Models, Management and Uncertainty: The future of Hydrological Science

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Abstract : The problems of modelling hydrological processes have long been recognised. We have significant uncertainty in the measurements of basic hydrological quantities (catchment rainfalls, discharges at a point, actual evapotranspiration from catchments); we have cost limitations on many types of measurements which means that information content is compromised (particularly for water quality and tracer information); we have measurements that are often only indirectly related to hydrological quantities of interest (particularly remote sensing measurements); we have a mismatch between the scale of measurement techniques and the scale at which we need to apply models for management purposes; and we have a mismatch between theory developed from small scale measurements and the scale at which that theory is applied. We can be hopeful that some of these constraints will be relaxed in the future, but it seems rather unlikely that they will cease to be constraints. The result is that the representation of hydrological processes and the predictions of hydrological models will remain uncertain. There are consequently two important issues that must be addressed in future hydrological science. The first is how to estimate that uncertainty (in both gauged and ungauged catchments) and constrain it using the most informative measurements. The second is how to present and use the uncertainty in management decisions. Solution of these issues will require a framework for spanning scales, for assessing the real information content of observations in testing models as hypotheses about system response; and for robust decision making under uncertainty. It will be suggested that this framework will actually develop naturally as part of a learning process as “models of everywhere” become available. But this needs thinking through: just how should such a framework be implemented to address the range of questions required in catchment management ?