P 2.4 THE ATMOSPHERIC COMPOSITION DATA AND INFORMATION SERVICES CENTER (ACDISC)

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1. INTRODUCTION

Studying Atmospheric Composition using Earth science data sets from multiple sources can be a daunting task. It involves identifying appropriate geophysical parameters, then trying to understand what datasets contain these parameters, then locating at various locations, and then obtaining voluminous amounts of data, subsetting to extract the parameters and spatial areas desired, and co-locating the data with other data. Thus, there is often a significant upfront investment before the core investigation can begin. To ease the burden of such investigations among the Atmospheric Composition community, the Goddard Earth Science (GES) Data and Information Services Center (DISC) has undertaken the development of the Atmospheric Composition Data and Information Services Center (ACDISC), Leptoukh (2005). ACDISC (http://acdisc.gsfc.nasa.gov/) is a portal to the Atmospheric Composition (AC) specific, user driven, multi-sensor, on-line, easy access archive and distribution system employing data analysis and visualization, data subsetting, and other user requested techniques for the better science data usage. It provides convenient access to AC data and information from various remote-sensing missions, from TOMS, UARS, MODIS, and AIRS datasets, to the most recent data from Aura OMI, MLS, HIRDLS, as well as AC datasets residing at other remote archive sites. It adequately addresses the NASA Strategic Atmospheric Composition Roadmap.

The goals of the AC-DISC are:

- Serve as a **one-stop shopping** data center for Atmospheric Composition (AC) Scientists, guided by Atmospheric Composition Scientists
- Provide **services and expertise** for effortless and convenient access to and usage of AC data
- **Collaborate with AC scientists** to establish a framework for seamless utilization of data from multiple sensors for long-term atmospheric research

2. ACDISC APPROACH

- AC scientist guided - AC community representatives make suggestions and evaluate results
- Multi-sensor - Archive and distribute AC data from multiple sensors to facilitate long term, AC-specific research.
- On-line archive - Allows for direct retrieval of data via ftp.
- Web-based access - Reuses popular and easy to use GES DISC home grown interfaces
- On-line analysis and visualization - Reuses popular customizable tool (Giovanni) for on-line analysis and visualization.
- Subsetting tools - Allows retrieval of smaller volume data.
- Data safely stewarded - Ensures all AC data and documentation is safely kept for long-term science objectives.

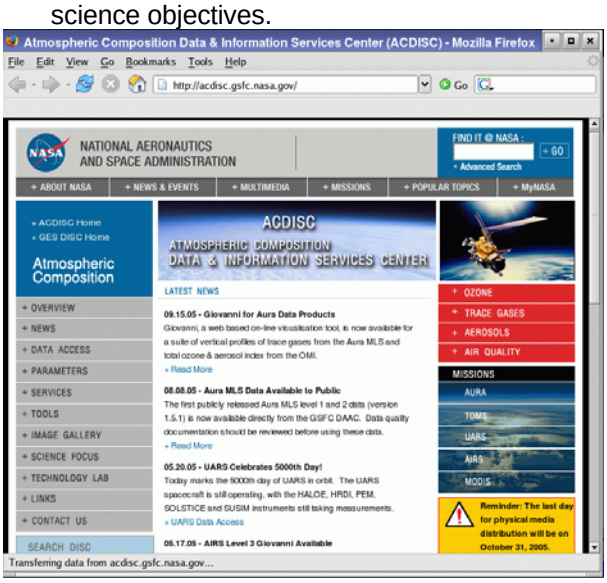

Fig. 1. Goddard ACDISC home page

3. ACDISC DATA ACCESS

Users can access ACDISC data via using several web interfaces. Fig. 2 shows ACDISC Parameters page, which have links to various atmospheric chemistry, aerosol and cloud parameter pages. Each parameter page, like one shown on Fig. 3, has short parameter description, parameter measurement specifics and links for access to specific GES DISC data products that contain this parameter. Data access links on this interface lead to the well-known GES DISC WHOM

interface, from which data products can be ordered.

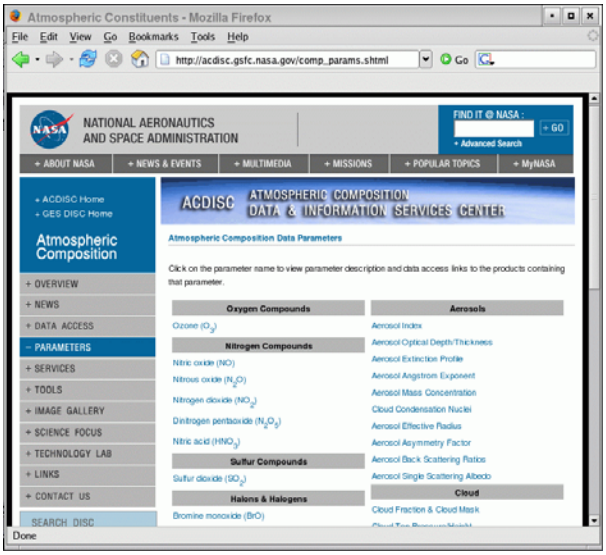

Fig. 2. ACDISC Parameters Page

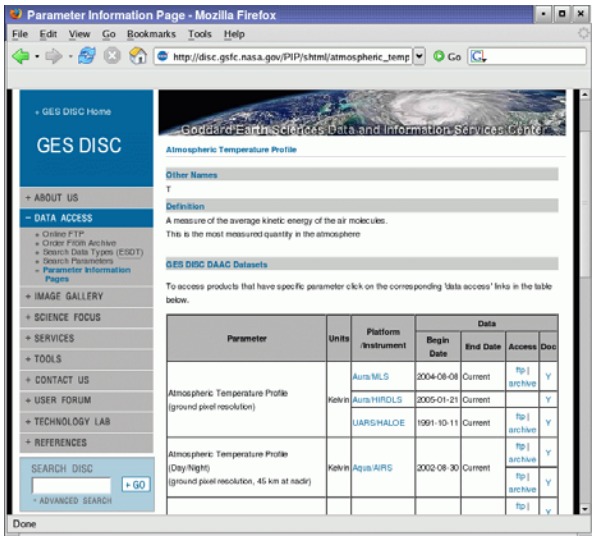

Fig. 3. ACDISC Temperature Parameter Page

Another ACDISC interface, shown on Fig. 4, provides more efficient ways of product search and ordering. When using this interface user can select one or more of 88 atmospheric data parameters, the platform/instrument, the data processing level, and the time range. Once these selections are done user will see the list of data products that contain all these preferences.

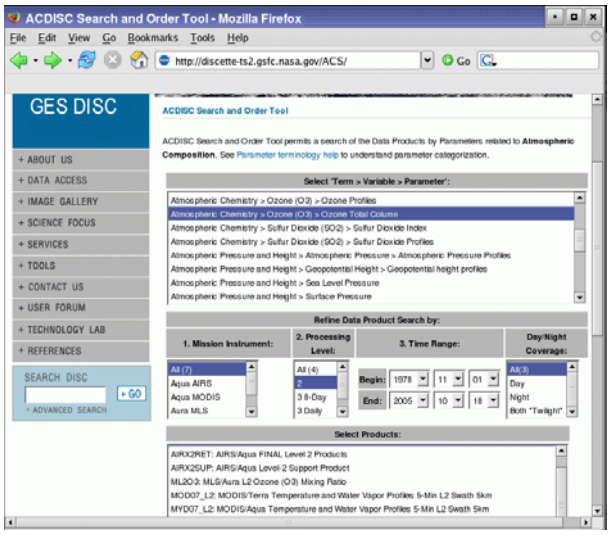

Fig. 4. ACDISC Search and Order Tool

After selecting those products, and coordinates of needed spatial region user will be transferred to another page like one on Fig. 5, which lists data products that contain 'Ozone Total Column' parameter. This page shows estimated number of granules per each product, the links on this page lead to the WHOM interface. On this page user can refine data search options and order the listed data products.

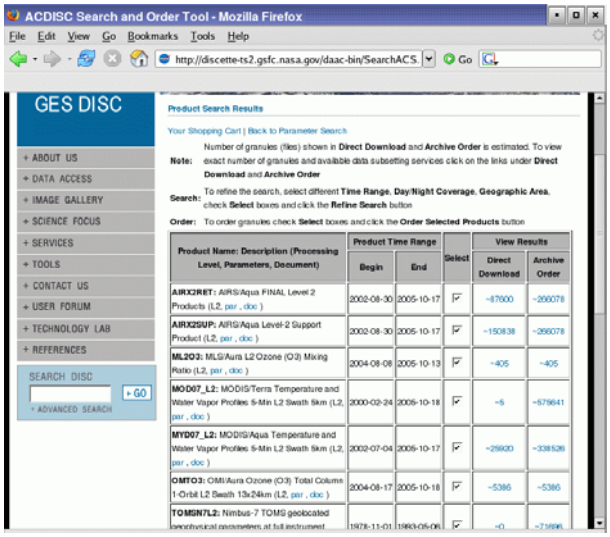

Fig. 5. ACDISC search results example

The ACDISC Parameter Pages and Search and Order interfaces provide search and order for the data products from historic missions such as Nimbus-7 (LIMS and TOMS instruments), TIROS and various NOAA missions (TOVS); current missions such as UARS (HALOE, MLS, ISAMS, etc), Earth Probe (TOMS), Aqua (AIRS and MODIS), Terra (MODIS) and the latest Aura (OMI,

MLS and HIRDLS) mission. In the future, data products from other historic and new missions as well as atmospheric composition data products from remote data sites will be added to search and order tool.

4. ACDISC DATA SUBSETTING

ACDISC employs subsetting as means to reduce data volumes during data transport to users. Depending on data product file format, various subsetters are used.

4.1 GES DISC HDF-EOS5 subsetter

To handle Aura that is packed in the so-called HDF-EOS5 data format, which is different from HDF4-based HDF-EOS typical for data from previous EOS missions, the HDF-EOS5 subsetter has been developed at the ACDISC. It is written in C Code using HDF-EOS5 libraries. It supports any properly formatted HDF-EOS5 file, and runs from the command line.

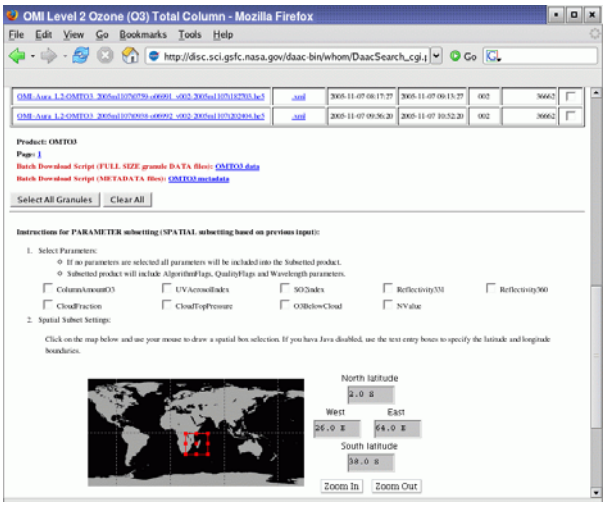

Fig. 6. WHOM interface for subsetting OMI Level 2 data

Currently, the subsetter works during FTP data download. The subsetter allows spatial and parameter subsetting of Aura/OMI and spatial subsetting of Aura/MLS Level 2 products and is available via GES DISC WHOM search and order tool. Fig. shows example of the WHOM interface that provides access to subsetting service for OMI OMTO3 data product. By limiting selection to the specific spatial region and certain parameters like Column Amount Ozone, UV Aerosol Index, SO2 Index, etc., users can significantly reduce data transfer sizes of ~48MB OMTO3 files. Note, that the original metadata and attributes are retained during subsetting.

4.2 HEW/HSE Subsetter

For handling Level 3 (gridded) data, HDF-EOS Subsetting Engine, HSE, libraries are used. HSE was developed and made available by the University of Alabama. GES DISC has configured HSE to subset Terra and Aqua Level 3 atmospheric globally gridded daily, weekly and monthly files, whose size varies from 450 MB to 800 MB. These files can be subsetted by 37 most popular aerosol and cloud parameters and well as by spatial regions. The subsetter works during FTP download and accessible via WHOM interface in a manner similar to Aura OMI and MLS interfaces.

HSE was recently enhanced to process HDF-EOS5 data files, which made it suitable for subsetting OMI and MLS Level 3 data. Once those data sets become available, ACDISC will develop WHOM interface to provide the subsetting service.

5. GIOVANNI

The goal of the GES-DISC Interactive Online Visualization and Analysis Infrastructure (Giovanni) is to relieve the science investigator of some of the upfront data preparation work and provide a tool for obtaining science knowledge via plots, graphs, and tables without having to download and prepare large amounts of data.

The principal design goal for Giovanni, Berrick (2004), was to provide a quick and simple interactive means for science data users to study various phenomena by trying various combinations of parameters measured by different instruments, arrive at a conclusion, and then generate graphs suitable for a publication. Alternatively, Giovanni would provide a means to ask relevant what-if questions and get back answers that would stimulate further investigations. This would all be done without having to download and preprocess large amounts of data. Another goal of Giovanni was to off-load as much as possible the data processing workload onto the machines hosting the data and to reduce data transfers to a minimum. Giovanni supports HDF, HDF-EOS, as well as binary formats.

5.1 Giovanni User Interface

From the user's perspective, Giovanni is a simple Web application. A user can select either the Java or non-Java version. The resulting Web page allows the user to select the spatial area via the Java image map applet or, if the non-Java version was selected, manually by entering in coordinates defining a bounding box. The user also selects the temporal range of the data, one or more

parameters from this data set, and the output type (ASCII or one of several plot types).

Depending upon the parameters selected, the vast majority of users will see the results in a matter of seconds. For users who choose large amounts of data either spatially or temporally, the results may take several minutes.

Giovanni allows scientists and researchers to easily access, visualize and analyze various gridded Level-3 and some Level-2 atmospheric products, thus helping them to understand seasonal-to-interannual variation of atmospheric parameters. Giovanni can provide information at every single point and in any rectangular area within the data domain, which allows researchers to conduct nearly unlimited investigations. The ASCII output option allows users to do their own customized analyses or applications.

5.2 TOMS and OMI Giovanni

TOMS from Nimbus-7 and Earth Probe missions were the first Atmospheric Composition daily datasets implemented in Giovanni. Later, similar interface, which is shown on Fig. 7, was added for analysis of Aura/OMI TOMS-like product.

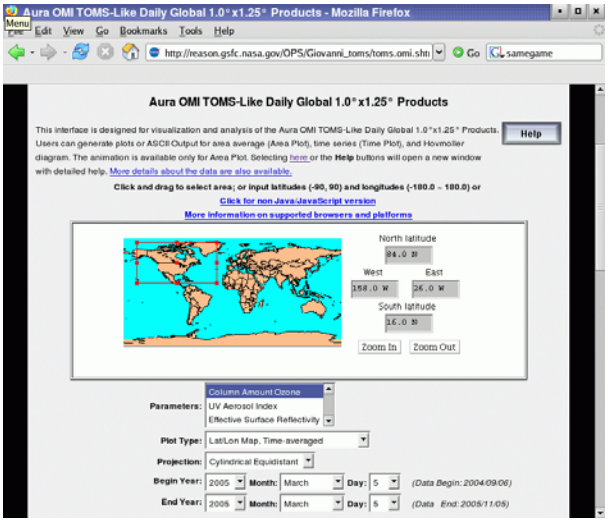

Fig. 7. Aura OMI TOMS-like product Giovanni interface

When using these interfaces, scientists can generate time-averaged area plots and area-averaged time-series plots for Ozone, Aerosol Index and Effective Surface Reflectivity parameters. Fig. 8 displays time-averaged area plot for OMI Ozone parameter over North America region. Other TOMS/OMI Giovanni plotting functions include animation and Hovmoller.

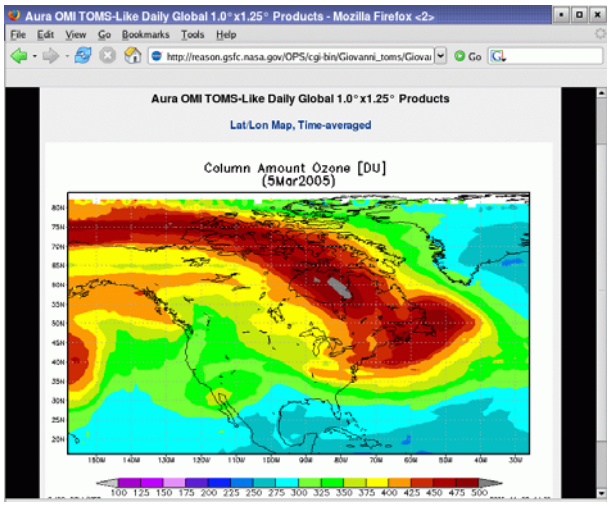

Fig. 8. Time-averaged area plot for OMI product

ACDISC will soon release L2G Giovanni interface, which will utilize OMI Level-2G daily product consisting of data from 15 orbits that are binned onto a 0.25 ^{o} x 0.25^{o} global grid. In Giovanni, user will be able to generate OMI gridded product at a coarser spatial resolution as well as to get its spatial and parameter subset.

5.3 HALOE Giovanni

UARS/HALOE Giovanni interface allow users displaying vertical profiles of ozone, water vapor, CH4, NO2, NO, HCl, HF, and temperature, as well as aerosol extinction profiles at four wavelengths.

5.4 MLS Giovanni

Similar to HALOE Giovanni, Aura/MLS Giovanni interface allows to display vertical profiles for ozone, temperature, water vapor, ClO, CO, HCl, HCN, HNO3, N2O, OH, geopotential height and relative humidity with respect to ice parameters.

5.5 AIRS Giovanni

The Aqua/AIRS interface is the first Giovanni instance where various vertical and horizontal 2D slices are employed within a single Giovanni instance. This interface allows display of zonal and meridional vertical cross-sections of temperature, water vapor, relative humidity and geopotential height. Time-series, spatial averages and hovmoller functions are also available.

5.6 Other Giovanni instances

- MOVAS: MODIS aerosol related
- Ocean-color (SeaWiFS and MODIS Aqua)
- TOVAS: TRMM and other gridded precipitation data

6. FUTURE ACDISC DIRECTIONS

In the near-term, other OMI products (Cloud, NO2, Aerosols, etc) will be available. The standard Aura Level-3 product will be made available as well as implemented in the Giovanni. Various Giovanni inter-comparison options will be employed to compare parameters from TOMS, OMI, MLS, AIRS, and MODIS data products.

7. ACKNOWLEDGMENT

The ACDISC wishes to thank Drs. M. Schoeberl, A. Douglass, P.K. Bhartia, E. Hilsenrath, Y. Kaufman, M. Chin and W. Gregg (NASA GSFC) for their support of the ACDISC effort.

8. REFERENCES

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ACDISC URL: http://acdisc.gsfc.nasa.gov