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Diagnostics for Model Structure: Improving Hydrological Models using Data from Experimental Basins

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This presentation discusses research conducted as part of the Predictions in Ungauged Basins (PUB) initiative to build a national hydrological model for New Zealand. Currently our hydrological model (TopNet) is based on a generic description of catchment processes that may not provide the best representation for New Zealand catchments. Our first research priority is therefore to use data from small experimental basins in New Zealand to evaluate our current model structure and recommend changes if necessary.

To achieve this we must develop perceptual model(s) of how these catchments function, and conceptual model(s) that provide an overview of the major storages and fluxes of water in the catchment. We then aim to test these multiple working hypotheses of model structure in an objective way, using diagnostics derived from data collected from experimental basins. This model development and validation exercise raises particular challenges as data at different spatial and temporal scales must be brought together with model parameters which may not have a direct physical interpretation at those scales.

In particular, this presentation focuses on our experiences in interpreting multi-depth soil moisture time-series data in conjunction with nested streamflow measurements, to test possible representations of the soil zone in the experimental Mahurangi catchment, North Island, New Zealand. Soil moisture measurements made at 30 minute intervals over a period of 34 months allow us to assess influences of rainfall, evapotranspiration and drainage in upper and lower soil zones, and to assess the connectivity between these zones and from near- to far-stream areas. Based on these observations, we discuss how best to combine this multi-scale, multi-response data into a coherent framework for evaluation of model structure.