WORLD METEOROLOGICAL ORGANIZATION

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (OF UNESCO)

JOINT WMO/IOC TECHNICAL COMMISSION FOR OCEANOGRAPHY AND MARINE METEOROLOGY (JCOMM)

SOT-7/ Doc. 9.1.1 (21.03.2013)

SHIP OBSERVATIONS TEAM (SOT)

ITEM: 9.1.1

Original: ENGLISH

SEVENTH SESSION

VICTORIA, CANADA, 22-26 APRIL 2013

REGIONAL SPECIALISED METEOROLOGICAL CENTRE (RSMC), EXETER, VOS **MONITORING REPORT**

(Submitted by Colin Parrett (United Kingdom), RSMC Exeter)

Summary and purpose of the document

This document provides information on the VOS data quality monitoring conducted by the Regional Specialized Meteorological Centre (RSMC) operated by the United Kingdom Met Office in Exeter.

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. Met Office on-line monthly VOS suspect list for February 2013

- Current criteria for monthly monitoring of marine surface observations
- C. Proposed criteria for monthly monitoring of marine surface observations
- Timeliness of VOS observations received at the Met Office, February 2013
- Met Office on-line time of receipt statistics for individual ships, February 2013 E.
- F. Met Office on-line time of receipt statistics for national fleets, February 2013
- Scheme for ranking VOS ships by quantity and quality of reports

- A - DRAFT TEXT FOR INCLUSION IN THE FINAL REPORT

9.1.1 - Regional Specialized Meteorological Centre (RSMC) Exeter VOS monitoring report

- 9.1.1.1 Ms Sarah North (United Kingdom) reported on the activities of the Regional Specialized Meteorological Centre (RSMC) Exeter, acting as CBS Lead Centre for monitoring the quality of surface marine observations. It routinely produces monthly and biannual quality reports as well as providing essential feedback to VOS operators regarding the quality of the data delivered by VOS ships.
- 9.1.1.2 The Met Office (RSMC Exeter) continues to compile lists of ships that have produced suspect observations each month (see Appendix A), which are available via the Met Office web site¹ and are also sent to the WMO Secretariat.
- 9.1.1.3 Following action 102 from SOT-6, the Met Office agreed that the criteria for labeling ships as 'suspect' should be substantially tightened for ships that report with automatic observing systems, because these systems are seen to be more reliable and less prone to errors than manual observing systems. Due to steady improvements in the background forecasts, the criteria for ships with manual observing systems should also be tightened slightly. The Team agreed that the monitoring criteria should be set at the values shown in Appendix C. To facilitate the separate monitoring of 'automatic ships' the station type ("ix") should be included in all reports; the alternative of using "atm" from the ship metadata would require changes at the Met Office, which may delay implementation of the separate monitoring of manual and automatic ships.
- 9.1.1.4 The Met Office also produces monthly lists of monitoring statistics for all VOS, which are sent to the VOS focal points and are also available from the Met Office web site. To maintain up to date lists of ships, the Met Office advised that it was using the latest data downloaded from the online E-SURFMAR metadata database, rather than from the WMO Pub47 database. In addition, the Met Office uses the masked call sign data available from the JCOMMOPS FTP site³.
- 9.1.1.5 It was noted that the SHIP masking scheme implemented by JMA in 2007 continues to prevent the Met Office from monitoring data from individual Japanese and possibly some US ships. Although the Met Office is able to collect data with real call-signs from JMA's FTP server, it is unable to route the data to its meteorological database due to problems with guaranteeing data security. In January 2013 there were 23457 reports of pressure from VOS with call-sign "SHIP", compared to just 3222 reports in March 2012, with the large increase being due to more automatic reports (now accounting for about 85% of the total) .
- 9.1.1.6 Timeliness information for VOS reports received at the Met Office is also made available from the observation monitoring web site² (see Appendices D and E). This information shows that the majority of ship reports continue to be received promptly, with about 70% received within 15 minutes and 90% within 60 minutes of the observation time. Timeliness information for individual ships is also available from the website. The Team agreed that the timeliness information for national fleets should be split into two, for automatic and manual reports.
- 9.1.1.7 The Team noted that the Met Office had made monthly VOS ranking scheme results available on their website for all VOS and for the national VOS fleets (action 101 from SOT-6). The monthly scheme is similar to the annual scheme that was described at SOT-6, ranking the VOS ships and whole fleets in terms of the timeliness, quantity and quality of their reports. Separate monthly lists of scores have been produced for automatic and manual ships. Details of the ranking scheme, an excerpt from the 2012 annual scores and national fleet rankings for February 2013 are shown in Appendix F. VOS operators were invited to consider the value of the monthly and annual performance ranking system and to advise the Met Office if they considered that the parameters used were appropriate.

 $^{^{1}:} http://research.metoffice.gov.uk/research/nwp/observations/monitoring/index.html\\$

^{2:} http://research.metoffice.gov.uk/research/nwp/observations/monitoring/marine/TOR/index.html

^{3:}ftp://mask2real:vosmask@ftp.jcommops.org/mask2real.csv

The meeting decided on the following action items:

- (i) RSMC to contact other monitoring centres regarding new monitoring criteria (*action*; *RSMC*; *August 2013*);
- (ii) Start using the new monitoring criteria (action; RSMC & other monitoring centres; deadline to be agreed possibly January 2014);
- (iii) PMOs to contact ships on monthly suspect lists to rectify any problems (*action*; *PMOs*; *ongoing*);
- (iv) RSMC to separate timeliness information for manual and automatic ships (*action; RSMC; April 2014*).

- B - BACKGROUND INFORMATION

Monitoring the quality and timeliness of VOS observations

- 1 The Met Office (RSMC Exeter), as WMO-designated lead centre for monitoring the quality of surface marine meteorological data (observations from ships, buoys and other in situ marine platforms), compares observations from individual platforms with the Met Office's global model background 6-hour forecast fields for each variable. Platforms for which the observed values differ from the background by a significant amount are flagged as suspect.
- Monthly lists of suspect marine platforms are sent to the WMO Secretariat and also exchanged among other monitoring centres (including JMA, NCEP, MeteoFrance and ECMWF) for comparison. Generally there is considerable agreement between the different centres, both in terms of suspect platforms (using the same criteria) and mean and standard deviation of differences from the background fields. The Met Office monthly suspect lists are available via the Met Office web site at http://research.metoffice.gov.uk/research/nwp/observations/monitoring/index.html. A recent example of our on-line VOS suspect list for February 2013 is shown in Appendix A. Monthly QC plots are also available from the website for each ship that is listed as suspect.
- Originally only mean sea level pressure was monitored, but wind speed, wind direction, sea surface temperature, air temperature and relative humidity have been added to the information being exchanged on a monthly basis. The current monthly monitoring criteria for the 6 variables are shown in Appendix B. In response to action 102 from SOT-6, we propose some tightening of these monitoring criteria. The selection criteria for labeling ships as 'suspect' have remained unchanged for up to 25 years (for pressure), during which time there have been large improvements in data assimilation, numerical modeling and data coverage (with many more satellite data types assimilated by the models). Consequently, the short-range background forecasts are more accurate now, resulting in smaller observation-background (o-b) differences overall. Thus we suggest a slight tightening of the criteria for manual observations (for which the criteria were originally agreed), as shown in Appendix C (i).
- Also, over recent years there has been a large increase in the number of ships that send in reports from automatic weather stations, which are generally more accurate and less prone to errors than manual reports. Therefore we suggest that the monitoring of 'automatic ships' be separated from the monitoring of 'manual ships' and tighter limits imposed for automatic ships), as shown in Appendix C (ii). These values are based on o-b statistics, with the mean (or bias) limits set at approximately 1.5 times the rms o-b values for all observations in each category over the past year. The meeting is invited to confirm that the monitoring criteria shown in Appendix C are set at the correct levels, or to propose more appropriate values. (N.B. The splitting of the monitoring into manual and automatic ships requires that "i_x" be set correctly in all reports. The alternative of using "atm" from the ship metadata would require changes to the Met Office processing and may delay implementation of the separate monitoring of manual and automatic ships.)

- The Met Office also produces monthly lists of monitoring statistics for the VOS fleets recruited by certain countries. To maintain up to date lists of the VOS fleets for each country concerned, the Met Office uses the meta-data available from the E-SURFMAR web-site.
- 6 Masked call sign data available from the JCOMMOPS Mask vs Real database is also taken into account when preparing the lists of VOS monitoring statistics.
- National focal points are notified when the latest VOS monthly monitoring reports and suspect lists become available on the Met Office website by means of an email sent by the Met Office to the SOT, VOS and PMO mailing lists, which are maintained by JCOMMOPS. It is important therefore that focal points wishing to receive this monitoring information check that their mailing list information is kept up to date. However, national monthly monitoring statistics continue to be emailed directly to major VOS operating countries, and as mentioned in reports to previous SOT meetings, any other national focal points who may wish to receive directly emailed copies of the monthly monitoring lists or 'suspect' ship lists should advise the Met Office of their email address.
- Every 6 months more detailed monitoring reports, for all platforms, are produced and made available to the WMO Secretariat via the Met Office web site. The statistics relating to suspect VOS operated by specific members are extracted from the report and distributed by the Secretariat to national focal points for the members concerned, under a covering letter requesting that remedial action be taken to correct the problems. The Team is invited to note that the Met Office intends to discontinue producing the individual time-series plots for each suspect platform, due to the time-consuming nature of this work and doubts as to the usefulness of these time-series for correcting problems, especially considering the monthly information available (mentioned above). If the general overview and statistics are still required these will continue to be produced and be available from the Met Office web site.
- 9 Timeliness statistics for VOS reports received at the Met Office are available from our web site at http://research.metoffice.gov.uk/research/nwp/observations/monitoring/marine/TOR/index.html where monthly timeliness data for individual VOS is available as well as tables and graphs showing the relative timeliness of national VOS fleets. A graphical example for February 2013 data is shown in Appendix D, where it can be seen from the upper graph that the majority of ship reports were received promptly, with about 70% received within 15 minutes and more than 90% received within 60 minutes of the observation time. The cut-off time for operational NWP global data assimilation is typically 90-150 minutes after the analysis times of 00, 06, 12 and 18 UTC, so that about 95% of global VOS data are being received in time to be assimilated. An example of timeliness information for individual call-signs during February 2013 is shown in Appendix E. The timeliness has improved markedly over the last 4 years, mostly due to increased automation. The Met Office proposes separating the automatic ships from the manual ships to produce two sets of timeliness statistics for national VOS fleets.
- For the last 2-3 years the Met Office has been producing annual lists of all VOS ships, ranked in order of importance to the numerical weather prediction (NWP) system, available from the Met Office web-site at http://research.metoffice.gov.uk/research/nwp/observations/monitoring/marine/VOSranking/index.html. The ships are ranked in terms of their quantity, quality and timeliness of reports, largely to assist in presenting awards to the best performing ships (initially in the UK VOS fleet). The method and latest results for the UK fleet are shown in Appendix F. Recently this system has been extended to produce monthly scores and ranking lists, separately for automatic and manual ships and for national VOS fleets. These monthly lists are also available from the above link.
- 11 As mentioned at SOT-5 and SOT-6, the Met Office's role as CBS Lead Centre for monitoring marine data is incomplete, with Japanese ships not being monitored individually, due to JMA's

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adoption of the 'SHIP' masking scheme. The Met Office continues to collect the original data from JMA's FTP server, but this data is not routed into our meteorological database due to issues concerning its security. Consequently, to ensure that the VOS can continue to be monitored efficiently, the Met Office (RSMC Exeter) would prefer that all countries adopt a masking method with a unique masked identifier for each ship, until a new ENCODE masking scheme is rolled out.

Appendices: 7

APPENDIX A

MET OFFICE ON-LINE MONTHLY VOS SUSPECT LIST FOR FEBRUARY 2013

Pub47 VOS Suspects for Feb 2013

SKAUBRYN

CA

To view the suspect threshold for each variable and statistic, hover your cursor over the relevant column. Please note that the bias and standard deviation statistics listed below exclude observations having gross errors.

error	э.						
		RESSUR	E (hPa				
CTR'		CALL SIGN	TOTAL	GE (%)	BIAS	SD	Graph
CA	SAMUEL RISLEY	CG2960	166	45	0.0	0.7	QC plo
DE	MSC ALTAIR	A8YN2	25	0	-7.4	1.0	QC plo
ΙT	COSTA FASCINOSA	ICPO	44	0	-4.5	4.3	QC plo
NL	HAPPY RIVER	PCAW	46	0	-6.8	0.6	QC plo
RU	VIKTOR TKACHEV	UCJX	29	0	7.0	1.6	QC plo
RU	VILNUS	UFJN	33	12	-4.1	0.9	QC plo
US	ENSIGN	WBN3012	26	0	-4.9	2.6	QC plo
US	HONOR	WDC6923	29	0	-4.3	0.9	QC plo
US	NIEUW AMSTERDAM	PBWQ	47	0	-4.9	1.0	QC plo
JS	VISION OF THE SEAS	C6SE8	27	0	-4.4	0.9	QC plo
		PERATU	RE (de				
CTR'	SHID NAME	CALL SIGN	TOTAL	GE (%)	BIAS	SD	Graph
CA	NEWFOUNDLAND LYNX	VAAZ	124	84	-12.4	3.7	QC plo
CA	OCEANEX SANDERLING	VOLG	602	36	-0.4	1.1	QC plo
		ND SPEE			0.1	1.1	QC pic
CTR	Y	CALL		GE			
COD		SIGN	TOTAL	(%)	BIAS	SD	Graph
T	LA SUPERBA	ICGK	90	3	5.9	3.4	QC plo
JS	EVER DELUXE	9V7953	60	10	8.2	3.5	QC plo
JS	TROPIC OPAL	J8NW	23	0	5.4	2.1	QC plo
	WINI	DIREC	TION ((deg)			
CTR		CALL	TOTAL	GE	BIAS	SD	Graph
COD	E	SIGN		(%)			
CA	ALGOSCOTIA	VAAP	332	17	74.2	111.1	QC plo
CA	NAMAO	CZ9742	51	0	-36.8	13.0	QC plo
-R	MAIDO	FNHC	167	0	41.2	16.3	OC plo
FR CO	MN COLIBRI (AWS)	FNHO	208	0	72.5	74.4	QC plo
GB	Berge Atlantic	LAIP5 ZCBU5	31 26	6 0	- 54.3 14.5	68.3 118.1	QC plo
GB GB	Grand Princess Maersk Patras	MYSU5	27	0	-21.8	89.4	QC plo
JP JP	NIKKEI PHOENIX	H9UY	21	0	-21.8	83.3	QC plo
TR	HILDE A	TCXV7	31	0	61.5	24.1	QC plo
JS	BULWARK	WBN4113	25	0	-32.8	29.5	QC plo
US	EAGLE TRENTON	S6NK4	26	0	-0.1	92.2	QC plo
US	EVER DELUXE	9V7953	36	17	-39.0	30.3	QC plo
US	LAURENCE M. GOULD (AWS)	WCX7445	121	0	12.7	82.0	QC plo
US	MARCUS G. LANGSETH (AWS)		53	8	-19.2	87.5	QC plo
	, ,	TIVE HU		_			40 pie
CTR	Y SHID NAME	CALL	TOTAL	GE	BIAS	SD	Graph
COD	E	SIGN		(%)			
CA	AIVIK	VOPP	426	7	31.2	15.5	QC plo
CA	NEWFOUNDLAND LYNX	VAAZ	71	0	29.8	7.3	QC plo
CA	OOCL MONTREAL	VRYO3	170	0	16.5	11.7	QC plo

230

3FZK3

0 27.2

8.5

QC plot



APPENDIX B

CRITERIA FOR MONTHLY MONITORING OF MARINE SURFACE OBSERVATIONS

Monitoring procedures

```
:One calendar month.
Period
Data monitored
                          :Reports from each unique identifier for ships,
                           fixed buoys and platforms.
Standard of comparison
                          :Background field from Exeter global model.
Observation times
                          :All hours
                          :Mean sea level pressure (hPa). :Wind speed (ms^{-1}).
Elements monitored
                          :Wind direction (degrees).
                          :Air temperature (°C).
                          :Relative Humidity (%).
                          :Sea surface temperature (°C).
Parameters monitored
        NOBS
                         :Number of observations received, excluding duplicates.
        %GE
                         :Percentage of observations with gross errors.
        %REJ
                         :Percentage of observations flagged, excluding
                           those with gross errors.
        SD
                         :Standard deviation of difference of observations from
                           background values, excluding those with gross errors.
        BIAS
                         :Mean difference of observations from
                           background values, excluding those with gross errors
                           (N.B. a positive bias indicates the wind
                           observation is veered to the background).
                         :Root Mean Square difference of observations from
        RMS
                           background values, excluding those with gross errors.
GROSS ERROR LIMIT
                          :15 hPa
                                       (pressure)
                          :25 ms<sup>-1</sup>
                                      (vector wind)
                          :15 °C
                                       (air temperature)
                          :50%
                                       (relative humidity)
                          :10 °C
                                     (sea surface temperature)
SELECTION CRITERIA
                          :NOBS >= 20 , and one or more of the following:
                          1.Bias
                                               4 hPa
                                                           (pressure)
                                     >=
                                               5~\mathrm{ms}^{-1}
                                                           (wind speed)
                                               30 degrees (direction)
                                               4 ^{\circ}C
                                                          (air temperature)
                                                           (relative humidity)
                                     >=
                                               15%
                                               3 °C
                                     >=
                                                          (SST)
                          2.SD
                                               6 hPa
                                                           (pressure)
                                     >=
                                               80 degrees (direction)
                                     >=
                                               6 °C
                                                          (air temperature)
                                     >=
                                                           (relative humidity)
                                               25%
                                     >=
                                               5 °C
                                     >=
                                                           (SST)
                          3.PGE
                                               2.5
                                     >=
```

N.B. Observations of wind direction are only included in the wind direction statistics if the observed or background wind speed is greater than 5 $\rm ms^{-1}$

APPENDIX C

PROPOSED NEW CRITERIA FOR MONTHLY MONITORING OF (I) MANUAL VOS, (II) AUTOMATIC VOS

I. Manual ships

SELECTION CRITERIA :NOBS >= 15 , and one or more of the following: 3 hPa 1.Bias >= (pressure) $4~\mathrm{ms}^{-1}$ >= (wind speed) 30 degrees (direction) >= 3 °C >= (air temperature) 15% >= (relative humidity) $2.5~^{\circ}\text{C}$ >= (SST) 5 hPa (pressure) 2.SD >= 70 degrees (direction) >= 5 °C (air temperature) >= 25% 4 °C

>=

>=

3.PGE >=

II. Automatic ships

SELECTION CRITERIA

:NOBS >= 50 , and one or more of the following:

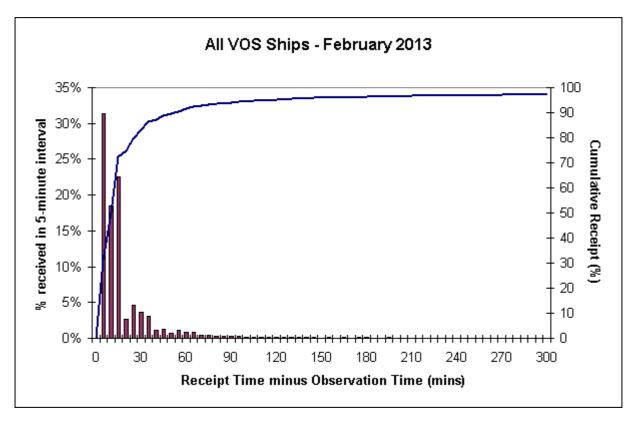
25

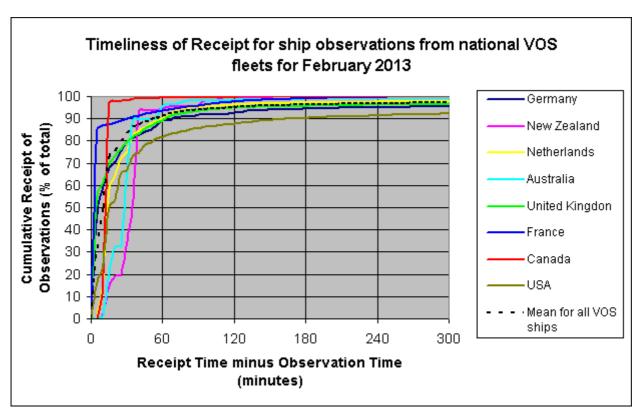
(relative humidity)

(SST)

1.Bias	>=	2 hPa	(pressure)
	>=	$4~\mathrm{ms}^{-1}$	(wind speed)
	>=	25 degrees	(direction)
	>=	2.5 °C	(air temperature)
	>=	12%	(relative humidity)
	>=	2 °C	(SST)
2.SD	>=	4 hPa	(pressure)
	>=	50 degrees	(direction)
	>=	4 °C	(air temperature)
	>=	20%	(relative humidity)
	>=	3 °C	(SST)
3.PGE	>=	15	

APPENDIX D
TIMELINESS OF VOS OBSERVATIONS RECEIVED AT THE MET OFFICE, FEB 2013





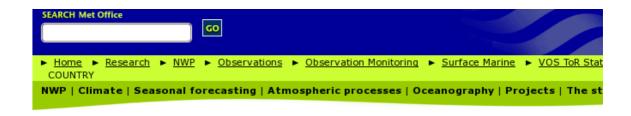
APPENDIX E

MET OFFICE ON-LINE TIME OF RECEIPT STATISTICS FOR INDIVIDUAL SHIPS, FEB 2013



APPENDIX F

MET OFFICE ON-LINE TIME OF RECEIPT STATISTICS FOR NATIONAL FLEETS, FEB 2013



Pub47 Time of Receipt Statistics by COUNTRY for February

			Average	N<30	N<60	N<120	N>36 <u>0</u>	%<3 <u>0</u>	%<6 <u>0</u>	%<120	%>36 <u>0</u>	Average
COUNTRY	Ships	Observations	(Obs/Ships)	mins	mins	mins	mins			mins	mins	(R-O) (mins
AU .	55	3964	72.1	2629	3787	3902	31	66%	96%	98%	1%	34.8
DK :	2	736	368.0	736	736	736	0	100%	100%	100%	0%	3.6
EU :	22	9314	423.4	8871	9312	9312	2	95%	100%	100%	0%	5.5
FR !	56	16022	286.1	14397	15012	15658	5	90%	94%	98%	0%	13.0
GB :	259	23889	92.2	19010	21320	22660	769	80%	89%	95%	3%	51.7
GR :	2	5	2.5	4	4	5	0	80%	80%	100%	0%	23.8
NL I	83	2868	34.6	2152	2589	2761	60	75%	90%	96%	2%	37.4
NZ :	18	1043	57.9	360	989	1037	0	35%	95%	99%	0%	33.2
CA .	41	21784	531.3	21432	21652	21712	12	98%	99%	100%	0%	12.3
DE .	440	19637	44.6	15621	17475	18188	270	80%	89%	93%	1%	37.8
HK :	28	449	16.0	15	414	428	12	3%	92%	95%	3%	78.7
IE :	2	32	16.0	29	29	30	0	91%	91%	94%	0%	24.6
IL	4	49	12.2	41	45	45	4	84%	92%	92%	8%	65.7
IN :	11	89	8.1	29	58	75	4	33%	65%	84%	4%	103.5
IS :	3	112	37.3	105	107	111	0	94%	96%	99%	0%	4.3
IT :	3	296	98.7	200	264	286	2	68%	89%	97%	1%	25.7
JP :	13	1179	90.7	1068	1152	1166	7	91%	98%	99%	1%	38.1
KR :	3	5	1.7	0	0	0	2	0%	0%	0%	40%	423.0
MY :	3	97	32.3	0	93	97	0	0%	96%	100%	0%	56.6
NO :	5	2758	551.6	2753	2757	2757	0	100%	100%	100%	0%	11.6
RU .	57	1398	24.5	831	1230	1280	75	59%	88%	92%	5%	56.5
SE :	16	817	51.1	418	483	742	58	51%	59%	91%	7%	95.9
US 4	429	24830	57.9	16639	20280	21796	1793	67%	82%	88%	7%	99.0
ZA :	1	17	17.0	5	10	12	2	29%	59%	71%	12%	173.8
ZZ :	2	36	18.0	20	35	35	1	56%	97%	97%	3%	59.7
Total :	1558	131426	84.4	107365	119833	124831	3109	82%	91%	95%	2%	42.2

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APPENDIX G

SCHEME FOR RANKING VOS SHIPS BY QUANTITY AND QUALITY OF REPORTS

Ranking Method

Statistics for each ship are accumulated for the year and these are used to rank the ships in terms of number of reports received, quality of the data and timeliness of the reports throughout the year.

The variables considered are:

- Pressure (P)
- Wind speed (Spd)
- Wind direction (Dir)
- Temperature (T)
- Relative humidity (RH)
- Visibility (Vis)
- Sea Surface Temperature (SST)
- these are the variables reported by SHIPs that are assimilated operationally at the Met Office.

Number of reports score

The set of numbers of reports received (Nobs) is 'capped' to limit the influence of any very high numbers from automatic stations, then a score is calculated for the number of observations (obs) received:

Firstly the values in Nobs are inversed to give low (good) scores to ships with high numbers of obs and vice-versa, Nobs = MAX(Nobs) - Nobs

Secondly, so that ships with below average numbers have scores greater than 1.0, and vice-versa, we set **NumObsScore** = **Nobs** / **MEAN(Nobs)**

Quality score

Quality scores for each variable are calculated, based on the following observation-minus-background (O-B) statistics:

MeanScore = (Absolute value of mean O-B) / VariableLimit

SDScore = (Standard Deviation of O-B) / VariableLimit

[where the following **VariableLimit** values are used, based on the Met Office reject list thresholds:

P = 2.0 hPa, Spd = 3.0 m/s, Dir = 40 degrees, T = 3.0 C, RH = 15.0 %, Log(Vis) = 1.0, SST = 1.0

3.0 C and GEScore = (Number of Gross Errors) / (Mean number of Gross Errors)

(N.B. For ships with 100% gross errors, the Mean and SD scores are set to the worst in the set.) All scores are capped at 2.0, then a "quality-score" is created for each variable:

QualityScore = (MeanScore + SDScore + GEScore) / 3

Time of receipt score

Time of receipt (ToR) scores are produced from yearly totals for the following ToR categories: reports received within 30 minutes of the report time, 30-60 minutes, 60-120 minutes, 120-360 minutes and after 360 minutes.

Each ship is given a score that is the sum of the following numbers of points for each category

multiplied by the number of observations in that category:

points_30 = 0.0, points_60 = 30.0, points_120 = 75.0, points_360 = 225.0, points_after = 345.0 (These scores are just the values of the mid points of the ranges minus the mid-point of the first range (15 minutes) to make the best score zero; and 'points_after' has just been set to 360 minus 15 as the range is unbounded.)

The ToR scores are then divided by the scores the ships would have received had all of their observations been received between 60 and 120 minutes, i.e. we are suggesting that observations should really have been received within two hours and that reports received later than that are less useful to NWP. The ToR scores are also capped at 2.0.

Combined score

The NumObs, Quality and ToR scores are combined with weights of 0.4, 0.4 and 0.2, respectively, for each variable.

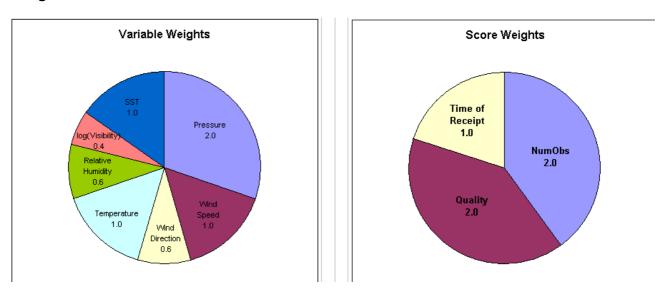
For ships that do not report certain variables the scores are set to the worst score for that variable (usually 2.0).

Then the scores for each variable are combined using the following weightings:

$$P = 2.0$$
, $Spd = 1.0$, $Dir = 0.6$, $T = 1.0$, $RH = 0.6$, $Vis = 0.4$, $SST = 1.0$.

These weightings are estimates of the relative importance of each variable to the NWP models (their values may need some further tuning).

Weights



N.B. The above ranking scheme is only intended to give an indication of the relative performance of individual observing ships and marine platforms. It is primarily aimed at usefulness for NWP and therefore only takes into account observations that have been received in near real time. It takes no account of delayed mode observations collected for climate studies (for which timeliness is largely irrelevant).

Annual VOS ranking scheme – some of the 'best' ships for 2012

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VACAGE NET RATE NO. 1216 11734 0.0032 0.0022 0.1246 0.0034		DBFR	WALTHER	0.212		0.121	//8//	0.138	7984	0.235	3803	0.095	8817	6.13	2008/	AISSING.		0.284	7826	0.009
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BATFR46		SGK	SIR WILFI	0.272		0.158	6873	0.239	9/89	0.385	1940	0.232	9/89	0.207	0289	0.570	192	0.428	2939	0.005
CC2360 LIMNOS 0.281 33629 0.123 7466 0.154 749 7511 0.198 7499 MISSING 0 0.473 CC2360 LIMNOS 0.287 20475 0.264 0.284 2047 6222 0.462 489 0.028 CC2900 SAMURE 0.289 20475 0.191 6949 0.243 3867 0.140 7714 0.360 6318 MISSING 0 0.461 BENT HENZ LASTROL 0.229 3673 0.243 287 0.241 287 0.262 6318 MISSING 0 0.461 BENT LASTROL 0.229 3673 0.242 2874 0.271 0.289 0.271 0.289 0.271 0.289 0.271 0.289 0.371 0.289 0.371 0.289 0.371 0.289 0.371 0.289 0.371 0.289 0.371 0.289 0.371 0.289 0.371 0.289 0.371 0.389 0.371	# _	BATFR4	(0)	0.275		0.220	6299	0.276	5664	0.347	2334	0.211	6299	0.252	6299	0.509	342	0.328	5643	0.002
MATCHES #WA 0.287	8 CA	CG2350		0.281	33629	0.123	7466	0.152	7541	0.439	1645	0.183	7511	0.198	7469 N	4ISSING	0	0.473	1997	0.005
CC22960 SAMUEL 0.287 34353 0.176 7867 0.449 1368 0.184 7799 0.205 7779 MISSING 0 0.461 DBCK HENCKE 0.293 38636 0.131 6751 0.191 6849 0.243 3607 0.186 0.361 0.367 0.360 0.361 0.360 0.361 0.360 0.361 0.360 0.361 0.360 0.361 0.360 0.361 0.361 0.360 0.361 0.361 0.360 0.361 0.361 0.360 0.361 0.361 0.360 0.361 0.361 0.360 0.361 0.361 0.361 0.362 0.361 0.362 0.361 0.362 0.361 0.362 0.361 0.362 <td></td> <td>BATFRS</td> <td>0</td> <td>0.287</td> <td>29475</td> <td>0.261</td> <td>5222</td> <td>0.296</td> <td>5215</td> <td>0.294</td> <td>2974</td> <td>0.237</td> <td>5222</td> <td>0.262</td> <td></td> <td>0.452</td> <td>485</td> <td>0.325</td> <td>5135</td> <td>0.004</td>		BATFRS	0	0.287	29475	0.261	5222	0.296	5215	0.294	2974	0.237	5222	0.262		0.452	485	0.325	5135	0.004
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Patrice Lasirhou U.292 36/72 U.128 BH33 U.233 7/112 U.387 U.351 U.235 U.235 U.246	1 DE	DBCK	HEINCKE	0.290		0.213	6751	0.191	6949	0.243	3607	0.150	7114	0.360	6318 №	#ISSING	0	0.366	5897	0.005
BATIFICIA MAYA 0.293 310.34 0.246 5/51 0.276 5/53 0.259 3010 0.250 5514 0.416 4452 0.391 1103 0.431 0.416 0.4245 0.246 0.234 0.245 0.243 0.244 0.416 0.416 0.416 0.416 0.244 0.416 0.244 0.243 0.244 0.245 0.243 0.244 0.255 0.234 0.245 0.256 0.243 0.256 0.257 0.256 0.257 0.256 0.256 0.256 0.257 0.256 0.257 0.256 0.257 0.256 0.257		LH41	LASIRO	7670		071.0	2 2 2	0.233	7117	0.387	2315	0.201	8183	0.252	/842 N	IISSING 0 000	0 00,7	0.435	700	0.227
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BATUKOT #N/A 0.314 31792 0.243 5761 0.377 5323 0.319 3164 0.240 5763 0.302 5761 0.367 5923 0.316 40.240 5763 0.302 5761 0.302 5763 0.340 4539 0.243 4549 0.243		DBBI	ATAIR	0.312		0.232	6564	0.271	6931	0.341	2631	0.189	6933	0.238	6623 N	4ISSING	0	0.366	5030	0.005
JPBN KEIFU M4 0.314 26791 0.274 4539 0.318 4539 0.306 2906 0.285 4538 0.340 4537 0.403 1521 0.373 (VRYO3 OOCL M4 0.314 35547 0.193 6764 0.474 6761 0.502 3582 0.184 6759 0.205 6750 0.561 105 0.381 (VRYO3 OOCL M4 0.314 31277 0.213 6748 0.202 7063 0.390 1766 0.189 7049 0.202 6902 MISSING 0 0.504 (VEGA 0.314 31277 0.213 6648 0.202 7063 0.390 1766 0.189 7049 0.202 6902 MISSING 0 0.504 (VEGA 0.314 31277 0.213 6648 0.202 7063 0.314 4508 0.315 3072 0.287 4524 0.281 4517 0.414 878 0.387		BATUKD		0.314		0.243	5761	0.377	5323	0.319	3164	0.240	5763	0.302	5741	0.587	292	0.363	5748	0.044
VRYO3 OOCL MG 0.314 36547 0.193 6764 0.474 6761 0.602 3682 0.184 6759 0.205 6750 0.561 105 0.381	43 JP	JPBN	KEIFU MA	0.314		0.274	4539	0.318	4539	0.306	2906	0.285	4538	0.340	4537	0.403	1521	0.373	4211	0.019
CGCX GEORGE 0.316 34141 0.143 7163 0.308 7163 0.387 2525 0.238 7156 0.243 7155 MISSING 0 0.458 BBBC WEGA 0.317 31277 0.221 6648 0.202 7063 0.390 1766 0.169 7049 0.202 6902 MISSING 0 0.504 BATFR13 #WA 0.318 28430 0.291 4521 0.314 4508 0.315 3072 0.287 4524 0.291 4517 0.414 878 0.387		VRY03	OOCL MC	0.314		0.193	6764	0.474	6761	0.502	3582	0.184	6529	0.205	6750	0.561	105	0.381	4826	200.0
DBBC WEGA 0.317 3127 0.221 6648 0.202 7.063 0.390 1766 0.169 7.049 0.202 6902 MISSING 0 0.504 BATFR13 #N/A 0.318 28430 0.291 4521 0.314 4508 0.315 3072 0.287 4524 0.291 4517 0.414 878 0.387		X (200	GEORGE	0.316		0.143	7163	0.308	7163	0.387	2525	0.238	7156	0.243	7155 N	AISSING	0	0.458	2979	90.0
BATER13 #WA U.318 2643U U.291 452 U.314 4508 U.315 3U/2 U.287 4524 U.291 4517 U.414 6/8 U.367		DBBC	> .	0.317		0.221	554g	0.202	(Ub3	0.390	1/86	0.169	(049	0.202	M 2002	AISSING 6 44 4	O oto	0.504	1849	900.0
\$40.00 - 10.00 0.00 0.00 0.00 0.00 0.00 0.	#	BAIFKI		0.318		0.291	4521	0.314	4508	0.315	30/2	/87'n	4254	167.0	4517	U.414	00/0	0.387	4410	0.004

on		ly	V	Ο	S	na	ati	OI	na	1 1 	le	et	ra	an	ki	nς	js	fc	r	Fe	eb	ru	ıaı	у	20)1: 	3 -	<u>-</u> r	na	เท ⊢	ual	Seint &	a	ut	on	na	tic	r	ep	00	rts	S			
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	ce Temp	10mn	2843	2195	198	ব	23	2136	5965	33	464	98	96	100	518	8162	27	18071	391	1073	22	4704	0	0	9	4	0		=	œ		ce Tem	10mn	2590	8266	640	2365	2751	12249	Ω.	0	1312	1799	1176	000
	Sea Surface Temp	S Sci +	0.134	0.088	0.492	0.503	0.549	0.528	0.565	0.649	0.492	0.562	0.564	0.421	0.516	0.597	0.505	0.642	0.672	0.607	0.608	0.660	31 MISSING	MISSING	0.838	0.773	MISSING			o		Sea Surface Temp	S Sci+	0.10	0.289	0.427	0.383	0.622	0.528	1.417	MISSING	0.318	0.541	0.339	111
		10mn	2940	0	214	ঘ	420	2731	7193	33	462	1168	97	111	230	9985	47	14043	433	1312	46	4641	31		88		2			_					0	0	0	0	88	0	2	83	141	0	C
	Visibility	Sco - N	0.083	MISSING	0.328	0.488	0.499	0.474	0.482	0.518	0.492	0.488	0.477	0.451	0.460	0.538	0.639	0.596	0.581	0.578	0.539	0.590	0.575	0.782	0.724	0.893	MISSING			0		Visibility	Sco + N	SSING	8573 MISSING	640 MISSING	MISSING	ISSING	0.449	733 MISSING	MISSING	0.480	0.399	2595 MISSING	010000000
	umidity	Λ 10mn	2804	2733 M	386	4	289	2581	7019	Ж	8	1149	88	0	392	9649	25	14067	396	112	14	3868	0	2	83		Σ 0			z		umidity	VI → IOmn	14818 MISSING	8573 M	640 M	2565 M	17658 MISSING	13677	733 M		12047	1754	2595 M	
	Relative Humidity	Scor - NumOt - RH Sc - NumOt - VI Sco - NumOt -	0.120	0.163	0.333	0.609	0.560	0.568	0.550	0.621	0.656	0.578	0.575	110 MISSING	0.579	0.638	0.564	0.675	0.688	0.548	0.699	0.713	MISSING	0.648	0.867	0.838	MISSING			Σ		Relative Humidity	Scor - Numot - IRH Sc - Numot - IVI Sco - Numot	1 188	0.368	0.574	0.473	0.456	0.653	0.537	0.549	0.537	0.587	0.432	01400011
	ature	lum0} ◀	2938	2758	38	4	230	2803	7229	Ж	464	1160	88	110	272	10301	33	21701	432	1323	46	4989	78	2	8	ঠ	≥.	-					um0! → R	17859	8864	640	2696	21630	15212	735	448	15396	2318	2595	
	Temperature	Scor	0.116	0.121	0.389	0.532	0.530	0.559	0.541	0.582	0.511	0.568	0.561	0.451	0.527	0.613	0.656	0.626	0.681	0.687	0.672	0.699	0.792	0.650	0.80	0.787	1.037			×		Temperature	Scor + IN	0.162	0.330	0.573	0.431	0.342	0.637	0.517	0.532	0.485	0.823	0.417	
	ction	10mn	2103	1087	137	4	410	1802	4326	19	352	705	88	84	362	5789	32	14244	254	750	æ	2860	22	0	24	4	m					ction	T → 10mn	92.29	4936	473	972	7968	8458	498	33	1243	1209	1166	(
	Wind Direction	SP_Sc. NumOt - DR_Sc NumOt -	0.167	0.208	0.541	0.513	0.546	0.577	0.609	0.625	0.517	0.589	0.671	0.495	0.545	0.602	0.509	0.641	0.680	0.642	0.615	0.683	0.629	MISSING	0.770	1.427	0.955					Wind Direction	SP Sci+ NumOi+ DR Sci+ NumOi+	0.19	0.321	0.385	0.572	0.499	0.532	0.377	0.757	0.316	0.814	0.632	01400040
	eed	lum0} →	2946	2758	583	4	29	2798	7239	Ж	464	1184	88	111	23	10325	23	23024	427	1292	49	4994	33		83	5	e			エ		pee	nm0l ←	17942	8889	640	2551	21720	13375	731	194	1716	2715	2014	
	Wind Speed	P Sci N	0.177	0.127	0.535	0.642	0.594	0.616	0.625	0.638	0.583	0.616	0.724	0.578	0.566	0.636	0.683	0.679	0.699	0.707	0.665	0.719	0.693	MISSING	0.791	1.320	0.991			9	p reports	Wind Speed	P Sci → N	0.220	0.342	0.564	0.514	0.357	0.702	0.535	0.851	0.491	0.878	0.794	01410004
-	_	_	2944	2750	78	ঘ	59	2814	7260	Ж	465	1154	97	111	525	10321	ස	22363	431	1319	43	5015	32		8	ঠ	m			ட		و			8441	640	2141	20235	15864	734	448	14420	2307	8713	100
	Pressure	Scol	0.231	0.061	0.591	0.545	0.584	0.553	0.585	0.572	0.585	0.590	0.589	0.543	0.549	0.636	0.732	0.700	0.763	0.741	0.754	0.791	0.674	629.0	0.953	0.831	1.210			ш	for autor.	Pressure	100	0.277	0.442	0.564	0.445	0.337	0.632	0.576	0.442	0.490	0.875	0.448	1100
	ned	lum0l ⋅ P	19518	14281	1693	88	3702	17665	46231	223	2719	7511	628	627	3384	64532	317	127513	2764	7181	255	30071	146	00	451	102	17	5		_	eet scores	led	d → 10mn	76890	47949	3673	13290	91962	79643	3436	1613	46192	12243	18259	000
	Combined	omb dmo	0.166	0.178	0.493	0.551	0.582	0.585	0.592	0.601	209.0	0.615	0.617	0.622	0.633	0.644	0.694	0.716	0.723	0.769	0.778	0.780	0.834	0.887	0.924	0.948	1.149	sMan_1302		၁	nal VOS fl	Combined	N → qmo	0.312	0.471	0.616	0.631	0.685	0.723	0.797	0.886	1.132	1.282	1.286	000,
		Country NumSty Comb v NumOty P Scoty NumOty	_	5	m	_	16	88	217	2	5	45	m	m	Ξ	419	4	409	24	52	4	185	2	-	60	-	=			<u> </u>	February 2013 national VOS fleet scores for automatic shi		Countr ← NumSr ← Comb ← NumOf ← P	-	17	2	9	41	54	2	-	æ	4	22	
		ountr ▼ N	"SHP"	NO No	_	GR GR	ZN		89	12 Ancillary	띯	AU	47		마	回	CA	NS Sn	壬	R		24 Unknown	11.1	띺		×	اع	▶ Mont		∢	ebruary 2		ountr • N	"SHP"	出	맠	AU	CA A	띺	X	Z	界	14 Unknown	EO	I (
				2	7	8	2 0	10	11 6	12 A	13 S	4	15 MY	16 IS		18	19	20	21 H		Z3 =	2 4 U	22 E	26 F	<u>≥</u>	≴ ജ	82 Æ	-	Ready		← c	ν m			9	7	≪	0	다 교		2 Z	13 GB	14 C		0