WORLD CLIMATE RESEARCH PROGRAMME

Extraordinary Session of the WCRP Joint Scientific Committee (JSC41B)

3. Lighthouse Science Plans
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 global and regional scales, with a focus on multi-annual to decadal timescales.

Changes in ocean and atmosphere circulation are likely to be a specific focus of interest – key issue for adaptation.
### Questions – to guide the discussions

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<th>1. Progress in developing Science Plan</th>
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<td>• Initial goals and objectives</td>
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<td>Include any new science / technologies / models / observations being envisaged</td>
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<td>• How to ensure geographic and gender diversity in the science planning team?</td>
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<td>Guidance: answer each of these in following slides</td>
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Overview of Progress so far

- Assembled a team with broad expertise and good representation from Core Projects/Homes, but much to do on diversity and inclusion
- In the process of identifying a co-chair
- Held two virtual meetings & set up a google doc to develop the science plan
- Identified 5 major areas of work & leads for 4 out 5 of these. Starting to flesh out the substance.
- Agreed important aspects of scope including areas of collaboration with other LHAs
1. Progress towards developing Science Plan

We have identified 5 linked contributing activities:

A. Monitoring and observing Earth System change
B. Modelling change
C. Integrated attribution, prediction and projection underpinned by process understanding
D. Assessment of current and future hazards
E. Early warning of high impact events including potential abrupt/regime changes
A capability for quantitative explanation of past changes/events is fundamental to:
(i) quantifying current risk
(ii) confidence in predictions (e.g. hiatus)
These headline reports currently include virtually no information on the attribution/explanation of multiannual to decadal changes in the Earth System.
Where can specific hazards occur?
How are hazard locations 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 are anticipated?
Collaboration with other LHAs

Safe Landing Climates

Explaining & Predicting Earth System Change

My Climate Risk

Digital Earths

Global change

Regional change & risks

Observing & Modelling change

SLC addresses:
• longer timescales
• a much wider range of potential “tipping points”

EPESC addresses likelihood of hazards (e.g. Tropical Cyclones)
• MCR takes decision-maker perspective on risk (inc. vuln & expo)
Collaboration with WCRP Homes

Explaining & Predicting Earth System Change

Work to do!
Topic B. Modelling Change

• What are the modelling requirements to have confidence in our ability to explain and predict changes in:
  i. global earth system properties (e.g. energy and carbon budgets) – collaboration with SLC LHA
  ii. global and regional circulation of the ocean and atmosphere
  iii. weather and climate hazards (e.g., hurricanes, floods, severe storms, droughts)?

• Primary focus on global models and large ensembles

• Collaboration with Digital Earths LHA
Topic C. Integrated attribution, prediction and projection underpinned by process understanding

- What is the scope?
  - To provide a process-based understanding of recent multi-annual to decadal climate changes and quantify the roles of internal variability and external drivers including greenhouse gases, aerosols, solar, volcanoes, ozone, land-use...
  - Include temperature, rainfall, atmosphere and ocean circulation, energy, carbon, sea level, sea ice, risks of extremes, biogeochemistry.
  - Assess predictability and sources of skill.

- Where are the key knowledge and capability gaps?
  - Almost no current capability for attributing multi-year changes.
  - Studies have tended to focus on temperature, so other aspects need further assessment (especially hydroclimate and energy).
  - Lack of observations (especially ocean).
  - Predictability hampered by weak modelled signals.

- What research is required? What other activities are required? What are the new opportunities?
  - How could we design a (quasi-operational) system for attribution of observed changes in the climate system on multiannual timescales?
  - How do we take underestimated modelled signals into account?
  - How can we use AI?
  - How do we provide information at regional scales?
Topic D. Assessment of current and future risks

• **What is the scope?**
  • Understand (explain), quantify and predict weather/climate hazards
  • Focus on specific target phenomena (eg, TC, ETC, heat waves)
  • Attribution in this LHA does not focus on individual high impact events but on understanding the natural and anthropogenic drivers of variability and change in *classes of weather/climate hazards*.
  • Collaboration with LHA My Climate risk

• **What research is required? What are the new opportunities?**
  • New methodologies to quantify likelihood of hazards, e.g.:
    • UNSEEN approach to exploit hindcasts. Perhaps extend this into forecasts and projections?
    • Design and use of large ensembles in assimilation, attribution, prediction, and projections to enable better risk assessment.
  • Extended ‘event’ attribution methodology w/ coupled models that enable attribution and explanation of decadal time-scale ‘events’?
2. Partners – external and internal to WCRP

- **Internal:**
  - *All* Homes
  - Other LHAs

- **External:**
  - Not yet discussed but some obvious e.g. GCOS, ESA CCI, ...
  - Mechanisms?

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2. Who are the critical Partners?

- Have they been contacted, and are they being engaged in the co-design?
- NB this includes those external (e.g. Future Earth) and internal to WCRP (esp. the Core Projects).
3. Resource requirements – early thoughts

• Not yet discussed
• Mechanisms? Need assistance from WCRP.

3. Early thoughts and recommendations
• Funding requirements?
• Other resource needs?
• Are there obvious funders to be approached?
4. Draft Timeline and Roadmap: Science Plans and LHA Launch

- **2021: Develop science plan**
  - Preparation and consultations
  - Complete first draft: June
  - Further consultations and revisions
  - Final version: December

- **2022 -**
  - Launch
  - Implementation

4. Timeline and roadmap

- Draft timeline / roadmap for developing the science plan, and the launch of the LHA.
5. Other

5. Other – anything else?