Geophysical Research Abstracts
Vol. 20, EGU2018-18925, 2018
EGU General Assembly 2018

Shallow aquifer modeling by disaggregating regional scale systems to simple hillslopes under Boussinesq approximation

Quentin Courtois (1), Jean-Raynald De Dreuzy (1), Laurent Longuevergne (1), Jean Marçais (1), Charlotte Le Traon (1), and Florence Habets (2)

(1) Univ Rennes, CNRS, Géosciences Rennes, UMR 6118 France, F-35000 Rennes, France, (2) Sorbonne Universités, UPMC, Univ Paris 06, CNRS, EPHE, UMR 7619 METIS, Paris, France

Key words: Regional models, Hillslope processes, Recession analysis

Groundwater flow and transport models are primarily based on 3D processes accounting for multiple superposed aquifers. While this approach is adapted to the widest variety of aquifers, it can be simplified in some cases where flows do not extend other multiple layers. We propose a simplified approach based on the decomposition of regions in watersheds and hillslopes, which can be deployed at the regional scale to assess aquifer responses to global climate evolutions and natural resource evaluations. We propose that shallow aquifers can be modeled by simple hillslope dominated free-surface flows, under Boussinesq approximation, with storage limitation to account for possible return flow and subsurface excess overland flows.

Shallow groundwaters are sustaining rivers discharge, where it becomes a major contribution during dry seasons. Though, little is known on aquifer properties and actual contribution to water cycle. Well networks are either too localized, or too scarce with respect to the extent of the flow structure and the large heterogeneity of aquifer systems to bring sufficient constrains.

One regular approach consists in analyzing river baseflow, and tracking the signature of groundwater contribution within the watershed response. Though, the interpretation of these recessions is difficult, considering that analytical solutions are available at hillslope scale, while analysis is performed at catchment scale. One question arises on how the internal structure of the catchment, its geometry and natural heterogeneity affects the interpretation of recessions.

Our strategy consists to perform the recession analysis on a hillslope-based model. Hillslopes can be aggregated to describe the equivalent response at catchment scale, providing insights into how elementary hillslopes contribute individually to sustain river flow. A last step consists in recovering aquifer properties from recessions. We apply this approach to the Brittany region (France), in crystalline context, where aquifers systems are generally shallow and unconfined. We performed the analysis on a range of watersheds (30km^2 to 2000km^2), which are decomposed in hillslopes of 0.1km^2 to 1km^2. We show how heterogeneity controls the structure of the recession.

Such modeling and parameterization approach is valuable to infer watershed aquifer properties and supports regional modeling to estimate the groundwater contribution to water cycle. As such, this approach will provide a calibration tool for model application within the AquiFR project, a French national project whose goal is to provide a global modeling tool of French aquifers based on segmented regional applications.