Frequency and persistence of low-wind power events in Germany

Nils Ohlendorf, Wolf-Peter Schill
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Motivation

Scope of research

Increasing share of onshore wind power

Public concern: Long periods of low wind

Research questions on low-wind power events:

1. Seasonal frequency
2. Magnitude of extreme events
3. (Geographical distribution)

- Simulation of wind power patterns based on weather data and power curves
2.1 Method

Data

- MERRA-2: 1981-2016, hourly resolution, $0.5^\circ \times 0.625^\circ$, wind speeds 50m above surface
- OPSD: Currently installed onshore wind capacity

➢ Geographical weighting with installed capacity
2.2 Method

Capacity factor calculation

Three wind zones

Power curves + hub heights

(100m, 125m, 139m)

Hourly weighted aggregated capacity factors for Germany
2.3 Method

Definition of low-wind power events

- Three thresholds: 10%, 5%, 2%
- Two definitions: Constantly and mean below threshold
3.1 Results

Frequency and seasonal persistence

- **Winter**: Fewest low-wind power events
- **Larger thresholds strongly increase frequency**
3.2 Results

Magnitude of annual extreme low-wind power events

- Longest event in 1985: 10 days of less than 10% mean capacity.
3.3 Results

Magnitude of monthly extreme low-wind power events

- Extreme events in winter months similar in magnitude to summer
Conclusion

Summary

Statistical analysis of frequency and persistence of low-wind power events based on weather data

- Low wind power events more frequent in summer
- Magnitude of most extreme low-wind events:
  - Differs strongly between years
  - Winter and summer months almost similar
  - Up to 10 days of mean capacity factors below 10%
  - Relevant for dimensioning of generation / flexibility options

Further research:

- Inclusion of offshore wind and European perspective
- Combined analyses covering wind power and PV
Vielen Dank für Ihre Aufmerksamkeit.
3.4 Results

Longest winter extreme events, 10% threshold

Mean below threshold
160 hours, 05.01.1997 – 11.01.1997

Annual mean capacity factors in 1997

Decentral solutions would be strongly affected by low-wind events