

SPECIAL PROJECT PROGRESS REPORT

Progress Reports should be 2 to 10 pages in length, depending on importance of the project. All the following mandatory information needs to be provided.

Reporting year2018.....

Project Title: ... Modeling MIS3: a mild glacial climate state
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Computer Project Account: spdklang

Principal Investigator(s): Peter Langen.....
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Affiliation: Danish Meteorological Institute

Name of ECMWF scientist(s) collaborating to the project
(if applicable)

Start date of the project: 1 Jan 2017.....

Expected end date: 31 Dec 2018.....

Computer resources allocated/used for the current year and the previous one
(if applicable)

Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)	2,250,000	0	2,250,000	0
Data storage capacity	(Gbytes)	3000	0	6000	0

Summary of project objectives

(10 lines max)

As part of the efforts under the ERC Synergy Grant project “ice2ice”, we aim to perform an EC-Earth simulation of climate conditions during Marine Isotope Stage 3 (MIS3), a time prior to the Last Glacial Maximum marking the period with the most pronounced climate shifts recorded in the Greenland ice core records. In light of the ongoing rapid decline of Arctic sea ice and its likely influence on the Greenland Ice Sheet, understanding of previous abrupt reorganizations in the North Atlantic/Arctic climate system is important for a clear mapping of the potential consequences of the current warming. We have devised a protocol for a coordinated set of experiments between the NorESM (run by ice2ice colleagues in Bergen), HadCM3 (by William Roberts, U Bristol) and EC-Earth models. The main experiment will consist of an equilibrium snap-shot at 38,000 years before present (38 ka). The protocol addresses the changed land-sea mask and ocean bathymetry (due to 70 m lowered sea level), ice sheet geometries for the Northern Hemisphere and settings for atmospheric composition, orbital parameters and changed/extended river routing.

Summary of problems encountered (if any)

(20 lines max)

We have made the MIS3 setup with an intermediate version of the EC-Earth code and done initial runs with this. However, to ensure proper integration with the CMIP6 process (including the PMIP paleoclimatic runs thereunder), we need to wait for the final, frozen version of the EC-Earth code to be used for CMIP6.

The CMIP6 version of the EC-Earth3.2 is not yet finished. This is a challenge and a headache for the entire EC-Earth consortium, and our delays with the MIS3 experiments are only a minor side-effect in that bigger picture. The debugging and re-tuning of the code is now almost a year delayed compared to the expectations we had at the time we applied for this project.

However, if we do not wait, we cannot compare the resulting climate to the present and pre-industrial climates simulated by the (eventual) CMIP6 version of the code. This will severely limit the utility of the experiment and we would likely need to rerun it.

Summary of results of the current year (from July of previous year to June of current year)

This section should comprise 1 to 8 pages and can be replaced by a short summary plus an existing scientific report on the project

With a non-final version of the code, we have implemented the changes needed to do the MIS3 paleo-experiment:

Orbital parameters and solar constant

- **Orbital parameters** chosen as those for 38 ka BP in the code of the models
- **Solar constant set** to same as in PI (like PMIP3)

Greenhouse gases and aerosols

- **CO₂**: 215 ppmv
- **CH₄**: 550 ppbv
- **N₂O**: 260 ppbv
- **CFC**: 0
- **O₃**: PI
- **Aerosols**: PI

Topo, ice sheet, and land-sea mask

June 2018

This template is available at:

<http://www.ecmwf.int/en/computing/access-computing-facilities/forms>

- The Tarasov et al 38 ka “reconstruction” includes topo, ice mask and land sea mask

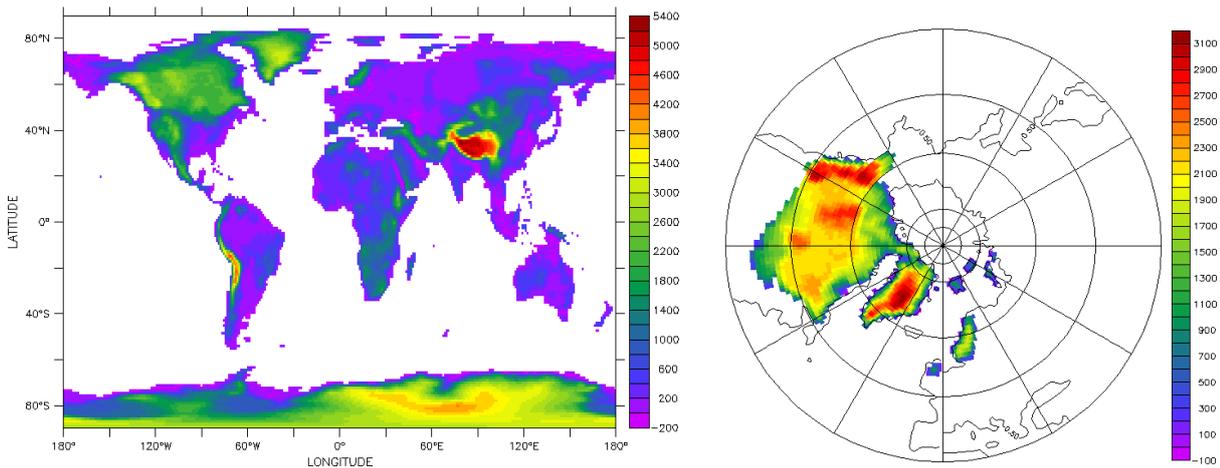
Surface types and river routing

- In new ice points, we choose the same surface type, vegetation etc as on the current Greenland ice sheet.
- Surface type, vegetation etc in new land points: Choose typical values for tundra everywhere
- River routing: current rivers extended out to new coastline

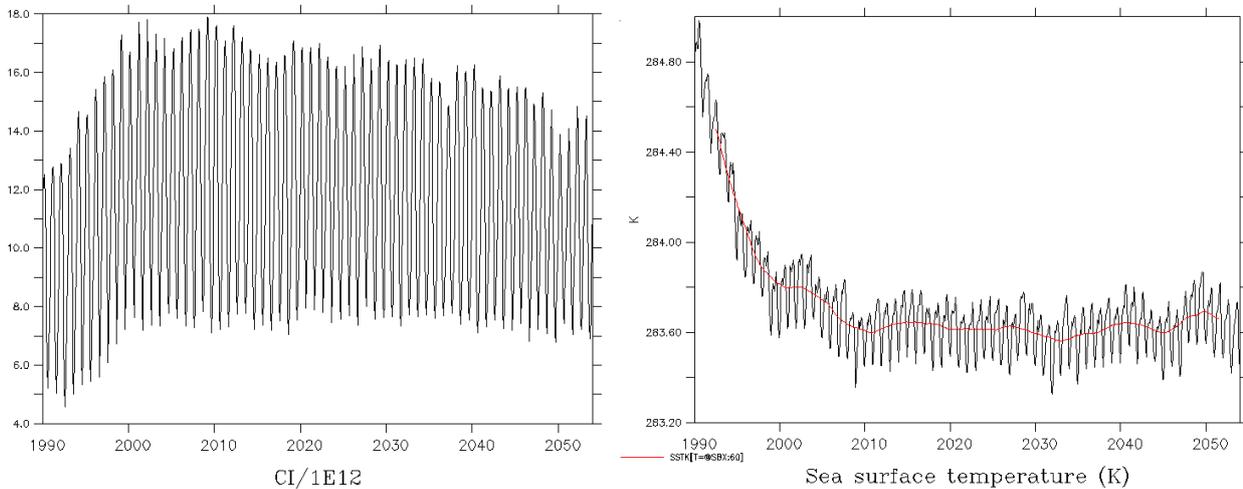
Initialization

- Sea level is 70 m lower, so we add 0.6 psu to global ocean salinity.

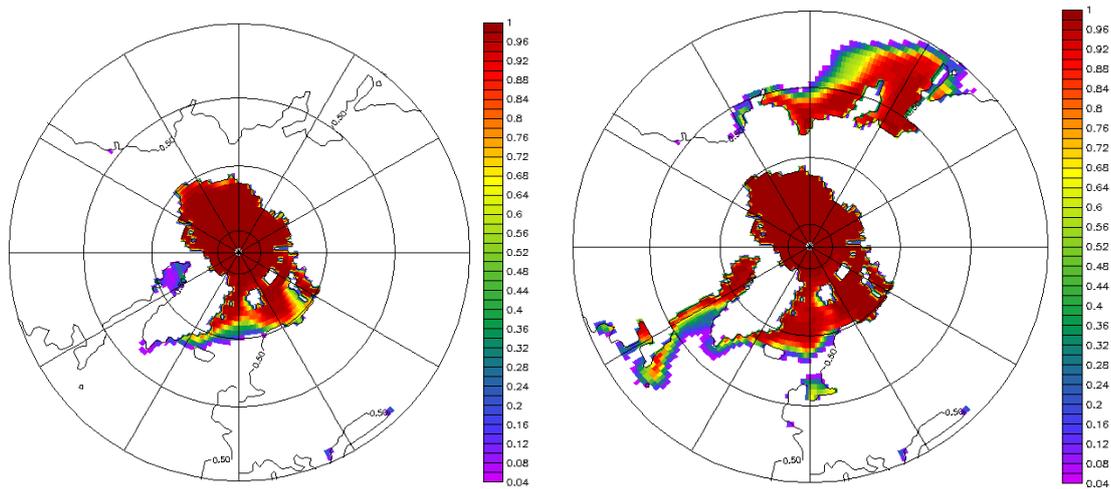
In the following figure, the resulting land sea mask is illustrated in the plot to the left, while the right hand panel illustrates the large Northern Hemisphere ice sheets of the time:



With this setup, we did an initial ~60 year test run to check the sanity. The below figure illustrates the evolution in NH sea ice area and sea surface temperature:



The final five years of the test run have been averaged to illustrate the September (left) and March (right) sea ice area. This rather modest sea ice cover (recalling that we are in a mild glacial state) is approximately as we would expect from the known paleo-records:



List of publications/reports from the project with complete references

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 None

Summary of plans for the continuation of the project

(10 lines max)

Once the EC-Earth code is frozen, we can start the full experiments. We expect this to occur within the next few months (but history has unfortunately shown that this may not hold). In either case, it will be difficult for us to finish the experiment and spend the allocated BU's by the end of the project on Dec 31 2018. We do therefore expect to apply for an extension of the project into 2019.