# Quality assessment of surface wind speed reproduction by the new detailed model COSMO-CLM hindcast in the Russian Arctic.

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Considering the rapid changes in the Arctic climate, the goal of the work was to assess detailed climate changes, primarily by wind speed, in the Russian Arctic according to COSMO-CLM Russian Arctic hindcast.

As part of the work, the following tasks were set:

- Assessment of wind characteristics from a model archive based on station and satellites data;
- Assessment of trends and other statistical characteristics on daily, monthly and long-term scales, average and extreme values;
- Investigation of regional features of distribution and trends of wind speed in the Russian Arctic based on high-resolution model archive data, their comparison with existing estimates, as well as refinement of estimates.

## Methods

For comparison, the model grids closest to the stations were found according to the coordinates. Then at chosen points the statistics were calculated. To study the extreme values of meteorological parameters, the quantile method was used. All calculations were carried out using the MatLab software package and NCL.

## Data Sources

### 1. COSMO-CLM Russian Arctic hindcast

- Covering the period from 1980 to 2016
- Spatial resolution of ~ 12 km
- Time resolution – 1 hour
- Includes about a hundred different hydrometeorological characteristics such as temperature, wind speed components, precipitation, atmospheric pressure etc. at both surface and model levels (50 levels)

The wind speed archive data was downloaded from the figshare repository [https://figshare.com/collections/Arctic_COSMO-CLM_reanalysis_all_years/5186714]

Currently, data are available from 1980 to 2008, 2010–2016 (36 years).

### 2. Station data

- Data of Roshydromet from the site meteo.ru
- 95 stations within the model domain
- From 1960 to 2016
- 3-hourly data

### 3. Satellite data

- Data captured by Synthetic Aperture Radar (SAR) on board Radarsat and Sentinel satellites
- Spatial resolution of ~ 2,5 km
- 31 cases for 2014 – 2016
- Novaya Zemlya area

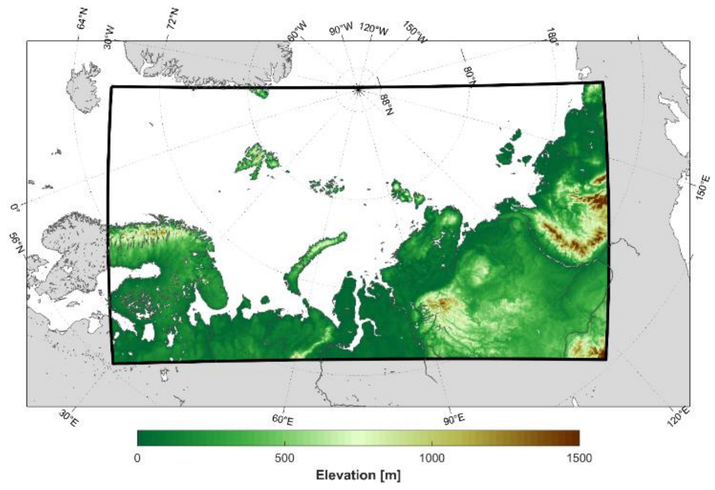


**Figure 1.** Scheme of a model domain with a grid step of ≈12 km used to create the COSMO-CLM Russian Arctic hindcast. Black rectangle - borders of the domain. [Platonov, Varentsov, 2021].

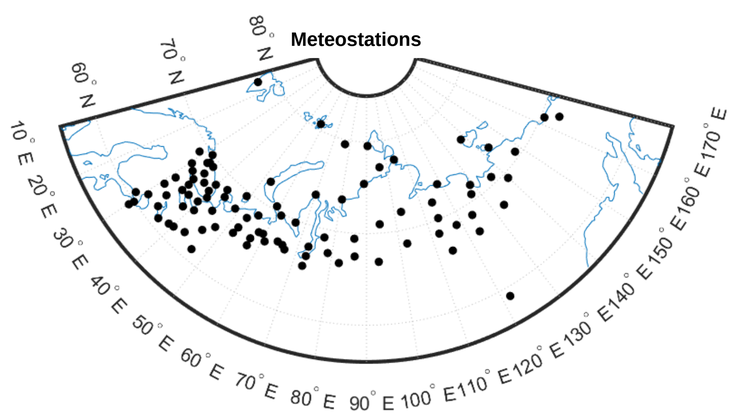


**Figure 2.** The location of the meteorological stations used in this work.

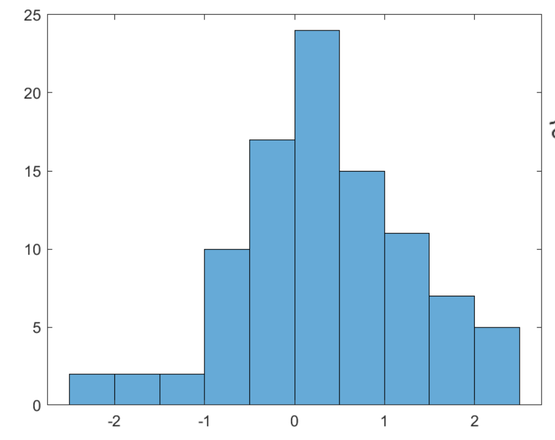

**Figure 3.** Distribution of mean errors, m / s.

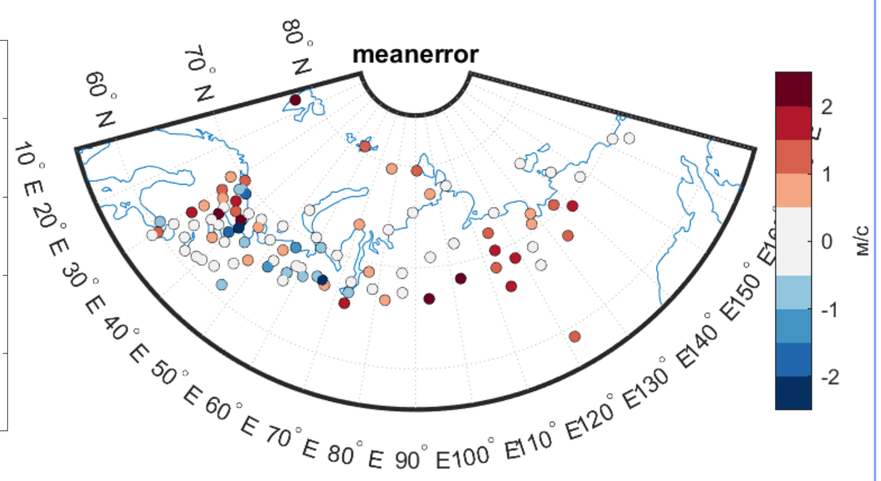


**Figure 4.** Map of mean errors of wind speed, m / s.

Large proportion of errors are associated with the overestimation of the wind speed by the model archive.
Overestimation by the model archive of wind speeds is indeed observed more often than underestimation.

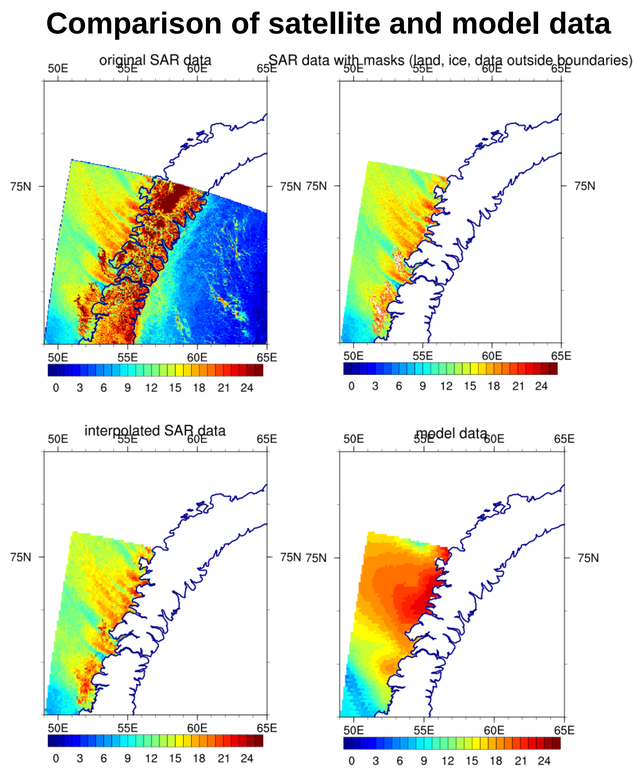


**Figure 6. I**nterpolation of satellite and model data to a common regular grid – 07.12.2014.

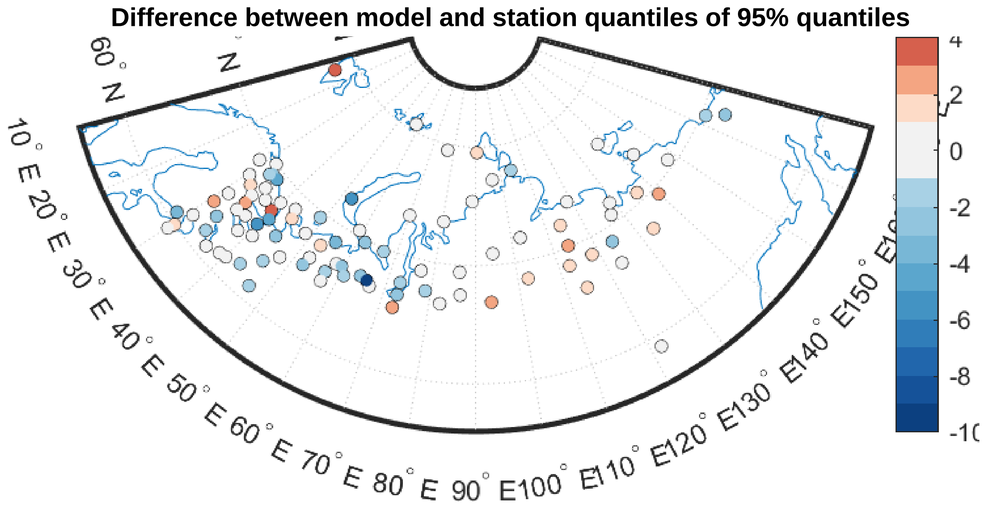


**Figure 5.** Map of the difference between model and station wind speed data for the 95% quantile.

The spatial distribution of quantile values is well represented on both model and station data.
The extreme speeds according to the model archive data are generally underestimated, compared with the station data.

## Conclusions:

- The research showed that the average wind speed is well reproduced by the COSMO-CLM Russian Arctic hindcast. However, there are stations where the model and the station data are not equal: in most of these stations hindcast is overestimating wind speed.
- The spatial distribution of the extreme values is well displayed on both model and station data.
- The study of the quantile difference showed that, in contrast to the average wind speed, the extreme speeds according to the hindcast data are underestimated - the error ranges from 2 to 10 m / s.
- In comparison with satellite data, due to coarse resolution, the model data overestimate the extreme values of wind speed.

## References:

- Vladimir Platonov and Mikhail Varentsov. Introducing a new detailed long-term COSMO-CLM hindcast for the Russian Arctic and the first results of its evaluation. Atmosphere, 12(3):350, 2021.