

# MONITORING SATOB PRODUCTS AT ECMWF: Availability, Quality Control And Impact

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## ABSTRACT

The status of AMW operational use at ECMWF is presented with a summary of recent history of changes and events affecting data availability. A summary of the tools used for the real time assessment of their data problems and/or impact on the operational forecast is given. Some examples of the signatures that can be detected from the compilation of statistics issued by ECMWF in the SATOB Quarterly Report are discussed. Finally results from the preliminary evaluation of METEOSAT5/INDOEX data given.

### 1. INTRODUCTION

Recent months have seen a large increase in the number and resolution of products made available as satellite atmospheric-motion winds (AMW) to the users. Indeed the year was rich of events both of planned and unplanned nature: we will in the first part of this paper present a summary of them, with impact of availability and actual use of data.

The monitoring of SATOB products at ECMWF is the result of both real time, human assessment in Meteorological Operations and of objective evaluation based on comparisons to collocated model short range forecasts and to other in situ measurements based on radiosondes and commercial aircraft. The second part of this contribution will be a summary and discussion of such monitoring statistics that are compiled on a quarterly basis and issued to CMW providers and NWP centres (ECMWF SATOB Data Monitoring Report). In the last part, we will present some of the experimental results on which the decision to use METEOSAT5/INDOEX winds in operations was based.

Similar evaluations were presented at the first three Winds workshops (Strauss, 1991; Strauss and McGrath, 1993; Strauss and Garcia Mendez, 1996).

### 2. RECENT CHANGES AND IMPACT ON AVAILABILITY

Recent changes in the operational use of AMW may be summarised as follows (italicised are those changes that only indirectly affected the use of AMW):

18/9/1997: introduction of high resolution (HR) Vis METEOSAT AMW;

25/11/1997: *4D-var data assimilation*;

3/3/1998: HR GOES winds used (except north of 20° N);  
 3/6/1998: swap from METEOSAT 6 to 7;  
 1/4/1998: *model resolution is increased to T<sub>L</sub>319*;  
 29/6/1998: New screening applied to GOES HR winds; use including beyond 20° N;  
 18/7/1998: GOES-9 failure;  
 10/8/1998: GOES-10 AMW used (GOES-9 replacement);  
 12/8/1998: Introduction of METEOSAT5 winds (INDOEX);  
 9/9/1998: METEOSAT 5 and 7 HR AMW are lost following format change;  
 21/10/1998: EUMETSAT Bufr format introduced (METEOSAT 5 and 7 used)

As a result of both increased resolution of the products and METEOSAT5/INDOEX dissemination, the availability of AMW have increased a lot over the last 12 months. This is illustrated on Figure 1 where AMW data coverage is compared for the same day (12 August) in 1997 and 1998, with 7 times more data in the latter than in the former date. These numbers are however subject to a lot of fluctuations in time, as can be seen from Figure 2 with both GOES eclipse problems and METEOSAT format change.

The use of data in a numerical weather prediction model is not only decided on the basis of data regular availability and quality, but also on the basis of the expected benefit in the context of the existing global observing system and limited model resolution. As a result, the use of AMW data in ECMWF data assimilation is currently as follows:

- platform used are GOES 8 and 10, METEOSAT 5 and 7, HIMAWARI
- data are excluded outside a 110x110 lat-lon square defined for each platform; their density is limited to 1 per 1.25x1.25 grid box; WV channels are not used when p (pressure) >400 hPa - the same is true for IR channels when 700 > p > 400 and for Vis channels when p < 700
- over land, AMW are not used for p > 500 hPa, and restrictions apply for higher elevations depending on other data availability.

Even with these restrictions, the effective use of AMW data has considerably increased in recent months, as can be seen in Figure 3 where only the data used by the operational model on 12/8/98 have been plotted (to be compared to Figure 1 for all data received: amount is in a ratio of 40%).

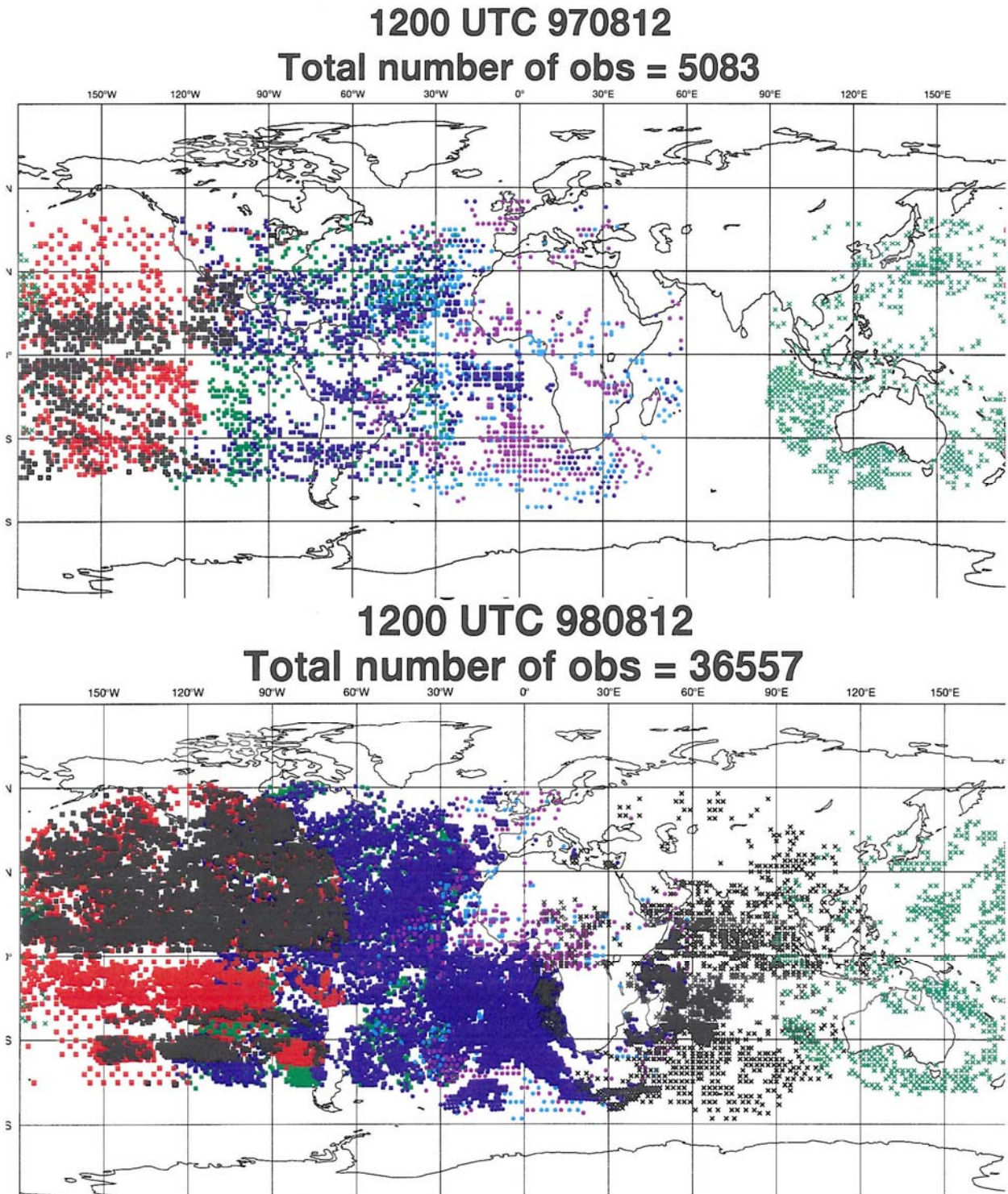
### 3. MONITORING OF AMW

As for other types of data, AMW are monitored at ECMWF both on a real time and a-posteriori basis. Real time (daily) assessment points at problems in availability and impact on the forecast by comparison to previous or other NWP centres forecasts - error tracking or superposition of analysis increments on adjoint computations of sensitive areas are among the tools used by the analyst on duty to perform these tasks. An example of in-depth investigation of the impact of GOES AMW on 4/8/98 following such a real time notification of possible problem is reported in M. Rohn contribution (same volume). Maps of data rejections by ECMWF data assimilation (Figure 4) are also used that often point out at the usual problem of AMW underestimation of the jets, but also at some “overconfidence” of the model in poorly observed areas.

Non-real time monitoring of AMW quality is performed on a monthly and quarterly basis by comparison both with model short-range (3 to 9h) forecasts and collocated radiosondes and aircraft in-situ observations. As these data are made available to data providers on a regular basis, only a few points are highlighted hereafter.

Time series for METEOSAT and GOES winds in the upper troposphere (above 400 hPa) are shown in Figure 5 : they give a fairly consistent picture over the period, with a consistent improvement observed notably in GOES time series. Following the introduction of high resolution GOES winds in March 1998, the bias reduction is very impressive indeed. This very positive result should however be balanced by those coming from a more model independent evaluation against in-situ observations (Figure 6); these show that there is still a

Figure 1: Availability of AMW products on 12/8/97 (above) compared to 12/8/98 (below)

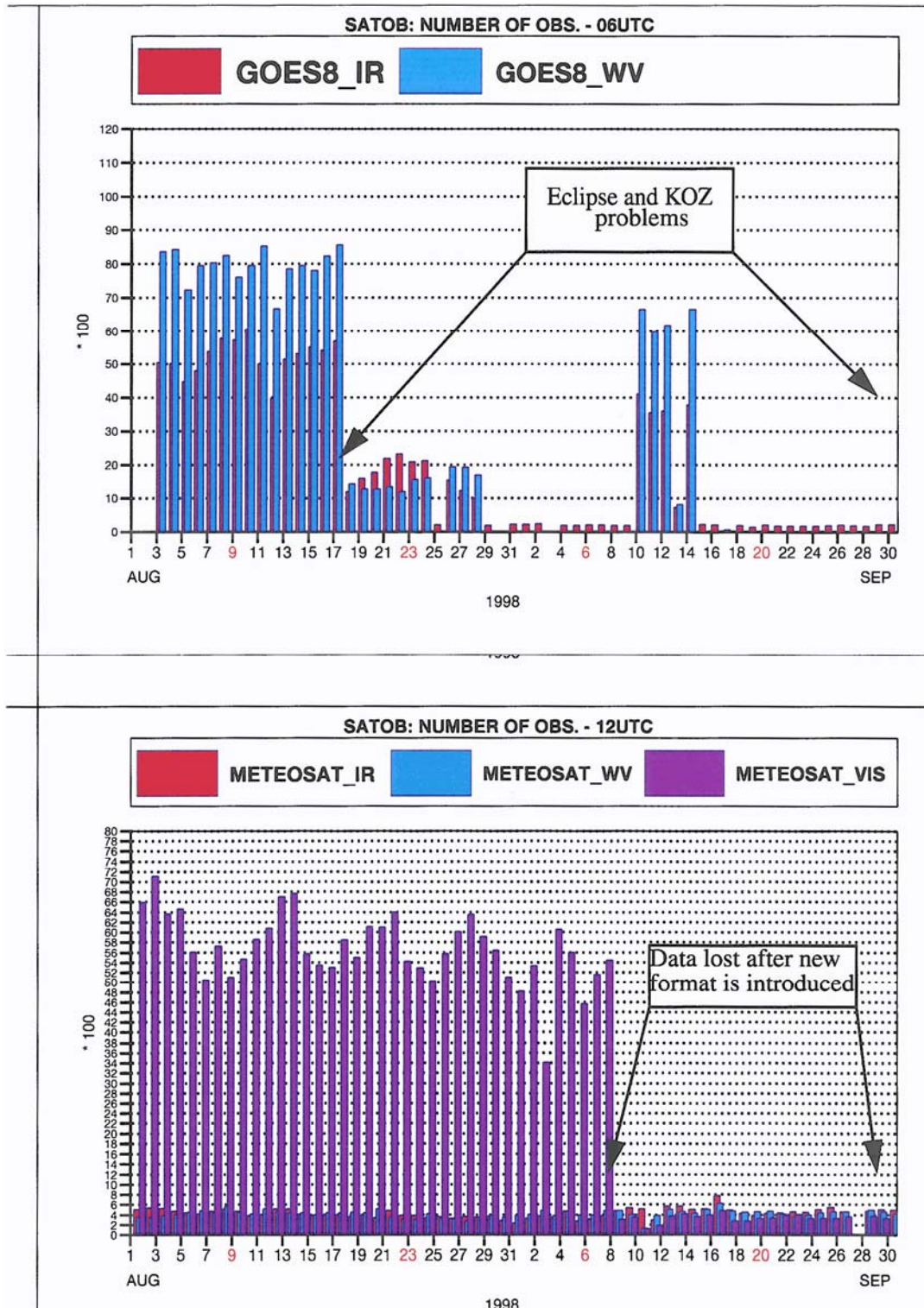


substantial bias of GOES AMW when compared to these observations, the signature of which is in agreement with what can be found for METEOSAT (not shown). Therefore the very good agreement of GOES AMW with the model first guess is likely to be either the signature of a good representativity (use of recursive filters for editing winds at NESDIS) or of the model being overwhelmed by possibly correlated AMW data and drifting away from other sources of observations.

Density plots of the 2D-space defined by the model vs satellite estimates of the wind are also used to highlight possible limited quality of either the data or the model. An example is shown in Figure 7 for High resolution visible winds from METEOSAT - although they show a good mean agreement, large overestimations of the



Figure 2: Time series of processed data volumes at ECMWF in August-September 1998; upper panel: GOES-8 (03-09UTC); lower panel: METEOSAT (09-15UTC)



AMW for low speeds are found, possibly correlated with height assignment problems in presence of high level, semi-transparent clouds.

#### 4. USE OF METEOSAT5/INDOEX DATA

As for any decision concerning the use of new data, METEOSAT5/INDOEX data have been



Figure 3: Data coverage of used AMW on 12/8/9812UTC

**1200 UTC 980812 (Wind )**  
**Total number of obs = 14713**

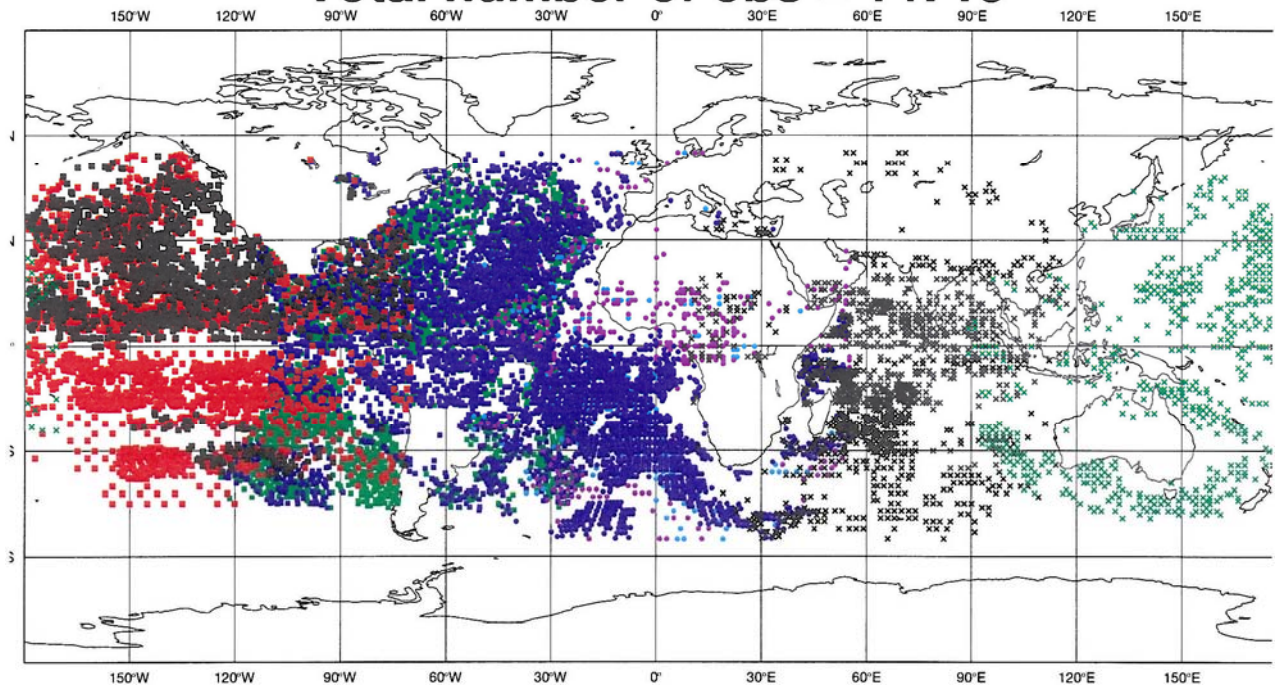


Figure 4: 12/8/98 rejection map: AMW are plotted as circles or squares (aircraft data as crosses, radiosondes as triangles); model 250-hPa wind speed is blue shaded beyond 40m/s.

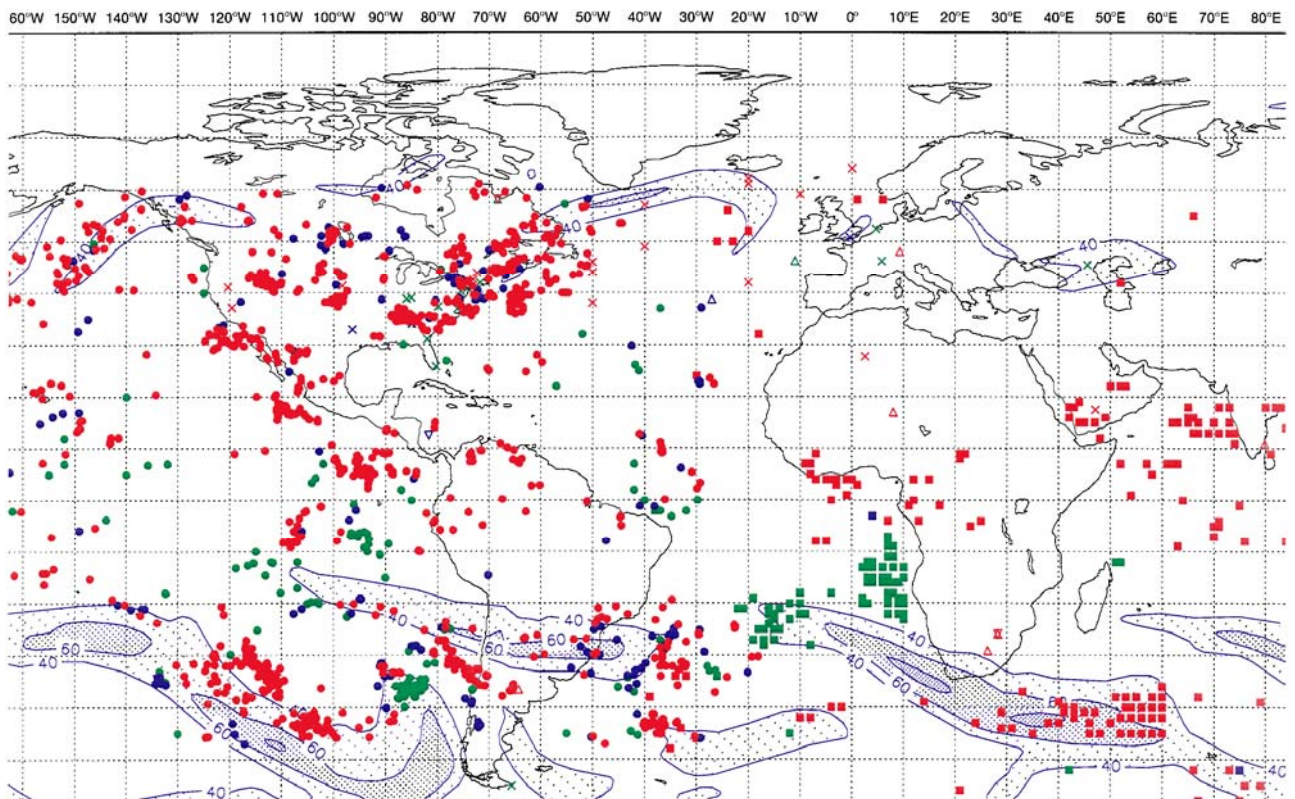


Figure 5: Time series of mean departures from ECMWF model first guess from 1989 to 1998

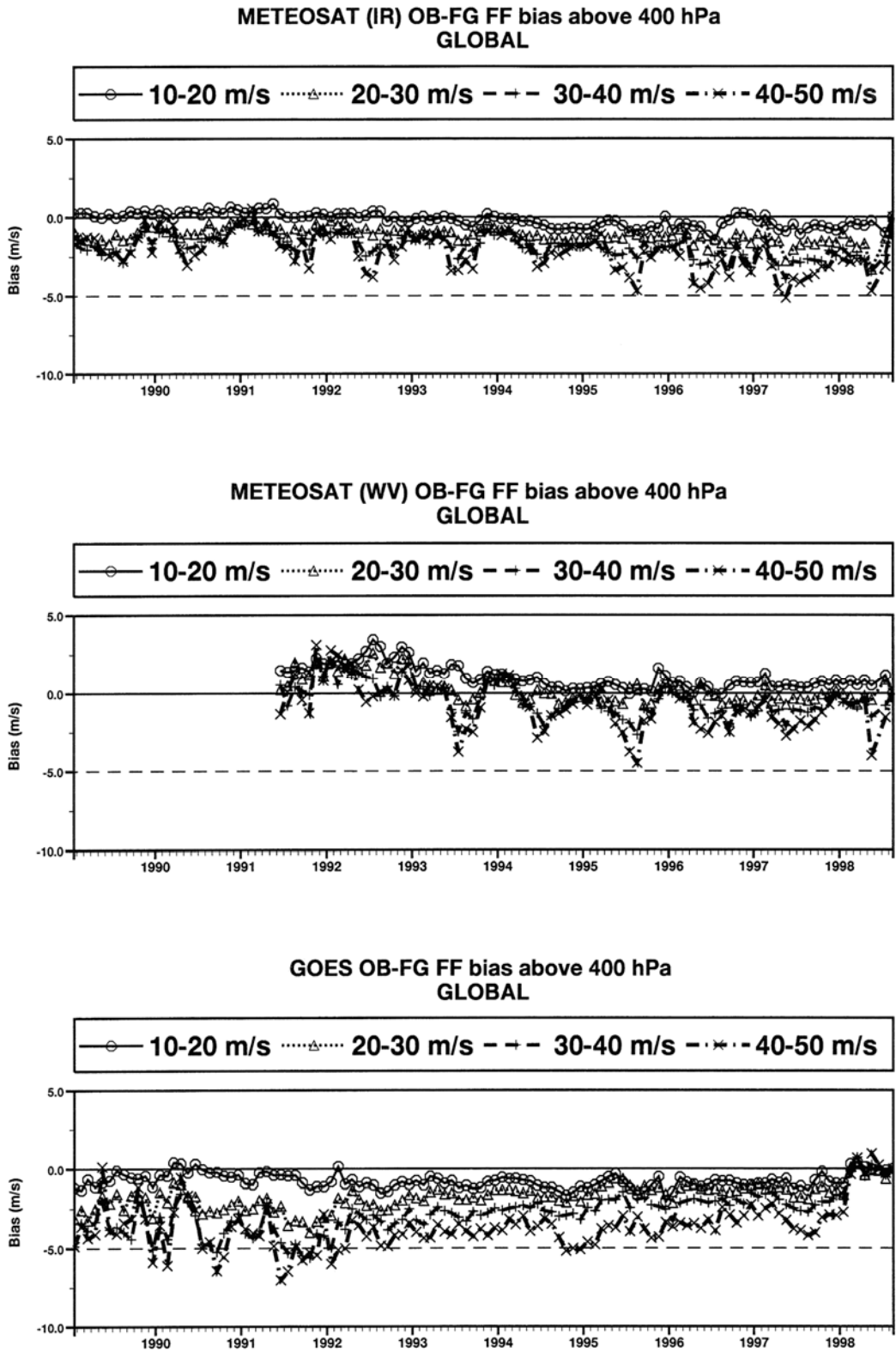
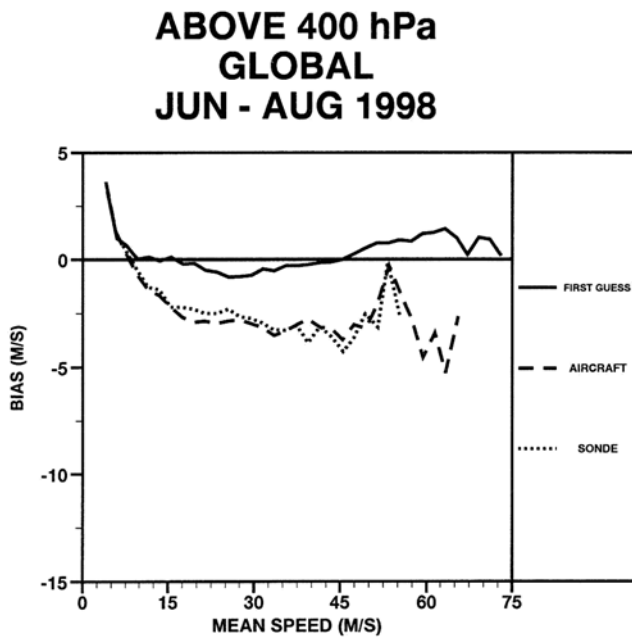


Figure 6: Statistics of mean departures of the GOES-8 IR AMW from collocated ECMWF short-range forecast (first-guess, full line), Aircraft (dashed) and radiosondes (dotted) observations. X-axis is for AMW speed, Y-axis for corresponding mean biases.



SATOB METEOSAT-7\_HRES  
1 JUN - 31 AUG 1998  
700-1000hPa  
AREA: 90S - 20S  
WINDSPEED

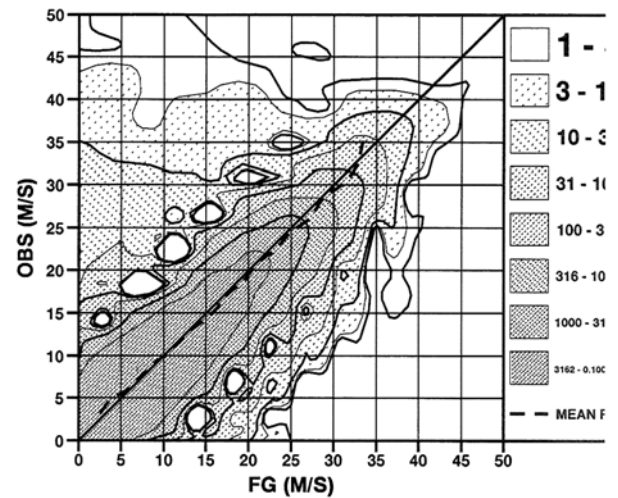


Figure 7: Density plot of METEOSAT 7 HR Vis AMW (y-axis) vs ECMWF collocated first guess (x-axis); contours are increasing in logarithmic scale

monitored for a few weeks before they were operationally used. This monitoring was both a production of statistics for first guess departures when the data were used in passive mode and a 20-days parallel run of the model with the new data. The mean difference of the 200-hPa wind field for this latter experiment is shown on Figure 8 where it is seen to re-enforce the easterly jet. The impact was found mainly neutral on global forecast scores; one case when the data were adding significant information on the location and intensity of a tropical storm is also depicted on the same figure (lower panel).

## 5. SUMMARY

A remarkable increase in both numbers, resolution and quality was observed in recent months; although objective measures show on average a modest impact on forecast quality, there are several indications that the assimilation of AMW can make the difference in some situations over Europe in the medium-range - missing GOES-W winds this summer following GOES-9 failure was followed by a spell of bad model performance at day 5-6 in that region.

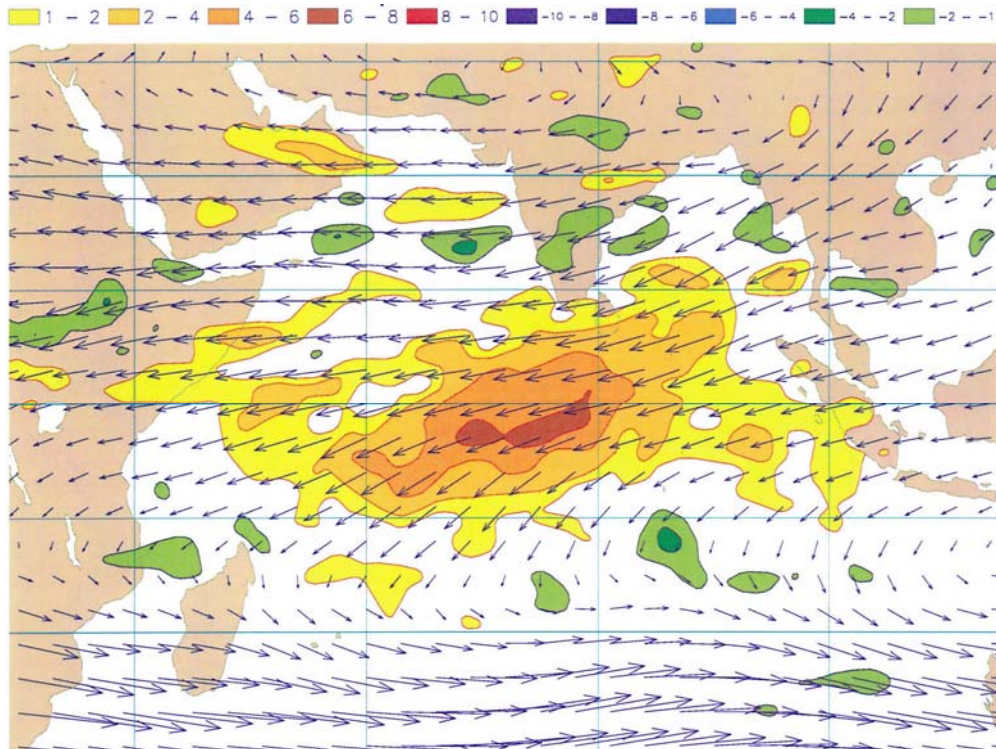
The increasing weight of these data on model performance means that more coordination than ever is needed between data providers and NWP centres in order to keep the number of interruptions under better control, and the information about changes in operational practice well known by the users

## 6. REFERENCES:

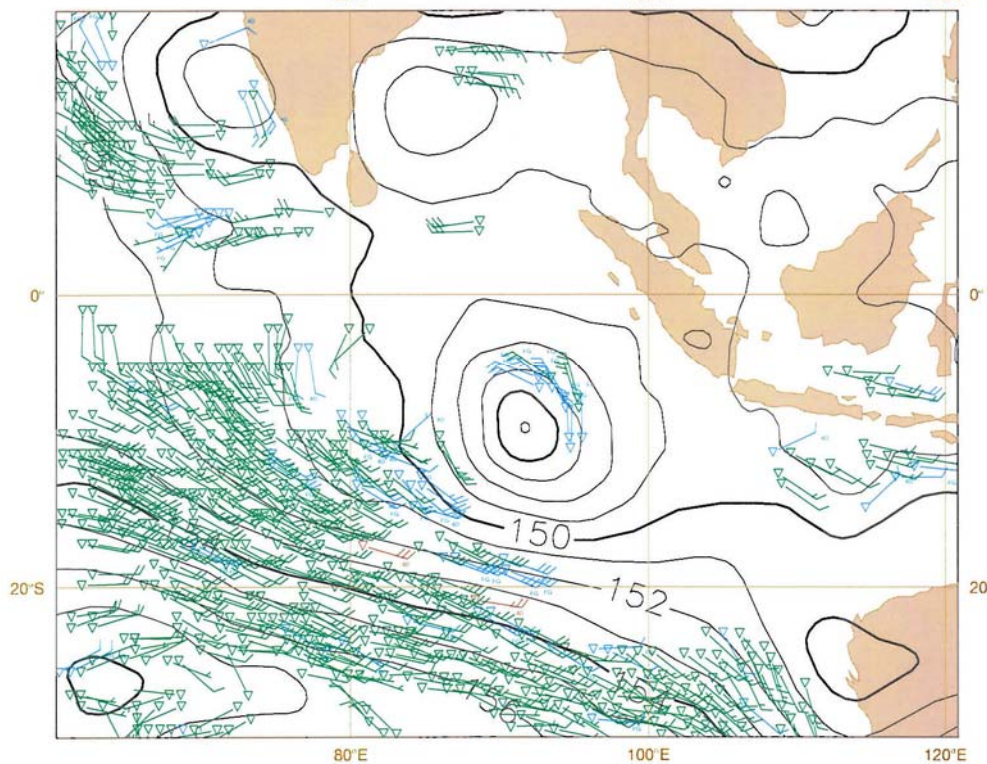
- Strauss, B. (1991): Monitoring of cloud-motion winds at ECMWF. EUMETSAT/NOAA/WMO Workshop on Winds extraction from operational meteorological satellite data, pp 151-157
- Strauss, B. and R. McGrath (1993): Quality assessment of operational cloud-motion wind data. EUMETSAT/



Figure 8: Impact of METEOSAT5/INDOEX winds on ECMWF data assimilation: mean 200-hPa wind difference found between the 20-days experiment with and without AMW (upper panel shading, vectors are mean analysed winds); lower panel: a case of good collocation of AMW with a tropical storm



850 hPa Z 06/10/98 06h exp:0011, Obs 6/10/1998 09z



JMA/WMO/NOAA Second International Winds Workshop, pp 175-184

Strauss, B. and A. Garcia-Mendez (1996): Quality assessment of operational cloud-motion wind data. EUMETSAT/JMA/NOAA/SMA/WMO Third International Winds Workshop, pp 215-220