Monitoring gold mining extraction in Suriname using Global Forest Watch data sources

Suriname is one of the smallest and least known countries in South America. A former Dutch colony, most of the historical development within the country took place along the coastal shoreline. By the time the Dutch officially left Suriname in 1975, the densely forested interior was left in near pristine condition. Suriname currently has over 90% forest cover, which makes it one of the most forested countries in the world. The rainforests of Suriname are located within the Guiana Shield ecosystem, home to high levels of biodiversity as well as cultural diversity.

Suriname’s rainforests are currently being impacted by several environmental threats. The most disconcerting of these are industrial and small-scale gold mining. Gold mining poses an increasing threat to tropical ecosystems across South America (Alvarez-Berríos and Aide 2015) and is considered to be the fastest growing cause of forest loss in the Guianas (WWF 2012). Most of the small-scale gold extraction in Suriname utilizes mercury, which is highly toxic and can linger in the ecosystem for disconcertingly long periods of time (Ouboter 2012). Industrial gold-mining, by contrast, uses cyanide which is better contained but still poses considerable spillage risks. The majority of the gold mining activity is taking place in the country’s mineral-rich greenstone belt, a region covering approximately 15% of Suriname’s landmass. This region is home to several indigenous and maroon groups, whose livelihoods risk being negatively affected by proximate gold-mining activity.

![Google Earth screenshot of gold mining activity around the Saramacca River, inhabited by the Matowai people.](image)

The [Amazon Conservation Team](https://www.amazonconservation.org) (ACT) is in the beginning stages of implementing a long-term project to use remote sensing technologies for monitoring and analyzing gold-mining activity across the country. Our eventual goal is to generate exceptionally accurate and time-sensitive spatial data for all mining activity across the Guianas. We will use this data to communicate the seriousness of the threat that
these activities pose for the ecosystem services accessed by our indigenous and maroon partners in the interior.

For the first phase of this project, we opted to utilize two of the data sources made available by Global Forest Watch: (1) Terra-i’s anthropogenic deforestation dataset (2003-2013)\(^1\) and (2) Global Forest Change (2000-2012) from the University of Maryland. Terra-i analyzes MODIS imagery to produce data on land-cover changes resulting from human activity. The Global Forest Change data from the University of Maryland shows global forest extent and was produced through classification analysis of LANDSAT imagery. Yearly forest loss data, as well as composite images for 2000 and 2012 are provided in this dataset (hereafter referred to as ‘UMD’). Down the road, we are planning to develop our own forest loss imagery specifically classified for gold-mining, but these sources can be used to generate a measurable and reasonably comprehensive data set of where mining activity is taking place across the country.

To isolate the gold-mining activity from other types of land cover change, some processing was needed for both data sources. We first drew polygons around all identified gold-mining areas, which were known to us through prior knowledge, ground truth, or by discovering these on satellite imagery. We then clipped out the Terra-i and UMD forest cover loss data (2000-2012) located within these polygons. For the UMD data, we opted to take the additional step of classifying the 2000 and 2012 forest cover maps, using supervised classification. This allowed us to include bare land areas caused by gold mining prior to 2000, which are not captured by either Terra-i detections or the UMD yearly forest loss data. This data was then smoothened for visualization. The final product can be seen in figure 1, where the close similarity of the two data sets can be appreciated.

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\(^1\) Terra-i actually distributes new land cover change data every 16 days, but having started this project in mid-2014, we decided to stick with the latest full calendar year.
Both datasets allow us to measure the actual extent of gold mining activity. The Terra-i data has a spatial resolution of 250m² per point and can be quantified on a yearly basis. The UMD data is based on 30m LANDSAT imagery, and can therefore be measured using GIS spatial calculator tools as well.

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<tbody>
<tr>
<td><strong>Terra-i (2003-2013)</strong></td>
<td>46,153 hectares</td>
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<td><strong>UMD lossyear (2000-2012)</strong></td>
<td>27,229 hectares</td>
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<tr>
<td><strong>UMD 2000 composite</strong></td>
<td>5,253 hectares</td>
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<tr>
<td><strong>UMD 2012 composite</strong></td>
<td>31,342 hectares</td>
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<td><strong>UMD lossyear and UMD 2012 composite combined</strong></td>
<td>38,720 hectares</td>
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Table 1. Total hectares of gold-mining included forest cover loss for each data set. UMD lossyear refers to the yearly forest data (2000-2012) provided by UMD, whereas UMD 2000 and UMD 2012 are the composite forest maps for those years. We opted to combine the UMD lossyear and 2012 composite data to include areas in the gold mining zones that were missed by the supervised classification process.

In 2012, WWF Guianas reported a total of 27,273 hectares of deforestation as a result of gold mining in 2007, as observed by satellite monitoring (WWF Guianas 2012, 44). As seen in table 1, both Terra-i and UMD data sets are showing a significant, worrisome increase in deforestation from that figure from
2007 (69% and 42%, respectively). Figure 2 shows the UMD composite data to visualize the expansion of gold mining from 2000 to 2012 in one of the hotspot areas in Suriname.

![Figure 2. UMD classified data from 2000 (orange) and 2012 (red), in one of the hotspot mining areas encompassing (a) the Rosebel industrial mines operated by IAMGOLD, (b) small-scale gold mining in and around the Brownsberg Nature Park, and (c) small-scale gold mining around the Saramacca river.](image)

Both data sets have their advantages as well as limitations. Terra-i’s great strength resides in being able to provide updated data every 16 days. The Terra-i detection data is therefore ideally suited for timely assessment of where gold mining activity took place within a specified time period, or where it is currently expanding. However, Terra-i is limited in temporal scope since it is only available from 2003 onwards, so any gold mining activity taking place prior to 2003 is not included. The classified UMD data, by contrast, is able to document this historical mining activity, because gold mining sites tend to stay bare for decades after the mining activity has ceased. For this reason, the UMD data can be used to generate a more historically comprehensive measurement of gold-mining induced forest cover loss to date. Additionally, the UMD yearly forest cover loss data provides an annual breakdown as well.
Figure 3. Terra-i gold mining data (green) overlaid on top of the UMD classified data (red) and Bing Maps imagery, nearby the Saramacca river and the Matawai village of Jacobkondre, visible in the center-left of this image. Click to enlarge.

Figure 3 illustrates both of these points. Here, the Terra-i data is overlaid on top of the classified UMD data along with Bing maps imagery for one of the major mining areas in the Saramacca river watershed. In this image, the northwest and southeast expansion of the site is visible via the Terra-i data. These points located outside of the UMD site boundaries were confirmed to be from 2013. Additionally, it is also possible to see how large areas of the UMD site are not being picked up by Terra-i. These are bare land sites left over from mining activity taking place prior to 2003, accurately represented within the classified UMD data.

Together, both of these data sets demonstrate the seriousness of the threat that gold-mining activity poses to regional ecosystem services, and underscores the point that gold mining is one of the most significant drivers of forest cover loss in Suriname. ACT plans to use this data in the making of environmental pressure maps and participatory land use maps showing the incursion of mining into tribal lands, as well as for mercury level testing performed by the Indigenous Park Guards sponsored by the organization.
References

