

TERENO Workshop: The Drought Year 2018

Insights From the TERENO Observatories

Reinhard Hüttl

GFZ German Research Centre for Geosciences

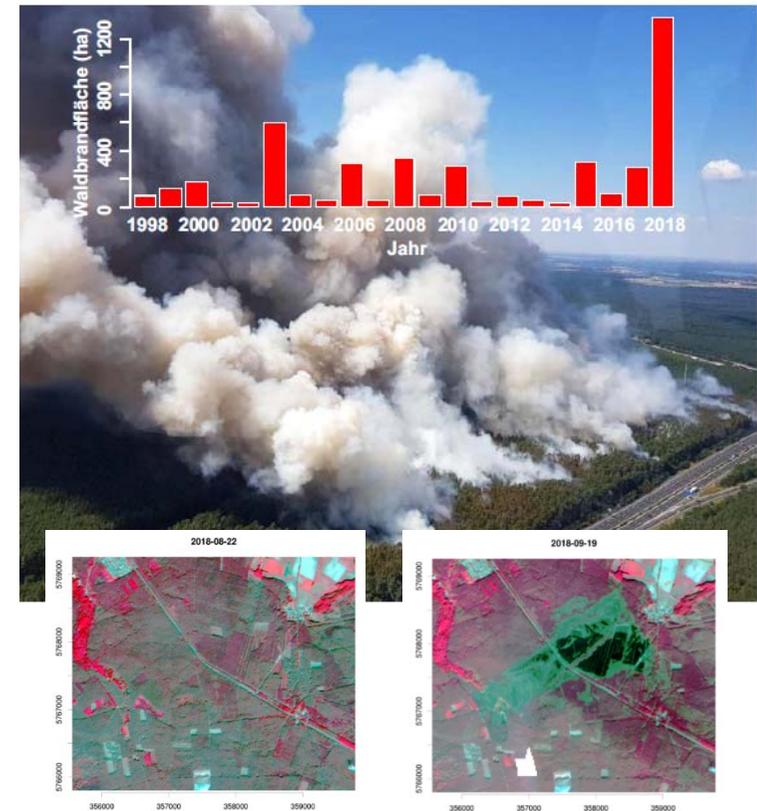
2018 – Year of Drought and Heat

2018 in Germany: Year of Extremes

- **Hottest** year since beginning of weather recording (1881)
- Sunniest year since start of comprehensive recording (1951)
- Among the three driest years since 1881 (586,3 mm)
- Eight of the nine hottest years since 1881 fall into the 21. century

2018: Records in Brandenburg

- **Hottest** year since beginning of weather recording
- **Driest** year since beginning of weather recording (390,4 mm)
- More than **500 forest fires** (>1300 ha forest fire area)
- Harvest losses (eg., worst potato harvest since Unification in 1989)



Current Forest Damages in Germany

- **2017-2019: most serious forest damages** since the “Waldsterben” (forest dieback) in the 1970s/80s (→ “Waldsterben 2.0”)
- Affected at least **110,000 ha** in southern and central Germany (especially Norway spruce)
- **Possible causes:** Storms, drought and insects (bark beetles)
- **Clearing and restructuring** of the damaged areas (→ Establishment of mixed forest ecosystems adapted to the “new” site conditions)
- **Total costs** amount to € 2.8 billion
- Federal Government announces **emergency program** for 2020 and “forestry summit” in September 2019
- In addition, extensive development and promotion of **forestry research** is necessary



Dead stand of Spruce in Harz mountains (Photo: S. Arend)

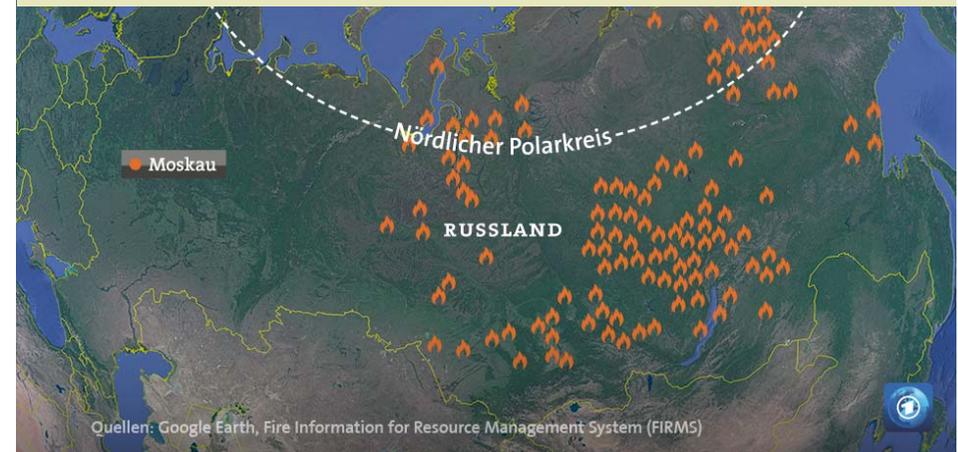
Current Forest Damages Globally

1) Clearing Amazon rainforest in Brazil



- **2018:** increase in deforestation compared to previous years
- **During the last 50 years,** about 800,000 km² of rainforest have been cleared (= 17 % of the original forest area)

2) Forest fires - summer of 2019 in Siberia



- In 2019, about **32,000 km²** of forest burned (equivalent to the area of Brandenburg)
- Soot particles promote **permafrost thawing** and **ice melting** in this region and in the neighboring Arctic

Climate Change Affects Jetstream over Europe

- Climate change warms the Arctic faster than other regions
- Result: temperature difference between high and low latitudes decreases
- Jetstream weakens and begins to meander more intensively

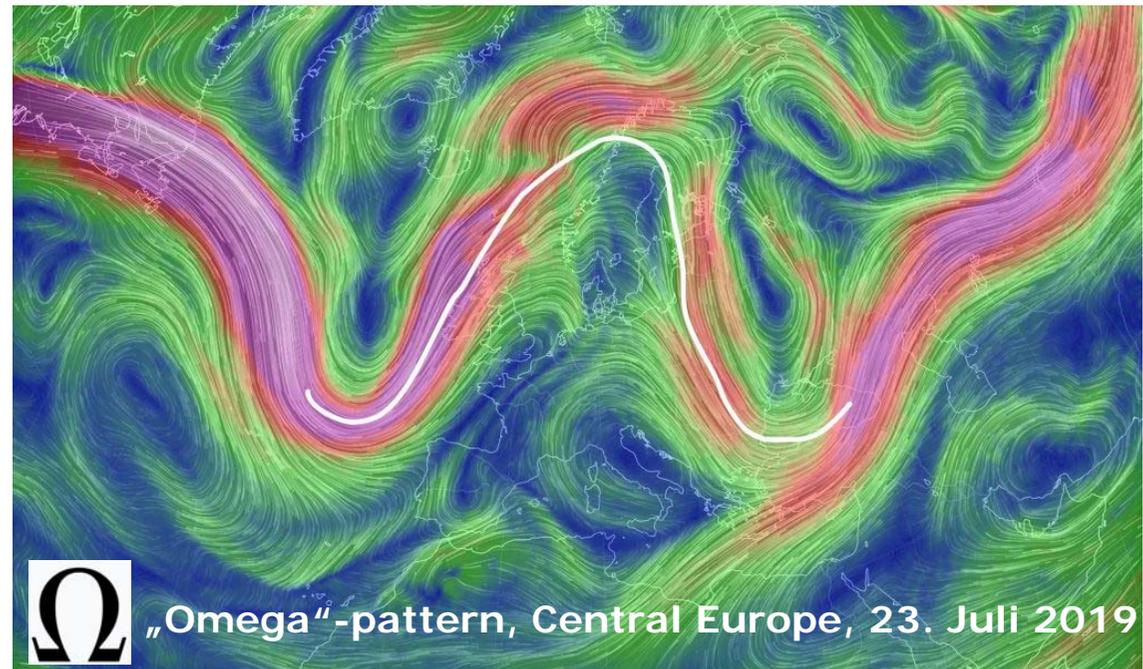


Fig.: Earth Simulator – earth.nullschool.net

TERENO Workshop: The drought year 2018 - Insights from the TERENO Observatories

This year's TERENO workshop deals with the drought year 2018.

When: 11.-13. Sep 2019, 09:00 - 16:00

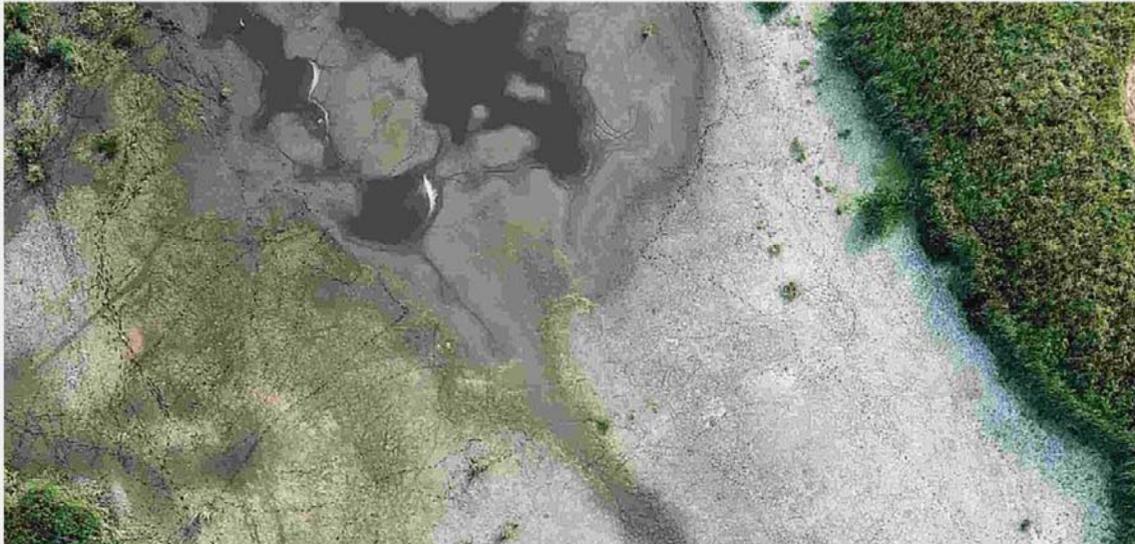
Where: GFZ Campus Telegrafenberg Potsdam, building H, lecture hall H

Who: Dr. Ingo Heinrich, Coordinator TERENO Northeast

Save appointment

Here you can download the date as ics format

(ics-Format can be imported from all common calendars)



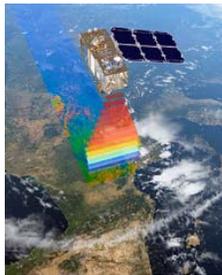
TERENO (Foto: M. Zöllner, GFZ).

Regional Impact of the Extreme Year 2018

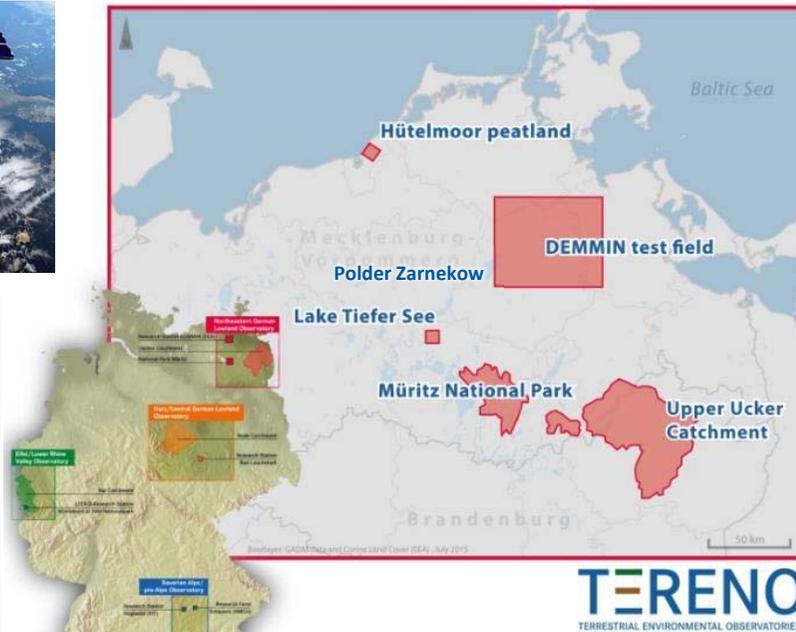
TERENO NE German Lowland Observatory

Regional set of laboratories in the temperate lowlands:

Remote sensing



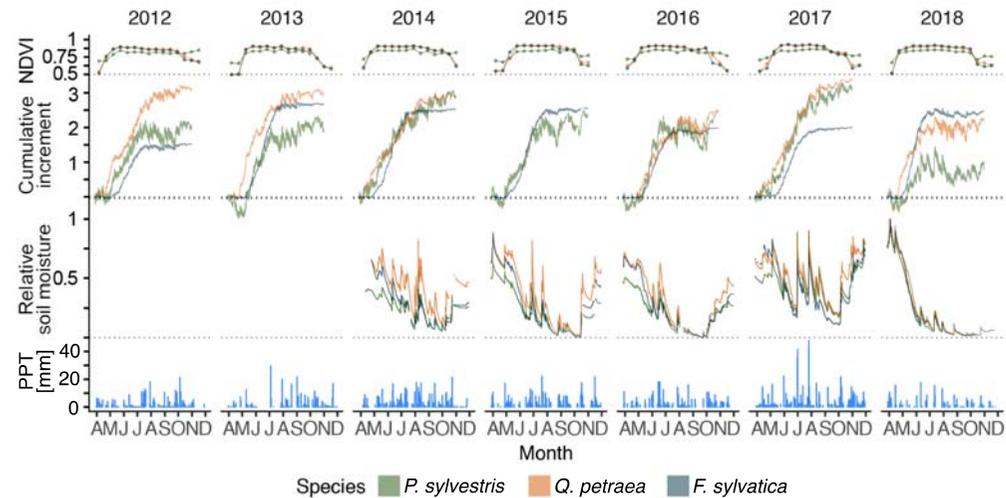
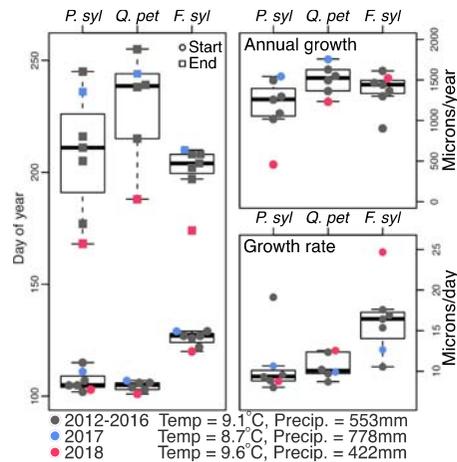
Proxy Data



Monitoring



The Year 2018 – Tree growth in Müritz N.P.



Balanzategui et al, in prep

Annual tree growth:

Strong decline in pine and oak, average growth of beech

Growth Period:

Shorter for all species, most extreme for oak and beech

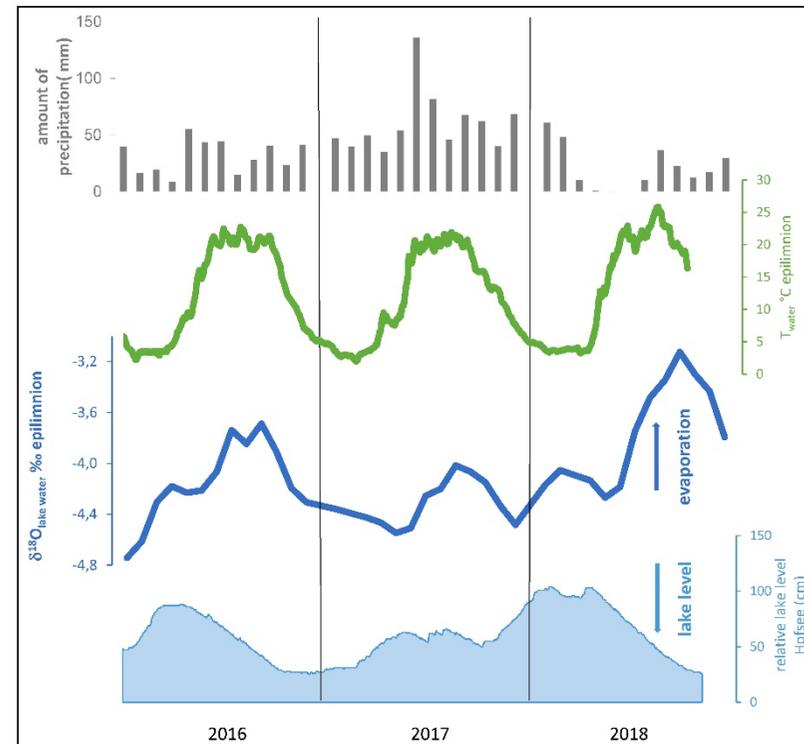
Growth Rate:

Beech compensated reduced growth period by enhanced growth rate

More details later by
our PhD student
Daniel Balanzategui

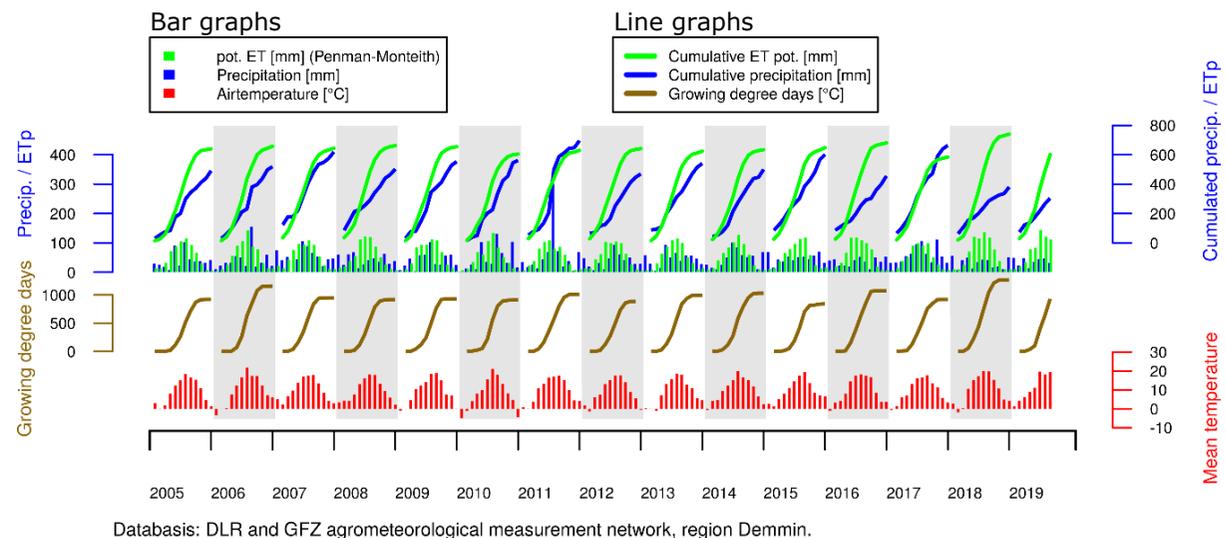
The year 2018 – Monitoring of Lake Tiefer See

- Comparison of 2016 – average year – with wet year 2017 and dry year 2018
- Less precipitation in 2018, water temperatures several degrees higher
- High oxygen isotope values ($\delta^{18}\text{O}$)
- Corresponds with high evaporation loss and correlates with the decrease of the lake level by about 80 cm
- Extreme year 2018: interesting situation for TERENO monitoring
- Improved understanding of processes as necessary basis for improved climate reconstructions



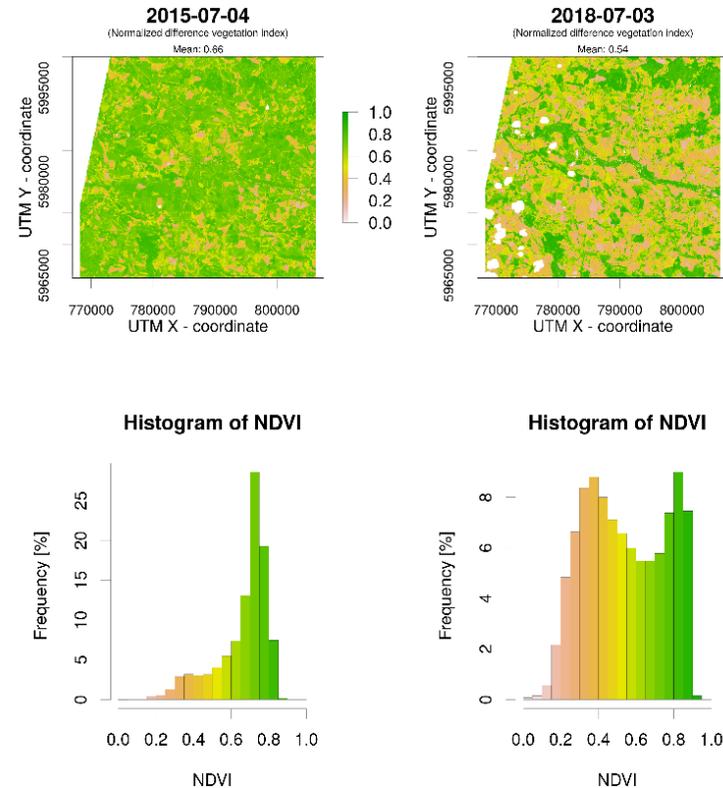
The Year 2018 – View from Space

- Mean values of temperature, evaporation and growing days at TERENO site DEMMIN (43 climate stations!) for the period 2005 to 2018
- 2018 driest (380mm) and hottest year (temperature sum 1263 °C)
- In contrast, 2015 wet and 2017 cool:
 - temperature sums of only 852 °C in 2015
 - precipitation of 712 mm in 2017



The Year 2018 – View from Space

- NDVI (vegetation index) map for TERENO site DEMMIN at acquisition dates 4 July 2015 (left) und 3 July 2018 (right)
- Indicator for the vitality of vegetation: high vitality in 2015, low vitality in 2018
- Histogram: one peak in 2015, two peaks in 2018
- 2018: Early harvest at many sites (e.g., barley already in July), in contrast to 2015
- Results/experience from DEMMIN as solid basis for projects to improve agriculture, e.g, AgriFusion, JECAM and CoolFarm

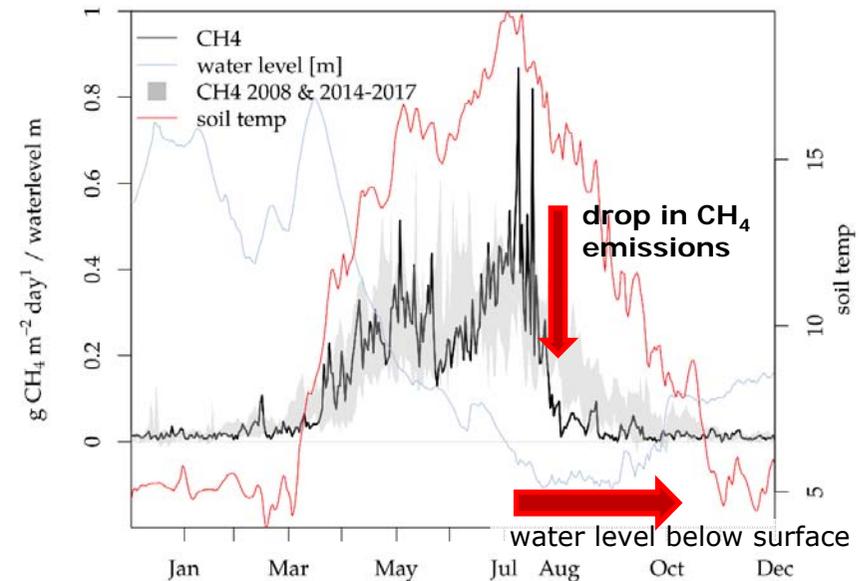
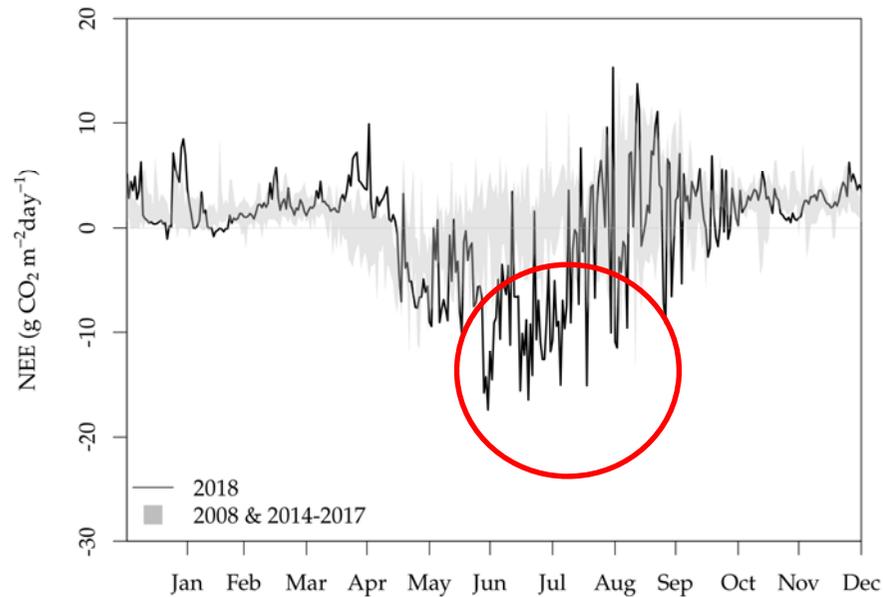


The Year 2018 – Impacts on Northern Wetlands Polder Zarnekow



- Water level below surface from August to October

2018 Drought – CO₂ & CH₄ Fluxes



- Relatively high CO₂ uptake during growing season 2018
- probably result of massive biomass increase by expanding vegetation
→ triggered by dry year 2016? → temporal drying may enhance vegetation growth

Drought-inflicted wetlands as a natural microbial laboratory



Fotos: V. Unger, 2018



| | Methane oxidizers |
|------------------------------------|----------------------------------|
| Pre drought total population size | $4.1 \times 10^7 \text{ g}^{-1}$ |
| Post drought total population size | $2.7 \times 10^7 \text{ g}^{-1}$ |
| % community pre drought | 0.05 |
| % community post drought | 1.3 |

- Large shift in microbial community structure in response to drought
- High responsiveness in particular of methane oxidizers despite relatively stable population size

Conclusions (1)

The year 2018 has left “deep traces” in the landscape of Northeastern Germany:

- ⇒ Many **forest fires**
- ⇒ **Wetlands fell dry**, with unknown consequences for microbial communities and gas exchange
- ⇒ **Tree growth declined significantly** in **oak** and **pine**, but beech could partly compensate via enhanced growth rate

Conclusions (2)

- Extreme years (e.g. 2018) present unique opportunities to analyze regional impacts of climate change
- Improved co-operations between TERENO, MOSES, ESM, DigEarth and other research activities are needed to further advance our understanding of system Earth
- From these findings, options for improved adaptation strategies to climate change and landscape change will be developed

More on TERENO Northeast

- in the current issue of

systemerde.gfz-potsdam.de



Welcome,
Thank You
And
Good Luck for the Workshop