

# ***Normalised Difference Vegetation Index: Product Guide***

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## Document Change Record

<i>Issue / Revision</i>	<i>Date</i>	<i>DCN. No</i>	<i>Summary of Changes</i>
v1	16-01-2012		Initial release of document as Factsheet
v1A	19 October 2015		Conversion to Product Guide format. Added specifications and graphics. Editorial changes by subject matter expert.

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## 1 PRODUCT DESCRIPTION

The Normalized Difference Vegetation Index (NDVI) product is an indicator of the photosynthetic activity of the vegetation. It varies between zero (deserts) and 1 (dense vegetation). The product is derived from the differences in the 0.6  $\mu\text{m}$  and 0.8  $\mu\text{m}$  reflectance bands. The daily NDVI product estimates the land surface characteristics derived from satellite data. It is widely used to characterise the density and health of the given vegetation cover as well as to identify area of vegetation stress and drought.

The decadal Normalised Difference Vegetation Index product (NDVD) is derived from the daily NDVI products. The NDVD is an aggregated product based on the daily NDVI products using the following aggregation periods:

- Aggregated NDVD product covering Days 1 to 10 of each month
- Aggregated NDVD product covering Days 11 to 20 of each month
- Aggregated NDVD product covering Day 21 to the last day of each month

As the NDVI/NDVD product estimates the land surface characteristics derived from satellite data, it is widely used to characterise the density and vigour of the given vegetation cover as well as to identify vegetation stress and drought. In Figure 1, blank areas show bodies of water, and there are a larger number of areas that are seen by the algorithm as completely cloud covered.

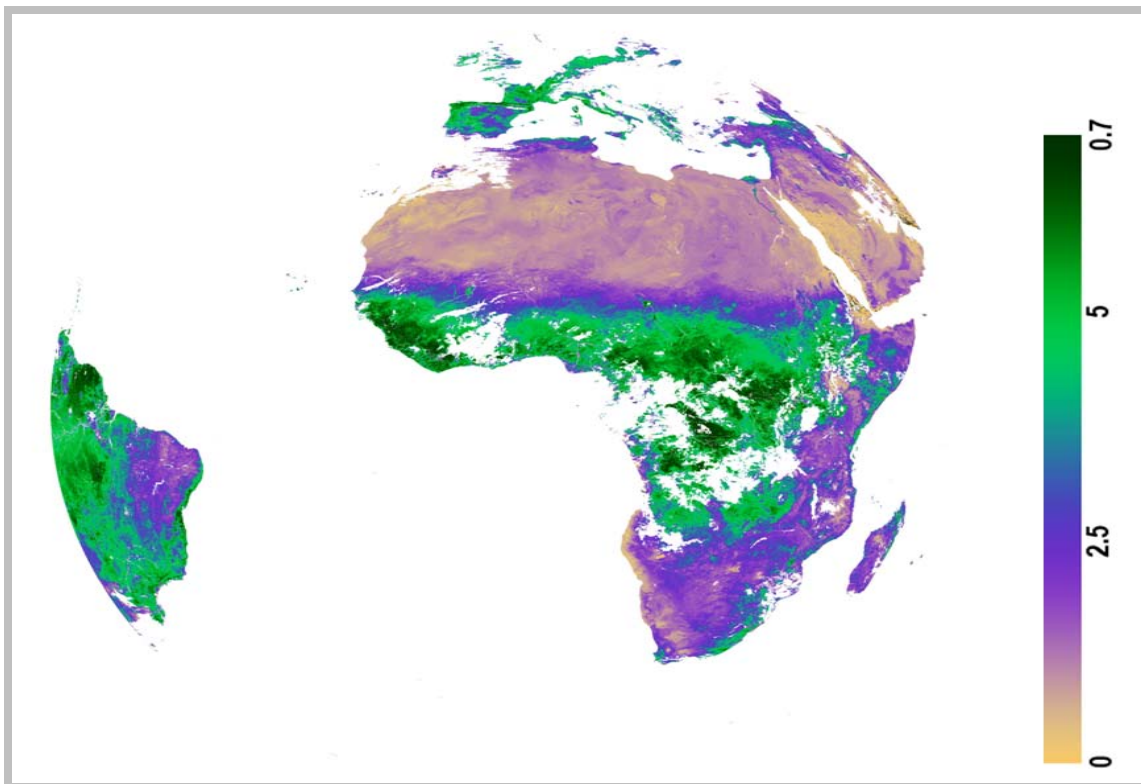


Figure 1: Full-disk NDVI product from 29 October 2012. A further explanation of NDVI values is in Section 2.

<i>Category</i>	<i>Specification</i>
<b>Type</b>	Meteorological Product
<b>Applications and users</b>	Land surface applications
<b>Product Distribution</b>	<ul style="list-style-type: none"> <li>• EUMETCast</li> <li>• EUMETSAT Data Centre</li> </ul>
<b>Product Area</b>	Full earth scanning (FES) Area
<b>Product Resolution</b>	pixel
<b>Product Distribution Frequency</b>	<ul style="list-style-type: none"> <li>• EUMETCast: once a day at 00:00 UTC</li> <li>• EUMETSAT Data Centre: once a day at 00:00 UTC</li> </ul>
<b>Product Format</b>	HDF5 format
<b>Product Size</b>	About 10 MB (variable)

### 1.1 Product history and gaps in coverage:

Initial development and Baseline	01 Jan 2011	
Operational start	17 February 2011	
Substantial Revision	8 February 2012	Aggregation of 10–day NDVI products
Substantial gaps in coverage	None	

## 2 PRODUCT ILLUSTRATION

An example of the NDVI product is presented in Figure 2 for 22 May 2012. Typically, the NDVI product values range from 0.0 to 1.0. The link between rainfall and vegetation is quite strong (direct) in large parts of Africa. In Europe, where you have more forests, lower evapotranspiration and more artificial irrigation, vegetation reacts more slowly to low rainfall. For this reason, Figure 2 shows relatively high NDVI values in areas that had not received substantial rainfall for months, like central Germany. Note that NDVI values greater than 0.1 generally denote increasing degrees in the greenness and intensity of vegetation. Values between 0 and 0.1 are commonly characteristic of rocks and bare soil, and values less than 0 often indicate clouds or snow. For dissemination efficiency, the encoded product is rescaled to integers from 0 to 100. The typical product values can be retrieved by using a scaling factor.

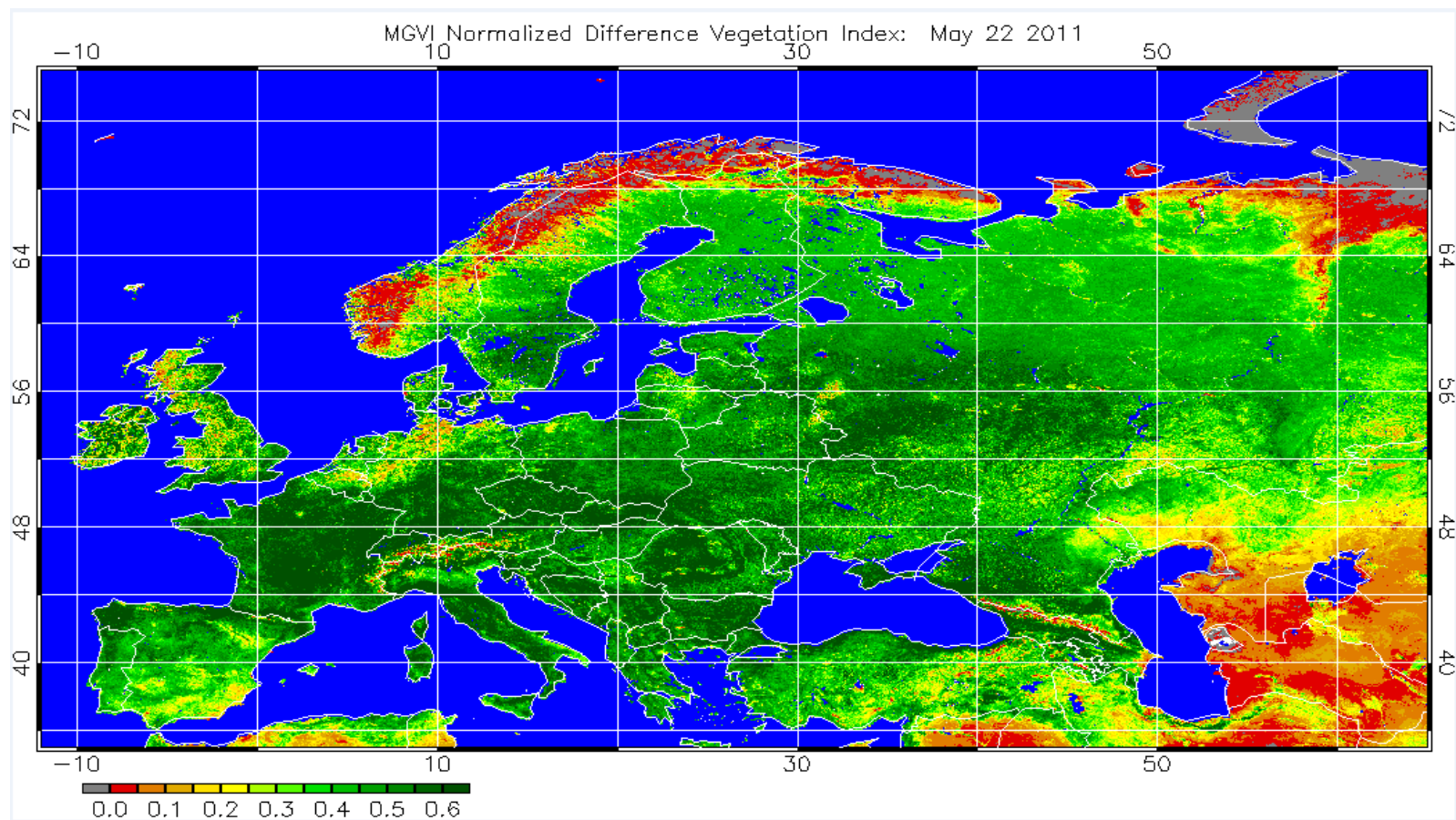


Figure 2: Example of NDVI Product for 22 May 2011. NDVI values greater than 0.1 denote increasing degrees in the greenness and intensity of vegetation. Values between 0 and 0.1 are commonly characteristic of rocks and bare soil, and values less than 0 often indicate clouds or snow.

### 3 BASIC STRUCTURE OF THE NDVI ALGORITHM

#### 3.1 Inputs

Reflectances from the SEVIRI Level 1.5 image data for the VIS0.6 µm and the VIS0.8 µm channels. The Normalised Difference Vegetation Index (NDVI) generation is technically part of the Scenes Analysis (SCE) product processing. For more technical information on the processing of input data, see the MSG Extraction Facility Algorithm Specification Document. The document reference number is in Section 5.

#### 3.2 Algorithm Description

The NDVI is defined as the following ratio:

$$NDVI = \frac{R(NIR) - R(VIS)}{R(NIR) + R(VIS)}$$

where:

R(VIS)	= the reflectance in the 0.6 µm channel
R(NIR)	= the reflectance in the 0.8 µm channel.

Usually, this formula applies to top-of-canopy reflectances, i.e. corrected for atmospheric transmission effects for low orbit sensors. In the case of Meteosat Second Generation (MSG), top-of-atmosphere reflectances are used. The consequences are greater distortions due to high view zenith angles and changing sun zenith angles during the year. To reduce these distortions, a corrected NDVI is calculated instead:

$$NDVI_{cor} = \frac{R_{cor}(NIR) - R_{cor}(VIS)}{R_{cor}(NIR) + R_{cor}(VIS)}$$

where  $R_{cor} = R_{mes} \times \frac{BDRF(0,0,0, surface\_type)}{BDRF(\theta_s, \theta_v, \phi, surface\_type)}$

$R_{mes}$	= the actual top-of-atmosphere reflectance
$\theta_s$	= the sun zenith angle
$\theta_v$	= view zenith angle
$\phi$	= relative azimuth angle

#### 3.3 Automatic Quality Control (AQC)

There is no automatic quality control mechanism in the algorithm. However, the number of accumulations in the generated product can be used as a quality indicator. A higher number indicates that the calculated NDVI is more accurate.

### **3.4 Outputs**

The NDVI daily product is generated by incremental update at each repeat cycle, every time a new clear-sky observation is available for a given pixel.

The output file contains the following fields:

- minimum NDVI for the day
- maximum NDVI for the day
- mean NDVI
- number of accumulations

The daily NDVI product is encoded in HDF5 format. In addition, a so-called 10-day NDVI or NDVD product is generated, also in HDF5, by accumulating the data of the daily product. This product is generated for every month according to the following scheme:

- Day 1–10
- Day 11–20
- Day 21 – end of month

### **3.5 Known product limitations**

The following product limitations have been identified:

- Despite the long accumulation period, the NDVI may not be calculated in some consistently cloudy areas.
- Negative NDVI/NDVD values may occur in the original due to cloud contamination or atypical desert scene types. These values are set to zero in the disseminated product.
- Since the BDRF correction for changing viewing and illumination angles is not perfect, NDVI time series might show a small seasonal signal correlated with the sun zenith angle.
- Possible variations in the atmospheric composition (e.g. aerosols) affect the NDVI estimates.

## 4 REFERENCES AND LINKS

### 4.1 Reference Documents

<i>Type</i>	<i>Document Name</i>	<i>Reference</i>
Validation	MSG-3 System Commissioning Product Validation Test Report	EUM/MSG/REP/12/0190
Detailed Algorithm	MSG Meteorological Products Extraction Facility Algorithm Specification Document	EUM/MSG/SPE/022
Research	<i>Pre-operational NDVI product derived from MSG SEVIRI</i> Ertürk et al., 2010,	EUMETSAT Meteorological Satellite Conference, Córdoba, Spain

### 4.2 Online Resources and Assistance

All of the reference documents listed above are in the EUMETSAT Technical Documents page. Find the product on this page and click on the link.

[www.eumetsat.int](http://www.eumetsat.int) > Satellites > Technical Documents  
> Meteosat Services  
> 0° Meteosat Meteorological Products

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

[www.eumetsat.int](http://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](http://www.eumetsat.int) > Data > Service Status

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

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