Satellite Processing and Remapping of Aqua and Terra Imagery Data

Charlie Stamm[1,2] | Elizabeth Ferreira[4] | Elius Etienne[2,3] | Paul K. Alabi[2,3] [1] Hunter College High School [2] NOAA Crest [3] City College [4] New York City College Of Technology

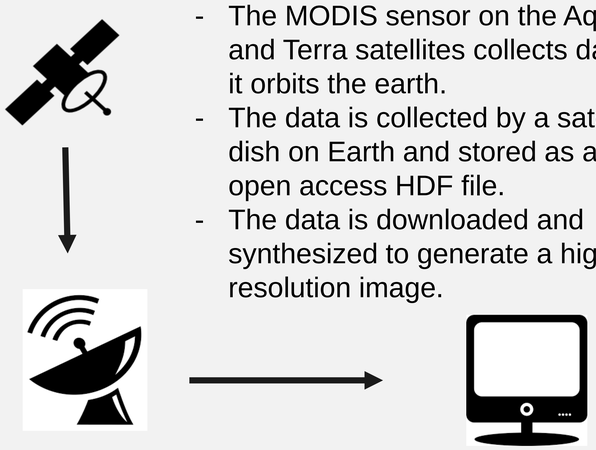
Abstract

A satellite can be defined as a fabricated object that orbits a celestial body. Satellites serve a variety of functions; they are used for communication, GPS (Global Positioning System) and environmental research. These environmental satellites collect data about the atmosphere, biosphere, and hydrosphere. Such data is critical to weather forecasting, aviation, and defense. Environmental satellites fall under two categories: Geosynchronous and Polar orbiting satellites (Low Earth Orbiting).

Terra and Aqua are environmental satellites that carry the Moderate Resolution Imaging Spectroradiometer (MODIS) sensor. This sensor collects imagery and radiometric measurements of the land, atmosphere, cryosphere, and oceans. MODIS is used for monitoring surface vegetation, land cover, and changes in sea ice. The versatility and high-resolution capabilities of the MODIS instrument make it ideal for various types of scientific study including forest fire and ocean color research.

In this project, data collected by the MODIS sensor was used to generate high-resolution true color images of the Gulf of Mexico and the coasts of Florida. These images are useful for forecasting or monitoring extreme events such as harmful Algae blooms, tropical storms and hurricanes.

Procedure



- The MODIS sensor on the Aqua and Terra satellites collects data as it orbits the earth.
- The data is collected by a satellite dish on Earth and stored as an open access HDF file.
- The data is downloaded and synthesized to generate a high resolution image.

Methods and Materials

System Applications

Aqua and Terra MODIS data, Satellite antenna, Linux OS

Software Applications

Python, MS2GT(fornav,ll2cr), Bash Shell, H5py, HDFView, Basemap, Pyresample

Terra and Aqua Specifications

- Orbit: 705km, sun-synchronous
- Swath Dimensions: 2330km x 10km
- Spatial Resolution: 250 m (bands 1-2), 500 m (bands 3-7), 1000 m (bands 8-36)

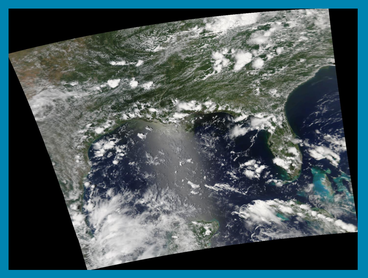
- Two satellites, Aqua and Terra, orbit the Earth, collecting data in 36 spectral bands with the MODIS instrument.
- An antenna on Earth captures the data signals from the satellite and stores the information as a raw data file.
- These Raw Data Format (RDR) files were processed and converted to HDF files that could be viewed in the HDFView program.
- A customized python program was used in the Linux server to access the data and display it as a high resolution image.
- The generated images were analyzed.

(clockwise from top left) Terra Satellite, Modis Cutaway, Aqua Satellite, Python code for accessing satellite images

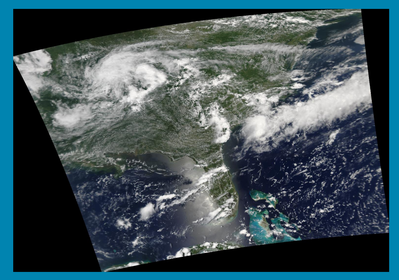
Results

Aqua Satellite Imagery

July 6, 2017

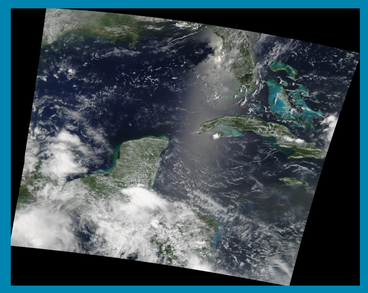


July 3, 2017

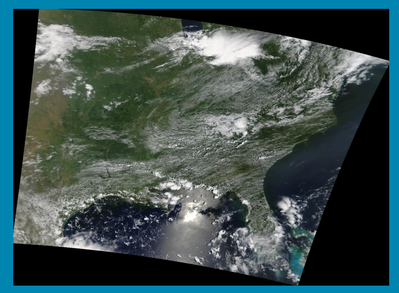


Terra Satellite Imagery

July 2, 2017



July 7, 2017



Conclusion

Satellites allow us to see from a distance the effects that extreme natural events may have on human populations and the environment. In this project, Terra and Aqua provided ocean and surface observations about the environmental changes in the Gulf of Mexico. These changes, which included ocean color and cloud cover help us identify and forecast extreme environmental events. While the observations that we made were unsurprising, they demonstrated the capabilities and importance that environmental satellites play in conducting scientific research.

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Email: charlestsestamm@hunterschools.org