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Probabilistic forecasts based on radar rainfall uncertainty

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The potential advantages resulting from integrating weather radar rainfall estimates in hydro-meteorological forecasting systems is limited by the inherent uncertainty affecting radar rainfall measurements, which is due to various sources of error [1-3]. The improvement of quality control and correction techniques is recognized to play a role for the future improvement of radar-based flow predictions. However, the knowledge of the uncertainty affecting radar rainfall data can also be effectively used to build a hydro-meteorological forecasting system in a probabilistic framework.

This work discusses the results of the implementation of a novel probabilistic forecasting system developed to improve ensemble predictions over a small urban area located in the North of England. An ensemble of radar rainfall fields can be determined as the sum of a deterministic component and a perturbation field, the latter being informed by the knowledge of the spatial-temporal characteristics of the radar error assessed with reference to rain-gauges measurements. This approach is similar to the REAL system [4] developed for use in the Southern-Alps. The radar uncertainty estimate can then be propagated with a *nowcasting* model, used to extrapolate an ensemble of radar rainfall forecasts, which can ultimately drive hydrological ensemble predictions.

A radar ensemble generator has been calibrated using radar rainfall data made available from the UK Met Office after applying post-processing and corrections algorithms [5-6]. One hour rainfall accumulations from 235 rain gauges recorded for the year 2007 have provided the reference to determine the radar error. Statistics describing the spatial characteristics of the error (i.e. mean and covariance) have been computed off-line at gauges location, along with the parameters describing the error temporal correlation. A system has then been set up to impose the space-time error properties to stochastic perturbations, generated in real-time at gauges location, and then interpolated back onto the radar domain, in order to obtain probabilistic radar rainfall fields in real time. The deterministic nowcasting model integrated in the STEPS system [7-8] has been used for the purpose of propagating the uncertainty and assessing the benefit of implementing the radar ensemble generator for probabilistic rainfall forecasts and ultimately sewer flow predictions. For this purpose, events representative of different types of precipitation (i.e. stratiform/convective) and significant at the urban catchment scale (i.e. in terms of sewer overflow within the urban drainage system) have been selected. As high spatial/temporal resolution is required to the forecasts for their use in urban areas [9-11], the probabilistic nowcasts have been set up to be produced at 1 km resolution and 5 min intervals. The forecasting chain is completed by a hydrodynamic model of the urban drainage network.

The aim of this work is to discuss the implementation of this probabilistic system, which takes into account the radar error to characterize the forecast uncertainty, with consequent potential benefits in the management of urban systems. It will also allow a comparison with previous findings related to the analysis of different approaches to uncertainty estimation and quantification in terms of rainfall [12] and flows at the urban scale [13].

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References

[1] Browning KA, 1978. Meteorological applications of radar. *Reports on Progress in Physics* 41 761 Doi: 10.1088/0034-4885/41/5/003

[2] Rico-Ramirez MA, Cluckie ID, Shepherd G, Pallot A, 2007. A high-resolution radar experiment on the island of Jersey. *Meteorological Applications* 14: 117–129.

[3] Villarini G, Krajewski WF, 2010. Review of the different sources of uncertainty in single polarization radar-

based estimates of rainfall. *Surveys in Geophysics* 31: 107–129.

[4] Germann U, Berenguer M, Sempere-Torres D, Zappa M, 2009. REAL – ensemble radar precipitation estimation for hydrology in a mountainous region. *Quarterly Journal of the Royal Meteorological Society* 135: 445–456.

[5] Harrison DL, Driscoll SJ, Kitchen M, 2000. Improving precipitation estimates from weather radar using quality control and correction techniques. *Meteorological Applications* 7: 135–144.

[6] Harrison DL, Scovell RW, Kitchen M, 2009. High-resolution precipitation estimates for hydrological uses. *Proceedings of the Institution of Civil Engineers – Water Management* 162: 125–135.

[7] Bowler NEH, Pierce CE, Seed AW, 2006. STEPS: a probabilistic precipitation forecasting scheme which merges and extrapolation nowcast with downscaled NWP. *Quarterly Journal of the Royal Meteorological Society* 132: 2127–2155.

[8] Seed AW, 2003. A dynamic and spatial scaling approach to advection forecasting. *Journal of Applied Meteorology* 42: 381–388.

[9] Verworn HR, 2002. Advances in urban–drainage management and flood protection. *Philosophical Transactions of the Royal Society of London. Series A: Mathematical, Physical and Engineering Sciences* 360, 1451–1460.

[10] Einfalt T, Arnbjerg-Nielsen K, Golz C, Jensen NE, Quirmbach M, Vaes G, Vieux B, 2004. Towards a roadmap for use of radar rainfall data in urban drainage. *Journal of Hydrology* 299, 186–202

[11] Krämer S, Fuchs L, Verworn HR, 2006. Aspects of radar rainfall forecasts and their effectiveness for real time control—the example of the sewer system of the City of Vienna. 7^{th} *International Conference on Urban Drainage Modelling and the 4th International Conference on Water Sensitive Urban Design; Book of Proceedings*, pp. 1187–1194.

[12] Liguori S, Rico-Ramirez MA. Quantitative assessment of short-term rainfall forecasts from

radar nowcasts and MM5 forecasts. *Hydrological Processes*, accepted article. DOI: 10.1002/hyp.8415

[13] Liguori S, Rico-Ramirez MA, Schellart ANA, Saul AJ, 2012. Using probabilistic radar rainfall nowcasts and NWP forecasts for flow prediction in urban catchments. *Atmospheric Research* 103: 80–95.