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TAKING THE PULSE OF OUR PLANET FROM SPACE

# EO for cholera risk and IPCC AR6 findings

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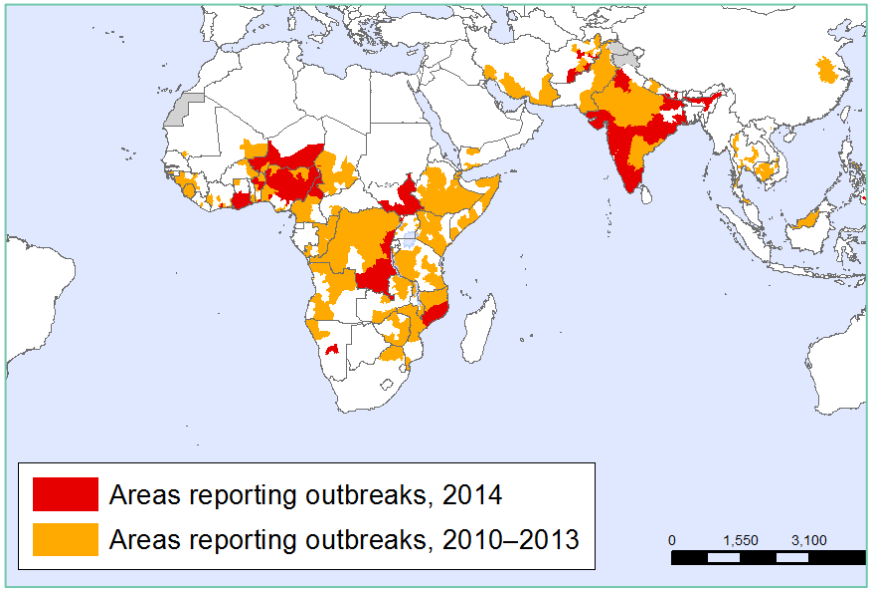
# Cholera

Cholera is a **waterborne epidemic disease** in humans, which is caused by the bacterial **pathogen *Vibrio cholerae***. The disease is a major public health threat, affecting globally **1.3 to 4 million people each year**, with 21,000 to 143,000 reported fatalities.




*Source: World Health Organization*

In the last decade, the World Health Organization (WHO) reported **cholera cases** in more than **80 countries** around the world with **57% of the cases** from **countries bordering the northern Indian Ocean**.

# Cholera and climate

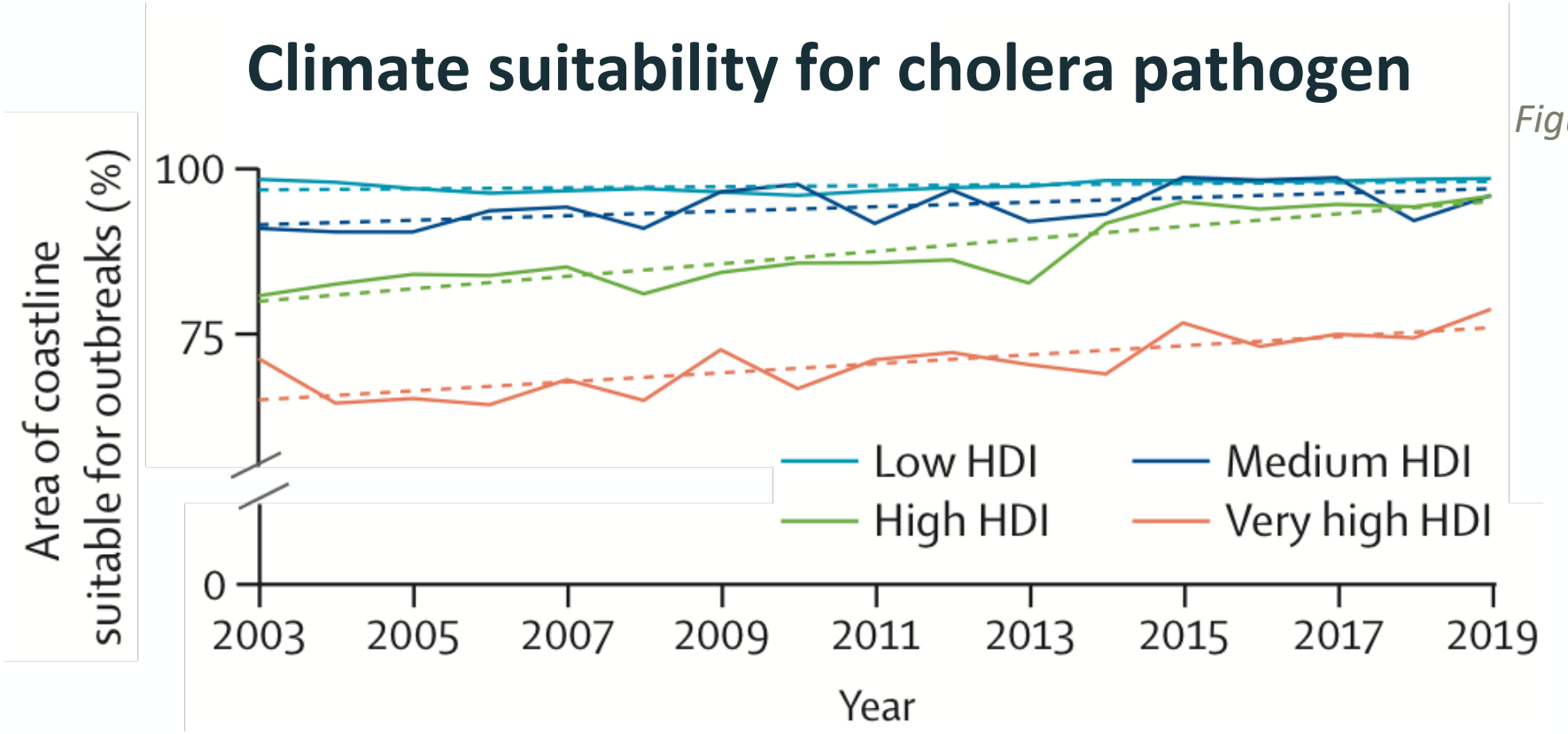



*Figure Romanello et al. 2021*

HDI
Human Development Index

However, in terms of **climate adaptation**, only **22 countries** (out of 195 worldwide) included **disease-risk warnings** as a potential measure to reduce risks to human health.

*Racault & Marcone, 2021: Paris Climate Agreement NDC analysis*

# Climate adaptation to reduce cholera risk

## AR6 WGII Chapter 2

Cross-Chapter Box ILLNESS

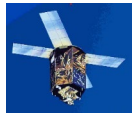
*Racault et al. 2022*

**Adaptation measures to reduce risks of ecosystem-mediated diseases under climate change**

| Type | Description of adaptation options | | | Climate impact | Confidence |
|---|---|---|---|---|---|
| Warning systems | Early surveillance in wildlife & humans | Seasonal & dynamic forecasts of disease outbreaks; detailed risk mapping | Early Warning systems targeted locally |  | +++ |
| Capacity building | Training health & environmental officials to respond to new disease emergent risks | Awareness of local populations of the health risks from pathogens & vectors | Robust healthcare systems with good facilities, access & epidemic protocols |  | ++ |
| Public policy | Policy-making and international cooperation within a One Health framework | Large-scale public health programs for diseases/vectors eradication | Herd-immunity level vaccination for pathogens with few host species |  | ++ |
| Financing | Green recovery funds to tackling biodiversity loss & climate change | National funds for nature-based projects for forest conservation, water services | Funds to provide jobs for tribal groups in plantation work, forest & water management |  | + |
| Technology | Non-insecticide-based controls of vectors | Other control alternatives (avoiding use of antibiotics & chemical drugs) | Genetic surveillance & control of disease vectors & pathogens |  | ++ |
| Management | Planning aligned with climate targets | Long-term observing & monitoring systems | Environmental regulations & sustainable agriculture [illegible] fisheries farming practice |  | ++ |
| Infrastructure | Urban forests & green spaces, standing water removal | Drinking water access, sewage & drainage maintenance | Better homes keeping mosquitoes out of hab[illegible]-door areas |  | +++ |
| Nature-based solutions | Natural habitats restoration, reforestation | Reducing habitats fragmentation & limiting human proximity to risky environments | Ecosystem[illegible]sed management to [illegible]ate pathogens & vectors [illegible]pulation |  | ++ |
| Practice change | Diets diversification, more resilient food systems | Reduction of wildlife trade | Alternatives to reduce [illegible] bushmeat and us[illegible] of [illegible] animals |  | ++ |
| Co-benefits from mitigation | Reducing local emission from energy systems | Clean transport systems | Better a[illegible]ss to food, water & energy |  | ++ |

# Earth observations for cholera-risk information

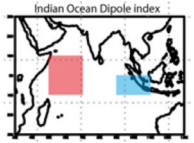
## *Bringing environmental, climate and health indicators to end-users*



Satellite observations

Epidemiological records

In-situ observations




El Niño, IOD indices

**Pilot model**

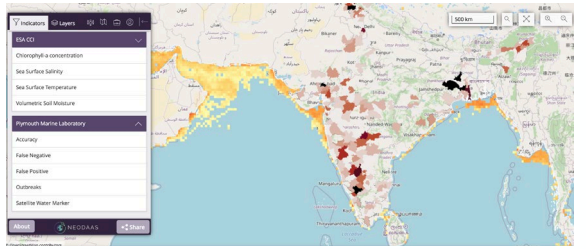
**Climate analysis**

**Products**
- EO datasets
- Clinical datasets
- *Vibrio* environmental suitability index
- Climate indices

**Climate Adaptation**
- Cholera-Risk Information for Anticipatory Action
- Supporting Paris Agreement NDCs
- Building Capacity
- Education

**End users**
Coastal communities, policy makers, scientists

**Web portal**
Geospatial data viewing and analysis tool



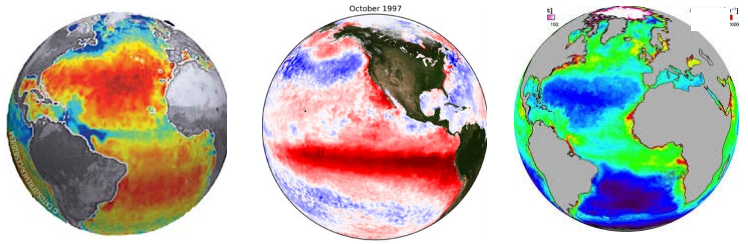
## PODCAST-DEMO proof-of-concept

Lead M-F Racault

# Earth observations for cholera-risk information

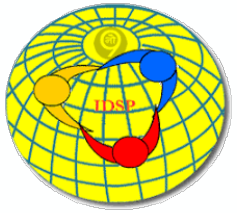
## *Cholera risk based on analyses of clinical and satellite climate datasets*

**Satellite data**



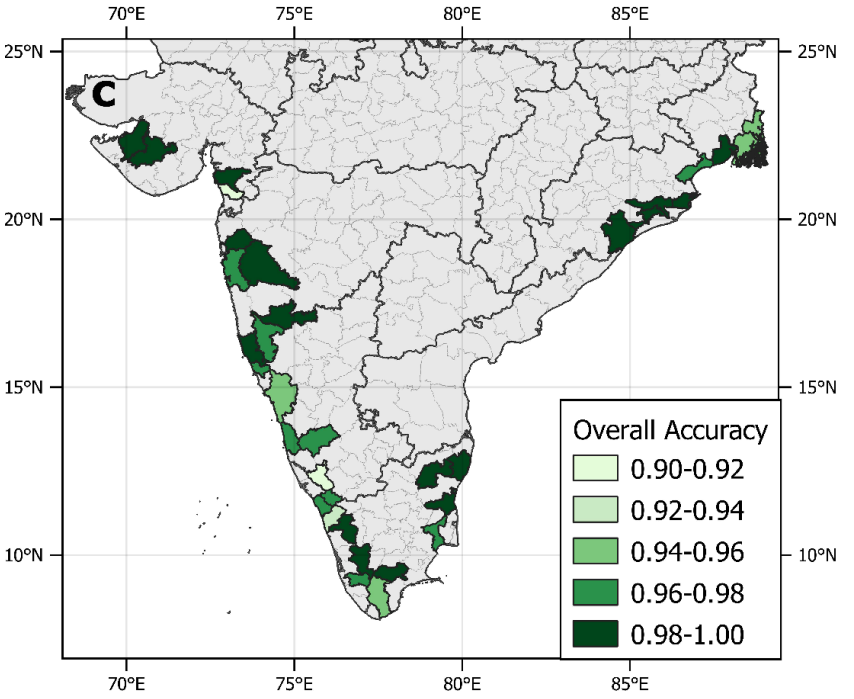

**ESA-CCI Climate Variables**

**Clinical data**




**IDSP Cholera Outbreaks**

**Machine Learning model**




→ **89.5% of outbreaks correctly identified across all coastal Indian districts reporting cholera during 2010-2018**



*Campbell A, Racault M-F, Goult S, Laurenson A (2020) Int. J. Environ. Res. Public Health, 17, 9378*

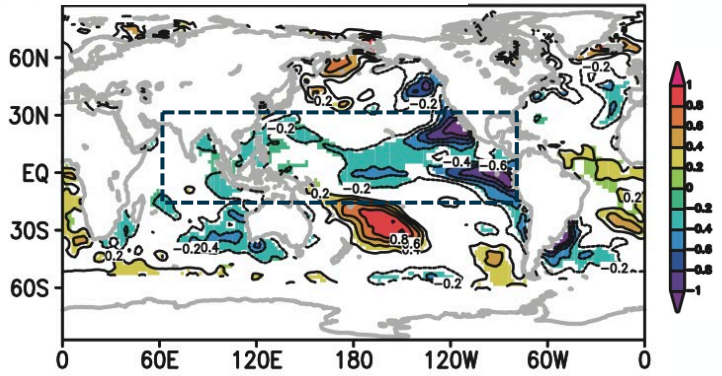
# Earth observations for cholera-risk information

## *Increasing prediction lead time using climate drivers of suitable habitat for* V. cholerae

Prediction Lead Time = **5 months** (Ogata et al. 2021)

Prediction Lead Time = 2 months (Jutla et al. 2013)

**La Niña** event in **Summer** -> **High rainfall** in North India in **Summer** -> **Favorable water** conditions for ***V. cholerae*** in Bay of Bengal in **Fall** -> **High cholera risk** in Bangladesh in **Spring**

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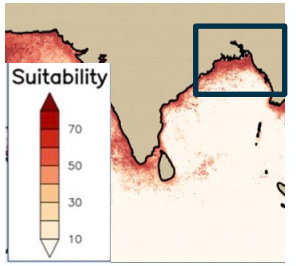


Racault et al., 2019

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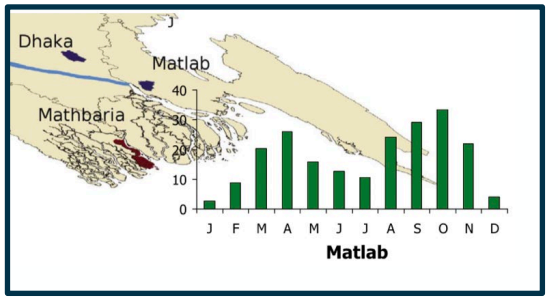



Akanda et al., 2009



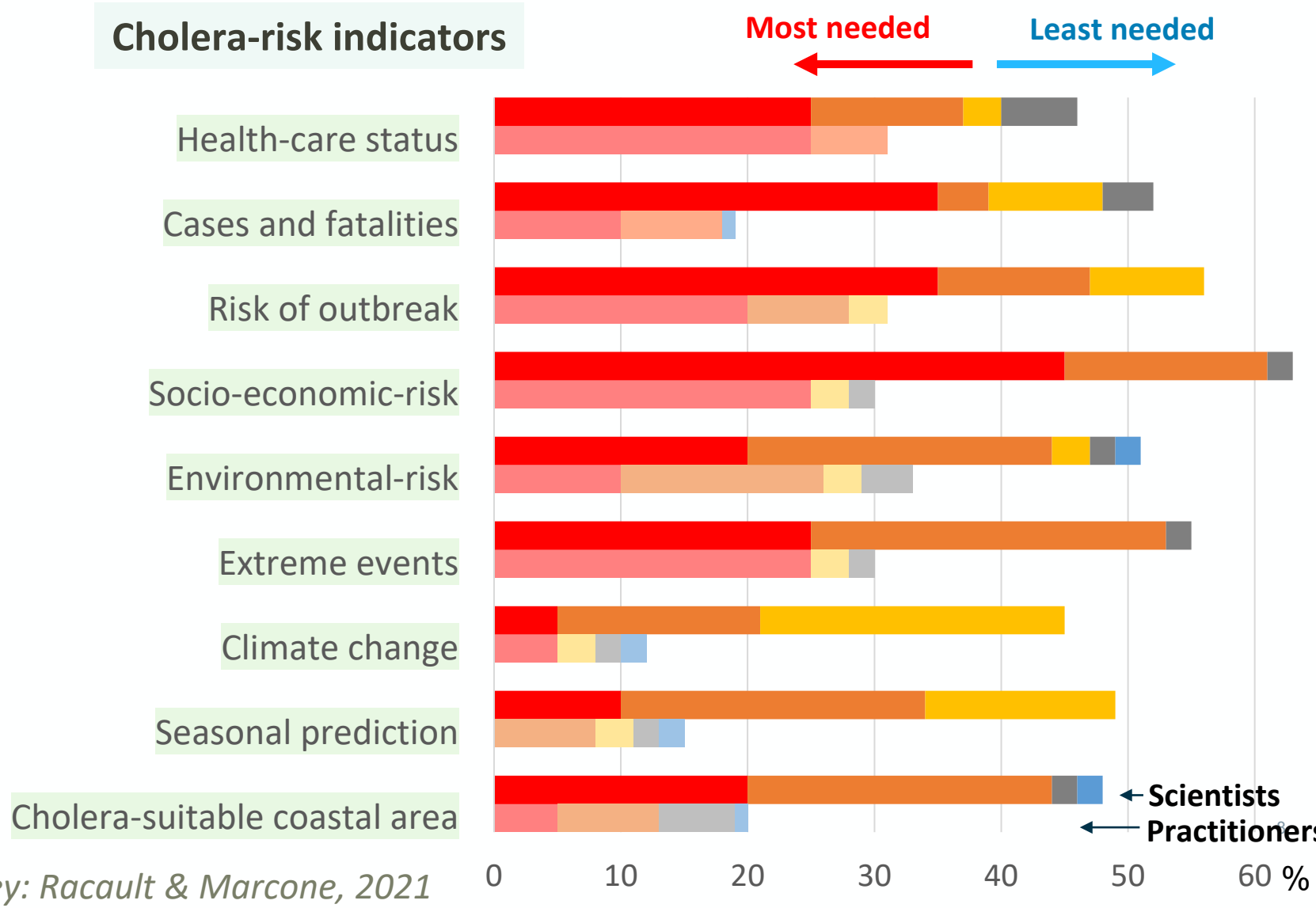
*Ogata T, Racault M-F, Nonaka M, Behera S (2021) Int. J. Environ. Res. Public Health, 18, 10201*

# Need for transdisciplinary research

## Conclusions

- Essential to include **socio-economic data** and consider **extreme events**
- Strong interest for further **education** and **capacity building**
- Potential to transfer **cholera-risk models** to other regions

**Thank you**




*Survey: Racault & Marcone, 2021*