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Nowcasting orographic precipitation growth and decay using machine learning algorithms on a 10-year radar archive in the Swiss Alps

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The common approach for precipitation nowcasting is to perform an empirical extrapolation of the radar precipitation echoes during the first 2-3 hours. As the future precipitation growth and decay processes are unknown, there is a rapid decrease in the forecast skill. Without using a numerical weather prediction model (NWP) it is difficult to infer the future evolution of precipitation from a real-time sequence of radar images.

Current operational convection resolving NWP models already have a sufficient spatial resolution for nowcasting applications (1-2 km), but are usually updated only every 1-3 hours, which is not enough for a number of users. Without significant advances in the assimilation of radar observations, it is unlikely that NWP will outperform a radar-based nowcast in the first 1-2 hours.

In this study, we exploit a 10-year archive of composite radar images over the Swiss Alpine region to investigate the geographical distribution of precipitation growth and decay patterns depending on the direction, speed and freezing level height of the mesoscale flows. These variables are then used as input predictors to train machine learning (ML) algorithms to predict specific properties of precipitation which are relevant for practical hydro-meteorological applications, such as the growth and decay of individual intense convective cells.

A verification and comparison of the accuracy of ML algorithms is performed using an independent test dataset. In addition to the classical comparison of skill scores, we also analyze the meteorological consistency of the predicted growth and decay maps.