DKRZ User Workshop
October 5-6 2015
Hamburg

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR-
UND MEERESFORSCHUNG

H Matthes, A Rinke, D Klaus, A Sommerfeld, X Zhou, W Dorn, F S Hanf, I Hebestadt

Modelling Arctic atmospheric circulation

HIRHAM-NAOSIM

- the coupled regional climate model HIRHAM-NAOSIM (atmosphere-ice-ocean) is used to investigate feedbacks between September sea ice anomalies in the Arctic and atmospheric conditions in autumn and the subsequent winter
- the model is forced with NCEP/NCAR reanalysis, an ensemble of 7 hindcast simulations was run for the period 1948–2008
- results show that negative Arctic sea ice anomalies are associated with increased heat and moisture fluxes, decreased static stability, increased lower tropospheric moisture, and modified baroclinicity, synoptic activity, and atmospheric large-scale circulation

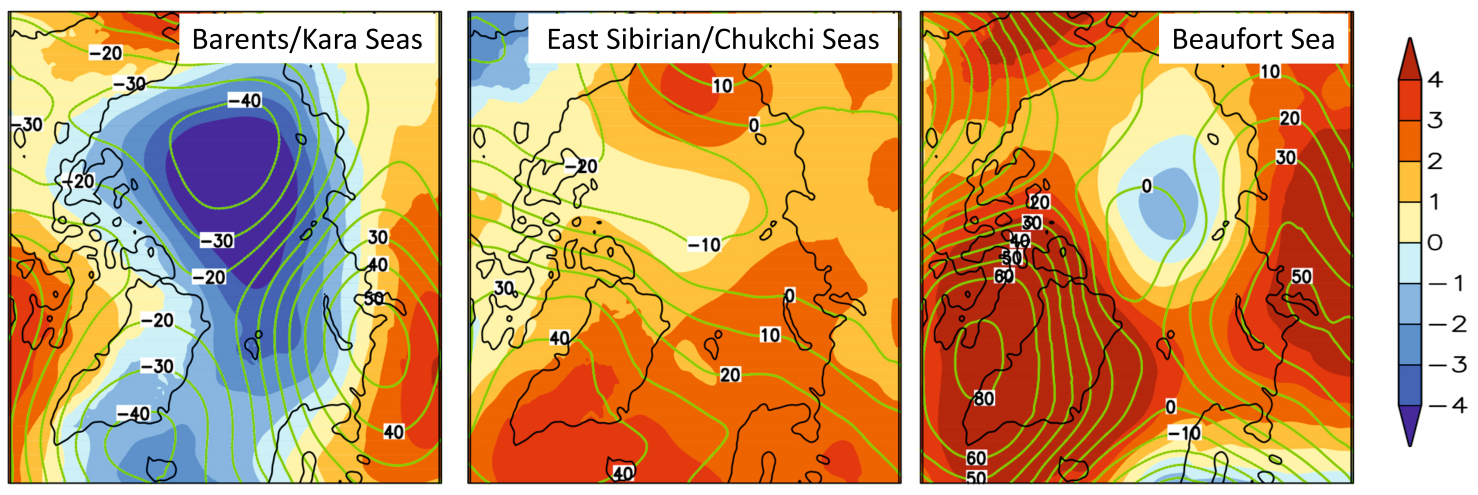


Fig. 1: Simulated mean sea level pressure differences [hPa] in winter for regional Sept. sea-ice anomalies from HIRHAM–NAOSIM ensemble, adapted from Rinke et al. (2013)

HIRHAM-CLM

- the coupled regional climate model HIRHAM-CLM (Matthes et al, 2015; Xu 2015) (atmosphere-land-soil) is used to investigate feedbacks of surfaces processes to the atmosphere
- to asses these feedbacks, model results are compared to an atmosphere - only run (HIRHAM)
- the model is forced with ERAInterim reanalysis 1979–2014
- results show that in addition to direct impacts of the land surface model eg on air temperature, large scale circulation over the Arctic is changed in the coupled model

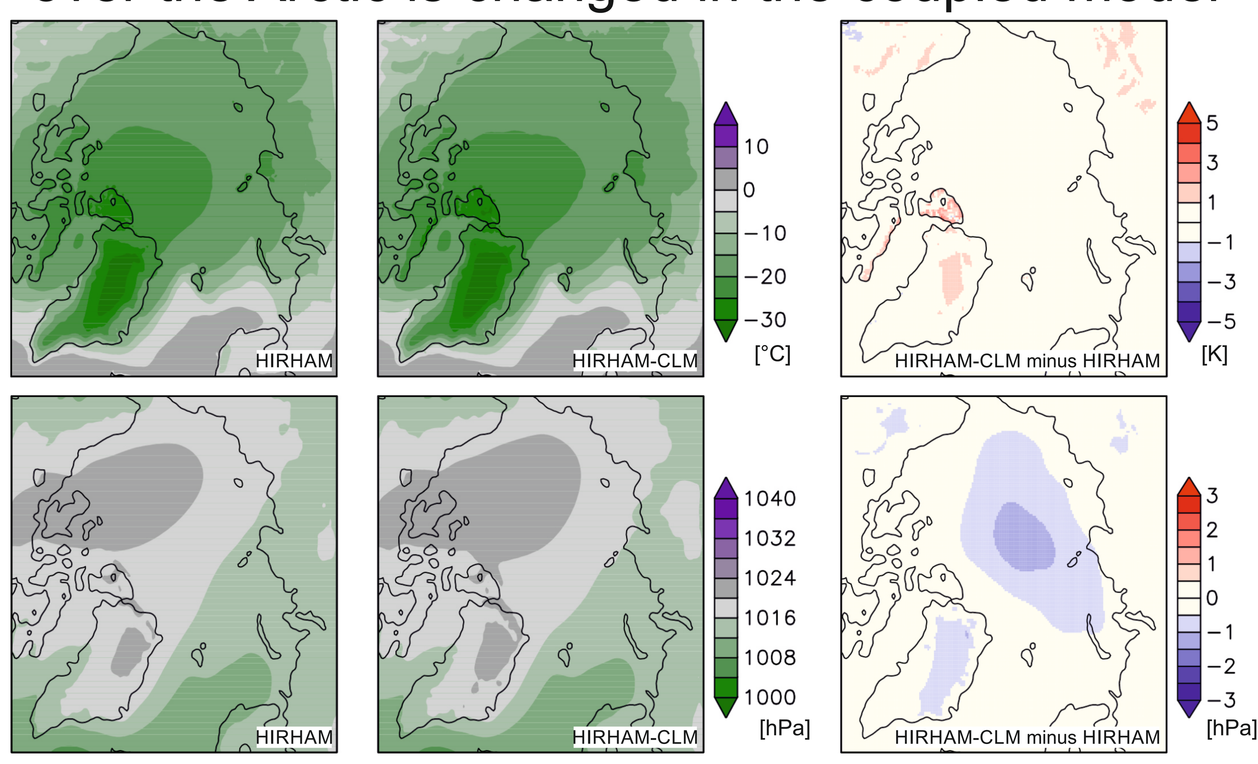


Fig. 2: Spring differences of coupled and uncoupled model runs. Upper panels: 2m air temperature, lower panels: mean sea level pressure.

Budget Study in HIRHAM

- dynamic atmospheric processes exhibit strong non-linear behavior; these non-linearities determine the internal variability in regional climate models simulating the atmosphere
- HIRHAM is applied for the Arctic with an ensemble of 20 members, differing in their initial conditions, for 2012 (Sommerfeld 2015a)
- internal variability is defined as inter-member variance (IV) of potential temperature, via a budget equation; contribution of different terms to IV tendency is quantified

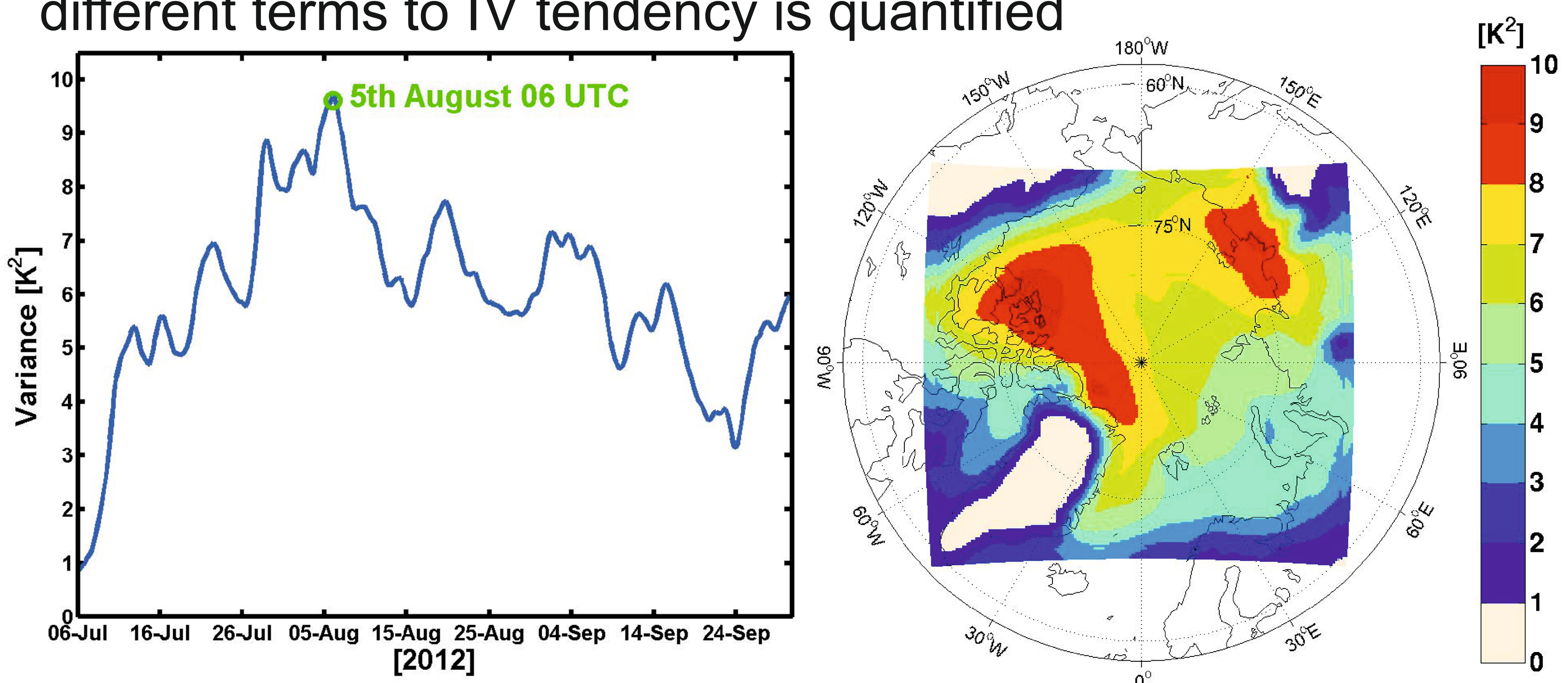
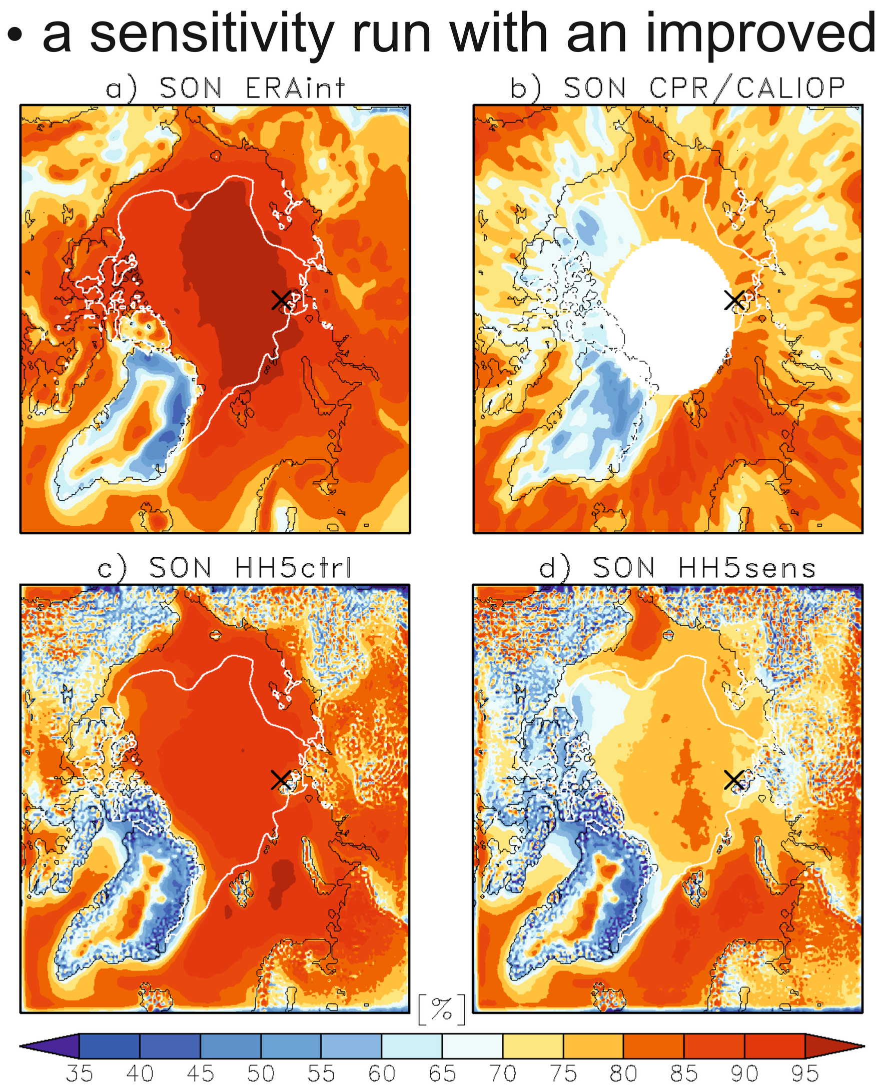


Fig. 3: Potential temperature inter-member variance (IV). Left panel: Domain and vertical averaged potential temperature IV, right panel: Spatial distribution of the time averaged potential temperature IV at 925 hPa (Sommerfeld et al., 2015b)

Cloud Parameterizations in HIRHAM

- comparison of cloud cover from a ERAInterim-forced HIRHAM run to satellite observations (CloudSat and CALIPSO) was used to identify shortcomings in simulated cloud cover
- a sensitivity run with an improved model setup was conducted



- Arctic climate conditions were found to be better reproduced when enabling (1) a more efficient Bergeron-Findeisen process and (2) more generalized subgrid-scale variability of total water content.

Fig. 4: Multi-year (2006-2010) autumn means of total cloud cover extracted from (a) EraInterim reanalysis, (b) CPR/CALIOP satellite data, (c) HIRHAM5 control and (d) sensitivity runs. Reanalyzed and observed data are interpolated to the model domain, the white line represents the multi-year autumn sea-ice edge based on EraInterim (Klaus et al., 2015).

DKRZ resources and

2015

resource	granted	used
Blizzard CPU time (CPUh)	477000	695473
GPFS work (GB)	9000	5038
HPSS arch (GB)	80000	67855

2014

resource	granted	used
Blizard CPU time (CPUh)	530000	471977
GPFS work (GB)	9000	5462
HPSS arch (GB)	80000	40109

DKRZ support

- DKRZ help desk offers support on virtually everything from post processing scripts to problems with moving data to job queuing to availability of software libraries
- DKRZ workshops on model perfomance, model optimization
- support with model runs (model performance, I/O errors ect., libraries, set up of model runs, job scripts)
- help with optimizing post processing of data, using post processing queues, visualization of data

References

Klaus, D., K. Dethloff, W. Dorn, A. Rinke, Wu, D.L. (2015): New insight of Arctic cloud parameterization from regional climate model simulations, satellite-based and drifting station data, Geophys. Res. Lett., submitted.

Matthes, H., Rinke, A., Zhou, X., Dethloff, K. (2015): Evaluation of a new regional coupled atmosphere-land-surface-soil model for the Arctic. In preparation.

Rinke, A., Dethloff, K., Dorn, W., Handorf, D., Moore, J.C. (2013): Simulated Arctic atmospheric feedbacks associated with late summer sea ice anomalies. JGR Atmospheres, 118, 7698-7714.

Sommerfeld, A. (2015a): Quantification of Internal Variability of the Arctic Summer Atmosphere based on HIRHAM5 Ensemble Simulations. Dissertation.

Sommerfeld, A., Nikiema, O., Rinke, A., Dethloff, K., Laprise, R. (2015b): Arctic Budget Study of Inter-member Variability using HIRHAM5 Ensemble Simulations, JGR Atmospheres, accepted.

Zhou, X. (2015): Atmospheric Interactions with Land Surface in the Arctic Based on Regional Climate Model Simulations. Dissertation.

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR-
UND MEERESFORSCHUNG
HELMHOLTZ GEMEINSCHAFT

BREMERHAVEN

Am Handelshafen 12
27570 Bremerhaven
Telefon 0471 4831-0
www.awi.de