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Regime-dependence of Impacts of Radar Rainfall Data Assimilation

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Experience from the first operational trials of assimilation of radar data in kilometre scale numerical weather prediction models (operating without cumulus parameterisation) shows that the positive impact of the radar data on convective precipitation forecasts typically decay within a few hours, although certain cases show much longer impacts. Here the impact time of radar data assimilation is related to characteristics of the meteorological environment. This QPF uncertainty is investigated using an ensemble of 10 forecasts at 2.8 km horizontal resolution based on different initial and boundary conditions from a global forecast ensemble. Control forecasts are compared with forecasts where radar reflectivity data is assimilated using latent heat nudging. Examination of different cases of convection in southern Germany suggests that the forecasts can be separated into two regimes using a convective timescale. Short impact times are associated with short convective timescales that are characteristic of equilibrium convection. In this regime the statistical properties of the convection are constrained by the large-scale forcing, and effects of the radar data are lost within a few hours as the convection rapidly returns to equilibrium. When the convective timescale is large (non-equilibrium conditions), the impact of the radar data is longer since convective systems are triggered by the latent heat nudging and are able to persist for many hours in the very unstable conditions present in these cases.