Dynamical Downscaling over Siberia: Assessment of the Added Value

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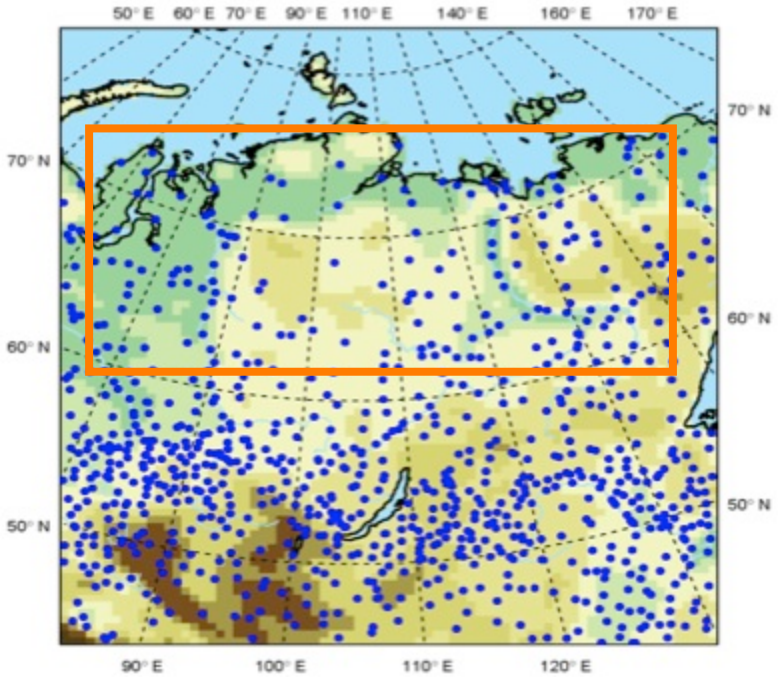
Motivation

Obstacle in assessing climate change in Siberia:

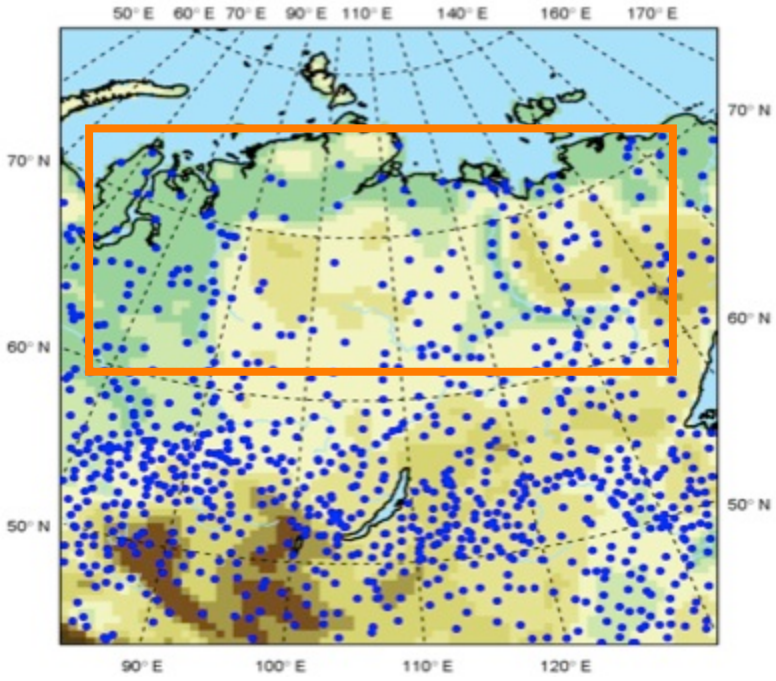
- Lack of long-term homogenous data records
- Sparse station network *(Roshydromet 2008)*
- Long-term global reanalyses on coarse resolution



Motivation

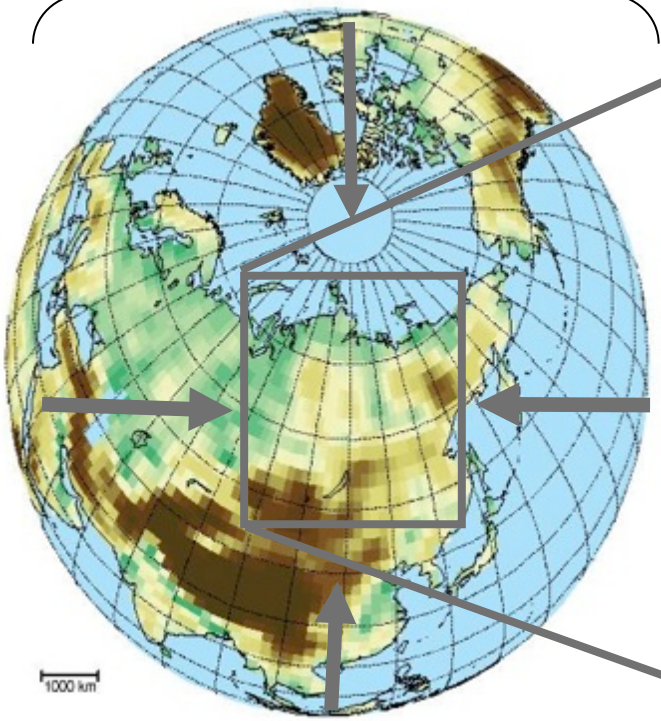
Reconstruction of recent-past climate

- Using a regional climate model (RCM)
- Long-term homogenous, consistent data set
- Higher temporal & spatial resolution than reanalyses
- Information of various atmospheric & terrestrial paramters

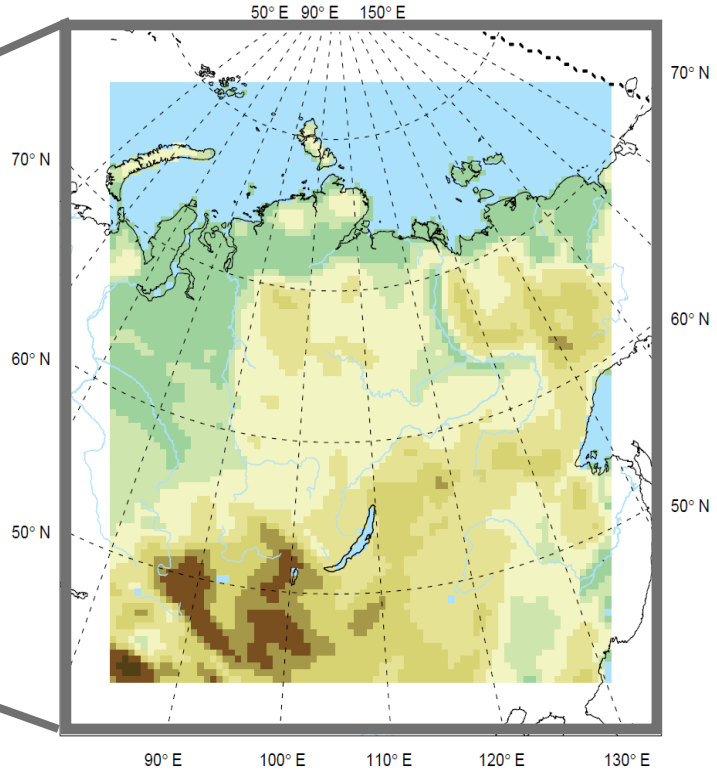


Dynamical Downscaling over Siberia

Large scale forcing: NCEP1 Reanalysis



Limited Area: Siberia



Orography of the RCM CCLM
Resolution: ~ 50km

- Expectation: added value gained by RCM
- Key issue in evaluation of RCM: Assessment of added value *(di Luca et al. 2011)*

Objective & Methods

Objective:

- **Climate Reconstruction of recent past for Siberia**
- **Assessment of added value of RCM over Siberia**
  Is there an added value in representing recent climate conditions?

Methods:

- Set up the regional climate model CCLM for Siberia
- Dynamical downscaling of reanalysis to perform hindcast simulation
- Comparison of RCM results with forcing, further reanalysis data, observations

RCM Data

CCLM (COSMO Model in CLimate Mode)

(www.clm-community.eu)

Forcing:

NCEP1-Reanalysis (6h) : 1948-2010
For initialization & boundaries, spectral nudging

External Datasets:

Orography: GTOPO30, Land Cover: GLC2000

Soiltype: FAO

Grid:

Rotated coordinate system
Number of grid points: 86 x 76

Resolutions:

Spatial: 0.44° (~50 km)

Temporal: hourly output

Vertical: 40 atmospheric layers, 13 soil layers (92m)

Land-surface Scheme:

Multi-layer soil and vegetation model TERRA-ML
Multi-layer snow model: 2 snow layers

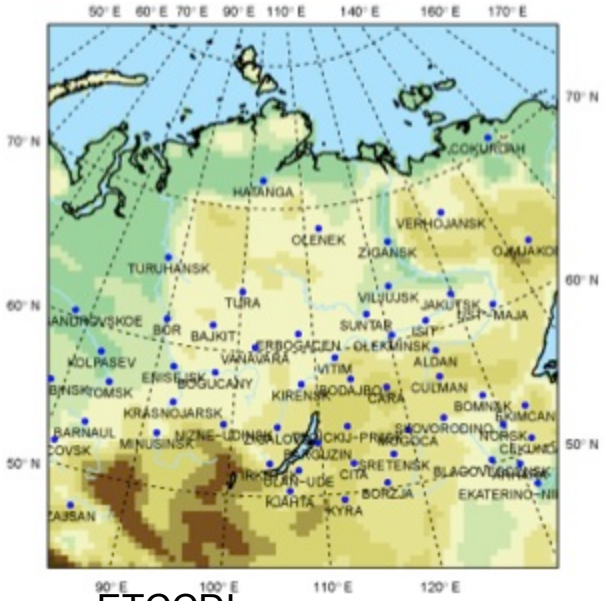
Reference Data

Reanalysis Data:
ERA40
ERA-Interim

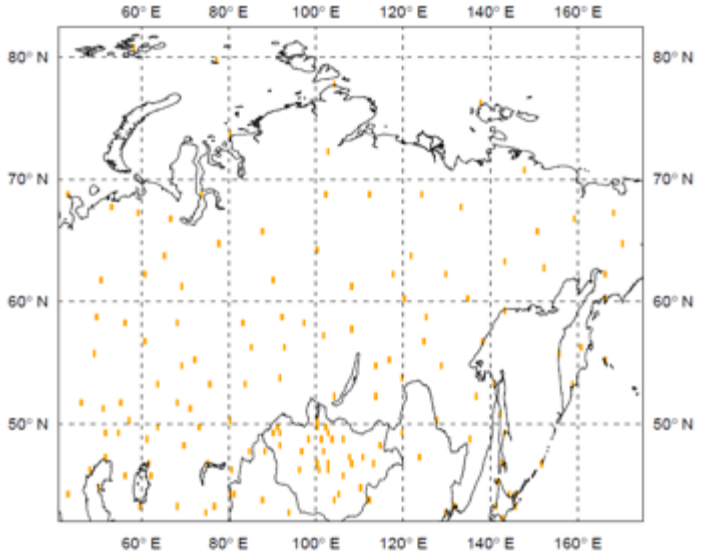
Observation Data:
global land-based climate extremes dataset (ETCCDI)
(The joint CCl/CLIVAR/JCOMM Expert Team on Climate Change Detection and Indices)

Gridded Observation Data:
Climate Research Unit (CRU)
Temperature

Satellite-derived Data:
ESA GlobSnow
Snow water equivalent (SWE)
Special Sensor Microwave/ Imager (SSM/I)
AMSR-E
(1987-2010)

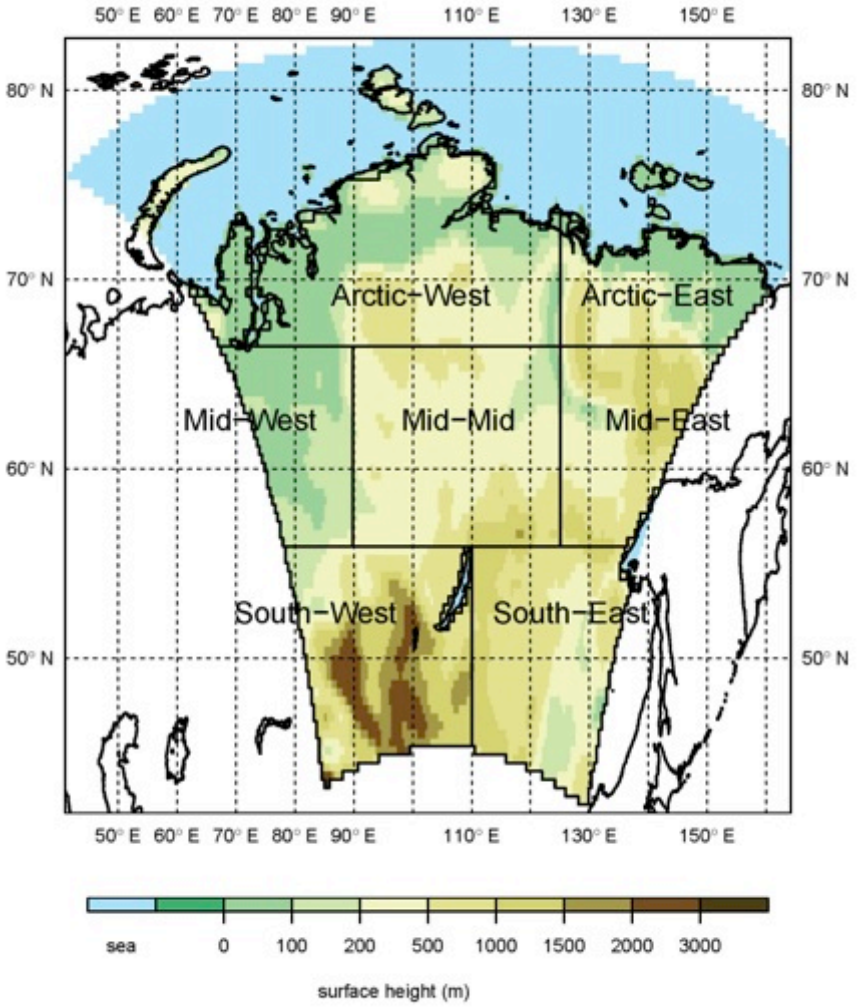


ETCCDI



Stations used in CRU 1990

Considered Subregions



Analysis

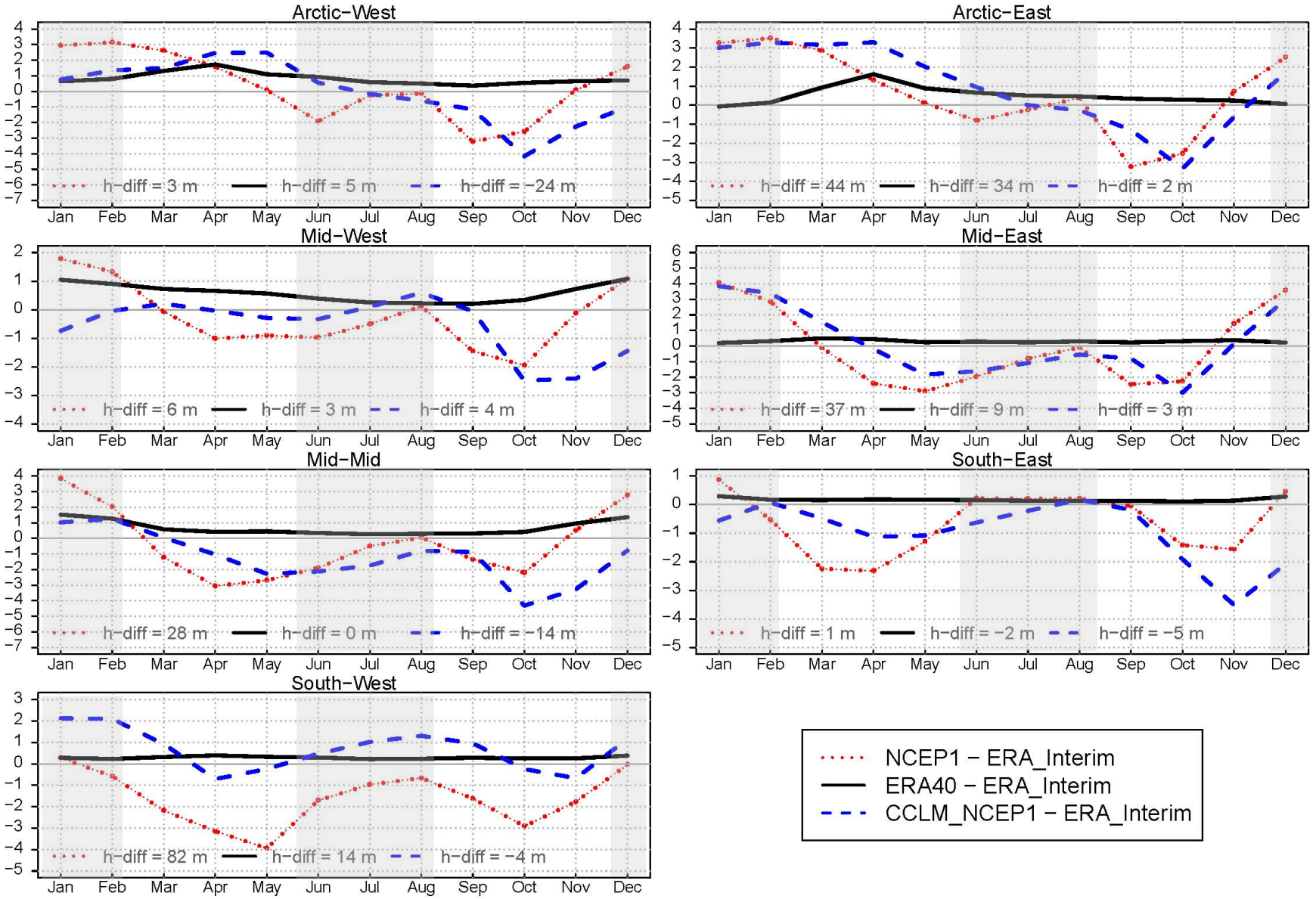
2m air temperature (mean, min. max.)
Total precipitation
Snow water equivalent (SWE)
Subregions of land grid points

Bias: mean Annual Cycle for subregions

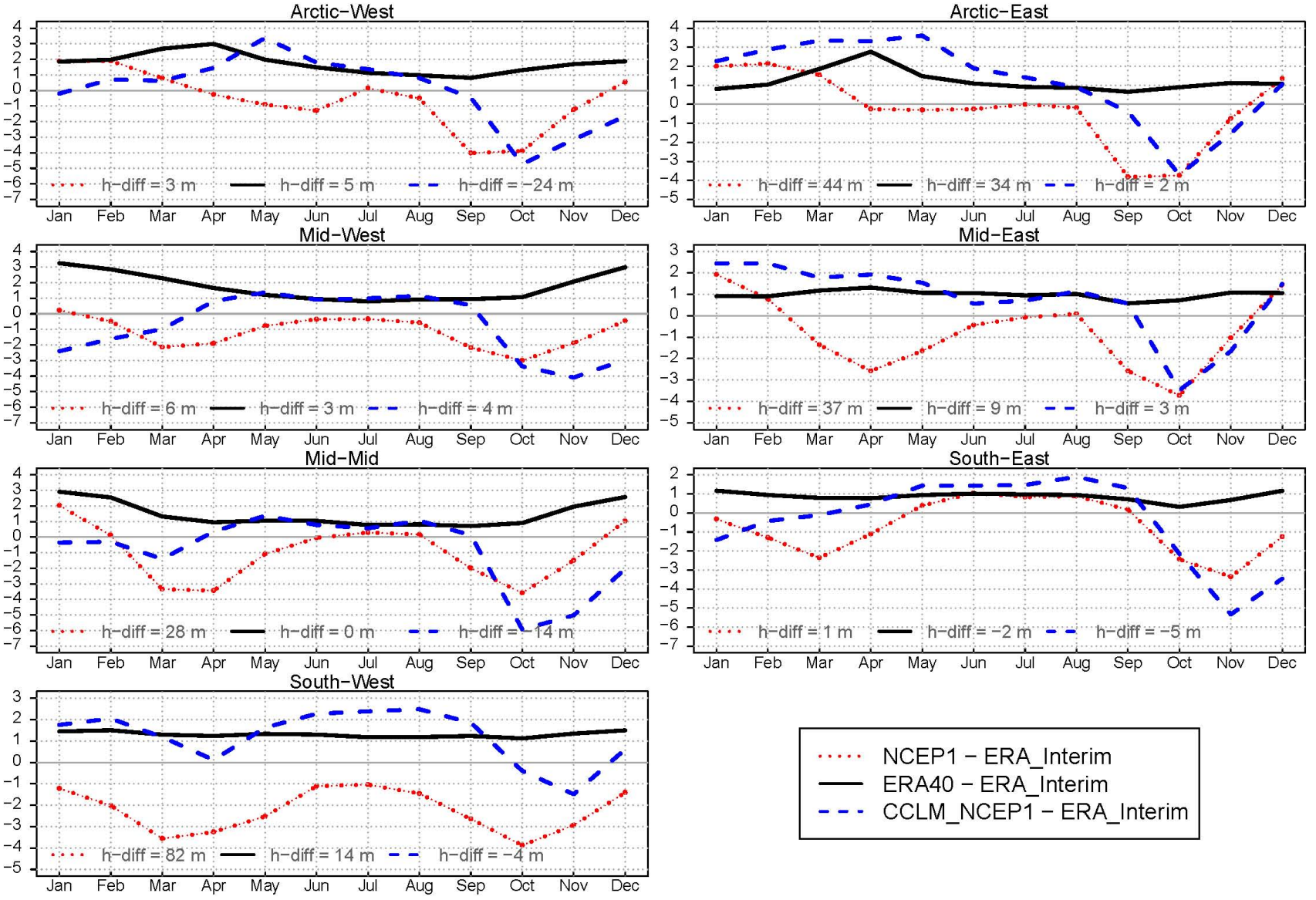
Bias: threshold-based extreme values
(e.g. Frost days, Summer days)

Temporal variations of monthly SWE

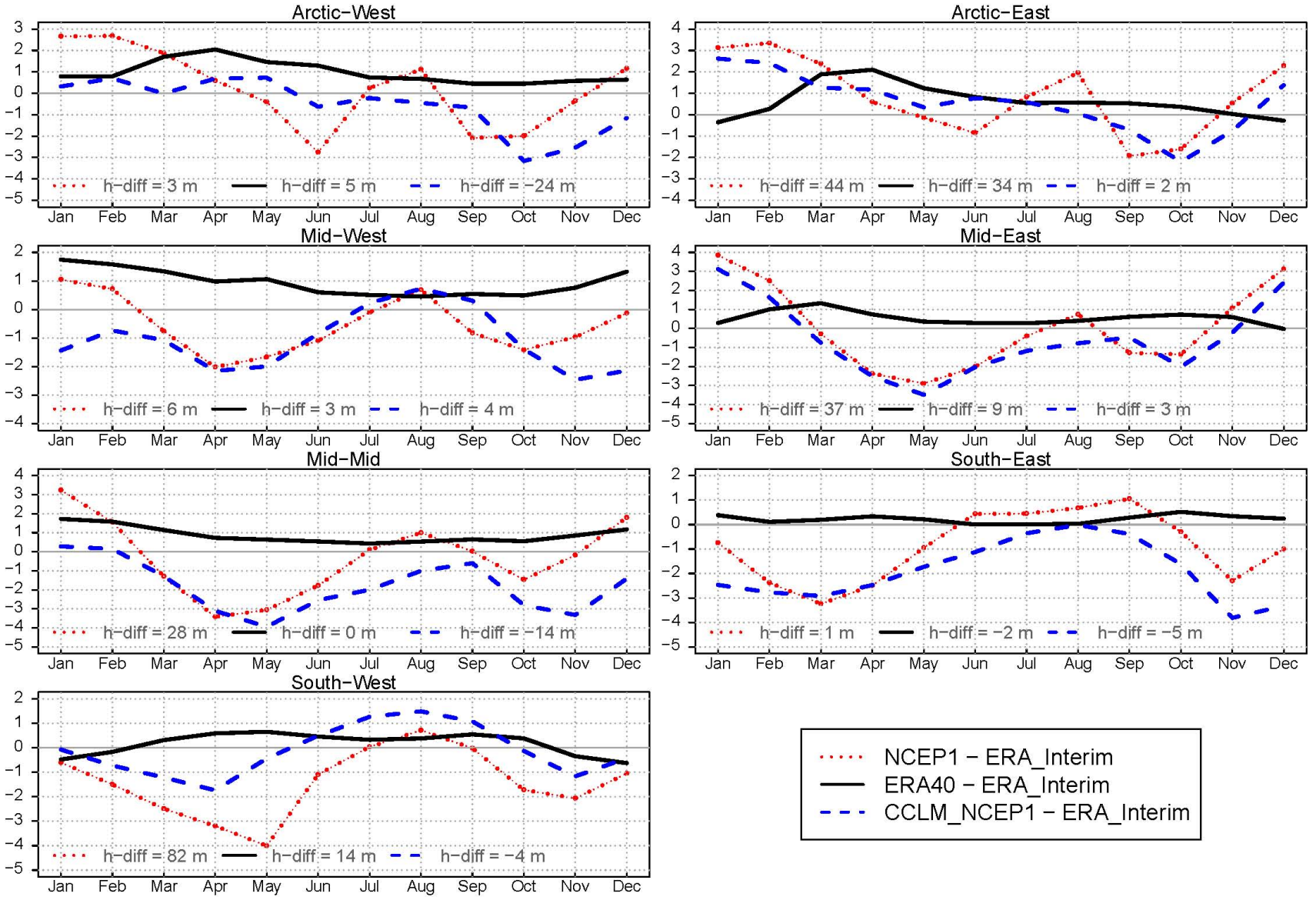
Bias Yearly Cycle (1979-2001) of 2m Temperature



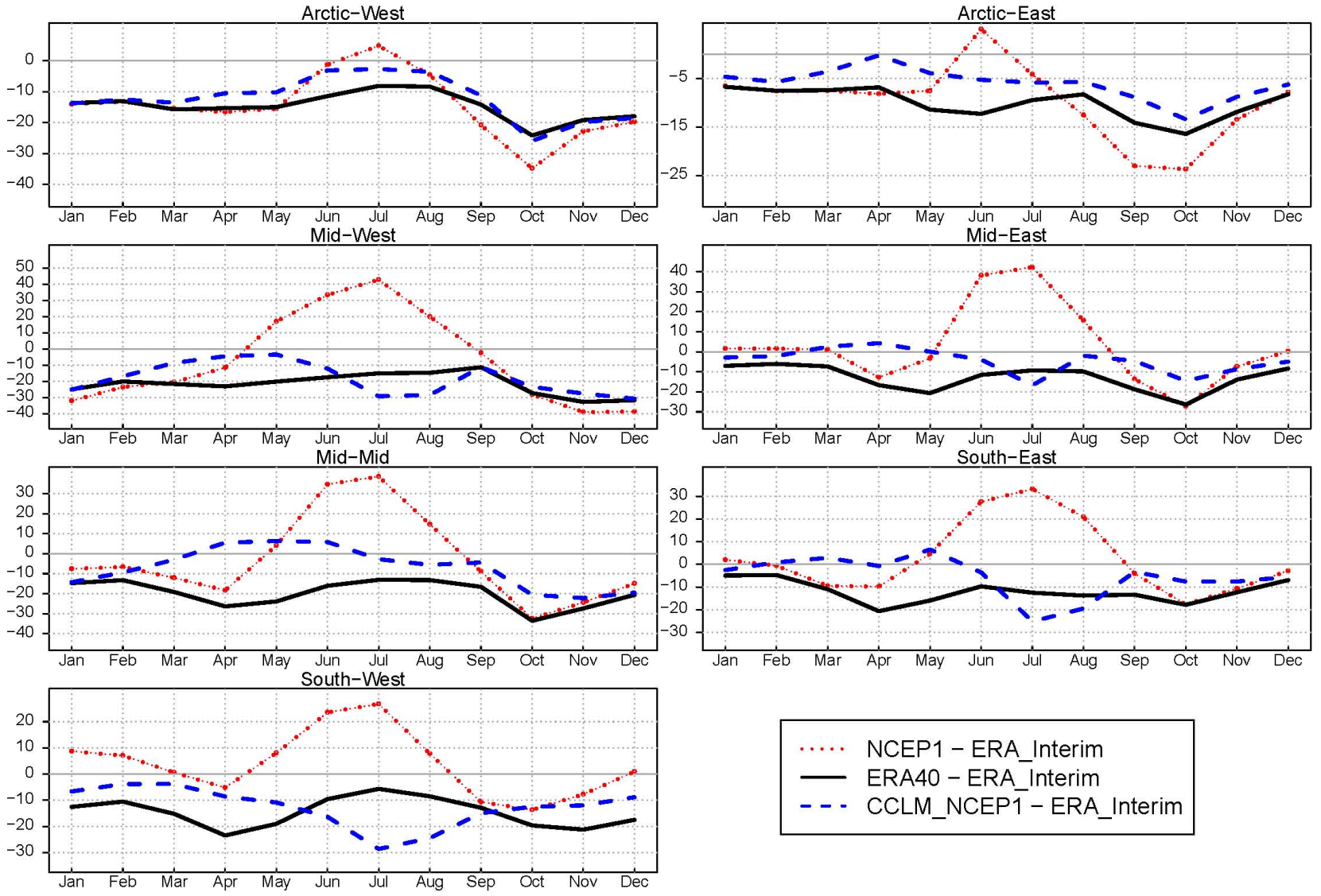
Bias Yearly Cycle (1979-2001) of Tmin



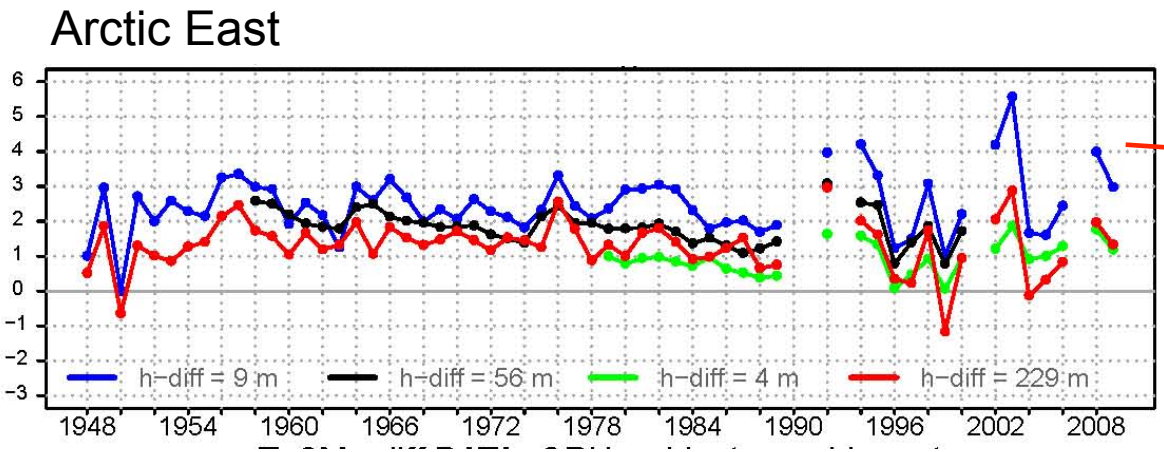
Bias Yearly Cycle (1979-2001) of Tmax

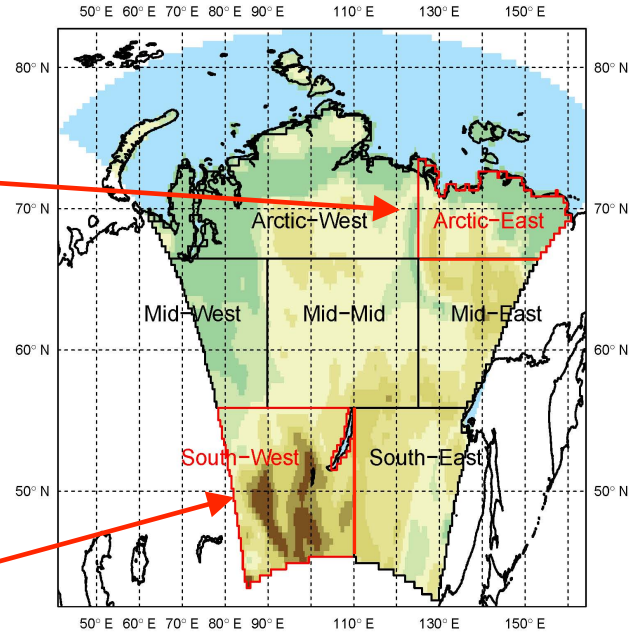


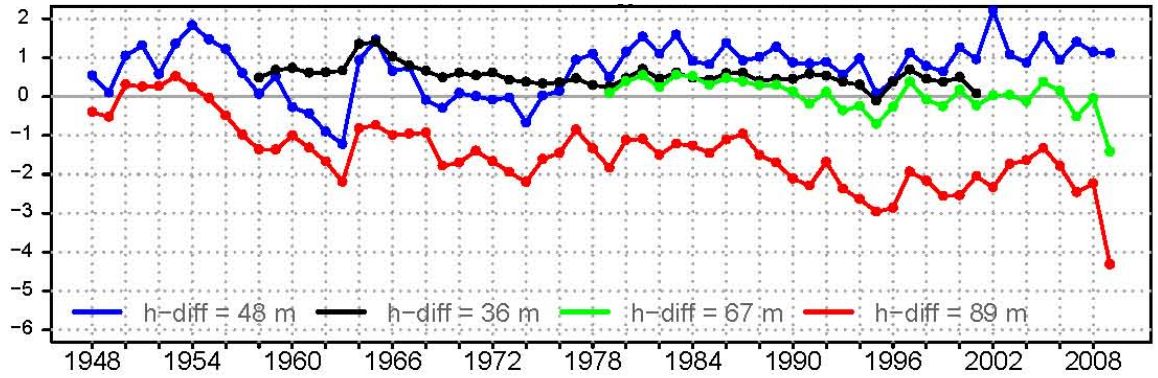
Bias Yearly Cycle (1979-2001) of Total Precipitation



Bias yearly means (2m Temperature)



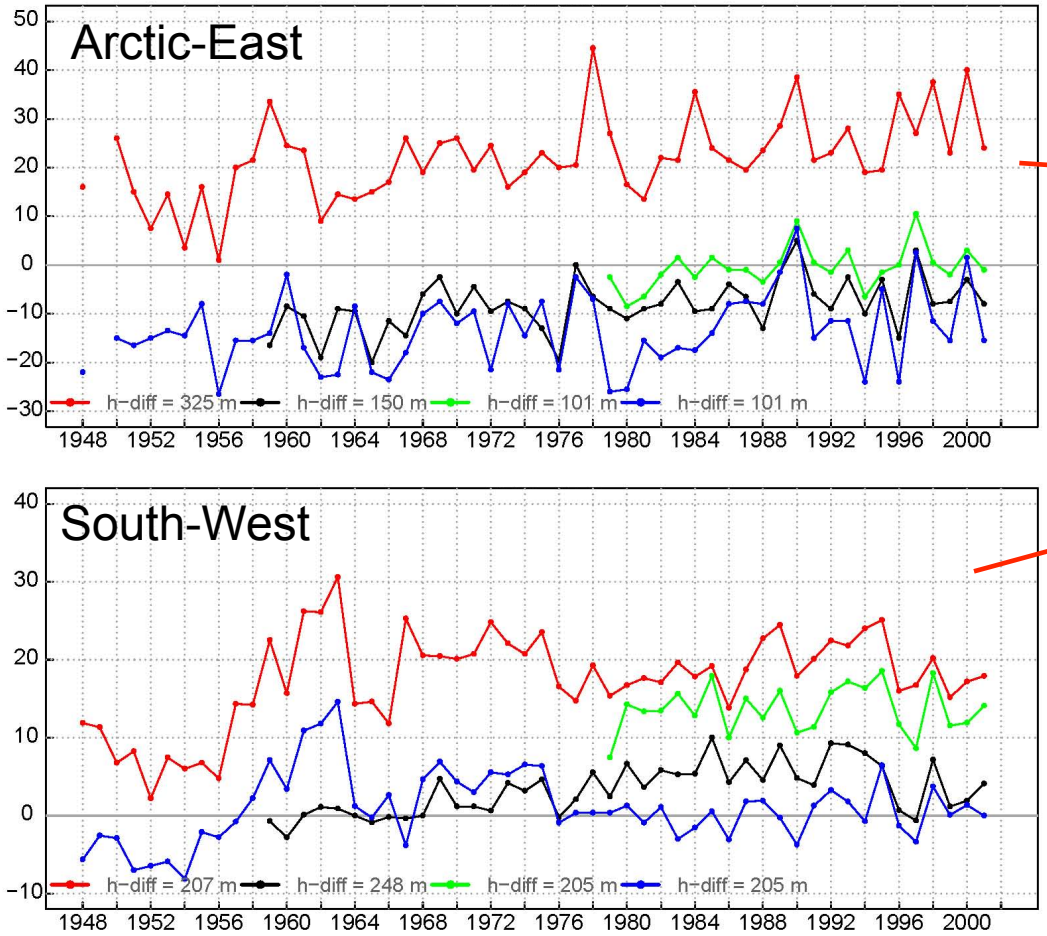


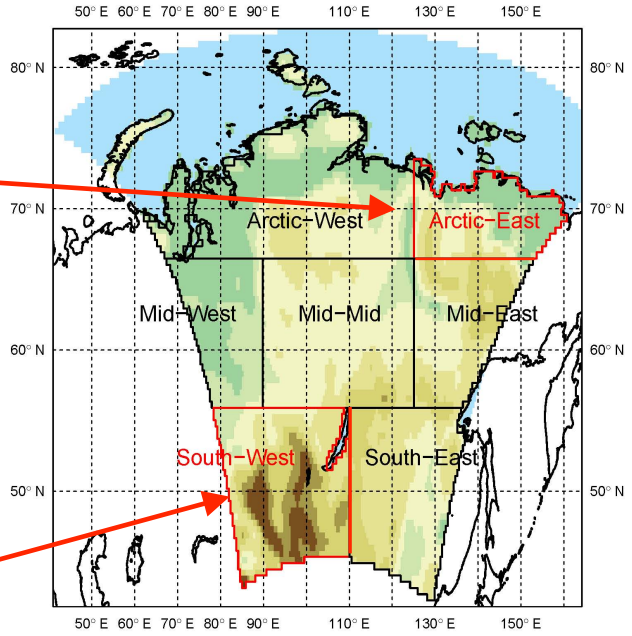


CCLM_NCEP − CRU
ERA40 − CRU
ERA−Int − CRU
NCEP − CRU

Bias Frost days

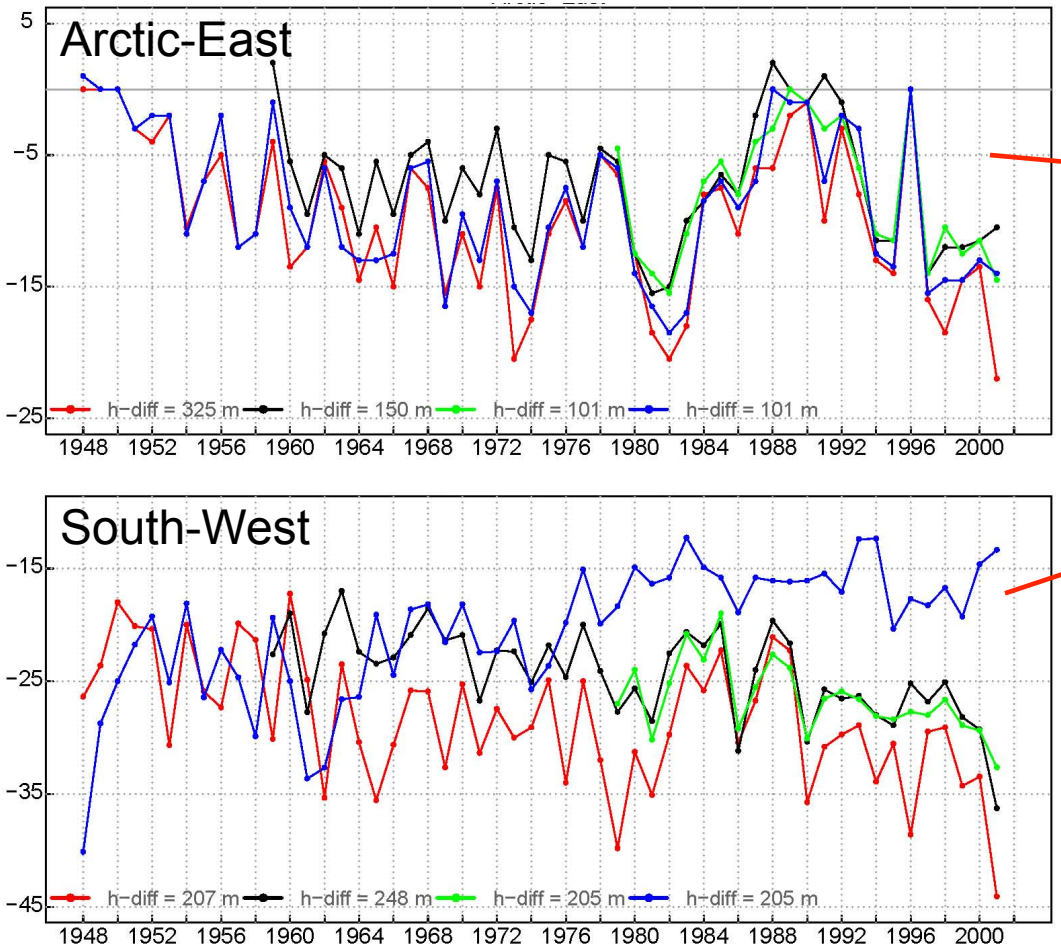
Frostdays: Annual count of days when daily minimum temperature < 0°C

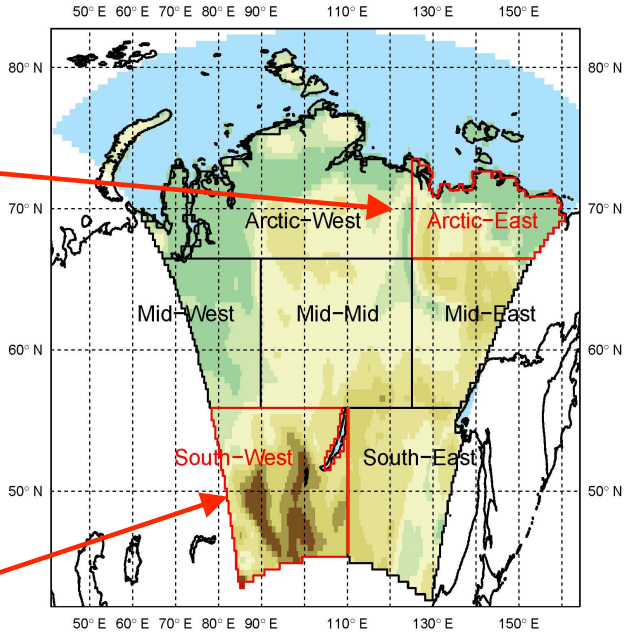




Bias Summer days

Summer days : Annual count of days when daily maximum temperature > 25 °C

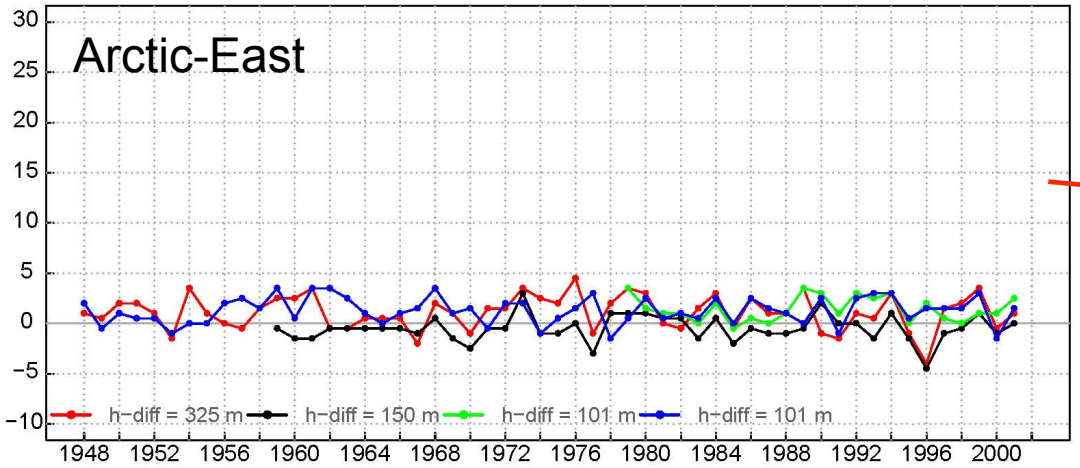


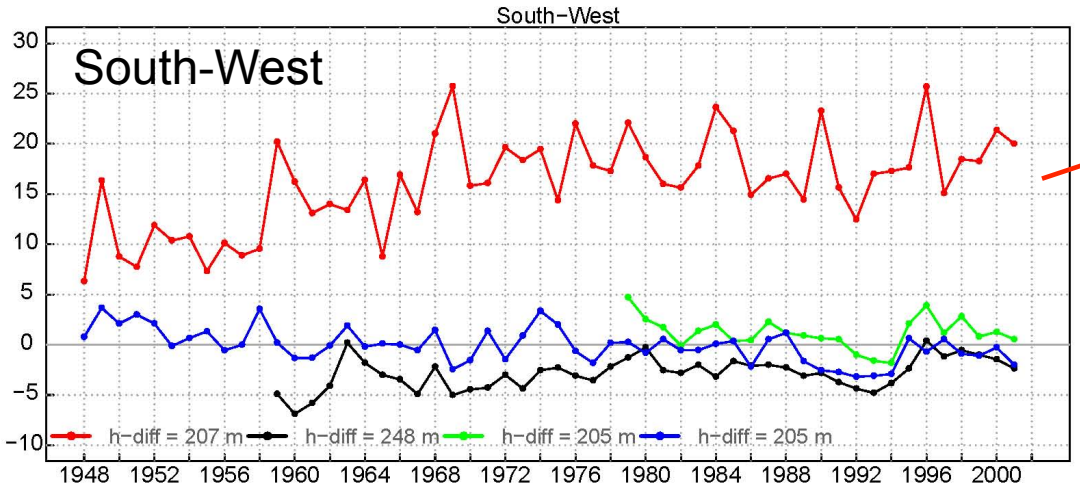


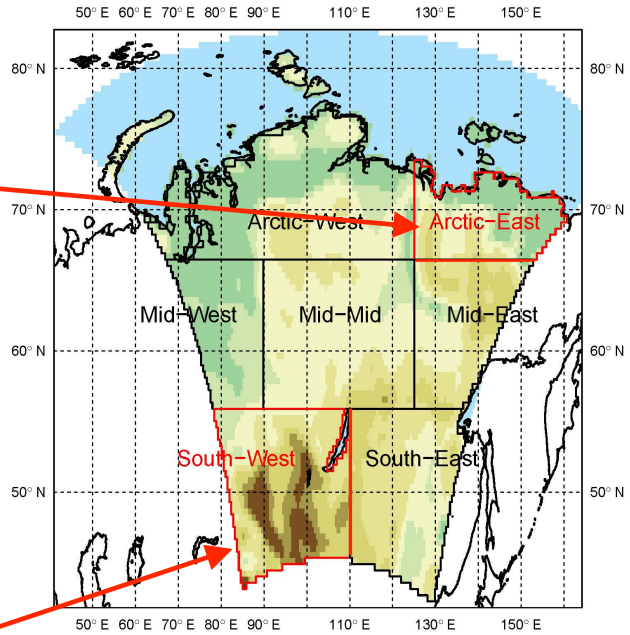
NCEP1 − ETCCDI
ERA40 − ETCCDI
ERA−Interim − ETCCDI
CCLM_NCEP1 − ETCCDI

Bias heavy precipitation days index

Daily precipitation sum > 10mm

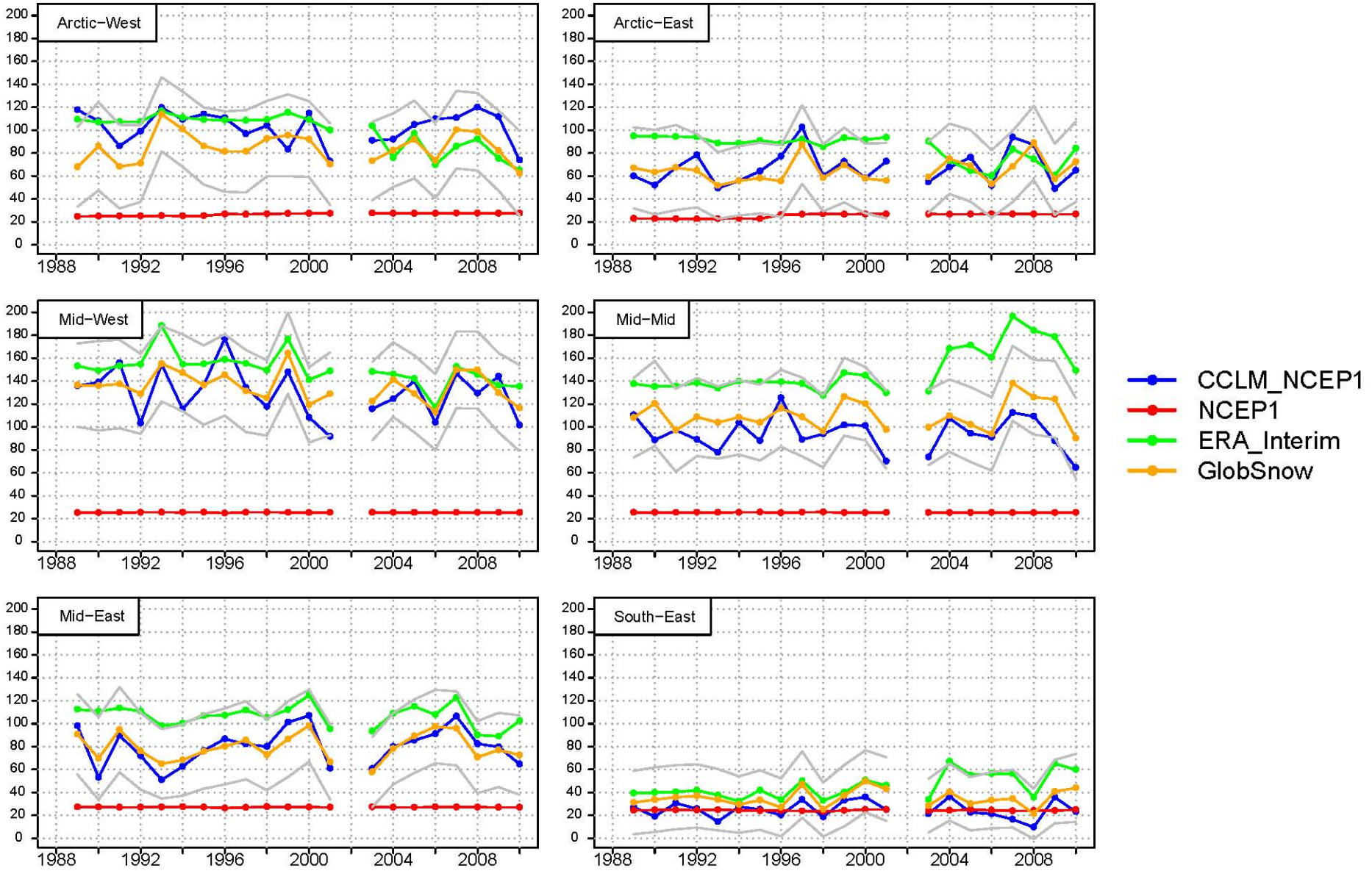




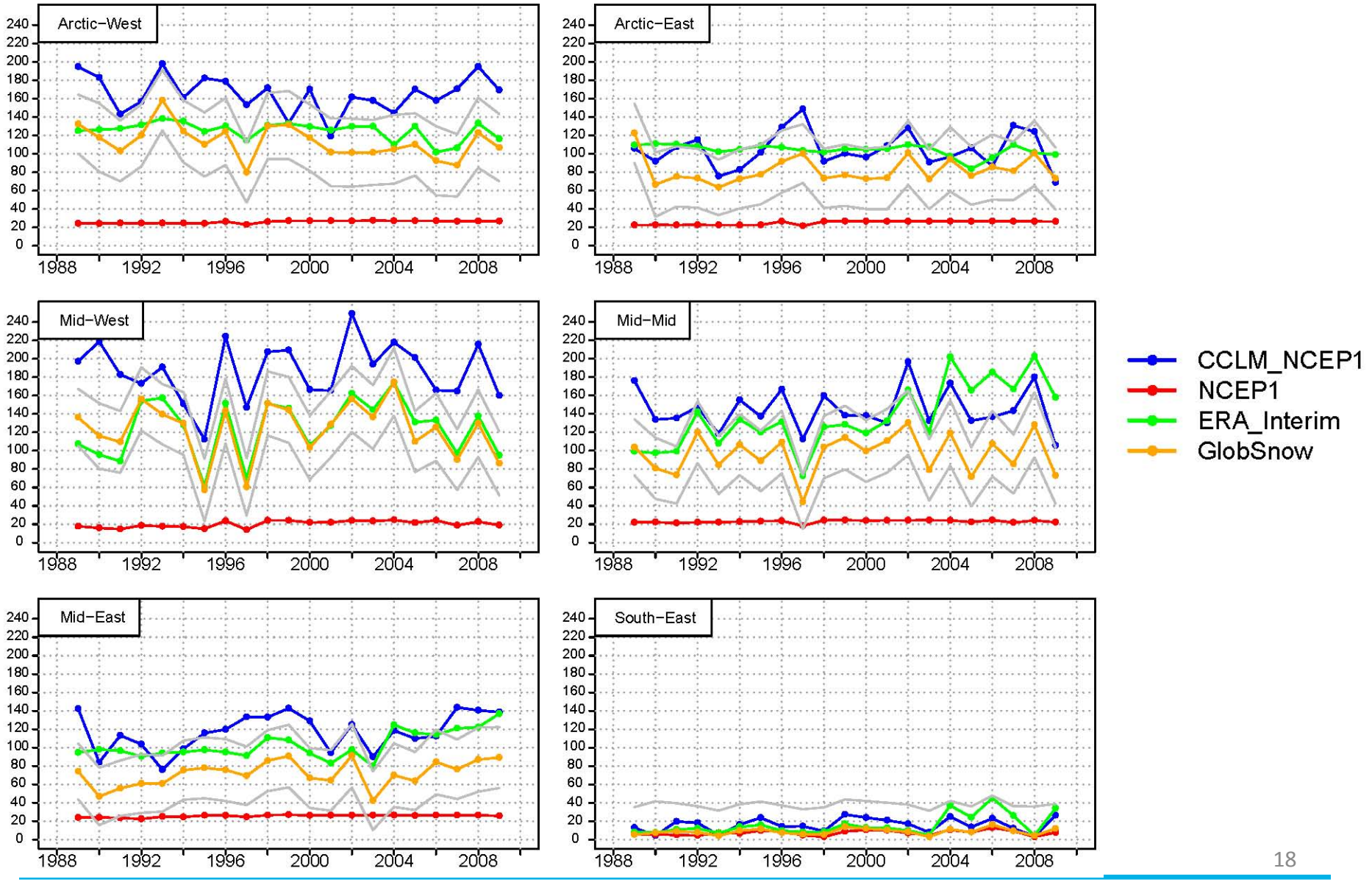


NCEP1 − ETCCDI
ERA40 − ETCCDI
ERA−Interim − ETCCDI
CCLM_NCEP1 − ETCCDI

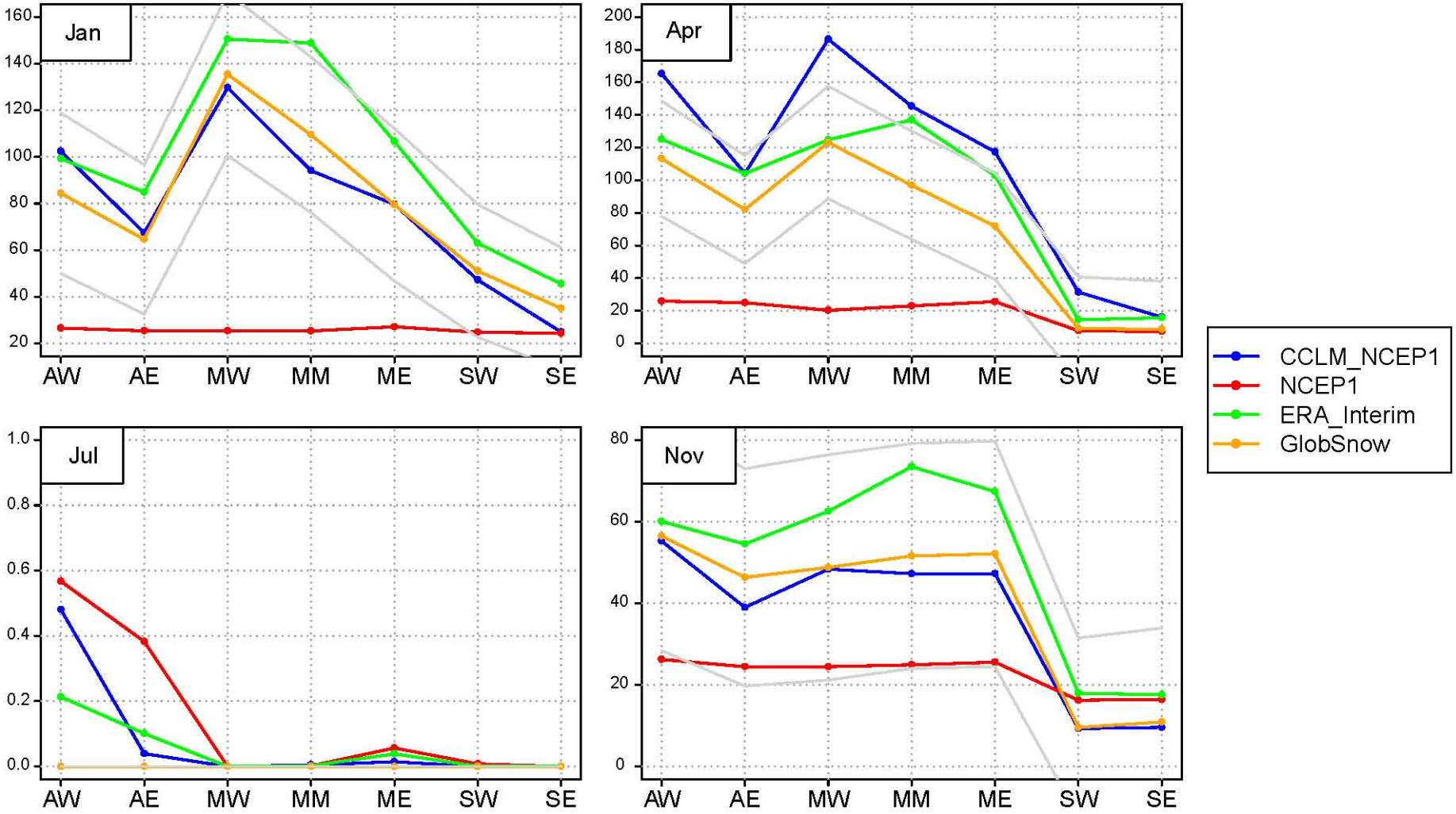
Snow water equivalent: January of 1988-2010



Snow water equivalent: April of 1988-2010



Multi-year monthly mean of SWE for subregions (1988-2010)



Summary & Outlook

Thank you for your attention

Summary

- Set up the RCM CCLM for Siberia
- Provide reconstruction of recent past climate (1948-2010)
- Assessment of added value
  - Added value for frost days, heavy precip. days especially in regions with strong orography
  - No added value in terms of summer days, only after 1980
  - Add realistic detail for SWE compared to NCEP1
- Assessment dependant on quality of observation data

Outlook

- Measures of skill (e.g. Brier skill score)
- More extreme indices and percentile based extreme values
- Consider added value in terms of variability, trends