Priority Program SPP 1167 of the DFG

Convective and Orographically Induced Precipitation Study

Karlsruhe Institute of Technology

Tracks of Thunderstorms as Evaluated by TRACE3D During IOP 9c

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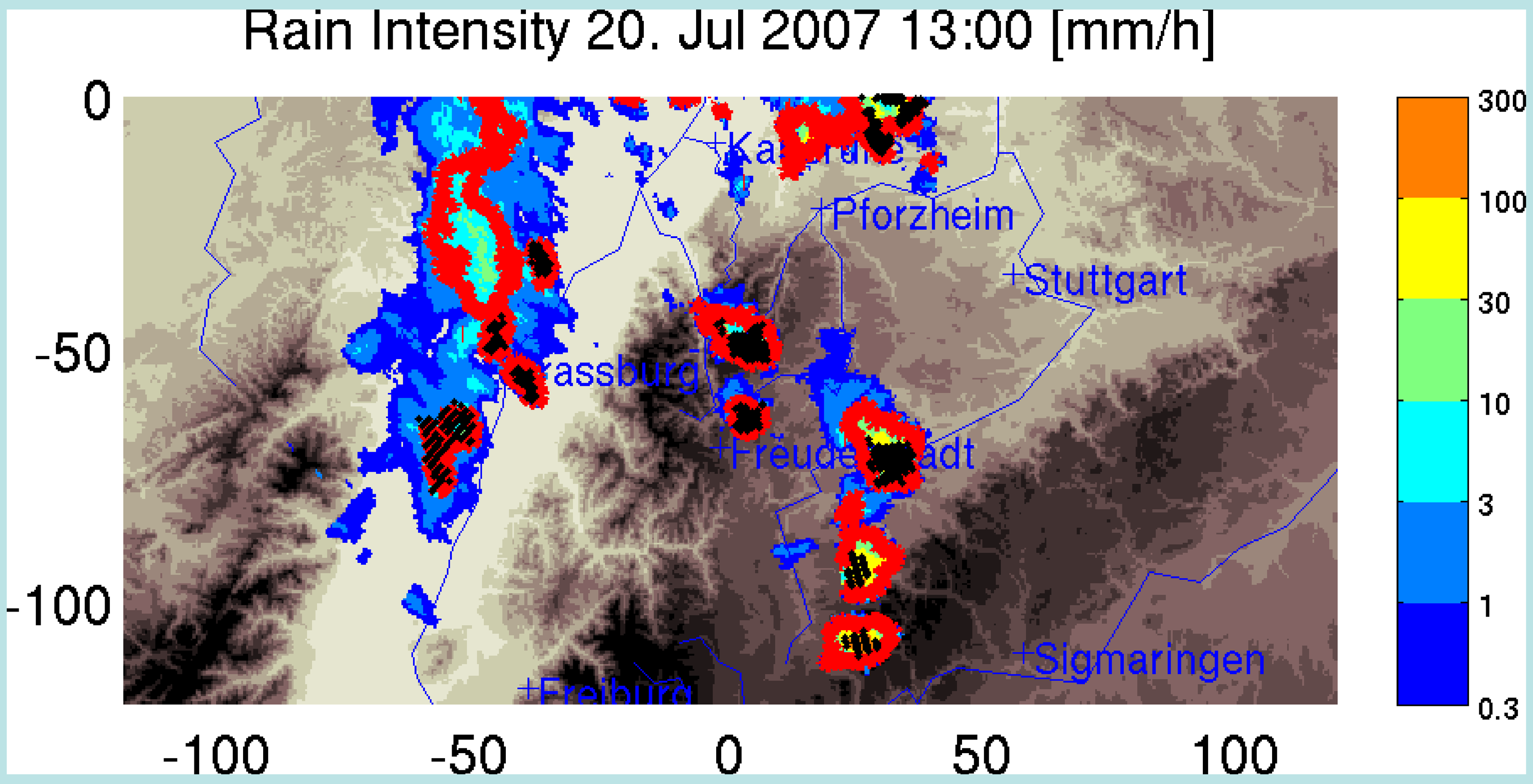
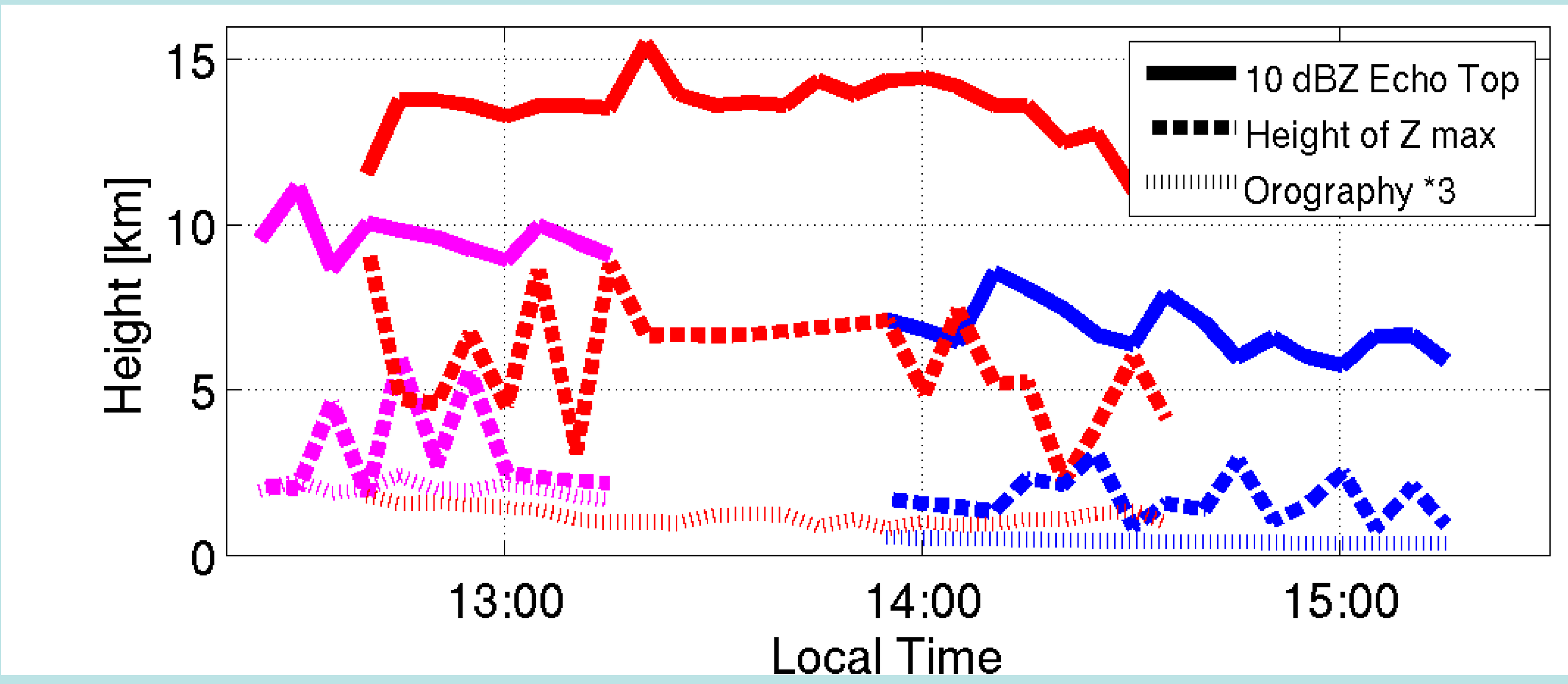
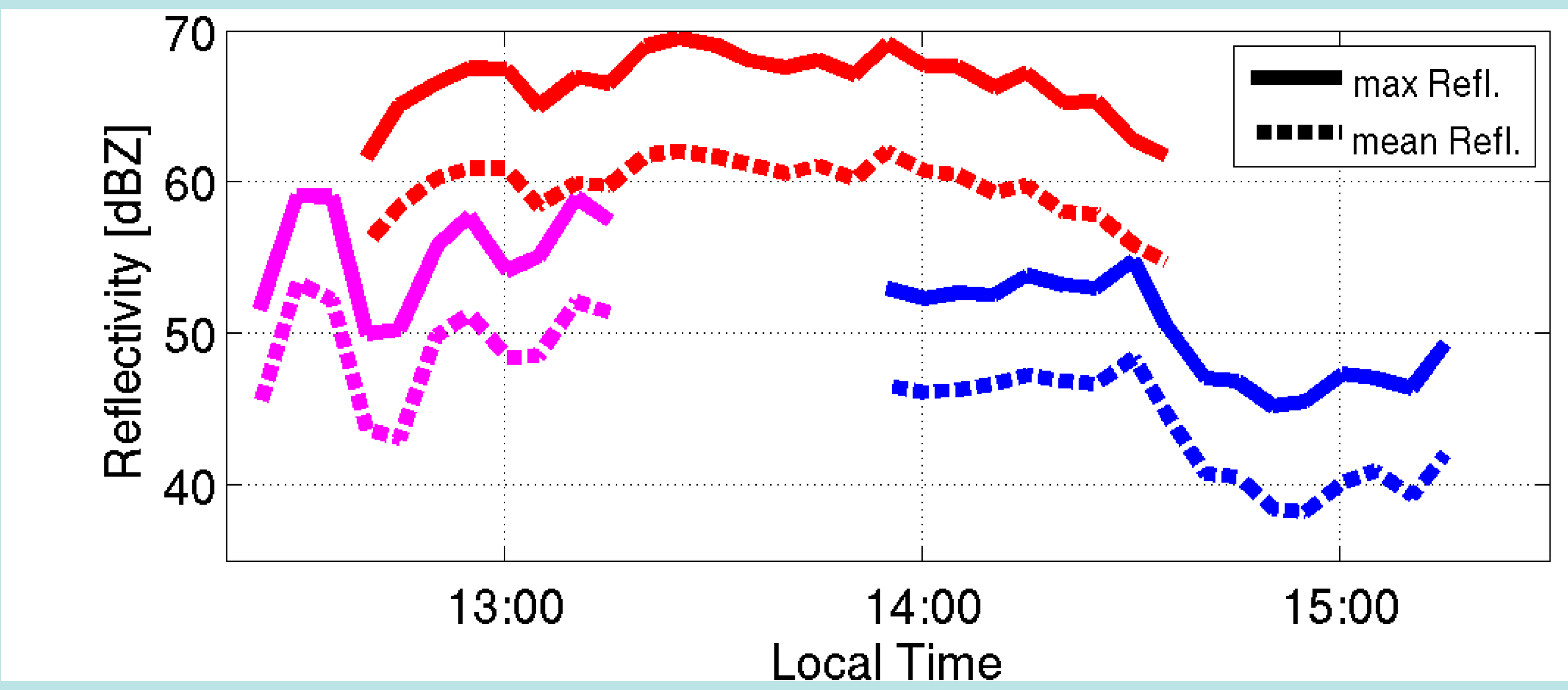
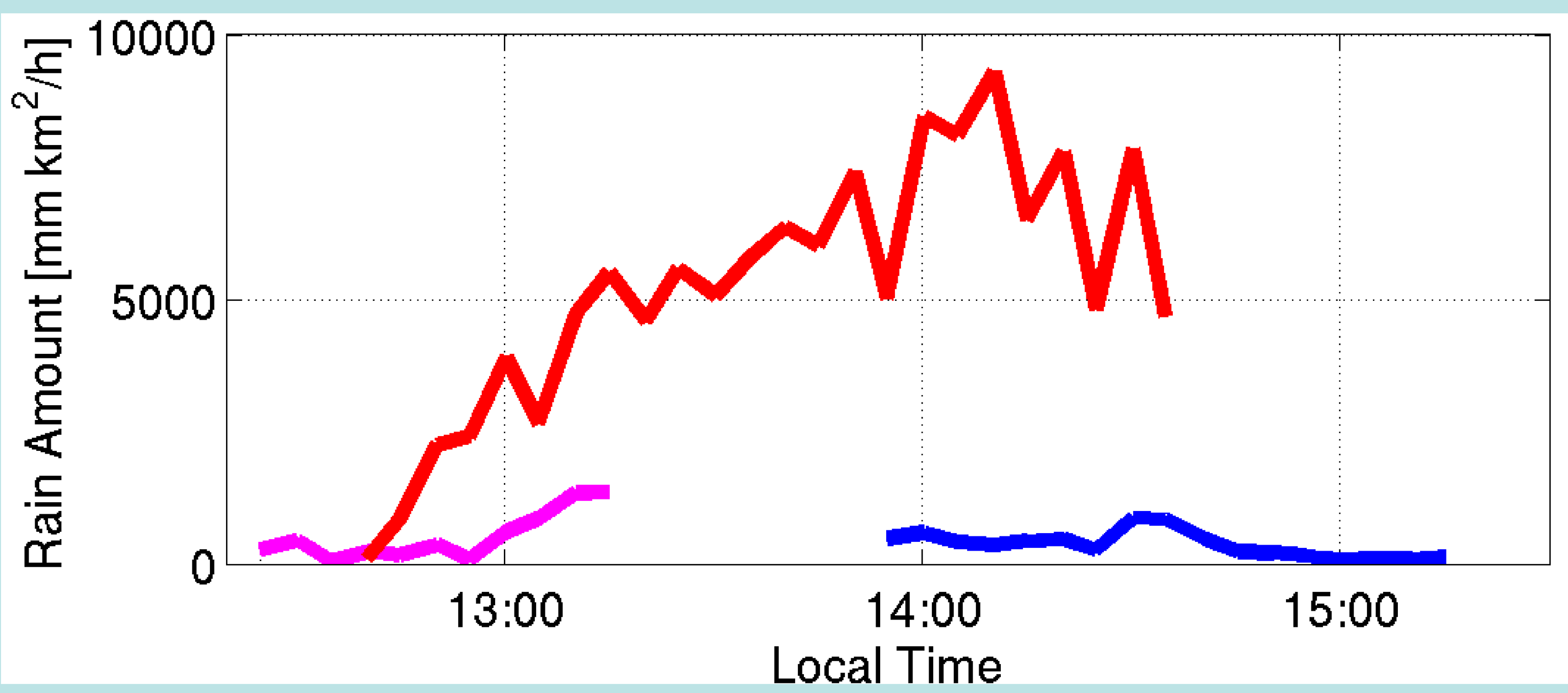


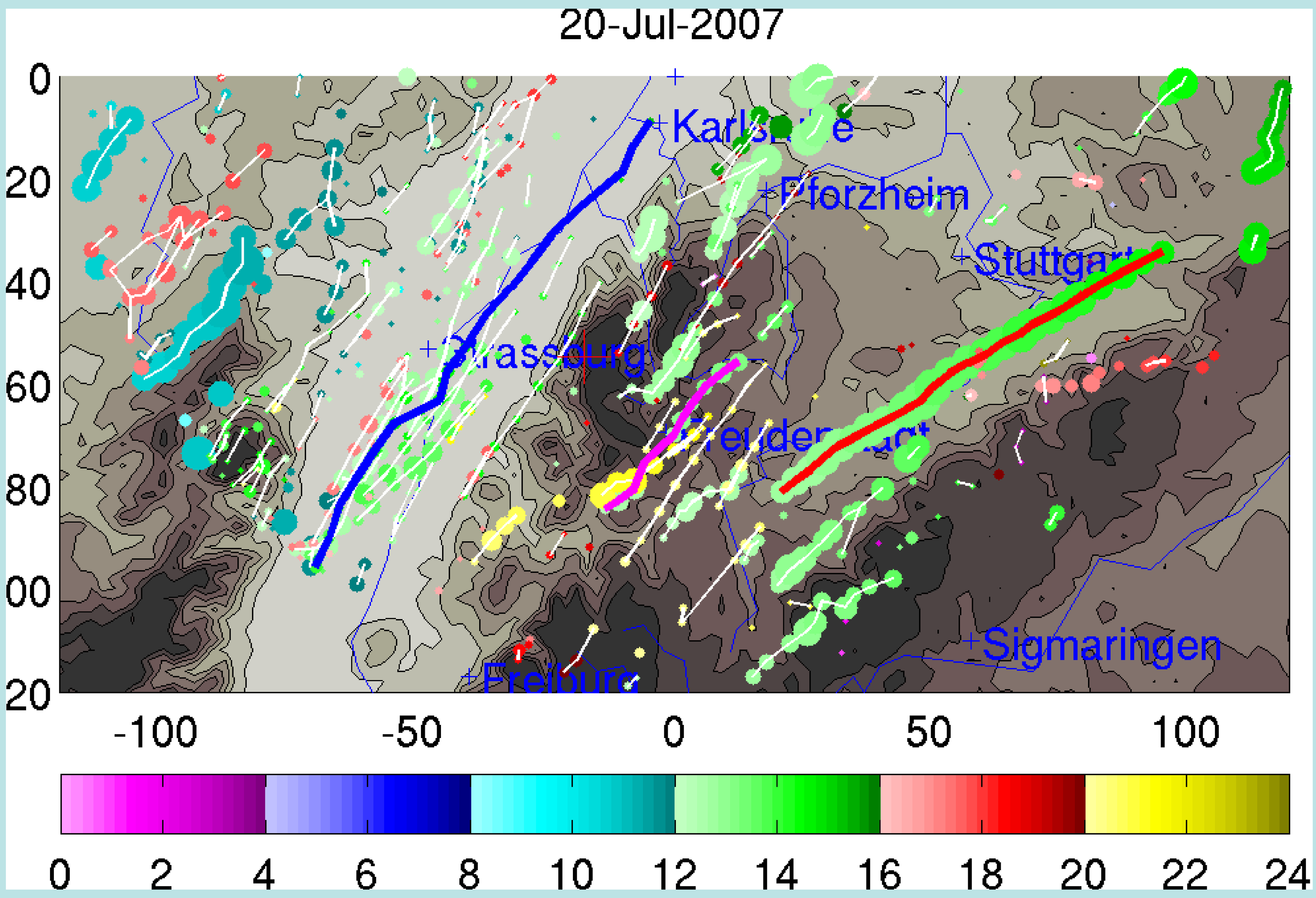
TRACE3D

The tracking algorithm TRACE3D identifies thunderstorms in two steps (see upper left image): First, regions of intense precipitation are identified as contiguous volumes with reflectivities above 35 dB_Z (here indicated as red contours at 1500 m agl.). Within each such region the maximum reflectivity $Z_{\max}$ is then determined. If this maximum exceeds 45 dB_Z, thunderstorms are defined as contiguous volumes with reflectivities above $Z_{\max}$-10 dB (indicated as black dots). These thunderstorms are then tracked in time.









COPS IOP 9c

The tracks observed on July, 20th 2007 (IOP9c) are shown in the upper right figure. The color of the circles denotes the time of the observation (in Local Time = UTC +2h, see colorbar below the figure), the size of the circles indicates the maximum reflectivity of that thunderstorm.

Three tracks are highlighted by colored lines, one in the upper Rhine valley (blue), one above the Black Forest (magenta) and one north of the Swabian Mountains (red). The three figures on the left show several properties of these thunderstorm events. It is obvious that the "red" storm developed stronger, higher and significantly longer than the two others.

The upper plate shows echo tops (solid lines) and the heights where the maximum reflectivity was observed. Whereas the "red" storm attains echo tops at 14 km and more, the two other storms only reach 10 km (magenta) and roughly 7 km (blue). Note that the echo tops of an individual storm is nearly constant in time, compared to the differences among different storms.

The heights of $Z_{\max}$ show as well, that the "red" storm reaches much higher levels than the two other storms (long dashed lines). Note that all storms show a more or less pulsating behaviour of $Z_{\max}$-heights. There is no effect of orography (stippled lines) on the development of the storms.

The middle plate exhibits mean (dashed) and maximum (solid) reflectivities of the storms. Again variations in time are significant smaller than differences among storms. All three storms reach reflectivities indicating the presence of hail (i.e. $> 50\,dB_Z$). Again the "red" storm exceeds the other storms significantly. This holds true for the area integrated precipitation rate (in mm km^2/h). The strong increase for the "red" cell is caused by a corresponding increase in covered area (up to 150 km^2).

With regard to the analysis of radar data presented no reason can be recognized for the different development of the storms.