WCRP Lighthouse Activity on Explaining and Predicting Earth System Change

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WCRP Lighthouse Activity on Explaining and Predicting Earth System Change

Overarching objective

- ***To design, and take major steps toward delivery of, an integrated capability for quantitative observation, explanation, early warning and prediction of Earth System Change on <u>global and regional scales</u> and <u>multi-annual to decadal timescales.</u>***

- *Examples: "hiatus", changes in IPO phase, changes in AMOC, rapid regional ocean warming, persistent drought.*

- *Changes in ocean and atmosphere circulation and their influence on hazards is a specific focus – key issue for adaptation.*

Science Plan Structure

Theme 1: Monitoring and modelling Earth System Change

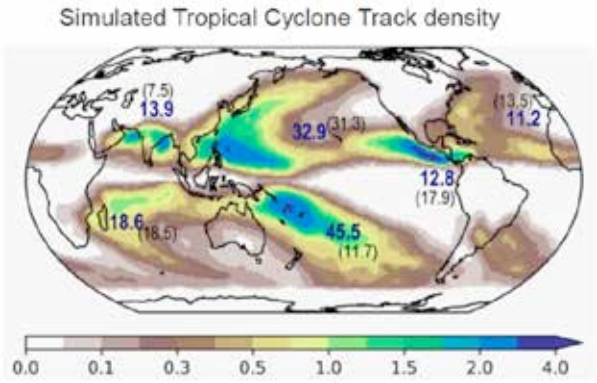
- Observational and modelling requirements to monitor, explain and predict earth system change
- Convergence between climate modelling and Earth system data assimilation & reanalysis

Theme 2: Integrated attribution, prediction, projection and early warning

- Quantitative process-based attribution of Earth System Change
- Integrated attribution, prediction and projection (building on GC in NTCP) including signal-to-noise "paradox"
- Contribute to WMO State of Global Climate & Annual to Decadal Climate Update reports
- Early warning of major changes – collaboration with SLC

Theme 3: Assessment of Current and Future hazards

- Focus on classes of events rather than individual events
- Understanding the natural and anthropogenic drivers of changing hazards in different regions; extending "event attribution" methodologies
- Collaboration with My Climate Risk & RifS



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Cross-cutting approaches / activities

Integrated use of observations and models

- Characterization and quantification of uncertainties - fundamental to attribution
- To what extent are models and observing systems adequate for explaining and predicting Earth System Change?

Case studies of significant changes and multi-annual-to-decadal events

- Targeted research to quantify, explain and assess the predictability of carefully selected recent events
- Integrating insights of all three Themes.

Large ensembles

- Large ensemble single forcing experiments necessary for quantitative explanation of Earth System change
- High resolution ensembles necessary to understand regional circulation changes and modulation of hazards
- Collaboration with Digital Earths

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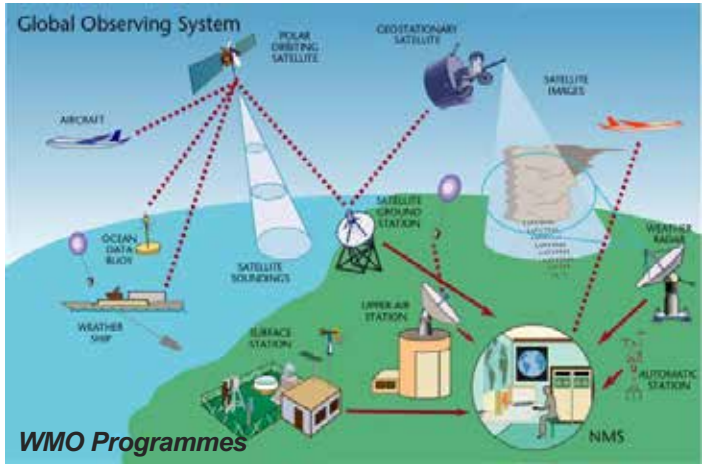
Implementation and Timeline

Within a year of launch (in early 2022), expected progress on case study efforts:

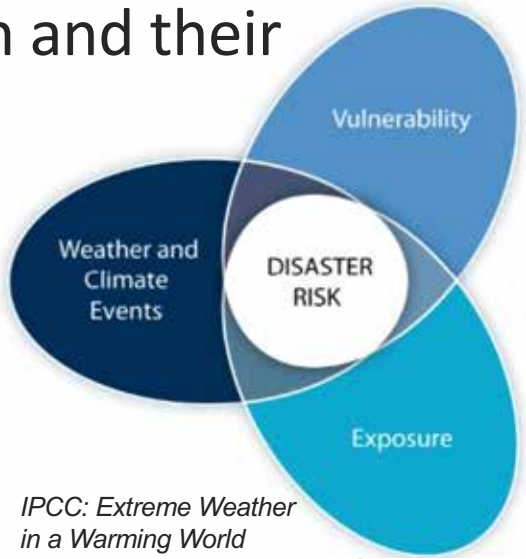
- **Attribution** of causal forcing factors, event evolution and early indicators of case study onset (Theme 2)
- Can the current **observing system** capture early indicators and monitor event evolution? Recommendations for system improvements (Theme 1)
- Assessment of case study **hazard risks** (Theme 3)
- Can **models** simulate the full evolution of the case study event? Relevant model biases? Methods to reduce these biases through improved process representation and/or model calibration (all themes).



Longer term deliverables

Within the first five years we aim to have:

- Established methodologies for novel case study application;
- An international open-access multi-model archive of seasonal-to-decadal hindcast and forecast data;
- Improved capabilities for prediction of multi-annual to decadal changes in the climate system and their impacts on hazards; and
- Quantitative assessments of the current risk of specific hazards and future risk under defined scenarios.



IPCC: Extreme Weather in a Warming World

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Relevance to Southern Asia

- **Specific hazards in this region:**
  - extreme precipitation and related hazards (such as floods and landslides), droughts, heat waves, tropical cyclones, storm surges, etc.
- **Scientific Questions**:
  - How are hazard distribution and other properties modulated by natural variability on interannual to decadal timescales, and how predictable are these modulations?
  - How has climate change affected the distribution and other properties of specific hazards and what further changes should we anticipate?
  - To what extent are models and observing systems adequate to address these questions? What are the required ensemble size and model resolution to address these questions?

These headline reports currently include virtually no information on the attribution/explanation of multiannual to decadal changes in the Earth System

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