

### PROJECTIONS AND SCENARIOS

# HEALTHY FUTURES ATLAS: A PUBLICLY AVAILABLE RESOURCE FOR EVALUATING CLIMATE CHANGE RISKS ON WATER-RELATED AND VECTOR-BORNE DISEASE IN EASTERN AFRICA

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#### CONTEXT

Global climate change is projected to have geographically varied and potentially substantial negative effects on health (70), with sub-Saharan Africa particularly vulnerable (71). Malaria remains one of the world's most devastating infectious diseases, with both the malaria vector and pathogen affected by climatic conditions (72). Prevailing levels of social vulnerability are increasingly recognized as additionally critical determinants of impact (73). Recent reports call for vulnerability and risk to be at the centre of future assessments of climate change impacts, and for increased research on effective decision-support systems.

The European Union-funded HEALTHY FUTURES (74) research project was designed to address these assessments. Completed at the end of 2014, the project is being communicated to senior decision-makers in national and international bodies that have an interest in human and animal health in the East African Community (EAC) countries.



Enabling environment

Capacity-building

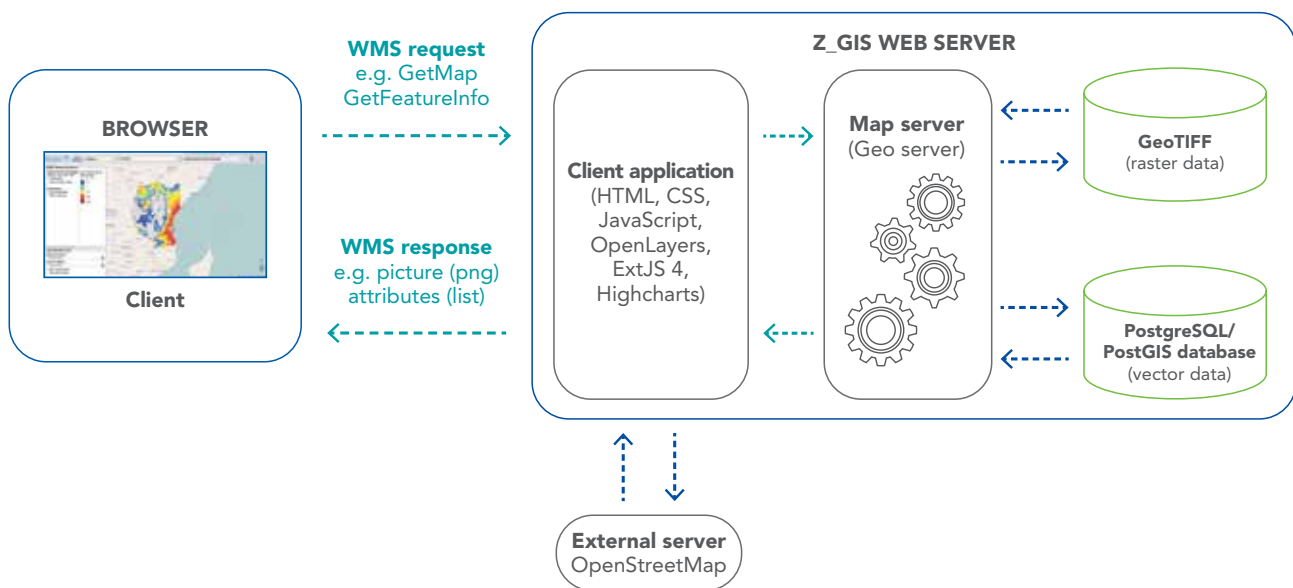
Research

Product and service development

## NEW APPROACHES

HEALTHY FUTURES Atlas is an interactive, web-based mapping and decision-support tool, built within an open-source framework, which aims to provide meaningful and guided access to information on climate change, potentiality of disease occurrence and population vulnerability to vector-borne diseases (Figure 5.28). Currently, the HEALTHY FUTURES Atlas focuses on three water-related, vector-borne diseases (malaria, schistosomiasis and Rift Valley fever) in eastern Africa that have major human and economic impacts. Here we provide a brief introduction to the malaria component, and an indication of the potential utility of the HEALTHY FUTURES Atlas in supporting decisions over present and future allocation of health resources, as well as the identification of targeted and location-specific intervention options. The HEALTHY FUTURES Atlas adds value through facilitating the preparation of health policy and planning strategies and plans, and, more widely, by providing a basis for research and education in the fields of climate change and environmental health.

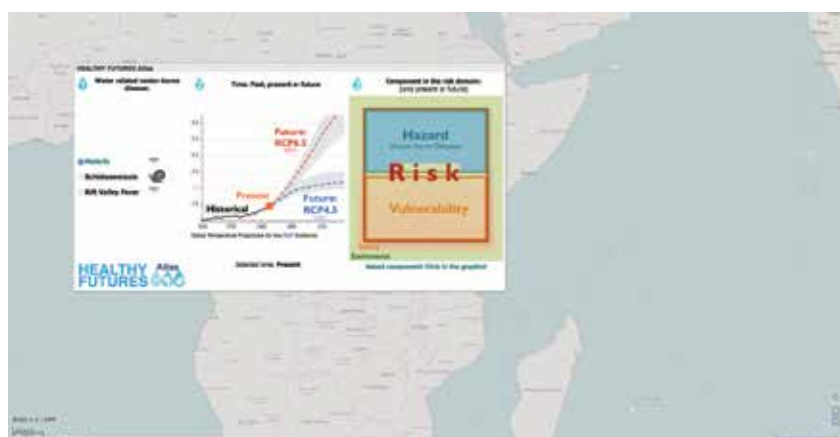
Figure 5.28 HEALTHY FUTURES Atlas WebGIS architecture.



Health and meteorological partners were involved in the development of the HEALTHY FUTURES Atlas, including through feedback following hands-on exposure to earlier versions of the platform at dedicated workshops. The platform integrates a range of modelled and observational climate, health and socioeconomic data from multiple sources. A core objective of the HEALTHY FUTURES Atlas is to communicate and visualise complex information in a guided and simple, yet interactive manner. Information can be queried based on three prime selection criteria: 1) infectious diseases targeted by the HEALTHY FUTURES project; 2) time, allowing comparisons of current conditions with a range of future projections, while also allowing access to information on historical outbreaks; and 3) different components of risk, in accordance with the Intergovernmental Panel on Climate Change (IPCC) AR5 (Figure 5.29).

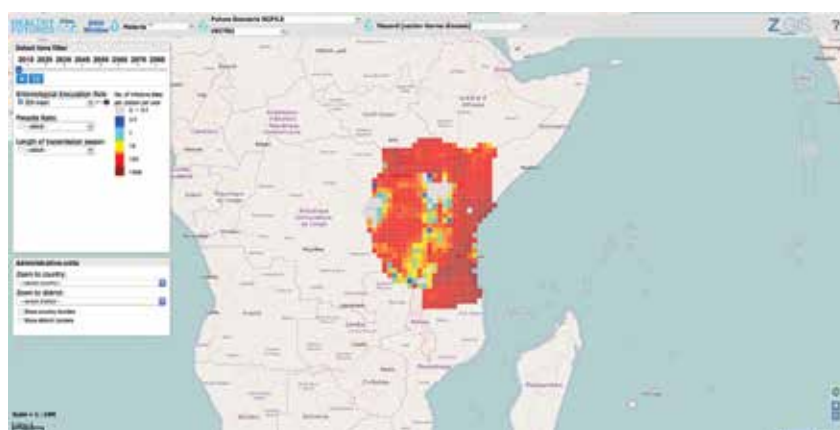
## CASE STUDY 5M

**Figure 5.29** Screen-shot of introduction window of the HEALTHY FUTURES Atlas.

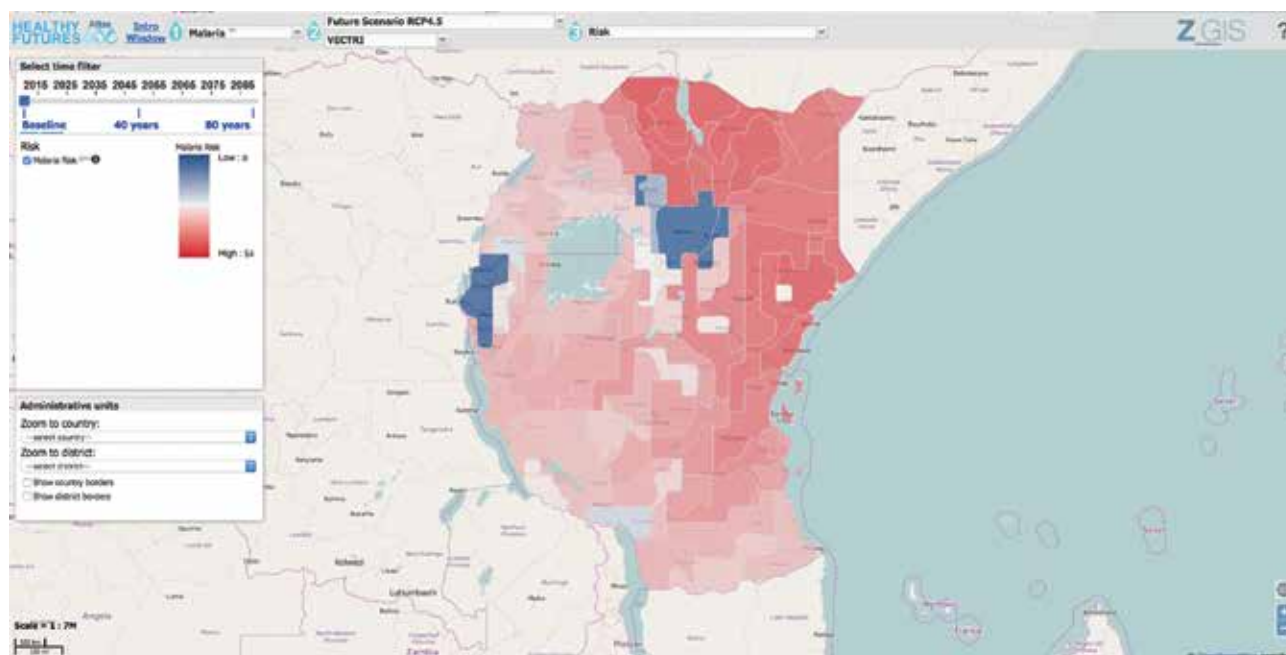


The HEALTHY FUTURES Atlas integrates multiple ensembles of down-scaled and bias-corrected, high-resolution, future climate change projections, which are based on two emission scenarios (RCP4.5 (mid-level change) and RCP8.5 (high-level change) used in IPCC AR5 (75). The projected climatic conditions drive two state-of-the-art dynamic malaria transmission models (LMM and VECTRI) (78) that provide information on the present and future probability of simulated transmission intensity (entomological inoculation rate – EIR), simulated prevalence and simulated length of transmission season (Figure 5.30). Each decade to 2100 can be sequentially examined using a slider function in the tool. In addition, temporal trends at locations throughout the study area can also be viewed. Relative values of social vulnerability are mapped based on indicators of levels of susceptibility to disease (e.g. immunity, malnutrition, poverty, conflict, remoteness) and lack of resilience (e.g. education level, health facilities, number of dependents). These indicators have been weighted and combined into a spatially explicit composite indicator, which can be decomposed into its underlying indicators to assess the factors contributing to vulnerability at a particular location. Combining spatial assessments of disease transmission intensity, susceptibility to illness and lack of resilience permits the interactive mapping of variations in estimated disease (in this case malaria) risk in eastern Africa.

**Figure 5.30** Screen shot of projected hazard of malaria (EIR) under high-estimate of projected climate change (scenario RCP8.5) for period 2045–2055. Hazard projected according to VECTRI model. National and health district boundaries shown for EAC countries.



**Figure 5.31** Screen shot of projected malaria risk under high-estimate of projected climate change (scenario RCP8.5) for period 2045–2055. Underlying EIR hazard projected according to VECTRI model; index of social-vulnerability determined through discussions with experts. National and health district boundaries shown for EAC countries.



## ACKNOWLEDGEMENTS

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## BENEFITS AND LESSONS

The HEALTHY FUTURES research project aimed ultimately to support the decision-making processes in national and international bodies that have an interest in the most effective utilization of scarce health resources. Key challenges in translating HEALTHY FUTURES research outputs into usable formats have been the identification of human (and animal) health decision-makers in the region, the types of decisions they are likely to need to make (and when, over what policy planning and implementation periods and how) and the kinds of support they need in order to make the best decisions. In permitting identification of likely hotspots for infectious disease risks under different climate change scenarios and at policy-relevant time-steps over the current century, the HEALTHY FUTURES Atlas is an important part of meeting the aims of the project. In addition to providing a means of assessing spatial variations in risk throughout eastern Africa, the HEALTHY FUTURES Atlas can be used to generate visualization aids for incorporation in policy and planning documents, for example, and to target surveillance and intervention strategies. The tool has been rolled-out through a series of stakeholder meetings in East African Community countries hosted by HEALTHY FUTURES. The stakeholder meetings involved key health partners, identified at an early stage in the HEALTHY FUTURES project, most notably ministries of human and animal health in eastern Africa, the Health Desk of the EAC, and national and international nongovernmental organizations. HEALTHY FUTURES had less success in engaging with meteorological service providers in eastern Africa, although the project consortium included climate modellers based in South Africa and in Europe. Additionally, the HEALTHY FUTURES Atlas adds value to outputs from Group on Earth Observation (GEO), Copernicus and Global Monitoring for Environment and Security for Africa by providing an integration of a range of datasets that were partly developed and disseminated within and through these initiatives.

National meteorological and health services – and climate change adaptation in general in eastern Africa – need to cooperate and integrate more smoothly, particularly at regional levels like the Eastern African Community, as both climate change and infectious diseases are transboundary challenges.