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Seasonal to decadal predictability in mid and high northern latitudes

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The upper limit of climate predictability in mid and high northern latitudes is analysed by performing perfect ensemble experiments with two different global coupled climate models. A range of oceanic and atmospheric parameters is investigated to find variables, regions and time-scales with potential for skilful predictions. The dependence of the skill from changes in start date and changes in parametrizations is analysed and physical processes, responsible for the predictability, are identified.

The predictability of air temperature shows a large land-sea contrast with highest values over the sub-polar oceans. Significant seasonal predictability of temperature up to half a year in advance is obtained over parts of Europe and North America, largest over southern Europe and western North America. After one year, almost no significant predictability of both seasonal and annual mean values of atmospheric parameters can be found over land anymore. Over the sub-polar North Atlantic and North Pacific Oceans, air temperature is significantly predictable for several years ahead. A combination of relatively high persistence and advection of sea surface temperature anomalies in the sub-polar gyres and the North Atlantic Current are the main contributors to the high predictability.

Sea ice in the Arctic shows significant predictability of up to 4 years in some parts of the Central Arctic and up to two years along the ice edges in the Atlantic Arctic sector. Persistence of ice anomalies and advection of ice thickness anomalies dominate the predictability.

On decadal time-scales, large scale ocean heat transport variations explain most of the predictability in mid and high northern latitudes. The predictability of 10-year averages of temperature is highest over the North Atlantic, however, parts of western and northern Europe are significantly predictable as well. Sea ice thickness is highly predictable along the ice edges in the North Atlantic Arctic Sector.