Current Status and Future Perspective of CEReS Satellites Data Archive and Distribution

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Abstract

Primary function of Center for Environmental Remote Sensing (CEReS) is to provide satellite dataset such as GMS, MTSAT-1R, and NOAA/AVHRR for research community. We started data archive system (DAS) re-construction since 2005. New DAS based on PC servers and RAID storages with Free Open Source Software (FOSS). Such configuration changes allow us to easy-expansion of DAS and random data access via internet, thus downloaded files by users have been increased since 2005. In addition, activities of Virtual Laboratory (VL) for diagnosing the climate system accelerate the volume of archived satellite data since 2007. Our primary task in VL is collection and utilizations of geostationary meteorological satellites, thus we re-process raw full-disk data into grided format (after geometric correction) and open through the internet. Such data processing is not only contributed to VL also related communities. We will play an important role as one of data active archive center (DAAC) in Asia for satellite and related dataset.

Keywords: CEReS, data archive system (DAS), geostationary meteorological satellites, virtual laboratory (VL)

1. Introduction

The earth observation from the space (satellite observations) is effective method to diagnose the earth environment. For more utilization of satellite data, the establishment of data active archive center (DAAC) was urgent issue. To account for the needs, Center for Environment Remote Sensing (CEReS) was established in 1995. From initial stage, CEReS was tasked to process and produce the basic satellite dataset as a function of DAAC.

2. History of CEReS DAAC

2.1. First stage (1995-2004)

After the CEReS establishment, we installed two receiving systems for GMS5 and NOAA/AVHRR. In addition, a tape archiver (300TB max. capacity) was installed. It was not suitable for random access, but it should be noted that it was best solution to account for technology in 1990's (**Fig. 1**).

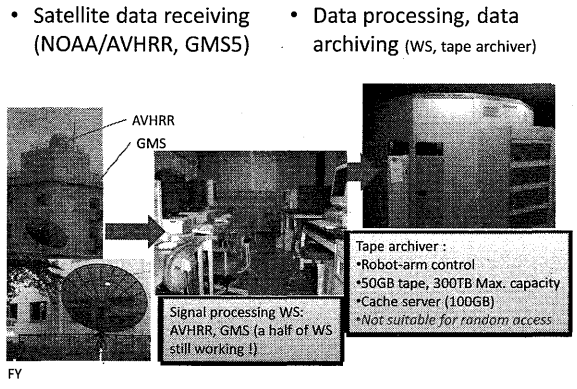

Fig. 1 Schematic illustration of DAAC in the first stage (1995-2004)

2.2. Second stage (2005-2006)

To satisfy the needs from users, we started to re-construct our data archive system (DAS). Since 2005, two PC servers with several RAID storages (total 12TB in capacity) were installed and operated (**Fig. 2**). New DAS was based on Free Open Source Software (FOSS) account for the scalability of easy-expansion (e.g., install additional RAID storage), easy-modification of configurations (version up). Most of advantage of adaptation of PC server based DAS is easy access to dataset via internet (by anonymous ftp protocol). In fact, download users were rapidly increased by the re-construction of DAS, thus our DAAC was truly renewal as D"A"AC.

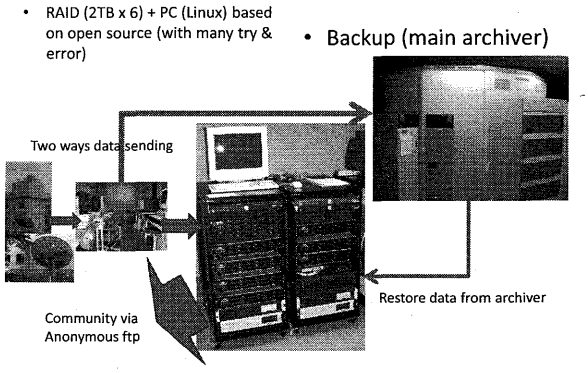

Fig. 2 Same as Fig. 1 but for the second stage (2005-2006)

3. Current DAAC activity highlights

3.1. Third stage of DAAC (start of VL: 2007-)

Since 2007, Virtual Laboratory (VL) for diagnose the Earth climate system with formation of Center for Climate

Table 1 Specifications of grided resampling format released by VL-CEReS for geostationary meteorological satellites.

GEO	Res.	Width	Grided	Release Status
MTSAT-1R	VIS: 0.01° IR: 0.04°	80° –200°	V.2.0 Released	Semi-Real time releasing
FY2-C, -D	0.04°	44.6° –164.6° (-C) 26° - 146° (-D)	V.2.0 Released	Semi-Real time releasing
METEOSAT (India)	0.04°	-2.5° –117.5°	V.1.95 (develop ver.)	Registration
METEOSAT	0.04°	-60° –60°	V. 1.95 (develop ver.)	Registration
GOES-W, -E	0.04°	225° –345° 165° –285°	V.2.0 Released	Semi-Real time releasing

Gridded resampling format (*level 1b*) Specification

- 60S – 60N, hourly (GOES 3 hourly, due to scan schedule)
- Data: image body (split each band), with calibration table
- 2 byte original data → big endian byte order
- Compressed by bzip2 (xxxxirx.tar.bz2, xxxxvis.tar.bz2)
- anonymous ftp servers (METEO restricted due to data policy)

System Research (CCSR) of Univ. Tokyo, Hydrospheric Atmospheric Research Center (HyARC) of Nagoya Univ., Center for Atmospheric and Oceanic Studies (CAOS) of Tohoku Univ. and CEReS. Our primary task in VL is to collect and utilized geostationary meteorological satellites (GEO, such as MTSAT-1R, FY2 series, Meteosat, MSG series and GOES-E, -W series; Yamamoto et al, 2009). To achieve them, we installed the receiving system for FY2 and define the output product to release dataset. Table 1 summarizes the specification of GEO product by VL-CEReS. We called gridded format of which already geometric correction procedure is conducted based on in-orbit navigation derived from header information of raw data. To account for re-radiometric calibration processes mentioned later, dataset consists of image body (filled by raw CCD count) and calibration table to convert from CCD to physical variables such as Tbb. Version 2 is the product of which improved the accuracy of geometric correction. Currently we collected a ten year (1998-2008) GEO and released via anonymous ftp servers as follows:

MTSAT-1R: *ftp://mtsat-1r.cr.chiba-u.ac.jp/*

FY series: *ftp://fy.cr.chiba-u.ac.jp/*

GOES series: *ftp://goes.cr.chiba-u.ac.jp/*

Meteosat and MSG[1]: *ftp://meteosat.cr.chiba-u.ac.jp/*

[1] Due to data policy of EUMETSAT, data access restricted authorized by IP clients and users.

Activities of VL-CEReS accelerate the number of downloaded files through the CEReS DAAC (**Fig. 3**) and capacity of DAS (**Fig. 4**). Until 10 December 2009) we have been performed 3.2 million data downloaded, furthermore number of downloaded files from outside of Chiba Univ. rapidly increased in 2009. To account for the scale of remote sensing-related communities, we truly contribute as one of DAAC in Japan. In the aspect of DAS, we re-constructed DAS approximately once per a year. Due to expensive management cost, we stopped the operation of a tape archiver in 2006.

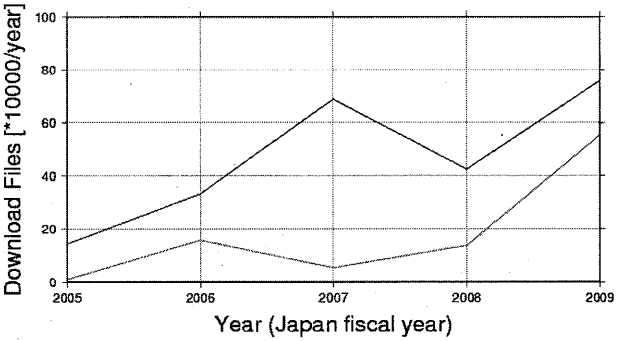

Fig. 3 Annual downloaded files from DAAC. Black line shows download from Chiba Univ., red line represents from outside of Chiba Univ. Unit is 10,000 files per year.

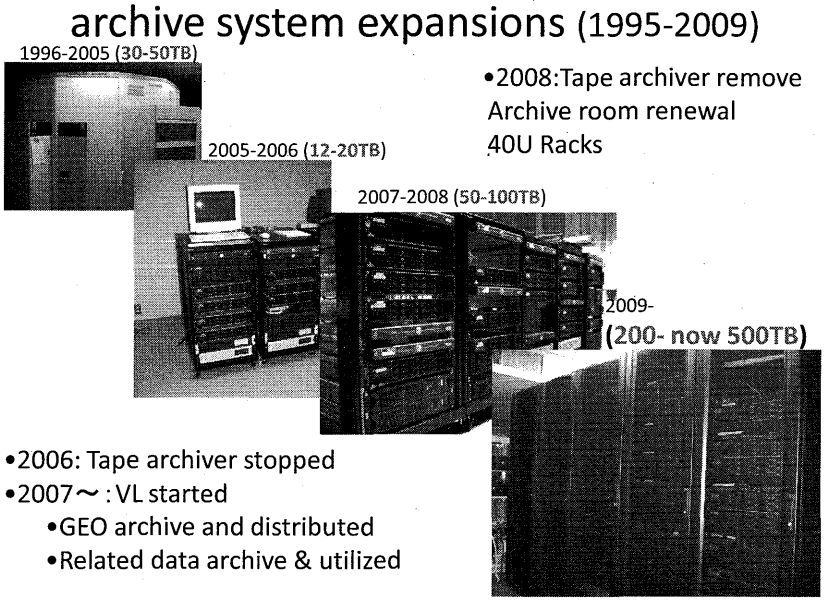

Fig. 4 Expansion of CRES-DAS since 1995.

A kind of risk owned by the operation stop of tape archiver; however the reduced costs can invest to new DAS. In 2008, replacement of tape archiver allows us to efficient space usage for DAS. In the end of 2008, we moved DAS into a new server room of which located tape archiver with enhancement of air-conditioner's power. With every-years re-construction of DAS, total capacity of DAS have been changed as 12-20 TB in 2005-2006, 50-100TB in 2007-2008 and 200-500TB in 2009. Now we face the door of "peta-byte (PB)" volume and it seems to open the door during 2010. Because we exactly need more data capacity to accelerate our activity.

3.2. Collaborations with several organizations

3.2.1. With Chiba Univ. Library (CUWiC)

Since 2006, we tried to collaboration with Chiba Univ. Library by the support of National Institute of Informatics (NII) e-Science project. In 2007, we made the prototype of searching engine of which can search article, report (CURATOR, developed by Library) and NOAA/AVHRR images. We called this system Chiba University Wisdom Collection (CUWiC http://cuwic.ll.chiba-u.jp/). Now CUWiC has a function of insert "tag" into each image by internet users, for example "a day of typhoon 16 attacked Japan". This challenge is one of tests how to utilize satellite image into other communities.

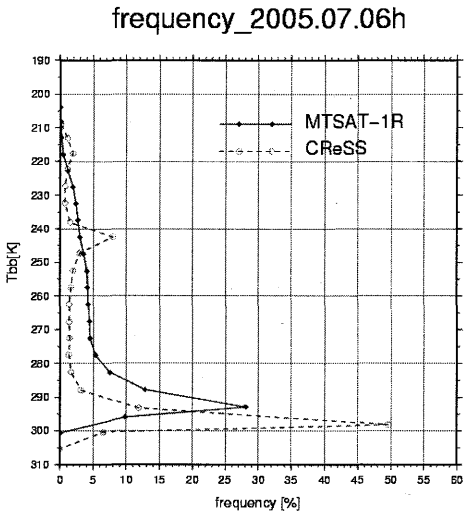

Fig. 6 Frequencies of Tbb in 2005 July 06UTC derived from CReSS-SDSU and MTSAT-1R (after Tsunashima, 2009).

3.2.2. Collaborations with atmospheric model developers (validation of CReSS; VL)

From the start of VL, we are done the performance check of Cloud Resolving Model (CRM) by satellite data one of our task for the collaborations. The Cloud Resolving Storm Simulator (CReSS) developing by Dr. Tsuboki, HyARC of Nagoya Univ. is research oriented CRM based on non-hydrostatic assumptions. We evaluated CReSS output through the Satellite Data Simulation Unit (SDSU) developed by Dr. Masunaga, HyARC of Nagoya Univ. with real-world satellite output such as MTSAT-1R, AMSR-E (Kato, 2008; Tsunashima,

2009; Hayasaki et al. 2009). Through a series of validation studies of CReSS, CReSS unfortunately tended to overshooting clouds (higher in cloud height, faster in cloud development stage: **Fig. 6**). This is relatively universal feature in CRM and recently CReSS improves microphysics then overshooting features reduced by the improvements (Hayasaki et al., 2009). Such interactions truly improve the CRM performance.

3.2.3. Collaborations with company (WNI) and operational agencies (MSC/JMA, GSICS)

Collaborations expand into the WNI and operational agencies (**Fig. 7**). In the case of WNI, since 2005, CEReS and WNI developed the system to provide radiation product based on MTSAT-1R (Takenaka et al., 2009, **Fig. 8**). Now we send the radiation product based on neural network to WNI, product is used to provide information of UV for cable TV in WNI. Such collaboration is one of linkage to the company.

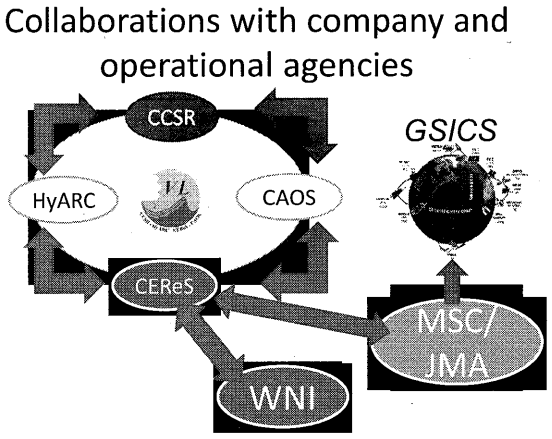

Fig. 7 Schematic illustration of collaborations with WNI and MSC/JMA, GSICS.

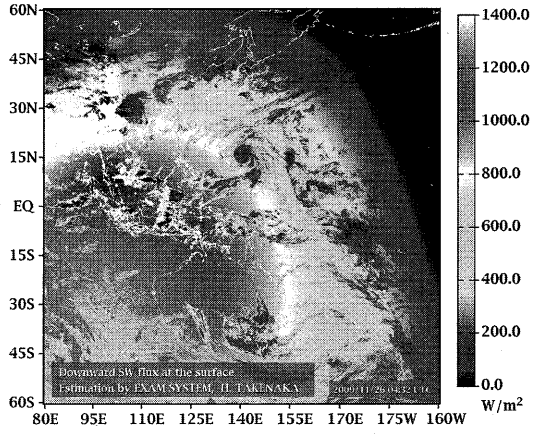

Fig. 8 Neural network retrieved downward solar radiation at the surface derived from MTSAT-1R.

To diagnose climate system by satellite data, calibrations of space-borne sensors is important issue. In VL-CEReS also pay attention about the calibration process. Global Space-based Inter-Calibration System (GSICS) is a framework of operational agencies under WMO. We also corroborate with Meteorological Satellite Center (MSC) in JMA to develop calibration methodologies for GEO, then updated (calibrated) GEO would be utilized for higher products such as radiation components.

4. Concluding remarks

We introduced our DAS and DAAC histories, current activities and collaborative researches examples briefly. As a future perspective, we will keep our function of DAAC as one of hub DAAC in Asia related satellite data. CEReS is now to having a responsibility to keep the function of DAAC as a nationwide corporation institute. Before to represent the responsibility, we truly need a big dataset to achieve our research, thus biggest users are ourselves. In addition, we will keep our DAAC position as a kind of "neutral" and "open" for all spectra. Essentially, university is based on the spirit of "open policy", we will follow it. Moreover, we will pay an attention for collaborative researches on the several ways. As introduced in this report, possibilities to utilize the satellites data are not small, so we will demonstrate "the power of satellite data". Finally, our DAS is always developing phase (with try and errors), so we also sometimes feel the difficulties to maintain our DAS. However we believe that we can enjoy the development of higher-stage DAS as a fun.

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