First Image Products from EcoSAR - Osa Peninsula, Costa Rica

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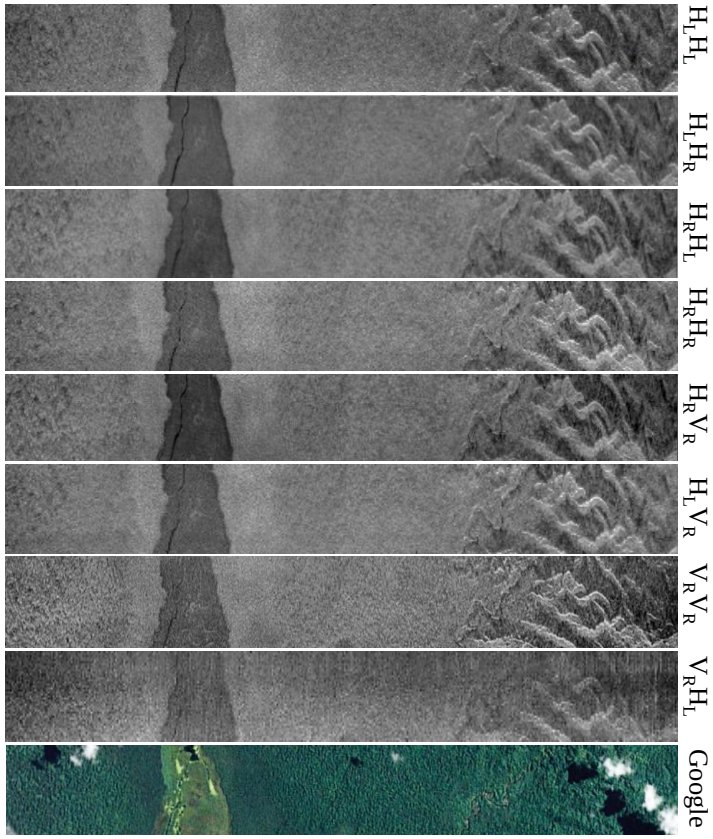
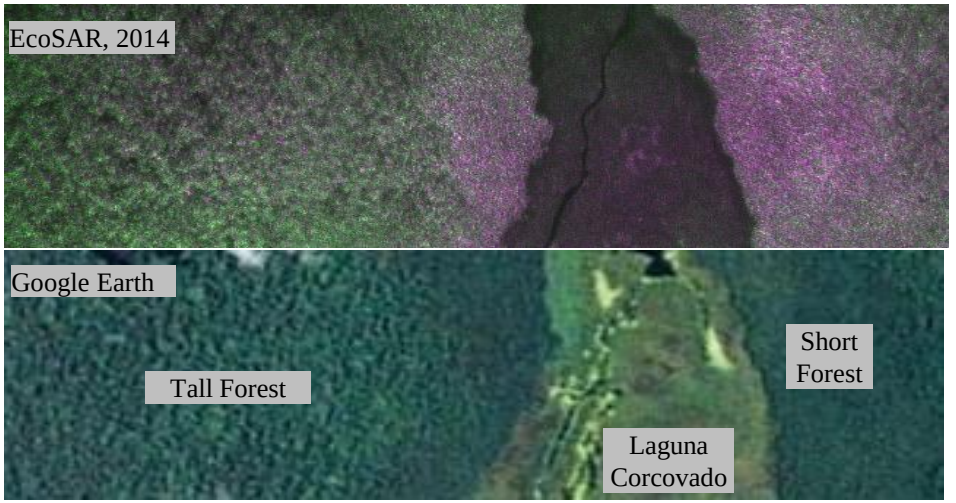
EcoSAR is an advanced airborne polarimetric and interferometric P-band (435 MHz) SAR instrument. The aim of EcoSAR is to provide two- and three-dimensional fine scale measurements of terrestrial ecosystem structure and biomass. Polarimetric and interferometric imagery from EcoSAR over Costa Rica are starting to come out. Preliminary analysis indicate good system performance as efforts focus on improving processing algorithms.

EcoSAR Measurements for March 2014

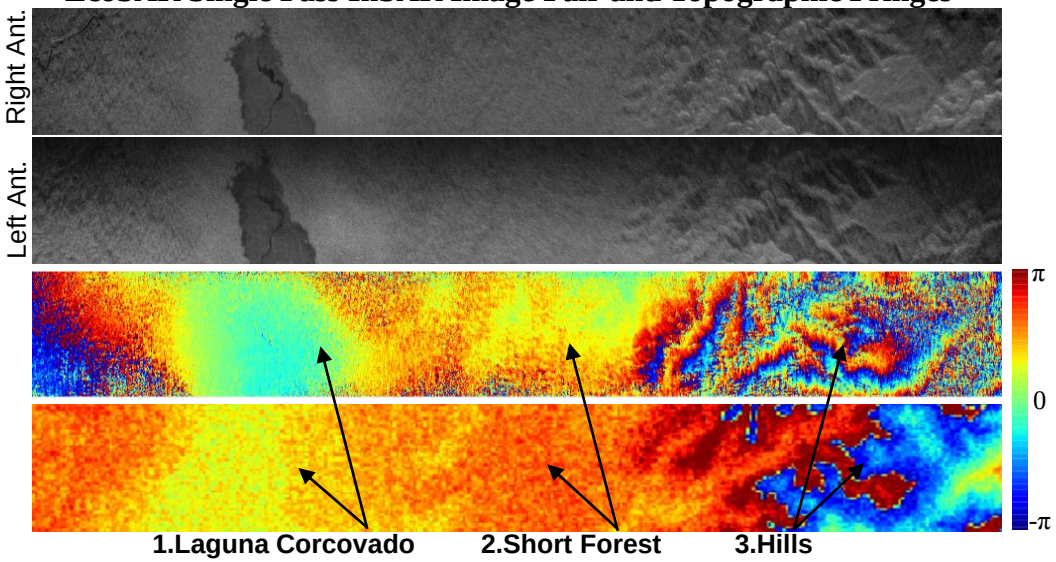


Pauli Decomposition of EcoSAR's Polarimetric Data

HH-VV (double bounce), 2*HV (volume scattering), HH+VV (surface scattering)



EcoSAR Single Pass InSAR Image Pair and Topographic Fringes



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References: 1. Rincon, R.F., Fatoyinbo, T., Osmanoglu, B., Lee, S., Ranson, K.J., Sun, G., Perrine, M. and Du Toit, C., 2015, May. ECOSAR: P-band digital beamforming polarimetric and single pass interferometric SAR. In 2015 IEEE Radar Conference (RadarCon) (pp. 0699-0703). IEEE.

2. Cloude S. R., Pottier E., "A review of target decomposition theorems in radar polarimetry", IEEE Trans. Geosci. Remote Sens., vol. 34, no.2, pp.498-518, Mar., 1996

Data Sources: EcoSAR, Google Earth, SRTM

Technical Description of Figures (Clockwise from left column):

Graphic 1: *"*EcoSAR Measurements for March 2014" shows the first images processed for Corcovado National Park in the Osa Peninsula, Costa Rica [1]. In its full capacity EcoSAR is capable of generating 16 polarimetric images using its two antennas. During the 2014 flight campaign EcoSAR collected fully polarimetric data on the right wing antenna and single pass interferometric data utilizing both antennae and horizontal polarization. Technical issues with the left side radar processor limited data acquisition to horizontal polarization. Recent upgrades fixed the problem and EcoSAR is ready to acquire full polarimetric interferometric (PolInSAR) data. Images are labeled with the first letter of polarization (H,V) and antenna location (L,R) as subscript.

Graphic 2: ***"***Pauli Decomposition [2] of EcoSAR's Polarimetric Data" shows the first polarimetric decomposition product generated from EcoSAR data using the Corcovado National Park dataset. In the figure green color denotes volume scattering, indicating *tall forest*, where red color indicates double bounce scattering, which mostly occurs with *shorter trees* in presence of water. The optical Google Earth and EcoSAR "see" *Laguna Corcovado* differently, even though the canopy-free open water appears dark in both figures. Optical imagery can not easily distinguish between the taller and shorter trees.

Graphic 3: *"*EcoSAR Single Pass InSAR Image Pair and Topographic Fringes" displays a section of the *right antenna transmit and receive* (HH_R) master image and a *left antenna transmit right antenna receive* (HH_L) slave image amplitude. Fringes from EcoSAR interferogram is shown on the third panel, where the colors indicate wrapped phase values due to topography. The cyan color indicates the extent of the swamp area (topographic low) while the mountains to the right create rapid color cycles due to sloping terrain. A simulation of the topographic phase signal based on the SRTM (C-band) DEM of the same area is shown in bottom panel. The simulation was done at 0.75 coherence level. Similar areas are indicated with numbers: 1) Laguna Corcovado, 2) Short Forest, 3) Hills. Please note that C- and P-band signals (SRTM 5.6 cm vs. EcoSAR 69 cm) have different penetration depths over vegetated areas resulting differences in obtained elevation maps. This effect can be seen over Laguna Corcovado.

Scientific significance, societal relevance, and relationships to future missions:

Designed especially for forest ecosystem studies, EcoSAR employs state-of-the-art digital beamforming technology to generate wide-swath, high-resolution imagery. EcoSAR's dual antenna single-pass imaging capability eliminates temporal decorrelation from polarimetric and interferometric analysis, increasing the signal strength and simplifying models used to invert forest structure parameters. With 32 active transmit and receive channels EcoSAR's digital beamforming is an order of magnitude more versatile than the digital beamforming employed on the upcoming NISAR mission. EcoSAR's long wavelength (P-band, 435 MHz, 69 cm) measurements can be used to simulate data products for ESA's future BIOMASS mission, allowing scientists to develop algorithms before the launch of the satellite. EcoSAR can also be deployed to collect much needed data where BIOMASS satellite won't be allowed to collect data (North America, Europe and Arctic), filling in the gaps to keep a watchful eye on the global carbon cycle. EcoSAR can play a vital role in monitoring, reporting and verification schemes of internationals programs such as UN-REDD (United Nations – Reducing Emissions from Deforestation and Degradation) benefiting global society. EcoSAR was developed and flown with support from NASA Earth Sciences Technology Office's Instrument Incubator Program.