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Compound events and pressures in coupled catchment and storm surge modelling

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Natural hazards in the coastal zone are a massive problem globally, and projected frequencies and magnitudes of high-impact events are expected to increase alongside rising sea levels. Further, a high concentration of urban environments, infrastructure and general assets in the coastal zone is seen. As a result, high future social and economic costs are projected. Even with mitigation, adaptation measures are urgently needed to reduce these costs. The physical nature of the optimal adaptation measures depends to a high degree on local conditions and individual subjective perceptions. Further, the optimal temporal timing of their implementation also needs assessment as based on a combination of the projected development of assets, climate change impact on hazardous events and even economy such as discount rates.

The Danish COHERENT project (2017-2020) addresses risks in the coastal zone through a cross-disciplinary approach across natural, social and economic sciences as well as long-term adaptation and hazard preparedness. We here present an approach to assess the combined physical impact of multiple, or compound, events and pressures occurring at a range of spatio-temporal scales and processes as well as initial results. The physical impacts include at its core the combined effect of storm surge induced flooding as well as the simultaneous contribution to flooding from the river catchment with an outlet through central parts of the municipalities. The approach therefore addresses storm surges that arise from extreme winds, their duration and direction as well as extreme precipitation. Additionally the effect of precipitation preceding the event is also addressed, i.e. the system saturation, as well as potentially direct pluvial flooding. These physical impacts are simulated using a combination of storm surge and catchment modelling software, which in the project feeds into economic impact analyses. One of the project outcomes is to create a platform where end-users can directly use these physical model output in conjunction with economic damage assessment to aid in adaptation planning.