SPECIAL PROJECT PROGRESS REPORT

Progress Reports should be 2 to 10 pages in length, depending on importance of the project. All the following mandatory information needs to be provided.

Reporting year	2015
Project Title:	Use and value of ECMWF short-range and seasonal forecast products for developing countries in terms of end-user impact variables
Computer Project Account:	SPITP4DC
Principal Investigator(s):	Adrian Tompkins …………………………………………………………
Affiliation:	Abdus Salam International Institute for Theoretical Physics (ICTP)
Name of ECMWF scientist(s) collaborating to the project (if applicable)	………………………………………………………… …………………………………………………………
Start date of the project:	1 January 2013
Expected end date:	31 December 2015

Computer resources allocated/used for the current year and the previous one

(if applicable)

Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)	300,000	0	300 000	219 718
Data storage capacity	(Gbytes)	100Gb		100 Gb	

Summary of project objectives

(10 lines max)

The projects examines the scope for operational seasonal forecasting of health risks in developing countries, with the primary interest concerning the prediction of malaria transmission and develop products that may be useful for the end-user he (bias corrected) monthly EPS and SYSTEM4 seasonal forecast system to the ICTP dynamical malaria model VECTRI. The precipitation and temperature forecasts then lead to forecasts of malaria transmission intensity, prevalence rates and eventually also actually hospital case data. The project will set up the pilot system, examine the skill in the target countries using hindcast datasets, analyze if improvements can be made including non-climatic factors, and finally, but most importantly, work directly with the ministry of health in the target countries to develop and hone end-user products that are directly useful to stakeholders and decision makers.

Summary of problems encountered (if any)

(20 lines max)

none to report

Summary of results of the current year (from July of previous year to June of current year)

The key activities undertaking over the previous 12 months :

a) *Upgrade the VECTRI model version in the forecast system*

- The system has been upgraded to v1.3.3
- VECTRI modifications including changes to the bite rate parameterization and numerous improvements to the model interfaces.
- VECTRI is now freely available through a GIT-hub repository to facilitate future upgrades at ECMWF, but in in advance of the ECMWF system by two cycles at v1.3.5

b) *Country-level hindcast analysis*

Further analysis at country and district level has been made for Uganda, Rwanda and Malawi. Some issues were found using an earlier VECTRI cycle, and the hindcast ensemble was thus reconducted with v1.3.3 of VECTRI, which slowed progress on the paper submission. The present results show that using high quality sentinel data the system is skillful for all stations, while for the district health data (unconfirmed cases) in Uganda and Rwanda, the system is skillful for approximately half of the districts at a lead of 4 months (Fig. 1). This work is ongoing with a publication in preparation and further details will be provided in the final report. The key difficultly encountered in this is the complexity of integrating this information into the key decision making processes in ministries. This aspect will form the key focus of the next phase of the special project.

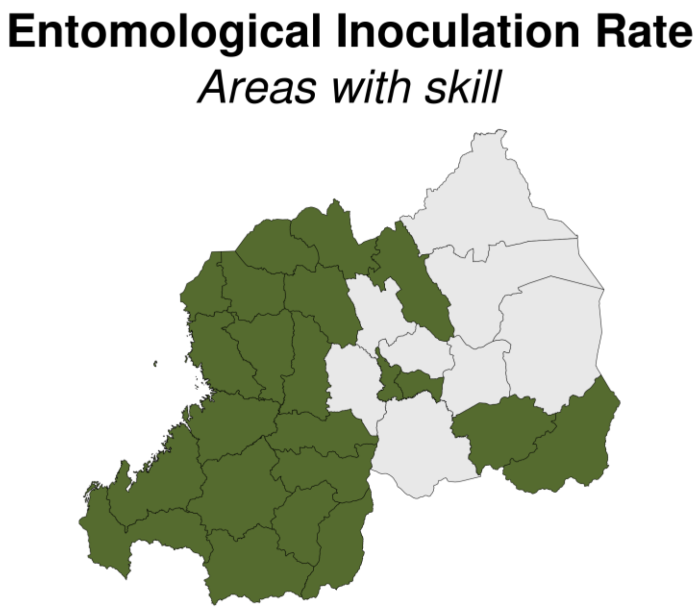

Figure 1: Example of hindcast simulations using the IFS to drive VECTRI in Rwanda. Shaded districts are those with significant skill on a four month lead time.

c) *Stochastic Ensembles of VECTRI runs*

In the earlier a framework has been set up to facilitate large-ensemble integrations using perturbed parameters to generate the ensemble. These have been tested for single locations in order to facilitate large Monte Carlo experiments. Each ensemble member includes a perturbation to a subset of VECTRI parameters, with the perturbation magnitude set to 20% for the majority of variables and 40% for those which are deemed highly uncertain from the literature. An example from a test case using long-term historical climate data is shown in fig. 2 for a location in Uganda. The figure reveals how small perturbations to relatively uncertain parameters can lead to some years being simulated as "outbreak" years, for which the default model simulates no transmission. The next step underway is to devise a genetic algorithm to select sets of parameter setting with a higher likelihood according to a verification metric using a handful of locations with high quality health data. These settings would then be used in the forecasts system framework to generate a "grand-ensemble", where by the ensemble accounts not only for forecast data uncertainty through the use of the IFS ensemble, but also some aspects of malaria model uncertainty through parameter perturbations.

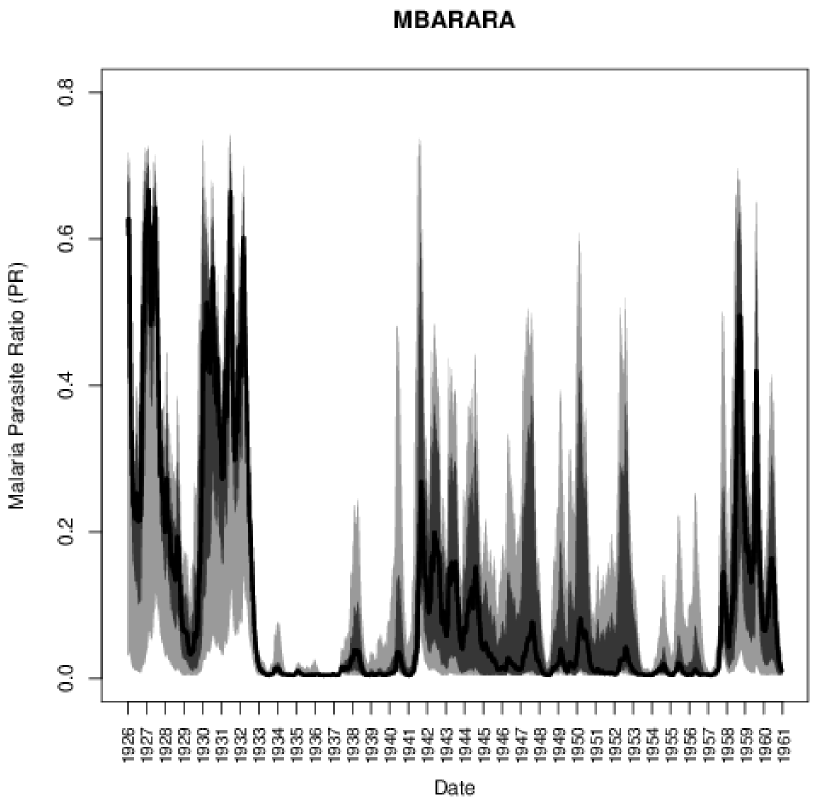

Figure 2: Stochastic historical simulations of the parasite ratio for a single location in Uganda. The dark shading indicates the 25-75% inner quartiles while the light shading is the 10-90%.

d) Collaborations of opportunity.

While not strictly related to the project topic, the project computer resources were partly used to conduct a number of tests of an IFS code development to implement an improved overlap parameterization in the radiation scheme code. While conducting this work the SPITP4DC PI found a number of related issues with the existing code which were corrected and the improved branch passed to the PA section of ECMWF. A separate internal report will be submitted soon with details.

Use of computer resources

74% of the 2015 units allocated to the project have been used.

List of publications/reports from the project with complete references

Tompkins, Adrian M., and Volker Ermert. "A regional-scale, high resolution dynamical malaria model that accounts for population density, climate and surface hydrology." Malaria journal 12.1 (2013): 65.

Caminade C, Kovats RS, Rocklov J, Tompkins AM, Morse AP, Jesus Colon-Gonzalez F, Stenlund H, Martens P, Lloyd SJ, 2014: Modelling the impact of climate change on malaria: a comparison of global malaria models, PNAS, doi: 10.1073/pnas.1302089111

Piontek et al. (incl. Tompkins) 2014: Multisectoral climate impact hotspots in a warming world, PNAS, doi: 10.1073/pnas.1222471110

A. M. Tompkins and F. Di Giuseppe. Potential predictability of malaria using ECMWF monthly and seasonal climate forecasts in Africa. J. Appl. Meteor. Clim, 54:521-540, 2015

F. Di Giuseppe and A. M. Tompkins. A parameterization for the vertical overlap of clouds as a function of wind shear. J. Atmos. Sci., 72: in press, 2015.

Christoph Dyroff, Andreas Zahn, Emanuel Christner, Richard Forbes, Adrian M. Tompkins, and Peter F. J. van Velthoven. Comparison of ECMWF analysis and forecast humidity data to CARIBIC upper troposphere and lower stratosphere observations. Q. J. R. Meteorol. Soc., 141:833-844, 2015.

A. M. Tompkins and F. Di Giuseppe. An interpretation of cloud overlap statistics. J. Atmos. Sci., -:in press, 2015

Summary of plans for the continuation of the project

An application will be made to continue the project for a further three years. The key goal of the next phase will be to investigate how best to integrate the IFS-derived climate-health information into the health decision making process. This will focus on Uganda and possibly Senegal. Further extensions to the system will be investigated, including extending the modelling system to account for dengue and lymphatic filariasis.