

## GLASS Panel Reports for the 32nd GEWEX SSG Meeting 2020

**Full Panel Name (Acronym)** : Global Land/Atmosphere System Study Panel  
**Reporting Period** : 01 January - 31 December 2019  
**Starting Date** : NA  
**End Date (where appropriate)** : NA  
**URL** : <https://www.gewex.org/panels/global-landatmosphere-system-study-panel/>

### Membership

**Chair(s) and Term Dates** : Mike Ek, 2015 - Present (member 2009 - Present)  
Kirsten Findell, 2019 - Present (member 2018 - Present)

**Members and Term Dates** : \*Gab Abramowitz, 2008 - Present  
^Eleanor Blyth, 2011 - Present  
Souhail Boussetta, 2018 - Present  
Nathaniel Chaney, 2019 - Present  
Martyn Clark, 2017 - Present  
^Paul Dirmeyer, 2000 - Present  
^John Edwards, 2014 - Present  
^Craig Ferguson, 2011 - Present  
Chiel van Heerwaarden, 2012 - Present  
Samiro Khodayar Pardo, 2019 - Present  
\*Hyungjun Kim, 2010 - Present  
Sujay Kumar, 2015 - Present  
\*David Lawrence, 2014 - Present  
Aude Lemonsu, 2017 - Present  
^Pere Quintana Seguí, 2017 - Present  
Joshua Roundy, 2016 - Present  
\*Joseph Santanello, 2011 - Present  
\*Anne Verhoef, 2018 - Present  
Kun Yang, 2017 - Present  
\* *GLASS Project Lead*  
^ *GLASS Liason to relevant initiative*

### Panel Objectives, Goals and Accomplishments during Reporting Period

#### Overall Panel Objective(s)

- Encouragement of land modeling developments by coordinating the evaluation and intercomparison of the new generation of land models and their applications to scientific queries of broad interest, including the proper representation of land-atmosphere interactions with focus on the role of land.
- To develop a protocol for evaluating experiments to address the central question, "Does my land model describe the processes in the climate system sufficiently well?"
- To develop an optimal system to create global land data sets in which information is extracted from both land models and sophisticated observations.
- To estimate the contribution of memory in the land system to the overall predictability of regional atmospheric phenomena at seasonal time scales.

## List of Panel Goals

### *Adjust yearly*

- SoilWat: Improve the understanding and representation of soil physics and groundwater flows in land and climate models. Processes and parameters of interest include hydraulic pedotransfer functions (PTFs), thermal PTFs, the impact of different PTFs on the water and energy balance, the impact of soil structure on surface evaporation, the viability of using vegetation characteristics as a surrogate for soil structure.
- PLUMBER: Prepare quality-controlled data and launch PLUMBER2 experiment for 200-300 FLUXNET site locations.
- PALS/modevaluation.org: Provide a simple-to-use workflow environment to allow the land model community to gauge model performance against a suite of standard reference tests at a variety of temporal and spatial scales and for a variety of process representations.
- ILAMB: Expand the suite of datasets incorporated into ILAMB; expand the usage and utility of the ILAMB suite of diagnostics; develop methods to incorporate uncertainty; apply ILAMB diagnostics to CMIP6 output.
- LUMIP: Coordinate multi-model assessment of the impacts of land use and land cover change (LULCC) as part of CMIP6. Develop metrics for assessment of model skill in simulating impacts of LULCC on climate and biogeochemical cycles.
- LoCo: Promote the importance and development of improved observations of the land-PBL system; pursue the adoption of LoCo metrics by operational NWP and climate centers; expand the reach of LoCo techniques and processes beyond warm season and 1-D column assumptions.
- GSWP3: Produce updated forcing for land experiments for LS3MIP.
- LS3MIP: Begin land-hist experiments.

## List of Key Results

### *Adjust yearly with respect to goals*

- Soil structure and PTFs: Simone Fatichi, Dani Or, Robert Walko, Harry Vereecken, Michael Young, Teamrat Ghezzehei, Tomislav Hengl, Stefan Kollet, Nurit Agam, Roni Avissar; Soil structure: an important omission in Earth System Models; Accepted by Nature Communications.
- PLUMBER2 and PLUMBER-Urban are underway, hosted by modevaluation.org.
- ILAMB used to assess CMIP6 models; found a general and broad improvement in models that participated in both CMIP5 and CMIP6.
- Land-use Harmonization version 2 (historical and future land use change scenarios for use by all CMIP6 modeling groups) completed. Paper is under review.
- LoCo: Successful field campaigns with increased instrumentation focused on the PBL has led to an effort to push for GEWEX/GLASS Land-Atmosphere Feedback Observatories (GLAFOs) with a common set of instruments collecting consistent, long-term observations at climatologically diverse locations.
- GSWP3: forcing for LS3MIP's EXP1 (land-hist) has been updated and EXP2 (land-future) is in beta version. Simulations are underway.

## Other Science Highlights

### *Not part of the 2-3 major accomplishments*

- The global pattern of changes in dry season water availability is extremely likely influenced by human-induced greenhouse gas emissions. (Padrón et al, submitted).

## Panel Activities during Reporting Period

### List of Panel Activities and Main Result

- SoilWat: Multiple survey projects investigating the scope of process representation in land models
- PLUMBER: QA/QC on land forcing data from 200-300 FLUXNET sites is nearing completion, including energy balance correction.

- PALS: Has been relaunched as modevaluation.org: a web-based platform that is more versatile and no longer limited to land models. Hosted the PLUMBER-MIP; PLUMBER2 and PLUMBER-Urban are underway.
- ILAMB widely utilized.
- LUMIP Workshop at Aspen Global Change Institute in September 2019 was productive; progress and plans for more than 20 manuscripts were discussed.
- GSWP3 and LS3MIP: Updated naming conventions for land variables for ALAM/GLASS and cf-convention. Modeling groups have begun testing and running land-hist and LFMIP simulations.

#### **List of New Projects and Activities in Place and Main Objective(s)**

- The NOAA-DOE Climate Process Team (CPT) on Coupling Land and Atmospheric Subgrid Parameterizations (CLASP) has begun work at multiple institutions. The goal is to understand how improved communication of heterogeneity from the land model to the atmospheric model influences boundary layer processes and the development of convection within climate models.

#### **List of New Projects and Activities Being Planned, including Main Objective(s) and Timeline, Lead(s)**

- LIAISE (Aaron Boone, Martin Best, et al). Summer 2020 Iberian Peninsula campaign that will be focused on land-atmosphere (L-A) interactions, including surface (soil moisture, surface fluxes) and atmospheric (PBL) observations, aircraft, and ground measurements. Also contains an anthropocene (irrigation) component. This project should have (will have) broad GEWEX participation.
- The NASA PBL Incubation Study Team selections were made and include Joe Santanello. There will be a community PBL Workshop sometime in mid-late May in DC or JPL hosted by this Study team but open to the whole community to help steer the effort.

## **Science Issues and Collaboration during Reporting Period**

### **Contributions to Developing GEWEX Science and the GEWEX Imperatives.**

#### **a. Data Sets**

- Quality-controlled land model forcing data for 200-300 FLUXNET sites.
- Use of GEWEX-supported datasets in ILAMB.
- Land use change datasets developed for LUMIP.
- GSWP3-EXP1 and EXP2 forcing data.

#### **b. Analysis**

- LUMIP: Wide range of analysis projects on impacts of land cover and land use change on climate and biogeochemistry.
- Observed changes in dry season water availability attributed to human-induced climate change.

#### **c. Processes**

- Improved understanding of land processes, land-atmosphere coupling and impacts on climate and weather.

#### **d. Modeling**

- Land model process improvements stems from work on all the GLASS projects.
- Many GLASS projects are closely tied to CMIP6 modeling work.

#### **e. Application**

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#### **f. Technology Transfer**

- ILAMB, PALS/modevaluation.org and LoCo's land-atmosphere coupling metrics

#### **g. Capacity Building**

- LoCo WG has many early career scientist working on land-atmosphere interaction issues.

## List contributions to the GEWEX Science Questions and plans to include these.

### a. Observations and Predictions of Precipitation

- Improved land-based process representation and land-atmosphere feedbacks in models will ultimately lead to better prediction of precipitation.
- LFMIP experiment will show how variability of soil-moisture and snow are coupled with regional precipitation.

### b. Global Water Resource Systems

- GSWP3-EXP1 & EXP2 (land-hist & land-fut of LS3MIP) will provide long-term changes of water availability globally.

### c. Changes in Extremes

- GSWP3-EXP1 & EXP2 (land-hist & land-fut of LS3MIP) will provide a large simulation set to be used for extreme analysis on various terrestrial hydrology variables.
- LS3MIP will provide a large simulation set to be used for extreme analysis on various terrestrial hydrology variables.

### d. Water and Energy Cycles

- Better representation of land processes and land-atmosphere interaction improves water and energy treatment in models.
- GSWP3-EXP1 & EXP2 (land-hist & land-fut of LS3MIP) will depict a century long water and energy balance in global scale.

## Other Key Science Questions

List 1 – 3 suggestion that you anticipate your community would want to tackle in the next 5-10 years within the context of a land-atmosphere project

- The role of soil evaporation in the climate system and how to model it reliably.
- Incorporation of land-atmosphere coupling diagnostics into ILAMB.
- Incorporation of all forms of land management in models.
- The impact of human interventions (e.g., groundwater pumping, irrigation) on surface energy and water cycles.
- The impact of groundwater on climate variability.

## Contributions to WCRP including Current Grand Challenges

Briefly list any specific areas of your panel's activities in particular to the grand challenges "Extremes" and "Water for the Food Baskets" which is not covered under 2.

- Many GLASS projects (e.g., LUMIP, GSWP3, LoCo) are interested in impacts of agricultural activities on climate as well as vulnerabilities of agriculture due to climate change.

## Cooperation with other WCRP Projects, Outside Bodies and links to applications

e.g. CLIVAR, CliC, SPARC, Future Earth, etc.

- Many GLASS projects are strongly linked with CMIP6 efforts.
- GSWP3 and LS3MIP cooperate with CliC.

## Workshops and Meetings

### List of Workshops and Meetings Held in 2019

Meeting title, dates and location

- 2019 GLASS Panel Meeting, 6-8 August, Boulder (CO), USA
- LUMIP Workshop at Aspen Global Change Institute, September 2019

### List of Workshops and Meetings Planned in 2020 and 2021

Meeting title, dates and location and anticipated travel support needs

- Sessions at EGU, AGU and at the PAN-GEWEX meeting
- Land Modeling Summit planned for September 2020 will have strong GLASS representation
- HESS5, June 15-19, 2020, Saskatchewan, Canada

## Other Meetings Attended On Behalf of GEWEX or Panel in 2019

- GEWEX evaporation workshop that took place from 8-10 October in Sydney, Australia (organised by Joan Cuxart, Toby Marthews, Jason Evans and Anne Verhoef. Attended by Or and Verhoef.
- AMS and AGU sessions on PBL from Space both led by Santanello and others.
- NASA Planetary Boundary Layer Incubation Community Forum Townhall meeting at AGU Fall 2019 meeting attended by Santanello and others.

## Publications during Reporting Period

### List of Key Publications

- Simone Fatichi, Dani Or, Robert Walko, Harry Vereecken, Michael Young, Teamrat Ghezzehei, Tomislav Hengl, Stefan Kollet, Nurit Agam, Roni Avissar; Soil structure: an important omission in Earth System Models; Accepted by Nature Communications
- Tafasca, S., Ducharne, A., and Valentin, C.: Weak sensitivity of the terrestrial water budget to global soil texture maps in the ORCHIDEE land surface model, *Hydrol. Earth Syst. Sci. Discuss.*, <https://doi.org/10.5194/hess-2019-305>, in review, 2019.
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- Bosman, P., C. van Heerwaarden, and A. Teuling. (2019). Sensible heating as a potential mechanism for enhanced cloud formation over temperate forest. *Quarterly Journal of the Royal Meteorological Society*, 145(719), 450–468. <https://doi.org/10.1002/qj.3441>
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- Campbell, M., C. R. Ferguson, \*D. A. Burrows and L. Bosart, 2019, Potential effects of regional soil moisture anomalies on the Great Plains low-level jet, *Mon. Wea. Rev.*, under minor revision.
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- Observations and Field Campaigns:
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- Reyer, C., R. S. Gonzalez, K. Dolos, F. Hartig, Y. Hauf, M. Noack, P. Lasch-Born, T. Rötzer, H. Pretzsch, H. Mesenburg, S. Fleck, M. Wagner, A. Bolte, T. G.M. Sanders, P. Kolari, A. Mäkelä, T. Vesala, I. Mammarella, J. Pumpanen, A. Collalti, C. Trotta, G. Matteucci, E. D'Andrea, L. Foltýnová, J. Krejza, A. Ibrom, K. Pilegaard, D. Loustau, J.-M. Bonnefond, P. Berbigier, D. Picart, S. Lafont, M. Dietze, D. Cameron, M. Vieno, H. Tian, A. Palacios-Orueta, V. Cicuendez, L. Recuero, K. Wiese, M. Büchner, S. Lange, J. Volkholz, H. Kim, G. P. Weedon, J. Sheffield, I. V. del Valle, F. Suckow, J. A. Horemans, S. Martel, F. Bohn, J. Steinkamp, A. Chikalanov, M. Mahnken, M. Gutsch, and K. Frieler (\_\_\_\_) The PROFOUND database for evaluating vegetation models and simulating climate impacts on forests, *ESSD*, submitted