VIIRS Data Analysis and Visualization of Hurricane Sandy

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Abstract

Remote sensing is the scanning of the Earth, typically from a satellite or an aircraft, in order to gain information about the environment.
The VIIRS (Visible Infrared Imaging Radiometer Suite) is a scanning radiometer mounted on the Suomi National Polar-orbiting Partnership weather satellite. It collects imagery of land, atmospheric, polar, and oceanic environments in the visible and infrared spectrum. VIIRS largely aids climatologists in understanding Earth's global change. VIIRS collects visible and infrared imagery, and radiometric measurements of the land, atmosphere, cryosphere, and oceans in order to monitor changes in the environment. VIIRS Sensory Data Records (SDR's) and Environmental Data Records (EDR's) provide reflectance, radiances, brightness temperatures, etc. The VIIRS swath covers a large area about 3040 km by 570 km as it orbits the north and south poles of the earth.
Our goal is to learn how satellite data is collected, processed and visualized. To achieve this goal we focused on Hurricane Sandy because it remains a scientifically and geographically relevant event.

Software, Tools, Procedure
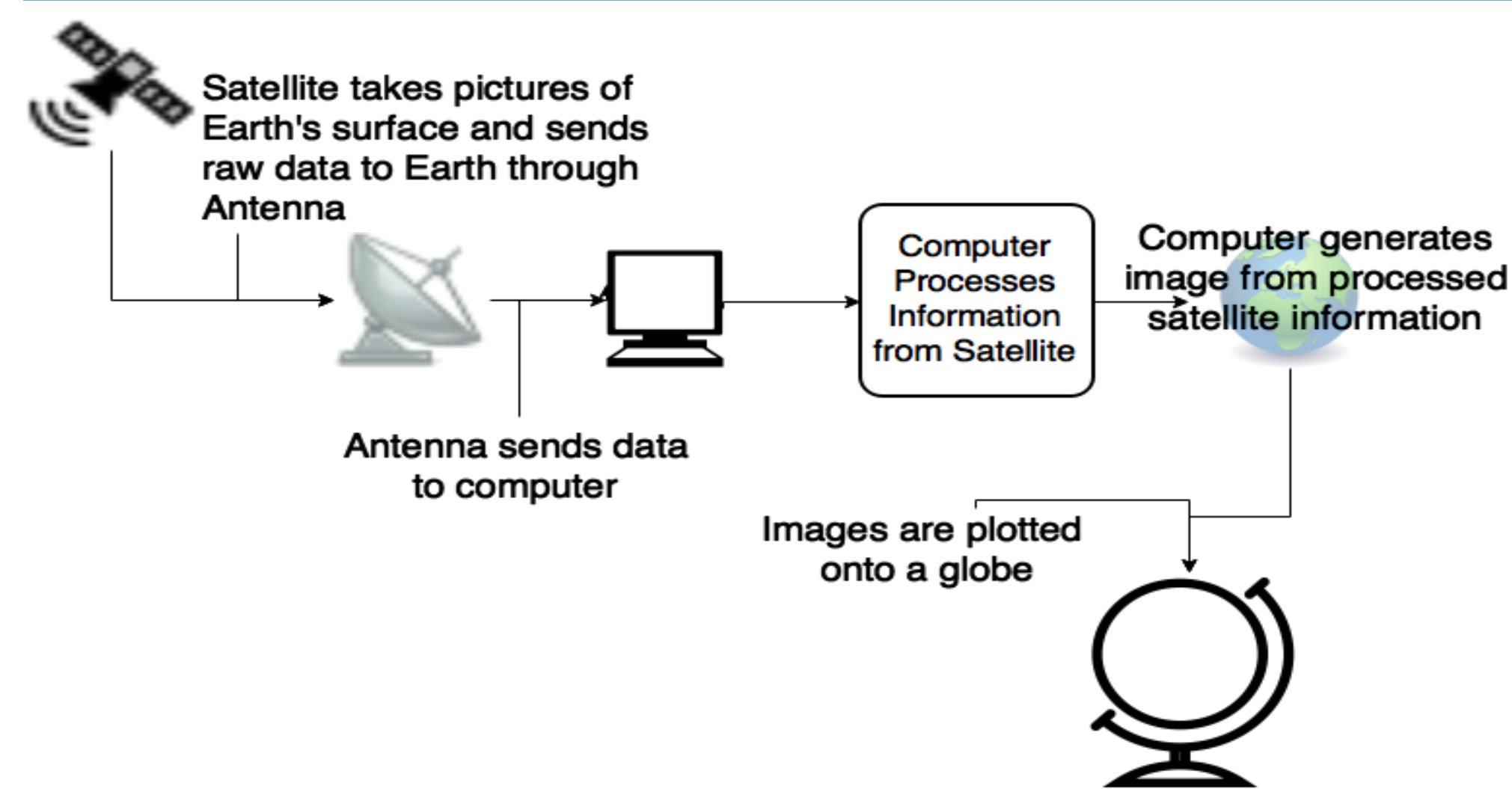
- Suomi NPP (polar orbiting satellite containing VIIRS) is used to take images of the Earth's surface with instruments aboard.

- Antennas on the roof of the NAC building (CCNY) are used to receive the RDRs (raw data record) from the satellite.

- The antenna sends the RDR it receives from the satellite to a specialized server that runs a Linux operating system.

- This server contains specialized software such as NASA rt-stps, MS2GT ll2cr, MS2GT fornav, and polar2grid (CSPP Package). This software is used to process the retrieved data.

- Using Python and Bash we ran customized scripts that allows us to create visual maps that are a lot easier to understand and more presentable.
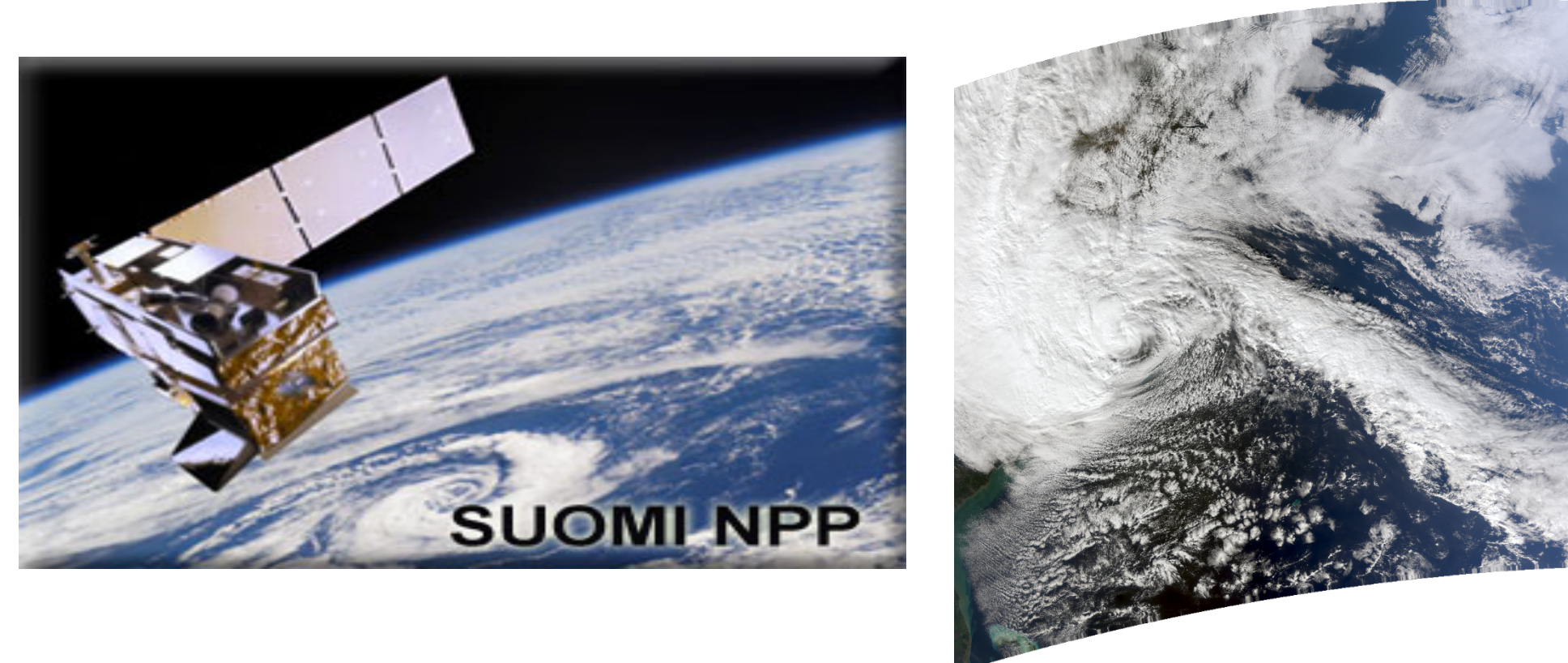
(Fig. 1) True color image composite of Hurricane Sandy on October 29, 2012 at about 17:30- 17:35

VIIRS Data

- VIIRS has 5 High Resolutions Channels (I-Bands) and 16 Moderate Resolutions Channels (M-Bands). It also has a Day/Night Band.
- M-bands and the DNB have 16 detectors to detect radiation.
- I-bands have 32 detectors (32 rows of pixels per scan), with twice the resolution of M-bands and the DNB.
- Each VIIRS file is stored in HDF-5 format.
- VIIRS SDR Visible and Near-IR channels also contain reflectance values.
- SW and LW-IR channels contain brightness temperature.
- Day/Night Band contains radiance only.

Results

Examples of NPP VIIRS SDR moderate resolution visible band

Eye of Hurricane Sandy

Lines caused by Bow-tie effect

(Fig. 2)

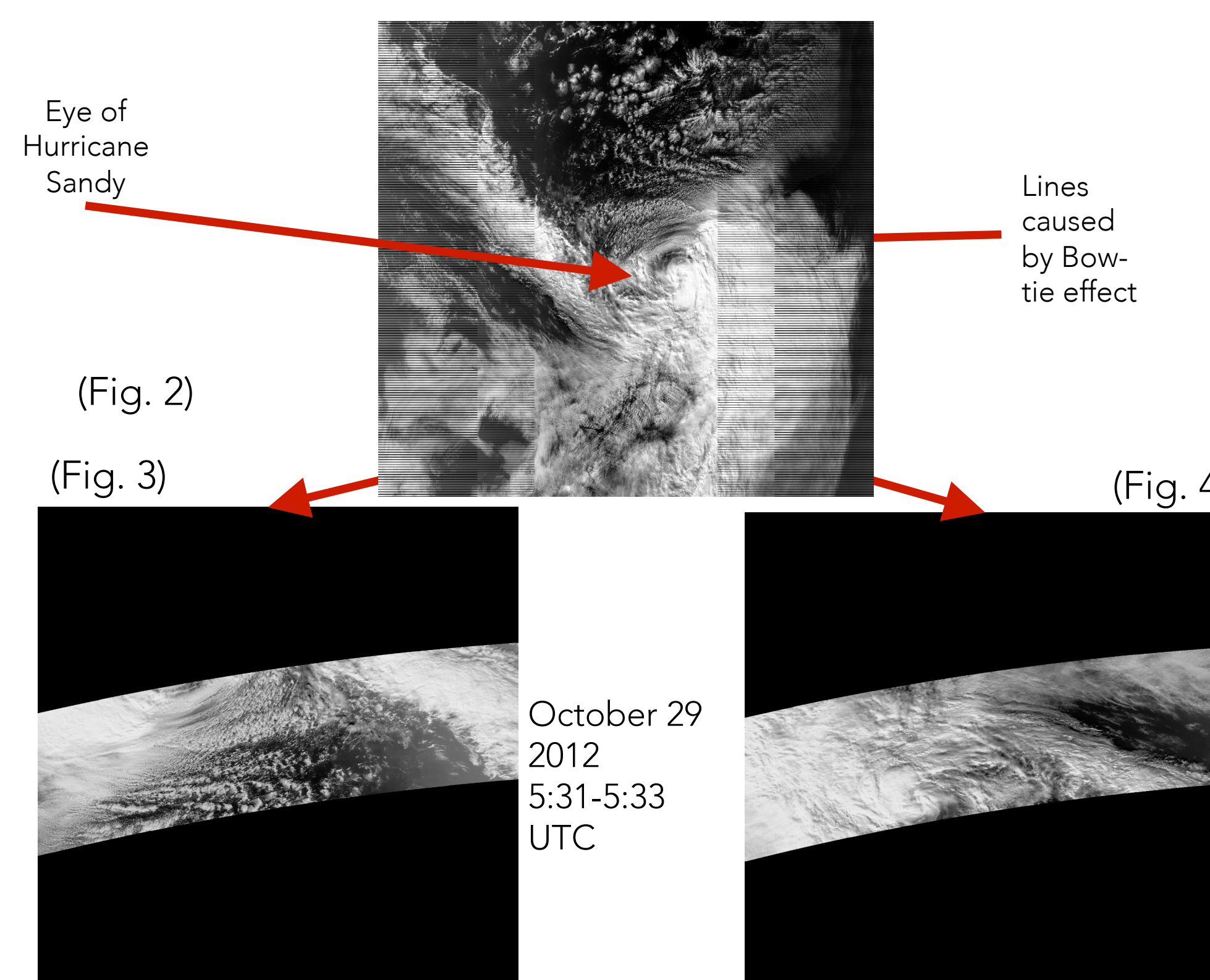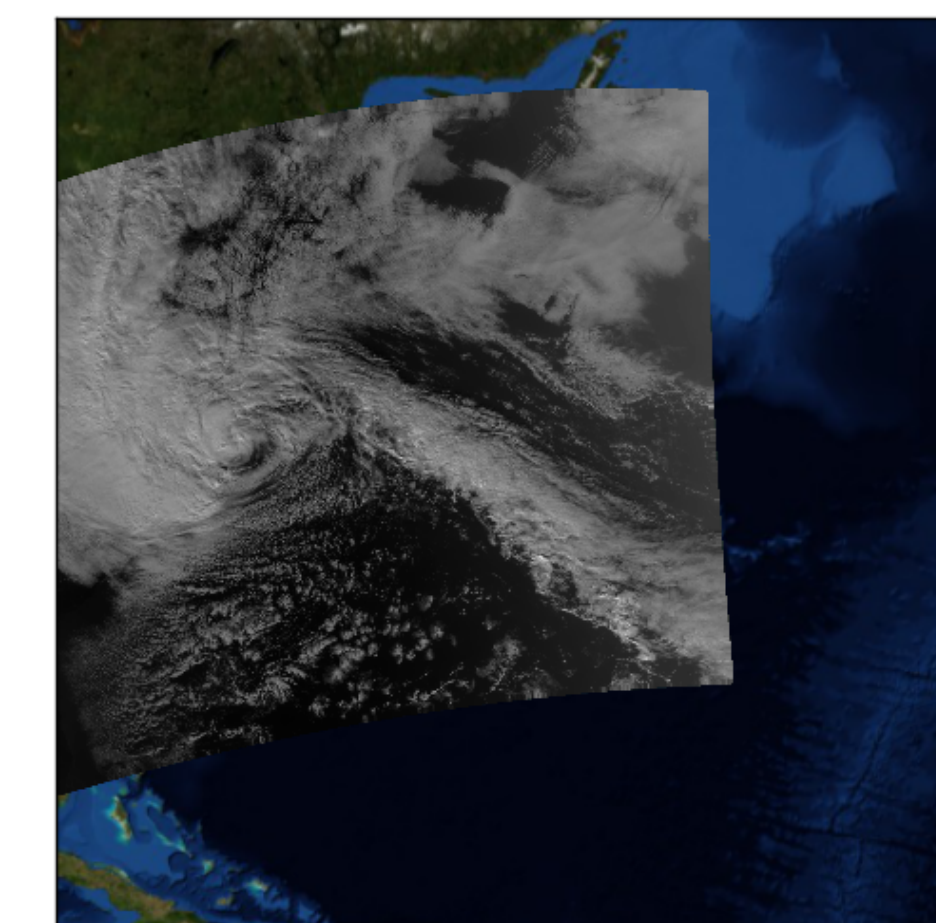(Fig. 3)

(Fig. 4)

October 29 2012 5:31-5:33 UTC

Fig. 2 depicts an unprocessed dataset for two swaths that were stitched together. It has stripes caused by the bow-tie effect. The bow-tie effect comes from the actual area of each scan line which has the shape of bow-ties overlapping each other. In order to fix the bow-tie effect we deleted the overlapping pixels (pixel-trim).
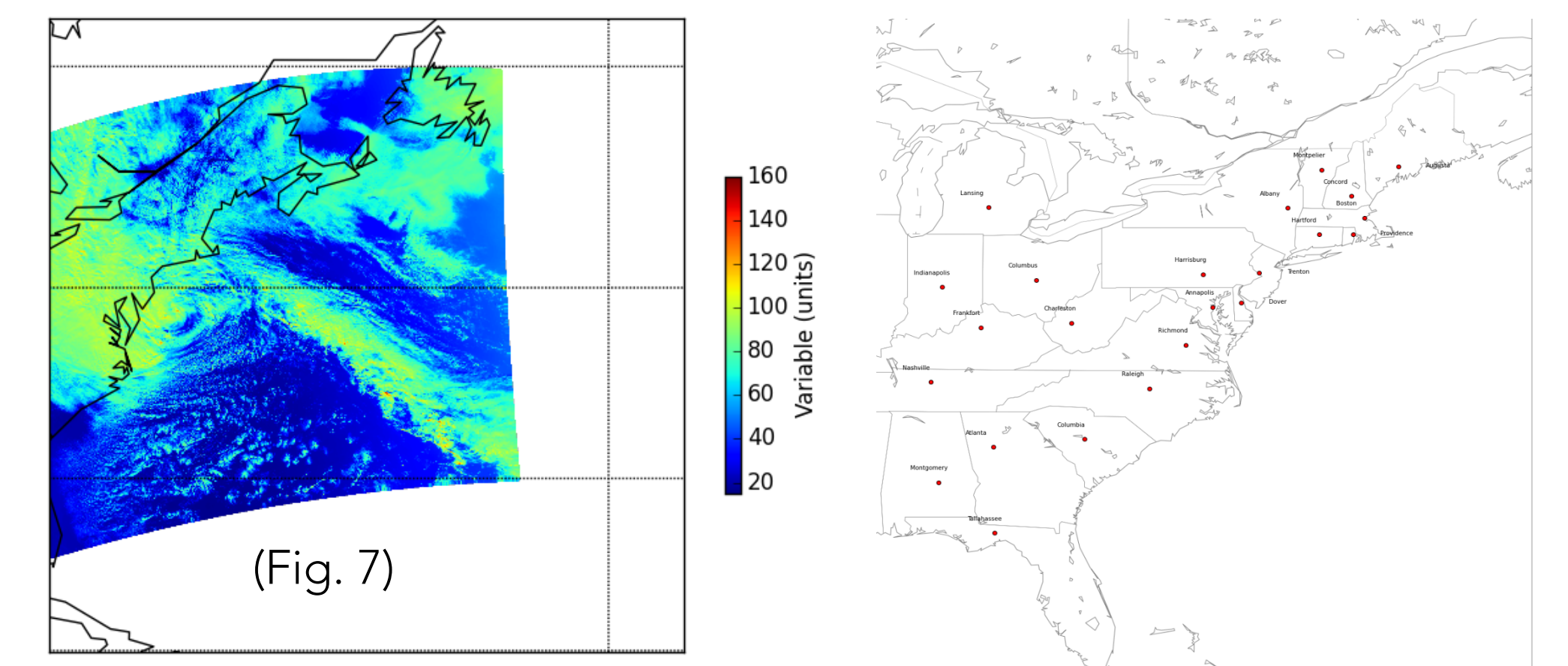
(Fig. 5)

(Fig. 6)
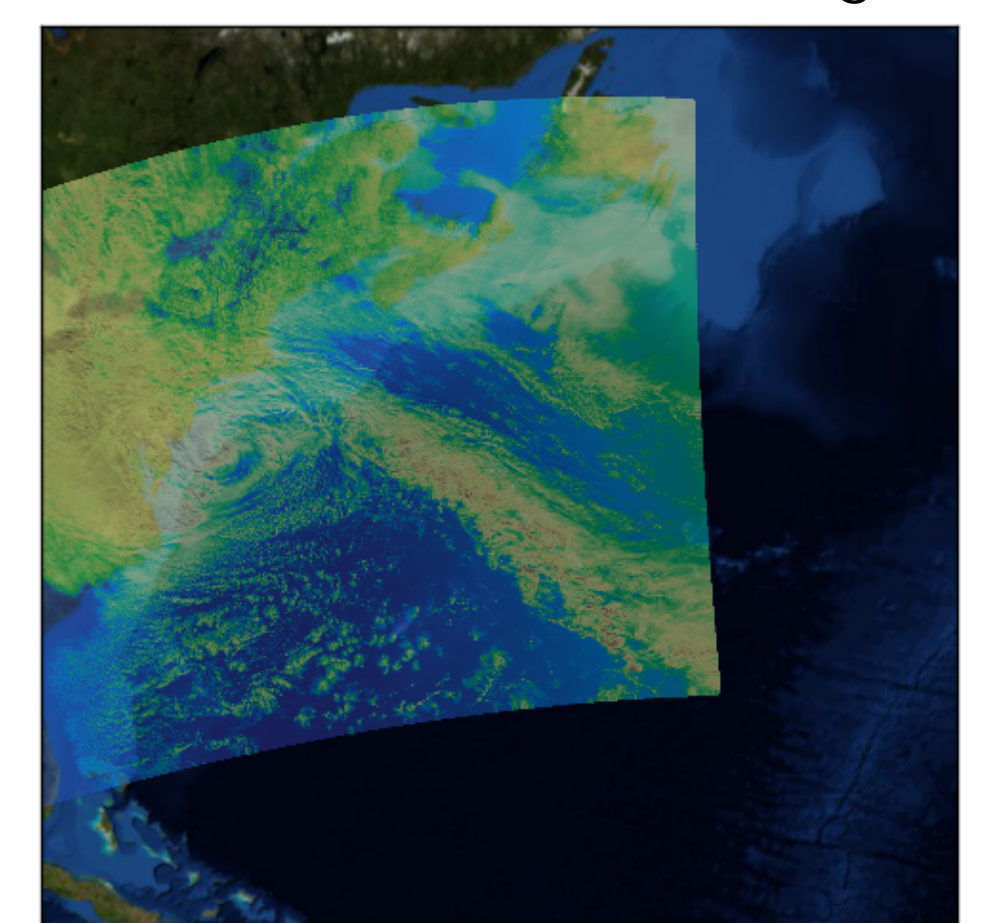
We reprojected our results onto the Blue Marble map. Figure 5 is a black and white projection that shows cloud patterns and movement of the storm while Figure 6 shows a different colormap of Figure 5 depicting terrain. Figure 7 shows the intensity ratio throughout the storm for reflectance.

(Fig. 7)

Conclusion

- Satellites such as Suomi NPP play a large role in helping us learn about our environment. They collect data from afar that can be analyzed and interpreted into useful information (weather forecasting and prediction). Instruments aboard these satellites collect different types of data, for example VIIRS aboard Suomi NPP can collect reflectances, radiances, and brightness temperatures of the Earth.

- Satellite data is processed using a suite of software. The data is stored in an HDF5 format.

- Using scripts written in Python and Bash we were able to process the data and generate images.

Acknowledgement