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Long turnover time and large C sequestration potentials in a dry pine forest based on 15-year flux and inventory records

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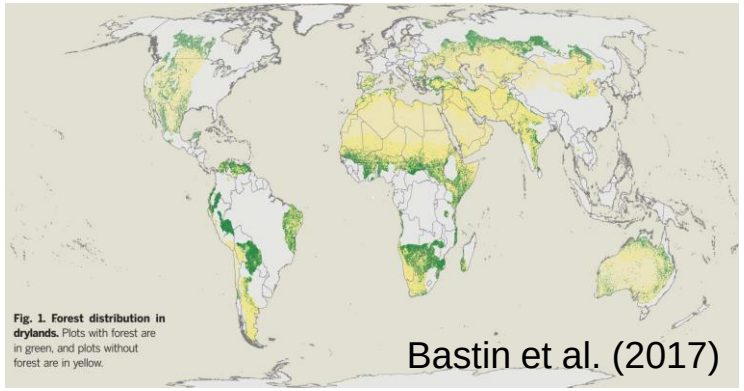
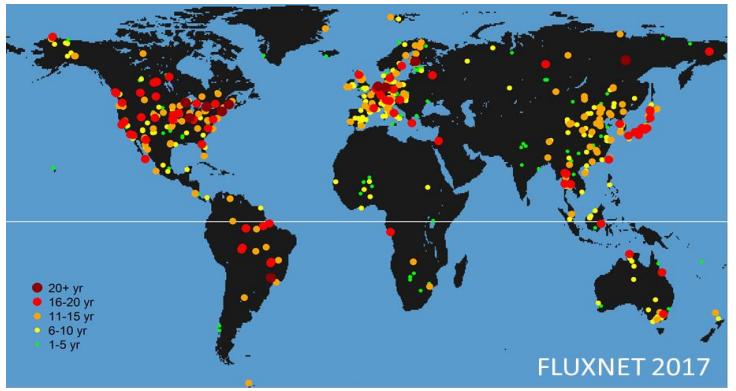
*With the help of the eco-physiological group

The need for carbon sink estimate during dry-land expansion

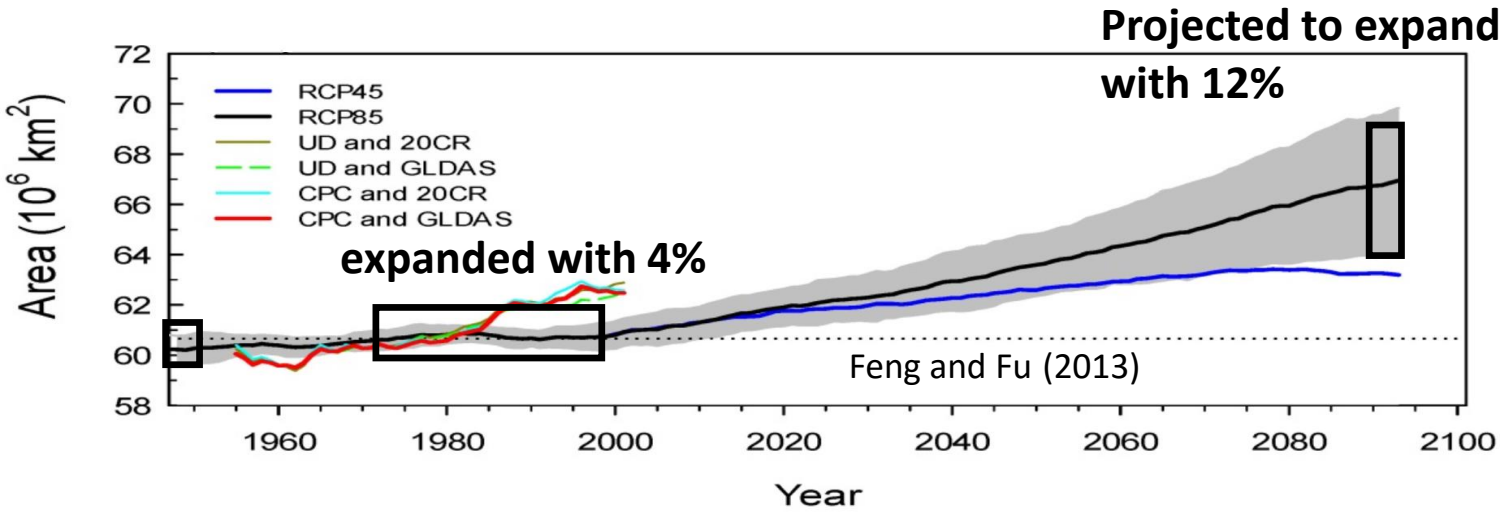
- 40% of the world's drylands have forests (Bastin et al. 2017)
- Drylands are poorly represented in global efforts to estimate NEP
- Drylands are projected to expand by ~12% by the end of the century.



Forest distribution in drylands (green)



Dryland poorly represented in FLUXNET



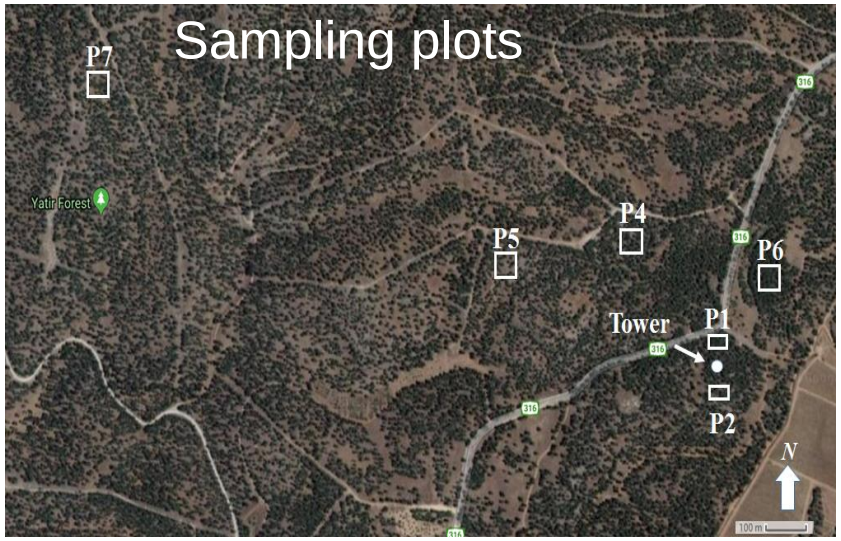
Temporal changes in global drylands

Methods

I. Study site: Yatir forest Period 15 years; 2001-2016

- Dominated by Pine-trees
- Planted mostly in 1965
- Size: 2800 ha

II. Carbon stocks based NEP (NEP_{CS}) across 15 years

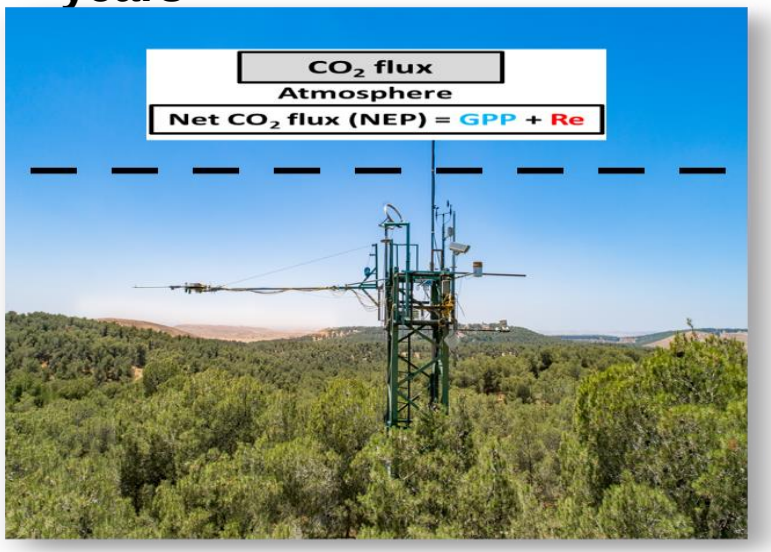


$$NEP_{CS} = (\Delta C_{soil} + \Delta C_{tree} + C_u + C_{t,m} + C_s)/15$$

- NEP_{CS} : Net ecosystem productivity for C
- Δ: is 15 years between 2001-2016
- u : grazing
- t, m : mortality and thinning
- s: sanitation

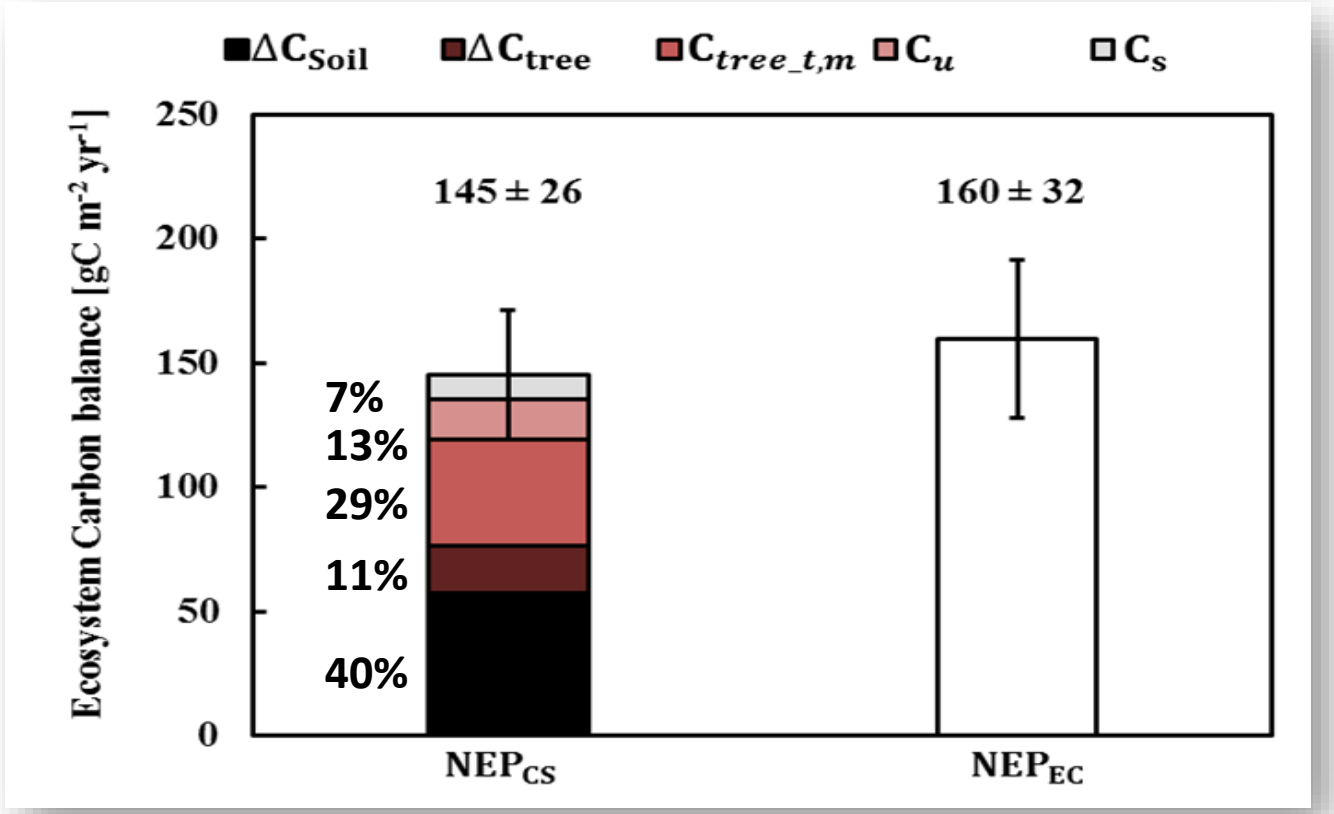
vs.

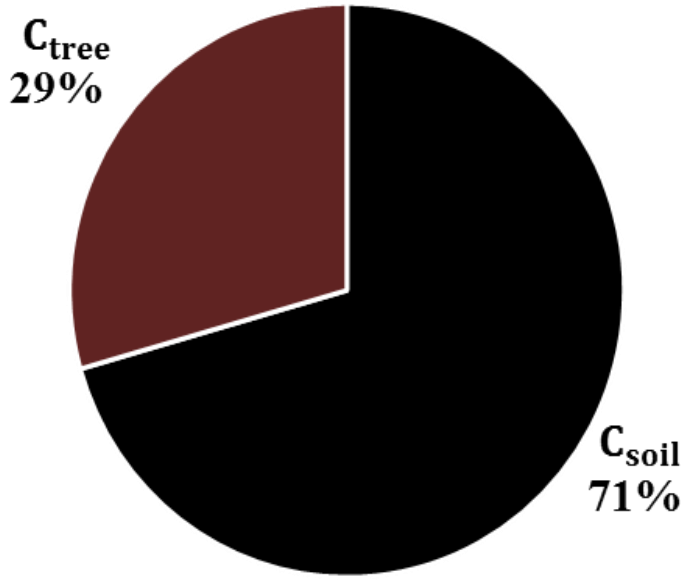
III. Carbon fluxes based NEP (NEP_{EC}) continuous over 15 years



$$\sum_{0}^{n=15\ years} NEP_{EC}$$

Results 1 - NEP_{EC} vs. NEP_{CS}





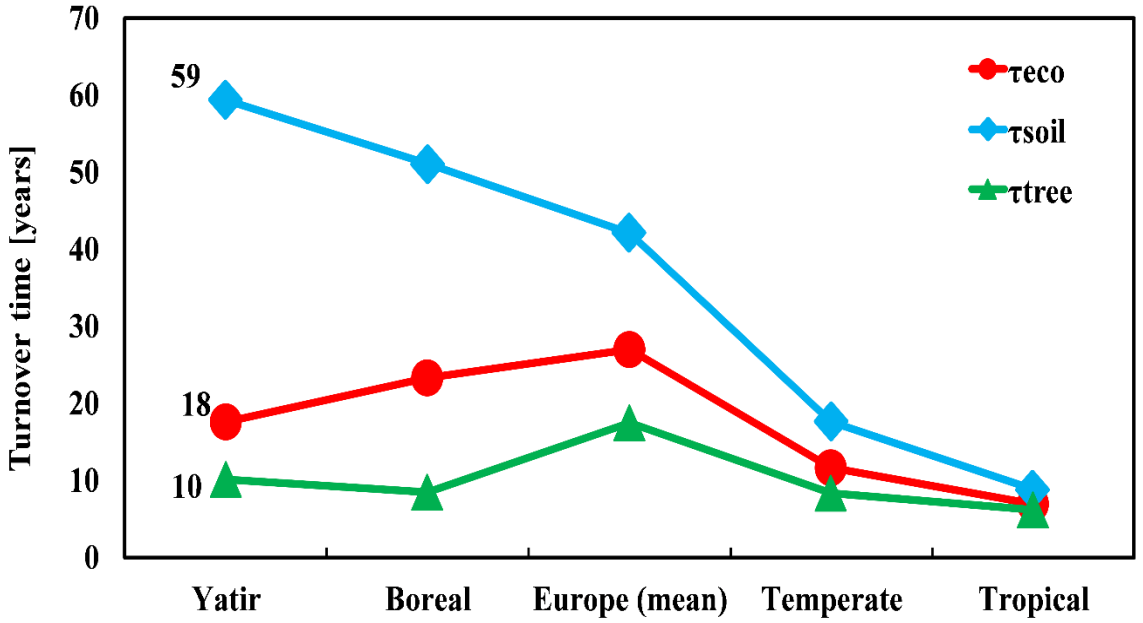
I. Carbon inventory vs. Eddy covariance: NEP_{CS}/NEP_{EC} = 91%

II. Carbon inventory shows dominance of soil C

Results 2 – Carbon turnover times and sequestration efficiency

C sequestration (C_{pool}) is determined by both flux (F) and turnover time:

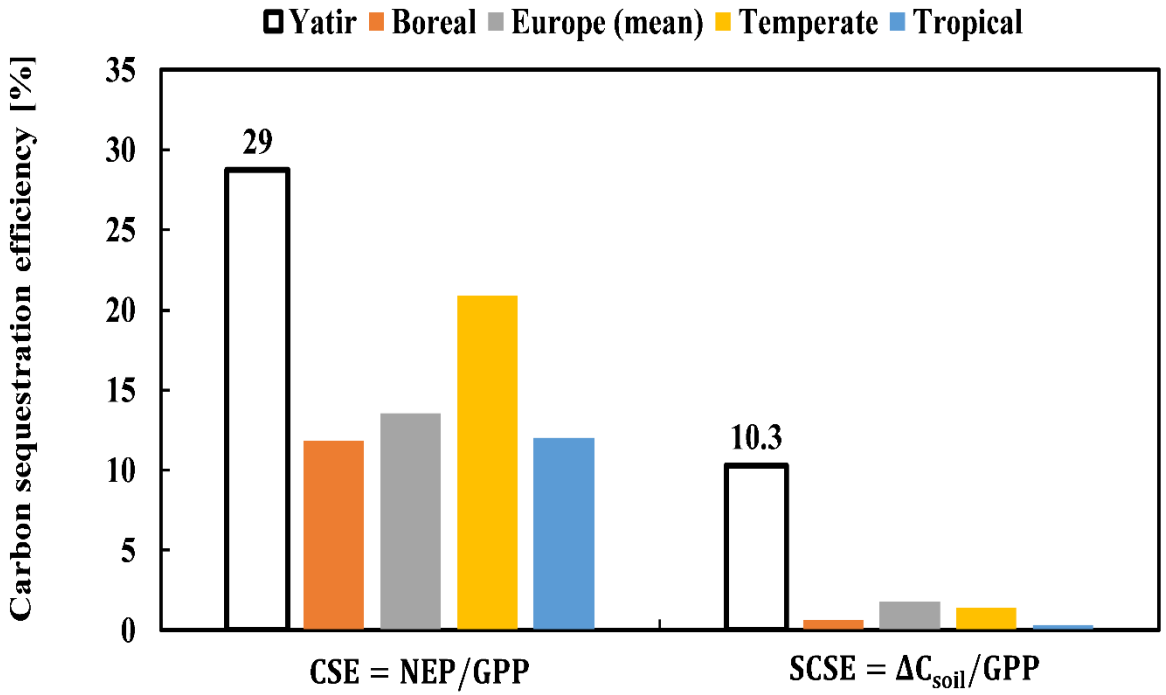
Turnover time (τ) = C_{pool}/F_{out}



Turnover times of carbon in terrestrial ecosystems (respiration-based in non-steady state systems).

Semi arid site:

CSE=NEP/GPP=29%; SCSE=ΔC_{soil}/GPP=10.3%



Carbon sequestration efficiency (CSE) in different climatic zones

Conclusion & Take-home message

In the semi-arid forest site:

- **Carbon accumulated mostly in the soil (~71%); and due to dryness has long soil carbon turnover time (59 years; ~x2 the average in other climates)**
- **The results support a considerable carbon sink potential in semiarid soils and forest plantations (even 10% of semiarid land area similar to the study site could sequester ~20 Pg C/50 years)**
- **This may have implications for the expanding global drylands area**

Thank you!