

REPORT ON THE USE OF SATELLITE DATA OVER LAND

This paper reports on:

- workshops that were held by a MSG Biosphere Working Group (MBWG) which was jointly established by the Joint Research Centre of the European Commission and EUMETSAT. The final report of the Working Group has been published as EUMETSAT Scientific Publication (EUM SP 01).
- a workshop on improved use of infrared sounding data over land, which was held within the framework of the International IASI Sounding Science Working Group.

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1. INTRODUCTION

EUMETSAT has taken initiative to enhance the utilisation of satellite over land. This initiative includes i) an in depth analysis of the potential of MSG for research in land applications and ii) stimulation of research aimed at improving retrieval of temperature and humidity sounding over land.

The initiative is phased with the development of new geostationary (MSG: Meteosat Second Generation) and polar satellite programs (EPS: EUMETSAT Polar System).

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2. METEOSAT SECOND GENERATION FOR LAND SURFACE RESEARCH AND APPLICATIONS

A MSG Biosphere Working Group (MBWG) was established jointly by the Joint Research Centre of the European Commission and EUMETSAT. The working group analysed requirements for weather and climate modelling, natural hazards, ecosystems and hydrology. Based on the requirements, specific biophysical variables were identified, which can potentially be observed from MSG. The major contribution of MSG to new land applications of satellite observations is due to the frequent observation of the same location on Earth with a multichannel imager which a reasonable spatial resolution. The utilisation is eased by the fact that the spectral channels of MSG are largely based on existing satellite channels, thus existing know-how can be used and extended.

The report addresses the following geophysical products:

- Land surface temperature and emissivity
- Surface albedo
- Aerosol
- Global solar and photosynthetically active radiation
- Soil moisture
- Fraction of absorbed photosynthetically active radiation
- Leaf area index
- Evaporation
- Fire

Other chapters provide examples of potential applications and research using MSG data and describe common data processing requirements for land applications.

The MBWG provided specific recommendations to ensure the success of MSG for land applications and research:

- a) EUMETSAT and other European agencies should support a sustained, focused R&D programme employing MSG data, together with other data types where appropriate, aimed at the development, testing and validation of accurate and robust algorithms capable of quantitative estimation of land biophysical variables.
- b) Critical R&D areas include the identification of land pixels contaminated by clouds and the extraction of aerosol information from MSG data, as a foundation for a successful extraction of other biophysical variables.
- c) Funding agencies that support satellite technology or applications R&D should examine the various aspects of MSG relevant to their areas of interest, and should collaborate in joint sponsorship of MSG research where appropriate.
- d) EUMETSAT and other agencies promoting operational use of SEVIRI data over land should periodically undertake a review of R&D progress to identify applications ready for proof-of-concept demonstration. Such reviews should be synchronised with the funding of research programmes and with major environmental monitoring initiatives or opportunities in Europe or Africa.
- e) To enable successful, sustained use of MSG data for land applications and research, EUMETSAT should ensure that:
 - The best possible information on the calibration and radiometric degradation of the MSG solar channels is available for the duration of the MSG programme;
 - Archived MSG level 1.5 data are available with the highest possible geometric accuracy;
 - Solar and viewing angles are available from the data archive;
 - Contemporaneous atmospheric information with MSG data is readily available to enable the derivation of biophysical variable products, particularly vertical profiles of atmospheric water content, pressure and temperature;
 - Cloud masks at pixel level and cloud physical properties including optical thickness (on a pixel level if feasible) are available from the archive;
 - MSG data are available in a user friendly way, along with appropriate tools such as conversion of the data into radiance values, extraction of geographic subareas, etc.;
- f) Operational use of MSG data will necessitate a guaranteed, sustained generation of products and their timely delivery to users; appropriate institutional mechanisms must be found to this end.

The final report of the Working Group has been published as EUMETSAT Scientific Publication (EUM SP 01) with the title 'MSG Opportunities for Land Surface Research and Applications'. This report should serve as a reference document for those interested in stimulating research using MSG data over land surfaces. EUMETSAT has taken steps to implement the recommendations related to the level 1.5 data service. In parallel, the recently approved SAF on Land Surface Analysis is expected to develop relevant level 2 products.

3. IMPROVED USE OF INFRARED SOUNDING DATA OVER LAND

The use of satellite data for NWP over land is less developed than over the oceans. This has two prime reasons, first of all the availability of conventional observations over land make the need to use satellite data less urgent, secondly, satellite observations over land of surface temperature and retrievals of temperature and humidity profiles are less accurate than over oceans due to uncertainties in surface emissivity which varies spectrally and geographically with time. Also the representation of surface temperature over land in NWP models is not adequate yet to justify the use of elaborate surface temperature retrieval schemes.

However the advent of new generations of sounding instruments (EOS-AIRS and IASI on EPS) will provide new capabilities for the derivation of global soundings including both land and sea surfaces. Numerical weather prediction models will also make major improvements in the physical representation of land surfaces, which will allow a better utilisation of accurate satellite radiance observations over land. It is also important to consider that the conventional upper air radiosonde network currently gets thinned out over wide areas of the globe. This will necessitate the ‘recovery’ of the lost information via other observing systems, of which the satellite observing system is the most prominent one because of its global capability.

In a special working session the International IASI Sounding Science Working Group (ISSWG) addressed the issues of:

- Assimilation of infrared radiances over land
- Datasets of land surface type and emissivities
- Radiative properties of land surfaces
- Retrieval of surface parameters

As further work the working group suggested:

- a. Derive an update land surface classification specifically for an IR and MW emissivity database using MODIS data
- b. Enhance in-situ emissivity measurements of representative surfaces and link them to the classifications in a). Develop parametric forms for the variation of surface emissivity with wavenumber that are applicable (and validated) over a wide range of surface types. Develop techniques for selecting (from the data or from prior information) the appropriate parametric form for each sounding.
- c. Carry out simulation studies for various forms of vegetated areas and homogeneous landscapes in order to transfer lab/*in situ* measurements form b) to scales observed from space.
- d. Analysis of real (e.g. HIRS, AVHRR, IMG, AGIRS, HIS, AIRES) radiances over land surfaces and relate to b) taking into account c).
- e. Development of simultaneous retrieval of land surface temperature (LST) and spectral surface emissivity (SSE) from cloud free IASI data.
- f. Verification and validation tests of the schemes developed in e) for LST and SSE retrievals from IASI radiances.
- g. Investigate correlation between NDVI index (or something similar) and average (spectral) emissivity.

A summary of the results of the working session has been published as a report of the IASI Sounding

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Science Working Group with the title 'Towards Improved Use of Infrared Sounding Data over Land'.