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Impact of cyclones on sea ice in the Fram Strait: Numerical simulations and observations

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The sea ice export from the Arctic through Fram Strait is of importance due to the fresh water which influences the oceanic stratification and, thus, the global thermohaline circulation. This study deals with the effect of cyclones on sea ice and sea ice transport on the basis of observations from two field experiments FRAMZY 1999 and FRAMZY 2002 (Framstraßenzyklonen, Fram Strait Cyclones) in April 1999 and March 2002 as well as on the basis of numerical simulations with a dynamic-thermodynamic sea ice model. The simulations are forced with 6-hourly atmospheric ECMWF-analyses (European Centre for Medium-Range Weather Forecasts) and 6-hourly oceanic data of a separate MPI-OM-simulation (Max-Planck-Institute Ocean Model). Comparing the observed and simulated variability of the sea ice drift and of the position of the ice edge shows that the model configuration is appropriate for the objectives of this study. The seven observed cyclones change the position of the ice edge up to 100 km per day and cause an extensive decrease of sea ice coverage between 2 % and 15 %. The decrease is simulated by the model only if the ocean current is strongly divergent in the centre of the cyclone. There is a remarkable impact of the ocean current on divergence and shear deformation of the ice drift. As shown by sensitivity studies the prescribed ocean current (at a depth of 6 m) is mainly responsible for ascertained differences between simulation and observation. The simulated sea ice transport shows a strong variability on a time scale from hours to days. Minima occur in the time series of the ice transport during periods when a cyclone is present in the Fram Strait. These minima are not caused by the local effect of the cyclone's wind field, but mainly by the large-scale pattern of surface pressure. Even a small displacement of cyclone tracks in the Nordic Seas change the ice transport considerably.