

# HEALTHY FUTURES



## HEALTHY FUTURES

Health, environmental change and adaptive capacity; mapping, examining & anticipating future risks of water-related vector-borne diseases in eastern Africa

Collaborative Project

Seventh Framework Programme

Cooperation

### *Final Report*

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<http://www.healthyfutures.eu/>





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## Final Publishable Summary Report

### Executive summary

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HEALTHY FUTURES (Health, environmental change and adaptive capacity: mapping, examining and anticipating future risks of water-related vector-borne diseases in eastern Africa [HF]), a FP7 Cooperative project, aimed to build a disease risk mapping system for three water-related high-impact vector-borne diseases (VBDs) (malaria, Rift Valley fever (RVF) and schistosomiasis) in eastern Africa. Projections of future risk were based on a combination of environment, notably climate, change data, output from dynamic disease models and spatially explicit assessments of vulnerability.

The major successes of HF include:

- 1) Development of a publically accessible Geoportal which facilitates searching and use of data produced in the project.
- 2) Production of new, state-of-the-art dynamic disease models for malaria, RVF and schistosomiasis. A second dynamic disease model for RVF has also been developed through the project that allows the efficacy of different interventions (e.g. vaccination campaigns) to be examined. These models have either been published or are in the process of being published in scientific journals.
- 3) Release of the HF Atlas, an interactive, web-based mapping and decision support tool (DST), built within an open-source framework and aiming to provide meaningful and guided access to information on environmental change, disease hazard and risk, and vulnerability for the three target VBDs in eastern Africa. An important aspect of the Atlas is use of climate models and future scenarios referred to in the latest (the 5<sup>th</sup>) IPCC Assessment Report.
- 4) Development and release of Decision Support frameworks (DSF) for the three target diseases in consultation with relevant decision makers in the East African Community (EAC) region.
- 5) Four PhDs, including the first ever PhD to be awarded in Science by the University of Rwanda (UR).
- 6) Extensive dissemination and exploitation of results through various channels including: 1) HF website receiving ~40,000 hits to date (<http://www.healthyfutures.eu/>), 2) seven contractual HF news releases, 3) project factsheet, 4) seven HF newsletters, 5) four project stakeholder updates, 6) a non-technical tri-fold project brochure, 7) inclusion in EC-produced promotional material and websites, 8) a short promotional video ([www.vimeo.com/70318624](http://www.vimeo.com/70318624)), 9) two



promotional items (a key-ring with bottle opener and torch, and post-it notes to increase the brand awareness), 10) contribution to a short documentary “Health and climate change in Africa” focusing on the collaborations between HF and its sister project, QWeCI - produced by the charity, Africa Turns Green (<https://www.youtube.com/watch?v=oYL4Nc-qnKE>), 11) HF Symposium (jointly coordinated by members of HF and QWeCI and held at the 4<sup>th</sup> Annual East African Health and Scientific Conference in Kigali, Rwanda in March 2013), 12) HF-focused and organised/hosted session at the ‘Impact of Environmental Changes on Infectious Disease’ (IECID) Conference, Sitges, Spain in March 2015, 13) 19 papers published in scientific journals with one more awaiting decision. Two submissions in a WHO-WMO special publication on climate services and health. One special issue of the journal Geospatial Health is currently in preparation, 14) oral presentations of HF results and networking through attendance and presentation at many key conferences and meetings and 15) inclusion as a case study in the World Health Organization/the World Meteorological Organization (WHO/WMO) special publication on Climate Services for Health.

With its integrated holistic approach, HF has considerably enhanced current understanding and dynamic modelling of links between the three target, water related VBDs and environmental change drivers and effects. As stated in the external evaluator’s report commissioned by project members, “HF has been an ambitious project that successfully joined the divergent scientific interests of climate specialists and health practitioners in a single project to address the health impacts of climate change on three VBDs in the EAC. It has provided key scientific information and models on present and future climate impacts on public health and the possibility of further development of the Atlas-Metadata portal as a practical research and learning tool for stakeholders in the EAC.”



## Summary description of project context and objectives

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### **HEALTHY FUTURES Context**

The health effects of future environmental, including climate, changes have been projected to be substantial, often negative and to vary geographically. The effects will be felt most acutely among the poorest members of society, who already carry a disproportionately high share of the burden of environmentally sensitive diseases, with sub-Saharan Africa a focus of adverse health impacts. Environmental change also has implications for health in the developed world, as changes in environment drive the emergence of new diseases, and changes in the distribution and epidemic potential of existing infectious diseases. Environmental change will impact health in a multitude of ways. Concern has, however, tended to focus on the future distribution and spread of infectious diseases, and in particular the negative health impacts of changes in transmission and outbreaks of VBDs as a result of anthropogenic climate change. The impacts may be direct, in terms of outbreaks of disease among human populations, or indirect, in the form of outbreaks of diseases that affect domesticated animals or plants, and therefore jeopardise food security, agriculture-based economic activities and trade.

These concerns provided the motivation for HF, which aimed to build a disease risk mapping system for three water-related high-impact VBDs (malaria, RVF and schistosomiasis) in eastern Africa, accounting for environmental/climatic trends to project future risk. The project involved a comprehensive, inter-disciplinary consortium of health, environment, socio-economic and climate experts in addition to governmental health departments, and throughout the four years of EU FP7 funding, sought and obtained input from stakeholders, including health decision makers. Concentrating on the three target VBDs in eastern Africa, HF produced improved understanding of the sensitivities to environmental conditions, new state-of-the-art dynamic disease models, down-scaled environmental change model outputs and scenarios of future conditions from the IPCC's 5<sup>th</sup> Assessment Report (2013 & 2014), and a novel, interactive, online disease risk-mapping platform (the HF Atlas).

### **HEALTHY FUTURES Objectives**

The main aims of HF were to develop (1) a basis for anticipating future environmental changes and their impacts on water-related VBDs in eastern Africa, and (2) the capacity of health and veterinary services in the study area to respond to early warnings of future outbreaks. These aims were met through seven, interlinked Work Packages (WPs) that:

- 1) provided effective management of the research (WP1);



- 2) ensured that full benefits are derived from synergies between this research project and other related research projects (WP7);
- 3) developed policy-relevant simulations of future levels of environmental correlates of the three VBDs and mapped spatial variations in vulnerabilities across the region (WPs 2,3,4);
- 4) combined results of the work outlined in 3) with improved understanding of the epidemiology of the targeted VBDs to model, dynamically, VBD emergence and spread and to improve (constrain) assessments of risks of future outbreaks (WPs 3,4);
- 6) enhanced the capacity of health and veterinary services at various geographic scales to respond to changes in risk of transmission and outbreaks of the targeted VBDs as a result of a convergence of changing climatic, land use and socio-economic conditions (WP5);
- 7) ensured that the findings of the research are widely disseminated among stakeholders, policy-makers and the global scientific community (WP6).

One further activity of crucial importance was the training of early stage researchers in the trans-disciplinary fields of environmental change and animal and human health. As part of this, four students (two from Africa and two from Europe) obtained their PhDs through direct support from HF.

Activities carried out per workpackage are detailed below:

**WP1** facilitated coordination and management of the project. During M37-48 there were two partner meetings. The fifth partners' meeting was held from 26-27 February 2014 in Nairobi, Kenya and was hosted by the International Livestock Research Institute (ILRI). The sixth partners' meeting was held from 9-10 September 2014 in Salzburg, Austria and was hosted by the Paris-Lodron University of Salzburg (PLUS).

**WP2** largely involved construction of a project database ('geoportal') comprising information drawn from a range of primary and secondary sources, including: historical, socio-economic, migration, settlement and conflict data; earth sciences data; direct climate observations and the results of regional downscaling of global reanalyses; and information on disease-environment relationships. Geoportal is at: <http://41.204.190.50/geoportal/catalog/main/home.page>

**WP3** focused on field-based evaluations of environment and hydrological data constructed in WPs 2 and 4, respectively, with the collection and collation of disease vector/host information, and with the development of new dynamic models and statistical multivariate



regression models for infection rates of the three VBDs. Outputs from these models were input to WP4 as part of disease risk mapping. Two PhD theses were also linked to WP3: 1) 'Modelling the effects of temperature changes on *Schistosoma mansoni* transmission' by Nicky McCreesh at UDUR; and 2) 'A simulation model of Rift Valley fever transmission in Kenya' by John Gachohi at ILRI/University of Nairobi.

**WP4** collated information relating to historical disease drivers and occurrence (collected in WP2), along with knowledge and models of dynamics of the three target VBDs (WP3). Spatial assessments of the current and projected future hazards and risks of the three target VBDs in eastern Africa were combined with a spatially explicit database relating to historical outbreaks with the aim of identifying hotspots of high risk. Projections were closely linked to procedures adopted in the IPCC's 5th Assessment reports. WP4 focused on two scales: the region comprising the five East African Community (EAC) countries and on smaller sub-national scales. The assessments of hazard and risk informed WP5, through input to discussions on DSF carried out with other consortium members and stakeholders in the findings of the research. The HF Atlas ([http://zgis186.geo.sbg.ac.at/hf\\_atlas/](http://zgis186.geo.sbg.ac.at/hf_atlas/)), an interactive, web-based mapping and visualisation tool, was built largely as part of WP4. Two PhD theses were also linked to WP4: 1) 'Climate change and malaria in Rwanda: Spatial assessment of social vulnerability at different scale levels' completed by Jean Pierre Bizimana at UR (formerly NUR); and 2) 'Integrated spatial indicators for modeling, exploring and visualizing vulnerability to vector-borne diseases' completed by Michael Hagenlocher at PLUS.

**WP5** was concerned with identifying and deploying the most appropriate environmental change adaptation strategies and decision support approaches (including relevant tools and information platforms) for adoption in the project. As part of this, input from decision-makers associated with the VBDs in the EAC area was obtained through a series of stakeholder engagement workshops hosted in the study region by HF consortium members.

**WP6** focused on the engagement of stakeholders in the research, the effective dissemination of research findings, and the training of Early Stage Researchers involved in the project. As part of this WP, HF led very successful sessions at the '4th Annual East African Health and Scientific Conference' Kigali, Rwanda (March 2013), and at the 'Impact of Environmental Changes on Infectious Disease' Conference, Sitges, Spain (March 2015).

**WP7** promoted synergy, cross-fertilisation, networking, and coordination with other climate and health-related research projects funded by the EU FP and other non-EU stakeholders and researchers internationally and regionally. The WP also provided independent, external



oversight, results review and evaluation, assurance of quality-control, guidance on next steps and use of best practices, including highest compliance with ethical guidelines. The WP operated mainly through an Expert Review Panel (ERP), chaired by an expert in the field and comprising four other members who were external to HF.





## Description of the main S&T results/foregrounds

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### **WORK PACKAGE 1 - Project Management**

Lead beneficiary: AquaTT

All deliverables in WP1, which ensured the efficiency and effectiveness of the work performed within the project, were successfully developed and submitted. Six formal partnership meetings took place throughout the project duration.

### **WORK PACKAGE 2 - Disease information and database construction**

Lead beneficiary: Trinity College Dublin

#### **Task 2.1 Collection of historical data**

This task involved an investigation of past outbreaks of the three target diseases (malaria, schistosomiasis and RVF) in the eastern African study region (Burundi, Kenya, Rwanda, Tanzania and Uganda). This was principally achieved through archival research involving a wide range of primary sources, including colonial reports, private papers and ministry files. Historical archival data were collected from documents held in the National Archives (London), Rhodes House (Oxford), the Wellcome Unit for the History of Medicine (Oxford), the School of African and Oriental Studies (London), the Kenya National Archives (Nairobi), Ministry of Public Health and Sanitation (Nairobi), the Uganda National Archives (Entebbe) and the National Archives of Tanzania (Dar es Salaam) (most of the data collected from the Tanzania National Archives in 2012, however, was unfortunately lost due to the theft of a laptop). The collected data were coded, compiled in an Access database and visually displayed in Google Earth. The resulting historical database is incorporated in the HF Atlas, publically accessible through the project's webpage. Thus this information can be, and is being, used to examine the historical framework of outbreaks of the target diseases in the study region in environmental, social and political contexts.

The HF Atlas is at: [http://zgis186.geo.sbg.ac.at/hf\\_atlas/](http://zgis186.geo.sbg.ac.at/hf_atlas/)

#### **Task 2.2 Collection of socio-economic data**

This task gathered information on current policies, regulations, strategies and challenges in addressing outbreaks of the three target diseases and on other socio-economic data thought to affect, and be affected by, the transmission and maintenance of the diseases in the study region (e.g. present-day migration, poverty, settlement patterns and settlement



densities, including informal settlements). In this context the task has generated knowledge (baseline information) on the extent to which outbreaks of malaria and RVF are a reflection of the socio-economic conditions in Ijara sub-county. Among the key findings in relation to malaria are that health education appears to be improving awareness of the benefits of owning mosquito nets in general, and insecticide treated nets (ITN) in particular. However, bednet control programmes are still grappling with distribution, and affordability and equity issues, as well as the trade-off between social marketing and commercial approaches. In relation to RVF, the main barriers restricting the abilities of health and veterinary services to respond to warnings of heightened disease outbreaks were identified. With respect to the vaccination of animals, which is one of the primary methods of preventing RVF outbreaks and the spread of the disease to humans, coverage is not universal. An important finding of the survey was the diversity in the frequency of vaccinations, and the leading reason for non-vaccination was non-affordability. A report based on all findings has been written and these results can better contextualise the socio-economic conditions of the diseases to enable the implementation of more effective response mechanisms in the framework of changing environments.

### **Task 2.3 Development of land cover/land use/terrain/surface water databases**

Under this activity, spatially-referenced data on land cover and elevation, soil types, normalised difference vegetation indices for the period 1999 – 2010, livestock, and precipitation for the entire eastern Africa region were processed by ILRI and used to map the risk of RVF. Additional data on surface hydrology and livelihood zones were compiled only for Kenya.

Under this task, NUR also compiled spatially referenced data on land cover and surface hydrology, as well as other secondary data on land use, elevation and population in eastern Africa, with a focus on Rwanda. These data have been used in the examination of malaria.

Furthermore, all the datasets produced and collected as part of this task were uploaded to an online database which was created within this task. The online database comprises data collected, quality assured and collated within WP 2 as well as other WPs of HF. It includes metadata (Task 2.7) of the produced output datasets as well direct access to data via a File Transfer Protocol (FTP). Where restrictions apply, relevant contacts are identified. Initially only accessible to members of the HF consortium and to non-consortium members of the project's Executive Committee, the information platform was made open access at the project end and it thus facilitates the dissemination of, and public access to, results and data produced in the project.

### **Task 2.4 Developing climate databases and regional climate simulations**



Four key disease models have been developed entirely or partly within HF and they have various data input requirements. These were provided by both externally generated datasets (e.g. satellite and ground based rainfall observations, land use change projections, global climate model integrations) and by new datasets created within the project research (such as regional climate model simulations, newly downscaled global model runs, and high resolution simulations of surface hydrological conditions). Task 2.4 was concerned with the generation of these datasets, the key ones being the high resolution regional climate simulations.

The two participating institutions (SMHI and ICTP) produced two sets of climate simulations at high resolution. Given the computational requirements and the availability of validation datasets at 10km, a lower resolution target than originally envisaged was set. In this regard, ICTP used its regional climate model (RegCM4), driven by reanalysis, to generate data at 24km resolution, covering an area between 20<sup>0</sup>S to 20<sup>0</sup>N in latitude and 6<sup>0</sup>E to 65<sup>0</sup>E in longitude. SMHI produced a simulation at a resolution of 0.15 degrees (~ 17km) covering an area between 13<sup>0</sup>S to 13<sup>0</sup>N in latitude and 18<sup>0</sup>E to 60<sup>0</sup>E in longitude. The model domain covers all the HF target countries and includes the important surrounding regional features that are known to affect the region's climate, such as the western Indian Ocean and the Congo basin. The model outputs were compared against Climate Research Unit (CRU) observations and ERA-Interim reanalysis to examine how well the model reproduces the spatial, inter-seasonal and inter-annual variability of the region's climate. The results are reported in deliverable D2.2.

In addition, the project applied a statistical downscaling technique to CMIP5 climate models in order to provide a wider range of lower-resolution benchmark driving fields. Self-Organizing Map based Downscaling (SOMD) is a leading empirical downscaling technique for Africa and provides meteorological station level or gridded data in response to global climate change forcing. The downscaling of a global climate model (GCM) is accomplished by deriving the normative local response from the atmospheric state on a given day (predictors), as defined from historical observed data (predictants). The method recognises that the regional response is both stochastic as well as a function of the large scale synoptics. As such it generates a statistical distribution of observed responses to past large scale observed synoptic states. This statistical downscaling methodology was used to downscale climate change projections from the latest two versions of the Coupled Model Intercomparison Projects (CMIP3 and CMIP5) over the HF study area.

Finally, research was also conducted to produce gridded socio-economic data for use in the dynamical disease modelling, in particular the assessment of population growth on fine-spatial scales. Total population estimates for the baseline period 1950-2010 were produced,



and for five different future Shared Socio-Economic Pathways (SSP) for the period 2011-2100. Population estimates for the baseline period and each of the five SSP scenarios were obtained at the national level at five year intervals (from 1950-2010, and from 2015-2100 respectively). Data for the baseline period were retrieved from the United Nations World Population Prospects (UNWPP) 2012. Revision Population data for the five SSPs were obtained from the Inter-Sectoral Impact Model Intercomparison Project. Yearly population estimates were computed for each country using a linear interpolation method. Population change rates were used as scaling factors to compute gridded population data for both the baseline period and the five SSPs. Not all countries present in the gridded dataset were present in the UNWPP and SSP data. The 37 countries not present in these datasets were assigned an average scaling factor per year by taking the mean of the population change rate of the 193 countries in the UNWPP and SSP datasets.

### **Task 2.5 Bringing Climate Databases to the kilometre-scale for use in disease analysis**

According to the original Description of Work (DoW) temperature and surface hydrology data, at ultra-high (1-10km) resolutions were to drive the Liverpool malaria model (LMM). In the course of the project development, however, a decision was reached to develop these modules within the disease models themselves to allow direct and computationally efficient interaction with other components of the disease models. In this way the task accomplished the direct incorporation of the surface hydrology within the new dynamical disease model VECTRI, and also directly downscaled the temperature to the high resolution topography.

The development of the new VECTRI model (a model not envisaged in the DoW) within the project framework allowed the integration of the surface hydrology and temperature downscaling directly into the model design from the outset. As a result, the consortium and scientists more widely now have access to a disease model that explicitly incorporates the direct interaction with the human population, allowing future population growth and urbanisation to be accounted for in disease risk projections, and that also directly incorporates the surface hydrology in a pond parametrisation.

The surface hydrology component has two parts:

1. A fraction of breeding sites associated with permanent water bodies. Initially this was set to a constant, but during the project several methods were investigated such as the use of existing databases including the global lakes and wetlands database of the WWF.
2. A pond parametrisation, which is driven by rainfall (available on scales down to 10km). The pond parametrisation is described in Tompkins and Ermert (2013).



The pond parametrisation is a novel aspect of the VECTRI model that allows for a more realistic association between rainfall and vector densities. The pond parametrisation accounts for topography in the maximum ponding fraction. This implies that while the input rainfall data do not have information below the 10km scale, the ponding fraction can be provided on scales down to 1km accounting for topography. The pond parameterisation has since been validated in comparisons with AMSR-E satellite derived statistics and also ultra-high resolution (10m) simulation with an explicit surface hydrology scheme. The magnitude of the pond fraction is much smaller for VECTRI indicating the need to tune the  $w_{max}$  parameter appropriately with observations, or the need to include soil texture in the parametrisation (see Tompkins and Ermert, 2013). Nevertheless, it is extremely encouraging that the VECTRI parametrisation scheme at 1km is able to almost exactly reproduce the pond temporal evolution. VECTRI tends to over-predict the pond fraction during the rainy season onset, and under-predict it during the main season. This is due to the fact that VECTRI does not account for soil moisture in the calculation of infiltration, which is apparently a second order effect.

The temperature information is also downscaled to the model resolution, up to a finest resolution of 1km as per the DoW, again using the topography to drive a simple lapse rate adjustment scheme. In the earlier version of VECTRI (up to v.1.3.1) the pond temperature is simply related to the atmospheric mean temperature with a fixed offset. This will be updated post project, with the implementation of an optional energy balance that has been developed and tested with in situ pond temperature measurements. The energy balance model is optional since it relies on the availability of radiation fluxes from the driving climate model, which can be subject to considerable biases associated with errors in the cloud fields, and which are not always archived on a daily timestep in the output of archives such as CMIP5. Thus, the option of using a simple offset from atmospheric 2 metre temperatures will be retained.

### **Task 2.6 Compilation of disease data**

Data on RVF outbreaks in Kenya for the period 1912-2010 were obtained from the Department of Veterinary services and Centres for Disease Control (Kenya). These data were used by ILRI to develop Milestone 16 and have also been analysed and presented in various workshops as part of the QWeCI (HF's sister project) research reports. These records identify the years when outbreaks occurred and include administrative units (province, district, division and area/village) affected. An RVF outbreak was defined as above normal occurrence of abortions, perinatal mortality and hemorrhagic syndrome in livestock with or without human involvement. In most cases, primary cases were screened using real-time reverse transcription polymerase chain reaction (RT-PCR) to satisfy requirements for official



declarations. Secondary cases for each outbreak were often diagnosed based on clinical signs. The total number of records in the database is 599,832 given repeated records per division. Similar data have been obtained from Tanzania identifying districts that have reported RVF outbreaks since 1930.

The georeferencing of RVF hotspot sites was also completed in Kenya, to enable a more intensive analysis using ecological niche models. The survey utilised a check list that collected additional data from each site on:

- Vegetation cover
- Types of livestock and wildlife found in each site
- Whether there were both human and livestock cases in the recent 2006/2007 outbreak
- Main livelihood activity

UDUR's work on this task was linked to WP3 Task 3.3 and formed part of the validation of the schistosomiasis dynamic modelling exercise. Georeferenced data on *S. mansoni* infection prevalence in human populations were extracted from the open access Global Neglected Tropical Disease (GNTD) database. Prevalence data were available from 2965 records in total, and 594 records when surveys that did not meet stricter inclusion criteria were excluded ('selected data'). When prevalence data was plotted on a map of the mean (across scenarios) model output 'infection risk' at baseline (2006-2015), the prevalence data yielded estimates of prevalence for 19% (279/1470) of grid squares when all data were used, and 7% (100/1470) when selected data were used. Prevalence estimates for each square were calculated from 1-119 (median=4) and 1-37 (median=4) individual estimates when all and selected data were used respectively.

### **Task 2.7 Creation of an online project database (information platform)**

This task was dedicated to the creation of an online metadata entry platform. It was decided to produce this with the ESRI Geoportal Server (version 1.2.2), which is free of charge and open source. The platform (/portal) is hosted by an Apache Tomcat Server (version 6.0.37), which is a virtual server running on a physical server (Ubuntu Server) located at ILRI. This platform has a MySQL database in the background where the (meta-)data are stored. The platform (a HTML/JavaServer Pages based portal) is also fully customisable and has been redesigned by PLUS to meet the needs of the project. For example, it fits the HF colour scheme, while the homepage now has buttons for searching and adding (meta-)data that help the user to more efficiently navigate the portal (<http://41.204.190.50/geoportal/catalog/main/home.page>). Different login levels are available: administrator, data editors identified for each partner institution, and guest



account. However, the entries, which are set to be public, can also be viewed without logging in. Finally a data upload function was developed, whereby data can be uploaded during the fill-out process of metadata. The data are stored in folders and the name of a folder is the ID of the metadata file. This helps the organisation of the data, particularly in case of deleting a metadata record. ICTP is providing the FTP storage. Once the data are uploaded they are reviewed and quality assured by an administrator at NUR. This process of uploading data will continue beyond project end as the metadata portal will be maintained post project.

### **WORK PACKAGE 3 - Environment-disease transmission relationships & modelling**

Lead beneficiary: University of Durham (UDUR)

#### **Task 3.1 Field Studies for the three target diseases**

##### **Schistosomiasis (UDUR)**

Collecting background data on schistosomiasis in this task also contributed to both task 2.6 (compilation of disease data) and task 3.3 (Development of dynamic models). Briefly, geo-referenced data on *S. mansoni* infection prevalence in human populations were extracted from the open access Global Neglected Tropical Disease (GNTD) database. Prevalence data were available from 2965 records in total, and 594 records when surveys that did not meet stricter inclusion criteria were excluded from modelling.

Previous field-based work at Lake Albert was reviewed with respect to understanding where major gaps existed in terms of data that could be used to give values to model parameters in task 3.3c. The conclusion of this review was a lack of information on the natural history of snail species responsible for transmission of *S. mansoni* in the region. To address these gaps UDUR undertook a series of experiments to test how fecundity and longevity of two species are affected by changes in water temperature. Laboratory experiments were conducted at Vector Control Division in Kampala, Uganda, to estimate *Biomphalaria sudanica* mortality, fecundity and growth rates at ten different constant water temperatures, ranging from 13-32°C. Field experiments took place on the shore of Lake Albert. Snail cages placed in open water at the Lake Albert field site were used to determine the effects of snail densities on *B. sudanica* and *B. stanleyi* mortality and fecundity rates in semi-natural conditions. *B. sudanica* survival and fecundity were found to be highest at 20°C and 22°C respectively. Growth in shell diameter was estimated to be highest at 23°C in small and medium sized snails, but the relationship between temperature and growth was not clear. The fecundity of both *B. sudanica* and *B. stanleyi* decreased by 72-75% with a four-fold increase in population density. Increasing densities four-fold also doubled *B.*



*stanleyi* mortality rates, but had no effect on the survival of *B. sudanica*. The optimum temperature for fecundity was lower for *B. sudanica* than for previously studied species of *Biomphalaria*. In contrast to other *Biomphalaria* species, *B. sudanica* have a distinct peak temperature for survival, as opposed to a plateau of highly suitable temperatures. For both *B. stanleyi* and *B. sudanica*, fecundity decreased with increasing population densities. This means that snail populations may experience large fluctuations in numbers, even in the absence of any external factors such as seasonal temperature changes. Survival also decreased with increasing density for *B. stanleyi*, in contrast to *B. sudanica* and other studied *Biomphalaria* species where only fecundity has been shown to decrease.

### **RVF and Malaria (ILRI)**

Field surveys on RVF were conducted in the Ijara study site in Kenya to generate empirical data that have been used in modelling RVF transmission dynamics. These activities included participatory, entomological and serological surveys; they were implemented in the second and third years of the project and their results were reported in deliverable D3.2 entitled: ***RVF/malaria study site analysis and major findings for RVF & malaria transmission***. The main results from this task included:

- Livestock movement patterns and their population structures required for RVF modelling were described
- Mosquito vectors that are prevalent in the area were sampled and characterised
- RVF sero-prevalences in sheep, goats and cattle were estimated

KEMRI organised the collection of in-patient malaria data from the project site in Ijara District hospital for the period 2006-2011. Data on the distribution of insecticide impregnated bednets was also collected. The malaria data were tested for seasonality and seemed to be consistent with trends in rainfall. Monthly Malaria case anomalies were computed. These data were made available to the modeling team.

### **Task 3.2 Evaluation and development of statistical disease models**

ICTP intended to develop a range of statistical models to estimate the relations between schistosomiasis, climate, environmental, and socio-demographic parameters in Uganda in collaboration with Durham University. This was not possible, however, owing to the lack of epidemiological surveillance data for schistosomiasis beyond the prevalence data used in task 3.3c. In addition, the collection of human schistosomiasis incidence data in Uganda was not possible due to issues for obtaining the ethical clearance to conduct a site analysis. Consequently, the development of statistical models was exclusively conducted on malaria data, which were more freely available in the project.





ICTP developed a range of statistical malaria models to examine how malaria incidence changes as a function of climatic, environmental, demographic and socioeconomic predictors in Uganda and Rwanda. The key component of this task was a dataset of epidemiological surveillance data (i.e. number of malaria cases) retrieved from our partners in the ministries of Health of Uganda and Rwanda. ICTP also collected environmental, socioeconomic and demographic data from various sources, including but not restricted to bureaus of statistics, remote sensing datasets, climate reanalyses, international malaria programmes, and censuses. It was possible to retrieve climate data for the same period of time, and at the same spatiotemporal resolution as the epidemiological data. Socioeconomic data were only available for selected periods of time, and for selected geographical regions. These features of the socioeconomic data prevented their incorporation into the statistical models. They also compromised the skill of the statistical models. In the end, a dataset of malaria, climate and non-climatic predictors was developed covering the whole of Rwanda and Uganda. To our knowledge, these are the longest and more spatially diverse malaria-related datasets yet assembled for both countries.

Some problems were inherent to the epidemiological data. First, some entries were missing or duplicated, and so statistical interpolation methods were implemented by ICTP to estimate a value for those data. Second, some of the entries in the malaria dataset had levels that were significantly lower or higher than the surrounding entries. For most of these entries, there was no available information in the ministries of health as to whether those values corresponded to real observations or were simply data entry errors. Since it was impossible to determine the veracity of such values, an algorithm was developed by ICTP to filter the data and reduce the impact of those suspicious entries in the performance of statistical models. Third, the length of the malaria time series was relatively short (just over a decade), posing challenges for estimating significant effects of climate drivers on malaria incidence using statistical models.

Statistical models were then developed using a time series cross-validation algorithm to detect the model specification resulting in the lowest prediction errors. These models accommodated the delayed and nonlinear effects of climate variables on malaria incidence. Given that data were unavailable for key malaria predictors, the statistical models incorporated random effects terms to account for the potential effects of unobserved variables. This modelling approach was used on both the Uganda and Rwanda datasets.

The risk of infection estimated by the model was evaluated through comparisons with malaria observations in both countries. Model outputs were found to reproduce the spatiotemporal dynamics of malaria in both countries. The estimated relationships between malaria and climate were statistically significant in both countries, and the functional form



of such relations was in agreement with previous research. The relations between malaria and socioeconomic development, however, were significant only for a small number of predictors. This finding may indicate that some of these variables are not important for describing changes in malaria incidence. However, it is likely that these results are due to the very short time series of socioeconomic data preventing the model from estimating significant effects. The significant relationships estimated between malaria incidence and socioeconomic drivers have to be cautiously considered too, because they arise from data aggregated at a different temporal resolution from the epidemiological data.

### **Task 3.3 Evaluation and development of dynamical disease models**

#### **Task 3.3a - Malaria**

This task involved the development and application of dynamical climate-dependent malaria transmission models for eastern Africa. The two malaria models produced or developed through HF, LMM and VECTRI, were driven using climate projections provided by a large ensemble of climate models derived from multiple bias correction techniques. A large inter-comparison exercise was carried out (Task 3.4) to provide a quantitative method for analysing the impact of the long-term effects of climate change on malaria transmission in eastern Africa.

The LMM, initially formulated in 2004, was further developed within HF with the addition of components representing transmission from a chronically infected immune population at the start of the season and influx of mosquitoes from permanent water bodies. These new components were tested, along with different LMM parameter settings, against records of observed malaria transmission parameters in Senegal and in South Africa. Additionally, LMM-simulated malaria transmission and variability patterns driven by various climate datasets have been compared with malaria maps from the Malaria Atlas Project 2010 (MAP<sub>2010</sub>), a statistical analysis of malaria prevalence based on observations. LMM is largely able to reproduce the spatial distribution and seasonal variability of malaria incidence in the eastern Africa when driven by observational climate timeseries (from the ECMWF interim reanalysis, Global Precipitation Climatology Project and the Tropical Rainfall Measurement Mission Multi-satellite Precipitation Analysis) and compared with Mapping Malaria Risk in Africa (MARA) and MAP<sub>2010</sub> products. Analysis comparing LMM hindcasts driven by ECMWF's state of the art seasonal forecast system (System 4) and the observationally driven simulations indicates some probabilistic skill for high (above upper tercile), above average (above median) and low (below lower tercile) malaria incidence with values (>0.7) of the area under the Relative Operator Characteristic (ROC) curve with a forecast lead time of approximately three months.



Different dynamical and statistical malaria models (MIASMA, MARA and UMEA) were also compared with LMM and VECTRI, both at the global scale and for Africa. This was carried out for both the recent context and under different climate change and population growth scenarios (consistent with Task 3.4). Results showed that the climate might become more suitable for malaria transmission in the highlands of eastern Africa and, to a lesser extent, less suitable over west Africa. This first multi-malaria model comparison exercise was carried out within the Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP), QWeCI and HF frameworks and this involved research teams at UNILIV, ICTP, UMEA, Maastricht University and the London School of Hygiene and Tropical Medicine.

A large ensemble of long-term climate projections under various emissions scenarios were integrated with the epidemiological models LMM and VECTRI to provide a range of projections of climate-related malaria risk in eastern Africa over the next century. This undertaking incorporated the two malaria transmission models, a range of emission scenarios (as defined by the IPCC), and four separate bias correction techniques comprising a total of 27 climate model datasets, many of which were developed by partners in HF. This implementation allowed us to compare between the two malaria models, two of the common RCPs and three of the bias-corrected climate model streams. Analysis was performed on these multi-model malaria risk projections by calculating the mean, spread (standard deviation) and relative differences in time (anomalies). For the historical period (1980 to 2005) both the malaria models were compared with MAP<sub>2010</sub>. Both LMM and VECTRI overestimate the prevalence for this period as these models represent the effects of climate on malaria transmission only, and do not take into account interventions that have been carried out during this period or any immunity effects. Despite the wide array of driving input data for the disease model projections there was some consistency to be found in the results, which was tested by quantifying multi-model agreement. Multi-model agreement is said to occur for a given period if all the component mean values for that period are within two standard deviations of the overall mean. For example, if all the Global Climate Models (GCMs) used within a modelling stream (particular bias-correction technique) have mean values within two standard deviations of the modelling stream mean then the multiple climate models are deemed to share a certain level of agreement. The multi-model spread (uncertainty) is generally higher near the epidemic fringes of the distribution (for low prevalence values).

Numerical malaria models solely driven by climate parameters cannot explain the decline in malaria endemicity observed over the 20<sup>th</sup> century at the continental scale (mostly due to human intervention, land use management and other socio-economic parameters). Generally, more significant climate impacts and greater consistencies across the multi-model ensemble are shown under higher emission scenarios (RCP8.5) for the end of the



21st century. There is no clear agreement between models for near-term projections (2020s). The largest uncertainties are associated with the methodology, e.g. the numerical malaria models, as opposed to the driving climate model projections. The uncertainties related to the spread in rainfall and temperature changes as simulated by the climate models are large over the northern fringe of the Sahel. This is consistent with the diverging rainfall projections shown by the various climate models over these regions. The uncertainties related to the emission scenarios are relatively small, but they linearly grow as a function of time over highland areas. For future climate projections, all numerical models generally agree on the increase in climate suitability for malaria transmission over the eastern African highlands of the Rift Valley and Ethiopia. Furthermore there appears to be general agreement between models on a southward shift of the epidemic fringe that lies to the north of the central African endemic belt.

### **Task 3.3b RVF**

As anticipated in the HF description of work, the sister EU FP7 project QWeCI developed a RVF version of the LMM, named the Liverpool Rift Valley fever model, or LRVF. This new epidemiological, dynamic transmission model underwent further development through detailed parameterisation in this project using literature-based data and data collected as part of HF. The LRVF model was further developed as part of Task 3.3 to include a complex dynamical host component to take into account the greater impact of transmission dynamics that livestock has for this disease. The relationship between environmental conditions and RVF outbreaks in Mauritania has also been investigated. Results show that the four reported RVF outbreaks over Mauritania (1998, 2003, 2010 and 2012) were preceded by similar rainfall conditions e.g. a rainless period lasting at least seven days followed by heavy precipitation. This result is consistent with former published studies focusing on RVF outbreaks over Senegal and was used to inform LRVF development.

Disease model development carried out as part of the FP7 QWeCI project resulted in the creation of a generalised disease-modelling library, EpiCS. EpiCS (Epidemiological modelling toolkit for Climate Sensitive disease) is a C/C++ library of generic functions that allows any host or vector process (such as mortality, population growth, biting rate) to be associated with any transmission model structure. The toolkit has been tested by recreating the existing LMM. A prototype two-vector, single host dynamic RVF model was also implemented using the EpiCS toolkit. The amplifying vectors for RVF, *Culex* spp mosquitoes, were modelled using the same structure as the dynamic mosquito model in LMM. The population dynamics of the reservoir vectors for RVF, *Aedes* spp mosquitoes, were modelled using a drying/wetting trigger for the larval stage, driven by rainfall, a physically based version of the rainfall criteria used in other RVF models. In LRVF, the eggs of *Aedes* require a



(configurable) period of drying and then re-wetting before they can proceed to larval and pupal stages. Prototype LRVF model parameters were taken from the literature, where available, and LMM settings were used as a starting point for parameters for which there are no published values. Plugins derived from the new version of the LMM and the newly developed LRVF model were embedded and tested for the Disease Model Cradle (DMC) GUI. The plugin deployment procedure used on each operating system platform (Linux, Mac OS X and Windows) has also been streamlined.

Task 3.3b required the development of a new climate driven dynamical model of RVF transmission based on LMM. Following the formulation of an initial prototype model, redevelopment of the host component of the LRVF model and model parameterisation was finalised. A more complex host component for LRVF was developed to take into account the greater impact of transmission dynamics that livestock has for RVF compared with malaria. In the new host module, the population is divided into two sub-populations based on age division due to the much higher susceptibility of young livestock to RVF infection. The sub-populations are dynamically coupled via new births and the young mature into adult livestock. The LRVF model was qualitatively calibrated based on past RVF epizootics in Kenya and Tanzania, in collaboration with ILRI, following anomalously high rainfall events using reanalysis climate data. Various parameterisations of the model were used in an iterative process that combined qualitative, inverse modelling and knowledge of the system (both local and from literature) to produce Culex EIR spikes in the expected years based on observations. This process guided previously unmeasured parameters away from the default LMM-derived set-up to a unique LRVF based parameterisation via an improved understanding of model parameter sensitivity.

The new LRVF model was integrated with climate model data in order to provide long-term projections for RVF dynamics in eastern Africa. LRVF was driven by five different GCMs comprising the models calibrated by ISI-MIP for moderate and extreme emission scenarios (respectively Representative Concentration Pathway (RCP)4.5 and RCP8.5). These climate models provide daily temperature and precipitation data for the period 1980 to 2099. The outputs of LRVF provide an estimate for areas that are vulnerable to RVF epizootics as a result of the state of the climate and predicted current livestock immunity. By driving LRVF with climate model projections, the long-term changes in epizootic susceptibility for eastern Africa were predicted. The precise nature of these changes was dependent on the climate model used but certain dynamics exhibited general trends from which a consensus could be drawn. In the long-term, LRVF considers potential shifts in regions that are especially suited to enzootic and epizootic activity based on climate-driven projections of vector dynamics. Results of LRVF suggest that there is a threat of the highland areas of eastern Africa becoming more suitable for RVF transmission as temperature increases and these regions



support greater populations of the RVF vectors. Whether regions susceptible to increased RVF transmission in the future are capable of supporting a major outbreak depends on shorter timescale rainfall dynamics, as well as on the local vector population, state of host immunity and level of vulnerability.

### **Task 3.3c Schistosomiasis**

An agent-based model of the temperature-sensitive stages of the *Schistosoma* and intermediate host snail life-cycles, parameterised using data from *S. mansoni* and *Biomphalaria pfeifferi* laboratory and field-based observations, was developed through HF (Task 3.1). Infection risk is calculated as the number of cercariae in the model, adjusted for their probability of causing infection. The number of snails in the model is approximately estimated to remain constant between 15–31°C. Outside this range, snail numbers drop sharply, and the snail population cannot survive outside the range 14–32°C. Mean snail generation time decreases with increasing temperature from 176 days at 14°C to 46 days at 26°C. Human infection risk is highest between 16–18°C and 1 pm and 6–10 pm in calm water, and 20–25°C and 12–4 pm in flowing water. Infection risk increases sharply when temperatures increase above the minimum necessary for sustained transmission. The model suggests that, in areas where *S. mansoni* is already endemic, warming of the water at transmission sites will have differential effects on both snails and parasites depending on abiotic properties of the water-body. Snail generation times will decrease in most areas, meaning that snail populations will recover faster from natural population reductions and from snail-control efforts. Links between the ecological properties of transmission sites and infection risk that could significantly affect the outcomes of interventions designed to alter water contact behaviour, with such interventions more likely to reduce infection levels at river locations than lakes, where infection risk remains high for longer. In cooler areas where snails are currently found, increasing temperatures may significantly increase infection risk, potentially leading to new, high-intensity foci of infection.

The model was run using low, moderate and high warming climate projections over eastern Africa. For each climate projection, eight model scenarios were used to determine the sensitivity of predictions to different relationships between air and water temperature, and different snail mortality rates. Maps were produced showing predicted changes in risk as a result of increasing temperatures over the next 20 and 50 years. Comparing baseline model output with prevalence data indicates suitable temperatures are necessary but not sufficient for both *S. mansoni* transmission and high infection prevalences. All else being equal, infection risk may increase by up to 20% over most of eastern Africa over the next 20 and 50 years. Increases may be higher in Rwanda, Burundi, south-west Kenya and eastern Zambia, and *S. mansoni* may become newly endemic in some areas. Results for 20-year



projections are robust to changes in simulated intermediate host snail habitat conditions. The baseline estimates of *S. mansoni* transmission potential were validated using data collected as part of Task 2.6.

An ensemble of regional climate simulations over Africa generated through work in task 4. 5 (provision of high resolution projections) was used to provide projected daily maximum and minimum temperature data for the eastern Africa study region. The ensemble consists of three members of the Rossby Centre Regional Climate Model (RCM) – RCA4 [22], driven by a coupled atmosphere ocean general circulation model (AOGCM) – EC-EARTH [23]. Three RCP scenarios were used – RCP2.6, RCP4.5 and RCP8.5 – which represent low, moderate and high levels of warming respectively. All three regional simulations were made within the African branch of the Coordinated Regional Downscaling Experiment (CORDEX), and cover the whole African continent at about a 50 km (0.44°) resolution. A smaller sub-domain in eastern Africa, with an area of 1470 (35 x 42) grid boxes, was selected for the study.

### **Task 3.4 Scenario integration**

This task was completed towards the end of the project in the form of the HF Atlas, an online system for analysing and visualising integrations of data and models in order to assess the projected risks of the three VBDs targeted by HF. A summary of activities related to this task, undertaken by UDUR, UNILV, ICTP and ILRI, is provided below for each of the three VBDs.

#### **RVF**

How peak-year frequency in RVF incidence changes in comparison to the historical period for both immature and mature livestock was tested. The two regions previously highlighted as hotspots for vector abundance (central/western Kenya and Rwanda) showed significant increases in incidence while most other areas show a significant decrease. These results appear to correlate with suitable mosquito habitat based largely on temperature. As the entire region heats up throughout the century, mosquito abundance is effectively forced into cooler, more highland regions in order to survive. It should be noted that this is a feature of the chosen mosquito-survival scheme implemented in the model, which would benefit from further rigorous analysis due to its evident sensitivity. The decrease in relatively warmer, lower areas was seen in both vectors in the late century. *Aedes* start to decrease significantly even earlier as large parts of the region also become wetter, but this does not affect *Culex* proliferation. These trends in vector population dynamics propagate through to the transmission characteristics of the model.

The change in incidence peaks for immature and mature livestock were similar (with significant increases in highland regions) but the increase around Rwanda was less



pronounced for mature livestock. Since livestock characteristics were the same in all but case fatality ratio this suggests that livestock immunity has a role to play. Since infected immature livestock either die from the disease (with a probability of approximately 70%) or mature into adults at approximately 2 months, the effects of immunity are negligible. Hence we can think of these immature livestock dynamics as representing an entirely susceptible population.

Information from this mapping exercise formed the basis of the hazard layer for the HF Atlas.

### **Schistosomiasis**

UDUR undertook analysis of different scenarios using the dynamic agent-based model developed in Task 3.3b. Model output was used as the basis for disease risk mapping in the HF Atlas.

### **Malaria**

Different malaria simulations were carried out within HF for the historical period (1980 to 2005).

The impact of future climate change on simulated malaria distribution was tested for LMM-VECTRI based on the super climate ensemble for two emission scenarios (RCP4.5 or RCP4p5 and RCP8.5 or RCP8p5) and for different time slices (2020s, 2050s, 2080s). The results of the super ensemble generally agree with former results obtained during the ISI-MIP and QWeCI EU projects. Those former results were based on a greater malaria model ensemble (including MARA, MIASMA and UMEA) using fewer climate model inputs as drivers (five GCMs were used whereas here we combined 23 different GCMs and RCMs). The climate seems to become increasingly suitable for malaria transmission over the highlands of eastern Africa. The LMM alone tends to simulate similar changes which are, however, smaller in magnitude with respect to the super ensemble and VECTRI.

As with RVF and Schistosomiasis, the HF Atlas provided a means of integrating projected disease hazard with indicators of vulnerability.

## **WORK PACKAGE 4 - Disease risk and vulnerability mapping**

Lead beneficiary: University of Rwanda (UR)

### **Task 4.1 Identification of current vulnerability hotspots for the 3 target diseases**





PLUS, ILRI and UR together adopted a risk and vulnerability framework that viewed humans and their environment as part of coupled socio-ecological systems (SES). Based on a comprehensive literature review and expert consultations, a list of indicators and related data for social vulnerability was agreed for malaria, RVF and schistosomiasis. Building on a methodology developed by PLUS, spatial vulnerability units/regions (geons) were modelled, representing the social vulnerability for the three target diseases (deliverable D4.1).

#### **Task 4.2 Assessment and provision of downscaled climate change projections for the study region from past and on-going projects**

An ensemble of statistically downscaled future projections of daily rainfall and temperature for 11 CMIP5 General Circulation Models (GCMs) using the historical and the RCP4.5 and RCP8.5 scenarios was provided through this task. The output covered the 140-year period 1960-2099 at 50 km resolution for the eastern Africa region. This ensemble of runs allowed for an exploration of the range of uncertainty introduced by the different GCMs and due to the different emission scenarios. The results were used as input into the different disease models used within HF.

#### **Task 4.3 Provision of land-use change scenarios**

To assess the effects of land use change (LUC) on the malaria risk, data from four of the five available Earth System Models (ESMs) that contributed to the LUC experiment of the CMIP5 were used to drive a spatially explicit, dynamical malaria model. Previous efforts to incorporate LUC in dynamical disease models have been extremely limited, and have mostly examined the indirect effect by which LUC impacts temperature and precipitation, which in turn impacts malaria. This study used the suite of ESMs that participated in the CMIP5 process and conducted twin investigations with and without LUC. Results from the task provide the first multi-model assessment of the potential impact of LUC on malaria transmission in Africa via its impact on climate.

To isolate the impact of LUC on climate, the five CMIP5 groups performed two sets of simulations for the period 2006-2100 using the same forcing as for RCP2.6 and RCP8.5 but with the land-use invariant over time. Daily precipitation and temperature output from four of the five ESMs was used to drive the VECTRI model for integrations to 2100 for the model's historical run (1960-2005) and the two RCPs (2005-2100). A malaria model was run for each available ESM member (three CanESM, two MPI and one member for IPSL and MIROC).

The impact of LUC on climate was assessed in terms of two variables only, the 2 metre temperature and precipitation, as these are key inputs to the malaria model. The first notable aspect of the impact of LUC on precipitation is that, for each ESM, the response is



considerably different between the two RCPs. This is in distinct contrast to the changes that occur between the present and future, where the higher greenhouse gas concentrations essentially amplify the magnitude of the spatial changes observed in the lower emissions scenarios (see for example section 2 of HF D3.4). This highlights the fact that the LUC maps are considerably different spatially between the two scenarios. The magnitudes of the changes are relatively small and considerably smaller than the changes observed due to greenhouse gas emissions.

As the impact of LUC on climate is minor in three of the four ESMs, LUC was expected to have a limited indirect impact on malaria in those models. Using the metric of the malaria prevalence (parasite ratio, PR) and length of the transmission season (LTS) this was indeed seen to be the case. In the IPSL, MPI and CanESM models, the change in prevalence was less than 5% everywhere within Africa, and the LTS were mostly less than 10 days. Only the MIROC model produced substantial changes, with prevalence increasing strongly in the southeast of Africa over the northern part of Mozambique and southern Tanzania. Over the Sahel region, the increases in temperature led to decreases in prevalence. This is because above about 30°C mean temperature, malaria transmission starts to decrease with temperature.

In conclusion, this task was the first attempt to isolate and assess the potential indirect impact of LUC on malaria transmission using a dynamical modelling framework, and multiple ESMs based on the latest projection of potential LUC that contributed to the latest round of the IPCC climate assessment. The study showed that in terms of indirect impact, whereby LUC impacts local climate, which can then alter transmission, the effect was very limited in three of the four available models. In one model, the impact was more significant.

The study also highlighted the uncertainty in projecting such extremely model dependent impacts.

#### **Task 4.4 Provision of socio-economic change scenarios**

The original intention was to integrate socio-economic indicators and their respective quantities, and future projected values for these, with spatially explicit output from dynamic disease models in order to generate risk maps for the three VBDs. Projected future changes in socio-economic indicators were to be based on IPCC scenarios. Two main activities were carried out in relation to this original intention. A joint scenario workshop was organised by ILRI from 5-7 November 2012. This was organised together with colleagues from CCAFS, where regionally based scenarios were adapted to the specific disease context. These scenarios are qualitative and help to better understand future development pathways in the



VBD context. Additionally, how levels for key demographic and economic social vulnerability indicators might be projected for the future and integrated within the HF Atlas was discussed (deliverable D4.4).

#### **Task 4.5 High resolution regional climate projections for eastern Africa study area**

A set of high resolution Regional Climate Model (RCM) simulations for eastern Africa was created for use by HF consortium members, in particular those directly involved in projecting future environmental change-driven disease outcomes. Simulations covered the period 1970 to 2100 and generally followed the WCRP CORDEX experiment protocol (<http://wcrp-cordex.ipsl.jussieu.fr/>). While the majority of Africa CORDEX simulations employed an RCM grid covering the entire African continent at a spatial resolution of 50km, special resolution of the RCM was increased and targeted eastern Africa in order to provide finely resolved spatial detail in simulated present and future climate variables. These simulated data were then input to subsequent assessments of disease risk.

#### **Task 4.6 Risk and vulnerability mapping of disease morbidity and related impacts**

The primary aim of Task 4.6 was to produce spatial assessments of current and projected future risks of, and vulnerability to, the three target VBDs in the EAC region. Future projections of risk were based on environmental change data-driven output from dynamic disease models and their subsequent integration with vulnerability indices. Achieving this aim also involved development of the HF Atlas through a highly consultative and reflective process.

Mr Jean Pierre Bizimana was recruited as PhD student for HF in October 2011. The title of his PhD, submitted before project end, was 'Climate Variability and Malaria in Rwanda: Spatial Assessment of Social Vulnerability at Different Scale Levels'. The specific objectives of the research were: to conceptualise social vulnerability to malaria in the context of environmental and socioeconomic changes; to identify suitable indicators of social vulnerability to malaria; to apply an indicator framework for spatial assessment and explicitly model the social vulnerability to malaria; and to examine the extent to which malaria incidence is the interplay of climate variability and socioeconomic conditions of highland communities in Rwanda.

### **WORK PACKAGE 5 - Adaptation and support tools: development of decision support tools**

Lead beneficiary: Stockholm Environment Institute (SEI)



### **Task 5.1 Identification and assessment of environmental management and climate change adaptation strategies**

An inventory of all strategies relevant to the project – health, environmental, water and sanitation – was created and a report summarising the findings was produced. A total of 50 country documents were posted to the internal project website.

### **Task 5.2 Identifying key stakeholders for strengthening human and animal health systems**

A database of relevant stakeholders and domain experts in the EAC included representatives of numerous sectors (ministries of environment, health, water and irrigation; environmental management agencies; climate change directorates; civil society; and donor agencies). The development of the database involved multiple visits to all five countries comprising the EAC, thus raising awareness of HF. The database was also instrumental in disseminating project outputs and identifying the appropriate mix of participants for the RVF and malaria/schistosomiasis workshops that provided a forum for discussing the architecture and content of the decision support facilities (frameworks and tools) that were important products of WP5 and the project in general.

### **Task 5.3 Use and assessment of current environmental management and climate change adaptation tools**

This task assessed environmental management and climate change adaptation tools that address the environment-related vulnerability of human health. Relevant literature on environmental health impact assessment tools and their application, including those developed specifically for addressing environmental health concerns, was evaluated. Feedback on recent and current use of assessment tools was also sought from domain experts in the EAC. The task informed later stages in the research project when decision support tools (DSTs) and frameworks (DSFs) were in the process of being discussed and developed.

### **Task 5.4 Refining the RVF Decision Support Tool**

Activities carried out as part of this task refined the RVF DSF that had been developed earlier by domain experts involved in attempts to mitigate the impact of RVF in eastern Africa. Three RVF workshops were organised by project members during 2014: 24-25 February (Nairobi, Kenya); 30 September – 1 October (Naivasha Kenya); and 12-13 November (Dar e Salaam, Tanzania). Discussions at the workshop enabled the DSF to be modified in line with up-to-date information, including data generated by HF, and recent past experience, with the amended DSF forming part of deliverable D5.4.



### **Task 5.5 Developing decision support framework**

This task resulted in the production of risk-based DSFs for malaria and schistosomiasis. These two DSFs address changing risk for the two diseases in light of environmental, including climate, change. The DSFs were developed in a workshop held in Nairobi in November 2014 that brought together HF researchers and decision-makers involved in managing the response to these two diseases.

## **WORK PACKAGE 6 - Stakeholder engagement and empowerment through sharing of knowledge and training**

Lead beneficiary: Trinity College Dublin (TCD)

### **Task 6.1 Identification – and if necessary grouping - of stakeholders and target end users of the HF project**

A number of partners contributed to identifying and grouping potential stakeholders and target end users of HF, including TCD, PLUS, NUS and CH. For example, PLUS provided contacts for relevant stakeholders in eastern Africa, within the EC and internationally. The specific focus provided by PLUS was on the identification of stakeholders in the domain of Earth Observation and GIS, including initiatives such as GEO, Copernicus and the WHO. CH helped identify key stakeholders in government and private institutions in Uganda. Information on stakeholders was also harvested from WP5, Task 5.2 'Identifying stakeholders for strengthening human and animal health systems' and other relevant WPs. Project deliverable D5.2 'Identification and engagement of key stakeholders' illustrates the grouping of stakeholders and maps the linkages and flows of information between various groups.

All identified stakeholders were input to a database with fields comprising: type of stakeholder; contact details; and preferred communication language (English or Kiswahili). A protocol was devised by AquaTT for updating and managing the database, and throughout the project the database continued to grow with the addition of the contact details of relevant stakeholders.

The stakeholder database was actively employed when carrying out dissemination activities to ensure those with an interest in HF outputs were kept up-to-date, to increase impact and to facilitate translation of research findings into meaningful actions on the ground. The database was also utilised to invite the participation of relevant stakeholders for the project's various stakeholder meetings and engagement workshops.



## **Task 6.2 General dissemination**

Over the course of the project, HF has employed a range of methods to disseminate project results and outputs to stakeholders and end users. Dissemination of information to project members was facilitated through the use of *Basecamp*, the project intranet site. A publically accessible website, available in both English and Kiswahili, was developed and maintained throughout the project providing regular updates on project news and outputs. The website has proven to be highly popular having received ~40,000 hits since its launch midway through the first year of the project. AquaTT will continue to maintain this website for up to five years after the completion of the project to ensure the continued and uninterrupted dissemination of HF outputs.

In addition to the website, a number of other dissemination activities has taken place including the production and distribution of:

- Seven contractual HF news releases (available in both English and Kiswahili) and additional news releases disseminated through such channels as AlphaGalileo (<http://www.alphagalileo.org>), the EC's CORDIS News services (<http://cordis.europa.eu/news/>), CORDIS WIRE, Twitter, LinkedIn and AquaTT's Training News.
- Seven HF newsletters (non-contractual)

A non-technical, tri-fold project brochure was developed for general release outlining the project and English and Kiswahili versions are available to download from the project website.

A short promotional video (c.90 seconds) that summarises HF was also developed. The video, hosted by VIMEO and aimed at raising awareness of the project, can be viewed at [www.vimeo.com/70318624](http://www.vimeo.com/70318624) or on the project website.

Two promotional items that include the HF logo and website address were designed to increase the brand awareness of the project: a key-ring with bottle opener and torch, and post-it notes. These have been distributed at a number of stakeholder engagement workshops and events over the course of the project. These items will continue to be disseminated after the completion of the project, for example, at the HF session at the 'Impact of Environmental Changes on Infectious Disease' Conference which will be held from the 23 – 25 March 2014 in Sitges, Spain.

HF also contributed to the completion of a short documentary produced by the charity Africa Turns Green. The documentary "Health and climate change in Africa" was released in August 2014 and is available to view on the project website:



[http://www.healthyfutures.eu/index.php?option=com\\_k2&view=item&layout=item&id=176&Itemid=276&lang=en](http://www.healthyfutures.eu/index.php?option=com_k2&view=item&layout=item&id=176&Itemid=276&lang=en)

and on YouTube:

<https://www.youtube.com/watch?v=oYL4Nc-qnKE>

The video focuses on the collaborations between HF and its sister project, QWeCI, and outlines how both projects have worked to increase capacity in Africa and reduce the impacts of the target VBDs in the study region. A number of representatives from HF partners (UDUR, UNILIV and ILRI) were featured in the documentary, while Dr Laragh Larsen and Professor David Taylor were consulted over the content of the script. This documentary has been used during stakeholder engagement events and will be employed in future to inform the general public about HF and about project outcomes.

HF has been included as a case study in the World Health Organization/the World Meteorological Organization (WHO/WMO) special publication on Climate Services for Health. The submission focuses on the HF Atlas, and is part of a small group of accepted pieces from more than 75 submissions globally. The final expected outputs of the Climate Services for Health project comprise an online e-book, interactive web repository and a hardcopy publication in the six UN languages.

### **Task 6.3 Targeted dissemination**

Four project updates have been distributed to all stakeholders listed in the stakeholder database. These project updates summarise the work that was carried out each year, highlighting noteworthy achievements. These short briefs provided readers with the means to obtain further information if desired.

### **Task 6.4 Communication and feedback**

A 'FAQ & Feedback' section on the project website:

[http://www.healthyfutures.eu/index.php?option=com\\_k2&view=item&layout=item&id=133&Itemid=265&lang=en](http://www.healthyfutures.eu/index.php?option=com_k2&view=item&layout=item&id=133&Itemid=265&lang=en)

provided a channel for communication and feedback. Furthermore, all stakeholder engagement workshops carried out during the project facilitated an interactive forum for two-way communication and feedback.

### **Task 6.5 Compilation of all knowledge generated from the project and translation (appropriate level, terminology, language) for end users**



All content on the HF website is available in both English and Kiswahili in order to be accessible to a wide range of target stakeholders. The same applies to all contractual news releases, and the project factsheet and brochure.

Within several work packages and tasks, user manuals and guidance documents on technical issues were produced, particularly those provided by PLUS on the metadata portal and the HF Atlas.

#### **Task 6.6 Scientific publications of research and presentations at scientific conferences**

A full list of peer reviewed publications can be found in deliverable D6.15. HF research, results and outputs have been presented in a variety of formats and capacities since the project's start.

#### **Task 6.7 Engagement and training workshops (for refinement of Decision Support tools developed in WP5)**

A number of engagement and training workshops for the refinement of DSTs developed in WP5 have been held.

##### **1. One-day stakeholders meeting on malaria and climate change, Kampala, Uganda, 25 October 2013**

CH (part of the Ministry of Health (MoH) Uganda) in collaboration with ICTP, NUS and SEI organised a one-day meeting themed 'Malaria seasonal forecasting and Climate Change adaptation'. The meeting, held in Kampala, Uganda, was attended by a variety of stakeholders, including those from the health sector, academia, researchers and malaria-related institutions. Key attendees included the Director General of Uganda National Health Research Organisation (UNHRO) Dr Sam Okware and Dr Myers Lugemwa of the Uganda National Malaria Control Programme. The meeting reviewed available malaria and climate data, current malaria forecasting by ICTP and the European Centre for Medium Range Weather Forecasts (ECMWF) and possible DSTs and approaches. One of the main aims of the meeting was the sharing of current knowledge on malaria and climate modelling using available data from Uganda. In his opening remarks to the meeting Dr Sam Okware observed that climate change affects health and the whole health system, noting that most diseases in the country are climate-sensitive, especially vector-borne and water-related diseases such as malaria and diarrhoea. Subsequent presentations at the meeting covered broad areas of data collection and quality, especially related to malaria data, malaria early warning systems and forecasting, the climate change national adaptation programme of action in the health sector in Uganda and DST. The workshop highlighted the need for the different stakeholders to use the outputs of the research to improve preparedness, quantify





disease impacts, and above all to enable the decision-making/disease outbreak forecasting and response processes. Recommendations results from the meeting included: the development of a hands-on module by ICTP and supported by MoH, Uganda, for training in the use of the malaria forecasting system output in the operational planning environment; the evaluation of the potential for directly using the VECTRI modelling system for intervention planning and also investigating potential adaptation strategies with regard to sensitivity to climate change; the identification and exploration of key areas of collaboration in vulnerability of health to climate change with a view to improving upon current adaptation strategies; undertaking further research on how to extend climate and disease modelling and forecasting to other diseases. A full report on the meeting including the presentations given is available to download from the project website.

## **2. Stakeholder Engagement Workshop, Nairobi, Kenya, 24-25 February 2014**

A second HF stakeholder workshop was held from 24-25 February 2014 at the International Livestock Research Institute (ILRI), Nairobi, Kenya. The aims of the workshop were to raise the profile of HF research among selected stakeholders in eastern Africa and to further the process of enabling the development and effective uptake of outputs from the project. Specifically, the workshop had the following objectives: to communicate the project research outputs (modelling, risk mapping etc.) that were currently in progress for each of the three target VBDs; to collect feedback on the value of the research outputs to date and on how to support their uptake by decision makers, for example, integration of modelling results into DSTs; to develop case studies for the application of DSTs and DSFs; to test different decision-making methods through the use of case study examples to compare the value of various intervention strategies; and, to define the outputs and needs for further stakeholder engagement in HF and beyond.

Participants in the workshop included a number of HF partners, external members of the HF Expert Review Panel (ERP) and representatives from government ministries and research institutes in eastern Africa. During the first day of the workshop, plenary presentations were made by project partners to introduce the project and provide updates on case studies of the three diseases. The presentation included: an overview of HF; malaria projections for 2050 and how climate information can be integrated into health planning; sources of climate data for national decision-making; guidance that models can provide for schistosomiasis control; and a DST for RVF. On the second day of the workshop, participants carried on working in three groups, each focused on one of the diseases using the case studies presented during day one. The groups tested two of the methods or 'engines' of the adaptation decision explorer (ADx) tool: the voting method and Analytic Hierarchy Process. ADx was being trialled at the workshop as a possible component of a DST.



This stakeholder engagement workshop was a positive step forward in communicating the latest research from the project to stakeholders, in receiving feedback about what specific concerns decision makers have, and in sharing insights into how those concerns could be best addressed. However, weaknesses in the ADx DST became apparent, as did a divide between time frame of main interest to HF (up to century scale) and the much shorter policy-oriented time scales that most concerned many decision-makers present at the workshop. One specific request to emerge from the workshop was for concise, user-friendly summaries of the likely risks of the three target diseases under changing conditions predicted for coming decades. These summaries were subsequently produced by members of the HF consortium and are available on the HF website. Overall, this stakeholder engagement workshop proved to be a valuable exercise in identifying how the outputs of HF could be designed to meet the needs of decision makers in the EAC. More information on this workshop can be found on the project website.

### **3. Decision-Makers Workshop for Malaria and Schistosomiasis, Nairobi, Kenya, 18-20 November 2014**

The third stakeholder engagement workshop for the refinement of DSTs was held in Nairobi from 18-20 November 2014. The objective of the meeting was to develop two separate risk-based DSFs for schistosomiasis and malaria that could assist decision-makers in the EAC by serving as guides to responses to these two diseases in the face of climate change. HF outputs include spatially explicit assessments of risks of the three target VBDs in eastern Africa as a result of projected changes in environmental conditions. These assessments are based on combined hazard and vulnerability data. This HF workshop reviewed the schistosomiasis and malaria research outputs of the project in the context of the general state of knowledge for these diseases and assessed the implications of the findings for future decision making and action. Risk-based DSFs are decision-making guides developed by decision-makers. This approach was pioneered in applications to RVF epidemic response; DSFs are developed through participatory consultations that bring together health decision-makers, control programme implementers and researchers. They systematically break down the decision-making process into sets of steps by defining decision points and action categories where decisions need to be taken. They are not prescriptive. Instead DSFs act as aide memoires to remind decision-makers of areas where action should be considered at appropriate points in time. DSFs are specifically intended to reduce the impact of uncertainty and risk in decision-making. DSFs are living documents that are part of an adaptive management process.

This workshop began in plenary session with a brief technical overview leading to a discussion to distil key action points coming from the research that should be captured in



the DSFs. Next the meeting discussed the objectives of the two frameworks and the time frame that they should cover. Thereafter the meeting broke into two parallel sessions: one on schistosomiasis and the other on malaria. These parallel sessions built the timelines describing the process of epidemiological change, identified the decision points and action categories and articulated the DSFs in detail. Many of the key action points arising from the technical discussion were captured in the statements of objectives and assumptions that guided the detailed construction of the DSFs.

In the case of malaria, major international control programmes are in place and the DSF is intended to be complementary to existing policy and strategy documents. The DSF accommodates the future effects on malaria epidemiology of three inter-related phenomena: climate, environment and land use change, and population migration and displacement.

In the case of schistosomiasis, international control efforts are lacking and the institutional context of schistosomiasis control is not well developed. The schistosomiasis DSF is intended to complement to regional and national policies and strategies, and to catalyse appropriate institutional development.

### **Task 6.8 Africa-EU Workshop**

The original intention was for the University of Rwanda to host a workshop, focusing on environmental change and VBDs, in the final year of the project to coincide with the release of the IPCC's 5<sup>th</sup> Assessment reports, particularly the report from Working Group II dealing with climate change impacts, including projected health effects. Unfortunately organisational delays, including delays releasing information about the meeting, key note speakers etc, led to a low level of international interest in the meeting and forced a decision, taken at the last (the 6<sup>th</sup>) partners' meeting in September 2014 to cancel the workshop.

Permission was sought and fortunately obtained from the project officer in the EC to organise and host a HF-focused session at the 'Impact of Environmental Changes on Infectious Disease' (IECID) Conference, Sitges, Spain, 23-25 March 2015. The session attracted a large, engaged audience and was deemed a major success. Papers delivered in the session are forming the core of a special issue of the journal *Geospatial Health*, which is now in the process of being produced. In addition to the HF-focused session at the IECID Conference in Sitges, Spain, HF project members organised a session (*CL2.5 Climate and infectious disease interactions*) at the European Geophysical Union (EGU) annual meeting in Vienna, Austria, in April 2012 (i.e. during the second year of the project). During the following year, HF project members also jointly coorganised and hosted a symposium, along



with its sister project QWeCI, as part of the 4<sup>th</sup> Annual East African Health and Scientific Conference that took place in Kigali, Rwanda from 27 to 29 March 2013.

**HF Symposium, 4<sup>th</sup> EAC Health And Scientific Annual Conference, Kigali, Rwanda, 27 to 29 March 2014**

The conference programmed comprised four sub-themes (Maternal and Child Health, Non Communicable Diseases and Trauma, Health Systems Strengthening, and Quality of Health Care) and four symposia: HIV and AIDS; Integrated disease surveillance and disaster preparedness; Tobacco Control; and the HF/QWeCI symposium on '*Environment and Health in Africa: climate and vector-borne diseases*'. Facilitated by NUR, the symposium was well-attended and brought together researchers at the cutting edge of efforts to understand the relationships between health and environment, and in particular the links between climate and VBDs in Africa. There were a total of 17 presentations in this session, including the plenary by Dr. Margaran Bagayoko (Protection of Human Environment Programme, World Health Organization Regional Office for Africa) whose talk centred on the potential of climate-based early warning systems for improved management of VBDs in Africa. The presentations that followed were wide ranging and delivered by speakers who had travelled from other parts of Africa and from Europe and Asia (the full programme is published in the third issue of the HF newsletter available on the HF website).

**WORK PACKAGE 7 - Enhancing research synergy & application**

Lead beneficiary: AquaTT

**Task 7.1 Identify relevant projects and conferences**

Over the course of the project, a list of relevant projects, events and conferences has been uploaded to the project intranet site and maintained. This list has been managed by AquaTT, which has worked to identify and add relevant information on an ongoing basis. Other consortium members have also contributed to the list by informing AquaTT of any relevant events and projects they have identified.

In addition to the Basecamp file, AquaTT has added information on all events and conferences to the HF website on both the homepage, under 'Upcoming Events', and to the dedicated 'Events' page, which displays all events on a Google calendar and provides the ability to search for events and conferences by date. There is also a dedicated 'Search' page that allows users to search using particular keywords.

The project website also contains a 'Useful Links' page. This page contains a list of relevant projects identified and links to those project websites as well as links to further information.



Currently there are eighteen links to relevant research projects, four links to relevant tools and four links to further Information.

### **Task 7.2 Establish an Expert Review Panel**

The ERP was established at the beginning of the project in order to provide guidance and direction to HF project members. The ERP advised and evaluated HF activities using a robust system of internal and external controls. Focusing on providing advice on project direction, the ERP did not have any authority to vote on project matters, nor had it a legal responsibility in the operation of the project or the partner organisations.

The ERP initially consisted of eight panel members comprising of five experts in the research field who were not members of HF and three members of HF, one of whom was based in Africa and two of whom were originally based in Europe (one of the two subsequently moved to Asia, but continued to attend ERP meetings). The composition of the ERP was designed to ensure some independent scrutiny of the operation and aims of the project, while also facilitating communication between external members of the ERP and the wider HF consortium.

The members of the ERP were:

- John B. Malone, Professor, *School of Veterinary Medicine, Baton Rouge, LA, USA (Chair of Expert Review Panel)*
- Madeleine Thomson, *Senior Research Scientist (Climate Information for Public Health), Africa Program, International Research Institute for Climate and Society, Columbia Earth Institute, USA*
- Simon Brooker, *Reader in Tropical Epidemiology in the Department of Infectious and Tropical Diseases at the London School of Hygiene and Tropical Medicine & Wellcome Trust Research Fellow, KEMRI, Kenya*
- Timothy Wesonga, *East African Community Secretariat (EAC) Senior Livestock and Fisheries Officer, Tanzania*
- Dr. Maurice Owuor Ope, *East African Community Secretariat (EAC) Disease Surveillance and Epidemiology Officer, Tanzania*
- Jan Semenza, *European Centre for Disease Prevention and Control (ECDC), Sweden*
- Paul Lowen/Ciara Egan (*AquaTT*), *Ireland*
- David Taylor (*National University of Singapore*), *Singapore (originally Trinity College Dublin, Ireland)*
- Theophile Niyonzima (*NUR*), *Rwanda*



### **Task 7.3 Formal peer-review and synergy events**

Over the course of the project four ERP meetings were held. Each meeting was organised to coincide with Partner meetings and other project workshops in order to provide ERP members the opportunity to meet with members of the HF consortium to discuss the project.

The first meeting took place on 13 October 2011 in Kampala, Uganda. This meeting established a relationship between the ERP members and HEALTHY FUTURERS partners. The ERP members reviewed and discussed the work done to date within each work package and provided a number of recommendations to be incorporated by partners.

The second meeting took place on 10 May 2012 in Arusha, Tanzania. The ERP was bolstered by the presence of Dr. Maurice Ope, an expert in disease surveillance and epidemiology in eastern Africa, representing the Secretariat of the EAC. Maurice made a highly valued contribution to the ERP and was able to brief other members of the ERP on the fourth Annual East African Health and Scientific Conference that was scheduled to take place in Kigali in March 2012. As a result of this synergy, HF organised and ran a session at the conference on the theme of 'Environment and health'.

The third ERP meeting was held on the 1 May 2013 in Trieste, Italy. Again the ERP met and reviewed the progress made in each work package including how the previous recommendations were incorporated by partners.

The fourth and final ERP meeting took place on the 28 February 2014 in Nairobi, Kenya. The ERP provided invaluable advice during this meeting on the strengths and weaknesses of the research approaches taken within the project, particularly in relation to the development of a DST.

### **Task 7.4 Report on meeting outcomes**

Reports from the each of the ERP meetings are available to download from the project website:

[http://www.healthyfutures.eu/index.php?option=com\\_k2&view=item&layout=item&id=140&Itemid=267&lang=en](http://www.healthyfutures.eu/index.php?option=com_k2&view=item&layout=item&id=140&Itemid=267&lang=en)

and have been disseminated to key stakeholders.

A report on the collaborations and synergies developed over the course of the project was also produced, and provides a comprehensive overview of the main collaborations established over the course of the project. The report has been disseminated to key stakeholders and is available to download from the HF website:



[http://www.healthyfutures.eu/images/HEALTHY FUTURES Synergies and Collaborations.pdf](http://www.healthyfutures.eu/images/HEALTHY_FUTURES_Synergies_and_Collaborations.pdf)



## **Potential impact (including the socio-economic impact and the wider societal implications of the project so far) and the main dissemination activities and the exploitation of results**

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HF with its integrated holistic approach has considerably enhanced current understanding and dynamic modelling of links between the three target, water related VBDs (malaria, schistosomiasis and RVF) and environmental change drivers and effects. The project has also raised awareness of potential future environmental change impacts on health among decision makers in the countries comprising the East African Community (EAC), and among the secretariat for the EAC. The potential impact of HF is described in relation to the expected impacts identified in the project proposal:

### ***(1) More accurate and reliable predictions for the distribution of three water related vector-borne diseases (VBDs) in Africa***

HF collected a wide range of existing and new data and collated these data within a project database ('Geoportal') (WP 2). These data comprise historical, socio-economic, migration, settlement and conflict data; earth sciences data; direct climate observations and the results of regional downscaling of global reanalyses; and information on disease-environment relationships. The Geoportal acts as a main repository for data and information on the current and future impact of environmental and socio-economic change on VBDs in eastern Africa, specifically the countries comprising the East Africa Community (EAC), and is an important resource for disease planning, further research and teaching and training in the study area and farther afield. The Geoportal provides a standardised format that enables communication between databases. The link, accessible to all interested parties, is:

<http://41.204.190.50/geoportal/catalog/main/home.page>

The HF Atlas, intended as a resource to support teaching, research and health planning, utilises the data collected and collated through HF to highlight hotspots of projected disease risk in the region. This interactive, web-based mapping and DST, aims to provide meaningful and guided access to information on environmental change, and disease hazard, vulnerability and risk relating to the three target VBDs in eastern Africa. Changes in projected disease hazard and risk can be visualised for different time periods up to the end of the current century and for different geographical scales. The Atlas also compiles searchable information on historical disease outbreaks in the study area. An important aspect of the Atlas is use of climate models and future scenarios referred to in the latest (the 5<sup>th</sup>) IPCC Assessment Report.





HF did not carry out any disease modelling for the European region owing to budget constraints. However, environmental change impacts have a transboundary nature, and the distributions of vectors and related diseases are variable. In a highly globalised and dynamic world, VBD surveillance and early warning systems targeted at Africa have therefore relevance for Europe. Moreover, research carried out through HF is, with further financing, extendable to neighbouring parts of continental Africa, and to continental Europe to the north.

### ***(2) Strengthening of the early warning, surveillance and monitoring systems for vector-borne diseases***

A key outcome of HF has been release of the DSF designed specifically to strengthen existing early warning, surveillance and monitoring systems in eastern Africa for the three target VBDs and developed in consultation with decision makers in the East African Community (EAC).

### ***(3) Support to policies on climate change and health***

HF identified and deployed the most appropriate environmental change adaptation strategies and decision support approaches (including relevant frameworks and information platforms) for adoption in the project. One of these tools is the RVF DSF, which has been established and field-tested in the study area. The RVF DSF has been designed to guide timely, evidenced based decision-making in the control of RVF, and decomposes the RVF epidemic cycle into explicit steps that are then matched against specified actions (including interventions). Many of the steps are explicitly time dependent. The integration of inputs from multiple partners, decision-makers and experts (through a series of stakeholder engagement workshops hosted in the study region) was designed to ensure ownership of the product, and relevance to the decision-making challenges that have been experienced during previous RVF outbreaks.

Refinement of the RVF DSF was based on new outputs from research, particularly those evaluating the impacts of climate change on RVF epidemiology and the incorporation of human health interventions into the framework in line with One Health principles. The RVF DSF makes clear links to policy. For example, during an inter-epidemic period the RVF intervention for animal health disease prevention is to develop a clear policy on vaccination against RVF, including during inter-epidemic periods, when risk of RVF outbreak is high and in the face of an outbreak; during a pre-outbreak phase the RVF intervention for human health and animal health is to conduct a rapid risk assessment incorporating the level of vaccination in the area and informing decision and policy-makers of results.



DSFs have also been developed for malaria and schistosomiasis, also in consultation with domain experts in the EAC. Guidance notes covering projected changes in disease rises for the three target VBDs over coming decades, driven by environment, including climate, change, have also been made publically available.

In recognition of the project's policy relevance in the field of environment and health, HF has been included as a case study in the World Health Organization/the World Meteorological Organization (WHO/WMO) special publication on *Climate Services for Health*. The case study focuses on the HF Atlas, and is part of a small group of accepted pieces from more than 75 submissions globally. The final expected outputs of the Climate Services for Health project comprise an online e-book, interactive web repository and a hardcopy publication in the six UN languages, produced by the WHO/WMO.

***(4) Promotion of sustainable management of the natural and human environment and its resources by advancing our knowledge on the interactions between the biosphere, ecosystems and human activities***

Water-related VBDs are transboundary in their distribution and effects. An integrated (i.e. regional and global), multi-national response is therefore required. The transmission and outbreaks of VBDs are also not only related to health and to environment. Their occurrence and severity are also products of socio- economic conditions, and the abilities of health and veterinary services to respond to early warnings of possible outbreaks. Joint action, across international boundaries, therefore represents the only effective way to ensure secure livelihoods and the health security of citizens. HF was guided by the concept that the stability of livelihoods, i.e. their strong resilience, crucially depends on maintaining environmental integrity. In this context, the consortium partners saw a strong link between animal and human health and environmental sustainability.

***(5) Developing new technologies, tools and services, in order to address in an integrated way global environmental issues [...tools and on technologies for monitoring, prevention and mitigation of environmental pressures and risks...]***

The HF project has led to the development and application of the following new technologies, tools and services:

- A publically accessible Geoportal comprising information drawn from a range of primary and secondary sources, including: historical, socio-economic, migration, settlement and conflict data; earth sciences data; direct climate observations and the results of regional downscaling of global reanalyses; and information on disease-



environment relationships. The Geoportal is at:  
<http://41.204.190.50/geoportal/catalog/main/home.page>

- Improved understanding of environment-disease dependencies in eastern Africa, and of the factors that act to confound any relationships
- A new generation of dynamic disease models for the three target, water related VBDs
- The HF Atlas ([http://zgis186.geo.sbg.ac.at/hf\\_atlas/](http://zgis186.geo.sbg.ac.at/hf_atlas/)), an interactive, web-based mapping and visualisation tool
- DSFs for the three target VBDs developed in consultation with relevant decision makers in the EAC region
- Environmental change and health in eastern Africa is now regarded as an important case study in discussions concerning the nature and effectiveness of climate services provision for health by the World Health Organization/the World Meteorological Organization (WHO/WMO). The case study focuses on the HF Atlas, and is part of a small group of accepted pieces from more than 75 submissions globally that will form the basis of an online e-book, interactive web repository and a hardcopy publication in the six UN languages produced by the WHO/WMO.

#### ***(6) Addressing 'Environmental safety and welfare' as an overarching theme***

By contributing to enhanced understanding of links between environmental, including climate, change and the emergence and spread of the three target VBDs, by improving related outbreak early warning systems and by having a relevance beyond the geographic boundaries of the study area – including raising awareness of the potential health and economic impacts of climate change in the developing world - HF addressed environmental safety and welfare as an overarching theme.

Moreover, by communicating the potential links between environment, including climate, change and animal and human health, HF added further weight to arguments in favour of the need to mitigate environmental/climate change impacts, through the reduction of greenhouse gas emissions and increased environmental protection and wise use of resources, and through supporting adaptation measures among the most vulnerable human populations.

#### ***(7) Assessing, reducing and preventing tensions and conflicts related to the depletion of natural resources and environmental services [...of all means including technologies, earth observation, modelling and socio- economic research approaches...]***



The HF project utilised Earth observation and environmental change technologies, in combination with existing data, to assess, monitor and model dynamic environmental conditions – and their potential implications for VBD burdens – in eastern Africa. The multi-disciplinary and consultative approach, adopted in the results generated, are fully compatible with ensuring sustainable development and the wise exploitation of natural resources in the study region.

Moreover, HF obtained input from decision-makers associated with the VBDs in the EAC region through a series of stakeholder engagement workshops. This series was an important foundation for the development of DSFs (WP 5). By working with the EAC, which is mandated to improve the wellbeing of citizens in eastern Africa, HF contributed to easing tensions within the region, and to the maintenance of good relationships within and between countries comprising the EAC.

***(8) Consideration given to the various geographical, sectoral and cultural differences which exist within Africa, and broader socio-economic factors***

The HF study area incorporated the eastern African countries of Burundi, Kenya, Rwanda, Tanzania and Uganda. The boundaries of the study area therefore equate to those of the EAC. The EAC is the regional intergovernmental organisation of the republics of Burundi, Kenya, Rwanda and Uganda and the United Republic of Tanzania. Regional cooperation towards a completely healthy society within member states is a key, stated aim of the EAC.

The choice of eastern Africa as a study area acknowledges the necessity of willingness at all levels of society – including supra-national organisations such as the EAC - to implement the findings and increased understanding that accrue from scientific research in order to mitigate effectively the negative health and economic effects of environmental, including climate, change. The cooperation of supra-national organisations is required because of the transboundary dimensions of environmental change causes and effects, the latter including health impacts. The study area also serves as a useful model in which to examine interlinkages between environment and water-related VBDs in Africa. A range of altitude- and latitude-related environmental conditions, including extensive highland areas and a lowland coastal plain, and a range of humidity, from more or less permanently humid highlands to arid and semi-arid plains, are accommodated within the study area. Moreover, large freshwater bodies and extensive wetlands, some of which are only now being exploited for food production, are also present.



Eastern Africa can also be viewed as a model of the African continent as a whole, in terms of human life. Environmental diversity in the study area is matched by a rich variety of human populations, languages, cultures and religions, and unevenness in the distribution of settlements, economic activities and investment in health. Highlands in the study area support disproportionately high densities of human populations. Many of the people in the study area are living in rural areas (rural population densities in some parts of the study area are among the highest in the world) as subsistence farmers. As such they are often distant from health and veterinary services. Parts of the study area have also experienced political instability in the relatively recent past, one consequence of which is the presence of temporary camps for displaced people, while urbanisation has also become a major factor. These are all factors that will influence the health effects of environmental change.

Within the project itself, there has been a strong representation of Africa-based partners, including in positions of responsibility, and stakeholders in the research. Several Work Packages were jointly-led by representatives from Africa-based institutional members of the HF consortium, while the Expert Review Panel was chaired by the representative of NUR (now University of Rwanda) in the project. Moreover, three of the six partners' meetings were held in eastern Africa – including in Arusha, Tanzania, in order to facilitate attendance by a representative of the EAC, as was one of the two research symposia and one of the two Early Stage Researcher Generic Skills and Networking workshops. All three meetings with stakeholders were held in eastern Africa. Two of the four PhD scholarships funded through the project went to Africa-based students. Finally news releases and summaries of HF research and results were made available in both English and Kiswahili, while project updates were frequently sent to stakeholders in the research. More than 30% of the c. 40,000 hits on the project website ([www.healthyfutures.eu](http://www.healthyfutures.eu)) have originated in Africa – with Kenya (over 6000 hits) and Rwanda (over 4500 hits) showing the greatest online interest in the project, according to the number of hits.

### ***(9) Training activities and exchange of staff***

HF had a strong commitment to training activities. There were two Early Stage Researcher (ESR) Generic Skills and Networking workshops held:

- The first took place in Arusha, Tanzania in May 2012. Eight ESRs funded through HF participated in the workshop, which was also attended by seven research trainers.
- The second took place at the ICTP, Trieste, Italy in April 2013, and included attendance at the Spring School on Modelling Tools and Capacity Building in Climate and Public Health in the ICTP. The content of this school was of particular relevance to the work being carried out in the HF project. Six ESRs from five of the HF partner



institutions participated in the two-week school, which was attended by more than fifty people in total (the vast majority from developing world countries). In addition, several other members of the HF team contributed to teaching at the school.

Four PhDs, funded through HF, has led to the publication of several papers in high impact, internationally refereed journals, in addition to theses. The titles of the PhD thesis research and the students concerned are:

- a. 'Modelling the effects of temperature changes on *Schistosoma mansoni* transmission' completed by Nicky McCreesh at Durham University.
- b. 'Integrated spatial indicators for modeling, exploring and visualising vulnerability to vector-borne diseases' completed by Michael Hagenlocher at PLUS.
- c. 'A simulation model of Rift Valley fever transmission in Kenya' completed by John Gachohi at the ILRI.
- d. 'Climate change and malaria in Rwanda: Spatial assessment of social vulnerability at different scale levels' completed by Jean Pierre Bizimana at the University of Rwanda (UR) - The first ever PhD to be awarded in Science by the UR.

**(10) *Innovative management and governance tools and adaptive technologies suitable for the relevant authorities and stakeholders in Africa***

As mentioned above, HF developed and implemented innovative management and governance tools through its online Geoportal and DSTs. These were designed and implemented together with key local partners – essential players in sustaining the technologies after the project end - but also through the integration of regional and local stakeholders through stakeholder engagement workshops. Furthermore, environmental change and health in eastern Africa was chosen as an important case study for *Climate services for health* by the World Health Organization/the World Meteorological Organization (WHO/WMO). The case study focuses on the HF Atlas, and is part of a small group of accepted pieces from more than 75 submissions globally. The final expected outputs of the Climate Services for Health project comprise an online e-book, interactive web repository and a hardcopy publication in the six UN languages.

**(11) *Integration of local stakeholders, and/or regional actors, and the necessary networking; clustering and coordination activities between the relevant selected projects***



HF partners consulted actively with local and regional stakeholders throughout the project. Besides strategic involvement of key local stakeholders in a number of engagement and training workshops for the refinement of DSTs, partners also networked with regional actors. For example, partners from TCD travelled to Burundi to investigate the country's archival collection and to establish better links with the country, meeting representatives from *Ministère de la Santé Publique et de la Lutte contre le Sida (Minisanté)* (Ministry of Public Health and Fight against AIDS) and the *Programme National Intégré de Lutte contre les Maladies Tropicales Négligées et la Cécité* (PNIMTNC) (National Integrated Program for Neglected Tropical Diseases and Blindness Control) amongst others. Burundi is the only country member of the EAC that had no institutional representatives in the HF project.

Furthermore, HF with its sister project QWECI (which focused on western Africa) jointly coordinated a symposium at the 4th annual East African Community Health & Scientific Conference, Kigali, Rwanda in 2013. Both projects also appeared together in the video documentary entitled *Health and Climate Change in Africa*, produced by Africa Turns Green, a charity that showcases the work of African green entrepreneurs who are protecting their environment.

As previously mentioned, within the project itself, there has been a strong representation of Africa-based partners, including in positions of responsibility, and stakeholders in the research. Several Work Packages were jointly-led by representatives from Africa-based institutional members of the HF consortium, while the Expert Review Panel was chaired by the representative of NUR (now University of Rwanda) in the project. Moreover, three of the six partners' meetings were held in eastern Africa – including in Arusha, Tanzania, in order to facilitate attendance by a representative of the EAC, as was one of the two research symposia and one of the two Early Stage Researcher training and networking workshops. All three meetings with stakeholders were held in eastern Africa. Two of the four PhD scholarships funded through the project went to Africa-based students. Finally news releases and summaries of HF research and results were made available in both English and Kiswahili, while project updates were frequently sent to stakeholders in the research. More than 30% of the c. 40,000 hits on the project website ([www.healthyfutures.eu](http://www.healthyfutures.eu)) have originated in Africa – with Kenya (over 6000 hits) and Rwanda (over 4500 hits) showing the greatest online interest in the project, according to the number of hits.



## Main Dissemination Activities and the Exploitation of Results

HF results were exploited through the prompt publication of research findings in a diversity of fora, including high impact scientific journals, webpages, frequent news releases, workshops and international conferences. HF deliverables were disseminated in English and, where relevant, material was translated into Kiswahili, which is also widely spoken in the study area. The variety of platforms and forms of media used – and the hosting of deliverables on an open access, project website - maximised the impact of the results of the project. Main dissemination activities included:

- **HF website** - has to date received over 40,000 hits and is available in both English and Kiswahili (<http://www.healthyfutures.eu/>)
- **Seven contractual HF news releases** - available in both English and Kiswahili **and additional news releases** disseminated through such channels as AlphaGalileo (<http://www.alphagalileo.org>), the EC's CORDIS News services (<http://cordis.europa.eu/news/>), CORDIS WIRE, Twitter, LinkedIn and AquaTT's Training News (also available on project website)
- **Project factsheet** - available in both English and Kiswahili (also available on project website)
- **Seven HF newsletters** - non-contractual (also available on project website)
- **Four project updates** - distributed to all stakeholders listed in the Stakeholder Database (also available on project website)
- **A non-technical, tri-fold project brochure** - available in both English and Kiswahili developed for general release outlining the project (also available on project website)
- **A short promotional video** - (c.90 seconds) summarising the HF project and hosted by VIMEO aimed at raising awareness of the project, viewable at [www.vimeo.com/70318624](http://www.vimeo.com/70318624) or on the project website
- **Two promotional items: a key-ring with bottle opener and torch, and post-it notes** - which include the HF logo and website address designed to increase the brand awareness of the project. These have been distributed at a number of stakeholder engagement workshops and events over the course of the project.
- **A short documentary "Health and climate change in Africa"** - produced by the charity, Africa Turns Green and HF contributed to its completion. The documentary was released in August 2014 and is available to view on the project website ([http://www.healthyfutures.eu/index.php?option=com\\_k2&view=item&layout=item&id=176&Itemid=276&lang=en](http://www.healthyfutures.eu/index.php?option=com_k2&view=item&layout=item&id=176&Itemid=276&lang=en)) and on YouTube (<https://www.youtube.com/watch?v=oYL4Nc-qnKE>). The video focuses on the





collaborations between HF and its sister project, QWeCI, and outlines how both projects have worked to increase capacity in Africa and reduce the impacts of the target VBDs in the study region.

- **HF Symposium** - Jointly coordinated by members of HF and its sister project QWeCI and held at the **4<sup>th</sup> Annual East African Health and Scientific Conference** in Kigali, Rwanda in March 2013. The conference programmed comprised four sub-themes (Maternal and Child Health, Non Communicable Diseases and Trauma, Health Systems Strengthening, and Quality of Health Care) and four symposia: HIV and AIDS; Integrated disease surveillance and disaster preparedness; Tobacco Control; and the HF/QWeCI symposium on '*Environment and Health in Africa: climate and vector-borne diseases*'. The symposium was well-attended and brought together researchers at the cutting edge of efforts to understand the relationships between health and environment, and in particular the links between climate and VBDs in Africa. There were a total of 17 presentations in this session, including the plenary by Dr. Margaran Bagayoko (Protection of Human Environment Programme, World Health Organization Regional Office for Africa) whose talk centred on the potential of climate-based early warning systems for improved management of VBDs in Africa. The presentations that followed ranged in topics related to the symposium title, from speakers who had travelled from other parts of Africa and from Europe and Asia.
- **HF-focused and organised/hosted session** - at the 'Impact of Environmental Changes on Infectious Disease' (IECID) Conference, Sitges, Spain in March 2015
- **Scientific Papers** - 19 papers published in scientific journals with one more awaiting decision. Two submissions in a WHO-WMO special publication on climate services and health. One special issue of the journal *Geospatial Health* is currently in preparation.
- **EC Promotion** - HF has featured prominently in two widely circulated magazines produced by the EC: Horizon ("Predicting disease outbreaks in East Africa") and Research EU ("Anticipating climate change, tackling disease") and most recently through the EC Horizon 2020 website (<http://ec.europa.eu/programmes/horizon2020/en/news/mapping-effects-climate-change-deadly-diseases>).
- **Oral presentations of HF results and networking** - partners have carried out dissemination activities through attendance (and in a lot of cases presentation of HF results) at many key conferences and meetings, details of which have been provided in the participant portal.
- **Case study in a special publication on Climate and Health (WHO/WMO)** – HF has been included as a case study in the World Health Organization/the World



Meteorological Organization (WHO/WMO) special publication on Climate Services for Health. The case study focuses on the HF Atlas, and is part of a small group of accepted pieces from more than 75 submissions globally. The final expected outputs of the Climate Services for Health project comprise an online e-book, interactive web repository and a hardcopy publication in the six UN languages, produced by the WHO/WMO.

## Public website address and relevant contact details

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The address of the public website is: [www.healthyfutures.eu](http://www.healthyfutures.eu)

Table 1 lists the email contact details and affiliations of HF project partners.

**Table 1** Affiliations and email contact details of project partners

Beneficiary number & short name		Country	List of contacts & emails
1	TCD	Ireland	Laragh Larsen <a href="mailto:llarsen@tcd.ie">llarsen@tcd.ie</a> Gayle McGlynn <a href="mailto:mcglyng@tcd.ie">mcglyng@tcd.ie</a>
2	ICTP	Italy	Adrian Tompkins <a href="mailto:tompkins@ictp.it">tompkins@ictp.it</a> Diro Gulilat Tefera <a href="mailto:gtefera@ictp.it">gtefera@ictp.it</a> Felipe de Jesús Colón-González <a href="mailto:fcolon_g@ictp.it">fcolon_g@ictp.it</a> Riccardo Biondi <a href="mailto:rbiondi@ictp.it">rbiondi@ictp.it</a> Susanne Henningsen <a href="mailto:hennings@ictp.it">hennings@ictp.it</a>
3	PLUS	Austria	Peter Zeil <a href="mailto:peter.zeil@sbg.ac.at">peter.zeil@sbg.ac.at</a> Stefan Kienberger <a href="mailto:stefan.kienberger@sbg.ac.at">stefan.kienberger@sbg.ac.at</a> Michael Hagenlocher <a href="mailto:michael.hagenlocher@sbg.ac.at">michael.hagenlocher@sbg.ac.at</a>
4	SMHI	Sweden	Colin Jones <a href="mailto:Colin.Jones@smhi.se">Colin.Jones@smhi.se</a> Grigory Nikulin <a href="mailto:grigory.nikulin@smhi.se">grigory.nikulin@smhi.se</a> Monica Wallgren <a href="mailto:Monica.Wallgren@smhi.se">Monica.Wallgren@smhi.se</a>
5	UoN	Kenya	Winnie Mitullah <a href="mailto:wvmitullah@swiftkenya.com">wvmitullah@swiftkenya.com</a> Eric Othieno Nyanjom <a href="mailto:othieno_n@yahoo.co.uk">othieno_n@yahoo.co.uk</a> Fredrick Obonyo Mukanga <a href="mailto:fredmukanga@yahoo.com">fredmukanga@yahoo.com</a>
6	AQUATT	Ireland	David Murphy <a href="mailto:david@aquatt.ie">david@aquatt.ie</a> Olivia Daly <a href="mailto:olivia@aquatt.ie">olivia@aquatt.ie</a>
7	ILRI	Kenya	An Notenbaert <a href="mailto:A.notenbaert@cgiar.org">A.notenbaert@cgiar.org</a> Jeffery Mariner <a href="mailto:j.mariner@cgiar.org">j.mariner@cgiar.org</a> Bernard Bett <a href="mailto:b.bett@cgiar.org">b.bett@cgiar.org</a> Wachira Theuri <a href="mailto:w.theuri@cigar.org">w.theuri@cigar.org</a> Jusper Kiplimo <a href="mailto:jusronohk@gmail.com">jusronohk@gmail.com</a> Nancy Ajima <a href="mailto:n.ajima@cgiar.org">n.ajima@cgiar.org</a> John Gachohi <a href="mailto:j.gachohi@cgiar.org">j.gachohi@cgiar.org</a>



8	UR	Rwanda	Theophile Niyonzima <a href="mailto:tniyonzima@nur.ac.rw">tniyonzima@nur.ac.rw</a> Jean Pierre Bizimana <a href="mailto:jpbizimana@nur.ac.rw">jpbizimana@nur.ac.rw</a> Jean Damascene Mazimpaka <a href="mailto:jdmazimpaka@nur.ac.rw">jdmazimpaka@nur.ac.rw</a> Rachel Murekatete <a href="mailto:rmurekatete@nur.ac.rw">rmurekatete@nur.ac.rw</a> Caritas Thereza Gasengayire <a href="mailto:tgasengayire@nur.ac.rw">tgasengayire@nur.ac.rw</a>
9	SEI Tanz/York	Tanzania/United Kingdom	Stacey Noel <a href="mailto:stacey.noel@sei.se">stacey.noel@sei.se</a> Neela Matin <a href="mailto:neela.mation@sei.se">neela.mation@sei.se</a> Victor Kongo <a href="mailto:victor.kongo@sei.se">victor.kongo@sei.se</a> Richard Taylor <a href="mailto:richardtaylor.sei@gmail.com">richardtaylor.sei@gmail.com</a> Sukaina Bharwani <a href="mailto:sukaina.bharwani@sei.se">sukaina.bharwani@sei.se</a>
10	Community Health	Uganda	Agaba E. Friday <a href="mailto:agabafriday@hotmail.com">agabafriday@hotmail.com</a> Didacus B. Namanya <a href="mailto:didamanya@yahoo.com">didamanya@yahoo.com</a>
11	KEMRI	Kenya	Andrew Githeko <a href="mailto:githeko@yahoo.com">githeko@yahoo.com</a> Diana Karanja <a href="mailto:Diana@cohesu.com">Diana@cohesu.com</a>
13	UCT	South Africa	Bruce Hewitson: <a href="mailto:hewitson@csag.uct.ac.za">hewitson@csag.uct.ac.za</a> Lisa Coop: <a href="mailto:lcoop@csag.uct.ac.za">lcoop@csag.uct.ac.za</a>
14	UDUR	United Kingdom	Mark Booth <a href="mailto:mark.booth@durham.ac.uk">mark.booth@durham.ac.uk</a> Nicky McCreesh <a href="mailto:Nicky.mccreesh@durham.ac.uk">Nicky.mccreesh@durham.ac.uk</a> Dajana Dzanovic <a href="mailto:dajana.dzanovic@durham.ac.uk">dajana.dzanovic@durham.ac.uk</a> Gary Mitchell <a href="mailto:Gary.Mitchell@durham.ac.uk">Gary.Mitchell@durham.ac.uk</a>
15	UNILIV	United Kingdom	Andy Morse <a href="mailto:A.P.Morse@liverpool.ac.uk">A.P.Morse@liverpool.ac.uk</a> Cyril Caminade <a href="mailto:Cyril.Caminade@liverpool.ac.uk">Cyril.Caminade@liverpool.ac.uk</a> Anne Jones <a href="mailto:Anne.Jones@liverpool.ac.uk">Anne.Jones@liverpool.ac.uk</a> Scott McGee <a href="mailto:S.Mcgee@liverpool.ac.uk">S.Mcgee@liverpool.ac.uk</a>
16	NUS	Singapore	David Taylor <a href="mailto:geodmt@nus.edu.sg">geodmt@nus.edu.sg</a>



## Use and Dissemination of Foreground

### Section A (public)

This section contains two templates:

- Template A1: List of all scientific publications relating to the foreground of the project.

No.	DOI	Title	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Date of publication	Relevant pages	Is open access(4) provided to this publication ?	Type
1	10.1073/pnas.1302089111	Impact of climate change on global malaria distribution	Cyril Caminade , Sari Kovats , Joacim Rocklov , Adrian M. Tompkins , Andrew P. Morse , Felipe J. Colón-González , Hans Stenlund , Pim Martens , Simon J. Lloyd	Proceedings of the National Academy of Sciences of the United States	Vol. 111/Issue 9	National Academy of Sciences	United States	04/03/2014	3286-3291	Yes	Peer reviewed publication
2	10.1186/s13071-014-0617-0	Predicting the effects of climate change on Schistosoma	Nicky McCreesh , Grigory Nikulin , Mark Booth	Parasites and Vectors	Vol. 8/Issue 1	BioMed Central	United Kingdom	06/01/2015		Yes	Peer reviewed publication



		mansoni transmission in eastern Africa									
3	10.1186/1475-2875-12-65	A regional-scale, high resolution dynamical malaria model that accounts for population density, climate and surface hydrology	Adrian M Tompkins , Volker Ermert	Malaria Journal	Vol. 12/Issue 1	BioMed Central	United Kingdom	01/01/2013	65	Yes	Peer reviewed publication
4		A generalized deforestation and land-use change scenario generator for use in climate modelling studies	L. Caporaso, A.M. Tompkins, R. Biondi, J.P. Bell	PLoS One	Revision	Public Library of Science		31/07/2015	n/a		Peer reviewed publication
5	<a href="http://dx.doi.org/10.1186/1475-2875-13-29">http://dx.doi.org/10.1186/1475-2875-13-29</a>	Spatial-explicit modeling of social vulnerability to malaria in	Stefan Kienberger , Michael Hagenlocher	International Journal of Health Geographics	Vol. 13/Issue 1	BioMed Central	United Kingdom	01/01/2014	29	Yes	Peer reviewed publication



		East Africa									
6	10.1002/2014JD022586	A process-based investigation into the impact of the Congo Basin deforestation on surface climate	Jean P. Bell , Adrian M. Tompkins , Clobite Bouka-Biona , I. Seidou Sanda	Journal of Geophysical Research: Atmospheres	Revision	American Geophysical Union		01/05/2015	n/a		Peer reviewed publication
7	10.1186/s12963-015-0036-2	Mapping malaria risk and vulnerability in the United Republic of Tanzania: a spatial explicit model	Michael Hagenlocher , Marcia C Castro	Population Health Metrics	Vol. 13/Issue 1	BioMed Central	United Kingdom	03/02/2015		Yes	Peer reviewed publication
8	10.1186/1475-2875-14-2	Assessing the social vulnerability to malaria in Rwanda	Jean-Pierre Bizimana , Emmanuel Twarabamenye , Stefan Kienberger	Malaria Journal	Vol. 14/Issue 1	BioMed Central	United Kingdom	07/01/2015		Yes	Peer reviewed publication
9	10.1029/2011JD016997	Dynamical downscaling of ECMWF Ensemble seasonal forecasts	G. T. Diro , A. M. Tompkins , X. Bi	Journal of Geophysical Research	Vol. 117/Issue D16	American Geophysical Union	United States	01/01/2012		Yes	Peer reviewed publication



		over East Africa with RegCM3									
10	10.1038/srep07264	Visualizing the uncertainty in the relationship between seasonal average climate and malaria risk	D. A. MacLeod , A. P. Morse	Scientific Reports	Vol. 4	Nature Publishing Group	United Kingdom	02/12/2014	7264		Peer reviewed publication
11	10.1371/journal.pone.0101462	The Effect of Increasing Water Temperature s on Schistosoma mansoni Transmission and Biomphalaria pfeifferi Population Dynamics: An Agent-Based Modelling Study	Nicky McCreesh , Mark Booth	PLoS One	Vol. 9/Issue 7	Public Library of Science	United States	02/07/2014	e101462		Peer reviewed publication
12	10.1371/journal.pone.008789	The Effect of Simulating Different	Nicky McCreesh , Mark Booth	PLoS One	Vol. 9/Issue 7	Public Library of Science	United States	02/07/2014	e87892		Peer reviewed



	2	Intermediate Host Snail Species on the Link between Water Temperature and Schistosomiasis Risk									public ation
13	10.1002/qj.2019	A rainfall calibration methodology for impacts modelling based on spatial mapping	Francesca Di Giuseppe , Franco Molteni , Adrian M. Tompkins	Quarterly Journal of the Royal Meteorological Society	Vol. 139/Issue 674	John Wiley and Sons Ltd	United Kingdom	01/07/2013	1389-1401	Yes	Peer reviewed public ation
14		Evaluation of breeding site availability model for malaria vectors using explicit pond-resolving surface hydrology simulations	E. O. Asare, A. M. Tompkins and A. Bomblies	Water Resources Research Institute News of the University of North Carolina	Submitted	Water Resources Research Institute		31/07/2015	n/a		Peer reviewed public ation
15	10.1175/JAMC-D-	Potential Predictability	Adrian M. Tompkins ,	Journal of Applied Meteorology and	Vol. 54/Issue 3	American Meteorolo	United States	01/03/2015	521-540		Peer revie





	14-0156.1	of Malaria in Africa Using ECMWF Monthly and Seasonal Climate Forecasts	Francesca Di Giuseppe	Climatology		gical Society					wed publication
16	10.1186/s13071-014-0503-9	Effect of water temperature and population density on the population dynamics of Schistosoma mansoni intermediate host snails	Nicky McCreesh , Moses Arinaitwe , Wilber Arineitwe , Edridah M Tukahebwa , Mark Booth	Parasites and Vectors	Vol. 7/Issue 1	BioMed Central	United Kingdom	01/01/2014	503		Peer reviewed publication
17	10.3390/ijerph110100903	Rift Valley Fever Outbreaks in Mauritania and Related Environmental Conditions	Cyril Caminade , Jacques Ndione , Mawlouth Diallo , Dave MacLeod , Ousmane Faye , Yamar Ba , Ibrahima Dia , Andrew Morse	International Journal of Environmental Research and Public Health	Vol. 11/Issue 1	Molecular Diversity Preservation International	Switzerland	01/01/2014	903-918		Peer reviewed publication
18	10.4081/gh.2013.76	A WebGIS tool for visualizing	Stefan Kienberger , Michael	Geospatial health	Vol. 8/Issue 1	University of Naples Federico II	Italy	02/11/2013	313		Peer reviewed



		and exploring socioeconomic vulnerability to dengue fever in Cali, Colombia	Hagenlocher , Eric Delmelle , Irene Casas								public ation
19	10.1186/1476-072X-12-36	Assessing socioeconomic vulnerability to dengue fever in Cali, Colombia: statistical vs expert-based modeling	Michael Hagenlocher , Eric Delmelle , Irene Casas , Stefan Kienberger	International Journal of Health Geographics	Vol. 12/Issue 1	BioMed Central	United Kingdom	01/01/2013	36	Yes	Peer reviewed publication
20		Special Issue of Geospatial Health. The Special Issue of Geospatial Health. The Special Issue, based on the 'Impact of Environmental Changes on Infectious Disease' (IECID)	HEALTHY FUTURES consortium	Geospatial health	TBC	University of Naples Federico II		31/07/2015	TBC	Yes	Peer reviewed publication



		Conference, Sitges, Spain which took place in March 2015, will contain 6-8 papers from the HEALTHY FUTURES project. The papers are currently going through the review process.								
		HEALTHY FUTURES ATLAS: a publicly available resource for evaluating climate change risks on water-related and vector-borne disease in eastern Africa. In L	Kienberger, S., Morper-Busch, L., Hagenlocher M., Morse, A.P., Tompkins, A. and Taylor, D. (in press)	WHO-WMO Special Publication				30/01/2016	Yes	Article /Section in an edited book or book series



		Fernandez Montoya & J Shumake-Guillemot (eds) Climate Services for Health.									
		A planned operational malaria early warning system for Uganda provides useful district-scale predictions up to 4 months ahead.	Adrian Tompkins, Francesca Di Giuseppe, Felipe Colón-González, Didacus Namanya (in press)	WHO-WMO Special Publication				30/01/2016		Yes	Article /Section in an edited book or book series
	10.1553/gi-science2014s197	Implications of spatial scales and reporting units for the spatial modelling of vulnerability to vector-borne diseases	Hagenlocher	GI Forum 2014		Wichmann Verlag, VDE Verlag, Berlin/Offenbach. ÖAW Verlag, Wien	Berlin/Vienna	31/12/2014	197-206	Yes	Paper in Proceedings of a Conference/ Workshop
		Modelling	Nicky McCreesh			Durham	United	01/12/201		Yes	Thesis



		the effects of temperature changes on Schistosoma mansoni transmission ( <a href="http://etheses.dur.ac.uk/10984/">http://etheses.dur.ac.uk/10984/</a> )				University (UDUR)	Kingdom	4			/Dissertation
		Integrated spatial indicators for modeling, exploring and visualising vulnerability to vector-borne diseases	Michael Hagenlocher			Paris-Lodron Universität Salzburg (PLUS)	Austria	18/12/2014		Yes	Thesis/Dissertation
		A simulation model of Rift Valley fever transmission in Kenya	John Gachohi			International Livestock Research Institute (ILRI)	East Africa	08/07/2015			Thesis/Dissertation
		Climate change and malaria in Rwanda: Spatial assessment	Jean Pierre Bizimana			University of Rwanda (UR)	East Africa	17/04/2015			Thesis/Dissertation



		of social vulnerability at different scale levels								
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- Template A2: List of all dissemination activities (publications, conferences, workshops, web sites/applications, press releases, flyers, articles published in the popular press, videos, media briefings, presentations, exhibitions, thesis, interviews, films, TV clips, posters).

No.	Type of activities	Main leader	Title	Date	Place	Type of audience	Size of audience	Countries addressed
1	Flyers	THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN	Showcasing Ireland's success in European Research Programmes: HEALTHY FUTURES <a href="https://www.tcd.ie/iiis/assets/pdf/EU%20Framework%207%20grant%20-%20Healthy%20Futures.pdf">https://www.tcd.ie/iiis/assets/pdf/EU%20Framework%207%20grant%20-%20Healthy%20Futures.pdf</a>	01/12/2010	EPA Strive leaflet	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Web dissemination



2	Articles published in the popular press	THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN	Healthy Futures: an example of international teamwork	01/12/2010	CAAST-Net's online Newsletter	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Web dissemination
3	Press releases	AquaTT UETP Ltd	HEALTHY FUTURES kick-off meeting, 14-15 February, Dublin, Ireland	01/02/2011	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide
4	Press releases	AquaTT UETP Ltd	HEALTHY FUTURES kick-off meeting a success	01/03/2011	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide



5	Web sites/Applications	AquaTT UETP Ltd	HEALTHY FUTURES kick-off meeting a success (Online article)	01/03/2011	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
6	Web sites/Applications	AquaTT UETP Ltd	PhD Position Announced (Online article)	11/07/2011	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry		Worldwide
7	Web sites/Applications	AquaTT UETP Ltd	Anticipating Future Climate Change Impacts on Water-related Vector-borne Diseases through International & Inter-disciplinary Collaboration (Online article)	01/08/2011	HEALTHY FUTURES website and beneficiaries networks	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide





8	Web sites/Applications	AquaTT UETP Ltd	Afya Bora ya Baadaye-Kutazamia mabadiliko katika tabia ya nchi kwa siku zijazo na namna yatakavyoathiri Magonjwa ya vimelea yanayotokana na maji kupitia ushirikiano wa kimataifa na taaluma mbalimbali (Posted online and distributed through network)	01/08/2011	HEALTHY FUTURES website and beneficiaries networks	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
9	Press releases	AquaTT UETP Ltd	Anticipating Future Climate Change Impacts on Water-related Vector-borne Diseases through International & Inter-disciplinary Collaboration	01/08/2011	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide
10	Press releases	AquaTT UETP Ltd	Anticipating Future Climate Change Impacts on Water-related Vector-borne Diseases through International & Inter-disciplinary Collaboration	01/08/2011	Aqua-tnet newsletter	Scientific community (higher education, Research) - Civil society	300	Europe



11	Web sites/Applications	AquaTT UETP Ltd	Second partner meeting October 2011 (Online article)	05/09/2011	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
12	Web sites/Applications	AquaTT UETP Ltd	HEALTHY FUTURES co-hosting a session with QWeCI at the forthcoming General Assembly of the European Geosciences Union (EGU), scheduled for Vienna, April 22-27, 2012 (Online article)	21/10/2011	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
13	Press releases	AquaTT UETP Ltd	HEALTHY FUTURES 2nd partner meeting a success	10/11/2011	Aqua-tnet newsletter	Scientific community (higher education, Research) - Civil society	300	Europe



14	Press releases	AquaTT UETP Ltd	HEALTHY FUTURES 2nd partner meeting a success	10/11/2011	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide
15	Web sites/Applications	AquaTT UETP Ltd	HEALTHY FUTURES 2nd partner meeting a success (Online article)	11/11/2011	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
16	Flyers	AquaTT UETP Ltd	Distribution of 45 x HEALTHY FUTURES Factsheets	16/11/2011	Aquainnova Workshop	Scientific community (higher education, Research)		Europe



17	Web sites/Applications	AquaTT UETP Ltd	David Taylor talks on health impacts of climate change at UN conference in Durban, South Africa (Online article)	02/12/2011	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
18	Press releases	AquaTT UETP Ltd	David Taylor talks on health impacts of climate change at UN conference in Durban, South Africa	06/12/2011	Aqua-tnet newsletter	Scientific community (higher education, Research) - Civil society	300	Europe
19	Press releases	AquaTT UETP Ltd	David Taylor talks on health impacts of climate change at UN conference in Durban, South Africa	06/12/2011	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide



20	Articles published in the popular press	THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN	HEALTHY FUTURES Newsletter Issue No.1 December 2011	19/12/2011	HEALTHY FUTURES website and beneficiaries networks	Scientific community (higher education, Research)		Worldwide
21	Web sites/Applications	AquaTT UETP Ltd	First issue of HEALTHY FUTURES newsletter now available (Online article)	21/12/2011	HEALTHY FUTURES website	Scientific community (higher education, Research)		Worldwide
22	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Crystal ball or support for decision makers? Exploring opportunities towards vulnerability scenarios and trends by Stefan Kienberger	28/08/2012	32nd International Geographical Congress, 26 - 30 August 2012, Cologne, Germany	Scientific community (higher education, Research) - Policy makers	150	Worldwide
23	Oral presentation to a scientific event	KENYA MEDICAL RESEARCH INSTITUTE	Presentation at AfriCAN Climate Kick Off Meeting	24/11/2011	Brussels, Belgium	Scientific community (higher education, Research)	15	Eastern Africa and Western Europe



24	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Water-related vector-borne diseases in eastern Africa: Present and future risks by Stefan Kienberger	30/08/2012	32nd International Geographical Congress, 26 - 30 August 2012, Cologne, Germany	Scientific community (higher education, Research) - Policy makers	150	Worldwide
25	Web sites/Applications	IKIGO GISHINZWE UBUVUZI N'UBUSHAKASHATSI KURI SIDA, MALARIYA, IGITUNTUN'IZINDI NDWARA Z'IBYOZEZO (TRAC PLUS)	Dedicated website for the VECTRI model developed during the project	01/01/2011	<a href="http://www.ictp.it/~tompkins/vectri">www.ictp.it/~tompkins/vectri</a>	Scientific community (higher education, Research)		Global
26	Web sites/Applications	AquaTT UETP Ltd	HEALTHY FUTURES website	04/07/2011	<a href="http://www.healthyfutures.eu/">http://www.healthyfutures.eu/</a>	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	40000	Global



27	Oral presentation to a scientific event	SVERIGES METEOROLOGISKA OCH HYDROLOGISKA INSTITUT	Health and socio-economic impacts of environmental changes	16/11/2011	Rosby Centre Day 2011, SMHI, Norrköping, Sweden	Scientific community (higher education, Research) - Policy makers	60	Sweden
28	Oral presentation to a wider public	Vector Control Division - Ministry of Health	Regular briefs to Ministry of Health, Uganda Top Management	31/12/2011	Ministry of Health	Scientific community (higher education, Research) - Policy makers	30	Uganda
29	Oral presentation to a scientific event	THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN	An archival examination of environment and disease in eastern Africa in recent history	24/04/2012	EGU, Vienna, Austria	Scientific community (higher education, Research)	40	Worldwide
30	Oral presentation to a scientific event	SVERIGES METEOROLOGISKA OCH HYDROLOGISKA INSTITUT	Regional climate modelling in the Africa-CORDEX initiative	02/05/2012	Tanzania Meteorological Agency, Dar Es Salaam, Tanzania	Scientific community (higher education, Research)	20	Tanzania



31	Oral presentation to a scientific event	International Livestock Research Institute	Spatial-temporal analysis of the of the risk of Rift Valley Fever in Kenya	20/08/2012	13th conference of the International Society of Veterinary Epidemiology and Economics, Maastricht	Scientific community (higher education, Research)	500	East African Community, Netherlands
32	Oral presentation to a scientific event	IKIGO GISHINZWE UBUVUZI N'UBUSHAKASHATSI KURI SIDA, MALARIYA, IGITUNTUN'IZINDI NDWARA Z'IBYOREZO (TRAC PLUS)	Session on HEALTHY FUTURES and QWeCI	07/04/2013	EGU, Vienna, Austria	Scientific community (higher education, Research)	300	EAC countries, Ghana, Malawi and Senegal
33	Organisation of Workshops	IKIGO GISHINZWE UBUVUZI N'UBUSHAKASHATSI KURI SIDA, MALARIYA, IGITUNTUN'IZINDI NDWARA Z'IBYOREZO (TRAC PLUS)	1. Modelling Tools and Capacity Building in Climate and Public Health, 2. Mathematical Models of Climate Variability, Environmental Change and Infectious Diseases. ( <a href="http://www.ictp.it/about-ictp/media-centre/news/news-archive/2013/4/climate_modelling_schools.aspx">http://www.ictp.it/about-ictp/media-centre/news/news-archive/2013/4/climate_modelling_schools.aspx</a> ) ( <a href="http://indico.ictp.it/event/a12175">http://indico.ictp.it/event/a12175</a> ) ( <a href="http://indico.ictp.it/event/a12171">http://indico.ictp.it/event/a12171</a> )	15/04/2013	ICTP, Trieste	Scientific community (higher education, Research)	40	Global
34	Oral presentation to a wider public	IKIGO GISHINZWE UBUVUZI N'UBUSHAKASHATSI KURI SIDA, MALARIYA, IGITUNTUN'IZINDI NDWARA Z'IBYOREZO (TRAC PLUS)	Poster presentation at "Challenges in Malaria Research" conference	22/09/2013	Oxford, UK	Scientific community (higher education, Research)	300	East African Community





35	Oral presentation to a scientific event	IKIGO GISHINZWE UBUVUZI N'UBUSHAKASHATSI KURI SIDA, MALARIYA, IGITUNTUN'IZINDI NDWARA Z'IBYOUREZO (TRAC PLUS)	Africa Climate Conference 2013	15/10/2013	Arusha, Tanzania	Scientific community (higher education, Research)	300	Uganda
36	Oral presentation to a wider public	Vector Control Division - Ministry of Health	Briefs to Uganda Ministry of Water and Environment Climate Change Department (CCD) - A multisectoral and multidisciplinary task force for development of second national communication to UNFCCC	01/04/2013	Climate Change Department, Ministry of Water and Environment	Scientific community (higher education, Research) - Policy makers	25	Uganda
37	Organisation of Workshops	Vector Control Division - Ministry of Health	Malaria and climate change ( <a href="http://www.healthyfutures.eu/images/healthy/Stakeholder_meeting_Kampala_Oct_2013/healthy_futures_stakeholder_meeting_report_kampala_uganda_october_2013.pdf">http://www.healthyfutures.eu/images/healthy/Stakeholder_meeting_Kampala_Oct_2013/healthy_futures_stakeholder_meeting_report_kampala_uganda_october_2013.pdf</a> )	25/10/2013	Kampala	Scientific community (higher education, Research) - Policy makers	20	Uganda, Ireland, Italy, UK
38	Organisation of Workshops	IKIGO GISHINZWE UBUVUZI N'UBUSHAKASHATSI KURI SIDA, MALARIYA, IGITUNTUN'IZINDI NDWARA Z'IBYOUREZO (TRAC PLUS)	Climate and Impact Modeling for Eastern Africa: Climate, Water, Agriculture, and Health ( <a href="http://indico.ictp.it/event/a12237/overview">http://indico.ictp.it/event/a12237/overview</a> )	28/10/2013	Addis Ababa, Ethiopia	Scientific community (higher education, Research)	30	Global



39	Oral presentation to a scientific event	SVERIGES METEOROLOGISKA OCH HYDROLOGISKA INSTITUT	Providing regional climate change information for East Africa: CORDEX and HEALTHY FUTURES	29/04/2013	Environment and health in Africa - Climate and vector-borne diseases Symposium, Kigali, Rwanda	Scientific community (higher education, Research) - Policy makers	40	East Africa
40	Oral presentation to a scientific event	SVERIGES METEOROLOGISKA OCH HYDROLOGISKA INSTITUT	Presentation of Rossby Centre African focused activities (featuring Healthy Futures) to visiting Burundian delegation	07/11/2014	SMHI, Norrköping	Scientific community (higher education, Research) - Policy makers	8	Burundi, Sweden
41	Oral presentation to a scientific event	International Livestock Research Institute	Mapping the distribution of potential Rift Valley fever hotspots in East Africa	28/05/2013	Kigali	Scientific community (higher education, Research) - Policy makers	100	East Africa
42	Oral presentation to a scientific event	IKIGO GISHINZWE UBUVUZI N'UBUSHAKASHATSI KURI SIDA, MALARIYA, IGITUNTUN'IZINDI NDWARA Z'IBYOREZO (TRAC PLUS)	Disease, Documents and Discourse in Eastern Africa	17/05/2013	QWeCI final project meeting, Barcelona, Spain	Scientific community (higher education, Research)	40	Eastern and Western Africa



43	Oral presentation to a scientific event	UNIVERSITY OF DURHAM	Predicting the impact of climate change on Schistosoma mansoni transmission in East Africa by N McCreesh	08/04/2014	Cambridge	Scientific community (higher education, Research)	100	Worldwide
44	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Vulnerability to vector-borne diseases: concepts and methods for an integrated spatial assessment by Michael Hagenlocher	07/11/2014	Department of Geography & Earth Sciences, UNC Charlotte, NC, USA	Scientific community (higher education, Research)	40	USA
45	Oral presentation to a scientific event	IKIGO GISHINZWE UBUVUZI N'UBUSHAKASHATSI KURI SIDA, MALARIYA, IGITUNTUN'IZINDI NDWARA Z'IBYOOREZO (TRAC PLUS)	Climate change and vulnerability to vector-borne diseases by Michael Hagenlocher	05/11/2014	Hazards & Vulnerability Research Institute (HVRI), University of South Carolina, SC, USA	Scientific community (higher education, Research)	25	USA
46	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Mapping the 'unmeasurable': Opportunities and challenges for spatial indicators to represent complex, latent phenomena by Stefan Kienberger	05/05/2014	Department of Geoinformatics ? Z_GIS, University of Salzburg, Austria	Scientific community (higher education, Research)	35	Austria



47	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Climate change, vulnerability and extreme events - What we know and how GIS and Remote Sensing can contribute to climate change adaptation by Stefan Kienberger	20/03/2013	Public lecture at the National University of Rwanda, Butare/Huye, Rwanda	Scientific community (higher education, Research)	45	Rwanda
48	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Mapping malaria risk and vulnerability in the United Republic of Tanzania by Michael Hagenlocher	01/11/2014	8th International Symposium on Geospatial Health, New Orleans, USA	Scientific community (higher education, Research) - Policy makers	50	Worldwide
49	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Räumliche Modellierung von sozialer Verwundbarkeit gegenüber Malaria und Denguefieber - Fallbeispiele aus Ostafrika und Südamerika by Michael Hagenlocher	10/10/2014	Arbeitskreis Medizinische Geographie - Jahrestagung 2014, Remagen bei Bonn, Germany	Scientific community (higher education, Research) - Policy makers	50	Germany



50	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Implications of spatial scales and reporting units for modeling vulnerability to vector-borne diseases by Michael Hagenlocher	03/07/2014	Geoinformatics Forum Salzburg 2014, Salzburg, Austria	Scientific community (higher education, Research)	70	Worldwide
51	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Crystal ball or future pathways: Opportunities and constraints for spatially explicit vulnerability scenarios to climate change impacts by Stefan Kienberger at Demographic Differential Vulnerability to Natural Disasters in the Context of Climate Change Adaptation by Stefan Kienberger	25/04/2014	Kao Lak (Phang Nga), Thailand	Scientific community (higher education, Research) - Policy makers	80	Worldwide
52	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Linking climate change adaptation and vulnerability assessments: Future impacts of vector-borne diseases in eastern Africa by Stefan Kienberger	04/04/2014	Österreichischer Klimatag 2014, Innsbruck, Austria	Scientific community (higher education, Research) - Policy makers	150	Austria
53	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Beyond image data: Representing complex, latent phenomena by modelling homogenous regions by Stefan Kienberger	30/01/2014	OBIA DK Mini Conference, Salzburg, Austria	Scientific community (higher education, Research)	40	Austria



54	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Integrating vulnerability assessments into humanitarian assistance - Mapping hotspots of vulnerability to vector-borne diseases in East Africa by Stefan Kienberger	27/10/2013	XV. Humanitarian Congress Berlin, 25 – 27 October 2013, Berlin, Germany	Scientific community (higher education, Research) - Civil society - Policy makers	100	Worldwide
55	Organisation of Workshops	PARIS-LODRON-UNIVERSITÄT SALZBURG	Health, environmental change and adaptive capacity - mapping, examining and anticipating future risks of vector-borne diseases in eastern Africa - Capacity building summer school for senior scientists from Uzbekistan by Michael Hagenlocher	20/11/2013	Uzbekistan	Scientific community (higher education, Research)	25	Uzbekistan
56	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Mapping vulnerability hotspots to vector-borne diseases in East Africa – Lessons for national and regional Spatial Data Infrastructures by Stefan Kienberger	04/11/2013	AfricaGIS 2013 - Global Geospatial Conference 2013, Addis Ababa, Ethiopia	Scientific community (higher education, Research) - Policy makers	80	Worldwide
57	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Why here, not there? Mapping, exploring and visualizing vulnerability to vector-borne diseases by Michael Hagenlocher	20/09/2013	GIScience Symposium, Salzburg, Austria	Scientific community (higher education, Research)	50	Worldwide



58	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Modeling hotspots of socioeconomic vulnerability to dengue fever in Cali, Colombia - supporting place-based intervention planning by Michael Hagenlocher	05/09/2013	7th International Symposium on Geospatial Health, Naples, Italy	Scientific community (higher education, Research) - Policy makers	50	Worldwide
59	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Integrated health risk assessment - Present and future hot spots of Malaria risk and vulnerability in eastern Africa by Stefan Kienberger	28/05/2013	Impacts World 2013 – International Conference on Climate Change Effects, Potsdam, Germany	Scientific community (higher education, Research) - Policy makers	300	Worldwide



60	Organisation of Workshops	PARIS-LODRON-UNIVERSITÄT SALZBURG	Policy-driven regionalization of space: Modeling social vulnerability to malaria in eastern Africa by Michael Hagenlocher (Summer school)	04/04/2013	11th Vespucci Initiative, Vespucci Institute "Synthesizing Population, Health and Place", CA, USA	Scientific community (higher education, Research)	30	Worldwide
61	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Mapping the underlying causes of vector-borne diseases in East Africa - Examining social vulnerability to Malaria by Stefan Kienberger (at 4th Annual East Africa Health, Scientific Conference, International Health Exhibition and Trade Fair, Environment and Health in Africa - Climate and vector-borne diseases Symposium)	29/03/2013	4th Annual East Africa Health, Scientific Conference, International Health Exhibition and Trade Fair	Scientific community (higher education, Research) - Policy makers	200	Worldwide
62	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Malaria vulnerability hot spots in East Africa: Examining the underlying causes for Malaria risk by Stefan Kienberger (at 9th International Conference African Association of Remote Sensing of the Environment (AARSE))	31/08/2013	El Jadida, Morocco	Scientific community (higher education, Research) - Policy makers	150	Worldwide





63	Oral presentation to a scientific event	UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION -UNESCO	Session on HEALTHY FUTURES and QWeCI	07/04/2013	EGU, Vienna, Austria	Scientific community (higher education, Research)	300	East African Community
64	Oral presentation to a scientific event	National University of Rwanda	Interactions between population dynamics, land use changes and malaria incidence in Kigali, Rwanda: added value of geospatial techniques for identifying urban malaria hotspots” Africa GIS 2013 and Global Spatial Data Infrastructure by Jean Pierre Bizimana	04/11/2013	World Conference; at the UN Economic Commission for Africa Conference Center at Addis Ababa	Scientific community (higher education, Research)	150	Worldwide
65	Oral presentation to a scientific event	PARIS-LODRON-UNIVERSITÄT SALZBURG	Identification of Malaria Transmission Hotspots for Targeting Malaria Control in Kigali City by Jean Pierre Bizimana	26/03/2013	East African Community Annual Health & Scientific Conference, Serena Hotel, Kigali, Rwanda	Scientific community (higher education, Research) - Policy makers	200	East African Community



66	Organisation of Workshops	UNIVERSITY OF YORK	HEALTHY FUTURES 1st Stakeholder Engagement Workshop	24/02/2015	Nairobi	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	28	Kenya, Tanzania, Uganda, Rwanda, Burundi
67	Organisation of Workshops	UNIVERSITY OF YORK	RVF Decision Makers Workshop	30/09/2014	Naivasha	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	25	Kenya, Tanzania, Uganda, Rwanda, Burundi
68	Organisation of Workshops	UNIVERSITY OF YORK	Stakeholder workshop for risk-based decision support frameworks for schistosomiasis and malaria	18/11/2014	Nairobi	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	19	Kenya, Tanzania, Uganda, Rwanda, Burundi



69	Organisation of Workshops	International Livestock Research Institute	Technical committee meeting for RVF	12/11/2014	Dar es Salaam	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	7	Kenya, Uganda, Tanzania
70	Web sites/Applications	AquaTT UETP Ltd	Minutes and report from 1st External Review Panel meeting available (Online article)	16/01/2012	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
71	Web sites/Applications	AquaTT UETP Ltd	Mark Booth (UDUR) talks about Neglected Tropical Disease (Online article)	03/02/2012	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide



72	Press releases	AquaTT UETP Ltd	HEALTHY FUTURES 3rd Partner Meeting to take place in Tanzania	07/03/2012	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide
73	Press releases	AquaTT UETP Ltd	HEALTHY FUTURES 3rd Partner Meeting to take place in Tanzania	09/03/2012	Aqua-tnet newsletter	Scientific community (higher education, Research) - Civil society	300	Europe
74	Web sites/Applications	AquaTT UETP Ltd	TCD Celebrates Africa Day with Conference on Developing Agri-Food Sector in Africa (Online article)	28/05/2012	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide



75	Web sites/Applications	AquaTT UETP Ltd	Climate Change posed risks to health highlighted at recent events in Dublin, May 2012 (Online article)	01/06/2012	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
76	Press releases	AquaTT UETP Ltd	Africa- and Europe-based institutes collaborating in EU-funded research on environmental change impacts on vector-borne diseases	01/06/2012	HEALTHY FUTURES website and beneficiaries networks	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
77	Press releases	AquaTT UETP Ltd	Mradi wa Afya Bora ya Baadaye - Taasisi mbalimbali katika Afrika na Ulaya zaungana kufanya utafiti wa jinsi mabadiliko ya tabia ya nchi yanavyoadhiri magonjwa yanayosababishwa na maji (vector-borne Diseases)	01/06/2012	HEALTHY FUTURES website and beneficiaries networks	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide



78	Press releases	AquaTT UETP Ltd	HEALTHY FUTURES 3rd partner meeting a success	06/06/2012	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide
79	Press releases	AquaTT UETP Ltd	HEALTHY FUTURES 3rd partner meeting a success	08/06/2012	Aqua-tnet newsletter	Scientific community (higher education, Research) - Civil society	300	Europe
80	Articles published in the popular press	AquaTT UETP Ltd	HEALTHY FUTURES Newsletter Issue No.2 June 2012	08/06/2012	HEALTHY FUTURES website and beneficiaries networks	Scientific community (higher education, Research)		Worldwide



81	Web sites/Applications	AquaTT UETP Ltd	Second issue of HEALTHY FUTURES newsletter now available (Online article)	13/06/2012	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
82	Web sites/Applications	AquaTT UETP Ltd	Minutes and report from 2nd External Review Panel meeting available (Online article)	25/06/2012	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
83	Flyers	AquaTT UETP Ltd	1st HEALTHY FUTURES project update for stakeholders	29/06/2012	Internal distribution contact list and project website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	255	Kenya, Rwanda, Burundi, Tanzania, Uganda, USA



84	Web sites/Applications	AquaTT UETP Ltd	VECTRI website launched (Online article)	03/09/2012	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
85	Web sites/Applications	AquaTT UETP Ltd	The Disease Model Cradle (DMC) now available as a free download from the QWeCI website (Online article)	31/10/2014	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
86	Press releases	AquaTT UETP Ltd	Call for Abstracts for Environment and Health in Africa (Climate and vector-borne diseases) Symposium	01/11/2012	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide





87	Press releases	AquaTT UETP Ltd	Call for Abstracts for Environment and Health in Africa (Climate and vector-borne diseases) Symposium	01/11/2012	Aqua-tnet newsletter	Scientific community (higher education, Research) - Civil society	300	Europe
88	Web sites/Applications	AquaTT UETP Ltd	Call for Abstracts for Environment and Health in Africa (Climate and vector-borne diseases) Symposium (Online article)	06/11/2012	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
89	Flyers	AquaTT UETP Ltd	Distribution of 30 HEALTHY FUTURES factsheets at 'Water is Life Workshop: How Can We Make A Difference – Routes to Progress'	08/11/2012	Royal Irish Academy, 19 Dawson Street, Dublin 2	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	40	Ireland, Uganda



90	Web sites/Applications	AquaTT UETP Ltd	Mark Booth (UDUR) interviewed by the Integrated Regional Information Networks (IRIN) (Online article)	19/11/2012	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
91	Web sites/Applications	AquaTT UETP Ltd	HEALTHY FUTURES and CIGAR discuss food security and disease linkages (Online article)	20/11/2012	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
92	Web sites/Applications	AquaTT UETP Ltd	4th EAC Symposium Information (Online article)	27/11/2012	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide



93	Press releases	AquaTT UETP Ltd	Researchers Collaborate to Explore Links Between Environmental Change and Vector-Borne Diseases in Eastern Africa	01/12/2012	HEALTHY FUTURES website and beneficiaries networks	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
94	Press releases	AquaTT UETP Ltd	Watafiti washirikiana pamoja kufumbua uhusiano ulioko kati ya mabadiliko ya mazingira na magonjwa yanayosababishwa na vekta Afrika mashariki	01/12/2012	HEALTHY FUTURES website and beneficiaries networks	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
95	Flyers	AquaTT UETP Ltd	Distribution of 20 HEALTHY FUTURES factsheets at the "Making environmental economics count in the developing world - insights from experience on three continents" seminar	18/12/2012	UCD Urban Institute Ireland, Richview Campus, Belfield, Dublin 4, Ireland	Scientific community (higher education, Research)	20	Ireland



96	Press releases	AquaTT UETP Ltd	Researchers Collaborate to Explore Links Between Environmental Change and Vector-Borne Diseases in Eastern Africa	19/12/2012	AlphaGalileo website: <a href="http://www.alphagalileo.org/ViewItem.aspx?ItemId=127143&amp;CultureCode=en">http://www.alphagalileo.org/ViewItem.aspx?ItemId=127143&amp;CultureCode=en</a>	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		Global
97	Oral presentation to a wider public	AquaTT UETP Ltd	Africa-call EC projects, cluster meeting (presentation and distribution of 20 HEALTHY FUTURES factsheets)	20/12/2012	South African Embassy, Brussels, Belgium	Scientific community (higher education, Research) - Policy makers	20	European
98	Press releases	AquaTT UETP Ltd	Researchers Collaborate to Explore Links Between Environmental Change and Vector-Borne Diseases in Eastern Africa	03/01/2013	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide



99	Press releases	AquaTT UETP Ltd	Researchers Collaborate to Explore Links Between Environmental Change and Vector-Borne Diseases in Eastern Africa	11/01/2013	Aqua-tnet newsletter	Scientific community (higher education, Research) - Civil society	300	Europe
100	Articles published in the popular press	THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN	HEALTHY FUTURES Newsletter Issue No.3 February 2013	01/02/2013	HEALTHY FUTURES website and beneficiaries networks	Scientific community (higher education, Research)		Worldwide
101	Press releases	AquaTT UETP Ltd	HEALTHY FUTURES – Researchers collaborate to explore links between Environmental Change and Vector-Borne Diseases in eastern Africa	01/02/2013	CORDIS Wire - <a href="https://cordis.europa.eu/wire/index.cfm?fuseaction=article.Detail&amp;rcn=33728">https://cordis.europa.eu/wire/index.cfm?fuseaction=article.Detail&amp;rcn=33728</a>	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide



102	Flyers	AquaTT UETP Ltd	2nd HEALTHY FUTURES project update for stakeholders	01/02/2013	Internal distribution contact list and project website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	255	Kenya, Rwanda, Burundi, Tanzania, Uganda, USA
103	Web sites/Applications	AquaTT UETP Ltd	Third HEALTHY FUTURES newsletter now available (Online article)	05/02/2013	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
104	Press releases	AquaTT UETP Ltd	Researchers Collaborate to Explore Links Between Environmental Change and Vector-Borne Diseases in Eastern Africa	28/02/2013	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide



105	Press releases	AquaTT UETP Ltd	Researchers Collaborate to Explore Links Between Environmental Change and Vector-Borne Diseases in Eastern Africa	28/02/2013	Aqua-tnet newsletter	Scientific community (higher education, Research) - Civil society	300	Europe
106	Flyers	AquaTT UETP Ltd	EPA Irish FP7 Environment research success	01/03/2013	EPA Irish FP7 Environment research success leaflet. <a href="http://www.slideshare.net/EPAIreland/irelands-nv">http://www.slideshare.net/EPAIreland/irelands-nv</a>	Scientific community (higher education, Research) - Civil society		Europe
107	Flyers	AquaTT UETP Ltd	Distribution of 30 HEALTHY FUTURES factsheets at the International Development Conference – a Dublin Institute of Technology (DIT) and Institutes of Technology Ireland (IOTI) initiative	21/03/2013	DIT Aungier St. Dublin2	Scientific community (higher education, Research)		Ireland, African



108	Web sites/Applications	AquaTT UETP Ltd	EAC Climate and vector-borne diseases Symposium successfully held (Online article)	11/04/2013	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
109	Press releases	AquaTT UETP Ltd	HEALTHY FUTURES Partners Meet in Trieste to Discuss Project Progress	31/05/2013	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide
110	Press releases	AquaTT UETP Ltd	HEALTHY FUTURES Partners Meet in Trieste to Discuss Project Progress	31/05/2013	Aqua-tnet newsletter	Scientific community (higher education, Research) - Civil society	300	Europe





111	Web sites/Applications	AquaTT UETP Ltd	Vacancy: Postdoctoral Research Associate in Disease Modelling (Online article)	05/06/2013	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
112	Web sites/Applications	AquaTT UETP Ltd	New HEALTHY FUTURES Project Brochure available in English and Kiswahili (Online article)	09/07/2013	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
113	Web sites/Applications	AquaTT UETP Ltd	Now available - Video Introduction to HEALTHY FUTURES (Online article)	15/07/2013	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide



114	Articles published in the popular press	THE PROVOST, FELLOWS, FOUNDATION SCHOLARS & THE OTHER MEMBERS OF BOARD OF THE COLLEGE OF THE HOLY & UNDIVIDED TRINITY OF QUEEN ELIZABETH NEAR DUBLIN	HEALTHY FUTURES Newsletter Issue No.4 August 2013	01/08/2013	HEALTHY FUTURES Website and beneficiaries networks	Scientific community (higher education, Research)		Worldwide
115	Web sites/Applications	AquaTT UETP Ltd	Fourth Issue of HEALTHY FUTURES Newsletter Now Available (Online article)	02/08/2013	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
116	Press releases	AquaTT UETP Ltd	Fourth Issue of HEALTHY FUTURES Newsletter Now Available	08/08/2013	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide



117	Press releases	AquaTT UETP Ltd	Fourth Issue of the HEALTHY FUTURES Newsletter Now Available	12/08/2013	CORDIS Wire - <a href="https://cordis.europa.eu/wire/index.cfm?fuseaction=article.Detail&amp;rcn=38408">https://cordis.europa.eu/wire/index.cfm?fuseaction=article.Detail&amp;rcn=38408</a>	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
118	Web sites/Applications	AquaTT UETP Ltd	Rift Valley Fever and malaria study site analysis available to download	21/08/2013	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
119	Web sites/Applications	AquaTT UETP Ltd	Minutes and report from third meeting of the External Review Panel Meeting available	26/08/2013	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide



120	Press releases	AquaTT UETP Ltd	Project Helping to Manage Human Response to Disease Risk in Eastern Africa	28/08/2013	CORDIS Wire - <a href="https://cordis.europa.eu/wire/index.cfm?fuseaction=article.Detail&amp;RCN=38667">https://cordis.europa.eu/wire/index.cfm?fuseaction=article.Detail&amp;RCN=38667</a>	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
121	Press releases	AquaTT UETP Ltd	Anticipating climate change, tackling disease	28/08/2013	CORDIS News - <a href="http://cordis.europa.eu/fetch?CALLER=EN_NEWS&amp;ACTION=DETAIL&amp;SESSIONID=&amp;RCN=36012">http://cordis.europa.eu/fetch?CALLER=EN_NEWS&amp;ACTION=DETAIL&amp;SESSIONID=&amp;RCN=36012</a>	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
122	Press releases	AquaTT UETP Ltd	HEALTHY FUTURES Project Helping to Manage Human Response to Disease Risk in Eastern Africa	30/08/2013	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide



123	Press releases	AquaTT UETP Ltd	HEALTHY FUTURES Project Helping to Manage Human Response to Disease Risk in Eastern Africa	30/08/2013	Aqua-tnet newsletter	Scientific community (higher education, Research) - Civil society	300	Europe
124	Flyers	AquaTT UETP Ltd	30 HEALTHY FUTURES brochures distributed at Towards 2050: Climate Change Research 2014-2020 (EPA)	19/09/2013	IFSC, Dublin, Ireland	Scientific community (higher education, Research) - Industry - Policy makers	60	Ireland
125	Flyers	AquaTT UETP Ltd	10 HEALTHY FUTURES brochures distributed at the EPA - Research Workshop: Sustainable Environment	26/09/2013	Clyde Court Hotel, Dublin, Ireland	Scientific community (higher education, Research) - Industry - Policy makers	100	Ireland



126	Flyers	AquaTT UETP Ltd	20 HEALTHY FUTURES brochures and 15 notepads disseminated at the WaterDiss2.0 Final Workshop	02/12/2013	Four Points Sheraton Hotel, Avenida Diagonal 161-163 • Barcelona 08018 Spain	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	40	Europe
127	Articles published in the popular press	AquaTT UETP Ltd	Anticipating climate change, tackling disease	01/11/2013	Research* EU Results Magazine	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
128	Web sites/Applications	AquaTT UETP Ltd	HEALTHY FUTURES featured article in the EU's Research and Innovation magazine	11/11/2013	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide



129	Web sites/Applications	AquaTT UETP Ltd	Identification and engagement of key stakeholders report now available to download	02/11/2013	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
130	Web sites/Applications	AquaTT UETP Ltd	HEALTHY FUTURES features in the EC's Research*EU Results Magazine	06/12/2013	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
131	Press releases	AquaTT UETP Ltd	HEALTHY FUTURES Featured in EU Research and Innovation Magazine	09/12/2013	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide



132	Web sites/Applications	AquaTT UETP Ltd	Charting the Future of Climate Impacts	18/12/2013	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
133	Web sites/Applications	AquaTT UETP Ltd	Report in "Malaria & climate change" Kampala workshop now available (Online article)	18/12/2013	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
134	Web sites/Applications	AquaTT UETP Ltd	Fifth issues of HEALTHY FUTURES newsletter now available (Online article)	07/01/2014	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide





135	Press releases	AquaTT UETP Ltd	Project to Predict Disease Risk in Eastern Africa Enters Crucial Phase	10/01/2014	HEALTHY FUTURES website and beneficiaries networks	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
136	Articles published in the popular press	AquaTT UETP Ltd	HEALTHY FUTURES Newsletter Issue No.6 August 2014	11/01/2014	HEALTHY FUTURES website and beneficiaries networks	Scientific community (higher education, Research)		Worldwide
137	Press releases	AquaTT UETP Ltd	Anticipating Risks of Disease Outbreaks in East Africa - Fifth Issue of HEALTHY FUTURES Newsletter Now Available	14/01/2014	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide



138	Web sites/Applications	AquaTT UETP Ltd	HEALTHY FUTURES meetings recently held in Nairobi, Kenya (Online article)	21/03/2014	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
139	Press releases	AquaTT UETP Ltd	Climate Change and Vector Borne Diseases Conference Announcement	21/03/2014	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide
140	Press releases	AquaTT UETP Ltd	HEALTHY FUTURES Benefits from Valuable Input from Stakeholders	21/03/2014	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide



141	Flyers	AquaTT UETP Ltd	3rd HEALTHY FUTURES project update for stakeholders	25/03/2014	Internal distribution contact list and project website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	255	Kenya, Rwanda, Burundi, Tanzania, Uganda, USA
142	Press releases	AquaTT UETP Ltd	Conference Announcement: Climate Change and Vector Borne Diseases: Past, Present and Future	09/05/2014	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide
143	Flyers	AquaTT UETP Ltd	Distribution of flyers at the Natural Hazards and Climate change workshop (EPA)	11/06/2014	Dublin, Ireland	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	30	Ireland



144	Web sites/Applications	AquaTT UETP Ltd	Report on HEALTHY FUTURES collaborations and synergies now available (Online article)	12/06/2014	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
145	Web sites/Applications	AquaTT UETP Ltd	HEALTHY FUTURES developing Online Visualisation Tool to Support Decision Makers (Online article)	23/06/2014	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
146	Press releases	AquaTT UETP Ltd	Researchers Developing Online Visualisation Tool to Support Decision Makers in Tackling Vector Borne Diseases	04/07/2014	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide



147	Web sites/Applications	AquaTT UETP Ltd	Sixth Issue of HEALTHY FUTURES Newsletter Now Available (Online article)	05/08/2014	HEALTHY FUTURES website	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		Worldwide
148	Articles published in the popular press	AquaTT UETP Ltd	HEALTHY FUTURES Newsletter Issue No.2 June 2012	05/08/2014	Internal distribution contact list and project website	Scientific community (higher education, Research)		Worldwide
149	Press releases	AquaTT UETP Ltd	Sixth Issue of HEALTHY FUTURES Newsletter Now Available	11/08/2014	AquaTT's Training News, online monthly e-newsletter for the European marine sector	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	6000	Worldwide
150	Web sites/Applications	National University of Rwanda	Environment and health in Africa - Climate and vector-borne diseases Symposium (Online article)	27/02/2013	EAC website	Scientific community (higher education, Research)		Rwanda, Burundi, Tanzania, Uganda and Kenya



152	Articles published in the popular press	IKIGO GISHINZWE UBUVUZI N'UBUSHAKASHATSI KURI SIDA, MALARIYA, IGITUNTUN'IZINDI NDWARA Z'IBYOOREZO (TRAC PLUS)	News release: "Malaria on the Rise Impact models predict regional increases in disease risks"	04/02/2014	<a href="http://www.ictp.it/about-ictp/media-centre/news/2014/2/malaria-on-the-rise.aspx">http://www.ictp.it/about-ictp/media-centre/news/2014/2/malaria-on-the-rise.aspx</a>	Scientific community (higher education, Research) - Civil society		Global
153	Oral presentation to a scientific event	IKIGO GISHINZWE UBUVUZI N'UBUSHAKASHATSI KURI SIDA, MALARIYA, IGITUNTUN'IZINDI NDWARA Z'IBYOOREZO (TRAC PLUS)	The Science of Malaria Eradication	02/02/2014	Merida, Mexico	Scientific community (higher education, Research)	300	All Africa
154	Oral presentation to a scientific event	IKIGO GISHINZWE UBUVUZI N'UBUSHAKASHATSI KURI SIDA, MALARIYA, IGITUNTUN'IZINDI NDWARA Z'IBYOOREZO (TRAC PLUS)	63rd Annual Meeting of the American Society of Tropical Medicine and Hygiene	02/11/2014	New Orleans, USA	Scientific community (higher education, Research)	4000	Uganda, Rwanda and Malawi
155	Oral presentation to a scientific event	Vector Control Division - Ministry of Health	Gender and climate conference	05/11/2014	Geneva	Scientific community (higher education, Research) - Industry - Policy makers	200	Switzerland, Uganda, Kenya, Tanzania, South Africa, United Kingdom and many others



156	Press releases	UNIVERSITY OF DURHAM	Mapping the effects of climate change on deadly diseases	22/04/2015	<a href="https://ec.europa.eu/programmes/horizon2020/en/news/mapping-effects-climate-change-deadly-diseases">https://ec.europa.eu/programmes/horizon2020/en/news/mapping-effects-climate-change-deadly-diseases</a>	Scientific community (higher education, Research)		East Africa
157	Oral presentation to a wider public	UNIVERSITY OF DURHAM	The Healthy Futures Atlas	14/05/2015	Barcelona	Scientific community (higher education, Research)	100	East Africa
158	Oral presentation to a wider public	UNIVERSITY OF DURHAM	The Healthy Futures Atlas	17/04/2015	Liverpool	Scientific community (higher education, Research)	400	East Africa



159	Oral presentation to a scientific event	UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL ORGANIZATION -UNESCO	Assessing the health impacts of environmental changes in eastern Africa - spatial modelling tools for integrated risk assessment	23/03/2015	Impact of Environmental Changes on Infectious Diseases conference, SITGES, Spain	Scientific community (higher education, Research) - Policy makers	300	East African Community
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## Section B (Confidential or public)

### Overview table with exploitable foreground

	Type of Exploitable Foreground(See footnote below table)	Description of Exploitable Foreground	Confidential (Yes/No)	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application	Timetable for commercial use or any other use	Patents or other IPR exploitation (licences)	Owner and Other Beneficiary (s) involved
1	General advancement of knowledge	Meta-database with links to data assembled through the project that is open-access. These data include down-scaled projected climate change information for eastern Africa. The HF Metadata portal is available at: <a href="http://41.204.190.50/geoportal/catalog/main/ho">http://41.204.190.50/geoportal/catalog/main/ho</a>	No	No	HF Metadata portal	Health, Veterinary, Life Sciences, Modelling, Research	n/a	n/a	HEALTHY FUTURES consortium





		<a href="#">me.page</a>							
2	General advancement of knowledge	Eastern Africa-specific, online data analysis and visualisation tool, providing open access to historical database, climate change-driven output from state of the art dynamic disease models developed through HF for the three target VBDS (malaria, schistosomiasis and RVF), information on social vulnerability to the three target VBDS, and assessments of risk of the three target VBDS as a result of projected changes in climate over the coming century. The Atlas is fully compliant with models, data and scenarios that have been used to inform the latest (the 5th) IPCC Assessment Report. The HF Atlas is available at: <a href="http://zgis186.geo.sbg.ac.at/hf_atlas/">http://zgis186.geo.sbg.ac.at/hf_atlas/</a>	No	No	HF Atlas and journal articles made publicly available	Education and decision support purposes	n/a	n/a	PLUS owned. All HEALTHY FUTURES consortium involved.
3	General advancement of knowledge	Links supported by the website to project deliverables, guidance notes, newsletters, videos, other websites of relevance. The HF website is available at: <a href="http://www.healthyfutures.eu">www.healthyfutures.eu</a>	No	No	HF website	Public Health and Veterinary Sectors, Life Sciences, General public	n/a	n/a	HEALTHY FUTURES consortium
4	General advancement of knowledge	Dynamic disease models that are available for other scientists to use – models developed for malaria, RVF (two models developed – one for climatically sensitive parts of the disease and one for the effects of interventions) and schistosomiasis. The new dynamical malaria model completed within the project is available to researchers under an open source GNU licence.	No	No	Code freely available to download from a GIT server. HF Atlas, journal articles	Research into the health impacts of climate  Policy makers, educationalists, health researchers	n/a	New dynamical malaria model is available to researchers under an open source	ICTP, UDUR, UNILIV, ILRI



					made publicly available			GNU licence.	
5	General advancement of knowledge	Climate simulation - Downscaling of the ERA-Interim reanalysis (1980-2010) by a regional climate model - RCA4 at 15km over eastern Africa	No	No	The simulation provides a reference for the simulated RCA4 climatology.	Impact modelling (disease models in particular)	n/a	n/a	ICTP, SMHI
6	General advancement of knowledge	RVF, malaria and schistosomiasis risk maps generated through the HF ATLAS - Statistical analysis of the data compiled identifies risk factors for the three diseases that have been used to identify hotspots for the disease	No	No	To be incorporated into Contingency Plans	Public Health and Veterinary Sectors	n/a	n/a	HEALTHY FUTURES consortium
7	General advancement of knowledge	Decision support frameworks for the three target VBDs that have been designed, through a series of workshops and in collaboration with relevant decision makers in eastern Africa, with a view to mitigating future disease impacts in member states of the East African Community.	No	No	Decision support frameworks	Public Health and Veterinary Sectors e.g. risk mitigation, control policies, disease outbreaks	n/a	n/a	HEALTHY FUTURES consortium
8	General advancement of knowledge	Scientific publications	No	No	Scientific publications	Health, Veterinary, Life Sciences, Modelling, Research	n/a	n/a	HEALTHY FUTURES consortium



9	General advancement of knowledge	PhD: 'Modelling the effects of temperature changes on Schistosoma mansoni transmission' completed by Nicky McCreesh at Durham University.	No	No	Research results	Life Sciences, Ecology	n/a	n/a	UDUR
10	General advancement of knowledge	PhD: 'Integrated spatial indicators for modeling, exploring and visualising vulnerability to vector-borne diseases' completed by Michael Hagenlocher at PLUS.	No	No	Research results	Modelling	n/a	n/a	PLUS
11	General advancement of knowledge	PhD: 'A simulation model of Rift Valley fever transmission in Kenya' completed by John Gachohi at the ILRI.	No	No	Research results	Modelling Health, Veterinary	n/a	n/a	ILRI
12	General advancement of knowledge	PhD: 'Climate change and malaria in Rwanda: Spatial assessment of social vulnerability at different scale levels' completed by Jean Pierre Bizimana at the University of Rwanda (UR).	No	No	Research results	Social Science, Modelling, Health, Veterinary	n/a	n/a	UR
13	General advancement of knowledge	Experimental data - New information on how snail vectors for Schistosoma mansoni are affected by changes in water temperature.	No	No	Journal articles made publicly available	Life sciences	n/a	n/a	UDUR

In addition to the table above, please provide text in the table below to explain the exploitable foreground, in particular:

- Its purpose
- How the foreground might be exploited, when and by whom
- IPR exploitable measures taken or intended
- Further research necessary, if any
- Potential/expected impact (quantify where possible)



Detailed information about the knowledge (foreground) generated within the HF project

	Description of Exploitable Foreground	Explain of the Exploitable Foreground
1	Meta-database with links to data assembled through the project that is open-access. These data include down-scaled projected climate change information for eastern Africa. The HF Metadata portal is available at: <a href="http://41.204.190.50/geoportal/catalog/main/home.page">http://41.204.190.50/geoportal/catalog/main/home.page</a>	The HF Metadata portal summarises existing outcomes of different projects or topics in one inventory and additionally, the portal provides an overview (cataloguing) and access to data produced in HF (sharing & searching). This provides a standardised format that enables interoperability with other metadata systems, or systems that are able to read metadata, that use ISO and FDGC standards.
2	Eastern Africa-specific, online data analysis and visualisation tool, providing open access to historical database, climate change-driven output from state of the art dynamic disease models developed through HF for the three target VBDS (malaria, schistosomiasis and RVF), information on social vulnerability to the three target VBDS, and assessments of risk of the three target VBDS as a result of projected changes in climate over the coming century. The Atlas is fully compliant with models, data and scenarios that have been used to inform the latest (the 5th) IPCC Assessment Report. The HF Atlas is available at: <a href="http://zgis186.geo.sbg.ac.at/hf_atlas/">http://zgis186.geo.sbg.ac.at/hf_atlas/</a>	An interactive, web-based mapping and decision support tool (DST), built within an open-source framework and aiming to provide meaningful and guided access to information on environmental change, disease hazard and risk, and vulnerability for the three target VBDS in eastern Africa.
3	Links supported by the website to project deliverables, guidance notes, newsletters, videos, other websites of relevance. The HF website is available at: <a href="http://www.healthyfutures.eu">www.healthyfutures.eu</a>	Publicly available website providing access to all project information and outputs.  End user and application: Researchers, Public Health and Veterinary sectors, wider public
4	Dynamic disease models that are available for other scientists to use – models developed for malaria, RVF (two models developed – one for climatically sensitive parts of the disease and one for the effects of interventions) and schistosomiasis	New, state-of-the-art dynamic disease models were produced for malaria, RVF and schistosomiasis. A second dynamic disease model for RVF has also been developed through the project that allows the efficacy of different interventions (e.g.



		<p>vaccination campaigns) to be examined. These models have either been published or are in the process of being published in scientific journals.</p> <p>End user &amp; application: Health researchers and advanced stakeholders</p> <p>How the foreground might be exploited: Dynamic model and integration framework for future research developed within HF can potentially be applied to other parasitic organisms that are prevalent in the tropics and sub-tropics</p> <p>Impact (potential/ expected): 1) Improved surveillance leading to reduced transmission in the face of climate change. 2) Application of framework to other parasitic infections in other parts of the tropics and sub-tropics</p>
5	Climate simulation - Downscaling of the ERA-Interim reanalysis (1980-2010) by a regional climate model - RCA4 at 15km over eastern Africa	<p>The simulation provides a reference for the simulated RCA4 climatology. Data will be made openly available after the end of the project.</p> <p>End user and application: The climate simulations can be exploited by environmental researches working on the impacts of climate change.</p> <p>Impact (potential/ expected): Have been used by the HF partners running the disease models and expected to be used by a wider range of environmental researches focusing on climate changes in environmental research in eastern Africa.</p>
6	RVF, malaria and schistosomiasis risk maps generated through the HF ATLAS - Statistical analysis of the data compiled identifies risk factors for the three diseases that have been used to identify	<p>End user &amp; application: Disease control agents</p>



	hotspots for the disease	Impact (potential/ expected): Better targeting of interventions
7	Decision support frameworks for the three target VBDs that have been designed, through a series of workshops and in collaboration with relevant decision makers in eastern Africa, with a view to mitigating future disease impacts in member states of the East African Community.	<p>Risk-based decision support frameworks (DSF) are decision-making guides developed by decision-makers. The DSF were developed through participatory consultations that brought together relevant decision-makers, control program implementers and researchers. DSF act as aide memoires to remind decision-makers of areas where action should be considered at appropriate points in time. DSF are specifically intended to reduce the impact of uncertainty and risk in decision-making. DSF are living documents that are part of an adaptive management process.</p> <p>End user and application: It is recommended that D5.5 Risk-based DSF for schistosomiasis and malaria is used as an entry point for a further workshop targeted to specific UN, NGO and private sector stakeholders including: UN Habitat, UN Environment Program, UN Development Program, UNESCO, UNICEF, DFID, SIDA, WHO, NGOs (ENVISION – USAID, IMA World Health, SCI).</p> <p>Further research: The tool has potential to be adapted for use with other NTDs including the soil transmitted helminths. Research is required to understand the effects of environmental change on soil ecology, as well as how changes in agricultural practices will affect the transfer of infections through contamination of food with parasite eggs deposited into soil used for agricultural purposes.</p> <p>Working with partner organisations: a) D5.5 will be presented to potential government partner organisations (e.g. NGOs) who will then work with individual governments to</p>



		implement some or all of the proposed actions, b) D5.5 will be presented to WHO Geneva (Neglected Tropical Diseases - NTDs) with a view to WHO issuing recommendations to the African Union and c) D5.5 will be presented to NEPAD, AU IBAR and other organisations with a view to establishing champions within these organisations who will help support implementation of the proposed action plan.
8	Scientific publications	19 papers published in scientific journals with one more awaiting decision. Two submissions in a WHO-WMO special publication on climate services and health. One special issue of the journal Geospatial Health is currently in preparation.  End user and application: Researchers (e.g. climate, health, veterinary)
9	PhD: 'Modelling the effects of temperature changes on Schistosoma mansoni transmission' completed by Nicky McCreesh at Durham University.	PhD: 'Modelling the effects of temperature changes on Schistosoma mansoni transmission' completed by Nicky McCreesh at Durham University.
10	PhD: 'Integrated spatial indicators for modeling, exploring and visualising vulnerability to vector-borne diseases' completed by Michael Hagenlocher at PLUS.	PhD: 'Integrated spatial indicators for modeling, exploring and visualising vulnerability to vector-borne diseases' completed by Michael Hagenlocher at PLUS.
11	PhD: 'A simulation model of Rift Valley fever transmission in Kenya' completed by John Gachohi at the ILRI.	PhD: 'A simulation model of Rift Valley fever transmission in Kenya' completed by John Gachohi at the ILRI.
12	PhD: 'Climate change and malaria in Rwanda: Spatial assessment of social vulnerability at different scale levels' completed by Jean Pierre Bizimana at the University of Rwanda (UR).	PhD: 'Climate change and malaria in Rwanda: Spatial assessment of social vulnerability at different scale levels' completed by Jean Pierre Bizimana at the University of Rwanda (UR).
13	Experimental data - New information on how snail vectors for Schistosoma mansoni are affected by changes in water temperature.	End user & application: Ecologists  Impact (potential/ expected): Improved control measures



## Report on Societal Implications

<b>B Ethics</b>	
<p><b>1. Did your project undergo an Ethics Review (and/or Screening)?</b></p> <ul style="list-style-type: none"> <li>• If Yes: have you described the progress of compliance with the relevant Ethics Review/Screening Requirements in the frame of the periodic/final project reports?</li> </ul> <p>Special Reminder: the progress of compliance with the Ethics Review/Screening Requirements should be described in the Period/Final Project Reports under the Section 3.2.2 'Work Progress and Achievements'</p>	No
<p><b>2. Please indicate whether your project involved any of the following issues (tick box) :</b></p>	
<b>RESEARCH ON HUMANS</b>	
• Did the project involve children?	No
• Did the project involve patients?	No
• Did the project involve persons not able to give consent?	No
• Did the project involve adult healthy volunteers?	No
• Did the project involve Human genetic material?	No
• Did the project involve Human biological samples?	No
• Did the project involve Human data collection?	Yes
<b>RESEARCH ON HUMAN EMBRYO/FOETUS</b>	
• Did the project involve Human Embryos?	No
• Did the project involve Human Foetal Tissue / Cells?	No
• Did the project involve Human Embryonic Stem Cells (hESCs)?	No
• Did the project on human Embryonic Stem Cells involve cells in culture?	No
• Did the project on human Embryonic Stem Cells involve the derivation of cells from Embryos?	No
<b>PRIVACY</b>	
• Did the project involve processing of genetic information or personal data (eg. health, sexual lifestyle, ethnicity, political opinion, religious or philosophical conviction)?	No
• Did the project involve tracking the location or observation of people?	No
<b>RESEARCH ON ANIMALS</b>	
• Did the project involve research on animals?	Yes
• Were those animals transgenic small laboratory animals?	No
• Were those animals transgenic farm animals?	No





• Were those animals cloned farm animals?	No	
• Were those animals non-human primates?	No	
<b>RESEARCH INVOLVING DEVELOPING COUNTRIES</b>		
• Did the project involve the use of local resources (genetic, animal, plant etc)?	Yes	
• Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	Yes	
<b>DUAL USE</b>		
• Research having direct military use	No	
• Research having the potential for terrorist abuse	No	
<b>C Workforce Statistics</b>		
<b>3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).</b>		
<b>Type of Position</b>	<b>Number of Women</b>	<b>Number of Men</b>
Scientific Coordinator	0	1
Work package leaders	3	2
Experienced researchers (i.e. PhD holders)	13	26
PhD Students	1	3
Other	12	8
<b>4. How many additional researchers (in companies and universities) were recruited specifically for this project?</b>	0	
Of which, indicate the number of men:	0	



**D Gender Aspects**

5. Did you carry out specific Gender Equality Actions under the project?  Yes  No

6. Which of the following actions did you carry out and how effective were they?

X Not applicable

- |   | Not at all effective  | Very effective |
|---|---|----------------|
| <input type="checkbox"/> Design and implement an equal opportunity policy         | <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> |                |
| <input type="checkbox"/> Set targets to achieve a gender balance in the workforce | <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> |                |
| <input type="checkbox"/> Organise conferences and workshops on gender             | <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> |                |
| <input type="checkbox"/> Actions to improve work-life balance                     | <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> <input type="radio"/> |                |
| <input type="radio"/> Other: <input type="text"/>                                 |   |                |

7. Was there a gender dimension associated with the research content – i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in trials, was the issue of gender considered and addressed?

- Yes- please specify
- X No

**E Synergies with Science Education**

8. Did your project involve working with students and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?

- X Yes- please specify

*Two Early Stage Researcher (ESR) Generic Skills and Networking workshops were held for postgraduate researchers and research assistants. One of the workshops was in Africa (Arusha, Tanzania), while the other was in Europe (Trieste, Italy).*

9. Did the project generate any science education material (e.g. kits, websites, explanatory booklets, DVDs)?

- Yes- please specify
- X No



F Interdisciplinarity				
<p><b>10. Which disciplines (see list below) are involved in your project?</b></p> <p><input type="radio"/> Main discipline<sup>1</sup>: Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; vertical-align: top;"> <p><input type="radio"/> Associated discipline<sup>1</sup>: Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)</p> </td> <td style="width: 50%; vertical-align: top;"> <p><input type="radio"/> Associated discipline<sup>1</sup>: Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary, methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences]</p> </td> </tr> </table>			<p><input type="radio"/> Associated discipline<sup>1</sup>: Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)</p>	<p><input type="radio"/> Associated discipline<sup>1</sup>: Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary, methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences]</p>
<p><input type="radio"/> Associated discipline<sup>1</sup>: Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)</p>	<p><input type="radio"/> Associated discipline<sup>1</sup>: Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary, methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences]</p>			
G Engaging with Civil society and policy makers				
<b>11a Did your project engage with societal actors beyond the research community? (if 'No', go to Question 14)</b>	X <input type="radio"/>	Yes No		
<p><b>11b If yes, did you engage with citizens (citizens' panels / juries) or organised civil society (NGOs, patients' groups etc.)?</b></p> <p>X No  <input type="radio"/> Yes- in determining what research should be performed  <input type="radio"/> Yes - in implementing the research  <input type="radio"/> Yes, in communicating /disseminating / using the results of the project</p>				
<b>11c In doing so, did your project involve actors whose role is mainly to organise the dialogue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?</b>	X <input type="radio"/>	Yes No		

<sup>1</sup> Insert number from list below (Frascati Manual).



**12. Did you engage with government / public bodies or policy makers (including international organisations)**

- No
- Yes- in framing the research agenda
- Yes - in implementing the research agenda
- Yes, in communicating /disseminating / using the results of the project

**13a Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?**

- Yes – as a **primary** objective (please indicate areas below- multiple answers possible)
- Yes – as a **secondary** objective (please indicate areas below - multiple answer possible)
- No

**13b If Yes, in which fields?**

Agriculture	Energy	Human rights
Audiovisual and Media	Enlargement	<b>X Information Society</b>
Budget	Enterprise	Institutional affairs
Competition	<b>X Environment</b>	Internal Market
Consumers	External Relations	<b>X Justice, freedom and security</b>
Culture	External Trade	<b>X Public Health</b>
Customs	Fisheries and Maritime Affairs	Regional Policy
Development	Food Safety	<b>X Research and Innovation</b>
Economic and Monetary Affairs	Foreign and Security Policy	Space
<b>X Education, Training, Youth</b>	Fraud	Taxation
Employment and Social Affairs	Humanitarian aid	Transport



<b>13c If Yes, at which level? (Choose one)</b> <input type="radio"/> Local / regional levels <input type="radio"/> National level <input type="radio"/> European level <input checked="" type="radio"/> International level		
<b>H Use and dissemination</b>		
<b>14. How many Articles were published/accepted for publication in peer-reviewed journals? (automatically calculated)</b>		27
<b>To how many of these is open access<sup>2</sup> provided?</b>		15
<b>How many of these are published in open access journals?</b>		15
<b>How many of these are published in open repositories?</b>		0
<b>To how many of these is open access not provided?</b>		0
<b>Please check all applicable reasons for not providing open access:</b>		
<input type="checkbox"/> publisher's licensing agreement would not permit publishing in a repository <input type="checkbox"/> no suitable repository available <input type="checkbox"/> no suitable open access journal available <input checked="" type="checkbox"/> no funds available to publish in an open access journal <input type="checkbox"/> lack of time and resources <input type="checkbox"/> lack of information on open access <input type="checkbox"/> other <sup>3</sup> : .....		
<b>15. How many new patent applications ('priority filings') have been made? ("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).</b>		0
<b>16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).</b>	Trademark	0
	Registered design	0
	Other	0
<b>17. How many spin-off companies were created / are planned as a direct result of the project?</b>		0

<sup>2</sup> Open Access is defined as free of charge access for anyone via Internet.

<sup>3</sup> For instance: classification for security project.





**Question F-10:** Classification of Scientific Disciplines according to the Frascati Manual 2002 (Proposed Standard Practice for Surveys on Research and Experimental Development, OECD 2002):

#### **FIELDS OF SCIENCE AND TECHNOLOGY**

##### 1. NATURAL SCIENCES

- 1.1 Mathematics and computer sciences [mathematics and other allied fields: computer sciences and other allied subjects (software development only; hardware development should be classified in the engineering fields)]
- 1.2 Physical sciences (astronomy and space sciences, physics and other allied subjects)
- 1.3 Chemical sciences (chemistry, other allied subjects)
- 1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geography and other geosciences, meteorology and other atmospheric sciences including climatic research, oceanography, vulcanology, palaeoecology, other allied sciences)
- 1.5 Biological sciences (biology, botany, bacteriology, microbiology, zoology, entomology, genetics, biochemistry, biophysics, other allied sciences, excluding clinical and veterinary sciences)

##### 2 ENGINEERING AND TECHNOLOGY

- 2.1 Civil engineering (architecture engineering, building science and engineering, construction engineering, municipal and structural engineering and other allied subjects)
- 2.2 Electrical engineering, electronics [electrical engineering, electronics, communication engineering and systems, computer engineering (hardware only) and other allied subjects]
- 2.3. Other engineering sciences (such as chemical, aeronautical and space, mechanical, metallurgical and materials engineering, and their specialised subdivisions; forest products; applied sciences such as geodesy, industrial chemistry, etc.; the science and technology of food production; specialised technologies of interdisciplinary fields, e.g. systems analysis, metallurgy, mining, textile technology and other applied subjects)

##### 3. MEDICAL SCIENCES

- 3.1 Basic medicine (anatomy, cytology, physiology, genetics, pharmacy, pharmacology, toxicology, immunology and immuno-haematology, clinical chemistry, clinical microbiology, pathology)
- 3.2 Clinical medicine (anaesthesiology, paediatrics, obstetrics and gynaecology, internal medicine, surgery, dentistry, neurology, psychiatry, radiology, therapeutics, otorhinolaryngology, ophthalmology)
- 3.3 Health sciences (public health services, social medicine, hygiene, nursing, epidemiology)



4. AGRICULTURAL SCIENCES

- 4.1 Agriculture, forestry, fisheries and allied sciences (agronomy, animal husbandry, fisheries, forestry, horticulture, other allied subjects)
- 4.2 Veterinary medicine

5. SOCIAL SCIENCES

- 5.1 Psychology
- 5.2 Economics
- 5.3 Educational sciences (education and training and other allied subjects)
- 5.4 Other social sciences [anthropology (social and cultural) and ethnology, demography, geography (human, economic and social), town and country planning, management, law, linguistics, political sciences, sociology, organisation and methods, miscellaneous social sciences and interdisciplinary , methodological and historical S1T activities relating to subjects in this group. Physical anthropology, physical geography and psychophysiology should normally be classified with the natural sciences].

6. HUMANITIES

- 6.1 History (history, prehistory and history, together with auxiliary historical disciplines such as archaeology, numismatics, palaeography, genealogy, etc.)
- 6.2 Languages and literature (ancient and modern)
- 6.3 Other humanities [philosophy (including the history of science and technology) arts, history of art, art criticism, painting, sculpture, musicology, dramatic art excluding artistic "research" of any kind, religion, theology, other fields and subjects pertaining to the humanities, methodological, historical and other S1T activities relating to the subjects in this group]