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Precipitation radar nowcasting in complex orography: a pyramidal-dynamical approach

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Nowadays, quantitative forecast of rainfall is usually obtained with Numerical Weather Prediction (NWP) models that allow to obtain reliable forecasts up to few hours. Due to physical basis these models are able to predict the formation of new rainy systems but often fail to forecast them at small scales because of, for example, their coarse temporal and spatial resolution. On the other hand, applications in the fields of hydrology, civil protection, flight assistance, agriculture warning, require quantitative precipitation forecasts (QPF) at high resolution in space and in time. These concepts lead to the need of so called short-term forecasts till few hours in advance (here referred as nowcasting) that can be used, in a operational framework, complementing the NWP models in order to fill their weakness at smaller temporal and spatial scales.

Nowcasting techniques usually are based on the extrapolations of weather conditions in the future assuming no significant changes in the future general behavior of the forecasted precipitation pattern. Starting from the work of Seed, 2003, a new nowcasting algorithm, based on ground based radar observations, named SPARE (Spectral Pyramidal Advection Radar Estimator) has been recently developed by the authors of this work. SPARE algorithm deal with the prediction problem separating the component associated with the growth of precipitation field (or roughly speaking its temporal evolution) and the component associated with changes in the field motion. An auto-regressive model of order 1 (indicated by AR(1)) revealed adequate to account the evolution component where for the field motion a multi scale field advection approach, labeled as Pyramidal Phase Correlation Motion Estimation (PPCME) method, has been set up

In this work further refinements of the SPARE algorithm are shown and discussed. Firstly the PPCME technique is reinforced by considering a variable past time history of radar observations, instead of only two; secondly the AR evolution component of the SPARE algorithm is compared with different approaches based on neural network tool. Tests will be performed on some case studies, occurred in the northern and central Italy, respectively observed by the C-band radars of S. Pietro Capofiume (Bologna, Italy) and Mt. Midia (L'Aquila, Italy). Comparisons between the proposed SPARE refinements and other nowcasting techniques, previously investigated in past works such as S-PROG, Eulerian (EP) and Lagrangian persistence (LP), will be dealt with. Eventually, results will be shown in terms of skill indexes such as correlation coefficient, absolute error and skill scores.