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JSC-44
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Request of input from core activities to the

44th Session of the WCRP Joint Scientific Committee (JSC)

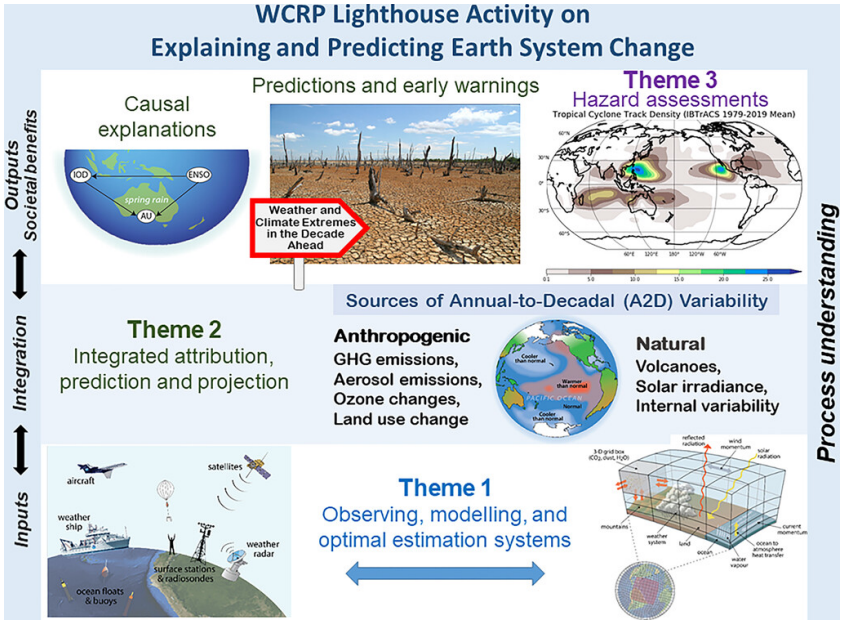
8-11 May 2023

Report to the WCRP Joint Scientific Committee

Explaining and Predicting Earth System Change Lighthouse Activity

1. Highlights achieved since JSC-43

- Kirsten Findell, EPESC co-chair, led the publication of a BAMS article (Findell et al., 2022; DOI:10.1175/BAMS-D-21-0280.1) that consolidated the science plan for EPESC. Key research questions of each of the EPESC themes were refined, and the figure below provides an overview of the three scientific themes, how they interact, and how they will deliver benefits to society.



- WG2 is leading the setup of Large Ensemble Single Forcings Model Intercomparison Project (LESFMIP), with the protocol described in Smith et al. (2022; doi.org/10.3389/fclim.2022.955414). Multiple modeling centers have already committed to producing these large ensembles and some have already begun the work. These LESFMIP experiments are expected to provide information on model behavior that will feed back on the model development process. Ideally, these experiments will also inform the activities in WG1 designed to identify high-priority regions for expansion of observational networks, though the complexity of this task should not be underestimated. Activities to be developed by WG3, particularly related to hazard prediction and attribution, will also benefit from these experiments.
- Three webinars have been organised in 2022-23 as part of the “EPESC webinar series”, with attendance around 250 participants in each of the sessions.
    - Record breaking extreme events (September 2022)
    - A focus on the ongoing triple La Niña (November 2022)

    - Global and regional changes in drought (February 2023)
- EPESC held our first in person workshop in Exeter, UK, in March 2023. This was an enormously valuable opportunity to bring together scientists from our three working groups to discuss the science needs and opportunities and identify clear priorities and action plans. The workshop was further enhanced by joint sessions with **DCPP** – there are many opportunities for collaboration between EPESC and DCPP. We also welcomed presentations from the International Detection and Attribution Group (**IDAG**), **ESMO**, **Safe Landing Climates**, and **My Climate Risk**
- EPESC convened a dedicated session at AGU 2022. We heard a diverse set of talks relevant to many aspects of EPESC's scientific breadth. Talks ranged from attribution techniques, observational assessments, prediction of wildfires, extreme river flows, Arctic conditions, and more.
- EPESC Co-Chair Kirsten Findell gave a presentation at COP27 in the Session on Climate Information for Near-Term Preparedness.

2. Planned science initiatives and major events *(next 3 to 5 years)*

As an outcome from our workshop in March 2023, each of our three working groups has identified a set of priority activities, as summarised below. In addition, we are implementing ***a cross-cutting EPESC-wide research activity on summer circulation and heatwaves***, focused on improving our ability to understand, attribute and predict summer circulation changes and heatwaves on annual-to-decadal scales. We have identified opportunities here to collaborate with **Safe Landing Climates** LHA, **SPARC**, and the **GEWEX** GLASS panel.

WG1: Observing and modelling Earth System Change (Co-leads: Patrick Heimbach and Anca Brookshaw)

- Case study on the recent trend in Earth's Energy Imbalance: focused on understanding the causes, impacts, and implications of this trend (lead Benoit Meyssignac).
- Project on tighter integration of observing and modeling systems: focused on the development of a workflow aimed at determining the strengths, limitations, and applicability of existing datasets relevant to the other research topics of interest across the three working groups of EPESC.

WG2: Integrated Attribution, Prediction and Projection (Co-leads: Doug Smith and Scott Osprey)

The cross-cutting priority is to understand trends and A2D variability in atmospheric circulation.
Priority science themes:

- Summer northern hemisphere trends in atmospheric circulation (contributing to the cross-cutting research activity on summer circulation and heatwaves)
- A2D variability in North Atlantic atmosphere and ocean circulation (especially in winter)
- Trends in the Southern Annualar Mode (collaboration with SPARC)

Key implementation steps are:

- Complete large ensemble single forcing MIP (LESFMIP) simulations (end 2023)
- Analysis of LESFMIP simulations, prioritising understanding drivers of circulation change and the signal-to-noise paradox
- Near real-time estimates of radiative forcings to update LESFMIP simulations (end 2024)
- Collaboration with DCPP on attribution of predictable signals (see section 3)
- Contribute attribution statements to WMO Annual-to-Decadal update (2025 onwards)

WG3: Assessment of Current and Future Hazards (Co-leads: Zhuo Wang & James Risbey)

Identified a set of key hazards (each has associated leads and teams):

- Tropical Cyclones
- Extreme precipitation and droughts
- Heatwaves
- Compound extremes

Key methodological aspects will address:

- Hazard-related circulation and processes
- Hazard likelihoods
- Hazard attribution
- Variability, predictability and prediction of hazards (includes collaboration with DCPP)

In addition:

- We plan to continue our very successful webinar series
- Many EPESC members have submitted abstracts to the Open Science Conference and we would like to convene an EPESC discussion at this event.

3. Active or planed collaborations with other Core Projects, Lighthouse Activities etc.

- The EPESC WG3 has started discussions with **Safe Landing Climates LHA** to integrate the work of the two LHAs on heat, fire, and drought hazards. Discussions to date have focused on the need to use common hazard indices and common model experiments to ensure interoperability across LHAs.
- Develop joint experiments with **DCPP**, particularly through a new component C, to verify attribution and process understanding. Signals in decadal prediction in precipitation, for instance, are not well understood, and update of the forcings for new model runs will be essential to further understand this and other processes.
- Following from previous point, we have identified a need to collaborate with **CMIP7** and particularly the forcings Task Team on the regular updating of forcing datasets which will be required for an operational attribution capability.
- Foster collaboration between the EPESC group looking at trends in Earth's Energy Imbalance and **GEWEX**'s Earth's Energy Imbalance Assessment team.
- We would like to promote the uptake and exploitation of LESFMIP results by other WCRP groups, especially **CLIVAR** and **SPARC**.

3a. Requests for the WCRP Academy to support your training activities?

- We haven't identified specific training needs but would be glad to collaborate with WGSIP and DCPP on any training initiatives related to near-term prediction.

4. Partnerships with projects outside WCRP

- EPESC Member Shoshiro Minobe has proposed to the **PICES** leadership that he serve as an ex-officio member of their Working Group 49 (Climate Extremes and Coastal Impacts in the Pacific) which already has strong ties with **CLIVAR**. This cross membership is intended to facilitate collaboration between EPESC, **PICES**, and **CLIVAR** on the topic of marine heatwaves.

5. Issues and challenges*:*

- *To enable the development of effective collaborations we urgently need a collaboration platform (with capabilities such as those offered by Slack) to enable live discussions, sharing of results etc without having to rely on cumbersome email.*
- The biggest challenge is to secure research funding aligned to the goals of EPESC. Various research proposals are in preparation.
- It was hard to generate momentum without in-person discussions. Our March workshop in Exeter was extremely valuable in addressing this problem and highlights the importance of face-to-face meetings.