Meeting/Workshop Reports

2023 GDAP Annual Meeting

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Accurately modeling Earth's energy imbalance and water cycle and their variability are fundamental to predicting the impacts of climate change. This motivated holding the 2023 GDAP Meeting in conjunction with the 2023 Clouds and the Earth's Radiant Energy System (CERES) fall science team meeting at the NASA Goddard Institute for Space Studies (GISS) in New York, USA from 19–20 October 2023. The venue provided an opportunity for GDAP to engage CERES and GISS researchers in scientific exchanges about the opportunities and challenges in using the growing satellite energy and water cycle data records for climate model development. The Panel meeting also included updates on all major GDAP projects and activities. Most Panel members and activity leads were able to join the Panel business meeting either virtually or in person on Friday morning.

CERES has played a key role in advancing energy budget science for more than two decades and has contributed to several GDAP activities. In addition to providing the latest updates on the CERES top of atmosphere and surface radiative flux products, the 2023 fall science team meeting addressed several current GDAP foci, including closure of the energy and water cycles, trends in Earth's radiation balance, and Earth's energy imbalance. Upcoming missions were introduced that promise to add a spectral dimension to radiation measurements and improve absolute calibration of top of atmosphere flux observations. Plans to extend the growing record of Earth radiation budget measurements with the Earth Ventures-Continuity Libera mission were also described, although some concerns remain regarding the ability to maintain a continuity with CERES.

The CERES meeting paved the way for GDAP to host a candid discussion between Panel members, CERES science leads, and GISS scientists on how GEWEX might foster increased use of global energy and water cycle observations to inform climate model development. Separate sessions covered the broad topics of water and energy cycles and convection. Introductory talks by Maria Hakuba, Ali Behrangi, Greg Elsaesser, and Kuniaki Inoue summarized current challenges and highlighted open questions to stimulate a broader discussion of potential avenues by which GDAP could contribute to advancing observation-model cooperation. Among the key messages were the acute needs for robust observational metrics and an understanding of structural uncertainties to avoid over-fitting models to spurious trends and variability. A careful distinction should also be made between observations for model evaluation and those that support model development. The latter generally consists of multi-dimensional metrics, or process-oriented diagnostics, that should be guided by model physics and able to be robustly simulated from model output. Spectrally-resolved radiation measurements spanning the top of atmosphere solar and thermal emission spectra that fit this model may be available soon. GDAP may sponsor a workshop focused on the value of spectrally-resolved radiation measurements for feedback analyses and model development.

The discussion revealed new methods for diagnosing systematic errors and improving model parameterizations such as multi-parameter tuning and energy and water closure, demonstrating progress in interfacing observations and models. However, the discussion concluded that, while there are many independent efforts to produce useful model diagnostics, progress is impeded by the lack of an internationally-coordinated effort to organize model and observational data and associated analytic tools on the cloud. While the shift toward open science is a valuable step toward expanding participation, higher-level coordination of assets and tools is needed to bring communities together and maximize progress, especially as data volumes grow.

The GDAP Panel convened on Friday to welcome two new members, Patrick Taylor and Brent Roberts, and offer our warmest thanks for departing member Seiji Kato. Hanii Takahashi accepted a nomination to join the Panel, representing new initiatives related to convective cloud tracking and observing energy and water cycle processes. Following new member talks by Brent Roberts and Patrick Taylor that highlighted challenges in compiling comprehensive reconstructions of Earth's energy and water cycles and understanding polar amplification, respectively, the Panel heard updates from each of the core projects and activities.

The GDAP Earth's Energy Imbalance (EEI) Assessment continues to advance under the leadership of Benoit Meyssignac and Tim Boyer. A second community workshop was held in Frascati, Italy, in May 2023, highlighting consensus between independent estimates from top-down (satellite-based) and bottom-up (in situ) approaches for deriving EEI. Several papers have emerged from this activity. Moving forward, the group will explore methods for increasing the spatial and temporal resolution of energy imbalance estimates with a target of demonstrating the potential for generating consistent regional, monthly estimates from multiple methodologies.

Following a productive meeting in 2022, the Baseline Surface Radiation Network (BSRN), under the leadership of Christian Lanconelli and Laura Riihimaki, has continued to expand the diversity of regimes monitored and implement enhanced quality control procedures. More efficient methods of data archival are being explored and a best practices white paper will be submitted soon. Plans to initiate a satellite working group in BSRN to strengthen the links between space-based and ground-based radiation measurements are ongoing.

The International Satellite Cloud Climatology Project Next Generation (ISCCP-NG) initiative continues to advance under project lead Andrew Heidinger. The Level 1 (L1G) data set

Participants of the 2023 GDAP Meeting

for the full Geostationary Earth Orbit (GEO)-ring of advanced geostationary imagers is being analyzed by several groups and feedback has been positive, prompting the application of Level-2 (L2) cloud algorithms to the L1G data. ISCCP-NG has been well received by agencies internationally and the National Oceanic and Atmospheric Administration (NOAA) and European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) have pledged to ensure continued progress.

In the past year, GDAP has been very active in sponsoring and participating in global energy and water cycle workshops. The Integrated Product (IP) workshop originally planned for spring 2020 was held in Toledo, Spain, in April 2023. Three days of fruitful discussions between land surface modelers, hydrologists, and the in situ and satellite observational communities laid the foundations for a future multi-scale, land-atmosphere closure initiative with the Global Land-Atmosphere System Studies (GLASS) Panel and GEWEX Hydroclimatology Panel (GHP). Both GDAP co-chairs also attended the 2nd EarthCARE modeling workshop in Shuzenji, Japan in March 2023. The meeting identified exciting new opportunities for engaging models with observations with the advent of km-scale Global Storm Resolving Models (GSRMs). Discussions are underway with the Global Atmospheric System Studies Panel (GASS) co-chairs regarding a potential cross-cutting activity centered on evaluating clouds and their radiative effects in GSRM simulations using modern satellite observations.

GDAP was also represented at the first convective tracking workshop in Oxford, UK, in April 2023 that highlighted the growing field of cloud tracking in global satellite observations and identified a need to coordinate efforts moving forward. Many tracking tools have been developed in the last few years that utilize different approaches to target different phenomena, but no coordinated effort has been undertaken to compare the results and articulate the performance of the various approaches. A key recommendation from the meeting was for GDAP to organize an assessment of cloud tracking algorithms in the near future.

The remainder of the meeting outlined future workshops and new initiatives in the coming year. In the next year, GDAP will continue to pursue cross-cutting activities with fellow GEWEX Panels GLASS, GASS, and GHP. GDAP will continue to support the Upper Tropospheric Clouds and Convection (UTCC) Process Evaluation Studies (PROES) activity with GASS by assisting with a second ISCCP-NG community workshop in Darmstadt, Germany (February 2024), focused on discussing time and space resolution needs and defining L2 ISCCP-NG products. GDAP will also sponsor a follow-up convection tracking workshop at NASA GISS in New York (April 2024) led by new panel member Hanii Takahashi. Approaches for implementing recent advances in cloud tracking in multi-channel geostationary observations (e.g., ISCCP-NG) and interfacing with km-scale models will be discussed. Another goal for this meeting will be to define the scope of a GDAP-led coordinated assessment of cloud tracking algorithms and to identify participants. The Panel pinpointed polar amplification, process-oriented model diagnostics, and a new radiation assessment addressing the vertical and spectral dimensions as avenues to target for new activities in the near future. Longer-range goals include a third precipitation assessment to update the previous assessment report published in 2021 with renewed foci including the global and regional precipitation trends over recent decades and challenges in solid precipitation estimates, which are expected to meet emerging GDAP interests such as EEI and polar energy and water cycles.

The meeting concluded with a brief discussion of remaining membership needs. The desire to establish liaisons with GASS and GHP was reiterated (Yunyan Zhang currently serves as a liaison to GLASS) and a gap in ground-based radar expertise was noted. GDAP continues to seek nominations for new members that complement existing expertise on the Panel and, especially, those who complement the gender, ethnic, and geographic diversity of the Panel. The next GDAP Panel Meeting will be held in conjunction with GEWEX Open Science Conference in Sapporo, Japan (July 2024).