Max Planck Institute
for Biogeochemistry

Email: nfan@bgc-jena.mpg.de

Changes in vegetation turnover times from 1992 to 2016

EGU live chat material

Naixin Fan[1]

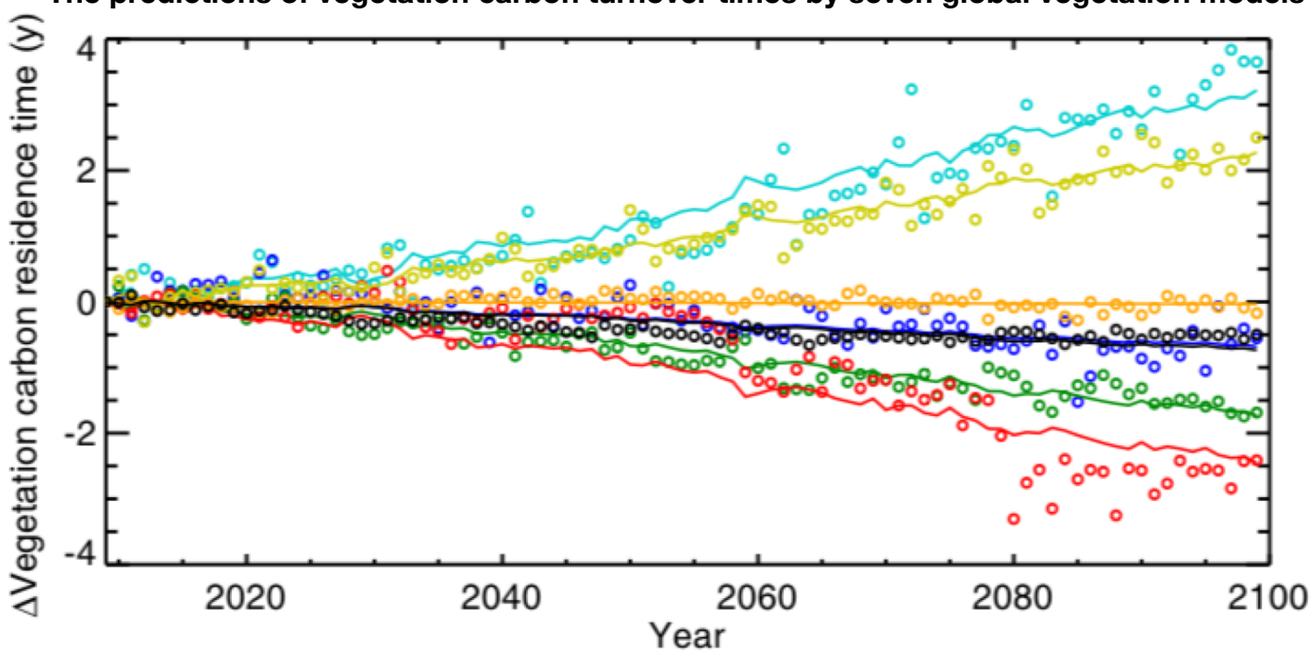
Nuno Carvalhais[1,2], Simon Besnard[1], Maurizio Santoro[3] , Oliver Cartus[3]

[1]Max Planck Institute for Biogeochemistry, Jena, Germany
[2]Departamento de Ciências e Engenharia do Ambiente, DCEA, Faculdade de Ciências e Tecnologia, FCT, Portugal
[3]Gamma Remote Sensing, Switzerland

Why matter?

- The dynamics of vegetation turnover is central to the global carbon cycle
- The vegetation turnover times (τ) is used to quantify the process of vegetation turnover and its response to climate change.
- However, we still lack understanding on the change of magnitude, spatial patterns and uncertainties in τ with time as well as the sensitivity of these processes to climate change due to lack of long-term observations.

The predictions of vegetation carbon turnover times by seven global vegetation models



[Friend et al., 2014, *PNAS*]

The BIOMASCAT AGB dataset

- **AGB estimates from 1992 to 2019 derived from backscattered signal of remoting sensing retrievals.**
- **Spatial resolution: 0.25º, global coverage**
- **Temporal resolution: Monthly, Annual**

If anyone is interested, please see methods and validations of the dataset in Maurizio's presentation (@Maurizio Santoro, Tuesday, D714 | EGU2020-19673, BG 3.20)

Challenging the steady-state assumption

Steady-state

$$\mathbf{0} = \boldsymbol{GPP} - \frac{\boldsymbol{C_{veg}}}{\boldsymbol{\tau}}$$

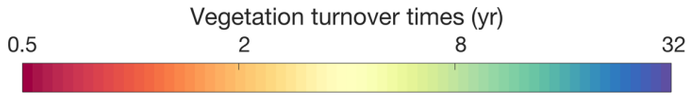
$$\boldsymbol{\tau} = \frac{\boldsymbol{C_{veg}}}{\boldsymbol{GPP}}$$

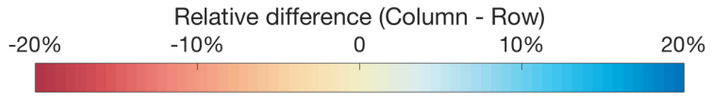
Non-steady-state

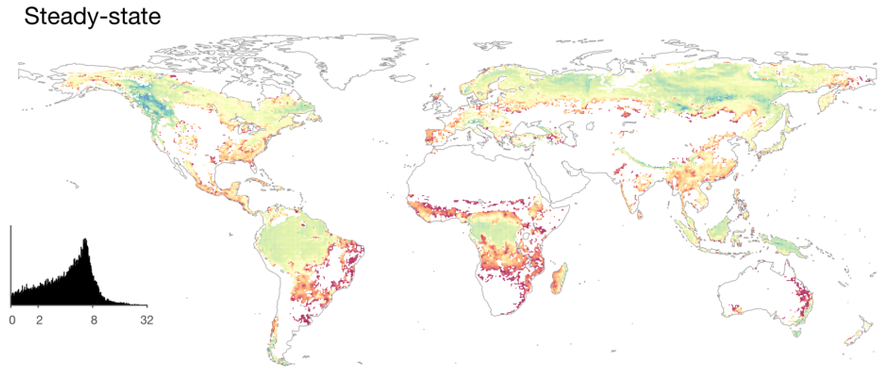
$$\frac{\boldsymbol{dC_{veg}}}{\boldsymbol{dt}} = \boldsymbol{GPP} - \frac{\boldsymbol{C_{veg}}}{\boldsymbol{\tau}}$$

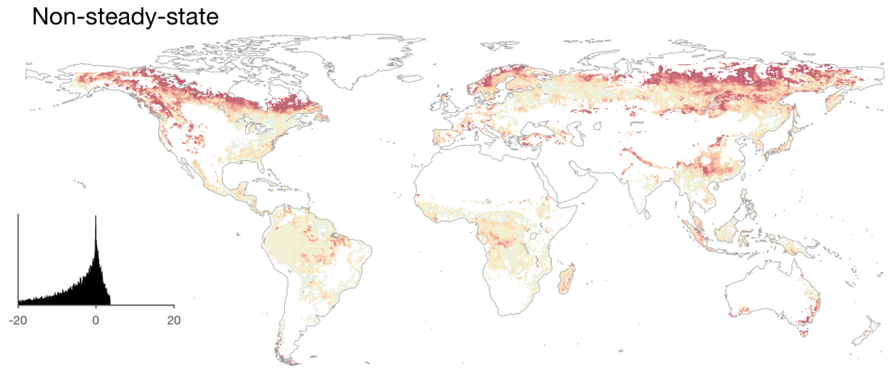
$$\boldsymbol{\tau} = \frac{\boldsymbol{C_{veg}}}{\boldsymbol{GPP - \Delta C_{veg}}}$$

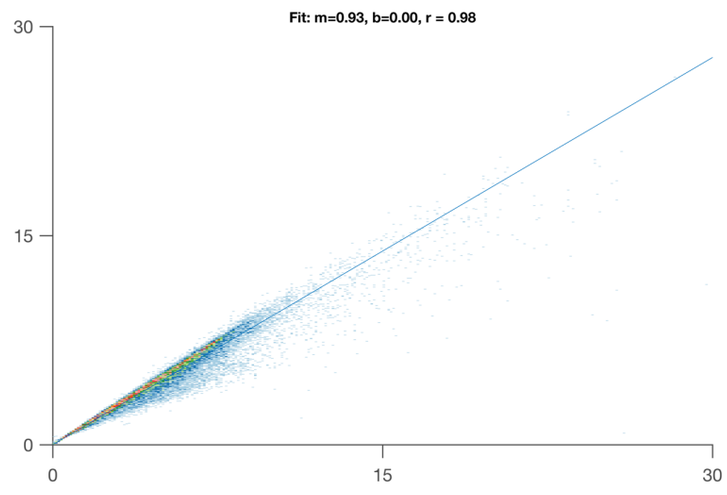
Challenging steady-state assumption

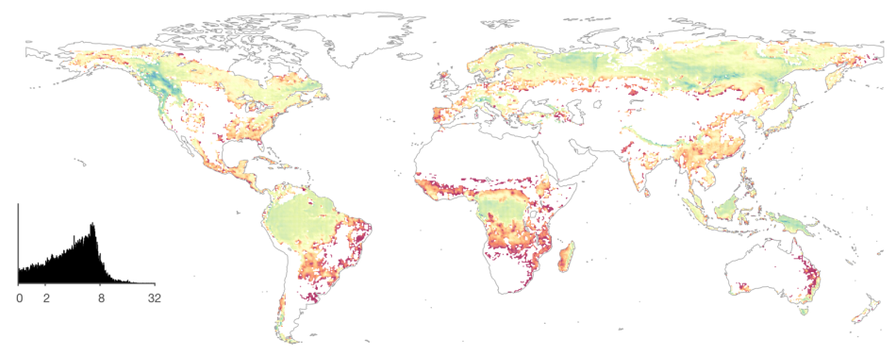








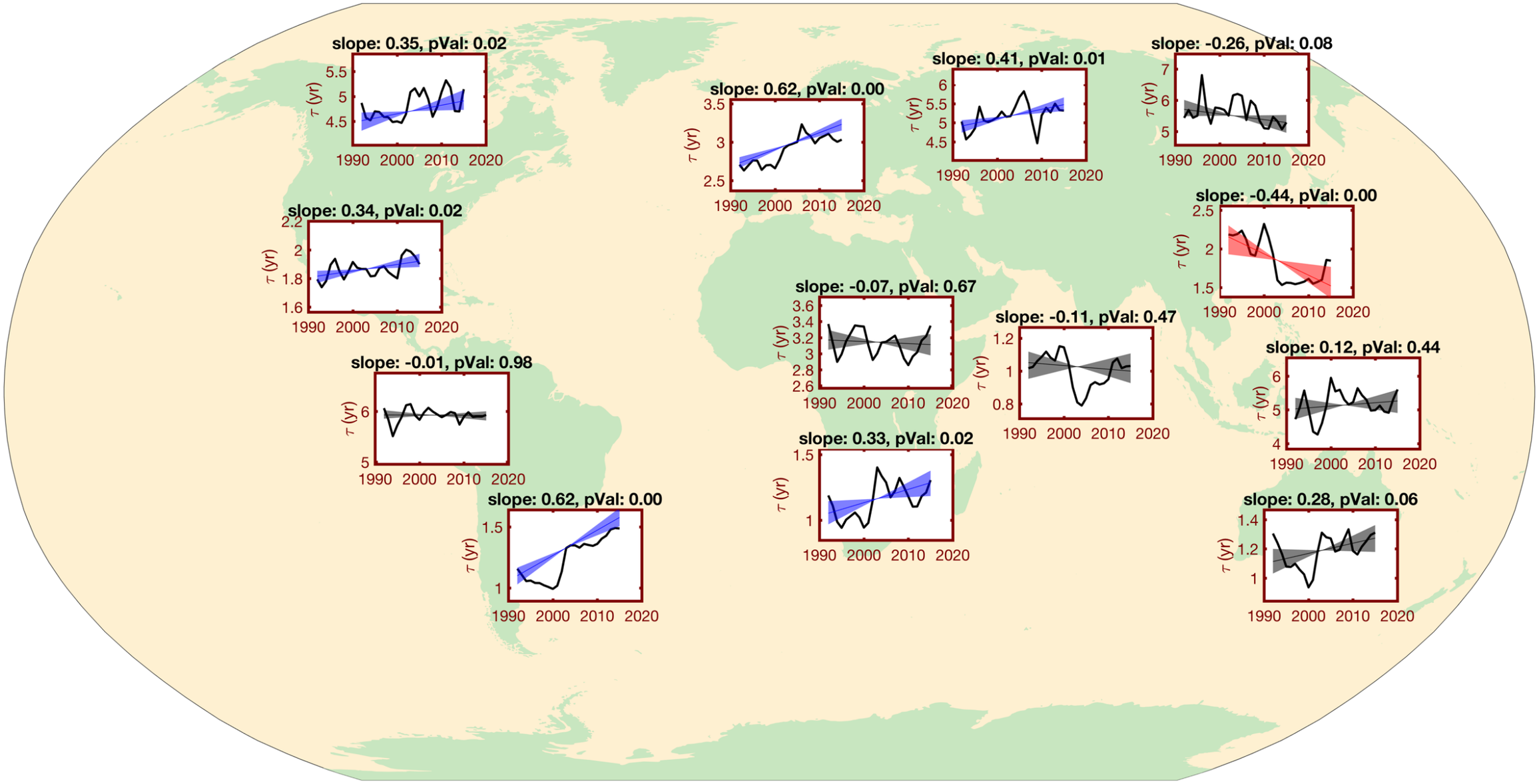




Steady-state

Non-steady-state

Global trend of turnover times



- Significant increase in many places.

- Significant decrease only in East China ! Meaning the carbon turnover is getting faster in here.

Conclusion

- Although the global patterns in vegetation turnover times under steady-state and non-steady-state are similar, regionally, turnover times inferred under non-steady-state is overall lower, especially in northern circumpolar region.

- We found significant increase in turnover times over majority of the world except for strong decrease trend in East China.