ААНИИ

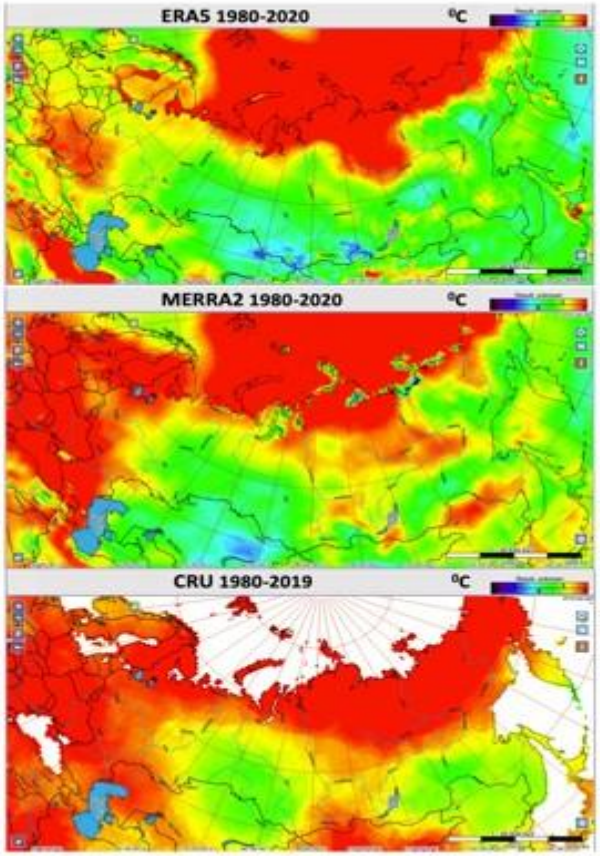
Арктический и антарктический
научно-исследовательский институт

Arctic and Antarctic Research Institute, Saint Petersburg, Russia

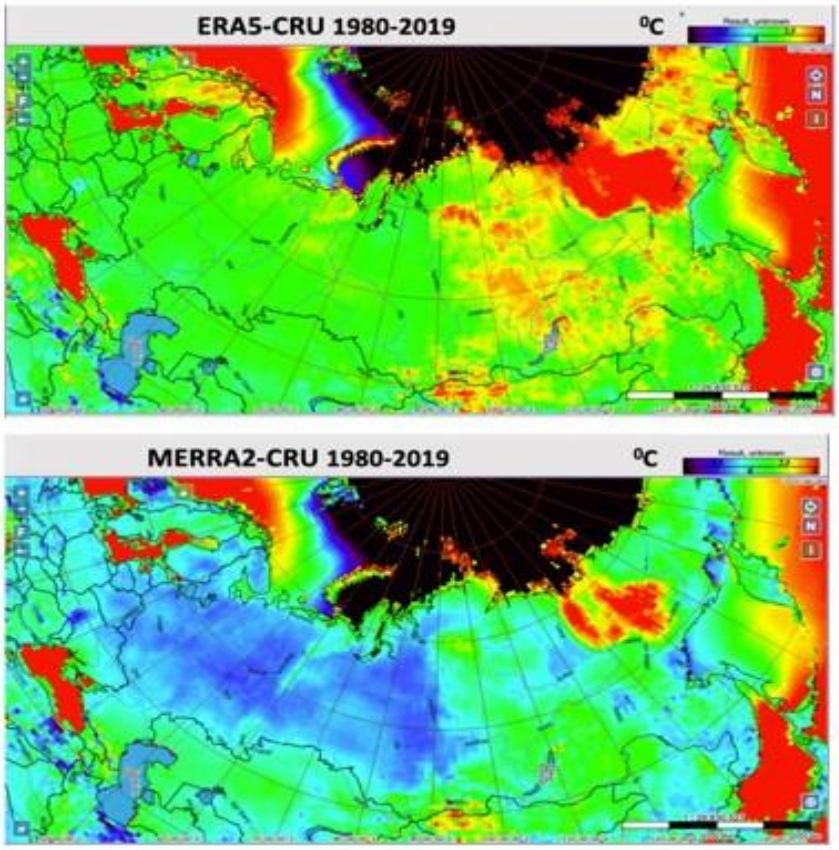
Monitoring of the Great Arctic Rivers discharge and its linkage with precipitation and evaporation

Trunin A.A., Shiklomanov A. I., Volkova D. D.

Long-term trends in air temperature over the territory of the Arctic Ocean basin in climate re-analyses

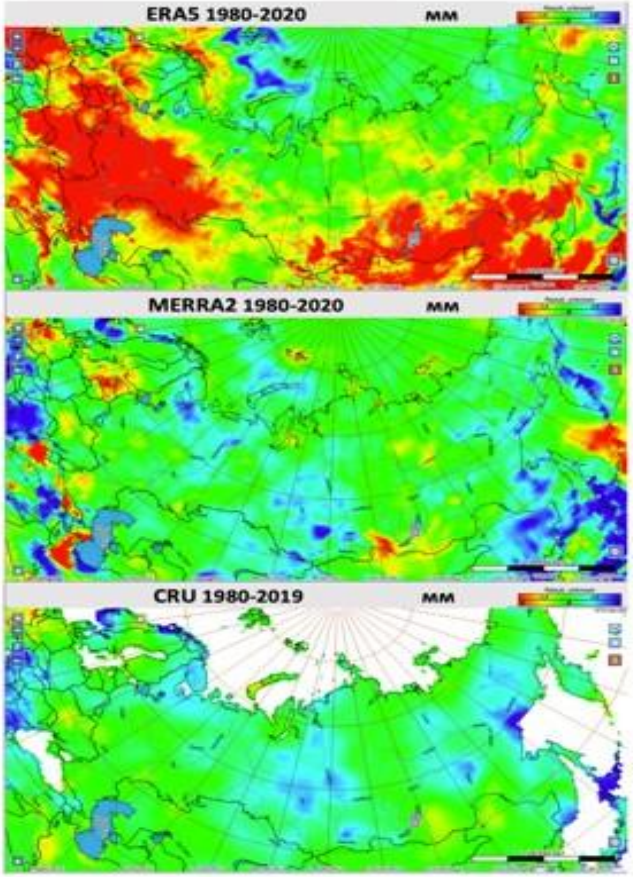


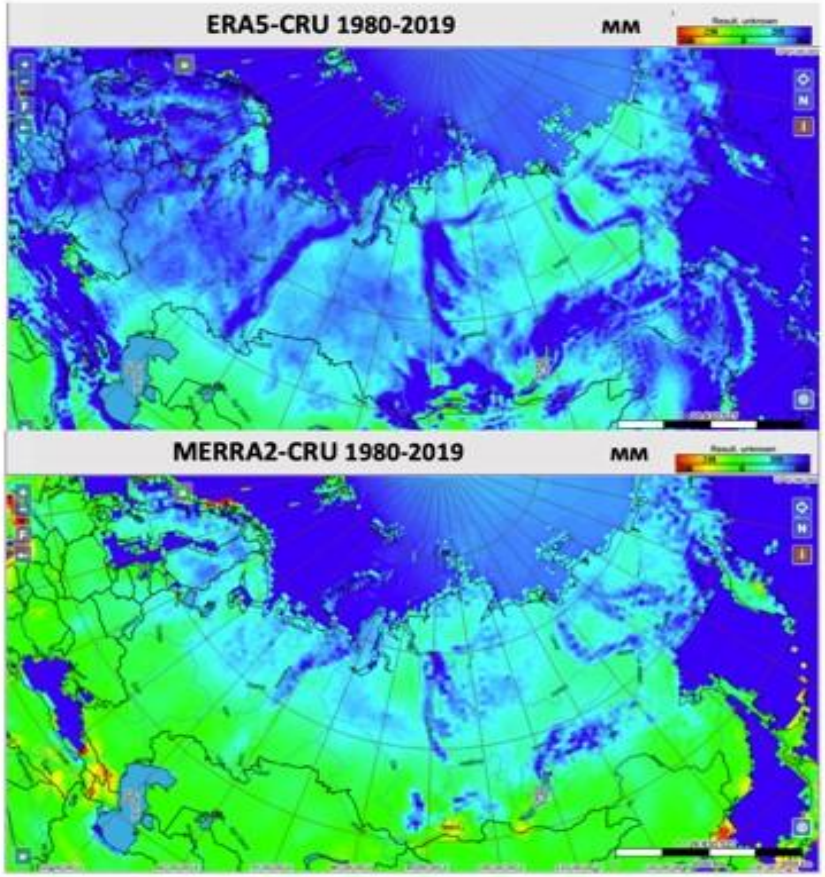
Change in mean annual air temperature based on various climate data, calculated from the slope of a linear trend from 1980 to 2020



The difference between the average annual air temperature for the period 1980-2019 according to re-analyses and fields built on the basis of ground-based meteorological observations (CRU)

Reliability of precipitation definition in climate reanalyses

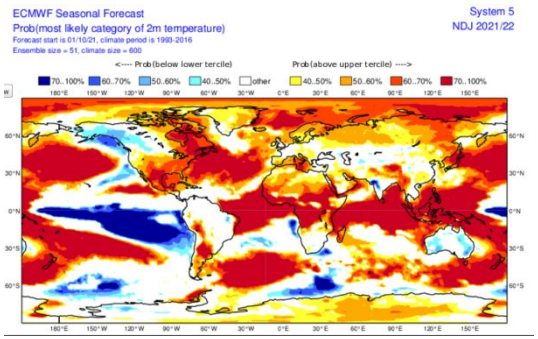




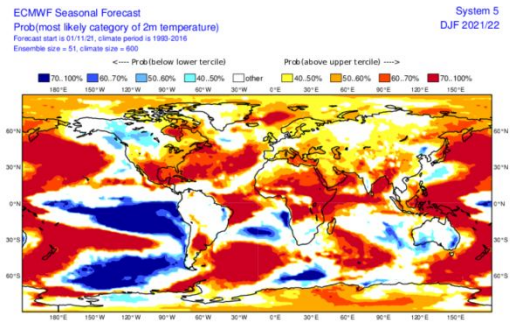
Slope of a linear trend in annual precipitation based on various climate data from 1980 to 2020, and to 2019 for CRU

The difference between the mean annual air temperature for the period 1980-2019 according to re-analyses and fields **taken** on the basis of ground-based meteorological observations (CRU) (CRU data are presented only for land).

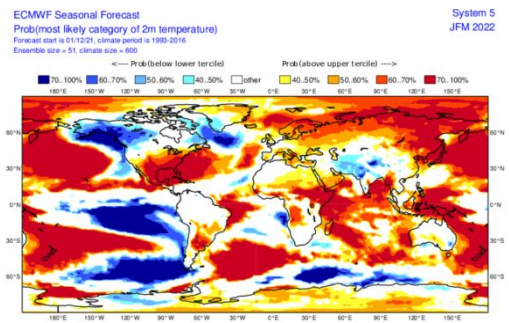
ERA5 2m temperature: Forecast type – tercile summary



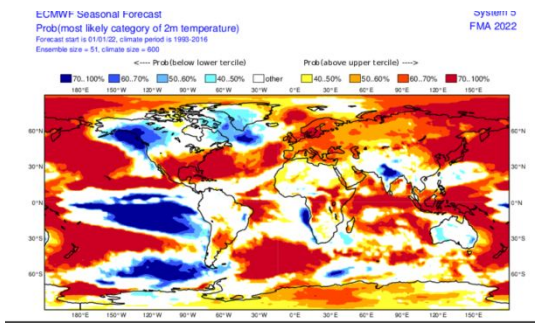
Nov 2021



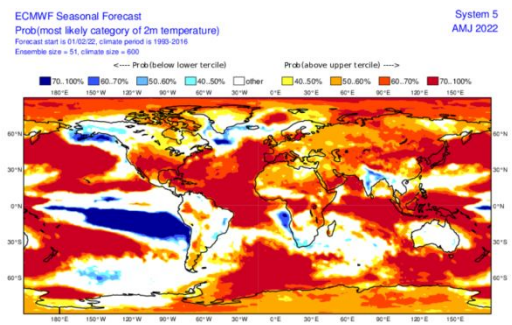
Dec 2021



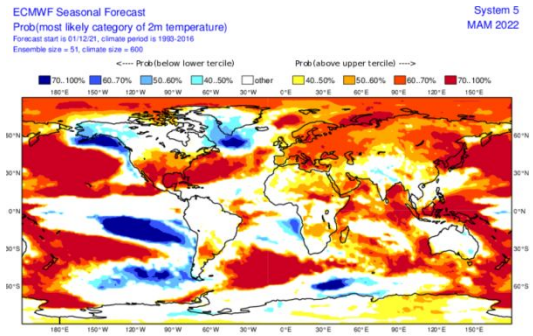
Jan 2022



Feb 2022



Apr 2022

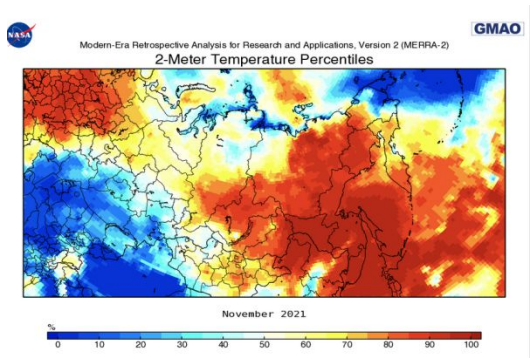


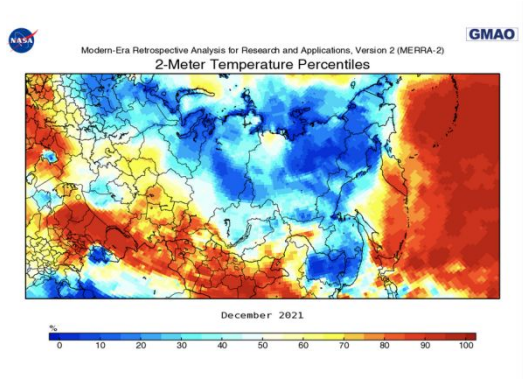
Mar 2022

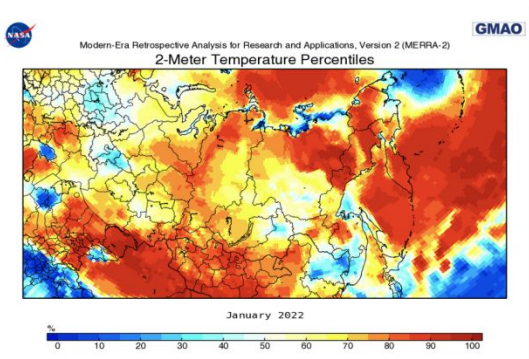
Seasonal forecast charts

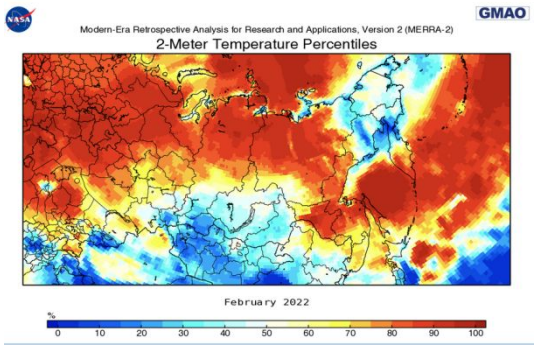
Anomalies are calculated from the 51 member model forecast distribution relative to the model climatological PDF calculated from a set of 25 member ensemble re-forecasts covering the 24 year period 1993-2016. For each forecast product several verification scores are also provided, calculated from the full 36 year period of the re-forecast 1981-2016

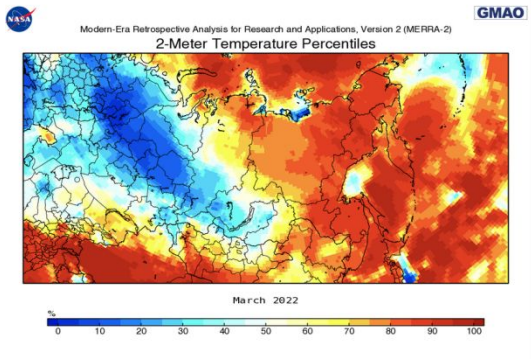
MERRA-2 Climate Statistics 2-Meter Temperature Percentiles





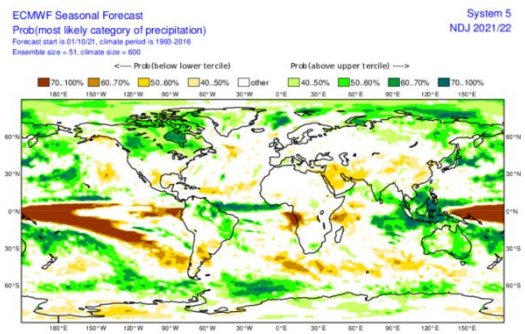




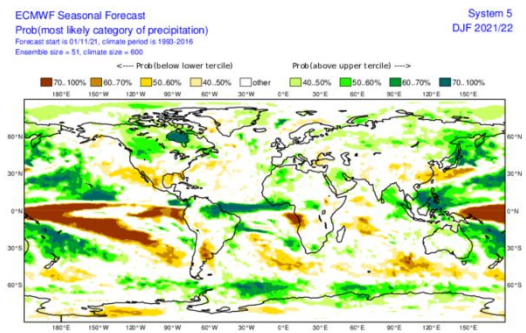


T2M PCNTL The percentile at which the monthly mean 2 m temperature falls in MERRA-2

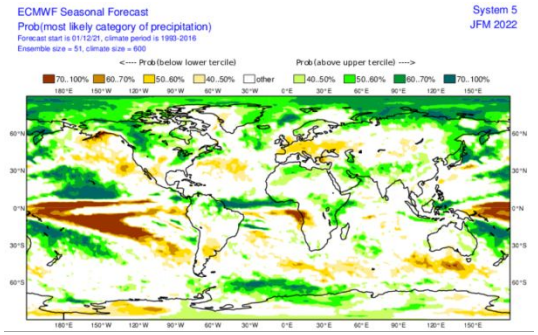
ERA5 2m precipitation Forecast type – tercile summary



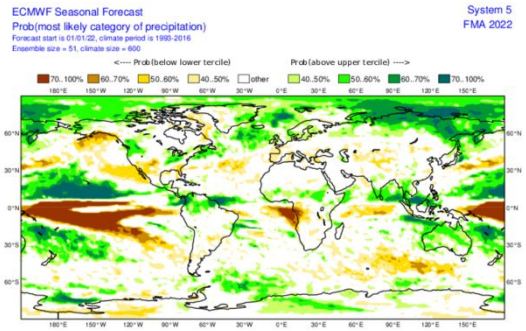
Nov 2021



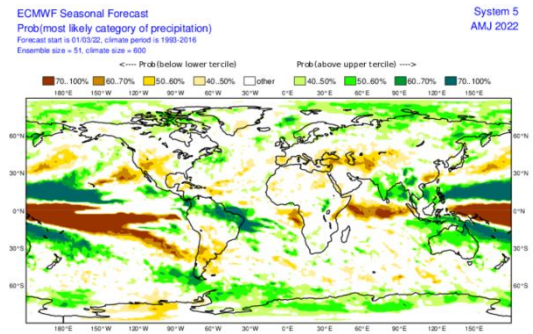
Dec 2021



Jan 2022



Feb 2022



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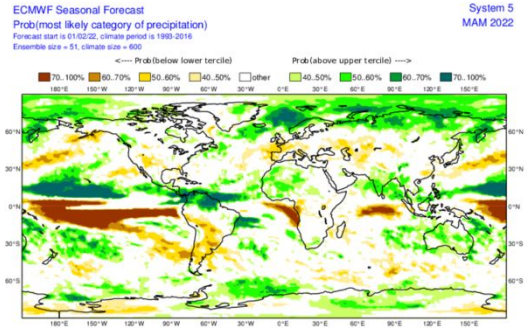

Mar 2022

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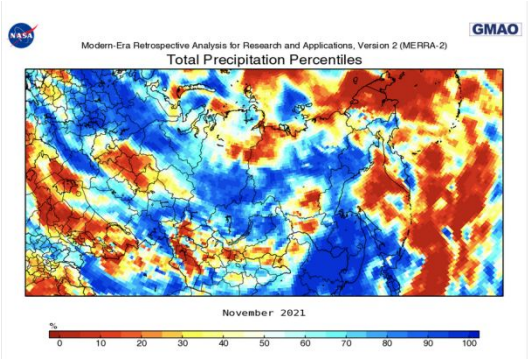
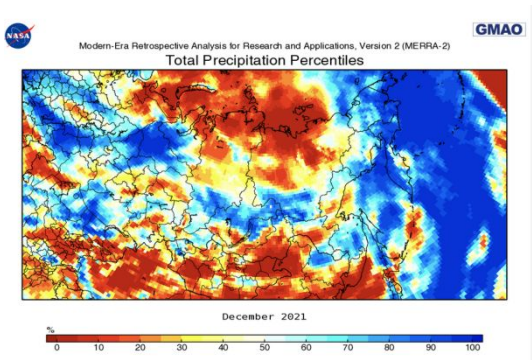
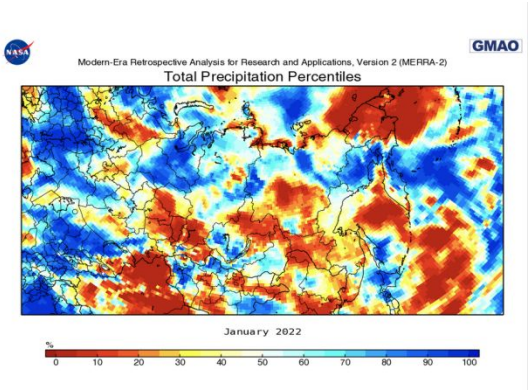
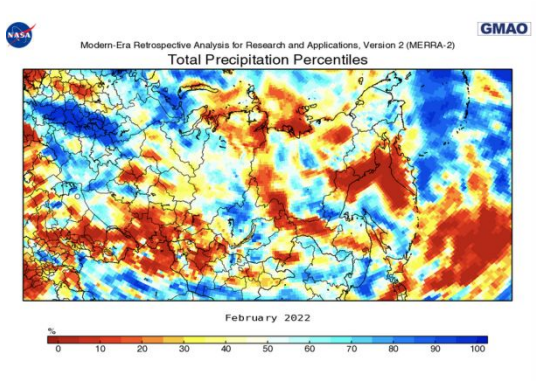
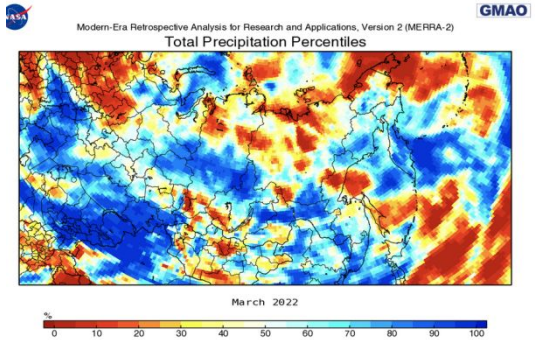
MERRA-2 Climate Statistics
Total Precipitation Percentiles





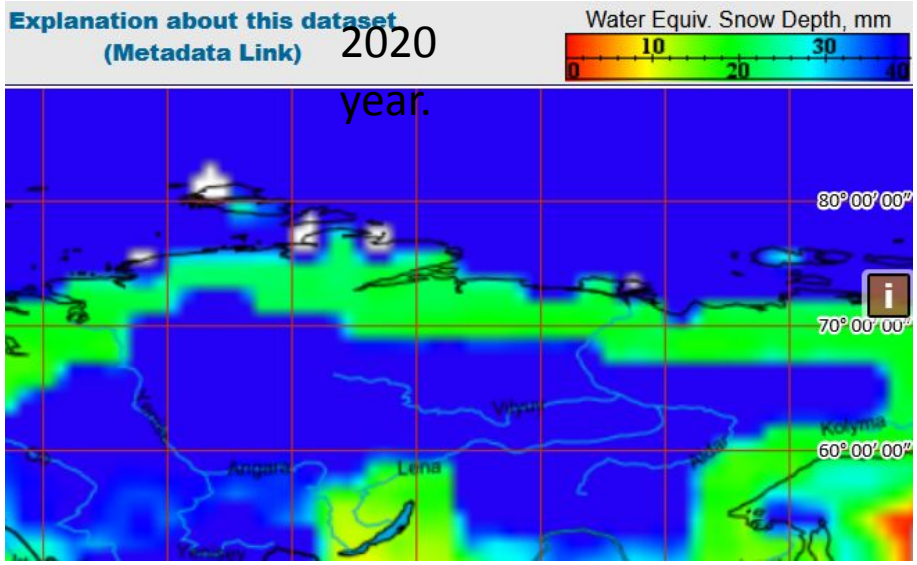


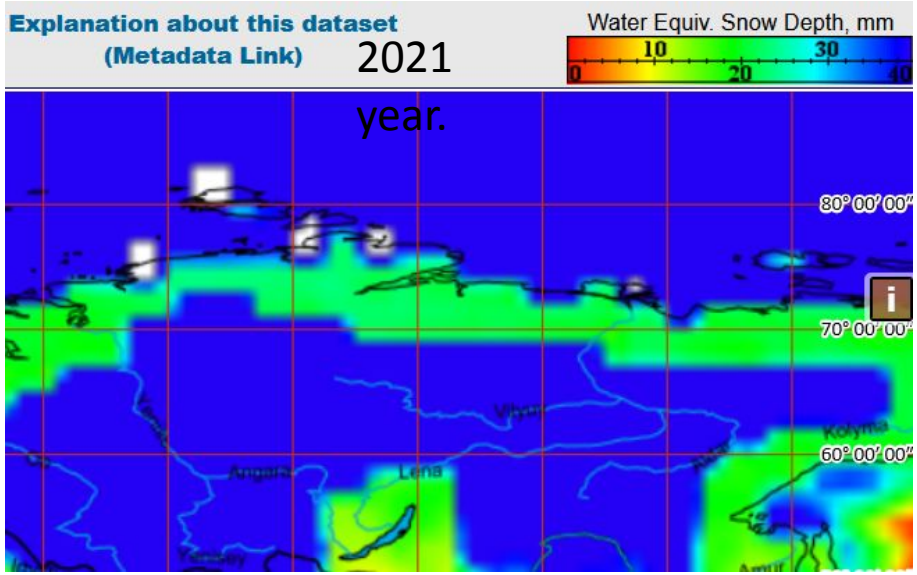




Precip PCNTL The percentile at which the monthly mean precipitation falls using the model generated precipitation in MERRA-2

NCEP Water Equivalent - snow accumulation depth



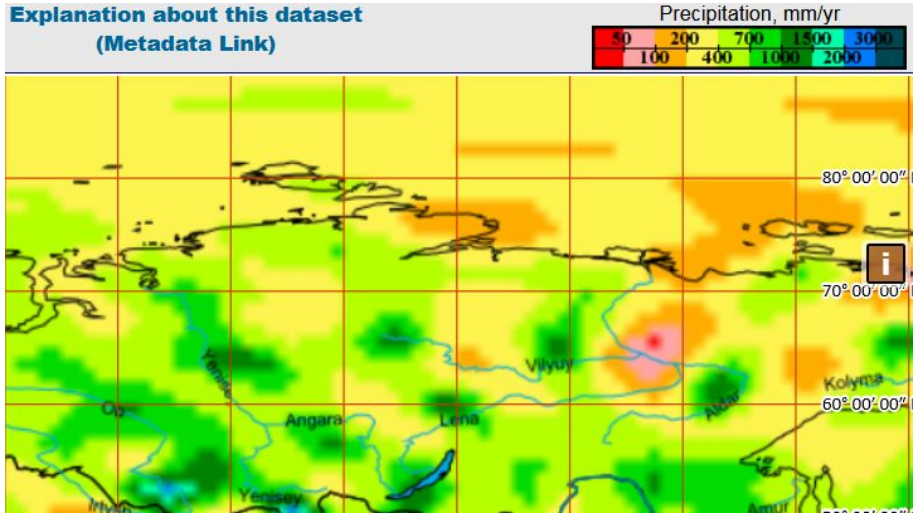


This slide shows snow accumulation depth maps

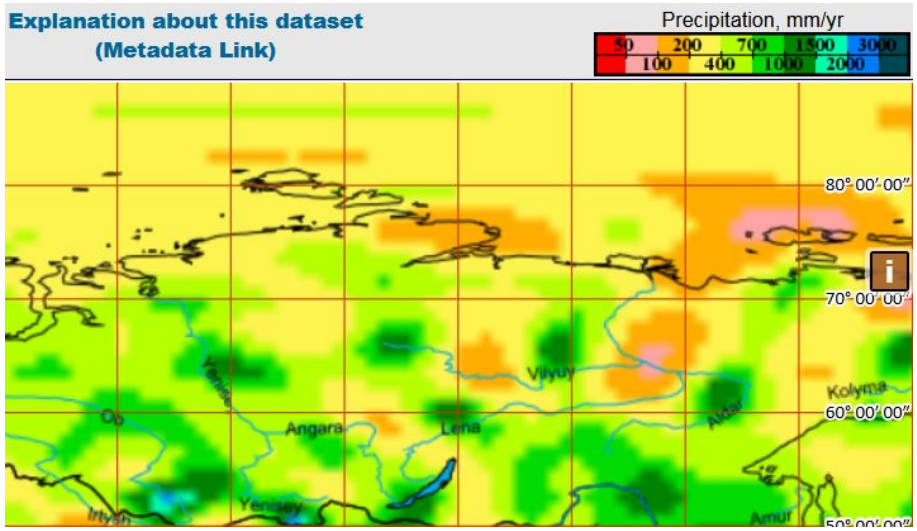
Developed by Alexander Prusevich (AKA Proussevitch) and Stanley Glidden

NCEP Precipitation

2020



2021

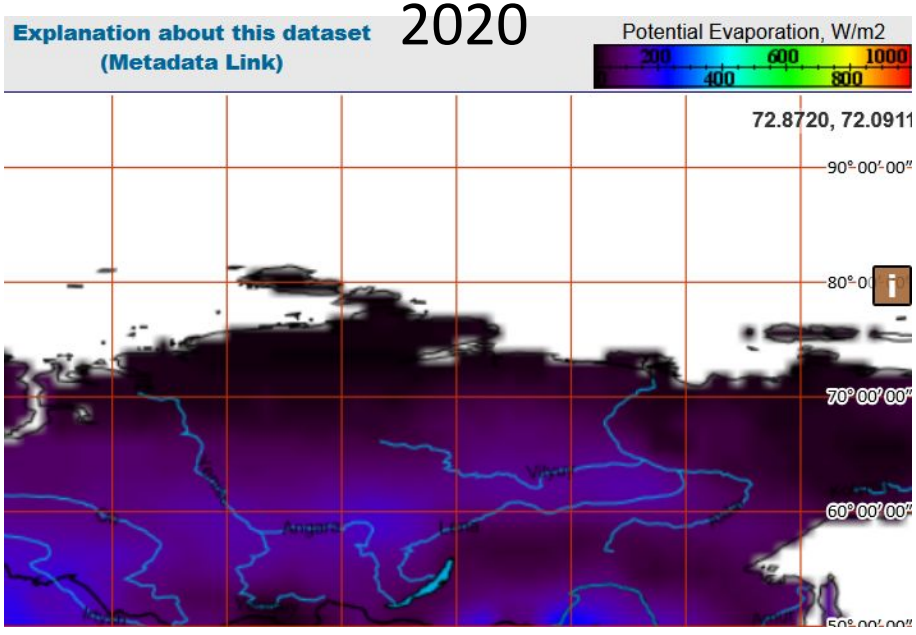


This slide shows precipitation maps

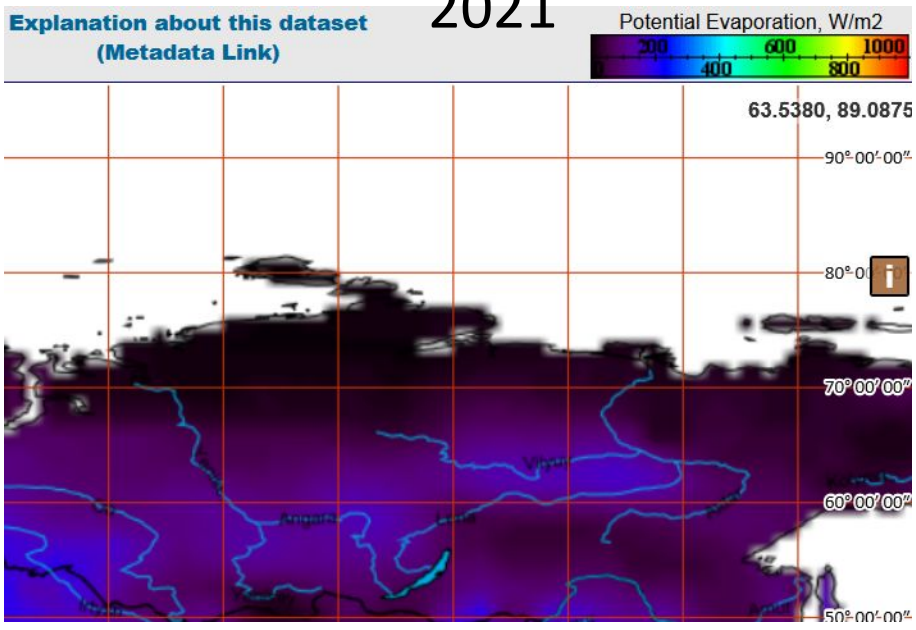
Developed by Alexander Prusevich (AKA Proussevitch) and Stanley Glidden

NCEP Potential Evaporation

2020



2021



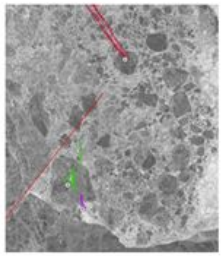
This slide shows potential evaporation maps

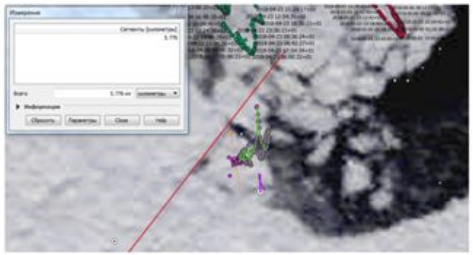
Developed by Alexander Prusevich (AKA Proussevitch) and Stanley Glidden

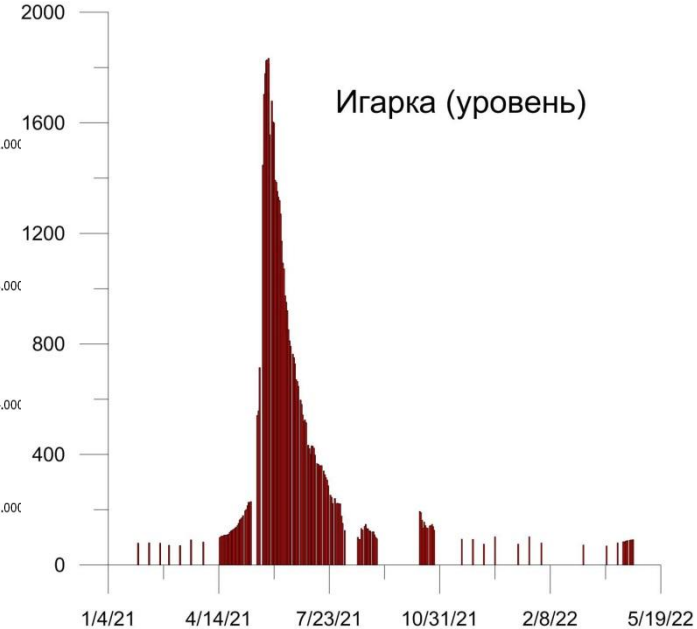
Summary

1. MERRA-2 data shows better correspondence of long-term air temperature changes with ground meteorological data (CRU), however significantly underestimates the increase in air temperature in Siberia eastward of the Lena river basin and for the area of the Ob-Taz mouth region.
2. ERA5 reanalysis significantly overestimates the average annual temperature in Eastern Siberia in the region from the Lena basin to the Kolyma basin.
3. ERA5 reanalysis data shows a decrease in average annual precipitation in a significant part of the Arctic Ocean drainage basin.
4. MERRA-2 annual precipitation trends are consistent with changes in average annual precipitation based on CRU data
5. ERA5 significantly overestimates the average annual precipitation for most of the Arctic Ocean's drainage basin

Operational data (in WMO exchange code)

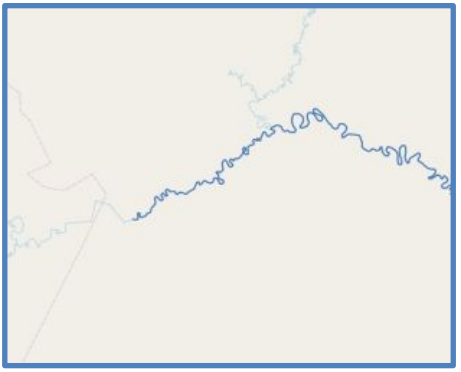


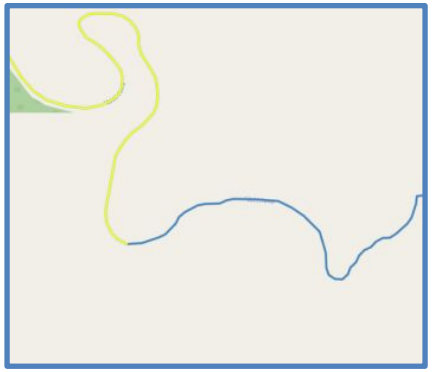


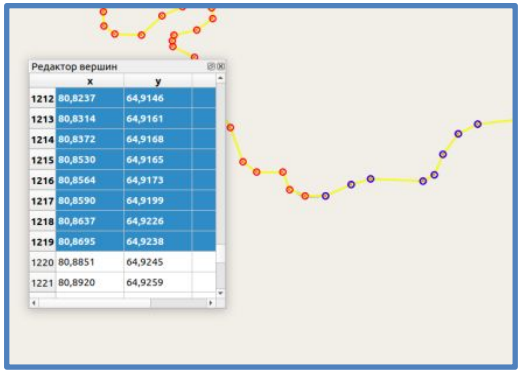


- Operational data (in WMO exchange code) are transmitted to the created datastore which enables further high-quality processing and visualization
- Developed software provides possibilities to download operational data in all modern formats though that requires coordination with the management engine (QGiS, SAGA, Python, PostgreSQL, PostGis)

Cartography – special features

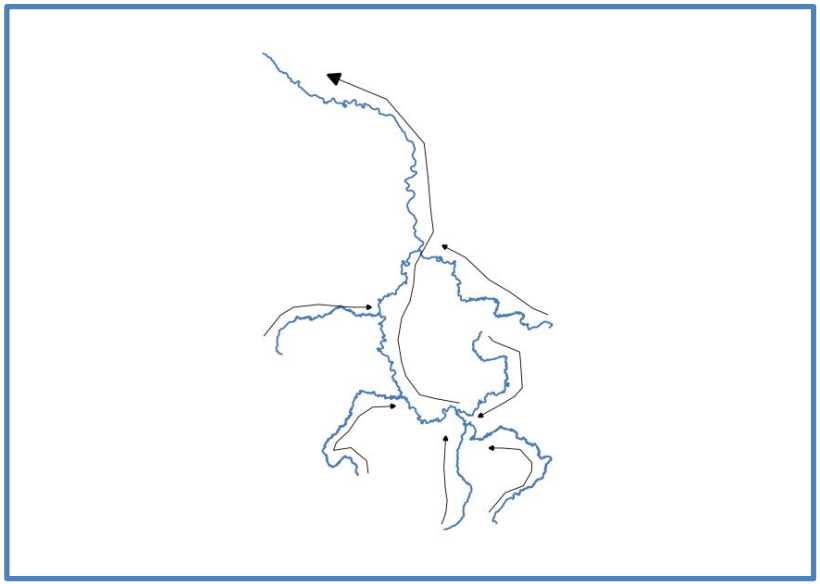






- Unfortunately a single river is not a single
- Unfortunately the open source software do not provide processing of data with the required accuracy
- The main problem is not the scale but the geometry of the lines and order of the vertexes inside
- In order to eliminate those shortcomings we were using an OSM (OpenStreetMap) module under QGIS, which makes it possible to obtain vector data with the required accuracy to create an adequate cartographic basis for hydrological climate data processing so that - **one river is one line with vertexes inside of the right order**

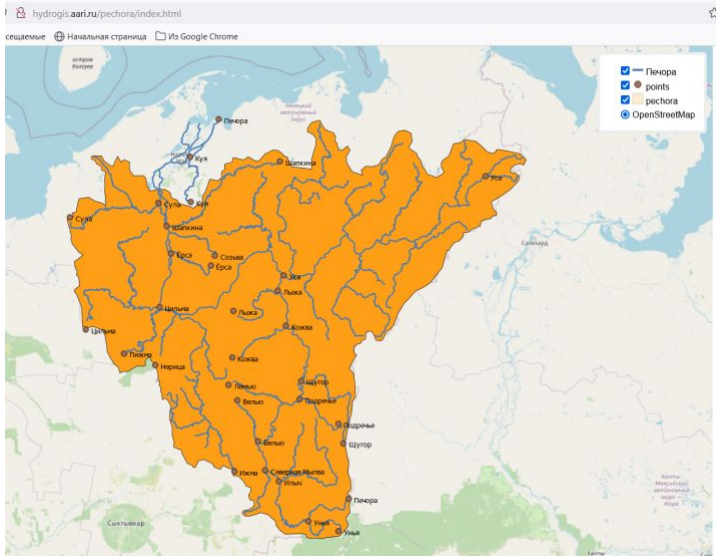
“good” river network

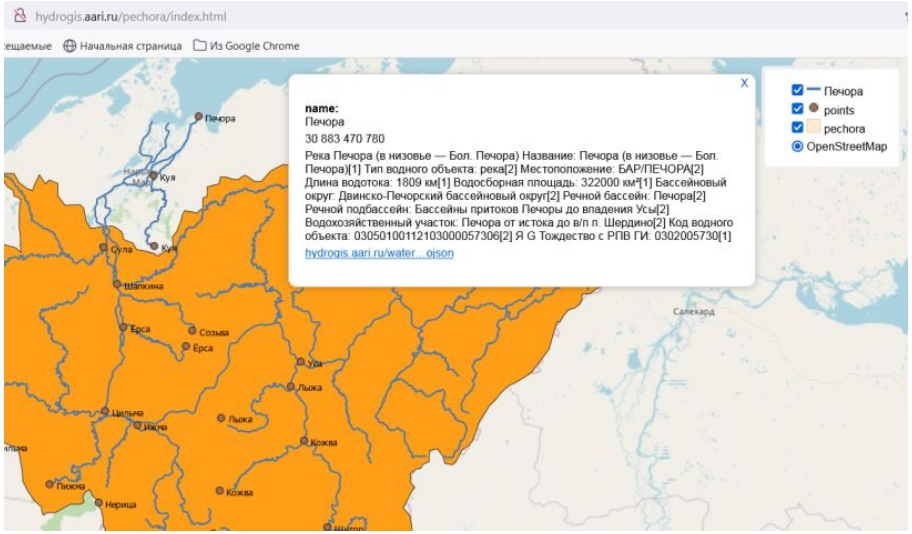


“wrong” river network

Vmap0
https://www.hydrosheds.org/products
www.vsegei.ru
Other source

Pechora river (as an example)





- Work was carried out to create vector bases for rivers from Pechora to Yenisei and clarify such hydrographic characteristics of the listed objects as length, sinuosity, area, etc.
- **A patent is being prepared to create a database, with an obligatory indication of the source of the primary OpenStreetMap data. This will significantly refine the hydrographic characteristics and enable publishing data in the relevant directories including Wikpedia**
- Creation of an adequate river network (cartographic image (layers) will make it possible to fully apply mathematical methods including hydrographic zoning
- **This will further lead to solving the problems of establishing flood zones, and as a result, the ability to assess the thawing of permafrost.**