Satellite Monitoring for Forest Management (SMFM) Project

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Monthly progress summary:	January 2018
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Main progress:

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

During the month of January 2018, overall project planning and management included a video conference with the World Bank DC (Technical Team Task Lead) and the World Bank Zambia providing an update on preparations and progress with partner country Zambia.

During the VC, the SMFM team informed about proposed partner country institution to directly involve in SMFM activities. Main objectives of the in-country workshop were highlighted and discussed, and new dates were proposed. It was agreed that one expected outcome of the workshop(s) should be tentative budgets for the country implementation work. These budgets will be submitted to the World Bank for processing.

1.4.1 Assess global and country-level requirements and capacities in dry-forest monitoring

The in-country workshop in Mozambique, initially planned for January 15-17, 2018 had to be postponed as necessary visa could not be obtained in time from the Mozambican Embassy. In discussions with the World Bank it was agreed to try to combine both partner country visits in one single trip to save cost.
The LTS team held separate discussions with Mozambique and Zambia partners and agreed on new dates for the two workshops. The Mozambique workshop will be held on February 21-22, 2018 and the Zambia workshop on February 26-27, 2018. There will also be one separate day in each country set aside for the planning and budgeting of field validation data collection. A draft workshop agenda has been prepared and shared for comments. Preparations for venues, logistics and catering are underway.

The SMFM team is presently looking into preparing a summary document presenting the findings on global and country-level requirements and capacities in dry-forest monitoring. Both aspects, already laid out in the inception report, will be updated accordingly. In particular, the country-level requirements will be updated during the upcoming workshops in Mozambique and Zambia.

Technical update:

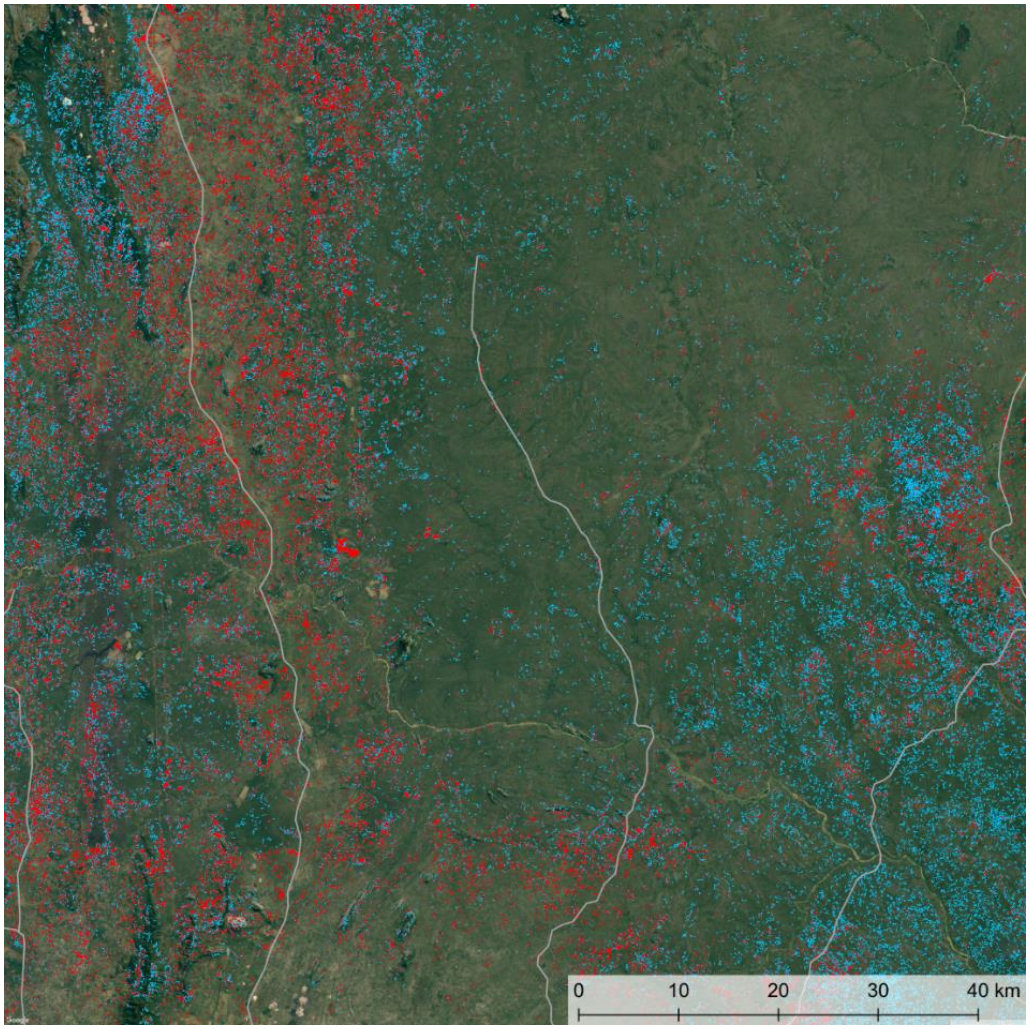
2.1.1 Semi-automated pre-processing of Sentinel-2 data for LULC Classification

- Following testing through development of 2.1.3, we've altered the structure of the code to process individual granules. This allows use of data prior to December 2016, and should help with parallelisation to speed up processing.
- We have also conducted further testing of the sen1mosaic tool. There are still some issues with incorrectly labelled no-data pixels to correct for, but the tool is now stable. Although the tool works somewhat differently to sen2mosaic, we plan to update the user interface so that the user experience of the two tools is similar. This work will be completed within the first couple of weeks of February, with draft documentation to follow shortly after.

2.1.2 Annual Forest Biomass Change and Degradation Mapping using ALOS PALSAR Mosaic

- This tool will take the form of a Python library, as it's clear that users will want to use this tool for a broad range of purposes. This will require more extensive documentation and in depth training, but should maximise the potential user base.
- We're testing the tool by applying it to a range of research problems at the University of Edinburgh, including plot biomass-backscatter calibration in dry forests of Mexico, quantification of landscape fragmentation in Mozambique, and mapping of woodland biomass in Tanzania.
- Further development of this tool will follow the requirements identified from visits to Mozambique and Zambia teams.

A summary output is shown below (red = deforestation, blue = degradation), for a location in the vicinity of Gorongosa National Park in Mozambique using data from 2007 - 2010.



2.1.3 Utilising dense Time-Series of Sentinel-2 data for Continuous Change Monitoring and Proxies of Forest Change

- Much of the month has focussed on further development of this tool, which continues to prove challenging.
- The tool works well for the detection of deforestation in true dry forests[1], but when applied to the woodland ecosystems more typical of Mozambique or Zambia the outputs are less reliable. The issue is that these woodlands are fully deciduous and so the dry season imagery carries almost no information about tree cover. The method requires a way to quantify forest state in any season and it is not clear that this is possible with these data in this ecosystem. We've implemented strategies from the literature to tackle this (Hamunyela *et al.*

[1] Dry forest = closed canopy, but deciduous, with little grass understory; Woodland = woody savanna, with a continuous grass layer and a discontinuous tree canopy; Savanna = as woodland but with very spares trees.

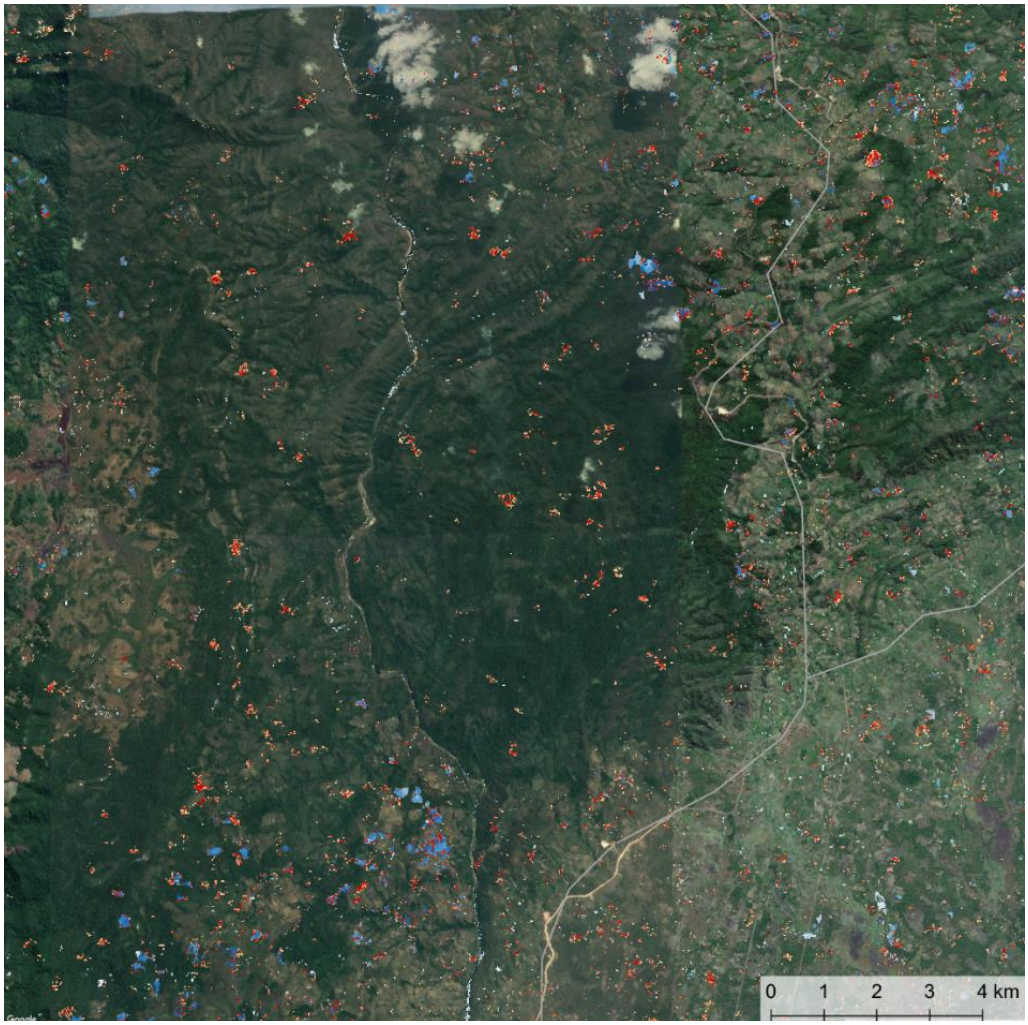
2016[2], Reiche *et al.* 2018[3]) as well as some of our own ideas, but the algorithms are not perfect and may work well in one location but poorly in another.

- In light of the challenges, our proposed strategy to further development will be:
  A. Testing the tool in a true dry forest, where similar methods have been developed on a research basis. This may reveal that the tool is globally applicable, with the limitations we're identifying a special-case for lower woody biomass woodland/savannah ecosystems.
  B. Further integration of measurements from Sentinel-1. Seasonality in Sentinel-1 images of woodlands seems to be less extreme, so a time series based on Sentinel-1 may contain more reliable information on woodland state.
  C. Depending on the results of A & B above, look at identification of the best times of year to use Sentinel imagery in woodlands. Certain times of year may provide little or misleading information about the state of woodlands; for instance in the height of the dry season in a deciduous woodland Sentinel-2 images may not be able to distinguish grassland from woodland.
- Use of this tool to identify degradation will follow collection of ground data in May.

[2] Reiche, J., Hamunyela, E., Verbesselt, J., Hoekman, D., & Herold, M. (2018). Improving near-real time deforestation monitoring in tropical dry forests by combining dense Sentinel-1 time series with Landsat and ALOS-2 PALSAR-2. Remote Sensing of Environment, 204, 147-161.

[3] Hamunyela, E., Verbesselt, J., & Herold, M. (2016). Using spatial context to improve early detection of deforestation from Landsat time series. Remote Sensing of Environment, 172, 126-138.

Summary outputs for a dry forest in Mozambique are shown below (blue = deforestation in 2017, red = early warnings of unconfirmed deforestation events).



2.1.4 Developing a method for identifying causes of forest change

- Will follow completion of 2.1.3 and field data collection in Mozambique.

Issues and potential bottlenecks:

2.3.1 Field data collection Zambia

The previously reported bottleneck on organising the Zambia in-country workshop has now been removed with assistance from the WB Zambia team.

Additional Updates:

The team has also been developing and planning materials for early February, as the SMFM team will present the technical developments of the SMFM tools at a Forests Monitoring Side Event within the Data.Space2018[4] conference in Glasgow (1-2, February 2018). The progress of the four tools, as well as preliminary outputs and challenges encountered, will be presented and discussed to an audience that included government agencies (DFID), private sector, and academia (University of Edinburgh, University of Leicester), which contributed to the global project outreach. Our project work has relevance to the UK Space Agency's Forest2020[5] project and we have had continued discussion with the implementing agency, Ecometrica, particularly around development of tools related to forest monitoring and further discussion will be held during this conference (However, their project focus is aimed at dense moist forests). Eric Monjoux from ESA (Head of Copernicus Ground Segment and Data Managements), will also be in attendance and present on the DIAS platform and this will be a great opportunity to connect and find out the latest in contracting of this work and its developments.

Additionally, the LTS team screened and assessed available services for building and hosting a SMFM project website that could serve as a platform for keeping stakeholders updated on activities, events and progress. This will be discussed further and developed in the comings weeks.

[4] https://www.dataspace.xyz/

[5] https://ecometrica.com/forests2020