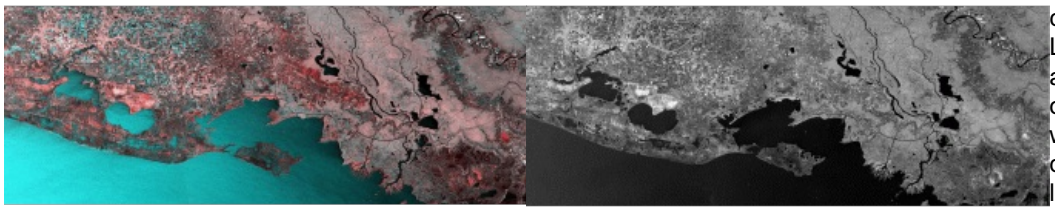
Processing Sentinel-1 Images of Hurricane Laura's Landfall in Louisiana



Hurricane Laura made landfall on the coast of Louisiana, southwest of Lafayette, USA, on 27 August at roughly 2 a.m. Eastern time. Hurricane-force winds of up to 74 miles per hour (120 km/h) were reported, causing considerable damage to property and sadly also the loss of many lives.

While the Sentinel-1 satellites (Sentinel 1A and 1B) are designed to collect standard coverages on fixed dates (repeat pass every 6 days typically using both satellites). As it turns out, Sentinel 1A collected an image just a few hours after the hurricane made landfall, at roughly 6.30 a.m. Eastern time.

At PCI Geomatics, we have developed SAR technology that stretches back several decades, and over the years have continually added more and more capability to process these types of images. I contacted one of our SAR data scientists, Gabriel Gosselin, to help with the interpretation of the images which were collected. Gabriel works with a dedicated SAR team that is developing technology to transform raw satellite imagery into information products at scale that can more easily be used by a broader user base. The team is leveraging the deep code base which has been developed over the years to provide great efficiencies in processing SAR imagery.

Processing steps are very straightforward in Geomatica for Sentinel-1 imagery, with options for complete automation using the Python API. The analysis shown below was derived using the following algorithms:

- SAR Ingest (supports direct import and uses the state vectors provided through ESA to precisely position the images within 1-2 pixels). More details: SARINGEST algorithm
- Co-register images using PCI's automated super registration algorithms (a specific algorithm is available for SAR images, others are tailored to optical imagery). More details: INSCOREG algorithm
- Data stacking (to produce the composite RGB image (R: 20200815_VV, G: 20200827_VV, B: 20200827_VV) using image merging technology.
- Intensity Change Detection algorithm to derive absolute backscatter. More details: CCDINTEN Algorithm

Interpretation of changes

The two images used in the change analysis are both collected from the same viewing geometry, ascending pass, 12 days apart (both by Sentinel 1A), using the dual pol configuration (VV, VH). The VV channels were used in the analysis, and upon visual inspection, the sensitivity of the vertical polarization to the backscatter over water and wetlands is evident, with very low returns on 15 August (indicating a very calm sea state and low winds) and very high returns on 27 August due to the high sea state and winds (4 hours following the landfall of the hurricane). Many inland water bodies and wetland areas are also quite a lot brighter (blue areas in RGB composite, light blue in change analysis) due to the sensitivity of the C-Band VV SAR to roughness of the open water bodies, as well as the increased moisture in fields due to rain.

Animation showing Sentinel 1A images (Hurricane Laura, Louisiana)

Watch the animation showing Sentinel 1A images here.

How far the industry has evolved

I am reminded of some of the first images I was able to work with at the beginning of my career, which were primarily captured by RADARSAT-1. Specifically, fine beam imagery, which was the highest resolution commercial SAR data available at the time, at 10m resolution (ground range). It's hard to believe that within a few hours of watching the news yesterday, we have the ability to access imagery through open-source licensing (thanks to ESA) at the same resolution to quickly conduct this type of analysis.

While this analysis did not reveal specific damages due to flooding (which would be the most typical use of SAR imagery for hurricane damage assessment), the availability of the imagery (all weather day/night capability) clearly shows the value of these systems. Persistent monitoring and access to information with more and more missions being launched is quickly becoming a reality thanks to innovative companies such as Iceye, who now have smaller SAR satellites capable of capturing imagery at much higher resolution. Other systems such as RADARSAT, TerraSAR already are proven to provide this information to emergency responders. More and more imagery will be available over the coming years (Capella, Umbra, PredaSAR), driving an increasing need to implement efficient production workflows that can support multi-sensor data to precisely derive actionable information.

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https://www.gim-international.com/content/blog/processing-sentinel-1-images-of-hurricane-laura-landfall-in-louisiana

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