

Predictive assessment of transmission conditions of cholera in the environment and human population using earth observations

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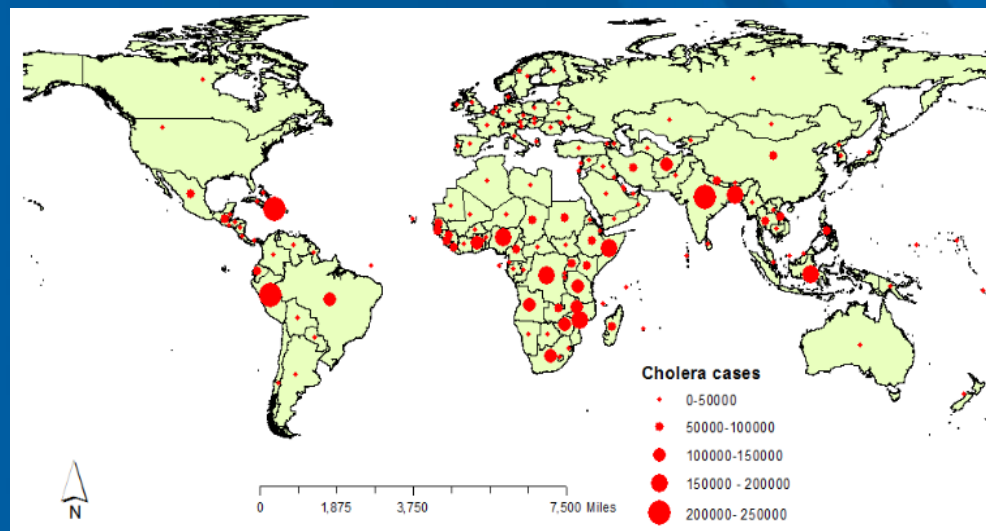


Goal of Research Project

We thematically envision “Cholera Ready Nations” where satellite based prediction (of risk of trigger and likelihood of transmission of cholera in the human population) will provide sustainable and resilient readiness to prevent outbreak of disease, saving human lives and improving quality of life.

Objectives

- Systematically validate the epidemic and endemic cholera hypothesis for trigger component of cholera in Africa
- Develop, calibrate, and validate predictive model for transmission component of cholera.



Research Pathway

Relevant earth observations

EPIDEMIC CHOLERA

MODIS/VIIRS [LST, Land cover]

TRMM/GPM [Precipitation]

SRTM [DEM]

ENDEMIC CHOLERA

MODIS/VIIRS [Chlorophyll, SST,
Organic matter, Land Cover]

AVHRR [SST]

TRMM/GPM [Precipitation]

SRTM [DEM]

TOPEX/JASON [SSH]

Aquarius [Salinity]

SST: Sea Surface Temperature; SSH: Sea Surface Height; LST: Land Surface Temperature; MODIS: Moderate Resolution Imaging Spectroradiometer; TRMM: Tropical Rainfall Measuring Mission; GPM: Global Precipitation Mission; AVHRR: Advanced Very High Resolution Radiometer; DEM: Digital Elevation Model; SRTM: Shuttle Radar Topography Mission

Use of earth observations to advance science of cholera (Section 2.1)

Validation of trigger hypothesis for Epidemic mode of cholera (Task 1)

Validation of trigger hypothesis for Endemic mode of cholera (Task 2)

Cholera Transmission Model (CTM) (Task 3)

Anticipated Results (Section 3)

Risk maps showing probabilities of occurrence of inland cholera infection

Risk maps showing probabilities of occurrence of cholera infection along coasts

Ensemble scenarios on how cholera infection may spread in human population

Capacity building initiatives (Section 2.2)

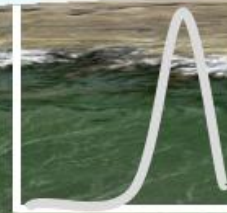
- Communication plan with African partners identified by GEO Secretariat to identify core working group for cholera (Task 4)
- Determine feasibility of encourage use of earth observations and testing algorithms by partner foundations (Task 5)
- Workshop on African Cholera Initiative, social media and dissemination kit to advance Agenda 2030 plan (Task 6)

Knowledge transfer from ending project

Epidemic Cholera

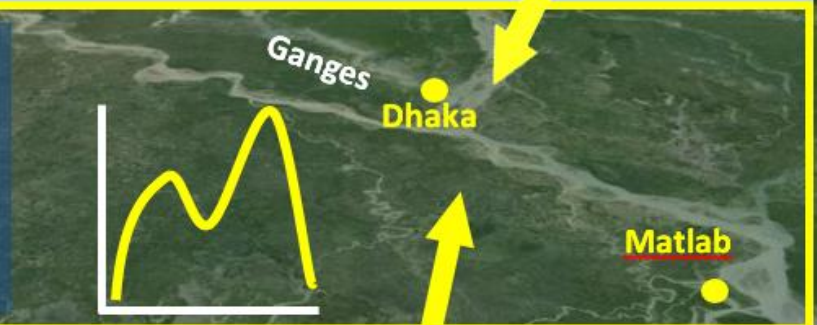
- Sporadic outbreak
- Usually occurs following floods or inundation of large landscapes
- Warm temperatures may increase growth of bacteria in aquatic bodies.

Typical cholera seasonality



Mixed-mode Cholera

- Usually two seasonal peaks
- One peak related to seawater intrusion; Second peak associated with widespread inundation
- Specific to Bengal Delta region



Endemic Cholera

- Cholera persists throughout year in coastal regions
- Seawater Intrusion from coasts to inland
- Cholera outbreaks occur during low river flow season



Background image: Bangladesh and Bay of Bengal

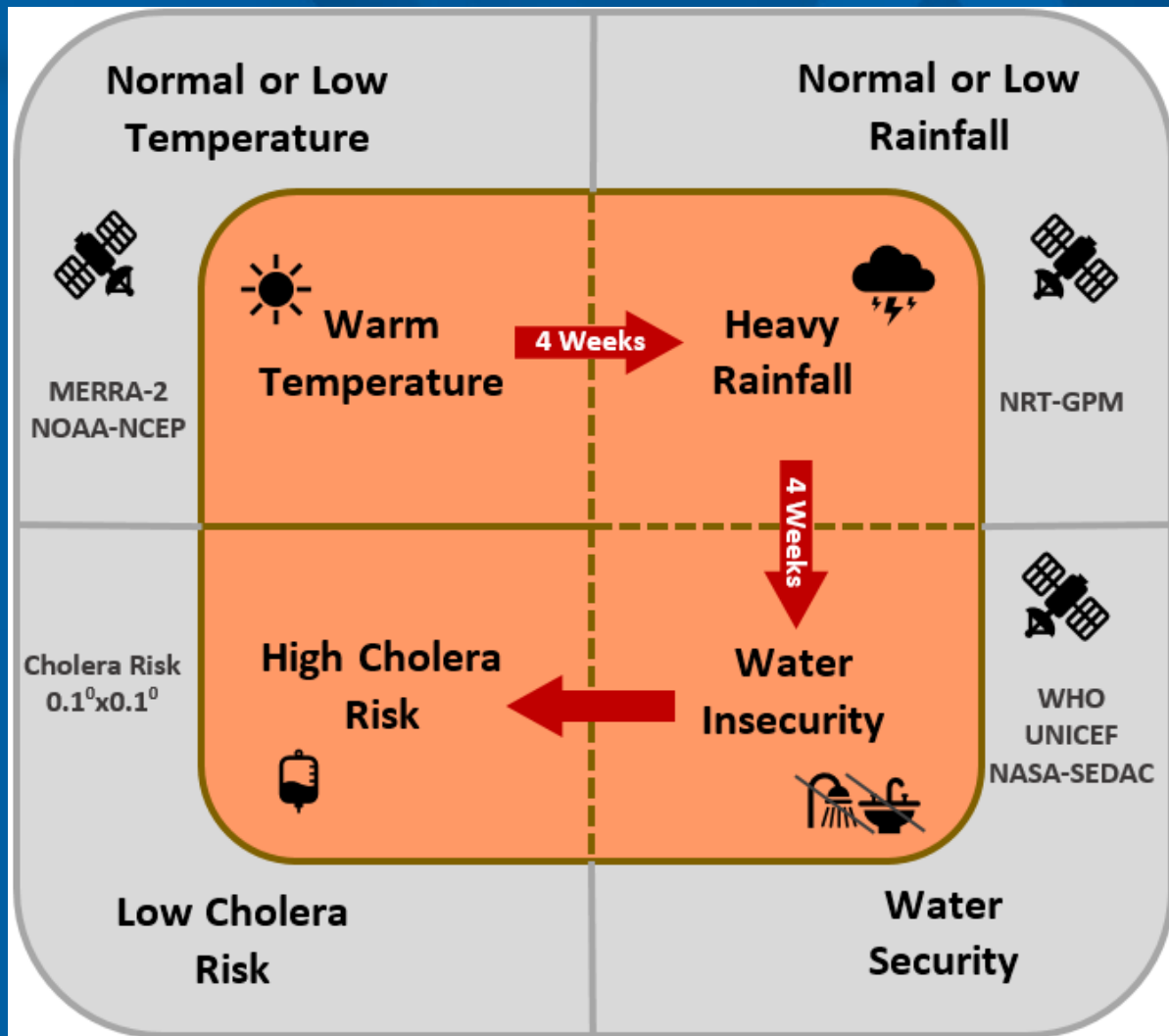


Overall timeline for research objective and activities at end user organization

Timeline of proposed activities and key milestones												
Activity	Year 1				Year 2				Year 3			
		Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Kick off meeting (Skype)	C											
Task 1: Epidemic cholera		C	C	X								
Task 2: Endemic cholera				X	X	X	X					
Task 3: CTM							X	X	X	X	X	
Task 4: Core group formation	C	X	X	X	X	X						
Task 5: Training/ dissemination plan with foundations					X	X	X					
Task 6: Workshop								x ¹	x ¹	x ¹	x ¹	x ²
PI meeting	Third week of every month											
Veolia/Health Initiatives Foundation/Kirschbaum/ Thiaw/ Jutla/Colwell meeting				C				X				X
#initiate discussion with GEO Secretariat; x ¹ : planning; x ² : workshop at WVU Morgantown campus, WV; Q1, Q2, Q3, Q4 represent quarter in a given year.												



Epidemic cholera model



Warm temperature= above climatological average temperature

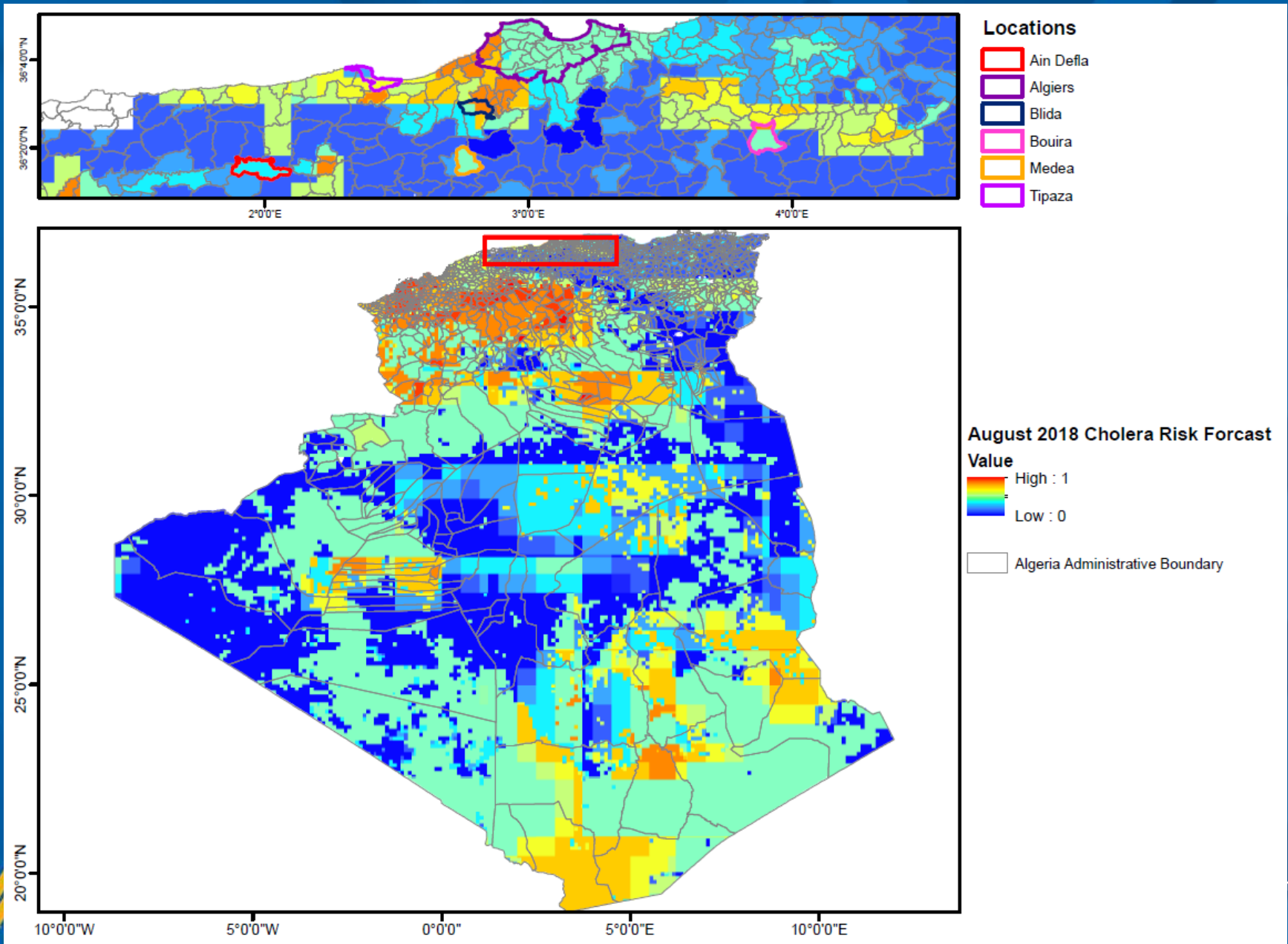
Heavy rainfall= above climatological average precipitation

Water insecurity=lack of access to water and sanitation access

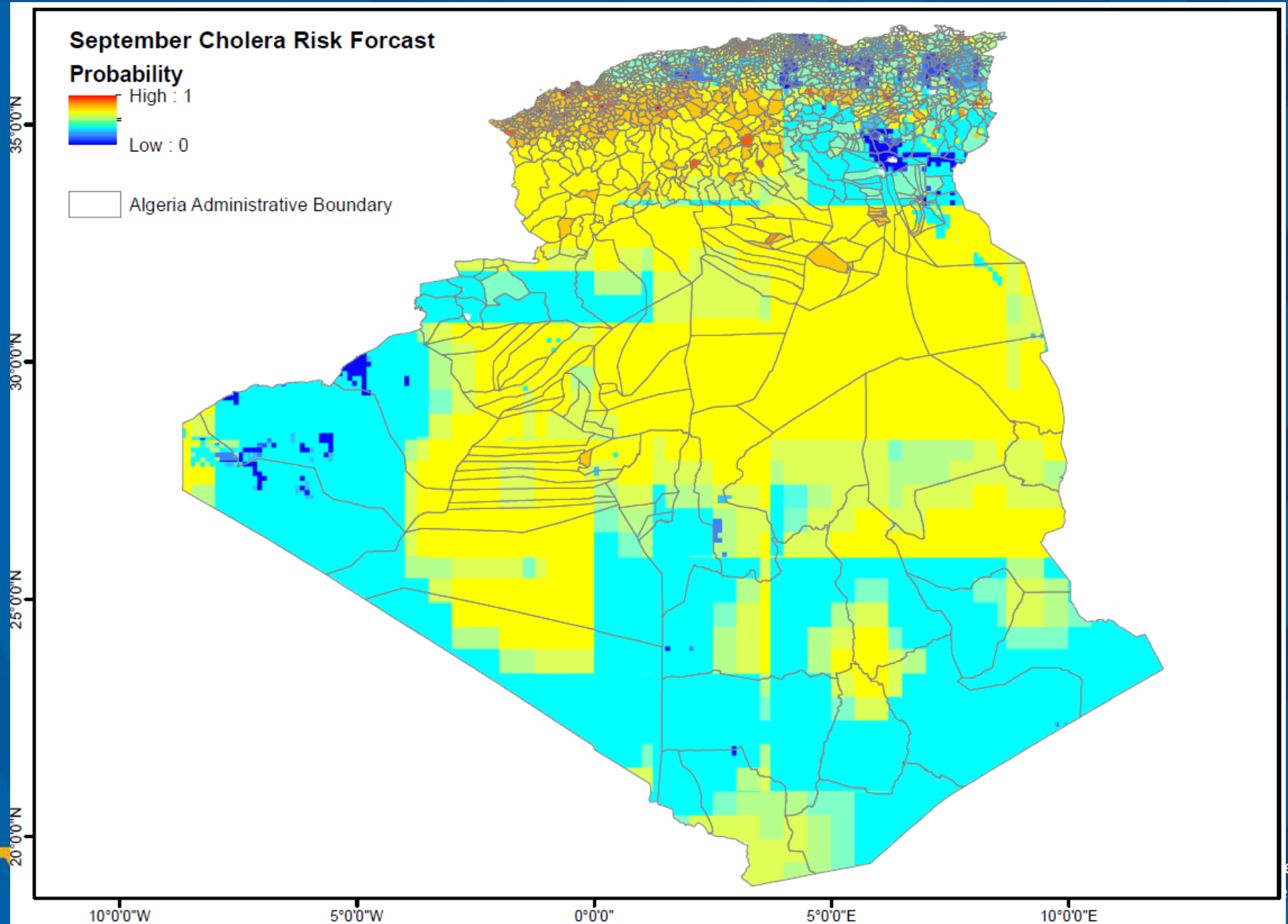
High cholera risk=probability of cholera greater than 50%



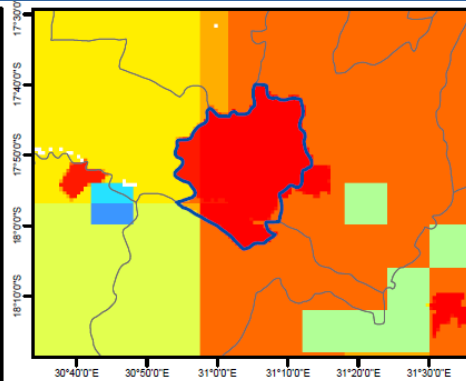
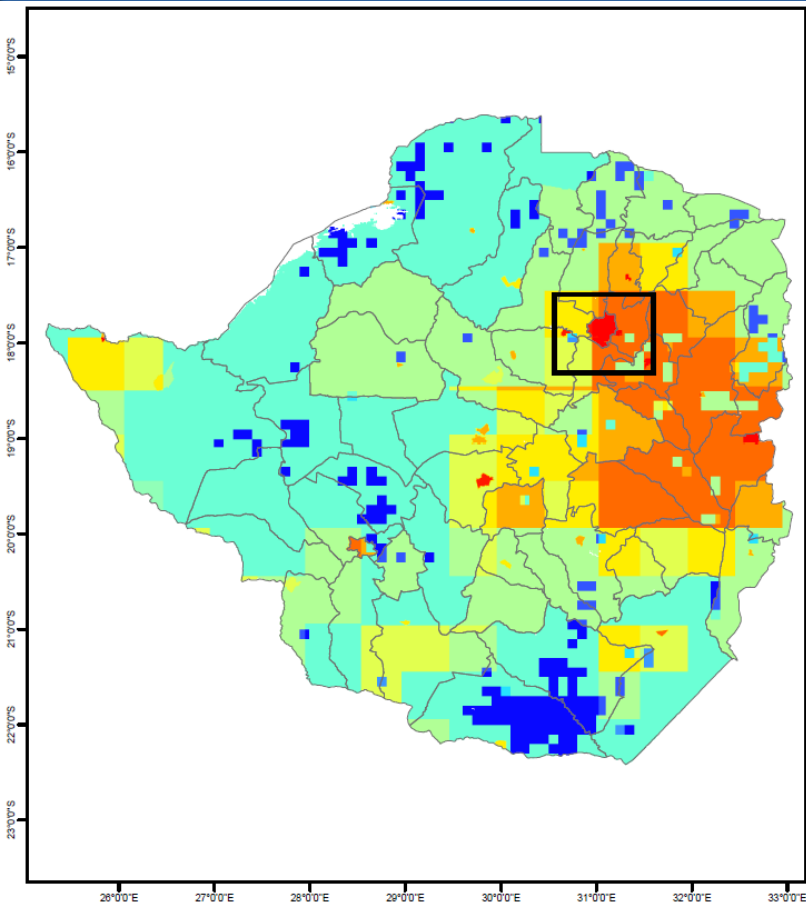
Epidemic Cholera-Algeria



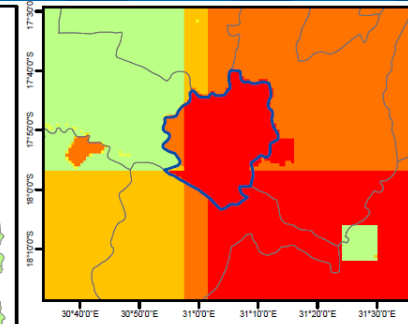
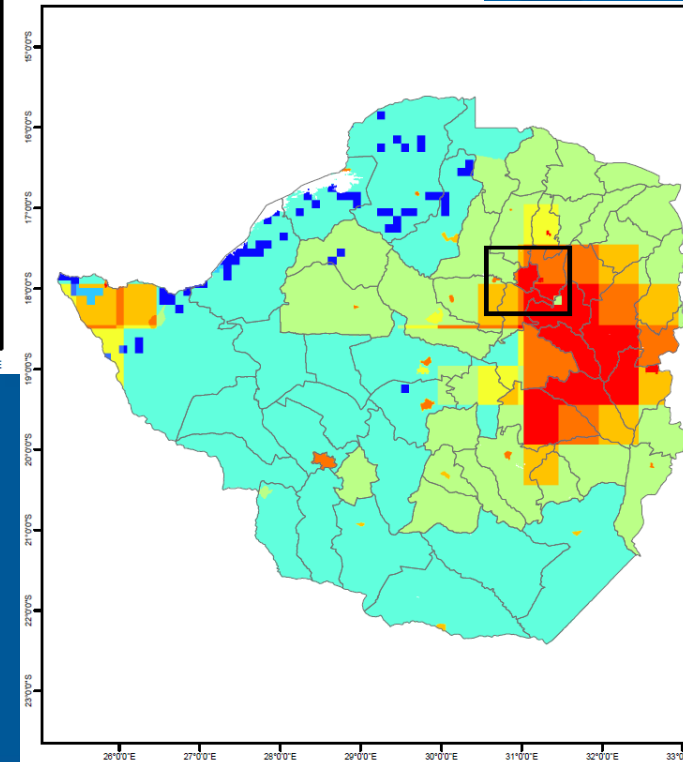
Epidemic Cholera-Algeria



Epidemic Cholera-Zimbabwe



August 2018 Cholera Risk Forecast Value



September 2018 Cholera Risk Forecast Value

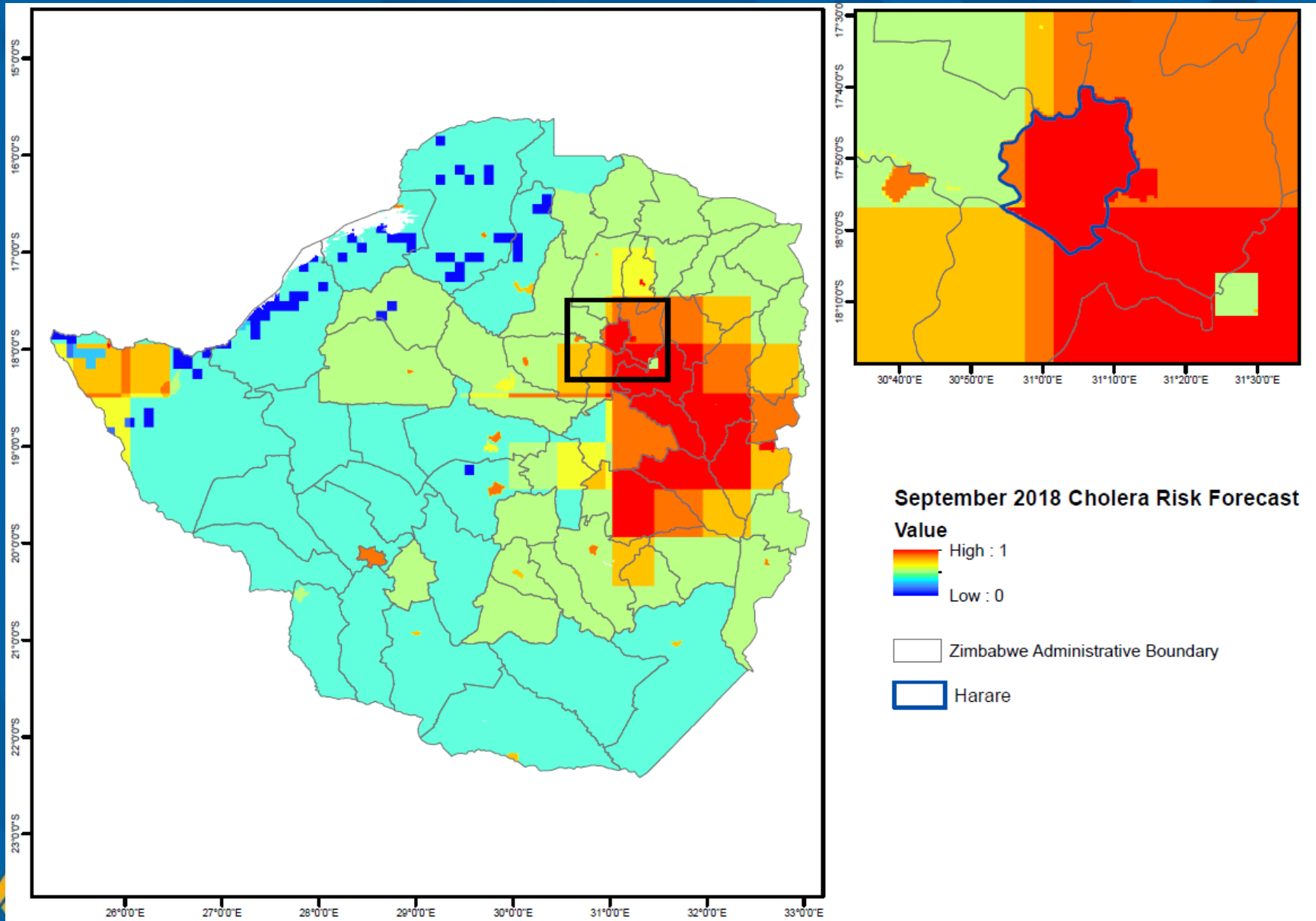
High : 1
Low : 0

Zimbabwe Administrative Boundary

Harare



Epidemic Cholera-Syria



Flood Models

<https://www.dropbox.com/s/lr0yz1owxk7gn0d/Jacksonville40in.mp4?dl=0>



ARL information

Starting ARL: 3

Current ARL: 4+

Components of eventual application system brought together and technical integration issues worked out

Organizational challenges and human process issues identified and managed

Target ARL: 8



Ongoing work

- **Epidemic cholera models**
 - Weekly scale
- **Synthesis of vibrio dataset**
- **Development of core working group**



Thank you

