WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

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

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VOS DEVELOPMENTS

(Submitted by Sarah North (United Kingdom))

Summary and purpose of the document

This document provides information on the VOS developments, including (i) Electronic logbooks, (ii) VOS meteorological instruments, and (iii) the status of VOS automation.

ACTION PROPOSED

The Team will review the information contained in this report, and comment and make decisions or recommendations as appropriate. See part A for the details of recommended actions.

Appendices: **A.** Status of VOS using Electronic Logbook Software
B. Status of VOS Automatic Weather Stations

- A - DRAFT TEXT FOR INCLUSION IN THE FINAL REPORT

8.3.1 Electronic logbooks

Electronic Logbook Status

8.3.1.1 The Panel recalled that the VOS Panel has been working to increase the number of e-logbooks. The use of electronic logbook software eliminates the need to digitise data in traditional hardcopy logbooks and helps to increase the quality of the data due to their built in quality checks. Moreover the software avoids the need for observer to have a detailed knowledge of the WMO codes.

8.3.1.2 The Panel noted that, despite a gradual rise in the provision of e-logbook software on observing ships over the last decade, there had been a disappointing fall in numbers over the last year. Information on the reported status of e-logbooks, derived from annual VOS reports at the end of 2014, is included in **Appendix A**.

8.3.1.3 It was recognised that there were several possible reasons for this decline. Firstly the figures are derived from information submitted in national VOS reports and unfortunately several national VOS operators had again failed to submit their reports. As a consequence numbers had, in some cases, to be estimated based on previous years submissions. Secondly the plans by some NMS to migrate to automatic weather systems appear to be having gradual impact on the size of national VOS fleets. In addition it was known that some VOS Operators were rationalising the composition of their national fleets by focusing mainly on the higher quality VOSClim ships.

8.3.1.4 There are three main types of electronic logbook software currently in use on VOS – OBSJMA developed by the JMA, Amver/SEAS developed by NOAA, and TurboWin developed by KNMI in cooperation with E-SURFMAR. However the Panel noted that NOAA's National Weather Service had recently made a policy decision to transition their VOS to the use of TurboWin software, as a replacement for Amver/SEAS. The Panel welcomed this decision and noted from the United States VOS report that well over a hundred of their observing ships had already moved over to using TurboWin software.

8.3.1.1 Electronic Logbook Developments

8.3.1.1.1 The Panel reviewed current initiatives for the enhancement of e-logbook software programs. In particular it was noted that version 5.5 of the TurboWin software was presently being beta tested. A key feature of the new version will be the facility to send messages using the E-Surfmar #101 dataformat (details available at the E-SURFMAR website[1]) which will allow the easy translation of incoming messages to the higher resolution BUFR format prior to circulation on the GTS.

8.3.1.1.2 Another significant development was the TurboWin+ software which is also being beta tested prior to formal release, and which is already available for download from the KNMI website[2]. The Turbowin+ software can be used in the same stand-alone version as the traditional TurboWin software, and is already being trialled on more than thirty observing ships. Whilst the TurboWin+ software doesn't include as many of the add-ons that are available in the traditional TurboWin software it incorporates several important new features , including the ability to

- be used in Web mode to send observation directly via the internet to the NMS server
- display pressure tendency graphs and data when connected a suitable barometer (i.e. currently a Vaisala PTB330 or PTB220 MintakaDuo barometer)

1 http://esurfmar.meteo.fr/doc/o/vos/E-SURFMAR_VOS_formats.pdf
2 http://www.knmi.nl/turbowin/

- interface with the new EUCAWS (European Automatic Weather Station) shipborne AWs system to display the measured sensor parameters, and allowing the observer to add visual observations to the measured values
- also run on Linux and Mac OS
- make and submit AMVER reports
- check the ship observation position on Google maps when the internet is available
- to be updated remotely via the internet when available

8.3.1.1.3 The Panel further noted that there had been a gradual growth in the number of ships using TurboWeb since it was first trialed back in 2010. This method of reporting is of course only available to ships that have internet access and suitable bandwidth, and where the parent ship owner has agreed to its use on board. In this respect VOSP Chair advised that one major UK based shipping company had recently agreed that the TurboWeb software could be rolled out to all their participating VOS (more than 20 ships)

8.3.1.1.4 A major advantage of the TurboWeb approach is that any updates to the software can be made remotely thereby avoiding the need for ships officers or visiting Port Meteorological Officers (PMO's) to install new versions on the ships computers. It therefore overcomes the onboard IT security issues that can present a problem for PMOs. The Panel noted that provided Java 7 is installed on the host computer the TurboWeb software would run from a specific link[3] on the KNMI website. It had been designed to work on a variety of computers (e.g. Windows, Linux, Mac, Solaris). Whilst observations can immediately be prepared and submitted, the Panel further noted that new users would receive a return message requiring them to add their call signs to the white list currently maintained at KNMI.

8.3.1.1.5 Recognising the advantages of moving over to web-based observing systems the Panel encouraged VOS Operators to liaise with ship owners and managers with a view to increasing the use of TurboWeb on suitable observing ships (***action; VOS Operators; ongoing***).

8.3.1.1.6 The Panel noted that TurboWin software also allowed observation data to be transmitted in a half-compressed format. This necessitated the use of a dedicated three figure Inmarsat Special Access Code (SAC) which the national VOS operator will need to set up prior to use. The raw messages are sent via Inmarsat-C (usually via Burum LES) and are processed at Meteo-France for insertion on the GTS. The Panel recognised that the use of this half compressed system could help reducing the currently unfair cost burden borne by the small number of NMS that currently host SAC 41 Land Earth Stations. The Netherlands VOS are already using this method.

8.3.2 VOS meteorological instruments

8.3.2.1 The VOSP Chair drew the Panel's attention to number of issues that were requiring VOS operators to review the instruments supplied to their national manned VOS fleets. In particular the ban on the sale, manufacture, import and export of products containing mercury arising from EU regulations, and from the Minamata Convention, (para 3.1.11 of this report refers) will inevitably impact on many current VOS operators that currently still use mercury thermometers either in whirling psychrometers or in dedicated marine screens.

8.3.2.2 The Panel recognised that the supply and stocks of mercury thermometers were expected to diminish in a relatively short space of time, and that the cost of continuing to use of mercury in glass (MiG) thermometry was already starting to increase as a consequence. Many VOS operators were therefore having to source, and rollout, alternatives as a matter of some urgency.

8.3.2.3 The VOSP Chair reported that trials of alternative organic spirit thermometers in the UK against the standards currently used for MiG thermometers had been inconclusive. Given the cost

3 http://www.knmi.nl/turbowin/webstart/turbowin_jws.jnlp

and inevitable breakages of glass thermometers it was expected that many VOS operators who currently use MiG thermometers would migrate to the use of digital hand held temperature/humidity sensors. Some meteorological services (e.g. DWD) had already trialled such systems and were rolling out such hand held devices to their manually reporting ships.

8.3.2.4 The Panel also agreed that the need to continue to equip manned VOS with traditional marine barographs was also in question now that programs such as TurboWin+, and the Australian Bureau of Meteorology's Marine Barograph software, have the facility to electronically display a barograph pressure trace.

8.3.2.5 Furthermore, higher quality barometers (e.g. the Vaisala PTB 330) which have the ability to display the pressure tendency on a built-in LCD display, were increasingly being rolled out to VOS, thereby avoiding the need to supply traditional barographs.

8.3.2.6 Whilst the Panel appreciated that most ship captains would like their ships to be equipped with a barograph, such equipment was quite often prone to failure in service. In addition there was the ongoing cost to VOS Operators of supplying barograms charts and pens. The Panel also noted that most, but not all, VOS operators set their barographs to read Mean Sea Level pressures. This can, occasionally, result in pressure bias errors when an observer incorrectly enters the pressure read from the barograph into the electronic logbook software (i.e. when the barometer itself is set to station level).

8.3.2.7 The Panel also questioned the value to forecasters of reporting the traditional 3 hourly tendency value required by the WMO Ship code now that the vast majority of VOS data was being submitted hourly via AWS systems.

8.3.2.8 The Panel recognised that the changes being made to VOS equipment in the next few years would inevitably impact on the climate record. This therefore highlighted the need to maintain good records of the observing practices employed by national VOS operators. In this regard the Panel recalled that the Task Team on Instrument Standards (TT-IS) was already tasked with compiling of information on existing activities, procedures and practices within the JCOMM relating to instrument testing, standardization and intercalibration as well as the standardization of observation practices and procedures. A list of the national instrument standards guidelines is attached to the TT-IS report.

8.3.2.9 However many of the national documents relating to VOS observing practices are in need of review. For instance the Met Office's Marine Observers Handbook, which is included in softcopy format within the TurboWin program, had not been revised since 1995 and needed updating to include information on the new instruments, current observing practices and their associated operational procedures and practices. Accordingly the Panel requested its members to review, and update as necessary, the content of their national observing guidance and documentation (***action; VOSP Members; asap & ongoing***).

8.3.2.10 In considering this issue the Panel note that the Task Team on Instrument Standards was already considering where the lists of current national observing practices should be maintained and were considering listing them on a webpage, as this would be more helpful and effective for the users of such information. The Task Team therefore invited the SOT Technical Coordinator, in liaison with the Chair TT-Instruments and the WMO Secretariat, to consider the feasibility of creating appropriate online tools to collect and display information on national observing practices, and also on the standard equipment used, on the JCOMMOPS website (***action; M. Kramp; SOT-9***).

8.3.3 VOS automation Status

8.3.3.0.1 The Panel once again recognized the importance of enhancing the automation of all aspects of shipboard procedures, from observation through to message transmission using readily available software and hardware. In this respect the VOS Panel recalled that it had previously recommended that Members should increasingly implement automated systems on their fleets, while at the same time recognising the requirements expressed by the Expert Team on Marine Climatology (ETMC) that traditional variables which can only be observed manually should continue to be submitted.

8.3.3.0.2 The VOSP Chair reported on the present status of VOS Automation. According to VOS national reports received in 2014 there were now 19 countries with AWS systems installed on their national VOS. This was a similar figure to that reported at the last session. However the number of deployed shipborne AWS had risen to 392 systems (an increase of approximately 60 systems since the last session). Information on the reported status of shipborne AWS derived from annual VOS reports at the end of 2014, is included in **Appendix B**.

8.3.3.0.3 The VOSP Chair advised that the number of AWS systems reported in the VOS national reports was inconsistent with the number of automated systems reported in the E-SURFMAR metadata database (257 systems listed in March 2015). She therefore reiterated the ongoing action placed on VOS Focal Points to ensure that their WMO Pub47 metadata records are maintained up to date.

8.3.3.0.4 The Panel noted that almost half the number of AWS systems reported by Members in their VOS reports had the facility to manually add the traditional visual observations to the measured automated observations. However the number of visual reports actually being added by observers to the automated reports was still disappointing. It was hoped that this trend would be reversed when EUCAWS links to the TurboWin+ software which will be more familiar to observers.

8.3.3.0.5 The Panel noted with some concern that most of the established major VOS operators now had plans to automate their national fleets and in some cases were planning to substantially reduce the size of their manually reporting VOS fleets. Because many of these automated systems were likely to fall into the Supplementary AWS VOS Class (i.e. without the ability to manually add visual data) there were potentially serious implications for the future of the VOS Scheme and for continuity of the climate records.

8.3.3.0.5 The Panel reviewed initiatives for the enhancement of automation, including on the E-SURFMAR AWS developments, and other AWS rollout systems/plans such as AMOS, as detailed in paragraphs 8.3.3.1 to 8.3.3.3 below.

8.3.3.1 E-SURFMAR- EUCAWS Developments

8.3.3.1.1 Mr Henry Kleta (Germany) reported on the extensive work that had been undertaken by E-SURFMAR Members to develop the new E-SURFMAR Shipboard AWS system, now named EUCAWS (European Common AWS), but being marketed under the name Neptune by the manufacturer Sterela.

8.3.3.1.2 The EUCAWS system was developed after lengthy discussions with the E-SURFMAR Membership which had resulted in detailed design specifications and recommendations. In its normal mode of operation the system requires no intervention from the ships staff, although visually observed parameters can be added by the observer using the TurboWin+ program.

8.3.3.1.3 EUCAWS essentially consists of a processing unit, an satellite position system and a two way Iridium satellite communication system providing global coverage. A service unit allows PMO’s or technicians to check and configure the system, while a Land-Based Monitoring Facility enable shore based staff to configure the system remotely using Iridium two way communication. The system has been designed to work with a wide range of different sensor types.

8.3.3.1.4 Tendering documents for the EUCAWS system were issued in mid 2012 and following detailed evaluation of the tenders it was decided to establish a Framework Agreement with the chosen manufacturer. Under this agreement participating E-SURFMAR Members are able to purchase the S-AWS systems through national contracts.

8.3.3.1.5 Mr Kleta advised the panel that under the agreement Sterela had built three prototype systems and that following the successful Factory Acceptance Tests. He reported that the prototype systems were now undergoing Ship board Acceptance Trials; the first prototype system having been installed on the Brittany ferry 'Amorique' in January 2015.

8.3.3.1.6 The Panel noted that expressions of interest to purchase as many as 300 E-SURFMAR EUCAWS systems had already been received from several European National Meteorological Services (notably Germany, France and the Netherlands).

8.3.3.2 AMOS Developments

8.3.3.2.1 The VOSP Chair reported on the roll out status of Met Office's Autonomous Marine Observing System (AMOS). She explained that more than 40 systems had now been installed on UK VOS. Most of the systems had been installed on ferries and coastal vessels operating around the UK coast and in near continental European waters. However systems had also been on several research and survey ship operating in the data sparse areas of the Southern Ocean.

8.3.3.2.2 In the coming year it was planned to install a further fifteen AMOS systems and that a target of 100 AMOS systems had been set by the Met Offfice. Up to now the system has essentially been a trial system but now that it had been proven in service it was planned to make it a fully operational system later this year and issue it with an internal production license. To do this the procedures and processes necessary for dealing with fault and asset management were being developed, and documented work instructions were being prepared.

8.3.3.2.3 It was noted that there were currently two variants of the AMOS system – a stand alone solar powered version that required no links to the ships systems, and a 24 volt that only required connection to the ships power supply. Whilst both systems were now operating well the preference was to install 24 v version, and to increasing move over to using such systems in the future. However several shipowners had expressed a preference for the solar variant.

8.3.3.2.4 Plans were also being made to develop a Mk2 version of the AMOS which would be able to connect, either wirelessly or via cable, to a visual display on the ships bridge. Many captains had expressed a wish to have such display information available to them to assist with their shipboard and navigational operations.

8.3.3.2.5 At present the raw CSV data from the AMOS systems was being processed by a third party and converted into FM-13 ship code. However the Met Office was in the process of developing a new marine data gateway which would soon permit the raw data to be processed within the Met Office and converted into BUFR format for circulation to Members via the GTS.

8.3.3.3 Other AWS Developments

8.3.3.3.1 The VOSP Chair pointed out that a number of other shipboard AWS systems had been reported by Members in their national VOS reports. Some of these related to well established systems such as the BATOS, AVOS, BAROS. MAWS and MILOS. However there were several systems reported that were not so well known internationally. She therefore stressed the benefits of exchanging information on ship AWS systems and to provide documentation on their design and operation and the algorithms used in their software. The Panel therefore requested its members who operate ship AWS systems on their VOS to keep the Panel and the TT on Instrumentation informed of any new AWS developments and to report on their system developments at the next session (***action; VOS Operators; SOT-9***).

8.3.3.4 The meeting encouraged the VOS Operators, in liaison with ship operators and managers, to start using web-based TurboWeb electronic logbooks on suitable observing ships (***action; VOS Operators; SOT-9***).

- B - BACKGROUND INFORMATION

- **Electronic logbook software**

  A Table and Graph showing the status and growth of e-logbooks installed on VOS over the last decade is given in **Appendix A**

- **Automation and electronic logbooks**

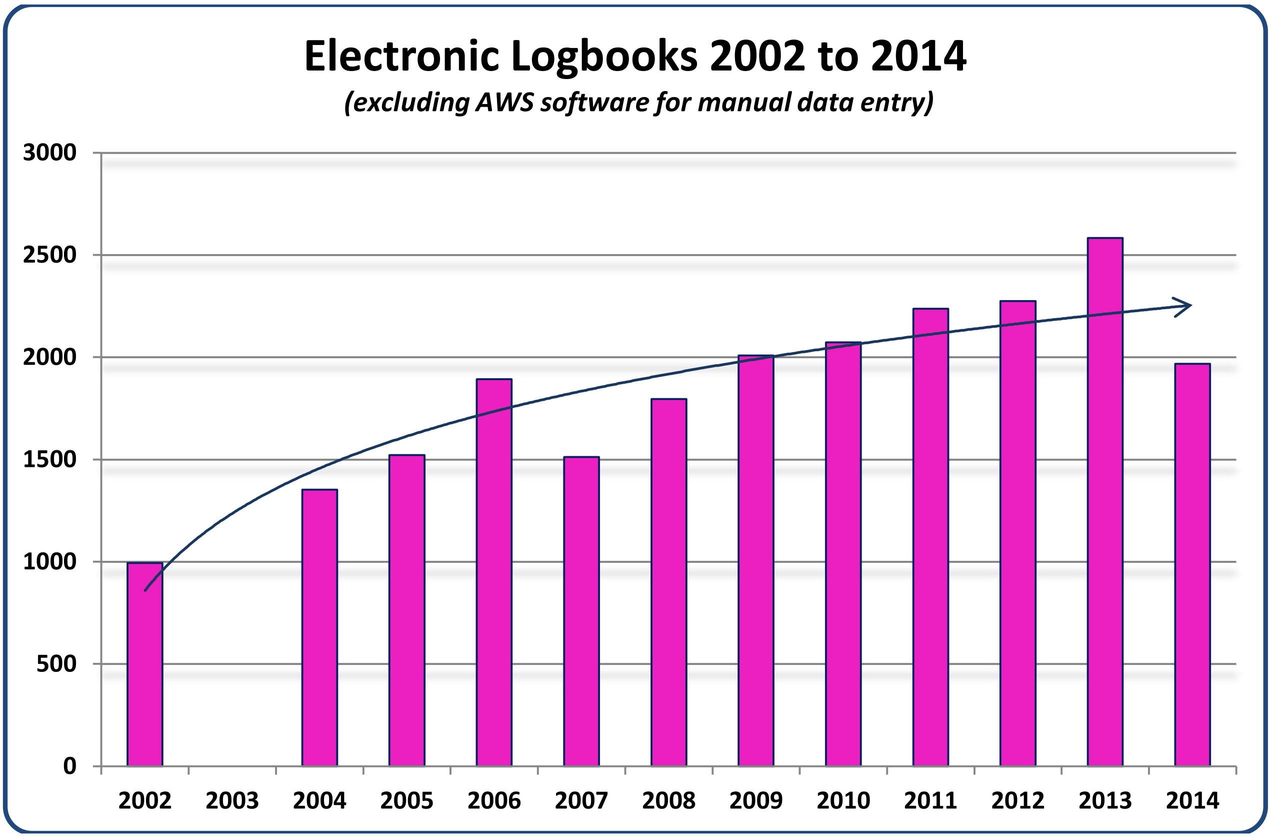
  A Table and Graph showing the status and growth in shipboard AWS systems over the last decade are included at **Appendix B**

Appendices: 2

APPENDIX A

STATUS OF VOS USING ELECTRONIC LOGBOOK SOFTWARE
(excludes AWS software for manual data entry)

Country	Electronic Logbook type	Number of Ships *(@ 31 December)*											
		2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	TurboWin	33	41	50	51	64	61	58	57	72	64	69	57
Canada	TurboWin	-	-	-	-	-	-	-	2	2	1	1	(1)
Chile	TurboWin										10	10	(10)
Croatia	TurboWin	3	4	3	7	(7)	(7)	(7)	(7)	-	-	-	
Denmark	TurboWin	-	-	-	32	0	-	-	-	-	-	-	-
France	TurboWin	-	7	6	7	10	4	4	2	3	2	1	2
Germany	TurboWin	315	412	556	600	709	730	780	800	825	695	637	551
Greece	TurboWin	2	0	0	0	1	3	1	4	3	2	2	2
Hong Kong	TurboWin	-	-	1	2	2	2	2	3	22	34	44	52
India	TurboWin	-	21	28	33	(33)	(33)	(33)	(33)	-	40	(40)	(40)
Indonesia	TurboWin									-		12	(12)
Italy	SEAS										-	7	9
Ireland	TurboWin	-	-	-	-	-	-	-	2	2	2	(3)	10
Japan	OBSJMA	-	49	61	70	74	95	102	100	141	129	162	171
Netherlands	TurboWin	200	259	198	195	193	195	185	172	112	96	97	93
	TurboWeb/ TurboWin+	-	-	-	-	-	-	-	-	-	6	5	5
New Zealand	TurboWin	0	12	15	22	20	19	22	24	25	26	25	23
Poland	TurboWin	-	-	-	-	-	-	-	61	-	-	-	-
Singapore	TurboWin	-	-	2	3	1	1	1	(1)	-	7	-	7
South Africa	TurboWin	5	5	8	(8)	8	14	14	19	15	17	-	15
Sweden	TurboWin	-	-	-	-	-	1	1	3	20	-	20	(20)
United Kingdom	TurboWin	82	104	147	241	261	286	272	276	268	263	263	248
	TurboWeb	0	0	0	0	0	0	0	0	0	1	1	2
United States	AMVERSEAS	353	439	447	622	129	344	524	507	722	849	1115	486
	TurboWin+	-	-	-	-	-	-	-	-	-	-	-	27
	TurboWin	-	-	-	-	-	-	3	-	5	30	67	122
	TurboWeb	-	-	-	-	-	-	-	-	-	-	2	2
TOTAL		**993**	**1353**	**1522**	**1893**	**1512**	**1795**	**2009**	**2073**	**2237**	**2274**	**2583**	**1967**


Electronic Logbooks 2002 to 2014
(excluding AWS software for manual data entry)
3000
2500
2000
1500
1000
500
0
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014

APPENDIX B

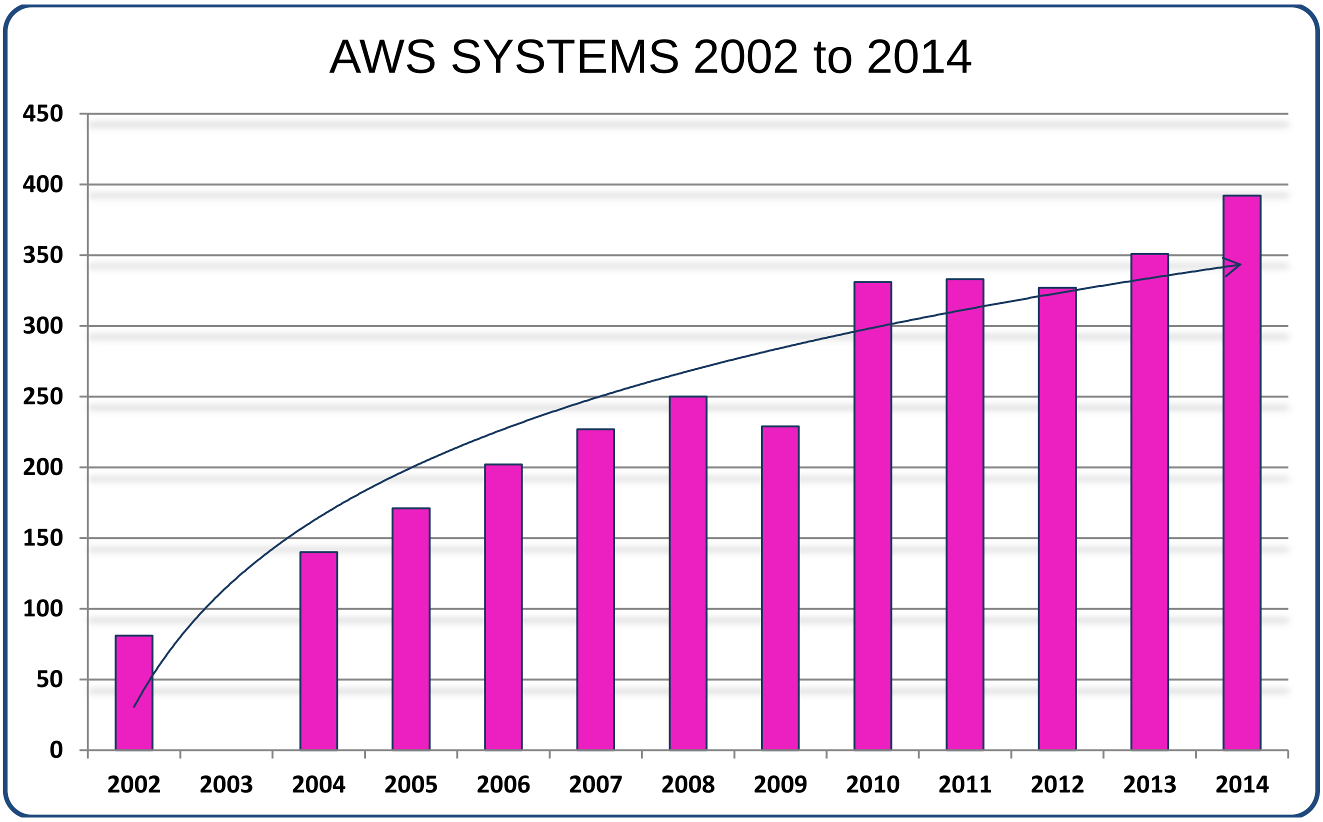
STATUS OF VOS AUTOMATIC WEATHER STATIONS

(derived for information submitted in SOT/VOS National reports)

Country	Type of AWS	Method of Comms	Manual Entry Facility	Number of Ships with AWS *(@ 31 December)*											
				2002	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Australia	Vaisala Milos 500 AWS	Inmarsat C (Data Mode)	Yes	9	11	10	8	9	9	8	8	8	6	6	5
	TECHSAS/ Other	Inmarsat Fleet Broadband	No	-	-	-	-	-	-	-	1	1	1	1	0
Brazil	VAISALA Maritime Observation System MAWS410	(not known)	No						-		4	6	6	(6)	6
Canada	AVOS – AXYS Technologies	Inmarsat C	Yes	13	14	14	39	41	45	35	18	4	2	-	-
		Iridium	Yes	-	-	-	-	1	1	17	35	48	49****	52	(52)
China	*DJQ-1*	BDS	No	-	-	-	-	-		-	33	(2)	2	(2)	15
	XZC2-2SA	Inmarsat C CDMA,BDS	Yes	-	-	-	-	-		-	12	(12)	12	(12)	11
	ZZ6-5	GPRS	No												5
	XZC5-1	(non real time)	Yes												5
	ZQZ-A/ZQZ-C II-Pro	GPRS	No												44
	XZC2-2SC	Inmarsat C CDMA,BDS, BeiDou nav satellite	Yes	-	-	-	-	-		-	-	(36)	36	(36)	8
	XZC6-1	Inmarsat C CDMA, BDS, BeiDou nav satellite	Yes	-	-	-	-	-		-	35	(17)	17	(17)	18
Croatia	BAROS	Iridium SBD	No									1*****	1*****	1*****	1*****
Denmark	BATOS	Inmarsat C (Data Mode)	Yes	-	-	-	2	*****	*****	*****	*****	*****	*****	*****	
Ecuador	Vaisala 101C	Tarjeta	Yes	-	-	-	-	-	-	-	-	-	-	-	1
EUMETNET	BATOS	Inmarsat C (Data Mode)	Yes	-	-	-	-	5	5	6	8	10	10	11	11
	BAROS	Iridium SBD	No					0	4	9	13	15	16	17	17
France	BATOS	Inmarsat C (Data Mode)	Yes	19	30	39	45	48	54	56	58	56	58	58	57
	Mini BATOS	Inmarsat C (Data Mode)	No		1	2	3	3	1	-	-	-	-	-	-
	Mercury	Iridium	Yes	-	-	-	-	-	-	-	-	-	-	-	2
	MINOS	Argos	No		6	7	8	8	7	8	7	6	5	4	3
	BAROS	Iridium	No	-	-	-	-	1	-	-	-	-	-	-	0
Germany	Vaisala Milos 500 AWS	Meteosat DCP	No	23	21	21	17	18	17	16	17	17	17	16	16

	AbWst Mk2	Email	No	-	-	-	-	-	-	-	-	-	-	3	2
	Ships' own data logger	Inmarsat/ Iridium	Yes	-	-	-	-	-	2	2	2	2	2	-	-
Hong Kong China	*AMOS*	Iridium	No	-	-	-	-	-	-	-	-	-	-	1¥	1¥
	Metocean deck drifter	Iridium	No	-	-	-	-	-	-	-	-	-	-	1	1
Indonesia	TECHSENSE MET	Inmarsat/Thuraya	No								(6)	6		12	(12)
	PROJEX DX4 PRO	GPRS	No								(1)	1	(1)	-	-
Ireland	Vaisala Milos AWS	Meteosat	No	1	1	1	1	1	1	-	-	-	-	-	-
	BATOS	Iridium	No	-	-	-	-			1	2	-	-	2*****	-
Italy	BAROS ++	Iridium	No										3*****	3*****	3*****
	BAROS	Iridium	No										3*****	6*****	6*****
Japan	Integrated System for Marine Met Observation (Koshin Denki Kogyo Co)	Inmarsat (4) MTSAT(2)	Some	13	12	13	9	9	9	9	6	6	6	6	5
	Weather Observation System (Nippon)	Inmarsat C	Some	-	-	-	4	5	5	6	6	6	5	5	5
	SOAR - Shipboard Oceanographic & Atmospheric Radiation (Brookhaven National Laboratory)	Inmarsat C	Yes	-	-	-	1	1	1	1	1	1	1	1	1
	Ogasawara Keiki Seisakusho Co (Japan)	Inmarsat	No	-	-	-	3	1	1	-	-	-	-	-	-
	JRCS MFG. Co. Ltd (Japan)	Inmarsat F	No	-	-	-	-	1	1	-	-	-	-	-	-
New Zealand	Sutron 9000RTU	MTSAT	Yes	1	1	1	1	1	1	1	1	1	1	1	1
	mSTAR-SHIP	GPRS Cell	No	-	-	-	-	1	1	1	1	1	1	1	1
Norway	AWS	VSAT	some	-	-	17	17	18	16	(15)	(15)	(15)	(5)	(5)	(5)
Portugal	BAROS ++	Iridium	No	-	-	-	-	-	-	-	-	-	-	1*****	1*****
Russia	GM6	Inmarsat C	Yes	-	38	(38)	(38)	(38)	(38)	0	0	0	0	-	
South Africa	Vaisala Milos 520	Inmarsat C	Yes	-		1	-1	1	1	1	1	1	2	(2)	2
Spain	Vaisala MAWS 410	Inmarsat C	Yes	1	1	(1)	1	1	1	1	1	1	1	(1)	(1)
United Kingdom	Automet	Inmarsat	No	1	1	1	1	1	0	0	0	0	0	0	0
	MINOS – GP	Argos	No	-	-	1	2	6	5	5	5	3	2	2	2
	MINOS-GPW	Argos	No	-	-	1	2	1	1	1	1	1	1	1	1
	BATOS	Inmarsat C (Data Mode)	Yes	-	-	-	1	3	3	2	5**	4**	4**	1	1
	AVOS	Inmarsat	Yes	-	-	-	-	1	1***	0	0	0	0	0	0

	Metpod	Iridium	No	-	-	-	-	-	1	1	0	0	0	0	0
	Metocean Deck Buoy	Iridium	No	-	-	-	-	-	2	2	2	1	0	0	0
	AMOS - Automated Marine Observing System (Met Office)	Iridium	No	-	-	-	-	-	-	-	-	21	33	37	39
United States	SEAS-Version 8.00/6.57 Autolmet NOAA SCS (Science Computing System) Type 1	VSAT Email	Yes	-	3	(3)	0	3	16*	25	9	12	12	10	7
	SEAS-Version >9.1 Autol met NOAA SCS (Science Computing System) Type 2	VSAT Email	Yes	-	-	-	-	-	-	0	0	0	0	5	6
	NOAA SCS Type 3 (developed by Alaska region)	Email	No								8	3	3	0	-
	Non NOAA (developed by Alaska Region)	Email	No	-	-	-	-	-	-	-	-	7	7	7	-
	Integrated - using no e-logbook	Email	No												24
	Other ship owned AWS systems	Email	Yes	-	-	-	-	-	-	-	12	5	6	11	-
TOTAL AWS SYSTEMS				**81**	**140**	**171**	**202**	**227**	**250**	**229**	**331**	**333**	**327**	**351**	**392**


AWS SYSTEMS 2002 to 2014
450
400
350
300
250
200
150
100
50
0
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014