Divergence Product: Product Guide

Doc.No.	:	EUM/TSS/MAN/15/795706
Issue	:	v1C
Date	:	27 February 2015
WBS	:	

EUMETSAT
Eumetsat-Allee 1, D-64295 Darmstadt, Germany
Tel: +49 6151 807-7
Fax: +49 6151 807 555
http://www.eumetsat.int

Document Change Record

Issue / Revision	Date	DCN. No	Summary of Changes
1	06/10/2010		Initial issue of document.
1A	08/09/2010		Initial review by subject matter expert
1B	06/11/2014		Conversion of document to Product Guide format. Addition of General Description, algorithm basics, and product illustration sections.
1C	27/02/2015		General update of contents by subject matter expert.

1 PRODUCT DESCRIPTION

This product could also be called the Upper Troposphere Divergence product. The Divergence (DIV) product is calculated directly from the field of Atmospheric Motion Vectors (AMVs). It is currently computed only for the water vapour 6.2 µm channel. In this channel, the AMV field describes the horizontal displacement of clouds and humidity features. The AMVs are derived from a cross-correlation technique on a 24 × 24 pixel template. A Barnes filter, weighted with the quality indicators of each wind vector, is applied, and the final divergence field is computed over 1 × 1 degree areas. The DIV product has a latitude range of -60 to +60 degrees, a longitude range of -60 to +60 degrees, and a grid resolution of 1 × 1 degree, thus providing an array of 121 × 121 grid points. Only AMVs with a Quality Index (QI) equal to or better than 30% and a height between 100 and 400 hPa are considered. The divergence is derived from the AMV Final product. This means that the divergence product is derived once per hour.

Figure 1 shows isolines of the upper tropospheric divergence over a large convective cell over Africa at 11:15 UTC on 29 March 2004. The AMV field, as shown by the wind barbs, was calculated from the WV6.2 channel of Meteosat-8. The divergence is given in 10^{-6} s^{-1}. The underlying IR10.8 image shows the exact position of the large convective cell.

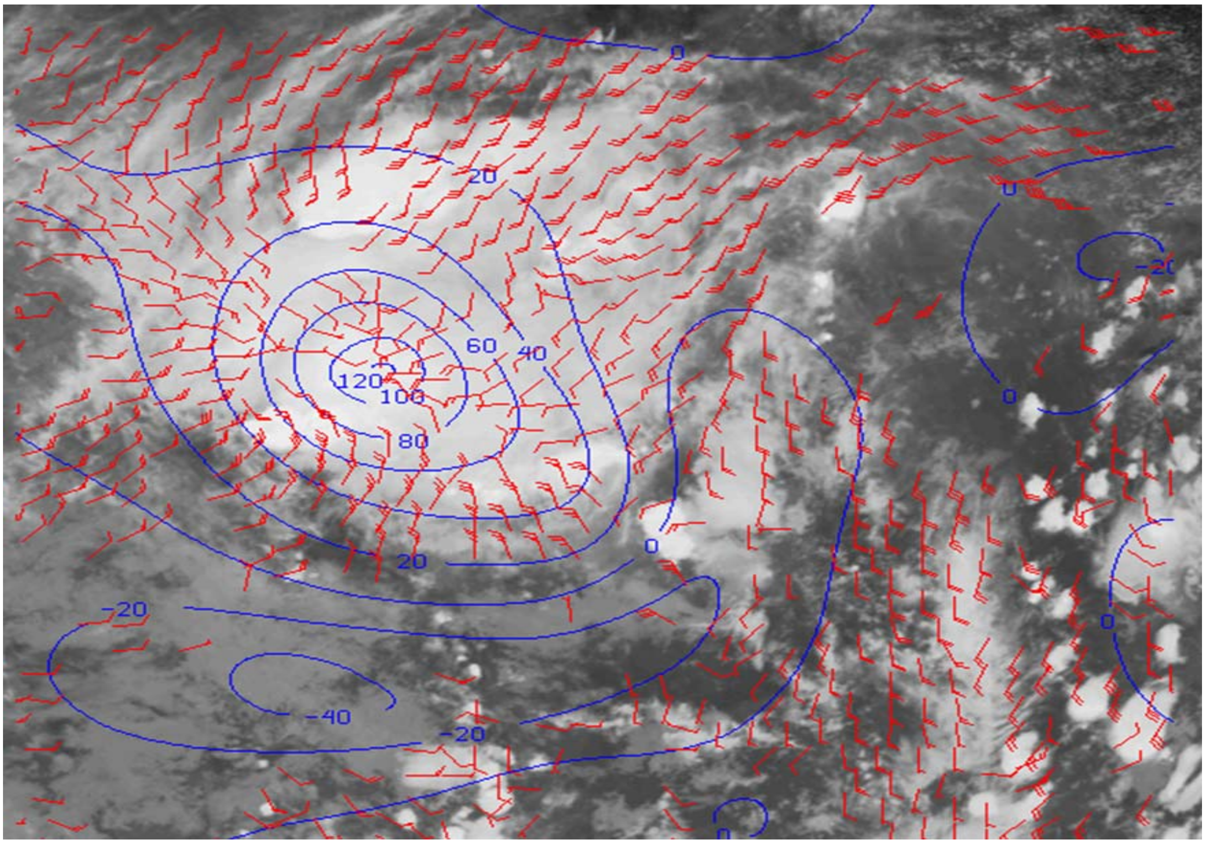

Figure 1: Isolines of the upper tropospheric divergence over a large convective cell over Africa at 11:15 UTC on 29 March 2004

2 PRODUCT SPECIFICATIONS

Category	*Specification*
Type	Meteorological Product
Applications and users	Primarily for nowcasting and analysis
Input satellite data	AMV product for the WV6.2 channel of SEVIRI
Product Distribution	Nowcasting
Product Area	Full Earth scanning area (FES): limited to 60º North and South, and 60º East and West
Product Resolution	1° by 1°
Product Distribution Frequency	Full Earth Scanning Area • EUMETCast: hourly for the 00:45, 01:45, 02:45, …23:45 UTC products • EUMETSAT Data Centre: hourly for the 00:45, 01:45, 02:45, …23:45 UTC products • Direct: hourly for the 00:45, 01:45, 02:45, …23:45 UTC products
Product Format	GRIB2 format
Product Size	Approximately 15 kB

2.1 Product history and gaps in coverage:

Initial operational dissemination:	2008
New colour palette showing divergence:	June 2010
Substantial gaps in coverage	None

2.1.1 Known Operations Limitations

No known operational limitations.

3 PRODUCT ILLUSTRATION

In Figure 2, the time evolution of this convective cell between 12:15 UTC (left) and 15:15 UTC (right) shows the split into two divergence maxima which coincide with clusters of developing deep convective clouds.

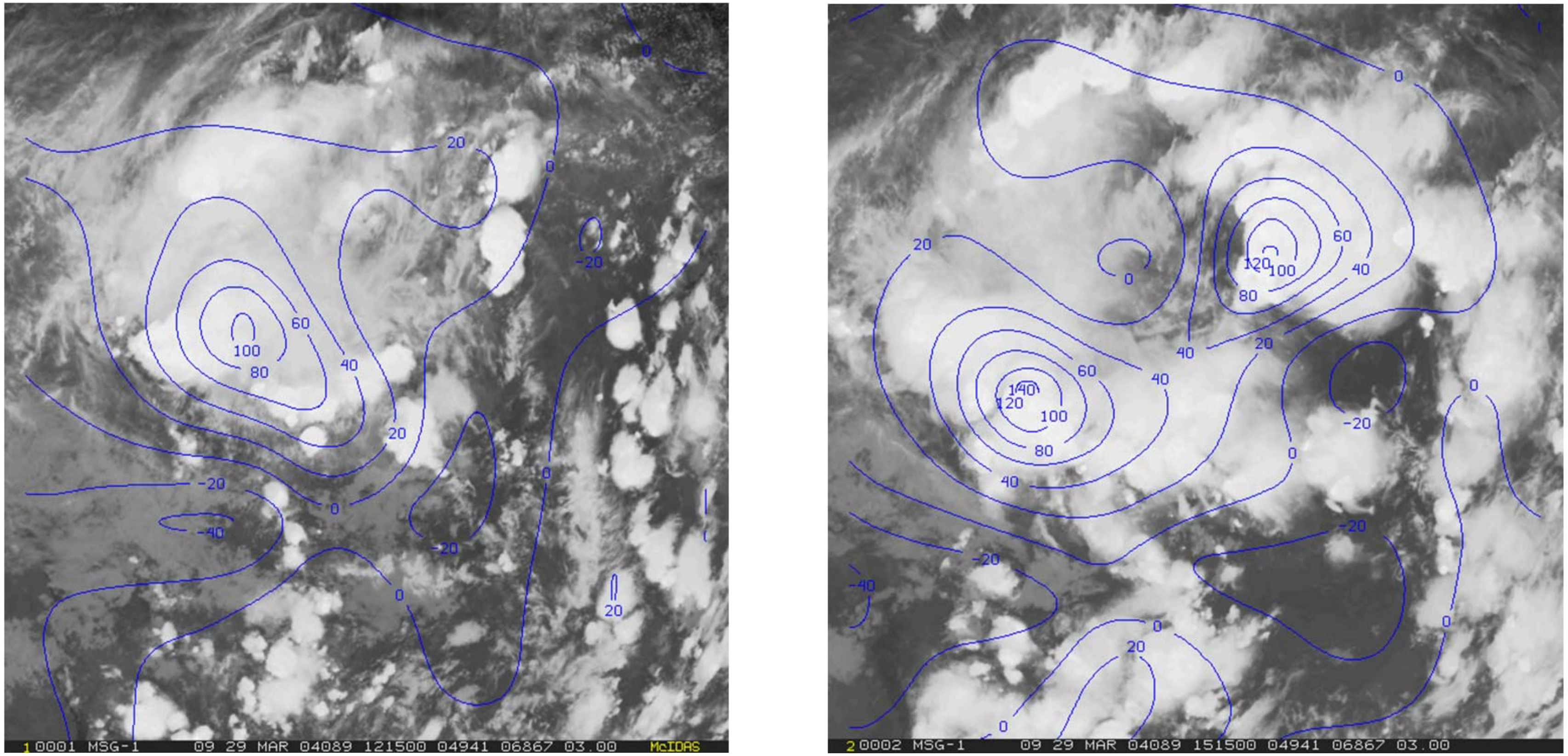

Figure 2: Convective cell at 12:15 UTC on 29 March 2004 and convective cell at 15:15 UTC on 29 March 2004.

Another tropical convective cell observed over Africa on 13 May 2004. The figure shows the divergence at 08:15 UTC.

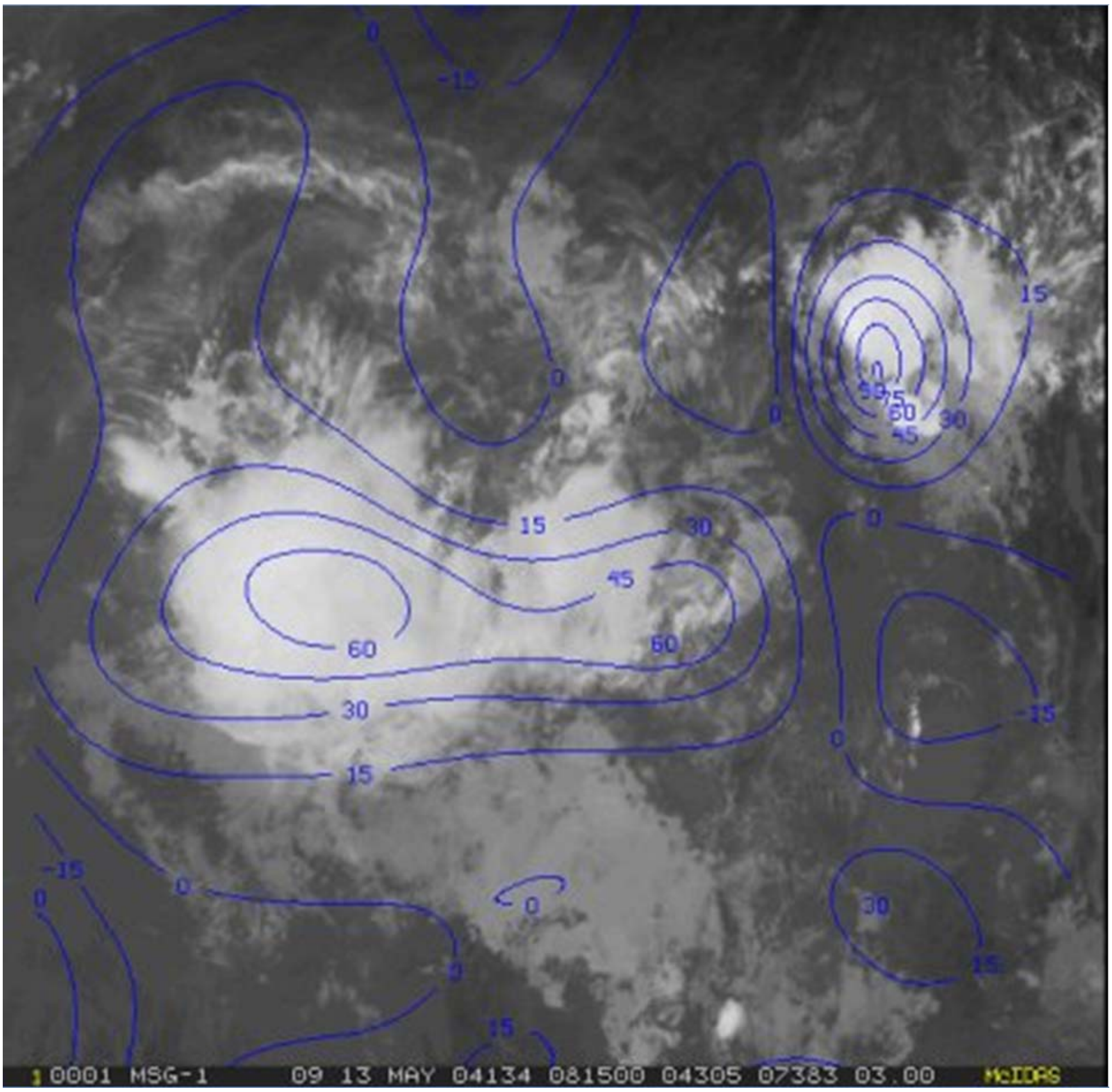

Figure 3: Divergence field at 08:15 UTC.

Figure 4 shows the Divergence product over the MSG FES area at 12:45 UTC on 19 December 2014.

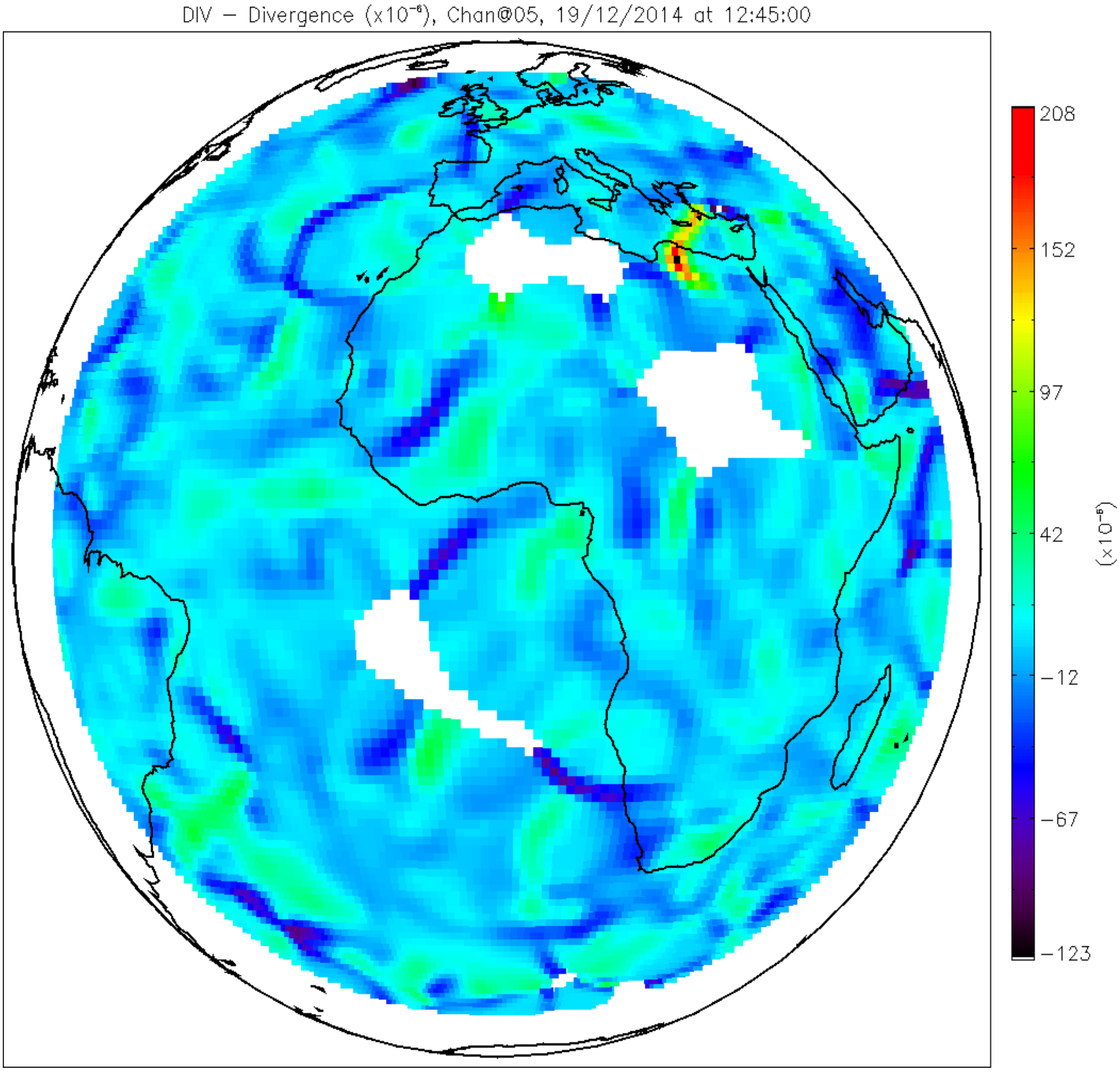

Figure 4: Divergence field at 12:45 UTC on 19 December 2014.

4 BASIC STRUCTURE OF THE DIVERGENCE ALGORITHM

The divergence algorithm takes its operational data from the Atmospheric Motion Vectors (AMV) product. The algorithm generates divergence values on a latitude-longitude processing grid. It uses as input data the Atmospheric Motion Vectors (AMVs) from the final AMV product for a prescribed atmospheric layer. It has a frequency of one product per hour.

The product shall be generated for the water vapour 6.2 µm channel only (channel 5). In principle, it shall be possible to derive divergence products from any spectral channel for which AMV data are available.

4.1 Inputs from the AMV Product

These data are provided from the AMV product:

Parameter	*Mnemonic*	*Units*
AMV latitude	latitude	degrees
AMV longitude	longitude	degrees
AMV speed	speed	m/s
AMV direction	direction	degrees
AMV pressure	height	hPa
AMV QI, excluding F/C consistency	qi_excl	%

4.2 Static Application Data

The Divergence Product has access to a set of static application data which defines the following:

- The rectangular processing grid.
- The atmospheric layer from which the AMV data should be used.
- Static parameters for the mathematical expressions used in the algorithm

The static data is defined in the AMV product static data files and is configurable.

4.3 Algorithm Description

The algorithm breaks down into the following steps:

Step 1	Read the AMVs from the WV6.2 final AMV product. Ignore AMVs that have an overall quality less than 30%. Moreover, consider only those AMVs having a final pressure in the range (100 hPa, 400 hPa).
Step 2	For each remaining AMV, convert its wind speed and direction to U and V wind components.
Step 3	Define a rectangular processing grid in a latitude-longitude coordinate frame.

Step 4	Apply a Barnes interpolation to the U and V wind components, as well as to the AMV quality (the one excluding the forecast consistency) and the AMV wind speed. This will map the U, V, quality and wind speed values onto the grid points. In data-sparse areas the grid point values will remain undefined; the U, V, quality and wind speed values shall be set to a pre-defined 'missing data' value—currently 999.9—for these cases

Step 5	Calculate the divergence at each grid point. If one or more of the U and V components that are used in the calculation have an undefined value, the divergence value itself shall become undefined as well. The value shall then be set to 999.9.

Step 6	Automatically derive the quality indicator for each grid point. The value of this indicator shall result from the Barnes interpolation of the AMV quality values

Note: For a complete explanation of the Barnes interpolation scheme as used in this algorithm, see the *Upper Level Divergence Product Algorithm Description*. Ask for the EUMETSAT reference number EUM/MET/REP/05/0163 as listed in the Reference section of this document.

4.4 Outputs

The Divergence product data is produced in GRIB Edition 2 coding.

Parameter	***Mnemonic***	***Units***
min latitude	DIV_min_latitude	degrees
maximum latitude	DIV_max_latitude	degrees
minimum longitude	DIV_min_longitude	degrees
maximum longitude	DIV_max_longitude	degrees
delta latitude	DIV_delta_lat	degrees
delta longitude	DIV_delta_lon	degrees
minimum pressure	DIV_min_pressure	hPa
maximum pressure	DIV_max_pressure	hPa
critical distance	DIV_crit_distance	km
critical QI	DIV_crit_QI	%
minimum QI	DIV_min_QI	%
mode	DIV_mode	-
minimum divergence	min_divergence	10^{-6} s^{-1}
divergence	divergence	10^{-6} s^{-1}
quality	quality	%
wind speed	windspeed	m/s

REFERENCES

Type	*Document Name*	*Reference*
Science	*The Atmospheric Motion Vector retrieval scheme for Meteosat Second Generation*, Holmlund, K., 2000.	*Proc. Fifth Int. Winds Workshop*, Lorne, Australia, 201-208
Published Science	*Upper tropospheric divergence in tropical convective systems from Meteosat-8* Schmetz, J., R. Borde, K. Holmlund, and M. König (2005), *Geophys. Res. Lett.*, **32**, L24804, doi:10.1029/2005GL024371	*Geophys. Res. Lett.*, **32**, L24804, doi:10.1029/2005GL024371
Algorithm Theoretical Basis Document	MSG Meteorological Products Extraction Facility: Algorithm Specification Document	EUM/MSG/SPE/022
Algorithm Description	Upper Level Divergence Product Algorithm Description	EUM/MET/REP/05/0163

Online resources and assistance

All of the reference documents listed above are on the EUMETSAT Technical Documents page.

www.eumetsat.int > Satellites > Technical Documents
> Meteosat Services
> 0° Meteosat Meteorological Products

A training presentation for the MPE Product is here:

http://www.eumetsat.int > home > Data
> Training > TrainingLibrary > index
> The Multisensor Precipation Estimate Product

To register for data delivery from this product, go to the Data Registration page on the EUMETSAT web page:

www.eumetsat.int > Data > Data Delivery > Data Registration

Information about the service status of EUMETSAT satellites and the data they deliver is this EUMETSAT web page:

www.eumetsat.int > Data > Service Status

To get answers to any questions about data delivery, registration or documentation, contact the EUMETSAT User Service Help Desk:

Telephone: +49 6151 807 3660/3770
e-mail: ops@eumetsat.int