

GLASS Panel Reports for the 31th GEWEX SSG Meeting 2019

Full Panel Name (Acronym) : Global Land/Atmosphere System Study Panel
Reporting Period : 01 January - 31 December 2018
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, ??
Souhail Boussetta, 2018 - Present
Nathan Brunsell, ??
Martyn Clark, 2017 - Present
Paul Dirmeyer, 2000 - Present
John Edwards, 2014 - Present
Craig Ferguson, 2011 - Present
Pierre Gentine, 2015 - Present
Chiel van Heerwaarden, ??
Hyungjun Kim, ??
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
Tomo Yamada, ??
Kun Yang, 2017 - Present

Panel Objectives, Goals and Accomplishments during Reporting Period

Overall Panel Objective(s)

- Encouragement of Land-surface modeling developments by coordinating the evaluation and intercomparison of the new generation of Land Surface Schemes (LSSs) 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-surface model describe the processes in the climate system sufficiently well?"
- To develop an optimal system to create global land-surface data sets in which information is extracted from both land-surface 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

- To advance the evaluation and representation of land surface models from component/process level (e.g., soil hydraulic functions, surface flux partitioning, etc.) to land-atmosphere coupling and fully integrated behavior within general circulation and earth system models.
- To advance the understanding of the role of land in earth system models from weather to climate time scales via model intercomparisons.

List of Key Results

Adjust yearly with respect to goals

- Model intercomparison projects are largely on the CMIP6 analysis cycle. PLUMBER2, PALS, LUMIP, ILAMB, LS3MIP, and GSWP-3 all improved their platforms, protocols, and forcing datasets in anticipation of the extensive analysis cycle expected in 2019.
- SoilWat was very active, with major assessments of model treatment of numerous individual processes.
- LoCo saw the publication of a BAMS article summarize the first decade of work developing a process-level paradigm for understanding land-atmosphere interactions. The topic has moved center-stage in many modeling centers and funding agencies, suggesting that the years ahead will see substantial focus on representation of land-atmosphere interactions during the model development process.

Other Science Highlights

Not part of the 2-3 major accomplishments

-

Panel Activities during Reporting Period

List of Panel Activities and Main Result

- SoilWat: Comprehensive papers on treatment of (1) infiltration, (2) surface evaporative capacitance, and (3) bare-soil evaporation in modern land surface models
- PLUMBER2: Protocol drafted. Site data for ~200 locations passed QC requirements.
- PALS: modevaluation.org web portal prepared to host and upload data and analyses. The new site has a much more flexible structure that is no longer specific to LSMs. Successfully incorporated ILAMB as an analysis package within modevaluation.org.
- LoCo: Published a LoCo overview article in BAMS (July 2018), after a ~decade of work in developing a process-level paradigm and suite of metrics for integrative analysis. Land-atmosphere interactions and application of LoCo-style metrics made prominent appearances in multiple proposal calls from funding agencies.
- LUMIP: Production of full set of historical and future land use trajectories. Three historical datasets estimates (low, medium, high) years 850 to 2014; Eight future trajectories spanning all the Tier 1 and Tier 2 ScenarioMIP scenarios.
- ILAMB: Overview paper published describing the ILAMB project. An additional paper published describing application of ILAMB to CLM assessment.
- LS3MIP: Preparing experiment protocol, data request and forcing data for the CMIP6 analysis cycle.
- GSWP-3: Improved forcing datasets. Preparing for CMIP6 cycle.

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

- SoilWat: Determination of global thermal properties from soil texture and mineralogy data. Completion of assessment of treatment of groundwater in global hydrological/climate models. Development of (1) new generation PTFs using vegetation attributes to inject soil structure into soil hydraulic properties including infiltration response at different scales and (2) new methods for imposing additional physical constraints on soil hydraulic parameters estimation.

- PLUMBER2: This second phase of the PLUMBER experiment will kick off in 2019 using the new modevaluation.org web portal.
- PALS/modevaluation.org: Process and host full suite of FLUXNET2015, La Thuile and OzFlux site data.
- LoCo: GRAINEX field campaign held in Summer 2018 over Nebraska, focused on impact of irrigation on L-A interactions. Over 70 in-situ soil moisture probes and met data, 12 flux towers, and 2 profilers along with enhanced sondes were conducted during 2 IOPs over irrigation and non-irrigated regions. NASA also flew the GREX (L-band) instrument during IOP2 (July) for high resolution transects of soil moisture. Modeling and analysis studies are underway and the data is available to the public at: https://data.eol.ucar.edu/master_list/?project=GRAINEX
- LUMIP: Analysis projects in cycle with the CMIP6 timeframe to understand the effects of LULCC on climate and biogeochemical cycling (past-future), the impacts of land management on surface fluxes of carbon, water, and energy, and the potential for land-management strategies with promise to help mitigate the impacts of climate change.
- ILAMB: Formulation of metrics related to the diurnal cycle. Improved techniques accounting for uncertainty in observations.
- LS3MIP: Analysis projects in cycle with the CMIP6 timeframe to assess the performance of current land surface modules within Earth System Models and quantify land surface feedbacks in a changing climate.
- GSWP3: Working with LS3MIP modeling groups to produce a century-long comprehensive and extensive set of quantities for hydro-energy-eco systems on 0.5 degree grids.

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

- LoCo: LIAISE (Aaron Boone, Martin Best) - Summer 2020 Iberian Peninsula campaign focused on L-A interactions, including surface (SM, flux) and atmospheric (PBL) observations, aircraft, and ground measurements. Also contains an anthropocene (irrigation) component.
- LoCo: Organization of Tropical East Pacific Convection (OTREC) field campaign (Ben Lintner): The goal of OTREC is to understand the formation of tropical convective clouds and rainfall over the southwestern Caribbean and eastern Pacific. Comprehensive observations and measurements during OTREC (in August-September 2019) will be obtained, and of particular relevance to LoCo, a principal aim of the coordinated radiosonde launches and GNSS column water vapor retrievals is to understand how the Central American landmass modifies tropical waves and associated convection propagating from the Caribbean to the eastern Pacific. (Lintner participating in this NSF-funded effort, on a project led by PI Yolande Serra [U. Washington] and in collaboration Dave Adams [UNAM], Ana Maria Duran Quesada [U. Costa Rica], and Marcial Garbanzo [U. Costa Rica])
- LoCo: Ruisdael Observatory - Wageningen (Chiel van Heerwaarden) - 100m resolution network over Netherlands to improve L-A understanding and weather prediction: <https://www.wur.nl/en/newsarticle/Ruisdael-Observatorium-Ruisdael-Observatory-will-model-the-Dutch-atmosphere-with-a-resolution-of-100-metres.htm>
- LoCo: LAFO (U. Hohenheim; Volker) Observatory - April 2019: <https://lafo.uni-hohenheim.de/en/1670>

Science Issues and Collaboration during Reporting Period

Contributions to Developing GEWEX Science and the GEWEX Imperatives.

a. Data Sets

- SoilWat: From pre-2018 efforts: <https://doi.pangaea.de/10.1594/PANGAEA.870605>
- PLUMBER: Land surface model forcing data from 200-300 FLUXNET sites.
- LoCo: NYS Mesonet flux tower data being prepared as an addition to the PLUMBER2 datasets.
- LoCo: Using NYS Mesonet for regional calibration of NASA-SMAP.

- LUMIP: Land-use Harmonization version 2 (historical and future land use change scenarios for use by all CMIP6 modeling groups).
 - GSWP3: Hyungjun Kim. (2017). Global Soil Wetness Project Phase 3 Atmospheric Boundary Conditions (Experiment 1) [Data set]. Data Integration and Analysis System (DIAS). <https://doi.org/10.20783/DIAS.501>
- b. Analysis
- SoilWat: Scrutiny of Pedotransfer functions for hydraulic and thermal properties
 - LUMIP: Wide range of analysis projects on impacts of land cover and land use change on climate and biogeochemistry.
 - ILAMB: Comprehensive multi-model assessment capability.
 - GSWP3: Trend analysis, Long-term mean balance, Interannual variability (& return period of extreme).
 - LS3MIP: Impact of terrestrial water storage memory to regional hydroclimatic cycle, trend analysis, long-term mean balance, interannual variability (return period for extreme events).
- c. Processes
- SoilWat: Infiltration, surface evaporation, soil water transfer, soil heat transfer, soil-groundwater interactions
 - PLUMBER: Surface flux partitioning
 - LoCo: Land-atmosphere interactions: flux partitioning at the land surface, boundary layer growth and development, convective triggering
 - LUMIP: Improved understanding of land impacts, as mediated by land use, on climate and weather
- d. Modeling
- SoilWat: Mainly using Hydrus 1-D as a common platform to explore differences between model parameterisations (e.g. with regards to hydraulic and thermal functions); A new surface evaporation capacitor (SEC) model - dynamic near surface domain representation.
 - PLUMBER: Improving land model representation of surface flux partitioning.
 - LUMIP: Support for modeling of transient land use change.
- e. Application
-
- f. Technology Transfer
- PALS/modevaluation.org is creating an infrastructure beneficial to the whole LSM community.
- g. Capacity Building
- Improving the capability of our current land surface and climate models.

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

- a. Observations and Predictions of Precipitation
- LoCo: Many papers on soil moisture-precipitation coupling.
 - GSWP3: A bias-corrected century-long daily precipitation dataset.
 - LS3MIP: Impact of snow and soil-moisture on predictability in present and warmer worlds.
- b. Global Water Resource Systems
- All projects are motivated to improve understanding and prediction of global water resources.
 - LoCo: Paper synthesizing future water availability projections based on CMIP5.
- c. Changes in Extremes
- All projects are motivated to better understand and predict how extremes will change.
- d. Water and Energy Cycles
- Improving understanding of soil water process, land surface models, land-atmosphere interactions and feedbacks all enhance understanding of water and energy cycles.

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

- How will we improve measurement and modeling of land-atmosphere interactions over managed (agricultural) and built (urban) environments beyond the instrumented grasslands of SGP-ARM and Cabauw, Netherlands?
- How can LoCo metrics better inform and be integrated into operational model development cycles, as well as to constrain multi-variate data assimilation?
- Community is interested in expanding assessment of land use to include all forms of land management. Humans are modifying as much as 75% of the global non-ice land surface (only about 25% has undergone land use change). Understanding the details of how land management is affecting land-to-atmosphere fluxes is imperative, as well as representing water management in land models.
- Incorporate diagnostics of land-atmosphere interactions into ILAMB.

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.

- LUMIP is 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.

- The SoilWat initiative is intricately linked to the activities by the International Soil Modelling Consortium (ISMC):<https://soil-modeling.org>
- LoCo: Collaboration with CORDEX group (NARCCAP) and Rachel McCrary on applying LoCo metrics to RCM output to assess variability in L-A coupling
- GSWP3 and LS3MIP collaborations with ESM-SnowMIP (CliC), ISI-MIP

Workshops and Meetings

List of Workshops and Meetings Held in 2018

Meeting title, dates and location

- 2018 GLASS Panel Meeting, 1-2 May 2018, Canmore (AB), Canada
- SoilWat break-out meeting at EGU (10 April 2018, Vienna, Austria)
- SoilWat Session at ISMC symposium (5 November 2018 Wageningen, the Netherlands)
- SoilWat break-out meeting AGU (9 December 2018, Washington, USA)
- LoCo: PBL from Space Workshops I (May 29) and II (Oct 3) 2018 in Pasadena and Greenbelt, respectively.
- LoCo: LAFE Workshop during AMS BLT Conference, June 2018 in OKC.
- LoCo: L-A Interaction Sessions at AMS 2018 and 2019 and AGU 2018, convened by LoCo WG members
- LUMIP and LS3MIP: LandMIP meeting in Toulouse, October 2018
- ILAMB meeting on soil carbon datasets; ILAMB discussed at CESM Land Model Working Group meeting and at DOE E3SM meetings (Feb, June, November); On the agenda at LandMIP meeting in Toulouse in October 2018; AGU and Japan AGU.

List of Workshops and Meetings Planned in 2019 and 2020

Meeting title, dates and location and anticipated travel support needs

- SoilWat: Break-out meetings at EGU, AGU and possibly at the GEWEX meeting in Sydney, Australia.
- LoCo: EGU 2019, 7-12 April 2019, Vienna: AS4.20/BG1.16/CL4.29/HS11.28: Land-Atmosphere Interactions: Implications from Past to Future Climate (co-organized) Convener: Volker Wulfmeyer Co-conveners: Wim Thiery, Matthias Mauder, Linda Schlemmer, Chiel van Heerwaarden, Diego G. Miralles, Ryan Teuling, Sonia I. Seneviratne
- LUMIP: Aspen AGCI meeting in August or September, 2019 (currently seeking funding through US and European funding agencies)

- LUMIP and LS3MIP: CMIP6 analysis meeting in Barcelona, March, 2019
- GLASS panel meeting 6-8 August 2019, at NCAR in Boulder, Colorado, USA

Other Meetings Attended On Behalf of GEWEX or Panel in 2018

- LoCo: ISWG Workshop #2, July 2018 in Lisbon, Portugal
- LoCo: DTC Testbed Workshop at NCEP, July 2018
- LoCo: US Climate Modeling Summit (CMS) at NCEP, April 2018
- LoCo: GEWEX GASS UMAP 2018, Land-atmosphere interaction session held by Yunyan
- LoCo: October 25-26, 2018: Ferguson attended, as GLASS liaison, the GHP meeting in Santiago, Chile.
- LoCo: October 22-24, 2018: Ferguson attended the ANDEX meeting in Santiago, Chile.
- LoCo: December 8-9, 2018: Ferguson presented at the GASS LS4P workshop.
- LoCo: December 12, 2018: Ferguson attended the GEWEX Water for Foodbaskets Townhall at AGU.

Publications during Reporting Period

List of Key Publications

- SoilWat:
- Van Looy, K., Bouma, J., Herbst, M., Koestel, J., Minasny, B., Mishra, U., Montzka, C., Nemes, A., Pachepsky, Y., Padarian, J., Schaap, M., Tóth, B., Verhoef, A., Vanderborght, J., van der Ploeg, M., Weihermüller, L., Zacharias, S., Zhang, Y. and Vereecken, H. (2017) Pedotransfer functions in Earth system science: challenges and perspectives. *Reviews of Geophysics*, 55 (4). pp. 1199-1256. ISSN 1944-9208 doi: <https://doi.org/10.1002/2017rg000581>
- Montzka, C., Herbst, M., Weihermüller, L., Verhoef, A. and Vereecken, H. (2017) A global data set of soil hydraulic properties and sub-grid variability of soil water retention and hydraulic conductivity curves. *Earth System Science Data*, 9 (2). pp. 529-543. doi: 10.5194/essd-9-529-2017.
- Or, D., and Lehmann, P. (2019). Surface evaporative capacitance: How soil type and rainfall characteristics affect global-scale surface evaporation. *Water Resources Research*, 55. <https://doi.org/10.1029/2018WR024050>
- Lehmann, P., Merlin, O., Gentine, P., & Or, D. (2018). Soil texture effects on surface resistance to bare-soil evaporation. *Geophysical Research Letters*, 45, 10,398–10,405. <https://doi.org/10.1029/2018GL078803>
- Rahmati, M. et al. (2018). Development and analysis of the Soil Water Infiltration Global database. *Earth Syst. Sci. Data*, 10, 1237-1263, <https://www.earth-syst-sci-data.net/10/1237/2018/essd-10-1237-2018.html>
- **LoCo:**
- Santanello, J. A., P. A. Dirmeyer, C. R. Ferguson, K. L. Findell, A. B. Tawfik, A. Berg, M. B. Ek, P. Gentine, B. Guillod, C. van Heerwaarden, J. Roundy, and V. Wulfmeyer, 2018: Land-atmosphere interactions: The LoCo perspective. *Bull. Amer. Meteor. Soc.*, 99, 1253–1272, doi: 10.1175/BAMS-D-17-0001.1.
- Many additional manuscripts from the LoCo community listed in the LoCo project report.
- **ILAMB:**
- Collier, N., F.M. Hoffman, D.M. Lawrence, G. Keppel-Aleks, C.D. Koven, W.J. Riley, M. Mu, J.T. Randerson, 2018: The International Land 1 Model Benchmarking (ILAMB) System: Design, Theory, and Implementation. *JAMES*, doi:10.1029/2018MS001354.
- Lawrence, D.M. and co-authors, 2019. The Community Land Model version 5: Description of new features, benchmarking, and impact of forcing uncertainty. Submitted to *J. Adv. Model. Earth Syst.*.
- Bonan, G., D. Lombardozzi, W. Wieder, K. Oleson, D. Lawrence, F. Hoffman, and N. Collier, 2019. Model Structure and Climate Data Uncertainty in Historical Simulations of the Terrestrial Carbon Cycle (1850-2014). Submitted to *GBC*.