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Sensitivities in the Rossby Centre Arctic models

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The development of the Rossby Centre regional coupled model RCAO for the Arctic has been carried out within the EU-GLIMPSE project to test parameterizations under conditions better controlled as possible in global models. The initial version of the model has been well adjusted to Baltic Sea conditions. Here we test to what extent parameterizations are universally functioning (i.e. in the Baltic and in the Arctic).

30-year ocean-standalone spin-up and sensitivity runs are carried out. Tests with respect to sea ice albedo and surface radiative fluxes indicate that the annual amplitude of ice extent is much improved after switching from Baltic Sea parameterizations to AOMIP recommendations. The differences indicate the non-universal character of certain parameterizations, which work well in marginal seas such as the Baltic Sea but not that well for extreme Arctic conditions. This poses even a problem within our large Arctic domain which includes both central arctic as well as marginal ice areas. We conclude that the degree of universality of key parameterizations needs to be raised in order to gain robustness in different application domains. This appears especially necessary for global models.

When employing the coupled model, ocean/ice-atmosphere interaction comes into play, which adds positive (destabilizing) or negative (stabilizing) feedback mechanism at the interface. In addition, biases in exchange fluxes can lead to problems not seen in standalone runs. A strong sensitivity with respect to ice albedo formulation is found in the coupled model. Disappearance of summer sea ice in the case of surface-temperature dependent albedo is triggered by an unrealisticly strong ice-albedo feedback during the onset of the melting phase in spring. A pure surface temperature - albedo relation inferred for SHEBA conditions in the central arctic might not be valid for the complete model domain including more marginal areas. On the other hand side, other GLIMPSE models do not show this strong sensitivity. Apparently, the models differ in their sea-ice related background sensitivity, which depends on other ice pa-

rameterizations such as lateral melting and lateral freezing

Different sea ice conditions as given in several coupled sensitivity runs generally affect the atmospheric circulation. Variations of e.g. the reference thickness of lateral ice freezing or T/S initial conditions can lead to reversed wind directions over large basins of the Arctic Ocean. In turn, the atmospheric circulation feeds back on the ice distribution. The simulated large scale air circulation agrees generally better with ERA40 fields if the coupled model is used instead of the standalone atmosphere model.