

Thoughts on socio-economic and other data for health climate change risk assessment



Cross-sectoral ISIMIP and PROCLIAS online Workshop 11-15 January 2021

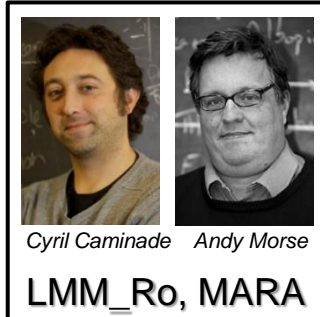
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ISI-MIP1: climate change and malaria

Overall aim: model the impact of climate change on malaria risk using a multi-model method

The malaria modelling team:

Liverpool Uni.



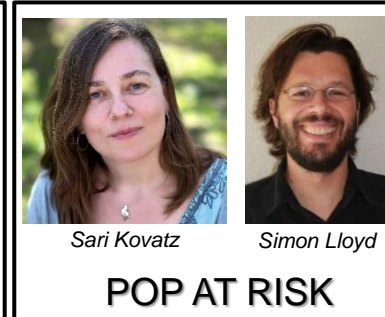
ICTP



Umea Uni.



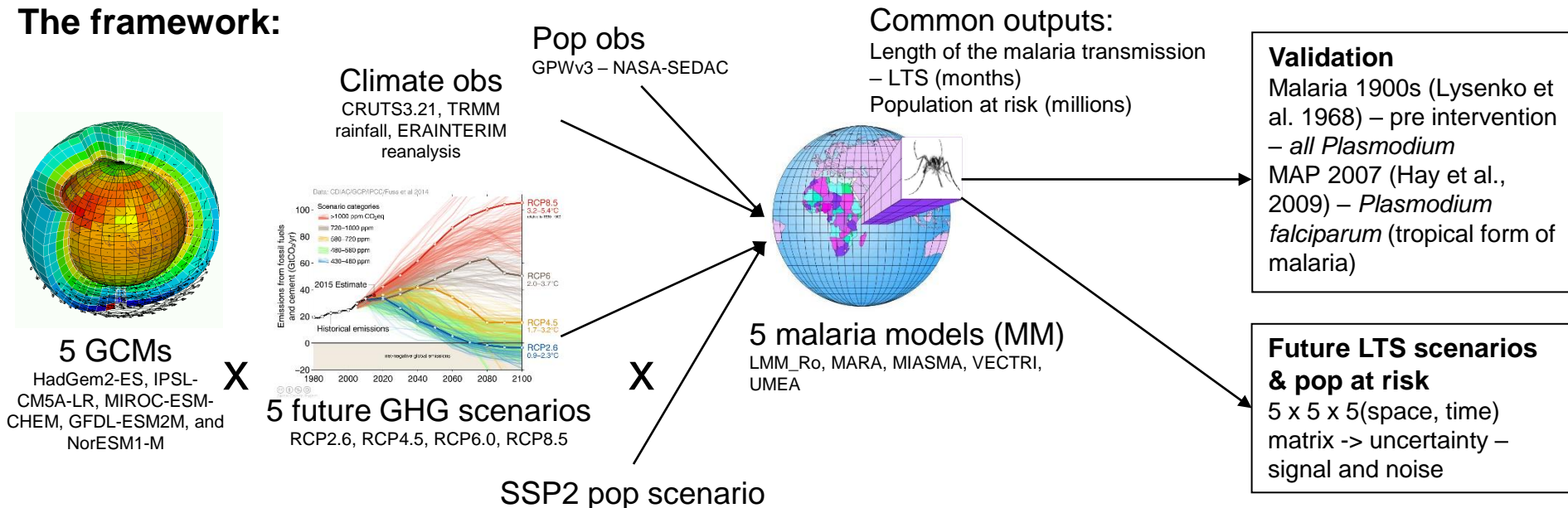
LSHTM



Maastricht Uni.



The framework:

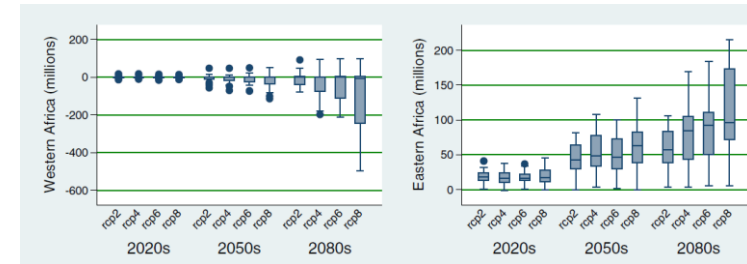
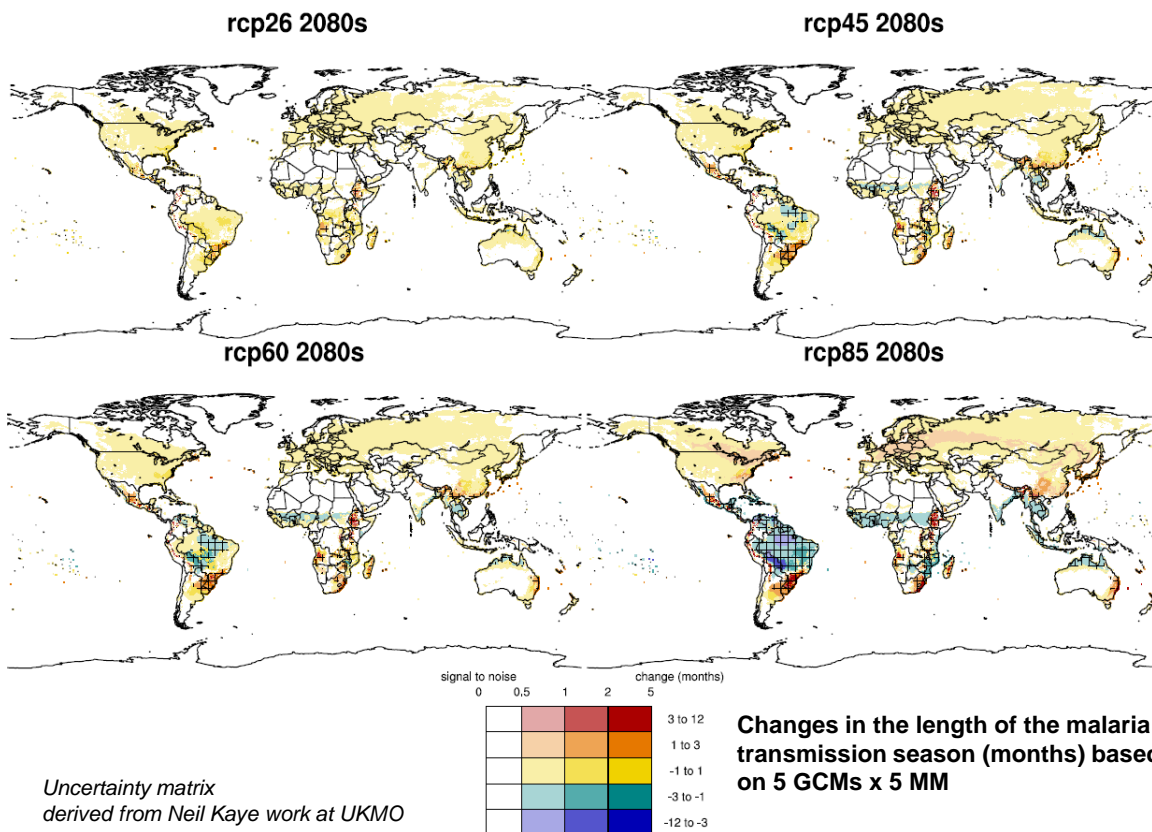


ISI-MIP1: climate change and malaria – results

Impact of climate change on global malaria distribution

Cyril Caminade^{a,b,1}, Sari Kovats^c, Joacim Rocklöv^d, Adrian M. Tompkins^e, Andrew P. Morse^b, Felipe J. Colón-González^e, Hans Stenlund^d, Pim Martens^f, and Simon J. Lloyd^c

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Pop at risk West Africa

Pop at risk East Africa

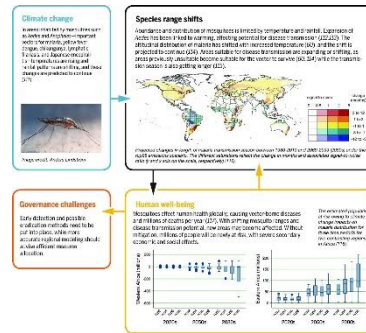
Main results:

- Large differences across malaria models to reproduce historical malaria distribution
- Future risk increases over Tropical highland regions – decreases over the warmest plains of West Africa and South America
- Largest uncertainties related to the impact model – large uncertainty in pop at risk
- Many important parameters omitted in the multi-model risk assessment (control – economic development except UMEA...)

ISI-MIP1: climate change and malaria - impact

Impact on science

Publication highly cited: 444 citations (Google scholar)



Biodiversity redistribution under climate change: Impacts on ecosystems and human well-being

Pecl et al. **Science** 31 Mar 2017, Vol. 355, Issue 6332, eaai9214
DOI: 10.1126/science.aai9214

Impact on NGOs and governmental bodies



Modeling the Impacts of Climate Change on Future Vietnamese Households: A Micro-Simulation Approach

Cited by World Bank on 25 Jul 2016

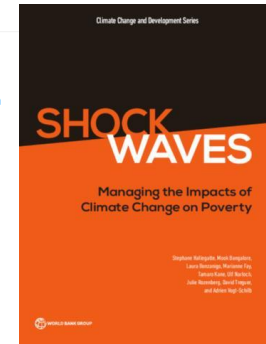
The World Bank is a United Nations international financial institution that provides loans to developing countries for capital programs. The World Bank is a component of the World Bank Group, and a member of the United Nations Development Group. The World Bank's mission is to end extreme poverty within a generation and boost shared prosperity.



Human health and climate change in Pacific Island countries

Cited by World Health Organization on 01 Jan 2015

The World Health Organization (WHO) is the directing and coordinating authority for health within the United Nations system.



"Hallegatte, S. et al. 2016. *Shock Waves : Managing the Impacts of Climate Change on Poverty. Climate Change and Development*. Washington, DC: World Bank. © World Bank. <https://openknowledge.worldbank.org/handle/10986/22787>
License: CC BY 3.0 IGO."



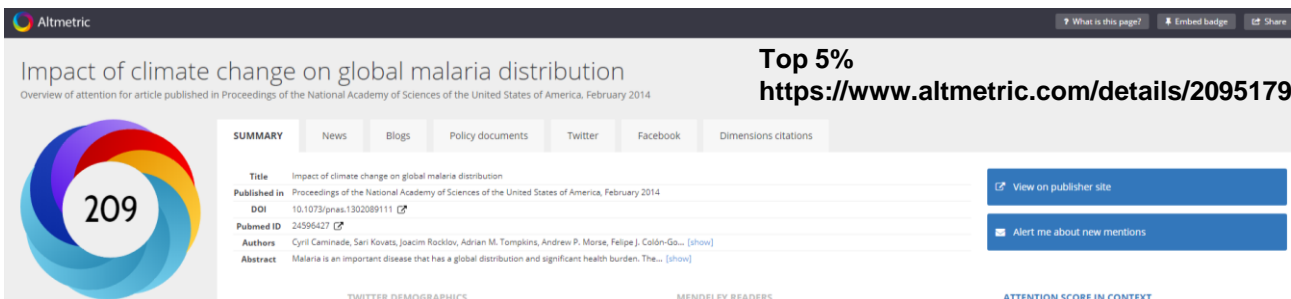
Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s

Cited by World Health Organization on 01 Jan 2014

The World Health Organization (WHO) is the directing and coordinating authority for health within the United Nations system.



Impact in the media



"There is still much that needs to be investigated in the field of climate change. Perhaps the best use of our limited financial resources should be in dealing with making sure that every person in the world has clean water. Perhaps we should focus on eliminating lingering diseases around the world like malaria." – Donald Trump for UK business insider - Sep 13, 2016

<http://uk.businessinsider.com/trump-clinton-climate-change-warming-2016-9?r=US&IR=T>



Disclaimer: multidisciplinary studies are complicated

Knowledge Mobilisation and Public & Community Involvement

Mosquito-borne viruses and tick-borne pathogens are the most important vector-borne disease agents threatening the health of people in Europe, including the UK. Endemic mosquito-borne diseases have not been a significant problem in the UK since the disappearance of malaria several decades ago, but emerging mosquito-borne viral diseases in Europe are an ever-growing threat. Certain tick-borne viral diseases are also emerging in Europe and potentially threaten the UK; and tick-borne borreliosis is already a public health issue here, and is increasing in incidence. The Vector Biology Theme will focus, over the initial five years, on mosquito- and tick-borne viral threats to the UK, and tick-borne borreliosis.

The long-term objectives are to:

1. Become a centre of excellence for the testing of indigenous mosquitoes and ticks (and other arthropods) for vector competence for pathogens that require high containment.
2. Assess the current risk presented by dengue, chikungunya and tick-borne pathogens to England.
3. Develop forecasting systems for *Ixodes ricinus* and Lyme borreliosis risk in England.
4. Model how the risk presented by such pathogens will change in future under scenarios of climate, environmental and demographic change.

Theme Leaders:



Professor Matthew Baylis
Department of Epidemiology and
Population Health
Institute of Infection and Global Health,
University of Liverpool



Dr Jolyon Medlock
Head of Medical Entomology
Public Health England



Professor Stephen Torr
Professor of Neglected Tropical Diseases
(joint appointment LSTM and the University
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Researchers:



Dr Marcus Blagrove

Postdoctoral Researcher
University of Liverpool

PhD Students:



Aislinn Corrie-Jordan



Liz McGhie

*Mosquito
biology
Lab expert*

*Mosquito
field
entomologist*

*Tick field
ecologist, lab
& modelling*

*Climate
and epi
modelling*



Dr Cyril Caminade

Tenure Track Fellow
University of Liverpool



Maya Holding

*Tick field
entomologist
Lab work*



Soeren Metelmann

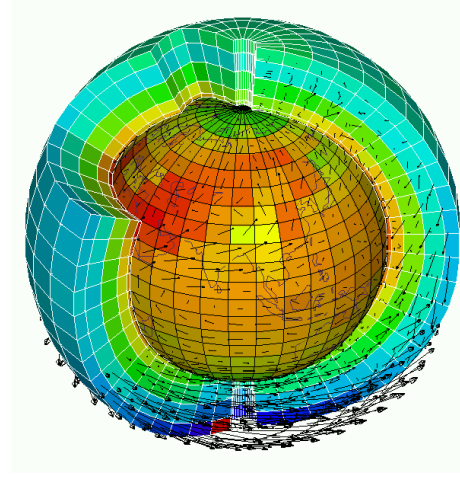
*Biology
applied maths*

- Multi-disciplinary framework is mandatory for climate-health studies
- Different scientific backgrounds, jargon, methods...
- Novel studies emerge from the One Health framework

Data

Climate Model data

Gridded global or regional data
Hourly, daily and longer time scales
Climate model is physically consistent
Biases and uncertainties
Climate observations available at same scales



Socio-economic data

Granular (country scale, city scale...) and diverse
Time resolution can be granular (census every 5 years)
It needs to be matched to the climate data grid, so three options:
A – good quality data already exists (population density for example)
B – you need to make some assumptions to create your own (country->raster)
C – data does not exist

Useful socio-economic data centres for health applications

<https://sedac.ciesin.columbia.edu/>
GPWv4 gridded population dataset



SOCIOECONOMIC DATA AND APPLICATIONS CENTER (SEDAC)

A Data Center in NASA's Earth Observing System Data and Information System (EOSDIS) — Hosted by CIESIN at Columbia University



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<https://data.oecd.org/>

Number of hospital beds per 1000 people...



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GDP, demographics...



THE WORLD BANK

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World Bank Open Data

Free and open access to global development data

Search data e.g. GDP, population, Indonesia



About

Welcome

Citation

SSP Public Database
Version 2.0

New release (V 2.0) SSP Database (Shared Socioeconomic Pathways) - Version 2.0

<https://tntcat.iiasa.ac.at/SspDb/dsd?Action=htmlpage&page=about>

Introduction

ND-GAIN Index Country Rankings

[VIEW FULL RANKINGS](#)

Top 5 Countries	Score	Bottom 5 Countries	Score
1 Norway	76.7	177 Dem. Rep. of the Congo	30.7
2 New Zealand	74.5	178 Eritrea	29.5
3 Finland	73.7	179 Somalia	27.7
4 Denmark	72.9	180 Central African Rep.	27.7
5 Sweden	72.6	181 Chad	27.1



ND-GAIN
Notre Dame Global
Adaptation Initiative

<https://gain.nd.edu/>



UNIVERSITY OF
LIVERPOOL

ISI-MIP Workshop, 11-15 Jan 2021

For specific health sectors you might need other data



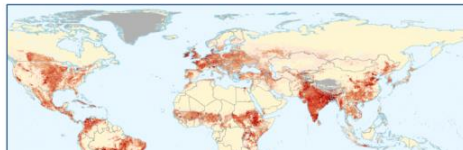
LIVESTOCK GEO-WIKI

Livestock Geo-Wiki

In a multi-partner collaboration centered on the International Livestock Research Institute (ILRI), the Food and Agriculture Organization of the United Nations (FAO) and the Université Libre de Bruxelles (ULB-LIBRES), global maps of livestock distributions and production systems are being revised and updated.

The Geo-Wiki is used to provide a central viewer, validation tool and repository for these data. The module currently contains data on livestock distributions (cattle, chicken, duck, pig, sheep & goat) but the platform aims to develop a comprehensive global livestock information system, and will be complemented by modules on major global benefit and impact linked to the livestock sector in i) poverty and growth, ii) health and nutrition and iii) climate and natural resource management.

Register or log in and go to the Geo-Wiki application to view and download this dataset. If it is not activated by default, don't forget to choose the "Livestock" branch in the drop down field in the top left corner.



Livestock animal density, important for zoonotic diseases

<https://livestock.geo-wiki.org/home-2/>

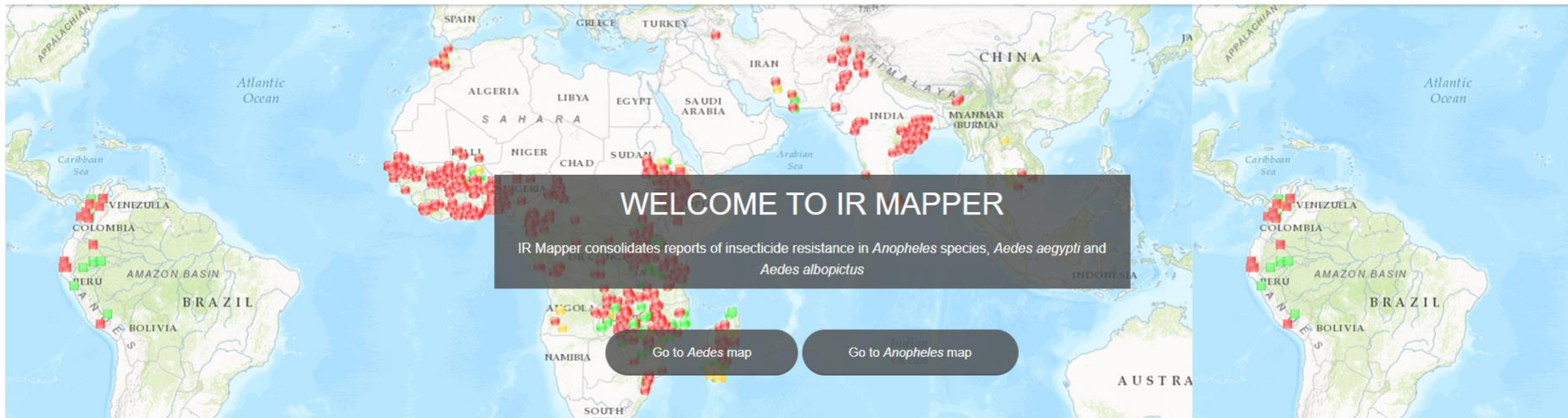
Insecticide resistance, important for vector-borne diseases

<https://www.irmapper.com/>

irmapper.com

IR Mapper

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The RCP-SSP matrix to estimate pop at risk

Scenario definitions

<https://protocol.isimip.org/protocol/ISIMIP3b/biomes.html>

Table 1: Climate scenario specifiers (climate-scenario).

Scenario specifier	Description
picontrol	Pre-industrial climate as simulated by the GCMs.
historical	Historical climate as simulated by the GCMs.
ssp126	SSP1-RCP2.6 climate as simulated by the GCMs.
ssp370	SSP3-RCP7 climate as simulated by the GCMs.
ssp585	SSP5-RCP8.5 climate as simulated by the GCMs.

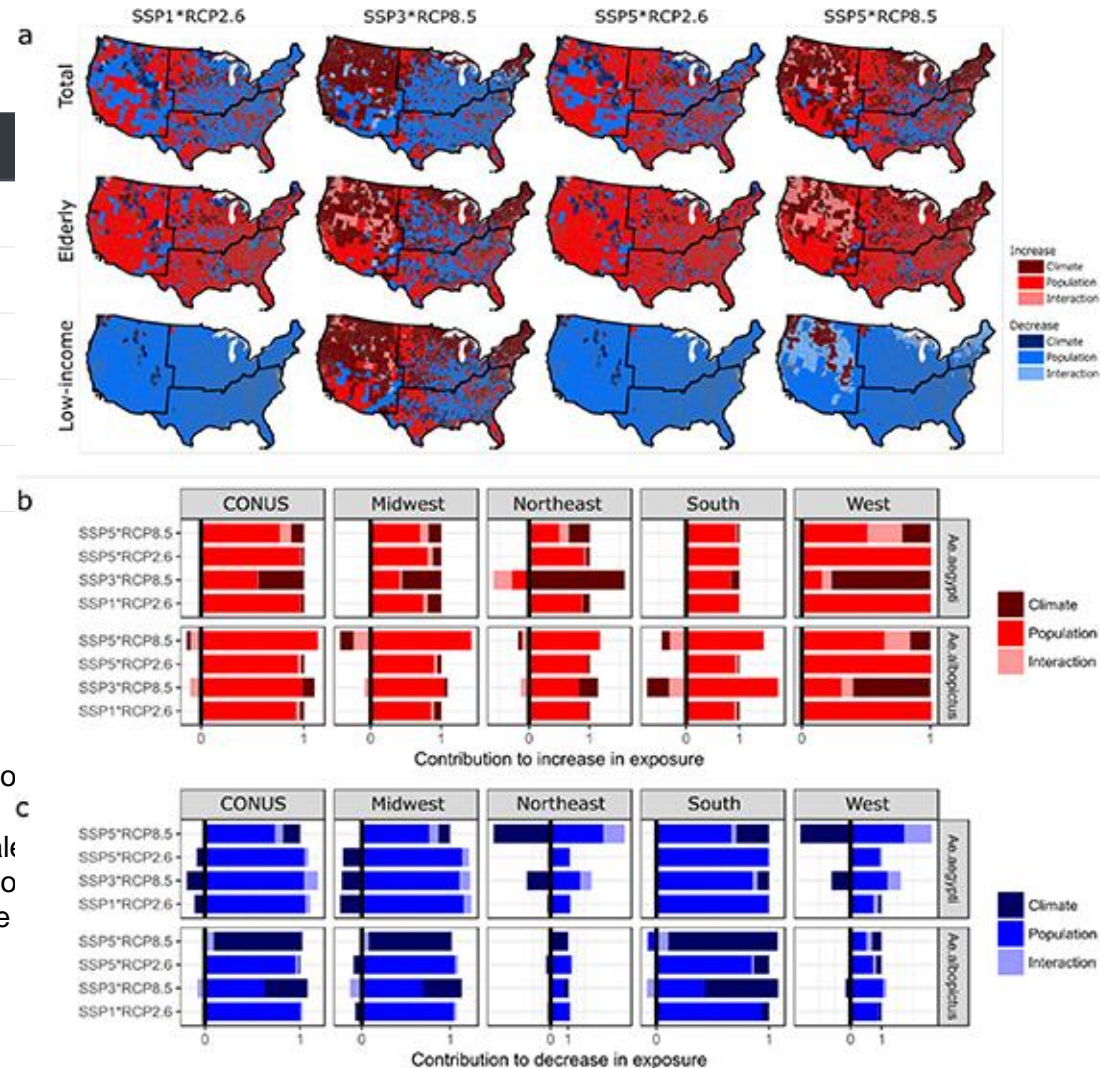


Figure 5. (a) Dominant effect (climate, population, or interaction) responsible for the highest increase (or decrease) in exposure at the county-level, for three population groups (see figure S6 for other population groups) and for exposure to *Ae. aegypti* VTR only (see figure S5 for exposure to *Ae. albopictus* VTR); (b) Contribution to increase in total population exposure of each individual effect, aggregated at the country (CONUS) and regional scale and (c) same for decrease in exposure (see figures S7–S9 for results associated with other population groups). Results are presented for year 2080 only, using the multi-model mean.

Rohat et al., 2020

<https://doi.org/10.1088/1748-9326/ab9141>

Another SSP-RCP example for Ebola

Article | [Open Access](#) | Published: 15 October 2019

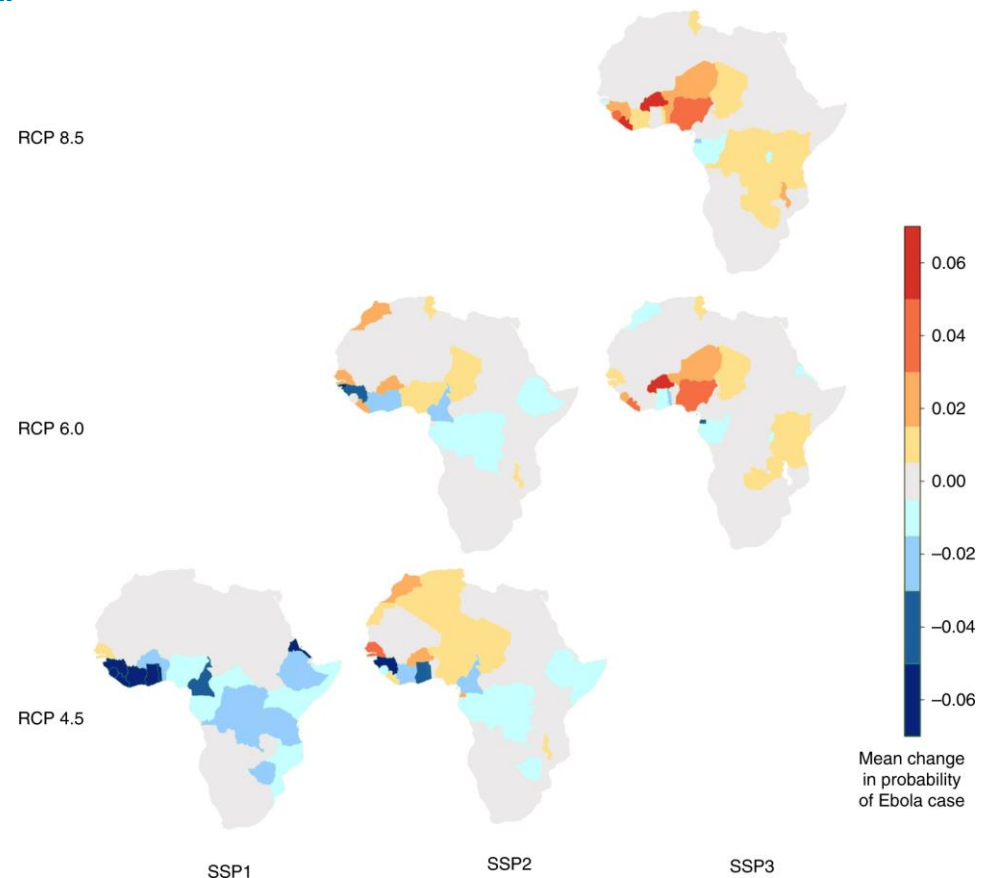
Impacts of environmental and socio-economic factors on emergence and epidemic potential of Ebola in Africa

David W. Redding [✉](#), Peter M. Atkinson, Andrew A. Cunningham, Gianni Lo Iacono, Lina M. Moses, James L. N. Wood & Kate E. Jones [✉](#)

Nature Communications **10**, Article number: 4531 (2019) | [Cite this article](#)

20k Accesses | **10** Citations | **339** Altmetric | [Metrics](#)

Change in future risk of EVD cases caused by Zaire Ebola virus (EBOV) for 2070. Maps represent mean change in per grid cell (0.0416° — 5.6 km at equator) EVD case probability from zero (yellow) to -0.06 (green) and 0.06 (red), aggregated at the country level with data from EMM simulations for 2070. Rows and columns show all reasonable combinations of the different scenarios of global change (GCAM-RCP4.5, AIM-RCP6.0, MESSAGE-RCP8.5 and SSP1 to 3)



No conclusion, this is a workshop so more work to do!

Idea initiated by Veronika Huber during one of our health sector meeting:

- Identify key physical and socio-economic factors per health sub sector
- Share a working document to add important missing socio-economic data, their sources, temporal and spatial resolution in a Table
- If available list different sources for key datasets (GDP, pop counts...)
- Assessment of data fitness for use, use the ISIMIP community expertise
- Fill the gap techniques (downscaling – time interpolation etc) to consider?
- Include data in repository for other impact modellers

Other points:

- Climate tipping point scenario, example: accelerated melting of the Greenland ice sheet, impact on African climate and malaria burden (PhD project ULIV-CEA-LSCE) – other sensitivity experiments (permafrost melting...)
- Tailor data for economic risk assessment further
- Assess the relative importance of climate vs population trends vs...