CGMS-XXXI EUM-WP-10
Prepared by EUMETSAT
Agenda Item: II/6

REVIEW OF CURRENT APPLICATION OF CLIMATE MONITORING PRINCIPLES FROM SATELLITES

This paper provides a first analysis addressing to what extent current practice of data handling at EUMETSAT adheres to the GCOS climate monitoring principles. The paper responds to Action 30.09, which reads: In view of the increasing use and importance of operational meteorological satellite data for climate research and monitoring, CGMS is invited i) to consider a review of current practice of satellite operators with regard to the climate monitoring principles from satellites, and ii) to provide pertinent reports at CGMS XXXI meeting.

REVIEW OF CURRENT APPLICATION OF CLIMATE MONITORING PRINCIPLES FROM SATELLITES

1 INTRODUCTION

The purpose of this paper is to provide a qualifying statement to what extent EUMETSAT adheres already to the GCOS Climate Monitoring Principles (CMPs). Section 2 lists the CMPs relevant to satellite observations and provides an item-by-item response highlighting open issues. The open issues should be discussed within Working Group II at CGMS XXXI. The concluding section also recalls that EUMETSAT will in due course operate a 'Satellite Application Facility (SAF)' on Climate Monitoring that currently is still in the development phase.

2 THE GCOS CLIMATE MONITORING PRINCIPLES AND CURRENT ADHERENCE BY EUMETSAT

Long-term data sets from operational meteorological satellite are increasingly used for studies of the variability of climate quantities. As these satellites have been designed for weather applications rather than climate they typically lack adequate instrument characterisation, calibration accuracy and orbit stability amongst other problems. Operational satellite systems are, however, in principle very suitable for climate observations because the operational satellite programmes have a long-term commitment.
In order to foster the usefulness of current and future observing systems for climate applications an effort has been made to formulate 'Climate Monitoring Principles (CMPs)' as firm guidance that should be adhered to. The effort was initiated by Dr. T. Karl of NOAA/NESDIS. CGMS XXX discussed and amended the CMPs relevant to satelite observations and WMO EC–LIV endorsed the CMPs.

In the following the ten CMPs referring to satellite observations are recalled (in italic). The original numbering, i.e. from 11 through 20 is kept because CMPs 1 to 10 refer to in-situ observing systems. An item-by-item response concerning the current adherence by EUMETSAT follows the corresponding CMP.

Furthermore, satellite systems for monitoring climate need to:

- *(a) Take steps to make radiance calibration, calibration-monitoring and satellite-to-satellite cross-calibration of the full operational constellation a part of the operational satellite system; and*
- *(b) Take steps to sample the earth system in such a way that climate-relevant (diurnal, seasonal, and long-term interannual) changes can be resolved.*

Thus satellite systems for climate monitoring should adhere to the following specific principles:

11. *Constant sampling within the diurnal cycle (minimizing the effects of orbital decay and orbit drift) should be maintained.*

The EUMETSAT polar system (EPS/Metop) will maintain its orbit (i.e. 0930h equator crossing time, descending node). The current requirement, is to maintain the orbit within +/- 5 minutes. Currently it is being considered to improve this to +/- 2 minutes due to additional constraints from the Space Segment.

12. *Overlapping observations should be ensured for a period sufficient to determine inter-satellite biases.*

For the geostationary Meteosat satellites overlapping periods were always planned on the basis of a 'hot-back-up'-strategy which requires a back-up satellite in space. This strategy is not being changed. The current baseline for EPS is to launch a new satellite six months before the end of the life-time of the previous satellite, so as to allow over lapping during commissioning phase.

13. *Continuity of satellite measurements (i.e. elimination of gaps in the long-term record) through appropriate launch and orbital strategies should be ensured.*

See response to item 12.

14. *Rigorous pre-launch instrument characterization and calibration, including radiance confirmation against an international radiance scale provided by a national metrology institute, should be ensured.*

Considerable efforts have been made to improve the characterisation of the imaging instrument SEVIRI on-board Meteosat Second Generation over and above what has been done for the first generation Meteosat satellites. The ongoing MSG commissioning and the experience of the first year of operation should confirm the success of those efforts. As for EPS, all new instruments including the high-spectral resolution sounding instrument IASI, are being developed with great care concerning their characterisation and calibration.

15. *On-board calibration adequate for climate system observations should be ensured and associated instrument characteristics monitored.*

The new MSG satellites have an on-board calibration system for the thermal IR channels with an absolute accuracy of about 1 K.
Solar channels are calibrated with a vicarious calibration based on stable earth's targets and radiative transfer calculations and an accuracy of 5% is envisaged. This is a substantial improvement over the currently obtained accuracy of about 10%.
Calibration issues and product accuracy requirements for EPS are addressed in the End User Requirements which in turn formed the basis for the system development.

16. *Operational production of priority climate products should be sustained and peer-reviewed new products should be introduced as appropriate.*

EUMETSAT has made conscientious effort to derive products from Meteosat for climate applications. The ISCCP and GPCP projects have been and are being served. EUMETSAT contributes to the re-analyis projects at ECMWF through a re-processing of AMVs (atmospheric motion vectors) including a re-calibration of the Meteosat thermal IR- and WV-channels. The production of a multiyear surface albedo data set from Meteosat is noted as a prototype exercise for future peer-reviewed climate product from archived data.

17. *Data systems needed to facilitate user access to climate products, metadata and raw data, including key data for delayed-mode analysis, should be established and maintained.*

This process is currently pursued; see also Action 30.28 and EUM-WP-22.

18. *Use of functioning baseline instruments that meet the calibration and stability requirements stated above should be maintained for as long as possible, even when these exist on de-commissioned satellites.*

This will be relevant to EUMETSAT as concerns the future EPS satellites (and possibly for MSG with SEVIRI and GERB). No clear response is possible at this in point in time.

19. *Complementary in-situ baseline observations for satellite measurements should be maintained through appropriate activities and cooperation.*

EUMETSAT has established co-operations with NWP centres (e.g. ECMWF) concerning the monitoring of satellite radiances and products. As these centres also assimilate other data, e.g. radiosondings, this type of monitoring is deemed to be most effective for bias detection.

20. *Random errors and time-dependent biases in satellite observations and derived products should be identified.*

CGMS has established a satellite inter-calibration for a selected number of imaging and sounding channels. This effort should be continued to provide a basis, together with NWP monitoring, for the assessment of bias and random errors.

3 CONCLUDING SUMMARY

WG II is invited to take note of the current adherence of EUMETSAT to CMPs and comment as appropriate.
WG II is also invited to foster the continuation of the CGMS inter-calibration efforts to include other channels than the IR and WV that are currently considered.

Finally it is recalled that a Satellite Application Facility (SAF) on Climate Monitoring has nearly completed its development phase and will provide products for climate applications in the future. A meeting between the CM SAF and GCOS is planned for May 2004.