

A browser-based Visualization Tool Designed for comparing CERES/CALIOP/CloudSAT level-2 data sets

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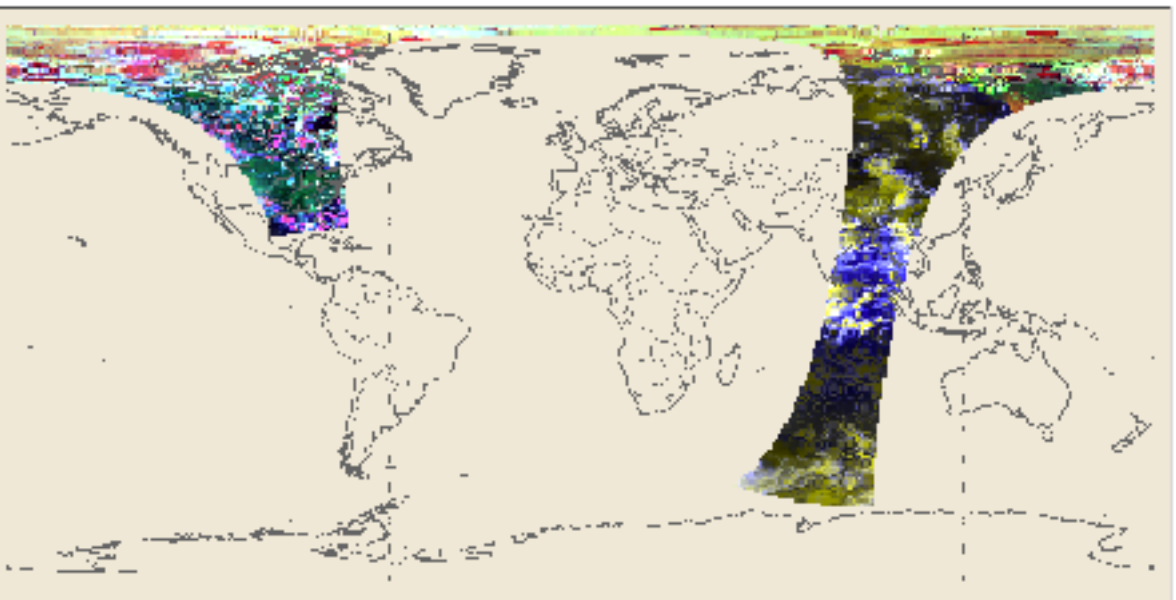
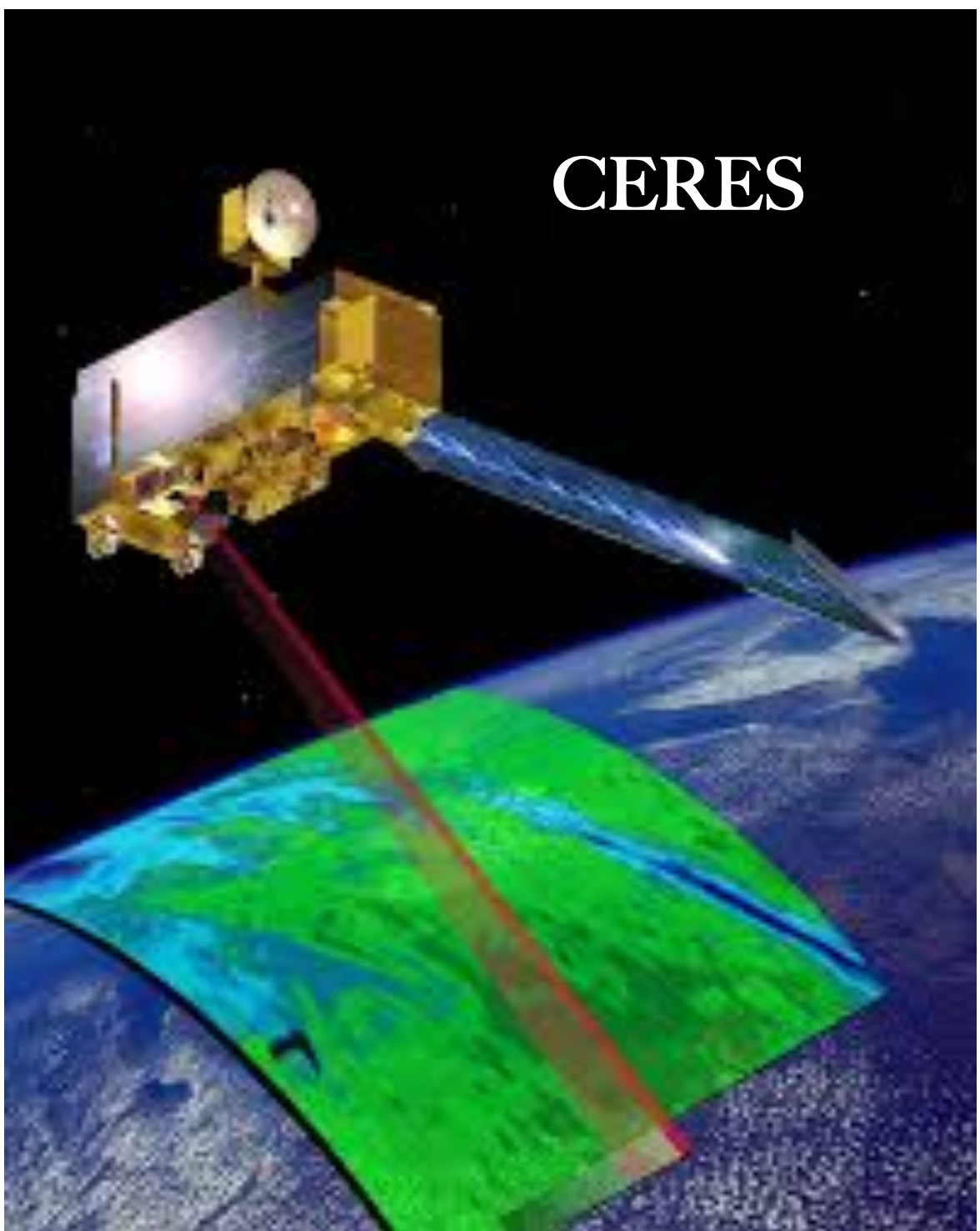
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MOTIVATION

In Langley NASA, Clouds and the Earth's Radiant Energy System (CERES) and Moderate Resolution Imaging Spectroradiometer (MODIS) are merged with Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) on the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) and CloudSat Cloud Profiling Radar (CPR). The CERES merged product (C3M) matches up to three CALIPSO footprints with each MODIS pixel along its ground track. It then assigns the nearest CloudSat footprint to each of those MODIS pixels. The cloud properties from MODIS, retrieved using the CERES algorithms, are included in C3M with the matched CALIPSO and CloudSat products along with radiances from 18 MODIS channels. The dataset is used to validate the CERES retrieved MODIS cloud properties and the computed TOA and surface flux difference using MODIS or CALIOP/CloudSat retrieved clouds. This information is then used to tune the computed fluxes to match the CERES observed TOA flux. The capability of viewing C3M product on browsers will be available on CERES ordering tool web site in the future, <https://ceres.larc.nasa.gov>

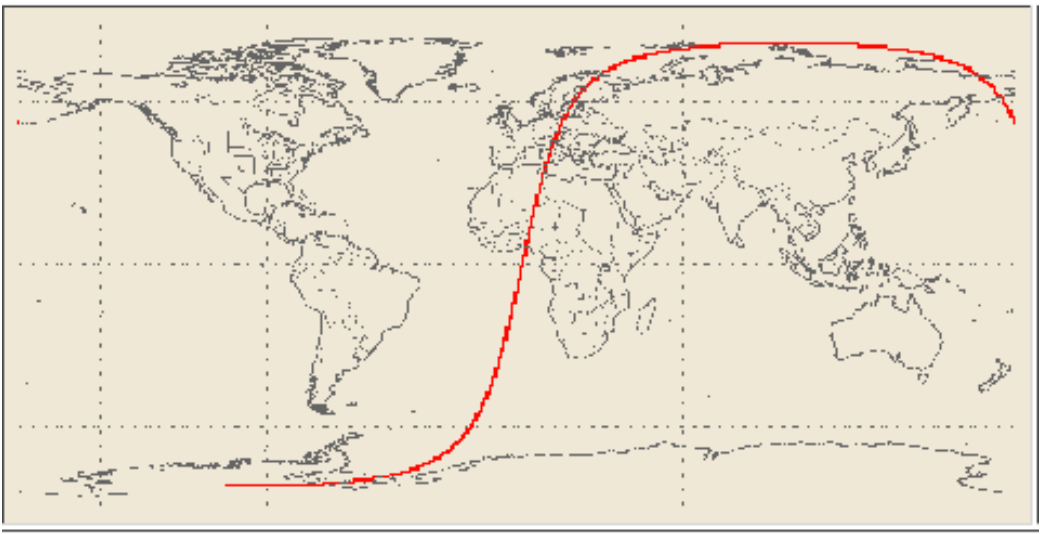
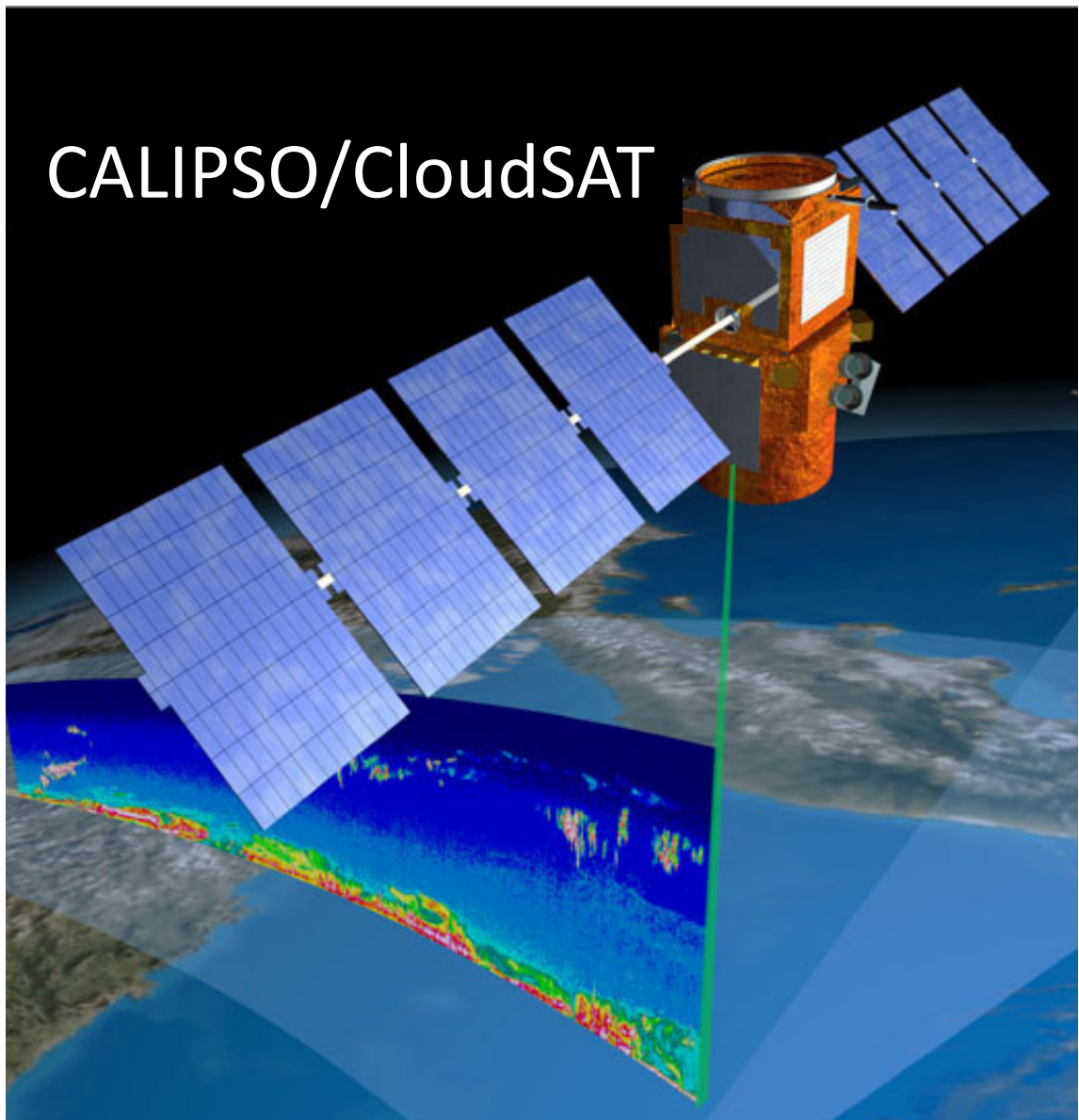


CERES projected footprints

CERES instruments are made of cross-track and bi-axial scanning radiometers to measure solar, emitted terrestrial, and total radiation. Their projected footprints on a map are like a wide ribbon. However, it lacks vertical information.

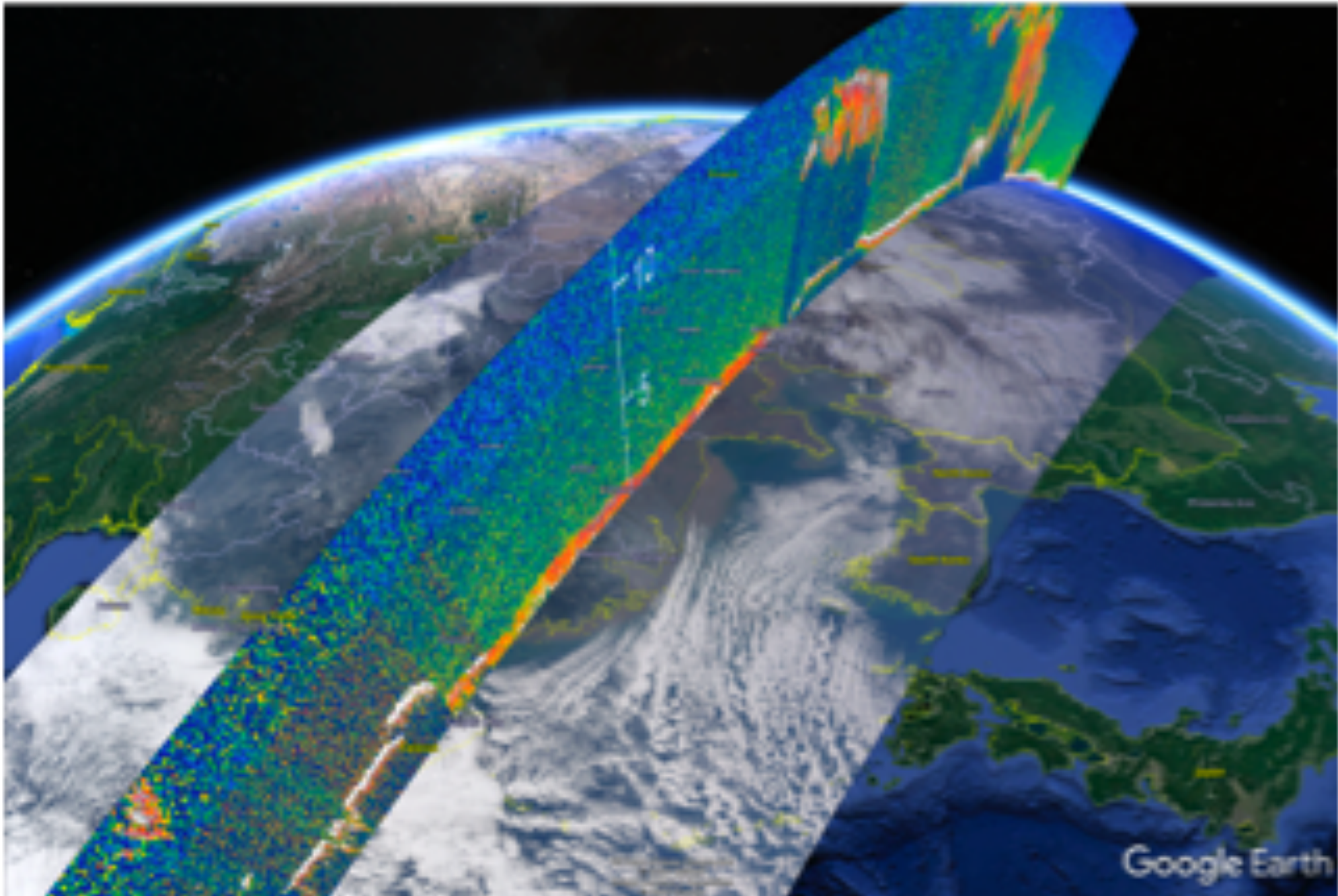
CALIPSO /CloudSat both consists of nadir-viewing instruments. They provide vertical profiles of aerosols and clouds. Their projected footprints on a map form a string.

Different Types of Instruments



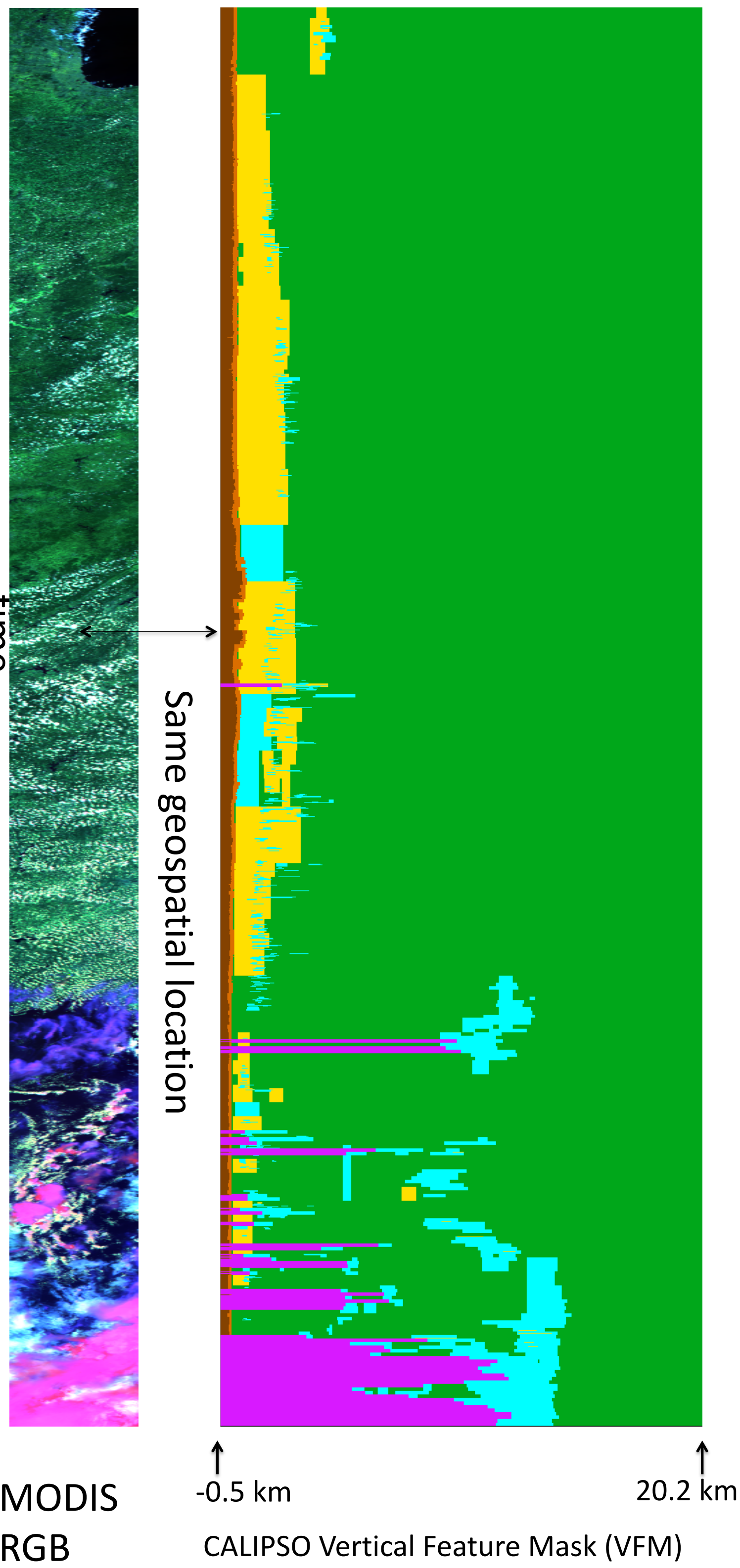
CALIPSO/CloudSat projected footprints

3D Representation



Even though these instruments are all on A-Train satellites, they are on different spacecraft and have different resolutions. In order to compare data from these instruments, preprocessing the data to align the time, location and to increase the resolutions is needed. An image of CALIPSO/CloudSat is projected to a 2-D image for the ease of comparison.

The y-axis of images represents time. The x-axis of images from CALIPSO/CloudSat indicates height from 0.5 meter below sea level. Each pixel represents 30 meter. The x-axis of images from CERES is footprint number from each scan packet. The geospatial location of the center line of a CERES image matches the location of the y-axis of a CALIPSO/CloudSat image.



MODIS RGB

CALIPSO Vertical Feature Mask (VFM)

Browser-Based Visualization Tool

A web-based visualization tool called 3D-CERESVis is used to generate images and user interfaces to display and manipulate images.

Behind the scene, there is a cluster of Linux servers which read data files, generate images on the fly in parallel. They can generate large volumes of images in a short period time. The capability of creating images on the fly not only provides the flexibility for users to manipulate images and save disk space.

Users' web browsers provide the user interface by using HTML5 and JavaScript. In order to take advantage of users' hardware, data are also pushed to the browsers. Some simple computations are done by the browsers. An open source JavaScript library called Cesium is used to project images on a globe.

ecv_CERESVis-CERESvisTest-ECVnarrow

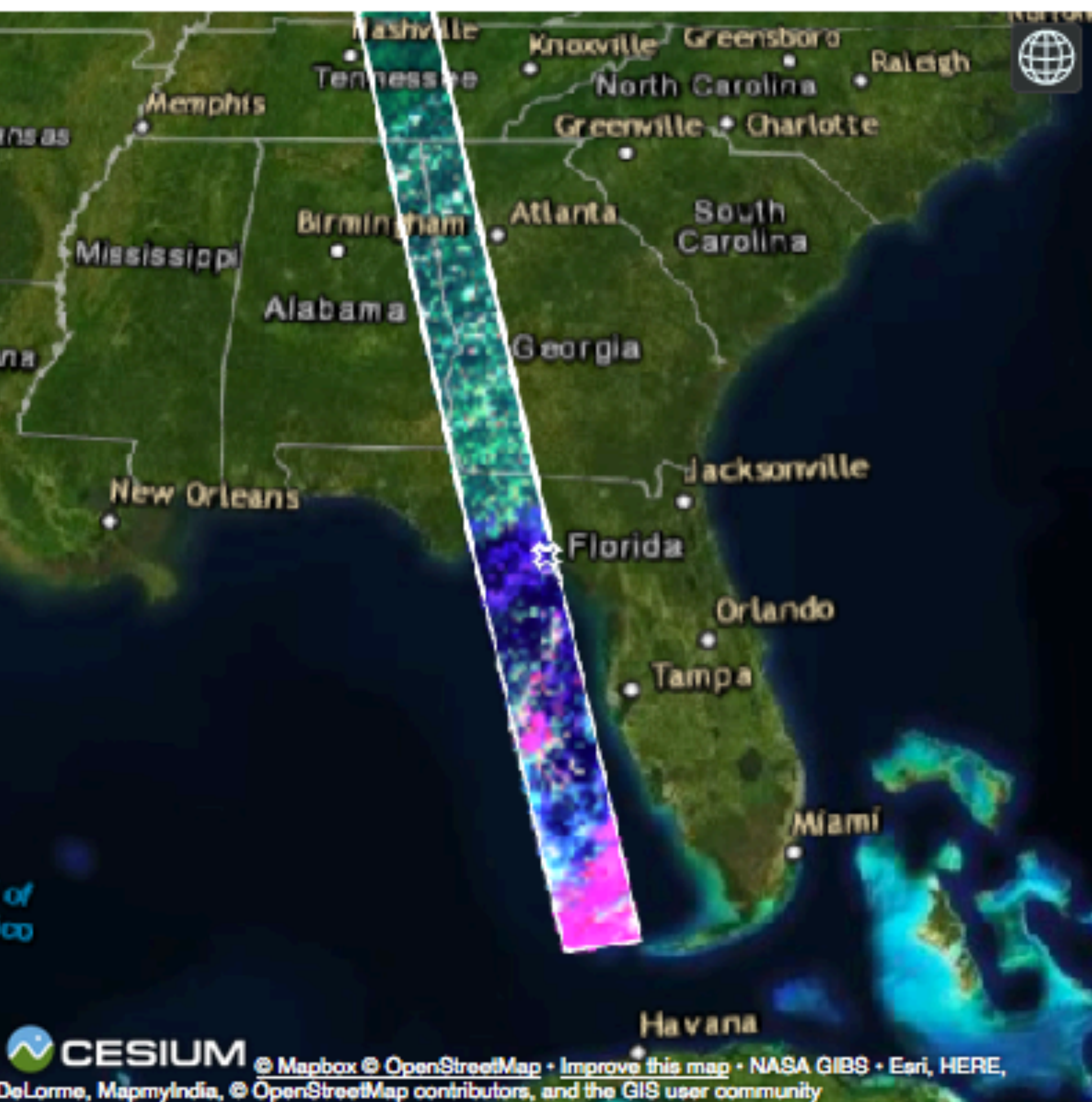
7/15/2008 GMT Hour 19

HELP



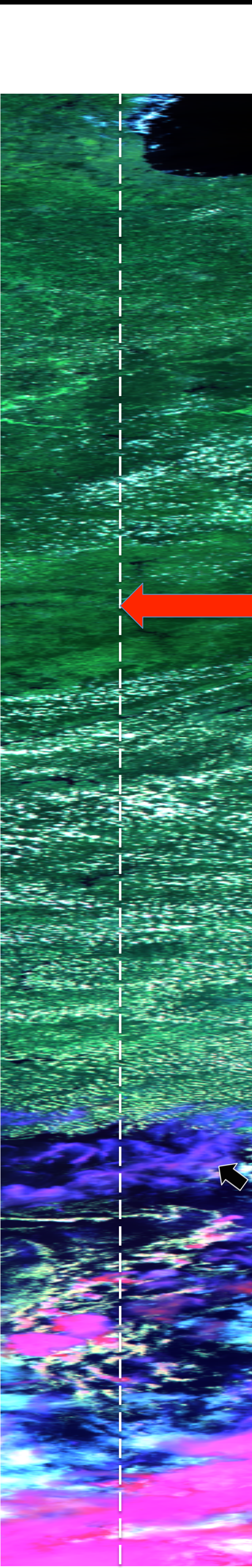
Satellite-Location CER_ECV Resolution: 15

Minute 0-5

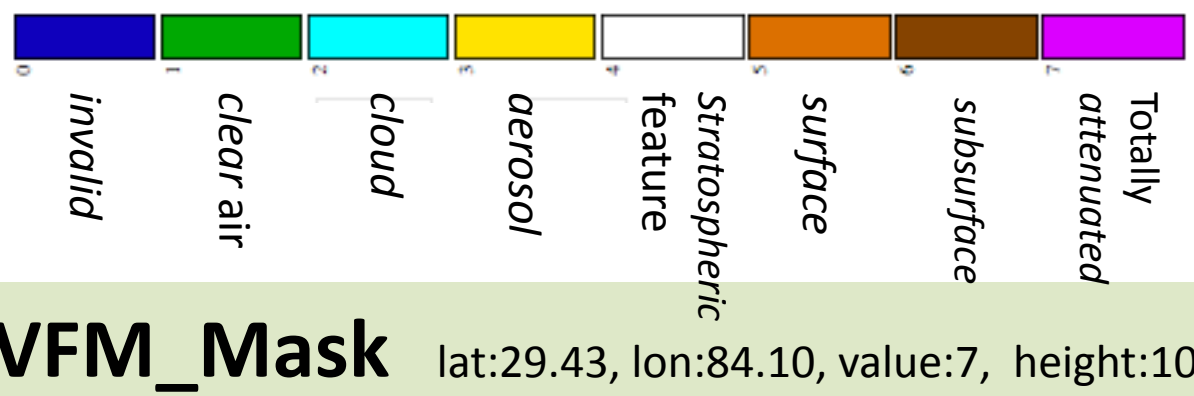
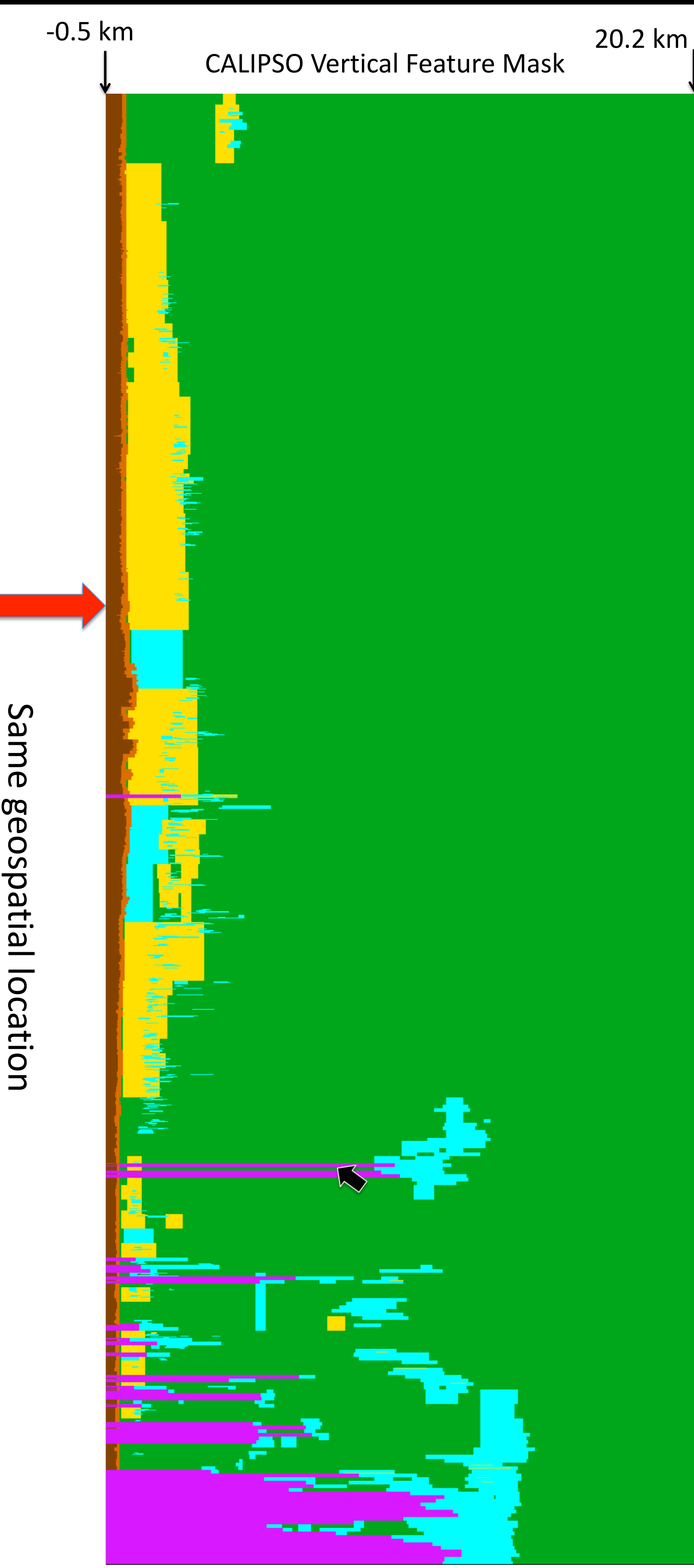


Pan/Zoom Control
Rotate mouse wheel to scroll the images.
Press shift key and rotate mouse wheel to zoom in/out the images.
Hold the mouse key down and move the mouse to pan the images

The values of fields lat, lon, height, on the right indicate the location and altitude of black arrows on the images and the cross sign on the globe.

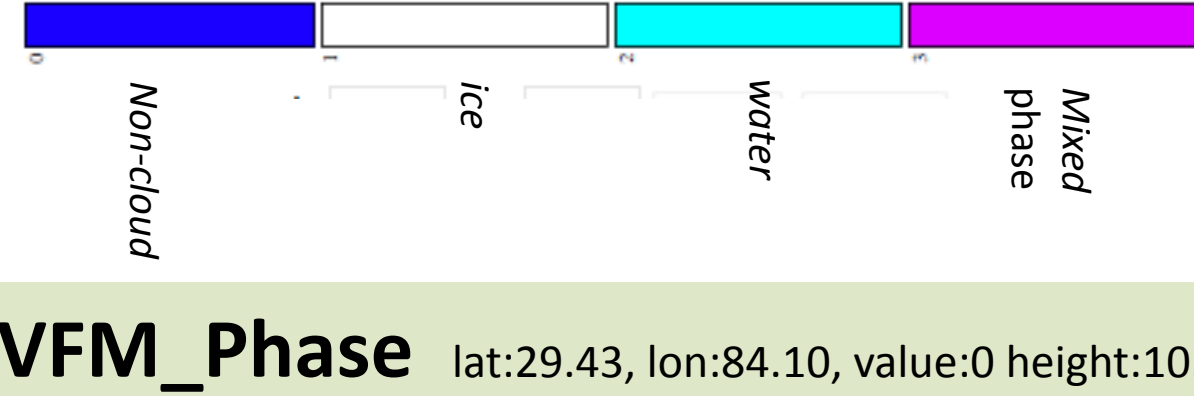
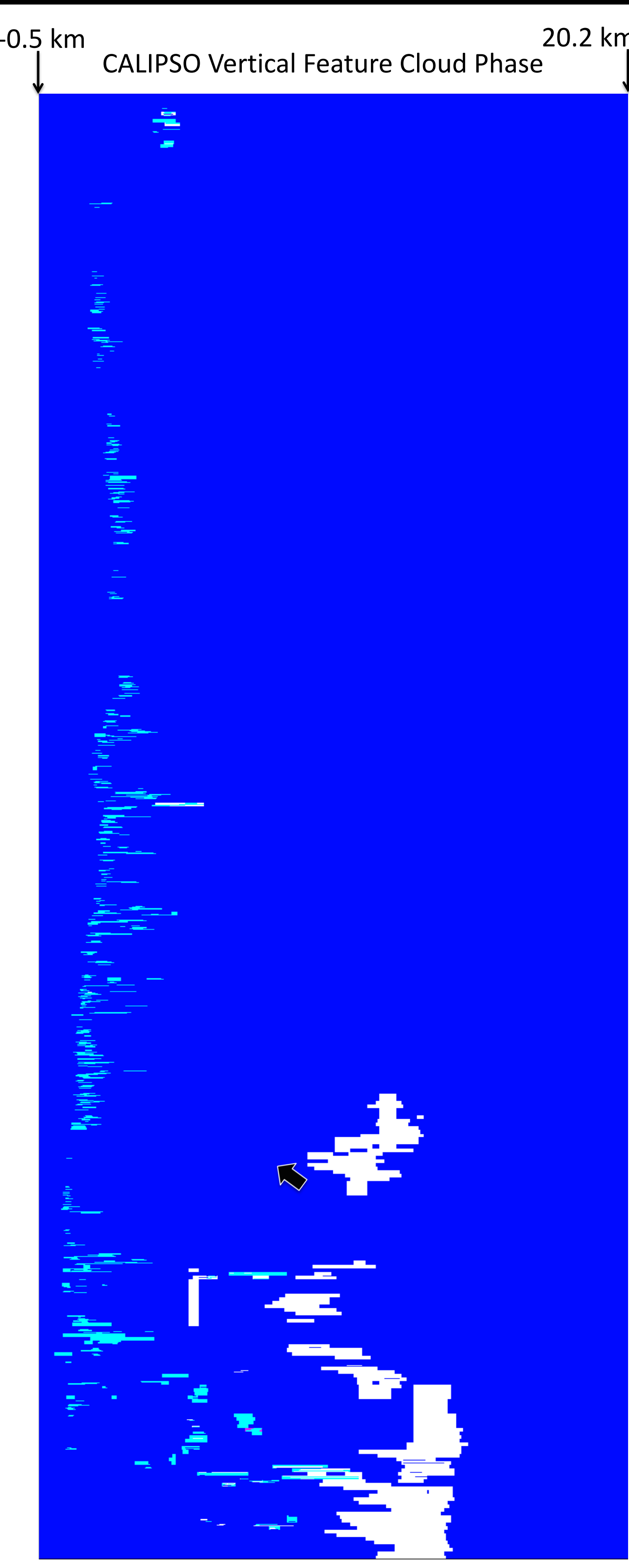


MODIS RGB



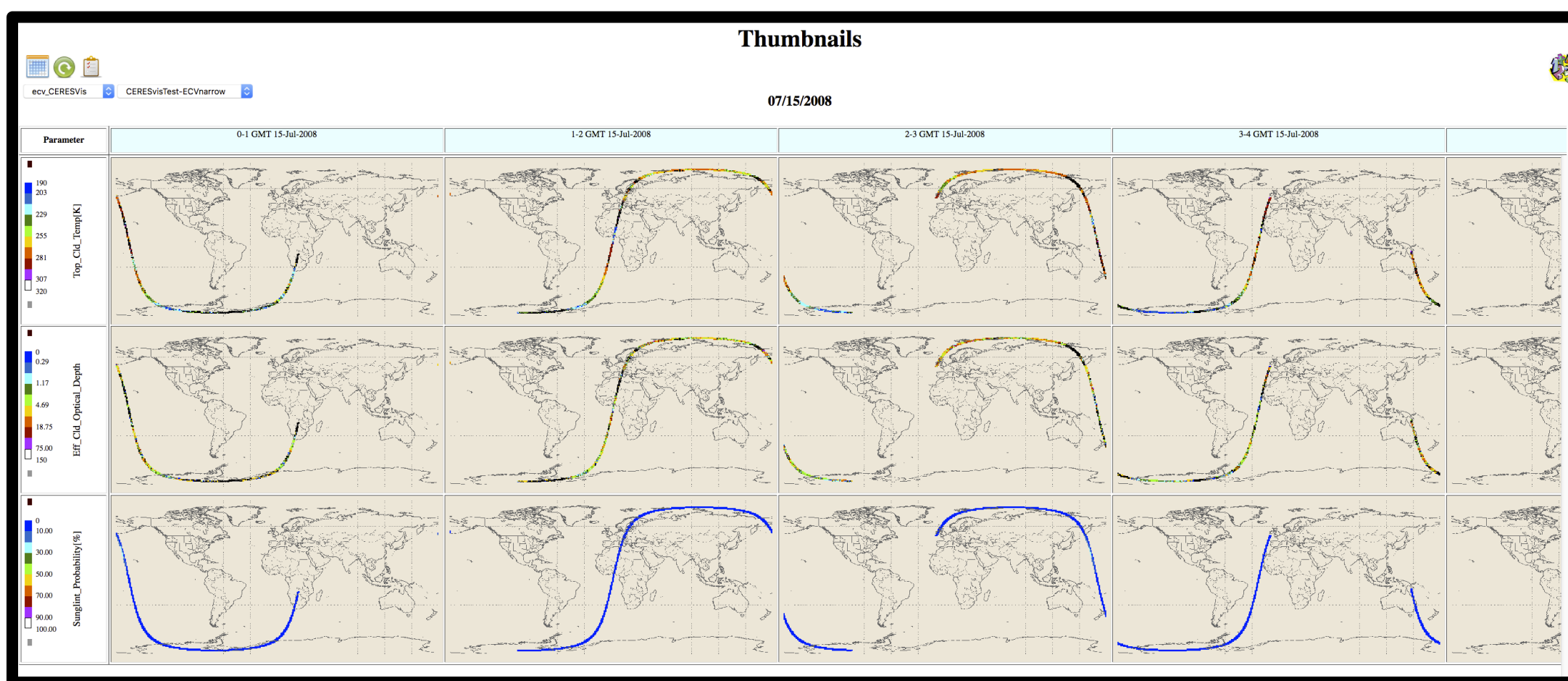
VFM_Mask

lat:29.43, lon:84.10, value:7, height:10.1



VFM_Phase

lat:29.43, lon:84.10, value:0 height:10.1



User Interface

Users use a list of thumbnail images above to find out the locations and scenes of interest. After clicking on a thumbnail, images with greater details are displayed. A set of synchronized cursors point to the pixels located at the same position on the images. A white cross sign is on the globe (Cesium) to indicate the geospatial location of those pixels. The latitude, longitude, altitude and values of those pixels are displayed below the images.

Conclusion

The poster demonstrates a new graphical 3D-interface, 3D-CERESVis, that allows users to view both passive remote sensing satellites (MODIS and CERES) and active satellites (CALIPSO and CloudSat), such that the detailed vertical structures of cloud properties from CALIPSO and CloudSat are displayed side by side with horizontally retrieved cloud properties from MODIS and CERES. Similarly, the CERES computed profile fluxes whether using MODIS or CALIPSO and CloudSat clouds can also be compared. 3D-CERESVis is a browser-based visualization tool that makes uses of techniques such as multiple synchronized cursors and a JavaScript library, Cesium.