

WORLD CLIMATE RESEARCH PROGRAMME OPEN SCIENCE CONFERENCE

Day 2, 24 October 2023

1. Morning Dome Plenary: Human Interactions with Climate

Heide Hackman (Director of Future Africa and Strategic Advisor on Transdisciplinarity and Global Knowledge Networks at the University of Pretoria, South Africa) chaired a session with speakers Tasneem Essop (Executive Director, Climate Action Network - International) and Aromar Revi (Director, Indian Institute for Human Settlements - IHS). This was followed by a panel discussion on Human Interactions with Climate.

Climate extremes, especially in terms of inequality and climate injustice – Tasneem Essop

2023 has been the year of extremes, with seemingly back-to-back extreme weather events – from flooding to heatwaves; droughts and wildfires – all being experienced around the world. Vanuatu is this week experiencing its third Category 4 (or above) Tropical Cyclone this year, and 2023 is almost certain to be the hottest year on record.

In addition, these extreme weather events are happening at the same time as extreme political conflicts around the world. We are not living in a time of peace, safety or security – this is the context for a discussion of what it means to deal with climate extremes in the context of climate inequity and justice. We cannot have climate justice without social, political and economic justice and especially without human rights. The climate emergency leads to disproportionate risks and harms to those who have done the least to cause the climate crisis – especially those living in the Global South.

Within this context, her key points were:

- The call for climate justice requires ethical considerations to be addressed.
- The IPCC Sixth Assessment Report (AR6) explicitly comments on inequity and climate justice, which is an important milestone and a huge advance.
- Inequities (around climate) sit alongside gender, economic, and cultural inequities. There are also national and within country inequities.
- Future climate actions need to consider equity and justice. This is a precondition to address the climate crisis. We are far away from both.
- There are inequities between countries, but also within countries.

Building a bridge between climate science and accelerated climate action – Aromar Revi

- We are at a very critical juncture: it is the most challenging and fragmented time since WWII.
- We are not doing well on our path to achieving the Sustainable Development Goals (SDGs): India and Brazil are doing much better than the global North.
- We require transformational development, considering local goals, and a global network of observations.
- “All nations are developing nations.”
- Systems transitions are key: energy; industrial; (land, water, ocean, ecosystem); urban infrastructure; societal choices and transitions!!

Panel Discussion

- All panelists highlighted climate education, the lack of local expertise and data, and the relevance of making more training opportunities/programs available (e.g. WCRP Academy).
- Besides the need for more climate scientists, training climate negotiators and ensuring a high level of local and champion engagement is also important.
- Engagement also demands the identification of stakeholders at different levels and sectors and extension services.
- Accurate information and adequate climate services are crucial in this dialogue. It is essential to consider what people need and what the end-users can comprehend (useful and usable information), integrating local and indigenous knowledge.
- Communicating risks also requires evaluating risk perception, as people exposed to risks have different profiles and cultural contexts.
- Vulnerable populations and countries have legitimate development demands and want to see themselves as part of the solution. Addressing climate change to pursue ambitious development goals has real value, and inequalities must be addressed as fundamental rights.

2. Evening Dome Plenary: Perspectives of Transformational Challenges – Examples from the Global South

The evening Dome Plenary session was chaired by Maria Ivanova (Director of the School of Public Policy and Urban Affairs – Northeastern University; Professor of Public Policy) and included speakers Maxwell Gomera (UNDP representative of Rwanda), who spoke about Equitable Transformation: Uniting for Climate and Abou Amani (Director, Intergovernmental Hydrological Program), whose topic was Water Security under a Changing Environment.

Equitable Transformation: Uniting for Climate Resilience in the Global South

The fundamental pillars for decarbonization are:

- Technology: this remains a challenge
- Finances: decarbonization costs significant money
- Human capacities

Developing countries don't have the financial resources to go in the direction of decarbonization, as debt is strangling them.

Water security under a Changing Environment

- Water security will become a real problem – in 2023, 85% of the world population will live in arid regions.
- Challenges of water: too much, too little, too polluted.
- Impact of water “in” security affects communities differently depending on their resilience and capacity. Similarly, water-related disasters affect communities differently.
- Water is at the centre of the SDGs and connects the goals, and all the big frameworks.
- Water is a connector and every drop counts:
 - Water is a victim of climate change but is also part of the solution, especially for adaptation.
 - Water is a connector between government's political and climate agendas and sectors. It is the medium for climate resilience.
- A new water culture is needed with education at all levels:
 - More open science, open data and citizen science

3. Parallel Sessions

- **Storms, eddies and jets in the atmosphere and ocean** – Understanding weather phenomena that lead to extreme events should hinge on dynamical analysis. For example, weather systems are embedded in jet streams that might cause non-linear processes, such as the breaking of baroclinic waves, to occur and result in the weather extremes. Current methods for identifying jet streams show a consistent decrease in jet latitude and tilt variability. Using the combined effect of the eddy heat and momentum fluxes may lead to more accurate location of precipitation, and therefore a reduction in uncertainty.
- **Rapid and/or irreversible changes in the climate system** – Hysteresis is a common feature of physical systems that comprise non-linearly coupled components with slow and fast response times, resulting in stable states that depend on their past evolution. This is well-known for the Atlantic meridional overturning circulation (AMOC). Ensemble simulations using a state-of-the-art climate model under moderate greenhouse gas forcing show the AMOC bifurcating to a significantly weaker state in a few ensemble members, while the AMOC recovers in most ensemble members when the warming is stabilized – this represents a serious challenge for the traditional approach of IPCC climate projections. The complexity of some of the processes that may be key in tipping behavior must be better captured in climate models, with both higher resolution modelling and better process understanding needed. Under climate change, the Amazon rainforest could undergo an irreversible die-back with serious consequences for regional climate and the global carbon cycle.
- **Advances in global and regional climate modelling** – New technology is at the forefront of issues related to climate modelling and it must be available to all. We need open access to this, transparent and reproducible methodologies and best practice guides and documentation. Better observation data is needed to support understanding, development and evaluation of models.
- **Advances in climate observations and model-data fusion** – Novel techniques of model-data fusion (including machine learning and Artificial Intelligence (AI)) will advance high-resolution climate modelling, understanding, adaptation and mitigation. There is a need to close observational gaps and build sustainable observing systems.
- **Carbon cycle** – Interannual variability of the ocean sink appears to be higher than previously thought while regional differences in ocean CO₂ uptake remain uncertain and change through time. The lateral transport of carbon by rivers to coastal zones, important for coastal and oceanic carbon budgets and estimating territorial emissions, is uncertain. Despite important recent advances, large uncertainties remain regarding the land carbon sink, especially the role of deforestation and land degradation, climate extremes that govern the interannual variability of carbon stocks, carbon turnover times, and gaps in process understanding that lead to model uncertainties. Both the oceans and land may become CO₂ sources, with possible ocean outgassing of CO₂ with accumulating carbon, and the land becoming carbon source under strong mitigation scenarios. These uncertainties are a barrier for effectively applying, monitoring, reporting, and validating Carbon Dioxide Removal (CDR) options.
- **Climate feedbacks and climate sensitivity** – Processes not currently represented in models could alter them outside the model range. Cloud-climate feedbacks continue to be uncertain and there is some uncertainty regarding changes in the water content of high clouds and phase changes. There are strong reasons to expect some climate-dependence of climate sensitivity. The sudden warming of 2023 is concerning and probably not all explainable by forcing changes.
- **Land use and land cover change** – Important because they affect climate through water and energy fluxes and can have significant socioeconomic consequences. There are challenges to understanding the trade-offs and co-benefits of sustainable land management practices, including those related to carbon dioxide removal and sustainable agriculture. There is a growing need for more advanced and accurate models for land use and land cover change.

- **Impacts on food security and water availability** – Seasonal prediction information can have a skilful 8-month lead time in many places, but we need to do a better job of using it to manage risk with respect to agricultural production. We need to consider CO₂ fertilization in models. A link between the “science” of agriculture and water availability needs implementation, including to develop information for the decision-making and policy community.
- **Connecting regional impacts and climate information** – Regional coordination, community engagement, holistic approaches, and data accessibility are important to address a need for improved data management, long-term resilience planning, and a focus on the unique challenges faced by indigenous communities. We need enhanced collaboration, data sharing, and a holistic approach to addressing climate change impacts in a rapidly changing world.
- **Lessons from failures** – Failure is hard to talk about but may often have more profound value than success by introducing necessary course corrections or encouraging objective assessment of alternative avenues. Better engagement, especially with real comprehension of the lived realities of those in the global south, is needed and it should begin at the design phase of any action. Risk communication methods should be informed by local customs and practices.



Session 17: Climate feedbacks and climate sensitivity chaired by Sandrine Bony, Steven Sherwood and Masahiro Watanabe in progress on Day 02 of the conference.



Session 11: Advances in global and regional climate modelling in progress, chaired by Bjorn Stevens, Ruby Leung and Tianjun Zhou.