

### **\*Introduction:\***

The Data/Visualization Team for the NASA SPHERE Program of 2006 consisted of TreAsia Fields, Cory Scott and Donald Williams. The mentors for the team were Dr. Shiladitya Chaudhury and Dr. Lin Chambers. Dr. Chaudhury is the executive project director for the NASA SPHERE program and an Associate Professor in the Department of PCSE at Christopher Newport University (CNU). Dr. Lin Chambers directs the MY NASA DATA Project and she is the LAS (Live Access Server) team leader at NASA Langley. This summer the Data/Visualization Team was responsible for creating a google map of local and remote GLOBE sites and their data on environmental phenomena that are linked using Google Maps and GPS (Global Positioning Service). Also the team created a walking tour of CNU and the Shenandoah Valley. The LAS stores satellite data on cloud coverage, surface Temperature, tropospheric ozone and other parameters, which is monitored by ground stations. This information will be linked to the google map to display the climate factors of each specific area. This information is useful for everyone, it makes it easy to identify geographical locations and their associated data from both satellite and ground stations.

### **\*Background:\***

A Live Access Server (LAS) is much like a server in a restaurant, where the customer can request different menu items, chosen by reading the descriptions of the food selections, and then the server brings the food to the table.

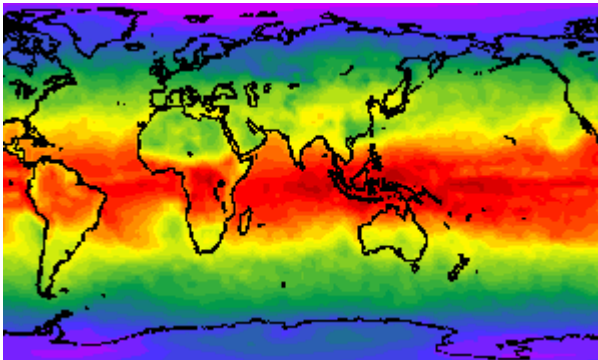
For the MY NASA DATA LAS, the customer (you) can select items (microsets of data) from the menu (list of datasets) using descriptions (parameters and time frames) of the items.

The Live Access Server (LAS) software allows access to scientific data referenced by latitude, longitude, and time. This is referred to as geo-referenced data.

LAS can:

- \* show visualizations (color plots and graphs) of the data as requested
- \* provide subsets of the specific parameters in a choice of file formats
- \* present the numerical data collected

<http://mynasadata.larc.nasa.gov>



(Top of Atmosphere All Sky Net Flux)

NASA scientists select parameters to study that will increase their understanding of humanity's impact on the atmosphere and how this impact might affect our climate. These parameters also assist in the understanding of natural climate variability. The parameters served by the LAS are a

selected portion of the atmospheric data collected by NASA, which is stored primarily at the Atmospheric Science Data Center.

The descriptions of the parameters can be found by clicking on the link to the Live Access Server or on the Data Access page and then clicking on one of the major dataset categories (Atmosphere, Snow and Ice, or Surface). The parameters in the LAS cover extended periods of time to identify trends or illustrate educational concepts.

The parameters have been named using the following convention:

<TIME INTERVAL> <PLACE> <PARAMETER> (<PRODUCT>)

<TIME INTERVAL> describes the time resolution of the measurement: Monthly, Daily, Seasonal, etc

<PLACE> tells where the measurement applies: Top of Atmosphere, Surface, Cloud, Tropopause, Column, Near-Surface, Stratosphere, Pressure Levels, High cloud, etc

<PARAMETER> name of the variable: Aerosol Optical Depth, Temperature, Cloud Fraction, etc

Radiation parameters are further defined as:

<PARAMETER>=<Sky Condition> <Wavelength> <Direction><Parameter>

<Sky Condition> All-sky, Clear-sky

<Wavelength> Longwave (LW), Shortwave (SW), Photosynthetically Active Radiation (PAR), etc

<Direction> Upward, Downward, Net

<Parameter>Ex: Flux, Albedo, etc

<PRODUCT> reference information identifying the data source: CERES, ISCCP, MISR, etc

Examples: Monthly TOA Clear-Sky LW Upward Flux (CERES)

Monthly Column Ozone (SAGE III)

The information that is stored in the LAS helps to show the current affects that are occurring on the earth. The Earth's climate system constantly adjusts in a way that tends toward maintaining a balance between the energy that reaches the earth from the sun and the energy that goes from the earth back to space. Scientist refers to this as the radiation budget. The components of the earth system that are important to the radiation budget are the planets surface, atmosphere and clouds. If the earth's radiation budget falls out of balance then there will be an excess amount of heat or coolness on the earth.

In order to connect the charts of the environmental phenomena locations, a google map must be created. Google Maps is an online map service that is free to the public and is powered by Google. Google Maps was launched in February 2005, and has already caused a significant amount of interest amongst various Internet communities. It is still in beta state, meaning newer versions are continuously coming out, along with new ideas. With these maps, the possibilities range anywhere from creating games, to tracing exact distances a person has run, which can be found at the website [www.mapmyrun.com](http://www.mapmyrun.com). All maps feature three different views of the particular part of the globe one is looking at. The choices are "Map", consisting of street map

views; "Satellite", consisting of satellite and high-resolution aerial photographs; and "Hybrid", consisting of the map view overlaying the satellite view. The map is draggable and has the ability to zoom in and out at any location for the viewer to achieve their desired perspective.

Thus far, countless people want to build their own applications around the Google Maps data.

For this to be possible, Google released an API to enable a user to create and manipulate their personal Google map. "The Google Maps API lets you embed Google Maps in your web pages using JavaScript. You can draw markers and lines on the map just like Google Maps, or you can build more sophisticated applications." [\\_http://www.google.com/apis/maps/faq.html#faq1\\_](http://www.google.com/apis/maps/faq.html#faq1) Signing up for an API key is free. All that is needed is a host for a webpage.

The following are features of Google Maps.

Integrated business search results - Find business locations and contact information all in one location, integrated on the map. For example, if you search for [pizza in San Jose, CA], locations of relevant listings and phone numbers appear on the map. You can also view additional information like hours of operation, types of payment accepted, and reviews.

Draggable maps - Click and drag maps to view adjacent sections immediately (no long waits for new areas to download).

Satellite imagery - View a satellite image (or a satellite image with superimposed map data) of your desired location that you can zoom in on and pan.

Detailed directions - Enter an address and let Google Maps plot the location and/or driving directions for you. Click any part of the driving directions to see a magnified map or satellite image of that part of the route.

Keyboard shortcuts - Pan left, right, up and down with the arrow keys. Pan wider with the Page Up, Page Down, Home and End keys. Zoom in and out with the plus (+) key and minus (-) keys.

To get the appropriate location of the sites marked in google maps the GPS calculated the exact longitude and latitude. GPS stands for Global Positioning System and it is a worldwide radio-navigation system that was developed by the U.S. Dept. of Defense. The design of GPS is based partly on the similar ground-based radio navigation systems, such as LORAN developed in the early 1940s, and used during World War II. Additional inspiration for the GPS system came when the Soviet Union launched the first Sputnik in 1957. A team of U.S. scientists led by Dr. Richard B. Kershner were monitoring Sputnik's radio transmissions. They discovered that, because of the Doppler effect, the frequency of the signal being transmitted by Sputnik was higher as the satellite approached, and lower as it continued away from them. They realized that since they knew their exact location on the globe, they could pinpoint where the satellite was along its orbit by measuring the Doppler distortion. The converse is also true: if the satellite's position was known then they could identify their own position on Earth.

The first satellite navigation system, Transit, used by the United States Navy, was first successfully tested in 1960. Using a constellation of five satellites, it could provide a navigational fix approximately once per hour. In 1967, the U.S. Navy developed the Timation satellite which proved the ability to place accurate clocks in space, a technology the GPS system relies upon. In the 1970s, the ground-based Omega Navigation System, based on signal phase comparison, became the first world-wide radio navigation system.

The first experimental Block-I GPS satellite was launched in February 1978. The GPS satellites were initially manufactured by Rockwell International and are now manufactured by Lockheed Martin.

In 1983, after Soviet interceptor aircraft shot down the civilian airliner KAL 007 in restricted Soviet airspace, killing all 269 people on board, Ronald Reagan announced that the GPS system would be made available for civilian uses once it was completed.

By 1985, ten more experimental Block-I satellites had been launched to validate the concept. The first modern Block-II satellite was launched on February 14, 1989 and achieved initial operational capability by December 1993. A complete constellation of 24 satellites was in orbit by January 17, 1994.

In 1996, recognizing the importance of GPS to civilian users as well as military users, President Bill Clinton issued a policy directive declaring GPS to be a dual-use system and establishing an Interagency GPS Executive Board to manage it as a national asset.

In 1998, Vice President Al Gore announced plans to upgrade GPS with two new civilian signals for enhanced user accuracy and reliability, particularly with respect to aviation safety.

In 2004, President George W. Bush updated the national policy, replacing the board with the National Space-Based Positioning, Navigation, and Timing Executive Committee.

The most recent launch was in September 2005. The oldest GPS satellite still in operation was launched in February 1989. The device can now pinpoint a location down to 1 cm accuracy over short distances.

### **\*Methods:\***

We used the LAS to compare and contrast surface temperature, tropospheric ozone and cloud coverage in different climate zones of the United States. The surface temperature and cloud coverage information was obtained from the International Satellite Cloud Climatology Project (ISCCP). Tropospheric Ozone Residual is the measure of ozone in the troposphere derived from satellite observations. It is called a residual because it is obtained by subtracting an estimate of stratospheric ozone from a total column measurement. In doing this we created color plots that gave a visual of the temperature over a certain period of time, we also took table data sets from the LAS and imported them into Microsoft Excel where line graphs were created to analyze the trend in surface temperature, tropospheric ozone and cloud coverage. In order to pinpoint a specific area the LAS required the longitude and latitude of the location. This information was obtained by the GPS. The LAS would not provide color plots if the area detected was too small. It would only give data value sets or line graphs.

Google Maps contributed a key role in the creation of the walking tour of CNU and the Shenandoah Valley and a google map of the local and remote GLOBE sites. They were created using HTML and XML coding, and consists of the five colleges the interns attend as well as a variety of schools involved with GLOBE within 100km of the latitude and longitude of N37 W76. This data was obtained from the GLOBE website [www.globe.gov](http://www.globe.gov).

Additionally, with the use of the Garmin GPS map 76CS receiving device our mission was made easier. We were able to pinpoint the location of certain buildings around the Christopher Newport University campus by standing outside of the building. With these measurements, the team was to import the data into the computer to create a walking tour of CNU. After the local measurements were obtained, the device was taken everywhere the group went to record the current location. When the interns visited the Shenandoah Valley they were given the task to create a walking tour of it as well. We also became familiar with some of the other features that the GPS was capable of; such as: a compass, stop watch, calculator, trip odometer, map, geocaching and the altimeter.

The Google Maps are more than a pretty picture. At each location -mainly schools-, links or images were placed inside the "marker". When one clicks on a marker, a description of the location is displayed, along with a link to information from the MY NASA DATA website. The monthly surface temperature from January, 2000 to September, 2001, monthly tropospheric ozone from January, 2000 to March, 2001 and monthly cloud coverage from January, 2000 to September, 2001.

In doing this a google map of the local and remote Globe sites was created. This map consists of environmental information along with the address, longitude, latitude and a picture of the site.

**\*Results:\***

The Data/Visualization Team successfully generated a google map consisting of colleges attended by the NASA SPHERE interns and local GLOBE sites. This google map is user friendly. It allows you to click the balloon associated with the location and there you will have options to view the site or graphs of monthly surface temperatures, monthly tropospheric ozone and monthly mean cloud coverage. The map gives the longitude and latitude of the specific location as well

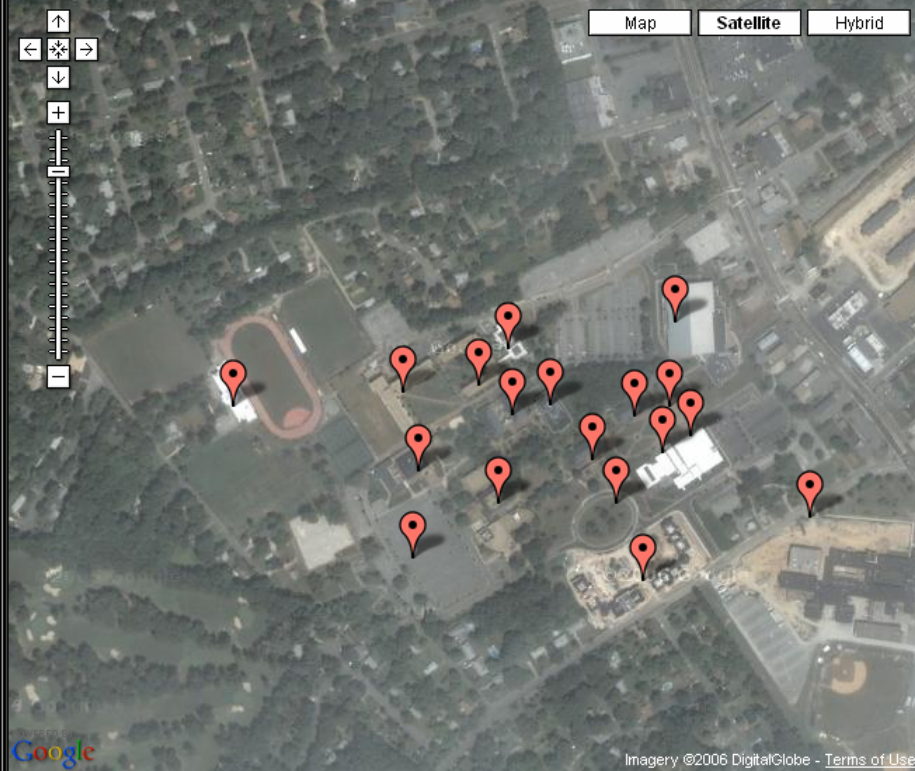
## SPHERE Locations



<http://www.pcs.cnu.edu/~cscott/corymap.html>

Aside from the google map a walking tour of CNU and the Shenandoah Valley trip was created. These maps provide pictures of the site and its longitude and latitude.

# CNU Tour



A satellite map of the CNU campus with 18 red location pins. The map includes navigation controls on the left (directional arrows, zoom in/out, and a scale bar) and map style options (Map, Satellite, Hybrid) at the top. A legend on the right lists 18 campus locations. The Google logo and copyright information are visible at the bottom of the map area.

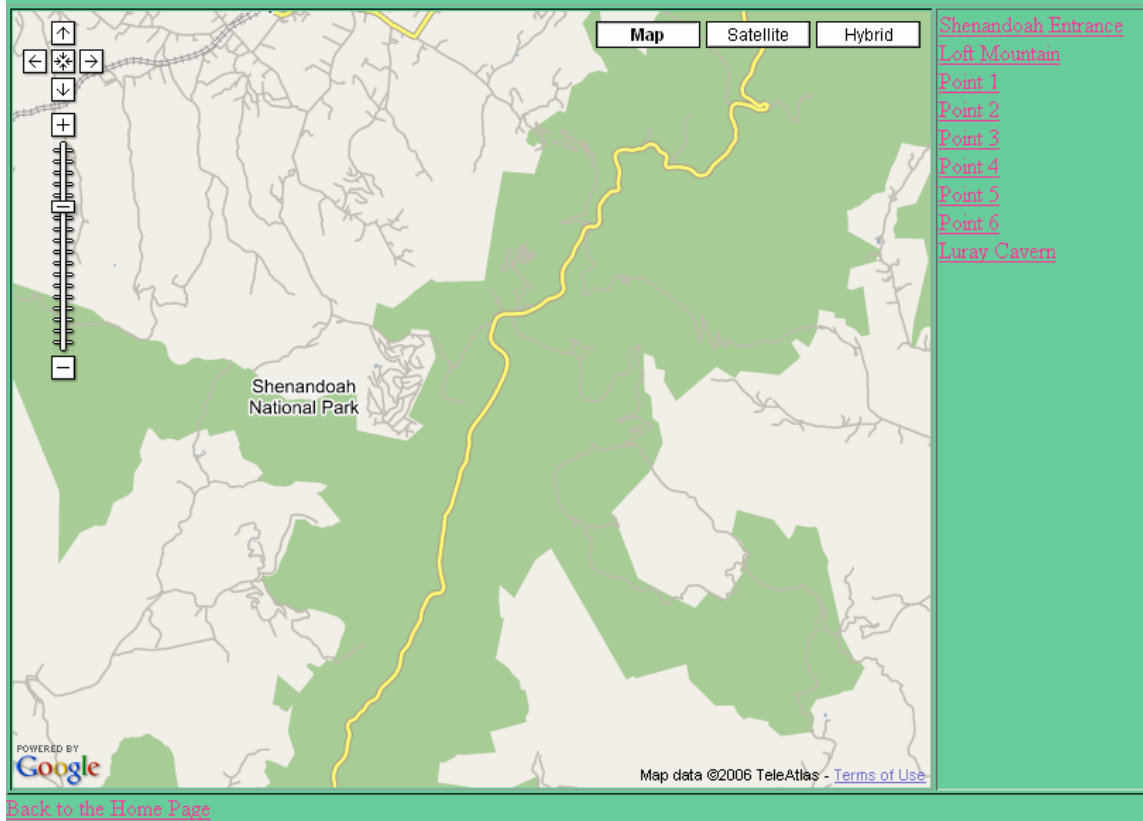
- [Santoro Hall](#)
- [Potomac Hall](#)
- [York River Hall](#)
- [James River Hall](#)
- [Ferguson Center](#)
- [Student Center](#)
- [New Student Center](#)
- [Ratcliffe](#)
- [McMurrin](#)
- [Cpt. John Smith Library](#)
- [New Student Library](#)
- [Administrative Building](#)
- [Wingfield](#)
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<http://www.pcs.cnu.edu/~cscott/tour.html>

## Shenandoah Tour



<http://www.pcs.cnu.edu/~dwilliam/shenandoah.html>

### **\*Conclusion:\***

In conclusion the Data/Visualization Team created the walking tour of CNU and the Shenandoah Valley along with the Google map of the local and remote GLOBE sites. The sites are currently up and running. In addition to what we have already created we would like the creation to advance. Further research should involve more in depth data research which be obtained from the LAS, GPS and other sources of your choice. Data that is current and accurate would be appropriate. This will keep the viewers updated on the environmental activity of that specific area. Also more locations should be added to the site that we have already created, that way a world wide map would be available containing useful information.

### **\*Summary:\***

The Data Visualization group started getting familiar with the MY NASA DATA website. From there, the work progressed to Google Maps and GPS. A connection was soon made to tie all three of these aspects together. GPS was used to get latitudes and longitudes for locations on the Google Maps. Data and maps were used from the MY NASA DATA website to create graphs of cloud coverage and surface temperature. These graphs were then linked to numerous different areas which were imported into the Google Map. Most of these areas were received from the GLOBE website and correspond to the GLOBE schools in the area of Newport News. Google Maps were also used to create several other maps, such as a walking tour of CNU, a walking tour of Shenandoah, and a map of the colleges the interns of NASA SPHERE 2006 attend; with a

picture of each person in the correct marker for the school. For further projects, a more in depth use of the GPS should be involved, along with a more detailed version of Google Maps. This was a very memorable experience for all of us and we're glad that we had the opportunity to be a part of this program.