Abstract
Previous studies have quantified the expansion of gold mining-related forest loss (Espio et al., 2018; Asner et al., 2017; Swenson et al., 2011) in the Madre de Dios region of Peru. This study uses Spectral Mixture Analysis (SMA) in a cloud-competing platform to map general forest loss within and outside key land tenure areas in this region. Landsat 7 Enhanced Thematic Mapper plus (ETM+) and Landsat 8 Operational Land Imager (OLI) Surface Reflectance data were utilized spanning 2013 and 2018 and spectral unmixing was performed to identify patterns of forest loss for each year. Planet Scope and RapidEye imagery were used to conduct an accuracy assessment and to identify potential drivers.

Objectives
- Quantify rates of forest loss within protected areas and indigenous communities
- Analyze how forest loss relates to other land tenures such as mining permits and reforestation concessions
- Identify potential drivers of forest loss to see if gold mining is the main driver and explain how these potential drivers relate to the land tenure

Methodology
- Spectral Mixture Analysis
  We defined photosynthetic vegetation (PV), non-photosynthetic vegetation (NPV), water and shadow as endmembers and applied the spectral unmixing algorithm embedded in Google Earth Engine.
- Change Detection
  Forest loss was based on a modified version of the algorithm applied in Asner et al., (2009) and is indicated by a decrease in 50% of the PV fraction between a pre composite and a post composite.
- Validation and Accuracy Assessment
  For 2013, 20 scenes with 3-m resolution from RapidEye-1, RapidEye-2, RapidEye-3, and RapidEye-5 were utilized, and for 2018, 46 scenes with 3-m resolution from Planet Scope were utilized, covering the entire study area. A stratified sampling design with 1100 randomly generated points and proportional allocation was used according to Olofsson et al. (2014) guidelines.

Datasets
- Data – Shapefile Source Last updated
  Mining Concessions INGEMMET 06/19/2018
  National Protected Areas (NPA) SERNANP 02/08/2018
  Indigenous Communities Amazonía Socio Ambiental/BIC 12/2015
  Reforestation Concessions SERFOR 11/13/2017
  Departments Boundaries MINAM No information
  Intercoastal Highway OpenStreetMap 03/2019

Earth Observations

Study Area
- Bahuaja-Sonene National Park Buffer Zone
- Arazaire Indigenous Community
- Kotsimba Indigenous Community
- Overlapping Mining and Reforestation Concessions
- Reboforestry Concessions

Results & Discussion
The figures above illustrate the progression of forest loss across space and time, with concentrations revealed along the Malinowski River, within the Kotsimba community, on the northern border of the Tambopata National Reserve, and within the buffer zone of the protected areas. Many possible small-scale mining sites are located alongside the Iñambari River. Overall Accuracy was 96%.

Extent and Rates (ha)

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Potential Drivers
- Mining
- Agriculture/Pasture
- River Flow
- Urban
- Misclassified

Conclusions
- Forest loss progression continues to prevail in this region, threatening specially the Kotsimba Indigenous Community
- Gold mining is not the only driver causing forest loss in the region, since Agriculture/Pasture represents 38% of the points identified
- The maps created with the use of Landsat data provide information for subsequent assessments on land cover planning and monitoring
- The use of the spectral mixture algorithm as a change detection technique provides accurate results