# 1st GEWEX Data and Assessments Panel (GDAP) Meeting

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The 1st meeting of the GEWEX Data and Assessments Panel (GDAP), formerly the GEWEX Radiation Panel (GRP), was hosted by the Laboratoire de Météorologie Dynamique (LMD) and the French National Space Centre (CNES). Dr. Claudia Stubenrauch, LMD, was the local host for the meeting, which was chaired by Professor Christian Kummerow, the GDAP Chair. Dr. Thierry Phulpin of CNES, opened the meeting and presented the CNES activities that are related to GDAP, particularly the instrument and algorithm work with the Infrared Atmospheric Sounding Interferometer (IASI), the Polarization and Anisotropy of Reflectances for Atmospheric Science coupled with Observations from a Lidar (PARASOL), and the MEGHA-TROPIQUES satellite.

Dr. Jörg Schulz, the GDAP Vice-Chair, reported on the first meeting of the new WCRP Data Advisory Council, where the inventory of Essential Climate Variables was reviewed. He also reported on the Sustained Coordinated Processing of Environmental Satellite Data for Climate Modeling (SCOPE-CM) that coordinates product development with reprocessing and transfer to operations. The initial network and structure of the activity has been established, along with principles, standards, and the selection of pilot projects to validate the practices.

### *Integrated GEWEX Product*

GDAP is developing data sets of global energy and water variables and conducting assessments of these products. An "Integrated GEWEX Product" with a common grid, ancillary data, assumptions, and space and time grids is being developed with a planned release date of mid-2013. There will be at least two versions of this product, one for algorithm developers that will contain as much diagnostic information as feasible, and a version for users who require only the most basic diagnostics. The processing will initially focus on 2007 before processing both forward and backwards in time to encompass the entire GEWEX time series. Colorado State University will combine the products into a single NetCDF4 file for initial assessments. After the product is finalized, GDAP will conduct an assessment of the state of the water and energy budgets to document the state of the Earth's observing systems. This will be the first assessment in a series of periodic re-evaluations consisting of global scale closure tests, temporal variability in the fluxes and states, attribution of changes to observed forcings, and a maturity index of various components based upon ongoing assessments of individual components of the budget.

### *Radiative Flux Assessment*

The recently completed Radiative Flux Assessment (see also page 4) showed that ancillary data are important in deriving surface radiative fluxes, and that although top-of-atmosphere solar irradiance is commonly known to be 1360.8 $Wm^{-2}$, many data sets and models still use an incorrect value for this quantity. For the cloud radiative effect, the study concluded that it is critical to have consistent definitions of "clear sky" before products can be compared in any meaningful way. Optical thickness values of 0.1–0.3 were determined to be a good working definition of "clear sky." Perhaps the most important result of the Assessment is that while there are differences between products, they tend to be significantly smaller than the differences between observations and climate models. As such, surface flux and atmospheric divergence products are still seen to be useful for climate model validation. The Radiative Flux Assessment is available at *http://gewex.org/gdap/gdap_assessment_wgs.html*. A summary of results has been submitted to the *Bulletin of the American Meteorological Society*.

### *Assessment of Global Cloud Data Sets*

Dr. Claudia Stubenrauch reported on the recently completed Cloud Data Assessment, which is available at *http://gewex.org/gdap/gdap_assessment_wgs.html*. A database was created for the Assessment that allowed for the first time an intercomparison of Level 3 cloud products of 12 global "state of the art" data sets (available at: *http://climserv.ipsl.polytechnique.fr/gewexca)*. Analyses show how cloud properties are perceived by instruments measuring different parts of the electromagnetic spectrum, and how cloud property averages and distributions are affected by instrument choice and methodological decisions. A key result from the Cloud Assessment is that absolute values, especially those of high-level cloud statistics, strongly depend on instrument (or retrieval) capability to detect and/or identify thin cirrus (decreasing from active lidar to infrared sounding to solar spectrum alone), and relative to geographical and seasonal variations in the cloud properties, agree very well with only a few exceptions, such as deserts and snow-covered regions. Probability density functions of radiative and bulk microphysical properties also agree well, when one considers retrieval filtering or possible biases due to partly cloudy pixels and due to ice water misidentification. When comparing one of these data sets to climate models, it is important to remember its specific sensitivity (even when using an observation simulator). A detailed description can be found in the report. Results are summarized in an article in the *Bulletin of the American Meteorological Society* (in press).

### *Water Vapor Assessment*

Dr. Marc Schroeder, who co-chairs the Water Vapor Assessment (G-VAP) activity with Drs. Lei Shi and Antonia Gambacorta, reported that the objectives of the assessment have been established and include total precipitable water, the water vapor profile, and upper tropospheric humidity. Prior to the recent G-VAP workshop held in Offenbach on 26–28 September 2012, data fact sheets were distributed to gather information on data records. Eighteen data fact sheets were received and more than 30 participants, mainly from ground-

based observation and satellite retrieval communities, attended the meeting which focused primarily on consolidating the G-VAP strategy and technical implementation. A summary of the meeting was published in the November 2012 issue of *GEWEX News*. Anyone wishing to participate in G-VAP should contact one of the three assessment organizers.

***Aerosol Assessment***

Dr. Stefan Kinne presented an update on the Aerosol Assessment, which is co-chaired by Drs. Sundar Christopher and Jeffrey Reid. The Assessment defines the nature of aerosol measurement problems and includes a synthesis of the literature and commentary on verification methods and findings. Subchapters on the use of satellite data in modeling and on aerosol optical depth trends have been added. Phase 2, a detailed independent evaluation, will start when the Moderate Resolution Imaging Spectroradiometer (MODIS) Collection 6, Level 1 Profile Products and the new Multi-Angle Imaging SpectroRadiometer (MISR) products are released. The number of aerosol data sets has grown exponentially, with many products developed for different applications. Most of the products are somewhere between research, development, and production, which makes it difficult to find distributed versions that exist long enough to make a meaningful assessment. This situation is in part reinforced by funding that provides far more money for product development than maintenance and verification.

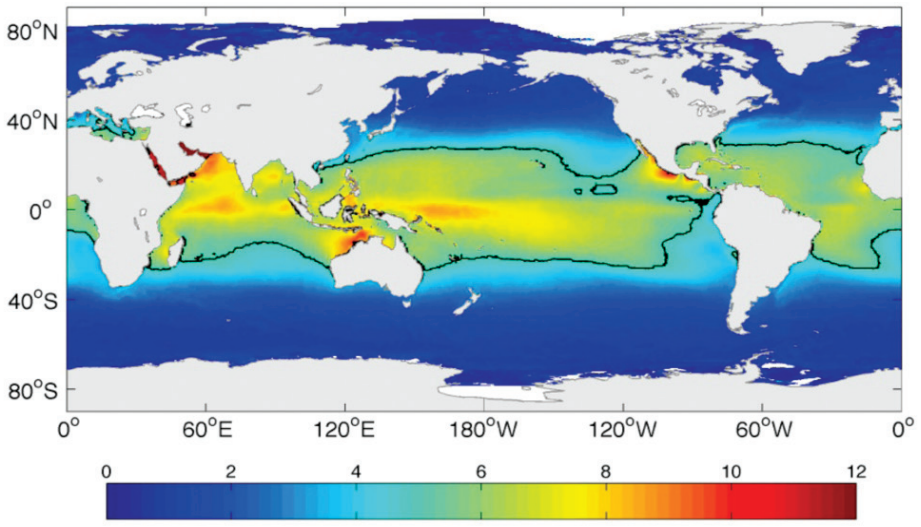
***LandFlux Assessment***

Dr. Carlos Jimenez presented the status of the LandFlux Assessment, which held its fourth workshop immediately after the GDAP meeting (see report in November 2012 issue of *GEWEX News*). Products for this Assessment were divided into three categories: (1) satellite-based; (2) diagnostic (satellite data combined with ancillary input data to diagnose latent and sensible heating); and (3) land-surface models (that use satellite data but derive fluxes from models and reanalyses). All the assessed products captured the seasonality of the heat fluxes and the expected spatial distributions (major climatic regimes and geographical features). The products correlated well with each other in general, aided by the fact that some of them use the same forcing data. There are, however, large evaporative fraction differences that suggest different partitioning of the radiative fluxes. The correlations are considerably lower when the seasonal component is removed from the fluxes, as seasonal variability is largely responsible for the high correlations. The LandFlux Assessment considered a common set of ancillary inputs to examine the relative impact of the method versus the impact of the input data. These common input data sets are being used to evaluate Version 0 of the LandFlux product to be used in the Integrated GEWEX Product.

***LandFlux Evaluation***

Dr. Sonia Seneviratne reviewed activities related to the LandFlux merged synthesis data sets. Given the large uncertainties and lack of a "true" reference estimate, this activity focuses on constructing a benchmark product that provides a range of existing estimates from several sources. Diagnostic, land-surface model-based, and reanalysis products are being considered for the time periods of 1989–1995 and 1989–2005. Monthly products with 1-degree resolution are used and from these, mean and standard deviations are constructed to provide an envelope of reasonable solutions. Outliers can generally be traced back to specific problems with the data. Also, it is clear from these studies that reanalysis fluxes are generally higher than the diagnostic and land-surface model-based estimates. Likewise, Coupled Model Intercomparison Project 5

## The Impact of Diurnal SST Variations on Surface Energy Losses




*Mean impact of diurnal sea-surface temperature variations on longwave radiation, sensible, and latent heat fluxes combined (Clayson and Bogdanoff, 2012, Journal of Climate).*

(CMIP5) evapotranspiration (ET) measurements generally overestimate the fluxes compared to observations. The high bias in ET may be related to excess shortwave downwelling radiation that is consistent with a low bias in clouds from these models.

The excess ET found in CMIP5 in Africa, Western North America, North of the Himalayas, and Western Australia can be linked to the excess precipitation (P) over these regions. This may explain a large underestimation of temperature in these regions as well. The opposite is true in South America, where ET and P are underestimated, while the temperature is overestimated. These analyses are powerful incentives to not validate fields individually as was done in the past, but to instead focus on integrated validation that can provide significantly more insight.

***...although top-of-atmosphere (TOA) solar irradiance is commonly known to be 1360.8 $Wm^{-2}$, many data sets and models still use an incorrect value for this quantity.***

### *SeaFlux Assessment*

SeaFlux produces ocean turbulent fluxes that are an element of the GEWEX reference products. The Climate Variability and Predictability (CLIVAR) Project is also interested in ocean fluxes, but from a salinity and ocean circulation perspective. Dr. Carol Anne Clayson reported that while GDAP and CLIVAR are fundamentally interested in the same parameters, because their focus and approaches are sufficiently different, their activities cannot be easily merged. Where GEWEX is trying to maintain separation between models and observations such that the GEWEX products can be used to diagnose model processes and overall fidelity, CLIVAR is focusing on a "best" flux data set that includes multiple input data sets and reanalyses. Dr. Clayson is the liaison between the two activities.

### *Assessments White Paper*

The product assessments portion of the meeting concluded with the status of the Assessments White Paper**.** The Paper begins with the statement "that it is often difficult to define a single best climate data source" and then provides the key steps that any assessment should consider. It is available from the GDAP website. The group also discussed possibilities for websites, such as *http://rain.atmos.colostate.edu/CRDC,* that allow simple comparisons among a number of available precipitation products, and could serve as a template for other assessment efforts, providing not only the data, but also simple online tools for general users to compare products.

### *GDAP Reference Products*

Updated cloud microphysics data have improved most of the **International Satellite Cloud Climatology Project (ISCCP)** cloud products; however, polar clouds still remain a challenge. Recent results show very stable cloud amounts as a function of incidence angle. Research regarding the calibration of VLT Imager and Spectrometer for the mid-Infrared (VISIR) data suggests that visible radiances have an absolute accuracy of 3 percent while infrared (IR) radiances are somewhat better quantified with an absolute accuracy of 2 percent. The latest version of ISCCP data for the Integrated GEWEX Product is well underway. The biggest changes in the product will likely come from the common ancillary products described below, and in particular, the new High Resolution Infrared Radiation Sounder (HIRS) product.

Release 3 of **Surface Radiation Budget (SRB)** data is available at the Atmospheric Science Data Center at Langley (*http://eosweb.larc.nasa.gov/PRODOCS/srb/table_srb.html*), and National Aeronautics and Space Administration (NASA) and National Climatic Data Center (NCDC) sites. Release 3 has improved the geosynchronous rings that were artifacts from the geostationary viewing geometry, increased polar fluxes that were known to be too low, and improved desert fluxes, increasing these over bright surfaces, while decreasing them over dark surfaces. Validation of Release 3 continues using Baseline Surface Radiation Network fluxes. The biggest impact is the large downwelling longwave radiation relative to some model-based studies, which further unbalances the water and energy budgets estimated from the GEWEX Reference Products. However, the larger surface downward longwave flux is consistent with new Clouds and the Earth's Radiant Energy System (CERES) and CERES/Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO)/CloudSat fusion products.

SRB Version 4 will be used in the Integrated GEWEX Product and aside from using the same grids as Release 3, will use common total solar irradiance, ozone, snow/ice, topography, and surface types. Version 4 will evaluate the new HIRS temperature and humidity product being used by ISCCP and will use ISCCP radiances and cloud products, as well as the Aerosol Comparison (AEROCOM) aerosol product. Incorporating and testing the impact of these new products should be completed early 2013 with a baseline run completed by April 2013.

Version 1.0 of the **SeaFlux** product is available at *http://seaflux.org* and a paper describing the product and the work done to quantify the uncertainties introduced by various components of the bulk flux formulation is being finalized. Latent heat fluxes still have an increasing trend from approximately 90 $Wm^{-2}$ in 1998 to nearly 95 $Wm^{-2}$ in 2007. The impact of changes in the input radiances from the Special Sensor Microwave Imager (SSM/I) is still being investigated. SeaFlux is now focused on the feedbacks between atmospheric states and turbulent fluxes. Version 2 of the product will represent the Integrated GEWEX Product and is now being tested. Aside from the common grids and sea ice data, it will include clouds from ISCCP and radiation from SRB to drive the diurnal cycle of the sea surface temperature.

There are many challenges associated with producing **LandFlux** products, chiefly that there are a large number of dependencies that must first be parameterized. There are three basic techniques—Penman-Montieth, Priestly-Taylor, and

energy balance methods—each requiring slightly different ancillary data. When each of these methods is compared to ET inferred from P minus the Water Vapor Divergence, the results looked consistent for each of three methods. Validation over AmeriFlux sites showed a slightly positive bias with correlations generally above 0.7 for most of North America. A possible explanation for this could be the lack of reporting from the Canadian stations during or immediately after rain. Current issues with the LandFlux product that must be resolved include: (i) snow evaporation; (ii) grid averages that show no differences between tall trees and the underlying surface temperature; (iii) land use and land cover change; and (iv) evaluation with 160+ FluxNET sites.

AEROCOM **aerosol products** are to be used instead of GEWEX Global Aerosol Climatology Project (GACP) products because the GACP data are only available over the ocean and cannot be made consistent with the AEROCOM land products. The AEROCOM product consists of a monthly 1° x 1° climatology for mid-visible aerosol properties of aerosol optical depth, single scattering albedo, and ångström exponent (related to the asymmetry factor). The product is constructed by starting with a median field of 15 models to eliminate extremes, which is then enhanced with Aerosol Robotic Network (AERONET) data to bring the model fields in alignment with observations where these exist. Simulations are used to scale the product forward and backwards in time based upon source information estimates. CALIPSO data are used to add vertical distribution to the aerosols. The net result is a spatially complete data set over the 30 years covered by the GEWEX products.

After some delays due to the change from SSM/I to the Special Sensor Microwave Imager/Sounder (SSMIS) as the microwave reference satellite, **Global Precipitation Climatology Project (GPCP)** Version 2.2 products are current through June 2011. It is important to note that the latest version of bias uncertainties is based upon variability between well-known and often-used global precipitation estimates that yield an uncertainty of about 8 percent for the global mean rainfall. This uncertainty is significantly less than the uncertainty ascribed to the product described in a recent water and energy budget study published by G. Stephens et al., 2012 in *Nature Geosciences*.

The National Oceanic and Atmospheric Administration (NOAA) is supporting transfer of the GPCP Version 2 products for operational processing at NOAA/NCDC. Version 3 of the GPCP product (see example on next page) corresponds to the Integrated GEWEX Product and will be produced with monthly, 0.5° resolution from 1979 onward; daily, 0.5° resolution from 1998 onward; and 3-hourly, 0.25° resolution from 1998 onward to match the other GEWEX products.

***Other Reports***

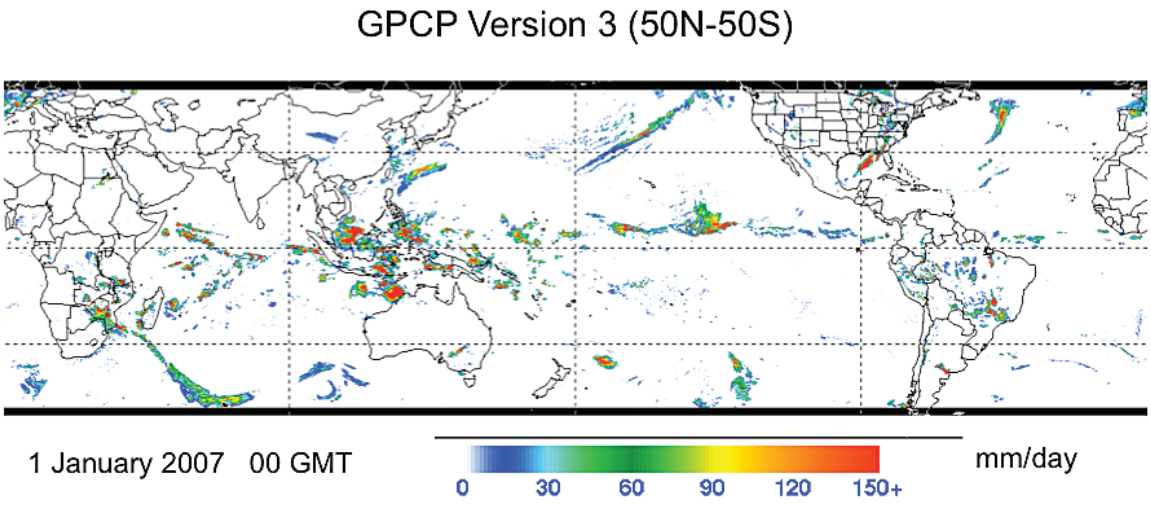
Journal articles on Global Precipitation Climatology Centre (GPCC) data sets and their verification have been submitted and the GPCC community has started the acquisition and processing of daily precipitation amounts. While GPCC cannot distribute these data directly because of agreements with data providers, it is aware of the need for daily precipitation data and is considering options.

Dr. Crevoisier presented an overview of work being done at LMD to retrieve climate variables from the Infrared Atmospheric Sounding Interferometer (IASI), particularly clouds, greenhouse gases, aerosols, and surface properties. The cloud property retrieval is similar to the one developed for the Atmospheric Infrared Sounder (AIRS) and leads to similar results, with a good sensitivity to thin cirrus during day and night. The improved spectral resolution from IASI allows the derivation of relative humidity with respect to ice in thinner atmospheric layers than AIRS, which should result in better predictions of potential contrail occurrence. The IR spectrum is particularly sensitive to large (e.g., dust) aerosols and the retrieval of dust aerosol properties (optical depth, height, effective particle size) consists of proximity recognition to pre-computed Look Up Tables. Good results have been shown in comparison to AERONET and CALIPSO retrievals.

In an update on the Atmospheric Radiation Measurement (ARM) sites, it was noted that all new instruments are now operating, and the data are available from the Department of Energy ARM archive. The ARM measurements of clouds, radiation, turbulent fluxes, and precipitation could be very useful in making point measurements of the Integrated GEWEX Products. Having similar products and formats from the two efforts would serve to anchor the global satellite product.

*Participants at the 1st GDAP Meeting.*

## Example of New Integrated GDAP Product




*Example of the next generation Global Precipitation Climatology Project (GPCP) product being developed for the "Integrated" GDAP product.*

Data related to the GEWEX Hydroclimatology Panel (GHP) efforts in the Murray-Darling River Basin in Australia (OzEWEX) could be used to validate some of the GDAP global products. The Australian Bureau of Meteorology collects extensive data on rainfall, temperature, humidity, solar downwelling radiation, and vegetation over the river basin. The Water Availability Project has monitored the terrestrial water balance on a monthly basis since 1900 and operationally on a weekly basis beginning in 2007. In addition, a regional Weather Research Foundation climate model that is currently being evaluated against satellite data is run over the river basin and can serve as common forcing data for many of the land turbulent flux schemes. Aside from the observations and models being run in the region, current analysis tools are being developed to evaluate different products that could easily be extended to include the GDAP products. There was broad consensus at the meeting that GDAP should move to exploit the available data, tools, and the desire of the GHP community to collaborate on this project.

Results from the 1st Pan-Global Atmospheric System Studies (GASS) Meeting held in September 2012 emphasized the need to develop a more unified voice for articulating critical measurement needs to the observation community. Although computed radiation data are considered to be "good enough" for climate models, detailed observations of the Southern Ocean are needed because models do not produce enough clouds and are generally too warm. Other critical measurements needed include: (i) vertical velocity (everywhere—but with particular need in tropical convective cores); (ii) profiles of condensate, especially ice properties (sizes, scattering); (iii) ice nuclei characteristics and concentrations; and (iv) soil moisture.

A report on assessing the increasing number of satellite simulator packages noted that these simulators are often used beyond the original cloud comparisons. Most of the users are not specialized in interpreting the Level 1 radiances and often the developers are not familiar with the real goals of the modeling community. Creating a satellite simulator portal that would allow users to interactively test the different packages was discussed and an invitation has been sent to all the satellite simulator developers to participate in this activity. The next step is to use a real example in the portal to determine its usefulness.

Monsoon studies represent a place where models and observations could be better coordinated. Comparisons between precipitation accumulations from models and various observation data sets clearly show a strong overestimation by all the reanalyses. Sensible heat fluxes over the Tibetan Plateau have a strong decreasing trend in nearly all the reanalyses. While the temperature difference between surface and atmosphere seems to be increasing in this region, the wind speed has decreased significantly to slow the sensible heat flux. It was also noted that the net cloud radiative forcing in CMIP5 appears to be significantly better over the Tibetan Plateau than CMIP3 models; however, most models still underestimate the strength of the forcing. This bias is caused by fewer clouds than in the ISCCP data, and biases in the cloud vertical structure as observed from CALIPSO. Both of these studies illustrate the usefulness of integrated validation to provide insight into observed discrepancies.

Finally, it was agreed that the next parameters that GDAP should focus on are the terrestrial water budget with soil moisture, runoff, and total storage [e.g., Gravity Recovery and Climate Experiment (GRACE)-type measurements]. The next GDAP meeting will be held jointly with GHP at the Universidade Federal do Rio de Janeiro (UFRJ) in Rio de Janeiro, Brazil on 2–6 September 2013.