Drought impacts on the carbon uptake of an old-growth deciduous forest in Central Germany

Lukas Siebicke, Fernando Moyano, Alexander Knohl

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Introduction

In recent years, Europe has seen hot summers and drought conditions occur with increasing intensity and frequency. Drought and soil water limitations impact on the carbon uptake and release of forests.

This study investigates the effect of recent drought events on carbon dioxide exchange of the unmanaged deciduous old-growth forest at the Fluxnet site Hainich (DE-Hai) in the years 2018 and 2019 and compares them to the previous century drought of 2003.

During the 2018 event the Hainich site was at the intensity maximum of the Middle European drought event. In combination with shallow soils with low water holding capacity, this lead to severe limitations of available soil water and therefore a to a reduction in carbon fluxes.

Methods

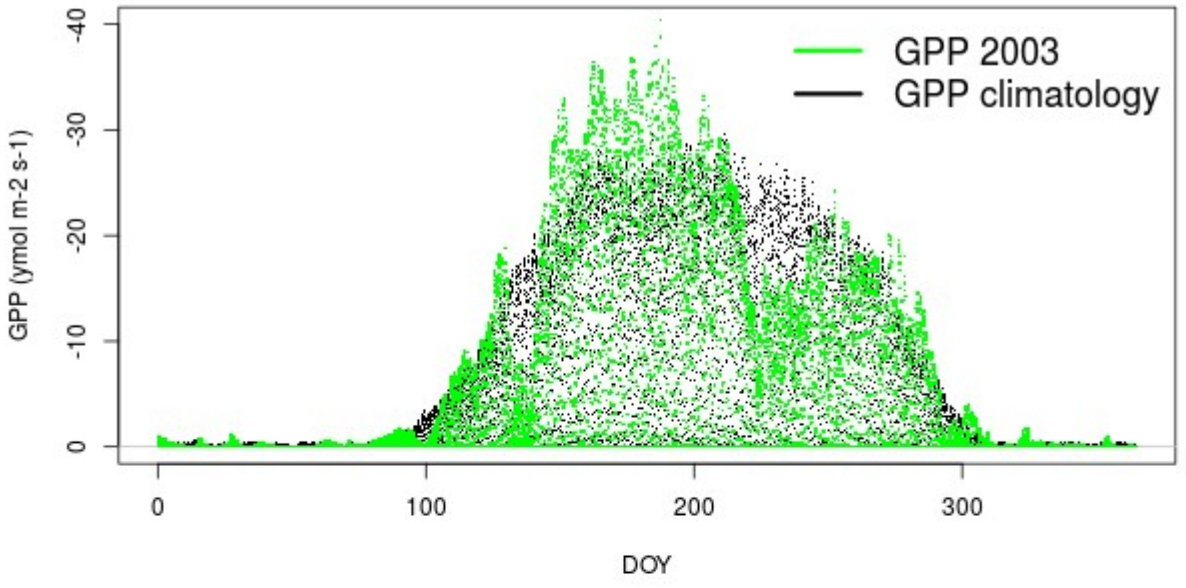
- **Site**: Fluxnet site „Hainich“ (DE-Hai)
- **Vegetation**: Mixed beech forest
- **Method**: Eddy covariance flux measurements. Flux partitioning after Reichstein et al (2005).
- **Instruments**: LI-6262 and LI-7200 (Licor Env. Inc, USA) gas analyzers / R3 (Gill Instruments, UK) sonic anemometer.

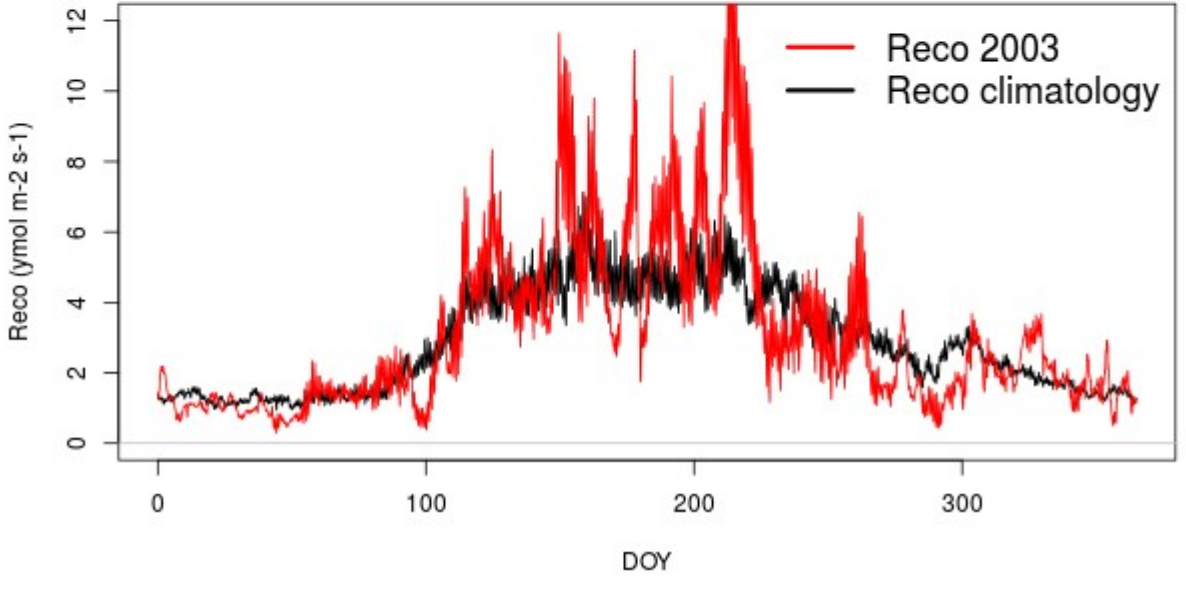
Results

2018 saw a significant reduction in the annual carbon uptake of the forest due to a drought starting early in Spring and limiting fluxes from May and June onwards.

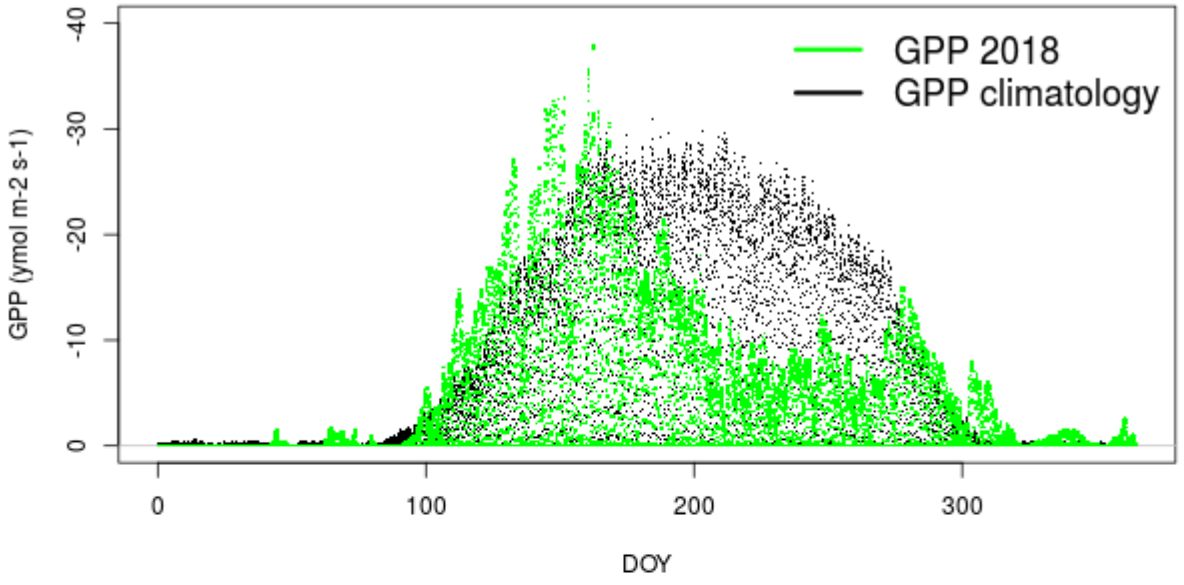
In 2019, the reduction in GPP and Reco was strong and in contrast to the mid-summer droughts in 2003 and 2018 more spread out over the year. The reduction of Reco in 2019 was stronger than in 2003 and 2018 and partially offset the reduction in GPP, mitigating the GPP reduction effect on cumulative annual carbon uptake (cumulative NEE).

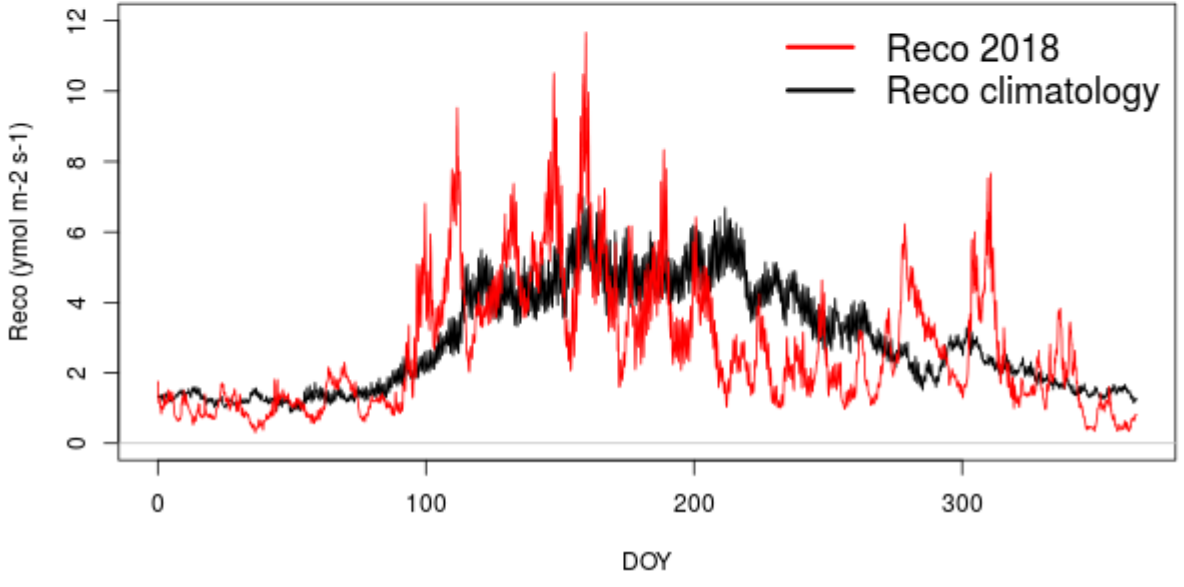
2003 drought



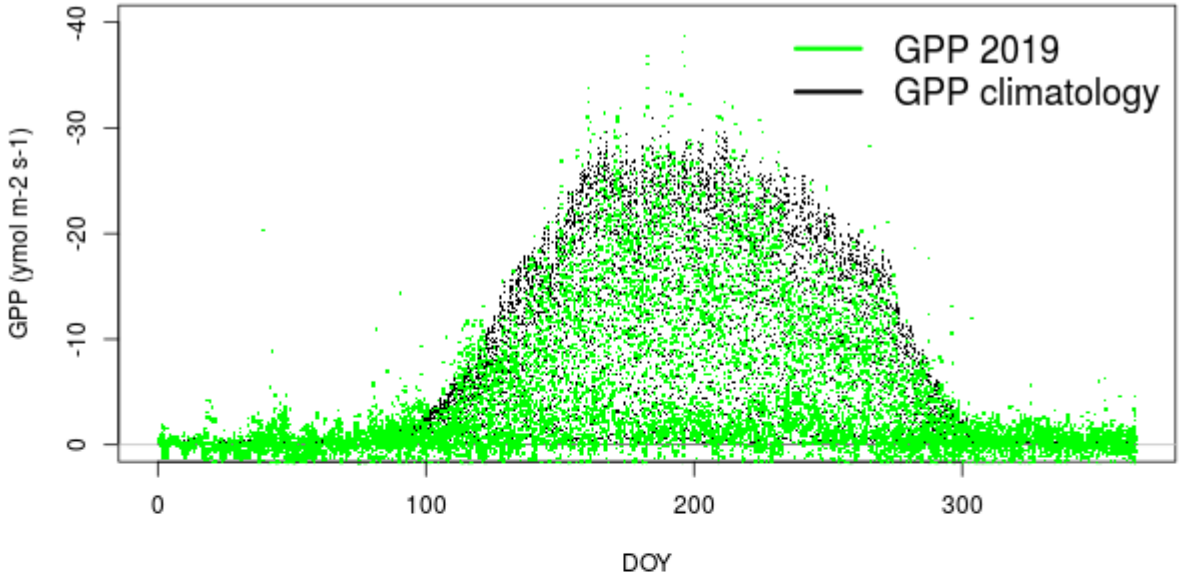


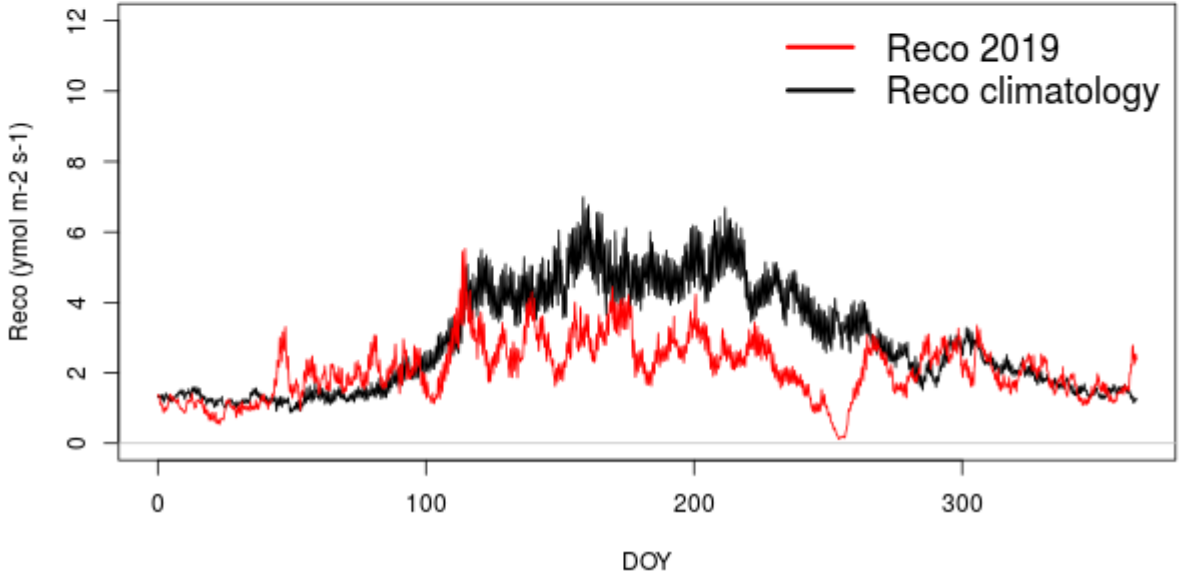
2018 drought



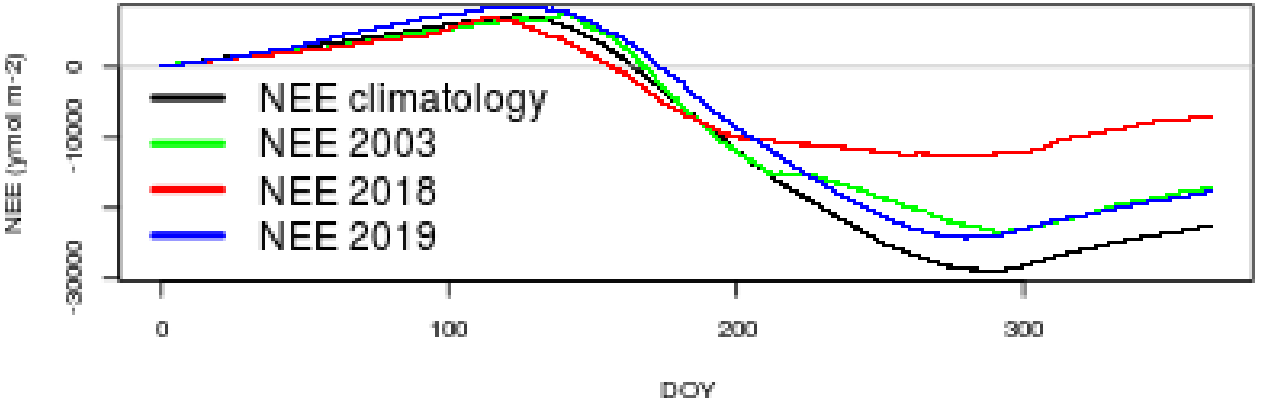


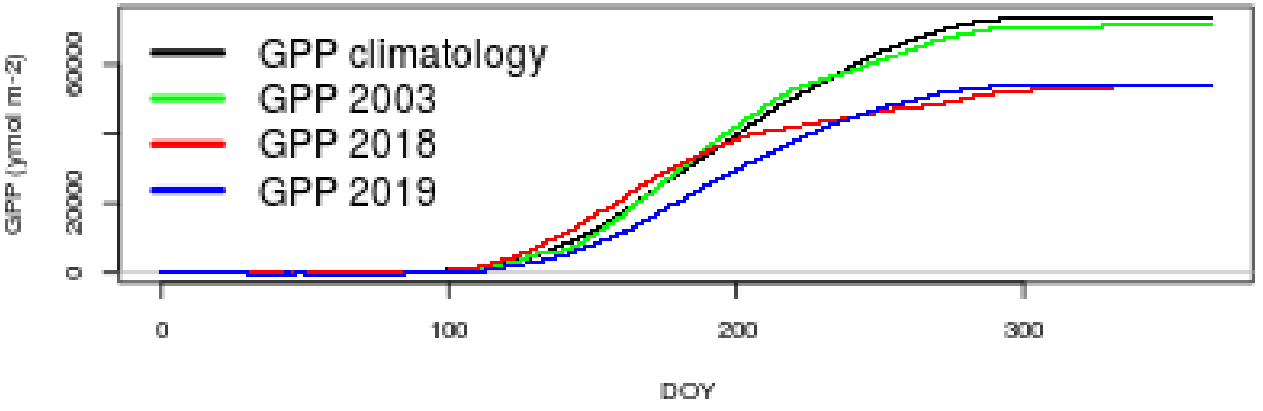
2019 drought

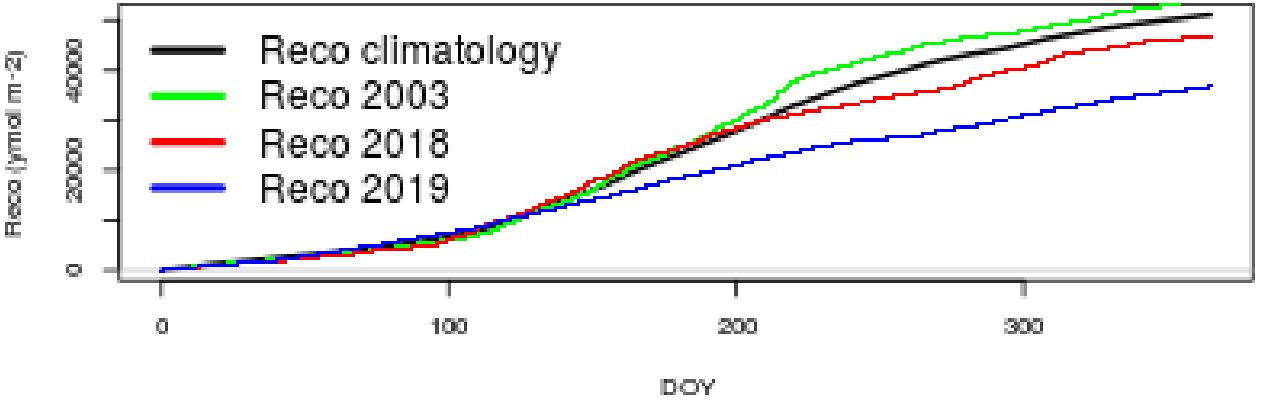




Cumulative carbon fluxes







Conclusions

Comparing the 2003, 2018 and 2019 drought years, we find that anomalies in the annual carbon balances are not only affected by the intensity of the drought events itself but most importantly by the seasonal timing and the balance between anomalies in the carbon uptake and release.

Acknowledgements

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References

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