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a way forward for socio-hydrology

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Alternative socio-centric approach for model validation – a way forward for socio-hydrology

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To better understand and mitigate the impacts of humans on the water cycle, the importance of studying the co-evolution of coupled human-water systems has been recognized. Because of its unique system dynamics, the Murrumbidgee river basin (part of the larger Murray-Darlin basin, Australia) is one of the main study areas in the emerging field of socio-hydrology. In recent years, various historical and modeling studies have contributed to gaining a better understanding of this system's behavior. Kandasamy *et al.* (2014) performed a historical study on the development of this human-water coupled system. They identified four eras, providing a historical context of the observed "pendulum" swing between first an exclusive focus on agricultural development, followed by increasing environmental awareness, subsequent efforts to mitigate, and finally to restore environmental health.

A modeling effort by Van Emmerik *et al.* (2014) focused on reconstructing hydrological, economical, and societal dynamics and their feedbacks. A measure of changing societal values was included by introducing environmental awareness as an endogenously modeled variable, which resulted in capturing the co-evolution between economic development and environmental health. Later work by Elshafei *et al.* (2015) modeled and analyzed the two-way feedbacks of land use management and land degradation in two other Australian coupled systems. A composite variable, community sensitivity, was used to measure changing community sentiment, such that the model was capable of isolating the two-way feedbacks in the coupled system. As socio-hydrology adopts a holistic approach, it is often required to introduce (hydrologically) unconventional variables, such as environmental awareness or community sensitivity. It is the subject of ongoing debate how such variables can be validated, as there is no standardized data set available from hydrological or statistical agencies.

Recent research (Wei *et al.* 2017) has provided one such avenue for validation, by using newspaper articles from the last 169 years to derive an index of economic development and environmental sustainability for the complete Murray-Darlin basin. Based on this alternative approach, the similar time periods as Kandasamy *et al.* (2014) were derived independently. Furthermore, their environmental sustainability index closely follows the parsimoniously modeled environmental awareness from Van Emmerik *et al.* (2014). Besides a direct validation of previous studies, this independent work provides credibility for the development and use of models such as those developed by Van Emmerik *et al.* (2014) and Elshafei *et al.* (2015).

With this presentation, we aim to highlight how alternative sources of societal data can be used to independently validate and assess the realism of socio-hydrological models in spite of the fact that at least a significant part of the societal values has to remain endogenous, and only coupled socio-hydrological models of the Van Emmerik *et al.* (2014) and Elshafei *et al.* (2014, 2015) are indispensable for any generalization from highly monitored to unmonitored places, underpinned by general theories.

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