Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Max-Planck-Institut für Bildungsforschung
Max Planck Institute for Human Development

Hans-Ertel-Zentrum
für Wetterforschung

How do emergency managers use probabilistic weather forecasts in different weather situations?

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Why communicate uncertainty in weather warnings?

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Contra	Pro
Preferences	
• for deterministic information • transfers responsibility	• some users ask for prob. information Morss et al. (2008) • differing costs/losses Gigerenzer & Muir Gray (2011)
Understanding	
• difficult to understand • leads to underestimation of risk	• essential to understand false alarms • otherwise uncertainty will be (under)estimated Joslyn & Savelli, (2010)
Decisions	
• loss of trust in forecasts	• increased trust in forecasts LeClerk & Joslyn (2015) • improved decisions Roulston et al. (2006); Nadav-Greenberg & Joslyn (2009)

Questions and approach

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Study design: we implemented **PRO**abilistic weather information into operational Fire Brigade Weather Information System (FeWIS PRO)

1) Which representations are preferred?

→ Long term analysis of **web usage behavior** via a new online information system for firefighters (N = 820 collective users)

2) Which representations are understood and effectively used?

→ Test emergency managers in an **online survey** (N = 100 respondents)

Vanessa J. Fundel, Nadine Fleischhut, Stefan M. Herzog, Martin Göber, Renate Hagedorn (2019): Promoting the use of probabilistic weather forecasts through a dialogue between scientists, developers, and end-users. Quarterly J. Royal Met. Soc., https://doi.org/10.1002/qj.3482,

FeWIS PRO (**F**ire Brigade **W**eather **I**nfo. **S**ystem)

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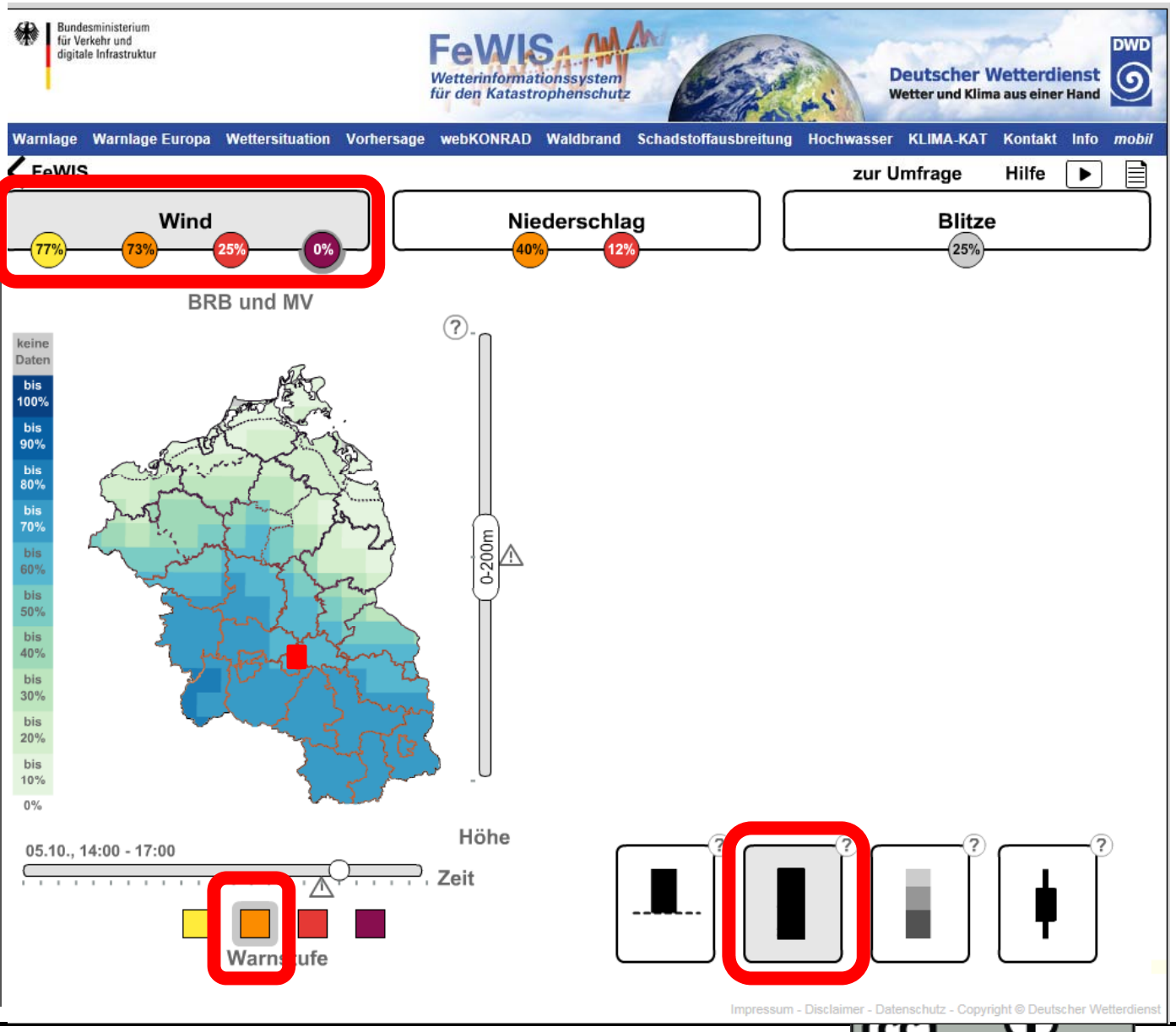

FeWIS PRO (**F**ire Brigade **W**eather **I**nfo. **S**ystem)

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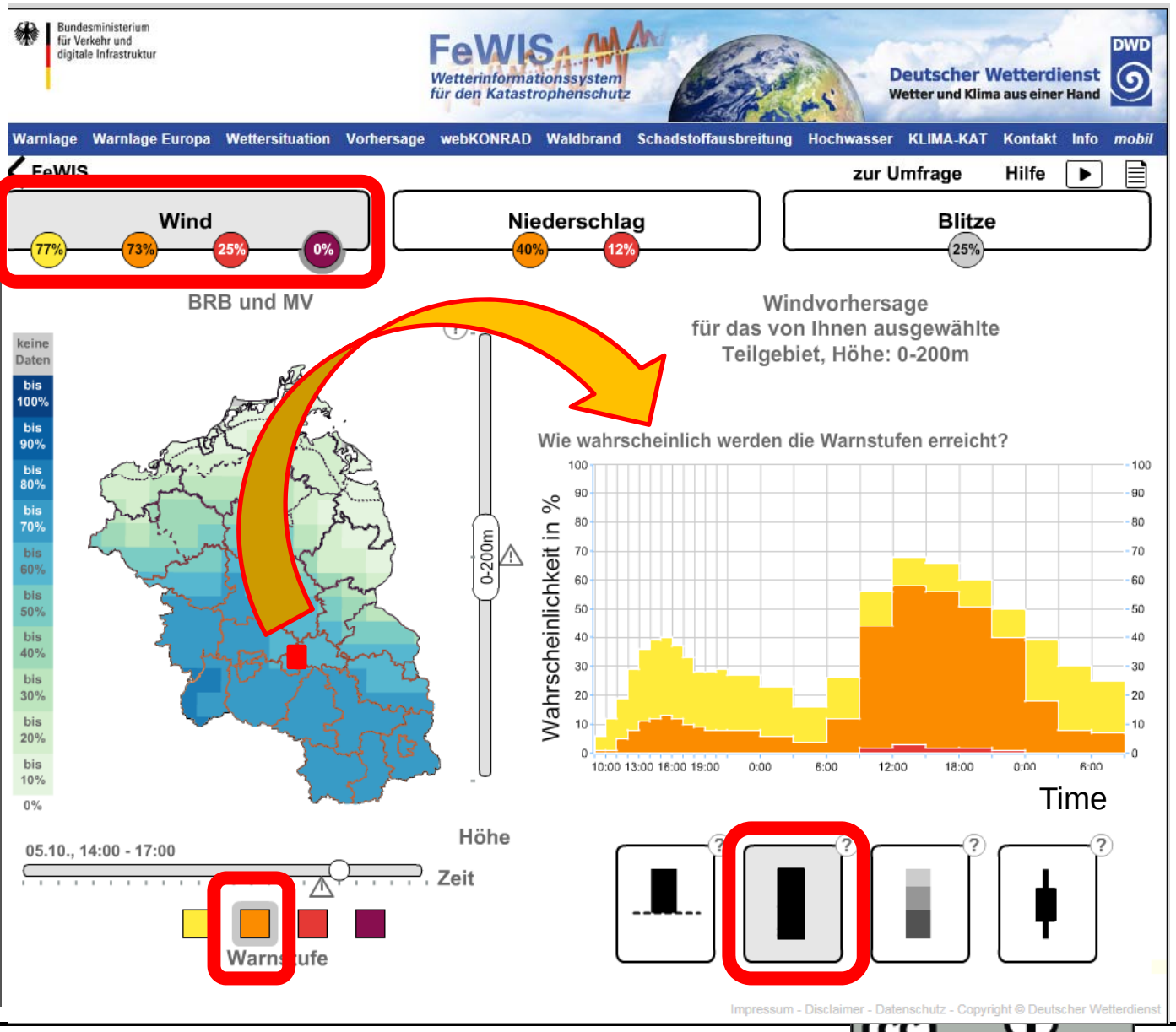

Implementation of five uncertainty representations

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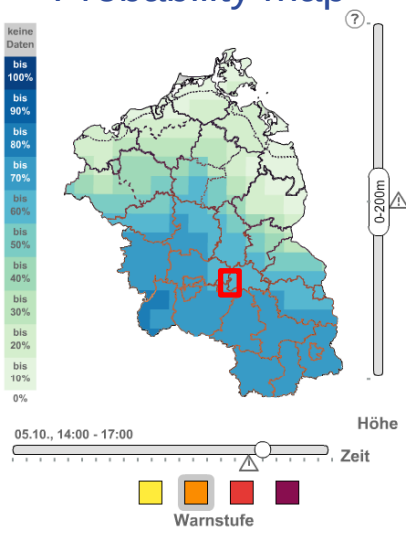
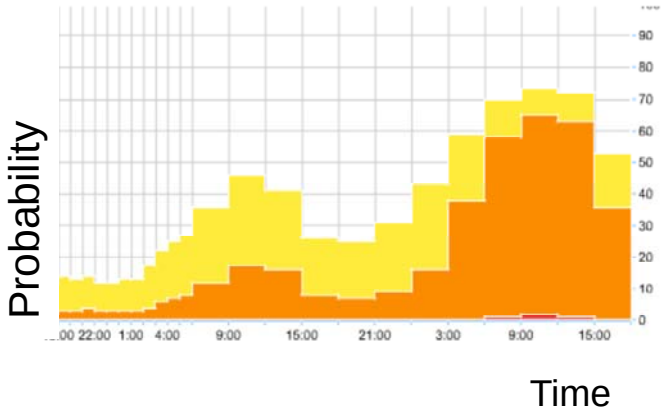
Probability of wind > warning thresholds

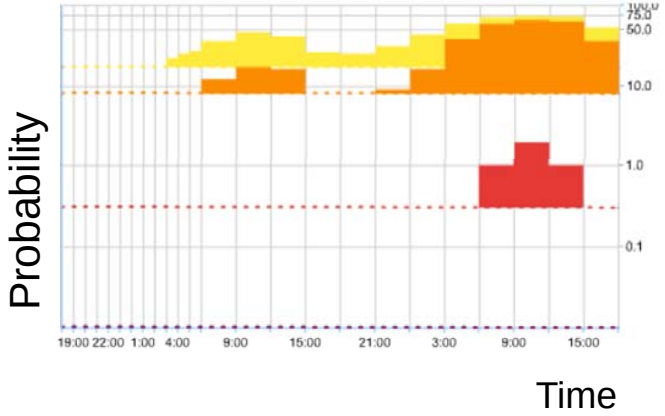
Probability map



Probability as height of a bar

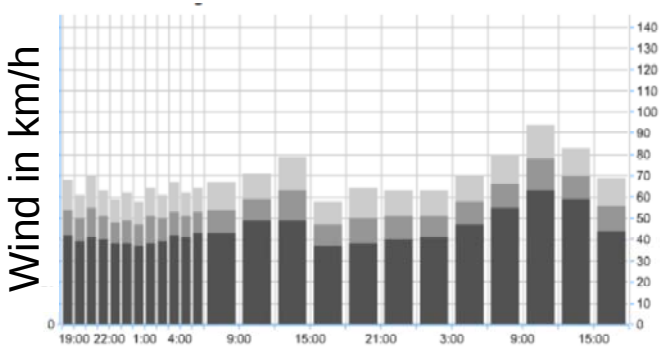


Comparison with climatology

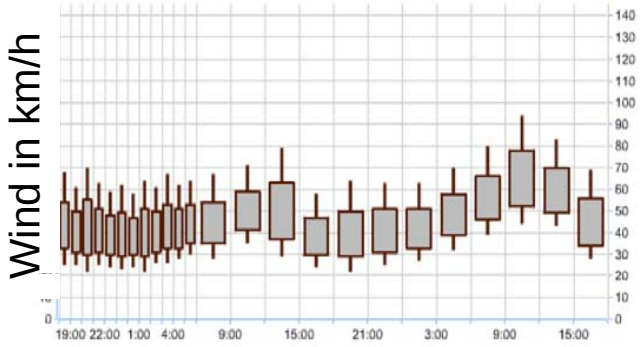


Wind speed at probability of x (quantile)

Quantiles as color shading



Range between quantiles



Which representation do emergency managers prefer?

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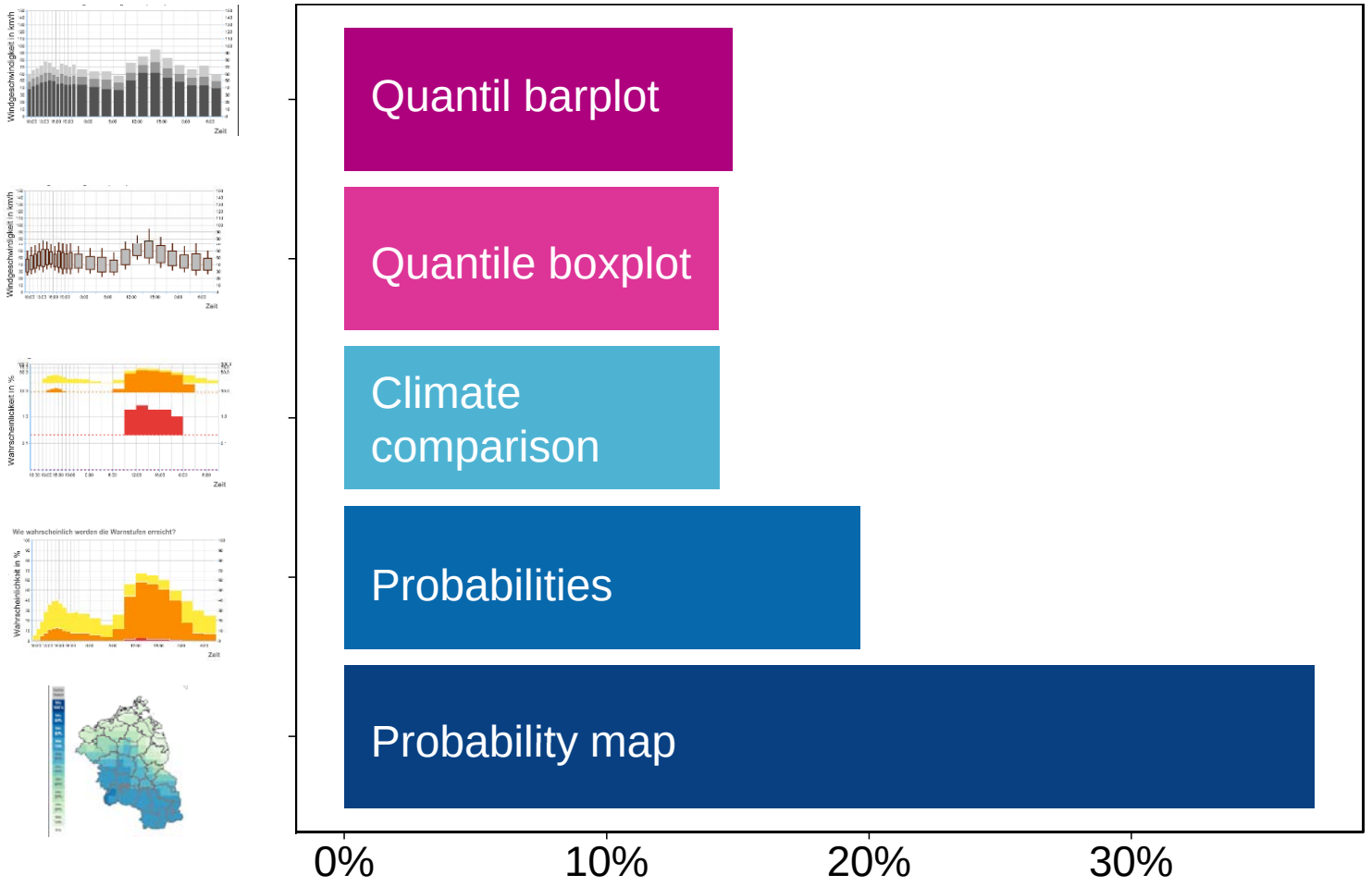
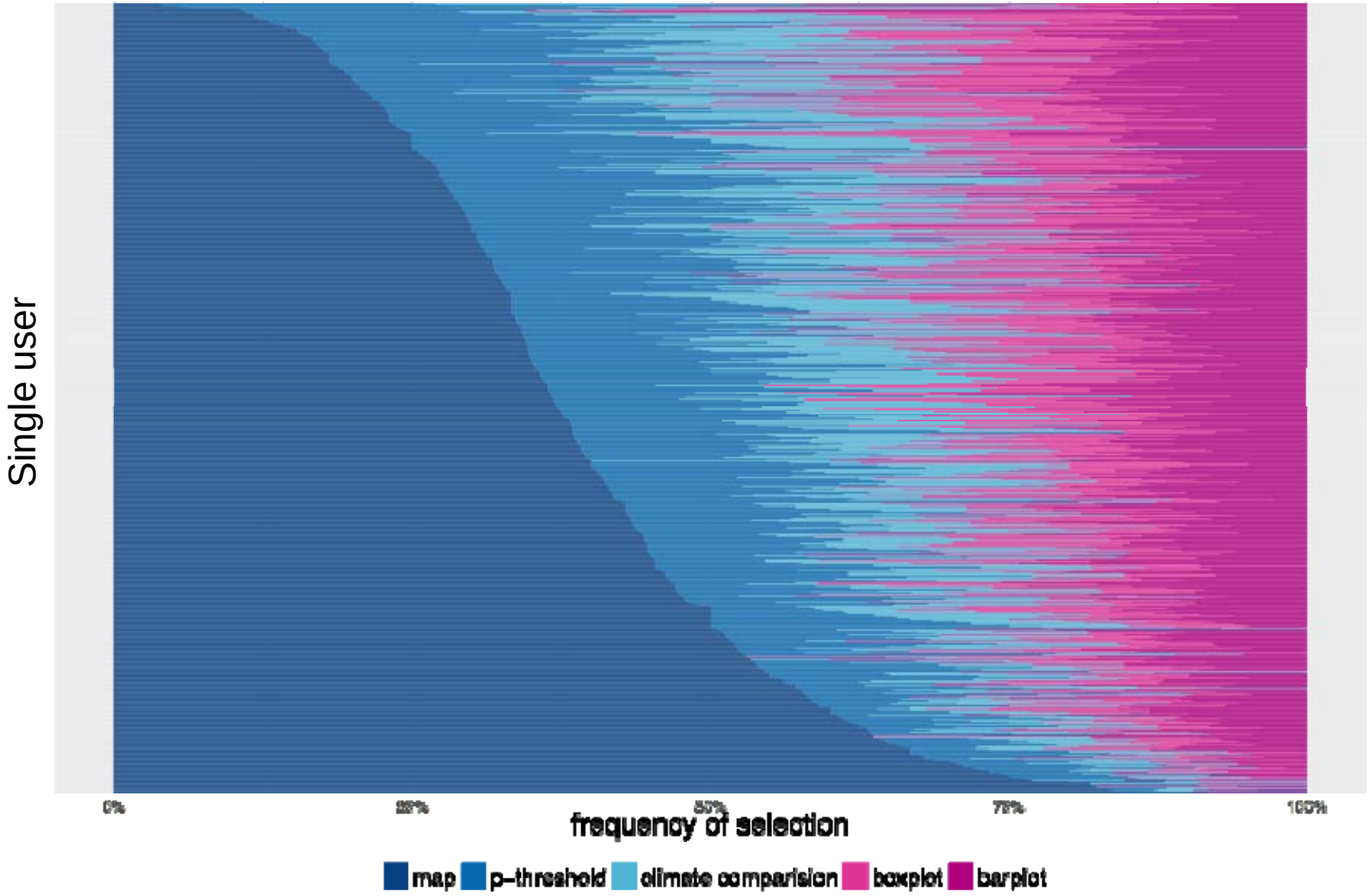


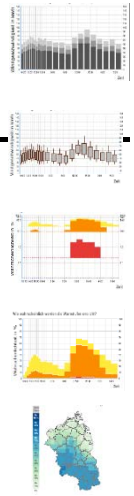
N = 55661 selections

Individual differences between users



First „Watch“

First „Severe warning“



Quantile barplot

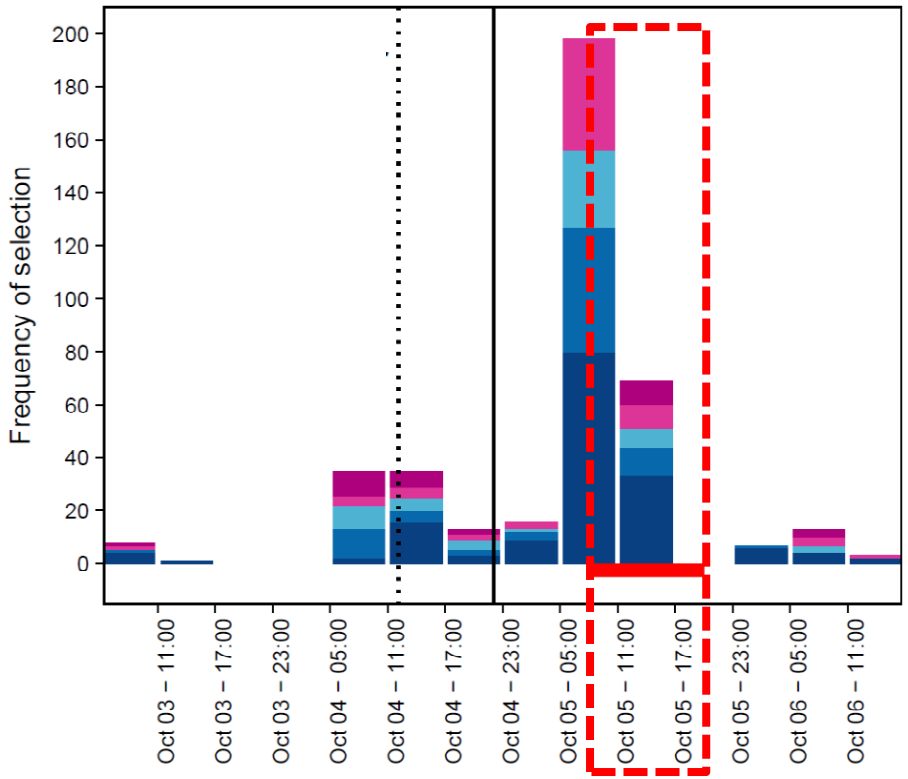
Quantile boxplot

Climate comparision

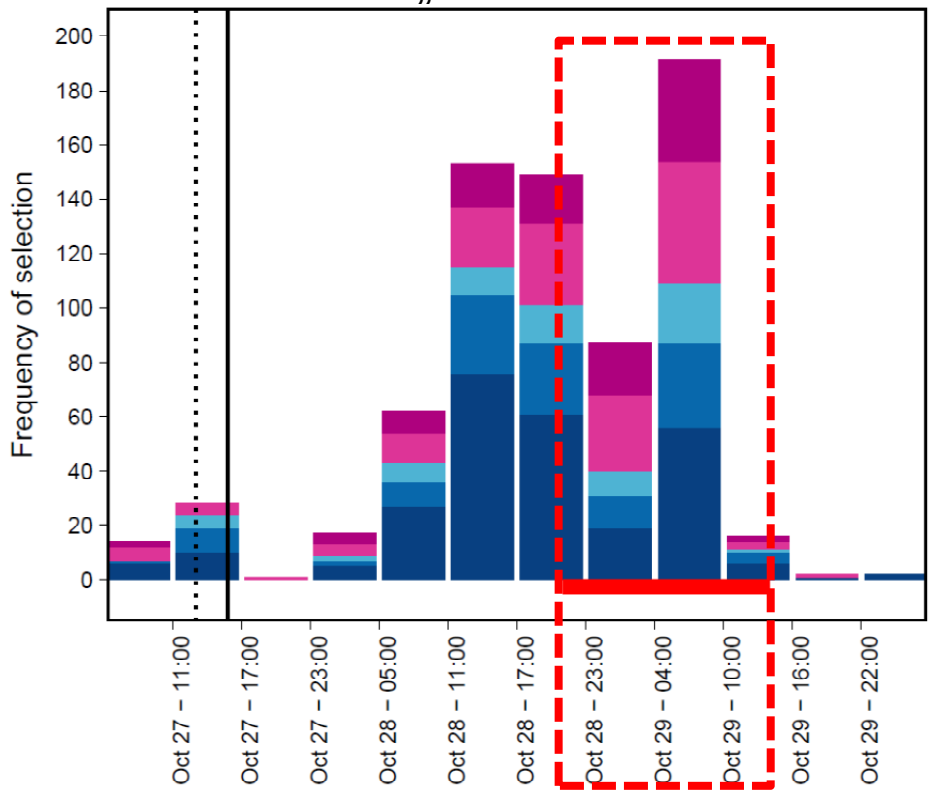
Exceedance probability barplot

Exceedance probability map

Storm „Xavier“ 5.10.2017



Storm „Herwarth“ 29.10.2017



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"The probability that it rains tomorrow is 30 Percent."

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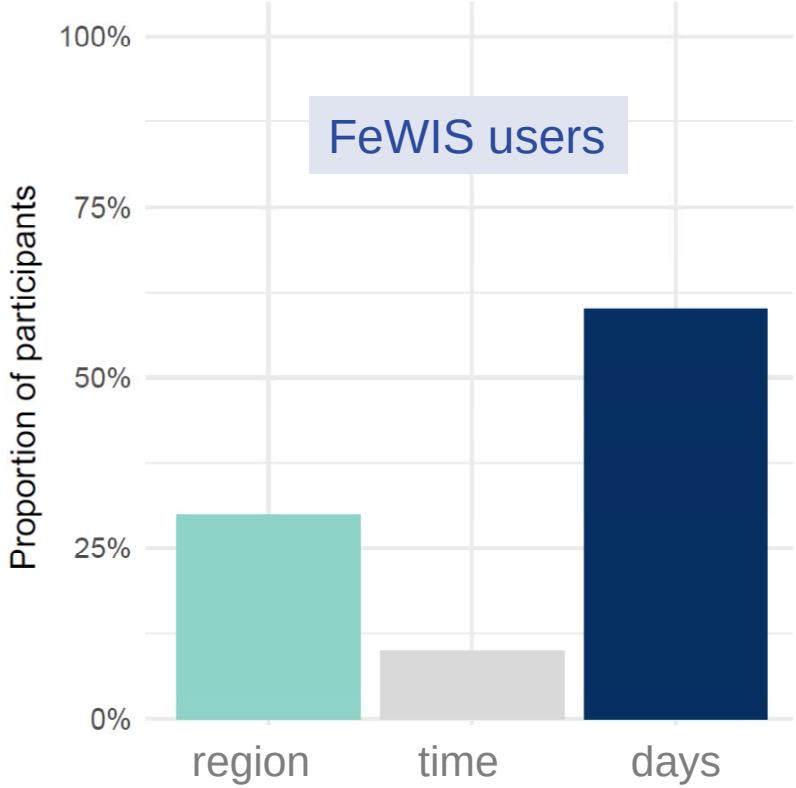
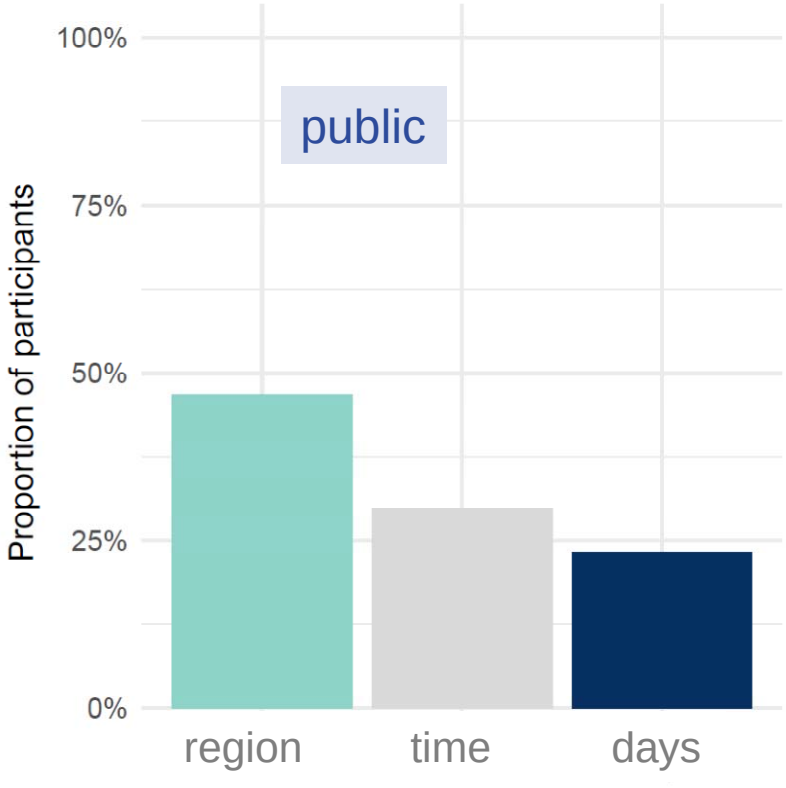
Which of the following statements best reflects this forecasts?

- *It is raining in 30 percent of the **region**.*
- *It is raining tomorrow 30 percent of the **time**.*
- *It rains on 30 percent on the **days**, for which this forecast was made.*





From a representative survey of German public

Survey answers

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"For which decisions was the probability information in FeWIS Pro useful for you?"

- *"During the **preparations** for possible situations (storm / flood / snow). It is a kind of **early warning instrument** for the decision of further measures (e.g. provision of personnel/pre-alarm), decision on whether personnel in the control centre (emergency call enquiry and alarming) should be increased or emergency forces should already be put on alert."*

- *"The probability can be helpful when deciding on a **pre-alarm**. It can be useful when deciding on **post-alarming,** if situations are already running."*

- *"Estimation of probable **deployment numbers."***

- *"For coordination with the lower water authority **before weekends**, in order to be prepared for possible heavy precipitation / flooding."*

Summary

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- The frequent use and positive feedback shows that uncertainty information is **informative** for emergency managers under operational constraints

- Click behaviour revealed a **preference** for a spatial overview (map) and probability information

- The most popular representations were **not the most effective ones**

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