Numerical weather prediction datasets for Svalbard at MET Norway:

AROME-Arctic forecasts
Experimental hectometric runs
# CARRA reanalysis

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The Ny-Ålesund Atmosphere Research Flagship Programme, Online Seminar exploring atmospheric models, 20 June 2024

Picture: Ketil Isaksen/MET

Numerical weather prediction datasets for Svalbard

1. For operational weather forecasting: **AROME-Arctic**

2. In development: **AROME-Svalbard 500m**

3. Reanalysis for climate studies: **Copernicus Arctic Regional Reanalysis (CARRA)**

1 — Configuration and model details

2 — Quality

3 — Data availability
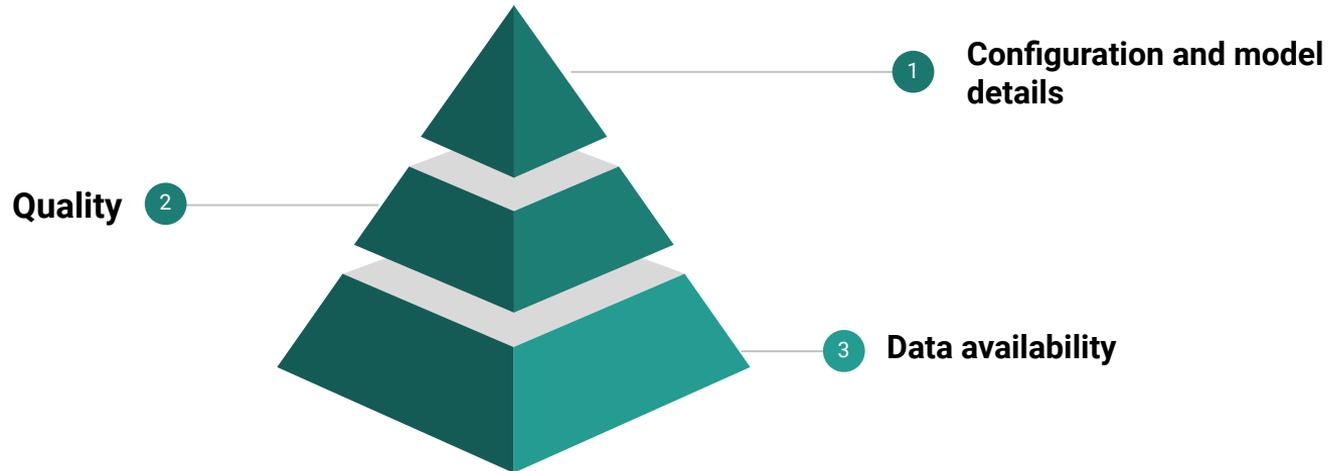
HARMONIE-AROME model system from the ACCORD

- The ACCORD consortium jointly develops computer codes for numerical weather prediction on limited area domains

- The model configuration defined by the HIRLAM consortium (green countries on the map) is called HARMONIE-AROME (Bengtsson et al 2017)

    - HARMONIE–AROME is based on the model AROME developed within the ALADIN consortium (blue countries on the map)
    - The same nonhydrostatic dynamical core as AROME-France
    - Updates to the model's physical parameterizations, configuration choices and scripting system

- The ACCORD common codes also utilize parts of the IFS-Arpege software jointly developed by Météo-France and ECMWF


ACC RD
A Consortium for COnvection-scale modelling Research and Development
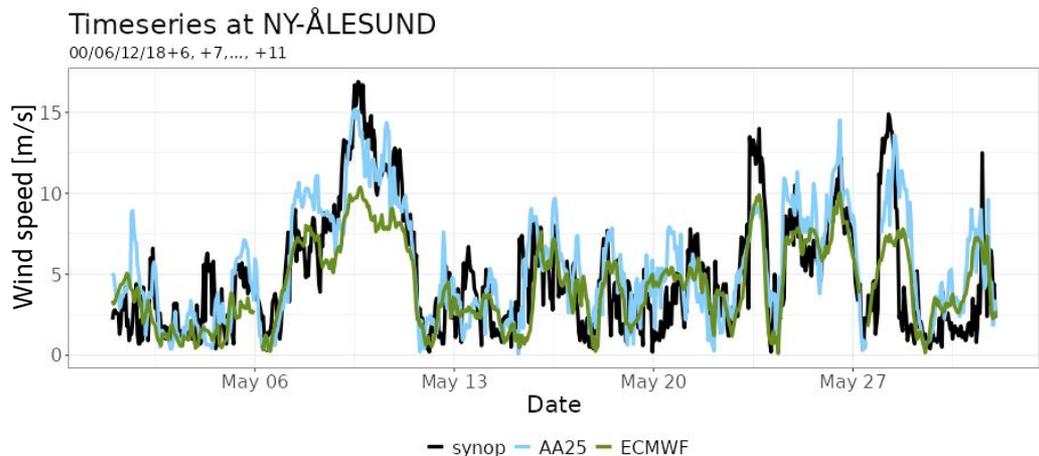
1. AROME-Arctic

- Our operational weather forecasting system for the European Arctic since 2015

- Based on HARMONIE-AROME model configuration developed jointly by the ACCORD consortium. Model version cy43h1 in production in 2024.

- 2.5 km horizontal grid spacing, 65 vertical levels

- 3D-Var assimilation upper air, OI surface assimilation

- ECMWF IFS-HRES as lateral boundary conditions & large-scale mixing

- Issues forecast 8 times a day with a lead time of 66 hours (1-hourly output). Output as lagged ensemble. EPS is coming!

- On Svalbard, Yr is based on AROME-Arctic
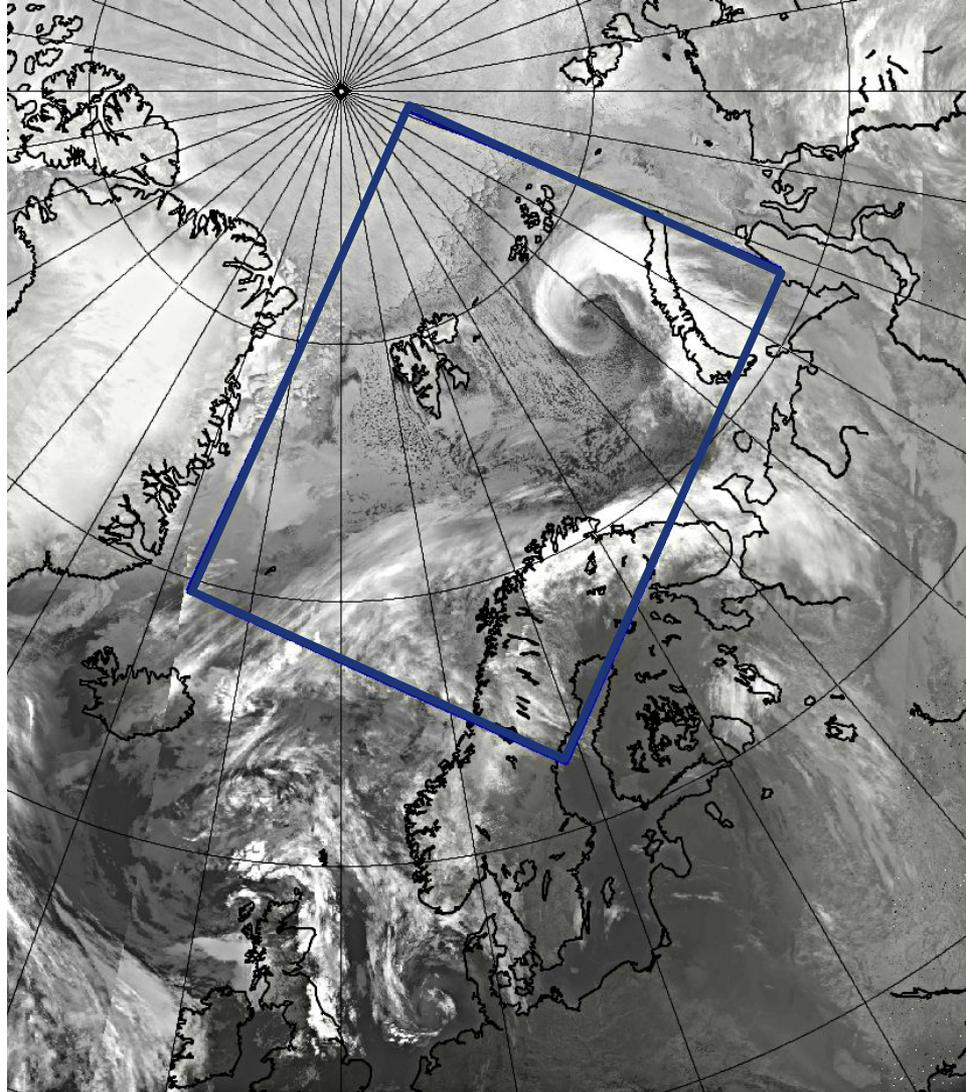
AROME-Arctic
Quality

- Quality is monitored regularly. Quarterly summary statistics published as METinfo https://www.met.no/publikasjoner/met-info

- We participate in model intercomparisons: AROME-Arctic on average performs better than many other models for surface variables (Køltzow et al 2019).

- However, model performance varies between sites. For February-March 2018, "there does not seem to be an obvious benefit [for wind] from the increased resolution, with the AROME configurations and CAPS model actually having worse biases than the lower resolution global models at Ny-Ålesund" (Day et al. 2024).

  This calls for more investigation focusing in the Ny-Ålesund area!

Figures: Timeseries of observed 2-m temperature and 10-m wind speed together with forecasts from AROME-Arctic (MET Norway), and IFS HRES (ECMWF) for May 2024.

AROME-Arctic
Data availability

- The Norwegian Meteorological Institute's official data sources and products are freely available to the public for use, dissemination and further processing.

- Forecast output is available as NetCDF files on https://thredds.met.no/thredds/metno.html

- More information about the data access on https://github.com/metno/NWPdocs/wiki

- We deliver both the **latest** operational forecasts and an **archive** of past forecasts.

- The files can be accessed from the thredds server using the **OPeNDAP protocol**.

- Commonly used tools for viewing and manipulating NetCDF files: ncdump, ncview, nco, fimex, gridpp, python, R etc.

Data freely available. Credit should be given to The Norwegian Meteorological institute, shortened "MET Norway", as the source of data.

Contact person for AROME-Arctic: Eivind Støylen eivinds@met.no
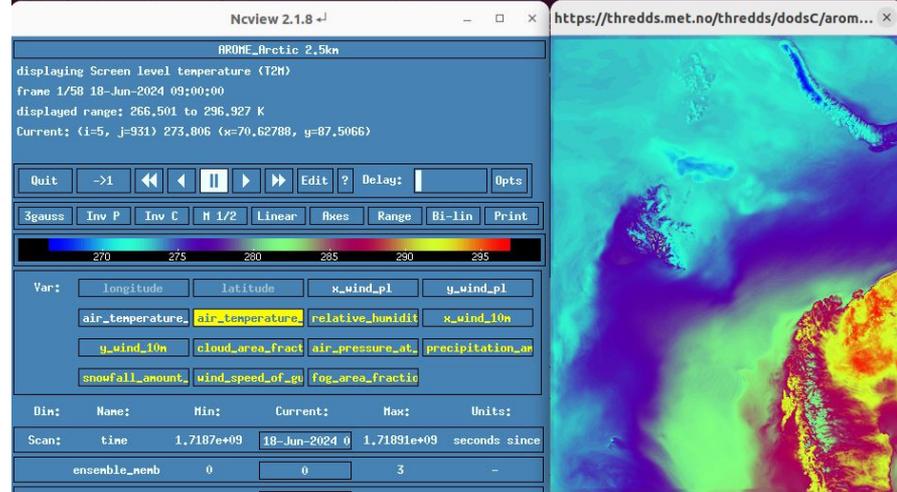
2. AROME-Svalbard 500m

- Experimental HARMONIE-AROME system run periodically since 2018

- Main users: research & development projects, UNIS courses, forecasters

- Simulations for short periods (1 week - 2.5 months)

- Settings under development and configuration is different from experiment to the next

- 0.5 km horizontal grid spacing, 90 vertical levels

- Domain (green) in the same orientation as AROME-Arctic (blue) after the very first experimentation (orange, Valkonen et al 2020)

- No upper air, and limited surface data assimilation

- Initial conditions and lateral boundaries either from AROME-Arctic or ECMWF IFS-HRES
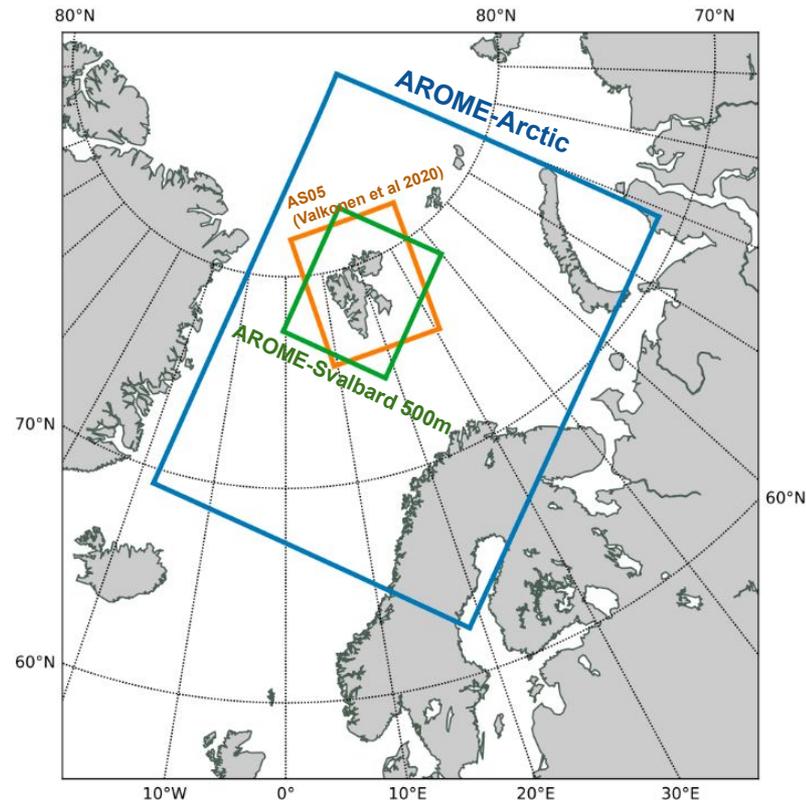
Quality

- For all periods and configurations tested, AROME-Svalbard 500m **improves wind forecasts** over the 2.5 km AROME-Arctic, on average.

- The performance varies a lot between stations. Added value of higher resolution is particularly large for wind in Ny-Ålesund.

- For other variables, the added value is not that clear, or have not been verified yet because of shortage of observations.

- AROME-Svalbard 500m simulations for February 2024 run with updated ICE-T microphysics (Engdahl et al. 2020) show more cloud cover and less precipitation than the runs without.

Total cloud cover (max 100 % of the time)
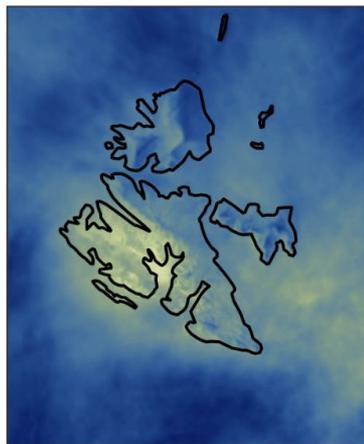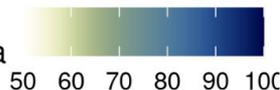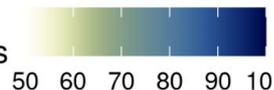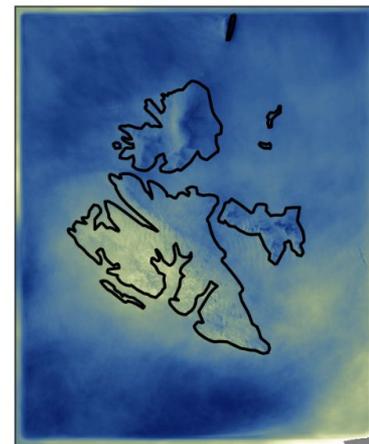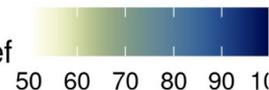
Figures: Total accumulated cloud cover during 26 January - 5 February 2024 in the operational AROME-Arctic, AROME-Svalbard 500m with ICE-T microphysics scheme, and AROME-Svalbard 500m without ICE-T microphysics scheme.

AROME-Svalbard 500m
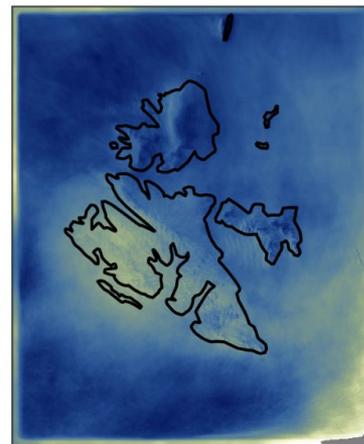# Data availability

AROME-Arctic
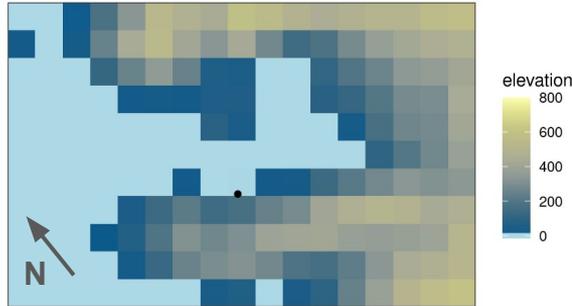
AS05 ECO2
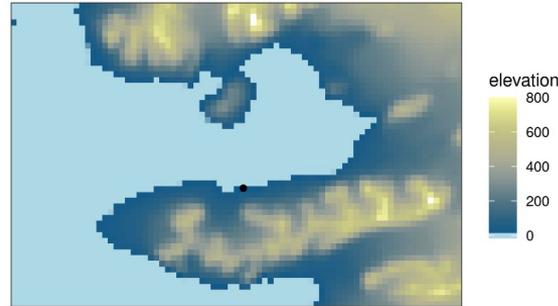
AS05 SG
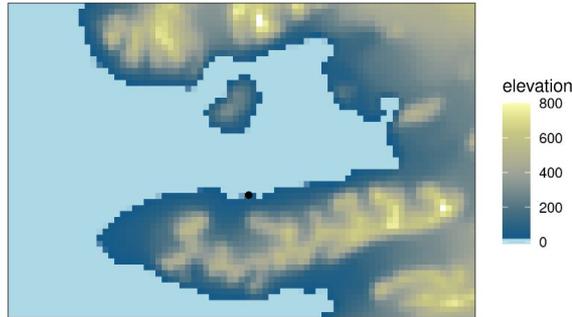
AS05 SG-MOD
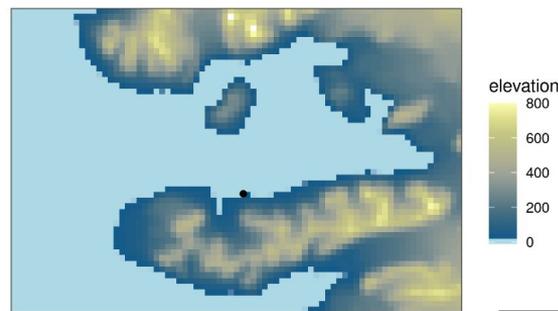
- Research data!

- Forecast output shared as NetCDF files on the thredds server, under projects or users

- Data available for use, no real documentation of the data available besides personal contact

- A lot of potential in these data:

We welcome collaboration projects!

Figures: Elevation in 2.5 km AROME-Arctic, and 3 different versions of physiography tested for AROME-Svalbard 500m. Verification: Venstad et al (2024)

AROME-Svalbard 500m data available on personal contact. We wish to be included in the interpretation of the data.

Contact person: Teresa Remes, teresav@met.no

Climate Change

- 1991 - present

- Model system: HARMONIE-AROME cycle 40h1.1 (fixed)

- Builds on experiences from operational forecasts at DMI and MET Norway

- 2.5 km horizontal grid spacing, 65 vertical levels

- 3D-Var assimilation upper air, OI surface assimilation

- Extensive use of local observations as input

- Focus on representation of cold surfaces

- ERA5 as lateral boundary conditions & large-scale mixing

- 3-hourly analysis output, 1-hourly forecast output
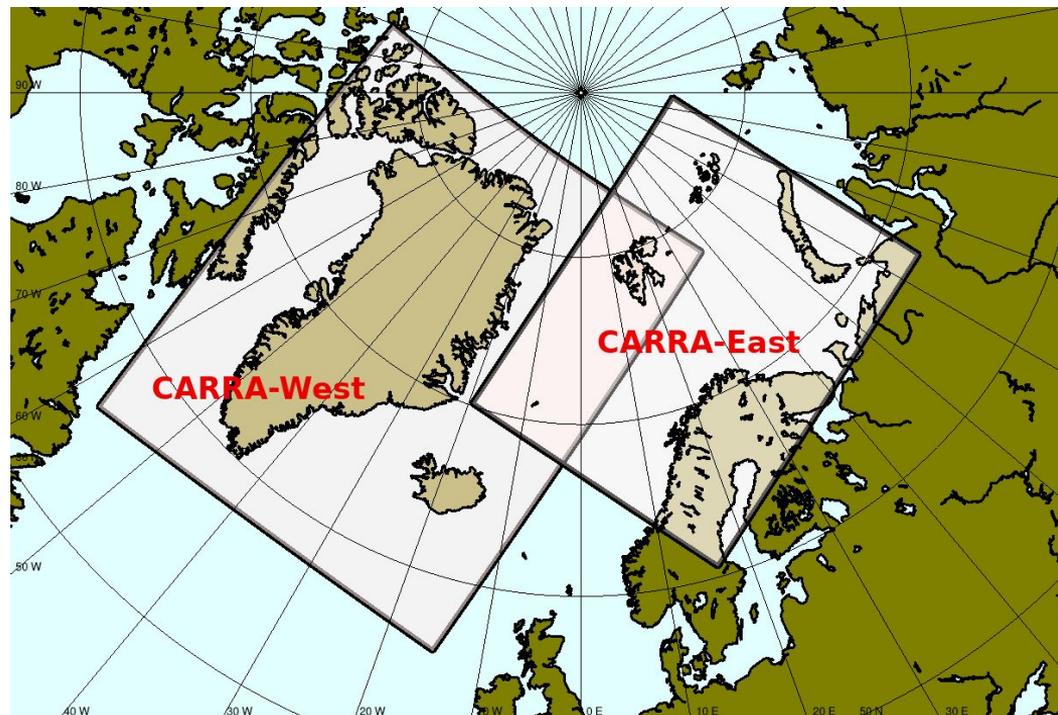
Climate Change

1 A more realistic glacier information for Svalbard from the Norwegian Polar Institute

2 Implementation of the new glacier mask into the original ECOCLIMAP

3 Use rock for the areas which are covered by glaciers in the original ECOCLIMAP

4 Model experiments on the impact and sensitivity
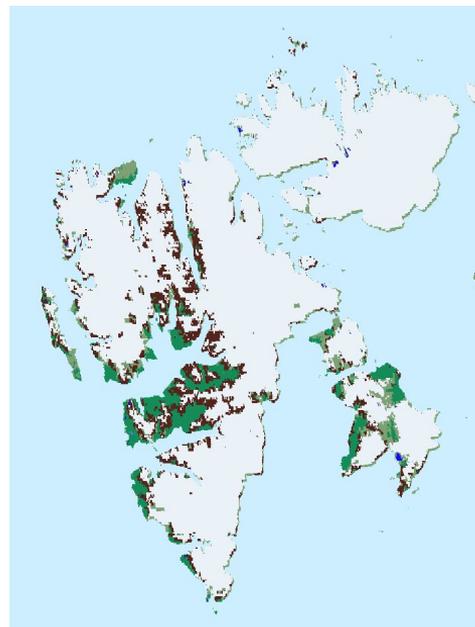
Original ECOCLIMAP
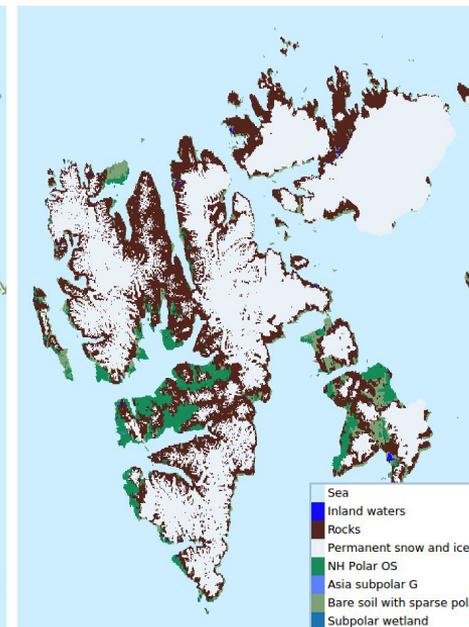
Glacier mask from NPI, remaining area as rock, otherwise ECOCLIMAP

Legend:
- Sea
- Inland waters
- Rocks
- Permanent snow and ice
- NH Polar OS
- Asia subpolar G
- Bare soil with sparse polar
- Subpolar wetland

ECMWF Copernicus Europe's eyes on Earth European Commission

CARRA Quality

- Quality has been monitored thoroughly during the development phase, production, and after the data release.

- CARRA provides more spatial and temporal details for near-surface parameters than ERA5, particularly in regions with complex terrain, coastlines and heterogeneous surface properties, and is in general in better agreement with in-situ observations than ERA5 (Køltzow et al 2022).

- CARRA provides a more detailed climatology and trends for Svalbard and the Barents Sea (Isaksen et al 2022).

Figure by Isaksen et al (2022): The spatial pattern of annual surface air temperature trends (°C/decade) derived from CARRA and ERA5.

Copernicus Climate Change Service (C3S) Climate Data Store (CDS):

- ○ [Single levels](#)
- ○ [Model levels](#)
- ○ [Pressure levels](#)
- ○ [Height levels](#)

More information: https://climate.copernicus.eu/copernicus-arctic-regional-reanalysis-service

- ○ [Data user guide](#)
- ○ [Full system documentation](#)

All users of data uploaded on the Climate Data Store (CDS) must cite each product used.

Please refer to [How to acknowledge, cite and reference data](#) published on the Climate Data Store for complete details.

Help with data: [User forum](#)

Copernicus Arctic Regional Reanalysis 2nd generation (CARRA2)

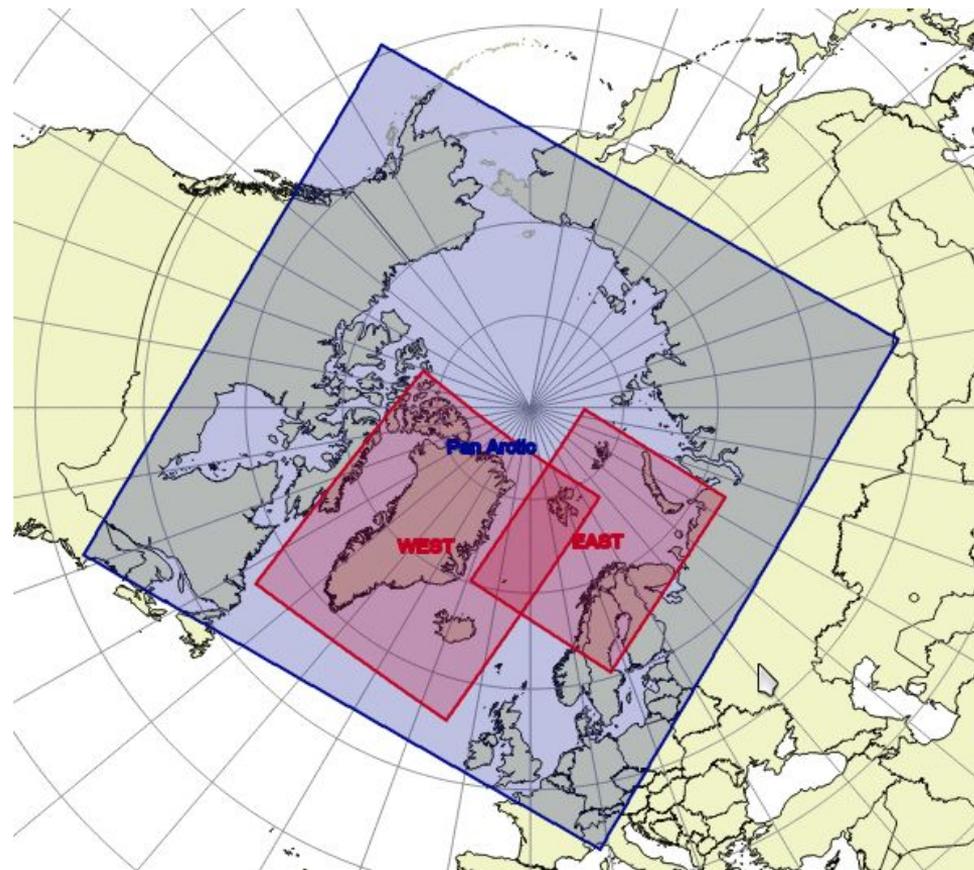- 1985 - 2025

- 2.5 km horizontal grid spacing, 65 vertical levels

- Differences from CARRA1:

  - Updated surface physics

  - Hydrostatic dynamics

- First data release planned February 2025

- Full data set available 2026

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Norwegian Meteorological Institute

Thank you!

For more information:
teresav@met.no

The Ny-Ålesund Atmosphere Research Flagship Programme, Online Seminar exploring atmospheric models, 20 June 2024

Picture: Ketil Isaksen/MET