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Climate Change and Sea Level Rise: A Challenge to Science and Society

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Society is challenged by the risk of an anticipated rise of coastal Local Sea Level (LSL) as a consequence of future global warming. Many low-lying and often subsiding and densely populated coastal areas are under risk of increased inundation, with potentially devastating consequences for the global economy, society, and environment. Faced with a trade-off between imposing the very high costs of coastal protection and adaptation upon today's national economies and leaving the costs of potential major disasters to future generations, governments and decision makers are in need of scientific support for the development of mitigation and adaptation strategies for the coastal zone.
Low-frequency to secular changes in LSL are the result of many interacting Earth system processes. The complexity of the Earth system makes it difficult to predict Global Sea Level (GSL) rise and, even more so, LSL changes over the next 100 to 200 years. Humans have re-engineered the planet and changed major features of the Earth surface and the atmosphere, thus ruling out extrapolation of past and current changes into the future as a reasonable approach. The risk of rapid changes in ocean circulation and ice sheet mass balance introduces the possibility of unexpected changes. Therefore, science is challenged with understanding and constraining the full range of plausible future LSL trajectories and with providing useful support for informed decisions. In the face of largely unpredictable future sea level changes, monitoring of the relevant processes and development of a forecasting service on realistic time scales is crucial as decision support. Forecasting and "early warning" for LSL rise would have to aim at decadal time scales, giving coastal managers sufficient time to react if the onset of rapid changes would require an immediate response. The social, environmental, and economic risks associated with potentially large and rapid LSL changes are enormous. Therefore, in the light of the current uncertainties and the unpredictable nature of some of the forcing processes for LSL changes, the focus of scientific decision support may have to shift from projections of LSL trajectories on century time scales to the development of models and monitoring systems for a forecasting service on decadal time scales. The requirements for such a LSL forecasting service and the current obstacles will be discussed.

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