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Workshop on High-Risk Cascading Shocks

WCRP Safe Landing Climates activity on High-risk Cascading Shocks

18-20th November 2024
World Meteorological Organization (WMO), Geneva, Switzerland

Laura Suarez-Gutierrez, Gabriele Hegerl, Ana Bastos

The Workshop on High-Risk Cascading Shocks, held from November 18-20, 2024, at the World Meteorological Organization (WMO) in Geneva, Switzerland, within the Safe Landing Climates (SLC) Lighthouse Activity of the World Climate Research Programme (WCRP), brought together communities working on high-risk large-scale extreme events and systemic risks as well as those applying novel methodologies and tools to assess risks across sectors and disciplines. This activity fosters multidisciplinary collaboration among experts in climate science, economics, agriculture, ecology, and risk management to develop innovative approaches for assessing and mitigating cascading shocks.

Through a combination of keynote addresses, panel discussions, and breakout group exchanges, participants engaged in knowledge exchange, identified key research gaps, and worked towards setting an agenda for future interdisciplinary studies on high-risk cascading shocks. The workshop facilitated knowledge exchange and identified research priorities to improve climate risk modeling, data integration, and policy responses.

Key objectives of the workshop included:

- **Assessing current challenges** in modeling and projecting cascading shocks across sectors and disciplines.
- **Fostering interdisciplinary collaboration** to enhance systemic risk assessment and adaptation strategies.
- **Identifying critical research priorities** that will inform peer-reviewed publications and policy-relevant assessments of climate risks.
- **Generating actionable outcomes** that contribute to global climate risk assessments and preparedness strategies.

By bringing together a diverse group of experts, the workshop successfully laid the foundation for advancing scientific understanding and policy responses to cascading climate shocks. The insights and recommendations generated during the event will serve as a critical resource for future research and international climate risk governance.

Key Workshop Outcomes:

- **Guidelines and Needs:** The workshop highlighted the need for more structured multidisciplinary approaches and methodologies, and more accessible climate and impact data, particularly regarding oceanic ecosystems, fisheries, and the Global South. It also emphasized the importance of case studies that connect local insights to global frameworks and the necessity of interdisciplinary discussions across major conferences.

- **Coupled Climate-Impact Modeling:** The workshop highlighted the strong need to enhance coupled climate and impact models, ensuring better integration of ecosystem disturbances and other earth system consequences of extremes, feedback mechanisms, and economic assessments of climate-related losses and how impacts may cascade across different systems and sectors.

- **Community Needs for CMIP and IPCC:** Participants underscored the importance of cross-working group training activities for maximizing the availability of CMIP outputs for extreme events, accelerating the incorporation of real-world changes into models, and advocating for a cross-working-group approach in the IPCC to address cascading risks comprehensively.

- **Outputs & Next Steps:** The workshop will produce a short perspective paper outlining key research priorities, examples of successful methodologies, and case studies. Additional follow-up research papers, a potential journal special issue, and a planned hands-on summer school joint with Risk KAN will support capacity-building efforts, particularly in underrepresented regions. Future workshops will focus on collaborative research development on key issues rather than showcasing completed work.

By fostering interdisciplinary collaboration and defining a clear research agenda, the workshop set the stage for advancing scientific understanding and policy responses to cascading climate shocks. Below, a more detailed account of the aforementioned guidelines and needs and outcomes and next steps can be found.

Guidelines and Needs

For the wider Climate & Impact Communities:

- **More and more structured data needed, especially impact data.**
  - We recognize data is richer and easier to use on the climate side than on the impact side. However, we also identify key gaps in climate data coverage (e.g., subsurface ocean data observations, key climatic variable observations on historically data sparse regions)
  - For impact data, examples of data gaps identified include oceanic ecosystem and fishery stocks, and impacts across all sectors, especially in the Global South.
  - Data quantity is growing, but it is often unstructured and hard to use/combine, especially regarding impacts.

- **More case studies with knowledge of local systems, and that extrapolate knowledge gained to a global perspective.**
  - There need to be more case studies addressing cascading impacts across sectors with a good base understanding of coupling and interactions across these sectors in the region of interest
  - These studies need to make efforts to extrapolate their gained knowledge to a wider regional or global area.
  - We recognize a bias in journals and the scientific community to penalize local case studies even if in high-impact events. To move forward in understanding cascading shocks, we need to bridge gained knowledge from local to global perspectives.

- **More spaces for multidisciplinary discussion:**
  - **Session proposals and talks/posters** in interdisciplinary sessions across big conferences are crucial (several examples at EGU25).
  - Especially bringing novel approaches and methodologies that have been successful in single sectors or disciplines to a wider multidisciplinary audience could be extremely useful.
  - Beyond exchange across communities, we need to think and reflect on who is the end user and receptor of the information we create, and tailor this information to their needs.

- **More and improved coupled climate and impact modeling:**
  - We need to do better at coupling components in the earth system, as well as coupling impacts and feedback on different sectors (e.g., carbon release from ecosystem disturbances)

- Communities need to exchange more and discuss their advancements as they're happening in order to better address cross disciplinary events such as 'ecoclimatic events' (Bastos et al 2023; Jézéquel et al., 2024).
- More exchange and capacity building is needed to use each other's methods, outputs and approaches adequately (e.g., sampling model vs. scenario vs. climate variability uncertainty from CMIP output; understanding which events are well captured in given simulations versus which are not).

- **Better assessment of loss and impacts across sectors, including non-direct effects and inputs from relevant communities.**
  - **E.g., realistic economic assessment of climate related loss**. (e.g., Several degrees of global warming could reduce GDP by 3%, when observed events seem to have massive economic impacts already today, suggesting higher losses.)
  - Recognize and exchange with communities that could have relevant inputs and may be often not included in the conversion of cascading shocks (e.g., Local stake-holders, especially those of the Global South; landscape, urban and infrastructure planners)
  - Assessment of how uncertainties cascade through the system when assessing cascading shocks?

Community needs for CMIP

- **Training** exercises: capacity building exercises to address how to make the most out of CMIP output and adequately sample the uncertainty and options it offers
  - Potential to join with upcoming CMIP/CORDEX/ISIMIP training workshop

- **Faster turnover of forcing and input data**,
  - faster implementation of real-world changes (aerosol emissions, land use changes, deforestation data). Importance of societal impacts on climate
  - Hopefully next year CMIP will move to annual extensions. Will is there, funding is difficult.

- **Joining efforts with Digital Twin Hackathon**
  - To address missing processes and gaps of knowledge, especially in the global south. Expertise is welcome and asked for by the modeling community, WCRP community could be a vector to facilitate networking and researching the right experts in the right regions.

Community needs for the IPCC

- Cross WG Activity/chapter: Cascading and compound risks and impacts are relevant for all WGs and should be addressed together.

- Statement to guide IPCC scoping meeting
    - Gather community needs and ideas to inform the WCRP Safe Landing Climates Statement for the IPCC scoping meeting (Done and acted on).

- Atlas of impacts or impact data
    - Protocol/glossary of available impact data and their uncertainties across different scales.

Annex 1 - Workshop Agenda

Day 1: Monday Nov 18, 2024 (9:15-17:30)

9:15 - Session 0: Introducing Cascading Shocks

Chaired by: Laura Suarez-Gutierrez (ETH Zürich & IPSL Paris)

- Opening address – Welcome & addressing workshop framing and goals (Gabi Hegerl, U Edinburgh, 10 mins)
- Introduction to cascading shocks and risks and real-world evidence from observations (Jana Sillman, U Hamburg , 20 mins, 5 min Qs)

9:50 - Coffee Break

10:15 - Session 1: Cascading Shocks to Terrestrial Ecosystems

Chaired by: Andreia Ribeiro (UFZ Leipzig)

Format: Introduction by Chair, 5 mins; talks 10 mins + 5 mins Qs; panel discussion, 40 mins.

- Recurring extremes and changes in disturbance regimes: climatic vs. non-climatic drivers (Ana Bastos, Leipzig University)
- What mechanisms control vulnerability and resilience? (Thomas Pugh, Lund U & U of Birmingham)
  - Advancing our understanding of biodiversity in forest adaptation to increasing climate extremes under climate change. (Kirsten Thonicke, PIK)
  - Cascading impacts and links between fire, climate and ecosystems (Lina Teckentrup, BSC)

12:00 - Lunch

13:30 - Session 2: Cascading Shocks to Agricultural and Food Systems

Chaired by: Leonard Borchert (U Hamburg)

Format: Introduction by Chair, 5 mins; talks 10 mins + 5 mins Qs; panel discussion, 30 mins.

- Changes in heat and drought extremes in a warming world: the role of changing atmospheric circulation and soil moisture limitation (Kirsten Findel, Geophysical Fluid Dynamics Laboratory)
  - Concurrent climatic extremes and their impact on food security (Sonia Seneviratne, ETH Zürich)
  - Modeling the agricultural impacts of extreme events: from AgMIP to ML Emulators (Alex Ruane, NASA Goddard Institute for Space Studies)
- Food pricing and dietary shocks from extreme events (Peter Alexander, U of Edinburgh)

15:05 - Coffee Break

15:40 - Session 3: Challenges and Opportunities to simulate and project Cascading Shocks and Impacts
Chaired by: Vikki Thompson (KNMI)
Format: Introduction by Chair, 5 mins; talks 10 mins + 5 mins Qs; panel discussion,30 mins.

- Simulating Cascading Shocks: From Probabilistic Projections towards High-Impact Storylines (Erich Fischer, ETH Zürich)
- Using Ensemble Boosting to generate physically consistent storylines of high-risk climate extremes. (Laura Suarez-Gutierrez, ETH Zürich & IPSL Paris)

- Atmospheric analogue storylines with spectral nudging: downward counterfactuals, attribution, and impacts (Raed Hamed, Vrije U Amsterdam)
  - Statistical Emulators for climate extremes: what can and cannot yet be done? (Yann Quilcaille, ETH Zürich)
- The potential of machine learning in informing risks of climate extremes (Peter Watson, U Bristol)

Session close: 17:30

19:30 - Conference Group Dinner

Day 2: Tuesday Nov 19, 2024 (9:00 - 17:50)

9:00 - Session 4: Identifying and Adapting to Cascading and Compounding Risks
Chaired by: Martha Vogel (Red Cross Red Crescent Climate Centre)
Format: Introduction by Chair, 5 mins; talks 10 mins + 5 mins Qs; panel discussion, 30 mins.

- Understanding and Identifying Compounding Risks and Increased Societal Vulnerabilities (Lisa Thalheimer, IIASA)
  - Identifying sector-specific potentially high-impact global climates under moderate global warming (Emanuele Bevacqua, UFZ Leipzig)
  - Leveraging Natural Language Processing to monitor the socioeconomic impacts of extreme events and their cascading effects (Mariana Madruga de Brito, UFZ Leipzig)
- Adapting to compound and cascading risks (Nicholas Simpson, U Cape Town)

10:35 - Coffee Break & Poster Session

11:15 - Breakout Discussion: What is missing to understand cascading shocks, adapt to them and predict their risk in the future?
Format: 4-5 groups, 1 chair and 1 rapporteur per group. 45 mins discussion, 30 mins to report back and discuss.

12:30 - Lunch

14:00 - Session 5: Economic Impacts and Costs of Cascading Shocks
Chaired by: Shouro Dasgupta (CMCC and Grantham Research Inst.)
Format: Introduction by Chair, 5 mins; talks 10 mins + 5 mins Qs; panel discussion,30 mins.

- Missing cascading effects in climate-economic modelling (Christian Franzke, Pusan National U)
- Climatic risks and extremes in IAMs and their impact on the costs of climate change (Benjamin Blanz, U Hamburg)
- Estimating climate risk: extreme weather, litigation, and navigating different climate scenarios. (Rupert Stuart-Smith, U Oxford)
- How is Industry Assessing Extreme Events and Cascading Shocks? (Terence Thompson, S&P Global)

15:35 - Coffee Break & Poster Session

16:00 Session 6: Cascading Shocks in the Oceans and Oceanic Ecosystems
Chaired by: Helene Hewitt (UK Met Office)
Format: Introduction by Chair 5 mins; talks 10 mins + 5 mins Qs; panel discussion 30 mins.

  - Extreme Marine Heat, Acidity, and Deoxygenazation events: climatic risks and impacts on ecosystems (Thomas Fröhlicher, U Bern)
- Extreme Compound Events in the Tropical and South Atlantic. (Regina Rodriguez, U Santa Catarina)
  - Role of extremes in AMOC collapse and role of AMOC state in heat and acidification ocean extremes (Anastasia Romanou, NASA-Goddard Institute for Space Studies & U Columbia)
  - Impact of AMOC and other ocean-borne sources of variability on land systems (Cristiano Chiessi, U of São Paulo)
- Sea level extremes and water-related compounding events at the coastal zones (Lidia Gaslikova, Helmholtz-Zentrum Hereon)

Session close: 17:50

Day 3: Wednesday Nov 20, 2024 (9:00-14:30)

9:00 - Breakout Discussion: What are low hanging fruits and multidisciplinary opportunities that are now possible to address cascading shocks?
Format: 4-5 groups, 1 chair and 1 rapporteur per group. 60 mins discussion, 30 mins to report back
10:30 - Coffee break
11:00 - Plenary discussion, Next Steps and Closing Remarks
12:00 - Keynote Address: Dr Stephane Hallegatte, Senior Climate Change Advisor, World Bank. (30 min talk, 30 min Q&A)
13:00 - Closing Lunch

Annex 2 - List of Workshop Participants

Name & affiliation	Bio (as provided by the participant)
Alexander Ruane NASA Goddard Institute for Space Studies alexander.c.ruane@nasa.gov	Alex Ruane is co-Director of the NASA Goddard Institute for Space Studies (GISS) Climate Impacts Group. He is co-founder, Science Coordinator, and Climate Lead of the Agricultural Model Intercomparison and Improvement Project (AgMIP), an international effort launched in 2010 now involving 1200+ experts linking climate, crop, livestock, economics, and food security models. He served on the Core Writing Team for the Intergovernmental Panel on Climate Change Sixth Assessment Report (IPCC AR6) Synthesis Report and as Coordinating Lead Author for IPCC AR6 Working Group 1 Chapter 12 on climate risk information. He advised UNDRR on its Global Risk Assessment Framework (GRAF).
Ana Bastos University of Leipzig ana.bastos@uni-leipzig.de	Ana Bastos received her PhD in Geophysics and Geoinformation Sciences from the University of Lisbon in 2015 and has been Professor of Land-Atmosphere Interactions at the University of Leipzig since 2024. Her main interests are related to the carbon cycle, ecology and climate. She is particularly interested in improving understanding of inter-annual to decadal variability in the global carbon cycle and land-atmosphere interactions and feedbacks. She is also interested in studying the influence of extremes and disturbances on ecosystem dynamics under present and future climate. In 2022, she received the Early Career Scientist Award from the Biogeosciences Division of the European Geosciences Union and was awarded an ERC Starting Grant to improve the understanding of forest vulnerability to extreme events under climate change.

Anastasia Romanou NASA-Goddard Institute for Space Studies/ Columbia University anastasia.romanou@nasa.gov	I am a Research Physical Scientist at NASA Goddard Institute for Space Studies in New York and Adjunct faculty at Columbia University, Department of Applied Physics and Applied Mathematics. I am interested in large scale ocean circulation and how it is changed by climate as well as how it controls climate change. I build and analyze numerical models and utilize observations and machine learning techniques to better understand how the ocean heat and carbon uptake is changing, how extremes maybe affecting the ocean physical and biogeochemical systems, what are the different climate and ecosystem tipping points.
Andreia Ribeiro Helmholtz Centre for Environmental Research (UFZ), Germany andreia.ribeiro@ufz.de	Dr. Andreia Ribeiro is a climate researcher with a Humboldt postdoctoral fellowship at the Department of Compound Environmental Risks, UFZ, Leipzig, Germany, and a PhD in Geophysical and Geoinformation Science from the University of Lisbon, Portugal. Dr. Ribeiro's most recent work has advanced the multivariate statistical modeling of climate extremes and compound event-related impacts, focusing on wildfires and agricultural risks in a changing climate. Currently, Dr. Ribeiro's postdoctoral research involves large ensemble climate-impact modeling, particularly related to fire activity. Dr. Ribeiro is also actively involved in mentoring young researchers, fostering international collaborations, conducting scientific outreach and pursuing funding opportunities.
Benjamin Blanz Universität Hamburg benjamin.blanz@uni-hamburg.de	Benjamin Blanz is an economist with a focus on sustainable management under uncertainty and climate risks.

Bette Otto-Bliesner NSF National Center for Atmospheric Research ottobli@ucar.edu	Bette Otto-Bliesner has a Ph.D in Meteorology. She is a Senior Scientist at the National Center for Atmospheric Research in Boulder, Colorado. Bette was a Lead Author for the IPCC AR4 and AR5. She is co-leading the High-Risk Theme of the WCRP Safe Landing Climates Lighthouse Activity, and particularly the CMIP7 What-If scenarios to explore the consequences and interactions if the Earth system crosses tipping points, such as the dieback of the Amazon rainforest and greening of the Sahel. Her current research project involves high-resolution CESM to study the statistics and drivers of past and future weather and climate extremes.
Christian Franzke IBS Center for Climate Physics, Pusan National University christian.franzke@pusan.ac.kr	I am an Associate Professor and Project Leader at the Center for Climate Physics, Institute for Basic Science, Pusan National University. I am a climate scientist with interest in the dynamics of extreme events, weather and climate risks, how extreme events affect economic damages, and the impact of climate on health. I am editors of Earth System Dynamics and Nonlinear Processes in Geophysics.
Cristiano Chiessi University of São Paulo, Brazil chiessi@usp.br	Cristiano M. Chiessi is a Professor at the University of São Paulo, Brazil. He has a BSc in Geology, a MSc in Sedimentary Geology and a PhD in Paleoceanography and Paleoclimatology. His research group reconstructs past oceanic and climatic conditions based on marine sediment cores and warm water corals to better understand future climates. Special focus is delivered to the effects that slowdowns and collapses of the Atlantic Meridional Overturning Circulation (AMOC) had over South Atlantic circulation and South American precipitation/vegetation.

Emanuele Bevacqua UFZ Leipzig emanuele.bevacqua@ufz.de	Trained as a physicist, I work as a climate scientist at UFZ Leipzig (Germany), where I lead an Emmy Noether research group and serve as a deputy head of the Department of Compound Environmental Risks. I study extreme climate events by focussing on compound events—combinations of climate drivers that cause large societal and environmental impacts. With my team, we integrate observations, large ensemble climate model simulations, and impact models to better understand these extreme events. We study the physical drivers of compound events and climate change effects, and investigate potential worst-case scenarios that could surprise society with extreme impacts.
Erich Fischer ETH Zürich erich.fischer@env.ethz.ch	Erich Fischer is a professor at the Institute for Atmospheric and Climate Science at ETH Zurich. He was a lead author of the IPCC AR6 assessment report. His research interests include understanding and quantifying changes in weather and climate extremes in a warming climate, climate model evaluation, detection and attribution of observed changes, changes in climate variability, quantifying and constraining uncertainties in global to regional model projections, heat stress in urban environments and the climate response to volcanic eruptions.
Gabriele Hegerl University of Edinburgh gabi.hegerl@ed.ac.uk	Gabriele Hegerl is professor of climate system science at the University of Edinburgh. Her research focuses on understanding the causes of climate change and change in extremes. She also uses and observations to constrain predictions of future climate change. Her work has determined causes of observed change in temperature, rainfall, and extreme events and she had key roles in Intergovernmental Panel on Climate Change assessments of climate change. Gabriele is a fellow of the Royal Society.

Hannah Liddy Columbia University hl3147@columbia.edu	Dr. Hannah Liddy is the executive officer of the global research project AIMES – Analysis, Integration and Modeling of the Earth System. AIMES is a core project of Future Earth and facilitates multidisciplinary and multinational activities aimed at addressing integrative research that is beyond the scope of individual scientists or institutes. Current focal areas include quantifying and understanding the consequences and feedbacks of human activities on biogeochemical cycles and the climate system past and present, development of Earth system models, global climate and land model benchmarking, and facilitating and encouraging a Young Scholar's Network that supports interaction between natural and social sciences as well as the humanities. She completed her Ph.D. in earth science with a focus in paleoclimate and isotope geochemistry at the University of Southern California.
Helene Hewitt Met Office, UK helene.hewitt@metoffice.gov.uk	Helene Hewitt was a Coordinating Lead Author of IPCC AR6 WGI on Oceans, Cryosphere and Sea Level change. She has worked at the Met Office Hadley Centre for almost 30 years on ocean/sea ice/climate modelling and is interested in how to represent small scale processes that might drive high impact, low likelihood events. She is current co-chair of the Coupled Model Intercomparison Project.
Jana Sillmann University of Hamburg, CICERO jana.sillmann@cicero.oslo.no	Jana Sillmann is Professor for Climate Extremes at the University of Hamburg (Germany) and Senior Researcher at the Center for International Climate Research – Oslo (Norway). Her work focuses on relating physical aspects of weather and climate extremes to socio-economic impacts and questions related to risk assessment and decision-making. She is co-chairing the Knowledge Action Network on Emergent Risks and Extreme Events (Risk KAN). She previously was co-leading activities of the WCRP Grand Challenge on Weather and Climate Extremes. She is also Lead Author of Chapter 12 "Climate change information for regional impact and for risk assessment" in IPCC AR6 WG1.

Kai Kornhuber IIASA / Columbia University kornhuber@iiasa.ac.at	Dr. Kai Kornhuber is a senior research scholar at the International Institute for Applies Systems Analysis, Austria, where he leads the theme Extreme Weather and Climate Dynamics. Within this theme he is advancing the understanding and modeling of high impact and compound extreme weather events to provide robust estimates of complex and cascading climate risks under present conditions and future climate scenarios. He teaches as an adjunct professor of Climate at the Columbia Climate School and serves as an associate fellow at the German Council on Foreign Relations (DGAP). He is designated chair of the Risk Knowledge Action Network, a joint initiative of World Climate Research Programme (WCRP), World Weather Research Programme (WWRP), Future Earth, and Integrated Research on Disaster Risk (IRDR).
Kelly Mahoney NOAA Physical Sciences Laboratory kelly.mahoney@noaa.gov	Dr. Kelly Mahoney is a Research Meteorologist with nearly 15 years of experience studying extreme precipitation with NOAA's Physical Sciences Laboratory in Boulder, CO. Her work focuses on flood risk, as well as the prediction and projections of extremes in a changing climate, and she is currently serving as a lead for modernizing NOAA's Probable Maximum Precipitation guidance. She holds B.S., M.S., and PhD degrees in Meteorology and Atmospheric Science from North Carolina State University.
Kirsten Findell Geophysical Fluid Dynamics Laboratory (GFDL) kirsten.findell@noaa.gov	Dr. Kirsten Findell works at the Geophysical Fluid Dynamics Laboratory (GFDL) in Princeton, NJ where she studies land-atmosphere interactions and hydroclimatic change, focusing on process-oriented questions about the land's role in climate, coupling of the global energy and water cycles, and how these are changing in a warming world. She co-chairs WCRP's Lighthouse Activity on Explaining and Predicting Earth System Change and is the Leader of GFDL's Climate Stakeholder Engagement, focusing on extending physical climate science to spheres of impacts and societal relevance. Dr. Findell completed her BSE at Princeton University, and her PhD at the Massachusetts Institute of Technology.

Kirsten Thonicke Potsdam Institute for Climate Impact Research (PIK) kirsten.thonicke@pik-potsdam.de	I am a Geoecologist by training. My research interest is in modelling wildfire and vegetation dynamics under climate and land-use change. I am interested in advancing our knowledge in climate extremes and the cascades wildfires can cause. Working also on how biodiversity increases forest resilience, I am working on the environmental limits of the supporting function biodiversity has for ecosystem stability.
Laura Suarez-Gutierrez ETH Zürich & IPSL Paris laura.suarez@env.ethz.ch	I am a MSCA Postdoc Fellow at ETH Zürich and IPSL in Paris. I investigate high-risk, worst-case climate extremes that could be physically plausible in the near-term future using state-of-the-art climate model simulations. Previously, I worked at the Max Planck Institute for Meteorology in Hamburg where I obtained my PhD in 2019, investigating the variability of extreme heat and drought and how soon extreme events typical of warmer climates could occur. My areas of interest cover heat and drought stress extremes, their driving mechanisms, and their associated socioeconomic and ecological impacts.
Leonard Borchert University of Hamburg leonard.borchert@uni-hamburg.de	Leonard is interested in climate extremes, their near-term prediction, and their interaction with society. He employs models of different kinds and complexity to better understand how particularly impactful climate extremes interact with society.

Lidia Gaslikova Helmholtz-Zentrum Hereon, Geesthacht, Germany lidia.gaslikova@hereon.de	I am a research fellow at the Helmholtz-Zentrum Hereon, Germany and work there in the group of Coastal Climate and Regional Sea Level Changes. Of particular interest for me are the long-term variability and sources of changes for water level extremes, primarily storm tides, in the near-shore areas for the past and future. Along with hydrodynamic modeling and statistical analysis, I am involved in various interdisciplinary projects dealing with the assessment of coastal risks and vulnerability associated with water-related compound extreme events, identification of local cascading effects and exploring sustainable adaptation possibilities.
Lina Teckentrup Barcelona Supercomputing Center lina.teckentrup@bsc.es	I'm currently a researcher at the Barcelona Supercomputing Center. My primary research interest revolves around the terrestrial carbon cycle and the impacts of global change on it, including disturbances such as fire and anthropogenic forcings, and how these affect the resilience of vegetation. I am also interested in sources of uncertainty in predicting terrestrial carbon. To address these topics, I primarily work with coupled and offline simulations of process-based models.
Lisa Thalheimer International Institute for Applied Systems Analysis (IIASA) Thalheimer-Prezyna@ehs.unu.edu	Lisa is a Research Scholar at International Institute for Applied Systems Analysis (IIASA) with a focus on migration, conflict and health. Her research approach is strongly interdisciplinary and collaborative, integrating numerical models and data science methods from extreme event attribution and climate econometrics to answer research questions related to estimating the impacts of climate change on vulnerable populations and environments.

Mariana Madruga de Brito Helmholtz Centre for Environmental Research mariana.brito@ufz.de	Mariana Madruga de Brito is an interdisciplinary scientist combining natural and social sciences methods. She holds an MSc in Engineering and a PhD in Geography, focusing on socioeconomic vulnerability to floods. In 2023, she founded the Computational Sociology for Extreme Events group at the Helmholtz Centre for Environmental Research, exploring computational social science techniques in multi-hazard risk research. Her work centers on developing innovative methods to assess the impacts of climate extremes using text data, and investigating human-water interactions.
Martha Vogel Red Cross Red Crescent Climate Centre Vogel@climatecentre.org	Martha Vogel is currently serving as a Climate & Health Technical Adviser to the Red Cross Red Crescent Climate Centre. She focuses on analyzing, synthesizing, and transferring knowledge on climate change and its (health) impacts in vulnerable regions. She utilizes Climate Risk Storylines to explore cascading and compounding risks. She holds a Doctor of Science from ETH Zurich, where she received an ETH Medal for her thesis on temperature extremes in a changing climate. She is a member of the steering committee of the Knowledge Action Network on Emergent Risk and Extreme Events (Risk KAN).
Molly Mitchell Virginia Institute of Marine Science molly@vims.edu	Dr. Molly Mitchell is a Research Assistant Professor at the Virginia Institute of Marine Science. Her research focuses on forecasting sea level changes and resulting shifts in coastal resources due to the interaction of sea level rise with human-driven changes. She works at the intersection of multiple disciplines, including projects involving ecology (marsh changes and blue carbon), physical dynamics (sea level rise trend analysis, shoreline geology) and human decision making (social vulnerability, sea level rise adaptation, adaptive management application). She works with representatives from many different groups to help translate research and current scientific understanding into practical recommendations.

Neil Harris Cranfield University neil.harris@cranfield.ac.uk	Neil Harris is Professor of Atmospheric Informatics in the Cranfield Environment Centre at Cranfield University who works principally on natural and anthropogenic trace gas emissions (e.g. isoprene, dimethylsulfide, methane), atmospheric composition and their link to climate. He was co-chair of the WCRP Atmosphere (formerly Stratosphere) Processes And its Role in Climate and is currently a member of the Safe Landing Climate Lighthouse and its Pathways group. He was awarded the NERC 50th anniversary International and the Overall Impact Awards for his "role in successful development of the Montreal Protocol on Substances that Deplete the Ozone Layer".
Nicholas Simpson African Climate and Development Initiative, University of Cape Town Nick.Simpson@uct.ac.za	Dr Nick Simpson is Chief Research Officer in the African Climate and Development Initiative at the University of Cape Town. His research focuses on how we can best respond to climate change with special interest in climate-resilient development pathways for Africa. An IPCC author, his work on complex climate change risk revised the new the IPCC risk framework and has advanced our understanding of compound and cascading climate risk, including adaptation, maladaptation, and mitigation response risk. He is currently working on research programmes that extend our understanding of education, heritage, and sport under the impacts from climate change.
Peter Alexander University of Edinburgh Peter.Alexander@ed.ac.uk	Peter Alexander is a Professor of Global Food Systems at University of Edinburgh. His work focuses on modelling food and land use systems to better understand the social, economic and environmental interactions of supply, demand and trade, as well as competition for land between agriculture, forests and conservation. He led the development of the Land System Modular Model (LandSyMM), was a Lead Author for the 2022 IPCC Working Group II report and is a Coordinating Lead Author on UNEP's 7th Global Environmental Outlook (GEO-7).

Peter Watson Bristol University peter.watson@bristol.ac.uk	I'm a research fellow and senior lecturer at Bristol University in the UK. The main focus of my work is understanding the risks posed to society by extreme climate events and how these are being affected by climate change. I primarily use physically-based computer models, augmented with machine learning methods to improve the quality of their simulated weather events. I also work on understanding how we can give sensible and useful guidance on the risks of extreme events given major uncertainties in how the Earth system behaves.
Raed Hamed Institute for Environmental Studies (IVM), Vrije Universiteit Amsterdam raed.hamed@vu.nl	I am a researcher within the Water & Climate Risk group at the Institute for Environmental Studies (IVM), Vrije Universiteit Amsterdam. My work focuses on weather and climate extremes and their impacts on the agricultural sector. Specifically, I use data-driven approaches to quantify the impacts of local and spatially compound hazard events on key global food-producing regions. Additionally, I apply the storyline approach to examine low-probability, high-impact events under current and future climate change scenarios.
Regina R. Rodrigues Federal University of Santa Catarina regina.rodrigues@ufsc.br	Regina R. Rodrigues is an Associate Professor of Physical Oceanography and Climate. Her research interests include understanding how tropical ocean basins interact and affect the extra-tropics leading to extreme events. Recently, she has focused on understanding compound extreme events of drought, land and marine heatwaves, as well extremes of high acidity and low productivity in the oceans. She is the co-chair of the WCRP Lighthouse Activity "My Climate Risk", CLIVAR Atlantic Region Panel and Marine Heatwaves Research Focus. She served as a review editor of IPCC-SRCCL and is currently a member of the editorial board of Nature's Communication Earth & Environment.

Rupert Stuart-Smith Oxford Sustainable Law Programme, University of Oxford rupert.stuart-smith@ouce.ox.ac.uk	Dr Rupert Stuart-Smith is a Senior Research Associate in Climate Science and the Law at the Oxford Sustainable Law Programme. In his research, Rupert advances methods in attribution science to shed new light on the impacts of climate change on health, glaciers, and extreme weather events. He studies how climate science can be leveraged to enhance legal scrutiny of corporate and state climate action and accountability for the impacts of greenhouse gas emissions. Rupert also publishes on the implications of burgeoning climate litigation on climate-related financial risk.
Shouro Dasgupta Fondazione CMCC and Grantham Research Institute, LSE shouro.dasgupta@cmcc.it	I am an Environmental Economist at Fondazione CMCC and a Visiting Senior Fellow at the Grantham Research Institute, LSE, I am dedicated to furthering our understanding of the socioeconomic impacts of climate change. My research primarily concentrates on the effects on the labour force, food (in)security, human health, and inequality, thereby aiding in the formulation of targeted strategies to mitigate and adapt to climate-related impacts. I recently led the health risk evaluation for the first European Union Climate Risk Assessment mandated by the European Parliament. Additionally, I am a co-author of the Lancet Countdown on climate change and health, contributing to Global, Europe, Latin America, and SIDS reports. I lead the labour impacts sector of the Inter-Sectoral Impact Model Inter-comparison Project. In collaboration with the governments of Bangladesh and Burkina Faso, I am also committed to establishing a solid evidence base to comprehend the impacts of climate change, facilitating actionable insights and policy modifications.

Sonia Seneviratne ETH Zürich sonia.seneviratne@ethz.ch	Sonia Seneviratne is a Professor for Land-Climate Dynamics at ETH Zurich. Sonia's research focuses on climate extremes and land-climate interactions. She investigates processes leading to droughts and heatwaves, the impact of land processes and land cover changes on regional climate, and their changes with global warming. She combines climate model experiments and statistical data analysis in her research, based on model data, ground observations and satellite measurements. Prof. Sonia Seneviratne was an author on several reports of the Intergovernmental Panel on Climate Change (IPCC), including the Special Report on 1.5°C global warming and the 6th assessment report of the IPCC.
Steve Sherwood UNSW, Sydney s.sherwood@unsw.edu.au	I study moisture-related processes in the atmosphere, particularly related to convection. My past work has addressed relative humidity, shown that improvements to weather balloons over time were unintentionally hiding global warming, established a limit to human tolerance of heat stress, and addressed extreme rainfall and cloud feedbacks on climate and global climate sensitivity, among others. I've contributed to major science assessments including as a Lead Author of the chapter on Clouds and Aerosols in the 2013 IPCC 5th Assessment WGI Report. I co-lead the WCRP Safe Landing Climates Lighthouse which seeks to identify safe future pathways for humanity.
Terence Thompson Climate Center of Excellence, S&P Global terence.thompson@spglobal.com	I am Chief Scientist at S&P Global's Climate Center of Excellence and have responsibility for long-term research regarding physical hazards and their economic impacts. My principal areas of research are hazard quantification (temperature, precipitation, drought, wildfire, coastal flooding, wind, landslides, subsidence, etc.), macro-economic impacts (GDP, productivity, etc.), nature/biodiversity impacts, and probabilistic scenario analysis.

Thomas Frölicher University of Bern thomas.froelicher@unibe.ch	Thomas Frölicher is a full Professor at the Climate and Environmental Physics Division of the University of Bern and the head of the ocean modelling group. He is interested in marine ecosystem-carbon-climate interac-tions with focus on ocean extreme events and their impacts on climate and on marine organisms and ecosystem services. He was the lead author of chapter six on Extremes, Abrupt Changes and Managing Risks of the IPCC Special Report on the Ocean and Cryosphere in a Changing Climate, including the summary for policy makers, and the Second World Ocean Assessment, and contributed to the fifth and sixth assessment report of working group I and II of the IPCC. He is also a member of the WCRP research focus group on marine heatwaves.
Thomas Pugh Lund University and University of Birmingham thomas.pugh@nateko.lu.se	Tom Pugh is a scientist interested in interactions and feedbacks between the terrestrial biosphere and the global climate system, which he primarily investigates using computer models and big data synthesis.
Vikki Thompson Royal Netherlands Meteorological Institute (KNMI) vikki.thompson@knmi.nl	Vikki Thompson is a climate scientist at the Royal Netherlands Meteorological Institute (KNMI) and visiting researcher in the climate extremes group at the IVM, VU Amsterdam. Her research focuses on climate extremes, using methods including flow analogues, statistical methods, and pseudo global warming. Currently, her work focuses on European rainfall extremes. Vikki has previously worked on extreme heat at the Cabot Institute, University of Bristol; in flood risk at the Scottish Environment Protection Agency; and as a research scientist at the Met Office Hadley Centre. She has a PhD in Meteorology from Reading University.

Yann Quilcaille ETH Zürich yann.quilcaille@env.ethz.ch	Climate scientist specialized in climate emulators, climate extremes and interface with integrated assessment models. Yann Quilcaille obtained his PhD at LSCE & CIRED (France), where he investigated transformation pathways and climate scenarios with the simple climate model OSCAR. He worked as research scholar at IIASA (Austria), where he contributed further to the development of OSCAR. Yann Quilcaille is now a postdoc at ETH Zürich (Switzerland), where he developed the regional climate emulator for climate extremes and climate impact drivers MESMER-X; created a database for fire weather; extended extreme event attribution to the emitters.