# Socio-hydrologic data assimilation: Analyzing human-flood interactions by model-data integration

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In socio-hydrology, human-water interactions are simulated by mathematical models. Although the integration of these socio-hydrologic models and observation data is necessary to improve the understanding of the human-water interactions, the methodological development of the model-data integration in socio-hydrology is in its infancy. Here we propose to apply sequential data assimilation, which has been widely used in geoscience, to a socio-hydrological model. We developed particle filtering for a widely adopted flood risk model and performed an idealized observation system simulation experiment to demonstrate the potential of the sequential data assimilation in socio-hydrology. In this experiment, the flood risk model’s parameters, the input forcing data, and empirical social data were assumed to be somewhat imperfect. We tested if data assimilation can contribute to accurately reconstructing the historical human-flood interactions by integrating these imperfect models and imperfect and sparsely distributed data. Our results highlight that it is important to sequentially constrain both state variables and parameters when the input forcing is uncertain. Our proposed method can accurately estimate the model’s unknown parameters even if the true model parameter temporally varies. The small amount of empirical data can significantly improve the simulation skill of the flood risk model. Therefore, sequential data assimilation is useful to reconstruct historical socio-hydrological processes by the synergistic effect of models and data.

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