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Methodological approaches to studying coupled human-water systems

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This paper reports on the progress being made on the “Methodologies” chapter of the *Panta Rhei* synthesis book due in May 2023 and to be officially launched at 2023 IUGG General Assembly in Berlin.

Panta Rhei cornerstone emphasis is to support policies and decision making through better understanding of social and hydrological processes and anticipate their future evolution. However definitions of and motivations for anticipating future evolution, e.g. prediction of trajectories, have different sets of challenges for different disciplines. Human-water relations have been studied from a variety of perspectives. And *Panta Rhei* is not the first time human water relations are being studied. There is decades of experience, so why is it different this time than the last decades. The dominant paradigm of *Panta Rhei* has been prediction, with a few exceptions. And prediction itself has been approached differently within *Panta Rhei* and the research traditions it draws on. What can we learn from these differences in perspectives and methods for studies of humans and water?

In spite of all such differences, all such diverse perspectives are similar in understanding human-water relations through their own lenses and unified in their goal of improving societal well being through better understanding of social-hydrological relations. Different disciplines have different societal objectives or similar objectives with different lens within the domain of *Panta Rhei*. As a result different are methods used, with their respective challenges.

Taking stock of extensive research conducted in the past decade in context Panta Rhei, this chapter explores the motivations of diverse disciplines and challenges faced. It identifies a spectrum of methods that have been used to understand and interpret human water relations, with predictive methods at one end and descriptive methods at the other end of the spectrum. The chapter then synthesizes all such methods by taking three diverse examples of human water relations and interrogates how diverse methods approach the same examples – one of which is presented from which diverse themes around terminologies, ontology vs. epistemology, diverse methodologies used, generalizability vs transferability of methods and new data sets emerge.

It is concluded that for the first time diverse disciplines are converging in their pursuit of understanding and predicting human water systems for social good and Panta Rhei has accelerated this convergence. This chapter ends with a call to action on what further methodological developments appear promising and what methods should be more widely adopted, i.e. a celebration of what has been accomplished so far.