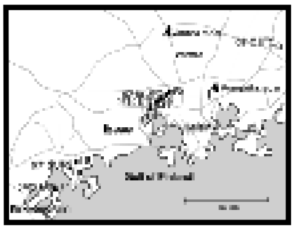
CASE STUDY OF A TORNADIC SUPERCELL IN FINLAND 28 AUGUST 2005

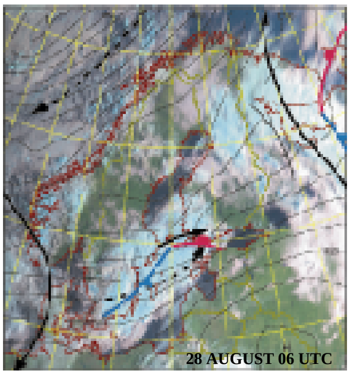
Kaisa Outinen and Jenni Teittinen
Finnish Meteorological Institute
kaisa.outinen@fmi.fi

During the morning and before noon hours of 28 August 2005, a supercell thundestorm developed in a surface trough over Gulf of Finland and moved over the Helsinki metropolitan area. The supercell storm produced two successive tornadoes, classified as weak (F1). The second tornado hit a golf course where several people were injured. The storm travelled trough Helsinki Testbed mesoscale observational network and the second tornado occurred near two weather radars.



The locations of the two radars and tornado damage with Fujita-scale ratings.

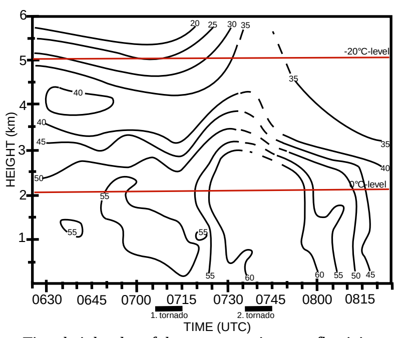
THE STORM ENVIRONMENT



Meteosat satellite image with ECMWF model and manual frontal analysis.

- Eastern North Atlantic and Finland were part of a vast low pressure area. A wave developed with 500-hPa trough in southern Sweden and moved toward the Gulf of Finland.
- The tornadic storm developed at the warm side of the warm front.
- A low level jet at 850 hPa stretched from the Baltic Sea to the Gulf of Finland and was strengthening and increasing the low-level wind shear during the tornadogenesis.
- The surface winds were southwesterly before and after the storm.
- The 300-hPa upper-level jet over southern Finland was weak with maximum wind speeds around 30 m/s.

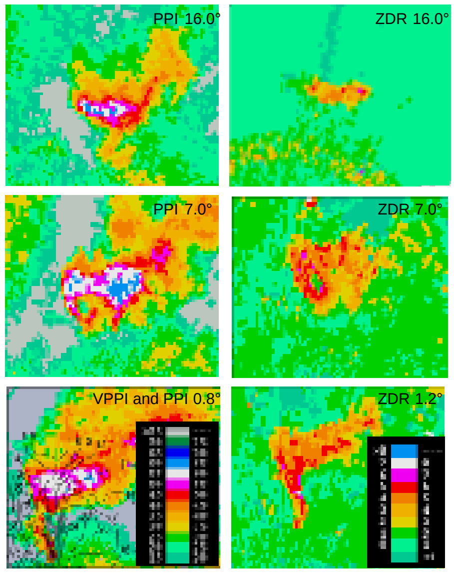
THE STORM EVOLUTION



Time-height plot of the storm maximum reflectivity.

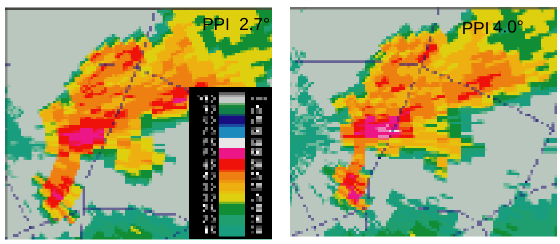
- The time-height profile shows contours ascending in time at 0717-0740 UTC indicating updraft growth.
- Reflectivity maximum increasing over time above freezing level indicating hail or graupel growth, however, those were not observed on the ground. The high reflectivity near the surface is sign of heavy rain.
- Storm diameter during first tornado was 12 km and height 6 km defined by 15 dBZ contour. During the second tornado the storm diameter was 15 km. The cloud top was less than 7 km throughout the storm's lifetime.

POLARIMETRIC RADAR OBSERVATIONS



PPI of reflectivity and differential reflectivity (ZDR) images from Kumpula polarimetric radar at 0750 UTC.

- A hook echo was observed for the first time at 0650 UTC, 15 minutes before first tornado, and it was evident throughout the storm's whole tornadic phase, until 0810 UTC.
- A bounded weak echo region (BWER) was not detected during the first tornado, but it was observed at 0750 UTC, when the storm had just passed the second damage track.
- The BWER can be also seen in differential reflectivity (ZDR). In the strong updraft, the smallest particles follow the flow and advect back to the cloud. Biggest particles fall against strong updraft and organize around it following the circulation.
- High ZDR values in high reflectivity area around BWER and on the storm left flank suggest massive particles with flattened shapes.
- High ZDR values dominate throughout the most of the storm, and when coincident with high radar reflectivity, suggest that graupel or hail were not associated with this storm, instead heavy rain.
- The mesocyclone signature in Doppler velocity data was detectable during storms lifetime beginning from 0650 UTC. Highest tangential velocity in mesocyclone was ±15 m/s.
- A tornado vortex signature (TVS), with 300-500 m diameter, was evident during the both tornadoes.



Debris cloud seen in PPI of reflectivity from Vantaa Doppler radar at 0747 UTC.

- The tornado debris cloud is visible in Vantaa radar images as reflectivity maximums in the tip of the hook echo. The reflectivity maximums are visible at height 300 and 400 m with 0.9 and 1 km diameters. During that time the tornado was confirmed at ground and caused F1-damage.

FINNISH METEOROLOGICAL INSTITUTE