Estimation of hydrological and thermal parameters in the hyporheic zone using a novel Bayesian inverse modeling approach
Karina Cucchi, Nicolas Flipo, Agnès Rivière, Yoram Rubin

To cite this version:
Karina Cucchi, Nicolas Flipo, Agnès Rivière, Yoram Rubin. Estimation of hydrological and thermal parameters in the hyporheic zone using a novel Bayesian inverse modeling approach. EGU General Assembly 2016, Apr 2016, Vienne, Austria. pp.2016 - 7014. hal-01396487

HAL Id: hal-01396487
https://hal.science/hal-01396487
Submitted on 14 Nov 2016

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L’archive ouverte pluridisciplinaire HAL, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d’enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.
Estimation of hydrological and thermal parameters in the hyporheic zone using a novel Bayesian inverse modeling approach

Karina Cucchi (1,2), Nicolas Flipo (2), Agnès Rivière (2), and Yoram Rubin (1)

(1) University of California, Berkeley, Department of Civil and Environmental Engineering, USA, (2) Centre de Géosciences, MINES ParisTech, PSL Research University, France

Hydrothermal properties of the stream-aquifer interface are key information for modeling water and heat transfers in hydrological basins. Our study introduces an algorithm to estimate hydrological and thermal parameters of the hyporheic zone (HZ), as well as their associated uncertainties.

Properties of the HZ are inferred from a combination of head differential time series and vertically-distributed temperature time series measured continually in a HZ vertical profile. Head differential and two temperature time series are used as boundary conditions for the vertical profile; the other temperature time series are used as conditioning measurements.

Following the Bayesian framework, model parameters are treated as random variables and we seek to characterize their probability density function (PDF) conditional on the temperature time series. Our algorithm follows the Method of Anchored Distributions (MAD) implemented in the MAD# software. In order to cut down the number of simulations needed, we develop a hybrid discrete-continuous inversion approach. We first identify the most sensitive parameters in a sensitivity analysis, these parameters are characterized with continuous PDFs. Less sensitive parameters are represented with a discrete PDFs using a finite number of discrete outcomes. We use a non-parametric likelihood function and time series dimension reduction techniques in order to calculate posterior PDFs of HZ parameters.

We demonstrate the approach on a synthetic study using an analytical solution and then apply it to field measurements gathered in the Avenelles basin, France. We present one application of this approach, the uncertainty-quantified time series of localized stream-aquifer exchanges.