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The Genesis of Sea Level Variability in the Barents Sea

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Satellite altimetry measurements for the last two decades have hardly been used for sea level studies in the Arctic Ocean, mainly because of sea ice and associated uncertainties in data quality. Recently reprocessed satellite altimetry data have proven to provide sufficient quality for sea level studies in the Nordic and Barents seas, most parts of which stay ice-free all year round. We present one of the first analyses of sea level variability in the Barents Sea using the sea surface height (SSH) measurements by ERS-1/2 and Envisat satellites, observations of the Earth's gravity field by GRACE satellites, and an ocean data synthesis product. We assess the contributions of the interannual, annual, and higher frequency variability, discuss the role of barotropic and baroclinic changes, and identify the mechanisms that drive the variability.

The interannual and longer-term variability in the Barents Sea is found to be small. The annual cycle and signals with periods less than 1 year are found to be the most important contributors to SSH variability: the annual cycle is dominant near the coast, while the higher frequency signals dominate in the interior. Based on the concurrent GRACE and altimetry measurements as well as on the ocean data synthesis product, we conclude that the non-seasonal sea level variability is mostly barotropic. The observed amplitudes of the annual cycle of the total and barotropic sea levels are about 4 and 2.5 cm, respectively. The analysis of the annual cycle reveals a 1-3 months delay of the maximum annual SSH in the Barents Sea relative to the adjacent deep areas of the Greenland and Norwegian seas. The time delay is observed for both the total and the barotropic sea level maxima. We suggest that this delay can be explained by the local importance of the combined effect of wind stress, varying bottom topography, and dissipation.