Influence of solar activity on the occurrence of weather types over Europe from 1763 to 2009

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Motivation & Research Questions

Data & Methods

Results
- Analysis of the influence of the solar cycle on the frequency of occurrence of weather types (inter-type).
- Analysis of within-type differences
- Comparison with FUPSOL simulations

Conclusion
Motivation & Research Questions

- How does the 11-year solar cycle affect the atmospheric circulation over Europe?
- Can changes be identified through variations in the frequency of occurrence of weather types?
- Huth et al. (2008)

www.ann-geophys.net/26/1999/2008/
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Solar activity affects the occurrence of synoptic types over Europe

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Weather Type Classifications (WTCs)

- WTCs aim at identifying recurrent dynamical patterns for a specific region.

- Manual or automatic.

- Many different methods.
Data & Methods - CAP7

> CAP (Cluster Analysis of Principal Components) is a classification method used by MeteoSwiss.
> The classification is available with 9, 18 and 27 types.
> Daily weather types from 1957 computed with ERA-40/-Interim.

=> CAP9 selected as reference

> Sea level pressure and temperature from 13 European weather stations used to reconstruct the weather types.
> 7 daily weather types from 1763 to 2009.

=> **CAP7** (Schwander et al., submitted)
Data & Methods - CAP7

1. (NE) NorthEast
2. (WSW) West-SouthWest
3. (W) Westerly flow over Northern Europe
4. (E) East
5. (HP) High Pressure over Europe
6. (N) North
7. (WC) Westerly flow over Southern Europe
Data & Methods - CAP7

> CAP7

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JFM 1763-2009
Data & Methods - Sunspot

January-February-March (JFM) monthly sunspot number.
Data & Methods - Classification

1921-01-25 5 72.306
1921-01-26 3 81.535
1921-01-27 6 97.773
1921-01-28 5 96.289
1921-01-29 5 91.53
1921-01-30 3 69.781
1921-01-31 7 94.315
1921-02-01 7 99.994
1921-02-02 7 92.813
1921-02-03 2 34.433
1921-02-04 1 98.516
1921-02-05 1 94.175
1921-02-06 4 84.224

Low, Moderate, High
Data & Methods – Model Simulations

- 4 model simulations (SOCOL)
- Large amplitude (L1/L2), Moderate amplitude (M1/M2)

Shapiro et al., 2011
Results – Weather Types Occurrence

1763-2009 CAP 7 low/moderate/high activity frequency of occurrence.
Results – Weather Types Occurrence

1763-2009 CAP 7 low/moderate/high activity frequency of occurrence.
Results – Weather Types Occurrence

1763-2009 CAP 7 (>75%) low/moderate/high activity frequency of occurrence.
Results – Within-Types Differences

1. min

1. max

1. diff

2. min

2. max

2. diff

ALL min

ALL max

ALL diff
Results –

1958-2009 Low/High solar activity difference

Sea level pressure and 850 hPa temperature
Results – Model Simulations

1958-2009 Low/High 11-year cycle solar activity difference

Sea level pressure and 850 hPa temperature
Results – Model Simulations

1763-2009 Low/High 11-year cycle solar activity difference

Sea level pressure and 850 hPa temperature
Results – Model Simulations

1600-1899 Low/High solar activity difference
Results – Model Simulations

1600-1899 Low/High solar activity difference

Sea level pressure and 850 hPa temperature
Summary

> Reduction in the occurrence of westerly types under low solar activity.
> Increase in the occurrence of easterly types under low solar activity.
> Weaker westerly flow under low solar activity and higher pressure over Scandinavia.
> Not confirmed by model simulations.
Thank You for your Attention!
References


