CONVECTION WORKING GROUP

DETECTION AND NOWCASTING OF SEVERE CONVECTION WITH MSG

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Introduction

After the first 5 years of MSG operations, a number of applications in the area of severe convective storm detection and nowcasting have been developed by various users. To make an inventory of all available applications a workshop was organised in late 2007 aiming to get a deeper insight into the differences and commonalities of the techniques and their specific area of application.

To maintain and stimulate the cooperation between partners a working group has been formed. This Convection Working Group (CWG) consists of scientists from more than 40 countries.

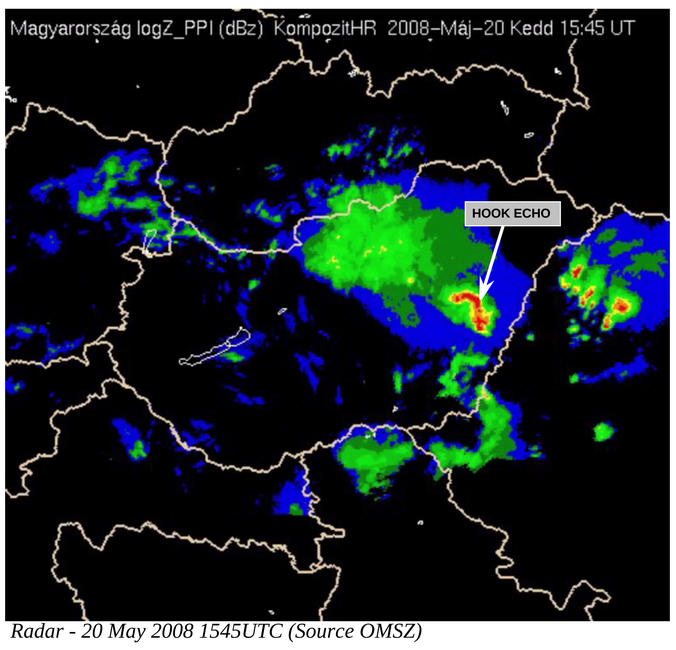
The CWG plans regular meetings to exchange results and to broaden the scientific expertise. This poster serves as a tool to support this information exchange.

Aim

The CWG has the aim to evaluate the existing convection nowcasting products in order to arrive at a "best practices" guideline for future use. Common test cases are processed and interpreted to support this goal.

Case Study

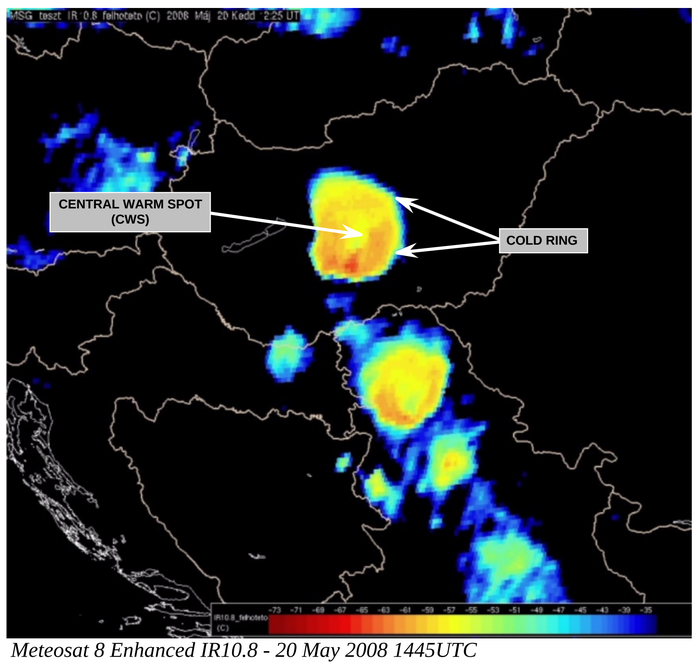
On 20th May 2008, rapid developments of severe convective storms were observed over Hungary. On the ground these storms where associated with torrential rainfall, flash floods, hail and even tornadoes.



Radar - 20 May 2008 1545UTC (Source OMSZ)

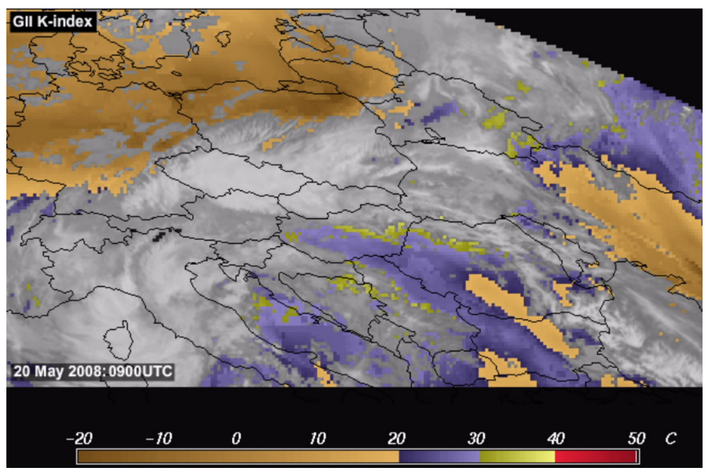
The hook echo is one of the classical hallmarks of tornado-producing supercell thunderstorms as seen on weather radar. The echo is produced by rain, hail, or even debris being wrapped around the supercell.

Fortunately Meteosat 8 was in rapid scan mode providing an excellent temporal resolution to monitor the events of this case. Below we see the enhanced IR10.8 image of 1425UTC. Cold ring shaped storms are found over Hungary and Serbia. The central warm spot with the overshooting tops is found towards the center of the storm and is indicative for the severe updrafts and the severity of the weather at the surface.



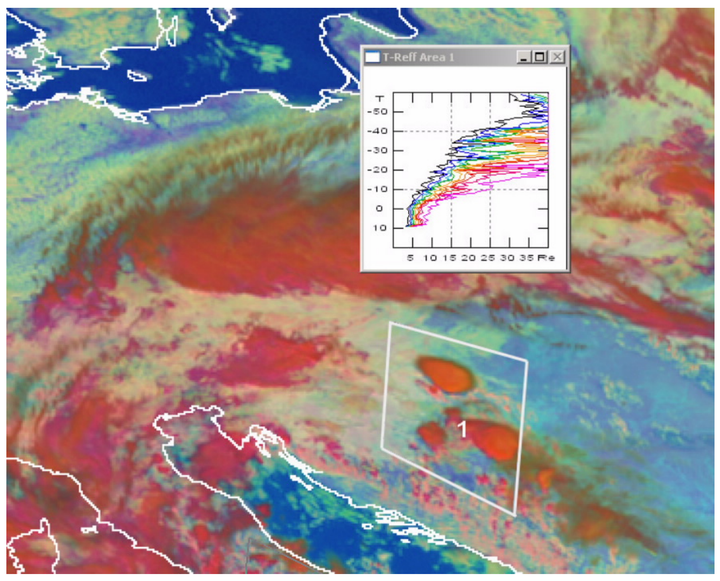
Meteosat 8 Enhanced IR10.8 - 20 May 2008 1445UTC

The convective activity was well forecasted by the Hungarian Meteorological Service. One tool that might have provided even further additional information is the GII (Global Instability Index) that shows over Hungary and Serbia large unstable airmasses with K-index values over 30ºC already in the morning hours, 3 hours prior to onset.



GII K-index with Meteosat 9 IR10.8 overlay - 20 May 2008 0900UTC

The possibility of hail and tornadoes can also be analyzed by making a *T*-r_e plot. For Area 1 this is done and the resulting scatter plot shows likelihood of some severe updrafts.

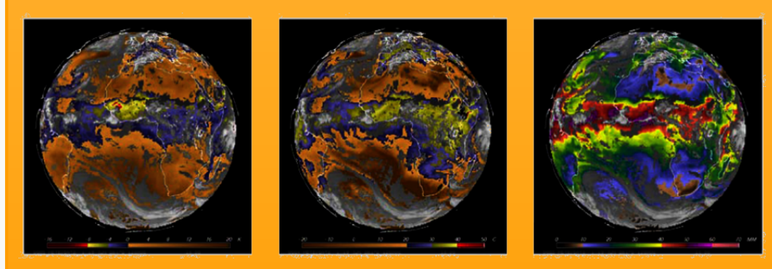


Meteosat 8 RGB VIS0.8; NIR3.9; IR10.8 - 20 May 2008 1155UTC

GII

The Global Instability Index product is one of the MSG meteorological products and describes the instability of the clear atmosphere by a number of airmass parameters.

The GII product should serve as a nowcasting tool to identify the potential of convection and possibly of severe storms in still preconvective conditions. The applied retrieval method makes use of six MSG SEVIRI thermal bands, and together with the a priori information of forecast profiles, the scheme infers an updated atmospheric profile for each MSG pixel, from which instability indices can be computed.

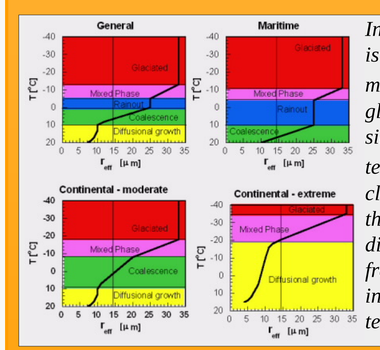


Example of the Lifted Index (left), the K-Index (centre) and the Total Precipitable Water (right) as provided by the operational GII product for the entire MSG coverage (example is for 19 June 2006, 1200 UTC). Detected clouds are overlaid in various grey scales to roughly indicate the cloud top temperature.

T - r_e

The theory developed by Rosenfeld *et al*. presents a conceptual model that learns us to recognize vigorous and severe convective storms, using satellite-retrieved vertical profiles of cloud top temperature (*T*) and particle effective radius (r_e) relationship.

The driving force of these severe weather phenomena is the high updraft speed, which can sustain the growth of large hailstones. Stronger updrafts are revealed by the delayed growth of r_e to greater heights and lower *T*, because they leave less time for the cloud drops to grow by coalescence. The strong updrafts also delay the development of mixed phase and eventual glaciation to colder temperatures.



In extremely continental clouds r_e at cloud base is very small, the coalescence zone vanishes, mixed phase zone starts at T<-15°C, and the glaciation can occur at the most extreme situation at the height of homogeneous freezing temperature of –39°C. In contrast, maritime clouds start with large r_e at their base, crossing the precipitation threshold of 14 mm short distance above the base. The large droplets freeze at relatively high temperatures, resulting in a shallow mixed phase zone and a glaciation temperature reached near –10ºC

Analysis of case studies making use of these and related criteria show that they can be used to identify clouds with sufficiently strong updrafts to possess a significant risk of large hail and tornados.

Contact

More information on this and other case studies and the various nowcasting methods but also on other activities of the convection working group please visit:

http://convection.satreponline.org