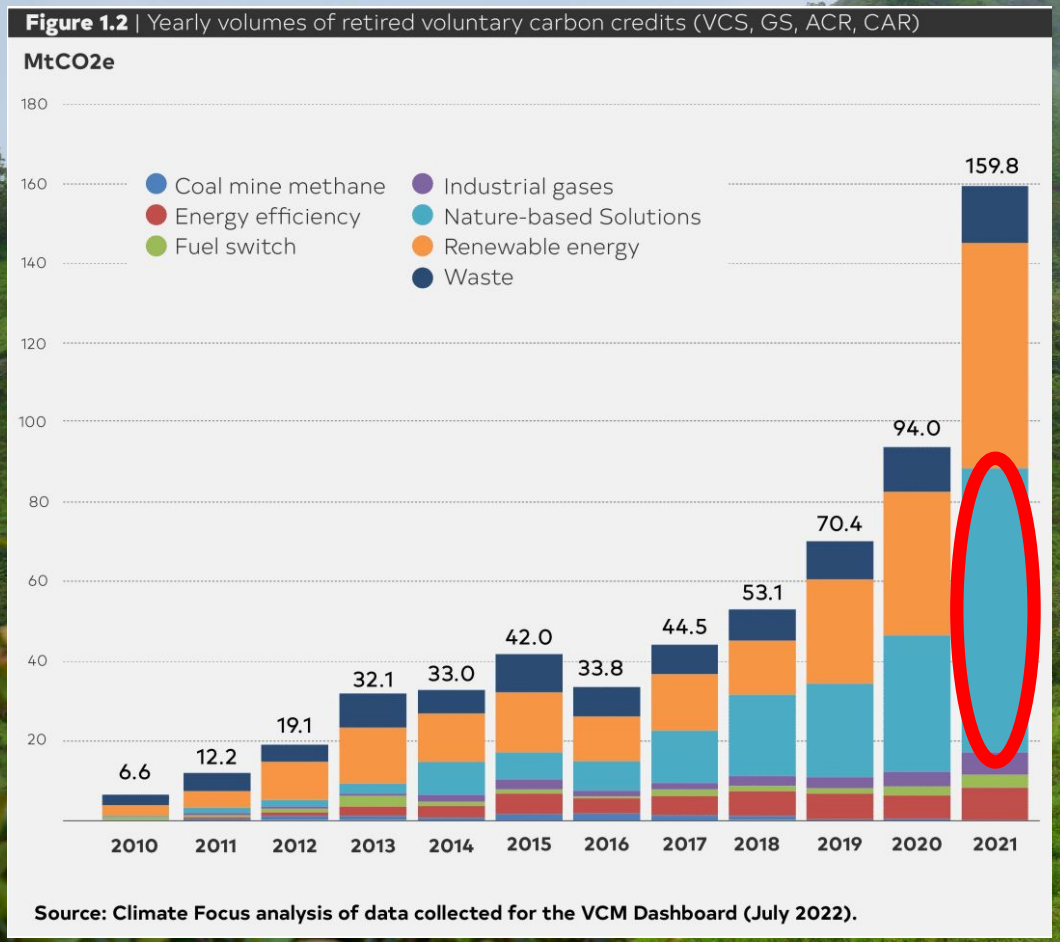
Using CLM-FATES in the Voluntary Carbon Credit Market



- Reliable carbon projections
- Account for natural risk
- Provide social and biodiversity co-benefits

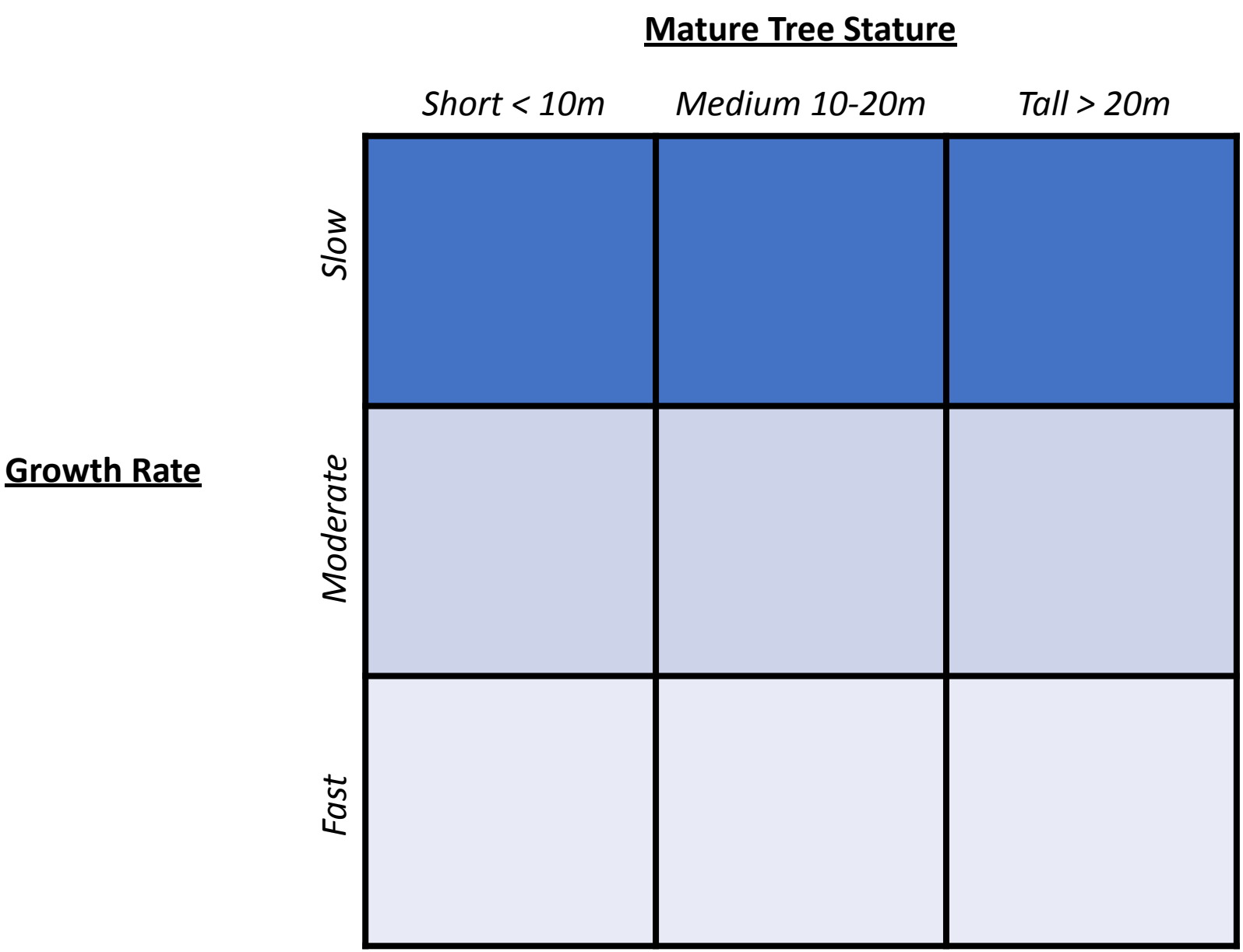
Polly Buotte
EARTHSHOT LABS

Initial Project Site: Azuero corridor, Panama

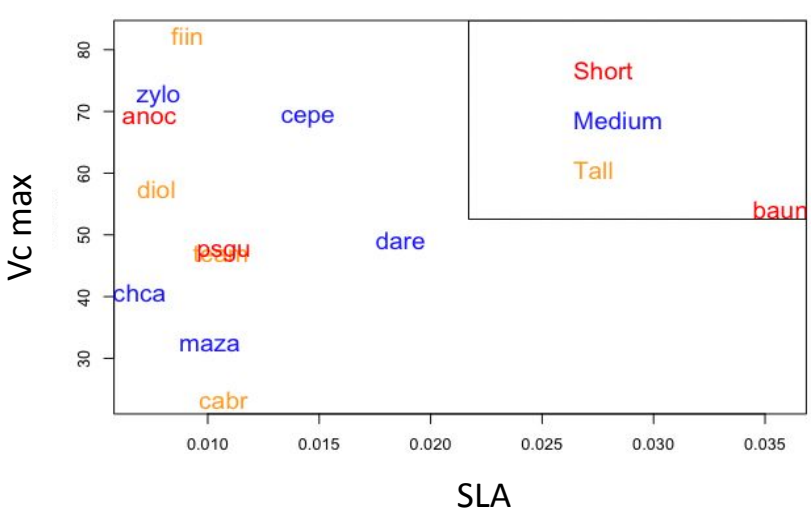
Photo: Andrew Coates

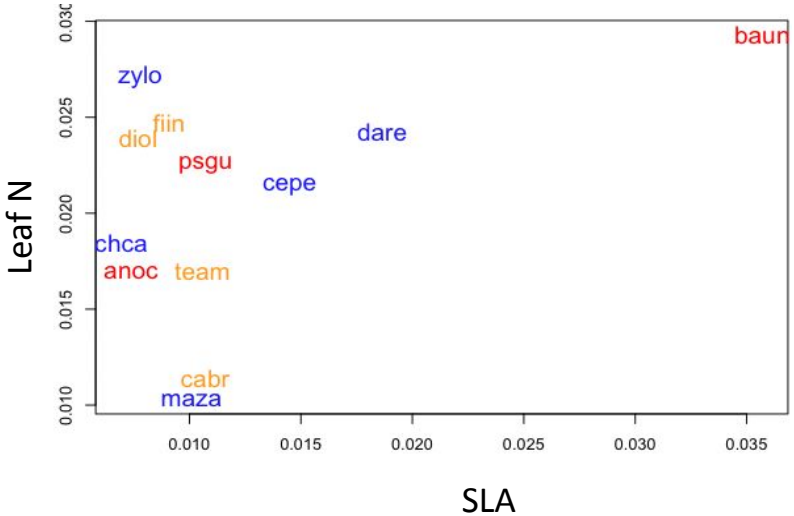
Cesar Augusto Zambrano

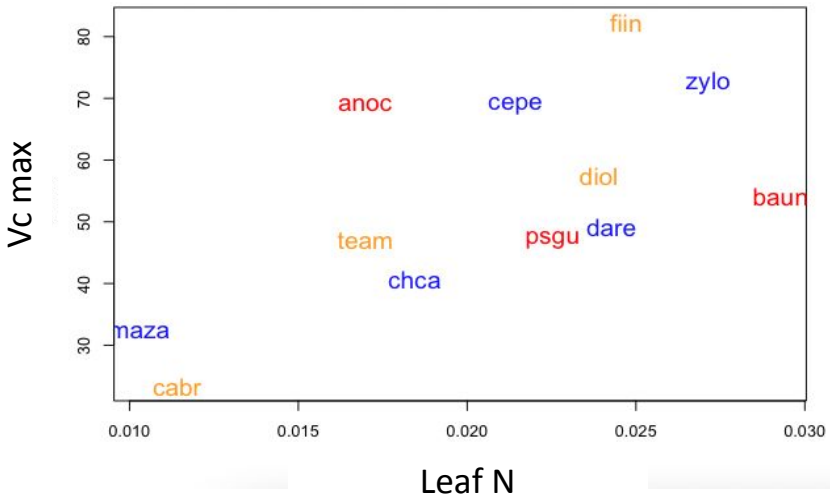
Group trees based on stature and growth rate

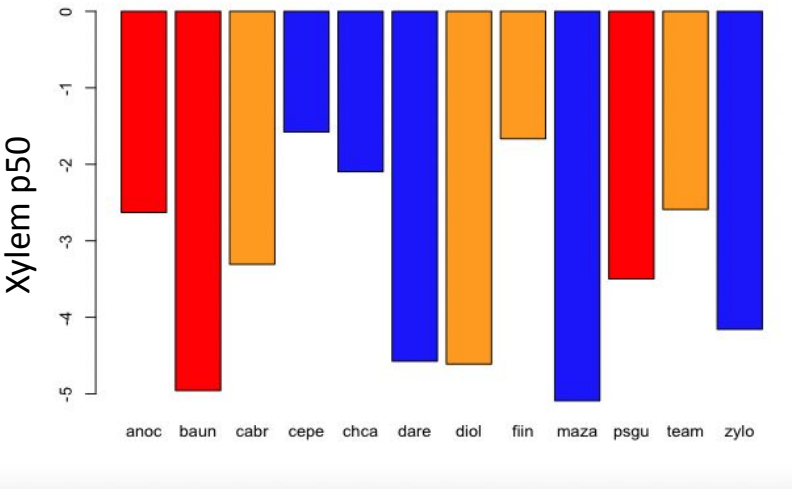


Gather trait data









- TRY database plus additional literature search including Spanish and Portuguese literature

Define PFTs

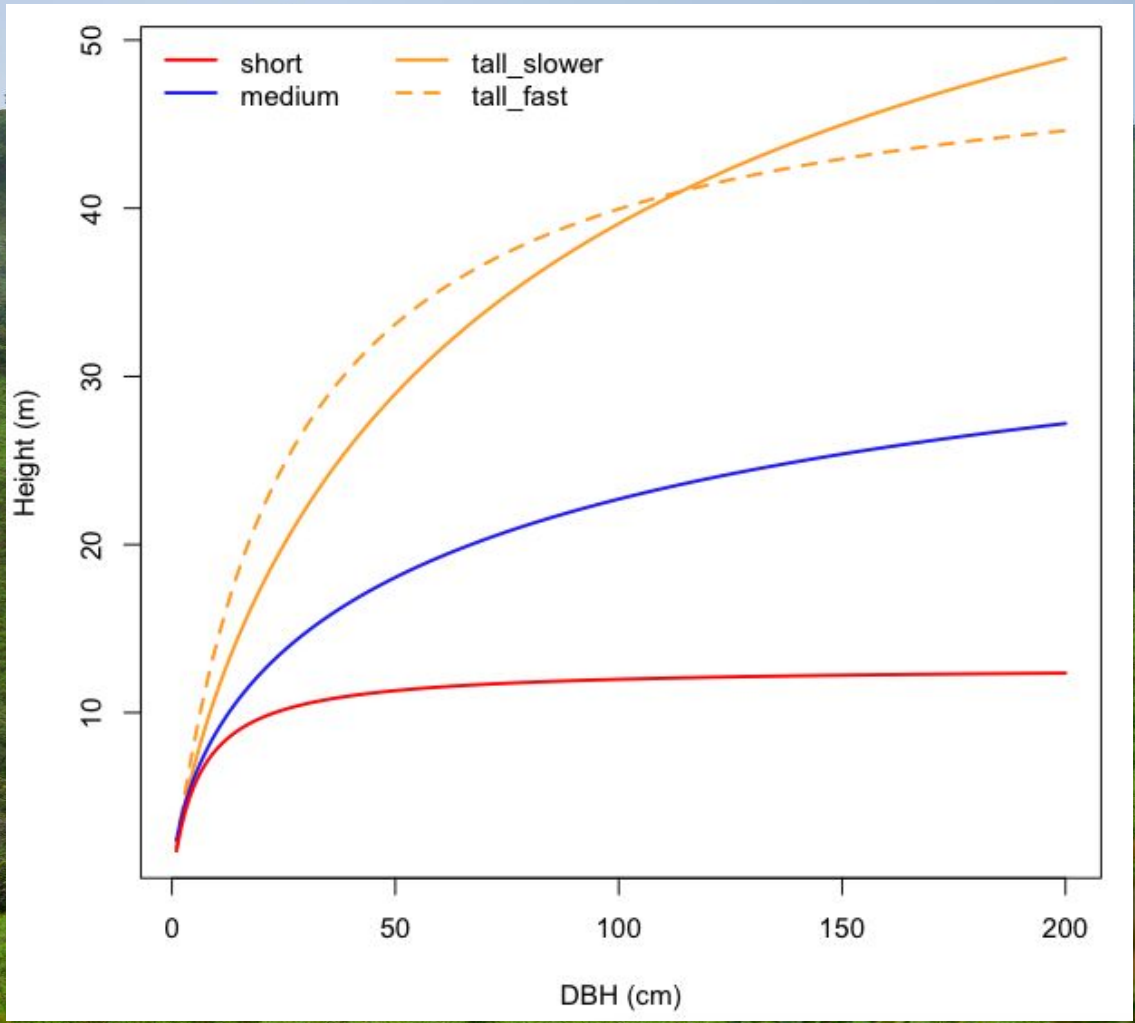
Mature Tree Stature

Growth Rate	*Short < 10m*	*Medium 10-20m*	*Tall > 20m*
Slow		**4 Manilkara zapota, Protium tenuifolium,Gustavia hexapetala:** low potential, cost, SLA, high drought; 0.81 density	**7 Calophyllum Brasiliense, Brosimum alicastrum** low potential, cost, SLA, moderate drought; 0.55-0.78 density
Moderate	**1 Zygia longifolia:** higher potential and cost, lower SLA, mod drought 0.71 density 2 A**nacardium occidentale**: high potential, moderate cost, low area, moderate drought, wide crown; 0.37-0.4	**5 Chrysophyllum cainito, Lacmellea panamensis:** low potential, mod cost, low SLA, mod drought. High SLA ratio top to bottom 0.66 - 0.74 density	**8 Terminalia amazonia, Brosimum alicastrum, Anacardium excelsum, Ormosia macrocalyx**: lower potential and cost, higher SLA, mod drought, higher SLA ratio; 0.65-0.75 density **9 Anacardium excelsum, Ficus insipida,Inga spectabilis, Pentaclethra macroloba:** high potential and cost, lower SLA, low drought; 0.40 - 0.50 density
Fast	**3 Cecropia peltata,Garcinia intermedia:, Psidium guajava** high potential and cost, moderate SLA, low drought;0.30 density	**6 Inga laurina, Inga punctata, Genipa americana, Brosimum utile, Vochysia ferruginea:** moderate potential and cost, high SLA, high drought; 0.86 density	

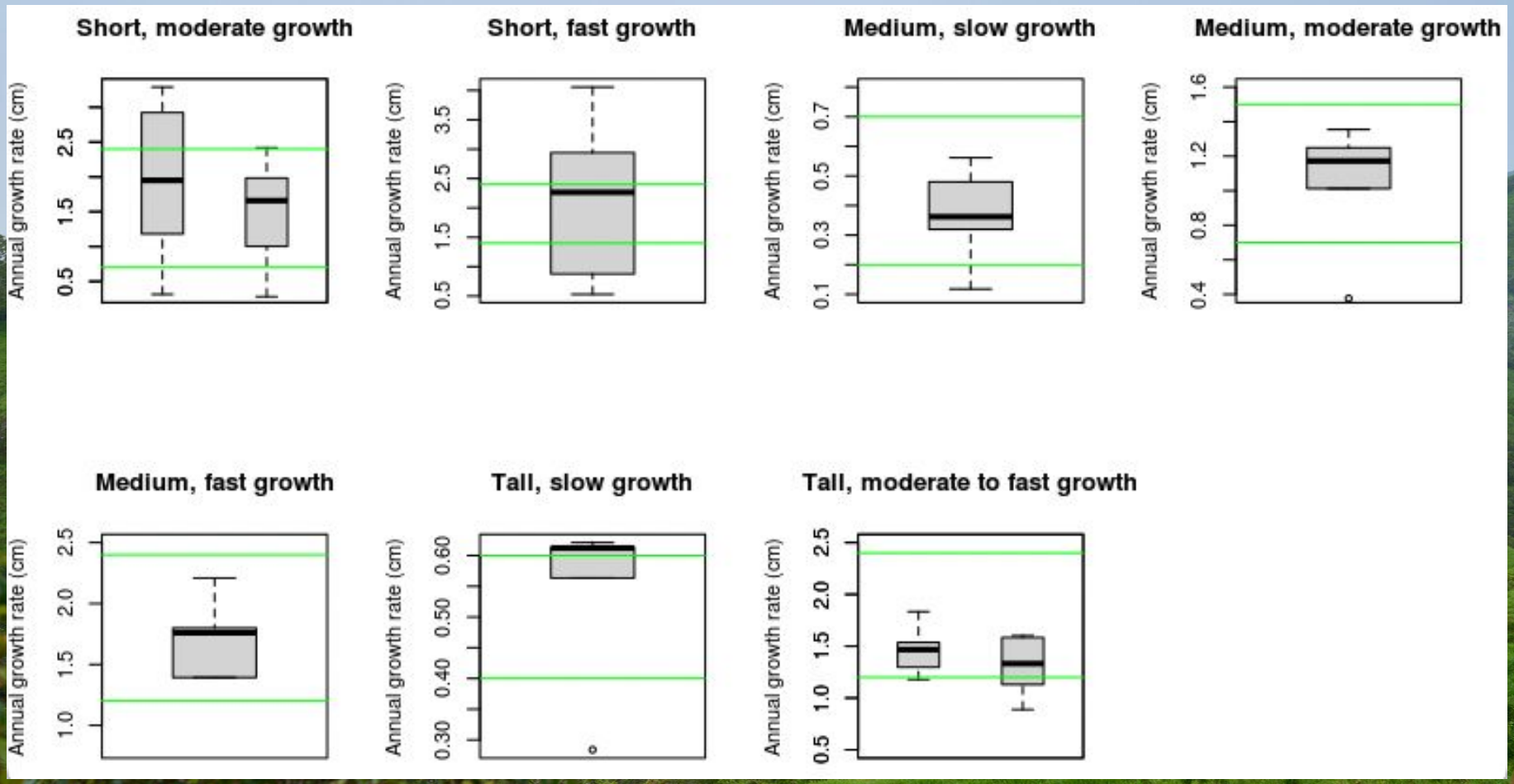
Define allometry from Tallo database

Martinez-Cano et al. 2016
h = (a*dbh**b)/(c+dbh**b)

	a	b	c
short	12.75	0.35	6.62
med	42.01	0.61	16.42
tall_slow	74.14	0.79	35.41
tall_fast	50.64	0.99	25.04



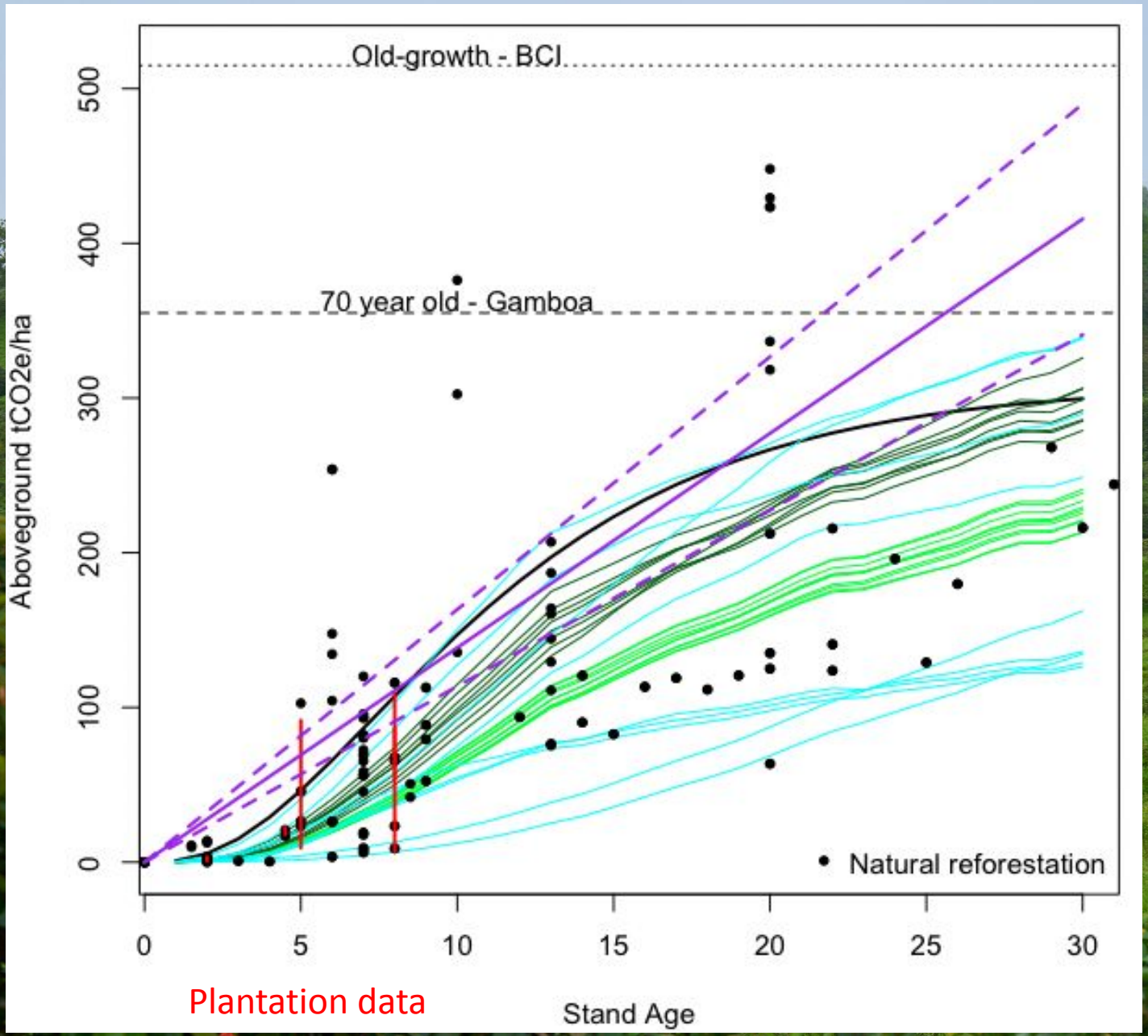
Benchmark growth rates from single PFT runs



Growth data from:
Hall, J.S. and M.E. Ashton, 2016. Guide to early growth and survival in plantations of 64 tree species native to Panama and the Neotropics. Smithsonian Tropical Research Institute. Balboa, Panama, 173pps

Sinacore, K., García, E.H., Howard, T. *et al.* Towards effective reforestation: growth and commercial value of four commonly planted tropical timber species on infertile soils in Panama. *New Forests* **54**, 125–142 (2023). https://doi.org/10.1007/s11056-022-09906-0

Benchmark carbon accumulation



Cook-Patton et al. 2020 model

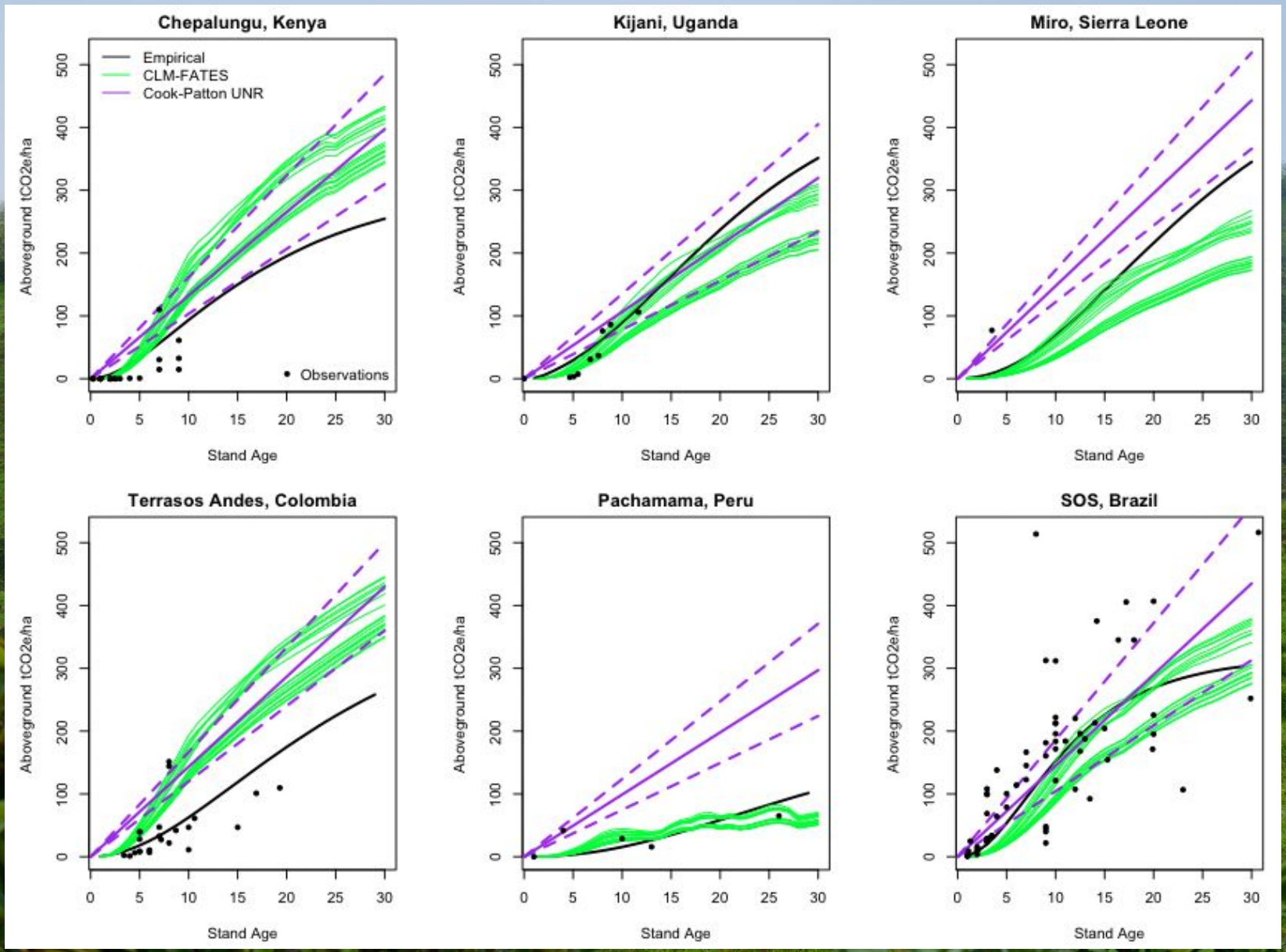
Empirical model

FATES uneven PFT mixtures

FATES more even PFT mixtures

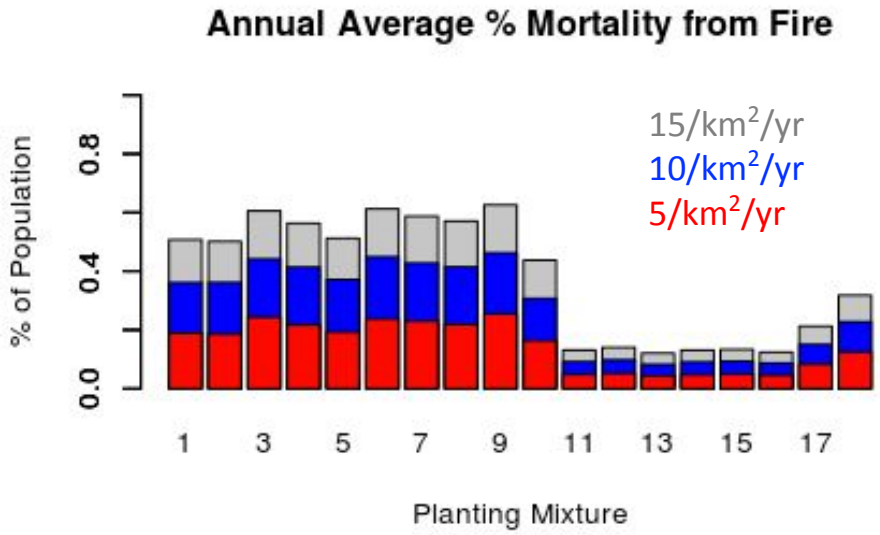
FATES single PFT

Benchmark carbon accumulation at new sites



Risk from fire and climate change

- Evaluating fire mortality across ignition frequencies (colors) and planting mixtures



- Will run with future climate scenarios

Conclusions and next steps

- PFT development for reforestation going well
  - Local knowledge was critical
  - Further evaluation across metrics and locations
- Exploring risks and co-benefits
  - Fire model and human ignitions
  - Structural diversity
  - Temperature and soil water effects
- Working towards
  - Annual planting to offset mortality
  - Agroforestry
  - Cloud-based capabilities to increase user access (with Brian Dobbins, Will Wieder, Teagan King)