Geophysical Research Abstracts
Vol. 16, EGU2014-11437, 2014
EGU General Assembly 2014

Radar observations of a tornado-spawning storm complex in Southeast Brazil and Meso-Eta forecasts of this extreme event

Gerhard Held (1), Jorge Luis Gomes (2), and Ana Maria Gomes (1)

(1) Instituto de Pesquisas Meteorológicas (UNESP), Universidade Estadual Paulista, Bauru, S.P., Brazil (gerhard@ipmet.unesp.br, +55 14 3203-3649), (2) Centro de Previsão do Tempo e Estudos Climáticos – CPTEC/INPE

During the early afternoon of 22 September 2013, severe storms, accompanied by large hail, damaging winds, heavy precipitation and intense lightning activity, devastated a region in the southeast State of São Paulo. Several extremely intense storm cells moved at up to 80 km/h east-southeastwards, ahead of a strong cold front approaching through Paraná, which created extremely unstable conditions that led to deep convection and overshooting towers up to 18 km. At least one of theses cells spawned a tornado when it reached the town of Taquarituba. The tornado traversed the town from south-southwest to north-northeast and was responsible for 63 people injured and two fatalities. Based on the damage reported, it was at least an F3 according to the Fujita scale. The objective of the present study is to characterize this severe thunderstorm event, using different types of data, and to evaluate the forecasts provided by the Meso-Eta model centered over Bauru.

The pre-frontal and frontal convective cells were tracked throughout their life-time by IPMet′s Doppler radars, which cover the western and central regions of the State São Paulo, as well as northern Paraná State. Radar volume scans, generated every 7,5 min, were processed with the TITAN (Thunderstorm Identification, Tracking, Analysis and Nowcasting) Software, yielding the following preliminary results: as the storm complex traversed the Paranapanema River, which forms the border between the two states, the cells intensified drastically and shortly before reaching the town of Taquarituba, that particular cell displayed extremely strong radial shear just above the cloud base (about -20 to +35 m/s), which led to the formation of a deep meso-cyclone, from which the tornado spawned and touched down at around 14:30 LT (LT=UT-3h). Cell properties calculated by TITAN showed a drastic increase of VIL (Vertically Integrated Liquid water content) from 13:52 LT (7,9 kg/m2) to a maximum of 61,8 kg/m2 at 14:15 LT. From 14:22 LT to 14:45 LT the VIL dropped to 14,2 kg/m2, indicative of destructive winds reaching the ground, coincident with the tornado touch-down. Simultaneously, the accumulated hail mass aloft increased from 0 to 802 ktons at 14:22 LT, which subsequently dropped to the ground, confirmed by the likewise decrease of VIL. Furthermore, the fact that the 40 dBZ radar reflectivity reached up to 16,6 km at the time of the tornado occurrence was also outstanding, while maximum reflectivities varied between 50 and 60 dBZ during 90 min.

The Meso-Eta model is initiated twice daily (00 and 12 UT) for a domain, which amply covers the State of São Paulo at a resolution of 10x10km horizontally and 38 levels from 1000 to 50 hPa. It also computes additional convective parameters (Storm Relative Helicity (SRH), BRN Shear, supercell index, etc), as well as vertical profiles (Skew-T–Log-P) at any specified grid point. Furthermore, each run of the model is executed twice, using the convection parameterization of Betts & Miller and Kain-Fritsch, respectively. Based on the forecast from the 21Sept2013-12UT and 22Sept2013-00UT model runs (+27h & +30h and +15h & +18h, respectively), a warning for very severe storms to occur in the region from Ourinhos to Taquarituba could be emitted during the night before the extreme event. Some of the indicators were: CAPE 3000–4000 J/kg; K Index 38–42; strong wind shear between 500 hPa and 250 hPa (northwest at $\pm$20 m/s to west at 30m/s); Omega at 500 hPa -1,0 to -1,4 Pa/s; Supercell Parameter -1 and SRH 150–200 m2/s2. The time window ranged from 12:00 to 18:00 LT. The Skew-T diagram at 09:00LT at Taquarituba indicated relatively dry air between 600–200hPa, which was quickly moistened as the cold front approached.