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Stratospheric influence on the extended-range predictability of the Eurasian cold spells

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SCREEN CAPTURE
WELCOME

Synoptic analysis of cold spells in ERA5

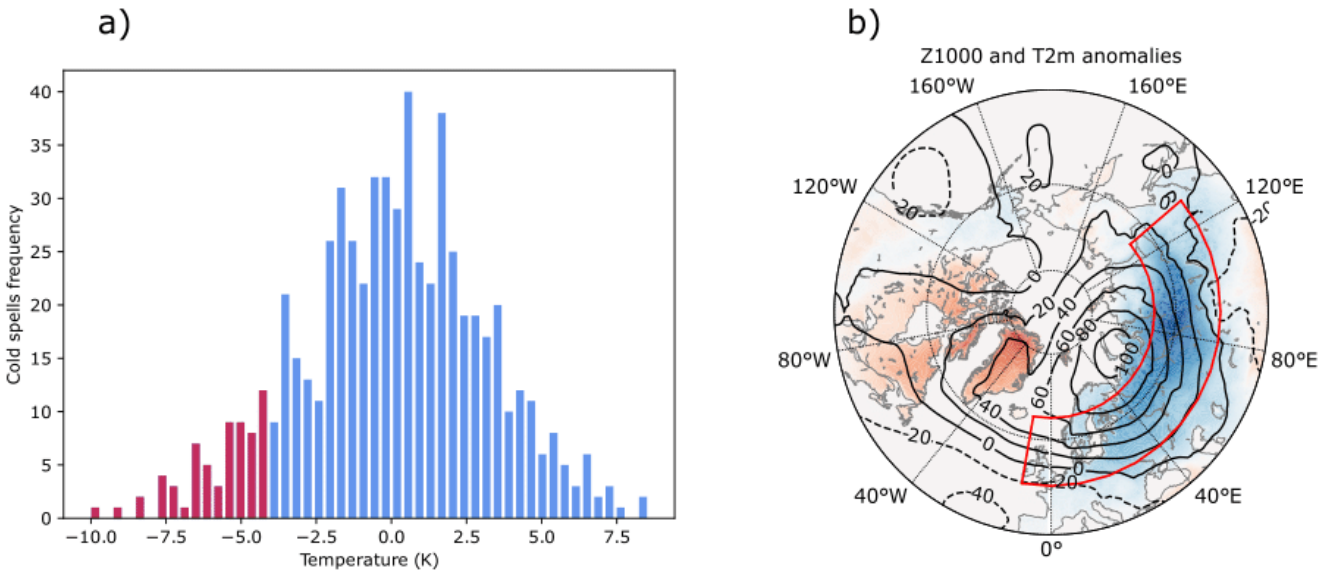

Figure 1. (a) Histogram of weekly averaged surface temperatures T2m over Eurasia in ERA5; (b) composite of observed 2-m temperature anomalies (T2m, shading) weekly averaged for all detected cold spell events, the red box shows the cold spell area in Eurasia

Two composites:

- 15 cold spell events after weak polar vortex (WPV)
- 15 cold spell events after strong polar vortex (SPV)

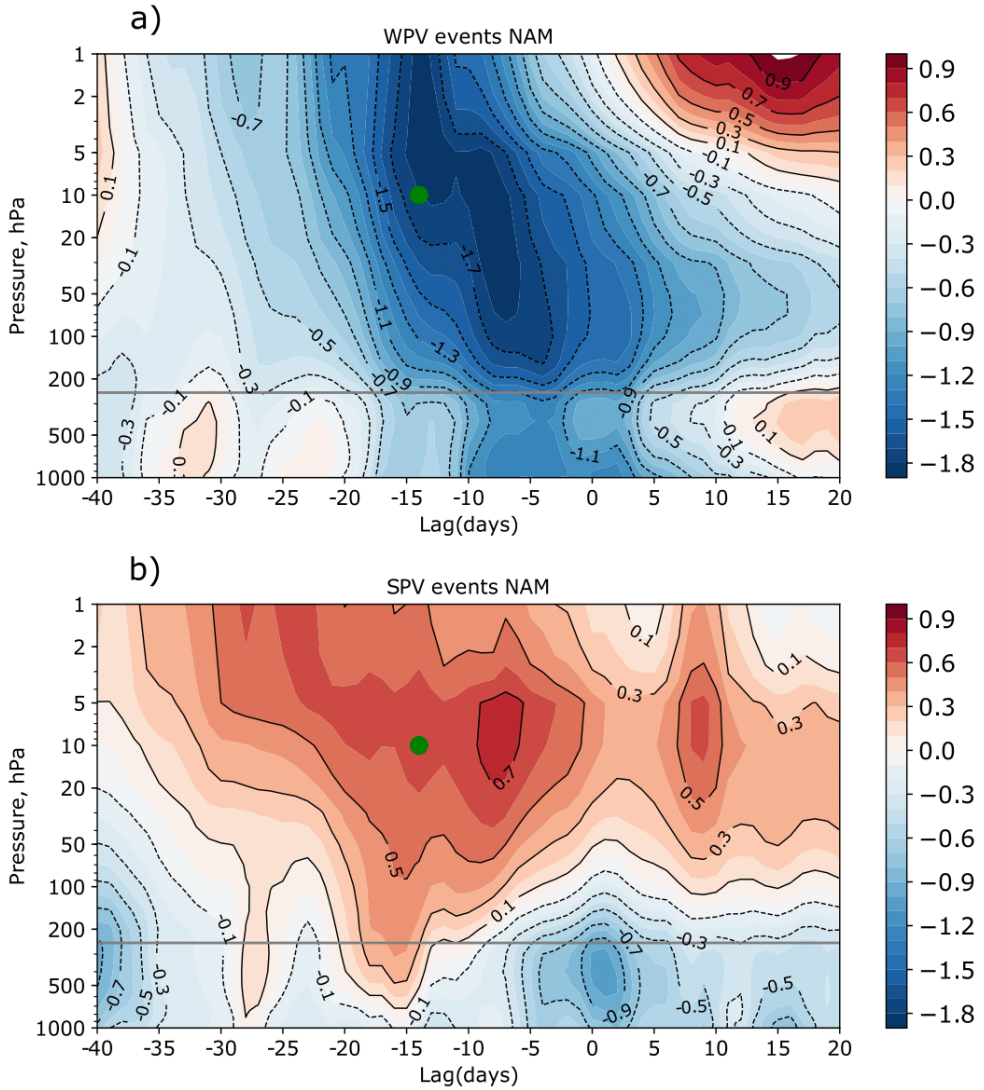

Figure 2. Lagged cross-sections of the NAM index composites in ERA5 (in standard deviation units) for cold spells preceded by the WPV (a) and by the SPV (b) events.

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Predictability of the Eurasian cold spells in the ECMWF hindcasts

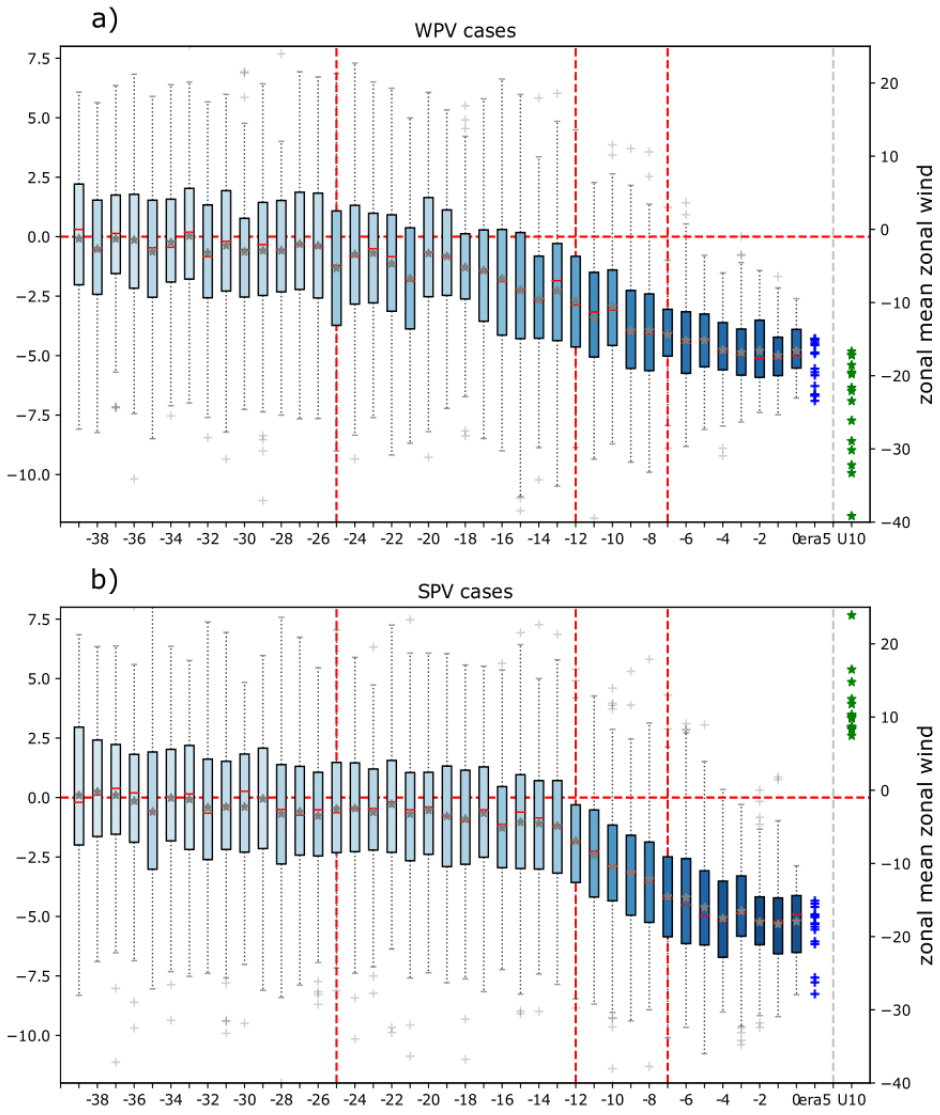


Figure 3. Boxplots of the Eurasian T2m anomaly (K) for different initialization lags of the ECMWF hindcasts for the (a) WPV cases and (b) SPV cases (1995-2020). The intensity of the blue color of boxes shows how fast the boxes become colder. The blue crosses show the ERA5 T2m anomaly (K) for the 30 cold spells cases, while the green stars show the preceding U10 (m/s).

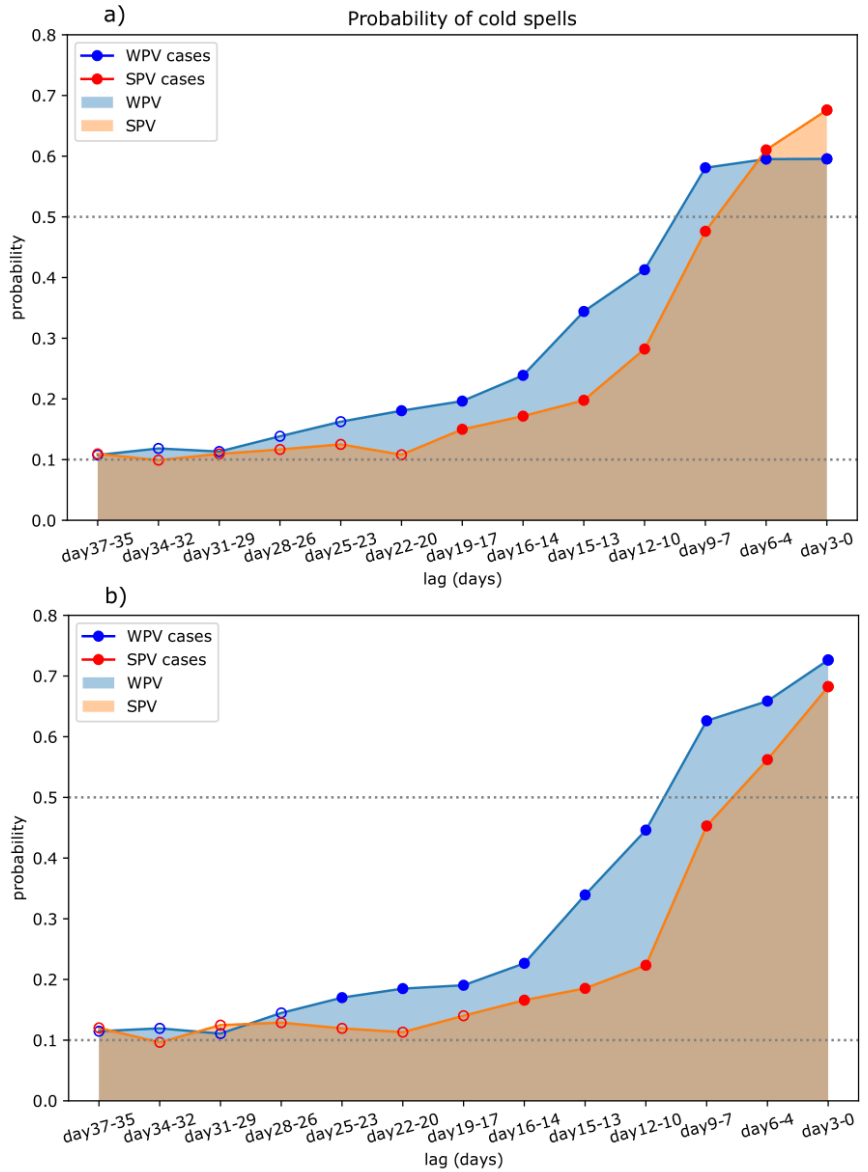
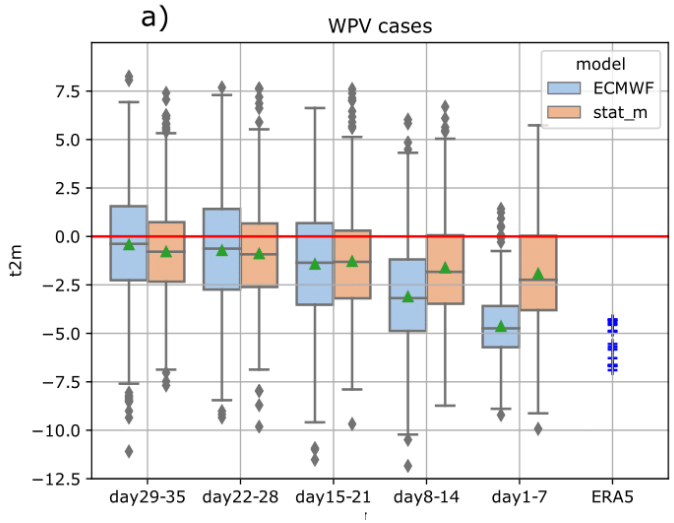
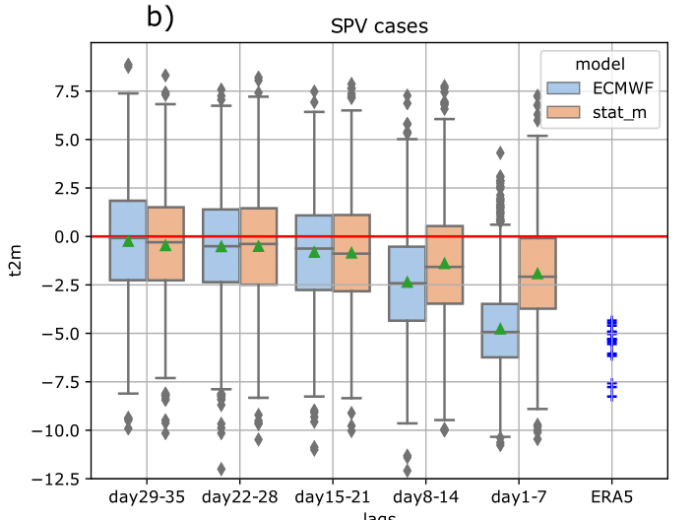


Figure 4. (a) Probability of cold spell events as a function of lead time of the ECMWF hindcasts averaged by three days.

Comparison with a statistical model





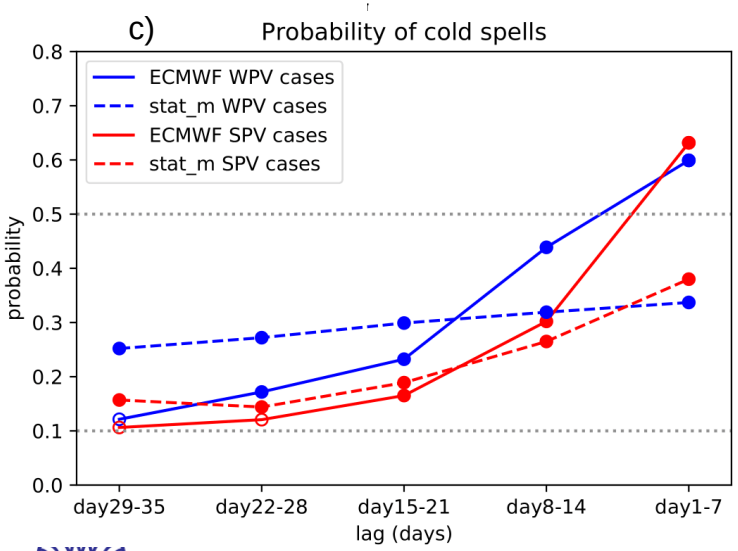


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Figure 5. Boxplots of the weekly averaged Eurasian T2m anomaly (K) for different initialization lags for the (a) WPV cases and (b) SPV cases. The boxes are grouped side to side to show the results for the ECMWF hindcasts and the statistical model forecasts. (c) Probability of cold spell events as a function of lead time for both models averaged by seven days.

Conclusions

- predicted probability of extreme cold spells that take place after the weakening of the stratospheric polar vortex is systematically higher by 0.05–0.15 than that in the cases with a strong vortex
- this translates into extension of probabilistic predictability by up to 4–8 days
- extended predictability following stratosphere-troposphere coupling is an inherent property of the atmosphere which can be captured even by a simple linear model

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Thank you!