Analysis of a Convective Event Using Different Sensors

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A multisensor analysis of the convective precipitation event occurred over Rome is presented. For investigating this event, used are the 3-D lightning data provided by the LINET network, the CNR ISAC dual-pol C-band radar (Polar 55C), located in Rome, the Drop Size Distributions (DSD) collected by a 2D Video Disdrometer (2DVD) and a collocated Micro Rain Radar (MRR). Using the polarimetric data a relation between microphysical structure of a convective cloud and electrical activity during the convective phase was pointed out. Properties of DSDs measured by the 2DVD and vertical DSD profiles estimated by MRR and their relation with the lighting activity registered by LINET were investigated with specific focus on the transition from convective to stratiform regimes.

1. Introduction

In this study a multisensor analysis of the convective precipitation event occurred over Rome during the IOP13 (October 15th, 2012) of the HyMeX (Hydrological cycle in the Mediterranean eXperiment) Special Observation Period (SOP) 1 is performed.

During IOP13 a weather warning was issued for the Rome area. The precipitation event was associated with a trough deepened significantly over northern Tyrrhenian Sea and with a frontal system moved eastward, causing moist air advection over the Tyrrhenian Sea and a consequent deep convection on the Tyrrhenian coast, West of Rome. Considering the Lazio region, almost all of the precipitation occurred in the late afternoon on the western slopes and on the Apennines.

Thanks to the cooperation among Italian meteorological services and scientific community and a specific agreement with NASA-GSFC, different types of devices for meteorological measurements were made available during the HyMeX SOP.1 in Central Italy. Among all the available instruments, for this study we use the 3-D lightning data provided by the LINET network, the CNR ISAC dual-pol C-band radar (Polar 55C), located in Rome, at ISAC premises, the Drop Size Distributions collected by the 2DVD and the collocated K-band micro rain radar (MRR), vertically pointed, installed at "Sapienza" University of Rome, located 14 km from the Polar 55C radar.

The main objectives of this study are *i)* to investigate the relationship between microphysical structure and electrical activity during the convective phase of the event with dual-polarization weather radar data and LINET data, and *ii)* to study transition from convective to stratiform regimes using DSD properties measured by 2DVD and MRR in relation to the lighting activity registered by LINET data.

2. Case study

2.1. Radar and lighting data

The Polar 55C is a research C-band Doppler Dual-Polarization radar and during IOP13 supervised scanning, adding vertical sections to a volume scanning strategy based on PPIs, was performed. The scanning strategy is composed of *i)* volume scan studied to obtain regular spaced level of 1 km over the University of Rome Sapienza instrumented site, where the 2DVD and the MRR were installed *ii)* Plan Position Indicators (PPI) at vertical incidence and *iii)* (RHI) along Sapienza site. In order to detect graupel, the Fuzzy Logic Hydrometeor [1] classification algorithm, trained using the result of T-matrix simulations, was applied to the dual polarization radar data, namely the reflectivity factor (Z_h), the differential reflectivity (Z_{dr}), the specific differential propagation phase shift (K_{dp}) and the differential propagation phase shift (φ_{dp}). Then using a relation between the Ice Water Content (*IWC*) and the reflectivity factor, obtained with T-matrix simulations, the estimation of the graupel *IWC* profile was performed. Finally a relation between the total amount and extension of graupel above the melting layer (ML) and the number of LINET strokes registered in the area covered by the Polar 55C radar is obtained (Fig.1).

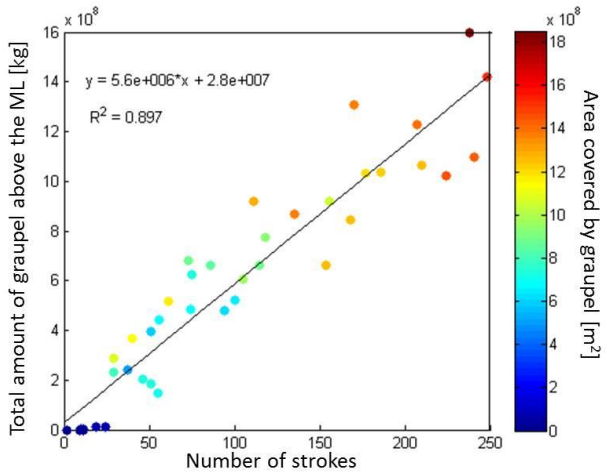

Figure 1: Scatterplot between the total amount of graupel above the ML and the number of strokes registered by the LINET network in the radar coverage. The colors represent the extension of the area covered by graupel.

2.2. Disdrometer and lighting data

On October 15th 2012 the 2DVD collected 233700 drops. The maximum raindrop diameter measured during the event was 7.49. In order to remove the spurious drops due to splashing or wind effect the filter criterion of [2] was adopted, while we assumed a threshold equal to 10 drops to identify a rainy minute. The observed diameters were partitioned into 50 bins with a constant width of 0.2 mm and 250 1-min DSDs were obtained. For each measured DSD the corresponding radar measurements (Z_h, Z_{dr}, K_{dp}) were computed using the T-matrix method. Then, the latter were represented in a 2D space (Fig. 2) where on the x-axis there is the differential reflectivity and on the y-axis there is the logarithm of K_{dp} minus Z_h (dBz) [3; 4]. In the figure, the colors of the dots are based on the C/S classification proposed in [5]. Two distinct clusters of points are clearly identified: the blue one for the convective rain and the red one for the stratiform rain. Therefore we were able to identify a threshold (reported in Fig. 2), based on polarimetric variables computed from disdrometer data, that allows to distinguish the stratiform and the convective phase of a rain event. A comparison between the output of the latter classification and the number of strokes measured in one minute in a circular area of radius 20 km surrounding the 2DVD was performed (Fig. 3). A good agreement between detected convection and number of strokes detected by LINET was found.

Finally the DSDs measured by the MRR were analysed. Due to the presence of a strong updraft during the convection, the MRR data need to be corrected. The preliminary results shown a difference in the vertical profile of the DSD during the convective and the stratiform phases of the event.

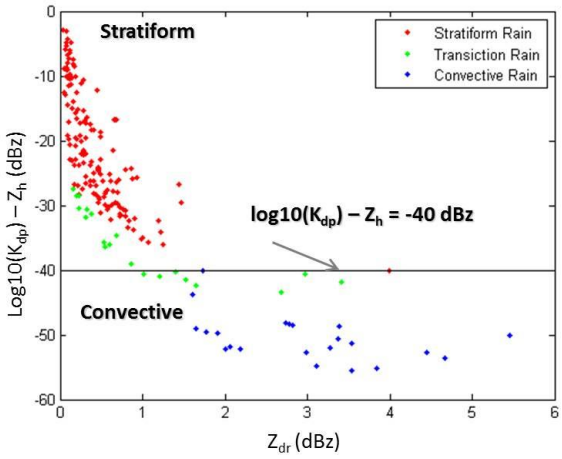

Figure 2: The dots are the radar measurements computed using the T-matrix method. The colors are based on the C/S classification of [5].

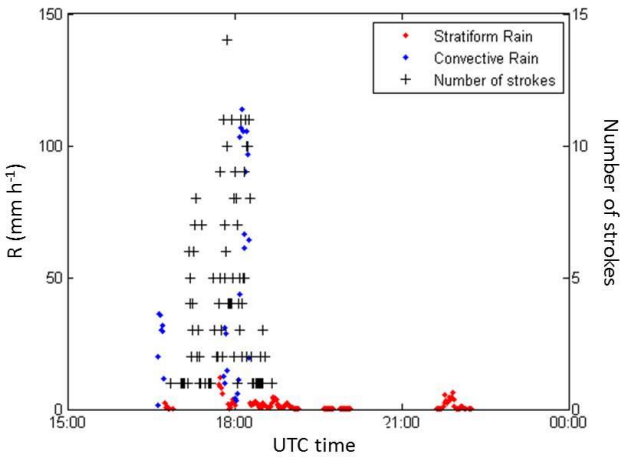

Figure 3: Time series of the rain rate and the number of LINET strokes.

3. References

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