CONSTRUCTION OF A THUNDERSTORM CLIMATOLOGY FOR VENETO REGION

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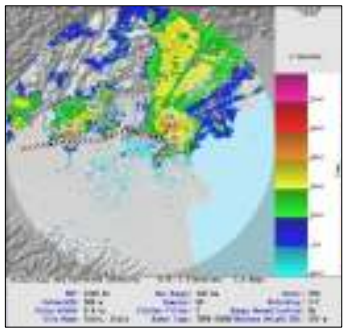
The Meteorological Centre of Teolo (CMT) has a relatively long tradition in using radar for monitoring convection, but a systematic thunderstorm climatology was never constructed. The purpose of this study is to take a first step in filling this gap by means of radar imagery. The Storm Cell Identification and Tracking Algorithm (SCIT), developed at NSSL, was used to process radar reflectivity volumes of CMT's Mt. Grande radar, located in the center of the region Veneto in north-eastern Italy. The SCIT was used to identify and track convective cells of the summer seasons 2005 and 2006.

The SCIT (Storm Cell Identification and Tracking) Algorithm

The SCIT algorithm processes volumetric reflectivity information from radar base data on a radial by radial basis. Three dimensional storm identification is performed in subsequent stages. First, storm segments are identified in the radial data. This process is repeated using seven different reflectivity thresholds (30,35,40,45,50,55,60). Then individual segments are combined into 2D storm component based on spatial proximity and finally 2D features are correlated in the vertical to give 3D storm centroid locations.

(From Johnson et al., 1998)

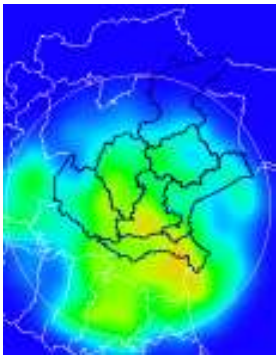
Storm cells identified in two consecutive volume scans (10 minutes apart) are associated temporally to determine the cell track.
The figure shows an example of cell identification and tracking. Each circle along the tracks corresponds to the position of the cells at each time step.
Note that the convective cell labeled 325 is tracked over a period of 4.5 hours.



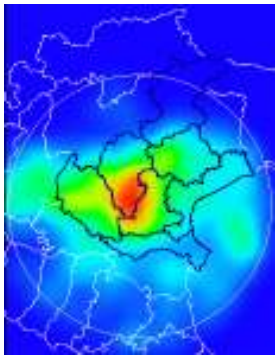
Use of SCIT to construct a storm cell density

The SCIT cell identification capability can be used to obtain the storm cell density all over the radar domain. Unfortunately the northern part of the Veneto region is not covered, thus it can not be included in this count, which has been performed on a lat/lon grid with a mesh size of 0.2°x0.2°. For each grid element the count of the total number of SCIT-detections during the summer trimester (June, July and August) of years 2005 and 2006, was performed. Furthermore, in order to investigate the preferred hours of the day for storm genesis, a histogram showing the number of first-time detections as a function of the hour of the day has been derived.

COMPARISON AUGUST 2005 AND AUGUST 2006 [cells/month]

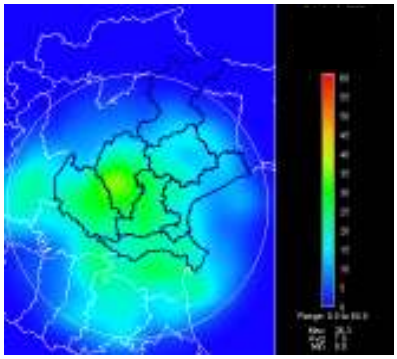


Storm cell density map for August 2005

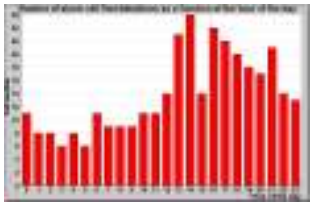


Storm cell density map for August 2006

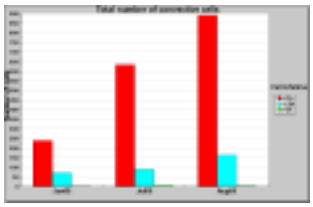
RESULTS SUMMER 2005 [cells/month]



Storm cell density map for the June-August 2005 trimester.



Number of SCIT first time detections as a function of the hour of the day.



Number of detections as a function of the month and of the cell lifetime.

Discussion and Outlook

This first analysis of thunderstorm frequencies for summer 2005 over the region Veneto revealed :
• a distinct maximum located to the west of the radar in the province of Vicenza, which in fact was repeateadly hit by severe convection;
• a strong convective activity over the plains, which again was notable in this summer;
• the number of first time detections exhibits a maximum in the afternoon and a minimum in the ealry hours of the day, which is in good agreement with convective activity;
• that the SCIT seems to be a valuable tool to contruct a multi-year climatology of convective activity over Veneto.

The next steps of this analysis include:
• extending the convective season to include May and September;
• exploiting CMT's radar data archive (which dates back to 1989) to obtain a significant climatology along with a probability of occurrence of storm cells.

Limits of the analysis

As far as cell identification is concerned the main issues can be traced back to the limits of the radar measurements, i.e.:

• decreasing resolution with range: storms close to the radar tend to be detected as multiple distinct cells, as opposed to those that are far away, while smaller cells far from the radar can be missed; this positive bias is partially overcome by filtering the data in order to reduce resolution close to the radar;
• increasing beam height with range: low cells far from the radar can be missed; the cell densities seem to have a negative bias with range;
• beam blocking over the mountains: partially screened cells may not match the algorithm's rules for identification; there may be a negative bias over the mountains.

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