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Agenda Item III/1

SUMMARY OF COMMENTS FROM NWP CENTERS REPRESENTED IN WGNE ON THE LARGE DIFFERENCES IN SATELLITE WIND OBSERVATION ERRORS ASSIGNED AT NWP CENTERS

In order to respond to Action Item 27.19, JMA on behalf of CGMS sent to members of WGNE/JSC a questionnaire on the observation errors assigned at NWP centers and requested their comments. This document is the summary of them from NWP centers represented in WGNE and was agreed to submit to CGMS-XXVIII.

CGMS Members to note the document and to inform and/or advise to NWP centers on the usage of satellite winds for NWP centers to improve their operational NWP systems.

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SUMMARY OF COMMENTS

It is the concern of each NWP center to assign the observation errors in the best way for their system; if this results in substantially different values being assigned between centers, there shouldn't really be of much concern. Since each NWP center uses different thinning, quality control, and assimilation methods, and different background error statistics, it is not surprising that the observation errors are different among centers (see Tables 1 and 2). It is to be noted that quite different values are assigned even to the observation errors of radiosonde data, and that ECMWF, for example, changed satellite wind observation errors over the years according to the change in assimilation methods as follows:

Method	1000	850	700	500	400	300	250	200	150	100 (hPa)
3D-OI	: 2.1	2.1	2.1	4.2	4.2	4.2	4.2	4.2	4.2	4.2 (m/s)
3D-Var(Jan96)	: 1.4	1.4	1.4	2.5	3.0	3.5	3.5	3.5	3.5	3.5 (m/s)
4D-Var(Nov97)	: 2.0	2.0	2.0	3.5	4.5	5.0	5.0	5.0	5.0	5.0 (m/s)

The specified observation error should reflect the subset of data used by the analysis scheme. Very strict quality control (by whatever means prior to the analysis) can restrict the spread of the data significantly, in which case a very low observation error can be appropriate. In the other extreme one can choose to assimilate a very dense set of observations, in which case it may be appropriate to use a larger observation error in order to guard against the ill effects of biases and/or error correlations in the observations. It is to be noted that some of the satellite winds are very strongly affected by a negative wind speed bias. In general the impact of satellite winds is to define broad shaped structures and not very narrow structures like jet streamline features. Systematic lowering of maximum wind speeds results mostly in undesirable damping of baroclinic activity in models. As for the error correlation, the satellite wind producers are distributing more and more sets of winds at high resolution and with a lot of internal redundancy. If this redundancy is not accounted for by a proper screening, data-selection or spatial correlation on the observation error, then it can be compensated by increasing the observation error.

There may also be a need to specify unrealistically large (or small) observation errors to compensate for known deficiencies in the specification of background errors used by the assimilation.

Information and/or advice from CGMS to NWP centers on the observation errors of satellite winds would be quite useful for NWP centers to improve their operational NWP systems.

Table 1. Observation errors of satellite and radiosonde winds and background error of winds assigned at NWP centers

NWP center (Assimilation method)	Level (hPa)	1000	850	700	500	400	300	250	200	150	100
BoM	Satellite (m/s)	3.0	3.0	3.0	3.0	6.0	6.0	6.0	6.0	6.0	6.0
	Radiosonde (m/s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
(3D-OI with T239 L29 model)	Background (6-hour prediction)	Background errors of winds from 1000 to 100 hPa vary with latitude, but are mostly between 2 m/s (500 hPa and below) and 5 m/s (100 hPa), for each component.									
CMA	Satellite (m/s)	2.5	2.5	2.5	2.5	5.0	5.0	5.0	5.0	5.0	5.0
	Radiosonde (m/s)	2.2	2.5	2.6	3.1	3.7	3.8	3.3	3.0	2.8	2.4
(3D-OI with T106 L19 model)	Background (6-hour prediction)	Background errors of winds from 1000 to 100 hPa vary with altitude and latitude, and depend on the data density in previous analysis. A typical tropical profile of the U-component background error increases from 1.0 m/s at 1000 hPa to 5.8 m/s at 300 hPa, and then decreases to 5.0 m/s at 100 hPa.									
CMC	Satellite (m/s)	3.8	3.8	3.8	3.8	7.5	7.5	7.5	7.5	7.5	7.5
	Radiosonde (m/s)	1.6	1.7	1.8	2.0	2.2	2.5	2.6	2.5	2.2	2.0
(3D-Var with 0.9 deg. L28 model)	Background (6-hour prediction)	The background errors vary with latitude and altitude. Typically, they are around 2.5 to 3.0 m/s at mid levels and varies from 3.0 to 4.5 m/s at jet level. The current values were determined from an ensemble of 48-24 hour forecasts statistics.									
DWD	Satellite (m/s)	3.0	3.0	3.0	3.0	6.0	6.0	6.0	6.0	6.0	6.0
	Radiosonde (m/s)	2.0	2.4	2.5	3.4	3.6	3.8	3.2	3.2	2.4	2.2
(3D-OI with 60km L31 model)	Background (6-hour prediction)	The background error is determined by a modified (dependant from analysis error of previous analysis) climatology of first guess errors. In region of satellite winds (subtropics and tropics, around 400-150 hPa) the background error of wind components starts at 5.0 m/s and reaches values of 15 m/s in very data sparse regions. A revision of the satellite wind observation error has to be combined with a revision of the climatology of background error.									
ECMWF	Satellite (m/s)	2.0	2.0	2.0	3.5	4.5	5.0	5.0	5.0	5.0	5.0
(4D-Var with TL319 L60 model)	Radiosonde (m/s)	1.8	1.8	1.9	2.1	2.5	2.6	2.5	2.5	2.4	2.2

NWP center (Assimilation method)	Level (hPa)	1000	850	700	500	400	300	250	200	150	100
	Background (3-hour prediction)	The specified background errors vary strongly with altitude and latitude, and depend on the data density in previous analyses. A typical tropical profile of the U-component background error increases from 1.0 m/s at 1000 hPa to 2.2 m/s in the upper troposphere. In mid-latitudes it is also around 1 m/s near the surface - it increases to 2.7 m/s at jet level, and then decreases to about 2.0 m/s at 100 hPa. These current values are significantly lower than those used at ECMWF until June 2000, which in turn were lower than those used before October 1999. The reductions in specified background error reflect the gradual improvement in short-range forecasts accuracy, and that the background now is a 3-hour forecast instead of 6-hour.									
JMA (3D-OI with T213 L30 model)	Satellite (m/s)	3.0	3.0	3.0	3.0	3.2	3.5	3.7	3.9	4.1	4.5
	Radiosonde (m/s)	1.0	1.0	1.1	1.2	1.3	1.5	1.6	1.8	1.9	2.2
	Background (6-hour prediction)	The background error of winds is the same as the observation error of satellite winds, since the latter is assumed to be equal to the former.									
Meteo France (4D-Var with T199 C3.5 L31 model)	Satellite (m/s) METEOSAT	2.75	2.86	3.08	3.85	4.29	4.62	4.84	5.06	5.06	5.06
	Satellite (m/s) GOES	2.75	2.86	3.08	3.85	4.29	4.62	4.84	5.06	5.06	5.06
	Satellite (m/s) GMS	3.25	3.38	3.64	4.55	5.07	5.46	5.72	5.98	5.98	5.98
	Radiosonde (m/s)	2.3	2.4	2.5	3.0	3.3	3.6	3.7	3.8	3.8	3.8
	Background (3-hour prediction)	They are derived from statistical computations performed on archived forecasts, using the so-called "NMC" technique. The background error standard deviation for the basic fields varies with latitude and longitude in a way similar to ECMWF. However, there is no variation from one assimilation cycle to the next one, except once or twice a year when the statistics are recomputed and updated. Note that because of the 4D-Var performed on a 6 hour time window, this background error standard deviation is directly applicable only at the beginning of the 4D-Var time window (21, 03, 09 and 15UTC). For any other time the background error implicitly used is dependent also on the atmosphere dynamics (as for ECMWF).									
UKMO (3D-Var with 0.83 x 0.56 deg. L30 model)	Satellite (m/s)	1.3	1.7	2.0	2.5	3.3	3.3	3.3	3.3	3.6	5.5
	Radiosonde (m/s)	1.8	1.6	1.5	1.9	2.4	2.6	2.8	2.5	2.2	1.9
	Background (6-hour prediction)	The background errors used in our 3D-Var are a function of latitude, level, and season, as described in “The Statistical Structure of Forecast Errors and its Representation in the Met. Office Global 3D-Var” by N Bruce Ingleby (To appear in QJRMS, accepted in June 2000). In the quality control (in our preliminary observation processing), we also allow for some dependence of errors on the synoptic situation.									

Table 2. Usage of satellite winds at NWP centers

NWP center	Method of Assigning Observation Error	Thinning Procedure	Re-assignment of Height
BoM	The observational errors for satellite tracked winds were based on advice from data producers some years ago.	Satellite winds are thinned by means of "superobs" (optimal averaging of closely spaced observations).	No.
CMA	The observational errors of satellite tracked winds were determined in a pure empirical way some years ago.	The satellite tracked winds over land of which latitude is greater than 30 degrees of north are not used.	No.
CMC	The observational errors for satellite tracked winds were based on values used at ECMWF many years ago.	No.	No.
DWD	We are monitoring the satellite winds against the 6-hour forecast of our global NWP-model. In general the standard deviations of wind components satellite wind against model show values in the range between 3.5 and 5.0 m/s depending on the satellite/height/type of wind (IR,VIS,WV). The mean difference of wind component is mostly negative and its maximum reaches up to 2.0 m/s (zonal wind, jet region, depending on satellite). The observation errors used in the analysis are quite large. The reason for this is mainly the fact that in optimum interpolation schemes only the ratio of observation to first guess error dominates the impact of observations used. (See Table.1)	Satellite winds are thinned to the model resolution of the global model. In a vertical slab of 40 hPa for the analysis at one grid point the effective number of satellite winds used is as follows: 50 25 9 6 rest [percentage of grid points with satellite winds] 1 2 3 4 > 4 [satellite winds] -depending on actual availability and data coverage- The satellite wind nearest to the grid point is taken first, so the impact is maximal.	No.
ECMWF	The sum of observation and background errors has been estimated through study of histograms of departures between observations and short-range forecasts. The background component of these error estimates is fairly well known by other means, and can be subtracted. The observation error estimates thus obtained are inflated in an ad hoc way, in a attempt to partly compensate for the otherwise neglected effects of observation error correlation.	Before final assimilation all satellite winds are thinned to the following: - One wind per box 1.25 x 1.25 degree; - One per nearest model pressure level.	No.

NWP center	Method of Assigning Observation Error	Thinning Procedure	Re-assignment of Height
JMA	The observation errors of satellite tracked winds in our global assimilation system are determined so that the errors are comparative to the background errors of winds.	Satellite winds are thinned so that the minimum distance of the winds is 50 km. Satellite winds are rejected if any reports from radiosonde, wind profiler, AIREP, AMDAR are available within 50km.	The GMS winds are re-assigned to 200hPa if the vertical level of reported winds are higher than 200hPa. Other satellite winds are not re-assigned.
Meteo France	In a pure empirical way combining the experience of producers, what is usually done in other centres, and (mainly) through experiments studying the response of our assimilation system to the use of satellite winds. Note that INSAT has never been used, and the figures given for INSAT in Table 2 of the working paper CGMS-XXVII EUM-WP-28 are for quality control and monitoring only, not for operational use.	The above ECMWF thinning technique is used.	No.
UKMO	For winds received in SATOB code, averaged over the course of a year, on different levels: We calculate the observation minus background RMS wind component difference (RMS(O-B)) from monitoring statistics. We make the assumption that background error variances and observational error variances have about the same magnitude, so we estimate the RMS observational error by dividing the RMS(O-B) by square root of two. Values are for all satellites combined, however INSAT statistics are not used in this calculation.	The GOES winds are thinned to one in every 2 x 2 degree grid box. The wind nearest the center of the box is chosen. Other satellite winds are not thinned, however if we start to assimilate EUMETSAT BUFR coded winds, these will also be thinned.	No.