Geophysical Research Abstracts
Vol. 16, EGU2014-11672-1, 2014
EGU General Assembly 2014


# Stepwise calibration procedure for regional coupled hydrological-hydrogeological models

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Stream-aquifer interaction is a complex process depending on regional and local processes. Indeed, the groundwater component of hydrosystem and large scale heterogeneities control the regional flows towards the alluvial plains and the rivers. In second instance, the local distribution of the stream bed permeabilities controls the dynamics of stream-aquifer water fluxes within the alluvial plain, and therefore the near-river piezometric head distribution. In order to better understand the water circulation and pollutant transport in watersheds, the integration of these multi-dimensional processes in modelling platform has to be performed. Thus, the nested interfaces concept in continental hydrosystem modelling (where regional fluxes, simulated by large scale models, are imposed at local stream-aquifer interfaces) has been presented in Flipo et al (2014). This concept has been implemented in EauDyssée modelling platform for a large alluvial plain model ($900\mathrm{km}^2$) part of a $11000\mathrm{km}^2$ multi-layer aquifer system, located in the Seine basin (France).

The hydrosystem modelling platform is composed of four spatially distributed modules (Surface, Sub-surface, River and Groundwater), corresponding to four components of the terrestrial water cycle. Considering the large number of parameters to be inferred simultaneously, the calibration process of coupled models is highly computationally demanding and therefore hardly applicable to a real case study of $10000\mathrm{km}^2$. In order to improve the efficiency of the calibration process, a stepwise calibration procedure is proposed.

The stepwise methodology involves determining optimal parameters of all components of the coupled model, to provide a near optimum prior information for the global calibration. It starts with the surface component parameters calibration. The surface parameters are optimised based on the comparison between simulated and observed discharges (or filtered discharges) at various locations. Once the surface parameters have been determined, the groundwater component is calibrated. The calibration procedure is performed under steady state hypothesis (to minimize the procedure time length) using recharge rates given by the surface component calibration and imposed fluxes boundary conditions given by the regional model. The calibration is performed using pilot point where the prior variogram is calculated from observed transmissivities values.

This procedure uses PEST (http//:www.pesthomepage.org/Home.php) as the inverse modelling tool and EauDyssée as the direct model. During the stepwise calibration process, each modules, even if they are actually dependant from each other, are run and calibrated independently, therefore contributions between each module have to be determined. For the surface module, groundwater and runoff contributions have been determined by hydrograph separation. Among the automated base-flow separation methods, the one-parameter Chapman filter (Chapman et al 1999) has been chosen. This filter is a decomposition of the actual base-flow between the previous base-flow and the discharge gradient weighted by functions of the recession coefficient. For the groundwater module, the recharge has been determined from surface and sub-surface module.

## References :

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