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A variable structure catchment model for investigating hydrological pathways with local knowledge.

Many catchment models, and particularly those calibrated to fit discharge series, can work well for river flows without being able to quantify correctly the components contributed by the individual pathways to the catchment outlet. This is a consequence of the ill-conditioned nature of the modelled system. When studying the movement of contaminants through the catchment, models are desired that can correctly partition the flow through the various pathways. Started in 2007, the Pathways project, funded by the Irish Environmental Protection Agency, is developing a tool to bring the benefits of a flexible, pathways-aware, model to a broader, technically aware, user group, interested in water quality modelling and its environmental consequences from a management perspective. The model is housed in a GIS based tool for viewing and analysing Irish national spatial data and for incorporating expert knowledge relating to flow pathways and contaminant transport along these pathways. The GIS tool acts as the user interface for the model, which can be used in a semi-distributed manner to investigate the hydrological pathways and contaminant processes and pathways at sub-catchment scale. Because of its flexible structure and potentially large number of parameters, calibration is a significant challenge. In the Pathways model, parameters are initially linked to geological, soils and vegetation information through the GIS tool and even when calibrated, using a variety of data sources, are constrained to plausible values determined from the physical setting.

Using the tool, catchment managers and other domain experts can enhance their understanding of the catchment's response and, through its flexible structure, add their local field knowledge to the model. The tool has a flexible network-based hydrological basis that can be modified by the user in a way that facilitates productive collaboration in the modelling process by allowing these experts from other disciplines to suggest structural changes and see the result of those changes and so promote confidence in the resulting model. This allows scientists to discuss and alter the catchment hydraulic connectivity, incorporating personal knowledge as well as field experience and to change the degree of complexity used to model individual processes, including source mobilisation and fate of water-borne contaminants, by interchanging modules containing the transform equations. In particular, knowledge of subsurface sources flow paths and hydraulic connections can be incorporated into the model structure. This presentation discusses the hydrological modelling aspects of the tool.