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Training: Seaspace Satellite Receiving Station Operation Sea Surface Training

Sea Surface temperature is an important research area studied by scientist in organizations such as the National Oceanic and Atmospheric Administration (NOAA). The scientist and members of NOAA record and sea surface temperatures to understand how our ocean water reacts to Earth's atmosphere. This research is vital to understanding different weather changes over time or rapid ones that occur randomly. In the sea space training program, we were taught how to use the Center of Excellence in Remote Sensing Education and Research (CERSER) satellites to record and understand data of sea surface temperature.

The CERSER program here at Elizabeth City State University (ECSU), has access to satellites on campus that receives data from other satellites in space. One of the Satellites in space is NOAA's polar satellite that orbits the Earth's polar points. NOAA's polar satellite orbits closer to the Earth. The other satellite that we receive information from is the Geostationary Operational Environmental Satellite (GOES). The GOES satellite orbits close to the Earth's equator; it captures data for meteorology research and sea surface temperatures. The NOAA and GOES satellite connects to the three satellites that are housed here at ECSU.

We have three satellites located on ECSU campus that are used by the CERSER program for sea surface research. The polar satellite that receives data from NOAA's polar satellite in space is connected to a server also housed on ECSU's campus. That server only holds information being passed by the NOAA. The other two available is GOES east and west, which also have a designated server that only receives data passed by the GOES satellite. The data is recorded in time intervals throughout a 24-hour cycle.
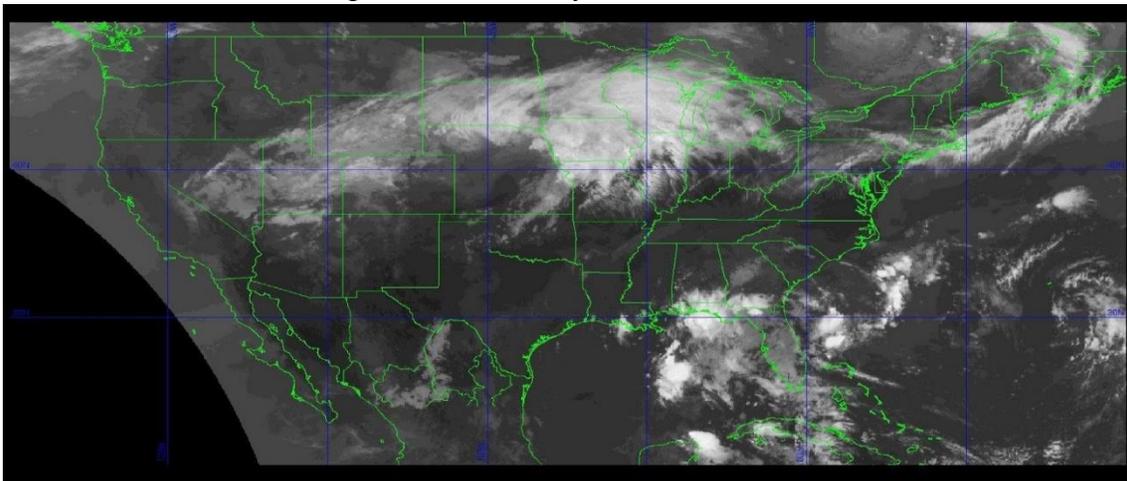
Figure 1

Using the GOES satellite and information sent to the goes east and west servers here at ECSU, the training team was tasked in learning how to create a local and global image using the linux terminal and Tarascan system. We first learned how to log in to the terascan system through the linux command line. To log in to the terascan system you need to use the login- ssh command along with the username and IP address for the tera-system. After logging in we checked the files of t-rex server. There were two folders that we were interested in during our sea space training. The first folder was Nexus, which held the pass images from the satellites and the corresponding data of each pass. The second folder, Opt, contained the scripts to help read the data obtained by Nexus to better solve certain tasks.

After learning how to access both files we were tasked with collecting a global image of the United States and a local image of any area in the Country. The first obstacle was accessing the images collected from the GOES satellite. We started by pulling the satellite data from the GOES servers by using the command line vi gvar.global. After entering the gvar command into linux a list of script options appears to specify how big of coverage we want to use. In the training, we pulled all data possible and used a full coverage area. After having the data pulled from the GOES satellites we had to input the data into the Nexus folder. We started by using the command input and a folder pathway to save all the passes to the whole_pass folder in the Nexus folder. After we have all the data pulled into the whole_pass folder we must chose an image to manipulate to become or global and local. Each image recorded was at a certain time interval of every 30 minutes between the 15th minute on the hour and the 45th minute on the hour. We each picked a time from the whole_pass folder and then pushed through the output so we can view it in our terascan software.

Terascan is the software that helps us read and analyze data received from satellites. Terascan displays the actual image received from the space satellites with accurate data
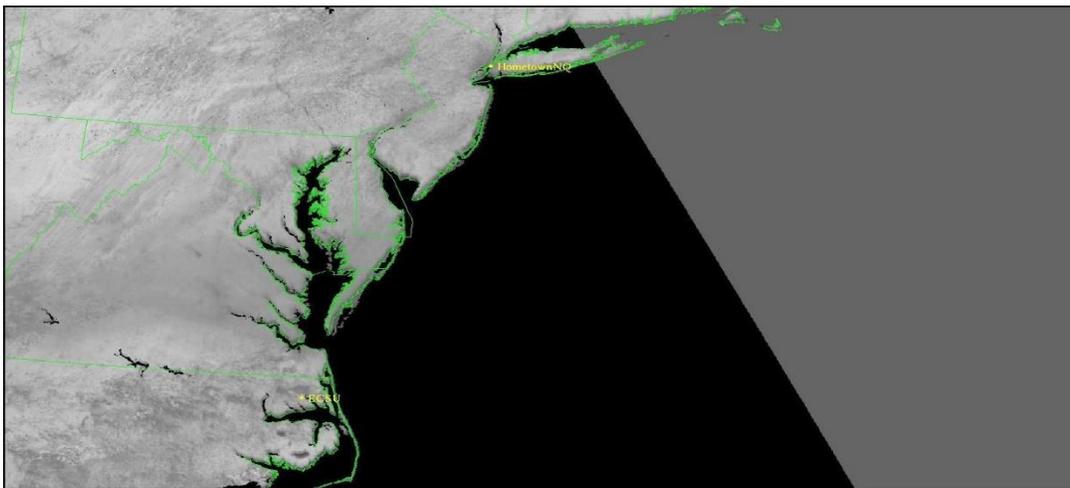
Figure 2

displayed such as cloud coverage, sea surface temperature, and land mass temperature. To make the global and local image we had to create a data shelf to view the images. The data shelf contained the shelf itself, the images that were going to be analyzed, and channels to view the image in. The channels in Terascan each show different data information over the image being processed. Also, the user/researcher has the option to create their own channel to target specific data found in the image. After creating the data shelf, we opened the image to view a full image of the earth. For us to create a global image we had to find a large area to survey. In our training, we were instructed to use United States as our global location, we used the zoom box tool to outline only the United States area. Using the Annotate tool we could put information on the image using a text tool. Next was to find a local image where we were instructed to use any location. I chose my hometown of New York by selected the zoom box tool and selecting only that state area. (See figure2)

With the whole_pass data collected from our data pull we created a line chart of the changing sea surface temperature at one point over a two-day pass. We started by reopening the terascan software and opened the data shelf previously created from our local and global image. Using a sst channel that highlighted readable sea surface temperature data that was recorded through the

satellites we each picked a desirable spot that would give us the most data. My pick was located off the Gulf of Mexico, close to Central America. After recording the sst data for each time interval we recorded our data into excel and used the excel tools to create a line chart.

The following task after finding our local and global image was learning how to annotate and enhance the image(s) to better read and interpret the data available. We started by opening terascan and using the same data shelf that was already created, we selected three images to manipulate. After using the zoom box tool and selecting a desirable area, in the training we were instructed to use Florida, we used the Palette Select tool in the *blue, green, red, and yellow* (bgry) palette to view the image. The bgry palette helped sort the components of the image, as in which area was land and showed the difference in sea surface temperature by color almost like an infrared reading. Next was the enhance tool which made the image more detailed for accurate visual representation. Using the *steps* tool, we enhanced the pixel density to have a crisper image. We also did a coastal and grid overlay to help define the image better. Coastal grid overlay shows land mass and water divide; it also does a detailed view of the land masses countries, states, etc. The grid overlay is responsible for latitude and longitude grid being visual on the image. The grid overlay helps with location of any point on the image. After learning the basics of enhancing and annotating an image we made a composite image out of the three chosen images from earlier.

During the second phase of our training that was led by a Sea Space representative, we learned about terascan channels remapping files, and script files. Each terascan channel uses a different palette to read images. The channels palette is derived from the electromagnetic spectrum, which is the measure of sun rays/light. Most channel use BGR in the visible section of the spectrum to read the images, however channel four for example uses Emissive waves also referred to as thermal reading. The R in BGR is what is used in terascan as channel 1, and right after R on the electromagnetic spectrum is channel 2. The difference between channel 2 and channel 1 is considered the Vegetation Index. The vegetation index measures the density of green on a patch of land; the two channels show different density readings. After selecting the channel there are two levels in which the data is read by. The first level is known as Sensor Data, which is what the satellite sees at that point of the data pull. Level 2 of the reading is called the Geophysical/Environmental process, which uses algorithms that process the history, changes, and other variables to get a dynamic reading.

Once we learned about the channels and how they process data, our next step was to essentially create our own channel. To make our own channel we needed to construct a script that will be the algorithm used in level 2 of processing the data. Luckily enough the system we used have preset scripts that we could simply manipulate to create our very own channels. The channel we created was to filter the image to show cloud data so we had to find a way to read the cloud data that isn't normally represented in the other terascan channels. To show the cloud data, we had to mask the sea and land data. We used a mathematical equation that separated the land and sea temperature that was readable data already collected, from the readings in the image that will be analyzed. The clouds tended to have a very low temperature due to the altitude so we knew that the land and sea surface temperature had to be at least warmer than zero degrees Celsius. Once we had our script finished we opened our image in the channel we created. (See
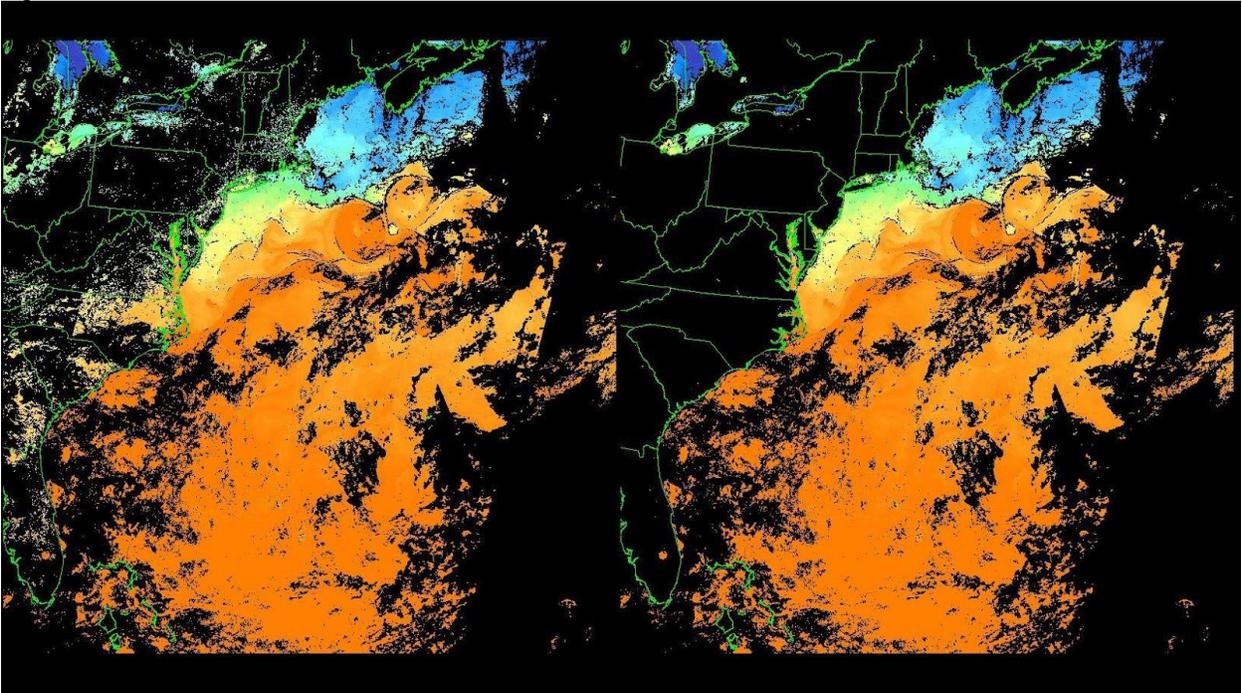
figure 3)

Figure 3

Overall, the Seaspace training was an entry level look at how to manipulate and read satellite image data. We know these techniques can apply to many research opportunities such as the effects on how climate change effects other elements of the earth such as cloud coverage and sea surface temperature. In addition, the Seaspace information and tools can also be used for meteorology to determine the weather and weather patterns over time. During this training we learned various topics, from electromagnetic waves to understanding the hardware system of how the satellites communicate with each other day to day.