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Prepared by EUMETSAT
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EUM-WP-24 IMPLEMENTATION OF A NEAR-REAL TIME PRECIPITATION ALGORITHM BY EUMETSAT

On basis of the recommendations by the IPWG of the CGMS, EUMETSAT implemented an operational service to provide precipitation estimates for the field of view of its geostationary satellites in near-real time. The algorithm is based on the so-called 'blending' technique and uses data from the SSM/I instruments on board of the polar orbiting DMSP satellites in combination with the infrared images from the geostationary EUMETSAT satellites. The estimated instantaneous rain rates encoded in the GRIB-2 data format and corresponding images in jpeg format can be downloaded from the EUMETSAT web-pages. A distribution of the GRIB-2 data files via EUMETCast is foreseen.

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1 INTRODUCTION

In Europe a dense radar network with high quality real-time precipitation observations is a reliable information source. The situation in many African and Asian countries is much worse. Usually data regarding the spatial distribution of rain are available only several hours or even several days after the rain event. EUMETSATs newly implemented Multi-sensor Precipitation Estimate (MPE) is intended to help to fill this gap. It provides data for the forecast of precipitation and for operational hydrology. The physics of the algorithm implies that it is most reliable for large scale convective precipitation that occurs in tropical and sub-tropical regions.

2 ALGORITHM

The major problem with the use of geostationary imagery for the remote sensing of precipitation is the lack of active or passive microwave systems in this orbit. While the cloud top temperature, measured in an infrared window channel, is connected to the surface rain rate only in a very indirect way, the absorption by liquid water and the scattering by ice particles or rain droplets, measured with microwave sensors, shows a much higher correlation to ground precipitation. Passive microwave sensors on polar orbiting satellites are providing these more accurate data but cannot reach the spatial and temporal coverage of a geostationary sensor. The logical consequence is the combination of both observing systems. EUMETSAT decided to implement an algorithm of this type, based on data from the IR channel of METEOSAT 7 and passive microwave data from the Special Sensor Microwave/Imager (SSM/I) onboard the polar orbiting DMSP satellites in its MPEF environment.

The MPE algorithm uses the classical dynamic blending concept. Basis for the retrieval of the rain rate is the IR-image from the Meteosat satellite. The basic assumption of all IR-methods is that the surface rain rate is a function of the cloud top temperature. The form of this function depends on many factors such as the geographical location, the orography, the precipitation type and the synoptic situation. For convective precipitation in a specific weather situation and for a limited geographical region the assumption is valid that higher and therefore colder clouds are representing stronger convection and produce more rain than warmer clouds. In these areas only the form of the function and the maximum cloud temperature threshold for precipitation have to be determined. The MPE algorithm uses rain rates derived from passive microwave measurements by the Special Sensor Microwave / Imager (SSM/I) onboard of the US-DMSP satellites to calibrate this function dynamically. For this purpose SSM/I data from a specified period are co-located with the corresponding Meteosat images on SSM/I pixel basis. The co-located data pairs (SSM/I rain-rate and corresponding Meteosat IR brightness temperature) are collected in geographical grid boxes of 5°x5°. With a histogram matching technique a monotonic look-up table is derived for each grid box. The look-up tables are used to determine the rain rate from the brightness

temperatures of the IR-image. The variable parameters of the algorithm are the start and end time of the accumulation period for the co-located data, the size of the geographical grid boxes, the bin size of the histogram matching and the method to calculate rain rates from the SSM/I data.

The instantaneous rain rates from the MPE algorithm were compared with ground based radar data, the direct SSM/I retrieval results and the NRL blending algorithm. The comparisons showed the expected results. A good agreement with the very similar NRL algorithm could be observed for the whole observation area. In weather situations with large-scale convective precipitation the results from MPE and SSM/I are similar. Problems occur in areas with strongly variable topography, for solid precipitation and over decaying cloud systems. Cold fronts can be described well, but the major precipitation may be miss-located. Precipitation from relatively low clouds at warm fronts cannot be described accurately enough. Very localised precipitation is *smeared* out to a larger area by the algorithm.

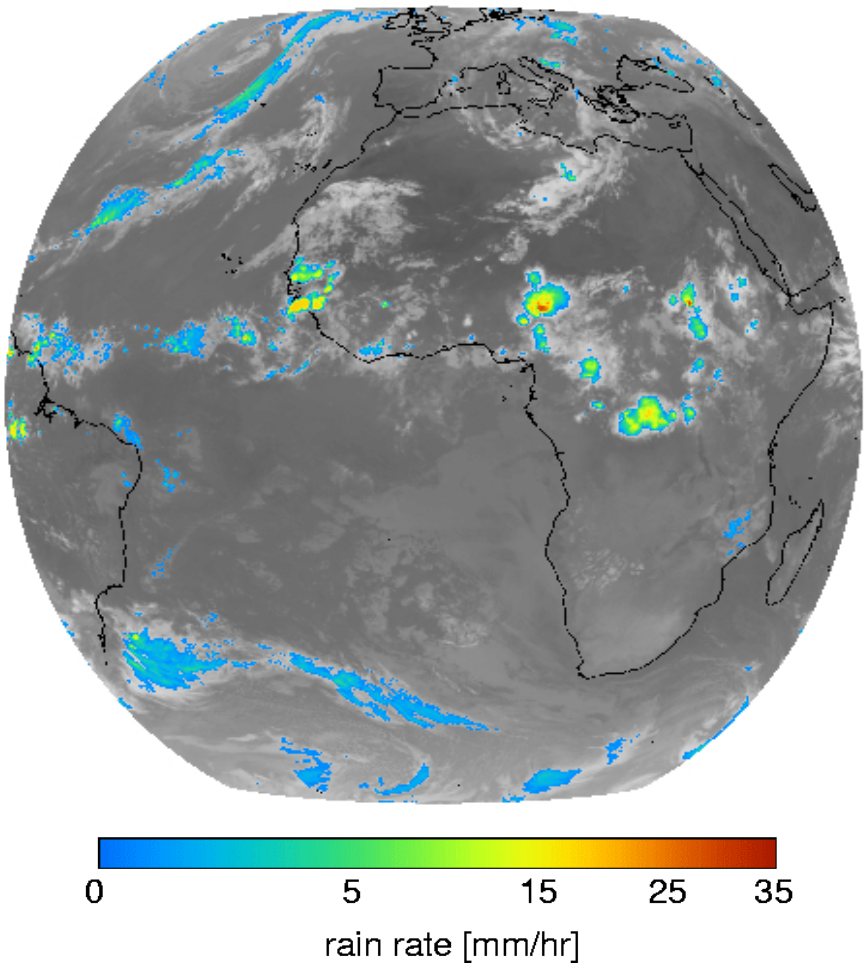

Fig. 1: *MPE rain rates image on the EUMETSAT Internet page. Rain rate for the Meteosat-7 field of view, June 16th 2005, 20:00UTC. Rain rates in colour, IR image in black/white.*

3 PRODUCT AND DISSEMINATION

The MPE product consists of instantaneous rain rates on the full spatial and temporal resolution of Meteosat. The data are produced during the ‘re-trace period’ between the reception of two Meteosat images and is available about 8-10 minutes after the nominal slot time. The rain rates are encoded in the GRIB-2 data format and JPEG images are produced. The JPEG images are transferred to the EUMETSAT web-server and can be viewed on the internet using the EUMETSAT image viewer. GRIB-2 data files are available for download on a separate web-page. At the moment MPE products from Meteosat-7 images (0° longitude, primary service) and METEOSAT-5 (63° longitude) are produced. In order to ensure continuity of the primary service an implementation for the Meteosat Second Generation (MSG) satellites will be performed. For the future a distribution via EUMETCast is foreseen.