

The WCRP Safe landing climates lighthouse

Steve Sherwood and Gabi Hegerl, with the safe landing lighthouse planning team (incl. Pascale Braconnot, Pierre Friedlingstein, Neil Harris, Beth Holland, Heiko Goelzer, Hyungjun Kim, Paulo Nobre, Bette Otto-Bliesner, Kevin Reed, Jim Renwick)

This Lighthouse Activity (LHA) 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), including those of climate action, zero hunger, clean water and sanitation, good health and well-being, affordable and clean energy, and healthy ecosystems above and below water. The lighthouse activity comprises five main scientific themes:

- 1) **Safe landing pathways:** This activity determines what climate trajectories and destinations are actually safe, and for whom, bringing together interdisciplinary communities to determine pathways and “landings” that preserve habitability and food security, and identify societal adaptation limits and changes that must be avoided.
- 2) **Understanding high risk events:** We aim to identify risks from low-probability, high-impact possibilities with global-scale ramifications. Risks include large natural carbon release, ice shelf/sheet collapse, regime shift of ocean/atmosphere circulation, extreme cloud feedbacks and climate sensitivity, multiplicative effect of compound hazards, biome (e.g., Amazon) collapse, “Fireball Earth,” and large-scale extremes that challenge adaptation.
- 3) **Perturbed carbon cycle:** We will explore the acceptability and climate implications of carbon dioxide removal (CDR) systems while maintaining food and water supply, preserving biodiversity, and limiting ocean acidification. A further goal is to assess the risk of surprises or a rapid change in Greenhouse Gases (GHGs), the reversibility of the anthropogenic perturbation, and climate and carbon cycle feedbacks in the context of negative emissions.
- 4) **Water resources:** We will address uncertainties in the long-term redistribution of water in land-based natural systems or reservoirs, their resilience and vulnerabilities, and impacts of changes to these systems. Key systems include glaciers (crucial for water supply in mountain regions) and tropical rainforests (which play an important role in the local water cycle and deliver other important ecosystem services).
- 5) **Sea level rise:** We aim to quantify an “acceptable” rate of sea level rise and its irreversibility from multiple decades to millennia. We will estimate the impact of storm surges and cyclones on coastal communities and assess the potential for adaptation.