

Forestry & canopy height mapping using Sentinel 2

Sensor Description

- Sentinel-2 provides 10-60 m spatial resolution imagery. Those data are free and available to the public.
- It covers a 290 km swath width.
- The revisit time is 5 days, thanks to its sun-synchronous orbit.
- Sentinel-2 is in fact two satellites orbiting 180° apart for continuous global coverage.
- Sentinel-2 captures data in 13 spectral bands (see figure below):
 - Blue (B2), Green (B3), Red (B4) and Near-Infrared (B8) bands are used for basic land-cover classification, environmental monitoring, water management, etc. They have a 10 m resolution.
 - B5, B6, B7, B8a, B11 and B12 bands help derive geophysical parameters, including Vegetation Red Edge (bands 5, 6, 7), near infrared narrow - NIR narrow (band 8a) and short-wave infrared - SWIR (bands 11, 12). They have a 20 m resolution.
 - B1, B9 and B10 bands are dedicated to atmospheric corrections. They have a 60 m resolution.

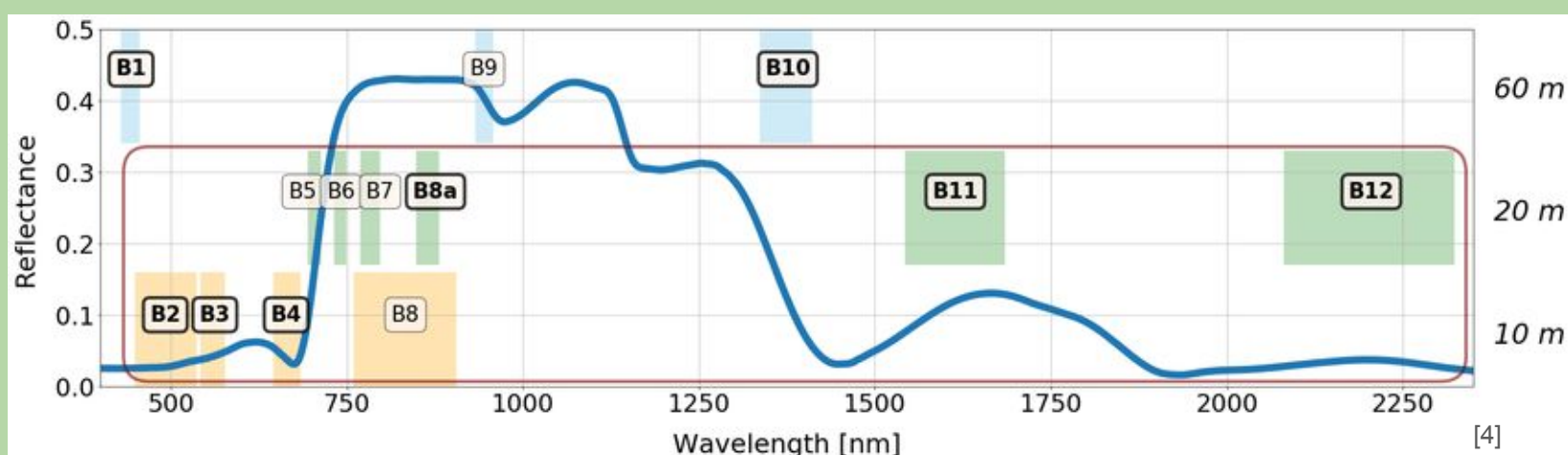
Description of the application, challenges

The forests are important for our planet. Indeed, they are keys elements in carbon capture processes, and are important places of biodiversity. Thus, forestry mapping is used in different domains. It can be used to :

- Look for any forest disturbances (deforestation, wildfires,...)[1]
- Identify tree species in a specific area. [2]
- Determine tree density and distribution in defined area.
It's used to determine canopy cover.
- Stay alert about the forest health.
- Etc ...

Map the forest from the space is also challenging in terms of tools precision. It is even more challenging than map the city because of the complexity of the terrain and the wide variation in structure and composition. It is more difficult to apply uniform mapping methods in forest than in cities.

Determine canopy height [3] is also challenging because of the need to know where the ground is. This is where others specialized tools like LIDAR are needed.



What makes it fit the application

Sentinel 2 images are really useful for mapping forest and canopy height. We can use multispectral bands (in particular Vegetation Red Edge) and it allows to gain meaningful information (chlorophyll, vegetative stress) on the forest and the canopy.

Also, Sentinel 2 resolution, in addition with its free access, allow a very wide usage and share of information. On top of its very large spatial scale and resolution, the high revisit frequency of Sentinel 2 allow a high update in time of the forest imagery. This feature is useful because it gives almost real-time images.

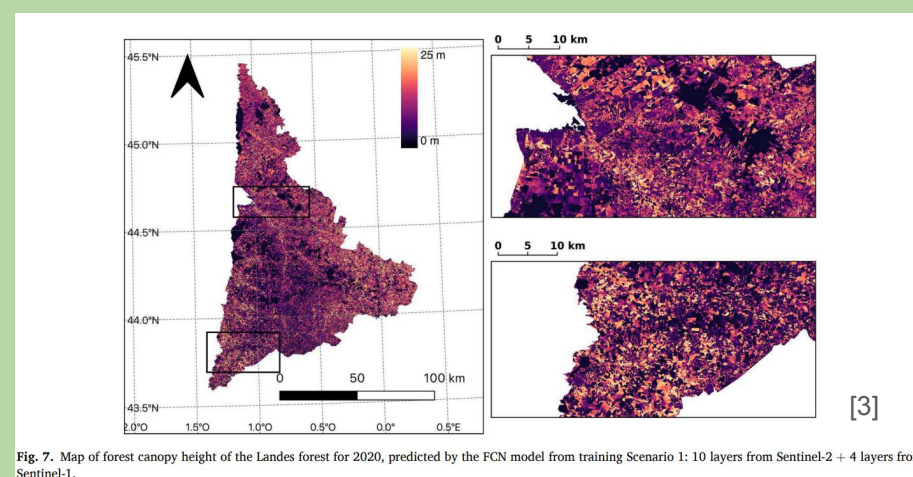


Fig. 7. Map of forest canopy height of the Landes forest for 2020, predicted by the FCN model from training Scenario 1: 10 layers from Sentinel-2 + 4 layers from Sentinel-1.

Studies :

- [1] Reinosch & al, Detailed validation of large-scale Sentinel-2-based forest disturbance maps across Germany
- [2] Grabska & al, Forest Stand Species Mapping Using the Sentinel-2 Time Series, 2019
- [3] Martin Schwartz & al, High-resolution canopy height map in the Landes forest (France) based on GEDI, Sentinel-1, and Sentinel-2 data with a deep learning approach, 2024
- [4] Wolanin & al, Estimating Crop Primary Productivity with Sentinel-2 and Landsat 8 using Machine Learning Methods Trained with Radiative Transfer Simulations, 2020 10.48550/arXiv.2012.12101.