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CARBON LENS-SENEGAL: A MULTI-SOURCE MACHINE LEARNING APPROACH FOR FOREST BIOMASS ESTIMATION IN TROPICAL WEST AFRICA

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01 - THE PROBLEM

Senegal does not have a clear picture of the carbon stored in its forests

Carbon finance, REDD+ and NDC reporting have in common one number - the carbon Senegal's forests hold. Yet many models that estimate it are trained on other countries data, not on African ground truth.

1

No ground truth

Senegal lacks validated biomass measurements, so degradation assessments carry large, unquantified uncertainty.

2

Imported models misfire

Global and regional biomass products are trained outside Senegal and fit Senegalese ecosystems poorly.

3

National stakes

Weak estimates undermine REDD+ reporting, national GHG inventories and NDC reporting

Funded by the European Union under Data Governance in Africa, a Team Europe Initiative - implemented via GIZ FAIR Forward.

02 - BUILDING THE SOLUTION

A locally-trained, multi-source geospatial AI pipeline

Ground truth from Senegal, fused with radar and optical satellite data, then learned by an ensemble model.

1

Field inventory

167 georeferenced plots surveyed with DEFCCS (2024 → Jan 2026). Tree diameter, height & species converted to biomass via an allometric equation.

2

Satellite fusion

Sentinel-1 radar sees through cloud; Sentinel-2 optical adds NDVI & NDWI - 17 predictor variables per plot.

3

Ensemble ML

Random Forest benchmarked against Linear Regression and SVR, then tuned by grid search - best accuracy overall.

4

Overfitting guardrails

15-fold cross-validation, out-of-bag error and feature-importance filtering keep a small dataset honest.

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03 - RESULTS, AND THE UNCERTAINTY WE OWN

Senegal's first data-driven carbon baseline model

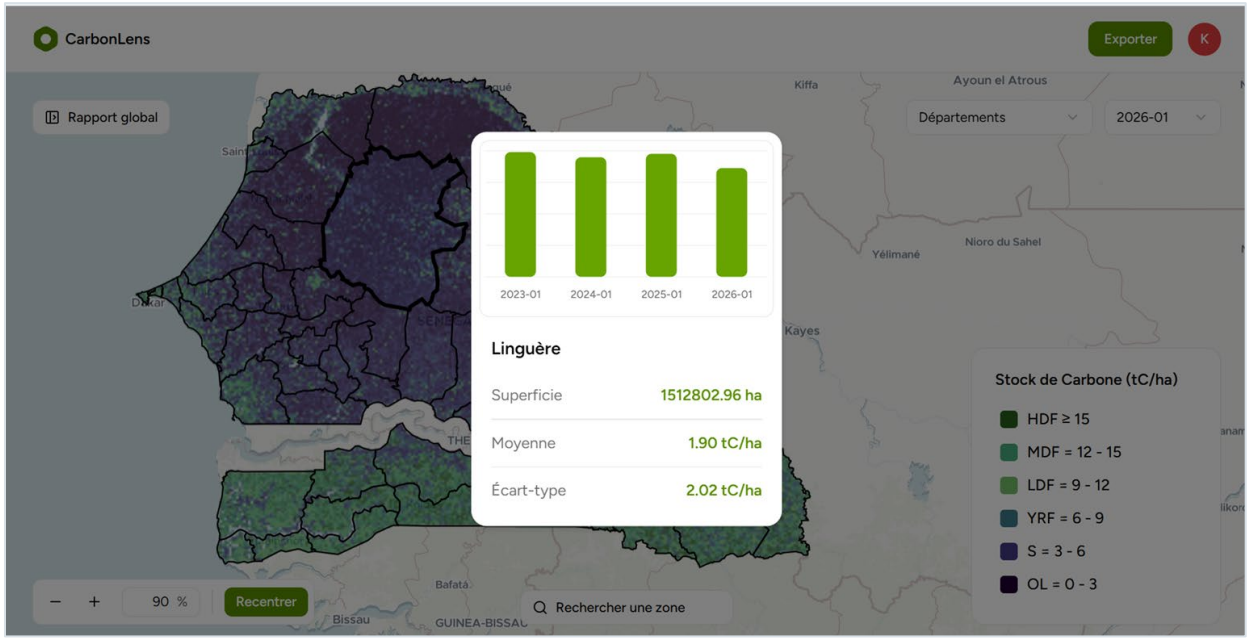

Figure 1 - Predicted above-ground carbon stock (Mg/ha) across Senegal, mapped by CarbonLens in six density classes.

18.66 **Mg/ha**

Random Forest test RMSE - best of three models (training 11.85).

Six density classes from Open Land (0–15 t/ha) to High-Density Forest (>150 t/ha) - an auditable baseline for REDD+ MRV.

The uncertainty we own

- Model drift - recalibrate every 3–5 years with DEFCCS inventories.
- Excludes below-ground biomass (20–40% of total carbon).

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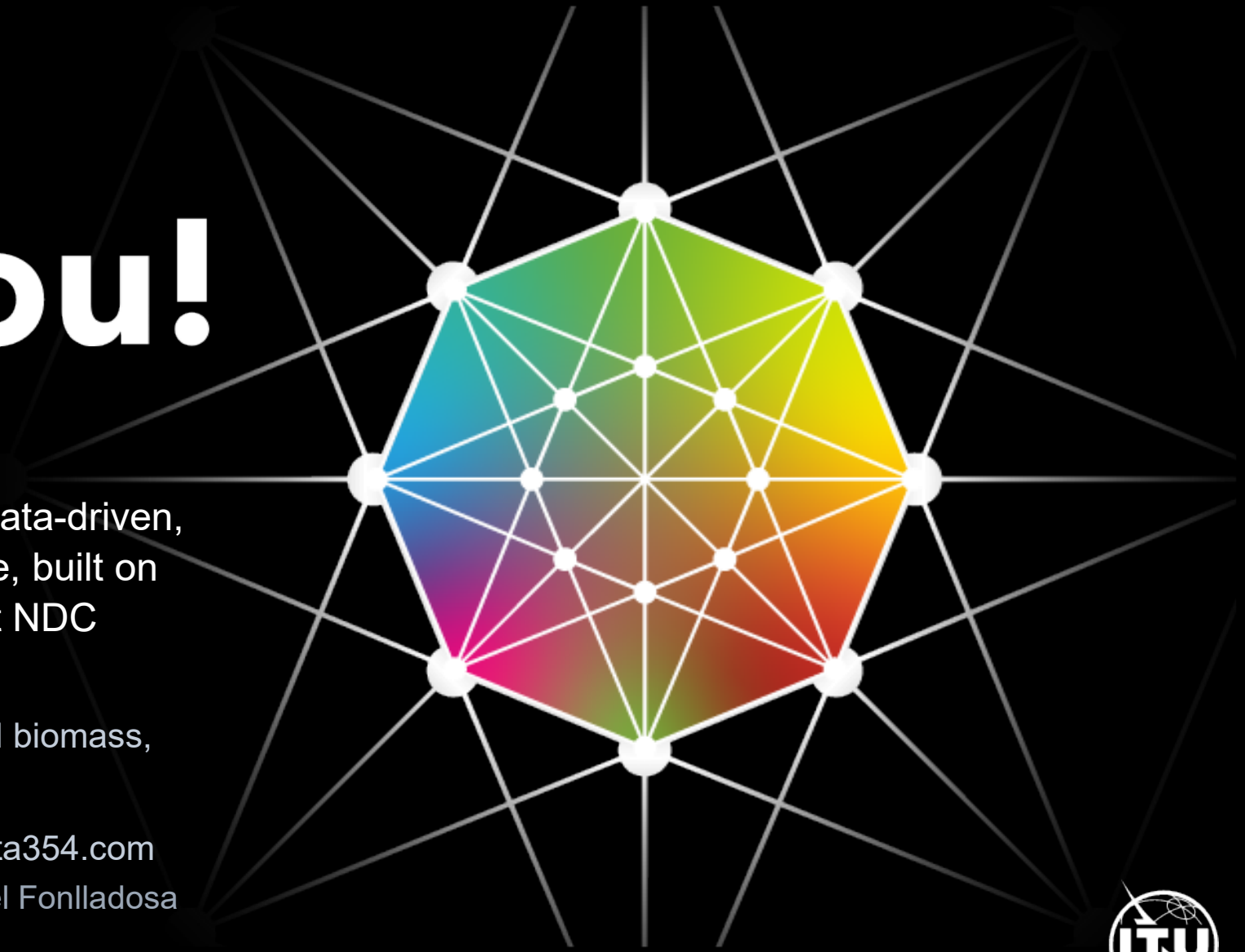
Thank you!



Carbon Lens Senegal - Senegal's first data-driven, auditable above-ground biomass baseline, built on African ground truth. Designed to support NDC reporting and national forest monitoring.

Future work: nationwide scaling, below-ground biomass, and a DEFCCS recalibration cycle.

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