NASA Airborne-acquired Vertical Data in Google Earth[tm] & Google Earth[tm] Portal at NASA GES DISC

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Overview and vertical data at NASA GES DISC

Google Earth is increasingly becoming a popular virtual platform for professionals doing their research related to geo-referenced data. NASA Goddard Earth Science Data and Information Service Center (GES DISC) has done some work to visualize NASA two-dimensional (2-D) mapped data and three-dimensional (3-D) vertical data in Google Earth (GE). Among them, there are mainly two kinds of 3-D vertical data from satellites and campaign missions respectively. Here, vertical data from campaign missions are detailed and illustrated.

The A-Train
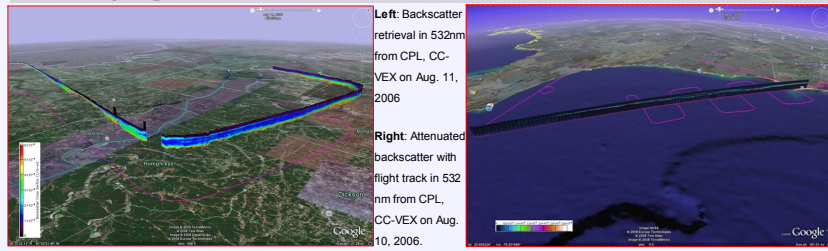

NASA Campaign Missions' Aircraft and Payload
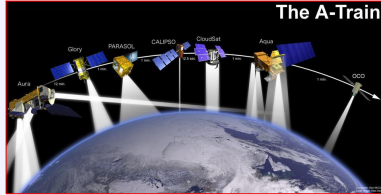
NASA Afternoon A-Train Satellite Constellation is a succession of seven US & international sun-synchronous orbit satellites, consisting of: --OCO (Orbiting Carbon Observatory) (not launched yet); --Aqua; --CloudSat; --CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations); --PARASOL (Polarization and Anisotropy of Reflectances for Atmospheric Science coupled with Observations from a Lidar); -- Glory; and -- Aura. Some of them collects vertical profiles about atmosphere, cloud, aerosol, etc. It makes possible synergy of information from multiple resources. More information about the earth condition is obtained from the combined observations than would be possible from the sum of the observations taken independently [Courtesy of NASA A-Train].
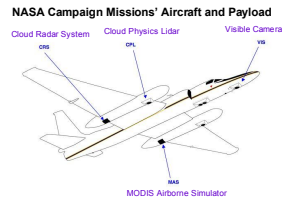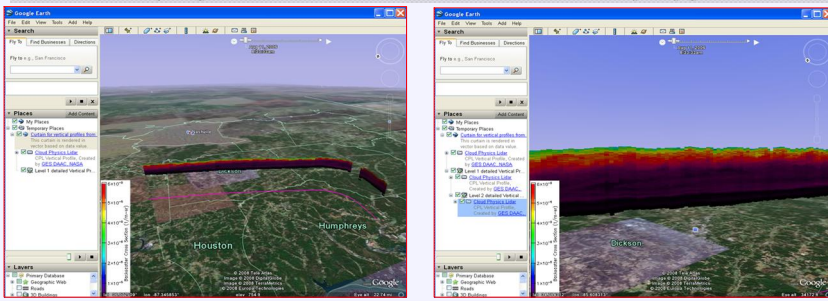
The campaign mission flights in July and August 2006 aims to validate A-Train CALIPSO and CloudSat satellites. The Cloud Physics Lidar is a primary validation tool for the CALIPSO lidar, while the Cloud Radar System is for the CloudSat radar. The validation campaign missions are based out of Warner-Robbins, Georgia, to permit validation over cirrus in the Florida area. The Cloud Physical Lidar (CPL) data for CALIPSO-CloudSat Validation Experiment (CC-VEX) are visualized here on Google Earth [Courtesy of NASA CPL].

Solutions to visualize campaign vertical data in GE

There are two ways to render the vertical data:
a) Using CPL data processing system to produce image for a specified temporal range, chopped the image into small slices and texture them to a pre-designed COLLADA model. Then, using the Keyhole Markup Language (KML) to display the model in GE.
b) Data values and corresponding spatial locations (in latitude and longitude) are directly read in the KML file and represented in numerous polygons which are rendered in GE.

Vertical data from Campaign missions are processed via CPL data rendering system. (**Left**: image curtain of CPL Backscatter Retrieval in 532nm for CALIPSO-CloudSat Validation Experiment (CC-VEX)).

Campaign vertical data in GE rendered in COLLADA model

Left: Backscatter retrieval in 532nm from CPL, CC-VEX on Aug. 11, 2006

Right: Attenuated backscatter with flight track in 532 nm from CPL, CC-VEX on Aug. 10, 2006.
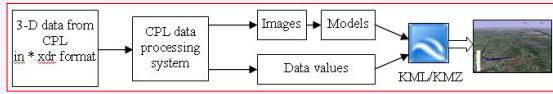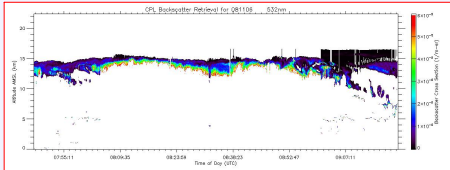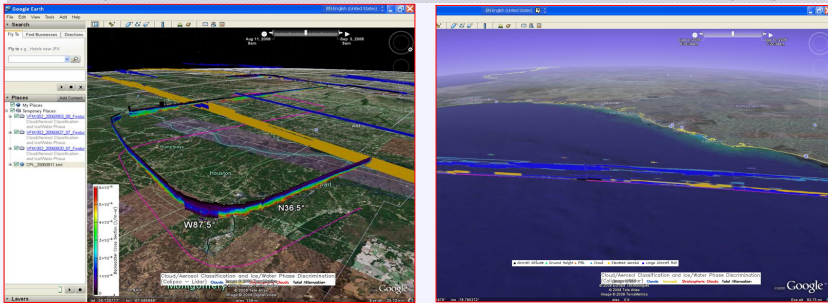
Campaign vertical data in GE rendered in polygons

Attenuated Backscatter retrieval in 532nm from CPL, CC-VEX on Aug. 11, 2006 in low resolution about 800m x 120m.

Attenuated Backscatter retrieval in 532nm from CPL, CC-VEX on Aug. 11, 2006 in high resolution about 200m x 30m.

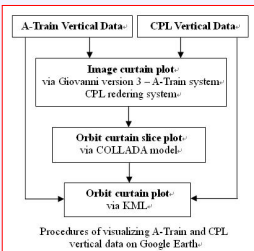## Comparison of vertical curtain from satellite and campaign

Comparison of Attenuated Backscatter in 532nm from CPL, CC-VEX on Aug. 11, 2006 & VFM from CALIPSO on Aug. 20 & 27, 2006.

Comparison of CPL layers and Ground Height from CPL, CC-VEX & VFM from CALIPSO on Aug. 10, 2006.
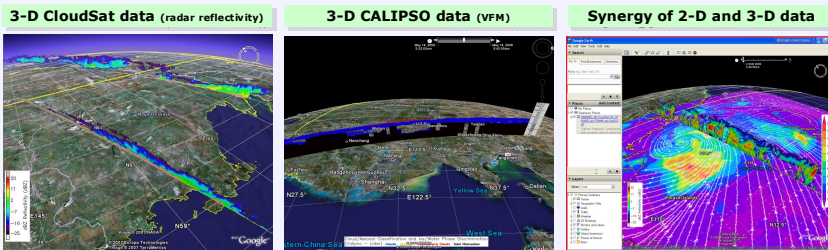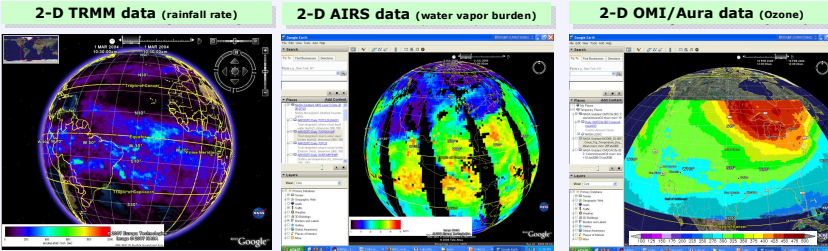
Google Earth[tm] Portal at NASA GES DISC

A web portal describing GE related scientific research and applications was launched at GES DISC (**Right figure**). The whole procedures of visualizing data in GE are seamlessly integrated into several GES DISC's online operation systems which serve data and provide data analysis. Both 2-D mapped and 3-D vertical data products and their online analysis results are enabled to be visualized in GE. The visualized data include: a) 2-D mapped data: TRMM, AIRS/Aqua, MODIS/Aqua & Terra, OMI/Aura, SeaWiFS, etc. b) 3-D vertical data: from satellites such as CloudSat, CALIPSO, MODIS/Aqua, AIRS/Aqua, MLS/Aura, ECMWF model, and from campaign missions such as CC-VEX, TC4, CLASIC, etc.

(**Left Figure**) A general framework is used for rendering and displaying both 2-D data and 3-D data in GE. Mapped data are processed via Open Source Project for a Network Data Access Protocol and standard Open Geospatial Consortium's Web Map Service or GES DISC's Giovanni to produce images that are displayed in GE. 3-D data are processed via Giovanni or CPL rendering system.

GES DISC available data enabled to be visualized in GE

2-D TRMM data (rainfall rate)

2-D AIRS data (water vapor burden)

2-D OMI/Aura data (Ozone)

3-D CloudSat data (radar reflectivity)

3-D CALIPSO data (VFM)

Synergy of 2-D and 3-D data

Above Right Figure: GMT 5:48:00am – 5:55:00am 2006-08-02
Vertical curtain describing cloud vertical structure (Radar Reflectivity, dBZ) derived from CloudSat satellite, and daily rainfall (3B42) from TRMM satellite, and wind field from QuikSCAT satellite for **Typhoon Prapiroon**.

Conclusion

This solution allows researchers to not only combine vertical data together with other geospatial data, but compare vertical profiles from satellite and campaign missions for scientific research in a visualized virtual environment. This ability to visualize and compare diverse data from different providers provides researchers with a novel and valuable tool for scientific data exploration.