

COMPARISON OF OBSERVED AND DIFFERENT REANALYSIS CLIMATIC CHARACTERISTICS OVER SIBERIA

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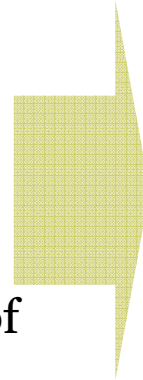


Objective

To assess reliability with which Reanalysis data describe observed climate change characteristics over Siberian region.

Siberia:

- vast territory (more than 10^7 km²)
- complicated geo- and bio-structure
- variety of climate zones
- inhomogeneous spatial distribution of anthropogenic impact in the region



Reliability and detailed meteorological information for analysis of climate dynamics in the region

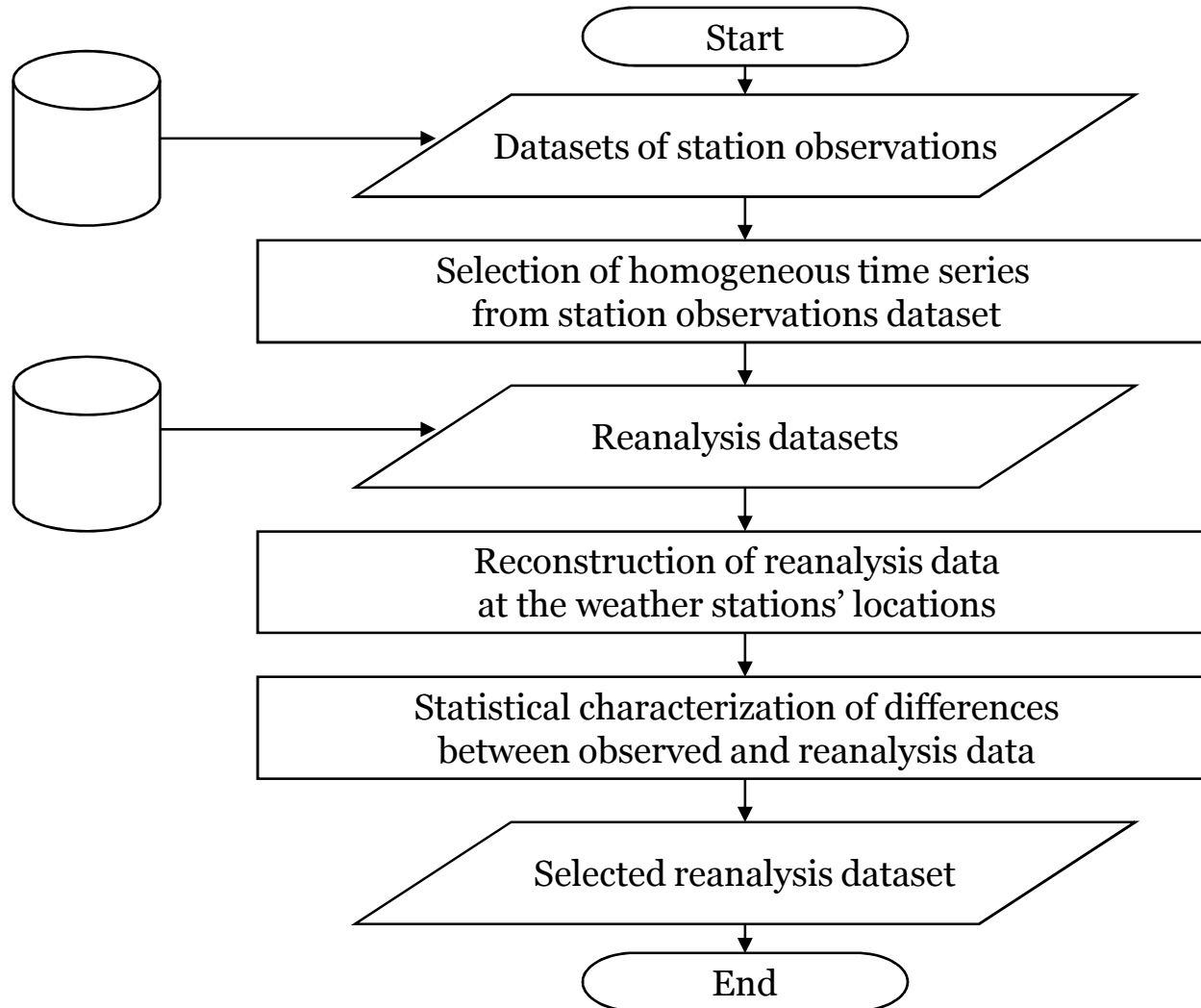
Datasets

<i>Dataset</i>	<i>Organization</i>	<i>Time period</i>	<i>Resolution</i>	<i>Assimilation</i>	<i>Data format</i>
<i>Station observation datasets</i>					
9092c Global Synop. Network (2095 stations)	RIHMI-WDC	1881-2001	8h(up to 1935) 6h(up to 1965) 3h (since 1966) 684 stations	-	ASCII
Dataset of daily temperature and precipitation (518 stations)	RIHMI-WDC/CDIAC	1881-2010	daily 221 stations	-	ASCII
<i>Modeled datasets</i>					
NCEP/NCAR Reanalysis	NCEP/NCAR	1951-2001	12 h., 2,5°×2,5° 17 pres.lev.	3D-Var	GRIB 1
NCEP/DOE Rean. AMIP II	NCEP/DOE	1973-2003	6 h., 2,5°×2,5° 17 pres.lev.	3D-Var	NetCDF
ECMWF ERA-40 Reanalysis	ECMWF	09.1957-08.2002	6 h., 2,5°×2,5° 23 pres.lev.	3D-Var	NetCDF
ECMWF ERA Interim Rean.	ECMWF	1979-present	6 h., 1,5°×1,5° surface	4D-Var	NetCDF
APHRODITE JMA Precipitation dataset	JMA	1951-2007	1 d. 0,25°×0,25° surface	Weight mean interpolation method	NetCDF

Content

- Technique for observed and modeled data comparison
- Results of data comparison for Siberian territory over the period 1979 - 2000:
 - air temperature
 - precipitation
 - atmospheric pressure
- Conclusion
- Plans

Data comparison technique



Data comparison technique

Station observations

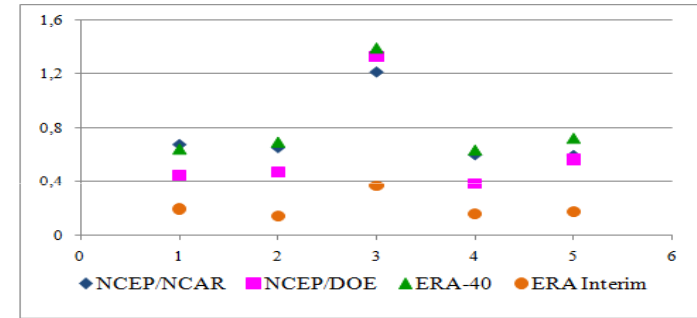
Selection criteria :

- Day:** gaps – 0,
terms - 4 (up to 1965)
/ 8 (since 1966);
- Month:** gaps – 3 days,
terms – 25 – 28 days;
- Year:** gaps – 0 month,
terms – 12 months;
- Time series:** gaps 0-5% elements,
terms - 95-100% elements.

Reanalysis dataset

Interpolation method selection:

- Methods:** bilinear (1), third-order polynomial (2),
inverse distance weighted (3),
modified Shepard's method (4),
kriging (5)



Data: reanalyses data

Period: 1989 – 2000

Area: 60°–90°N, 50°– 65°E

Characteristics: ME, RMSE

Data comparison

1. Mean error (ME) and root mean-square error (RMSE)
2. Correlation coefficient
3. Chi-square and Wilcoxon homogeneity criteria

Modified Shepard's method:

$$C(x, y) = \frac{\sum_{k=1}^N W_k(x, y) C_k(x, y)}{\sum_{i=1}^N W_i(x, y)}$$

$$W_k(x, y) = \left[\frac{(R_w - d_k)_+}{R_w d_k} \right]^3 (R_w - d_k)_+ = \begin{cases} R_w - d_k, & d_k < R_w \\ 0, & d_k \geq R_w \end{cases}$$

Task

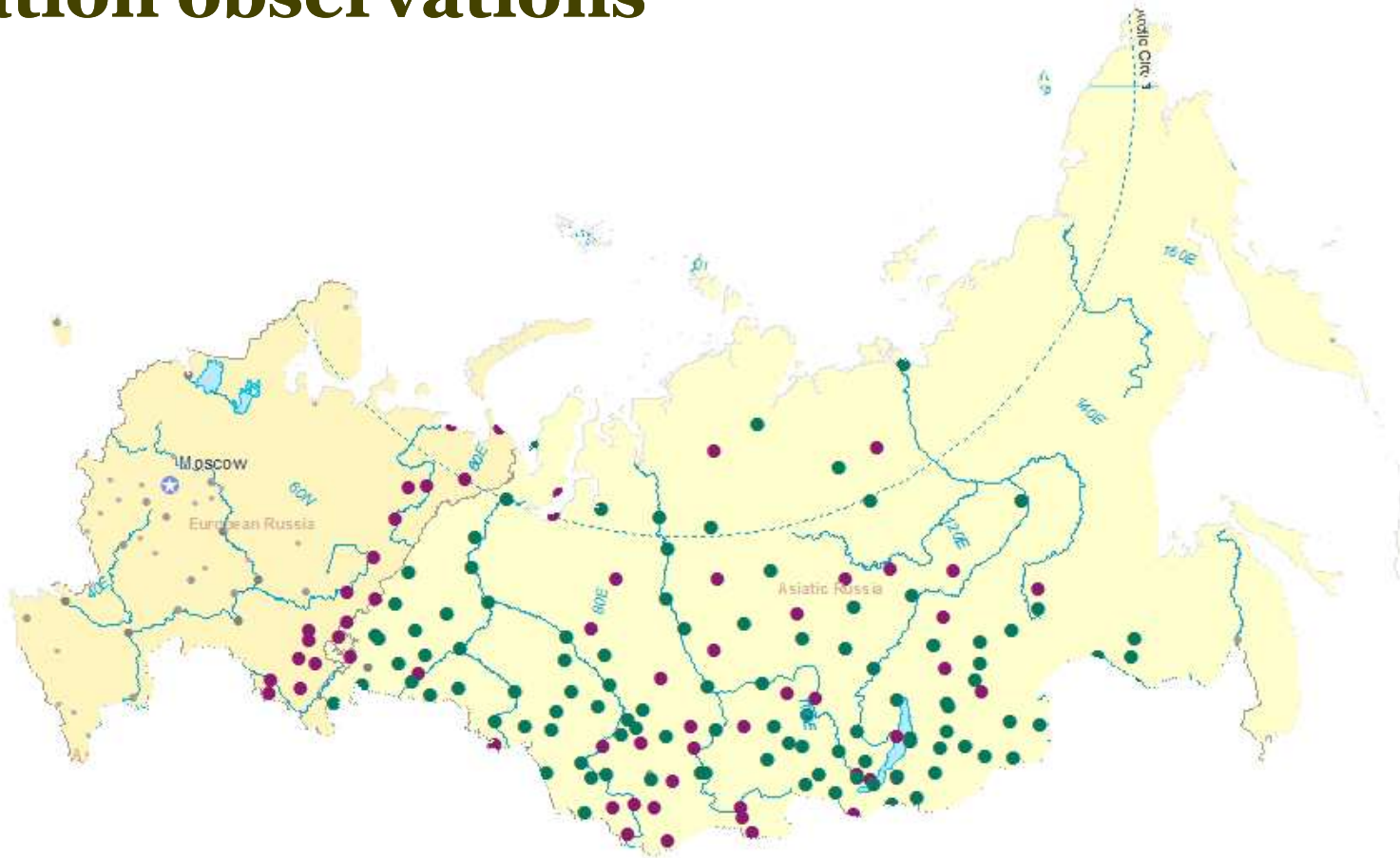
- **Area:** Siberia
- **Time period:** 1979 – 2000
- **Datasets:**
 - Stations: GSN 9092c, Daily temperature and precipitation dataset
 - Reanalyses: NCEP/NCAR, NCEP/DOE AMIP II, ECMWF ERA-40, ECMWF ERA Interim
 - Interpolation fields: APHRODITE JMA

To select the modeled datasets of:

- air temperature,
- precipitation,
- atmospheric pressure

for detailed spatiotemporal characterization of regional climate dynamics.

Station observations



164 time series of daily surface air temperature and precipitation from **RIHMI-WDC/CDIAC dataset** of 518 time series over Russia

103 time series of atmospheric pressure from **Global Synoptic Network 9092c dataset** (green points)

Air temperature data comparison

□ Station data:

164 time series of daily surface air temperature from **RIHMI-WDC/CDIAC dataset**

□ Reanalysis data:

- NCEP/NCAR
- NCEP/DOE AMIP II
- ECMWF ERA-40
- ECMWF ERA Interim

□ Time and spatial domain:

- Time period: 1979 – 2000
- Area: Siberia (50° – 75° N, 55° – 130° E)

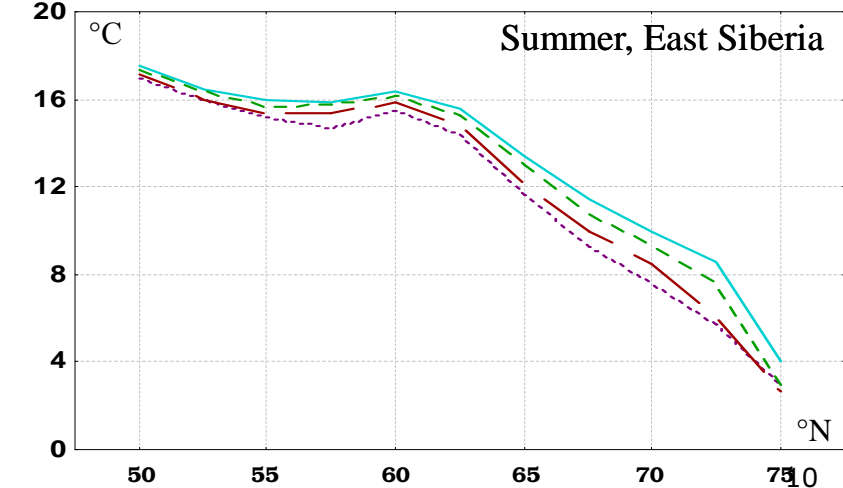
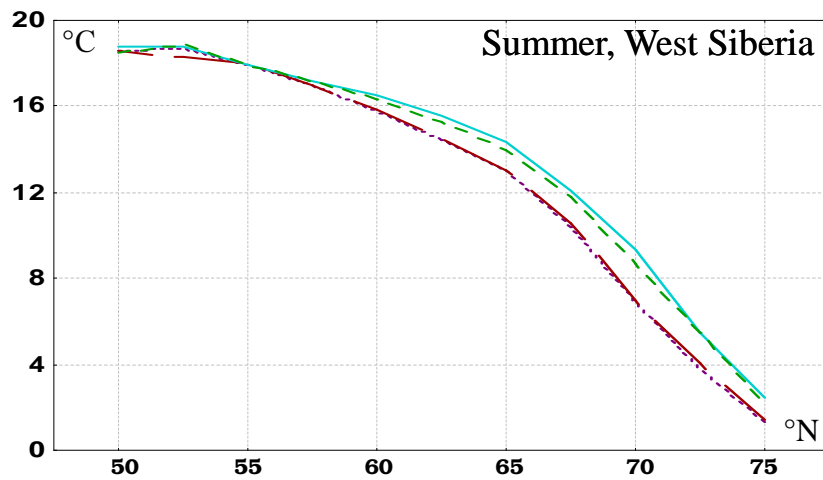
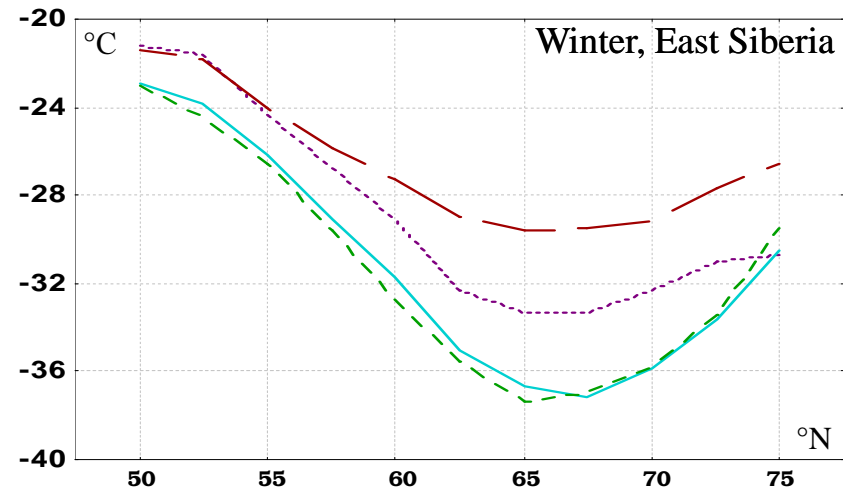
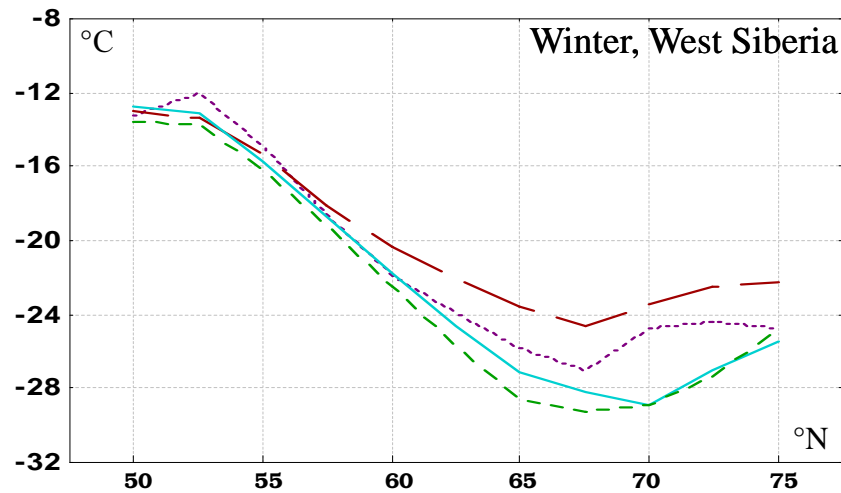
□ Climatic characteristics:

- Annual mean air temperature
- Seasonal mean air temperature

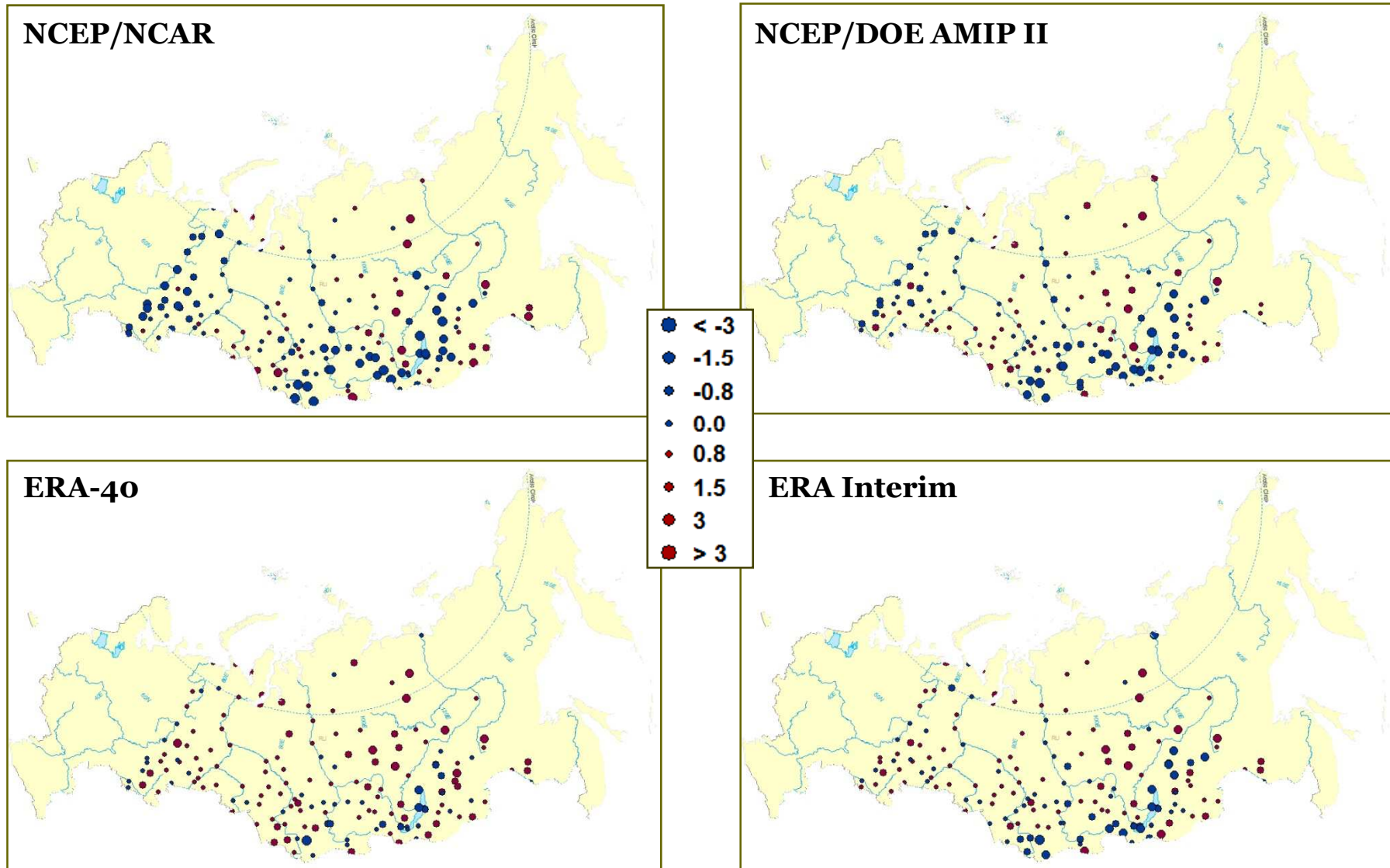
Reanalyses data comparison

Seasonal mean air temperature (°C) averaged by latitude. 1979-2000.

Legend:
- - - NCEP/NCAR (purple dotted)
- - - ERA INTERIM (green dashed)
- - - NCEP/DOE (red solid)
- - - ERA-40 (cyan solid)



Reanalysis data vs. station observations



Difference of annual mean temperature values calculated based on reanalyses data and station observation for the period 1979 – 2000.

Precipitation data comparison

□ Station data:

164 time series of daily precipitation from **RIHMI-WDC/CDIAC dataset**

□ Reanalysis data:

- NCEP/NCAR
- NCEP/DOE AMIP II
- ECMWF ERA-40
- ECMWF ERA Interim
- APHRODITE JMA

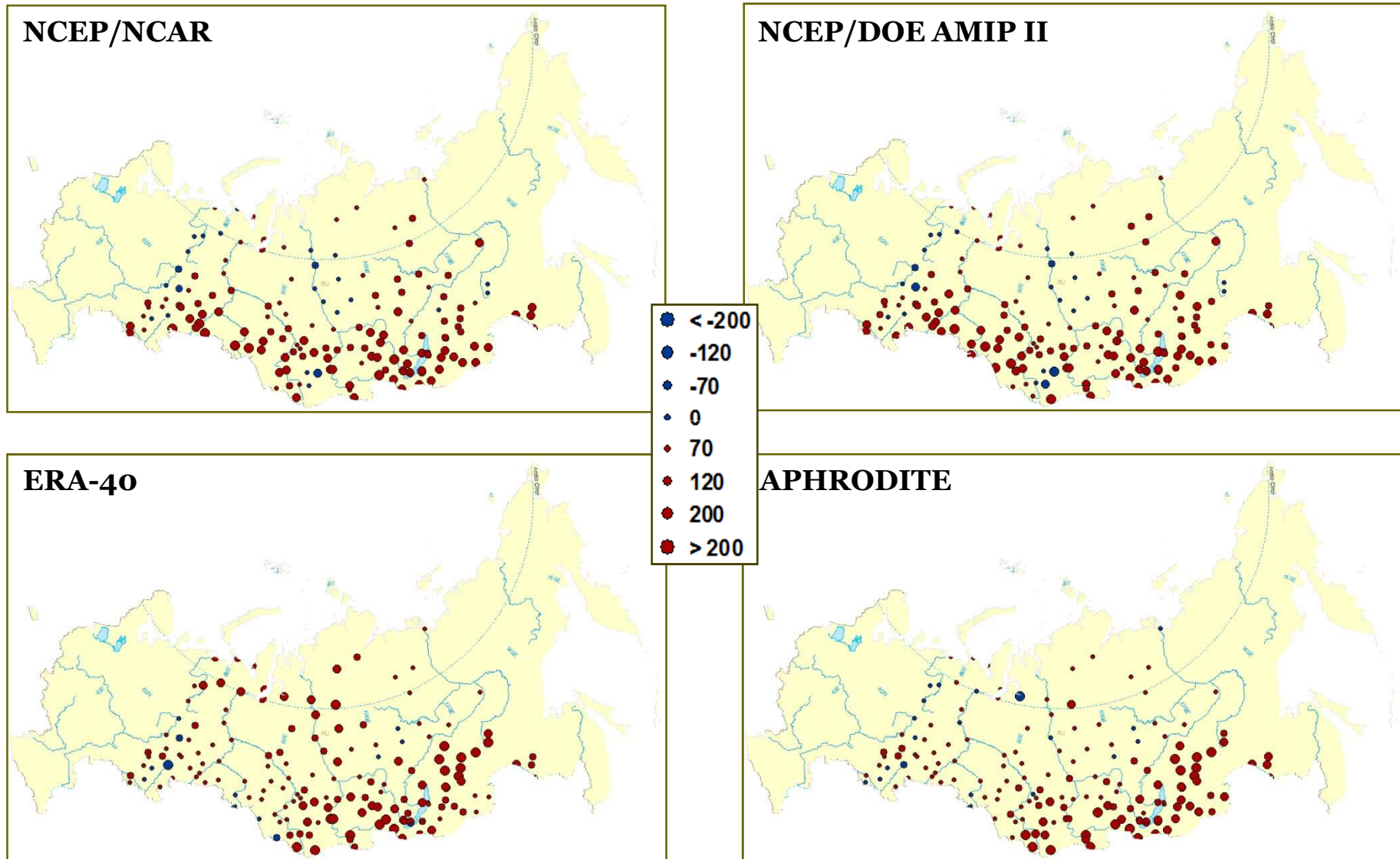
□ Time and spatial domain:

- Time period: 1979 – 2000
- Area: Siberia 50° – 75° N, 55° – 130° E

□ Climatic characteristics:

- Annual precipitation
- Warm (May-October) and cold (November-April) seasonal precipitation

Reanalysis data vs. station observations



Difference of annual precipitation sums calculated based on reanalysis data and station observation for the period 1979 – 2000.

Atmospheric pressure data comparison

□ Station data:

103 time series of atmospheric pressure from *Global Synoptic Network 9092c dataset*

□ Reanalysis data:

- NCEP/DOE AMIP II
- ECMWF ERA Interim

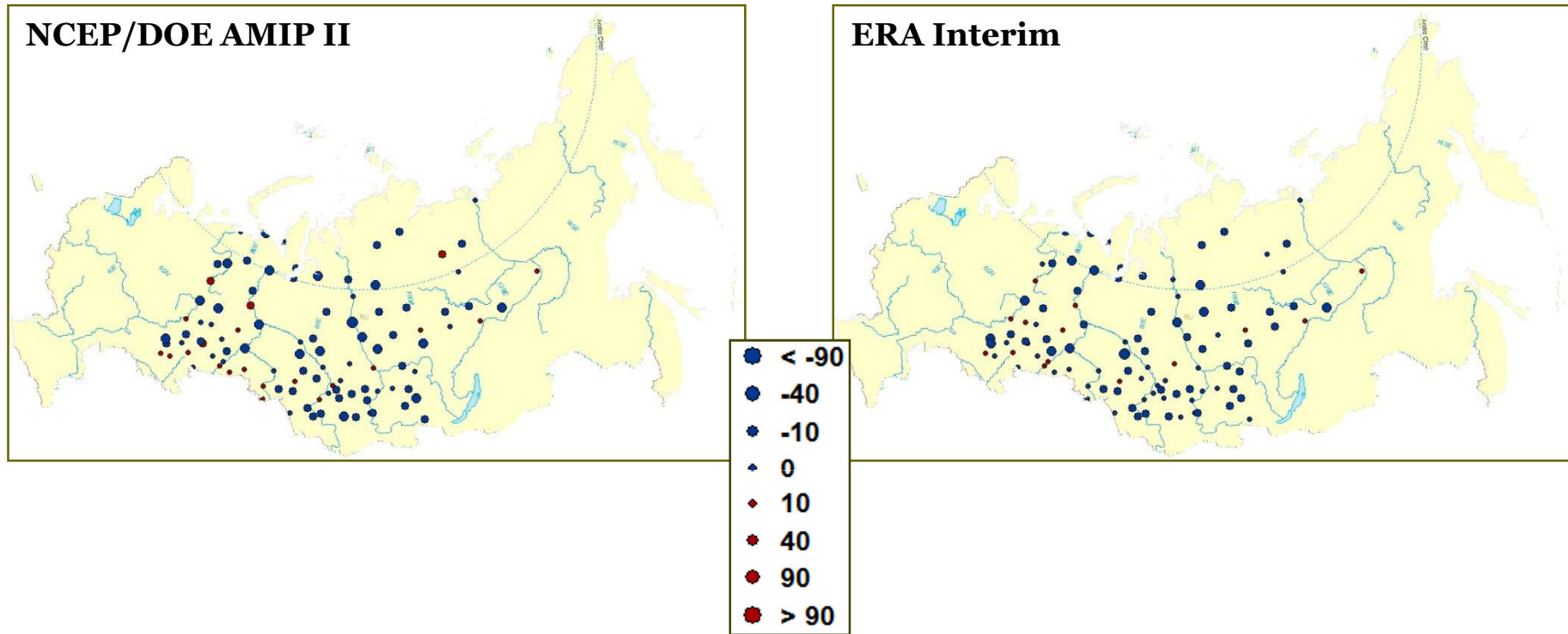
□ Time and spatial domain:

- Time period: 1979 – 2000
- Area: Siberia 50° – 75° N, 55° – 130° E

□ Climatic characteristics:

- Annual mean value of atmospheric pressure

Reanalysis data vs. station observations



Difference of annual mean atmospheric pressure value calculated based on reanalysis data and station observation for the period 1979 – 2000.

Conclusion

- It was shown that the following reanalysis datasets are reproduced the statistics of observed climate features in Siberia more accurately:
 - ERA Interim – for air temperature
 - APHRODITE JMA – for precipitation amount
 - ERA Interim – for atmospheric pressure.
- Obtained error maps can help researchers to select proper datasets for regional climate studying and correctly interpret investigation results.

Plans

- To perform similar analysis for:
 - datasets generated by high resolution global model running.
 - Regional meteorological model outputs.



Thank you for your attention!