Formation of a Virtual Laboratory for Diagnosing the Earth's Climate System

- Construction of Globally-Merged Geostationary Satellites Dataset -

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Abstract

One of the best advantages of the earth observations by a geostationary satellite is the capability of obtaining visible (VIS) and infrared (IR) data with high resolution in both space and time. By combining the multiple IR channels, not only the heights but also types of clouds can be identified. However, there has been no global dataset of the VIS and multiple IR channels because of difficulties in the data calibration among different satellite sensors and in handling huge data volume. As one of the main targets of the ongoing project, "Formation of a virtual laboratory for diagnosing the earth's climate system", the globally-merged geostationary satellites dataset is being constructed. This dataset provides 1 hour temporal resolution and spatial resolution of 0.04° for 2 or 3 IR channels and 0.01° for the VIS channel, in a latitude range of ±60°. In addition, global radiation data will be derived from the dataset by utilizing some radiative models. In this way, this dataset will greatly contribute to studies on precipitation/cloud characteristics and validations of numerical models.

Purpose

In order to diagnose the earth's climate system under severe stress such as a global warming, the cooperative research centers (CCSR, Tokyo Univ., HyARC, Nagoya Univ., CAOS, Tohoku Univ., and CEReS, Chiba Univ.) construct "Virtual Laboratory", and research climate and environmental studies cooperatively with properties of each center (Figs. 1, 2). Each center provides datasets about global warming materials, aerosols, microphysical parameters, vegetation indices, and precipitation system structures, develops the regional and global circulation models to analyze the earth's climate systems accurately, and educate young researchers in this field. Synergy of the cooperative researches establish diagnostic method in climate system.

As a part of this project, CEReS constructs and publishes the globally-merged geostationary satellites dataset. This dataset will contribute to studies on precipitation/cloud characteristics and validations of numerical models.

Goal

- Archive earth observation satellite data such as AVHRR, MODIS, GMS, GOES, MTSAT, and FY2
- Publish the satellite data as a geolocated easy-handling format
- Develop a retrieval algorithms for radiative budget at the top of atmosphere and at the surface and for a primary product derived from vegetations (i.e. fAPAR and biomass) using satellite observation data
- Validate the retrieved product by surface observation network (SKYNET)
- Identify the signals of environmental variations in land (vegetation, ice etc.) cover and use from the long-term (about 30 years) satellite data and interpret mechanisms from the interaction among climate, vegetation, and human activities

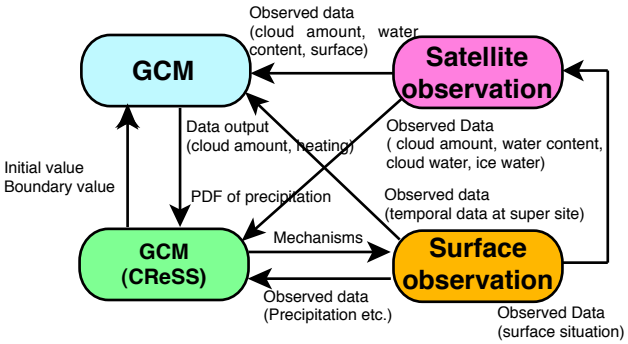


Figure 1. Schematic diagram of the "Virtual Laboratory" by the 4 cooperative research centers.

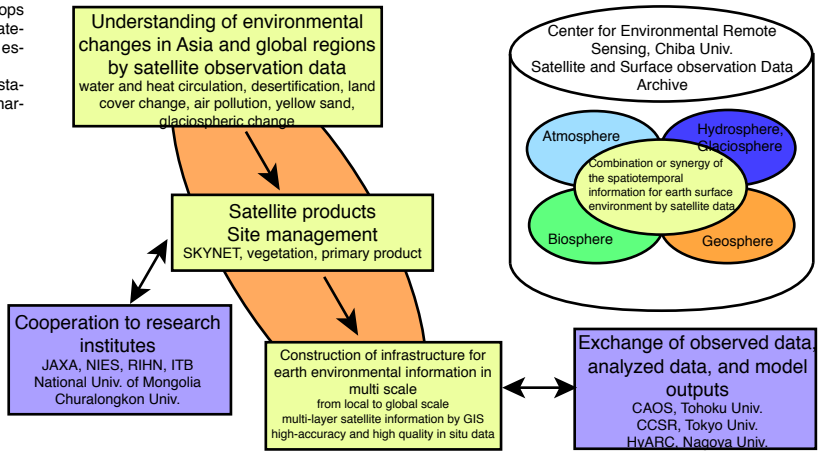


Figure 2. Schematic diagram of research cooperation in CEReS, Chiba Univ.

Globally-Merged Geostationary Satellites Dataset

Geostationary satellite observation is a powerful tool to monitor the Earth system by visible and infrared data with wide area and high resolutions in space and time. Since the single satellite can not cover the global area (Fig. 3), it is difficult to compare the regional differences in cloud systems. An globally-merged geostationary satellite dataset has been published. However, there are just one IR channel. The globally merged dataset in visible and multiple infrared channels are strongly requested by a climate model research groups and satellite data user communities.

Major tasks of the CEReS are to archive and supply the satellite observation data. The CEReS equips receiving systems from satellite and cooperate institutions and get satellite observation data. The globally-merged geostationary satellites dataset in visible, IR1, IR2, and water vapor channels will be established and published in near future (Fig. 4).

Each satellite data has been constructed and published. Gridded MTSAT data is put on

ftp://mtsat-1r.cr.chiba-u.ac.jp/grid-MTSAT-1.01/

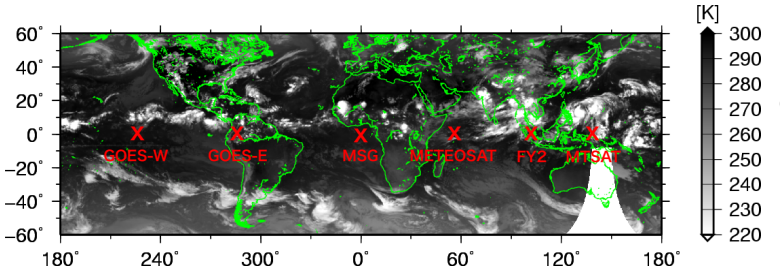


Figure 4. Geophysical distribution of brightness temperature in IR1 at Aug. 1. 2005 00Z using NCEP/CPC 4km Global IR Dataset provided by the NASA GSFC DAAC.

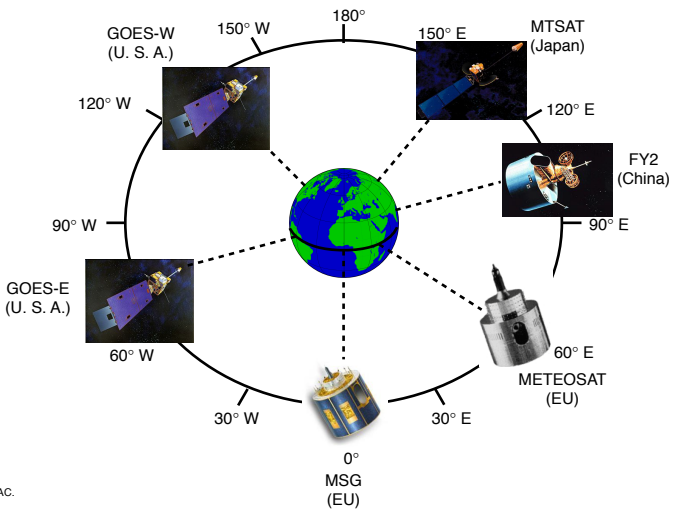
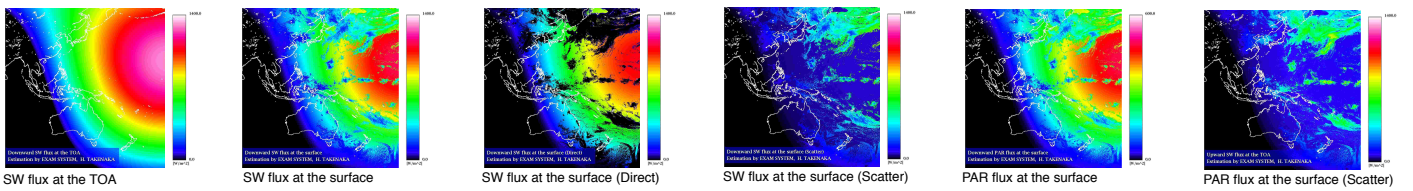


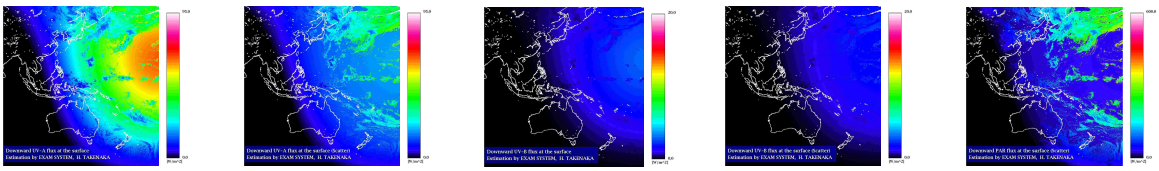
Figure 3. Position above the main geostationary meteorological satellites.

Estimation of radiative budget

It is important for the earth's climate system diagnostics to retrieve the earth's radiative budget accurately. CEReS develop the retrieval algorithms using geostationary meteorological satellites. publish the various parameters of atmospheric radiation, and investigate global radiative budget.



SW flux at the TOA | SW flux at the surface | SW flux at the surface (Direct) | SW flux at the surface (Scatter) | PAR flux at the surface | PAR flux at the surface (Scatter)



UV-A flux at the surface | UV-A flux at the surface (Scatter) | UV-B flux at the surface | UV-B flux at the surface (Scatter) | Upward SW flux at the TOA

Figure 5. Examples of retrieval products of radiative budget derived from MT-SAT data.