		• IN (1/8)
		• IS (2/109)
		• JP (24/1020)
		• KR (2/2)
		• MY (4/65)
		• NL (68/2901)
		• NO (4/2102)
		• NZ (18/1668)
		• RU (23/715)
		• SE (17/2248)
		• US (463/32364)
		• n/d (25/1232)

7.4 Accuracy of Observations

The Special Observing Project for the North Atlantic (VSOP-NA) revealed many sources of inaccuracy in ships' observations, e.g. in relation to exposure of the instruments, calculation of true wind from observed wind and ship's velocity, differing means of measuring sea surface temperature.

7.5 The Beaufort Scale

The Beaufort Scale of wind speed was devised in the eighteenth century with reference to the behaviour of a fully-rigged sailing ship.

Whilst the Beaufort Scale at best gives only an estimate of the 'true wind' speed, many National Meteorological Services (NMS) still prefer to use the Beaufort Scale in preference to ship's-own anemometers that generally suffer from a lack of regular servicing and calibration.

8. AUTOMATION OF OBSERVATIONS

In an effort to reduce the workload on ships' officers, several means of automation of the observations have been developed. Using Electronic Logbook Software, the observations are still taken manually but then entered into a software package which then calculates the true wind, the mean sea level pressure (correcting for the height of the bridge) and the dew point. This same software can also perform quality control, code the observation for transmission, and format the observation in logbook format for digitisation. If this software is run on a ship's personal computer, care must be taken, to ensure this process does not adversely affect the ship's network PC and/or its communication carriage requirement under the International Convention for the Safety of Life at Sea (SOLAS).

Increasingly, many NMS are equipping ships with an Automatic Weather Station (AWS) that may either operate totally in stand-alone mode, or accept manual input of the visual parameters (cloud, weather, sea and swell) via a computer. The best locations for sensors are not easy to find, particularly for wind and dew point. Most sites for an anemometer sensor will be affected by wind flow distortion over the superstructure.

An additional factor is that the changing nature of international shipping creates problems in selecting a vessel that is likely to stay on the same trade route for a predetermined period. NMS may be reluctant to invest in ship AWS installations when there is no guarantee that a ship will continue trading in their area of forecasting responsibility.

9. RELATION TO THE GOOS

The observations from the VOS make an important contribution to the GOOS. The VOS Panel will work in close collaboration with the general organisation and implementation of the GOOS. Scientific advice on the VOS, particularly relating to the role of VOS observations in global climate studies, will be provided by the GOOS/GCOS/WCRP Ocean Observations Panel for Climate (OOPC).

10. IMPLEMENTATION STRATEGY

The **General Aims** are:

- a. To obtain accurate meteorological data from the oceans for preparation of meteorological forecasts and warnings for shipping on the oceans;
 - i. monitoring the state of the oceans;
 - ii. provision of climatological data for the oceans;
 - iii. research into changes in the climate of the earth;
- b. To provide data as far as possible in accordance with the specified spatial, temporal and accuracy requirements of the GOOS/GCOS.

The **Specific Aims** are:

- a. To make use of every suitable ship to obtain data from the parts of the oceans from which little data are currently received;
- b. To keep up with changes in technology in the automation of the taking and transmission of meteorological observations from ships and to encourage improved practice;
- c. To improve the accuracy of ships' observations as recommended by the VOSP-NA;
- d. To upgrade as many ships as practicable to VOSClm class status.
- e. To monitor observations received from ships and take action to rectify any deficiencies in accuracy that are detected;
- f. To use changes in technology to improve the flow and treatment of the meteorological data obtained from ships;
- g. To maintain marine-trained Port Meteorological Officers at the major ports of the world;
and

h. To maintain close collaboration with the organization and implementation of the GOOS/GCOS.

Actions:

1. Encourage maritime Members, particularly those in the southern hemisphere, to recruit VOS that travel to data-sparse areas, such as vessels proceeding to the Antarctic, or making regular voyages across the central and south-eastern Pacific Ocean;
2. Encourage the use of hull-attached temperature sensors for the measurement of sea-surface temperature;
3. Encourage the automation of observations and reporting;
4. Investigate with real-time monitoring centres the value of including the height or depth of observed parameters;
5. Prepare comprehensive guidance on observing procedures to vessels of the VOS to help standardise observing practices among national observing fleets;
6. Monitor observations in real-time and drawing to the attention of the appropriate Members any deficiencies in accuracy;
7. Extend real-time monitoring systems to cover all variables required for surface flux calculations;
8. Encourage more recruitment of VOSclim class vessels;
9. Derive an acceptable standard scale of Beaufort wind speed equivalents;
10. Organise training seminars and conferences for Port Meteorological Officers every 3-4 years;
11. Encourage national award schemes to ships and or ships' officers as recognition for high standards in taking, recording and reporting observations;
12. Keep under review the flow of meteorological data from ships to ensure the most efficient method of providing world-wide climatological data to users;
13. Keep Members informed of advances in technology in the taking and transmission of ships' observations by means of technical notes and similar publications;
14. Encourage Members to submit each quarter, all metadata that are required in WMO Publication No. 47.
15. WMO to maintain an up-to-date listing of all VOS ships, name, call sign, country of recruitment etc. so that a PMO may know the status of a ship before visiting it;
16. Encourage PMOs to collect INMARSAT C numbers at recruitment in the event that contact with the ships is necessary to check an observation, advise on correct coding procedures or request additional observations in storm or Tropical Cyclone conditions;
17. WMO to maintain an up-to-date list of INMARSAT Land Earth Stations (LES) that accept observations free of charge to the ship, as well as the special access codes required to lodge ship's weather reports with LES;

18. Encourage all research vessels to transmit meteorological observations in real-time; and
19. Organise an international meeting with active participation of the World Meteorological Organization (WMO), the International Maritime Organization (IMO), the International Chamber of Shipping (ICS) and the Intergovernmental Oceanographic Commission (IOC) of UNESCO to emphasise the importance of VOS observations.

Coordination of the VOS will continue to be the responsibility of the JCOMM VOS Panel and the flow and treatment of non-real-time data the responsibility of the JCOMM Expert Team on Marine Climatology (ETMC).

APPENDIX A

LIST OF ACRONYMS

AOPC	Atmospheric Observations Panel for Climate (of GCOS/WCRP)
ASAP	Automated Shipboard Aerological Programme
ASAPP	Automated Shipboard Aerological Programme Panel (of SOT)
AWS	Automatic Weather Station
CBS	Commission for Basic Systems (of WMO)
CMM	Commission for Marine Meteorology (of WMO, now JCOMM)
ETMC	Expert Team on Marine Climatology
GCOS	Global Climate Observing System (of ICSU, IOC, UNEP, WMO)
GDPFS	Global Data Processing and Forecasting System (of CBS)
GMDSS	Global Maritime Distress and Safety System (of IMO)
GOOS	Global Ocean Observing System (of ICSU, IOC, UNEP, WMO)
GTS	Global Telecommunication System (of WWW)
ICS	International Chamber of Shipping
ICSU	International Council for Science
IMO	International Maritime Organization
INMARSAT	International maritime satellite private company
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
JCOMM	Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology
JCOMMOPS	JCOMM in situ Observing Platform Support Centre
LES	Land Earth Station (INMARSAT)
NMS	National Meteorological Service
NWP	Numerical Weather Prediction
OOPC	Ocean Observation Panel for Climate (of GOOS, GCOS, WCRP)
PMO	Port Meteorological Officer
SHIP	GTS Report of surface observation from a Sea Station (FM-13)
SOLAS	International Convention for the Safety of Life at Sea
SOT	Ship Observations Team (of JCOMM)
SST	Sea Surface Temperature
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USB	Universal Serial Bus
UTC	Universal Time Coordinated
VOS	Voluntary Observing Ship
VOSP	Voluntary Observing Ship Panel (of SOT)
VOSClim	Voluntary Observing Ships Climate Subset Project
VSOP-NA	VOS Special Observing Project-North Atlantic
WCRP	World Climate Research Programme (of ICSU, IOC, WMO)
WMO	World Meteorological Organization
WWW	World Weather Watch (of WMO)

APPENDIX B

JOINT WMO/IOC TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE METEOROLOGY TECHNICAL REPORT SERIES

No.	Title	Issued
85	The JCOMM Marine Climate Data System (MCDS) – <i>pdf only</i>	Pending
84	Final Report, JCOMM Pilot Intercomparison Project for Seawater Salinity – <i>pdf only</i>	Pending
83	Ship Observations Team (SOT) Annual Report 2014 – <i>Website only</i>	Pending
82	Report of the 2014 Meeting for the WCRP- JCOMM Coordinated Global Wave Climate Projections (COWCLIP)	2014
81	S-411 Ice Information Product Specification	2014
80	Electronic Chart Systems Ice Objects Catalogue	2014
79	Proceedings of the Fourth JCOMM Workshop on Advances of Marine Climatology (CLIMAR-4), Asheville, North Carolina, USA, 9 - 12 June 2014. – <i>pdf only</i>	Pending
78	Proceedings and Recommendations: Training Workshop on Marine Forecasting for Gulf of Guinea and North Atlantic Region, 3-7 March 2014, Dakar, Senegal	2014
77	JCOMM Ship Observations Team (SOT), Annual report for 2013 – <i>Website only</i>	2014
76	WCRP-JCOMM Coordinated Global Wave Climate Projections (COWCLIP) Review	2014
75	Coastal Inundation Forecasting Demonstration Project: System Design for Bangladesh	2013
74	Coastal Inundation Forecasting Demonstration Project: System Design for Fiji	2013
73	Coastal Inundation Forecasting Demonstration Project: National Capacity Assessment for Bangladesh	2013
72	An Oceanographer's and Marine Meteorologist's Cookbook for Submitting Data in Real Time and In Delayed Mode – <i>pdf only</i>	Pending
71	Coastal Inundation Forecasting Demonstration Project: National Capacity Assessment for Fiji	2013
70	Fiji Stakeholders Workshop for WMO Coastal Inundation Forecasting Demonstration Project, 18-21 February 2013, Nadi, Fiji – <i>Website only</i>	2013
69	JCOMM Ship Observations Team (SOT), Annual report for 2012– <i>Website only</i>	2012
68	Proceedings: 8th JCOMM/TCP Workshop on Storm Surge and Wave Forecasting, 19~23 November 2012, Nairobi, Kenya – <i>Website only</i>	2012
67	12th International Workshop on Wave Hindcast and Forecasting, and 3rd Coastal Hazard Symposium, 2011, Kona, Hawaii, USA – <i>Website only</i>	2012
66	GLOSS Implementation Plan 2012 – <i>pdf only</i>	2012

No.	Title	Issued
65	Bangladesh Stakeholders Workshop for JCOMM-CHy Coastal Inundation Forecasting Demonstration Project, 28 November - 1 December 2011, Dhaka, Bangladesh - Website only	2012
64	Coastal Inundation Forecasting Demonstration Project – Implementation Plan – Website only	2012
63	Recommended algorithms for the computation of marine meteorological variables – pdf only	2015
62	Proceedings: 7th TCP-JCOMM Workshop on Storm Surge and Wave Forecasting, 10 ~ 14 October 2011, Macao, China – Website only	2011
61	SOT Implementation Strategy – pdf only	2014
60	SOT annual report for 2011– Website only	2012
59	Proceedings of the 3 rd International Workshop on Advances in the Use of Historical Marine Climate Data (MARCDAT-III), 2-6 May 2011 – Website only	2011
58	Extreme value analysis: still water level – pdf only	2011
57	Extreme value analysis: wave data – pdf only	2011
56	Final Report: 3 rd Ice Analysts Workshop, Copenhagen, Denmark, 18-22 June 2011 – pdf only	2011

As of July 2011 TD numbers are no longer allocated

No.	Title	WMO/TD-No.	Issued
55	WCRP-JCOMM Workshop on Coordinated Global Wave Climate Projections – pdf only	1518	2011
54	Ship Observations Team (SOT) Annual Report 2010– Website only	1568	2011
53	The WMO-IOC Network of Regional Marine Instrument Centres (RMICS) – pdf only	1564	2010
52	11th international workshop on wave hindcasting and forecasting and 2nd coastal hazard symposium – Website only Halifax, Canada, 18-23 October, 2009.	1553	2010
51	SOT Annual Report for 2009– Website only	1525	2010
50	JCOMM-III – Scientific Lectures – Website only	1518	2009
49	Proceedings of the 2nd Ice Analysts Workshop, Rostock, Norway 15-19 June 2009 – Website only	1517	2009
48	Project report, Pilot Project for the Integration of marine meteorological and other appropriate oceanographic observations into the WMO Integrated Global Observing System (WIGOS) – pdf only	1515	2011
47	JCOMM Technical Workshop on Wave Measurements from Buoys, 2-3 October 2008, New York City, USA – Website only	1466	2008
46	SOT Annual Report for 2008 – Website only	1459	2008
45	Proceedings of the 3 rd JCOMM Workshop on Advances in Marine Climatology, Gdynia, Poland, 6-9 May 2008 – CD-ROM and Website	1445	2008
44	Proceedings of 1) 1 st JCOMM Scientific & Technical Symposium on Storm Surges, Seoul, Korea 2-6 Oct. 2007 2) 10 th International Workshop on Wave Hindcasting & Forecasting & Coastal Hazard Symposium , North Shore Oahu, Hawaii, 11-16	1442	2008

No.	Title		Issued
	November 2007 – CD ROM and – Website		
43	Proceedings of the Ice Analysts Workshop, Rostock, Germany 12-17 June 2008 – CD ROM and Website	1441	2008
42	Proceedings of the OGP/JCOMM/WCRP Workshop on Climate Change & the Offshore Industry Geneva, 27-29 May 2008 – CD ROM and Website	1440	2008
41	SOT Annual report for 2007 – CD-ROM and Website	1431	2008
40	JCOMM Data Management Plan	1426	2008
	Revision 1		2012
	Revision 2 – pdf only		2015
39	JCOMM Expert Team on Marine Accident Emergency Support (ETMAES), First Session - National Reports (Angra dos Reis, Brazil, 29-31 January 2007) - Website only	1399	2007
38	JCOMM Expert Team on Maritime Safety Services (ETMSS), Second Session - National Reports (Angra dos Reis, Brazil, 24-27 January 2007) - Website only	1398	2007
37	Application of collected data, Presentations at the DBCP Technical Workshop, Buenos Aires, Argentina, 17-18 October 2005 – Website only	1388	2006
36	SOT Annual Report for 2006 – Website only	1394	2007
35	Application of collected data, Presentations at the DBCP Technical Workshop, Chennai, India, 18-19 October 2004 – Website only	1387	2006
34	Ninth International Workshop on Wave Hindcasting and Forecasting (Victoria, Canada, 24-29 September 2006) – CD ROM and Website	1368	2007
33	Techniques and Benefits of Satellite Data and Wave Models, J.-M. Lefèvre, J.-R. Bidlot and S. Abdalla – pdf	1357	2006
32	SOT Annual Report for 2005 – CD ROM and Website	1346	2006
31	Manual on Sea Level, Measurement and Interpretation, Volume IV: An Update to 2006 - pdf	1339	2006
30	Verification of Operational Global and Regional Wave Forecasting Systems against Measurements from Moored Buoys, by J.-R. Bidlot and M.W. Holt – pdf	1333	2006
29	Eighth International Workshop on Wave Hindcasting and Forecasting (North Shore, Oahu, Hawaii, 14-19 November 2004) – Website only	1319	2006
28	Third International Workshop for Port Meteorological Officers (Hamburg, Germany, 23-24 March 2006 – CD ROM and Website	1318	2006
27	An International Seminar to Celebrate the Brussels Maritime Conference of 1853 - An Historical Perspective of Operational Marine Meteorology and Oceanography - Proceedings - CD ROM and Website	1226	2004
26	Automated Shipboard Aerological Programme (ASAP) - Annual Report for 2003 – pdf (p. 4, 5, 6)	1224	2004
25	Second International Workshop for Port Meteorological Officers - CD ROM and Website	1216	2004
24	Ice Chart Colour Code Standard	1215	2004
23	SIGRID-3: A Vector Archive Format for Sea Ice Charts	1214	2004
	Revision 1– pdf		2010

No.	Title		Issued
22	Proceedings of CLIMAR-II - Second JCOMM Workshop on Advances in Marine Climatology (Brussels, Belgium, 17-22 November 2003) - CD ROM and Website	1199	2004
21	Workshop on Wind Wave and Storm Surge Analysis and Forecasting for Caribbean Countries (Dartmouth, Canada, 16-20 June 2003) - CD ROM and Website	1171	2003
20	JCOMM Ship Observations Team, Second Session - National Reports (London, United Kingdom, 28 July - 1 August 2003) – pdf only	1170	2003
19	Automated Shipboard Aerological Programme (ASAP) - Annual Report for 2002 – pdf (p. 4, 5, 6)	1169	2003
18	JCOMM Expert Team on Maritime Safety Services (ETMSS), First Session - National Reports (Lisbon, Portugal, 11-14 September 2002) - e-version only (doc , pp. 74-75 pdf)	1135	2002
17	JCOMM Ship Observations Team, First Session - National Reports (Goa, India, 25 February - 2 March 2002) - Website only (doc , pp. 48-63 doc)	1121	2002
16	Scientific and Technical Workshop of the JCOMM Ship Observations Team - Presentations at the first session of the Ship Observations Team (Goa, India, 26 February 2002) - CD ROM	1118	2002
15	Automated Shipboard Aerological Programme (ASAP) - Annual Report for 2001 – pdf (pp. 4, 5, 6)	1112	2002
14	Operational Oceanography - Scientific Lectures at JCOMM-I (Akureyri, Iceland, June 2001)	1086	2001
13	Advances in the Applications of Marine Climatology - The Dynamic Part of the WMO Guide to the Applications of Marine Climatology – CD ROM	1081	2003
	Revision 1 – Website only		2005
	Revision 2 – Website only		2011
12	Automated Shipboard Aerological Programme (ASAP) – Annual Report for 2000	1069	2001
11	JCOMM Capacity Building Strategy	1063	2001
10	Proceedings of CLIMAR99 - WMO Workshop on Advances in Marine Climatology (Vancouver, Canada, 8-15 September 1999) - CD ROM and Website	1062	2003
9	Estimation of Extreme Wind Wave Heights	1041	2000
8	Oceanographic and Marine Meteorological Observations in the Polar Regions - A Report to the Joint WMO/IOC Technical Commission on Oceanography and Marine Meteorology – E-version	1032	2000
7*	Proceedings of a Workshop on Mapping and Archiving of Sea Ice Data – The Expanding Role of Radar, Ottawa, Canada, 2-4 May 2000 – pdf	1027	2000
6	Automated Shipboard Aerological Programme (ASAP) – Annual Report for 1999	1011	2000
5	Voluntary Observing Ships (VOS Climate Subset Project (VOSCLIM) – Project Document)	1010	2000
	Revision 1	1042	2001
	Revision 2 - e-version only (pdf , pp. 17-18 pdf , pp. 19-20 pdf , pp. 21-29 pdf)	1122	2002

No.	Title		Issued
4	The Voluntary Observing Ships Scheme – A Framework Document Revision 2 – <i>pdf</i> Revision 3 – <i>pdf</i>	1009	2000 2010 2015
3*	JCOMM Ship-of-opportunity Programme Implementation Panel, Third Session, La Jolla, CA, USA, 28-31 March 2000 – SOOP Status Reports – SOOP Scientific and Technical Developments	1005	2000
2	Meeting of Experts on a JCOMM/GOOS Polar Region Strategy, Geneva, Switzerland, 6-8 December 1999 - Status Reports from Existing Polar Region Observing Systems	-	2000
1*	First Transition Planning Meeting - St Petersburg, Russian Federation, 19-23 July 1999 – Status Reports from JCOMM Component Bodies and Activities	-	1999
