Simulating flow pathways in Irish catchments using a lumped and semi-distributed modelling approach

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Introduction

The main pathways that can transport diffuse contaminants to rivers in Ireland are: overland flow, interflow, shallow groundwater flow and deep groundwater flow conceptually are the pathways transporting diffuse contaminants. The aims of the ***Pathways Project***, funded by the EPA STRIVE programme, are to achieve a better understanding of these hydrological pathways, the fate and transport of waterborne contaminants, and the subsequent impact of these contaminants on aquatic ecosystems in Irish catchments (Archibold et al. 2009). The contaminants being investigated include phosphorus, nitrogen, sediments, pesticides and pathogens. The project is leading to the development of a Catchment Management Tool (CMT) to assist the EPA and River Basin District managers in achieving the objectives of the Water Framework Directive.

Project Outline

An important element of the Pathways project is to quantify the proportion of the river hydrograph that is derived from each of the main pathways. The conceptual model for flow pathways is shown in Figure 1. The separation of the hydrograph is to be achieved using various separation techniques in order to constrain each of the pathways within credible bounds.

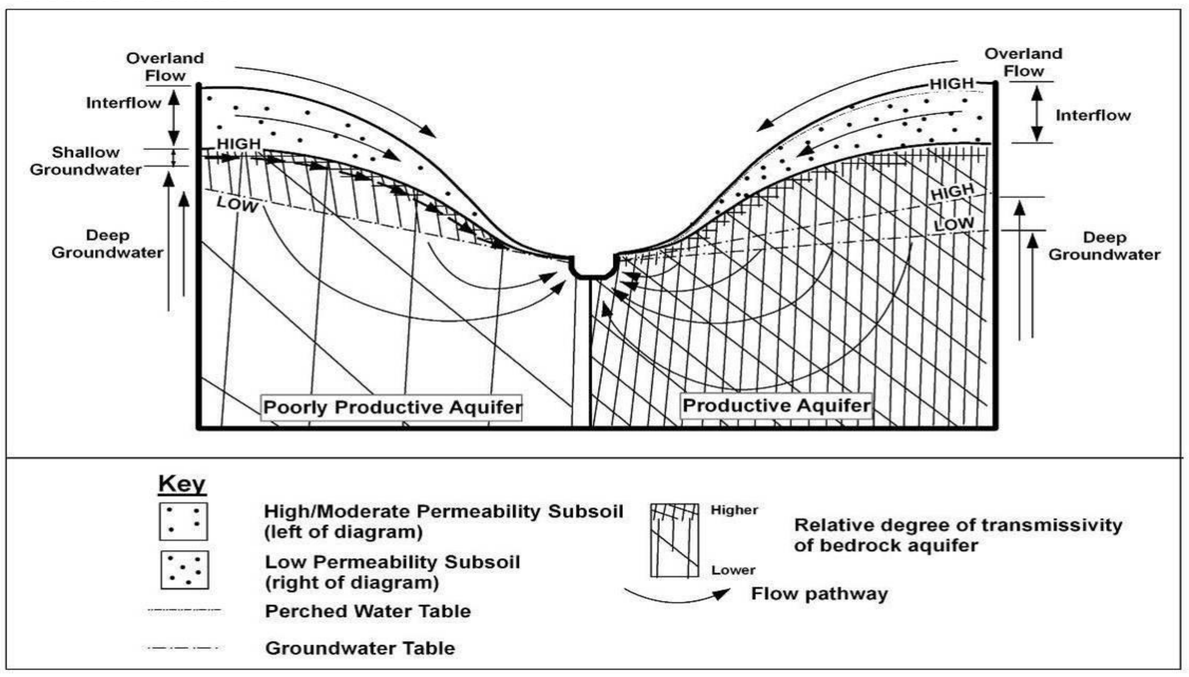

Figure 1. Components of surface and groundwater flow (Donal Daly, RPS, 2008).

These pathways are simulated using the NAM model. NAM is a deterministic, lumped rainfall-runoff model, simulating the water content in four different storages. These interconnected storages within NAM simulate the different pathways. Once these constraining boundaries have been identified, NAM is populated with rainfall and evapotranspiration data to simulate river discharges, providing further insight. Observed river discharges are then used to calibrate NAM's internal parameters.

The model results are being calibrated using a range of hydrograph separation techniques, including traditional physical methods, modified as appropriate, and more novel chemical separation methods.

Results

The approach was applied to numerous catchments. Results are displayed in figures 2 and 3 and in table 1. Monitoring of conductivity during a series of events in the Mattock catchment is shown in figure 2, output from NAM for the Blackwater catchment are shown in figure 3, while the effect of data temporal resolution on modelling results is displayed in table 1.

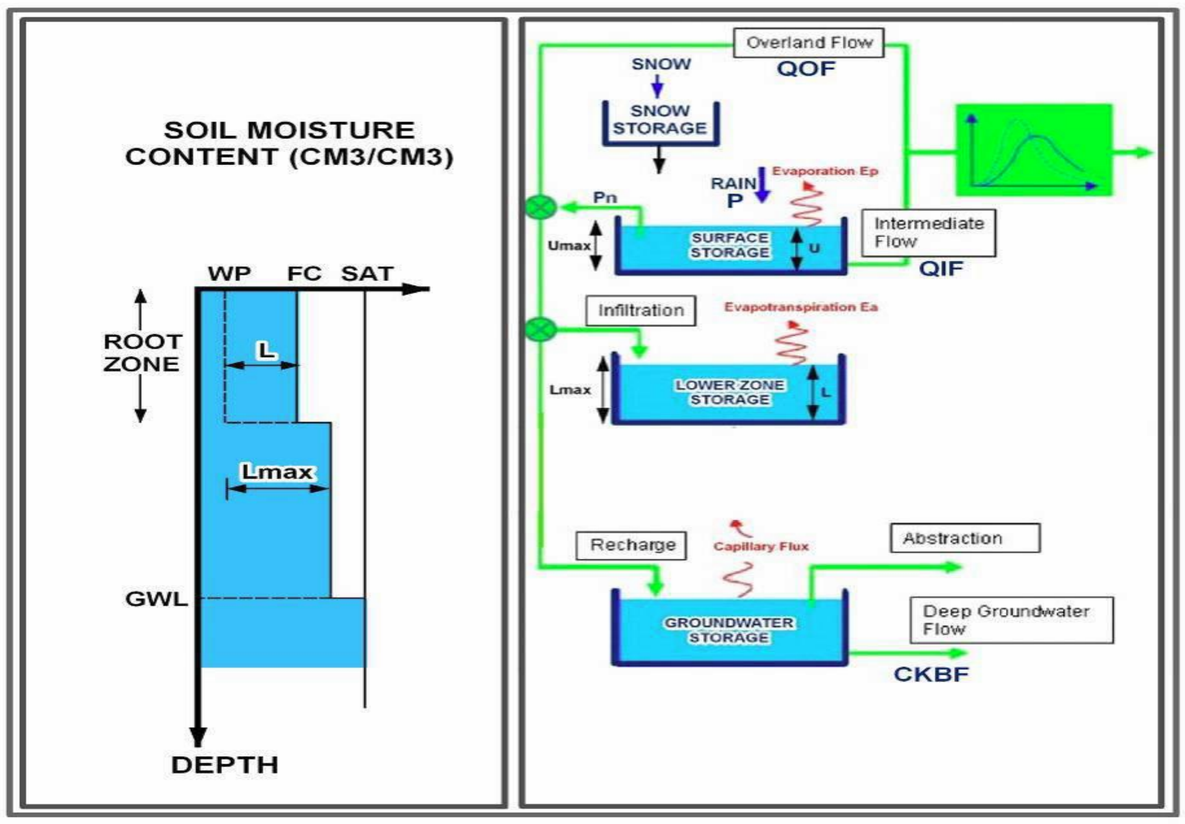

Figure 2. NAM structure (Madsen, 2006).

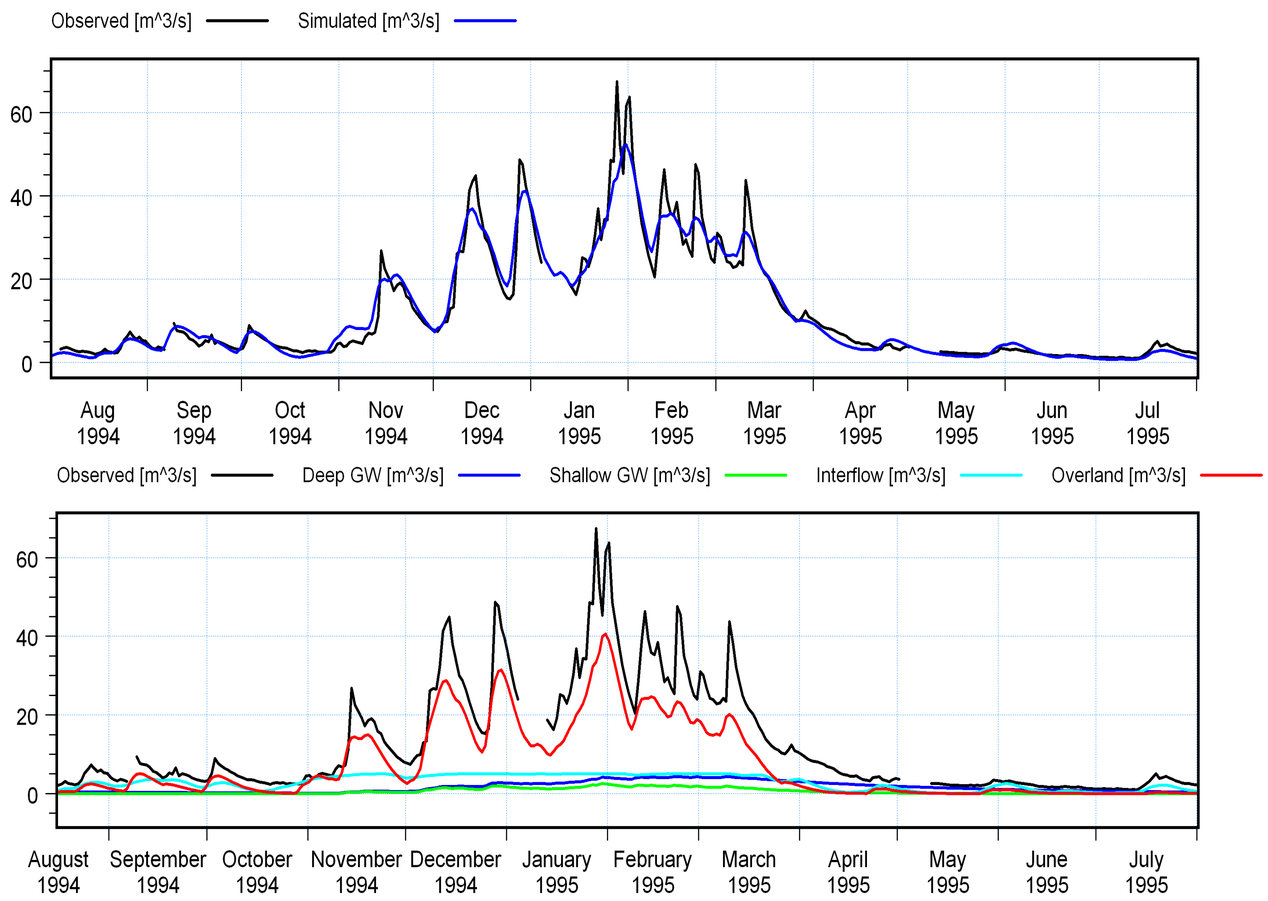

Figure 3. NAM output for Blackwater catchment

Catchment Name	Size (km^2)	Daily R^2	Hourly R^2	15min R^2
Balycahalan	48	0.33	0.79	0.85
Owenshree	35	0.61	0.8	0.89
Owendullalagh	89	0.45	0.79	0.9
Bawn	5	0.35	0.75	

Table 1. Data resolution vs. catchment size

Discussion

NAM has produced encouraging results for the catchments modelled. NAM has been successful at modelling small catchments with high temporal resolution data,. This is encouraging for the next step of the project which is to model the project's study catchments. These are Mattock in Louth, Nuenna in Kilkenny, Gortinlieve in Donegal and Mount Stewart in Down.

References

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