World Meteorological Organization

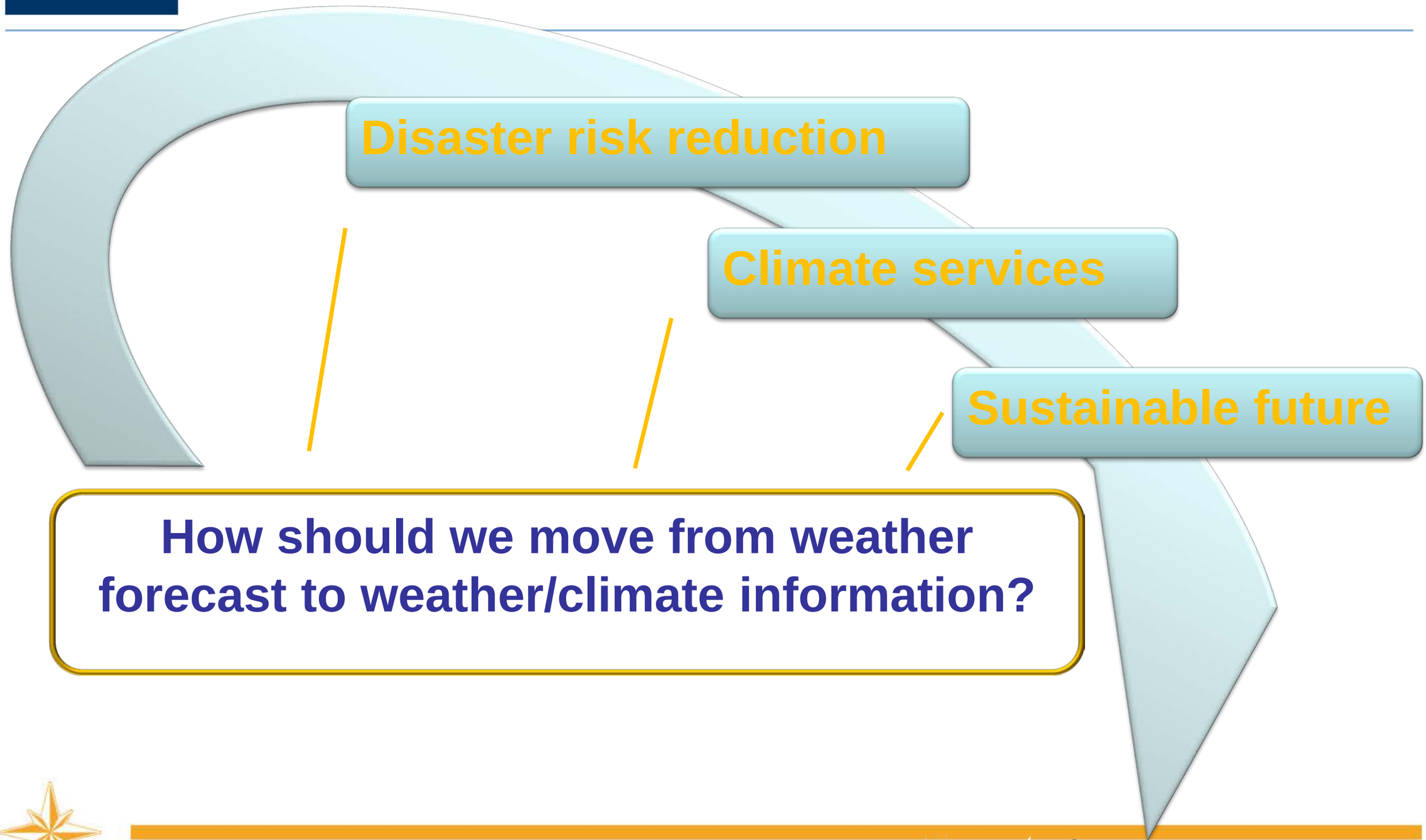
Weather • Climate • Water

World Weather Research Program: High Impact Weather

PM Ruti, B Golding

WGNE – March 2015 - NOAA

An overarching question



How should we move from weather forecast to weather/climate information?

The Mission


HIWeather
Promoting cooperative international research
to achieve a dramatic increase in resilience to high impact weather, worldwide,
through improving forecasts for timescales of minutes to two weeks
and enhancing their communication and utility in social, economic and environmental applications
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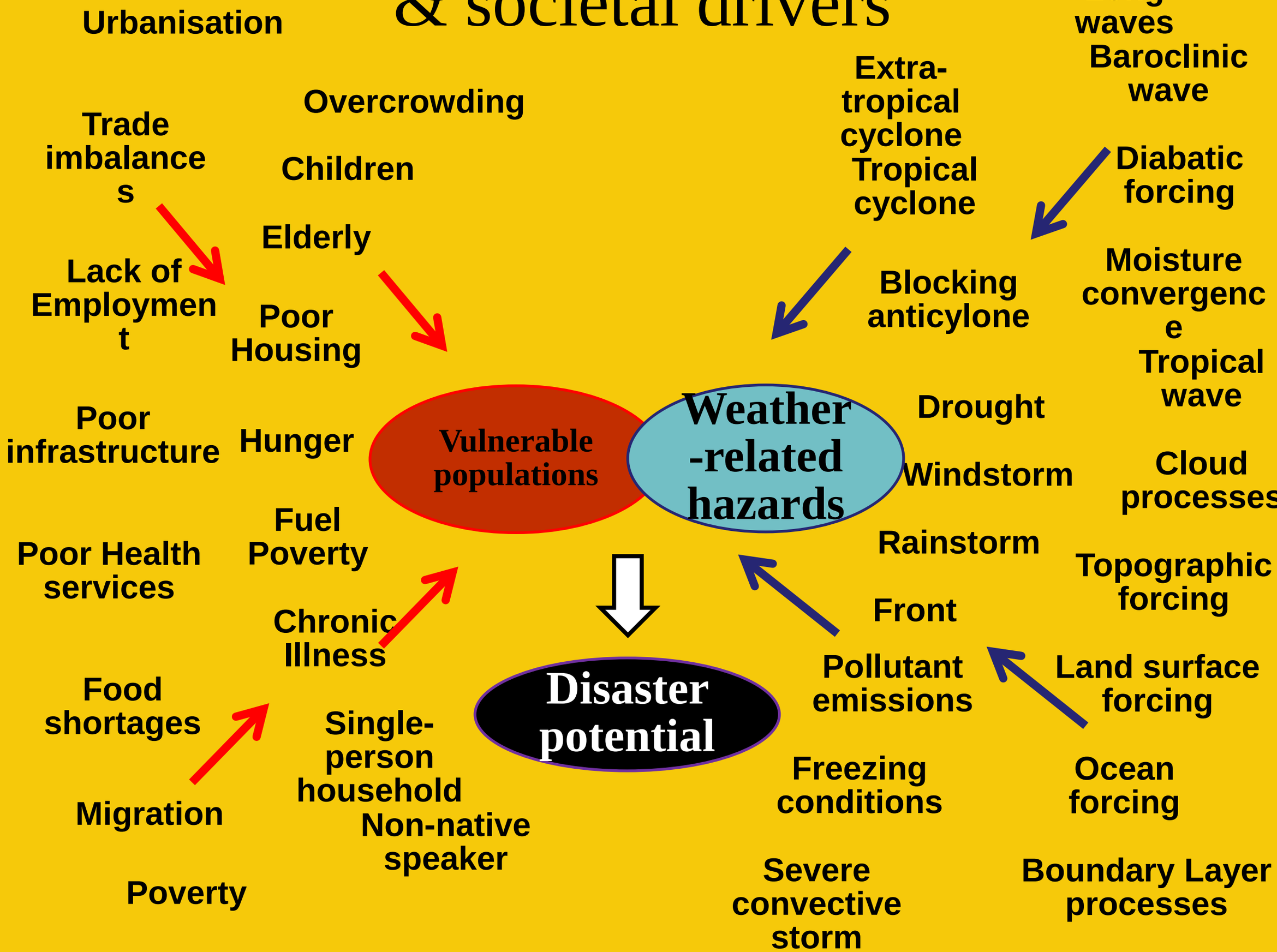
Context: Relationships between key weather & societal drivers



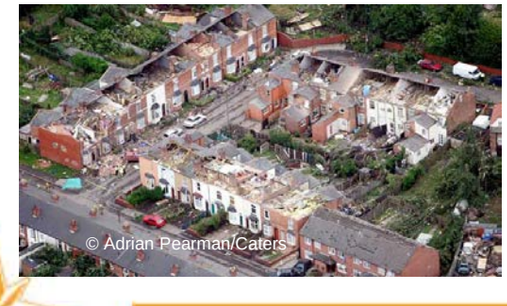
Scope defined by a set of hazards …

Urban Flood: Reducing mortality, morbidity, damage and disruption from flood inundation by intense rain.

Disruptive Winter Weather: Reducing mortality, morbidity, damage and disruption from snow, ice and fog to transport, power & communications infrastructure.

Wildfire: Reducing mortality, morbidity, damage and disruption from wildfires & their smoke.

Urban Heat Waves & Air Pollution: Reducing mortality, morbidity and disruption from extreme heat & pollution in the megacities of the developing and newly developed world.



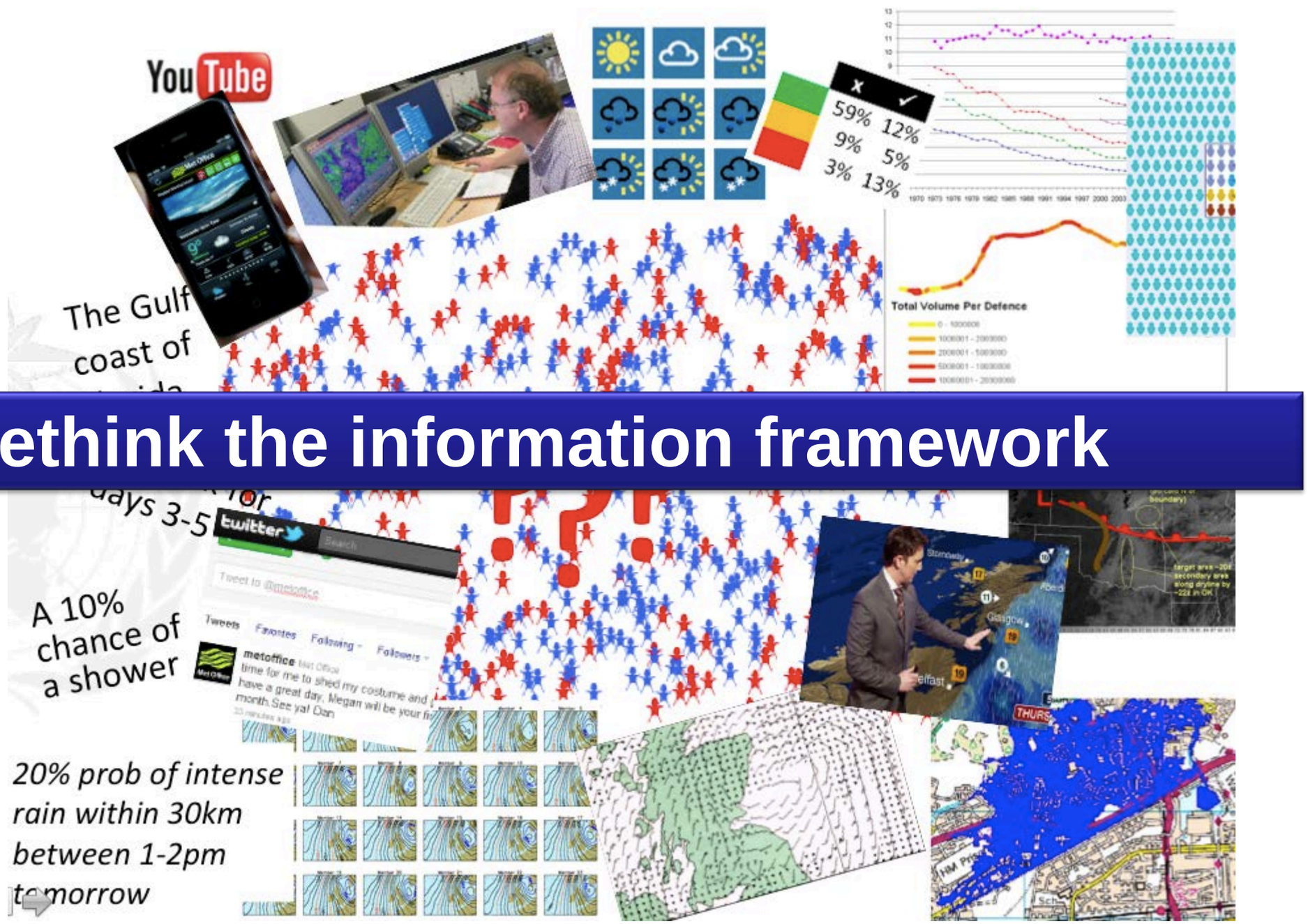
Extreme Local Wind: Reducing mortality, morbidity, damage and disruption from wind & wind blown debris in tropical & extra-tropical cyclones, downslope windstorms & convective storms, including tornadoes.

Who takes mitigation actions

Lead Time (major river & coast floods)												
-14d	-10d	-7d	-5d	-3d	-2d	-1d	-12h	0h	+12h	+1d	+5d	+14d
Lead Time (flash floods)												
-5d	-3d	-2d	-1d	-12h	-6h	-3h	-1h	0h	+3h	+1d	+5d	+14d
Routine & Enhanced Forecasting												
		Enhanced Monitoring										
			Flood Advisory Teleconferences									
			Staff Preparedness									
			Public Flood Awareness									
	Empty Water Storage											
			Enhanced Maintenance									
				Temporary Defences								
					Controls							
			Response Staff Deployment									
					Flood Warnings							
					Evacuation							
								Rescue				
										Refurbishment & Rebuilding		

Individuals

… why just improving



Rethink the information framework

Which is the research approach

Seconds

Hours

Communication

Vulnerability and risk

Impact Modeling

Information transfer

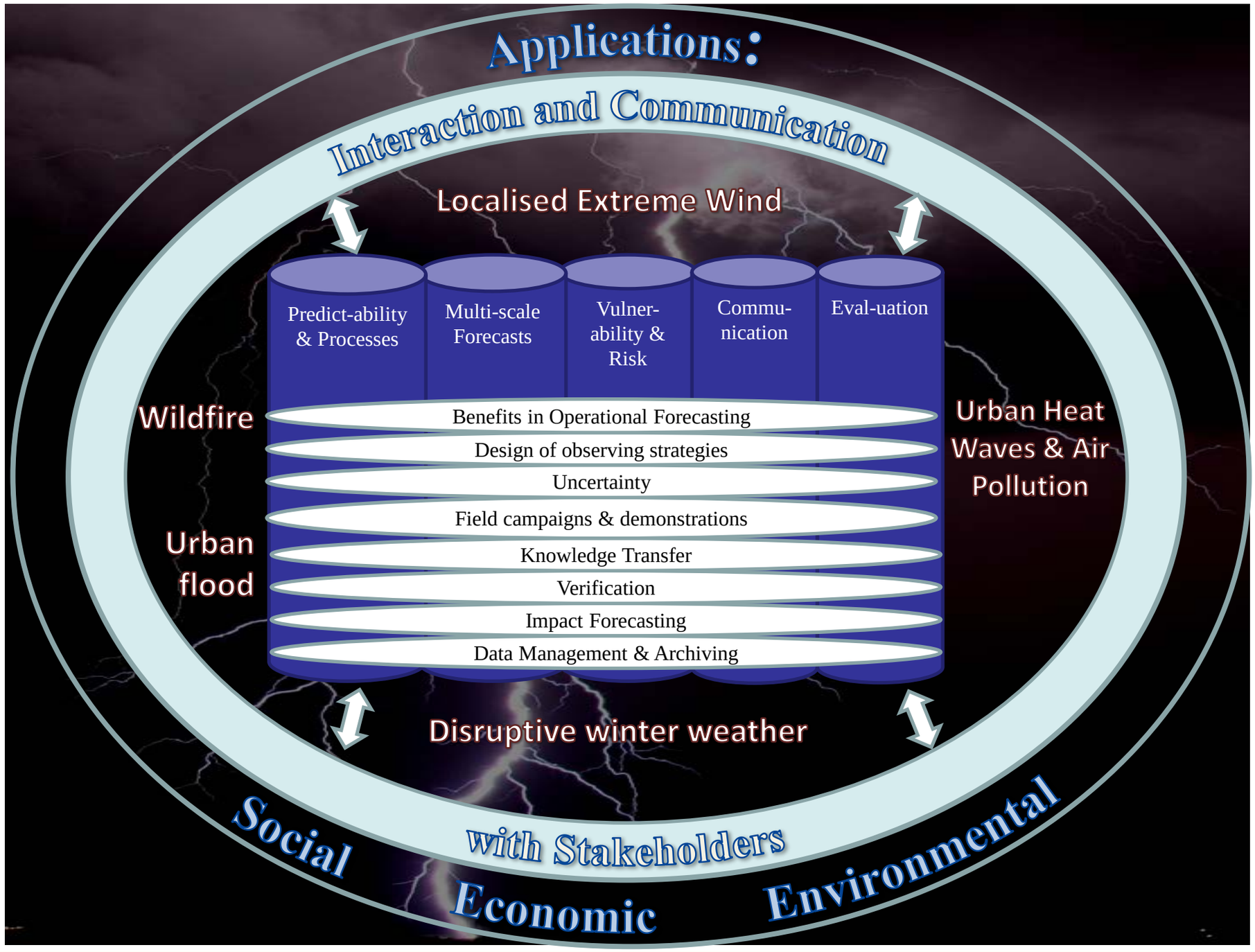
Multi-scale Forecasts & obs

Predictabiliy and Processes

m

Km

HIWeather structure



HIWeather pillars 1

Predictability & Processes

Initiation & evolution of hazard-related weather systems

- Scale interactions & implications for predictability at km-scale
- Error growth for hazardous weather
- Quasi-stationary conditions
- Dynamic role of diabatic heating
- Processes specific to individual hazards

HIWeather pillars 2

Multi-Scale Forecasting

Multi-scale prediction of weather hazards in coupled modelling systems

- Observing km-scale weather, hazards & impacts
- Hazard nowcasting methods
- Coupled km-scale data assimilation methods
- Km-scale hazard prediction with improved convective initiation, microphysics & land surface interactions
- Coupled km-scale ensemble predictions
- Products tailored to user needs, inc uncertainty

HIWeather pillars 3

Vulnerability & Risk

Hazard impacts on individuals, communities & businesses, their vulnerability & risk

- Growing impacts research capacity
- Synthesising previous fragmented work
- Using social media
- Identifying & characterising vulnerability
- Representing dynamic vulnerability
- Understanding counter-intuitive responses

HIWeather pillars 4

Communication

More effective responses to forecasts through better communication of hazard risk warnings

- Effectiveness of communication methods
- Effective use of social media
- Reasons for lack of trust & routes to building trust
- Good practice in communicating forecasts & warnings
- Growing research capacity

HIWeather pillars 4

User-Oriented Evaluation

Measure skill and value of forecasts & warnings at all stages of production to focus research in weak areas & support users in developing responses

- Verification methods for hazards
- Information loss through the production chain
- Information to enable users to develop response strategies
- Verification of impacts & responses
- Economic value of forecasting & warning services
- Growing research capacity

HIWeather governance

WMO Commission for the Atmospheric Sciences

WWRP SSC and Secretariat

HIWeather Steering Group

Physical/Social Science co-chairs

Brian Golding & tbd

Task team leaders

ICO

Stakeholders Advisory Group

P&P task team

George Craig (Germany)

MSF task team

tbd

VR task team

Brian Mills (Canada)

C task team

tbd

E task team

Beth Ebert (Australia)

Workshop Proposal

1. Convective-scale data assimilation

→ intercomparison of radar DA schemes

→ inter-comparison of capability to simultaneously initialise convective/sub-synoptic scales

→ proposed 2016 workshop

2. Characterising error growth and uncertainty at km-scale

→ application in DA, ensembles and product design

→ what the maths of nonlinearity can teach us about km-scale behaviour

→ proposed 2017 workshop

3. Progress in coupled (ocean-atmosphere-land surface)

→ DA – through intercomparison/workshops

→ extend to chemistry, hydrology

Diagnostics/Verification activities

1. MICROPHYSICS INTERCOMPARISON

   → OPTIMISING PRECIPITATION AND FEEDBACK ON DYNAMICS

   → TROPICAL CYCLONE PERFORMANCE NEEDS DIFFERENT MICROPHYSICS FROM THAT FOR EXTRA-TROPICAL CYCLONES.

2. DIAGNOSIS TOOLS FOR SHORT RANGE/CONVECTIVE SCALE BUSTS

3. VERIFICATION TOOLS FOR ENSEMBLE FORECASTS OF HI WEATHER

4. INTERCOMPARISON OF CONVECTIVE SCALE PREDICTION SYSTEMS, USING SELECTED CASE STUDIES FOCUSSING ON MULTI-SCALE PERFORMANCE, COUPLING, BOUNDARY LAYER

Experiment design

1. **Optimisation of parametrization suites for km-scale models & ensembles – importance of stochastic elements – km-scale grey-zone issues**
2. **Optimising coupled models both for feedbacks to the atmosphere and for non-atmosphere impacts – eg surges in the ocean, floods on the land surface**

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WMO Trust Fund

High Impact Weather

HIWeather

26th IUGG GENERAL ASSEMBLY 2015
INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS
UNION GÉODÉSIQUE ET GÉOPHYSIQUE INTERNATIONALE

PRAGUE, CZECH REPUBLIC
PRAGUE CONGRESS CENTRE
JUNE 22–JULY 2, 2015
Earth and Environmental Sciences for Future Generations

M22 Understanding and Predicting High-impact Weather and Climate Extremes

IAMAS

Convener: Richard Swinbank *(Exeter, UK)*

Co-convener: *Xuebin Zhang (Toronto, Canada), Richard Grotjahn (Davis, USA), Lisa Alexander, (Sydney, Australia), Julia Keller (Offenbach, Germany)*

We encourage presentations on

- Prediction of high-impact weather events and climate extremes
- Causes of changes to large-scale circulation systems and resulting extremes
- Statistics of extreme events
- Provision of risk-based forecasts for extreme events
- Resea[illegible]igns, TIGGE
- Resea[illegible]

January 15, 2015	Grant applications CLOSE
January 31, 2015	Abstract submission DEADLINE

WMO
OMM

Opportunity to use information on multiple time scales

Figure B5: Ready-Set-Go tool demonstrating actions to be taken with seasonal, intraseasonal and weather forecasts.