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Comparison of the ocean surface vector winds over the Nordic Seas and their application for ocean modeling

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Ocean processes in the Nordic Seas and northern North Atlantic are strongly controlled by air-sea heat and momentum fluxes. The predominantly cyclonic, large-scale atmospheric circulation brings the deep ocean layer up to the surface preconditioning the convective sites in the Nordic Seas for deep convection. In winter, intensive cooling and possibly salt flux from newly formed sea ice erodes the near-surface stratification and the mixed layer merges with the deeper domed layer, exposing the very weakly stratified deep water mass to direct interaction with the atmosphere. Surface wind is one of the atmospheric parameters required for estimating momentum and turbulent heat fluxes to the sea ice and ocean surface. In the ocean models forced by atmospheric analysis, errors in surface wind fields result in errors in air-sea heat and momentum fluxes, water mass formation, ocean circulation, as well as volume and heat transport in the straits. The goal of the study is to assess discrepancies across the wind vector fields from reanalysis data sets and scatterometer-derived gridded products over the Nordic Seas and northern North Atlantic and to demonstrate possible implications of these differences for ocean modeling. The analyzed data sets include the reanalysis data from the National Center for Environmental Prediction Reanalysis 2 (NCEPR2), Climate Forecast System Reanalysis (CFSR), Arctic System Reanalysis (ASR) and satellite wind products Cross-Calibrated Multi-Platform (CCMP) wind product version 1.1 and recently released version 2.0, and Remote Sensing Systems QuikSCAT data. Large-scale and mesoscale characteristics of winds are compared at interannual, seasonal, and synoptic timescales. Numerical sensitivity experiments are conducted with a coupled ice-ocean model forced by different wind fields. The sensitivity experiments demonstrate differences in the net surface heat fluxes during storm events. Next, it is hypothesized that discrepancies in the wind vorticity fields should manifest different behaviors of the isopycnals in the Nordic Seas. Time evolution of isopycnal depths in the sensitivity experiments forced by different wind fields is discussed. Results of these sensitivity experiments demonstrate a relationship between the isopycnal surfaces and the wind stress curl. The numerical experiments are also analyzed to investigate the relationship between the East Greenland Current and the wind stress curl over the Nordic Seas. The transport of the current at this location has substantial contribution from wind-driven large-scale circulation. This wind-driven part of the East Greenland Current is a western-intensified return flow of a wind-driven cyclonic gyre in the central Nordic Seas. The numerical experiments with different wind fields reveal notable sensitivity of the East Greenland Current to differences in the wind forcing.