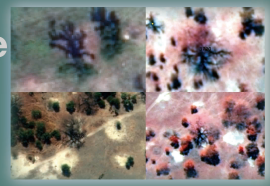
Using deep learning to map Baobab trees (Adansonia digitata L.) from high resolution satellite imagery in Senegal at country scale



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Motivation and objectives

The **African Baobab tree (Adansonia digitat L.)** is one of the biggest and longest-living angiosperm trees. It has a wide ecological and economic functions, is important for people's nutrition,also as medical plant. Knowing the location of this trees is highly important to understand their meaning for people's live, as well as make use of their economic value.

We showcase that deep learning and commercial satellite images can be used to map the location & size of each Boabab tree at country scale.

Baobab trees have a specific shape, which can be clearly seen in very high resolution satellite imagery. Deep learning has been shown to enable countrywide mapping of individual trees *(M Brandt, Nature, 2020)*.

We test if the algorithm can distinguish between Boabab and other trees.

Africa's majestic baobab trees are mysteriously dying
Some of the continent's oldest and biggest specimens collapsed suddenly during a study (A. Patrut, Nature Plants, 2018).

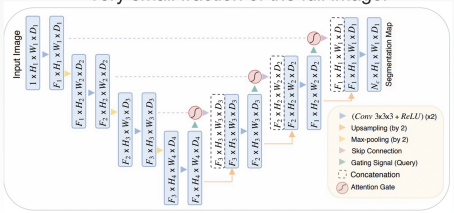
Dataset and methodology

Data source: Thousands of *DigitalGlobal/Maxar* multispectral images from the *QuickBird-2, GeoEye-1, WorldView-2* and *WorldView-3* satellites, collected from 2005-2018 (in Nov to Mar, Dry season) ~via the *NextView License agreement*.

Spectral & Spatial: Red, Blue, Green, Near-infrared; all pansharpened to 50cm and covering all Senegal.

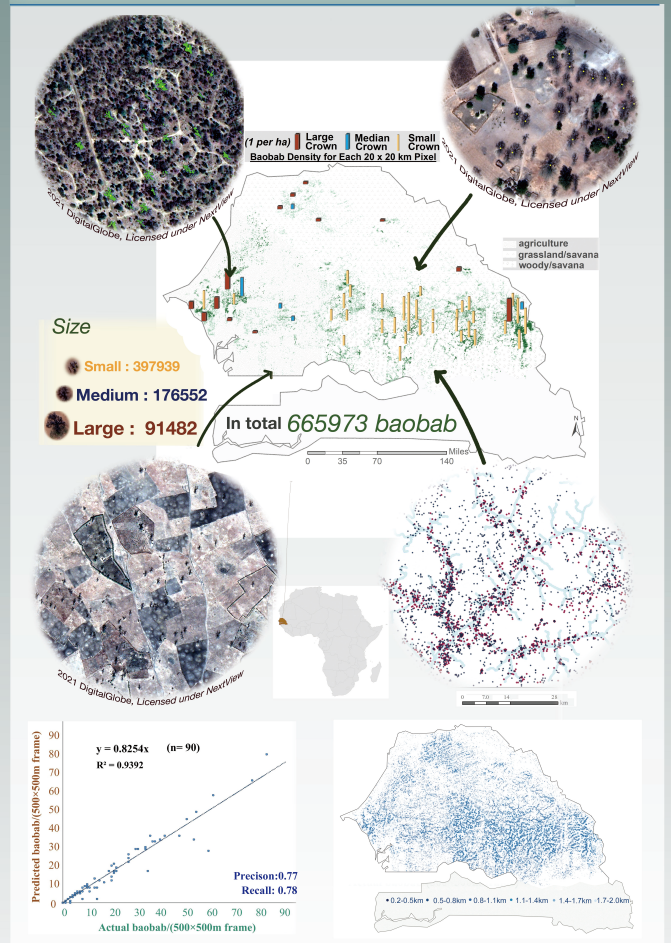
Methodology: UNet+attention block -> segmentation task

Challenge: *Data Imbalance* -the targe object occupies a very small fraction of the full image.



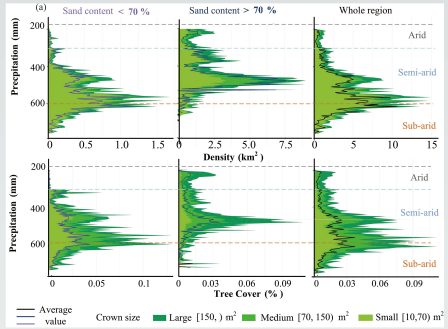
Attention u-net: Learning where to look for the pancreasarXiv preprint arXiv:1804.03999 (2018).

Mapping and Counting

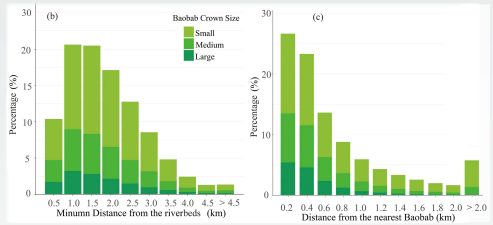


* The upper figure shows the distribution of 665,973 mapped Baobab trees in Senegal.
* The crown size is classified in small, medium and large.
* The lower left panel shows the validation of the predictions with independently labeled data. The lower right panel shows the distance from each baobab to the nearest riverbeds.

Distribution Characters

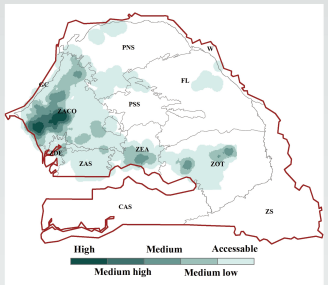


- Baobab trees grow best on sandy soils and in a rainfall range of 400-650 mm.



- Most (57%) of the Baobab trees grow in a distance of 1 - 2 km from riverbeds.
- Almost all rural households (78%) have a Baobab tree in their immediate distance (< 1 km). Only 6% of the households do not have a Baobab tree within 2 km distance.

Further Utility Potential



The friction distance *(A.Nilsen, Science Data,2019)*, gives indications on the accessibility of Baobab trees, which could be used for economic exploitation in Senegal.

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Next steps

- **Explore the relationships between land management and the distribution of Baobab trees.**
- **Explore the impact of Baobab trees on the nutrition of the rural population.**
- **Expand the mapping to other countries.**

Reference: Patrut A, Woodborne S, Patrut R T, et al. The demise of the largest and oldest African baobabs[J]. Nature plants, 2018, 4(7): 423-426. Brandt M, Tucker C J, Kariryaa A, et al. An unexpectedly large count of trees in the West African Sahara and Sahel[J]. Nature, 2020, 587(7832): 78-82.