

## 7.6 REAL TIME DETECTION OF LIGHTNING ACTIVITY USING A LOW-COST AND PORTABLE X-BAND RADAR AND A CLUSTER ANALYSIS APPROACH

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This work proposes a multi-parameter method for the detection of cloud-to-ground (CG) lightning activity, using a low-cost and portable single-polarization X-band weather radar. With respect to previous works on the same topic, in this study various lightning proxy parameters are extracted for each rain cell seen by the radar and are jointly considered to produce an estimation of the expected stroke activity for each rain cell.

The developed methodology foresees two main steps: i) a rain cell identification based on a modified Storm Cell and Identification Tracking method for the convective cell identification and ii) on a cluster analysis, which is aimed at combining the selected lightning proxy parameters into a single label indicating the most likely category of Cloud to Ground (CG) activity that is flash rate equal or greater than zero, respectively.

Three lightning radar based proxy parameters have been selected after a correlative analysis, which considered a large number of predictors. The three radar based lightning proxy parameters selected are: i) the altitude thickness between the iso-reflectivity at  $Z=40$ -dBZ and the  $T=-20^{\circ}\text{C}$  isotherm ( $\Delta_{HZ,T}$ ); ii) the rain cell area contoured by iso-reflectivity at  $Z=40$ -dBZ found at  $T=-10^{\circ}\text{C}$  isotherm ( $A_{Z,T}$ ) and iii) the vertical integral of ice equivalent water (VII).

In order to train and test our procedure, a dataset collected in the pilot study area of Naples metropolitan environment and consisting of 1575 radar reflectivity volumes acquired from April 2012 to March 2016, LINET lightning network of cloud-to-ground (CG) and intra-cloud (IC) strokes and meteorological in-situ data has been used. Radar data have been accurately processed, in order to remove clutter and partially compensate for attenuation effects.

Results will be discussed in terms of detection scores showing as the developed techniques, although with some limitations, outperforms those that make use of single lightning proxy parameters. Overall, the main results are fairly reasonable compared with other studies and more advanced radar systems, showing a Proportion Correct (PC) detection of 0.60, a Probability of Detection (POD) of 0.67, a False Alarm Ratio (FAR) of 0.29, a Critical Success Index (CSI) of 0.52 and a Heidke Skill Score (HSS) of 0.47.