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REPORT ON CURRENT USE OF AND PLANS ON USE NWP MONITORING RESULTS IN QUALITY MONITORING ACTIVITIES AT EUMETSAT

This report summarises the current and planned use of NWP monitoring results in quality monitoring activities at EUMETSAT.

It is in response to Action 30.24.

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1 INTRODUCTION

The monitoring of satellite data and derived product quality remains a significant task for the data producers. EUMETSAT currently co-operates closely with several European NWP centres, providing instantaneous feed-back on product quality and also provide long term monitoring of the products. The main counterpart beside the European Centre for Medium Range Weather Forecasts is the Numerical Weather Prediction (NWP) Satellite Application Facility (SAF) that is an integral part of the overall EUMETSAT Ground System.

The activities performed follow the recommendation done by ITSC XII: "The data provider quality assure all data, including level 1b and level 1d. The quality of the data (including, e.g. navigation) should be monitored at all stages including the final stage, which may have to be reformatted. The provider should attempt to identify and flag questionable poor data. Data providers, e.g. EUMETSAT and NOAA/NESDIS are encouraged to use NWP monitoring results to help them in diagnosing data problems."

Currently EUMETSAT operates the geostationary satellites system consisting of Meteosat-5, -6 and –7. Meteosat-8 (MSG-1) will become operational early 2004. EUMETSAT also provides quick access to ATOVS data with the EUMETSAT ATOVS Retransmission System (EARS). Outside the NWP SAF framework there are detailed discussion with respect to other monitoring activities with selected users (e.g. German Weather Service regarding IASI). The current NWP related monitoring activities are additionally to the before mentioned systems also used as a baseline for defining the future monitoring activities related to the EUMETSAT Polar System and the EUMETSAT contribution to the Ocean Surface Topography Mission (OSTM) with JASON-2. This paper will give a brief overview of the current and foreseen activities.

2 THE NWP SAF APPROACH

The development of the EUMETSAT Satellite Application Facility for Numerical Weather Prediction (NWP SAF) was started in February 1999 aiming at improving and supporting the interfa□e between satellite data/products and European activities in NWP. The NWP SAF is hosted by the Met Office, with ECMWF, KNMI, and Météo France as partners.

The objectives of the NWP SAF are:

- to improve the benefits derived by European NMSs from NWP, by developing techniques for more effective use of satellite data, and

- to prepare for effective exploitation within NWP of data/products from satellites in the EPS and MSG programmes and related programmes of other agencies.

The main functions of the SAF are:

- to co-ordinate user requirements for the interfaces between the data assimilation systems of European NWP centres and satellite data/products, and to evaluate priorities for meeting these requirements;
- to develop satellite data processing modules, including: pre-processing modules, retrieval modules, assimilation modules (including so-called 'observation operators'), modules for monitoring, tuning and quality control, and modules for validation of satellite products and of observation operators;
- to assist with the implementation of processing modules and to provide user support.

The SAF is concerned with the NWP data assimilation process rather than with generating geophysical parameters. Its main deliverables are software packages for implementation at NWP centres within their data assimilation schemes, or at EUMETSAT central processing facilities or at other SAFs. However, it should be noted that the monitoring of the quality of satellite data and derived products form an integral part of the NWP SAF functions.

3 CURRENT MONITORING ACTIVITIES

3.1 Monitoring of Atmospheric Motion Vectors derived with image data from geostationary satellites

Atmospheric Motion Vectors (AMVs) are derived by EUMETSAT and other satellite operators from the observed displacements of tracers (clouds or gases) between successive satellite images. These AMVs are used as observations by NWP centres. The NWP centres compare the AMVs with NWP background fields (very short range forecast fields) and gather statistics of the differences, which are generally characterised as "bias" (mean difference) and "scatter" (standard deviation) in the wind speeds. Vector differences are also examined. Errors in both the AMVs and NWP models contribute to the observed differences, and the contributions cannot usually be separated. Comparison of the O-B statistics from several NWP centres, running different NWP models, could potentially indicate which errors are attributable to the AMVs and which to individual models.

Comparable, selected O-B statistics from participating NWP centres presented in uniform (usually graphical) formats and integrated into a single report each month, enable immediate easy visual comparison and recognition of similarities and differences.

Initially, the choice of statistical display is restricted to plots that are already available at the contributing centres, for ease and speed of contribution. They will be contour density plots of mean O vs B wind speed for different AMV types in different geographical regions and global colour maps of mean and standard deviation of O-B wind speed differences. The former will give information on number of AMVs in

each region, and the overall fit to background. The latter will highlight geographical locations of persistent O-B wind speed bias. It is not in the plans of the NWP SAF to compare AMVs with other observation types, e.g. radiosondes or aircraft. These comparisons are already being undertaken both at EUMETSAT and at ECMWF and usefully complement the O-B comparison.

Figure 1 presents an example of the current monitoring results provided by ECMWF for the NWP SAF.

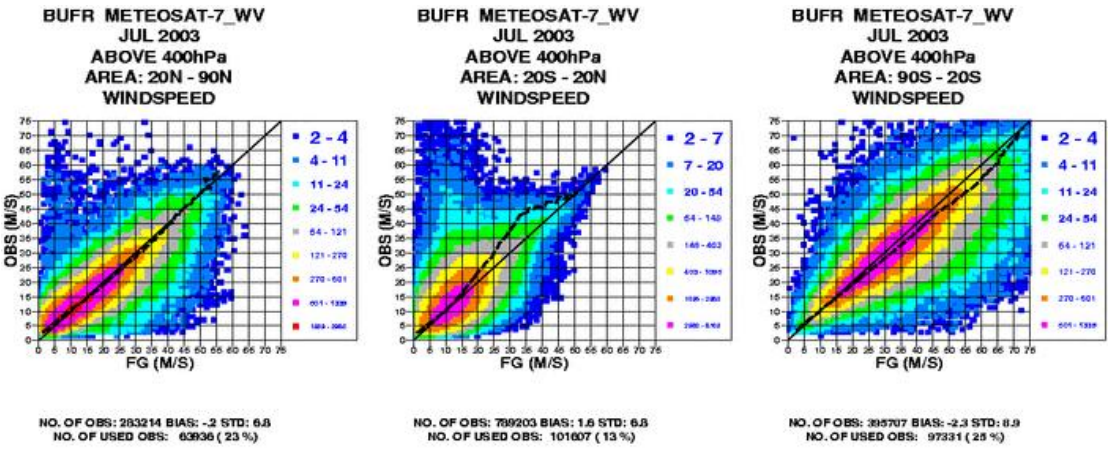

Figure 1. Observation vs. first guess departures for Meteosat-7 high levelcloud tracked water vapour winds.

3.2 Monitoring of radiances derived from geostationary observations

The MVIRI and SEVIRI radiometers on the METEOSAT and MSG platforms provide top-of-atmosphere radiances in 2 or 8 (respectively) infrared channels. The radiances can be either spatially averaged clear-sky radiances that are available in BUFR format from EUMETSAT or clear and cloudy radiances as received via user-stations at full resolution (5km for MVIRI and 3km for SEVIRI at the sub-satellite point**).** These radiance data can be used in several ways for NWP model developments. EUMETSAT started to provide Meteosat high resolution clear sky radiances in 1999 from the water vapour and window infrared channels, averaged over 80km areas, as an operational product. The aim of the NWP SAF is co-ordinate the monitoring of the Meteosat/MSG radiances by comparing them with the model simulated radiances.

The measured METEOSAT and MSG radiances are compared in near real time with corresponding simulated radiances from global NWP model fields. Time series plots of observed minus simulated radiances can highlight changes in the instrument performance, calibration, radiance preprocessing or NWP model.

The NWP SAF make monitoring reports available on the NWP website indicating the statistics of the radiance-model differences including reports issued documenting the monitoring statistics and assumed observation/forward modelling errors.

Figure 2 presents an example of the current monitoring results provided by the Met Office for the NWP SAF.

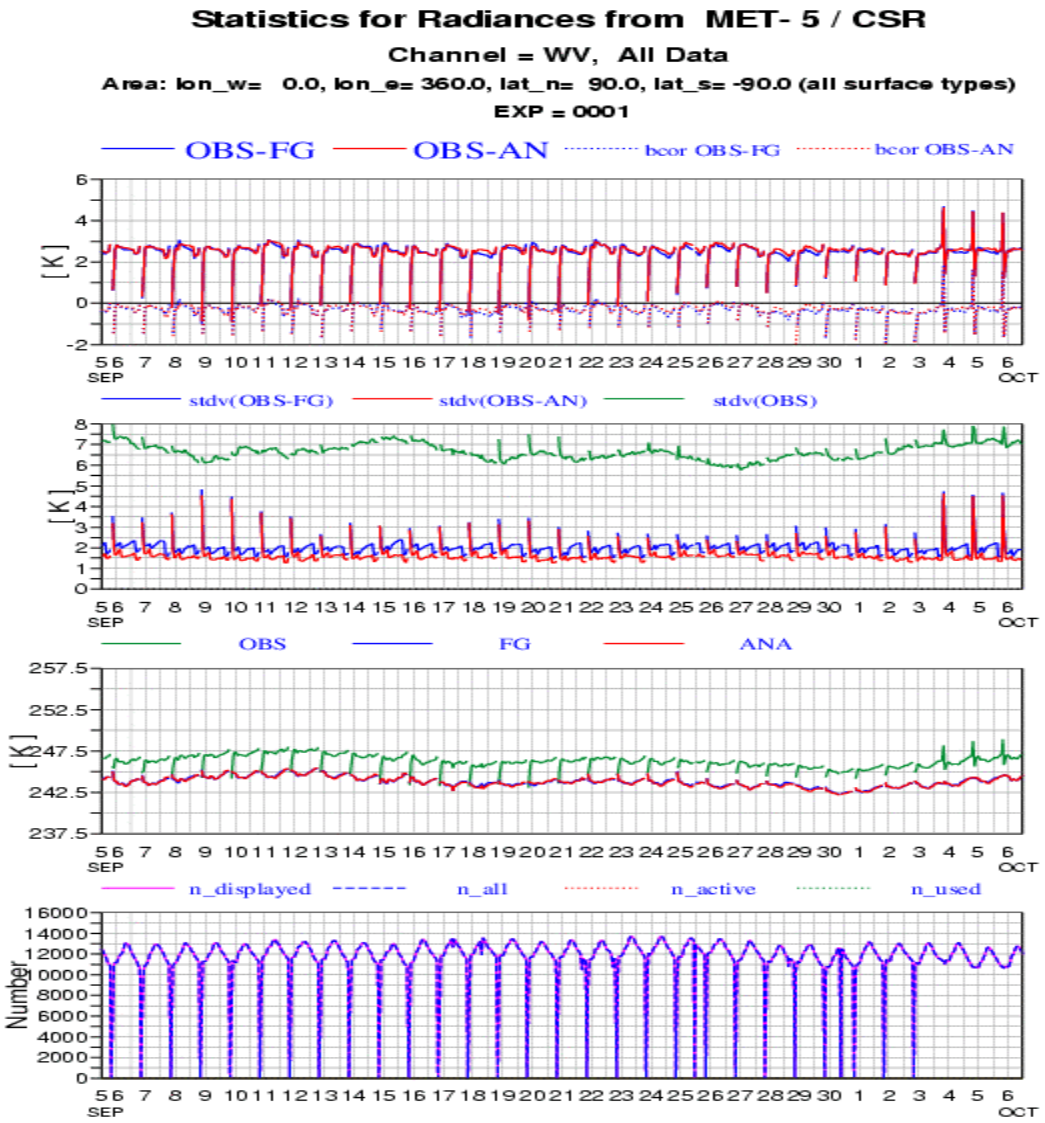

Figure 2. Radiance monitoring for Meteosat-5 water vapour channel provided by the Met Office.

3.3 Monitoring of ATOVS data

The quality of ATOVS data is monitored through the examination of the differences between the observed values and values calculated from short range NWP model forecasts. The NWP SAF provides unified monitoring reports on the Internet. In the short term useful information can be obtained by unifying some features (e.g. showing the same quantities for the same areas) and providing hypertext links between different centres' monitoring web pages. The objective is to provide some benefits in the short term by monitoring the same things whilst working towards unified monitoring in the longer term. This is of benefit to any user of ATOVS data.

The monitoring consists of daily time series of the mean and standard deviation of the difference between observed and calculated brightness temperatures for each channel

for selected regions. In addition data coverage plots are shown so that the user can determine whether the data being analysed are the same. When a user of such data sees an apparent change in their system the first priority is to determine whether the change is a change in the incoming data or a change in their system. This is most easily determined by examining whether other centres using the data have seen the same change. This can only be achieved if centres provide real time data monitoring showing the same quantities displayed an a very similar manner (ideally identically). Initially there will be subtle differences between the different centres providing the monitoring results. One of the problems is that the short range forecasts from ECMWF and the Met Office might change due to a change in the global observing network (e.g. temporary loss of a key data type). Therefore it is important to have a completely independent real time monitoring. This will be provided by Météo France at Lannion placing results of real-time monitoring against radiosondes on the internet.

Figure 3 presents an example of the current monitoring results.

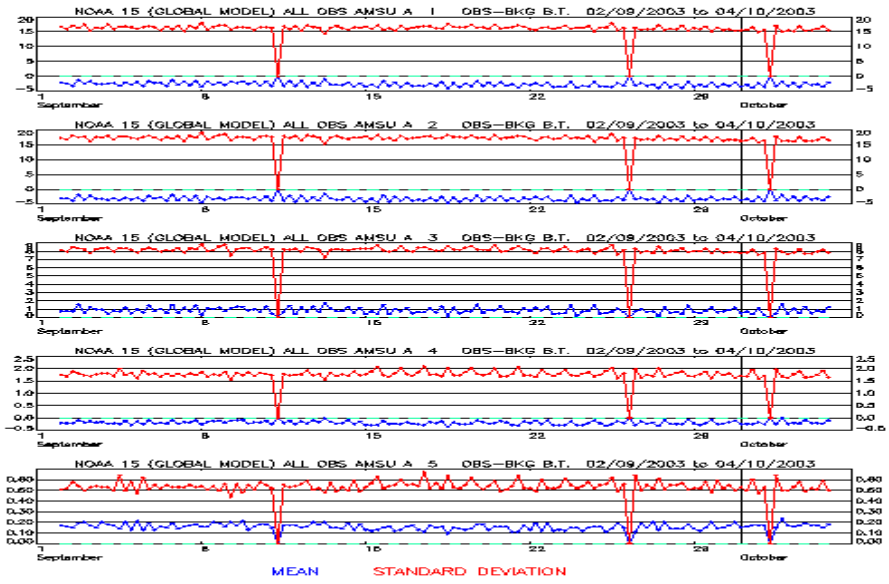

Figure 3. Example NOAA-15 Observed – Background all cloud types, 1 month strict quality control global, AMSU 1- 5

4 CONCLUSION

Additionally to the monitoring results presented above the NWP SAF is also monitoring other types of data e.g. SSM/I or scatterometer data (Figure 4.)

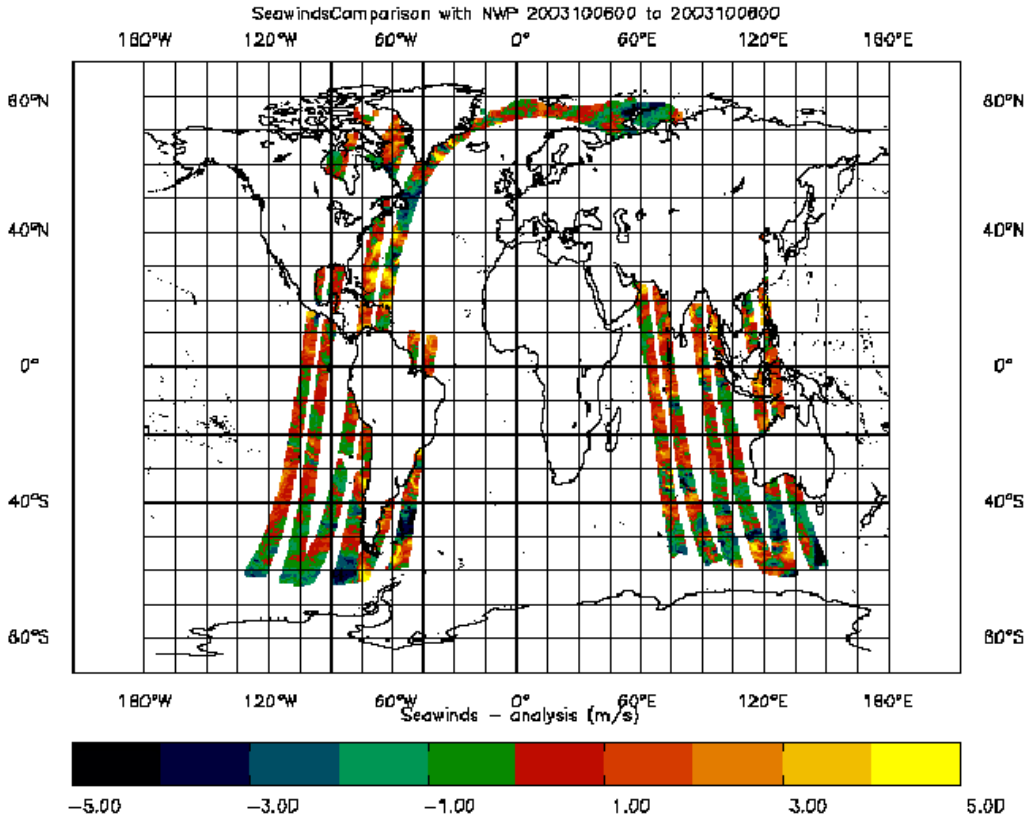

Figure 4. An example of scatterometer monitoring results provided by the NWP SAF.

It should be noted that the European weather services and NWP centres provide real time feed-back via email or other means together with detailed information e.g. plots on satellite data and product quality issues.

The current activities form an initial step to a consolidated approach involving also the EUMETSAT Polar System for which the first satellite METOP-1 is foreseen to be launch in the 4th quarter of 2005. In these activities the NWP SAF will play a key-role, however specific discussions, e.g. vis-a-vis the monitoring of IASI radiances by the German Weather Service are on-going.

For further details on current monitoring activities are available via the EUMETSAT WEB page http://www.eumetsat.de
or with respect to the NWP SAF Activities at the host institute WEB page at the Met Office http://www.metoffice.gov.uk/research/interproj/nwpsaf/index.html