An important topic on the agenda was the organization of the 9th GEWEX Open Science Conference to be held in Sapporo, Japan from July 7–12, 2024. A short overview was presented on the location and venue as well as first ideas on the program and side events. Much more on this event online at *https://www.gewexevents.org/meetings/gewex-osc2024/*.

GEWEX continues to have a strong working relationship with the World Weather Research Program (WWRP), mainly through GASS. We hope to further develop similar strong relationships with the World Meteorological Organization (WMO)-Hydrology Program. The coordination with the LHAs and the new core projects was also discussed. All these recent developments are seen in a positive light, yet several participants expressed concerns regarding the resources needed for all these activities while also not overburdening our volunteer community.

The 35th GEWEX SSG turned out to be a very a successful and pleasant meeting with special thanks to our hosts and René Garreaud and his student Monica Zamora Zapata, who took care of the many practical issues including organizing a wonderful group dinner.

9th Global Energy and Water Exchanges Open Science Conference

Sapporo, Japan | 7–12 July 2024

Water • Climate | 水 • 気候

GEWEX Open Science Conference Program

The conference is organized around three themes:

1. Water, Climate, Anthropocene
2. Extremes and Risks
3. Water, Energy, and Carbon Processes

In the context of these themes, the sessions will focus on research that contribute to the following areas:

- Determination of the extent to which Earth's water cycle can be observed and predicted
- Quantification of the inter-relationships between Earth's energy, water, and carbon cycles to advance our understanding of the system and our ability to predict it across scales
- Quantification of the anthropogenic influences on the water cycle and our ability to understand and predict changes to Earth's water cycle
- Extremes in the water cycle and risks to society

An overview of each research area with associated topic(s) and the full list of sessions can be found at **https://www.gewexevents.org/meetings/gewex-osc2024/program/themes-and-sessions/**.

Important Dates

Abstract submission and registration open:	Late November 2023
Abstract submission closes:	1 February 2024
Travel support application closes:	1 February 2024
Abstract acceptance notification:	19–23 February 2024
ECR Workshop acceptance notification:	26 February–1 March 2024
Travel support notification:	4–8 March 2024
Early bird registration closes:	4 March 2024 at 24:00 UTC

The 2023 GLASS Panel Meeting

Hohenheim, Germany
15–17 August 2023

Anne Verhoef[1] and Kirsten Findell[2], GLASS Panel Co-Chairs
[1]University of Reading, Reading, UK; [2]Geophysical Fluid Dynamics Laboratory, Princeton, NJ, USA

For three lovely, hot days in the middle of August, the Global Land-Atmosphere System Studies (GLASS) Panel met on the beautiful campus of the University of Hohenheim in Germany, graciously hosted by Volker Wulfmeyer. We are grateful to Volker, Andreas Pyka (Vice President for International Affairs at the University of Hohenheim), Volker's research group, and especially his assistant Elisabeth Ott for the myriad ways they rolled out the red carpet for our GLASS community.

This year's meeting focused on the importance of observations to assess model behavior, improve parameterizations, and understand how land-atmosphere interactions are changing in a warming world. We considered how we might expand ongoing projects focused on ecological and hydrological processes, and grow new projects that highlight the role of humans in the global energy, water, and carbon cycles.

We kicked off our meeting with a welcome and introductory talk by GLASS Co-Chairs Kirsten Findell and Anne Verhoef. The first day focused on observing and understanding sub-daily processes in the land-atmosphere system, from soils to vegetation to the atmospheric boundary layer. We heard in-depth progress reports from five GLASS projects: **GEWEX Land/Atmosphere Feedback Observatories** (**GLAFO**), **GEWEX Soil and Water Initiative** (**SoilWat**; jointly sponsored by the International Soil Modeling Consortium, ISMC, and presented by Yijan Zeng), **Coupling of Land and Atmospheric Subgrid Parameterizations** (**CLASP**; led by Nate Chaney, presented by Meg Fowler), **Local Land-Atmosphere Coupling** (**LoCo**) Working Group (led by Joe Santanello, with Kirsten Findell contributing portions of the update), and **Solar Induced Fluorescence Model Intercomparison Project** (**SIF-MIP**; led and presented by Nick Parazoo).

Additionally, we heard about the progress of a few cross-cutting initiatives between GLASS and the other GEWEX Panels. Anne Verhoef filled us in on the Impact of Initialized Land Temperature and Snowpack on Sub-seasonal to Seasonal Prediction (LS4P-II) project (a Global Atmospheric System Studies, or GASS, Panel project; slides kindly provided by Aaron Boone, who co-leads the LS4P project with Yongkang Xue) and the **Determining Evapotranspiration** (**dET**) project (a cross-cut with the GEWEX Hydroclimatology Panel, or GHP; Anne co-leads this initiative with Oscar Hartogensis and Aaron Boone). She included a summary of high-resolution modeling efforts proposed by the Land surface Interactions with the Atmosphere over the Iberian Semi-arid Environment (LIAISE) team. We also heard about the research of new GLASS member Marina Hirota from the Federal Uni-

versity of Santa Catarina, Brazil, who looks at disturbances, impacts, and the resilience of tropical ecosystems. Her work includes Amazon basin-wide ecological and physiological field studies, as well as remote sensing, to ultimately help determine if models can represent the high heterogeneity present in Amazonian ecosystems. She challenged the reliability of climate-vegetation feedbacks simulated, given the heterogeneity we can see on the ground for these ecosystems, especially during their transitions, or when they reach eco-climatic "tipping points". The topic of heterogeneity fits nicely with our GLAFO and CLASP project aims, so some potential avenues for collaborations were discussed during our meeting. The GLAFO project update included highlights of two GLAFO observational platforms: the Land-Atmosphere Feedback Observatory (LAFO) near Hohenheim, Germany (set in a highly heterogeneous agricultural landscape), and the Cabauw Atmospheric Research Station (situated near Utrecht, the Netherlands on a large, relatively homogeneous managed grassland area affected by shallow groundwater), operated by The Royal Netherlands Meteorological Institute (KNMI). The Cabauw highlights were shared by Arnoud Apituley, who was invited to our meeting to underscore the common interests between his research team overseeing the Cabauw research station (part of the Ruisdael Observatory; *https://ruisdael-observatory.nl/cabauw/*) and the GLAFO project.

During the evening, we were treated to a beautiful quatremains professional piano recital in the ornate ballroom of Hohenheim Palace.

Day 2 of our GLASS Panel meeting focused on benchmarking models against observations, assessments of global model performance, and expanding our scope of hydrological projects. We heard progress reports from the remaining five GLASS projects: Gab Abramowitz filled us in on **Protocol for the Analysis of Land Surface models** (**PALS**) **Land Surface Model Benchmarking Evaluation Project, Phase 2** (**PLUMBER2**) and **modelevaluation.org**; Dave Lawrence discussed **The International Land Model Benchmarking** (**ILAMB**); and Hyungjun Kim spoke about **The Global Soil Wetness Project, Phase 3** (**GSWP-3**) and the **Land Surface, Snow and Soil Moisture Model Intercomparison Project** (**LS3MIP**), which were both tightly coupled to the Coupled Model Intercomparison Project Phase 6 (CMIP6) cycle and are therefore nearing completion.

The PLUMBER2 project has revealed that mechanistic land models (including land surface models, ecosystem and hydrology models) perform poorly in the prediction of turbulent fluxes against out-of-sample empirical benchmarks, including regression models and machine learning approaches. This is particularly true for sensible heat flux. Land surface models tend to significantly outperform other mechanistic models at flux prediction, including carbon flux prediction. These results are discussed in a manuscript that will be submitted by the end of the year.

ILAMB continues to gradually evolve, adding data sets and new metrics. A focus this year was on incorporation of hydrology metrics and some simple metrics that evaluate land-atmosphere interactions (terrestrial coupling strength and critical soil moisture metrics). A new scoring methodology aims to make errors from different areas of the globe comparable.

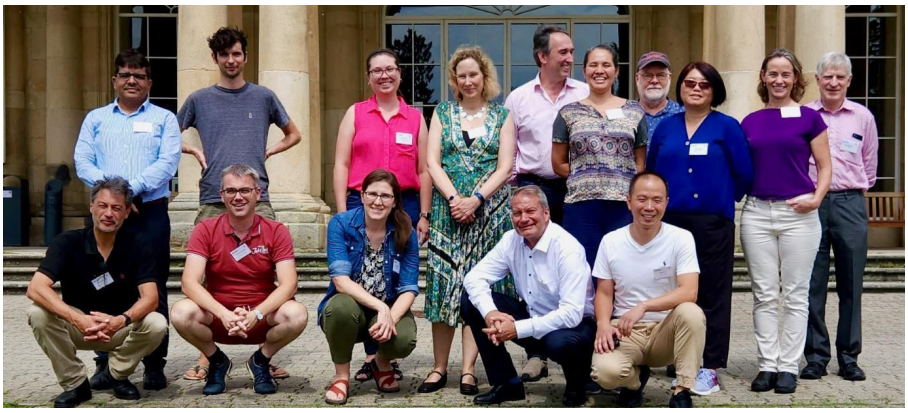
On Day 2 we also learned about projects with connections to the GEWEX Data and Analysis Panel (GDAP) from our GDAP liaison, Yunyan Zhang, and about projects with connections to GHP from our Panel members Laura Condon, Tricia Parker-Lawston, and Josh Roundy (our GHP liaison). Laura spoke about the **Groundwater cross-cut** led by Laura and Stefan Kollet, Tricia spoke about the **Irrigation cross-cut** she leads, and Josh spoke about the proposed cross-cuts on surface water and floods. We then heard about the research and scientific views of new GLASS member Vimal Mishra (from IIT Gandhinagar, India) on data and land surface modeling-related challenges in South Asia. He posed a range of pertinent questions relating to land surface hydrology in South Asia, with a key one being "how the interplay between climate and human interventions (e.g., aerosols, land use/land cover change, irrigation) affects the changes and variability in the summer monsoon". Finally, he highlighted the critical importance of shifting some of our collective attention to the urgent needs of climate services with the aim of developing pathways to bridge science and solutions.

A tour of the heavily instrumented LAFO field site, led by Volker and his colleagues, provided us all with observational inspiration at the end of this second day. Some of our modelers were particularly intrigued and grateful to see the intricate 3-D atmospheric scanning equipment in action, given their heavy reliance on these important observations.

In the evening, we visited Hohenneuffen Castle for a guided tour and medieval banquet. Apart from wonderful food and entertainment, this provided a great bonding experience for our Panel members and invited collaborators.

The morning of Day 3 shifted to potential collaborations with some of the initiatives in the broader World Climate Research Programme (WCRP) sphere. We heard from colleagues at the Integrated Land Ecosystem-Atmosphere Processes Study (iLEAPS; presented by Xianhong Meng) and three of the WCRP Lighthouse Activities: *Safe Landing Climates* (presented by Hyungjun Kim), *Explaining and Predicting Earth System Change* (presented by Kirsten Findell), and *Digital Earth*. Discussions are already underway between GLASS and Digital Earth's efforts on urban modeling (kindly presented by Gyorgy Zoltan Nagy, in lieu of Dev Nyogi, who was not able to attend) and high-resolution land modeling (led and presented by Min-Hui Lo). Gert-Jan Steeneveld, our GLASS Panel member representing urban modeling and monitoring efforts, gave a brief overview of recent developments in this arena.

An important focal point of the last day was provided by our local hosts: Lisa Jach shared results from her investigations of interannual variability of land-atmosphere coupling in Europe, and Hans-Stefan Bauer provided highly informative visualizations indicating the power of large eddy simulations of the region surrounding the LAFO field site. This site is providing data that will be at the heart of the next phase (GA-



***Top left**: GLASS Meeting participants at the LAFO field site. **Top right**: meeting attendees are treated to a piano recital at Hohenheim Palace. **Bottom left**: GLASS Meeting participants. **Bottom right**: a closer look at LAFO field site instrumentation. Thanks to Arnoud Apituley for the top two and bottom right photos.*

BLS5) of the long-standing GEWEX Atmospheric Boundary Layer Study (GABLS) initiative, which gained great momentum during our Panel meeting, based on a discussion following the presentation by John Edwards, with inputs from Mike Ek and Volker. The Panel was enthusiastic about the idea of reviving the GABLS project to focus on boundary-layer turbulence and land-atmosphere interactions, making use of the detailed observations available from GLAFO and capitalizing on synergies with CLASP. Initial simulations of a diurnal cycle have been performed by modeling groups at the University of Hohenheim and the UK Met Office at convection-permitting and large eddy simulation (LES) resolutions over domains centered on the GLAFO site at Hohenheim. We intend to develop a definitive case over the coming year. In the longer term, we envisage extending the project to encompass other sites.

During the final part of the afternoon, we reflected on how GLASS has been steadily re-adjusting its course, e.g., through better representation of the carbon cycle (via projects such as SIF-MIP and recent appointments to the Panel) and by ensuring we consider the multi-faceted problem of modeling human intervention in the Earth system, together with the other GEWEX Panels and WCRP initiatives. We also touched upon the topic of how to best collaborate and interact with the recently-established International Land Modeling Forum (ILMF), which focuses on the technological challenges that land modeling centers face, and how they can share best practices (*https://hydro-jules.org/international-land-modeling-forum-ilmf*). The ILMF (led by Dave Lawrence and Eleanor Blyth) is growing, with over 200 members spanning most major land modeling groups and a wide range of expertise. The ILMF is hosting a series of webinars this fall to kick start international collaborative activities on (1) sharing modules across land models, (2) parameter estimation, and (3) integrating humans more deeply into next generation land models. During the final part of our GLASS meeting, we also discussed potential new initiatives. In this context, worthy of particular mention are a working group on alternatives to the Monin-Obukhov Similarity Theory (MOST), and closer collaborations with GDAP and GASS (via LS4P-II) on the use of (remotely sensed) land surface temperatures (LSTs) in the context of land model verification and development. As seen in the results of PLUMBER2 mentioned above, our models are struggling with the prediction of sensible heat flux, in which LST plays a dominant role. These discussions also inspired some of our propositions for GLASS (co-)chaired sessions at the 9th Global Energy and Water Exchanges Open Science Conference, in Sapporo, Japan, from 7–12 July, 2024.

As we closed out the meeting, the urgency of the climate crisis motivated our discussion as we considered how GLASS can continue to grow and diversify to make sure we keep honing our models and increasing our observational capabilities to meet the societal needs of this Anthropocene Era.

This GLASS meeting was Kirsten's final meeting as co-chair, so we convey our heartfelt thanks for her dedicated and inspired services throughout the past 5 years. Nate Chaney will be taking over as co-chair from 1 January 2024 onwards.