SPECIAL PROJECT FINAL REPORT

All the following mandatory information needs to be provided.

Project Title:	Blue Action
Computer Project Account:	spnlatte
Start Year - End Year :	2019 - 2019
Principal Investigator(s)	Dr. Jisk Attema
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Other Researchers (Name/Affiliation):	Netherlands eScience Center, Liu Yang MSc, Dr. Gijs van den Oord

The following should cover the entire project duration.

Summary of project objectives

(10 lines max)

Study the mechanisms and predictability of a specific climatic event: the exceptionally cold conditions in the subpolar gyre, the "cold blob", of 2015.

Participate with Blue Action (Horizon2020, 727852) partners to create a large ensemble of initialized hindcasts and predictions with the coarse resolution EC-Earth V3 (Shuting Yang, DMI) and with other models (Juliet Mignot IPSL, Daniela Matei MPI-M, Alessio Bellucci CMCC, Noel Keenlyside UiB and Stephen Yeager NCAR).

Summary of problems encountered

(If you encountered any problems of a more technical nature, please describe them here.)

None.

Experience with the Special Project framework

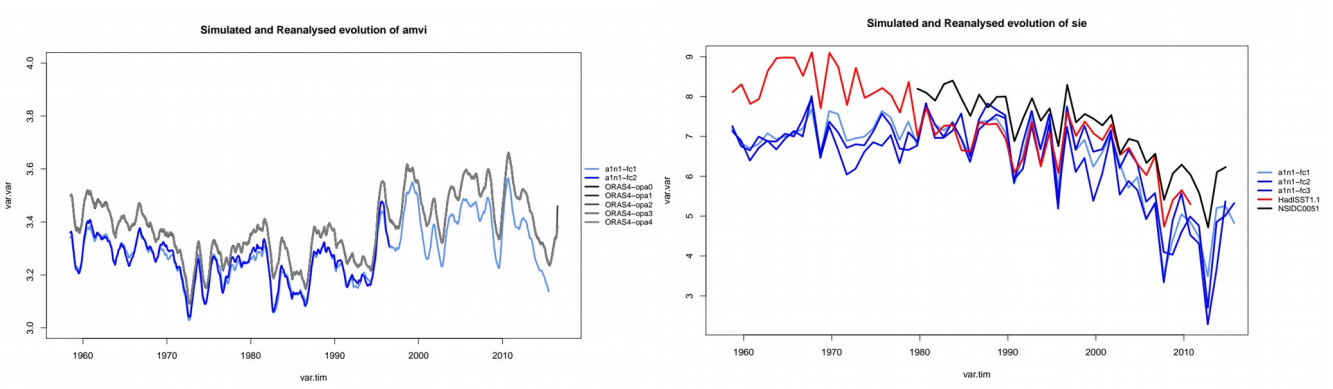
(Please let us know about your experience with administrative aspects like the application procedure, progress reporting etc.)

The administrative procedures are fine.

Summary of results

We have conducted experiments to address predictability of subpolar Atlantic and Arctic climate, with a special focus on the ocean's role in mid-latitude and high latitude climate variability. In particular we have focused in detail upon the subpolar Atlantic "cold blob" event, a rapid cooling of the high latitude North Atlantic which took place in 2014 and 2015. The cooling started in a period with above average SST's, which was associated with the most recent positive phase of the Atlantic Multidecadal Oscillation (AMO). The event took place in a year which was, at that time, the warmest since instrumental observations have been made.

The experiments consisted of 100 year-long simulations with the high-resolution coupled atmosphere-ocean configuration of EC-Earth-3.3.1 (Doblas-Reyes et. al., 2018), which is based on the IFS cycle 36r4 at a resolution T511L91 and NEMO 3.6 on the ORCA025 mesh. This amounts to a atmospheric resolution of about 40km and eddy-permitting ocean resolution around 25km. The ensemble was constructed from a full ocean and sea-ice initialization, constructed by the climate prediction group at Barcelona Supercomputing Center (BSC). The initialization method consisted of a standalone ORCA025 ocean run starting in 1958 (denoted 'a1n1') nudged towards ORAS5 (Zuo et al., 2014) member 0 with weak relaxation coefficients. Atmospheric surface fluxes have been taken from the Drakkar DFS5 forcing set (Dussin et al., 2016). The preliminary AMO and sea-ice extent have been plotted below. It should be noted however that this model version has not been tuned at high resolution, causing the reconstruction to display some non-stationary biases. As a consequence we have decided to use it for a large ensemble of one-year runs rather than decadal simulations.



We have constructed 100 member initial states by taking the product of the 5 members of the a1n1 reconstruction described above and 10 perturbations of ERA-5 interpolated states at November 1st 2014 and 10 more at May 1st 2015. The runs have been conducted at the ECMWF Cray machine, using 1730 cores per member, achieving about 2 simulated years per day and allowing us to complete the experiment in only 6 days. Subsequently the output has been CMORized using the ece2cmor3 tool (Oord, Bakhshi 2017) to produce a dataset complies with the HighresMIP data request (Haarsma et al., 2016). The NetCDF files have been stored at ECFS and are available to all users.

References

Doblas-Reyes, F., Acosta Navarro, J., Acosta, M., Bellprat, O., Bilbao, R., Castrillo, M., Prodhomme, C. (2018). *Using EC-Earth for climate prediction research* (No. UCL-Université Catholique de Louvain).

Hao Zuo, M. Balmaseda and K. Mogensen (2014), *The ECMWF-MyOcean2 eddy-permitting ocean and sea-ice reanalysis ORAP5. Part 1: Implementation*, ECMWF Techn. Memor. no. 736, 10/2014, doi 10.21957/Sawbusgo.

R. Dussin, B. Barnier and L. Brodeau (2016), *The making of the Drakkar forcing set DFS5.1*, DRAKKAR/MyOcean Report 01-04-16, LGGE, Grenoble, France.

G van den Oord, R Bakhshi, Parallel prost-processing of the ec-earth climate model output, Procedia Computer Science, 2017

Haarsma, R. J., Roberts, M. J., Vidale, P. L., Senior, C. A., Bellucci, A., Bao, Q., Chang, P., Corti, S., Fučkar, N. S., Guemas, V., von Hardenberg, J., Hazeleger, W., Kodama, C., Koenigk, T., Leung, L. R., Lu, J., Luo, J.-J., Mao, J., Mizielinski, M. S., Mizuta, R., Nobre, P., Satoh, M., Scoccimarro, E., Semmler, T., Small, J., and von Storch, J.-S.: *High Resolution Model Intercomparison Project (HighResMIP v1.0) for CMIP6*, Geosci. Model Dev., 9, 4185-4208, doi:10.5194/gmd-9-4185-2016

List of publications/reports from the project with complete references

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Future plans

(Please let us know of any imminent plans regarding a continuation of this research activity, in particular if they are linked to another/new Special Project.)

Analysis of the ensemble is in progress, and will continue as part of the Blue-Action Horizon2020 project.
An analysis focussing on the cold blob event and the role of model resolution in predictability is in progress.