The 2024 GLASS Panel Meeting

6 July 2024
Sapporo, Japan

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GLASS Co-Chairs

On 6 July 2024, the Global Land-Atmosphere System Studies (GLASS) Panel convened at Hokkaido University in Sapporo, Japan, for its annual meeting. This one-day event focused on reviewing ongoing projects as well as discussing new directions and themes within the Panel.

The morning began with brief overviews from each GLASS project, emphasizing future directions and potential collaborations within GLASS and with other GEWEX Panels' initiatives, wider WCRP activities, as well as external activities. The projects discussed included the GEWEX Land/Atmosphere Feedback Observatory (GLAFO; led by Volker Wulfmeyer), the Solar Induced Fluorescence Model Intercomparison Project (SIF-MIP; led by Nicholas Parazoo), the Irrigation cross-cut (led by Patricia Parker and new co-lead Jacopo Dari; presented by Joshua Roundy), the International Land Model Benchmarking project (ILAMB; led by David Lawrence), the PALS Land Surface Model Benchmarking Evaluation Project, Phase 2 (PLUMBER 2; led by Gab Abramowitz), the Coupling of Land and Atmospheric Subgrid Parameterizations (CLASP; led by Nathaniel Chaney), the GEWEX Soil and Water Initiative (SoilWat; led by Yijian Zeng), and the Machine Learning for Land Modeling project (ML4LM; led by Souhail Boussetta).

A few highlights from the morning presentations and discussions included:

1. The new ML4LM project provides an exciting opportunity to galvanize the global land modeling community to leverage Machine Learning for improved process understanding, parameterization, and model development.

2. The recent PLUMBER 2 activities highlight the continued significant deficiencies in contemporary land surface models to accurately represent surface fluxes and provide strong arguments for a renewed focus on modeling surface fluxes and land-atmosphere coupling (Abramowitz et al., 2024).

3. The GLAFO initiative is considering a new site at Huancayo, Peru; a site in Africa is also desirable, but financing this site is a concern. The establishment of shared data screening and processing protocols across the GLAFOs is of key importance; there is also an interest in adding SIF measurements to GLAFO sites to help understand the role of the carbon cycle in land-atmosphere interactions.

4. CLASP is exploring the potential to leverage Doppler Lidar observations in GLAFO sites to measure heterogeneity-driven circulations to inform parameterization development.

Participants of the 2024 GLASS Panel Meeting

5. SoilWat is planning a 3rd joint meeting (largely invitation only) with the International Soil Modeling Consortium (ISMC) on improved soil modeling and soil parameter sets in land surface models (14–16 July 2025 at the University of Reading, UK) to coincide with the week of the next GLASS Panel meeting (16–18 July 2025, also in Reading).

6. Our Panel member Laura Condon attended briefly to summarize the aims of the first GEWEX Groundwater Workshop (led by Laura and Stefan Kollet) that took place concurrently on the same Hoikkado University premises. An overview of this overall effort can be found at *https://www.gewex.org/gewex-content/files_mf/1677625320Q12023.pdf* (*GEWEX Quarterly*, Vol. 33, No.1, Quarter 1 2023, pg. 5,6) and the summary of the workshop is presented in this newsletter.

7. The Panel needs to establish closer connections with the Earth System Modelling and Observations project (ESMO) and the Working Group on Numerical Experimentation (WGNE) to synergize our efforts.

During the second morning session, GLASS Co-chairs Anne Verhoef and Nathaniel Chaney provided an overview of the role of GLASS within GEWEX and the World Climate Research Program (WCRP) more generally; they also discussed potential interactions of GLASS with other GEWEX Panels and WCRP projects. The focus then turned to providing feedback from an internal GLASS Panel survey, conducted by the chairs, from earlier in the year to understand the strengths and weaknesses of the Panel and its international role. One of the key take-homes from those discussions included recognizing the key role that GLASS must continue to play towards encouraging the global community to focus on improving the modeling of surface fluxes and land-atmosphere interactions in land surface models; this point was the focus of the Panel's recent article in the second *GEWEX Quarterly* issue of 2024 (*https://www.gewex.org/gewex-content/uploads/2024/06/Q22024.pdf*). It also highlighted the importance of ensuring that the GLASS Panel is outward-look-

ing and seeks to facilitate regular interactions of the international al community of modelers, theoreticians, and experimentalists of land-atmosphere processes and their interactions.

The first afternoon session featured insights from Joshua Roundy and Yunyan Zhang, who shared their experiences with the operation of the GEWEX Hydroclimatology Panel (GHP), the GEWEX Data and Analysis Panel (GDAP), and the Global Atmospheric System Studies Panel (GASS) and related communities. Their contributions sparked discussions about establishing clearer short-term to mid-term priorities for GLASS and emphasized the importance of focusing on depth over breadth in initiatives. These discussions also highlighted opportunities for more formal engagement with the global community, including workshops on key topics identified as weaknesses in land-atmosphere modeling, such as Monin-Obukhov similarity theory, the poor representation of lateral advection in the atmospheric boundary layer in surface coupling schemes, the diurnal cycle, and a potential Pan-GLASS meeting in 2027.

The final session focused on emerging projects within the Panel, notably the next phase of the GEWEX Atmospheric Boundary Layer Study (GABLS). Led by John Edwards, this project aims to utilize Large Eddy Simulations and GLAFO measurements to advance our understanding of boundary layer processes in climate and weather prediction models. This project seeks to foster strong collaborations between CLASP, GLAFO, and SoilWat, particularly regarding the impact of soil and vegetation heterogeneity on boundary layer dynamics. Concluding discussions also considered a slight restructuring of GLASS projects into three thematic pillars: observations and benchmarking, process understanding, and model improvement. Ongoing and emerging projects would fall into one of the pillars or across multiple ones.

As the meeting was held immediately before the GEWEX Open Science Conference that the Panel members later attended, many of the discussions and topics were furthered throughout the week, including dinner on the evening after the GLASS Panel meeting and other activities culminating in the highlight of a karaoke night on Friday.

Finally, the Panel would like to give a special thanks to our host, Hokkaido University, which made the meeting proceed flawlessly whether it was through the technical support that we had throughout the entire event, the food and coffee breaks that were provided throughout the day, or the overall level of detail to ensure a successful meeting. We look forward to our gathering next year in Reading, UK.

References

Abramowitz, G., A. Ukkola, S. Hobeichi, J. Cranko Page, M. Lipson, M.G. De Kauwe, S. Green, C. Brenner, J. Frame, G. Nearing, M. Clark, M. Best, P. Anthoni, G. Arduini, S. Boussetta, S. Caldararu, K. Cho, M. Cuntz, D. Fairbairn, C. Ferguson, H. Kim, Y. Kim, J. Knauer, D. Lawrence, X. Luo, S. Malyshev, T. Nitta, J. Ogee, K. Oleson, C. Ottlé, P. Peylin, P. de Rosnay, H. Rumbold, B. Su, N. Vuichard, A.P. Walker, X. Wang-Faivre, Y. Wang, and Y. Zeng, 2024. On the predictability of turbulent fluxes from land: PLUMBER2 MIP experimental description and preliminary results. *Biogeosciences* 21(23):5517–5538. *https://doi.org/10.5194/egusphere-2023-3084*

ML4LM Webinar Series 2025

Coordinator: Dr. Souhail Boussetta, ECMWF

With the continuous improvement in computer science and high performance computing systems on one hand, and the availability of more accurate and frequent observations on the other hand, especially satellite-based ones, data-driven models, namely AI-based and machine learning models, are becoming more efficient and accurate in simulating the Earth system. These developments have opened a paradigm shift between considering physical-based models and data-driven ones, or even both combined in so-called hybrid systems.

Machine Learning for Land Modeling (ML4LM) aims at exploring the extent and the role that machine learning would play for better land surface studies, especially identifying the main areas where it could be applied and providing tools and data to the land surface modeling community. The ML4LM is a GEWEX project of the Global Land-Atmosphere System Study (GLASS) Panel. One of its activities includes a webinar series that gathers eminent scientists to share their experience in these combined fields. For the 2025 series, visit the webinar page at *https://www.gewex.org/project/ml4lm/2025-ml4lm-webinar-series/* for information on how to participate.

Date and Time (UTC)	Title and Presenter
20 January 2025 15:00 UTC	Advances in ML for Earth System Modeling *Dr. Peter Dueben, ECMWF*
20 February 2025 15:30 UTC	Towards Flexible Interfacing of ML with Land Models *Dr. David Lawrence, NCAR*
12 March 2025 09:30 UTC	ML for Benchmarking Land Models *Prof. Gab Abramowitz, UNSW*
3 April 2015 14:30 UTC	Advancing Predictive Understanding of Hydrological Systems through Trustworthy AI *Dr. Dan Lu, ORNL*
14 May 2025 13:30 UTC	Physically-Based Land Modeling & ML—What Are the Complementarities? *Prof. Christoph Rüdiger, ECMWF*
9 June 2025 14:30 UTC	Exploring the L-A Coupled System with ML *Prof. Pierre Gentine, LEAP-STC, U. Colombia*
9 July 2025 15:30 UTC	Hybrid Modeling for Land *Prof. Andrew Bennett, U. Arizona*
9 September 2025 13:30 UTC	On the Use of ML for Modeling Land Surface Dynamics *Prof. Nuno Carvalhais, Max Plank Institute*
15 October 2025 14:30 UTC	Machine Learning for Land Data Assimilation in Global NWP and Reanalysis Systems *Prof. Patricia de Rosnay, ECMWF*
12 November 2025 14:30 UTC	Physics Constrained ML which Benefits for Land Modeling *Dr. Paula Harder, Mila-Quebec*
10 December 2025 15:30 UTC	General discussion & future plans (1h:30) *All*