NOAA/NESDIS/NCDC Scientific Data Stewardship (SDS) Project
Announcement of Opportunity
FY07+ Funds

Selections (7)

Title: Investigation and tool development for storing NASA ECS data using HDF5 Archival Information Package(AIP)

Investigator(s): **MuQun Yang (PI)**

Institution: **The HDF Group**

While not necessarily Climate Data Records (CDRs) themselves, data from the primary instruments of NASA's Earth Observing System (EOS) will be an important input to many CDRs developed by NOAA over the next few decades. EOS missions, precursors to the National Polar-orbiting Operational Environmental Satellite System (NPOESS) and its precursor mission, the NPOESS Preparatory Project (NPP), provide a long time series of validated, well-calibrated data. Yet, CDRs utilizing these data cannot be created unless these data remain archived, available, and usable for the long-term. NASA is currently responsible for the generation, archival, and distribution of the EOS data products. However, a NOAA-NASA Memorandum of Understanding (MOU) from 1989 ultimately assigns responsibility for the long-term archive of many of these products to NOAA. Successfully transitioning from NASA to NOAA will be a major transformative migration event in the life of these data products. The primary emphasis of this proposal is on the tools and techniques needed to ensure that these data survive the transition. As such, the proposal is directly responsive to the third area of the announcement of opportunity, “Generation of CDR context capable of surviving transformative migration.” This project has been endorsed by the National Geophysical Data Center (NGDC)

Title: Creation and Preservation of a Sea Ice Climate Data Record

Investigator(s): **Walter N. Meier (PI)**
Julienne Stroeve
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Institution: **University of Colorado/ NSIDC**

The passive microwave record of sea ice provides one of the longest satellite climate records, with a continuous record dating back to 1978. This record spans several sensors and efforts have been made to account for intersensor differences; the data have also included other quality controls to provide a consistent and accurate timeseries over the entire record. However, there remain many issues that could be improved to elevate the sea ice timeseries to the standard of a climate data record. These include using recalibrated brightness temperatures, better intersensor calibration using sensors overlaps from multiple seasons (e.g., winter and summer) if possible, and calibrating to a baseline of the most advanced sensor as opposed to the earliest sensor.

Due to the complexities of the passive microwave signal, sea ice fields such as extent and concentration are produced using a combination of sensor frequencies and polarization within an empirically based algorithm. Several algorithms have been implemented and while all provide reasonable estimates of the overall sea ice cover, all have limitations. Currently, there is not one universally accepted passive microwave sea ice algorithm from which to produce a climate data record. Nor are there error estimates or data quality flags associated with each measurement. Finally, sea ice concentration products have been developed and implemented in a research mode and accompanying metadata have been rudimentary.

This project will address many of these issues by (1) recalibrating the record based on the highest quality more recent instruments and the most advanced algorithms, (2) develop and implement automated error estimates and data quality information based on the internal properties of the dataset as well as ancillary fields, and (3) implement more comprehensive metadata information to provide longer-term secure data preservation with lower maintenance.

Title: Validation and Calibration of MSU/AMSU Measurements and Radiosonde Observations using GPS RO Data for Improving Stratospheric and Tropospheric Temperature Trend Analysis

Investigator(s): **Shu-Peng Ho (PI)**
Cheng-Zhi Zou

Institution: **UCAR**

The monitoring and detecting of the vertical structure of atmospheric temperature trends are a key element in the climate change problem. The Microwave Sounding Unit (MSU), on board the National Oceanic and Atmospheric Administration (NOAA) polar orbiting satellites, has provided data for climate studies since its first launch in 1979. Because MSU measurements, which are in the 50 to 60 GHz oxygen band, are not affected by clouds and are directly proportional to the specific atmospheric layers corresponding to the weighting functions, their data are unique for long-term temperature trend analysis.

Nonetheless, due to different adjustment and analysis procedures used to calibrate the shift of sensor temperatures caused by on-orbit heating/cooling of satellite components and inter-satellite offsets, large trend differences were found between different groups.

These temperature trend differences have resulted in a global warming controversy over the surface versus the free troposphere temperatures, and have plagued efforts to quantify tropospheric and stratospheric temperature changes. Radiosonde observations have been used as benchmarks to calibrate satellite derived soundings. However, because of changing instruments and measurement practices and limited spatial coverage, especially over the oceans, the use of radiosonde observations as a reference to construct a long-term climate quality data set has also presented many difficulties.

Recently, the Global Positioning System (GPS) radio occultation (RO) limb sounding technique, which provides all-weather high vertical resolution refractivity profiles, has emerged as a robust global observing system. Because the basis of the GPS RO measurement is a time measurement against absolute timed and calibrated atomic clocks on the ground, this data type is ideal for use as a climate benchmark. Recently, the Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC) mission was successfully launched in April 2006. With about an order of magnitude more data (around 2500 profiles per day) than that available from previous missions, COSMIC presents a unique opportunity for validating the vertical structure of atmospheric temperatures (because of its short data records, detecting trends is not realistic at this stage). In this study, we propose to carry out three tasks: (i) To use GPS RO data to identify radiosondes of climate quality for further climate studies; (ii) To use GPS RO data in the stratosphere and use the identified radiosondes in the troposphere as climate benchmark datasets to validate the precision and accuracy of pixel level MSU and Advanced Microwave Sounding Unit (AMSU) brightness temperatures generated from different analysis teams, depending on their data availability; (iii) To generate long term stratospheric and tropospheric climate quality temperature datasets by reprocessing multiple years of MSU/AMSU data. Although only CHAMP data since June 2001 and upcoming COSMIC data are available, the ‘adjusted’ MSU/AMSU data can serve as reference data to other overlapped AMSU/MSU data. We will reprocess AMSU/MSU data from 2001 to 2009.

Title: Transfer of NOAA/NASA AVHRR Pathfinder SST Processing to NODC

Investigator(s): **Bob Evans (PI)**

Institution: **University of Miami**

This joint proposal between NOAA-NODC (Dr. Ken Casey) and the University of Miami Rosenstiel School of Marine and Atmospheric Science (UM/RSMAS) to NOAA’s Scientific Data Stewardship program (SDS) is structures to transfer processing of the highly successful NOAA/NASA AVHRR Pathfinder sea surface temperature fields (PFSST) to the NOAA National Oceanographic Data center (NODC), where their long term availability, survivability, and provenance will be ensured. These activities will focus on the transfer of the processing framework including code and quality control procedures, maintenance of the Pathfinder in situ, AVHRR satellite match-up database and extending the currently extensive metadata to encompass the requirements of the SDS program. The Pathfinder SST program was originally initiated as a cooperative research project in 1991 between the UM/RSMAS and the NASA JPL Physical Oceanography Distributed Active Archive Center (PO.DAAC). Beginning in 2002, NODC began partnering with RSMAS to improve the Pathfinder CDR, improve its long-term stewardship, and broaden its usage. The PFSST products have been reprocessed several times over the years, as the scientific understanding of the AVHRR instruments and the algorithms and in situ matchup calibration data improved, and now provide a mature archive record of over two decades of global satellite measurements of sea surface temperature (SST) from multiple generations of AVHRR sensors. Many designated communities including climate-change scientists, weather and hurricane research, ecosystem managers, and shipping and maritime interests currently use the PFSST data set. These users are located at US and international academic institutions as well as a wide range of US federal, international, operational, and commercial agencies. Within the existing Pathfinder program framework, RSMAS has been responsible for production of the SST fields using heritage software developed in the late 1980's, generation of algorithm retrieval coefficients, and providing the basis for SST calibration, validation and sensor characterization via generation and analysis of a collocated satellite in situ matchup database. The global fields are then transferred to NODC for additional metadata and quality control and then on to the PO.DAAC to enhance distribution to the ensemble of user communities. Building on the success and maturity of the PFSST and the importance of this thematic climate record for research and industry, it is time to transition the production and quality control from the academic setting to a more stable and sustainable setting at the NODC. This transition will be accomplished by modernizing the current PFSST processing code into a package that will be compliant with the NODC architecture and easily scalable from large institutional data centers to single users that endeavor to continue to evolve the PFSST CDR in the future. The transition also requires a software and analysis package for the continued quality control and associated matchup database, used for calibration and validation, as well as formal documentation to ensure the provenance of the data set is clearly communicated. Formal documented procedure manuals will be developed so new personnel at NODC can be easily trained in the processing methodology and product quality control. The ability to perpetuate the legacy knowledge of the AVHRR processing is significant given that AVHRR are expected to continue to fly until at least 2010 on US platforms and through 2018 on the European METOP platforms. Thus the Pathfinder SST data set is well positioned to provide an important transfer function and calibration reference standard between multiple SST sensors (e.g., linking AVHRR, MODIS, and VIIRS on NPP/NPOESS).

Title: Preparation of *in situ* temperature and salinity profile data CDRs for joint studies of sea level with altimeter and GRACE data

Investigator(s): **Syd Levitus (PI)**

Institution: **NESDIS NODC**

This proposal is for support of the development of "*World Ocean Database 2009*" which is a collection of ocean Climate Data Records (CDRs) that are frequently used in conjunction with satellite observations of the world ocean to study the role of the ocean as part of the earth's climate system. The World Ocean Database produced by the NODC Ocean Climate Laboratory is the world's largest collection of ocean profile-plankton data available internationally without restriction. There have been four versions of the World Ocean Database compiled and published to date. During the past 16 years the NODC Ocean Climate Laboratory (OCL) has provided international leadership in the development of global, comprehensive, integrated, scientifically quality-controlled, ocean profile databases. These databases, and products based on these databases, are frequently used by the scientific community as evidenced by citations in the scientific literature. In particular, the remote-sensing satellite community has used WOD in studies of satellite altimetry, ocean color studies, and ocean data assimilation.

Title: Towards a Consensus AVHRR Reflectance Calibration

Investigator(s): **Steven A. Ackerman (PI)**
Andrew Heidinger
Xiangqian (Fred) Wu
Jerry Sullivan

Institution: **University of Wisconsin / CIMSS**

The Advanced Very High Resolution Radiometer (AVHRR), which flies on the NOAA Polar Orbiting Environmental Satellites (POES), has proven to provide a unique data-set for multi-decadal satellite climate studies. The AVHRR provides global data with a spatial resolution of 4 km with 4 times per day sampling. The three thermal channels (3.75, 11 and 12 mm) have on board calibration but the three solar reflectance bands (0.63, 0.86 and 1.6 mm) do not. Various methods have been developed to address the lack of onboard calibration for the solar reflectance bands. As many studies have shown, the accuracy of the AVHRR reflectance calibration is one of the major drivers in the errors of some of the key climate parameters measured by the AVHRR (NDVI, aerosol, cloud). Unlike the thermal calibration that varies rapidly, the solar reflectance calibration is a smooth function of time and described by a few coefficients for each channel on each satellite.

Unfortunately, the multiple methods for providing a post-launch correction for the AVHRR often do not agree within the expected and needed accuracy. The goal of this proposal is to undertake activities to develop a consensus on the historical AVHRR reflectance calibration and its uncertainty. Now is the optimal time to conduct this work. With launch of imagers with onboard calibration, there exists new data contemporaneous with the AVHRR that can be used to generate more accurate calibration of the current

AVHRR instruments and test methods used to calibrate historical AVHRR data. In addition, the various groups that develop AVHRR reflectance calibrations, have expressed a desire to meet and tackle the lack of consensus among the results. This desire was expressed in person by most groups at the recent AMS Radiation Conference in Madison, Wisconsin. In addition, the GEWEX Radiation Panel chair (Bill Rossow) has also expressed his support and has stated that GEWEX will help coordinate these activities.

The major goal of this work is to hold two workshops whereby the various AVHRR reflectance calibration groups can meet, exchange ideas and attempt to reach consensus. To aid this process, we seek funds for hosting the workshop and for a scientist to conduct the bulk of the analysis of the various calibration results. The secondary goal of this workshop is to finalize the preliminary historical NESDIS AVHRR reflectance calibration method that is based on MODIS. This proposal speaks directly the Scientific Stewardship mission of producing authoritative long-term records. Once the consensus calibration is achieved, these improvements can be implemented into the level 1b archive at NCDC or be made publicly assessable and used by any AVHRR application that derives its own reflectance calibration.

Title: Operational Generation of the HIRS Outgoing Longwave Radiation Climate Data Record

Investigator(s): **Hai-Tien Lee (PI)**
Arnold Gruber

Institution: **University of Maryland/ CICS**

The outgoing longwave radiation (OLR) at the top of the atmosphere is a necessary component for the Earth radiation budget studies and one of the key parameters used in diagnosing and monitoring climate changes. The longest available global OLR time series were derived from the operational polar-orbiting satellite observations. Nevertheless, the quality of these OLR time series were impaired by discontinuity and inconsistencies as being processed in an operational environment that was not designed to produce data in climate quality.

Past research at CICS has developed methodologies to generate climate quality OLR time series product from the operational High-resolution Infrared Radiation Sounder (HIRS) radiance observations. We propose to develop a system that will allow operational generation of the HIRS OLR Climate Data Record (CDR); with consistent radiance calibration and retrieval algorithms, with continuity ensured by inter-satellite calibration, and with diurnal models to minimize temporal integral errors. Most importantly, we propose end-to-end solutions that include product validation and monitoring, science maintenance, algorithm improvement and address issues of future instruments that ultimately will ensure the validity, availability and longevity of this product for the foreseeable future.