Wednesday, June 24, 2:00 pm – 4:00 pm EDT, Breakout Session 1

LASSO Expansion Plans: Deep convection during CACTI

Conveners: William I. Gustafson Jr., Andrew M. Vogelmann, and James H. Mather
Description: The Large-Eddy Simulation (LES) ARM Symbiotic Simulation and Observation (LASSO) activity is growing to include simulations of deep convection in addition to the shallow-convection LES runs currently available. The new scenario will focus on deep convection during the CACTI field campaign in Argentina with a primary focus on convective initiation and upscale growth. As such, the simulations will be much more ambitious than the current shallow convection LES runs.

After a short update on the status of the current, shallow-convection scenario, the primary focus of this breakout will be to share the current plans for the new LASSO scenario and get community feedback to refine the path forward. Of particular importance will be a discussion of the science drivers, as these guide both the model configuration to be used along with how the observations will be employed within the LASSO data bundles. Potential model configurations and outputs will be discussed. We also seek to engage those involved with the CACTI observation data sets to evaluate options for how to best use the available measurements.

ARM Aerial Instrumentation Update and Discussion

Conveners: Fan Mei, Dari Dexheimer, Beat Schmid
Description: This session will provide a forum for the atmospheric research community to discuss the implementation of existing, and new measurement capabilities on ARM's recently acquired piloted aircraft (the Bombardier Challenger 850 regional jet), its midsize unmanned aerial system (the ArcticShark UAS), and its tethered balloon systems (TBS) to enhance ARM's aerial observation capabilities and better link ARM airborne observations to the surface-based observatories. Results from the ARM Aerial Instrumentation Workshop and ARM white paper call will be presented.

Preliminary Agenda:
Beat Schmid – Intro, workshop goals, structure and participants (2 min)
Beat Schmid - Challenger 850 and ArcticShark update (10 min)
Jason Tomlinson: Challenger 850 modifications (10 min)
Fan Mei: Instruments (existing and proposed) for Challenger 850 aircraft (15 min)
Dari Dexheimer: Instruments (existing and proposed) for TBS (15 min)
Beat Schmid: Instruments (existing and proposed) for UAS (10 min)
All Participants – Discussion (58 min)

Shortwave-absorbing aerosols and their interactions with the large-scale environment

Conveners: Paquita Zuidema, Allison Aiken, Yan Feng, Art Sedlacek
Description: Biomass-burning aerosols (BBA) represent complex mixtures of black and brown carbon that include organic aerosols, distinguishing them from the soot emitted by fossil fuels. The aerosol chemical composition, irrespective of source, will change with age, affecting the aerosol's optical and cloud-nucleating properties in time-dependent ways. These affect the direct aerosol radiative effect, which also depends on the underlying albedo, either of the earth's surface or clouds. Such aerosols are also effective cloud nucleators. Clouds, if present, adjust to the presence of smoke. Clouds can adjust both radiatively to the shortwave absorption, or indirectly through changes to their microphysics when clouds and aerosols mix. The dominant processes will vary with the aerosol-cloud vertical structure, which can vary seasonally, while the dominant cloud adjustments will also evolve as the clouds advect with the prevailing wind.

Modeling efforts are necessary to help articulate the significant processes, with model-observational closure/validation studies necessary for promoting confidence in model-based analyses. The characterization of truly aged biomass-burning aerosol, its relationship to the prevalent marine cloud, and the processes by which the clouds interact with the smoke, motivated the LASIC (Layered Atlantic Smoke Interactions with Clouds) campaign held in the remote southeast Atlantic on Ascension Island. The motivating issues occur globally. Lab studies are encouraged. We invite all attendees with relevant material.

Participants: We are soliciting short presentations. If you would like to present, please send a title and a few sentences describing your contribution to the conveners (pzuidema@miami.edu, aikenac@lanl.gov, yfeng@anl.gov and sedlacek@bnl.gov) by early June.

Thursday, June 25, 11:00 am – 1:00 pm EDT, Breakout Session 2

Advance Atmospheric Process Studies in High-Altitude Complex Terrain with the Surface Atmosphere Integrated field Laboratory (SAIL) Campaign

Conveners: Daniel Feldman, Allison Aiken, Scott Collis, Jim Smith, Adam Varble

Description: This breakout session will present an overview of the upcoming Surface Atmosphere Integrated field Laboratory (SAIL) campaign and its science questions and objectives. The campaign includes the use of the AMF2 facilities and a precipitation radar to make intensive atmospheric and surface measurements in the Rocky Mountains from 2021-2023 in southwestern Colorado near the town of Crested Butte. Speakers will discuss science opportunities in high-altitude complex terrain, the types of observations that are needed to advance these opportunities, and how specifically the observations will be used to characterize precipitation processes, aerosol-precipitation interactions, aerosol processes, surface-atmosphere interaction processes, and radiation. We will schedule significant time for questions and discussion. There are several goals for this session including:

1. To introduce the ARM/ASR community to the SAIL campaign and its science questions and objectives.
2. To provide a survey of ongoing and upcoming fieldwork that is external to SAIL but will occur in and around Crested Butte and which can complement the SAIL.
3. To solicit feedback from the ARM/ASR community regarding researchers' data product needs and atmospheric process studies that those data products can enable.
4. To discuss the opportunities to study spatial heterogeneity in complex terrain in order to ensure that observations are scientifically relevant beyond the range of the observations.

Preliminary Agenda:

11:00 – 11:15 Campaign Overview (Dan Feldman)
11:15 – 11:25 Precipitation Observations and Process Study Opportunities (Chandra)
11:25 – 11:35 Aerosol Observations and Process Study Opportunities (Allison Aiken)
11:35 – 11:45 Aerosol/Precipitation Interaction Study Opportunities (Jiwen Fan)
11:45 – 11:55 Land-atmosphere Interaction Study Opportunities (Ryan Sullivan)
11:55 – 12:05 Testing Integrated Process Models with SAIL data (Dave Gochis)
12:05 – 1:00 Discussion

Discussion topics:

- ARM data products and needs
- Connecting to mountain hydrology research
- Testing Earth System Models

Aerosol and Cloud Experiments in the Eastern North Atlantic (J. Wang)

Conveners: Jian Wang, Jason Tomlinson, Beat Schmid

Description: The main focus of this breakout session is to bring together members of the ASR Science Team, ARM Aerial Facility, ARM infrastructure, and other colleagues to present and discuss the progresses towards quality controlled data streams, value-added data products, scientific results, and ongoing research activities of ACE-ENA. Discussions will be aimed at identifying collaborative research opportunities and unaddressed research avenues.

The session agenda includes (1) presentation and discussion of data availability, data quality, and value-added data products, (2) presentation of scientific results and ongoing research, (3) discussion on what science questions can be addressed most effectively using the data available, and (4) discussion on the development of cases for model simulations/validation.

Participants: Please contact the conveners for more information.

Pairing SCM/LES and GCM/ESM for observation-guided model development

Conveners: Ann Fridlind, Israel Silber, Robert Jackson, Scott Collis, Shaocheng Xie

Description: The performance of a climate model's single-column model (SCM) physics may provide a quite faithful representation of that climate model's regional cloud properties. For instance, the SCM representation of subtropical marine low clouds along boundary layer Lagrangian trajectories is expected to resemble the parent model's regional physics along similar trajectories (Neggers JAMES 2015). An actionable implication is that suitable SCM case studies and long-term observations can be combined to effectively guide climate model physics improvements and confirm their impacts in relevant long-term statistics. This session invites discussion of current and potential future community projects that are motivated by specific climate model development objectives, and that employ a combination of SCM/LES and GCM/ESM approaches using ARM observations. A leading example is provided by the GASS Diurnal Cycle of Precipitation Project (https://portal.nersc.gov/cfs/capt/diurnal/). A recently derived Lagrangian SCM/LES case study of highly supercooled drizzling stratus over Antarctica and development of an open source radar-lidar forward simulator for statistical evaluation of GCM/ESM cloud phase offer a pairing that is focused on polar cloud phase.

Planned objectives of the breakout discussion:
(1) establish degree of interest in this general approach, or modifications thereon
(2) collect input on known climate model biases or ECS-relevant processes of interest
(3) discuss possible coupled LES-SCM/GCM-obs exercises to address those

Short introductory talks will be limited to briefly outlining the concept, the DCP project example, the role for a ground-based simulator component, and a climate modeling perspective.

Thursday, June 25, 2:00 pm – 4:00 pm, EDT Breakout Session 2

AMF3 Southeast United States Deployment

Conveners: Chongai Kuang, Scott Giangrande, Shawn Serbin, Joe Hardesty, Nicki Hickmon, Jim Mather

Description: The third ARM Mobile Facility (AMF3) will be relocated from Oliktok Point to the Southeast United States (SEUS) for a five-year deployment starting in the fall of 2022. The SEUS is a region characterized by abundant surface-forced shallow to deep convection, high rates of vegetative-driven biogenic emissions, and strong local coupling of the land surface with atmospheric processes. The AMF3 SEUS site science team is working with ARM and the larger scientific community to guide the siting of the new deployment in order to address critical science focal areas spanning five cross-cutting topics: convective cloud initiation, deep convective cloud processes, aerosol controls on cloud condensation nuclei, aerosol direct impacts on radiation, and land-atmosphere two-way interactions (LAI). This long-term campaign will serve as the basis for a wide range of observational, analysis, and modeling studies to

characterize the region and will be of interest to a large sector of the Earth science community. This breakout session will enable outreach to the broader ARM/ASR scientific community by providing a venue for discussing SEUS science drivers and associated siting considerations and for gathering feedback from the community. The goals of the session are to present and solicit feedback on: [1] high-level goals of the upcoming deployment; [2] siting maps with general regions identified that meet criteria of the proposed science drivers and operational requirements; [3] a preliminary timeline for deployment decisions and rollout; [4] the transition plan from Oliktok Point; and [5] SEUS science drivers targeting aerosol, convective clouds, and LAI topics.

Participants:
To facilitate our breakout session discussion, our site science team solicits input prior to the breakout session from the ARM/ASR scientific community regarding: [1] critical measurement needs; and [2] spatial and temporal observational scales that would support a successful deployment of the AMF3 to the SEUS. Please send input to Chongai Kuang (ckuang@bnl.gov).

COMBLE and high-latitude clouds over open water

Conveners: Bart Geerts
Description: This session will present preliminary findings from the recently completed COMBLE campaign; as well as other studies of boundary layer clouds during cold-air outbreaks over open water. While the emphasis is on Boreal open waters (COMBLE), we will also cover Southern Ocean observational and modelling work (MARCUS).

Preliminary agenda:

- Aerosol-Cloud-Precipitation Interactions in Mixed-Phase Clouds over the Southern Ocean (Greg McFarquhar)
- Overview of Data Collected in COMBLE (Nathan Wales)
- Case Study of a CAO in COMBLE (Yonggang Wang)
- Cloud Properties during Marine Cold Air Outbreaks in COMBLE: a Preliminary Survey (Bart Geerts)
- Large Eddy Simulation of CAO Clouds in the Fram Strait, validated against Airborne and Satellite Measurements (Roel Neggers)
- Preliminary Plans for VAPs and Model Forcing Datasets in COMBLE (Shaocheng Xie)
- Discussion: approaches for LES/CRM model setups, initializations, and coordinated evaluation in COMBLE (moderator: Mikhail Ovchinnikov)
- Discussion: data product needs (moderator: Mike Jensen)

Presentations will be ~10 min long, followed by Q&A.
Participants: We can make room for 1-2 additional brief presentations. Please contact Bart Geerts (geerts@uwyo.edu) if you are interested in presenting.

Friday, June 26, 11:00 am – 1:00 pm EDT, Working Group Session 1

Aerosol processes

Conveners: Nicole Riemer and Jim Smith
Description: The aerosol processes working group focuses on understanding of processes that control spatial and time-related distribution of aerosols and their chemical, microphysical (occurring on a microscopic scale), and optical properties. The goal is to reduce the uncertainty in radiative forcing (energy imbalance) due to these atmospheric particles. Research areas include: 1) new particle formation; 2) effects of aerosol composition, mixing state, and physical properties on growth, aging, and removal processes; 3) direct and indirect radiative effects of optically absorbing aerosols; and 4) understanding and

predicting secondary organic aerosol concentrations and properties.
Participants: Please contact Nicole Riemer (nriemer@illinois.edu) and Jim Smith (jimsmith@uci.edu) if you have suggestions for discussion topics.

Convective processes

Conveners: Adam Varble and Hugh Morrison
Description: The convective processes working group focuses on improving understanding and model representation of convective (heat-transferring) cloud processes and properties, including cloud cover, precipitation, life cycle, dynamics, and microphysics, over a range of spatial scales. Research areas include: 1) convective vertical velocity (upward heat transfer) and interactions with cloud microphysics and precipitation; 2) shallow to deep cloud transitions and organization of convective clouds on larger scales; and 3) interactions between cloud microphysics, aerosols, precipitation, and radiation.
Participants: Please contact Adam Varble (adam.varble@pnnl.gov) and Hugh (morrison@ucar.edu) if you have suggestions for discussion topics.

Friday, June 26, 2:00 pm – 4:00 pm EDT, Working Group Session 2

High-latitude processes

Conveners: Gijs de Boer and Greg McFarquhar
Description: The High Latitude Processes Working Group focuses on the understanding and model representation of physical processes controlling the surface energy budgets in northern and southern high-latitude regions. This includes work to understand: 1) cloud microphysical and macrophysical properties, with emphasis on hydrometeor (rain, snow, etc.) phase division and ice crystal properties; 2) aerosol particle properties, including sources and transport, chemical and optical properties, and the role of the particles in cloud structure; 3) tropospheric states (pertaining to the lowest atmospheric layer, where most weather occurs), including the role of clouds in atmospheric mixing, development of convective boundary layers in regions with diverse surface conditions, and the role of microscale and mesoscale meteorological circulation patterns on thermodynamic evolution; and 4) surface-atmosphere interactions, including elements affecting radiative and turbulent surface energy exchange.

Participants: Please contact Gijs de Boer (gijs.deboer@colorado.edu) and Greg McFarquhar (mcfarq@ou.edu) if you have suggestions for discussion topics.

Warm boundary layer processes

Conveners: Rob Wood and Yunyan Zhang
Description: The Warm Boundary Layer Processes working group focuses on understanding and model representation of processes controlling the structural and radiative properties of clouds, aerosols, and their interactions with the underlying surface in the lowest few kilometers of the atmosphere. Research areas include: 1) characterization of boundary layer and cloud dynamics; 2) cloud and aerosol microphysics and their interactions; 3) factors influencing cloud formation; and 4) radiative processes that together influence the vertical transfers of energy, moisture, and atmospheric components.

Participants: Please contact Robert Wood (robwood2@uw.edu) and Yunyan Zhang (zhang25@llnl.gov) if you have suggestions for discussion items.