



WORLD CLIMATE RESEARCH PROGRAMME

Extraordinary Session of the WCRP Joint Scientific Committee (JSC41B)

3. Lighthouse Science Plans



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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 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.



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Questions – to guide the discussions

1. Progress in developing Science Plan

- Initial goals and objectives
- Include any new science / technologies / models / observations being envisaged
- How to ensure geographic and gender diversity in the science planning team?

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. Early thoughts and recommendations

- Funding requirements?
- Other resource needs?
- Are there obvious funders to be approached?

4. Timeline and roadmap

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

5. Other – anything else?

Guidance: answer each of these in following slides

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



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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

1. Progress in developing Science Plan

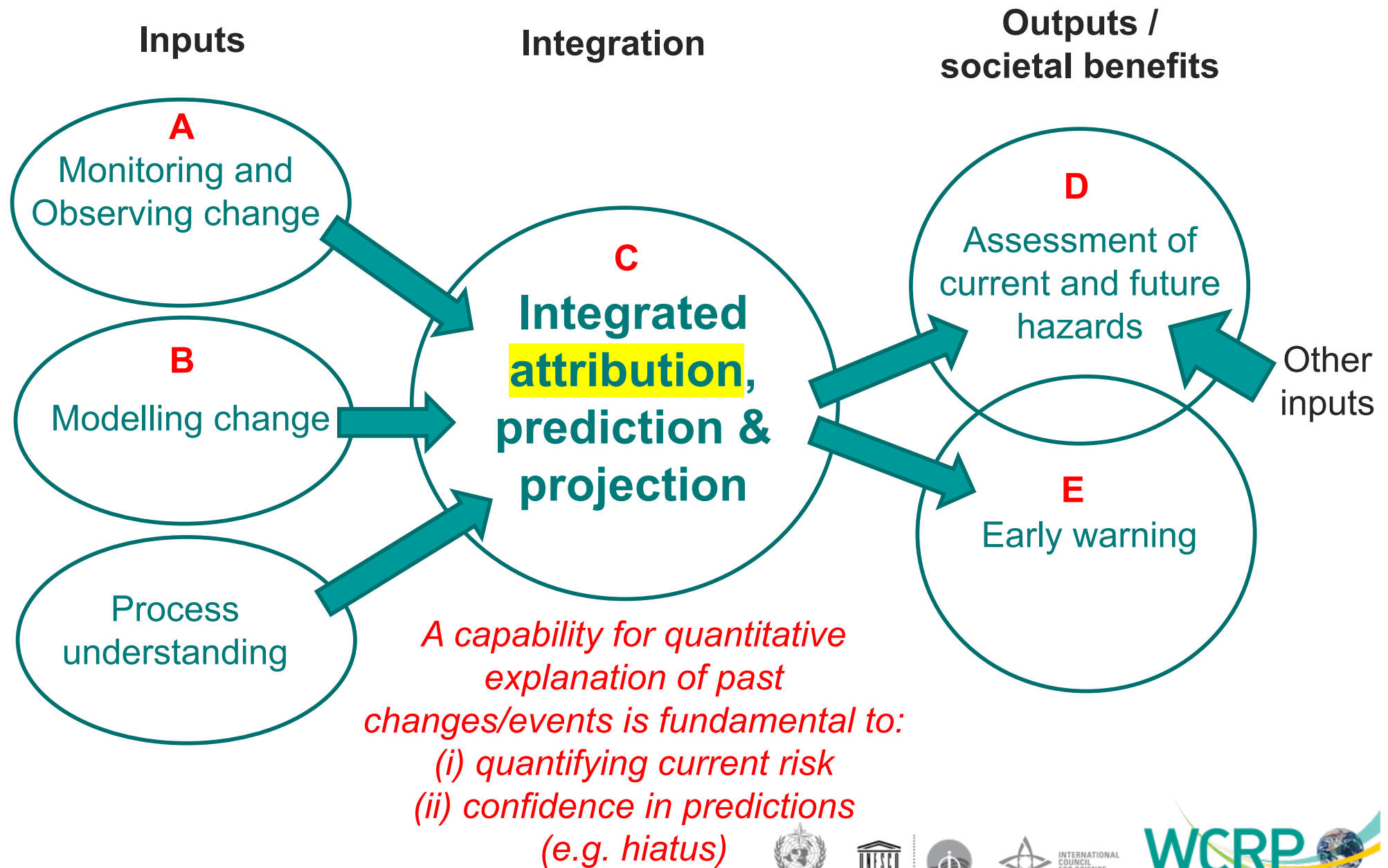
- Initial goals and objectives
- Include any new science / technologies / models / observations being envisaged
- How to ensure geographic and gender diversity in the science planning team?



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WCRP Lighthouse Activity on Explaining and Predicting Earth System Change



Headline output: quantitative explanation of Earth System change



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

WORLD METEOROLOGICAL ORGANIZATION
Commission for Basic Systems / Commission for Climatology

Global Annual to Decadal Climate Update

Target years: 2019 and 2019-2023 TRIAL PHASE

Executive Summary

This update presents a summary of annual to decadal predictions from [WMO designated Global Producing Centres and non-designated contributing centres](#) for the period 2019-2023. Latest predictions suggest that:

- Annual global temperature is likely to be at least 1°C warmer than preindustrial levels in each of the coming 5 years
- There is a small but growing chance (~10%) that one of the next 5 years will be at least 1.5°C warmer than preindustrial levels



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Headline output: quantification of current and future weather and climate hazards

Simulated Tropical Cyclone Track density

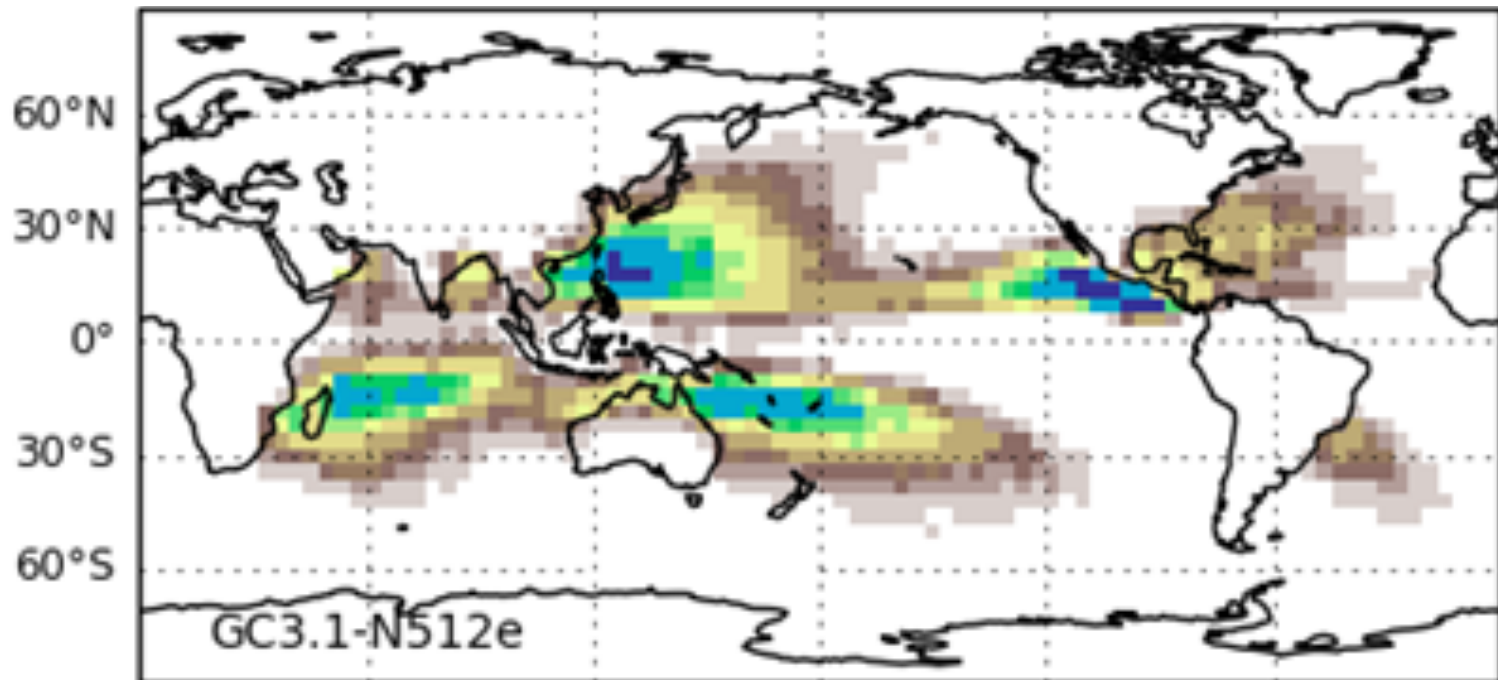
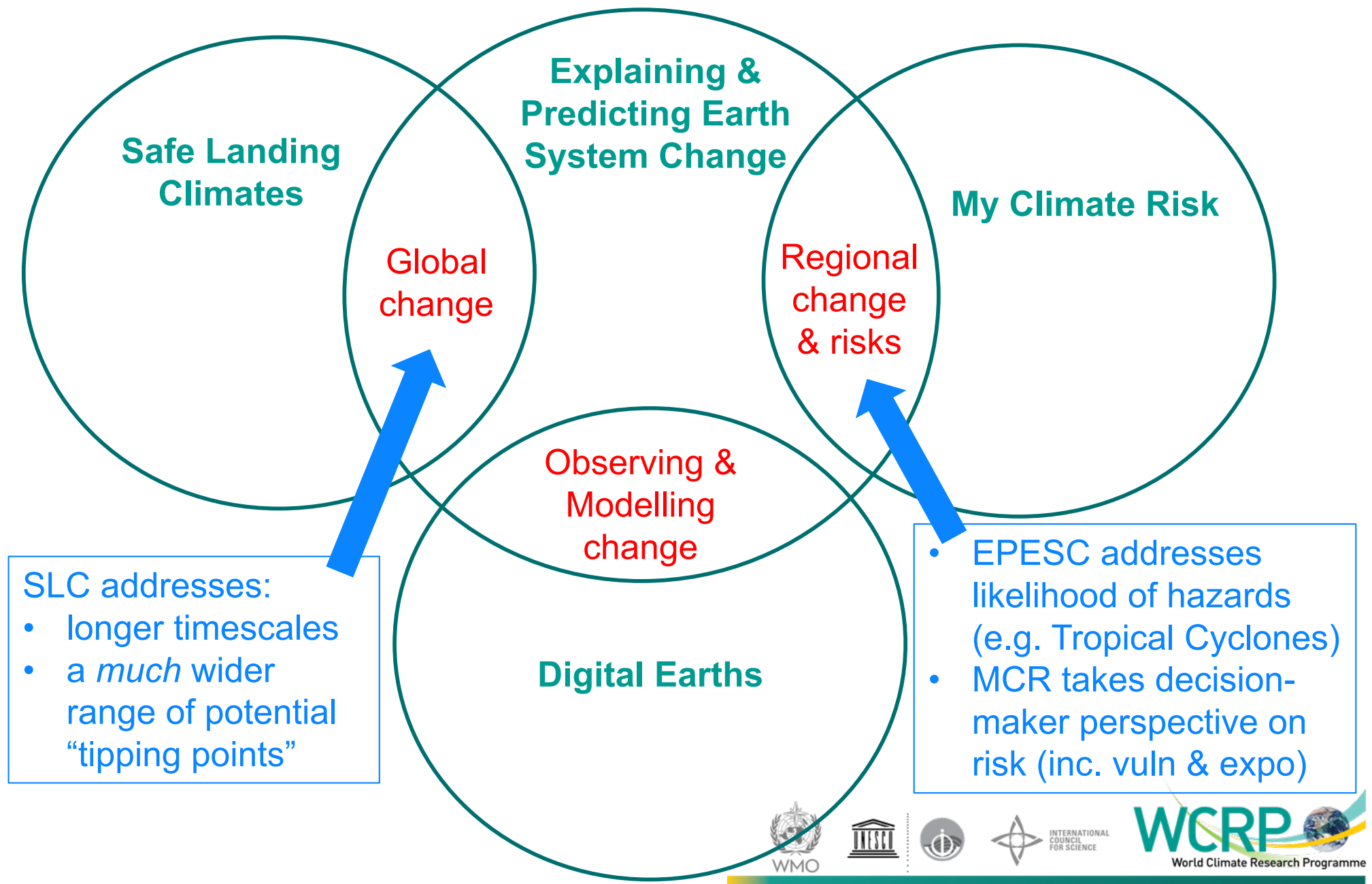


Figure from
Pier Luigi
Vidale

- 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



Collaboration with WCRP Homes

Explaining &
Predicting Earth
System Change

Work to do!



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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



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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?



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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'?



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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?

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).



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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?



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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.



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5. Other

5. Other – anything else?



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