Geophysical Research Abstracts, Vol. 8, 06816, 2006
SRef-ID: 1607-7962/gra/EGU06-A-06816

Rainfall runoff modeling and the incorporation of a geochemically-based geographic source separation in a large meso-scale catchment.

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Catchment heterogeneity plays an important role in the spatiotemporal evolution of both water quantity and water quality. Mechanistic understanding of the role of heterogeneity in large catchments is difficult to establish, however its effects can be inferred through catchment tracer response. One method to accomplish this is distributed sampling of a suite of geochemical tracers, with further analysis to dynamically separate contributions to the stream hydrograph originating within different catchment regions. These separations provide an opportunity to quantify the effects of spatial heterogeneity on runoff generation. While the experimental methodology is well established, the use of these results to better evaluate the parameterization and structural basis of process-based rainfall runoff models has not been fully explored. This paper examines how estimates of geographic sources of water can be utilized to better evaluate the performance of a distributed hydrologic model. The work is based in the Dill catchment (693km2) Germany, where a detailed geochemical sampling program has been employed to estimate catchment wide mixing patterns. The modelling results are developed under a Monte Carlo framework to evaluate the potential of various parameter configurations to capture both the discharge response and the contributions of various catchment sources. Water sources are tracked using a virtual multi-tracer approach. Results indicate that the model can capture the effects of catchment heterogeneity, as outlined through the experimental program. Additionally, various model configurations capture the discharge response without correctly capturing the source area separation. The work adds to a growing body of literature indicating the continuing need to incorporate process understanding into the practice of hydrologic modelling.