

# Myth of Complementarity: Spatiotemporal Variability of Solar and Wind Energy in Germany

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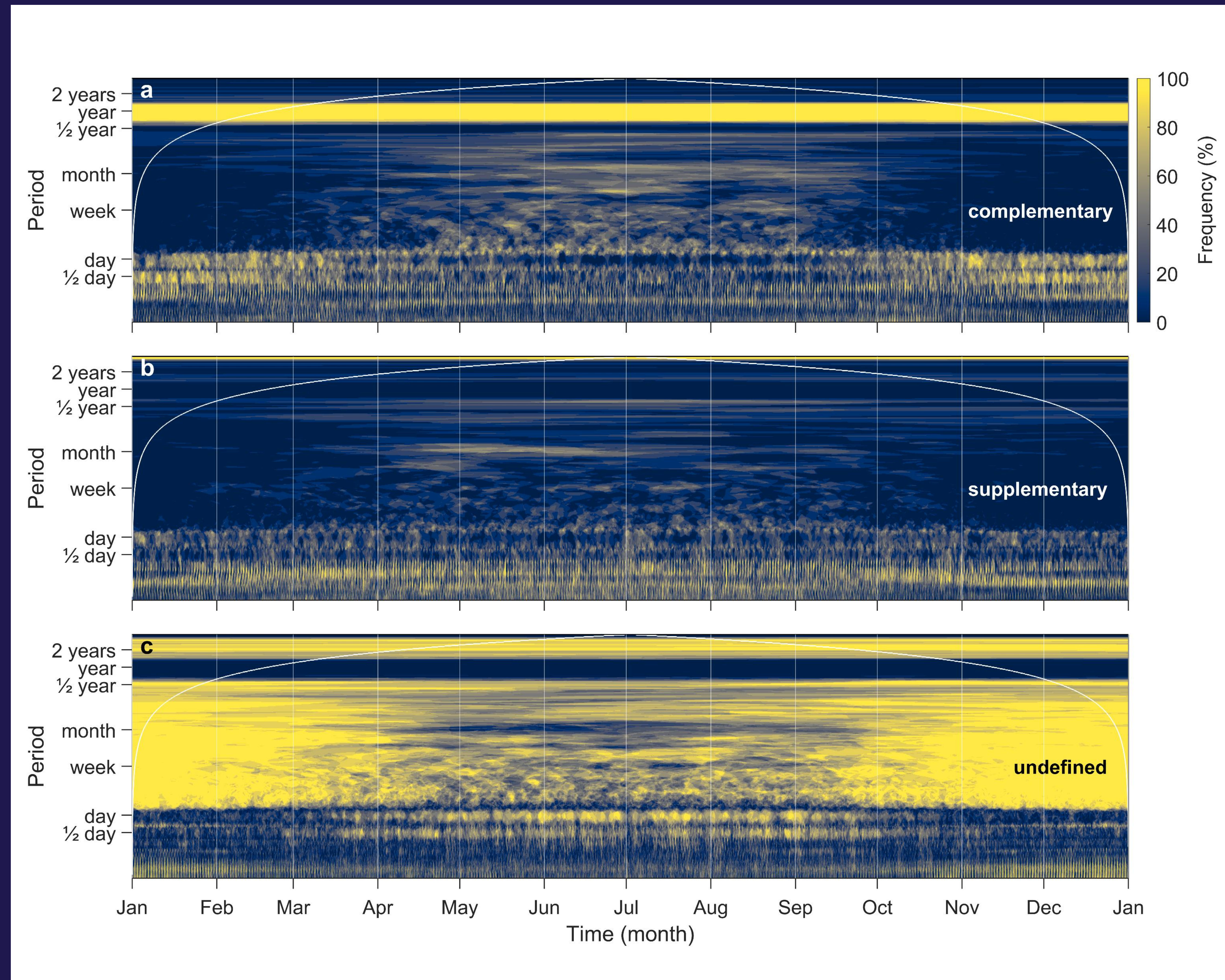
## Introduction

- Assessment of spatiotemporal wind-solar complementarity to optimize their hybrid use, stabilize their power feed-in, reduce grid congestion, and curtailment
- Time series decomposition and matrix factorization identify dominant wind & solar patterns
- Scale-specific analysis of complementarity is a prerequisite

## Methods

- Data from 2015-2024, Germany
- Modeled wind power data (Jung and Schindler, 2023)
- Satellite-measured solar data (Sander et al., 2023)
- Wavelet analysis (WA) & singular value decomposition (SVD) of hourly wind and solar data
- Consideration of time series phase and magnitude in the calculation of complementarity

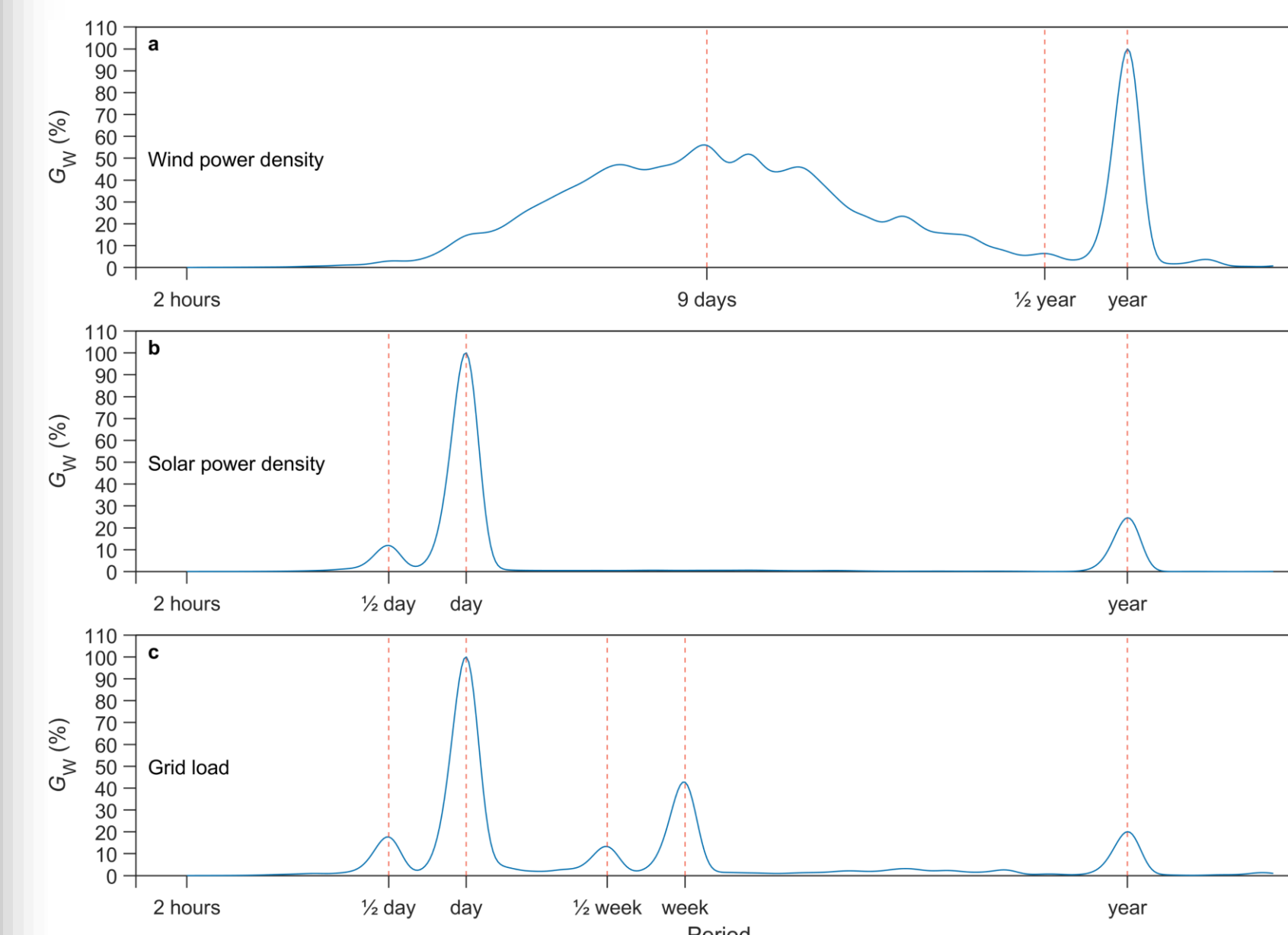
Wind and solar power exhibit strong temporal complementarity at the annual scale, while their complementarity is noticeably weaker at shorter time scales.



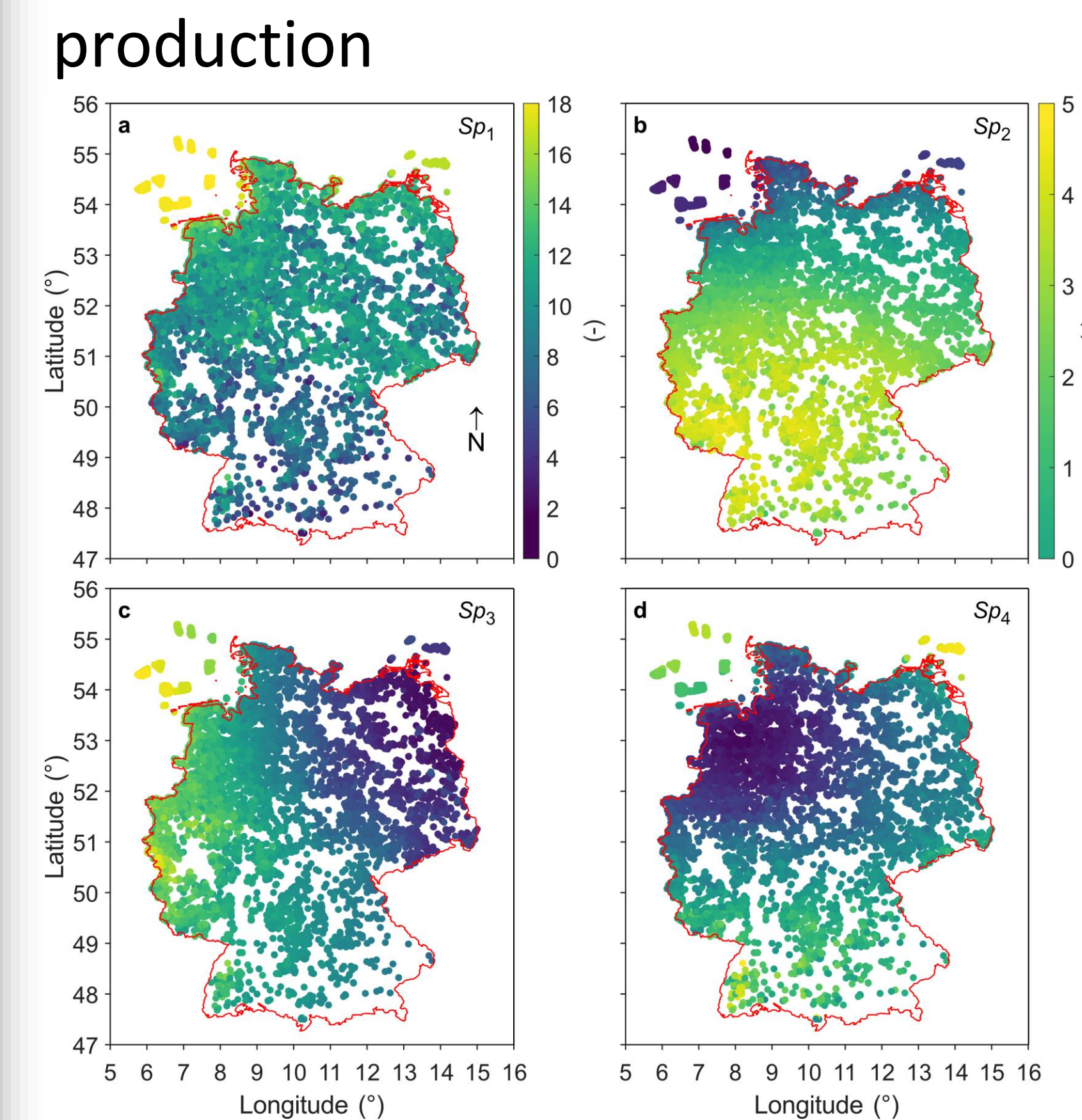
Download the poster

## More information

1 Global wavelet spectra ( $G_W$ ) highlight dominant time scales in wind, solar, and grid load data



2 Spatial patterns of four SVD components ( $Sp_1$ - $Sp_4$ ) highlight wind turbines sites that contribute the most to wind energy production



3 The combination of WA and SVD enables detailed spatio-temporal analysis of wind-solar complementarity

## References

- Jung, C.; Schindler, D. Introducing a new wind speed complementarity model. *Energy* 2023, 265, 126284. <https://doi.org/10.1016/j.energy.2022.126284>
- Sander, L.; Jung, C.; Schindler, D. New concept of renewable energy priority zones for efficient onshore wind and solar expansion. *Energy Convers. Manage.* 2023, 294, 117575. <https://doi.org/10.1016/j.enconman.2023.117575>