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Hydrology and Earth System Sciences Discussions

Interactive comment on "Bringing it all together" *by* J. C. I. Dooge

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The interesting paper by J. C. I. Dooge stimulates a number of challenging considerations. In fact, the author deals with many aspects of the science of hydrology. I am particularly interested in discussing about the mass balance equation as a fundamental principle in hydrology. In section 2 of the paper, from lines 19 to 28, the author in fact states that "Hydrologists are lucky that in progressing from the continuum scale to the global scale the equation of continuity can be integrated in order to move from a lower scale to a higher scale. This useful result occurs because the equation of continuity can be written in a linear form which contains no empirical coefficients. None of the other basic equations of hydrology possess these two properties and hence we can identify the equation of continuity as the fundamental equation of hydrology and its validity as the fundamental theorem of hydrology". I certainly recognise the validity of this principle from a physical point of view. Nevertheless, when reading the above statement I remembered one of the main conclusions drawn in a very interesting meeting

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Interactive Discussion

Discussion Paper

I attended last summer. It was the International IAHS-PUB workshop on Uncertainty Analysis in Environmental modelling, held in Menaggio (Italy) on July 6-8, 2004. The workshop sought to answer three main questions: (1) What is the current state of the art of uncertainty analysis in environmental and hydrological science and in other relevant fields? (2) What are the limitations and problems of current methods, and what are the bottlenecks that prevent progress? (3) What are promising directions for progress in uncertainty analysis in environmental and hydrologic science? (Meixner et al., 2004; see also http://www.es.lancs.ac.uk/hfdg/uncertainty_workshop/uncert_intro.htm). One of the most interesting discussions we had at the meeting focused on the use of the mass balance equation in hydrological modelling. The validity of the conservation of mass principle from a physical point of view was of course not questioned. However, because input and output variables of hydrological models are always uncertain, one may note that the conservation of mass might not always lead to a satisfactory simulation of the internal state variables and output variables of hydrological processes. To make it simpler, one may refer to an ideal situation where all the hydrological information is perfectly known except for the model input variables, which are affected by uncertainty. In this case, an ideal "perfect" hydrological model based on the mass balance equation would not be able to perfectly simulate the output variables, while a model that relaxes the conservation of mass could lead to an improved representation. Therefore, some participants at the meeting argued that the conservation of mass should not be a requirement for hydrological models, when uncertainty is to be dealt with. I think this issue raises a interesting point about how hydrologists should consider and apply the mass balance equation in their modelling studies.

References Meixner, T., Gupta, H., Montanari, A., and Jackson, B.: Understanding Hydrologic Model Uncertainty: A report on the IAHS-PUB workshop, EOS, 85, 51, 556, 2004.

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