Geophysical Research Abstracts
Vol. 13, EGU2011-6756-2, 2011
EGU General Assembly 2011

Temporal Moments revised, or is there a better way for physically-based model reduction in time?

Philipp Leube (1) and Wolfgang Nowak (2)

(1) University of Stuttgart, Institute of Hydraulic Engineering, Department of Hydromechanics and Modeling of Hydrosystems, Germany (philipp.leube@iws.uni-stuttgart.de), (2) University of Stuttgart, Institute of Hydraulic Engineering, Department of Hydromechanics and Modeling of Hydrosystems, Germany (wolfgang.nowak@iws.uni-stuttgart.de)

Many hydrogeological problems are highly complex in space and time, coupled with scale issues, variability and uncertainty. Especially when the system or the driving question involves time dependence, such problems often consume enormous computational resources. Model complexity reduction techniques allow to control the prediction quality whilst reducing computational costs to a much more tractable level. Temporal Moments (TM) are a promising approach to reduce time demands of transient hydrogeological simulations. They convert the original transient equation to steady-state equations which directly simulate the temporal characteristics of the system. This is achieved by an integral transform, projecting the system response onto monomials in time. In comparison to the classical approach of model reduction, however, TM rely on non-orthogonal base-functions. Since non-orthogonality introduces redundancy among TM this might impair the quality and efficiency of model reduction. Thus, we raise the question if there are more suitable (e.g., orthogonal) base-functions than the monomials that lead to TM. That also helps to make uncertainty quantification more accurate and efficient.
In this work, we will show that there is only a limited class of orthogonal temporal base-functions that reduces complex hydrogeological models. By comparing those to TM we conclude that, in terms of reduction efficiency, the integral transformation that leads to TM is, in general, the best possible choice.