Increasing compound warm spells and droughts during the growing season in the Mediterranean Basin

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Mediterranean Basin: a particularly imperiled region

- Increasing number of droughts and heat waves and heavy precipitation events (Cramér et al. 2018)
- Future warming in the Mediterranean expected to exceed global rates by 20% (Lionello & Scarascia 2018)

→ Climate change Hot-Spot region (Giorgi 2006)

- Research questions:
  - Does the number of compound warm spells and droughts increase in the Mediterranean over the last 40 years?
  - Which months show the highest increase?
  - Which is the main component for increases of compound droughts and warm spells?
Data from ERA5 and study area

• Time Span: 1979 – 2018
• Spatial resolution: 0.25° x 0.25°
• Variables
  • Daily maximum 2m air temperature
  • Monthly Standardized Precipitation Index (SPI)
  • Monthly Standardised Precipitation-Evapotranspiration Index (SPEI)

• Study area
  • Köppen-Geiger categories Csa and Csb (Warm temperate climate with dry and hot / warm summer) within the Mediterranean Basin
Event coincidence analysis on compound warm spells and droughts

- Warm spells defined by *daily* maximum air temperature above the 90th percentile for a duration of at least 5 days
- Droughts defined by *monthly* Standardized Precipitation Index SPI < - 0.8
- Compound events termed as co-occurrence of warm spells and droughts
- Deseasonalisation for assessment of extremeness respective to the corresponding time of the year

Warm season compound events

- without deseasonalisation
  - May - Oct

Deseasonalised compound events

- with deseasonalisation
  - Jan - Dec
Development over time

**Significant increases** for both warm season and deseasonalised compound events over the last 40 years
Change in number of compound events for each month

- Peak in change of number of compound events in spring and early summer
  - Potential cause: Depletion of water resources earlier in the year caused by increased temperatures and associated ecosystem productivity (and thus transpiration) in spring
Proportion of events between 1979-1998 and 1999-2018 for warm spells and droughts

\[ E_{\text{prop}} = \frac{N_{99-18} - N_{79-98}}{N_{79-18}} \]

- \( N_{79-98}, N_{99-18} \) and \( N_{79-18} \) are the number of events occurring in the time spans 1979 - 1998, 1999 - 2018 and 1979 - 2018, respectively.
- Strong increases are observed in the number of warm spells, whereas SPI droughts remain mostly constant.
Main findings

• **Significant increases** in the **number** of compound warm spells and droughts in the Mediterranean Basin over the **last 40 years**

• **Increases** of deseasonalised compound warm spells and droughts especially occur **in spring (peak of growing season)** with potentially harmful effects on ecosystems and agriculture

• **Increase in temperature** and **not decline in precipitation** is the **main driver** for these changes
References

