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Communicating uncertainty in seasonal and interannual climate forecasts in Europe: organisational needs and preferences

Andrea L. Taylor, Suraje Dessai and
Wändi Bruine de Bruin

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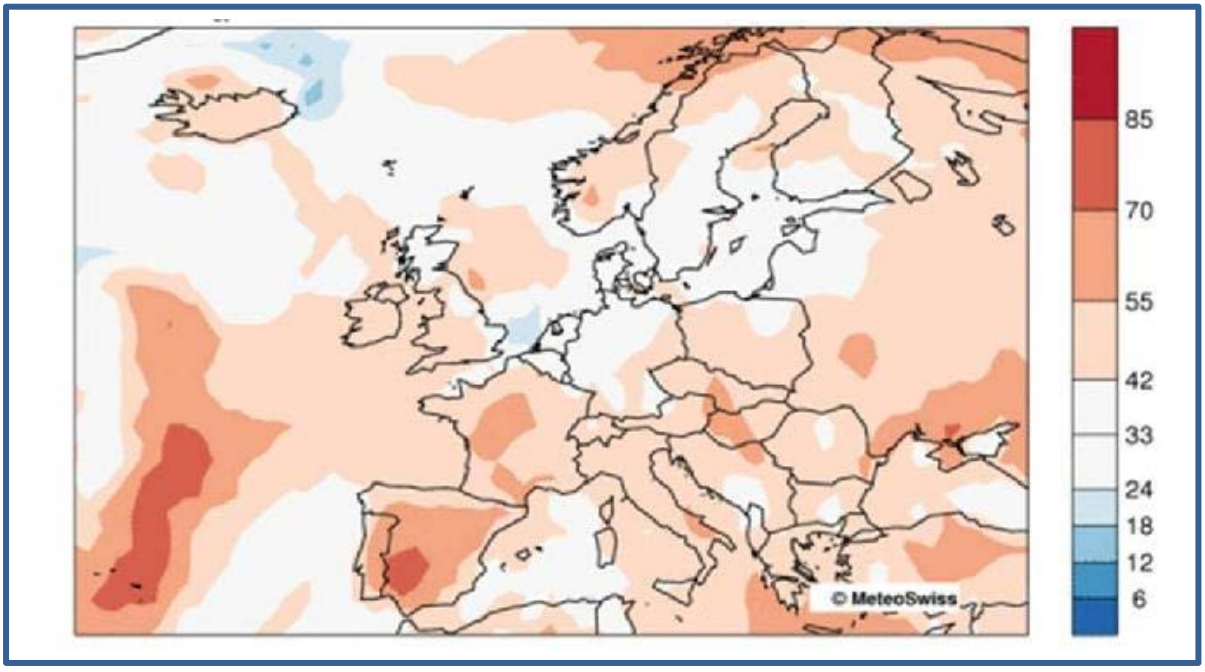

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Communicating uncertainty in seasonal and interannual climate forecasts in Europe

SUMMARY

Seasonal climate forecasts of European winters now outperform historical averages[1]. If the quality of seasonal and interannual forecasts continues to improve, their use is likely to increase. A challenge for forecast providers will be to communicate the uncertainty inherent in these forecasts to a wider audience. We report the results of a user-needs survey conducted with 50 European organisations from a variety of sectors to understand users' information needs, preferences and level of understanding of forecast uncertainty.

Key Messages

1. Users found seasonal forecasts to be useful but difficult to understand.

2. Information about forecast uncertainty (reliability and skill) is currently not easy to access or understand.

3. Users tended to prefer familiar formats for receiving information about uncertainty.

4. Most organisations require some form of data processing and interpretation by forecast providers.

5. The research highlights the need to find communication formats suitable for both expert and non-expert users.

Across Europe, decision-makers in diverse sectors face the challenge of adapting to climate variability and change. Climate forecasts therefore have the potential to be of high value to these organisations. Here we look at forecasts in the range of one month to a year (seasonal) or one year to ten years (interannual).

It is expected that as the accuracy of these seasonal and interannual climate forecasts increases, so will their use. This will mean that, in the future, the proportion of users without technical or statistical expertise is likely to grow. Climate providers thus face the challenge of communicating the uncertainty inherent in these forecasts to decision-makers in a way that is transparent, widely understood and does not lead to a false sense of certainty.

Uncertainty in climate forecasts comes from two sources (1) first order uncertainty is the likelihood of an event happening according to a particular model, and (2) second order uncertainty is how accurate the model is that is used to generate the forecast. Second order uncertainty is mostly shown as a measure of reliability (how well predictions have matched observations) and skill (how well predictions have performed relative to historical averages).

Currently there is a lack of empirically supported recommendations for presenting uncertainty in long-range climate forecasts. To address this we conducted a survey in order to: understand how participants' organisations approach uncertain information in their decision making; assess how accessible, understandable and useful current forecasts are perceived to be; and find out how participants prefer to receive information about uncertainty.

Survey Method

The survey was conducted as part of the EUPORIAS project (European Provision of Regional Impact Assessments on Seasonal and Decadal Timescales), with 50 participants recruited from EUPORIAS stakeholders and organisations who had expressed an interest in seasonal and interannual forecasts. A diverse range of sectors were represented including water management, forestry, energy, health, tourism, agriculture, transportation, emergency services, climate consultancy and finance. The sample was highly educated with about three-quarters educated to postgraduate level.

Organisations' use of uncertain climate information in decision-making

The majority organisations within the sample were mostly concerned with the climate events that are 'most likely' to happen, but this did not stop them also being concerned with unlikely but high-impact events.

In addition, the majority of participants agreed that their organisation liked to receive information in a format that facilitated Yes/No decision-making. However, relatively few organisations had clear guidelines as to how much statistical confidence was needed before taking action. Also, while it was found that tolerance for uncertainty among the sample was generally high, lower tolerance for uncertainty tended to correspond with a stronger preference for formats that provide recommendations for action.

Most organisations require the climate information providers to perform at least some processing and interpretation, even if they also did their own in-house analysis. As our participants were characterised by their interest in climate forecasts, it is likely that this need for interpretation by providers would be even greater in a wider sample.

Perception of current forecasts

Participants were asked about their experiences of climate forecasts on weather timescales (up to 1 month into the future), seasonal timescales (1 month to 1 year), and interannual timescales (1 to 10 years).

All forecasts were perceived to be more useful than they were accessible or understandable, although this difference was even greater for seasonal and interannual forecasts than weather forecasts. Ratings of accessibility, understandability and usefulness decreased as the forecast lead time increased; with weather forecasts scoring best and the interannual forecasts worst. As weather forecasts are more widespread than the long-range forecasts, differences in perceived accessibility are in keeping with actual availability.

The lower perceived understandability of seasonal and interannual forecasts is concerning as this indicates that the forecast information that is currently available does not tend to be user-friendly. It highlights a pressing need for more user-friendly formats to be developed in order for these forecasts to be more widely adopted in the future.

Receiving information on uncertainty

Personal preference for certain information formats is not always linked to better understanding[2]. However, as users may be reluctant to use other formats, it is important to understand their initial preferences. To determine this, we presented participants with seven visualisations showing first order uncertainty (figure 1). We also asked about participants' comfort with statistics.

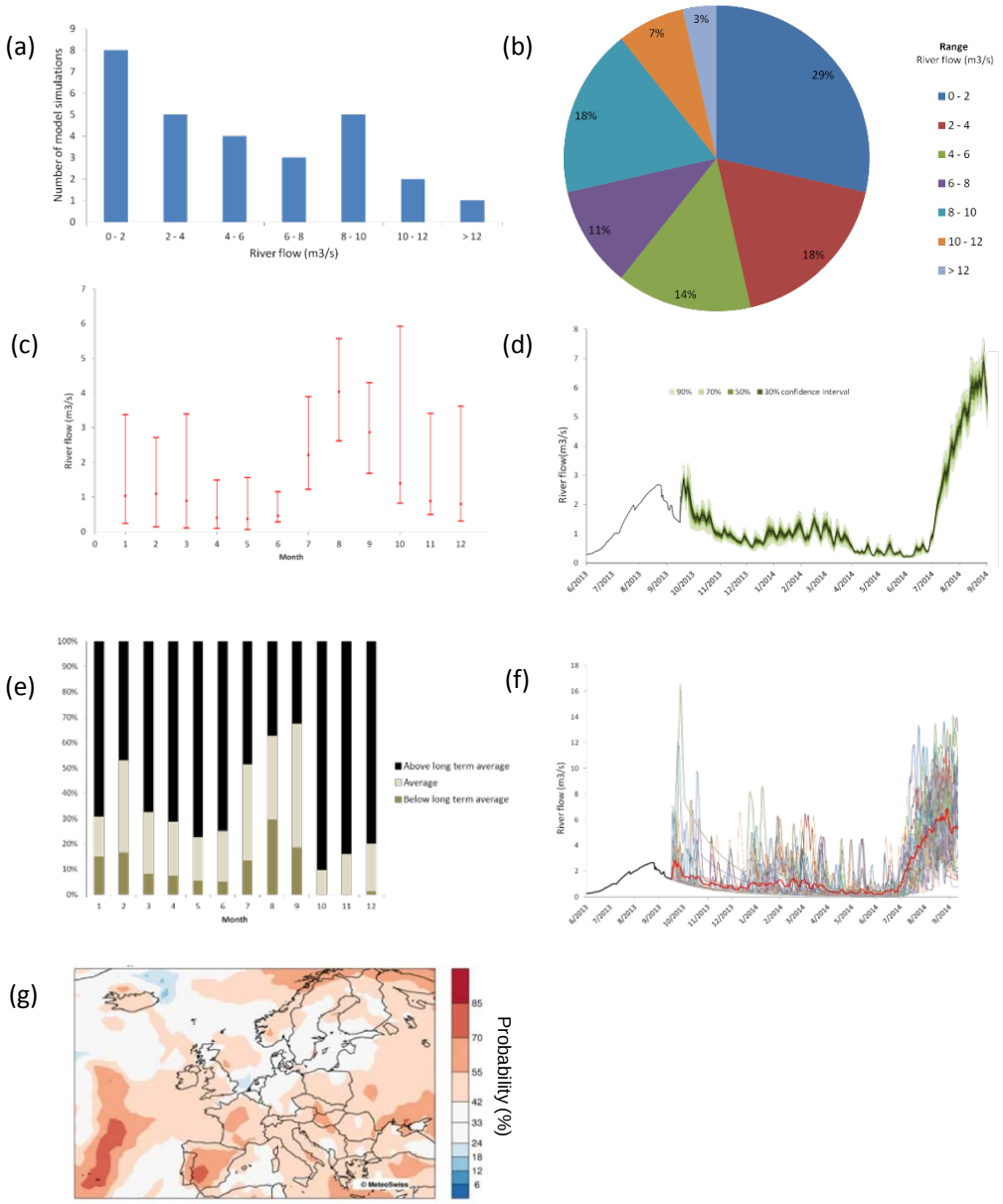

Figure 1. Visualisations rated for preference and familiarity. (a) Bar graph showing forecast distribution. (b) Pie chart. (c) Error bars. (d) Fan chart. (e) Tercile Bar graph. (f) Spaghetti plot. (g) Map. (a–f) A hypothetical seasonal river flow forecast. (g) A hypothetical forecast for likelihood of above-average seasonal temperatures

(i) Methods of representing probability

We found that the map, fan chart and error bar received the highest preference ratings, while the tercile bar graph, spaghetti plot and pie chart received the lowest. It therefore appears that maps and representations of spread are more popular among our sample than representations of discrete categories.

(ii) Is preference associated with familiarity and statistical comfort?

For all visualisations, preference was strongly associated with familiarity, indicating that participants tended to prefer those visualisation formats with which they were already most familiar. On the other hand, preference for the seeing an error bar was linked to a participant's comfort with statistics. As our sample contained a large proportion of respondents with a high level of statistical expertise, it is possible that these graph formats would be favoured less among a broader sample.

(iii) What information about uncertainty in climate forecasts are users currently receiving, and what else would they like to receive?

We found that confidence intervals, ranges of values and verbal descriptions were the most commonly received formats of uncertainty information, followed by raw data and probability distributions.

Most users reported that they did not currently receive information about how well forecasts have matched past-climate observations (reliability). However, out of those who did not receive this information, nearly half indicated that they would like to.

These results suggest that information about the reliability and skill of is not currently being presented to all users who wish to receive it, or at least not in a way that is relevant to them or well understood. As this information on second order uncertainty is necessary for users to avoid a false sense of certainty, this is an area of concern.

Acknowledgements

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About the Authors

Andrea Taylor is a research fellow split between the Centre for Decision Research, Leeds University Business School, and the School for Earth and the Environment, University of Leeds. This paper arose from Andrea's work on the EUPORIAS project.

Suraje Dessai is Professor of Climate Change Adaptation at the Sustainability Research Institute, University of Leeds.

Wändi Bruine de Bruin is Professor in Behavioural Decision Making and Co-director of the Centre for Decision Research, Leeds University Business School.

Further Information

Information advising this policy brief is taken from the academic paper: Andrea L. Taylor, Suraje Dessai, Wändi Bruine de Bruin "Communicating uncertainty in seasonal and interannual climate forecasts in Europe" Philosophical Transactions A 2015; volume 373, issue 2055 (in press) doi: 10.1098/rsta.2014.0454

More information on the EUPORIAS project can be found at: http://www.euporias.eu/

For more information, please contact:

Andrea Taylor
Sustainability Research Institute, University of Leeds, Leeds, LS2 9JT
A.L.Taylor@leeds.ac.uk

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