Weather Information Tailored to the Needs of Renewable Energy Industry

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Research project EweLiNE (2012-2016)

- Overarching goal: improved wind and PV power forecasts
- Users' requirements are directly integrated into the R&D activities
How Do we proceed?

1. Get to know the users’ world and understand (weather-dependent) decision making processes
Identification of user needs

- user workshop
- questionnaires
- frequent project meetings
- visits at control rooms
- reports of large forecast errors

weather

developer

power
How Do we proceed?

1. Get to know the users’ world and understand (weather-dependent) decision making processes

2. Identify the deficits and processes for additional weather information
What weather information is needed?

- as input for power forecast models
- as input for dynamic thermal rating models
- as input for week-ahead demand outlook
- as additional information for decision making processes

What weather variables are needed?

- wind speed & direction on hub height, temperature, relative humidity, pressure, radiation

Additional information about weather is mainly needed when power forecast from diverse sources differ → mainly connected „difficult“ weather situations

Need for weather warnings for critical weather situations
## Identified critical weather events

<table>
<thead>
<tr>
<th>Weather phenomenon</th>
<th>Important for TSOs</th>
</tr>
</thead>
<tbody>
<tr>
<td>snow and icing</td>
<td>how long does the snow and the ice persist on the panels</td>
</tr>
<tr>
<td>fog (all kinds)</td>
<td>development, partial or complete dissipation</td>
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<tr>
<td>clouds</td>
<td>development of fair-weather clouds</td>
</tr>
<tr>
<td>mineral dust</td>
<td>deposition on the panels</td>
</tr>
<tr>
<td>sudden changes in weather regimes</td>
<td>- timing of the change</td>
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<td></td>
<td>- shutdown of wind turbine</td>
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<td></td>
<td>- effects on offshore production</td>
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<tr>
<td>turbulence in the boundary layer</td>
<td>vertical wind reduces production</td>
</tr>
<tr>
<td>icing</td>
<td>consequences on production</td>
</tr>
</tbody>
</table>

**Photo-voltaic**

**Wind**
Large wind power forecast error reported by TSOs, 09-08-2014:

Day ahead forecast error: Max: 7.8 GW
Mean: 3.2 GW

Andrea Steiner
How Do we proceed?

1. Get to know the users’ world and understand (weather-dependent) decision making processes

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3. Start in iterative process of product development

4. Elaborate an accepted visualization
Probabilistic Forecast

Reasons not to use probabilistic forecasts:

• Lack of experience.
• Business Software processes only deterministic forecasts.
• Transfer from probabilistic forecasts to categorical decision is difficult.

What could be done to make the use of probabilistic forecasts possible:

• User-friendly forecasting products.
• Analyse the use of probabilistic forecasts different countries.
• Analyse the interface between forecast and application.
• Quantify the added value of probabilistic forecasts.
Alert product for critical situations

→ Automated indication of critical weather developments: cyclone tracking algorithm
  - Definition of critical areas
  - Definition of thresholds concerning time, that a cyclone or trough remains there

→ Automatically advice TSOs to consult further information concerning the NWP forecast uncertainty (e.g. EPS)
3) Cyclone Detection

Example

2014-08-09
Alert product for critical situations

- indication of critical weather developments
- COSMO-DE-EPS mean
- COSMO-DE-EPS spread

- critical event in warning area & information from COSMO-DE-EPS
- cyclone warning area
- no cyclonic influence
Web based viewer for power and weather
Probabilistic wind ramp forecasts

COSMO-DE-EPS 15UTC run, 05.12.2012

Probability for the occurrence of an increase in wind speed of 7 m/s within the next 3 hours.

Combination of weather information with specific user data

- Installed capacity per postcode („Anlagestammdaten 2012“)
  - < 20MW
  - 20-50MW
  - 50-100MW
  - > 100MW

How Do we proceed?

1. Get to know the users’ world and understand (weather-dependent) decision making processes

2. Identify the deficits and processes for additional weather information

3. Start in iterative process of product development

4. Elaborate an accepted visualization

5. Organise training courses (end of 2015)

6. Introduce the products to “real” end user (test phase in 2016)
• development of probabilistic and deterministic forecasting products

• development of web-based visualisation platform (using geoserver)

• high priority is given to customer-orientated development -> regular meetings – face to face communication

• testing phase in 2016 with an objective and subjective verification

Dialogue is crucial
3) Cyclone Detection

→ COSMO-EU forecasts of mean sea level pressure (MSLP)

- Preprocessing

Unsmoothed MSLP

Smoothed MSLP
(9 point local smoothing)

Upscaling
(every 20th grid point)
3) Cyclone Detection

**COSMO-EU forecasts of mean sea level pressure (MSLP)**

Object recognition on basis of quasigeostrophic relative vorticity

Recognized objects (grid points > subjective threshold) (lows, troughs are highlighted)
Reliable Customer-oriented probabilistic forecasting products

1) NWP models of DWD

COSMO-DE-EPS (see pres. Keane. Kohlhepp)
COSMO-DE (see present. Declair)

2) Product generation + Calibration

3) Concept

4) Visualisation

5) Decision making with prob. forecasts

Which critical probability?

N

250°

categorical decision

chance for e.g. wind > v$_{crit}$ longer than 1 hour