

45th Session of the WCRP Joint Scientific Committee (JSC)

27-30 May 2024

Report to the WCRP Joint Scientific Committee

Digital Earth Lighthouse Activity

1. Highlights for Joint Scientific Committee (including high-level publications, new achievements/products, and capacity building activities – in particular anything you feel should go into a WCRP annual achievement report or brochure)

- Coordinated (and led part of) WMO Bulletin Special issue on Climate Modelling. Digital Earth co-chairs were involved in coordinating and leading an article for the WMO Bulletin on km-scale climate modelling.
- Monthly Webinar series: Part of two activities: General webinars (<https://www.wcrp-climate.org/de-webinar-series>) and High Resolution Land-Atmosphere Modeling group series (<https://www.wcrp-climate.org/digital-earths-webinar-series-on-high-resolution-land-model-and-land-atmosphere-coupling>). Coordinators: Huw Lewis, Met Office (UK), Rosimar Rios, NCAR (USA)
- Developing Process Intercomparison Teams for several different topics. These include:
 - Land Modelling and Land-Atmosphere coupling at km-scale, tied to webinars above (joint with GLASS). Lead: Min-Hui Lo, National Taiwan University (Taiwan)
 - Convective organization and tropical waves (Joint with GASS), Leads: Martin Singh, Monash Univ (Australia), Falco Judt, NCAR (USA)
- Active group on Urban Digital Twins. Lead: Dev Niogi, Univ. Texas (USA)
- Discussion group on Initialization and Spin up of Coupled models at km-scale. Lead: Baylor Fox-Kemper, Brown Univ (USA)
- Started km-scale working group (collaboration with WGNE in ESMO). Lead: Cathy Hohenegger, MPI-Meteorology (Germany). This group has met twice, and currently has 9 members from different modelling centers (including one from regional models). The group is discussing topics important to the different model development centers, and will help spawn new activities.
- Digital Earth Scientific Steering Group has met twice virtually in the last year

2. Planned science initiatives and major events (over next 1- 5 years)

- Continue to advance process comparisons and nurture their development. In the next year, we hope to advance the convective processes at km-scale group, and will see papers published by some of the other groups
- Digital Earth LHA is contributing to several different meetings in the next year by helping organize sessions and in some cases co-sponsoring
 - Convective Permitting Modeling Meeting (Sep 2024, Colorado, USA)
 - Royal Society proposal for meeting on km-scale models (planned Spring 2025, UK)
 - USCLIVAR Bridging Weather-Climate Divide Meeting 2025 (planned Spring 2025, USA)
- We may host another topical meeting in 2025 or 2026 (see below under section 6).
- We are planning a global 'pan-hackathon' (aka Hack-a-Palooza) for km-scale modelling in Spring 2025. Coordinators: Bjorn Stevens, MPI-Meteorology (Germany), Pier Luigi Vidale, U. Reading (UK),

Andrew Gettelman, PNNL (USA). The hackathon will have multiple sites in one week in the March–May 2025 period. The goal is to have a distributed group of developers and users working with model output, sharing best practices for preparing and distributing this output. We are currently contacting centers/projects and forming a steering committee. Probable ‘nodes’ in Japan, China, USA, Europe, Australia, S. America & Africa. The preparations may also engender further discussion about common methods and infrastructure

- We hope new topics will ‘bubble up’ from the km-scale model working group and from some of the other interactions that have been started.
- We intend to keep pushing on the Data Assimilation piece, evolving it into Data Assimilation and Model-Data Fusion, which would include machine learning for climate

3. Planned Products, high-level assessments or other key outputs/publications

- WMO Bulletin Article on km-Scale Models: <https://wmo.int/media/magazine-article/kilometre-scale-modelling-of-earth-system-new-paradigm-climate-prediction>
- Webinar series:
 - General webinars (<https://www.wcrp-climate.org/de-webinar-series>)
 - High Resolution Land-Atmosphere Modeling (<https://www.wcrp-climate.org/digital-earths-webinar-series-on-high-resolution-land-model-and-land-atmosphere-coupling>)

4. Linkages with other lighthouse Activities, Core Projects, Academy etc.

- We have good active synergies with GEWEX core projects (GLASS and GASS) at process level
- Integrating with ESMO on modelling activities as they push to km-scale (e.g. WGNE, WGCM collaborations with km-scale group)
- Seeking to build connections with RfS and especially CORDEX to advance building of a ‘regional-global alliance’. P.L. Vidale has joined two of the RfS workshops in 2023 (Barcelona) and 2024 (Bruxelles). It is clear that global km scale models are not integrated enough with regional efforts (which have already covered a lot of this territory), but given the RfS scientific and societal ambitions, continuing to identify and exploit synergy has strong potential.
- Trying to understand user needs and human system interactions better with work through RfS. The human system integration has not achieved as much as we thought. We are still looking for the correct strategy for this piece.

5. Partnerships with entities outside of WCRP

- Digital Earth is collaborating with the Earth Visualization Engines (EVE) project on km-scale models. EVE shares a goal with digital of interactive digital information systems. The hackathon idea is one joint effort.
- The University of Reading – ECMWF – Met Office – NCAS “Advancing the Frontiers of Earth System Prediction (AFESP) programme has two themes that strongly overlap with WCRP DE: “km-scale modelling” and “Earth System Data Assimilation (for km-scale)”. Both themes include Machine Learning aspects.

6. Suggestions, issues or challenges, for example:

- Data Assimilation for Climate is going to add a Co-Chair with expertise in Climate and Machine Learning, and we are planning on making a push to advance both data assimilation, data-model fusion and possibly data use for human systems in this effort. This effort may evolve into ‘Model-Data Fusion for Climate’ encompassing DA, but also ML use in models, and for downscaling to human systems. The activity will evolve once we name a new co-chair and have some further discussions. Feedback from the JSC would be useful.

- *We are also (as noted) seeking to evolve the human systems component of the Digital Earth concept. We have not quite found the right niche net. Looking to collaborate on RIFS on this, and will explore the Machine Learning and AI space as well.*
- *We tried some efforts on collecting data sets and workflows for km-scale and there was little motivation in the community to build such efforts. We also originally put off any common discussion of infrastructure and 'big data' for km-scale modelling and digital twins, thinking that would get covered under other efforts (the WMO Research Board was making some noise about this). But that has not happened, so we may revisit the infrastructure piece around km-scale models if there is interest, and it may arise out of the pan-hackathon*