CGMS-XXVIII EUM-WP-21
Prepared by EUMETSAT
Agenda Item: II.4

REPORT ON SATELLITE APPLICATIONS OVER LAND

This paper responds to ACTION 27.15 of CGMS XXVII, which requested ‘all satellite operators to report at CGMS XXVIII on activities concerning satellite radiance applications over land (e.g. thermodynamic soundings, surface albedo)’. The paper summarises relevant activities pursued in Europe.

REPORT ON SATELLITE APPLICATIONS OVER LAND

1. INTRODUCTION

At CGMS XXVII EUM-WP-24 reported on EUMETSAT activities to enhance the use of satellite data over land. A Meteosat Second Generation (MSG) Biosphere Working Group (MBWG) had been established jointly with the Joint Research Centre of the European Commission in order to analyse requirements and the potential of MSG to contribute to the observation of relevant geophysical quantities. A successful series of workshops of the MBWG was concluded with a report summarising requirements, potential and specific recommendations that should ensure the success of MSG land applications. A second item addressed in EUM-WP-24 was the improved use of infrared soundings over land. A report on this matter has been produced by a working group of the International IASI Sounder Science Working Group (ISSWG). Both reports are available from EUMETSAT upon request. WG II welcomed the proactive work and encouraged further rapid progress. Following the pertinent discussion CGMS placed the following action:

ACTION 27.15 All satellite operators to report at CGMS XXVIII on activities concerning satellite radiance applications over land (e.g. thermodynamic soundings, surface albedo).

This paper responds this action summarising some relevant activities pursued in Europe.

2. A SURFACE ALBEDO PRODUCT FROM THE CURRENT METEOSAT

A new land surface albedo retrieval algorithm has been developed by the Space Applications Institute of the European Commission and implemented in the reprocessing environment of EUMETSAT. This algorithm derives the surface albedo in the Meteosat VIS band every 10 days at the pixel resolution. The Meteosat Surface Albedo (MSA) algorithm accounts for water vapour and ozone absorption, aerosol scattering and surface anisotropy (Pinty et al, 2000a and b). The MSA algorithm derives two quantities:

(1) The Directional Hemispherical Reflectance (DHR), namely the integral of the Bidirectional Reflectance Factor (BRF) over all exiting angles for direct illumination conditions only, computed for a solar illumination at 30 degrees. This quantity indicates the capacity of the Land surfaces to scatter the direct solar radiation and can therefore be used as an indicator of the state of these surfaces.

(2) The Daily Directional Hemispherical Reflectance (DDHR), namely the integral of the DHR for all possible location of the Sun during every single day. This quantity, which is permanently changing with the pixel location and the date of the year, can be incorporated into climate models to represent the daily average amount of solar radiation

which is absorbed by the Land surfaces. The MSA algorithm has been applied on Meteosat-5 data of 1996 to document the seasonal variations of the surface albedo.

The analysis of these results has also revealed a potential influence of intense biomass burning activities on the observed seasonal surface albedo changes at a continental scale over Africa (Pinty et al, 2000c). Thus the algorithm could also contribute to the monitoring of biomass burning. In principle, this algorithm could be applied to the entire Meteosat archive for climate analysis.

3. LAND SURFACE OBSERVATIONS FROM SPACE FOR HYDRO-METEOROLOGICAL AND CLIMATE MODELLING

An informal workshop on ‘Land surface observations from space for hydro-meteorological and climate applications’ took place at ECMWF on 16 May 2000. In this workshop ESA (European Space Agency) presented, following the approval of their Living Planet Programme in 1998, the ‘Land surface processes and interactions mission (LSPIM). Primary research objectives are to further Carbon Cycle- and Hydro-meteorological modelling by i) increasing the understanding of land surface processes and their interactions with the atmosphere, ii) advancing the understanding of these processes across spatial and temporal scales. The mission would have 2 years nominal duration and 4 years design lifetime. It would measure BRDF with a spectral resolution of 10 – 15 nm in the spectral regions 0.45 – 2.35 µm, 8.1 – 8.5 µm and 8.6 –9.1 µm. The spatial resolution is about 50 m and the temporal revisit period for any site is 2 – 3 days, under the proviso that the site is cloud free. The mission would support the advancement of the understanding of land-surface processes and their modelling in global earth system models.

ECMWF reported on the use of satellite data over land. The land surface itself constitutes an important element in NWP for two reasons: i) it has direct effect in the forecast model, ii) it affects the model indirectly via the radiance assimilation, i.e., the use of satellite radiances over land requires knowledge of the surface emissivity. Due to insufficient characterisation or knowledge of the surface emissivity over land and ice surfaces a large impact on radiance measurements in the window region is observed. The influence of spatially varying surface emissivity is especially large in the microwave region.

It is expected that the use of sounding data over land will have a beneficial impact on forecasts. Surface temperature observations from space will be useful to decrease the bias errors observed in current NWP surface schemes. This in turn will lead to a more realistic depiction of surface energy fluxes over land. Assimilation of sounding channels over land will also potentially benefit the analysis of the atmospheric state. A precondition is an improved modelling of the surface characteristics. The spatial heterogeneity will be considered in revised land surface models which consist of compositions (tiles) of different surface types. This will bring the model closer to reality and hence improve the possibilities to assimilate the observed radiances.

4. CONCLUDING REMARKS

CGMS is invited to take note of the activities and express a view with regard to future activities.

5. REFERENCES

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