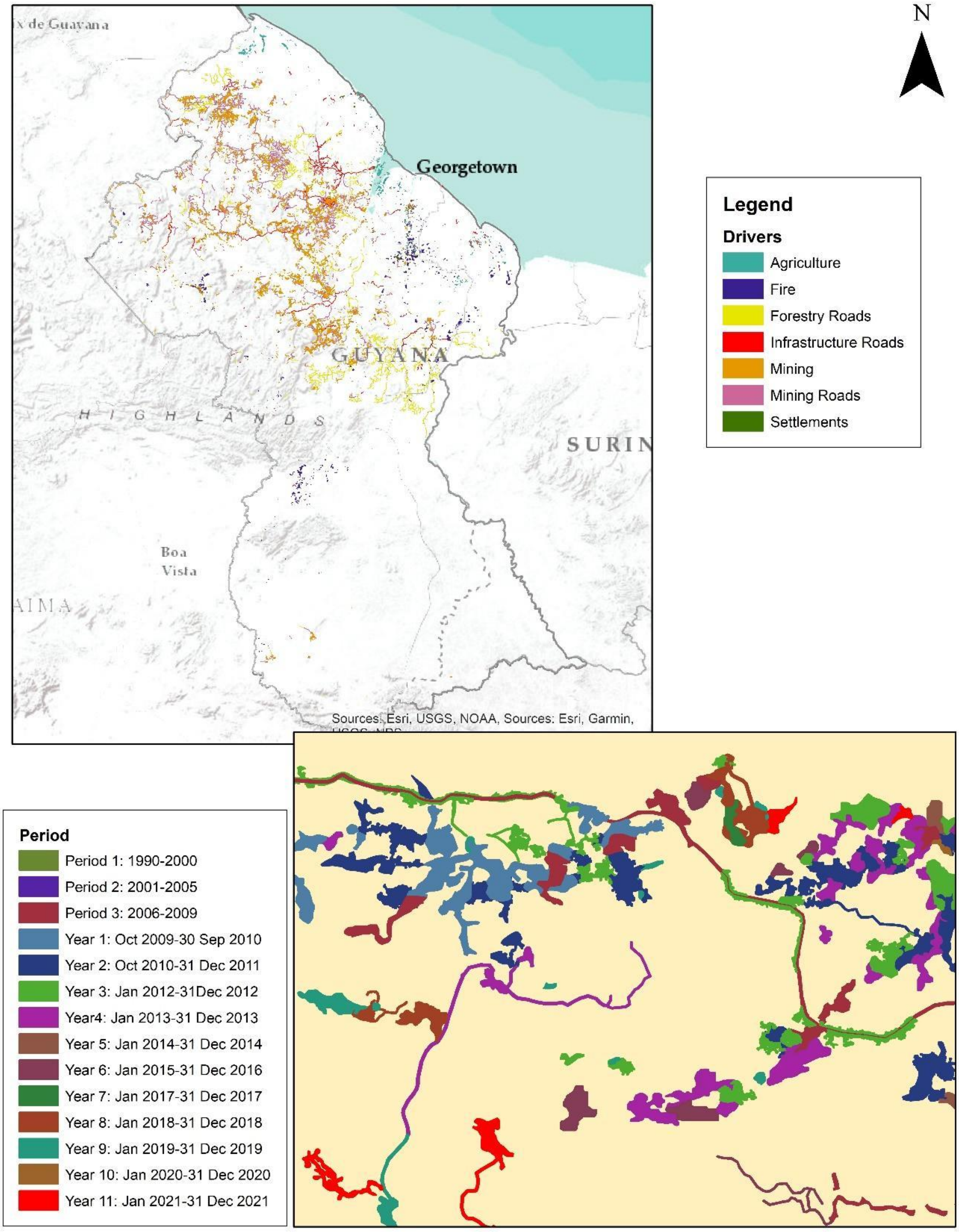
Guyana REDD+ Monitoring Reporting & Verification System (MRVS)

MRVS Report – Assessment Year 2021



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DISCLAIMER

The Guyana Forestry Commission (GFC) makes its best effort to provide accurate and complete information while executing the assignment. GFC assumes no liability or responsibility for any outcome of the Report.

PREFACE

Guyana commenced the implementation of Assessment Year 2021 of the MRVS with continued support from the Government of Norway. This support is a successor to Phase 1 and 2 of the MRVS under the climate and forest partnership between the Government of Guyana and the Government of the Kingdom of Norway that was initiated in 2009.

The Year 2021 covers the period January 1 to December 31, 2021 and demonstrates the continued support to the establishment and long-term sustainability of a world-class MRVS, as a key component of Guyana's national REDD+ programme. The system has further expanded the basis for verifiably measuring changes in Guyana's forest cover and resultant carbon emissions from these forests as an underpinning for results-based REDD+ compensation in the long term.

It is essential that the MRVS is seen as a continuous learning process that is progressively improved. This is particularly relevant as the MRV matures and forest change trends are better understood.

Critically, the results generated from the MRVS have potential applications to a range of functions relating to policy setting and decision-making within the natural resources sector and in particular, to forest management. Guyana's MRVS has, over the past eleven years, generated a wealth of data that can be used to understand the multiple uses of forests.

As started in Year 2018, reporting is based on full forest carbon emissions and removals by drivers of deforestation and forest degradation.

In 2009 Guyana developed a framework for a national MRVS. This framework was created as a "Roadmap[1]" that outlines progressive steps over a 3-year period that would build towards a full MRVS being implemented. The MRVS aims to establish a comprehensive, national system to monitor, report and verify forest carbon emissions resulting from deforestation and forest degradation in Guyana. The first year of the roadmap commencement was 2010, which required several initial reporting activities to commence. These were designed to assist in shaping the next steps planned for the following years. In 2014, a Phase 2 Roadmap was developed for the MRVS. The overall objective of the Roadmap Phase 2 sought to consolidate and expand capacities for national REDD+ monitoring and MRV. This supported Guyana in meeting the evolving international reporting requirements from the UNFCCC while continuing to fulfil additional reporting requirements. In 2020, Guyana developed its Phase 3 Roadmap. This charted the path forward for the next phase of the MRVS to a fully operational forest carbon reporting platform, suitable for a potential market-based mechanism and meeting all UNFCCC recommendations.

To date, eleven national assessments (2010 to 2021) have been conducted, including the one detailed in this Report.

These Reports are issued by the Guyana Forestry Commission (GFC). Indufor Asia Pacific has provided support and advice as directed by the GFC.

Guyana Forestry Commission

[1] http://www.forestry.gov.gy/Downloads/Guyana_MRV_workshop_report_Nov09.pdf

SUMMARY

In 2020, the Monitoring Reporting and Verification System (MRVS) moved into its third phase in line with tasks set out in the MRVS Road Map. This document outlines the stepwise progression and development of the MRVS for the next five years 2020 – 2024.

In Year 8 (2018), the GFC reported total forest carbon emissions and removals, focusing on reporting emissions. This move was part of the continuous improvement of the system, allowing the GFC to move from the Interim Indicators used, and progressively to full emissions reporting. The reference measures and the interim performance indicators were to be applied while aspects of the MRVS were under development and were to eventually be phased out and replaced by a complete forest carbon accounting system as methodologies are further developed. Year 8 has placed Guyana at this stage. In 2020, there was a full move towards full accounting of forest carbon emissions under the MRVS and this has continued in 2021.

For reference, the ongoing comparison of performance for the area-based interim indicators is against the values reported in the 2009 "Benchmark Map[2]". From that point onwards, the reporting periods are numbered sequentially, with Year 1 covering 2009 to 2010. This report presents the findings of the eleventh national assessment, which spanned a twelve-months period, 1 January 2021 to 31 December 2021.

The purpose of the MRVS is to track at a national-level, forest change of deforestation and degradation by change drivers. Deforestation is monitored using a national coverage of satellite imagery. The GFC has sought to incorporate continuous improvements into the MRVS to allow for further efficiencies and sustainability elements to be included. For instance, estimates of degradation resulting from mining and infrastructure are now computed using new methods developed over the years 2018 and 2019. This new method does not necessitate costly high-resolution imagery or aerial surveys to derive these estimates. Further, the procedure for accounting for shifting cultivation was updated; while reporting on timber harvesting and illegal logging has been mainstreamed under full emissions accounting using existing methods. These improvements provide robust measures of both deforestation and degradation that align with Guyana's desire to pursue a low or no-cost REDD+ implementation option – this was an integral part of Phase 2 objective whilst moving toward total emissions accounting.

Deforestation for the period between 1 January 2021 and 31 December 2021 was estimated at 7630 ha. This equates to an annualised deforestation rate of 0.042%, lower than the change reported in the previous year (0.057%). As with previous assessments, the accuracy of GFC's deforestation area has been verified by the Durham University (DU) team using a statistically representative independent sample. The area of deforestation reported by DU closely aligns with the values reported by the GFC (see Appendix 1).

The main deforestation driver for the current forest year reported was alluvial gold mining, which accounted for 89% of the deforestation in this period. Most of the deforestation was observed within the State forest. The temporal analysis of forest changes post-1990 indicated that most of the change was clustered around existing road infrastructure and navigable rivers. The findings of this assessment will assist in designing REDD+ activities that aim to maintain forest cover while enabling continued sustainable development and improved livelihoods for Guyanese.

A summary of the key reporting measures and main results are outlined in Table S1.

[2] Originally the benchmark map was set at February 2009, but due to the lack of cloud-free data the period was extended to September 2009

Table S1 (a): MRVS Results 2021 (Year 11)

Measure Ref.	Reporting Measure on Spatial Indicators	Indicator	Reporting Unit	Adopted Reference Measure (2009)	Year 2021	Difference between the Year 2021 and Reference Measure
1	Deforestation Indicator	Rate of conversion of forest area as compared to the agreed reference level	Rate of change (%)/yr	0.275%	0.042%	0.233%

Table S1 (b): MRVS Results 2021

MRVS Results 2021

Deforestation			
Driver	**Area (ha)**	**EF (t CO2/ha)**	**Emissions (t CO2)**
Mining	6086	1,051	6,398,386
Mining Infrastructure	739	1,051	776,932
Forestry Infrastructure	228	1,051	239,703
Infrastructure	117	1,051	123,005
Agriculture	216	1,110	239,846
Settlements	105	1,051	110,390
Fire	139	1,044	145,162
Shifting Cultivation	393	1,097	431,241
Deforestation Total			**8,464,665**
Degradation			
Driver	**AD (see driver)**	**EF (t CO2/unit AD)**	**Emissions (t CO2)**
Timber Harvest volume (m^3)	547,516	5.32	3,268,521
Skid trail (kmg)	2,070	171.84	
Mining and Infrastructure Degradation (ha)	26,650	8.1	215,865
Degradation Total			**3,484,386**
TOTAL CO_2 EMISSIONS FOR GUYANA FOR 2020 FROM FOREST SECTOR			**11,949,050**

- Reporting on forest carbon removal from REDD+ activities will commence when these activities are initiated.
- Volume of illegal logging is included as part of the timber harvest volume.
- Emission Factors are rounded thus total emission may not directly match.

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ACKNOWLEDGEMENTS

In addition to GFC, several agencies and individuals have assisted in providing inputs into the MRVS programme. GFC and Indufor Asia Pacific would like to acknowledge the support of the Ministry of Natural Resources for its strategic guidance.

The continued support and oversight of the members of the MRVS Steering Committee are also acknowledged.

The GFC team would also like to acknowledge the following entities for their support.

- Guyana Geology and Mines Commission for providing location datasets for mining areas.
- Guyana Lands & Surveys Commission for providing spatial data relating to settlements and agricultural leases.
- Conservation International- Guyana for their role in supporting the implementation of this, as well as other aspects of the Guyana MRVS.
- WWF-Guyana for supporting work on CMRV.
- Winrock International for work on the forest carbon monitoring system.
- Other Partners

GLOSSARY

The following terms and abbreviations are used throughout the report.

AA	Accuracy Assessment
AD	Activity Data
BAU	Business as Usual
CMRV	Community Monitoring Reporting and Verification
CRMS	Continuous Resource Monitoring System
DMC	Disaster Monitoring Constellation
EF	Emission Factors
EPA	Environmental Protection Agency
ESA	European Space Agency
FCMS	Forest Carbon Monitoring System
FCPF	Forest Carbon Partnership Facility
FIRMS	Fire Information for Resource Management System
FRA	Forest Resource Assessment
GFC	Guyana Forestry Commission
GGMC	Guyana Geology and Mines Commission
GIS	Geographic Information System
GLSC	Guyana Lands and Surveys Commission
GOFC GOLD	Global Observation of Forest Cover and Land Dynamics
IFL	Intact Forest Landscape
IPCC	Intergovernmental Panel on Climate Change
JCN	Joint Concept Note
LCDS	Low Carbon Development Strategy
LULUCF	Land Use Land Use Change and Forestry
MNR	Ministry of Natural Resources
MODIS	Moderate Resolution Imaging Spectroradiometer
MRVS	Monitoring Reporting and Verification System
MSI	Multi Spectral Imager
NFMS	National Forest Monitoring System
PAC	Protected Areas Commission
QA/QC	Quality Assurance/Quality Control
REDD+	Reducing Emissions from Deforestation and Forest Degradation Plus
SFA	State Forest Area
SOP	Standard Operating Procedures
UK	United Kingdom
UN REDD	United National Reducing Emissions from Deforestation and Forest Degradation
UNFCCC	United Nations Framework Convention on Climate Change
UoD	University of Durham
UoG	University of Guyana
VCS	Verified Carbon Standard

1. INTRODUCTION

1.1 Country Description

The total land area for Guyana is 21.1 million hectares (ha) and spans from 2 to 8° N and 57 to 61° W. Guyana shares common borders with three countries: to the north-west - Venezuela, the south-west - Brazil, and on the east - Suriname. Guyana's 460 km coastline faces the Atlantic on the northern part of the South American continent.

The coastal plain is only about 16 km wide but is 459 km long. It is dissected by 16 major rivers and numerous creeks and canals for irrigation and drainage. The main rivers that drain into the Atlantic Ocean include the Essequibo, Demerara, Berbice, and Corentyne. These rivers have classic wide mouths, mangroves, and longitudinal sand banks so much associated with Amazonia, and mud flows are visible in the ocean from the air.

The geology in the centre of the country is a white sand (*zanderij*) plateau lying over a crystalline plateau penetrated by intrusions of igneous rocks, which cause the river rapids and falls.

1.2 Establishing and Monitoring Changes to Guyana's Forested Area

Land classified as forest follows the definition as outlined in the Marrakech Accord (UNFCCC, 2001). Guyana has elected to classify land as forest if it meets the following criteria:

- Tree cover of minimum 30%
- At a minimum height of 5 m
- Over a minimum area of 1 ha.

In accordance with the JCN, the national forest cover as of 1990, based on this definition, is used as a start point. The interim measures are benchmarked against 2009 reported values.

In summary, the MRV monitoring process has involved:

- Determination of the 1990 forest area using medium resolution satellite images (Landsat) by excluding non-forest areas (including existing infrastructure) as of 1990. It should be noted that continual updates have been introduced to improve the non-forest boundary based on improved satellite resolution and repeat observation of the forest fringe.
- From this point forward, we account for any forest to non-forest land-use changes between 1990 and 2009 using a temporal series of satellite data.
- Establishing the benchmark period (1990-2009) and using 30 September 2009 Benchmark Map as a reference point.
- Comparing annual change post-2009 against the 2009 benchmark values

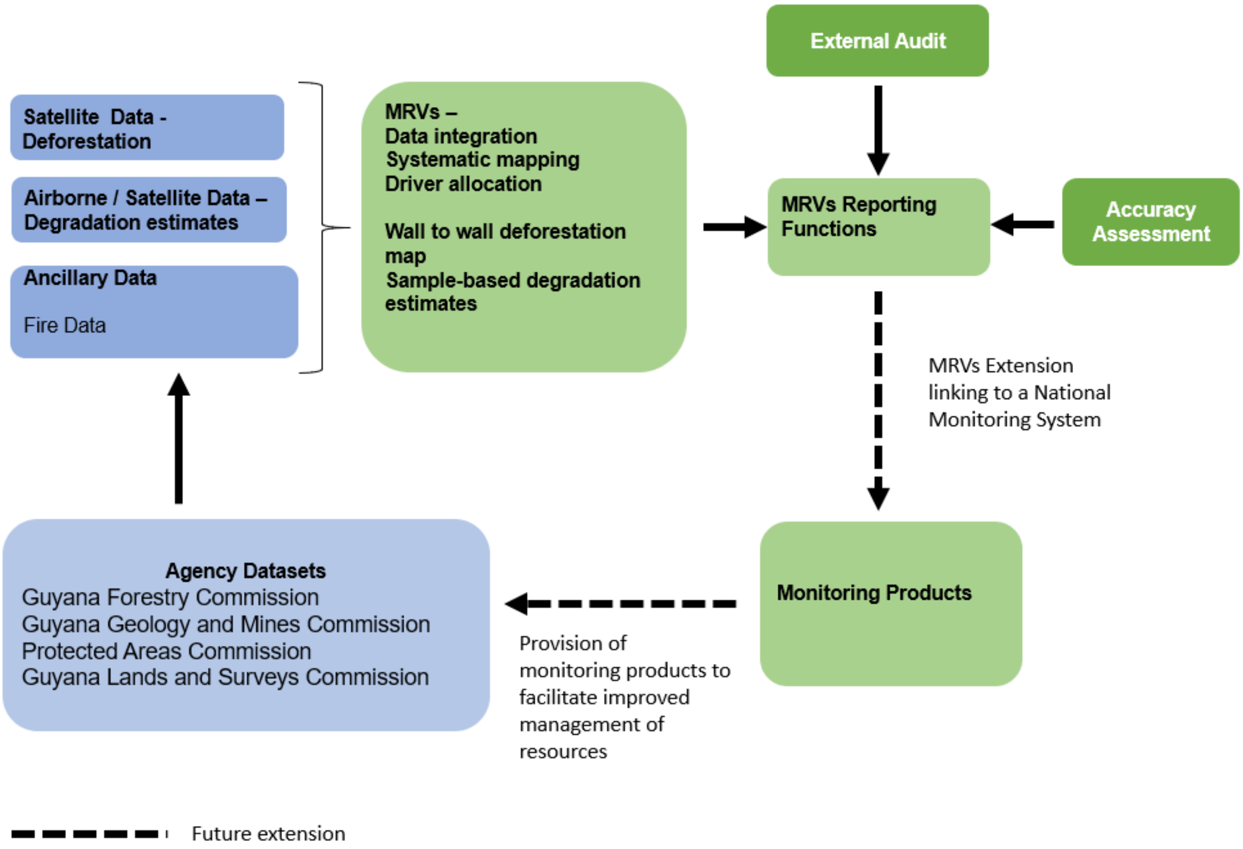
1.3 Guyana's Forest Monitoring System

An overview of the processes, datasets and outputs of the MRVS is given in Figure 1. It shows how the different parts of the MRV system are linked and used to generate annual forest change reports.

Central to the system are inputs from satellite images and datasets provided by Guyana's agencies. GFC's Forest Resource Assessment Unit interprets and analyses the data and generates maps and associated spatial layers required to meet annual reporting requirements. There are two levels of external verifications within the process. The first is the map accuracy assessment, a feature of the MRVS since its inception. This analysis is conducted externally by a team from Durham University.

The second level of verification is conducted by externally appointed auditors who review and verify methods and analytical processes to ensure these meet the specified reporting requirements.

Figure 1-1 Overview of Guyana's MRVS



1.4 National Monitoring - Future Directions

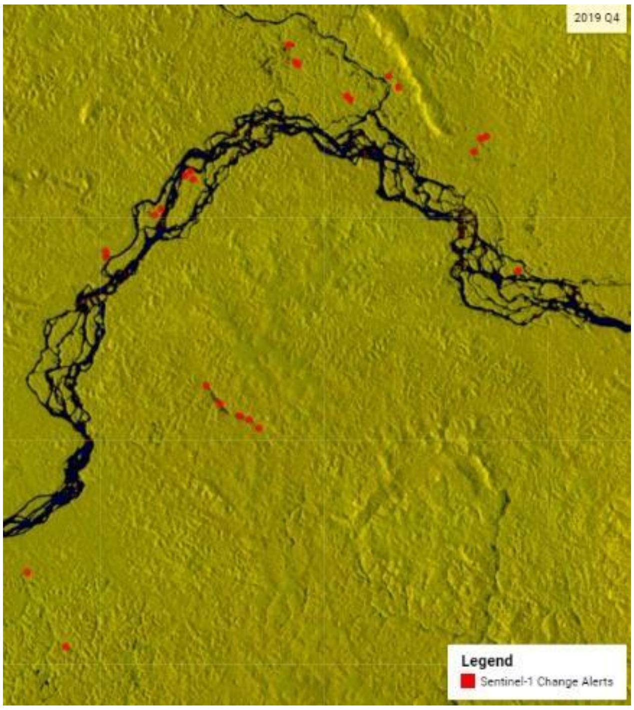
As Phase 3 commences, the efforts and funding support received over the last decade have led to the development of a world-class national monitoring verification system. The system and verification processes, refined over time, provide confidence that nationally forest cover changes are accurate.

Today, Guyana is well-placed to join programmes like forest protection initiatives that tie sustainable forest management to forest carbon markets. The ART TREES initiative provides such an opportunity that has the potential to support the continuation and further improvement of MRVs.

Several areas of development are identified to help propel the current monitoring system forward to extend its present application. Within the next phase, the GFC and other land management agencies see a compelling need to monitor land cover change more frequently – a feature that offers benefits beyond the intended application of the monitoring system. Some of these features already exist within the prototype developed at the end of Phase 2 (2019).

Figure 1-2 below illustrates one such improvement that uses radar imagery to produce forest change alerts.

Figure 1-2 Example showing near-real-time detection of deforestation using Radar images

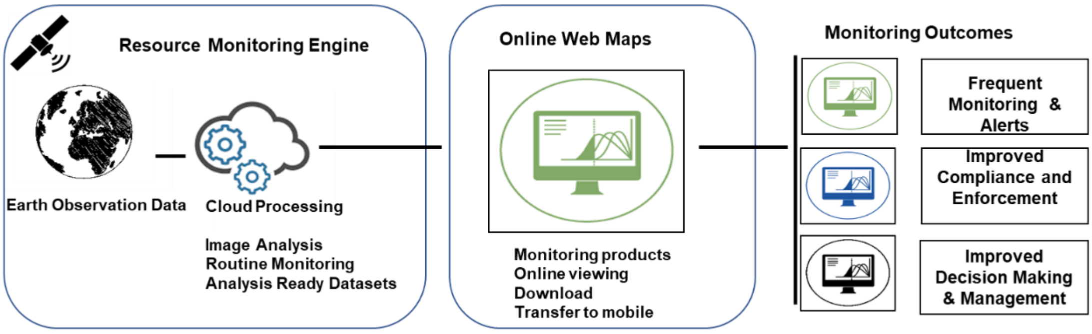


Phase 3 is expected to commence in full in 2022 and will focus on distributing the layers and information to Guyana's land management agencies to facilitate data sharing and align monitoring efforts.

The solution design incorporates several novel features that consider the working environment, resident expertise and advancements in the availability and processing of satellite data. The general process is illustrated in Figure 1-3, which shows the link between satellite imagery now held and processed in the cloud and the final output layers hosted on a web-based GIS.

The intention is that the products created will be shared across different agencies who would receive monitoring alerts and maps that can be downloaded to a mobile device via the internet and used offline.

Figure 1-3 Future Monitoring System



These improvements aim to further extend Guyana’s monitoring and compliance capabilities and improve information and data sharing between different agencies responsible for managing Guyana’s natural resources.

A key strength of the MRVS program and its success has been a coordinated approach to the system's in-country development and Guyana's desire to improve the underlying monitoring processes. Today the MRVS provides a tool that supports the design of REDD+ activities that aim to maintain forest cover while enabling continued sustainable development and improved livelihoods for Guyanese.

Architecture for REDD+ Transactions (ART)

In continuing the implementation of REDD+ activities, on December 18, 2020, Guyana submitted an application to the Architecture for REDD+ Transactions (ART) Secretariat. The Architecture for REDD+ Transactions (ART) is a global voluntary initiative that seeks to incentivize governments to reduce emissions from deforestation and forest degradation (REDD), as well as restore forests and protect intact forests. Guyana is seeking payments for the initial crediting period- 2016-2020. Guyana’s submissions to ART have largely been informed by reporting carried out by the MRVS for this 2016 to 2020 period. Submissions from Guyana will be independently validated and verified in accordance with the ART standard, The REDD+ Environmental Excellence Standard (TREES). TREES has been designed to ensure that all ART credits issued are real, measured, permanent, additional, net of leakage, verified by an accredited independent third party, and are not double counted. As a result, ART credits will represent high quality while still allowing flexibility for implementation of REDD+ programs at a national level or subnational as an interim measure.

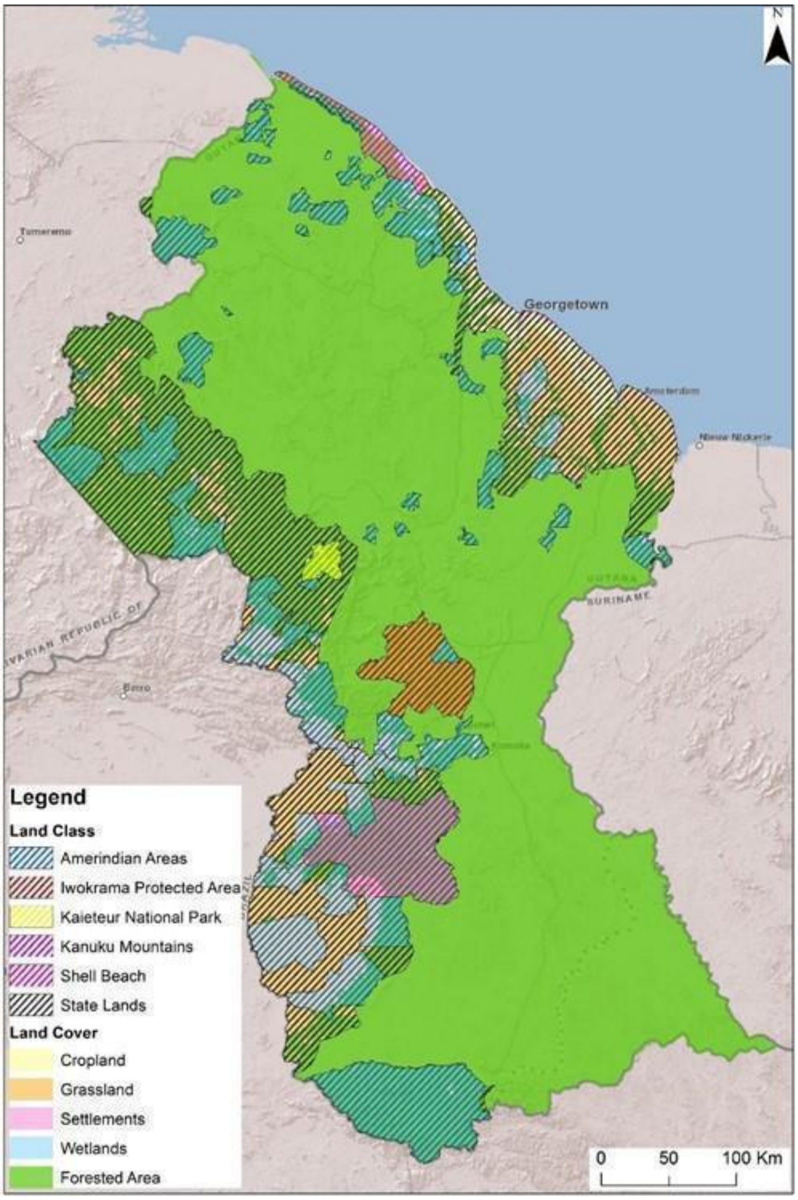
2. OVERVIEW OF GUYANA'S LAND CLASSES

There are four main tenure classifications in Guyana; the largest is State Forest covering about 60% of the total land area, followed by State Lands (19%), Amerindian lands (15%), and Protected Areas (6%). At the commencement of the MRVS, existing maps of Guyana's land cover developed in 2001 were evaluated and coalesced to align to the six broad land use categories in accordance with IPCC reporting guideline. A description of the land use categories is provided in the Forest Change SOP. The location of these areas is shown below.

State Forest Area

According to the Forest Act Section 3, Chapter 61:01, the State Forest Area is that area of State Land that is designated as State Forest. This area of State Forest has been gazetted.

Figure 2-1 Guyana's Land Classes



State Lands

For purposes of this assessment, State Lands are identified as areas that are not included as part of the State Forest Area that is under the mandate of the State. This category predominantly includes State Lands, with isolated pockets of privately held land, but does not include titled Amerindian villages.

Protected Areas

To date, the four Protected Areas that come under the scope of the Protected Areas Act are Iwokrama, Shell Beach, Kanuku Mountains and Kaieteur National Park. Altogether these account for a total of 1,141,000 ha designated as Protected Areas.

Titled Amerindian Land

The Amerindian Act 2006 provides for areas that are titled to Amerindian villages. It includes both initial titles as well as extensions that have been granted to these titled areas.

The areas are: State Forest Area (SFA) and State Lands, which are calculated from the mapping analysis, is estimated at 14.8 million ha. This excludes Iwokrama, Kaieteur National Park and titled Amerindian Land. Combined, these forested areas make up 3.69 million ha.

Distribution of Tenure by IPCC Land Classes

Table 2-1 shows the area by the adopted IPCC classes at the start of Year 11 (2021), divided by land tenure class. The forest area is 17.9 million ha, about 85% of Guyana's total area.

Table 2-1 Tenure by Adopted IPCC Land Cover Classes

Land Tenure Class	Forest	Non-Forest					
		Cropland	Grassland	Settle-ments	Wetlands	Other Land	Total
(Area '000 ha)							
State Forest Area	12 143	19	192	8	127	112	12 600
Titled Amerindian Lands (*including newly titled lands*)	2 299	7	637	7	26	329	3 305
State Lands	2 452	340	912	41	131	193	4 070
Protected Area	1 092	0	30	0	12	4	1 139
Total Area	17 986	367	1 770	57	296	638	21 114

3. DATASETS

The process aims to enable areas of change (>1 ha) to be tracked spatially through time by the driver (i.e., mining, infrastructure and forestry). The approach adopted seeks to provide a spatial record of temporal land-use change across forested land (commensurate to an IPCC Approach 3). Mapping is undertaken by a dedicated team located at GFC. All spatial data is stored on the local server at GFC and builds on the archived and processed data output from the previous analyses. The server is managed by the IT department at GFC and is routinely backed up and stored off-site.

3.1 Agency Datasets

Several Government agencies involved in managing and allocating land resources in Guyana hold spatial datasets. Since 2010, GFC has coordinated the storage of these datasets for the MRVS. Datasets are provided by the GFC, GGMC, GL&SC and the PAC, and is progressively updated as necessary.

Table 3-1 Agency Datasets Provided

Government Level	Agency	Role	Data Held
Ministry of Natural Resources	Guyana Forestry Commission (GFC)	Management of forest resources	Resource management related datasets
	Guyana Geology and Mines Commission (GGMC)	Management of mining and mineral resources	Mining concessions, active mining areas
Office of the President	Protected Areas Commission	Management of Protected Areas System in Guyana	Spatial representations of all protected areas
	Guyana Lands and Surveys Commission (GL&SC)	Management of land titling and surveying of land	Land tenure, settlement extents and country boundary

3.2 Monitoring Datasets - Satellite Imagery

In keeping with international best practice, the method applied in this assessment utilises a wall-to-wall approach that enables complete, consistent, and transparent monitoring of land use and land-use changes over time.

The approach employed allows for land cover change greater than one hectare in size to be tracked through time and attributed by its driver.

The datasets used for the change analysis have evolved. Initially, the historical change analysis from 1990 to 2009 was conducted using Landsat imagery. From 2010 a combination of DMC and Landsat was used, and from 2011 onwards, these datasets were primarily superseded with high-resolution images from RapidEye. For 2015 and 2016 (Year 6), Landsat and Sentinel data were used.

Since 2017, data from the Sentinel (2A/2B) multispectral imager (MSI) has been the primary dataset for monitoring deforestation, supplemented by Landsat and fire monitoring datasets. Over the 2021 census period, 576 tiles were acquired from August to December (156 Sentinel 2A, 47 Landsat 8 and 373 Cloudless Sentinel).

4. KEY CATEGORIES - METHODS AND ANALYSIS

Table 4-1 divides the reporting into either deforestation or degradation and interim measures. Interim measures will be phased out beyond 2021. Also summarised is an overview of drivers and associated deforestation or degradation activities reported within the MRVS. Appropriate methods have been established for all activities. Reforestation/Afforestation is the only activity not yet reported in the MRVS. Identifying the driver of specific land-use change depends on the characteristics of the change. Certainty is improved by considering the shape, location and context of the change combined with its spectral properties.

Table 4-1 Summary of Activities & Drivers Captured in the GIS

Reporting Class	Activity	Driver	Criteria	Ancillary Info Available	Spatially Mapped	End Land Use Class
Deforestation	Roads	Infrastructure	Roads > 10m	Mapped layers, Satellite imagery	Yes	Settlements
	Settlements	Settlements	Areas of new human Settlement >1 ha	Population data, image evidence.	Yes	Settlements
	Mining	Infrastructure	Roads >10 m	Existing road network, Satellite imagery	Yes	Settlements
		Deforestation	Deforestation sites > 1 ha	Dredge sites, GIS extent of mining concessions, previously mapped layers, Satellite imagery	Yes	Bareland
	Agriculture[3]	Deforestation	Deforestation sites > 1 ha	Registered agricultural leases, satellite imagery	Yes	Bareland or crop land
		Fire	Deforestation sites > 1 ha	FIRMs fire points, Spatial trends satellite imagery	Yes	Bareland or crop land
Degradation	Forestry	SFM	Harvested timber volumes and illegal logging totals.	Annual harvest plans, GIS extent of timber concessions	No	Degraded forest by type
	Mining	Degradation	A buffer is calculated around the area deforested and is used to estimate the degradation impacts of mining and infrastructure deforestation	The appropriate EF is applied to the buffer to estimate the degradation emission	Yes	Degraded forest by type
Reported Interim Measures	Fire	Degradation	The reference level is the area burnt from 1990 to September 2009 period. Over	FIRMs fire points	Yes	Bareland or crop land

[3] Note: shifting cultivation activities are also captured within the MRVS. The area of deforestation is used to calculate total emissions for this driver. The annual value is reported as a total emission in Table 8-2.

			these 19 years, 33 700 ha of forest was degraded by burning[4]. This equated to a mean annual area of 1 700 ha.			

5. DEFORESTATION

Guyana's GIS-based monitoring system is designed to map change events in the year of their occurrence and then monitor any changes over that area each year. If an area (polygon) remains constant, the land-use class and change driver are updated to stay consistent with the previous analysis. Where there is a change in the land cover of an area, this is recorded using the appropriate driver. Deforestation is mapped manually using a combination of repeat coverage Landsat and Sentinel 2 images.

5.1 Deforestation Definition

Formally, the definition of deforestation is summarised as the long-term or permanent conversion of land from forest use to other non-forest uses (GOFC-GOLD, 2010). An important consideration is that a forested area is only deemed deforested once the cover falls and remains below the elected crown cover threshold (30% for Guyana). In Guyana's context, forest areas under sustainable forest management (SFM) that adhere to the forest code of practice are not considered deforested if they regain the elected crown cover threshold.

The anthropogenic change drivers that lead to deforestation include:

1. Forestry (clearance activities such as roads and log landings)
2. Mining (ground excavation associated with small, medium and large-scale mining)
3. Infrastructure such as roads (included are forestry and mining roads)
4. Agricultural conversion
5. Fire (all considered anthropogenic and, depending on intensity and frequency, can lead to deforestation). Deforestation, for example occurs when areas are cleared for shifting activities
6. Settlements change, such as new housing developments.

5.2 Deforestation Analysis Methods

To facilitate the analysis, Guyana has been divided into a series of regularly spaced grids. The mapping process involves a systematic review of each 24 x 24 km tile, divided into 1 km x 1 km tiles at a resolution of 1:8000.

If a cloud is present, then multiple images over that location are reviewed. The process involves a systematic tile-based manual change detection analysis in the GIS.

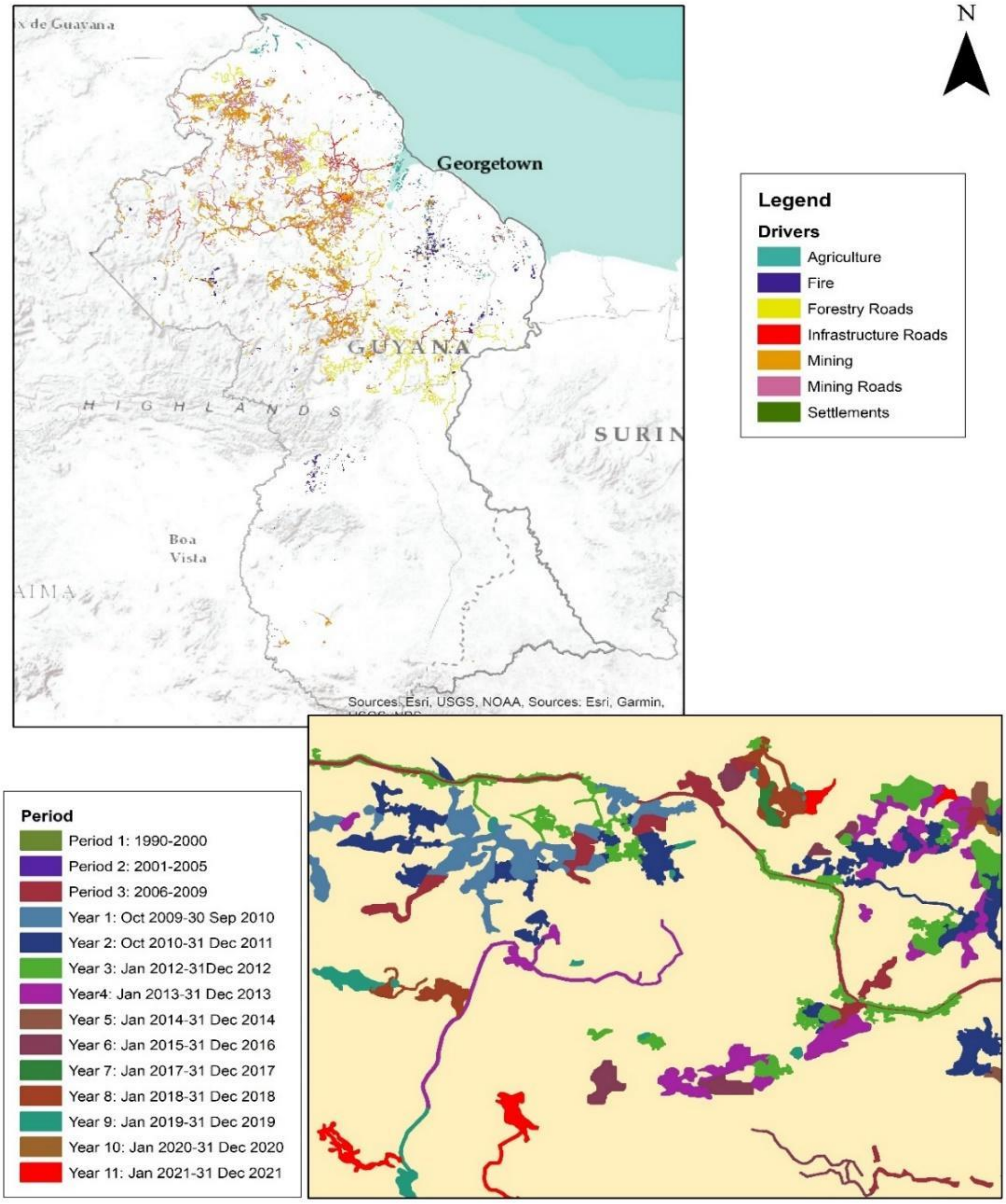
Each change is attributed with the acquisition date of the pre-and post-change image, driver of change event, and resultant land-use class. A set of mapping rules has been established that dictate how each event is classified and recorded in the GIS.

The input process is standardised using a customised GIS tool that provides a series of pre-set selections saved as feature classes. The mapping process is divided into mapping and QC. The QC team operates independently of the mapping team and is responsible for reviewing each tile as it is completed.

Additional GIS layers are also included in the decision-making process to reduce this uncertainty. The decision-based rules are outlined in the mapping guidance documentation, or Standard Operating Procedures (SOPs). This documentation, held at GFC, provides a comprehensive overview of the mapping process and rules. The following example provides an overview of the detail captured in the GIS. Evident are temporal changes in forest cover due to a range of forest change drivers.

[4] This does not include areas deforested because of fire events. This has been recorded as deforestation. The El Niño weather pattern is known to have occurred during this period.

Figure 5-1 Example of Forest Change Mapping



5.3 Natural Events

Natural events are considered a non-anthropogenic change, so they do not contribute to deforestation or degradation figures. These changes are typically non-uniform in shape and have no evidence of anthropogenic activity nearby. While these are not recorded in the MRVS, they are mapped in the GIS. These areas are attributed with a land class of degraded forest by forest type or bareland as appropriate.

6. DEGRADATION

A commonly adopted definition of degradation, as outlined in IPCC's (2003) report, is:

"*A direct human-induced long-term loss (persisting for X years or more) of at least Y% of forest carbon stocks [and forest values] since time T and not qualifying as deforestation or an elected activity under Article 3.4 of the Kyoto Protocol* ".

The primary sources of degradation are identified as:

1. Harvesting of timber (reported since 2011 using the Gain Loss Method)
2. Surrounding deforested mining sites and road infrastructure.

Image evidence and fieldwork have shown that each of these drivers produces a significantly different type of forest degradation. Forest harvest operations are temporally persistent. Forest degradation surrounding new infrastructure is different. Image evidence suggests that this type of degradation is dependent on the scale of the deforestation activity.

Forest degradation associated with mining is a minor source of emissions in Guyana[5]. This can be considered 'diffuse' degradation, to distinguish it from clumped or condensed forms of forest degradation occurring where there are recognizable patches of cleared forest such as is associated with roads, skid trails and gaps in timber harvest.

Forests adjacent to mines are impacted by the mining activity so that the carbon stocks are reduced even though forest cover remains. Such impact occurs for several reasons, such as when trees are removed to provide wood for building mining camps or when mine tailings lead to tree mortality or when areas are subjected to pre-mining exploration. While the resulting emissions are relatively small, they are included in REDD+ accounting to ensure completeness in reporting[6]. This can be considered 'diffuse' degradation, as it is not concentrated in a specific location, rather is spread out across the landscape.

The method Guyana uses for diffuse forms of forest degradation such as occurs surrounding mining sites is to establish a buffer zone of an established width around areas of deforestation, and develop an emission factor for the entirety of the buffer zone. The analysis is conducted in ArcMap using Guyana's yearly forest change dataset. The deforestation due to mining can be identified in Guyana's yearly forest change driver dataset including the drivers of mining. The forest change dataset is multipart, meaning that multiple loss polygons have the same attributes, i.e. type and date of observation and total area. For mining, buffers of 100 m width have been determined to be appropriate to capture the degradation associated with mining activities. The activity data therefore requires calculating the total area within 100 m buffers around all new areas of mining deforestation in a given year.

6.1 Forest Management

Forest management includes selective logging activities in natural or semi-natural forests.

This measure intends to ensure sustainable forest management with net-zero emissions or a positive carbon balance in the long term. The requirement is that areas under SFM be rigorously monitored and activities documented, such as harvest estimates. The following information is documented by the GFC and is available annually:

- Production by forest concession
- Total production.

Production volumes are recorded on declaration/removal permits issued by the GFC to forest concession and private property holders. Upon declaration, the harvested produce is verified, permits collected and checked and sent to the GFC's Head Office, followed by data input into the central database. The permits include details on the product, species, volume, log tracking tags number used, removal and transportation information, and in the case of large timber concessions, more specific information on the location of the harvesting. Production reports are generated by various categories, including total volume, submitted to multiple stakeholder groups and used in national reporting. Details on the main processes are provided below:

[5] 0.3% of total emissions, 1.1% of forest degradation emissions according to 2016 data.

[6] Brown, Mahmood, Goslee, Pearson, Sukhdeo, Donoghue and Watt. 2020. Accounting for greenhouse gas emissions from diffuse forest degradation: gold mining in Guyana as a case study. Forests.

Monitoring of Extracted Volume: Monitoring in the forest sector is coordinated and executed by the GFC and occurs at four main levels: forest concession monitoring, monitoring through the transportation network, monitoring of sawmills and lumberyards, and monitoring ports of export.

For forest harvesting and transport, monitoring is done at station level, at concession level and supplemented by random monitoring by the GFC's Internal Audit Unit and supervisory staff. At all large active concessions, resident forest officers perform the function of ensuring that all monitoring and legality procedures are strictly complied with. In instances of a breach, an investigation is conducted, and, based on the outcome, action is instituted according to GFC's standard procedures for illegal activities and procedural violations.

Prior to harvesting, all forest concessions must have valid removal permit forms. Permit numbers are unique to operators and are issued along with unique log tracking tags. Production volumes are declared at designated GFC offices with checks made to verify the legality of origin and completion of relevant documents, including removal permit, production register and log tracking. Removal permits require that operators declare: date of removal, type of product, species, volume, destination, vehicle type, vehicle number, name of driver/captain, tags, the diameter of forest product (in case of logs) and other relevant information. This is one of the initial control mechanisms in place whereby monitoring is done for proper documentation and on the declared produce. Control and quality checks are also undertaken at another level once entered in the centralised database for production. Removal permits and log tracking tags are only valid for a certain period and audit for use beyond that time is also an important part of the QA/QC checks conducted by the GFC. The unique identity of each tag and permit by the operator also allows QA/QC to be undertaken for individual operators' use. Thus, checks are allowed across time, by the operator and by produce being declared.

In the case of large forest concessions, only approved blocks (100 ha) in Annual Plans are allowed to be harvested in a given year. Even if these areas are within the legally issued concessions, harvesting outside of those blocks is not permitted. As such, this forms part of the QA/QC process for large concessions (Timber Sales Agreements and Wood Cutting Leases). As one prerequisite for approval of Annual Plans, forest inventory information at the pre-harvest level must be submitted, accompanied by details regarding the proposed operations for those 12 months, such as maps, plans for road establishment, skid trail alignment etc. The QA/QC process that is executed at this initial stage requires the application of the guidelines for Annual Plans, which must be complied with prior to any such approval being granted. A new addition to the monitoring mechanism has been the use of bar code scanners that allow for more real-time tracking of the legality of the origin of forest produce.

In the case of Amerindian lands and private property, the documentary procedures outlined above regarding the removal permitting and log tracking are only required if the product is being moved outside the area's boundaries. From this point onwards, the procedures that apply to State Forest concessions apply to this product as well.

Data Collection: Following receipt of removal permits and production registers, monthly submissions are made to GFC's Head Office for data entry. There is a dedicated unit in the GFC's Management Information System section responsible for performing the function of data collection, recording, and quality control. Data is entered in SQL databases custom-designed for production totals. This database has built-in programmatic QA/QC controls that allow automatic validation and red flagging of tags. These checks include tags being used by unauthorised operators, or permits being incorrectly, incompletely or otherwise misused. The system also allows cross-checking of basic entry issues including levels of production conversion rates, etc.

In the second stage of QA/QC process, all entries are validated, and the validated data is then secured in a storage area in the database. There are security features at several levels of the database operations, including a read/write only function for authorised users, change tracking of production information by staff and others. At the end of every month, data is posted to the archives. A separate unit of the GFC is responsible for cross-checking volume totals by species, concession and period, and preparing the necessary report for external consumption.

Forest Products included in MRVS Report: in tabulating the declared volumes for forest management, the following primary products that are extracted from the forest were:

- Logs
- Lumber (chainsawn lumber)
- Roundwood (piles, poles, posts, spars)
- Splitwood (shingles, staves)
- Fuelwood (charcoal, firewood)

6.2 Logging Damage – Default Factor

In 2011 progress was made in developing a methodology and finalising factors to assess Collateral Damage in a Technical Report developed by Winrock International for the GFC: *Collateral Damage and Wood Products from Logging Practices in Guyana,* December 2011.

The objective of the report is to examine how emission factors were developed that relate total biomass damaged (collateral damage) and thus carbon emissions to the volume of timber extracted. This relationship will allow the estimation of the total emissions generated by selective logging for different concession sizes across Guyana. The following field data have been collected with which the emission factors have been developed: The development process included.

1. Measurements of a sample of logging gaps. Measurement of the extracted timber biomass and carbon per timber tree and any incidental carbon damage to surrounding trees.
2. Estimating the carbon impact caused by the logging operations such as skid trails. Although selective logging clears forest for roads and decks, their emissions are calculated through the stock-change method based on estimates of area deforested by logging infrastructure determined in the land cover change monitoring.

Accounting for the impact of selective logging on carbon stocks involves the estimation of several different components:

- Biomass removed in the commercial tree felled – emission.
- Incidental dead wood created as a result of tree felling – emission.
- Damage from logging skid trails – emission.
- Carbon stored in wood products from extracted timber by product class – removal.
- Regrowth resulting from gaps created by tree felling - removal.

The **emissions** from selective logging are expressed in equation form as follows:

Emissions, t CO_2/yr = {[Vol x WD x CF x (1-LTP)] + [Vol x LDF] + [Lng x LIF]}*3.67 (Eq. 1)

Where:

Vol = volume of timber over bark extracted (m^3)

WD = wood density (t/m^3)

CF = carbon fraction

LTP = proportion of extracted wood in long term products still in use after 100 yr (dimensionless)

LDF = logging damage factor—dead biomass left behind in gap from the felled tree and incidental damage (t C/m^3 extracted)

Lng = total length of skid trails constructed to extract Vol (km)

LIF = logging infrastructure factor—dead biomass caused by construction of infrastructure (t C/km of skid trail to remove the Vol)

3.67 = conversion factor for t carbon to t carbon dioxide <u>Wood in long term products</u>

Not all the carbon in harvested timber gets emitted to the atmosphere because a proportion of the wood removed may be stored in long term wood products. Total carbon stored permanently into wood products can be estimated as follows.

$$C_{WP} = C*(1-WW)*(1-SLF)*(1-OF)$$

(Eq. 2)

Where:

$C_{WP:}$ = Carbon stock in long-term wood products pool (stock remaining in wood products after 100 years and assumed to be permanent); t C ha^{-1}

C = Mean stock of extracted biomass carbon by class of wood product; t C ha^{-1}

= Wood waste. The fraction immediately emitted through mill inefficiency by class of wood product

SLF = Fraction of wood products with a short life that will be emitted to the atmosphere within 5 years of timber harvest by class of wood product

OF = Fraction of wood products that will be emitted to the atmosphere between 5 and 100 years of timber harvest by class of wood product

The methodology presented here is a module in an approved (double verified) set of modules for REDD projects posted on the Verified Carbon Standard (VCS) set of methodologies.

6.3 Illegal Logging

Areas and processes of illegal logging must be monitored and documented as far as practicable. Monitoring and estimation of such areas are recommended to be done by assessing the volumes of illegally harvested wood.

The rate of illegal logging for the assessment Year 11, 1 January 2021 to 31 December 2021, is informed by a custom-designed database updated monthly and subject to routine internal audits. This database records infractions of illegal logging in Guyana in all areas.

Reporting on illegal logging activities is done via the GFC's 36 forest stations located strategically countrywide and by field monitoring and audit teams through the execution of both routine and random monitoring exercises. The determination of illegal logging activities is made by the application of standard GFC procedures. The infractions are recorded, verified and audited at several levels. All infractions are summarised in the illegal logging database and result in a total volume being reported as illegal logging for any defined time period.

7. DEFORESTATION RESULTS

The results presented summarise the Year 11 period (1 January 2021 to 31 December 2021) forest change from deforestation and forest degradation.

In terms of background, the change for each period has been calculated by progressively subtracting the deforestation for each period from the forest cover as of 1990.

The forest cover estimated as of 1990 (18.47 million ha) was determined using a manual interpretation of historical aerial photography and satellite images. This area was determined during the first national assessment (GFC 2010) and verified independently by Durham University (DU 2010 and 2011).

Over time, the forest area has been updated after a review of higher resolution satellite images. The outcome has been that the forest/non-forest boundaries were improved, but the forest area also changed-particularly at two points in time 2012 and 2014. In 2018, the forest area was revised to remove areas of historic shifting cultivation. This change was made based on a further study that concluded that these areas should be considered non-forest, aligning with Guyana's definition of forests.

Table 7-1 summarises the total change and change percentage for the entire country as a percentage of forest remaining. The forest area at the end of Year 11 is 17.99 million ha.

Table 7-1 National Area Deforested 1990 to 2021

Reporting Period	Year	Years	Satellite Image Resolution	Forest Area	Annualised Change	
				('000 ha)		(%)
Initial forest area 1990	1990		30 m	18 473.39		
Benchmark (Sept 2009)	2009	19.75	30 m	18 398.48	74.92	0.021
Year 1 (Sept 2010)	2010	1	30 m	18 388.19	10.28	0.056
Year 2	2011	1.25	30 m & 5 m	18 378.30	9.88	0.054
Year 3	2012	1	5 m	*18 487.88	14.65	0.079
Year 4	2013	1	5 m	18 475.14	12.73	0.068
Year 5	2014	1	5 m	*18 470.57	11.98	0.065
Year 6	2015-16	2	10 m & 30 m	18 452.16	9.20	0.050
Year 7	2017	1	10 m & 30 m	18 442.96	8.85	0.048
Year 8	2018	1	10 m & 30 m	*18 070.08	9.22	0.051
Year 9	2019	1	10 m & 30 m	*18 019.35	12.74	0.071
Year 10	2020	1	10 m & 30 m	*18 001.79	10.23	0.057
Year 11	2021	1	10 m & 30 m	17,986	7.63	0.042

*Continual forest area updates based on remapping, using high spatial and temporal resolution imagery and removal of shifting cultivation areas.

The following figure shows the annualised deforestation trends for all change periods. The trend shows that deforestation rates increased from the 1990 level and, in parallel with gold price increases, peaked in 2012 (0.079%). Post-2012, the rate of change fell and in recent years fluctuated between 0.048 to 0.071% and then decreased in 2021 to 0.042%.

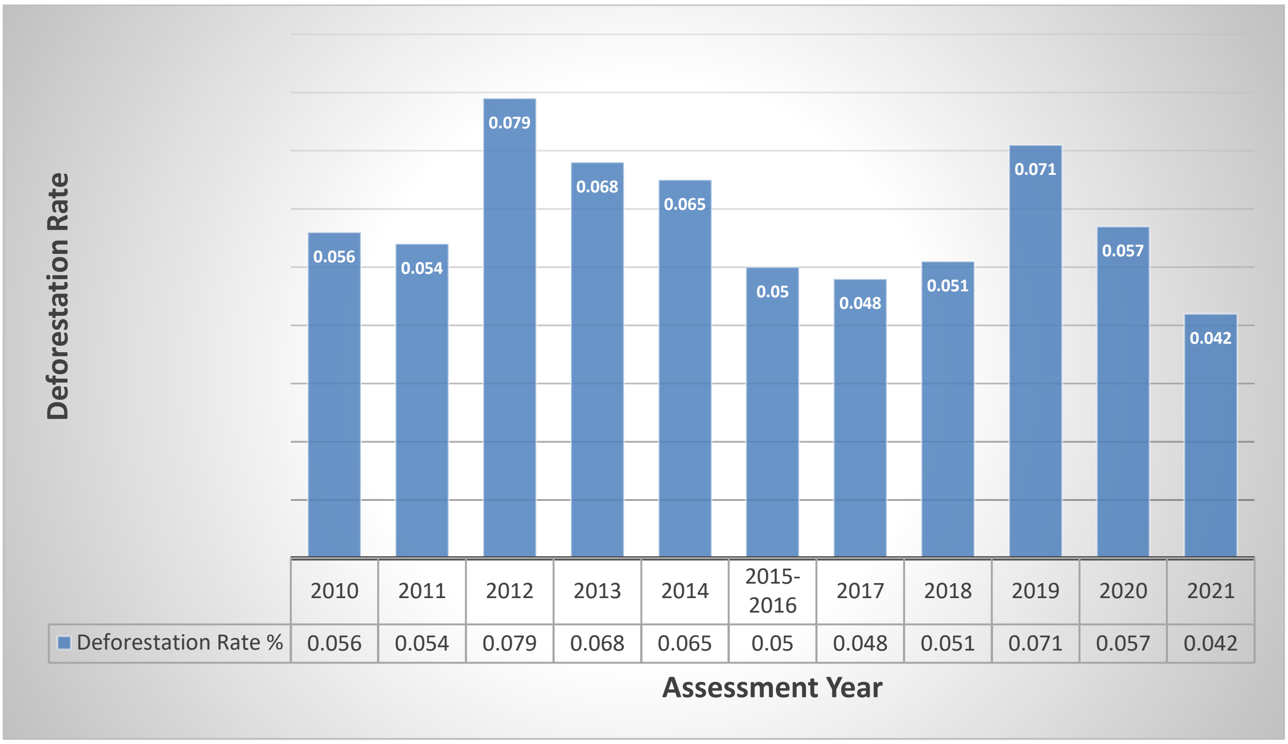


Figure 7-1 Annual Rate of Deforestation by Period from 1990 to 2021

7.1 Forest Change by Driver - Deforestation

Forest change caused by deforestation is divided and assessed by the driver. Table 7-2 provides a breakdown by forest change drivers. The temporal analysis offers a valuable insight into deforestation trends relative to 1990. Shifting cultivation is not included as a driver of deforestation but included in full emissions reporting. A more meaningful comparison is provided if the rates of change are divided by driver and annualised. In general, the following trends by driver are observed:

- In this reporting period, Mining and associated infrastructure is the most significant contributor to deforestation, at 6,825 ha.
- The deforestation due to fire has decreased markedly from 2,933 ha 2020 to 139 ha in 2021.
- Forestry related change has remained relatively stable is around 228 ha. As in the case of earlier assessments, forest roads are attributed to a forestry driver rather than attributing this change to Infrastructure.
- Agricultural developments causing deforestation peaked in Year 5, increasing to 817 ha. Over the past three reporting periods, it has been less than 500 ha. This figure has been reported at 216 ha for Year 2021.

Table 7-2 Annualised Rate of Forest Change by Period & Driver from 1990 to 2021

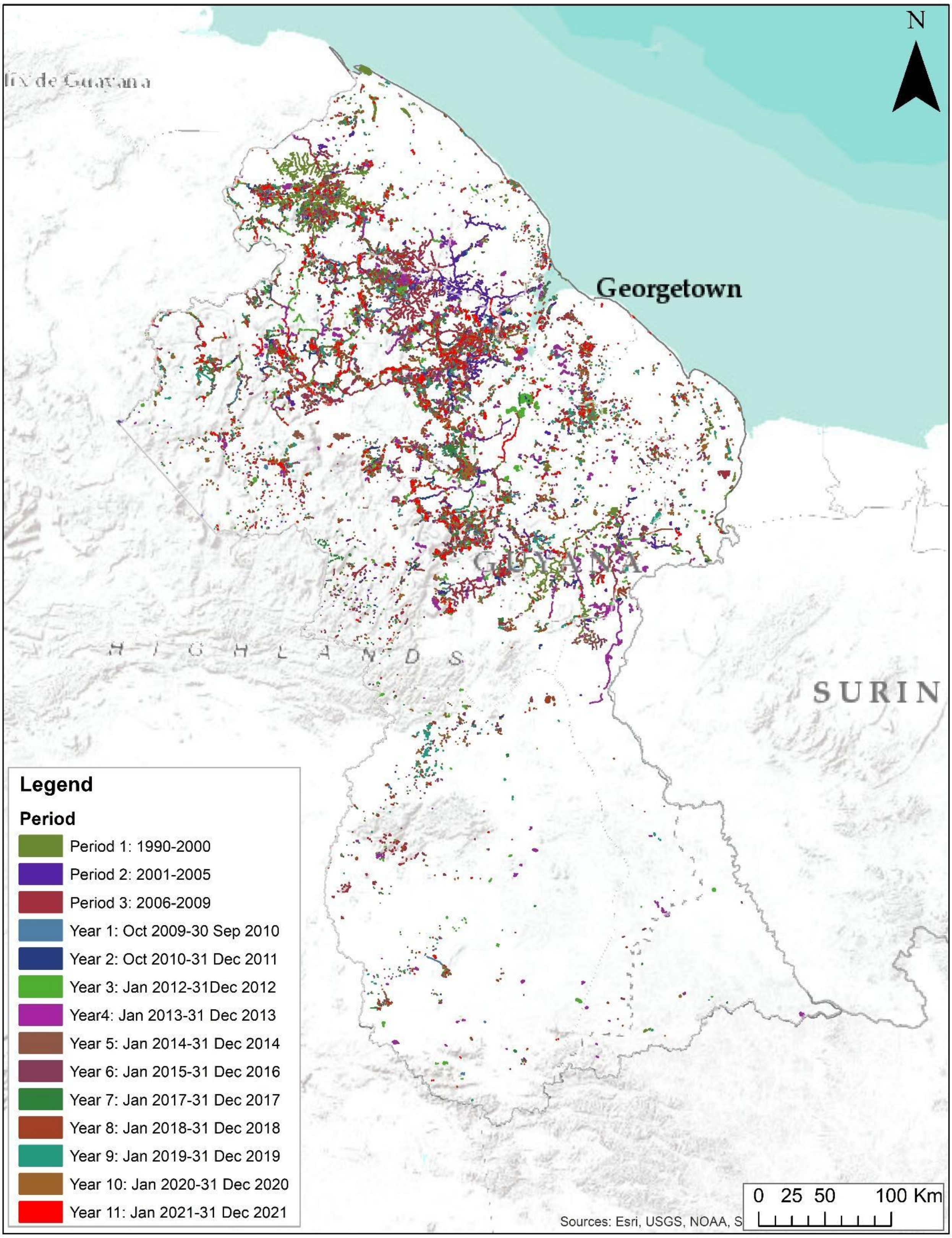
Reference Period	Change Period	Change Period	Annualised Rate of Change by Driver						Annual Change
			Forestry	Agriculture	Mining	Infrastructure	Fire	Settlements	
		Year	Annual Area (ha)						(ha)
Historic	1990-00	10	609	203	1 084	59	171	-	2 127
	2001-05	5	1 684	570	4 288	261	47	-	6 850
	2006-09	4.8	1 007	378	2 658	41	-	-	4 084
	2009-11	1	294	513	9 384	64	32	-	10 287
MRV Phase 1	2010-2011	1.25	186	41	7 340	298	46	-	7 912
	2012	1	240	440	13 664	127	184	-	14 655
	2013	1	330	424	11 518	342	96	23	12 733
	2014	1	204	817	10 919	141	259	71	11 975
MRV Phase 2	2015-2016	2	313	379	6 782	217	1 509	8	9 208
	2017	1	227	477	7 442	195	502	7	8 851
	2018	1	356	512	7 624	67	661	7	9 227
	2019	1	226	246	5 821	52	6 371	22	12 738
MRV Transition Phase	2020	1	195	489	6 452	103	2 933	60	10 232
MRV Phase 3	2021	1	228	216	6 825	117	139	105	7630

7.2 Deforestation Patterns

The temporal analysis of deforestation by reporting periods is shown in Figure 7-2. The map, which presents change from all drivers, shows that most of the change is clustered[7] and that new areas tend to be developed near existing activities. Most of Year 2021 deforestation activities occur close to or inside the footprint of historical change areas in the north and west.

[7] For the purposes of display the areas of deforestation have been buffered to make them more visible.

Figure 7-2 Forest Change by Reference Period



7.3 Forest Change Across Land Classes

The following table provides a summary by change drivers and land class for the 2021 assessment.

Table 7-3 2021 Area Change by Driver & Land Class

Land Classes	Area Change by Drivers & Land Class						Total Change	Proportion of Total (%)
	Forestry	Agriculture	Mining	Infrastructure	Fire	Settlement		
State Forest Area	203	33	6 056	73	52	64	6 481	85
Titled Amerindian Lands (*including newly titled lands*)	9	13	476	5	25	0	528	7
State Lands	16	170	275	38	62	41	603	8
Protected Area	0	0	18	0	0		18	0
Total Area	228	216	6 825	117	139	105	7 630	100

Trends by driver for the reporting year follow and are supported by the driver map presented in Figure 7-3 above.

Mining

As with the previous years, most of the deforestation activity occurred in the State Forest Area (SFA). Mining activities are consolidated in the centre of Guyana. The area mined has increased by 373 ha compared to 2020, but still lies well below the 2012 value, which marked a point where the gold price was the highest since 1980. Post-2012, the price declined to around USD1200/ounce.

Forestry

Most forestry activities are located inside the SFA. During this period, all deforestation events were associated with forestry harvest operations. The leading causes of forest clearance include road and log market construction. The reported value of 228 ha is a slight increase when compared to the previous year.

Infrastructure

Infrastructure developments (117 ha) contributed to a small area with the level change relatively stable between reporting periods. The area of clearance is in a similar location. The main difference is related to road construction activities and tends to be near townships. Figure 7-3 shows the distribution of infrastructure developments. There have been new hinterland roads constructed to enhance access to villages.

Agricultural Development

Agricultural developments led to 216 ha deforestation. The main areas of development were located close to Georgetown and the north-eastern regions of Guyana. Development tends to be near river networks.

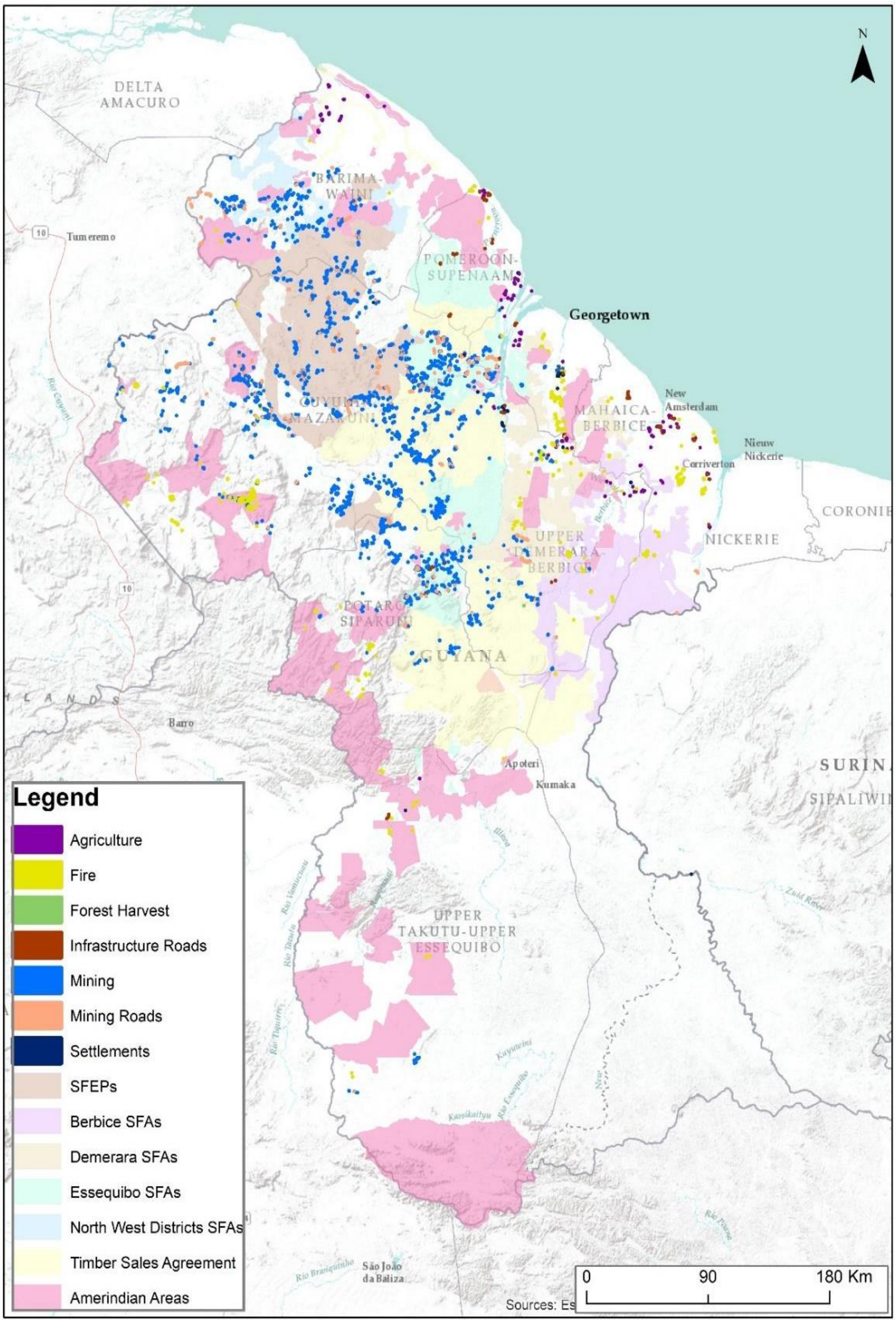
Biomass Burning - Fire

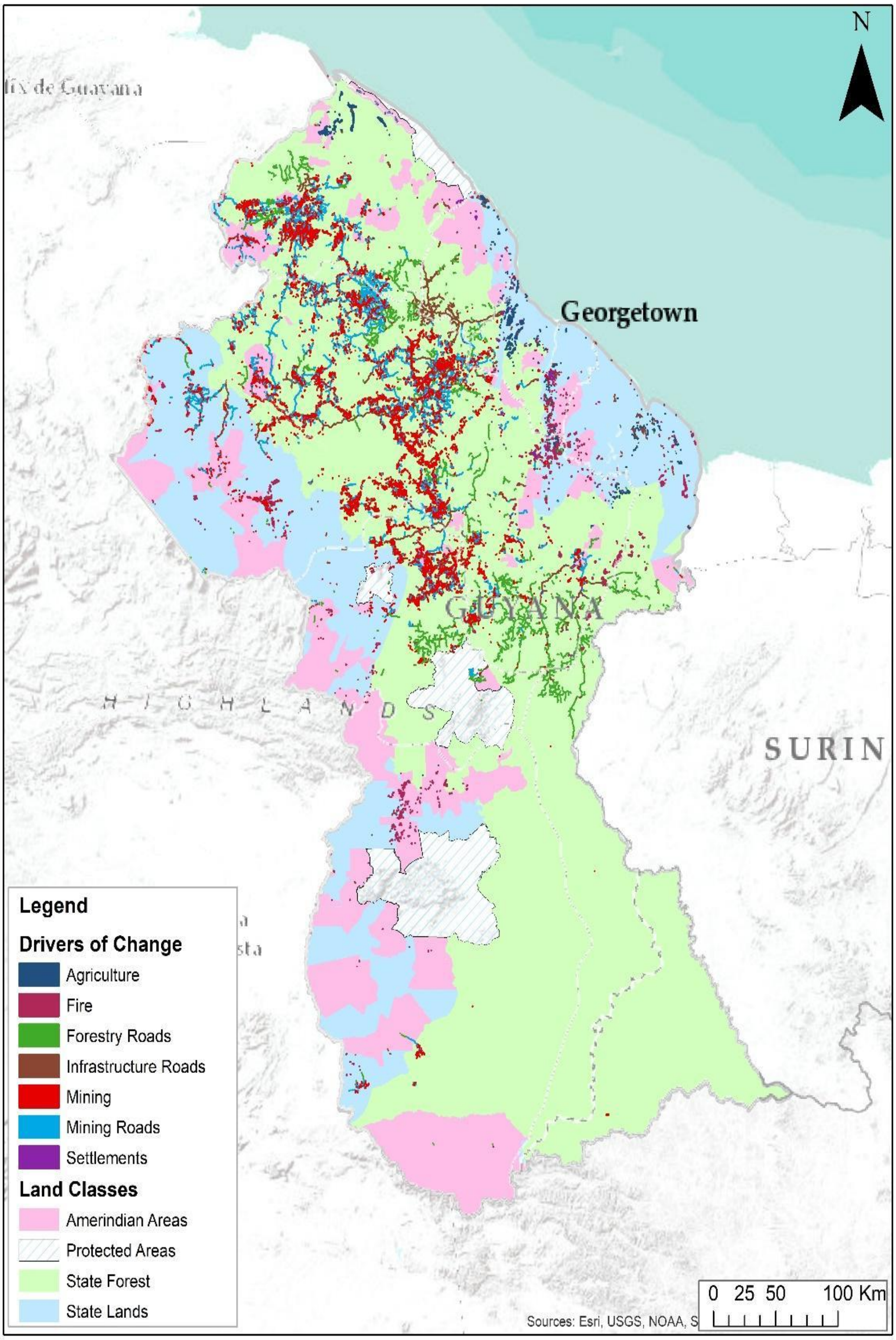
Fire events have drastically decreased when compared to the two previous years, which were uncharacteristically dry[8]. An area of 139 ha was mapped for year 2021. Spatially, they follow historical trends, where events occur in the white sand forest area surrounding Linden and extend towards the eastern border of Guyana.

[8] As of August 29, 2019, INPE reported more than 80,000 fires across all of Brazil, a 77% year-to-year increase for the same tracking period, with more than 40,000 in the Brazil's Legal Amazon (*Amazônia Legal* or BLA), which contains 60% of the Amazon. Similar year-to-year increases in fires were subsequently reported in Bolivia, Paraguay and Peru, with the 2019 fire counts within each nation of over 19,000, 11,000 and 6,700, respectively, as of August 29, 2019.[1]

The following map shows the distribution of deforestation by drivers (mining, forestry, infrastructure, settlements, agricultural and biomass burning) for the 2021 reporting period. Mining dominates the map as it is the largest single driver of change.

Figure 7-3 - Distribution of Forest Change Drivers (2021)




N
Georgetown
GUYANA
SURIN
HIGHLANDS
Legend
Drivers of Change
Agriculture
Fire
Forestry Roads
Infrastructure Roads
Mining
Mining Roads
Settlements
Land Classes
Amerindian Areas
Protected Areas
State Forest
State Lands
0 25 50 100 Km
Sources: Esri, USGS, NOAA, S

8. EMISSIONS REPORTING AND ACTIVITY DATA

Emissions from the loss of forests are identified as among the largest per-unit emissions from terrestrial carbon loss in tropical forests. Above-ground biomass and below-ground biomass combined represent approximately 82% of total biomass. Several key performance indicators and definitions have been developed as follows.

- Comparison of the conversion rate of forest area as compared to historic reference level
- Forest area as defined by Guyana in accordance with Marrakesh Accords.
- Conversion of natural forest to tree plantations shall count as deforestation with full loss of carbon.
- Forest area converted to new infrastructure, including logging roads, shall count as deforestation with full carbon loss.

Guyana has moved toward full emissions reporting, as presented in Table 8-2 (b). However, one useful metric, which compares the rate of forest loss against the 2009 reference level, has been retained and is reported in Table 8-1 (a).

Table 8-1 (a) MRVS Results 2020 2021 (Year 1011)

Measure Ref.	Reporting Measure on Spatial Indicators	Indicator	Reporting Unit	Adopted Reference Measure	Year 2021	Difference between Year 11 and Reference Measure Difference
1	Deforestation Indicator	Rate of conversion of forest area as compared to the agreed reference level	Rate of change (%)/yr	0.275%	0.042%	0.233%

Year 2021 Emission Reporting

Deforestation			
Driver	**Area (ha)**	**EF (t CO2/ha)**	**Emissions (t CO2)**
Mining	6086	1,051	6,398,386
Mining Infrastructure	739	1,051	776,932
Forestry Infrastructure	228	1,051	239,703
Infrastructure	117	1,051	123,005
Agriculture	216	1,110	239,846
Settlements	105	1,051	110,390
Fire	139	1,044	145,162
Shifting Cultivation	393	1,097	431,241
Deforestation Total			**8,464,665**
Degradation			
Driver	**AD (see driver)**	**EF (t CO2/unit AD)**	**Emissions (t CO2)**
Timber Harvest volume (m^3)	547,516	5.32	
Skid trail (kmg)	2,070	171.84	3,268,521
Mining and Infrastructure Degradation (ha)	26,650	8.1	215,865
Degradation Total			**3,484,386**
TOTAL CO_2 EMISSIONS FOR GUYANA FOR 2020 FROM FOREST SECTOR			**11,949,050**

- *Reporting on forest carbon removal from REDD+ activities will commence when these activities are initiated.*
- *Volume of illegal logging is included as part of the timber harvest volume.*
- *Emission Factors are rounded thus total emission may not directly match.*

Appendix 1: Accuracy Assessment Report

Accuracy Assessment Report Year 11(2021) Guyana REDD+ MRVS

Assessment Year 2021

ACCURACY ASSESSMENT REPORT GUYANA REDD+ MRVS

22 May 2022

Version 1.0

Guyana REDD+ Monitoring Reporting and Verification System (MRVS)

Accuracy

Assessment

Report Year 11

Daniel Donoghue,

Nikolaos Galiatsatos

EXECUTIVE SUMMARY

This report was commissioned by Indufor Asia Pacific Ltd for the Guyana Forestry Commission (GFC) in support of a system to Monitor, Report and Verify (MRVS) for forest resources and carbon stock changes as part of Guyana's engagement in the UN Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation Plus (REDD+). The scope of the work was to conduct an independent assessment of deforestation, forest degradation and forest area change estimates for the period January–December 2021. Specifically, the terms of reference asked that confidence limits be attached to forest area estimates.

The methods used in this report follow the recommendations set out in the GOFC-GOLD guidelines to help identify and quantify uncertainty in the level and rate of deforestation and the amount of degraded forest area in Guyana over the period January-December 2021. ESA Sentinel-2, Planet-PlanetScope and Skysat, and MAXAR-Worldview imagery was used to assess change.

A change analysis using two-stage stratified sampling design was conducted to provide precise estimates of forest area. Three strata were selected according to "risk of deforestation". The drivers (cause) of change were identified from expert image interpretation of high spatial resolution satellite imagery.

The estimate of the total area of change in the 12 month Year 11 period - Forest to Non-forest is 5397 ha with a standard error of 956 ha and a 97.5% confidence interval (3523 ha; 7271 ha)

The estimate of the total area of change in the 12 month Year 11 period from Degraded forest to Non-forest between Y10 and Y11 is 2699 ha with a standard error of 676 ha and a 97.5% confidence interval (1373 ha; 4024 ha).

Changes totalling 1.35 ha were detected within the boundary of the Intact Forest Landscape. These are interpreted as caused by shifting agriculture.

The sample-based estimates for land cover class areas for December 2021 are as follows:

a) Forest = 17,629,661 ha

b) Degraded forest = 175,143 ha

c) Non-forest = 1,870,104 ha

d) Note that the total area of Guyana in the sample-based estimates is about 97% different from the GIS-based area because about 3% of the sample area is cloud covered and therefore not classified.

1 AREAS OF ACTIVITY

To assess Year 11 deforestation, taking note of IPCC Good Practice Guidelines and GOFC/GOLD recommendations.

To outline a methodology for accuracy assessment including an outline of the (1) sample design, (2) response design, and (3) analysis design[9]. For the design component, reference data to be used should be identified, and literature cited for methods proposed. The design must ensure representativeness of the scenes selected for analysis. The sampling specifications used must be stated.

To support independent verification of the REDD+ interim measures and national estimates of Gross Deforestation associated with new infrastructure, and emissions from forest fires – referred to in the context of the Joint Concept Note between the Governments of Guyana and the Kingdom of Norway, including initial interim results, with a priority being on gross deforestation and the associated deforestation rate (i.e. change over time) and assessing their error margins/confidence bands, and providing verification of the deforestation rate figure for Year 11 (Year 2021) as an area change total and by driver.

To conduct an independent assessment of the deforestation mapping undertaken by the Guyana Forestry Commission and comment on the attribution of types of changes e.g. agriculture, mining, forestry and fire. Make recommendations that can be used to improve efforts in the future. This assessment should be done with the recognition that “best efforts” will have to be applied in situations where there is a challenge in terms of availability of reference data. The error analysis should highlight areas of improvement for future years to decrease uncertainties and maintain consistency. Additionally, the assessment should also consider the quality on how missing data were treated for national estimation (if this is observed to be the case). It is required that real reference data is used either from the ground, ancillary data (e.g. for concessions), and/or high resolution imagery.

For 2021 (Year 11), forest degradation was not interpreted and mapped from satellite imagery to create a ‘forest degradation’ GIS layer. Instead, forest degradation was estimated from a two-stage statistical sample with randomisation of the first stage.

To use the sample data to estimate the extent of forest degradation for Year 11 for the whole of Guyana and to report error margins/confidence bands, and provide verification of the forest degradation rate for Year 11 as an area change total and by driver. This assessment is done with the recognition that “best efforts” will have to be applied in situations where there is a challenge in terms of availability of reference data. The discussion section highlights areas of improvement for future years to decrease uncertainties and maintain consistency. Additionally, the assessment considers the effect of missing data for national estimation. It is required that real reference data are used either from the ancillary map data (e.g. for concessions), and the data acquired specifically for accuracy assessment including high spatial resolution imagery.

[9] GOFC GOLD Sourcebook (2016) Section 2.7.

2 AREA REPRESENTATION

The total land area for Guyana is 21,123,486 hectares, calculated from the national boundary Shapefile provided by GFC in 2014. The digital maps contained in the report were obtained from the Guyana Forestry Commission (GFC), the Guyana Land and Surveys Commission (GL&SC). All maps use the WGS 84 datum and are projected to UTM Zone 21N.

2.1 Forest Area

Land classified as **forest** by GFC follows the definition from the Marrakech Accords (UNFCCC, 2001). Under this agreement, forest is defined as: a minimum area of land of 1.0 hectare (ha) with tree crown cover (or equivalent stocking level) of more than 10-30% with trees with the potential to reach a minimum height of 2-5 m at maturity in situ.

In accordance with the Marrakech Accords, Guyana has elected to classify land as forest if it meets the following criteria:

- Tree cover of minimum 30%
- At a minimum height of 5 m
- Over a minimum area of 1 ha.

The forest area was mapped by GFC / IAP by excluding non-forest land cover types, including water bodies, infrastructure, mining and non-forest vegetation. The first epoch for mapping is 1990, and from that point forward land cover change from forest to non-forest has been mapped and labelled with the new land cover class and the change driver. GFC have conducted field inspections and measurements over a number of non-forest sites to verify the land cover type, the degree of canopy closure, the height of the vegetation and its potential to regenerate back to forest.

The forest area and forest loss assessments in this report do not look at the GFC / IAP mapping, it is an independent analysis. Details of the GFC / IAP mapping are explained in the Standard Operating Procedure for Forest Changes Assessment. Areas mapped as deforested during the period 1990- 2009 are used to establish the *deforestation rate* for the benchmark reporting period.

The purpose of this report is to build upon the estimates of deforestation and to quantify the precision of the estimate of deforestation observed in the Year 11 period. A second task is to identify the processes (drivers) that are responsible for deforestation and forest degradation, and, where possible to estimate the precision of area estimates.

3 SAMPLING DESIGN FOR VERIFYING YEAR 11 FOREST CHANGE

3.1 Change sample design

The Year 11 assessment for gross deforestation and forest degradation in Guyana used a two-stage stratified random sampling design. Stratification was based on past patterns of deforestation from Period 1 (1990) through to Year 10 (Dec 2020), where the primary drivers of land cover change are alluvial gold mining, logging, anthropogenic fire, agriculture and associated infrastructure including roads.

The assessment is guided by established principles of statistical sampling for area estimation and by good practice guidelines (GOFC-GOLD, 2016, UNFCCC Good Practice Guidance and Guidelines, Penman et al., 2003). The purpose of stratification is to calculate the within-stratum means and variances and then calculate a weighted average of within-stratum estimates where the weights are proportional to the stratum size. Stratification will reduce the variance of the population parameter estimate and provide a more precise estimate of forest area and forest area change than a simple random sample (Olofsson et al 2013).

The sampling design and the associated response design are influenced by the quality and availability of suitable reference data to verify interpretations of the GFC Forest Area Assessment Unit (FAAU). In Year 3, 4 and 5 the GFC Forest Area Assessment Unit (FAAU) used RapidEye as the primary mapping tool and so the whole country was mapped from multiple looks of orthorectified RapidEye resampled data to 5m pixel size. For Year 6, 7, 8, 9 and 10, the GFC Forest Area Assessment Unit (FAAU) used Landsat and Sentinel-2 imagery as the primary mapping tool. The Y11 response design used Planet PlanetScope & Skysat, MAXAR Worldview and GeoEye, and Sentinel-2 imagery as an appropriate fine-resolution source of data to validate land cover changes in all but the low risk of change areas where assessment was based on interpretation of Sentinel-2 data.

For Guyana, the established MRV protocol is for the entire country to be remapped on an annual basis, and so a forest change map will be generated from wall-to-wall coverage of satellite data. To assess the accuracy of land cover change statistics an independent reference sample is needed. The focus of the independent assessment places emphasis on inference, that is optimising the precision of the change estimates. Therefore, we generate an *attribute change sample* as the reference data to estimate gross deforestation and forest degradation area.

A change sample for reference data will:

a) have a smaller variance than an estimate of change derived from two equivalently sized sets of independent observations, provided the correlation coefficient is positive;

b) increase the precision of the change estimate by virtue of the reduction of the variance of estimated change;

c) despite its obvious advantage, encounter practical and inferential problems if resampling the same areas proves difficult, or if, as time passes, the sample or the stratification of the sampling scheme, is no longer representative of the target population (Cochran 1963; Schmid-Haas, 1983);

d) for the same sample size, require no additional resource but allow both map accuracy and area estimation to be performed;

e) be an alternative to wall-to-wall mapping and may be preferred because of lower costs, normally smaller classification error, and rapid reporting of results;

f) have value when assessing any additional forest change map product such as the University of Maryland Global Change map 2000-2021 or any annual updates published by Maryland.

The desired goal of this validation is to derive a statistically robust and quantitative assessment of the uncertainties associated with the forest area and area change estimates.

Several factors potentially impact on the quality of forest mapping (GOFC GOLD, 2016), namely

(i) The spatial, spectral and temporal resolution of the imagery

(ii) The radiometric and geometric pre-processing of the imagery

(iii) The procedures used to interpret deforestation, degradation and respective drivers

(iv) Cartographic and thematic standards (i.e. minimum mapping unit and land use definitions)

(v) The availability of reference data of suitable quality for evaluation of the mapping

The Guyana Forestry Commission's Standard Operating Procedure for Forest Change Assessment outlines approaches used to minimize sources of error following IPCC and GOFC-GOLD good practice guidelines as appropriate.

The verification process used follows recognised design considerations in which three distinctive and integral phases are identified: response design, sampling design, and analysis and estimation (Stehman and Czaplewski, 1998).

3.2 Response Design

Table 3.1 summarises the data available to validate the deforestation and forest degradation change estimates for 2021, that is the end of 2020 (year 10) and the end of 2021 (year 11). It also specifies the areal coverage of the imagery used for change assessment.

Table 3.1: Data sources used for Validation (Application: Forest Change Assessment)

Satellite	**Time period**	**Resolution (m)**	**Spectral**	**Revisit**	**Radiometric**
WV/GE	Sept-Dec 2021	Varies sub-metre	B, G, R, NIR	Daily (agility)	11-bit
Skysat	Sept-Dec 2021	Varies sub-metre	B, G, R, NIR	Sub-daily	16-bit
Planet	Aug-Dec 2020 and 21	3m	B, G, R, NIR	Sub-daily	12-bit
Sentinel-2	Aug-Dec 2020 and 21	10m	B, G, R, NIR	5 days	12-bit

A critical component of any accuracy assessment is the need for appropriate reference data (Herold *et al.*, 2006; Powell *et al.*, 2004). It is often the case that reference data itself contains errors and is not a gold standard and at least one study reports large differences of the order of 5-10% between field- based and remotely sensed reference data (Foody, 2004, 2010; Powell *et al.* 2004). Therefore, a key aspect of the response design is to use reference data that allow forest / non- forest land cover to be classified with certainty. Year 11 deforestation and degradation was mapped by the IAP/GFC team from Sentinel-2 imagery, while the accuracy assessment primarily used PlanetScope, Skysat and MAXAR imagery supplemented by the detailed reinterpretation of Sentinel-2 satellite imagery in parts of Guyana that were within the Low Risk stratum.

For 2021, as with 2016-17, forest degradation was **not mapped** wall-to-wall across Guyana. The level of degradation was estimated from a change analysis of reference data using a two-stage stratified sample with randomisation of the first stage sample transects. The change analysis interpreted land cover at two time periods using the best available reference data - primarily PlanetScope, Skysat and MAXAR imagery supplemented by reinterpretation of Sentinel-2.

The degradation analysis was carried out by the Durham mapping team (three persons) using a rules-based approach that is described in the Standard Operation Procedure for degradation assessment. Note that the definition of forest degradation requires the interpreter to make a quantitative assessment of the area of forest lost and to record the loss as a proportion of each hectare sample analysed. Even though the interpreter has access to the area 'measure tool' within ArcMap, any misinterpretation or miscalculation of change is most likely to arise from human-error or interpretation using poor quality imagery or areas partially obscured by cloud or cloud shadow. In addition to assessing evidence for land cover change, the interpreter is required to assign a driver to every sample area that exhibits change. The choice of change driver is selected from a drop-down menu of known reasons for deforestation and forest degradation. However, the process of selecting a change driver is subjective and depends on the knowledge of the interpreter and the level of care taken in interpreting the imagery and with following the definitions / rules and respecting the exclusions (e.g. Table 3.2) specified in the SOP.

Table 3-2 – Year 11 Deforestation and Forest Degradation Assessment Exclusions

Reference	Criteria
1	Land use change that occurred prior to 1 January 2021 or after 31 December 2021
2	Roads less than a 10 m width.
3	Naturally occurring areas – i.e. water bodies
4	Cloud and cloud shadow

The following sections provide a summary of the datasets available and the way they were used for the accuracy assessment.

3.3 Maxar: WorldView/GeoEye

The WorldView/GeoEye satellites are a constellation of four satellites (WorldView-1, -2 ,-3, and GeoEye-1) offering submetre spatial resolution (Panchromatic) and agility that allows daily revisit. While WorldView satellites offer eight bands (WorldView-3 offers more bands) in multispectral mode, the acquisition is restricted to four bands as a) there is no need for more bands at this stage, and b) to reduce costs.

3.4 Planet: Planetscope and Skysat

PlanetScope is a swarm of more than120 micro (10cm x 10cm x 30cm) satellites orbiting the Earth at 475 km altitude, and offering the capability of daily revisit. The first three generations of Planet's optical systems are referred to as PlanetScope 0, PlanetScope 1, and PlanetScope 2. PlanetScope 2 has a 4-band multispectral imager (blue, green, red, near-infrared) with a Ground Sample Distance of 3.7m. The radiometrically-corrected orthorectified product (that was used in this project) is resampled to 3m.

The radiometric resolution is 12-bit and sensor-related effects are corrected using sensor telemetry and a sensor model. The bands are co-registered, and spacecraft-related effects are corrected using attitude telemetry and best available ephemeris data. Data are orthorectified using GCPs and fine DEMs (30 m to 90 m posting). While in 2020 the PlanetScope imagery was found to be of varied quality with different radiometric integrity displayed by different sensors, and on some occasions the imagery was offset, in 2021 the PlanetScope imagery was substantially better both radiometrically and geometrically, but not perfect. PlanetScope data were downloaded from the Planet Explorer Beta GUI tool that can be used to search Planet's catalogue of imagery, view metadata, and download full-resolution images[10].

Skysat: The Skysat mission comprises a constellation of 21 satellites offering sub-metre spatial resolution, in three groups: Skysat-1 and -2 [A/B Generation] with 0.86m Panchromatic and 1.0m multispectral resolution; Skysat-3 until -15 [C Generation, sun-synchronous] with 0.65m Pan and 0.81m MS resolution; and Skysat-16 until -21 [C-Generation, non-sun-synchronous] with 0.57m Pan and 0.75m MS resolution. The sub-daily revisit time that these satellites provide can increase the chances to acquire cloud-free imagery.

3.5 Sentinel-2

The Sentinel satellites are launched by ESA in support of the EU Copernicus programme. Sentinel- 2A and -2B carry an innovative wide swath high-resolution multispectral imager with 13 spectral bands primarily intended for the study of land and vegetation. The bands vary in spatial resolution, with four bands (Blue, Green, Red, and NIR) at 10m, six bands (four in NIR and two in SWIR) at 20m, and three bands (Blue, NIR and SWIR) at 60m. Although data are processed to different levels, but only Level-1C (orthorectified product) is provided to users. The Sentinel Toolbox[11] can then be used to generate a Level-2A (Bottom of Atmosphere reflectance product). Although the pixel size of 10m is not as fine as PlanetScope, the Sentinel-2 radiometric resolution was found to be superior, thus providing a clearer (but not finer) land cover image. For the periods Aug-Dec 2020 and Aug-Dec 2021, Google Earth Engine was used to select the best cloud-free images that matched the target sampling period. These were clipped to the buffered PSUs and downloaded. The S2 provided via GEE was level 1C, and cloudiness was calculated using the ESA s2cloudless and CDI* with areas of likely cloud shadow also included as 'cloud' (Frantz et al. 2018).

GFC acquired multiple Sentinel-2 scenes to cover the whole land area of Guyana for Aug-Dec 2020 and Aug-Dec 2021. Multiple scenes area required to cope with cloud cover.

3.6 Sampling Design for Change Analysis

The sampling design refers to the methods used to select the locations at which the reference data are obtained. As the area of the country is large, and deforestation is observed to be clustered around relatively small areas of human activity, it is efficient to adopt a stratified sampling framework rather than use simple random or systematic sampling (Gallego, 2000; Foody, 2004; Stehman, 2001). For each stratum, sample means and variances can be calculated; a weighted average of the within stratum estimates is then derived, where weights are proportional to stratum size. In this case, the goal is to improve the precision of the forest (or deforestation) area using a stratum-based estimate of variance that will be more precise that using simple random sampling (Stehman and Czaplewski, 1998; Stehman, 2009; Potapov *et al.*, 2014).

To assess the area and rate of deforestation, a two-stage sampling strategy with stratification of the primary units was adopted.

While the strata unit size was chosen in the past to assist with the aerial collection and the shape to minimise the cost of imagery acquisition, the decision to move towards VHR (Very High Resolution) satellite imagery requires a re-think of the strata unit.

Regarding the size, the minimum area that can be ordered from the VHR imagery archive is one sq.km, and therefore this is the minimum size we would choose (i.e. not smaller than one sq.km). As for a larger size, 95% of Guyana deforestation takes place in plots less than 10ha in size (see figure 1). Therefore, the size of one sq.km seems sufficient.

[10] http://www.planet.com/explorer (last accessed: December 2021)

[11] https://earth.esa.int/web/sentinel/toolboxes/sentinel-2 (last accessed: December 2021)

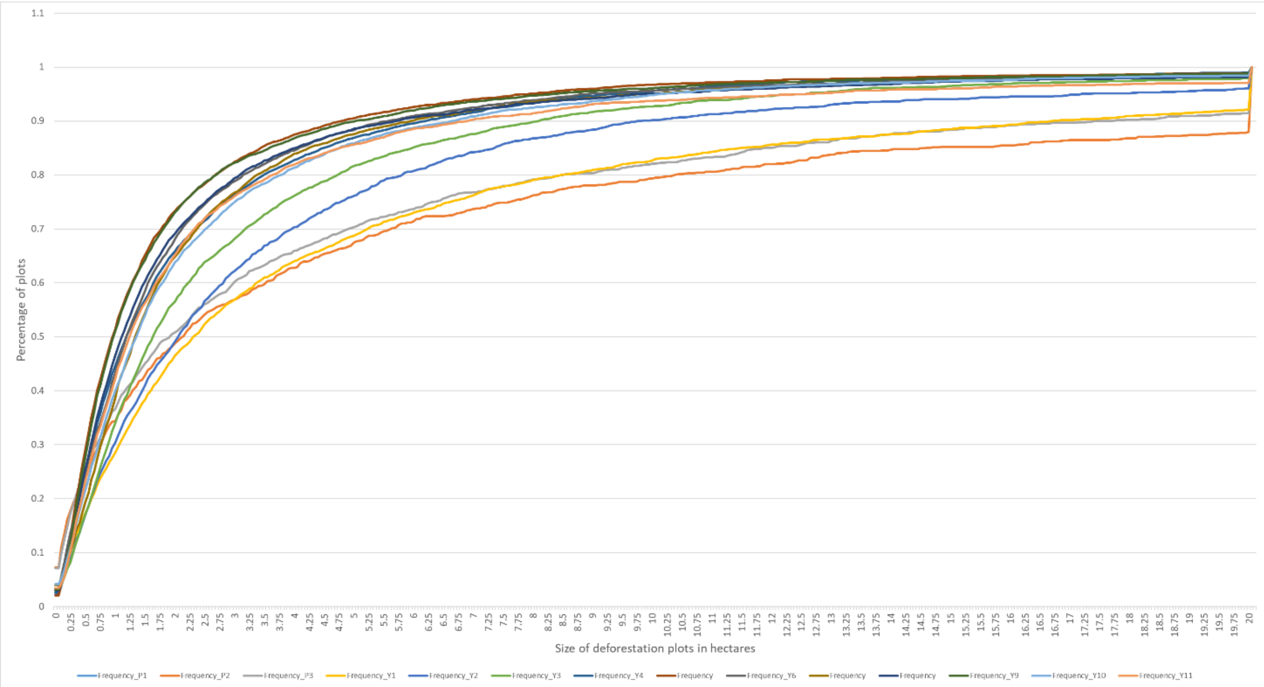


Figure 1 – With the exception of the three first periods and Y1, all other periods have 90% of the detected deforestation plots at an area of less than 10ha, while Y3-9 and Y11 have 95% of the plots below 10ha.

Regarding the shape, the satellite imagery pixels are square. For this, rectangular or square would be the right shapes to avoid sub-pixels especially when assessing change with imagery from Sentinel-2 (10m pixel size), or Landsat (30m pixel size). As there is no reason for a particular orientation in the shape, the square shape seems appropriate.

First, a square grid of 1 km by 1 km in size was created within the spatial extent of the country's national boundary[12]. Gridding resulted in 211,259 squares (see figure 2); note that only rectangles with a centroid within the Guyana national boundary were selected.

[12] According to the Interim Measures Report November 2015, the national boundary (that was used for the stratification) was defined with the aid of updated RapidEye ground control points, which resulted in an increase in spatial accuracy of the imagery.

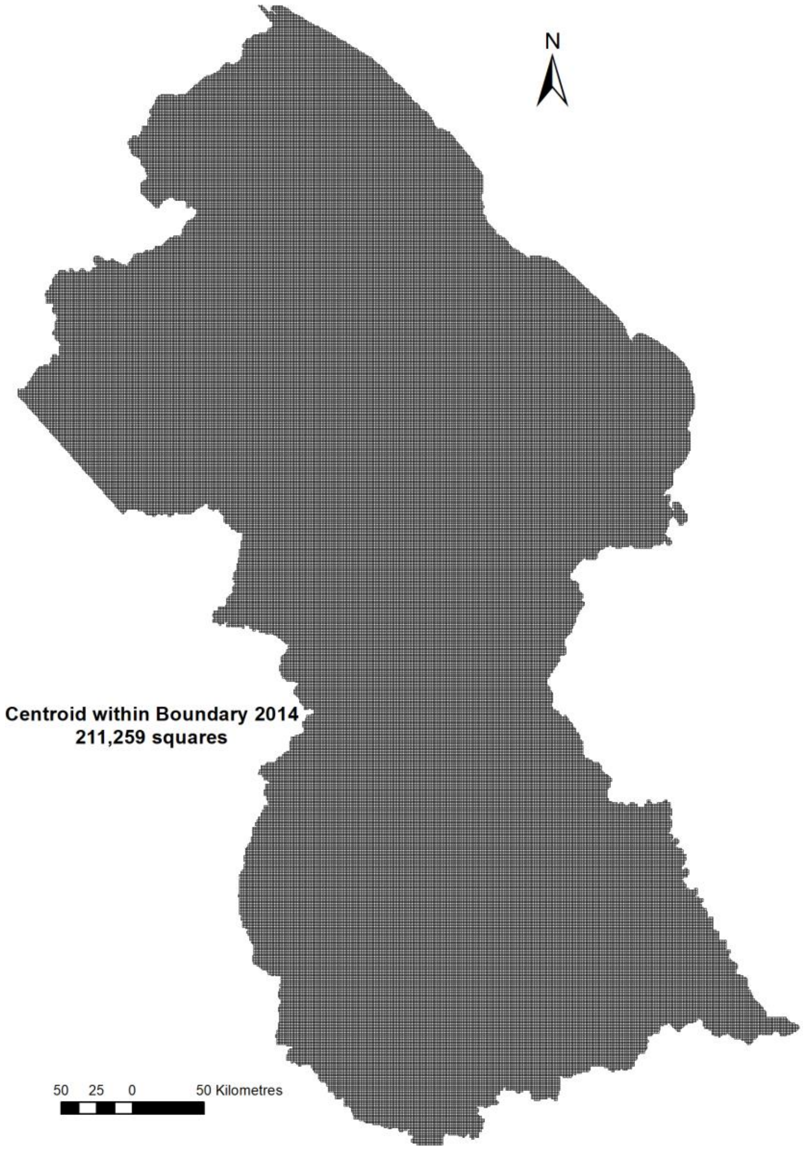


Figure 2 – Guyana broken down to 211,259 one sq.km squares. This forms the basis for the stratification.

Strata are based on actual observations of deforestation (particularly Years 1 to 11[13]). The method first selected the grid rectangles that intersected deforestation events. For every year of deforestation, the value 1 (one) was given. If no event was recorded, then the value 0 (zero) was given. For example, the rectangle with value 00000011000 intersects deforestation events that were recorded in Years 7 and 8. By using this record, it is easy to identify areas of persistent (i.e. occurring almost every year) deforestation (see figure 3).

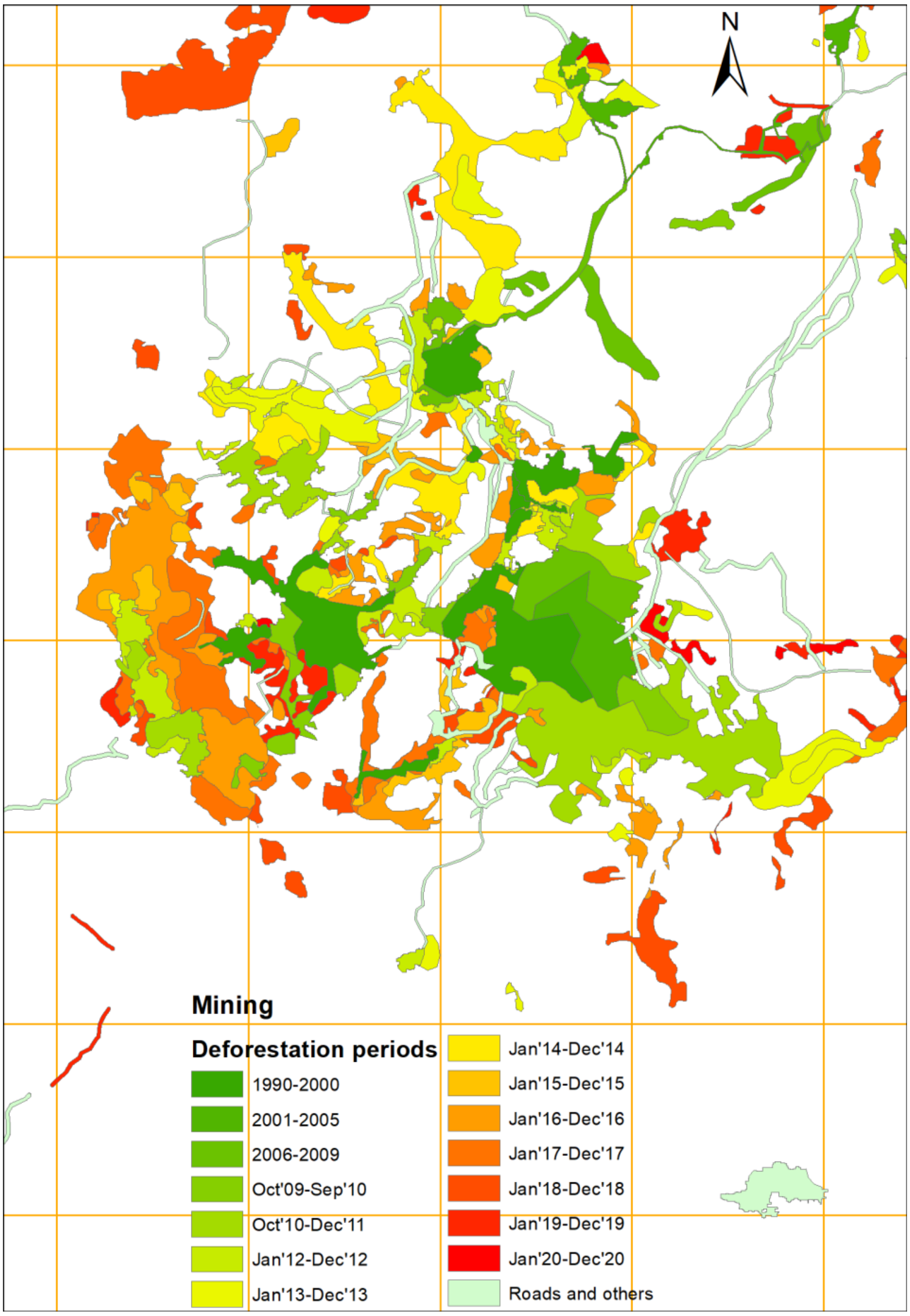


Figure 3 – This is an example of an area where deforestation happens almost every year. In this particular example, the change driver is mining. Most of the deforested areas are adjacent to each other, that is, new deforestation events appear clustered close to already deforested land.

These areas provide a good indication of the patterns of deforestation for each change driver. For example, in figure 3, the mining operations remove forest mostly adjacent to the operations, year-by-year. While placing the mining areas within the high risk stratum, there

[13] Note that in GFC mapping Y11 is the Jan-Dec 2020 period, while the Jan-Dec 2021 period is mapped as Y12.

should be a consideration of how deep in the forest a mining operation may proceed within the year. Figure 1 illustrated an expectation that 95% of the areas of forest loss will be less than 10 ha. After placing a *minimum bounding geometry* around deforestation with mining as driver, the maximum width for these areas was 895m. Therefore, for mining areas, to capture expanding deforestation, a buffer of 900m can reasonably be applied and so include more squares in the High Risk stratum.

When deforestation events have been observed for the last two years, then the sample square was assigned to the High Risk (HR) stratum. A buffer of 900m was then applied to include more sample squares in the High Risk stratum. All other sample squares were assigned to LR (Low Risk) stratum.

This resulted in the classification of sample squares into three strata: 25,549 HR, 177,258 LR, and 8452 0R (zero risk) (see figure 4 – left). Proportionally, aiming for a total of 1,000 randomly sampled squares, 126HR and 874LR were selected. However, the minimum order of VHR data (in particular WV/GE and Skysat) resulted to 150 scenes. For this, 156HR and 874LR were the final selection (see figure 4 – right).

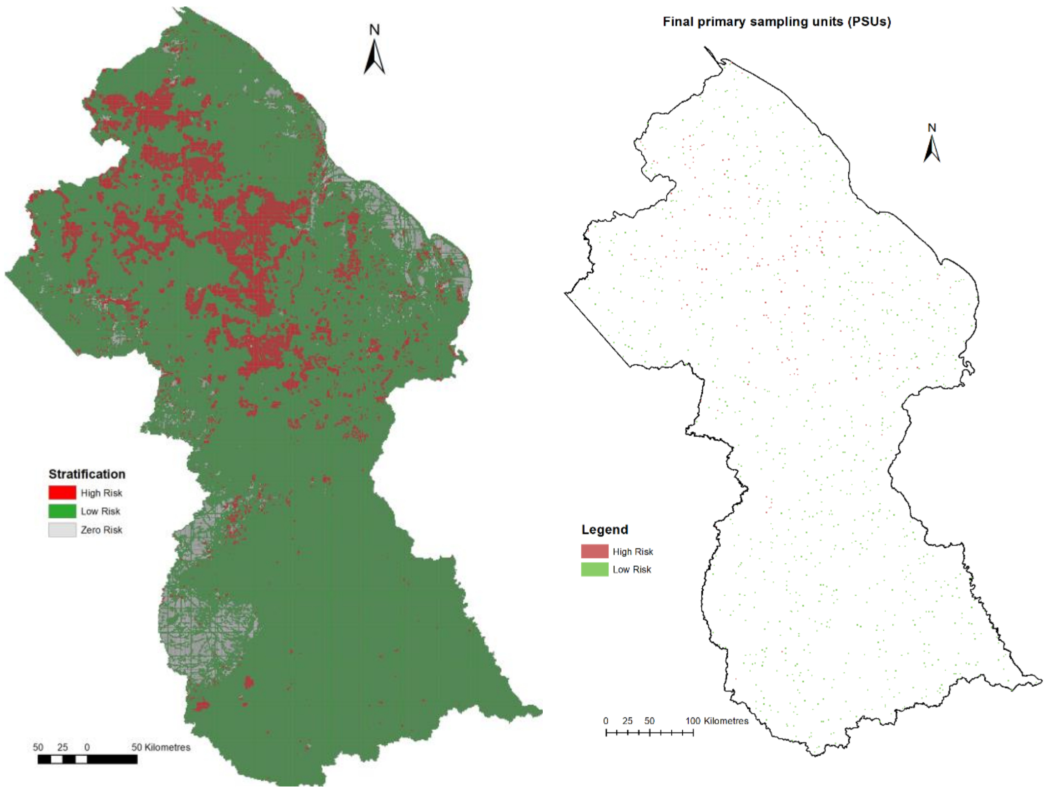


Figure 4 – High and Zero Risk strata (left) and final random sampling of the strata (right image).

Within each first-stage sample, a systematic grid of 100 hectares was generated. The centre point of the each of the first-stage samples was generated randomly. In total 103,000 one-hectare samples became available for accuracy assessment.

For each primary sampling unit (PSU), the land cover class (e.g. Forest or Non-Forest, Degradation or Non- Degradation) is determined for the Year 11 deforestation and degradation map. The assessment follows a systematic procedure where the GIS table for the samples is populated using a GIS toolbar.

Specifically, the tools used to interpret and validate Year 11 land cover change included high resolution satellite imagery (see Table 3.1). Also available were GIS data indicating mining, forestry and agricultural concessions.

Year 11 Change Assessment involved the collection of 1030 equally sized primary sample units (each with 100 ha) with a direct correspondence with Year 10. The reference data selected for the change assessment in Year 11 was a combination of PlanetScope, Maxar and Sentinel-2 imagery for the High Risk stratum, and Sentinel-2 imagery for the Low Risk stratum.

3.7 Precision of Area Estimates for Deforestation and Forest Degradation

The two-stage sampling with stratification of the primary units design optimises the probability of sampling deforestation and forest degradation in Year 11 when the area concerned represents only a small fraction of the national land area. Furthermore, there are several factors such as cloud cover, accessibility, safety and cost that limit the availability and quality of reference data.

A key consideration is minimising the risk of introducing any possible bias into the estimates. Bias may arise from sampling, from cloud cover patterns and perhaps from the distribution and coverage of the reference data. Sampling bias can be assessed from the joint probability matrices. The distribution of cloud cover has been assessed qualitatively from cloud cover masks but this can be quantified more formally from the sample area data and from the cloud mask data derived from analysis of the satellite imagery.

The validation team consists of three well qualified and experienced image interpreters. The analysis involved identifying change, paying strict attention of the definitions of ‘forest cover’, ‘degraded forest cover’ and ‘non- forest’ as well as the interpretation rules for deforestation and forest degradation. The procedure uses an ArcMap Change-Assessment Toolbar, and follows the mapping rules as detailed in the Standard Operating Procedures for Forest Change Assessment: A Guide for Remote Sensing Processing & GIS Mapping, along with Operating Procedures for REDD+ Accuracy Assessment.

3.8 Decision Tree for 2021 (Year 11) Change Analysis

The analysis will report a gross deforestation change estimate based on a stratified random change estimator. This will provide confidence interval information on the deforestation estimate (i.e. the amount of change). Put another way, there is no sub-sampling other than to break down the measurement into a hectare-sized grid to make the assessment manageable. Appendix 8 provides information about how decisions are made when a deforestation, forest degradation, or afforestation event is met by the interpreter, to complete the contingency matrix (see Table 3- 4).

Table 3-4 Contingency matrix to represent change as detected by the assessment team.

	End Reference Class			
Start Reference Class	Forest	Degradation	NonForest	Total
Forest	Stable Forest	Loss	Loss	
Degradation	Gain	Stable Degradation	Loss	
NonForest	Gain	Gain	Stable NonForest	
Total				

When assessing degradation, it is important to follow the Mapping Rules that define degraded-forest and non-forest that are detailed in the Standard Operating Procedure for Forest Change Assessment (see Appendix 8).

The most important points to note are:

1. Only areas of forest degradation that relate to Years 10 and 11 are assessed.
2. Areas of shifting cultivation are classified as “Pioneer” and “Rotational” even if they are smaller in size than the minimum mapping unit (1 ha). “Pioneer” areas are evaluated as deforestation and “Rotational” as forest degradation.
3. Areas of water bodies are classified as non-forest.

4. Areas cloud and shadow or missing data are labelled as Omitted.
5. Areas representing Year 12 change (post Dec 2021) were also omitted from the analysis as this change postdates the Year 11 reference imagery.

The rules for validating each sample unit point account for small discrepancies with the geometric alignment among the various remote sensing data sets. The change samples are ideally interpreted at 1:5,000 scale using 2020 imagery (PlanetScope, or Sentinel-2) and 2021 imagery (Maxar, Skysat, PlanetScope, or Sentinel-2) imagery. Factors, other than human error, that might explain misinterpretation include land obscured by cloud or cloud shadow and change that is too small to be detected on the available cloud-free imagery.

Furthermore, where a discrepancy between the mapping and the validation data is detected, an interpretation will be made of the correct assignment for the sample point. The toolbar included a confidence label on a 0-4 scale. The uncertainty refers to confidence in interpreting either change or the driver for change and is recorded on a four interval percentage scale. This allows for uncertainties in interpretation to be removed from the estimation and validation process if required.

3.9 Precision of Area Estimates for Deforestation and Forest Degradation

A consistency check on 100 samples was undertaken to provide assurance that the interpretations of change were agreed among the team. A small 'refresher' also took place a week before the Accuracy Assessment exercise. Following the exercise, a consistency check was run on the areas of change. The outcome was a 90% agreement between two independent operators for change and 93% for Driver allocation.

4 STATISTICAL METHODOLOGY

4.1 Change Sample Estimates

We treat the design as a stratified cluster design. The clusters are squares. The strata are HR and LR. A simple random sample of squares from each stratum is taken. Then, within each rectangle, all hectares are systematically evaluated, and all change measured quantitatively. This sample design can be analysed routine primarily used Maxar, Skysat and PlanetScope imagery supplemented by reinterpretation of Sentinel-2 satellite imagery in parts of Guyana that were within the Low Risk stratum.

The reference data consisted of 1030 primary sample units stratified into HR (2,554,900 ha) and LR (17,725,800 ha) areas as described in the sampling design (Section 4.3) and randomly sampled within each stratum. This design allows a probability-based inference approach to be applied. This approach assumes (1) that samples are selected from each stratum randomly; (2) that the probability of sample selection from each stratum can be estimated; (3) the sampling fraction in each stratum is proportional to the total population and that the relative sample size reflects, in this case, a ratio of 65:35 between HR and LR stratum respectively.

The total number of 1 ha samples analysed in the whole survey was 103,000. Of this total only 2,916 were Omitted due to cloud cover or cloud shadow in the reference imagery. The proportion of the total omitted is 0.0283 which represents 2.8 % of the sample. This is more than in previous years where GeoVantage aerial imagery was available as reference data.

Key inputs to the analysis are the total number of samples in each stratum. These are 2,554,900 ha (15,600 sampled hectares) for HR and 17,725,800 (87,400 sampled hectares) for LR.

Apart from no change samples (Forest-Forest; NonForest-Non Forest; Degradation-Degradation), the key changes are Forest-Non Forest, Forest-Forest Degradation, and Forest degradation – Non Forest.

4.2 Software and estimators

To carry out the analysis, we have used the survey package available with the statistical package R Core Team (2014). This package is free and used by and supported by most of the world's academic statisticians, and increasingly is the commercial tool of choice. The survey package provided in Lumley (2004, 2014) provides functionality similar to that provided by the SAS package[14], and uses the same standard formulae for estimation of means and variances. These formulae are set out below and described conveniently in Lumley (2014).

---

[14] SAS SURVEYMEANS procedure. http://www.math.wpi.edu/saspdf/stat/pdfidx.htm

Definitions and Notation

For a stratified clustered sample design, together with the sampling weights, the sample can be represented by an $n \times (P+1)$ matrix

$$(W, Y) = \left(w_{hij}, y_{hij}\right)$$
$$= (w_{hij}, y_{hij}^{(1)} y_{hij}^{(2)}, \dots \dots \dots, y_{hij}^{(p)})$$

Where

$h = 1,2, \dots \dots \dots, H$ is the stratum number, with a total of H strata

$i = 1,2, \dots \dots \dots, n_h$ is the cluster number within stratum h, with a total of n_h clusters

$j = 1,2, \dots \dots \dots, m_{hi}$ is the unit number within cluster i of stratum h, with a total of m_{hi} units

$p = 1,2, \dots \dots \dots, P$ is the analysis variable number, with a total of P variables

$n = \sum_{h=1}^{H} \sum_{i=1}^{n_h} m_{hi}$ is the total number of observations in the sample

w_{hij} denotes the sampling weight for observation j in cluster i of stratum h

$y_{hij} = (y_{hij}^{(1)} y_{hij}^{(2)}, \dots \dots \dots, y_{hij}^{(p)})$ are the observed values of the analysis variables for observation j in cluster i of stratum h, including both the values of numerical variables and the values of indicator variables for levels of categorical variables.

Mean

$$\underline{\hat{Y}} = \frac{\left(\sum_{h=1}^{H} \sum_{i=1}^{n_h} \sum_{j=1}^{m_{hi}} w_{hij} y_{hij}\right)}{w}$$

Where

$$w_{\dots} = \sum_{h=1}^{H} \sum_{i=1}^{n_h} \sum_{j=1}^{m_{hi}} w_{hij}$$

Is the sum of the weights over all observations in the sample.

Confidence limit for the mean

The confidence limit is computed as

$$\underline{\hat{Y}} \pm StdErr\left(\underline{\hat{Y}}\right) . t_{df,\infty/2}$$

Where $\underline{\hat{Y}}$ is the estimate of the mean, $StdErr\left(\underline{\hat{Y}}\right)$ is the standard error of the mean, and $t_{df,\infty/2}$ is the $100(1-\frac{\infty}{2})$ percentile of the t distribution with the df calculated as described in the section “t Test for the Mean”.

Proportions

The procedure estimates the proportion in level c_k for variable C as

$$\hat{p} = \frac{\sum_{h=1}^{H} \sum_{i=1}^{n_h} \sum_{j=1}^{m_{hi}} w_{hij} y_{hij}^{(q)}}{\sum_{h=1}^{H} \sum_{i=1}^{n_h} \sum_{j=1}^{m_{hi}} w_{hij}}$$

Where $y_{hij}^{(q)}$ is value of the indicator function for level $C = c_k$

$y_{hij}^{(q)}$ equals 1 if the observed value of variables C equals c_k, and

$y_{hij}^{(q)}$ equals 0 otherwise.

Total

The estimate of the total weighted sum over the sample,

$$\hat{Y} = \sum_{h=1}^{H} \sum_{i=1}^{n_h} \sum_{j=1}^{m_{hi}} w_{hij} y_{hij}$$

For a categorical variable level, $\hat{Y}$ estimates its total frequency in the population.

Variance and standard deviation of the total

$$\hat{V}(\hat{Y}) = \sum_{h=1}^{H} \frac{n_h(1-f_h)}{n_h - 1} \sum_{i=1}^{n_h} (y_{hi\cdot} - \underline{y}_{h\cdots})^2$$

Where

$$y_{hi\cdot} = \sum_{j=1}^{m_{hi}} w_{hij} y_{hij}$$

$$\underline{y}_{h\cdot\cdot} = (\sum_{i=1}^{n_h} y_{hi\cdot})/n_h$$

The standard deviation of the total equals

$$Std(\hat{Y}) = \sqrt{\hat{V}(\hat{Y})}$$

Confidence limits of a total

$$\hat{Y} \pm StdErr\left(\hat{Y}\right).\, t_{df,\infty/2}$$

5 RESULTS

5.1 Estimates of forest cover in Year 10

We can ignore that we have Year 11 information and obtain estimates of Year 10 forest cover. These can be compared to estimates obtained by other means. Table 5.1 shows the total areas classified as Degraded, Forest, and NonForest, together with a standard error and a 97.5% confidence interval. For example, the estimate of non- degraded Forest cover in Dec 2020 (year 10) is 17,652,007 ha, standard error 18,897 ha, and 97.5% confidence interval (17,614,000; 17,689,041) ha.

Table 5.2 gives the same information as in Table 5.1, but shows proportions rather than totals. So, the proportion of Forest cover in 2020 is 0.8972, standard error 0.001, 97.5% confidence interval (0.8953, 0.8999). Note that proportions add to one.

Table 5.1 Analysis of Y10 (2020) hectares of all classes

	Hectares	SE	2.5%	97.5%
Degraded forest	160,893	5,421	150,267	171,519
Non-degraded forest	17,652,007	18,897	17,614,970	17,689,041
Non forest	1,861,806	18,258	1,826,224	1,897,792

Table 5.2 Analysis of Y10 (2020) proportions of all classes

	Mean	SE	2.5%	97.5%
Y10 Degraded forest	0.0082	0.0003	0.0076	0.0087
Y10 Non-degraded forest	0.8972	0.001	0.8953	0.8991
Y10 Non-forest	0.0946	0.0009	0.0928	0.0965

5.2 Estimates of forest cover in 2021 (Year 11)

We now repeat these analyses for Year 11. Table 5.3 shows the total areas classified as degraded forest, non- degraded forest, and non-forest, together with a standard error and a 97.5% confidence interval. For example, the estimate of non-degraded forest cover in Year 11 is 17,629,661 hectares, standard error 18,979 hectares, and 97.5% confidence interval (17,592,400; 17,666,000) hectares. Table 5.4 shows proportions instead of totals. Otherwise, the interpretation is as for Year 10.

Table 5.3 Analysis of Y11 (2021) hectares of all classes

	Ha	SE	2.5%	97.5%
Degraded forest	175,143	5656	164,058	186,228
Non-degraded forest	17,629,661	18,979	1.75925 e+07	1.7667 e+07
Non forest	1,870,103	18,288	1,834,260	1,905,947

Table 5.4 Analysis of Y11 (2021) proportions of all classes				
	Mean	SE	2.5%	97.5%
Degraded forest	0.0089	0.0003	0.0083	0.0095
Non-degraded forest	0.8960	0.001	0.8942	0.8979
Non forest	0.0951	0.0009	0.0932	0.969

5.3 Estimates of change from Year 10 to Year 11

We analyse change from Year 10 to Year 11 as follows. We have matched pairs of sample data, where the hectares seen in Year 10 are seen again in Year 11. Therefore, it is natural to concentrate upon the change for each pair. This is analogous to the matched paired t-test, where we calculate differences between pairs, and then analyse the differences.

There are three possible outcomes for each pair, depending on how the hectare was classified in Year 10. If the classification had been Forest (non-degraded), the possibilities are Forest in Year 10 and Year 11, Forest in Year 10 and Degraded in Year 11, and Forest in Year 10 and Non Forest in Year 11. Therefore, these will result a total of nine possible combinations of change.

Table 5.5 Totals of Class Changes from Forest for 2020-2021				
Stratum / Class	Hectares	SE	2.50%	97.50%
Forest/Degraded to NonForest	8,096	1,171	5,801	10,390

In Table 5.5 we estimate the area of Guyana which was classified as Forest, including degraded forest in Year 10 and NonForest in Year 11. The estimate is 8,096 hectares, standard error 1,171 hectares, 97.5% confidence interval (5,801 ha; 10,390 ha). Appendix 1 gives the same information as Table 5.5, but disaggregated by stratum and by proportions rather than totals.

In Year 11 the GFC mapping team found no change from Non-Forest to Forest or Degraded Forest to Forest (i.e. reforestation). Note that it would be difficult to identify reforestation with any certainty in the LR stratum because only Sentinel- 2 data are available. Nevertheless, no reforestation was found in the HR stratum using the high resolution Maxar, Skysat, PlanetScope or Sentinel-2 imagery. Note that, although not a formal requirement of the accuracy assessment, the change from forest to degraded forest was measured precisely for each sample where change (forest loss) was identified. This was done manually using the 'measure tool' in ArcGIS and the value entered in the database using the Accuracy Toolbar to the nearest 5% for each sample hectare. The amount of loss is classed as degraded forest when forest area of 0.25 ha or more is lost, up to the point that 30% or less of the area is forest canopy covered; after that, the sample hectare would be classed as deforested. In this way partial deforestation and forest degradation is assessed quantitatively within each sample area. The total area for change from Forest to Degraded forest is 16,949 hectares, standard error 1,766 hectares, 97.5% confidence interval (13,487 ha; 20,410 ha).

5.4 Estimating rate of change.

The key issue is to estimate the rate of change of gross deforestation. To do this, we restrict attention to hectares which in Year 10 were classified as forest or degraded, and then estimate the rates at which they continued to be forest, or were classified as non-forest. The estimated number of hectares of forest and degraded forest in Year 10 changed to non-forest in Year 11 is 8,096 hectares with a standard error of 1,171 hectares, 97.5% confidence interval (5,801 ha; 10,390 ha). These changes translate into a mean rate of deforestation on 0.0329 % with a SE of 0.041 % with a 97.5% confidence interval for the rate of change of 0.025 % to 0.0409 %, see Table 5.6.

Table 5.6 Mean Deforestation annual rate per hectare (%)				
	Mean	SE	2.5%	97.5%
Year 11 (2021) Forest loss	0.0329	0.0041	0.025	0.041

5.5 Deforestation rate comparison

Table 5.7 shows the Year 10 to Year 11 deforestation area and rate data compared. Note that the map-based estimate does not have a standard error associated with it but that the mapping and the change sample estimates are of similar magnitude. Note that the sample-based estimate considers only the areas available to sample, that is, the LR and HR strata. Year 11 shows the lowest rate of change according to the sample-based change estimates.

Table 5.7 Comparison of Forest Change Estimates Source			
	Area change (ha)	Change Rate (%)	SE Rate (%)
GFC / Indufor GIS Map Estimate	7,630		
Change Sample Estimate	8,096	0.03295	0.0041

6 DISCUSSION

The results divide into three areas that warrant further discussion:

(i) the strategy used to identify and quantify deforestation and estimate change area from imagery

(ii) estimation of the drivers of forest loss;

(iii) quality of the imagery needed to undertake the assessment.

6.1 Quantifying deforestation level

The approach taken by GFC to produce a comprehensive (wall-to-wall) map for forest/non-forest for Guyana is ambitious and provides very precise, location-specific data. The mapped area of gross deforestation is slightly lower than the sample-based estimate although the mapped area falls within the confidence interval of the sample-based estimate.

There are a number of possible reasons that might explain the small difference between the two measures of gross deforestation.

1. The MRV mapping is based on Sentinel-2 MSI imagery and so areas identified as deforestation might, in fact, be forest degradation and vice versa.
2. The overall amount of deforestation is low and so it is possible that a few small areas account for the differences and these areas, by chance, fall outside the sampled areas.
3. The proportion (approx. 2.8%) of samples omitted (because of cloud cover) is higher in Y11 than in Y10 and so may obscure some change areas.
4. The accuracy assessment for deforestation did not check the GIS map product, rather it estimated forest loss from an independent probability-based sample.

In the figures 6.1-6.2, different examples are presented that illustrate the quality of the data and how it is used in the sample-based estimation process noting the rules as described in the standard operating procedures.

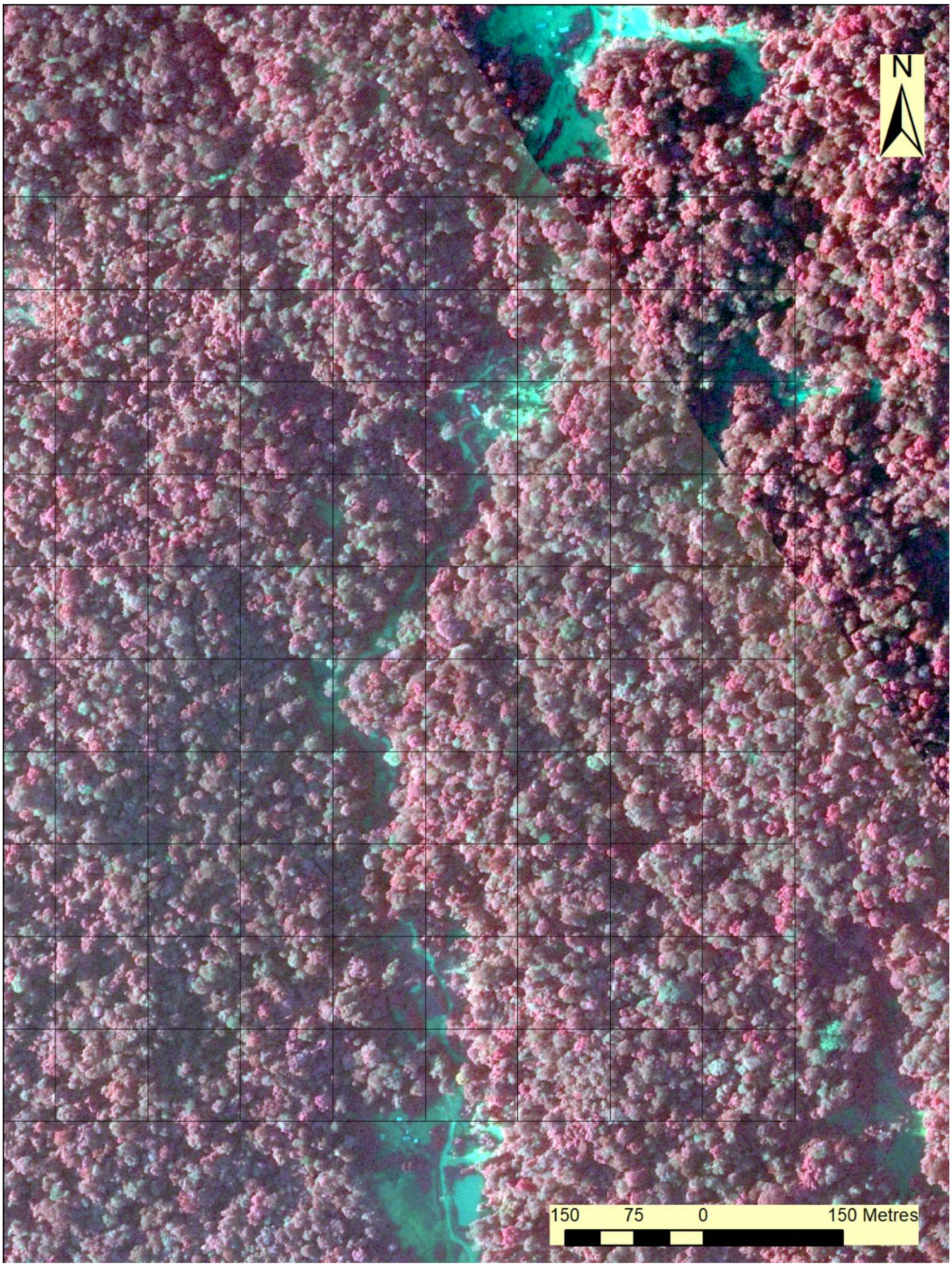


Figure 6.1 – Pan-sharpened Skysat image acquired in September 2021, showing the final state of the forest after mapping deforestation and detecting forest degradation.

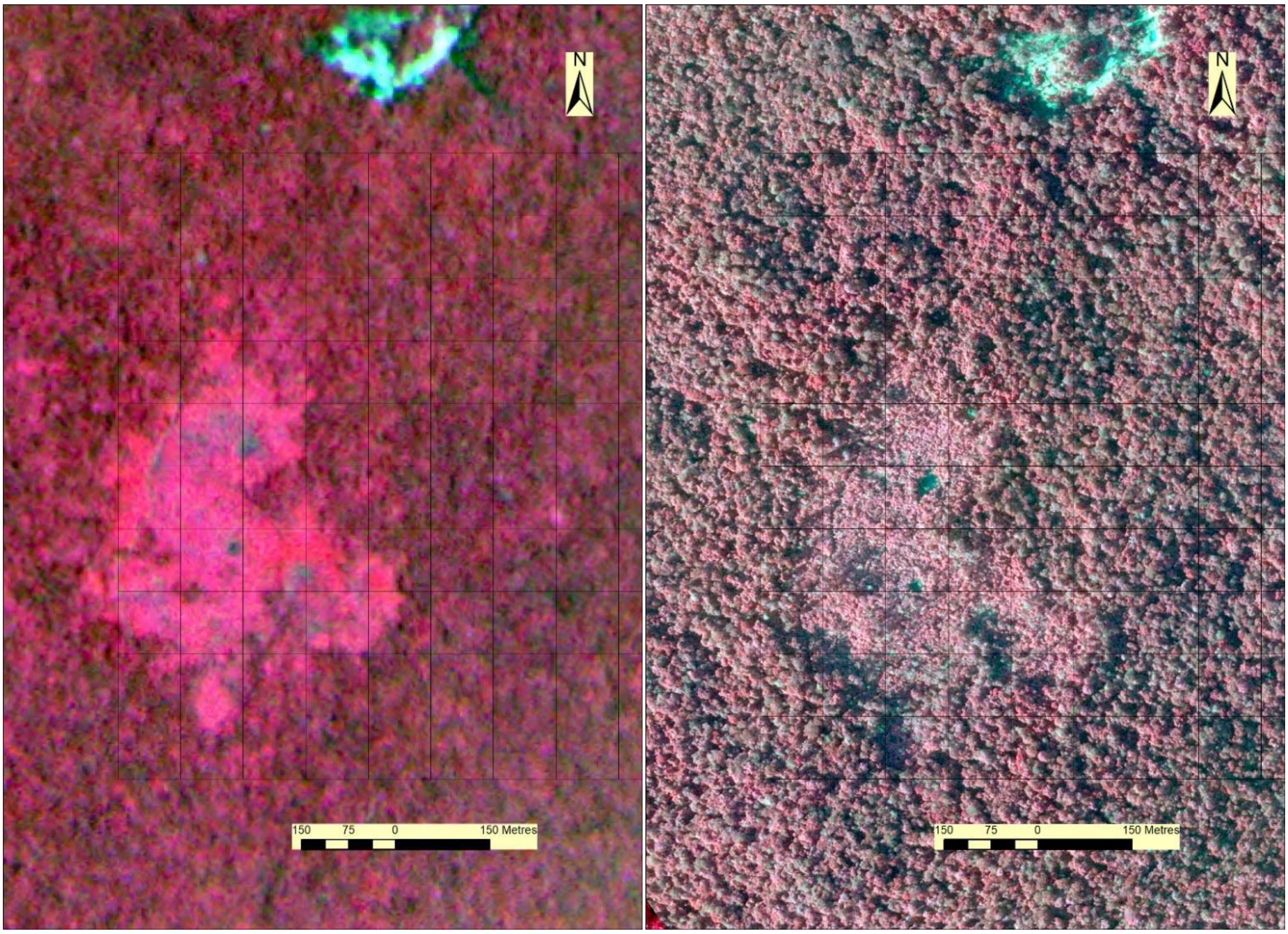


Figure 6.2 – This is an example where the spatial resolution of the imagery plays an important role in the interpretation of the land cover. The left image is Planetscope and the right image is pan-sharpened Skysat satellite data. While an interpreter may have seen a different forest type in the PlanetScope satellite image, it is obvious from the Skysat image that this area is in fact comprised of low vegetation. Further exploration showed that this is an abandoned mine from 2015, which is not yet reforested.

6.2 Drivers of Deforestation

Table 6.1 shows the deforestation data broken down by driver for the assessment sample. This shows that 89% of deforestation is associated with mining and mining infrastructure, 4% with agriculture and 4% settlements. The results confirm GFCs conclusion that mining and mining-related infrastructure including settlements is the overwhelming driver for deforestation in Year 11 (2021).

Table 6.1 Drivers of Deforestation				
Driver	Area in ha	SE	2.5%	97.5%
Agriculture	367	260	-144	878
Mining	7199	1099	5044	9353
Settlements	328	321	-126	781
Fire				
Shifting agriculture	202	202	-195	600
Unknown				
Total	8096	1,171	5801	10399

6.3 Image Datasets for Deforestation Mapping

The strategy for accuracy assessment in year 10 and year 11 is to move away from airborne imagery and towards the use of fine (sub-metre pixel size) and medium-fine (3-10 m) spatial resolution satellite imagery. Table 3.1 details the types of imagery used for the reference data set where the pixel size varies from sub-metre (MAXAR and SkySat) to 3m (PlanetScope) and 10m (Sentinel 2 MSI). It must be noted that acquiring suitable cloud-free satellite imagery presents a considerable challenge and a risk to the project. To mitigate the risk, two contracts were awarded to different suppliers for the fine resolution data, and their ability to deliver of these contracts varied between a 20% success rate for MAXAR and a 65% success rate for Planet for SkySat data[15]. PlanetScope satellite constellation data were available via the NICFI Data Program for Guyana that includes an agreement between Norway (NICFI) and Planet to provide Guyana with Level 2 access to original rather than mosaiced PlanetScope 'Visual Basemaps' image data.

Our assessment on the quality of the reference data can be summarised in the following statements:-

(i) Drivers of change are easily identified on Maxar and Skysat imagery,

(ii) Maxar, Skysat and PlanetScope imagery was not available for the Low Risk stratum, thus giving a possible bias in driver classification by stratum.

(iii) Skysat images have a relatively small footprint and so several of the AA images were (visibly) mosaicked but this did not cause any difficulties with change sample interpretation.

(iv) Sentinel-2 MSI data were, in general, of good radiometric and we found no geometric/positional quality problems.

[15] The larger (than Maxar) number of satellites in the Skysat constellation, combined with the non-sun synchronous orbits, provided more chances for cloud-free acquisitions.

(v) At two PSU locations, there were geometric differences between PlanetScope and Sentinel-2 data.

(vi) At one PSU location, PlanetScope data from different years did not overlay perfectly.

(vii) There is noticeable variability in radiometric image quality of the PlanetScope acquisitions, noting that different instruments from the constellation of satellites were used in the analysis (PS2, PS2.SD, PSB.SD).

7 SUMMARY AND CONCLUSIONS

We conclude that the estimates of deforestation based on the mapping undertaken by GFC based largely on interpretation of Sentinel-2 MSI and PlanetScope imagery matches closely with the independent change sample analysis undertaken by the Durham University mapping team using Maxar, Skysat, PlanetScope and Sentinel-2 MSI data.

The methods used by GFC, and assisted by IAP, follow the good practice recommendations set out in the GOFC-GOLD guidelines and considerable effort has been made to acquire cloud free imagery towards the end of the census period October-December 2021 (Year 11).

The estimate of Year 11 deforestation, derived independently from GFC, using a change sample analysis of the total area of change in the 12-month Year 11 period from forest to non-forest and degraded forest to non-forest is **8,096 ha**, with a standard error of **1,171 ha** and a 97.5% confidence interval (5,081 ha; 10,399 ha).

The estimate of the annual rate of deforestation that occurred over the Year 11 (12 month) period is **0.0329%** with a standard error of **0.0041%** and a 97.5% confidence interval (0.025%; 0.041%).

Four changes of total 1.35 ha was detected within samples that fell within the boundary of the Intact Forest Landscape. The change was interpreted as forest degradation associated with shifting agriculture.

The Maxar, Skysat and PlanetScope data provided sufficient detail (spatial resolution) to assess the Sentinel-2 MSI deforestation mapping as provided by GFC.

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9 APPENDIX A: STATISTICAL TABLES

Table A1 – ANALYSIS OF 2020 Hectares OF ALL CLASSES

	Hectares	SE	2.50 %	97.50 %
2020 Degradation	160893	5422	150267	171519
2020 Forest	17652007	18897	17614970	17689043
2020 Non Forest	1862008	18258	1826224	1897792

Table A2 - ANALYSIS OF 2020 Hectares OF ALL CLASSES BY STRATUM

	Hectares	SE	2.50 %	97.50 %
HR:2020 Degradation	72061.3	3386.6	65423.6	78699
LR:2020 Degradation	88831.8	4233.5	80534.2	97129.4
HR:2020 Forest	2236848	6721.3	2223674	2250021
LR:2020 Forest	15415159	17660.7	15380544	15449773
HR:2020 NonForest	242551.7	5995.8	230800.1	254303.3
LR:2020 NonForest	1619457	17244.9	1585657	1653256
HR:2020 NonForest	72061.3	3386.6	65423.6	78699
LR:2020 NonForest	88831.8	4233.5	80534.2	97129.4

Table A3 - ANALYSIS OF 2020 Proportions OF ALL CLASSES

	Mean	SE	2.50%	97.50%
2020 Degradation	0.0082	3.00E-04	0.0076	0.0087
2020 Forest	0.8972	1.00E-03	0.8953	0.8991
2020 NonForest	0.0946	9.00E-04	0.0928	0.0965

Table A4- ANALYSIS OF 2020 Proportions OF ALL CLASSES BY STRATUM

	Mean	SE	2.50%	97.50%
HR:2020 Degradation	0.0282	0.0013	0.0256	0.0308
LR:2020 Degradation	0.0052	0.0002	0.0047	0.0057
MR:2020 Degradation	0.8767	0.0026	0.8715	0.8819
HR:2020 Forest	0.9002	0.001	0.8982	0.9023
LR:2020 Forest	0.0951	0.0023	0.0905	0.0997
MR:2020 Forest	0.0946	0.001	0.0926	0.0965
HR:2020 NonForest	0.0282	0.0013	0.0256	0.0308
LR:2020 NonForest	0.0052	0.0002	0.0047	0.0057
MR:2020 NonForest	0.8767	0.0026	0.8715	0.8819

Table A4 - ANALYSIS OF 2021 Hectares OF ALL CLASSES

	Hectares	SE	2.50%	97.50%
2021 Degradation	175143.4	5655.507	164058.8	186228
2021 Forest	17629661	18978.99	17592463	17666859
2021 NonForest	1870104	18287.86	1834260	1905947

Table A6 - ANALYSIS OF 2021 Hectares OF ALL CLASSES BY STRATUM

Stratum / Class	Hectares	SE	2.50%	97.50%
HR:2021 Degradation	77793.4	3514.7	70904.8	84682.1
LR:2021 Degradation	97349.9	4430.8	88665.8	106034.1
HR:2021 Forest	2224237	6835.3	2210840	2237634
LR:2021 Forest	15405424	17705.4	15370722	15440126
HR:2021 NonForest	249430.3	6071.2	237531	261329.6
LR:2021 NonForest	1620674	17250.7	1586863	1654484

Table A5 - ANALYSIS OF 2021 Proportions OF ALL CLASSES

	Mean	SE	2.50%	97.50%
2021 Degradation	0.0089	3.00E-04	0.0083	0.0095
2021 Forest	0.896	1.00E-03	0.8942	0.8979
2021 NonForest	0.0951	9.00E-04	0.0932	0.0969

Table A8 - ANALYSIS OF 2021 Proportions OF ALL CLASSES BY STRATUM

Stratum / Class	Mean	SE	2.50%	97.50%
HR:2021 Degradation	0.0305	0.0014	0.0278	0.0332
LR:2021 Degradation	0.0057	0.0003	0.0052	0.0062
HR:2021 Forest	0.8718	0.0027	0.8665	0.877
LR:2021 Forest	0.8997	0.001	0.8976	0.9017
HR:2021 NonForest	0.0978	0.0024	0.0931	0.1024
LR:2021 NonForest	0.0946	0.001	0.0927	0.0966

Table A9 - ANALYSIS OF 2020-2021 TOTALS OF CLASS CHANGES

	Hectares	SE	2.50 %	97.50 %
2020-2021 Degradation.Degradation	158194.6	5381.1	147647.9	168741.4
2020-2021 Forest.Degradation	16948.8	1766.1	13487.2	20410.3
2020-2021 Forest.Forest	17629661	18979	17592463	17666859
2020-2021 Degradation.NonForest	2698.5	676.4	1372.8	4024.1
2020-2021 Forest.NonForest	5397	956.2	3522.9	7271
2020-2021 NonForest.NonForest	1862008	18257.5	1826224	1897792

Table A10 - ANALYSIS OF 2020-2021 proportions OF CLASS CHANGES

	Mean	SE	2.5	%
2020-2021 Degradation.Degradation	0.00804	0.00027	0.0075	0.00858
2020-2021 Forest.Degradation	0.00086	0.00009	0.00069	0.00104
2020-2021 Forest.Forest	0.89605	0.00096	0.89416	0.89794
2020-2021 Degradation.NonForest	0.00014	0.00003	0.00007	0.0002
2020-2021 Forest.NonForest	0.00027	0.00005	0.00018	0.00037
2020-2021 NonForest.NonForest	0.09464	0.00093	0.09282	0.09646

Table A11 - ANALYSIS OF 2020-2021 TOTALS OF CLASS CHANGES BY STRATUM

Stratum / Class	Hectares	SE	2.50%	97.50%
HR:2020-2021 Degradation.Degradation	69768.4	3333.9	63234.2	76302.7
LR:2020-2021 Degradation.Degradation	88426.2	4223.9	80147.5	96704.9
HR:2020-2021 Forest.Degradation	8025	1144.7	5781.5	10268.5
LR:2020-2021 Forest.Degradation	8923.7	1345	6287.7	11559.8
HR:2020-2021 Forest.Forest	2224237	6835.3	2210840	2237634
LR:2020-2021 Forest.Forest	15405424	17705.4	15370722	15440126
HR:2020-2021 Degradation.NonForest	2292.9	612.5	1092.3	3493.4
LR:2020-2021 Degradation.NonForest	405.6	286.8	-156.5	967.8
HR:2020-2021 Forest.NonForest	4585.7	865.9	2888.6	6282.8
LR:2020-2021 Forest.NonForest	811.2	405.6	16.3	1606.2
HR:2020-2021 NonForest.NonForest	242551.7	5995.8	230800.1	254303.3
LR:2020-2021 NonForest.NonForest	1619457	17244.9	1585657	1653256

Table A12 - ANALYSIS OF 2020-2021 proportions OF CLASS CHANGES BY STRATUM

Stratum / Class	Mean	SE	2.50%	97.50%
HR:2020-2021 Degradation.Degradation	0.02734	0.00131	0.02478	0.02991
LR:2020-2021 Degradation.Degradation	0.00516	0.00025	0.00468	0.00565
HR:2020-2021 Forest.Degradation	0.00315	0.00045	0.00227	0.00402
LR:2020-2021 Forest.Degradation	0.00052	0.00008	0.00037	0.00068
HR:2020-2021 Forest.Forest	0.87175	0.00268	0.8665	0.877
LR:2020-2021 Forest.Forest	0.89967	0.00103	0.89764	0.90169
HR:2020-2021 Degradation.NonForest	0.0009	0.00024	0.00043	0.00137
LR:2020-2021 Degradation.NonForest	0.00002	0.00002	-0.00001	0.00006
HR:2020-2021 Forest.NonForest	0.0018	0.00034	0.00113	0.00246
LR:2020-2021 Forest.NonForest	0.00005	0.00002	0	0.00009
HR:2020-2021 NonForest.NonForest	0.09506	0.00235	0.09046	0.09967
LR:2020-2021 NonForest.NonForest	0.09458	0.00101	0.0926	0.09655

Table A13 - ANALYSIS OF 2020-2021 TOTALS OF CLASS CHANGES FROM FOREST/DEGRADED

	Hectares	SE	2.50%	97.50%
2020-2021 Forest/Degraded.Degradation	175143.4	5655.5	164058.8	186228
2020-2021 Forest/Degraded.Forest	17629660.8	18979	17592463	17666859
2020-2021 Forest/Degraded.NonForest	8095.5	1170.6	5801.1	10389.8
2020-2021 NonForest.NonForest	1862008.4	18257.5	1826224	1897792

Table A14 - Mean Area that is not Forest per hectare

	Mean	SE	2.50%	97.50%
Area	0.03295309	0.00405095	0.02501	0.04089

Table A15 - ANALYSIS OF 2021 HECTARES OF ALL CLASSES BY DRIVER

	Hectares	SE	2.50%	97.50%
Change - bareland:YBDegradation	0.00E+00	0	0	0.00E+00
Change - forest-road:YBDegradation	2.03E+03	641.3148	771.1697	3.29E+03
Change - forest harvest:YBDegradation	2.03E+02	202.8124	-194.693	6.00E+02
Change - mining:YBDegradation	1.01E+04	1334.761	7507.491	1.27E+04
Change - mining-road:YBDegradation	1.19E+03	449.4619	304.5372	2.07E+03
Change - settlement:YBDegradation	2.03E+02	202.8124	-194.693	6.00E+02
Change - shifting cultivation:YBDegradation	1.79E+03	596.5383	617.0808	2.96E+03
Change - unknown:YBDegradation	1.42E+03	536.572	368.0247	2.47E+03
No change:YBDegradation	1.58E+05	5381.093	147647.9	1.69E+05
Change - bareland:YBForest	0.00E+00	0	0	0.00E+00
Change - forest-road:YBForest	0.00E+00	0	0	0.00E+00
Change - forest harvest:YBForest	0.00E+00	0	0	0.00E+00
Change - mining:YBForest	0.00E+00	0	0	0.00E+00

Change - mining-road:YBForest	0.00E+00	0	0	0.00E+00
Change - settlement:YBForest	0.00E+00	0	0	0.00E+00
Change - shifting cultivation:YBForest	0.00E+00	0	0	0.00E+00
Change - unknown:YBForest	0.00E+00	0	0	0.00E+00
No change:YBForest	1.76E+07	18978.9 9	17592463	1.77E+07
Change - bareland:YBNonForest	3.67E+02	260.682 4	-144.34	8.78E+02
Change - forest-road:YBNonForest	0.00E+00	0	0	0.00E+00
Change - forest harvest:YBNonForest	0.00E+00	0	0	0.00E+00
Change - mining:YBNonForest	7.20E+03	1099.11 3	5044.277	9.35E+03
Change - mining-road:YBNonForest	0.00E+00	0	0	0.00E+00
Change - settlement:YBNonForest	3.28E+02	231.606 3	-126.389	7.81E+02
Change - shifting cultivation:YBNonForest	2.03E+02	202.812 4	-194.693	6.00E+02
Change - unknown:YBNonForest	0.00E+00	0	0	0.00E+00
No change:YBNonForest	1.86E+06	18257.5 1	1826224	1.90E+06

Appendix 2: IPCC Tables

	forest land	cropland (managed)	grassland (managed)	wetland (managed)	settlement	other land	**End of Year 2021**
from: **(start of year 11)**	***area (kha)***						
forest land (HPfC, MA)	4,521.15	0.18	**NO**	**NE**	0.73	3.20	**4,517.04**
forest land (HPfC, LA)	2,233.73	0.02			0.17	1.66	**2,231.89**
forest land (MPfC, MA)	1,223.59	0.00			0.10	0.49	**1,222.99**
forest land (MPfC, LA)	4,302.85	0.01			0.16	0.71	**4,301.97**
forest land (LPfC, MA)	200.31	0.00			0.00	0.03	**200.28**
forest land (LPfC, LA)	5,504.62	0.01			0.02	0.14	**5,504.45**
cropland (managed)	**NE**						**885.13**
grassland (managed)							**1,770.25**
wetland (managed)							**295.70**
settlement							**57.88**
other land							**126.11**
start of year 11	**17,986.25**	**884.91**	**1,770.25**	**295.70**	**56.69**	**119.88**	21,113.67
net change	7.63	-0.22			-1.19	-6.23	

NE – not estimated
NO – not occurring

Appendix 3: Year 2021 Image Catalogue

Stack Name	Satellite/Instrument	Data Provider	Res (m)	Acqu. Month	Acqu. Year
20210805T141739_20210805T141736_T21NUF.tif	Sentinel	ESA	10	August	2021
20210805T141739_20210805T141736_T21NUG.tif	Sentinel	ESA	10	August	2021
20210805T141739_20210805T141736_T21NUH.tif	Sentinel	ESA	10	August	2021
20210808T142729_20210808T142731_T20NQL.tif	Sentinel	ESA	10	August	2021
20210808T142729_20210808T142731_T20NRL.tif	Sentinel	ESA	10	August	2021
20210808T142729_20210808T142731_T21NTF.tif	Sentinel	ESA	10	August	2021
20210808T142729_20210808T142731_T21NUH.tif	Sentinel	ESA	10	August	2021
20210808T142729_20210808T142731_T21NUJ.tif	Sentinel	ESA	10	August	2021
20210810T141741_20210810T141752_T21NTC.tif	Sentinel	ESA	10	August	2021
20210810T141741_20210810T141752_T21NUD.tif	Sentinel	ESA	10	August	2021
20210818T142729_20210818T142730_T20NRH.tif	Sentinel	ESA	10	August	2021
20210823T142731_20210823T142813_T20NRG.tif	Sentinel	ESA	10	August	2021
20210823T142731_20210823T142813_T20NRH.tif	Sentinel	ESA	10	August	2021
20210823T142731_20210823T142813_T20NRL.tif	Sentinel	ESA	10	August	2021

20210823T142731_20210823T142813_T21NTB.tif	Sentinel	ESA	10	August	2021
20210823T142731_20210823T142813_T21NTC.tif	Sentinel	ESA	10	August	2021
20210823T142731_20210823T142813_T21NTD.tif	Sentinel	ESA	10	August	2021
20210823T142731_20210823T142813_T21NTE.tif	Sentinel	ESA	10	August	2021
20210823T142731_20210823T142813_T21NUD.tif	Sentinel	ESA	10	August	2021
20210823T142731_20210823T142813_T21NUE.tif	Sentinel	ESA	10	August	2021
20210825T141739_20210825T141733_T21NTB.tif	Sentinel	ESA	10	August	2021
20210825T141739_20210825T141733_T21NUH.tif	Sentinel	ESA	10	August	2021
20210830T141741_20210830T141835_T21NUE.tif	Sentinel	ESA	10	August	2021
20210902T142731_20210902T142746_T20NRJ.tif	Sentinel	ESA	10	September	2021
20210907T142729_20210907T142727_T20NRG.tif	Sentinel	ESA	10	September	2021
20210907T142729_20210907T142727_T20NRH.tif	Sentinel	ESA	10	September	2021
20210912T142731_20210912T143002_T20NRJ.tif	Sentinel	ESA	10	September	2021
20210912T142731_20210912T143002_T20NRK.tif	Sentinel	ESA	10	September	2021
20210912T142731_20210912T143002_T20NRL.tif	Sentinel	ESA	10	September	2021

20210912T142731_20210912T143002_T20NRM.tif	Sentinel	ESA	10	September	2021
20210912T142731_20210912T143002_T20NRP.tif	Sentinel	ESA	10	September	2021
20210912T142731_20210912T143002_T20PRQ.tif	Sentinel	ESA	10	September	2021
20210912T142731_20210912T143002_T21NTB.tif	Sentinel	ESA	10	September	2021
20210912T142731_20210912T143002_T21NTG.tif	Sentinel	ESA	10	September	2021
20210912T142731_20210912T143002_T21NTJ.tif	Sentinel	ESA	10	September	2021
20210912T142731_20210912T143002_T21NUF.tif	Sentinel	ESA	10	September	2021
20210912T142731_20210912T143002_T21NUG.tif	Sentinel	ESA	10	September	2021
20210912T142731_20210912T143002_T21NUH.tif	Sentinel	ESA	10	September	2021
20210912T142731_20210912T143002_T21NUJ.tif	Sentinel	ESA	10	September	2021
20210912T142731_20210912T143002_T21PTK.tif	Sentinel	ESA	10	September	2021
20210914T141729_20210914T141731_T21NUC.tif	Sentinel	ESA	10	September	2021
20210914T141729_20210914T141731_T21NVB.tif	Sentinel	ESA	10	September	2021
20210914T141729_20210914T141731_T21NVC.tif	Sentinel	ESA	10	September	2021
20210914T141729_20210914T141731_T21NVD.tif	Sentinel	ESA	10	September	2021

20210914T141729_20210914T141731_T21NVH.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210914T141729_20210914T141731_T21NWC.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210915T143731_20210915T143728_T20NQM.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210915T143731_20210915T143728_T20NQN.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210915T143731_20210915T143728_T20NQP.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210917T142729_20210917T142727_T20NRM.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210922T142731_20210922T142929_T20NQM.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210922T142731_20210922T142929_T20NRK.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210922T142731_20210922T142929_T20NRL.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210922T142731_20210922T142929_T20NRM.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210922T142731_20210922T142929_T21NTD.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210922T142731_20210922T142929_T21NTE.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210922T142731_20210922T142929_T21NTF.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210922T142731_20210922T142929_T21NTH.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210922T142731_20210922T142929_T21NTJ.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**

20210922T142731_20210922T142929_T21NUG.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210922T142731_20210922T142929_T21NUH.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210922T142731_20210922T142929_T21NUJ.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210924T141739_20210924T141733_T21NUB.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210925T143731_20210925T143929_T20NQN.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210925T143731_20210925T143929_T20NQP.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210927T142729_20210927T142729_T20NRK.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210927T142729_20210927T142729_T20NRN.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210927T142729_20210927T142729_T20NRP.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210927T142729_20210927T142729_T20PRQ.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210927T142729_20210927T142729_T21NTB.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210927T142729_20210927T142729_T21NTC.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210927T142729_20210927T142729_T21NTJ.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210927T142729_20210927T142729_T21NUD.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**
20210927T142729_20210927T142729_T21NUF.tif	**Sentinel**	**ESA**	**10**	**September**	**2021**

20210927T142729_20210927T142729_T21NUG.tif	Sentinel	ESA	10	September	2021
20210929T141741_20210929T141739_T21NUC.tif	Sentinel	ESA	10	September	2021
20210929T141741_20210929T141739_T21NUF.tif	Sentinel	ESA	10	September	2021
20210929T141741_20210929T141739_T21NUG.tif	Sentinel	ESA	10	September	2021
20210929T141741_20210929T141739_T21NUH.tif	Sentinel	ESA	10	September	2021
20210929T141741_20210929T141739_T21NVF.tif	Sentinel	ESA	10	September	2021
20210929T141741_20210929T141739_T21NVH.tif	Sentinel	ESA	10	September	2021
20210929T141741_20210929T142159_T21NTB.tif	Sentinel	ESA	10	September	2021
20210929T141741_20210929T142159_T21NTC.tif	Sentinel	ESA	10	September	2021
20210929T141741_20210929T142159_T21NUB.tif	Sentinel	ESA	10	September	2021
20210929T141741_20210929T142159_T21NUC.tif	Sentinel	ESA	10	September	2021
20210929T141741_20210929T142159_T21NVB.tif	Sentinel	ESA	10	September	2021
20210930T143729_20210930T143726_T20NPM.tif	Sentinel	ESA	10	September	2021
20210930T143729_20210930T143726_T20NPN.tif	Sentinel	ESA	10	September	2021
20211002T142741_20211002T142934_T20NRN.tif	Sentinel	ESA	10	October	2021

20211002T142741_20211002T142934_T21NTG.tif	Sentinel	ESA	10	October	2021
20211002T142741_20211002T142934_T21NTH.tif	Sentinel	ESA	10	October	2021
20211004T141739_20211004T141735_T21NVE.tif	Sentinel	ESA	10	October	2021
20211009T141741_20211009T141740_T21NVF.tif	Sentinel	ESA	10	October	2021
20211009T141741_20211009T141740_T21NVG.tif	Sentinel	ESA	10	October	2021
20211012T142741_20211012T142736_T20NQN.tif	Sentinel	ESA	10	October	2021
20211012T142741_20211012T142736_T20NRG.tif	Sentinel	ESA	10	October	2021
20211012T142741_20211012T142736_T20NRJ.tif	Sentinel	ESA	10	October	2021
20211012T142741_20211012T142736_T20NRM.tif	Sentinel	ESA	10	October	2021
20211012T142741_20211012T142736_T20NRN.tif	Sentinel	ESA	10	October	2021
20211012T142741_20211012T142736_T21NTC.tif	Sentinel	ESA	10	October	2021
20211012T142741_20211012T142736_T21NTD.tif	Sentinel	ESA	10	October	2021
20211012T142741_20211012T142736_T21NTE.tif	Sentinel	ESA	10	October	2021
20211012T142741_20211012T142736_T21NTG.tif	Sentinel	ESA	10	October	2021
20211012T142741_20211012T142736_T21NUD.tif	Sentinel	ESA	10	October	2021

20211012T142741_20211012T142736_T21NUE.tif	Sentinel	ESA	10	October	2021
20211012T142741_20211012T142736_T21NUF.tif	Sentinel	ESA	10	October	2021
20211014T141739_20211014T141736_T21NTB.tif	Sentinel	ESA	10	October	2021
20211014T141739_20211014T141736_T21NUB.tif	Sentinel	ESA	10	October	2021
20211014T141739_20211014T141736_T21NUC.tif	Sentinel	ESA	10	October	2021
20211014T141739_20211014T141736_T21NUD.tif	Sentinel	ESA	10	October	2021
20211014T141739_20211014T141736_T21NUE.tif	Sentinel	ESA	10	October	2021
20211014T141739_20211014T141736_T21NVB.tif	Sentinel	ESA	10	October	2021
20211014T141739_20211014T141736_T21NVC.tif	Sentinel	ESA	10	October	2021
20211014T141739_20211014T141736_T21NVD.tif	Sentinel	ESA	10	October	2021
20211014T141739_20211014T141736_T21NWC.tif	Sentinel	ESA	10	October	2021
20211015T143731_20211015T143732_T20NPM.tif	Sentinel	ESA	10	October	2021
20211015T143731_20211015T143732_T20NPN.tif	Sentinel	ESA	10	October	2021
20211017T142729_20211017T142732_T20NRP.tif	Sentinel	ESA	10	October	2021
20211017T142729_20211017T142732_T20PRQ.tif	Sentinel	ESA	10	October	2021

20211017T142729_20211017T142732_T21NTJ.tif	Sentinel	ESA	10	October	2021
20211020T143729_20211020T143728_T20NQM.tif	Sentinel	ESA	10	October	2021
20211022T142741_20211022T142736_T20NRL.tif	Sentinel	ESA	10	October	2021
20211027T142729_20211027T142732_T21NTF.tif	Sentinel	ESA	10	October	2021
20211029T141741_20211029T141740_T21NUF.tif	Sentinel	ESA	10	October	2021
20211029T141741_20211029T141740_T21NVE.tif	Sentinel	ESA	10	October	2021
20211029T141741_20211029T141740_T21NVH.tif	Sentinel	ESA	10	October	2021
20211101T142741_20211101T142735_T21PTK.tif	Sentinel	ESA	10	November	2021
20211103T141739_20211103T141736_T21NTC.tif	Sentinel	ESA	10	November	2021
20211111T142731_20211111T142733_T20NQL.tif	Sentinel	ESA	10	November	2021
20211111T142731_20211111T142733_T20NQM.tif	Sentinel	ESA	10	November	2021
20211113T141739_20211113T141734_T21NWC.tif	Sentinel	ESA	10	November	2021
20211119T143729_20211119T143724_T20NQL.tif	Sentinel	ESA	10	November	2021
20211119T143729_20211119T143724_T20NQP.tif	Sentinel	ESA	10	November	2021
20211123T141729_20211123T141731_T21NVC.tif	Sentinel	ESA	10	November	2021

20211123T141729_20211123T141731_T21NVD.tif	Sentinel	ESA	10	November	2021
20211123T141729_20211123T141731_T21NWC.tif	Sentinel	ESA	10	November	2021
20211126T142729_20211126T142726_T20NRH.tif	Sentinel	ESA	10	November	2021
20211126T142729_20211126T142726_T21NTF.tif	Sentinel	ESA	10	November	2021
20211126T142729_20211126T142726_T21NTG.tif	Sentinel	ESA	10	November	2021
20211126T142729_20211126T142726_T21NTH.tif	Sentinel	ESA	10	November	2021
20211126T142729_20211126T142726_T21NUE.tif	Sentinel	ESA	10	November	2021
20211128T141741_20211128T141735_T21NUD.tif	Sentinel	ESA	10	November	2021
20211128T141741_20211128T141735_T21NUE.tif	Sentinel	ESA	10	November	2021
20211128T141741_20211128T141735_T21NUG.tif	Sentinel	ESA	10	November	2021
20211128T141741_20211128T141735_T21NVE.tif	Sentinel	ESA	10	November	2021
20211128T141741_20211128T141735_T21NVF.tif	Sentinel	ESA	10	November	2021
20211128T141741_20211128T141735_T21NVG.tif	Sentinel	ESA	10	November	2021
20211128T141741_20211128T141735_T21NVH.tif	Sentinel	ESA	10	November	2021
20211203T141729_20211203T141730_T21NVE.tif	Sentinel	ESA	10	December	2021

20211203T141729_20211203T141730_T21NVF.tif	Sentinel	ESA	10	December	2021
20211203T141729_20211203T141730_T21NVG.tif	Sentinel	ESA	10	December	2021
20211204T143731_20211204T143726_T20NPM.tif	Sentinel	ESA	10	December	2021
20211221T142731_20211221T142732_T21PTK.tif	Sentinel	ESA	10	December	2021
20211226T142729_20211226T142726_T20NQN.tif	Sentinel	ESA	10	December	2021
20211226T142729_20211226T142726_T20PRQ.tif	Sentinel	ESA	10	December	2021
20211226T142729_20211226T142726_T21PTK.tif	Sentinel	ESA	10	December	2021
0_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
100_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
101_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
102_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
104_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
105_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
106_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
107_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

108_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
109_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
10_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
111_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
112_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
114_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
116_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
117_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
118_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
119_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
11_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
120_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
121_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
122_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
123_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

124_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
125_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
126_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
127_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
128_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
129_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
130_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
131_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
132_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
133_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
134_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
135_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
136_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
137_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
138_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

139_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
13_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
141_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
143_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
144_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
145_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
147_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
149_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
14_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
153_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
155_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
156_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
157_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
158_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
159_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

15_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
160_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
162_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
163_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
164_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
165_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
166_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
167_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
168_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
169_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
16_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
171_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
173_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
174_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
175_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

176_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
177_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
178_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
179_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
17_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
181_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
182_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
184_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
185_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
186_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
187_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
190_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
191_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
193_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
194_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

195_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
198_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
199_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
19_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
200_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
202_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
203_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
206_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
209_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
20_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
210_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
211_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
212_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
213_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
214_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

215_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
217_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
218_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
219_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
21_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
220_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
221_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
222_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
223_S2_SR_2021_08_01_2021_12_31_median_S2Cloudless_RGB_8bit.tif	Sentinel	ESA	10	August-December	2021
224_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
225_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
226_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
227_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
228_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
229_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

22_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
230_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
235_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
236_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
237_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
238_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
239_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
23_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
240_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
241_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
242_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
243_S2_SR_2021_08_01_2021_12_31_median_S2Cloudless_RGB_8bit.tif	Sentinel	ESA	10	August-December	2021
243_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
244_S2_SR_2021_08_01_2021_12_31_median_S2Cloudless_RGB_8bit.tif	Sentinel	ESA	10	August-December	2021
244_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

245_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
246_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
247_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
248_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
249_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
250_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
251_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
252_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
253_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
254_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
255_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
256_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
257_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
258_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
259_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

25_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
260_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
261_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
262_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
263_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
264_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
265_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
266_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
267_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
268_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
269_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
26_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
270_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
271_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
272_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

273_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
274_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
275_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
276_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
277_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
278_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
279_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
27_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
280_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
281_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
282_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
283_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
284_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
285_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
286_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

287_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
288_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
289_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
290_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
291_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
292_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
293_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
294_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
295_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
296_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
297_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
298_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
299_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
29_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
2_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

300_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
301_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
302_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
303_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
304_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
305_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
306_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
307_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
308_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
309_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
30_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
310_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
311_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
312_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
313_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

314_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
315_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
316_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
317_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
318_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
319_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
31_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
320_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
321_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
322_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
323_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
324_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
325_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
327_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
328_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

329_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
32_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
330_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
331_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
332_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
333_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
334_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
335_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
336_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
337_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
338_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
339_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
33_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
340_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
341_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

342_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
343_S2_SR_2021_08_01_2021_12_31_median_S2Cloudless_RGB_8bit.tif	Sentinel	ESA	10	August-December	2021
344_S2_SR_2021_08_01_2021_12_31_median_S2Cloudless_RGB_8bit.tif	Sentinel	ESA	10	August-December	2021
347_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
348_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
349_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
34_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
350_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
351_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
352_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
353_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
354_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
356_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
357_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
358_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

359_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
35_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
360_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
362_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
363_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
364_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
367_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
368_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
369_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
36_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
370_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
371_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
372_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
373_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
374_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

375_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
376_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
378_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
379_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
37_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
380_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
382_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
383_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
384_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
386_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR (1).tif	Sentinel	ESA	10	August-December	2021
387_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
389_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
38_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
391_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
392_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

393_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
396_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
397_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
398_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
39_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
3_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
401_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
404_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
405_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
407_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
408_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
409_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
40_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
411_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
412_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

413_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
414_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
415_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
416_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
418_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
419_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
41_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
420_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
421_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
424_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
427_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
42_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
430_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
432_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
436_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

43_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
44_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
45_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
46_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
47_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
48_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
49_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
4_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
50_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR (1).tif	Sentinel	ESA	10	August-December	2021
50_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
51_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
52_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
53_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
54_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
57_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

58_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
59_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
5_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
60_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
61_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
62_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR (1).tif	Sentinel	ESA	10	August-December	2021
63_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
64_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
65_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
66_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
67_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
68_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
69_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
6_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
70_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

71_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
72_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
73_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
74_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
75_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
76_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
77_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
78_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
79_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
7_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
80_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
81_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
82_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
83_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
84_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021

85_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
86_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
87_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
88_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
89_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
8_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
90_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
91_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
92_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
93_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
96_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
97_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
98_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
99_S2_SR_2021_08_01_2022_01_01_median_S2Cloudless_RGB_NIR.tif	Sentinel	ESA	10	August-December	2021
L8_P229R59_20210812_U_O.tif	Landsat 8 DCM	USGS Glovis	30	August	2021

L8_P230R58_20210819_U_O.tif	Landsat 8 DCM	USGS Glovis	30	August	2021
L8_P230R59_20210819_U_O.tif	Landsat 8 DCM	USGS Glovis	30	August	2021
L8_P233R55_210824_U_O.tif	Landsat 8 DCM	USGS Glovis	30	August	2021
L8_P231R57_210826_U_O.tif	Landsat 8 DCM	USGS Glovis	30	August	2021
L8_P231R58_210826_U_O.tif	Landsat 8 DCM	USGS Glovis	30	August	2021
L8_P231R59_210826_U_O.tif	Landsat 8 DCM	USGS Glovis	30	August	2021
L8_P232R54_210902_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P233R56_20210909_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P231R55_20210911_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P231R56_20210911_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P229R58_20210913_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P229R59_20210913_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P232R54_210918_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P232R55_210918_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P232R56_210918_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021

L8_P232R57_210918_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P230R59_20210920_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P233R56_20210925_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P233R55_210925_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P231R55_20210927_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P231R56_20210927_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P231R57_210927_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P231R58_210927_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P231R59_210927_U_O.tif	Landsat 8 DCM	USGS Glovis	30	September	2021
L8_P230R57_20211006_U_O.tif	Landsat 8 DCM	USGS Glovis	30	October	2021
L8_P230R58_20211006_U_O.tif	Landsat 8 DCM	USGS Glovis	30	October	2021
L8_P230R59_20211006_U_O.tif	Landsat 8 DCM	USGS Glovis	30	October	2021
L8_P231R58_211013_U_O.tif	Landsat 8 DCM	USGS Glovis	30	October	2021
L8_P231R59_211013_U_O.tif	Landsat 8 DCM	USGS Glovis	30	October	2021
L8_P229R58_20211015_U_O.tif	Landsat 8 DCM	USGS Glovis	30	October	2021

L8_P229R59_20211015_U_O.tif	Landsat 8 DCM	USGS Glovis	30	October	2021
L8_P232R54_211020_U_O.tif	Landsat 8 DCM	USGS Glovis	30	October	2021
L8_P232R55_211020_U_O.tif	Landsat 8 DCM	USGS Glovis	30	October	2021
L8_P232R56_211020_U_O.tif	Landsat 8 DCM	USGS Glovis	30	October	2021
L8_P232R57_211020_U_O.tif	Landsat 8 DCM	USGS Glovis	30	October	2021
L8_P231R55_20211029_U_O.tif	Landsat 8 DCM	USGS Glovis	30	October	2021
L8_P231R56_20211029_U_O.tif	Landsat 8 DCM	USGS Glovis	30	October	2021
L8_P231R57_211029_U_O.tif	Landsat 8 DCM	USGS Glovis	30	October	2021
L8_P232R56_211105_U_O.tif	Landsat 8 DCM	USGS Glovis	30	November	2021
L8_P232R57_211105_U_O.tif	Landsat 8 DCM	USGS Glovis	30	November	2021
L8_P233R55_211112_U_O.tif	Landsat 8 DCM	USGS Glovis	30	November	2021
L8_P230R56_20211123_U_O.tif	Landsat 8 DCM	USGS Glovis	30	November	2021
L8_P230R57_20211123_U_O.tif	Landsat 8 DCM	USGS Glovis	30	November	2021
L8_P230R58_20211123_U_O.tif	Landsat 8 DCM	USGS Glovis	30	November	2021
L8_P230R56_20211225_U_O.tif	Landsat 8 DCM	USGS Glovis	30	November	2021

L8_P230R57_20211225_U_O.tif	**Landsat 8 DCM**	**USGS Glovis**	**30**	**November**	**2021**