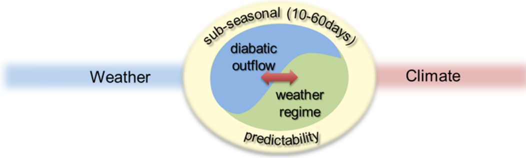

S2S / TIGGE Workshop ECMWF | April 2019

Stratospheric influences on subseasonal predictability of European energy-industry-relevant parameters

Dominik Büeler [1,2] / Remo Beerli [3,2], Heini Wernli [2], Christian M. Grams [1,2]

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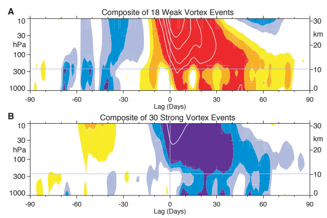
2) Institute for Atmospheric and Climate Science, ETH Zurich, Switzerland
3) AXPO Solutions AG, Switzerland

"The 'Beast from the East fails' to bite"
Alex Froley, Gas Market Analyst, 18 March 2019

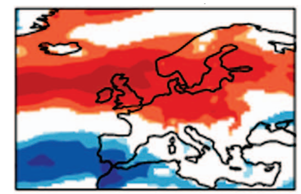
Motivation | **Polar vortex – weather regimes – wind power**

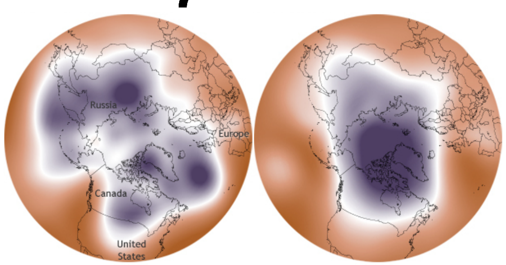
KIT Karlsruhe Institute of Technology

e.g., Baldwin & Dunkerton, 2001, SCI;
Tripathi et al., 2015, ERL;
Charlton-Perez et al., 2018, QJRMS

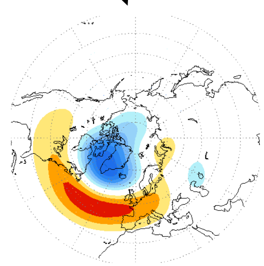


e.g., Clark et al., 2017, ERL;
Brayshaw et al., 2011, RE





NOAA

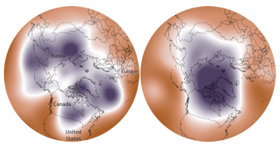


NOAA

EnergyWay

State of the **stratospheric polar vortex (SPV)** as a direct **source of subseasonal predictability** for **European energy industry**?

Data | Statistical forecast

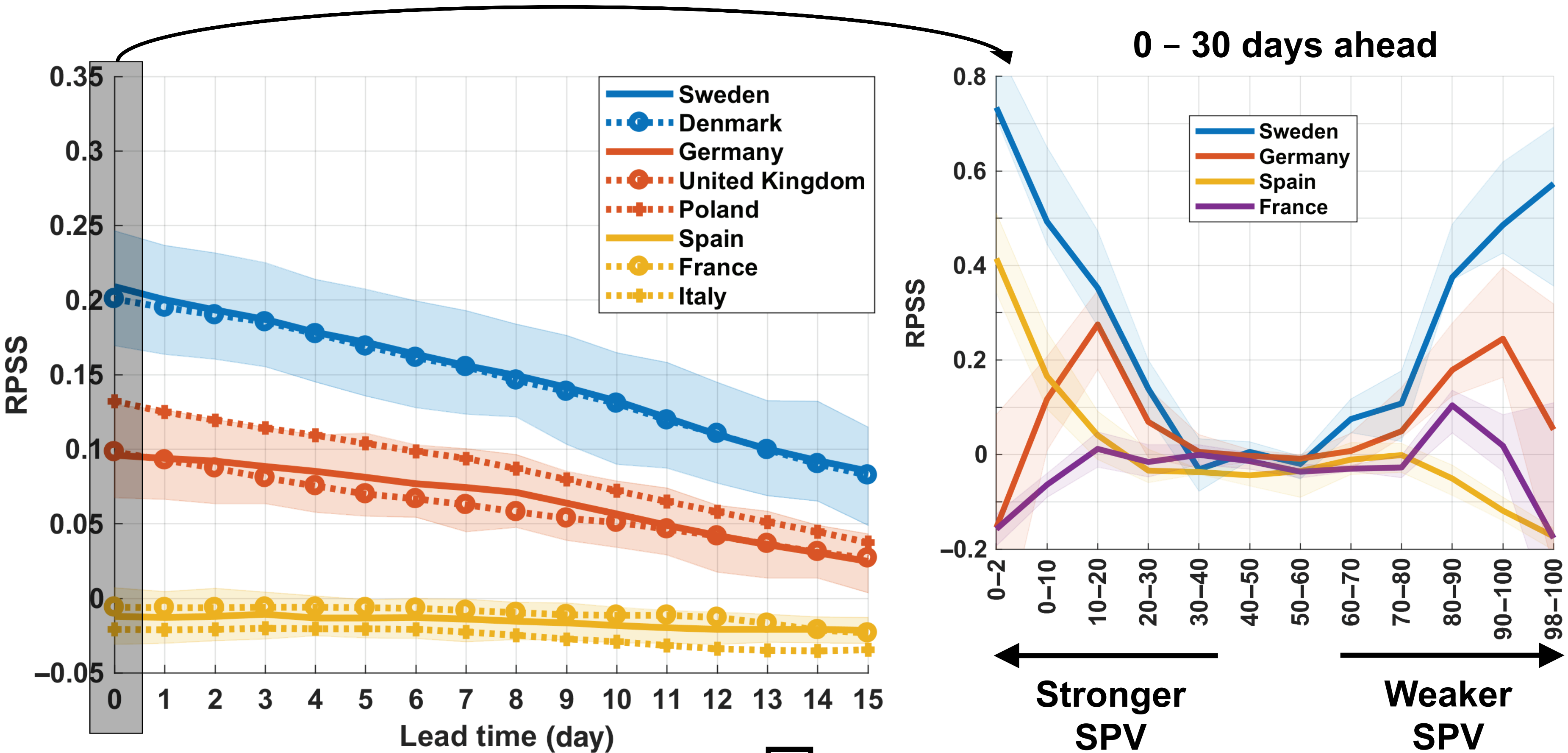


- **Strength of SPV**
  - $(\Delta Z@150hPa)_{60°\text{-}90°N}$ from ERA-Interim
  - **Daily**, DJF, 1985 – 2014

- **Wind power generation for every European country**
  - *Renewables.ninja* dataset (Staffel & Pfenninger, 2016, ENE; www.renewables.ninja)
  - **Daily month-ahead average**, DJF, 1985 – 2014

Beerli et al., 2017, QJRMS

Results | Simple 3-categorical statistical forecast



Beerli et al., 2017, QJRMS

How does this mechanism influence the
skill of subseasonal numerical weather models?

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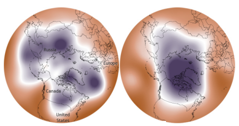
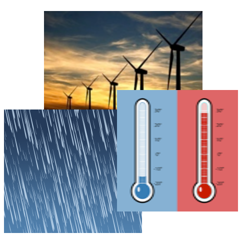
Data | Numerical forecast

- **Subseasonal ECMWF model** (www.s2sprediction.net)
  - 2 reforecasts / week, DJF, 1995 – 2017
  - 11 ensemble members

- **Fields calculated for each reforecast**



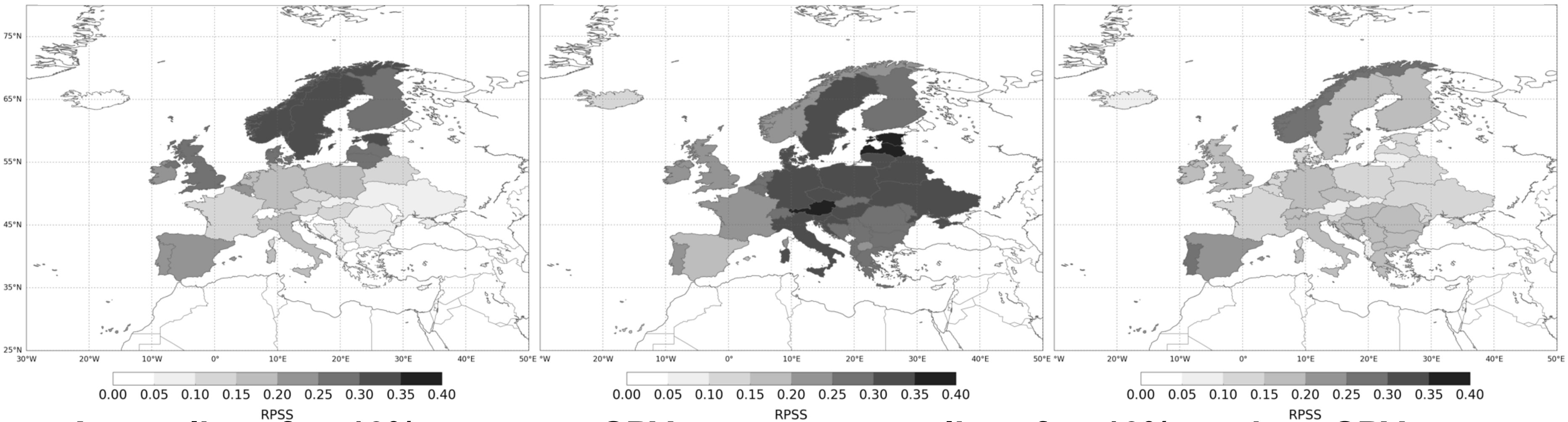
  - Strength of SPV = $(\Delta Z@100hPa)_{60°\text{-}90°N}$
  - **At forecast initial time**



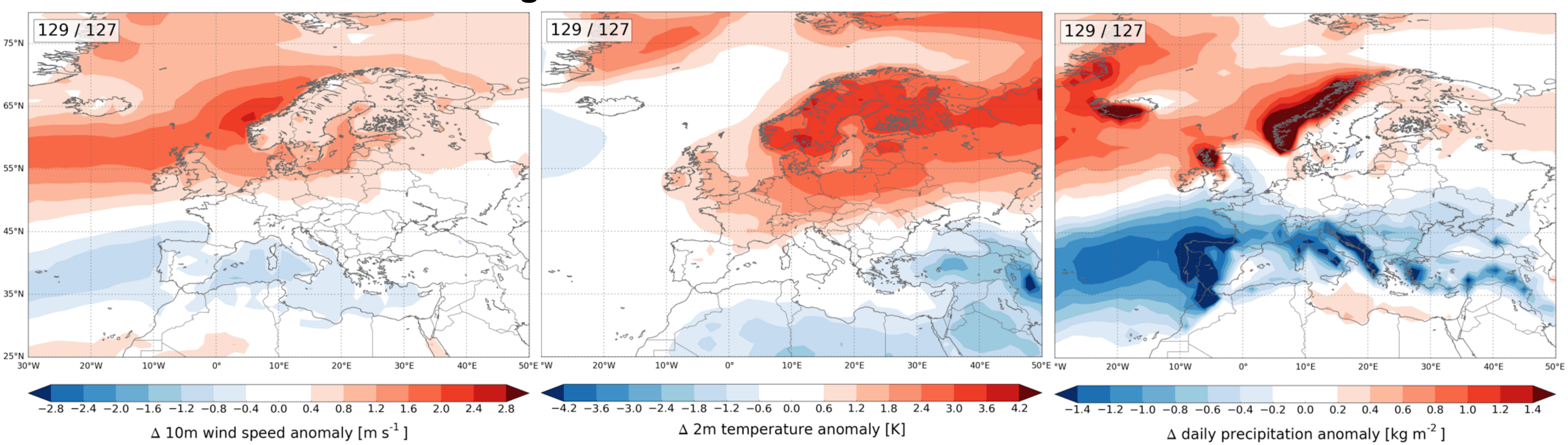
  - $(\Delta\ 10m\ wind)_{European\ Countries}$
  - $(\Delta\ 2m\ temperature)_{European\ Countries}$
  - $(\Delta\ precipitation)_{European\ Countries}$
  - **Average over 1 month lead time**

Results | Regional model skill pattern

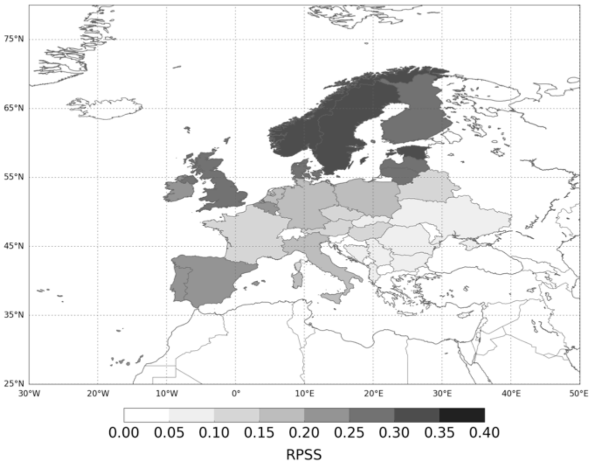
10m wind | 2m temperature | Precipitation

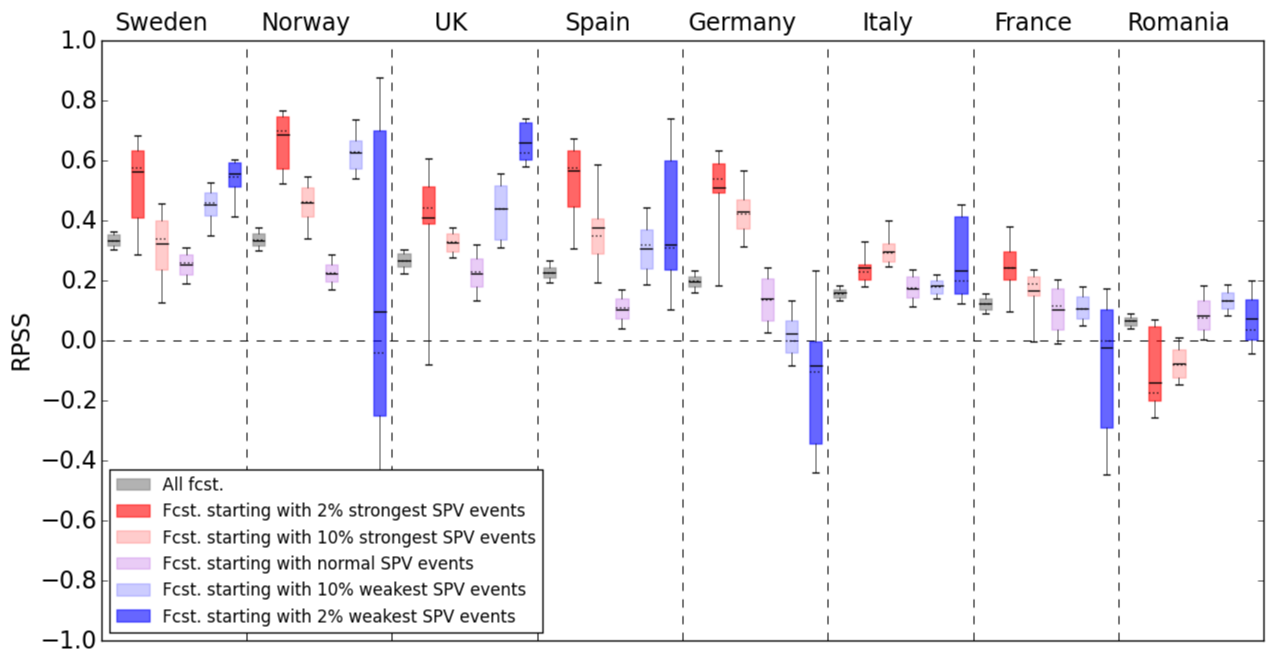


Anomalies after 10% strongest SPV states – anomalies after 10% weakest SPV states

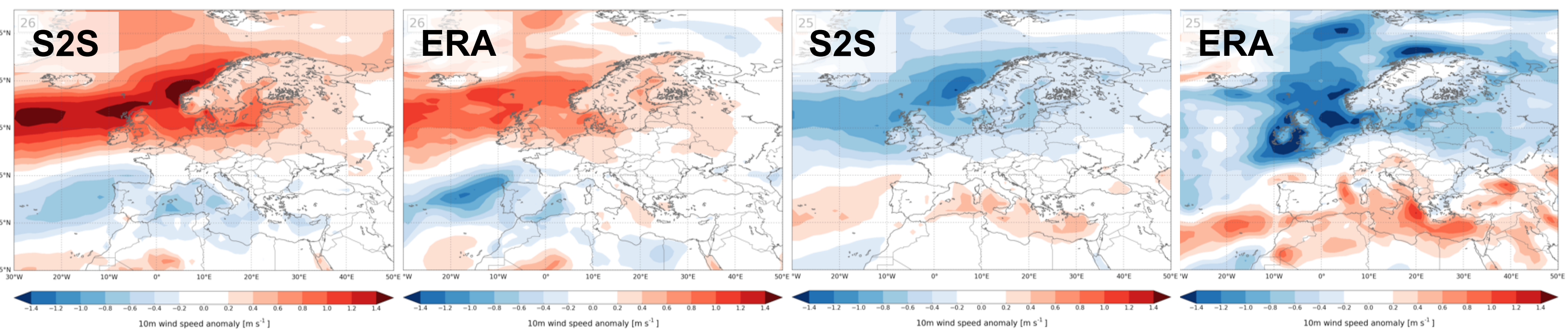


Results | Model skill for 10m wind

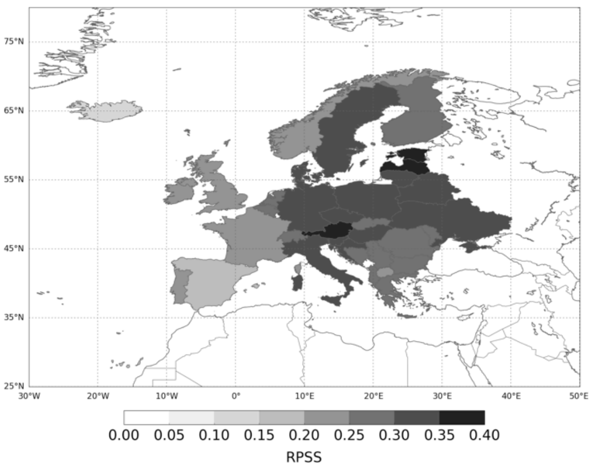


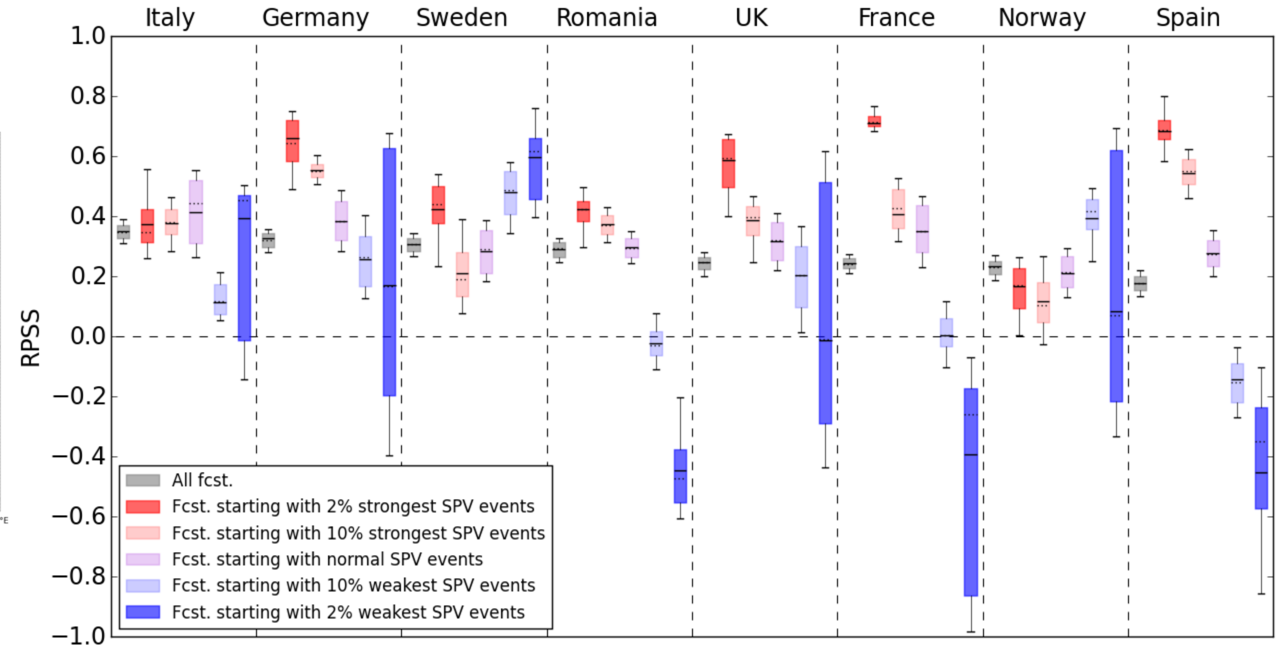


Anomalies after 2% strongest SPV states **Anomalies after 2% weakest SPV states**



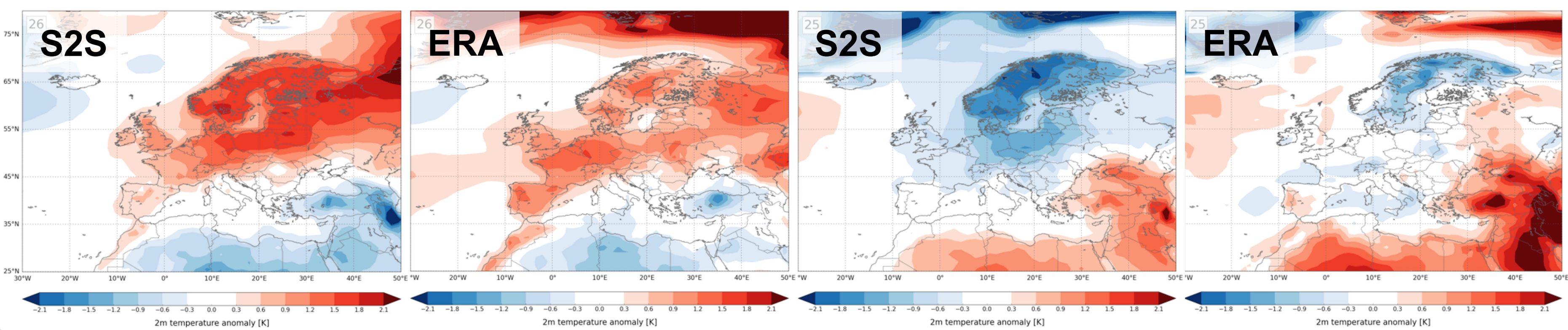
Results | Model skill for 2m temperature





Anomalies after 2% strongest SPV states

Anomalies after 2% weakest SPV states



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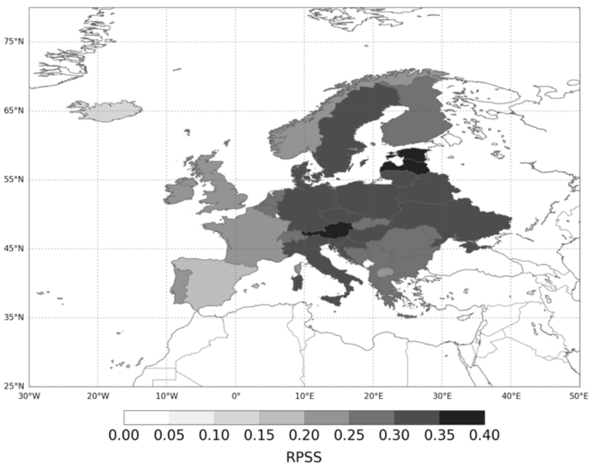
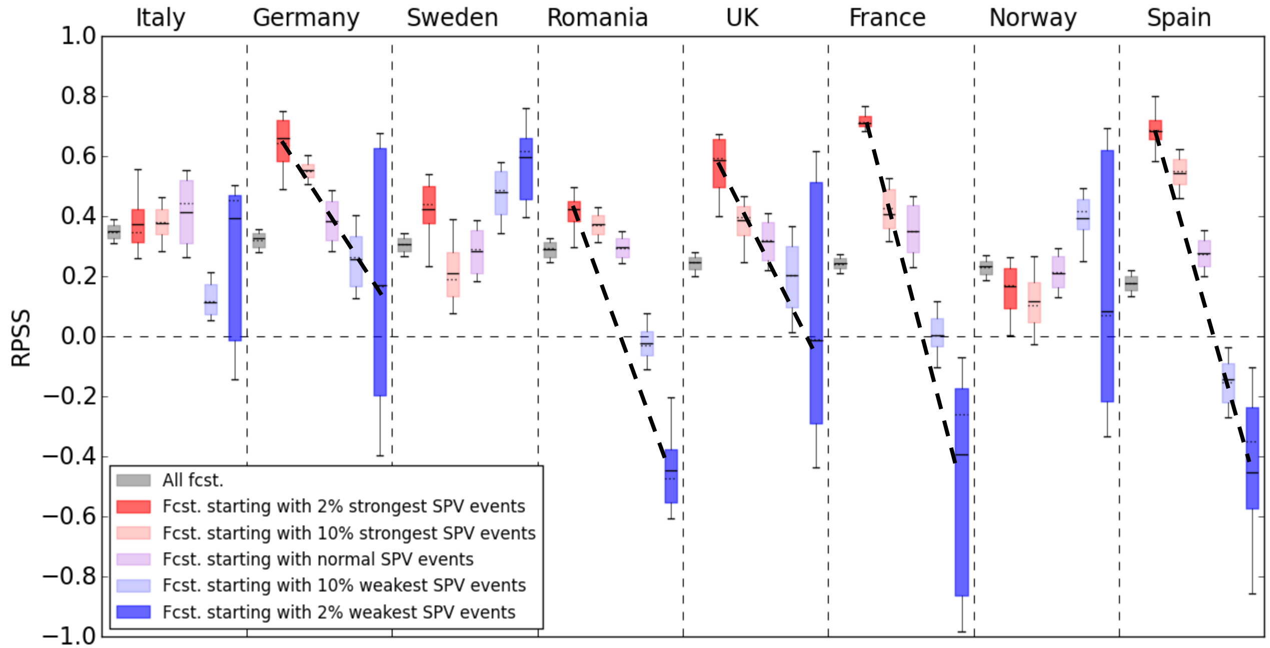
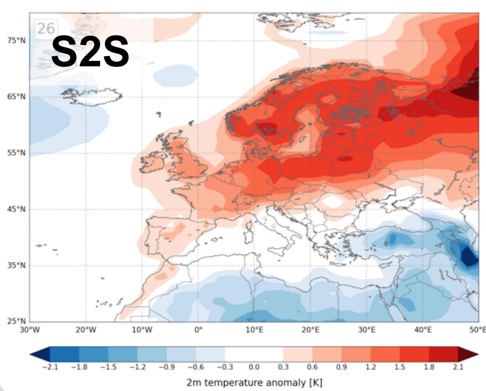
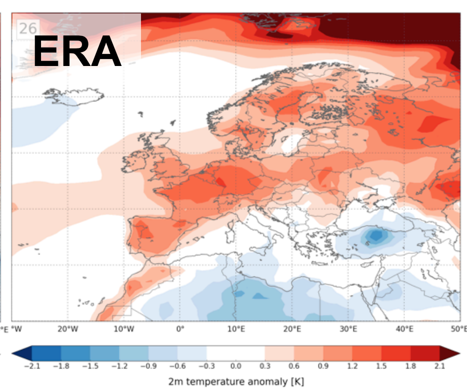
Results | Model skill for 2m temperature



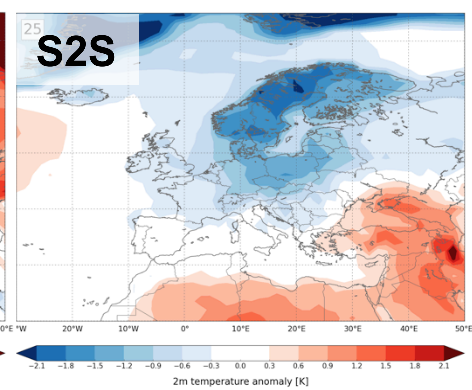


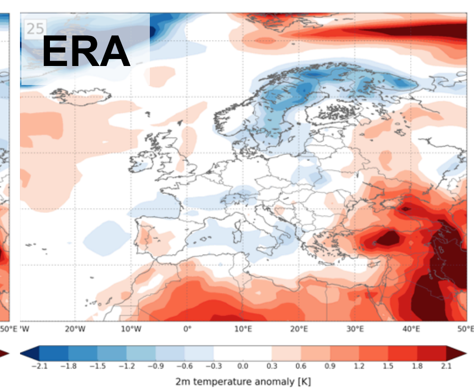
Anomalies after 2% strongest SPV states





Anomalies after 2% weakest SPV states





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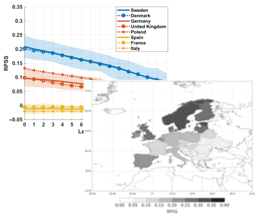
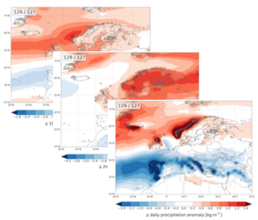
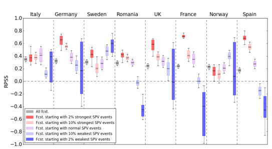
Conclusions



- **Strong spatial variability of statistical and numerical model skill** for month-ahead prediction of wind power generation / surface weather in Europe



- Reason: **anomalous SPV states** at forecast initial time lead to **persistent NAO-like anomaly patterns** → model skill for countries located in affected regions tends to be enhanced



- However, model skill increase **much more significant and robust after strongest SPV states than after weakest SPV states (~ SSWs)**, which even lead to significant skill reduction for certain countries (particularly T@2m)

- **Implications**
  - **Energy meteorology** cannot rely on enhanced predictability after weakest (~ SSWs) but more after strongest SPV states
  - Regional SSW response in **S2S models** needs to be improved