

Predictability of temperature extremes in Europe and biases in Rossby wave amplitude

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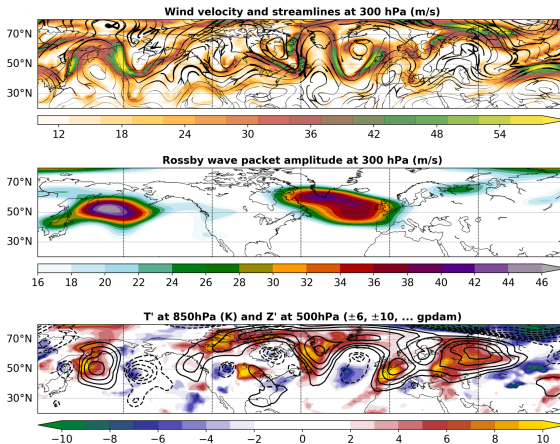
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Motivation:

- ▶ The midlatitude upper-tropospheric flow tends to organize in eastward-propagating Rossby wave packets (RWPs) [1]. Recent studies have documented their role in European temperature extremes [1–5].



Synoptic-scale view of 23/08/2016 - 1200UTC (ERA5).

Objectives:

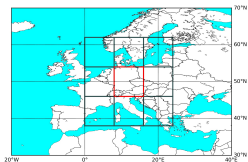
- ▶ Examine medium-range predictability of European persistent temperature extremes in 40 years of reforecasts.
- ▶ Detect biases in Rossby wave amplitude and assess their role in the predictability of persistent temperature extremes.

Data:

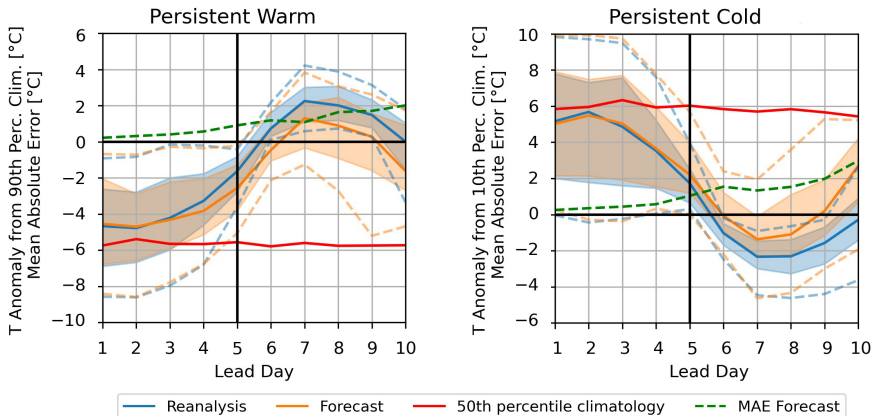
- ▶ 1979–2019 v at 300hPa and T at 850hPa in:
 - ERA5 reanalysis ($2^\circ \times 2^\circ$, 12-hourly)
 - ERA5 reforecasts ($2^\circ \times 2^\circ$, issued daily at 00 UTC, 12-hourly lead times up to 10 days)

Methodology:

- ▶ Identify persistent (≥ 4 days) temperature extreme events. Warm (cold) extremes denotes days when area-averaged 850hPa T $\geq 90\%$ ($\leq 10\%$)
- ▶ Evaluate the Gilbert Skill Score and Mean Absolute Error of reforecasts issued 5 days prior to the events' onset in each season.
- ▶ Quantify errors in Rossby wave amplitude prior and during the events. Assess whether they are systematic (i.e., biases) or specific to the events.



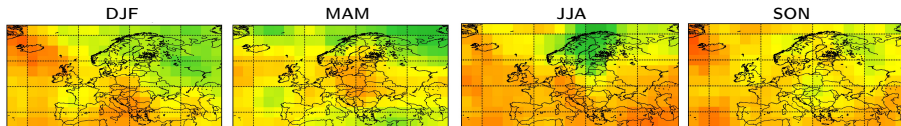
Area-averaged 850hPa T evolution in reanalysis and reforecasts (Central Europe; all seasons)



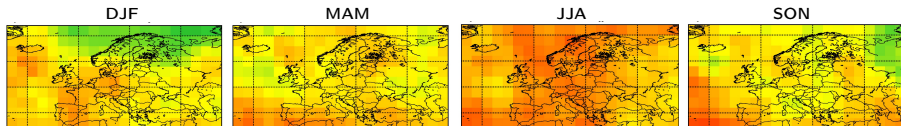
Doensen et al. (in prep.)

Seasonal and regional variability of Gilbert Skill Scores

Persistent warm extremes



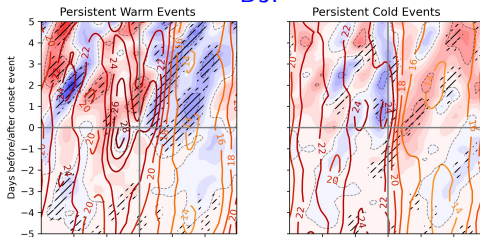
Persistent cold extremes



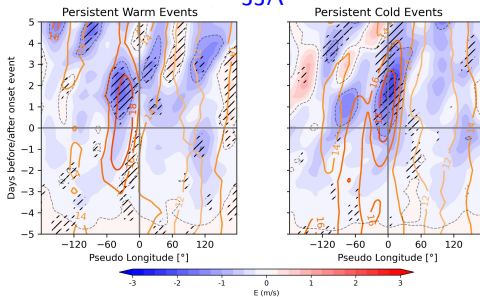
Doensen et al. (in prep.)

Composite Hovmöller diagrams of Rossby wave amplitude and its error

DJF

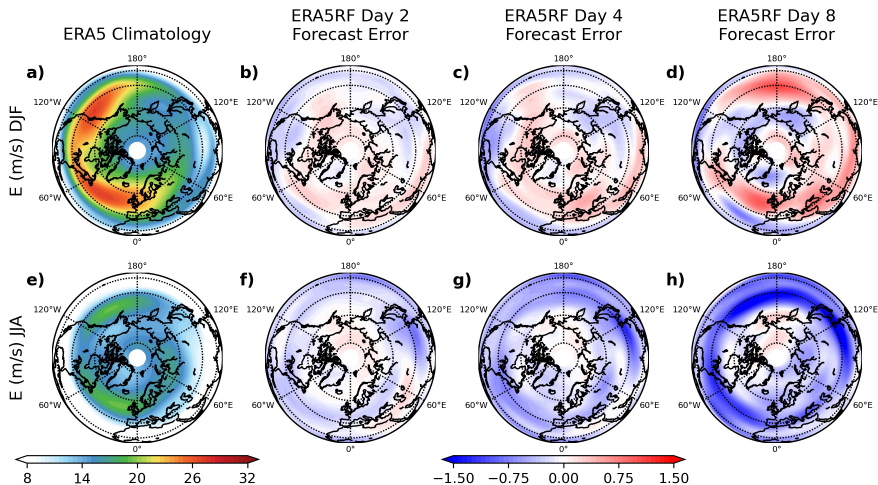


JJA



Doensen et al. (in prep.)

Rossby wave amplitude bias in DJF and JJA



Doensen et al. (in prep.)

Key outcomes:

- ▶ Seasonal and regional variability emerges in Gilbert Skill Scores of persistent temperature extremes in Europe. Lowest predictability is found in JJA cold extremes.
- ▶ JJA extremes are associated with underestimation of RWP amplitude. Less consistent error in DJF.
- ▶ Distinctly different biases grow with lead time in DJF and JJA that plausibly contribute to the observed GSS values. The underestimation in JJA is rather uniform.

Thank you!

References:

- [1] Wirth, Riemer, Chang, and Martius, 2018: Rossby Wave Packets on the Midlatitude Waveguide — A Review, *Mon. Wea. Rev.*, <https://doi.org/10.1175/MWR-D-16-0483.1>.
- [2] Zschenderlein, Fragkoulidis, Fink, and Wirth, 2018: Large-scale Rossby wave and synoptic-scale dynamic analyses of the unusually late 2016 heatwave over Europe, *Weather*, <https://doi.org/10.1002/wea.3278>.
- [3] Fragkoulidis, Wirth, Bossmann, and Fink, 2018: Linking Northern Hemisphere temperature extremes to Rossby wave packets, *Quart. J. Roy. Meteor. Soc.*, <https://doi.org/10.1002/qj.3228>.
- [4] Fragkoulidis and Wirth, 2020: Local Rossby wave packet amplitude, phase speed, and group velocity: Seasonal variability and their role in temperature extremes, *J. Climate*, <https://doi.org/10.1175/JCLI-D-19-0377.1>.
- [5] Grazzini, Fragkoulidis, Teubler, Wirth, and Craig, 2020: Extreme precipitation events over northern-Italy. Part II: Dynamical precursors, *Quart. J. Roy. Meteor. Soc.*, <https://doi.org/10.1002/qj.3969>.