REQUEST FOR A SPECIAL PROJECT 2012–2014

MEMBER STATE: …………………ITALY…………………………………………...…

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Project Title: Interactions between the Atlantic Ocean, African monsoon, the Indian and Pacific Oceans using the EC-Earth and IFS modelling systems ……………………………

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

Computer resources required for 2012-2014: (The maximum project duration is 3 years, therefore a continuation project cannot request resources for 2014.)		**2012**	**2013**	**2014**
High Performance Computing Facility	(units)	500,00	500,00	
Data storage capacity (total archive volume)	(gigabytes)	1000	1000	

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):

……18.04.2011………………

Continue overleaf

[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.

Principal Investigator: ………………Dr. Fred Kucharski…………………

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Extended abstract

It is expected that Special Projects requesting large amounts of computing resources (500,000 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 the technical 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.

The influence of the El Nino-Southern Oscillation (ENSO), being the largest forcing for interannual global Climate variations, on the surrounding land and ocean regions is well established, and has been analyzed in many studies (e.g. Trenberth et al., 1998).

However, recent studies using observational data and intermediate complexity models suggest a strong influence of the Atlantic Ocean on the surrounding regions, in particular on the Indian and Pacific region (Kucharski et al. 2007, Kucharski et al. 2008, Kucharski et al., 2009, Wang et al. 2009, Rodriguez-Fonseca et al. 2009). Kucharski et al. (2007), Kucharski et al. (2008) and Kucharski et al. (2009) showed that south tropical Atlantic SST anomalies have a substantial influence on the Indian monsoon rainfall interannual variability. Since the relationship between tropical Atlantic and eastern Pacific SST anomalies is strongly varying the last 50 years of the 20th century, the competing effects of tropical Atlantic and eastern Pacific SSTs on the Indian monsoon may have contributed substantially to the decadal variations of the Indian monsoon-ENSO relationship that have been observed in the past century. In particular, in the period 1975 to 1999 a strong anticorrelation between tropical Atlantic and east Pacific SSTs has been observed. Given that positive SST anomalies in both basins act to reduce the Indian monsoon rainfall, this could have contributed to the dramatic reduction of the ENSO-Indian monsoon relationship that has been observed in the same period.

The physical mechanism for the tropical Atlantic influence on west African and Indian monsoon precipitation that has been proposed based on relatively coarse resolution intermediate complexity model simulations is that a Gill-Matsuno-type response excited in the tropical Atlantic is affecting also the Indian region.

The tropical Atlantic is also important for West African rainfall as well, especially in the coastal countries. In particular, phase changes of the Atlantic multidecadal mode are accompanied by fluctuations in the West African monsoon (WAM) system with an enhanced monsoon seen during the 1950s-60s compared to the 1970s-mid 90s (e.g. Folland et al 1986, Rowell et al. 1995, Nicholson 1996). In turn, variations in the WAM influence the upper-level atmospheric circulation across the tropical Atlantic and Africa in both hemispheres, and they are likely a contributing factor to the observed decadal variations in the North Atlantic hurricane activity (Goldenberg and Shapiro, 1996).

Moreover, a study by Chelliah and Bell (2004) evidences also a systematic organization of a Walker-type circulation in the vertical-zonal plane at both interannual and decadal/multi-decadal time scales, linking portion of the monsoon system activity, strictly connected to the Atlantic SST, over equatorial America-Africa-southeast Asia.

Wang et al. (2009) and Rodriguez-Fonseca et al. (2009) also suggested influences of the tropical Atlantic on the Indian Ocean and Pacific Ocean. Wang et al. (2009) emphasise the importance of a tropical Atlantic-eastern Pacific SST gradient and the role the Atlantic Ocean plays in this. Also, the influence of the tropical Atlantic on the Indian Ocean has been investigated. On the other hand, Rodriguez-Fonseca et al. (2009) present evidence for the hypothesis that spring and summer tropical Atlantic SST anomalies may lead to (or enhanced) ENSO developments in the following winter.

Since most of these studies are based only on observational data and intermediate complexity model simulations, the aim of this project is to use the latest state-of-the-art modelling systems EC-Earth and/or the IFS to confirm and refine the various hypothesises outlined above. Relatively high-resolution and complex physics simulations are essential to increase confidence in the hypothesis that the tropical Atlantic may have a much stronger impact on the surrounding ocean and land masses than previously thought. However, also simulations with the intermediate complexity ICTPAGCM coupled to OPA/NEMO will be performed, because the efficiency of this model enables to assess and validate new techniques quickly.

In this project a number of targeted, at least 50-year long simulations are planned where the tropical Atlantic SSTs are prescribed from observations, but elsewhere a fully coupled model is adopted. Also, SSTs may be prescribed in the tropical Atlantic region and climatological SSTs elsewhere to isolate the effect of tropical Atlantic SST anomalies on the surrounding regions. Both together strategies are important to also understand the role of air-sea coupling in the various teleconnections to the tropical Atlantic. Prescribing SSTs in the tropical Atlantic regions avoids the problem of drift in SSTs often present even in state-of-the-art modelling systems (Tompkins and Feudale, submitted to WAF). The outcome will have substantial importance for seasonal forecasting of in general and in particular for the ECMWF forecasting system**.**

The planned integrations require yearly a minimum of 250 years of integrations (6 ensemble members of 50 year integrations), with an estimate that 1 year of integration needs 16 h on 16 cpu's. This gives an estimate of the yearly need of 50,000 cpu hours.

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