



Sea level Atlantic-to-Arctic: an examination of the altimeter record

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We explore changes in the ocean circulation in the Atlantic, Nordic Seas, and Arctic during the past two decades through examination of the combined historical satellite altimeter sea level record. On seasonal timescales sea level variations have amplitudes of 1-5cm with a phase in shallow seas (e.g. Barents Sea) that lags the seasonal cycle in the open ocean by 2-3 months. The cause of this phase lag is related to the change in phase lag with depth of steric anomalies in this region. The difference in phase lag induces currents along regions of topographic gradient of a few cm/s.

On interannual timescales the altimeter record reveals 4.5-5.5 cm anomalies in the sub-Arctic gyre and Norwegian Sea, and smaller 2.5 cm in the Barents and Greenland Seas. As in the case of the seasonal cycle, interannual variations in sea level are shown to be related to steric changes (determined from examination of the historical hydrographic archive), where salinity changes in the Greenland and Norwegian Seas in particular play an important role. In contrast, wind forcing plays an important role in the the northern Barents Sea.

Finally we examine the trend over the full 18-year record. Everywhere in the Nordic Seas sea level has increased. The highest rate of rise is about 7 mm/yr which occurs in the Labrador Sea near the south-east coast of Greenland. In the center of Norwegian Sea maximum the rate is \sim 5 mm/yr, while in the Baltic Sea it changes from \sim 2.5 mm/yr on south to practically zero on north.