HDF/HDF-EOS Data Access, Visualization and Processing Tools at the GES DAAC

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Abstract- **To help users of remote sensing data, the NASA Goddard Earth Sciences Distributed Active Archive Center (GES DAAC) has developed a series of desktop and on-line tools. These are presented in this article. Various HDF readers for AIRS and MODIS data have been written in IDL, C and Fortran. HDFLook for AIRS and MODIS works as a desktop application as well as an integral part of various subsetting systems. AIRS QuickLook is an on-line package that allows users to view AIRS/HSB/AMSU Level-1B data online by specifying a channel prior to obtaining data. AIRS Online Channel/Variable subsetter provides on-line subsetting of the AIRS Level 1B and Level 2 data products. OASIS (Online data AnalySIS) is an IDL-based HTML/CGI interface for search, selection, and simple analysis of earth science data. TRMM Online Visualization and Analysis System is designed for quick exploration, analyses, and visualization of TRMM Level-3 and other precipitation products. WebGIS is online web software that implements the Open GIS Consortium (OGC) standards for requesting rendered maps from OGC-compliant servers.**

I. INTRODUCTION

The Goddard Earth Sciences (GES) Distributed Active Archive Center (DAAC) plays a major role in enabling basic scientific research and providing access to scientific data to the general user community. Several GES DAAC Data Support Teams provide expert assistance to users in accessing data, including information on visualization tools and documentation for data products. To provide easy access to, and processing and visualization of the science data, the Data Support Teams have additionally developed, or supported the development of many desktop and online tools, described in this paper.

II. GES DAAC DESKTOP TOOLS

A. AIRSMETA

AIRSMETA is a C-program developed at the GES DAAC to read various components of a data file, and display them in ASCII format. The program was designed and tested on SGI UNIX workstations. The HDF-EOS calling interface library must be installed on a local machine and linked to this program during compilation. See:

ftp://daac.gsfc.nasa.gov/data/atmos_dyn/tools/airsmeta.tar

B. HDF_reader

HDF_READER is a command line program developed by the GES DAAC to allow a user to view the contents of an HDF file, as well as to subset the data therein. A list of options controls what is displayed. One may list any of the HDF objects within a file, and the data within them. They may be subsetted along any dimension, or the entire data may be dumped if no subset options are given. There is also a mode to print a hierarchical tree list of the objects in the file. Data can be sent to an ASCII text file, a set of flat binary files, or displayed on the screen (default). See:

ftp://daac.gsfc.nasa.gov/data/atmos_dyn/tools/read_hdf.tar

C. IDL_reader

IDL_Reader is a data reader for AIRS Level 1B radiances written in IDL by the AIRS Project. It contains separate codes for each of the four data products currently available to the public. See:

ftp://daac.gsfc.nasa.gov/data/atmos_dyn/tools/airs_idl_reader.tar

D. HDFLook

HDFLook is a new multifunctional data processing and visualization tool developed to work with MODIS Land, Ocean and Atmosphere, and AIRS HDF-EOS products [1]. It has been used as the main subsetting engine for the GES DAAC MODIS Ocean Level 2 on-demand subsetting and for the MODIS Ocean Level 2 on-the-fly subsetting for the on-line Data Pool holdings. Features include (1) accessing and visualization of all swath (Levels l and 2) MODIS and AIRS products, and gridded (Levels 3 and 4) MODIS products; (2) re-mapping of swath data to a world map; (3) geo-projection conversion; (4) interactive and batch mode processing capabilities; (5) subsetting and multi-granule processing; and (6) data conversion from HDF-EOS to ASCII, binary, JPEG, GeoTIFF. HDFLook is also used operationally for the spatial on-the-fly subsetting of MODIS Level 3 Ocean products from the Data Pool, and for the on-demand parameter subsetting of MODIS Ocean Level 2 products. It is going to be the main programs to routinely generate Level 1B browse images (true-color for daytime, and brightness temperature for nighttime) for MODIS data from the Terra and Aqua satellites. It is also used to generate daily global MODIS images. HDFLook for AIRS and

MODIS is the result of a joint collaboration between the GES DAAC and the Laboratoire d'Optique Atmosphérique (LOA), University of Lille, France. It has been developed for XWindows environment, and works on all major Unix/Linux/Mac platforms.

It is free and available from the NASA GES DAAC web-site http://daac.gsfc.nasa.gov/MODIS/HDFLook and LOA http://www-loa.univ-lille1.fr/Hdflook/hdflook_gb.html

E.   simap

simap is an IDL based script that is designed to read and map MODIS Level 1B and Level 2 Ocean and Atmosphere products. It is a non-interactive, command line executed tool that can generate maps of the above products. The resulting maps are scaled to physical units (radiances, concentrations, brightness temperatures, etc.) and are saved as binary files. One of simap's strengths is the compositing of global maps, and stitching together of multiple Level 1B or Level 2 granules on a single world map. This can be useful in a variety of applications, such as a quick display of data directly downloaded from MODIS instruments onboard Terra or Aqua satellites (Direct Broadcast), or producing high resolution maps of MODIS data over a specific area. See:

http://daac.gsfc.nasa.gov/MODIS/simap/simap1.pro

F.   geoview

geoview is an interactive IDL program to read Level 1B and Level 2 MODIS products, list Science Data Sets (SDS) and their attributes, and show granule location on a world map. It can overlay the first three user-selected channels or other data layers, geolocate each one of them, and produce a mapped true color image. See:

ftp://g0dug03u.ecs.nasa.gov/data/modis/tools/hdf/geoview/geov.pro

G.   modis_atmos

modis_atmos is an IDL-based program initially designed to read MODIS Level 2 and 3 atmospheric products. It also can read other HDF-EOS files such as MODIS Level 1B radiances, land, ocean, snow and ice, and subset products. It produces quick look browse images, provides parameter subsetting, and creates binary and ASCII files as output. See:

ftp://g0dug03u.ecs.nasa.gov/data/modis/tools/hdf/modis_atmos/modis_atmos.pro

H.   TRMM_HDF

TRMM_HDF is a program (both C and Fortran versions are available) that reads in TRMM HDF data files and writes out user-selected SDS arrays and Vdata tables as separate flat binary files. See:

ftp://lake.nascom.nasa.gov/software/trmm_software/Read_HDF/

III.   GES DAAC ONLINE TOOLS

A.   AIRS QuickLook

AIRS QuickLook is a CGI/IDL package that allows users to view AIRS/HSB/AMSU Level 1B data online by specifying a channel prior to obtaining data. A global map is also provided along with the image to show geographic coverage of the granule and flight direction of the spacecraft. http://daac.gsfc.nasa.gov/atmodyn/airs/airs_tools.html

To illustrate abilities of this tool, we provide several images generated by the AIRS Quicklook on the tropical cyclone Inigo. Packing sustained winds of 212 km/hr, tropical cyclone Inigo was tracking to the west-southwest at 9 km/hr. Inigo brought torrential rainfall and flooding to the Indonesian islands and a large part of Western Australia. Strong upward motion just outside the eye wall pushes clouds upper in the atmosphere, resulting in relatively lower brightness temperature than the surroundings. See Figs 1-3.

AIRS Vis/NIR Level-1B Quick Browse Image
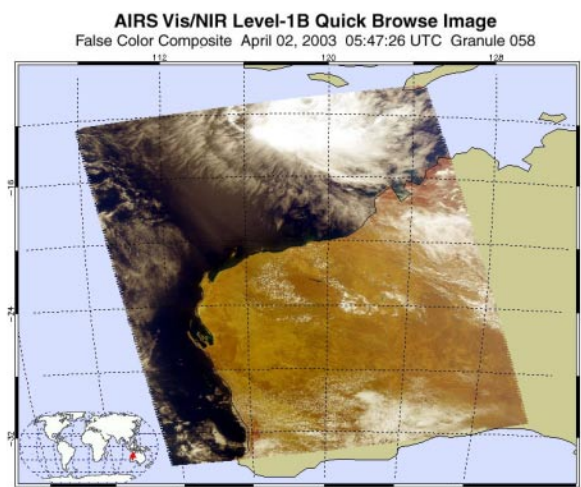False Color Composite   April 02, 2003   05:47:26 UTC   Granule 058

Figure 1.   The Vis/NIR false color composite image shows the southern half of the cloud system associated with the cyclone, with the eye clearly visible.

AIRS Level-1B Quick Browse Image
11 μm Brightness Temperature   April 02, 2003   05:47:26 UTC   Granule 058

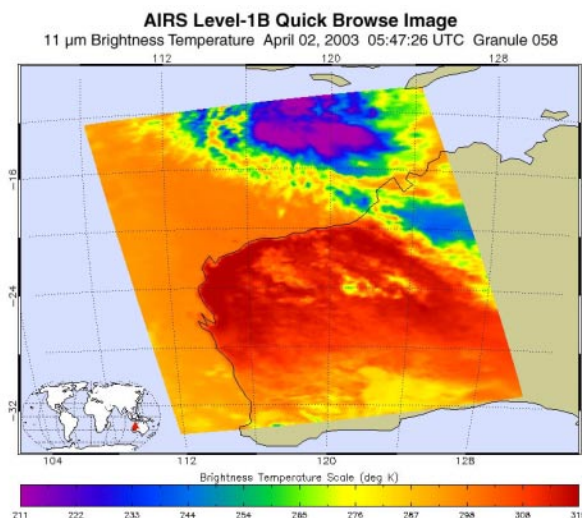Brightness Temperature Scale (deg. K)

Figure 2.   The AIRS 11.0 micron IR thermal window channel shows temperature structure of the cyclone cloud system, and the effects of dynamic surface heating just after local noon. The brightness temperature over the land surface can be more than 20 Kelvin warmer than that over the ocean surface.

AMSU Level-1B Quick Browse Image
52800 MHz Brightness Temperature   April 02, 2003   05:47:26 UTC   Granule 058

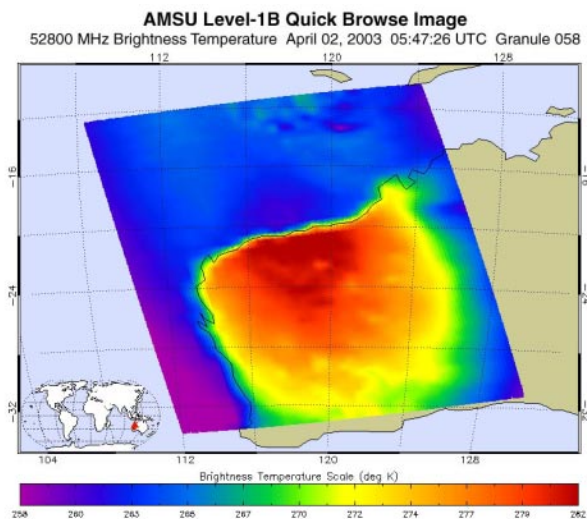Brightness Temperature Scale (deg K)

Figure 3.   The AMSU image shows the ability of microwave to penetrate clouds. Information from AMSU in the presence of clouds is used to correct the infrared measurements for the effects of clouds.

B. AIRS on-demand Channel/Variable Subsetter

AIRS on-demand Channel/Variable Subsetter is a web-based, on-the-fly/on-demand subsetter that performs channel/variable subsetting and restructuring for Level 1B and Level 2 data products. Users can specify criteria to subset data files with desired channels and variables, and then download the subsetted file. See:

http://daac.gsfc.nasa.gov/atmodyn/airs/airs_tools.html.

C. TRMM Online Visualization and Analysis System (TOVAS)

TRMM Online Visualization and Analysis System (TOVAS) has been designed for exploration, analysis, and visualization of TRMM Level-3 and other precipitation products: daily (3B42), monthly (3B43), near-real-time (3B42RT), and Willmott's climate data. TOVAS is simple and easy to use: users can plot the average or accumulated rainfall over their region of interest for a given time period, or plot time series of the regional rainfall average. Data used in those plots can be outputted in ASCII format. See:

http://daac.gsfc.nasa.gov/hydrology/TRMM_analysis.html

D. WebGIS

WebGIS is an online web software that implements the Open GIS Consortium (OGC) standards for requesting rendered maps from any OGC-compliant server. It allows users access to TRMM, MODIS, SeaWiFS, and AVHRR data from several DAAC map servers, as well as externally served data such as political boundaries, population centers, lakes, rivers, and elevation. See:

http://daac.gsfc.nasa.gov/WEBGIS/

E. OASIS

OASIS (Online data AnalySIS) is an IDL-based HTML/CGI interface for search, selection, and simple analysis of Earth Sciences data. It supports binary, GRIB, BUFR and HDF-EOS formatted data, such as TOVS, Data Assimilation products, and some NCEP operational products. See:

http://daac.gsfc.nasa.gov/atmodyn/online_analysis/OASIS/html/

REFERENCES

[1]   D. Ouzounov., A. Savtchenko, G. Leptoukh, B. Zhou, D. Ostrenga, C. Deroo and L. Gonzalez, "GES DAAC tools for accessing Terra and Aqua MODIS data," *Adv. Space Res.*, 2003, in press