# Information Technology Infusion Case Study: Integrating Google Earth™ into the A-Train Data Depot


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**NASA/GES DISC ATDD Portal**
**http://disc.gsfc.nasa.gov/atdd**
**NASA/GES DISC Google Earth Portal**
**http://disc.gsfc.nasa.gov/googleearth/**

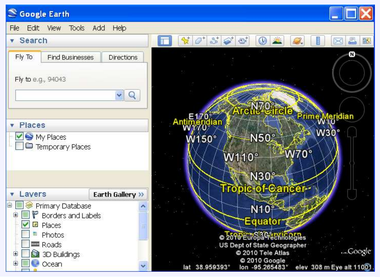
## NASA Funding project


**Utilizing 3 Dimensional Data Views to Access Data and Discover Relationships Between Multiple Heterogeneous Data Sets Along the A-Train Tracks' (Kempler, PI, NASA ROSES NNH07ZDA001N ACCESS Proposal)**


**Objective**: Utilizing the latest three dimensional visualization technology to explore and provide direct data access to heterogeneous A-Train datasets, 'operationally', along, and on either side of the A-Train tracks.

## Google Earth™

**A foundation and public platform for organizing, managing, publishing, visualizing, and synergizing geospatial data, especially public interested data, in virtual three dimension.**




**Facilities:**

KML: Keyhole Markup Language

COLLADA Model

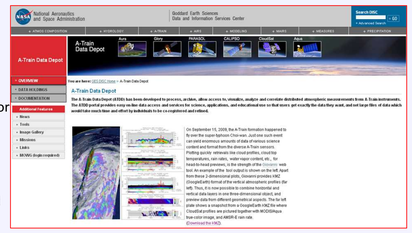
SketchUp ™ Tool

## NASA Goddard A-Train Data Depot (ATDD)

**The A-Train Data Depot (ATDD)** ***-- http://disc.gsfc.nasa.gov/atdd*** processes, archives, allows access to, and visualizes distributed atmospheric measurements from various A-Train sensors, for analysis and correlation.

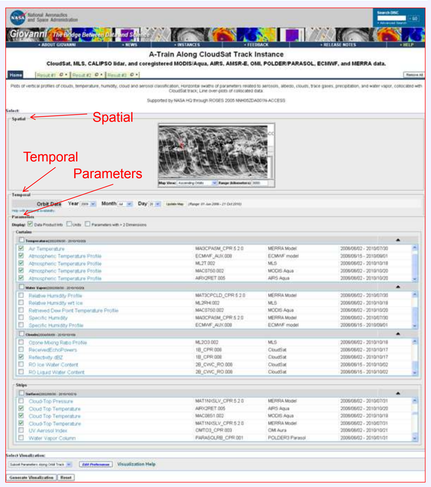
**The ATDD Portal (right)** provides easy on-line data access and services for science, applications, and educational use, so users easily get exactly the data they want, not need to download large volumes whole data.

The NASA **Afternoon A-Train Satellite Constellation** is a succession of seven US & international sun-synchronous orbit satellites, consisting of: **OCO-2** (will launch in Feb. 2013), **GCOM-W1** (schedule in 2012), **Aqua**, **CloudSat**, **CALIPSO**, **Glory**, and **Aura.**

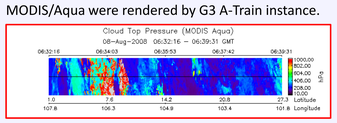



## A-Train Data online analysis and visualization system

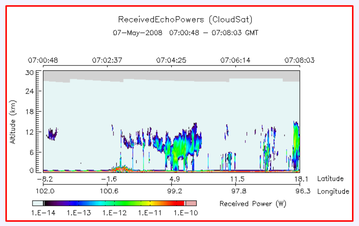
**Right**: A-Train data online analysis and visualization system web interface: Giovanni provides a convenient and useful platform for bridging the geospatial imagery data with implied science and explicitly visualizing the results for the scientific community. Giovanni Version 3 (G3) adopts service- and workflow-oriented asynchronous architecture and uses standard protocols, such as FTP, OPeNDAP, GrADS Data Server to transparently access to local and remote data. Service-Oriented Architecture guarantees that data processing and rendering modules are implemented through standard web services.




**Below**: 2D swath data of Cloud Top Pressure from MODIS/Aqua were rendered by G3 A-Train instance.




**Right**: 3D Vertical profiles of cloud from CloudSat satellite were rendered by G3 A-Train instance.

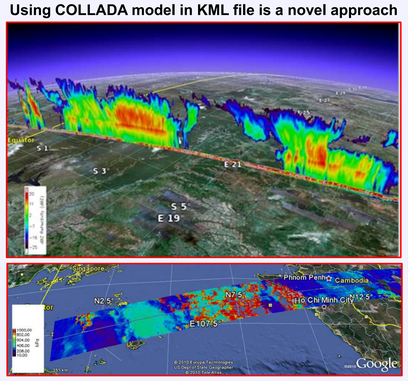


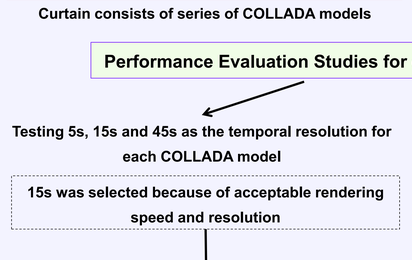

## Challenges 1 of infusing these two technologies

**Challenge 1**: **No direct way for automatic method of rendering level 2 swath data (vertical profiles and horizontal strips) in Google Earth**

**Two schematic methods for rendering 3D model**

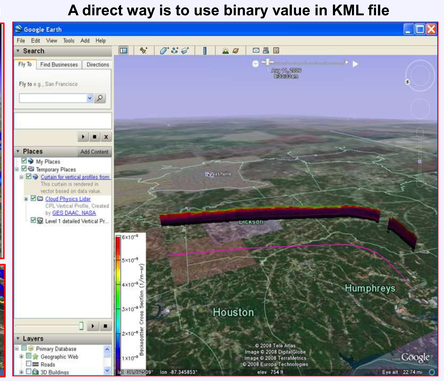
**Using COLLADA model in KML file is a novel approach**




**Curtain consists of series of COLLADA models**

**A direct way is to use binary value in KML file**




**Curtain consists of numerous vector rectangles**

**Performance Evaluation Studies for determining which way is better**

**Testing 5s, 15s and 45s as the temporal resolution for each COLLADA model**

**15s was selected because of acceptable rendering speed and resolution**

**Pyramidal rendering strategy: 200m X 30m → 400m X 60m → 600m X 90m**

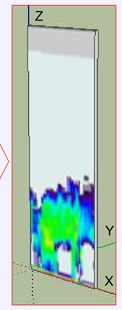
**Shortcomings**: **a. Rendering speed is slow**
**b. Different views from both sides of the curtain**
**(more details will be available on request.)**

### 3D Model template design

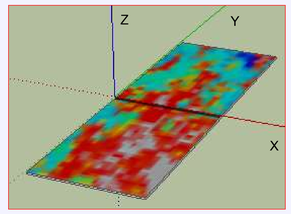
**Based on Google SketchUp™ tool, strategies we adopted for the 3D model:**

a. **x=103m, y≈0, z=300m and left-bottom corner point is placed at the origin point of coordinate system of SketchUp for vertical profile.**

b. **x=103m, y=200m, z≈0 and the middle point of the left side is placed at the origin point of coordinate system of SketchUp for horizontal strips.**




**Left: 3D COLLADA model for vertical profile in SketchUp**

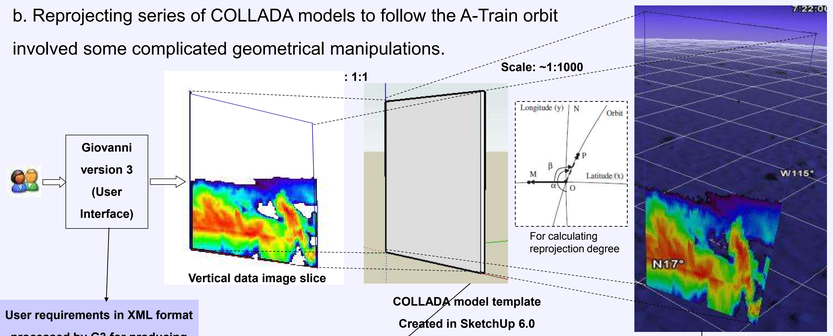



**Top: 3D COLLADA model for strips**

**Data reprojection along orbit track**
**(image curtain from ATDD→ COLLADA model → orbit curtain in GE)**

a. Some external s/w (Trakstar and TLE orbital element data) are used to display A-Train orbit in GE. This part went smoothly as it was already being used in ATDD.

b. Reprojecting series of COLLADA models to follow the A-Train orbit involved some complicated geometrical manipulations.




**User requirements in XML format processed by G3 for producing image curtain**

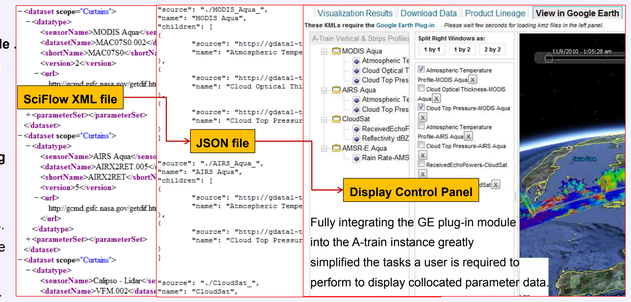
**COLLADA model template Created in SketchUp 6.0**

**COLLADA and its XML-compatible Model with image texture (*.dae)**

**Orbit Curtain in KMZ format, including KML, images, COLLADA models, and texture files**

## Challenge 2 to improve ATDD existing system

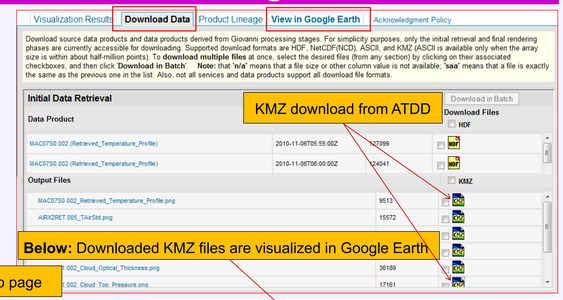
a. **Function for automatically analyzing workflow XML file in ATDD to produce and update JSON file .**
b. **Utilize AJAX to automatically update the control panel for user control of the data display in Google Earth.**
c. **Add new tab "View in Google Earth" in Web interface for user directly viewing and comparing multiple parameters in multiple Google Earth windows in one browser window.**
d. New interface for transferring necessary parameters.
e. Produce undecorated data image, legends and scale for producing KMZ files.
f. New download functions for downloading KMZ files.



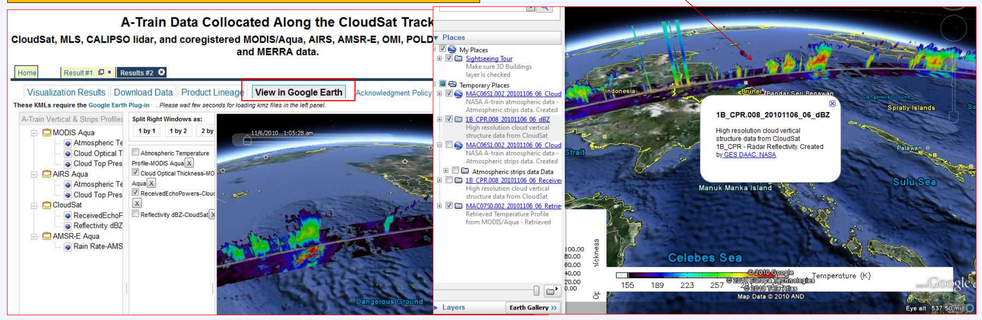

## Interoperability between ATDD & Google Earth

Several ways for interoperating ATDD and Google Earth:

a. Any user required data can be downloaded and visualized via KMZ files in Google Earth while they are available and viewed via ATDD in web browser.
b. User can learn more details via opened KMZ files in Google Earth, especially metadata information about the data.
c. Google Earth is integrated into and becomes part of the ATDD. Any changes caused by user requirements to A-Train output data can be reflected and visualized in Google Earth.
d. Users can freely add data to, remove data from, view and un-view data in Google Earth.

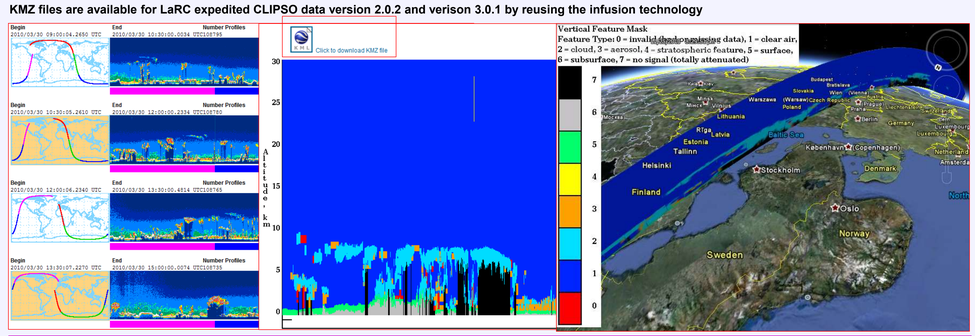



**Below**: Using Google Earth Plugin to directly view data in web page



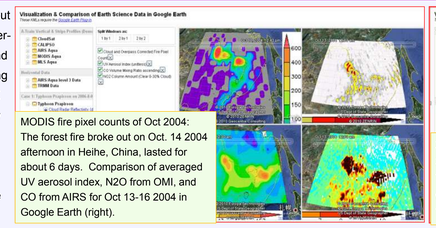

## Reuse the infusion technology for LaRC Expedited CALIPSO

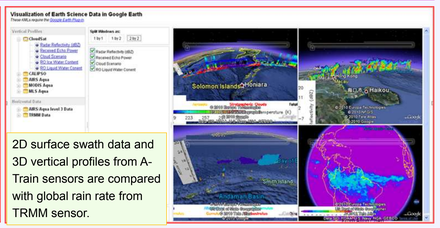
**KMZ files are available for LaRC expedited CLIPSO data version 2.0.2 and verison 3.0.1 by reusing the infusion technology**




## Future work: Combining other data with A-Train data in Google Earth

Future work holds out the possibility of inter-comparing atrain and non-atrain data using multiple window GE interface. Ultimately the interface could also be used for downloading the visualize data to the user's computer.





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