



REGIONAL – GLOBAL MODELLING WORKSHOP

29 November – 1 December 2023

Venue: Stellenbosch University Museum, 52 van Ryneveld Str, Stellenbosch, and online

This workshop brings together the South African Earth System and Ecosystem Modelling communities to discuss three key goals:

1. What atmospheric-ocean-land forced and coupled models are in current use in the community and what are the high-level science objectives for their use and challenges?
2. What is the local and international outlook (beyond AR7) in terms of the future of ES models and modelling?
3. How can the South African modelling community coordinate its efforts to strengthen its regional (Africa) and global Climate Earth System and Ecosystem science and assessment impacts?

The South African ESS community has over the past 10 years developed strong capabilities across the atmospheric, ocean and land ES domains, but these remain largely fragmented within those domains and in research groups. The community is also precarious in in-depth model engineering as well as modelling and analysis skills. This limits the global reach of SA climate and ecosystem science for both analysis and impact. The fragmentation also limits our ability to extend our modelling capacity beyond the local research needs towards the large-scale societal challenges of the 21st century. We all share common challenges of temporal and spatial scales of processes, which determine the sensitivities of responses and feedbacks to the large temporal and spatial scales of the carbon-climate – ecosystem projections.

This global challenge under positive emissions will become even more complex under negative emissions when non-linearities in the feedbacks are already raising challenges to current modelling capabilities. Using these future challenges as a starting point we will examine the science challenges and their societal impacts in the rapidly emerging needs of the effectiveness and scalability of regional and global CDR. This is not planned as a CDR modelling workshop. CDR interventions present new challenges to our assumptions about the scale sensitivities of feedbacks of terrestrial carbon – water nexus and ocean carbon – heat nexus under negative emissions, which may require additional or new modelling capabilities. The science challenges linked to negative emissions may help strengthen the confidence of the carbon-climate-ecosystem projections until net-Zero.

We also aim to examine emerging new approaches to deal with long-standing obstacles such as computational limits, local vs international clusters, suitability of our clusters, digital twin approaches, integrating machine learning and prognostic models and model resolution.

We can examine our choices by reflecting on global perspectives from invited international colleagues on the future (10 years +) of forced and coupled models, the convergence of models and observations, closer integration of machine learning and more, including the future of clusters. This will be on Day 2. This will provide stimulating initial conditions for Day 3, when we discuss how to grow our individual and collective integrated capabilities. This includes modellers and model users from high resolution forced models to global ESMs (Climate-Mitigation spheres), as well as users in the Adaptation – Climate Services domains.

LIVESTREAM LINK: <https://bit.ly/47VAQsy>



This workshop is jointly hosted by the Stellenbosch University School for Climate Studies and NITheCS



Programme

Day 1: How are we using models across the regional and global domains

Main goal: to "take the pulse" of our climate – carbon - ecosystem models and modelling choices (runs) and activities. We want to share the high-level science questions that frame these choices, how these activities are limited by processing capacity and how big the modelling teams are (including students) and how the model outputs are used. Attendees are asked to prepare **15min** presentations that map some/all these issues.

8:30-09:15	<p>Welcome, brief introductions and workshop outline – Pedro Monteiro Introduction into School for Climate Sciences – Guy Midgley (SU) Introduction into NITheCS – Francesco Petruccione (NITheCS-SU)</p> <p>Why are we here? – Pedro Monteiro</p>
09:15 -11:00	<p>Forced Models: What kinds of forced models are we setting up and how/why are we using them?</p> <ul style="list-style-type: none"> • Science framing • Societal framing <p>09:15 – 10:15 Terrestrial Models and Modelling [Chair: Mary-Jane Bopape] Gregor Feig Petra Holden Hector Chikoore</p> <p>10:00 – 11:00 Ocean Models and Modelling [Chair: Mary-Jane Bopape] Nicolette Chang (Hierarchy of Southern Ocean Models: Temporal–Spatial Ocean Dynamics) Jenny Veitch (Coastal physics-ecosystem modelling)</p>
11:00 – 11:30	Coffee break
11:30 – 12:00	<p>Atmospheric (Climate) Models and Modelling [Chair: Jonathan Muller] Babatunde Abiodun Mary-Jane Bopape</p> <p>Machine Learning Reconstructions: Model verification Laique Djeutchouang (Regional and global reconstructions) Warren Joubert (Inversions: emissions constraints)</p> <p>Open Discussion: The discussion will be in plenary mode with the aim to explore gaps in our community capabilities in terms of the science and societal questions and challenges related to climate – carbon - ecosystem nexus.</p>
13:00 – 14:00	Lunch
14:00 – 17:00	<p>What kinds of Coupled Models are we setting up, using and how? [Chair: Guy Midgley]</p> <ul style="list-style-type: none"> • Francois Engelbrecht (SA Coupled CAM) • Gregor Feig (CABLE) • Precious Mongwe (CMIP5 and 6) • Shingirirai Mutanga (Climate Downscaling) • Chris Jack (CSAG: Climate-Adaptation) • Hector Chikoore (Rivers) <p>Discussion: Two discussion groups (convenors: Pedro Monteiro; Mary-Jane Bopape)</p> <ul style="list-style-type: none"> • What is limiting what we need to do vs what we can do? • Is a coupled Regional – Global model (not downscaled) necessary? • What are the three most important ES – Ecosystem science-society challenges that require model projections that cannot yet be done with ESMs? <p>Rapporteur feedback and discussion</p>
17:30	Open evening

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Day 2: Where do we want to go? > 10 years - Horizon Scan

Main goal: to look 10 years ahead at emerging directions in Earth System Modelling globally and in South Africa. This is planned around several international and local presentations with follow up discussion. This plan is to stimulate the ideas for the discussions in the 3rd day where we plan to identify community modelling initiatives.

08:30-09:00	Synthesis of Day 1 and Clarifications Lighthouse Presentations and Discussions [Chair: Pedro Monteiro]
09:00 -10:00	Improving Earth System Models with Machine Learning Prof Veronika Eyring Discussion
10:00 – 11:00	Towards a South African ESM Francois Engelbrecht (GCI-Wits U)
11:00-11:30	Coffee break
11:30 – 13:00	Digital twin models as platforms to strengthen the modelling -society links (converging models and observations) Prof Martin Visbeck Discussion
13:00 – 14:00	Lunch
14:00 – 17:00	Lighthouse Presentations and Discussions: [Chair: Laique Djeutchouang] 14:00 Projecting regional climate modelling challenges and needs over the next decade Mary-Jane Bopape (SAEON-NRF) 14:30 Reconstructing sub-grid-scale ocean dynamics using Machine Learning Zakiena Hoosen (PhD – GCI Wits) [Online] 14:45 Ocean eddies: Why is 10km resolution essential for ocean carbon – climate feedbacks? Tasha Smith PhD student [Online]
15:00-15:30	Coffee break
15:30-16h00	What kind of ESM do we need? Chris Jack (CSAG-UCT)
16:00-17:00	Gaps and challenges in ESMs – how should we contribute to addressing them? Precious Mongwe (SOCCO-CSIR)
17:00-18:00	Existing and future developments in the CESM model Peter Lawrence (NCAR)
18:00	Workshop Dinner

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Day 3: How do we get there? What kind of Community ESM do we need / want?

Main goal: to obtain community consensus on the next steps and convene a steering committee to formulate a White Paper that sets out the roadmap towards a science plan.

08:30-09:00	<p>Synthesis of discussions from Day 2 [Pedro Monteiro]</p> <p>Perspectives on where SA climate-carbon-ecosystem community modelling could be heading over the coming decade: AR7 and beyond</p> <p>Marcello Vichi</p>
09:00 -11:00	<p>Discussion groups</p> <p>For the way forward, we will break into two groups that will discuss similar questions:</p> <ol style="list-style-type: none"> 1. Do we want to invest in a community model? 2. What kind of community model? 3. How do we strengthen the community? 4. What kind of infrastructure do we need? 5. International collaborations and partnerships 6. Next steps (proposals/white paper)
11:30 – 13:00	<p>Synthesis of proposed way forward and the next steps</p> <p>Next steps (community platform / proposals / white paper)</p>
13:00	Close
13:00-14:30	Lunch

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