REQUEST FOR A SPECIAL PROJECT 2017–2019

MEMBERSTATE:	Serbia
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Project Title:	Mineral Aerosol Impacts to Sub-seasonal to Seasonal Predictability (MASP)

If this is a continuation of an existing project, please state the computer project account assigned previously.	**SP**__________________	
Starting year: (Each project will have a well-defined duration, up to a maximum of 3 years, agreed at the beginning of the project.)	2017	
Would you accept support for 1 year only, if necessary?	YES ☒	NO ☐

Computer resources required for 2017-2019: (To make changes to an existing project please submit an amended version of the original form.)		**2017**	**2018**	**2019**
High Performance Computing Facility	(SBU)	5000000	5000000	5000000
Accumulated data storage (total archive volume)[2]	(GB)	12000	12000	12000

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): 8 July 2016

Continue overleaf

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[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.

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Extended abstract

It is expected that Special Projects requesting large amounts of computingresources (1,000,000 SBU or more) should provide a more detailed abstract/project description (3-5 pages) including a scientific plan, a justification of the computer resources requested and thetechnical characteristics of the code to be used.The Scientific Advisory Committee and the Technical Advisory Committee review the scientific and technical aspects of each Special Project application. The review process takes into account the resources available, the quality of the scientific and technical proposals, the use of ECMWF software and data infrastructure, and their relevance to ECMWF's objectives. - Descriptions of all accepted projects will be published on the ECMWF website.

Scientific background

Mineral dust as the most abundant aerosol plays important role in the Earth system. Dust is identified as the aerosol with major uncertainty in the climate system (IPCC, 2013) when compared with other particles types. Generally, there are two major ways in dust interactions with the atmosphere depending on its time scales ranging from synoptic (Perez et al., 2006) to seasonal and climate scales (Mahowald et al., 2010).

The first dust effect is direct, related to modification of atmosphere radiation budget through absorption and scattering of incoming solar radiation, and absorption and reemission of outgoing longwave radiation. The intensity of dust effects depends on the optical properties of dust, its vertical distribution, cloud cover, and albedo of the underlying surface. Both the magnitude and the sign of the dust radiative forcing are still not satisfactory in atmospheric models and the dust-radiation issue is a matter of extensive research (Perez et al., 2006; Rémy et al., 2015).

The second effect is indirect which relates to [dust]-[cold cloud] interactions. A breakthrough in understanding the role of dust in cold clouds formation has been achieved in several most recent studies (Cziczo et al., 2013; Atkinson et al., 2014; DeMott et al., 2016). Namely, about 2/3 of ice residues in cold clouds is pure dust, which triggers ice nucleation even at quite low concentrations. Ice nucleation due to dust therefore occurs often at distant locations. Both direct and indirect dust-atmosphere interactions play important role to scales spanning from weather to climate features and are the matter of extensive research over last decade (Rémy et al., 2015; Perez et al., 2006).

The aim of this special project is to assess the impact of dust aerosol in sub-seasonal to seasonal model predictions. Our focus will be on the first month and months 2-4 of seasonal re-forecast runs.

For the purpose of this study we will use the Dust Atmospheric Model - DREAM (Nickovic, 2001; Nickovic, 2004; Vukovic et al., 2014; Pejanovic et al., 2012) driven by the NMM atmospheric model (Janjic et al., 2001) coupled with the POM ocean model (Djurdjevic and Rajkovic, 2008).

DREAM is one of the most widely used dust models in the operational and scientific community. RHMSS with DREAM also participates in the WMO SDS-WAS dust model intercomparison project.

We will implement parameterization of direct dust effects following Nickovic (2004) and Perez et al. (2006). Indirect effects will be included following the parameterization of ice nucleation due to dust (Nickovic et al., 2016). Our study will examine effects of mineral dust aerosol, introduced as prediction parameter, to eventually increase the NWP model predictability at sub-seasonal and seasonal temporal scales.

RHMSS develops an Earth System Model (RCM-SEEVCCC model) within the South East European Virtual Climate Change Center (SEEVCCC, WMO RA VI RCC-Network member) for providing operational seasonal predictions (Pejanovic et al., 2011; Djordjevic et al., 2014). The system is based on dynamical downscaling of ECMWF System 4 seasonal forecast, using a regional atmosphere-ocean coupled model. The forecast run is for 7 months ahead. Horizontal resolution is 0.25 degrees for atmospheric model and 0.2 degrees for the ocean model. The connection between the two components is through a coupler that performs the exchange of atmospheric surface fluxes and sea surface temperature (Djurdjevic and Rajkovic, 2008). The forecast consists of 51 ensemble members and is issued ones per month. Model outputs are regularly used for WMO Regional Climate Outlook Forum in SEE. RHMSS/SEEVCCC started to issue seasonal forecast for South East Europe region in June 2009.

Work plan

The main objective of this special project is to investigate the impact of aerosol direct and indirect effects on the predictability of a prognostic model at sub-seasonal and seasonal (S2S) scales.

In the initial project phase we will determine a suitable model configuration and setup in order to meet the objectives of the project.

After finalizing the setting up the model configuration, we will perform 5-weeks model runs covering the period of 10 years. This runs will be forced by the ERA-Interim reanalysis in order to provide a control experiment dataset without mineral aerosol component.

The second phase will include interaction between the coupled atmospheric-ocean model (NMM-POM) and dust (DREAM) model components in which direct and indirect effects of dust will be activated. Within the DREAM model, we will use 8 particle bins ranging from sub-micron to 8 microns, the range critically important for both radiation aerosol forcing and for cloud nucleation. A global mineralogy of arid soils (Nickovic et al., 2012) will be also incorporated to include impact of dust mineralogy to cold cloud formation as proposed by the ice nucleation parameterization of Atkinson et al. (2014).

An extensive validation of the control and the run with atmosphere-aerosol feedbacks will be performed against conventional meteorological parameters (temperature, wind, moisture, geopotential) in order to estimate possible improvements in the model S2S predictability. In addition, the aerosol component will be validated against the aerosol optical depth AERONET observations. A special attention will be paid to examine if improved predictability could support better disease/planning control of meningitis in the Sahel region which is highly correlated with dusty weather (WMO, 2012)

In the case of expected positive results with respect to improved predictability, we will replace ERA-INTERIM forcing with the ECMWF ensemble extended range forecasts to assess potential improvements in the operational S2S forecasts.

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