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Evaluating the dynamic resilience process of a regional water resource system through the nexus approach and resilience routing analysis

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The increasing magnitude and frequency of undesirable events, driven by climate and anthropogenic changes, have given rise to various approaches for quantifying the resilience of regional water resource systems. However, the deficiencies of these approaches in describing linkages among subsystems and disturbance-dependent resilience have hindered the assessment and prediction of resilience in water resource management. The nexus approach enables the propagation of a disturbance to be simulated (a process called surrogate disturbance generation). An approach analogous to a unit hydrograph is developed, and resilience routing (strain flow routing), which is a novel framework and model of the dynamic resilience process, is proposed for the evaluation of a regional water resource system. The proposed framework and model are applied to the Jinghong regional water resource system. Taking a pollution event as a disturbance, the responses of the water supply, fishery and electricity subsystems are simulated to test the validity of the proposed methods. The linkages among subsystems are determined according to the sink-source dynamic using the nexus approach, and the levels of surrogate disturbance transformed from the disturbance event can be quantified by the processes of dynamic resilience evaluation. The shape of the dynamic resilience process is quantified by the parameters of unit resilience routing with disturbance independence and reflects the characteristics of the system responding to the disturbance. The proposed method helps to assess the adaptive capacity of a water system to alleviate and regulate disturbances. Furthermore, after the calibration and validation of the assumptions of linearity inherent in the method, it can also be used to predict the dynamic resilience processes of every subsystem in response to any disturbance event affecting a regional water resource system.