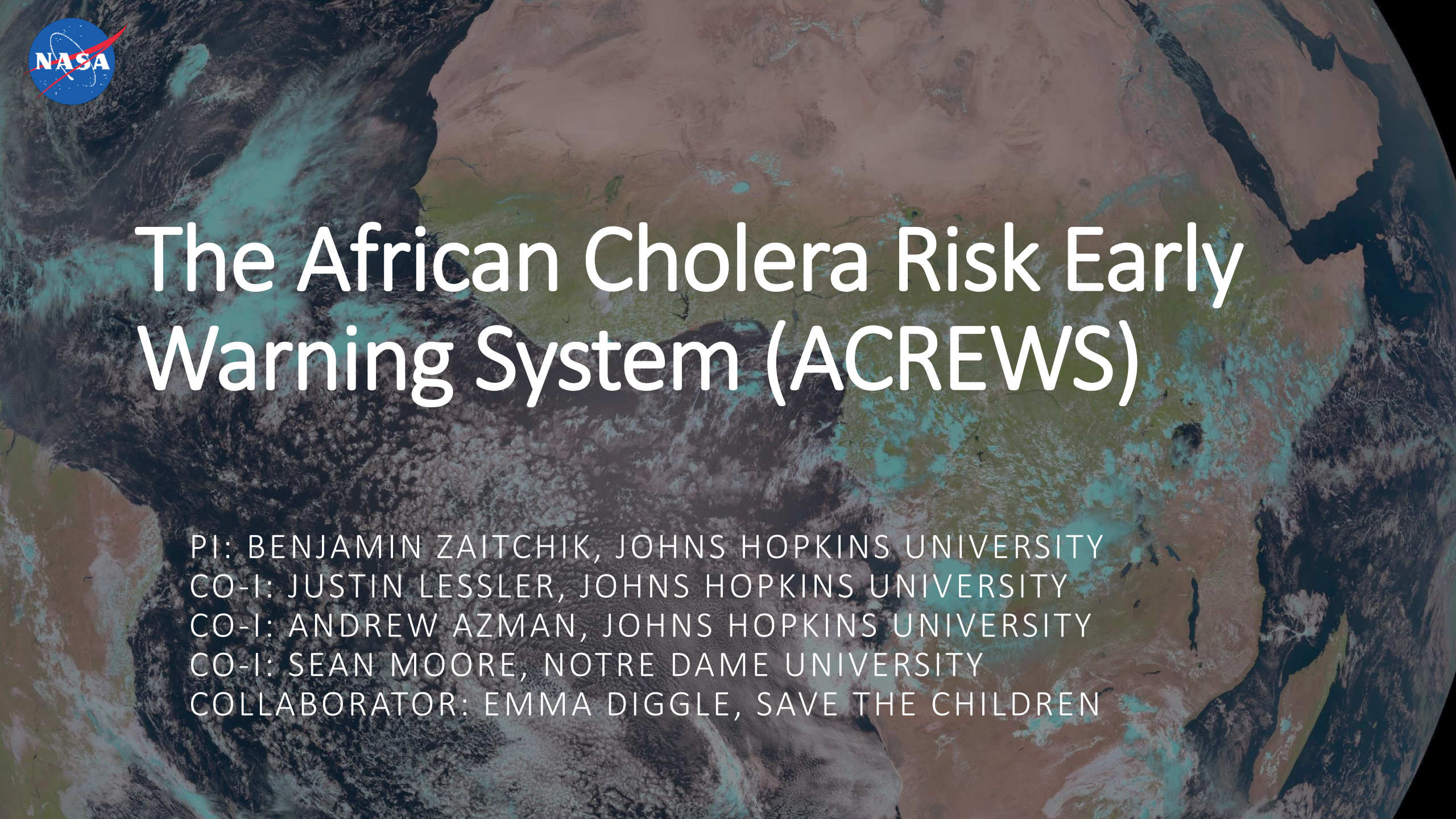
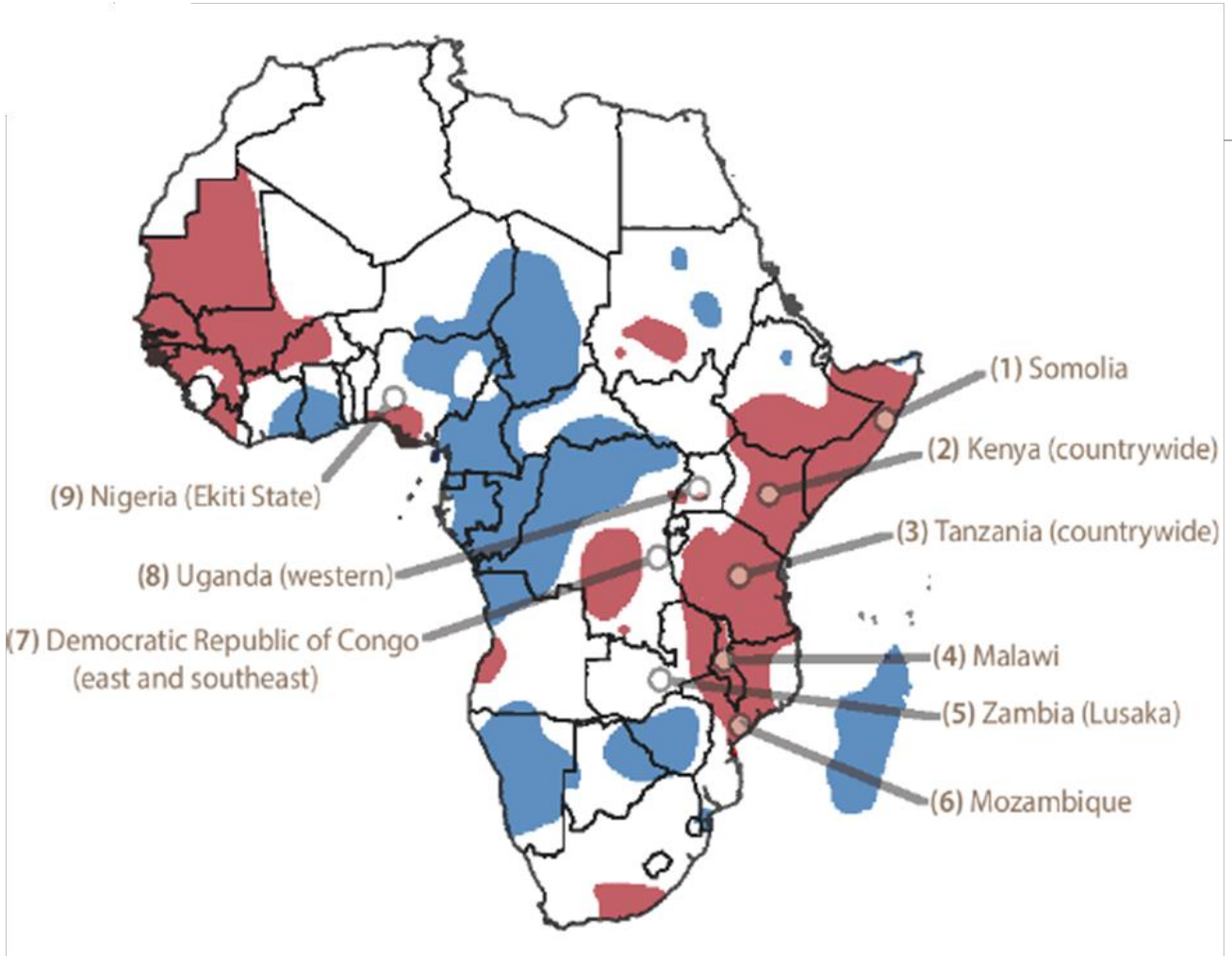
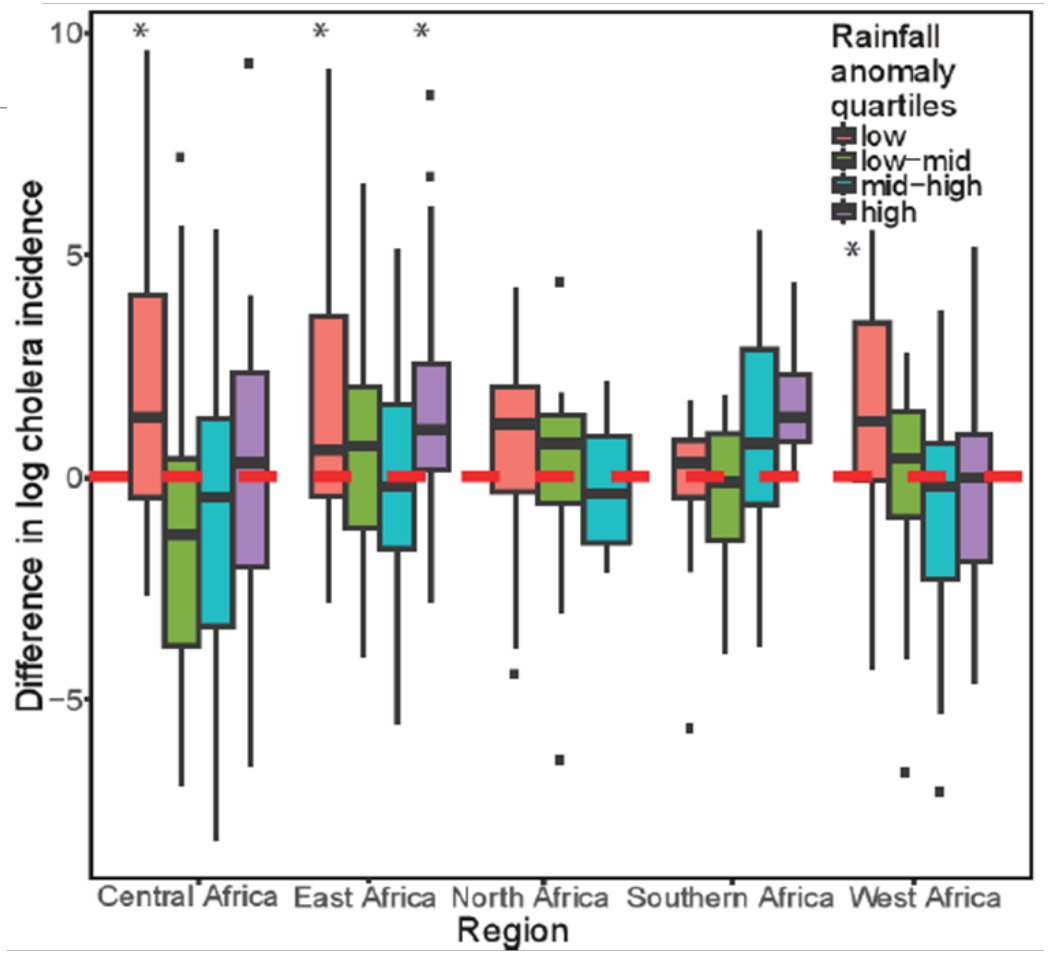


The African Cholera Risk Early Warning System (ACREWS)

PI: BENJAMIN ZAITCHIK, JOHNS HOPKINS UNIVERSITY
CO-I: JUSTIN LESSLER, JOHNS HOPKINS UNIVERSITY
CO-I: ANDREW AZMAN, JOHNS HOPKINS UNIVERSITY
CO-I: SEAN MOORE, NOTRE DAME UNIVERSITY
COLLABORATOR: EMMA DIGGLE, SAVE THE CHILDREN



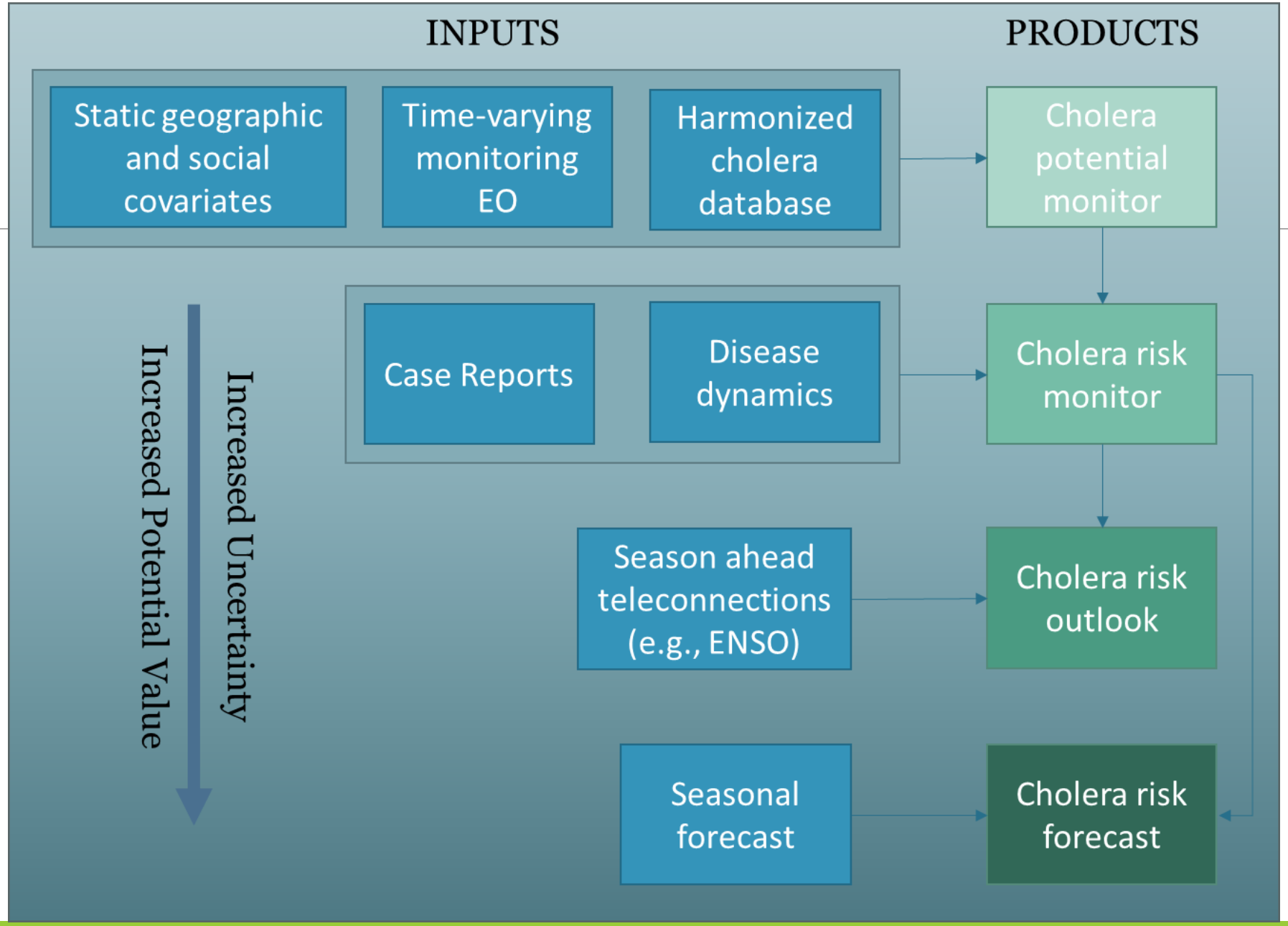


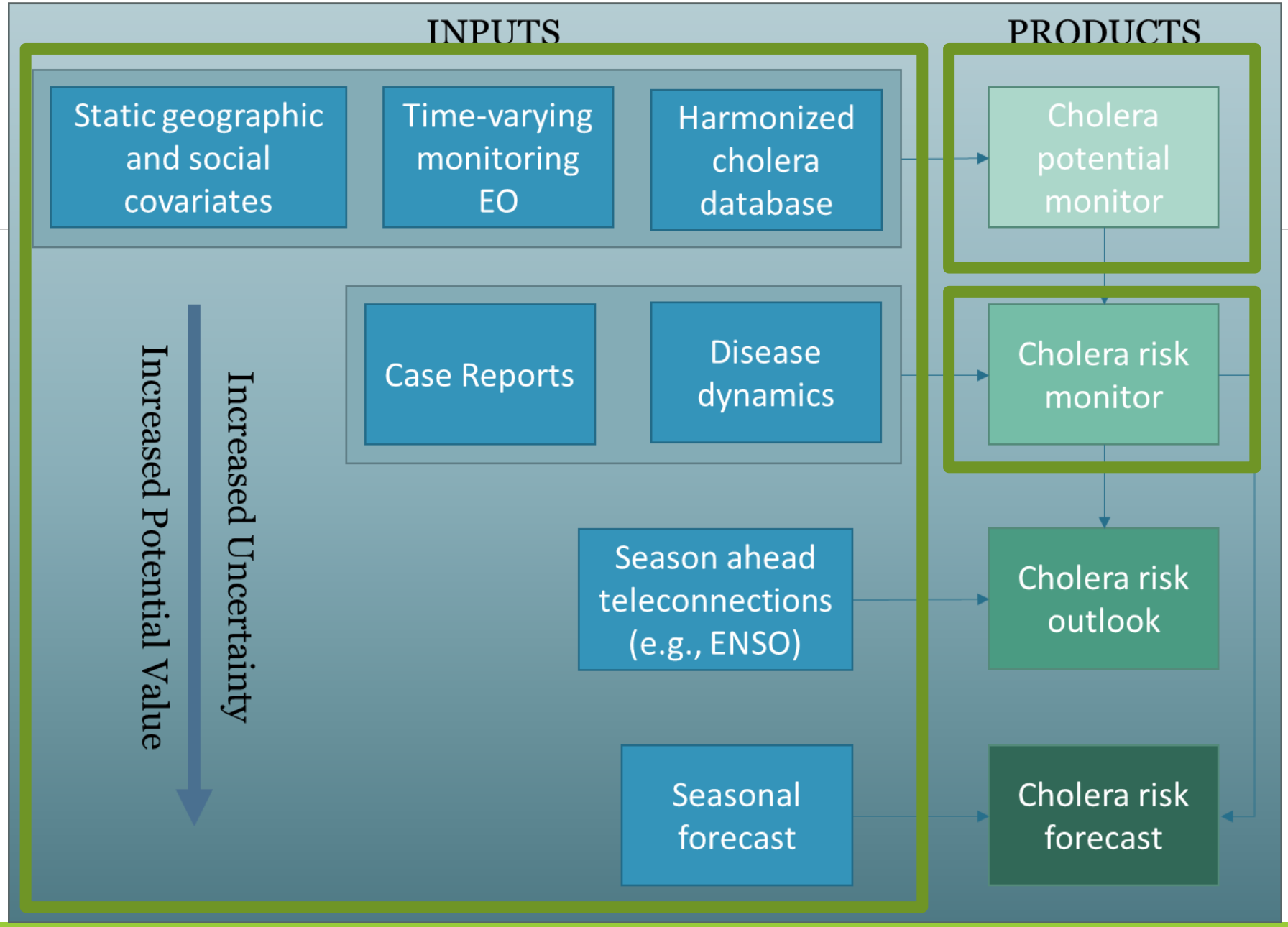
Moore et al. (2017)

Project Goal

Develop and operationalize an **Earth Observation-informed African Cholera Risk Early Warning System (ACREWS)** to support rapid response interventions

End users: UN Taskforce on Cholera Control, Save the Children, MSF


INPUTS
PRODUCTS
Static geographic and social covariates
Time-varying monitoring EO
Harmonized cholera database
Cholera potential monitor
Case Reports
Disease dynamics
Cholera risk monitor
Increased Potential Value
Increased Uncertainty
Season ahead teleconnections (e.g., ENSO)
Cholera risk outlook
Seasonal forecast
Cholera risk forecast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Season ahead teleconnections (e.g., ENSO)
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Increased Potential Value
Increased Uncertainty
Cholera potential monitor
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Cholera risk outlook
Cholera risk forecast

Objectives

1. Deliver a database of spatial and temporal variability in cholera burden across the continent.
2. Align our cholera database with a matching EO database of potential cholera predictors.
3. Collaboratively design a baseline system that generates weekly maps of environmental cholera potential based on historical correlations between ENSO, rainfall, and local cholera response.
4. Enhance the system to monitor actual cholera risk using EO-informed predictive models that account for the roles of population susceptibility, spatial correlation, and introduction probability
5. Apply two seasonal prediction techniques to extend the ACREWS time horizon: an ENSO analog-based cholera risk outlook and a dynamically-based cholera risk forecast.
6. Operationalize the system for decision support through partnership with the GTFCC.

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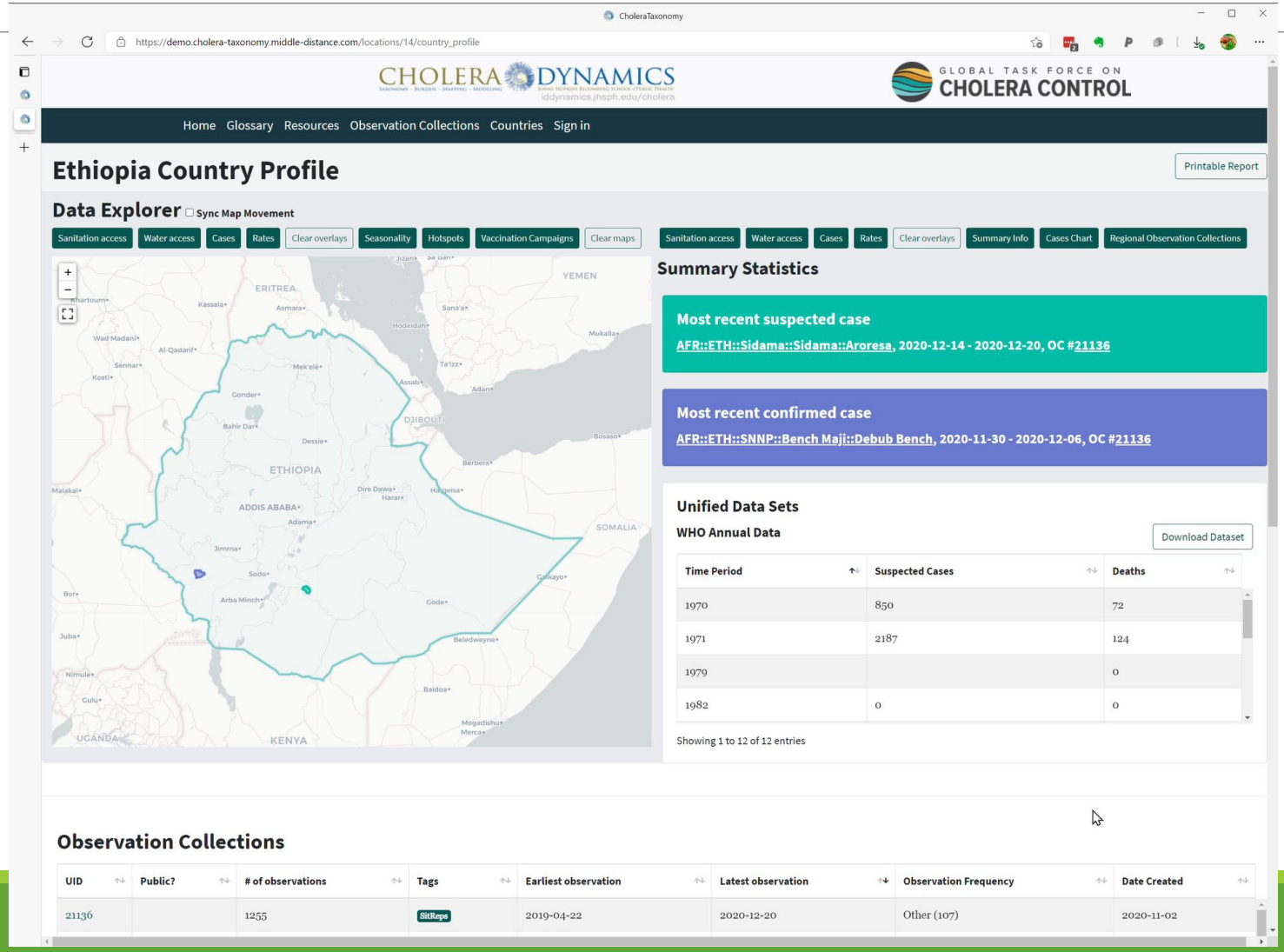
GTFCC Web Portal



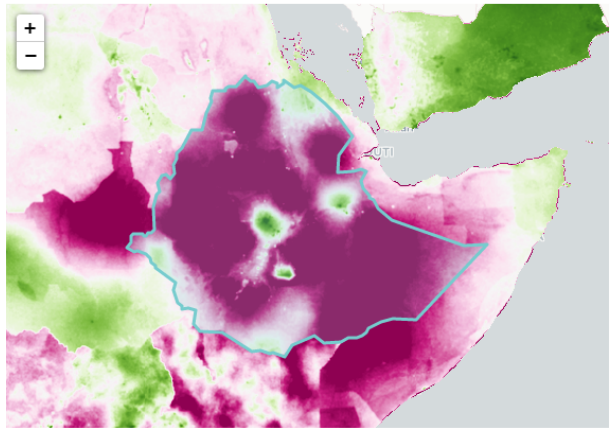
GTFCC Web Portal

Compare Figures and Maps

Sync maps

Maps | Figures

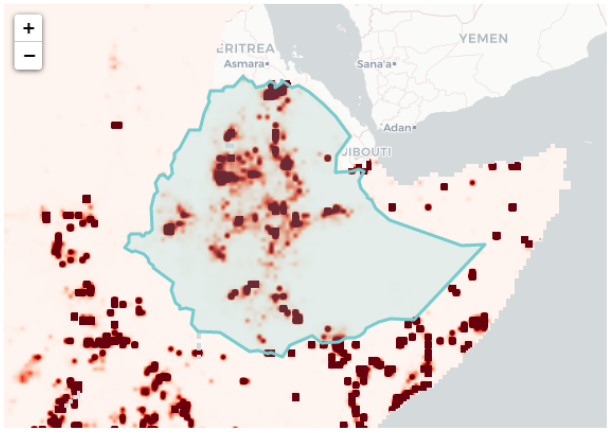
Sanitation access | Water access | Cases | Rates | Clear overlays



Modeled estimate of the percent of the population with access to improved water in 2017 (5 km x 5 km grid)
Source: Institute for Health Metrics and Evaluation, https://doi.org/10.1016/S2214-109X(20)30278-3

Maps | Figures

Sanitation access | Water access | Cases | Rates | Clear overlays



Modeled estimate of mean annual suspect cholera cases from 2010-2016 (20 km x 20 km grid)
Source: Johns Hopkins Infectious Disease Dynamics Group, https://doi.org/10.1016/S0140-6736(17)33050-7

GTFCC Web Portal

Compare Figures and Maps

Maps

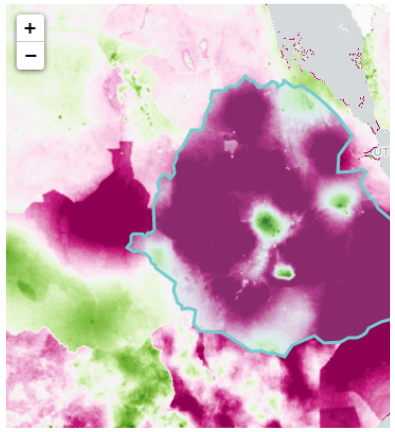
Sanitation access

Water access

Cases

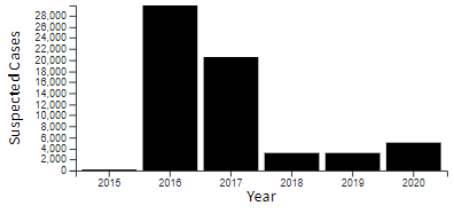
Rates

Clear overlays



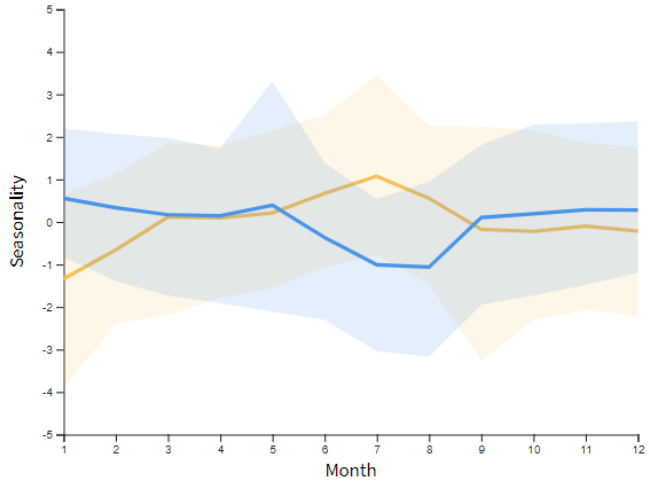
Modeled estimate of the percent of the population w
in 2017 (5 km x 5 km grid)
Source: Institute for Health Metrics and Evaluation, h
109X(20)30278-3

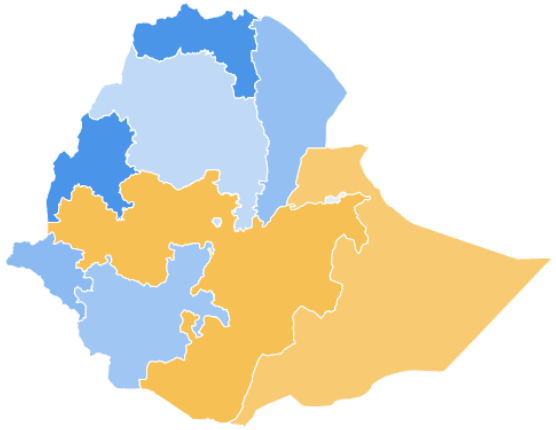
Cases



Annual suspect cholera cases reported nationally
Source: Ethiopian Public Health Institute

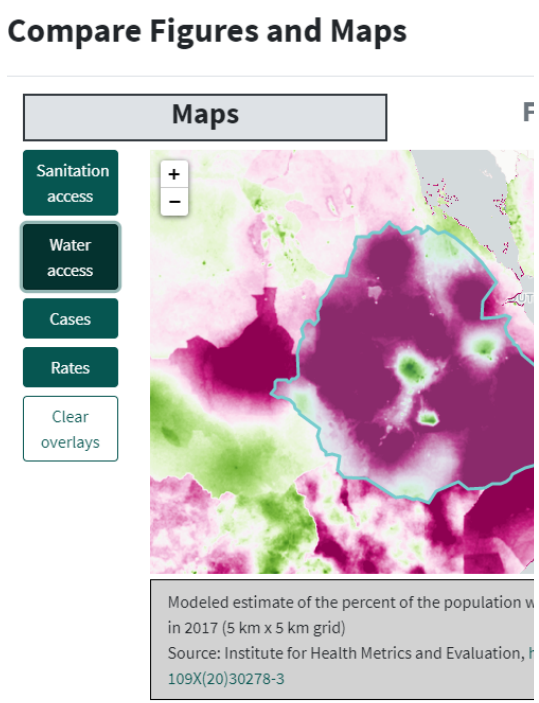
Seasonality

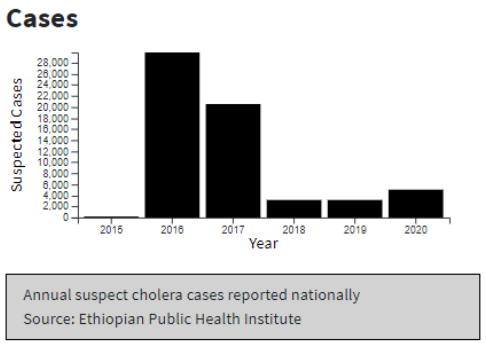


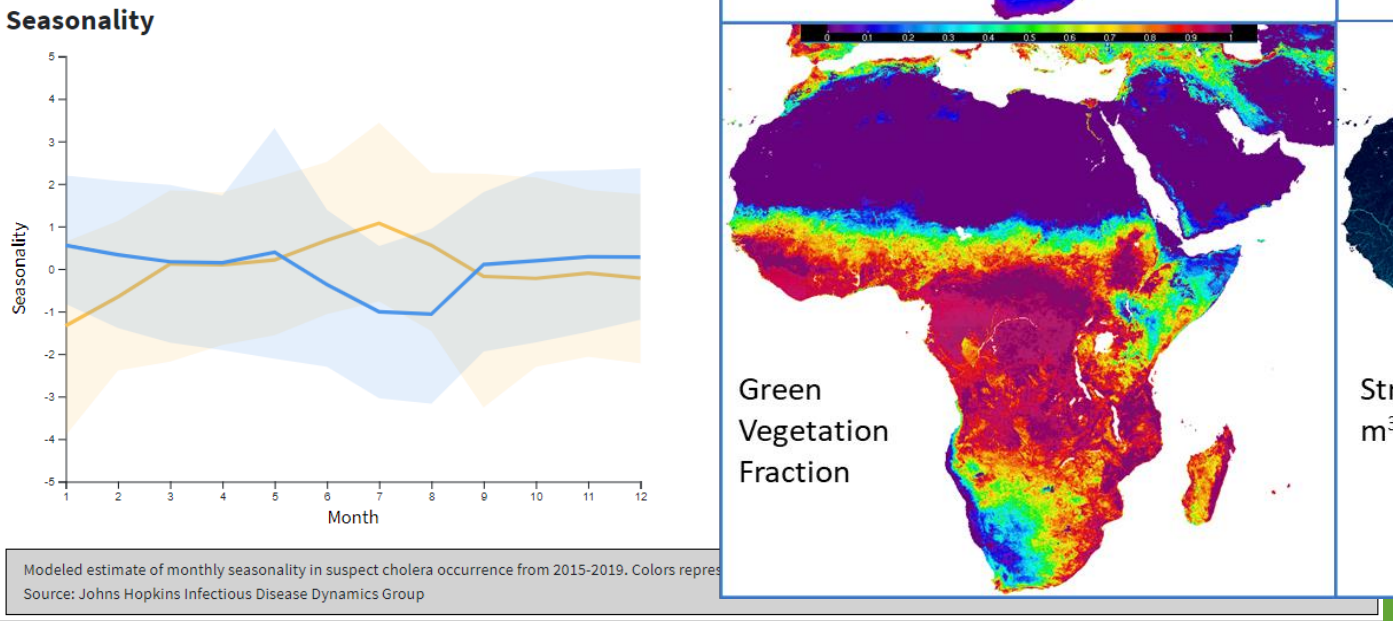


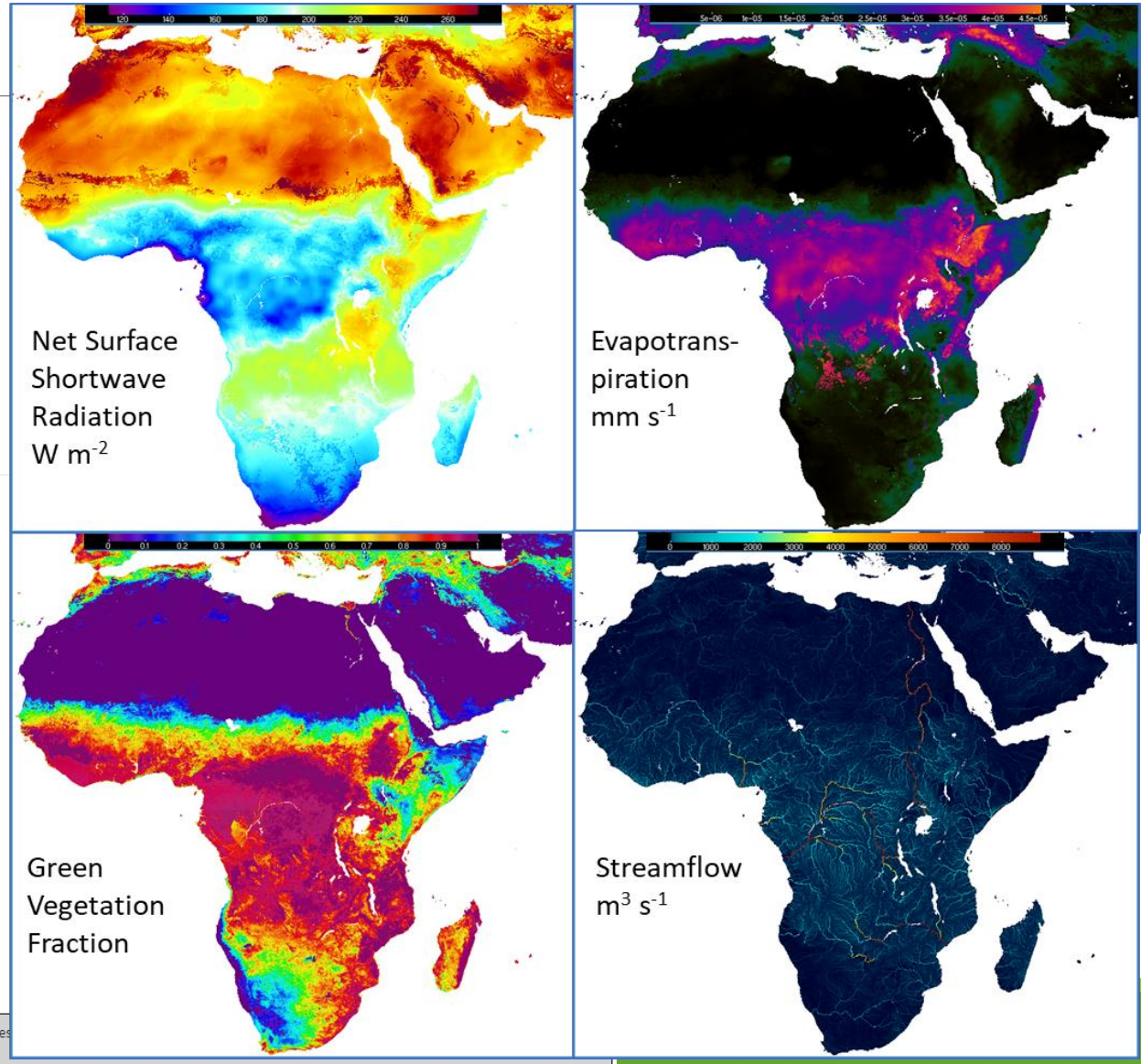
Modeled estimate of monthly seasonality in suspect cholera occurrence from 2015-2019. Colors represent geographic groupings (map) with similar monthly seasonal patterns (line chart).
Source: Johns Hopkins Infectious Disease Dynamics Group

GTFCC Web Portal





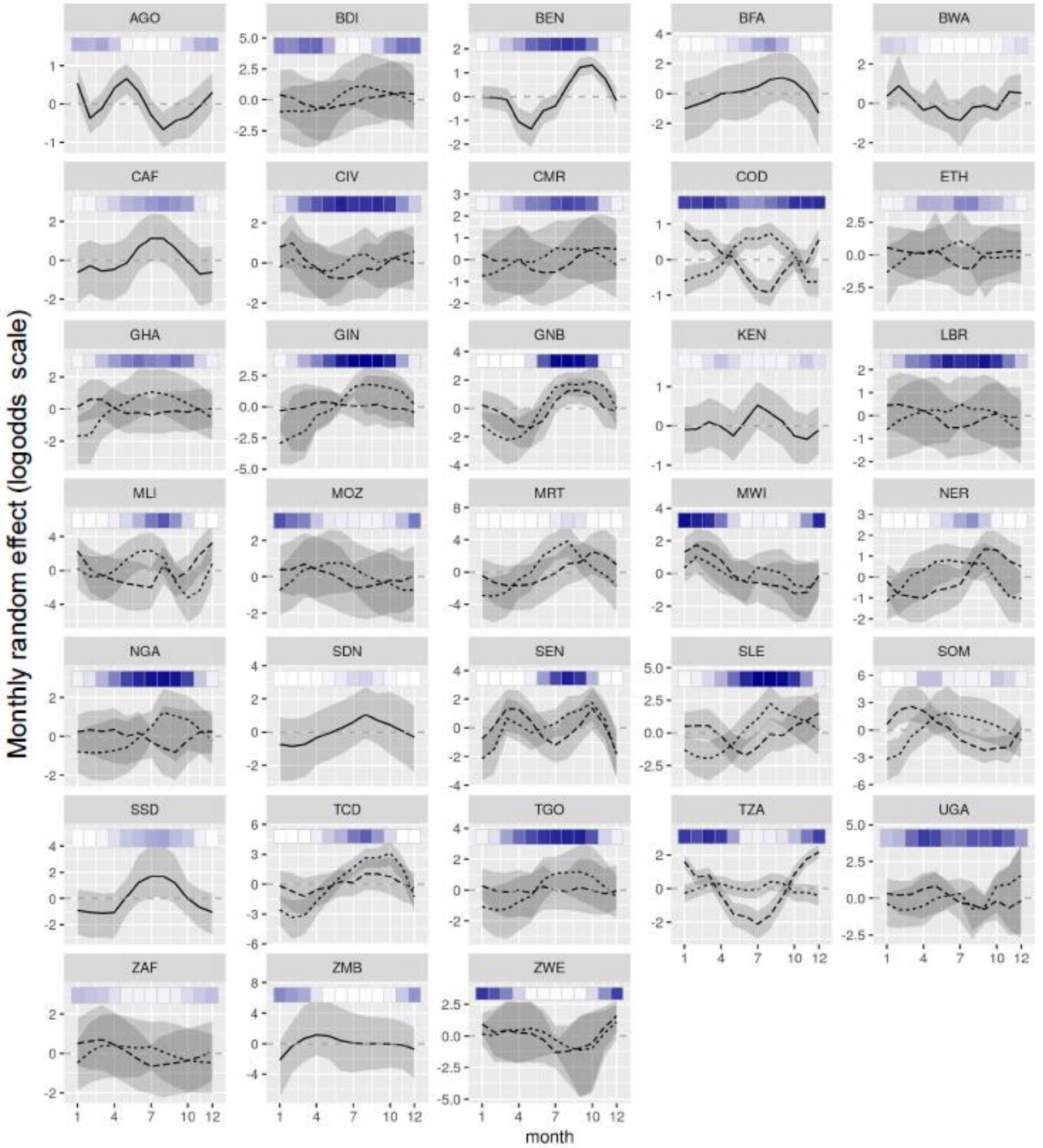




Risk modeling: seasonality

Need to account for probability of cholera and probability of detection

Attempt to leverage data at all administrative levels, with differing precision, data coverage, and record lengths.


AGO
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BWA
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CIV
CMR
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MOZ
MRT
MWI
NER
NGA
SDN
SEN
SLE
SOM
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Monthly random effect (logodds scale)
month
1
4
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10
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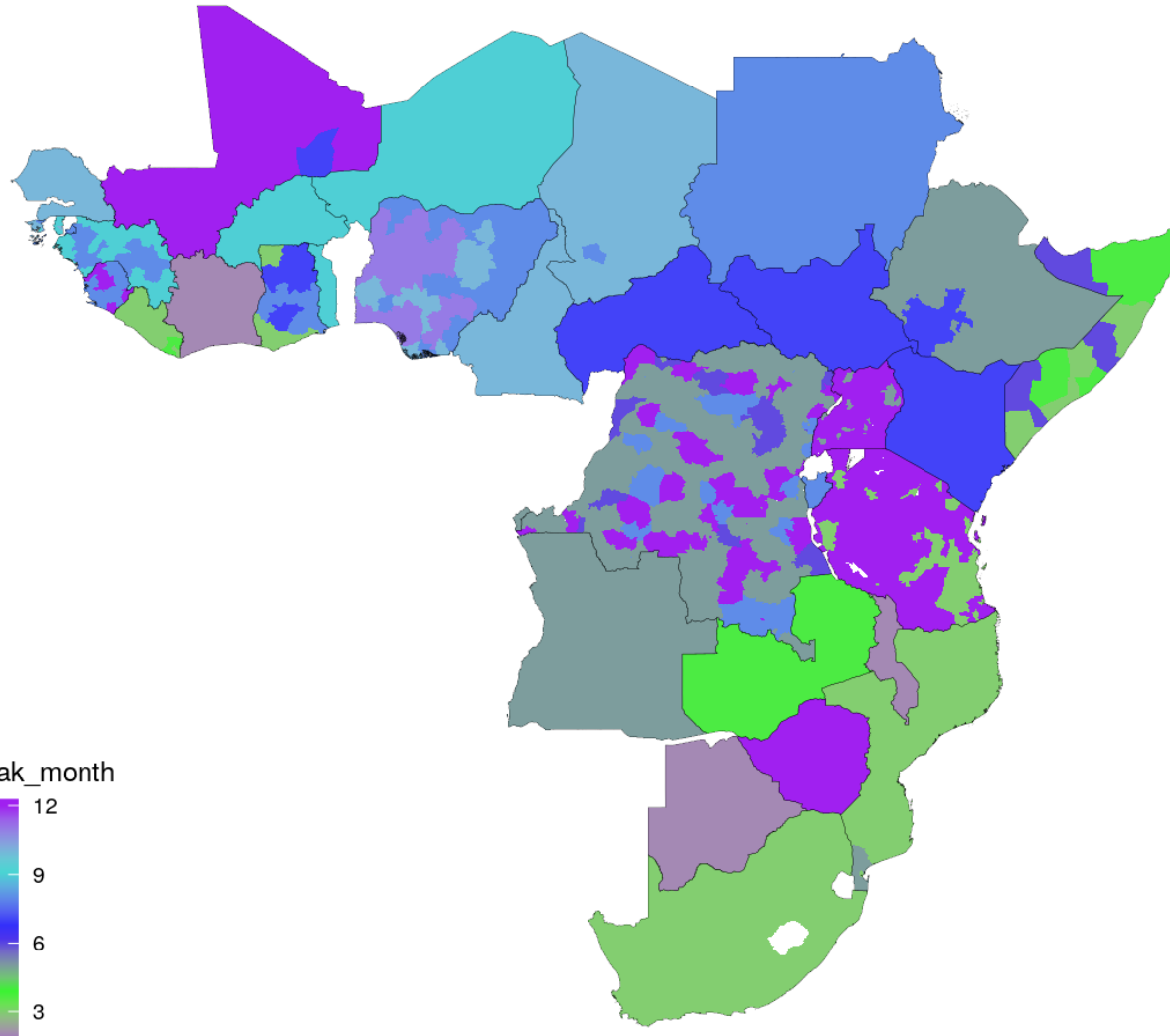
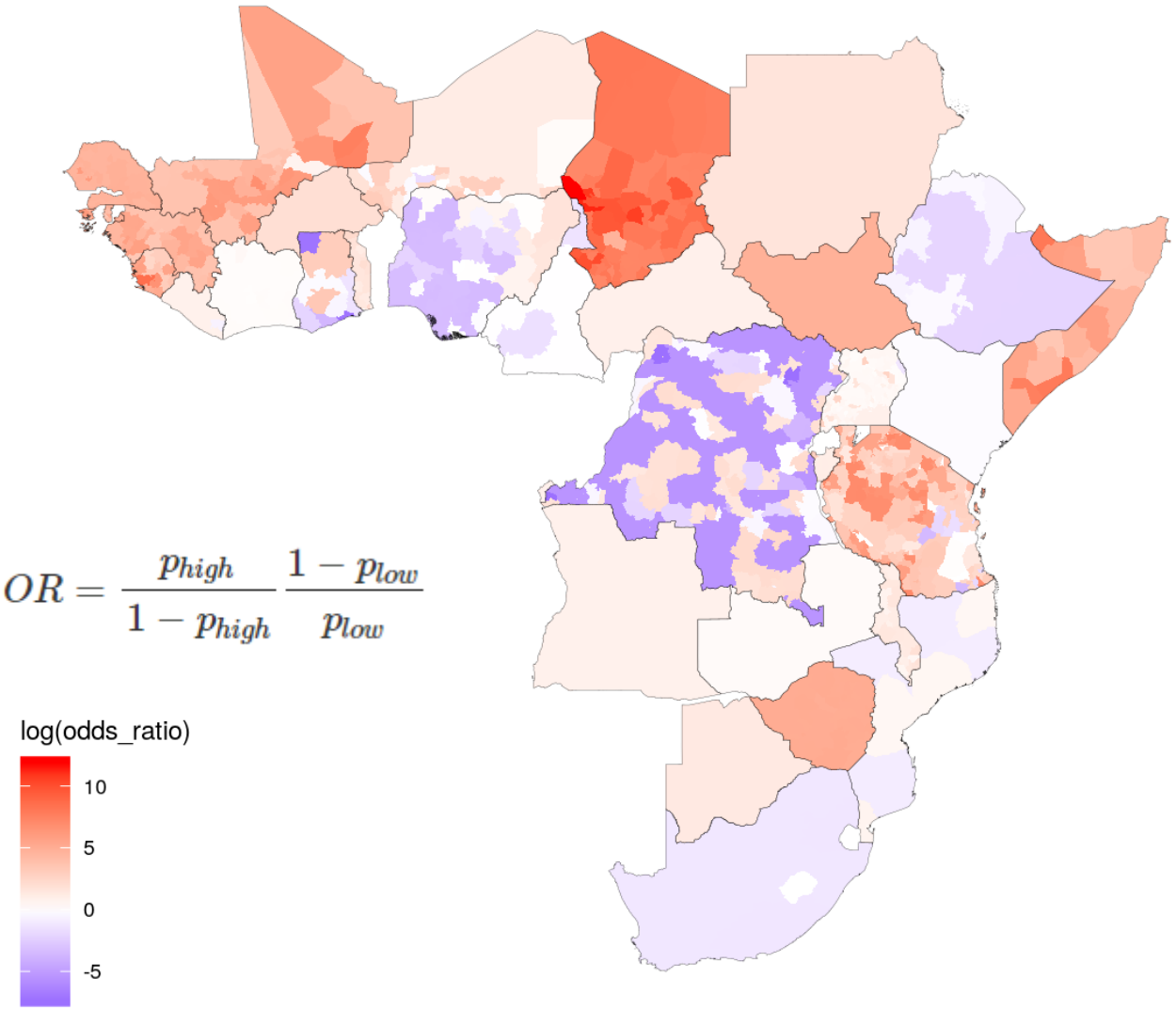
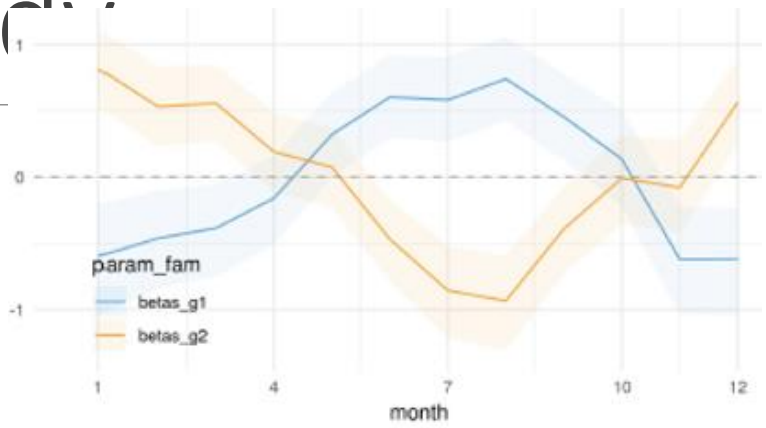
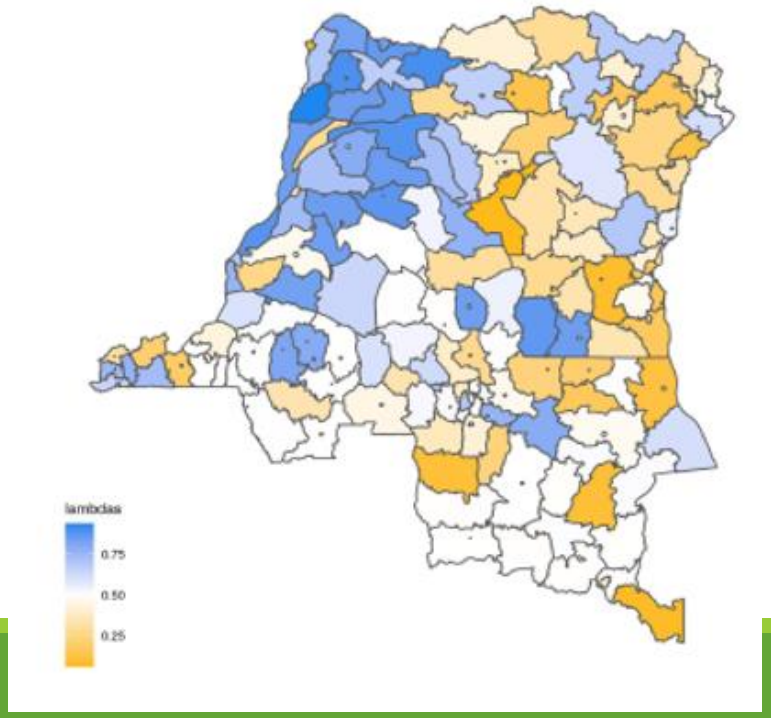


$$OR = \frac{p_{high}}{1 - p_{high}} \frac{1 - p_{low}}{p_{low}}$$

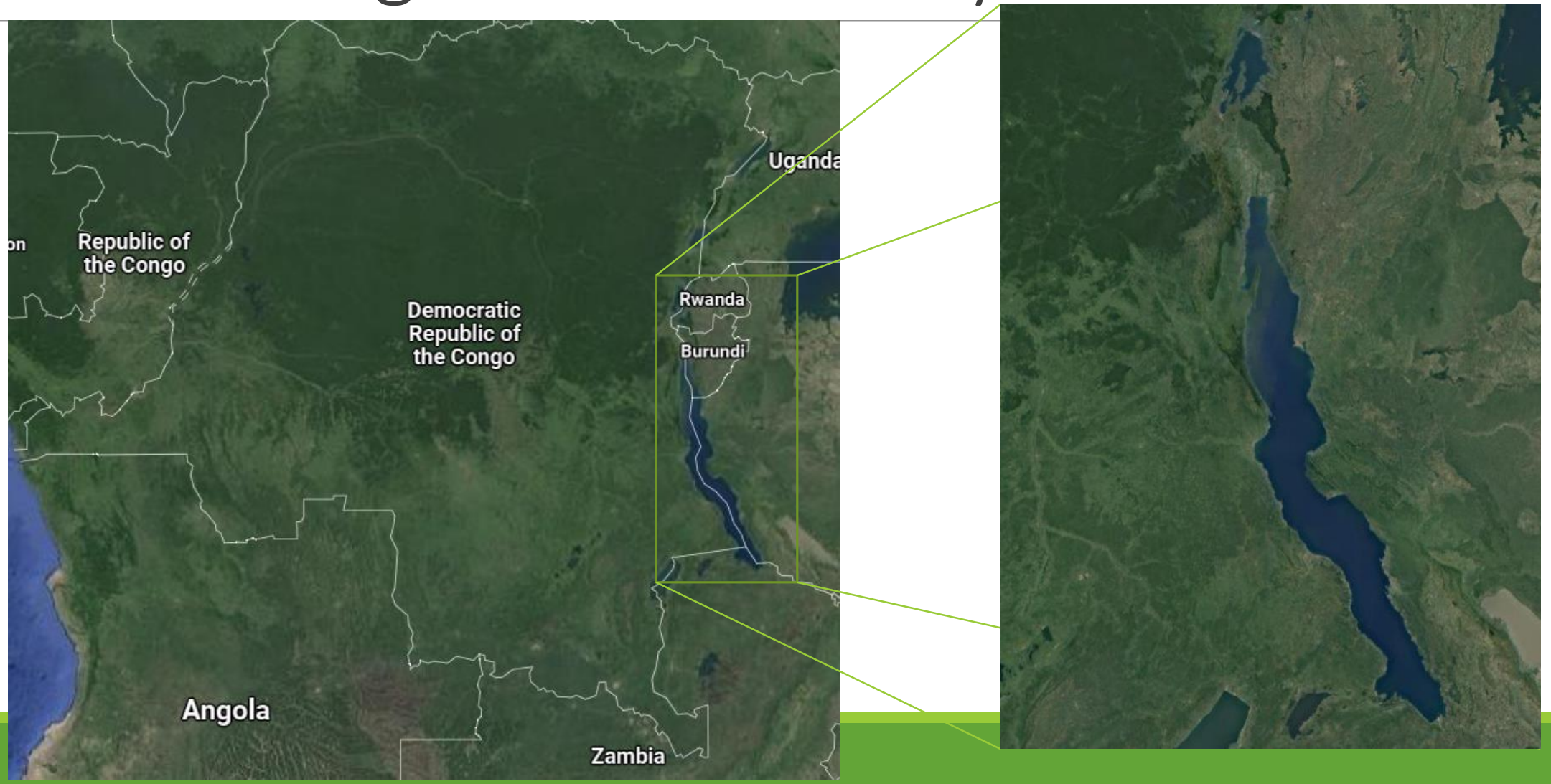


Risk modeling: DRC case stud

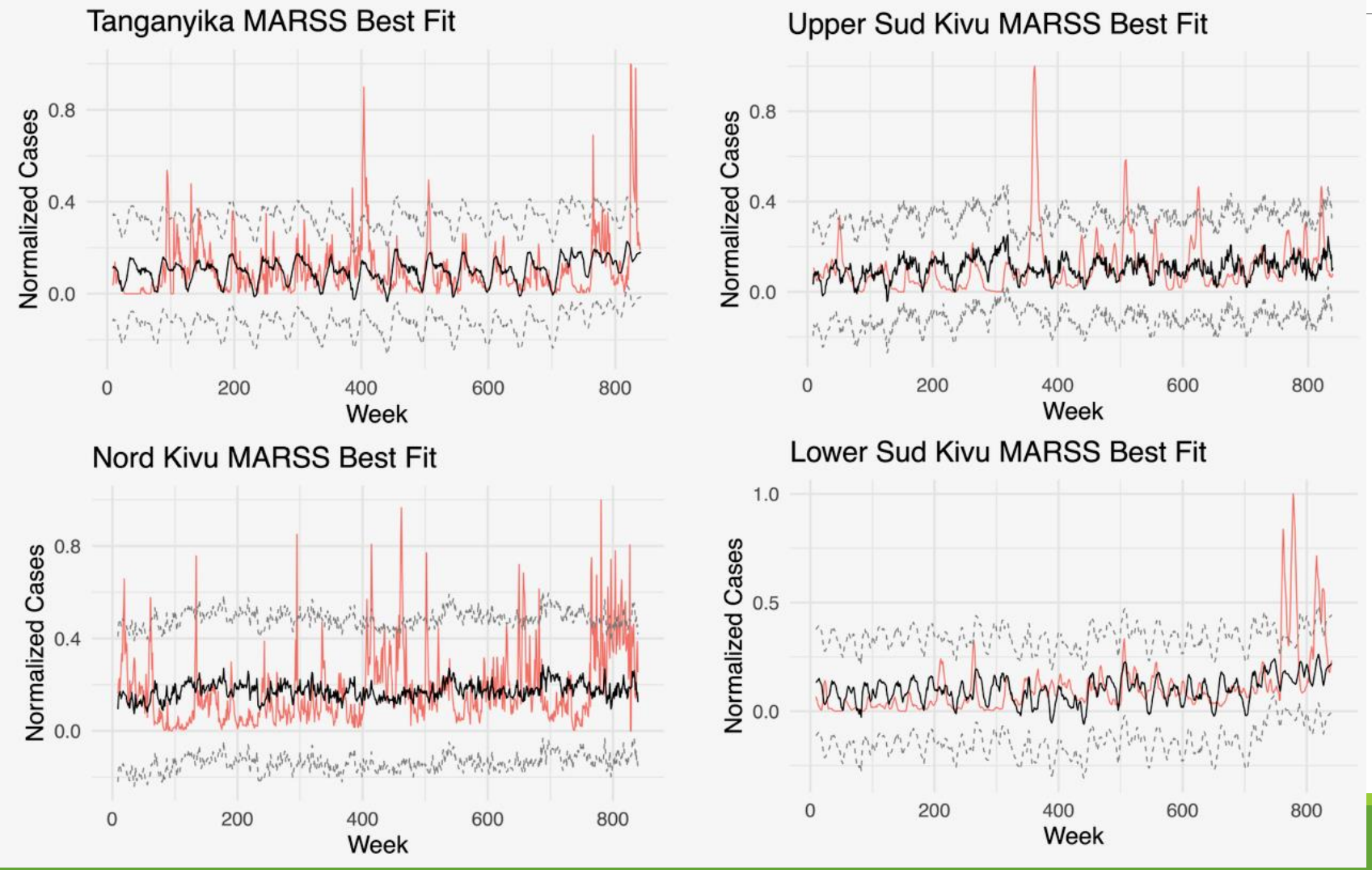




Risk modeling: DRC case study



Risk modeling: DRC case study



Risk modeling: DRC case study

We're doing reasonably well on seasonality, but outbreaks are still a problem.

Variables that are important for the best-performing models:

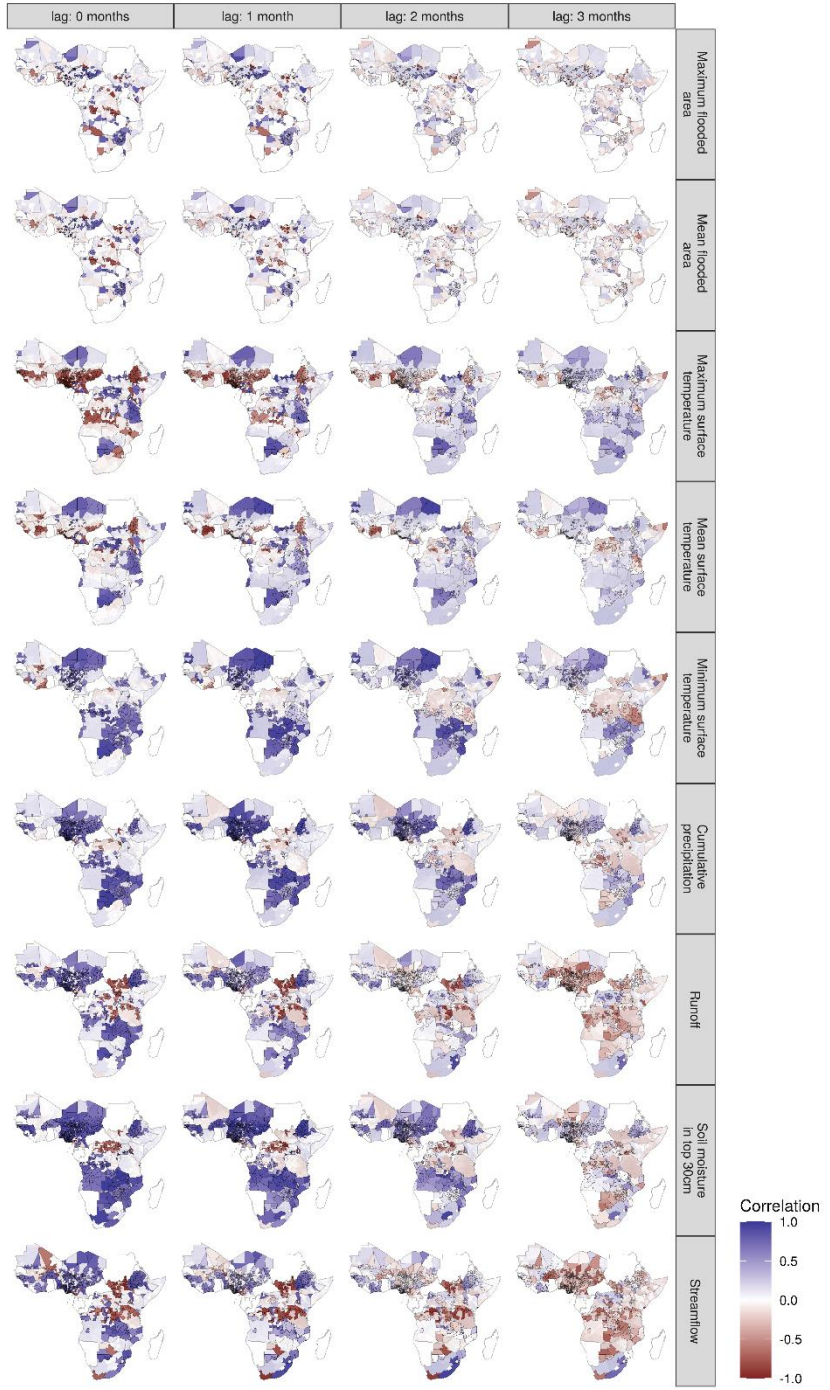
- GPM rainfall
- MERRA-2 air temperature
- Altimeter-derived lake height
- MODIS-derived Lake Surface Temperature
- FloodScan passive-microwave inundation
- Deaths from conflict in the region

Other variables that show up in reasonably good models:

- Land NDVI
- Lake chlorophyll

Risk modeling: continental scale

Risk modelin e



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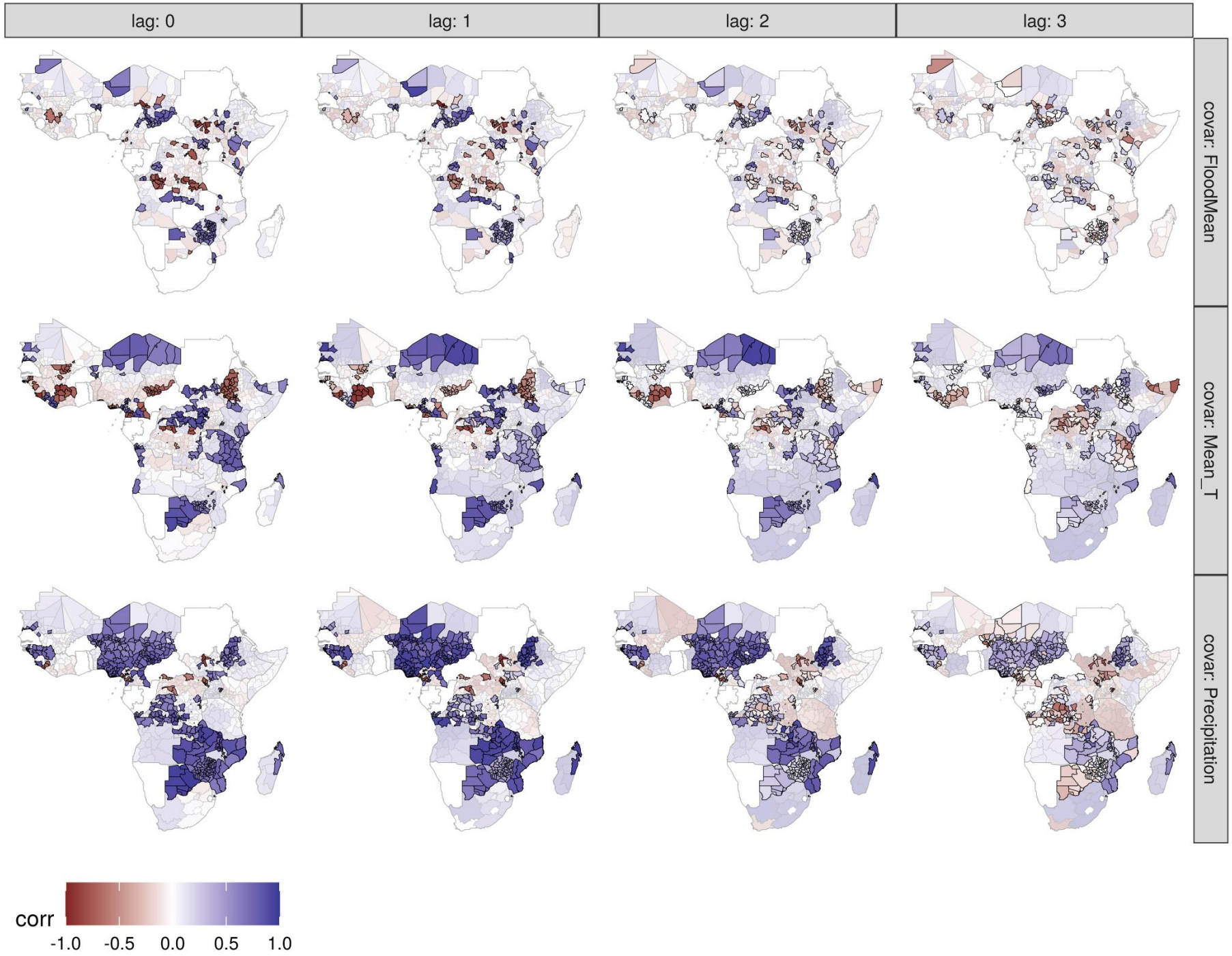
lag: 0
lag: 1
lag: 2
lag: 3
covar: FloodMean
covar: Mean_T
covar: Precipitation
corr
-1.0
-0.5
0.0
0.5
1.0

Next steps

1. Predictive modeling using our Enteric Infectious Disease modeling framework (Bayesian GAM)
2. Introduction of season-ahead predictors
3. Continued interaction with the GTFCC to ensure that our enhancements of the information portal effectively support decision making

ARL

Current: ARL 5

Goal: ARL 8

Thank You