Geophysical Research Abstracts
Vol. 18, EGU2016-11982, 2016
EGU General Assembly 2016

Sea surface height in the northern North Atlantic Ocean - validation of CMIP5 models against observations and implications for observed change

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We evaluate the representation of steric and dynamic sea surface height (SSH) in the northern North Atlantic Ocean in 18 climate models that contributed to the Coupled Model Intercomparison Project Phase 5 (CMIP5).
The Nordic Seas and the subpolar North Atlantic comprise a dynamically complex area that is bounded by glaciated land masses and, through gravitational adjustment, regional SSH changes are heavily impacted by changes in land-based ice masses. Freshwater input from melting land ice is not yet implemented in the CMIP5 models but is suspected to already have an impact on the observed ocean dynamics and waters distribution. Therefore, it is important to validate the models in this region as they form the basis for numerous national assessment reports of future regional sea level rise.

Models are compared to observations from altimetry (20 years) using metrics like the time-mean, interannual variability as well as linear trend patterns. Prior to the analysis, the effect of melting land ice on regional sea level is quantified and taken into account which is particularly important when analysing modelled and observed SSH trends. By comparing the model simulations with observations it can be assessed whether the modelled natural variability is in line with observed changes and whether a forced signal is already detectable over the past 20 years of altimetry observations. As models are expected to reproduce the location and magnitude but not the timing of internal variability, the observations are compared to the full 150-yr historical simulations to assess whether the observed changes can be explained by internal variability only.
The models perform reasonably well with respect to the time mean dynamic topography. However, performance degrades considerably when interannual variability and linear trends are considered. There is evidence for an externally forced sea level rise along the Northern European coast.