Hydrol. Earth Syst. Sci. Discuss., 12, C808–C811, 2015
www.hydrol-earth-syst-sci-discuss.net/12/C808/2015/

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Evolution of hydrological sciences from dimensions of object, discipline and methodology" *by* L. L. Ren et al.

L. L. Ren et al.

gongluyan20@163.com

Received and published: 31 March 2015

This manuscript examines hydrology from three perspectives, that of object, discipline, and methodology, as defined by the authors. As is, I find this manuscript does not add any new knowledge to the field nor does it synthesize existing knowledge to review how hydrology has evolved in various ways. Based on the title and abstract, the focus of the manuscript is to survey how hydrology has evolved and lay out the frontiers in hydrology over the next decade. The article falls far short of this, treating each topic superficially without appropriate references. For example:

Referee comment: The sections describing the three dimensions as laid out in the article consist of 1-2 paragraphs each. The authors choose to divide hydrology into phys-

ical, chemical/environmental, and biological. It is unclear how these three branches were chosen, if the authors see them as distinct or interrelated, and what the implications of any of this are.

Author Response: It is understood that physical-hydrological sciences include physical hydrology, geomorphology, paleo-hydrology, and climate science; chemical-hydrological sciences include chemical hydrology and aquatic geochemistry; and biological-hydrological sciences include eco-hydrology, aquatic ecology, biogeochemistry, soil science, and limnology. These three major areas reflect both an assessment of intriguing open questions in the field and an assessment of the potential for making significant progress by virtue of previous progress coupled with new ideas, techniques, and instrumentation. The authors divide hydrology into physical, chemical, and biological stages from the dimension of discipline, according to the time coordinate axis of the development in scientific recognition, main research contents, and focused themes of hydrology. As it was remarked in the manuscript, physical, chemical, and biological stages correspond to water quantity, water quality, and life, respectively. In fact, although the authors identify the three areas separately, it is clear that there are overlaps; many of the specific research questions that will be addressed under the umbrella of these areas will bridge across the three major areas.

Referee comment: It is unclear what is meant by the "Object dimension". Based on Figure 1, it appears that it's the objective/problem under consideration. If so, what is the difference between engineering hydrology and water resources hydrology in terms of practice and research questions?

Author Response: Yes, object dimension refers to research object, i.e. answering or solving the problem in hydrology. As shown in Figure 1, it is also the problem dimension. With the progress of science and technology, the ability to control and manage water was increasing. The appearance of hydraulic projects requires not just a description of hydrological phenomena, but also a prediction of hydrological variables. Engineering hydrology, also called applied hydrology, emerged as the times required,

in response to the requirement of the construction of hydraulic projects. Engineering hydrology aims to serve for the design and operation of hydraulic projects, and to solve practical problems of water conservancy projects, such as flood control, irrigation, hydropower generation. Water resources hydrology belongs to a comprehensive cross-disciplinary subject, in which water resources system is taken into consideration, including the quantity, quality, and potential energy of surface water and groundwater flow. Meanwhile it needs not only science and technology knowledge related to water, but also needs the knowledge of economics and management. It adopts the combination of quantitative method and qualitative one.

Referee comment: Hydrology has a rich history of advances, which are not cited in Sections 3.1 or 3.2. The methodology section does not add any new knowledge or synthesis of approaches. The example of deterministic vs. stochastic approaches is not particularly illustrative as one could argue that the discrete and continuous processes are both stochastic.

Author Response: Yes, the discipline of hydrology has a rich history of advances. Due to the limit of manuscript pages, the authors could not introduce more in details in Sections 3.1 or 3.2. Table 1 just illustrated that the deterministic method and stochastic one have a certain of compatibility. It does mean that the discrete and continuous processes are both stochastic. As stated in the manuscript, Dooge (1988) pointed out that progress in the development of hydrological theory has been hampered by a fragmentation of the approach to the subject and by a failure of communication between those using different techniques. The deterministic approach and the stochastic one have too often been considered as rivals to one another rather than as complementary. In fact the two approaches have similar response functions (Dooge, 1988). The author (Ren, 1992)proposed the compatibility between two approaches in his thesis at University College Galway by comparing Bernoulli and Poisson processes in terms of probability distributions, specifically for the Nash-form IUH case (Table 1). It is recognized that deterministic and stochastic approaches have been combined together for hydrological

forecasting (such as linear perturbation models, probabilistic forecasting of hydrological variables) and for the quantitative manifestation of hydrological uncertainties since the 1980s. Grayson and Bloeschl (2000) gave a typical example showing that a combined deterministic (by soil type) and stochastic (by soil hydraulic conductivity) pattern produced patterns of runoff occurrence that were most similar to the observed patterns in the tropical environment.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 1189, 2015.