How early is early warning of climate extremes?

By

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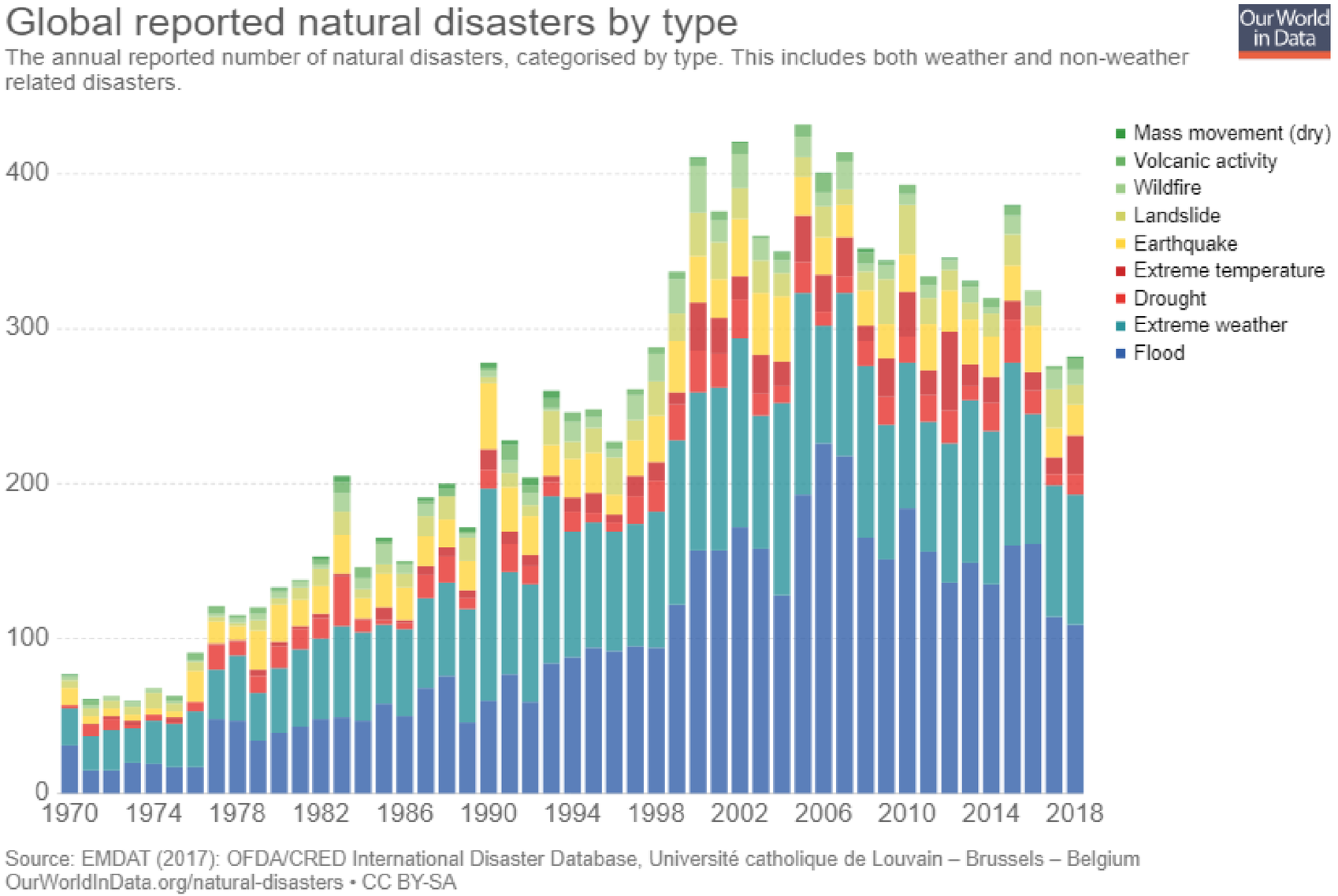
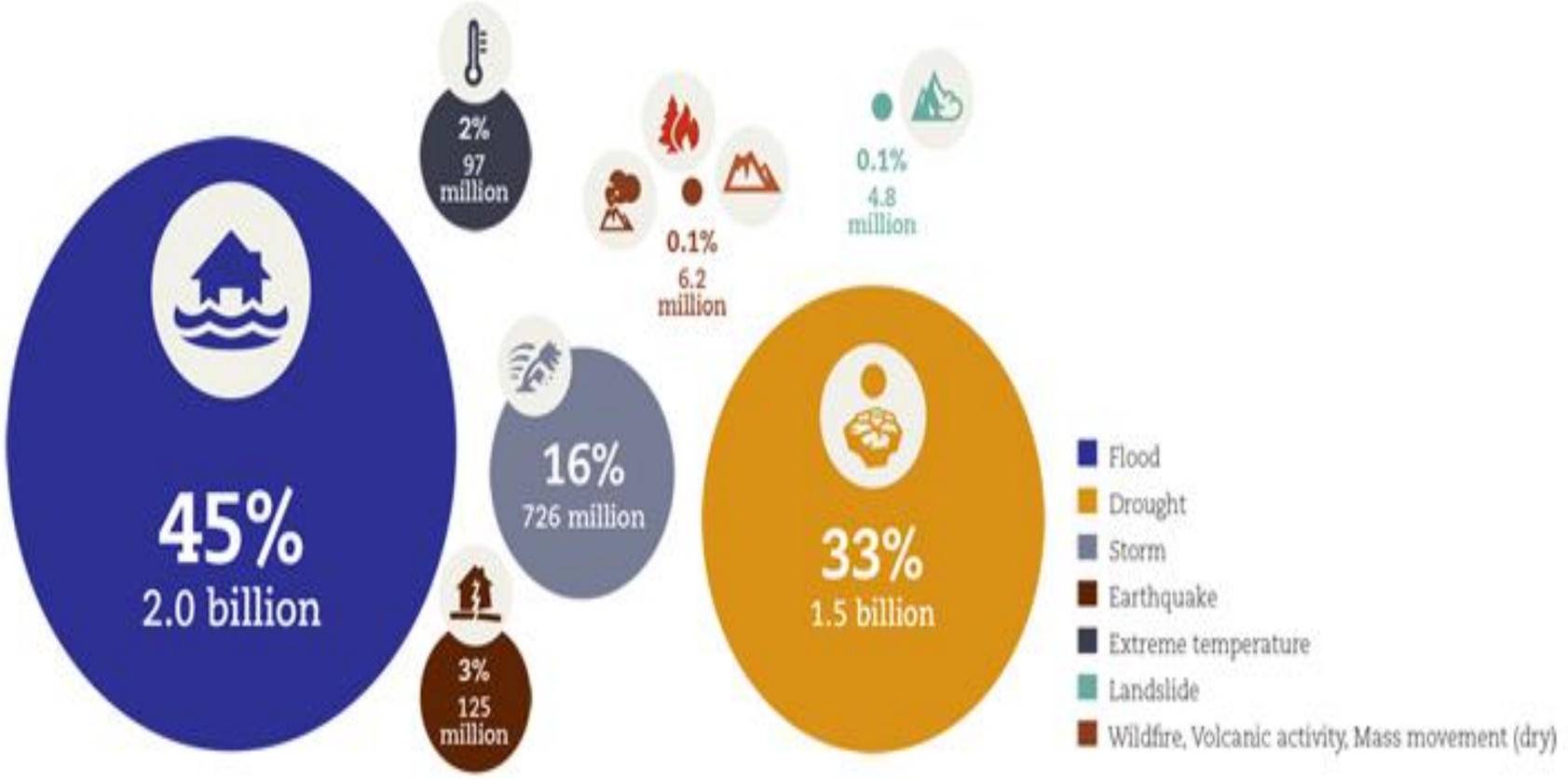
Population & Human Development

Natural disasters are increasing



Number of people affected per disaster type 1998-2017



Source: CRED, UNISDR, 2018

Trends in climate related disasters

- In terms of occurrences, climate-related disasters dominated the past 20 years, accounting for 91% of all 7,255 recorded events between 1998 and 2017 . Within this total, floods were the most frequent type of disaster, 43% of all recorded events
- Floods also affected the largest number of people, at more than two billion, followed by drought, which affected a further 1.5 billion people in 1998-2017

The connection between extreme weather and climate change

Little or no rain

Extreme precipitation (rain and snow)

High-tide flooding and increased storm surge

Extreme heat

Tornados and thunderstorms

Western wildfire activity

More Atlantic hurricanes

Parched soil

Extreme rainfall from hurricanes

Weakest Evidence — Growing Evidence

Strong Evidence — Strongest Evidence

Natural Disasters affecting Vulnerable People

- Low-income groups are more vulnerable to natural disasters due to lack of coping capacity;

- In general, floods and cyclones cause maximum damages and casualties in low-income groups, while earthquakes cause more casualties in middle-income groups;

- Drought and flood affect most people in low and middle income groups.

Strategies for combating Climate Change

Two basic components

- **Mitigation**
- **Adaptation**

Third element for coping with extreme events;

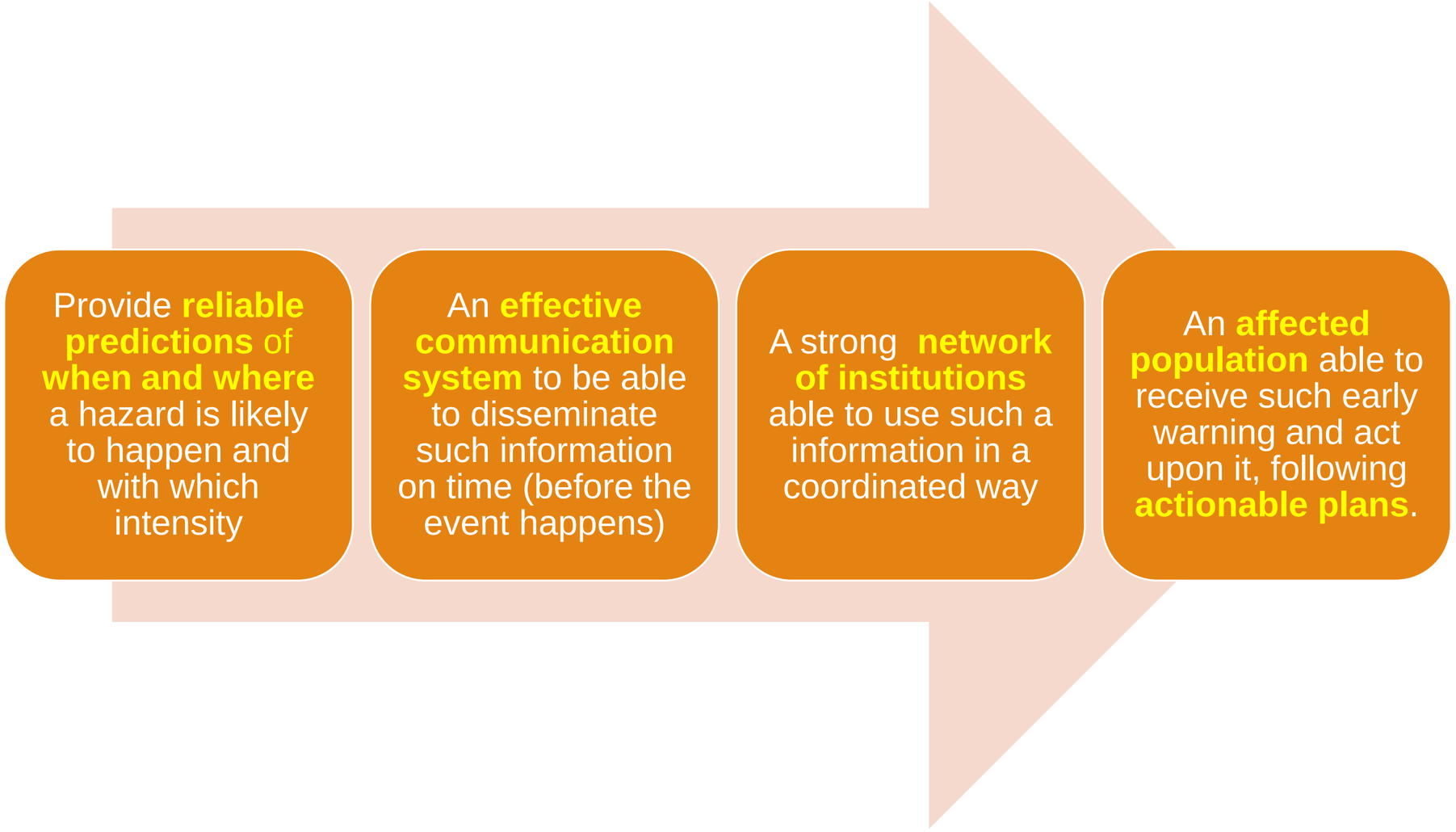
Early warning of climate-related extreme events, including heat waves, forest fires, floods and droughts, by providing it with ***timely, reliable and actionable warnings*.**

Some are slow - onset (such as changes in temperature and precipitation leading to droughts, or agricultural losses), while others happen more suddenly (such as tropical storms and floods)

Definition of Early Warning Systems (EWS)

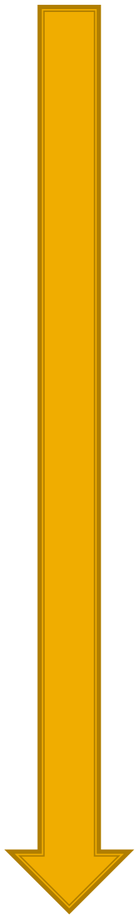
UN-ISDR defines an Early Warning System as "*the set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities, and organizations threatened by a hazard to prepare and act appropriately and in sufficient time to reduce the possibility of harm or loss*."

Early Warning Systems



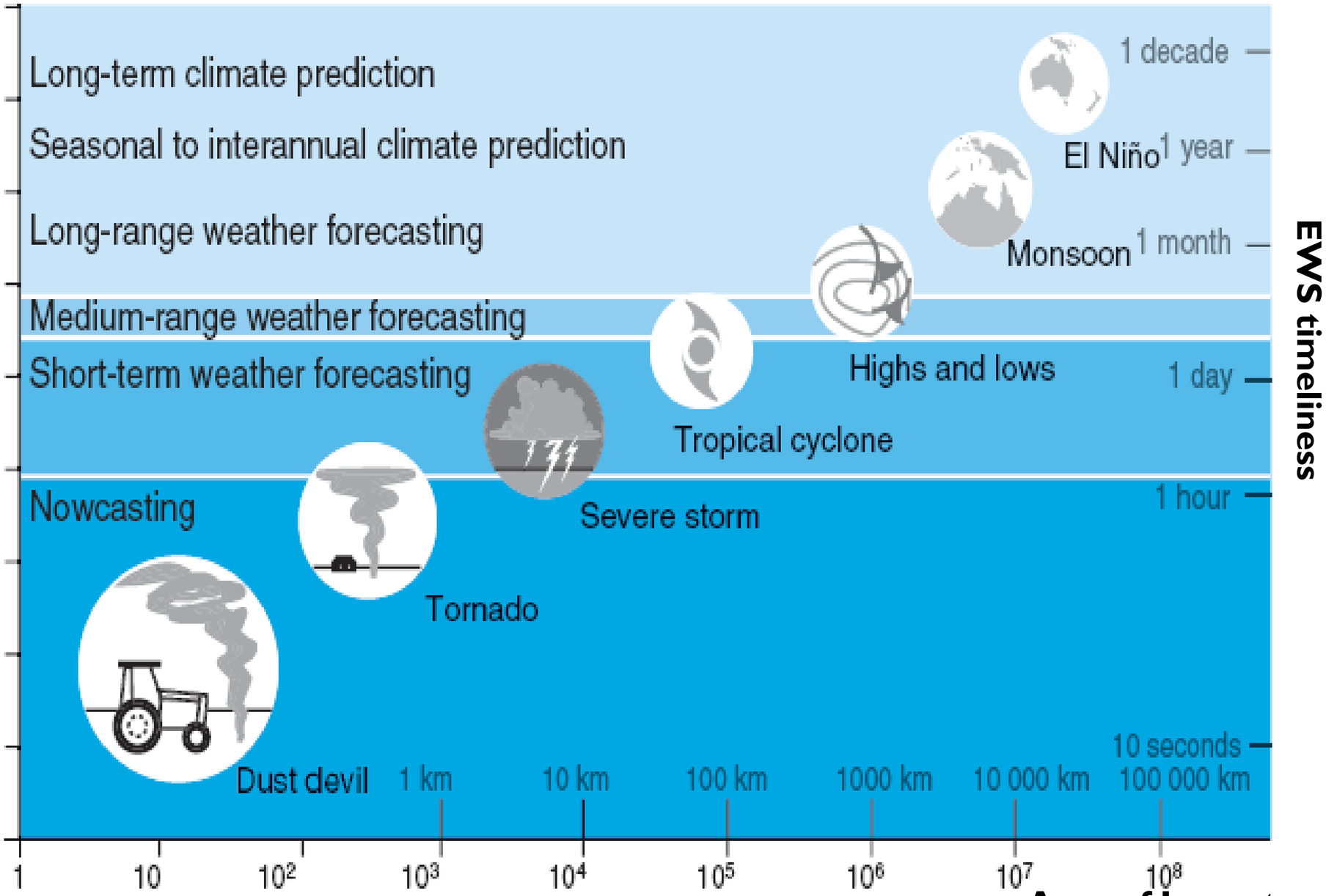
Three components **of Early Warning Systems**

How early is Early Warning?



- Tens of **seconds** of lead time for earthquakes;
- **Minutes** for tornadoes;
- **Hours** for tsunamis;
- **Days to hours** for volcanic eruptions;
- **Weeks to hours** for hurricanes/Cyclone;
- **3 to 5 Days** for Flood
- **(Minutes** for Flash Flood)
- **Months to weeks** for droughts;
- **Years or even decades** for slow-onset threats (such as El Nino, climate change impacts)

How early is Early Warning?



Source: M. Golnaraghi, 2005

Basic principle of EWS

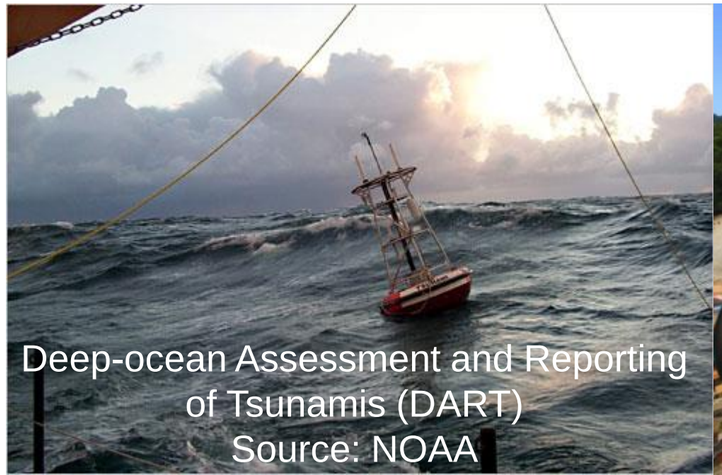
EWS uses the lead time between the warning and the disaster occurrence for mitigation actions

Lead time=T (disaster)- {T(detection)+T(processing data)+T(transmitting information)}

Lead time to communicate

Early warning applications depend on the lead time available (between the warning and the disaster occurrence) for alerting the population, evacuation, stopping industrial operations, etc.

This is why it is key to reduce communication lead time



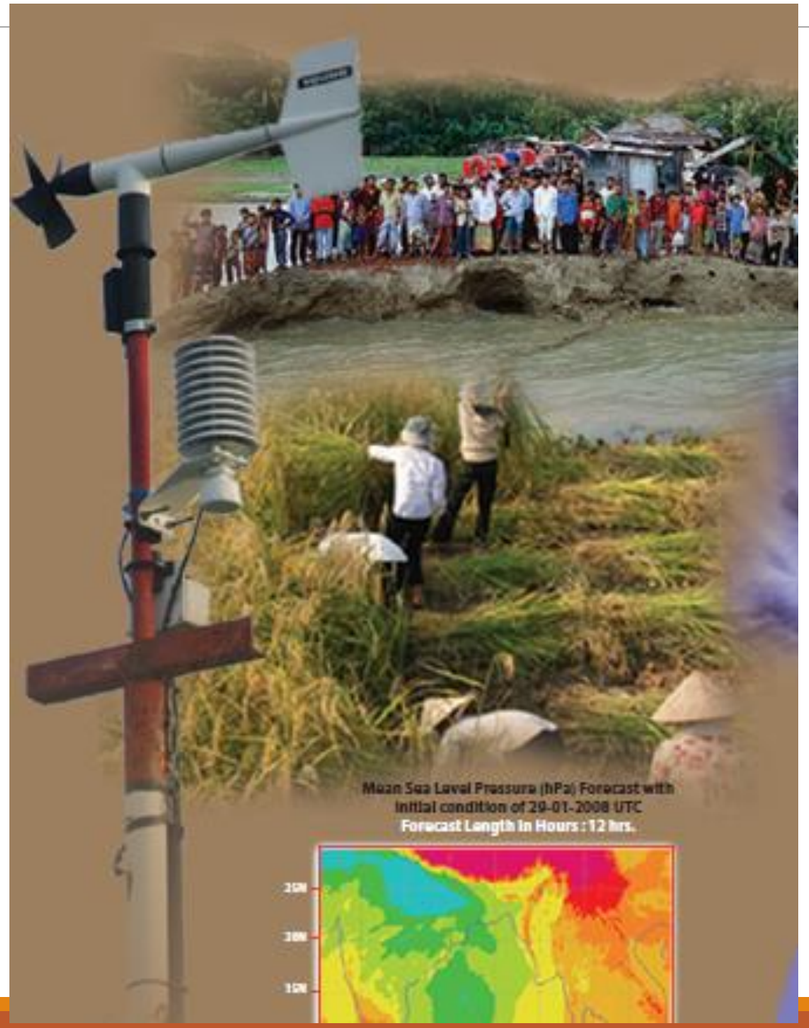
Deep-ocean Assessment and Reporting of Tsunamis (DART)
Source: NOAA

Source: Rio Times

Early warning system in Nepal

Desired Communication Capability

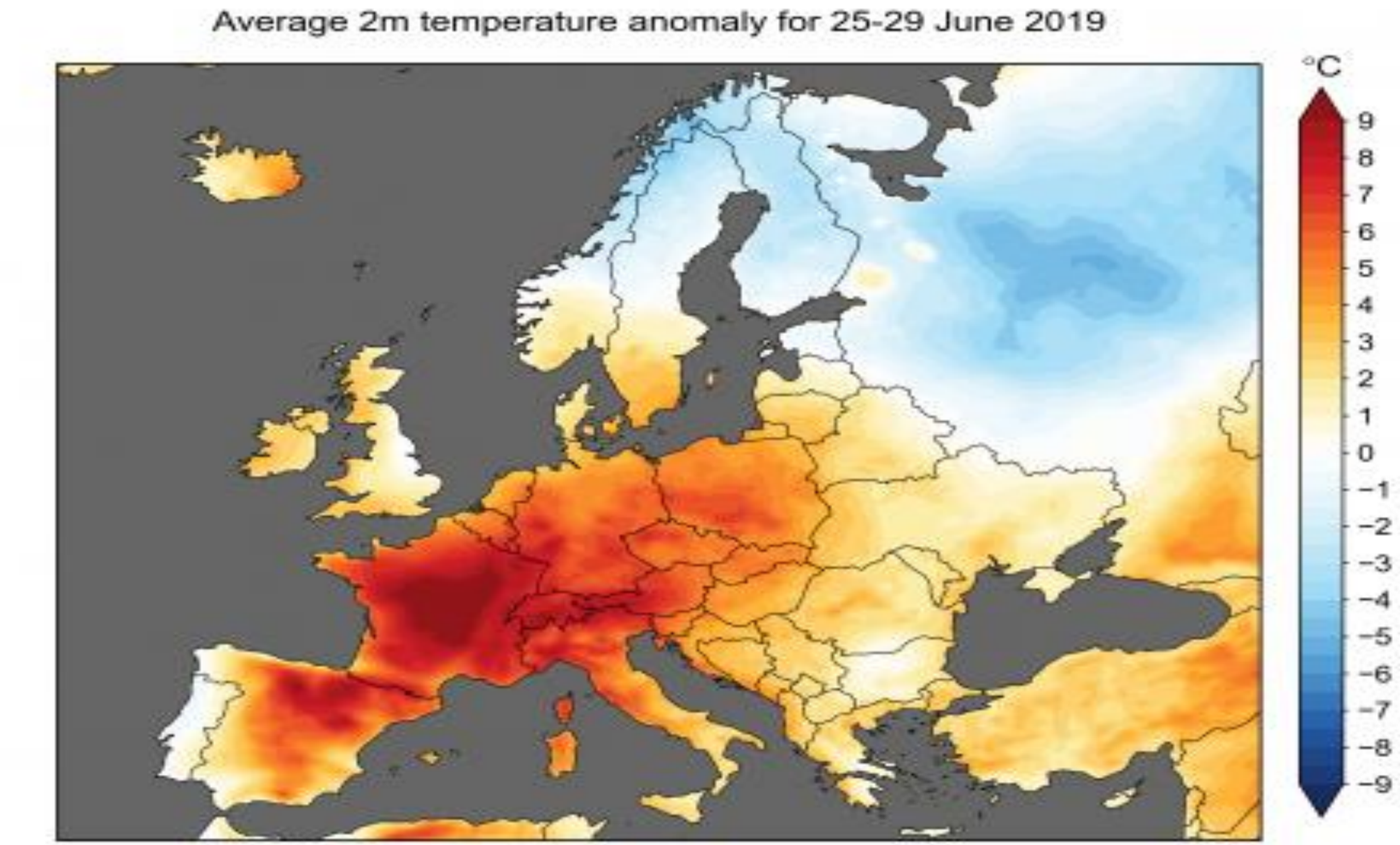
Gap between early warning and action



- Warning not understood;
- Warning understood, but ignored;
- Warning understood, not ignored, but no response

Current capabilities of EWS

Heat –Health warning system



Wild land fires

It is estimated that nearly 400 Million ha of natural areas are burnt every year .

Fire detection and alerts : Ground observations and satellite based

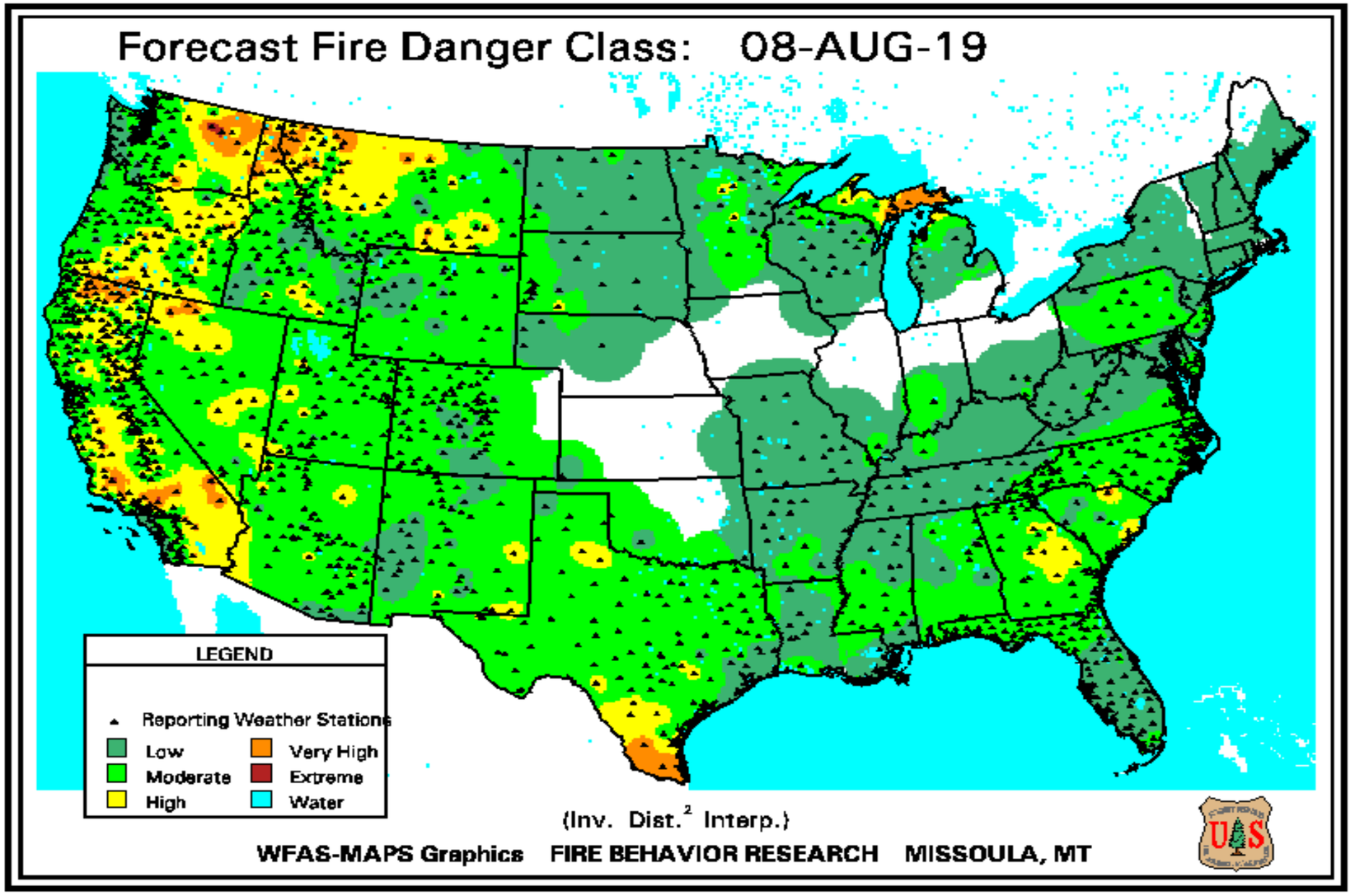
Fire Report for Chile 1 Aug 2019 - 6 Aug 2019 During this time period, there were 249 Fire Alerts

Province	#
Maule	62
Libertador General Bernardo O'Higgins	41
Antofagasta	33
Bío-Bío	30
Valparaíso	29
Atacama	23
Coquimbo	9
Araucanía	8
Región Metropolitana de Santiago	8
Arica y Parinacota	3

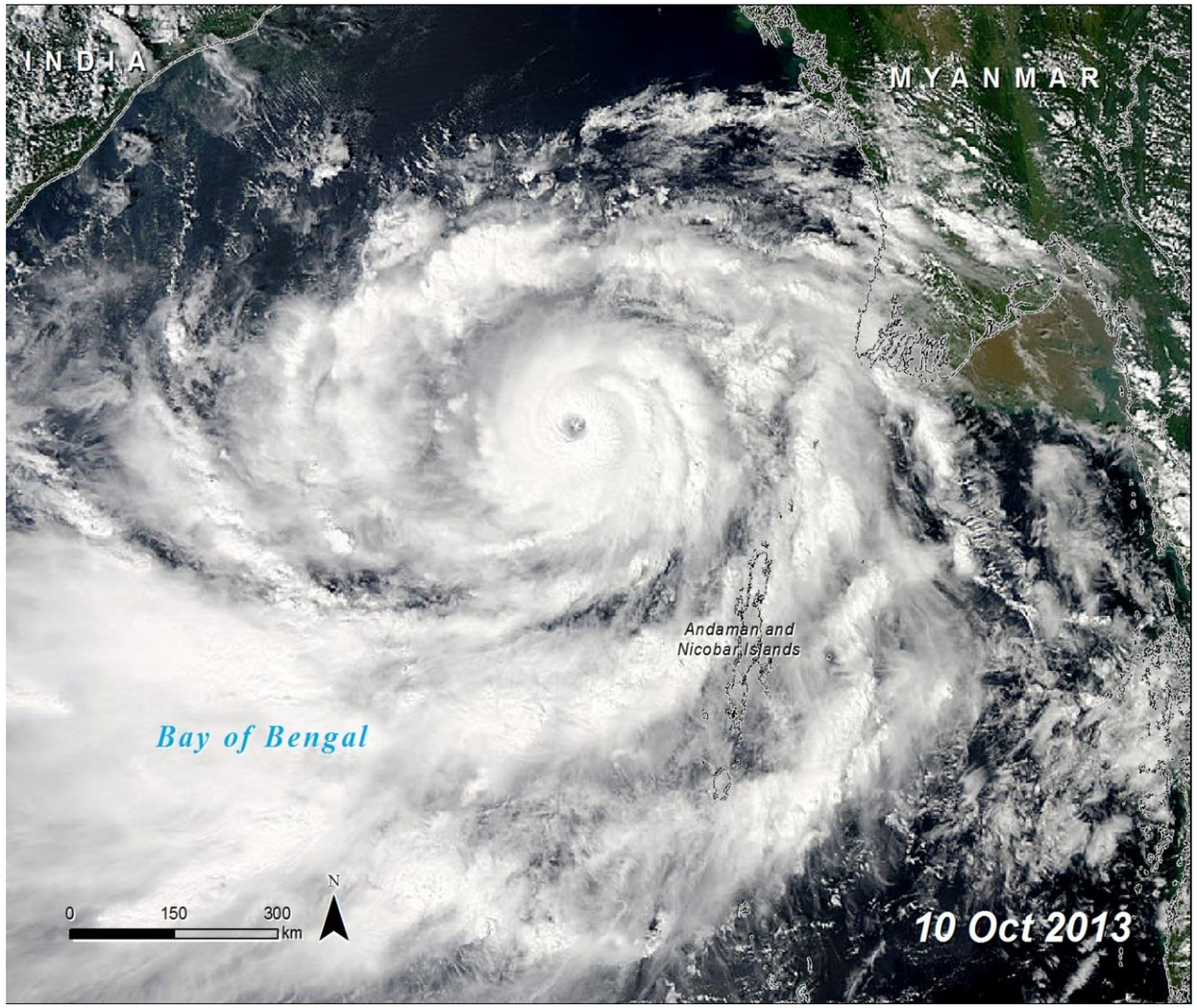
https://fires.globalforestwatch.org/_ based on data from University of Maryland, USA

Forecasting fire danger rating

Based on weather, fuel types, and both live and dead fuel moisture



Typhon/Cyclone Tracking : Tropical Cyclone Phailin Over India



Cyclone Phailin in India

Early warning and timely actions saved lives

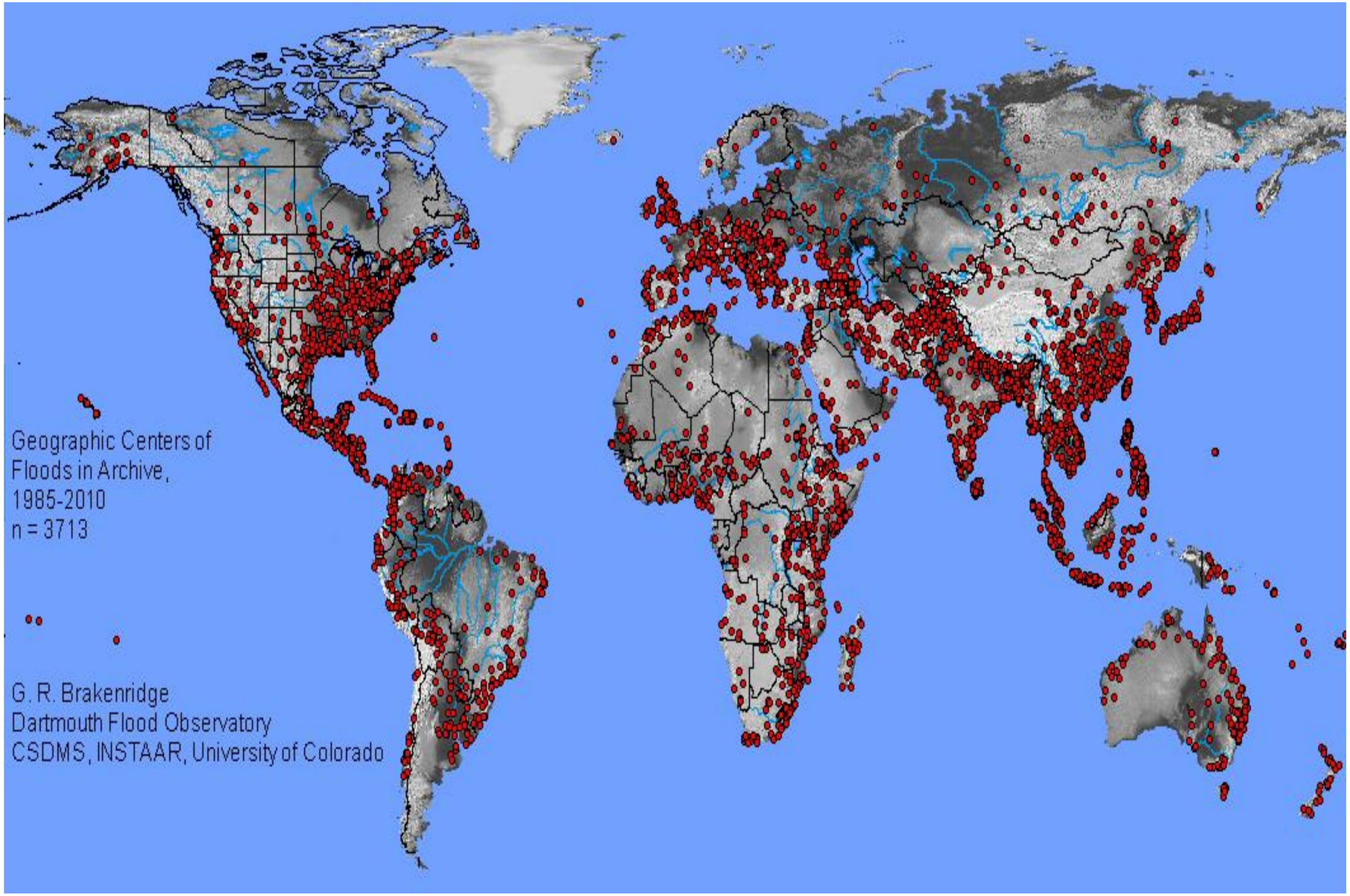
- Evacuation of > 1 million people
- Accurate wind velocity prediction
- Better forecasts and more effective communications
- Alerts 4 days before landfall
- Early warning alerts:
  - Prompted thousands of evacuations
  - Precautions to protect cattle
  - Reservoirs were lowered to mitigate anticipated flooding

Communication, Communication, Communication

Several means of communication used

- Constant news coverage before and throughout the event, including broadcasts of Doppler radar information providing coordinates of location, intensity and timing of impending cyclones
- Use of email, fax, telephone and print media to communicate warnings/alerts – SMS sent to > 10,000 people the day before the cyclone made landfall
- Warnings/alerts delivered through online news networks
- Loudspeakers to warn residents of impending danger and to warn fishing boats out at sea
- Distribution of satellite phones to 14 most vulnerable districts to ensure continued communications during storm

Flooding event during 1995-2010



Early warning of floods

Bangladesh on of the most flood prone countries in the world : Minimizing flood damage in Bangladesh

- **Rainfall monitoring**
- **Water level monitoring,**
- **Flood Forecasting modeling**
- **Tailor made forecasts**
- **Preparedness**

1988 killed **2,379** people

1998 killed **1,050** people

2007 killed **1,110** people

2014 killed **17** people

Photos: BBC News

Early Waring of Drought

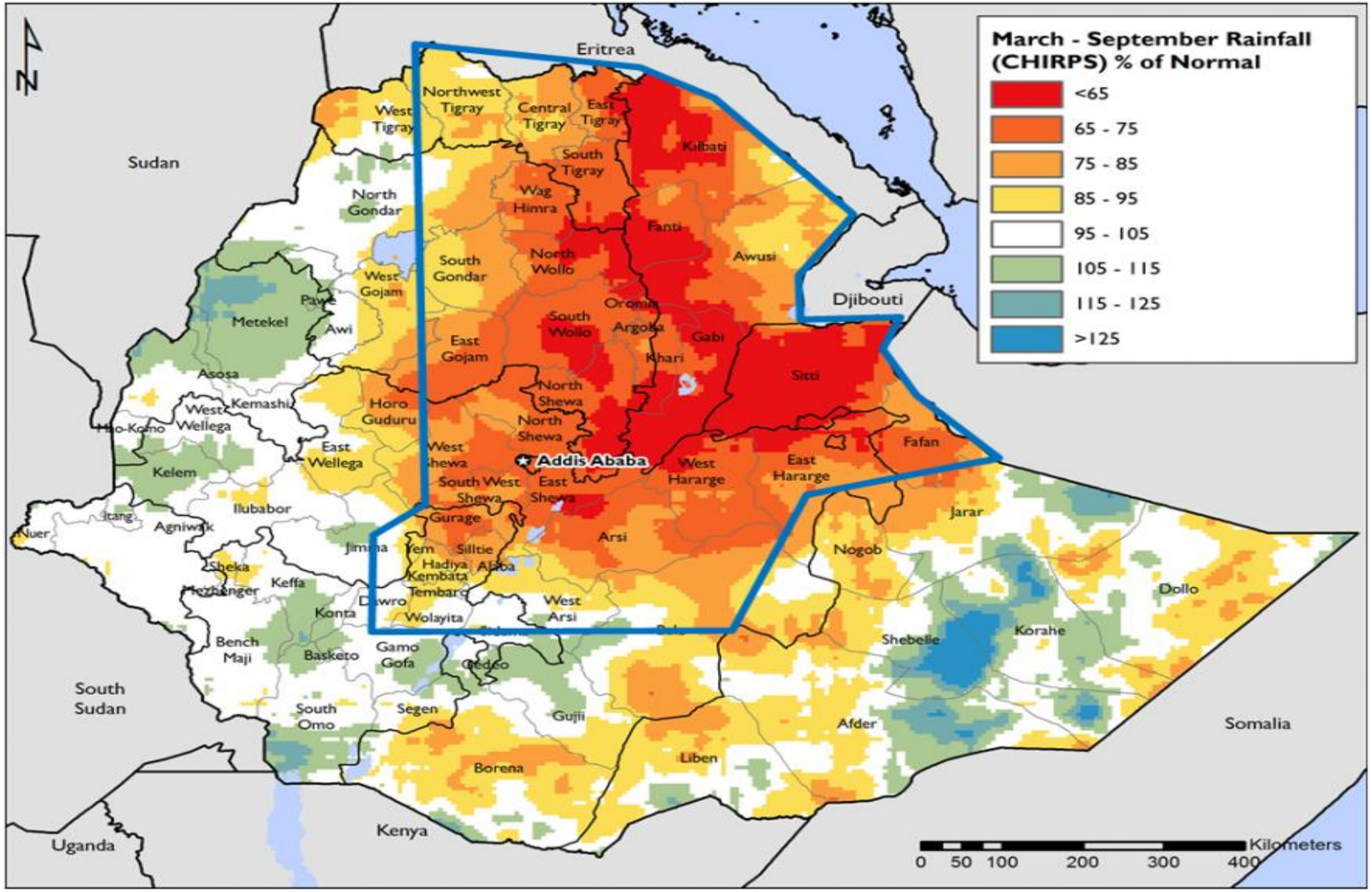
- Most difficult as slow-onset phenomena

- In 1983 to 1985 the worst famine to hit Ethiopia in a century, it left 1.2 million dead, 400,000 refugees left the country, and 2.5 million people were internally displaced.

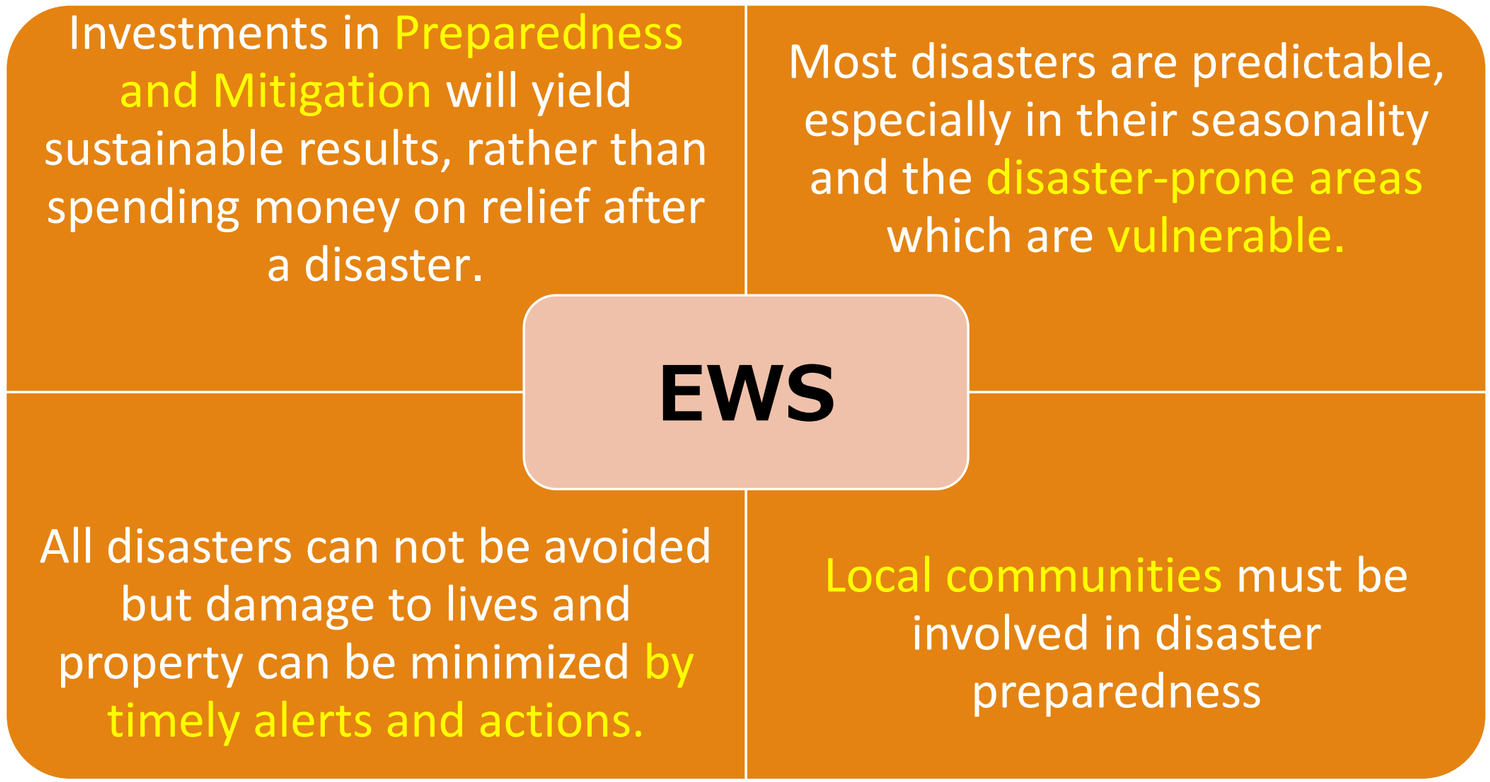
- Although 2016 drought may be more severe compared to drought in 1980s but not a single person died.

- Early warning systems alerted the government when famine threatened in 2015, kicked action after the spring and summer rains failed.

Drought in Ethiopia (in 2015 rainfall 35 % below average compared to 1981-2014)



Lessons Learned

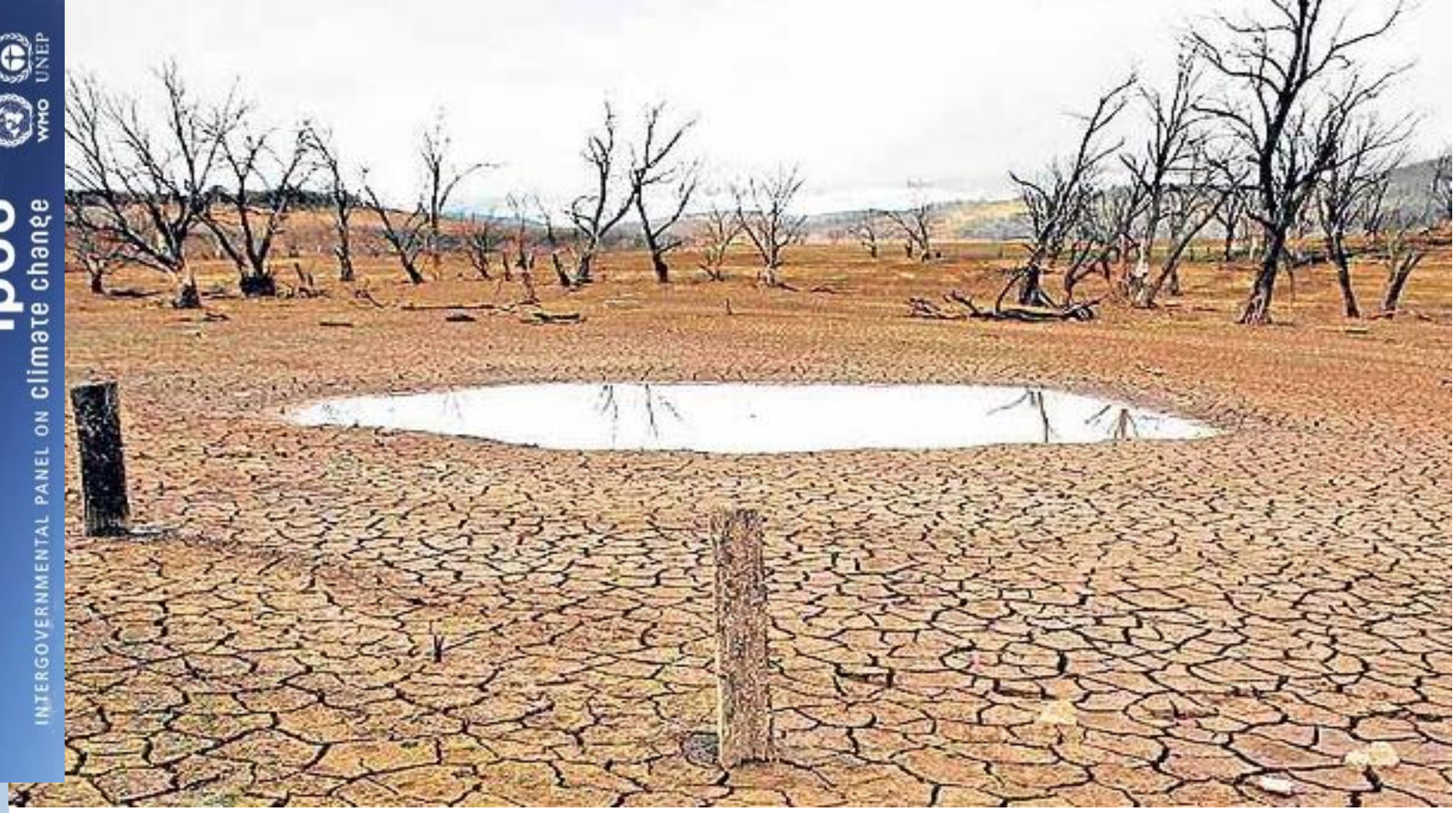


Further Directions

- Living in Risk Zones: Governments to move from “crisis based event based management” to long term investment in preparedness;
- Disseminate good practices in providing end to end solutions;
- Invest in Science and Technology of Early Warning Systems and upgrade with the latest tools (data collection, analysis, modelling, communicating);
- Use smart devices and all available media to provide credible information to people in a timely manner.

Grand Challenges in research

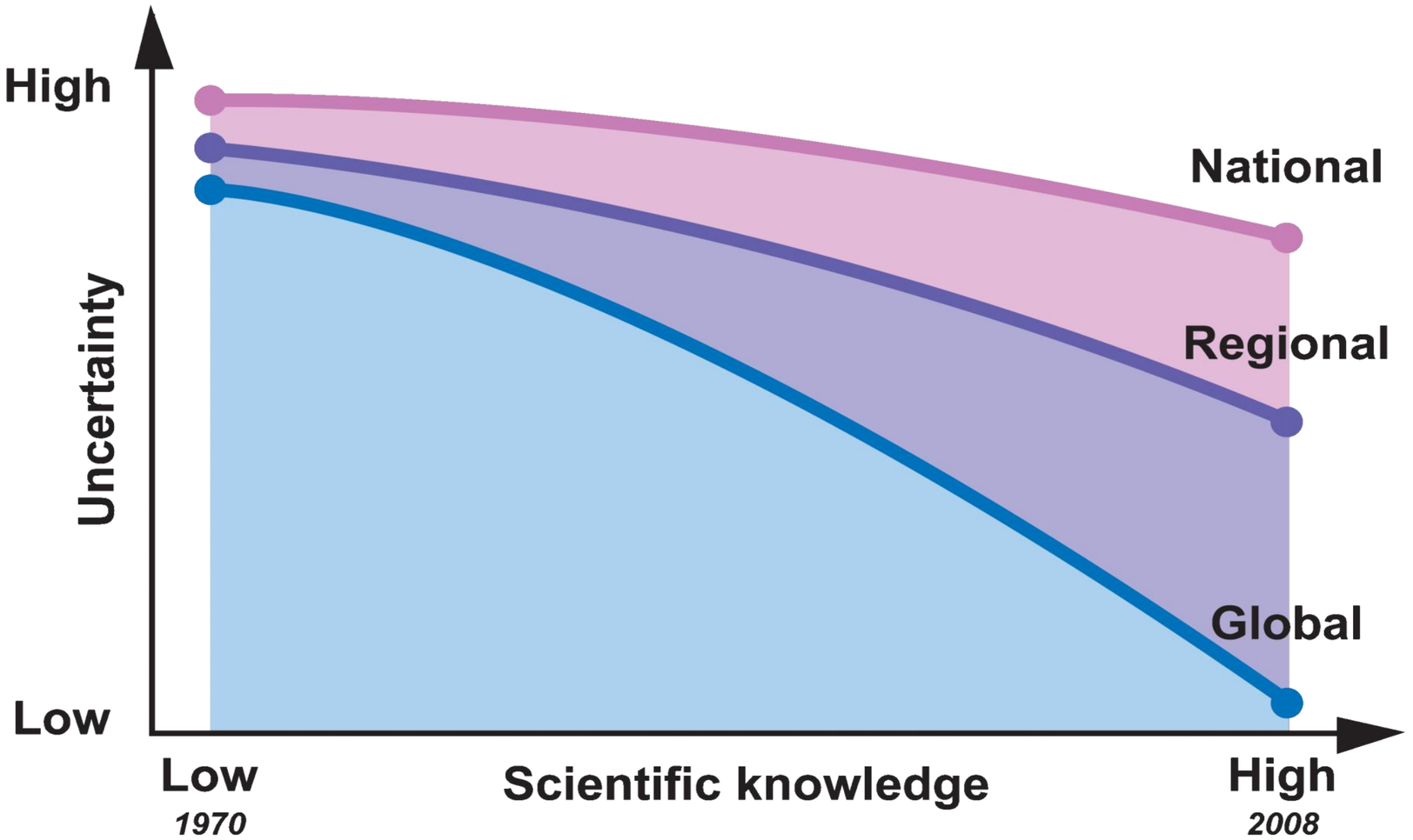
Early warning of how much rainfall (normal, more, less, none) and where??



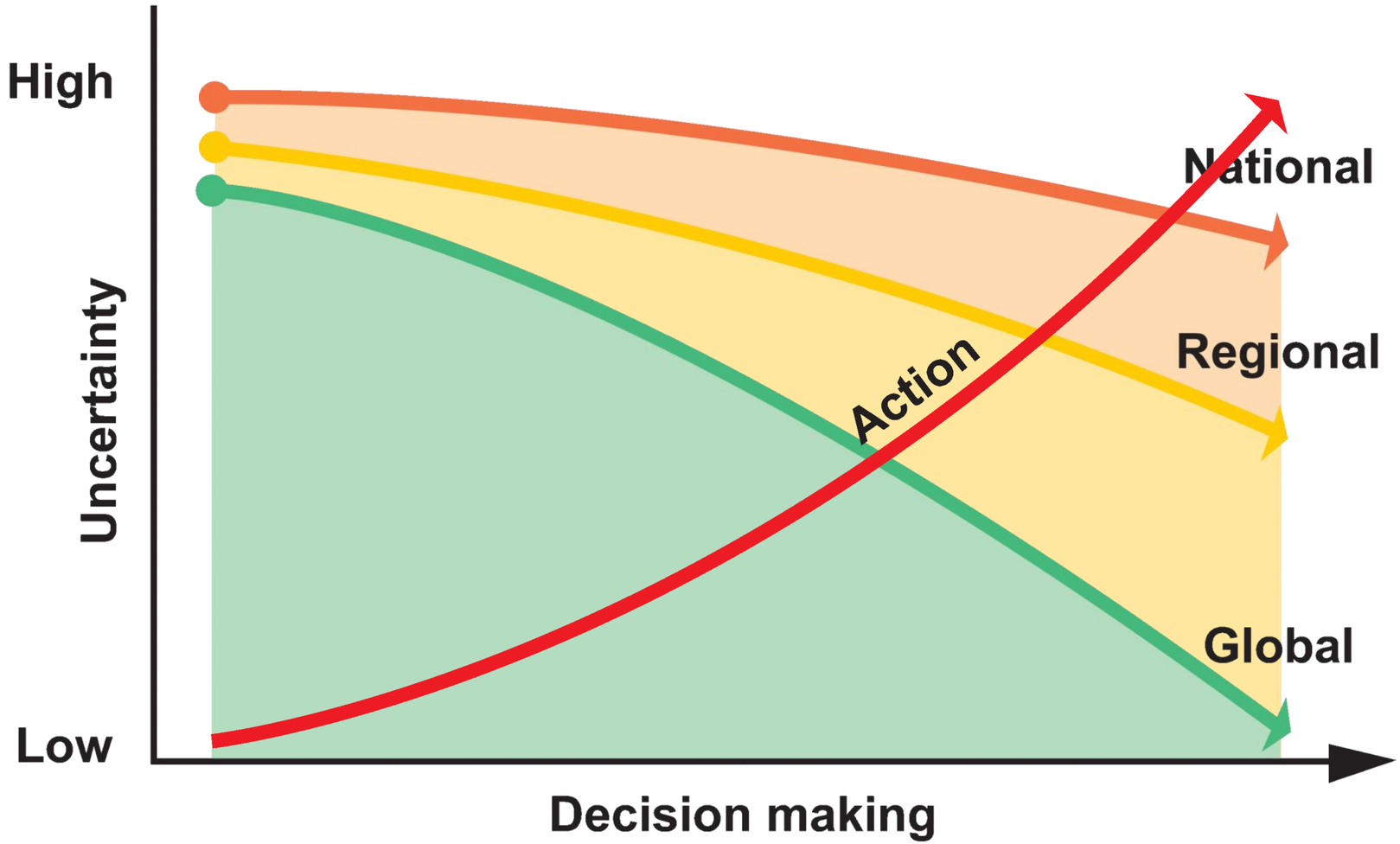
There is *low confidence* in projections of changes in large-scale patterns of natural climate variability.

Confidence is *low* in projections of changes in monsoons (rainfall, circulation) because there is little consensus in climate models regarding the sign of future change in the monsoons. Model projections of changes in El Niño–Southern Oscillation variability and the frequency of El Niño episodes are not consistent, and so there is ***low confidence*** in projections of changes in this phenomenon.

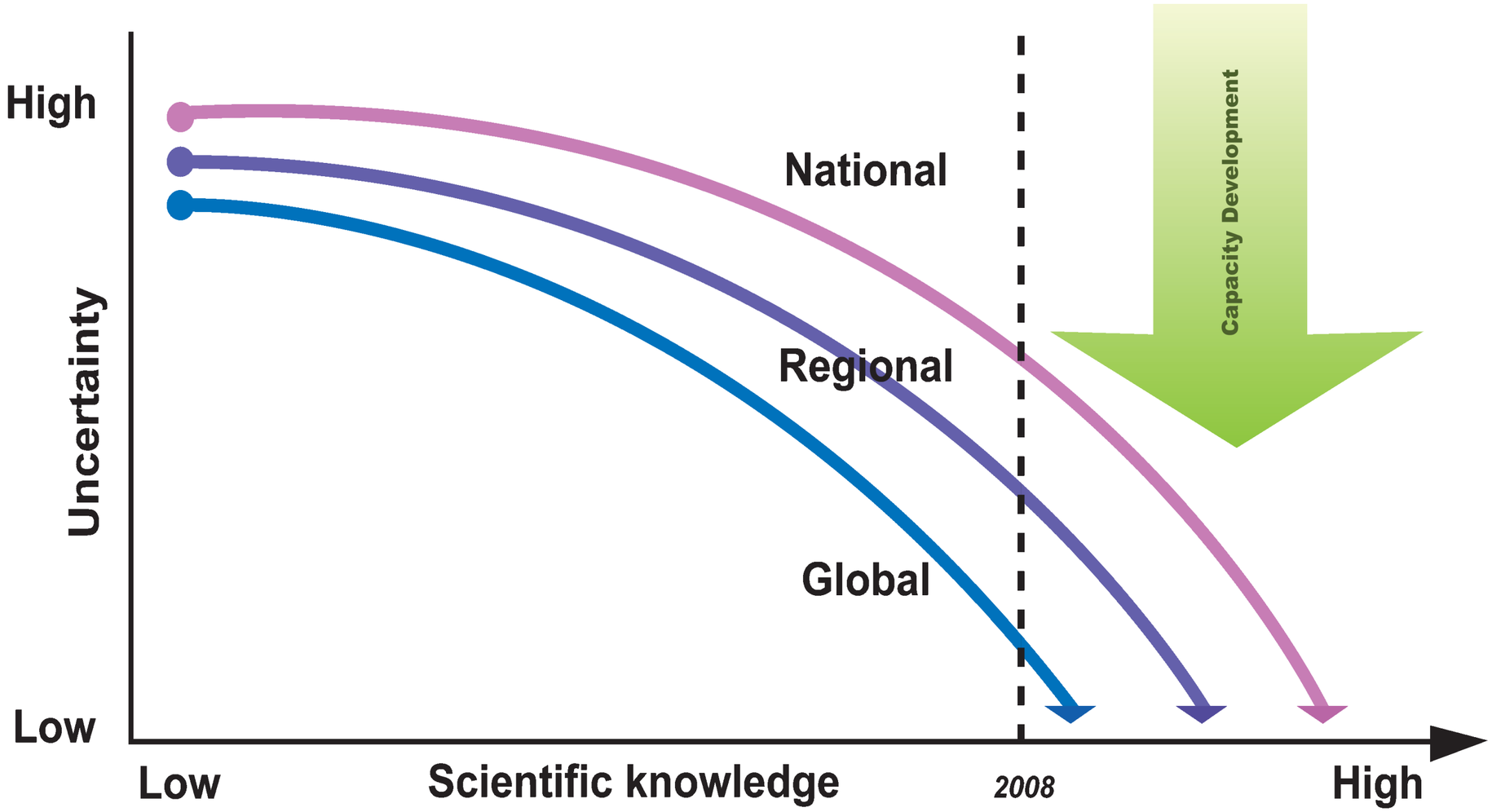
The role of science *in reducing uncertainty*



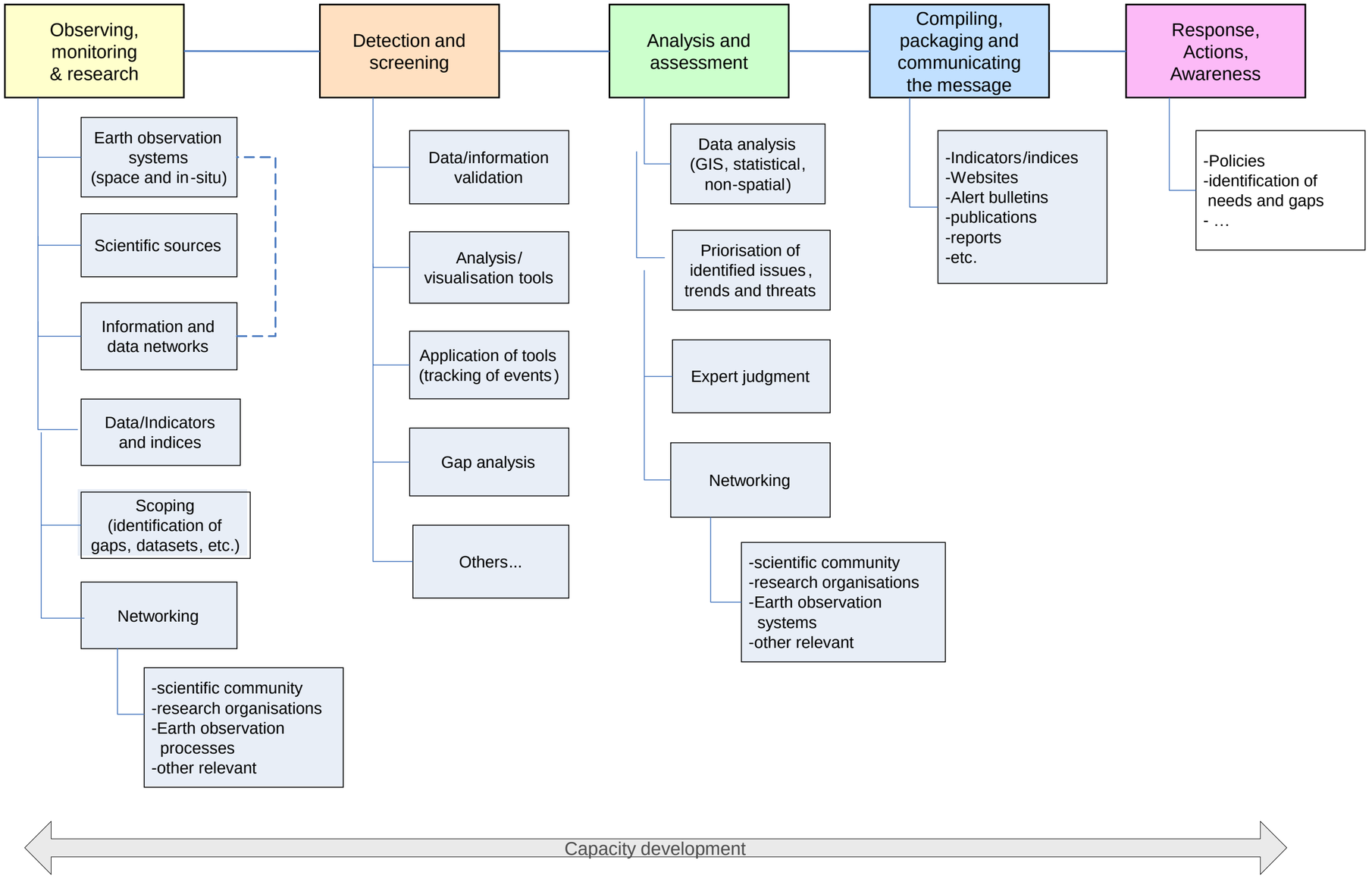
Reducing uncertainty leads to action



Narrowing the uncertainty gap through capacity development



The early warning model :a complex process

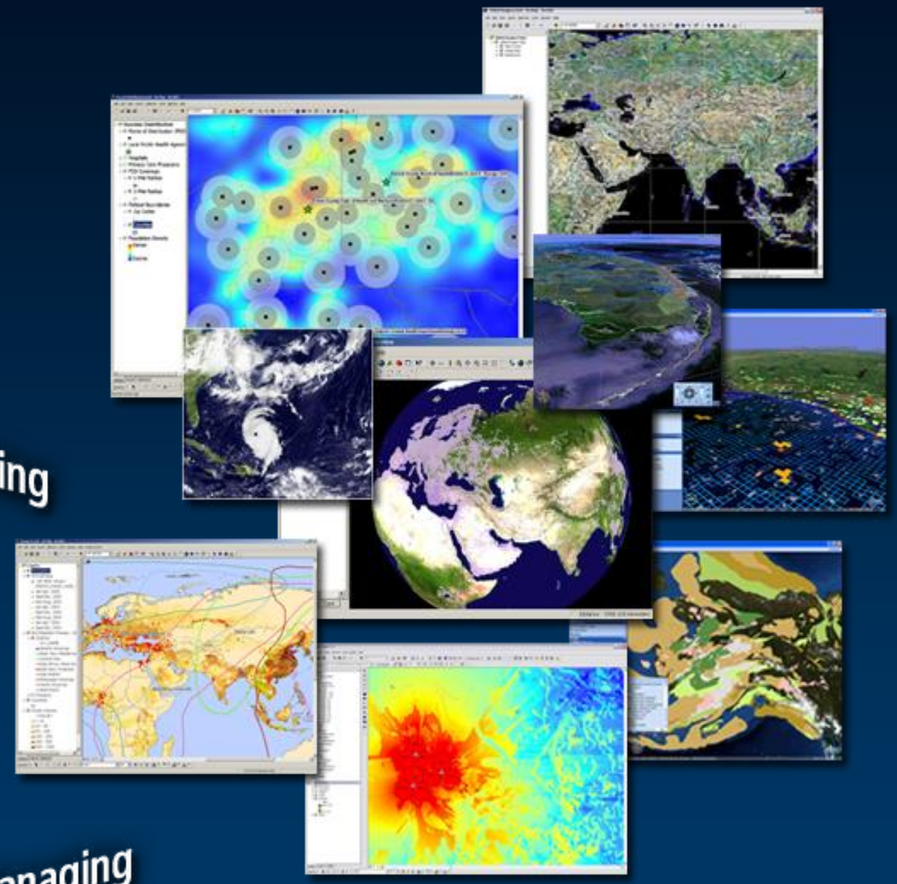


A Science – based Approach is must

- Systematic
- Holistic
- Analytic
- Quantitative
- Visual

Courtesy ESRI Inc

Improving How We Organize & Create Our Future



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THE BOTTOM LINE

Building capacity and resilience of local communities is must to help minimize damages

Early Warning but No where to go??