Temporal and spatial variability of convective predisposition across Europe and most relevant drivers

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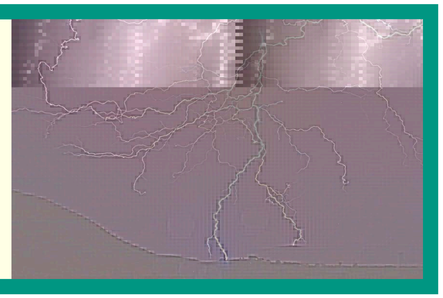
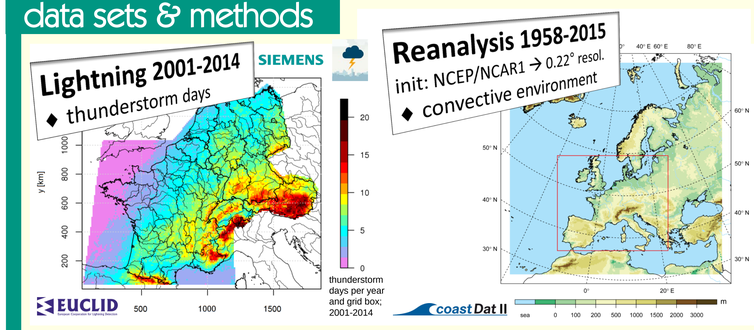
overview

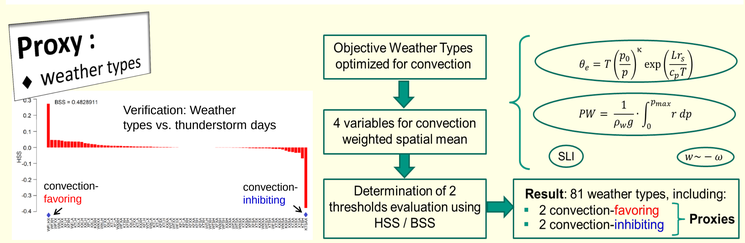
Due to the lack of consistent long-term information about convective storm occurrence in Europe, a novel **weather type classification scheme** has been developed with the objective to investigate the spatiotemporal variability of convective predisposition in high-resolution reanalysis data. Time series of weather patterns favoring large-scale convective activity show positive trends in only a few regions.

Furthermore, the crucial role of large-scale flow is studied by assessing the impact of **teleconnection** patterns on the occurrence of convective events. It is found that convective activity in several locations is controlled by low-frequency modes of the climate system such as North Atlantic Oscillation (NAO) or East Atlantic pattern (EA), but also by sea surface temperature (SST), leading to a large annual and multi-annual variability of convective days.

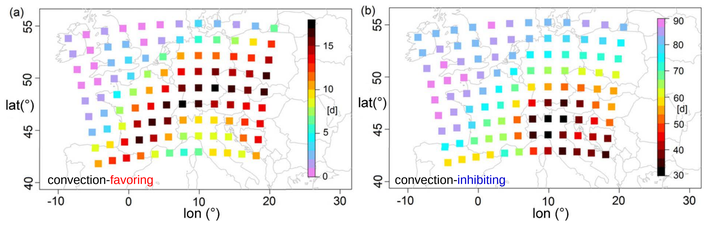


data sets & methods



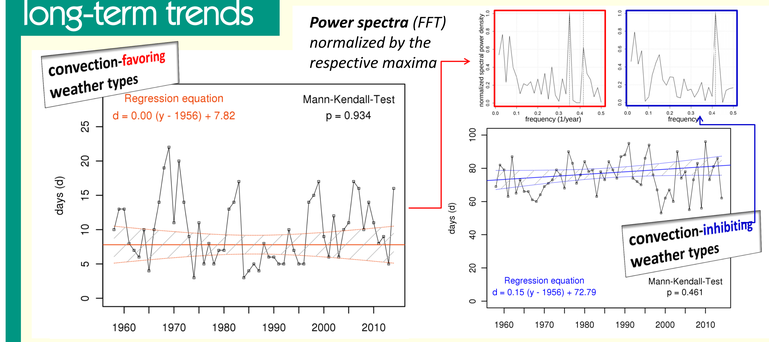


Examples: convection-favoring **W – M – U – A** (warm – moist – unstable – ascend; 6% of all days) convection-inhibiting **C – D – S – D** (cold – dry – stable – descend)

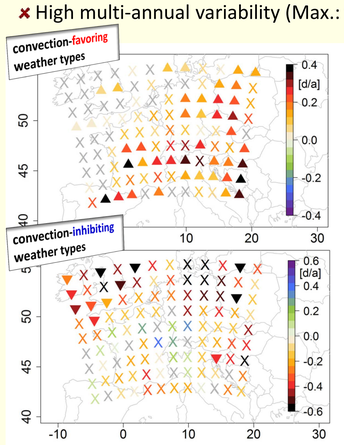


Mean annual frequency (days) of convection-favoring (e.g., WMUA; a) and convection-inhibiting (e.g., CDSD; b) conditions (1958-2015).

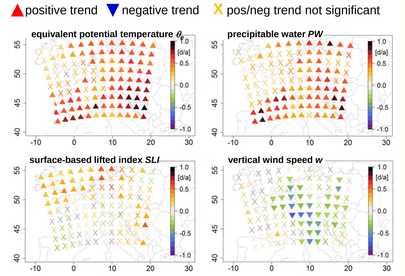
long-term trends



- Time series of convection-favoring and –inhibiting weather patterns do not show a trend during 1958-2014 (mean over the investigation area; robust regression + trend-free prewhitening; confidence intervals from bootstrap).
- High multi-annual variability (Max.: ~ 3 years for convection-favoring patterns).



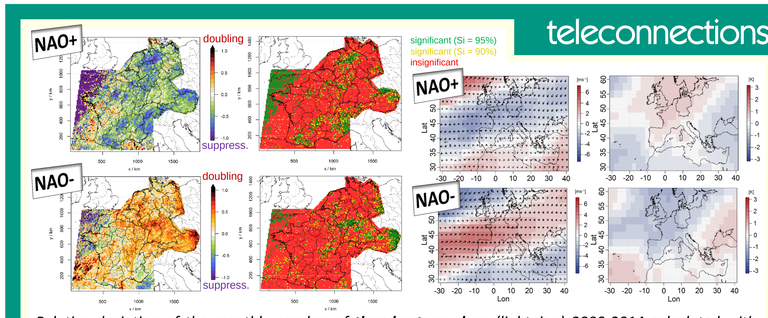
- Trends of weather patterns differ substantially between the regions.
- Positive trends for thermodynamic parameters, negative trends for lifting.



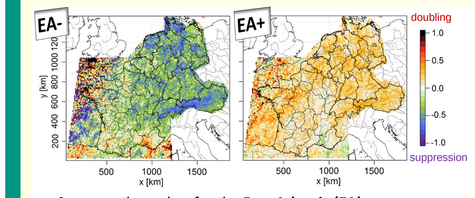
*Regional trends of convection-favoring (top) and –inhibiting (bottom) **weather patterns** during the 30-years period **1985-2014**.*

*Regional trends of **atmospheric variables** defining the weather patterns during the 30-years period **1985-2014**.*

teleconnections

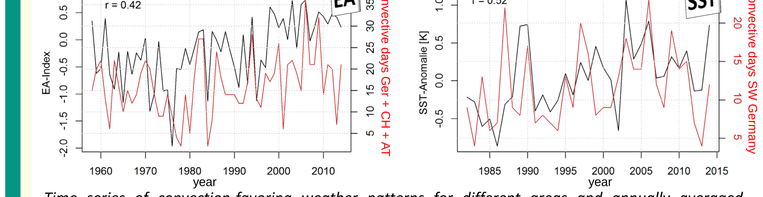


*Relative deviation of the monthly number of **thunderstorm days** (lightning) 2000-2014 calculated with respect to months with an **North Atlantic Oscillation (NAO)** index greater than +1 (NAO+) and less than -1 (NAO-) with respect to all months (left) and results from a bootstrap significance test (left panel); anomalies of **zonal velocity** at 300 hPa and **equivalent potential temperature** at 850 hPa (right panel).*



*Same as above, but for the **East Atlantic (EA)** pattern.*

- Increased convective activity during negative NAO, positive EA, negative SCAND-patterns.
- Several simultaneous peaks in the time series of EA/SST and days with convection-favoring conditions.



Time series of convection-favoring weather patterns for different areas and annually averaged EA-Index (left) and sea surface temperature (SST) over the Bay of Biscay (right).

main conclusions

- No trend in convective weather patterns (1958-2014);
- Trends of convection-favoring conditions differ substantially on the regional scale;
- Most regions feature positive trends for thermodynamic and negative trends for dynamic quantities;
- Large-scale teleconnections (e.g., NOA, EA) substantially impact local-scale convective activity.

references

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