REQUEST FOR A SPECIAL PROJECT 2025–2027

MEMBER STATE: United Kingdom

Principal Investigator[1]: Kristian Strommen

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Other researchers: Dr. Antje Weisheimer (ECMWF)

Project Title: The role of ENSO in generating skilful winter NAO forecasts

To make changes to an existing project please submit an amended version of the original form.)

If this is a continuation of an existing project, please state the computer project account assigned previously.	**SP** ……..	
Starting year: (A project can have a duration of up to 3 years, agreed at the beginning of the project.)	2025	
Would you accept support for 1 year only, if necessary?	YES ☒	NO ☐

Computer resources required for project year:		**2025**	**2026**	**2027**
High Performance Computing Facility	[SBU]	10,000,000		
Accumulated data storage (total archive volume)[2]	[GB]	8,000		

EWC resources required for project year:		**2025**	**2026**	**2027**
Number of vCPUs	[#]			

[1] The Principal Investigator will act as contact person for this Special Project and, in particular, will be asked to register the project, provide annual progress reports of the project's activities, etc.
[2] These figures refer to data archived in ECFS and MARS. If e.g. you archive x GB in year one and y GB in year two and don't delete anything you need to request x + y GB for the second project year etc.
[3]The number of vGPU is referred to the equivalent number of virtualized vGPUs with 8GB memory.

Total memory	[GB]			
Storage	[GB]			
Number of vGPUs[3]	[#]			

Continue overleaf.

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Extended abstract

Some state-of-the-art seasonal forecast models are able to skilfully predict the winter NAO when initialised in November. This includes recent versions of the IFS, like SEAS5. Indeed, if the SSTs and sea-ice are prescribed from ERA5 in recent cycles of the IFS, then the ensemble mean correlation between the ensemble mean NAO and the observed NAO over the period 1980-2015 is around 0.6, competitive with the highest correlations obtained (0.62 by the UK Met Office).

However, while many hypotheses, have been made, it is still largely unknown where this skill is coming from.

In 2023 we were awarded the Special Project titled spgbstro:

https://www.ecmwf.int/en/research/special-projects/spgbstro-2023

In that special project, we requested units to perform novel seasonal hindcast experiments using prescribed SSTs and sea-ice boundary forcing. The goal was to do two experiments. In the first hindcast experiment, interannual variations in Barents-Kara sea ice would be suppressed, by altering the sea-ice forcing files. In the second hindcast, a similar procedure would be done to suppress ENSO variability. By comparing the skill in these two hindcasts against that of a control hindcast, one could begin to estimate how much of the seasonal forecast skill comes from Barents-Kara and ENSO, two suggested sources of NAO forecast skill.

As documented in follow-up reports and requests for additional units (see the spgbstro project page linked above), several points resulted in a change to the experiments. These points were related to Covid, the move to the new Atos supercomputer, technical implementation of the experiments, and preliminary analysis of the first results. In brief, we ended up making a pragmatic decision to focus on Barents-Kara only, and did not in the end run experiments testing the effect of ENSO. The Barents-Kara experiments are currently being analysed, with preliminary results having been announced at previous workshops.

We would now like to request units to carry out these additional ENSO experiments. In other words, we request units to perform a seasonal hindcast (50 ensemble members), using IFS Cycle 48R1, Tco199ORCA1 at half-precision using prescribed boundary forcing. The period covered is 1980-2015.

This configuration has already been used as part of the previous special project spgbstro, including the method for removing interannual SST or ice variability from a region. The method we implemented in our Barents-Kara experiments was found to work well, and we have already prepared modified boundary forcing files which similarly remove ENSO variability. Note that this relies on defining “ENSO” to mean “SSTs in the Nino 3.4 region”. Our method forces these SSTs to take on climatological values for the duration of each forecast carried out.

Thus we anticipate that carrying out this experiment will be almost trivial to do. All that's missing are the units. A control experiment already exists as well, so we only need to perform one hindcast. The units have been estimated based on our experience in spgbstro: 10,000,000 units are approximately what is needed to generate such a hindcast on the Atos computer.

Extended scientific justification for studying the role of ENSO in seasonal forecasts was given in the application for spgbstro, so we do not repeat this justification here. Understanding how much of the skill comes from ENSO is of clear interest to ECMWF, also because it may help clarify sources of skill from elsewhere that are currently being overlooked. Collaboration with Dr. Antje Weisheimer will ensure the relevant results are quickly disseminated to ECMWF.