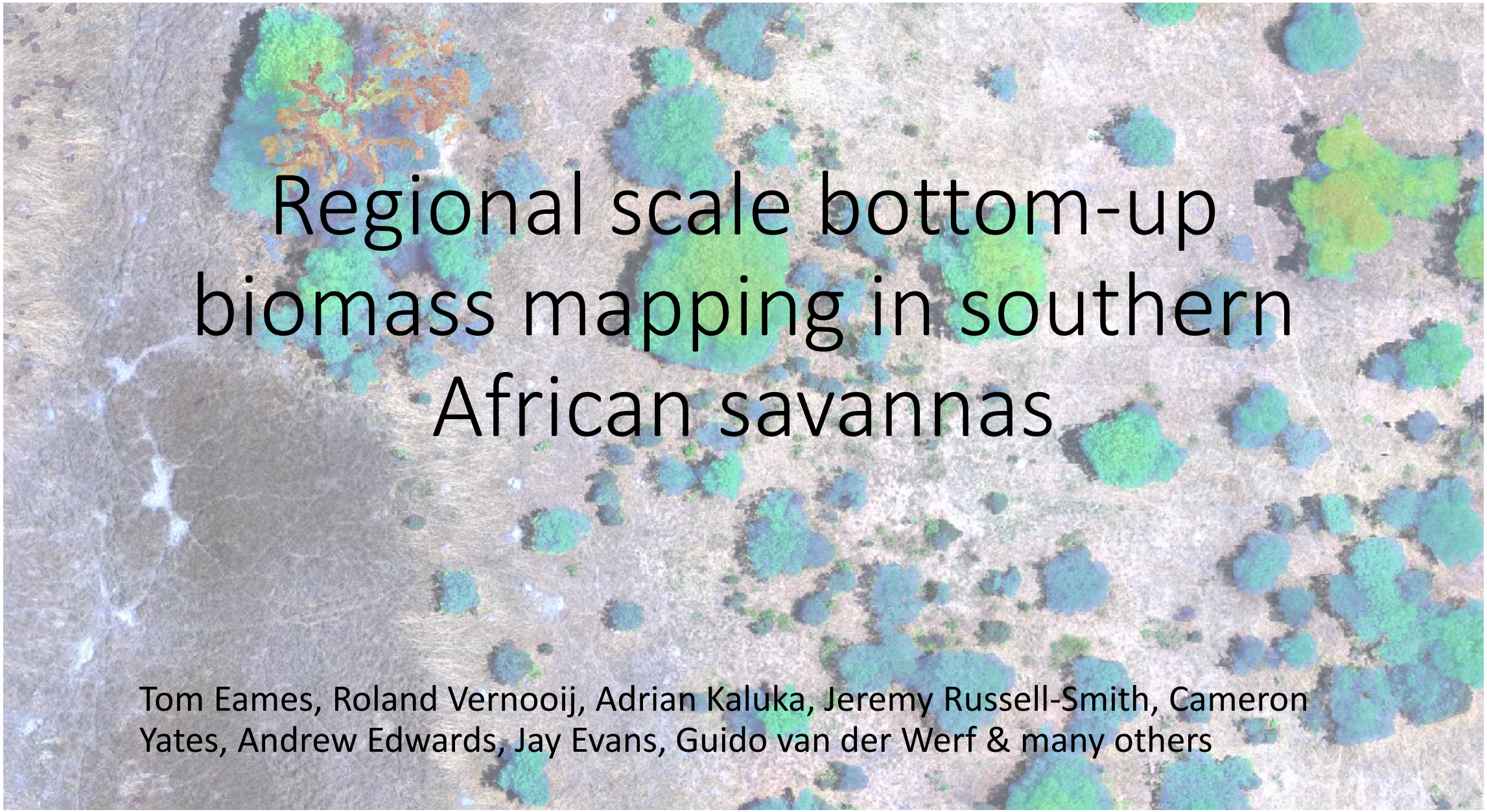


Regional scale bottom-up biomass mapping in southern African savannas

Tom Eames, Roland Vernooij, Adrian Kaluka, Jeremy Russell-Smith, Cameron Yates, Andrew Edwards, Jay Evans, Guido van der Werf & many others

Vrije Universiteit Amsterdam & Charles Darwin University

How can we measure surface-level biomass relevant to savanna burning?

Emissions = BA x FL x CC x EF

➔Higher resolution satellite imagery means better BA estimation

➔EFs are becoming better understood (e.g. Vernooij et al., 2023)

➔BUT most biomass products are limited to standing woody vegetation

Most savanna fires are surface fires

https://www.globalforestwatch.org/dashboards/global/

Linking in-situ measurements to satellite imagery

Plot locations in southern Africa

Each plot contains 2-3 Transects (total of about ~200 datapoints)

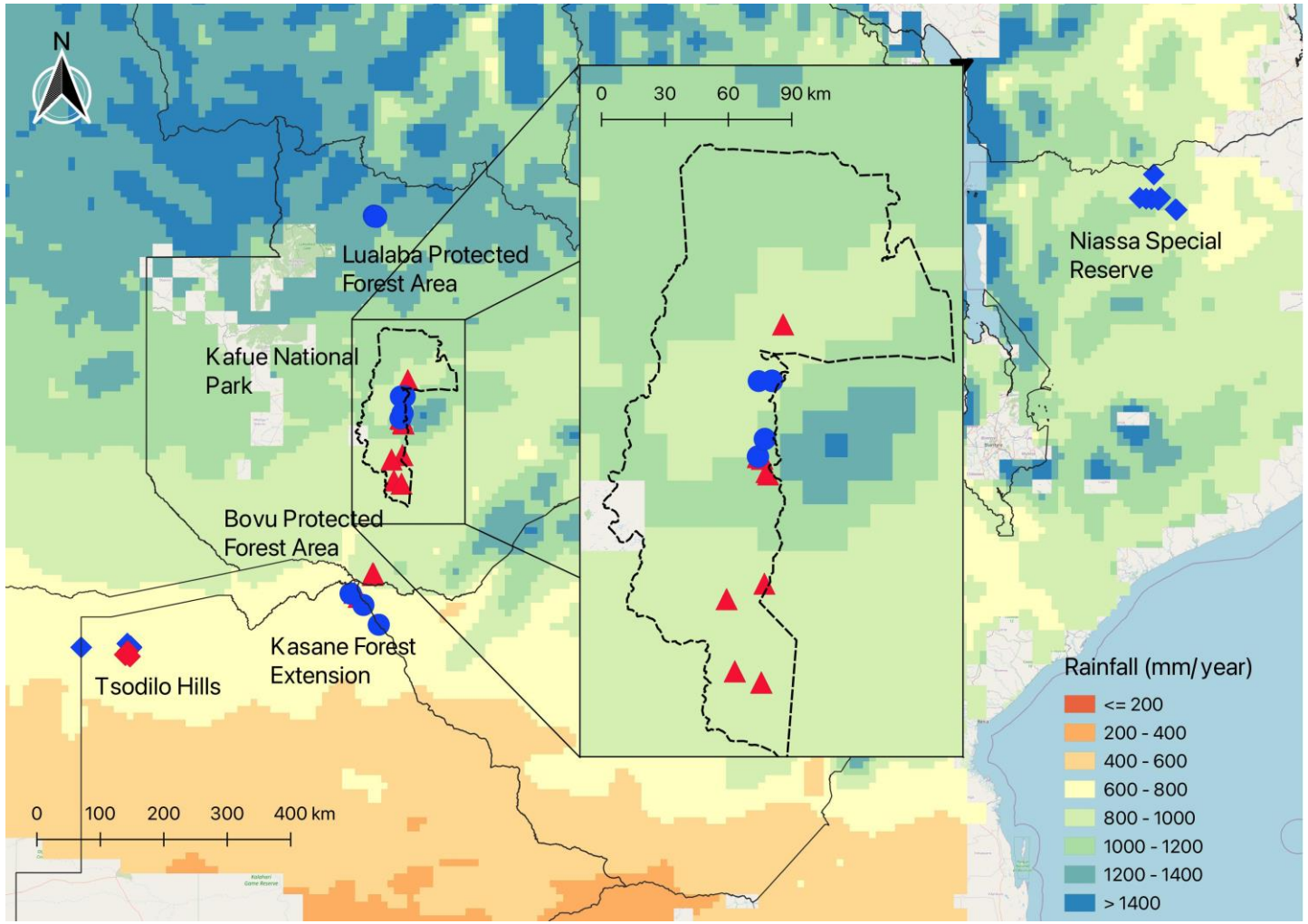
Blue = May-July

Red = August-October

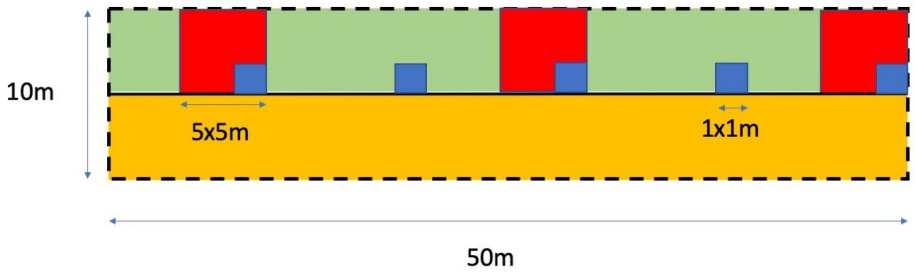
Diamond = 2019

Triangle = 2021

Circle = 2022

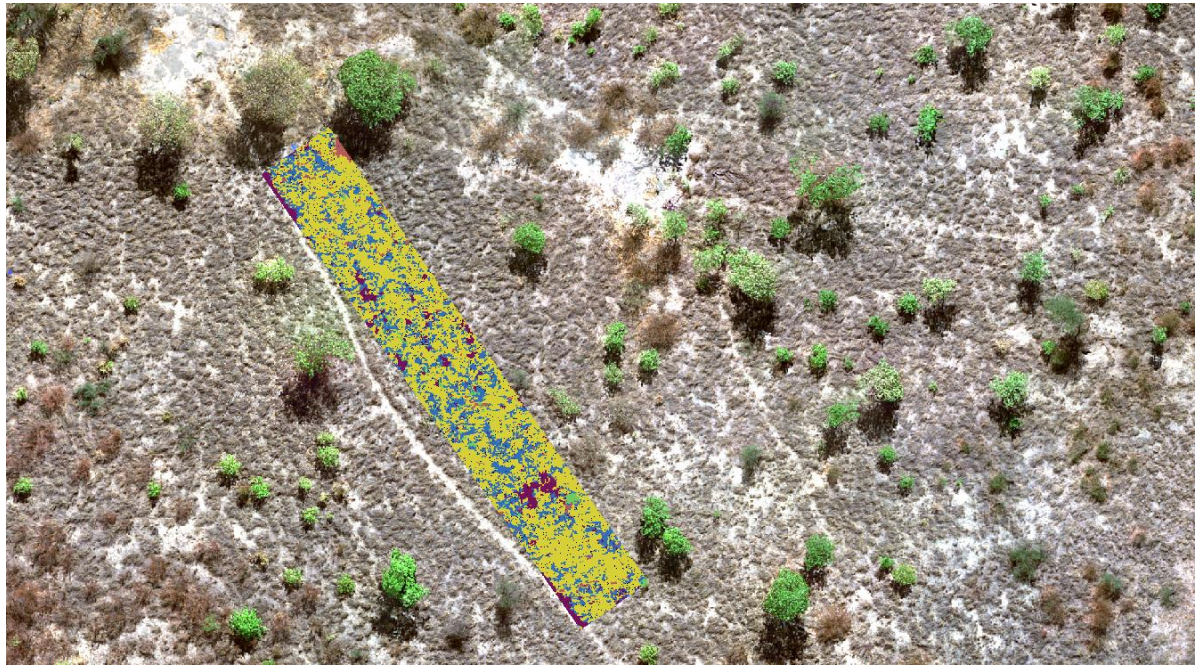


Linking in-situ measurements to satellite imagery



Transect schematic diagram sampling areas

- 3 5x5m red squares: coarse woody debris
- 5 1x1m blue squares: live grass & dead material



Transect highlighted on a UAV-generated orthomosaic

➔ Collect & connect ground-based features with features generated from multi-spectral cameras and meteorological ‘history’ (e.g. total rainfall since last disturbance)

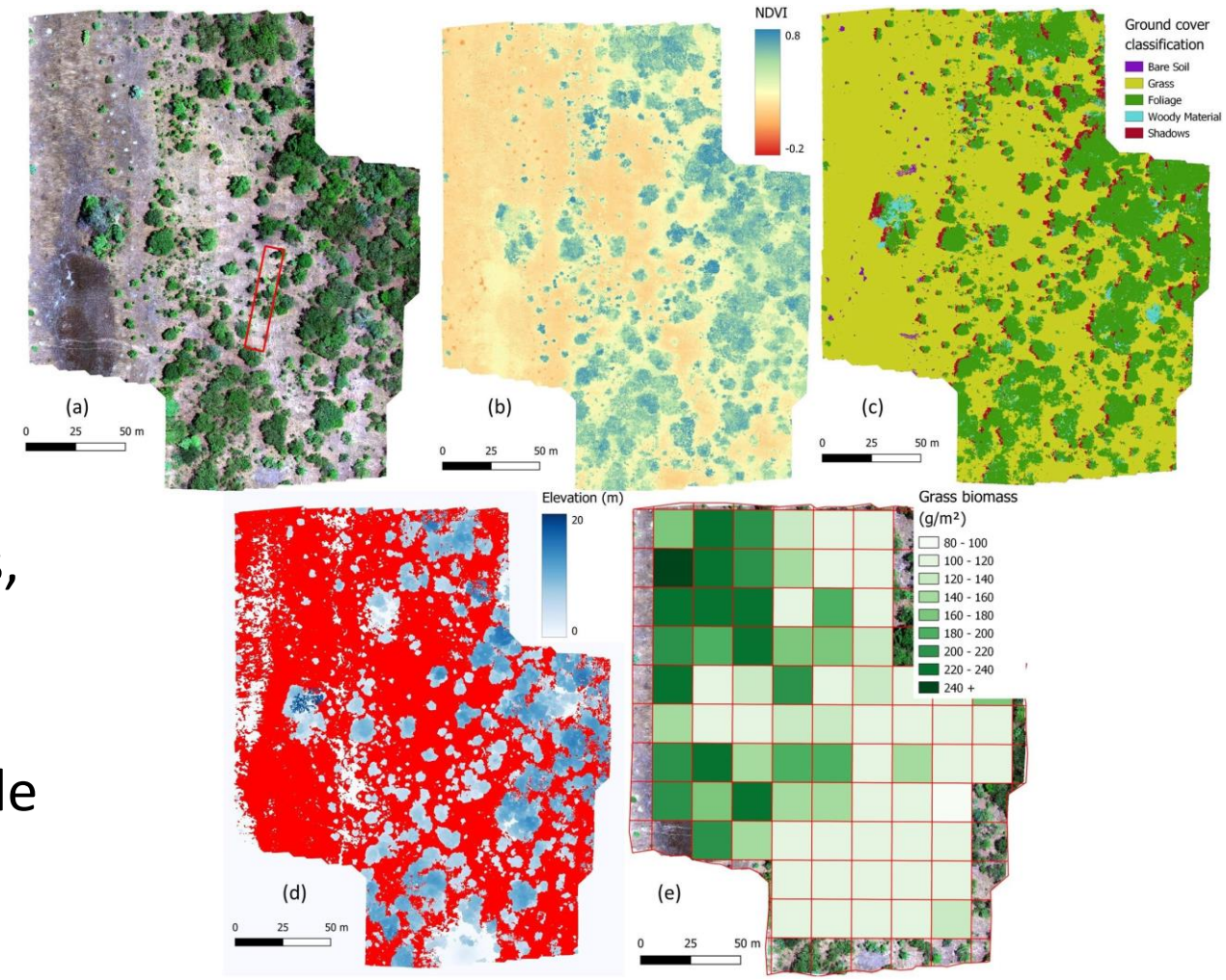
Linking in-situ measurements to satellite imagery

Using ML model, generate biomass in major fire-relevant surface fuel classes:

- Grass
- Litter
- Coarse woody debris*

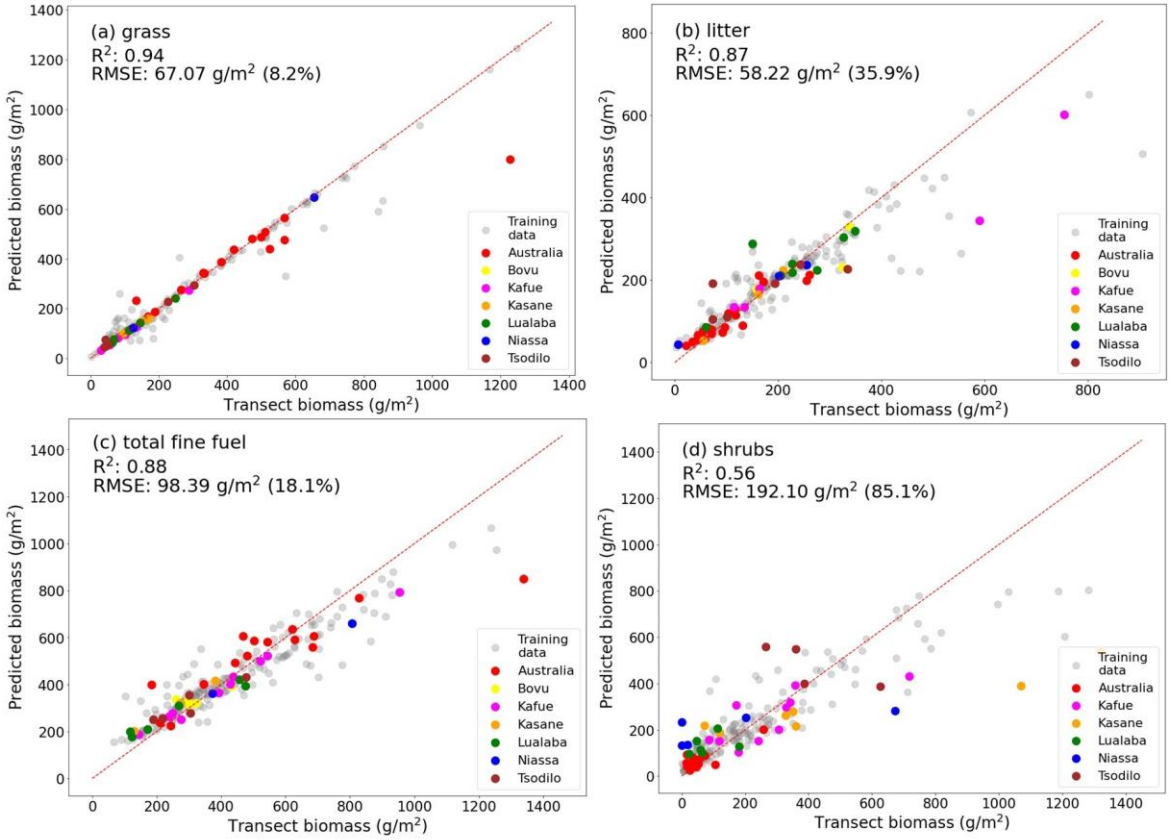
➔Large-scale standing woody biomass (shrubs, trees) done using SAR (Bouvet et al., 2018)

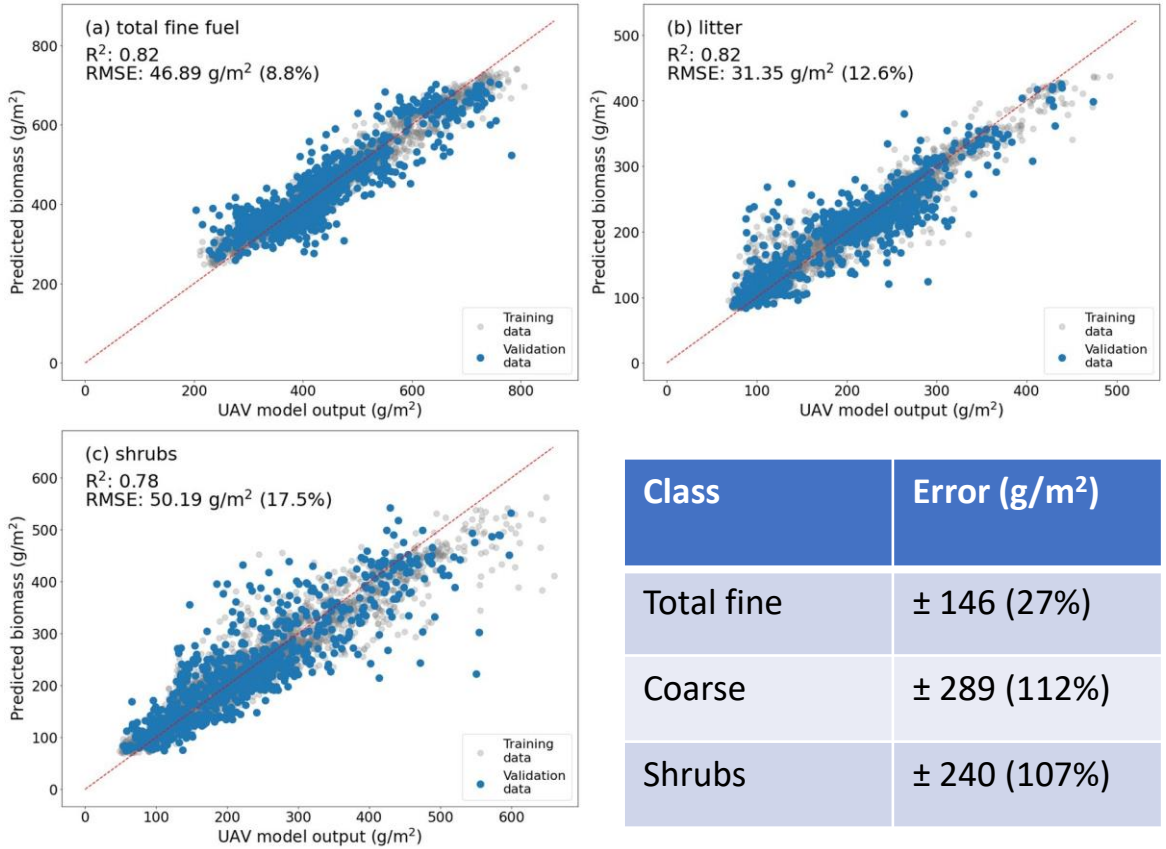
➔Overlay Sentinel-2 grid, and we can upsample ~200 ground measurements to ~4,500 data points



*litter-derived

Linking in-situ measurements to satellite imagery



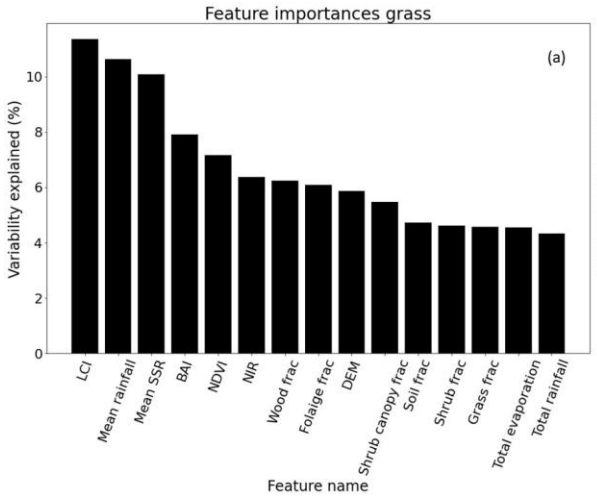


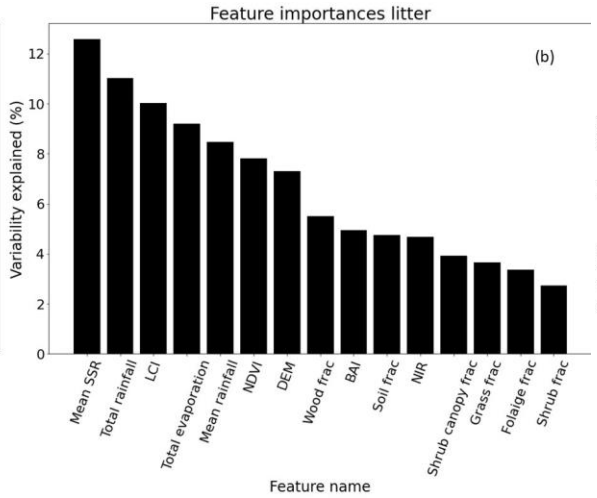
Class	Error (g/m²)
Total fine	± 146 (27%)
Coarse	± 289 (112%)
Shrubs	± 240 (107%)

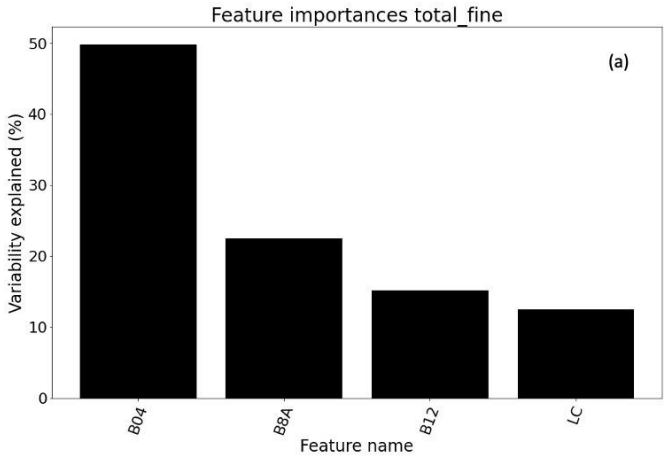
UAV RF model

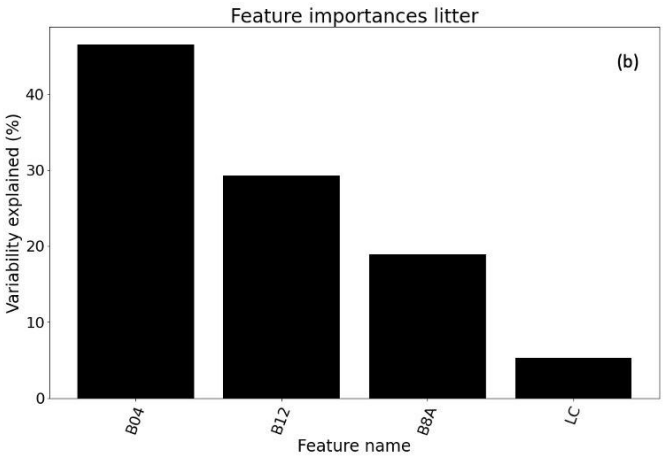
Sentinel-2 RF model (S2 land cover + 3 bands)

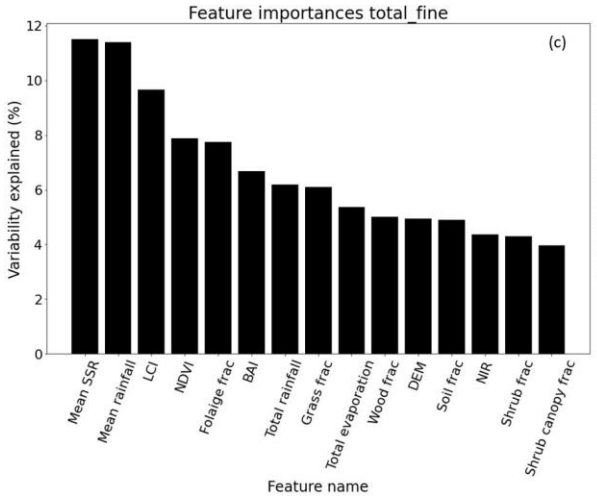
Feature importances

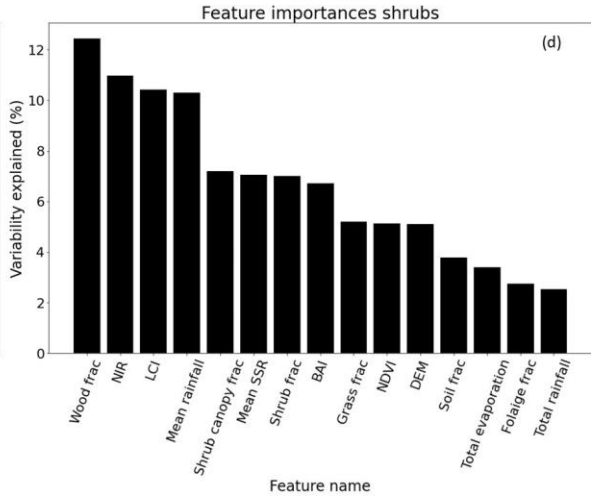


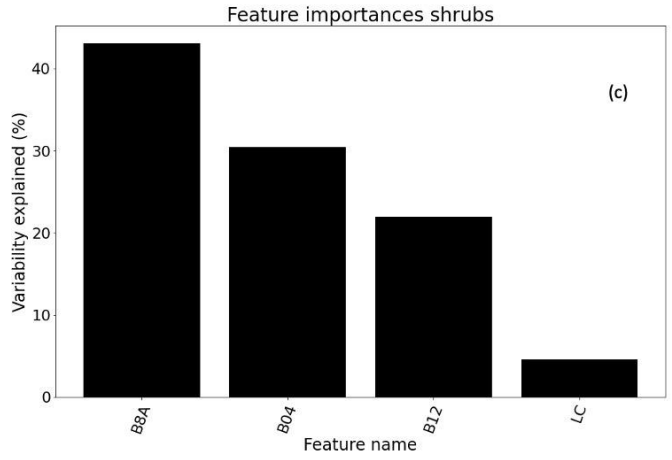




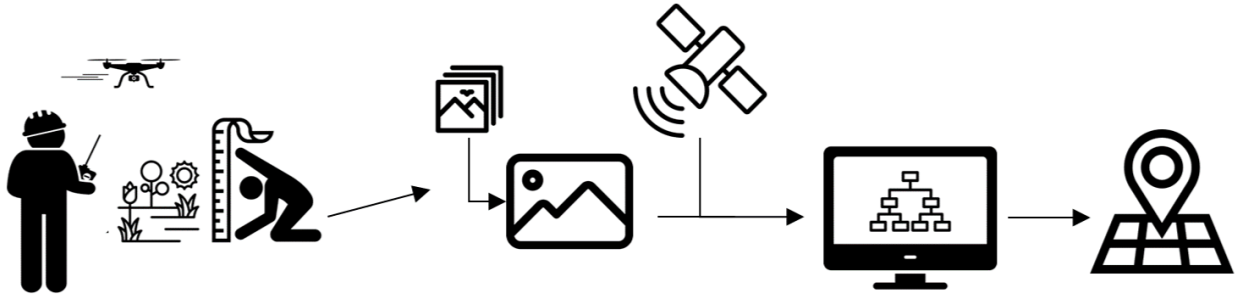






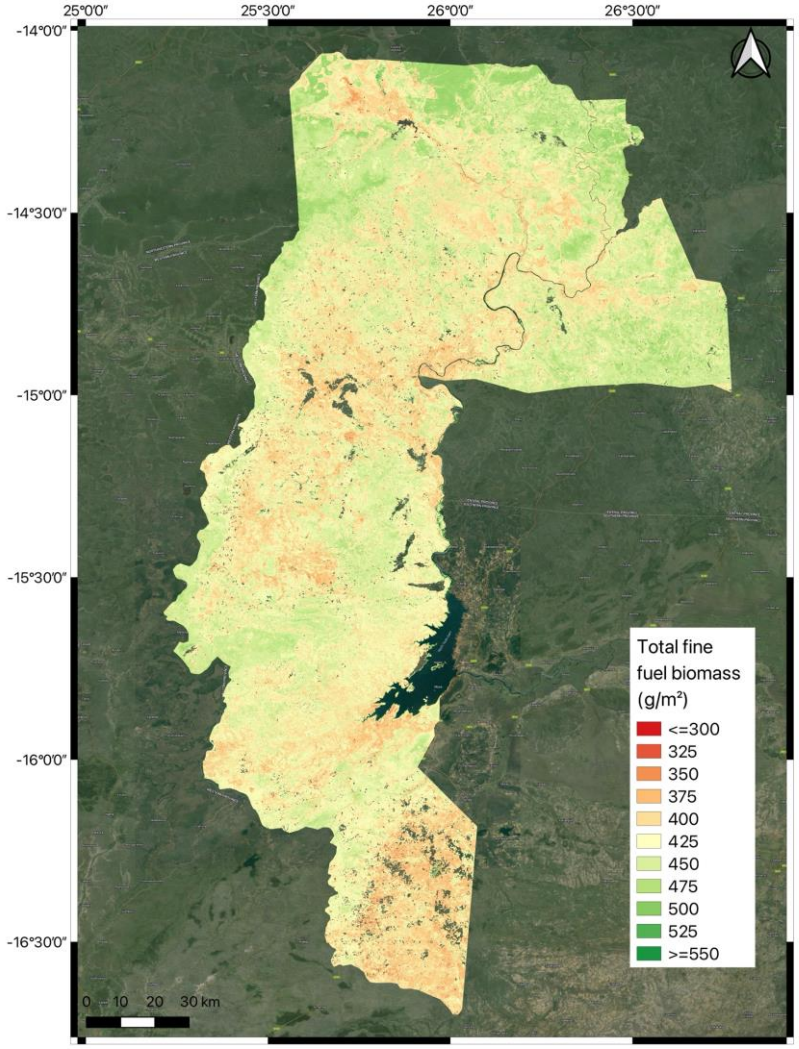


Sentinel-2 based biomass maps



Drone images available here:

https://doi.org/10.5281/zenodo.15578057



Conclusions

- Better performance for more continuous fuels (grass, litter)
- Poorer performance for more stochastic fuels (e.g. Coarse) or standing vegetation (shrubs)
- No standout determining factor for UAV method – both meteorological AND spectral information needed to determine biomass
- Red band is of primary importance for Sentinel-2

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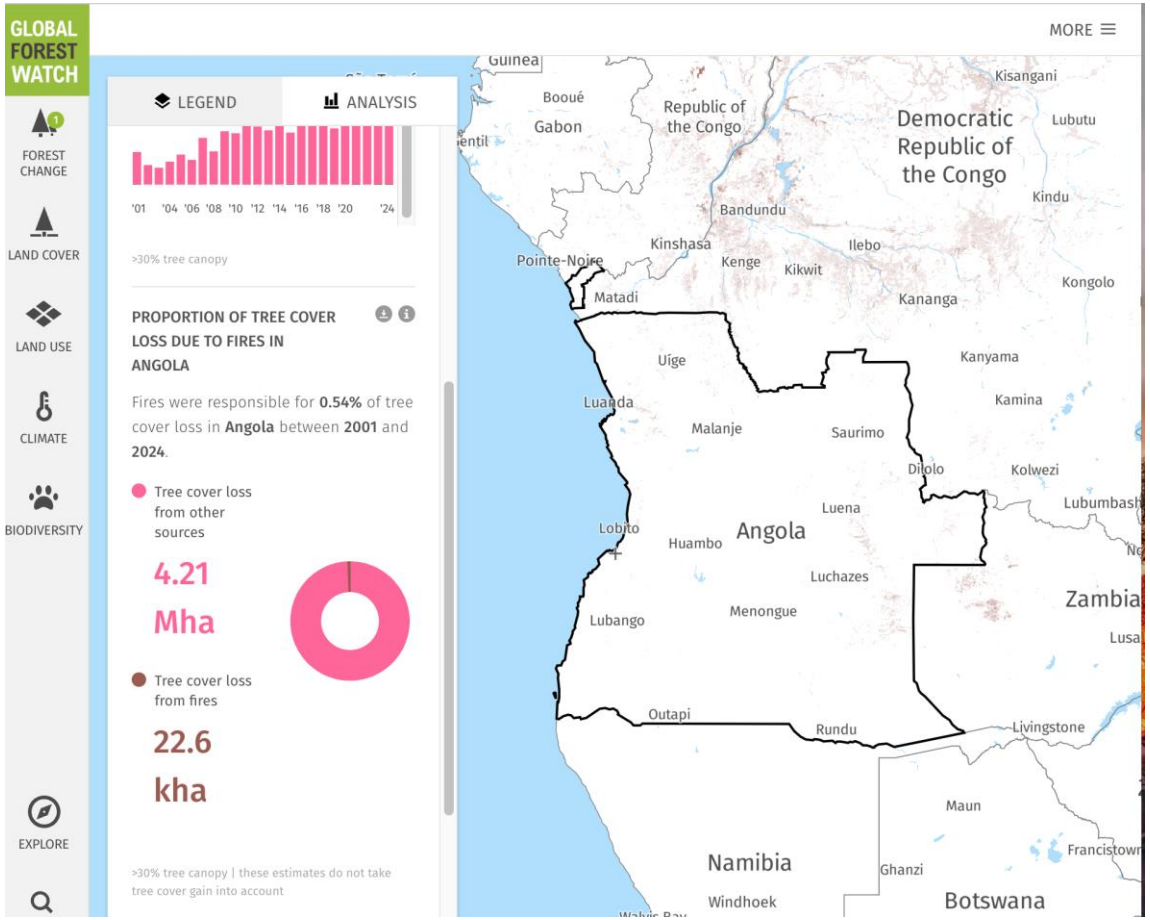

Plot locations