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Verification of radar driven forecasts in a flashy catchment

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The ability to predict floods in flashy catchments at a lead time that is sufficient for meaningful action to be taken, depends very much on the availability of reliable precipitation forecasts. Typically flood events in such flashy catchments are triggered by high intensity, short duration, often convective, rainfall events. These events are difficult to forecast, resulting in an equally difficult forecast of the subsequent flood event. To provide a forecast for such catchments, several operational flood forecasting systems now use radar rainfall nowcasts for short term rainfall predictions, and catchment average rainfall sampled from these nowcasts are used to force hydrological rainfall-runoff models, thus providing a flow forecast for relevant forecast locations at the catchment outlet.

In this paper forecasts using radar rainfall in three small catchments in central Scotland are assessed using common verification measures. A large sample of hindcasts are made using a conceptual hydrological model of the catchments, and different sets of rainfall forcing are applied, including; observed gauge rainfall from the same weighted rain gauges used in model calibration, radar actuals, and radar rainfall nowcasts from the UK Met Office Nimrod system. Hindcasts using a zero rainfall forecast show these catchments to indeed be flashy as not a single flood event is predicted for the full verification period, implying that the response of the catchments is so fast that without a rainfall forecast of some kind a meaningful forecast service cannot be provided. When the mean areal rainfall for each of the catchments derived from radar is verified against the observed rainfall, this shows that the radar actuals are generally reliable, with a slight negative bias for one catchment and slight positive bias in the other two. For the more extreme events bias tends to increase, although there is again not a clear over or under estimation.

When the radar nowcasts are considered this is quite different, with a general negative bias, particularly for the more extreme events. These biases are reflected in the resulting flow forecasts, although the difference in catchment response time also has a clear effect. The Probability of Detection (POD) and False Alarm Ratio (FAR) show that with observed gauge rainfall to force the models in the forecast period, a high POD and low FAR can be achieved, indicating the hydrological models are reliable. When using the radar actuals to force the models in the forecast period, the POD drops only marginally, while the FAR increases significantly. When using the radar nowcasts, however, the POD drops significantly.

Despite the significant bias in the radar nowcasts, and relatively low POD, a metric introduced to show the average lead time with which a threshold crossing was successfully indicated by a forecast to be in the order of 4½ to 5 hours; which is quite an improvement over the near zero lead time if zero rainfall is used in the forecast period, and quite a bit longer than the minimum 3 hours lead time requirement. Improving the quality of this six hour nowcast through for example bias correction could additionally increase the lead time to the order of 6-6½ hours found when using the radar actuals.