7.11 STUDIES OF THE MELTING LAYER OF PRECIPITATIVE SYSTEMS USING X-BAND DUAL POLARIZATION WEATHER RADAR AND SMARTLNB NETWORK

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The characterization of the melting layer (ML) is an important task for operational radar meteorology. Melting layer identication may be used to establish distances at which radar rainfall estimates become affected by melting hydrometeors, with benets for operational hydrometeor classication, as snowfall, freezing rain and liquid precipitation. Consequently, this yields a significant performance improvement in radar-based quantitative precipitation estimation (QPE) on ground. Furthermore, knowledge of the ML location is also important for microphysical cloud characterization and the evaluation of icing potential.

Several studies and algorithms exist in literature for characterizing ML through radar measurement signature, the most popular being the increase in the radar reflectivity factor known as bright. For dual polarization radar, ML detection can be pursued using specific signatures of dual polarization measurements, such as differential reflectivity Z_{DR}, co-polar correlation coefficient ρ_{HV} , specific differential phase K_{DP}, and linear depolarization ratio LDR that exhibit well-pronounced ML signatures both in stratiform and even in convective situations.

Moreover, ML and rainfall have a strong influence on satellite links signals, as they are attenuated due to the presence of hydrometeors along the propagation path. In stratiform precipitation systems, the ML is the upper limit of the rainfall column height that is responsible of the attenuation of radio signals. Therefore, ML climatology is proficiently used for designing satellites links relative to a specific area.

Very recently, a new X-band Doppler, dual-polarization weather radar system has been installed in Florence funded by the Tuscany Region Government within the NEFOCAST project. The latter investigates a new concept system that aims at providing real time precipitation maps trough the attenuation measurements collected by a dense population of new-generation interactive satellite terminals (called SmartLNB, Smart Low-Noise Block converter). A number of SmartLNB has been deployed in the Tuscany region and a test bed has been established in cooperation with the schools of the Florence Metropolitan city.

In the present study, the potential of the new weather radar system is investigated for characterizing the ML in terms of height and thickness under different meteorological conditions and cloud systems. Measurements collected in the RangeHeight Indicator (RHI) scan mode along the direction to the Eutelsat 10A satellite (used for the experimental campaign of the NEFOCAST project) have been analysed with the simultaneous attenuation estimation obtained by the SmartLNBs with radar coverage during selected precipitative events. Statistical analyses have been performed based on both weather radar and SmartLNB measurements, supplemented by ancillary observations from some raingauges (both impact and tipping-bucket types) co-located with SmartLNBs. In addition, a C-band radar system (Polar 55C) located in Rome has also been used for this work. Polar 55C dual polarization measurements have been analysed with respect to co-located SmartLNBs and laser disdrometer.

The results of this analysis highlight the effects of ML on radio signal attenuation, as the total attenuation of signal increases also with the increase of ML vertical thickness. Therefore, the characterization of the vertical profile of precipitation is mandatory for implementing accurate QPE on ground, both from radars and satellite links.