

Global Land-Atmosphere System Study (GLASS) Update

Michael Ek (National Center for Atmospheric Research)

On behalf of the **GLASS panel** and **GLASS co-chairs Kirsten Findell** (NOAA GFDL) & **Anne Verhoef** (University of Reading), incoming GLASS co-chair **Nathaniel Chaney** (Duke University), and **Peter van Oevelen** (director, International GEWEX Program Office).

38th session of the Working Group on Numerical Experimentation (WGNE-38)

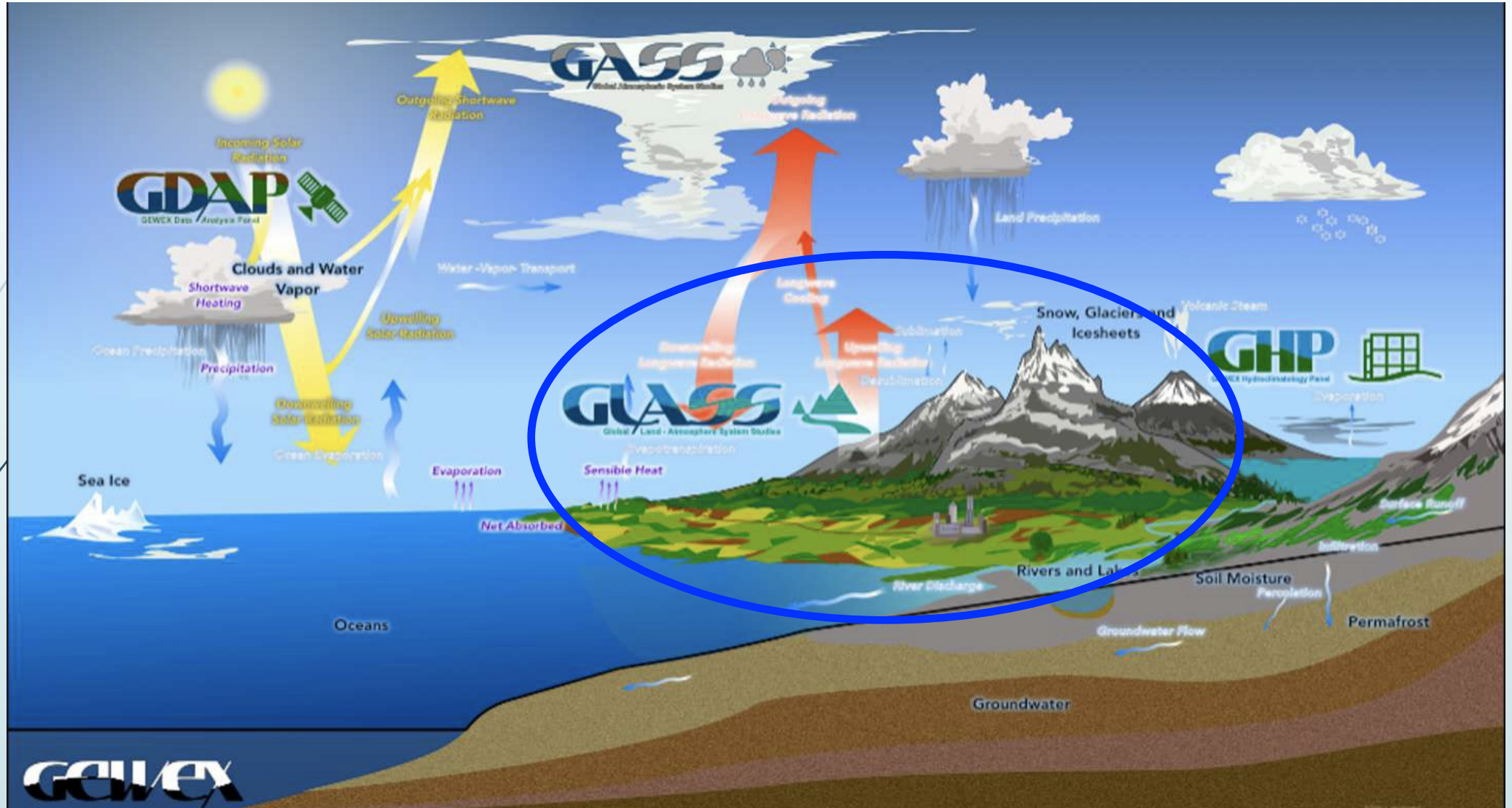
São José dos Campos, SP, Brazil, 27 November - 01 December 2023

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GEWEX's Four Panels

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- **GDAP:** GEWEX Data Analysis Panel
- **GASS:** Global Atmospheric System Studies
- **GLASS:** Global Land–Atmosphere System Studies
- **GHP:** GEWEX Hydroclimatology Panel

*Global Datasets Analysis and Assessments
 Atmospheric Processes - Dynamics
 Land Processes and Land-Atmosphere Interactions
 Regionally Focused Processes and Hydroclimate Projects*

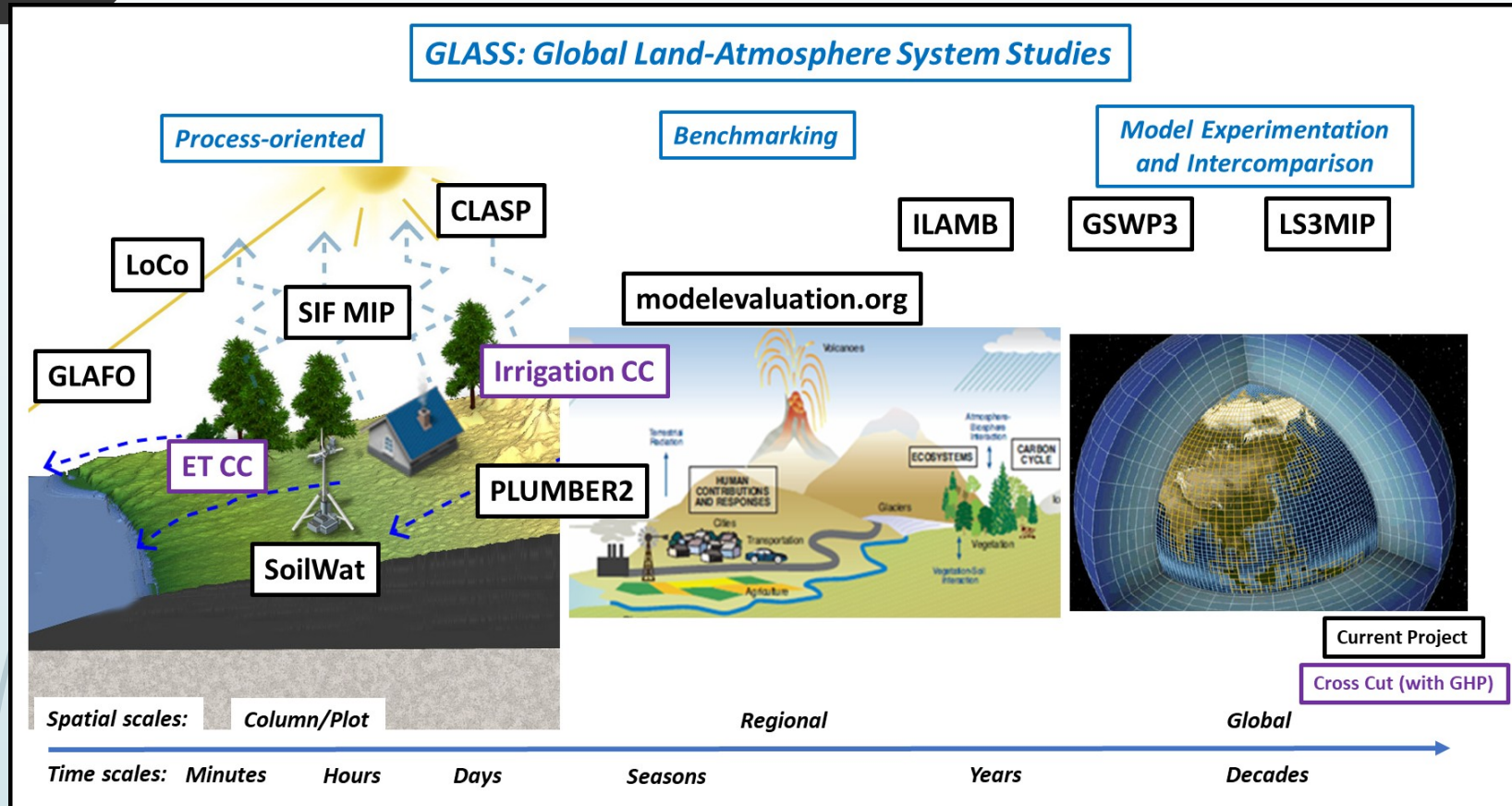


GLASS role in GEWEX:

- **The Global Energy and Water Cycle Exchanges Project (GEWEX)** is a core project in the **World Climate Research Programme (WCRP)**, where GEWEX is dedicated to *understanding Earth's water cycle and energy fluxes at and below the surface and in the atmosphere.*
- The **Global Land-Atmosphere System Study (GLASS)** Panel in GEWEX coordinates the evaluation and intercomparison of the new generation of land models and land-atmosphere interactions in Earth system models, and their applications to scientific queries of broad interest. Thus, a key objective of GLASS is ***model development and evaluation***, emphasizing ***process-level understanding and comparisons to observational benchmarking datasets***. Projects:
 - Energy and water fluxes, partitioning at the surface, interactions with the boundary layer (relevant collaborations with GASS).
 - Linkage w/soil physics & hydraulics, groundwater, wetlands, cryosphere, flooding.
 - Linkage with the carbon cycle: vegetation phenology, vegetation dynamics, carbon allocation, plant hydraulics.
 - Anthropogenic influences on these cycles: irrigation; urbanization, human water management (dams & reservoirs, irrigation, water extraction); crop selection; fertilization, tillage and cultivation choices; mixed agroforest systems; etc.

GLASS Panel Projects: From column to global scale

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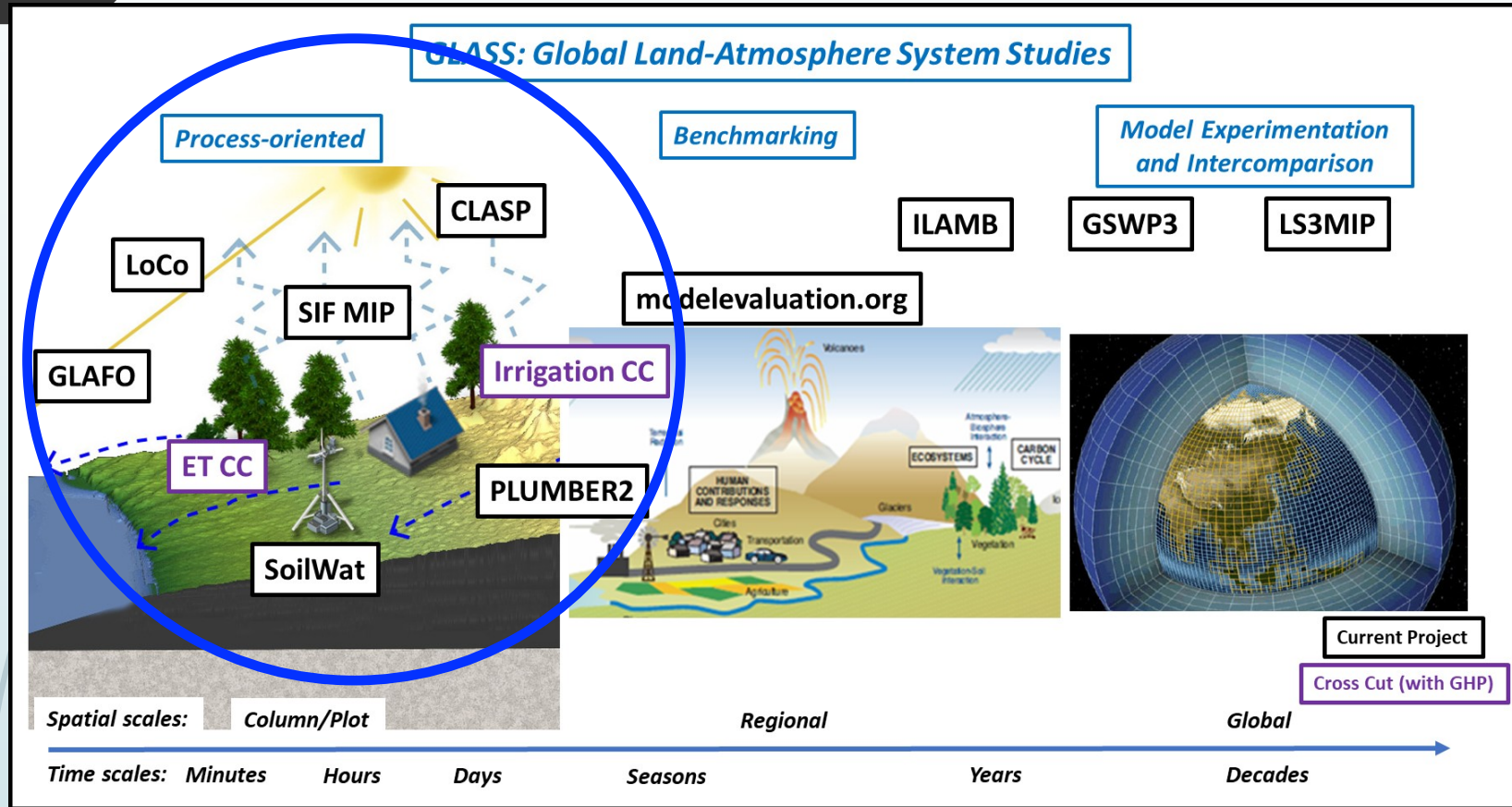
- **LoCo: Local Coupling Working Group.**
- **GLAFO: GEWEX/GLASS Land-Atmosphere Feedback Observatories.**
- **SIFMIP: Solar-Induced Fluorescence MIP.**
- **CLASP: Coupling of Land and Atmospheric Sub-grid Parameterizations.**
- **SoilWat: Soils and Subsurface processes.**
- **PLUMBER2: The Protocol for the Analysis of Land Surface Models (PALS) Land Surface Model Benchmarking Evaluation Project, phase 2.**
- **Cross Cut (CC): projects with GEWEX/GHP on Irrigation and on Evapotranspiration and Irrigation.**

- **ILAMB:** International LAND Model Benchmarking
- **Modevaluation.org:** web application for evaluating and benchmarking computational models.
- **GSWP3:** Global Soil Wetness Project, phase 3
- **LS3MIP:** Land Surface, Snow and Soil Moisture MIP

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WGNE-relevant: Process-oriented GLASS projects

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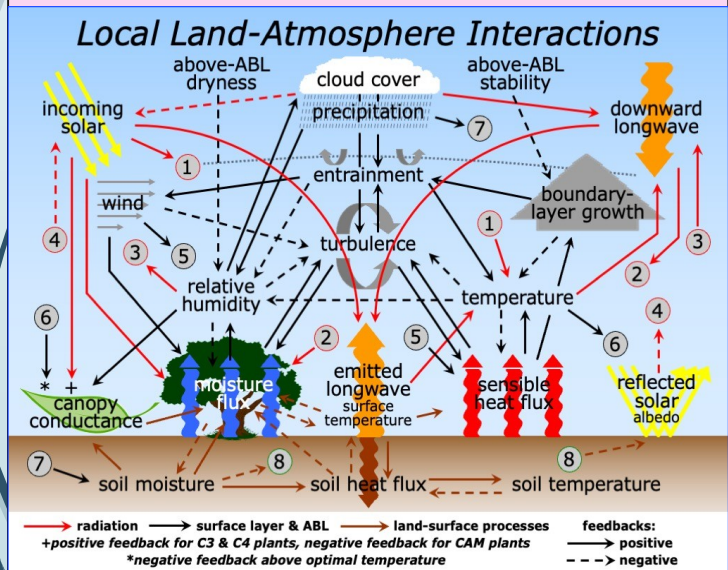
WGNE-relevant: LoCo, GLAFO, CLASP

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LoCo

Local Land-Atmosphere Coupling (LoCo) Project:

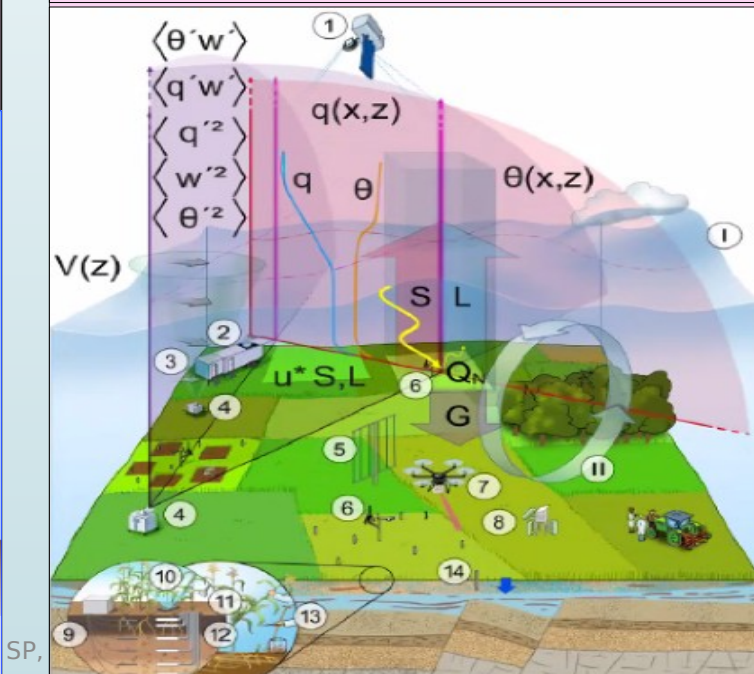
- Understand, quantify, model, and predict the role of local land-atmosphere coupling in the evolution of land-atmosphere fluxes and state variables and the respective water and energy cycles, including clouds.



GLAFO

GEWEX Land/Atmosphere Feedback Observatory:

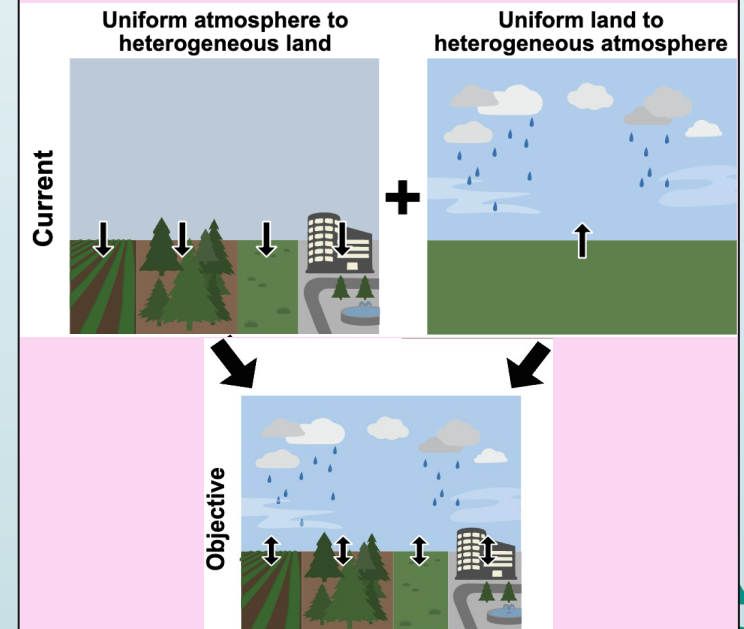
- Understand land-atmosphere feedbacks over different large-scale forcing regimes and characterize coupling strength with observation of surface, PBL and entrainment fluxes.



CLASP

Coupling of Land and Atmospheric Subgrid Parameterizations:

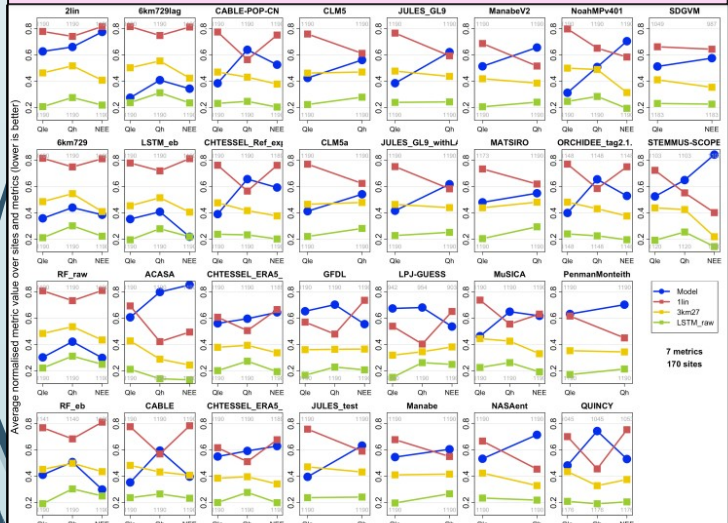
- Enable interaction between “tiling” approach over land and existing atmospheric sub-grid schemes. Moves beyond the uniform land and atmosphere assumptions. Modeling & obs.



PLUMBE

Protocol for the Analysis of Land Surface models (PALS) Land Surface Model Benchmarking Evaluation Project, Phase 2:

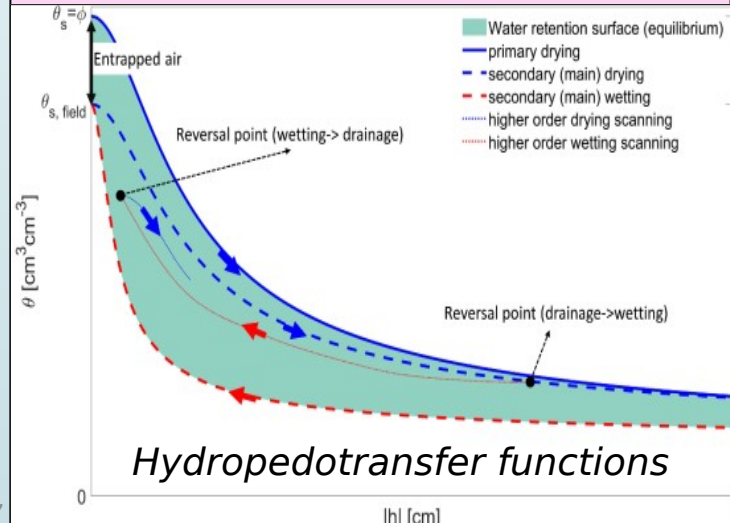
- Comparison of multiple land models with 170 Fluxnet sites. Focus on surface fluxes and net ecosystem exchange compared with empirical models--which still win the "beauty" contest!



SoilWA

Soil-Water in Earth System Models:

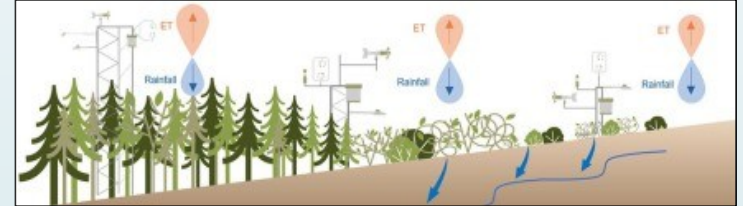
- Understand and improve soil hydraulic and thermodynamic processes, and soil-plant representation in Earth system models. "Soil-Cloud Cascade" connections with LoCo, CLASP. Improve soils data sets. A joint project between with GEWEX & Int'l Soil Modeling Consortium.



dET

Determining Evapotranspiration (dET):

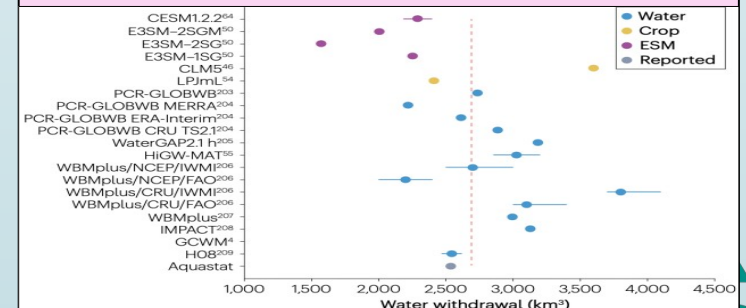
- Key term in Earth's water and energy budgets. Evaluate ET schemes and observations.



Irrigation CC

Irrigation representation in Earth system models:

- Global irrigation withdrawals.



GLASS discussion topics (August 2023 mtg

#1): ● Initiate and nurture synergies with:

● WCRP Lighthouse Activities (LHAs):

- **Explaining and Predicting Earth System Change (EPESC):** e.g. on summer circulation and heatwaves, with SoilWat-S2S soil moisture/temp memory.
- **Digital Earths:** Collaboration on **high-resolution land modeling, urban modeling.** Potential new initiative on 'actionable-ready' LSMs for holistic interactive adaptation and mitigation ES modelling.
- **Safe Landing Climates:** Opportunities with water working groups in WCRP.

● **WGNE, WWRP:**

● **WGNE:**

- **Continue to provide input at the process level on: land-hydrology modeling and land-atmosphere interaction in weather and climate models.**
- **Surface Flux Intercomparison project.** Land phase?
- **Model Uncertainty Model Intercomparison Project (MUMIP).** Multi-institute joint effort (including NCAR) using Single Column Models (SCMs). Move from current phase over ocean to over land? Again using SCMs.
- **Systematic Errors** attributable to land (hydrology) & land-atmosphere interactions.

GLASS discussion topics (August 2023 mtg

- #2):**
- Sunsetting of **GSWP3** and **LS3PMIP**; a need for follow-on initiatives?
 - Expand **Cross-Cut projects with GHP: groundwater, surface water, floods, irrigation.**
 - Joint 'model observables' initiative with **GDAP**? Could focus on **land surface temperatures** & effect of soil property maps (link to SP-MIP SoilWat, S2S, LS4P-II, CAUSES <https://portal.nersc.gov/project/capt/CAUSES/>).
 - Role of GLASS in the **International Land Modelling Forum.**

Addition topic areas:

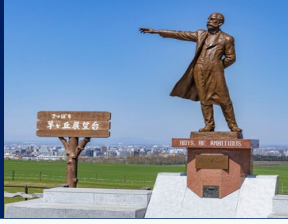
- Cryosphere, permafrost.
- Vegetation-related efforts: do we need a companion to SIF-MIP?
- Ecosystem functioning.
- Agricultural management and crop yield.
- Bio-geoengineering, e.g. WCRP Climate Intervention Lighthouse

See: GLASS webpages on the GEWEX website:

<https://www.gewex.org/panels/global-landatmosphere-system-study-panel/>



9th The Global Energy and Water Exchanges Open Scientific Conference



Water

水

Climat

気候



7-12 July 2024
Sapporo, Japan

Keio Plaza
Hotel



Join us in beautiful Sapporo, Japan, to address the challenges facing humanity in terms of freshwater availability and associated disaster risk reduction and the sustainable development in the context of climate

GLASS-related topics with WGNE relevance:

- Water cycle and precipitation extremes.
- Water and climate research for sustainable society.
- Coupled water, energy, and carbon cycles.
- Anthropogenic effect on water cycles.
- Disaster risk reduction and water solutions.

<https://www.gewexevents.org/meetings/gewex-osc2024/>

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GEWEX
The Global Energy and
Water Exchanges
Program



Thank you!