EMS Annual Meeting Abstracts,
Vol. 6, EMS2009-131, 2009
9th EMS / 9th ECAM

9th EMS Annual Meeting
9th European Conference on Applications of Meteorology
High resolution meteorology
- applications and services

Innovative radar products for the 3D, high-resolution and real-time monitoring of the convective activity in the airspace around airports

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Airports are recognized to become critical areas in the future given the expected doubling in air traffic by 2020. The increased density of aircrafts in the airport airspaces calls for improved systems and products to monitor in real-time potential hazards and thus meet the airport objectives in terms of safety and throughput. Among all meteorological hazards, convection is certainly the most impacting one. We describe here some innovative radar products that have recently been developed and tested at Météo France around the Paris airports.

Those products rely on the French Doppler radar network consisting today of 24 elements with some of them being polarimetric. Reflectivity and Doppler volumetric data are concentrated from all 24 radar sites in real-time at the central level (Toulouse) where 3D Cartesian mosaics covering the entire French territory (i.e. a typical 1,000 by 1,000 km^2 area) are elaborated. The innovation with respect to what has been done previously is that the three components of the wind are retrieved by operational combination of the radial velocities. The final product, available in real-time every 15 minutes with a spatial resolution of 2.5 km horizontally and 500 m vertically, is a 3D grid giving the interpolated reflectivity and wind field (u, v and w) values. The 2.5 km resolution, arising from the fact that the retrieval is carried out every 15 minutes from radars typically spaced apart by 150 km, is not sufficient for airport airspace monitoring but is valuable for en-route monitoring. Its extension to the entire European space is foreseen.

To address the specific needs in the airport areas, a downscaling technique has been proposed to merge the above-mentioned low-resolution 3D wind and reflectivity fields with the high resolution (5 minutes and 1 km^2) 2D imagery of the Trappes radar that is the one that covers the Paris airports. The merging approach is based on the assumption that the Vertical Profile of Reflectivity (i.e. the relative value of reflectivity at a given height with respect to the value at ground level) remains unchanged over 15 minutes. This allows retrieving the 3D structure of the convective cells at high-resolution. In addition, using the polarimetric / Doppler capability of the Trappes radar, the hail content and maximum wind shear value of the cell is assessed. Finally, a limited number of relevant parameters (echo top, maximum reflectivity, height of maximum reflectivity, Vertically Integrated Liquid Content, Hail content, wind shear) are computed and ingested in now-casting objects that are subsequently introduced in ATM systems both at ground and in air.