CHAC 2024
Climate and Health Africa Conference

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Identifying climate-drivers of three common infectious diseases in Madagascar via participatory modeling

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Ryan et al. 2023, *Lancet Plan Health*

Why?

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Why?

Models are not interpretable or credible to stakeholders

Global models may not match the local context

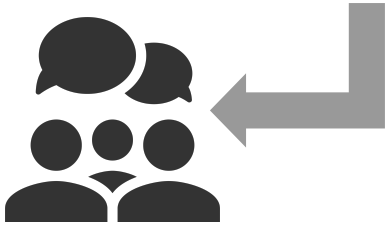
Software tools are not maintained

Traditional modeling process is linear and siloed

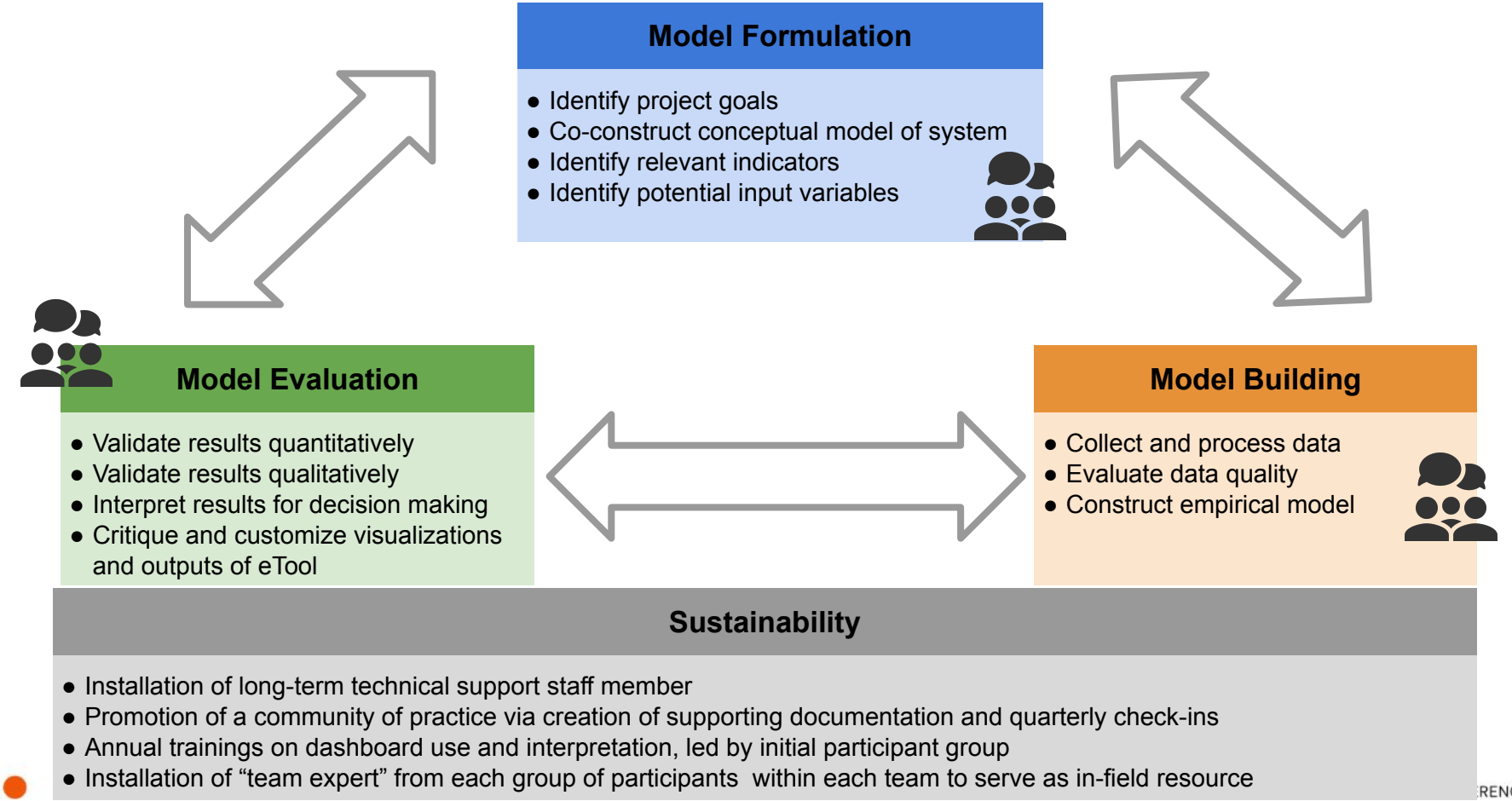
Initial discussion between researchers and health actors

Model Formulation	Model Building	Model Evaluation
• Identify project goals • Identify relevant indicators • Identify potential input variables	• Collect and process data • Evaluate data quality • Construct empirical model	• Validate results quantitatively

Final presentation of results to health actors

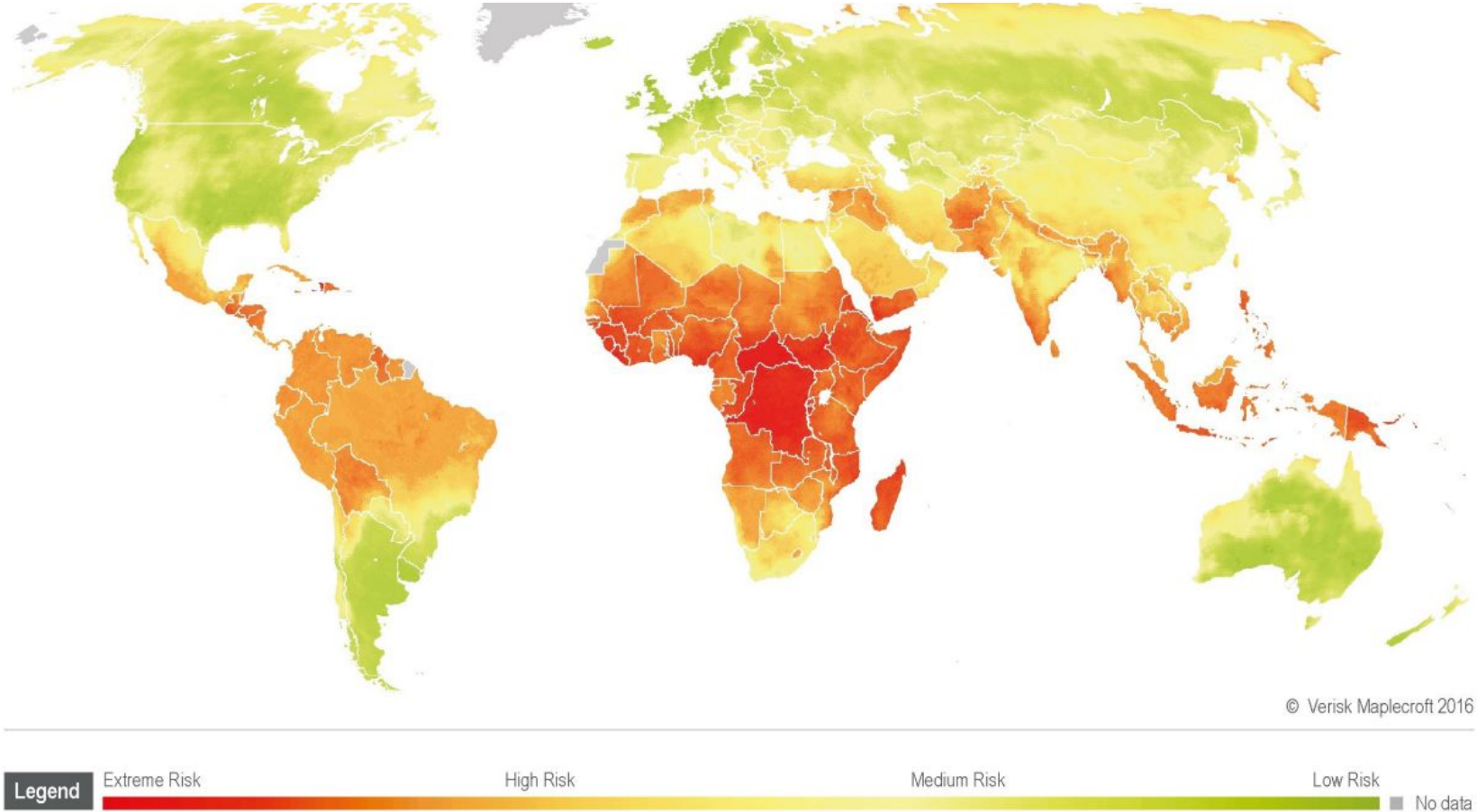


Participatory modeling is iterative and inclusive

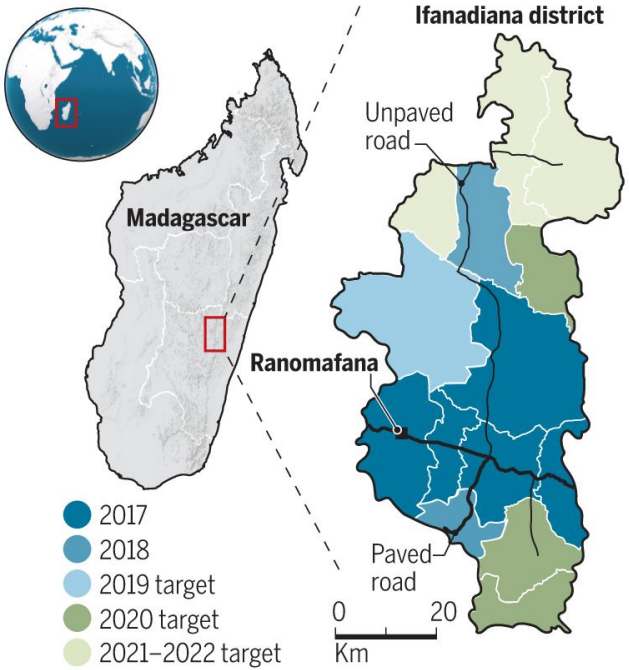


Participatory modeling offers a way to operationalize disease forecasting models into usable software designed with and for decision makers within the health system

Madagascar is one of the most vulnerable countries to climate change



A health-system strengthening partnership



Began in 2014, in the District of Ifanadiana, Vatovavy.

Now serves over 1 million

Focuses on universal health coverage and community health programs

Existing partnership facilitates a participatory approach

Co-creation of disease forecasting system via participatory modeling to be integrated into a DHIS2 application

Targets last-mile healthcare delivery at the community level (<5km resolution)

Multi-pathogen

Malaria

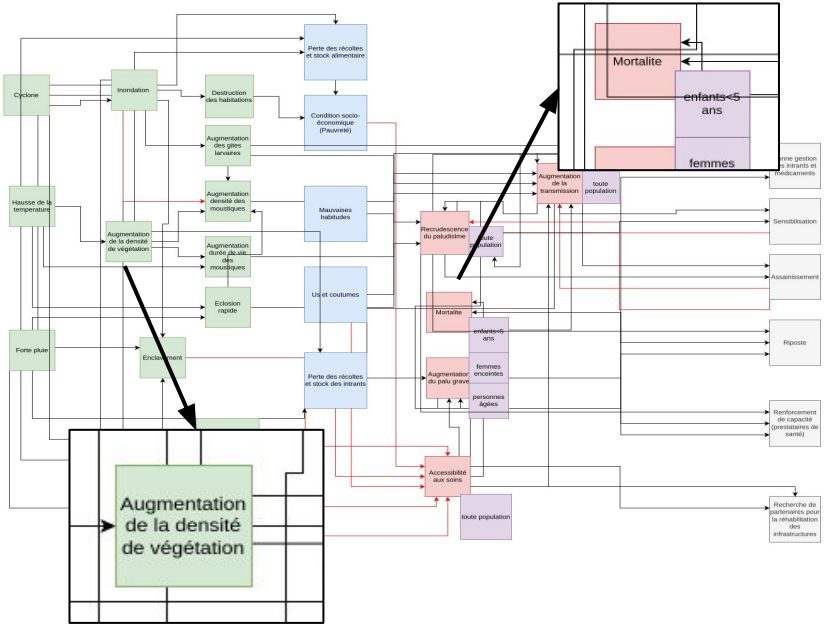
Diarrheal Disease

Acute Respiratory Inf.

PRIDE-C

Predicting Infectious Diseases via Environment and Climate

Model co-creation: conceptual to statistical



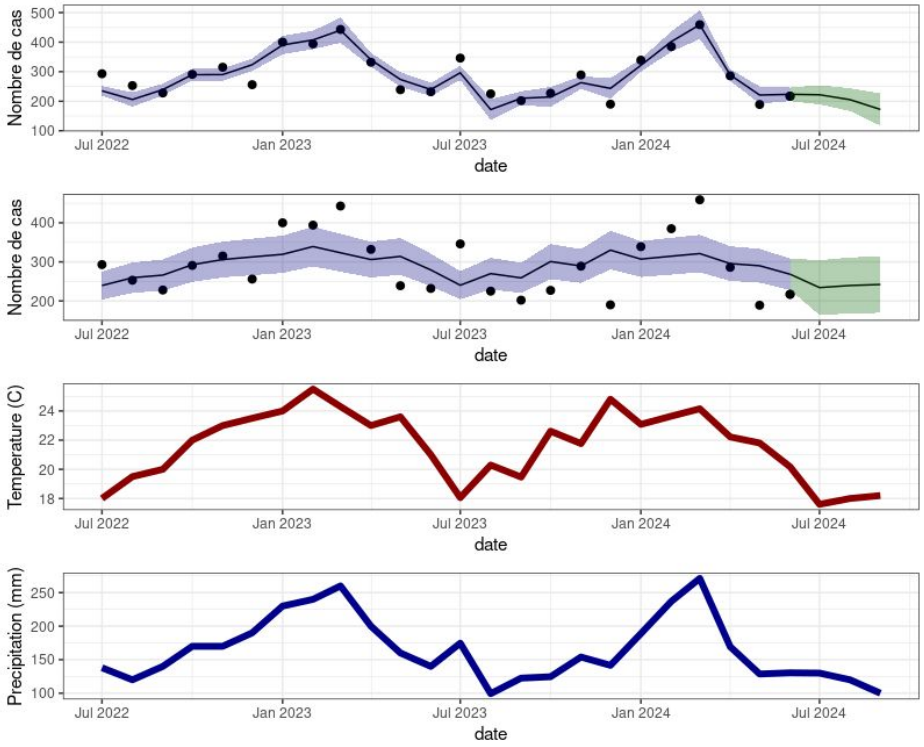
Used participatory research methods to identify environmental conditions and hazards relevant for each disease

Model co-creation: conceptual to statistical

INLA models : Bayesian approximation with spatio-temporal structures

Models trained on 4 years of health, social, climate, and environmental data

Disease rates forecast up to 3 months in the future



Data sources

Digitized health clinic registers

DHS-like household survey

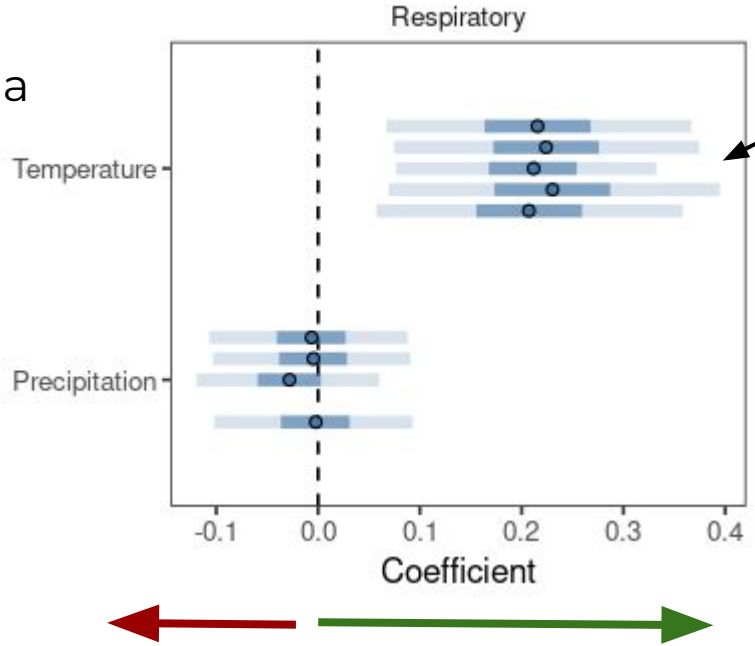
Routine HMIS indicators

Environmental and climate data from satellite imagery

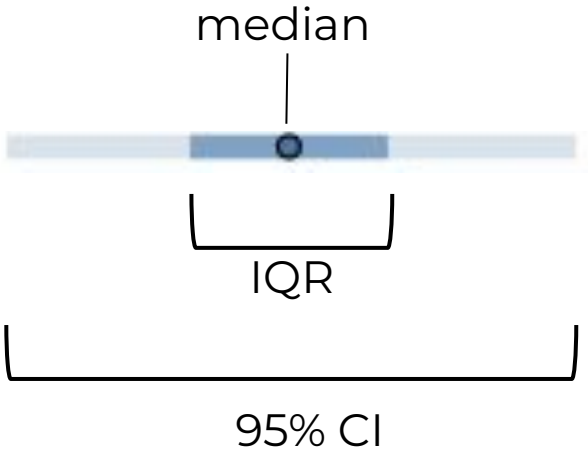
Crowd-sourced dataset of buildings and transport networks

Results: How to Interpret

Each row is a variable



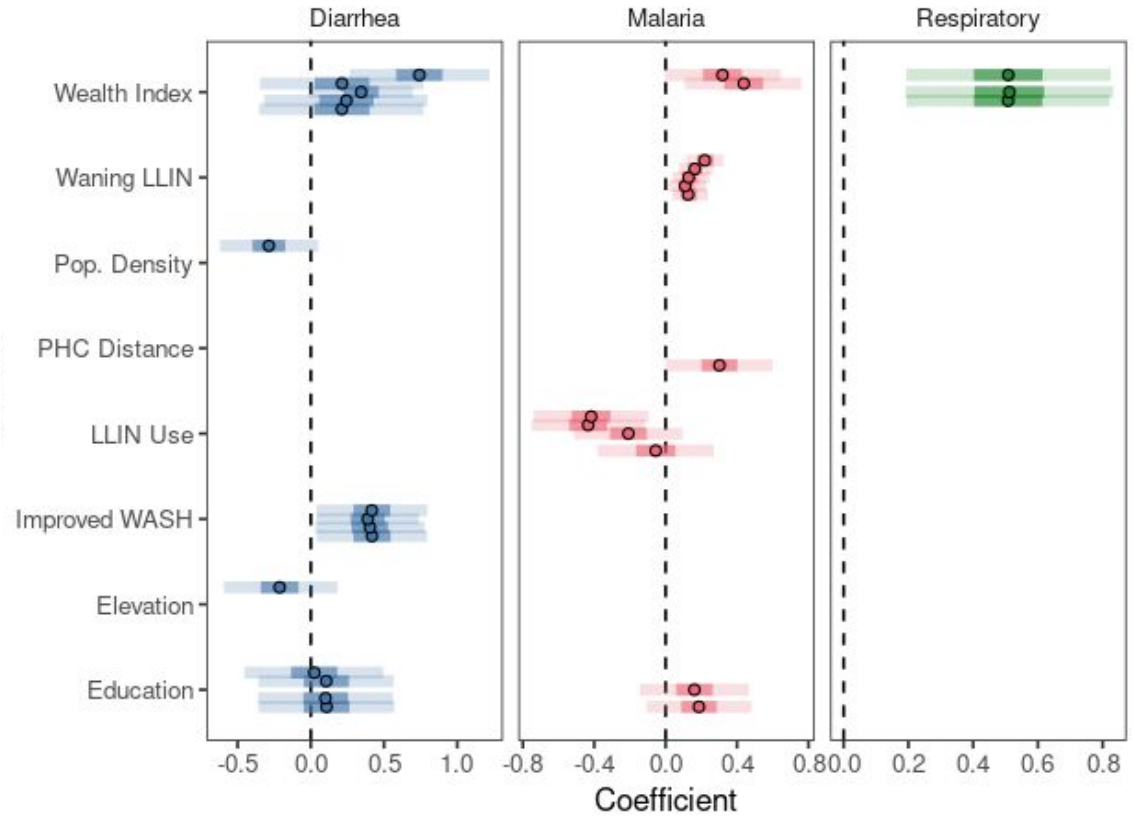
Each bar represents one of 5 models



Negative association

Positive association

Social and geographic variables



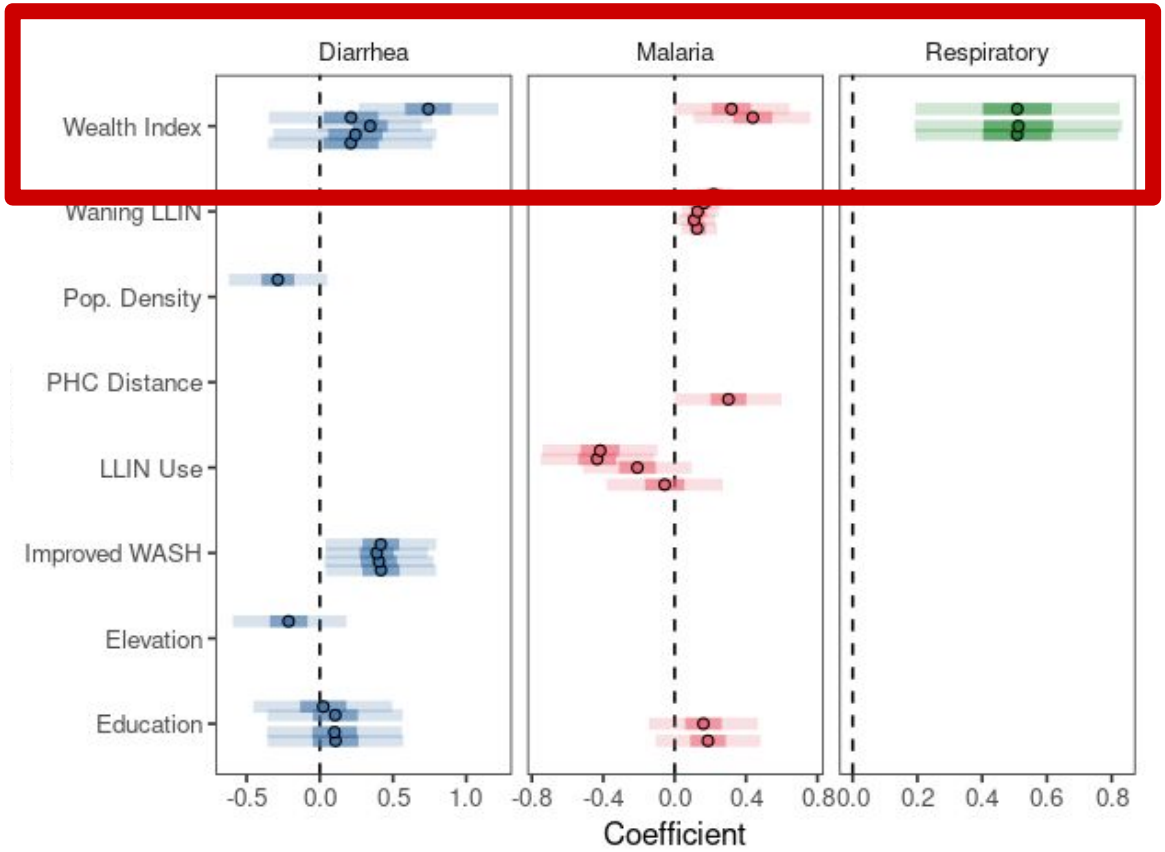
Wealth has a positive association for all diseases

Social variables may represent access to care, rather than exposure

- Need to correct for estimation bias

Importance of controlling for interventions (LLINs)

Social and geographic variables



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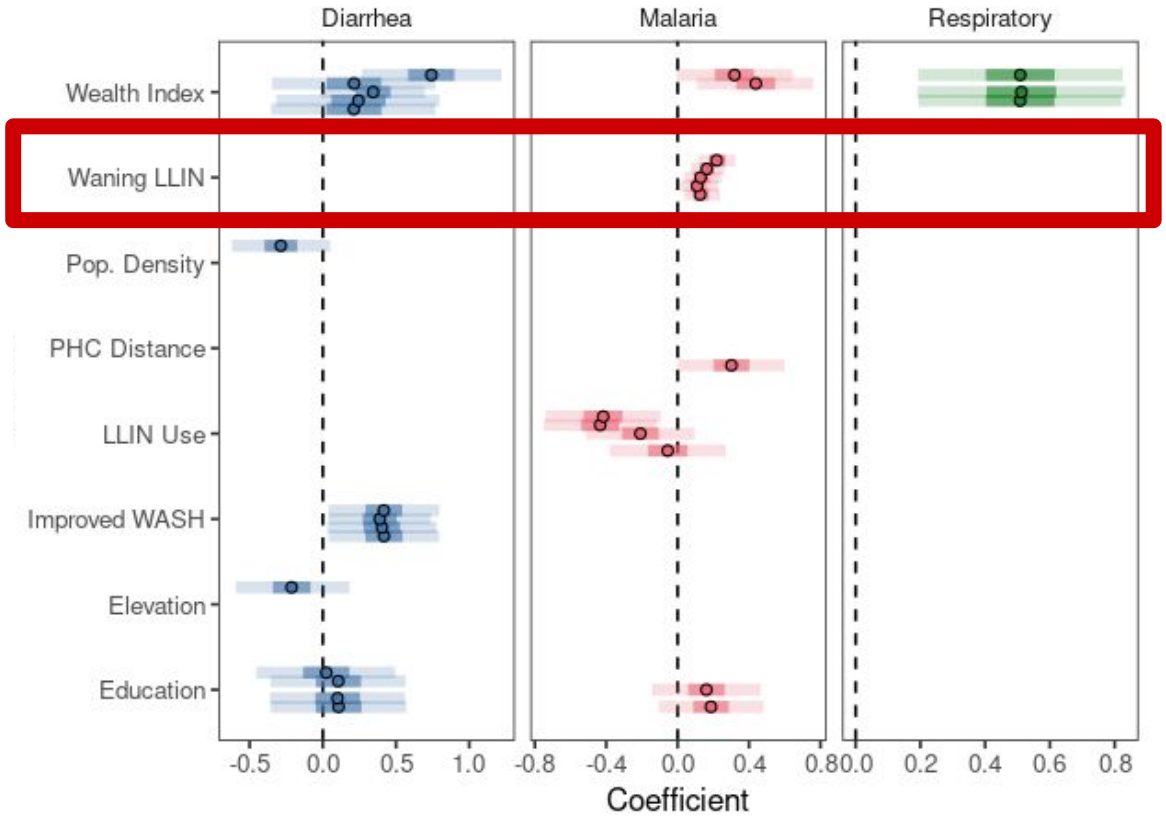

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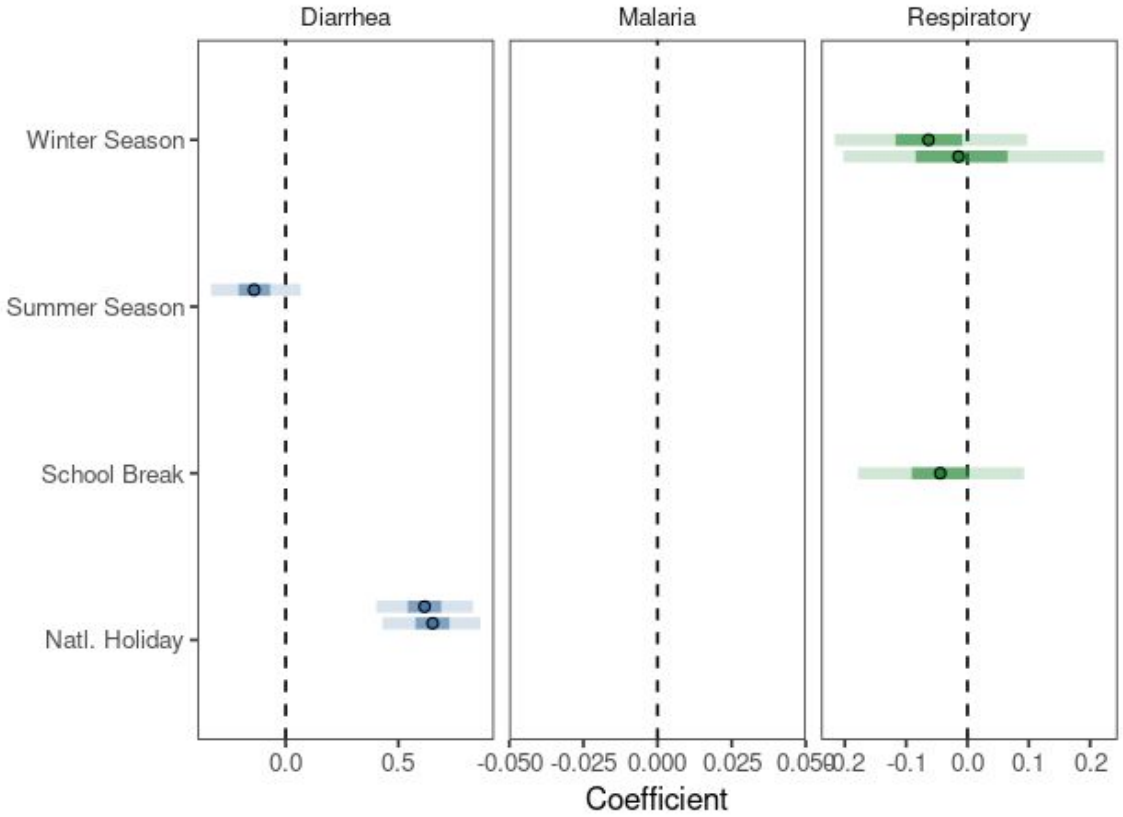
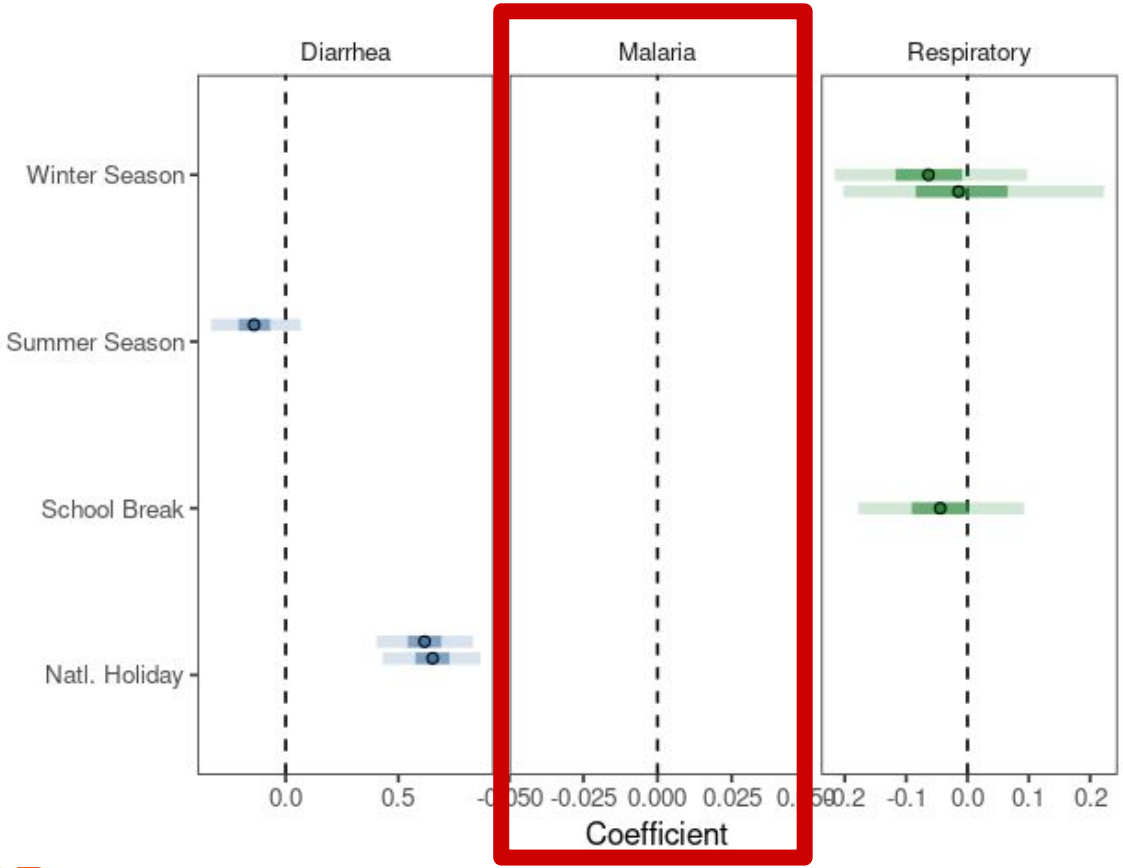
Calendar variables



No calendar variables were identified as important for malaria

Strong role of national holiday for diarrheal disease

Calendar variables



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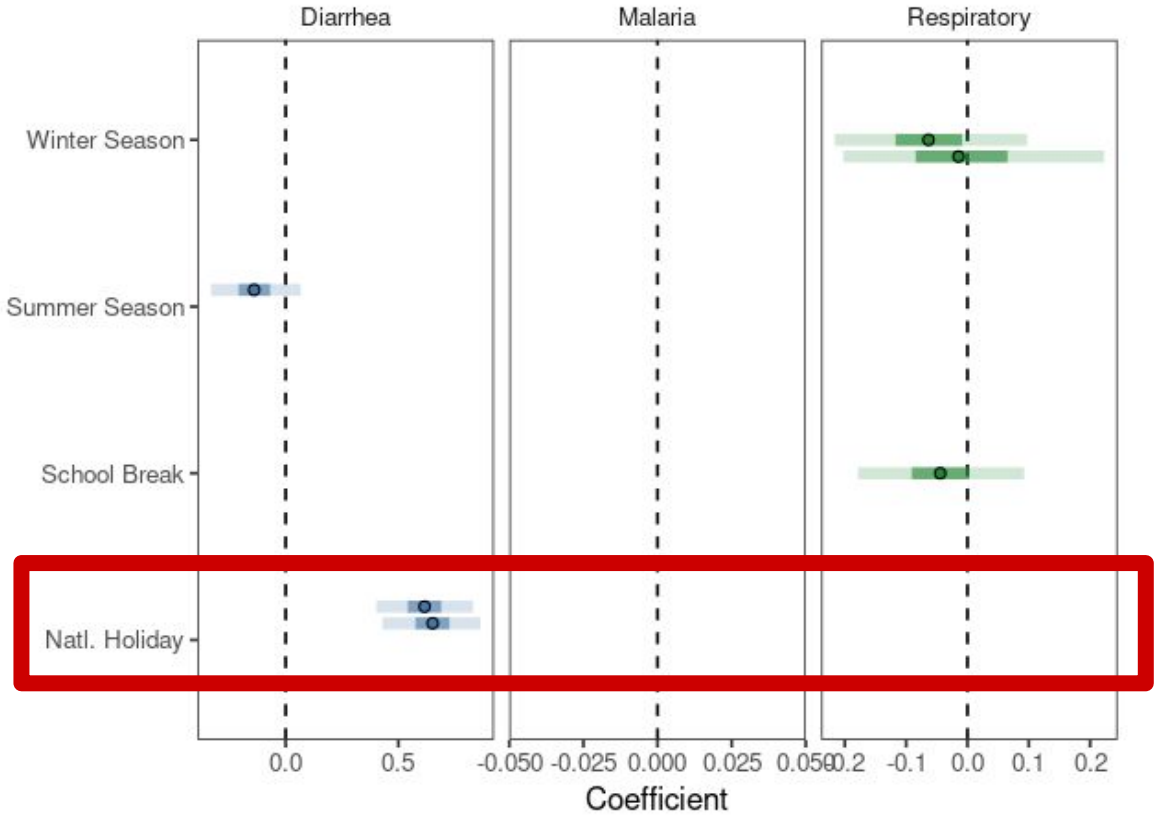

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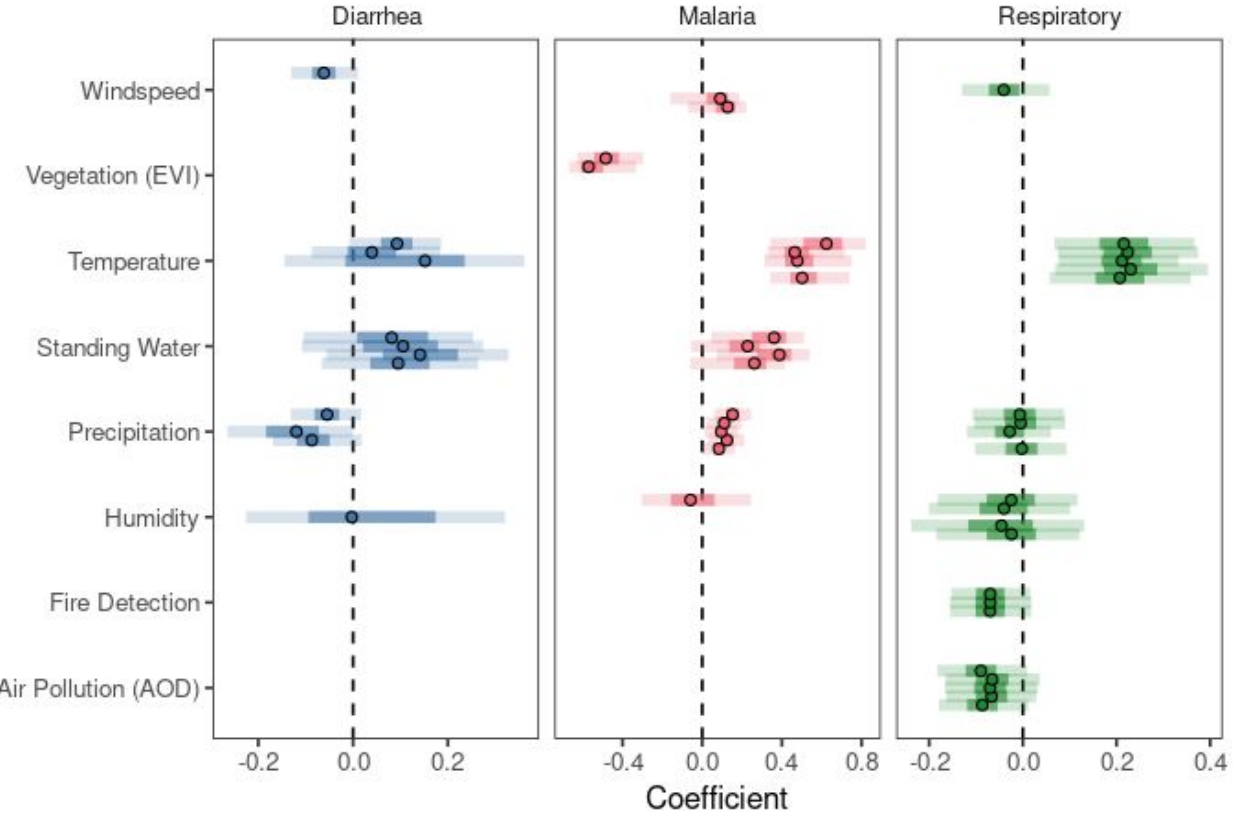
Climatic and environmental variables



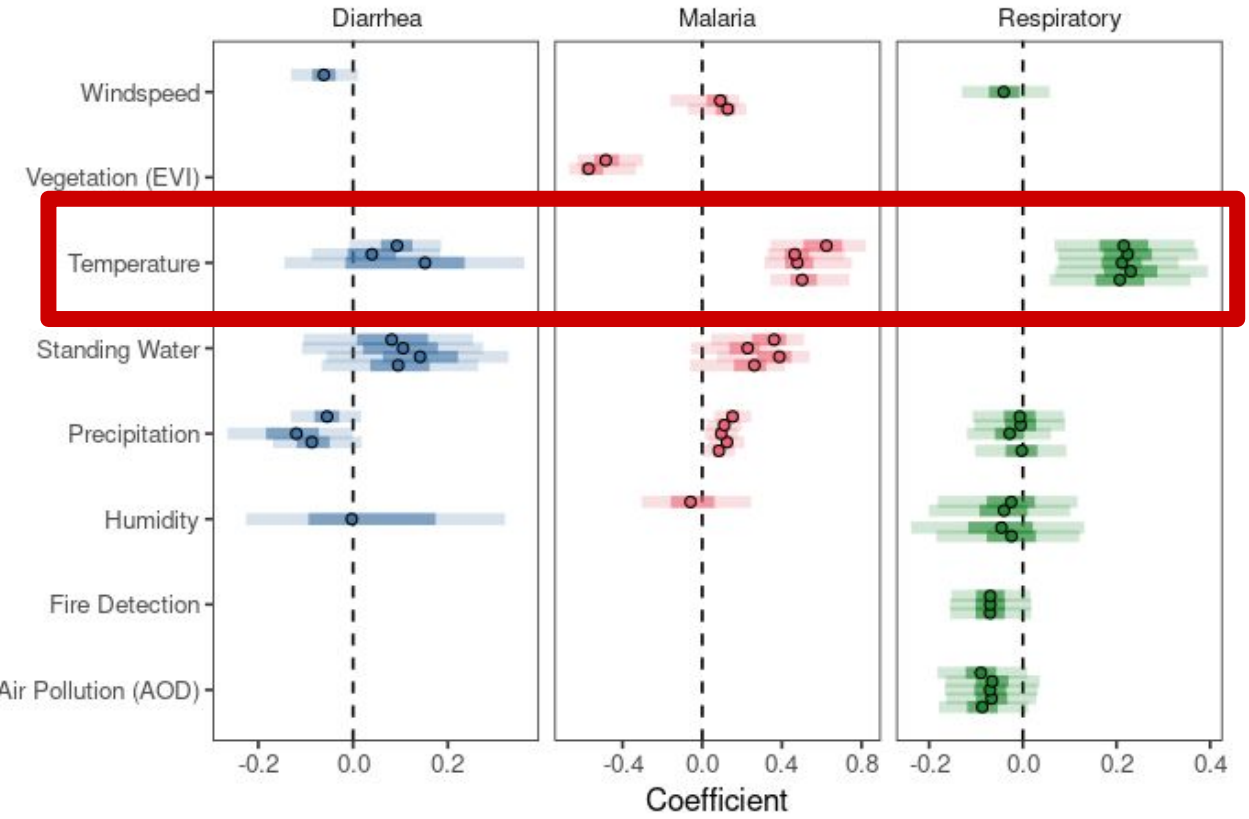
Many shared variables across diseases

Temperature is positively associated with all diseases

Variables with clear seasonality have larger coefficients

→Role of stochasticity

Climatic and environmental variables



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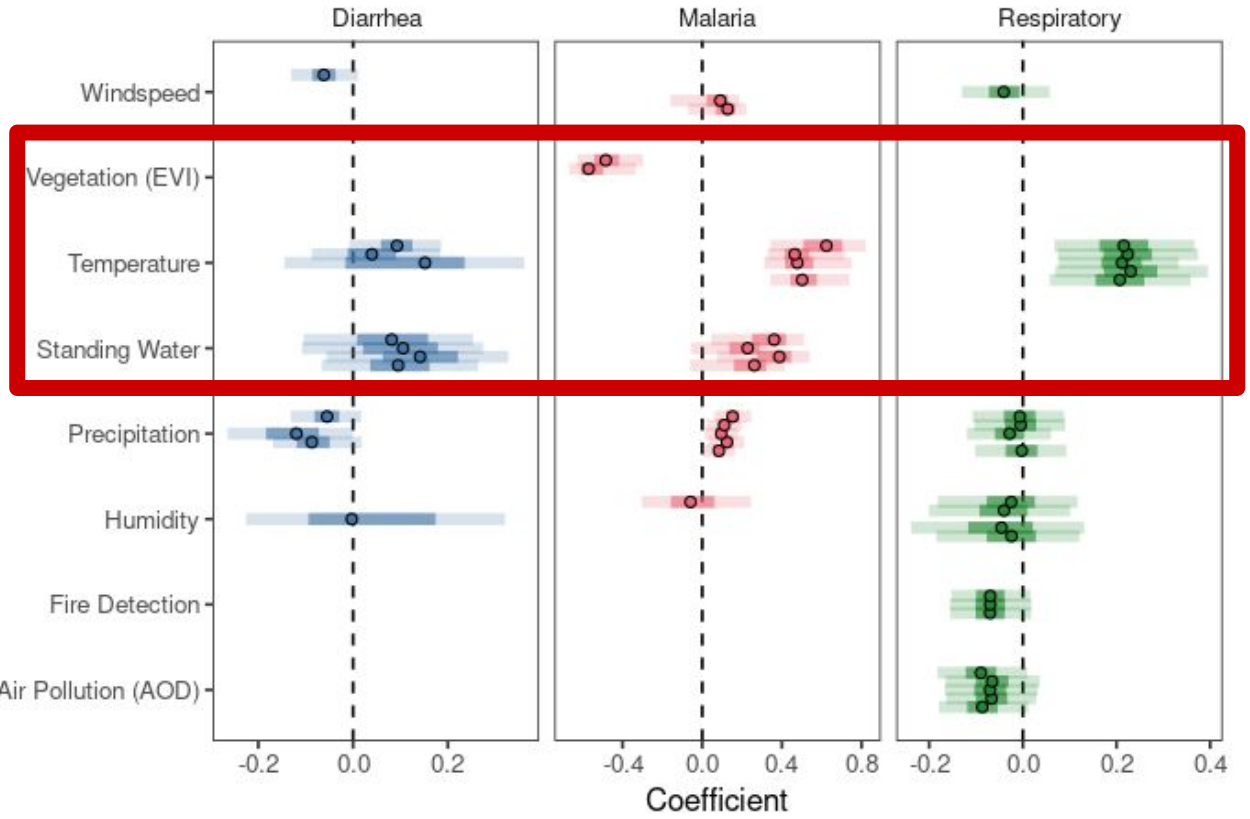

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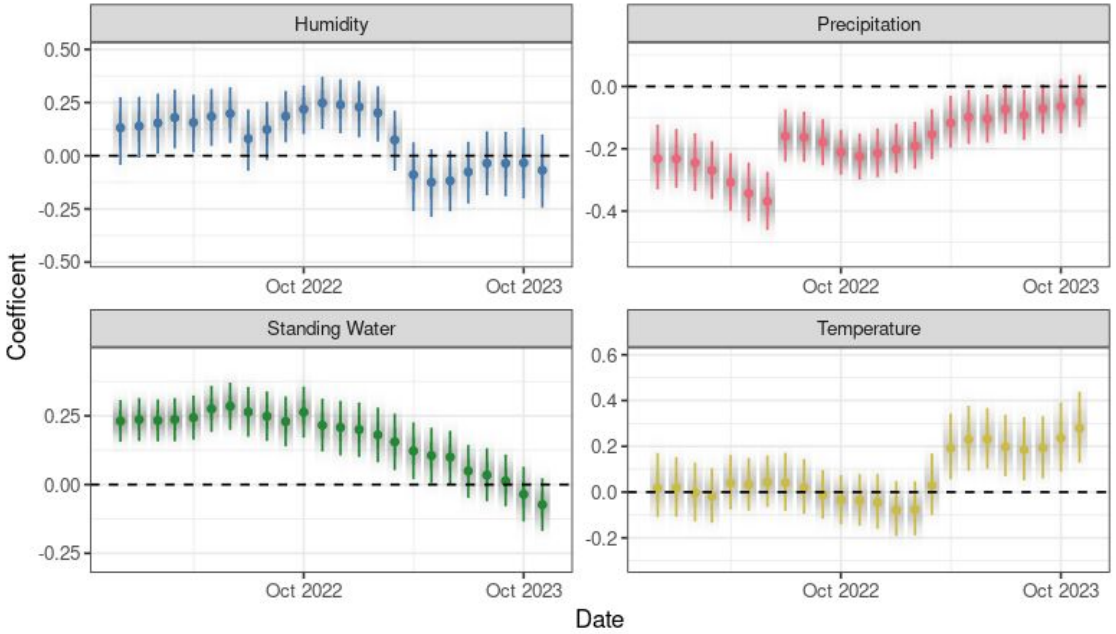
→Role of stochasticity

Variable coefficients change over time

Models trained on historical data must be updated regularly

Due to changing climate or interaction with changing social context (e.g. HSS)?



Next steps

Creating ensembles of models using different modeling frameworks (ARIMA, Random Forest, GAM)

Second validation of models with health actors in November 2024

Deployment of beta version of DHIS2 application for district-wide use

Release of R package containing modeling workflow for use with DHIS2 data

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Questions?

Vous avez des questions?

Misy fantanina?

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