Welcome!
Welcome to the AIMES Land DA Working Group’s virtual workshop on “Tackling Technical Challenges in Land Data Assimilation”! The key goals of this workshop are to begin building a land DA community and to share knowledge on the technical challenges that we’re all facing. We look forward to seeing you on Monday, June 14th!

-- The AIMES Land DA Working Group

Table of Contents:
- Agenda
- Breakout Group Descriptions
- Workshop Organization
- Talk Abstracts
- Participant Roster
- Zoom Guidance
### Monday, June 14

**Applicability of data assimilation approaches across different land modeling groups**

**Meeting Link**

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<thead>
<tr>
<th>Time (EDT/CEST)</th>
<th>Session</th>
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<tbody>
<tr>
<td>8:50 AM/14:50 CEST</td>
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<tr>
<td>9:00 AM/15:00 CEST</td>
<td>Welcome from the Co-Chairs: Introduction to the workshop context and goals</td>
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<tr>
<td>9:10 AM/15:10 CEST</td>
<td><strong>Speaker 1: Patricia De Rosnay</strong> (ECMWF) - Technical challenges of coupled land-atmosphere data assimilation for operational Numerical Weather Prediction and reanalyses</td>
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<td>9:25 AM/15:25 CEST</td>
<td><strong>Speaker 2: Eunjee Lee</strong> (NASA GSFC) - Effect of land initialization on the skill of forecasting carbon fluxes on sub-seasonal to seasonal (S2S) time scales</td>
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<tr>
<td>9:40 AM/15:40 CEST</td>
<td><strong>Speaker 3: Bertrand Bonan</strong> (CNRM) - Monitoring land surface variables with LDAS-Monde: focus on assimilation approaches and applications to kilometric-scale spatial resolutions</td>
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<td>Break (5 minutes)</td>
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<tr>
<td>10:00 AM/16:00 CEST</td>
<td><strong>Speaker 4: Marko Scholze</strong> (Lund University) - Experiences on terrestrial model parameter optimisation based from the Carbon Cycle Data Assimilation System using multiple observations</td>
</tr>
<tr>
<td>10:15 AM/16:15 CEST</td>
<td><strong>Speaker 5: Breo Gomez</strong> (UK Met Office) - Differences between atmospheric and land data assimilation and challenges for strong coupling</td>
</tr>
<tr>
<td>10:30 AM/16:30 CEST</td>
<td><strong>Speaker 6: Sujay Kumar</strong> (NASA GSFC) - Land hydrology data assimilation – Are we on the right track?</td>
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<td>10:45 AM/16:45 CEST</td>
<td>Introduction to Break Out Groups</td>
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<td>1) <em>DA approaches in Numerical weather prediction vs. Earth system modeling</em></td>
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<td>1. Discussion Lead: Clara Draper</td>
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<td>1. Chat Moderator: Min Huang</td>
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<td>2. Discussion Lead: Alex Ruane</td>
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<td><strong>Tuesday, June 15</strong></td>
<td><strong>Emerging techniques</strong></td>
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<td>Welcome from the Co-Chairs: Introduction to Day 2</td>
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<tr>
<td>9:05 AM EDT/15:00 CEST</td>
<td>Speaker 1: Jianzhi Dong (MIT) - The added value of brightness temperature assimilation for global soil moisture estimation</td>
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<tr>
<td>9:20 AM EDT/15:20 CEST</td>
<td>Speaker 2: Ewan Pinnington (University of Reading) - Hybrid data assimilation methods for land surface modelling</td>
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<tr>
<td>9:35 AM EDT/15:35 CEST</td>
<td>Speaker 3: Istem Fer (Finnish Meteorological Institute) - Gaussian process emulators for efficient Bayesian calibration of process-based models</td>
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<td>Speaker 5: Moha El Gharamti (NCAR/UCAR) - Enhanced streamflow Forecasting using ensemble data assimilation</td>
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<td>10:25 AM EDT/16:25 CEST</td>
<td>Speaker 6: Anthony Bloom (NASA JPL/Caltech) - Using an ever-growing Earth Observation record to infer and predict terrestrial C and H₂O dynamics</td>
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<td>2) Model structural and parameter uncertainties</td>
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**Wednesday, June 16**

*Challenges in dealing with observations*

**Meeting Link**

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<td>9:05 AM EDT/15:05 CEST</td>
<td>Speaker 1: Nina Raoult (LSCE) - Using the temporal dynamics of surface soil moisture to deal with biases when calibrating land surface models</td>
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<tr>
<td>9:20 AM EDT/15:20 CEST</td>
<td>Speaker 2: Susan Steele-Dunne (Delft University of Technology) - Towards constraining water and carbon cycle processes with radar data through assimilation</td>
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<tr>
<td>9:35 AM EDT/15:35 CEST</td>
<td>Speaker 3: Jina Jeong (Vrije Universiteit Amsterdam) - Using the International Tree-Ring Data Bank (ITRDB) records as century-long benchmarks for land-surface models</td>
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<td>Speaker 4: Ann Raiho (NASA GSFC/University of Maryland) - Advances and challenges for using paleoecological data for state data assimilation within a forest gap model</td>
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<td>Speaker 5: Clara Draper (NOAA) - Time scales in land data assimilation</td>
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<tr>
<td>10:25 AM EDT/16:25 CEST</td>
<td>Speaker 6: Manuela Girotto (UC Berkeley) - Technical challenges of assimilating observations with large spatiotemporal resolutions</td>
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<td>Break (10 minutes)</td>
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<td><strong>Break Out Groups</strong>&lt;br&gt;1) Observation uncertainties&lt;br&gt;   - Discussion Lead: Jo Waller&lt;br&gt;   - Chat Moderator: Philippe Peylin&lt;br&gt;2) Spatial and temporal scaling issues&lt;br&gt;   - Discussion Lead: Manuela Girotto&lt;br&gt;   - Chat Moderator: Andria Dawson&lt;br&gt;3) Novel data and approaches in vegetation data assimilation&lt;br&gt;   - Discussion Lead: Mike Dietze&lt;br&gt;   - Chat Moderator: Adrian Rocha&lt;br&gt;4) Novel data and approaches in hydrology, snow, and land surface temperature data assimilation&lt;br&gt;   - Discussion Lead: Harrie-Jan Hendricks-Franssen&lt;br&gt;   - Chat Moderator: Sujay Kumar</td>
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<td><strong>Co-chair wrap up: Next steps</strong></td>
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**Tackling Technical Challenges in Land Data Assimilation**

*June 14-16, 2021 · 9:00-12:00 EDT / 3:00 - 6:00 CEST*

Virtual Workshop: Breakout Groups

**Breakout discussion section:**
- The workshop organizers will introduce the breakout room themes, and you are welcome to join the breakout room of your choice.
- Discussions will be guided by a breakout discussion lead for 35-45 minutes.
- A chat moderator will review the chat.
- If you would like to speak for yourself, please type “!” at the beginning of a chat box line.
- Notes from the discussion can be captured on the google jam board provided by the breakout group moderator (and found below). All participants are encouraged to add to the jam board. A designated note taker will further capture the discussion in a google doc.
- A plenary session will follow the discussion during which each BOG moderator will provide a short (1-2 minute) summary of what was discussed.
- All breakout group documents can be found in this Google drive folder. (Requires sign-in. Please email aimes@futureearth.org if you have any issues accessing the folder.)

**Monday, June 14:**

**Applicability of data assimilation approaches across different land modeling groups**

11:00 - 11:45 EDT/ 17:00 - 17:45 CEST

<table>
<thead>
<tr>
<th>Breakout Group 1: DA approaches in Numerical Weather Prediction vs. Earth System Modeling</th>
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<td><strong>Leads</strong></td>
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<td><strong>Motivating questions</strong></td>
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<td><strong>Jamboard</strong></td>
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Breakout Group 2: DA uses for modeling human driven changes and disturbance

**Leads**
Discussion Lead: Alex Ruane  
Chat Moderator: Clément Albergel  
Rapporteur: Natasha MacBean

**Motivating questions**
- How can DA be used to better quantify and reduce uncertainty in crop models?  
- Can DA be used to account for missing processes related to land management, land use change and anthropogenic disturbance in land models? If so, how?

**Jamboard**  
https://jamboard.google.com/d/1prFxUsix4JiQNdbw2B0hGqrEukZZq52GXiPv-vX49A/edit?usp=sharing

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**Tuesday, June 15:**  
Emerging techniques  
10:55 - 11:40 EDT / 16:55 - 17:40 CEST

Breakout Group 1: Uses of machine learning and artificial intelligence in land data assimilation

**Leads**
Discussion Lead: Forrest Hoffman  
Chat Moderator: José L Gómez-Dans  
Rapporteur: Jana Kolassa

**Motivating questions**
- How can machine learning and AI techniques be used to improve or advance or complement land DA frameworks?

**Jamboard**  
https://jamboard.google.com/d/1YR9af4lmVXw--LWQE7RRY52_oAzy2Rfijr9KeC13G8/edit?usp=sharing

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Breakout Group 2: Model structural and parameter uncertainties

**Leads**
Discussion Lead: Marko Scholze  
Chat Moderator: Nina Raoult  
Rapporteur: Natasha MacBean

**Motivating questions**
- What methods are groups using to characterise model structural or parameter uncertainty?  
- What are the main barriers to being able to accurately define those uncertainties, and what approaches are people taking to address those barriers?

**Jamboard**  
https://jamboard.google.com/d/1U08SiOjvRMn7QdMlS9XxZZG6gtdlp7i6uXQJWAGp0mo/edit?usp=sharing
Breakout Group 3: Optimal model complexity for DA-based model projections

Leads
Discussion Lead: Anthony Bloom
Chat Moderator: Kashif Mahmud
Rapporteur: Tristan Quaife

Motivating questions
- How does model complexity (resolution, process representation, parametric dimensionality) enhance or limit the ability of models to predict land water, energy and carbon states?
- How do present and future observing systems dictate the optimal model complexity needs for DA-informed projections?
- Do some process representations warrant more complexity than others in land models?

Jamboard
https://jamboard.google.com/d/1mFc2HyFr5SVh4Qs7mUfTh5fONKue4I8KL6XgJE2UJq/edit?usp=sharing

June 16:
Challenges in dealing with observations
10:55 - 11:30 EDT/ 16:55 - 17:30 CEST

Breakout Group 1: Observation uncertainties

Leads
Discussion Lead: Joanne Waller
Chat Moderator: Philippe Peylin
Rapporteur: Natasha MacBean

Motivating questions
- How do we quantify observation uncertainties?
- Are any groups routinely quantifying error correlations between observations?
- Is current information available with e.g. satellite products adequate?

Jamboard
https://jamboard.google.com/d/1Mi56QJ96HiBN5weBakL4dwHK6YinGZAtv19IFphFOo0/edit?usp=sharing

Breakout Group 2: Spatial and temporal scaling issues

Leads
Discussion Lead: Manuela Girotto
Chat Moderator: Andria Dawson
Rapporteur: Andy Fox

Motivating questions
- What methods are people using to deal with the mismatch in temporal and spatial scales between model and observations in land DA systems?
- To what extent are we able or need to deal with complex footprint information from e.g. eddy covariance or satellite data?

Jamboard
https://jamboard.google.com/d/1CGoHyejHazDelt9DtsD1c0HVpch1Ovqrbgxi6D39JQ/edit?usp=sharing
**Breakout Group 3: Novel data and approaches in vegetation data assimilation**

| Leads | Discussion Lead: Mike Dietze  
Chat Moderator: Adrian Rocha  
Rapporteur: Tristan Quaife |
| --- | --- |
| **Motivating questions** | • Which novel vegetation-related observations and retrieval algorithms are groups using to constrain land models?  
• Which novel assimilation algorithms are groups using to constrain land models? |
| Jamboard | [https://jamboard.google.com/d/1HE1NTJKPlI8VYQxZNAmj07Xzqj4B_qkBmBBOfQx7tSg/edit?usp=sharing](https://jamboard.google.com/d/1HE1NTJKPlI8VYQxZNAmj07Xzqj4B_qkBmBBOfQx7tSg/edit?usp=sharing) |

**Breakout Group 4: Novel data and approaches in hydrology, snow, and land surface temperature data assimilation**

| Leads | Discussion Lead: Harrie-Jan Hendricks-Franssen  
Chat Moderator: Sujay Kumar  
Rapporteur: Jana Kolassa |
| --- | --- |
| **Motivating questions** | • Which novel hydrology or snow-related observations and retrieval algorithms/observation operators are groups using to constrain land models?  
• What issues and challenges are people facing when using these novel datasets and approaches and how are people tackling those issues? |
| Jamboard | [https://jamboard.google.com/d/1s6Jh-d75QH3QhNJKW8q91k9IVaSiJyVNgc9eSdZIQ/edit?usp=sharing](https://jamboard.google.com/d/1s6Jh-d75QH3QhNJKW8q91k9IVaSiJyVNgc9eSdZIQ/edit?usp=sharing) |

To wrap up the session, all breakout groups will conclude with the following two questions:

1. What factors are hindering progress in this area, and what are the next steps to address these challenges?
2. What do you think the land DA WG and/or a land DA community could do to facilitate progress in this area? (e.g. help organize collaborative studies, organize more focused, one-off meetings on a specific topic, identify funding for research, make connections between people interested in working on this topic?)
Tackling Technical Challenges in Land Data Assimilation

June 14-16, 2021 · 9:00-12:00 EDT / 3:00 - 6:00 CEST
Virtual Workshop: Organization

General guidelines for how the two main sessions will be run each day:

**Keynote talks:**
- Each speaker will present for 15 minutes.
- The moderator of each session will say when a speaker has 2 minutes left and when time is up.
- We encourage interaction through the chat box where you can post questions at any time.
- If speakers end early, the moderator will be able to field questions raised in the chat box.
- Where speakers have agreed, we will record the talks and post these online for later viewing by those who are unable to attend the meeting. The working group will retain but not publicly post the discussion.

**Breakout group discussion section:**
- The workshop organizers will introduce the breakout room themes, and you are welcome to join the breakout room of your choice.
- Discussions will be guided by a breakout discussion lead for 35-45 minutes.
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**Tackling Technical Challenges in Land Data Assimilation**

*June 14-16, 2021*  
*9:00-12:00 EDT / 3:00 - 6:00 CEST / Time Zone*  
Virtual Workshop: Abstract Booklet

**Monday, June 14, 2021**: Applicability of data assimilation approaches across different land modeling communities  
*Invited Speakers:* Patricia De Rosnay, ECMWF; Eunjee Lee, NASA/GSFC; Bertrand Bonan, Météo France; Marko Scholze, Lund University; Breo Gomez, UK Met Office; Sujay Kumar, NASA/GSFC

**Tuesday, June 16, 2021**: Challenges in dealing with observations  
*Invited Speakers:* Jianzhi Dong, MIT; Ewan Pinnington, University of Reading; Istem Fer, Finnish Meteorological Institute; Joanne Waller, UK Met Office; Moha El Gharamti, NCAR/UCAR; Anthony Bloom, NASA/JPL

**Wednesday, June 15, 2021**: Emerging techniques  
*Invited Speakers:* Nina Raoult, LSCE; Susan Steele-Dunn, TU Delft; Jina Jeong, Vrije Universiteit Amsterdam; Ann Raiho, NASA GSFC/University of Maryland; Clara Draper, NOAA ESRL; Manuela Girotto, UC Berkeley
Technical challenges of coupled land-atmosphere data assimilation for operational Numerical Weather Prediction and reanalyses

Patricia De Rosnay¹, Philip Browne¹, David Fairbairn¹, and Peter Weston¹

¹European Centre for Medium-Range Weather Forecasts

Abstract: This paper presents technical challenges of coupled land-atmosphere data assimilation for operational Numerical Weather Prediction (NWP) and reanalysis at the European Centre for Medium-Range Weather Forecasts (ECMWF).

ECMWF uses a weak land-atmosphere coupling approach, which relies on a coupled background forecast and separate land and atmosphere analyses. The ECMWF land data assimilation system uses a simplified Extended Kalman Fitter for the soil moisture analysis, and an Optimal Interpolation for screen level and snow data assimilation. In situ observations from the SYNOP network and satellite observations are assimilated in Near Real Time to provide land initial conditions to the forecast model. They are located at the land-atmosphere interface and include two-meter temperature and relative humidity, snow depth, and soil moisture related observations. I will describe the ECMWF land data assimilation system and briefly illustrate the impact of snow and soil moisture assimilation on the NWP performances.

I will present our activities related to modular infrastructure developments, to explore several coupling methods and to enable different coupling degrees to support consistent research and operations. I will introduce ongoing work to develop coupling through the observation operator for assimilation of satellite observations sensitive to the land-atmosphere interface conditions (e.g. snow). This requires consistent suite definition, file systems and observation interfaces for the land and atmosphere assimilation systems. Operational coupled assimilation requires having sustainable and near real time access to observations with consistent acquisition, pre-processing, archiving, and monitoring across the Earth system components. I will present these activities and discuss related practical and technical aspects.
Effect of Land Initialization on the Skill of Forecasting Carbon Fluxes on Sub-seasonal to Seasonal (S2S) Time Scales

Eunjee Lee$^{1,2}$, Randal. D. Koster$^2$, Lesley E. Ott$^2$, Joanna Joiner$^4$, Jana Kolassa$^{2,3}$, and Rolf Reichle$^2$

$^1$Goddard Earth Sciences Technology and Research, Universities Space Research Association, Columbia, MD, USA
$^2$Global Modeling and Assimilation Office, NASA Goddard Space Flight Center, Greenbelt, MD, USA
$^3$Science Systems and Applications, Inc., Lanham, MD, USA
$^4$Atmospheric Chemistry and Dynamics Laboratory, NASA Goddard Space Flight Center, Greenbelt, MD, USA

In this talk, we demonstrate an ability to forecast carbon fluxes accurately at multi-month leads in the Northern Hemisphere boreal region, an ability that appears to be linked in part to snowpack initialization in the forecast model. Using 20 years of forecasted meteorology from NASA GMAO’s S2S ensemble forecast system (from forecasts initialized in December each year) to drive offline runs of the Catchment-CN model, we evaluate the degree to which we can forecast greening onset date and Gross Primary Production (GPP) relative to a fully independent observation dataset. We find that skillful forecasts of the greening onset date largely occur where we have skillful forecasts of snow cover removal date in western North America and Europe, and this snow cover removal date is naturally tied to the amount of snow at the start of the forecast. The ability to predict greening onset date in turn leads to an ability to predict annual (or more specifically, January-September) GPP, presumably because an earlier greening start date implies a longer time period for carbon uptake. We also, however, identify some regions for which GPP is accurately predicted without the snow mechanism; in these areas, it appears to be the initialization of the carbon/vegetation reservoirs in December that leads to the skill. Overall, this study demonstrates the significance of accurate land initialization for S2S carbon forecasts.
Monitoring accurately the evolution of land surface variables (LSVs) such as soil moisture, biomass or leaf area index (LAI) is critical for various applications such as weather predictions, climate change or agricultural practices. Powerful instruments in that context are Land Data Assimilation Systems (LDASs) as they combine information from numerical simulations from Land Surface Models (LSMs) and satellite observations using data assimilation. One of them is LDAS-Monde, the offline LDAS developed by Météo-France’s research centre (CNRM). It aims to monitor the evolution of LSVs at various scales, from regional to global. One specific feature of LDAS-Monde is to assimilate jointly satellite-derived observations of both surface soil moisture and LAI in order to update model estimations of LAI and soil moisture over the first metre of soil obtained with the multilayer and interactive vegetation ISBA LSM.

This presentation highlights two recent developments with LDAS-Monde. First, the impact of an Ensemble Kalman Filter (EnKF) and a Simplified Extended Kalman Filter (SEKF), that is routinely used in LDAS-Monde, on LSVs is assessed on an experiment over Europe and the Mediterranean basin at 0.25° spatial resolution. While the EnKF, newly applied in LDAS-Monde, exhibits on average a similar behaviour as the SEKF on LAI, it tends to have a positive impact on other LSVs such as surface soil moisture, evapotranspiration or gross primary production. The EnKF particularly improves simulations of river discharges obtained with the CTRIP river routing model coupled to ISBA. Secondly, the possibility to set-up LDAS-Monde to the context of kilometric-scale resolution is studied. To that end, satellite observations of LAI are assimilated into the ISBA LSM forced (offline mode) with Météo-France’s small scale numerical weather prediction system AROME. It provides a system able to monitor LSVs at 2.5-km spatial resolution on a domain centred on France. The ability of LDAS-Monde to monitor the evolution of LSVs is demonstrated in the context of the severe drought that France suffered during the summer 2018 and 2020. LDAS-Monde’s capacity to compensate the absence of irrigation in the ISBA LSM during summer by assimilating LAI is also shown over the Ebro valley. The presentation will focus on the technical challenges related to these experiments. In the future, merging those two recent developments is planned in order to create an ensemble-based LDAS operating at kilometre scale over France using ensemble atmospheric forecasts.
June 14, 2021: Applicability of data assimilation approaches across different land modeling communities
10:00 AM EDT

Experiences on terrestrial model parameter optimisation based from the Carbon Cycle Data Assimilation System using multiple observations

Marko Scholze¹

¹Lund University

In the context of climate change it is of paramount importance to understand CO2 sources and sinks and their spatio-temporal distribution. This information is needed to improve the projections of future trends in carbon sinks and sources, and thus the potential magnitude of climate change. However, there are large uncertainties in the quantification of the terrestrial carbon sinks arising mainly from uncertainties in the underlying models used for the quantification of these sinks. A major source for these model uncertainties are uncertainties in their parameterisations and parameter values. Reducing these uncertainties is critical for reducing the spread in simulations of the global carbon cycle, and hence in climate change projections. The Carbon Cycle Data Assimilation System (CCDAS) is designed to optimise model process parameters based on the assimilation of multiple data streams. Besides deriving an optimal set of parameters for the underlying process-based terrestrial biosphere model, here the BETHY model, a main feature of CCDAS is its capability of determining posterior parameter uncertainties consistent with the observational uncertainties of the assimilated data. These parameter uncertainties are then propagated onto the target quantities such as the net atmosphere surface exchange flux (NEP). In this presentation, I will report on the experiences gained in parameter optimisation from CCDAS studies assimilating multiple observations such as, e.g. CO2, FAPAR, soil moisture, vegetation optical depth.
Differences between atmospheric and land data assimilation and challenges for strong coupling

Breo Gomez

UK Met Office

Earth system modelling is part of the strategic plans of most numerical weather prediction (NWP) centres, including the Met Office. In recent years, significant effort has been put to implement a fully coupled atmosphere-ocean-land model in operations and the ambition is to extend this stronger interaction to data assimilation (DA) in the medium term. Integrating the DA components of two earth systems such as land and atmosphere presents a significant challenge as these typically use different scientific schemes and software packages. Even within the same earth system, there can be different approaches depending on the analysed variables, and such is the case for land surface DA. Soil variables (i.e. soil moisture) are typically analysed using Kalman Filter based algorithms and the analyses are usually produced independently for each soil column. Innovations are sometimes estimated in model quantities (i.e. soil moisture and snow products) and on other occasions in observation quantities (i.e. screen temperature values). Snow analyses follow a different approach to soil. Snow fields are commonly estimated using optimal interpolation algorithms which imply a global minimisation for the 2D field and snow innovations are typically calculated in observation space. On the contrary, atmospheric DA typically uses variational algorithms which process all the variables at the same time, over the full 3-D domain and over a time window (4-Dimensional). Innovations are computed in observation space and they ingest orders of magnitude more observations than land. All of these differences make reconciling the land and atmosphere systems a challenging task. Implementing a stronger coupling necessarily implies that land DA and atmosphere DA should eventually converge to a unified methodology and code base. In this talk, I will discuss the differences between atmospheric and land DA and outline some options to progress into a stronger coupling between the two.
Land hydrology data assimilation – Are we on the right track?

Sujay Kumar

1NASA Goddard Space Flight Center

Physical modeling approaches are important tools for developing spatially and temporally continuous estimates of the terrestrial water cycle components. In addition to the limitations imposed by uncertainties in boundary conditions and model parameters, representing the heterogeneity and impacts of human management across different spatial scales are significant challenges in terrestrial hydrological modeling. The availability of remote sensing measurements offers the opportunity to mitigate some of these limitations, which are typically incorporated within physical models through data assimilation. Though assimilation studies have demonstrated the beneficial impact of remote sensing measurements both for improving the representation of catchment scale processes, there are significant challenges related to assimilation strategies, limitations in model formulations, and observational data processes that limit the potential utility of the remote sensing measurements. In this presentation, results from recent studies that highlight these challenges will be discussed. The information utilization within data assimilation approaches will be contrasted with data driven techniques based on machine learning. The use of nonparametric metrics founded in information-entropy methods that are more efficient for characterizing the information utilization efficiency will be discussed. The presentation argues for the need for hybrid approaches that integrate both physical and data-driven modeling to improve the representation of hydrologic processes across...
The added value of brightness temperature assimilation for global soil moisture estimation

Jianzhi Dong¹

¹Massachusetts Institute of Technology

Assimilation of microwave brightness temperature (TB) has been frequently used for improving global soil moisture estimates. However, the performance of data assimilation is sensitive to multitude factors, e.g., the reliability of the pre-defined observation and model error. As a result, assimilating brightness temperature does not necessarily improve soil moisture accuracy and for some cases, it may even degrade the baseline model run (open-loop, or OL). Therefore, the added value of TB assimilation is necessary for diagnosing and improving the land data assimilation systems. However, previous analyses have been confined to a few high-intensity networks and have limited global representativeness. Here, we developed statistical tools to evaluate the added value of TB data assimilation without any access to “ground-truth”. Based on the statistical methods, we evaluated the added value of TB assimilation for global soil moisture estimation in the SMAP L4 system. Results show that TB assimilation benefits soil moisture mostly in data-sparse regions, where OL is expected to have higher uncertainty levels due to inaccurate precipitation inputs, e.g., Africa and Central Australia. As for data-rich regions (e.g., Europe and US), data assimilation has marginal and even negative impacts on soil moisture estimates – suggesting SMAP L4 system should increase model weights to avoid soil moisture estimates being contaminated by remote sensing errors over these regions. We further showed that high-intensity soil moisture networks are generally located in data-rich regions. As such, traditional ground-based evaluations tend to underestimate the added value of TB assimilation at the global scale.
Hybrid Data Assimilation Methods for Land Surface Modelling

Ewan Pinnington¹

¹University of Reading

Land surface models often suffer from uncertain parameterisations and structural uncertainties. Variational data assimilation techniques can be optimal for the problem of parameter estimation with land surface models due to their ability to use a time series of observed data in a single minimisation and avoid the retrieval of unphysical time-varying parameters. Traditional variational data assimilation techniques such as Four-Dimensional Variational Data Assimilation require access to the model derivative and adjoint, these can be prohibitively costly to compute and maintain. In this talk we present a hybrid data assimilation technique that allows for the approximation of such variational techniques by using an ensemble of model runs. We will show examples of this technique applied to the JULES land surface model, assimilating NASA SMAP satellite observations, to optimize model soil parameters and improve hydrological predictions over the UK and Africa.
Bayesian calibration allows informing land surface models (LSMs) with data from multiple sources and scales, iteratively updating analyses as new data become available, propagating uncertainty into model predictions, and dealing with complex systems. While the primary aim of the calibration is constraining uncertainties in the model parameters, associated analyses help identify missing processes, feedback mechanisms or state variables.

The traditional Bayesian calibration algorithms, however, fail to leverage high-performance computing environments that are optimized for parallel computation and advances in computing power that are increasingly being made in terms of number of processors rather than CPU speed. This is more than an inconvenience where most LSMs are simply too slow to be plugged into these algorithms that require thousands to millions of sequential model evaluations.

To overcome this challenge we established an emulator-based Bayesian calibration framework where the emulator, that is orders of magnitude faster than the original computer simulator, is used in place of the full model and passed to Bayesian calibration algorithm. In this approach time limiting steps of running the full model are reduced and parallelized.

We use the Gaussian process (GP) model as our statistical emulator where GP always passes exactly through the design points, and allows for the estimation of uncertainties associated with interpolation in between design points. Key features of this approach involve emulating the error surface instead of model outputs, proposing and refining training points strategically, and modifying the calibration algorithm to accommodate for the uncertainty in GP.

The gains in terms of computation time using the emulator-based calibration are shown to be substantial with opportunities to explore more complex statistical models at the hierarchical level. We generalized and implemented the emulator-based Bayesian calibration and multi-site hierarchical Bayesian calibration work flows as part of an ecological informatics toolbox, PEcAn, where we make use of distributed architecture that facilitates community collaboration. We also discuss current limitations of the approach as well as potential solutions and more advanced applications that are under progress.
Estimating the full observation error covariance matrix

Joanne Waller¹

¹UK Met Office

For computational speed and simplicity the observation error covariance matrices used in geophysical data assimilation systems are typically assumed to be diagonal. However, recent research has shown that a variety of different observation types do have correlated errors; hence the diagonal error covariance matrix approximation is poor. Furthermore, using full observation error covariance matrices in the data assimilation scheme can inject small scale information into the analysis, reduce analysis errors and improve forecast skill. To attain these benefits, it is necessary to have an accurate estimate of the full observation error covariance matrix. In this presentation I will introduce some of the methods that can be used to estimate the observation error statistics. In particular I will discuss the advantages and deficiencies of a popular diagnostic that makes use of observation-minus-background and observation-minus-analysis statistics.
Enhanced Streamflow Forecasting using Ensemble Data Assimilation

Moha El Gharamti

1NCAR/UCAR

Predicting major floods during extreme rainfall events remain an important challenge. Rapid changes in flows over short time-scales combined with multiple sources of model error makes it difficult to accurately simulate intense floods. This work presents a general data assimilation framework that aims to improve flood predictions in channel routing models. The ensemble framework features: (i) along-the-stream (ATS), topology-based, localization and (ii) spatially and temporally varying adaptive inflation. Simulations show the importance of ATS localization compared to traditional approaches in mitigating not only sampling errors but also physically incorrect correlations between ungauged basins. Adaptive inflation on the other hand is utilized as a vigorous bias correction scheme in areas where the model’s prediction skill is poor due to various biases and forcing errors. For a study case, hurricane Florence flooding in the Carolinas in 2018 is considered where hourly streamflow data – from USGS gauges – are assimilated. A regional configuration of WRF-Hydro (NOAA’s National Water Model) is used to model the streamflow. The Data Assimilation Research Testbed (DART) is interfaced with WRF-Hydro to produce ensemble streamflow forecasts and analyses.
Using an ever-growing Earth Observation record to infer and predict terrestrial C and H$_2$O dynamics

Anthony Bloom$^1$

$^1$NASA Jet Propulsion Laboratory/Caltech

Understanding ecosystem-scale carbon (C) and water (H$_2$O) exchanges is a challenging task, largely due to uncertainties in states, processes, C-H$_2$O interactions, and their dynamic responses to climate variability and disturbance. In particular, both a process-based mechanistic understanding of C & H$_2$O fluxes and a dynamical consideration of legacy effects on the terrestrial C and H$_2$O states are needed to understand and predict the net land C sink in the coming decades. While land models explicitly represent these terms, considerable structural and parametric biases hinder efforts to accurately resolve C and H$_2$O dynamics. The ever-growing Earth Observation record provides a unique opportunity for using observation to inform structural and parametric model configurations, and reduce associated uncertainties. Using the Bayesian CARbon DAta-MOdel fraMework (CARDAMOM) approach—constrained by an array of in-situ and satellite-based terrestrial ecosystem observations (including measurements of leaf area, biomass, solar-induced fluorescence, groundwater storage, satellite-informed estimates of CO2 and CO surface fluxes, and eddy covariance datasets)—we demonstrate the capacity of Earth Observations to jointly provide key insights into processes regulating the evolution of terrestrial ecosystem C fluxes on seasonal-to-decadal timescales. We present some of the key methodological steps—including spatially-explicit parametric inference, ecologically-based parameter regularization, joint state-parameter estimation, and explicit non-linear parameter optimization—which we argue are critical for accurately characterizing uncertainty in predictions of the land C sink in the coming decades.
June 16, 2021: Challenges in dealing with observations
9:05 AM EDT

Using the temporal dynamics of surface soil moisture to deal with biases when calibrating land surface models

Nina Raoult\(^1\)

\(^1\) LSCE

One of the biggest challenges we face when using surface soil moisture (SSM) data to evaluate and calibrate land surface models are the large biases that exist between modelled and observed values. These biases are further exacerbated when dealing with merged remote sensing products, such as the ESA CCI SM product, where the retrievals have been rescaled to match the climatology of an intermediate model. Methods to deal with these biases include preprocessing the data (e.g., cdf-matching) and assessing model-data fit through specialised metrics (e.g., unbiased root-mean squared error). Here we consider the novel approach of using only temporal dynamics of SSM to calibrate a model. Specifically, we consider ‘drydowns’ - the SSM temporal dynamics following a significant rainfall event - characterized by an exponential decay time scale \(\tau\). In this talk we also will discuss the important first step of selecting parameters through a sensitivity analysis. Using both the sensitivity analysis to calibrate only the most sensitive parameters and \(\tau\) approach in our calibration, we find that the relative drydowns of SSM can be well calibrated using observation-based \(\tau\) estimates. Furthermore, we investigate the overall model skill improvement using eddy-covariance measurements and discuss next steps.
Towards constraining water and carbon cycle processes with radar data through assimilation

Susan Steele-Dunne

1Delft University of Technology

Variations in radar backscatter reflect changes in soil moisture, vegetation structure and the moisture content of the vegetation constituents. Radar’s ability to “look into” the vegetation, can therefore provide unique insight into how water is pumped from the soil to the atmosphere through the vegetation, and how this pumping is regulated by the vegetation’s physiological response to environmental conditions. Assimilation of radar data provides a way to estimate the states, and constrain the parameters related to carbon and water exchanges between the land surface and atmosphere.

The challenge in assimilating radar data into land surface models lies in the measurement operator. Advances in the representation of plant hydraulics in land surface models is improving our ability to simulate vegetation water dynamics. However, models used to simulate backscatter from vegetated surfaces still treat vegetation as a static dielectric medium. Furthermore, radiative transfer models require the dielectric properties of the soil and vegetation as well as a description of the size, shape, orientation and distribution of scatterers in the canopy. These parameters are seldom known, and they are not simulated in land surface models. Therefore, there is a mismatch between the representation of vegetation water dynamics in land surface models and our ability to simulate the backscatter variations due to those dynamics. Here, we will present preliminary results from a recent study where the use of machine learning is explored to address this mismatch.
June 16, 2021: Challenges in dealing with observations
9:35 AM EDT

**Using the International Tree-Ring Data Bank (ITRDB) records as century-long benchmarks for land-surface models**

Jina Jeong¹, Jonathan Barichivich²,³, Philippe Peylin², Vanessa Haverd⁴,⁵, Michael N. Evans⁶, Flurin Babst⁶,⁷,⁸, and Sebastiaan Luyssaert¹

¹Department of Ecological Sciences, VU University, 1081HV Amsterdam, the Netherlands.
²Laboratoire des Sciences du Climat et de l’Environnement, IPSL, CNRS/CEA/UVSQ, 91191 Gif sur Yvette, France.
³Instituto de Conservación Biodiversidad y Territorio, Universidad Austral de Chile, 5090000 Valdivia, Chile.
⁴CSIRO Oceans and Atmosphere, Canberra, 2601, Australia.
⁵Department of Geology ESSIC, University of Maryland, MD 20742-4211, USA.
⁶Dendro Sciences Group, Swiss Federal Research Institute WSL, Zürcherstrasse 111, CH-8903 Birmensdorf, Switzerland.
⁷School of Natural Resources and the Environment, University of Arizona, Tucson, USA.
⁸Laboratory of Tree-Ring Research, University of Arizona, Tucson, USA.
¹Deceased 29 January, 2021.

The search for a long-term benchmark for land-surface models (LSM) has brought tree-ring data to the attention of the land-surface community as they have recorded growth well before human-induced environmental changes became important. The most comprehensive archive of publicly shared tree-ring data is the International Tree-ring Data Bank (ITRDB). Many records in the ITRDB have, however, been collected almost exclusively with a view on maximizing an environmental target signal (e.g. climate), which has resulted in a biased representation of forested sites and landscapes and thus limits its use as a data source for benchmarking. This study aims to propose advances in data processing to enable the land-surface community to re-use the ITRDB data as a much-needed century-long benchmark. Given that tree-ring width is largely explained by phenology, tree size, and climate sensitivity, LSMS that intend to use it as a benchmark should at least simulate tree phenology, size-dependent growth, differently-sized trees within a stand, and responses to changes in temperature, precipitation and atmospheric, CO2 concentrations. Yet, even if LSMS were capable of accurately simulating tree ring width, sampling biases in the ITRDB need to be accounted for. This study proposes two solutions: exploiting the observation that the variation due to size-related growth by far exceeds the variation due to environmental changes, and simulating a size-structured population of trees. Combining the proposed advances in modeling and data processing resulted in four complementary benchmarks - reflecting different usage of the information contained in the ITRDB - each described by two metrics rooted in statistics that quantify the performance of the benchmark. Although the proposed benchmarks are unlikely to be precise, they advance the field by providing a much-needed large-scale constraint on changes in the simulated maximum tree diameter and annual growth increment for the transition from pre-industrial to present-day environmental conditions over the past century. Hence, the proposed benchmarks open up new ways of exploring the ITRDB archive, stimulate the dendrochronological community to refine its sampling protocols to produce new and spatially unbiased tree-ring networks, and help the modeling community to move beyond the short-term benchmarking of LSM.
Advances and challenges for using paleoecological data for state data assimilation within a forest gap model

Ann Raiho$^{1,2}$

$^1$NASA Goddard Space Flight Center
$^2$University of Maryland

Paleoecological data can be used to constrain forest gap model state variables and improve long-term predictions of forest demography. But, applying these constraints can be difficult because forest gap models can have high process variance and paleoecological data are often non-normally distributed. We built a new state data assimilation algorithm to estimate process variance and account for data containing zeros (left-censored) named the Tobit-Wishart Ensemble Filter (TWEnF). We applied our algorithm to a forest gap model at Harvard Forest using both tree-ring-derived species biomass and fossil pollen-derived fractional composition. We found that the TWEnF greatly improved predictions from the forest gap model and opened the door for further development. Possible next challenges include eliminating MCMC with Gibbs sampling methods, expanding paleoecological state data assimilation to larger spatial domains and models, updating parameters as well as states, and accounting for sudden events like disturbance.
Time scales in land data assimilation

Clara Draper¹

¹NOAA, Earth System Research Laboratories, Physical Sciences Laboratory

Land surface dynamics typically occur over longer time scales than those of the atmosphere. However, the observations available for assimilation are often of variables close to the land/atmosphere interface (e.g., near-surface soil moisture), which have faster time scales than the land surface variables of most interest (e.g., root-zone soil moisture). This presentation will review previously published work exploring aspects of these time scale differences. Draper and Reichle, (2015; HESS) assimilated AMSR-E near-surface soil moisture observations into that Catchment land surface model, showing that the assimilation improved the model near-surface soil moisture at both sub-seasonal (fast) and inter-annual (slow) time scales. More recent synthetic twin data assimilation experiments with a simple force-restore soil moisture model demonstrate that data assimilation algorithms can also effectively filter short time-scale observation errors to improve the longer-time scales of the root-zone soil moisture. This result was quite robust, and occurred even in the presence of large systematic model errors, and large fast-time scale observation errors. However, Draper and Reichle (2015) point out that the differences in time scales between the modeled and observed soil moisture have under-appreciated consequences in terms of soil moisture bias correction strategies, and in terms of the evaluation strategies used to assess different soil moisture estimates.
Technical challenges of assimilating observations with large spatiotemporal resolutions

'Manuela Girotto

'UC Berkeley

The GRACE and GRACE-FO missions (hereafter both will be referred to as “GRACE”) revolutionized large-scale remote sensing of the Earth’s hydrologic cycle, allowing scientists to peer deeper into the terrestrial water storage (TWS) across regional and continental scales. However, the spatial/temporal resolution and latency of GRACE data have limited their real time application in monitoring and characterizing land surface processes. In particular, because of the uniqueness of the spatial and temporal resolutions of GRACE data, it is not trivial to assimilate GRACE data and merge them with any other remotely sensed observations. This presentation will focus on benefits, challenges and applications of recent land surface data assimilation research efforts targeted at improving soil moisture, groundwater, and terrestrial water storage hydrological states using gravimetry observations from the GRACE and GRACE-FO missions.
# Tackling Technical Challenges in Land Data Assimilation

**June 14-16, 2021 • 9:00-12:00 EDT / 3:00 - 6:00 CEST**  
**Virtual Workshop: Participants**

| **Tuula Aalto**  
Finnish Meteorological Institute  
tuula.aalto@fmi.fi | Head of Carbon cycle research group at FMI, supervised 2 PhDs on atmospheric inversion modeling and data assimilation & parameter optimization of a land model |
|---|---|
| **Camille Abadie**  
LSCE  
camille.abadie@lsce.ipsl.fr | I am currently a master student working at LSCE on the use of carbonyl sulfide and sun-induced fluorescence to improve the representation of GPP in the land surface model ORCHIDEE. I would like to continue on a PhD and I would be using DA techniques to co-assimilate COS, SIF and VOD data to better constrain photosynthesis and transpiration fluxes in ORCHIDEE. |
| **Ekundayo Adeleke**  
USDA-NRCS NSSC  
ekundayo.adeleke@usda.gov | In the last 5 years, Ekundayo has been involved in research understudying mass balance of trace elements in soil, rejuvenation of degraded soil and soil and water quality assessment. Recently, he is contributing his expertise to research on modeling of carbon and water fluxes for soil ecosystem functions and services. |
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<th>Name</th>
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<tbody>
<tr>
<td>Maricar Aguilos</td>
<td>North Carolina State University</td>
<td><a href="mailto:mmaguilio@ncsu.edu">mmaguilio@ncsu.edu</a></td>
<td>I work on long-term eddy covariance flux data assimilation in the coastal plains of North Carolina, USA</td>
</tr>
<tr>
<td>Clément Albergel</td>
<td>ESA Climate Office</td>
<td><a href="mailto:Clement.albergel@esa.int">Clement.albergel@esa.int</a></td>
<td>I am a Climate Applications Scientist working at the ESA Climate Office (ECSAT, Harwell, UK). My main areas of expertise are in land surface modelling, remote sensing of soil moisture and vegetation as well as data assimilation. I have a PhD on satellite derived observations assimilation in land surface models. Prior to joining ESA, I held positions at ECMWF and CNRM/Météo-France as a scientist from the French National Research Centre (CNRS) to develop land surface activities</td>
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<tr>
<td>Anca Anghelea</td>
<td>European Space Agency</td>
<td><a href="mailto:anca.anghelea@esa.int">anca.anghelea@esa.int</a></td>
<td>Earth Observation Open Data Scientist, Earth System Data Lab</td>
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</table>
| **Sebastian Apers**  
Department of Earth and Environmental Sciences, KU Leuven  
sebastian.apers@kuleuven.be | I am a PhD student at the Remote Sensing and Data Assimilation Research Group of the KU Leuven. In my research I will develop a novel global-scale land surface modeling and satellite data assimilation framework for tropical peatlands. I will leverage the operational data assimilation algorithm of the Level 4 Soil Moisture Active Passive (SMAP) satellite mission and try to enhance the radiative transfer modeling with a correction for open water along coastal areas, and for dense vegetation layers. |
| --- | --- |
| ![Cédric Bacour](image)  
Cédric Bacour  
NOVELTIS SAS  
cedric.bacour@lsce.ipsl.fr | Research engineer at NOVELTIS SAS (France). I work on the joint constraints broughts by remote sensing products (with a focus on SIF) and in situ measurements to improve the parameterisation of terrestrial biosphere models (ORCHIDEE) - wrt the carbon cycle mainly - using data assimilation techniques. |
| **Subhajit Bandopadhyay**  
University of Zurich  
subhajit.iirs@gmail.com | I am Subhajit Bandopadhyay, the NAWA Iwanowska Fellow at Remote Sensing Laboratories (RSL), Department of Geography, University of Zürich (UZH), Switzerland and a near-to-complete final year PhD student from Poznan University of Life Sciences (https://skylark.up.poznan.pl/en/), Poland.  
My PhD research is exclusively focused on vegetation traits analysis and modelling using novel Sun-Induced fluorescence (SIF) signal and reflectance using airborne imaging spectrometric data and field spectroscopy.  
I have extensively used novel HyPlant airborne imaging spectrometer data (the airborne demonstrator of FLEX FLORIS satellite) which will be in space in 2023 in tandem with Sentinel-3 under the ESA FLEX mission. |
I'm currently working on the evaluation of LUE models, which is parameterized using DA method. I think the parameters uncertainties limit the model extrapolation and need to be constrained. I'm curious about relative studies or how you do with these issues.

Environmental Researcher and Data Scientist at Science Partners (France). Working on the ecosystems modelling within the land surface models ORCHIDEE (LSCE/IPSL) and CTESSEL (ECMWF), development of the data assimilation systems and visualization platforms.
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<tbody>
<tr>
<td>Michel Bechtold</td>
<td>KU Leuven, Belgium</td>
<td><a href="mailto:michel.bechtold@kuleuven.be">michel.bechtold@kuleuven.be</a></td>
<td>Michel Bechtold is researcher in the research group &quot;Land surface modeling, remote sensing and data assimilation&quot; at KU Leuven, Belgium. His current research is about the peatland water and carbon cycle including wildfire occurrence, coupled land-atmosphere simulations and lightning in the boreal zone, and streamflow modeling. His current data assimilation work includes the assimilation of raw microwave satellite data (L-band brightness temperature, radar backscatter) into land surface models to improve hydrological states and fluxes, including streamflow.</td>
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<tr>
<td>Riasad Bin Mahbub</td>
<td>University of Arkansas</td>
<td><a href="mailto:rbmahbub@uark.edu">rbmahbub@uark.edu</a></td>
<td>I have not done any work on data assimilation before but have interest to work in the future.</td>
</tr>
<tr>
<td>A. Anthony Bloom</td>
<td>Jet Propulsion Laboratory,</td>
<td><a href="mailto:abloom@jpl.nasa.gov">abloom@jpl.nasa.gov</a></td>
<td>I use model-data fusion to constrain terrestrial carbon, water, energy and nutrient cycles, and underlying process parameters relating to C allocation and turnovers (and their associated climate sensitivities), soil hydraulic properties and carbon-water interactions. I mostly work with fluorescence, GRACE, LAI, biomass and atmospheric CO and CO2 flux estimates. Using these insights, my interests include quantifying and characterizing the integrated climate sensitivity of terrestrial ecosystems, and attributing net carbon and water flux variations to underlying processes.</td>
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<tr>
<td>Bertrand Bonan</td>
<td>CNRM / Meteo-France</td>
<td><a href="mailto:bertrand_bonan@meteo.fr">bertrand_bonan@meteo.fr</a></td>
<td>I have been a postdoctoral researcher working at CNRM, Meteo-France's research centre since 2018. I am currently working on improving LDAS-Monde, the Land Data Assimilation System developed at CNRM, focusing on (ensemble based) assimilation schemes and on adapting LDAS-Monde to higher spatial resolutions. I am interested in any DA-related topics but also in linking DA with biogeophysical processes.</td>
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<tr>
<td>Valeria Briones</td>
<td>University of Maine/ Woodwell</td>
<td>Will be starting work to support the development of a data assimilation model, and as an early career researcher want this opportunity to learn about various DA methods and opportunities and challenges associated from experts in the field.</td>
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<tr>
<td>Iuliia Burdun</td>
<td>University of Tartu</td>
<td>I am a PhD in Physical Geography and working as a Research Fellow in Geoinformatics at the University of Tartu (Estonia). DA is an exciting and new topic for me. I have never tried DA in my work, but I hope to obtain the basic skills in a range of DA methods during this workshop to continue the independent exploration of the DA technique in my future research. Particularly, I am interested in DA of passive and active remotely sensed observations.</td>
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<td>Daniela Cala</td>
<td>Indiana University</td>
<td>I'm a first year PhD student at the Novick Lab. I'm interested on carbon, energy fluxes and water relations in a changing planet. I would like to gain experience on DA to inform better sustainability practices and environmental policy around the world.</td>
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<tr>
<td>Silvia Caldararu</td>
<td>Max Planck Institute for Biogeochemistry</td>
<td>I am currently working on the QUINCY land surface model and my broad research interests are ecologically realistic models and how plants adapt to changes in their environment. I am interested in finding a balance between model realism and complexity within data availability constraints.</td>
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<tr>
<td>Carla Cardinali</td>
<td>CMCC</td>
<td>I mainly worked on atmospheric DA and I am leading the DA group at CMCC. CMCC plans are on coupled data assimilation Land/Atms with particular attention on the initialisation of their seasonal forecast.</td>
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<tr>
<td>N Carvalhais</td>
<td>MPG BGC</td>
<td>PhD in Environmental Engineering from the Faculty of Sciences and Technology, New University of Lisbon, Portugal, on integrating multiple observational data streams and diagnostic modeling of ecosystem carbon fluxes. Currently, Group leader of the Model-Data Integration group, Department Biogeochemical Integration, MPI-BGC (<a href="https://www.bgc-jena.mpg.de/bgi/index.php/Research/ModelDataFusion">https://www.bgc-jena.mpg.de/bgi/index.php/Research/ModelDataFusion</a>)</td>
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<tr>
<td>Cristina Charlton-Perez</td>
<td>Met Office, UK</td>
<td>Dr. Charlton-Perez works on DA for NWP at the Met Office. Her role is to pull through scientific innovations in LSDA to improve operational weather forecasting. Her interests are in all types of soil and snow observations and their use in both DA and verification. She is keen to build stronger connections with hydrological modellers in future.</td>
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<td>Thomas Chen</td>
<td>Academy for Mathematics, Science, and Engineering</td>
<td><a href="mailto:thomasyutaocchen@gmail.com">thomasyutaocchen@gmail.com</a></td>
<td>Thomas Chen is a student researcher whose primary interests lie in machine learning and computer vision. He serves on the U.S. Technology Policy Committee of the Association for Computing Machinery. As much of his work lies at the nexus of artificial intelligence and earth science, he is also an active early-career scientist member of the European Geosciences Union and the American Geophysical Union. Previously, Thomas has presented work at a number of conferences, workshops, and meetings, from NeurIPS workshops, to Applied Machine Learning Days, to the Open Data Science Conference, to Machine Learning Week Europe.</td>
</tr>
<tr>
<td>Weijing Chen</td>
<td>The University of Texas at Austin</td>
<td><a href="mailto:wchen19@utexas.edu">wchen19@utexas.edu</a></td>
<td>I got my PhD degree from Wuhan University, China. Now, I am a postdoc at the University of Texas, United States. The research content during the doctoral period is state and parameter estimation by data assimilation, assimilation of microwave brightness temperature. Now I focus on the quantitative analysis of temporal and spatial characteristics of agricultural drought based on data assimilation.</td>
</tr>
<tr>
<td>Yan Chen</td>
<td>University of Connecticut</td>
<td><a href="mailto:yanc1002@uconn.edu">yanc1002@uconn.edu</a></td>
<td>My project is about the response of the forest carbon cycle to extreme climates. The data involved include changes in forest cover, carbon emissions, precipitation, soil moisture, etc.</td>
</tr>
<tr>
<td>Kasper Coppieters</td>
<td>Ghent University</td>
<td><a href="mailto:kasper.coppieters@ugent.be">kasper.coppieters@ugent.be</a></td>
<td>My name is Kasper Coppieters. As a starting PhD student in the CAVElab at Ghent university, I will work on the impact of lianas on the energy and water balance in tropical forests. I will collect data to parametrize and validate the ecosystem demography model, which includes a liana plant functional type, and use the model to simulate the impact of lianas on tropical forests.</td>
</tr>
</tbody>
</table>
| **Amie Corbin**  
Leiden University  
corbin.amie@gmail.com | I'm currently working on implementing and testing priors in a land-surface parameter DA platform (MULTIPLY). I'm focusing on the vegetation/plant priors and land-surface retrievals to hopefully improve the accuracy of land-surface parameter retrieval from the platform. The Platform tries to take multiple satellite sources and wavelengths to create a unified product for a variety of land-surface parameters (such as soil moisture or leaf/canopy chlorophyll). |
| --- | --- |
| **Andria Dawson**  
Mount Royal University  
andria.dawson@gmail.com | I am an Assistant Professor of Mathematics at Mount Royal University. My research addresses questions about Earth system change across a range of spatio-temporal scales using quantitative methods informed by data. I work primarily with paleoecological data (fossil pollen and tree-rings), towards understanding biosphere changes and biosphere-atmosphere interactions. The objective of most of my work is integration of estimates of past change into models (land-use, ecosystem, Earth System). |
| **Gabrielle De Lannoy**  
KU Leuven  
Gabrielle.delannoy@kuleuven.be | Gabrielle De Lannoy is a professor at the KU Leuven, Belgium, leading a research group on Land Surface Remote Sensing, Modeling and Data Assimilation. |
<table>
<thead>
<tr>
<th>Shannon de Roos</th>
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<tr>
<td>KU Leuven</td>
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<td><a href="mailto:shannon.deroos@kuleuven.be">shannon.deroos@kuleuven.be</a></td>
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<tr>
<td>My name is Shannon de Roos, I am a PhD student at KU Leuven in the team lead by prof. Gabrielle de Lannoy. My work focuses on regional crop modelling, where I look at biomass and soil moisture. During my research I will assimilate Sentinel-1 microwave backscatter into a regional version of the AquaCrop model, to improve model simulations.</td>
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<table>
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<tr>
<th>Patricia de Rosnay</th>
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<tr>
<td>ECMWF</td>
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<td><a href="mailto:patricia.rosnay@ecmwf.int">patricia.rosnay@ecmwf.int</a></td>
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<tr>
<td>Patricia de Rosnay is a Senior Scientist with the European Centre for Medium-Range Weather Forecasts (ECMWF) where she is leading the Coupled Assimilation Team in the Earth System Assimilation Section. She implemented the current soil moisture analysis scheme based on a combined Ensemble Data Assimilation (EDA) and simplified Extended-Kalman Filter (EKF), as well as the 2D Optimal Interpolation snow analysis, in the ECMWF Integrated Forecasting System. She is coordinating the land assimilation developments at ECMWF for both NWP and reanalysis purposes.</td>
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<td>Michael Dietze</td>
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<td>Jianzhi Dong</td>
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<td>Jiarui Dong</td>
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<td>Clara Draper</td>
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<td>Dr Draper</td>
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| **Annemarie Eckes-Shephard**  
Lund University  
annemarie.eckes-shephard@nateko.lu.se | Project Assistant at Lund University working on tree mortality, previously PhD student at Cambridge University studying tree growth. My background is Biological Sciences (Bsc) and Climate Change (MSc). I have also been a Data Champion for four years and am interested in all things data in general. My previous experience in data assimilation are Bayesian calibration and comparison of wood formation models. |
|---|---|
| **Mike Ek**  
NCAR  
ek@ucar.edu | Land modeler (and land-atmosphere interaction in models) that very much depends on land DA. |
| **Istem Fer**  
Finnish Meteorological Institute  
istem.fer@fmi.fi | Istem Fer is a senior researcher at the Finnish Meteorological Institute. She has a background in quantitative ecology and carbon-cycle modeling. Her work focuses on improving process-based mechanistic ecosystem models through model-data synthesis. Dr. Fer has also been one of the core developers of the PEcAn Project, an open source ecological-informatics toolbox, for >5 years with key contributions on data assimilation modules where she developed and generalized a novel emulator-based Bayesian calibration approach for process-based models. She has recently developed this workflow into an emulator-based hierarchical Bayesian calibration framework, and currently exploring more advanced implementation of the scalable emulators and more complex statistical models at the hierarchical level. |
Andy Fox is co-organizing this workshop and is the Land Project lead at the inter-agency Joint Center for Satellite Data Assimilation. He has worked with many land models and DA systems in the past, from site to global spatial scales, and over short to long timescales. Whilst previously focused on studying the terrestrial carbon cycle with climate models in the university research community, his work now largely focuses on developing operational land DA systems for NOAA’s Unified Forecast System and National Water Model using the Joint Effort for Data Assimilation Integration. He is particularly interested in developing techniques and infrastructure for utilizing the latest generation of remote sensing observations of the land surface, and preparing for future observation capabilities.

Kristina Fröhlich
Deutscher Wetterdienst
kristina.froehlich@dwd.de

I am a meteorologist and responsible for the seasonal forecasts at DWD. As we are setting up a new climate forecast system, we want to include land data assimilation for climate forecasts. So far we have been using Newtonian relaxation in atmosphere and Ensemble Kalman Filter in the ocean but we have no experience for the land and all the coupling issues.

Gaglo, Koudjo Espoir
Cheikh Anta Diop University/ LMI IESOL
espoirgaglo@gmail.com

My name is Espoir Gaglo. I'm a doctoral student and my research focuses on vegetation-climate interactions and ecosystem services from agro-silvo-pastoral systems in the Sahel.
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<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Description</th>
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<tbody>
<tr>
<td>Kevin Gallo</td>
<td>NOAA/NESDIS/STAR</td>
<td>Land lead within NWS Center for Satellite Applications and Research for accelerating the use of satellite-derived products within numerical weather models.</td>
</tr>
<tr>
<td>Yanjun Gan</td>
<td>University of Texas at Arlington</td>
<td>I am a Research Engineering Scientist at the UT Arlington. I am working on a program to assimilate a blended in situ-satellite SWE product into the National Water Model for improving snow and streamflow simulations.</td>
</tr>
<tr>
<td>Helene Genet</td>
<td>University of Alaska Fairbanks</td>
<td>I am an ecosystem modeler specialized in high latitude ecology. My research is focused on carbon, nitrogen, permafrost and land cover dynamics in boreal and arctic systems using process-based and state-and-transition models. Starting this year, I'll work on developing a data assimilation system for our terrestrial ecosystem model to reduce uncertainty associated with modeling the ecological impacts of wildfire and climate change.</td>
</tr>
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<tr>
<td>Gernot Geppert</td>
<td>DWD</td>
<td><a href="mailto:gernot.geppert@dwd.de">gernot.geppert@dwd.de</a></td>
</tr>
<tr>
<td>Moha Gharamti</td>
<td>NCAR</td>
<td><a href="mailto:gharamti@ucar.edu">gharamti@ucar.edu</a></td>
</tr>
<tr>
<td>Tseganeh Z Gichamo</td>
<td>CIRES/NOAA</td>
<td><a href="mailto:tseganeh.gichamo@noaa.gov">tseganeh.gichamo@noaa.gov</a></td>
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<tr>
<td>Manuela Girotto</td>
<td>UC Berkeley</td>
<td><a href="mailto:mgirotto@berkeley.edu">mgirotto@berkeley.edu</a></td>
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<tr>
<td>Breo Gomez</td>
<td>Met Office</td>
<td><a href="mailto:breogan.gomez@metoffice.gov.uk">breogan.gomez@metoffice.gov.uk</a></td>
</tr>
<tr>
<td>Jose Gómez-Dans</td>
<td>NCEO/UCL</td>
<td><a href="mailto:j.gomez-dans@ucl.ac.uk">j.gomez-dans@ucl.ac.uk</a></td>
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<tr>
<td>Farhad Hassani</td>
<td>University of Texas at Arlington</td>
<td><a href="mailto:farhad.hassani@mavs.uta.edu">farhad.hassani@mavs.uta.edu</a></td>
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<tr>
<td>Keqi He</td>
<td>Duke University</td>
<td><a href="mailto:keqi.he@duke.edu">keqi.he@duke.edu</a></td>
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<tr>
<td>Name</td>
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<td>Research Focus/Interests</td>
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<tr>
<td>Lei HE</td>
<td>University of Strasbourg</td>
<td>I am focusing on the influence of precipitation regimes and temperature change on phenology and plant growth. Recently, I am using Trendy-v8 models data. My research interest relating to DA is about practical applications.</td>
</tr>
<tr>
<td>Sophie Hebden</td>
<td>Future Earth</td>
<td>Sophie Hebden - research coordinator on Earth observations and liaison to ESA, based at ESA Climate Office, UK.</td>
</tr>
<tr>
<td>Seung Hee kim</td>
<td>Chapman University</td>
<td>My expertise is in mesoscale dynamics and modeling. I have not been working on DA but am planning to apply IoT sensor data in the urban area modeling using DA techniques.</td>
</tr>
<tr>
<td>Ako Heidari</td>
<td>George Mason University</td>
<td>My professional and academic interests include Statistical Modeling and Analytical problems. I started to work on climate change with NASA data and models. Did my internship at ESRI for geo-spatial data and then worked with Machine learning and deep learning ever since. Statistical analysis and hypothesis testing, different machine learning algorithms, statistical inference techniques, data assimilation methods, risk assessment, uncertainty quantification and dimensionality reduction of large-scale dynamical systems, Quantum computing are my interests.</td>
</tr>
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</table>
Harrie-Jan Hendricks-Franssen
Forschungszentrum Julich GmbH
h.hendricks-franssen@fz-juelich.de

I am Harrie-Jan Hendricks-Franssen and work at the Research Centre Julich in Germany and the RWTH Aachen. My research group is focused on land surface and subsurface modelling, including data assimilation and parameter estimation. Other research activities are more centred on the analysis of time series of measurement data, with a focus on evapotranspiration.

Sanaa Hobeichi
The University of New South Wales
s.hobeichi@unsw.edu.au

Sanaa Hobeichi is a post-doctoral researcher at the University of New South Wales. Her key interests are improving the estimates of the surface terrestrial water and energy budgets, and applying machine learning to aid climate change/extremes research. She developed a new data merging technique and used it to derive observationally constrained hybrid estimates of Evapotranspiration and Runoff known as Derived Optimal Linear Combination Evapotranspiration (DOLCE), and Linear Optimal Runoff Aggregates (LORA) respectively. She also developed Conserving Land-Atmosphere Synthesis Suite (CLASS), monthly gridded estimates of simultaneously balanced surface water and energy budget components and their uncertainties.

Forrest M. Hoffman
Oak Ridge National Laboratory
forrest@climatemodeling.org

Forrest develops and applies Earth system models (ESMs) to investigate the global carbon cycle and feedbacks between biogeochemical cycles and the climate system. He applies data mining methods using high performance computing to problems in landscape ecology, ecosystem modeling, remote sensing, and large-scale climate data analytics. He is particularly interested in applying machine learning methods to explore the influence of terrestrial and marine ecosystems on hydrology and climate.
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<tr>
<th>Name</th>
<th>Institution</th>
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<tr>
<td>Jennifer Holm</td>
<td>Lawrence Berkeley National</td>
<td><a href="mailto:jaholm@lbl.gov">jaholm@lbl.gov</a></td>
<td>My main area of research is terrestrial ecosystem modeling. Within this area my research topics of interest include forest disturbance and recovery processes, dynamic vegetation processes, model sensitivity and uncertainty, and understanding forest response to changing climates from local to global scales, with an emphasis on tropical forests.</td>
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<tr>
<td>Natan Holtzman</td>
<td>Stanford University</td>
<td><a href="mailto:nholtzma@stanford.edu">nholtzma@stanford.edu</a></td>
<td>Natan Holtzman is a PhD candidate in the department of Earth System Science at Stanford University, working in the Remote Sensing Ecohydrology Lab with Dr. Alex Konings. Natan uses a combination of remote sensing, modeling, and field measurements to investigate plant hydraulics at the ecosystem scale. His current work involves assimilating passive microwave remote sensing observations into a land surface model as a constraint on plant water content.</td>
</tr>
<tr>
<td>JUN HU</td>
<td>Chiba University</td>
<td><a href="mailto:huijunjune@gmail.com">huijunjune@gmail.com</a></td>
<td>It is a good opportunity to learn the latest technology in the land data assimilation for a beginner.</td>
</tr>
</tbody>
</table>
| **Min Huang**  
George Mason University  
mhuang10@gmu.edu | Dr. Huang has been working on multi-scale weather and atmospheric chemistry modeling and DA for over a decade. Since 2016, Dr. Huang has been the Principal Investigator of a NASA SMAP-funded project, integrating satellite soil moisture data into weather, emission and air quality modeling. This project contains the development and applications of an observation-constrained (with land and chemical DA) coupled modeling system that includes global-to-regional, meteorology-chemistry-aerosols, and land-atmosphere couplings, and it has supported a wide range of activities across weather, atmospheric chemistry and air quality communities. |
| **Xin Huang**  
Northern Arizona University  
xh59@nau.edu | My DA work is to assimilate real-time observations into multiple models for ensemble prediction |
| **Xueli Huo**  
University of Arizona  
huoxl90@email.arizona.edu | I am a postdoc working on data assimilation of carbon observations into the community land surface model since 2019 Sep. |
| **Sunniva Indrehus**  
University of Oslo  
sunniva.indrehus@geo.uio.no | Research software engineer at the land modeling group at the University of Oslo, helping researchers establish software engineering excellence in their daily work |
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<th>Name</th>
<th>Affiliation</th>
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<tr>
<td>Paul C. Inkenbrandt</td>
<td>Utah Geological Survey</td>
<td><a href="mailto:paulinkenbrandt@utah.gov">paulinkenbrandt@utah.gov</a></td>
<td>I am a hydrogeologist with the Utah Geological Survey, and have been working there for 10 years. I have been focusing on critical zone hydrology, including the deployment and operation of micrometeorology stations. I have interest in agricultural operations and how they play a role in critical zone hydrology. I am interested in soil-water balance models, leveraging Google Earth Engine, and tying point measurements to remote sensing models.</td>
</tr>
<tr>
<td>Elchin Jafarov</td>
<td>Los Alamos National Laboratory</td>
<td><a href="mailto:elchin.jafarov@gmail.com">elchin.jafarov@gmail.com</a></td>
<td>I am a computational earth scientist interested in changes in hydrological and thermal state of the Arctic region. I am using fine, regional, and large scale land models to assess the current state of the system and model it into the future. I have some experience in using data tools in my research and interested to learn more. This workshop sounds very relevant to my current research and I am looking forward to learn more and expanding my collaboration network by attending the workshop.</td>
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<tr>
<td>Jina Jeong</td>
<td>Vrije Universiteit Amsterdam</td>
<td><a href="mailto:jina.i.jeong@gmail.com">jina.i.jeong@gmail.com</a></td>
<td>I studied Earth &amp; Environmental Sciences for Bachelor, and Agricultural &amp; Forest Meteorology for Master's at Seoul National University, South Korea, before enrolling a Ph.D. in Systems Ecology at Vrije Universiteit in Amsterdam. My DA work focuses on using century-long tree-ring widths datasets to benchmark a land-surface model, despite their biases.</td>
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<tr>
<td>Aolin Jia</td>
<td>University of Maryland</td>
<td><a href="mailto:aolin@terpmail.umd.edu">aolin@terpmail.umd.edu</a></td>
<td>surface temperature assimilation</td>
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<td>Name</td>
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<td>Jen Johnson</td>
<td>Carnegie Institution for Science</td>
<td><a href="mailto:jjohnson@carnegiescience.edu">jjohnson@carnegiescience.edu</a></td>
<td>I am an early career scientist working at the Department of Global Ecology at the Carnegie Institution for Science. My current research focuses on developing a new quantitative model of photosynthesis that relates chlorophyll fluorescence to gas-exchange. The aim is to provide an improved framework for assimilating solar-induced fluorescence and interpreting vegetation states and fluxes.</td>
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<tr>
<td>Jana Kolassa</td>
<td>NASA GSFC</td>
<td><a href="mailto:jana.kolassa@nasa.gov">jana.kolassa@nasa.gov</a></td>
<td>Jana Kolassa is co-organizing this workshop and a researcher and scientific land model developer at the Global Modeling and Assimilation Office (GMAO) at the NASA Goddard Space Flight Center. She obtained her PhD in Environmental Science and Remote Sensing from the Université Pierre et Marie Curie in 2013. Before joining the GMAO as a full-time researcher, she worked as a postdoctoral fellow at Columbia University in New York and through the NASA Postdoctoral Program. Her research focusses on improving the representation on land-atmosphere interaction in global Earth System Models through (1) improvements in process representation and (2) data assimilation. She is currently developing the next version of the NASA Catchment-CN model and is leading a project that aims to investigate the potential of SMAP soil moisture data assimilation to improve the forecast of tropical cyclone landfall behavior in the GMAO’s operational GEOS model.</td>
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<tr>
<td>Alexandra Konings</td>
<td>Stanford University</td>
<td><a href="mailto:konings@stanford.edu">konings@stanford.edu</a></td>
<td>My research group at Stanford studies how the carbon and water cycles interact at regional to global scales. We are particularly interested in how plant hydraulics effects large-scale water and carbon fluxes, and how to best capture the diversity in plant traits in large-scale models. We also work a lot with microwave remote sensing of vegetation. Our group uses data assimilation in a number of contexts - both for carbon cycle estimation using CARDAMOM and for plant hydraulics.</td>
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</table>
Sujay Kumar is a research physical scientist in the Hydrological Sciences Lab at NASA Goddard Space Flight Center. He is the technical lead for the NASA Land Information System (LIS), a widely used, open-science terrestrial hydrology modeling and data assimilation system. He has pioneered the development of data assimilation, machine learning, optimization, uncertainty estimation, and verification capabilities within NASA LIS.

<table>
<thead>
<tr>
<th>Sujay Kumar</th>
<th>NASA</th>
<th><a href="mailto:Sujay.V.Kumar@nasa.gov">Sujay.V.Kumar@nasa.gov</a></th>
</tr>
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</table>

I am currently working on detection of abiotic stress in crops using proximal and remote sensing data. I assimilate field acquired spectral reflectance with the satellite based observations for identification of important wavelength that represents nutrients and water stress in plants. Moreover, I am also trying to use solar induced fluorescence for detecting the same.

| Sharad Kumar Gupta | Punjab Remote Sensing Centre | sharad.prsc@gmail.com |

Eunjee Lee is a scientist of the Goddard Earth Science Technology and Research (GESTAR) and works in the Global Modeling and Assimilation Office (GMAO) at NASA Goddard. She studies the water-carbon interactions between the land and the atmosphere, utilizing NASA's land surface model and GEOS Earth system model.

| Eunjee Lee | Universities Space Research Association / NASA Goddard | eunjee.lee@nasa.gov |

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<th>Name</th>
<th>Affiliation</th>
<th>Email</th>
<th>Research Interests</th>
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<tbody>
<tr>
<td>Hoontaek Lee</td>
<td>Max Planck Institute for Biogeochemistry</td>
<td><a href="mailto:hlee@bgc-jena.mpg.de">hlee@bgc-jena.mpg.de</a></td>
<td>I am a PhD student at the Max Planck Institute for Biogeochemistry, Germany. My research topic is to understand the global water-carbon cycle interactions. For this end, I am using a process-based modeling framework which includes parameter calibrating procedures constrained by available data stream. I may not have a technical issue, as I am mostly the user of the simulation results, but I am interested in listening to talks and discussions from this workshop to have a chance to enlarge my viewpoint.</td>
</tr>
<tr>
<td>Fangni Lei</td>
<td>Mississippi State University</td>
<td><a href="mailto:minifang89@gmail.com">minifang89@gmail.com</a></td>
<td>My research interests include quantifying global/regional surface soil moisture, evapotranspiration, and the data assimilation of multi-source remote sensing data into land/hydrological models. In my recent works, I have been focused on analyzing the impact of model variable coupling strength on the performance of data assimilation, particularly the relationship between soil moisture and evapotranspiration. Targeting a high-resolution data assimilation system at the field-scale for agricultural applications is also one of my recent research topics.</td>
</tr>
<tr>
<td>Mengna Li</td>
<td>University of Twente</td>
<td><a href="mailto:m.li-3@utwente.nl">m.li-3@utwente.nl</a></td>
<td>I'm a phd student, major in hydrogeology. My research focuses on integrated surface-subsurface modeling, and data assimilation. I would like to know more about data assimilation in this workshop.</td>
</tr>
<tr>
<td>Zhan Li</td>
<td>Helmholtz Centre for Environmental Research</td>
<td><a href="mailto:zhan.li@ufz.de">zhan.li@ufz.de</a></td>
<td>Zhan Li is currently a researcher at Helmholtz Centre for Environmental Research in Germany. He specializes in remote sensing of land at a range of spatial scales (plot to global, fine to medium resolution), by multiple sensors (multispectral, lidar, radar) on different platforms (ground, airborne and satellite). He is currently interested in using DA techniques to leverage the information from multisource remote sensing data to improve the estimates of land surface states (albedo, biomass, soil moisture) and fluxes (CO2, CH4 and H2O).</td>
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<td>Name</td>
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<tr>
<td>Hannah Liddy</td>
<td>Columbia University</td>
<td><a href="mailto:hl3147@columbia.edu">hl3147@columbia.edu</a></td>
<td>Hannah Liddy is the executive officer for the Analysis, Integration and Modeling of the Earth System (AIMES) global research project of Future Earth. She is based at the Center for Climate System Research at Columbia University and NASA Goddard Institute of Space Studies. She is a paleoclimatologist by training and uses carbon and hydrogen isotopes and pollen data to reconstruct changes in vegetation and the hydrologic cycle in the tropics.</td>
</tr>
<tr>
<td>Sebastian Lienert</td>
<td>University of Bern</td>
<td><a href="mailto:sebastian.lienert@climate.unibe.ch">sebastian.lienert@climate.unibe.ch</a></td>
<td>I'm a postdoc working at the Institute for Climate and Environmental Physics at the University of Bern, working primarily with the DGVM LPX-Bern. During my PhD thesis, I used a DA approach using Latin Hypercube Sampling to update model parametrization and constrain land-use emissions. Currently, I'm working on using atmospheric carbon isotope measurements as a potential novel constraint for land-biosphere processes.</td>
</tr>
<tr>
<td>Chang Liu</td>
<td>CAVElab, Ghent University, Belgium</td>
<td><a href="mailto:chang.liu@ugent.be">chang.liu@ugent.be</a></td>
<td>Accurate simulation of light transmission within forests is essential to advance ecological modelling. Radiative Transfer Models (RTMs) can simulate the interaction between light and forest structure. It can provide reference data for DA research.</td>
</tr>
<tr>
<td>Gerardo Lopez Saldana</td>
<td>Earth Observation Applications Scientist</td>
<td><a href="mailto:gerardo.lopezsaldana@assimila.eu">gerardo.lopezsaldana@assimila.eu</a></td>
<td>The main focus of my DA work relies on using EO data and associated uncertainties to constrain land surface models aim to derived vegetation biophysical parameters.</td>
</tr>
<tr>
<td>Name</td>
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<td>Statement</td>
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<tr>
<td>Dan Lu</td>
<td>Oak Ridge National Laboratory</td>
<td><a href="mailto:lud1@ornl.gov">lud1@ornl.gov</a></td>
<td>I used machine learning techniques to build a fast-to-evaluate surrogate model of the land model and then use DA methods such as Markov chain Monte Carlo for parameter optimization.</td>
</tr>
<tr>
<td>Yang Lu</td>
<td>University of Southampton</td>
<td><a href="mailto:yang.lu@soton.ac.uk">yang.lu@soton.ac.uk</a></td>
<td>I assimilated microwave and thermal data for ET estimation before. Currently I'm working on agricultural assimilation of soil moisture and LAI data. The goal is to produce high-resolution crop yield.</td>
</tr>
<tr>
<td>Natasha MacBean</td>
<td>Indiana University</td>
<td><a href="mailto:nlmacbean@gmail.com">nlmacbean@gmail.com</a></td>
<td>Natasha MacBean is co-organizing this workshop and a leading expert on using a wide range of in situ and satellite datasets within a data assimilation framework to test, develop, and constrain terrestrial biosphere model (TBM) carbon cycle processes and parametric uncertainty. Her research also includes studies investigating satellite greening trends and the impact of satellite land cover mapping uncertainties on TBM carbon, water and energy budget estimates.</td>
</tr>
<tr>
<td>Claire Macintosh</td>
<td>European Space Agency</td>
<td><a href="mailto:claire.macintosh@esa.int">claire.macintosh@esa.int</a></td>
<td>I am a Climate Applications Scientist at the European Space Agency. My core interest is in observational uncertainty in climate quality data, and how it relates to assimilation into reanalysis.</td>
</tr>
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<tr>
<td>Kashif Mahmud</td>
<td>Indiana University</td>
<td><a href="mailto:kmahmud@iu.edu">kmahmud@iu.edu</a></td>
<td>I am a Research Scientist in the Department of Geography at Indiana University. I am a modeler and remote sensing expert with both hydrogeology and terrestrial carbon cycle background. I am interested to understand the response of the carbon cycle and terrestrial ecosystems to climate and environmental changes. I am currently using data assimilation methods with ORCHIDEE terrestrial biosphere model to constrain global carbon cycle sink projections and modeled carbon-climate feedbacks.</td>
</tr>
<tr>
<td>Fabienne Maignan</td>
<td>LSCE</td>
<td><a href="mailto:fabienne.maignan@lsce.ipsl.fr">fabienne.maignan@lsce.ipsl.fr</a></td>
<td>I’m a researcher at LSCE using the ORCHIDEE Land Surface Model, in situ and satellite observations to better represent GPP. I want to co-assimilate GPP proxies such as SIF and carbonyl sulfide (COS).</td>
</tr>
<tr>
<td>Nooshin Mashhadi</td>
<td>University of Alberta</td>
<td><a href="mailto:nmashhad@ualberta.ca">nmashhad@ualberta.ca</a></td>
<td>As a new PhD student in Environmental science and Msc student in the field of Geo science, I have done several projects in respect to water cycle and drought during my Msc. However working on surface temperature and climate change is the main idea of my field as a phd student.</td>
</tr>
<tr>
<td>Elias Massoud</td>
<td>UC Berkeley</td>
<td><a href="mailto:eliasmassoud@berkeley.edu">eliasmassoud@berkeley.edu</a></td>
<td>My work focuses on fusing computer models with climate data to investigate Earth system processes, in order to gain scientific understanding and to make predictions of natural systems with confident uncertainty bounds. I have worked on topics related to groundwater, precipitation, and vegetation, and have researched how these systems are linked with one another. My current efforts are aimed towards subseasonal to seasonal (S2S) prediction of the hydrologic cycle in High Mountain Asia for improving the forecast skill of various water processes relevant for water resources and hazard management.</td>
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<td>Name</td>
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<tr>
<td>Pascal Maugis</td>
<td>LSCE</td>
<td><a href="mailto:pascal.maugis@lsce.ipsl.fr">pascal.maugis@lsce.ipsl.fr</a></td>
<td>I set up automatic differentiation of any version of the land surface model Orchidee (fortran 90) to help build Jacobian and Hessian matrices of the model for gaussian minimisation. I apply data assimilation with Orchidée on field-scale hydrological processes.</td>
</tr>
<tr>
<td>Félicien Meunier</td>
<td>Ghent University</td>
<td><a href="mailto:felicien.meunier@ugent.be">felicien.meunier@ugent.be</a></td>
<td>In my group, we are using DA to calibrate a new plant functional type accounting for lianas with the Ecosystem Demography model, version 2. Lianas are structural parasites responsible for decreased tree growth and increased tree mortality that are most often neglected by vegetation models. We implemented for the very first time a new plant functional type accounting for lianas in a DGVM (namely the Ecosystem Demography model, version 2). Many new processes and parameters required to account for lianas were calibrated and fine-tuned using data assimilation from various origins and scales.</td>
</tr>
<tr>
<td>Hannah Mevenkamp</td>
<td>University of Alaska Fairbanks</td>
<td><a href="mailto:hkmievenkamp@alaska.edu">hkmievenkamp@alaska.edu</a></td>
<td>I am Hannah Mevenkamp, a graduate student at the Institute of Arctic Biology at the University of Alaska Fairbanks. I work on ecosystem modeling of the Arctic and model intercomparison. One focus is on how field data can be used efficiently to parameterize Arctic ecosystem models and how to close the gap between available field data and data needs for modeling.</td>
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<tr>
<td>Sara Modanesi</td>
<td>National Research Council, Research Institute for Geo-Hydrological Protection (CNR-Irpi)</td>
<td><a href="mailto:sara.modanesi@irpi.cnr.it">sara.modanesi@irpi.cnr.it</a></td>
<td>I am working at the Research Institute of Geo-Hydrological Protection (IRPI) of the National Research Council (CNR) of Perugia (Italy) since October 2017 and from May 2019 I am carrying out research activities as a research fellow. In November 2018 I also started a dual PhD in a collaboration between the University of Florence and KU Leuven on the topic “Innovative use of Earth observations into a land surface model for tracking human-induced changes to the terrestrial water cycle”. My main interests are related to Data Assimilation in Hydrological and Land Surface Models (LSM), remote sensing and droughts. Currently my research focuses on Data Assimilation of the backscatter from Sentinel-1 into the Noah-MP LSM, running within the NASA LIS framework, to update both soil moisture and vegetation and improving irrigation quantification.</td>
</tr>
<tr>
<td>Christoph Müller</td>
<td>Potsdam Institute for Climate Impact Research, Potsdam, Germany</td>
<td><a href="mailto:cmueller@pik-potsdam.de">cmueller@pik-potsdam.de</a></td>
<td>Working with DGVM and crop models, we need much better reference data to assess models at the process level rather than end-of-cycle metrics only (such as crop yields). Also, we need to better understand how to make use of remotely sensed data and how these can be attributed to specific vegetation types (natural ecosystems, crops, grasslands) and management stages.</td>
</tr>
<tr>
<td>SIELATCHOM NGALAHIA</td>
<td>Cameroon national météorological department</td>
<td><a href="mailto:elsy.sielatchom@gmail.com">elsy.sielatchom@gmail.com</a></td>
<td>Cédric is a meteorologist working on weather forecasting and climate modeling.</td>
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<tr>
<td>Name</td>
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<tr>
<td>Rodolfo Nobrega</td>
<td>Imperial College</td>
<td><a href="mailto:r.nobrega@imperial.ac.uk">r.nobrega@imperial.ac.uk</a></td>
<td>I'm an ecosystem modeller with a focus on ecosystem and climate sciences. I study the synergy between terrestrial ecosystems, the atmospheric environment and climate. I'm currently a PDRA at the Imperial College London, where I support the development of theories of optimal allocation of water, energy, and carbon from ecosystem to global scales. My DA work is related to make the most of different type of data products to provide full data integration in model development, and not only an ensemble with different inputs.</td>
</tr>
<tr>
<td>Bamidele Oloruntoba</td>
<td>Forschungszentrum Jülich</td>
<td><a href="mailto:b.orluntoba@fz-juelich.de">b.orluntoba@fz-juelich.de</a></td>
<td>I work on land surface-subsurface modelling and data assimilation at high resolution over the African continent in order to capture locally specific information and produce simulation results at resolutions at which considered variables affect human lives.</td>
</tr>
<tr>
<td>Catherine Ottle</td>
<td>CNRS-LSCE</td>
<td><a href="mailto:catherine.ottle@lsce.ipsl.fr">catherine.ottle@lsce.ipsl.fr</a></td>
<td>I am working on LSM processes modeling. My present research focuses on the developments of the hydrological processes and on methods to constrain them with multiscale and multispectral satellite data like soil moisture, snow cover, albedo or surface temperature. I am working both with filtering and 4DVar approaches.</td>
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<tr>
<td>Name</td>
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<tr>
<td>Philippe Peylin</td>
<td>LSCE</td>
<td>I am working on land surface carbon, water and energy budgets and in particular on Data Assimilation with the ORCHIDEE global land surface model to calibrate the main parameters of the carbon and water cycle (since more than 15 years). Searching for optimal approaches for multiple data stream assimilation.</td>
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</tr>
<tr>
<td>Ewan Pinnington</td>
<td>University of Reading</td>
<td>Research scientist at the University of Reading developing hybrid data assimilation methods for parameter estimation with land surface models. Working primarily with the JULES land surface model over Africa and the UK, optimising model ancillaries and parameters with satellite and in-situ data.</td>
<td></td>
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<tr>
<td>Stephen Plummer</td>
<td>European Space Agency</td>
<td>Stephen Plummer is based, since the start of 2020, at the ESRIN site of European Space Agency (ESA) in Frascati, Italy. From 2001 to 2009, he was an independent consultant between the European Space Agency (ESA) and International Geosphere–Biosphere Programme (IGBP), developing Earth observation products for the IGBP before joining ESA in 2010. Between 2010 and 2020 he helped set up and run the ESA Climate Change Initiative (CCI) at ECSAT in the UK. He coordinates the ESA Carbon Cycle Cluster and is helping set up the joint ESA-EC activities for terrestrial carbon. His research interests include the interaction of radiation with vegetation, the consistency of observations with spatial scale and the use of remotely sensed data in global vegetation models with a particular emphasis on the terrestrial carbon cycle.</td>
<td></td>
</tr>
<tr>
<td>Christian Poppe</td>
<td>Research Centre Jülich</td>
<td>I look forward to assimilate ecosystem processes data (LAI, ET, GPP) from in-situ and remote sensing into a european land surface model.</td>
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<td>Name</td>
<td>Institution</td>
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<td>Role/Research Focus</td>
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<tr>
<td>Tom Pugh</td>
<td>Lund University</td>
<td><a href="mailto:thomas.pugh@nateko.lu.se">thomas.pugh@nateko.lu.se</a></td>
<td>My work focuses on how climate, environment and management influence the dynamics of terrestrial vegetation, particularly forests. The primary tool here is the LPJ-GUESS dynamic vegetation model, in which we are working to constrain woody growth and mortality with new data syntheses. I'm interested in further integrating these data sources in a more formalised and flexible framework.</td>
</tr>
<tr>
<td>Tristan Quaife</td>
<td>University of Reading, UK</td>
<td><a href="mailto:t.l.quaife@reading.ac.uk">t.l.quaife@reading.ac.uk</a></td>
<td>Tristan Quaife co-organizing this workshop and is an Associate Professor of Carbon Cycle Science and the University of Reading, UK, and an investigator in the UK’s National Centre for Earth Observation. His research focuses on the interface between models and observations, especially those from satellites, and a central theme to his work has been using Data Assimilation to integrate EO and field data with models of the land surface, often using complex, non-linear observation operators. His DA work has covered Ensemble Kalman Filters, Particle Filters and 4DVAR. Most recently his group has been working on hybrid data assimilation techniques (in particular the iterative ensemble Kalman smoother) to assimilate EO data into the JULES land surface model. This has resulted in an operational soil moisture product for Africa that integrates NASA SMAP data with JULES.</td>
</tr>
<tr>
<td>Brett Raczka</td>
<td>Associate Scientist</td>
<td><a href="mailto:bmraczka@ucar.edu">bmraczka@ucar.edu</a></td>
<td>I am most interested in using satellite observations to constrain land-atmospheric processes. Of particular interest is simulating water limited, spatially heterogeneous terrain (Western United States) that is inherently difficult to model. Especially interested in using data assimilation to understand carbon cycling processes.</td>
</tr>
<tr>
<td>Ann Raiho</td>
<td>NASA Goddard / University of Maryland</td>
<td><a href="mailto:ann.raih@gmail.com">ann.raih@gmail.com</a></td>
<td>I'm a postdoc with Ben Poulter at NASA Goddard working on SGB optimal design for Earth observation. In the past, I have worked with paleoecological data and forest gap models doing both model calibration as a postdoc at CSU and state data assimilation as a graduate student at Notre Dame. I'm interested in incorporating process uncertainty in state data assimilation and improving modeled forest demography with paleoecological data in general.</td>
</tr>
</tbody>
</table>
Nina Raoult
LSCE
nina.raoult@lsce.ipsl.fr

Post-doc Researcher at LSCE with a Master’s degree in Mathematics and a PhD in Land Surface Modelling and Data Assimilation. Currently working on constraining the hydrology and carbon cycles within the ORCHIDEE model using soil moisture and land-surface temperature satellite measurements as part of an ESA CCI fellowship. Also involved in developing the adjoint code of the ORCHIDEE model.

Rolf Reichle
NASA GSFC
rolf.reichle@nasa.gov

My research interests are primarily in data assimilation of satellite land surface observations, satellite remote sensing of the land surface, the global terrestrial water, energy, and carbon cycles, large-scale land-atmosphere interactions, and applications to numerical weather prediction, short-term climate forecasting, and retrospective climate analysis.

Humberto Ribeiro da Rocha
Universidade de São Paulo
humberto.rocha@iag.usp.br

Hydroclimatologist, interested in using novel techniques to assimilate field data (flux tower, hydrological gauges) and remote sensing information to either calibrate and run fine resolution land surface models on an operational basis.
<table>
<thead>
<tr>
<th>Name</th>
<th>Institution</th>
<th>Email</th>
<th>Interest</th>
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<tbody>
<tr>
<td>Martin Donald Richardson</td>
<td>Royal Holloway University of London</td>
<td><a href="mailto:mobilitydream@hotmail.com">mobilitydream@hotmail.com</a></td>
<td>Biologist interested in future-appropriate river ecosystems restoration. Very high resolution DA for empirical models to be used in commercial applications software for rapid, automated analysis and knowledge acquisition.</td>
</tr>
<tr>
<td>Sami Rifai</td>
<td>University of New South Wales</td>
<td><a href="mailto:srifai@gmail.com">srifai@gmail.com</a></td>
<td>I am an ecosystem ecologist currently employed as a UNSW postdoc at the ARC Centre for Climate Extremes. I am getting started with the CABLE land surface model and am interested in learning about techniques for Data Assimilation in land models.</td>
</tr>
<tr>
<td>Danny Risto</td>
<td>Institute for Atmospheric and Environmental Sciences, Goethe University Frankfurt, Germany</td>
<td><a href="mailto:risto@iau.uni-frankfurt.de">risto@iau.uni-frankfurt.de</a></td>
<td>I am a PhD student at Goethe University Frankfurt and working on snow in seasonal forecasts. I am interested in the snow-atmosphere interaction on a seasonal timescale. For this purpose, I want to investigate the impact of snow data assimilation and modelling on predictive skill.</td>
</tr>
<tr>
<td>Adrian Rocha</td>
<td>University of Notre Dame</td>
<td><a href="mailto:arocha1@nd.edu">arocha1@nd.edu</a></td>
<td>Rocha is an ecosystem ecologist who is interested in using model-data fusion techniques to quantitatively test and validate hypotheses on ecosystem function. Rocha uses remote sensing, eddy covariance datasets, and models to address this interest in the arctic biome. For example, his lab has used model-data fusion techniques to statistically attribute arctic greening trends to climate change.</td>
</tr>
<tr>
<td>Brendan Rogers</td>
<td>Woodwell Climate Research Center</td>
<td><a href="mailto:brogers@woodwellclimate.org">brogers@woodwellclimate.org</a></td>
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<td><strong>Brendan Rogers</strong> uses a variety of techniques including field observations, remote sensing, and modeling to analyze carbon and climate feedbacks in high latitude terrestrial ecosystems (boreal forests and tundra). Much of this work is focused on disturbances, particularly wildfire, and the impacts of intensifying fire regimes. We have a new project that involves building a data assimilation version of a terrestrial ecosystem model, so I am mainly hoping to learn during this workshop.</td>
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<tr>
<th>Tasnuva Rouf</th>
<th>UC Berkeley</th>
<th><a href="mailto:tasnuva@berkeley.edu">tasnuva@berkeley.edu</a></th>
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<tr>
<td><strong>Satellite observations</strong> give us the opportunity to improve modeling capabilities and to monitor the hydrological cycle in its entirety, without differentiating whether natural or human driven processes cause its variability. The soil moisture dedicated missions such as the Soil Moisture and Ocean Salinity (SMOS) and the Soil Moisture Active Passive (SMAP) missions have the potential to detect agriculture irrigation [He et al., 2017]. Data assimilation, through a weighted combination of model predictions and observations, allows us to estimate hydrological states better than either source of information individually [Reichle et al., 2007].</td>
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<tr>
<th>Alex Ruane</th>
<th>NASA Goddard Institute for Space Studies</th>
<th><a href="mailto:alexander.c.ruane@nasa.gov">alexander.c.ruane@nasa.gov</a></th>
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<tbody>
<tr>
<td><strong>Alex Ruane</strong> is a Research Scientist and co-Director of the Climate Impacts Group at the NASA Goddard Institute for Space Studies and a leader of the Agricultural Model Intercomparison and Improvement Project (AgMIP). His work focuses on climate impacts and agricultural and food system risks spanning historical, monitoring, forecast, and climate change projection time scales. Alex is also a member of the AIMES Scientific Steering Committee and an IPCC Coordinating Lead Author (WGI) and Core Writing Team member (AR6 Synthesis Report).</td>
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<tr>
<td>Name</td>
<td>University</td>
<td>Research Focus</td>
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<tr>
<td>Ma Rui</td>
<td>Wuhan University</td>
<td>Using high-quality satellite observation to calibrate the parameters of the land surface model, with machine learning methods as the primary method.</td>
</tr>
<tr>
<td>André Santos</td>
<td>PPGEA/UFPR</td>
<td>Research on interactions between soil, vegetation, and atmosphere modeling, focusing on vegetation dynamics and physiological vegetation processes, with particular attention to turbulent transfer coefficients and respiration processes, respectively.</td>
</tr>
<tr>
<td>Ayan Sasmal</td>
<td>University of Northern Iowa</td>
<td>My work focuses on bio-geography and remote sensing of cold environments and cryosphere. I used energy model to estimate snow metamorphism in different land surface and detecting it through hyperspectral imaging for my M.A. dissertation work at University of Northern Iowa. My previous research work consists of wildlife and atmospheric interaction relation and habitat management.</td>
</tr>
<tr>
<td>Ann Scheliga</td>
<td>UC Berkeley</td>
<td>I am a second-year master's student at UC Berkeley in Environmental Engineering. I do research on remote-sensing hydrology, and my current project looks at isolating and quantifying anthropogenic influences on terrestrial water storage by comparing DA and model-only estimates.</td>
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<tr>
<td>Samuel Scherrer</td>
<td>TU Vienna</td>
<td><a href="mailto:samuel.scherrer@geo.tuwien.ac.at">samuel.scherrer@geo.tuwien.ac.at</a></td>
</tr>
<tr>
<td>Toni Schmidt</td>
<td>UFZ Leipzig</td>
<td><a href="mailto:toni.schmidt@ufz.de">toni.schmidt@ufz.de</a></td>
</tr>
<tr>
<td>Marko Scholze</td>
<td>Lund University</td>
<td><a href="mailto:marko.scholze@nateko.lu.se">marko.scholze@nateko.lu.se</a></td>
</tr>
<tr>
<td>Xu Shan</td>
<td>Delft university of technology</td>
<td><a href="mailto:x.shan-2@tudelft.nl">x.shan-2@tudelft.nl</a></td>
</tr>
</tbody>
</table>

**Samuel Scherrer**
TU Vienna

I recently started my PhD in Geodesy & Geoinformation at TU Vienna, and have a background in Environmental Science and Physics, especially numerical modelling, but only theoretical knowledge of data assimilation algorithms. I am working in a project on multi-satellite VOD and soil moisture assimilation using the Noah-MP LSM. The goal of the project is to obtain improved estimates of root zone and surface soil moisture, as well as vegetation state.

**Toni Schmidt**
UFZ Leipzig

After doing my master's at U Potsdam (Germany) in Remote Sensing and Geoinformation I gained a theoretical insight into DA but never used it in practice. Now I've started my PhD at UFZ Leipzig (Germany) and want to use DA practically for the first time to spatially downscale global soil moisture measurements using remote sensing imagery and hydrological models.

**Marko Scholze**
Lund University

Dr Marko Scholze leads the "Inverse modelling of the interaction between the atmosphere and the earth's surface" research group which investigates the global carbon cycle and its interactions with climate and humans by means of inverse modelling and assimilating observations into process-based models. He is a physicists by training and one of the main developers of the Carbon Cycle Data Assimilation System CCDAS. He is currently coordinating the European Space Agency's Land surface Carbon Constellation project (http://lcc.inversion-lab.com) demonstrating the synergistic exploitation of satellite observations in data assimilation for an improved understanding of the terrestrial carbon. He is an expert member of the European Commission's CO2 Monitoring Task Force to support the development of an operational capacity to monitor fossil CO2 emissions from atmospheric observations.

**Xu Shan**
Delft university of technology

constraining plant water dynamics in land surface model
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<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Description</th>
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<tbody>
<tr>
<td>Zheng Shi</td>
<td>Oak Ridge National Lab</td>
<td>I am a global change ecologist. I work with global soil carbon model and data. Using data assimilation, I assess the uncertainties introduced by model processes and parameter values.</td>
</tr>
<tr>
<td>Shibin</td>
<td>India Meteorological Department</td>
<td>I had worked on the ORCHIDEE model and currently planning to use the model data offline land data assimilation.</td>
</tr>
<tr>
<td>Sonu Singh</td>
<td>KIIT</td>
<td>I'm an Applied math MS student at KIIT, India. I've experience in DA for numerical weather prediction.</td>
</tr>
<tr>
<td>yang song</td>
<td>University of Arizona</td>
<td>I am an assistant professor from the Department of Hydrology and Atmospheric Sciences at the University of Arizona, and a faculty member of the NSF-NRT funded interdisciplinary training in Genomic and Ecosystem Sciences (BRIDGE) program. My research specializes in Biospheric-Earth System Modeling, which focuses on advancing our understanding and predictive power of the role of vegetation, microbial communities, and humans -the biotic components of the Earth system - in terrestrial-atmospheric interactions. I am particularly interested in developing scaling solution to integrate multi-scale data(e.g., genomics data, ecological observation, satellite observation) to represent the functions of vegetation and microbial communities in the land surface models.</td>
</tr>
<tr>
<td>Susan Steele-Dunne</td>
<td>Delft University of Technology</td>
<td>My group uses microwave remote sensing to monitor the transport of water through vegetation from the land surface to the atmosphere in order to understand the role of vegetation in the water, energy and carbon cycles. We perform research from field to global scales, combining in-situ and spaceborne sensors to improve our understanding of the influence of vegetation water dynamics on radar observables. Our research embraces the latest developments in modeling, data assimilation and machine learning to exploit existing spaceborne radar instruments for a wide range of applications in ecosystem and agricultural monitoring, and prepare for future missions.</td>
</tr>
<tr>
<td>Name</td>
<td>Affiliation</td>
<td>Research Focus</td>
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<tr>
<td>Santosh Subhash Palmate</td>
<td>Texas A&amp;M AgriLife Research</td>
<td>I am working on data assimilation technique for arid region agriculture. My focus is on land states and fluxes of carbon and water cycles. The aim of my research is on sustainable crop production under salinity and water scarcity issues.</td>
</tr>
<tr>
<td>Travova Svetlana</td>
<td>Hydrometcenter of Russia</td>
<td>I currently work at the development group of assimilation module for the global atmosphere model SL-AV, Hydrometcenter of Russia. I do research in data assimilation of soil moisture for multilayer soil model, using the simplified extended Kalman Filter method.</td>
</tr>
<tr>
<td>Dong Taifeng</td>
<td>Agriculture and Agri-Food Canada</td>
<td>data assimilation, crop growth model and multi-remote sensing observations</td>
</tr>
<tr>
<td>Jalisha Theanutti</td>
<td>Lund University</td>
<td>I am a second-year Ph.D. student at the Lund University. I work on the Data assimilation algorithms for improving the quantification of CH4 fluxes from wetlands using the LPJ-GUESS model. I am interested in vegetation modelling, global carbon budget accounting, wetland dynamics, and data assimilation techniques.</td>
</tr>
<tr>
<td>Hans Verbeeck</td>
<td>UGent</td>
<td>I am a Professor at CAVElab UGent (Computational and Applied Vegetation Ecology), we are using multiple vegetation models (ED2, ORCHIDEE, LPJguess), we are trying to improve them for specific ecosystems mainly in tropics using both field and remote sensing data.</td>
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<td>Institution</td>
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<tr>
<td>Santiago Vianna Cuadra</td>
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<td><a href="mailto:santiago.cuadra@embrapa.br">santiago.cuadra@embrapa.br</a></td>
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<td>Toni Viskari</td>
<td>Finnish Meteorological Institute</td>
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<td>Joanne Waller</td>
<td>Met Office, UK</td>
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<td>Huiqi Wang</td>
<td>University of California, Berkeley</td>
<td><a href="mailto:whq225@berkeley.edu">whq225@berkeley.edu</a></td>
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<td>Siyuan Wang</td>
<td>MPI-BGC</td>
<td><a href="mailto:swang@bgc-jena.mpg.de">swang@bgc-jena.mpg.de</a></td>
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<tr>
<td>Jennifer Watts</td>
<td>Woodwell Climate</td>
<td><a href="mailto:jwatts@woodwellclimate.org">jwatts@woodwellclimate.org</a></td>
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<tr>
<td>Ensheng Weng</td>
<td>Columbia University/NASA GISS</td>
<td><a href="mailto:wengensheng@gmail.com">wengensheng@gmail.com</a></td>
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<tr>
<td>Peter Weston</td>
<td>ECMWF</td>
<td>Peter Weston works at ECMWF on land surface data assimilation. His current research interests are in using observations from SMOS and SMAP to exploit information on soil moisture.</td>
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<tr>
<td>Georg Wohlfahrt</td>
<td>University of Innsbruck</td>
<td>Interested in using DA for land surface models, especially the role of multiple constraints</td>
</tr>
<tr>
<td>Matthew Worden</td>
<td>Stanford</td>
<td>I am a first year phd student at Stanford University. My interests involve modeling the global carbon and water cycle as well as constraining the uncertainties in their projection into the future. I am currently working on assimilating output from Terrestrial Ecosystem Models (TEMS) into a simpler carbon model to see if the plant functional types that drive TEMS emerge in the data constrained simple carbon model parameters.</td>
</tr>
<tr>
<td>Xinlei</td>
<td>Beijing Normal University</td>
<td>A multipass land data assimilation scheme (MLDAS) is proposed based on the Noah-MP model.</td>
</tr>
<tr>
<td>tongren xu</td>
<td>Beijing Normal University</td>
<td>I'm working on multi-source observation land data assimilation to improve turbulent heat fluxes. The satellite observations (e.g. smap, modis, oco-2) and ground measurements (soil moisture, leaf area index) can be integrated with physical models with data assimilation and machine learning methods to correct model's biases and errors.</td>
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<tr>
<td>Kailiang Yu</td>
<td>LSCE</td>
<td>I have been interested in carbon allocation and carbon turnover which is my research focus in recent years. I am keen and working on adding more ground based dataset into the data-model fusion with interests to improve the models in term of below ground processes.</td>
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<tr>
<td>Name</td>
<td>Affiliation</td>
<td>Description</td>
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<tr>
<td>Sönke Zaehle</td>
<td>MPI Biogeochemistry</td>
<td>I have spent my last few years developing (probably too complex) land surface models including a representation of carbon-nutrient cycle interactions, as well as advanced representation of important ecophysiological processes. I have also developed a carbon-cycle data assimilation system around the land surface model JSBACH. I'm particularly interested in this workshop to learn more about new ideas for an efficient DA with computationally heavy models.</td>
</tr>
<tr>
<td>Chunhui Zhan</td>
<td>Max Planck Institute for Biogeochemistry</td>
<td>I am working on the rising CO2 effect on carbon and water cycle based on model simulation and observational data. So far my work does not involve DA but probably will need it in the future.</td>
</tr>
<tr>
<td>Lijie Zhang</td>
<td>forschungszentrum jülich, IBG3</td>
<td>The program applies to fertilization in combination with Digital Agricultural Avatars (DAA) that inform robots and the next generation of tractors to address crop nitrogen deficiency based on information received from in-situ observations from ground or airborne autonomous systems. Such digital avatars are based on a hierarchical model system based on the TerrSysMP platform and process- based crop growth models. My DA work is large eddy simulation and data assimilation over agricultural areas to detect plant stress.</td>
</tr>
<tr>
<td>Yu Zhang</td>
<td>UT Arlington</td>
<td>Veteran of National Weather Service Hydrology Program. PI for a NOAA-funded project on assimilating SWE products into the National Water Model. In the current project, we developed a 3DVar DA scheme for Noah-MP snow model.</td>
</tr>
<tr>
<td>Zhen Zhang</td>
<td>University of Maryland</td>
<td>I'm a land surface modeler and I'm interested in using DA to integrate soil moisture observations into carbon cycle modeling.</td>
</tr>
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| **Hong Zhao**  
ITC, University of Twente, the Netherlands  
h.zhao@utwente.nl |
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<td>I am a post-doctoral researcher at ITC, University of Twente. My DA work focuses on the retrieval of soil physical property using the Local Ensemble Transform Kalman Filter (LETKF) algorithm assimilating SMAP L1C brightness temperature observations into the coupled CLM 4.5 and a discrete scattering-emission model. My current work is on microwave scattering-emission modeling at multi-frequency.</td>
</tr>
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| **Long Zhao**  
Southwest University  
zhaol04@swu.edu.cn |
|---|
| I have worked with SiB2-, CLM-, and Noah-MP-based regional and global land DA, and have worked with Zong-Liang Yang at UT-Austin to develop a prototype multi-sensor land DA system using CLM and the Data Assimilation Research Testbed, which is proven capable of improving global soil moisture and snow estimation.  
I also participated in establishing a multi-scale soil moisture and temperature monitoring network in the central Tibetan Plateau (CTP-SMTMN), which is a member of ISMN since 2012. |

| **Hui Zheng**  
Institute of Atmospheric Physics, Chinese Academy of Sciences  
hzheng_iap@outlook.com |
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<tr>
<td>I am working on ensemble data assimilation with DART and NoahMP, primarily focusing on soil moisture and snow.</td>
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</table>

| **Weizhong Zheng**  
NOAA/NCEP/EMC  
Weizhong.Zheng@noaa.gov |
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<td>Work on NCEP's models and data assimilation.</td>
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Tackling Technical Challenges in Land Data Assimilation

June 14-16, 2021 · 9:00-12:00 EDT / 3:00 - 6:00 CEST
Virtual Workshop: Zoom Guidance

If you are new to using the Zoom video conferencing platform, we put together a short (non-exhaustive) guide to the main features that we will be using during this workshop:

To join the meeting each day:

To join the meeting, click the join link that we provide each day either by email or found here in the agenda. You can also click Join in your Zoom client and enter the meeting ID (946 2637 6151) and passcode (913897).

To use the chat box:

Navigate to the menu bar by hovering over the bottom of your Zoom screen. Once the menu bar is visible, click on the chat box highlighted below in red to access the chat box in your window.

To join a breakout room:

The host will broadcast a message to open the breakout rooms. This message will open a breakout room dialog box on your screen. You can then click ‘Join’ to enter the breakout room of your choice, as highlighted in the following image:
One minute before the end of the breakout session, the host will again broadcast a message announcing the end of the breakout groups. Participants will then see a dialog box indicating that breakout rooms will close in 60 seconds. After the 60 seconds are up, all participants will be returned to the main room - requiring no action on your part.

**To set your Zoom screen background:**

1) Check the [system requirements](#) for setting a virtual background in Zoom.

2) To enable virtual backgrounds if you have a Zoom account,
   a) Sign in to the Zoom web portal.
   b) In the navigation menu, click **Settings**.
   c) In the **Meeting** tab, navigate to the **Virtual Background** option (under the In Meeting (Advanced) section) and verify that the setting is enabled:

   - Virtual background
     Customize your background to keep your environment private from others in a meeting. This can be used with or without a green screen.

   - Allow use of videos for virtual backgrounds

   - Manage virtual background

3) To set your background ahead of time:
   a) Under the **Virtual Background** option, click 'Manage 5 virtual backgrounds'
b) Drag and drop files or upload your file at the prompt.

2) To set your background after joining the meeting:
   a) At the bottom of the Zoom window, click the up arrow next to Stop Video.
   b) Select **Choose Virtual Background...**:

![Virtual Background Setting](image.png)

   c) In the Virtual Background tab, select or upload your own image by clicking the + icon.

For additional references, the Zoom video tutorials [found here](#) are very helpful. Please also reach out with any concerns or questions to [aimes@futureearth.org](mailto:aimes@futureearth.org).