Modeling infrastructure

Z04

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1. Summary

Main aims

1) Setup and perform high-resolution ICON simulations for regional areas in the Arctic

2) Prepare, setup and perform global ICON simulations with a special Arctic focus

3) Support scientists for the setup of specific ICON simulations as well as the handling of model output, foster exchange between the project scientists on model issues and offer specific training courses

Central task

Perform consistent simulations to be used by scientists and support all (AC)³ projects during setup and performance of simulations as well as handling model output.

2. Rationale

ICON modeling framework and community support

- German weather and climate model
- Offers configurations from global climate projections to large-eddy simulations (LEM)
- Complex modeling system requires support of especially early career scientists
- Synergies by centralised model output handling and computing time coordination

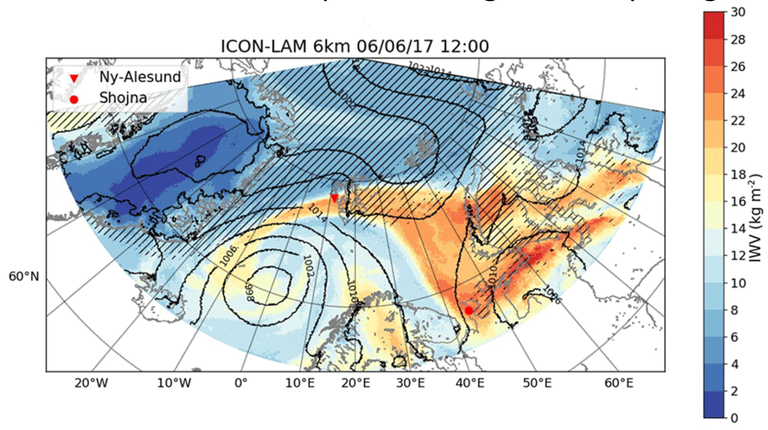

Fig.1: Integrated water vapor (kg m^{-2}, color shading), mean sea level pressure (hPa, black isolines), and sea ice (black hatches for sea-ice fraction > 0.15) from ICON-LAM 6 km for an atmospheric river case.

Arctic case studies and Ny-Ålesund testbed

- Consistent sets of simulations for previous campaigns for statistical analysis
- Dedicated configurations for Arctic simulations
- Need for improved large-scale forcing (e.g. for cold-air outbreaks), improved sea-ice coverage and albedo properties
- Setup of semi-operational simulations at the AWIPEV research station (Svalbard)

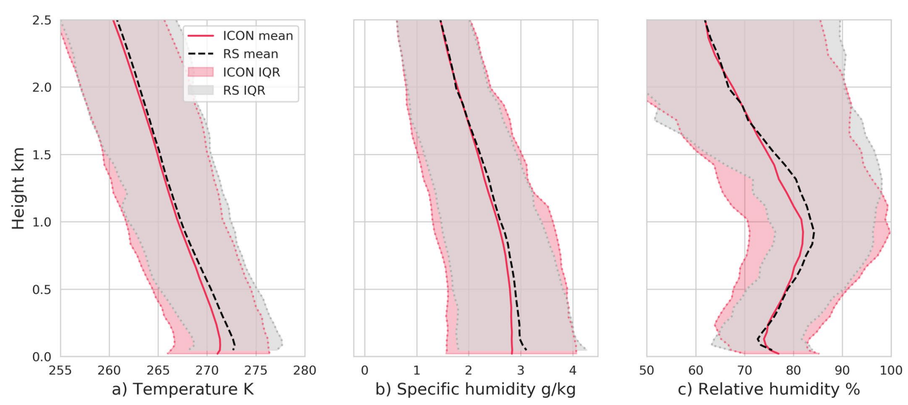

Fig.2: Mean vertical profiles for ICON-LEM (600m) and radiosondes at Ny-Ålesund from August to December 2020. Shaded areas show the interquartile ranges.

Development of global ICON model

- Continuous progress on km-resolution global simulations - interest in dedicated Arctic simulations
- Development of parameterizations within several projects - support required for technical implementation as well as specific model evaluation and potential tuning
- Need for at least decade-long simulations

3. Plan phase III

WP1 Parameterization testbed

- Professionalization of semi-operational ICON-LEM testbed (Ny-Ålesund) by tailored model diagnostics
- Synthesis of observations and simulations to be easily accessible for model evaluation and process analysis

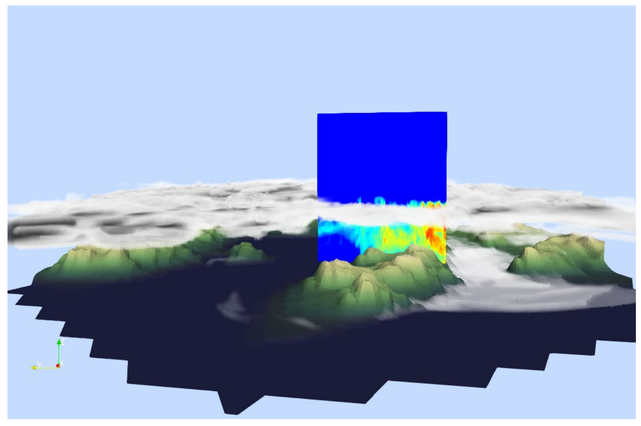

Fig.3: Visualization of simulated liquid clouds and observed radar reflectivity at Ny-Ålesund.

WP2 Limited area simulations for campaigns

- Consistent simulations for all (AC)³ campaigns
- Support for new planned campaigns and case studies
- Support of project scientists for requirements and simulations

WP3 Global ICON simulations

- Technical support for implementation of improved parameterizations
- Decade-long simulations, basic evaluation and necessary adjustments (e.g. for energy balance)
- Short-term (month) coupled simulations with local refinement (km-scale)

WP4 Improved large-scale forcing

- Provide improved large-scale forcing datasets - e.g. topography and sea-ice fraction
- Made publicly available for dedicated Arctic simulations

WP5 Community management

- Management of all simulations and support for analysis of CMIP simulations, support of proposals and output management
- Establishment of regular meetings and training courses
  - 2024: “How to design, prepare and setup experiments with the ICON model”
  - 2025: “How to obtain, handle, process and visualize model output”
  - 2027: “How to handle (AC)³ simulations - prepare the available simulations for the time beyond (AC)³ (Hackathon)”

4. Major expected results

Major expected results within phase III

- Arctic parameterization testbed at Ny-Ålesund (Svalbard)
- Consolidated setup for hecto- and kilometer-resolution Arctic ICON simulations
- ICON simulations for all (AC)³ campaigns
- Global ICON model with improved parameterizations implemented and decade-long simulations
- Trained early career scientists and offered training courses

TRR 172 TRANSREGIONAL COLLABORATIVE RESEARCH CENTRE

(AC)³ ArctiC Amplification: Climate Relevant Atmospheric and SurfaCe Processes, and Feedback Mechanisms

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