Using remote sensing to detect, map and monitor illegal gold mining in Colombia

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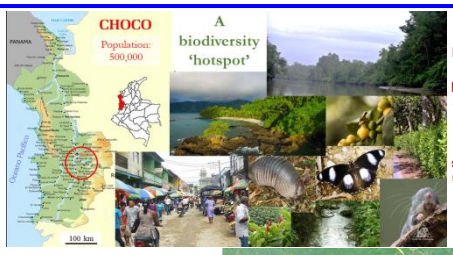
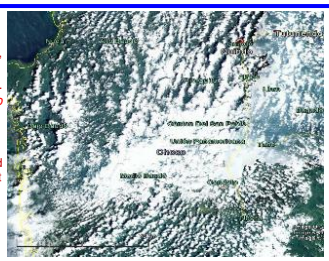
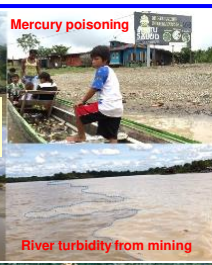


Colombia's Choco region, extending from the Andes mountains to the Pacific Ocean and the Caribbean Sea, is one of the wettest places on the planet, averaging 9000 mm of rain p.a. *It is a biodiversity hotspot, but it is also a hotspot of devastating illegal gold mining.*

The aim of this project is to use free satellite remote sensing to detect map and monitor sites of illegal mining. On the right is a typical cloud-covered Landsat scene; fortunately *Google EarthEngine* provides annual time series scenes illustrating the mining-driven deforestation.





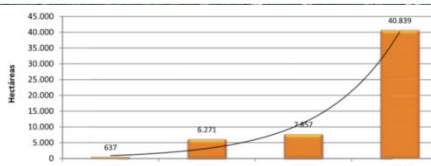
Artisanal gold mining:

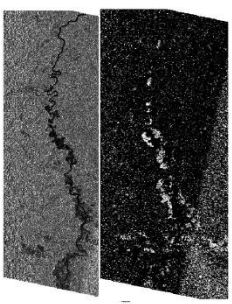
- c. 80% of Colombia's gold, value: ca. US$ 2.8 Bn / yr
- rural employment
- primarily run by militias
- minimal community benefit
- theft of community resource
- intimidation by militias
- deforestation
- loss of community farm land
- often loss of biodiversity
- loss of eco-tourism
- mosquitoes in mine ponds
- diseases: malaria, Zika
- Mercury contamination
- accelerated erosion
- more floods & debris flows
- river siltation / pollution
- Mercury in river food chain

Rio Quito, Colombia: Landsat images from Google EarthEngine (https://earthengine.google.com/timelapse/#v=-5.373,-76.79923,9.759,latLng&t=-3.27)

UNDOC: estimated extent of illegal gold mining in Colombia's Pacific Region, focused on the Rio Quito

UNDOC (2016) *Colombia – Exploitacion de oro de alluvion. Evidencias a partir de perception remota.* 162pp.

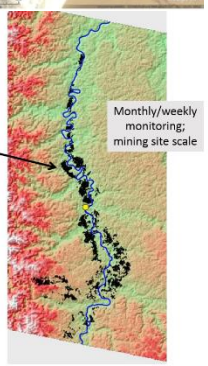




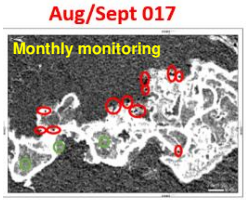
Rio Quito, Colombia: change analysis with Sentinel-1 radar images

Black areas: clearance of rainforest between Dec 2014 and May 2017

Forest and floodplain destroyed by illegal gold mining, in 2.5 years = **17.2 km²**



Aug/Sept 017 | **Sept/Oct 2017** | **Oct/Nov 2017**

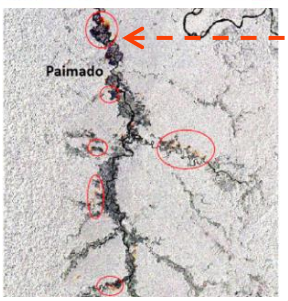


Rio Quito mining district:

Sentinel-1 multi-temporal imagery from 05/2017 to 02/2018

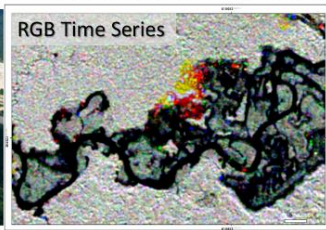
- detection of changes associated with deforestation and mining

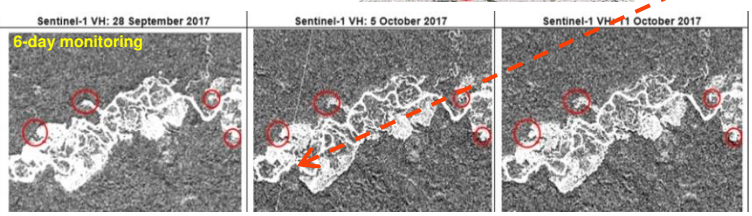
The freely downloadable S-1 imagery was found to be very effective for detecting land cover types associated with alluvial gold mining sites at monthly intervals (opposite), with more recent processing at weekly (6-day) intervals, as shown below.



Red circles Mining dredges

Aerial photo 7 Oct 2017





Summary

Optical satellite imagery:

- of minimal use, due to cloud cover and cloud shadows;
- some use for detecting and monitoring turbid water in rivers impacted by mining.

Sentinel-1 radar imagery:

- provided a relatively reliable all-season / all-weather means of detecting land cover features through cloud cover;
- adequate for detecting land cover changes associated with mining, e.g. forest to logged ground, cleared ground to flooded pit/pond, bare ground to grassland or scrub; also: detection of corner reflectors, such as metal roofs, dredges and excavators;
- 6-day return period enables weekly and monthly monitoring of land cover features associated with mining activities.

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