CGMS-XXXI EUM-WP-22
Prepared by EUMETSAT
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Discussed in WG II

CONSIDERATIONS ON SATELLITE DATA FOR CLIMATE APPLICATIONS AND A CONSOLIDATED LIST OF METADATA

The document provides input to discussions in Working Group II with regard to the current work at EUMETSAT on data and products for climate applications.

This paper responds to Action 30.28 and 30.22.

CONSIDERATIONS ON SATELLITE DATA FOR CLIMATE APPLICATIONS AND A CONSOLIDATED LIST OF METADATA

1 INTRODUCTION

Discussions at CGMS XXX within Working Group II addressed the opportunity and need to establish data sets from operational meteorological satellites suitable for climate applications. In that regard WG II placed the following two actions which are briefly addressed in this paper (also through cross-referencing to other papers):

ACTION 30.22: Space agencies are invited to report at the next CGMS on their approaches to produce satellite data for climate purposes.

Action 30.28: AOPC is invited to consider the consolidated list of metadata (including time of observation, Earth location, observation angles, spectral channel response, calibration coefficients, and field of view size as well as the associated error in each parameter) and to comment on its adequacy for their applications.

It should be mentioned that this activity is not novel per se but is preceded by two decades of successful work within the International Satellite Cloud Climatology Project (ISCCP), within the Global Precipitation Project and others projects like the Pathfinder Programme, initiated jointly by NASA and NOAA. WG II at CGMS XXXI is also invited to discuss carefully the way to draw on those projects such that the relevant experience is utilised and transferred.

2 SATELLITE DATA FOR CLIMATE APPLICATIONS AT EUMETSAT

It is worth while to recall that climate observation can be divided into two categories. The first one aims at *understanding* climate processes and their variability. The second one addresses the *detection* of climate change and then seeks for the *attribution* of the cause of the change. The International Satellite Cloud Climatology Project (ISCCP) represents a good example of the first approach. It was the first project of the World Climate Research Programme (WCRP) tasked to produced a global data set on cloud parameters that has been and is widely used to better understand of the Earth's radiation budget and the hydrological cycle and is also useful for testing climate simulation models. The possibilities of detecting trends from satellite data appear to be more limited primarily due to the fact that trends, if any, are presumably subtle and difficult to disentangle from natural variability or buried within the accuracy of the observations.

It is however also important to realise that operational meteorological satellites have not been designed for climate applications, i.e. they often lack the required accuracy in terms of instrument characterisation and calibration. However, their great advantage is consistency and long-term continuity.

Furthermore it is noted that the Expert Team on Observational Data Requirements and Redesign of the Global Observing System (ET/ODRRGOS), with support from GCOS, is currently working on two Statements of Guidance on ‘Monitoring Climate Change’ and ‘Monitoring Climate Variability’.

EUMETSAT has already made substantial efforts to address to production of data sets from satellites that are useful for climate applications. Relevant to discussion at WG II are the following examples:

- a so-called Climate Data Set (CDS) has been an operational product in the Meteosat era since two decades and is also being derived from Meteosat Second Generation (MSG). The product is essentially a condensed radiance data set that associates radiances with observed targets, i.e. surface and level of cloud, and provides relevant statistics. It is fair to state that the use of the data set has been rather limited though several peer-reviewed journal papers are based on the CDS.
- EUMETSAT contributes operationally to ISCCP and GPCP
- EUMETSAT has embarked on the production of a novel data set, i.e. surface albedo, from Meteosat satellites, going through a painstaking effort of re-analysing archived image data and also performing a re-calibration. A paper dedicated to this effort is EUM-WP-19.
- Also relevant to this aspect is the re-calibration effort at EUMETSAT as described in EUM-WP-18.

3 REQUIREMENTS FOR META-DATA

EUMETSAT paper EUM-WP-22 to CGMS presented the following list of meta-data that should be available with satellite data:

- **Time**: The definition of the acquisition time of each pixel is quite straightforward for geostationary satellites because of the data acquisition mechanism.
- **Position**: The definition of the location of each pixel requires the accurate characterisation of the spacecraft position and attitude at the time of the data acquisition. The accuracy of the rectification can be assessed by means of ground control points.
- **Observation angles**: The definition of the observation angles requires in addition the characterisation of the instrument optics.
- **Sensor spectral response**: This quantity should be observed before launch. Its temporal degradation is difficult to assess, however means to estimate the degradation should be established.
- **Calibration coefficient and offset**: The evaluation of calibration coefficient, associated error and temporal drift are the most critical information. In the absence of on-board calibration device, vicarious calibration is required. On board calibration systems should be fully characterised.

In the discussions at CGMS XXX WG II added the following parameter:

- **Field of size (view)**: The area at the earth surface wherein the encircled energy is greater than 99% or the half power points of the received energy,

Following Action 30.28 the above list of meta-data was taken to the 9th meeting of the GCOS-AOPC for comments and amendments by AOPC members. In response AOPC

IX concurred with this list and found it suitable as a mandatory set of meta-data that must be available with all satellite data.

Furthermore a list of essential meta-data should also include:

- characterisation of instruments (e.g. spectral response function of overall system and of components)
- calibration information (i.e. functional relationship and corresponding coefficients)
- documentation of actual calibration algorithm
- information on the geo-referencing of level 1.5 data
- all information necessary to reproduce the actual geo-referencing from level 1 data and necessary for improved future geo-referencing
- for each product a controlled documentation of the algorithm version used for the product derivation.

4 CONCLUDING REMARKS

WG II is invited to:

- comment on the work at EUMETSAT on climate data from operational meteorological satellite
- make, if possible, a general recommendation on the production of climate data from satellites embracing all CGMS members
- take note of the concurrence of GCOS-AOPC with the list of meta-data that must be available with satellite measured data
- amend the list of meta-data to include instrument and data processing information.