SPECIAL PROJECT PROGRESS REPORT

Progress Reports should be 2 to 10 pages in length, depending on importance of the project. All the following mandatory information needs to be provided.

Reporting year 2014

Project Title: The role of the polar regions in weather and seasonal prediction

Computer Project Account: SP_SPDEJUN2

Principal Investigator(s): Prof. Dr. Thomas Jung

Affiliation: Alfred-Wegener-Institute for Polar and Marine Research, Bussestraße 24, D-27570 Bremerhaven, Germany

Name of ECMWF scientist(s) collaborating to the project (if applicable) Dr. Tido Semmler, Dr. Soumia Serrar

Start date of the project: 1. January 2013

Expected end date: 31. December 2014

Computer resources allocated/used for the current year and the previous one

(if applicable)
Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)	615,000	615,000	2,950,000	
Data storage capacity	(Gbytes)	3,300	3,300	12,000	

Summary of project objectives
(10 lines max)

The aim of this project is to determine how improvements in the predictive skill over the Arctic and Antarctic atmosphere would influence forecast quality in lower latitudes on time scales from daily to seasonal. To this end experiments are carried out in which forecast error in the polar regions is reduced by relaxing the ECMWF model towards reanalysis fields over the Arctic and Antarctic. The skill of the the relaxation experiments are compared with control experiments without relaxation. In 2013 the focus has been on medium-range and subseasonal prediction; in 2014 the focus will be on seasonal forecasting.

Summary of problems encountered (if any)
(20 lines max)

No major problems have been encountered.

Summary of results of the current year (from July of previous year to June of current year)

A large number of 14-day forecast experiments with and without relaxation of the Arctic and Antarctic (poleward of 75°) has been carried out and analysed for all seasons. All experiments were carried out with a recent version of the ECMWF model at a resolution of T255 with 60 levels in the vertical. ERA-Interim data were used as relaxation fields.

For both hemispheres, the strongest influence of the polar relaxation on the mid-latitudes has been found for the respective winter season. Reductions of the root mean square error (RMSE) of up to 15% due to Arctic relaxation are found for Northern Asia in autumn and winter. No discernable impact is found over the North Atlantic and North Pacific.

The influence of the Arctic atmosphere on mid-latitude prediction turns out be flow-dependent with an increased link during weather situations with an anomalous northerly flow from the Siberian Arctic into Northern Asia and in situations with a southward shifted jet stream.. Fig. 1 shows anomalous 500 hPa geopotential heights for a composite with improved forecasts over East Asia (green box). This finding is in line with previous studies showing that Siberia is a key region when it comes to the influence of the Arctic on the Northern Hemisphere mid-latitudes. Other regions with a noticable improvemt of mid-latitude skill due to Arctic relaxation include Eastern Europe and northeastern parts of North America. Oceanic areas and land areas with a strong maritime influence such as the west of Northern North America and Western Europe are less influenced by the Arctic.

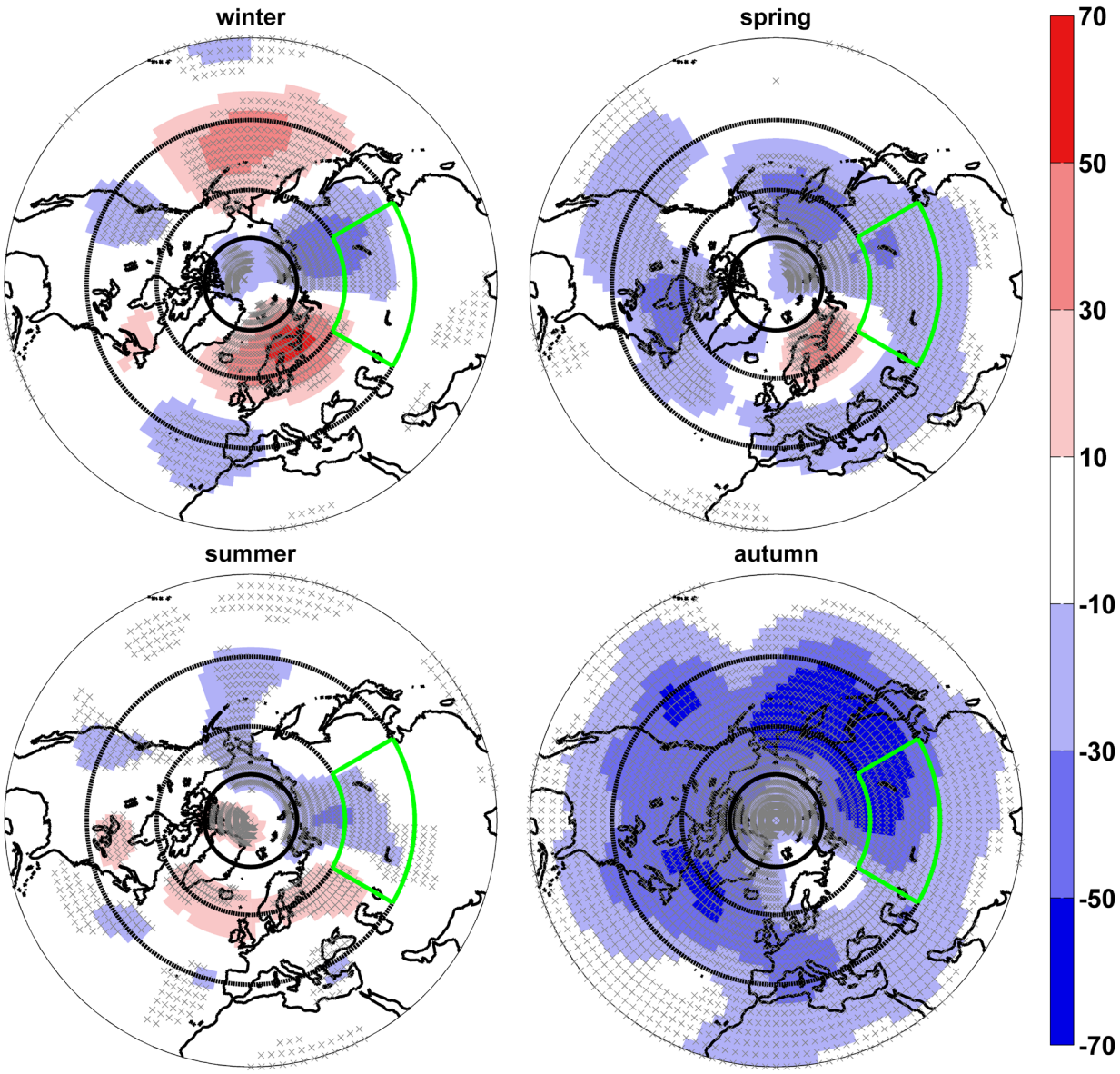

Fig. 1: Anomalous 500 hPa geopotential height [m] for exceptionally improved forecasts in Northern Asia (40°N to 60°N, 60°E to 120°E) indicating the flow dependence of the error reduction due to Arctic relaxation.

For the Southern Hemisphere, error reductions are generally smaller and amount to 5% in austral winter and only 2-4% in the other seasons, averaged over the Southern mid-latitudes. Slightly larger improvements can be found in an area downstream of the southern tip of South America. Here largest forecast errore reduction is associated with an anomalous southerly flow from Antarctica towards South America. There is a known link between ENSO and the large-scale circulation over Southern South America. If there is an ENSO dependence on the improvement of weather forecasts over Southern South America due to Antarctic relaxation is subject of current investigations.

The seasonal forecast experiments for 2014 have not been started yet, since the relaxation code will first need to be migrated to the new model cycle that runs on the new Cray supercomputer. It is expected that all integrations proposed for 2014 will be successfully finished by the end of the year.

List of publications/reports from the project with complete references

Jung, T., M. A. Kasper, T. Semmler, and S. Serrar (2014), Arctic influence on subseasonal midlatitude prediction, Geophys. Res. Lett., 41, doi:10.1002/2014GL059961.

Kasper, M. A., T. Semmler, T. Jung, and S. Serrar (2014), Remote impact of the Arctic atmosphere on the Northern mid-latitudes. Submitted to Monthly Weather Review.

Semmler, T., M. A. Kasper, T. Jung, and S. Serrar (2014), Remote impact of the Antarctic atmosphere on the Southern mid-latitudes. Submitted to Environmental Research Letters.