45th Session of the World Climate Research Programme
Joint Scientific Committee

Digital Earth Lighthouse Activity

Co-chairs:

Andrew Gettelman, NCAR/PNNL
Pier Luigi Vidale, NCAS/U. Reading

Our Chat-CPT logo….

JSC-45, May 2024, Lima, Peru
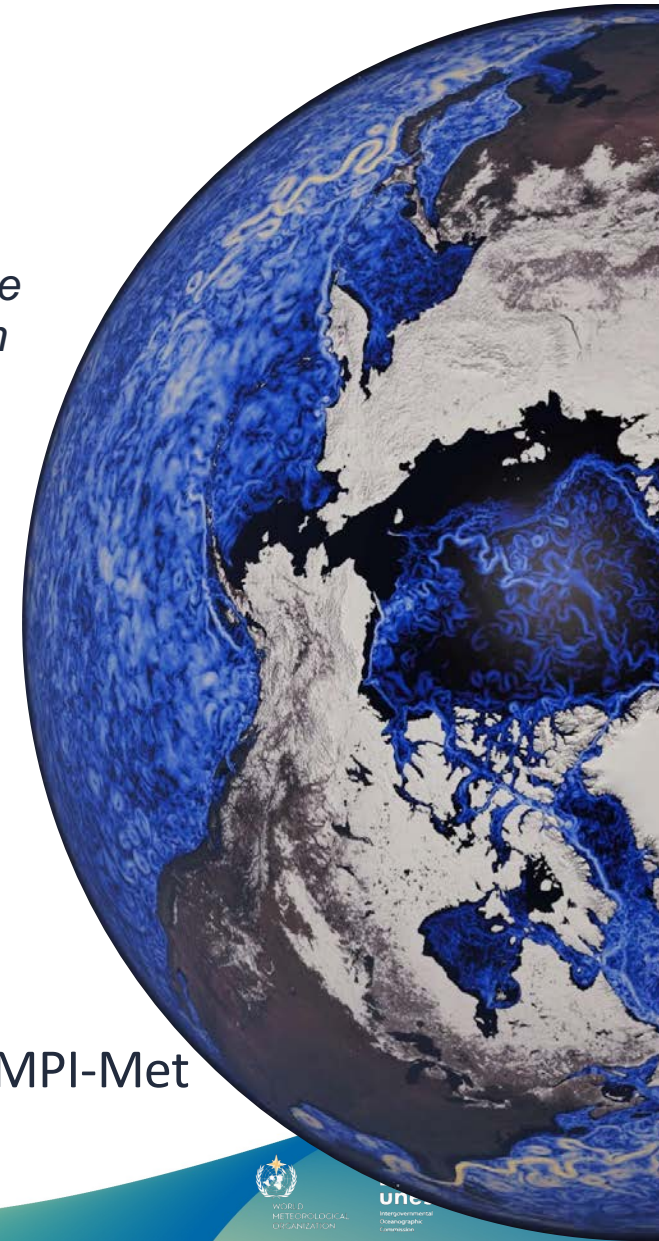
Digital Earth LHA Goal

*Support the design and building of **integrated interactive digital information systems** that provide global and regional information on the past, present, and future of our planet, including both natural and human systems*

Areas of activity

- **Fully coupled km-scale regional and global models:** Need a global research network in km-scale modeling of the Earth system and individual components

- **Data assimilation for climate:** Establish an active community in data assimilation for climate, expanding on the existing numerical weather prediction and re-analysis efforts

- **Beyond the Physical Earth System:** Include human interactions on and impacts to human systems in ESMs

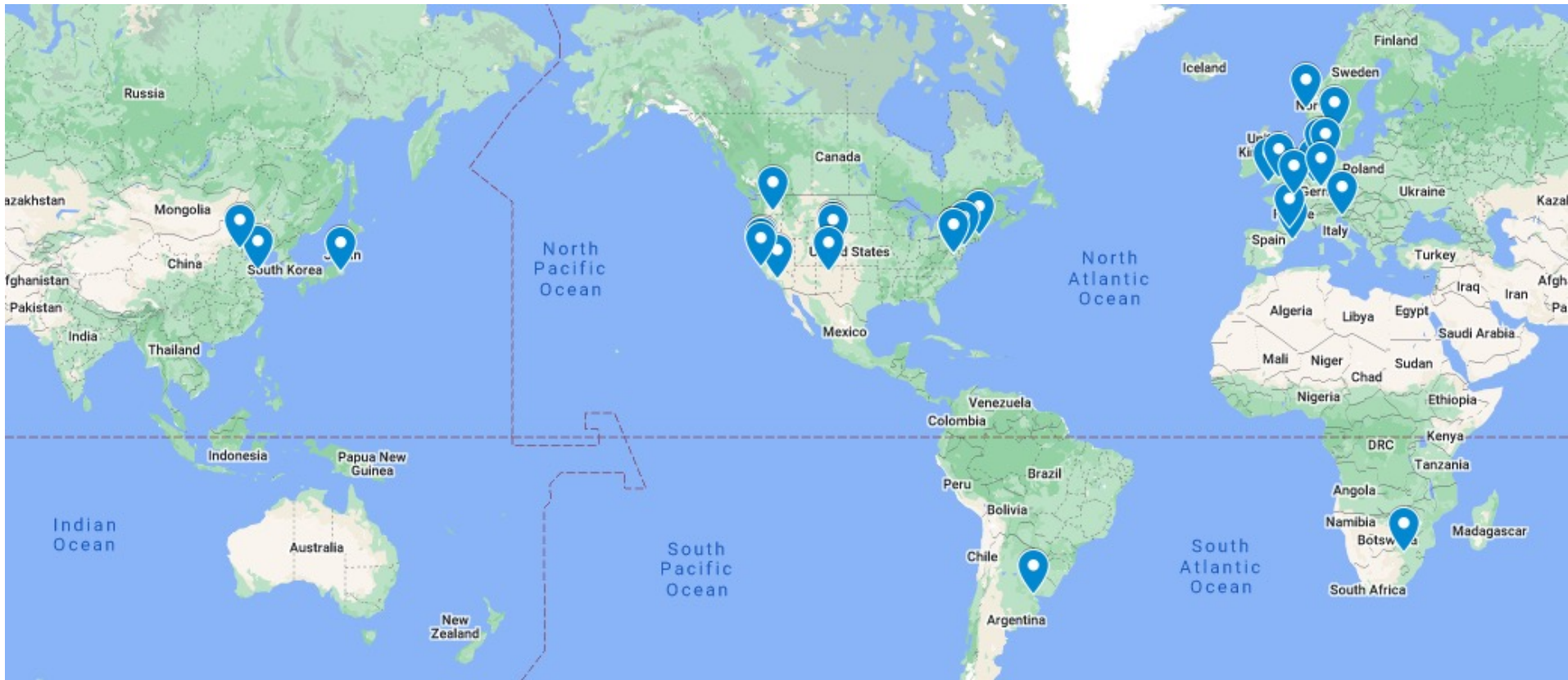1.2km ICON

D. Klocke MPI-Met

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Km-Scale Model Efforts: Regional & Global

21 different efforts identified. 12 global, 9 regional.
About ⅔ of these groups attended meetings in person or virtually

Current Activities

- Process intercomparisons with km-scale models (global & regional)
  - Land-Atmosphere Coupling (with GLASS)
  - Convective organization at km-scale (with GASS)
- High resolution processes seminar series: [~1/month]
  - General and Land-Atmos Topics
- Urban Digital Twin Group
- Km-scale modeling working group launched (with ESMO-WGNE)
- Group for initialization/spin up of km-scale coupled models (with ESMO, OMDP)
- Joint hackathon to encourage analysis of km-scale models planned for 2025

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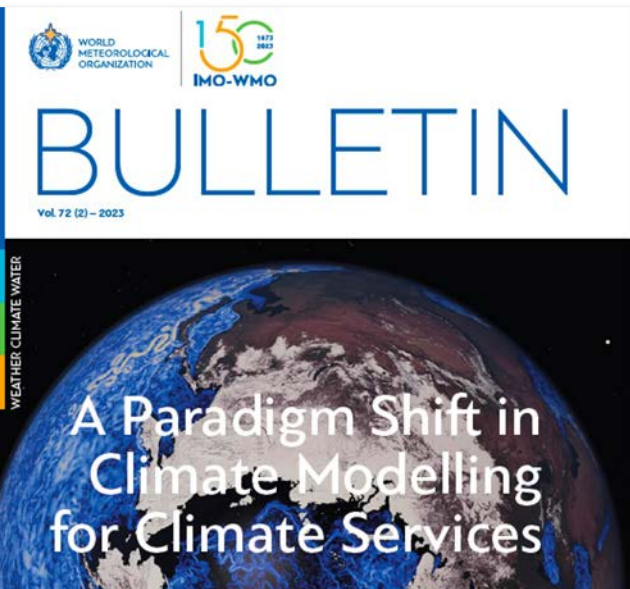
Digital Earth Highlights

- *Coordinated WMO Bulletin Special issue on Climate Modelling*

- *Monthly Webinar series:*
  - *General webinars*
  - *High Resolution Land-Atmosphere Modeling group series*
  - *Coordinators: Huw Lewis, Met Office (UK), Rosimar Rios, NCAR (USA)*
  - *Getting about 60-80 participants*

WORLD METEOROLOGICAL ORGANIZATION
IMO-WMO

BULLETIN
Vol. 72 (2) – 2023

WEATHER CLIMATE WATER

A Paradigm Shift in Climate Modelling for Climate Services

14   Vol. 72 (2) – 2023

Kilometre-Scale Modelling of the Earth System: A New Paradigm for Climate Prediction

By Andrew Gettelman[1], Bayler Fox-Kemper[2], Gregory Flato[3], Daniel Klocke[4], Detlef Stamer[5], Bjorn Stevens[4] and Pier Luigi Vidale[6]

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Successes and Challenges for the Simple Cloud-Resolving E3SM Atmosphere Model

Speaker: Dr. Peter Caldwell
Laurence Livermore National Laboratory, US

Tuesday 12 September 2023
15:00-16:00 UTC

WCRP Digital Earths Lighthouse Activity Webinar Series

Planned science initiatives and major events

- Continue to advance process comparisons and nurture their development
- 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' for km-scale modelling in Spring 2025. Coordinators: Bjorn Stevens, MPI-Meteorology (Germany), Pier Luigi Vidale, U. Reading (UK), Andrew Gettelman, PNNL (USA).
  - Likely nodes in UK, Europe, USA, Japan, China, Australia, South America and Africa
  - Requested some WCRP funding for supporting S. American and Africa
  - Other nodes working on funding (e.g. US)

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)*
- *Hackathon Documents and results*

Linkages with other WCRP activities

- *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)*
- *Building connections with RIfS and especially CORDEX to advance building of a 'regional-global alliance'.*
  - *Attending RIfS meetings*
  - *It is clear that global km scale models are not integrated enough with regional efforts (which have already covered a lot of this territory).*
- *Trying to understand user needs and human system interactions better with work through RIfS. The human system integration has not achieved as much as we thought. We are still looking for the correct strategy for this piece.*

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.*

Suggestions, issues or challenges

- *Data Assimilation for Climate is going to add a Co-Chair with expertise in Climate and Machine Learning (ML).*
  - *Advance both data assimilation, data-model fusion and possibly data use for human systems*
  - *May evolve into 'Model-Data Fusion for Climate' encompassing DA, but also ML use in models, and for downscaling to human systems.*
- *Seeking to evolve the human systems component of the Digital Earth*
  - *Collaborating with RIfS key, and will explore the Machine Learning and AI space as well.*
- *Revisit efforts on collecting data sets and workflows for km-scale*
  - *There was little motivation in the community to build such efforts (or we did not approach it correctly)*
  - *Includes a broader infrastructure piece*
  - *This may arise out of the hackathon*

Thank You

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