

Potential Impacts of anthropogenic forcing on the consecutive 2018-19 droughts in the central Europe

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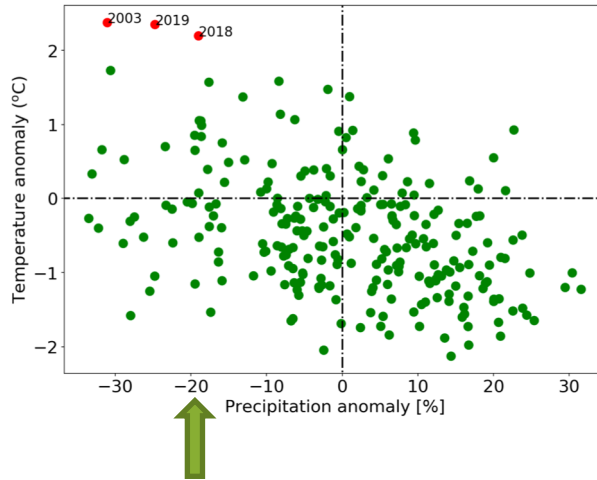
eXtreme EuRopean drOughtS:
multimodel synthesis of past,
present and future events

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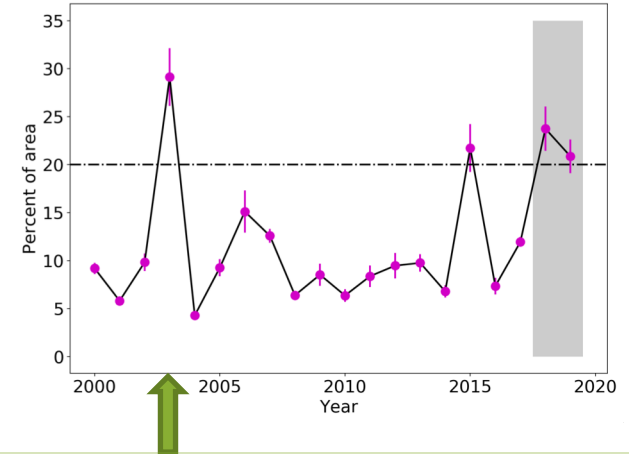
- Human-induced climate change is evident and it poses a great concern to society, primarily due to its potential to intensify extreme events around the globe (Pall et al., 2011; Min et al., 2011).
- The damages caused by climate extremes to socio-economy and environment is unprecedented during the recent decades, and it causes even more damage when the climate extremes occur in consecutive years.
- In the past two decades, Europe experienced an increased frequency of droughts (Ciais et al., 2005) with estimated loss of about EUR 100 billion (Liu et al., 2020).
- One such devastating event was the drought in summer 2003, which was exceptionally warm and dry across most of central and western Europe.
- Although, the 2003 drought event was rare and exceptional, even in a multi-centennial time window, its likelihood is expected to increase in the near future (Barriopedro et al., 2011) mainly due to the anthropogenic warming (Samaniego et al., 2018).

Motivation



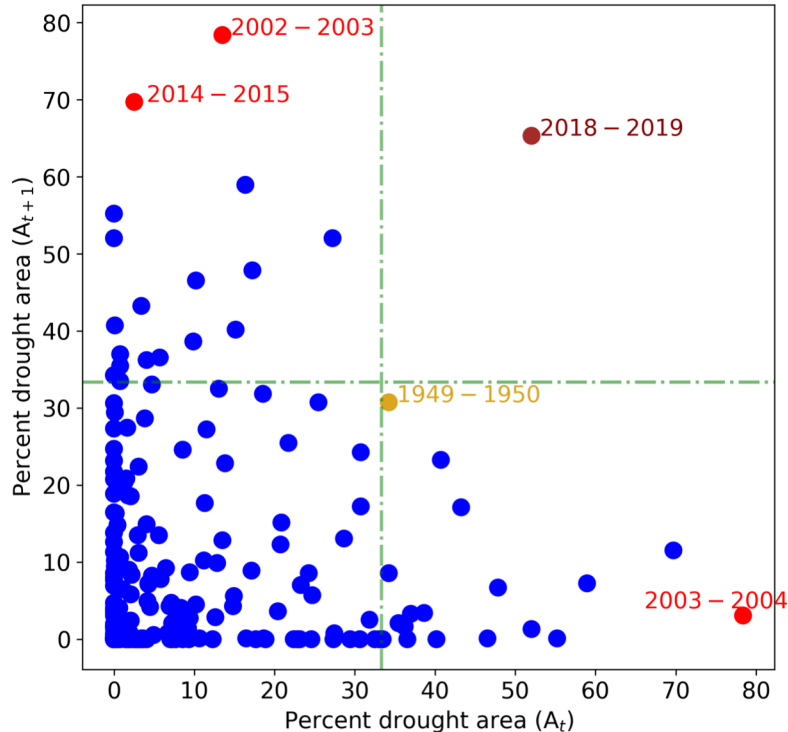
- The historical reconstruction of composite 254-year long-term climatic database shows that 2018–2019 were two out of the three warmest and driest summer periods (June–August).

Impact on Vegetation



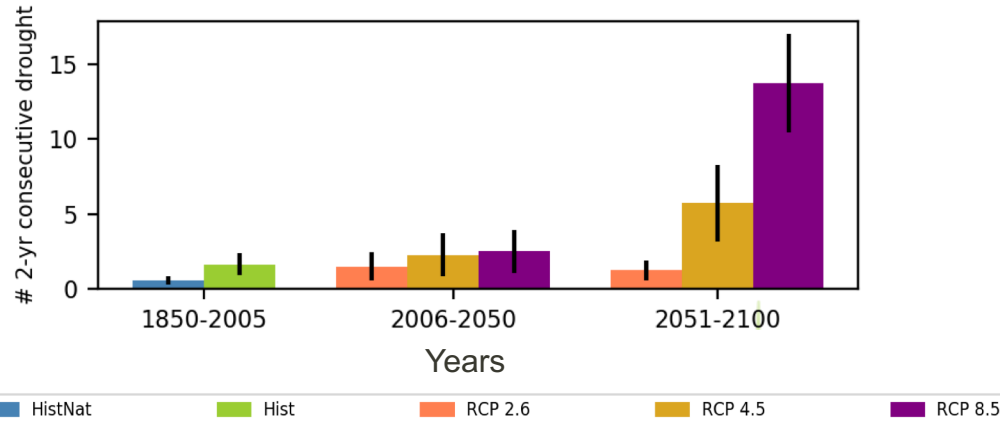
- Assessment of the vegetation stress over central Europe (in terms of vegetation health index) shows impaired condition for vegetation activities in the summer of 2003.
- The vegetation health recovered and returned to its normal condition during the following year.
- On the contrary, the impact of the 2018 drought on vegetation activities propagated to 2019 and the recovery is still underway, as shown in the time series of VHI

Results



- The drought index based on the standardised precipitation evapotranspiration index (SPEI) was employed to account the joint effect of precipitation and temperature anomalies during 2018-19.
- We compute the areal extent of drought (A_t) with $SPEI \leq 0.1$ for a given year with the corresponding estimates for the next year (A_{t+1}).
- It is evident from the long-term observational record that the 2018-2019 drought is a record breaking event in terms of the consecutive 2-year event in the last 254 years, with nearly 50% of the Central European area being classified under the extreme drought conditions.

Results



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- In comparison to the simulations (N=12) based on natural-only forced simulations (HistNat), the occurrence of the 2-year consecutive drought event shows a slight increase in the historical simulations (Hist) during the common period of 1850-200.
- Climate model simulations based on the Representative Concentration Pathway (RCP) 8.5 scenario further indicates a strong increase in areas under drought towards the end of the 21st century.
- We find a seven-fold increase in the number of the 2-year consecutive drought events in RCP 8.5, covering at-least one third of Central European domain.
- Compared to the RCP 8.5 scenario, the number of 2-year consecutive droughts events reduces significantly by almost half under the RCP 4.5 scenario and to a very negligible number in RCP 2.6.

Conclusions

- The observational record suggests that the ongoing 2018-2019 European drought event is unprecedented in the last 250 years.
- Our analysis based on an ensemble of climate model simulations suggests a strong increase in the occurrence of such a rare event, post 2050 under RCP 8.5 scenario, as a result of anthropogenic warming.
- Further, the frequency and the areal extent of these droughts strongly depend on the level of anthropogenic warming scenarios (as encoded in RCPs).
- Our analysis also demonstrates that the occurrences of the consecutive droughts as well their impact can be significantly reduced, if the mitigation strategies leading to amendment of global warming are adopted.

Thank You!



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