

Planet Action Report Summary for Sudan / Imatong Mountains Project

Summary

This project uses satellite data to provide insight into the consequences of conflict and post-conflict population migration on land cover/land use, fire dynamics, and biodiversity. In the Imatong Mountains of southern Sudan, the end of hostilities associated with civil war has caused significant demographic change, resulting in heightened tensions between competing groups as well as increased pressure on the environment. Human encroachment and the frequent use of fire now pose major threats to the long-term ability of the region's ecosystems to simultaneously support local livelihoods and conserve natural resources. For this study, multi-resolution remote sensing data is being integrated with information on human factors within a modeling framework to understand how changes in human population pressure are modifying the local fire regime and land cover. The study will also model the future extent of forest habitat under different scenarios and assess potential impacts on biodiversity in a historically inaccessible and conflict-prone region.

Introduction (general rating of the project advancement)

This project has advanced according to schedule. Satellite imagery provided through the Planet Action program have been used in conjunction with other data to create preliminary results in the form of land cover and change detection maps, and to begin to explore the impact of human activity on the natural landscape. Fieldwork for this project began in early 2009 with aerial and ground surveys and is ongoing. A final report was prepared with and for the Government of South Sudan in December 2009 and current efforts are using information about fire activity to better understand the drivers of land cover change both in Southern Sudan and Northern Uganda.

Overall Project Goals

Specific research questions to be addressed through this project are as follows:

- How have human activities impacted forest cover found in the study region, both during and immediately following the most recent conflict?
- How have demographic shifts during the conflict and post-conflict period affected the fire regime, and what do these changes reveal about human activity during this time?
- How do observed changes in land cover and land use impact biodiversity and what are the implications for conservation?

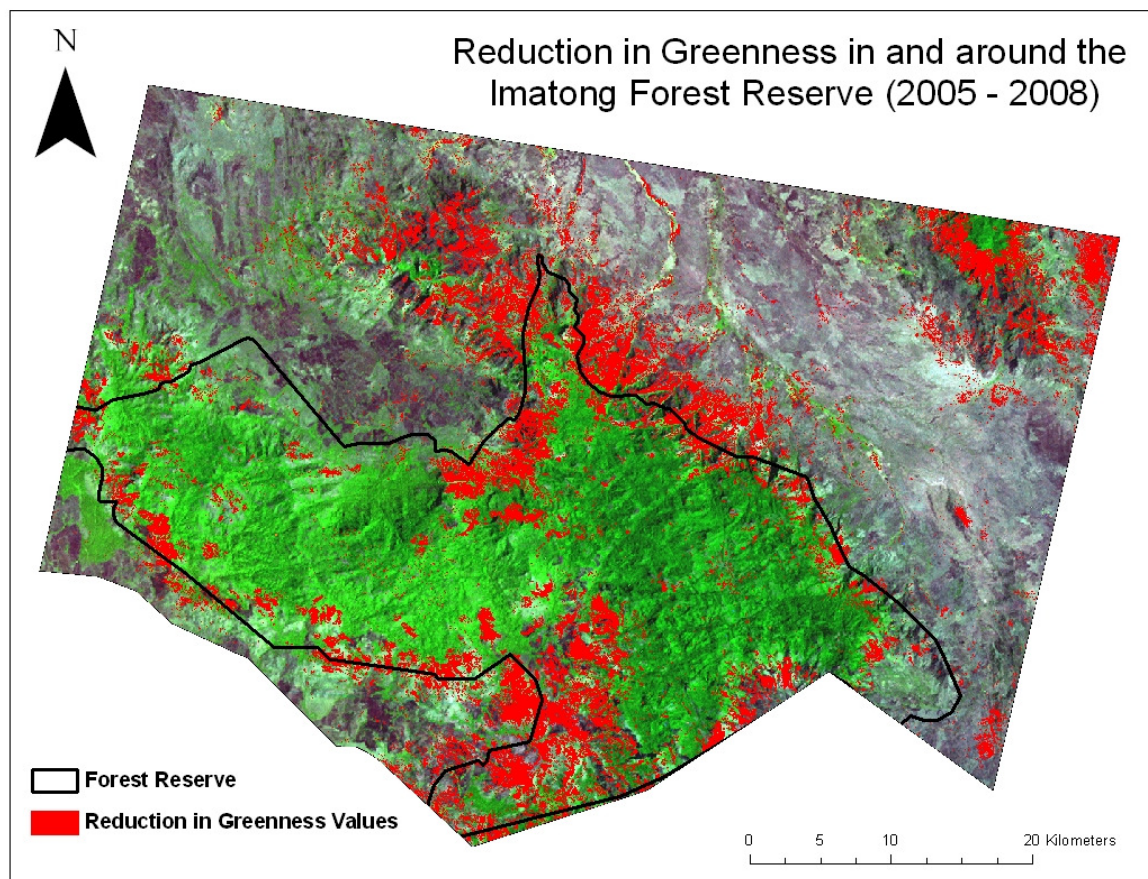
From a practical perspective, results from this project are being used to produce a land use plan for the Imatong Central Forest Reserve that integrates different types of land uses based on the needs of commercial plantations, community requirements, and conservation priorities. This plan will be developed by WCS with in-country partners including the Ministry of Wildlife Conservation and Tourism and the Ministry of Agriculture and Forestry of the Government of Southern Sudan as part of a broader initiative to assess the status of wildlife resources and protected areas including forest reserves in post-conflict Southern Sudan.

Satellite Image Analysis and Findings

Through the Planet Action Program, two SPOT 20 m satellite images were acquired and processed for January 2005 and February 2008 (Level 3A full scene 20m XI, scene ID: 41283420501070835311I0 and Level 3A full scene 20m XI, scene ID: 41283420802250829452I0, respectively).

In order to address RQ1 (the impact of human activities during and after war on changes in forest cover), the 2005 and 2008 SPOT images were preprocessed and then compared to detect changes in forest cover believed to result primarily from human encroachment during this period. A direct change detection method was employed in order to avoid compounding error, which can occur when separately comparing two classified images. This method involved first converting the calibrated 2005 and 2008 datasets into normalized difference vegetation index (NDVI) images in order to highlight changes in live green vegetation. A Principal Components Analysis (PCA) was then performed on the 2005 and 2008 stacked images and compared with the NDVI results to highlight areas of change. A threshold for forest loss was developed based on PC band 8 (which most closely matched the areas of change detected by the NDVI analysis) and exported to a GIS to highlight reduction in vegetation during this period. Red areas in figure one below depict those regions of vegetation loss. Discussions with local residents during a field visit in early 2009 appear to corroborate these findings, though additional work is needed to confirm the accuracy of this assessment.

Figure 1



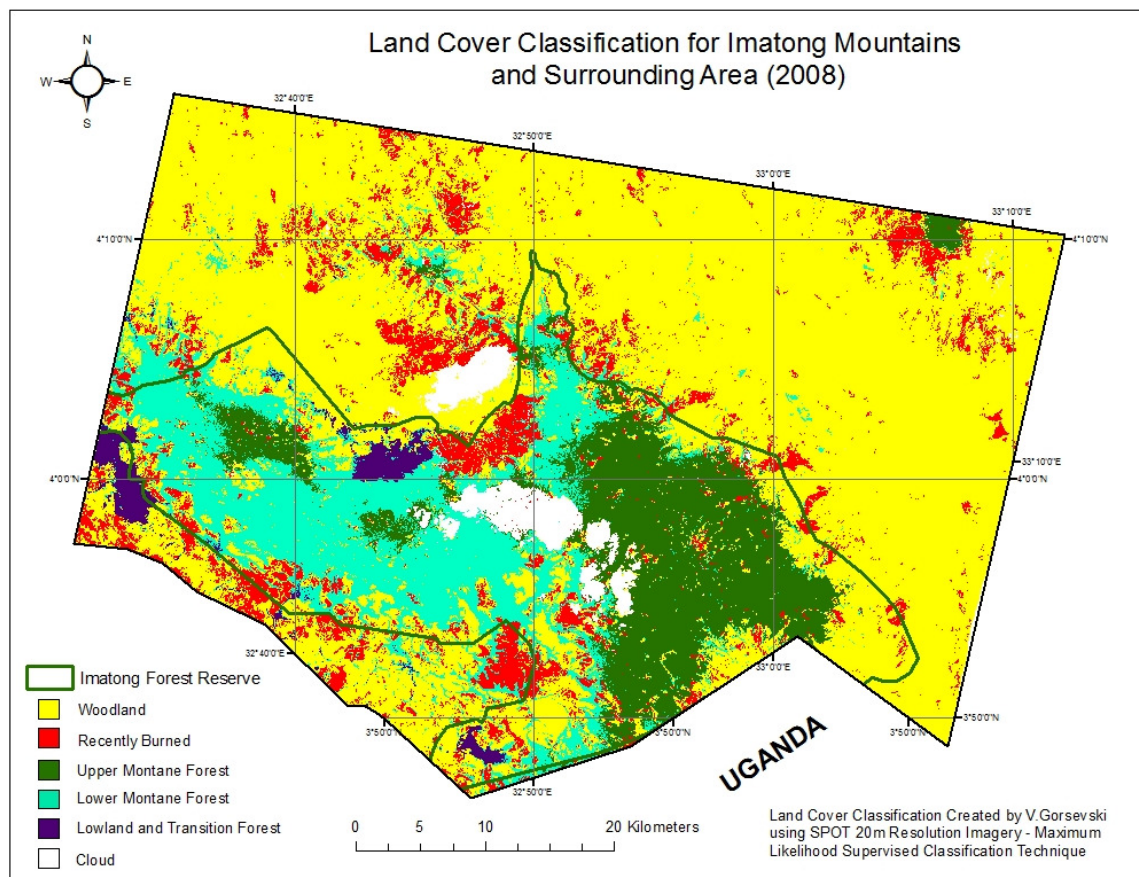
Forest loss due to intentional felling around the Dongotana Hills (upper right-hand corner of the SPOT image) is confirmed by aerial photographs (figure 2) taken of this area in January 2009.

Figure 2



SPOT imagery combined with aerial photographs was used to create a land cover map for 2008. A supervised classification using the maximum likelihood algorithm resulted figure 3 with the following land cover categories: woodland, recently burned, upper montane forest, lower montane forest, lowland and transition forest, and cloud/cloud shadow.

Figure 3



Activities Undertaken

In addition to the acquisition of aerial photographs in January 2009, a 2-week field expedition took place in March/April of the same year to gather additional data on vegetation and wildlife. Natural surveys established benchmark sites for monitoring vegetation dynamics over time and assessed the population structure of forest tree species contained in these sites. As a result of this initial work, management recommendations have been proposed for conserving different vegetation types. Terrestrial surveys of wildlife were also conducted to assess the distribution of large bodied wildlife species within the Imatong massif and to identify important habitats and forest blocks for wildlife conservation. Among other things, the surveys confirmed the presence of two important population of duiker.

Challenges or Difficulties Encountered

Major challenges that have arisen with respect to the project include (1) the general inaccessibility of the area due to decades of conflict, (2) lack of cloud free imagery, (3) fear of war and lack of capacity of local population, and (4) lack of socio-economic data to help explain observed changes in land cover and land use.

What is Next?

Next steps include finalizing the fire analysis, including linking observed changes to socio-economic data on population movements and war/peace time activities and modeling the potential impacts of land cover change on biodiversity given a variety of scenarios.

Conclusion

In general, this project is on track. Numerous recommendations have been made and are being considered by the GOSS. Additional analysis will help to move these discussions forward.