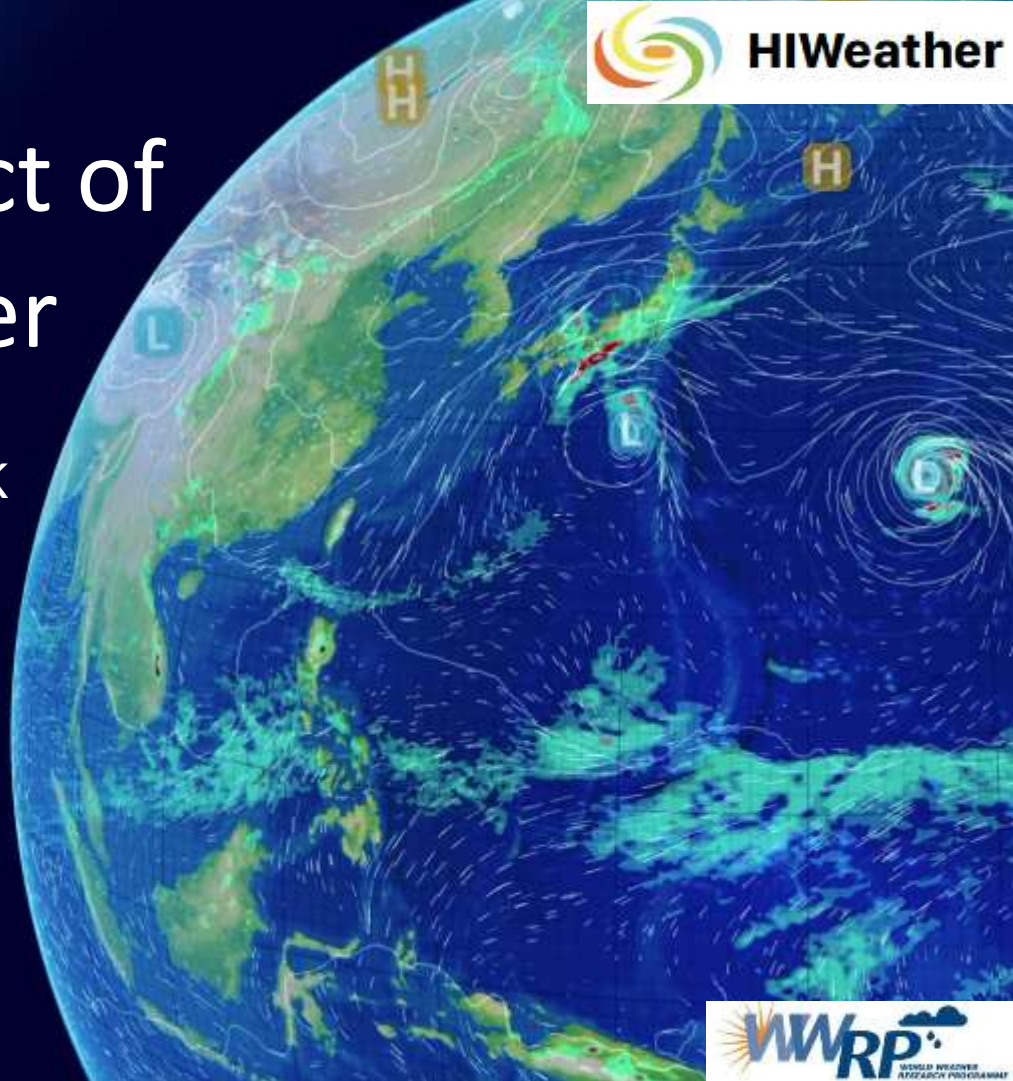


Reducing the impact of high impact weather

Prof Brian Golding OBE, Met Office, UK
WMO/WWRP HIWeather



- A priority of weather services is to protect lives and property from hazardous weather.
- Research on how to achieve that most effectively is the mission of the World Weather Research Programme's High Impact Weather (HIWeather) project.
- HIWeather brings together physical and social scientists from a wide variety of disciplines and from across the world to study each step of the process from monitoring the weather to making effective protective responses.
- HIWeather uses a simple model of the warning production and communication chain that highlights the roles of key actors and organisations involved in forecasting the weather, the resulting hazard and its socio-economic impacts, in formulating the warning and communicating it to the end-user.
- In my talk I shall summarise the results of that research in the context of severe weather associated with monsoons, identifying key principles for the design of weather-related warning systems.
- In doing so, I shall connect this work with ideas from the design of community-based warning systems, with developments in social media communication, with research on impact-based forecasting, and with progress in convection-permitting and higher resolution NWP models.
- A key result is that the communication of knowledge is at least as important as its content, and that the creation and nurturing of partnerships between organisations is critical to that.
(15mins)

Outline

Warnings Matter

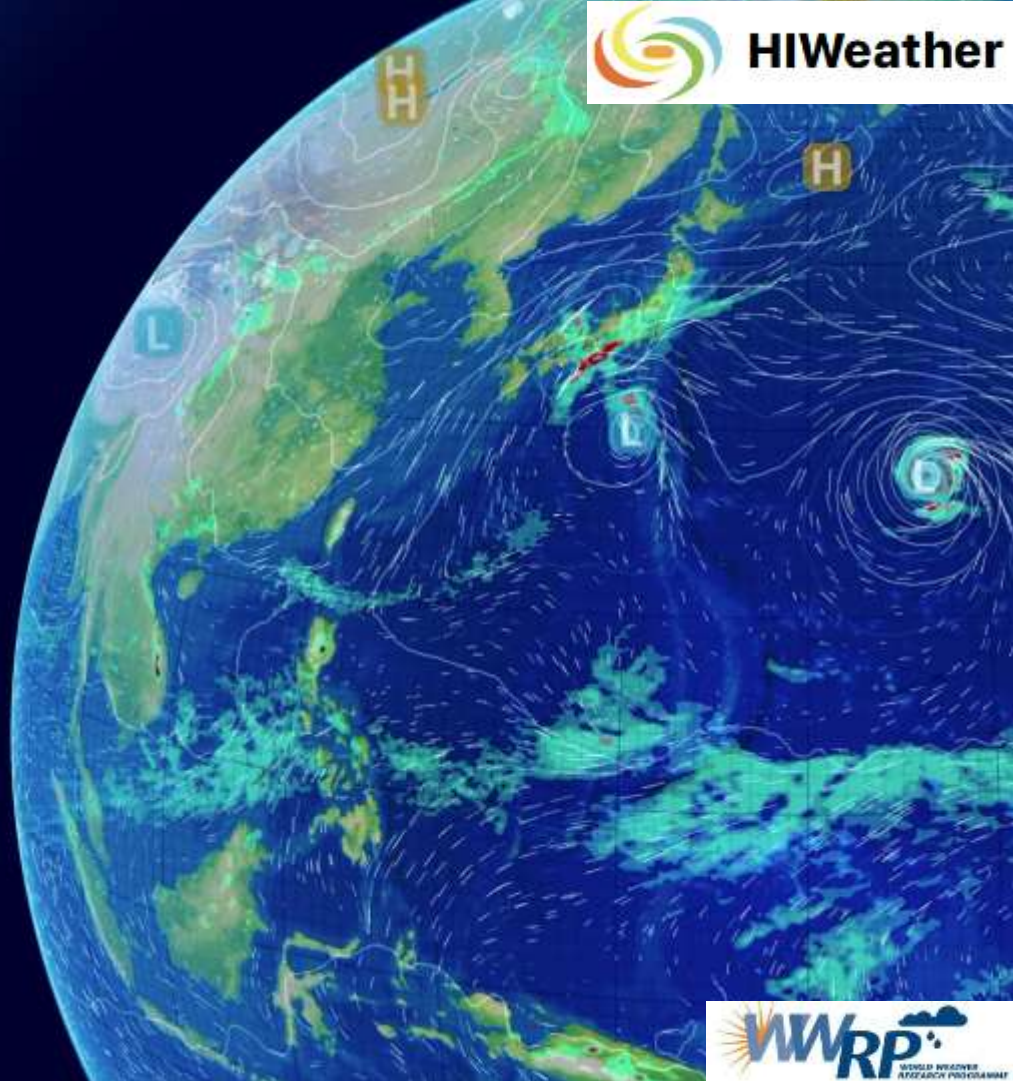
The HIWeather project's aim is more effective warnings

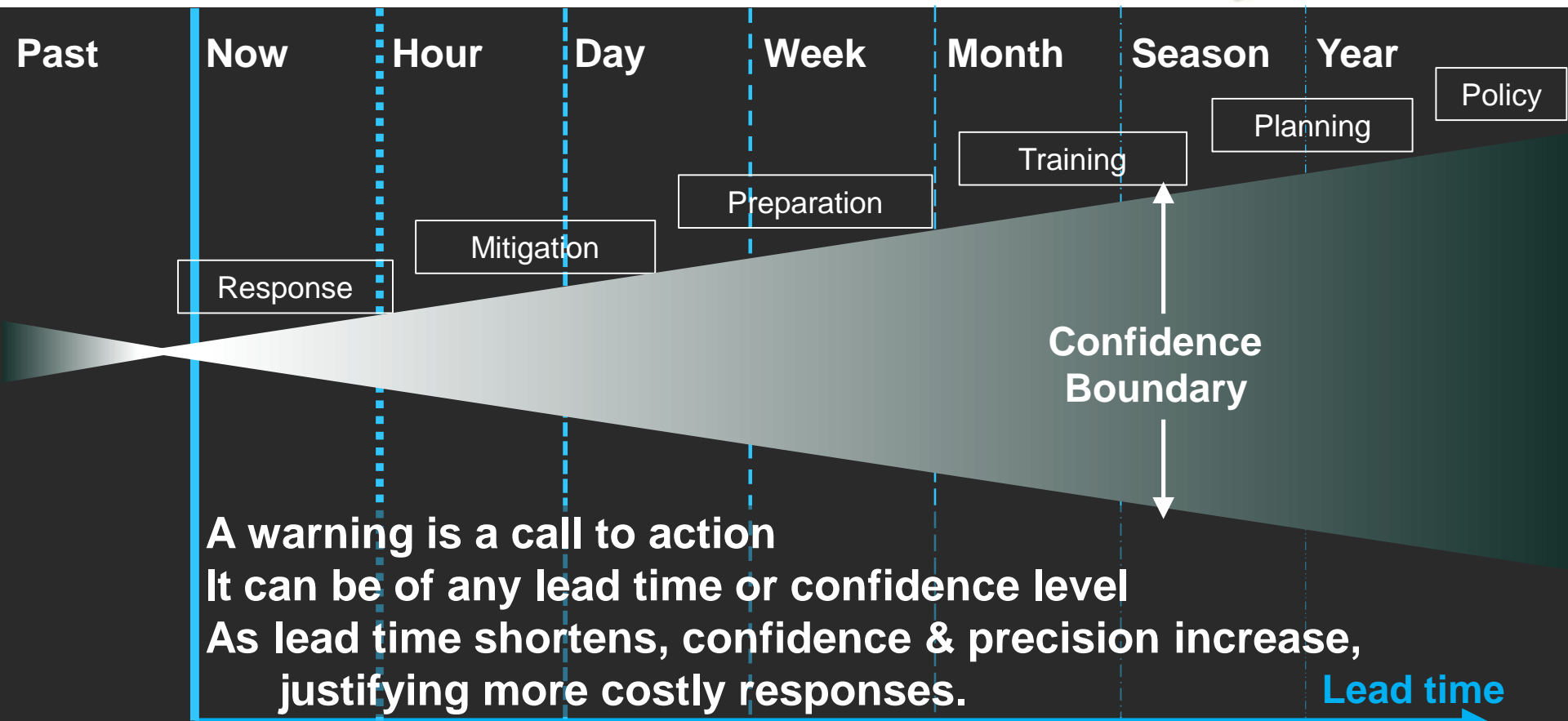
Key lessons for an effective warning

Lessons from Extreme Impact Events in 2021

Analysis & Conclusions

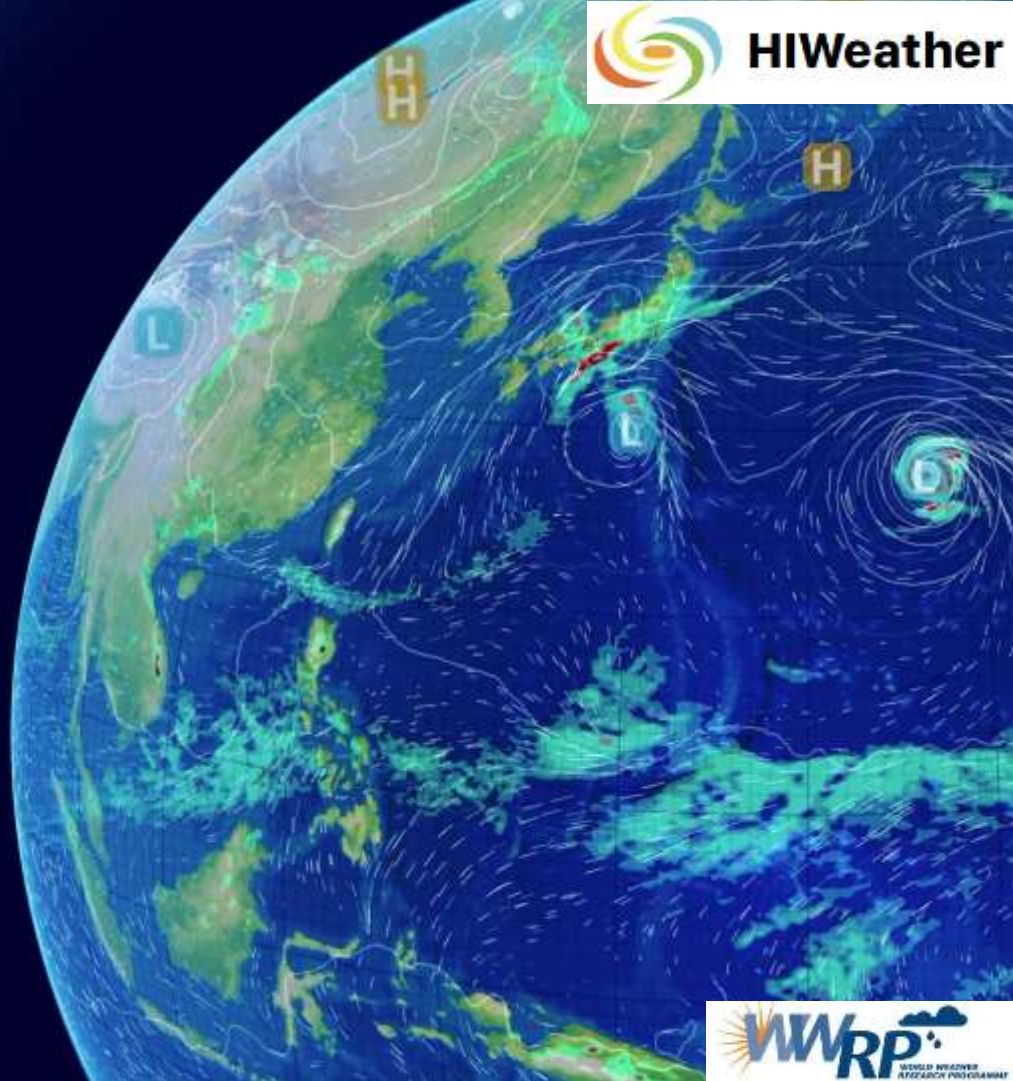
Warnings protect lives,
property, livelihoods and
essential services from
weather-related hazards





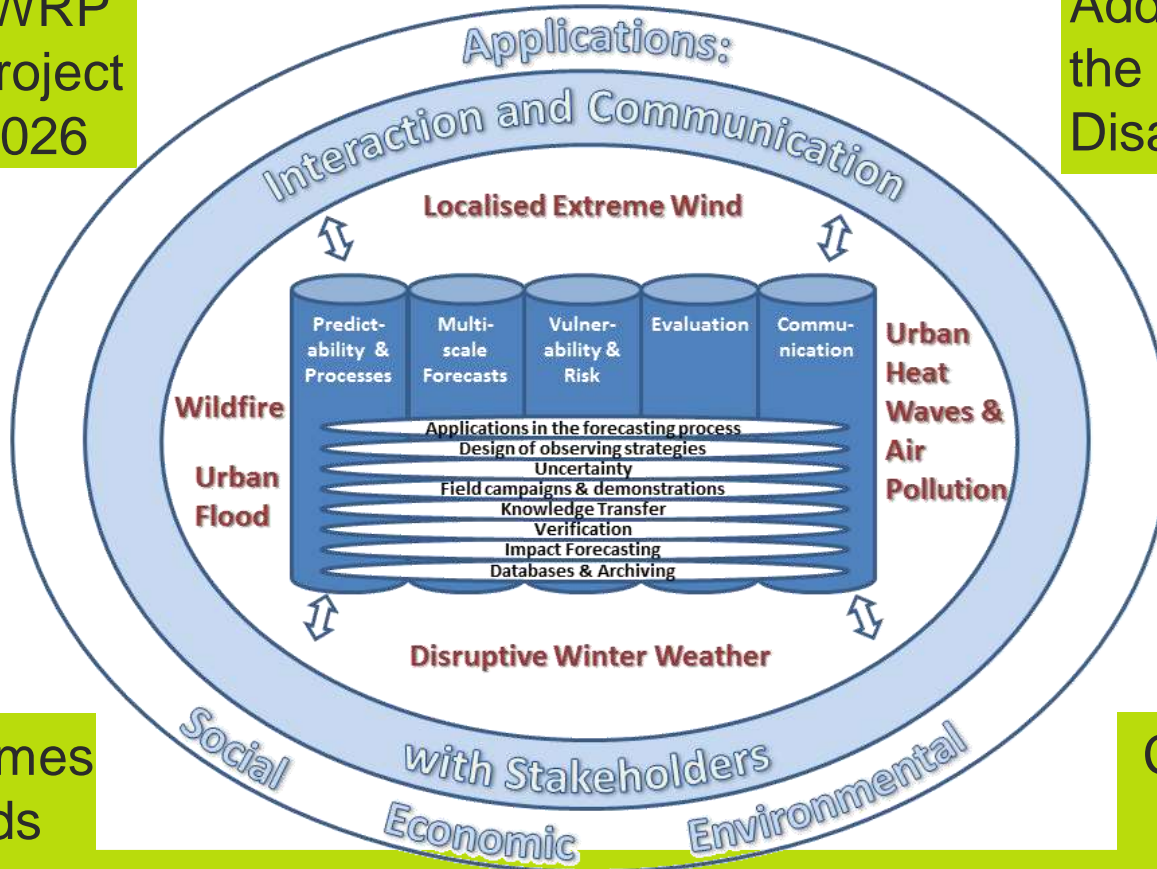
The WMO World Weather Research Programme

High Impact Weather project (HIWeather)



WMO/WWRP
10-year project
2016 - 2026

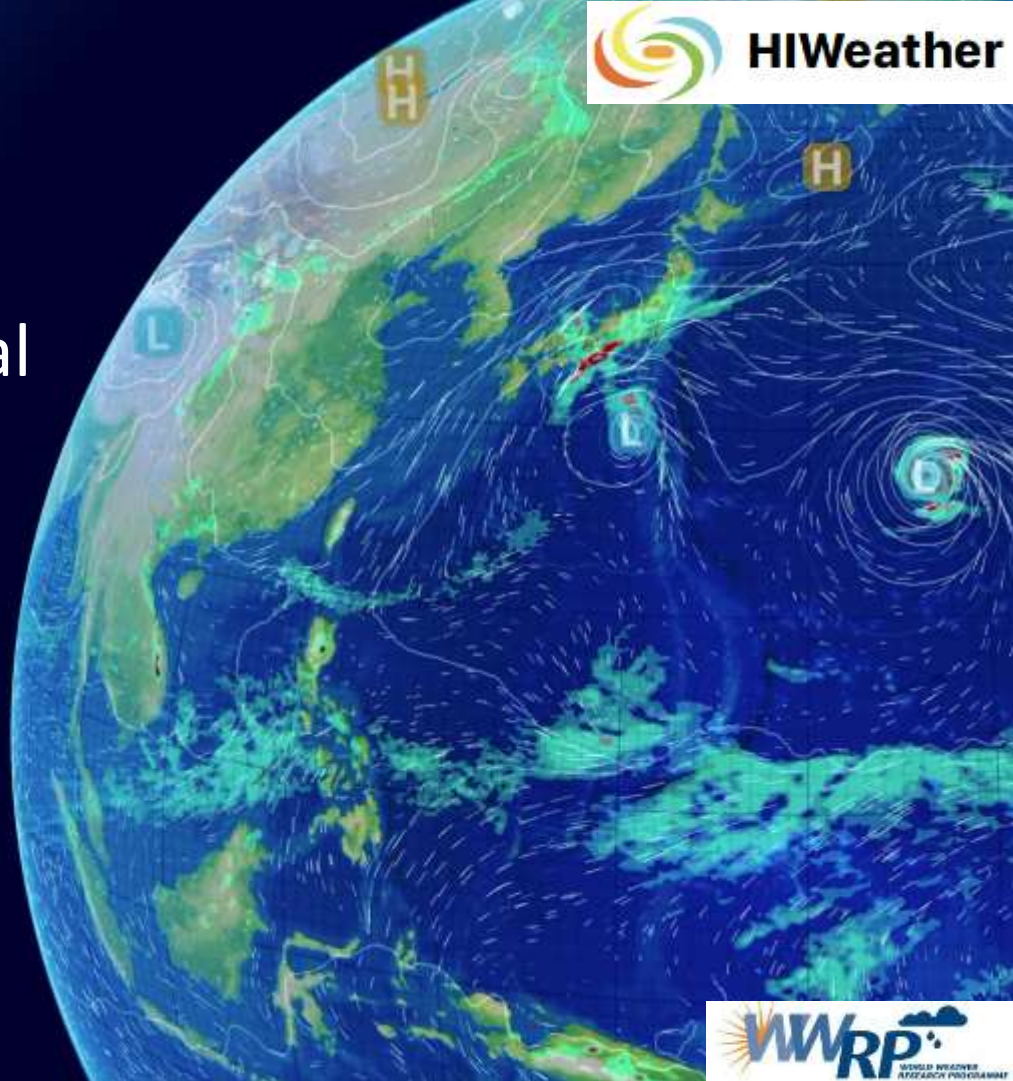
Addresses target (g) of
the Sendai framework for
Disaster Risk Reduction



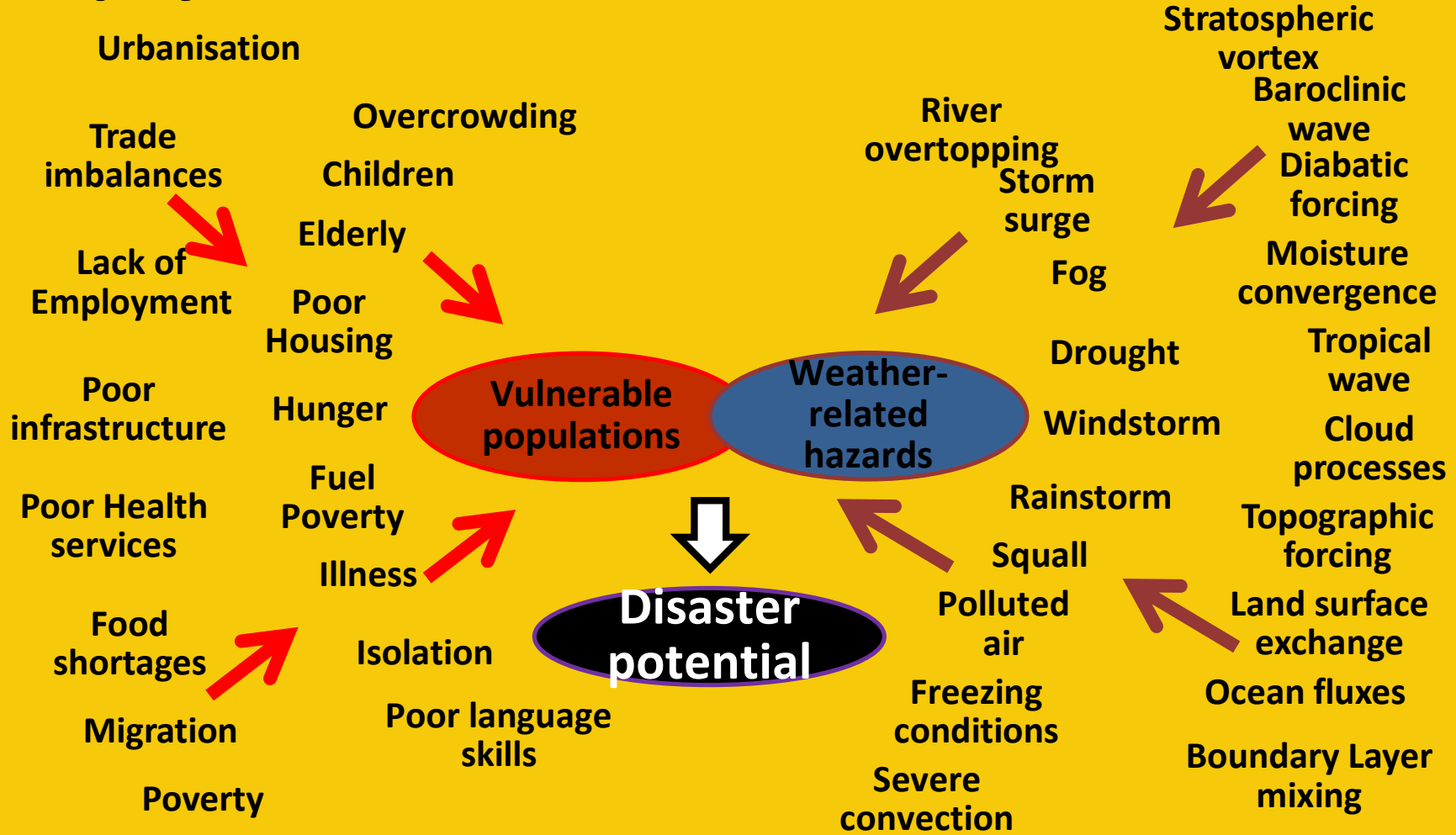
5 core themes
5 hazards

Cross-cutting science
with global reach

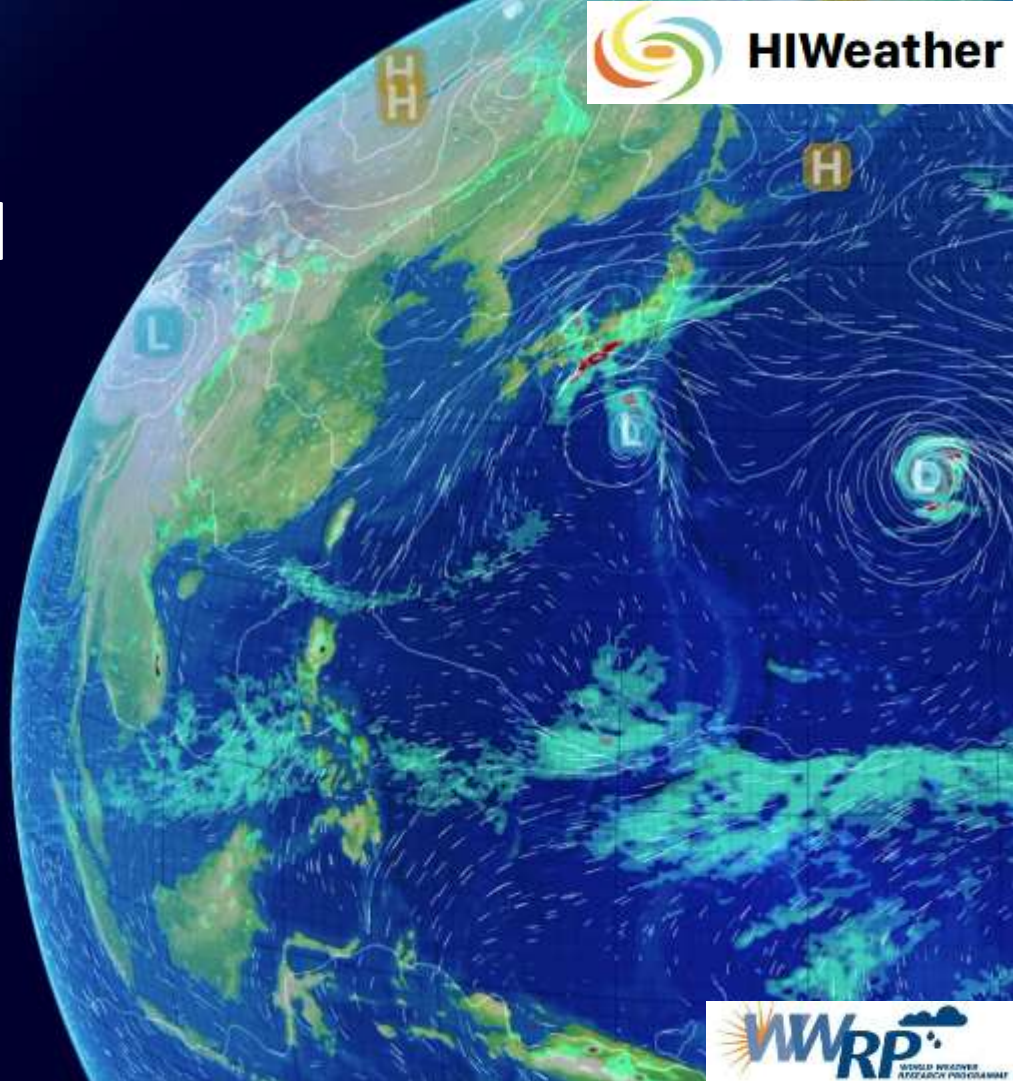
HIWeather has brought together physical and social scientists to jointly explore what makes an effective warning



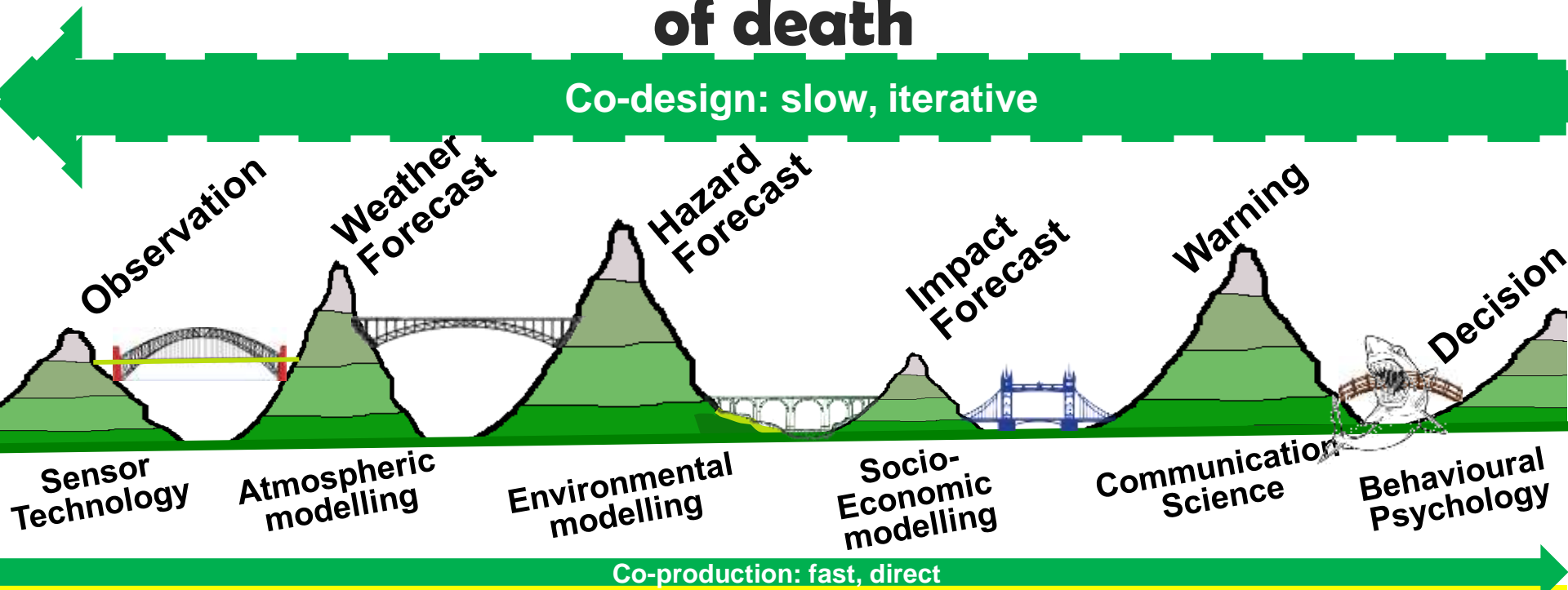
physical & societal causes of disaster



HIWeather has developed a simplified conceptual model of the warning value chain:
the “five valleys of death”

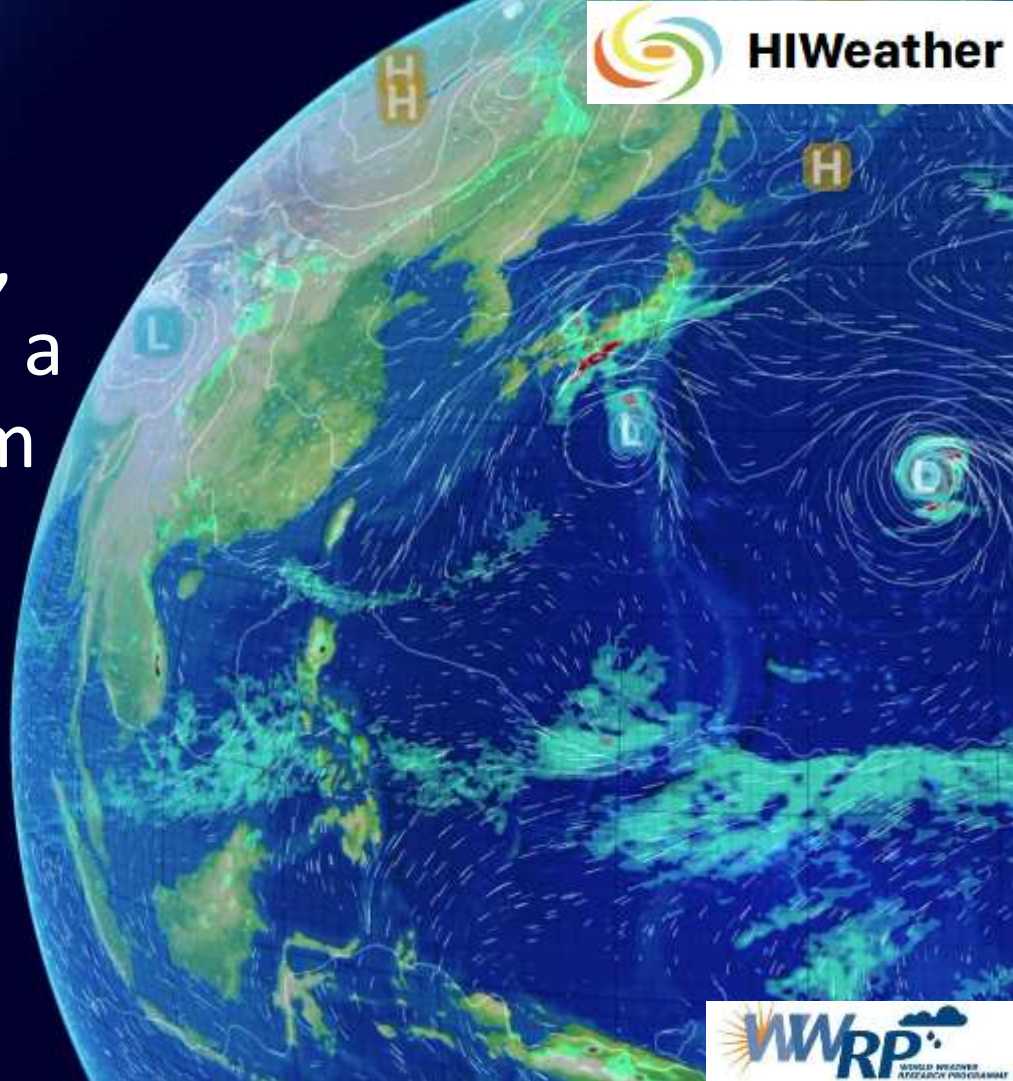


Conceptual Warning Chain: **the five valleys of death**



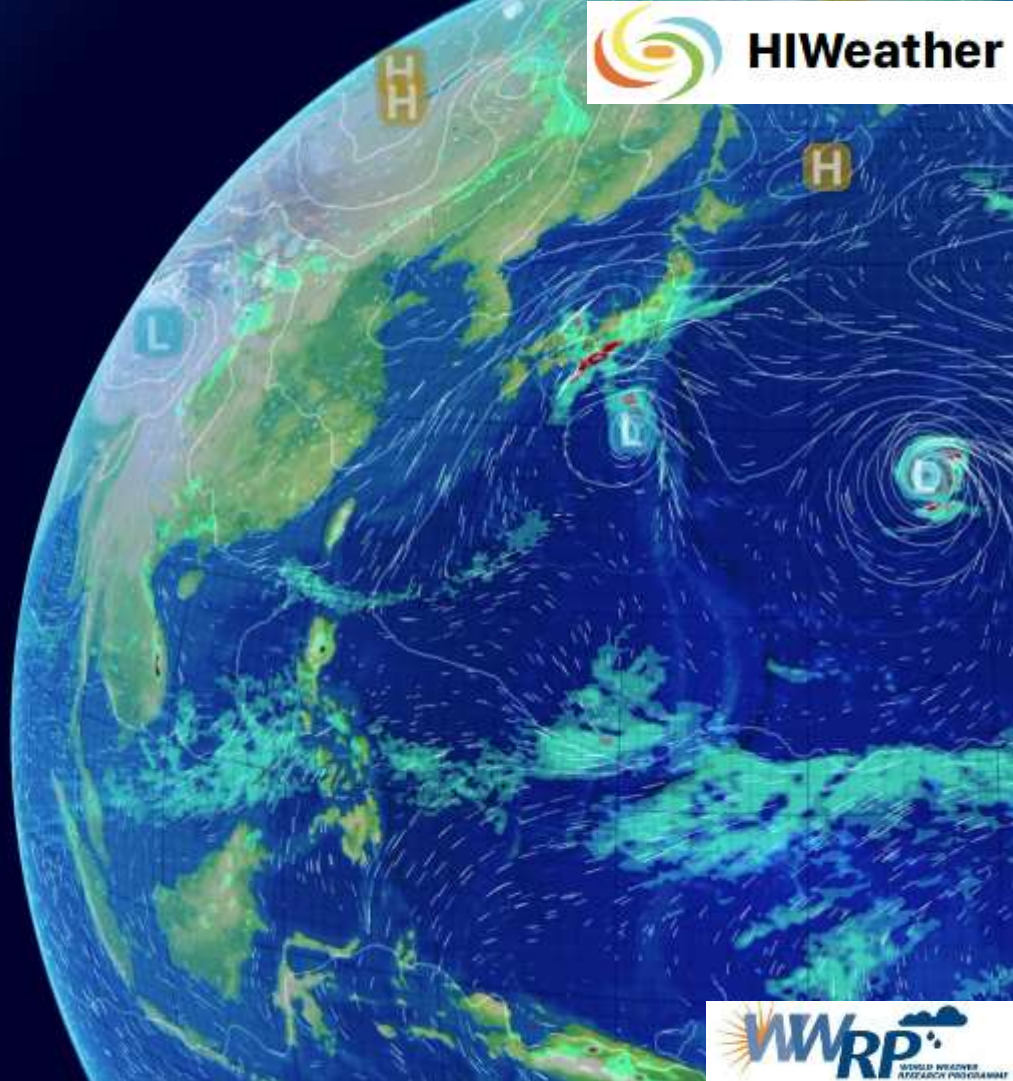
**Mountains represent expertise; Value is lost in each valley;
Bridges represent effective partnership**

HIWeather has promoted,
reviewed and synthesised a
vast body of research from
multiple disciplines



- behaviour of the recipient is the key success metric
- co-design ensures the warning is relevant and trusted
- the source needs to be recognised and trusted
- communication is as important as content
- warnings should refer to the impact of the hazard and give advice on how to respond
- the hazard forecast should be combined with vulnerability & exposure information
- hazards and weather forecasts should be at the highest available resolution
- monitoring of the physical & social situation requires high temporal / spatial resolution observations from a variety of official and community sources including social media
- predictability, uncertainty & confidence should be tracked and communicated
- partnerships are essential
- **an effective warning is useful, usable and used**

Application



Application in a Monsoon Climate

- Primary hazards are Tropical Cyclones and Heavy Rain (with associated flood, landslide & lightning)
- Other hazards are Drought, with associated wildfires; Poor air quality; Heatwave.
- Where are these hazards more frequent / intense, how is that likely to change?
- Who is at risk, when & where? Are rural or urban settlements more vulnerable? Are certain occupations more vulnerable? Which public services are vulnerable – water?
- Is timing important? Heavy rain during the monsoon is expected but is it less dangerous? Heavy rain at night is more dangerous than in the day.
- How can people, their property & essential services be protected? Warnings should be related to ability to protect.
- Can the information needed for protective actions be provided: how and when?
- Who has the information and who should communicate it. A governance structure is needed to make this happen and provide the funding.

Met Office Some 2021 disasters analysed HIWeather

	Weather	Hazard	Impact	Warning	Response	Comments
Filomena (Spain)	Winter Storm	Snow	Transport, Waste	3-days 1-day	Transport Homeless shelter	Failure to clear streets after initial response.
Uri (Texas)	Winter Storm	Cold, Snow	Transport, Power, Deaths	3-days	Transport, Farming Warming stations	No power outage warnings.
Seroja (Indonesia)	Tropical Storm	Flash flood & mudslide	Deaths, Infrastructure	12-hours	None known	Rainfall under-predicted; Failure to predict flash floods/mudslides or communicate risk.
Hot Dome (Canada)	Blocking Anticyclone	Heatwave, Wildfire	Deaths	3-days	Cooling stations	Lack of response from most vulnerable.
Floods (Germany)	Rainstorm	Flood	Infrastructure Deaths	3-days 12-hours	Targeted Evacuation	Local rainfall under-predicted until late; impact of flash flood not communicated.
Floods (China)	Rainstorm	Flood	Industry Deaths	1-day	None known	Uncertainty in rainfall; Poor communication of potential impact.
Wildfires (Greece)	Blocking anticyclone	Wildfires	Trees Displacement	3-days Hours	Targeted Evacuation	Limited ability to fight fires
Ida (Louisiana)	Tropical Storm	Wind, Flood	Deaths Infrastructure	4-days 2-days	Partial Evacuation	Lack of recognition of impacts on most vulnerable.
Ida (New York)	Tropical Storm	Wind, Flood	Deaths	3-days	Gully clearance	Lack of recognition of impacts on most vulnerable. Poor communication.

- Warnings must mobilise people to take action – there should be “no surprises”!
 - not just in the weather, but in its consequences and in the expected responses, especially for those with specific vulnerabilities.
- To achieve this, our warnings must:
 - Be delivered through trusted channels
 - Reach the people at risk and be understood
 - Provide advice to people on what to do and why
- To predict unprecedented hazards, our forecasting systems must deliver:
 - Models that produce unbiased probability distributions of extremes
 - Initial conditions that capture the ingredients for an extreme event
 - Ensembles that reliably identify the range of uncertainty
 - Diagnostic tools for communication of low probability, high impact events
 - Prediction of hazard-related impacts, including for specific vulnerabilities
- Warning performance must be measured: Did people respond? Were lives saved? Were essential services maintained? Were properties protected?

Watch out for our book, on Open Access in May, published by Springer:
Towards the “Perfect” Weather Warning:
bridging disciplinary gaps through partnership and communication

Join Us!

Twitter: @WMO_HIWeather; #hiweather

Facebook: HIWeather

Website: <http://hiweather.net>