REQUEST FOR A SPECIAL PROJECT 2018–2020
AMENDMENT

MEMBER STATE: ……The Netherlands.……...……..

This form needs to be submitted via the relevant National Meteorological Service.

Principal Investigator[1]: …… Andrea Alessandri …….……

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Other researchers: …Etienne Tourigny (BSC), Franco Catalano (ENEA), Frank Selten (KNMI), Virginie Guemas (BSC)…….……

Project Title: Decadal climate predictions: exploit vegetation dynamics and improve fire risk assessment.…….……

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.)	2018	
Would you accept support for 1 year only, if necessary?	YES ☒	NO ☐

Computer resources required for 2018-2020: (To make changes to an existing project please submit an amended version of the original form.)		**2018**	**2019**	**2020**
High Performance Computing Facility	(SBU)	4,6 Millions	5 Millions	
Accumulated data storage (total archive volume)[2]	(GB)	13900	29000	

***An electronic copy of this form must be sent via e-mail to**:* *special_projects@ecmwf.int*

Electronic copy of the form sent on (please specify date): ……

[1] The Principal Investigator will act as contact person for this Special Project and, in particular, will be asked to register the project, provide an annual progress report of the project's activities, etc.

[2] 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.

Continue overleaf

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Extended abstract

All Special Project requests should provide an abstract/project description including a scientific plan, a justification of the computer resources requested and the technical characteristics of the code to be used.

Requests asking for 1,000,000 SBUs or more should be more detailed (3-5 pages).

Following submission by the relevant Member State the Special Project requests will be evaluated by ECMWF as well as the Scientific and Technical Advisory Committees. The evaluation of the requests is based on the following criteria: Relevance to ECMWF's objectives, scientific and technical quality, disciplinary relevance, and justification of the resources requested. Previous Special Project reports and the use of ECMWF software and data infrastructure will also be considered in the evaluation process.

Large requests asking for 10,000,000 SBUs or more will receive a detailed review by members of the Scientific Advisory Committee.

All accepted project requests will be published on the ECMWF website.

The Royal Netherlands Meteorological Institute (KNMI) is coordinating a new H2020-MSCA project, PROCess-based sEamless development of useful Earth system predictions over lanD (PROCEED), which aims to achieve improved Earth system predictions on multiple time scales by filling the gap between the models used for short-term prediction (verification-based) and the latest developments in the Earth System Models (process-based).

The Barcelona Supercomputing Center (BSC) is also coordinating another new H2020-MSCA project, Seasonal Prediction of Fire danger using Statistical and Dynamical models (SPFireSD). The aim of SPFireSD is to make progress in seasonal to decadal prediction of fire risk in southern Europe and globally. The BSC is leading the EC-Earth consortium's participation in the Decadal Climate Prediction Project (DCPP, Boer et al., 2016), which contributes to the 6th Coupled Model Intercomparison Project (CMIP6). The BSC will perform a large number of hindcast decadal predictions (Component A, scheduled to be ready by early 2018), semi-operational decadal predictions (Component B) and decadal climate predictability studies (Component C).

The Italian National agency for new technologies, Energy and sustainable economic development (ENEA) is partner in the European Union H2020 project: Coordinated Research in Earth Systems and Climate: Experiments, kNowledge, Dissemination and Outreach (CRESCENDO). The aim of CRESCENDO is the improvement of the process representation and simulation quality of European Earth System Models (ESMs) and ENEA contribution is particularly aimed at improving the representation of vegetation component in the EC-Earth ESM.

In a set of potential predictability experiments, a recent paper by Alessandri et al. (2017) showed the possible contribution to enhance the skill of decadal climate predictions that could come from improved representation of vegetation processes in EC-Earth. This motivates further experimentation to include vegetation dynamics in retrospective decadal climate predictions, with the aim at improving their performance and usefulness, and with a particular focus on fire risk management. The objective of this special project is (i) to verify the actual improvement of the decadal climate predictions due to improved land surface/vegetation and (ii) assess the related benefit for the prediction of fire risk. To this aim a set of sensitivity experiments will be performed with a modified version of EC-Earth that improves vegetation representation and variability by either prescribing or modeling the vegetation state and variability.

Improved representation of vegetation cover/variability

Following the approach described in Alessandri et al. (2017), an improved representation of vegetation processes will be included in the latest version of EC-Earth. In addition, the ongoing developments in the framework of the PROCEED and CRESCENDO projects will be as well incorporated, including a realistic variability of vegetation and land use cover. The realistic representation of the vegetation cover will be either modeled by the LPJ-Guess dynamic vegetation model (LPJG, Smith et al., 2014) or prescribed from observations together with a detailed representation of the land-use cover changes and the associated changes in the phenology. The year-to-year variations in land use cover will be prescribed from the LUH2 dataset (Hurtt et al. 2011). Furthermore, the current parameterization, prescribing time-invariant blended albedo for each grid point, will be replaced with an interactive albedo scheme discriminating between vegetation and soil. The bare soil albedo for extremely dry and wet conditions will be derived from the available global datasets of soil textures and colors. A parameterization of the bare soil albedo is then deduced as a function of soil water content.

Planned experiments and analyses

The EC-Earth ESM with the improved vegetation representation will be used to perform a sensitivity experiment (hereinafter DCPP-vege) covering a subset of the tier-1 (Component A1) decadal hindcasts which are already planned in the framework of DCPP. The additional DCPP-vege set of decadal hindcasts, will allow to assess the effect of the improved representation of vegetation by comparison with the control DCPP hindcasts (DCPP-ctrl) originally scheduled to be completed by early 2018 as part of BSC's contribution to DCPP (DCPP - Component A1). Note that, due to delays in the development and tuning of the physical model configuration (EC-Earth3.2 to be used for CMIP6), the DCPP-ctrl hindcasts at BSC have been rescheduled to be performed during the last 3-months of 2018 and the beginning of 2019

To evaluate the usefulness of the decadal hindcasts in forecasting fire risk occurrence, we will use the GlobFIRM fire module (Thonicke et al., 2001) included in the LPJG Dynamic Vegetation model for the prediction of burned area. A series of control runs using the offline version of LPJG, part of the EC-Earth model, will be forced by the daily output of DCPP-ctrl, providing ensemble values of burned area which will be converted to fire risk

forecasts through statistical techniques. An enhanced set of fire risk predictions will be performed using the DCPP-vege decadal prediction hindcasts by using the GlobFIRM fire module either online in EC-Earth coupled to LPJG or off-line using standalone LPJG forced by the output from DCPP-vege. The enhancement of the performance in the DCPP-vege with respect to DCPP-ctrl will be assessed in terms of the relative skill in forecasting the fire risk occurrence and by comparison with the burned area and fire risks obtained from available observed burned area datasets, such as GFED4 (Giglio et. al, 2013) .

Summary of experiments and resources

Overall, the improved set of decadal (5-years) hindcasts (DCPP-vege) will cover at least 22 start dates in the recent 1982-2010 period, i.e. when reliable satellite-derived vegetation observations are available. Selection of the start dates will also follow from an in depth evaluation of the available satellite-derived vegetation observations, so that the years when vegetation is expected to have the strongest impact will be identified. For each start date, we will perform ensembles of 5-member hindcasts, of 5-year forecast-length each, for a total of 550 years of simulation The simulations will be performed using EC-Earth at T255 horizontal resolution (corresponding to approximately 80 km lat x lon) and 91 vertical levels in the atmosphere, and ORCA1 grid in the ocean (irregular grid corresponding to nominally an average of 1 deg lat x lon) with 75 vertical levels. Part of the simulations will be performed during 2018 and the remaining in 2019 as reported in Table 1, according with the revised scheduling of the DCPP experiments.

Experiment name	Description	Start	End	Start dates (years)	Ens	Frcst length	Total years	Schedule
DCPP-vege	Decadal prediction experiment with improved vegetation	1982	2010	22	5	5 years	263.5	2018
							286.5	2019

Table 1: Summary of the Experiments planned in this project, total years of simulation and schedule.

Note that the planning as indicated in the revised table above deviates from that in the original project request that allocated all resources for 2018. The reason is that the development and tuning of the physical model configuration (EC-Earth3.2 to be used for CMIP6) has been delayed by several months and not yet completed in the frame of the EC-Earth Consortium. It is expected that the final version of EC-Earth for CMIP6 will be ready only after the summer (most likely September 2018 instead of late 2017 as envisaged at the time of submission of this Special Project) and this could significantly affect the realization of SPNLALES and therefore jeopardize the realization of DCPP-vege for the originally scheduled time in 2018. Thus, we expect to spend only a reduced part of the resources assigned for this year. To be able to complete the simulations, it will be necessary to move resources (5 Million SBU) from the first (2018) to the second year of the project (2019).

Configuration and justification of resources.

We will use EC-Earth3.2 in the standard configuration: IFS cycle 36r4, NEMO 3.6, LIM 3, LPJG v4, OASIS3-MCT and XIOS 2 (input/output server). The default resolution is T255 with 91 vertical levels in the atmosphere, and ORCA1 with 75 vertical levels in the ocean. Based on the extensive evaluation performed in the framework of the EC-Earth consortium using EC-Earth 3.2beta (Boussetta et al., 2016), the optimal configuration (without LPJG) on cca is obtained by using 11 nodes, i.e. 396 total cores. The processors are allocated such that 216 are for IFS, 108 for NEMO, 1 for XIOS and 1 for the runoff mapper. With this optimal configuration, we estimate that the model requires about 16600 SBUs per year. Overall, the total resources estimated for the project is rounded to 9600000 SBUs, which includes a small buffer of 5% to account for failing jobs that will need to be repeated (See simulation summary reported in Table 2).

Experiment name	Description	Start dates	Ensemble members	Total years
DCPP-vege	Decadal prediction experiment with improved vegetation sensitivity	22	5	550
5% buffer				27.5
Total				577.5

Table 2: Experiment planned in this project and total years of simulation

The storage (atmosphere+ocean) required reaches about 50 GB per year of simulation assuming 6-hourly output storage for the atmosphere and monthly means for the ocean. Therefore, the total storage required for the project is rounded to: 29000 GB

In case additional resources will become available through applications to PRACE and analogous programmes, further simulations will be performed with enlarged sampling (i.e. increase the number of ensemble members from 5 to 10), increased hindcast length (10 years instead of 5 years), and/or increased number of start dates.

References

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