



*Global Energy and Water Cycle Exchanges Project*

# Global Land-Atmosphere System Studies (GLASS) Panel: Brief Update

Mike Ek and Kirsten Findell, GLASS co-chairs  
GLASS Panel Project Leaders

The 32<sup>nd</sup> Meeting of the GEWEX Scientific Steering Group  
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# GLASS Science Objectives and Activities

## ► Scientific Objectives of GLASS:

- To improve understanding of energy and water cycling on land and in the coupled land-atmosphere system; to improve representation of these processes in earth system models.

## ► Activities of GLASS:

- To facilitate and support international projects that use observations, process studies, and numerical model experiments to develop and improve the representation of the land and land-atmosphere system in climate models.
- At present, GLASS has 8 active projects, one project on hold, and one more in the pipeline.

# GLASS Panel Structure and Organization

## GLASS Panel Co-Chairs:

Michael Ek (USA), Kirsten Findell (USA)

## Member Project Leads:

Gab Abramowitz (Australia; PALS, PLUMBER2), Hyungjun Kim (Japan; GSWP3, LS3MIP), David Lawrence (USA; ILAMB, LUMIP), Joseph Santanello (USA; LoCo), Anne Verhoef (UK; SoilWat)

## Member Liasons to relevant initiatives:

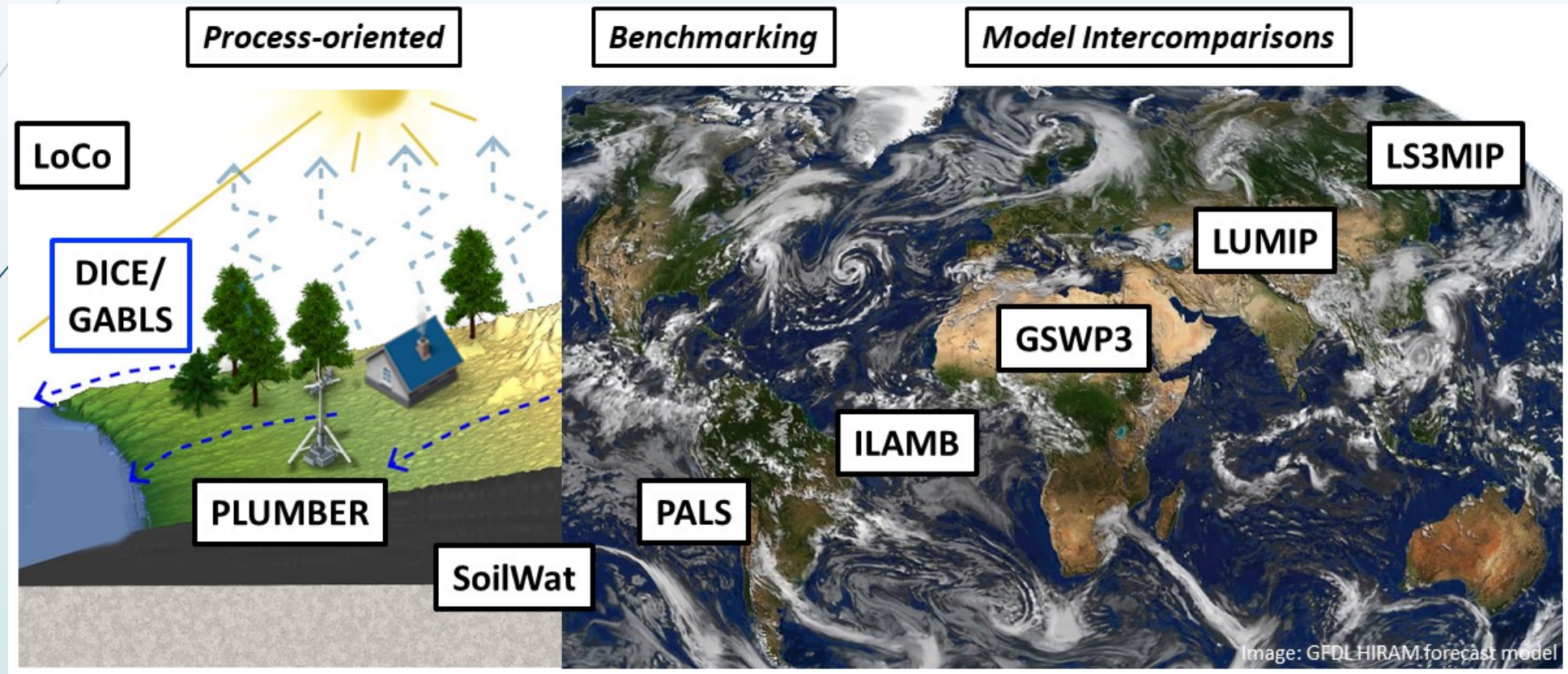
Eleanor Blyth (UK; iLEAPS), Paul Dirmeyer (USA; SSG, S2S), John Edwards (UK; GASS), Craig Ferguson (USA; GHP), Pere Quintana Segui (Spain; HYMEX)

## Members:

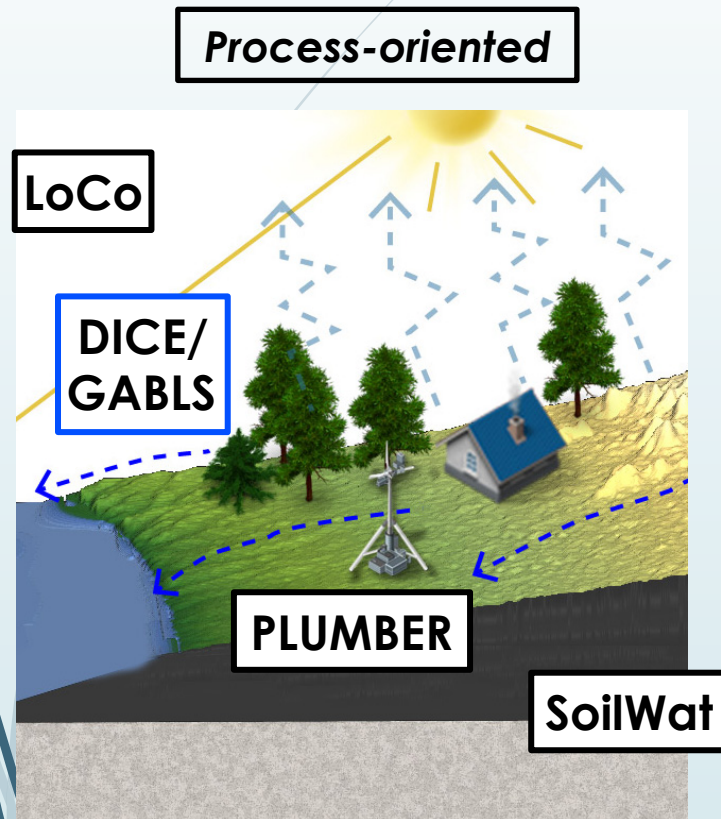
Souhail Boussetta (UK), Nathaniel Chaney (USA), Martyn Clark (Canada), Chiel van Heerwaarden\* (Netherlands), Samiro Khodayar Pardo (Spain), Sujay Kumar\* (USA), Aude Lemonsu (France), Joshua Roundy\* (USA), Kun Yang (China)

\* Joined prior to 2017

# GLASS Panel Projects: From process to global scale

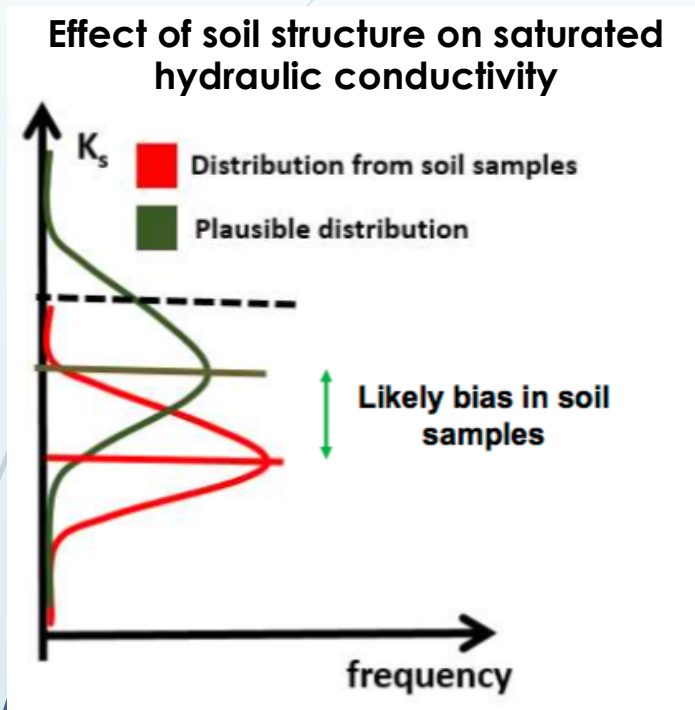


# Process-oriented projects



- ▶ **LoCo:** Local Coupling Working Group
  - ▶ Land-atmosphere interactions at local to regional (to global) scales
- ▶ **DICE/GABLS (joint with GASS):** Single-column atmospheric boundary layer model experiments
- ▶ **PLUMBER2:** The Protocol for the Analysis of Land Surface Models (PALS) Land Surface Model Benchmarking Evaluation Project, phase 2
  - ▶ Offline single-column land model experiments
- ▶ **SoilWat:** Soils and Subsurface processes
  - ▶ Understanding and improving representation of soil physics and groundwater transport in earth system models at local to global scales

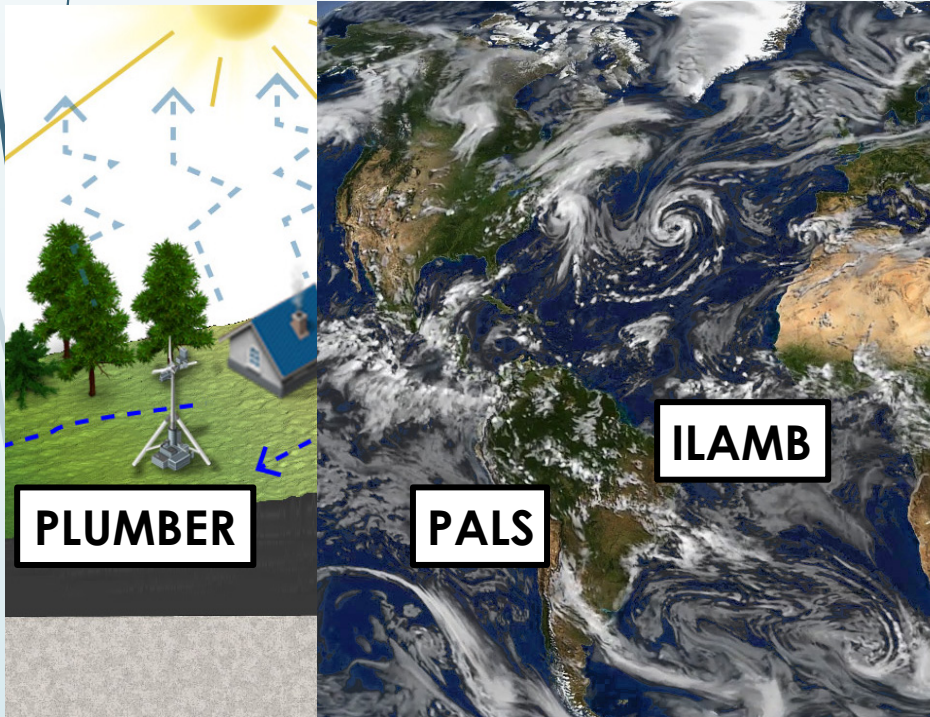
# GLASS Panel Key Result



- Does introducing soil-structure modify the hydrological and land-surface fluxes?
- Could soil structure affect large-scale climate?
- Soil structural effects, particularly introduced by vegetation (e.g., roots), strongly modify soil water content, infiltration rate and partitioning between fast surface runoff and deep recharge.
- **Conclusion: Small-scale soil structural features may have large-scale implications in water and carbon cycles and ultimately on climate.**

# Benchmarking Projects

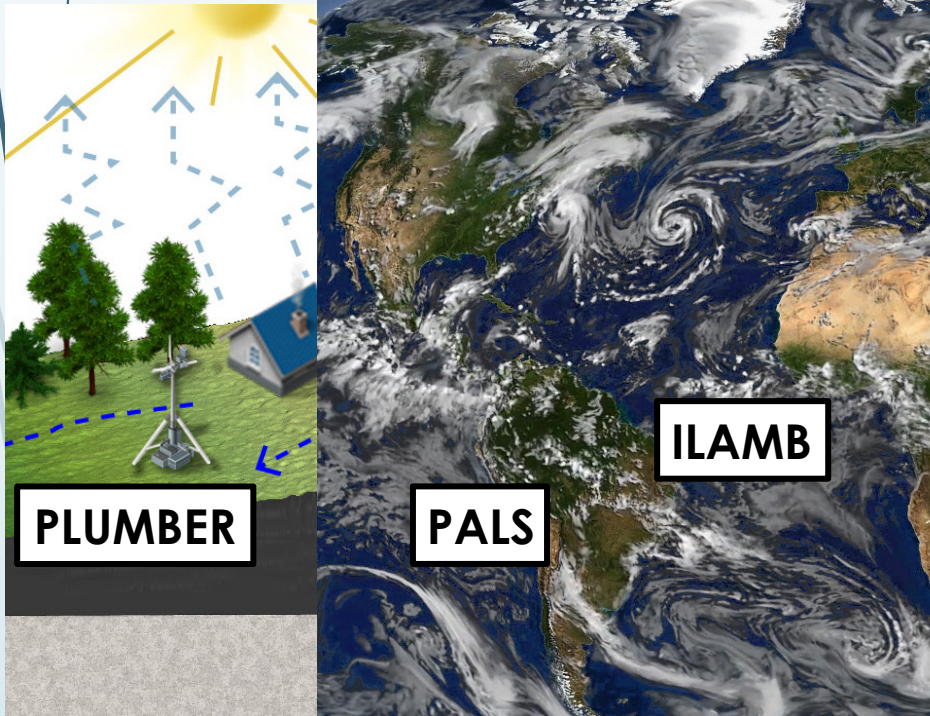
## Benchmarking



- ▶ **PLUMBER2:** Greatly expanded set of observational site locations; better QA/QC (still proceeding) including energy balance correction; improved empirical benchmarking models.
  - ▶ Surface hydrology, data assimilation, urban effects, and water-management efforts being incorporated into the PLUMBER initiative
  
- ▶ **PALS/[modevaluation.org](http://modevaluation.org):** Broader implementation of PLUMBER, web-based platform for benchmarking models against observations
  - ▶ Hosts experiments: forcing data is on web platform, users run experiments locally then upload simulations, me.org runs analysis routines to compare simulations to benchmarks and other models

# Benchmarking Projects

## Benchmarking

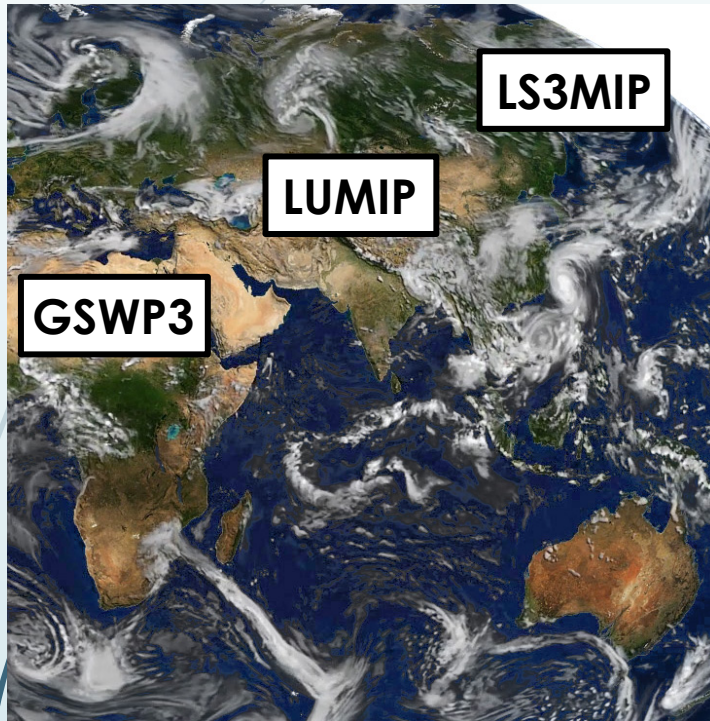


- ▶ **ILAMB:** International LAnd Model Benchmarking
  - ▶ Global benchmarking toolkit for climate model variables (seasonal to annual)
  - ▶ Model-data comparisons: consolidated location for datasets and diagnostics relevant to land and vegetation modeling communities
  - ▶ Documented in Collier et al. (2018); It is being used by several modeling centers and intercomparison projects and to analyze CMIP6 (vs CMIP5) models.



# Model Intercomparison Projects

## Model Intercomparisons



- ▶ **GSWP3:** Global Soil Wetness Project, phase 3
  - ▶ terrestrial modeling activity, produces a long-term land reanalysis and investigates changes of the energy-water-carbon cycles
- ▶ **LS3MIP:** Land Surface, Snow and Soil Moisture MIP
  - ▶ assess the performance of current land surface modules of earth system models and quantify land surface feedbacks in a changing climate
- ▶ **LUMIP:** Land Use MIP
  - ▶ understanding the impact of land use and land use change on climate

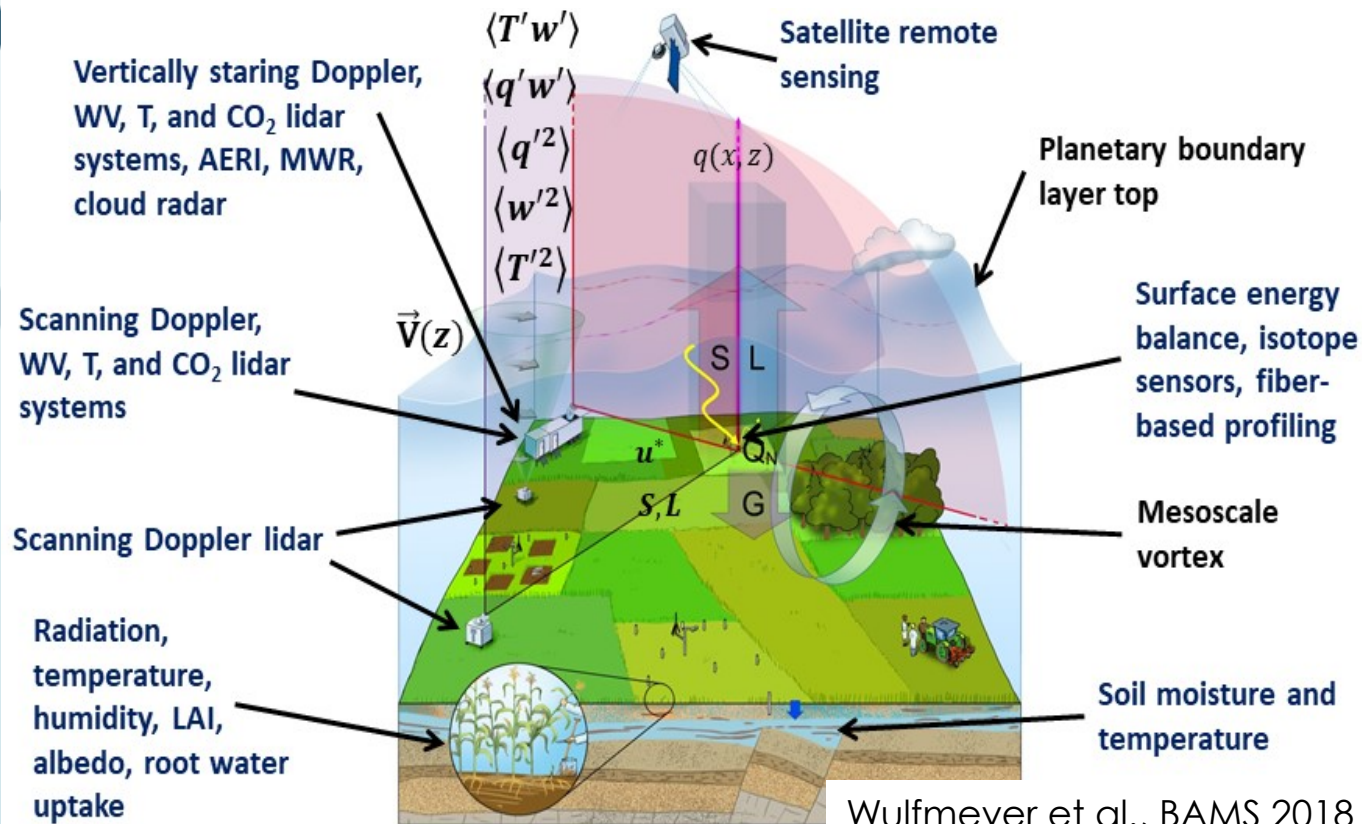
# Ongoing Initiatives: Closely tied to CMIP6 activities and timelines

- ▶ **GSWP3:** The forcing dataset has been finalized and is being distributed.
- ▶ **LS3MIP:** “land-hist” experiments have been completed by several groups; “land-future” experiments are underway. SSP126 and SSP585 were chosen to be projected future, and at least one each of GCMs will be selected from of low and high climate sensitivity groups.
- ▶ **LUMIP:** Simulations and analysis ongoing as part of the CMIP6 initiative.

# GLASS Proposal: GLAFOs

- **LoCo**: Continuing to promote the importance and development of improved observations of the land-atmosphere system, particularly in the planetary boundary layer.

## The Land-Atmosphere Feedback Experiment (LAFE)



- We propose the development and operation of multiple **GEWEX/GLASS Land-Atmosphere Feedback Observatories**
- These observatories should record long-term, high-frequency observations of soils, vegetation, surface fluxes and the planetary boundary layer.

# GLASS Proposal: GLAFOs

## LAFE Goals and Objectives

- 1) determine profiles of turbulent moments and fluxes and investigate new similarity relationships among gradients, variances, and fluxes.
- 2) map surface momentum, sensible heat, and latent heat fluxes using a synergy of scanning wind, humidity, and temperature lidar systems;
- 3) characterize L–A feedback and the moisture budget at the SGP site in dependence of different soil moisture regimes; and
- 4) verify LES and improve turbulence parameterizations in mesoscale models.

Wulfmeyer et al., BAMS 2018