

## Satellite Monitoring for Forest Management (SMFM) Project

Project Reference no: 1231131  
Monthly progress summary: September 2018  
Project month no: 22  
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### Main progress:

#### 1 Project planning and analysis

The month of September 2018 has seen project activities concentrating on (i) potential integration of the SMFM EO tools on existing cloud processing platforms, (ii) the preparation of a major capacity building event at the University of Edinburgh (UoE), and (iii) the continuation of planned field work in Mozambique.

The remaining field work in Mozambique, initially re-scheduled to the month of September 2018 due to operational and administrative delays, had again to be postponed.

A video conference was held with the World Bank DC and the ESA on September 28, 2018 covering the preparation of the regional SMFM event in Nairobi, Kenya scheduled for November 2018.

Several other VCs were held with WB participation focussing more on technical aspects of the project. These are presented in more detail in the respective chapters of the present report.

#### 1.1 Develop a detailed work plan for the SMFM project; review after 12 months

The previously reviewed overall SMFM project work plan is already under implementation. With the training at University of Edinburgh brought forward, preparations for training as well as travel fell into the month of September.

Equally, discussions on the potential timing, agenda and preparation for the re-scheduled regional SMFM event began by end of September 2018.

### Technical update:

#### 2.1 Design new or enhanced satellite EO methods to address requirements and gaps

In preparation of the upcoming deployment and testing of the Tools 1 & 2 on a cloud processing platform, technical developments have focussed on various trials and related adjustments.

##### SMFM Tool 1a/1b:

A range of tweaks has been implemented to ensure operability with data formats (mostly input/output formats) provided by cloud platforms. Further modifications will be required once a cloud platform is decided.



To test the CREODIAS platform a specific search script was produced that returns lists of available Sentinel-2 tiles for dense time series analysis (<https://bitbucket.org/sambowers/s2cdsearch>), requiring further modifications to the sen2mosaic script.

### **SMFM Tool 2:**

This tool has been tested using a range of academic research problems. The UoE has recently tested this tool to produce biomass change maps to analyse the efficacy of sustainable forest management in Tanzania. UoE has also arranged for a visitor from Yale University to test this tool next month to assess the impacts of a recent drought on woody biomass in Kruger National Park, South Africa.

This practical testing allows to make continuous and incremental modifications to the scripts to best meet user needs, which will be passed on to the larger-scale applications by SMFM partner countries under the planned tool co-development.

### **SMFM Tool 3:**

Issues of insufficient training data have been eased through modifications allowing existing land cover maps to be used to produce training data pixels. This will require a reasonable quality land cover map, which both Mozambique and Zambia have already produced. To test the procedures, a prototype 20 m land cover map for Africa produced by ESA<sup>1</sup> has been used.

A new prototype output for the Chimanimani region of Mozambique / Zimbabwe has been produced for assessment by country partners. This location is marked by heterogeneous forest structures, rapid deforestation, and the presence of forest plantations which make for a good test case. In addition, this is the location of one of the SMFM field work sites.

Prototype data outputs are available for download and assessment at: <https://drive.google.com/drive/folders/1w0g1cZUoQC-5bKsLHsRca624BXAUFxoX>

These data will also be disseminated to participants from partners countries at the training workshop in Edinburgh.

Prototype outputs are summarised in Fig 1. and Fig. 2 below:

<sup>1</sup> <http://2016africallandcover20m.esrin.esa.int/>



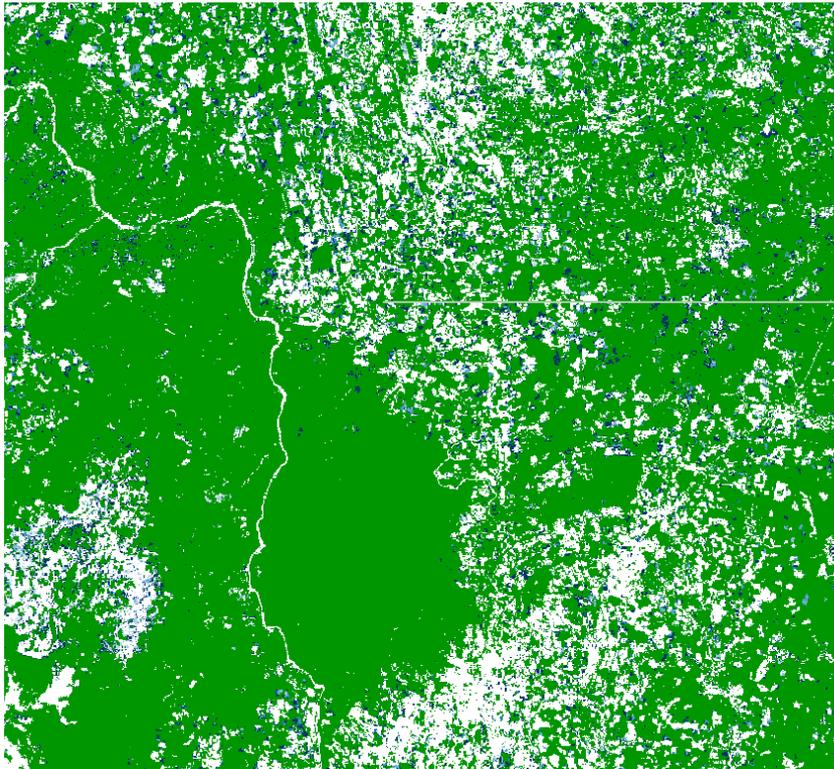


Figure 1: Forest extent (green) and deforested areas (blue) for the period 2017-2018 in Sussundenga District, Mozambique, location of the SMFM fieldwork workshop in July 2018.

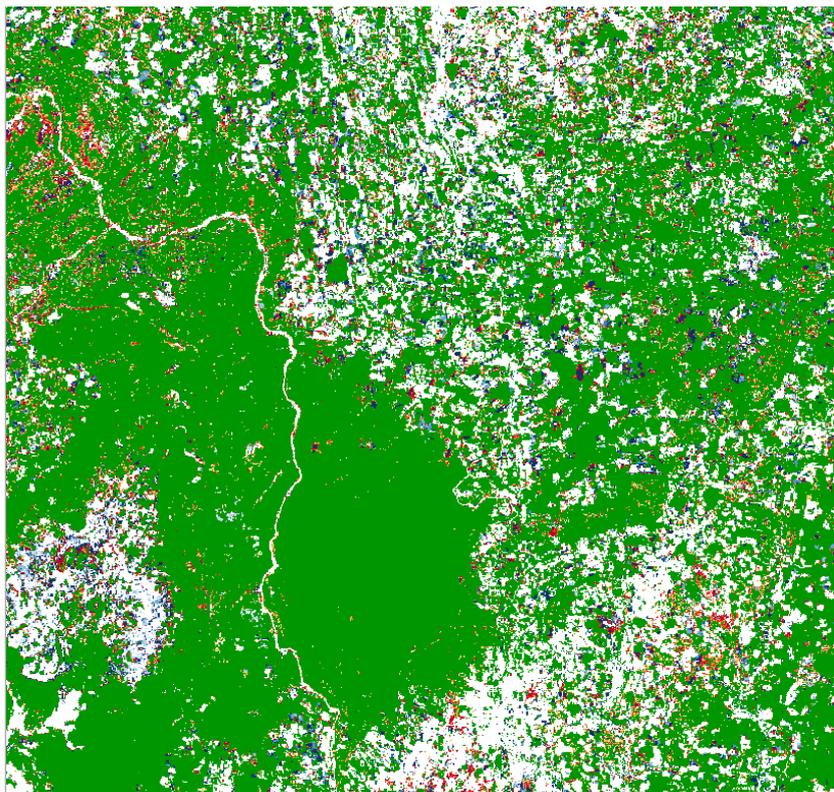


Figure 2: 'Early warnings' of deforestation are indicated in red. Many of these areas are likely to be false positives, but this can provide an important clue about upcoming forest change.

### *Where does this dataset currently perform well?*

Areas of dense closed-canopy and evergreen forest tend to be represented well by this tool. The most dramatic forest changes are more readily detected. For example, plantation forestry in Zimbabwe:

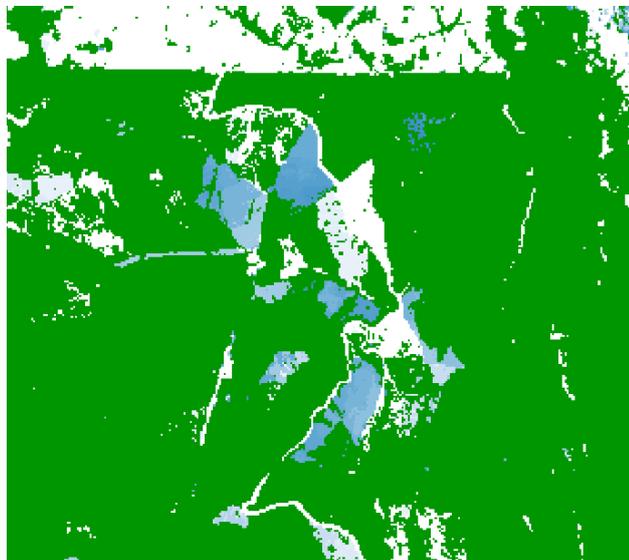


Figure 3: The progressive harvesting of trees from plantation forestry in the Chimanimani region of Zimbabwe is well represented by the tool. Deforestation from early 2017 (light blue) can be distinguished from deforestation in late 2017 (dark blue).

### *Where does this dataset perform poorly?*

Open-canopies, areas subject to frequent fires and forest types with greater seasonality tend to be more problematic. Forests that are on the borderline of forest / non-forest may be detected as 'deforestation' after a run of very dry images or following fires, which can be hard for the classifier to deal with.

This can result in some likely spurious detections of deforestation. An example is presented in figure 4 below.

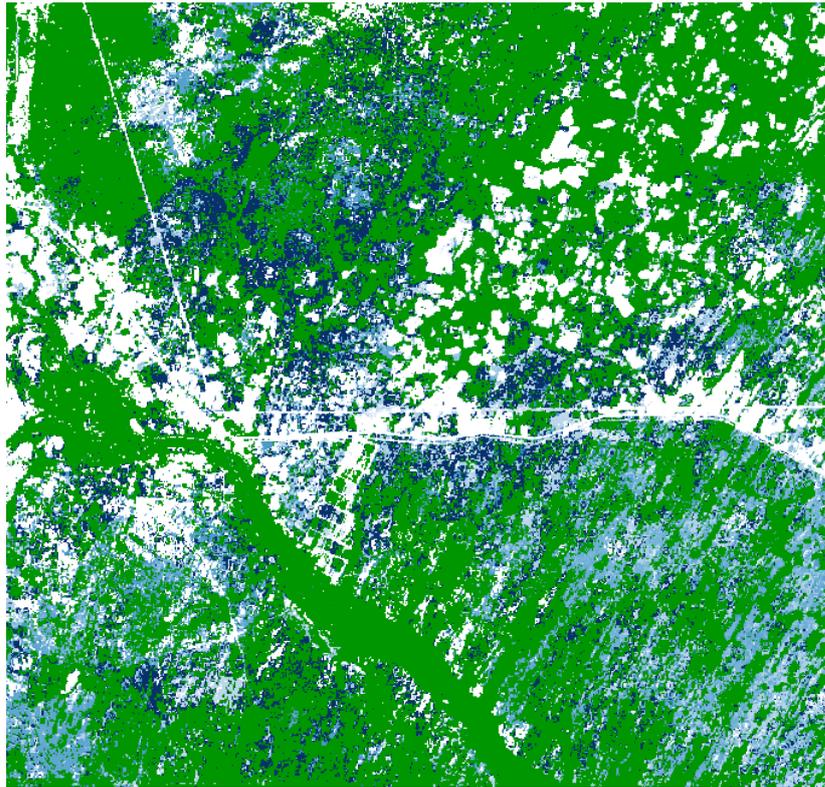


Figure 4: An area of sparse woodland near Dombé in Mozambique is detected as deforested (blue) after a run of dry images. These woodlands are on the cusp of the 10 % canopy cover forest definition, meaning a run of 'dry' images can lead to some areas being falsely detected as deforestation.

### EO platform discussions:

Following up on previous month's suggestions from ESA during a VC on August 30, the SMFM team set up a VC with the CREODIAS<sup>2</sup> team on September 6, 2018. During this meeting, the CREODIAS team, represented by technical, support and sales experts, informed the SMFM team about current scope and limitations of the CREODIAS platform and data repository.

For instance, the CREODIADS cloud platform does not mirror the entire ESA Sentinel repository for level-2 products but rather offers batch processing of remotely stored level-2 data. Equally, ALOS mosaic data are currently not available from the CREODIAS repository but can be uploaded to the user storage (up to 1 TB of data). In addition, the global coverage of Sentinel-1 data can be accessed via the CREODIAS platform.

Discussion then focussed on potential need for a front-end for the SMFM tools. However, it was suggested to start exploring the CREODIAS using a trial account and see how the tools work in general. The CREODIAS team promised to hold internal discussions about the possible extension of the trial period, as otherwise the project

<sup>2</sup> A DIAS platform previously selected by the SMFM project for tool testing

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will incur cost for an extended trial. Currently, the credits that come along with the free trial amount to about € 150.

On the back of the CREODIAS VC, the SMFM team engaged with ESA representatives to set up a VC meeting with the Forestry-TEP team. This VC was successfully held on September 21, 2018 with the participation of ESA representatives and participants from VTT<sup>3</sup> in Finland, the company coordinating the Forestry-TEP<sup>4</sup> project on behalf of the ESA. The Forestry-TEP (or F-TEP) project provides a technology platform for remote processing of big data from remote sensing sources, i.e. Sentinel-1 and Sentinel-2.

Explaining the principles behind the F-TEP platform, the F-TEP team confirmed that the platform is hosted by Cloudferry in Poland<sup>5</sup> and that the F-TEP will ultimately become integrated into the DIAS platform. Datasets that can be accessed are Sentinel-1, 2 and 3, as well as Landsat. Processing services already available include for instances forest change detection between images from two different dates.

In addition, external applications, such as QGIS, SNAP or OTB, can be launched from within an application browser. Own user tools, such as the SMFM tools could be integrated via a developer interface using a docker container and a processing script.

So far, time stacks of images, which would be important for the SMFM tools using dense time series is not yet implemented, but plans are to implement these in the future. A functioning workaround, however, is already available. Uploading of ALOS data would be possible, but potential licensing issues would have to be considered.

A trial account has been made available to the SMFM team the same day, together with assurances that the F-TEP team will make it possible for the SMFM team to exceed currently existing technical limitations of the trial account. The F-TEP team also reminded that a payment scheme will be introduced at one point of time in the future.

## Initial testing of cloud platforms

### CREODIAS:

The CREODIAS platform is clearly capable and can readily provide all the data and processing power required by all of the SMFM tools. The platform operators have provided very thorough documentation (though occasionally confusing), and support was generally found to be responsive and helpful. Future functionality regarding automated pre-processing of Sentinel-2 L1C data is likely to be very useful, though this has not yet been implemented.

However, after initial testing the SMFM team concluded that for the purposes of a novice user, CREODIAS at present does not yet offer a viable solution for the SMFM

<sup>3</sup> VTT Technical Research Centre of Finland LTD

<sup>4</sup> <http://forestry-tep.eo.esa.int/>

<sup>5</sup> Cloudferry is the company operating the CREODIAS platform

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project. Setting up computing instances is complicated, requiring rather detailed knowledge of hardware requirements. Computing instances are charged on an hourly basis, and it would be easy to leave these instances running and generate unnecessary costs.

Effective system management will be tough even for an experienced user of Linux. In the case that no other viable alternatives are identified, the LTS / UoE team can develop detailed instructions for the setup and operation of the SMFM tools on CREODIAS, but this service is much more suitable for use by IT specialists than by end users in forestry departments.

#### Forestry-TEP:

Initial and very very brief testing has shown that the burden of installation, testing, and modification of the SMFM tools to ensure functionality on the F-TEP will probably be substantial. Clear advantage of the F-TEP platform is that once set up the tools should be accessible by multiple users without the need to perform any installation procedure.

As currently formatted, the F-TEP platform does not make available enough processing power to effectively operate analysis of dense time-series over very large scales. In time and given the exposure of more computing power to users this issue is expected to ease.

Further in-depth testing of the F-TEP is required and will continue in October 2018 after the completion of the SMFM training at the University of Edinburgh.

### **2.3 Obtain / collect in-situ datasets for validation**

#### **Mozambique:**

Still outstanding field work in Zambezia Province was planned for September 2018 but had again to be postponed. The completion of the field work is now expected to take place during the month of October 2018

The LTS/UoE team has received first batches of the collected field data from Mozambique. The data sets are currently undergoing cleaning and evaluation.

#### **Zambia:**

Zambia field work has been completed in all three provinces.

### **4.3 Implement at least two training events; including SSKE**

The earlier proposed one-week training event at the University of Edinburgh was approved for the planned dates (October 8-12) and all necessary preparations were carried out during the month of September.



The UoE team, in particular Prof. Iain Woodhouse and Dr. Sam Bowers, prepared the training agenda and materials and organized suitable venues as well as computer equipment. Table 1 below provides details about the proposed agenda for the SMFM tool training at the UoE.

Table 1: Proposed agenda for the SMFM training event at UoE

Day / venue	Morning	Afternoon
Mon 8 <sup>th</sup> October <i>Institute of Geography</i>	Introductions Accessing Sentinel data from SciHub	<u>Practical</u> Introduction to the Linux command line
Tue 9 <sup>th</sup> October <i>Crew Building</i>	Radar remote sensing concepts	<u>Practical</u> Automating data access with SMFM tools Radar/optical pre-processing with SNAP and SMFM tools.
Wed 10 <sup>th</sup> October <i>Inst. of Geography / Crew Building</i>	<u>Practical</u> Generating mosaics with SMFM tools (tool 1a/1b)	<u>Practical</u> Optical remote sensing concepts Introduction to SMFM dense time series outputs (tool 3)
Thu 11 <sup>th</sup> October <i>Institute of Geography</i>	<u>Practical</u> Introduction to Python	Radar remote sensing for forest monitoring
Fri 12 <sup>th</sup> October <i>Crew Building</i>	<u>Practical</u> Introduction to SMFM tool (tool 2)	<u>Practical</u> Application of SMFM tools for areas of interest

In addition, the UoE provided participants from Mozambique and Zambia with the necessary initiation letters to facilitate visa application procedures.

During a VC with the WB and ESA on September 28, the SMFM team also provided inputs to the planned regional project event that is expected to be the first major SSKE event under the project. Possible suitable venues in Nairobi were discussed and overall expectations were presented by the WB task team leader. The WB earlier developed a first concept note for the planned 3-day event, now scheduled to take place between November 19 and 21, 2018.

The LTS / UoE team will take over the planning and preparation of day 1 of this 3-day workshop, with the first day being earmarked for technical presentations by the project and by partner countries, as well as inputs from ESA and other relevant institutions from the region. Day 2 of the event is expected to cover high-level policy-related presentations and a panel discussion, while day 3 is planned to be a field day for visits to relevant institutions or projects in Kenya.

In preparation of this event, the LTS / UoE team was asked to update the project presentation to include latest developments and to prepare separate versions for technical and non-technical audiences.



### Issues and potential bottlenecks:

- 2.1 With initial testing of the CREODIAS and the F-TEP platforms underway, the project might incur cost resulting from charges for data storage and processing on these platforms, once free quotas are exceeded. For the SMFM team it is difficult to judge upfront how much funds might be required as time required for testing is not known in advance. Also, price schemes are not very transparent or not yet fully disclosed.
- 2.3 Further postponed commencement of field work on the 3<sup>rd</sup> site in Mozambique may result in these data not being used during the tool calibration phase.

