WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

JOINT WMO/IOC TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE METEOROLOGY (JCOMM)
SHIP OBSERVATIONS TEAM (SOT)

SEVENTH SESSION

VICTORIA, CANADA, 22-26 APRIL 2013

SOT-7/ Doc. 6 Rev. 3
(10.04.2013)

ITEM: 6

Original: ENGLISH

REPORTS AND RECOMMENDATIONS BY THE TASK TEAMS

(Submitted by the Chairs of the Task Teams)

Summary and purpose of the document

This document provides for the reports of the Chairpersons of the SOT Task Teams with their recommendations.

ACTION PROPOSED

The Team will review the information contained in this report, consider the recommendations by the Task Team, and make comments or recommendations as necessary. See part A for the details of recommended actions.

Appendices:
A. Report by the Task Team on Satellite Communication Systems
B. Report by the Task Team on ASAP
C. Report by the Task Team on VOS Recruitment and Programme Promotion
D. Report by the Task Team on Metadata for WMO No. 47
E. Report by the Task Team on Instrument Standards
F. Report by the Task Team on Call Sign Masking and Encoding

- A - DRAFT TEXT FOR INCLUSION IN THE FINAL REPORT

6.1 Task Team on Satellite Communication Systems

(the Terms of Reference & membership of the Task Team are detailed on the JCOMM web site[1])

6.1.1 The Chairperson of the SOT Task Team on Satellite Communication Systems (TT-SatCom), Mr Pierre Blouch (Météo-France), reported on the activities of the Task Team during the last intersessional period and follow-up actions from SOT-6.

6.1.2 The Team noted that a comprehensive statistics scheme was established to monitor the use of the various satellite data telecommunications systems used by the VOS to report their observations ashore, thanks to the prST communication types entered into Pub47 by VOS operators (SOT-6 Action 39). Results showed that Iridium SBD is now the main communication system used by VOS (about 25% of all observation reports in 2012). By contrast, at least 36% of visual observations were sent through Inmarsat-C "Code 41" during the same year (15% of all ship observations).

6.1.3 The TT-SatCom was informed of the future withdrawal of the GMDSS Inmarsat-C terminal onboard ships. Data safety services will eventually switch to new FleetBroadband terminals. This, development combined with the obsolescence of FM13 messages, implies that the procedure presently used to report observations from conventional VOS must be totally revised. The Team agreed that the termination of the "Code 41" service could have negative impacts on VOS programs in some countries. The Team noted that contacts with IMSO and Inmarsat have been initiated in this regard.

6.1.4 Mr Blouch presented the recent improvements made on E-SURFMAR binary ship-to-shore dataformats. Since SOT-6, modifications have been brought to dataformat #100 to take into account requirements from the JCOMM Expert Team on Marine Climatology (DMPA/ETMC) and to allow the transmission of oceanographic measurements in real time. E-SURFMAR decided to use this dataformat for Shipborne Automated Weather Stations (S-AWS) exclusively and to design a new dataformat (#101) for conventional VOS.

6.1.5 E-SURFMAR dataformats are not restricted to a given communication system. They represent a compromise between FM13-SHIP messages which cannot be used for many parameters now required by users and FM94-BUFR messages which are not compressed enough (communications would be too expensive).

6.1.6 The full report by the Task Team on Satellite Communication Systems is provided in Appendix A.

6.1.7 The meeting made the following recommendations:

(i) The TT-SatCom Term of Reference number 2 should be removed as the DBCP Iridium-PP has ended;

(ii) A new term of reference should be inserted with regards to the design of a new communication system for conventional VOS based on their future FleetBroadband GMDSS terminals to replace Inmarsat-C Code 41;

(iii) VOS operators are requested to consider adopting the E-SURFMAR dataformat for their S-AWS fleets or to propose alternative formats if necessary;

(iv) VOS operators and PMOs should carefully enter information in the prST field in their Pub47 metadata;

1: http://www.jcomm.info/sot-tt-satcom

(v) VOS operators are requested to invite shipmasters (and ship owners) to report their observations by emails if they wish (if observations can be sent immediately).

6.1.8 The meeting decided on the following action items:

(i) TT-SatCom to closely work with Inmarsat Safety Services team and IMSO to propose a new method for conventional VOS to report their observations ashore using the GMDSS FleetBroadband terminals (***action; TT-SatCom; SOT-8***);

(ii) E-SURFMAR to closely work with DMPA/ETMC to define a binary ship-to-shore dataformat (#101) to be used by conventional VOS in the future (***action; E-SURFMAR; end 2013***);

(iii) TT-SatCom to continue to monitor the ways used by VOS and SOOP ships to report their observations ashore and to report the results during SOT sessions (***action; TT-SatCom; SOT-8***).

6.2 Task Team on ASAP

(the Terms of Reference & membership of the Task Team are detailed on the JCOMM web site[2])

6.2.1 The SOT Task Team Chairperson on ASAP, Mr Rudolf Krockauer (DWD, Germany), reported on the activities of the Task Team during the last intersessional period and follow-up actions from SOT-6. His report focused on the EUMETNET ASAP (E-ASAP) as E-ASAP is the only programme worldwide which is based on a fleet of commercial vessels (except two research ships and one hospital ship).

6.2.2 ASAP monitoring issues are discussed under the VOS Panel session in agenda item 9.1.5. ASAP Trust Fund issues are discussed under agenda item 13.3.

6.2.3 Detailed report by the Task Team is provided in Appendix B.

6.2.4 The meeting made the following recommendations:

(i) ASAP operators are invited to address and fix the position errors that sometimes appear in ASAP reports;
(ii) Other operators than E-ASAP are invited to consider operating ASAP vessels in other areas that the North Atlantic Ocean.

6.2.5 The meeting decided on the following action items:

(i) [TBD by SOT-7 if needed]

6.3 Task Team on VOS Recruitment and Programme Promotion

(the Terms of Reference & membership of the Task Team are detailed on the JCOMM web site[3])

6.3.1 The acting Chair of the Task Team on VOS Recruitment and Programme Promotion, Ms Sarah North (United Kingdom) reported on the activities of the Task Team during the last inter-sessional period.

6.3.2 The full Task Team report is provided in Appendix C. The status of Action Items from SOT-6 are also included in the report.

2: http://www.jcomm.info/sot-tt-asap
3: http://www.jcomm.info/sot-tt-vosrpp

6.3.3 The meeting made the following recommendations:

(i) That the Terms of Reference (no 7) of the Task Team should be amended to read

'*Develop a new survey/questionnaire directed at the VOS observers and shipowners with a view to assessing the performance of VOS Scheme and identifying issues that need to be addressed by the SOT. Review proposed content of the 2013 Marine Meteorological Monitoring Survey, and propose amendments as necessary'.*

(ii) the Terms of Reference (no 3) of the Task Team should be amended to read

'Progress the generic pre-installation design recommendations with a view to developing 'best practices' guidance that can be used by shipowners when ordering new ships, liaising with the ICS, WOC, IMO, WMO Secretariat, IACS etc., as appropriate'.

(iii) That Port Met Officers should help to ensure that the 2013 Marine Meteorological Monitoring Survey is widely distributed to observing ships to ensure a representative response from the VOS fleets

(iv) That the VOS website should be the main access point for newsworthy articles and should include a link to the articles maintained on the E-SURFMAR website

(v) That SOT should approve the proposed content for the revised VOS brochure

(vi) That the SOT Coordinator should be responsible for ensuring that the VOS Brochure is maintained up to date in future , acting in liaison with the VRPP Task Team

(vii) That the final revised VOS brochure should be circulated to the PMO, VOS and SOT mailing lists in pdf format, with a recommendation that it should replace any existing copies

(viii) That a new VOS Poster should be developed

(ix) That the VOSClim DAC website should in future focus solely on providing access to the VOSClim data sets, as well as photographs of all VOSClim vessels and certificate presentations.

(x) The VOS website should in future provide the primary access point for information related to VOSClim Class Ships

(xi) That the VOSClim ship list currently held on the DAC website should be discontinued and that in future the E-SURFMAR metadata database should provide the main repository for active and inactive VOSClim ships

(xii) That the JCOMM Catalogue of Practices and Standards (http://bestpractice.iode.org/) should be used by the SOT to determine which JCOMM Publications need to be reviewed to ensure that they are up to date.

(xiii) The Team to approve a change to the membership of the Task Team to:

Add

a. Ms Annina Kroll (Germany)

Remove

i. Mr Volker WEIDNER(Germany)
ii. Ms Julie Fletcher (New Zealand)

6.4.3 The meeting decided on the following action items:

(i) The Chair of the Task Team to liaise with the ETMSS Secretariat and keep the Task Team informed of relevant developments concerning the 2013 MMM Survey (***action; TT-VRPP Chair and WMO/ETMSS Secretariat; SOT-8***);

(ii) The Task Team to draft a new survey/questionnaire directed at the VOS observers and shipowners with a view to assessing the performance of VOS Scheme for (***action; TT- VRPP Chair; SOT-8***);

(ii) The SOT Chair to include a link to the E-SURFMAR articles on the VOS website (***action; SOT Chair; ASAP***);

(iii) The US VOS Focal Point to consider the potential for widening the scope of the Mariners Weather Log to encompass international VOS activities (***action; US Focal Point; SOT-8***)**;**

(iv) VOS Focal Points and PMOs are encouraged to submit suitable newsworthy articles, and PMOs are encouraged to make suitable copies available to visiting VOS (***action; VOS Focal Points; ongoing***);

(v) SOT Coordinator to provide the SOT Chair with updated JCOMMOPS global network maps for inclusion in the SOT recruitment presentations (***action; SOT Coordinator; ASAP***);

(vi) The SOT Chair to update the SOT recruitment presentation on the VOS website when a list of the required changes is available. (***action; SOT Chair; ASAP***);

(vii) Task Team Members to propose amendments to the SOT recruitment presentation and to supply suitable new digital images for inclusion in the presentation. (***action; TT –VRPP members; ASAP***);

(viii) SOT Coordinator to undertake the final editorial review of the VOS Brochure in liaison with the Task Team (***action; SOT Coordinator; end 2013***);

(ix) The Chair of the Task Team to circulate the final revised brochure to the PMO, VOS and SOT mailing lists (in pdf format) and to KNMI with a view to inclusion in the TurboWin program. (***action; TT –VRPP Chair; Jan 2014***);

(x) The WMO Secretariat and SOT Chair to consider whether funding could be made available to publish hardcopies of the VOS Brochure (***action; WMO Secretariat and SOT Chair; end 2013***);

(xi) E-SURFMAR to investigate the possibility of recording the issue of SOT Certificates in the E-SURFMAR database (***action; E-SURFMAR; end 2013***);

(xii) VRPP Chair and SOT Chair to review the content of the Quick Reference Guides and to send copies of the revised text to the Task Team for approval (***action VRPP Chair and SOT Chair; end 2013***);

(xiii) VRPP Chair to prepare an initial draft of a VOS Poster for circulation to the Task Team **(*action; VRPP Chair; end 2013***);

(xiv) Task Team to investigate the potential of using social media sites to promote the VOS with a view to making future recommendations to SOT (***action; VRPP Task Team; SOT-8***);

(xv) Task Team to investigate the potential for using video for promoting the VOS and for training observers (***action; VRPP Task Team; SOT-8***);

(xvi) The Team to instruct the Task Team on how to progress the Generic Design Recommendations in the light of recent developments e.g. discussions with ICS and WOC initiatives (***action; SOT and WMO Secretariat; SOT-7***);

(xvii) SCOR to keep the Task Team informed of any discussions they might have with ICS or the marine industries that impact on the design requirements (***action; SCOR; SOT-8***);

(xviii) ICOADS, in liaison with the VOSClim DAC, to make the delayed mode VOSClim data and call sign fully available in ICOADS. (***action; DAC and ICOADS; ASAP***);

(xix) WMO Secretariat to forward the approved VOSClim certificate to the SOT Chair for posting on the VOS website and subsequent advice to the SOT, PMO and VOS mailing lists (***action; WMO Secretariat; ASAP***);

(xx) The VOSClim DAC to review the content of the DAC website in view of decisions taken by the Task Team (***action; VOSClim DAC; end 2013***);

(xxi) SOT Coordinator to remove the VOSClim mailing list from the JCOMMOPS website (***action; SOT Coordinator; ASAP***);

(xxii) SOT Chair to undertake minor revision to the VOS Framework Document so that it includes links to latest JCOMMOPS global maps and information on VOS numbers (***action; SOT Chair; end 2013***);

(xxiii) SOT Chair to add links to the WMO Publications listed in this report to the VOS Website (***action: SOT Chair; end 2013***);

(xxiv) DAC to remove the project Ship List from the DAC website (***action; DAC; April 2014***);

(xxv) VRPP Chair to send email to PMO and VOS mailing lists to advise that in future any changes to their VOSClim fleets should be made to their WMO Pub 47 lists (by submission to WMO or by updating E-SURFMAR Metadata database). VOSClim Ship operators to continue to separately notify the DAC of such changes until April 2014 (***action; VRPP Chair; Apr. 2014***);

(xxvi) The Team to comment on the need to convene another international PMO Workshop (***action; SOT-7 and WMO Secretariat; SOT-7***);

(xxvii) The Team to consider the value of arranging a shipping industry forum to be held in conjunction with the next SOT-8 session. (***action; SOT-7 and WMO Secretariat; SOT-7***);

6.4 Task Team on Metadata for WMO Publication No. 47

(the Terms of Reference & membership of the Task Team are detailed on the JCOMM web site[4])

6.4.1 The Chair of the Task Team on Metadata for WMO Publication No. 47 (TT-Pub47), Mr Graeme Ball (BOM, Australia), reported on the activities of the Task Team during the last intersessional period and follow-up actions from SOT-6.

6.4.2 Detailed report by the Task Team is provided in Appendix D.

6.4.3 The meeting made the following recommendations:

(i) The Team to endorse the new metadata element **sstP** – Sea Surface Temperature reporting practice. The element will share the existing Code Table 2003 with **tscale**:

(ii) The Team to endorse the new metadata element **humC** - Last calibration date of the electronic humidity sensor;

(iii) The Team to endorse changing the plain language fields of **logE** (name and version of the electronic logbook software), **awsP** (name and version of the AWS processing software) and **awsC** (name and version of the AWS data entry console software) to Code Tables with associated footnotes.

(iv) Members are encouraged to use the descriptors in the non-mandatory lists maintained at E-SURFMAR for **logE**, **awsP** and **awsC** until such time that these elements are officially changed to Code Tables.

(v) The Team to approve the addition of new elements to Code Table 1901 – Method of obtaining Sea Surface Temperature:

b. **TSG** - Thermosalinograph or thermosalinometer,
c. **XBT** - Expendable bathythermograph and
d. **RDIT** - Remote Digital Immersion thermometer;

(vi) VOS Program Managers to actively seek to recruit ships that regularly report their BBXX on the GTS that are not already members of a national VOS fleet or self-recruited as an Ancillary VOS vessel.

(vii) The Secretariat to remind VOS Focal Points, national VOS Program Managers and Port Meteorological Officers to provide additional information as a footnote whenever OT (Other) is selected from a Pub47 Code Table;

(viii) The Secretariat to remind VOS Focal Points and VOS Program Managers not using the E-SURFMAR VOS Metadata Database operationally, to submit their national Pub47 metadata to WMO at least each quarter (by January 15, April 15, July 15 and October 15) or preferably each month;

4 http://www.jcomm.info/sot-tt-pub47

(ix) The Team to approve a change to the membership of the Task Team to:
e. Add:
i. Mr David Berry (United Kingdom)

6.4.4 The meeting decided on the following action items:

(i) The Task Team to submit a proposal to JCOMM-5 (later than SOT-8) of recommended changes affecting the structure of WMO No. 47 (***action; TT-Pub47; 2016***);

(ii) The Task Team to update the Pub47 XML Generator Tool to Pub47 version 04 specifications (***action; TT-Pub47; 1 June 2013***);

(iii) E-SURFMAR to provide VOS Program Managers with the list of ships that regularly report on the GTS but are not members of a national VOS Fleet or self-recruited as an Ancillary VOS vessel (***action: E-SURFMAR; 1 June 2013***);

(iv) E-SURFMAR to maintain the non-mandatory list of descriptors for logE, awsP and awsC, and to make the location of these list available to VOS Focal Points and VOS Program Managers (***action: E-SURFMAR; 1 June 2013***).

6.5 Task Team on Instrument Standards

(the Terms of Reference & membership of the Task Team are detailed on the JCOMM web site[5])

6.5.1 The Chair of the Task Team on Instrument Standards (TT-IS), Mr Henry Kleta (DWD, Germany), reported on the activities of the Task Team during the last intersessional period and follow-up actions from SOT-6.

[If needed add here text that would be useful to include in the final report of the Session in order to support the recommendations and actions proposed below]

6.5.2 Detailed report by the Task Team is provided in Appendix E.

6.5.3 The meeting made the following recommendations:

(i) The Team recommends that instead of preparing a JCOMM Technical Report on existing activities, procedures and practices within JCOMM relating to instrument testing, standardization and intercalibration, as well as the standardization of observation practices and procedures, to prepare dedicated WebPages listing such procedures.
(ii) The Team recommends to complete the review of relevant sections of the WMO No. 8 Guide, and to submit those changes to CIMO as needed.

6.5.4 The meeting decided on the following action items:

(i)

6.6 Task Team on Call Sign Masking and Encoding

(the Terms of Reference & membership of the Task Team are detailed on the JCOMM web site[6])

6.6.1 The Chair of the Task Team on Call Sign Masking and Encoding, Mr Graeme Ball (BOM, Australia) reported on the activities of the Task Team during the last intersessional period and

5 http://www.jcomm.info/sot-tt-is
6 http://www.jcomm.info/sot-tt-masking

follow-up actions from SOT-6.

6.6.2 Detailed report by the Task Team is provided in Appendix F.

6.6.3 The meeting made the following recommendations:

(i) The Team to approve a change to the membership of the Task Team to:
   f. Remove:
      (i) Ms Julie Fletcher (New Zealand)
      (ii) Mr Mathieu Belbeoch (JCOMMOPS)
      (iii) DBCP/SOT Technical Coordinator
   g. Add:
      (i) SOT Technical Coordinator (JCOMMOPS)
      (ii) Mr David Berry (United Kingdom)
      (iii) Security Adviser (TBA)

(ii) Members are encouraged to maintain the MASK details of their ships in the E-SURFMAR VOS Metadata Database as an alternative to submitting their quarterly advices to JCOMMOPS.

(iii) E-SURFMAR to continue to provide JCOMMOPS with a list of current MASK details on a daily basis.

6.6.4 The meeting agreed with the proposal detailed in Annex 3 of Appendix F, which outlines the **ENCODE** solution, including the development of encryption and decryption keys, on the basis of techniques based on symmetric (secret-key) algorithms, as well as the proposed governance for the management of encryption methods and keys. The meeting requested the TT-Masking to submit the proposal to the CBS Inter-Programme Expert Team on Data Representation Maintenance and Monitoring (IPET-DRMM) through the Task Team on Table Driven Codes (TT-TDC) (***action; TT-Masking; ASAP***).

Appendices: 6

APPENDIX A

REPORT BY THE TASK TEAM ON SATELLITE COMMUNICATION SYSTEMS

(Submitted by Pierre Blouch, Chairperson, Task Team on Satellite Communication Systems)

1) Task Team members

- Mr Pierre BLOUCH (Chairperson, E-SURFMAR, France)
- Mr Graeme BALL (Australia)
- Mr Frits B. KOEK (Netherlands)
- Mr Michael MYRSILIDIS (Greece)
- Ms Sarah C. NORTH (United Kingdom)
- Mr Satoshi OGAWA (Japan)
- Ms Paula RYCHTAR (USA)
- Mr Derrick SNOWDEN (United States)
- Mr Johan STANDER (South Africa)
- Mr. John WASSERMAN (USA)
- Any representatives of countries where LES accepting Code 41 are located
- A representative of RA III.

2) The Task Team addressed its Terms of Reference as detailed below.

ToR no.	***Terms of Reference***	***Action(s) undertaken during the intersessional period***
1	Evaluate the operational and cost-effective use of satellite data telecommunication systems for the real-time collection of VOS and SOOP data in support of the World Weather Watch, GOOS, and GCOS;	The use of Pub47 metadata prST field allows statistics to be computed on the methods used by VOS to report their observations (SOT-6 action 39). Despite the fact that unknown metadata accounts for about 14% of observations (including 10% having SHIP as callsign) and a further 9% have no prST information filled in the E-SURFMAR database, actual practices can be now roughly estimated (see Annex 1). The prST table, previously maintained on the E-SURFMAR website (SOT-6 Action 50), is now included in version 4 of WMO-No. 47. Since the field became mandatory, all future table amendments will be done according to the official documentation. Similar statistics should be established for SOOP data. Inmarsat, Iridium, Argos, Email are used for XBT and TSG. Code 41 seems to be rarely used or, when used, the country which pays the communications is this which operates the station The evaluation of the AIS binary format for the collection of VOS data from ship to shore, by E-SURFMAR (SOT-6 Actions 10 & 77) was suspended pending the availability of future European S-AWS.
2	Work closely with the DBCP Iridium Pilot Project;	Experiences gained from the DBCP Iridium-PP were fruitful. They helped to ensure that this communication system was used efficiently on S-AWS. See ToR No 3. ToR No 2 should be removed after the DBCP Iridium-PP is disbanded.
3	Continue to evaluate the operational use of Iridium Satellite data telecommunication technology for the real-time collection of VOS and SOOP data in support of the OBS, GOOS, GCOS, and Natural	Iridium SBD is increasingly used by S-AWS stations to report their observations ashore. In 2012, about 25% of ship observations – including those of conventional VOS – were transmitted through this system. The main S-AWS fleets using it were those of Environment Canada, Met Office and, in part, E-SURFMAR. As for drifting buoys, the system appears to be the most suitable for such stations.

	Disaster Prevention and Mitigation applications;	A dataformat (called #100) was proposed by E-SURFMAR for Iridium SBD. Since SOT-6, it was slightly revised to take into account requirements from the JCOMM Expert Team on Marine Climatology (DMPA/ETMC) and to allow the transmission of oceanographic measurements in real time. E-SURFMAR decided to use it for S-AWS only – future European S-AWS report through it – and to design a new format (#101) for conventional VOS reporting through different methods. For the latter, the data will be prepared by TurboWin before ship-to-shore transmission (e.g. thanks to the half compression technique, pending the arrival of FleetBroadband terminals onboard ships). With regards to these dataformats and SOT-6 Action 124, E-SURFMAR considers that it is not necessary to report metadata from ship to shore since this data can now be efficiently collected ashore and incorporated in BUFR messages with observation data before GTS transmission Iridium dial up is widely used for XBT and TSG in some countries.
4	Continue to monitor the cost implications of Inmarsat satellite communications sent by Code 41;	The use of Inmarsat-C text (including SAC 41) to report observations from S-AWS appears to have decreased since SOT-6. With regards to visual observations, at least 36% of them were still transmitted through SAC 41 in 2012… but, as mentioned above, prST values are still unknown for many ships. The Task Team was informed of the future withdrawal of the GMDSS Inmarsat-C terminal onboard ships. Data safety services should move over to the new FleetBroadband terminals. This, combined with the obsolescence of FM13 messages, means the procedure presently used to report observations from conventional VOS must be totally revised. Contacts with the Inmarsat Safety Services team and IMSO have been initiated. A new ToR is proposed for TT-SatCom to prepare the migration to a new system.
5	Review all relevant JCOMM Publications to ensure that they are kept up-to-date and comply with the Quality Management terminology;	The list of Inmarsat LES stations accepting SAC 41 messages was updated on WMO Website under the form proposed by the Task Team at SOT-6 (http://www.wmo.int/inmarsat_les/). In May 2012, JCOMM-4 agreed to modify WMO No 9 Volume D in order to remove this list from the document. It is now maintained by SOT on WMO website.
6	Report to the next SOT Session on any relevant issues/proposals.	

3) Recommendations of the Task Team to SOT-7

(1) Term of Reference no 2 should be removed. Work with DBCP Iridium-PP ended.
(2) A new term of reference should be inserted with regards to the design of a new communication system for conventional VOS based on their future FleetBroadband GMDSS terminals to replace Inmarsat-C Code 41.
(3) VOS operators to consider E-SURFMAR dataformat #100 as a possible standard for their S-AWS fleets or to propose alternative formats if considered necessary.
(4) VOS operators and PMOs to carefully enter prST values in their Pub47 metadata.
(5) VOS operators to invite shipmasters (and shipowners) to report their observations by emails if they wish (if observations can be sent immediately).

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ANNEX 1 of APPENDIX A

I. Communication systems used by VOS ships in 2012

The use of Pub47 metadata prST field allows statistics to be computed on the methods used by VOS to report their observations. Despite the fact that total of unknown metadata amounts to about 14% of the observations (including those of SeaKeepers and those having SHIP as callsign) and a further 10% of metadata not having prST values entered in the E-SURFMAR database, actual practices can be now assessed.

The statistics are based on ship observations received by Meteo-France from the GTS in 2012 and containing at least air pressure. The percentages given below for each communication system are still approximate because some existing errors must be corrected in the metadata. 100% corresponds on the total observations received from VOS. They include observations for which prST is unknown (~24%). Fixed stations and moored buoys reporting in FM13-SHIP code onto the GTS are excluded.

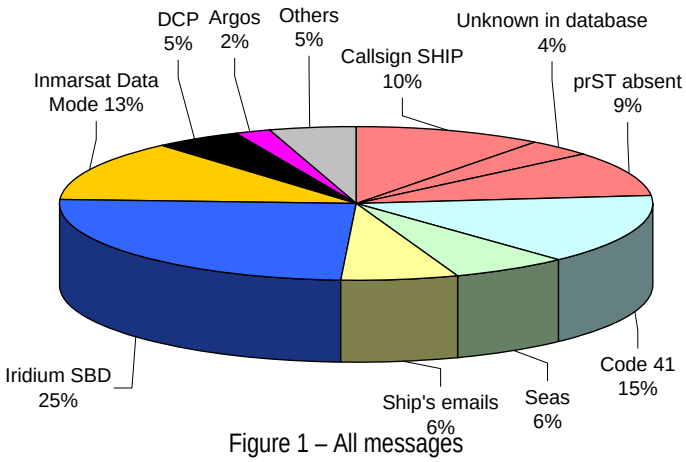


Figure 1 – All messages

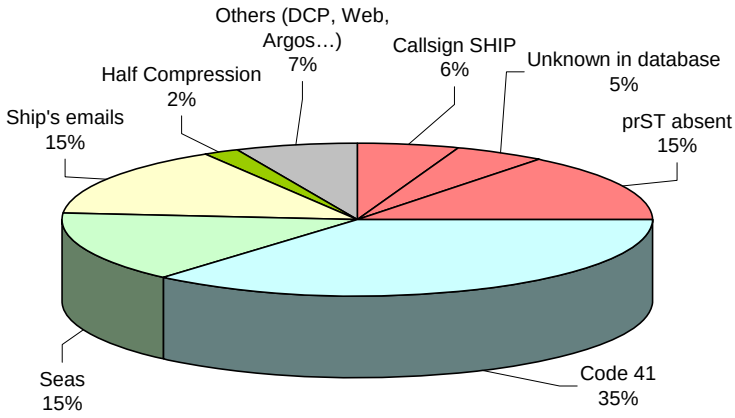


Figure 2 – Messages containing visual observations

1. **Iridium SBD** (~25%) is now the main communication system to report observations from shipborne Automated Weather Stations (S-AWS). This cost effective global system, primarily used to report drifting buoy data ashore, seems very well adapted to ships AWS. Presently, it is mainly used by:

   - Environment Canada for their AVOS S-AWS fleet. Ship-to-shore message format is presently FM13-SHIP;
   - UK Met Office for their AMOS S-AWS. Raw data are sent ashore through a CSV format. They are then converted to FM13-SHIP code (BUFR later) before GTS transmission;
   - E-SURFMAR BaRos S-AWS fleet. Ship-to-shore message format is binary (dataformat #100). Experience was got from the DBCP Iridium Pilot Project to build such a format. Raw data are converted in FM13-SHIP and FM94-BUFR messages (B/C10 template) which are transmitted onto the GTS.

   Iridium SBD will be also used by the future European S-AWS (dataformat #100 - prototypes under construction).

2. **Inmarsat-C Data Mode** (~13%) is mainly used by:

   - French BaTos AWS (French and E-SURFMAR fleets). Ship-to-shore message format is binary. Raw data are converted in FM13-SHIP and FM94-BUFR messages (B/C10

template) which are transmitted onto the GTS. The replacement of Inmarsat-C Data Mode by Iridium SBD has started on these stations;
- and by MILOS stations operated by BoM. Ship-to-shore message format is a compressed binary version of FM13-SHIP.

In contrast to SEAS (see below), theS-AWS system uses its own terminal, not the GMDSS terminal of the ship. The system is almost global (limitations in polar regions).

3. **Inmarsat-C "Code 41"** (at least about 15% of all reports but 36% of those containing visual observations). This system is the historical system used by conventional VOS (FM13-SHIP dataformat). The requirement for ships to carry Inmarsat communications systems is derived from SOLAS/GMDSS requirements. It must be however noticed that use of Special Access Codes (SAC), including code 41, is not mandatory as far as GMDSS is concerned.
   Despite a very good reliability, the system presents important drawbacks where funding is concerned. The costs for ship observations are borne by a small number of National Met Services (NMS) that have an Inmarsat Land Earth Stations (LES) in their respective countries that accept SAC 41 communications (see the list on http://www.wmo.int/inmarsat_les/). These NMS bear the costs irrespective of the country that recruited the ship to do weather observations.

   In March 2013, the Task Team was informed of the future withdrawal of the GMDSS Inmarsat-C terminal onboard ships. Data safety services should move on new FleetBroadband terminals. The SAC 41 procedure will disappear gradually. The migration to the new system should last five years.

   This announcement, combined to the obsolescence of FM13 messages, means the procedure presently used to report observations from conventional VOS must be totally revised (see proposal in § II of the present Appendix).

4. **Ship's Email** (at least 6% of all reports but 15% of those containing visual observations). This system is increasingly being used by conventional VOS. The shipowner accepts to bear the communication costs. Through VOS operators, SOT invites shipmasters (and shipowners) to report their observations by emails if they wish and if observations can be sent immediately.

5. **SEAS** (at least 6% of all reports but 15% of those of those containing visual observations). This system relies on Inmarsat-C Data Report service provided by the GMDSS terminal of the ship. Ship-to-shore dataformat is binary. Since the GMDSS terminal of the ships will no longer be based on Inmarsat-C, the procedure will have to be revised.

6. **Geostationary Meteorological Satellites** (~5%). This system is used by the existing MILOS AWS fleet operated by DWD, two Japanese and one New Zealand ships. Ship-to-shore dataformat is FM13 i.e. alphanumeric. No protocol ensures the control of the transmission. Due to this, data are corrupted. Up to 5% of gross errors on atmospheric pressure may be seen on some German AWS for instance. EUMETSAT recently developed a High Rate Collection Platform system. Its use for ship reports will be analysed.

7. **Argos** (~2%) is used by a few S-AWS. Dataformat is binary. The use of this system is declining. Main drawback is the transmission delays which are too long.

8. **VSAT Email** (~2%) is used by Norwegian S-AWS operated by Met.no and a few US ones.

9. **Inmarsat-C Half Compression** (<1% of all reports, 2% of those of conventional VOS). This technique is used by conventional operated by KNMI. Inmarsat-C text is used to report binary data which are "BinHex" like converted by TurboWin. A version close to E-SURFMAR dataformat #100 should be used in the future. As for SEAS, the purpose is to use the GMDSS terminal of the ship through a more cost effective and fairer procedure than "Code

41". A cookbook on how to use this technique was prepared by KNMI. Since the GMDSS terminal of the ships will no longer be based on Inmarsat-C, the procedure will have to be revised.

II. **A new system for conventional VOS using ship GMDSS terminals**

The Task Team on Satellite Communications was informed of the future withdrawal of the GMDSS Inmarsat-C terminal onboard ships. Data safety services should move to new **FleetBroadband** terminals. This, combined to the obsolescence of FM13 messages, means the procedure presently used to report observations from conventional VOS – so called "Code 41" – must be totally revised. Contact with Inmarsat Safety Services team has been initiated. It must be noticed that, presently, the use of Inmarsat-C SACs is not mandatory as far as GMDSS is concerned and it is up to Land Earth Station (LES) operators to support or not support any codes including code 41.

Inmarsat Safety Services team is now working on a new generation of data safety services on FleetBroadband (FB) and needs guidance from WMO and national meteorological services on what services would be needed in future and what performance would be expected. It is a good time to start talking about the subject with them because IMO has already started work on the GMDSS revision.

For FB services, since there only three SASs (Shore Access Stations - analogue to LESs for Inmarsat-C system) - one in each ocean region and if the SAC "approach" is used, number of destinations ashore will be limited, for example, maximum three destinations in all three ocean regions, e.g. Dutch, US and AUS meteorological offices and ships will not be able to select any other destination. The billing of communications will be still an issue.

To avoid that, Inmarsat Safety Services team proposes to introduce the following service:

1. Develop and build in a template in user (ship's) terminals called, for example, "Weather Observation" which provides all necessary data fields to be filled in. It is important to note that the FB system will transmit only user defined weather data and not details of the template. (Similar templates may be developed for other services as well, e.g. IMO sailing plan, arrival report, deviation report, etc.)
2. Allocate a service code for each "template type" service (can be any).
3. Insert address (email) where the observation will be routed to.
4. Build in the same template into Inmarsat Maritime Safety Server (MSS) which will "recognize" the required service code looking through the look-up table, then retrieve the required template and insert received data in the template, so the message is "assembled".
5. When the message is assembled, it will be sent in the formatted form by the MSS to the final destination as, for example, e-mail message (or multiple addressing).
6. Another issue is billing that can be arranged in the way that all messages addressed to a particular e-mail address, for example, used by meteorological offices, will be billed to the "owner" of that address, i.e. meteorological offices, so ships will not pay. It may be another arrangement as well.

The dataformat could look like one of those proposed by E-SURFMAR (see below).

III. **E-SURFMAR binary dataformats**

Further to the presentation of E-SURFMAR **dataformat #100** at SOT-6 in Hobart, discussions with the JCOMM Expert Team on Marine Climatology (DMPA/ETMC) and the oceanographic community lead to enhance it. Most of the requirements done with regards to atmospheric parameters were taken into account. The dataformat now also allows to report several oceanographic parameters such as sea surface salinity, dissolved CO_2 pressure, turbidity, fluorescence, pH, dissolved nitrates and oxygen as well as global and long wave radiations.

See http://esurfmar.meteo.fr/doc/o/vos/E-SURFMAR_VOS_formats_v014.pdf

Initially devoted to Iridium SBD, this dataformat may be used by any communication system. It is actually a compromise between FM13-SHIP messages which cannot be used for many parameters now required by users and FM94-BUFR messages which are not compressed enough (communications would be too expensive). Metadata are not transmitted with the observation data from ship to shore but collected separately (e.g. through the E-SURFMAR metadata database) and inserted in BUFR messages before GTS transmission.

Further to recent requirements from DMPA/ETMC, it was decided to restrict the use of dataformat #100 to S-AWS and to build a new dataformat (**#101**) for conventional VOS. E-SURFMAR will propose a draft before the end of June 2013 for endorsement by DMPA/ETMC.

Pierre Blouch
20th March 2013

APPENDIX B

REPORT BY THE TASK TEAM ON ASAP

(Submitted by Mr Rudolf Krockauer, Chairperson of the JCOMM ASAP Task Team)

1) Task Team members

- Mr Rudolf KROCKAUER (Chairperson, E-ASAP & Germany)
- Mr Graeme BALL (Australia)
- Ms Sarah C. NORTH (United Kingdom)
- Mr Satoshi OGAWA (Japan)
- Mr Johan STANDER (South Africa)
- Mr Bruce SUMNER (Associated Member, HMEI)
- Plus any other country making ASAP soundings
- Possible participation by POGO

2) The Task Team addressed its Terms of Reference as detailed below.

ToR no.	***Terms of Reference***	***Action(s) undertaken during the intersessional period***
1	Coordinate the overall implementation of the ASAP, including recommending routes and monitoring the overall performance of the programme, both operationally and in respect of the quality of the ASAP system data processing;	See items 1,2, 4, 3, and 5 in the ASAP Task Team report in the annex
2	As may be required by some members, arrange for and use funds and contributions in kind needed for the procurement, implementation and operation of ASAP systems and for the promotion and expansion of the programme;	ASAP Trust Fund not used anymore for such purposes since the end of the WRAP programme.
3	Coordinate the exchange of technical information on relevant meteorological equipment and expendables, development, functionality, reliability and accuracy, and survey new developments in instrumentation technology and recommended practices;	See item 3 in the ASAP Task Team report in the annex
4	Review all relevant JCOMM Publications to make sure they are kept up to date and comply with Quality Management terminology;	No Action.
5	Prepare annually a report on the status of ASAP operations, data availability and data quality.	See ASAP Task Team report in the annex.

3) Recommendations of the Task Team to SOT-7

(iii) ASAP operators are invited to address and fix the position errors that sometimes appear in ASAP reports;
(iv) Other operators than E-ASAP are invited to consider operating ASAP vessels in other areas that the North Atlantic Ocean.

ANNEX

1. Introduction

The number of ships which routinely provide upper air soundings on the GTS throughout the year is around 20 worldwide. Occasionally there are some research vessels which perform soundings during certain research campaigns. But these activities are usually limited to some weeks.

After the reduction of the Japanese ASAP fleet from 5 to 2 research ships in 2010, there is only one significant ASAP programme left: The European (EUMETNET) E-ASAP fleet with 18 ships plus one 'laid up' station in NE Iceland (operated as land station since 2010).

E-ASAP is the only programme worldwide which is mainly based on a fleet of commercial vessels (plus two research ships and one hospital ship). Therefore the report of the ASAP Task Team is focused on E-ASAP.

2. Basics

Following key differences to land based radiosonde stations shall be pointed out:

- 83% (15 out of 18) stations in the E-ASAP fleet are installed on commercial container vessels. The ships sail with 15-20 knots (producing strong turbulences at the launcher) and undergo heavy vibrations from the machinery (thus shortening the lifetime of the technical equipment). Routine maintenance is limited to short berthing times in the port.
- Transmission of sounding data to the NMS is only possible through satellite communication. Satellite communication is generally less reliable than land based cable communications.
- ASAP stations on merchant ships are operated by members of the ships crews, not by professional observers. Skill and experience depend on the respective operator/crew member.
- Japanese ASAP ships are research vessels of the JMA (Japan Meteorological Agency) and Japan Agency for Marine-Earth Science and Technology (JAMSTEC). Since the stations are operated by skilled staff there are less technical and operational problems than in the E-ASAP fleet.

3. E-ASAP fleet

Table 1 lists 18 active E-ASAP ships (status Feb 2013). 10 out of 18 stations (ASEU- and ASDE-) are operationally managed by the E-ASAP management team of the Deutscher Wetterdienst DWD in Hamburg, Germany. The other stations are part of the E-ASAP fleet but are managed by the NMS's of France (ASFR-), Denmark (ASDK-), and Spain (ASES01). The naming convention of the stations in the E-ASAP fleet is as follows:

Char	Content
1, 2	AS (fixed data type, i.e., 'Aerology' and 'Ship')
3, 4	ISO alpha-2 country code ('EU' for EUMETNET)
5, 6	Sequential number

This unambiguous naming convention is an efficient ship masking scheme which could also be applied to other ASAP stations outside the E-ASAP fleet.

Table 1: Ships in the E-ASAP fleet in Feb 2013

Station	Service	Sounding equipment
ASEU01	No regular service, Research ship	The 10' container launcher is equipped with a Vaisala DigiCORA III (MW21). Launches are usually carried out by

Station	Service	Sounding equipment
		the electronic engineer (system administrator).
ASEU02	Northern Europe – Chile	The 10’ container launcher is equipped with a Vaisala DigiCORA III (MW21). Launches are usually carried out by the officers and cadets.
ASEU03	Western Mediterranean – Montreal	The ship has a 10’ container launcher portside and a manual deck launcher starboard. The Vaisala DigiCORA III (MW21) system is installed on the bridge. Launches are usually carried out by two cadets on board. (MW21).
ASEU04	Montreal – Northern Europe	The ship has a 10’ container launcher portside and a manual deck launcher starboard. The Vaisala DigiCORA III (MW21) system is installed on the bridge. Launches are usually carried out by two cadets on board.
ASEU05	Northern Europe – East coast US	The 10’ container launcher is equipped with a DigiCORA III (MW21). Most crew members are involved in launching operations.
ASEU06	Northern Europe – East coast US	The 10’ container launcher is equipped with a DigiCORA III (MW21). Most crew members are involved in launching operations.
ASDE01	Northern Europe – East coast US	The 20’ container launcher is equipped with a Vaisala DigiCORA III (MW21). Most crew members are involved in launching operations.
ASDE02	No regular service, Research ship	The 20’ container launcher is equipped with a Vaisala DigiCORA III (MW21). Launches are carried out by a professional observer of Deutscher Wetterdienst DWD.
ASDE03	Northern Europe – East coast US	The ship is equipped with 2 manual deck launchers starboard and portside and DigiCORA III (MW21) sounding system on the bridge. Most crew members are involved in launching operations.
ASDE04	Northern Europe – Chile	The ship is equipped with an E-ASAP manual launcher and DigiCORA III (MW21) on the bridge. Launches are usually carried out by the officers and cadets.
ASDK01	Denmark – West coast Greenland	The ship is equipped with a 10’ container launcher. The Vaisala DigiCORA III (MW21) sounding system is installed on the bridge.
ASDK02	Denmark – West coast Greenland	The launcher is integrated in the ship. The Vaisala DigiCORA III (MW21) sounding system is installed on the bridge.
ASDK3	Denmark – West coast Greenland	The ship is equipped with a 10’ container launcher. The GRAW MET 5 sounding system is installed on the bridge.
ASFR1	North West Europe – French West Indies	The ship is equipped with a open deck launcher and MODEM SR2K sounding system in the wheelhouse. Launches are usually carried out by the electricians.
ASFR2	North West Europe – French West Indies	The ship is equipped with a open deck launcher and MODEM SR2K sounding system in the wheelhouse. Launches are usually carried out by the electricians.
ASFR3	North West Europe – French West Indies	The ship is equipped with a open deck launcher and MODEM SR2K sounding system in the wheelhouse. Launches are usually carried out by the electricians.

Station	Service	Sounding equipment
ASFR4	North West Europe – French West Indies	The ship is equipped with a open deck launcher and MODEM SR2K sounding system in the wheelhouse. Launches are usually carried out by the electricians.
ASES01	No line service, Hospital ship	The 10' container launcher is equipped with a Vaisala DigiCORA III (MW21). Launches are usually carried out by the 1st officer.

The number of participating ships in the reporting period 2011-2012 was 18. However, some stations had to be transferred to other ships due to changes in the trade pattern of the ships. EUMETNET is mainly interested in soundings in the North Atlantic. If ships leave this sailing area for new services (e.g. in or to East Asia) the station is transferred to another ship.

Table 2 shows the development of the E-ASAP fleet since 2003.
Table 2: Development of the fleet from 2003 to 2012.

Year	Ships leaving the E-ASAP fleet[1)]	Ships joining the E-ASAP fleet	Active stations at the end of the year
2003	- 1	+ 1	13
2004	- 0	+ 1	14
2005	- 1	+ 4	17
2006	- 1	+ 0	16
2007	- 1	+ 0	15
2008	- 4	+ 1	12
2009	- 1	+ 4	15
2010	- 0	+ 4	18 + 1 temporary land station
2011	- 1	+ 1	18 + 1 temporary land station
2012	- 2	+ 2	18 + 1 temporary land station

[1)] Usually due to changes in the trade pattern of the ships (i.e. routes away from the EUCOS area).

Figures 1 and 2 demonstrate the different types of launchers on board the ships.

Figure 1: Examples of container launchers.

Figure 2: Examples of manual launchers.

4. Performance of the E-ASAP fleet

The performance of the ASAP stations is included in the annual EUMETNET SOT ASAP report. Figure 3 shows the spatial distribution of bulletins in 2012 on a 2x2° grid without interpolation.

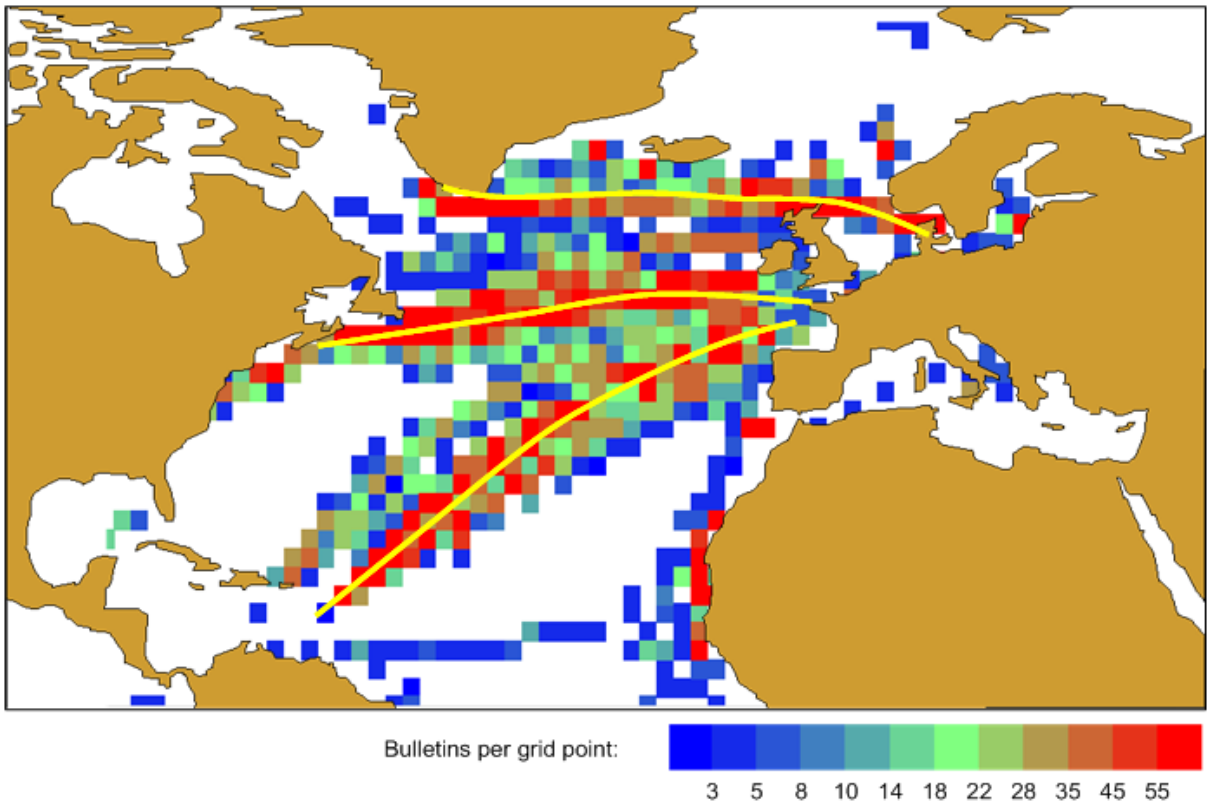


Figure 3: Distribution of TEMP bulletins in 2012 on a 2x2° grid without interpolation.

The distribution demonstrates the main trading routes between Europe and North America of the participating container vessels. Basically, there are three legs (yellow lines in figure 4):

- Northern leg: Denmark – Greenland,
- 'Fifties' leg: along 50°N,
- Southern leg: Channel – West Indies.

The individual performances differ widely from month to month and from ship to ship. Red spots away from the three main legs are soundings performed on board the Research Vessels MARIA S. MERIAN, METEOR and the Spanish hospital ship ESPERANZA DEL MAR (off West Africa).

The total number of soundings on the GTS was around 4763 in 2012. Taking into account the total number of launches on board versus the received soundings on the GTS, the average output (GTS/Launches ratio) was 90%. Main reasons for failed launches are

- technical problems of the equipment due to the permanent vibrations on board,
- unfavourable wind conditions at 15-20 knots sailing speed,
- unexperienced operators, and
- poor satellite communication.

5. Other ASAP ships

Table 3 lists four ships providing ASAP soundings on the GTS in 2012. The Japanese Met Service JMA operates an ASAP stations on the research vessel RYOFU MARU in the western north Pacific and seas adjacent to Japan. JAMSTEC (JAPAN AGENCY FOR MARINE-EARTH SCIENCE AND TECHNOLOGY) operates a station on the oceanographic research vessel MIRAI. In total, 272 soundings were received from the Japanese ASAP ships in 2012.

The German research vessel POLARSTERN operates in polar regions in the summer periods (Apr-Sep in the Arctic, Oct-Mar in the Antarctic) and provided 362 soundings. The US research vessel ROGER REVELLE provided 70 soundings in the Jan-Feb 2012. Both research vessels transmit their upper air data to the GTS but do not cooperate with any WMO or regional ASAP programme.

Table 3: Japanese ASAP ships.

Ship name	Area	Sounding equipment	Received soundings in 2012
Mirai (JAMSTEC)	North West Pacific	Semi-automatic Container, Vaisala sounding system, Vaisala RS92 GPS radiosondes, Inmarsat-C satcom.	54
Ryofu Maru (JMA)	North West Pacific	Semi-automatic Container, Vaisala sounding system, Vaisala RS92 GPS radiosondes, DCP satcom	218
Polarstern	Arctic and Antarctic		362
Roger Revelle	Indian Ocean		70

6. Satellite communication and timeliness

All 18 ships in the E-ASAP fleet are equipped with Iridium satcom systems to enable binary HiRes Bufr reporting from the ships. Most ships report HiRes Bufr and TEMP. The average timeliness of all stations in the E-ASAP fleet in 2012 was around HH+30 min.

The vertical resolution of the HiRes Bufr of the E-ASAP stations is 10 sec (ca. 50 m) plus mandatory and significant levels. Purpose is to limit the file size to 20 Kbyte to reduce

transmission time. A vertical resolution of 50 m is fully compliant to the minimum WMO requirements (Goal = 100 m, Breakthrough = 200 m, Updated on 28 May 2010).

Soundings from the two Japanese stations are transmitted via Inmarsat-C or DCP (through Meteosat). The timeliness of the soundings on the GTS in 2012 was around HH+150 min for Ryofu Maru and HH+110 min for Mirai.

7. Summary and recommendations

In total, around 5120 soundings were received in 2012 from all ASAP stations worldwide. The distribution is as follows:

- 86% E-ASAP,
- 7% RV POLARSTERN,
- 7% RV MIRAI, RV RYOFU MARU, and RV ROGER REVELLE.

The spatial distribution is shown in figure 4. Occasional position errors (sign error in longitude) can be seen as soundings over East Europe. These errors were only observed at stations in the E-ASAP fleet and are due to operator errors.

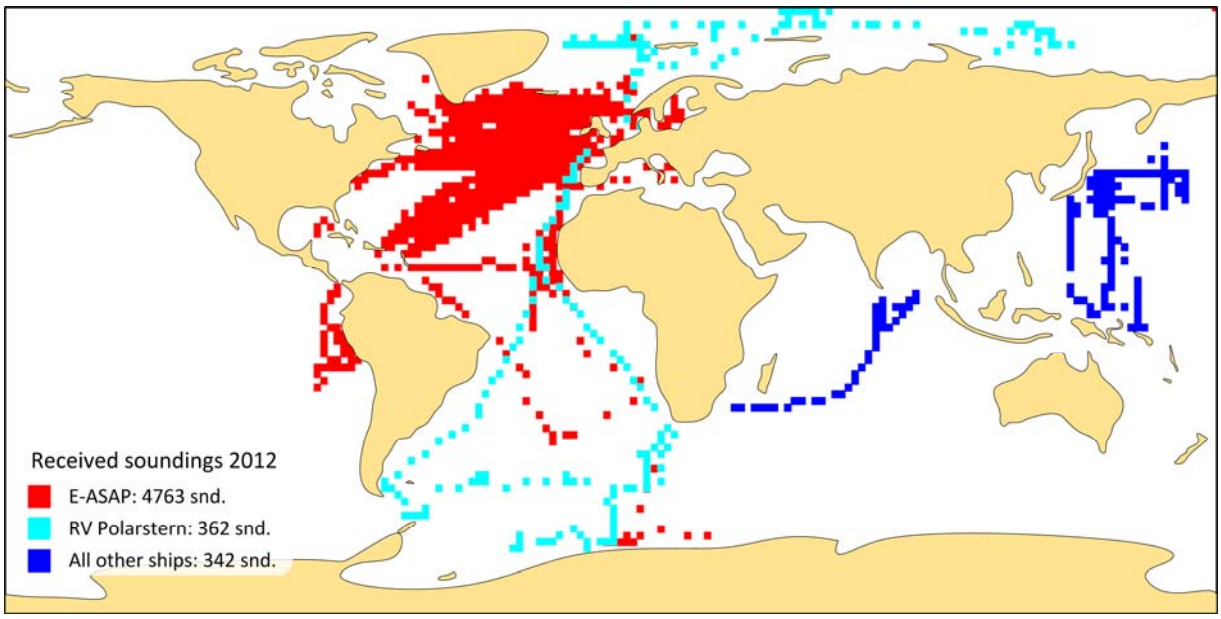


Figure 4: Distribution of global ASAP soundings from sailing ships in 2012.

The spatial distribution of global ASAP soundings show clearly the predominant and unique coverage of the North Atlantic by the European E-ASAP fleet.

APPENDIX C

REPORT BY THE TASK TEAM ON VOS RECRUITMENT AND PROGRAMME PROMOTION
(report submitted by the acting Chair of the Task Team, Ms Sarah North)

1) Task Team members

- Ms Sarah C. NORTH (Acting Chairperson, United Kingdom)
- Mr Graeme BALL (Australia)
- Mr Pierre BLOUCH (E-SURFMAR & France)
- Ms Gerie Lynn LAVIGNE (Canada)
- Dr Thomas ROSSBY (United States)
- Mr Johan STANDER (South Africa)
- Mr Volker WEIDNER (Germany)
- John Wasserman (USA) - VOSClim Focal Point
- VOSClim DAC
- VOSClim Scientific Advisors

2) The Task Team addressed its Terms of Reference as detailed below.

ToR no.	***Terms of Reference***	***Action(s) undertaken during the intersessional period***
1	Promote and monitor the upgrading of existing ships to VOSClim class standard **(Action by DAC and VOSClim Focal Point);**	The Task Team recalled that to keep the profile of VOSClim at a high level, it had been decided at the last session to appoint a VOSClim Focal Point (John Wasserman) to champion and promote the cause of VOSClim. It was further recalled that because VOSClim is now a dedicated class of VOS and no longer a project it had been decided to merge the activities on the VOSClim Panel with the VRPP Task Team. The VOSClim FP, the DAC and the VOSClim scientific advisors therefore became members of the TT-VRPP *[Note – A detailed examination of status of VOSClim participation and the Key Performance Indicators for VOCLIM ships set at SOT 6 will be addressed under SOT agenda item 7.2.2. This report purely addresses VOSClim promotional issues]* In terms of VOSClim promotion the Team reported that ; • A draft revised VOSClim Certificate had now been prepared. The Certificate no longer makes reference to the VOSClim project and will be made available in Arabic, Spanish, Chinese, French and Russian. However, at the time of writing this report, authorisation has not yet been received from the Secretary General to start using it. It is hoped that such authorisation will be available for SOT-7. A copy of the draft certificate will be made available for comment at the SOT-8 session (an advance draft copy is attached at **Appendix B**) • A new VOSClim logo had now been developed and was now in use on the VOSClim website and would be included on the new VOSClim certificate VOS Voluntary Observing Ship Scheme VOS Climate Fleet The Team requested the WMO Secretariat to forward the approved VOSClim certificate to the SOT Chair for posting on the VOS website

		and subsequent advice to the SOT, PMO and VOS mailing lists as soon as it was completed (**Action WMO Secretariat)** The Task Team recalled that at the last SOT session it was agreed that the VOSClim DAC website should be maintained for the time being. In considering this issue further the Task Team recommended that • The VOSClim DAC website should in future focus solely on providing access to the VOSClim data sets and hosting photographs of the VOSClim vessels and certificate presentations. • The VOS website should in future be the primary access point for information related to VOSClim and should provide a link to the data sets held on the DAC website (this has now been done) The Task Team recalled that at the last SOT session it was recommended that the E-SURFMAR metadata database should in future be used for obtaining the list of VOSClim ships. A link to the E-SURMFAR database, and to the relevant E-SURFMAR ftp listing (ftp://esurfmar.meteo.fr/pub/Pub47/), had already been added on the DAC website. The Task Team therefore agreed that project VOSClim ship list held on the DAC website should be discontinued **(Action DAC**), although it was realised that it could take some time for the DAC to the transition their systems over to using the E-SURFMAR listing. A target date of April 2014 was therefore set, during which time VOSClim operators were encouraged to continue to notify the DAC of any changes to VOSClim ships. It was also considered that VOS Operators should be advised of this change in procedures, via the VOS and PMO mailing lists **(Action VRPP Chair)** *[Note - see agenda item 7.2.2 for further discussion on this issue]* The Task Team requested the DAC to review any implications for the DAC website and noted that a link to the E-SURMFAR database (and to the relevant E-SURFMAR ftp listing) had already been added on the DAC website so that climate users can continue to have access to accurate VOSClim ship lists **(Action DAC)** The VOSCLIM FP advised that there had been several obstacles to overcome to encourage promotion of the VOSClim Class in the US. Despite several meetings with PMOs and their supervisors there remained considerable resistance to upgrading existing ships to VOSClim standard. To try and overcome such resistance to upgrading ships to VOSClim class it was agreed that the section of the VOS website entitled 'VOSClim Requirements for PMOs' should be reviewed. The SOT Chair had undertaken to do this, as and when time permitted. **(Action SOT Chair).** In this regard it was also suggested that a simple bullet point check list might help PMOs ensure that all requirements are met when upgrading new and existing ships to VOSClim class. It was recalled that at SOT 6 it had been decided that the JCOMMOPS mailing list for VOSClim focal points was no longer required. However this list is still on the JCOMMOPS website. The SOT Coordinator was requested to remove the list **(Action SOT Coordinator).** It was noted that the requirement to list VOSClim Focal Points had already been removed from the national SOT reports
2	Liaise with Scientific Advisors to monitor and report on compliance with	The Task Team noted that since SOT-6 the VOSClim dataset hadn't been greatly used. The Scientific Advisers currently mostly use the VOS data as a whole sourced through ICOADS (which includes those observations from the VOSClim ships). However, since the loss of call

	VOSClim class requirements **(Action by DAC and VOSClim Focal Point**)	signs from the VOS data stream it was difficult for them to differentiate between VOSClim and non VOSClim ships in ICOADS, and there hadn't been resource time allocated to do the merge of the two separate datasets (i.e. ICOADS and the VOSClim data). In considering the ideal size of the VOSClim dataset, the scientific advisers had expressed a preference for the enhanced parameters to be collected from as many VOS as possible (i.e. to upgrade to VOSClim wherever possible) and not worry too much about the requirement in the VOSClim definition for VOSClim ships to be inspected at routine 6 monthly intervals. *[Note - this gave rise to a separate discussion on the issue of self recruitment to VOSClim Class. This will be addressed under SOT-8 agenda item 7.2.2]* On their own the VOSClim observations were unfortunately too few to form a climate quality dataset – the sampling errors currently dominate any fields produced and the benefit of the higher quality observations is lost. One thing that VOSClim does allow however is the characterisation of the observations using the enhanced metadata and additional parameters reported. Inferences can then be drawn about the quality of the observations made by the wider VOS fleet. However before this can be done the scientific advisers need the delayed mode data and call sign information to be fully available in ICOADS. (Currently they only have call sign information up to the end of ~2007) **(Action DAC and ICOADS)**
3	Complete the generic pre-installation design standards that will eventually be available to ship builders and classification societies;	Although the text of the proposed generic design recommendations had been finalised in December 2009 the Task Team noted that there had unfortunately been no significant movement on this issue. However it was recalled that the VRPP Chair had raised the need to progress the design standards at an **informal** meeting with the International Chamber of Shipping (ICS) in March 2011. At this meeting the industry had responded positively but suggested that it would be preferable to develop a 'best practices' guidance document rather than making formal approaches to IMO or involving the IACS. This lack of movement since this meeting was largely due to resource limitations on both sides to progress the issue. However the Task Team noted that the need for generic ship design standards was subsequently raised within the World Ocean Council (WOC) meeting which the VRPP Chair attended at UNESCO-IOC, Paris, and 12-13 December 2011. Again there were positive responses from the industry but nothing concrete emerged. The Task Team noted that another WOC meeting, called the Sustainable Ocean Summit (SOS), would be held in Washington from 22 to 24 April 2013 (i.e.at the same time as SOT-7) and will be attended by major shipping and oil companies and by the ICS (http://www.oceancouncil.org/site/summit_2013/index.php?page=supporters) With this in mind the VRPP Chair recently contacted the Secretary General of ICS who is planning to chair one of the SOS sessions. Because the summit programme is fairly structured and it was felt that it would be difficult to make a formal presentation of our design guidance proposals, but if the opportunity arose, offered to make an intervention from the floor. A copy of the Generic Design Recommendations (**Appendix C)** was therefore made available to the ICS Secretary General. It was pointed out that for most ships very minimal assistance (financial or material) would be needed from

		shipowners other than to take account of our needs in the design of their new-builds. It was also pointed out that the recommendations were mainly a scoping paper and would need more drafting work to develop into the sort of best practice guidance that ICS members were looking for. Furthermore it was suggested that this could be an area where the WOC bridge building role (between the industry and the meteorological/oceanographic community) could potentially be put to good use. It is hoped that WOC will be able to report progress on this issue before the closure of SOT-7 ICS have confirmed that they remain supportive of our aims to develop design recommendations – for new ships – and are willing to support their circulation with a view to endorsement by their members. However it was suggested that the bulk of any future drafting of the recommendations would need to be done by SOT. In considering the issue in the light of moves to automate the VOS, the Task Team recognised that there was potential overlap with the current IMO initiatives to introduce e-navigation requirements In the light of such initiatives and developments SOT-7 requested to instruct the Task Team on how to progress this issue which has been pending for several years now without resolution (**Action SOT-7 and WMO Secretariat**). One suggested approach might be to propose an ICS/JCOMM correspondence group to further draft the proposals into an ICS guidance document that can be used to encourage shipowners to build their ships so that they are suitable for meteorological/oceanographic observing. Another approach would be for WMO to submit the recommendations to the IMO for progression with a view to developing an IMO Resolution. However this approach risked jeapardising the good will of the shipowners associations. The Task Team also noted that there was some overlap with the OceanScope proposals being developed by Scientific Community for Oceanic Research (SCOR) and The International Association for the Physical Sciences of the Oceans (IAPSO). In particular OceanScope was seeking to promote partnerships between the Maritime Industries and the Ocean Observing Community with a view, inter alia, to the preparation of vessels "ready-built" to join the OceanScope fleet. To avoid the risk of mixed messages being given to the shipping industry the Task Team requested SCOR to keep them informed of any discussions they might have with ICS or the marine industries that impact on the design requirements (**Action SCOR).**
4	Review existing promotional aids (flyer, certificate) and recommend new promotional aids;	At SOT6 it was agreed that the VOS brochure needed to be updated to include VOSClim as a class of VOS, and reference added to other ocean observing systems, e.g. ASAP, SOOP etc. A copy of the latest draft which was prepared by the previous TT chair (Julie Fletcher) and reviewed by the Task Team in 2012 is attached at **Appendix D**. The Task Team recommended that the Team should be invited to approve the proposed content. It was further considered that the SOT Coordinator, acting in liaison with the Task Team, should in future be responsible for ensuring that the VOS Brochure is maintained up to date. . (**Action TT –SOT Coordinator**) Following approval at SOT-7 the Brochure should be referred to the SOT Coordinator for final editorial review in liaison with the Task Team

as appropriate.

When finalised, the Task Team requested that the revised brochure should be circulated to the PMO, VOS and SOT mailing lists in pdf format with a recommendation that it should replace any existing copies. A copy should also be sent to KNMI with a view to it replacing the copy currently included in the TurboWin program. (**Action TT – VRPP Chair**)

The Task Team also considered that there were advantages in having hardcopy copies of the VOS brochure printed for distributing to prospective VOS ships and shipowners and to make available at marine organisation meetings. The SOT was requested, in liaison with the WMO Secretariat, to consider whether funding could be made available to publish hardcopies **(Action WMO Secretariat and SOT Chair)**

The Task Team noted that SOT flyer and SOT certificate are unchanged from the last SOT meeting and remained available on the VOS website at http://www.bom.gov.au/jcomm/vos/information.html and http://www.bom.gov.au/jcomm/vos/resources.html .

Although the flyer was very rarely being used, the Task Team considered that its content remained valid and it could still be used to encourage participation in the VOS Scheme and other SOT observing programmes

It was recalled that the SOT Certificate of Appreciation was not intended to be an award based on strict criteria, or for participation in an established program, but was meant as a "thank you" from the SOT in recognition of the contribution made to support JCOMM. To the best of the Task Teams knowledge it appeared that SOT certificates were not being widely issued to new observing vessels as originally intended.

Noting that there was no mechanism to record which ships had been issued with such certificates, the Task Team requested the E-SURFMAR Program Manager to investigate whether there was any possibility of recording such information in the E-SURFMAR database **(Action E-SURFMAR PM)**

Other promotional items on the VOS website include...

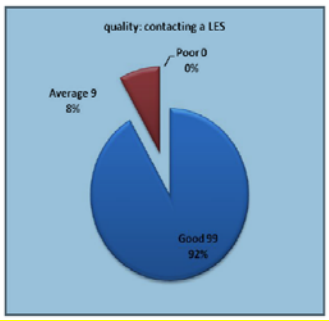
- IMO MSC Circular 1293 on participation in the VOS Scheme
- Various scienitfic studies showing the impact of VOS data
- VOS Quick Reference Guides for PMOs and VOS Programme Managers

The Task Team agreed that the Quick reference Guides provided a valuable overview of the tasks involved without going into explicit detail. It was nevertheless felt that they may need minor review to include new developments such as the use of email for data transmission, entering data on the metadata database and inspections of AWS. The Task Team therefore requested the VRPP Chair and the SOT Chair to review the content and to send copies of the revised text to the Task Team for approval (Action **VRPP Chair and SOT Chair**)

The Task Team recalled that at the last session the acting VRPP Chair was requested to investigate the suitability of developing a VOS Poster such as that used by the UK Met Office (**Appendix E**). The Task Team agreed that such posters would help to promote the VOS at international Conferences and other forums and invited the VRPP Chair to prepare an initial draft for circulation to the Task Team for

		consideration **(Action VRPP Chair)** The VRPP Chair also proposed the idea of using social media sites such as Facebook, Twitter, LinkedIn etc. to promote the international VOS and as an interactive tool for observers. Whilst it wouldn't capture all observers Facebook could perhaps help to encourage some of the younger ones to be more involved. It could perhaps also be used for posting articles and notifying changes or developments of interest related to observing. It was pointed out that whilst it would be relatively easy to establish a group on Facebook it would need someone to maintain and moderate the information being posted. Although it was recognised that the use of social networking would help to promote the VOS to a wider audience the Task Team had mixed views on the proposal. It was noted however that NDBC had a facebook presence which allowed subscribers to regularly receive news and photos on their activities (e.g. moored buoy deployments), strong weather conditions met by their buoys (e.g. hurricanes), etc.. It was recommended that the Task Team should investigate the potential of using social media sites in greater depth before making any firm recommendations to the Team **(Action VRPP Task Team)** The Task Team noted that the Australian BoM was considering the possibility of producing a video to help their XBT operators use our XBT system. The Task Team considered that the there was also potential for using videos for promoting the VOS. It was also considered that there was potential for developing training videos for observers that could potentially be bundled with electronic logbook software. It was recommended that the Task Team should investigate the potential for developing video for promoting the VOS and for training observers **(Action VRPP Task Team)** The Task Team also considered the potential for arranging a Forum or conference for VOS shipowners and managers to keep them abreast of VOS developments including moves to automate the VOS and to encourage participation at the major shipping company level. Whilst the merit of such forums was appreciated it was recognised that this could involve significant logistic and resource implications. It was generally considered therefore that efforts should be focused via existing national and international industry organisations (such as ICS, WOC, IMO etc) In promotional terms it was recognised that the VOS Ancillary Pilot Project had considerable potential to enhance the scope of the VOS Scheme especially to ship types that are under-represented in the VOS at present e.g. yachts and fishing vessels. Similarly it was recognised that the DBCP-SOT Donor Drifter Program would help to promote VOS and PMO activities in regions that are currently under represented. *[Note – the initiatives will be addressed under SOT-8 agenda item 7.2.7 and 7.3.1]* The promotional value of International PMO Workshops and Conferences was also considered by the Task Team, it being noted that the last PMO Workshop (PMO-IV, 8-10 Dec 2010) had been great success. In this context it was noted that an offer had kindly been received from Chile to host the next International PMO workshop. The Team was invited to comment on the need to convene another international PMO Workshop **(Action SOT7 and WMO Secretariat)** In terms of knowledge transfer it was recalled that at PMO-IV the idea of PMO exchanges was mooted whereby PMOs would send a short time shadowing a PMO in another country to learn how they do the job and with a view to developing a best practices approach to ship

		inspection work. In a similar vein it was recognized that there was considerable merit in promoting the VOS Scheme to Nautical Colleges. This would help to engender a culture of weather observing to navigating cadets and to serving navigation officers studying for their certificates of competency. Another suggested method of promoting VOS activities would be arrange an SOT forum or meeting for VOS shipping company and marine industry representatives. This would provide an opportunity to inform them of the latest developments, to seek their views, and hopefully their buy-in to the aims of the VOS Scheme. Given the logisitics that would be involved in arranging a global forum, and the limited availability of resources to make the necessary arrangements, the Task Team generally felt that this might be too ambitious. However the Task Team felt that it was nevertheless a good idea and suggested that the Team should consider the possibly of arranging such an industry forum in conjunction with the next SOT-8 session to ensure that all the relevant SOT members were present. **(Action SOT-7 and WMO Secretariat)**
5	Promote the use of, and keep under review, the promotional 'SOT Recruitment Presentation';	The Task Team noted that whilst the main SOT recruitment presentation is accessible on the VOS website at http://www.bom.gov.au/jcomm/vos/information.html , this link also provided access to separate short presentations on the VOS, ASAP, SOOP, Argo and DBCP. The Task Team considered that the basic content of the presentations remained valid but needed some revision to include more up to date maps and to reflect more recent changes e.g. to VOSClim Class ships. Noting that JCOMMOPS is presently developing new maps the SOT Coordinator was requested to provide the SOT Chair with updated global network maps for inclusion in the presentations (**Action SOT Coordinator**) The SOT Chair kindly undertook to update the presentation on the VOS website when a list of the required changes is available. (**Action SOT Chair**) Members of the Task Team were invited to propose amendments and to supply suitable new images to include in the presentation. (**Action TT –VRPP members**)
6	Establish a store of newsworthy articles for use in SOT or VOS publications or in national newsletters;	Articles are being collected on the ESURFMAR Wiki webpage at; http://esurfmar.meteo.fr/wikisurf/index.php/Marine_Observing_Articles_Summary . Some articles are also on the VOS website at http://www.bom.gov.au/jcomm/vos/information.html#info05 The Task Team recommended that there only needed to be one repository for VOS related articles. Because the VOS website is the main focus for international VOS activities it was considered that this should be the main access point and all articles should be accessed via this website. The SOT Chair was therefore requested to include a link to the E-SURFMAR articles on the VOS website (**Action SOT Chair**). In considering the issue it was suggested that they may also be a good case for a repository of articles to be included on the main SOT website, to include articles covering the wider range of SOT related programs The Task Team noted that there were very few articles being posted on these websites – although the Acting Chair recently posted an article on the oldest UK observing ship having achieved 50 years of

		observing (Copy attached at **Appendix F** for information only) Although many established national observing journals had been discontinued in recent years to due financial constraints, the Task Team was pleased that the NOAA publication Mariners Weather Log was still being published and remained willing to publish articles prepared by other national VOS Operators. In view of the changes being made to national VOS fleets, the US VOS Focal Point was invited to consider the potential for widening the scope of the MWL to encompass international VOS activities **(Action US Focal Point).** VOS Focal Points and PMOs should be encouraged to submit suitable newsworthy articles for inclusion on, or to be linked to, the VOS website (**Action VOS Focal Points)**. In addition PMOs are encouraged to make suitable copies available to their VOS, either electronically or by downloaded hardcopy taken to visiting VOS
7	Review the questionnaire used for the 2009 Marine Meteorological Services Monitoring Programme, and propose any amendments :	The last Marine Meteorological Monitoring Survey was completed in 2011. Copies of the Survey and the preliminary results were reported to JCOMM-4 and are available at http://www.jcomm.info/MMMS. It was noted that the survey was primarily intended to focus on GMDSS and MSI issues and that only one section (section 8) of the current survey currently relates to the VOS. In so far as observations are concerned, the 2011 survey indicated that ships had few problems in contacting LES and, whilst some experienced short delays, no respondents reported having no success in sending their observations. *Land Earth Stations Inmarsat*: Contacting LES shows few problems, and whilst some experienced short delays, no respondents reported having no success in sending OBs.  It was noted that in future it is planned to conduct an online survey every other year (instead of every 4 years, as with the previous "manual" survey). The next survey, after a review and update of its questions and structure, as appropriate, will be issued in the 4th quarter of 2013. Further consideration of the survey was given at the 4th session of the JCOMM Expert Team on Maritime Safety Services (ETMSS - 27 February-2 March 2013, Japan) when there was general satisfaction that the online survey had worked well. However ETMSS has decided that the survey should be kept as simple and straightforward as possible focusing on "monitoring GMDSS MSI quality", for the purpose of “global coordination of information broadcasting” Although observations are the key ingredient of MSI it is therefore unclear at the present time whether the new survey will address observational issues On this basis, the Task Team therefore noted that consideration should be given to developing an independent VOS survey directed at the ships observers and shipowners. The aim of this survey would be to assess the performance of VOS Scheme and identify any issues that need to be addressed by the SOT. It was recommended that, subject

		to SOT approval, the development of such a survey should be added to the ToR of the Task Team It was noted that the Task Team should liaise with the other Task Teams (and in particular with the TT on Satellite Communications) regarding relevant content for the proposed VOS Survey It was nevertheless requested that ETMSS should keep the Task Team Chair informed of any changes to the proposed content of the 2013 MMMS that may have a bearing on observational requirements so that they can be referred to the Task team for consideration as appropriate (**Action VRPP Chair and WMO/ETMSS Secretariat**) In considering the current MMMS survey it was suggested that it would be helpful if it could be used to ensure that ships using Inmarsat Code 41 transmissions are only sending to approved LES As most VOS still do not have routine internet access the Task Team noted that Port Met Officers should have a role to play in ensuring that the finalised MMMS is widely distributed in pdf format to observing ships **(Action PMOs)**
8	Review all relevant JCOMM Publications to ensure they are up to date (in particular with respect to the new VOS classes) and comply with Quality Management terminology.	The VOS Framework document WMO/TD No 1009, JCOMM Tech report No.4 -2010 Rev 2 was last updated in July 2010 and was therefore considered to remain valid. However the Task Team recognised that the tables of ships numbers and the JCOMMOPS global maps were likely to be out of date. Accordingly the Task Team agreed that it would be sufficient for the document to provide links to the latest version of information **(Action SOT Chair and TT-VRPP Chair)** Similarly the Task Team considered that WMO Pub 471, which was was revised in July 2009 to reflect the new VOS classes, didn't need further revision right at this time. The Team noted that WMO No. 8, Guide to Meteorological Instruments and Methods of Observations - CIMO Guide- Chapter 4 (Marine Observations), was currently being updated by the TT on Instrument Standards The Task Team recommended that links to the following WMO Publications should be included on the VOS Website • WMO-558 (Manual on Marine Meteorological Services http://library.wmo.int/pmb_ged/wmo_558_en-v1.pdf , • WMO-471(Guide to Marine Meteorological Services http://www.jcomm.info/components/com_oe/oe.php?task=download&id=15970&version=3rd%20Edition,%202001&lang=1&format=1), and • WMO-8 (WMO Guide to Meteorological instruments and Methods of Observation) http://www.wmo.int/pages/prog/www/IMOP/CIMO-Guide.html. **(Action SOT Chair)** Whilst it was appreciated that the use of alphanumeric codes like SHIP code was being discontinued it was recognised that the code would still be used on ships for some years yet. Also, recalling the recommendations from the International PMO-IV meeting that PMOs should have a basic understanding of BUFR Table Driven codes the Team recommended that a link to for the relevant Volumes of WMO Publication no 306 should be included on the VOS website. **(Action SOT Chair)**

		Finally the Teams attention was drawn to the existence of the JCOMM Catalogue of Practices and Standards (http://bestpractice.iode.org/). The JCOMM Catalogue contains guides and manuals which are reference documents for WIGOS. The Task Team recommended that this catalogue should serve as basis for groups such as SOT (and DBCP) Panels to check which documents should be revised.

3) Status of Recommendations arising from SOT- 6

1. WMO to resume high level discussions on a regular basis with IMO to promote VOS issues (***action; WMO; ongoing***). The JCOMM Management Committee was invited to support this initiative
2. The VOS brochure and/or a Poster to be updated by the Secretariat to reflect current VOS status and other related activities, and new draft version submitted to the TT-Chair for review, further editing, and approval by the Task Team (***action; WMO Secretariat; Done***);
3. That a VOSClim Focal Point be appointed to join the TT-VRPP (***action; TT-VRPP; Done***);
4. The TOR for the TT-VRPP be amended to include an emphasis on VOSClim class requirements (***action; TT-VRPP; Done***);
5. The TT-VRPP membership to be expanded to include that the VOSClim FP, the DAC and the scientific advisors (***action; TT-VRPP; Done***);
6. The new focal point on VOSClim was requested to contact the scientific advisors for further advice, in particular regarding the need to continue to maintain the list of VOSClim National Focal Points (***action; VOSClim FP; SOT-VI Done***).

ANNEX A OF APPENDIX C

DRAFT EXAMPLE OF NEW VOSCLIM CERTIFICATE
(not to be used operationally yet)

ANNEX B OF APPENDIX C

Proposed Generic Design Recommendations for Voluntary Observing Ships (VOS), Ships of Opportunity (SOOP) and Automated Shipboard Aerological Programme (ASAP) ships

Submitted by WMO & IOC Secretariats

1. Weather observations submitted by ships recruited into the World Meteorological Organisation's Voluntary Observing Ship (VOS) Scheme[7] are essential for the provision of quality marine weather forecasts and warnings, and also provide vital data for use in climate research and climate prediction studies

2. The importance of such observations for the safety of navigation is recognised in Regulation 5 of Chapter V of the SOLAS Convention which states that '*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'*

3. Unfortunately, the number of VOS being recruited worldwide has decreased in recent years and this has inevitably had a consequential effect on the number, and quality, of observations being received from observing ships. This is due, at least in part, to the changing dynamic of modern ship operations, with reduced manning levels, and sudden changes of vessel ownership, flag and trading patterns.

4. To some extent, this decline in observations can be overcome by the use of Automatic Weather Stations (AWS) installed on suitable host ships. However, whilst the number of such AWS ships has increased in recent years they only provide a limited number of measured and observed parameters, and should only be considered as supplementing the traditional manually reporting VOS (where ships' officers provide additional visual observations of clouds, weather conditions, and sea states).

5. When recruiting existing ships to the VOS Scheme, problems are often experienced by meteorological and oceanographic services when trying to install, and locate instruments to ensure that they have the correct exposure, or when trying to install cables and meteorological/ oceanographic sensors for automatic systems.

6. Such problems could be largely avoided if meteorological and oceanographic observing considerations could be taken into account at the ships initial commissioning and new-build design stage. In the overwhelming majority of cases only minor design adjustments are likely to be needed, and should therefore have no appreciable impact on overall ship costs.

7. With a view to reducing the impact of such downstream problems the JCOMM[8] Ship Observations Team has prepared initial draft generic recommendations that are considered appropriate for new ships intending to perform meteorological or oceanographic observations. A copy of these draft recommendations is annexed to this paper (*Annex 2*). These recommendations have been categorised according to the type of meteorological or oceanographic observations that the host ship is recruited by the meteorological services to perform. They range from simply making provision for suitable space in the wheelhouse for positioning meteorological instruments, to providing extra cabling capacity for remotely sensed sea temperatures, or gyro output connections to provide compass data to anemometers.

8. Because the observing scheme is entirely voluntary there should be no necessity to mandate the requirement for new ships to be designed for meteorological and or oceanographic observing by

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7 *http://www.bom.gov.au/jcomm/vos/*

8 *Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (http://www.jcomm.info/)*

introducing amendments to the SOLAS Convention. Clearly the meteorological services rely on the continued support of shipping companies and their officers and masters for the success of the VOS Scheme – and it is pleasing to note that many ship owners now pro-actively request their newly delivered ships to be recruited, as they recognise the merits of the VOS scheme

9. However, it would be helpful if, at the initial design stage, ship owners could, if they so wish, request that their vessels be designed and constructed to allow their future recruitment to perform meteorological and or oceanographic observations

10. Most ships that agree to participate in the VOS scheme are provided with calibrated instruments by the national meteorological service that has recruited them, and transmit a full range of observed parameters. These are referred to as 'Selected' observing ships, including VOSClim ships. However, in some cases, ships may be recruited by the national meteorological service to use their own ships instruments and to transmit a limited number of observed parameters. These ships are referred to as 'Auxiliary' observing ships and are often recruited because they operate in areas where data is in sparse supply

11. Many new ships are already being equipped by the ship owners themselves with modern weather observing equipment such as sonic anemometers, and in some cases automatic weather stations. Subject to the suitability of the instruments, being provided, such ships would lend themselves to recruitment as 'Auxiliary' observing ships. Development of specifications based on those annexed herewith, could therefore also be of assistance to ship owners and shipbuilders when determining the suitability of the ships meteorological arrangements. For instance, it is essential that ships anemometers be correctly exposed, ideally on the foremast, so that wind effects caused by the ship superstructure or other adjacent structures do not adversely affect them. Similarly, the quality of measurement using dry and wet bulb thermometers in a marine screen will diminish if the screen is not properly exposed e.g. if it is positioned under a ship's overhang or adjacent to ship's vents

12. In addition to their value to the meteorological and oceanographic communities, observations from ships at sea clearly have an important role to play in ensuring the ongoing safety of ships, their crews and their cargoes. The data provided by observing ships are needed for a variety of marine activities including having to deal with incidents such as search and rescue, marine pollution and safe weather routing of ships. The VOS Scheme therefore needs active support from the marine community, and particularly, support and assistance from ship owners, if we are going to reverse the current decline in ships weather data.

13. The Maritime Safety Committee is invited to consider the issues raised in this paper and to advise on the most appropriate way to proceed, e.g. referring this subject to the work programme of the Ship Design and Equipment Sub Committee to develop appropriate specifications that could then be issued as guidance to ship owners, or be used as the basis for reviewing classification requirements.

ANNEX C OF APPENDIX C

Generic Design Recommendations for Voluntary Observing Ships (VOS), Ships of Opportunity (SOOP) and Automated Shipboard Aerological Programme (ASAP) ships

The following recommendations provide a basic guide to ship owners, ship builders and classification societies concerning the design and construction arrangements that should be taken into account for new ships that will be engaged in undertaking meteorological and or oceanographic observations.

Ship owners are encouraged to liaise with the national meteorological services concerning the level of observational activity they wish their vessels to become involved in, so these can be taken into account in the initial ship build specifications and design.

Voluntary Observing Ships (VOS)

1. Selected Voluntary Observing Ship (VOS) and VOSClim - Basic

'Selected' and 'VOSClim' ships recruited to participate in the VOS scheme are provided with range-calibrated instruments by the national meteorological services and transmit a full range of observed meteorological parameters. The following basic design requirements are therefore recommended to facilitate the installation of such instruments and to allow ships' officers to prepare their observations in a suitable environment that does not hamper other activities performed within the ships wheelhouse:

- A dedicated locker within the wheelhouse for storing spare meteorological equipment spares and stationery [dimensions approx 0.6m x 0.6m x 0.6m]
- A non-slip work surface for locating meteorological instruments supplied by the Meteorological Services (e.g. barograph, barometer, electronic logbooks) [dimensions approx 0.6m x 0.6m] with free area above for fixing instruments to bulkhead.
- A dedicated adjacent power socket to the ship's power supply (for use in connection with electronic logbooks or other digital observing instruments that require a power supply)
- Ability to pre-load electronic logbook software on to one of the ships bridge computers that is connected to the ships email system for transmitting observations to the national meteorological service, or which provides easy access for transferring the observations to the ships Inmarsat C equipment

2. Selected Voluntary Observing Ship (VOS) and VOSClim – Advanced

In addition to the basic provisions listed in para 1, 'Selected' and 'VOSClim' ships recruited to participate in the VOS scheme may have additional requirements that need to be taken into account, subject to the level of instrumentation being provided by the national meteorological service involved. These may include some or all of the following recommendations, which will need to be agreed with the national meteorological service involved:

- For ships provided by meteorological services with marine screens, containing dry and wet bulb thermometry of sensors - Two slotted vertical stanchions [approx 1m length] on the aft port and starboard bridge wings. To be located in a suitably exposed location and positioned so that screens can be fixed at a height above ships rails of [approx 1.6 m], but such that their position will not impair the taking of azimuth compass readings by navigating officers, or interfere with any other of the ships normal functions or requirements. For ships without bridge wings provision should be made for securing screens in alternative locations that are easily

accessible from the ships bridge, but which are not, in so far as is reasonable and practicable, located under superstructure overhangs or adjacent to heat sources such as searchlights or ships vents.

- For ships provided by the meteorological service with a precision aneroid barometer located within a pressurised wheelhouse - a dedicated bulkhead penetration from the wheelhouse to the exterior atmosphere for leading a pressure static head tube [Dimensions approx 15mm].
- For ships provided by the meteorological service with electrical resistance thermometers or electrical humidity sensors - a bulkhead penetration to permit cables to be run from a digital indicator at the meteorological work surface in the wheelhouse (para 1 refers) to the marine screens located on either bridge wing [Dimensions approx 15mm]
- For ships provided by the meteorological service with hull contact sensors for measuring sea surface temperatures – a cable run from the digital indicator at the meteorological work surface in the wheelhouse (para 1 refers) to the hull contact sensor located in the engine room, or suitable void space, at a distance of [approx 1 metre] below the light waterline. Existing cable runs from the bridge to the engine control room, bus connector may be utilised if spare capacity is available. Wireless connectivity has been successfully deployed by the Australian Bureau of Meteorology and cabling may no longer be considered a requirement but a cable run would be a backup option.
- For ships provided by the meteorological service with a dedicated anemometer for measuring wind speed and direction – a cable run and associated deck/hull penetrations from the meteorological work surface in the wheelhouse (para 1 refers) to the anemometer location on the foremast, mainmast or a dedicated meteorological mast, (as agreed with the meteorological services). To provide optimum exposure, free from obstructions, the preferred location for the anemometer will usually be on the foremast (i.e. for ships with aft accommodation superstructures).

3. Selected Voluntary Observing Ship (VOS) and VOSClim – Autonomous Automatic Weather Station (AWS)

The Ships recruited to participate in the VOS scheme, which are provided by the meteorological service with simple, autonomous AWS systems, measuring a limited number of observed parameters e.g. pressure, temperature and humidity. Depending on the system provided the following arrangements be recommended for new build ships:

- For systems that rely on connection to the ships power supply – a dedicated power socket providing access to the ships power supply.
- For systems that incorporate a digital or visual readout unit on the bridge – a suitable installation location, or housing, on the ships bridge console or other suitable location within the wheelhouse or chartroom
- bulkhead or deck penetrations in the vicinity of the location chosen for the AWS installation for leading cabling, as necessary, to the wheelhouse power socket and/or digital readout
- A suitable location for securing the AWS to an adjacent handrail or bulwark together with a suitable securing bracket. AWS systems will often incorporate their own transmission systems, the installation position chosen should comply with specified electrical clearance distances to avoid interference both to and from other ship's antennae or electrical sources

4. Selected Voluntary Observing Ship (VOS) and VOSClim – Integrated Automatic Weather Station (AWS)

The Ships recruited to participate in the VOS scheme which are provided, by the meteorological

service with integrated AWS systems, measuring a variety of meteorological parameters, including pressure, sea temperature, air temperature, humidity, wind speed and wind direction. Depending on the system provided by the meteorological service, the following additional arrangements may be needed for new build ships:

- When AWS sensors, transmission systems, and associated units are located on a dedicated small mast, the deck plating should be suitably strengthened. Deck securing points may also need to be provided to facilitate guy wires.
- When the meteorological sensors are distributed on the ships structure the following installation considerations should be taken into account
    - The position of transmission antennae should comply with specified electrical clearance distances to avoid interference both to and from other ship's antennae or electrical sources and should ideally be located on the mast in a position that will allow unobstructed line of sight to geostationary satellites.
    - The position of the anemometer should provide good exposure, free from any obstructions that may interfere with the airflow. The optimum location for the anemometer will usually be on the foremast (i.e. for ships with aft accommodation superstructures)
    - The position of the temperature/humidity screen should provide good exposure to allow unobstructed airflow and to avoid radiation heat sources. They are usually located on the ships monkey island fixed by brackets to an adjacent handrail or bulwark.
    - The hull contact sensor for measuring sea surface temperatures should normally be located on the ships hull plating in the ships engine room or a suitable void space, and positioned [approx 1 metre] below the waterline at the ships lightest operating draft, free from any adjacent heat sources in so far as is possible
- bulkhead or deck penetrations should be provided to allow cables to be led from the AWS unit or sensors to the central bridge computer, display and electronic junction boxes (when applicable) which would normally be located at the meteorological work surface in the wheelhouse (para 1 refers), and will need a dedicated electrical socket to provide access to the ship's power. Typical cable requirements include for example;
    - Wind Sensor - [8 core multi-strand shielded cable from wheelhouse to sensor location on the mast]
    - Gyro Compass - [2 core multi-strand shielded cable from wheelhouse to gyro room]
    - Sea temperature sensor - [4 core braid-shielded cable from wheelhouse to sensor location in engine room or void space]. Existing ships spare cable capacity to engine room may be useable
    - Transmission system - [dedicated cable dependant upon system used – Inmarsat, iridium etc – from wheelhouse to antennae location]
    - Pressure sensor (Barometer) - [4 core multi-strand shielded cable from sensor to wheelhouse (depending on location)]
    - [Data transfer logging cables – multi- strand shielded cable as required]
- Access to the ships gyrocompass or gyro-repeaters may be needed to provide directional values to the ships anemometer readings, although some AWS systems may incorporate built in magnetic or fluxgate compasses. Where connection to the gyro is needed it may be considered necessary to provide an optical isolator to ensure that there is no interference with navigational safety

5. Auxiliary Voluntary Observing Ship (VOS)

Auxiliary ships recruited by the meteorological service to the Voluntary Observing Ship (VOS) Scheme use their own ships' instruments to prepare and submit weather observations. To ensure

that new ships can be considered suitable for future recruitment to the VOS Scheme it is recommended that ship owners ensure that the instruments or automatic weather systems pre-installed, comply with the WMO and, where applicable, ISO standards.

Ships of Opportunity (SOOP)

Within the SOOP scheme, ships are recruited to perform oceanographic sampling, mainly through the deployment of eXpendable BathyThermographs (XBT), but other types of measurements are also carried out, such as sea surface salinity and temperature using Thermosalinographs (TSG), partial pressure of CO2 (pCO2) in surface sea water and ocean currents using Acoustic Doppler Current Profilers (ADCP). Depending on the measurement systems provided by SOOP operators, the following design considerations are recommended to improve installation and maintenance of instrumentation and to ensure effective and continuing operation within applicable quality requirements:

- bulkhead or deck penetrations should be provided to allow cables to be lead from the instrument location to the central bridge computer. If SOOP systems incorporate their own communications infrastructure, cable penetrations would be required from computer to transmission antennae. Optimal performance during transmission generally requires the shortest cable length, unobstructed line of sight and minimum RF interference from other devices. Antennae location should not interfere with normal operations of the vessel.
- A dedicated work area for locating instruments. TSG operations require pumped sea water usually available in the ship’s engine or bow thruster rooms. XBT launch site locates preferably at the stern of the ship. In any case, easy access to instrumentation should be provided for maintenance and operation purposes.
- For TSG and pCO2 systems, a water intake should be available as close as possible to the sea water to prevent biases due to warmer temperatures in the engine room.
- A dedicated desk or table to accommodate computer, cabling and other electronic equipment within the wheelhouse.
- A dedicated power socket providing access to the ships power supply within the wheelhouse and at the instrument's location.
- A dedicated locker within the wheelhouse to be used as storage for tools and spare parts. Deployment of XBT, drifters and Argo floats requires appropriate storage areas preferably in close proximity to the deployment location.

Automated Shipboard Aerological Programme (ASAP) ships

A small number of observing ships are recruited to provide upper air data from radiosonde balloons, and are provided by the meteorological services with equipment. These ships contribute to the ASAP programme. ASAP ships designs can be based upon a 'modular' configuration with all the ASAP systems housed within standard 10 or 20 foot shipping containers, or may use a 'distributed' configuration, where the ground station and associated transmission system can be located in the host ship's wheelhouse. Depending on the arrangements provided by the meteorological Service, the following considerations should be taken into account in the ships initial design:

- Sufficient free deck space should be allocated for a [10 or 20 foot] shipping container, or any manual deck launching devices that may be provided by the meteorological services. The locations chosen for these launching systems should not interfere with the ship's emergency embarkation arrangements, fire protection or safety arrangements, or with safe navigation of the ship.
- Where manual deck launchers are used there should be sufficient free space available to enable the launcher to be transferred to either side of the ship (to facilitate launching in lee wind conditions).

- The launching area should permit, as far as is possible, the radiosonde balloon to be launched such that it will not snag the funnel or ships superstructure during its ascent.
- Where containerised systems are used suitable deck securing points should be provided and the deck plating strengthened where needed.
- Access to the ships power supply should be available to the container.
- When they are not located in a dedicated container, a suitable locker or other suitable storage location should be provided for spare radiosondes and balloons Storage dimensions should be sufficient for at least 3 months of sounding operations. Depending on the size of the packages the required total storage is about 0.75 m^3.
- A suitable free deck space of at least 1.5 x 1.0 m^2 for securing the helium gas bottle racks, ideally located close to the launching area, but positioned so that replacement gas bottles/pallets can be easily loaded and positioned using the ships lifting appliances.
- Plastic or copper piping from the helium bottles to the launching container and/or deck launcher. The piping should not interfere with the ships working or safety arrangements.
- A suitable location high up in the ship (usually the monkey island) may be needed to install the dedicated aerial for receiving the raw data from the radiosonde. (This could be a directional mushroom aerial or a multi-directional dipole aerial). Lugs may need to be welded to the deck and a stand plate may be needed to secure the aerial pedestal. Anti vibration, mountings may be needed.
- A suitable location may also be needed for installing a dedicated satellite communication system for transmitting the upper air observations back to the meteorological services i.e. if the ships transmission system is not used.
- A suitable location for an independent GPS aerial for determining the relative position of the ship and radiosonde.
- bulkhead or deck penetrations should be provided to allow cables to be lead from the ASAP ground station computer when located in the wheelhouse to the required antennae.
- The position of ASAP transmission antennae should be located to avoid interference from other ships antennae or electrical sources and free of obstructions that could prevent them from receiving or transmitting signals e.g. masts, large funnels containers etc.

……

In accommodating all the above recommendations ship owners, ship builders and naval architects should ensure that the arrangements are in accordance with, and do not conflict with, SOLAS requirements applicable to new vessels. In particular, it should be ensured that SOLAS fire class division requirements are observed and that the arrangements do not interfere with any navigational or life-saving requirements that may be applicable.

ANNEX D OF APPENDIX C

DRAFT REVISED VOS BROCHURE

World Meteorological Organization

United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

THE JCOMM **V**OLUNTARY **O**BSERVING **S**HIP SCHEME AN ENDURING PARTNERSHIP

VOS Voluntary Observing Ship Scheme

DRAFT BROCHURE

JCOMM 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 mechanism.

Mariners face many hazards — 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.

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

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

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.

Under the JCOMMVOS Programme, ships are recruited by National Meteorological Services (NMSs) to record and transmitmeteorological observations (the most critical data being air pressure, wind speed and direction, sea state,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 compiled every six hours, using NMS supplied electronic logbook software. The officer enters data read from instruments and observed visually, and the software codes this informationin to a standardized 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 observationsare 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.

Severe weather conditions will always pose a hazard to ships and cargoes.

Vessels participating in the VOS Programme are generally classified into one of four major categories. So-called “Selected Ships” carry out a complete programme of meteorological observations and utilize the full WMO SHIP code for relay of their reports; “VOSClim” ships provide higher quality data and more detailed information about the observations for climate applications; “Supplementary Ships” undertake a somewhat reduced observational programme and use an abbreviated code form; and any vessel travelling through a data-sparse region may be recruited into a fourth category, known as “Auxiliary Ships”, and requested to supply limited observations. Worldwide VOS numbers reached a peak of about 7700 ships in 1984–85 but have declined since that time with about 4000 vessels from 26countries 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.

The VOS Programme 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.

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

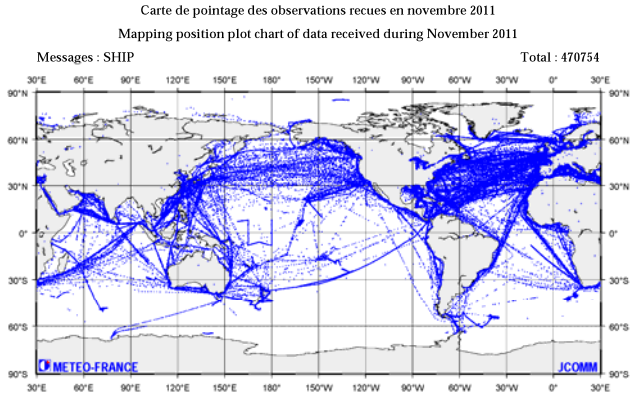
ARE OBSERVATIONS FROM VOLUNTARY OBSERVING SHIPS REALLY NECESSARY TODAY?

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. 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 9 . 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.

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 of oceanic weather conditions, WMO established the Marine Climatological Summaries Scheme in 1963. Under this scheme, observations recorded in ships’ electronic logbook software are extracted, quality controlled, archived, processed into climatological summaries and exchanged in a globally coordinated and consistent manner. In addition, historical marine meteorological observations recorded in 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.



Mapping position plot chart of VOS ship data received during November 2011 (total 470754observations) – ***More VOS are needed in the southern oceans and high latitude waters.***

9 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.

In summary, the observations from VOS continue to provide essential inputs to operational weather forecasting, supply "ground truth" measurements for calibration of satellite readings, add to our growing knowledge of ocean climates, increase our understanding of the linkages between the oceans and the atmosphere and contribute to the development of important historical databases. The advent of the age of the weather satellite has in no way diminished the importance of reports from VOS.

VOS meteorological instrumentation is maintained and calibrated by port meteorological officers.

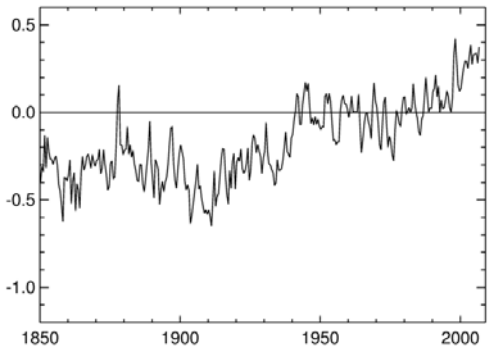
THE EXPANDING REQUIREMENTS FOR OCEAN OBSERVATIONS

During the past 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.



Evolution of global Sea Surface Temperature since 1850 (J. Kennedy et al., MARCDAT-III, 2011)

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 fishing effort.

Tailored products support increased traffic volumes and ship sizes in coastal regions and harbours 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 respond to oil spills at sea. All of these services have generated an increasing need for more detailed and accurate observational data from the open sea, coastal waters and harbour 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. 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) where efforts to enhance climate services and the required coordination at the international level were initiated.

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.

Both the ocean and atmosphere are regularly measured from the VOS.

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

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 VOSClim Class of VOS builds on the strong foundation of the VOS Climate Project that ran between 2001 and 2009.

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.

Today there are more than 400 VOSClim ships reporting observations from the world oceans.

Over 400 VOSClim ships now provide higher quality VOS data for climate applications

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

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...

Data coverage is very poor, particularly in southern latitudes, in Polar regions, and in the deep ocean.

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.

General Regulations determined by the International Conference on Safety of Life at Sea, London, 1960,Regulation 4(a), Chapter 5.

Volunteer observer David Vail of MV Bluerose receiving an award from Canadian PMO Randy Shepherd.

OTHER OCEAN 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 (ASAP)

The JCOMM ASAP programme provides vertical profiles of temperature, humidity, wind speed and wind direction from data sparse ocean areas. The ASAP uses radiosondes tethered to gas filled balloons to sample the atmosphere from the sea surface to a height of 30km. It operates mostly on VOS ships, but also on some research and naval vessels. Some25 ships are actively involved in ASAP, producing more than6300 profiles of the atmosphere per year. This data significantly enhances the accuracy of the meteorological analyses over the oceans.

Ship of Opportunity Programme (SOOP)

The JCOMM SOOP programme 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.

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 SOOP sampling lines from VOS ships and a range of other merchant, research and naval vessels.

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

- ENSO prediction
- Tropical ocean variability and prediction
- Global and regional heat storage
- Ocean transport and circulation
- Mid latitude variability
- Ocean state estimation and model evaluation, and
- Climate Change

Data Buoy Co-operation Panel (DBCP)

The DBCP is an international programme co-ordinating 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 co-operation of merchant and research vessels. Typically a buoy deployment requires only the removal of plastic wrapping, buoy activation by removal of a magnet and dropping at a pre-arranged location along a ship's normal route.

Argo - International Profiling Float Project

Argo is an international project 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 below the ocean surface.

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. Sometimes a ship rider will accompany the floats to activate and test them prior to launch. Opportunities to deploy floats away from the main shipping routes are keenly sought.

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 of satellite observations. These realities will remain unchanged in the foreseeable future.

The VOS and other ocean programmes described in this pamphlet represent a highly cost-effective approach to oceanic 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 programme such a classic example of enlightened cooperation and enduring partnership.

For more information about the VOS, please contact:

The JCOMM VOS web site

*http://www.bom.gov.au/jcomm/vos/**World Meteorological Organization***
Marine Meteorology and Oceanography Programme
http://www.wmo.int/pages/prog/amp/mmop/index_en.html

Remember: help improve the quality of forecasts and warnings and contribute to the enhancement of safety at sea.

Become involved with the VOS!

ANNEX E OF APPENDIX C

VOS POSTER

The UK Voluntary Observing Fleet

Met Office

Introduction

The Met Office maintains a fleet of more than 350 Voluntary Observing Ships (VOS) operating on a worldwide basis, and 30 offshore rigs and platforms in the North Sea. Officers and staff on recruited ships are encouraged to record and transmit weather observations in support of the World Meteorological Organisation's VOS Scheme, the World Weather Watch (WWW), and the International Maritime Organisation's SOLAS (Safety of Life At Sea) Convention. Observations are typically made every 6 hours while at sea.

VOS

The VOS Climate Project

A subset of 60 UK observing ships have additionally been recruited to the International VOS Climate Project (VOSClim). These ships report to higher standards and their data are used for climate studies and research.

Instruments and data transmission

Suitable VOS are loaned instruments for manually taking meteorological measurements – notably a precision aneroid barometer, a marine barograph and a marine screen containing dry-and wet-bulb thermometers. Selected ships may also be equipped with a sea-water bucket and sea thermometer for recording sea temperatures, although for practical reasons the ships seawater intake temperatures are more commonly used nowadays. Some ships are also fitted with a dedicated hull sensor in the engine room. In addition to the instrument measured parameters, observers are also requested to submit visual observations of the sea state, weather conditions and cloud cover.

Observations are normally compiled using electronic logbook software that is provided to each ship (called 'TurboWin'). This software automatically codes the observations into WMO SHIP Code format before it is transmitted using the ships Inmarsat C or e-mail systems. In the coming years alphanumeric codes such as the SHIP Code will be gradually replaced by more efficient formats designed to reduce transmission costs.

VOS Observations are assimilated into our Numerical Weather Prediction (NWP) and ocean models, and added to our climatological databases. They are also exchanged internationally so they can be used for a variety of purposes, including:

- the preparation of forecasts and warnings
- ships weather routing
- marine consultancy;
- monitoring the state of the oceans
- verifying satellite calibrations
- climate research and prediction

Automation

The level of automation on UK observing ships has increased significantly in recent years and this trend is expected to continue in the future. Automatic Weather Stations (AWS) have now been installed on 10 ferries and container ships and research vessels. They have the advantage that basic meteorological parameters can be automatically measured and transmitted at hourly intervals.

There are two basic types of AWS in use:

- 'simple' AWS that usually report only pressure and air temperature and,
- 'complex' AWS that usually report air temperature, pressure, humidity, wind speed and direction, and sea temperature, and which also allow the observer to add visual observations.

Participation in European and International Forums

The Met Office has close links with other VOS Fleet operators within Europe where operations are coordinated through the EUCOS* Surface Marine programme (E-SURFMAR).

EUCOS Surface Marine Programme

In addition the Met office is a lead centre for monitoring real-time international marine data quality, and also acts as a Global Collecting Centre (GCC) with responsibility for the collection, quality control and exchange of delayed mode VOS data.

VOS data quality statistics are routinely compiled by the Met Office, and distributed monthly to Port Meteorological Officers, both in the UK and around the world, so that early action can be taken to address observational errors or instrument calibration problems.

Upper air observations

The Met Office also participates in the EUMETNET Automated Shipboard Aerological Programme (E-ASAP) which equips suitable ships to perform upper air radiosonde balloon ascents. These ships are primarily trading in the North Atlantic and Mediterranean.

Met Office FitzRoy Road, Exeter, Devon, EX1 3PB United Kingdom
Tel: 01392 885680 Fax: 01392 885681
Email: obsmar@metoffice.gov.uk

ANNEX F OF APPENDIX C

RECORD BREAKER - 50 YEARS OF DISCOVERY AND VOLUNTARY OBSERVATIONS

'Image courtesy Barry Marsh'

RRS Discovery leaves Southampton for the final time

In December 2012 the Royal Research Ship *Discovery*, the oldest UK Voluntary Observing Ship, was withdrawn from service and sailed from Southampton on its final voyage. This brought to an end a period of 50 years participation in the International VOS Scheme – a record for the UK observing fleet, and possibly a world record?

RRS Discovery 's long and distinguished observing career began on 16 January 1963 when she was formally recruited to the VOS Scheme. During the next half-century its officers, scientists and crew have contributed more than 34000 highly valued weather observations.

When RRS *Discovery* was built in Aberdeen in 1962 there was no satellite navigation, man had yet to step foot on the moon, and John F Kennedy was the US President. Until 2006, she was the largest general purpose oceanographic research vessel in use in the UK, measuring 90 metres in length, and fitted with a wide range of oceanographic equipment.

The ship takes its name from the 1901 ship, RRS *Discovery,* the three-masted sailing ship designed for Antarctic research, and famous for being commanded by iconic British hero and explorer Captain Robert Falcon Scott on his ill- fated expedition to be the first to reach the South Pole. Scott now immortalised as 'Scott of the Antarctic' led an expedition which reached the Pole on 17 January 1912, only to find he had just been beaten to the post by Roald Amundsen's Norwegian rival expedition. On their return journey, Scott and his comrades all died from a combination of exhaustion, starvation and extreme cold

The illustrious *Discovery* name will however continue in the future as a new, state-of-the-art Royal Research Ship, also to be called *Discovery*, is currently being built in Spain and will be delivered later this year. The UK Met Office are already in discussions with the UK's National Oceanography Centre (NOC), who will operate the ship on behalf of the Natural Environment Research Council, to recruit this latest namesake to the VOS Scheme and to install one of its new Autonomous Marine Observing Systems (AMOS) on board.

To formally recognise *RRS Discovery's* remarkable 50 year contribution a commemorate plaque was presented to its Master, Captain Peter Sarjeant by Sarah North, Ship Observations Manager at the Met Office. In due course the plaque will be mounted on a bulkhead on the new Discovery as an ongoing reminder of its predecessor's outstanding observing record. In return Captain Sarjeant kindly presented a plaque of the Discovery to the Met Office.

The opportunity was also taken to present Captain Sergeant with a marine barograph in recognition of his personal contribution and long service to the UK observing fleet, which began in the mid 1970's. Captain Sarjeant remarked that during his time at sea "*there had been a continuous evolution and development of navigational aids and systems, but undoubtedly the most enduring and symbolic instrument has been the barograph".* He added that *"a glance at the barograph trace gives that quiet nudge, that reminder, as to the weather's 'state of play ' and to what is in store".*

Captain Sarjeant and Sarah North exchange plaques

Lalinda Namalarachchi, Southampton Port Meteorological Officer, presents Captain Sarjeant with a marine barograph

During his visit to the Met Office Headquarters in Exeter Captain Sarjeant was also invited to view some of the historic hardcopy logbooks which are stored in the Meteorological Archive. Many of these logbooks were submitted during his service as an officer, and later as Master, of the *RRS Discovery.* He was also invited to view other famous and historical ships logs that are held in the archive, including the original logs of the *HMS Beagle*, famous for being the ship which under the command of Vice-Admiral FitzRoy took Charles Darwin on his voyages of scientific discovery and which led to him formulating his controversial (at the time) theory on the origin of species. The log containing Admiral Sir Francis Beaufort's original wind scale was also displayed and was examined with great interest by Captain Sarjeant.

Captain Sarjeant examines one of the first logbooks submitted during his seagoing career

Besides its notable contribution to the field of meteorology, *RRS Discovery* has undertaken hundreds of missions to push the boundaries of ocean science. During its many voyages around the globe it has surveyed the ocean floor, measured the ocean currents, monitored climate change and discovered new biological species. Her final cruise investigated changes to the Atlantic Ocean currents collecting data from an array of moorings between the Canaries and the Bahamas.

It is therefore with a little sadness but with great gratitude that we wave farewell to the UK's oldest research vessel, and longest serving voluntary observing ship.

APPENDIX D

REPORT BY THE TASK TEAM ON METADATA FOR WMO PUBLICATION NO. 47
(report submitted by the Chair of the Task Team, Mr Graeme Ball)

1) Task Team members

- Mr Graeme BALL (Chairperson, Australia)
- Mr Pierre BLOUCH (France)
- Ms Gerie Lynn Lavigne (Canada)
- Mr John Wasserman (USA)
- Dr Elizabeth C. KENT (United Kingdom)
- Ms Sarah C. NORTH (United Kingdom)

2) The Task Team addressed its Terms of Reference as detailed below.

ToR no.	***Terms of Reference***	***Action(s) undertaken during the intersessional period***
1	Regularly review the WMO Publication No. 47 (Pub47) metadata requirements and make recommendations as appropriate.	The Task Team submitted a proposal to JCOMM-4 describing proposed changes to the structure of WMO No. 47 as agreed to at SOT-6. The Task Team subsequently developed Pub47 Metadata Format version 04 and its accompanying XML schema. The Task Team recommended changes to Pub47 for consideration at SOT-7 as follows: New field **sstP** – Sea Surface Temperature reporting practice. The element will share the existing Code Table 2003 with tscale; New field **humC** - Last calibration date of the electronic humidity sensor. New table elements to existing Code Table 1901 – Method of obtaining the Sea Surface Temperature: • TSG – Thermosalinograph or thermosalinometer • XBT – Expendable Bathythermograph • RDIT – Remote Digital Immersion Thermometer The Task Team endorsed a request from E-SURFMAR that the following plain language elements are changed to tables with predefined lists of elements: • **logE** – name/version of the logbook software • **awsP** – name/version of AWS processing software • **awsC** – name/version of AWS console software The Task Team proposed that members use non-mandatory lists maintained at E-SURFMAR for **logE**, **awsP** and **awsC** until such time that Pub47 is formally changed.
2	Monitor the receipt of regular Pub47 updates at WMO from participating VOS members.	Periodic checks of the E-SURFMAR VOS Metadata Database indicate: • Most countries regularly update their metadata either directly in the database or via submission to WMO. Countries that are not regularly updating their metadata are: AR, HR, IL, IS and RU. • Some countries are omitting to include additional detail as a footnote whenever the element OT (Other) is selected from a Code Table.

		• A small number of ships are regularly reporting their BBXX on the GTS but are not members of a national VOS Fleet or self-recruited as an Ancillary VOS vessel.
3	Review all relevant JCOMM Publications to ensure they are up to date and comply with Quality Management terminology.	Relevant JCOMM publications were maintained as required. The Pub47 XML Generator Tool that is available on the VOS website, will be upgraded to Pub47 version 04 specifications before June 1, 2013

3) Recommendations of the Task Team to SOT-7

(1) The Team to endorse the new metadata element **sstP** – Sea Surface Temperature reporting practice. The element will share the existing Code Table 2003 with **tscale**.

(2) The Team to endorse the new metadata element **humC** - Last calibration date of the electronic humidity sensor.

(3) The Team to endorse changing the plain language fields of **logE** (name and version of the electronic logbook software), **awsP** (name and version of the AWS processing software) and **awsC** (name and version of the AWS data entry console software) to Code Tables with associated footnotes.

(4) Members are encouraged to use the descriptors in the non-mandatory lists maintained at E-SURFMAR for l**ogE**, **awsP** and **awsC** until such time that these elements are officially changed to Code Tables.

(5) The Team to approve the addition of new elements to Code Table 1901 – Method of obtaining Sea Surface Temperature.

a. TSG - Thermosalinograph or thermosalinometer
b. XBT - Expendable bathythermograph,
c. RDIT - Remote Digital Immersion thermometer

(6) VOS Program Managers to actively seek to recruit ships that regularly report their BBXX on the GTS that are not already members of a national VOS fleet or self-recruited as an Ancillary VOS vessel.

(7) The Secretariat, on behalf of the Task Team, to remind all national VOS Focal Point, VOS Program Managers and Port Meteorological Officers to provide additional information in a footnote whenever the table element OT (Other) is selected from a Code Table.

(8) The Secretariat to remind VOS Focal Points and VOS Program Managers not using the E-SURFMAR VOS Metadata Database operationally, to submit their national Pub47 metadata to WMO at least each quarter (by January 15, April 15, July 15 and October 15) or preferably each month.

(9) The Task Team recommends the following changes to its membership:

a. Add:

i. Mr David Berry (United Kingdom)

4) Proposed Action Items

(i) Subject to endorsement by SOT of the changes affecting the structure of Pub47, the Task Team shall submit a proposal to JCOMM-5 describing the proposed changes.

(ii) The Pub47 XML Generator Tool available on the VOS website will be upgraded to Pub47 version 04 specifications before June 1, 2013

(iii) E-SURFMAR to provide VOS Program Managers by June 1, 2013, with the list of ships regularly reporting on the GTS that are not members of a national VOS Fleet or self-recruited as an Ancillary VOS vessel.

(iv) E-SURFMAR to maintain the non-mandatory lists of descriptors for **logE**, **awsP** and **awsC**, and to provide the location of these lists to VOS Focal Points and VOS Program Managers.

Annex of Appendix D

Proposed standardisation for logE, awsP and awsC

(Name and Version of the Electronic Logbook Software,

the AWS processing software and the AWS data entry and display console software)

Version 0.1 – 26 September 2012

The SOT Task Team on Pub47 (TT-Pub47) considered a request from E-Surfmar to use tables of prescribed values to report the plain language elements **logE**, **awsP** and **awsC**. The submission noted that using common values would enhance the reporting of these elements to SOT.

The TT-Pub47 supports the request from E-Surfmar, but noted that changing text fields to table fields and introducing footnote attributes, as is the case with all other table fields, would involve structural changes to Pub47. This would require JCOMM approval and could not be implemented immediately.

As an interim solution that can be implemented immediately, and follows the precedent set by element **prST** following SOT-6, the TT-Pub47 recommends that Members use non-mandatory lists of prescribed values for **logE**, **awsP** and **awsC** as appropriate.

Recommendations :

- Members are invited to select descriptors for **logE**, **awsP** and **awsC,** as appropriate, from the following lists. The descriptor syntax is “name-space-version” without additional qualifiers;
- On behalf of the TT-Pub47, E-SSURFMAR will maintain the lists of recommended descriptors on the E-SURFMAR website. The most recent version is available at ftp://esurfmar.meteo.fr/pub/Pub47/;
- Members are invited to contact the E-SURFMAR Programme Coordinator, Pierre Blouch <Pierre.Blouch@meteo.fr> if additional software types and versions are required to be added to the lists.

Examples :

logE	AMVER/SEAS 6.57
	OBSJMA 2.0
	TURBOWIN 5.01
awsP	AVOS 1.28
	BAROS 4.1
	BATOS 4.3
	DWD 2.44

APPENDIX E

REPORT BY THE TASK TEAM ON INSTRUMENT STANDARDS

(report submitted by the interim Chairperson of the Task Team, Mr Henry Kleta - Germany)

1. Introduction

This report addresses the key issues assigned to the Team in its Terms of Reference and identifies the key areas where progress has been made since SOT 6.
The report invites the SOT to consider carefully how the project should develop in the future, so that it can help to raise the climate quality of data within VOS, and thereby contribute to the Global Climate Observing System (GCOS).

The following supporting documents are appended to this report

Annex A - Instrument Standards Guidelines
Annex B - Instrument Standards Equipment Status Report
Annex C - Status of actions agreed at SOT VI
Annex D - Additional information to Annex C

1) Task Team members

- Mr Henry KLETA (Chairperson, Germany)
- Mr Graeme BALL (Australia)
- Mr Jean-Baptiste COHUET (France)
- Dr Gustavo J. GONI (United States)
- Ms Gerie Lynn LAVIGNE (Canada)
- Dr Elizabeth C. KENT (United Kingdom)
- Mr Rudolf KROCKAUER (Germany)
- Ms Sarah C. NORTH (United Kingdom)
- Mr Shawn SMITH (United States)
- Mr Derrick SNOWDEN (United States)
- Mr Johan STANDER (South Africa)
- Mr Scott WOODRUFF (United States)
- HMEI representative (Associated Member, HMEI)

2) The Task Team addressed its Terms of Reference as detailed below.

ToR no.	***Terms of Reference***	***Action(s) undertaken during the intersessional period***
1	Compile information on existing activities, procedures and practices within JCOMM relating to instrument testing, standardization and intercalibration, as well as the standardization of observation practices and procedures;	Annex A.
2	Using guidance contained in existing guides including the WMO Guides on Instruments and Methods of Observation (WMO-No.8) communicate with manufactures regarding new technologies and recognized equipment problems;	Ongoing activity.
3	Prepare a JCOMM Technical Report containing this information, to be made widely available through relevant web sites (JCOMM, JCOMMOPS, VOS, DBCP, SOOP, and SOT);	Lists are existing. Decision to create TR from them is pending. As the compilation of a JCOMM TR does take several months, the TT-IS comes to the conclusion, that it

		might be more feasible to create an online version only, that can be changed easier and quicker.
4	Provide guidance on testing and the intercalibration of marine meteorological and oceanographic observing systems;	Ongoing activity.
5	Liaise closely with WMO/CIMO, both in the compilation of the information and in assessing what additional work in this area might be required under JCOMM;	Relevant sections of the CIMO Guide reviewed. Final approval pending.
6	Liaise closely with IOC in the preparation of the wider compilation of existing instrumentation and observing practices standards in oceanographic observations in general, with a view to inputting an appropriate contribution from JCOMM;	Permanent, ongoing task . A real intercomparison of AWS systems (systems operating side by side) is not feasible.
7	Perform intercomparisons as required by SOT Sessions;	No action.
8	Review all relevant JCOMM Publications to make sure they are kept up to date and comply with Quality Management terminology;	CIMO Guide reviewed.
9	Work with the WMO Commission on Instruments and Methods of Observations for updating the WMO Guide No. 8 section dealing with ship-based observations.	Relevant sections of the CIMO Guide reviewed. Final approval pending.

3) Recommendations of the Task Team to SOT-7

(ii) The Task Team recommends that instead of preparing a JCOMM Technical Report on existing activities, procedures and practices within JCOMM relating to instrument testing, standardization and intercalibration, as well as the standardization of observation practices and procedures, to prepare dedicated WebPages listing such procedures.

(iii) The Task Team recommends to complete the review of relevant sections of the WMO No. 8 Guide, and to submit those changes to CIMO as needed.

Annex A of Appendix E

Instrument Standards Guidelines

1. VOS
   a. WMO
      1. Guide To Meteorological Instruments And Methods of Observation (WMO-No. 8)

         a. 7th Edition (Aug 08)
            http://www.wmo.int/pages/prog/www/IMOP/publications/CIMO-Guide/CIMO_Guide-7th_Edition-2008.html

         b. Approved changes from SOT-IV have been submitted to CIMO for endorsement and inclusion in next edition

   b. NMS
      1. Australia
         a. Port Meteorological Agents Guide
         b. TurboWin User Guide
         c. TurboWin Setup Manual

      2. Germany
         a. Port Met Officers Work Instruction
         b. Marine Observers Guide

      3. Hong Kong
         a. Guidance Notes on Port Meteorological Services
         b. Marine Observers Handbook
         c. UK Met.O. 740

      4. Japan
         a. Guide to Weather Observations for Ships (JMA)
         b. Guide to Ship's Weather Reports (JMA)
         c. Manual on Port Meteorological Services (JMA, in Japanese)

      5. United Kingdom
         a. Marine Observers Handbook
         b. Port Met Officers Work Instruction
         c. UK Met.O.740

      6. United States of America
         a. US/NWS (National Weather Service), 2004: Marine Surface Weather Observations. National Weather Service Observing Handbook No.1 (May, 2010)
            http://www.vos.noaa.gov/ObsHB-508/ObservingHandbook1_2010_508_compliant.pdf
         b. Military Specification MIL-B-17089
         c. National Weather Service NWS G101 – SP004
         d. National Weather Service NWS G222 – SP002
         e. NWS Instruction 10-201 (Feb 24, 2012)
            http://www.nws.noaa.gov/directives/sym/pd01002001curr.pdf

2. SOOP
    1) IOC
        1. Guide to IGOSS (now JCOMM) Data Archives and Exchange (BATHY and TESAC) - IOC Manual and Guides No.1
        2. Guide to Operational Procedures for the Collection and Exchange of IGOSS (now JCOMM) Data - IOC Manual and Guides No.3
        3. IGOSS (now JCOMM) Plan and Implementation Programme - IOC Technical Series No. 43
        4. Best Guide And Principles Manual For The Ships Of Opportunity Program (SOOP) and Expendable Bathythermograph (XBT) Operations
        5. GO-SHIP Repeat Hydrography Manual http://www.go-ship.org/HydroMan.html

    2) NMS
        1. Australia
            a. Devil XBT User Manual

3. ASAP
    a. WMO
        1. No guidance available at this time.

    b. EUCOS
        1. No guidance available at this time.

    c. Germany
        1. ASAP-Manual for sounding procedures

    d. Japan
        1. Guide to Upper-Air Observation (JMA; in Japanese)

Annex B of Appendix E

Instrument Standards Equipment Status Report

A. VOS

a. Barometers

BAROMETERS				
National VOS	**Barometer**	**Barometer Type**	**Barometer Setting**	**Type of Correction Tables Used**
Australia	Vaisala PTB220	Digital	Station Level	Height
Australia		Precision Aneroid	Station Level	Pressure/Temperature, Drift & Height
Croatia	Barigo Fisher SUNDO	Ship's Aneroid Ship's Aneroid Ship's Aneroid	MSL MSL MSL	NIL NIL NIL
Ecuador		Aneroid	MSL	NIL
France	Vaisala PTB220 Vaisala PTU200	Digital Digital	Station Level Station Level	Height Height
Germany	Fuess	15PM	MSL	NIL
Greece	Belfort	Aneroid	Station Level	Height / Temperature
Hong Kong	Hisamatsu OTA	Precision Aneroid Precision Aneroid Ship's Aneroid	MSL MSL MSL	U.K. Met. O. 740 U.K. Met. O. 740 U.K. Met. O. 740
Iceland	Fuess Vaisala PA11	Ship's Aneroid Digital	MSL MSL	Air Pressure Dependent
Ireland		Ship's Aneroid Aneroid	MSL MSL	NIL NIL
Japan		Aneroid Digital	Station Level Station Level	Height Height
Netherlands	Fuess Vaisala PTB220 Vaisala PTB330	Aneroid Digital Digital	MSL MSL MSL	NIL NIL NIL
New Zealand	Fuess Vaisala PTB330	Aneroid Precision Aneroid Digital	MSL Station Level Station Level	NIL Instrument & Height Height
Norway	Vaisala PTB220	Digital	MSL	NIL
Singapore	PAB MK2 M2236		MSL	U.K. Met. O. 740
South Africa	Fuess	Aneroid	MSL	NIL
Sweden	Vaisala PTB220	Digital	Station Level	Height or TurboWin
United Kingdom	Negretti & Zambra PAB MK2 Vaisala PTB220 Vaisala PTB330	Precision Aneroid Barometer Digital Digital	Station Level	NIL (for ships using TurboWin) U.K. Met. O. 740 (for ships not using TurboWin)
United States	Belfort Meteograf	Aneroid Digital	MSL MSL	NIL NIL
NOTES: 1) For Ships using TurboWin, the Height correction is applied by the software. 2) Information can also be found on VOS web site at: http://www.bom.gov.au/jcomm/vos/national_practices_pressure.html				

b. Barographs

BAROGRAPHS			
National VOS	**Barograph**	**Barograph Type**	**Barograph Setting**
Australia		Open Scale	Station Level
Croatia	KOMPAS	Open Scale	MSL
Ecuador		Micro-Barograph	MSL
France	None		
Germany	Mueller 78A Lambrecht 290		MSL MSL
Greece	Belfort	Open Scale (4 Day)	Station Level
Hong Kong	Fischer Sato Hisamatsu Isuzu Seisakusho OTA	Small Scale Small Scale Small Scale Small Scale Small Scale	MSL MSL MSL MSL MSL
Iceland	None		
Ireland		Open Scale (7 Day)	MSL
Japan		Open Scale (1 Day) Open Scale (7 Day)	Station Level Station Level
Netherlands	Fuess Vaisala PTB220 Vaisala PTB330	Aneroid Digital Digital	MSL MSL MSL
New Zealand	 Vaisala PTB330	Open Scale Digital Display	MSL Station Level
Norway	Vaisala PTB220	Digital Display	MSL
Singapore		Open Scale MK3	MSL
South Africa	Mason		MSL
United Kingdom	Negretti & Zambra Fischer	Open Scale (7 Day) Open Scale (7 Day)	MSL MSL
United States	Belfort Meteograf	Open Scale (4 Day) Digital (1 year)	MSL MSL

c. Transfer Standard Barometers

VOS Transfer Standard Barometers		
National VOS	**Barometer**	**Frequency of Barometer comparison**
Australia	Vaisala PTB220B	4 monthly
Equador	OACI mercury	6 monthly
France	Vaisala PTB220	12 monthly
Germany	Vaisala Digital Barometer	6 monthly
Greece	Belfort Aneroid	3 - 6 monthly
Hong Kong, China	Digital Aneroid Barometer	9 monthly
Japan	Vaisala Digital Barometer Paroscientific	6 monthly
New Zealand	Vaisala PTB220AD	12 monthly
Norway	Digiquartz	12 monthly
South Africa	Vaisala PA11 & Precision Aneroid	3 - 6 monthly
Sweden	Vaisala PA11A	12 monthly

United Kingdom	Precision Aneroid Barometer	3 - 6 monthly
United States	Digiquartz	6 monthly

d. Thermometers

VOS THERMOMETER TYPES and SETTINGS			
National VOS	**Thermometer**	**Thermometer Type**	**Thermometer Fluid**
Australia	AMA	Liquid-in-glass	Hg
Germany	Sling Eigenbrodt	Liquid-in-glass	Hg
Greece	Schneider	Liquid-in-glass	Hg
Netherlands	Schneider	Liquid-in-glass	Alcohol
Norway	PT100		
Sweden	PT100		
United Kingdom	Zeal 2C AMA	Liquid-in-glass Liquid-in-glass	Hg Hg
United States	Zeal P2505	Mason Hygrometer	Glycol

e. Sea Surface Temperature

VOS SEA SURFACE TEMPERATURE TYPES and SETTINGS			
National VOS	**Sensor**	**Sensor Type**	**Sensor Scale C/F**
Australia	Sea thermometer	Ship’s intake Bucket (UK)	C C
France	Sea thermometer	Ship's intake Hull contact sensor	C C C
Germany	Sea thermometer	Bucket Ship's intake Hull contact sensor	C C C
Greece	Sea thermometer	Ship's intake	C
Netherlands	Sea thermometer	Ship's intake Bucket (alcohol or mercury)	C
Norway	Sea thermometer	Hull contact	C
United Kingdom	Sea thermometer	Bucket Ship’s intake Hull contact sensor	C C C
United States		Ship's Intake	Either (ship Dependent)

f. Automated Systems

VOS AUTOMATED SYSTEMS			
National VOS	**Type of AWS (as of 31/12/2008)**	**Communication Method**	**Manual Entry Facility**
Australia	Vaisala Milos 500 AWS	Inmarsat C (Data Mode)	Yes
Canada	AVOS – AXYS Technologies	Inmarsat C Iridium	Yes
Denmark	BATOS BAROS	Inmarsat C Iridium SBD	Yes (not used) No
EUMETNET	BATOS BAROS	Inmarsat C (Data Mode) Iridium SBD	Yes No
France	BATOS MINOS	Inmarsat C (Data Mode) & Iridium SBD Argos	Yes No
Germany	Vaisala Milos 500 AWS Ship's own datalogger SCAWS	Meteosat Inmarsat / Iridium Meteosat	Some Yes No
Ireland	Vaisala Milos AWS	Meteosat	No
Japan	Koshin Denki Kogyo Co., Ltd (Japan) Nippon Electric Instrument Inc. (Japan) Brookhaven National Laboratory (USA)	MTSAT & Inmarsat C Inmarsat C Inmarsat C	Some Some Yes
New Zealand	Sutron 9000RTU mSTAR-SHIP	MTSAT GPRS Cell	Yes No
Norway	PC with QLC50	VSAT with Iridium	Yes
Russia	GM6	Inmarsat C	Yes
South Africa	Vaisala Milos 520	Inmarsat C	Yes
Spain	Vaisala Milos	Inmarsat C	Yes
United Kingdom	MINOS-GP MINOS-GPW BATOS Vaisala MAWS Metocean Deck Buoy AMOS	Argos Argos Inmarsat C (Data Mode) Iridium Iridium Iridium	No No Yes Yes No No
United States	SEAS-AutoImet	SEAS	Some

B. SOOP

i. Expendable BathyThermograph (XBT)

XBT Probe	
National SOOP	**Equipment Type**
Australia	Sippican
United States	Sippican (DeepBlue and FastDeep)

ii. XBT Recorder System

XBT Recorder	
National SOOP	**Equipment Type**
Australia- BOM Australia- CSIRO	Devil XBT Devil XBT
United States	Sippican MK21 ISA Sippican MK21 USB (DAQ)

iii. XBT Launcher System

XBT Launcher	
National SOOP	**Equipment Type**
United States	Sippican Hand Launcher (LMA3) AOML Autolauncher (AOML) Scripps Autolauncher (SIO)

iv. XBT Transmission System

XBT Transmission	
National SOOP	**Equipment Type**
United States	T&T Sailor 403026S Mini-C transceiver Iridium NAL SAF4070-IG Iridium NAL A3LA-XG Furuno GPS Navigator GP-32

v. ThermoSalinoGraph (TSG)

Thermosalinograph (TSG)	
National SOOP	**Equipment Type**
United States	Seabird 21 TSG Seabird 38 Remote Temperature Sensor Seabird 45 MicroTSG

vi. TSG Transmission System

TSG Transmission	
National SOOP	**Equipment Type**
United States	Iridium Antenna / Modem

vii. Conductivity, Temperature, and Depth (CTD)

Conductivity, Temperature, and Depth (CTD)	
National SOOP	**Equipment Type**
United States	Seabird 19 Seabird 25 Seabird 911+

viii. Expandable Conductivity, Temperature, and Depth (XCTD)

Expandable Conductivity, Temperature, and Depth (XCTD)	
National SOOP	**Equipment Type**
United States	Sippican TSK

ix. Acoustic Doppler Current Profile (ADCP)

Acoustic Doppler Current Profile (ADCP)	
National SOOP	**Equipment Type**
United States	RD Instruments

x. Partial Pressure of CO_2 (pCO_2)

Partial Pressure of CO2 (pCO2)	
National SOOP	**Equipment Type**
Australia	CSIRO
United States	General Oceanics

xi. Moving Vessel Profiler

Moving Vessel Profiler	
National SOOP	**Equipment Type**
United States	Brooke
United States	Scripps

C. ASAP

ASAP TYPES and COMMUNICATIONS				
National ASAP		**Container**	**Sounding Equipment**	**SATELLITE TRANSCEIVER**
E-ASAP	Denmark		MW31, version 3.62	
		10ft container	MW31, version 3.62	Iridium Sailor SC4000
		Built-In launcher	GRAW GS-E, Grawmet	Iridium Sailor SC4000
		10ft container	40803	Iridium Sailor SC4000
	E-ASAP	10ft container	MW21, version 3.62	Iridium Sailor SC4000
		10ft container	MW21, version 3.62	Iridium Sailor SC4000
		10ft container	MW21, version 3.62	Iridium Sailor SC4000
		10ft container	MW21, version 3.62	Iridium Sailor SC4000
		10ft container	MW21, version 3.62	Iridium Sailor SC4000
	France	Deck launcher	MODEM SR2K	Iridium Sailor SC4000
		Deck launcher	MODEM SR2K	Iridium Sailor SC4000
		Deck launcher	MODEM SR2K	Iridium Sailor SC4000
		Deck launcher	MODEM SR2K	Iridium Sailor SC4000
	Germany	20ft container	MW21, version 3.62	Iridium Sailor SC4000
		20ft container	MW21, version 3.62	Iridium Sailor SC4000
		Deck launcher	MW21, version 3.62	Iridium Sailor SC4000
		Deck launcher	MW21, version 3.62	Iridium Sailor SC4000
	Spain	10ft Container	MW21, version 3.62	Iridium Sailor SC4000
	United Kingdom	10ft Container & Deck launcher	MW21, version 3.62	Iridium Sailor SC4000
Japan		10ft Container	MW11	MTSAT & Inmarsat-C

Annex C of Appendix E

Status of Actions agreed at SOT VI

No	*Ref*	*Action item*	*By*	*Status*
8	3.1.4.3(c)	The TT-IS to complete the production of a JCOMM Technical Report to include guidelines on standards for instruments (including a list of related WMO, UNESCO/IOC, and national publications for each of the SOT programme components) and high quality best practices for the Voluntary Observing Fleet (VOF) and the Ship Of Opportunity Programme (SOOP)	TT-IS	Lists are existing. Decision to create TR from them is pending.
12	3.1.4.4(b)	Continued review of relevant chapters of the WMO Publications No. 8, No. 471, and No. 488	TT-IS	Final approval pending
16	3.1.4.4(g)	Contribute to the completion and updating of the JCOMM Cookbook for the submission of ocean data in real time and delayed mode	TT-IS	Permanent, ongoing task
24	5.1.2.2(4)	TT-IS to address feasibility of developing automated wave/sea state sensors	TT-IS	Should be routed to ET on Wind Waves and Storm Surges
57	6.5.3	TT-IS to continue to collect information from AWS systems used by SOT members in the view to have sufficient materials to eventually perform the intercomparison and be able draw significant conclusions from the available information	TT-IS	A real intercomparison (systems operating side by side) is not feasible
118	9.2.1.2	the TT-IS to look at those ship-based related practices elements from WMO No. 306, identify appropriate publication(s) to which the identified observation practices should be relocated, and make recommendations to the CBS as appropriate	TT-IS	Pending
128	9.2.4.4(3)	The Team emphasized the importance for marine climatology of safeguarding old (expired) e-logbook documentation, formats, and software, including through the efforts of the Task Team on Instrument Standards	TT-IS & ETMC	Needs to be discussed with ETMC
129	9.2.4.5(1)	The Team agreed to liaise with the E-SURFMAR's VOS Technical Advisory Group (VOS-TAG) and try to reconcile the different views and methods of ship to shore real-time transmission	TT-IS & TT-Satcom	See Annex D
130	9.2.4.5(3)	the TT-IS to liaise with the ETMC ad hoc group in the view to make further recommendations to the Team at its Seventh Session	TT-IS	Ongoing
147	10.2.1(1)	to legacy recommendation 2, the Team agreed to contribute to the review of WMO and IOC Publications through its Task Team on Instrument Standards, and other Task Teams as appropriate	TT-IS	Permanent, ongoing task

149	10.2.1(3)	Referring to legacy recommendation 4, the Team agreed to contribute to the development of JCOMM guidelines for marine instrument intercomparisons through its Task Team on Instrument Standards, and liaise with the JCOMM Observations Coordination Group (OCG) as appropriate	TT-IS	Permanent, ongoing task
159	10.2.7	The SOT requested the TT-IS, in liaison with other Task Teams as appropriate, and in a way consistent with the strategy proposed by the JCOMM Pilot Project for WIGOS, to participate in the efforts to further update the above publications as well as IOC M&G No. 4 & 26, WMO No. 544 & 488	TT-IS	Permanent, ongoing task
P10	SOT-V/III.4.5.10	to define guidelines for instrument certification, and inspection for inclusion as an annex in a future revised version of JCOMM TD No. 4	TT-IS	Permanent, ongoing task
P6	SOT-V/I-5.3.6-(i)	to keep under review WMO Publications No. 544, 488, and 8 and make proposals through the WMO Secretariat and the JCOMM Focal Point on CIMO matters if necessary	TT-IS	Done for No. 8

Annex D of Appendix E

Additional information to Annex C

8	3.1.4.3(c)	The TT-IS to complete the production of a JCOMM Technical Report to include guidelines on standards for instruments (including a list of related WMO, UNESCO/IOC, and national publications for each of the SOT programme components) and high quality best practices for the Voluntary Observing Fleet (VOF) and the Ship Of Opportunity Programme (SOOP)	TT-IS	Lists are existing. Decision to create TR from them is pending.

The information collected for this task is changing on a permanent basis, sometimes even more than once a year.

As the compilation of a JCOMM TR does take several months, the TT-IS comes to the conclusion, that it might be more feasible to create an online version only, that can be changed easier and quicker.

57	6.5.3	TT-IS to continue to collect information from AWS systems used by SOT members in the view to have sufficient materials to eventually perform the intercomparison and be able draw significant conclusions from the available information	TT-IS	Permanent, ongoing task. A real intercomparison (systems operating side by side) is not feasible

A thorough intercomparison requires access to the systems to be compared. Furthermore there is the need for many resources (personnel, comparable sensors and data sources to name only a few…). Due to these needs the TT-IS came to the conclusion, that this task is not feasible.

129	9.2.4.5(1)	The Team agreed to liaise with the E-SURFMAR's VOS Technical Advisory Group (VOS-TAG) and try to reconcile the different views and methods of ship to shore real-time transmission	TT-IS & TT-Satcom	

The chairperson of the TT-Satcom gave the following information:

We may consider that 3 main formats are presently used by conventional VOS to report their observations to the shore in real-time.

1. FM13 messages sent through different communication systems:
Inmarsat-C SAC41, Inmarsat-C other SAC, Email, Meteosat DCP... This dataformat is becoming obsolete for GTS. So, it is not recommended to keep it. The use of SAC41 is also unfair due to the fact that a few NMS pay the communications costs for all. The disappearance of FM13 could lead a fewer use of SAC41 before its own disappearance.

2. Binary messages generated by the SEAS software and sent through Inmarsat-C Data Mode service. It seems this dataformat wasn't discussed internationally. It also has some limitations (e.g.

in size) and it needs to switch the Inmarsat terminal of the ship from a mode to another (Text and Data). It is exclusively used by US VOS and it has an AMVER extension. Received raw data are processed at NOAA. FM13 (and BUFR?) messages are generated for GTS transmission. Advantage against FM13: the messages are compressed so communication costs are lower. I believe that our US colleagues are looking at what we did (see below) to replace their SEAS dataformat if ours is judged better. Contacts between our Dutch colleagues (René and Martin) and US VOS operators (John and Paula) are ongoing.

3. E-SURFMAR half compressed messages generated by TurboWin and sent through Inmarsat-C Text Mode. A first version of the dataformat is presently under deployment on all Dutch VOS (fitted with TurboWin 5.0). Received raw data are processed at Meteo-France. FM13 and BUFR messages are generated for GTS transmission. A new version was set up after many discussions between JCOMM ETMC group and E-SURFMAR (format #100 - see http://esurfmar.meteo.fr/doc/o/vos/E-SURFMAR_VOS_formats_v013.pdf). This format will be implemented in a future version of TurboWin. Advantages: compression, more parameters than SEAS, extensible size... It must be noticed that the same dataformat (but kept compressed) is used by some S-AWS and will be used by the common EUMETNET S-AWS stations (through Iridium).

APPENDIX F

REPORT BY THE TASK TEAM ON CALL SIGN MASKING AND ENCODING (TT-MASKING)

(report submitted by the Chair of the Task Team, Mr Graeme Ball)

1) Task Team members

- Mr Graeme BALL (Chairperson, Australia)
- Mr Mathieu BELBEOCH (JCOMMOPS)
- Mr Etienne CHARPENTIER (WMO Secretariat)
- Ms Julie FLETCHER (New Zealand)
- Ms Sarah C. NORTH (United Kingdom)
- Mr Colin PARRETT (United Kingdom)
- Mr Scott WOODRUFF (United States)
- DBCP/SOT Technical Coordinator

2) The Task Team addressed its Terms of Reference as detailed below.

ToR no.	***Terms of Reference***	***Action(s) undertaken during the intersessional period***
1	Oversee the implementation of **MASK** [10], **SHIP** [11] and **ENCODE** [12] and develop guidelines as necessary;	Ongoing activity. Communication with MSNZ describing the monthly reporting requirements to JCOMMOPS and the RSMC following the implementation of **MASK**.
2	Review and approve national **MASK** schemes to ensure they remain unique and do not impinge on (1) the ITU callsign series allocated to a country, or (2) any other marine or oceanographic identification scheme used by WMO, e.g. buoy identification numbers;	Approved the **MASK** series N8Z001 – N8Z999 to NZ.
3	Ensure the **MASK** v **REAL** [13] database is kept up-to-date by NMSs implementing **MASK**;	This activity to be resurrected following the appointment of the new SOT TC. E-SURFMAR currently maintains the **MASK** details of all ships in the E-SURFMAR VOS Metadata Database, and offers all members the facility to directly update their **MASK** details in the database.
4	Develop the **ENCODE** encryption strategy, as well as develop the encoding and decoding keys.	The outcome of SOT-6 discussions in this regard, including the current **ENCODE** proposal (see Annex) was presented to the 4th Session of JCOMM (Yeosu, Republic of Korea, May 2012), and the 4th Session of the Expert Team on Marine Climatology (ETMC), Ostend, Belgium, November 2012. JCOMM-4, in noting the importance of this initiative in retaining the participation of the VOS and in permitting thorough quality analysis and feedback to participating

10: MASK - Unique, repeating identifier. The masking identifier is assigned by the NMS that recruited the ship.
11: SHIP: Letters "SHIP" used in place of the real ship identifier.
12: ENCODE - Unique, non-repeating identifier. The identifier is derived from encrypting elements in the message, e.g. callsign + latitude + longitude.
13: REAL - Official ITU callsign of the ship.

		ships, urged the SOT to work closely with expert bodies such as the WMO CBS in developing a common and robust standard for call-sign masking. ETMC-4 concurred with the decisions of SOT-6, and urged the SOT and the Data Management Programme Area (DMPA) Task Team on Table Driven Codes (TT-TDC) to speed up the development of a proposal so that the corresponding and required BUFR template for VOS data can be passed to the Commission for Basic Systems (CBS) Inter-Programme Expert Team on Data Representation Maintenance and Monitoring (IPET-DRMM). ETMC-4 also invited the Secretariat to approach the Chair of the SOOPIP to indicate whether some of those ships data are also masked and to investigate solutions in that case to make sure that un-masked data eventually reach the international archives. See also SOT-7 document 9.2 on coding.

3) Recommendations of the Task Team to SOT-7

(i) The Task Team recommends the followings changes to its membership:

a. Remove:
   (i) Ms Julie Fletcher (New Zealand),
   (ii) Mr Mathieu Belbeoch (JCOMMOPS)
   (iii) DBCP/SOT Technical Coordinator

b. Add:
   i. SOT Technical Coordinator (JCOMMOPS)
   ii. Security Adviser (TBA)
   iii. Mr David Berry (United Kingdom)

(ii) The Task Team recommends that members directly update their MASK details in the E-SURFMAR VOS Metadata Database as an alternative to submitting a quarterly advice to JCOMMOPS.

(iii) That E-SURFMAR continue to provide JCOMMOPS with a list of current MASK details on a daily basis.

4) Planned activity during the next intersessional period

(1) Develop the **ENCODE** encryption and decryption keys.

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Annex 1 of Appendix F

Ship Callsign Masking: ENCODE Proposal
(v5, 10 November 2010; minor rev. 3 March 2011)

S. Woodruff (Chair ETMC) and E. Estes
(NOAA Earth System Research Laboratory);
E. Charpentier (WMO); and R. Keeley (ISDM, Canada—retired)

1. Introduction

Many merchant (and some Research Vessels and other) ships are members of the World Meteorological Organization (WMO) Voluntary Observing Ship (VOS) Scheme and/or of the Ship Of Opportunity Programme (SOOP). The VOS vessels report meteorological observations while those in SOOP report ocean measurements. Whereas the discussion below explicitly speaks about the VOS Scheme, the concepts may apply equally to ships in the SOOP.

Most ships reporting marine meteorological data under the VOS Scheme use as the ship identifier their radio callsign. Specifically, each country has a set of 3-character alphanumeric prefixes designated by the International Telecommunication Union (ITU)[14] with which their callsigns must begin, and merchant vessels dependent on their country of registry are assigned individual callsigns by their national licensing authorities (Wikipedia 2010b)[15], usually by adding 1-2, and probably no more than four, characters; thus yielding an expected maximum of seven characters for the resultant individual callsign (as presently reported).

Callsigns are used to identify VOS data circulated in real-time over the Global Telecommunication System (GTS) data, and/or collected in delayed-mode (DM) under the WMO Marine Climatological Summaries Scheme (MCSS)—from paper electronic logbooks—using the International Maritime Meteorological Tape (IMMT) format. Moreover callsigns are required to establish a link between those GTS/DM ship meteorological reports, and platform and instrumental metadata gathered periodically into WMO–No. 47 (1955–) by the country that recruited the ship under the VOS scheme (which may differ from the aforementioned country of registry). Finally callsigns are required to permit appropriate quality monitoring of reports from any given ship by making comparisons of individual observations from a ship with end-user products (e.g. first guess field of Numerical Weather Prediction models) or nearby observations and deriving quality information and monitoring statistics.

Unfortunately, following concerns expressed by ship owners and masters (starting around 2005) with regard to ship's identification and position being made available via public websites, the effective utilization of recent VOS data for critical applications, including weather prediction and climate research, is being obstructed by increasing levels of GTS (and to a more limited extent DM) callsign masking for commercial and security reasons. This is resulting in difficulties experienced by these and other applications to access all required information, including association of the ship reports with WMO–No. 47 metadata, or to make the necessary adjustments to their data processing systems in order to derive such information.

As part of the international responses to these problems, the WMO-Intergovernmental Oceanographic Commission (IOC) Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) Ship Observations Team (SOT) has defined four different schemes for transmitting or masking ship callsigns, i.e. REAL[16], SHIP[17], and MASK[18], which were previously in

14: Table of International Call Sign Series (Appendix 42 to the ITU *Radio Regulations*): http://www.itu.int/online/mms/glad/cga_callsign.sh?lng=E.

15: Or by states such as Liberia or Panama, which are "flags of convenience" for ship registration. A merchant ship is said to be flying a flag of convenience if it is registered in a country different to that of its owners (Wikipedia 2010a).

16: REAL: Official ITU callsign of the ship (i.e. unmasked).

17: SHIP: Non-unique (generic) identifier. The callsign is uniformly replaced by the letters "SHIP". Japan and USA are using this scheme for some ships, and are distributing the data through a secured parallel system for authorized legitimate users.

18: MASK: Unique, repeating identifier. The masking identifier is assigned by the NMHS that recruited the ship. This scheme is being implemented by Australia, and European countries participating in E-SURFMAR.

existence or have been implemented already (see also ***Annex 1***); together with the planned ENCODE[19] scheme, which is the topic of this report and viewed as the preferred long-term solution to be potentially universally accepted. This solution will need to meet the requirements of ship owners and operators, National Meteorological and Hydrological Services (NMHSs), and climate users.

Section 2 of this report outlines the underlying technical considerations, including logistical considerations in the underlying WMO GTS environment.

Section 3 compares and contrasts two general methods for encrypting call signs (both of which advantageously can readily be implemented using open-source software), including technical and operational considerations. As discussed in Section 3, we have not yet been able to resolve several complex technical questions and tradeoffs associated with those two general methods (including potential BUFR data volume transmission cost issues), and thus cannot yet offer a specific ENCODE solution. However this report does explore in some detail those available methods and should hopefully be useful for wider discussion leading to a specific solution.

Annex 1 provides additional background on the VOS callsign masking issues from the perspectives of WMO and JCOMM, together with a brief discussion of some user impacts arising on the principal surface marine meteorological archive used for climate research—the International Comprehensive Ocean-Atmosphere Data (ICOADS; http://icoads.noaa.gov/).

Annex 2 provides further encryption and software details (including prototype Perl modules implementing the two general methods, using a specific candidate algorithm in each case).

Annex 3 provides relevant excerpts from the latest VOS template proposal for the Binary Universal Form for the Representation of meteorological data (BUFR, WMO 2009b).

Under the new WMO Information System (WIS) the requirement has been expressed to transition all time-critical observational GTS traffic (and possibly some other data exchanges) to use Table-Driven Code (TDC) forms. In the VOS context the BUFR format appears likely to be the only appropriate TDC form, but it is optimized for contemporary and operational data requirements, and the need to handle all possible forms of meteorological data leads to a high degree of complexity.

2. Technical considerations

In the context of the GTS traditional alphanumeric SHIP code (presently FM 13–XIV; WMO 2009a) there does not appear to be any restriction on callsign (**D….D**) length.[20] However owing to GTS data storage logistics, practical limits can be imposed nationally by NMHSs, and thus sizes exceeding nine characters are probably unrealistic in this regard. At least recently for example, Météo-France could only accommodate a callsign to seven characters, and NOAA's National Centers for Environmental Prediction (NCEP) allocate a field of eight characters in their current version of BUFR, into which FM 13 (and other marine) data are translated (Woodruff 2006).

The current (IMMT-3) and upcoming revised IMMT-4 formats both allocate (element 42) seven characters. For WMO–No. 47 there does not appear to be any size limitation, at least in the XML input data (SOT 2007) (also emphasizing however that we do not intend to encrypt the ship's call sign in WMO–No. 47). The International Maritime Meteorological Archive (IMMA) format used for ICOADS, presently allocates nine characters for a generalized identification (ID) field (to store callsign or other forms of ID, as differentiated by a separate ID indicator). In the proposed new VOS BUFR template, nine characters are also allocated for callsign (see ***Annex 3***). For purposes of this ENCODE proposal we therefore assume that nine characters is the maximum callsign

19: ENCODE: Unique, non-repeating identifier. The identifier is derived from encrypting callsign, plus if necessary other elements in the message, e.g. latitude + longitude + date + time.

20: Also, FM 62–VIII Ext. TRACKOB calls for the use of ITU callsigns (**D….D**); as do FM 63–XI Ext. BATHY, FM 64–XI Ext. TESAC, and FM 65–XI Ext. WAVEOB when the reports are from ships (otherwise those three forms utilize WMO numbers, as discussed below; additionally, in the case of WAVEOB reports, other code figures are to be used to report satellite/aircraft data, etc.).

length that may need to be input.

In GTS data, ship callsigns have been "masked" (i.e. using the generic callsign SHIP) to a limited degree for many years. Currently this practice appears to be governed by part of WMO (2009a) FM 13 (SHIP code) Regulation 12.1.7[21]:

> "(*b*) In reports of sea stations other than buoys, drilling rigs and oil- or gas-production platforms, and in the absence of a ship's call sign, the word SHIP shall be used for **D….D**."

Additionally it should be noted that some buoys and other marine stations also report in FM 13 but under another part of Regulation 12.1.7 using instead WMO (buoy) numbers:

> *"(a)* The identification of stations located at sea on a drilling rig or an oil- or gas-production platform shall be indicated by the group $\mathbf{A_1 b_w n_b n_b n_b}$.[22]"

As noted in Section 1, for circulation of data on the GTS, BUFR represents the required TDC format as of 2012 to replace the earlier traditional alphanumeric codes, including FM 13. BUFR is generally limited to storage of data in SI units (e.g. temperatures are stored in Kelvin). This means that the original data forms would no longer be available (at least under currently proposed template schemes), thus transformed binary BUFR data elements may need to form the input to the encryption (in case any such additional data elements are factored into the ENCODE computation together with callsign, to achieve randomization as discussed in Section 3). Furthermore it is important to bear in mind that the reverse transformation of binary data back into human-readable characters (CCITT IRA[23]) can be subject to rounding problems (due to finite precision), if executed using different computer systems or software.

Consequently the encryption software will likely need to be closely linked with the BUFR encode/decode software. Having WMO-standardized BUFR software readily available internationally therefore could be an important related ingredient of the ENCODE solution (e.g. to guarantee that the same encryption/decryption results are repeatable on different systems). WMO (2009b) describes the presently BUFR validation procedures as follows:

> "For new or modified WMO code and data representation forms, proposed changes should be tested by the use of at least two independently developed encoders and two independently developed decoders which incorporated the proposed change. Where the data originated from a necessarily unique source (for example, the data stream from an experimental satellite), the successful testing of a single encoder with at least two independent decoders would be considered adequate."

However, strengthened WMO requirements for software availability would appear desirable in order to possibly establish a more formal WMO "certification" process for rigorously tested encoded/decoders, while also considering the software availability ramifications of complying for instance with potentially burdensome licensing schemes that may be associated with nationally developed BUFR software.

3. Comparison of known encryption solutions

Two general encryption methods have been considered, with different strengths and weaknesses (see also ***Annex 2***):

- **Option (a)** Techniques based on asymmetric ("public-key") algorithms; and
- **Option (b)** Techniques based on symmetric (secret-key) algorithms.

21: Also for FM 62–VIII Ext. TRACKOB, FM 63–XI Ext. BATHY, FM 64–XI Ext. TESAC, and FM 65–XI Ext. WAVEOB, in the absence of a ship's call sign, the word SHIP shall be used for **D….D**.

22: Other buoys, including most drifting buoys, report instead in FM 18–XII BUOY, also using a WMO buoy number. A description of the form of these and other WMO numbers ($\mathbf{A_1 b_w n_b n_b n_b}$), and allocation rules, is available here: http://www.wmo.int/pages/prog/amp/mmop/wmo-number-rules.html. For example, while not directly relevant to VOS/SOOP requirements, the Argo programme (http://www.argo.ucsd.edu/) reports upper ocean temperatures and salinities over the GTS using an 8-character identifier (a WMO number preceded by "Q" in FM 64–XI Ext. TESAC).

23: International Reference Alphabet (CCITT 1992), formerly known as the International Alphabet No. 5, or CCITT IA5. ASCII is the US version of the IRA.

SOT originally proposed adoption of method (a), which actually involves the use of a public key for encoding and a private key (restricted distribution) for decoding. ETMC subsequently suggested alternative consideration of method (b), which is significantly simpler and computationally more efficient (provided the key can be held securely). Specifically, Advanced Encryption Standard (AES) 256 (i.e. using 256-bit key size) was recommended to ETMC, which can easily be implemented via open-source software methods.

More recently however, recognition of requirements for many parties (e.g. possibly extending to individual ships) to encrypt callsigns, but fewer trusted parties to decrypt, led to reconsideration of public-key method (a), and specifically of what is known as "RSA" encryption (Rivest et al. 1978) (also used for Secure Socket Layer – SSL). The advantage of such an asymmetric public-key solution in the VOS environment is that we can put the public key on an electronic logbook or other automated weather system (AWS) without risk of theft—since the private key will not reside in the e-logbook/AWS or elsewhere on the ship. Only downstream data users (including NMHSs) would need to know the private key and this limits the number of people having it and therefore the risk of unauthorized release. This scheme also simplifies the procedure for distributing the public key to the field and Port Meteorological Officers (PMOs).

See Table 1 for a comparison of performance metrics between the two general methods. Unfortunately as clearly illustrated in Table 1 the RSA method appears to have a major additional disadvantage (not initially recognized by SOT), in that the key size, and thus also the encrypted result size, must be relatively large in order to ensure that the method secure (at least 1024 bits = 128 bytes; absent the unexplored possibility of very frequent key refreshes, ref. Table 1 footnote).

An encrypted output field of that size would dwarf the remaining BUFR message fields and may be impractical from a data transmission cost standpoint in the GTS environment, but these tradeoffs against the secret-key distribution disadvantages of the AES method may benefit from discussion by a wider group of experts (including the possibility of tapping additional cryptographic expertise). At this time therefore we are unable to recommend a specific encryption solution, but the reminder of this section discusses the pros and cons of the two known general methods, with the aim to provide background information needed to agree a solution following wider discussion of costs/benefits and other issues.

Table 1. Comparison of performance metrics of AES (symmetric) and RSA (asymmetric) encryption algorithms. Tests were run on a desktop computer: Dell Optiplex 755, dual core 2.66GHz, 2GB RAM. We note that the CPU results may also be dependent on the specific RSA implementation chosen. Under both methods "padding" is an important part of ensuring the variability ("semantic security") of each encrypted message; each of the specific example implementations (Crypt::CBC and Crypt::RSA) detailed in ***Annex 3*** handle this padding behind the scenes.*

Algor.	Key size	Encrypted result (binary)	CPU time (encryption)	CPU time (decryption)	Computational security**
AES	128 bits (16 bytes) (AES-128)	32 bytes (256 bits)	~0 (near real time)	~0 (near real time)	Adequate for the foreseeable future (even with massive resources)
	256 bits (32 bytes) (AES-256)	32 bytes (256 bits)	~0 (near real time)	~0 (near real time)	Adequate for the foreseeable future (even with massive resources)
RSA	512 bits (64 bytes)	64 bytes (512 bits)	~0 (near real time)	~0 (near real time)	Inadequate with even moderate resources***
	1024 bits (128 bytes)	128 bytes (1024 bits)	~0 (near real time)	3 seconds	Inadequate with massive resources
	2048 bits (256 bytes)	256 bytes (2048 bits)	~0 (near real time)	45 seconds	Adequate for the foreseeable future (even with massive resources)

** Padding is critical to implement RSA securely, which the open-source modules described in ***Annex 2*** handle automatically. See e.g. http://en.wikipedia.org/wiki/RSA for more information on the inherent weaknesses and necessity for RSA padding.
** From: http://en.wikipedia.org/wiki/Key_size.
*** While frequent key refreshes might be used to offset the security risk of a smaller key, determining how often you would need to refresh so as to achieve adequate security is not known, and would appear to require deeper research and theoretical cryptographic analysis.
Table 2 lists the VOS BUFR template field configuration currently envisioned for callsign (explained in further detail in ***Annex 3***), together with tentative BUFR descriptors for the ENCODE result and associated fields. Under the items that follow Table 2, we provide further detailed discussion of several technical and operational considerations, including possible schemes for governance and management of the encoding/decoding keys. Clearly however, encryption technology will continue to change, and the scheme needs to allow for documenting in the BUFR data changes in the method through time (as would be tracked via a proposed new BUFR field in Table 2).

Table 2. The proposed representation of ship's callsign in the latest BUFR VOS template (see ***Annex 3***), and the output ENCODE encrypted callsign field, together with associated fields proposed for inclusion in BUFR. [Note: this table will eventually need to include bit-lengths and other BUFR technical details for the proposed new fields.]

Name	**Unit**	**Scale**	**Ref. value**	**Data Width (bits)**	**Possible JCOMM field abbrev.**	**Note**
Ship's callsign (9 char.)	CCITT IA5	(Ann. C)	(Ann. C)	72	*Callsign*	(1)
ENCODE result (32 bytes)	Binary	0	0	256	*Enc*	(2)
Encryption method code	Code Table	0	0	8	*EncM*	(3)
Encryption key version	Code Table	0	0	16	*EncV*	(4)

Notes:

1. The currently proposed VOS template (***Annex 3***) calls for the actual identifier (0-01-011) to be stored (under 3-01-003) together with ship's motion (0-01-012 and 0-01-013).
2. This assumes use of symmetric (AES-256) encryption (see Table 1) with binary output. Alternatively the binary results could be transformed to alphanumeric characters e.g. using hexadecimal, however then doubling the storage size (i.e. to 64 bytes)
3. This proposed new field is an indicator for the encryption method employed, so that as encryption technology changes (and existing methods possibly become insecure), a new ENCODE solution can be adopted, and this indicator will document which method has been used in the given BUFR report, e.g.:
   0 = preliminary encryption method (for testing prior to international adoption)
   1 = first internationally adopted encryption method
4. For purposes of processing archived BUFR data (e.g. possibly years after the key used to encrypt the callsign became obsolete and was replaced), this proposed new field would provide the means of locating a specific archived key (i.e. via a code table to include a version number, and the date and time the key was released, and terminated) at which it was issued by WMO. Additionally for this scheme to work, WMO (or contributing partner) would need to permanently archive in a database all the keys that have been issued through time, together with the associated *EncM* and *EncV* fields. Possibly portions of this database could be made generally public at a considerably later date (e.g. one or more years) assuming security or commercial sensitivity regarding releasing the real callsigns and ship positions dissipates.

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a) "Variability" requirements: The result of the encryption of each callsign is nominally required to be a unique, non-repeating identifier. However, non-repetition is actually only required (and realistically, depending on the length of the ENCODE result, achievable) in a more localized sense, so that for a given ship track the encrypted value will vary from one report to the next, with the purpose of preventing an illicit user from being able to identify with certainty two different reports

from the same ship when he/she does not have access to the decryption key[24]. To achieve variability (or randomization) it was therefore originally envisioned that computation of the ENCODE result might need to incorporate, in addition to callsign, selected other reported data elements (e.g. date/time in addition to latitude/longitude, in the event VOS report from a fixed location). Fortunately however, both the AES and RSA encryption methods (provided a sufficiently reliable and robust implementation is chosen) appear to handle this variability automatically. Also, the encode variability still needs to be alphanumeric so current NMHSs can still process incoming data (e.g. NOAA AOML's SEAS initial ingest point can only process alphanumeric callsigns as it sees pure numeric identifiers as buoy only and ignores them).

b) Extent of the encrypting/decrypting parties:

- *Encryption (requiring: AES secret-key; or RSA public-key):* This will be done either onboard ships using e-logbooks/AWS, with the encrypted callsigns automatically transmitted to shore; or this may strictly be done onshore by NMHSs in charge of receiving the raw data from the ships, converting them to BUFR units, and inserting the data onto the GTS.
- *Decryption (requiring: AES secret-key; or RSA private-key):* In theory, all legitimate users of VOS GTS data would require access, i.e. all NHMSs internationally, including real-time (e.g. NWP) and delayed mode users (e.g. climate users), as well as archiving centres. In practice however, NMHSs, who all have direct GTS connections, are likely to be the principal decryption centres (followed by archive centres). Oceanographic centres e.g. may receive data relayed from an NMHS in the GTS format and do their own decoding, and thus may also need to be a decryption centre.

c) Key(s): format and size considerations: Further clarification is needed in this area. However for the prototype implementations in ***Annex 2***:

- *Symmetric method (AES):* the key itself in this implementation is generated from a human-readable passphrase (not literally the key, but the passphrase used to derive it; but also what will be distributed to all parties involved with encryption/decryption).
- *Asymmetric method (RSA):* A key pair is produced that occupies 2048 bits (256 bytes), which may also be human-viewable in text format (characters).

d) Encryption result: format and size considerations: We anticipate implementing the scheme as part of a future BUFR VOS template format still under development (see Table 1 and ***Annex 3***), but the format (e.g. binary or character) and size of the resultant ENCODE string represent critical considerations. If we attempted to store the ENCODE result in current formats there would be problems if it exceeds the currently permitted callsign length in the message recognition software in some NMHSs. Additionally, storing the ENCODE result in BUFR in human-readable characters would require translating the binary data into e.g. hexadecimal characters (thus doubling storage cost), therefore the output of both encryption schemes currently under consideration is binary.
Unfortunately there is no way to fulfill the requirement that the encrypted string be the same length and contain the same character set as the original callsign. In order to encrypt the callsign, you must introduce variability and therefore increase the size and/or character set of the ENCODE result. Otherwise, you would have a 1-to-1 mapping of symbols that could easily be reversed. Therefore, as shown in Table 1, the minimum size of the encryption results is currently estimated as 32 bytes (represented in binary as shown in Table 2).

e) Additional operational considerations: Initially, the ENCODE solution should only require action by NMHSs and global monitoring centres (and eventually archive centres) to incorporate encryption and decryption routines in their messaging centres, and its implementation should be transparent to all other parties. Centres receiving the data would provide raw ENCODE data to satisfy any obligations to provide data to third parties (ships cannot be tracked with ENCODE because the encrypted callsign should change with each report), but for the centre's own

24: We recognize however that no solution, absent more complete encryption of the ship reports, exists to prevent a user from deducing that an isolated ship track in a remote area is from the same vessel. Moreover, no suggestions have been made that anything except the callsign should be transmitted in encrypted form only, because that would make the report useless for users without access to the encryption key. In other words, ship reports containing encrypted callsigns may still be very useful for many meteorological applications.

operational and monitoring purposes it would use the decoded callsigns. However, the practicalities of downstream access to the decrypted callsigns e.g. for individual climate researchers not well connected to NMHSs (and not necessarily readily able to work through their Permanent Representatives to contact WMO in this regard) will need to be explored to ensure that practical data access solutions are available in due course for legitimate research purposes.

f) Governance: Specifics of distribution and management of the key(s) will depend on the eventual choice of a specific encryption method (symmetric or asymmetric). Generally however we propose governance by which all those centres with legitimate requirements to decrypt the callsigns would be granted access to the private key after formally requesting it through the Permanent Representative of their country with WMO. The private key would be made available by the WMO Secretariat to the Permanent Representatives requesting access and signing an agreement not to release it to non legitimate users. Legitime users include data users of WMO and IOC Applications, including in particular those participating in WMO co-sponsored programmes such as the Global Ocean Observing System (GOOS), the Global Climate Observing System (GCOS), and the World Climate Research Programme (WCRP).

A critical issue for the scheme will be detection (if possible) and recovery in the event the method or key(s) are compromised. In general terms we propose that WMO should be able to withdraw key privileges if rules of use are broken. Withdrawal may mean the issuance of a new key(s) to legitimate users and withholding the new key(s) from any violators. Additionally these issues will probably have at least two components:

- Management of the encryption method metadata.
- Management of the ENCODE/DECODE software (and links with the BUFR encode/decode software).

For initial implementation purposes, it is assumed we would simply provide the key(s) (e.g. supposing adoption of the RSA scheme at least the private key; but the availability and visibility of the public key should also be considered) to authorized centres through some “manual” procedure, such as temporarily placing the key on some secured (password protected) ftp site for download by authorized users, and providing those access codes to authorized persons strictly via telephone. As an additional safeguard however, in the event an asymmetric solution is adopted, we also recommend publishing the hash of the public key on a known website and instructing people to verify that hash before installing/using the key (related to issues as discussed in the following item).

g) Additional asymmetric (public-key) security considerations: Compared with the symmetric (e.g. AES) method, the public-key scheme offers the advantage of not needing to secure that key (as opposed to its private key, which should be carefully safeguarded). But it’s important to add that this feature comes at a cost, in that a method is required to distribute the public key in a trustable manner. Otherwise, a malicious entity could distribute their (false) public key, claiming that it was the legitimate one. If the sender was tricked into accepting the malicious public key (and the malicious entity also had the ability to receive or intercept the messages), the malicious entity could then decrypt the messages. Moreover the sender would have no idea that this happened.

Consequently in the asymmetric (public/private) key model, public keys are usually “signed,” so that the signatures can be verified (hence e.g. the use of “Certificate Authority” within the SSL transport model). Thus in the event the asymmetric method is adopted, and a public key will be distributed at large, it is important to consider how that key will be signed/verified. People often see the phrase “public key” and interpret it to mean that the key can be distributed freely with no concerns, but overlooking this key-validity concept has led to many problems. In the general SSL context, distributing private keys to all of the people that potentially need to decrypt the contents of a given encrypted website is very difficult. A tiered Certificate Authority system is used to validate keys, and implementation is complicated (web browsers must have trusted Certificate Authorities embedded, etc.).

h) Software issues: Open-source (Perl) software is suggested as one option for the technical

solution (***Annex 2***). We do note however the potential for national requirements for more "official" encryption software than free Perl modules. Most US governmental encryption, for example, has to be FIPS 140-2 compliant (NIST 2001b). Generally however we suggest these issues can be left to the discretion of each country, based on making a generic recommendation to make sure the software being used is internationally (JCOMM/WMO) certified in some way. On the other hand, it will be useful to have software in different languages (e.g. Java, C++, Perl) to make sure national developers with limited resources can easily implement a portable solution.

i) Developmental testing: Some further preliminary ENCODE testing using actual call signs and one or both candidate methods (AES/RSA) would probably prove useful to flesh out more details in this proposal. At NOAA ESRL, for example, we have access to BUFR libraries both from NOAA/NCEP and from the UK Met Office (licensed).

j) Possible future expanded access issues under WIS/GEOSS: Once the new WMO Information System (WIS) is fully operational and there are connections between it and the Global Earth Observation System of Systems (GEOSS) and the Ocean Data Portal, potentially GTS data will be made available outside of NMHSs, and thus such longer-term expanded access complications need to be borne in mind during implementation of this proposal. At the same time, the decrypted callsigns should not be made publicly available to users outside of the WMO and IOC communities.

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Annex 1 of Annex 1 of Appendix F

Background on VOS Callsign Masking Issues and Impacts

1. WMO/JCOMM background on VOS callsign masking issues

Following concerns expressed by ship owners and masters with regard to ship's identification and position being made available via public websites, the Executive Council (WMO 2006) adopted Resolution 7 (EC-LVIII), which subsequently it kept in force (WMO 2007), and also adopted Resolution 27 (EC-LIX) authorizing Members, under certain conditions, to mask the identification of the ship from Voluntary Observing Ship (VOS) reports being exchanged in real-time.

The Fourth Session (in 2007) of the Ship Observations Team (SOT-IV) established a Task Team on Callsign Masking and Encoding (TT-CME)[25] to start to address these issues, while also taking into account the requirements for quality monitoring and climate applications. SOT-IV also defined four different schemes that permitted to address implementation of Resolution 27, i.e. REAL, SHIP, MASK, and ENCODE (see Table A1). Part of the mandate of TT-CME is to approve national callsign MASK schemes and to ensuring that the proposed scheme does not interfere with the official ITU callsign series of a country or an existing masking scheme.

Table A1. Callsign masking schemes considered by SOT-IV (adapted from ETMC-III/Doc. 4, *Data and Metadata: Operational Flow*).

Label	Description	Comments
REAL	Official ITU callsign of the ship	Traditional scheme; fortunately, many ships are still transmitting their identification this way in FM 13
SHIP	Non-unique identifier: the callsign is unilaterally replaced by the letters "SHIP"	This scheme is implemented by Japan and USA. Countries implementing this scheme at the NMHS level are (i) collecting the raw (non-masked) FM 13 reports in a secured database and provide these data to the monitoring centres or NMHSs as required; (ii) if these data are not provided in real-time they are then performing the real-time Quality Monitoring (QM) on ships that it masks and provide feedback to the appropriate VOS Focal Point; (iii) storing delayed-mode data using **REAL** unless expressed otherwise by ship owners and master; and (iv) developing technical solutions to supply the raw data in collaboration with the receiving centres to ensure there is one agreed delivery method.
MASK	Unique, repeating identifier: the masking identifier is assigned by the NMHS that recruited the ship	Implemented by Australia, and European countries participating in E-SURFMAR. JCOMMOPS is hosting a centralized/historical/password protected **MASK** v **REAL** database. Access to this database is requested by mean of a letter from Permanent Representatives of countries with WMO. Countries implementing **MASK** should supply (i) Quarterly VOF list of **MASK** v **REAL**, and (ii) Monthly update of significant changes to its list of **MASK** v **REAL**.

25: http://www.jcomm.info/index.php?option=com_oe&task=viewGroupRecord&groupID=150.

ENCODE	Unique, non-repeating identifier: derived from encrypting callsign, plus (if necessary to achieve randomness) other elements in the message, e.g. latitude + longitude + date + time	Preferred long-term solution.

The Third Session (in 2010) of the Expert Team on Marine Climatology (ETMC-III) discussed the current status of these issues, and reviewed a preliminary proposal to encode ships' callsigns. ETMC concluded that an ENCODE scheme, possibly also incorporating other reported data elements such as latitude and longitude, was achievable using symmetric encryption (e.g. AES-256). Subsequent discussion however led to renewed consideration of an asymmetric (public/private key) approach, as originally suggested by SOT. Based on the feedback at the ETMC meeting, the Team requested Scott Woodruff to refine an ENCODE proposal to be submitted to the TT-CME. In particular the proposal was requested to include information about the encryption scheme to be used, proposed BUFR descriptor(s) (including bit-length of the descriptors), and recommendations regarding the governance and management of the encoding/decoding keys.

2. Impacts of ship masking for ICOADS

Currently ICOADS utilizes as its primary marine GTS source BUFR data, including attached original message(s) (e.g. FM 13 or FM 18), provided monthly by the NOAA/NCEP. These "dumped" BUFR data are subjected to a "dup-merge" processing at NCEP in which exact duplicates are removed and partial duplicates blended to create more complete BUFR reports, thus a single BUFR message may have attached one or more original messages.

Effective with the NCEP files for December 2007 and onward, because of the introduction during that month of the new SHIP masking procedures by Japan and the US (and since NCEP does not have the mandate to implement selective unmasking based on confidential time-varying lists), all ship reports have their BUFR IDs reset to the string "MASKST." (The attached original FM 13 message(s) also have their ID fields masked out, in this case with a string of X's in place of the original ID field length.) In the future, alternative US or international GTS sources, such as from the NOAA National Climatic Data Center (NCDC), once more thoroughly validated, may alleviate the wholesale masking problem in the NCEP data (e.g. unmasked IDs are left intact in the NCDC source). Also, after a 90-day delay we receive from the NOAA VOS Program, unmasked reports (FM 13) that were originally masked over GTS, which will benefit delayed-mode ICOADS updates.

Annex 2 of Annex 1 of Appendix F

Encryption Technical Details (including prototype Perl symmetric/asymmetric encryption/decryption modules)

As discussed in Section 3 above, two general encryption approaches to implementing the ENCODE scheme have been considered in the development of this proposal: symmetric (secret-key) encryption, and asymmetric (public-key) encryption. In addition to AES (NIST 2001a), 3DES (i.e. Triple Data Encryption Algorithm (TDEA; NIST 2004))[26] is another asymmetric encryption scheme that has been approved by the US National Institute of Standards and Technology (NIST). Besides RSA, other asymmetric implementations also exist, such as GNU Privacy Guard (GnuPG, also known as GPG; http://www.gnupg.org/). Only AES and RSA, however, have thus far been considered in any detail for the development of this proposal.

Table B1 provides a simple example of symmetric (AES-128) encryption and decryption (using two Perl modules), and with a key size of 128 bits (in Table B1 "-keysize => '16'," indicates that keysize is forced to 16 bytes = 128 bits). Similarly, Table B2 illustrates an open-source asymmetric (RSA) encryption/decryption solution (using three Perl modules).

Table B1. Two prototype Perl modules*: (1) implementing symmetric (AES-128**) encryption on the dummy callsign "abcd1234" and then (2) decrypting and printing the same input data. The key in this implementation is generated from the passphrase entered as the "-key" parameter. So it's not literally the key, but the passphrase used to derive it. For our purposes, it is basically the key (as it is what would be distributed to the parties involved.)

(1) Perl module: callsign-aes-cbc-encrypt.pl:

```
#!/usr/bin/perl

use Crypt::CBC;

my $callsign = "abcd1234";
my $passphrase = "Password1234!";

print "Encrypting callsign '$callsign'\n";
$cipher = Crypt::CBC->new( -key => $passphrase,
                           -cipher => 'Rijndael'
                         );
$ciphertext = $cipher->encrypt($callsign);

print "Writing output to local file 'callsign-aes-cbc-encryptedmessage'...\n";
open ENC, ">callsign-aes-cbc-encryptedmessage" or die $!;
binmode ENC;
print ENC $ciphertext;
print "Done\n";
```

26: See also: http://csrc.nist.gov/groups/ST/toolkit/block_ciphers.html.

Table B1 (continued).

(2) Perl module: callsign-aes-cbc-decrypt.pl:

```
#!/usr/bin/perl

use Crypt::CBC;

my $passphrase = "Password1234!";
my $ciphertextfile = "callsign-aes-cbc-encryptedmessage";

$cipher = Crypt::CBC->new( -key => $passphrase,
                           -cipher => 'Rijndael'
                          );

print "Decrypting message stored in file:  $ciphertextfile...'\n";

open FILE, "$ciphertextfile" or die $!;
binmode FILE;
my ($buf, $data, $n);
while (($n = read FILE, $data, 4) != 0) {
        $buf .= $data;
}
close(FILE);

$plaintext = $cipher->decrypt($buf);

print "Decrypted message is $plaintext\n";
print "Done\n";
```

* A Perl “module” is a code designed to perform a specific task and not necessarily included with the main Perl environment, but can be downloaded separately. The main platform we have used so far is Perl (http://www.perl.org/), since it is free and its applications can be run on Windows as well as Unix/Linux/Mac operating systems.

** AES-128 uses a key size of 128 bits (i.e. 16 bytes). The external module also used (Crypt::CBC) can be found at: http://search.cpan.org/~lds/Crypt-CBC/CBC.pm, where the double colon notation is used to identify hierarchy (i.e. the “Crypt” library is the main one, and CBC a sub-library). This cipher block chaining (CBC) module is more general and able to utilize various other encryption algorithms, but “-cipher => 'Rijndael'” selects the AES algorithm.

Table B2. Three prototype Perl modules: (1) generating an asymmetric (RSA) public/private key pair; (2) encrypting the dummy callsign “ABCD1234”; (3) decrypting and printing the same input data.

(1) Perl module: callsign-rsa-keygen.pl:

```
#!/usr/bin/perl
use Crypt::RSA;
$rsa = new Crypt::RSA;

print "Generating 2048-bit key pair as 'callsign-rsa-key.public' and 'callsign-rsa-
key.private'...\n";
($public, $private) = $rsa->keygen(
        Size => 2048,
        Filename => "callsign-rsa-key",
        );
print "Done\n";
```

(2) Perl module: callsign-rsa-encrypt.pl:

```
r/bin/perl
use Crypt::RSA;
$rsa = new Crypt::RSA;

if ( $#ARGV eq 0 ) {

        $key = "callsign-rsa-key.public";
        $message = $ARGV[0];

        print "Encrypting message '$message' with public key '$key'...\n";
        $pubkey = new Crypt::RSA::Key::Public (     Filename => "$key");
        my $output = $rsa->encrypt(Message => $message,Key=> $pubkey)|| die $rsa-
>errstr();
        print "Writing output to local file 'callsign-rsa-encryptedmessage'...\n";
        open ENC, ">callsign-rsa-encryptedmessage" or die $!;
        binmode ENC;
        print ENC $output;
        print "Done\n";
}

else {
        print "\nUsage:  callsign-rsa-encrypt.pl WXYZ1234\n\n";
}
```

Table B2 (continued).

(3) Perl module: callsign-rsa-decrypt.pl:

```
#!/usr/bin/perl
use Crypt::RSA;
$rsa = new Crypt::RSA;

$key = "callsign-rsa-key.private";
$message = "callsign-rsa-encryptedmessage";

open FILE, "$message" or die $!;
binmode FILE;
my ($buf, $data, $n);
while (($n = read FILE, $data, 4) != 0) {
        $buf .= $data;
}
close(FILE);

print "Decrypting '$message' with private key '$key'...\n";
$privkey = new Crypt::RSA::Key::Private->read(Filename => "$key");
my $output = $rsa->decrypt(Cyphertext => "$buf",Key => $privkey)|| die $rsa->errstr();

print "Decrypted message is: $output\n";
print "Done\n";
```

The external module also used (Crypt::RSA) can be found in http://search.cpan.org/dist/Crypt-RSA/lib/Crypt/RSA.pm.

Annex 3 of Annex 1 of Appendix F

Proposed New VOS BUFR Template: Relevant Common Sequence Excerpts

For reference, following are excerpts from the *Marine Template Common Sequences* document (V1; R. Keeley; last update 3 June 2010) showing the fields currently proposed for the new VOS template within these four selected sequences:

3-01-200: Ship information
3-01-202: Location information
3-01-203: Date and time information

These include fields related to callsign or other ship (or buoy) identification, as well as latitude/longitude and the date/time fields. The note below regarding callsign (0-01-011) includes the statement that "…this is where a masked call sign would be recorded," presumably intended to refer to the ENCODE result, but that field is of insufficient length and the result will probably need to be stored in binary. [Note: At a later stage this Annex could also include the proposed new descriptors, including ENCODE output field, encryption method flag, etc.]

Last update: 3 Jun 2010

Notes:
1. Text highlighted in blue are new BUFR descriptors / code tables
2. Text in yellow indicate there is an issue to resolve

[…]

3-01-200: Ship information

F	X	Y	Name	Unit	Scale	Ref value	Data Width (bits)	JCOMM field abbrev.	Note
0	01	079	Unique identifier for this message	Numeric	0	0	33	UID	(1)
0	01	078	IMO ship identifier	CCITT IA5	0	0	80		(2)
3	01	003	Ship's call sign plus motion 0-01-011 identifier 0-01-012 direction 0-01-013 speed	CCITT IA5 Degree true m s^{-1}	 0 0 0	 0 0 0	 72 9 10		(3)
0	04	024	Time period or displacement	Hour	0	-2048	12		(4)
0	01	044	Ship's ground course: the direction the vessel actually moves over the fixed earth and referenced to true north.	m s^{-1}	0	0	10		(5)
0	07	071	Maximum height of deck cargo above summer maximum load line	m	0	0	6		(6)
0	07	072	Departure of summer maximum load line from actual sea level	m	0	-32	6		(7)

Notes:
1. This is an identifier that can be used to track the data throughout its lifetime. Some countries are using a 32 bit CRC calculation to generate a unique identifier. If using the CRC algorithm, input to the algorithm should be the entire data stream beginning with the IMO ship identifier.
2. This is the IMO unique identifier for a ship. It consists of the 3 characters "IMO" followed by the 7 digit Lloyds registry number.

3. This field expands to:
   0-01-011: Ship or mobile land station identifier. Note this is where a masked call sign would be recorded.
   0-01-012: Direction of motion of moving observing platform (note 4)
   0-01-013: Speed of motion of moving observing platform (note 5)
   Note that 3-01-003 is filled only if the platform is a ship. If another type of platform, fill descriptor 0-02-045, or if a data buoy, use 0-02-149.
4. This field indicates the time period over which the direction and speed of motion of the ship has been determined.
5. This field is required for meeting additional requirements for VOSClim
6. Allows for a maximum height of 64 m.
7. When the load line is above sea level, record this as positive. This field is required for meeting additional requirements for VOSClim.

3-01-202: Location information

F	X	Y	Name	Unit	Scale	Ref value	Data Width (bits)	JCOMM field abbrev.	Note
3	01	021	Latitude and longitude 0-05-001 (Lat; high accuracy) 0-06-001 (Lon; high accuracy)	 Degree Degree	 5 5	 -9000000 -18000000	 25 26		(1)
0	08	080	Qualifier for quality class	Code table	0	0	6		(2)
0	33	050	GTSPP quality class	Code table	0	0	4		
0	22	063	Total water depth	m	0	0	14		
1	05	000	Replication of 5 descriptors						
0	31	000	Short delayed descriptor replication factor	Numeric	0	0	1		(3)
0	33	023	Quality of buoy location	Code table	0	0	2		
0	33	027	Location quality class (range of radius of 66 % confidence)	Code table	0	0	3		
0	02	148	Data collection and/or location system	Code table	0	0	5		
0	27	004	Alternate latitude (high accuracy)	Degree	5	-9000000	25		(4)
0	28	004	Alternate longitude (high accuracy)	Degree	5	-18000000	26		(4)
1	04	000	Replication of 4 descriptors						
0	31	000	Short delayed descriptor replication factor	Numeric	0	0	1		(5)
0	08	021	Time significance	Code table	0	0	5		(6)
3	01	011	Date (of position) 0-04-001 (year) 0-04-002 (month) 0-04-003 (day)	 Year Month Day	 0 0 0	 0 0 0	 12 4 6		
3	01	012	Time (of position) 004004 (Hour) 004005 (Minutes)	 Hour Minute	 0 0	 0 0	 5 6		
0	08	021	Time significance	Code table	0	0	5		(7)

Notes:

1. These fields report the location of the platform
2. Set to qualifier = 20 to indicate the quality flag applies to position
3. For buoy reports and if the Argos location system is used, the information in the next descriptors (down to 0-28-004) may be available. If so, the value of this descriptor is set = 1, otherwise it is set to 0. If =0 the data from these descriptors are not present in the data section.
4. If the Argos system is used to determine position (or some other system that produces alternative locations) provide the alternative position here.
5. If the time of observation matches the time of when the position was determined, the value of this is set to 0 and none of the following fields need appear in the BUFR message. This is often the case for fixed or moored platforms.
6. If the time of position differs from the time of observation of the data, set this indicator =”26” and use the next date fields to record the time when the position was determined
7. Set this value = “31” (missing) to cancel the previous value. (Is this necessary?)

3-01-203: Date and time information

F	X	Y	Name	Unit	Scale	Ref value	Data Width (bits)	JCOMM field abbrev.	Note
3	01	011	Date (of observation) 0-04-001 (year) 0-04-002 (month) 0-04-003 (day)	 Year Month Day	 0 0 0	 0 0 0	 12 4 6		
3	01	012	Time (of observation) 004004 (Hour) 004005 (Minutes)	 Hour Minute	 0 0	 0 0	 5 6		
0	08	080	Qualifier for quality class	Code table	0	0	6		(1)
0	33	050	GTSPP quality class	Code table	0	0	4		

Notes:

1. Add a new meaning in this code table. Set 21 = date and time.

Annex 4 of Annex 1 of Appendix F

Conditions for accessing JCOMMOPS database of masked call signs

1. Access to the MASK vs. REAL list shall be restricted to WMO approved subscribers contributing to WMO Programmes or co-sponsored Programmes and with legitimate requirements for:

1.1 Real-time quality monitoring of VOS data;

1.2 Climate database applications (e.g., linking archived MASK observations with REAL WMO Publication No. 47 metadata); and

1.3 National VOS and PMO activities (e.g. provision of monitoring feedback and encouragement to ships; ensuring a ship under consideration for recruitment is not already a member of another national VOF).

2. Requests for access shall be made by means of a letter from the PR of a country to the WMO Secretary-General, who, is consultation with WMO experts and concurrence from the SOT Chair, will grant access.

3. Approved subscribers may include:

3.1 Recognised monitoring centres, including RSMC Exeter, and VOSClim RTMC;

3.2 NMHSs;

3.3 Recognised JCOMM DACs or GCCs;

3.4 National VOS Programme Managers; and

3.5 Port Meteorological Officers.

4. An approved subscriber shall not: (1) disclose, (2) confirm, or (3) otherwise make publicly available; the masking details of any ship or group of ships, without written permission from the Programme Manager implementing the masking scheme.

5. Failure to observe these rules shall result in a loss of access privileges.

_____

Annex 2 of Appendix F

SOT-VI DECISIONS REGARDING THE SHIP MASKING ISSUE
(excerpt of SOT-VI Final Report, Hobart, Australia, April 2012)

6.6 Task Team on Call Sign Masking and Encoding

(The Terms of Reference and membership of the Task Team are detailed on the JCOMM web site[27])

6.6.1 The Chair of the Task Team on Call Sign Masking and Encoding, Mr Graeme Ball (BOM, Australia) reported on the activities of the Task Team during the last intersessional period and follow-up actions from SOT-V. The Meeting particularly reviewed the status of ship masking schemes implemented by Members in line with WMO Executive Council Resolution 27 (EC-LIX).

6.6.2 The major activity of the Task Team during the intersessional period was the development of the **ENCODE** encryption strategy, under the lead of Scott Woodruff. The **ENCODE** strategy was developed as part of a future scheme that will have to be universally accepted by all parties. In particular, the Team agreed that except for the navies, those Members currently using **SHIP** for the real-time distribution of VOS reports on GTS should eventually switch to using **ENCODE**, a solution that will satisfy their concerns while being more acceptable to the quality monitoring centres, and long-term archives. The Team also agreed that those Members currently using **REAL** or **MASK** should be able to continue to do so.

6.6.3 **ENCODE** produces a unique and non-repeating identifier and is derived by encrypting the callsign[28]. This identifier replaces the callsign in BUFR and is inserted – on shore – in BUFR GTS reports by the NMS receiving the original data from the ship for GTS distribution of the data in real-time.

6.6.4 On receipt of an **ENCODE** BUFR message, the receiving agency must be in possession of a decoding key to be able decode the callsign. An agency without the decoding key cannot decode the callsign.

6.6.5 The Team agreed that standard, preferably open-source (non proprietary), software permitting to decode the data shall be made available to end users free of charge. The Team noted that Governance for the management of keys, based on formal authorization from the Permanent Representatives of countries with WMO would have to be proposed and agreed upon.

6.6.6 The Team agreed with the Expert Team on Marine Climatology (ETMC) perspective emphasizing that incorporating un-masked VOS GTS data historically[29] eventually into key climate databases including ICOADS remains a critical requirement to support the research community but also a significant challenge (and not adequately resourced at present).

6.6.7 The TT-Masking also considered a **MASK** proposal from the Korea Meteorological Administration (KMA). KMA was approved to use the **MASK** scheme B2K0000 – B2K9999.

6.6.8 The Team agreed on the following actions:

1. The Team provisionally endorsed the **ENCODE** proposal as an eventual replacement for the **SHIP** scheme, and optionally also for the **MASK** scheme (used exclusively for callsign masking), and requested the Task Team on Callsign Masking and Encoding to liaise with the JCOMM DMPA Task Team on Table Driven Codes (TT-TDC), consult with operational

27: http://www.jcomm.info/sot-tt-masking
28: Originally it was envisioned the ENCODE encryption might require also utilizing other elements in the message in order to introduce “variability, e.g. latitude + longitude + date + time, however the methods that have been reviewed take care of this automatically.
29 : i.e. primarily back to ~Dec. 2007 when masking accelerates in available GTS data

users of the data and GTS routing centres (e.g. AOML/SEAS, NOAA Gateway, ECMWF), Japan, and update the proposal to reflect the SOT preference for option 'b' and to elaborate in more detail the governance regarding the management of the keys (***action; TT-Masking; Aug. 2011***). The TT was also invited to consider whether it would be realistic to propose that all automated systems eventually use MASK.

2. The new BUFR descriptors, templates, and BUFR table entries constituting the proposal shall then be submitted to the CBS Inter Programme Expert Team on Data Representation and Codes (IPET-DRC) for its meeting in Geneva, Switzerland, September 2010 (***action; SOT Chair; Sept 2011***) in the view to have the proposal endorsed by the CBS-XV in 2012 for inclusion of appropriate elements in the WMO Manual on Codes.

3. The Team also requested the TT-Masking to find, or possibly develop, and propose standard software for the encoding and decoding of encrypted callsigns (***action; TT Masking; Sep 2011***).

4. The TT-Masking recommends to replace Hester Viola (former SOT TC) with Mathieu Belbéoch (current SOT TC) and Robert Luke (USA) with John Wasserman (USA) in its membership.

6.6.9 The Team noted that the universally accepted solution – once agreed – may take some time to implement because of required the re-negotiations with the shipping companies in some countries.

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Annex 3 of Appendix F

JCOMM PROPOSAL FOR THE ENCRYPTION OF SHIP'S CALLSIGNS WITHIN BUFR REPORTS

(v 1.00 of 5/4/2012)

Introduction and rationale

Resolution 27 (EC-59) is recommending that Members who, in consultation with ship owners, wish to protect the identity of VOS may implement a callsign masking scheme, as a process which would facilitate open distribution of masked data on the Global Telecommunication System.

Such schemes have therefore been implemented by the JCOMM Ship Observations Team (SOT) to address the ship owners and master's concerns with regard to VOS data exchange for ship security and commercial competitiveness reasons.

The following masking schemes have been proposed:

Scheme	***Definition***	***Comment***
REAL	Official ITU callsign of the ship.	**IMPLEMENTED** The call sign is not masked so this scheme is not addressing the ship owners and masters concerns
SHIP	Letters "SHIP" used in place of the real ship identifier.	**IMPLEMENTED** This scheme is addressing the ship owners and master concerns but the ship's identification completely disappears from GTS reports forcing NMHS to make parallel distribution of unmasked reports to legitimate users in order to allow quality monitoring activities
MASK	Unique, repeating identifier. The masking identifier is assigned by the NMS that recruited the ship.	**IMPLEMENTED** This scheme is addressing the ship owners and master concerns while still allowing quality monitoring activities. However, access to a cross reference list of MASK vs. Callsign identifiers is required to allow access to ship metadata (WMO No. 47) which is based on the normal ITU callsigns
ENCODE	Unique, non-repeating identifier. The identifier is derived from encrypting elements in the message, e.g. callsign + latitude + longitude.	**PENDING** This is regarded as the potential universally accepted solution, which is addressing (i) ship owners and master concerns, (ii) the requirements for quality monitoring, and (iii) allow legitimate users to readily access the ITU Callsign identifier thus the ship metadata.

Per Resolution 27 (EC-59), all Members implementing masking schemes, are recommended to seek long-term solutions, and to continue the trial masking schemes in successive years, unless decided otherwise by the Executive Council, while pending the universal acceptance and implementation of a more suitable solution and the Commission for Basic System migration to

table-driven codes[30].

The proposal

The proposal described herewith is the result of an extensive consultation within JCOMM, in particular through the Ship Observations Team (SOT), and the Expert Team on Marine Climatology (ETMC). Details about the proposal can be found in the following reports:

- JCOMM MR No. 97, Final Report, Seventh Session of the JCOMM Ship Observations Team (SOT), Victoria, Canada, 22-26 April 2013, Section 6.6 (available on the web[31]).
- SOT-7 preparatory document No. 6, Report by the Task Teams, Appendix F and its Annexes (available on the web[32]);
- JCOMM MR No. 94, Final Report, Fourth session of the Expert Team on Marine Climatology (ETMC), Ostend, Belgium, 26 - 28 November 2012, Section 5.4 (available on the web[33]);
- JCOMM MR. No. 84, Final Report, Sixth Session of the JCOMM Ship Observations Team (SOT), Hobart, Australia, 11-15 April 2011, Section 6.6 (available on the web[34]).

Description of the proposal for the encoding of ship observations in BUFR reports

If required by shipping companies where VOS ships are recruited, for ship reports the Ship call sign can be encrypted in BUFR reports according to the following method:

- The normal callsign (i.e. descriptor 0 01 011) shall be encoded with missing value;
- The encryption method shall be indicated using a new descriptor. Initially, it is recommended to use AES Encryption with 256-bit secret key;
- The version of the encryption key that is used shall be indicated using a new descriptor; proposed governance for the management of the key is detailed in the Annex;
- The callsign itself shall be encrypted according to the indicated method, and key version, and coded in BUFR report using a new descriptor.

To do that, it is recommended to create the required new descriptors and update the common sequence 3 01 003 (Ship's call sign and motion) as described in Table 1 below (new fields highlighted in blue):

Table 1: Required new sequence

Sequence	***Descriptors***	***Name***
3 01 003	Ship's call sign and motion	
	0 01 011	Ship or mobile land station identifier Ship's call sign
	0 01 YYY	Encrypted Ship or mobile land station identifier Ship's call sign
	F XX YYY	Encryption method used
	F XX YYY	Encryption key version
	0 01 012	Direction of motion of moving observing platform
	0 01 013	Speed of motion of moving observing platform

30 EC-59 had in mind that the completion of the migration to Table Driven Codes would have included a universally accepted solution on the basis of encrypting ship call signs within BUR reports.
31 Pending at the time of writing this report
32 http://www.jcomm.info/index.php?option=com_oe&task=viewDocumentRecord&docID=10511
33 ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-MR/JCOMM-MR-94-ETMC-4.pdf
34 ftp://ftp.wmo.int/Documents/PublicWeb/amp/mmop/documents/JCOMM-MR/JCOMM-MR-84-SOT-VI.pdf

Table 2 below described the requirements for the new proposed descriptors.

Table 2: Required new descriptors

Name	***Unit***	***Scale***	***Ref. value***	***Data Width (bits)***	***Note***
Encrypted station identifier (ENCODE result - 32 bytes)	Binary	0	0	256	(1)
Encryption method code	Code Table	0	0	8	(2)
Encryption key version	Code Table	0	0	16	(3)

Notes:

5. This assumes use of symmetric (AES-256) encryption with binary output.
6. This proposed new field is an indicator for the encryption method employed, so that as encryption technology changes (and existing methods possibly become insecure), a new ENCODE solution can be adopted, and this indicator will document which method has been used in the given BUFR report, e.g.:
   0 = preliminary encryption method (for testing prior to international adoption)
   1 = first internationally adopted encryption method
7. As the encryption method, and the key version are provided together with the encrypted ship's call sign, this will provide the means of locating a specific archived key (i.e. via a code table to include a version number, and the date and time the key was released, and terminated) at which it was issued by WMO. See also the Annex.

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Annex of Annex 3 of appendix F

Proposed governance for the management of encryption methods and keys

This annex describes the proposed governance for the management of ship's callsigns encryption methods and keys.

The encryption method used shall be public and properly documented by the WMO Secretariat. The encryption method shall be indicated (un-encrypted) in the BUFR reports together with the ship's callsign encrypted value.

While the decryption private key version will be public and documented by the WMO Secretariat together with the documentation of the encryption methods, the access to the key itself will be restricted to legitimate users. Legitimate users include data users of WMO and IOC Applications, including in particular those participating in WMO co-sponsored programmes such as the Global Ocean Observing System (GOOS), the Global Climate Observing System (GCOS), and the World Climate Research Programme (WCRP).

Encryption methods, and keys shall be proposed by the WMO Secretariat in compliance with the encryption scheme, and in consultation with relevant CBS experts (e.g. the Chair of the CBS Inter-Programme Expert Team on Data Representation Maintenance and Monitoring (IPET-DRMM)). Encryption keys shall normally be updated on a yearly basis.

WMO shall keep a record of the encryption methods used and their metadata as well as the different versions of the secret keys. It shall also record the periods during which these have been in operational use and effective. Additionally, WMO should provide public access to available encrypting and decrypting software.

All those centres with legitimate requirements to decrypt the ship's Callsigns shall be granted access to the private key after formally requesting it through the Permanent Representative of their country with WMO, and signing an agreement not to release it to third parties.

The Permanent Representatives shall routinely provide the Secretary General of WMO with the list of legitimate users in his/her country.

The Secretary General in turn will provide access to the private key the legitimate users through some "manual" procedure, such as temporarily placing the key on some secured (password protected) ftp site for download by them, and providing those access codes to the authorized persons strictly via telephone.

To allow for the historical use of the data by all users, portions of the WMO record of encryption keys shall be made public after a period of two years.

A critical issue for the scheme will be detection (if possible) and recovery in the event the method or key(s) are compromised. In general terms, WMO shall have the authority to withdraw key privileges if rules of use are broken. Withdrawal implies the issuance of a new key(s) to legitimate users and withholding the new key(s) from any violators.
