

Combining space-based forest dynamics data with National Forest Inventory (NFI) data to explore tropical forest disturbance and recovery

Daniela Requena Suarez, Veronique De Sy, Danaë Rozendaal, Natalia Málaga, Mathieu Decuyper, Martin Herold

Living Planet Symposium
May 2022



Carbon (C) stocks and sinks in *recovering* tropical forests

- Tropical forests are a major (and highly uncertain) terrestrial component of the carbon cycle, acting as carbon sources and sinks.
- The mitigating capacity of forests recovering from disturbances is underpinned by socio-environmental factors, most of which remain unexplored at large scale.
- Murky boundaries between natural and human disturbances, as well as presence/absence of human use.

Carbon (C) stocks and sinks in *recovering* tropical forests

- Limited data on C sinks/sources across tropical forests recovering from varying disturbance intensities (not only stand-replacing disturbances, i.e. secondary forests).
- Extensive RS methods, data and derived products available for characterizing deforestation, degradation and follow-up human activities.
- Increasing availability of National Forest Inventory Data in the tropics.
 - High number of plots
 - Covering broad environmental gradients
 - No quantitative information on disturbance history

Leveraging RS and NFI data to explore forest establishment and disturbance across large scales

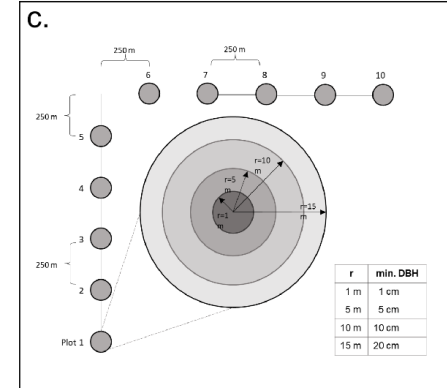
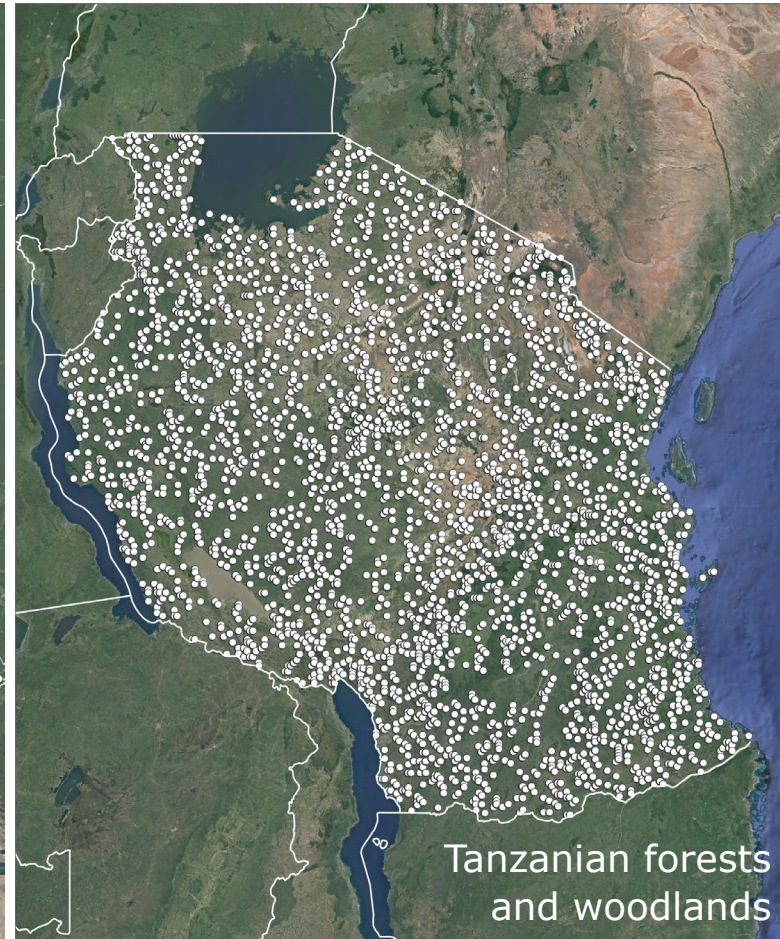
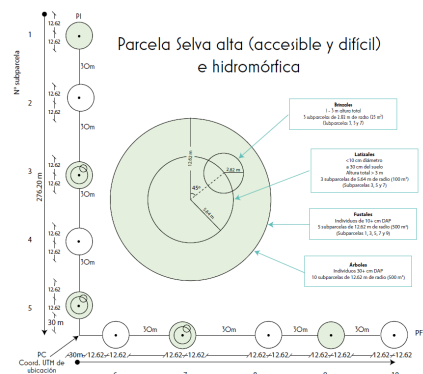
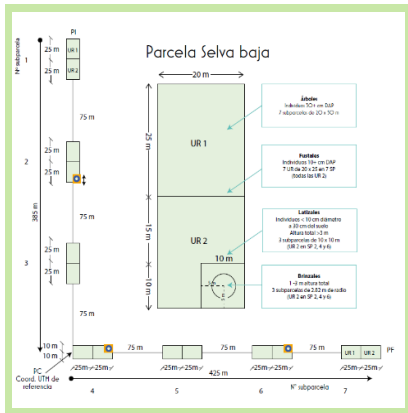


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Prof. E. Zahabu

Leveraging RS and NFI data to explore forest establishment and disturbance across large scales












Leveraging RS and NFI data to explore forest establishment and disturbance across large scales

ENVIRONMENTAL RESEARCH LETTERS

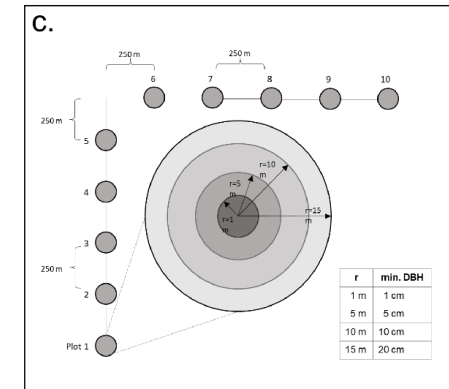
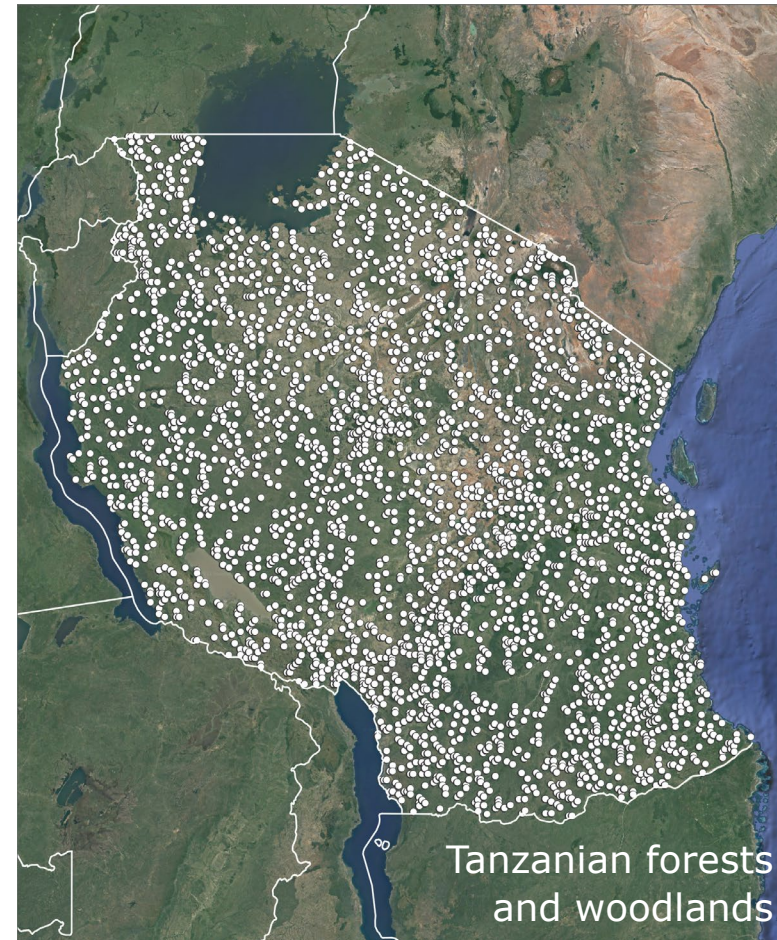
LETTER • OPEN ACCESS

Variation in aboveground biomass in forests and woodlands in Tanzania along gradients in environmental conditions and human use

Daniela Requena Suarez¹ , Danaë M A Rozendaal^{1,2,3} , Veronique De Sy¹ , David A Gibbs⁴ , Nancy L Harris⁴ , Joseph O Sexton⁵ , Min Feng⁵ , Saurabh Channan⁵ , Eliakimu Zahabu⁶ , Dos Santos Silayo⁷  + Show full author list

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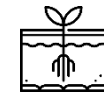
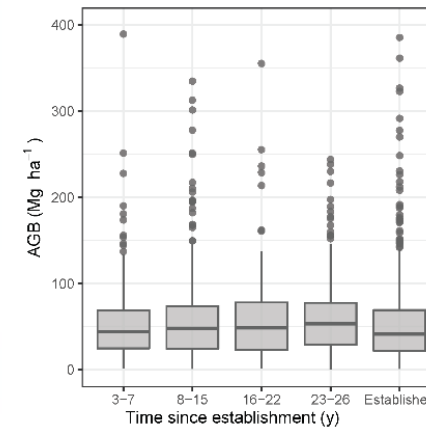
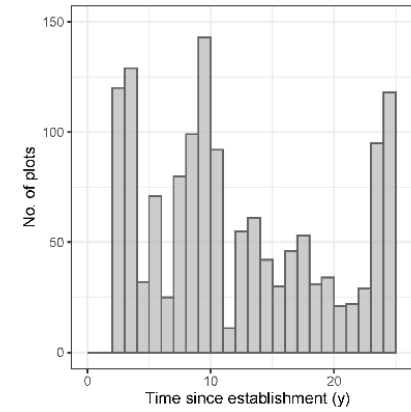
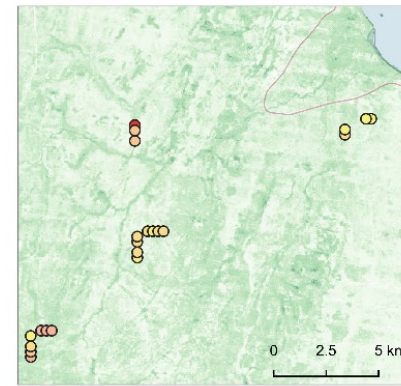
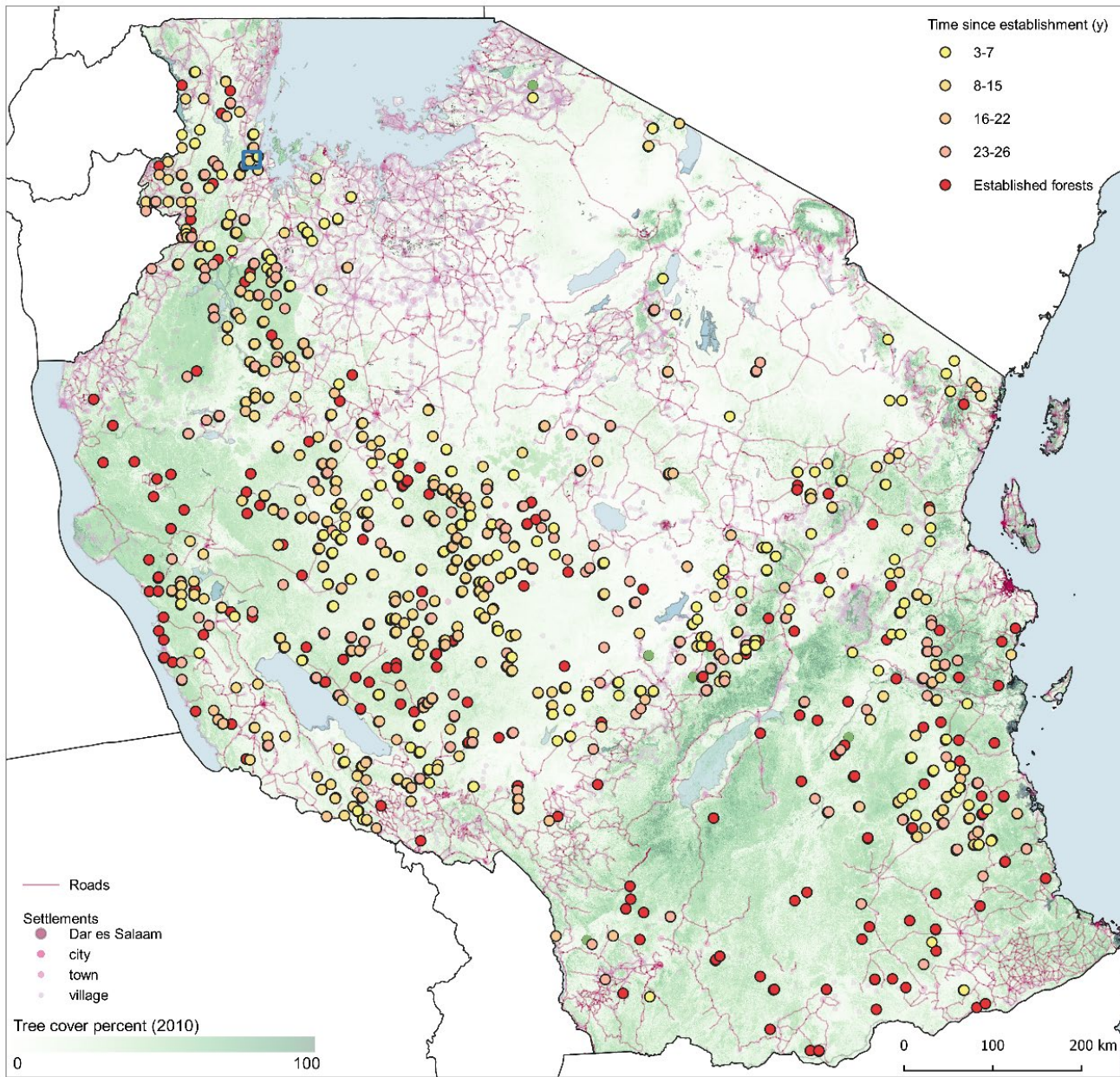
[Environmental Research Letters](#), Volume 16, Number 4



NFI information:
Plot-level biomass

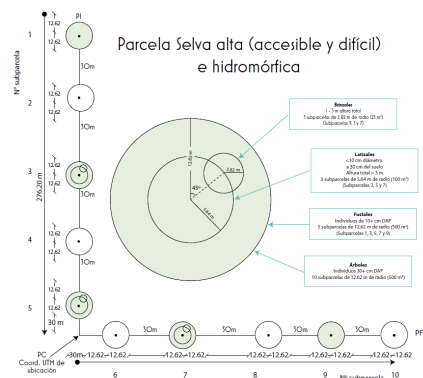
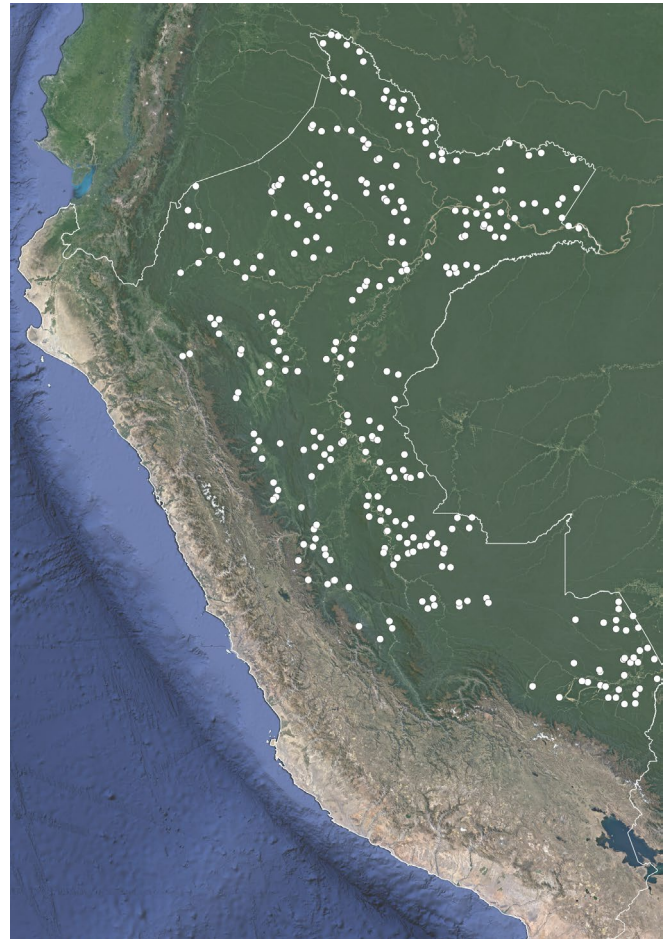
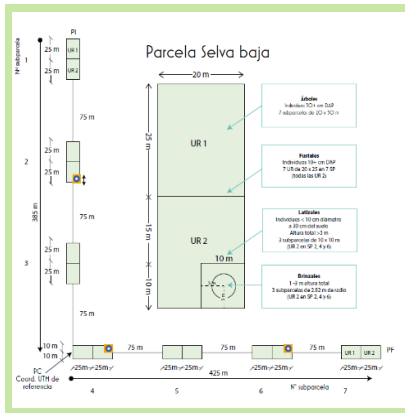
RS-derived year
since forest
establishment

Detection of change in the
probability of forest
cover derived from the
estimate and uncertainty
of tree-canopy cover using
the Landsat archive
(1984-2018).



$\Delta\text{AGB} = 0.4 \text{ Mg ha}^{-1} \text{ year}^{-1}$

Leveraging RS and NFI data to explore forest establishment and disturbance across large scales



Forest disturbance and recovery in Peruvian Amazonia (*under review*)

D. Requena Suarez, D.M.A. Rozendaal, V. De Sy, P. Durán Montesinos, A. Arana Olivos, R. De la Cruz Paiva, M. Decuyper, N. Málaga, C. Martius, M. Herold.

NFI information:
Tree-level biomass and Tree species

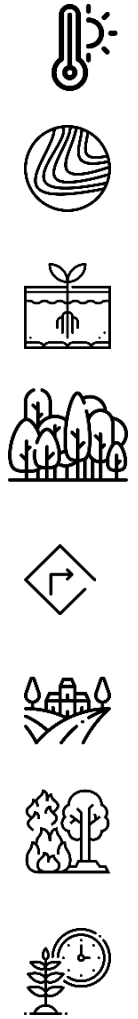
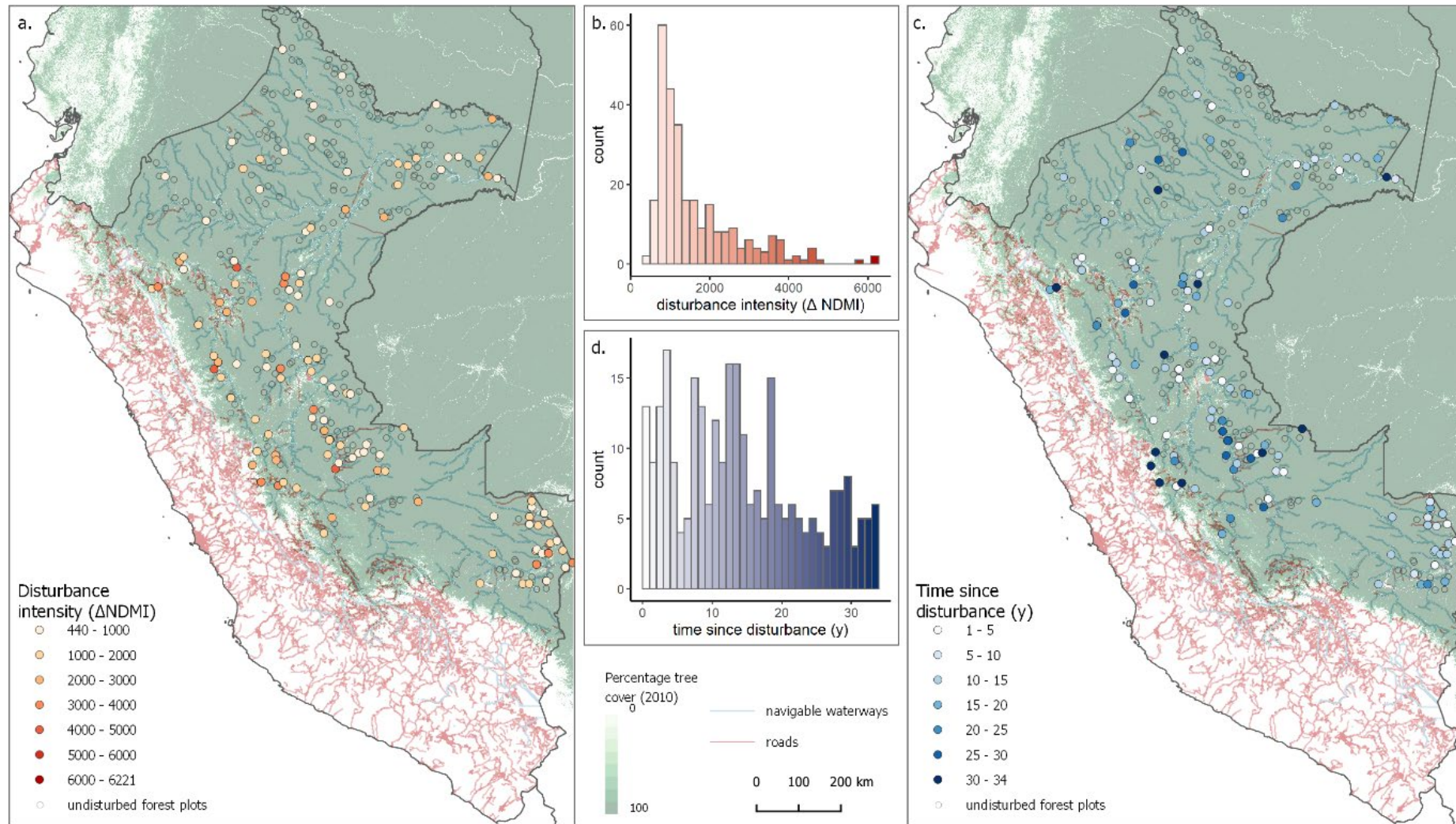
RS-derived metrics:

- time since disturbance**
- disturbance intensity** (anomaly of VI at time of disturbance)

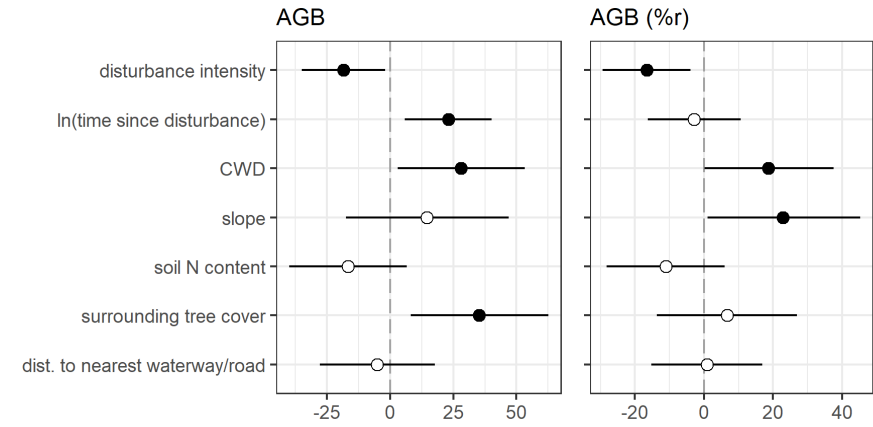
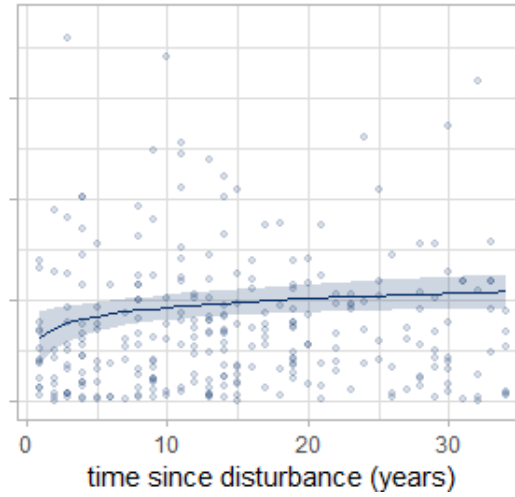
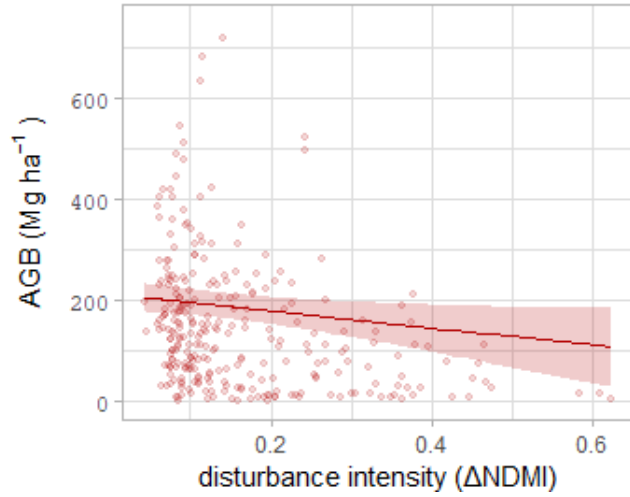
AVOCADO (Anomaly Vegetation Change Detection) – Decuyper et al. (2022). <https://doi.org/10.1016/j.rse.2021.112829>

AVOCADO, a new algorithm for monitoring of forest change dynamics in a continuous way.
Friday, 12:35; No. 379

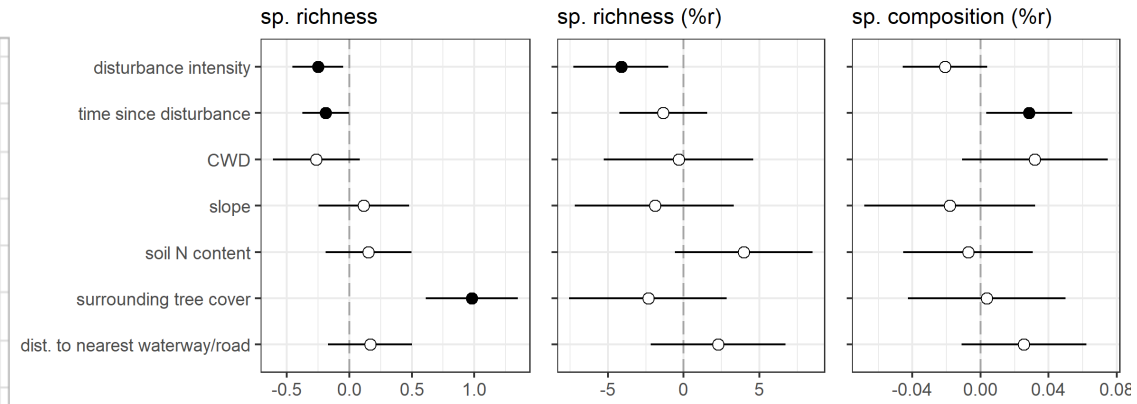
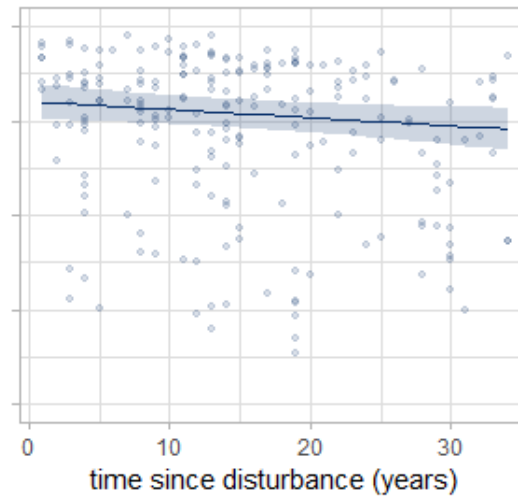
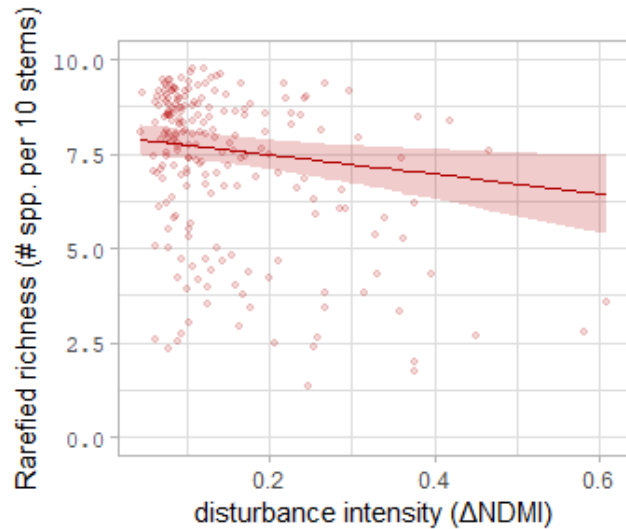
Time and intensity of disturbance



Aboveground biomass



Tree species richness and similarity in composition



Current challenges & opportunities

- RS dense time series analysis enables the use of NFI plot data for assessing forest recovery (in biomass and diversity) at large scale.
- NFI data + disturbance/recovery history allows for the exploration of fine-scale variations in environmental conditions and degree of disturbance intensity.
- Important for both forest conservation and restoration endeavours
- Large-scale analyses of biomass and biodiversity in disturbed forests, as well as their recovery, are an important step towards including disturbed forests and their recovery in climate change mitigation policies.

Thanks for listening!

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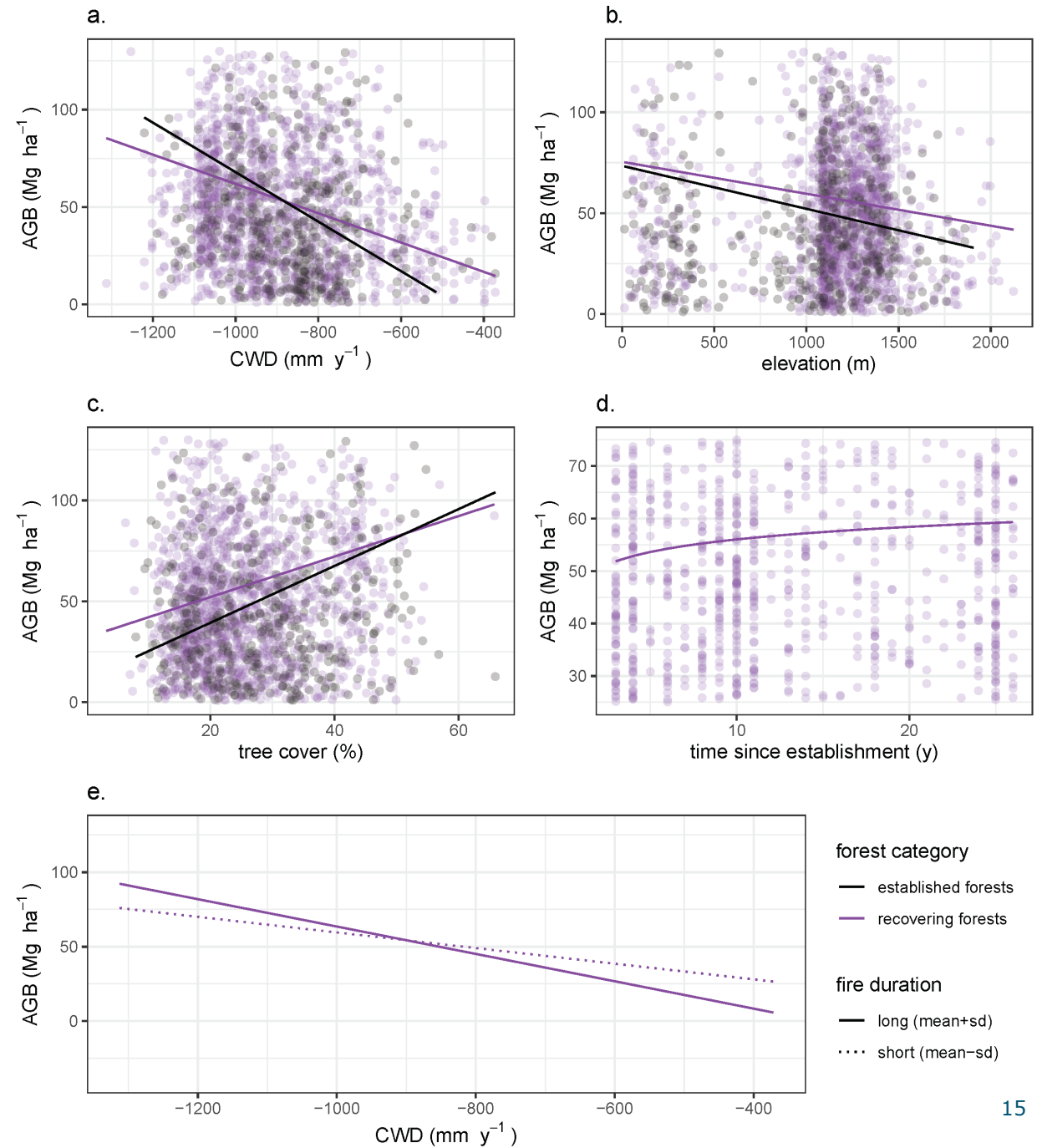
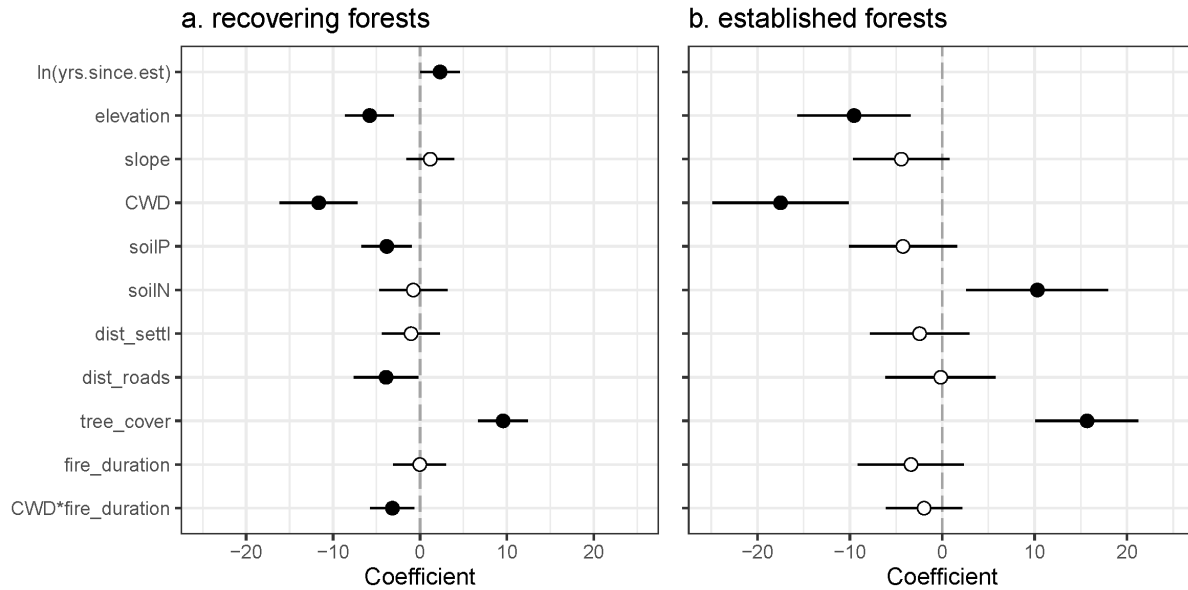
Extra slides

Estimating forest establishment in Tanzanian forests and woodlands



1. **Defining a forest threshold:** 10% tree cover (to account for the low AGB values in tropical dry forests and woodlands in SE Africa).
2. **Generating a forest reference baseline:** corresponding to 2018. Plots in locations that did not exceed the forest threshold at 2018 were excluded from further analysis.
3. **Detection of stand age / year of forest gain:** Stand age was estimated using the terraPulse algorithm, which estimates stand age by detecting changes in the probability of forest cover derived from the estimate and uncertainty of tree-canopy cover (Feng et al. *in prep*, Sexton et al., 2013, 2016) using the Landsat archive (1984-2018). (<https://terrapulse.com/solutions.html#Forests>)
4. **Estimation of time since forest establishment and final plot selection:** time since establishment was estimated by subtracting the year of gain from the measurement year.
 - **Established forests:** Plots with no forest cover change
 - **Recovering forests:** Plots with forests established from 1984 onwards
(Plots with forest gain detected 2 years or less before NFI year were discarded)



Results Tanzania



Detection of forest disturbance & recovery

- Avocado (**A**nomaly **V**egetation **C**hange **D**etection) – Decuyper et al. (2022).
Continuous monitoring of forest change dynamics with satellite time series,
Remote Sensing of Environment; (<https://doi.org/10.1016/j.rse.2021.112829>)
- Continuous detection of disturbance and recovery 
- Pre-processing of NDMI Landsat bricks (1984-2019) 
- Previous steps before running the algorithm: selecting an area of seemingly undisturbed forest in order (1) calibrate the algorithm and (2) to use the full time series of the selected place.
- Result: 4 potential cycles of disturbance/recovery + anomalies at the time of detection.

Processing of NFI sites

