



Using X-Band radar reflectivity data for hail detection and lightning nowcasting in Naples urban area

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The objective of this work is to exploit the potentiality of a single-polarization X-band weather radar measurements in hail detection and in lightning nowcasting. Even though X-band radars may suffer of two-way path attenuation especially at long ranges, due to their relatively low cost their use is rapidly increasing for short-range applications, such as urban environments. Since November 2011, one innovative single-polarization X-band miniradar system, named WR-10X, has been installed and tested in Naples metropolitan area, which is often affected by severe thunderstorm events.

To identify hail through radar measurements, two different methodologies, based on single-polarization X-band radar data, have been selected and adapted within the study area. The first one combines the reflectivity measurements with aerological data, whereas the other one uses the Vertically-Integrated Liquid Density product. The study aims at developing a Probability-of-Hail (POH) index that could be useful to support hail risk management by using radar data. In order to find the optimal threshold values to discriminate between hail and severe rain, an extensive intercomparison between outcomes of the two methodologies and ground truth observations of hail has been performed, using a 2x2 contingency table and statistical scores. The relationship between the output of the two methodologies and POH has been derived through a heuristic approach, using a third-order polynomial fitting curve.

To face the second aim of this work, the difference between the maximum height of a reflectivity echo value found by WR-10X radar equal to a specific threshold (i.e. 35 or 40 dBZ) and the altitude of a given isotherm (i.e. -10 or -15°C) has been correlated with lightning activity observed in the following 10 minutes. The relationship between this difference and the probability of lightning strikes occurrences has been expressed through fourth-degree polynomials.

The results show that WR-10X reflectivity data could be useful in an operative context for a real-time hail and lightning alert information.