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Conference on European Tornadoes and Severe Storms

Monitoring rapidly developing thunderstorms using Meteosat Second Generation

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Meteosat Second Generation will provide a coverage of Europe at high spatial and temporal resolution. Among the Satellite Application Facilities (SAFs) designed and developed by EUMETSAT member states to maximize its benefits, the SAF in support to Nowcasting and Very Short Range Forecasting (NWC-SAF) foresees a variety of products, and a number of them are relevant to convection nowcasting. The Rapidly Developing Thunderstorm product is designed in order to support the forecaster through i) the early identification of new convective developments, and ii) the monitoring of already developed convective systems. This talk addresses the ongoing development and testing of this product.

The basis for this product is the tracking of cold cloud systems in infrared images. Images are thresholded above a given temperature, and then labeled. This defines cloud shields named "cells", which basic morphological and radiative properties are first computed on an image-by-image basis. The tracking phase relies on a sufficient overlap between cells in successive images, cells move being accounted for. Trajectories are thus defined, which link cell descriptions throughout time. The tracking has been validated for cells which area exceeds 1000 square kilometer.

A next step is the decision about the convective nature of the trajectories, which is based on the sharpness of the edges of the systems at the beginning of their life-cycle. Brightness temperature gradients along the edges of the cells then show distributions with high values of their high percentiles. This method has been tuned and validated, thanks to a "ground truth" based on lightning (cloud-to-ground) data; this allowed to choose i) a temperature threshold of -45°C as providing the best set of compromises between false alarm rate and detection efficiency, and ii) a given temperature peripheral gradient threshold value as the decision method.

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Such a temperature threshold, while allowing to track developed systems, does not however permit the early detection of growing cumulonimbii. Careful examination of the early stages of a large number of convective "cells" has shown that i) they exhibit high values of peripheral gradient even at warmer temperature thresholds, ii) the overlap between successive "cells" is often large enough to ensure a correct tracking of small cells, down to an area of 100 square kilometers, and iii) a large percentage of the convective "cells" are detected in the visible channel up to 1 hour before being detected clearly in the infrared channel. Those findings suggest improvements to the method which are currently under development and which results will be shown at the conference.

Lastly, the context of this development, which aims at providing a real-time diagnosis of meteorological objects to be used by a number of NMS, has led to a proposal of a list of relevant attributes of convective systems documentation for their nowcasting; these attributes are not restricted to the satellite-based diagnosis of such systems. The BUFR code has been chosen as the method for coding such objects. A discussion may occur on this proposal.