

# Probability of rapid climate change

- **What do you think is the probability of the THC weakening rapidly enough to have a discernable impact on the climate of the UK and NW Europe by 2100?**
  - $\leq 0.1\%$ ,  $\leq 1\%$ ,  $\leq 5\%$ ,  $\leq 10\%$ ,  $\leq 20\%$ ,  $\leq 30\%$ ,  $\leq 40\%$ ,  $\leq 50\%$ ,  $\leq 60\%$ ,  $\leq 70\%$ ,  $\leq 80\%$ ,  $\leq 90\%$ ,  $\leq 100\%$
- **Do you consider yourself to be:**
  - an expert, have some expertise, have little expertise, complete amateur

## Answers

probability $\leq$	expert	some	little	amateur	sums
0.1		1			1
1		1			1
5	3	3	4	1	11
10		3	3	2	8
20	1	8	2	1	12
30	1	2	3		6
40		2	1	3	6
50		5	2	3	10
60		1	1		2
70			2	2	4
80		2	1		3
90					0
100		1	2		3
<b>sums</b>	<b>5</b>	<b>29</b>	<b>21</b>	<b>12</b>	<b>67</b>
spoiled					1
no idea		2			2
<b>total no.</b>					<b>70</b>

# Analysis of Survey at RAPID Annual Meeting 2005

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Respondents were asked to answer two questions. The first was ‘what is the probability that the thermohaline circulation has collapsed by the end of the century’. Possible answers were ‘<0.1%’, ‘between 0.1 and 1%’, ‘between 1 and 5%’, ‘between 5 and 10%’, ‘between 10 and 20%’, ‘between 20 and 30%’, ‘between 30 and 40%’, ‘between 40 and 50%’, ‘between 50 and 60%’, ‘between 60 and 70%’, ‘between 70 and 80%’, ‘between 80 and 90%’ and ‘greater than 90%’. The second question asked what level of expertise they considered they had. Possible answers here were ‘amateur’, ‘a little expertise’, ‘some expertise’ and ‘expert’. Table 1 shows the number responding by probability and expertise. Figure 1 gives a bar chart of the

Table 1: The number responding by probability and expertise

prob	expert	some	little	amateur	total
0.1	0	1	0	0	1
1.0	0	1	0	0	1
5.0	3	3	4	1	11
10.0	0	3	3	2	8
20.0	1	8	2	1	12
30.0	1	2	3	0	6
40.0	0	2	1	3	6
50.0	0	5	2	3	10
60.0	0	1	1	0	2
70.0	0	0	2	2	4
80.0	0	2	1	0	3
90.0	0	0	0	0	0
100.0	0	1	2	0	3
Total	5	29	21	12	67

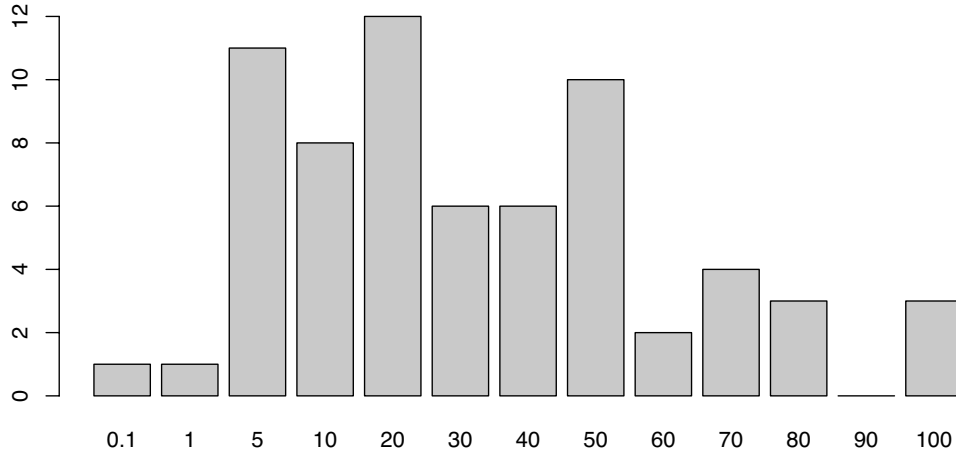


Figure 1: Barchart showing the total number of responses for each probability

probabilities summed over the expertise. The distribution is broad, skew and looks as if it might be multimodal.

Figure 2 shows bar charts for each level of expertise.

None of the bar charts are particularly smooth but this is probably due to the small sample size. The only distribution that appears to be bi-modal is ‘some’. The barcharts we shown so far have ignored the values on the probability response and simply treated it as a factor. If we now regard it as a quantitative estimate we obtain the histogram in figure 3. The general shape is now apparent and appears to be almost negative exponential in form.

As with the bar charts we can plot histograms for each level of expertise separately in figure 4. The main difference between the four is that as the level of expertise increases the distribution narrows. The ‘amateur’ histogram in many ways appears uniform whereas the ‘expert’s is sharply peaked. An alternative to a histogram is a boxplot, shown in figure 5. The box plot shows that on average the estimated probability of THC collapse decreases as expertise increases, but it should be noted that the spread is much wider for ‘little’ and ‘some’. Is there a significant difference in the estimated probability of MOC collapse between the different levels of expertise? One way to look at this is to fit a linear model.

$$(\textit{Estimated probability of collapse}) = \mu + \alpha_i + \epsilon_j \quad (1)$$

where  $\mu$  is the mean estimated probability (or intercept),  $\alpha_i$  is the variation

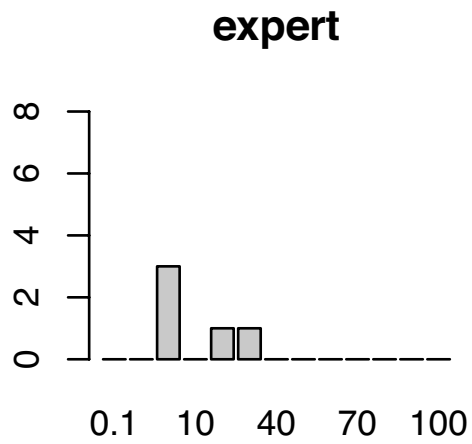
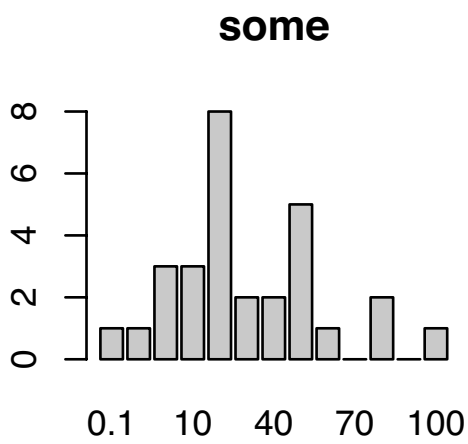
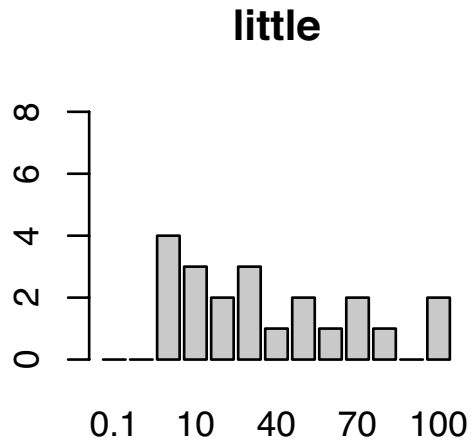
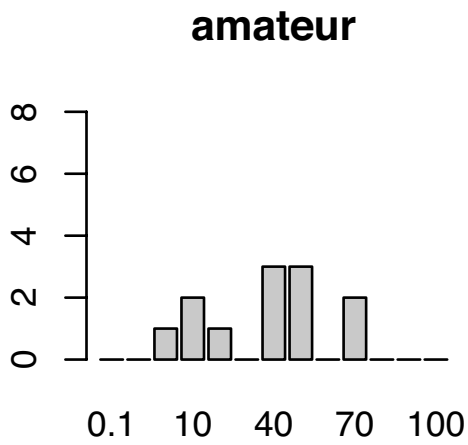


Figure 2: Bar charts of estimated probability by expertise

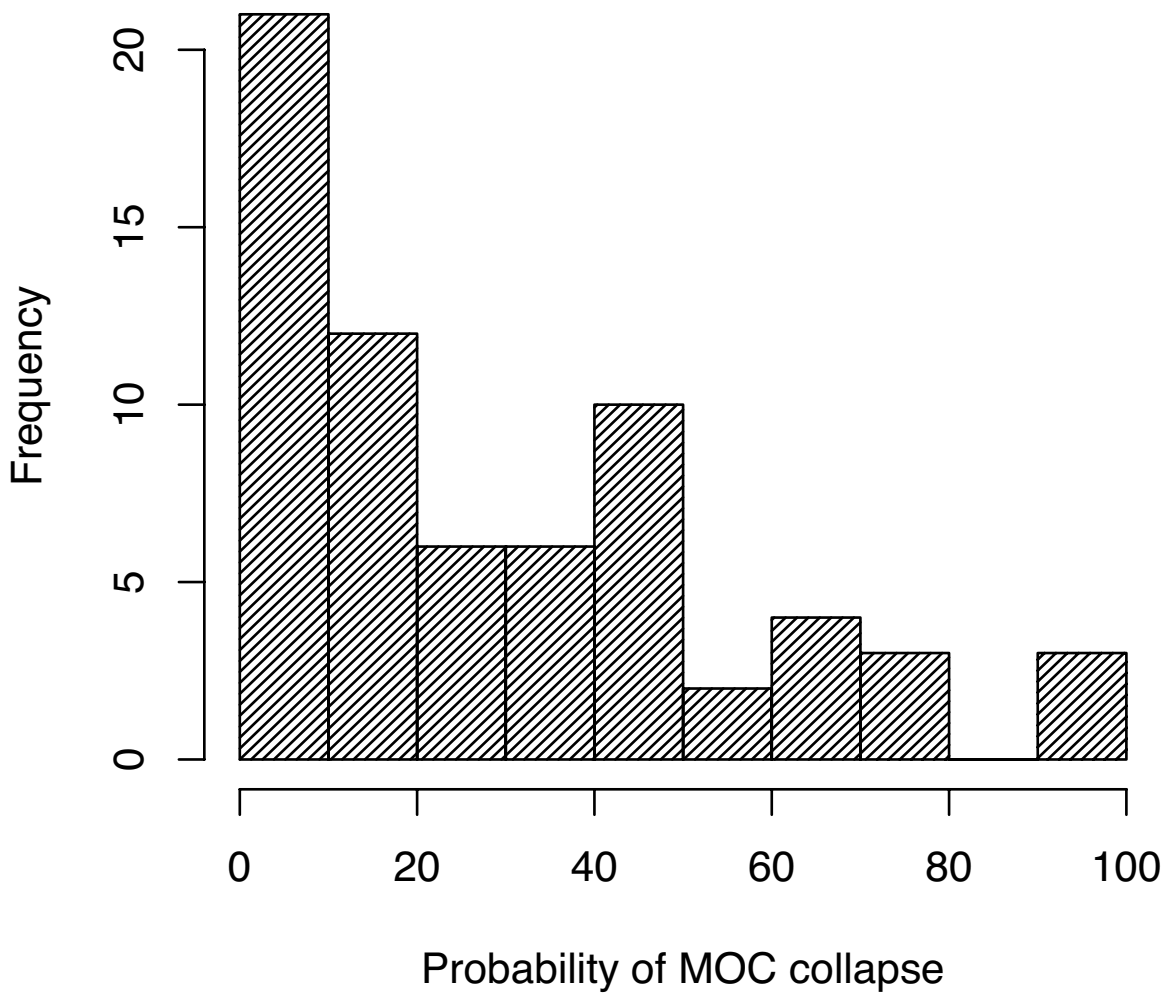


Figure 3: Histogram of estimated probability

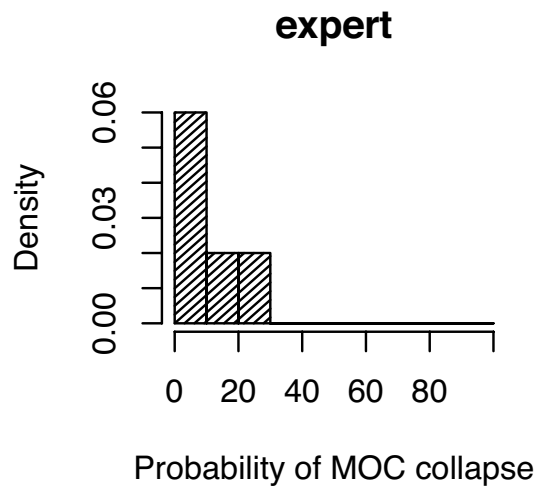
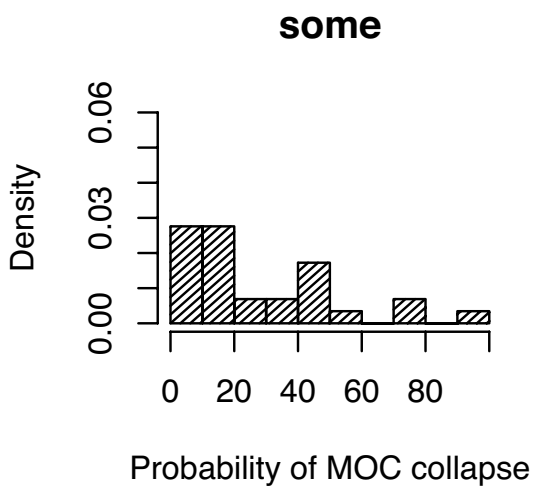
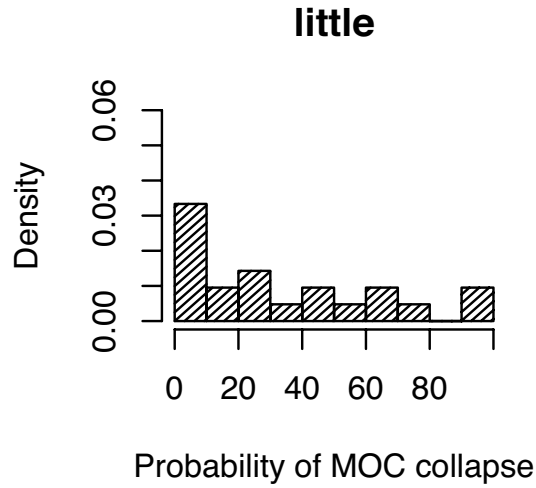
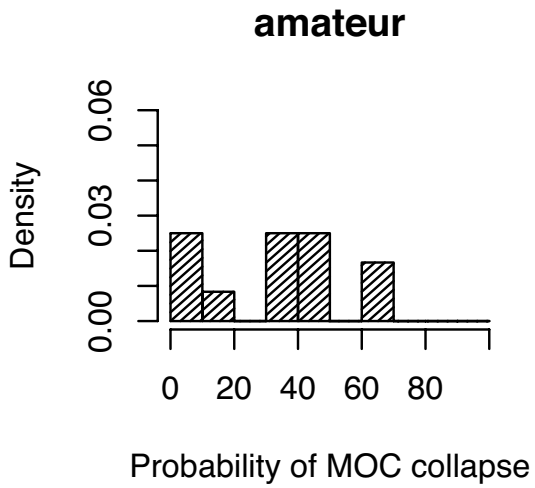


Figure 4: Histogram of estimated probability by expertise

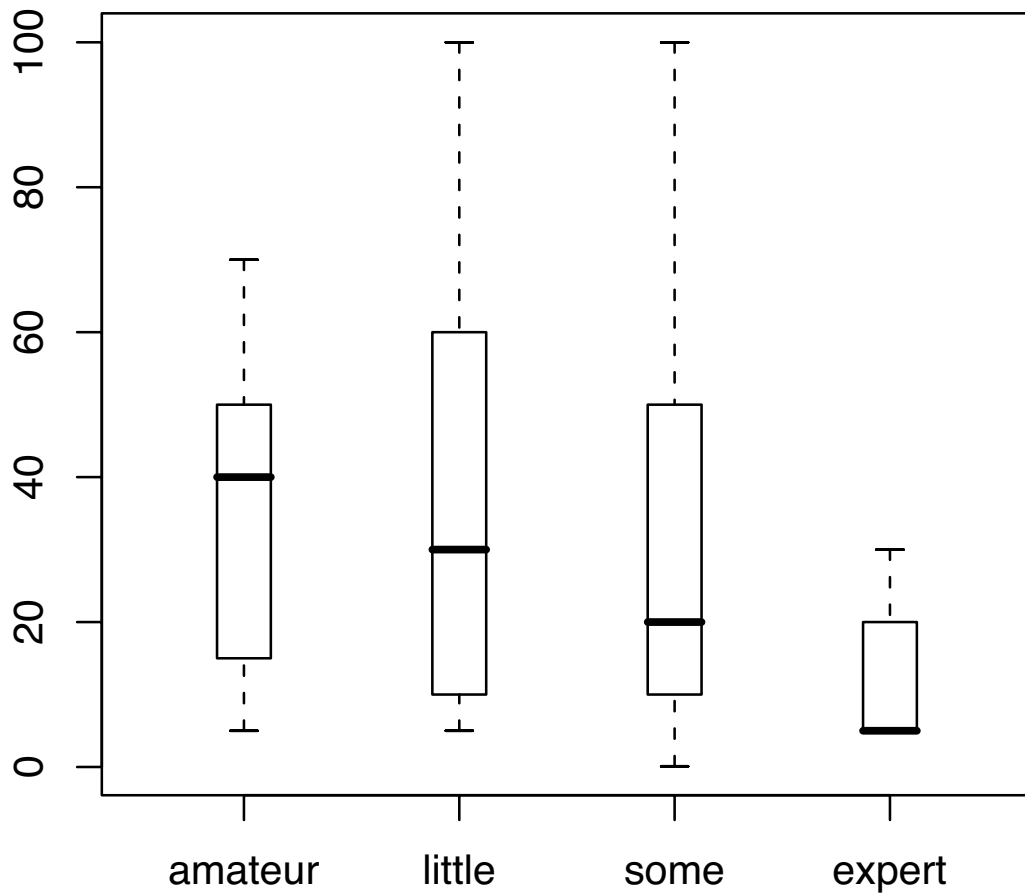


Figure 5: Box plot of estimated probability by expertise

from the mean for each level of expertise ( $i = \text{'amateur'}$ ,  $\text{'little'}$ ,  $\text{'some'}$  and  $\text{'expert'}$ ) and  $\epsilon_j$  is a random error term distributed  $N(0, \sigma^2)$ .

If we fit such a model we obtain the estimates of the coefficients shown in table 2. An analysis of variance shows no significant difference between the various levels of expertise. One can criticise the rather simple linear model in

Table 2: Estimated coefficients in equation 1

(Intercept):	30.15039			
expertise:	amateur	little	some	expert
	7.766277	7.944848	1.439265	-17.150390

(1). For example our estimated probabilities are constrained to lie between 0 and 100 whereas the RHS in (1) is in the interval  $[-\infty, \infty]$ . However modifications to (1) to cope with these differences, for example transforming the probabilities, do not make the differences in expertise significant. We therefore conclude that there is no evidence that the level of expertise makes any difference to the estimated probability of MOC collapse by the end of the century.