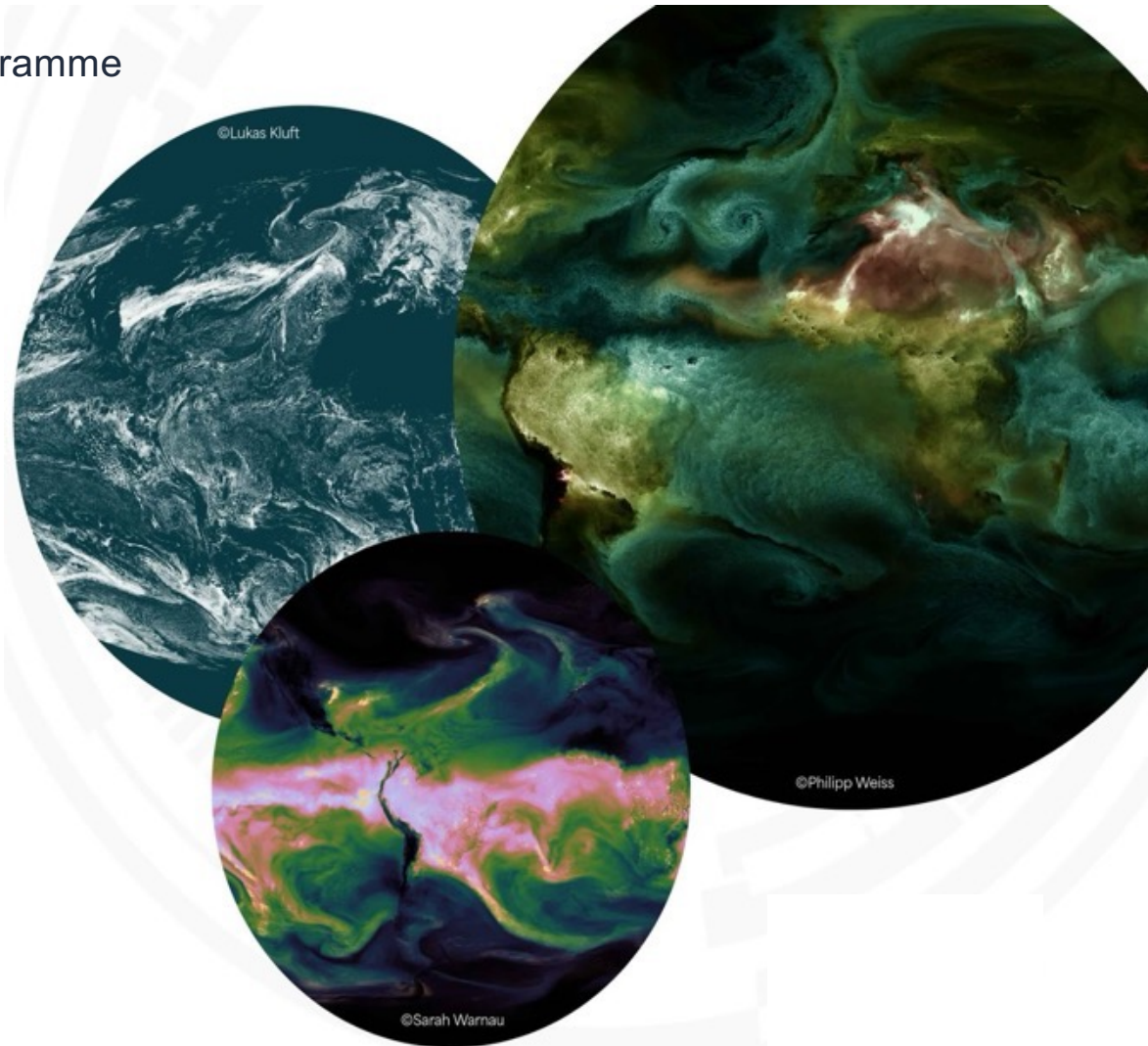


47th Session of the World Climate Research Programme
Joint Scientific Committee

The Digital Earth Lighthouse Activity: JSC47 Update



Andrew Gettelman, U. Colorado
Pier Luigi Vidale, NCAS/U. Reading



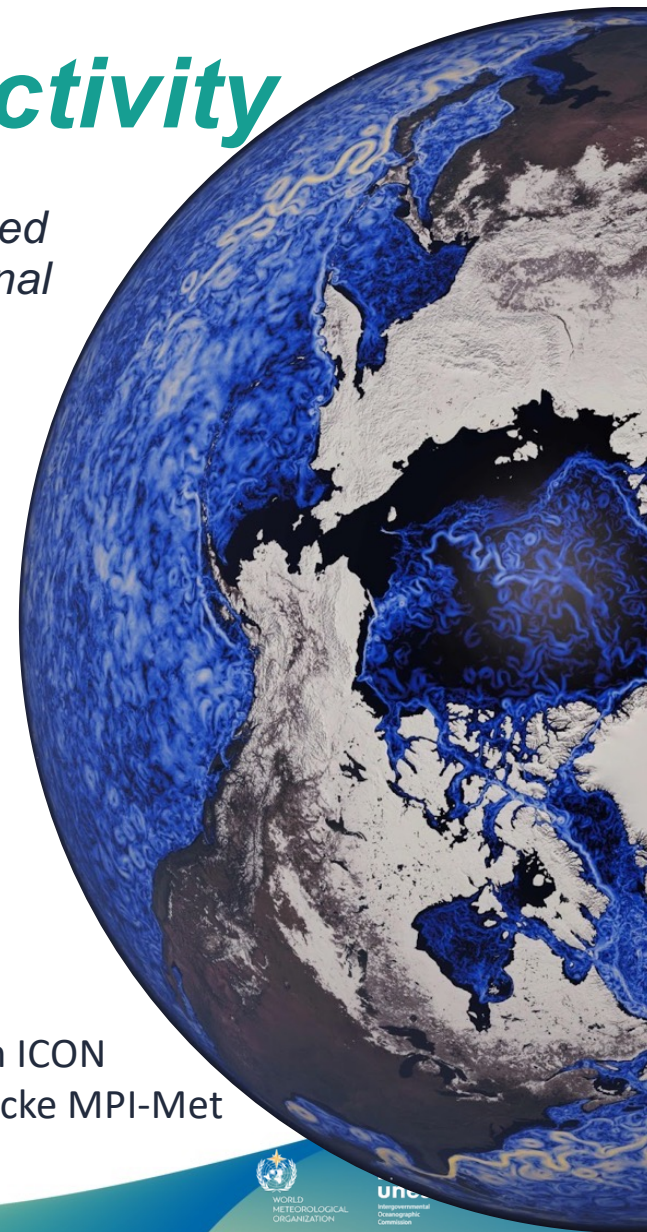


Digital Earth Lighthouse Activity

Cross-Cutting WCRP Activity supporting development of integrated interactive digital information systems providing global and regional information, including both natural and human systems

Areas of activity

- **Fully coupled km-scale regional and global models:** Foster a global research network in km-scale modeling of the Earth system and individual components (**km-scale = $\Delta x < 10\text{km}$**)
- **Data-Fusion for climate:** Establish an active community for *climate data assimilation* and *data driven modeling* (e.g. Machine Learning/AI methods), expanding on numerical weather prediction and re-analysis
- **Beyond the Physical Earth System:** Include human interactions on and impacts to human systems in ESMs



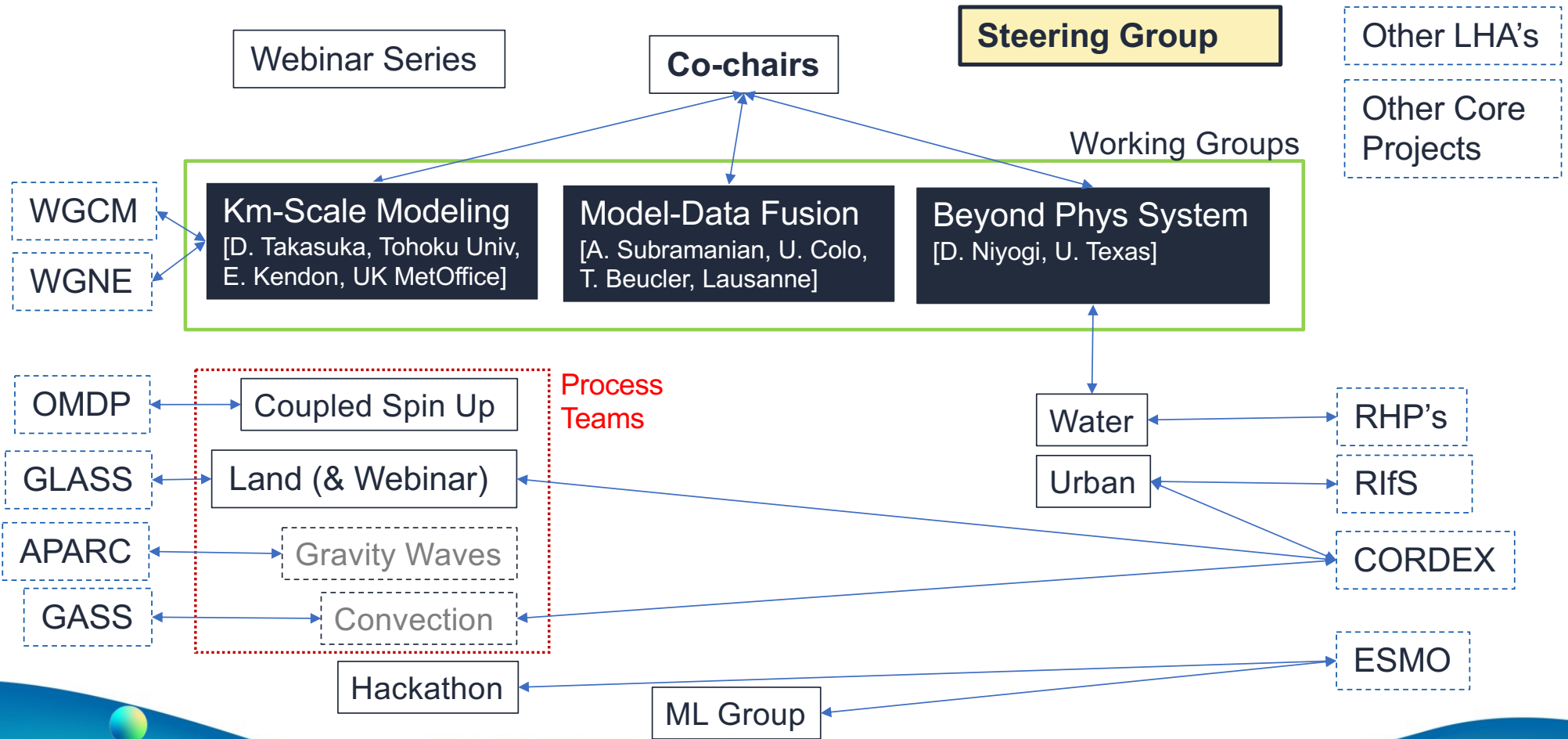
1.2km ICON
D. Klocke MPI-Met

Key highlights for the Joint Scientific Committee

- *Reorganization of Digital Earth LHA Management*
 - *New working group members, chairs: selected with an open call (with some encouragements). Attempted to balance geography and demographics*
 - *Refocusing and developing groups*
- *km-scale modeling: May 2025 Hackathon*
 - *Lots of impact on the field*
 - *Moving towards broader societal benefit*
- *Developing ‘Model-Data Fusion’ piece with more AI for Climate*
 - *Navigating the evolving landscape*
- *More Urban Digital Twin activities*
 - *Strong societal benefit links*

Digital Earth LHA Structure

2026





DE km-scale Modeling Working Group

Chairs: D. Takasuka (Tohoku Univ.), E. Kendon (UK MetOffice)

- Nurture the development of **process comparisons/teams**
 - Km-scale **Land-Atmosphere interactions**
 - Trying to organize: **Convective organization (GASS), Gravity waves (APARC)**
- Reformulate Km-scale model development group with WGNE
- **Seminar Series** on km-scale modelling
- Participating in **conferences/workshops**
 - Hosting/supporting meetings/sessions where necessary
- Global **‘pan-hackathon’ for km-scale modelling** (May 2025, 2027)
 - Multiple models, sharing tools and workflows, data sets
 - Increase ability of users to analyse km-scale models
 - Bring analysis capabilities and data to users worldwide

All these activities are for **global AND regional models**

WCRP Digital Earth Lighthouse Activity Global km-Scale Hackathon



When: 12-17 May 2025

Where: 11 regional nodes worldwide

Join us and contribute to strengthening collaborations in weather and climate research, driving advances in storm-resolving models for better predictions!

Organisers: WCRP Digital Earths Lighthouse, in collaboration with other international partners and initiatives

Our partners:



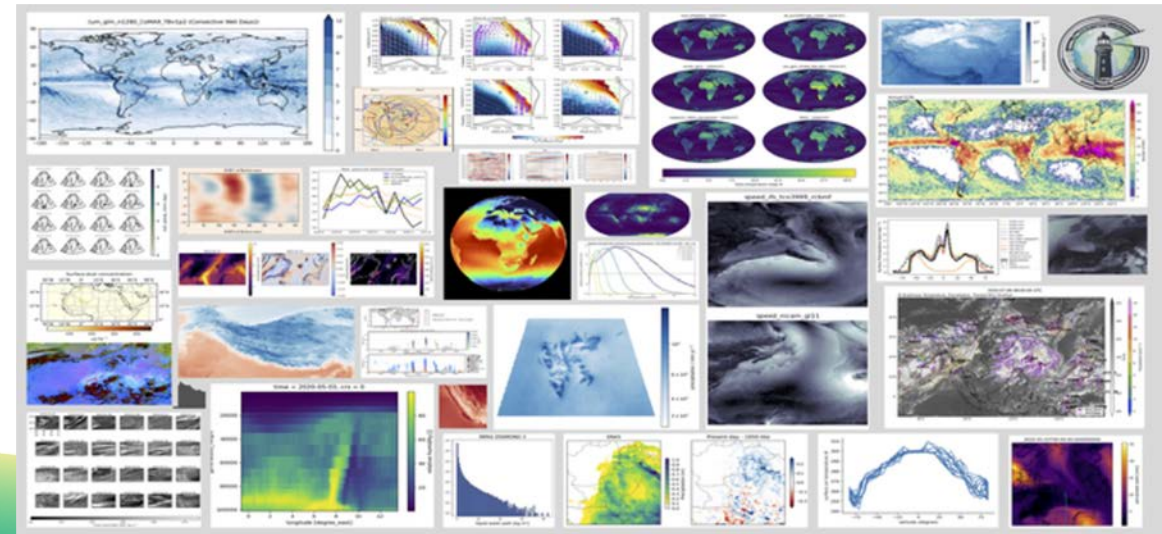
700 participants

10 nodes, 5 continents

+ Observations and AI teams

Over 1000 plots in a week!

Prototyped new methods for delivery of climate innovation





58 Princeton



70 Oxford



115 Beijing



47 Boulder



+6
116 Hamburg



53 Tokyo



+12
52 Berkeley



km-Scale Hackathon 2025



27 Buenos Aires



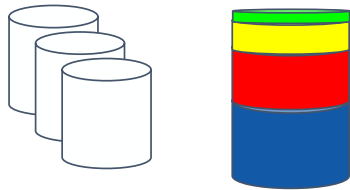
69 São Paulo



68 Canberra

Hackathon Technical Stack

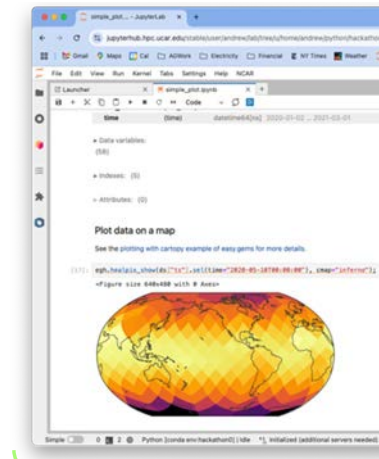
Local Storage



Object Storage (S3)



Model Output / Observations



Data

Storage

Communication

User

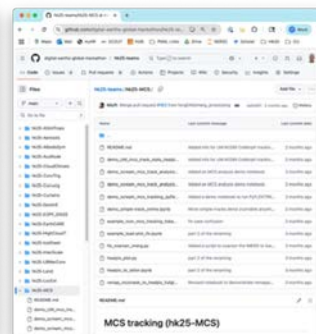
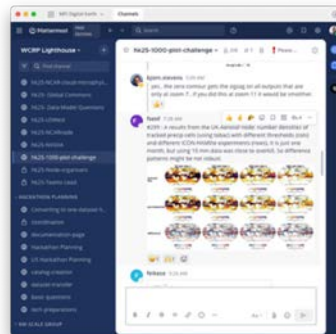
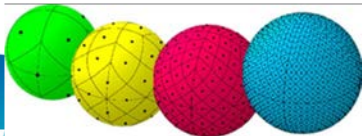
Organization



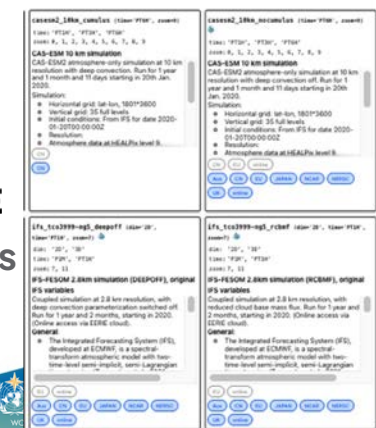
Zarr

Format

HEALPix Grids



INTAKE
Catalogs



WCRP
World Climate
Research Programme

Mattermost

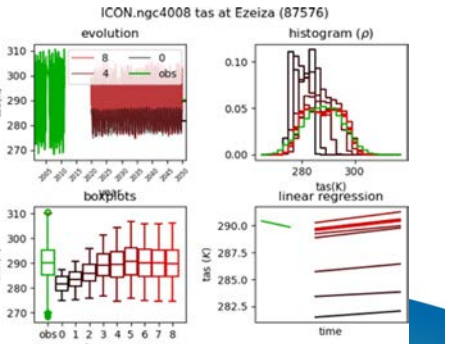
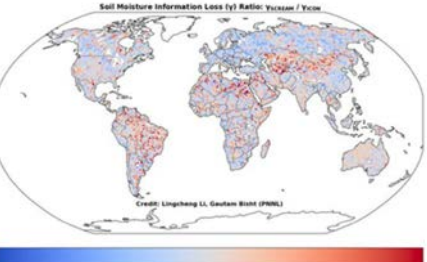
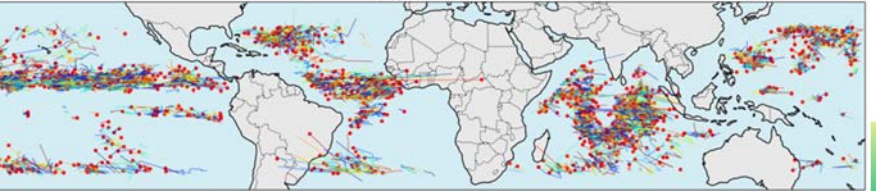
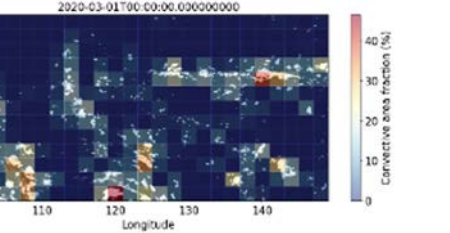
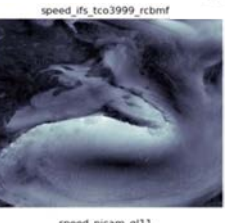
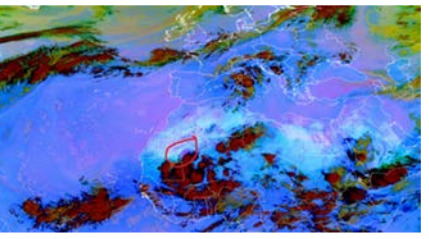
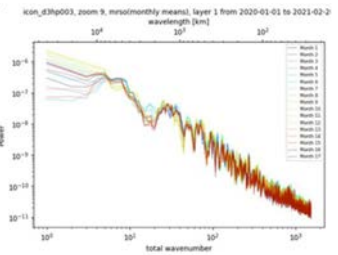
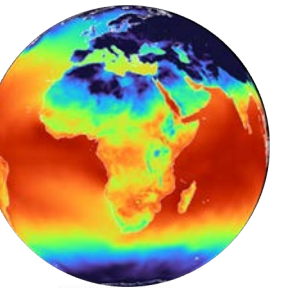
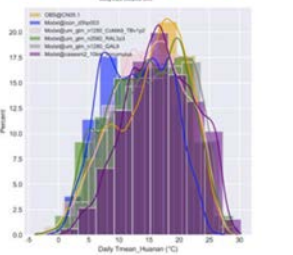
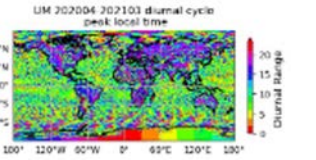
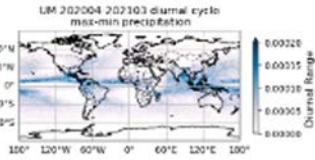
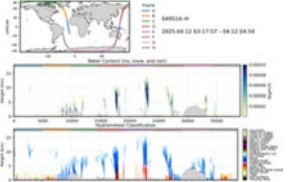
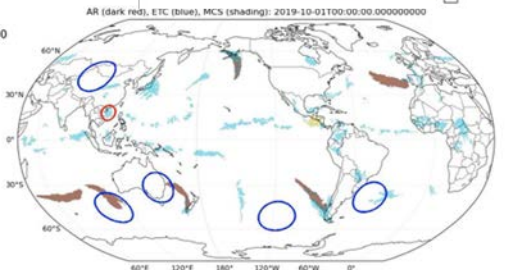
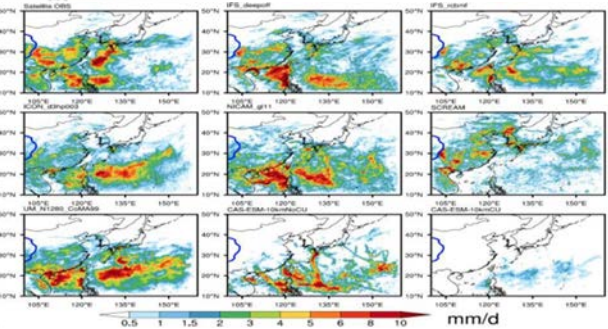
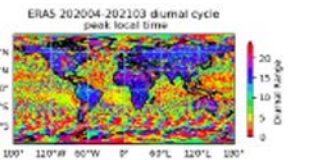
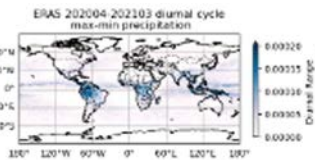
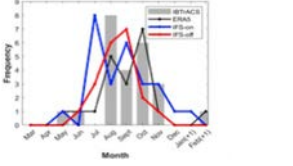
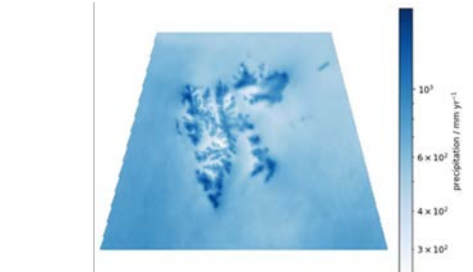
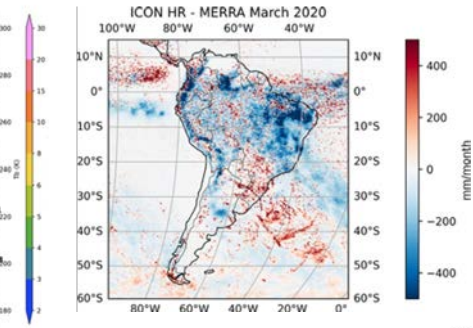
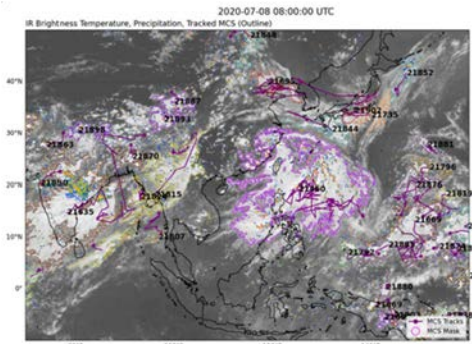
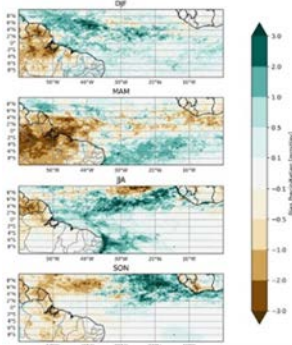
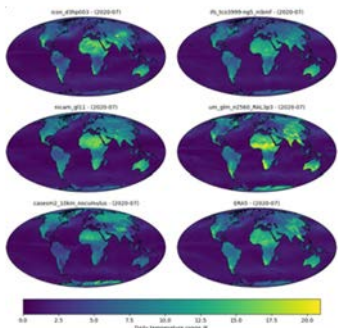
GitHub

zoom



Organization

Organization





Hackathon Take Aways/Next Steps

- New technologies can democratize climate information
 - Common analysis platforms (python), over the web delivery (jupyter)
- Climate information can move into the cloud
 - Object (cloud) storage + new formats (zarr) for efficient access
- Works at all scales (km–scale, ‘CMIP’ scale) regional and global
- Overview paper (BAMS) Accepted, Technical paper to be submitted
 - Many scientific papers in development
- Discussion of a 2027 Hackathon
 - Assess where community wants to go next: choose science topics with broad appeal
Evolve the technical stack
 - Hierarchical protocol so smaller groups can contribute (also regional)
 - Involve the Global South Early (help shape it and prepare): get more funding as well
 - Send ambassadors to and from global south for the heackathon
 - Involve more regional km-scale groups



Physical to Virtual Data Fusion for Climate

Chairs: A. Subramanian (Univ. Colorado), T. Beucler (Laussane univ.)

- Data Assimilation for Climate
 - Co-hosted several workshops (Boulder 2022, Boston 2024)
 - Connecting with coupled DA efforts lead by WWRP DAOS
 - Climate DA: participating in investigations of ML based DA, currently it does NOT outperform traditional methods
- Machine Learning and Data Driven Modeling
 - Coordinating efforts for Climate (with ESMO): joint group
 - Connecting to WWRP PDEF who are starting a new ML effort for NWP
 - ML Exploration in all aspects of ‘digital earth’
 - Urban Digital Twin group at UT-Austin has produced a ML Hindcast Dataset, we are helping to advertise it for community use.
 - Bi-monthly webinars and WG meetings will start soon
 - Planning a meeting on AI/ML Climate modeling for November 2026 (Boulder, CO)

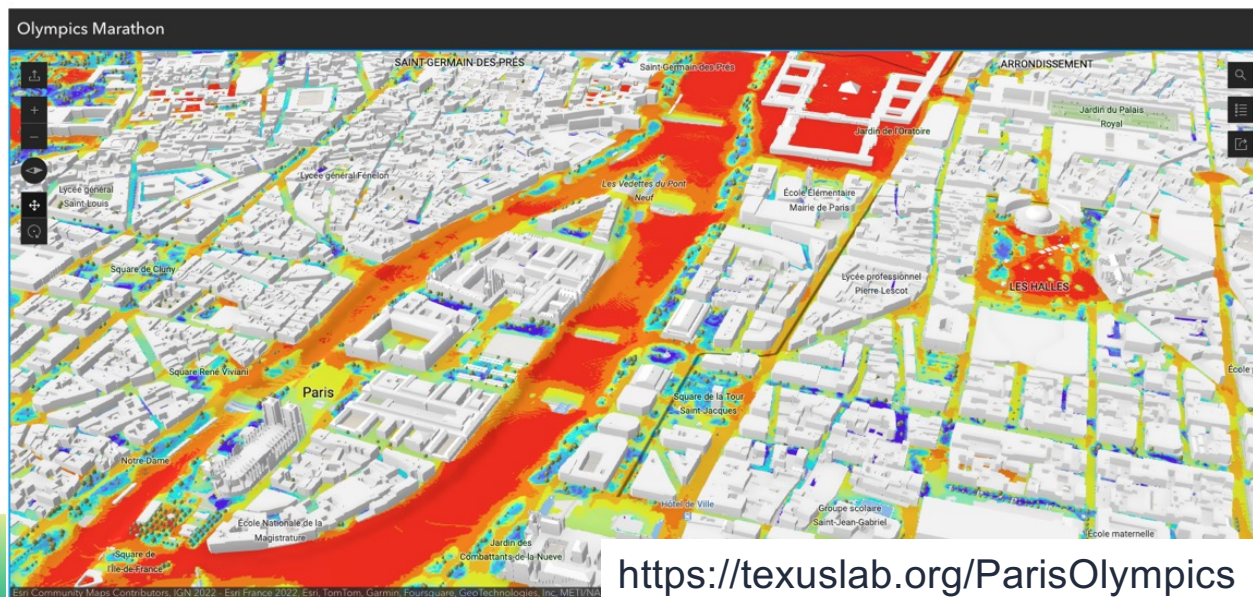


Human Systems: Beyond the Physical

Chair: D. Niyogi (U. Texas)

- Core competencies of Earth System Models: Water, Energy, Land
 - Emerging efforts with: Hydrology, Energy Systems, Crops
 - Example: GEWEX Regional Hydroclimate Project (RHP) for the US (H2US)
- Humans dominate in Urban environments
 - Urban Digital Twin effort started: data sets, academic/city twins (Dev Niyogi, U. Texas)
 - Connecting with CORDEX Urban FPS
 - Also WWRP Urban warning systems project

2024 Paris Olympics Weather Forecast by Street....



<https://texuslab.org/ParisOlympics>



Future Plans and Priorities

- Km-Scale Modeling
 - Stock take with reformulated working group, and discussions with ENSO: km-scale modeling meeting in July 2025 (Hamburg)
 - km-scale Land-Atmos Interactions review paper (Lead: Min-Hui, Lo, NTU Taipei)
 - Process teams? Convection (with GASS), Gravity Wave (APARC)
 - Thinking about hackathon in 2027
- Machine Learning and AI
 - DE is focusing on climate (not weather generators, but climate and coupled models)
 - Hosting a meeting on climate modeling
- Beyond the physical system
 - Still working on the right foci here (maintaining urban digital twins focus)

WCRP

World Climate
Research Programme



WORLD
METEOROLOGICAL
ORGANIZATION



unesco
Intergovernmental
Educational, Scientific and
Cultural Organization



International
Science Council

Suggestions, issues or challenges

- *Has been a bit harder to get things going across WCRP*
 - *Process teams*
 - *Regional / Global Alliance*
 - *Why? Are we doing something wrong, or is the community not ready?*
- *Lots of work in the Climate-AI space*
 - *How do we coordinate this? Working with several entities now*
- *How do we do things without money?*
 - *We have relied on other IPOs (ESMO very helpful for Hackathon)*
 - *Focus on connecting people*
 - *Aligning with other scientific projects: where can WCRP add value and what are the principles we can add to activities (e.g. broader perspectives, global south, etc.)*
 - *Other actors bring resources (e.g. technical assistance, travel support, etc.)*