

Part 5

# Implementation in Practice

Improving public health decision-making  
in a new climate



## Part 5 – IMPLEMENTATION IN PRACTICE

### Sections

- 5.1. Designing programmes to implement and scale up climate-informed decision support tools
- 5.2. Collaborative co-creation of climate services for health: Partnerships and stakeholder engagement
- 5.3. Implementing climate-informed decision-support tools: Risk Communication
- 5.4. Challenges in the development of climate services and case studies





## Section 5.1:

# Designing programmes to implement and scale up climate-informed decision support tools

### Learning objectives:

- Evidence the associations between disease outcomes and climate-informed predictors and operational factors in the process
- Understand methods for engaging key partners and stakeholders in the development and evaluation of the tool
- Identify aspects to consider for the implementation, integration, and coordination of the tool

### Case Studies / Further reading

- [Cardenas R, Hussain-Alkhateeb L et al. \(2022\) The Early Warning and Response System \(EWARS-TDR\) for dengue outbreaks: can it also be applied to chikungunya and Zika outbreak warning? \*BMC Infectious Diseases\*](#)
- [Benitez-Valldares et al. \(2021\) Validation of the Early Warning and Response System \(EWARS\) for dengue outbreaks: Evidence from the national vector control program in Mexico. \*PloS NTD\*](#)
- [Sanchez Tejeda G et al. \(2023\) Early warning and response system for dengue outbreaks: Moving from research to operational implementation in Mexico. \*PloS Glob Public Health\*](#)
- [Schlesinger M, Prieto Alvarado FE, Borbón Ramos ME, Sewe MO, Merle CS, Kroeger A, Hussain-Alkhateeb L. Enabling countries to manage outbreaks: statistical, operational, and contextual analysis of the early warning and response system \(EWARS-csd\) for dengue outbreaks. \*Frontiers in Public Health\*. 2024 Jan 19;12:1323618.](#)



## Section 5.1:

# Designing programmes to implement and scale up climate-informed decision support tools

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# Background

Infectious disease outbreaks threaten the stability of national health systems worldwide. Every year, late detection and inadequate response mechanisms compound the effects of rapid infectious disease transmission. Currently, the initiation of interventions is heavily reliant on surveillance data from climate and clinical passive surveillance systems, and their combination in a climate-informed decision tool shows promising potential.

To function effectively, a **climate-informed decision tool** should be perceived as an information system designed to support decision-making by national- and local-level institutions, while also enabling vulnerable groups in society to take actions to mitigate the impacts of impending risks.

This section proposes and discusses key aspects for designing programmes to **enable the overall evaluation of the implementation, integration and coordination of climate-informed decision support tools.**



# How this section is organised

This section aims to present and discuss key aspects of developing a **logic model**, as well as methods for implementing and maintaining climate-informed decision tools. This programme is guiding the **involvement of key partners and stakeholders** in the evaluation process.

**It is organised around four objectives, each explored in its own part:**

- Introduce means for analysing the rising global public health threats posed by climate-sensitive diseases and the urgent need for robust, data-informed prediction systems.
- Illustrate mechanisms for constructing the organisational, technical, and data foundations required to set up a climate-informed decision tool before deployment.
- Demonstrate approaches for piloting and expanding a climate-informed decision tool from a pilot project to a national tool, ensuring wide geographic coverage and strong local capacity.
- Identify aspects to consider for ensuring the long-term reliability and accuracy of a climate-informed decision support tool through regular maintenance, annual calibration, and continuous feedback.





# Objective 1

Introduces means for analysing the rising global public health threats posed by climate-sensitive diseases and the urgent need for robust, data-informed prediction systems.

✓ Essentially, all programme designs, including the implementation and integration of the tool should be based on **existing evidence outlining the relationships between disease outcomes, their predictors and mechanisms.**

# Climate-Sensitive Disease Threat



## Environmental Drivers

Rising temperatures, erratic rainfall, and extreme weather alter insect vectors' geographic ranges and accelerate pathogen development. Systems are vulnerable to sudden environmental shifts.

## Public Health Burden

Developing nations encounter severe challenges with endemic transmission of dengue, chikungunya, Zika, cholera, and malaria, requiring proactive instead of passive healthcare models.

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# The genesis & evolution of a climate-informed decision support tool

## Collaborative Co-Design

A climate-informed decision support tool, namely the Early Warning and Response System for climate-sensitive diseases (EWARS-csd), was launched in 2012 by the Special Programme for Research and Training in Tropical Diseases / TDR (WHO/World Bank/UNDP/UNICEF) alongside the University of Gothenburg and other partners. Both TDR and the WHO Climate Change and Health team contributed to the tool's further development and roll-out at the country level.

This joint initiative brought together ministries of health, meteorological agencies, and district health managers across five WHO regions to establish a unified predictive platform.



# The case of developing a Climate-informed tool for dengue outbreaks, TDR, WHO

## Systematic literature reviews



2011-14

5 Reviews on:  
Surveillance systems,  
Contingency plans, cost of dengue outbreaks, Vector management

## Country case studies on dengue surveillance



2011-12

10 countries:  
Brazil, Colombia, Dominican Rep., Mexico, Peru, Vietnam, Malaysia, Sri Lanka, Indonesia, Maldives

## Retrospective study on outbreak definition and alarm signals



2012-14

5 countries:  
Brazil, Dom. Rep, Mexico, Vietnam, Malaysia

## Prospective study of new model of outbreak detection & response



2014-16

5 countries:  
Brazil, Mexico, Malaysia  
  
Plus:  
Dominican Rep, Vietnam

## Innovating EWARS Automatized dashboards, Capacity building



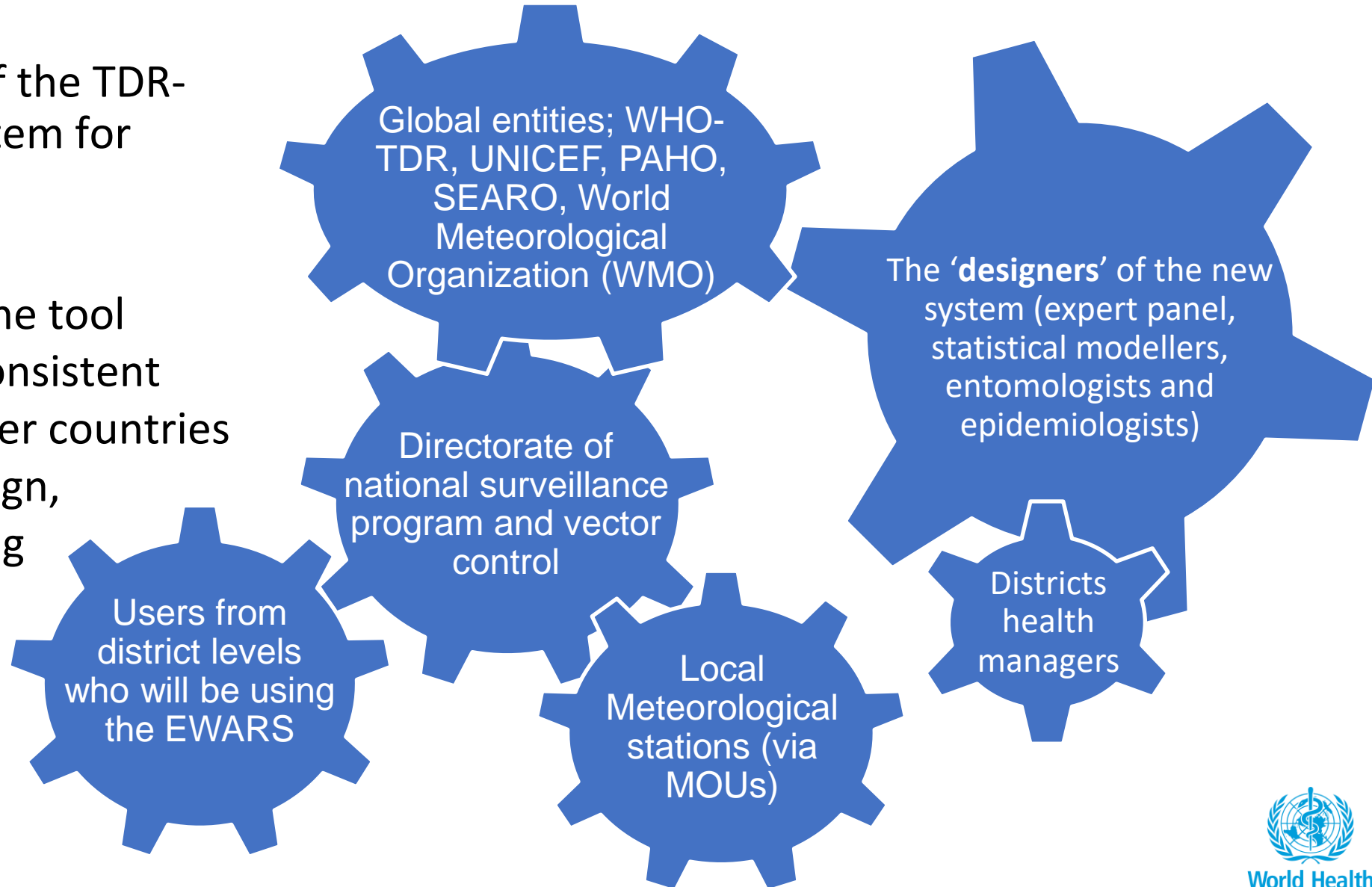
2016 onwards

Mexico introduced EWARS at the national level;  
Regional & country training;  
Automatic calibration

# The case of developing a Climate-informed tool for dengue outbreaks, TDR, WHO

✓ This is an example of the TDR-WHO Early Warning System for dengue outbreak

✓ The Co-creation of the tool maintained equal and consistent participation of all partner countries throughout the tool design, development, and testing and innovation.



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# Proven Global Footprint

**17+**  
ACTIVE COUNTRIES

## Global Validation

The climate-informed decision support tool is used and validated across 17+ countries in five WHO regions (including Mexico, Colombia, Dominican Republic, Ethiopia, Burkina Faso, Thailand and others).

It provides outbreak warnings ranging between 4 and 12 weeks in advance, allowing for highly targeted vector control operations. This window is specifically designed to optimize the disease-associated operational activities.



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# Key Implementation Process

- Focuses on stakeholder mobilisation, targeting priority diseases, checking data quality, and setting up initial local servers.
- Running climate-informed decision tool in select districts, generating prospective bulletins, and establishing response mechanisms.
- Transitioning to national capacity, standardising training programs, and optimising thresholds.
- Continuous calibration, system maintenance, and programmatic integration within existing health frameworks.



## Objective 2

Illustrate mechanisms for constructing the organisational, technical, and data foundations required to set up a climate-informed decision support tool before deployment.

 To ensure an effective implementation of a climate-informed decision support tool, it should be people- and system-centred and integrate elements underpinned by effective institutional arrangements and the involvement of all relevant stakeholders.

# Diseases & Geographic Scope

## | Target Disease Selection

Focus first on prioritised climate-sensitive diseases (e.g., dengue, chikungunya, Zika, meningitis, cholera). It is recommended to start with one disease and add others once users are familiar with EWARS-csd operations.

## | Geographical Boundaries

Define clear objectives and specify warning scopes at national, regional, or district levels. Establish shapefiles (GADM or DIVA-GIS) to build maps of the target areas. EWARS-csd is now fully automated and integrated with open-access sources, such as meteorological and geographical boundary files, simplifying the process.



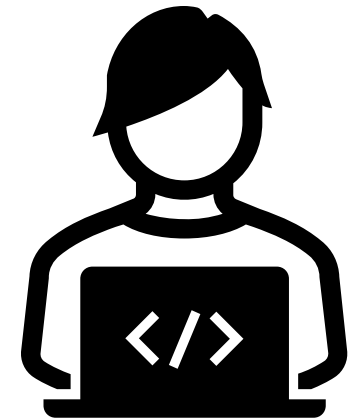
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# Staff Engagement & Alignment

## Technical and Response Personnel

**Setup & Calibration:** Engage IT professionals, epidemiologists, and national meteorological focal points to feed weather and disease surveillance datasets into EWARS tools using 'R' or 'Docker' engines. Docker is primarily provided for unskilled users, whereas a compatible R version is for expert users.

**Response Actions:** Align entomology specialists, district clinical personnel, and One Health community groups to take early action when alert signals are triggered.



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# Steering and Platform Integration

**Formalise Alliances:** Build cross-agency Memoranda of Understanding (Meteorological, Health, Environment) and establish a dedicated Steering Committee to ensure system reliability.

**Audit Existing Platforms:** Assess national disease-tracking databases, dashboards, and registries (such as DHIS2) to plan future technical integration.

**Maximise Cost-Efficiency:** Leverage existing systems to lower maintenance costs and reduce technical strain on staff.



# Data and Resource Requirements

Data Streams	Required Format & Detail	Mandatory Status
<b>Epidemiological Cases</b>	Weekly historic case metrics covering at least the last 3 years.	<b>Mandatory</b>
<b>Meteorological Data</b>	Weekly temperature and cumulative rainfall statistics (Station/Satellite).	<b>Mandatory</b>
<b>Demographic &amp; GIS</b>	Target area population statistics and shapefile boundaries.	<b>Mandatory</b>
<b>Entomological and other (social, sero-types...etc.) Indicators</b>	Ovitrap and larval density indices at local level.	<b>Optional</b>



# Dataset Prep & Central Training

## Dataset Prep

Gather historical case, demographic, and weather data into a weekly layout covering at least the last 3 years to calibrate the models. Most of this information is now available via open sources, including hubs such as the DHIS2.

## Technical Training

Train core staff on the user guide, GitHub tools, and statistical concepts. Given the recent advancement and optimisation of the EWARS-csd tools, most of the training will be focused on the operational aspects, i.e. how the results are operationalised and aligned with the local policy making.

## Demo Workflows

Practice risk mapping and dashboard use using standardised WHO demo datasets before importing actual country data.



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# Server and Communication Setup

## Server Infrastructure

Set up a local server to ensure data security.

Recommended: Linux/Ubuntu, 64GB DDR4 RAM, 4GB GPU, and CPU speed above 4.10 GHz. This infrastructure ensures security and allows for real-time model runs.

## Alert Channels

Set up clear communication lines between central and district offices. Use dashboards, bulletins, and SMS alerts to quickly share warnings with decision-makers.



A woman with dark hair tied back, wearing a white lab coat, is looking out a window. The background is slightly blurred, showing what appears to be a laboratory or office setting. A large blue diagonal banner is overlaid on the image, containing the text for Objective 3.

## Objective 3

Demonstrate approaches for piloting and expanding a climate-informed decision tool from a pilot project to a national tool, ensuring wide geographic coverage and strong local capacity.

- ✓ **Assessing whether the tool is tailored to the needs of policymaking and the characteristics of the underlying surveillance data is crucial. The tool should, in essence, provide practical, operational support to local district health managers, enabling timely responses and action plans.**

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# Workplans & System Deployment

**Detailed Pilot Workplan:** Define pilot boundaries, assign institutional duties, set realistic milestones, and establish a clear timeline.

**Local Sandboxing:** Run both retrospective and prospective dashboards on personal computers to help technical teams build confidence.

**Server Deployment:** Move the climate-informed decision tool to the local server and connect it with systems like DHIS2 (digital surveillance system) to ensure institutional ownership.

## Key terms for this step

**Local sandboxing:** running the tool on a personal computer in a safe, self-contained test setup, so staff can practice and build confidence before the system is connected to live national infrastructure.

**Retrospective dashboard:** runs the model on historical data to assess and calibrate how well it would have predicted past outbreaks.

**Prospective dashboard:** runs the model on current, incoming data to produce live, forward-looking outbreak forecasts.



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# Weather Pipelines & Calibration

## Connecting Data with Models

**Weather Data Access:** Set up regular access to weather data from local stations or satellite services (like NASA POWER or WMO WIS2). EWARS-csd is a good example of advanced automation design that instantly links the tool to multiple open-source tools for direct extraction, mapping, and processing of climate data.

**System Calibration:** Run calibrations to analyse data quality, highlight missing inputs, and establish initial outbreak thresholds.



Source: [www.noaa.gov](http://www.noaa.gov)

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# Dashboard Alerts & User Accounts

## | Dashboard 2 Interpretations

Generate predictions, probability curves, and risk maps. Turn these findings into weekly district bulletins that include action points and a green/yellow/red alert signal.

## | District Accounts Management

Set up secure local user logins. Central administrators can manage permissions and grant district officers access to relevant local risk projections.

### Key term for this step

**Dashboard 2 (the analysis dashboard):** the EWARS-csd view that turns the weekly data into predictions, probability curves and green/yellow/red alert levels. (Dashboard 1 is the earlier view used to enter and check the weekly case and weather data.)



# Response Planning & Vector Logs

Response Component	Implementation Action Items	Primary Goal
<b>Staged Alert Plan</b>	Group responses into tiers based on alert levels and disease endemicity.	Prevent system panic & optimize resource distribution.
<b>Existing Infrastructure</b>	Utilize existing local human resources and emergency networks.	Lower overhead costs and launch response actions faster.
<b>Vector Log Tracking</b>	Record spray campaigns, larviciding actions, and coverage areas.	Evaluate the direct public health impact of early responses.



# SOP Drafting & Automation

## Standardise

Develop clear Standard Operating Procedures (SOPs) outlining roles, calibration schedules, data formats, and response steps.

## Automate

Test tools that automate weekly health and weather updates, reducing manual entry errors and saving valuable staff time.

## Alert Pipelines

Verify that risk maps and alerts are updated and delivered correctly to key focal points without manual intervention.



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# Pilot Evaluation & Lessons Learned

**Statistical Performance:** Measure system accuracy by evaluating false alarms, missed outbreaks, and overall predictive precision.

**Analyse System Bottlenecks:** Assess operational delays in data sharing, data quality issues, or instances where alerts did not trigger response actions.

**Finance Auditing:** Review the total cost of installation, training, and database management during the pilot.

**Capture Best Practices:** Hold debrief meetings with key partners to list strengths, weaknesses, and next steps for the scale-up phase.



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# Expanding District Coverage

**District Targeting:** Expand coverage to areas at high risk for outbreaks, guided by climate vulnerability assessments.

**National Workplans:** Set up clear expansion timelines, secure funding, and assign roles across new regions.

**Online Training:** Shift to cost-effective online modules to build local capacity at scale.



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# Nationwide Implementation

**100%**  
DISTRICT COVERAGE

## Proactive Public Health

Roll out the climate-informed decision tool to every district, province, and municipality across the country.

Expanding the system nationwide ensures that even historically low-risk areas are protected as climate patterns shift and bring new risks to new regions.



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# National Communications & Action Plans

## | Nationwide Risk Channels

Tailor alert channels to share risk updates with all districts. Ensure communication keeps local health teams informed regardless of current outbreak levels.

## | Tailored Response Actions

Adapt response protocols to match local capacity and resources. Districts with the same alert level can run different, tailored response plans.



# Evaluation of Scale-Up Progress

Evaluation Area	Metrics & Analysis Methods	Target Outcome
<b>Predictive Performance</b>	Measure and analyse false alarms and missed outbreaks across various regions.	High sensitivity & trusted alerts.
<b>System Bottlenecks</b>	Identify delays in data sharing or communication issues among decision-makers.	Eliminate delays in data and alerts.
<b>Cost-Benefit Ratio</b>	Compare the cost of false alarms against the financial impact of missed outbreaks.	Determine the optimal threshold for alert triggers.
<b>Economic Impact</b>	Calculate surveillance costs per unit and estimate expenditures saved per outbreak avoided.	Proven system affordability and value.



# Design features to ensure coordination and resources for the tool (1)

- ✓ The tool should be designed to enable instant communication of information to decision-makers and the public
- ✓ Ideally, the program partners should be hosted within the same coordination unit
- ✓ If not, the tool should facilitate an active online communication platform between national-level stakeholders and tool partners.

## Design features to ensure coordination and resources for the tool (2)

- ✓ Human, technical and financial resources are key to ensuring that the decision tool is effective and sustainable
- ✓ Coordination is important for maintaining efficient and resilient EWS functioning
- ✓ The coordination will secure adequate reporting, analysing, and monitoring & responding to acute public health events

# Aspects to consider for the coordination of the tool (1)

- Is the tool designed to systematically link the national level with local levels?
  - This will allow timely and routine feedback on possible unwanted health events
  - Provide a more cost-effective hub of (digital) communications
- How well does the tool link severity and frequency of unwanted health outcomes to a local intervention?
- Does the tool comprise communication channels with the public?
  - This will ensure a more effective response
  - It will also enable the systematic involvement of key stakeholders in this process



# Aspects to consider for the coordination of the tool (2)

- Whether or not the tool is being exercised by skilled epidemiologists
- To ensure adequate integrated all-hazard approach training was received
- The coordination team should clearly define pathways for the system outputs and how it can reach local decision-making
- Essentially, to observe if the tool is well equipped by reference document and materials for public health emergencies
- The laboratory services for rapid confirmation are an equally important aspect in this process





# Objective 4

Identify aspects to consider for ensuring the long-term reliability and accuracy of the climate-informed decision support tool through regular maintenance, annual calibration, and continuous feedback.

- ✔ **Assessing the sustainability of the tool's practices and operationalisation; Ensuring key measures are in place for securing the sustainable and consistent operation of the tool**

# Feedback, Reports, & Data Integrity

## Standard User Form

Launch a digital reporting form (capturing location, timing, actions, and comments) to help make adjustments and guide improvement decisions.

## Feedback Analysis

Regularly review user feedback to identify system bugs, design improvements, and training needs across all administrative levels.

## Weekly Verification

Manually verify spatial and temporal predictions with regional epidemiologists to catch and correct anomalous data early.



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# System Operations & Annual Calibration

**Operational Maintenance:** Ensure the server runs smoothly with regular security updates, data backups, and routine hardware checks.

**Annual Calibration:** Calibrate the model annually with new epidemiological and weather data to maintain prediction accuracy.

**System Health Indicators:** Track key performance metrics, including annual alert volumes, community involvement levels, and response speed.



## Case Studies & Real-World Use

**Dominican Republic:** Used EWARS-csd to predict dengue outbreaks 12 weeks in advance. The system achieved 97% sensitivity, allowing teams to launch early, targeted vector control campaigns before case numbers rose.

**Malawi:** Evaluated malaria prediction models using local weather data to design early response systems and improve resource planning.

# Operationalising the EWARS-csd outputs for skilled and unskilled users

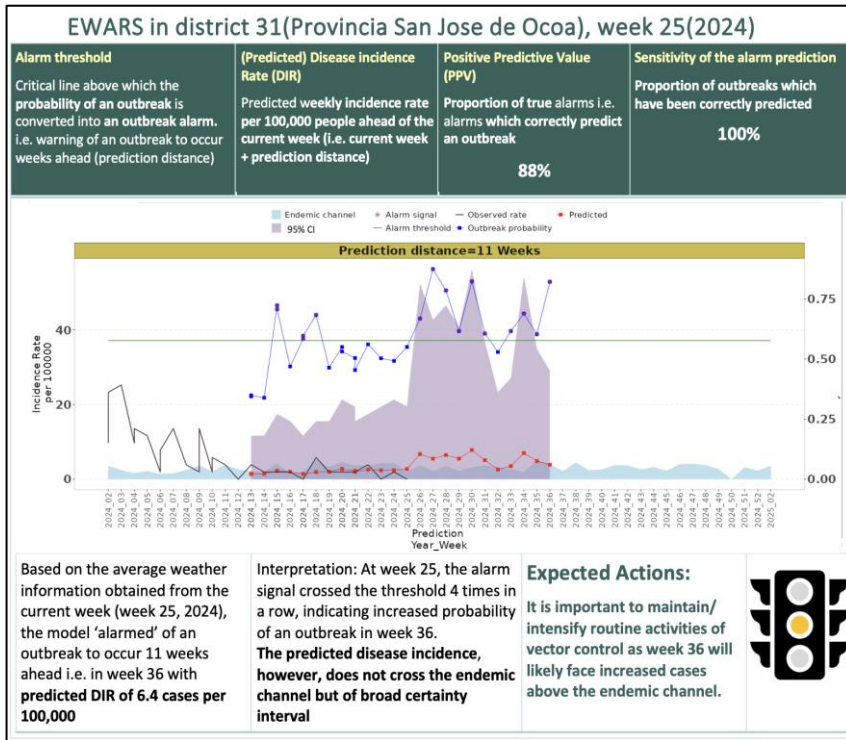
## An example from Colombia

- Operationalising the EWARS output is an equally important piece of this overall disease prediction and control process.
- Based on expert opinion and validation process in partner countries, including Thailand and Colombia, an algorithm was proposed and integrated within the WHO-EWARS tool for auto-generating evidence-based thresholds for action plans.
- The following slide presents an example from Colombia, among other countries!



# Operationalising the EWARS-csd outputs for skilled and unskilled users

## An example from Colombia



### Algorithm for outbreak alarms Dom Rep Dengue (confirmed cases)

Observations with EWARS-csd	Recommended Actions
<p><b>A. CHECK OF RELIABILITY</b></p> <p>1 Good agreement between observed and predicted incidence (&lt;20% difference)</p> <p>2 Poor agreement between observed and predicted incidence (&gt;20% difference) (no precise prediction possible)</p> <p><b>3 Sensitivity/PPV above or below 65% (no prec. prediction)</b></p>	<p><b>Action points (see national guidelines):</b></p> <p><b>AP1 (green traffic light):</b> Routine = cleaning, covering or eliminating water containers, awareness raising, focal intervention, larval survey incl. elimination of larvae, larviciding, larvivorous fish</p>
<p><b>B. ALARM ALGORITHM</b></p> <p><b>1. Alarm levels</b> (according to alarm probability, predicted incidence rate, confidence interval)</p> <p>1 Alarm below threshold</p> <p>2 Alarm for 1-2 weeks above threshold</p> <p>3 Alarm for 3-4 weeks above threshold</p> <p>4 Alarm for &gt; 4 weeks above threshold</p>	<p><b>AP2 (yellow traffic light):</b> Stepping up routine activities (increased coverage, increased quality of application), risk communication, involving other actors.</p> <p><b>AP3 (red traffic light):</b> Intensified vector control as response to outbreak alarm: space spraying (fogging; day 1-7-14); increased larviciding; risk communication</p> <p><i>(Att.! No. of houses reached is important)</i></p>
<p><b>2. Predicted incidence, alarm levels (confirmed cases)</b></p> <p>1 Predicted incidence within endemic channel</p> <p>2 Predicted incidence just above endemic channel (&lt;20%)</p> <p>3 Predicted incidence well above end. channel (&gt;20%)</p>	<p><b>Proposed algorithm for alarm levels:</b></p> <p><b>For AP1:</b> <math>1 + 1 + (2 \times 1) + 0 = 4</math> <b>green &lt;8</b></p> <p><b>For AP2:</b> <math>3 + 2 + (2 \times 2) + 0 = 9</math> <b>yellow 8-13</b></p> <p><b>For AP3:</b> <math>4 + 3 + (2 \times 3) + 1 = 14</math> <b>red &gt;13</b></p>
<p><b>3. Predicted incidence per 100,000 pop.</b> at prediction distance:</p> <p>1 &lt;50 = low</p> <p>2 50-100= medium</p> <p>3 100-250= high</p> <p>4 &gt; 250= super high (double weight for this factor)</p>	
<p><b>4. Confidence interval (CI) of predicted incidence</b></p> <p>0 CI within or just above endemic channel</p> <p>1 CI above endemic channel</p>	<p><b>NB.: The algorithm leading to AP is country- and disease-specific. Level of incidence depends on case definition (hospitalized/confirmed/suspected)</b></p>

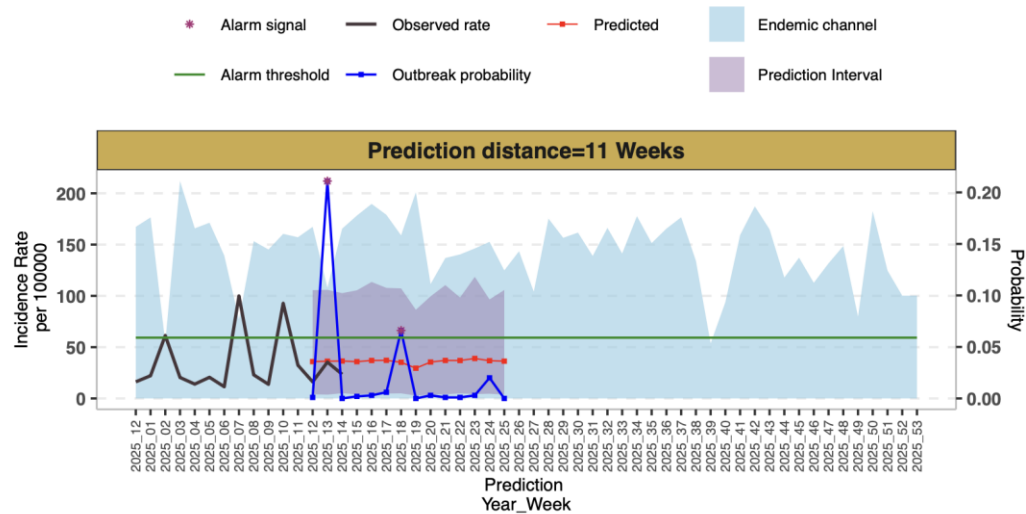
# Operationalising the EWARS-csd outputs for skilled and unskilled users

## An example from Colombia

*EWARS-automatically generated bulletin on weekly basis for guiding the action plan:*

**District: 1151 Year :2026 Week: 12**

(Sensitivity: 100%; PPV: 50%)



**1+1+1+0 = 3**

**AP1 – GREEN**

### Algorithm Reference

#### Alarm Level Thresholds:

- . AP1 (Green): Score < 8 – Routine Activities
- . AP2 (Yellow): Score 8–13 – Stepping Up Activities
- . AP3 (Red): Score > 13 – Intensified Response

#### Score Calculation:

Total = Factor1 + Factor2 + (2 x Factor3) + Factor4

#### Factor 1 – Alarm Duration:

1=Below threshold, 2=1–2 weeks, 3=3–4 weeks, 4=>4 weeks

#### Factor 2 – Endemic Channel:

1=Within, 2=Just above (<20%), 3=Well above (>20%)

#### Factor 3 – Incidence Rate (Double Weight):

1=<50, 2=50–100, 3=100–250, 4=>250 per 100,000

#### Factor 4 – Confidence Interval:

0=Within/just above endemic channel, 1=Above endemic channel

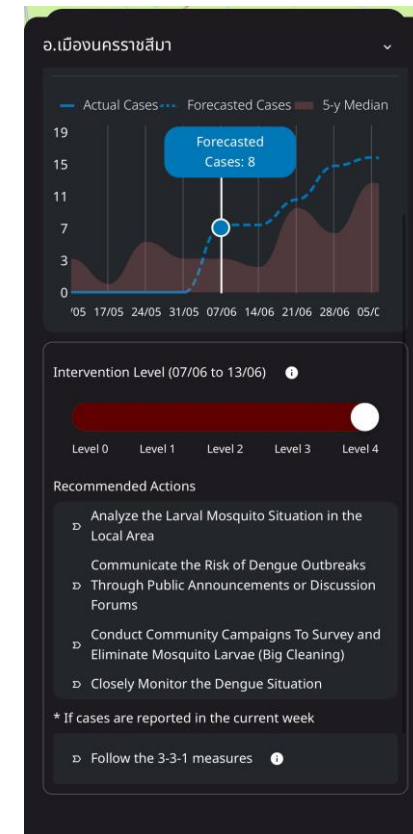
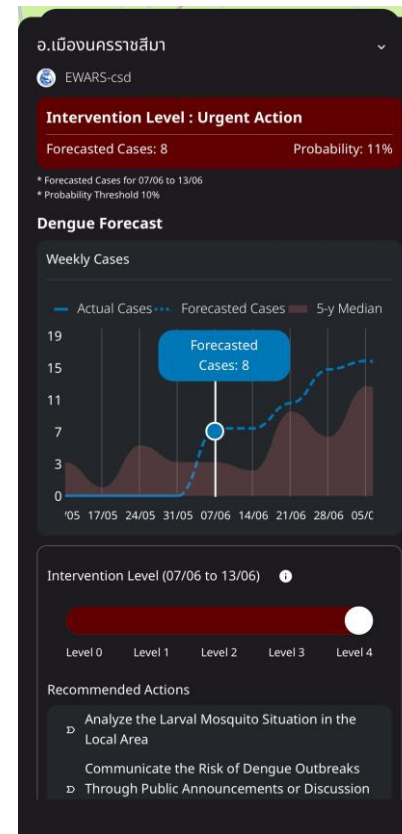
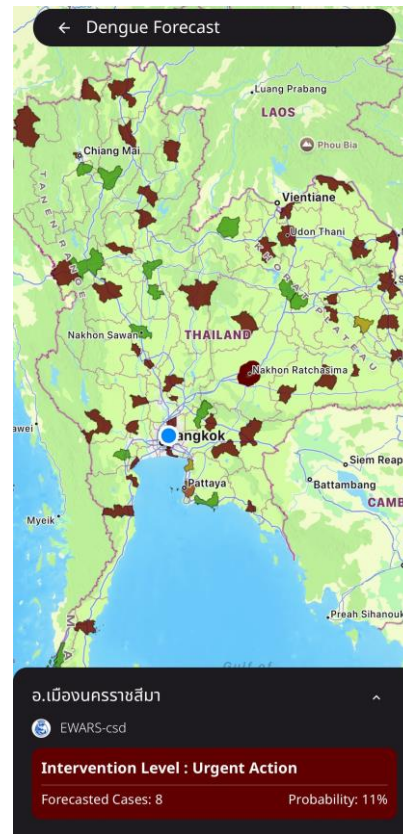
### Expected Actions:

**It is important to continue with routine activities of vector control but no response activities for an imminent outbreak. The two isolated alarm signals do not yet qualify for an initial outbreak response.**

Dengue prevention is a task for everybody. Key interventions are: eliminate larvae from water containers, larviciding, larvivorous fish for large water containers, remove trash and discarded containers, change every week water in flower vases and other containers, indoor and outdoor spraying according to national guidelines,



# Engaging the local community in planning, decision-making and response: The case of Mobile-EWARS in Thailand

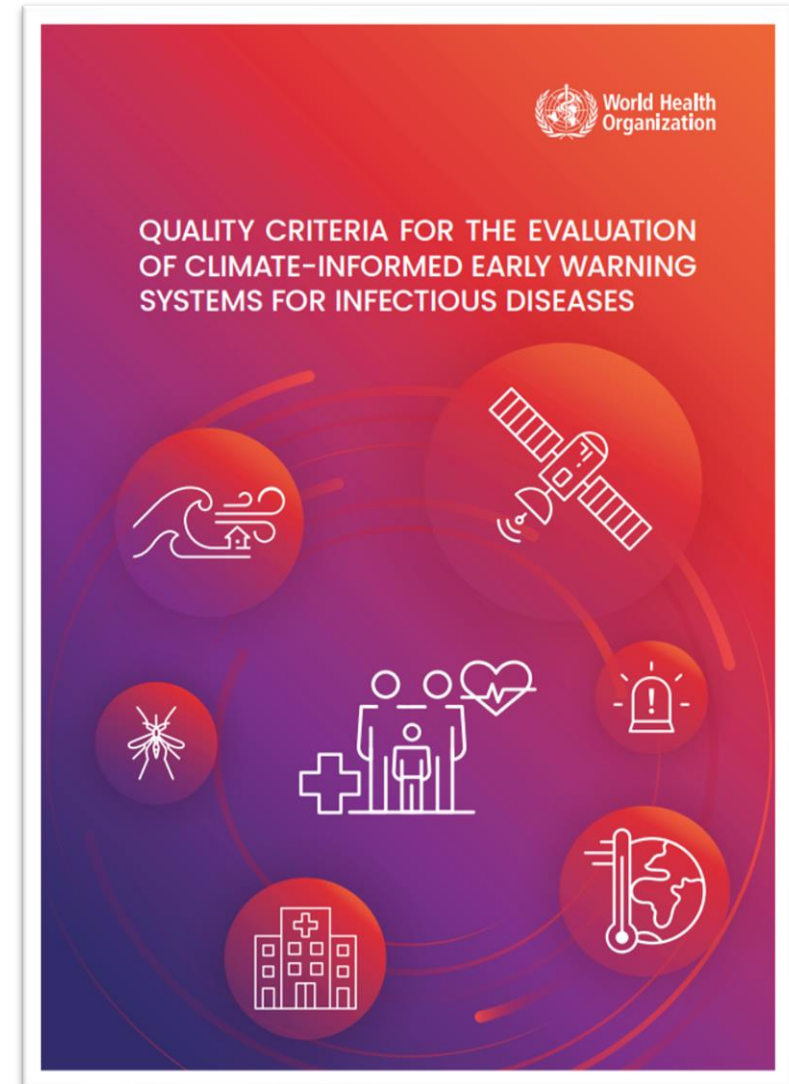


Source: RooTan x EWARS-csd mobile application, Thailand. Courtesy of:

1. Department of Disease Control, Ministry of Public Health, Thailand
2. National Electronics and Computer Technology Center (NECTEC), NSTDA, Ministry of Higher Education, Science, Research and Innovation, Thailand

# Introduction to the Quality Criteria for climate-informed EWS

- **Early warning systems (EWS)** are designed to
  - support decision-making of national and local-level institutions
  - Inform about probable disease outbreaks (when and where)
  - Help improve stakeholder coordination, response strategy development, and public health communication
- The outlined quality criteria focus on the **performance, application, implementation and effectiveness** of an EWS
- **The key aspects outlined to enable the evaluation of a climate-informed decision support tool as a ready-to-use guidance**



[WHO 2021- Quality criteria for the evaluation of climate-informed early warning systems for infectious diseases](#)



World Health Organization

# Five evaluation steps

Step 1: **Defining** the outbreak and climate **predictors**

Step 2: Evaluating the **structural and statistical** features of the EWS

Step 3: Evaluating the **performance of the EWS** (retrospective phase)

Step 4: Evaluating the **cost-effectiveness** of the EWS (prospective phase)

Step 5: Evaluating the **operational** features of the EWS

## Explore the full guidance

The detailed criteria for each of these five steps are set out in the WHO standalone guidance. Work through them in your own setting using the interactive Quality Criteria tool:

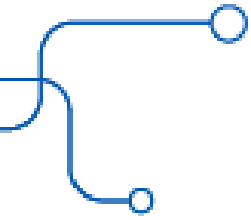
[Quality criteria for the evaluation of climate-informed early warning systems for infectious diseases](#)



# References and further readings

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## Section 5.2:

### Collaborative co-creation of climate services for health: Partnerships and stakeholder engagement

#### General objective:

- Understand the process and best practices in the collaborative co-creation of climate services for health

#### Case study:

Stewart-Ibarra AM, Romero M, Hinds AQ, Lowe R, Mahon R, Van Meerbeeck CJ, et al. Co-developing climate services for public health: Stakeholder needs and perceptions for the prevention and control of Aedes-transmitted diseases in the Caribbean. PLoS Negl Trop Dis. 2019;13:e0007772.

#### Resources:

- [Caribbean Health-Climatic Bulletin](#)
- [GFCS Health Exemplar](#)

#### Further learning opportunities:

- [Shumake-Guillemot J et al. 2023 - Good practices: Co-producing integrated climate, environment and health services, PLoS Climate](#)



A large group of people, likely delegates at a conference, are holding up white signs with country names. The signs are held high, and the people are looking towards the camera. The background is slightly blurred, showing a large room with other people and structures.

# MODULE 5.2

**Collaborative co-creation of climate services for health: Partnerships and stakeholder engagement**

**Dr Anna Stewart Ibarra  
Inter-American Institute for Global  
Change Research (IAI)**

# LEARNING OBJECTIVES

*Developing climate services for health requires strong partnerships between the climate and health sectors and other key partners.*

## General objective:

Understand the process and best practices in the collaborative co-creation of climate services (CS) for health

## Topics:

- Why/when do we need collaboration to develop CS for health?
- What does this collaboration look like?
- Identifying partners and understanding the roles/needs of potential users of CS
- Steps in the collaborative process
- Forms of engagement with partners
- Conditions for the implementation of CS for health
- Barriers to implementation
- Strategies/best practices for strengthening partnerships
- Examples from a case study of CS for health from the Caribbean region:

# Case study: Caribbean climate services for health

RESEARCH ARTICLE

## Co-developing climate services for public health: Stakeholder needs and perceptions for the prevention and control of *Aedes*-transmitted diseases in the Caribbean

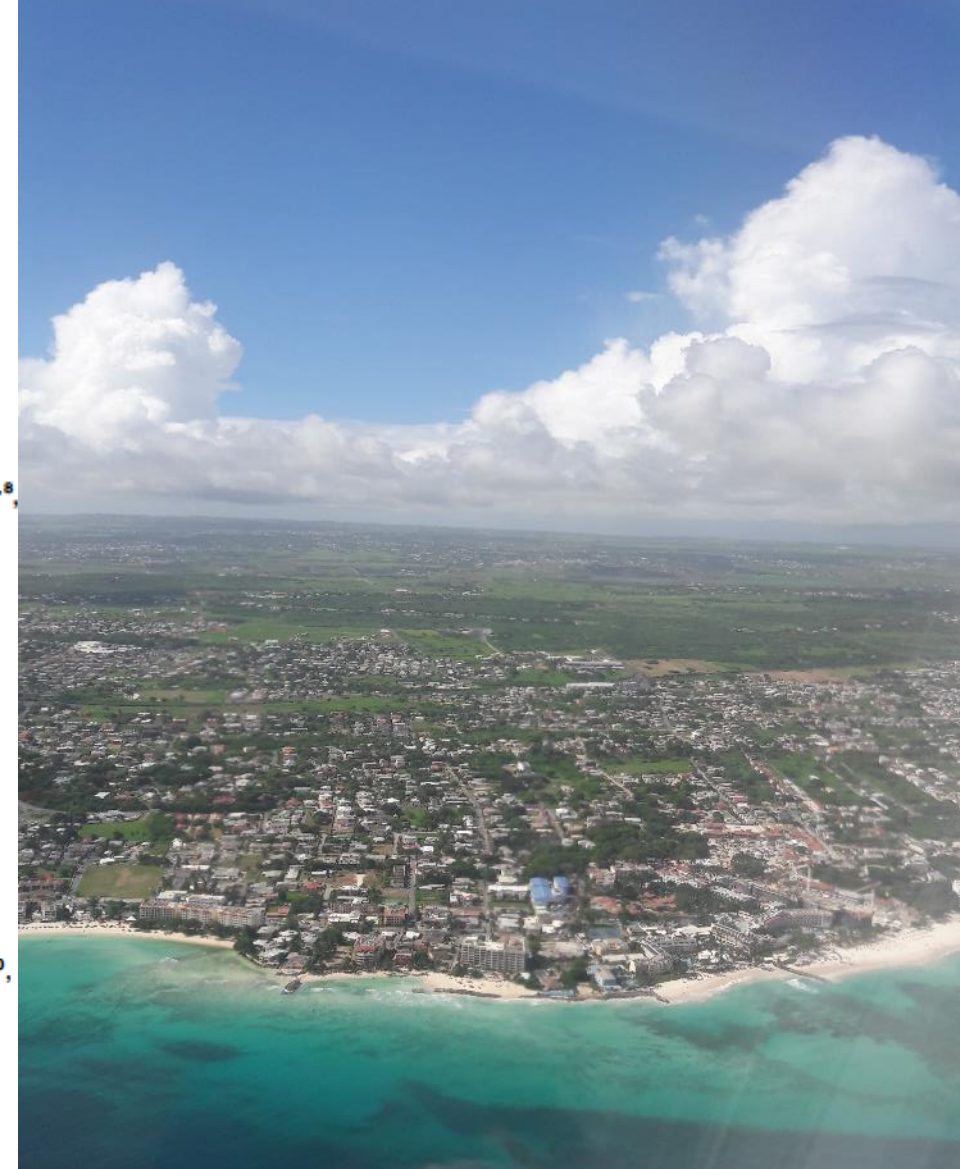
Anna M. Stewart-Ibarra<sup>1,2,3\*</sup>, Moory Romero<sup>1,4</sup>, Avery Q. J. Hinds<sup>5</sup>, Rachel Lowe<sup>6,7,8</sup>, Roché Mahon<sup>9</sup>, Cedric J. Van Meerbeeck<sup>9</sup>, Leslie Rollock<sup>10</sup>, Marquita Gittens-St. Hilaire<sup>11,12</sup>, Sylvester St. Ville<sup>13</sup>, Sadie J. Ryan<sup>14,15</sup>, Adrian R. Trotman<sup>9</sup>, Mercy J. Borbor-Cordova<sup>16</sup>

RESEARCH ARTICLE

## Nonlinear and delayed impacts of climate on dengue risk in Barbados: A modelling study

Rachel Lowe<sup>1,2,3\*</sup>, Antonio Gasparini<sup>4,5</sup>, Cédric J. Van Meerbeeck<sup>6</sup>, Catherine A. Lippi<sup>7</sup>, Roché Mahon<sup>8</sup>, Adrian R. Trotman<sup>9</sup>, Leslie Rollock<sup>8</sup>, Avery Q. J. Hinds<sup>9</sup>, Sadie J. Ryan<sup>7,10</sup>, Anna M. Stewart-Ibarra<sup>11,12</sup>

*Am. J. Trop. Med. Hyg.*, 98(6), 2018, pp. 1857–1859  
doi:10.4269/ajtmh.17-0978  
Copyright © 2018 by The American Society of Tropical Medicine and Hygiene



## Outbreak of Zika Virus Infections, Dominica, 2016

Sadie J. Ryan,<sup>1</sup> Colin J. Carlson,<sup>1</sup>  
Anna M. Stewart-Ibarra, Mercy J. Borbor-Cordova,  
Moory M. Romero, Shelly-Ann Cox,  
Roché Mahon, Adrian Trotman,  
Sylvester St. Ville, Shalauddin Ahmed

Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 23, No. 11, November 2017

## Strengthening Climate Services for the Health Sector in the Caribbean

By Adrian Trotman<sup>1</sup>, Roché Mahon<sup>1</sup>, Joy Shumake-Guillemot<sup>2</sup>, Rachel Lowe<sup>3,4</sup> and Anna M. Stewart-Ibarra<sup>5</sup>

## Zika Virus Outbreak, Barbados, 2015–2016

Sadie J. Ryan,<sup>1,2,3\*</sup> Catherine A. Lippi,<sup>1,2</sup> Colin J. Carlson,<sup>4,5</sup> Anna M. Stewart-Ibarra,<sup>6</sup> Mercy J. Borbor-Cordova,<sup>7</sup> Moory Romero,<sup>8</sup> Shelly-Ann Cox,<sup>8</sup> Roché Mahon,<sup>8</sup> Adrian Trotman,<sup>9</sup> Leslie Rollock,<sup>9</sup> Marquita Gittens-St. Hilaire,<sup>10,11</sup> Desmond King,<sup>8</sup> and Steven Daniel<sup>9</sup>



# What are Climate Services for health?

## Emerging field of applied science

Defined as “the entire iterative process of joint collaboration between relevant multidisciplinary partners to identify, generate and build capacity to access, develop, deliver, and use relevant and reliable climate knowledge to enhance health decisions” (WMO/WHO, 2016)

# Why/when do we need collaboration to develop CS for health?



**Find out more:** Are there existing collaborations between the climate and health sectors in your jurisdiction? Are these short-term ad hoc (on a per-project/grant basis) collaborations or longer-term formal partnerships with a stable budget and joint work plan? What steps can be taken to strengthen these partnerships?

## Examples

- Fundraising
- Local studies linking climate and health outcomes
- Design of the tool
- Development of the tool
- Capacity building and training
- Implementation of the tool
- Evaluation and learning

# For climate services to be usable/useful for the health sector, the knowledge or tools must be...

***Salient*** – information relevant to decision-making bodies and provided when it is needed.

***Credible*** - authoritative, believable, and trusted.

***Legitimate*** - developed via a process that considers the values and perspectives of all actors (e.g. scientists and stakeholders).

Scientific knowledge and tools (e.g., climate services) that meet these criteria are more likely to translate into public health action.

Cash DW, Clark WC, Alcock F, Dickson NM, Eckley N, Guston DH, et al. Knowledge systems for sustainable development. Proc Natl Acad Sci. 2003;100:8086–91.

# Who are the potential users of the climate service?

## Users

- National and local governments
- International funders and initiatives
- Public health service providers
- Health service providers
- Health emergency and humanitarian actors
- Researchers
- Journalists
- Public educators
- Community leaders

## Roles

- Policy, resource allocation, operations
- Policy, resource allocation
- Operations, policy
- Operations
- Planning and operations
- Research, risk identification, policy
- Inform communities
- Training, capacity building
- Response, risk identification

Adapted from Table 11, [Health Exemplar to the user interface platform of the Global Framework for Climate Services \(GFCS\)](#). Geneva, Switzerland: World Meteorological Organization; 2014.

# Stakeholder analysis

## Example: Barbados and Dominica

- Stakeholder mapping is a useful exercise to identify institutional partners that are currently engaged in the specific climate-health issue and to identify key partners that may be missing.
- Although the primary end users are likely the public health sector, there may be other end users who should be involved.
- Partners may include government agencies and donors, NGOs, universities, and the private sector



Fig 2. from Stewart-Ibarra AM, Romero M, Hinds AQ, Lowe R, Mahon R, Van Meerbeeck CJ, et al. Co-developing climate services for public health: Stakeholder needs and perceptions for the prevention and control of Aedes-transmitted diseases in the Caribbean. PLoS Negl Trop Dis. 2019;13:e0007772.



# What conditions are needed to create usable climate services for the health sector?

- Ownership by the health sector
- Evidence that the needs of the health sector are met
  - Relevance to measurable health outcomes (benefits to human lives and health)
  - Evidence that climate services enhance the delivery of health services
  - Tight linkages to existing health priorities, goals, mandates, agendas
  - Evidence that the use of the climate service is cost-effective for the health sector
- Accountability of joint commitments/outcomes by climate & health sectors
- Political and financial commitment by the climate and health sectors
- Existence of organisational resources, such as technical capacity to use and understand the climate service

[Health Exemplar to the user interface platform of the Global Framework for Climate Services \(GFCS\)](#). Geneva, Switzerland: World Meteorological Organization; 2014.

Dilling L, Lemos MC. Creating usable science: Opportunities and constraints for climate knowledge use and their implications for science policy. *Glob Environ Change*. 2011;21:680–9



# Questions to consider when engaging with partners

- Is the final product aligned with health sector **needs/priorities**?
- What resources currently exist to support the **design and development** of the tool?
- Is the final product aligned with climate and health sector capacities? What resources are needed for **implementation**?
- What **capacities** need to be strengthened?
- Is there sustainable **funding/resourcing** to support the tool? What institution is responsible for implementation going forward?
- Is there **political/institutional/community support** for the development and implementation of the tool?

# Assessing capacity to implement climate services for health

## Example from Barbados and Dominica



Health sector stakeholders in Barbados and Dominica were asked about the current strengths and weaknesses of the health sector with respect to capacities needed to implement a climate-driven early warning system for arboviral diseases.

Fig 3 from Stewart-Ibarra AM, Romero M, Hinds AQ, Lowe R, Mahon R, Van Meerbeeck CJ, et al. Co-developing climate services for public health: Stakeholder needs and perceptions for the prevention and control of Aedes-transmitted diseases in the Caribbean. PLoS Negl Trop Dis. 2019;13:e0007772.



# Collaboration creates an environment that enables the translation of scientific knowledge to public health action

- Key partners work together through a **collaborative, continuous and iterative process** throughout the design, development and implementation of the climate service.
- **Trust is key.** A trusting relationship lies at the foundation of sustained partnerships.
  - Early involvement of key partners
  - Create a sense of shared ownership
  - Result: Greater credibility, effectiveness and performance of the final product.

[Health Exemplar to the user interface platform of the Global Framework for Climate Services \(GFCS\)](#). Geneva, Switzerland: World Meteorological Organization; 2014.

Kotova L, Terrado M, Krzic A, Djurdjevic V, Garrett N, Strachan J, et al. Lessons and practice of co-developing climate services with users. 2017. [https://www.climateurope.eu/wp-content/uploads/2018/03/Climateurope\\_D4.2\\_FINAL.pdf](https://www.climateurope.eu/wp-content/uploads/2018/03/Climateurope_D4.2_FINAL.pdf). Accessed 22 Jun 2020.

Lemos MC, Kirchhoff CJ, Ramprasad V. Narrowing the climate information usability gap. *Nat Clim Change*. 2012;2:789–794.



World Health  
Organization

# Climate services are co-created through a collaborative process that addresses an urgent health problem, in which partners share concerns and interests.

Team members...

- Work together as equals.
- Are open to new ways of thinking.
- Are inclusive, adaptable, reflective, and flexible.
- Are committed to a long-term process of collaboration.

Rouhaud E. Co-producing climate knowledge: Great in theory, how about practice?  
2018. <https://cdkn.org/2018/03/feature-co-production/>



# The collaborative process is centered on co-learning, where partners learn from each other as equals

## A focus on co-learning allows the team to:

- Better understand each other's contexts, needs, and limitations
- Address barriers to climate information use, such as issues that affect decision-making
- Better understand local climate, social, and ecological factors that influence health risk factors
- Adapt and respond to changes in the needs/expectations of the end users
- Better understand each partner's role, responsibilities and expectations.

[Health Exemplar to the user interface platform of the Global Framework for Climate Services \(GFCS\)](#). Geneva, Switzerland: World Meteorological Organization; 2014.

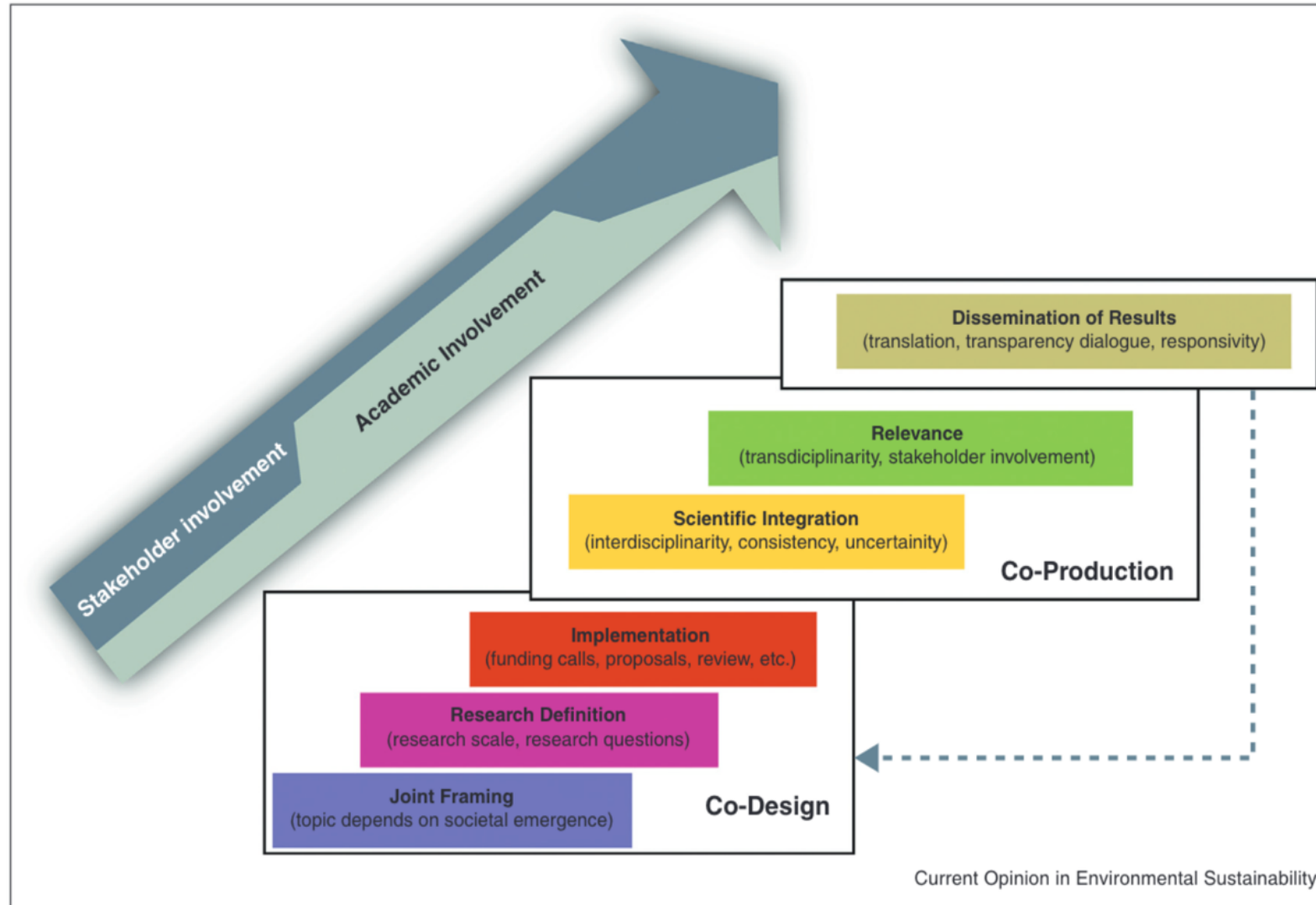
Kotova L, Terrado M, Krzic A, Djurdjevic V, Garrett N, Strachan J, et al. Lessons and practice of co-developing climate services with users. 2017. [https://www.climateurope.eu/wp-content/uploads/2018/03/Climateurope\\_D4.2\\_FINAL.pdf](https://www.climateurope.eu/wp-content/uploads/2018/03/Climateurope_D4.2_FINAL.pdf).

Lemos MC, Kirchhoff CJ, Ramprasad V. Narrowing the climate information usability gap. *Nat Clim Change*. 2012;2:789–794.

Foundation TR. Learning to support co-production. BRACED. <http://www.braced.org/resources/i/?id=f69880ae-f10f-4a51-adb5-fb2a9696b44d>.



# Steps in the collaborative co-creation of climate services



1. Co-Design
2. Co-Production
3. Dissemination

Fig 3 from Mauser W, Klepper G, Rice M, Schmalzbauer BS, Hackmann H, Leemans R, et al. Transdisciplinary global change research: the co-creation of knowledge for sustainability. *Curr Opin Environ Sustain.* 2013;5:420–431.

Framework for interdisciplinary and transdisciplinary co-creation of the knowledge castle.

# A collaborative modeling process

Partners work together to develop the climate service or tool through an iterative and dynamic process.

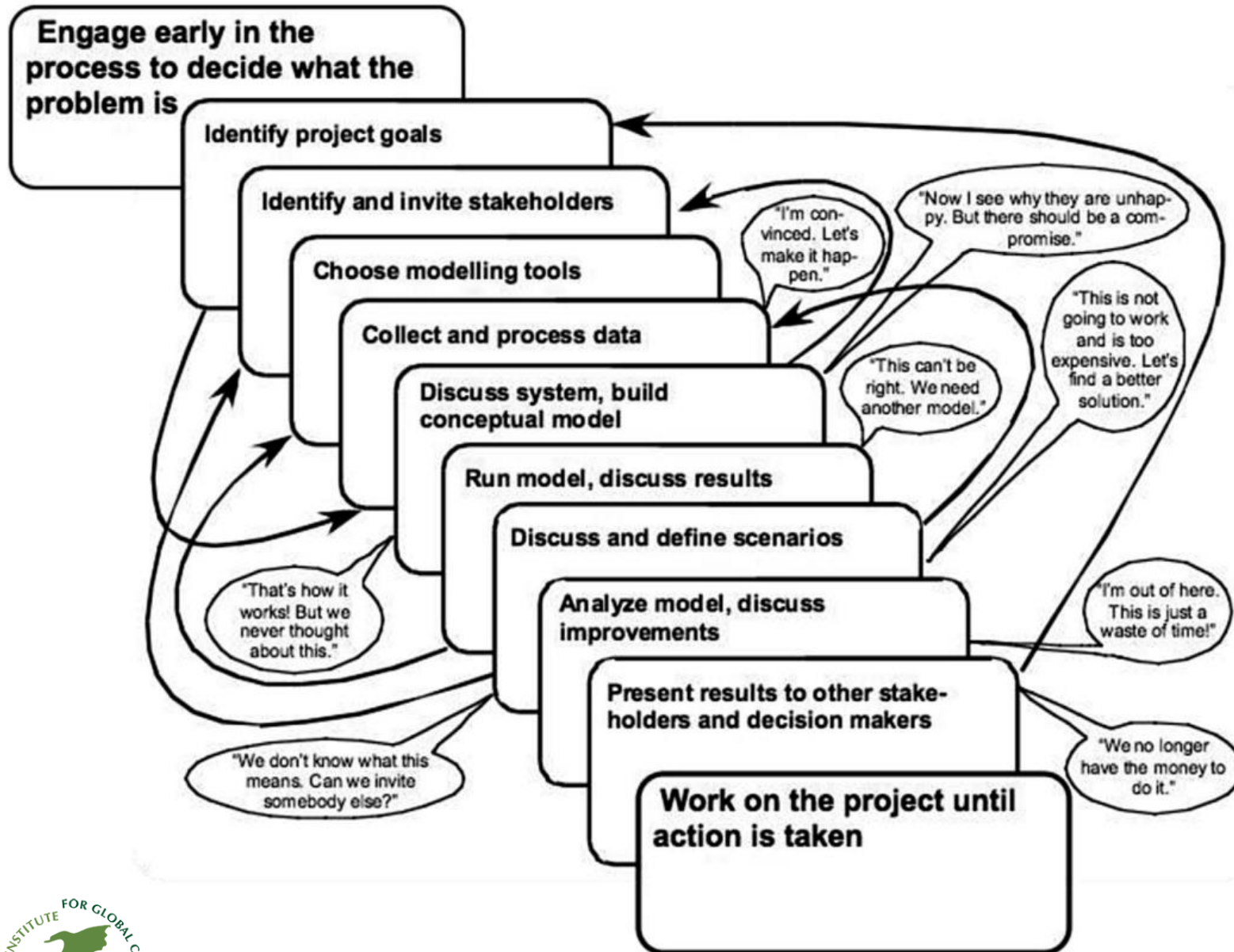


Fig 4 from Voinov A, Kolagani N, McCall MK, Glynn PD, Kragt ME, Ostermann FO, et al. Modelling with stakeholders—next generation. *Environ Model Softw.* 2016;77:196–220.

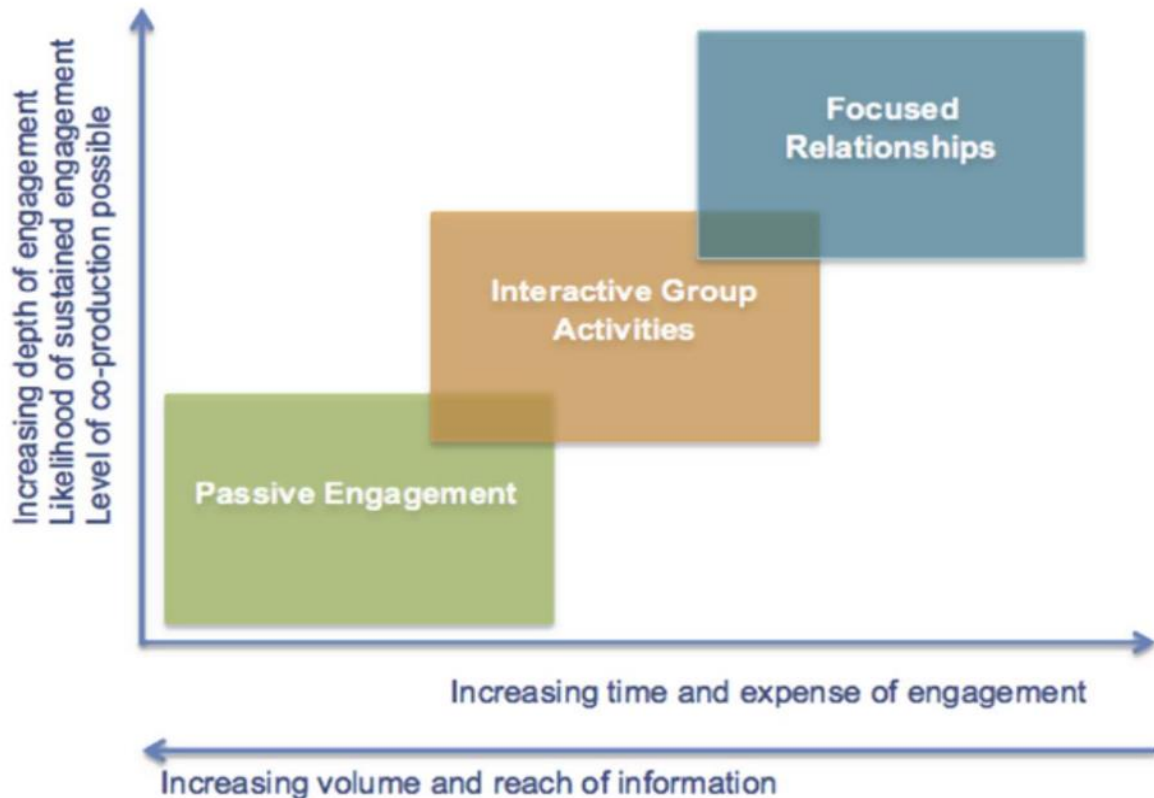
Adapted from Voinov A, Bousquet F. Modelling with stakeholders. *Environ Model Softw.* 2010;25:1268–1281.



What are the users' needs?

# Different ways to interact with partners and end users

Climate Services 8 (2017) 72–76



Multiple interfaces for user engagement and informing decisions

Active engagement

- Bespoke services
- More intense interaction
- Highly iterative
- Directly usable data
- One-to-one contact
- In-depth understanding

Focused relationships

Tailored and targeted

- Multi-way communications
- Build trust
- Co-learning
- Co-producing
- Capacity-building
- Regular interaction

Interactive group activities

Dialogue-based

- One-stop shop window
- Up-to-date
- Wide range of products
- Easy to use
- User-guided design
- Intuitive

Websites and web tools

Information provision

Passive engagement

Fig 1 from Golding N, Hewitt C, Zhang P. Effective engagement for climate services: Methods in practice in China. Clim Serv. 2017;8:72–6

Fig 1 from Hewitt CD, Stone RC, Tait AB. Improving the use of climate information in decision-making. Nat Clim Change. 2017;7:614–616.

# Common barriers to climate services (CS)

- Lack of trust, perceived lack of relevance, perceived lack of skill of the CS.
- Inflexible institutional procedures and decision rules
- Preference for established/tested approaches instead of unproven tools
- CS are less important than other kinds of information in decision processes
- CS are not aligned with existing health policy goals
- Low willingness/ability to consider the risk/uncertainty of a forecast
- Perception that CS were not relevant to improving health outcomes
- Potential for public criticism if the CS forecast fails
- Funding models that (1) limit the involvement of partners in research design and (2) do not support long-term collaborations.
- Academic systems that do not incentivise relationship building and collaborative science
- Excessive demands on partners who have limited capacity/resources/time

Rouhaud E. Co-producing climate knowledge: Great in theory, how about practice? 2018. <https://cdkn.org/2018/03/feature-co-production/>

Dilling L, Lemos MC. Creating usable science: Opportunities and constraints for climate knowledge use and their implications for science policy. *Glob Environ Change*. 2011;21:680–9.



# Caribbean case study: Key strategies to strengthen climate-health partnerships

- An integrated approach to the development of climate services for health spanning research, operations, data/knowledge sharing platforms, outreach, awareness raising, education, in-country response, and mitigation plans/policies.
- Securing political support from the senior leadership of the Ministry of Health.
- Formal collaboration agreements amongst climate, health, and other sectors.
- National committees on climate and health.
- Shared spaces for dialogue between the climate and health sectors.
- Framing of climate services for health as a national development priority.



Stewart-Ibarra AM, Romero M, Hinds AQ, Lowe R, Mahon R, Van Meerbeeck CJ, et al. Co-developing climate services for public health: Stakeholder needs and perceptions for the prevention and control of Aedes-transmitted diseases in the Caribbean. *PLoS Negl Trop Dis.* 2019;13:e0007772.

# Key strategy: Create spaces of joint dialogue/listening to build trust

*“Just sitting with people in the sectors makes such a big difference... Understand them, what drives them, what are their needs? Because we might think they need something they don’t... Sometimes it’s about forgetting yourself and putting yourself in the other person’s shoes to really figure out what the need is about. That’s true engagement”*

*“Once we build the trust, then we build the network, then we can see what the willingness to collect, to centralize, to digitize, and to share the data really is.”*

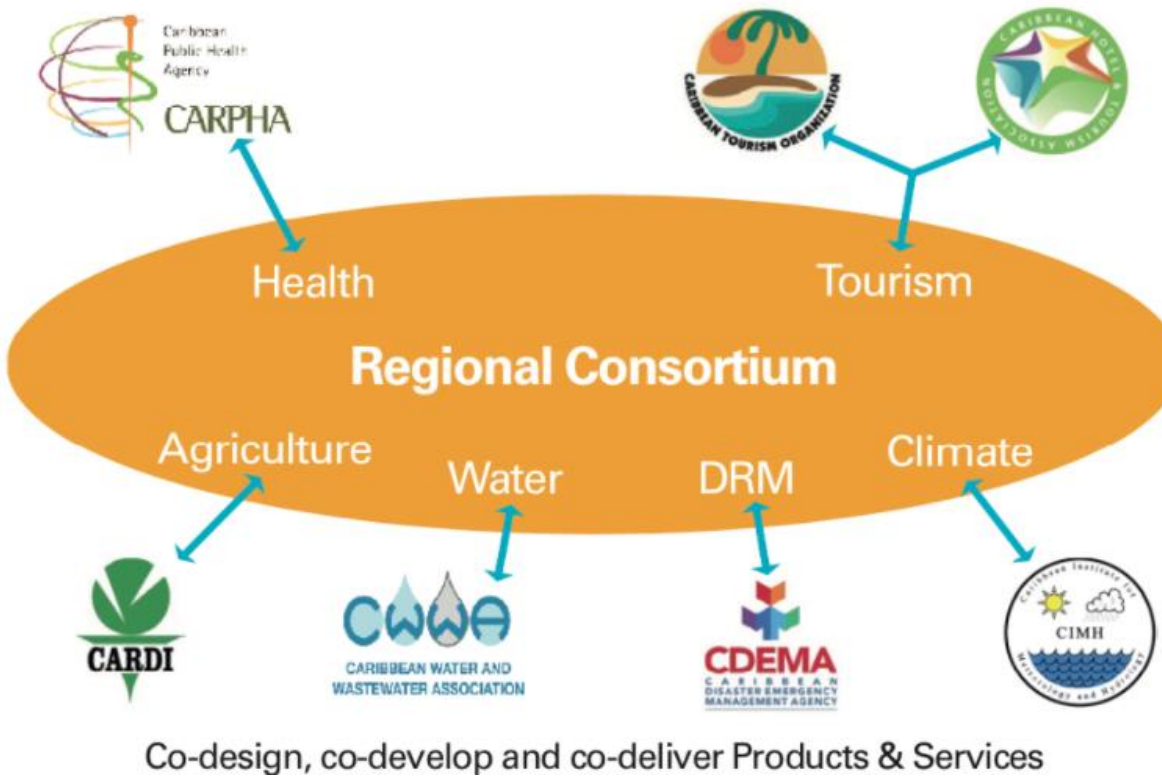
-Caribbean climate sector stakeholders

Stewart-Ibarra AM, Romero M, Hinds AQ, Lowe R, Mahon R, Van Meerbeeck CJ, et al. Co-developing climate services for public health: Stakeholder needs and perceptions for the prevention and control of Aedes-transmitted diseases in the Caribbean. PLoS Negl Trop Dis. 2019;13:e0007772.



# Key strategy: Formal collaboration agreements

## Example: Caribbean Regional Consortium



- A regional consortium of sectoral coordination partners and a regional climate service provider (CIMH) work together to co-design, co-develop and co-deliver user-specific and actionable climate information products.
- The health sector joined this consortium in 2017.
- Formal collaboration agreements signed.
- Allows for synergies across sectors.

Fig 1 from Trotman AR, Mahon R, Shumake-Guillemot J, Lowe R, Stewart-Ibarra AM. Strengthening Climate Services for the Health Sector in the Caribbean. Bull World Meteorol Organ. 2018;67.

# Example: Caribbean Health-Climatic Bulletin



## Caribbean Health Climatic Bulletin

Vol 4 | Issue 2

June 2020

This Bulletin is a joint effort between the Caribbean Public Health Agency (CARPHA), the Pan American/World Health Organization (PAHO/WHO) and the Caribbean Institute for Meteorology and Hydrology (CIMH). It aims to help health professionals identify and prepare health interventions for favorable or inclement climate conditions in the Caribbean. The period covered is June - August 2020. It is that health stakeholders should use the combination of monitoring (February - April 2020) and forecast (June - August 2020) climate information presented in this Bulletin in tandem with weather forecasts (1-7 days). This suite of information is intended to guide strategic and operational decisions related to health interventions and the management of health care systems.

### What are the Key Climate Messages for June - August 2020?

- The **2020 Hurricane Season** officially starts on June 1st, but storms and hurricanes have occurred before the official start date (including 2 named Tropical Storms this year). There is a strong consensus that this year will bring an active season with around 16 named storms, of which there would be around 8 hurricanes. Severe weather systems, which can come with a range of hazards, including high winds, landslides, flash floods, among others, are expected to affect Caribbean territories.
- We expect wetter than usual conditions will bring progressive drought relief and keep daytime temperatures close to normal, though high humidity by the end of August will elevate daytime heat stress. However, nighttime heat stress, flood potential and tropical cyclone activity will be particularly elevated. That said, there is a **chance** that more heat stress and slower drought relief will take place than anticipated, wherever rainfall does not end up being very high.

### What are the Health Implications for June - August 2020?

#### Respiratory Illness



- Frequent episodes of Saharan dust incursions into the Caribbean in the coming season may increase the risk of exacerbations of **allergic rhinitis** and **asthma** in susceptible persons. The short term drought and associated increase in dust, as well as, potential soot and smoke from bushfires may contribute to higher concentrations of airborne particulate matter. This could result in an increase in acute

#### Vector-Borne Illness



- Where there is ongoing drought and with recurrent dry spells during this period, there may be increased use of containers for storage, as well as water accumulating in any unattended, open containers. This may potentially create more breeding sites for mosquitoes, especially those associated with diseases, such as **Dengue**, **Chikungunya** and **Zika**. Proper management of water

### More on Climate

### Looking Back: February - April 2020

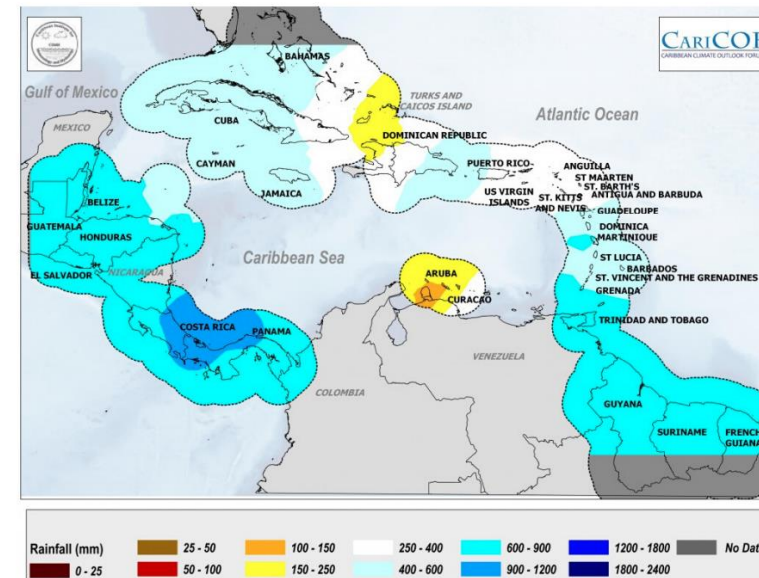
#### Rainfall

- Due to **rainfall deficits** from February to April, short term drought has developed across central and southeastern parts of the Bahamas, in northern Belize, the Cayman Islands, Cuba, northern and western Guyana, Hispaniola, Martinique, southern Saint Lucia, southeastern Suriname and western Trinidad.

### What do we Usually Expect for June to August?

#### Rainfall

- This period typically marks the first half of the wet season in Belize and the Lesser Antilles, the centre of the wet season in The Bahamas and the Greater Antilles, the transition from the primary wet season to the dry season during August in the Guianas, and part of the long dry season in the ABC Islands. This is illustrated in the Figure below (Historical Average Rainfall Totals). Click on the image to see a larger map.



<https://rcc.cimh.edu.bb/health-bulletin-archive/>



World Health Organization

# Summary: Key strategies for strengthening partnerships

- A dynamic and iterative approach focused on joint learning, design, development, and dissemination.
- Identify ethical common principles to guide the collaborative process
- Define roles and responsibilities, outcomes, and manage expectations.
- Ongoing evaluation of the CS and assessment of user needs
- Clear communication
- Identify an appropriate funding model
- Identify, share and adapt useful approaches and best practices
- Assess and strengthen existing capacities to understand/use CS
- Create shared spaces and networks to build relationships and trust

Health Exemplar to the user interface platform of the Global Framework for Climate Services (GFCS). Geneva, Switzerland: World Meteorological Organization; 2014.

[https://gfcs.wmo.int/sites/default/files/Priority-Areas/Health/GFCS-HEALTH-EXEMPLAR-FINAL-14152\\_en.pdf](https://gfcs.wmo.int/sites/default/files/Priority-Areas/Health/GFCS-HEALTH-EXEMPLAR-FINAL-14152_en.pdf). Accessed 22 Jun 2020.

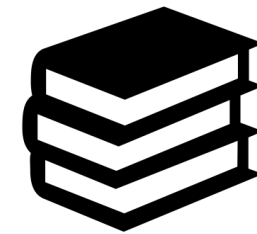
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Trotman AR, Mahon R, Shumake-Guillemot J, Lowe R, Stewart-Ibarra AM. Strengthening Climate Services for the Health Sector in the Caribbean. *Bull World Meteorol Organ*. 2018;67.





## Section 5.3:

### Implementing climate-informed decision-support tools: risk communication

#### Learning objective:

Understand the general principles and resources needed for risk communication, as well as the key components of a risk communication strategy.

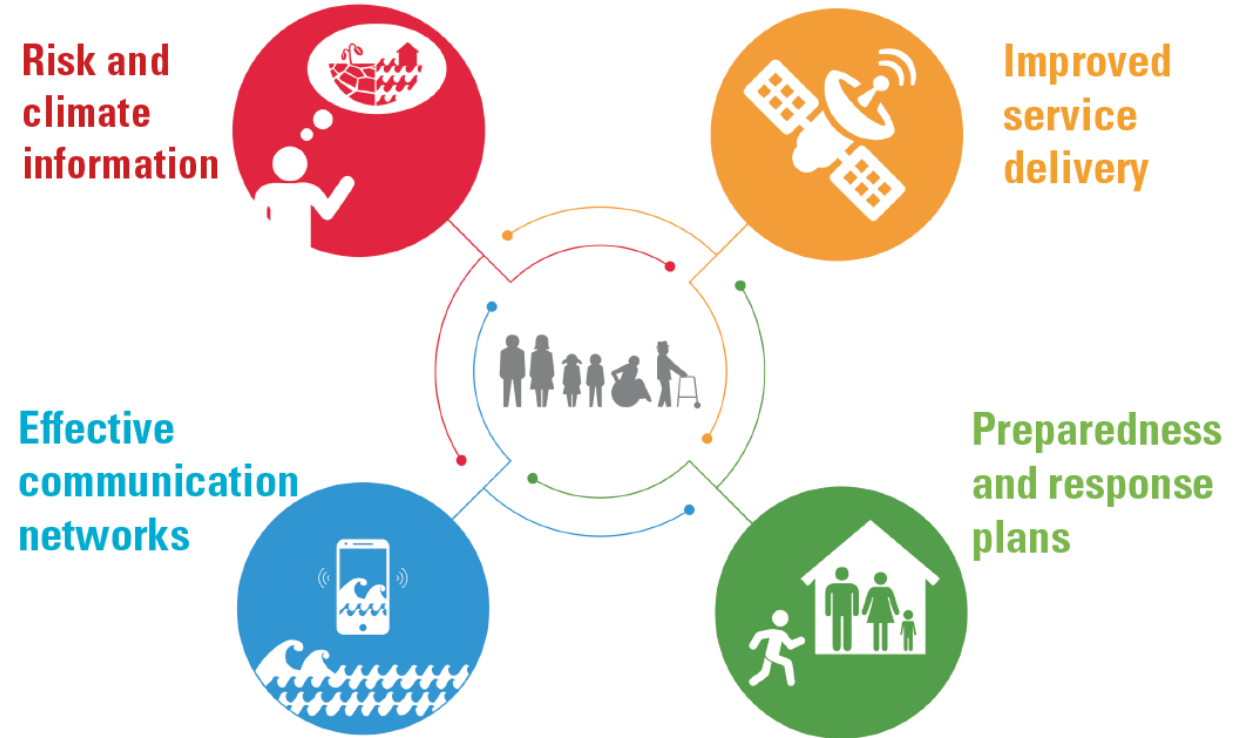
#### Resources:

- [Climahealth: Risk Communication](#)
- [Communicating risk in public health emergencies: a WHO guideline for emergency risk communication \(ERC\) policy and practice](#)
- [Communicating on climate change and health: Toolkit for health professionals](#)
- [Multi-hazard Early Warning Systems: A checklist](#)



# Implementing climate-informed decision-support tools

## *Risk communication*

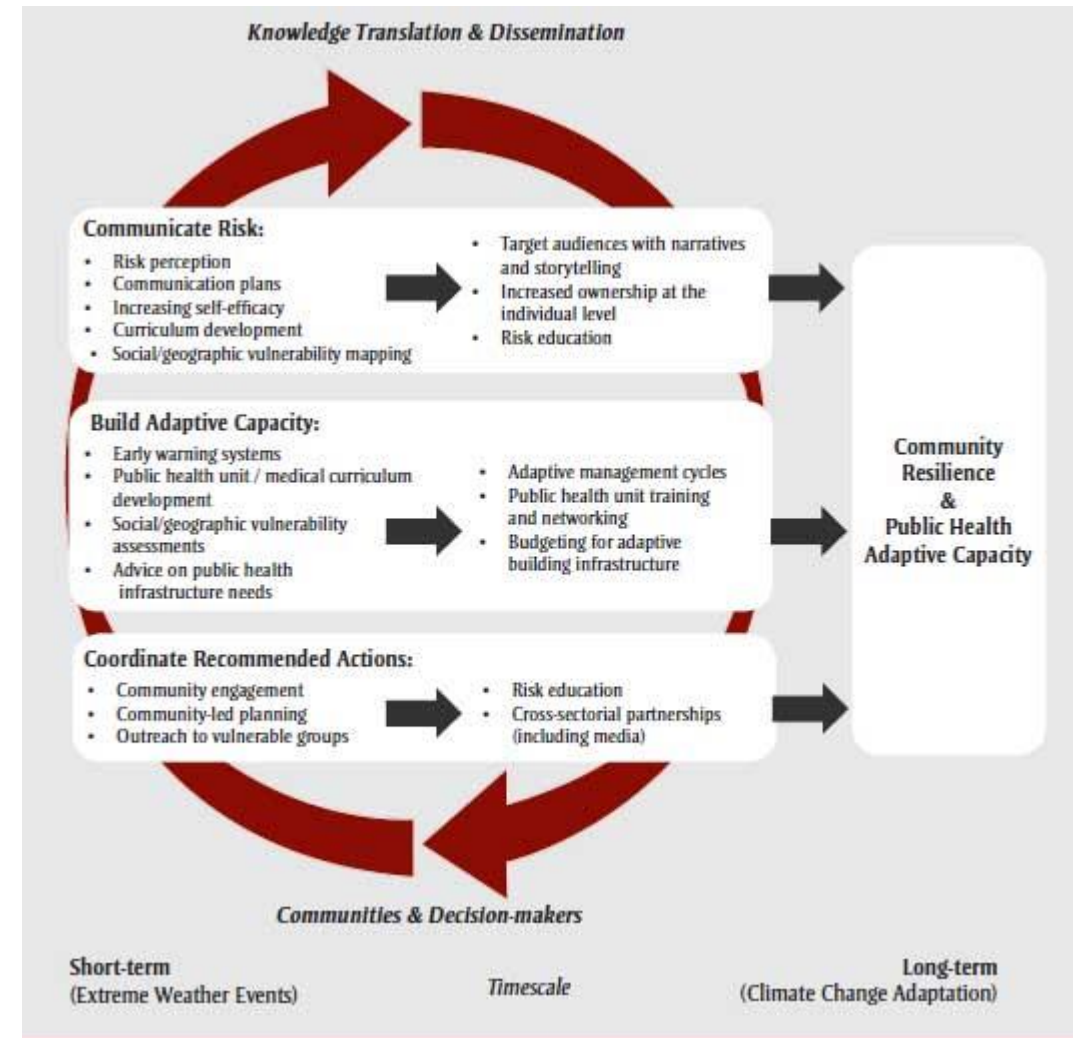




An officer from the National Meteorological and Hydrological Service introduces health officers to the Maprooms, a newly installed climate service in Malawi. Photo credit: Lucía Fernández Montoya.

# Risk communication

- The **real-time exchange** of information, advice and opinions between experts, community leaders, officials and the people at risk
- Allowing **people at risk** to understand and adopt protective behaviours
- Allowing **authorities and experts** to listen to and address people's concerns and needs



Conceptual framework for extreme weather and climate change risk communication and public health adaptive capacity

# General principles for risk communication

1. Create and maintain trust
2. Acknowledge and communicate even in uncertainty
3. Coordinate
4. Be transparent & fast with the first and all communications
5. Be proactive in public communication
6. Involve and engage those affected
7. Use integrated approaches
8. Build national capacity, support national ownership



## WHO's integrated systems model for assessing emergency risk communication capacity in joint external evaluations

A Systems Perspective on Strengthening Risk Communication and Community Engagement in Disease Outbreak Response (2017); [Link](#)



World Health Organization

# Risk communication resources

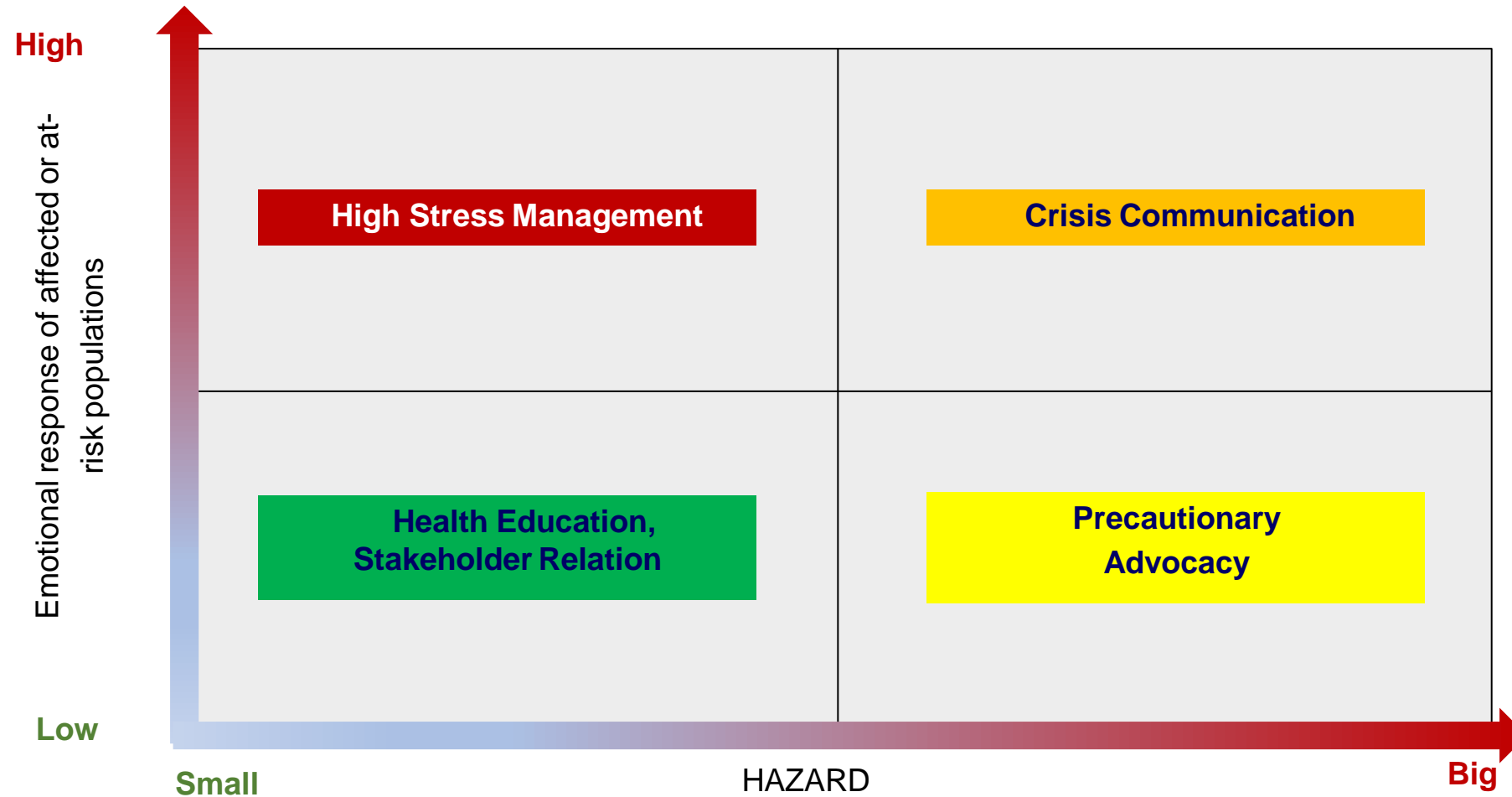
**Uses a mix of tactics and approaches,** including but not limited to

- public communication
- media communication
- social media
- reputation management and institutional communications
- mass awareness initiatives
- health promotion
- partner engagement
- social mobilization
- community engagement



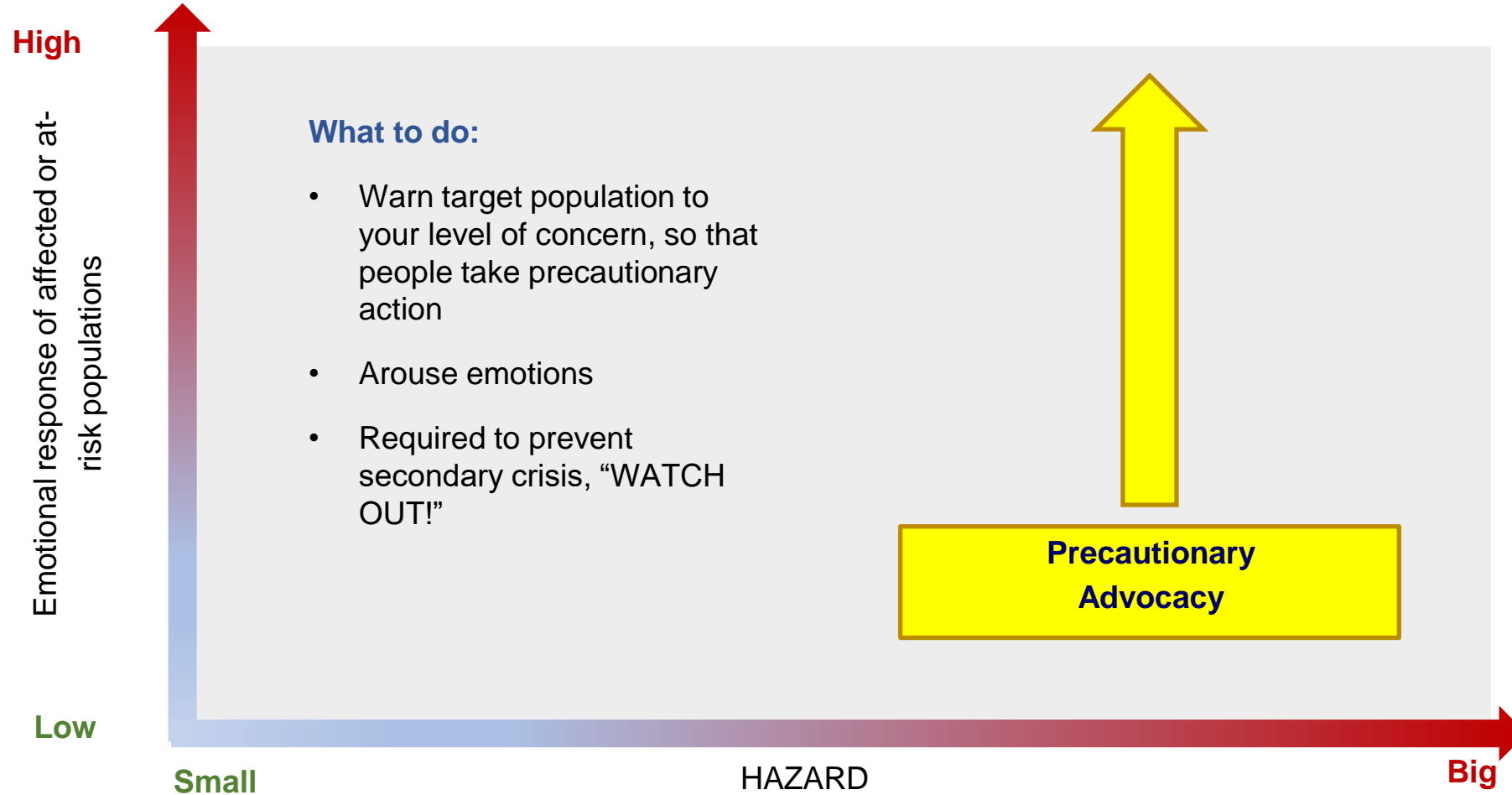
<https://www.compare-europe.eu/News/2015/05/Risk-communication-in-the-COMPARE-project>

# General risk communication strategy



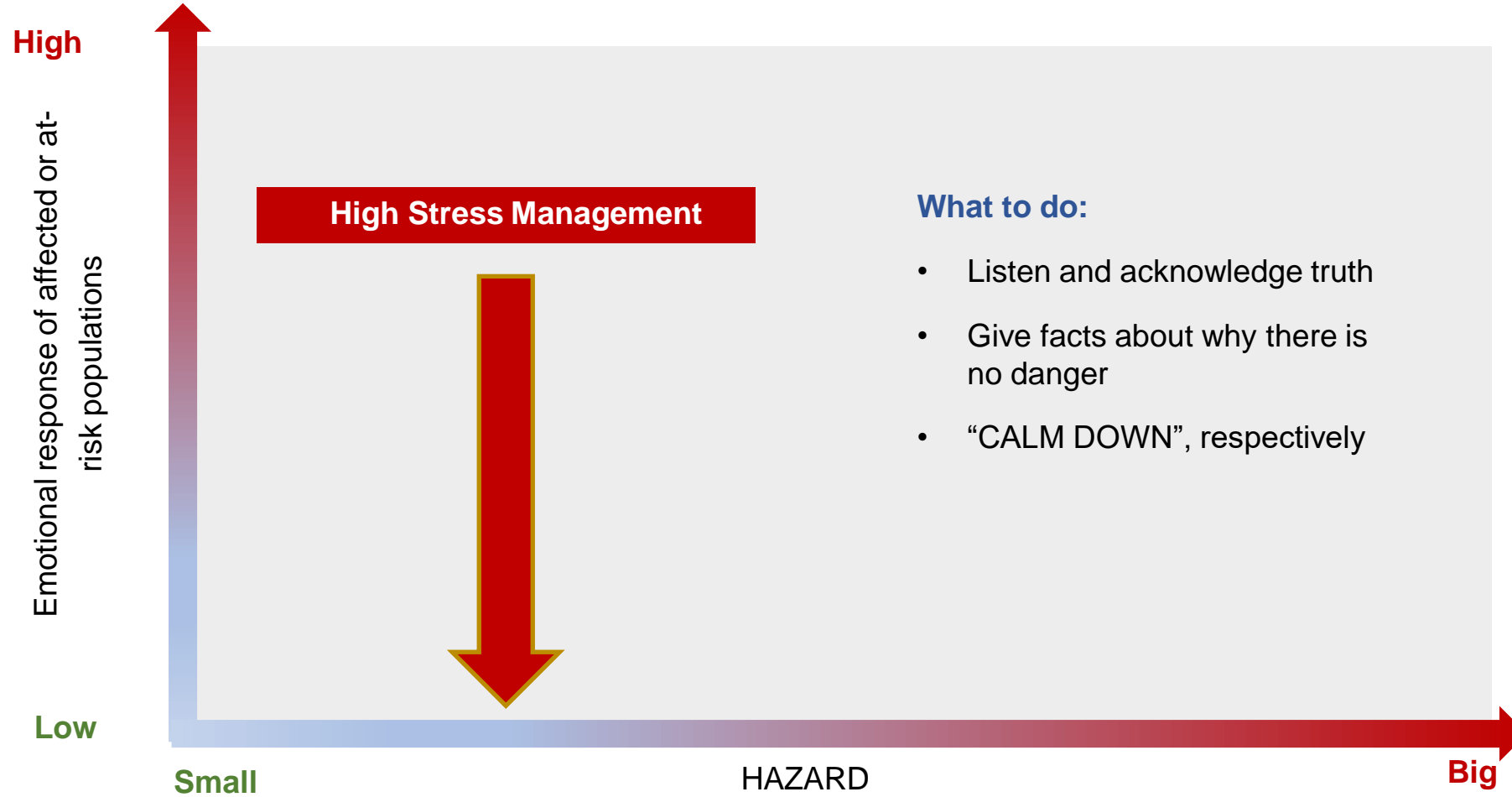
Modified from Peter Sandman

# General risk communication strategy



Modified from Peter Sandman

# General risk communication strategy



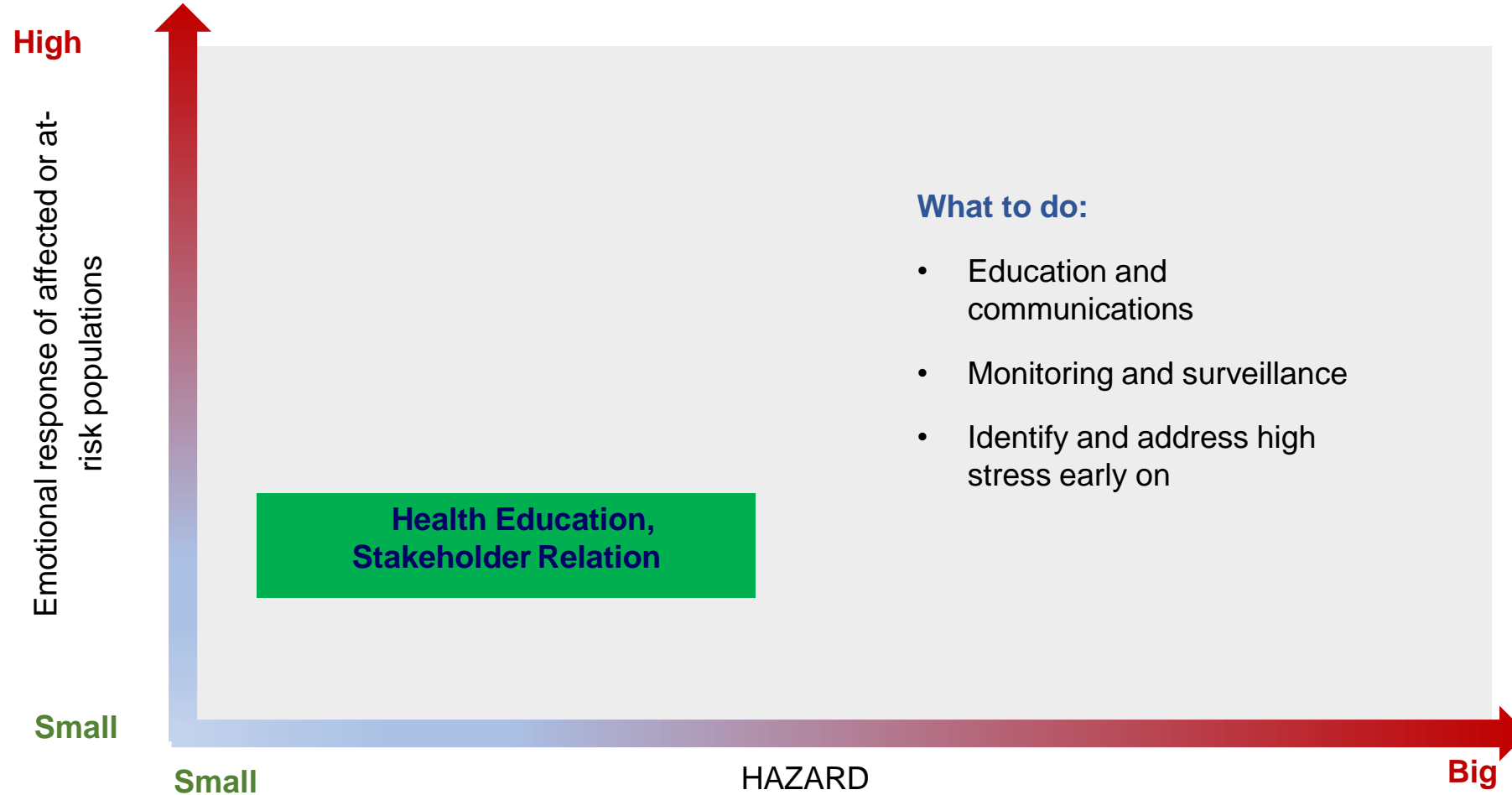
Modified from Peter Sandman

# General risk communication strategy



Modified from Peter Sandman

# General risk communication strategy



Modified from Peter Sandman

# Common approaches to building effective climate risk communication for health

- Mainstream partnerships and information products into **health policies and programmes**
- Jointly engage the Ministry of Health and the national meteorological services to **co-develop climate services for health**
- Conduct workshops to **co-develop research and climate service features** with national health authorities
- Ensure **open access** to processed information and promote available resources



# Common approaches to building effective climate risk communication for health

- Encourage **open discussion and feedback** to enhance understanding, ownership, and consensus on essential climate service features
- Communicate **local evidence of climate and weather impacts** on community health, highlighting opportunities for climate-informed risk management
- **Pilot test** the service before widespread implementation
- Provide **decision-makers** with hands-on exposure to prototypes or preliminary versions of the services



# Caribbean Health Climatic Bulletin

Vol 2 | Issue 3

September 2018




This Bulletin is a joint effort between the Caribbean Public Health Agency (CARPHA), the Pan American/World Health Organization (PAHO/WHO) and the Caribbean Institute for Meteorology and Hydrology (CIMH). It aims to help health professionals identify and prepare health interventions for favorable or inclement climate conditions in the Caribbean. The period covered is September 2018 to November 2018. It is recommended that health stakeholders should use the combination of monitoring (May 2018 - July 2018) and forecast (September 2018 - November 2018) climate information presented in this Bulletin in tandem with weather forecasts (1-7 days). This suite of information is intended to guide strategic and operational decisions related to health interventions and the management of health care systems.

## What are the Key Climate Messages for September to November 2018?

- The period September to November usually marks the **wettest part of the year** in Belize and the Caribbean islands, with an annual peak in the frequency of wet days, wet spells and extreme wet spells. In the coastal Guianas, the **dry season** usually lasts until mid to late November. Meanwhile, the ABC Islands usually transition into their wet season at this time.
- **Temperatures** are usually initially high which, combined with a peak in air humidity, can feel **uncomfortable** until the end of September in northern parts of the region, and until October in the southern Caribbean. High temperatures are usual across the Guianas at this time.
- **Rainfall totals** from September to November are forecast to likely be the usual or drier across the ABC Islands, Belize, the Lesser Antilles and the Guianas (*medium confidence*). By contrast, The Bahamas and Cayman Islands are forecast to be at least as wet as usual (*medium confidence*).
- It is not unusual to have spells of moderate to heavy rainfall, i.e. wet spells, interspersed with dry spells during the late wet season. Most of the region is forecast to see a slightly lower number of **wet days and wet spells** than usual, reducing the potential for long-term flooding.
- At the same time, **flash floods** are a concern in the event of **extreme wet spells** in any area, but less likely so in the Guianas.
- Notwithstanding, a number of **dry spells** can still be expected in the ABC Islands, The Bahamas, northern and central portions of Belize, the Greater Antilles and the Guianas, but very few in the Lesser Antilles (*high confidence*).
- Region-wide, **drought** or excessive dryness is not forecast to be a major concern during this period (*high confidence*), but should be monitored closely in particular in northern Belize, the Cayman Islands and the Leewards.
- **Night-time and day-time temperatures** are forecast to be slightly cooler than in most recent years, making the September (and October) heat likely more tolerable than in recent years (*medium confidence*).
- **Heat waves** will become less likely towards November across the region (*high confidence*).
- The **tropical cyclone activity** of the 2018 Hurricane Season as a whole is unlikely to match last year's (*high confidence*). Although the credible forecasting sources suggest a below-normal to near-normal season as a whole (*medium to high confidence*), **preparedness** for the range of hazards brought about by tropical depressions, storms and hurricanes still **remains critical**.
- Episodes of **Saharan dust** incursions into the Caribbean usually are infrequent in this period, but can occur ahead of tropical weather systems. In the absence of drought this year, local dust levels should be on the low end.
- The **UV index** on sunny days will steadily decrease from around 10 to 8 in the north and from 12 to 10 in the south (on a scale from 1 to 12. For more information, see: <https://www.epa.gov/sunsafety/uv-index-scale-1>). Note that, despite the period marking the wet season in Belize and the Caribbean islands, many days in most areas have long sunny spells, increasing UV exposure.



## What are the Health Implications for September to November 2018?

### Non-communicable Diseases

-  Excessive heat from high temperatures across the region (exacerbated by humid air across Belize and the Caribbean islands) will become less prevalent towards November. That said, especially during September (and October in the Guianas), **heat waves** can increase the risk of morbidity from **heat stress** in vulnerable persons, especially smaller children, the elderly, pregnant women and persons with NCDs such as diabetes and hypertension.
-  Particularly in September (and October in the Guianas), there will be an increased risk of **dehydration**, which may present an associated increase in its symptoms such as apathy, general weakness, dizziness, fainting, and, in extreme cases, kidney failure. This risk decreases as we approach November.
-  During the period, excessive exposure due to dangerous UV radiation can cause **skin damage** across the population on sunny days (for more information, see: <https://www.epa.gov/sunsafety/uv-index-scale-1>).

- There is the possibility of **skin infections** due to contact with contaminated stagnant and/or flood waters particularly in any area across Belize and the Caribbean islands.

### Vector-Borne Illness

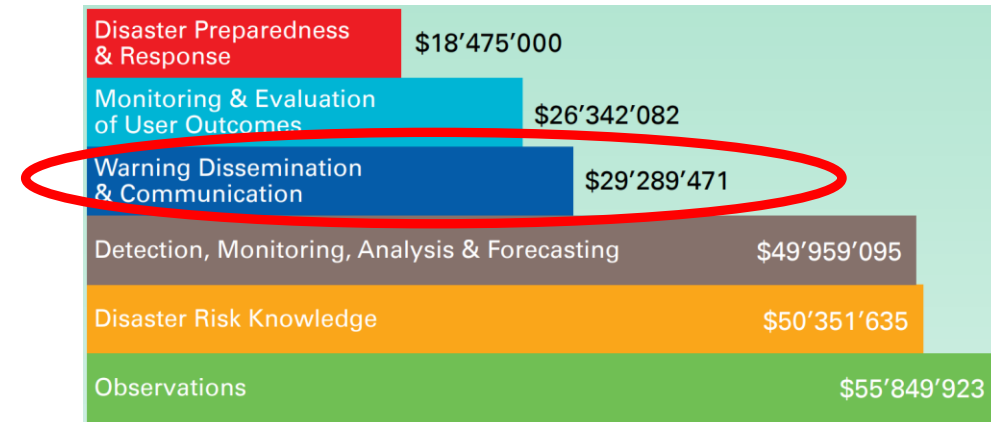
-  The presence of stagnant water in the aftermath of a flood may promote the breeding of mosquitoes and increase the risk of associated mosquito borne diseases, such as **Dengue, Chikungunya and Zika** which are of great concern for Caribbean territories (For more information, [click here](#)).
-  As the region enters the peak of the wet season, increased rainfall may also create more breeding places for mosquitoes, but it may not be to the same extent as in years with extremely high rainfall in the wet season.

*continued on page 2*

An example of a routine communication:  
*Page 1 of the September 2018 issue of the quarterly Caribbean Health Climatic Bulletin*

# Common approaches to building effective climate risk communication for health

- Increase the **capacity** of medical professionals and health decision-makers to value and use the information generated by the climate service
- Support national agencies in **technical implementation** to address capacity gaps and enhance the quality and reliability of information
- Encourage **regional knowledge exchange** to ensure the sharing of local lessons
- Ensure appropriate and adequate **investment in communication** and capacity-building for end-users and ultimate beneficiaries



Funding to address the five multi-hazard early warning system components plus observations (as identified in the 34 out of 57 reviewed projects).

2020 State of Climate Services: Risk information and Early warning systems, [Link](#)

# Warning dissemination and communication

- Deliver **clear messages** with simple, useful and actionable information
- **Trust** is crucial and takes time to establish
- Utilise **pre-identified authoritative voices**
- Employ **multiple communication channels**
- The [Common Alerting Protocol \(CAP\)](#) is an international standard format for emergency alerting and public warnings



[Multi-hazard Early Warning Systems: A checklist – Warning dissemination and communication](#)



# Checklist for warning dissemination and communication

## Are organisational and decision-making processes in place and operational?

- *Clear roles and responsibilities among actors are defined; warning communication strategies are in place; regular coordination occurs between warning issuers and distributors; feedback mechanisms are in place to determine where warnings are received; and mechanisms exist to update the information*

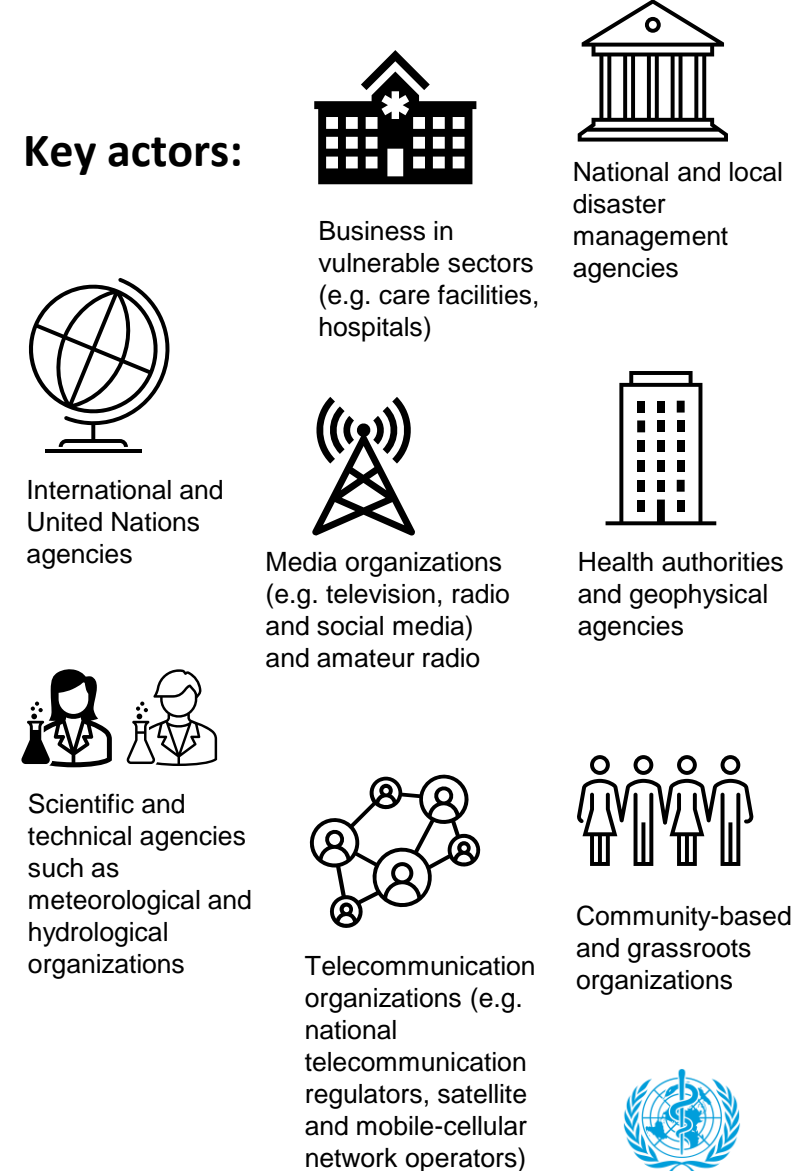
## Are communication systems and equipment in place and operational?

- *Trust between stakeholders is established; communication is tailored to target groups; warnings reach the entire population (e.g., those living in remote areas); communication strategies are evaluated to ensure message effectiveness; communication channels and backup systems are resilient to failure; agreements are in place to utilise private sector resources if needed*

## Are impact-based early warnings communicated effectively to prompt action by target groups?

- *Warnings entail clear guidance on actions to take (e.g., evacuation); automated systems are in place when reaction time is short (e.g., automatic stop of transport in case of an earthquake early warning); warnings consider different risks and needs of subpopulations; the public knows which authority issues the warnings and has confidence in their reliability.*

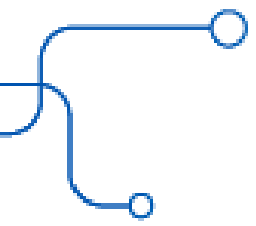
### Key actors:



# Common approaches to building effective climate risk communication for health

- Partner with the media and use social media and other communication technologies to conduct extensive communication campaigns
- Hold evaluation meetings or use survey instruments to collectively evaluate and improve underperforming aspects of a service
- Measure and communicate the value and impact of using the climate information on health outcomes and health system performance





## Section 5.4:

# Challenges and solutions in the development of climate services

### Learning objective:

Outline common challenges and potential solutions in developing climate services for health

### Resources:

- [Climate Services for Health Fundamentals and Case Studies for improving public health decision-making in a new climate](#)
- [2023 State of Climate Services: Health](#)



# Five common challenges in developing climate services for health

1. Working with available data to develop fit-for-purpose products and services;
2. Drawing upon and developing sufficient foundational capacities to support climate services;
3. Generating adequate demand and endorsement for mainstream climate service applications;
4. Securing and sustaining sufficient financial and human resources;
5. Communicating climate information and risks effectively.



# COMMON CHALLENGES

## 1 Working with available data to develop fit-for-purpose products and services

- Unaligned data collection considering spatial scales (climate data is collected at localised weather stations, health data is collected and aggregated at different administrative levels)
- Gaps and inaccuracies in climate data due to poor coverage and quality of observation networks
- Global climate products unable to provide quality data for all locations and climate variables
- Unaligned data collection frequency (health data typically collected at weekly or monthly frequencies; climate data at hourly or daily frequencies).
- User-unfriendly data formats
- Inconsistencies across data from different sources
- Poor and discontinued access to climate observations (e.g., access limited by data dissemination policies of national meteorological agencies; reluctance to provide raw observational data)

## SOLUTIONS

Produce consistent and integrated datasets containing health and climate data at the same time and spatial scales



# COMMON CHALLENGES

## 2 Drawing upon and developing sufficient foundational capacities to support climate services

- Limited capacity of both Meteorological Services and Health partners
- Inability of core observation and surveillance systems to produce quality data at adequate scales.
- Lack of appropriate information communication technology infrastructure (e.g., internet access, robust data management systems and analysis tools)
- Scientific limitations to the reliability of core climate products and services
- Lack of human understanding of the limitations of climate products and services and health surveillance systems

## SOLUTIONS (1)

- Assess process requirements and readiness
- Policy advocacy and strong documentation for investment in surveillance systems and observations
- Use community-based surveillance to complement national health records
- Understand how data is collected
- Develop, test and improve products and services



# COMMON CHALLENGES

## 2 Drawing upon and developing sufficient foundational capacities to support climate services

- Limited capacity of both Meteorological Services and Health partners
- Inability of core observation and surveillance systems to produce quality data at adequate scales.
- Lack of appropriate information communication technology infrastructure (e.g., internet access, robust data management systems and analysis tools)
- Scientific limitations to the reliability of core climate products and services
- Lack of human understanding of the limitation of climate products and services and health surveillance systems

## SOLUTIONS (2)

- Have appropriate expectations of what is scientifically feasible
- Establish partnerships with experienced project teams
- Seek mentorship and establish technology transfer mechanisms
- Facilitate access to relevant global climate data products
- Take advantage of online data management and analysis systems
- Explore suitable software and web-based applications



# COMMON CHALLENGES

## 3 Generating adequate demand and endorsement for mainstream climate service applications

- Lack of experience using climate services and information as decision-making tools
- Limited number of evaluations demonstrating the value and cost-benefit
- Poor involvement of either health or climate authorities and a lack of sufficient in-country coordination.
- Products and services developed that inadequately respond to operational health decision needs.

## SOLUTIONS

- Establish multi-sectoral and multidisciplinary groups
- Use academia and nongovernmental institutions as mediators, translators and knowledge brokers when needed
- Communicate and establish dialogue with local expert climate science experts
- Establish bilateral agreements and memoranda of understanding.
- Comply with data access and use policies



# COMMON CHALLENGES

## 4 Securing and sustaining sufficient financial and human resources

- Lack of sustained funding
- Lack of human capacity
- Lack of training opportunities

## SOLUTIONS

- Conduct cost-effectiveness and cost-benefit evaluations.
- Demonstrate benefits for health service provision and saving lives.
- Document public appreciation and value.
- Build partnerships.
- Gain hands-on experience.
- Establish students and staff exchanges.
- Attend international training courses and seek placements and funding for master's and doctoral-level studies



# COMMON CHALLENGES

## 5 Communicating climate information and risks effectively

- Poor understanding of uncertainty.
- Lack of awareness of climate-driven health risks.
- Diverse and poorly understood risk perceptions

## SOLUTIONS

- Better understand the local risk perceptions.
- Use modern communication technologies.
- Partner with local and global media.
- Include community representatives in service development processes.
- Engage communities in more effective health prevention and promotion.
- Present information in a visual and clear manner



# Case studies of climate services for health

- **India:** Innovative heat wave early warning system and action plan in Ahmedabad, India
- **Europe:** Early warning systems to guide infectious disease control in Europe
- **Spain:** Finding the right thresholds to trigger action in heat wave early warning systems in Spain
- **Brazil:** Using climate knowledge to guide dengue prevention and risk communication ahead of Brazil's 2014 FIFA World Cup
- **Global:** The spatio-temporal climate-informed early warning and response system for infectious disease outbreaks

# Innovative heat wave early warning system and action plan in Ahmedabad, India

## Context

- More than 7 million people live in Ahmedabad
- Heatwaves have caused increased heat stress, heat stroke, and heat-related illnesses in the city
- After a deadly heatwave in 2010, Ahmedabad Municipal Corporation (AMC) initiated coordinated action to protect people from extreme heat and to become more climate-resilient



A local resident reads advertisement in Gujarati with tips on how to stay cool during extreme heat events. Photo credit: Nehmat Kaur.

# Innovative heat wave early warning system and action plan in Ahmedabad, India

## New approaches

- A coalition of academic, health and environmental groups partnered with the AMC in 2011 to create an early warning system and heat preparedness plan
- Developed an interagency health action plan, including longer-term forecasting
- Identified the city's most vulnerable residents
- Three key strategies were developed
  1. *Building public awareness and community outreach*
  2. *Initiating an early warning system to alert residents and coordinate an interagency emergency response effort by establishing formal communication channels among all level stakeholders*
  3. *Increasing capacity among health professionals to recognise and respond to heat-related illnesses by providing training and advanced warnings*
- In 2013, the initial heat action plan was launched and designated to the health department for overarching coordination of all activities, including heat monitoring and dissemination of warnings



# Innovative heat wave early warning system and action plan in Ahmedabad, India

## Benefits and lessons

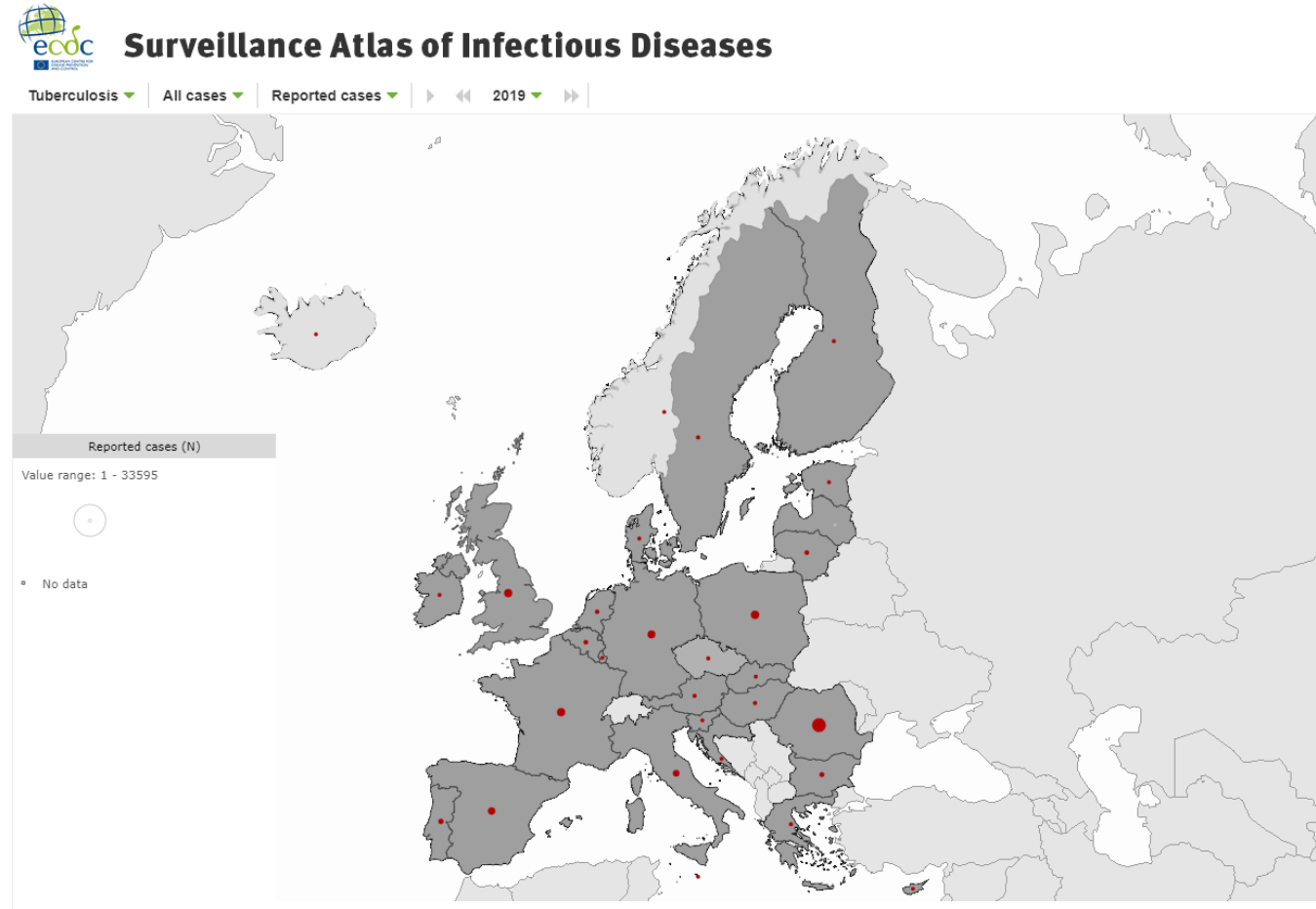
- Developed a seven-day heat forecast by increasing capacity to the local MET service to provide 5-7 day forecast
- A survey was used to assess the effectiveness by measuring whether stakeholders believed the plan was successfully administered and reached vulnerable groups
- The survey found that many lives have likely been saved, and local health professionals' awareness has increased
- Over 10 cities in India are now developing heat action plans based on this successful project
- India MET service now provides a five-day forecast to more than 100 cities in India



# Early warning systems to guide infectious disease control in Europe

## Context

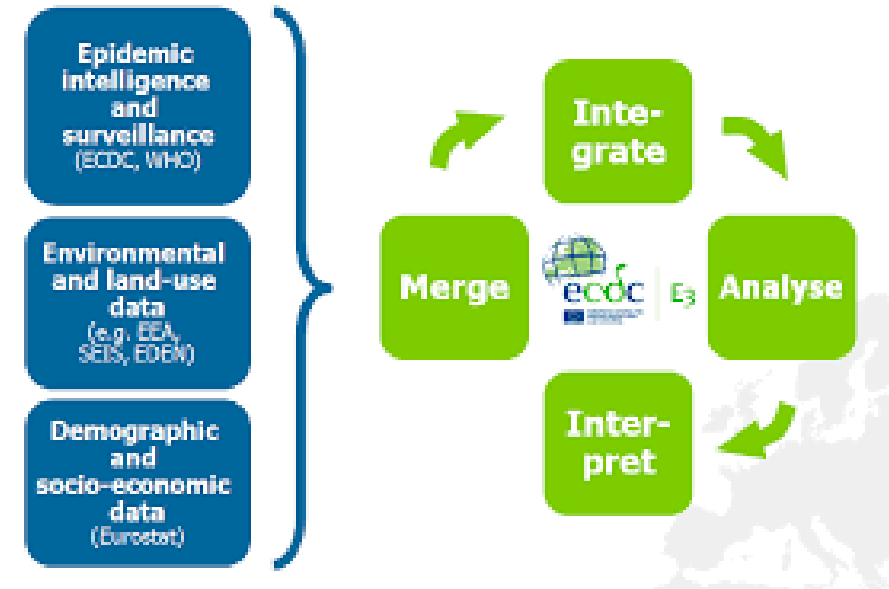
- Globalisation and environmental change, social and demographic determinants, and weak health system capacity are significant drivers of infectious diseases
- Monitoring changes in these drivers can help anticipate, or even forecast, an upsurge of disease



# Early warning systems to guide infectious disease control in Europe

## New approaches

- The European Centre for Disease Prevention and Control (ECDC) has developed the European Environment and Epidemiology (E3)
- A large set of climatic, environmental and social data has been aggregated, processed and stored in the E3 Network repository and is accessible through the E3 Geoportal
- Advanced mathematical modelling (e.g. non-linear discriminant analysis) has been used to compute the risk maps and forecasting tools

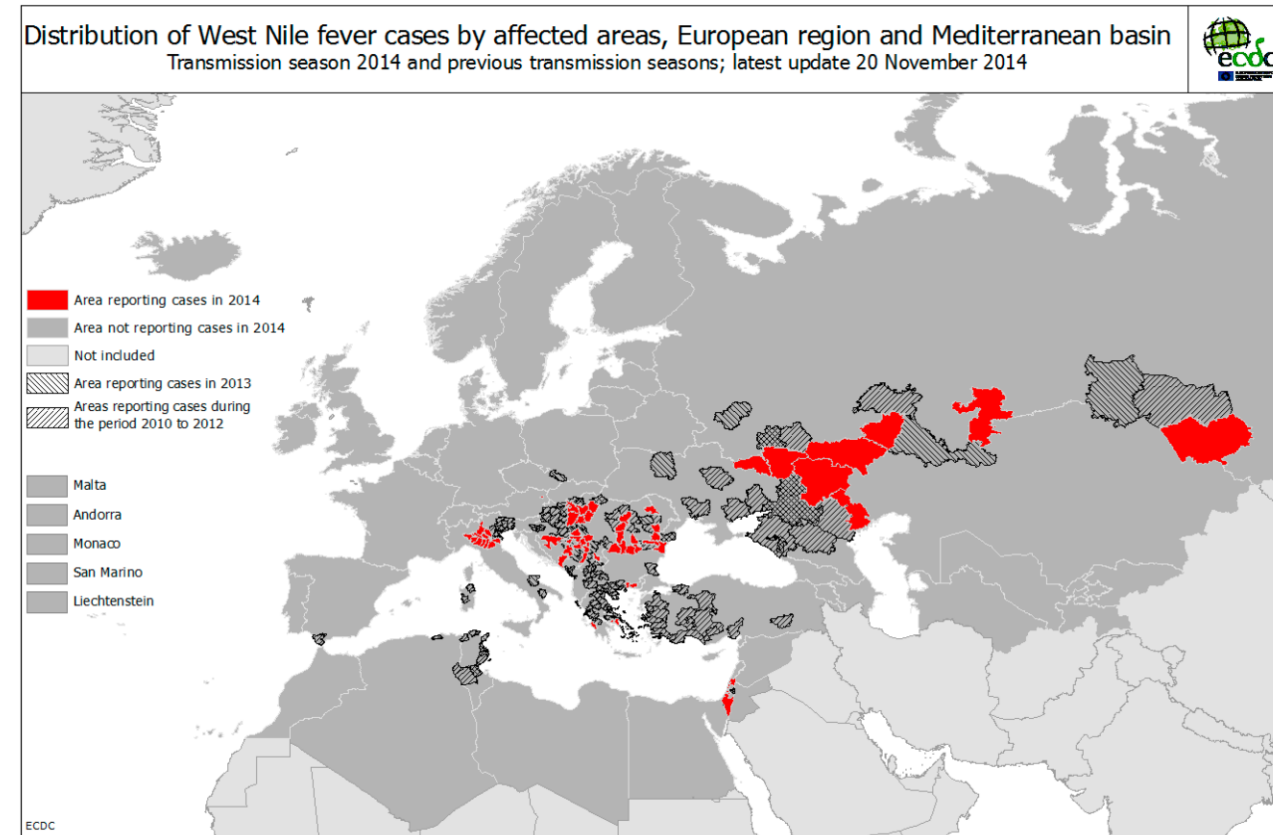


The European Environment and Epidemiology (E3) Network

# Early warning systems to guide infectious disease control in Europe

## Benefits and lessons

- Since 2010, recurrent West Nile fever outbreaks have occurred in southeastern Europe.
- Temperature deviations from a 30-year average have been proven to be associated with these outbreaks
- To assist public health decision-making in Europe, several workshops have been held with Member State representatives to train them on the E3 functions
- Such early warning systems, based on climatic and environmental conditions, can help improve and accelerate alert and public health response capabilities and provide the evidence base for strategic public health action



# Finding the right thresholds to trigger action in heat wave early warning systems in Spain

## Context

- In Spain, the State Meteorological Agency (AEMET) has been successful in using weather prediction models to forecast short- and medium-range extreme temperatures, and an early warning system (Meteolerta) has been implemented in cooperation with European EUMETNET member countries (MeteoAlarm)
- Determining threshold temperature is a key, not only when it comes to impact, but also for implementing prevention plans

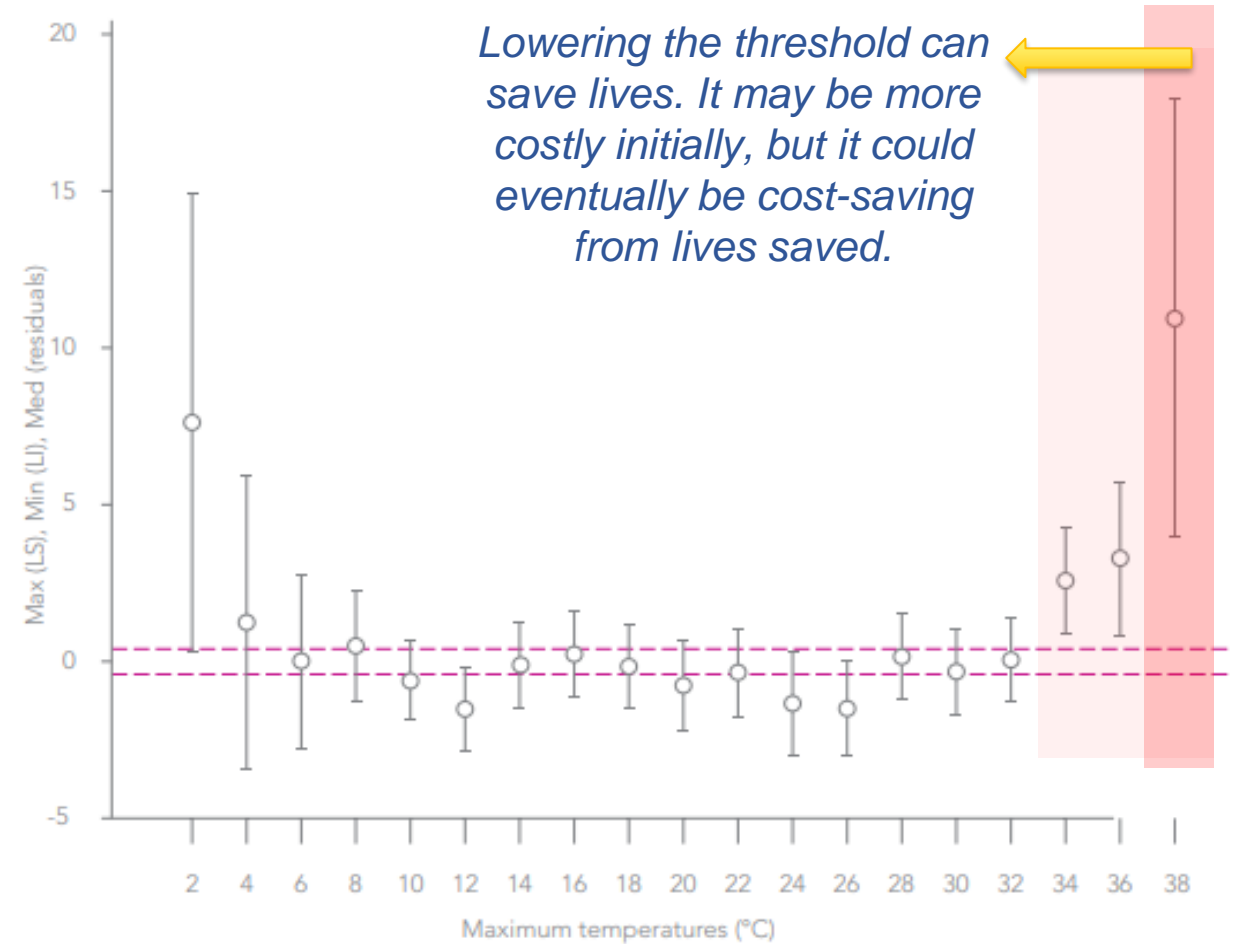


The weather station in Madrid-Retiro was used to collect temperature data for the study.

# Finding the right thresholds to trigger action in heat wave early warning systems in Spain

## New approaches

- The heat-related mortality trigger temperature in the city of Madrid across the study period was set at a daily maximum temperature of 34°C
- The threshold of 34°C was exceeded on 198 days, resulting in 1150 extra deaths
- At the threshold of 36.5°C, only 371 deaths were captured
- Thus, by lowering threshold from 36.5°C to 34 °C, additional 779 people can be saved



# Finding the right thresholds to trigger action in heat wave early warning systems in Spain

## Benefits and lessons

- Since the use of updated climate data to determine prevention plan trigger temperatures could significantly reduce heat-related mortality and produce significant cost savings
- The study suggests that over the period 2001-2009, 86 deaths could have been averted by lowering the threshold to 34°C
- Assuming each death results in an average reduction of life expectancy of 1 year and that each year of life lost equals €90 000
- This would have resulted in an annual economic benefit of €7.7 million (95% CI: €6.3–9.3 million), calculated based on 2013 values



# Dengue risk communication ahead of Brazil's 2014 FIFA World Cup

## Context

- Brazil has reported more than 7 million dengue cases in this century
- Tropical and sub-tropical climatic conditions are good for the dengue mosquito
- Seasonal climate forecasts provide an opportunity to anticipate dengue epidemics several months in advance

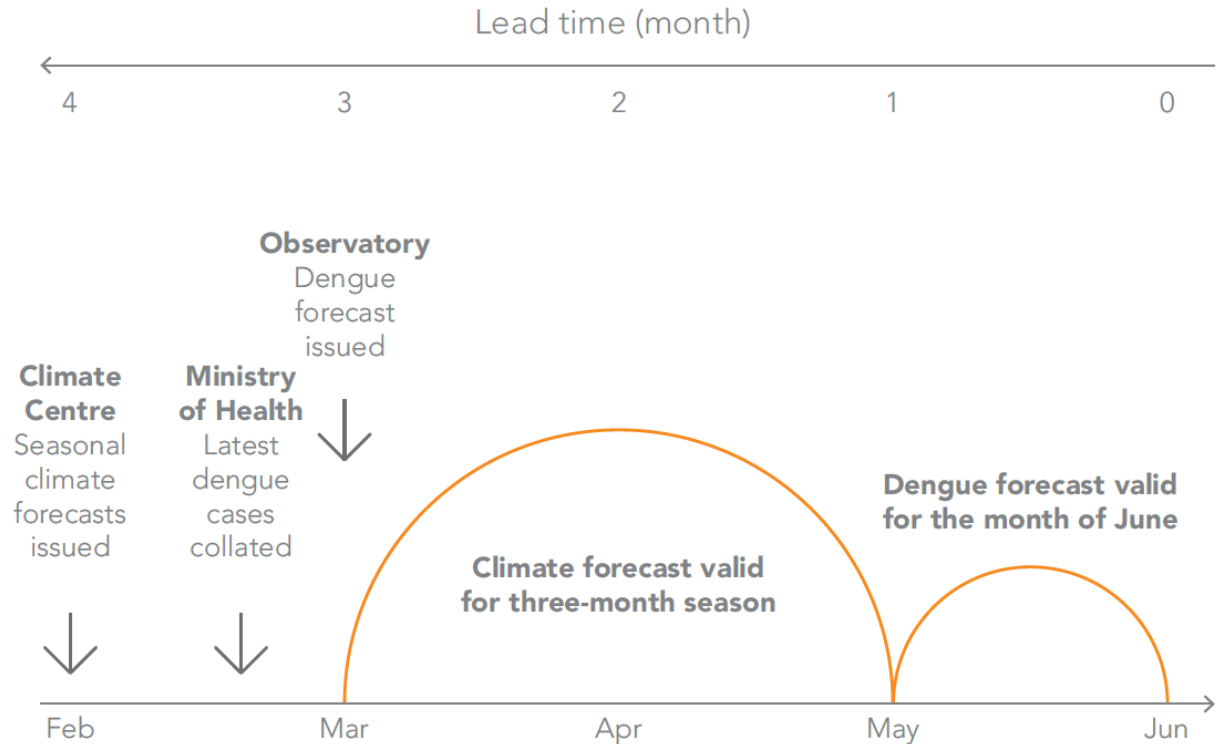


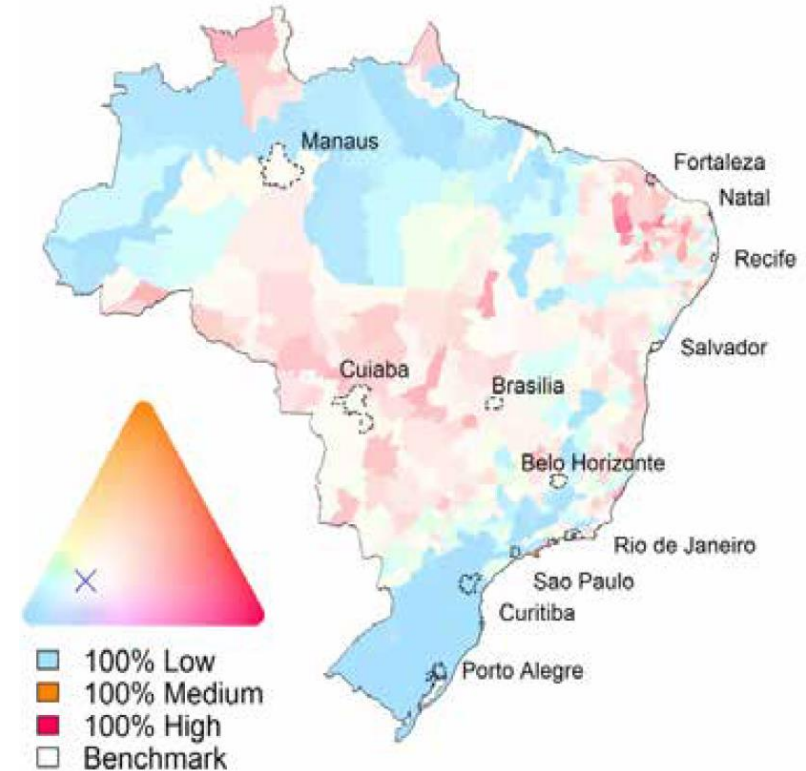
Diagram showing the lead-time gained through a probabilistic dengue forecast driven by climate forecast and current dengue risks. Temperature forecasts were produced by the empirical model described in (Coelho et al). Rainfall forecasts were produced by the multi-model 3-month average (March, April, May) precipitation forecast from the EUROBRISA integrated system. Current dengue cases were obtained from the Ministry of Health, Brazil.



# Dengue risk communication ahead of Brazil's 2014 FIFA World Cup

## New approaches

- A new predictive model framework for climate-sensitive diseases was developed based on the European seasonal climate forecast technique
- The model produced dengue predictions for the 553 microregions of Brazil with the identified best threshold to trigger an alarm
- The model predicted a high risk of outbreaks in the northeastern cities of Natal, Fortaleza and Recife
- Retrospective evaluation of the model confirmed the model performance was better than the traditional approach in all 12 WC host venues



Probabilistic dengue risk forecast for Brazil, June, 2014. The continuous colour palette (ternary phase diagram; see Jupp et al.) conveys the probabilities assigned to the low-, medium-, and high-risk dengue categories. The greater the colour saturation, the more certain is the forecast of a particular outcome. Category boundaries are defined as 100 and 300 cases per 100,000 inhabitants. Strong red shows a high probability of high dengue risk. Strong blue indicates a high probability of low dengue risk. Colours close to white indicate a forecast similar to the benchmark (long-term average distribution of dengue incidence in Brazil, June 2000–13:  $p_{low}=68\%$ ,  $p_{medium}=16\%$ ,  $p_{high}=16\%$ ), marked by a cross (Source: Lowe et al.).



# Dengue risk communication ahead of Brazil's 2014 FIFA World Cup

## Benefits and lessons

- The dengue EWS assisted the MoH to implement mitigation and control action timely, three months ahead of the WC
- Financial resources were increased to reduce mosquitoes, and a multilingual campaign was launched on how to protect themselves from dengue
- Destroyed potential mosquito breeding sites, and a campaign was launched to clear water containers
- Early warnings were disseminated to the public and visitors locally and internationally
- As a result, overall reported dengue cases for 2014 were much lower than in the past



# The spatio-temporal climate-informed early warning and response system for infectious diseases outbreaks

## Context

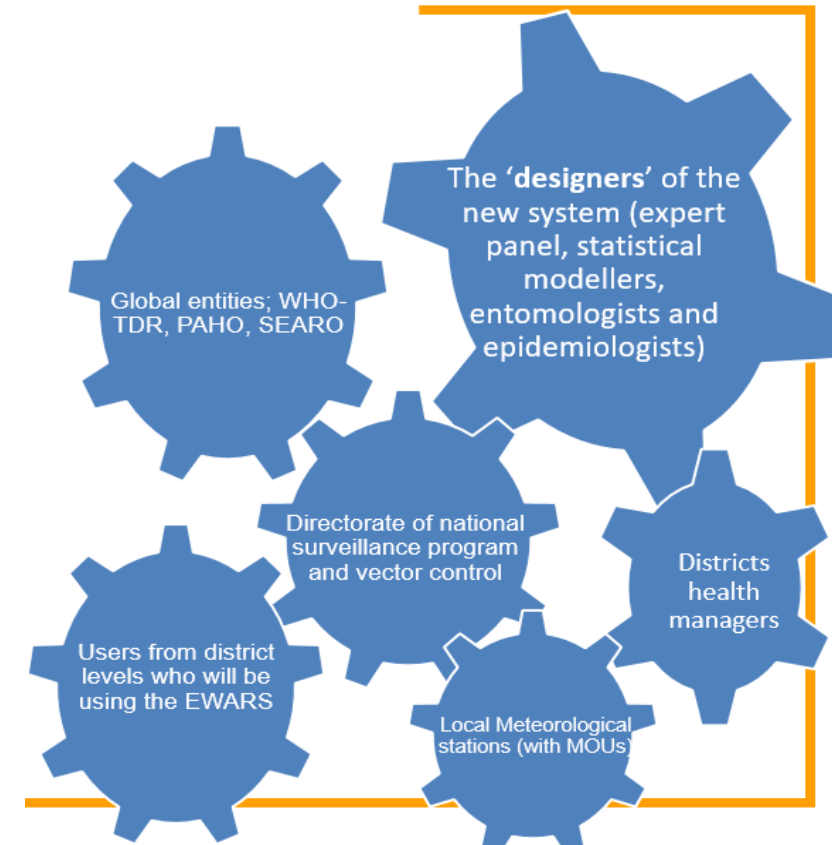
- In the context of vector-borne and water-borne disease epidemics, where no effective vaccine is available, the use of climate-informed early warning and response systems has the potential to increase the effectiveness of response operations by intervening before the epidemic rather than when the epidemic is waning.
- Combined prediction of “space” and “time” (spatio-temporal) is crucial for effective response but remains limited, particularly in the world's most disadvantaged settings where data and resources are scarce.



# The spatio-temporal climate-informed early warning and response system for infectious diseases outbreaks

## New approaches

- WHO-TDR-led Research Work Programme to develop an adaptable model for climate-sensitive disease surveillance and outbreak response
- A model disease (dengue, Zika, chikungunya, malaria, cholera) outbreak contingency plan has been developed together with the WHO Regions and endemic countries
- A co-production, co-creation approach was followed involving relevant stakeholders of epidemiologists, climatologists, entomologists and statistical modellers, as well as local and regional health managers and meteorological stations
- A calibrated statistical modelling (e.g. logistic and Poisson regression) using the Shewhart and Endemic Channel design has been used to compute the risk maps and forecasting tools

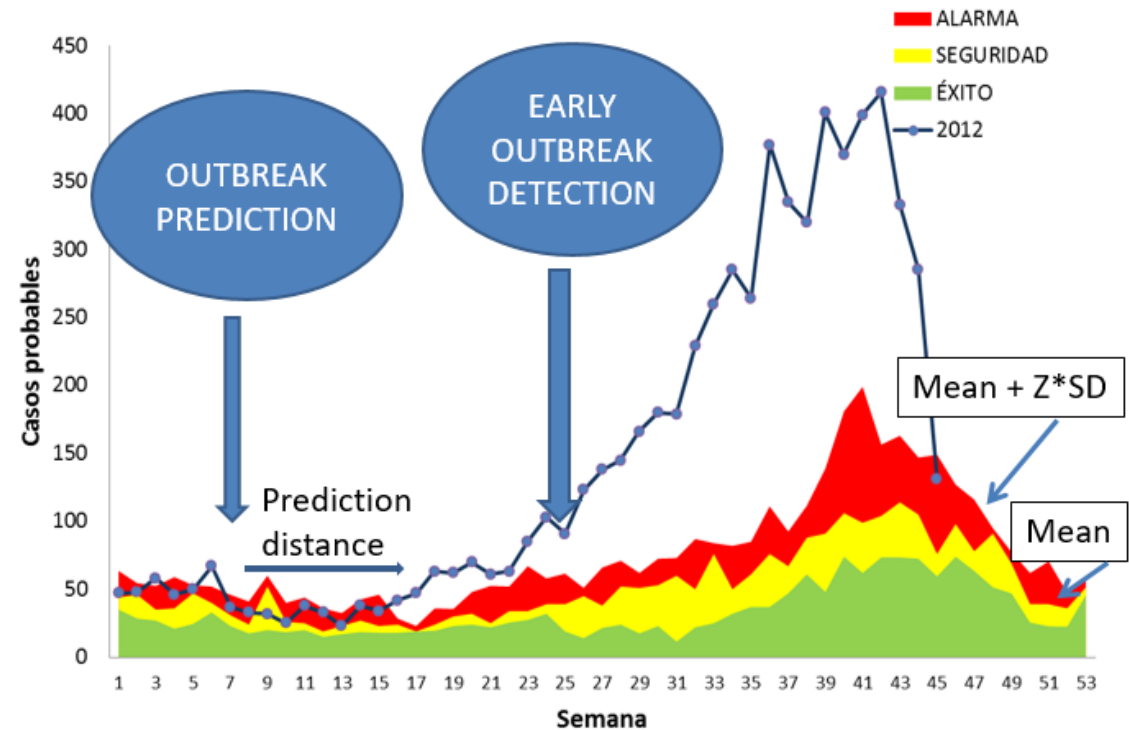


**Co-designing the EWARS development  
maintained participation of all partner countries**

# The spatio-temporal climate-informed early warning and response system for infectious diseases outbreaks

## Benefits and lessons

- Approximately 2.5 billion people live at risk of these diseases, with an estimated 390 million infections annually in about 100 countries
- Climate information has been proven to be associated with these diseases' outbreaks
- The EWARS tool has been evaluated in more than 10 countries and against five diseases, which showed improved and timely response
- The tool has not only focused on disease outbreaks but has succeeded in improving the surveillance process, coordination among stakeholders, and contributed to further research in this area.



# The spatio-temporal climate-informed early warning and response system for infectious diseases outbreaks

## Benefits and lessons

Based on reports from countries where EWARS has been implemented:

- EWARS is a tool that can be adapted to any country and has demonstrated elevated sensitivity and predictive value
- Disease outbreaks in regions monitored by EWARS are not due to early warning failures but usually due to late response and low coverage or duration of control measures
- EWARS is helping to train program staff and field workers to change from the culture of vector control and supervision to the culture of surveillance, decision-making based on the evaluation of results, and feedback to the operational level

