

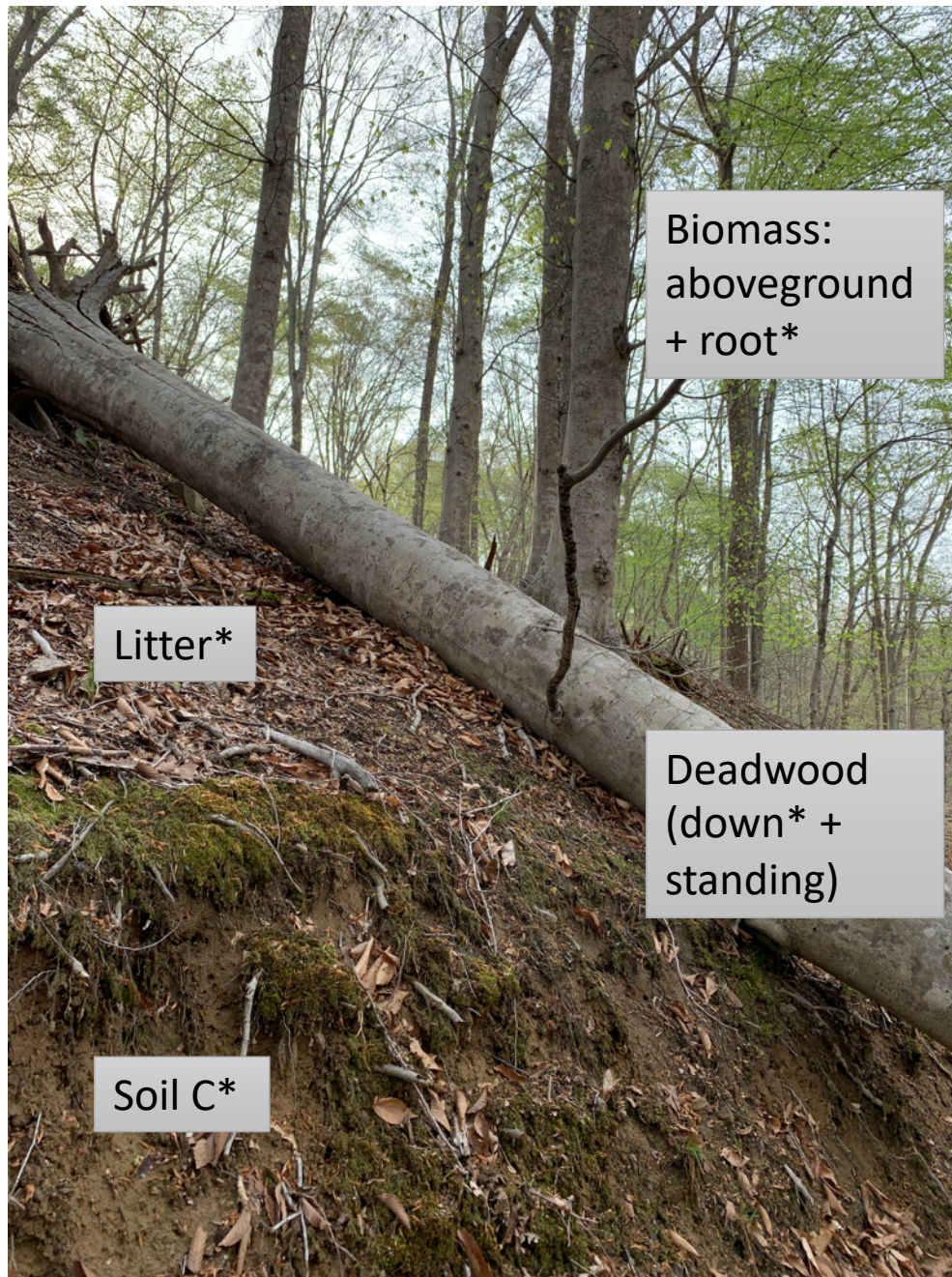
Field observations of carbon stocks

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April 14, 2021



Forest C pools



- These are as defined IPCC guidelines for national greenhouse gas inventories.
- IPCC accounting is concerned with **stocks** and **increments**, where increments can be calculated based on **fluxes**.
- Live biomass is usually the largest and most rapidly changing pool, and my main focus today.

*Cannot be observed via remote sensing.

Methods for estimating biomass (C) from the field

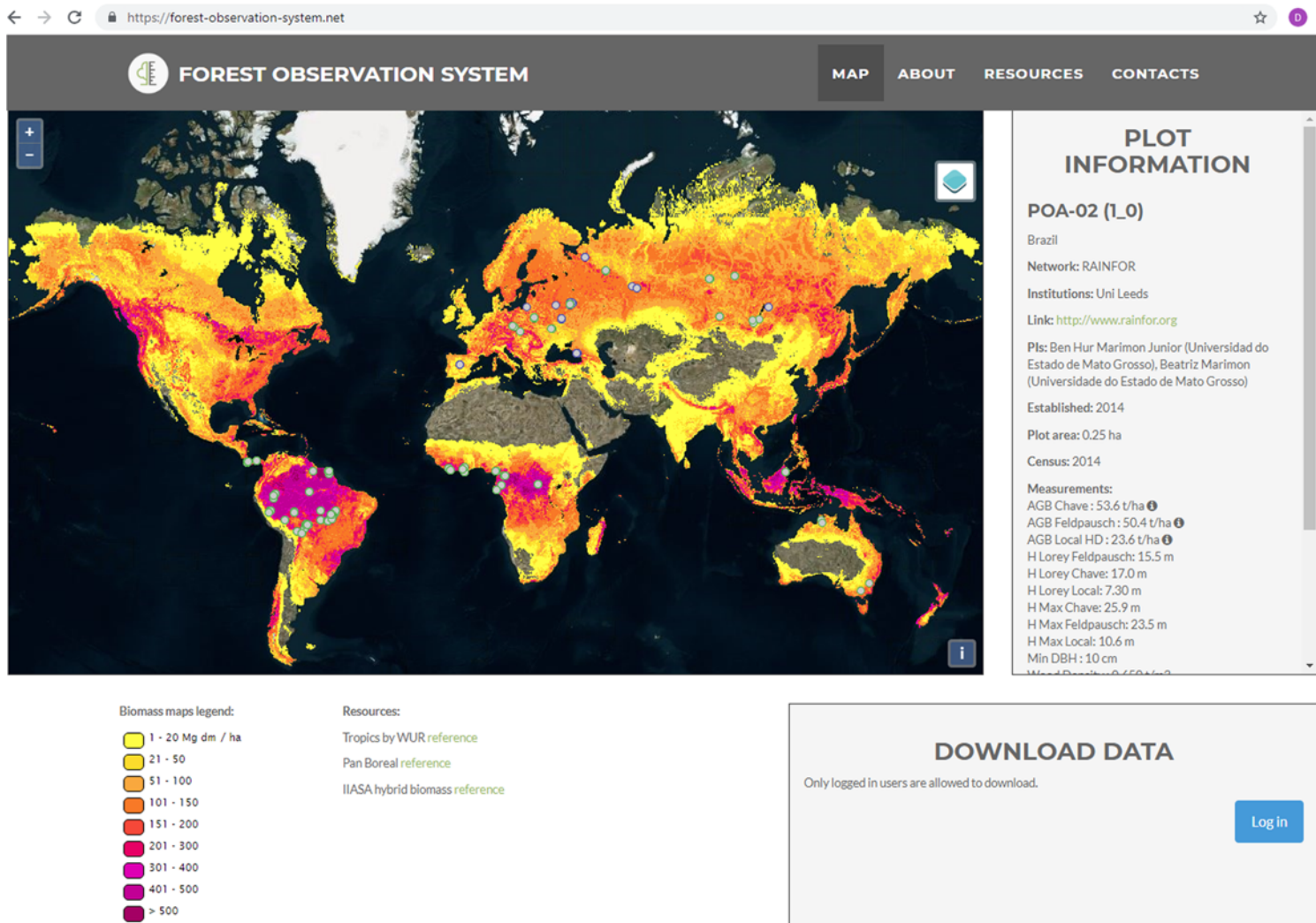
Step	Typical Protocol	Key sources of bias or uncertainty
1. Establish plot	<ul style="list-style-type: none">• Location selected based on research questions, accessibility, etc.• Plot sizes vary (ForC mean: 0.78 ha)	<ul style="list-style-type: none">• Non-random plot placement• Higher error in small plots
2. Census*	<ul style="list-style-type: none">• ID each tree to species• Measure diameter breast height (DBH)• Measuring height can increase accuracy	<ul style="list-style-type: none">• Inadvertently or deliberately incomplete inventories• Min DBH censused
3. Calculate biomass (C)	<ul style="list-style-type: none">• Apply biomass allometry to individual trees• Sum across plot• (Convert organic matter to C)	<ul style="list-style-type: none">• Biomass allometries

**Ground-based lidar is an emerging option.*

Various networks and national inventory programs standardize protocols across sites.



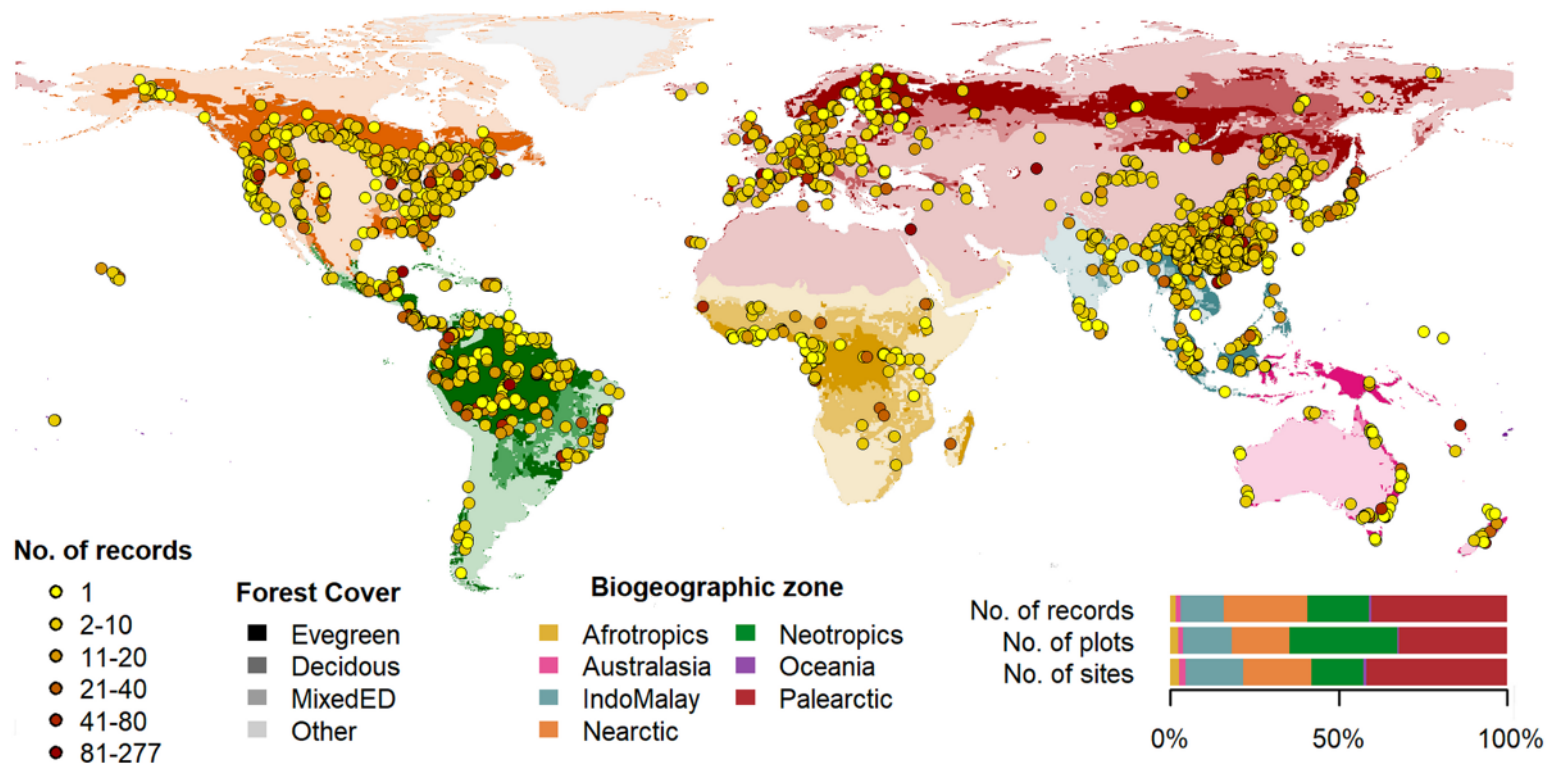
Calibration and validation of remote sensing and modeling require data that meet certain specifications.



Published estimates of forest C stocks, fluxes, and increments compiled in Global Forest C Database (ForC)

39,762 records | 10,608 plots | 1,532 distinct geographic areas

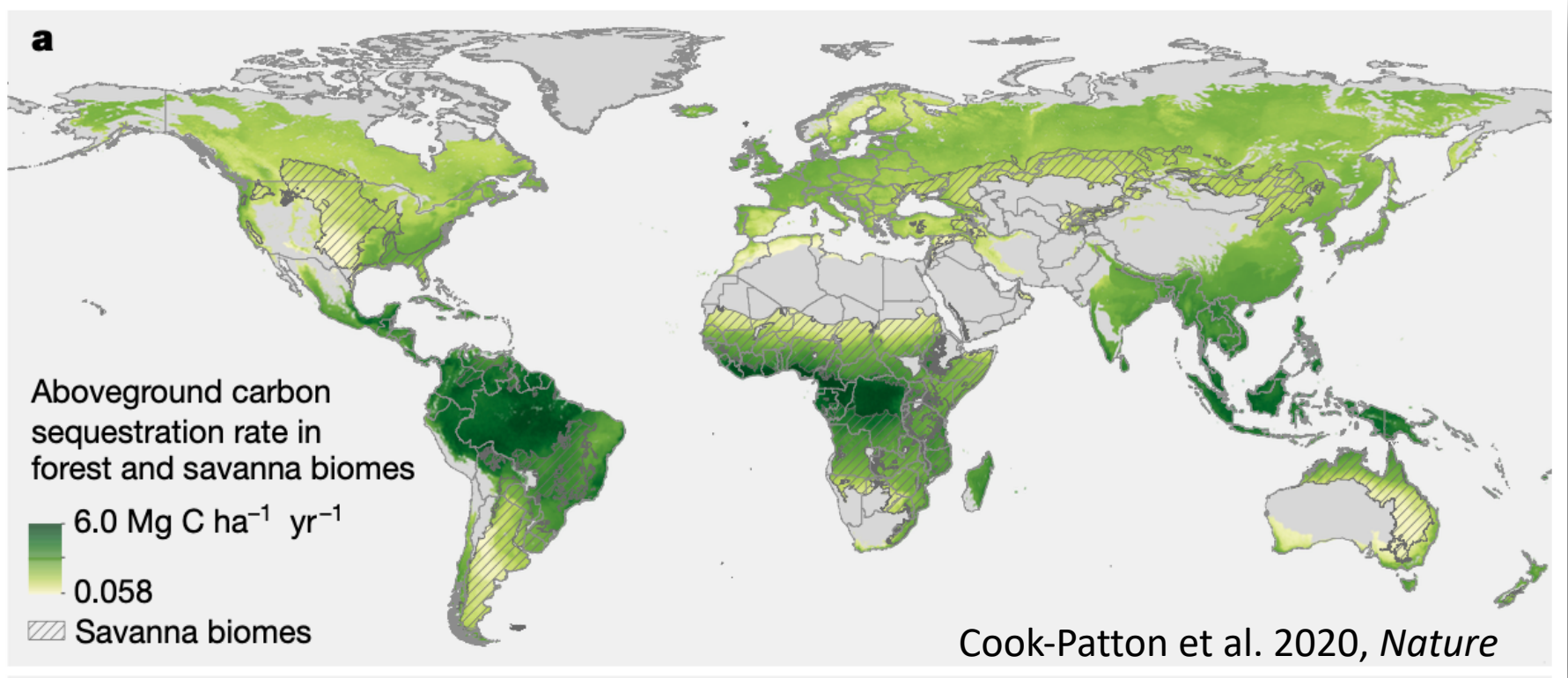
<https://forc-db.github.io/>



Anderson-Teixeira et al. 2021, *Environmental Research Letters*

We recently started a project to map ForC into IPCC's Emission Factors Database.

ForC contains sufficient aboveground biomass data to resolve age trends and biome differences.



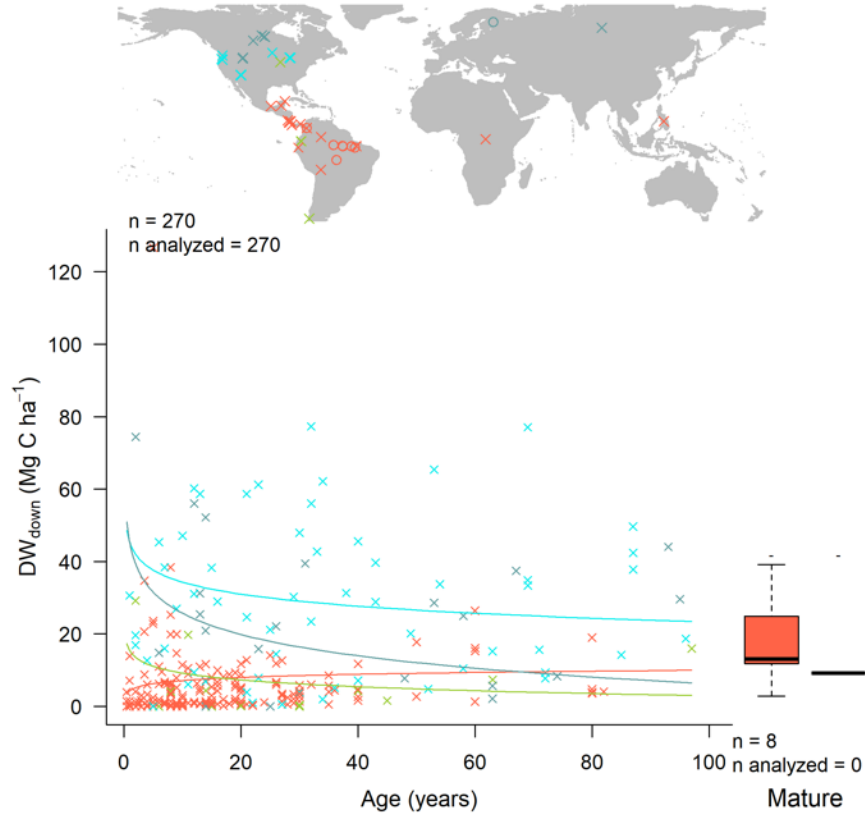
Age (years)

Mature

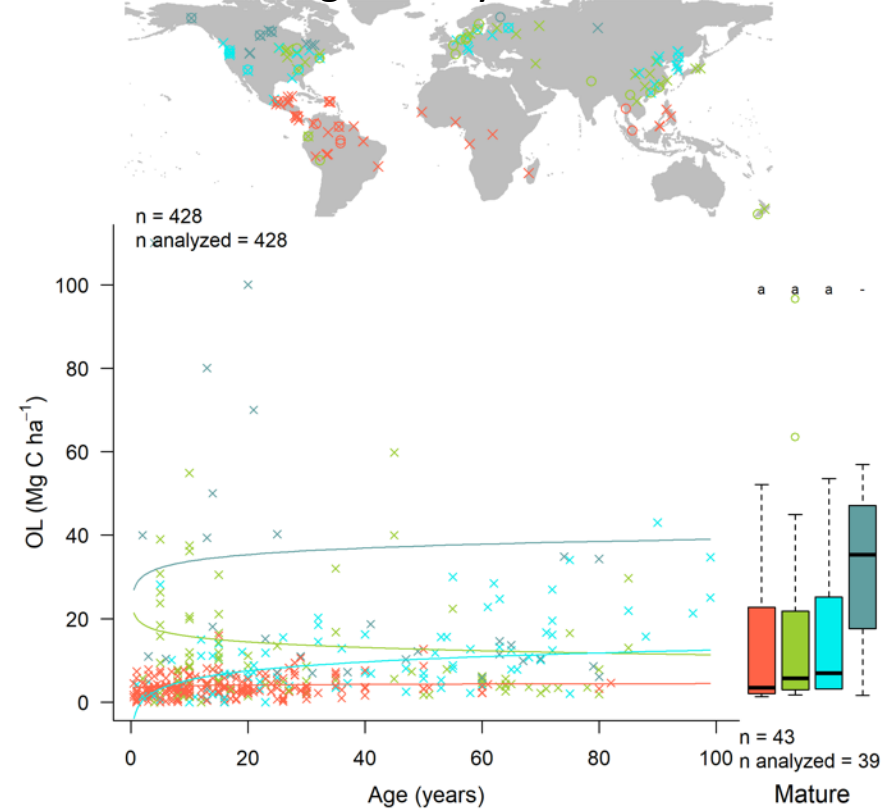
Anderson-Teixeira et al. 2021,
Environmental Research Letters

Other C pools remain less well-represented in ForC.

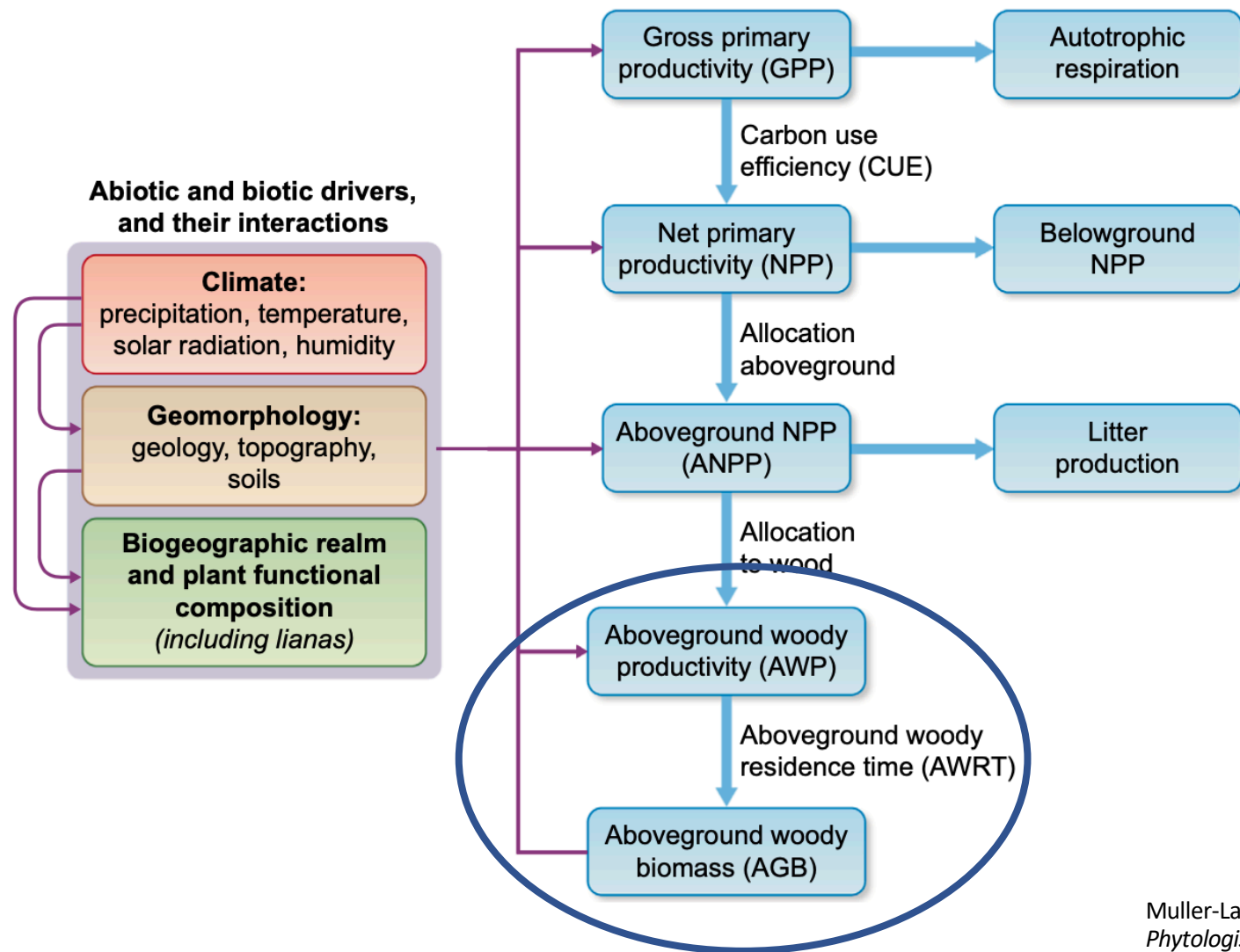
Deadwood - down



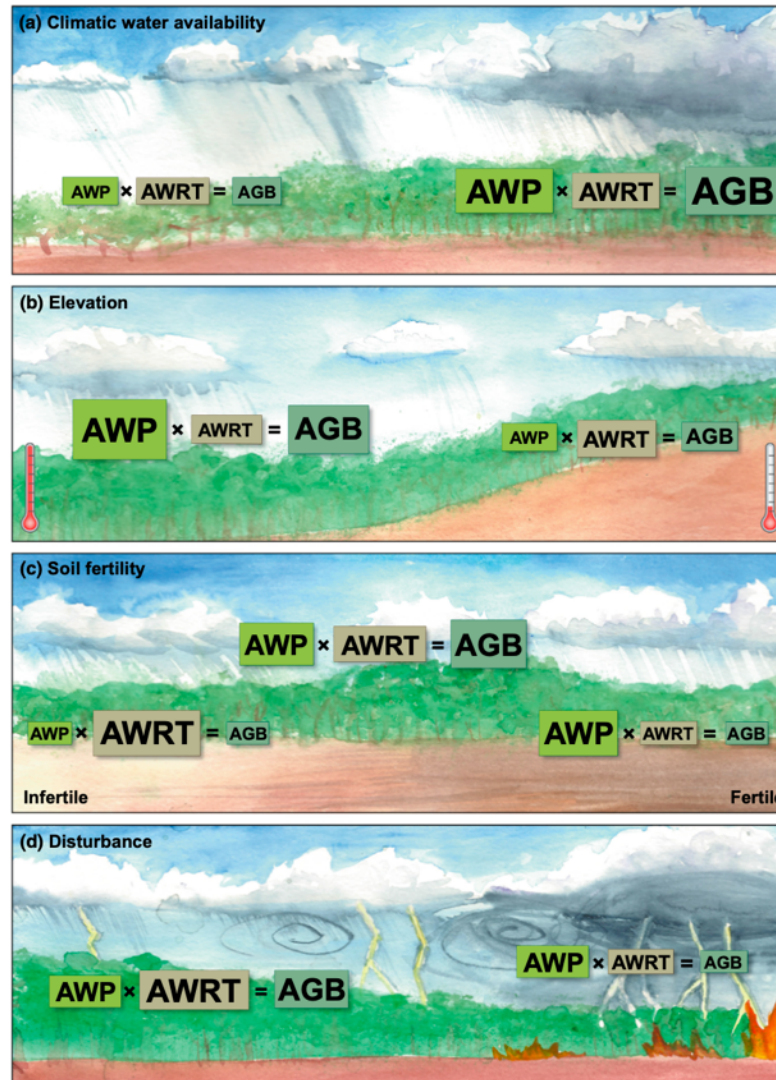
Organic Layer



To *predict* biomass, we need to understand mechanisms and accurately represent them in models.



Tropical forest productivity, woody residence time, and biomass vary spatially across gradients in climate, soil fertility, and disturbance.

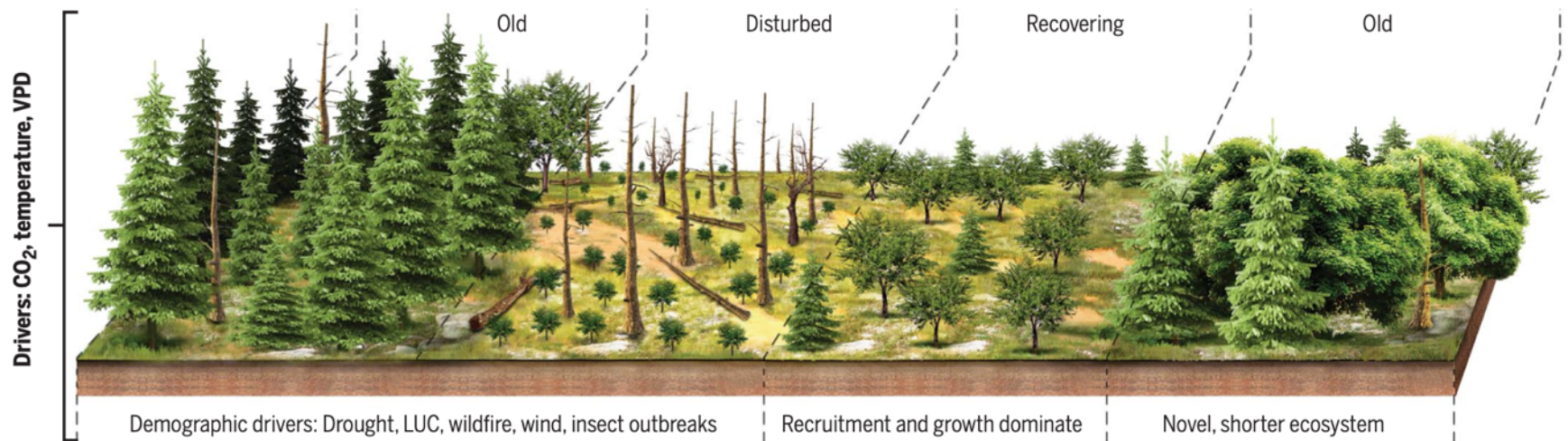


AGB- aboveground biomass

AWP- aboveground woody productivity

AWRT- aboveground woody residence time

As the climate changes, prediction of biomass based on historical empirical data becomes increasingly unreliable.





Take-home messages

- The availability of standardized, accessible data on forest C stocks is rapidly increasing.
- There remain major gaps in (accessible) forest C data for some geographies and C pools.
- Prediction of C stocks based on historical empirical data will become increasingly unreliable as the climate changes, so we need models that reliably capture key mechanisms.