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Flood Protection Decision Making Within a Coupled Human and Natural System

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Due to the perceived threat from climate change, prediction under changing climatic and hydrological conditions has become a dominant theme of hydrological research. Much of this research has been climate model-centric, in which GCM/RCM climate projections have been used to drive hydrological system models to explore potential impacts that should inform adaptation decision-making. However, adaptation fundamentally involves how humans may respond to increasing flood and drought hazards by changing their strategies, activities and behaviours which are coupled in complex ways to the natural systems within which they live and work. Humans are major agents of change in hydrological systems, and representing human activities and behaviours in coupled human and natural hydrological system models is needed to gain insight into the complex interactions that take place, and to inform adaptation decision-making.

Governments and their agencies are under pressure to make proactive investments to protect people living in floodplains from the perceived increasing flood hazard. However, adopting this as a universal strategy everywhere is not affordable, particularly in times of economic stringency and given uncertainty about future climatic conditions. It has been suggested that the assumption of stationarity, which has traditionally been invoked in making hydrological risk assessments, is no longer tenable. However, before the assumption of hydrologic nonstationarity is accepted, the ability to cope with the uncertain impacts of global warming on water management via the operational assumption of hydrologic stationarity should be carefully examined. Much can be learned by focussing on natural climate variability and its inherent changes in assessing alternative adaptation strategies.

A stationary stochastic multisite flood hazard model has been developed that can exhibit increasing variability/persistence in annual maximum floods, starting with the traditional assumption of independence. This has been coupled to an agent based model of how various stakeholders interact in determining where and when flood protection investments are made in a hypothetical region with multiple sites at risk from flood hazard. Monte Carlo simulation is used to explore how government agencies with finite resources might best invest in flood protection infrastructure in a highly variable climate with a high degree of future uncertainty. Insight is provided into whether proactive or reactive strategies are to be preferred in an increasingly variable climate.