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Ground Surface Water Hydrology

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Commentary

Because of the intricacy of surface water (SW) and groundwater (GW) interactions in mild climate lowland catchments, detailed hydrological water balance information is required to create management methods for the sustainable use of water resources. Because of the growing problems with available water resources, hydrological research and forecasting has become increasingly important, and as a result, hydrological forecasts have been modernised, extending from simple flood predictions to detailed water management decisions and practises that require extensive hydrological process information. Integrated hydrological models are critical because they provide information on biological, physical, and chemical processes as well as their interactions within a watershed. The temporal and spatial changes of GW and SW resources are generally unknown, which has an impact on water resource management.

Environmental interactions, solute transport, flood modelling, and catchment hydrology are all being studied more and more using physically-based dynamically-coupled SW and GW hydrological models. An integrated hydrological model's forecast depends not only on the code, but also on the modelling tool's capacity to accurately characterise the complex surface and subsurface hydrological processes and parameter distributions, which would otherwise result in increased uncertainty and inaccuracies. Hydrological processes that transport mass or energy between hydrologic systems produce exchange fluxes (e.g., groundwater, surface water, and atmosphere). Processes that move mass (i.e., water) between the surface and groundwater systems are referred to as exchange fluxes in this work.

Water from a non-saturated region that crosses the phreatic surface (i.e., the flowing water table below which fully saturated conditions exist) is referred to as recharge. Depending on where the phreatic surface is in relation to the topographic surface, water crossing the topographic surface into the subsurface may be considered infiltration or recharge. Water crossing the phreatic surface from the saturated zone, and hence the topographic surface, is considered discharge when the phreatic surface is connected to the topographic surface. All surface and subsurface hydrological processes, as well as their dynamic interconnections, may be simulated using integrated hydrological models. The modelling of water exchange between the surface and subsurface models is also possible thanks to the linking of surface and subsurface models. However, when employing integrated hydrological models, estimates of these exchange fluxes (e.g., recharge, discharge) at non-point scales may not always match estimates of exchange fluxes at a point discovered when studying recharge rates at numerous locations.

Without an explanation for why this seeming misfit is reasonable, the variance in exchange flux values may make it difficult to get a model accepted. While regional scale modelling is becoming more popular, there are few papers that describe how the scale of discretization influences the fit. Using water balance approaches, empirical models can easily predict recharge fluxes at a site. However, for discretized (i.e., not lumped) spatial systems, the point values of these exchange fluxes may not be suitable. These systems may result in hydrologic process behaviour such as groundwater recharge and discharge occurring within a single grid block of the discretized system, allowing only the scale-dependent net flux (point recharge minus groundwater efflux to the surface) to be quantified, depending on the characteristics of their shallow subsurface environment. When considering point exchange fluxes, each point is normally classified as either recharge or discharge; however, when the exchange fluxes occur over a larger area, both processes may occur within the same cell. As a result, point interchange flux estimations must be up scaled to account for the size of the discretized model's elements or grid blocks.

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