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Development of Terra MODIS data pre-processing system on WWW

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Abstract

Terra MODIS is one of the few space-borne sensors currently capable of acquiring radiometric data over the range of view angles. Institute of Industrial Science, University of Tokyo, has been receiving Terra MODIS data at Tokyo since May 2001 and Asian Institute of Technology at Bangkok since May 2001. They can cover whole East Asia and is expected to monitor environmental changes regularly such as deforestation, forest fires, floods and typhoon. Over eight hundred scenes have been archived in the storage system and they occupy 2 TB of disk space so far. In this study, MODIS data processing system on WWW is developed including following functions: spectral subset (250m, 500m, 1000m channels), radiometric correction to radiance, spatial subset of geocoded data as a rectangular area with latitude-longitude grid system in HDF format, generation of a quick look file in JPEG format. Users will be notified just after all the process have finished via e-mail. Using this system enables us to process MODIS data on WWW with a few input parameters and download the processed data by FTP access. An easy to use interface is expected to promote the use of MODIS data. This system is available via the Internet on the following URL from September 1 2002, "<http://webmodis.iis.u-tokyo.ac.jp/>".

Keywords: Terra MODIS, East Asia, Environmental monitoring, WWW

1 Introduction

Terra MODIS is one of the few space-borne sensors currently capable of acquiring radiometric data over the range of view angles. With its sweeping 2,330-km-wide viewing swath, MODIS sees every point on our world every 1-2 days in 36 discrete spectral bands. Consequently, MODIS greatly improves on the heritage of the NOAA Advanced Very High Resolution Radiometer (AVHRR) and tracks a wider array of the earth's vital signs than any other Terra sensor.

NOAA AVHRR data have been received and archived in database for almost 20 years at Institute of Industrial Science, University of Tokyo and for 5 years at Asian Institute of Technology in Bangkok, and the spatial subset system is available.²⁾ To improve on the heritage of that, Terra MODIS data has been also received at IIS in Tokyo since May 2001 and at AIT in Bangkok since May 2001. The combined coverage of both data can cover whole East Asia and is expected to monitor environmental changes regularly such as deforestation, forest fires, floods and typhoon (Figure 1). Over eight hundred scenes have been archived in the storage system and they occupy 2 TB of disk space so far. Quick look service for all the data is available with database system.¹⁾ AVHRR data have been also received and archived in database for almost 20 years and the spatial subset system has started.²⁾ However, raw data can not be freely downloaded due to the heavy network traffic and they have to be processed after download. In this study, we develop a MODIS data pre-processing system on WWW for spatial and spectral subset.

2 System structure

2.1 MODIS data processing system

Data processing system is mainly composed of three parts; database system, data processing and web system design. First, anonymous user access to the data processing server on WWW and input mapping parameters through the graphical user interface (Figure 2-A). Secondly, data processing server will download MODIS data via the FTP access, subset geo-referenced data spatially and spectrally and move them in the FTP directory along with quicklook images and meta information (Figure 2-B). Finally, users will be informed of the instructions how to download data via the e-mail (Figure 2-C).

2.2 Pre-processing software

In this system, "HDFLook" is used as a pre-processing software for MODIS data. HDFLook is a comprehensive application for viewing NCSA HDF v.4.x and HDF-EOS 2.x science datasets. This is a result of joint collaboration between LOA USTL, France, and GES DAAC and is based on the very popular HDFLook tool philosophy.³⁾ The main features are as follows.

- Accessing and visualization of all swath (level-1, and 2) and gridded (level-3 and 4) MODIS radiometric and geolocation, atmosphere, land, and ocean products and binned (level-3 and 4) MODIS products.
- Re-mapping of swath data to world map. Geo-projection conversion. Reprojection of the initial projection into several pre defined selection.

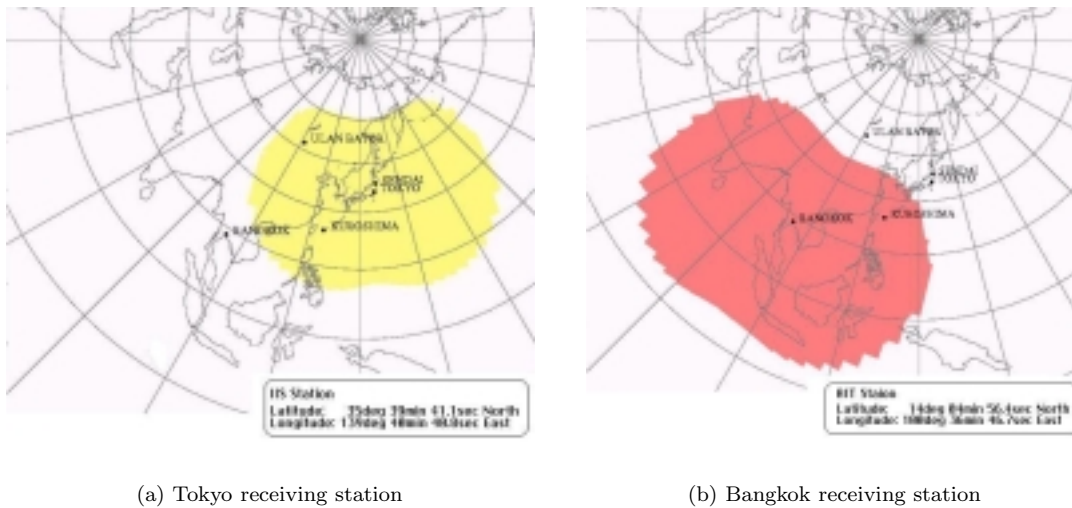


Figure 1. Spatial coverage of MODIS data

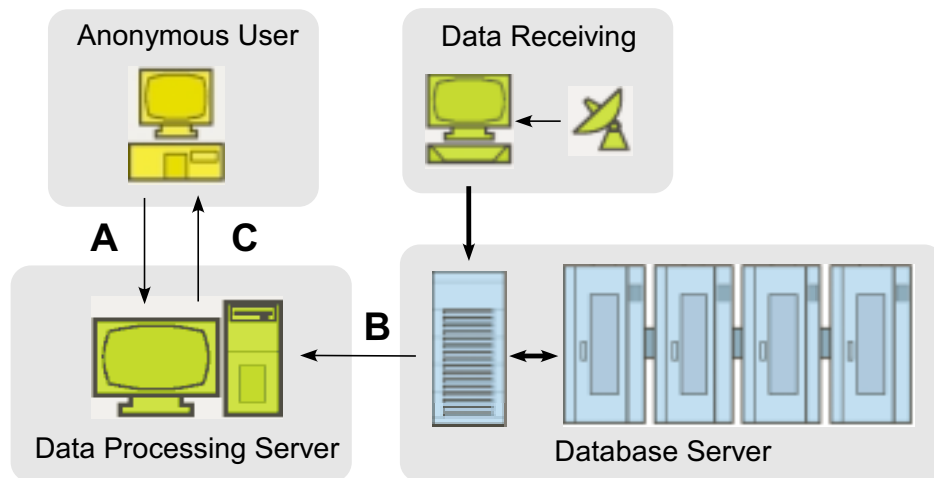


Figure 2. System configuration of WebMODIS

- Availability of parameter, band, and spatial sub-setting; - Multi-granule processing - Mosaic and stitch capabilities.
- Data conversion from scaled quantities to physical units. Format conversion HDF-EOS to ASCII, Binary, JPEG.
- Aerosol and other ancillary data available from the ground based sun photometer measurements (AERONET data base) for the atmospheric correction.

MODIS data can be processed by commercial software such as ENVI, ERDAS or Terra, however, HDFLook is a freeware which can do geometric correction with high accuracy. This software is supported under Linux operation system, which can run on any personal computer at low

cost compared with UNIX (Sun or HP) machine. Considering that both operating system and software are freely available, the system can be developed at considerably low cost.

3 Web system design

Nowadays, broadband Internet access is available at universities, public institutes, schools and homes. To make the most of Internet network resources, all the processing is packed on WWW through HTTP access. Graphical user interface is designed under the following policy.

- At the top page, users should select spatial resolutions. MODIS has three resolutions including 250m(2

channels), 500m(5 channels) and 1000m(29 channels) (Figure 3-(a)-A).

- The required input parameters are diminished as much as possible because even users who are not familiar with remote sensing data processing can use the system easily. What users have to input are only three parameters; 1) filename, 2) area of interest for mapping, 3) e-mail address.
- First, filename of your interest should be typed in the blank (Figure 3-(b)-A). In data search, user can view quick look images, spatial coverage, acquisition date and filename using only mouse click since the database is hierarchically structured as year, month and day (Figure 4).
- Secondly, area of interest for mapping should be typed in the four blanks including north latitude, south latitude, west longitude and east longitude in decimal degrees (Figure 3-(b)-C). Major geographical locations in Asian countries are registered in advance and you can select them easily by pull down menu (Figure 3-(b)-B).
- Finally, a corresponding e-mail address should be carefully typed in the blank (Figure 3-(b)-C). The instructions how to download data and meta informations will be sent to users via the e-mail.

After the input of three parameters successfully, the confirmation screen will be shown. The data processing will start as soon as the job is accepted by the server. One remarkable point of this system is that users have not to wait for the server response unlike CGI programs because all the process is running as a background jobs. Processing time depends on the request congestion, however, it takes about 20 minutes for the users to receive an e-mail as an instruction to FTP access. One example of data list users can download by FTP access is shown below.

- YYYYMMDDHHMM_QKM_RefSB.hdf: Reflective channel values in radiance (hdf format, 32-bit floating values)
- YYYYMMDDHHMM_QKM_QuickLook.jpg: Reflective channels quick look image (JPEG format)
- YYYYMMDDHHMM_QKM.met: Meta information

Quick look image of reflective channels is overlaid with coastal lines, country boundaries, major rivers and latitude-longitude lines so that the users can check the geometric correction accuracy easily by manual interpretation. Due to the data volume limitation of the server, processed data will be deleted 72 hours after the e-mail notification.

4 Data distribution

This system has been in operation since September 1, 2002 at "<http://webmodis.iis.u-tokyo.ac.jp>". System configuring hardware and software are as follows (Table 1).

Table 1. System configuration of the server

Data processing, Web, FTP, Mail server	Dell PowerEdge 6400 (Pentium4 700MHz × 2, 4GB of memory)
Software	OS: Redhat Linux Ver. 7.2 httpd: Apache Ver. 1.3.2 ftpd: Wu-FTP Ver. 2.6.1 smtp: sendmail Ver. 8.11.6

5 Conclusion

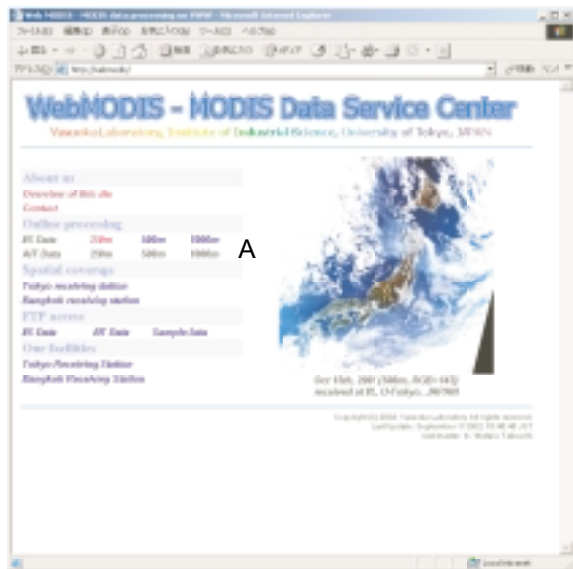
In this study, we developed a system to process and distribute MODIS data WWW. IIS has been storing MODIS data received at Asian Institute of Technology and they will be available on this system within the year of 2002. Since application software to process remote sensing data is getting easy to access, there is much demand on our directly received data. This system will work as a rapid monitoring system for forest fires or floods along with our AVHRR data.

Acknowledgment

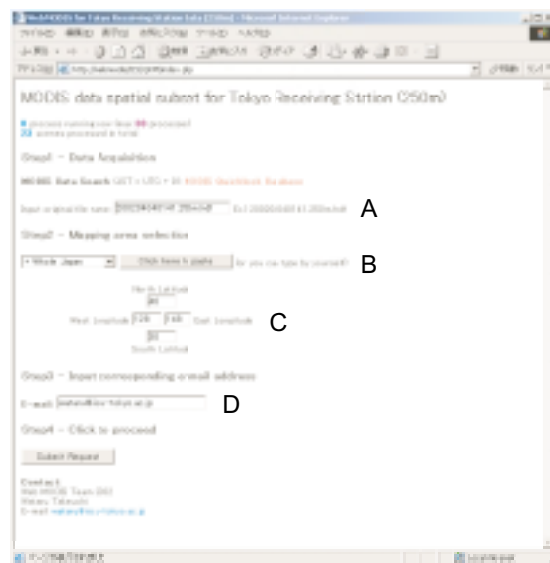
This study was partially carried out under the research project "Development of satellite monitoring network system for environment and disasters in Asian region" (Japan Science and Technology Agency). The authors would like to thank JST for their support.

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- 3) HDFLook homepage at the Laboratory of Optic Atmosphere, University of Lille, France, "<http://loasys.univ-lille1.fr/Hdflook/>".



(a) Gateway page



(b) 250m top page

Figure 3. Graphical user interface of WebMODIS

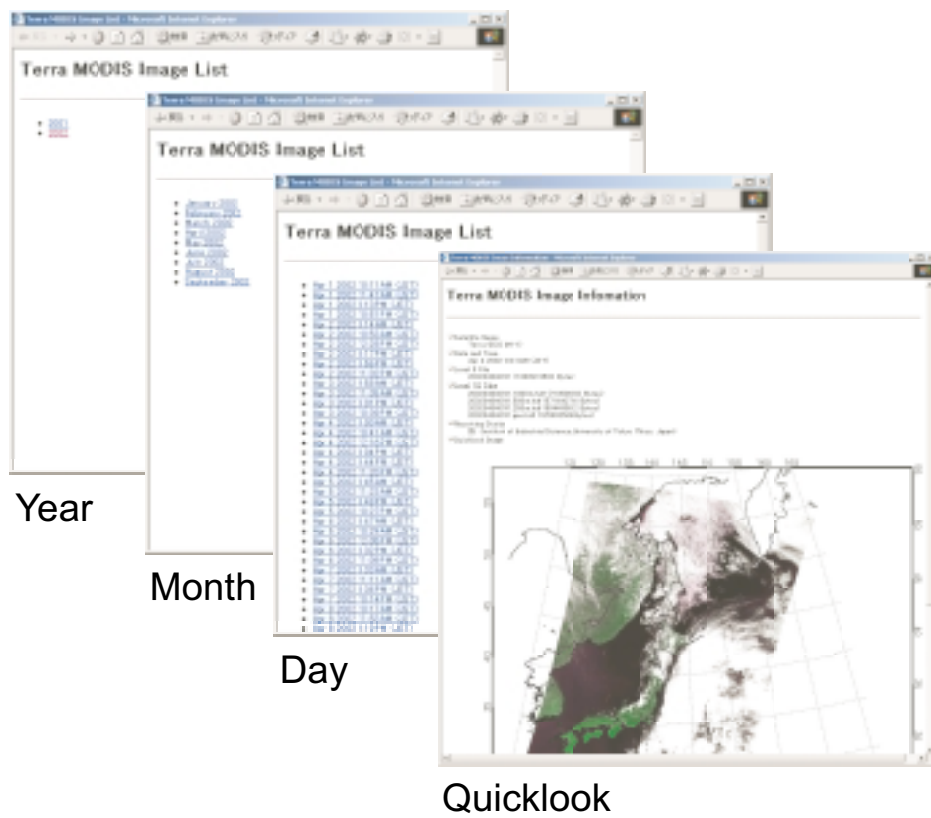


Figure 4. Hierarchical MODIS data search