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GEOG 419

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Lab 3

Q1: Compare and contrast the VV and VH amplitude images for their variability and contrast around the water, oil spill and land.

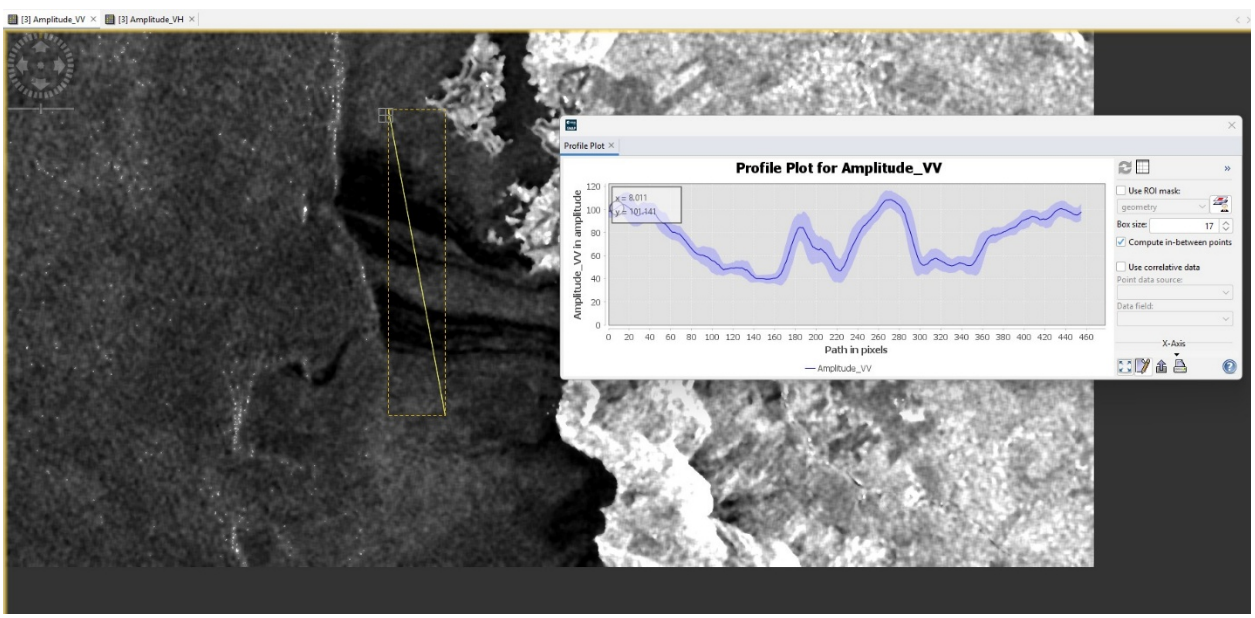
VV polarization enhances backscatter, improving oil spill detection by increasing contrast with surrounding water. The VV band better distinguishes oil-covered from non-oil-covered areas. In contrast, VH polarization is more sensitive to surface roughness, adding texture but also noise, which can hinder oil slick identification.

ok. such as speckle needing filtering, small

Q2: Evaluate the effectiveness of the speckle filter.

The speckle filter reduces noise-like granularity in the SAR image, enhancing oil spill visibility. The photo clearly shows the oil and its distribution along the coast.

Q3:Make a screenshot of your profile line (on the image) and graph and interpret the effects of the oil on SAR reflectance.



Oil spills lower SAR reflectance, forming dark patches in the Amplitude_VV band. The profile graph of the Amplitude_VV image reveals reduced intensity values in oil-affected regions, signifying decreased backscatter relative to surrounding waters.

Q4: Make a screenshot of your resulting oil spill and include it with your answer to the following question. What areas of the coast of Mauritius appear to be most affected by the spill? Describe the area and potential influence or impacts of the ocean swell, coral reefs and other features in your selected area. How confident are you in the results, and what, if any, concerns do you have for the process or accuracy?

The oil spill primarily impacted Mauritius's southeastern coast, especially Pointe d’Esny. The barrier reef and lagoons trapped the oil, posing a risk to coral ecosystems. Ocean swells and currents likely influenced its spread. I have high confidence in the due to SAR’s reliability in detecting spills, though false positives from natural slicks or calm waters could be a variable.

Q5: The reading by Chaturvedi et al. (2020) covers the theory and recent application of Sentinel-1 C-band SAR for oil spill detection and mapping. Reading the background and focusing on the case study in this paper (section 12 onward), compare and contrast their methods and results for the Persian Gulf to our results in Mauritius.

Both studies utilize Sentinel-1 C-band SAR data with a focus on VV polarization for oil spill detection. The Persian Gulf study applied machine learning techniques, whereas this lab used a threshold-based approach. Environmental conditions differ, with Mauritius involving complex coral reef interactions and the Persian Gulf displaying distinct hydrodynamic characteristics.

Q6: Make a screenshot of your results and save it. How does the algorithm perform in your opinion considering the over-/under-prediction of ships? Certainly, you could iteratively tweak this algorithm, optimizing it for types of ships or boats or at least sizes. Explain how you might given the results or a scenario of your choosing (e.g., recreational/small fishing boats, vs. cargo container or bulk carrier ships such as coal/colliers.)

The algorithm accurately detects large ships but may overlook smaller vessels due to resolution constraints. Stationary objects misclassified as ships can lead to false positives. Optimization involves adjusting the minimum target size to enhance small boat detection. (I followed the instructions and the demo but could not produce the same output in this scenario. I was not sure of the issue, however the table still listed the ship location and I was able to continue and use the data for the next step.)

Q7How do the ship detections compare with the general vessel AIS traffic patterns? Does this spatial coincidence affect your confidence or uncertainty in the SAR data capability or ship detection algorithm applied? Briefly explain. Include a screenshot (optional annotation) to highlight any pros/cons you discern.

SAR ship detections align with high-density AIS traffic, notably near ports, reinforcing confidence in SAR's detection capability. However, unregistered military or small civilian vessels without AIS introduce uncertainties. Despite SAR's all-weather utility, misclassifications may occur due to wave conditions or stationary structures.

Q8-10: Write a one paragraph summary of your lab insights and describe how the data and techniques used in this lab could enhance coastal GIS/RS in the Hampton Roads and Chesapeake Bay.

SAR remote sensing is a crucial tool for monitoring maritime activities, oil spills, and ship traffic. Its all-weather capability ensures reliability for emergency response and environmental protection. When integrated with GIS analysis, AIS data, and machine learning, SAR enhances maritime monitoring, disaster response, and coastal management. In the Hampton Roads and Chesapeake Bay region, its applications include:

• **Ship Traffic Monitoring** – Managing port congestion and security.
• **Environmental Protection** – Detecting oil spills and pollution.
• **Naval and Homeland Security** – Identifying unregistered or suspicious vessels.
• **Climate and Coastal Change Analysis** – Tracking shoreline shifts and hurricane effects.