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Recent scholars’ work in Vol 58 Issue 1 (2015) and Cheng & Li’s paper in Vol 58 Issue 7 (2015) in Science China Earth Sciences propose development of “Watershed science” by “Bridging new advances in hydrological science with good management of river basins”. An analysis of the language and key concepts used in the abstracts, titles and keywords of this set of 8 papers and an editorial reveals that ‘Watershed’, ‘River’, ‘Science’ and ‘System’ are the main terms employed by authors (Figure 1). It is not surprising that ‘Watershed’, ‘River’, and ‘Science’ are used most frequently, given the nature of this special issue in a science-driven journal. That the concept ‘system’ features highly is somewhat surprising but understandable as this journal is devoted to the concept ‘earth system’. So, our first interest is how employing the concept system in particular ways can assist in developing watershed systems science.

Figure 1. Words clouds included in titles, key words and abstracts of 7 papers in China Science Vol 58 Issue 1 (2015) and Cheng & Li’s paper in Vol 58 Issue 7 (2015)
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However, there is a systemic trap in the use of the concept system, a noun in the English language (Ison 2016). Whilst the concept draws attention to the elements and relationships that might exist and operate in a system of interest, what is concealed by the use of the term are (i) the act of making a boundary judgment by an observer or observers; (ii) an appreciation that making a boundary judgement realises another relational dynamic – the act of making a distinction between a system and its environment and (iii) awareness that using the term system is always a shorthand for a system-environment relationship mediated by a boundary judgement. Cheng & Li (2015) frame the watershed as a basic unit of the Earth system. They argue that watershed science shares the characteristics of fundamental research in Earth system science and ground their arguments in six intellectual platforms: (i) systems science; (ii) complex systems; (iii) scale problems and (iv) Newtonism vs. Darwinism (v) hydro and eco-economics and (vi) meta-synthesis. Consistent with their claim that watershed science ‘should be integrated with philosophical conceptualization, theorization, methodological exploration, infrastructure construction and field experimentation’ (p. 1167) it is necessary to explore how the concept ‘system’ is employed by authors and how their conceptions relate to, or shape, research practice in a new field of watershed science. We believe that philosophical clarification of the concept ‘system’ could facilitate the systemic integration of all six intellectual platforms of Cheng & Li (2015) and

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Cheng & Li (2015) argue that watershed systems are highly co-evolved, complex human-nature systems. They thus set the groundwork for how co-evolutionary processes function. However, this co-evolution is based on long term and complex ‘negotiations’ between culture and nature. The negotiation is a result of human decision-making, which is the primary driver of earth system change. We argue that any human decision is determined by the interactions between social values (willingness to change), technology progress (capacity to change) and institutional arrangements (change regulated formally by government or through self-organising informal institutions) at different system levels (Wei and Zhang, 2017 and Wei et al. 2017). Therefore, while we agree with Cheng & Li (2015) that hydro-economics is important for understanding interdependence between economic activities and natural systems, three sub-disciplinary fields from hydrology: socio-hydrology, techno-hydrology and institutional-hydrology are needed for the development of watershed systems science. Developments in these sub-disciplines can provide understanding of the mechanisms for governing the impact of human activities on the earth’s surface in the Anthropocene.

Unfortunately, very limited research on a single watershed has been conducted from the perspective of different sub-disciplines of watershed systems science. Such studies could cross-fertilise the development of individual sub-disciplines and generate systemic knowledge for watershed managing and governing. The Heihe River basin (HRB) in China is perhaps the one exception; it is the second longest inland river in China, with a length of 948 km and an area of approximately 143,000 km². HRB covers typical ecosystems and catchment processes in an arid and semi-arid region; it sits within an important part of the ancient Silk Road established in the Han Dynasty (206 BC–AD 220) and thus within the new Belt and Road initiative being undertaken by China. The HRB ‘story’ is of a typical watershed involving many catchment processes related to hydrology and experiencing several management phases in early civilization, rapid economic development, serious environmental degradation and rebalance between humans and environment. The Heihe
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