OCEAN, EARTH & ATMOSPHERIC SCIENCES

OLD DOMINION UNIVERSITY

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DEPARTMENT OF OCEAN, EARTH, AND ATMOSPHERIC SCIENCES
3PM – ROOM 200 IN THE OCEANOGRAPHY/PHYSICS BUILDING
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"INTERANNUAL TO DECADAL LOCAL SEA LEVEL FORECASTING: DO WE NEED IT AND CAN WE DO IT?"

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ABSTRACT

Societal and environmental effects of sea level rise are among the major impacts of climate change. The USA is one of the countries most exposed to high economic costs of sea level rise and the resulting coastal flooding, and the U.S. East Coast is a "hotspot of accelerated sea level rise." Recent assessments of future local sea level (LSL) rise mostly addressed the next 50 to 200 years, and they revealed a very large range of plausible LSL trajectories, which provides limited actionable decision support. However, rapid LSL changes far exceeding those experienced over the last 6,000 years or those considered plausible in most recent assessments of future changes can not be excluded, not even for the next few decades. Such changes pose an unparalleled threat to humanity. A reliable interannual LSL forecasting service would provide "early warning" in case of an onset of rapid LSL rise with lead times sufficient for considerable mitigation of such a low-probability, high-impact event. Although many scientific issues need to be addressed before reliable LSL forecasting can be achieved, it is important to start forecasting as soon as possible to assess the forecasting capabilities. LSL is the combined output of many Earth system processes acting on spatial scales from global to local. The processes include mass relocation and exchange between ice sheets, glaciers, land water storage, and oceans; deformation of the solid Earth and gravity-field changes caused by the mass relocation; changes in ocean heat storage and ocean currents; changes in atmospheric circulation; tectonic processes; and natural and anthropogenic local coastal subsidence. Interannual to decadal LSL forecasting therefore needs to be based on a comprehensive system model. Current modeling capabilities require a flexible modular system model that rapidly can make use of improvements in the individual modules achieved in a broad modeling community. We are implementing a system model, which is designed to interface with existing modules including global models (climate, ocean, ice sheets, glaciers, continental hydrosphere); regional models for steric and circulation effects; local models for vertical land motion; and physical models to convert global processes into local effects. Initially, some of the modules are weakly coupled and based on input from complex models (both internal and external), while other modules are networked locally. Assimilation of observations on global to regional scales (e.g., gravity field, Earth rotation, sea surface heights) and on local scale data (e.g., InSAR, GNSS, tide gauges) provide additional constrains. The system model ensures global consistency for key Earth system parameters, such as mass and momentum conservation. The model will be validated with observations covering ca. 1970 or earlier to the present. Performance is being assessed using NCEP's metrics. Depending on performance, the validated system model could be a key element of a pilot decadal forecasting service for LSL changes for integration in the portfolio of NOAA's climate services.

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