Operational user-centric verification of severe weather warnings

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The object of interest

Severe Weather Warnings for German post code areas by MeteoGroup
Warning areas

Warnings for 8,200 post code areas generated by MeteoGroup

- Area size relates to population density
- Adds spatial granularity where most people profit from
- Helps to prevent dilution of awareness
### Warning types, levels and thresholds

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<tr>
<th>Severe weather type</th>
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<td>Greater areas</td>
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<tr>
<td><strong>Storm</strong></td>
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The weather room and the users

**Severe weather alert team in the 24/7 weather room**

The forecaster draws a polygon into the tool and issues an according weather warning. The warning is distributed via various communication channels.

**Users**

- Agencies, companies, private persons
The challenge
How good are our warnings from a users perspective?
The challenge: How good are our warnings?

• What data can we take as ‘reality’?

• How do we join hourly observations into events?

• How do we blend overlapping warnings?

• How do we cope with the area warning vs point measurement?

• Do we find observations for all warn types?

• What measures do we apply?

• How often should we measure the warning quality?

• How do we communicate our system and our results to the product’s users and the forecasters?
The approach

Pragmatism and communication
The approach: What is our reality?

Wind gusts

- 650 ground weather stations
- Operated by DWD and by MeteoGroup

Extreme heat, extreme cold, ground frost

- 1100 ground weather stations
- Operated by DWD and by MeteoGroup

Point measurement vs Warning for an area
The approach: What is our reality?

Heavy showers and persistant rain

- MeteoGroup calibrated radar
- Precipitation radar calibrated with reports from 1,300 ground weather stations

Hail

- MeteoGroup hail detection
- 3-dimensional radar and model data used to detect vertical structures prone to hail

‘Reality’ of 2x2km pixels, covering the area to compare with warnings for the area
The approach: What is our reality?

Lightning

• Nowcast Linet cloud-to-ground lightning strike observations
• 100 m accuracy in Germany

Match observed event locations with shapes of post code areas
The approach: What measures do we apply?

Hit Rate
Event view
The user experiences an event. Was he warned?

False Alarm Ratio
Warning view
The user receives a warning. Can he connect it with an event?
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The approach: Inspect and adapt

During the development phase we ran through several iterations, to inspect and adapt our system.

These iterations included workshops with clients and sessions with the forecasters.

The feedback from these workshops and the feedback sessions with our weather room drove our decisions on the next features.
The implementation
An example day and a high level overview
The implementation: Example daily results

Low Paul, 22 June 2017

Severe thunderstorms with hail, heavy precipitation, storm gusts
The implementation: Example daily results 22 June 2017

Hit Rate Hail 93.2% ~ Heavy Shower 98.9% ~ Lightning 96.7% ~ Windgusts 93.8% False Alarm Ratio Thunderstorm 36.6%
The implementation: Example high level dashboard

**Current Performance:**

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<th>last 7 days</th>
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<td>windgust_HR</td>
<td>94.3%</td>
<td>---</td>
</tr>
<tr>
<td>heavyshower_HR</td>
<td>91.7%</td>
<td>93.0%</td>
</tr>
<tr>
<td>thunderstorm_FAR</td>
<td>68.0%</td>
<td>80.4%</td>
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**Total # warnings issued yesterday:**

176

**Performance Last Month:**

The pie charts indicate which warning types and event types have been most important in the last month (in terms of total number of warnings/events). The colors show the quality of the individual metric.
The implementation: Example high level dashboard
The conclusion

“Verification of Weather Warnings is very difficult. But this must not prevent us from doing it.”
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An automated, daily monitoring of weather warning quality is possible. To-the-point communication about the method and the results is crucial. Forecasters and clients can profit from high-frequency quality monitoring.
Thank you

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