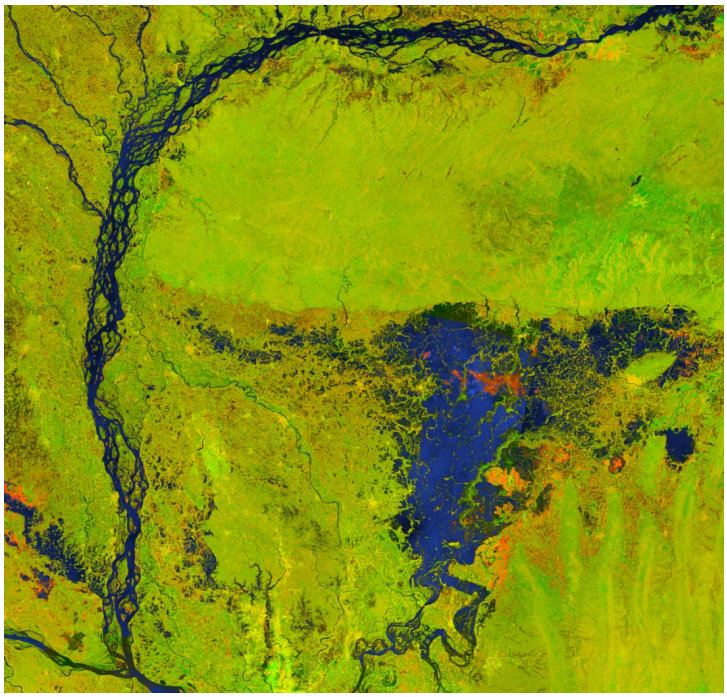
Synthetic Aperture Radar (SAR) RGB

Quick Guide

Why a SAR RGB ?

The Synthetic Aperture Radar (SAR) on the Sentinel-1 satellites transmit microwave signals in two polarizations at the Earth's surface. The signal is either reflected or scattered, depending on the characteristics of the surface . The signal that is collected at the sensor measures and discriminates ground features based on their texture. Rough surfaces, such as trees, vegetation, and other structures produce higher backscatter values resulting in lighter areas in the return image whereas smoother surfaces, such as water, appear dark. By assigning the polarized signals to individual channels of the RGB, qualitative analysis of the terrain to monitor events such as vegetation change and flooding can occur.



How is the RGB created?

Color	Band	Physically relates to	Small contribution to pixel indicates…	Large Contribution to pixel indicates…
Red	Co-Pol (VV signal)	Surface scattering: (polarized/simple)	Smooth surface	Rough surface
Green	Cross-Pol (VH signal)	Volume scattering: (depolarized/ random)	Low volume (water, roads, plowed or newly planted fields)	High volume (trees, buildings, mature crops, built up areas)
Blue	Co-Pol when Cross-Pol near 0 dB	Surface scattering when Volume scattering is very low	Scattering measurable in red channel, no value	Co-pol backscatter values near -24bB (smooth water, roads)

Impact on Use:

SAR RGBs offer a ***qualitative*** product depicting the terrain during the sensor overpass.

- Monitor vegetation and mature crops for storm damage
- Detection of water, especially during flooding events. Comparison to ancillary data required.

Things to keep in mind:

- SAR measurements are affected by satellite incidence angle to terrain, moisture content of scene, steep terrain (beam blockage), etc.
- Colors produced in the RGB may be affected by time of day (day/night pass), calibration errors and differences in orbit for the same feature in subsequent passes. Always use with ancillary data for clarification.
- Wind can change the surface roughness of water, raising the value in red channel. Water may not be blue if this occurs.

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Interpretation

Sentinel-1B RGB from 7 July 2021 over Melandaha in Bangladesh.

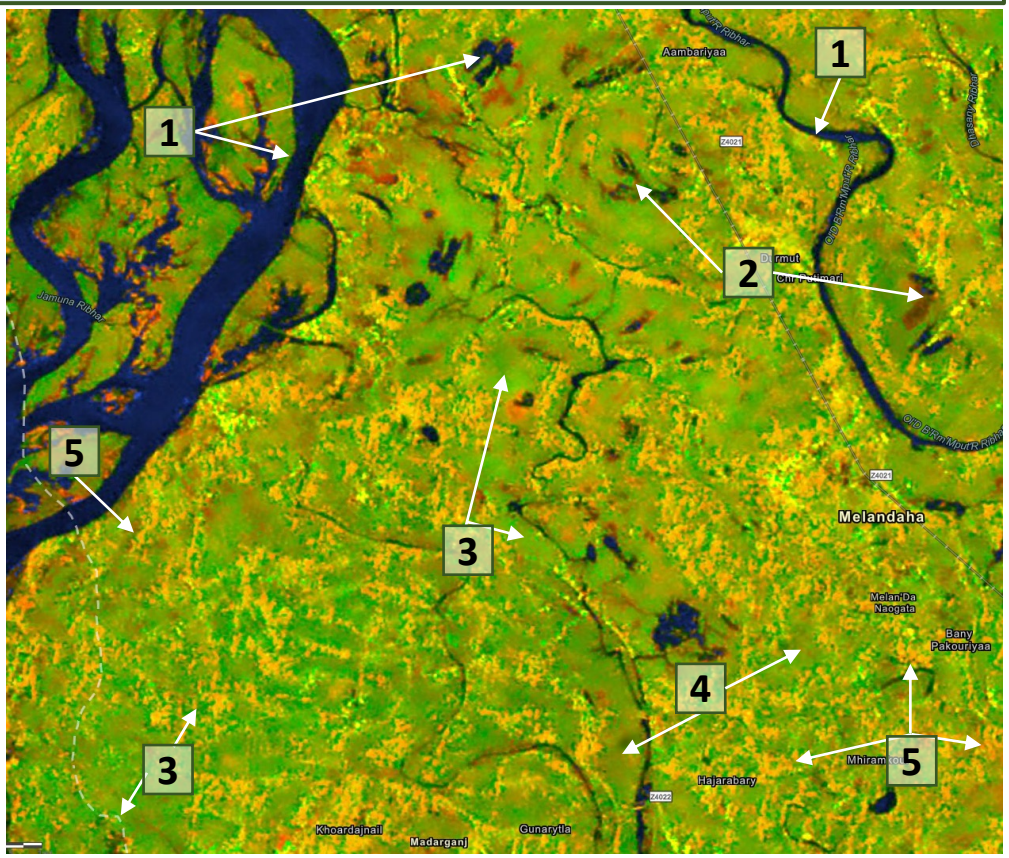
1 **Low Backscatter/smooth feature: Likely water, road**
Black to Blue

2 **Low-Mid backscatter: Likely wet or recently plowed field**
Blue to Brown

3 **Mid backscatter: Vegetation, crops, trees**
Greens, light to dark

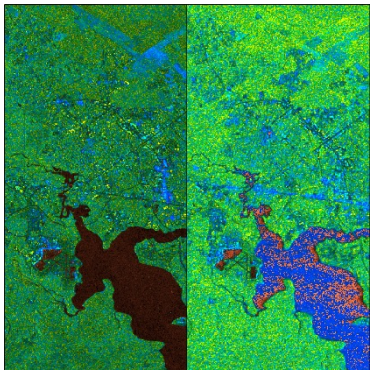
4 **Mid backscatter: Bare fields or short crops, suburban**
Orange to brown

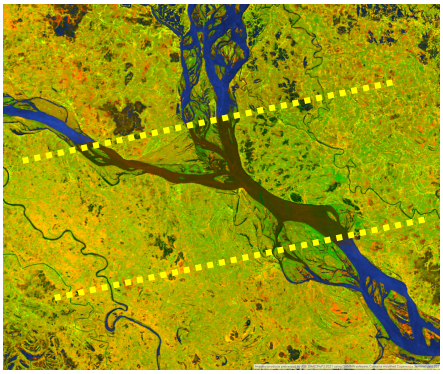
5 **Mid-High backscatter: Multiple structures, built up area**
Orange to yellow



Caveats

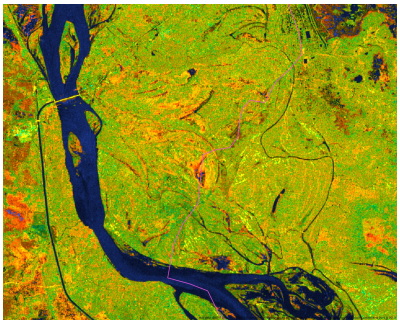
RGB images from 26 Aug 18 and 14 Sept 18 of the same area in North Carolina (left) show how the satellite incidence angle and weather conditions such as wind; changing surface roughness – changes RGB color interpretation. RGB (right) shows example of how a calibration error in input RTC files skew color generation. Ancillary information is recommended to assist in interpretation





Comparison to other products:

SAR RGBs can detect water – even through cloud cover but the methods are different from the passive measure used in optical images. In the following RGBS (left: SAR RGB; right: Sentinel-2 (S2) SWIR RGB; both from 2 Aug 20), water interpretation in the SAR image is reinforced by water seen in S2 image from the same day within 8 hours of SAR pass.



Resources

Alaska Satellite Facility Data Recipes
https://asf.alaska.edu/how-to/data-recipes/data-recipe-tutorials-2/

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