Regional Instability Index Product: Product Guide

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Document Change Record

Issue / Revision	Date	DCN. No	Summary of Changes
1	06/10/2010		Initial document creation.
v1A	28/08/2015		Review/corrections by subject matter expert. Deleted projected product examples.

Table of Contents

1 PRODUCT DESCRIPTION

Convective systems can develop in a thermodynamically unstable atmosphere. Such systems may quickly reach high altitudes and can cause severe storms. Meteorologists are thus especially interested in identifying such storm potential while the system is still in a pre-convective state. A number of instability indices have been defined to describe such situations. Traditionally, these indices are taken from temperature and humidity soundings by radiosondes. Indices derived from satellite data offer a superior temporal and spatial resolution because a sounding is, effectively, only a point measurement done only a few times a day.

The RII product is the pixel-based version of the Global Instability Index (GII) product. It is produced for a subset of the MSG image disc over Europe. The GII product consists of a set of indices which describe the stability of the atmosphere. These indices are highly empirical in nature and might even be only relevant in certain geographic regions or under certain circumstances. Usually, each of these indices is defined such that it describes a potentially unstable layering if it exceeds a certain threshold. The RII product comprises four common instability indices together with information about the precipitable water content:

- K-Index
- KO Index
- Lifted Index
- Maximum Buoyancy
- Layer precipitable water content as an air mass parameter
  - layer precipitable water values for low level—surface to 850 hPa
  - layer precipitable water values for mid level—850 hPa to 500 hPa
  - layer precipitable water values for high level— above 500 hPa
- Total precipitable water

Illustrations of the RII Product output are in Section 3.

2 PRODUCT SPECIFICATIONS

Category	*Specification*
Type	Meteorological Product
Applications and users	Nowcasting, severe weather
Product Distribution	• EUMETCast • EUMETSAT Data Centre
Product Area	RRS Area: limited to Europe
Product Resolution	Pixel
Product Distribution Frequency	• EUMETCast: every 5 minutes for the 00:00, 00:05, 00:10, …23:55 UTC products • EUMETSAT Data Centre: every 15 minutes for the 00:00, 00:05, 00:30, …23:55 UTC products
Product Format	BUFR
Product Size	about 6 MB (variable)

2.1 Product history and gaps in coverage GII and RII:

Initial development and baseline:	27 Nov 2000	
Substantial Revision	16 Sep 2001	
Substantial Revision	01 July 2005	Major change in algorithm implementation.
Substantial Revision	29 Oct 2009	Layer Precipitable water content parameters added to the product
Substantial Revision	17 Feb 2011	Resolution for GII product for 0° service increased from 15 × 15 to 3 × 3 pixels
Product change	24 March 2011	The RII product is generated in the Rapid Scanning Service over an enlarged area. Coverage increased from the original area over central Europe to the entire European area.
Substantial gaps in coverage	None	

3 PRODUCT ILLUSTRATION

Regional Instability Product (RII) output is the same as Global Instability Product (GII) output but covers about 1/3 of the full disk. The includes all of Europe up to 60°N latitude. The RII product is a pixel-based product with much higher resolution than the GII Product. Examples of potential uses for the product are in the GII Product Guide.

4 BASICS OF THE ALGORITHM

4.1 Inputs to the Algorithm

- EBBTs for the SEVIRI Level 1.5 image data of the following channels: WV6.2, WV7.3, IR8.7, IR10.8, IR12.0 and IR13.4
- Scene types on pixel level from the scenes analysis
- Geographical information and satellite zenith angles from the Level 1.5 image data

4.2 Description of the Indices:

Both the Global Instability Index (GII) and Regional Instability Index (RII) products use MSG-SEVIRI observed brightness temperatures plus some additional data to generate indices of atmospheric instability for Nowcasting of severe weather. We list only the indices calculations here. See Section 5 for document references for the complete algorithm descriptions and values tables.

The following eight indices are defined and set up as part of the baseline GII/RII product:

- K Index (KI)
- KO Index (KO)
- Lifted Index (LI)
- Maximum Buoyancy (MB)
- Precipitable Water Content Index (TPW)
- Layer Precipitable Water (LPW) content between the TOA and 500 hPa
- Layer Precipitable Water content between 500 hPa and 850 hPa
- Layer Precipitable Water content between 850 hPa and the surface

For simplicity, the four instability indices (KI, KO, LI and MB), TPW and LPW will all be referred to as *instability indices*.

The instability indices are defined as follows:

- Lifted Index $LI = T^{obs} - T^{\text{lifted from surface}}$ at 500 hPa
- K Index $KI = (T^{obs(850)} - T^{obs(500)}) + TD^{obs(850)} - (T^{obs(700)} - TD^{obs(700)})$
- KO Index $KO = 0.5 * (\theta_e^{obs(500)} + \theta_e^{obs(700)} - \theta_e^{obs(850)} - \theta_e^{obs(1000)})$
- Maximum Buoyancy $MB = \theta_e^{\text{obs(maximum between surface and 850)}} - \theta_e^{\text{obs(minimum between 700 and 300)}}$

where:

T^{obs}	is the observed temperature
TD^{obs}	is the observed dew point temperature
θ_e^{obs}	is the observed equivalent potential temperature
	all at the indicated pressure level (in hPa)

Lifted Index

$LI = T^{obs} - T^{lifted\ from\ surface}$ at 500 hPa

where:

T^{obs}	is the observed temperature

K Index

$KI = (T^{obs}(850) - T^{obs}(500)) + TD^{obs}(850) - (T^{obs}(700) - TD^{obs}(700))$

where:

$T^{obs}(x)$	is the observed temperature at x hPa height
$TD^{obs}(x)$	is the observed dew point temperature at x hPa height.

KO Index

$KO = 0.5 * (\Theta_e^{obs}(500) + \Theta_e^{obs}(700) - \Theta_e^{obs}(850) - \Theta_e^{obs}(1000))$

where:

$\Theta_e^{obs}(x)$	is the observed equivalent potential temperature at x hPa height.

Maximum Buoyancy

$MB = \Theta_e^{obs}$(maximum between surface and 850) – Θ_e^{obs}(minimum between 700 and 300)

where:

Θ_e^{obs}	is the observed equivalent potential temperature

Precipitable Water

$$W = \frac{1}{g}\int_{surface}^{0} q(p)dp$$

5 REFERENCES AND LINKS

5.1 Reference Documents

Type	*Document Name*	*Reference*
Related Product	Global Instability Index (GII) Product Guide	EUM/TSS/MAN/15/802106
Validation Report	MSG-3 System Commissioning Product Validation Test Report	EUM/MSG/REP/12/0190
Detailed Algorithm	The Global Instability Indices Product. Algorithm Theoretical Basis Document	EUM/MET/REP/07/0164
Detailed Algorithm	GII Physical Retrieval Algorithm description	EUM/MET/DOC/04/0155

5.2 Online Resources and Assistance

All of the reference documents listed above can be found on the EUMETSAT Technical Documents page.

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

There are excellent illustrated (and animated) case studies of GII and RII product results in the EUMETSAT Images web page:

http://www.eumetsat.int > Images > Image Library > Filter by: Global Instability Index

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

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

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