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Hydrology and Earth System Sciences
Discussions

# *Interactive comment on* "Moment-based Metrics for Global Sensitivity Analysis of Hydrological Systems" *by* Aronne Dell'Oca et al.

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We would like to thank Dr. Bensabat for the careful and thorough reading of our manuscript and for the insightful comments and constructive suggestions offered. It is our view that these have helped to improve the quality of the manuscript. Following is an itemized list of his comments (in italic) and our responses.

1) This paper addresses the important topic of Sensitivity analysis of the output produced by hydrological models. The method is novel and provides a more mathematically rigorous framework for the evaluation of parameter sensitivity and a methodology for approximating the output produced by models in case they are demanding in terms of computational resources (PCE).



We thank Dr. Bensabat for his appreciaton of our work and his very positive comments.

2) Three examples are investigated: 1) a synthetic case (the Ishigami function); 2) an analytical solution for seawater intrusion in a coastal aquifer (Pool and Carrera, 2011) and 3) A laboratory scale model of a solute transport. These three cases are all calculated and the relevant measures are presented. Without any doubt this paper is substantial contribution and could lead to a better handling of complex hydrological systems

We thank Dr. Bensabat for his positive assessment of our work.

3) I would suggest to address a number of issues, which could make the paper attractive to an audience that is less familiar with the mathematical formulation of the method and more sensitive to its impact. The presented cases are for either analytical solutions (cases 1 and 2) or small scale settings (case 3). Therefore it could be of value to discuss how this suggested methodology could be applied to hydrological problems (regional groundwater flow models, flow and transport models and or density dependent seawater intrusion), what would be the steps needed to be taken and what would be the implications in terms of required computational resources.

We thank Dr. Bensabat for pointing out this very relevant issue. The diret application of our novel metrics for global sensitivity analysis (GSA) to field scale hydrological settings is envisioned as a future study. Such an application should be structured according to the steps detailed in Section 2. A critical limiting factor to any GSA approach is the associated computational burden. The latter is expected to increase according to two features associated with the conceptual and mathematical model used to describe the target variables of interest: (a) the complexity of the hydrological system (in terms of, e.g., hydrogeological heterogeneity, non-linear and/or transient effects), and/or (b) the number of uncertain model input parameters considered. According to the relative weight of these features, there can be some constraints to (i) perform the analysis by relying solely on the full system model, and (ii) construct a sufficiently accurate

surrogate model through a number of full model runs which is affordable in terms of computational resources. We will revise the opening statements of Section 3 of the manuscripts to highlight these relevant aspects.

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