Geophysical Research Abstracts
Vol. 18, EGU2016-8073, 2016
EGU General Assembly 2016

Interaction between Rivers and Aquifers: a method for rapid Identification of Transience in Streambed Conductance

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Streambed hydraulic conductance controls the interactions between surface water and groundwater. In order to quantify river-aquifer dynamics, quantifying conductance is indispensable. However, the streambed conductance is often subject to transience, as a result of the erosion and deposition processes in rivers. This transience has to be quantified and considered for any approach (i.e. numerical or analytical models) aimed at quantifying exchange fluxes. Directly measuring hydraulic properties in a river yields only point values, is time-consuming and therefore not suited to detect transience of the physical properties. We present a method to continuously and rapidly monitor transience of streambed conductance. Input data are time series of stream stage and hydraulic head variations in the aquifer. The method is based on the inversion of a floodwave response. The analytical model consists of only 3 parameters: x, the distance between streambank and an observation well, α, the aquifer diffusivity and a, the retardation coefficient that is inversely proportional to the streambed conductance. Estimation of a is carried out over successive time steps in order to identify transience in streambed conductance. The method is tested on synthetic data and is applied to field data from the Rhône River and its alluvial aquifer (Switzerland). The synthetic method demonstrated the robustness of the proposed methodology. Application of the method to the field site allowed identifying transience in streambed properties, following flood events in the Rhône. This method requires transience in the surface water, and the river should not change its width significantly with a rising water level. If these conditions are fulfilled, this method allows for a rapid and effective identification of transience of streambed conductance.