REQUEST FOR A SPECIAL PROJECT RENEWAL 2011–2012

MEMBER STATE: … ITALY ……

Principal Investigator[1]: … Dr. Adrian Tompkins ……

Affiliation: Abdus Salam International Centre for Theoretical Physics (ICTP)

Address: ……..……

Strada Costiera 11, 34014 Trieste, Italy

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E-mail: Tompkins@ictp.it

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Other researchers: External Organisations are specified below These organisations will access processed forecast fields for analysis and validation but will not require access to ECMWF computing facilities The task of conducting sensitivity experiments and data access on MARS will be solely conducted by ICTP.

Project Title: Use and value of ECMWF short-range and seasonal forecast products for developing countries in terms of end-user impact variables ……..……

Computer resources required for 2009-2011:	**2010**	**2011**	**2012**
High Performance Computing Facility (units)	100,000	300,000 (additional resources of 2000000 requested and granted	500,000
Data storage capacity (total archive volume) (gigabytes)	100	100	500

Is this a continuation of an existing project?	YES ☒	NO ☐
If YES, please state the computer project account assigned previously	SPITP4DC	
Would you accept support for 1 year only if necessary?	YES ☒	NO ☐

*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): ……06/2011……

[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

Continue overleaf

Extended abstract

(It is expected that Special Projects requesting large amount of computer resources should provide a more detailed abstract/project description including a scientific plan and a justification of the computer resources requested)

The purpose of this Special Project is to use ECMWF hindcasts output directly to drive end-user impacts models in three distinct pilot projects focussing on developing countries in Africa, namely Ghana, Senegal and Malawi, with a possible extension to Uganda and Ethiopia if access to data sources can be established . The science in each project focuses on the coupling of the ECMWF systems to end-user dynamical models for water discharge and crop production, and then test the predictability of these coupled system in tropical regions. The project will test CDF-based bias correction techniques developed at ICTP under the EU-FP WATCH project to join the medium range, monthly and seasonal models seamlessly to drive the end-user impacts models.

A limited allocation of computing resources is requested to allow a small set of sensitivity experiments to be conducted for each subproject to investigate the predictability of the region concerned with sensitivity integrations conducted with the IFS or possibly also the EC_Earth system

This request was then extended in 2011 due to ICTP's participation in the QWeCI project concerned with climate-health interactions on monthly to seasonal timescales and beyond. The allocation of extra computing resources to ICTP is to provide regional model seasonal forecast ensembles that are driven by seasonal forecasts for a three month lead time. The aim is to see if the resolving the complex topography in the target regions with the higher resolution of the regional model can add to the quality of the local forecasts in Southern and Western Africa, and if the use of a regional model is an effective method to produce seamless seasonal range forecasts joining the discrete ECMWF systems.

Experiments 1 and 2 will conduct a suite of downscaling integrations downscaling each member of the seasonal forecast to a resolution of approximately 25km One integration is covers the project target regions in West Africa, Senegal and Ghana, and thus will downscale the ENSEMBLES (the ENSEMBLES integrations using system 3 are used as they have 6 hourly model level fields archived to provide lateral boundary conditions) seasonal forecasts starting in May and will examine a lead time of 4 months as the seasonal system is unlikely to have significant skill beyond this range although it does mean that the tail-end of the rainy season will be missed. The second experiment instead targets Malawi and will use the November start and run for 4 months as well.

The groundwork of setting up the REGCM model under the SMS suite has already been accomplished using the ENSEMBLES projects hindcast series under the SPITP4DC member state account

As the dynamical downscaling technique relies on frequency archiving of model level data for boundary conditions, a third stream of experiments will examine the downscaling the forecasts with the novel approach of using a "tropical band model". The tropical band model of the REGCM4 1 represents a tropical strip around the equator thus with only the need to provide lateral period boundary conditions Using the band model means that the availability of 12 hourly model level data for boundary conditions is less important for the diurnal cycle of the meteorology since these are only applied at the north and southern edge and thus the lack of East-West boundaries implies that 12 hourly archiving is sufficient to model the diurnal cycle (this will be tested with smaller integrations using the ENSEMBLES runs) The band models 12 hourly boundary condition requirement means it can be used to downscale both monthly and seasonal forecasts.

The band model will thus be used to see if this method can effectively join the monthly EPS and seasonal forecast systems together "seamlessly" without a significant shock at the simulation temporal boundaries

These integrations are more expensive and will be conducted for a shorter period and only using month 2 of the seasonal forecast system.

Apart from the direct application to the QWeCI project this work will also have wider implications for whole approach of climate dynamical downscaling since despite their wide-spread use as downscaling tools for climate, most validation of these systems are conducted in terms of the mean climate and the statistics of its variability. It is argued that if these modelling systems are unable to improve regional skill on monthly to seasonal timescales then it brings their value in climate regional downscaling into question

Some of these experiments are motivated by the work of Tompkins and Feudale 2009 *"West Africa Monsoon Seasonal Precipitation Forecast in ECMWF System 3 with a Focus on the AMMA SOP" manuscript under revision in monthly weather Review,* which showed how such influenced impact the seasonal precipitation forecast skill in West Africa in the coupled system.

The benefit of this project to ECMWF will be validation and feedback concerning the performance of the IFS in these tropical regions, using data unavailable on the GTS from local Meteorological services In each case where the hindcast coupled integrated demonstrate useful skill, the ultimate aim would be for the developing country partner institute to run the validated *end-user model* for flood forecasting or crop production on a pseudo-operational fashion

Specifically the 2011 sub-projects consist of:

1) Crop forecasting on seasonal timescales in Ghana using the GLAM crop model

External Partners: Ghana/Senegal National Meteorological Agencies, Leeds University, UK.

Agriculture in West Africa is largely rain-fed and thus crop production is subject to the variability of the monsoon precipitation over seasonal and sub-seasonal timescales Both Senegal and Ghana suffer from periodic droughts in the interior regions away from the coasts the most recent example in Ghana occurring in 2006, followed by localized flooding events in 2007 Prediction of crops on seasonal timescales allows preparation for governmental and aid agencies to prepare mitigation actions in a timely fashion however the reliable prediction of crops over these timescales is hindered by the predictability of the rains and the lack of validated crop models. Recent work on the ECMWF system 3 seasonal forecast system by Tompkins and Feudale (2009) reemphasizes the importance of the coupled model sea surface temperature errors in the Gulf of Guinea for this region but shows potential predictability on monthly timescales Most crop models used in this region are statistical in nature and tend to miss extremes while dynamical crop models have not been tested extensively.

This project would aim to (1) Drive the GLAM crop model using SYNOP observations provided by the partner Met Agencies to validate and improve the model's ability to predict seasonal crop yield for each region (2) Drive GLAM using the reanalysis and determine the impact of using a grid-based model product and predictability potential (3) drive GLAM using monthly and seasonal forecast output both raw and bias corrected to determine the predictability limit of seasonal yield

2) Seasonal hydrological discharge modelling for the Volta basin using CHYM

External Partners: Maritime University Accra/CSIR-Water Research Institute, Accra, Ghana-MET

Ghana relies heavily on hydroelectric power and thus droughts such as suffered in 2006 have far reaching socio-economical consequences beyond the direct and potentially severe impact on agriculture This project funded by the Italian Ministry for Foreign Affairs collaborates with the water research institute and the researchers at IWMI and the Maritime University to investigate the potential for seasonal discharge prediction with focus on the management of the Volta dam facilities The ICTP discharge model has been set up to model the upper Volta basin discharger routing network and will be driven by forecast output either directly from ECMWF, or using ECMWF boundary conditions to drive the WRF model to determine if well

resolving the local topology may add skill This project shares the same region as project 2 above, and the sensitivity integrations conducted there will also be used to drive the CHYM model to determine the impact on Volta discharge predictions.

3) Seasonal-forecasting of malaria in Malawi

External partners: Malawi ministry of health, College of Medicine Blantyre, Blantyre polytechnique, Malawi

This is a new project component that is being carried out as part of the QWeCI project. The new VECTRI malaria model (Tompkins and Ermert, manuscript in preparation) developed at ICTP will be driven by bias corrected monthly and seasonal forecasts over Malawi and Uganda (bias correction manuscript in preparation, Di Giuseppe, Molteni and Tompkins). Further details will be compiled in the progress report of 2011-12.