Geophysical Research Abstracts, Vol. 9, 08075, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-08075


# Hydrological modelling at gauged and ungauged locations using radar- and raingauge-based rainfall estimators

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Deriving accurate areal rainfall estimates from observations is an essential prerequisite for successful hydrological modelling and its application, for example, to short-term flood forecasting at gauged and ungauged locations. The space-time resolution requirements for areal rainfall estimates vary depending on the application, catchment, type of rainfall event and form of model used. Three types of gridded rainfall estimator, based on raingauge and/or radar observations, are considered and their merits for hydrological modelling explored. Gridded multiquadric surface fitting techniques are developed to form raingauge-only and 'raingauge-adjusted radar' rainfall estimators. A third estimator is provided by the unadjusted radar data which comes in raw or Nimrod quality-controlled form. The latter is a post-processed radar product that aims to apply physically-based corrections. Although these estimators can be assessed from a rainfall perspective, a more relevant test from a hydrological viewpoint is to use their rainfall estimates as input to hydrological models and see how well the simulated flows compare with observations. The PDM, a lumped conceptual rainfall-runoff model, and the Grid-to-Grid model, a distributed grid-based runoff and routing model, are used for the hydrological assessment over nested upland catchments in north-west England. Important insights are gained into the performance of the different rainfall estimators in assessing rainfall over space and their use in lumped and distributed hydrological models. The need for frequent and spatially-varying gauge-adjustment of radar is identified as crucial for the weather radar products assessed. At a given gauged location the performance of the lumped hydrological model proves hard to better. However, the distributed model is shown to provide particular benefits at ungauged sites when used with the gridded rainfall estimators.