REQUEST FOR ADDITIONAL RESOURCES IN THE CURRENT YEAR FOR AN EXISTING SPECIAL PROJECT

Please email the completed form to special_projects@ecmwf.int.

MEMBER STATE: Netherlands

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Project title: **Regional climate modelling of Greenland and Antarctica**

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Project account: **SPNLBERG**

Additional computer resources requested for		2020
High Performance Computing Facility	(units)	10.000.000
Data storage capacity (total)	(Gbytes)	58.000

Continue overleaf

[1] The Principal Investigator is the contact person for this Special Project

Technical reasons and scientific justifications why additional resources are needed

Research aims

The cryosphere is an important component of the Earth's climate system, and changes in the cryosphere will have large societal impacts. For example, sea level rise due to mass loss from the Greenland (GrIS) and Antarctic Ice Sheets (AIS) may disrupt coastal communities worldwide. The SPNLBERG project is tailored for our research on the land-based cryosphere, for which we use the polar adapted regional climate model RACMO2 and the multiyear snow (firn) densification model (FDM). Our research has three aims: increased understanding of the relevant physical processes, monitoring of ongoing changes also in support of (remote sensing) mass balance studies, and projections of future mass loss from the ice sheets and their contribution to sea level rise.

Completed plans in 2020

As described in more detail in the 2020 progress report, we have already successfully completed the following simulations and tasks:

- Historical simulations for the AIS at 27 km resolution using an updated snow albedo scheme. The tuning, as mentioned in the 2020 progress report, has been completed and a manuscript and PhD thesis are now being prepared.
- Updating our operational climate and surface mass balance (SMB) estimates of the GrIS and AIS to July 2020 at 5.5 and 27 km resolution, respectively, using ERA5(T) as boundary forcing.
- A 2015-2100 projection of the Greenland and Antarctic climate and ice sheet surface mass balance under RCP5-8.5 using climate boundaries from the earth system model CESM2. A paper describing this simulation is currently being prepared.
- Retuning of FDM against deep snow profiles collected in Greenland.

Additional plans for 2020 and justification

1) Updating our operational climate and SMB estimates of the GrIS and AIS to September 2020 at 5.5 and 27 km resolution, respectively, using ERA5T.
   As we share these data with several international research partners, extending the operational estimates to the present day would keep our data up to date for assessments like the Greenland mass balance for the summer of 2020 (as requested from IMBIE (see http://imbie.org/) and IPCC AR6). Computational costs: ~300.000 HPCF units and ~1 Tb of storage space.
2) Completing a state-of-the-art 11 km resolution, 1995-2020 ERA5 driven simulation for the AIS which will replace the current operational estimate on 27 km resolution.
   Given the continued improvement of the resolution of global numerical forecasts, our current operational product for the AIS on 27 km provides no longer a refinement in the modelled precipitation fields compared to, for example, ERA5. The added value of our current product for Antarctica are still the superior estimates of surface melt, other cryospheric near-surface processes like snow drift, and subsequently, the surface mass balance. On 11 km, our product would provide continent-wide refined spatial estimates of the Antarctic precipitation and similarly refined estimates of, for example, snow melt. Given the relevance of this simulation, postponement to 2021 is undesirable. Computational costs: ~7.500.000 HPCF units and ~35 Tb of storage space.
3) A 2015-2100 projection of the Antarctic climate under RCP1-2.6 using climate boundaries from the ESM CESM2.

Having completed a RCP5-8.5 scenario simulation for both Greenland and Antarctica, we now plan to complete a RCP1-2.6 scenario simulation for Antarctica. This simulation will employ a resolution of 27 km and will be driven by CESM2 data. This simulation will be used to inquire whether RCP2.6 does indeed result in sufficient mitigation of significant warming of Antarctica. This simulation is also part of the commitment of our institute to the H2020 project PROTECT (see https://protect-slr.eu/). Computational costs: ~3.000.000 HPCF units and ~21 Tb of storage space.

4) Running FDM for the whole of GrIS to derive improved estimates of ongoing changes in the snow layer covering the GrIS.
   After the completion of the retuning of the FDM model, the next step in this PhD project is to update our firn layer product of the GrIS. The model data will be used to assess the ongoing changes in the refreezing capacity of the firn layer, but will also support ongoing altimetry studies (CryoSat-2 and ICESat-2). This refreezing capacity is the resilience of the GrIS to climate change, as without the current firn layer, the ongoing and projected warming would lead to a much larger (~factor 2) contribution of the GrIS to the global mean sea level rise. Computational costs: ~ 1.000.000 HPCF units and 1 Tb of storage space.

Concluding remark

The combined HPCF request of the four projects exceeds the maximum budget for additional resources (10.000.000 HPCF units). If the requested budget is indeed depleted before all four plans are completed, and no further budget is available, the RCP1-2.6 scenario simulation for the AIS will be paused. It will be continued in 2021, presuming that the SPNLBERG request for 2021 will be (partially) granted.