CURRENT STATUS OF EUMETSAT OPERATIONAL WINDS

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ABSTRACT

EUMETSAT currently operates two geostationary satellite systems and one polar satellite system. Wind data, or relevant information, is derived both by tracking atmospheric features in consecutive multi-spectral images or by scatterometry.

The paper will give an overview of the EUMETSAT wind products and the recent changes that have been introduced. A special focus will be given to the introduction of a new baseline radiative transfer model into operations, enabling consistency between development and end user applications. As the change was at the core of product generation from geostationary satellite data, a complete validation of comparable to the commissioning of a new satellite had to be performed. With respect to the Atmospheric Motion Vectors the change affected directly the height assignment of the vectors, one of the pertinent problem areas of this data.

1 INTRODUCTION

Derivation of Atmospheric Motion Vectors has always been a central part of the product generation using EUMETSAT satellite data. In the beginning only data from the infrared window was used for tracking, whereas as the water vapour channel was used to support the height assignment. Since the initial configuration many changes have occurred and now high resolution multi-channel wind products are derived with two geostationary satellite system, the Meteosat First and Second generation satellites using both full-disc and rapid scan data. In addition winds are also derived over the polar region using AVHRR data from Metop and finally the ASCAT scatterometer on Metop provides essential measurements with respect to the ocean surface wind conditions.

This paper will give an overview of the current and upcoming satellite activities, anticipated changes in affecting the wind generation and gives an overview of major recent changes. A special focus is given to the change in the radiate transfer model in summer 2009. This change affected all the products generated at EUMETSAT and with respect to the Atmospheric Motion Vectors the change affected directly the height assignment of the vectors, one of the pertinent problem areas of this data.

2 SATELLITE CONFIGURATIONS

2.1 The Geostationary satellites

Since the previous International Winds Workshop, no major change in the EUMETSAT geostationary satellite configuration has taken place. The primary service over the European-African region is now provided by the Meteosat Second Generation (MSG) satellite Meteosat-9 whereas. Meteosat-8 is the hot standby satellite and provides also the rapid scan service over Europe. Meteosat-8 has now been in orbit over its specified lifetime of seven years and is still performing well.

Over the Indian Ocean area the last of the Meteosat First Generation (MFG) satellites, Meteosat-7, provides the nominal service from 57.5 degrees east, whereas Meteosat-6 provides the hot standby service from 67.5 degrees. It should be noted that Meteosat-6 is now running out of fuel for any station keeping and hence the re-orbiting of the spacecraft is now planned for spring 2011.

In addition to the re-orbiting of Meteosat-6, the launch of MSG-3 satellite early 2012 and MSG-4 roughly two years later, will influence the in-orbit configuration of the Meteosat satellites. These two satellites will be renamed Meteosat-10 and -11 respectively as they enter operations.

Figure 1 presents the satellite transitions discussed above and gives an overview of the current planning until the end of 2014. It should be noted that the operations of Meteosat-7 is currently agreed until end of 2013 and the continuation of the Indian Ocean Data Coverage service will be reassessed after the successful launch of MSG-3, and is also depending on the quality of service provided by other satellite operators in the region in question.

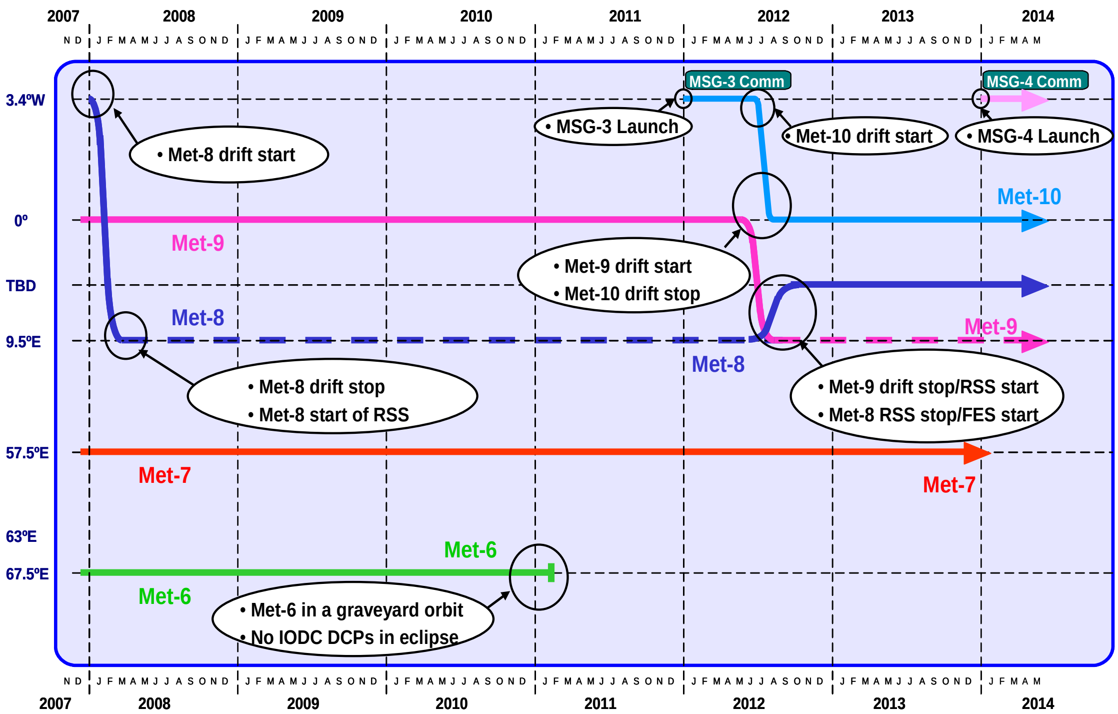

Figure 1. The EUMETSAT geostationary satellite configuration for 2007 – 2014.

2.2 The Polar System

In addition to the geostationary satellite system EUMETSAT also operates the Metop-satellites and provides services from other missions like JASON-2 and SARAL as well as data relay and formatting services from further missions like MODIS.

With respect to the Metop satellite, all instruments are in very good health, with the exception of AMSU-A for which the channel 7exhibits out of spec noise. In addition a small spectral anomaly has been noted on the IASI ground-processing, affecting in particular detector 2 (for certain wavelengths the noted difference between detectors is up to 0.5 K). The cause has been identified to an uncorrected Gibbs effect, due to asymmetrical alignment in the optical axis causing non-linear effects in the Fourier transformation. An improved processor is currently under development by the French space agency CNES.

The launch of the next satellite, Metop-B, is now planned for 2012 and a full parallel service for the functioning instruments is planned to continue until the end of Metop-C commissioning currently foreseen in 2016. The parallel operations will significantly improve the coverage of the Metop data, but opens also up a possibility for new exciting dual-satellite products using the overlap area of the two satellite footprints.

In addition to the launch of Metop-B EUMETSAT is together with NOAA looking at the possibility to improve the timeliness for the Metop data through the use of a ground station at McMurdo in Antarctica. The start of a demonstration service with a limited number of orbits is expected in 2011, with a full operational service for all orbits in 2014. This will reduce the time delay for data distribution to the users by half. The oldest Level-1 data will then be ca 65 mins from sensing.

2.3 Other relevant Activities

2.3.1 ASCAT Fast Extraction Service

Shortly after the launch of Metop-A the onboard Advanced High-Resolution Picture Transmission system failed. This impacted seriously the users using local reception stations. A limited coverage service using redundant onboard equipment has now been implemented, and a widening of the service is considered in 2010. As part of the mitigation activities a fast extract service for ASCAT has also been implemented. This service extracts the ASCAT data for the northern hemisphere and provides it via alternative routes to the processing at EUMETSAT that generates the so-called sigma 0 Level-1 data. The level-1 data is then transferred to KNMI (Koninklijk Nederlands Meteorologisch Instituut) for the generation of the winds over the oceans and provides a timeliness of the data of ca 30 mins, which is significantly better than the ca 115 min service for the global data. Figure 1 gives an example of the coverage for the level-1 data

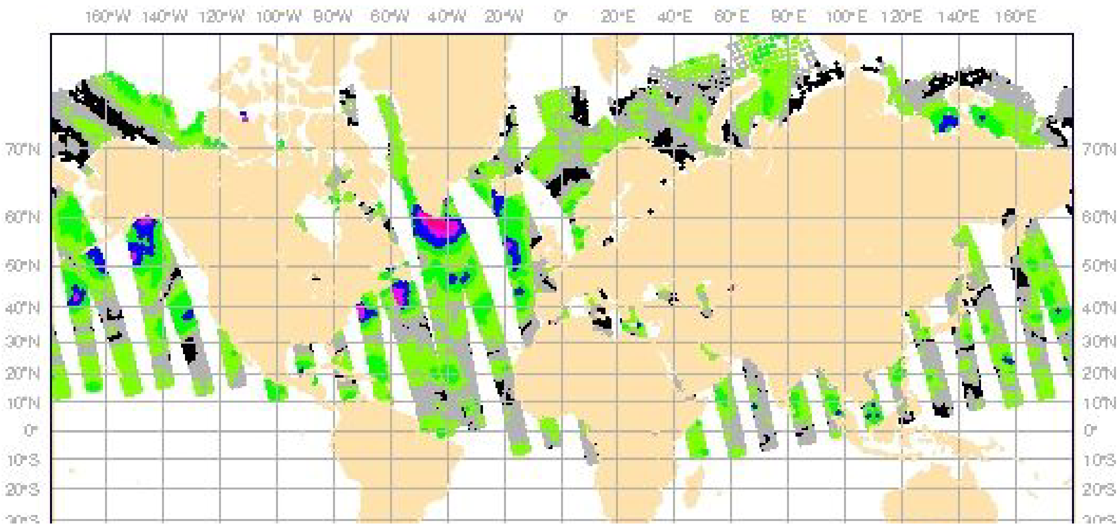

Figure 2. An example of the coverage of the fast extract ASCAT Level-1 data.

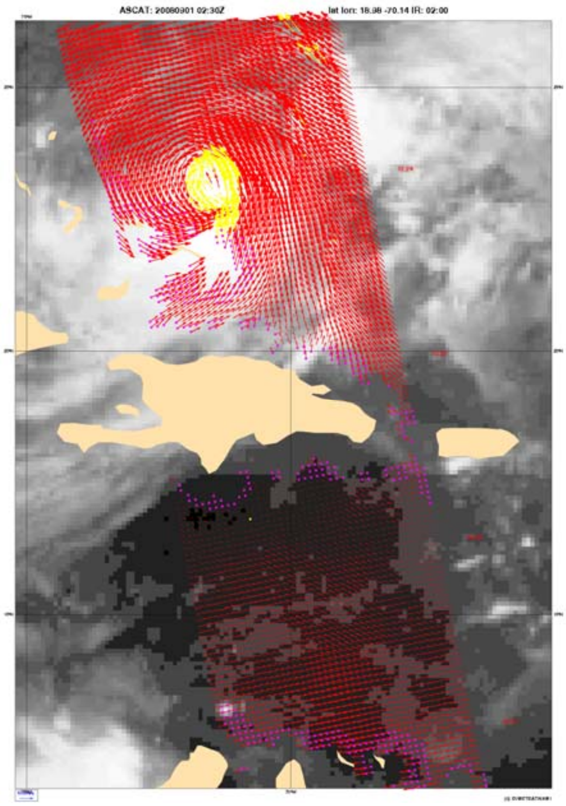

Figure 3. An example of wind data provided by the OSI-SAF KNMI (wind speed and direction over the oceans at 12.5 and 25 km resolution).

2.3.2 Oceansat-2

On 23 November 2009 the SeaWinds instrument onboard QuicSCAT failed. Since then, only ASCAT provides a global near-real time scatterometer mission. However, on 23 September 2009 the Oceansat-2 satellite was successfully launched by the Indian Research organisation ISRO. The spacecraft includes the SCAT scatterometer mission, which originally was intended for a regional mission only. With the loss of the QuicSCAT mission

EUMETSAT and NOAA are now negotiating with ISRO to make the data from SCAT globally available in near-real time. A potential scenario includes acquisition of the data in Svalbard as well as in Wallops and Fairbanks with derivation of Level-1 data at ISRO (and potentially also EUMETSAT and/or NOAA) and wind generation at KNMI. Data distribution would be performed globally via GTS and locally using EUMETCast with a similar timeliness to the ASCAT data from Metop.

3 ATMOSPHERIC MOTION VECTOR PRODUCTS GENERATED AT EUMETSAT

3.1 The Geostationary Atmospheric Motion vectors

3.1.1 Current Products

Table 1 gives an overview of the current operational wind products from the EUMETSAT geostationary satellites The products are available in BUFR over the GTS and a subset is available also over EUMETCast. For further details please consult the EUMETSAT web-site (www.eumetsat.int).

Table 1. The EUMETSAT operational wind products from the Meteosat satellites.

Product	Satellite	Region	Bulletin header	Product times
Clear Sky Water Vapour Winds	Meteosat-7	IODC	IXCN01-IXCN03 IXCS01-IXCS03	Every 1.5 h 00:00,01:30…
Expanded Low Res Winds	Meteosat-7	IODC	IXCN05-IXCN11 IXCS05-IXCS11	Every 1.5 h 00:00,01:30…
High Res Water Vapour Winds	Meteosat-7	IODC	IXCN13-IXCN22 IXCS13-IXCS22	Every 1.5 h 00:00,01:30…
High Resolution Visible Winds	Meteosat-7	IODC	IXCN24-IXCN29 IXCS24-IXCS29	Every 1.5 h 00:00,01:30…
Atmospheric Motion Vectors	Meteosat-9	Africa/ Europe	IUVA01-IUVA89 IUVD01-IUVD89 IUVE01-IUVE89 IUVH01-IUVH89 IUVI01-IUVI89 IUVL01-IUVL89	Hourly 00:45,01:45...
RSS AMVs	Meteosat-8	Europe		Every 20 mins 00:20,00:40...

Since the last International Winds Worksop the most significant change affecting the extraction of winds data from the Meteosat satellites was the introduction of RTTOV radiative transfer model together with improved surface emissivity maps in MSG operational processing. The use of RTTOV as the main RTM as compared to the old operational RTM the SYNSATRAD introduces significant savings in overall computing resources, particularly important in optimal estimation techniques. Since the start of the development of the MSG Meteorological Product Extraction Facility the RTTOV model has been significantly improved, in particular in the water vapour bands so the impact in product quality is expected to be negligible. Furthermore the use of RTTOV brings advantages as the same model is used by many users and scientific developers.

The introduction of RTTOV was however complicated as RTMs lie in the core of product generation and such a change will impact all products. With respect to the Atmospheric Motion Vectors the impact is twofold:

⇒ Direct impact on AMV height assignment

⇒ Indirect impact via cloud detection

The validation of this change can be compared to the launch of a new satellite. In general the changes were small and expected. Table 2 and Figure 4 present the outcome of the in-house AMV validation.

Table 4. The impact of the RTM change on AMVs.

	All AMV's				AQC			AMV's QI > 80%			
	TOT	HGH	MID	LOW	FCST	TVEC	SVEC	TOT	HGH	MID	LOW
WV 6.2											
OPE-B	11113	9057	2052		41.7	68.4	69.2	3880	3623	257	
Diff	-40	-326	287		0.0	-0.1	-0.3	-42	-57	15	
% of OPE	-0.4	-3.6	**14.0**		-0.1	-0.1	-0.5	-1.1	-1.6	**5.9**	
WV 7.3											
OPE-B	11710	5142	6117	451	39.5	74.8	70.3	4190	3217	831	142
Diff	-38	-4	-190	156	0.1	0.0	-0.3	-22	-24	-37	40
% of OPE	-0.3	-0.1	**-3.1**	**34.5**	0.2	0.0	-0.4	-0.5	-0.8	**-4.5**	**28.1**
IR 10.8											
OPE-B	10254	4629	998	4627	55.4	80.1	75.7	5056	2348	316	2392
Diff	29	58	-100	70	-0.1	0.0	-0.4	-23	8	-64	33
% of OPE	0.3	1.3	**-10.0**	1.5	-0.2	0.1	-0.5	-0.5	0.4	**-20.2**	1.4
VIS 0.8											
OPE-B	5916			3077	48.4	83.2	74.6	1724			1724
Diff	-5			21	-0.2	0.0	-0.9	6			6
% of OPE	-0.1			0.7	-0.4	0.1	-1.2	0.3			0.3
HRV											
OPE-B	14439			8362	53.2	83.0	80.3	5059			5059
Diff	-25			16	-0.5	0.3	-0.1	14			14
% of OPE	-0.2			0.2	-1.0	0.3	-0.1	0.3			0.3

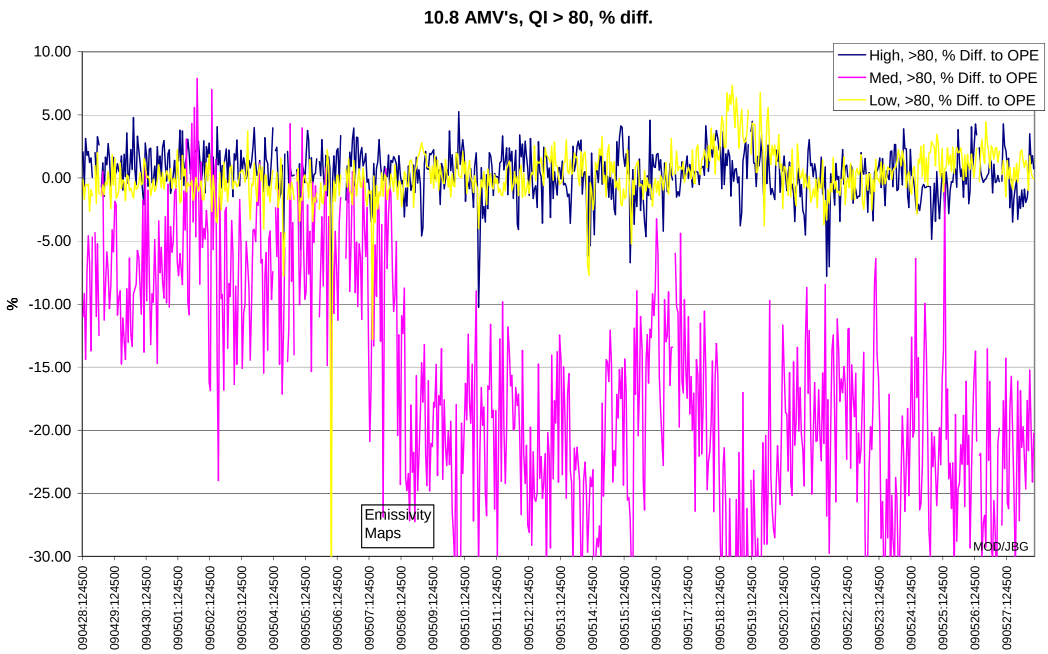

Figure 4. Time series plots over 1 month (28 April to 27 May 2009) of high-, mid- and low-level AMV numbers for IR10.8 channel after applying 80% QI filter. Values are shown as difference (Validation minus Operational) expressed as percentage difference from Operational.

In addition to in-house validation there was also feedback from ECMWF. Figure 5 presents the monitoring of the heights for the old system (left) and the new system (right). For further details see Genkova et al (2010).

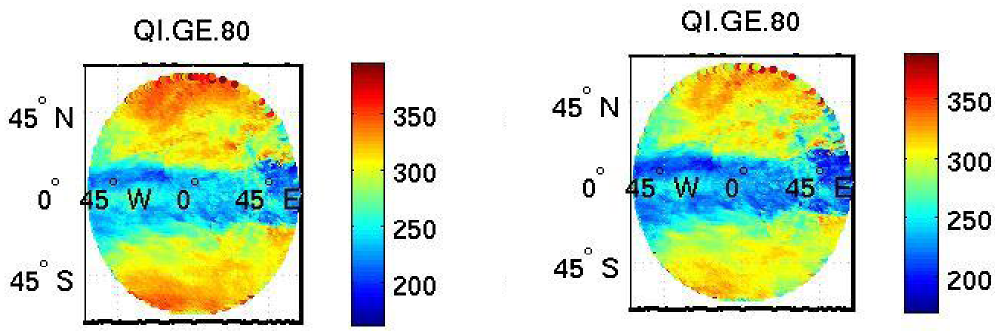

Figure 5. Changes in heights for high quality winds (Quality Indicator > 80) due to the new RTM as depicted by EC MWF.

The overall outcome of the change has been a redistribution of the assigned heights, which depend on the changes in the average temperature of the channels used for AMV height assignment. The AMV heights at high/medium levels are dominated by channels IR10.8 and IR13.4 as well as IR12.0, where IR10.8 has become slightly colder but IR13.4 is almost unchanged.

The largest differences with respect to the number of generated AMVs (in %) are seen for medium levels (especially the WV6.2 and the IR10.8 channels), but it should be noted that the absolute amounts are small for these levels. The average quality indices are very similar, with absolute differences matching the size of the rounding error and the noise within the system.

The RTM change also raised some concerns on how to validate changes and which parameters should be chosen to determine if a change should be introduced operationally or not. Traditional radiosonde statistics or NWP monitoring do not always provide conclusive results. For NWP purposes impact studies could be performed, but also here the interpretation of the results is not straight forward. Hence a further discussion is required and has been triggered in the context of the 10^{th} International Winds Workshop (de Smet et al, 2010).

With respect to upcoming changes the most significant change is the transition to a new NRT computing environment scheduled for spring 2010. This will enable the introduction of more model levels for the RTM calculations. In addition a small increase in the processing area is foreseen (65^o => 67.5^o). With respect to current activities related to rapid scan winds see Carranza et al. (2010) and for improvements in methodologies Borde et al (2010).

3.2 Winds generated from the polar system

Currently two types of wind data is generated from the EUMETSAT polar system. Global data coverage is provided by the ASCAT instrument and the associated wind processing performed by the Ocean and Sea Ice Satellite Application Facility. The processing is performed in NRT and the data is provided to the users generally within 135 mins after sensing. For further details see http://www.osi-saf.org/. In addition, EUMETSAT provides together with KNMI, wind data from the ASCAT fast extract service is provided as described above.

In addition to ASCAT wind data EUMETSAT, is currently implementing a polar wind processing product that uses AVHRR data. For details see Dew and Ackermann (2010).

4 REPROCESSING

EUMETSAT has in the past supported various NWP centre reananlysis activities though reprocessing and regeneration of AMVs using historical data. These activities have until now only been performed for MFG satellites. However, with the upcoming reprocessing of the MSG imagery data due to the change in the radiance definition (see Holmlund et al, 2008) it is now also planned to regenerate all the AMV products from the MSG-satellites. This reprocessing is currently foreseen for 2011. In addition, reprocessing of MFG data is foreseen when further improvements in calibration is realised. Finally, it should be noted that EUMETSAT regularly reprocess ASCAT data for the provision of better surface wind observations over the oceans.

5 CONCLUSIONS

An overview of the current geostationary satellite system and the derived wind products has been given. Upcoming changes, both with respect to the derivation of the products as well as to the satellite configuration have been given. Additionally a brief overview of the EUMETSAT reprocessing activities was presented.

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