A value chain approach to Extreme Earth

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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

Observations

Sensor Technology

Atmosphere, Ocean, Land Surface & Pollution Modelling

Prediction

Super Computer

Impact Forecast

Social, Economic & Water, Health ...

Warning and preparedness

Communication Science: Messages & Media

Behavioural Psychology

Reduce Impact

Decision

Extreme

Hazard

Exposure

Vulnerability

Impact
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.
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)
...following a value chain approach...

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Seamless Earth System Modelling

Impact Forecast

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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
Multi-scale Forecasting

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


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.

Waves 2 Weather
G Craig (UN Munich)
...following a value chain approach...

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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

Courtesy of Prof Q Zhang
Value Chain Journey

Observations
- Operational Field Campaign (YOPP, HighWay)
  - GHP-RHP
  - GASS

Seamless Earth System
- Grey Zone
- Precipitation Diurnal Cycle

Impact Prediction
- High Mountain Region (Summit) ... Joint RHP
  - Health Sector

Warnings & Preparedness
- Socio-Economic
  - COMMUNITY
  - Vulnerability

Decision Processes
- Decision
  - Private Public Partnership
  - TWITTER/SOCIAL

Cognitive Process

TOUCHPOINT: Extreme Grand Challenge, Knowledge Action Network, GHP-RHP, GLASS ...
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Thank you

Merci
... 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!
... 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