WCRP Safe Landing Climates Lighthouse Activity Meeting

Royal Society, London | 7 - 9 March 2023

Version 7, 7 March 2023

The Safe Landing Climates (SLC) Lighthouse Activity will meet at the Royal Society in London in March to discuss the plans and way forward of the activity. The meeting will take place over three days and is by invitation only. The first and third days of the meeting have been designed to accommodate the strategic discussions of the five SLC Working Groups: Understanding High-Risk Events, Perturbed Carbon Cycle, Water Resources, Sea Level Rise, and Safe Landing Pathways. The second day will be a hybrid meeting, where partner perspectives and break-out room discussions will ensure that the activity builds key collaborations.

Overview

The Safe Landing Climates Lighthouse Activity is an exploration of the routes to "safe landing" spaces for human and natural systems. It will explore future pathways that avoid dangerous climate change while at the same time contributing to the United Nations Sustainable Development Goals (SDGs). There are **two overarching research questions**

- *Q1: what potential high-impact climate hazards, surprises or irreversible changes should we be genuinely worried about and how do we usefully quantify and communicate the associated risks?*
- *Q2: what do achievable, internally consistent and safe pathways to a future climate to meet broader human needs look like?*

Meeting Goal

The goal of the WCRP Safe Landing Climates Lighthouse Activity Meeting is to identify processes that will provide answers to our two LHA research questions, and plan their implementation.

Short scientific presentations: We invite the members of the Safe Landing Climates Working Groups and invited guests to self nominate for short scientific presentations on Day 1 related to the lighthouse, from either their own research or bringing science ideas or important viewpoints they would like us to think about from other work. If there is insufficient time for all proposed talks, preference will be given to those not speaking elsewhere in the program and/or to ideas not already covered in the WG presentations. Please provide us with a talk title by filling out this page (no abstract needed at this time):

https://forms.office.com/e/Juh6hef9TC

Remote access: Day 2 the meeting will be hybrid to allow additional online attendance, but with maximum in-person attendance of 30 participants. On Days 1 and 3 the meeting will be in-person only, to allow the five SLC Working Groups to have effective strategic discussions.

Draft Agenda

Day 1: 7 March 2023, 9:00 - 17:45 (GMT)

Morning 9:00-12:40

9:00 Opening remarks from the convenors

9:05 Presentations from each working group (WG) (15 minutes each + questions). These should address:

a. Current plans/activities

b. How will the WG address the two LHA Research Questions (see above)

9:05 High Risk Events

9:25 Perturbed Carbon

9:45 Water Resources

10:05 Sea Level Rise

10:25 Safe Landing Pathways

10:45 Coffee

11:15 Breakout groups (across individual tables): Discuss where we are, identify themes across working groups, missing issues and gaps

11:45 Breakout groups report back to plenary, and discussion. Organizers collect suggestions/concerns

Lunch 12:40 - 13:45

Afternoon 13:45 - 17:45

13:45 Science presentations by individual attendees [12 mins per person incl. Questions] including discussion and a short coffee break.

Dinner (TBC)

Day 2: 8 March 2023, 9:00 - 18:00 (GMT)

[Hybrid day including extra WG members and external invites]

Morning; 9:00 - 12:00

9:00 Brief introduction round of guests

9:10 Recap of outcomes/questions arising from day one (convenors)

9:25 Breakout groups I: identify & explore new key ideas from Day 1 (presentations)

- What were the most interesting/compelling science ideas that emerged?
- How well are these aligned with the current WG plans?

Breakout groups organized by tables, hybrid attendants by zoom breakout rooms

9:55 Breakout I groups report back to plenary, and discussion

10:30 Coffee

Presentations and discussion on key strategies. Talks should summarise current activities, identify gaps/opportunities. Talks should use ~⅓ of the allocated time, discussion ~2/3.

11:00 Scenario building and SSPs - current plans - Ben Sanderson

11:30 Risk frameworks across the human/earth system - Jana Sillmann [Risk KAN]

12:00 CMIP7 plans - Helene Hewitt

Lunch 12:30 - 13:40

Afternoon 13:40 - 18:00

13:40 Modeling capacity for addressing global risk (coupling, etc.)
ESMO plans - Cath Senior
Vegetation modeling - Victor Brovkin
Ice modeling - Robin Smith

14:40 TIPMIP plans - Jonathan Donges and Sina Loriani

15:10 Discussion

15:30 Coffee

16:00 Safe landing input to CMIP: Bette Otto-Bliesner followed by discussion

16:30 Breakout groups II: discuss the WG plans in light of new information

a. Are the WG plans feasible? Which ones can we do in partnerships, and which ones are better addressed by others?
b. New ideas for the WGs/LHA to consider

17:30 Breakout II groups report back to plenary, pitching ideas to take forward, and discussion; vote for key ideas of activities (number of activities TBD)

Self-Organized Dinners

Day 3: 9 March 2023, 10:00 - 16:45 (GMT)

Morning (10:00 - 1:00)

10:00 Reflections from S&P (reflecting industry/economy risks) & convenors

10:30 Breakout groups III: progress major key activity ideas [One group per idea; World cafe style, using poster boards and ticks to clarify support to select most productive ideas - 1-2 rounds where people can visit a different table]. Coffee included.

- Ideas can (and if possible should) be cross-WG
- How would we do it
- By whom, or with whom (do we lead, collaborate or contribute?)
- Desired tangible outcome(s) and time frame
- Timeline with goals for leading near-term and longer-term activities

Lunch (12:30 - 13:40)

Afternoon (13:40-16:45)

13:40 Breakout III groups report back to plenary (+ brief questions)

14:40 Plenary discussion, prioritization and identification of timeline. Identify leads for each activity, and a time plan/resources. Coffee break around 15:30

- Outcome: confirmed/reshaped action plan for next year and next 5 years

16:40 Meeting adjourns

End of meeting

Science Talks

Simulating and analyzing rare heat extremes
Gabi Hegerl for Erich Fischer

This is a talk that presents work in Erich's group on ensemble boosting and analysis of record-shattering extreme events. I think it is useful input for the Lighthouse to know about. It presents a method to encourage the simulation of very rare extreme events and their characteristics in climate models. It will also contain information on observed links to fire.

Operational event attribution frameworks for quantifying climate change impacts
Kevin Reed

Significant advances have been made in attribution frameworks to quantify climate change impacts on individual extreme events, including devastating hurricanes. Here we present the results of the hindcast attribution methodology throughout the entire hurricane season using the Community Earth System Model. The implementation of the framework systematically throughout the hurricane season demonstrates the feasibility of such tools for operational attribution applications more broadly.

TCRE assessment
Chris Jones & Pierre Friedlingstein*

Proposal and rationale for a community-driven assessment of TCRE and uncertainty.

Some possible hydroclimate tipping elements
Hyungjun Kim

Under a warming climate, numerous hydroclimate processes exhibit non-stationary behaviors, such as irreversible and/or accelerated changes, which are referred to as tipping elements. In this presentation, several recent studies are briefly introduced, including: 1) an abrupt shift to a hotter and drier climate beyond the tipping point in inner East Asia, 2) the observed influence of anthropogenic climate change on heavy rainfall from typhoons, 3) the timing of unprecedented hydrological droughts under climate change, and 4) global aridity changes resulting from differences in surface energy and water partitioning.

Risk: Can the past inform the present... and the future?
Michael Evans

Paleoclimatology can inform risk assessment in a changing climate, via estimation of: (1) baseline event probabilities; (2) extreme event definitions; (3) the amplitude and structure of the unforced variability, regime shifts and tipping points; (4) analog ecosystem resilience; and (5) identification (or not) of mechanisms of climate change, on timescales not well replicated in the historical climate record.

Global and regional health and food security under strict conservation scenarios
Peter Alexander

Global biodiversity is rapidly declining, and goals to halt biodiversity loss, such as the Aichi Biodiversity Targets, have not been achieved. To avoid further biodiversity loss, area-based

protection will form part of new biodiversity targets. We use a state-of-the-art global land-use model, the Land System Modular Model, to explore global and regional human health and food security outcomes under strictly enforced 30% and 50% land protection scenarios, such as Half-Earth. We find protection scenarios cause additional human mortality due to diet- and weight-related changes. Low-income regions such as South Asia and sub-Saharan Africa experience the highest levels of underweight-related mortality, causing an additional 200,000 deaths related to malnutrition in these regions alone. High-income regions, by contrast, are less affected by protection measures. Our results highlight that radical measures to protect areas of biodiversity value may jeopardize food security and human health in the most vulnerable regions of the world.

Irreversible loss in marine ecosystem habitability after a temperature overshoot
Roland Séférian

Anthropogenic warming of the oceans and consequent deoxygenation are altering marine ecosystems. Current knowledge suggests that these changes might be reversible in the centennial timescale in the ocean surface if global warming were to decline. However, knowledge on the persistence of their combined effects on marine ecosystems remains limited. Here we explore to what extent global warming will drive alterations on marine habitats by following the evolution of a metabolic index that captures the ecophysiological response of marine organisms to both changes in temperature and oxygen, through an idealised ramp-up ramp-down atmospheric CO2 concentration experiment. Using a multi-model approach, we find that changes in ocean temperature and oxygen drives a centuries-long irreversible loss of ~4% in the habitable volume of the upper 1000 m of the world ocean. These results suggest the combined effect of warming and deoxygenation will diminish the capability of the ocean to hold life far after recovering from a temperature overshoot.

Role of permafrost and snowpack in hydrological cycle
Kazuyoshi Suzuki

Permafrost is one of the tipping points of global warming. We will present an example of studies on the effects of permafrost on the terrestrial hydrological cycle and vegetation, as well as the impact of snowpack on extreme winter precipitation. Finally, an ongoing international project on "The status of mountain snow cover" will be presented.

Paleoclimate perspectives on the Atlantic Meridional Overturning Circulation as a tipping element of the climate system and its effect over tropical precipitation
Cristiano Mazur Chiessi

The paleoclimate record allows the investigation of different modes of the Atlantic Meridional Overturning Circulation (AMOC). During the last glacial (ca. 71-19 kilo years before present (ka)) and deglaciation (ca. 19-11.7 ka), the AMOC showed a number of millennial-scale rapid departures from its strong mode. These departures into weaker modes of operation were most probably triggered by freshwater input into the high latitudes of the North Atlantic. The apparent existence of a hysteresis behavior in the AMOC response to freshwater forcing prompted its characterization as a tipping element of the climate system. In this presentation we will explore the effects that a substantial slowdown of the AMOC had over past tropical precipitation.

The Amazon rainforest and global climate modeling
Paulo Nobre

The talk will cover the roles of the Amazon rainforest and global warming on the continental water cycle. Also, the importance of the proper representation of atmospheric convection over the Amazon for global atmospheric and oceanic circulation will be commented on.

Could global warming produce a fungal pandemic?
Steve Sherwood

I will review suggestions that the emergence of dangerous new fungal infections could be driven by the closing gap between environmental and human core body temperatures, and consider whether this could represent a possible unexpected climate tipping point related to heat extremes.

List of Participants

In person participants

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Remote participants on the hybrid day (8 March 2023)

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Safe Landing Climates Working Groups

WG Members and Affiliate Members

High Risk Events
Sea Level Rise
Water Resources
Perturbed Carbon
Safe Landing Pathways
Affiliate for multiple WGs