A value chain approach to Extreme Earth

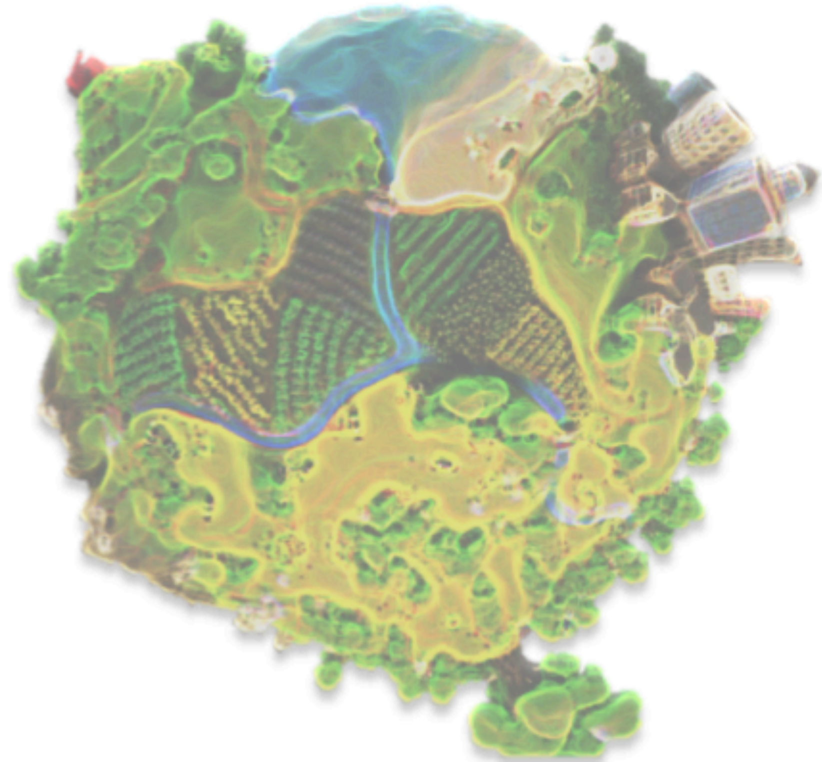
Paolo Ruti, World Weather Research Division
Sarah Jones, Chair Scientific Steering Committee
Brian Golding, UK Metoffice, HIWeather Project
David Johnston, Massey UN, HIWeather Project
Julia Keller, WMO

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

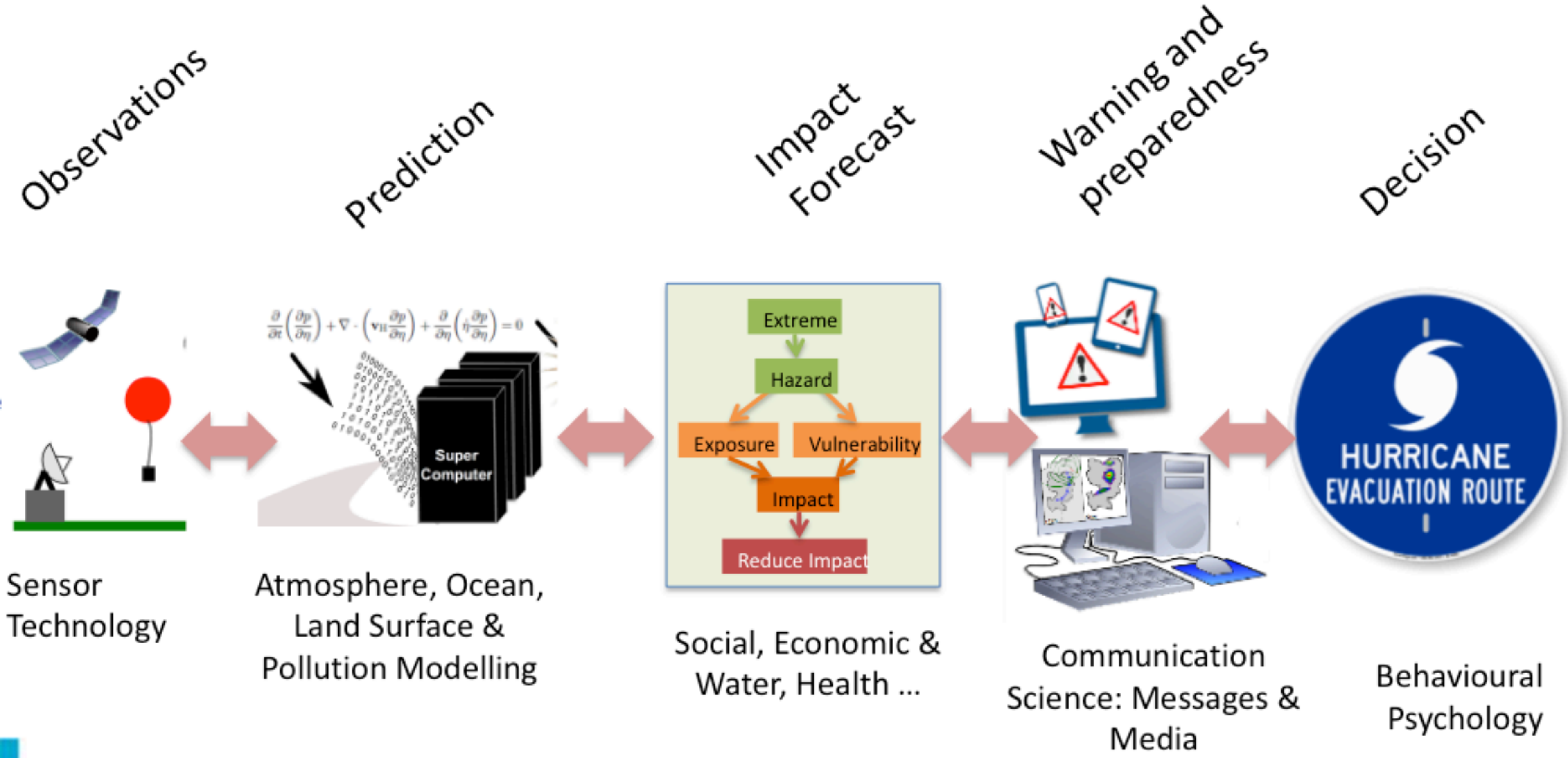
Extreme Earth



Urbanization (Megacities such as Shanghai or Mexico City), population increase in vulnerable areas (i.e. Lake Victoria region, Mediterranean), social and economic interconnectivity are challenging adaptation capacity

Research faces formidable challenges to capitalize on the social and economic benefits promised by improvements in weather, water, climate information. In this context, co-design means that the scientific priorities are articulated in a continuous dialogue across the different elements of a decision making chain (value chain)

Disaster Risk Reduction Value Chain



WMO OMM

Research across the value chain

- Interdisciplinary collaboration between the research community, stakeholders and users of weather, water, climate information is required to identify the gaps and address them
- Seamless prediction of high-impact weather events at a wide range of scales – from nowcasting to seasonal prediction – must be improved, with a particular focus on smaller scales
- Relevant and targeted communication of forecasts and warnings, including information on potential consequences of high-impact events, together with user-oriented verification, is crucial for capitalizing on the achievements made in the prediction of high-impact weather events.

WMO OMM

High-Impact Weather Project

Increase resilience to Urban Flood, Wildfire, Urban Heat and Air Pollution in Megacities, Localised Extreme Wind and Disruptive Winter Weather through improving forecasts for timescales of minutes to two weeks and enhancing their communication and utility in social, economic and environmental applications.

Links to WCRP through quantifying vulnerability and risk assessment, and for response to High Impact Weather in a changing climate.

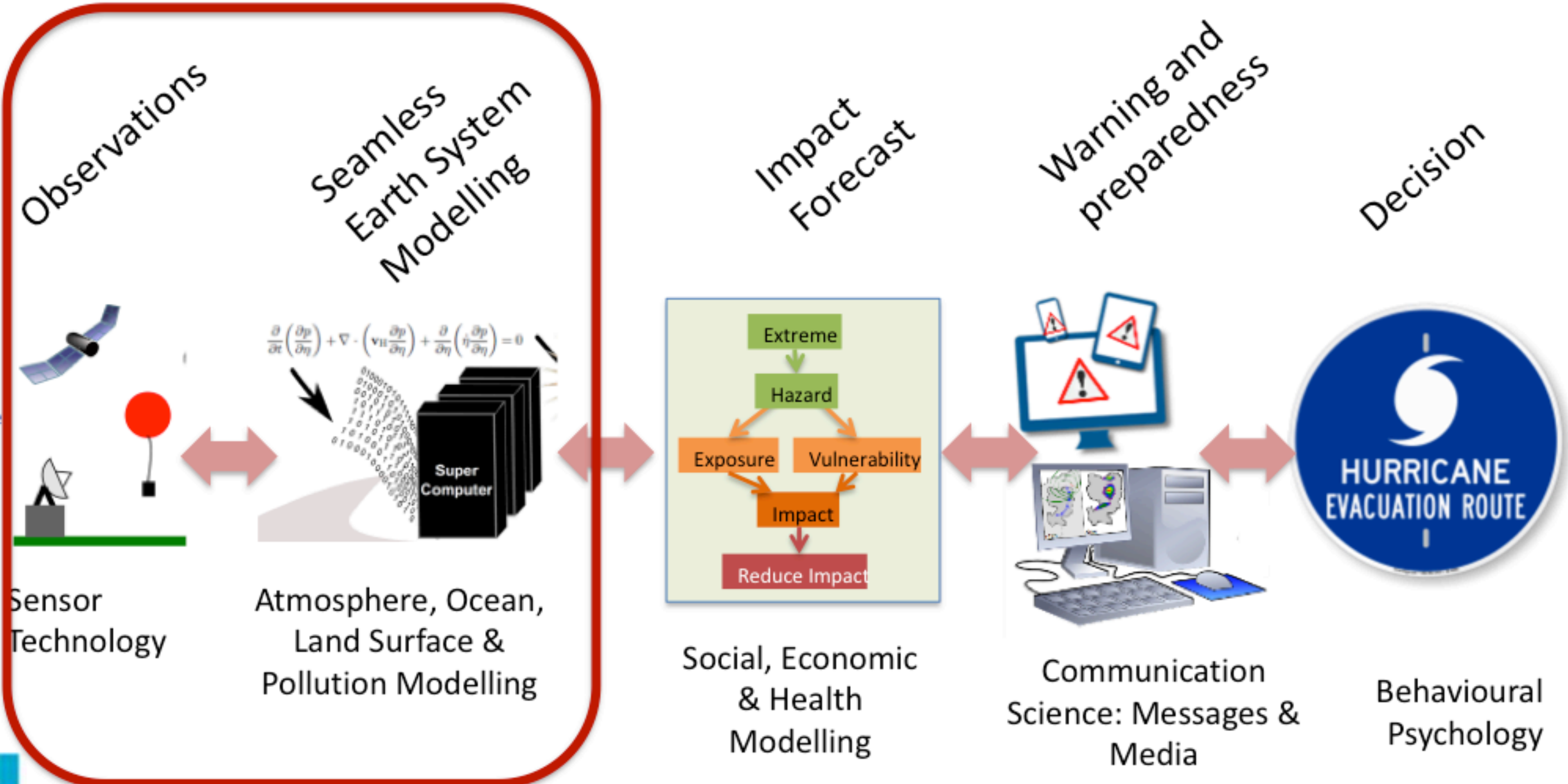
Co-Chairs: Brian Golding (Met Office), Prof David Johnston (Massey/GNS Science)

International Coordination Office: CMA, China, Prof Qinghong Zhang (Pekin UN)

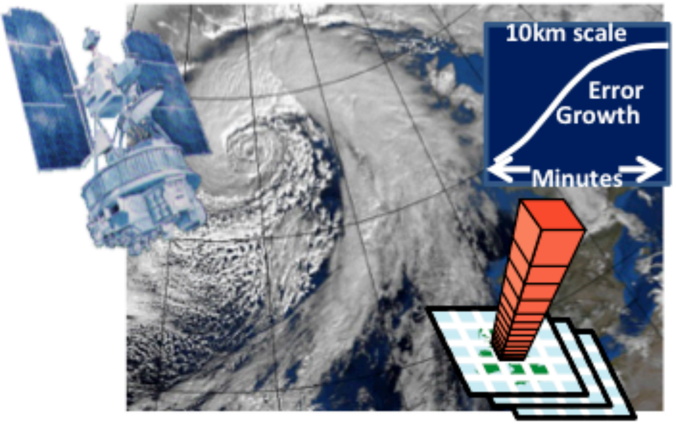
WMO OMM

WWRP WORLD WEATHER RESEARCH PROGRAMME

…following a value chain approach…



Processes – Multi-scale Forecasting



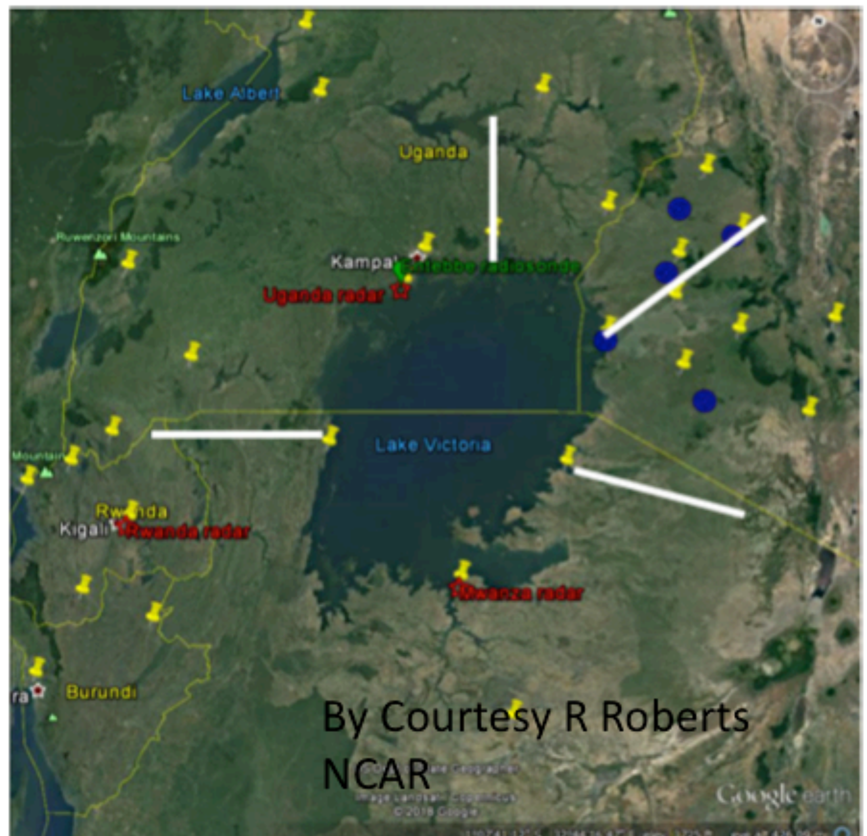
Processes & Predictability:

Initiation & evolution of hazard-related weather systems

Multi-scale Forecasting:

Multi-scale prediction of weather hazards in coupled modelling systems

HighWay (WMO-DFID)



By Courtesy R Roberts NCAR

WMO OMM

Multi-scale Forecasting

***Example:** Upscale error growth in high-resolution experiment*

Selz and Craig 2015 Mon. Wea. Rev.

Perturbation error growth: Shown as difference between control and perturbed experiment

Perturbations spread out from the convective regions at a speed consistent with that of a deep (troposphere filling) gravity wave to synoptic scale disturbances.

0.1 0.3 1 3 10 Inf
Precipitation Rate [mm/h]

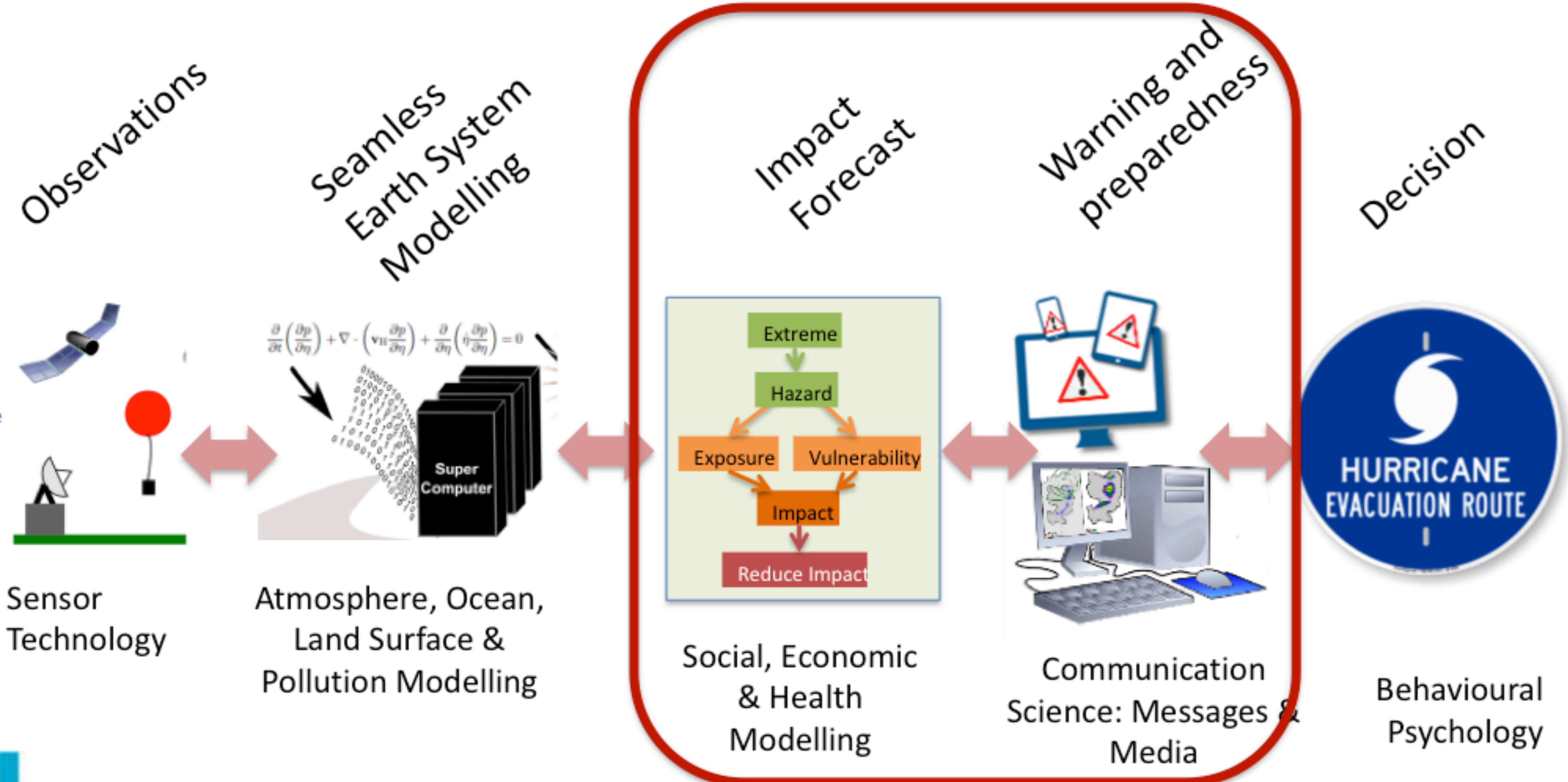
1e-3 1e-2 1e-1 1 Inf
Difference Total Energy [m^2/s^2]

500 hPa geopotential
line spacing 250 m^2/s^2

500 hPa geopotential difference on large scales
(>1000 km). Red positive, blue negative, line spacing 5 m^2/s^2

Waves 2 Weather
G Craig (UN Munich)

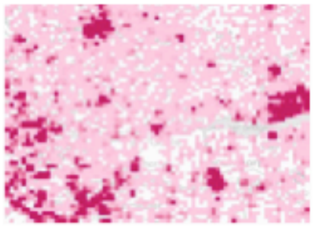
…following a value chain approach…



WMO OMM

Impacts, Vulnerability, Communication

Infrastructure and density of vulnerable people

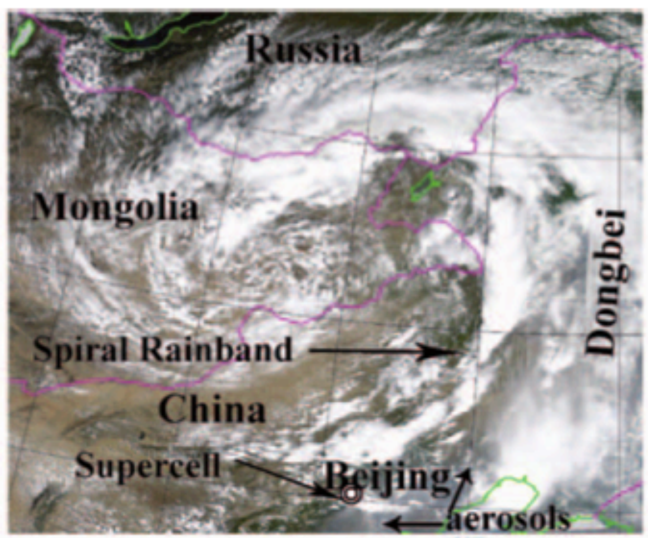


Human Impacts, Vulnerability & Risk:

Hazard impacts on individuals, communities & businesses, their vulnerability & risk – working on participatory science

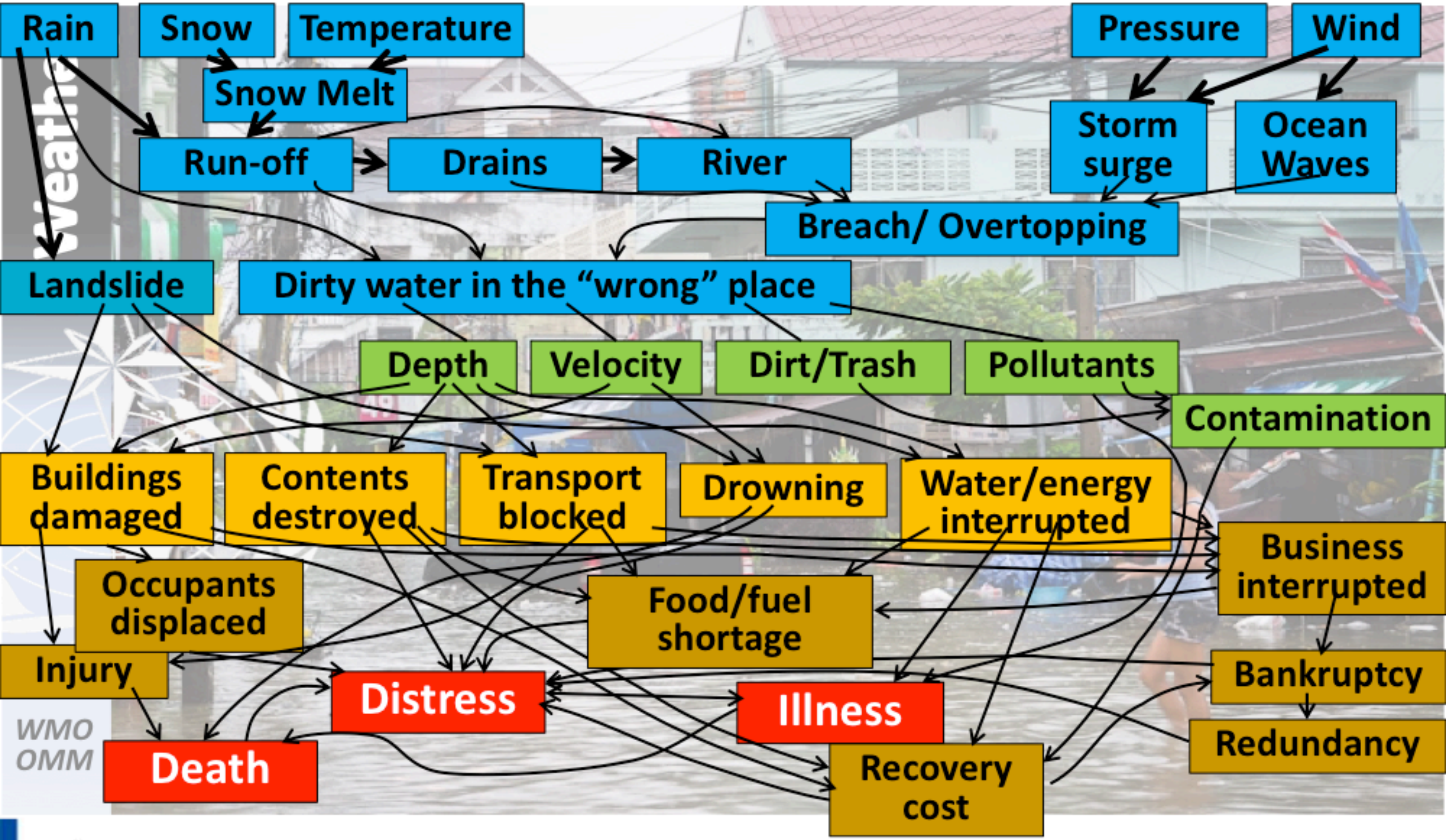
Communication:

Achieving more effective responses to forecasts through better communication of hazard risk warnings



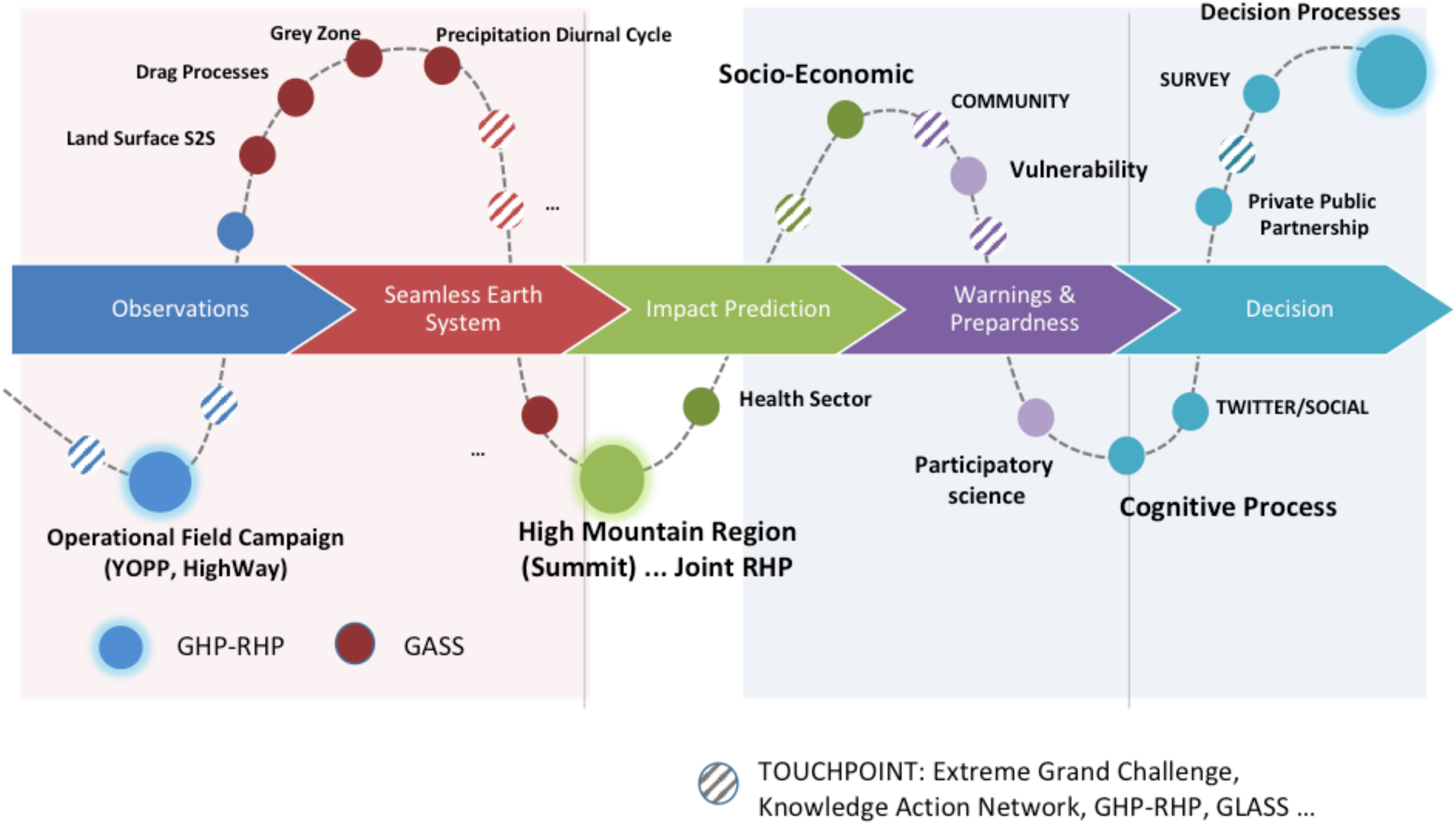
WMO OMM

Flood impacts



WMO OMM

Value Chain Journey



WMO OMM

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

A value chain approach to Extreme Earth

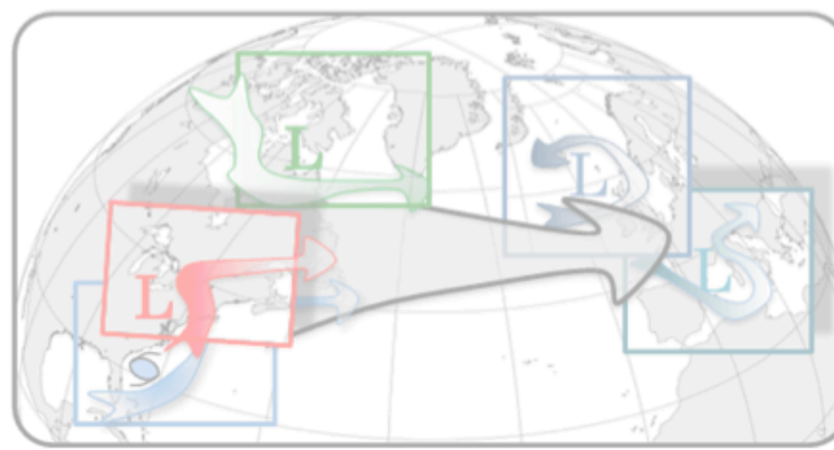
Thank you
Merci

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

… to tackle key challenges at intersection of weather, climate and environment

- Understanding multi-scale interaction of high-impact weather events
- Coupling between physical and dynamical processes across scales
- Subseasonal to seasonal predictability, impact of geosphere
- Coupled Earth system modeling from minutes to decades
- Linking the impact of regional circulation systems to decision making processes (monsoons, tropical cyclone variability, air-quality)
- Diurnal cycle of precipitation, fog,
- …and many more!

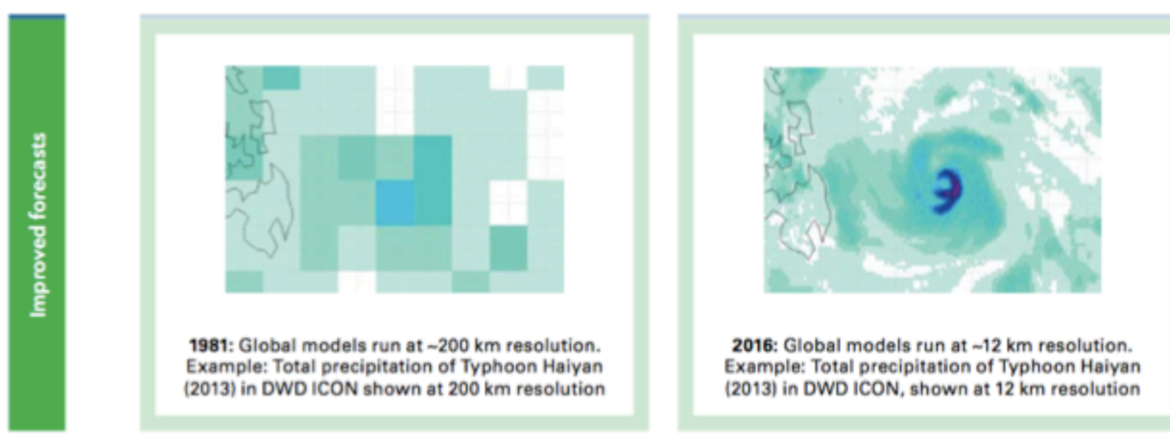


WMO OMM

… to tackle key challenges at intersection of weather, climate and environment

Advancing modelling and observations:

- Consider needs for weather, climate and environment when developing new observation systems
- Move toward seamless weather and climate models
- HPC and data handling represent major future challenges
- Innovation in ensemble prediction, data assimilation, verification, post-processing applicable at all scales (Reanalysis, CMIP, …)
- Modelling and observing impacts needs shared expertise on vulnerability and risk



1981: Global models run at ~200 km resolution. Example: Total precipitation of Typhoon Haiyan (2013) in DWD ICON shown at 200 km resolution

2016: Global models run at ~12 km resolution. Example: Total precipitation of Typhoon Haiyan (2013) in DWD ICON, shown at 12 km resolution

WMO OMM