



Communicating Forecast Uncertainty for service providers

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**International Symposium on Public Weather Services:
A Key To Service Delivery**



Communicating Forecast Uncertainty

- The WMO Strategic Plan 2008-11 identifies the need for the provision of “quantitative measures of information certainty and/or uncertainty to increase the utility of weather, hydrology and seasonal climate information in decision-making.”
- Such information has no value if it is not communicated effectively and it does not assist decision-making. **Usability** is key

Communicating forecast uncertainty

- The need to communicate uncertainty has been recognised for a long time
- W.E. Cooke, Monthly Weather Review 1906

5	We may rely upon this with almost absolute certainty
4	We may rely upon this with tolerable certainty, but may be wrong about once in ten times
3	Very doubtful. More likely right than wrong, but probably wrong about four times out of ten
2	Just possible, but not likely. If showers are indicated, for example, they will not be heavy even if they occur at all
1	The barest possibility. Not at all likely

And a forecast might read:

Southwest district: Fine weather throughout (5) except in the extreme southwest where a few light coastal showers are possible (2). Warm inland (4), with a cool change expected on the west coast (3).



Why communicate uncertainty

- Assists decision making
 - users can ‘tune’ their response to the forecast likelihood
- Manage user expectations
 - helps users understand the limits of the service
- Retain user confidence
 - fosters **credibility**
- Reflects state of science

Sources of uncertainty

- Atmospheric unpredictability
- Uncertainty of measurement
- Uncertainty of data interpretation
- Uncertainty introduced when formulating the forecast - semantic uncertainty
- User interpretation of the forecast

How to communicate uncertainty: spoken words

- Can often be the most effective way for users to gauge the confidence of the forecaster
- Flexible language, including body language, allows the forecast to be 'nuanced'
- Radio interviews are very popular because "*I can get a real feel for how likely the event is, just by the way the forecaster is talking*"
- Users get to know which forecasters are cautious and which are adventurous
- Downside is that the information can be too subjective

How to communicate uncertainty: simple numerical scale



- 4-day forecast, including forecast reliability (Télévision Suisse and Swiss Federal Office of Meteorology and Climatology)

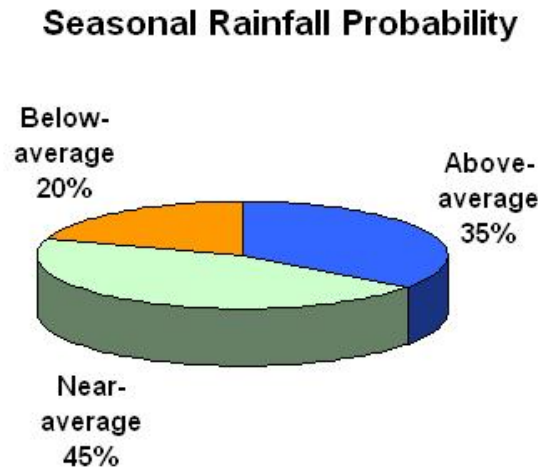
How to communicate uncertainty: simple worded scale

Terminology	Likelihood of the occurrence/outcome
Virtually certain	Greater than 99% probability
Very likely	Greater than 90% probability
Likely	Greater than 66% probability
About as likely as not	33% to 66% probability
Unlikely	Less than 33% probability
Very unlikely	Less than 10% probability
Exceptionally unlikely	Less than 1% probability

- IPCC Likelihood scale. Important to match words carefully to a defined, objective scale in order to avoid ambiguity and confusion

How to communicate uncertainty: graphs

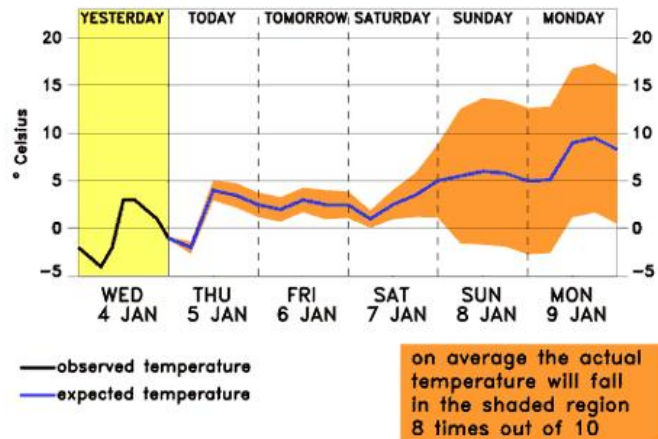
- Can be simple



- This format is nice because it shows all possibilities - users are made aware of not only the most likely outcome but also the possible alternatives

How to communicate uncertainty: graphs

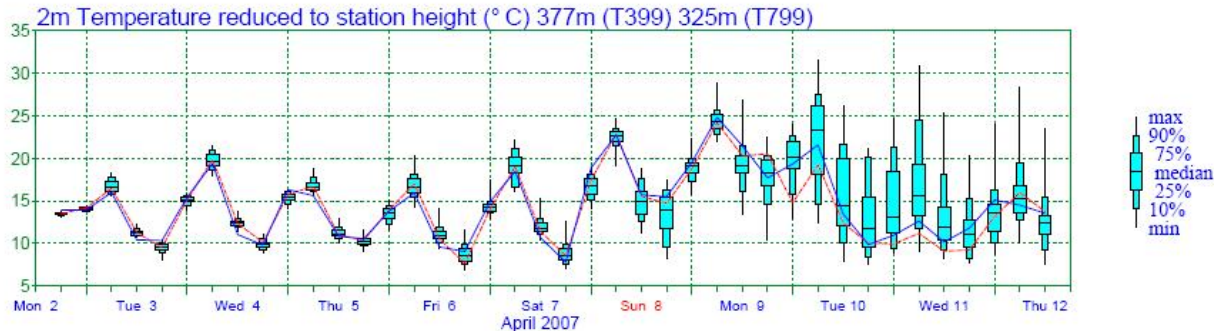
- Can be more complex



- UKMO study shows a high rate of understanding of a seemingly complex graph like this. Note:
 - the use of 'natural frequencies' rather than probabilities, percentiles, etc
 - the inclusion of yesterday's weather as a reference point

How to communicate uncertainty: graphs

- Can be even more complex



- More specialised users often need, and can understand, more specialised and complex information. Understand your users before designing their service.

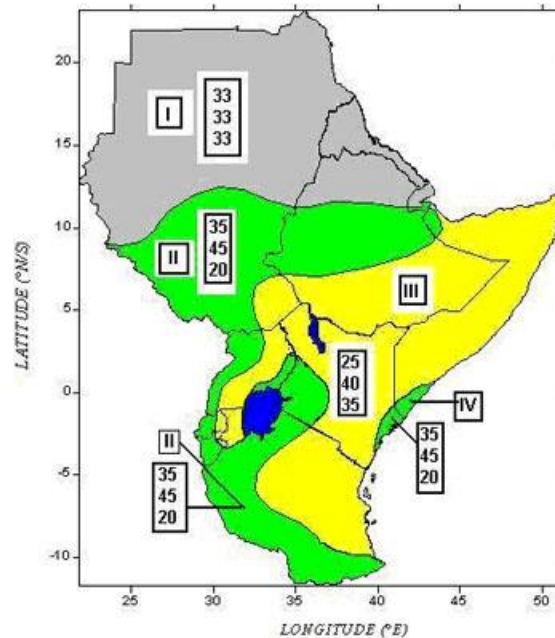
How to communicate uncertainty: icons

- Can be difficult to communicate forecast uncertainty using icons. One approach is to superimpose an uncertainty quantity (e.g. probability) onto the icon



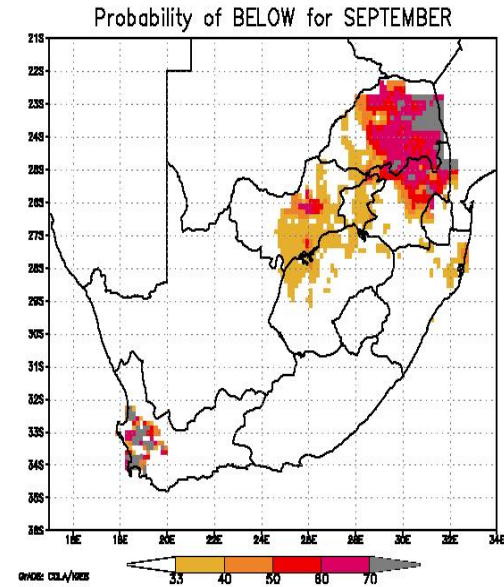
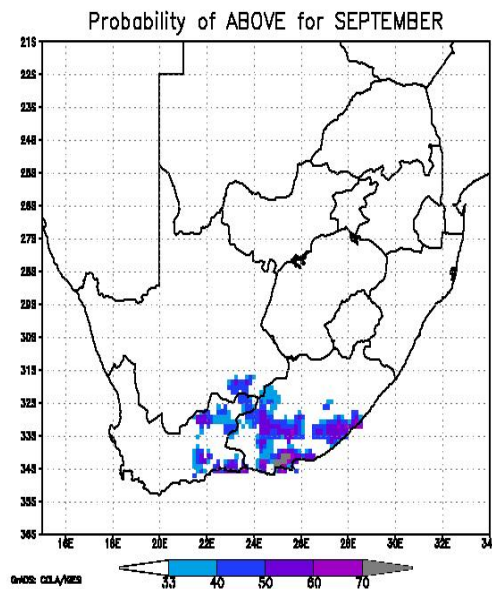
(US National Weather Service)

How to communicate uncertainty: charts and maps



- Greater Horn of Africa Consensus Climate Outlook: the boxes show the probability of above-, near- and below-normal rainfall, i.e all possibilities are canvassed.

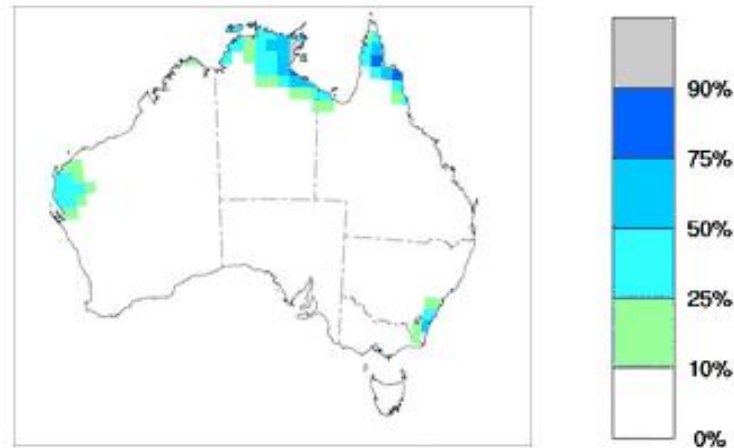
How to communicate uncertainty: charts and maps



- Probability of above and below average monthly rainfall. These are most effective when the climate signal is strong - where it is weak, or the forecast has low skill, a 'mask' can be used over areas where no forecast should be made

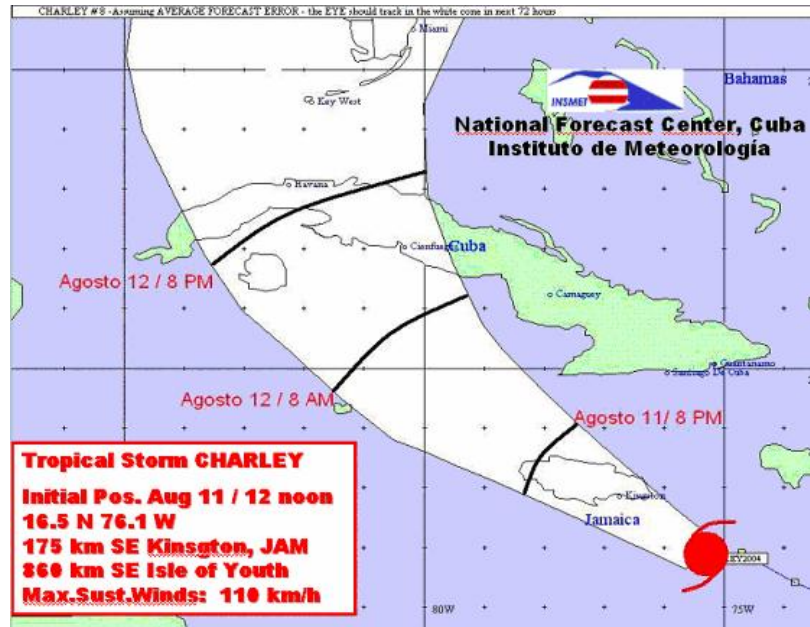
How to communicate uncertainty: charts and maps

Chance of at least 5 mm



- Probabilities of rainfall above a defined amount. This is a useful way of presenting forecast rainfall derived from Ensemble NWP prediction schemes

How to communicate uncertainty: charts and maps

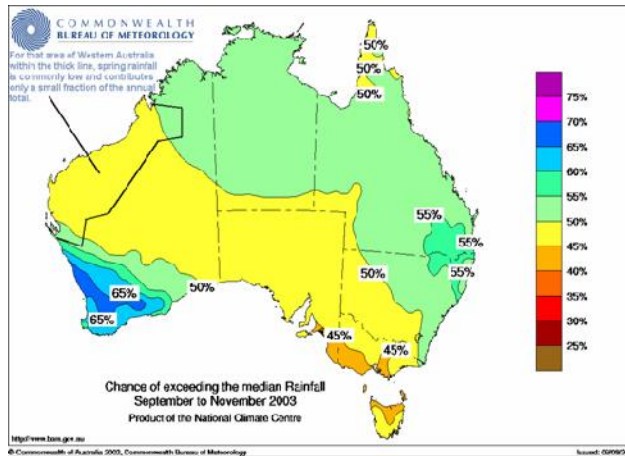


- Tropical cyclone/hurricane track forecast showing envelope or 'cone' of the average forecast error. A variation of this could colour-code the cone according to a 'strike probability'

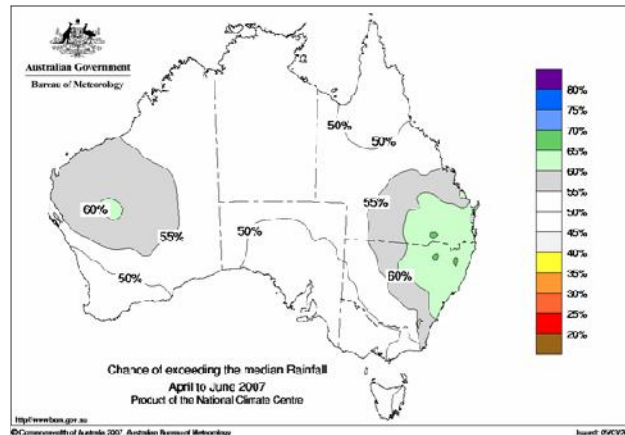
Understanding probabilities

- People's perception of a particular probability is influenced by the significance of the event. If light rain and heavy rain are both forecast to have a 10% chance, people subjectively *feel* that the heavy rain event is more likely.
- Important to precisely define probability, and educate users accordingly. The public *can* learn that 10% chance of rain means 10% chance within the forecast area during the forecast period.

Take care when using colour



- Emotive colours can lead users to 'over-react' to the forecast. Is there really much difference between 49% and 51% (or is there sufficient forecast skill to make the distinction)?



- Better, more restrained use of colour leads the user to the appropriate message

Communicating Forecast Uncertainty: Take Home Messages

- There is an ever-growing need for forecast uncertainty information
- Unless this information is communicated well, its benefits will not be realised. Worse, users will be confused and service effectiveness will be damaged
- Uncertainty information need not be complex
- **Users benefit by making better decisions**

THANK YOU (100%)