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USING BAYESIAN NETWORKS TO EVALUATE SEA-LEVEL RISE IMPACTS FOR DECISION MAKING

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Projections of sea-level rise for the coming decades indicate that future impacts will be large and sustained, including land loss from inundation and erosion, migration of coastal landforms and environments, increased elevation and duration of storm-surge flooding, wetland losses, changes in coastal aquifer hydrology, as well as impacts to human development, infrastructure, and social systems. Improving the ability to predict future sea-level rise effects on coasts is a challenge. Not only are there uncertainties in how the coastal system will respond to changes in sea level, but there are also large uncertainties in the prediction of other variables associated with future climate conditions (e.g., storm frequency and intensity, air and ocean temperature, rainfall) that drive the relevant physical and biological processes. Confronted with a problem with many uncertainties and a clear need for scientific guidance in coastal management decisions, the development of probabilistic approaches to evaluate the potential for a range of sea-level rise impacts to coastal regions is a vital need.

Here we describe a Bayesian statistical analysis framework developed from a wide range of geologic, biologic and hydrologic information on coastal systems and the related uncertainties in physical and process characterizations. Inputs are used to define the initial states of coastal systems, relevant forcing factors, historical observations, and idealized model simulations. The Bayesian network is used to make probabilistic predictions of the future state of coastal environments. Competing hypotheses regarding the relationships between forcing and responses are evaluated and their uncertainties are compared. Initial results from the U.S. mid-Atlantic coastal region are used to identify relationships between the forcing factors and response scenarios, as well as identify research needed to reduce uncertainty. The Bayesian network approach provides a means to support decision making and evaluate specific management questions about alternatives for adapting to sea-level rise.

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