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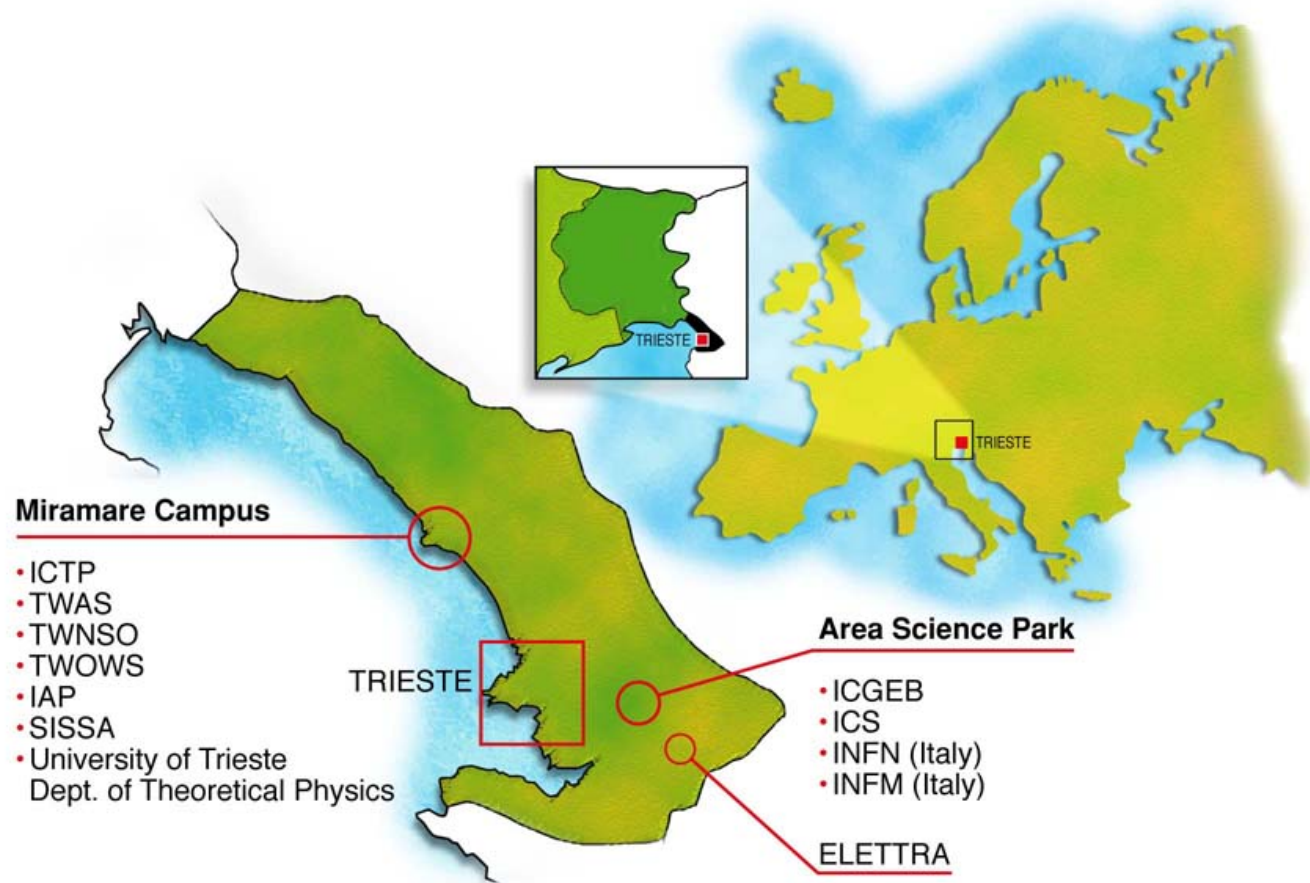
**Joint ICTP-IAEA Advancing Modelling of Climate, Land-use,  
Energy and Water (CLEW) Interactions**

***7 - 11 October 2013***

**ICTP Overview**

**Adrian Tompkins**  
***ICTP - Trieste***

# ICTP Overview



# What we do



- Foster the growth of advanced studies and research in physics and mathematics, especially among researchers from developing countries
- Provide an international forum for the exchange of information and ideas among scientists from the North and South
- Maintain excellent research facilities for visitors, associates and fellows, principally from developing countries, who participate in the Centre's research and training activities

# Who benefits

- 4,000 scientists/year
  - 5 research groups
  - 50 scientific activities/year
    - Conferences
    - Workshops
    - Schools



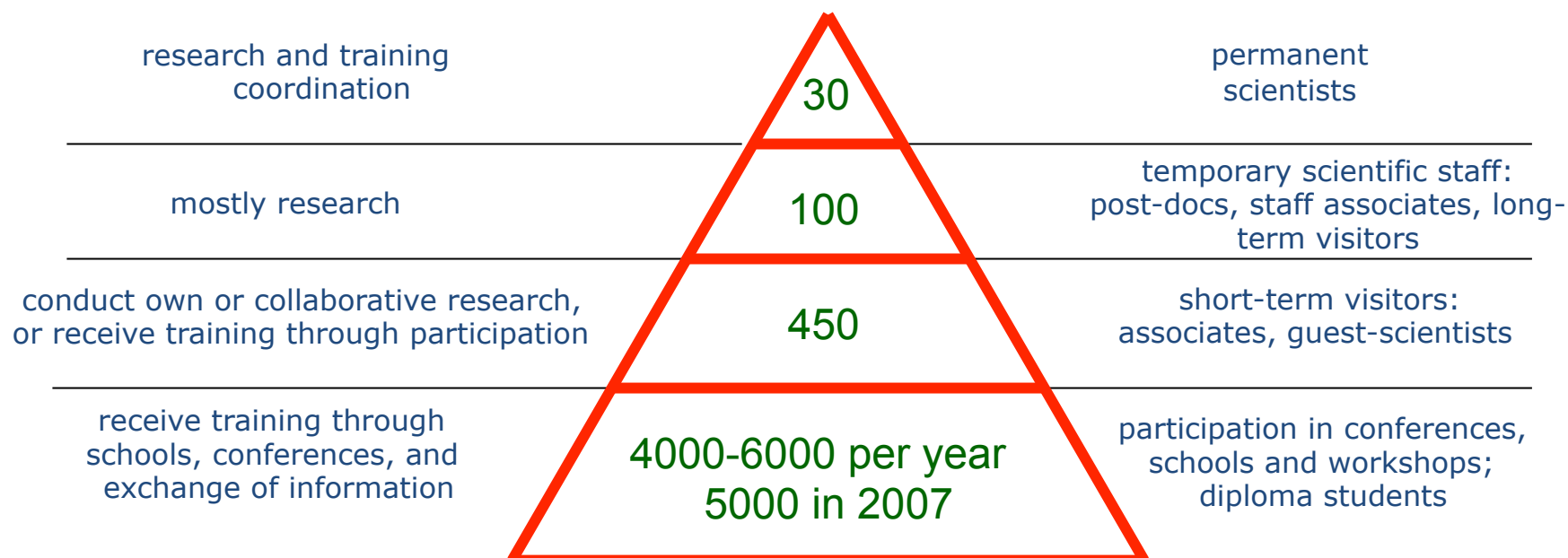
- More than 100,000 visits since 1964
  - 60% from developing countries
  - 40% from developed countries
  - 170 nations represented





## ICTP Scientists, Visitors and their Functions

**ICTP is an institution run by a few scientists for the benefit of many**





# ICTP training opportunities

- Associate and federation scheme: <http://portal.ictp.it/assoc>  
deadline :30 September of each year
- Diploma Program: <http://diploma.ictp.it>, deadline: 31 December of each year
- STEP PhD Sandwich Program:  
[http://users.ictp.it/www\\_users/STEP/STEP.html](http://users.ictp.it/www_users/STEP/STEP.html), deadlines: 15 February and 15 August of each year.
- Training and Research in Italian Laboratoris ICTP-TRIL:  
<http://portal.ictp.it/tril/>



# Beyond Trieste

TRIL Programme since 1983

- Training and Research in Italian Laboratories (TRIL)
  - Offers scientists from developing countries an advanced experimental counterpart of ICTP's primarily research and lecture-based training
  - More than 350 Italian laboratories have participated in the Programme.
  - Over the past two decades, TRIL has awarded some 1700 grants to more than 1100 fellows from 74 countries



# On-campus Programmes

## Sandwich Training Educational Programme (STEP)

- Started in 2002
  - Offers fellowship opportunities to Ph.D students from developing countries
  - Nuclear physics, soil physics, lasers, environmental physics, synchrotron radiation, fluid dynamics, condensed matter
  - The programme has supported 74 fellows: 36 from Africa, 13 from Asia, 20 from Europe, 4 from Central America
  - Funded by ICTP, IAEA's Department of Technical Cooperation, CEI (Central European Initiative), Japanese Government through UNESCO-ICTP Mori Fellowship Scheme.



# On-campus Programmes

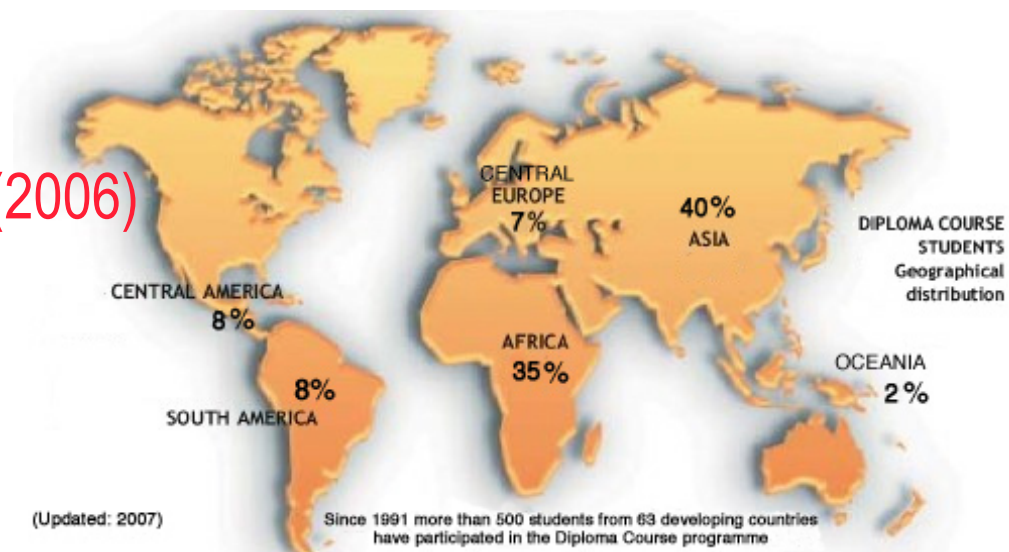
Associate Programme – almost as old as ICTP.

- Three levels – junior, regular and senior
- 6 year appointment, during which associate visits ICTP 3 times for stays between 35 and 70 days.
- Deadline - 1 October - 31 January of year prior to year of commencement

# On-campus Programmes

## Diploma Programme — Courses of Study

- Condensed Matter Physics
- High Energy Physics
- Mathematics
- **Earth System Physics (2006)**
- Basic Physics (2007)

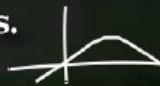




# Diploma Programme

diploma.ictp.it

An intense 12 month pre-PhD educational programme of the ICTP for talented young science students from developing countries. The Diploma Programme is made of four specialized fields, reflecting the core research activities of the ICTP sections (Condensed Matter, Earth System Physics, High Energy Physics & Mathematics) and one field in Basic Physics designed to students from sub-Saharan Africa, with an intense and comprehensive revision of undergraduate physics.







## Diploma Programme

diploma.ictp.it



Talented young science students in developing countries are sometimes limited in achieving their full potential by the absence of advanced training at a postgraduate level, and up to standard international criteria.

Our goal in these programmes is to take good students from the least developed countries generally and provide an opportunity for them to compete favorably for graduate studies in any centre of learning in the world.

October 27, 2013



11





## Diploma Programme

diploma.ictp.it



The Earth System Physics diploma is a taught course that lasts for one year. The course has the equivalent level of a masters degree, and includes subjects from solid Earth geophysics and both atmospheric and oceanic physics, in addition to a groundwork on skills such as Fortran programming and numerical and mathematical methods.





# Diploma Programme

diploma.ictp.it



## I Term (September – December)

- Wave Physics (ESP-WP)
- Fluid Mechanics (ESP-FM)
- Earth System Thermodynamics (ESP-EST)
- Physics of the Solid Earth (ESP-PSE)
- Physics of the Atmosphere (ESP-PA)
- Physics of the Oceans (ESP-PO)
- Numerical Methods I (ESP/CMP-NUM I)

## II Term (January – May)

- Seismology (ESP-SEIS)
- Mechanics of Earthquakes and Tectonophysics (ESP-MET)
- Numerical Methods II (ESP-NUM II)
- Biogeochemical Cycles (ESP-BC)
- Climate Dynamics (ESP-CD)
- Hydrology (ESP-HYD)
- Space Geodesy and Observational Seismology (ESP-GS)
- Specific Topics on Atmospheric Monitoring and Extreme Events (ESP-ST)

## Individual Research Projects (June - August)



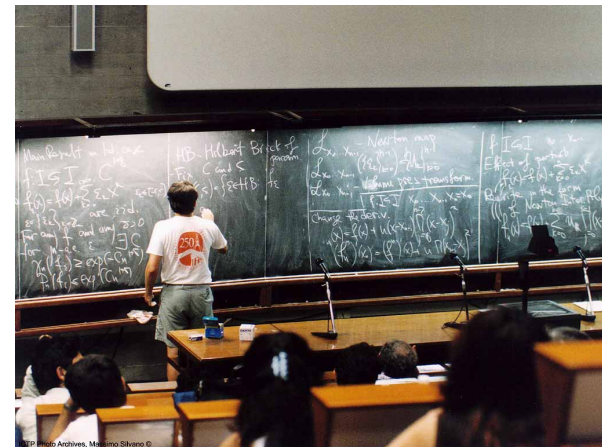
# ICTP Marie-Curie Library



- The ICTP Library is one of the best equipped specialized libraries in Europe with a collection of over 67,000 books, 400 printed journals and 4,000 electronic journals
- The ICTP library hosts the eJDS (Electronic Journals Delivery Service) <http://library.ictp.it/ejds>

# Fields of study

- Applied physics (AP)
- Condensed matter and statistical physics (CMSP)
- **Earth system physics (ESP)**
- High energy, cosmology and astroparticle physics (HECAP)
- Mathematics (Math)
- Multidisciplinary Laboratory (Mlab)







**SOCIETY**

**DEVELOPMENT**

# Earth System Physics Section (ESP)

- 6 Scientific staff
- 12 Long term visitors and postdoctoral fellows
- 2 staff associates
- 7 PhD and step students

**ENVIRONMENT**

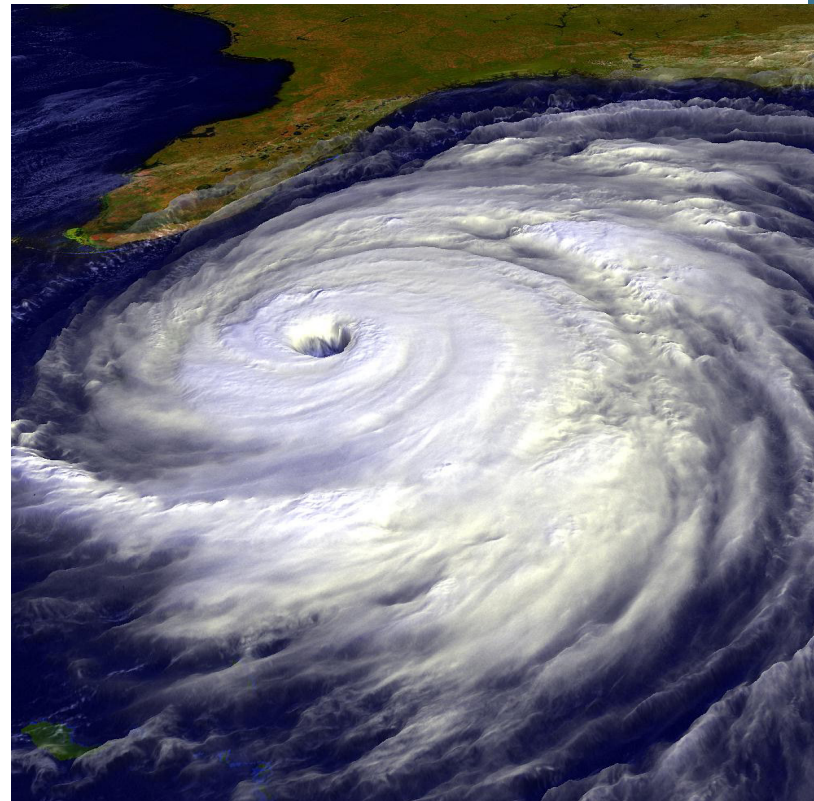
# Active externally funded projects



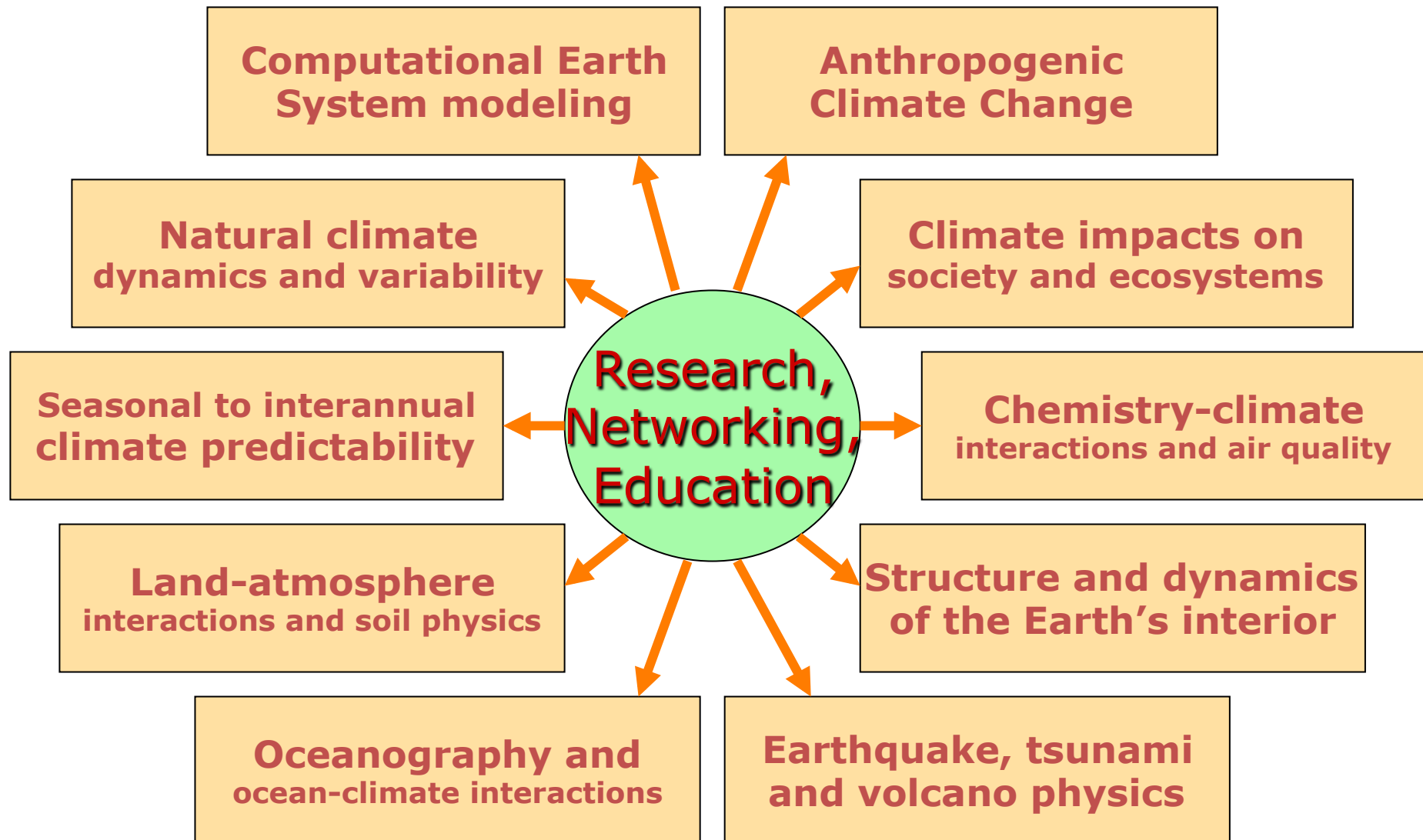
- ACQWA, EU, Climate change and water in mountainous system
- WATCH, EU, Global climate change and water resources
- MEGAPOLI, EU, Effect of megacities on air quality and climate
- QWECI, EU, Forecasting system for disease outbreaks in Africa
- HEALTHY FUTURES, EU, Climate change and vector borne diseases in equatorial Africa
- CLIM-RUN, EU, Climate service network in the Mediterranean region
- ATOPICA, EU, Climate change and atopic diseases
- EU-India Grid, EU, Grid computing towards climate change research
- SOCOCA, Norwegian Research Council, Climate change, water, agriculture and economical impacts in sub-equatorial Africa
- AFRICARP, Ministry of Foreign Affairs, Network for Africa Community Access to regional (seasonal and climate) prediction for end-user groups
- Italian fund trust with UNESCO on building environmental (seismological) networks in Africa
- PAPRIKA, CNR, Effect of climate change on melting of Himalaya glaciers
- SUDD-IAEA, Effect of SUDD swamps on regional climate
- ILLY post-doctoral fellowship on climate change and coffee.
- CASPIAN, SHELL, Effect of climate change on Caspian Sea Level Change



# ESP Main Research Areas

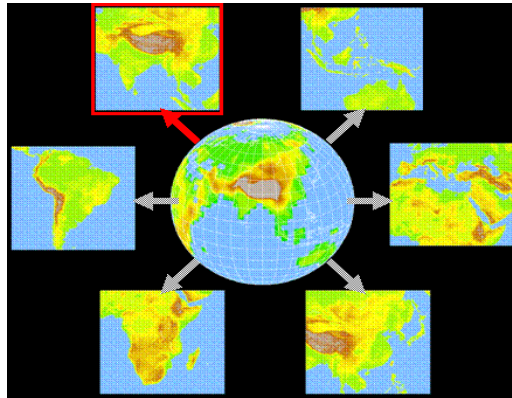


# ESP Main Research Areas





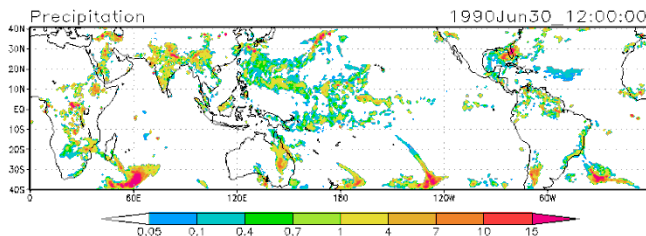
# Computational Earth System modeling



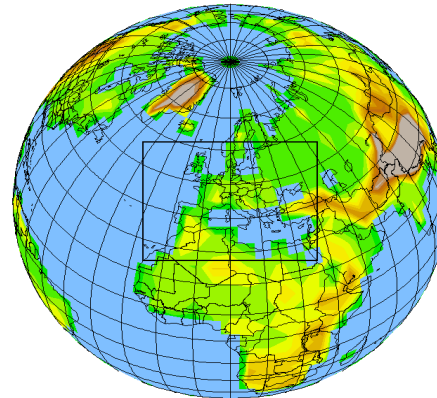
**Regional Earth System  
Modeling (RegCM)**



**Global Earth System  
Modeling  
(ECHAM, SPEEDY)**



**RegCM Tropical Band**



**Computing resources:  
Local cluster (ARGO)  
SISSA cluster  
CINECA  
ECMWF**

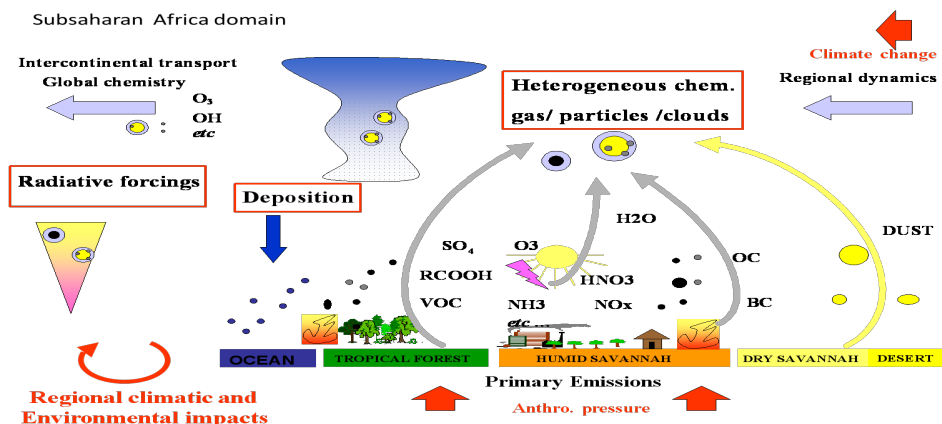
**Developing flexible and economical tools for developing country needs**

# The RegCM System



**Release of new version  
RegCM4  
CR Special issue**

**About 3000 downloads  
since June 2010**



Countries where RegCM is used



**RegCM training workshops:  
ICTP, June 2010**

**Turunc, Turkey, August 2010**

**New Delhi, India, December 2010**

**Amman, Jordan, March 2011**

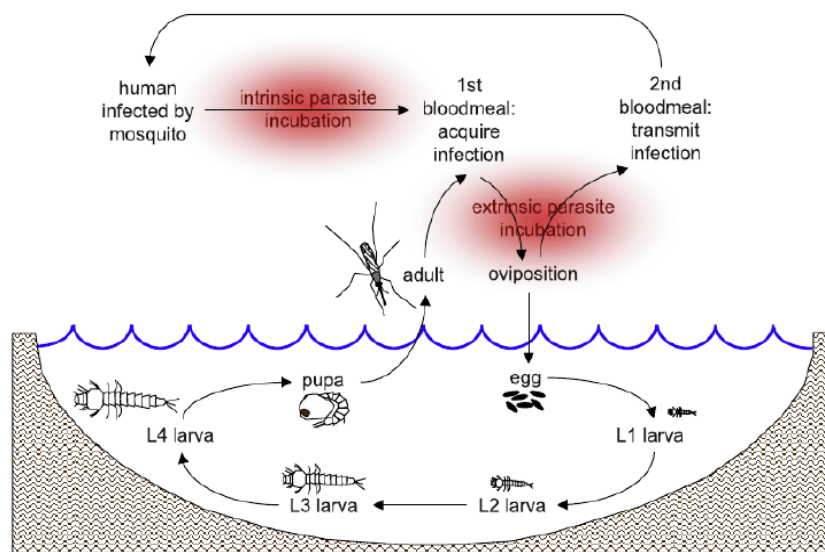
**ICTP, May 2011**

**Strengthening of the model software  
development and user support team**

# Impacts Modelling

- Climate and land-use change – FOREST-SAGE
- Climate and health – the VECTRI malaria model

- **Rainfall** : provides breeding sites for larvae.
- **Temperature**: larvae growth, vector survival, egg development in vector, parasite development in vector.

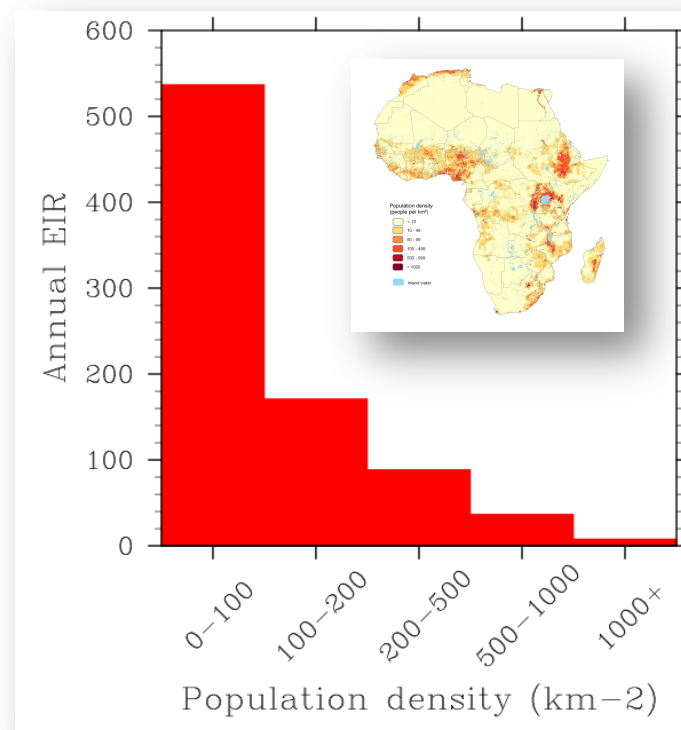


# VECTRI



## Surface Hydrology

VECTRI contains a dynamical pond model to represent the net aggregated effect of the small scale breeding sites in each grid-cell.



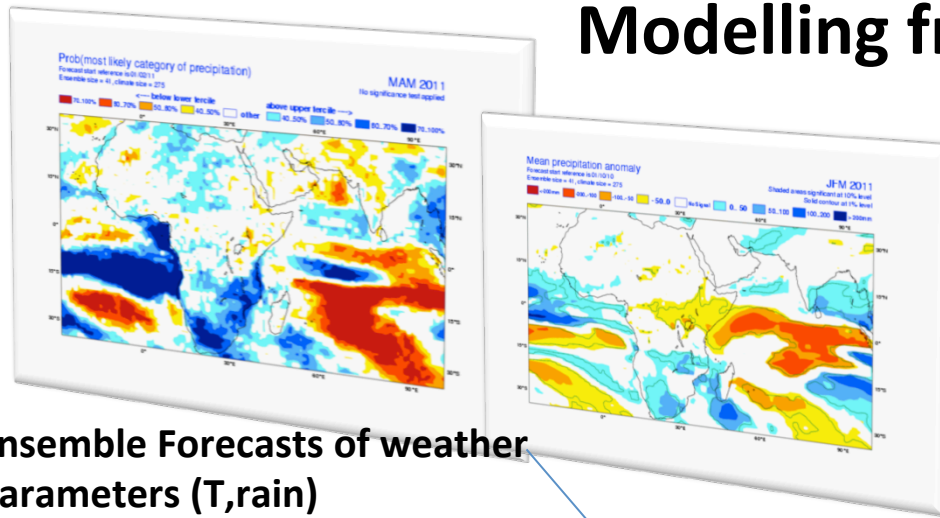
## Population

Population densities affect the biting rates per person while migration can reintroduce disease. The relation is complex since many socio-economic factors are involved.

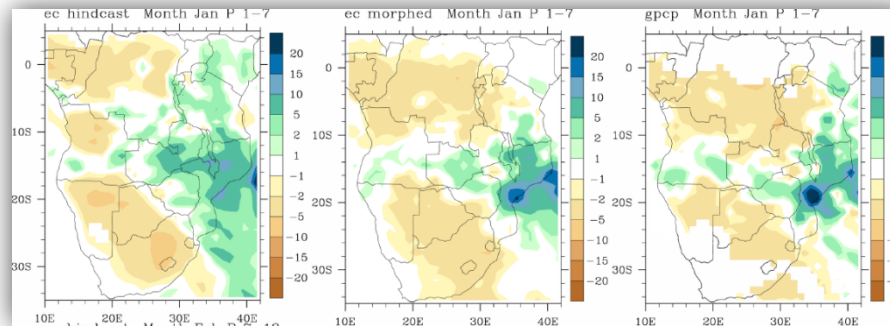
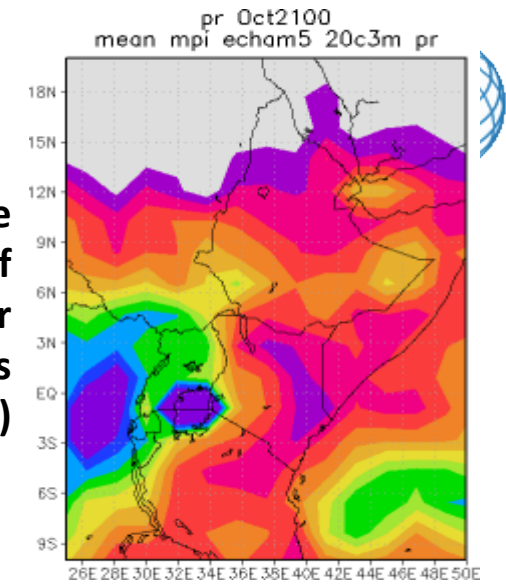


# Modelling framework

Ensemble Forecasts of weather parameters (T,rain)

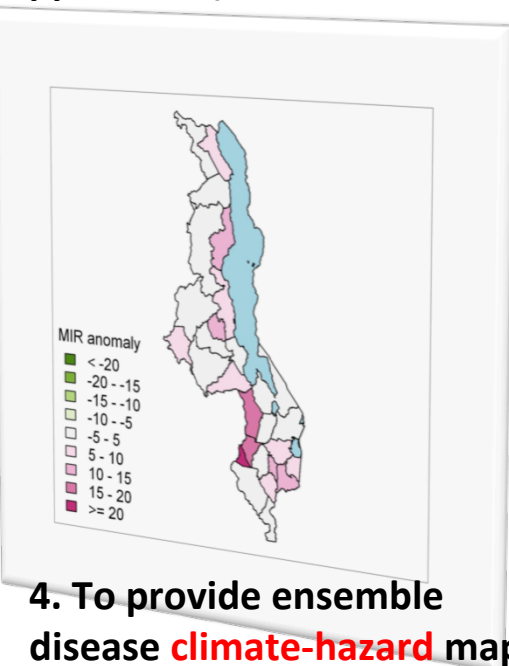
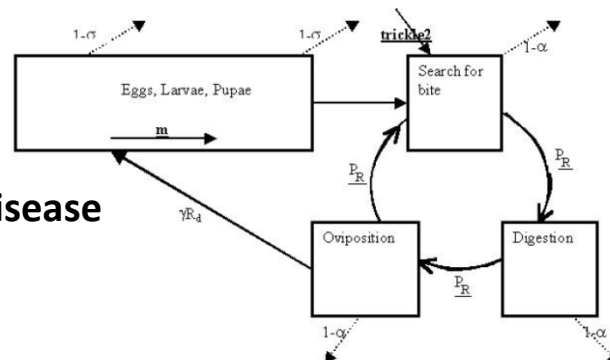


Climate projection of weather parameters (T,rain)



2. Biases corrected statistically and/or dynamically (CDF and EOF approaches)

3. Driving dynamical disease models



4. To provide ensemble disease **climate-hazard** maps



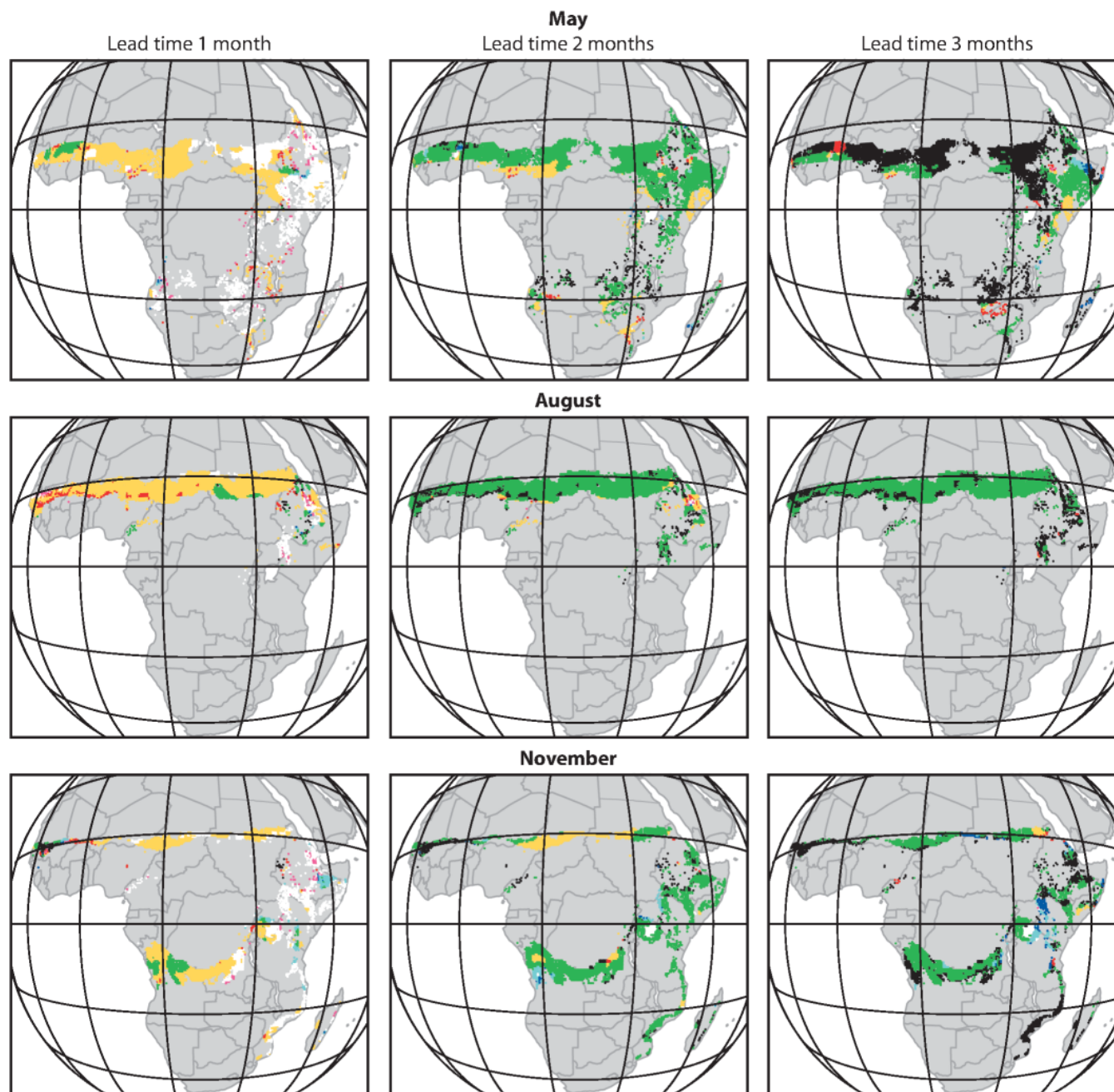


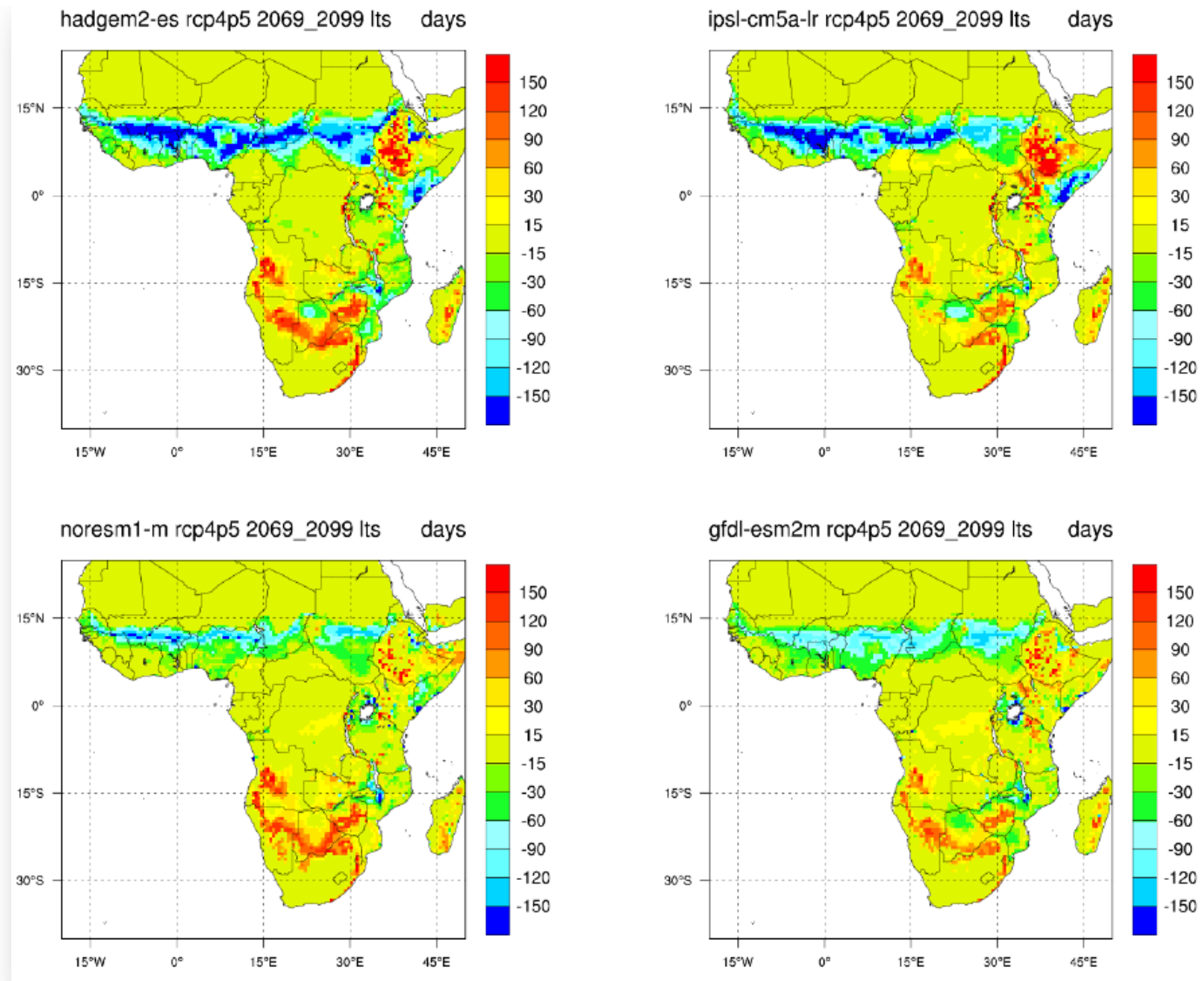
FIGURE 3

Tompkins and Di  
Diuseppe 2013,  
submitted

## Climate change related malaria projections

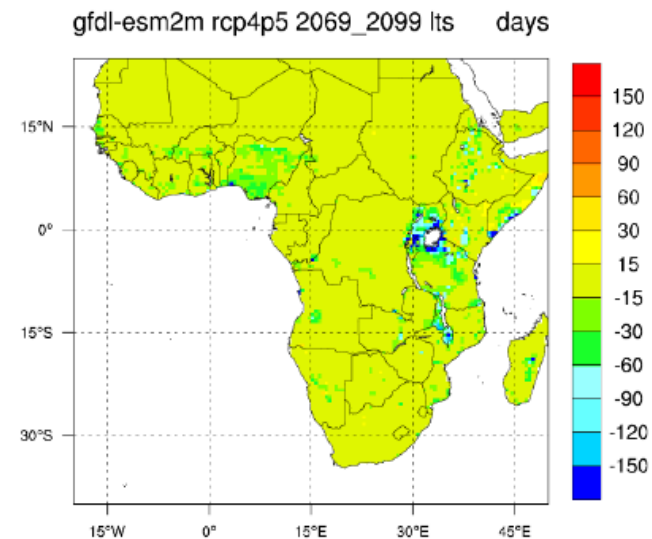
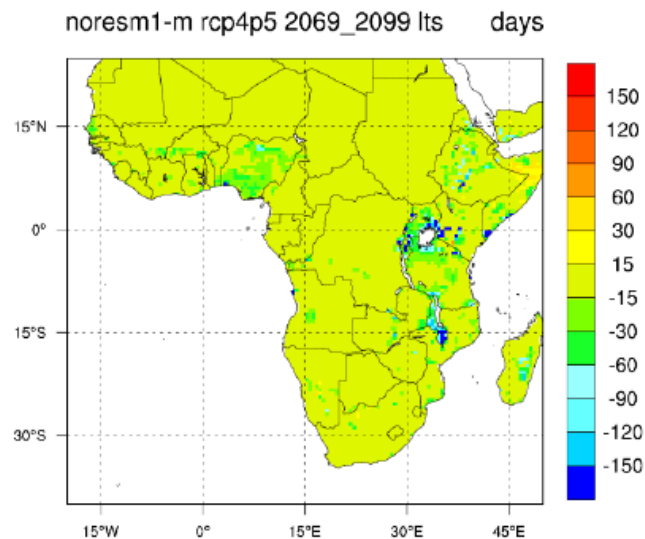
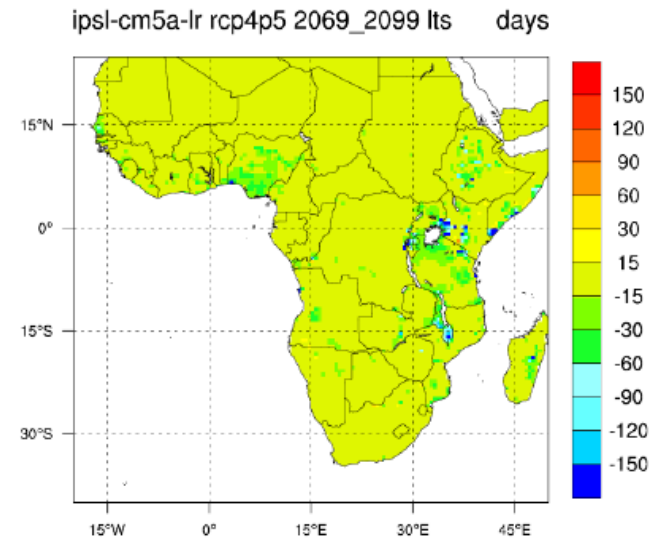
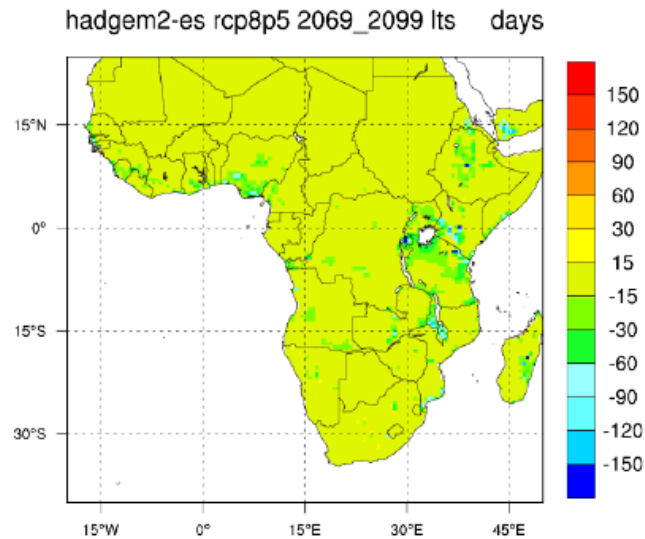
decrease in Sahel due to oft-neglected water temperature sensitivity... Increasing temperature extends season in highlands.

Currently investigating uncertainty due to parameter settings in VECTRI



## Socio-economic related malaria projections

Projections of decreases in transmission season 2070-2100 due to population density increases. VECTRI is the first model available able to examine such socio-economic interactions - will be used to gauge impact of urbanization and migration on transmission



# Future Directions?

- More integrated assessments, particularly to linkages with socio-economic factors.
  - Migration
  - Economy
  - Emissions
- Linkage with CLEW?
  - Speedy global climate model for online climate coupling?
  - Water/climate and health?
  - Migration model (under development)?
  - Spatial projections to link national to subnational scale? (e.g. FOREST-SAGE)