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Spatial resolution of probabilistic forecasts and its impact on risk perception and precautionary action

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In the context of probabilistic forecasting, low probabilities are known to be often underestimated by forecast users. This underestimation of low probabilities may have severe consequences, if people fail to take adequate precautions to protect against high-impact events like storms.

One solution is to communicate higher probabilities by lowering the forecasts' spatial resolution: the lower the resolution, the higher the probability that the event will occur within the area. At the same time, a lower resolution entails more uncertainty about where exactly the event could occur. Thus, whereas a lower forecast resolution may heighten forecast users' risk perception through larger probabilities, an increase in spatial uncertainty could reverse this effect.

In an online experiment, we investigate the effects of forecast resolution and spatial uncertainty on risk perception and precautionary decisions ($N = 149$). For 12 probabilistic thunderstorm forecasts, participants (i) entered how likely they believed their location would be hit by a thunderstorm, and (ii) decided whether to host an outdoor event at that location at a risk of a high loss or cancel in advance at a smaller cost (blocks randomized).

We find that a lower forecast resolution significantly reduced how likely participants believed to be hit and how often they chose to protect against thunderstorms. At the same time, higher forecast probabilities increased participants' risk perception and likelihood to take precautionary action. Furthermore, the interpretations of the forecast's spatial reference assessed in multiple choice formats were only a rough proxy for experimentally observed perceptions of risk.

The results constitute a starting point for investigating the trade-off between forecast probability and spatial uncertainty. They also reiterate that the spatial resolution forecasters choose for their products directly influence forecast users' risk perception and behavior.