NOAA-20 & SUOMI-NPP VIIRS Natural Color RGB Useful in Analyzing Tropical Cyclones

"RAMMB Blog, March 28, 2019, Tropical Cyclone Idai Before, During, and After"

Sofia Basto-Cabrera, Aparna Venugopal, Mason Vo

7th grade, 7-1, Medford Memorial Middle School, Medford, NJ, USA

ABSTRACT

The cause for this research was to be able to understand and examine satellite imagery of the phenomena from our blog. The two satellites involved in the creation of the images are NOAA-20 and Suomi-NPP, which are both parts of the JPSS series. The JPSS series is a series of polar-orbiting satellites which are satellites that orbit above the north and south poles while the earth is rotating. This means that the polar-orbiting satellites can collect big swaths of data and aren't limited to one specific area. The main instrument on the JPSS satellites, the Visible Infrared Imaging Radiometer Suite (VIIRS), involves measuring the energy emitted by the land, ocean, and atmosphere in different wavelengths and 22 spectral bands. We did some in depth background research about VIIRS, its bands, and the satellites that make up the JPSS series before choosing our blog. We researched about our phenomenon, tropical cyclones, and about the bands in the blog. Tropical cyclones are clusters of thunderstorms that form over warm tropical oceans. The warm air rises, gets into contact with the cool air, and turns from water vapor to liquid droplets. This is the formation of thunderstorms. However, as more warm air rises to form the storm cloud, winds get more intense and fast, causing it to be classified as a hurricane or cyclone, depending on the location. The bands used in the blog are I-1, I-2, and I-3. These are high resolution bands that, when combined, form Natural Color RGB. Natural Color RGB is what most of the images from our blog are created by. Using those bands, we were able to predict where the tropical cyclone will go so it can alert the forecasters, who can alert the public. With the spectral bands from VIIRS, the phenomenon in our blog was able to be pictured in great detail.

RESEARCH QUESTION

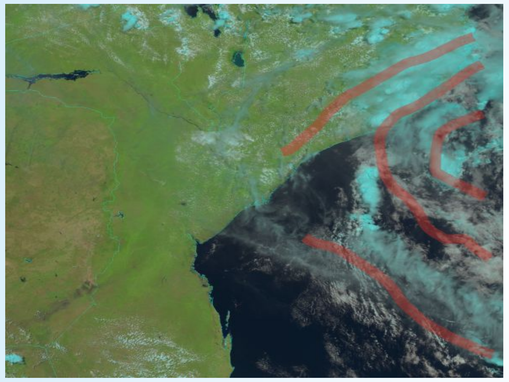
How does NOAA-20 and Suomi-NPP imagery created using VIIRS product Natural Color RGB help analyze the phenomena, tropical cyclones.

UN World Food Programme (WPF) - https://www.wfp.org/

Image 1: Cyclone Idai Flooding Mozambique
This picture was taken on March 16, 2019. From this image, you can see the power and immense effect that this tropical cyclone had on this community.

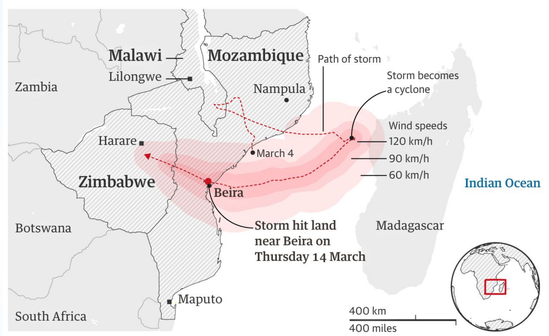
RESEARCH METHODS & RESULTS

To be able to understand what NOAA-20 and Suomi-NPP was, we needed to research about the JPSS series and what instruments were involved in the creation of the pictures. As we took notes on the JPSS learning module on the CIRA website, we saw that the main instrument on the JPSS series was VIIRS. VIIRS had 22 spectral bands based on the Electromagnetic Spectrum, so we learned about what the spectrum was. After we had understood that, we chose our blog and read it carefully, trying to understand and analyze the images. However, we needed more information on what our phenomenon, tropical cyclones, was. Once we were positive that we understood what tropical cyclones were, we researched the bands involved in the images. Natural Color RGB, a combination of the high-resolution bands I-1, I-2, and I-3, was used to capture the majority of the pictures in the blog of the cyclones.



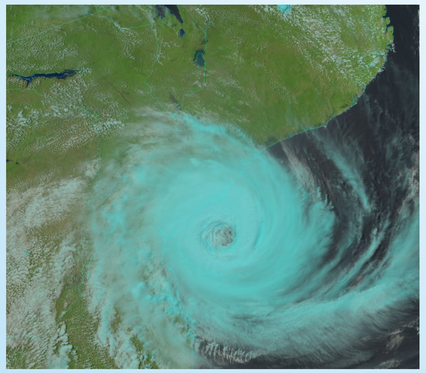
RAMMB Blog - https://rammb2.cira.colostate.edu/

Image 2: Satellite Imagery taken with NOAA-20 (Formation)
This image shows the tropical cyclone forming. This is represented by the red lines we drew on the image. We can tell that it is still developing since the clouds are slightly separated and moving in a spiral direction to come together. Knowing this, we can infer by image that the tropical cyclone will most likely hit the east side of Africa. This picture is created using the Natural Color RGB.



Guardian graphic. Source: Global Disaster Alert and Coordination System

Image 3: The Path of Cyclone Idai
The image above represents the movement of cyclone Idai. It first formed in the Indian ocean and due to the force of the cyclone's rotation and the strong wind, it moved enough to hit Mozambique. Once that cyclone hit land, all of its force and energy was transferred onto land and so the cyclone dimmed down and went back into the ocean. Afterwards, the cyclone started to get energy and force again and one more time hit land, but this time hitting a more western Mozambique.



RAMMB Blog -https://rammb2.cira.colostate.edu/

Image 4: Satellite Imagery taken with NOAA-20 (Impact)
This image was taken with Natural Color RGB, which is a mixture of the high resolution bands I-1, I-2, and I-3. This picture was taken at 10:47 UTC on March 14, 2019, and shows a detailed image of the cyclone heading toward Africa.

World Meteorological Organization - https://public.wmo.int/en

Image 5: Tropical Cyclone Idai taken on Earth
This picture which was taken on March 14, 2019 in Mozambique. We realized that the image was taken soon after Mozambique was hit by the tropical cyclone. We noticed this because of the strong moving wind that is blowing the trees to the right in the background of the image and we know that when tropical cyclones are in the area it creates high wind speeds.

RESULTS

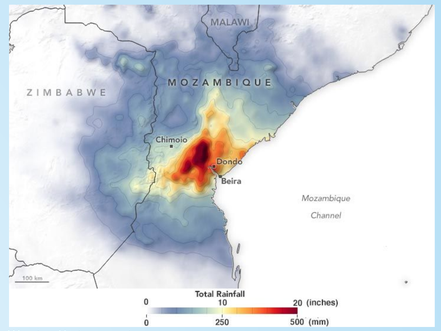


Image 6: Total Rainfall from Cyclone Idai. The red parts of the cyclone represent about 15 to 20 inches of rain while on the outside it ranged from 7 to 9 inches of rain. The center of the cyclone had more inches of rain due to the strength and speed of the winds and the fact that the center is the origin of the cyclone.

Weather Underground - https://www.wunderground.com/cat6/Death-Toll-Idai-Rises-Above-800-3rd-Deadliest-Southern-Hemisphere-Cyclone-Record

DISCUSSION AND CONCLUSION

Utilizing the Natural Color RGB, comprised of the high-resolution bands I-1, I-2, and I-3 from the VIIRS instrument, we were able to get a good understanding of the images used in the CIRA blog. We know that tropical cyclones are formed when a cluster of thunderstorms is over a warm tropical ocean and a low-pressure area. This can create a spiral rotation (tropical cyclone) and then create high wind speeds on Earth. We also know that a tropical cyclone moves and gets steered mainly by the wind. Knowing this information we can get a good understanding of the images taken by NOAA-20 and SUOMI-NPP. Also, using this information we were able to observe that the tropical cyclone was created in the Indian Ocean and then traveled to Mozambique. After, hitting Mozambique it gave off all its energy to the land and created high wind speeds. It then made its way back into the indian ocean and then once more started to form the tropical cyclone again. It also hit Mozambique again, but this time the cyclone died completely. Since it is easy for us to understand the images and the story told by the images, it makes it even easier for scientists and weather forecasters to tell what the images mean. This is an efficient way for scientists and weather forecasters to get alerts, warnings, etc sent out to people. This can lead to people having a little extra time to prepare for a weather disaster which can save lives. In conclusion, NOAA-20 and Suomi-NPP imagery created using VIIRS product Natural Color RGB help analyze the phenomena, tropical cyclones in a rapid and time-savingly.

REFERENCES

1. Regional and Mesoscale Meteorology Branch (RAMMB) https://rammb2.cira.colostate.edu/
2. JPSS Series Learning Module http://cimss.ssec.wisc.edu/education/jpss/intro.html
3. Tropical Cyclones http://www.bom.gov.au/cyclone/tropical-cyclone-knowledge-centre/understanding/tc-info/#:~:text=How%20do%20tropical%20cyclones%20form,develop%20into%20a%20tropical%20cyclone.
4. World Meteorological Organization (WMO) https://public.wmo.int/en