



Presenting Uncertainty in 5-day site-specific forecasts on the web.

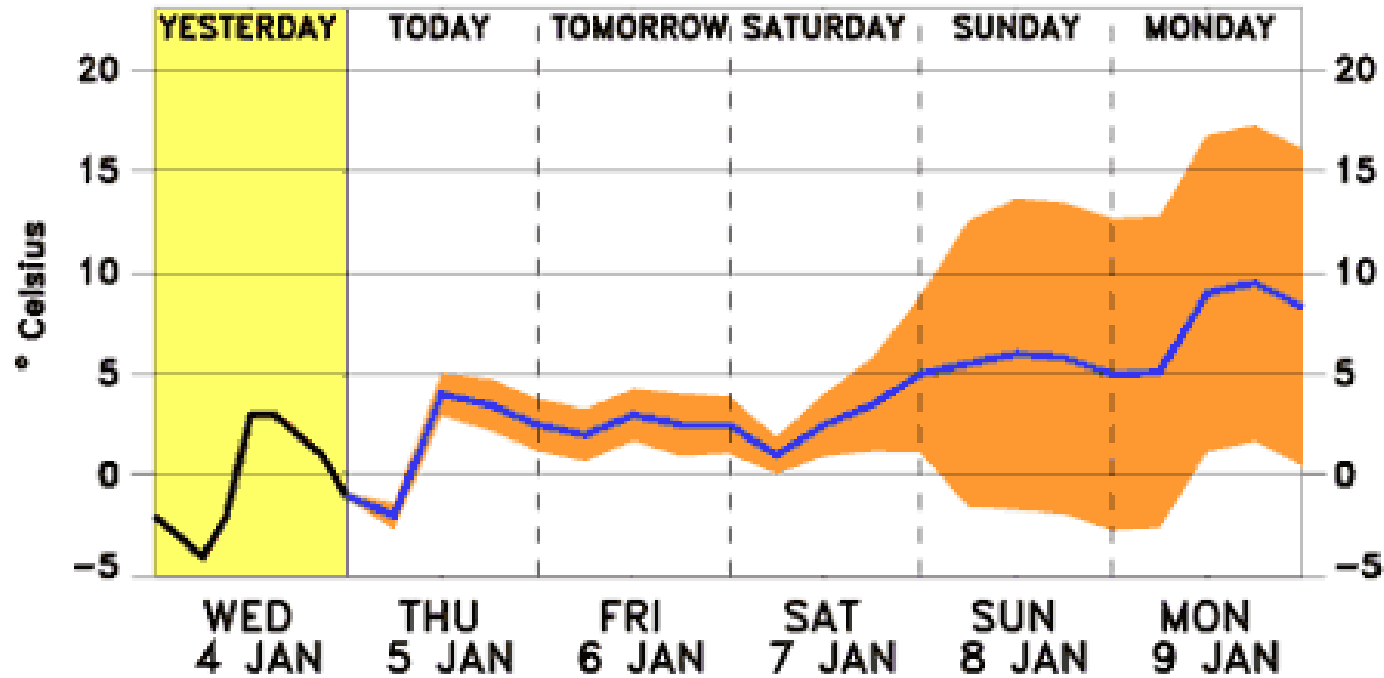
Prepared for Ken Mylne by

Mark Roulston

- Questionnaire about uncertainty in the 5-day temperature forecast placed on Met Office public website from Tuesday 13th June until Monday 19th June 2006. (1144 external responses).
- Experiments conducted in the experimental economics laboratory at Exeter University to test undergraduates' understanding of format for 5-day temperature forecasts.

Temperature Uncertainty Questionnaire

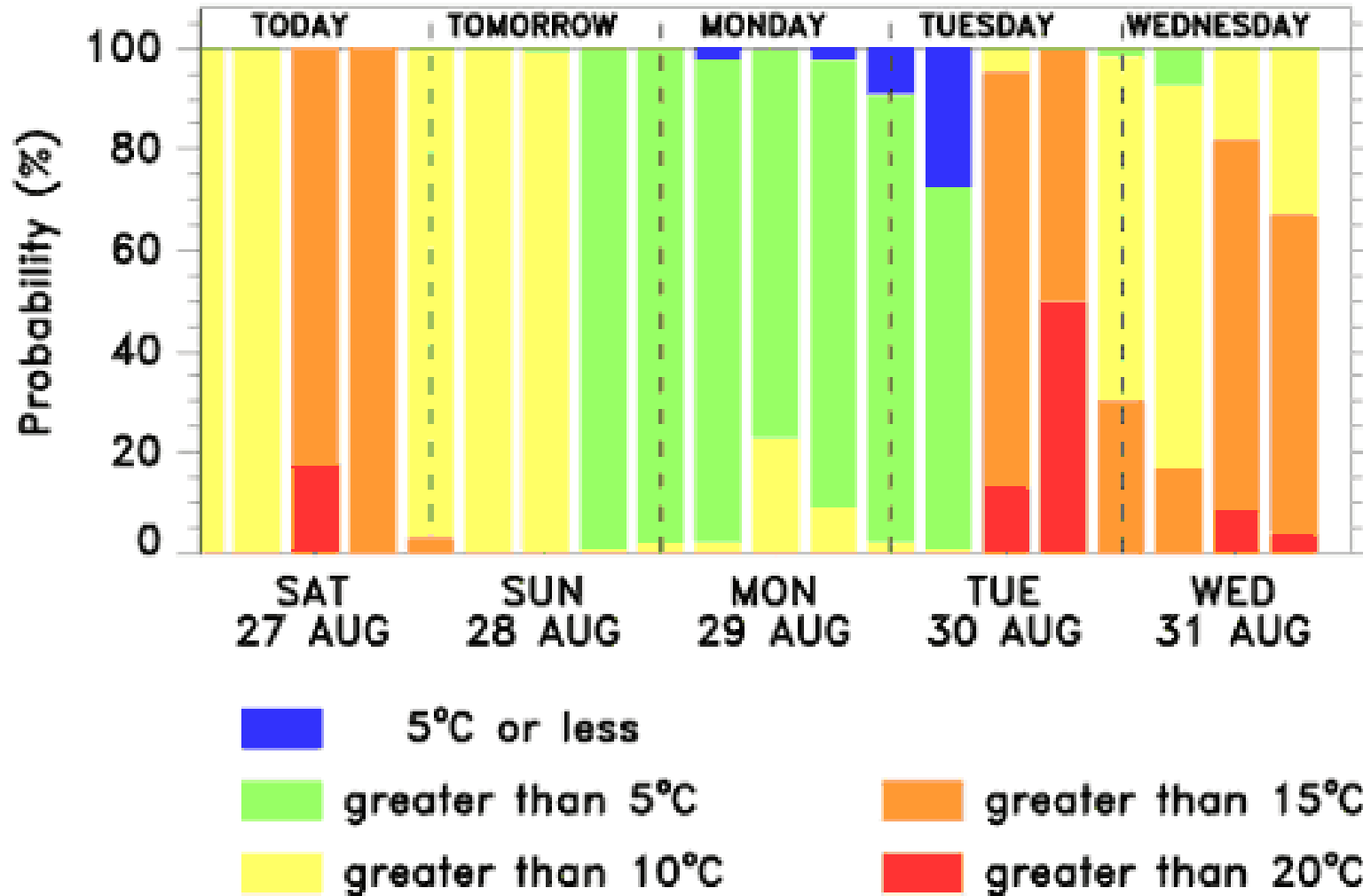
Option 1



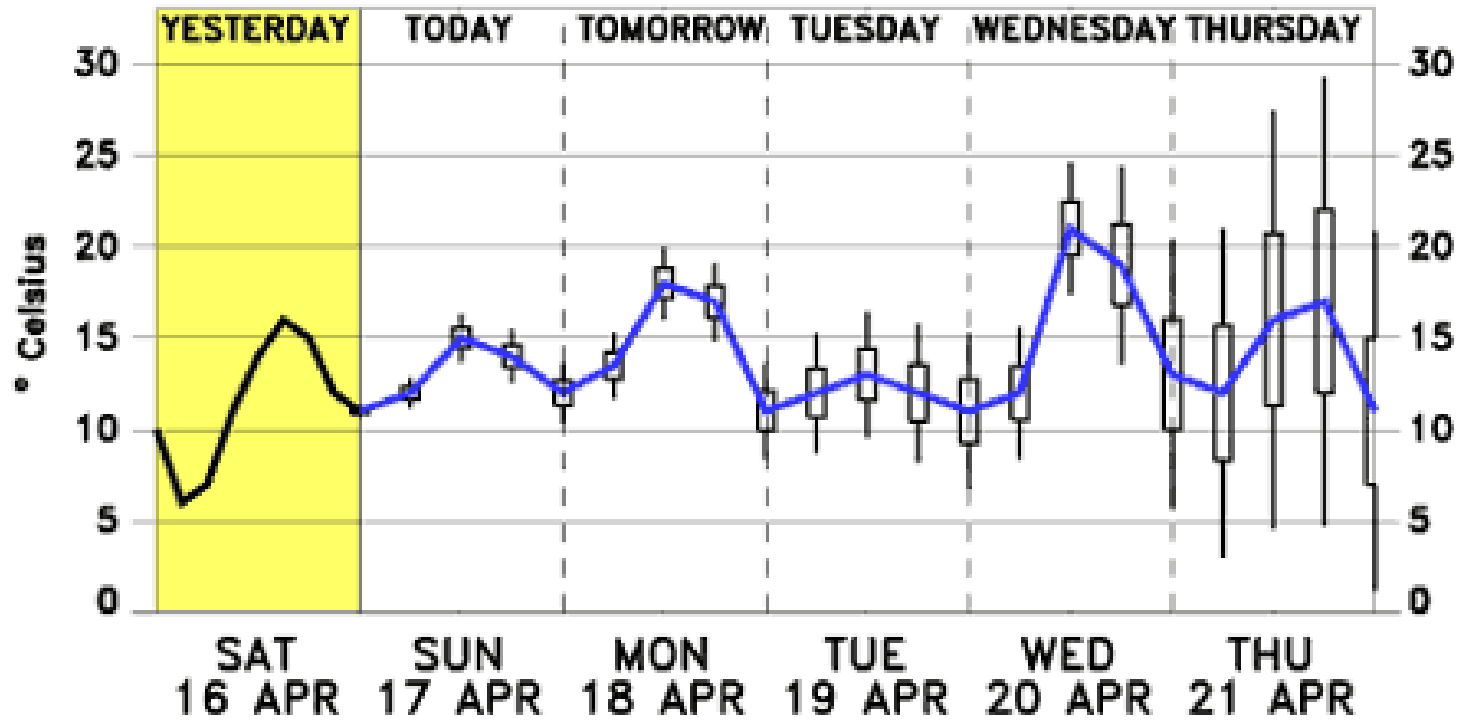
— observed temperature
— expected temperature

on average the actual temperature will fall in the shaded region 8 times out of 10

Option 2



Option 3

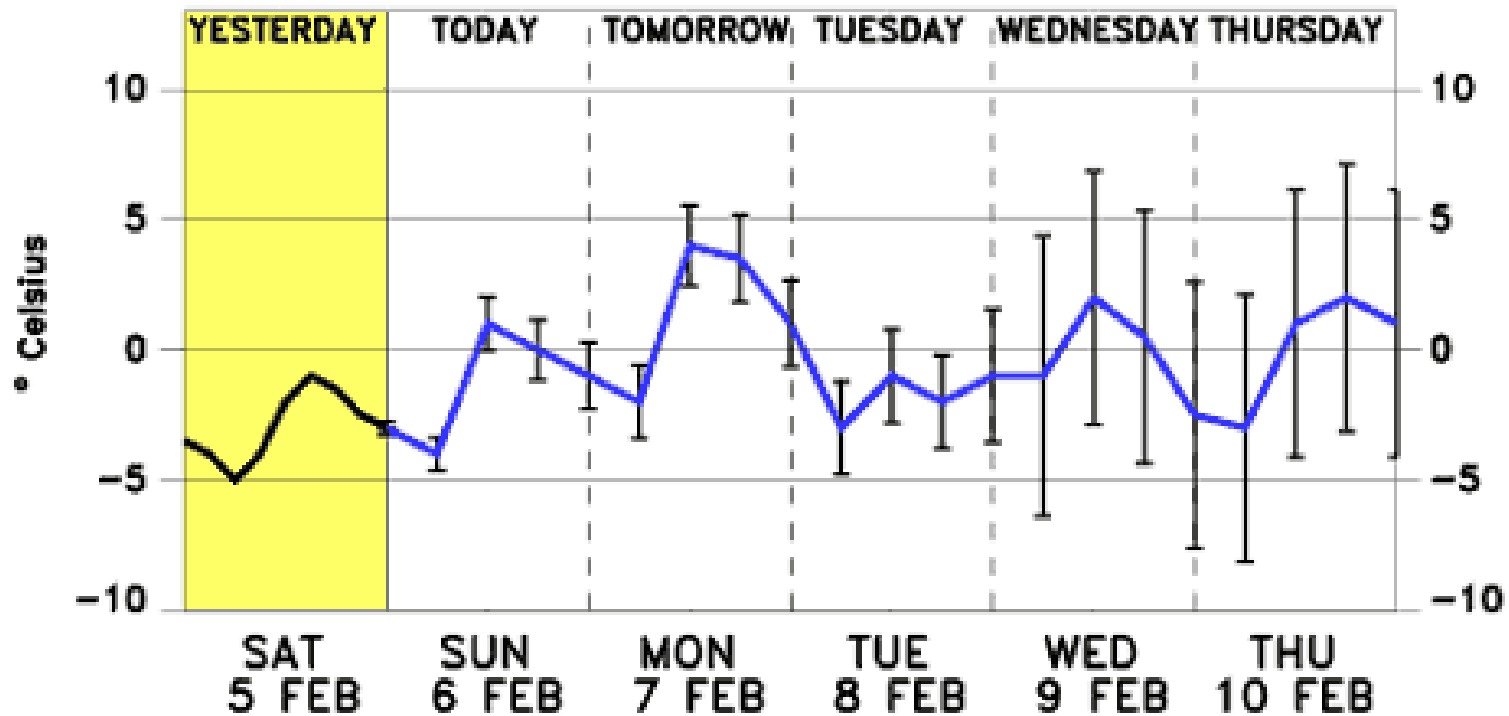


— observed temperature
— expected temperature

on average temperature will fall in inner range 5 times out of 10

on average temperature will fall in outer range 9 times out of 10

Option 4



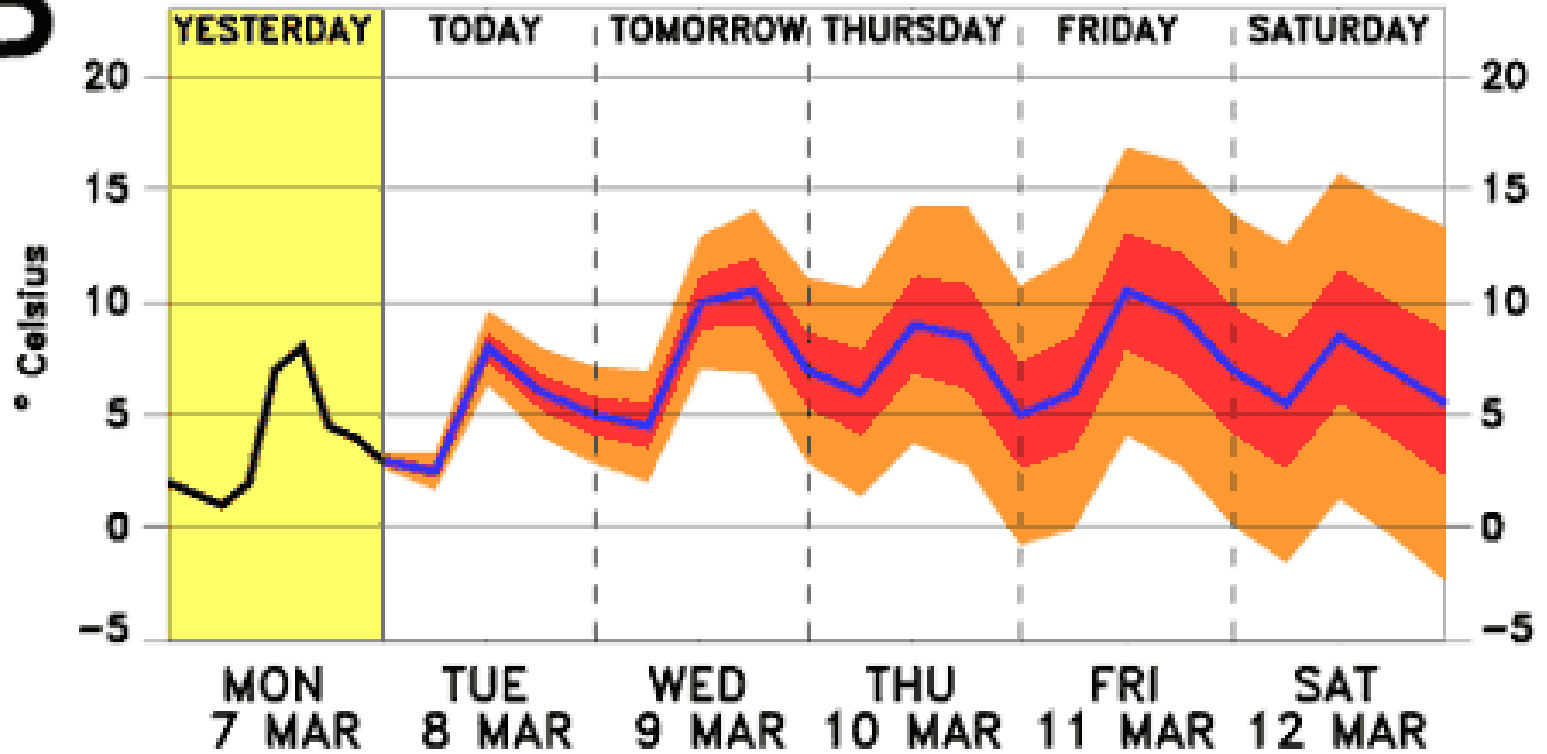
— observed temperature
— expected temperature

on average the actual temperature will fall within the error bars 8 times out of 10

Option 5



B

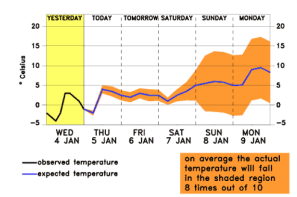


— observed temperature
— expected temperature

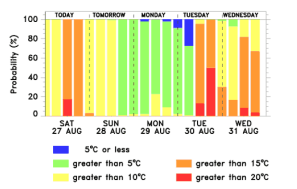
on average temperature will fall in inner range 5 times out of 10

on average temperature will fall in outer range 9 times out of 10

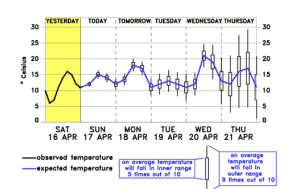
Most Useful?



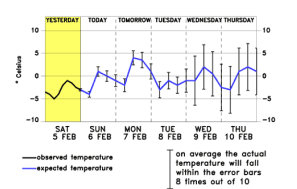
Option 1



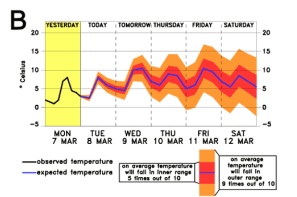
Option 2



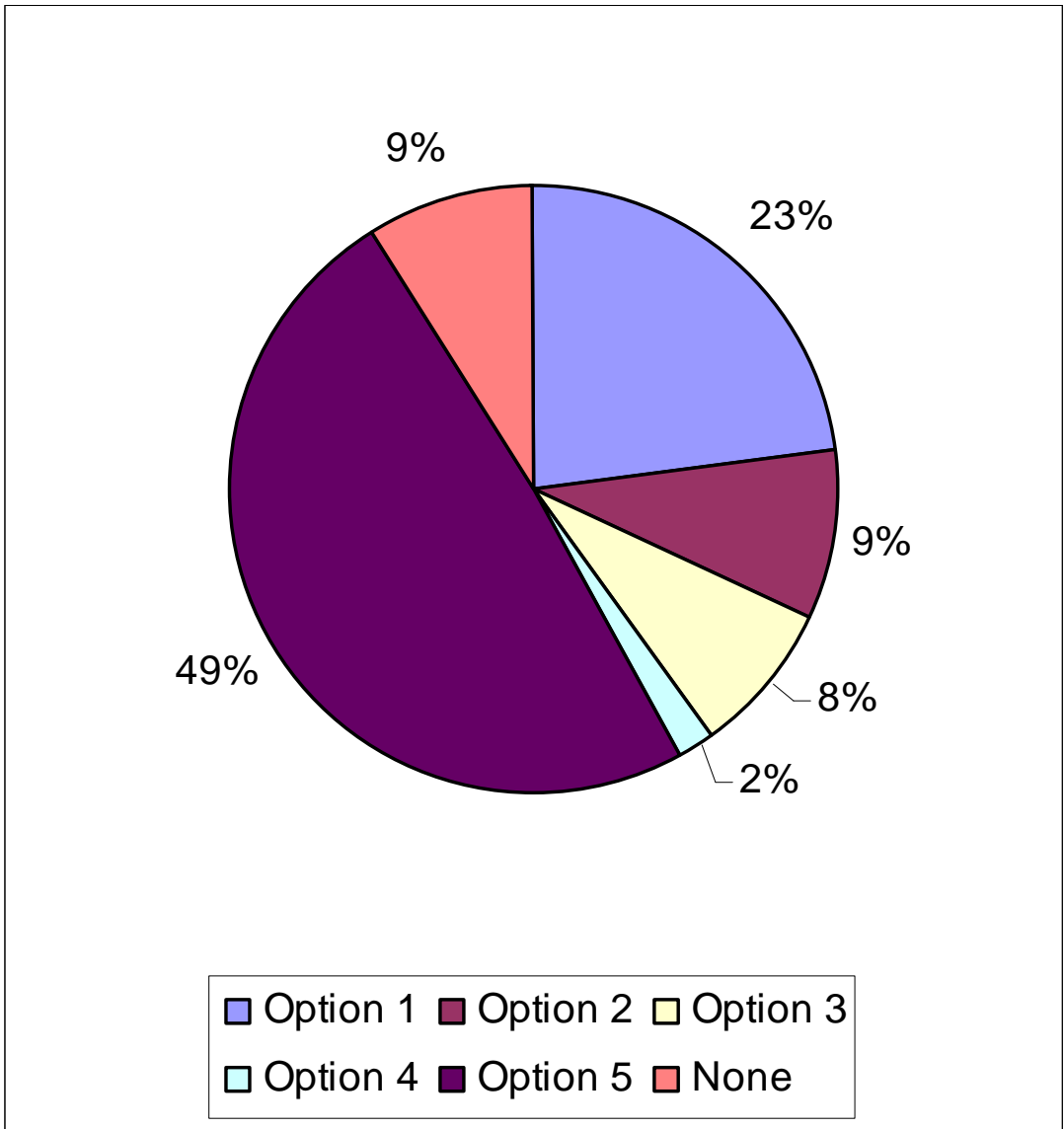
Option 3



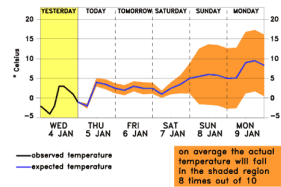
Option 4



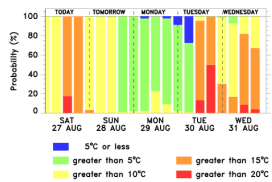
Option 5



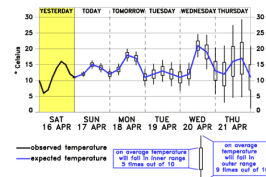
Easiest Format?



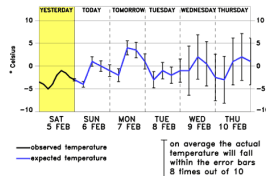
Option 1



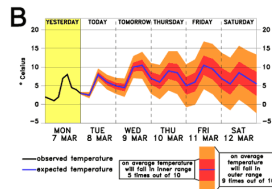
Option 2



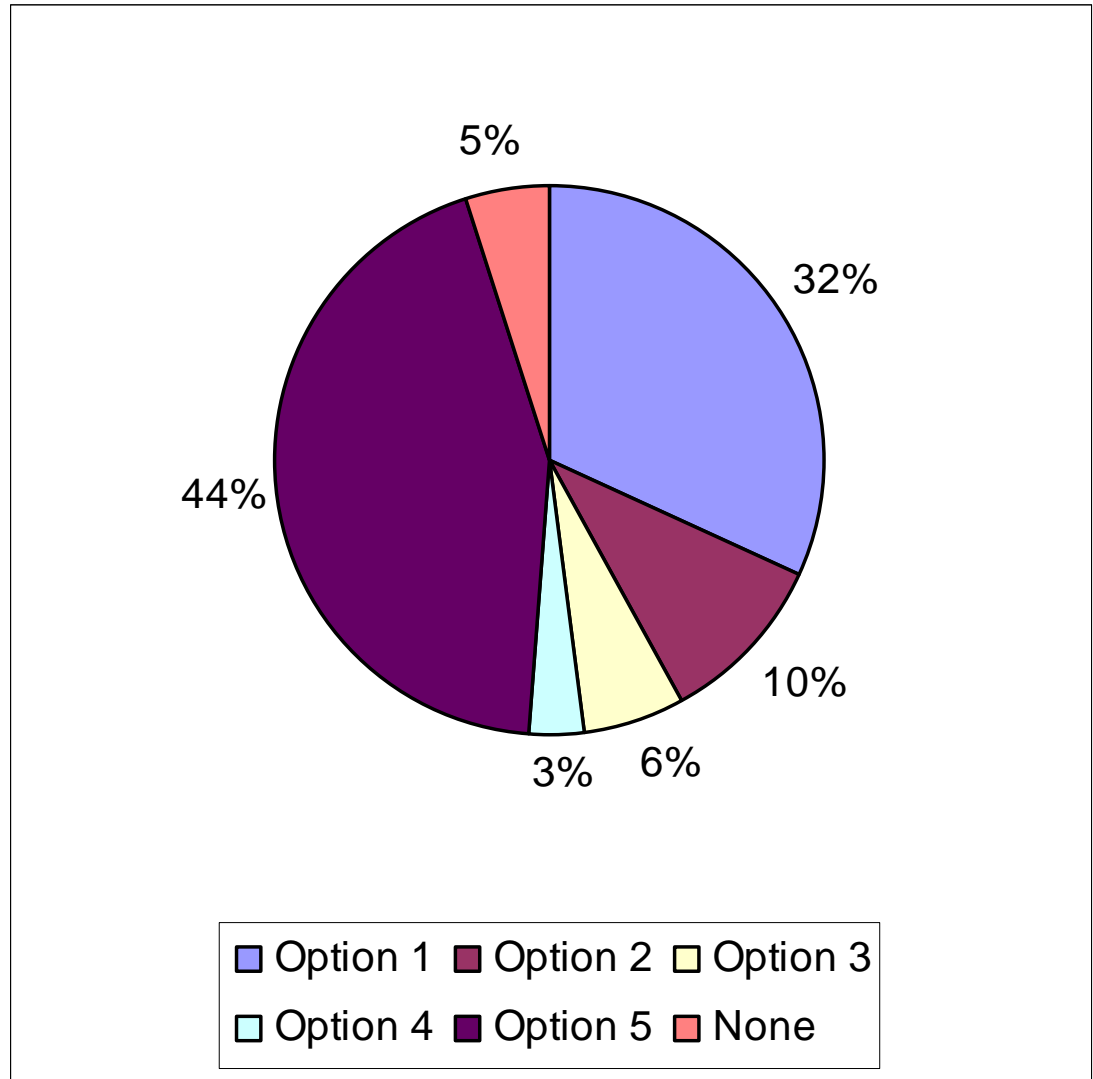
Option 3



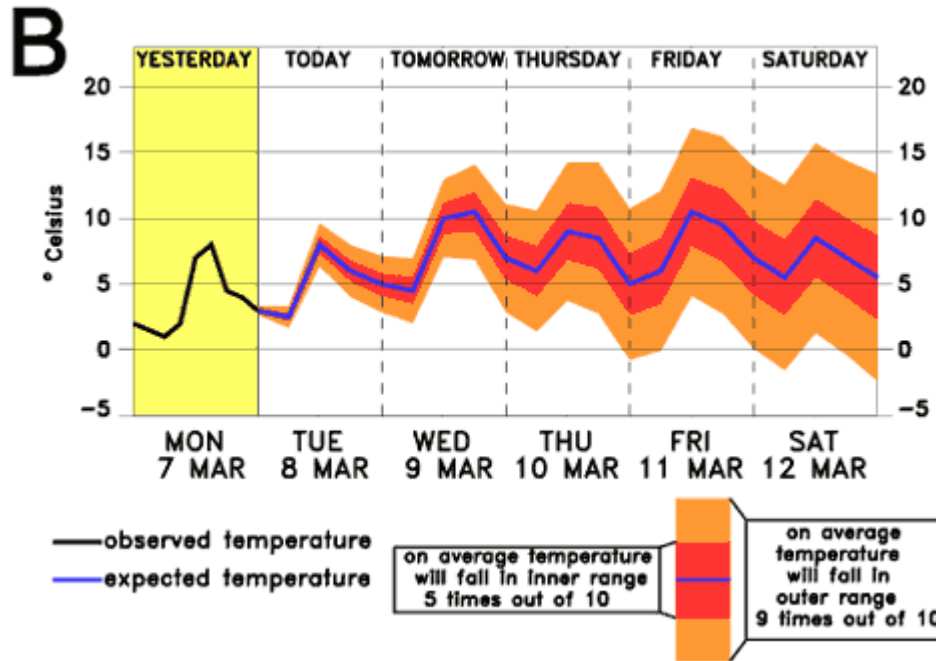
Option 4



Option 5



Option 5: Popular



“option 5 is good actually but a person has to be an experienced graph reader or have time to devote to deciphering it.”

“If the graph type option 5 appeared regularly on the regional forecast pages we'd get used to it very quickly.”

“option 5 is MUCH better than the rest”

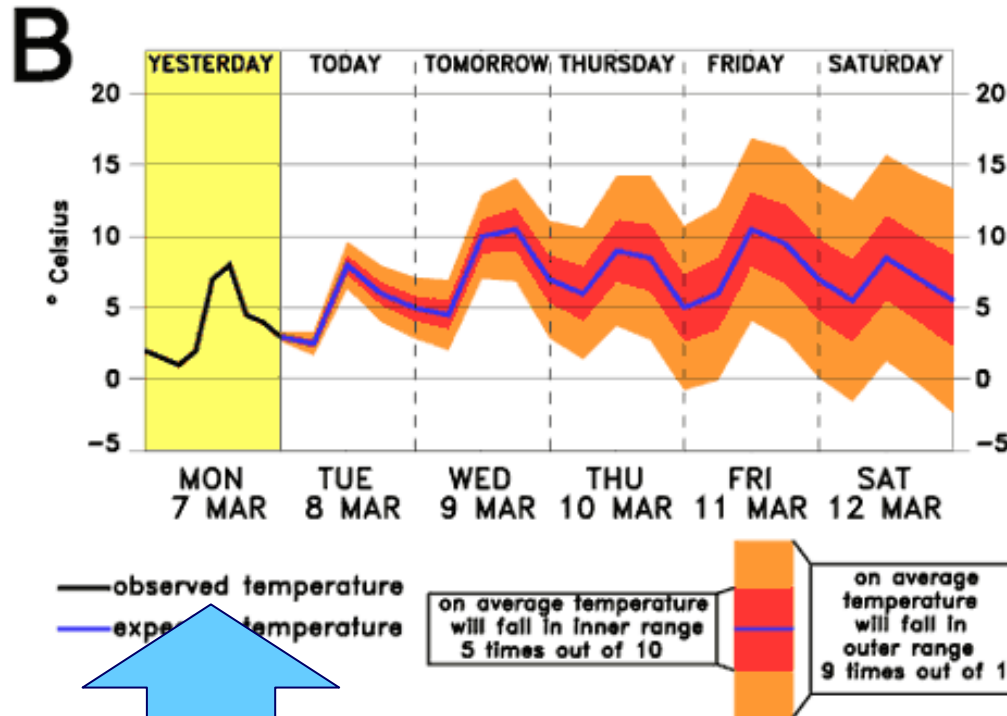
“Tried it on my kids too. They also found Option 5 simplest.”

“Option five looks particularly good”

“Options 3 and 5 seem equivalent 5 looks best.”

“I really like Option 5 - very useful.”

Option 5 – design features



Include yesterday's observations

- Natural reference that user can remember

Wording in "Natural Frequencies"

- after Gigerenzer

No:

- "Probabilities"
- "Percentiles"
- "Confidence Limits"

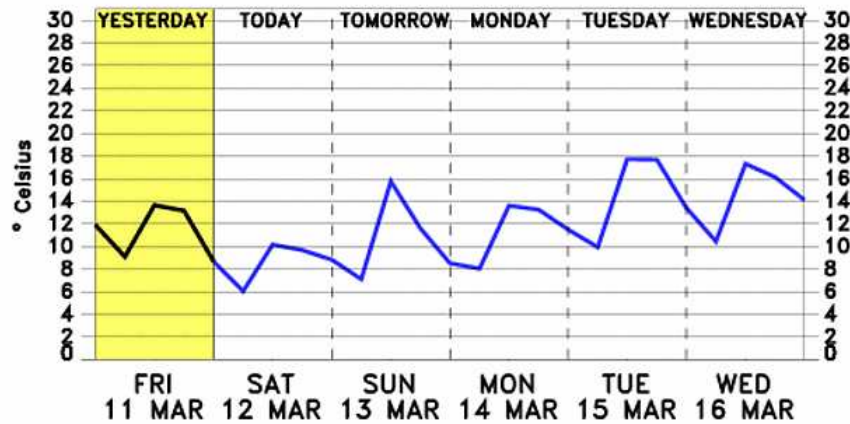
Temperature Uncertainty Laboratory Experiments

Experimental Design

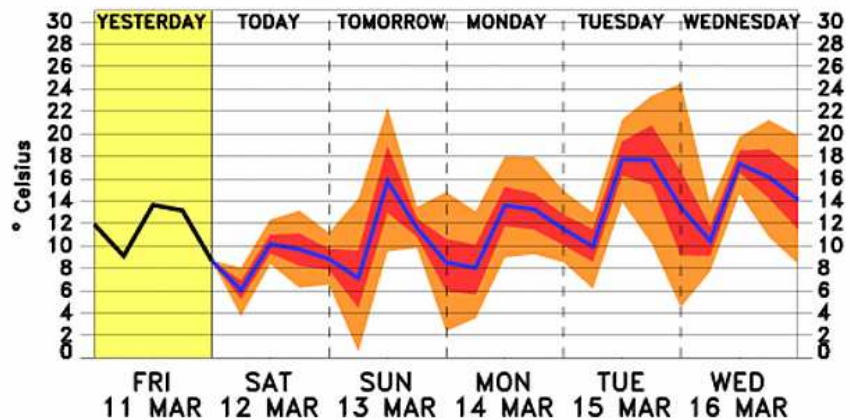


- Experiments conducted at the Finance and Economics Experimental Economics Laboratory at Exeter University (FEELE) with Todd Kaplan.
- 153 undergraduates at Exeter University participated.
- Students studying business, economics, humanities and sciences/mathematics
- Group A (77) received no uncertainty information.
- Group B (76) received uncertainty information.
- Presented with a set of 20 “lotteries”.

Example of a “lottery”



—observed temperature
—expected temperature



—observed temperature
—expected temperature

on average temperature will be in inner range 5 times out of 10

on average temperature will be in outer range 9 times out of 10

Participants asked whether they would rather receive £0.50 (US\$1.00) if

- GROUP A**
- A: Temperature at midday on Sunday is below 9°C
 - B: Temperature at midday on Monday is below 12°C

20 questions of this type asked of each group.

GROUP B

Questions in which someone assuming uniform uncertainty would make a *different* decision to someone with Format B were called “swing” questions.

How did they do?



Group	% correct (Format A)	% correct (Format B)
Business/Econ	69.6	85.7
Science/Engr	68.5	85.8
Humanities	66.5	83.8
Male	69.3	85.8
Female	66.8	83.7
Overall	68.5	85.2

**Average earnings
£7.25**



**Average earnings
£8.48**



Statistical Analysis



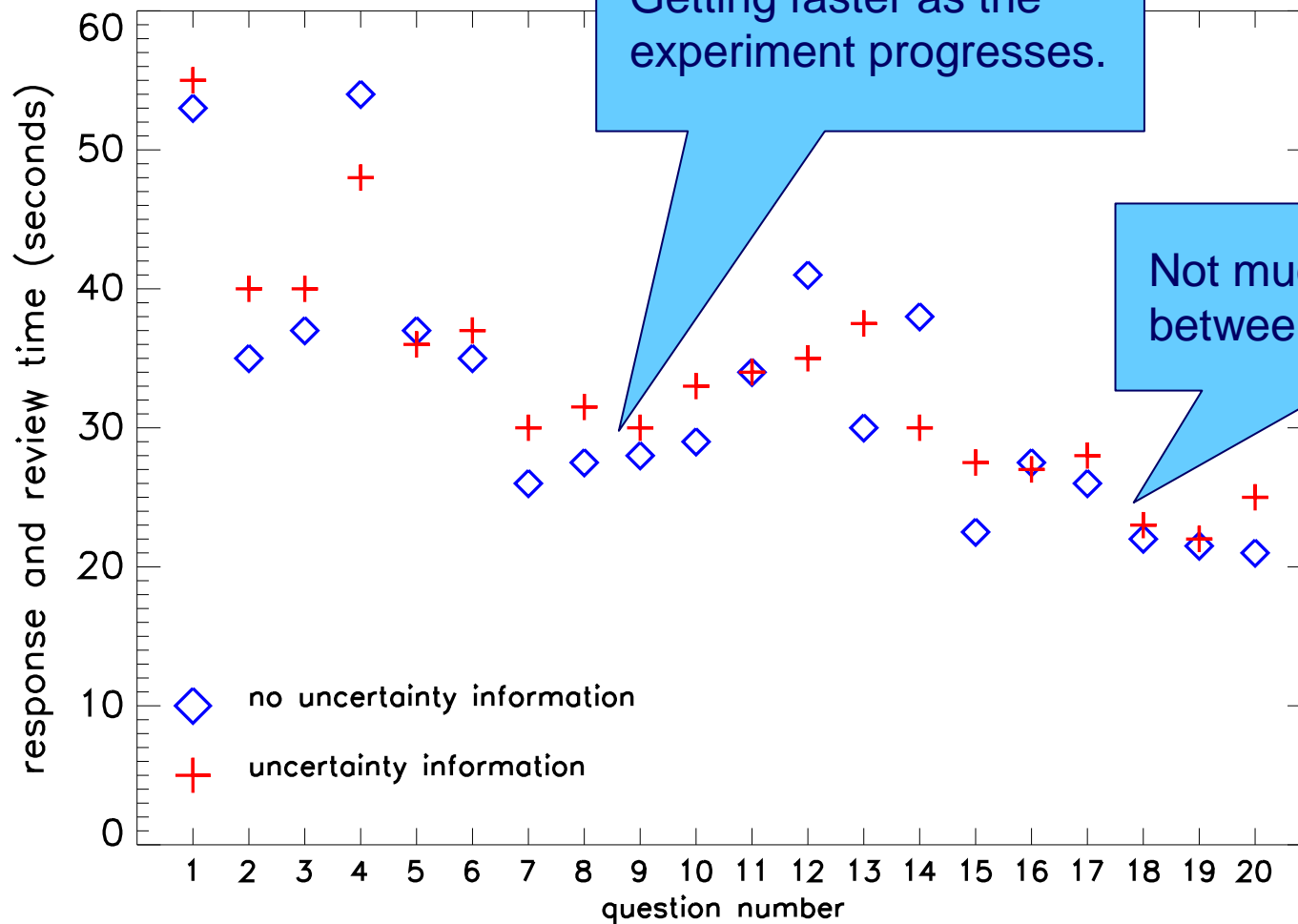
Predictor	Coef	Std. Err	P-value
Question Number			0.236
Reverse order			0.295
Early Correct	-0.2446	-0.0699	0.003
Early Correct & Format B	-0.1560	-0.0451	0.180
Format B	0.0244	0.0068	0.785
Swing Question	-0.5287	-0.1587	0.000
Swing Question & Format A	-1.2672	-0.4761	0.000
Gender is Male		0.0096	0.587
Humanities		-0.0422	0.086
Science/Engineering	-0.0256	-0.0256	0.254
Nationality is British	0.3842	0.1207	0.001
Prob Question Mistake	-0.1269	-0.0361	0.082
Sample Question Mistake	-0.0169	-0.0047	0.793
Constant	0.9932		0.000

People 16% less likely to get "swing" questions right – 63% less likely if they had no uncertainty information.

Bias towards picking the later option.

British people (aka native English speakers) were 12% more likely to get answers right.

How long did it take them?



- Laboratory experiments suggest people are able to correctly interpret uncertainty information.
- Laboratory experiments can be used to objectively evaluate how well people understand forecasts.

The background of the slide features a light blue color with several overlapping, wavy, horizontal bands of a slightly darker shade of blue, creating a sense of movement and depth.

Any questions?

Supplementary Slides

Temperature Uncertainty Laboratory Experiments

The Participants and Treatments

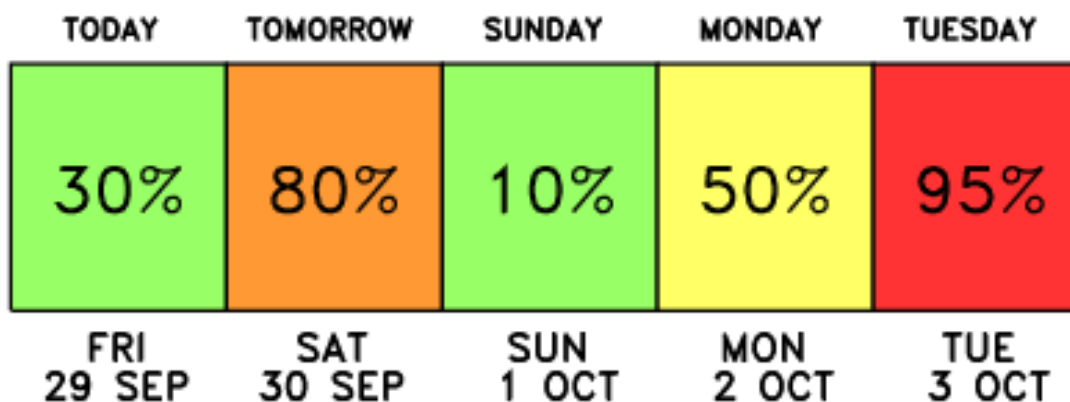


Discipline	Gender	Order of options*	Format A	Format B
Business/Econ	Male	normal	13	15
Business/Econ	Female	normal	7	5
Business/Econ	Male	reversed	14	12
Business/Econ	Female	reversed	3	4
Science/Engr	Male	normal	16	15
Science/Engr	Female	normal	4	5
Humanities	Male	normal	9	11
Humanities	Female	normal	11	9

Precipitation Uncertainty Questionnaire

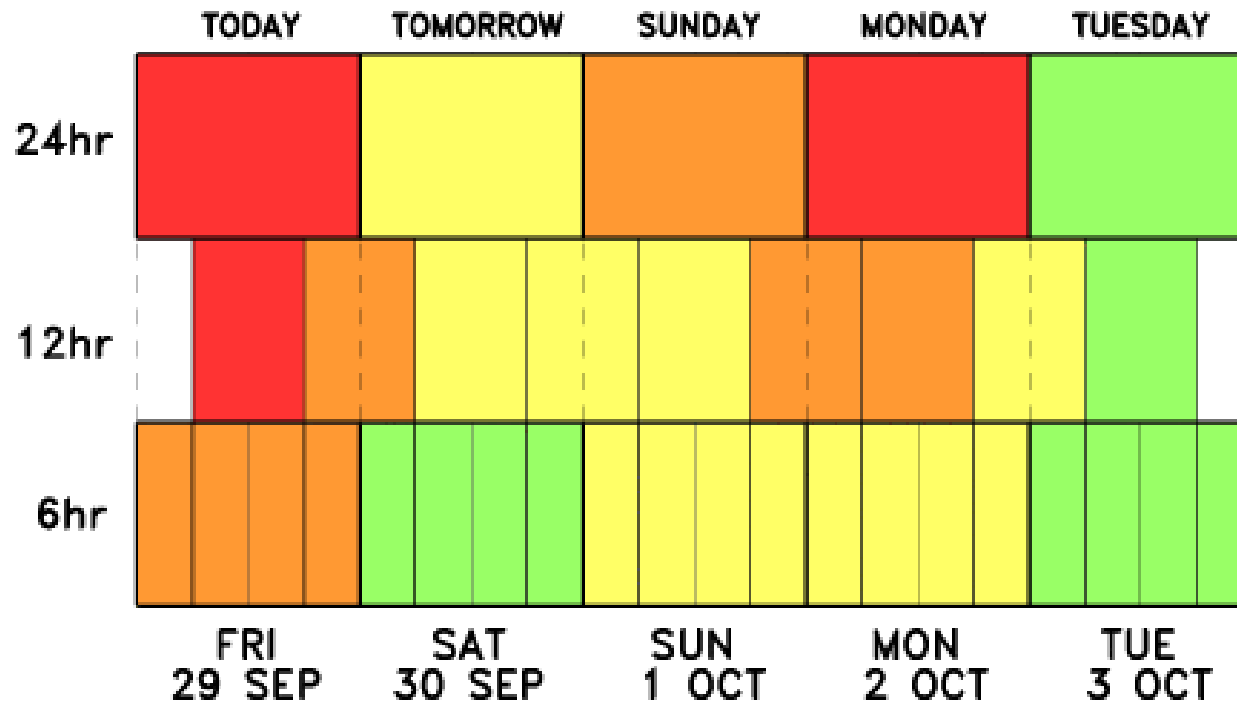
- Questionnaire about uncertainty in the 5-day precipitation forecast placed on Met Office public website from 17th January to 9th March (883 external responses).

Probability of Precipitation



Probability of precipitation occurring at a single location within a 24 hour (midnight to midnight) period

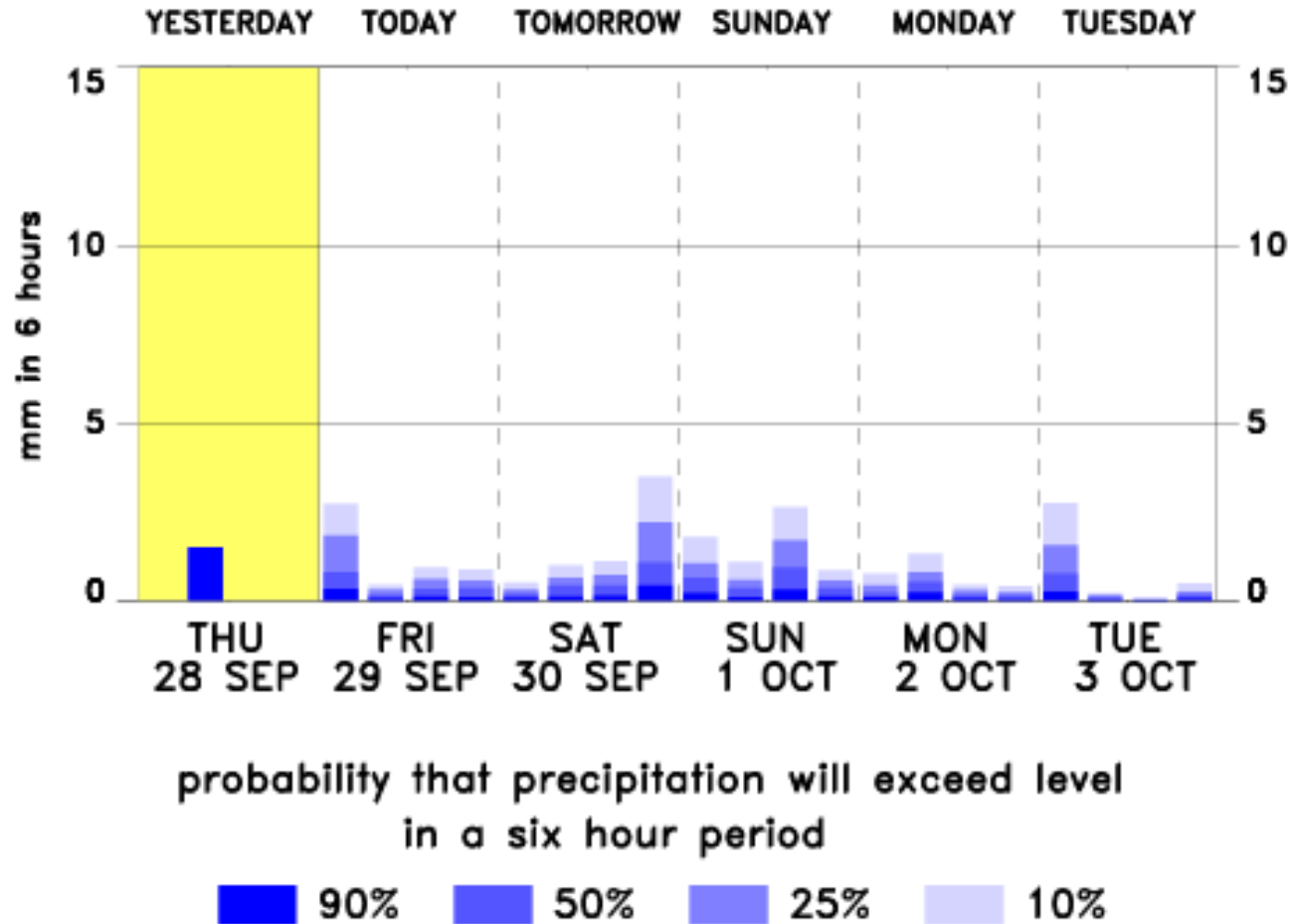
Option 2



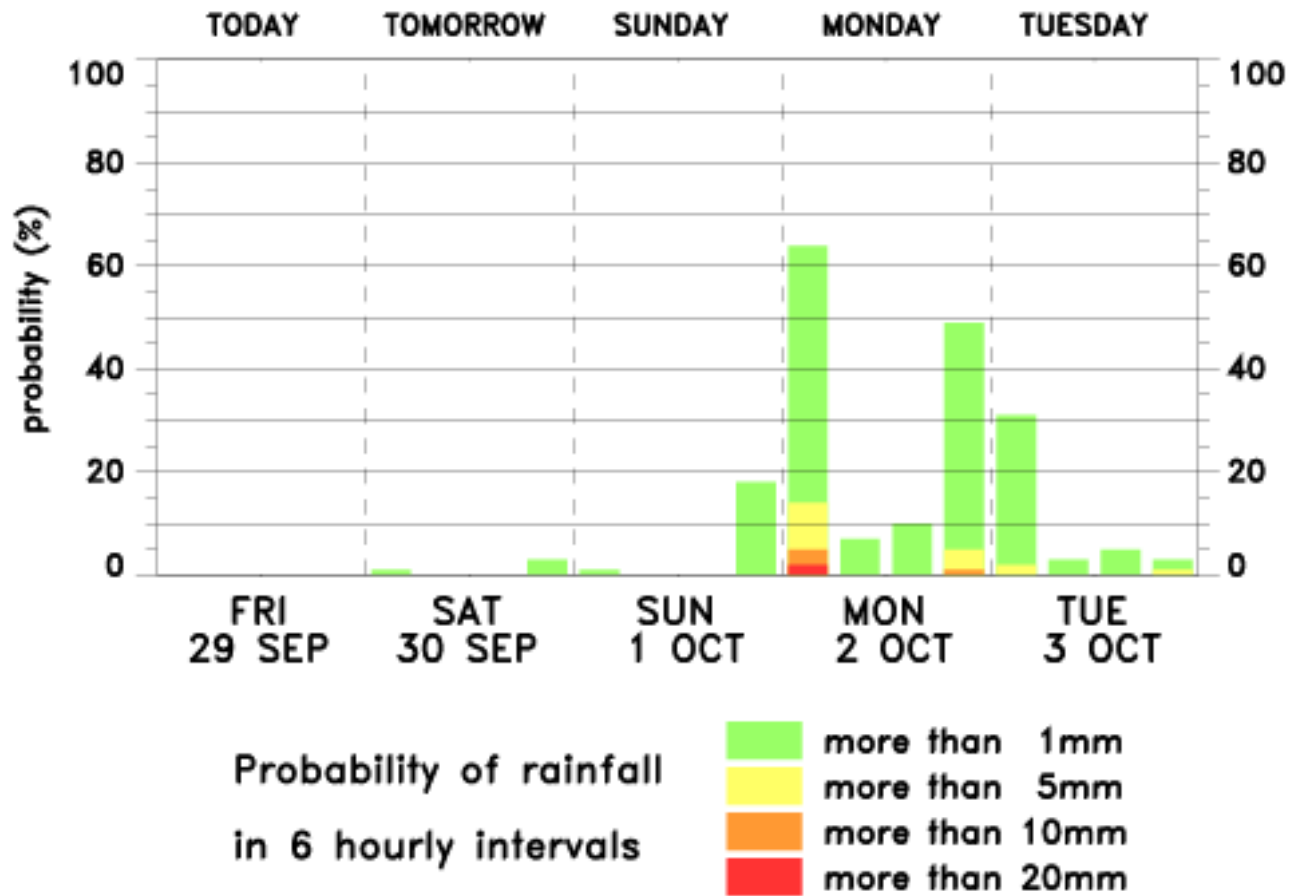
Risk of more than 1mm of rain occurring in 6 hr, 12 hr and 24 hr periods



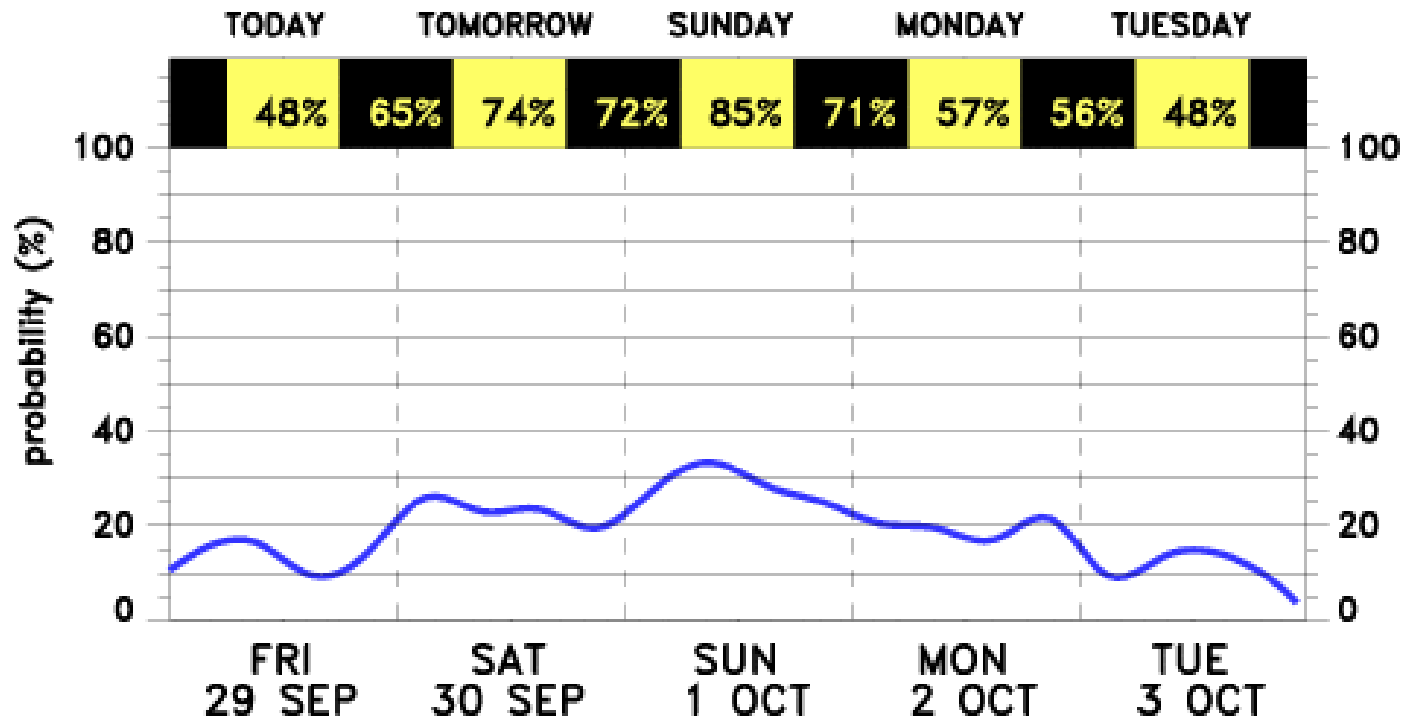
Option 3



Option 4



Option 5

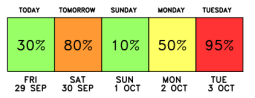


probability of more than 1mm falling in one hour
and overall probabilities for day and night

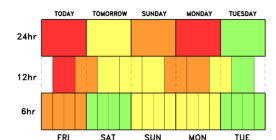
Most Useful?



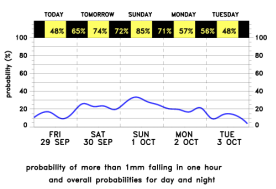
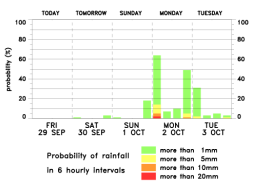
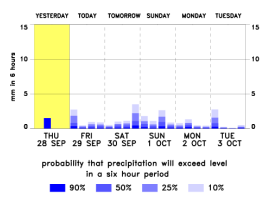
Probability of Precipitation



Probability of precipitation occurring at a single location within a 24 hour (midnight to midnight) period



Risk of more than 1mm of rain occurring in 6 hr, 12 hr and 24 hr periods



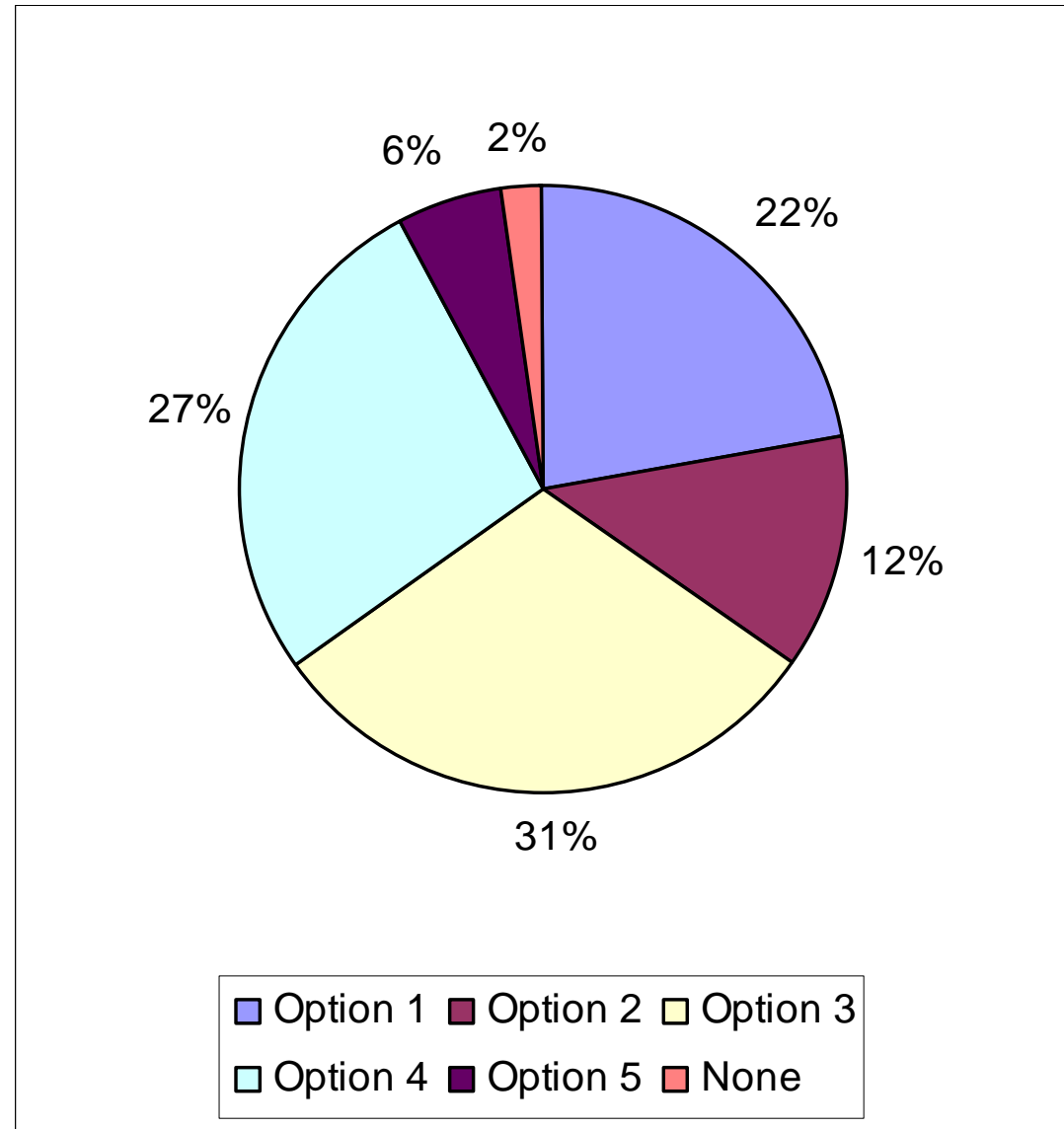
Option 1

Option 2

Option 3

Option 4

Option 5

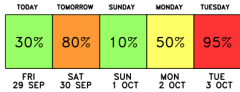


- Option 1
- Option 2
- Option 3
- Option 4
- Option 5
- None

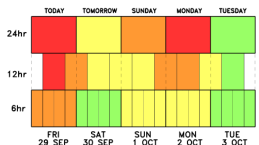
Easiest to Understand?



Probability of Precipitation

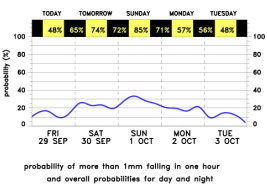
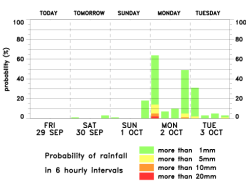
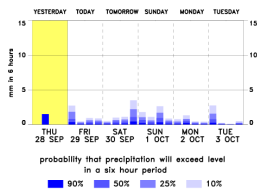


Probability of precipitation occurring at a single location within a 24 hour (midnight to midnight) period



Risk of more than 1mm of rain occurring in 6 hr, 12 hr and 24 hr periods

- unlikely
- possible
- likely
- very likely



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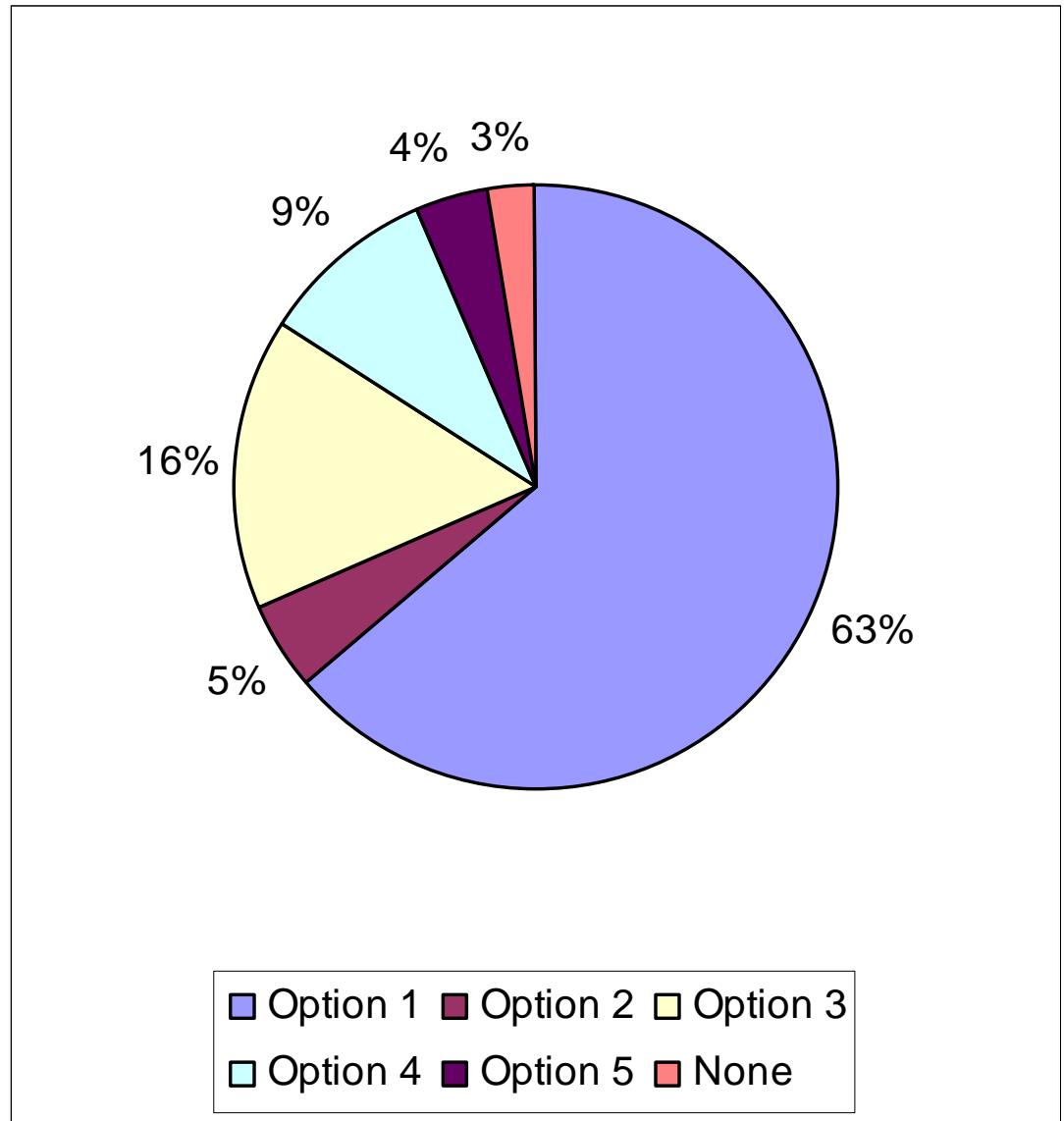
Option 1

Option 2

Option 3

Option 4

Option 5

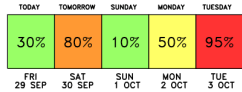


Option 1 Option 2 Option 3
Option 4 Option 5 None

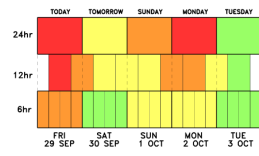
Would like to see on website?



Probability of Precipitation

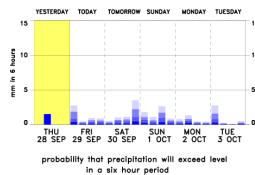


Probability of precipitation occurring at a single location within a 24 hour (midnight to midnight) period



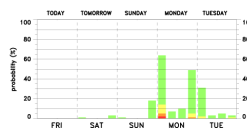
Risk of more than 1mm of rain occurring in 6 hr, 12 hr and 24 hr periods

- unlikely
- possible
- likely
- very likely



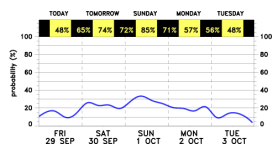
probability that precipitation will exceed level in a six hour period

- 90%
- 50%
- 25%
- 10%



Probability of rainfall in 6 hourly intervals

- more than 1mm
- more than 5mm
- more than 10mm
- more than 20mm



probability of more than 1mm falling in one hour and overall probabilities for day and night

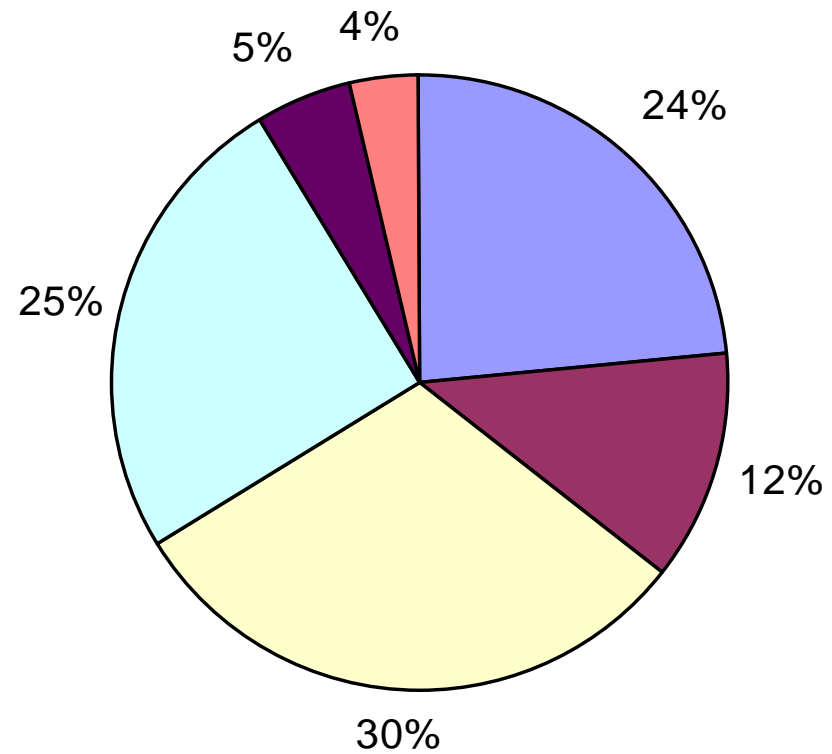
Option 1

Option 2

Option 3

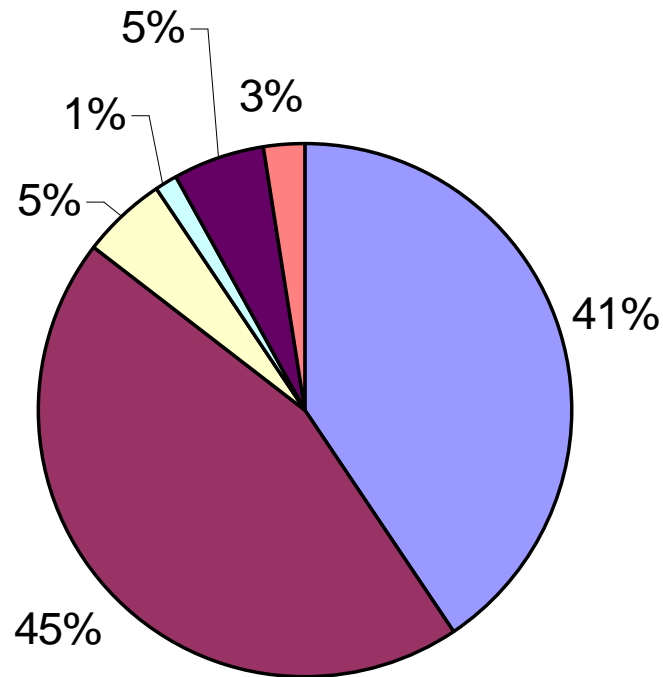
Option 4

Option 5



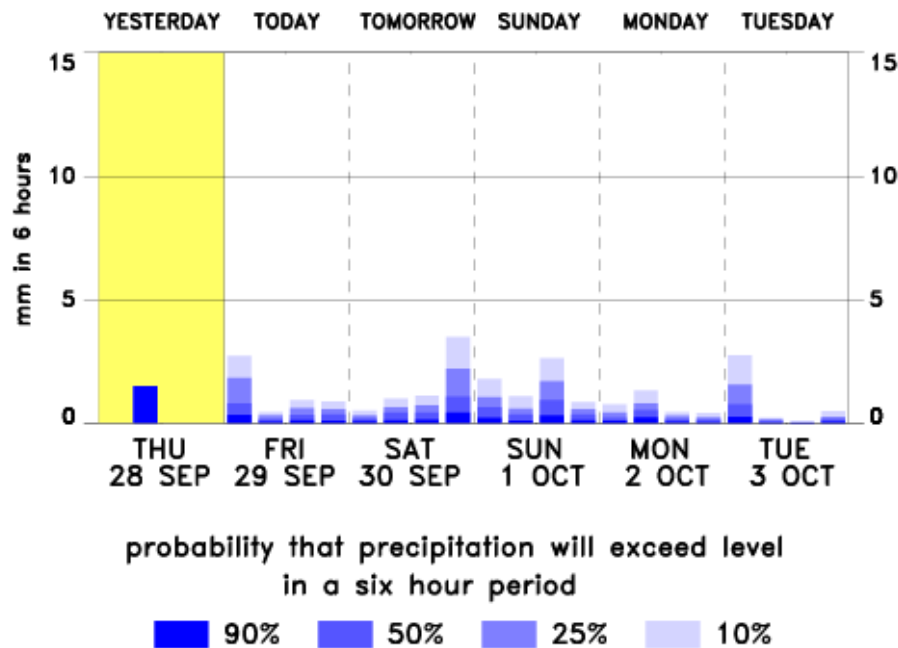
- Option 1
- Option 2
- Option 3
- Option 4
- Option 5
- None

How often would you look at it?



- Daily
- At least once a week
- At least once a month
- Less than once a month
- Whenever rain is forecast
- Never

Option 3: Most popular.



“Option 3 is the most intuitively easy format to understand and interpret. It tells you when it's likely to rain and how much is likely to fall at a glance.”

“Format ‘1’ is the easiest to interpret quickly but ‘3’ gives much more information and is also easy to interpret.”

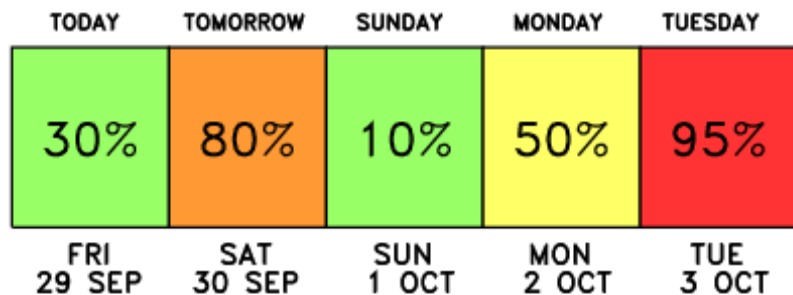
“I favour 3 because the principal information - amount of rain - is seen at a glance, probabilities become apparent on further inspection.”

“The key for format 3 might be better colour coded with red green etc. I like the height of the bar representing amount of rain.”

Option 1: Easiest to understand



Probability of Precipitation



Probability of precipitation occurring at a single location within a 24 hour (midnight to midnight) period

“Are these options mutually exclusive? Could users not be presented with the most simplified option 1 as a default and then request to see the other more complex options according to preference?”

“Although I say 1 is easiest to understand that is because it provides least information. I definitely would not want to see that version used.”

“I think ‘1’ preferable to the others. The easy and quick to look at format gives the basic information that is needed by most of the public.”

“This would be very useful to display in the Weathercall and Marinecall services and option A seems the clearest and easiest way of expressing the information.”