Main goal of SPARCS:

Parametrization of near-surface transport of momentum and energy over different sea ice regimes for climate models as ECHAM6. The focus is on regimes with an open water fraction (leads, melt ponds).

Regime I
The marginal sea ice zone with drifting floes

Regime II
The inner Arctic during summer with melt ponds and leads

Main achievement in 2014:

Development of a stability dependent parametrization of transfer coefficients for momentum and heat over polar sea ice to be used in climate models (Lüpkes and Gryaniak, 2015)

Edges of floes, leads, and melt ponds influence the atmospheric flow over sea ice and thus the transport processes of momentum and heat near the surface. The edge impact on the drag coefficients has been parametrized during SPARCS/MiKlip by distinguishing coefficients for skin drag (C_{d,i}, C_{d,w}) (i= ice, w= water) and form drag C_f.

The resulting 10 m drag coefficients (C_{d,10m}) are shown in the right figure for different ice regimes together with observations (Andreas et al., 2010; Hartmann et al., 1994, Mai et al., 1996) and C_{d,w} from present climate models (e.g. ECHAM6).

For neutral conditions the form drag coefficient C_{d,w} was derived on the basis of a theoretical model and in-situ turbulence measurements as a function of sea ice concentration A as

\[ C_{d,w} = \frac{C_{d,10m}}{A(1-A)} \]

The number +2 represents the 95% significance level.

A prototype of the new parametrization has been used in ECHAM6/FESOM (Project TORUS). Normalized differences (new – old) are shown below for the ensemble average over 10 runs over 20 years. The stability impact on the drag coefficients is demonstrated for idealized atmospheric forcing using satellite data of sea ice concentration and melt pond concentration (Rösel et al., 2012). The figures below are valid for summer. The upper pair shows a case with prescribed slight warm-air advection, the lower one shows a case with slight cold-air advection. The AWI scheme (new parametrization) results in higher values in regions with many melt ponds and leads.

References


