What is the uncertainty of weather warnings? Can we predict it? How can this uncertainty estimate be used?

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Acknowledgments: C. Primo, S. Trepte, colleagues from DWD‘s regional office Potsdam, Berliner Feuerwehr

Summary

1. Are weather warnings uncertain ? ✓
2. Can we predict this uncertainty ? ✓
3. How can this uncertainty estimate be used?
   - *Don‘t know !*
   - *Come back, when you are certain !*
   - ***It reduces my uncertainty !***
   - ***I can make a balanced decision !***

1. Are weather warnings uncertain?

*„What is the verified occurence of events given a deterministic YES forecasts (**implying 100% certainty**) ?“* $p = 1 - \text{False Alarm Ratio}$

DWD-forecasts:

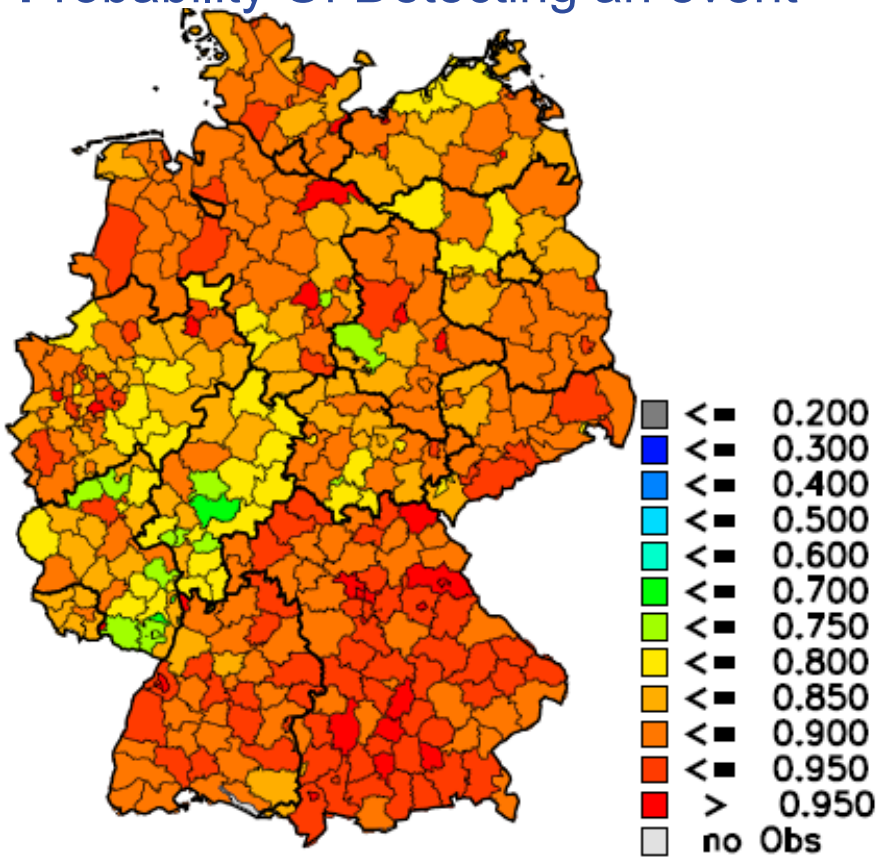
- Rain tomorrow in 12h interval: YES/NO = 80 %
- > 10 mm = 40 %
- County based wind warnings: (+ 20% representativity error of obs.)
  - Strong gale (>21 m/s) = 60 %
  - hurrican force winds (> 33 m/s) = 5 %
    - At least storm (> 25 m/s) = 30 %
    - At least gale (> 18 m/s) = 80 %
    - At least near gale (> 14 m/s) = 98 %

Thunderstorm warnings

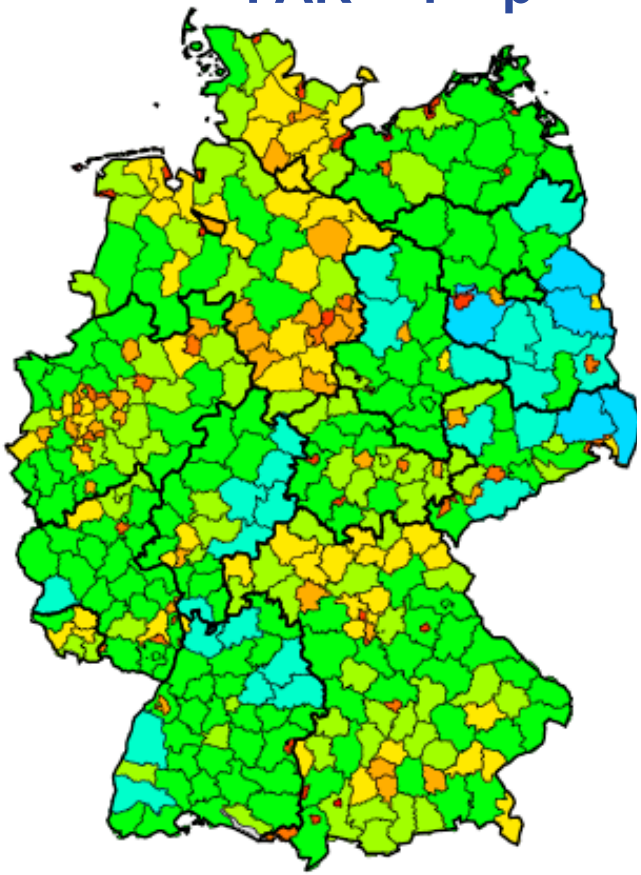
verified with (continuous)lightning observations, Germany, summer 2012

POD

Probability **O**f **D**etecting an event



FAR = 1 – p



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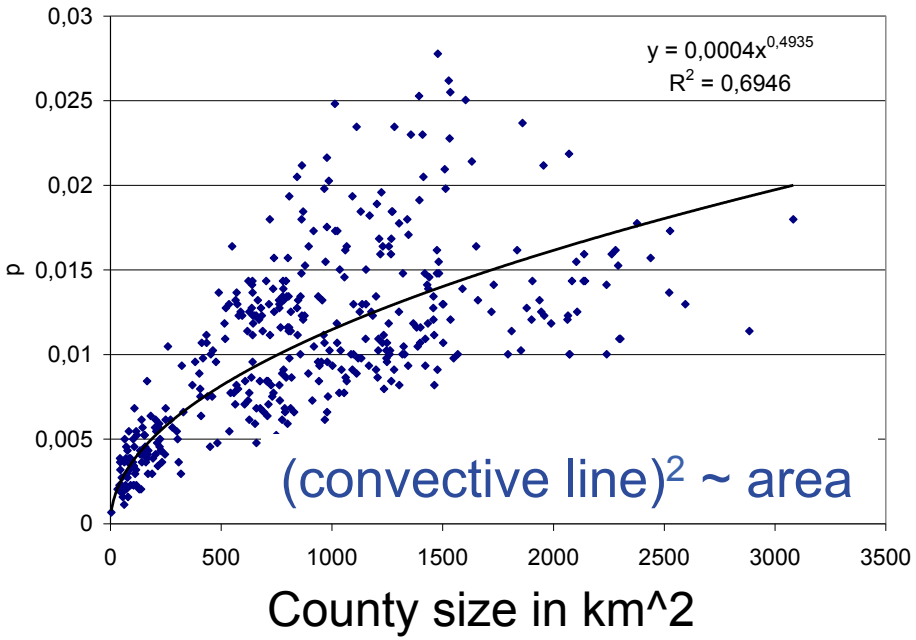
p(occurence)=„base rate“



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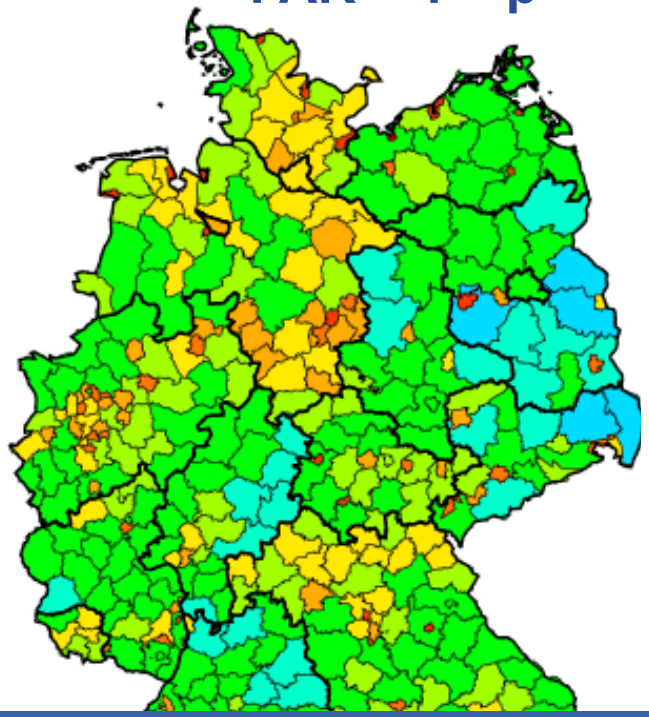


Should the decision to issue a warning be dependent on the county size ?

2. Can we predict the uncertainty of warnings ?

Follwing examples: gale force gusts (> 18 m/s), winter

2 methods:

Physical, mesoscale model: raw COSMO-DE-Ensemble
Statistically post-processed global model: WarnMOS

Courtesy of: Cristina Primo, Sebastian Trepte

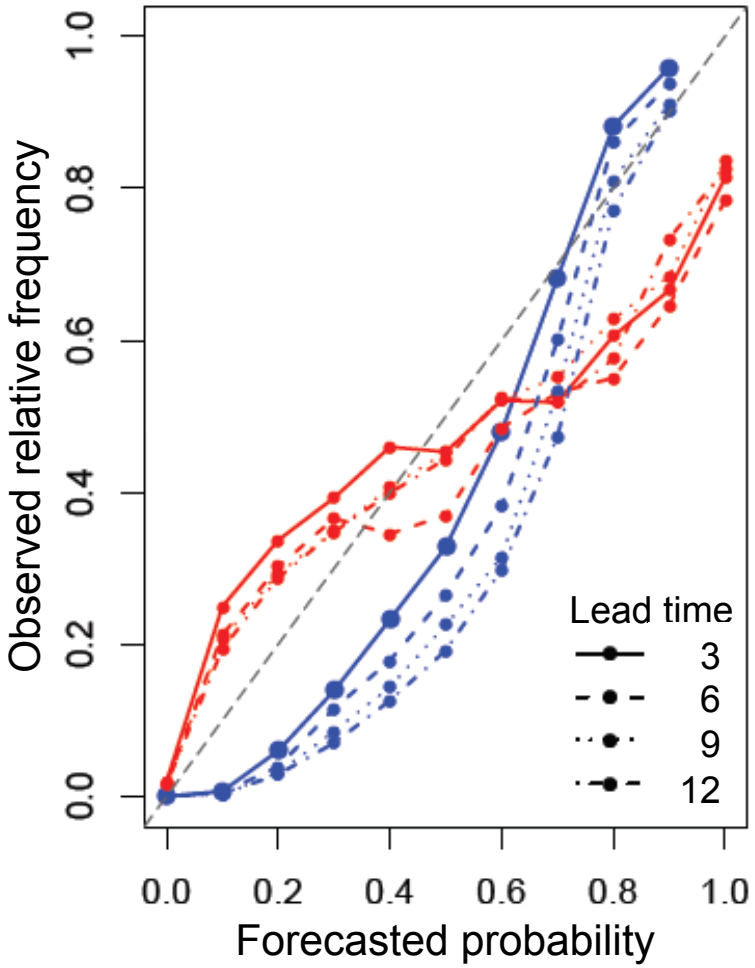
Reliability diagram *(„is the prob. forecast really a probability?“)*

COSMO-DE-Ensemble

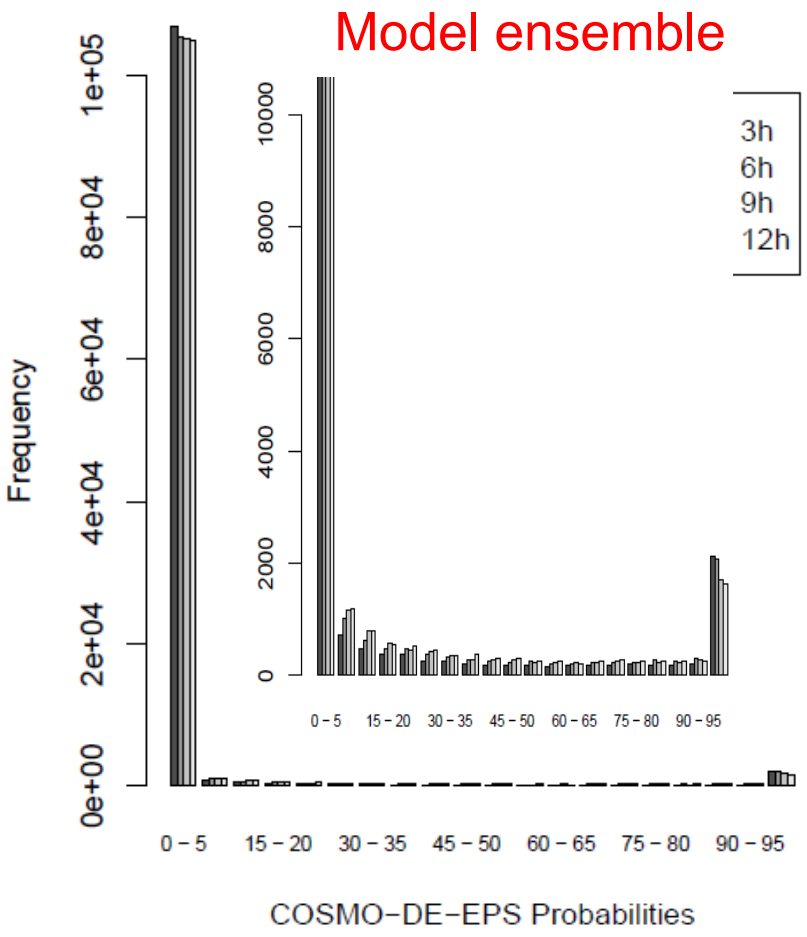
Overconfident

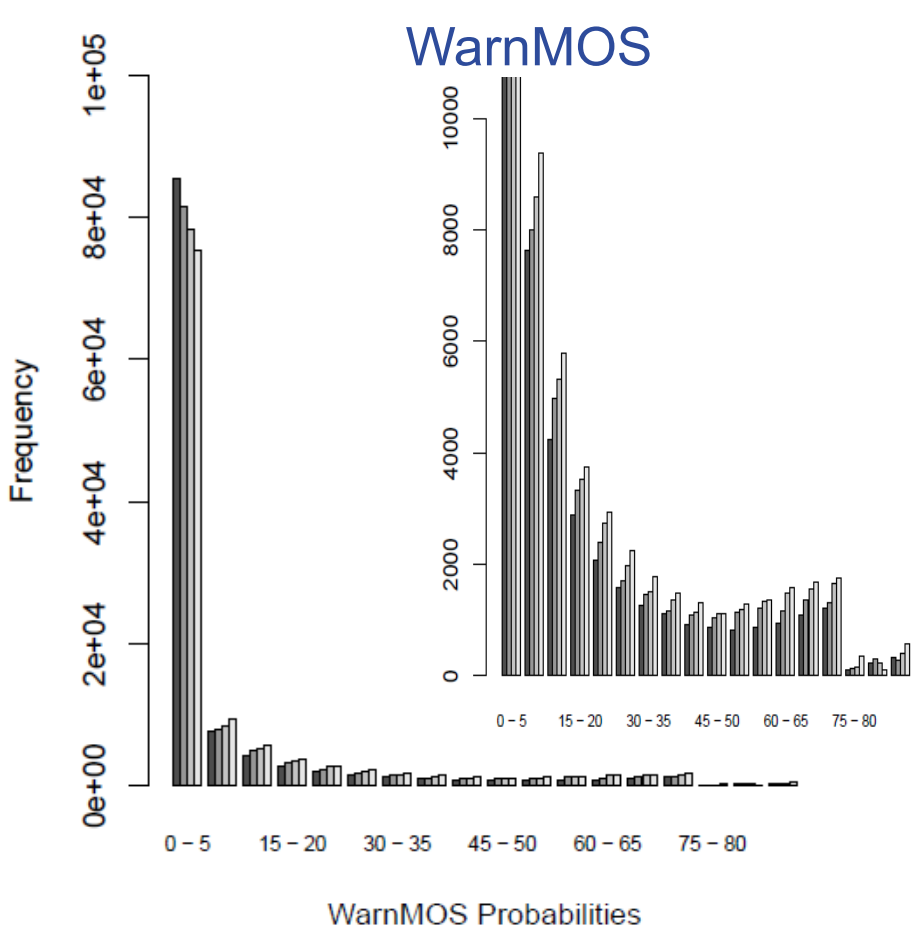
WarnMOS (statistical)

underconfident



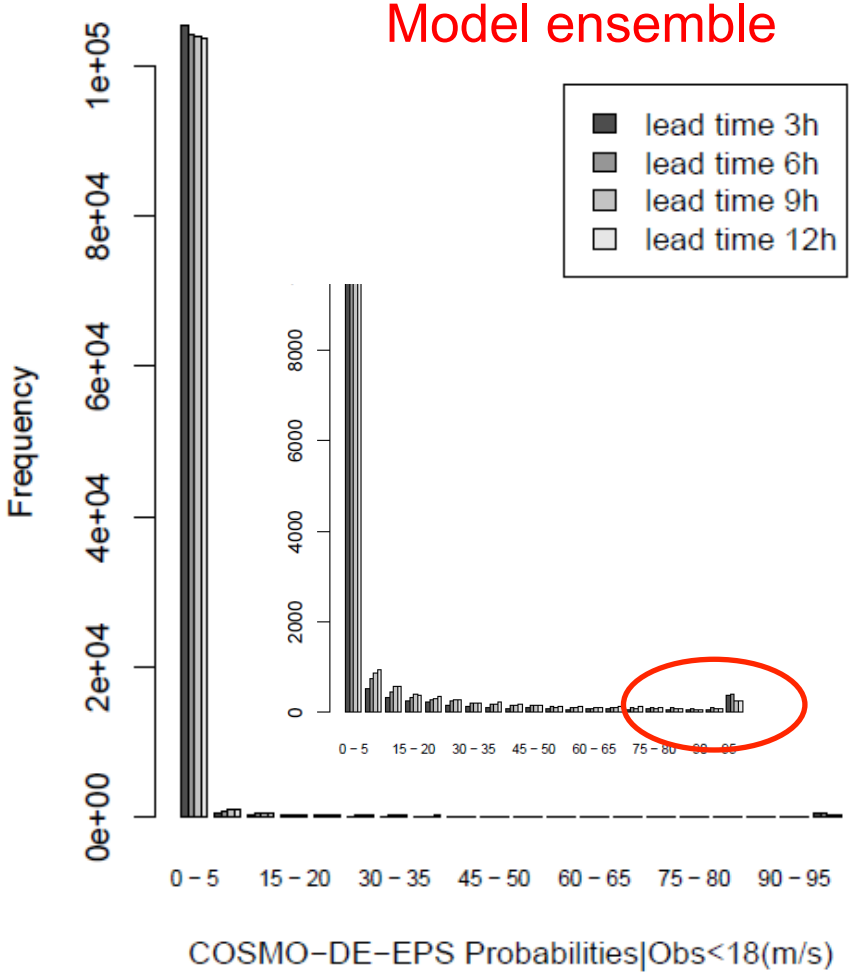
Sharpness diagram



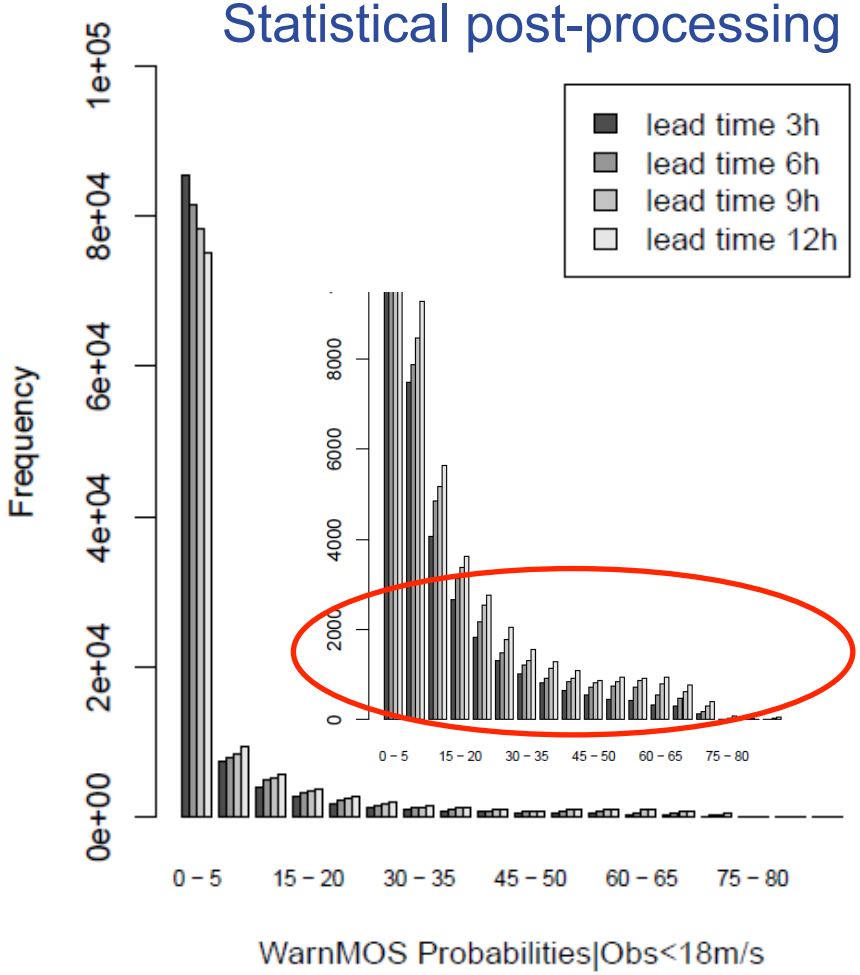


„nothing happened“ = gust < 18 m/s

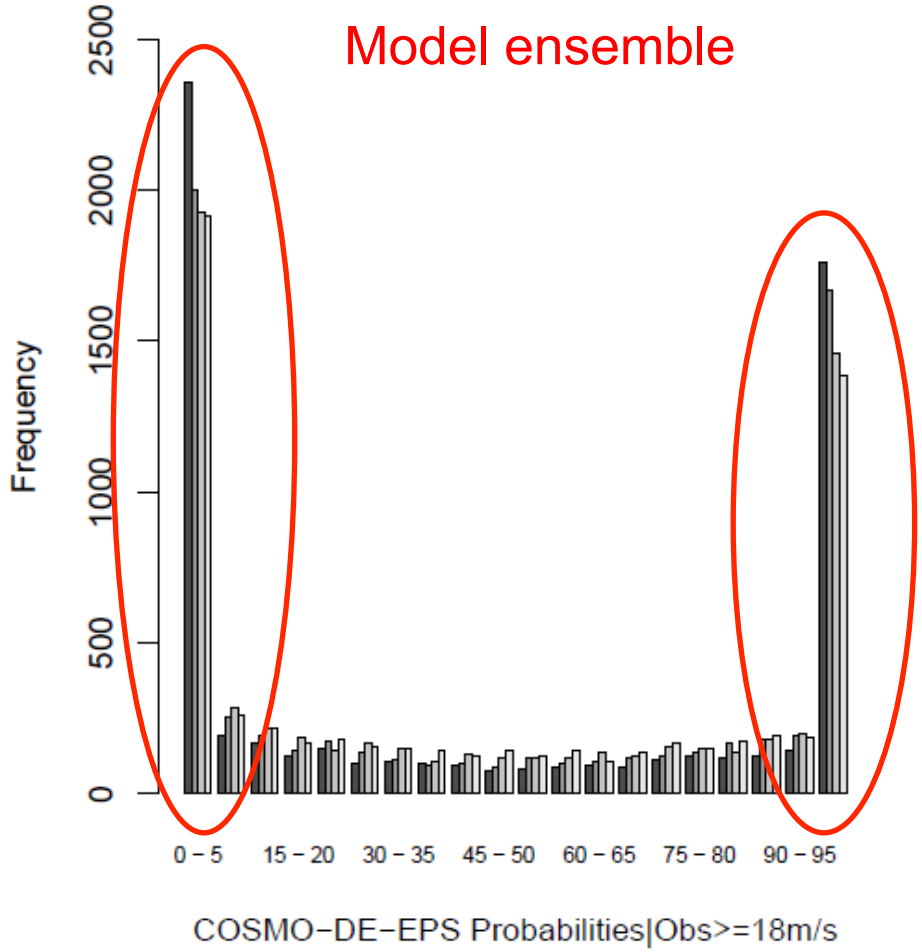
Model ensemble

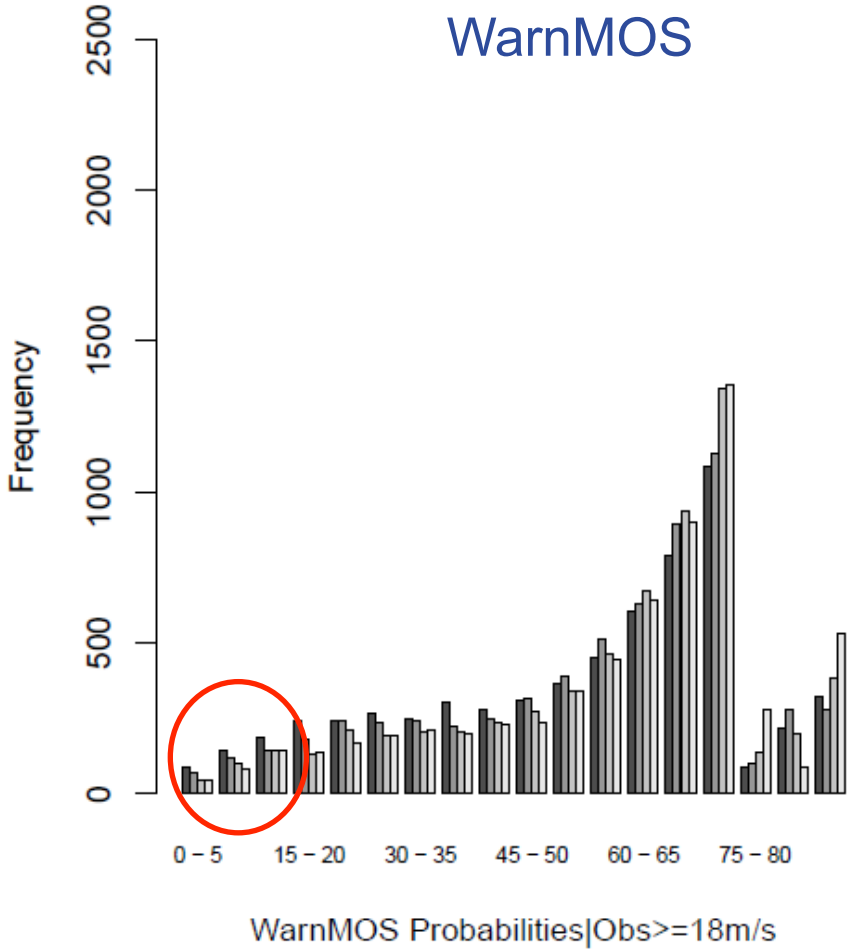


Statistical post-processing

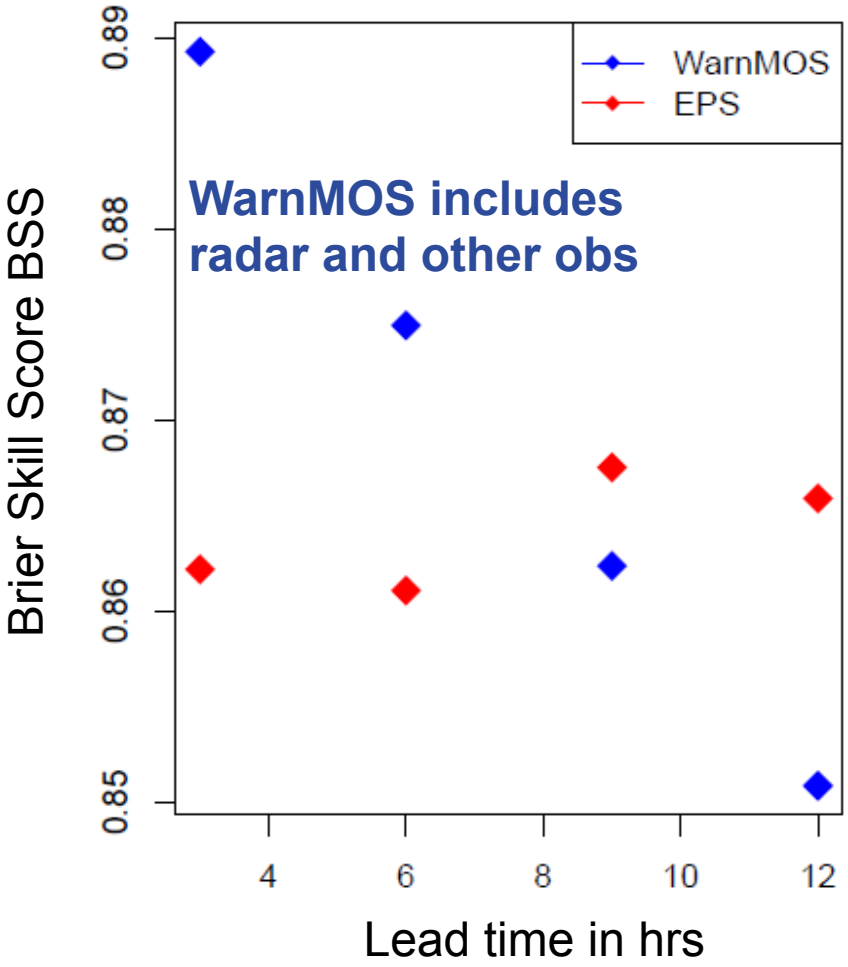


„event happened“ = gust >= 18 m/s





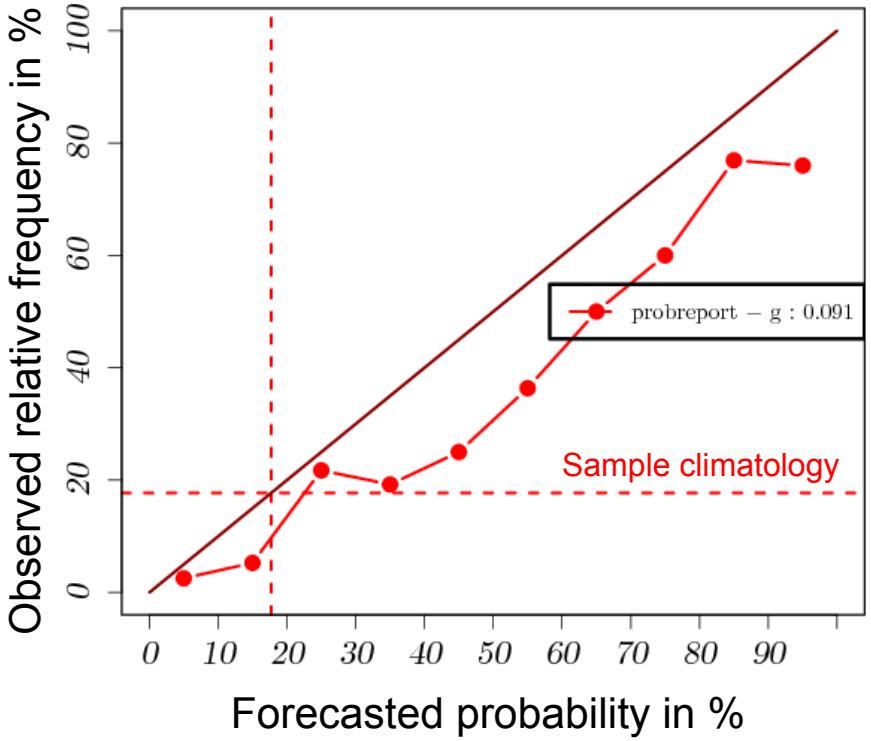
Skill (Brier Skill Score)



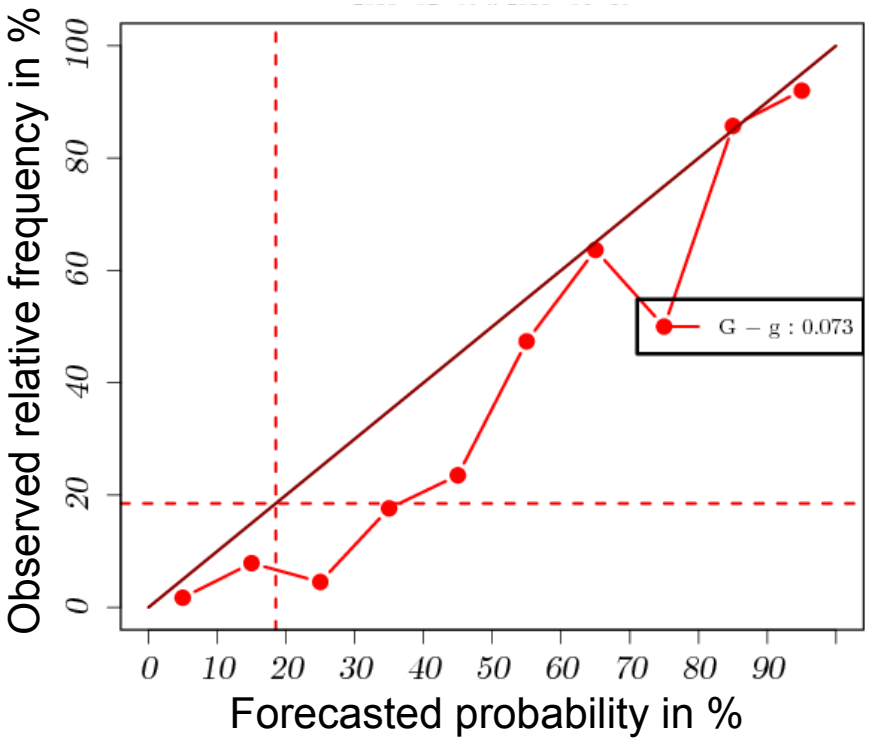
Human vs machine

light snow probabilistic test forecast for Berlin: February – April 2013

Human uncertainty estimate



WarnMOS



3. How can this uncertainty estimate be used?

- part of an interdisciplinary project of meteorologists and social scientists
- **WEXICOM**: COMunication of Extreme Weather Information
- Which itself is part of the „Hans-Ertel-Centre for Weather Research“, HErZ
- More details on the social side of the project:
  - Thursday, 17:45 in talk by Thomas Kox on ***„Perception and use of severe weather warnings by emergency management professionals in Germany”*** (paper 29)
  - Poster No. 30, Thursday, 14:30 ***„An assessment of weather warnings communication products”*** (Ulbrich, Ulbrich, Göber)

Interview with an operational emergency manager

„I‘m no weather expert, I don‘t want to make a decision.“

„I‘m no emergency expert, I don‘t want to make a decision.“ (me)

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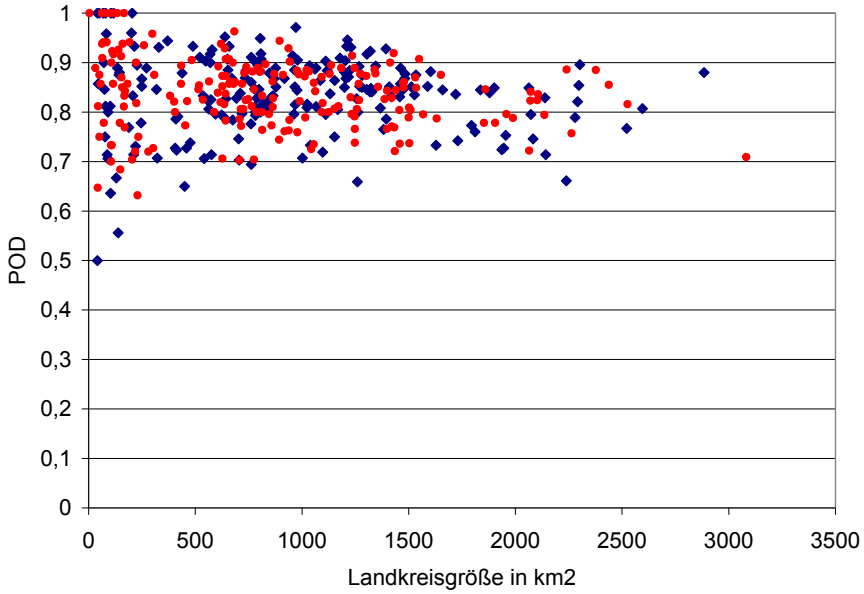

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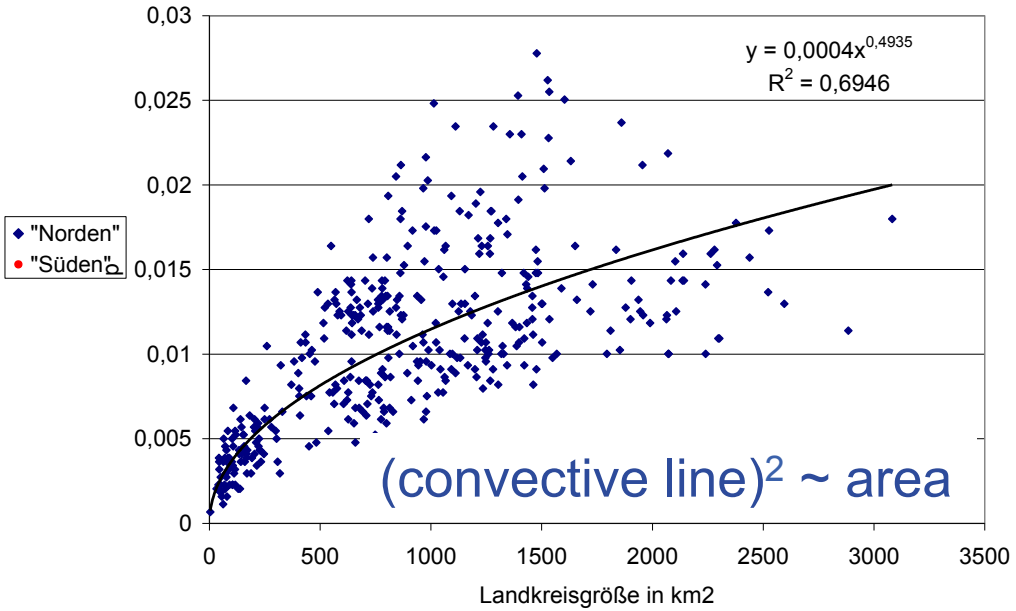

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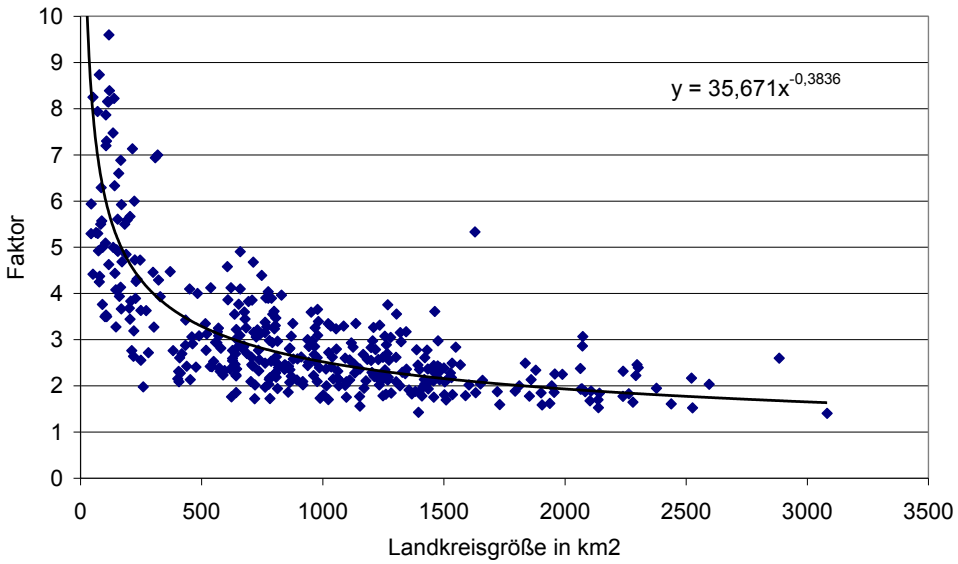
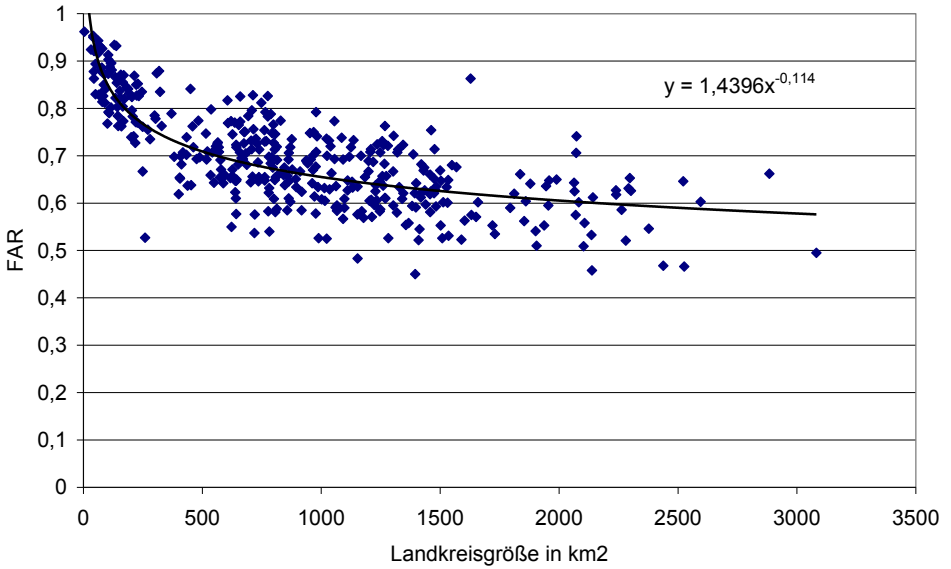
Frequency bias



FAR



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Why information about uncertainty of forecasts ?

- Economic decision theory reveals advantage (e.g. Murphy, 1994)
- Increases confidence in forecasts (MORSS, 2008; FRICK und HEGG, 2011)
- Users ask about the confidence of warnings, especially for severe events (e.g. from user survey of the regional offices München, Potsdam), but WHY → in-depth interviews