P1.18 CLIMATE DATA AT NASA GODDARD EARTH SCIENCES DAAC

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1. Introduction

To improve our understanding of seasonal-to-interannual and decadal-to-multidecadal climate variability and for the detection of anthropogenic climate change, long-term global data sets of key climate parameters are needed. The NASA Goddard Earth Sciences Data and Information Services Center (GES DISC) Distributed Active Archive Center (DAAC) has a vast collection of climate data from several important satellite-based missions, field campaigns, and surface measurement networks including historical precipitation and surface temperature climatologies.

The GES DISC DAAC long-term data collections consists of data from the major climate related disciplines such as atmospheric dynamics, atmospheric chemistry, global land and ocean biosphere, and hydrological sciences. To facilitate the use of multiyear data sets, a number of tools and server-side capabilities for data access, visualization, subsetting, and analysis have been developed at the DAAC.

This presentation will provide highlights of the climate data available from the Goddard DAAC, including several data applications, and the data services provided by the DAAC Data Support Teams (DST's) in support of the users of the data.

2. Climate Data Sets

2.1 Data From Satellite-based Missions

The DAAC has been engaged in the collection, archive, distribution and support of satellite-based remote sensing data since its inception in 1993. In addition, it has been generating long term, consistently processed, “Pathfinder” data sets from heritage sensors for explicit use in climate-related studies. The DAAC maintains climate data sets from several important satellite-based missions and projects such as, MODIS, SeaWiFS, CZCS, TRMM, TOMS, GOME, SBUV, BUV, LIMS, UARS, ACRIM, AVHRR and TOVS Pathfinders, GPCP, and DAO. The production, archive and distribution processes are continuing at the DAAC for the current instrumentation flown aboard the EOS series of satellites. Table 1 provides a summary of current and future satellite-based climate data sets available at the DAAC.

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2.2 Climate Interdisciplinary Data Collection (CIDC)

This collection consists of global land, ocean and atmospheric parameters mapped to uniform spatial and temporal scales for basic research and applications studies. A set of 70 climate parameters selected from over 24 important climate data sets from the Goddard DAAC and other archive sites (e.g. NOAA, GISS), have been mapped on uniform spatial (1x1 degree) and temporal scales (monthly means) and made available on CD-ROM and online via anonymous FTP download. This Climatology Interdisciplinary Data Collection CD-ROM, developed in collaboration with George Mason University's Center for Earth Observing and Space Research, has been popular in the educational as well as Earth System Science research communities. Easy-to-use software provided for data display and analysis has facilitated the use of the data in various Earth Science projects, for example in the study of ozone depletion, changes in land-cover and land-use, and long-term trends and correlations of different climate parameters.

2.3 Long Term Historical Climate Data Sets

Several well know climatologies are also available from the DAAC, including

- Legates Surface & Ship Observations of Precipitation - 1920-1980
- Jaeger Precipitation - 1931 to 1965
- Climate Research Unit Surface Temperature Anomalies 1851 – 1996

These climatologies are useful for validating the low frequency components of satellite-based fields as well as evaluating anomalies in these fields as a function of space and time.

2.4 Field Experiment Data Sets

In support of several satellite data validation efforts the GES DAAC provides data collected from several field experiments. These data sets consist of aircraft and ground-based observations coincident with satellite overpasses. TRMM related field campaigns data sets consist of measurements made during TEFLUN-A, TEFLUN-B/CAMEX3, TRMM-LBA, KWAJEX, SCSMEX, TOGA COARE, and SGP97 & 99. In support of the MODIS algorithm development and MODIS data validation, measurements from the MODIS Airborne Simulator (MAS) flown aboard the ER-2 aircraft for several field campaigns are also archived at the DAAC.

Table 1. Climate Data Sets at Goddard DAAC

Data Set	Data Dates	Key Parameters	Resolution
CZCS	10/78 - 06/86	Ocean Color, Radiances (5 bands; 0.4-0.75 microns, and 11.5 micron), Chlorophyll, Phytoplankton, Sea Sediments	I km, 4km, 9 km
SeaWiFS	09/97 - present	Ocean Color, Radiances (8 bands 0.4-0.86 microns), Chlorophyll, Phytoplankton, Sea Sediments, PAR, Aerosol	I km, 4 km, 9 km
MODIS (Terra: 03/00 -present) (Aqua launch: 2002)	03/00 - present	Radiances (36 bands 0.4 -14 microns)	250 m, 500 m, 1km
		Aerosol, Cloud Optical and Physical Parameters, Water Vapor, Ozone, Temperature & Humidity Profiles, Stability Indices, Cloud Mask, Brightness Temperatures	1 km, 5 km, 10km 1 x 1 degree
		Ocean Color, Chlorophyll, Phytoplankton, Sea Sediments, Vegetation Index, Fluorescence, PAR, SST	I km, 4 km, 36 km
TOMS (Nimbus-7,Meteor-3, Earth Probe, ADEOS)	11/78 - present	Total Ozone, SO2 Index Reflectivity, N-Values	50 km, 1 x 1.25 deg.
GOME (Mirror data site)	4/95 - present	Total Ozone (GOME data fills TOMS gap July 95-July 96)	0.36 x 0.36 degree
BUV (Nimbus-4), SBUV (Nimbus-7)	4/70 - 1/87	Total Ozone, Ozone Profile, Reflectivity	
UARS Sensors: CLAES, HALOE, SOLSTICE, SUSIM, HRDI, MLS, PEM, WINDII, ISAMS	09/91 -present	Upper Air Trace Gas Profiles: Ozone, SO2, CH4, CO, CLO, CF2CL2, CFCL3, CLONO2, HCL, HF, HNO3, O2, NOx, Aerosol, Temperature, Humidity, Upper Atmospheric Wind Field, X-Ray/Electron/Proton Energy Deposition Profile, UV Radiation , Solar Irradiance/ Solar Constant,	4 degrees Lat & 2-5 km Lon, 2.5 x 3.75 deg. 3-5 km altitude, Solar Disk
TRMM	12/97 - present	Rainfall Rate, Rain Profile, Rain Type, Storm and Freezing Height, Drop Size Distribution, Cloud Liquid Water, Cloud Ice, PR Reflectivity and Attenuation, TMI Microwave Brightness, Temperature, VIRS Radiances (5 bands: 0.63 -12 micron)	2.2 - 45 km
GPCP	1/79 - Present	Rainfall Rate and Error estimates (combined satellite and surface measurements)	2 x 2.5 & 1 x1 deg.
TOVS Path Finder	11/85- 07/95	Temperature and Humidity Profiles, Cloud Parameters, Ozone, Precipitable Water Vapor, Rainfall Rate, Long Wave Radiation Flux, Radiative Cloud Forcing	1 x 1 degrees
AVHRR Path Finder	07/81 - present	Vegetation Index, Visible & NIR Reflectance, Thermal Infrared Brightness Temperature, Cloud Mask	8 km, 1 x 1 degrees
DAO Assimilations	3/80 - 11/93 12/99 - present	Atmospheric Profiles (Temperature, Humidity, Wind, Kinetic Energy, Moisture/Heat/Momentum/ Cloud Mass Fluxes, Cloud Fraction, Cloud Detrainment, Ozone, Wind), Radiation Flux ,Total Precipitable Water Vapor, Precipitation, Surface Stress & Other PBL Quantities, Moisture & Temperature Tendencies, Soil Wetness, Surface Roughness & Albedo, Surface Temperature & Pressure	2 x 2.5 degree 1 x 1 degree
MSU-LIMB93	1/79 - present	Deep Layer Atmospheric Temperatures (lower stratospheric, upper & lower tropospheric), Oceanic Precipitation	2.5 x 2.5 degrees
ACRIM	2/80 - 12/97	Total Solar Irradiance/ Solar Constant	Full Solar Disk
TIM/SOLCTICE/SIM/XPS	SORCE (launch 2002)	Total Solar Irradiance/Solar Constant	Full Solar Disk
AIRS/AMS-U/HSB	Aqua (launch 2002)	Temperature and Humidity Profiles	15 km, 50 km
OMI /HIRDLS/ MLS	Aura (launch 2003)	Ozone, Aerosol & Upper Air Trace Gas Profiles	13 x 2 4 km
ATMS/CrIS/VIIRS	NPOESS Preparatory Project (NPP) -2005	Atmosphere, land, and Ocean Parameters	0.44 -1, 15-55 km

3. Data Applications

The GES DAAC provides almost all key climate parameters that are being used by scientists from a variety of disciplines to study human impacts on the earth and its climate, and to predict and monitor natural disasters such as wild fires, volcanoes, floods, and drought. The DAAC is developing several means of promoting a broader use of the archived satellite data, particularly with respect to the large segment of applications users. As an example GDAAC is offering geographic subsets (at the state and regional level) of its satellite data in a format compatible with Geographic Information Systems (GIS) software (e.g., Arc/info) so that it can be readily used by universities and state and local agencies. The University of New Mexico Earth Data Analysis center (EDAC), for example, is routinely obtaining GIS- compatible data from the DAAC derived from the Tropical Rainfall Measuring Mission (TRMM), to augment their ground-based measurements for the purposes of environmental monitoring and resource management.

The GES DAAC is also engaged in supporting a GSFC initiative focused on the effects of environmental conditions on a variety of health issues, including for example the spread of infectious diseases, increased incidence of asthma in municipal environments, and correlations between surface ultraviolet radiation and skin disorders. Plans are being made to provide TRMM and MODIS products to health researchers and institutions in a form that is easily imported into their local GIS packages, and preprocessed in such a way as to minimize the need for further manipulation at the user's end.

4. Data access

The DAAC's key objectives are to facilitate data access, provide data in the format compatible with the user requirements, explore and promote the potential applications, and reach the broader satellite data user community**.** The fundamental climate data sets, as well as special products such as regional subsets, applications products in GIS compatible format, related ancillary data sets, and data analysis tools are freely available to the public for Earth System Science studies, environmental applications, and educational use. Detailed information pertaining to the availability of climate data sets is available from the Web site http://daac.gsfc.nasa.gov/

To promote wider distribution and use of NASA remote sensing data archived at the DAAC, web based servers have been developed to provide on-line, interactive capabilities for data searching, visualization, mapping, analysis, and retrieval of data in user requested formats. Specific ongoing efforts include WebGIS, WMT-DODS (Web Mapping Testbed-Distributed Oceanographic Data System) server, and GrADS-DODS (Gridded Analysis and Display System) server, as well as a basic DODS server capability (see http://daac.gsfc.nasa.gov/DAAC_DOCS/DODS.html). WMT-DODS provides a means to serve up DODS-enabled data set collections in a form compatible with OpenGIS standards, while GrADS-DODS capitalizes on the extensive analysis capabilities of the GrADS package applied to DODS-enabled data sets. WebGIS (http://daac.gsfc.nasa.gov/WEBGIS) was developed to provide on-the fly format conversion of data from large data sets (including the HDF format). For the data requested, WebGIS searches the DAAC online data holdings and creates a map of spatially subsetted data in GIS formats (shapefiles, OGC standards). The user can quickly download the requested data layers and maps via the web for use in local analysis packages.

The Goddard DAAC Data Support Team (DST) members provide expert assistance to the user in the areas of accessing data products, documentation, browse, and data analysis. A user friendly web-based search and order system (with simple point & click buttons for drill down navigation or full-feature spatial & temporal search) has been implemented for each data discipline, and is supported by the respective DST responsible for that discipline. For users' convenience, features such as spatial subsetting and attribute filtering are also provided. For each discipline, several data manipulation, reprojection, subsetting, and visualization tools have been made available to the Earth science community.

5. Summary

The Goddard DAAC long-term data collections consists of data from the major climate related disciplines such as atmospheric dynamics, atmospheric chemistry, global land and ocean biosphere, and hydrological sciences. Taken as a whole, these collections provide continuous measurements of important variables spanning heritage missions and their EOS counterparts. Some of the key parameters included are: reflected and emitted radiance, solar irradiance, aerosol, ozone and other trace gases, temperature and humidity profiles, total precipitable water vapor, cloud parameters, precipitation, vegetation index, sea surface temperature, ocean chlorophyll and other sea sediment concentrations, zonal and meridional winds, heat and moisture fluxes, and numerous assimilated fields. These data sets are used by the scientific community to detect subtle signatures of climate change, study regional and global phenomena, and for predictions and characterization of natural disasters.

These climate data sets are freely available (http://daac.gsfc.nasa.gov/data/dataset) to the scientific and other data user communities. The DAAC data

support team members provide expert assistance to the user in accessing and using the data products and related visualization and analysis tools.

6. Acknowledgements

The authors would like to acknowledge the data operation and all data support teams at the Goddard DAAC for their contributions. This work is supported by the NASA/GSFC Earth Science Enterprise.

7. List of Acronyms

ACRIM - Active Cavity Radiometer Irradiance Monitor
AIRS - Atmospheric Infrared Sounder
AMSU - Advanced Microwave Sounding Unit
ATMOS - Atmospheric Trace Molecule Spectroscopy
ATMS - Advanced Technology Microwave Sounder
AVHRR - Advanced Very High Resolution Radiometer
BUV - Backscatter Ultraviolet Spectrometer
CAMEX - Convection and Moisture Field Experiment
CLAES - Cryogenic Limb Array Etalon Spectrometer
CrIS - Cross-Track Infrared Sounder
CZCS - Coastal Zone Color Scanner
DAO - Data Assimilation Office
ESSP - Earth Science System Pathfinders
GOME - Global Ozone Monitoring Experiment
GPCC - Global Precipitation Climatology Center
GPCP - Global Precipitation Center Project
HALOE -Halogen Occultation Experiment
HIRDLES - High Resolution Doppler Imager
HRDI - High Resolution Doppler Imager
HSB - Humidity Sounder for Brazil
IRIS - Infrared Interferometer Spectrometer
ISAMS - Improved Stratospheric and Mesospheric Sounder
LBA - Large Scale Biosphere-Atmosphere Field Experiment
LIMS - Limb Infrared Monitor of the Stratosphere
MAS - MODIS Airborne Simulator
MLS - Microwave Limb Sounder
MODIS - Moderate-Resolution Imaging Spectroradiometer
MSU - Microwave Sounding Unit
NPOESS -National Polar-orbiting Operational Environmental Satellite System
OMI - Ozone Monitoring Instrument
PEM - Particle Environment Monitor
PR - Precipitation Radar
SBUV - Solar Backscatter Ultraviolet Spectrometer
SeaWiFS - Sea-Viewing Wide Field-of-View Sensor
SCSMEX - South China Sea Monsoon Field Experiment
SME - Solar Mesosphere Explorer
SORCE - Solar Radiation and Climate Experiment
SOLSTICE - Solar Stellar Irradiance Comparison Experiment
SIM - Spectral Irradiance Monitor
SSM/I - Special Sensor Microwave/Imager
SPG - Southern Great Plains Field Experiment
SUSIM - Solar Ultraviolet Spectral Irradiance Monitor
TEFLUN - Texas Florida Underflight Field Experiment
TIM - Total Irradiance Monitor
TMI - TRMM Microwave Imager
TOGA COARE -Tropical Ocean Global Atmospheres Coupled Ocean Atmosphere Response Field Experiment
TOMS - Total Ozone Mapping Spectrometer
TOVS - TIROS Operational Vertical Sounder
TRMM -Tropical Rainfall Measuring Mission
UARS - Upper Atmosphere Research Satellite
VIIRS - Visible Infrared Imager Radiometer Suite
VIRS - Visible Infrared Scanner
WINDII - WIND Imaging Interferometer
XPS - XUV Photometer System