

The New Manú:

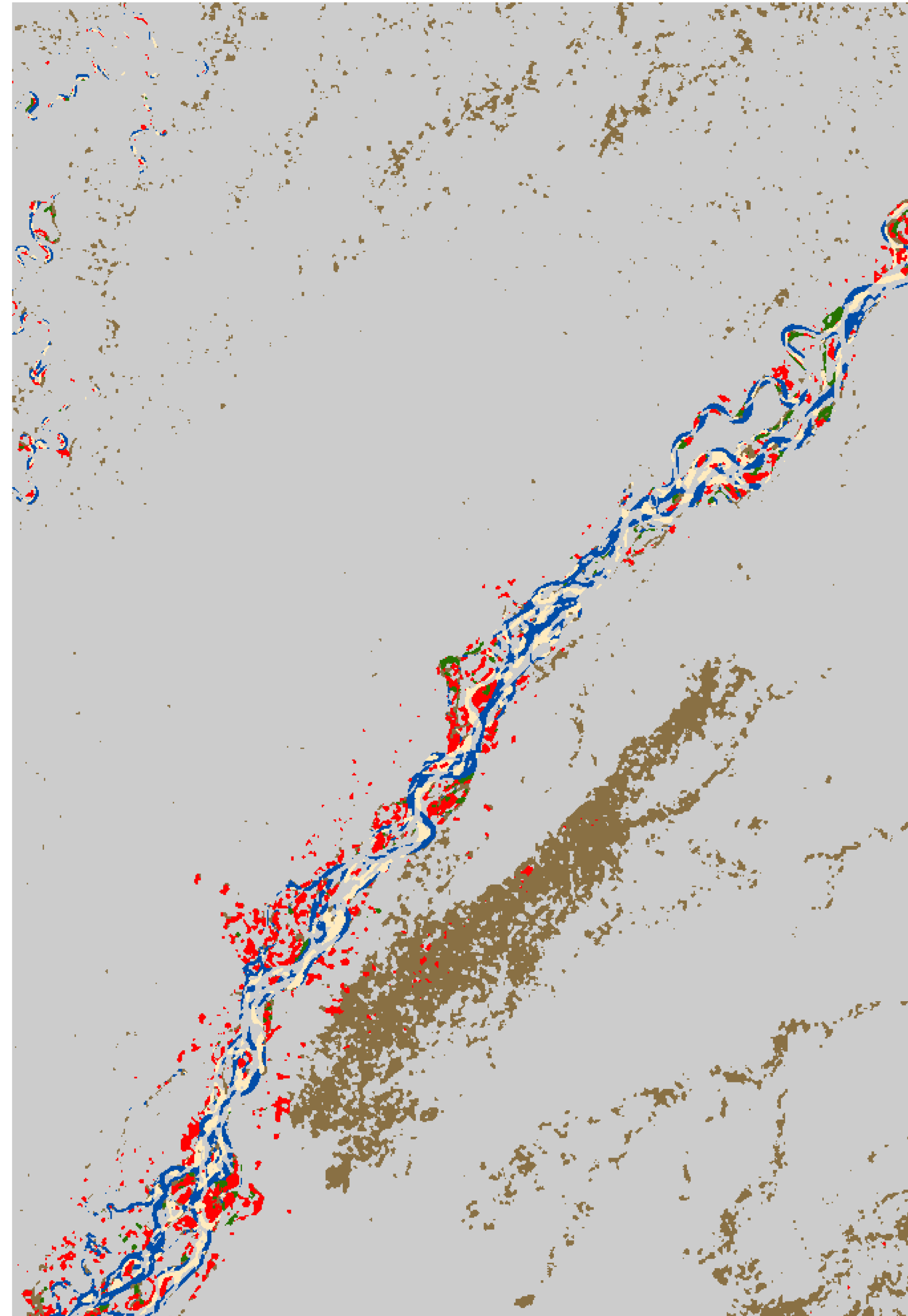
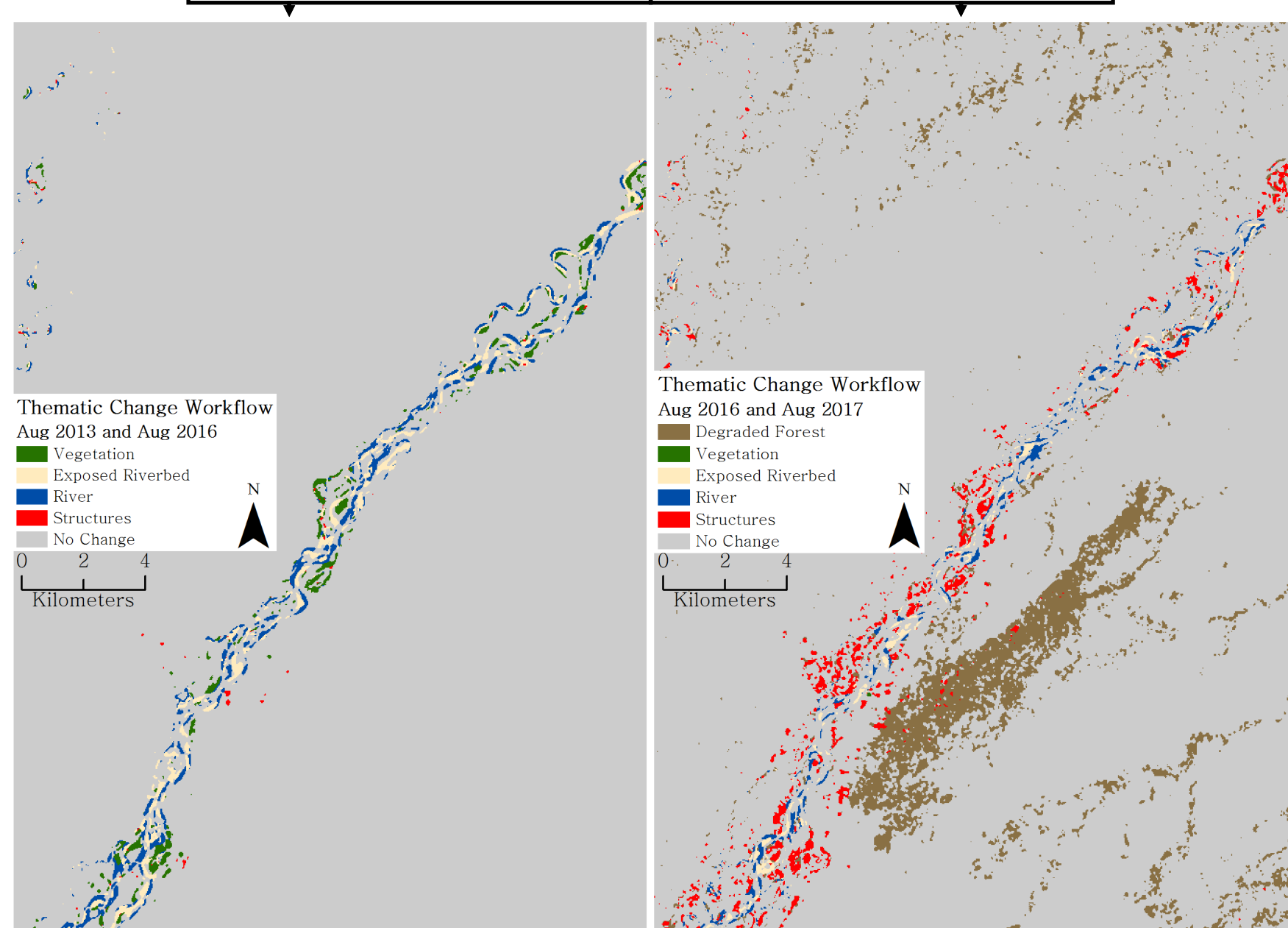
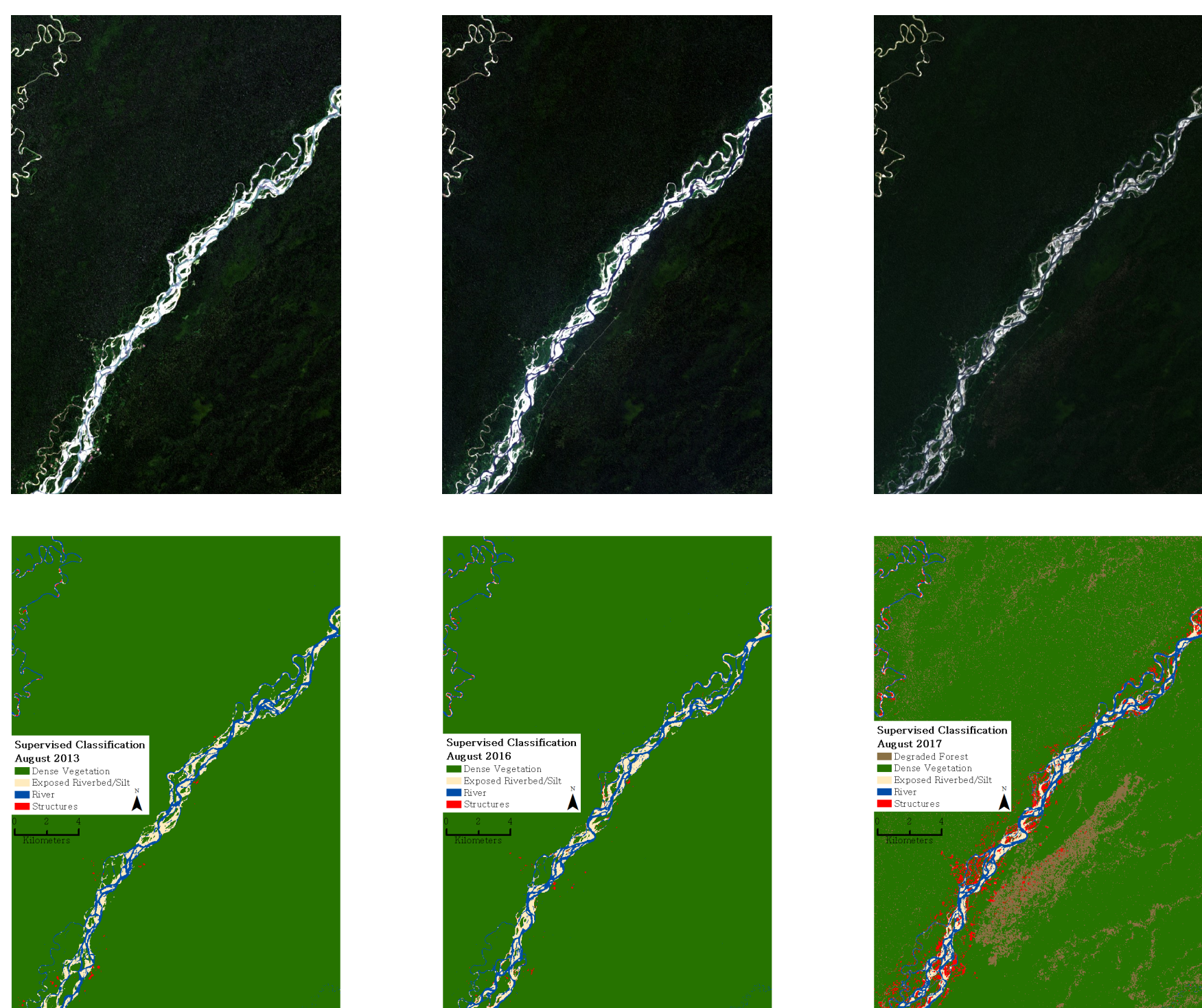
A Glimpse of Deforestation Along the Edge of Manú National Park

INTRODUCTION

Peru, located in South America, is characterized by three topographic areas: the Amazon basin, the Andes, and the coastal plain. The Amazonia makes up approximately three-fifths of Peru and is further characterized by dense cloud forest and jungle. It provides important ecosystem services including regulation of river and fresh waterflows, reduces soil erosion, carbon sequestration, and it provides forest goods such as timber, various foods, and textile materials. Manú National Park, located in the regions of Cusco and Madre de Dios, is recognized as a United Nations Educational, Scientific, and Cultural Organization (UNESCO) World Heritage Site. Measuring approximately 17,163 km², the park encompasses the Manu River watershed and includes large areas of rainforest. It is inhabited by numerous indigenous groups, which are in remote settlements or remain uncontacted, and is a biodiversity hotspot. A biodiversity hotspot is an area that has significant levels of biodiversity and that is potentially under some threat of destruction.



The Peruvian economy, which relies on exportation industries of various materials, exhibited an average yearly growth of 5.6% between 2009 and 2013. This was primarily due to the exportation of metals and minerals such as silver, gold, copper, and bismuth, accounting for 55% of total exports. It is currently the world's fifth producer of gold, third of copper, and the top producer of silver. Other industries include timber, textiles and agricultural products. As development in the Peruvian Amazon continues to increase, environmental degradation is eminent. A region that has some of the highest biodiversity on the planet, habitat loss is a significant threat to rainforest ecosystems in Peru. Additionally, thousands of indigenous people who rely on the natural resources of the rainforest for their survival are also at risk. Illegal operations, gold mining, logging, oil exploration, and agricultural expansion have jeopardized the health of indigenous people and local wildlife through pollution and exposure to disease. Unfortunately, although it is illegal to exploit protected areas it is not strictly enforced and it is difficult to judge the extent of deforestation or degradation. Thus, this remote sensing project aims to assess forest degradation along the border of Manú National Park.



Thematic Change Workflow
Aug 2013 and Aug 2017

- Degraded Forest
- Vegetation
- Exposed Riverbed
- River
- Structures
- No Change

SUPERVISED CLASSIFICATION

Supervised Classification and Thematic Change Workflow
The Minimum Distance supervised classification technique was selected for land-cover classification in this analysis because it demonstrated the greatest accuracy for all three dates. ROIs were manually selected in all three images as training sites. Three change detection analyses were performed between the three images using Thematic Change Workflow, producing the final output of the extent of forest loss from 2013—2017.

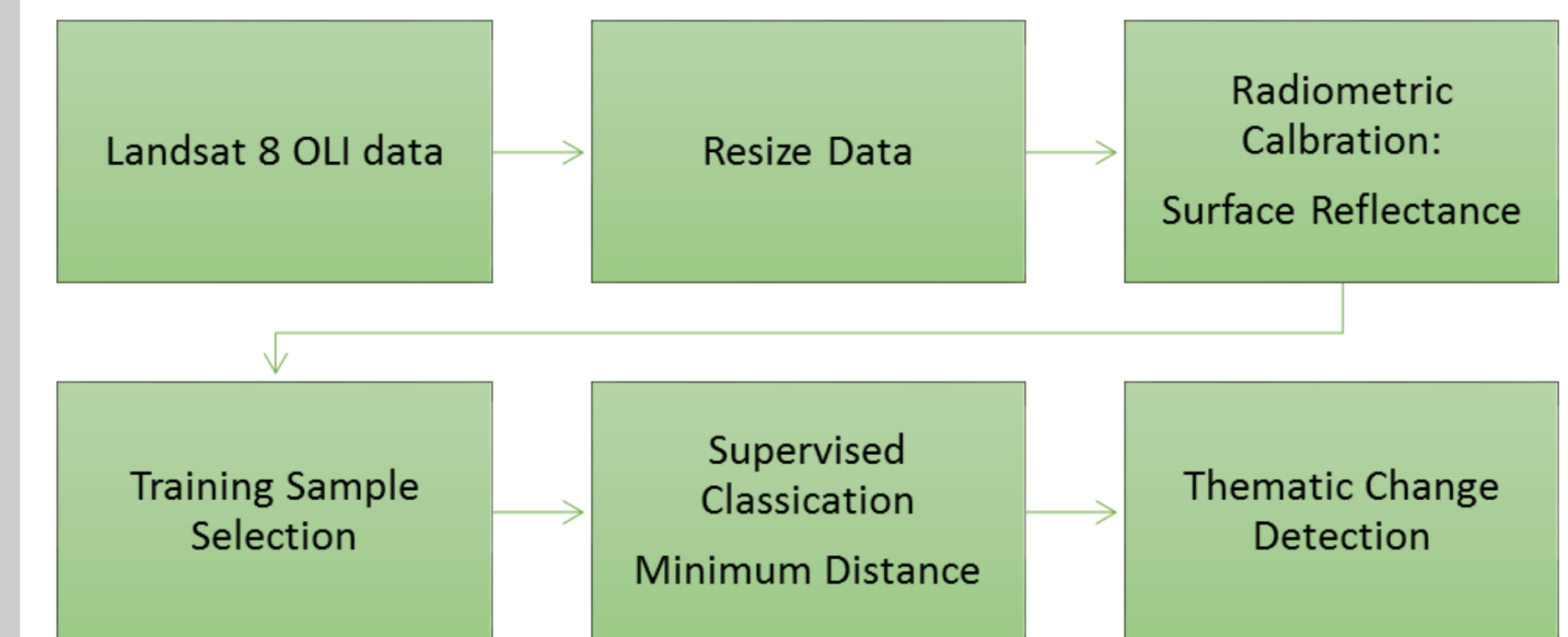
Between August 2013 and August 2016, 97.4% of the study area remained unchanged. The largest land cover change occurred from three classes – structures, vegetation, and exposed riverbed – to river at 5.96 km². There was also an increase of approximately 0.33 km² of change to human structures. However, there was little evidence of deforestation. In comparison, the change detection analysis between August 2016 and August 2017 showed a greater rate of forest loss, with approximately 92.3% remaining unchanged. Between 2016 and 2017, 5.5 % of the forest in the study site was degraded, measuring approximately 33.56 km².

Land Cover in August 2017

Land Cover Type	Area (km ²)	Percent
Degraded Forest	33.89	5.56 %
Vegetation	540.64	88.75 %
Structures	8.35	1.37 %
River	16.69	2.74 %
Exposed Riverbed	9.59	1.57 %

METHODOLOGY

A study site adjacent to the border of Manú National Park in was selected to analyze forest change (shown in red to the left). The study site measured 609.17 km² and was located on the south eastern border of Manú National Park near the Madre de Dios river. Landsat 8 Operational Land Imager (OLI) data were selected for this analysis because they are provided freely by the United States Geological Survey (USGS) and have a high spatial



resolution of 30 m x 30 m. Three annual images from 2013 to 2017 were downloaded from the USGS website for the analysis (path/row: 4/68). The OLI images selected were cloud-free over the study area and collected during the dry season of the south eastern Peruvian Amazon in the month of August. Images were processed using ENVI 5.4 + IDL 8.6 and designed using ArcMap 10.5.1.

All data images were resized to the study area. A spatial subset was created by drawing a polygon over the study area to generate a region of interest (ROI). The ROI was then used as the image subset to resize all data. Following resizing, the image data were converted to top-of-atmosphere (TOA) reflectance (0 to 1.0) with the Radiometric Calibration tool to prepare the data for supervised classification.

CONCLUSION

Although there is evidence of deforestation between 2013 and 2016, it is evident from this analysis that the majority of the change occurred within a year's time between 2016 and 2017. The total loss of forest is equal to three times the area of Somerville, Massachusetts and is in a small area of 609.17 km². Manú National Park is 17,163 km², and although it is a protected area, the restrictions are not enforced. If the results of this data are extrapolated to the remaining area of Manú National Park, with a pattern of 32.8 km² of forest lost within an area of 609.17 km² in a year, it is possible that there was 946.66 km² of forest lost along the borders of or within Manú National Park. Deforestation at that scale has great implications for the biodiversity of the area, and the livelihoods and health of indigenous communities. It is important for further analysis to be conducted to better understand the rate of deforestation in the Peruvian Amazon.

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