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Implementation of the Short-Term Ensemble Prediction System (STEPS) in Belgium and verification of case studies

Loris Foresti, Maarten Reyniers, and Laurent Delobbe

Radar and Lightning Detection group, Royal Meteorological Institute of Belgium, Brussels, Belgium
(loris.foresti@gmail.com)

The Short-Term Ensemble Prediction System (STEPS) is a probabilistic precipitation nowcasting scheme developed at the Australian Bureau of Meteorology in collaboration with the UK Met Office. In order to account for the multiscaling nature of rainfall structures, the radar field is decomposed into an 8 levels multiplicative cascade using a Fast Fourier Transform. The cascade is advected using the velocity field estimated with optical flow and evolves stochastically according to a hierarchy of auto-regressive processes. This allows reproducing the empirical observation that the rate of temporal evolution of the small scales is faster than the large scales. The uncertainty in radar rainfall measurement and the unknown future development of the velocity field are also considered by stochastic modelling in order to reflect their typical spatial and temporal variability.

Recently, a 4 years national research program has been initiated by the University of Leuven, the Royal Meteorological Institute (RMI) of Belgium and 3 other partners: PLURISK ("forecasting and management of extreme rainfall induced risks in the urban environment"). The project deals with the nowcasting of rainfall and subsequent urban inundations, as well as socio-economic risk quantification, communication, warning and prevention. At the urban scale it is widely recognized that the uncertainty of hydrological and hydraulic models is largely driven by the input rainfall estimation and forecast uncertainty. In support to the PLURISK project the RMI aims at integrating STEPS in the current operational deterministic precipitation nowcasting system INCA-BE (Integrated Nowcasting through Comprehensive Analysis).

This contribution will illustrate examples of STEPS ensemble and probabilistic nowcasts for a few selected case studies of stratiform and convective rain in Belgium. The paper focuses on the development of STEPS products for potential hydrological users and a preliminary verification of the nowcasts, especially to analyze the spatial distribution of forecast errors. The analysis of nowcast biases reveals the locations where the convective initiation, rainfall growth and decay processes significantly reduce the forecast accuracy, but also points out the need for improving the radar-based quantitative precipitation estimation product that is used both to generate and verify the nowcasts. The collection of fields of verification statistics is implemented using an online update strategy, which potentially enables the system to learn from forecast errors as the archive of nowcasts grows. The study of the spatial or temporal distribution of nowcast errors is a key step to convey to the users an overall estimation of the nowcast accuracy and to drive future model developments.