Title: The Global Precipitation Climatology Project (GPCP) Data Products—Transfer to Operations at NCDC

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The objective of this proposal is to successfully transfer the routine production of Global Precipitation Climatology Project (GPCP) products to NCDC. The suite of GPCP precipitation products has become a science community standard, having been used in over 1200 journal articles. The current monthly (1979-present), pentad (1979-present) and daily products (1997-present) have been developed by research groups over the last 15 years and are produced by a consortium of those groups, funded by various agencies. Transfer of the routine processing of the GPCP products to an operational entity would ensure continuation of these important data analysis sets.

This proposed activity will develop (with NCDC partners) a detailed strategy for transfer of scientific knowledge, satellite and other data source accesses, and processing code for successful implementation of an end-to-end processing system that would routinely produce the GPCP current (Version 2) products for archival and dissemination. Although the proposal will present an initial plan of action for the transfer, the early part of the proposal period would focus on reviewing the requirements with a small group of advisors and the larger outside user community.

The current GPCP processing involves computation of individual intermediate products or data sets by a number of government and university entities and a merger of these products by another group. The proposed work would organize, streamline, update and document all code needed for product production from the level of the satellite-calibrated radiances to the final merged products. Arrangements will be made to ensure continued access to the various input data sets. Testing and evaluation of output products from the new system will be a key part of this project, as will an evaluation of the feasibility of reprocessing the 30-plus-year-record to make minor upgrades. Maintaining science quality of the output products will be a critical aspect and will require significant on-going effort.

Title: Generation of Altimeter Climate Data Records Using Retracking and Updated Corrections

Investigator(s): **Philip S. Callahan (PI)**
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Lead Institution: Jet Propulsion Laboratory

Problem Statement: Nearly 20 years of high precision altimetry data have been acquired from TOPEX and the Jason series, but they have not been processed in a uniform way with advanced waveform retracking methods (determine measurement parameters by fits to the waveforms). There are project plans to reprocess the Jason data, but not TOPEX. This proposal will apply retracking and updating of TOPEX data to the Jason standards. After reprocessing and application of the latest orbits and corrections including improved radiometer calibration and processing, the Sea State Bias (SSB, variation of range measurement with surface wave height and wind speed) – one of the largest remaining error sources – must be determined and added as a correction. With this processing, the TOPEX data should reach the 3.5 cm accuracy level in Sea Surface Height (SSH) and be suitable for determining sea level change over the entire record at the millimeter per year, or better, level with well-understood errors. Retracking is particularly important for the TOPEX data because TOPEX Alt-A, in use from the beginning of the mission until February 1999, exhibited instrumental changes from about cycle 140 (1996) until cycle 235 when a switch was made to Alt-B that can only be corrected by retracking with an adjusted point target response (PTR) for the radar.

Proposal Summary: JPL proposes to retrack the entire TOPEX data set from building on the method described by Rodriguez and Martin (1994) and used in producing TOPEX Retracked GDRs (Geophysical Data Records). JPL will incorporate improvements to improve stability and separation of parameters. JPL will then update these records with improved orbits, tides, and radiometer data. JPL's work will build on NASA work under the Ocean Surface Topography Science Team (OSTST), the MEASURES program to develop an improved altimeter data set under PI Richard Ray of Goddard Space Flight Center (GSFC). Two Co-Is from that team will contribute to this work in the area of orbits, tides, radiometer corrections, and validation of the data. JPL's work will use products and tools from the NASA ACCESS07 proposal ―Web-based Altimeter Service and Tools by PI P. Callahan (Callahan et al., 2007) to update the records in netCDF format. JPL will also process the TOPEX/Jason-1 and Jason-1/Jason-2 overlap periods to verify project processing and cross-calibration results. JPL will consult with NOAA subject matter experts on models and corrections and data validation. JPL will coordinate with CNES and NOAA to produce a consistent data format in netCDF to provide improved access to the data.

Title: Enabling Consistent Calibration of Multispectral Solar Reflective Imager Data for Climate Data Record Development Using the Moon

Investigator(s): Thomas C. Stone

Lead Institution: U.S. Geological Survey

To develop Climate Data Records (CDRs) by aggregating multiple observational datasets from different instruments on the same or different platforms requires that the instruments be calibrated to a consistent scale and that the calibration be maintained over the instruments' lifetime. This can be challenging for reflected solar radiometer sensors, e.g. Earth observing satellite imagers, due to the degradation of optics and on-board calibration systems suffered in the space environment. A methodology for using the Earth's moon as a reference light source has been developed at the U.S. Geological Survey under NASA sponsorship. The USGS lunar calibration system has demonstrated the capability for stabilizing satellite sensor calibration at the 0.1% per year level, and for inter-calibration at the sub-percent level. This meets calibration requirements for measuring climate change from space (NISTIR-7047, ASIC3).

The proposed activity will develop guidance procedures to implement the results of lunar calibration analysis in the framework of CDR development, to assure stable and consistent calibration of the observational data used to construct CDRs. Source datasets will include current and historical operational sensors such as geostationary imagers and the NOAA AVHRRs, and possibly extend to research satellite sensors (e.g. from the NASA EOS program). Application to future instruments such as the Advanced Baseline Imager on GOES–R and VIIRS on NPP will be discussed. Deliverables will include assessments of sensor calibration biases based on reference against the Moon, quantitative evaluation of the uncertainty in these assessments, and recommendations for validation of calibration consistency and stability for CDR constituent data.

Title: Development of new 3-hourly, global, long-term, multisatellite-based TOA-to-surface radiative flux profile data product with high horizontal resolution and homogeneous quality

Investigator(s): **Yuanchong Zhang (PI)**
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Lead Institution: Columbia University

Since the early 1980's, we have been developing the capability to calculate global radiative fluxes from multisatellite-based data products describing the properties of clouds, the atmosphere and the surface. This work culminated in the first radiative flux profile product, ISCCP-FD, which is based on the NASA Goddard Institute for Space Studies (GISS) radiative transfer model for its climate GCM SI2000 and the International Satellite Cloud Climatology Project (ISCCP) D-series cloud climatology, together with several other satellite-based data products. This product contains global, TOA-to-surface radiative flux profiles (5 levels) at 280-km intervals, every 3 hours for 24 years (currently 1983 – 2007). It includes all broadband, upward and downward, SW and LW fluxes for all-, clear- and overcast-sky.

However, our and many other authors' evaluation studies indicate that there are still some problems with using this product for the more subtle tasks of monitoring and investigating climate variations and change. Most of the problems appear to be caused by the input datasets but there are also a few deficiencies of the radiative transfer model that have been noted. The leading problems known are: (1) algorithm-change-induced inhomogeneities in the atmospheric temperature-humidity dataset, (2) poor characterization of aerosols and their variations, (3) too crude representation of cloud vertical structure, (4) absence of weak solar absorption by some gas species in the SI2000 radiative transfer model, and (5) poor specification of land surface properties (albedo and emissivity). In addition, FD uses the current ISCCP products based on sparsely sampled (about 30 km intervals) satellite images, which limits the spatial resolution achievable because of sampling noise. The Global Energy and Water Experiment (GEWEX) is now undertaking a reprocessing of all of its global data products, including ISCCP, to reduce the magnitude of these problems. Other new, improved data products have become available. Several NOAA and NASA funded efforts contribute to this work. For ISCCP, this includes comparing radiance calibration to more recent standards, refining the atmospheric properties dataset and processing a version of the radiance data with 10-km sampling. Moreover, the GISS climate GCM has been updated to ModelE with various improvements including more accurate treatment of greenhouse gases in its radiation code.

Given all of the above, we propose to extract the new radiation code from GISS GCM ModelE, to incorporate more recent improvements, to make the necessary modifications to use improved input datasets, to modernize and document this version of the code, and to produce a new flux profile data product for the whole period 1983 – 2010. The goals are to make the radiation code more flexible and capable of handling an even wider variety and more detailed input datasets and to produce a climate-quality version with better spatial resolution, better homogeneity and better accuracy. The new code will be tested and the new product evaluated by a similar broad set of comparisons against more direct observations (ERBE, CERES, BSRN) and by more detailed calculations (Line-By-Line and vector doubling-adding). In addition, we will improve all the supporting information so that the new product, along with its production code, can be released to the community (possibly by delivery to the NOAA National Climatic Data Center). The target is to reduce flux uncertainties of ISCCP-FD by 2 – 5 W/m2 at top-of-atmosphere (TOA) and by 3 – 7 W/m2 at the surface with sufficient homogeneity and stability for climate studies. The project is relevant to the FY 2011 priority TCDR associated with both the focus areas of the CDRP and will require 3 years to accomplish.