Protocol for eliciting expert judgments about climate response to future radiative forcing

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Thank you for agreeing to participate in this study of expert judgment about climate response to future radiative forcing.

In the pages that follow, we mainly focus on transient responses because that is what the world will see and what is of greatest concern to public and private decision makers.

Here is an outline of how today's discussion will proceed:

1. A few comments about issues involved in making judgments about uncertainty.

2. Introduction of plausible trajectories for future climate forcing.

3. Discussion of the relative importance of factors which influence transient climate response and the possibility that with strong enough forcing the climate system might actually undergo some sort of "state change."

4. Exploration of whether, and at what point, there might be a "state change" in the climate system given varying levels of forcing that have been reached by the year 2200.

5. Probabilistic judgments about the amount of warming resulting from alternative plausible future levels of forcing.

6. Discussion of whether and how your uncertainty about transient response might change as a function of future research progress in your understanding of key factors contributing to uncertainty.

7. Value of classic climate sensitivity.

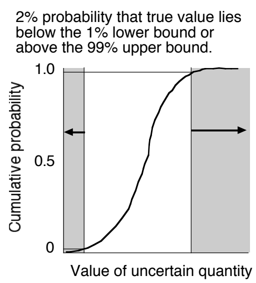
8. Some questions about regional climate.

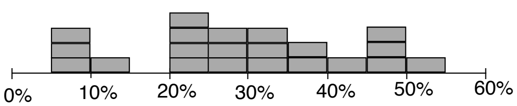
1. A few comments about issues involved in making judgments about uncertainty.

In asking you for your judgments, we have to be concerned about very strong evidence in the literature that shows that people often display considerable overconfidence when asked to make probabilistic judgments. That is, they produce probability distributions that are too narrow.

The figures below illustrate this problem.

In 21 separate studies, well educated people were asked to make judgments about the value of a large number of known quantities (such as the length of the Panama Canal). They were also asked to provide a 98% confidence interval on those judgments. The proportion of the time that the true answers lay outside the 98% confidence interval the respondents had given, which, of course, should have been 2%, in fact looked like this (each box in the histogram reports the results of a separate study, several of which had more than 1000 participants):

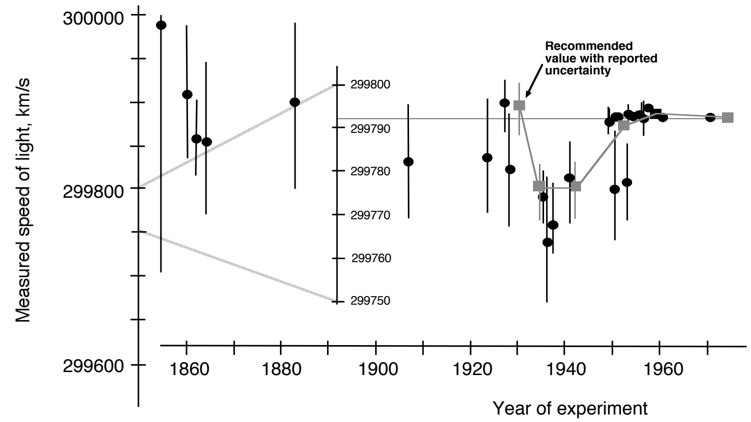




Percentage of estimates in which the true value lay outside of the respondent's assessed 98% confidence interval.

For details see Morgan and Henrion, *Uncertatinty*, Cambridge Univ. Press, 1990, pg 117.

Laypeople are not the only ones subject to overconfidence. Consider, for example, the history of estimates of the speed of light:



For details see: Henrion and Fischhoff, "Assessing Uncertatinty in Physical Constants," *American Journal of Physics* , 54, pp791-798, 1986.

Because of this problem, and because of some other issues such as the cognitive heuristics known as "anchoring and adjustment," later, when we ask you to provide probability estimates, we will go about it in a somewhat indirect way, asking first for upper and lower bounds before asking questions about more central values.

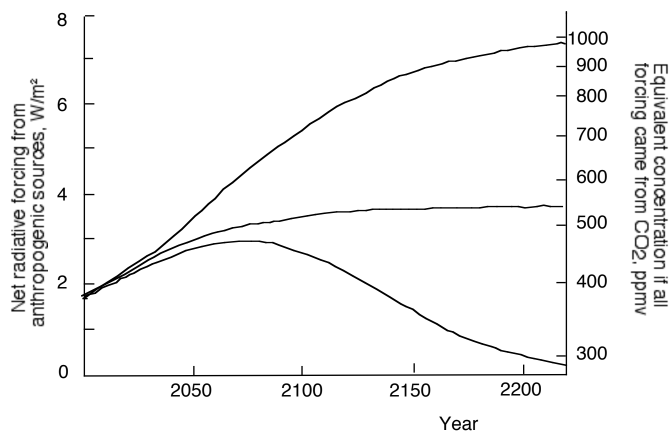
If you are interested, you can find a more detailed discussion of these issues, and the subject of designing expert elicitations, in Chapters 6 and 7 of Morgan and Henrion, *Uncertainty* (Cambridge, 1990).

2. Introduction of plausible trajectories for future climate forcing.

For the purposes of this study we have constructed what we believe are plausible low and high trajectories for net radiative forcing at the top of the atmosphere from anthropogenic sources through the year 2200 as shown below.

NOTES:

- We will assume that global aerosol forcing remains roughly constant.
- The right hand scale is the equivalent forcing as CO_2 concentration considering ALL forcings (i.e. GHG *and* aerosols)



Since in some of our later questions we want to be able to display net forcing from GHGs and aerosols in terms of equivalent concentration of CO_2, we have started the trajectories at a net forcing level of 1.8 W/m^2.

3. Discussion of the relative importance of factors which influence transient climate response and the possibility that with strong enough forcing the climate system might actually undergo some sort of "state change."

In the simple questionnaire that we mailed out to everyone we asked folks to provide us with a set of factors that are most important in influencing transient climate response.

We have summarized and combined the responses to produce the following list:

Atmospheric chemistry
Atmospheric convection and precipitation
Cloud radiative feedbacks
Deep water formation (e.g., oceanic convection)
Horizontal/isopycnal ocean mixing
Ice-albedo feedback on land
Lapse rate feedback
Large-scale atmospheric circulation including meridional heat transport
Mesoscale/sub-mesoscale ocean eddies
Ocean circulation (wind-driven and thermohaline circulation)
Sea ice
Soil moisture
Vegetation-albedo feedback
Vertical/diapycnal ocean mixing
Water vapor feedback

In a moment, we will ask you to sort these factors in terms of their relative importance in influencing *your uncertainty* about the time trajectory of average global temperature given a plausible time varying change in radiative forcing. However, before we do that please consider three questions:

1. Will the relative importance that you assign to these factors be different for different levels of forcing (for example, for a scenario that rises to forcing levels that are roughly 4 W/m^2 (CO_2 equivalent of roughly 550 ppm) versus one that rises to roughly 7 W/m^2 (CO_2 equivalent of roughly 920 ppm)?.

   ❑ No

   ❑ Yes
   Please explain:

2. If F(t) rises in some continuous monotonic way to levels of forcing up to about 7 W/m^2 (CO_2 equivalent of ~920 ppm), then will your estimates of T(t), *and their associated uncertainties*, also rise in an essentially continuous monotonic way?

   ❑ Yes
   Is there some still higher level of forcing at which this would no longer be the case?

   ❑No
   Please explain. Specifically, we would like to know what sorts of physical processes, or climatic "state changes" *might* come in to play.

3. Finally, please tell us your views about possible hysteresis in the system. That is, if F(t) first rises to roughly 7 W/m^2 (CO_2 equivalent of roughly 920 ppm) for several centuries and then subsequently falls over the course of several centuries, will T(t) simply track F(t), perhaps with some time lag, or will the response during the decline in F(t) be significantly different than the response during the increase in F(t).

   ❑ No significant hysteresis.

   ❑ Significant hysteresis or other asymmetry in the response of T(t).
   If you can, please describe and explain.

Now, please sort these factors in terms of their relative importance in influencing *uncertainty* about the time trajectory of average global temperature given a plausible time varying change in radiative forcing.

[NOTE: If the answer was yes to question 1 above, do two sorts, one at 4 W/m^2 and one at 7 W/m^2.]

Assume the radiative forcing increases to 4 W/m^2 over a period of a century.

Please sort the cards to indicate the six factors that would *most* contribute to you *uncertainty* about the resulting change in temperature, T(t), over that interval.

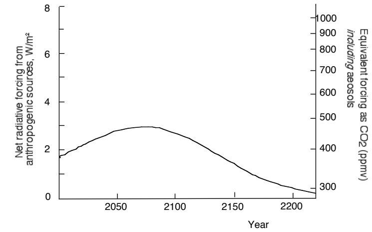
1. ____
2. ____
3. ____
4. ____
5. ____
6. ____

Now assume that instead of increasing to 4 W/m^2 over the course of a century the radiative forcing instead increases to 7 W/m^2 over that same period

Please sort the cards again to indicate the five factors that would *most* contribute to you *uncertainty* about the resulting change in temperature, T(t), over that interval.

1. ____
2. ____
3. ____
4. ____
5. ____
6. ____

Please look now the low forcing trajectory we have specified:



Would the same factors enter in the same order for this trajectory as you listed for the case where the radiative forcing increased to 4 W/m^2 over a period of a century?

❑ Yes ❑ No – please indicate your revised ranking below:

1. ____
2. ____
3. ____
4. ____
5. ____
6. ____

If you have not already done so, please unpack your answer a bit more. For each of the three factors that you ranked as most important in contributing to your uncertainty (under each forcing scenario) we'd like you to:

- Give us a very brief tutorial on the physics that in your view makes this factor important;
- Tell us what you think are the primary sources of evidence about the role of this factor;
- Give us some indication of how well understood you believe the influence of this factor to be on T(t) given a specific F(t).

4. Exploration of whether and at what point there might be a "state change" in the climate system given varying levels of forcing that have been reached by the year 2200.

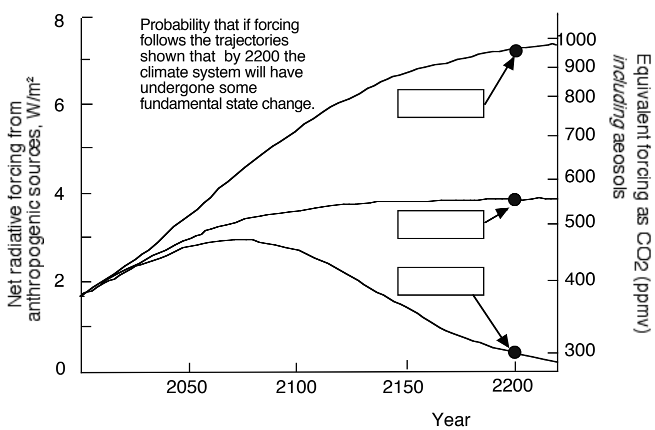
Because some aspects of the climate system are non-linear, and because there is evidence in paleo data that the climate system has operated in rather different states in the past, many have argued that as forcing becomes stronger and stronger there is a growing probability that the climate system may actually undergo some basic state change (i.e. a state change whose effects will be felt globally for many decades).

Please insert a subjective probability estimate (a value between 0 and 1) in each of the three boxes below, where:

0 = no chance for this trajectory the climate system will have undergone, or been irrevocably committed to such a change by the year 2200.

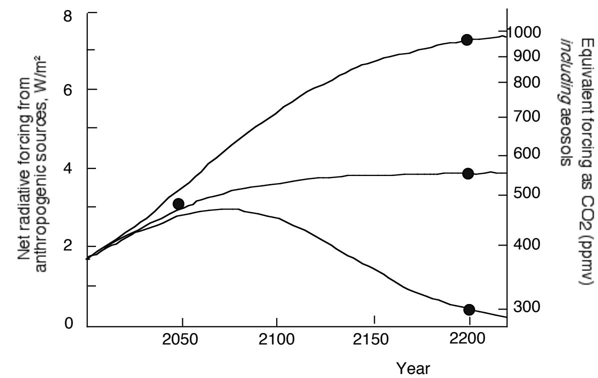
1 = it is definite that for this trajectory the climate system will have undergone or been irrevocably committed to such a change by the year 2200.

If, as you go through this, you believe that you have some insight about what such a future state, or states, might be like, we'd very much like to hear about it.



5. Probabilistic judgments about the amount of warming resulting from alternative plausible future levels of forcing.

At each of the four locations in the diagram marked with a solid black dot in the diagram below, we'd like you to make a judgment for us of the amount of average global warming that might result.



We are not going to ask for just a point estimate, but rather for a probability distribution that represents your best professional judgment of the warming at each of the points.

If for some of these points you have indicated a possible "state change," we would be happy to handle that either by asking for your estimates of ΔT with and without the change (we'll then combine the two using the probabilities you gave us in the previous part), or you consider both possibilities together when you give your answer.

To assist you in thinking about this problem, we have constructed a simple heuristic aid in the form of a Mathematica® model that solves:

$$CT'(t) = F(t) - \lambda T(t)$$

Where:

C = the ocean heat capacity expressed as a time constant
T(t)= the average global temperature over time
F(t)= the net radiative forcing over time
λ = the climate feedback parameter.

In this Mathematica® model the forcing is determined from CO_2 using the IPCC TAR radiative forcing formula:

F[Conc] = 4.841 Log[Conc/280] + 0.0906(Sqrt[Conc] - Sqrt[280])

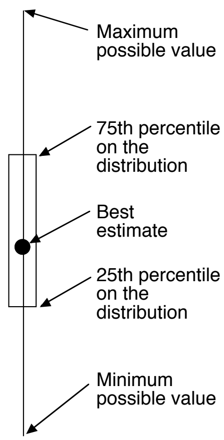
The climate sensitivity that is adjusted by the slider bar is the equilibrium climate change in global mean surface temperature for radiative forcing given by $2xCO_2$. Climate sensitivity is often expressed as the feedback parameter, λ, with units W/m^2K. If the $2xCO_2$ radiative forcing is 4 W/m^2 (the value from the IPCC TAR radiadive forcing formula used in this simulation), a $2xCO_2$ climate sensitivity 2 as set on the slider bar corresponds to a λ of $2W/m^2K$. Or in general:

$$\lambda = (4W/m^2)/(\Delta T@\ 2xCO_2)$$

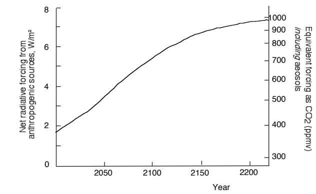
Note that if you choose to use this model, it is an approximation that becomes less and less valid as T(t) becomes larger, so you should only use it as an aide to help you in thinking things through.

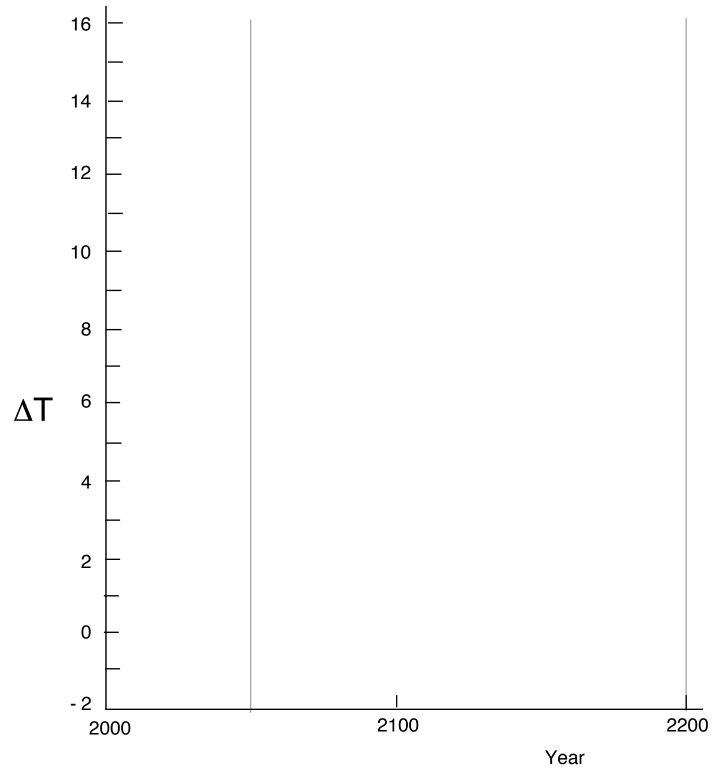
Insert **six** pages here on which to record elicited CDFs .

We now have your full probability distributions for 2050 and for a high and low forcing scenario in 2200. On the pages that follow, we will draw the distributions you gave us on this plot of T(t) in the form of box plots, using the following convention:

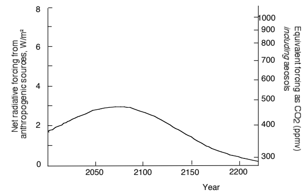


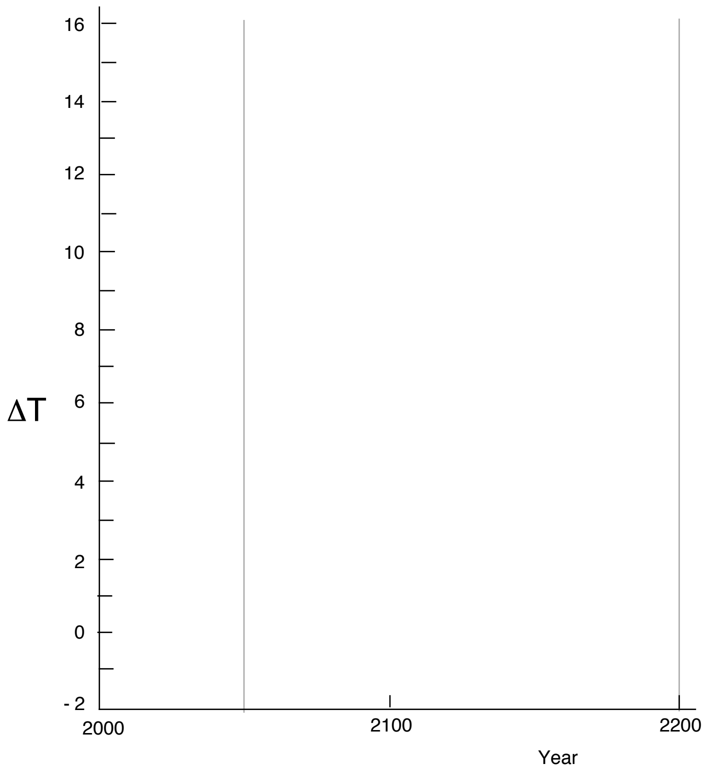
Please sketch your best estimate of the trajectory for T(t) over the interval from 2050 to 2200 in the case of the high forcing trajectory.





Please sketch your best estimate of the trajectory for T(t) over the interval from 2050 to 2200 in the case of the low forcing trajectory.





6. Discussion of whether and how your uncertainty about the transient response might change as a function of future research progress in your understanding of key factors contributing to uncertainty.

Earlier we asked you to rank the factors that would contribute to uncertainty in your ability to estimate T(t) given a specific forcing trajectory F(t). Now that you have completed your estimates of the uncertainty in the ΔT that would result in 2050 and 2200, we'd like to ask you to revisit and build on those estimates.

Suppose that we could turn to an oracle who could tell you everything you need to know to completely eliminate the uncertainty in your understanding about the influence one of the top ranked factors in Part 3 has on the resulting ΔT.

Michelangelo's depiction of an oracle in a fresco at the Sistine Chapel.

Of course, even if she could do that, your uncertainty about the resulting ΔT might not be reduced very much. Indeed, even if she could do that for all three of your top ranked, you would likely still have uncertainty about the value of ΔT since there are a number of other factors that also contribute to your uncertainty.

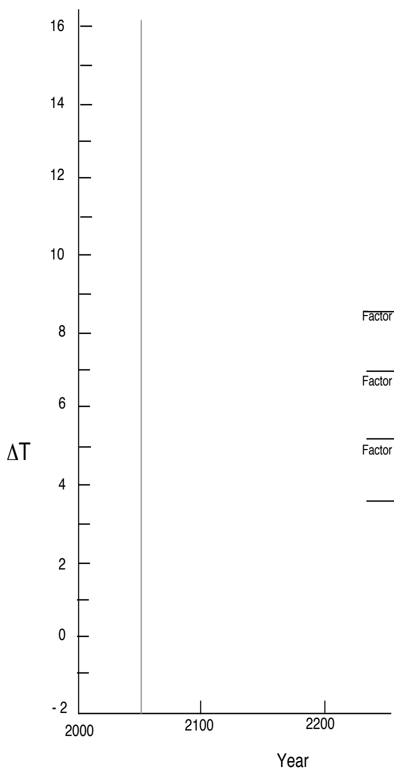
On the next pages, we have constructed box plots based on the probability distributions that we previously elicited from you.

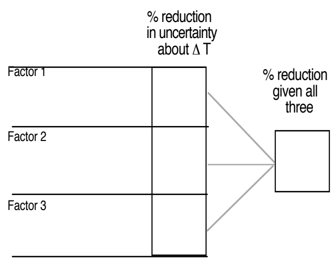
In each case, we'd first like to learn something about whether and how much the length of those box plots might shrink under the hypothetical scenario with the oracle who can tell you everything about your three top ranked factors, and then under two more realistic scenarios.

% reduction in uncertainty about ΔT in 2050 if the oracle could completely eliminate your uncertainty about each of your top three factors, taken alone and then together.

We understand that this is a difficult question, and that depending on which factors you have chosen, it may not be possible to think about eliminating uncertainty about them one at a time.

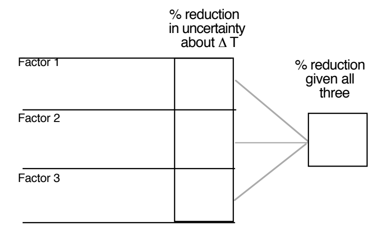
We are not expecting a precise answer.   We are simply trying to get some *rough* sense of the relative contribution of each to over all uncertatinty.



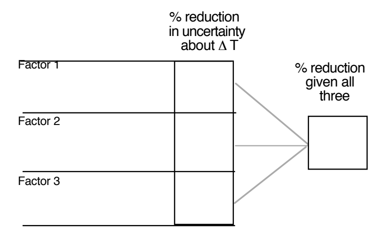


Now we'll ask two somewhat more realistic questions:

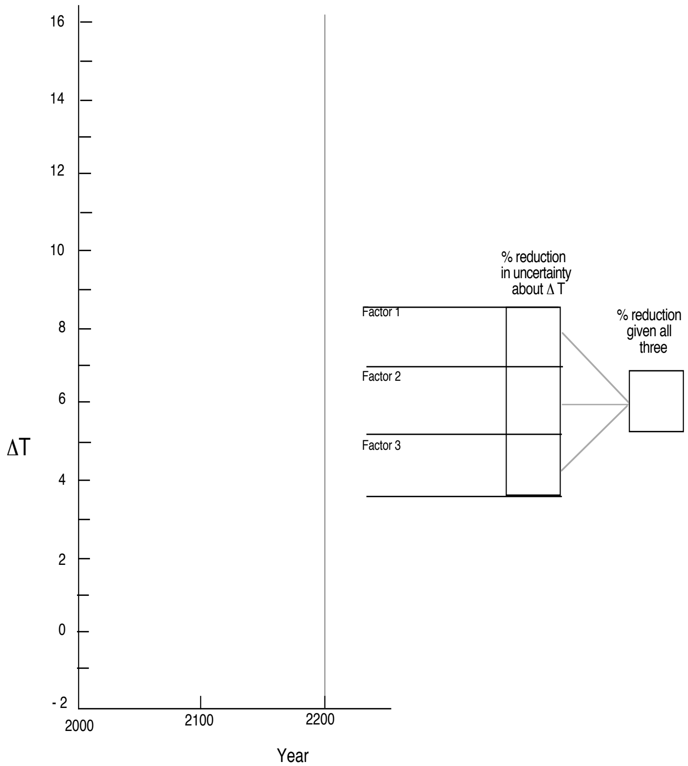
% reduction in uncertainty about ΔT in 2050 if data collection and model development continue <u>on the current path and at current funding levels</u> for 20 more years (i.e. to 2027).



% reduction in uncertainty about ΔT in 2050 if data collection and model development is <u>funded at 3X the current funding levels</u> from now for 20 more years (i.e. to 2027).

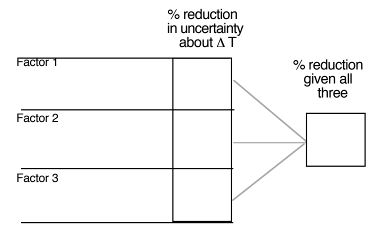


% reduction in uncertainty about ΔT in 2200 for the high forcing if the oracle could completely eliminate your uncertainty about each of your top three factors, taken alone and then together.

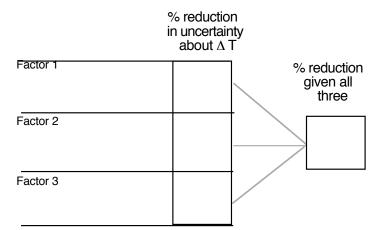


Again, two somewhat more realistic questions:

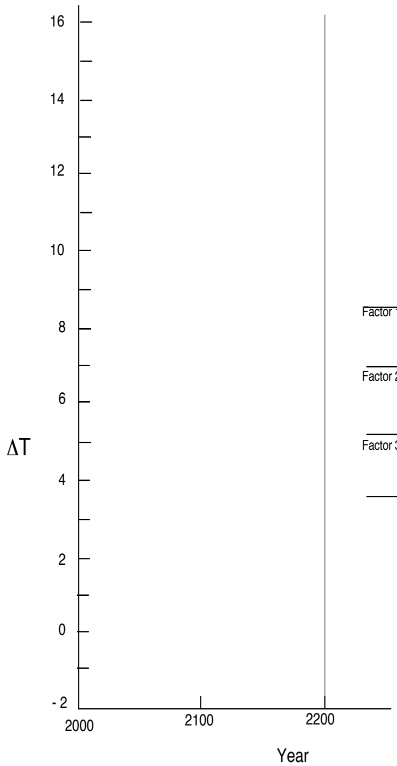
% reduction in uncertainty about ΔT in 2200 if data collection and model development continue <u>on the current path and at current funding levels</u> for 20 more years (i.e. to 2027).

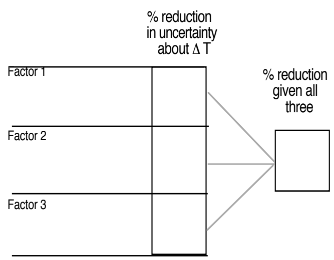


% reduction in uncertainty about ΔT in 2200 if data collection and model development is <u>funded at 3x the current funding levels</u> from now for 20 more years (i.e. to 2027).



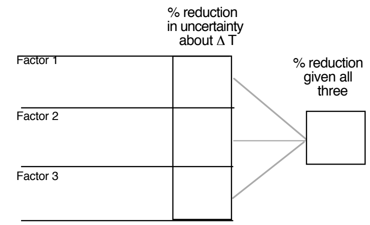
Finally, % reduction in uncertainty about ΔT in 2200 for the low forcing if the oracle could completely eliminate your uncertainty about each of your top three factors, taken alone and then together.



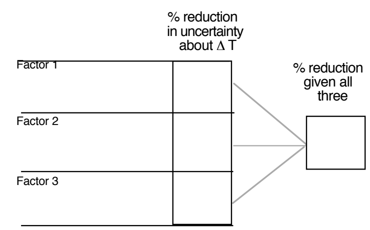


And again, two somewhat more realistic questions:

% reduction in uncertainty about ΔT in 2200 if data collection and model development continue <u>on the current path and at current funding levels</u> for 20 more years (i.e. to 2027).



% reduction in uncertainty about ΔT in 2200 if data collection and model development is <u>funded at 3X the current funding levels</u> from now for 20 more years (i.e. to 2027).



7. Value of classic climate sensitivity.

Classic climate sensitivity, as it is widely discussed in the literature, is the equilibrium warming that will occur if CO_2 is doubled (e.g., at 1% per year) and then held constant indifinetely. While our main focus in this study is on transient response, we would also like to know your current views about the value of classic climate sensitivity. We will do that by asking you to produce another probability distribution of the sort we have asked for before.

However, first we'd like you to sort the cards to indicate the six factors that *most* contribute to you *uncertainty* about the value of classic climate sensitivity.

1. ____
2. ____
3. ____
4. ____
5. ____
6. ____

Insert page here on which to record elicited CDF.

8. Some questions about regional climate.

While the change in global mean temperature is important, most impact assessments would like to have rather more specific information about how the climate may change at specific locations. For example, we learned recently that SwissRe is using various models to do downscaling from GCMs to estimate local and regional impacts to assess future insurance risks.

Among the types of information that folks doing impact assessment often ask for are:

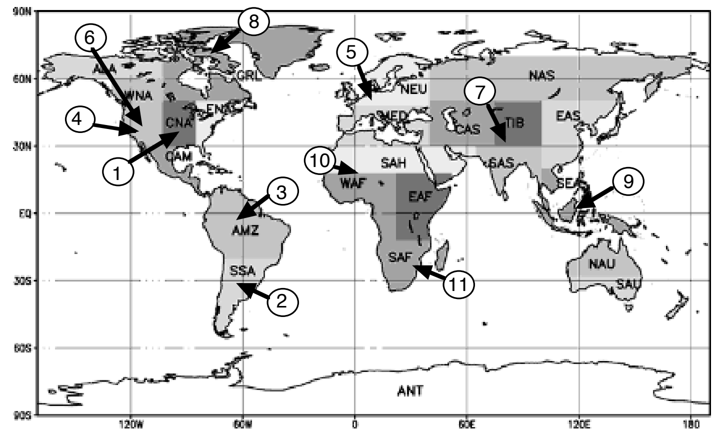
- statistics on temperature as a function of the time of year,
- statistics on the frequency and intensity of precipitation as a function of the time of year,
- statistics on stream flows as a function of the time of year,
- fraction of precipitation that falls as snow (when relevant),
- times of first and last frost (when relevant),
- frequency of wildfire
- frequency of extreme weather events.

We realize you are not primarily engaged in research on regional climate modeling or down-scaling. Nevertheless, we would like to learn your views on whether and to what extent you believe that over the coming decade it will be possible to provide meaningful predictive statements for specific locations about at least some of these climate-related variables for the period 2090-2110.

First, please provide us with a general discussion of regional climate modeling and downscaling approaches that you believe do and/or do not hold the greatest potential and what you see as their inherent limitations.

Now, assuming research continues at its current levels, we'd like you to give us some indication of how well you think it will be possible to make site-specific predictions in the year 2015 about the sign and the magnitude of changes in each of the climate-variables listed above for the two decades 2090-2110.

We will be asking questions about the following ten locations:



ALA	Alaska	NEU	Northern Europe	NAS	Northern Asia
WNA	Western North America	MED	Mediterranean	TIB	Tibet
CNA	Central North America	CAS	Central Asia	EAS	Eastern Asia
ENA	Eastern North America	SAH	Sahara	SAS	Southern Asia
GRL	Greenland	WAF	West Africa	SEA	South East Asia
CAM	Central America	EAF	East Africa	NAU	Northern Australia
AMZ	Amazonia	SAF	Southern Africa	SAU	Southern Australia
SSA	Southern South America	ANT	Antarctic		

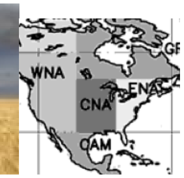
Source: Giorgi and Francisco, 2000 as reproduced by IPCC TAR WG I.

Please note that the regions we will ask about vary widely in their size and geography. Some are large-scale "Giorgi regions" while others are smaller regions such as agricultural valleys or mountain ranges that are important for regional water supply.

In each case, we will give you a choice between 5 different responses:

Will ***not*** be able to provide meaningful location-specific predictions of Δ in this quantity	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence & magnitudes to a factor of four	Will be able to correctly predict sign of Δ w/ ≥ 90% confidence & magnitudes to a factor of two	Will be able to correctly predict sign of Δ w/ ≥ 95% confidence & magnitudes to ±10%

1. Central great plains portion in the region CNA.



Given the current rate of research progress, in the year 2015 how well are we likely to be able to predict the *change* from current climate in this region for the period 2090-2110?

Will ***not*** be able to provide meaningful location-specific predictions of Δ in this quantity	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence & magnitudes to a factor of four	Will be able to correctly predict sign of Δ w/ ≥ 90% confidence & magnitudes to a factor of two	Will be able to correctly predict sign of Δ w/ ≥ 95% confidence & magnitudes to ±10%

Statistics on temperature as a function of the time of year:

☐ ☐ ☐ ☐ ☐

Statistics on the frequency of precipitation as a function of the time of year:

☐ ☐ ☐ ☐ ☐

Statistics on the intensity of precipitation as a function of the time of year:

☐ ☐ ☐ ☐ ☐

Statistics on magnitudes of stream flows as a function of the time of year:

☐ ☐ ☐ ☐ ☐

Fraction of precipitation that falls as snow:

☐ ☐ ☐ ☐ ☐

Times of first and last frost:

☐ ☐ ☐ ☐ ☐

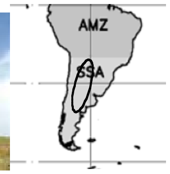
Frequency of wild fire:

☐ ☐ ☐ ☐ ☐

Frequency of extreme weather events. Specify type: ______________________________

☐ ☐ ☐ ☐ ☐

2. The Pampas portion of the region SSA.



Given the current rate of research progress, in the year 2015 how well are we likely to be able to predict the *change* from current climate in this region for the period 2090-2110?

Will ***not*** be able to provide meaningful location-specific predictions of Δ in this quantity	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence & magnitudes to a factor of four	Will be able to correctly predict sign of Δ w/ ≥ 90% confidence & magnitudes to a factor of two	Will be able to correctly predict sign of Δ w/ ≥ 95% confidence & magnitudes to ±10%

Statistics on temperature as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on the frequency of precipitation as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on the intensity of precipitation as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on magnitudes of stream flows as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Fraction of precipitation that falls as snow:

❑ ❑ ❑ ❑ ❑

Times of first and last frost:

❑ ❑ ❑ ❑ ❑

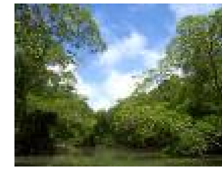
Frequency of wild fire:

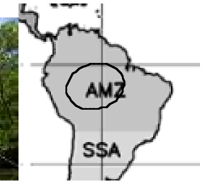
❑ ❑ ❑ ❑ ❑

Frequency of extreme weather events. Specify type: ______________________________

❑ ❑ ❑ ❑ ❑

3. The Central Amazon forests in AMZ.





Given the current rate of research progress, in the year 2015 how well are we likely to be able to predict the *change* from current climate in this region for the period 2090-2110?

Will ***not*** be able to provide meaningful location-specific predictions of Δ in this quantity	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence & magnitudes to a factor of four	Will be able to correctly predict sign of Δ w/ ≥ 90% confidence & magnitudes to a factor of two	Will be able to correctly predict sign of Δ w/ ≥ 95% confidence & magnitudes to ±10%

Statistics on temperature as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on the frequency of precipitation as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on the intensity of precipitation as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on magnitudes of stream flows as a function of the time of year:

❑ ❑ ❑ ❑ ❑

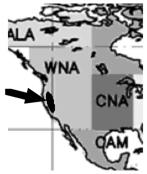
Frequency of wild fire:

❑ ❑ ❑ ❑ ❑

Frequency of extreme weather events. Specify type: ______________________________

❑ ❑ ❑ ❑ ❑

4. The Central Valley in California in the region WNA.



Given the current rate of research progress, in the year 2015 how well are we likely to be able to predict the *change* from current climate in this region for the period 2090-2110?

Will ***not*** be able to provide meaningful location-specific predictions of Δ in this quantity	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence & magnitudes to a factor of four	Will be able to correctly predict sign of Δ w/ ≥ 90% confidence & magnitudes to a factor of two	Will be able to correctly predict sign of Δ w/ ≥ 95% confidence & magnitudes to ±10%

Statistics on temperature as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on the frequency of precipitation as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on the intensity of precipitation as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on magnitudes of stream flows as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Fraction of precipitation that falls as snow:

❑ ❑ ❑ ❑ ❑

Times of first and last frost:

❑ ❑ ❑ ❑ ❑

Frequency of wild fire:

❑ ❑ ❑ ❑ ❑

Frequency of extreme weather events. Specify type: ______________________________

❑ ❑ ❑ ❑ ❑

5. North Central Europe in NEU.

Given the current rate of research progress, in the year 2015 how well are we likely to be able to predict the *change* from current climate in this region for the period 2090-2110?

Will ***not*** be able to provide meaningful location-specific predictions of Δ in this quantity	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence & magnitudes to a factor of four	Will be able to correctly predict sign of Δ w/ ≥ 90% confidence & magnitudes to a factor of two	Will be able to correctly predict sign of Δ w/ ≥ 95% confidence & magnitudes to ±10%

Statistics on temperature as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on the frequency of precipitation as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on the intensity of precipitation as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on magnitudes of stream flows as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Fraction of precipitation that falls as snow:

❑ ❑ ❑ ❑ ❑

Times of first and last frost:

❑ ❑ ❑ ❑ ❑

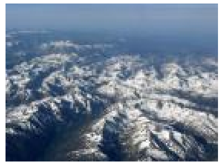
Frequency of wild fire:

❑ ❑ ❑ ❑ ❑

Frequency of extreme weather events. Specify type: ______________________________

❑ ❑ ❑ ❑ ❑

6. Sierra Nevada Mountains in the region WNA.



Given the current rate of research progress, in the year 2015 how well are we likely to be able to predict the *change* from current climate in this region for the period 2090-2110?

Will ***not*** be able to provide meaningful location-specific predictions of Δ in this quantity	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence & magnitudes to a factor of four	Will be able to correctly predict sign of Δ w/ ≥ 90% confidence & magnitudes to a factor of two	Will be able to correctly predict sign of Δ w/ ≥ 95% confidence & magnitudes to ±10%

Statistics on temperature as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on the frequency of precipitation as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on the intensity of precipitation as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on magnitudes of stream flows as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Fraction of precipitation that falls as snow:

❑ ❑ ❑ ❑ ❑

Times of first and last frost:

❑ ❑ ❑ ❑ ❑

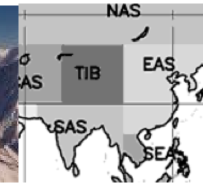
Frequency of wild fire:

❑ ❑ ❑ ❑ ❑

Frequency of extreme weather events. Specify type: ______________________________

❑ ❑ ❑ ❑ ❑

7. The Himalayan Mountains in the southernTIB region.



Given the current rate of research progress, in the year 2015 how well are we likely to be able to predict the *change* from current climate in this region for the period 2090-2110?

Will ***not*** be able to provide meaningful location-specific predictions of Δ in this quantity	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence & magnitudes to a factor of four	Will be able to correctly predict sign of Δ w/ ≥ 90% confidence & magnitudes to a factor of two	Will be able to correctly predict sign of Δ w/ ≥ 95% confidence & magnitudes to ±10%

Statistics on temperature as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on the frequency of precipitation as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on the intensity of precipitation as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on magnitudes of stream flows as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Fraction of precipitation that falls as snow:

❑ ❑ ❑ ❑ ❑

Times of first and last frost:

❑ ❑ ❑ ❑ ❑

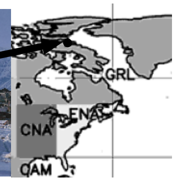
Frequency of wild fire:

❑ ❑ ❑ ❑ ❑

Frequency of extreme weather events. Specify type: ______________________________

❑ ❑ ❑ ❑ ❑

8. Pond Inlet, Baffin Island, NU in GRL.



Given the current rate of research progress, in the year 2015 how well are we likely to be able to predict the *change* from current climate in this region for the period 2090-2110?

Will ***not*** be able to provide meaningful location-specific predictions of Δ in this quantity	Will be able to correctly predict sign of Δ w/ $\geq$ 70% confidence	Will be able to correctly predict sign of Δ w/ $\geq$ 70% confidence & magnitudes to a factor of four	Will be able to correctly predict sign of Δ w/ $\geq$ 90% confidence & magnitudes to a factor of two	Will be able to correctly predict sign of Δ w/ $\geq$ 95% confidence & magnitudes to $\pm$10%

Statistics on temperature as a function of the time of year:

☐ ☐ ☐ ☐ ☐

Statistics on the frequency of precipitation as a function of the time of year:

☐ ☐ ☐ ☐ ☐

Statistics on the intensity of precipitation as a function of the time of year:

☐ ☐ ☐ ☐ ☐

Statistics on magnitudes of stream flows as a function of the time of year:

☐ ☐ ☐ ☐ ☐

Fraction of precipitation that falls as snow:

☐ ☐ ☐ ☐ ☐

Times of first and last frost:

☐ ☐ ☐ ☐ ☐

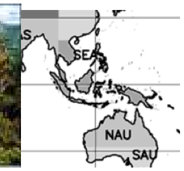
Frequency of wild fire:

☐ ☐ ☐ ☐ ☐

Frequency of extreme weather events. Specify type: ______________________________

☐ ☐ ☐ ☐ ☐

9. Central Indonesia in the SEA region.



Given the current rate of research progress, in the year 2015 how well are we likely to be able to predict the *change* from current climate in this region for the period 2090-2110?

Will ***not*** be able to provide meaningful location-specific predictions of Δ in this quantity	Will be able to correctly predict sign of Δ w/ $\geq$ 70% confidence	Will be able to correctly predict sign of Δ w/ $\geq$ 70% confidence & magnitudes to a factor of four	Will be able to correctly predict sign of Δ w/ $\geq$ 90% confidence & magnitudes to a factor of two	Will be able to correctly predict sign of Δ w/ $\geq$ 95% confidence & magnitudes to $\pm$10%

Statistics on temperature as a function of the time of year:

☐ ☐ ☐ ☐ ☐

Statistics on the frequency of precipitation as a function of the time of year:

☐ ☐ ☐ ☐ ☐

Statistics on the intensity of precipitation as a function of the time of year:

☐ ☐ ☐ ☐ ☐

Statistics on magnitudes of stream flows as a function of the time of year:

☐ ☐ ☐ ☐ ☐

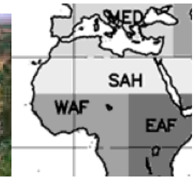
Frequency of wild fire:

☐ ☐ ☐ ☐ ☐

Frequency of extreme weather events. Specify type: ______________________________

☐ ☐ ☐ ☐ ☐

10. The Sahel at the boundary between the SAH and WAF regions.



Given the current rate of research progress, in the year 2015 how well are we likely to be able to predict the *change* from current climate in this region for the decade 2090-2100?

Will ***not*** be able to provide meaningful location-specific predictions of Δ in this quantity	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence & magnitudes to a factor of four	Will be able to correctly predict sign of Δ w/ ≥ 90% confidence & magnitudes to a factor of two	Will be able to correctly predict sign of Δ w/ ≥ 95% confidence & magnitudes to ±10%

Statistics on temperature as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on the frequency of precipitation as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on the intensity of precipitation as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on magnitudes of stream flows as a function of the time of year:

❑ ❑ ❑ ❑ ❑

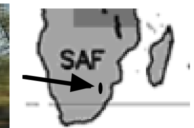
Frequency of wild fire:

❑ ❑ ❑ ❑ ❑

Frequency of extreme weather events. Specify type: ______________________________

❑ ❑ ❑ ❑ ❑

11. Kruger National Park in the SAF region.



Given the current rate of research progress, in the year 2015 how well are we likely to be able to predict the *change* from current climate in this region for the period 2090-2110?

Will ***not*** be able to provide meaningful location-specific predictions of Δ in this quantity	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence	Will be able to correctly predict sign of Δ w/ ≥ 70% confidence & magnitudes to a factor of four	Will be able to correctly predict sign of Δ w/ ≥ 90% confidence & magnitudes to a factor of two	Will be able to correctly predict sign of Δ w/ ≥ 95% confidence & magnitudes to ±10%

Statistics on temperature as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on the frequency of precipitation as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on the intensity of precipitation as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Statistics on magnitudes of stream flows as a function of the time of year:

❑ ❑ ❑ ❑ ❑

Frequency of wild fire:

❑ ❑ ❑ ❑ ❑

Frequency of extreme weather events. Specify type: ______________________________

❑ ❑ ❑ ❑ ❑