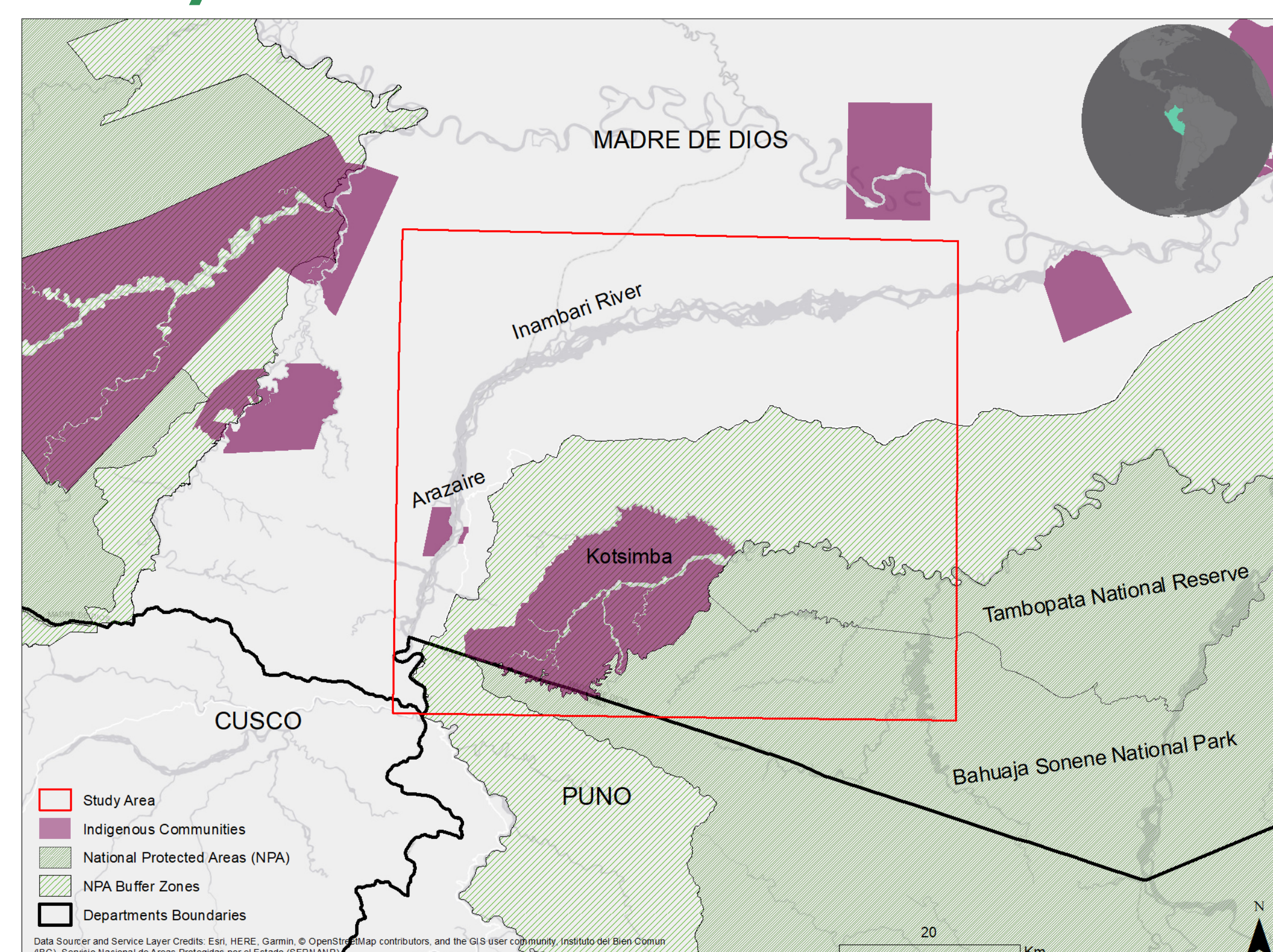


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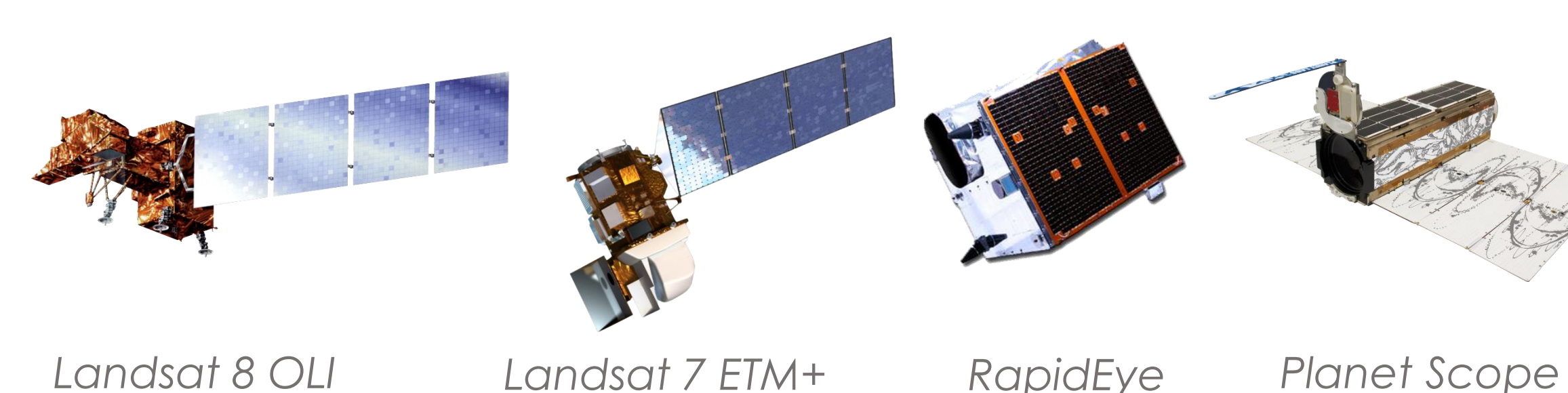
## Abstract

Previous studies have quantified the extension of gold mining activities (Swenson et al., 2011; Elmes et al., 2014) and associated it with forest loss (Asner et al., 2013; Asner et al., 2017) in the Madre de Dios region of Peru. This study uses Spectral Mixture Analysis (SMA) in a cloud-computing platform to map 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 2017 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.

## Study Area



## Earth Observations



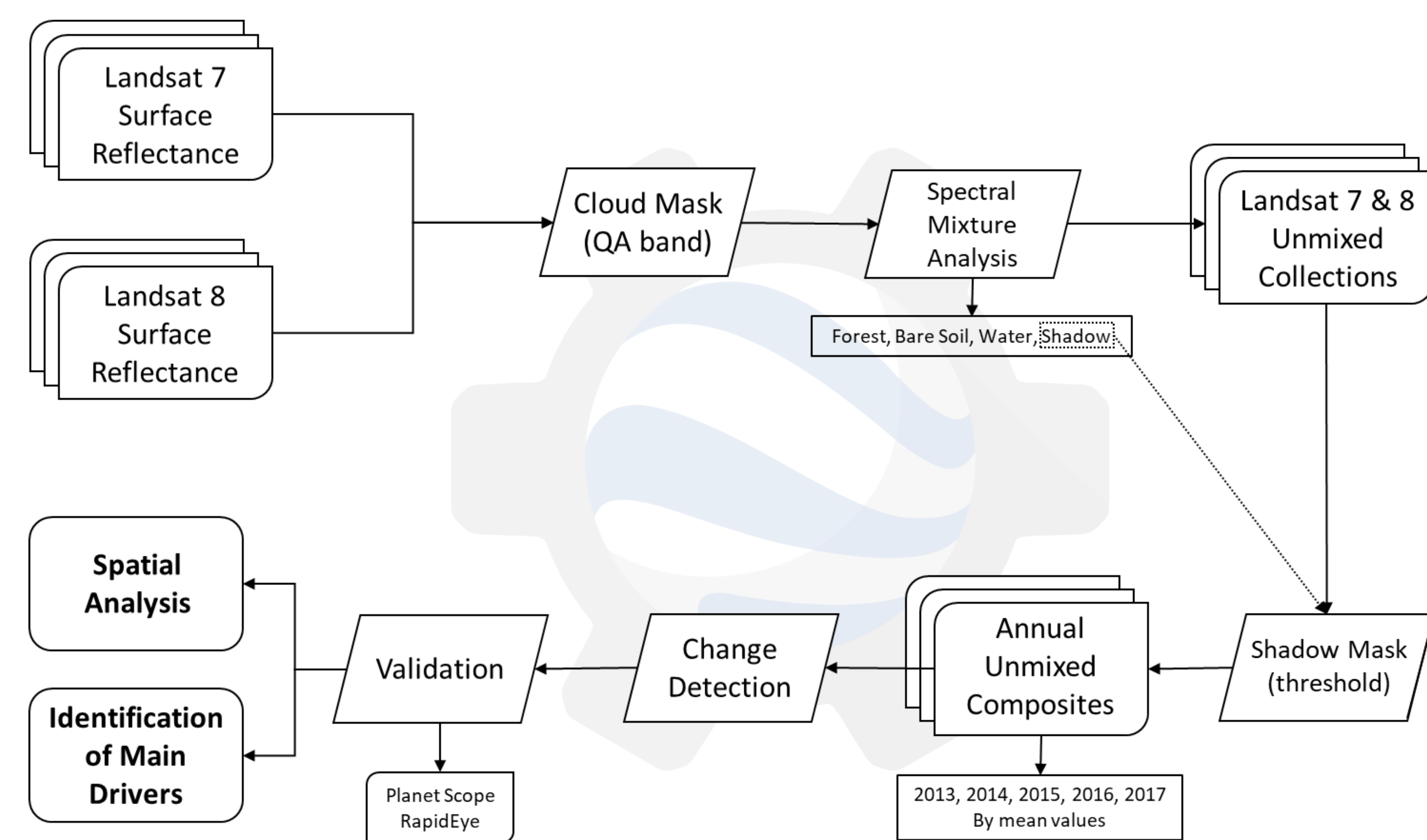
## Datasets

Data – Shapefile	Source	Last updated
Mining Concessions	INGEMMET	06/19/2018
National Protected Areas (NPA)	SERNANP	02/08/2018
NPA Buffer Zones	SERNANP	06/11/2018
Indigenous Communities	Amazonia Socio Ambiental/IBC	12/2015
Reforestation Concessions	SERFOR	11/13/2017
Departments Boundaries	MINAM	-
Legal Mining Zone	MINEM	-

## 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 main drivers of forest loss and explain how they relate with land use dynamics

## Methodology



### ► Spectral Mixture Analysis

We defined forest, bare soil, water and shadow as endmembers and applied the spectral unmixing algorithm embedded in Google Earth Engine

### ► Change Detection

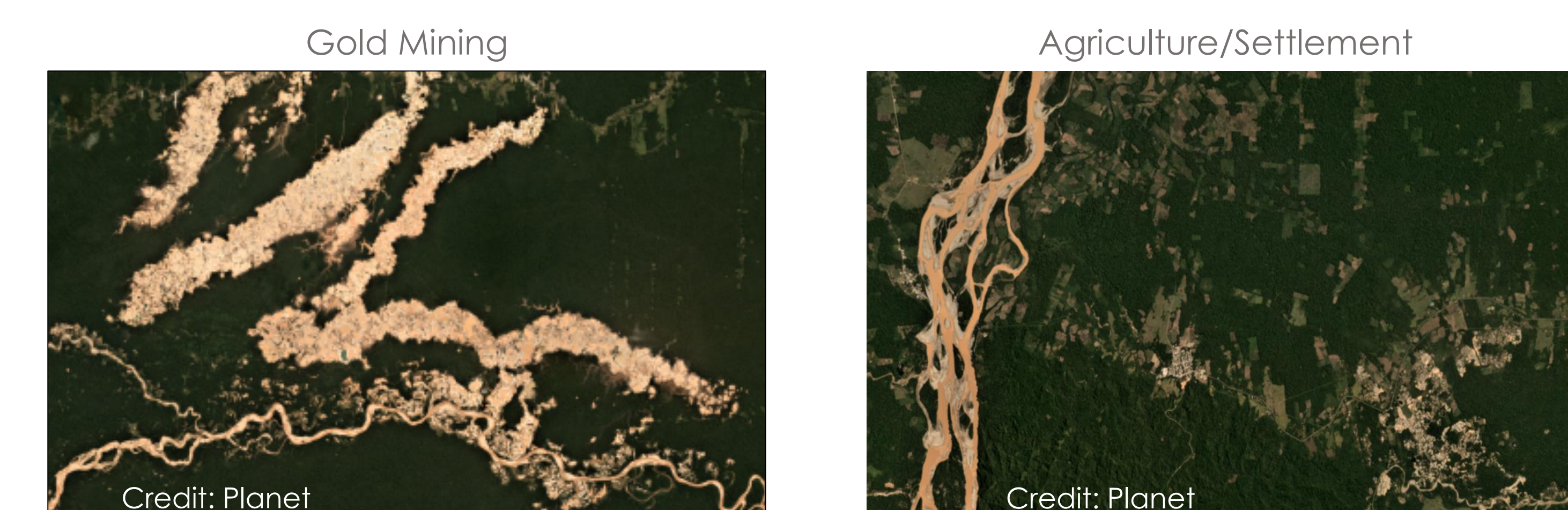
Forest loss is indicated by a decrease in 50% of the forest fraction between a post composite and a pre composite

### ► Validation and Accuracy Assessment

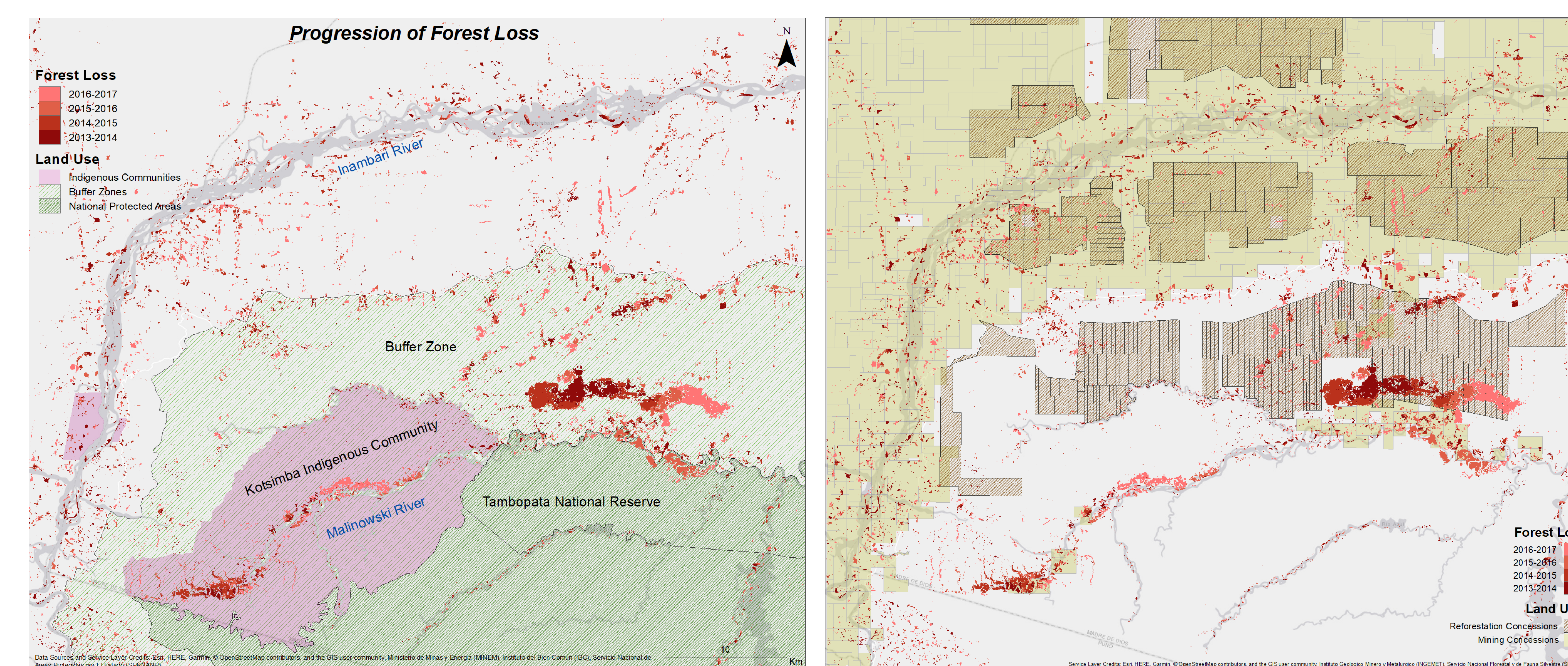
For 2013, 20 scenes with 5-m resolution from RapidEye-1, RapidEye-2, RapidEye-3, and RapidEye-5 were utilized, and for 2017, 41 scenes with 3-m resolution from Planet Scope were utilized

A stratified sampling design with 1008 randomly generated points and proportional allocation was used according to Olofsson et al. (2014) guidelines

## High Resolution Imagery



## Results & Discussion



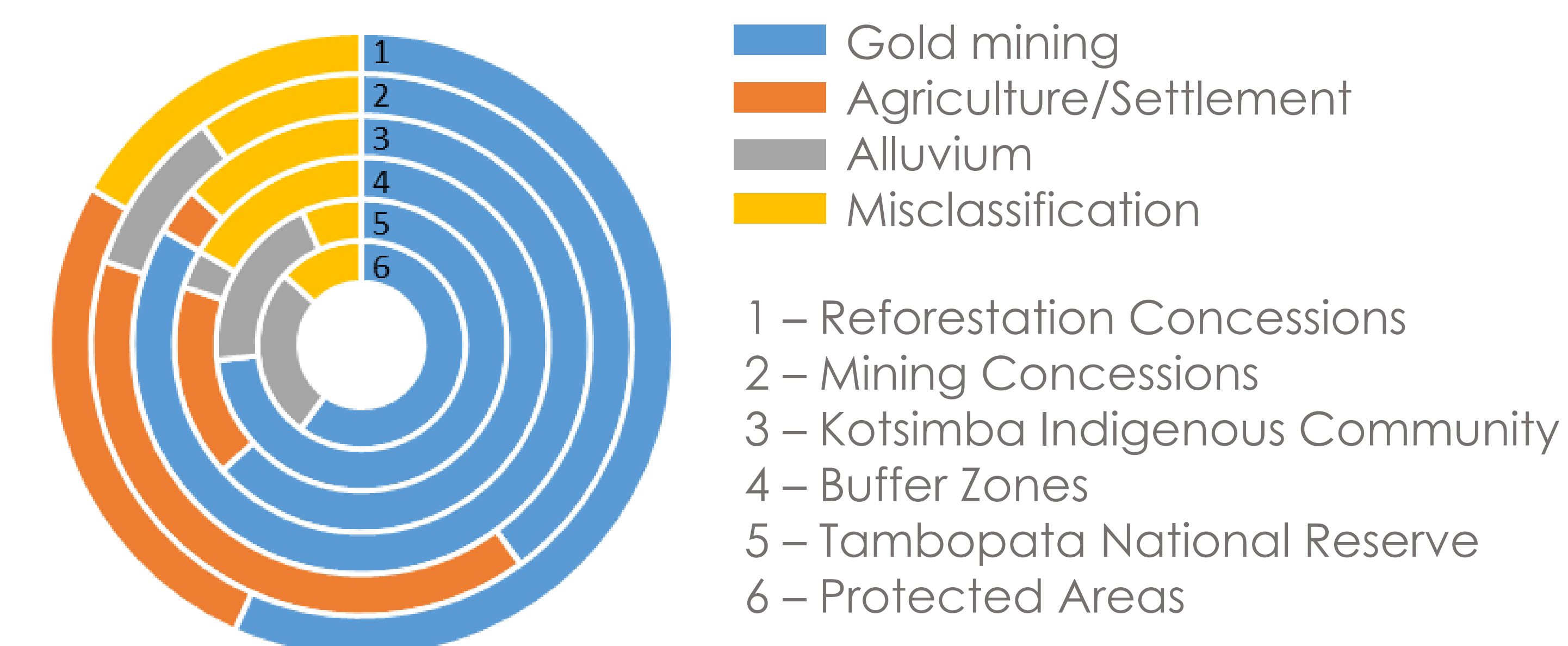
Temporally and extensive forest loss progression can be observed, with concentrations revealed along the Malinowski River, within the Kotsimba community, on the northern border of the Tambopata National Reserve, and within the buffer zone of the protected areas. Many possible small-scale mining sites are located alongside the Inambari river

## Extent and Rates (ha)

Features	2013-2014	2014-2015	2015-2016	2016-2017	Average Rate	Total
Reforestation Concessions	757	548	629	1244	795	3178
•Reforestation - Mining Concessions	730	396	314	653	523	2093
•Overlapping Mining + Reforestation	514	233	234	104	271	1085
Mining Concessions	1538	1572	1314	1760	1546	6184
•Outside Mining Concessions	1670	1386	1515	2086	1664	6657
Kotsimba Indigenous Community	217	382	302	491	348	1392
Buffer Zones	1733	1706	1425	2183	1762	7047
Tambopata National Reserve	89	21	380	124	154	614
•Protected Areas	151	58	430	169	202	808
Study Area	3207	2958	2830	3846	3210	12841

The average rate of forest loss in the study area between 2013 and 2017 is 3210 ha/yr. Our results also suggest that approximately 52% of the forest loss lies outside the mining permits' locations

## Potential Drivers



## Accuracy Assessment

- Overall Accuracy: 95%
- Producer's Accuracy
  - Forest Loss: 78%
  - No Forest Loss: 97%
- User's Accuracy
  - Forest Loss: 74%
  - No Forest Loss: 98%

## Conclusions

- Forest loss expansion continues to prevail in this region, threatening protected areas like the Tambopata National Reserve and the Indigenous Community of Kotsimba
- 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

