Committee on Earth Observation Satellites (CEOS)

Space Data Coordination Group (SDCG)

**Satellite Data in support of the**

**Global Forest Observations Initiative (GFOI)**

**Research & Development (R&D) Activities**

SDCG Element 3

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## 

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# EXECUTIVE SUMMARY

The **SDCG Element-3 Strategy** is focussed on the acquisition and supply of Earth Observation (EO) data in support of GFOI research and development (R&D) activities. The strategy comprises coordinated observations for acquisition of dense time-series, multi-sensor data (optical and SAR) over a limited number of dedicated study sites to address priority R&D topics as identified by GFOI. With the support of CEOS space agencies, the GFOI research programme will in 2016 continue to provide targeted acquisitions over dedicated study sites and R&D activity that simultaneously addresses several priority R&D topics.

The GFOI R&D programme aims at improving and operationalising EO-based inputs to countries’ national forest monitoring and carbon accounting systems (Chapter 1). Specifically this will allow countries to participate effectively in IPCC Tier 3, Approach 3 reporting under the UN REDD+ initiative. Research needs have been identified and prioritised (Chapter 2), after which, a dedicated R&D programme is being initiated with the aim of advancing priority R&D topics towards operational status for inclusion in the GFOI Methods and Guidance Documentation MGD) and ultimately in countries’ National Forest Monitoring Systems (NFMS)..

The study sites and satellite data requirements for R&D have been defined during technical expert workshops, country consultation days and former GEO Forest Carbon Tracking (FCT) contacts (Chapter 3). Sites were selected on the basis of ongoing research activity, active collaboration with country representatives, and availability of ground data. The focus of the data provision under the Element-3 strategy is on time-series for accurate change estimates, archive data for baseline generation, and complementary SAR and optical data for exploring the benefits of sensor synergy.

The support of CEOS space agencies is reflected in the Element-3 strategy. Their contribution is by way of providing new acquisitions and archive satellite data over GFOI study sites. Data observation requests, with minimum observation requirements for each sensor have been collated. The extent of space agency support, including data availability and access procedures is outlined (Chapter 4). The context for R&D activity, including background on study sites, research partners and R&D topics is provided (Annex A). The Element-3 Strategy was endorsed by CEOS at SIT-30 (March 31 – April 1, 2015). Provision of satellite data commenced in the second half of 2015. Progress reports will be available to CEOS agencies and presentation of research results is anticipated at an annual science summit as part of the GFOI R&D Coordination component programme.

# Introduction

## Background and purpose

This document outlines how Committee on Earth Observation Satellites (CEOS) space agencies are coordinating their relevant Earth observing satellite systems to acquire data to support information requirements pertaining to Research and Development (R&D) arising from the Group on Earth Observation’s (GEO) Global Forest Observations Initiative (GFOI).

The GFOI (<http://www.gfoi.org>) The GFOI sets out to facilitate widespread implementation of REDD+. It aims to support countries that are developing and implementing NFMS and associated emissions MRV systems to take full advantage of Earth observation technology, by

* encouraging the use and assuring sustained availability of satellite observations required for forest monitoring by engaging space agencies and satellite data providers;
* developing methods and protocols on the combined utilisation of remotely sensed and ground data for transparent assessment and reporting;
* capacity building programmes to provide sustained assistance and guidance; and,
* promoting directed research and development on high priority topics where further development is needed (e.g. forest degradation, above-ground biomass, satellite data synergy).

CEOS, having effectively coordinated space-based acquisitions in support of Forest Carbon Tracking (FCT) demonstration activities since 2009, has responsibility for coordination of the satellite data contribution to the observations and measurement component of GFOI – the regular and routine (systematic) observations and measurements for effective reporting – ensuring continuity of supply of time series data for consistent reporting.

Recognising the magnitude of the challenge involved in meeting GFOI and requirements, given the global scale and sustained coverage needed, CEOS in 2011 endorsed the three-element “CEOS Space Data Strategy for GFOI” as a framework for its coordination efforts[[1]](#footnote-2).

**Element 1: A baseline, coordinated global data acquisition strategy** involving a number of space-based *core data streams* that can be utilised and shared free-of-charge for GFOI purposes. This involves systematic and sustained wall-to-wall Earth Observation (EO) acquisitions of forested areas globally and provides the default forest observations data for all countries without specific technical requirements, heritage or data preference. The Element 1 plan was first endorsed in 2013 at CEOS SIT-28.

**Element 2: A coordinated strategy for national data acquisitions**. This aims to accommodate countries that have specific technical requirements, or heritage and experience on working with a particular EO data source or type, as well as the numerous intergovernmental arrangements that may exist or emerge for the supply of certain data to one or more countries. This involves a wider range of satellite data sources, including data that is ordinarily provided on a commercial basis. The Element 2 plan was first endorsed in 2014 at CEOS SIT-29.

**Element 3: Data supply in support of GFOI R&D activities**, including support of: the science studies assisting the development and evolution of the MGD for GFOI; interoperability studies; and validation activities – typically also involving higher resolution EO data, some of which is provided commercially and is generally beyond the scope of CEOS agency responsibility. The Element 3 plan was endorsed in 2015 at CEOS SIT-30.

## Joint strategy for R&D

CEOS support to the GFOI R&D Coordination component is provided through the SDCG Element 3 plan, which simultaneously addresses several priority R&D topics identified by GFOI. While it is not possible to anticipate all potential user requests, the Element-3 plan is based on sampled user input collected through a limited number of expert workshops, country consultations and previous GEO-FCT contacts.

### 1.2.1 Contribution from CEOS space agencies

The Element 3 strategy outlines different means for CEOS space agencies to support the GFOI R&D Coordination component:

* Provision of satellite data over GFOI R&D study sites
  + New data acquisitions
  + Historical (archive) data
* Coordinated research announcements (RA) and solicitations
  + RAs targeted at selected GFOI priority R&D topics
  + Coordinated open calls targeted at GFOI support
  + Funding opportunities

Research announcements and opportunities can be posted on the GFOI R&D website (http://www.gfoi.org/rd).

### 1.2.2 Contribution from GFOI Research and Development teams

In return for the provision of satellite data over GFOI Study Sites, the GFOI R&D teams are responsible for:

* Processing and sharing data
* Processing satellite imagery and derived map products
* Share ground data with space agencies
* Communicating results
* Present results at GFOI Annual Science Meeting (attendance encouraged wherever possible)
* Contribute to GFOI annual technical report
* Share any publications arising from R&D

## Document scope

This document focuses on Element 3, satellite data acquisitions and provisions in support of the GFOI R&D Coordination component.

The prime objective of the Element 3 strategy is to provide adequate satellite data required to progress GFOI priority R&D topics to pre-operational or operational status for subsequent inclusion in the GFOI Methods and Guidance Document (MGD).

Following this introductory chapter, this report contains:

* Chapter 2: *The GFOI R&D Coordination component* – outlines the GFOI R&D strategy, supported forest map products, and review of R&D priorities
* Chapter 3: *Collection of user requirements* – summarises user requests arising from technical expert workshops, country consultations and former GEO-FCT National Demonstrator team leads, and lists the GFOI Study Sites.
* Chapter 4: *Coordinated acquisition strategy in support of GFOI R&D* – outlines coordinated acquisition requests for each data stream including archive data.
* Chapter 5: *Governance*: summarises coordinating role of CEOS, SDCG and GFOI, recommendations for advancing the Element-3 Plan, and research announcements.
* Annexes:

A: *Contributing agencies and missions*

*B: GFOI research partners and R&D topics*

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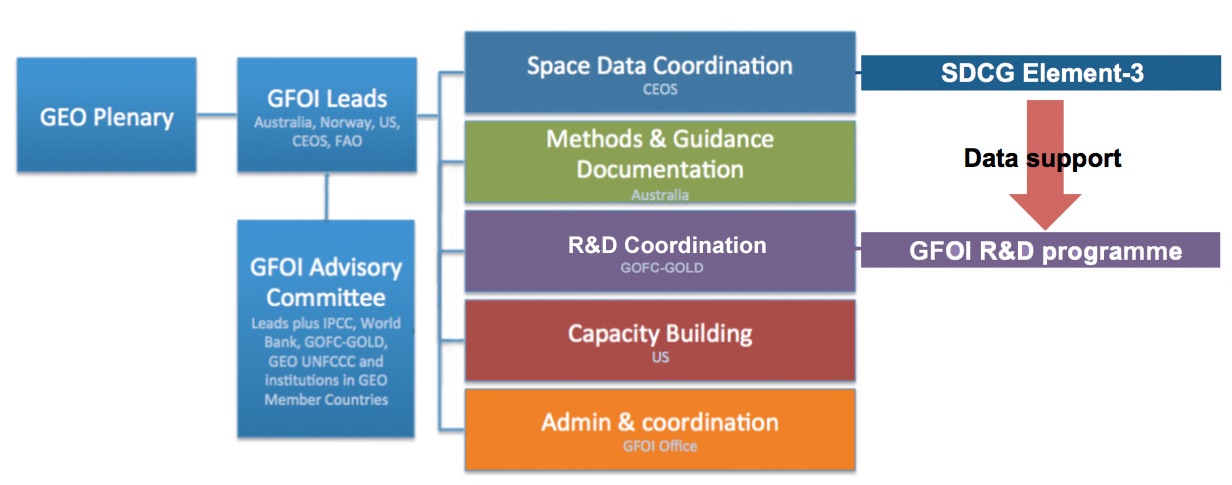
# Coordination of GFOI R&D activities

## GFOI R&D Coordination (RDC) component

GFOI research activities are coordinated by the **GFOI R&D Coordination (RDC) component**. With funding support from ESA, the GOFC-GOLD Land Cover Office at Wageningen University in The Netherlands is since January 2016 leading the RDC component. R&D coordination was previously led by Norway (2012) and the GFOI Office (2013-2014).

In the GFOI organisational structure (Fig. 2.1), the RDC component has the following main functions:

* Development and implementation of a R&D Plan for GFOI;
* Review user needs for R&D and requirements for space data (Review of GFOI Priority R&D Topics);
* Catalysing Priority R&D Topics through:
  + Organisation of R&D Expert workshops and science meetings;
  + Management of research groups participating in the GFOI R&D programme;
* Liaise with other GFOI components:
  + Integration of new methods into the Methods and Guidance Document;
  + Support GFOI Capacity Building;
  + Work with SDCG to assure availability of relevant space data for R&D (SDCG Element-3)



*Figure 2.1 – GFOI organisational structure and relationship between SDCG and the GFOI R&D Coordination component*

## GFOI R&D framework documents

### 2.2.1 GFOI R&D Plan

The GFOI R&D Plan[[2]](#footnote-3) identifies priority areas for remote sensing research and development targeted at improving and operationalising of inputs to support emissions estimation and reporting that will facilitate country engagement in IPCC Tier 3, Approach 3 accounting and future REDD+ implementation[[3]](#footnote-4). It focuses on progressing priority R&D topics to an operational status for integration in future revision and development of the GFOI Methods and Guidance Document (MGD).

The RDC component covers focused R&D actions addressing immediate needs for NFMS, rather than more long-term, basic research activities in the forest monitoring domain. Improvements to those products considered useful for a basic NFMS and non-operational products, either due to lack of regular or cost-effective data access issues or insufficient application across different regions and forest types, will be prioritised for R&D.

R&D is already underway on many topics as countries try to implement their NFMS. GFOI aims to complement these activities by promoting R&D that fills gaps in the existing work. The research needs were prioritised in the *GFOI Review of Priority R&D Topics* [[4]](#footnote-5)to highlight those most urgently needed by countries to implement practical and affordable NFMS that comply with IPCC GPG. As a next step in advancing the R&D programme, a synthesis of R&D tasks and suitable research and partner organisations was completed: The *Landscaping Study [[5]](#footnote-6)* .

Preparations for a dedicated R&D programme for GFOI were initiated in 2014 with the aim to progress the priority R&D topics towards an operational status for incorporation in future revisions of the MGD. With no GFOI budget available to directly fund research groups to undertake dedicated R&D, the approach was instead to capitalise on and catalyse already on-going R&D of relevance to GFOI and to encourage focus on operational status. This was achieved through:

• Dedicated expert workshop series that focus on specific priority topics

• Assessment of R&D needs through GFOI, SDCG and SilvaCarbon country consultations and through experiences from the GEO-FCT National Demonstrators

• Invitation of research groups to participate in a dedicated research programme, and identification of a limited number of dedicated study sites

• Liaison with SDCG to establish a programme for acquisition and provision of relevant space data (i.e. the SDCG Element-3 strategy)

• Follow-up of results and progress through release of regular status reports and organisation of annual science and result presentation meetings.

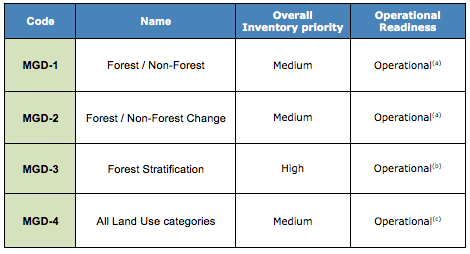
### 2.2.2 MGD Recommended Forest Map Products

The RDC component aims to support research required to progress and/or improve methods required for the operational development of the MGD Recommended Forest Map Products. The GFOI MGD defines seven thematic forest map products recommended to enable countries to measure *Forest Area Change* and *Carbon Stock Change Estimates*. Four supplementary forest map products defined in the *GFOI Review of Priority R&D Topics* document (section 2.4 below) are also considered of high relevance to countries, but additional R&D efforts will be required to bring them to an operational or pre-operational stage, and with subsequent inclusion in the MGD**.** Progressing such targeted R&D is a main objective of the GFOI R&D Coordination component.

These eleven products (Table 2.1) determine the data acquisition strategies being developed by CEOS to make satellite data available. It is not the responsibility of CEOS agencies to generate these products, but to make the necessary satellite data available so that countries can generate selected products of their choice to meet their monitoring needs. It should be emphasised that the map products are not end products; rather they represent intermediate information and inputs for GHG emissions estimates that provide improved confidence intervals for country emissions estimates.

The basic requirements of a REDD+ system include estimates of the area and annual rate of land use conversion (i.e., deforestation) and the long term loss and/or gain of carbon (i.e., degradation and/or enhancement of carbon stocks). In Table 2.1, those products with a high priority rating are essential components of the system. Medium priority products can be generated routinely and at reasonable accuracy to assist the inventory, with the exception of degradation type (RD-1). Products considered a low priority may be useful in future REDD+ systems pending the success of R&D.

The perceived operational readiness of each of the forest map products is also indicated in Table 2.1. The logic behind this determination is described in the *GFOI Review of Priority R&D Topics*. All seven recommended forest map products are considered operational when suitable medium resolution optical data are available (the optimal resolution for NFMS). Caveats are associated with certain products, depending on the available technology and satellite data. All four supplementary forest map products are considered to be in an R&D phase.



### 

### 2.2.3 GFOI Review of Priority R&D Topics

The *GFOI Review of Priority R&D Topics*: *R&D related to the use of Remote Sensing in National Forest Monitoring[[6]](#footnote-7)* is a peer-reviewed study released by the GFOI Office in December 2013. The document (hereafter referred to as the Review) covers those remote sensing derived forest map products needed by countries as they establish a NFMS, deciding if they are operational, pre-operational or are still in an R&D phase, and considering what additional R&D is needed to improve them.

The Review identifies current gaps and opportunities for improving NFMS with newly available EO technologies or ground-based measurement methods. The research needs have been prioritised to highlight those most urgently needed by countries to implement practical NFMS that comply with IPCC GPG, and are sustainable and affordable.

The full list of R&D topics identified in the Review (Table 2.2) constitute the drivers for the GFOI R&D plan and forms the basis of the research program to improve NFMS. They also link to the observation requests in the Element-3 plan. The highest priority topics are those that address immediate data needs, including accuracy and stratification according to national requirements, sensor interoperability, data-model integration, and improvements to land use change and forest degradation products. Readers are referred to the Review document (http://gfoi.org/rd) for detailed justification of the R&D topics included.

**Forest stratification** (MGD-3) is a minimum requirement, with forest types separated on the basis of biomass/carbon densities that can be associated with specific emissions factors. There is increasing interest in the use of SAR and LiDAR for improved discrimination and classification of forest structural types. Further R&D is needed to determine the consistency and transferability of methods across biomes. Improvements to sampling approaches and species distribution modelling would benefit from additional R&D effort.

**Satellite sensor interoperability and/or complementarity (“sensor synergy”)** are cross-cutting topics that address the accuracy and reliability of several products. Current R&D is focused on the consistency, comparability and methods of combining time-series data/products from different satellite sensors, together with the uncertainties involved, in order to derive accurate GHG emissions estimates from forest and land use change. Optimising information extraction from optical and SAR data sources for improved accuracy of the **Land use change** (MGD-5) product is a high priority. R&D is needed on the use of very high resolution (VHR; <5 m) data for calibration and validation (cal/val) of change products.

The technical capacity to monitor forest degradation is lacking. A better understanding of the capabilities and accuracies of remote sensing approaches to fill this gap is needed. R&D on quantitative techniques (utilising SAR and LiDAR technologies) and proxy methods for producing the **degradation/enhancement of Carbon stocks** (RD-2) product is considered a high priority. Where degradation involves the removal of individual trees, the use of VHR data will likely be key. Guidance on best use of VHR and ground data for Cal/Val is needed.

An assessment of soil carbon budget dynamics in peat forests versus other tropical forests is required to better understand the emissions associated with these landscapes.

Continuous improvement of **forest/non-forest** (MGD-1) and **forest/non-forest change** (MGD-2) mapping is possible with the use of multi-sensor data. R&D in these topics is considered a medium priority, and is focussed on an assessment of the achievable accuracies of annual forest area mapping when interspersing some scenes with alternate optical (varying resolution) or SAR data (varying frequency). The research requires access to dense time-series of optical and SAR (in particular, C-band) datasets to determine the temporal imaging requirements and minimum number of observations required to adequately detect change. Improved methods of burned area mapping are also needed.

**All land use categories** (MGD-4) mapping would benefit from further exploitation of SAR, particularly in cloud-affected regions. Guidance is also needed on the data needs and methods for evaluation of global land use products.

Although not a requirement for REDD+ reporting, there is increasing interest in establishing early warning systems of forest change. R&D is needed to determine the optimal satellite configuration (in terms of resolution and observation frequency) and methods for producing maps of **Near-Real Time forest change indicators** (MGD-7). Further exploitation of SAR wide beam modes and high frequency C- and X-band observations is needed. The development of rapid methods for NRT processing and the data needs and ways of attributing uncertainty in each identified change are required.

Mapping of forest **degradation type** (RD-1) and proxies/indicators is considered a medium priority. Advances in change detection approaches are possible, and mapping methods for regrowth and extracting land use history from time-series optical and/or SAR data are needed.

Estimation of **Above-ground biomass** (AGB) and **change in AGB** (RD-3 and RD-4) at the high accuracies required for emissions reporting are still in the basic R&D domain and therefore considered of lower priority for GFOI. Further R&D is needed on multi-sensor approaches, comprising wall-to-wall optical and/or SAR data and LiDAR, and modelling approaches that integrate repeat coverage. Advances in InSAR and polarimetric InSAR (Pol-InSAR) techniques are needed for canopy height estimation and extending the saturation level for biomass estimation. Additional R&D is needed on robust sampling design and establishing the links between AGB and other carbon pools.

|  |  |  |
| --- | --- | --- |
| **Map Code and Product (if applicable)** | **R&D Topics** | **Priority** |
| **MGD-3**  **Forest stratification** | * SAR texture metrics and polarimetry * Sampling and species distribution models * Consistent methods across biomes * Airborne LiDAR or InSAR structural classification * Forest type mapping from simulated future hyperspectral data | **High** |
| **MGD-5**  **Land use change** | * Exploitation of SAR texture and polarimetry for greater class separability * Sensor interoperability and complementarity for improved detection and mapping of land use change * Use of VHR data for calibration/validation of change products |
| **RD-2**  **Degradation/ Enhancement of Carbon stocks** | * Mapping methods for regrowth * Proxy measures * Quantitative measures of degradation * Deriving forest degradation products and field validation from VHR data * Use of SAR data for mapping degradation * Use of airborne LiDAR for deriving biomass/carbon stocks and change * Assessment of the relationship among definitions of degradation, degree of degradation that can be detected, associated accuracies, and useful kinds of remotely sensed data |
| **General forest mapping method improvements** | * Sensor interoperability - Generating similar thematic products from different sensor systems for assembly of time-series * Sensor complementarity for improved information extraction and monitoring * Uncertainty and inference * Assess potential generation of products using simulated future datasets such as (i) Sentinel-1/RCM time-series, (ii) Sentinel-2, and (iii) Hyperspectral (EnMAP) data * Optimising information extraction using dense time-series C-band SAR |
| **Data-Model integration** | * Improved ground data and soil carbon budget models for new forested areas (e.g., peat soils) |
| **MGD-1**  **Forest/Non-forest** | * Investigate alternative non-GFOI data streams for F/NF mapping | **Medium** |
| **MGD-2**  **Forest/Non-forest change** | * Improved methods for burned area mapping * Optimising F/NF change mapping using dense time-series C-band SAR |
| **MGD-4**  **All Land use categories** | * Further exploitation of SAR for mapping land use categories * Identify data needs and methods for evaluation of global product accuracy |
| **MGD-7**  **Near-Real Time Forest Change Indicators** | * Test different spectral fractions to identify disturbance pixels in different forest types and regions * Investigate alternative non-GFOI data streams, such as TerraSAR-X and future ALOS-2 ScanSAR * Methods and data for validation of products * Exploiting dense time-series C-band SAR |
| **RD-1**  **Degradation type** | * Methods of extracting land use history (e.g., forest type and age, land use transitions following clearing/re-clearing) from optical time-series * Automated mapping methods * Use of fractional cover and evaluate different spectral indices * Evaluate different change detection approaches |
| **RD-3**  **Above-ground biomass** | * Biomass stock stratification approaches (design- and model-based) * Link between AGB and other carbon pools (e.g., soil carbon) * Transferability of methods from boreal to temperate to tropical forest * Airborne LiDAR or SAR tree height correction * Bi-static SAR for estimating tree height * Integration of ground,- and airborne LiDAR, SAR and optical data * Integration of LiDAR and optical data for calculating past emissions | **Low** |
| **RD-4**  **Change in above-ground biomass** | * Modelling approaches using repeat LiDAR * Integration of repeat LiDAR and SAR to estimate biomass change across different forest types * Sampling design options * Transferability of methods to tropical biome |

*Table 2.2– Summary of R&D needs identified in the GFOI Review of Priority R&D Topics4.*

*[GFOI R&D Review document, Table 3]*

## GFOI R&D Expert Workshops

As a means to progress Priority R&D Topics the RDC component is organising a series of technical Expert workshops. The workshop have the following objectives:

* Assessment of existing approaches and current state of the art for the topic in question;
* Identification of obstacles to operational (widespread) use;
* Development of an action plan to progress development;
* Input/recommendations to CEOS and commercial data providers (i.e. SDCG Element-3)

**Expert workshop 1** – Sensor interoperability/complementarity (Woods Hole, MA/USA, June 10-11 2014) <http://www.gfoi.org/rd/first-rd-expert-workshop/>

**Expert workshop 2** – Forest degradation (Wageningen, Holland, Oct. 1-3, 2014)

<http://www.gfoi.org/rd/second-rd-workshop/>

**Expert workshop 3** – Approaches to Remote Sensing for Vegetation Biomass Estimation (Brisbane, Australia, Feb. 24-26, 2015)

<http://www.gfoi.org/wp-content/uploads/2016/04/GFOI-GOFC_ExpertWorkshop_Feb-2015.pdf>

**Expert workshop 4** – Global Datasets for National REDD+ Measuring and Monitoring

(Wageningen, The Netherlands, Nov. 9-10, 2015)

<http://www.gofcgold.wur.nl/sites/glc4redd-workshop2015.php>

**Expert workshop 5** – (Joint GFOI / GOFC-GOLD / CONABIO / SilvaCarbon R&D Expert and Capacity Building workshop) – Regional solutions to forest type stratification and characterising the forest state for national forest monitoring and carbon emissions reporting (REDD+ MRV and LULUCF)

(Mexico City, Mexico, June 7-10, 2016)

<http://www.gofcgold.wur.nl/sites/gfoiRD_mexico.php>

Workshops and science meeting scheduled for 2016:

* GFOI R&D and GOFC-GOLD Land Cover Science Meeting (The Hague, The Netherlands, 31 Oct – 4 Nov, 2016)

## The GFOI R&D programme

The RDC component is responsible for the coordination of a research programme for GFOI. The programme was first initiated in 2014, in conjunction with the organisation of the Expert Workshops described above. Due to a funding impasse for the RDC component in 2015, the R&D programme was restarted again in early 2016.

Since GFOI does not possess any dedicated budget to support own research activities, the R&D programme instead aims to capitalise on already on-going research, undertaken by external experts and research groups already active in the field of REDD+ and NFMS.

What the GFOI can bring to the table, and which can be used to motivate the R&D groups to focus their activities towards the GFOI Priority R&D Topics, is the provision of satellite data which they currently do not have access to.

Through the Expert workshops, meetings and user consultations described above, contacts have been established with 18 research groups which have expressed interest to participate in and contribute to the GFOI R&D programme. The map in Figure 2.1 shows the locations of the Study Sites where the R&D groups are active.



*Figure 2.1 – GFOI R&D Study Sites.*

*Interactive map at* [*http://www.gfoi.org/rd/study-sites/*](http://www.gfoi.org/rd/study-sites/)

The R&D groups and Study Sites are listed below in Table 2.3. The list includes both sites that previously have not been used within GFOI, and well as several of the Validation Sites in the GEO-FCT National Demonstrator countries that still are active, where time-series data have already been collected by CEOS agencies and where good opportunities for change studies exist. The study sites are mostly located in sub/tropical regions, with a few in temperate-boreal biomes to test the transferability of methods across different regions/forest types. The sites are multi-disciplinary and aim to address several of the GFOI priority R&D topics.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Research group** | **Site Code** | **Site name** | **Country** | **Coordinates** | |
| **lat** | **long** |
| Group 1 | BRA-1 | Mato Grosso | Brazil | S11.75 | W54.25 |
| Group 2 | MLW-1 | Mulanje | Malawi | S15.911 | E35.640 |
| GAB-1 | Gabon | Gabon | S1.018 | E10.729 |
| Group 3 | FCT-COL-3 | Pacifico-Bajo\_Mira | Colombia | N1.65 | W78.76 |
| FCT-COL-4 | Amazonia-Tinigua | N2.17 | W74.15 |
| FCT-COL-5 | Andes-Antioquia | N7.83 | W76.45 |
| COL-6  COL-7 | Caqueta  La Victoria | N1.4079  N6.26 | W73.5747  W74.64 |
|  | ETH-1 | Kafa BR | Ethiopia | N7.3 | E35.6 |
| Group 4 | FIJ-1 | Lololo & Nakavu | Fiji | S17.3 | E177.4 |
|  | PER-1 | Peru | Peru | S11.1 | W74.3 |
| Group 5 | GFC-1 | GFC Site 1 (FCT) | Guyana | N3.3069 | W59.6672 |
| GFC-2 | GFC Site 2’ | N5.2671 | W59.1066 |
| Group 6 | FCT-BOR-3 | Mawas | Indonesia | S2.24 | E114.48 |
| FCT-SUM-2 | Harapan | S2.20 | E103.38 |
| Group 7 | FCT-TNZ-5 | Amani | Tanzania | S5.13 | E38.63 |
| FCT-TNZ-6 | Liwale | S9.50 | E38.17 |
| Group 8 | PNG-1 | Kokoda | Papua New Guinea | S9.184 | E147.374 |
| PNG-2 | Milne bay | S10.598 | E150.185 |
| Group 9 | FCT-MEX-2 | Chiapas-1 | Mexico | N16.45 | W91.40 |
| MEX-3 | Durango | N23.74 | W105.49 |
| FIN-1 | Hyytiälä | Finland | N61.85 | E24.32 |
| FIN-2 | Sodankylä | N67.48 | E26.34 |

*Table 2.3a – GFOI R&D Study Sites (as of June, 2016)*

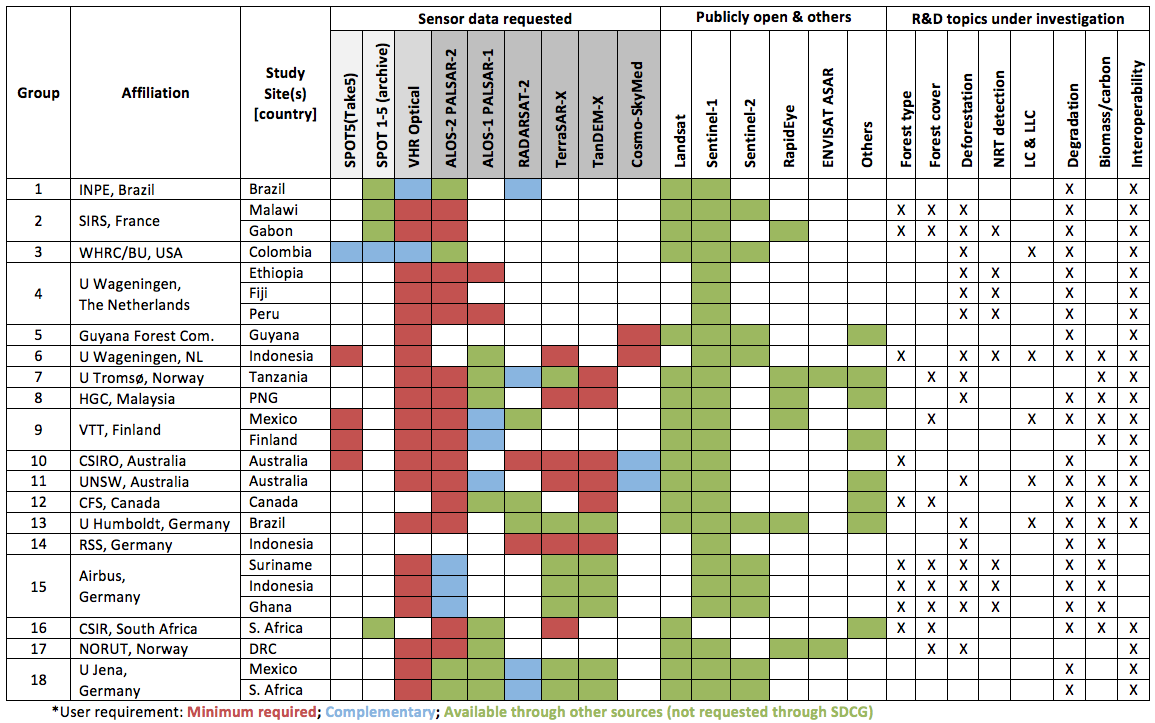
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Research group** | **Site Code** | **Site name** | **Country** | **Coordinates** | |
| **lat** | **long** |
| Group 10 | AU-4 | Robson Creek (QLD) | Australia | S17.119 | E145.631 |
| FCT-AU-3 | Warra (Tasmania) | S43.1046 | E146.656 |
| Group 11 | AU-5 | Injune (QLD) | Australia | S25.5 | 147.7 |
| Group 12 | CAN-1 | Site 1 NW Territories | Canada | N61.4 | W121.3 |
| CAN-2 | Site 2 NW Territories | N62.0 | W116.50 |
| CAN-3 | Site 3 NW Territories | N61.52 | W120.35 |
| Group 13 | BRA-2 | Novo Progresso | Brazil | S7°02’4.07” | W55°24’1.82” |
| Group 14 | KAL-1 | Sebangu N.P. / xMRP | Indonesia | S2°24’ | E114°6’30” |
| SUM-1 | South Sumatra | S2°29’30” | E103°28’30” |
| Group 15 | SUR-1 | Klaaskreek | Suriname | N5°12’12.70” | W54°57’4.40” |
| KAL-2 | Malinau | Indonesia | N3°1’57.23” | E116°36’5.45” |
| MAD-1 | Kade | Ghana | N6°11’41.14” | W0°56’21.90” |
|  | SA-1 | Lowveld / Kruger N.P. | South Africa | S24°47’ | E31°26’ |
| Group 16 | SA-2 | Eastern Cape | S32°50’ | E26°06’ |
|  | SA-3 | KwaZulu-Natal | S28° 19' | E32° 00' |
| Group 17 | DRC-1 | Mai Ndombe district | D.R. Congo | S2.70 | E18.50 |
| Group 18 | MEX-4 | Campeche/Kulic | Mexico | N20.3 | W90.1 |
| MEX-5 | Marques de Comillas | N16.3 | W90.9 |
| Mex-6 | Hidalgo | N20.6 | W98.59 |
| SA-4 | Skukuza / Kruger N.P. | South Africa | S25.2 | W31.5 |

*Table 2.3b – GFOI R&D Study Sites (as of June, 2016)*

# 3 Space Data in support of GFOI R&D

## 3.1 Data requirement summary

The table below provides an overview of the space data requirements raised through the GFOI R&D programme, as well as which of the Priority R&D Topics the groups address. Detailed descriptions of the R&D groups, their research, Study Sites and data requirements are provided in Annex A.



*Table 3.1 – GFOI R&D group space data requirement summary and* *Priority R&D Topics addressed.*

## 3.2 The Element-3 strategy

In response to the requirements above, the proposed Element-3 strategy comprises systematic dense time-series of multi-sensor data (optical, L-, C- and X-band SAR) over the GFOI study sites in order to provide information-rich datasets which fulfil the requirements for experimental analysis. Redundancy is built into the strategy to test the transferability of methods using similar sensors.

Common for all sensors is that dense time-series are required for testing the robustness and consistency of methods of deriving change estimates. Historic (archive) data are needed to extend time series backwards and for baseline generation. Complementary SAR and optical data are needed to assess the benefits of sensor synergy for forest monitoring and degradation assessment. Additional R&D tasks can be added for sites at a later stage.

The section below comprise the data observation requests for each sensor, both new acquisitions and archive, for the GFOI R&D Study Sites. Minimum requirements for are given in case of capacity constraints.

SAR mission agencies are asked to keep the following general considerations in mind:

* Collection of consistent time-series is a key requirement and missed acquisitions and data gaps that inevitably will occur should be re-programmed for fill-in acquisitions the next satellite cycle.
* In order to accommodate SAR-optical interoperability studies, observations in descending pass direction are recommended.
* A key point for each of the SAR sensors is to remain consistent with one single observation mode selected to maximise band sensitivity to forest parameters, and successively build up a uniform and homogeneous multi-temporal coverage over each of the Study Sites. In particular it should be noted that a change in the SAR off-nadir look angle introduces additional uncertainty in time-series analyses and should be avoided.

## 3.3 Governance

3.3.1 Roles and responsibilities

The R&D activities under GFOI are a partnership between the space agencies – federated under the SDCG Element-3 strategy – the GFOI R&D Coordination component and the GFOI R&D groups. The roles and responsibilities of these various entities are as follows:

**GFOI R&D Coordination Component (GOFC-GOLD)**

The RDC component is responsible for the following:

* Management of the GFOI R&D programme and coordination of the GFOI R&D groups;
* Act as main interface between SDCG space agencies and GFOI R&D groups;
* Provide mechanism for reporting and feed-back to space agencies and GFOI
* Organisation of R&D Expert workshops and science meetings

**SDCG Space Agencies**

The space agencies are responsible for the following with respect to approved projects:

* Review and approve satellite data requests from GFOI R&D groups;
* Ensure lending of processed satellite data addressing the minimum required dataset as described in the project forms (Annex A) for approved projects;
* Provide limited technical support for the products supplied.

**GFOI R&D Groups**

The research groups shall:

* Agree to have their satellite data requests evaluated by the SDCG and GFOI R&D committees and allow subject matter experts to evaluate the level of maturity of the application and compliance with the GFOI Priority R&D Topics;
* Certify that their request is for R&D, non-operational, non-commercial project;
* Comply with the data policy and data restrictions related to every datasets requested;
* Provide a project timeline and milestone dates;
* Coordinate the project execution;
* Ensure their project has sufficient funding and resources to complete the planned research within the stated timeframe;
* Publish the results of the research project and appropriately acknowledge the data sources;
* Submit to GFOI R&D and SDCG, on request, the results and methods used;
* Attend a GFOI R&D science workshop to present results;

3.3.2 Recommendations

To advance the Element-3 Plan, the following recommendations are made:

* The Element-3 plan was endorsed by CEOS at SIT-30 (Mar 31 - April 1, 2015). The plan should be updated on an annual basis. The next update (this document) will be presented to CEOS at SIT-31 (April 19-20, 2016).
* Space agencies are requested to provide updated lists list of archive data available over GEO-FCT ND verification sites and new study sites (when available).
* In the interests of securing dense time-series and extending previous R&D, space agencies are encouraged to start acquiring data over ND and new study sites as soon as can be accommodated in their acquisition plan.
* GFOI research partners are encouraged to consult the data archives and advise GFOI on specific data requests for R&D.

# 4 Contributing agencies and missions and corresponding data requests

## 4.1 ASI

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sensor** | **Agency** | **Contact point(s)** | **Email** | **Access conditions** | **Archive and Data search tool** |
| COSMO-SkyMed | ASI | Anna Rita Pisani | annarita.pisani@est.asi.it | Research institutional users | http://87.241.31.78/index.php |

4.1.1 COSMO-SkyMed

**New acquisitions:** ASI is currently making significant contributions to the GEO Geohazard Supersites and Natural Laboratories (GSNL) initiative. ASI is interested in supporting R&D activities involving X-band – in particular integration with C-band, L-band and optical data.

**Archive data availability:** Refer to <http://gfoi.org/RD> for the COSMO-SkyMed Background Mission on Guyana, Cameroon, Borneo, Tasmania, Peru, Colombia, DRC and Sumatera sites and for the COSMO-SkyMed archive data on GFOI R&D Study Sites.

**Data access procedure:**

* Access to COSMO-SkyMed data is for research/institutional users;
* Submission of an R&D project to ASI for the exploitation of COSMO-SkyMed data;
* Principal Investigators of accepted proposals have to sign and return to ASI a “COSMO-SkyMed License to use” to obtain the data provision;
* After the approval of the project ASI will provide a COSMO-SkyMed Request Form to order the products.
* Access to the official COSMO-SkyMed archive is possible through the website <http://87.241.31.78/index.php> by subscription.

4.1.2 Research Announcements

* The “Open Call for Science” started on February 25th, 2015 and is available on the ASI website at: <http://www.asi.it/en/agency/bandi_en/calls/cosmoskymed_open_call_for_science>
* The Open Call is open to national and international scientific investigators and submission of proposals will be accepted anytime. The selected projects will be supported for two years with a quota of data free-of-charge.
* *Land cover and vegetation* is among the primary application domains.
* ASI is open to exploring the possibility of a coordinated announcement of opportunity (AO) for R&D on GFOI key science questions with CEOS partners.

### 4.1.3 Requests for COSMO-SkyMed data

**MINIMUM REQUIRED1 DATASETS** (1Critical: without which the study cannot be completed)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Site code** | **Location** | **Time window** | **Required duration** | **(Minimum) observation frequency** |
| Group 5 | GFC-1 | Guyana | Jan-Dec | Aug 2016 Aug 2017 | Monthly |
| GFC-2 | Guyana | Jan-Dec | Aug 2016 Aug 2017 | Monthly |
| GFC-3 | Guyana | Jan-Dec | Aug 2016 Aug 2017 | Monthly |
| Group 6 | BOR-3 (FCT) | Mawas (Kalimantan), Indonesia | Jan-Dec | Apr2016-2017 | Monthly |
| SUM-2 (FCT) | Harapan (Sumatra), indonesia | Jan-Dec | Apr2016-2017 | Monthly |

**COMPLEMENTARY2 DATASETS** (2Non-critical but can enhance outcomes)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Sites** | **Location** | **Time window** | **Required duration** | **(Minimum) observation frequency** |
| Group 10 | FCT-AU-3 | Warra (TAS), Australia | Apr-Dec | 2015-2016 | Monthly |
| FCT-AU-4 | Robson Creek (QLD), Australia | Apr-Dec | 2015-2016 | Monthly |
| Group 11 | AU-5 | Injune (QLD), Australia | July/Aug 2007  Jan-Dec2015 | 2007  2015 | Monthly |

Table 4.1 GFOI R&D Study Sites requested for coverage by X-band SAR.

## 4.2 CNES

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sensor** | **Agency** | **Contact point(s)** | **Email** | **Access conditions** | **Archive and Data search tool** |
| SPOT 1 to 5 | CNES | Steven Hosford | Steven.hosford@ cnes.fr | Non commercial use | [www.geostore.com](http://www.geostore.com)  Data access via SWH website (not yet open) |
| Pléiades | CNES | Steven Hosford | Steven.hosford@ cnes.fr | Research use | [www.geostore.com](http://www.geostore.com)  Data access via CNES website (not yet open) |

4.2.1 SPOT-4 and -5

**Archive data availability:** Refer to <http://www.geostore.com>. Archive data available to be processed through SPOT World Heritage programme includes all SPOT 1-5 data at least 5 years old and data acquired in the Congo Basin Initiative. All archive data over GFOI R&D Study Sites will be processed and made available at no cost.

**Data access procedure:**

* Free and open access via SPOT World Heritage website to all data already processed. User must be identified and non-commercial use licence must be signed.
* One proposal is recommended to cover all GFOI R&D Study Site requests for the SPOT5(Take5) experiment.

4.2.2 PLÉIADES

**New acquisitions:** Requests for new acquisitions with Very High Resolution Pléiades-1A and -1B is possible. With the current budget available for processing, CNES would be able to provide in the order of a total 25 scenes per year for GFOI.

**Archive data availability:** Refer to <http://www.geostore.com>

**Data access procedure:**

* Registered science users (ISIS programme) can download data from the CNES image database. Registration involves the laboratory signing an agreement with CNES.

4.2.3 Research Announcements

* Offer annual calls for science proposals (“TOSCA”), open to French laboratories in February of each year for funding commencing the following year. Project support is provided for the purchase of data, experimental equipment, travel and temporary (post-doc) positions.
* Coordination with other national/international initiatives is possible, e.g., future research announcements that partly/fully support GFOI.
* CNES is open to exploring the possibility of a coordinated announcement of opportunity (AO) for R&D on GFOI key science questions with CEOS partners.
* CNES is looking for co-funding opportunities to process all SPOT1-5 archive data over GFOI countries through the SPOT World Heritage Programme. The SPOT archive presents a substantial resource for establishing forest baseline information.

### 4.2.4 Requests for VHR (Pléiades) data

Pléiades VHR (<5 m resolution) data are requested for validation (Table 4.2a and Table 4.2b).

**MINIMUM REQUIRED1 DATASETS** (1Critical: without which the study cannot be completed)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Site code** | **Location** | **Time window** | **Required duration** | **(Minimum) observation frequency** |
| Group 2 | MLW-1 | Malawi | Jun – Oct &  Nov-April | Jun 2016 - Sep 2018 | Twice yearly |
| GAB-1 | Gabon | Jun – Oct &  Nov-April | Jun 2016 - Sep 2018 | Twice yearly |
| Group 4 | ETH-1 | Ethiopia | Jan-Dec | 2016-2018 | 1 scene |
| PER-1 | Peru | Jan-Dec | 2016-2018 | 1 scene |
| FIJ-1 | Lololo & Nakavu | Jan-Dec | 2016-2018 | 1 scene |
| Group 5 | GFC-1 | Guyana | Jan-Dec | Aug2016-Aug2017 | Monthly |
| GFC-2 | Guyana | Jan-Dec | Aug2016-Aug2017 | Monthly |
| GFC-3 | Guyana | Jan-Dec | Aug2016-Aug2017 | Monthly |
| Group 6 | FCT-BOR-3 | Mawas | Jan-Dec | Apr2016-Mar2017 | Monthly |
| FCT-SUM-2 | Harapan | Jan-Dec | Apr2016-Mar2017 | Monthly |
| Group 7 | FCT-TNZ-5 | Amani, Tanzania | June-Sept, Jan-Feb | 2016-2017 | Monthly |
| FCT-TNZ-6 | Liwale, Tanzania | June-Sept, Jan-Feb | 2016-2017 | Monthly |
| Group 8 | PNG-1 | Kokoda, PNG | Jan-Dec | 2015-2017 | Monthly |
| PNG-2 | Milne bay, PNG | Jan-Dec | 2015-2017 | Monthly |
| Group 9 | FCT-MEX-2 | Chiapas, Mexico | Jan-Dec | 2007, 2010 , 2013, 2015 | Monthly |
| MEX-8 | Durango, Mexico | June 15 - Aug 31 | 2010 , 2014, 2015 | Monthly |
| FIN-1 | Hyytiälä, Finland | Jan-Dec | 2007, 2010, 2013  2015, 2016 | Monthly |
| FIN-2 | Sodankylä, Finland | Jan-Dec | 2007, 2010, 2013  2015, 2016 | Monthly |
| Group 10 | AU-4 | Robson Creek, QLD, Australia | Apr-Dec | 2015-2016 | Monthly |
| AU-3 | Warra, Tasmania, Australia | Apr-Dec | 2015-2016 | Monthly |
| Group 11 | AU-5 | Injune, QLD, Australia | Jan-Dec | 2010  2017 | Monthly |
| Group 13 | BRA-2 | Novo Progresso, Brazil | entire year | 2014 - 2018 | weekly |
| Group 15 | SUR-1 | Klaaskreek, Suriname | Jan - Dec | 2015-2017 | 2 times / year |
| KAL-2 | Malinau, Kalimantan | Jan - Dec | 2015-2017 | 2 times / year |
| GHA-1 | Kade, Ghana | Jan - Dec | 2015-2017 | 2 times / year |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Group 17 | DRC-1 | Mai Ndombe district, DRC | June-Sept  Jan-Feb | 2016-2017 | Monthly |
| Group 18 | MEX-4 | Campeche, Mexico | Whole year | 2015-2018 | Once/year |
| MEX-5 | Marques de Comilias, Mexico | Whole year | 2015-2018 | Once/year |
| MEX-6 | Hiladgo, Mexico | Whole year | 2015-2018 | Once/year |
| SA-4 | Skukuza/KNP, South Africa | Whole year | 2015-2018 | Once/year |

**COMPLEMENTARY2 DATASETS** (2Non-critical but can enhance outcomes)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Sites** | **Location** | **Time window** | **Required duration** | **(Minimum) observation frequency** |
| Group 1 | BRA-1 | Mato Grosso, Brazil | June-Oct | 2016-2017 | 1 scene |
| Group 3 | FCT-COL-3 | Pacifico-Bajo-Mira, Colombia | Since launch | Cloud free | Once a year |
| FCT-COL-4 | Amazonia-Tinigua, Colombia | Since launch | Cloud free | Once a year |
| FCT-COL-5 | Andes-Antioquia, Colombia | Since launch | Cloud free | Once a year |
| FCT-COL-6 | Cacueta, Colombia | Since launch | Cloud free | Once a year |
| FCT-COL-7 | La Victoria, Colombia | Since launch | Cloud free | Once a year |

Table 4.2 GFOI R&D Study Sites requested for coverage by optical VHR sensors (Note: same as Table 4.8)

### 4.2.5 Requests for SPOT 1-5 (archive) data

**COMPLEMENTARY2 DATASETS** (2Non-critical but can enhance outcomes)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Sites** | **Location** | **Time window** | **Required duration** | **(Minimum) observation frequency** |
| Group 3 | FCT-COL-3 | Pacifico-Bajo-Mira, Colombia | Since launch | Cloud free | Once a year |
| FCT-COL-4 | Amazonia-Tinigua, Colombia | Since launch | Cloud free | Once a year |
| FCT-COL-5 | Andes-Antioquia, Colombia | Since launch | Cloud free | Once a year |
| FCT-COL-6 | Cacueta, Colombia | Since launch | Cloud free | Once a year |
| FCT-COL-7 | La Victoria, Colombia | Since launch | Cloud free | Once a year |

### *Table 4.3 GFOI R&D Study Sites requested for coverage by archive SPOT 1-5*

## 4.3 CSA

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sensor** | **Agency** | **Contact point(s)** | **Email** | **Access conditions** | **Archive and Data search tool** |
| Radarsat-2 | CSA | Yves Crevier | yves.crevier  @canada.ca. | Restricted to science support (NEODF) | NEODF-Cat.  www.neodf.nrcan.gc.ca |
| MDA | MDA Client Service Rep | Clientservices  @mdacorporation.com | Commercial | Same as above |

The Canadian Space Agency (CSA) overarching objectives in support of the GFOI Element-3 are to support our National Forest community (government, academic and private sectors) and to enable end-users to exploit the large amount of SAR data that is now or will soon be available in support of their programs for forest management, ecosystem protection, carbon accounting, etc.

Due to the commercial nature of the RADARSAT-2 mission, the CSA is restricted to supporting science related activities as identified and endorsed by the GFOI science framework under the Element-3. The CSA is mostly interested in the following topics:

* Use of Synthetic Aperture RADAR (SAR) for the monitoring of forest related attributes;
* Interoperability and complementarity between SAR and optical datasets;
* SAR/SAR mission interoperability;
* Development of SAR-based approaches, algorithms, and methods that are viably sustainable to support local, regional, national, continental and global forest monitoring and carbon accounting.

In this context the CSA is willing to contribute archive data and develop dense time series over punctual sites to support key science and demonstration activities.

### 4.3.1 New acquisitions: RADARSAT-2

The Canadian Space Agency will contribute data, under the coordinated framework, to projects which will directly contribute to the defined and agreed upon key science questions articulated under the GFOI R&D component. The number of scenes, the preferred sites, and the observation frequency are to be defined and agreed with the project PIs.

The CSA will need to go through a user/data set certification process as planned under the Master Agreement with the owner of the satellite (MDA) and the Canadian remote sensing space system act (RSSSA). Once users and data will be certified, a secured access/open sharing portal hosted in Canada will be put in place. All of the RADARSAT-2 data contributed to the Element-3 component will be open for internal sharing among the list of certified PIs of GFOI. This will include the pertinent dataset acquired under the framework of the FCT project and new dataset acquired in a background mission framework to be defined and agreed under the GFOI.

The CSA will comply to the open sharing principle of the Element-3 and expects, in return, an open sharing of ground data, methods, and derived results. The RADARSAT-2 data will be contributed at no costs to the users. All of the data and processing costs will be covered by the CSA.

In summary, the CSA expects its contribution to GFOI science plan (Element-3 component) to generate better understanding on issues related to SAR only, SAR/SAR and SAR/Optical data interoperability for forest attributes derived information.

It is expected that the key science requirements, articulated in the context of Element-3, represent the position of the Global federated community under GFOI. In addition to our data contribution, the CSA Earth Observation programs (for data, science and demonstration) will remain available to support innovative development of solutions. In this context the CSA is supporting the Canadian Research Team (Group 13).

### 4.3.2 Archive data: RADARSAT-2

Refer to <http://gfoi.org/RD>. Full or partial wet and dry coverage was acquired over Mexico, Colombia, Guyana, Cameroon, Tanzania, Indonesia and Tasmania by RADARSAT-2. A total of 727 images were acquired, with 2 national coverages planned. The RADARSAT-1 archive is of limited coherent use for forest monitoring.

### 4.3.3 Research Announcements

* CSA is open to exploring the possibility of a coordinated announcement of opportunity (AO) for R&D on GFOI key science questions with CEOS partners.

### 4.3.4 Requests for C-band SAR data

**MINIMUM REQUIRED1 DATASETS** (1Critical: without which the study cannot be completed)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Site code** | **Location** | **Time window** | **Required duration** | **(Minimum) observation frequency** |
| Group 10 | AU-4 | Robson Creek, QLD, Australia | Apr-Dec | 2015-2016 | Monthly |
| AU-3 | Warra, Tasmania, Australia | Apr-Dec | 2015-2016 | Monthly |
| Group 14 | KAL-1 | Sebangu N.P. / xMRP | Aug - Oct | 2012/2015 | 4 consecutive acquisitions |
| SUM-1 | South Sumatra | Aug - Oct | 2012/2015 | 4 consecutive acquisitions |

**COMPLEMENTARY2 DATASETS** (2Non-critical but can enhance outcomes)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Sites** | **Location** | **Time window** | **Required duration** | **(Minimum) observation frequency** |
| Group 1 | BRA-1 | Mato Grosso, Brazil | June-Oct | 2016-2017 | 1/year |
| Group 7 | FCT-TNZ-5 | Amani, Tanzania | June-Sept + Jan | 2016-2017 | Monthly |
| Group 18 | MEX-4 | Campeche, Mexico | Whole year | 2015-2018 | 1 acquisition per month |
| MEX-5 | Marques de Comilias, Mexico | Whole year | 2015-2018 | 1 acquisition per month |
| MEX-6 | Hiladgo, Mexico | Whole year | 2015-2018 | 1 acquisition per month |
| SA-4 | Skukuza/KNP, South Africa | Whole year | 2015-2018 | 1 acquisition per month |

Table 4.4 GFOI R&D Study Sites requested for coverag-e by C-band SAR.

## 4.4 DLR

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sensor** | **Agency** | **Contact point(s)** | **Email** | **Access conditions** | **Archive and Data search tool** |
| TerraSAR-X | DLR | TerraSAR-X Science Service System | tsx.science @dlr.de | Standard DLR research type. COFUR costs waived for GFOI related proposals | http://terrasar-x-archive.infoterra.de/ |
| TanDEM-X | DLR | TanDEM-X Science Service System | tandemx-science @dlr.de | Standard DLR research type | http://tandemx-science.dlr.de/ |

4.4.1 TerraSAR-X background mission

DLR is running a background mission since June 2015 to cover the R&D sites systematically based on the centre coordinates supplied by the R&D teams.

* All former Prior 1 siteswere regularly (every 22 days) monitored from an ascending and a descending orbit. All Prio 2 sites were monitored at least monthly. For about half of the Prio 1 sites the regularly acquisitions every 22 days were successful. All other sites have at a minimum 3 successful acquisitions (Status March 2016).
* The Status of acquisitions can be checked by R&D teams via the EOWEB NG tool: <https://centaurus.caf.dlr.de:8443/eoweb-ng/template/default/welcome/entryPage.vm>
* KML Files of the acquisitions will be provided again to the R&D teams in July 2016.
* A feedback to the DLR GFOI team is a mandatory requirement for the continuation of the background mission till July 2016.

4.4.2 TerraSAR-X new acquisitions

New acquisitions forGFOI R&D Study Sites can be acquired by submitting a research proposal to DLR. All acquisition modes are possible, according to user requests. As a stop-gap solution a background mission was initiated by DLR.

**Data access procedure:**

* For new acquisitions over GFOI R&D Study Sites a research proposal is required. The primary entry point is the TerraSAR-X Science Service System: [http://sss.terrasar-x.dlr.de](http://sss.terrasar-x.dlr.de/) using the AO for General Proposal Submission. For GFOI R&D groups the usual COFUR costs can be waived for a reasonable amount of data.  Therefor the DLR GFOI contact person has to be informed prior to submission of the proposal, the proposal name should include “GFOI” and the scientific GFOI R&D purposes have to be described in the proposal.
* All science proposal submission details are included in <http://sss.terrasar-x.dlr.de/pdfs/how_to_submit_a_tsx_proposal.pdf>.

4.4.3 TerraSAR-X archive data

TerraSAR-X acquisitions (mostly StripMap) have been acquired and archived since 2008 over selected GEO-FCT and GFOI R&D Study Sites. Detailed search results from the 1Q 2008 to the 1Q 2015 are available at <http://gfoi.org/RD>.  Newer Archive data can be searched via EOWEB: <https://centaurus.caf.dlr.de:8443/eoweb-ng/template/default/welcome/entryPage.vm>

**Archive data access:**

* Archived data older than 18 months at the time of ordering from the archive is provided free of charge on request through the AO for the utilization of the TerraSAR-X archive. Entry point is the TerraSAR-X Science Service System: [http://sss.terrasar-x.dlr.de](http://sss.terrasar-x.dlr.de/). For specific conditions, see <http://sss.terrasar-x.dlr.de/pdfs/TSX-Archived-Data-2014-AO-1.0.pdf>  for archived data requests. It is strongly recommended to check the EOWEB catalogue <https://centaurus.caf.dlr.de:8443/eoweb-ng/index2.html>  for data availability before submitting a proposal.
* Archived data newer than 18 months can be accessed using the AO for General Proposal Submission as described under 4.4.2

4.4.4 Upcoming TerraSAR-X AO’s

A new AO for TerraSAR-x Like Products From Tandem-x Pursuit Monostatic Mode was released in  April 2016.

4.4.5 TanDEM-X new acquisitions

**New acquisitions:** The TanDEM-X data acquisition plan will focus on High resolution DEM (HDEM) Demo products acquisitions until the end of 2016. The planning for 2017 is not yet finalised. A discussion forum for new requirements on the scientific data acquisition plan will be organised at the TerraSAR-X/TanDEM-X Science Workshop 17-20 October 2016.

Please note that acquisitions during the HDEM phase are not suitable in all cases:

a) For equatorial regions near and low latitudes the baselines is unsuitable, both ascending and descending

b) Medium and particularly high latitude of the Northern Hemisphere: descending orbits are useful with limitation

c) Medium and particularly high latitude Southern Hemisphere: ascending orbits are useful with limitation

In case b) or c) please contact the Tandem-X Science team [tandemx-science@dlr.de](mailto:tandemx-science@dlr.de) before submitting a proposal

4.4.6 TanDEM-X archive data

The TanDEM-X science phase AO (Oct.2014 – Dec. 2015) is already closed. TanDEM-X bistatic and/or polarimetric acquisitions of the science phase may still be acquired on request for GFOI R&D teams and the COFUR costs may be waived for a reasonable amount of data. Please contact the DLR GFOI contact point for further details

The TanDEM-X DEM AO will be launched in Q3 2016. The AO will provide access to final TanDEM-X DEM data and to the Cost that were used for DEM production. There will be a quoted access for the data in the two highest posting classes (12m & 30m), the amount of data will be restricted. Currently, > 90% of the globe’s surface is available, 100 % will be reached by 3Q 2016.

TanDEM-X acquisitions have been acquired and archived since 2011 over selected GEO-FCT and GFOI R&D Study sites. Over a few forest super sites a higher amount of data was acquired. The KML’s of this super sites will be provided trough the GFOI website. Moreover detailed search results till end 2014 available at <http://gfoi.org/RD>.  Newer archive data can be searched with the EOWEB NG tool:

<https://centaurus.caf.dlr.de:8443/eoweb-ng/template/default/welcome/entryPage.vm>

**Data access procedure:**

* A research proposal is required. The primary entry point is the TanDEM-X Science Service System: <https://tandemx-science.dlr.de/>. All science proposal submission details are included in <https://tandemx-science.dlr.de/pdfs/TD-GS-UM-0115-TanDEM-X-Science-Service-System-Manual_V1.0.pdf>.

### 4.4.7 Requests for TerraSAR-X data

**MINIMUM REQUIRED1 DATASETS** (1Critical: without which the study cannot be completed)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Site code** | **Location** | **Time window** | **Required duration** | **(Minimum) observation frequency** |
| Group 6 | FCT-BOR3 | Mawas, Borneo | Jan-Dec | 2015-2017 | Monthly |
| FCT-SUM-2 | Harapan, Sumatra | Jan-Dec | 2015-2017 | Monthly |
| Group 8 | PNG-1 | Kokoda, PNG | Jan-Dec | 2015-2017 | Monthly |
| PNG-2 | Milne bay, PNG | Jan-Dec | 2015-2017 | Monthly |
| Group 10 | AU-4 | Robson Creek, QLD, Australia | Apr-Dec | 2015-2016 | max |
| AU-3 | Warra, Tasmania, Australia | Apr-Dec | 2015-2016 | max |
| Group 11 | AU-5 | Injune, QLD, Australia | Jan-Dec | 2015, 2017 | Monthly |
| Group 14 | KAL-1 | Sebangu N.P. / xMRP | July - Nov | 2012/2015 | 4 consecutive acquisitions |
| Group 16 | SA-1 | Lowveld / Kruger N.P. |  |  | Monthly |
| SA-2 | Eastern Cape |  |  | Monthly |
| SA-3 | KwaZulu-Natal |  |  | Monthly |

**COMPLEMENTARY2 DATASETS** (2Non-critical but can enhance outcomes)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Sites** | **Location** | **Time window** | **Required duration** | **(Minimum) observation frequency** |
| Group 8 | PNG-1 | Kokoda, PNG | Jan-Dec | 2010-2011  2014 | Monthly |
| PNG-2 | Milne bay, PNG | Jan-Dec | 2010-2011  2014 | Monthly |

*Table 4.5 GFOI R&D Study Sites requested for coverage by TerraSAR-X*

### 4.4.8 Requests for TanDEM-X data

**MINIMUM REQUIRED1 DATASETS** (1Critical: without which the study cannot be completed)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Site code** | **Location** | **Time window** | **Required duration** | **(Minimum) observation frequency** |
| Group 7 | FCT-TNZ-5 | Amani, Tanzania | Fixed timeframe | Fixed timeframe |  |
| FCT-TNZ-6 | Liwale, Tanzania | Fixed timeframe | Fixed timeframe |  |
| Group 8 | PNG-2 | Milne bay, PNG | Fixed timeframe | Fixed timeframe | Several interferometric obs. |
| Group 10 | AU-4 | Robson Creek, QLD, Australia | Apr-Dec | 2015-2016 | max |
| AU-3 | Warra, Tasmania, Australia | Apr-Dec | 2015-2016 | max |
| Group 11 | AU-5 | Injune, QLD, Australia | Fixed timeframe | 2010, 2017 | max |
| Group 12 | CAN-1/2/3 | NW Territories, Canada | June-Sept | Up to 2015 | Once |
| Group 14 | KAL-1 | Sebangu N.P. / xMRP | July - Nov | 2015 | 4 consecutive acquisitions |

**COMPLEMENTARY2 DATASETS** (2Non-critical but can enhance outcomes)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Sites** | **Location** | **Time window** | **Required duration** | **(Minimum) observation frequency** |
| Group 8 | PNG-2 | Milne bay, PNG | Jan-Dec | 2011 | Several interferometric obs. |

Table 4.6 GFOI R&D Study Sites requested for coverage by TanDEM-X.

## 4.5 ESA

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sensor** | **Agency** | **Contact point** | **Email** | **Access conditions** | **Archive and Data search tool** |
| Sentinel-1A | ESA | Frank Martin Seifert | frank.martin  .seifert  @esa.int | Free and open | https://scihub.esa.int/ |
| ENVISAT ASAR (archive) | One Category-1 proposals | http://earth.esa.int/EOLi/EOLi. Html |

4.5.1 Sentinel-1A and Sentinel-2A

Sentinel-1A data in Interferometric Wide-Swath (IWS) mode will be acquired over GFOI R&D Study Sites. The Sentinel-1A observation scenario is available at

<https://sentinel.esa.int/web/sentinel/missions/sentinel-1/observation-scenario/archive>

When in full operations, Sentinel-2A will systematically acquire data over land and coastal areas in a band of latitude extending from 56° South to 83° North.

**Data access procedure:**

* The Sentinel Scientific Data Hub (<http://scihub.esa.int>) provides free and open access to a rolling archive of Sentinel-1 L0 and L1 products. The latest 2 months of data acquired over specific regions of interest are stored in the archive.
* Data can be downloaded via HTTP.

4.5.2 ENVISAT ASAR

ENVISAT operations were terminated on April 8, 2012. ENVISAT ASAR are provided free of charge by ESA.

ENVISAT ASAR wall-to-wall coverage has been acquired over Guyana, Brazil, Cameroon, Tanzania, Tasmania and additionally Sumatra, DC Congo, Peru and Colombia (from 2010 onwards) in 2009 to 2012. Data acquisitions can be viewed with the EOLi catalogue and ordering tool.

**Data access procedure:**

* Order preparation within EOLI-SA – download latest version at <http://earth.esa.int/EOLi/EOLi.html> and save as user set.
* Send processing order to Frank Martin Seifert (frank.martin.seifert@esa.int)
* L1 Processing by ESA

## 4.6 INPE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sensor** | **Agency** | **Contact point(s)** | **Email** | **Access conditions** | **Archive and Data search tool** |
| CBERS-4 | INPE | TBC | TBC | Unrestricted use for data acquired by INPE | http://www.dgi. inpe.br/CDSR/ |
| CBERS-2B  (archive) |

4.6.1 CBERS-4

CBERS-4 was launched in December 2014 with radiometric and geometric commissioning of all four instruments (PAN, MUX, IRS, WFI) commencing in November 2015. The MUX camera is operational (Feb 2016) while the PAN, IRS and WFI instruments are expected to be operational by July 2016.

Data collected during 2015 are archived, but currently no plans for processing.

CBERS-4 data acquired at INPE’s ground stations are available open to the public free of charge at <http://www.dgi.inpe.br/CDSR/>

4.6.2 CBERS-4, CBERS 2B and Landsat TM

**Data access procedure:**

* INPE will process and distribute, free of charge, via its Image Data Catalogue (www.dgi.inpe.br/CDSR), all CBERS-2B CCD data available over GEO-FCT verification sites in Brazil and Guyana.
* INPE will process and distribute, free of charge, via its Image Data Catalogue (www.dgi.inpe.br/CDSR), all CBERS-2B CCD data available over GEO-FCT verification sites in Brazil and Guyana.
* Similarly, any requested Landsat TM data can be directly downloaded at no cost using the Catalogue.

## 4.7 JAXA

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sensor** | **Agency** | **Contact point(s)** | **Email** | **Access conditions** | **Archive and Data search tool** |
| ALOS-2 PALSAR-2  &  ALOS PALSAR  (archive) | JAXA | Masanobu Shimada / Ake Rosenqvist | shimada. masanobu@jaxa.jp / ake.rosenqvist @soloEO.com | Standard data at cost of reproduction | https://auig2.jaxa.jp/ips/home |
| 25m mosaic data: Free of charge | http://www.eorc.jaxa.jp/ALOS/en/palsar\_fnf/fnf\_index.htm |
| JERS-1 SAR (archive) | JAXA | Masanobu Shimada / Ake Rosenqvist | shimada. masanobu@jaxa.jp / ake.rosenqvist @soloEO.com | Free of charge | https://www.gportal.jaxa.jp |

4.7.1 ALOS-2 PALSAR-2 Basic Observation Scenario (BOS)

**New acquisitions:** New acquisition requests for GFOI cannot be accommodated, however it is anticipated that the ALOS-2 Basic Observation Strategy (BOS), which is fully compliant with SDCG recommendations for L-band SAR will satisfy the requirements for GFOI R&D.

The ALOS-2 BOS plans for past and future acquisitions can be viewed at <http://www.eorc.jaxa.jp/ALOS-2/en/obs/pal2_obs_guide.htm>

Ortho-corrected PALSAR-2 mosaics from 2014/2015, and at 25 m pixel spacing, are available for free download at <http://www.eorc.jaxa.jp/ALOS/en/palsar_fnf/fnf_index.htm>

**Data access procedure: TBD**

4.7.2 ALOS PALSAR

**Archive data availability:** ALOS PALSAR featured a global systematic acquisition strategy through which all land areas on Earth were acquired in stripmap 20 m (HH+HV) and 10 m (HH) mode 3-5 times per year between 2007 and 2011. Consistent time-series over all GFOI R&D sites are available. Detailed archive information is available at <https://auig2.jaxa.jp/>

Ortho-corrected PALSAR mosaics (2007-2010) at 25 m pixel spacing are available for free download at <http://www.eorc.jaxa.jp/ALOS/en/palsar_fnf/fnf_index.htm>

**Data access procedure: TBD**

4.7.3 JERS-1 SAR

The 1992-1998 archive of JERS-1 data (SAR, VNIR, SWIR) is open to the public free of charge.

SAR data are currently available at processing level 2.1 (ground range), with Level 0 products to be available in mid 2016.

**Data access procedure:**

Data are available from JAXA’s G-Portal www (https://www.gportal.jaxa.jp) as well as by direct download through Safe FTP (SFTP). Please refer to the User Manual (section 3) about generating a public key and direct download:

<https://www.gportal.jaxa.jp/gportal_file/contents/help/UserManual_en.pdf>

### 4.7.4 Requests for ALOS-2 (FBD) data

**MINIMUM REQUIRED1 DATASETS** (1Critical: without which the study cannot be completed)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Site code** | **Location** | **Time window** | **Required duration** | **(Minimum) observation frequency** |
| Group 2 | MLW-1 | Malawi | As available | 2014-2018 | 4 times/year |
| GAB-1 | Gabon | As available | 2014-2018 | 4 times/year |
| Group 4 | ETH-1 | Kafa Biosphere reserve, Ethiopia | Jan - Dec | 2016-2018 | As frequent as possible, but at least 3-5 obs./year |
| PER-1 | Province Satipo and Pasco, Peru | Jan - Dec | 2016-2018 | As frequent as possible, but at least 3-5 obs./year |
| FIJ-1 | Fiji archipelago | Jan - Dec | 2016-2018 | As frequent as possible, but at least 3-5 obs./year |
| Group 7 | FCT-TNZ-5 | Amani, Tanzania | June-Sept  Jan | 2016-2017 | Monthly |
| FCT-TNZ-6 | Liwale, Tanzania | June-Sept  Jan | 2016-2017 | Monthly |
| Group 8 | PNG-1 | Kokoda, PNG | Jan - Dec | 2015-2017 | Monthly |
| PNG-2 | Milne bay, PNG | Jan - Dec | 2015-2017 | Monthly |
| Group 9 | FCT-MEX-2 | Chiapas | Jan - Dec | 2015-2016 | Bi-monthly |
| MEX-8 | Durango | Jan - Dec | 2014-2016 | Bi-monthly |
| FIN-1 | Hyytiälä | Jan - Dec | 2014-2016 | Bi-monthly (or once/season) |
| FIN-2 | Sodankylä | Jan - Dec | 2014-2016 | Bi-monthly (or once/season) |
| RUS-1 | Pechora-Ilych | Jan - Dec | 2015-2016 | Monthly |
| Group 10 | AU-4 | Robson Creek, QLD, Australia | Apr-Dec | 2015-2016 | Monthly |
| AU-3 | Warra, Tasmania, Australia | Apr-Dec | 2015-2016 | Monthly |
| Group 11 | AU-5 | Injune, QLD, Australia | Jan - Dec | 2015 | Bi-monthly |
| Group 12 | CAN-1 | NW Territories, Canada | June-Sept | 2014-2016 | 3 / summer |
| CAN-2 | NW Territories, Canada | June-Sept | 2014-2016 | 3 / summer |
| CAN-3 | NW Territories, Canada | June-Sept | 2014-2016 | 3 / summer |
| Group 13 | BRA-2 | Novo Progresso, Brazil | entire year | 2014 - 2018 | All 2/3 months |
| Group 16 | SA-1 | Lowveld / Kruger N.P. |  |  | Bi-monthly |
| SA-2 | Eastern Cape |  |  | Bi-monthly |
| SA-3 | KwaZulu-Natal |  |  | Bi-monthly |
| Group 17 | DRC-1 | Mai Ndombe district, DRC | June-Sept  Jan | 2016-2017 | Monthly |

*Table 4.7a GFOI R&D Study Sites requested for coverage by ALOS-2 PALSAR-2.*

**COMPLEMENTARY2 DATASETS** (2Non-critical but can enhance outcomes)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Site code** | **Location** | **Time window** | **Required duration** | **(Minimum) observation frequency** |
| Group 15 | SUR-1 | Klaaskreek, Suriname | Jan - Dec | 2015-2017 | Once / year |
| KAL-2 | Malinau, Kalimantan | Jan - Dec | 2015-2017 | Once / year |
| GHA-1 | Kade, Ghana | Jan - Dec | 2015-2017 | Once / year |

*Table 4.7b GFOI R&D Study Sites requested for coverage by ALOS-2 PALSAR-2.*

## 4.8 USGS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sensor** | **Agency** | **Contact point(s)** | **Email** | **Access conditions** | **Archive and Data search tool** |
| Landsat 7 & 8 | USGS | Eugene Fosnight | Fosnight @usgs.gov | Unrestricted use | http://earthexplorer.usgs.gov |

4.8.1 Landsat TM/ETM+/OLI

All Landsat data archived by the US Geological Survey (USGS) is accessible, free of charge to users. The Landsat-8 Long Term Acquisition Plan (LTAP was in December 2014 modified to acquire all descending day-lit land images between 58° N and S latitude. At higher latitudes with more than 50% side lap, the priority is decreased in proportion to the amount of overlap between paths to maintain a 16-day or better revisit period.

Landsat-7 continues to operate within the continental landmass model. Ninety percent of the opportunities are acquired with Landsat-7. No daily limits are set for Landsat-7. All images rejections are due to instrument duty cycle and onboard memory constraints. Investigations are ongoing to reduce these constraints.

**New acquisitions:** Both missions support special requests that can be used to improve the probability of acquisitions in support of coordinated field measurements. Special requests are more critical to Landsat-7 acquisitions than for Landsat-8 acquisitions.

**Archive data availability:** The Landsat archive can be accessed through the USGS Global Visualization Viewer (GloVis) at <http://glovis.usgs.gov/>

**Data access procedure:**

* Research teams can be directly download Landsat data using Earth Explorer or GloVis. Data are available without restriction, at no cost to users.

4.8.2 Research Announcements

* USGS funds the Landsat Science Term co-chaired by USGS and NASA (landsat.usgs.gov/science\_Landsat\_Science\_Team.php). The current team is funded through 2017. In 2017, a request for proposals for the next Landsat Science Team will be announced.
* NASA publishes open solicitations for Earth Science Data Systems (http://science.nasa.gov/earth-science/earth-science-data/open-solicitations-earth-science-data-systems/)

## 4.9 Commercial Data providers

4.9.1 Airbus Defence & Space

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sensor** | **Agency** | **Contact point(s)** | **Email** | **Access conditions** | **Archive and Data search tool** |
| SPOT 6/7 | Airbus D&S | Patrick Houdry | Patrick.Houdry@astrium.eads.net | Special GFOI |  |

Following a Commercial Provider information session organised in conjunction with SDCG-8 (Sept 2015), ADS have analysed the list of GFOI R&D projects that have requested VHR data, and are ready to support a selection of them with SPOT6/7 HR imagery. More information to be provided.

### 4.9.2 Requests for VHR data

**MINIMUM REQUIRED1 DATASETS** (1Critical: without which the study cannot be completed)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Site code** | **Location** | **Time window** | **Required duration** | **(Minimum) observation frequency** |
| Group 2 | MLW-1 | Malawi | Jun – Oct &  Nov-April | Jun 2016 - Sep 2018 | Twice yearly |
| GAB-1 | Gabon | Jun – Oct &  Nov-April | Jun 2016 - Sep 2018 | Twice yearly |
| Group 4 | ETH-1 | Ethiopia | Jan-Dec | 2016-2018 | 1 scene |
| PER-1 | Peru | Jan-Dec | 2016-2018 | 1 scene |
| FIJ-1 | Lololo & Nakavu | Jan-Dec | 2016-2018 | 1 scene |
| Group 5 | GFC-1 | Guyana | Jan-Dec | Aug2016-Aug2017 | Monthly |
| GFC-2 | Guyana | Jan-Dec | Aug2016-Aug2017 | Monthly |
| GFC-3 | Guyana | Jan-Dec | Aug2016-Aug2017 | Monthly |
| Group 6 | FCT-BOR-3 | Mawas | Jan-Dec | Apr2016-Mar2017 | Monthly |
| FCT-SUM-2 | Harapan | Jan-Dec | Apr2016-Mar2017 | Monthly |
| Group 7 | FCT-TNZ-5 | Amani, Tanzania | June-Sept, Jan-Feb | 2016-2017 | Monthly |
| FCT-TNZ-6 | Liwale, Tanzania | June-Sept, Jan-Feb | 2016-2017 | Monthly |
| Group 8 | PNG-1 | Kokoda, PNG | Jan-Dec | 2015-2017 | Monthly |
| PNG-2 | Milne bay, PNG | Jan-Dec | 2015-2017 | Monthly |
| Group 9 | FCT-MEX-2 | Chiapas, Mexico | Jan-Dec | 2007, 2010 , 2013, 2015 | Monthly |
| MEX-8 | Durango, Mexico | June 15 - Aug 31 | 2010 , 2014, 2015 | Monthly |
| FIN-1 | Hyytiälä, Finland | Jan-Dec | 2007, 2010, 2013  2015, 2016 | Monthly |
| FIN-2 | Sodankylä, Finland | Jan-Dec | 2007, 2010, 2013  2015, 2016 | Monthly |
| Group 10 | AU-4 | Robson Creek, QLD, Australia | Apr-Dec | 2015-2016 | Monthly |
| AU-3 | Warra, Tasmania, Australia | Apr-Dec | 2015-2016 | Monthly |
| Group 11 | AU-5 | Injune, QLD, Australia | Jan-Dec | 2010  2017 | Monthly |
| Group 13 | BRA-2 | Novo Progresso, Brazil | entire year | 2014 - 2018 | weekly |
| Group 15 | SUR-1 | Klaaskreek, Suriname | Jan - Dec | 2015-2017 | 2 times / year |
| KAL-2 | Malinau, Kalimantan | Jan - Dec | 2015-2017 | 2 times / year |
| GHA-1 | Kade, Ghana | Jan - Dec | 2015-2017 | 2 times / year |
| Group 17 | DRC-1 | Mai Ndombe district, DRC | June-Sept  Jan-Feb | 2016-2017 | Monthly |
| Group 18 | MEX-4 | Campeche, Mexico | Whole year | 2015-2018 | Once/year |
| MEX-5 | Marques de Comilias, Mexico | Whole year | 2015-2018 | Once/year |
| MEX-6 | Hiladgo, Mexico | Whole year | 2015-2018 | Once/year |
| SA-4 | Skukuza/KNP, South Africa | Whole year | 2015-2018 | Once/year |

**COMPLEMENTARY2 DATASETS** (2Non-critical but can enhance outcomes)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Group** | **Sites** | **Location** | **Time window** | **Required duration** | **(Minimum) observation frequency** |
| Group 1 | BRA-1 | Mato Grosso, Brazil | June-Oct | 2016-2017 | 1 scene |
| Group 3 | FCT-COL-3 | Pacifico-Bajo-Mira, Colombia | Since launch | Cloud free | Once a year |
| FCT-COL-4 | Amazonia-Tinigua, Colombia | Since launch | Cloud free | Once a year |
| FCT-COL-5 | Andes-Antioquia, Colombia | Since launch | Cloud free | Once a year |
| FCT-COL-6 | Cacueta, Colombia | Since launch | Cloud free | Once a year |
| FCT-COL-7 | La Victoria, Colombia | Since launch | Cloud free | Once a year |

*Table 4.8 GFOI R&D Study Sites requested for coverage by VHR data (same as CNES table 4.2)*

1. http://ceos.org/ourwork/ad-hoc-teams/sdcg/ [↑](#footnote-ref-2)
2. GFOI R&D Plan for 2015+. An action plan for advancing priority R&D topics related to the use of Remote Sensing in National Forest Monitoring – February 2015 [↑](#footnote-ref-3)
3. Baker et al. (2010). Achieving forest carbon information with higher certainty: A five-part plan. *Environmental Science & Policy*, 13: 249-260. [↑](#footnote-ref-4)
4. http://www.gfoi.org/sites/default/files/GFOI\_ReviewPrioityRDTopics\_V1.pdf [↑](#footnote-ref-5)
5. Landscaping the Research and Development Situation – DRAFT, July 2014 [↑](#footnote-ref-6)
6. GFOI (2013): *Review of Priority Research & Development Topics: R&D related to the use of Remote Sensing in National Forest Monitoring*. Pub. GEO, Switzerland, 2013 ISBN 978-92-990047-5-3. [↑](#footnote-ref-7)