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

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

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Project title:	The influence of CO2 on an individual extreme event - the high February temperatures in the UK 2019……. ……
Project account:	**SPGBLEAC _ _**

Additional computer resources requested for		**24/11/20**
High Performance Computing Facility	(units)	2,000,000
Data storage capacity (total)	(Gbytes)	10,000

Continue overleaf

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

Technical reasons and scientific justifications why additional resources are needed

We have been conducting a study into the foundations of medium-range forecast-based attribution. We have focussed on the European heatwave observed between 2019-02-25 and 2019-02-27; an event that was well-forecast by the ensemble prediction system. In order to the interpretation of the experiments as much as possible we have restricted ourselves to an attribution of the increased CO2 concentrations over pre-industrial levels just over the days immediately preceding the event.

To do this, we have been running experiments that are identical to the operational ensemble prediction system, except for the CO2 concentrations, which we set to pre-industrial levels; and 600 ppm.

One important factor that is unique to forecast-based attribution is the lead time at which you initialise the forecast. This heavily influences to what extent you are conditioning the attribution analysis on the synoptic situation associated with the event. So far, we have run these reduced+increased CO2 experiments at three lead times, initialising on: 2019-02-23, 2019-02-17 and 2019-02-11. This spans a wide range of levels of conditioning.

With this study, we not only aim to demonstrate how forecast-based attribution could be carried out in order to improve the robustness of attribution analyses (by using a model that clearly is able to simulate the event in question), but also to "titrate" between two schools of thought in attribution: the "risk-based" and "storyline" approaches. In brief, the risk-based approach seeks to determine the increase in likelihood of an extreme event attributable to anthropogenic activities, by defining the event in terms of some observed variable (such as the hottest day of the year), and calculating the difference in likelihood of events exceeding this in: a factual model ensemble; and a counterfactual model ensemble with anthropogenic drivers removed. This approach can also be applied to changes in event likelihood over history, and conditioning on the synoptics of the event can be included by finding analogues of the event in the two ensembles (or over history). The storyline approach suggests that a more effective approach may be to complete a "physical investigation of how the event unfolded, and how the different contributing factors might have been affected by known thermodynamic aspects of climate change" (Shepherd, 2016).

In our study, we suggest that a forecast-based approach to attribution may be able to answer the questions asked by both of these frameworks by varying the initialisation date of the forecast. Shorter lead times produce confident estimates of the "storyline" impact on an event, while longer lead times could be used to produce relatively unconditioned estimates of the increased risk due to anthropogenic drivers.

Although we have carried out experiments that span a good range of conditioning on the forecast initial conditions, we think that being able to run two more experiments (reduce+increased CO2) would strengthen our analysis. We would like to run these experiments at a longer lead time (from 2019-02-04), which would provide an ensemble that is very close to climatology (and is therefore almost entirely unconditioned). With these experiments, we would be able to more confidently state that we have fully spanned the range of "risk-based" → "storyline" approaches.

Based on the units and storage we have remaining in our project account and the experiments already completed, we calculate that to complete the two experiments at the longer lead date we will require an additional 2,000,000 SBU and 10,000 GB.