



PBL Netherlands Environmental
Assessment Agency

CLIMATE SCIENCE SURVEY

Questions and Responses

Bart Strengers, Bart Verheggen and Kees Vringer

10 April 2015

PBL
2015

Contents

1	INTRODUCTION	5
	PART I. GENERAL QUESTIONS	7
	I.1 Recent trend	7
	1a Attribution	7
	1b Confidence level	9
	2a Changes in recent trend	10
	2b Interpretation of recent trend	11
	I.2 Attribution	12
	3a Contributing factors	12
	3b Level of scientific understanding	13
	3c Underlying mechanisms	13
	I.3 Climate Sensitivity	16
	4a Best estimate and range of Climate Sensitivity	16
	4b Reasons for skipping Question 4a	18
	4c Explanations for a lower estimate than that of IPCC	18
	4d Explanations for a higher estimate than that of IPCC	19
	I.4 Lifetime	20
	5 Lifetime of anthropogenic CO ₂	20
	PART II. PROFESSIONAL BACKGROUND AND VIEWS ON SCIENCE AND SOCIETY	21
	II.1 Professional background	21
	6 Fields of expertise	21
	7a Years of professional involvement	22
	7b Number of publications	22
	8a Breadth of knowledge	23
	8b Depth of knowledge	23
	II.2 Views on Science and Society	24
	9a Public controversy	24
	9b Public controversy: other factors	25
	10 Role of science in society	25
	11 Media exposure	26
	12 Concern	27

PART III. DETAILED QUESTIONS	29
III.1 Sea level rise	29
13 Past sea level rise	29
14 Future sea level rise	29
III.2 Climate observations	31
15 Glaciers, arctic sea ice, ice sheets, ocean heat content, and extremes	31
16a Current temperatures compared to medieval times	32
16b Explanation of the Hockeystick	33
III.3 Statements on attribution	34
17 Sun (recent)	34
18a Agreement with statements related to attribution	35
18b Reasons for agreeing with statements related to attribution	36
III.4 Statements on climate models	37
19a Agreement with statements on climate models	37
19b Reasons for agreement with statements on climate models	38

1 Introduction

In the Spring of 2012, PBL, in collaboration with other researchers from the Netherlands and Australia, conducted a detailed survey about climate science. More than 1800 international scientists studying various aspects of climate change, including e.g. climate physics, climate impacts and mitigation, responded to the questionnaire. Certain results were selected from this survey, namely those pertaining to the causes of recent global warming (attribution), and have since been published in *Environmental Science and Technology* (ES&T)¹.

This document presents the responses to each survey question, both as an absolute number of responses and as a fraction of the total. In some cases, the responses were also divided into seven groups of respondents: co-authors of the Working Group I report of IPCC AR4 ('AR4 authors'); signatories of public declarations critical of mainstream climate science as embodied by IPCC ('unconvinced'); and four subgroups divided by their self-declared number of climate-related articles published in peer-reviewed scientific journals (0–3; 4–10; 11–30; more than 30). The four subgroups constitute similar numbers of respondents.

The answer options, as they appeared to the survey respondents, are shown above each figure. A brief outline of how the survey was conducted is provided below. We refer to the abovementioned article in ES&T for more detailed information on the survey set-up and the interpretation of the questions on attribution. [FAQs](#) are available, in which specific questions you may have about our survey are discussed.

Approximately 6550 people were invited to participate in this survey, which took place in March and April 2012. Question 1 was answered by 1868 respondents; the subsequent questions by progressively fewer people. Respondents were selected on the basis of a few criteria. The first criterion was having authored articles with the key words 'global warming' and/or 'global climate change', covering the 1991–2011 period, via the Web of Science (~6000 names). Another criterion was the inclusion in the climate scientist database assembled by Jim Prall (~2000 names). Names were also derived from surveying the recent climate science literature (~500 names). Prall's database includes signatories to public statements disapproving of mainstream climate science (~200 names). They were included in our survey to ensure that the main criticisms of climate science would be included. This last group amounted to almost 5% of the total number of respondents, about half of whom only published in the gray literature on climate change. There was some overlap between these various sources and valid email addresses were not found for every name, which is why the total number of people contacted (~6550) is less than the sum of the individual sources.

¹ Verheggen, Bart, Bart Strengers, John Cook, Rob van Dorland, Kees Vringer, Jeroen Peters, Hans Visser, and Leo Meyer. **Scientists' Views about Attribution of Global Warming**. DOI: 10.1021/es501998e, 2014. <http://pubs.acs.org/doi/abs/10.1021/es501998e>

Based on these criteria and on the number of respondents, we are confident that our results are representative of the wider scientific field of researchers studying various aspects of climate change. We deliberately surveyed a broad group of scientists; this is different from, for example, an expert elicitation. We checked that our survey respondents were representative of the larger group of invitees, by using various pieces of meta-information. Because the respondents to our survey also included signatories to public statements who are not necessarily published scientists, it is likely that viewpoints that run counter to the prevailing consensus are somewhat (i.e. by a few percentage points) magnified in our results.

Detailed questions were posed about a variety of physical climate science issues, which are discussed in the public debate about climate change. Answer options reflected a variety of viewpoints, all of which were phrased as specific and neutral as possible. Before executing the survey, questions and answer options were reviewed by physical and social scientists and climate change public commentators with a wide range of opinions to minimise the chance of bias.

Consistent with previous studies, we found that the level of agreement with the IPCC position increases with increasing expertise in climate science, as judged by the self-reported number of peer-reviewed publications on climate change. Likewise, this level of agreement is stronger for respondents with self-reported domain expertise. When comparing the level of consensus with those in other surveys, a few factors should be considered: Is it an opinion survey or a literature survey? How is the 'consensus' position defined? Who is being surveyed? Considering these factors, our results are in good agreement with those from comparable studies, with some main differences being that our survey is more detailed and our definition of the 'consensus' position more specific. The level of detail allowed us to make a number of other inferences regarding, for example, aerosol cooling vs greenhouse warming, the IPCC statement on attribution, and media coverage. The interested reader is referred to our article in ES&T¹ for more information.

This document only provides information on the responses to 'closed' questions, where respondents had to choose between pre-defined answer options. Responses to open questions are not included here, because they cover a few hundred pages of text. Additional information is provided where necessary, to avoid misinterpretation of responses.

This document was prepared for the purpose of sharing the general survey results with the respondents and the general public. When reproducing or discussing these results elsewhere, please refer to this document, its URL and the abovementioned article in ES&T. For more information regarding this survey, please contact [PBL](https://pbl.nl) or send an e-mail to bart.strengers@pbl.nl or verheggen.bart@gmail.com.

Part I. General questions

I.1 Recent trend

Questions 1a and 1b together mirror the attribution statement made in the Fourth Assessment Report (AR4) of the IPCC. This statement, and how the survey responses pertain to it, was the major focus of our study as published in ES&T¹. Grouped responses to these questions can be found in said manuscript. We argued that the AR4 statement, by providing a lower limit on the isolated greenhouse gas contribution without mentioning aerosol cooling, leads to an underestimate of this contribution. Many respondents seem to have interpreted this question –as well as the corresponding AR4 statement- as pertaining to the net anthropogenic effect rather than to the isolated greenhouse gas contribution.

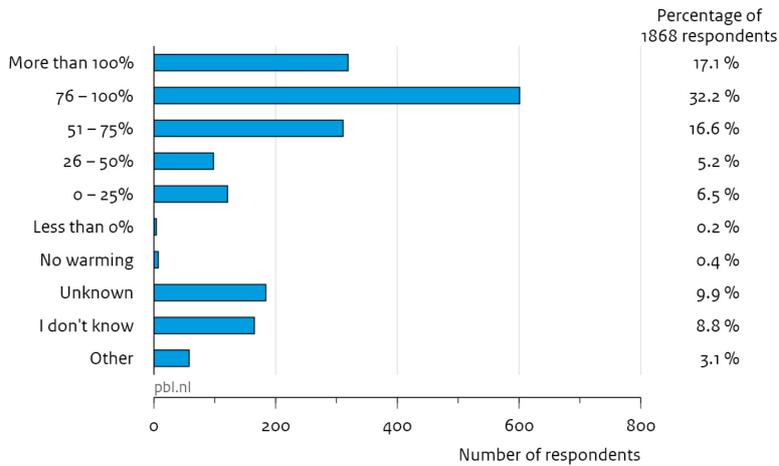
1a Attribution

What fraction of global warming since the mid-20th century can be attributed to human induced increases in atmospheric greenhouse gas (GHG) concentrations?

- *More than 100% (i.e. GHG warming has been partly offset by aerosol cooling)*
- *Between 76% and 100%*
- *Between 51% and 76%*
- *Between 26% and 50%*
- *Between 0 and 25%*
- *Less than 0% (i.e. anthropogenic GHG emissions have caused cooling)*
- *There has been no warming*
- *Unknown due to lack of knowledge*
- *I do not know*
- *Other (please specify)*

Question 1a

What fraction of global warming since the mid-20th century can be attributed to human induced increases in atmospheric greenhouse gas (GHG) concentrations?

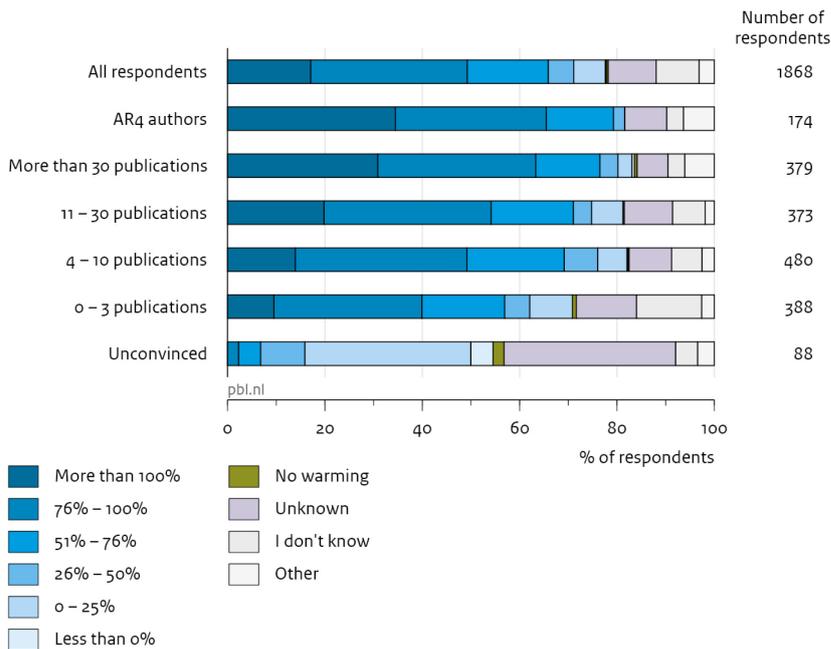


Source: PBL

Figure 1a.1 Responses to Question 1a.

Question 1a

What fraction of global warming since the mid-20th century can be attributed to human induced increases in atmospheric greenhouse gas (GHG) concentrations?



Source: PBL

Figure 1a.2 Responses to Question 1a, divided into seven groups. The group 'All respondents' is equivalent to that of figure 1a.1.

1b Confidence level

If the answer to Question 1a was **more** than 50% the following Question was asked:
*What confidence level would you ascribe to the anthropogenic GHG contribution being **more** than 50%?*

If the answer to Question 1a was **less** than 50%:
*What confidence level would you ascribe to the anthropogenic GHG contribution being **less** than 50%?*

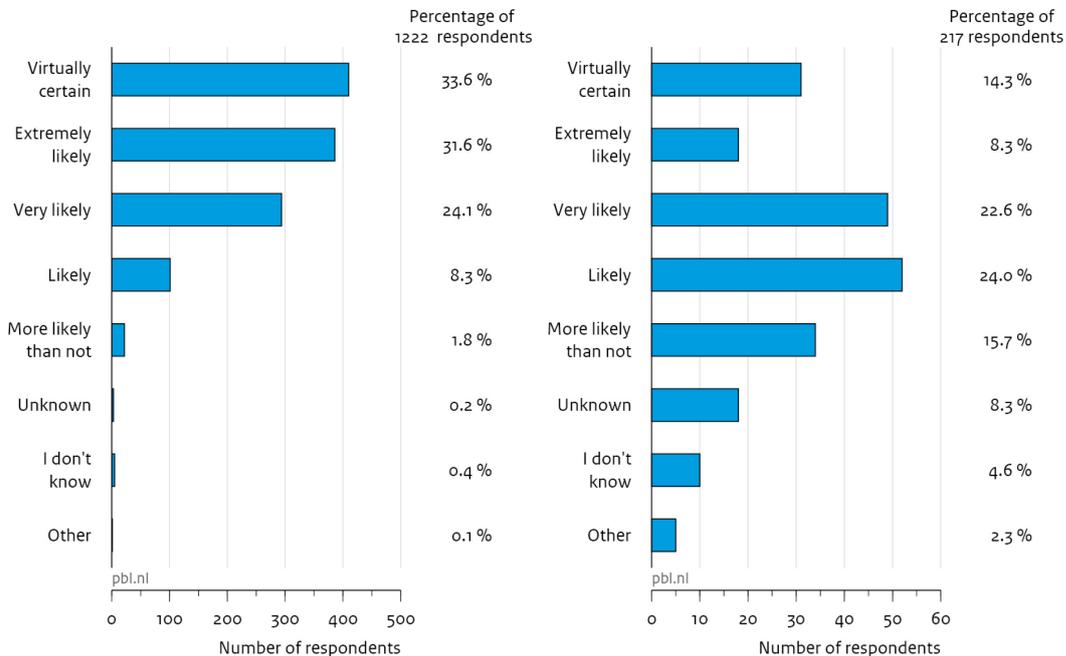
- *Virtually certain (>99% likelihood)*
- *Extremely likely (>95% likelihood)*
- *Very likely (>90% likelihood)*
- *Likely (>66% likelihood)*
- *More likely than not (between 50% and 66% likelihood)*
- *Unknown due to lack of knowledge*
- *I do not know*
- *Other (please specify)*

Question 1b

What confidence level would you ascribe to your estimate that the anthropogenic GHG contribution is ...

... more than 50%?

... less than 50%?



Source: PBL

Figure 1b Responses to Question 1b. The figure on the left refers to respondents having answered to Question 1a that the GHG-contribution to the warming since mid-20th century is more than 50%, and the figure on the right refers to those having responded that this is less than 50%.

2a Changes in recent trend

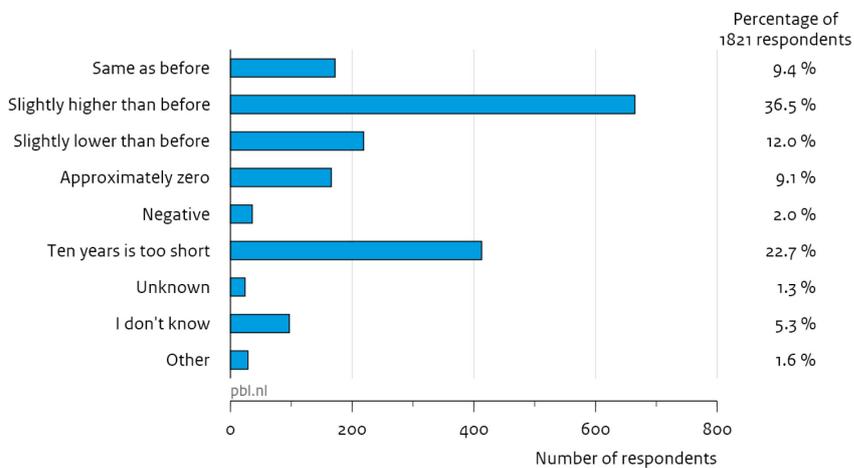
Has the trend in global average temperature changed over the past decade, compared to the preceding decades?

- *The trend over the past decade is approximately the same as before*
- *The trend over the past decade is slightly higher than before*
- *The trend over the past decade is slightly lower than before*
- *The trend over the past decade is approximately zero (i.e. no change in temperature)*
- *The trend over the past decade is negative (i.e. cooling)*
- *10 years is too short to establish a significant (change in) trend amidst the uncertainty*
- *Unknown due to lack of knowledge*
- *I do not know*
- *Other*

The reference timescale 'preceding decades' is imprecise. This probably contributed to this question having been interpreted differently by different respondents, as reflected by the responses given.

Question 2a

Has the trend in global average temperature changed in the past decade, compared to the preceding decades?



Source: PBL

Figure 2a Responses to Question 2a.

2b Interpretation of recent trend

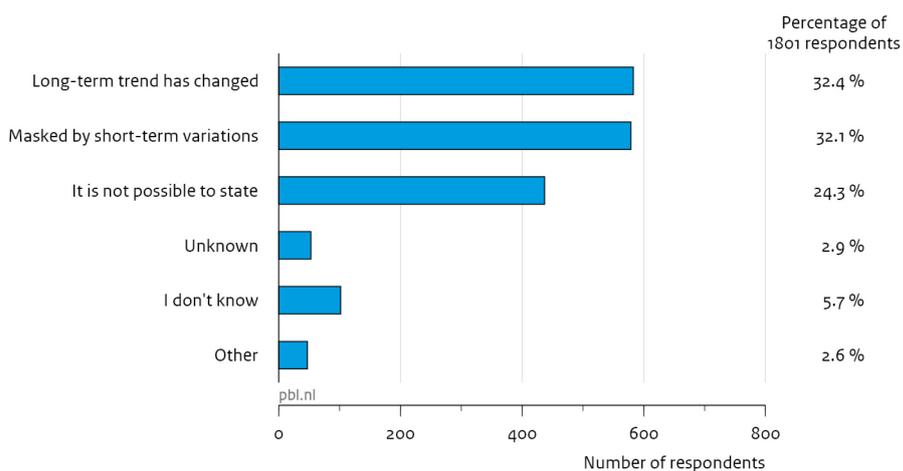
What is your interpretation of the trend over the past decade with respect to the long term (multi-decadal) trend?

- Long-term warming trend has changed as indicated in my previous answer
- Long-term warming trend has not changed; it is masked by short-term variations
- It is not possible to state whether the long-term trend has changed.
- Unknown due to lack of knowledge
- I do not know
- Other

Responses to this question should be seen in the context of the responses to the previous question (2a). The timescale of the long-term trend is imprecise, hampering the interpretation of responses.

Question 2b

What is your interpretation of the trend in global average temperature over the past decade with respect to the long term (multi-decadal) trend?



Source: PBL

Figure 2b Responses to Question 2b.

I.2 Attribution

3a Contributing factors

How would you characterize the contribution of the following factors to the reported global warming of ~ 0.8 °C since pre-industrial times? *

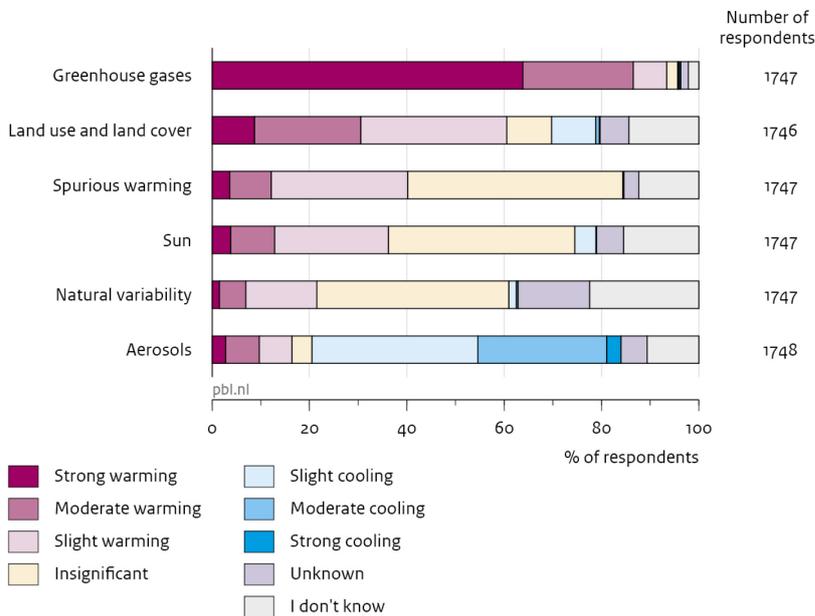
The contributing factors:

- greenhouse gases (CO_2 , CH_4 , N_2O , O_3 , halocarbons)
- aerosols (reflection, absorption, indirect effects via clouds), land-use and land- cover change
- sun (total solar irradiance, cosmic rays, UV)
- internal variability (random variation, oscillations)
- spurious warming (urban heat island effect, siting of weather stations).

*Examples are given in brackets; these need not be exhaustive. greenhouse gas emissions resulting from land use and land cover change should be included under 'greenhouse gases'. 'spurious warming' refers to global mean surface temperature change being overestimated due to artefacts in the data.

Question 3a

How would you characterize the contribution of the following factors to the reported global warming of ~ 0.8 °C since pre-industrial times?



Source: PBL

Figure 3a Responses to Question 3a.

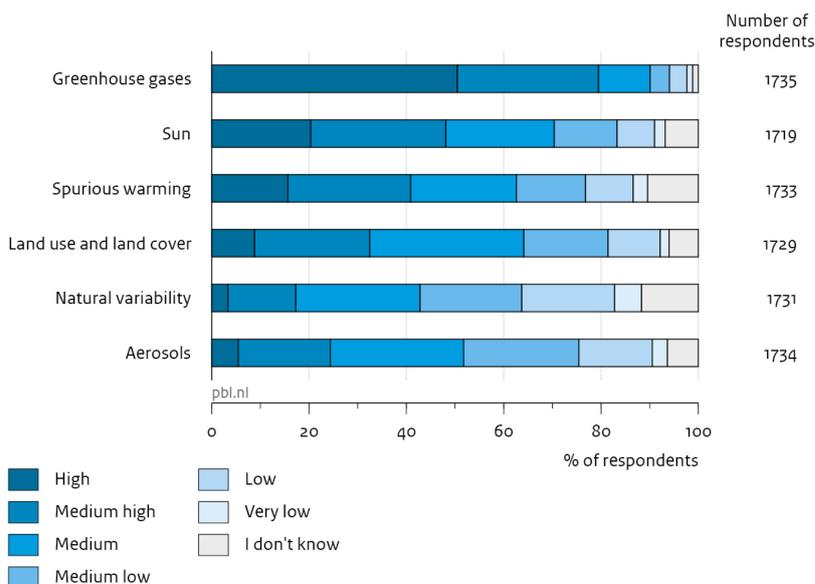
3b Level of scientific understanding

How would you describe the level of scientific understanding for each of these factors?

where 'these factors' refer to the contributing factors distinguished as mentioned in Question 3a. The response options for each contributing factor are:

Question 3b

How would you describe the level of scientific understanding for the following factors?



Source: PBL

Figure 3b Responses to Question 3b.

3c Underlying mechanisms

If a category other than greenhouse gases was considered by the respondent to have had a (slight, moderate or strong) warming influence, a follow-up question was asked about its underlying mechanism. Multiple responses could be given.

If the respondent indicated that part of the warming was due to **aerosols**, the following question was asked:

You attributed part of the warming to aerosols. Which factors cause the net aerosol effect to be warming? Check any that apply.

- Absorption by black carbon outweighs reflection by the other aerosol and indirect effects via clouds
- Indirect effects via clouds cause warming
- Other (please specify)

If the respondent indicated that part of the warming was due to **land use and land cover change**, the following question was asked:

You attributed part of the warming to land use and land cover change. What are the main mechanisms via which this has caused warming? Check any that apply

- *Decreasing surface albedo*
- *Decreasing evaporation*
- *Other (please specify)*

If the respondent indicated that part of the warming was due to the **sun**, the following question was asked:

You attributed part of the warming to the sun. What are the main mechanisms via which the sun exerts influence over the Earth's climate? Check any that apply.

- *Directly, via total solar irradiance*
- *Indirectly, via its shielding effect on cosmic rays, thus suppressing cloud cover*
- *Indirectly, via effects of the ultraviolet part of the solar spectrum*
- *Other (please specify)*

If the respondent indicated that part of the warming was due to **internal variability**, the following question was asked:

You attributed part of the warming to internal variability. Which processes or oscillations are most important in this respect? Check any that apply.

- *Random variations*
- *Spontaneous changes in cloud cover*
- *Pacific Decadal Oscillation (PDO)*
- *Atlantic Multidecadal Oscillation (AMO)*
- *El Nino Southern Oscillation (ENSO)*
- *Other (please specify)*

If the respondent indicated that part of the warming was due to **spurious warming**, the following question was asked:

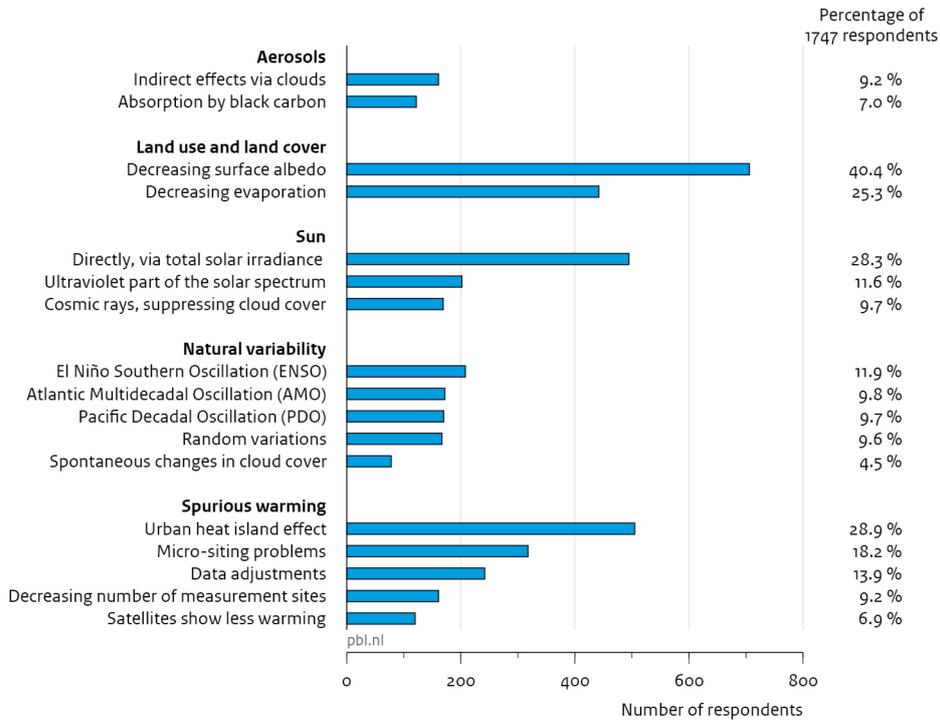
You indicated part of the warming to be spurious (i.e. overestimated). Which factors contribute to, or provide an indication of, this overestimation? Check any that apply.

- *Urban heat island effect*
- *Micro-siting problems (e.g. measurements close to local heat sources)*
- *Data adjustments*

- *Decreasing number of measurement sites*
- *Satellites show less warming of the lower troposphere*
- *Other: (please specify)*

Question 3c

You attributed part of the global warming to aerosols, land use/cover change, the sun, natural variability and/or spurious warming. What underlying factors/mechanisms contribute to this warming?



Source: PBL

Figure 3c Responses to question 3c. Response percentages were calculated based on a sample size of 1747, based on the number of respondents that answered question 3a.

I.3 Climate Sensitivity

4a Best estimate and range of Climate Sensitivity

This was an open question, but for figure 4a.1 the responses have been grouped into bins spreading 1 degree in sensitivity range.

*What is your estimate of equilibrium (Charney) climate sensitivity, i.e. the temperature response (°C) to a doubling of CO₂?**

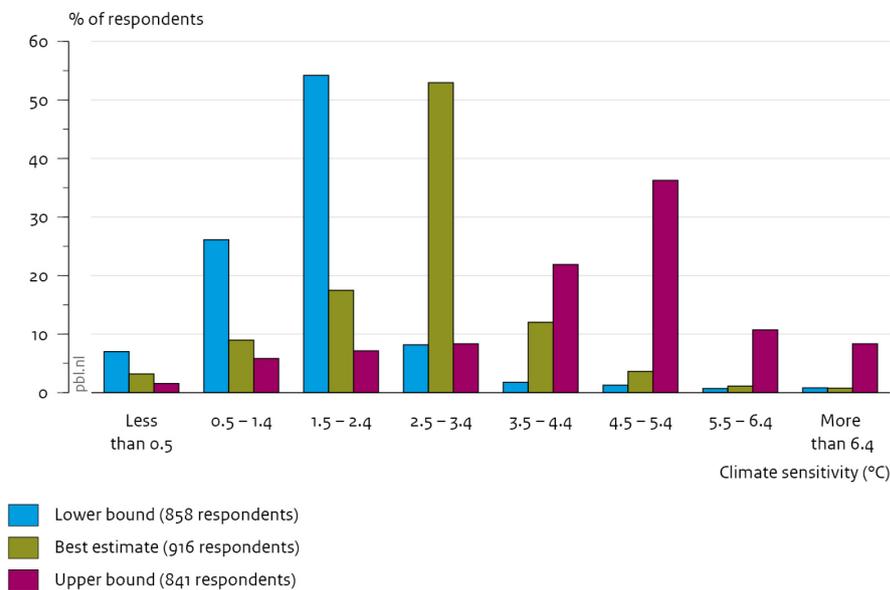
- *Most likely value: [number] °C*
- *Lower bound of likely range: [number] °C*
- *Upper bound of likely range: [number] °C*

**Please provide both a best estimate and a likely range (66% probability interval). Skip this question if you think it is unknown or if you do not know. Here the Charney sensitivity is meant, i.e. taking into account feedbacks that operate on a timescale of decades to centuries. Slow response of ice sheets and vegetation is excluded.*

Question 4a

What is your estimate of equilibrium (Charney) climate sensitivity, i.e. the temperature response (°C) to a doubling of atmospheric CO₂?

Please provide both a best estimate and a likely range (66% probability interval).



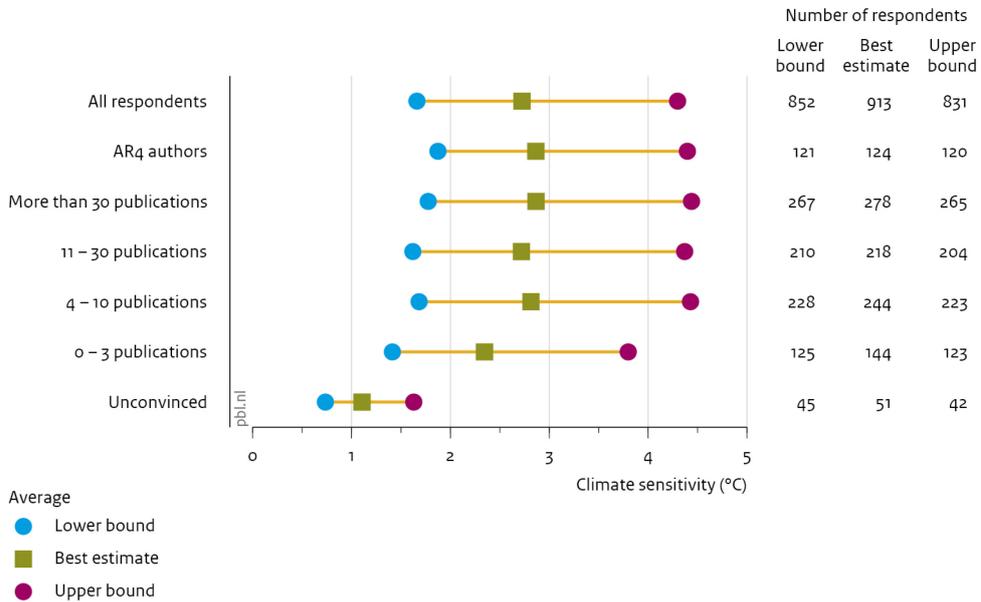
Source: PBL

Figure 4a.1 Responses to Question 4a. Responses are grouped into bins spreading 1 °C in sensitivity range.

Question 4a

What is your estimate of equilibrium (Charney) climate sensitivity, i.e. the temperature response (°C) to a doubling of atmospheric CO₂?

Please provide both a best estimate and a likely range (66% probability interval).



Source: PBL

Figure 4a.2 Average response to question 4a for the 'best estimate' and the likely range (66% probability range) for seven different groups. Values higher than 10°C were excluded.

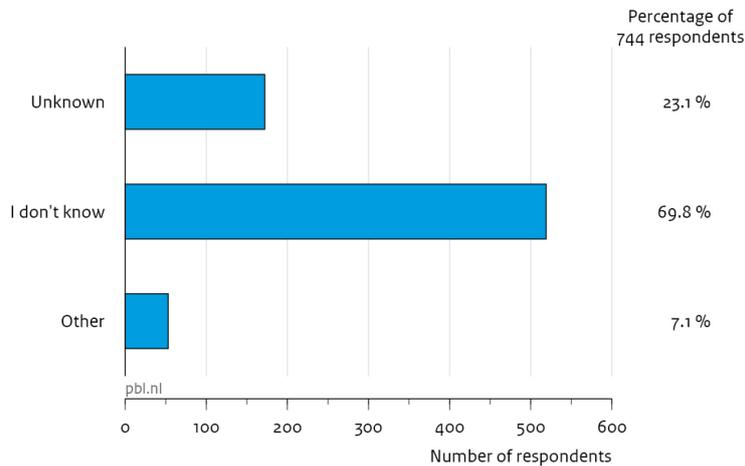
Figure 4a.2 shows the average response to Question 4a. Estimates for ECS exceeding 10 °C were excluded under the assumption that these were made in error. Note that the results for most groups (except those tagged as 'unconvinced' which strongly deviated from the other groups) are very close to the IPCC range in its fifth assessment report (1.5-4.5 degrees C).

4b Reasons for skipping Question 4a

Question 4b was only asked to respondents who did not provide an estimate for the most likely value of climate sensitivity:

Question 4b

Please indicate why you did not enter a best estimate of climate sensitivity?



Source: PBL

Figure 4b.1 Responses to Question 4b.

4c Explanations for a lower estimate than that of IPCC

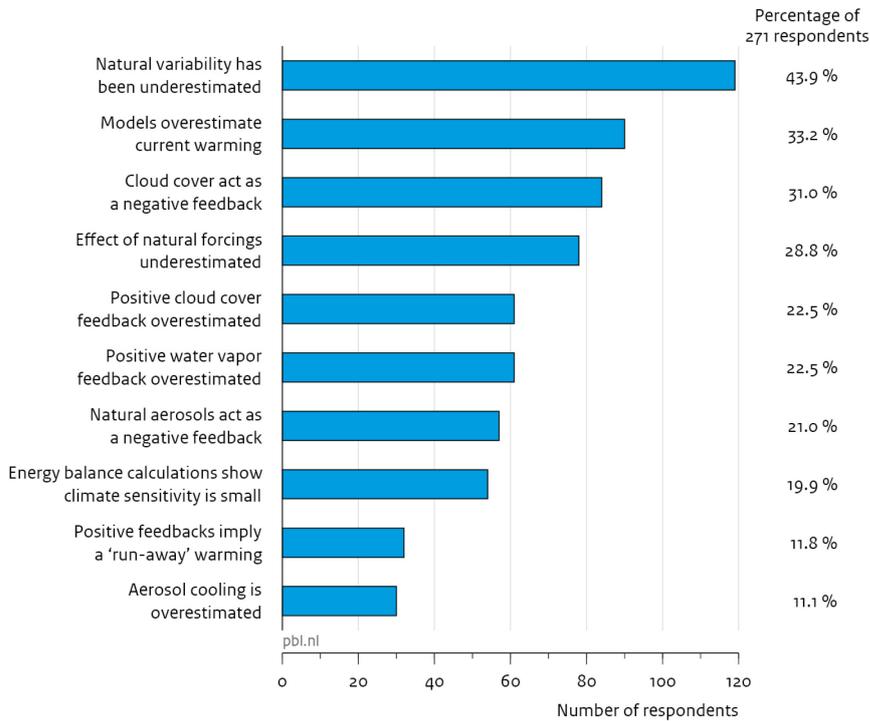
The following question was asked if the answer to question 4a (about the best estimate of Climate Sensitivity) was lower than 2.5 °C, i.e. more than 0.5 °C below the best estimate of Climate Sensitivity (3.0 °C) in the Fourth Assessment Report of IPCC.

Please indicate the reason(s) for your estimate being lower than IPCC's

- *Cloud cover acts as a thermostat (negative feedback)*
- *Positive cloud cover feedback is overestimated*
- *Positive water vapor feedback is overestimated*
- *Cooling by natural aerosols acts as a negative feedback*
- *Positive feedbacks would imply a 'run-away' warming*
- *Simplified energy balance calculations show that climate sensitivity is small*
- *Aerosol cooling is overestimated, thus net positive forcing is underestimated and climate sensitivity overestimated*
- *Effect of natural variability has been underestimated*
- *Effect of natural forcings has been underestimated*
- *Current warming is less than predicted by climate models*
- *Other: [please specify]*

Question 4c

Please indicate the reason(s) for your best estimate of climate sensitivity being significantly lower than IPCC's, i.e. lower than 2.5 °C



Source: PBL

Figure 4c Responses to Question 4c. This multiple-choice question was only addressed to those whose estimate for the most likely value of climate sensitivity (Question 4a) was smaller than 2.5 °C.

4d Explanations for a higher estimate than that of IPCC

The following question was asked if the answer to question 4a (about the best estimate of Climate Sensitivity) was higher than 3.5 °C, i.e. more than 0.5 °C above the best estimate of Climate Sensitivity (3.0 °C) in the Fourth Assessment Report of IPCC.

Please indicate the reason(s) for your estimate being higher than IPCC's.

The sample size of this question was N=127. Responses have not yet been analysed.

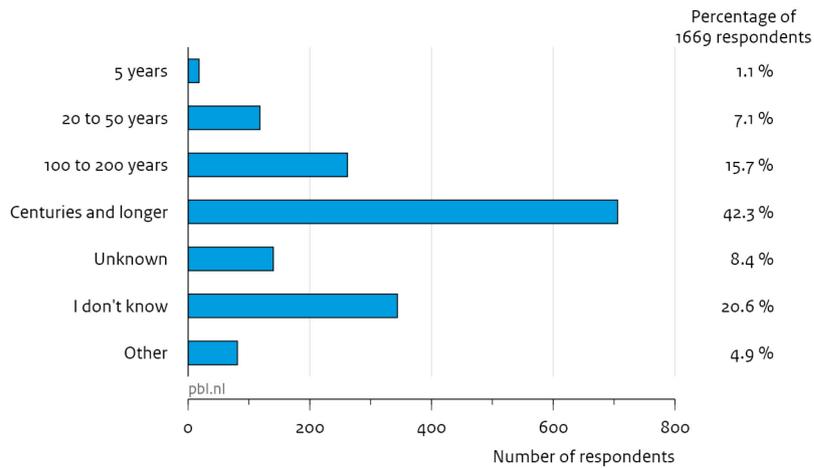
I.4 Lifetime

5 Lifetime of anthropogenic CO₂

What is your estimate of the perturbation lifetime of anthropogenic CO₂, i.e. the time needed for a peak in atmospheric CO₂ concentration to return to its background level?

Question 5

What is your estimate of the perturbation lifetime of anthropogenic CO₂, i.e. the time needed for a peak in atmospheric CO₂ concentration to return to its background level?



Source: PBL

Figure 5 Responses to Question 5.

Part II. Professional background and views on science and society

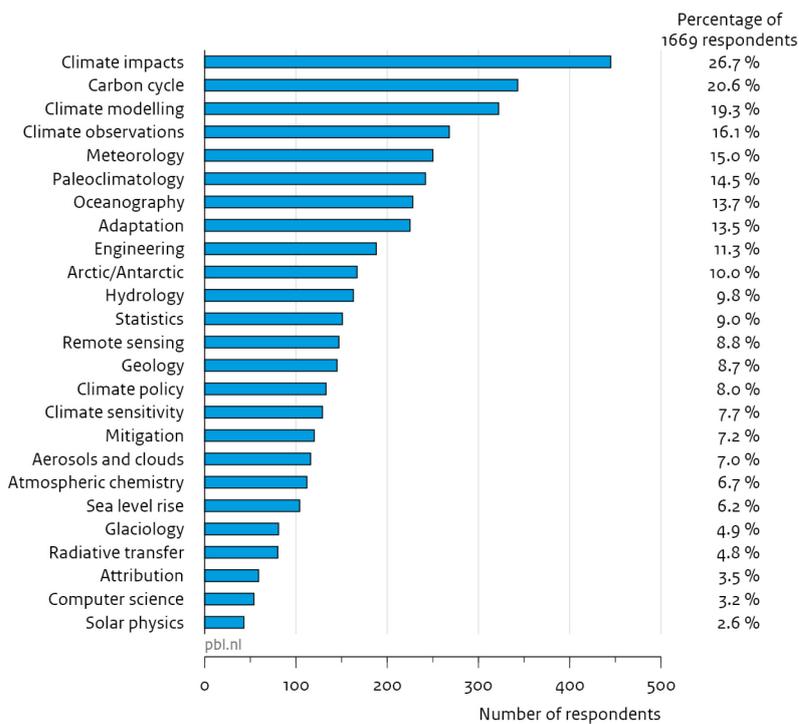
II.1 Professional background

6 Fields of expertise

Please indicate your field(s) of expertise in climate science. Check any that apply.

Question 6

Please indicate your field(s) of expertise in climate science



Source: PBL

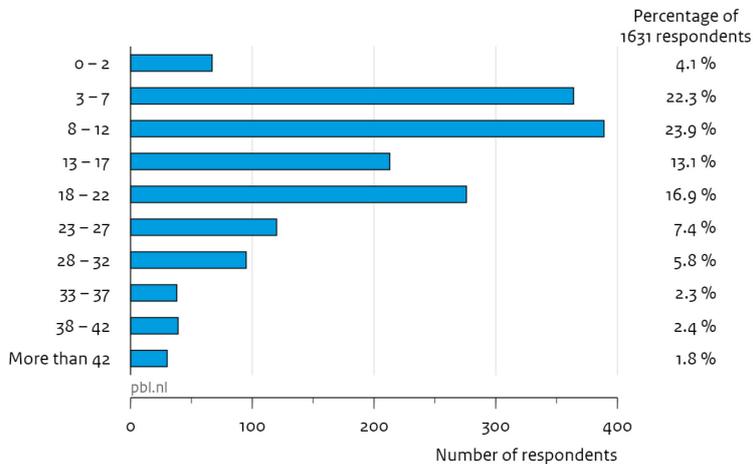
Figure 6 Responses to Question 6. Percentage response is calculated based on the sample size of the previous Question 5.

7a Years of professional involvement

For how many years have you been professionally involved in climate change issues?

Question 7a

For how many years have you been professionally involved in climate change issues?



Source: PBL

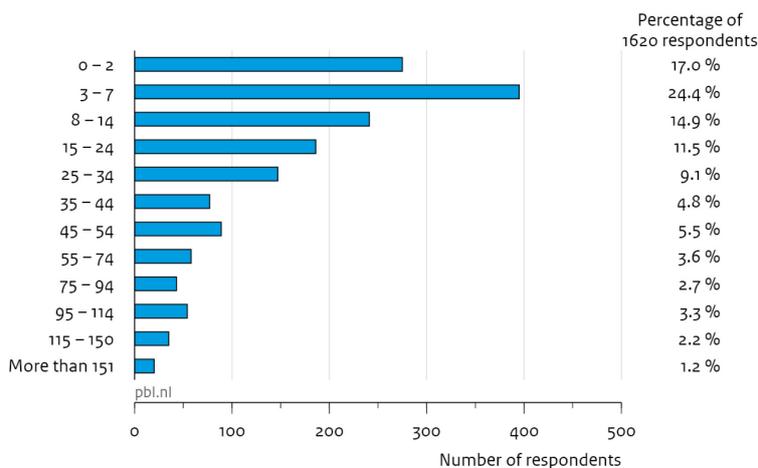
Figure 7a Responses to Question 7a. Responses were grouped into ranges for ease of viewing.

7b Number of publications

Please indicate the approximate number of climate related articles you have published in peer reviewed scientific journals, including as co-author.

Question 7b

Please indicate the approximate number of climate related articles you have published in peer reviewed scientific journals, including as co-author



Source: PBL

Figure 7b Responses to question 7b. Responses were grouped into ranges for ease of viewing.

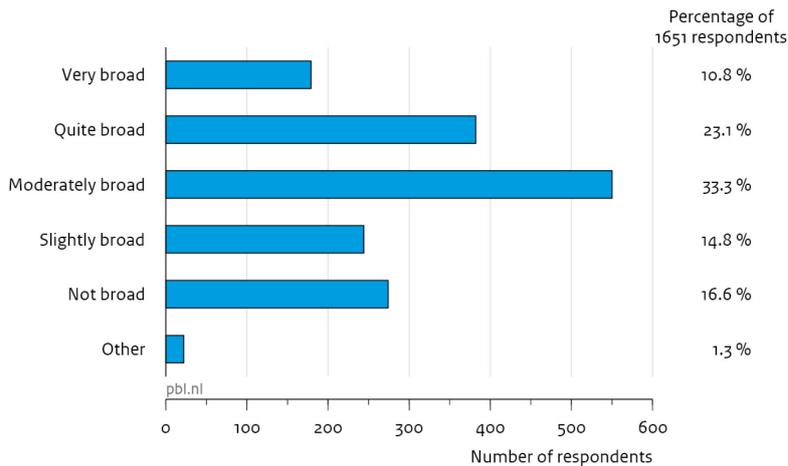
8a Breadth of knowledge

How would you describe your general knowledge of physical climate science? *

*This refers to the breadth of your knowledge: How wide is the range of topics, related to physical climate science, that you consider yourself reasonably knowledgeable about?

Question 8a

How would you describe your general knowledge of physical climate science?



Source: PBL

Figure 8a Responses to Question 8a.

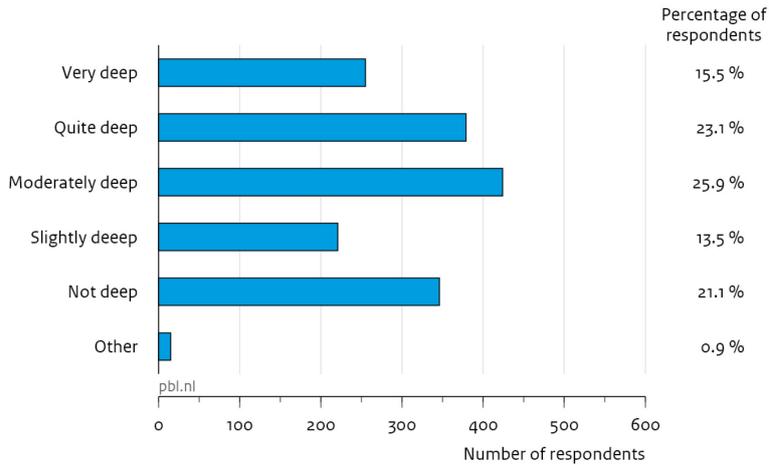
8b Depth of knowledge

How would you describe your specialist knowledge of one or more aspects of physical climate science? *

*This refers to the depth of your knowledge on one or a few aspect(s) related to physical climate science

Question 8b

How would you describe your specialist knowledge of one or more aspects of physical climate science?



Source: PBL

Figure 8b Responses to Question 8b.

II.2 Views on Science and Society

9a Public controversy

How important are the following factors according to you in having contributed to public controversy about climate change?*

Factors:

- *Lack of public understanding about the nature of science*
- *Lack of public knowledge about climate science*
- *Relative immaturity of climate science*
- *Serious mistakes made by climate scientists*
- *Suppression of alternative viewpoints*
- *Suppression of uncertainties*
- *Opposition to proposed mitigation measures*
- *Differences in worldview*
- *Undermining the credibility of climate science and scientists*
- *Other factors*

*Only assign a degree of importance if you deem the statement to be (at least somewhat) true.

Question 9a

How important are the following factors according to you in having contributed to public controversy about climate change?

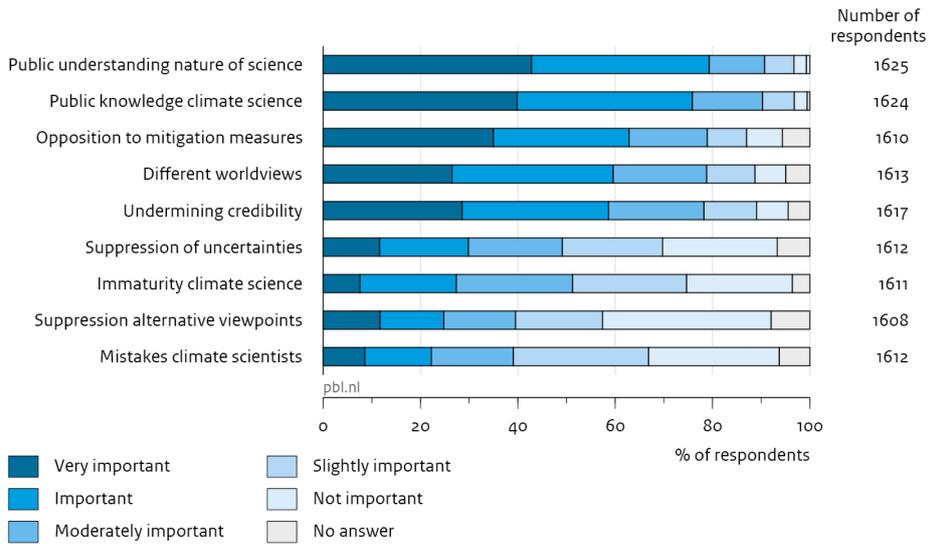


Figure 9a Responses to Question 9a. Responses are ordered by the sum of 'important' and 'very important'.

9b Public controversy: other factors

If an important reason for the public controversy was not listed, please describe it here.

The answers to this question have not been analyzed yet.

10 Role of science in society

*To what extent do you agree with the following statements regarding the role of science in society?**

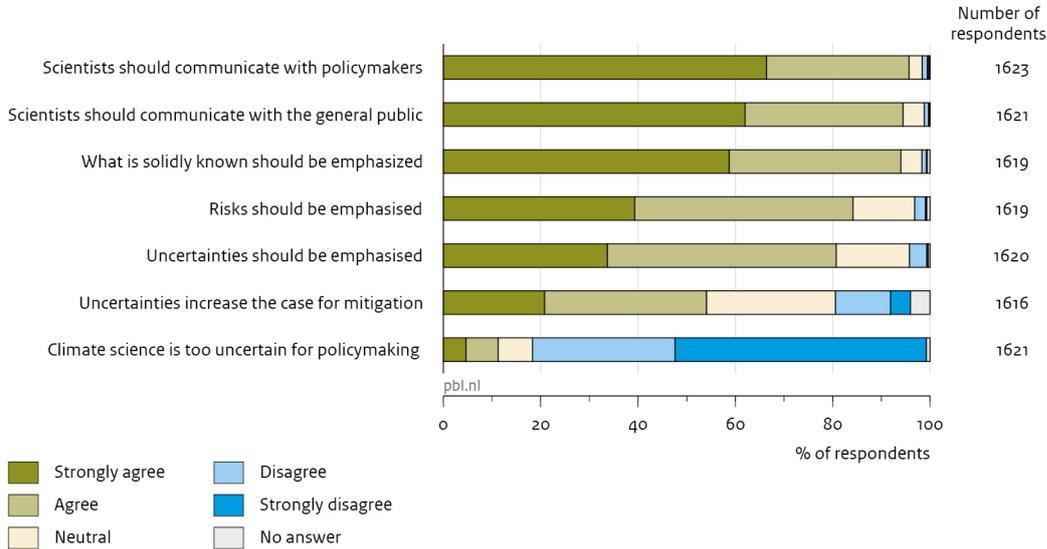
Statements:

- *Scientists should communicate with policymakers about climate change*
- *Scientists should communicate with the general public about climate change*
- *Uncertainties should be emphasised when communicating with the general public*
- *What is solidly known should be emphasized in communicating with the general public*
- *Risks should be emphasised when communicating with the general public*
- *Existing uncertainties in climate science strengthen the case for mitigation.*
- *Climate science is too uncertain to be useful for policymaking on climate change*

*Only assign a degree of importance if you deem the statement to be (at least somewhat) true.

Question 10

To what extent do you agree with the following statements regarding the role of science in society?



Source: PBL

Figure 10 Responses to Question 10.

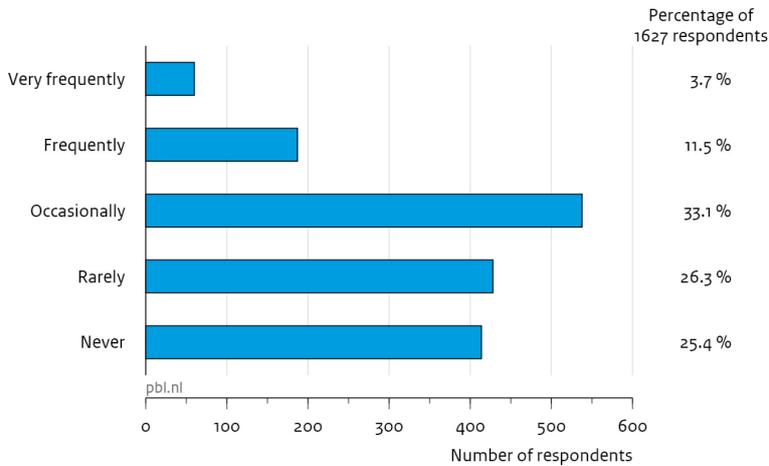
11 Media exposure

How frequently have you been featured in the media regarding your views on climate change?*

*Examples of media include newspapers, magazines, television, radio, on-line platforms, etc.

Question 11

How frequently have you been featured in the media regarding your views on climate change?

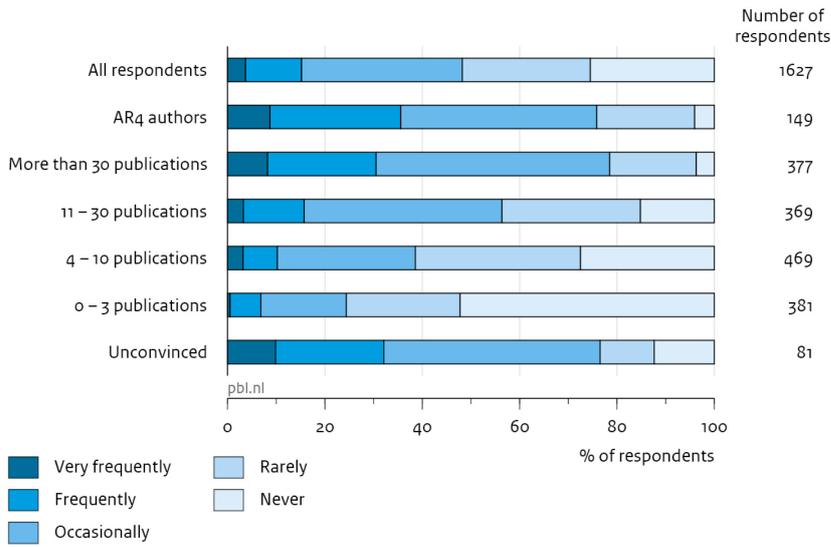


Source: PBL

Figure 11.1 Responses to Question 11.

Question 11

How frequently have you been featured in the media regarding your views on climate change?



Source: PBL

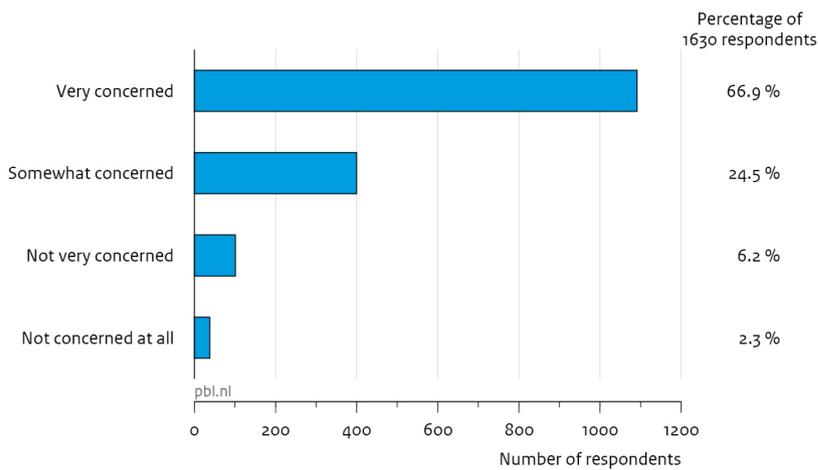
Figure 11.2 Responses to Question 11, divided into seven groups. The group 'All respondents' is equivalent to that of figure 11.1.

12 Concern

How concerned are you about climate change as a long-term global problem?

Question 12

How concerned are you about climate change as a long-term global problem?

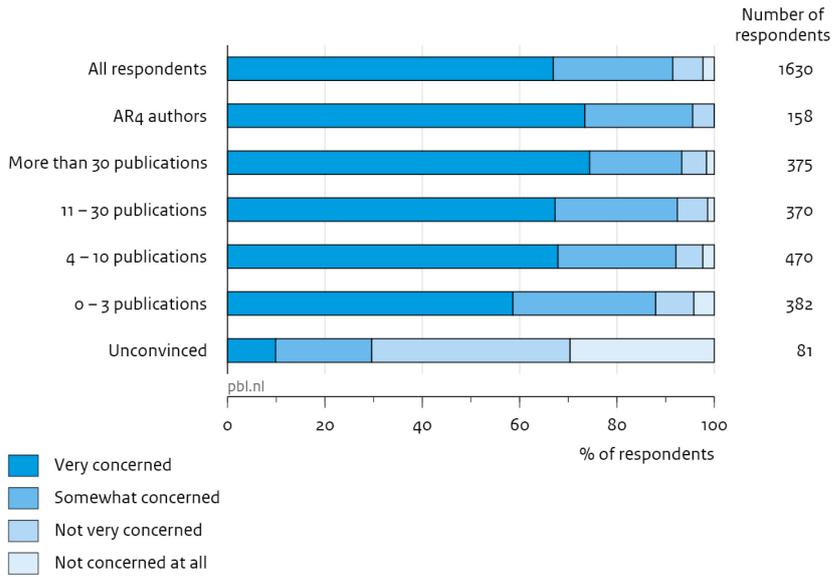


Source: PBL

Figure 12.1 Responses to Question 12.

Question 12

How concerned are you about climate change as a long-term global problem?



Source: PBL

Figure 12.2 Responses to question 12, divided into seven groups. The group 'All respondents' is equivalent to that of Figure 12.1.

Part III. Detailed questions

III.1 Sea level rise

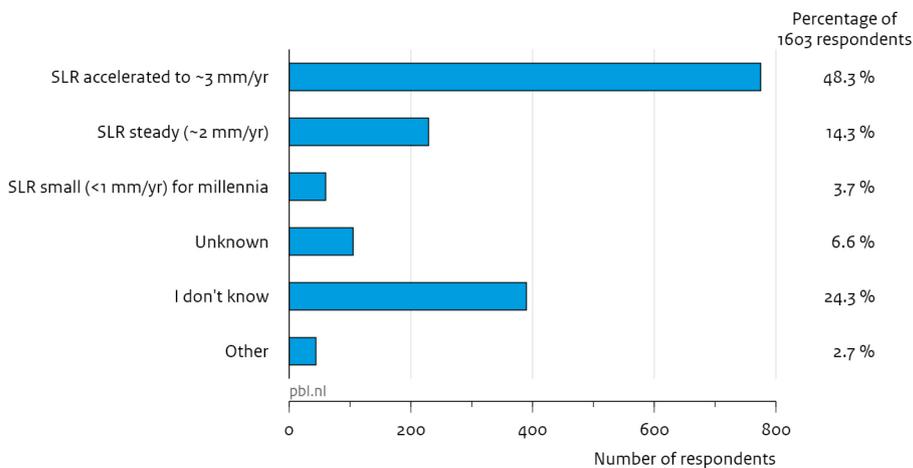
13 Past sea level rise

Which of the following best describes your view of global average Sea Level Rise (SLR) since pre-industrial times?

- SLR has accelerated gradually to the current multi-decadal trend of ~ 3 mm/yr
- SLR has been steady (~ 2 mm/year)
- SLR has been small (< 1 mm/yr) and steady for thousands of years
- Unknown due to lack of knowledge
- I do not know
- Other (please specify)

Question 13

Which of the following best describes your view of global average Sea Level Rise (SLR) since pre-industrial times?



Source: PBL

Figure 13 Responses to Question 13.

14 Future sea level rise

What is your estimate of the likely range (66% probability interval) of sea level rise by the year 2100, compared to 2000?*

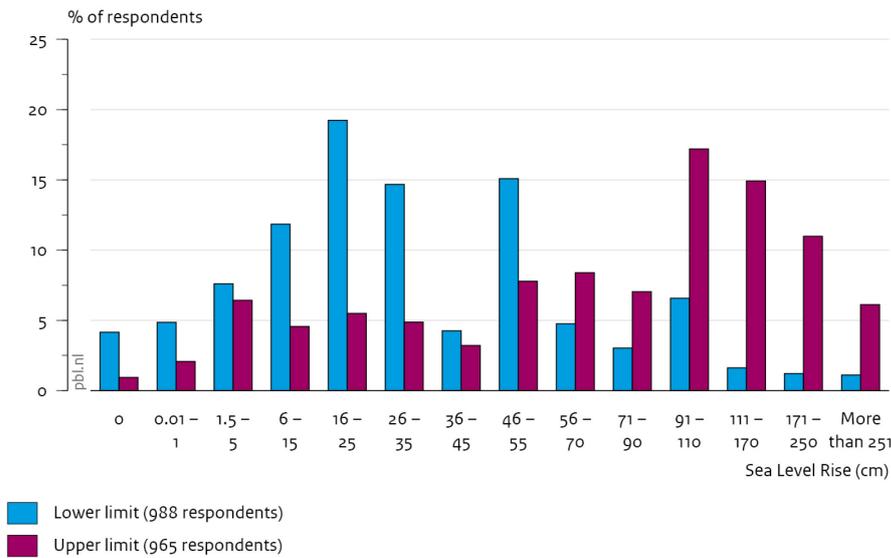
- lower bound of likely range approximately ... cm
- upper bound of likely range approximately ... cm

*No emissions scenario is specified; please include scenario uncertainty in your answer.

This was an open question, but for graphing purposes the responses have been grouped into bins. Note that even though the measurement unit was supposed to be in centimetres, as indicated to the right of the answer box, it is likely that some of the respondents (e.g. with answers between 0.01 and 3) gave their estimate in metres instead. In preparing the figure above all responses were interpreted as being in centimeters.

Question 14

What is your estimate of the likely range (66% probability interval) of sea level rise by the year 2100, compared to 2000?



Source: PBL

Figure 14 Responses to Question 14. Sample sizes are given in the legend. These sample sizes represent approximately 60% of the total number of respondents at this stage of the survey (1603 for the previous question).

III.2 Climate observations

15 Glaciers, arctic sea ice, ice sheets, ocean heat content, and extremes

How would you describe the change in the following quantities over the past few decades (or since it has been measured; whichever period is shorter)?

Quantities:

- *Glacial length*
- *Minimum arctic sea ice extent*
- *Minimum antarctic sea ice extent*
- *Greenland ice sheet mass*
- *Antarctic ice sheet mass*
- *Upper ocean heat content (0 to 700 m)*
- *Deep ocean heat content (0 to 2000 m)*
- *Hydrological extremes (floods, droughts)*
- *Hurricane intensity*

Question 15

How would you describe the change in the following quantities over the past few decades (or since it has been measured; whichever period is shorter)?

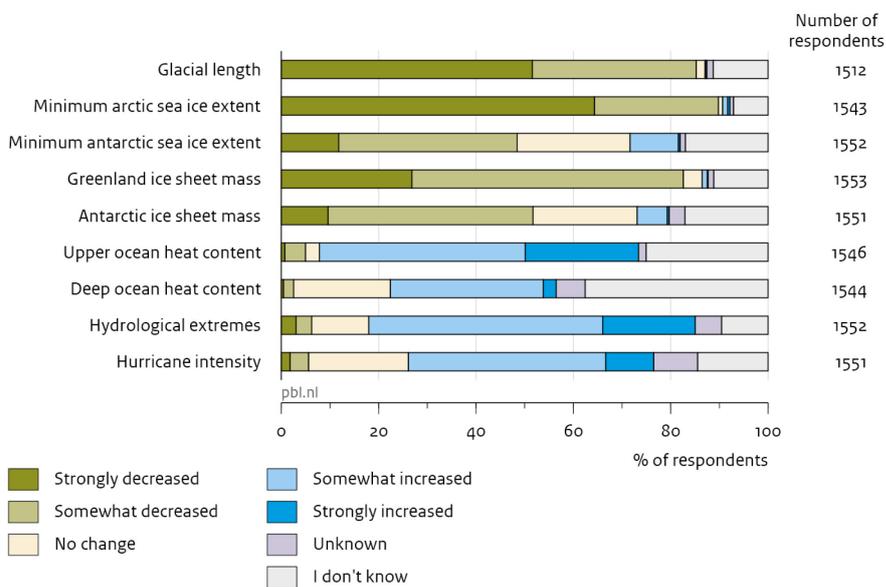


Figure 15 Responses to Question 15.

16a Current temperatures compared to medieval times

How does the global average temperature of this past decade compare with that of medieval times (900-1200 AD)?*

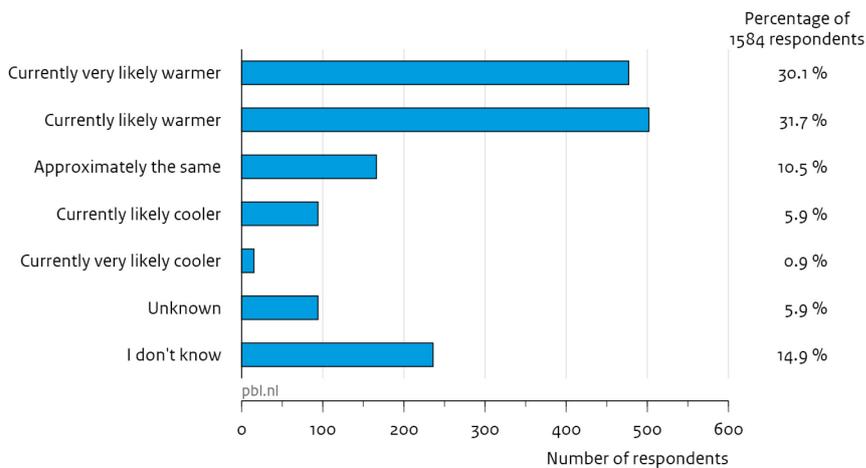
- *Currently very likely warmer than in medieval times*
- *Currently likely warmer than in medieval times*
- *Approximately the same*
- *Currently likely cooler than in medieval times*
- *Currently very likely cooler than in medieval times*
- *Unknown due to lack of knowledge*
- *I do not know*
- *Other (please specify)*

*Very likely refers to >90% probability; Likely refers to >66% probability.

Question 16a

How does the global average temperature of this past decade compare with that of medieval times (900 – 1200 AD)?

Very likely refers to more than 90% probability; Likely refers to less than 66% probability



Source: PBL

Figure 16a Responses to Question 16a.

16b Explanation of Question 16a

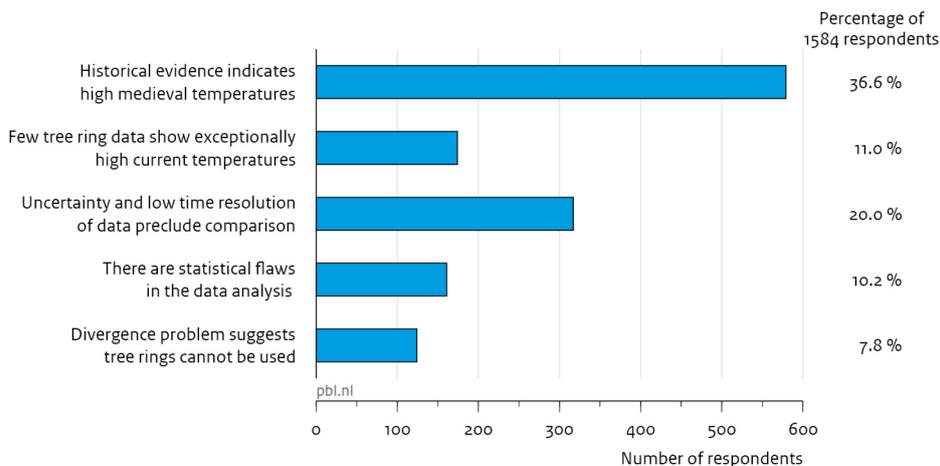
The explanatory question below was meant only for those respondents who answered to Question 16a that it is currently likely/very likely cooler than in Medieval times, but unfortunately it was addressed to all respondents. This hampers interpretation of the responses.

What factors contribute to your judgment on this comparison? Check any that apply

- *Regional historical evidence indicates high medieval temperatures*
- *Only few tree ring data series show exceptionally high current temperatures*
- *The uncertainty and low time resolution of proxy reconstructions preclude a meaningful comparison*
- *There are statistical flaws in the data analysis of proxy temperature reconstructions*
- *Divergence problem suggests that tree rings are bad proxies for temperature*
- *Other (please specify)*

Question 16b

What factors contribute to your judgment on the comparison between the global average temperature between this past decade and medieval times (900 – 1200 AD)?



Source: PBL

Figure 16b Responses to question 16b.

III.3 Statements on attribution

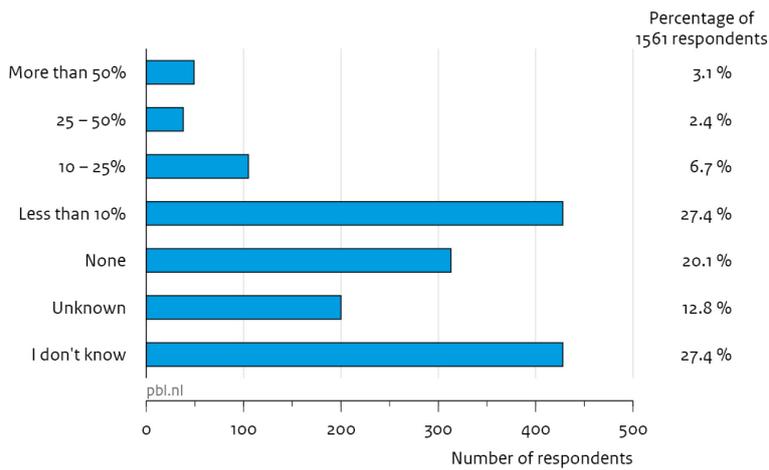
17 Sun (recent)

What fraction of global warming since the mid-20th century can be attributed to the sun?

- none, since the sun has been slightly cooling over that period
- warming less than 10%
- 10% to 25%
- 25% to 50%
- more than 50%
- Unknown due to lack of knowledge
- I do not know
- other (please specify)

Question 17

What fraction of global warming since the mid-20th century can be attributed to the sun?



Source: PBL

Figure 17.1 Responses to question 17.

Question 17

What fraction of global warming since the mid-20th century can be attributed to the sun?

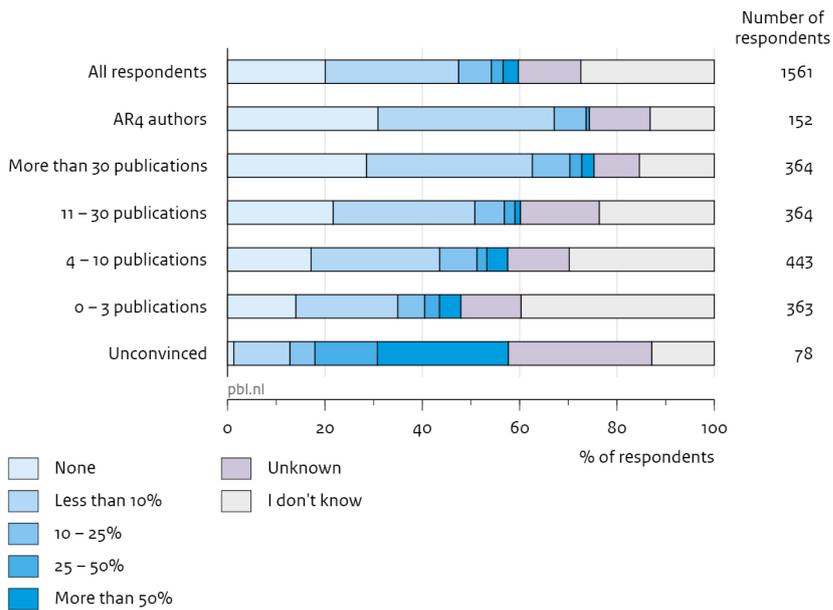


Figure 17.2 Responses to Question 17, divided into seven groups. The group 'All respondents' coincides with that of Figure 17.1.

18a Agreement with statements related to attribution

This question asked about the respondents' agreement with statements regularly used in the public debate on the attribution of global warming to anthropogenic greenhouse gases:

Do you agree with the following statements?

- *Greenhouse effect of CO₂ is saturated*
- *During the ice age cycles, CO₂ followed temperature*
- *The greenhouse effect is constant*
- *Climate has changed throughout the Earth's history*
- *There have been multidecadal periods when CO₂ and temperature did not correlate*
- *Anthropogenic CO₂ emissions are lower than natural CO₂ emissions to the atmosphere*

Question 18a

Do you agree with the following statements?

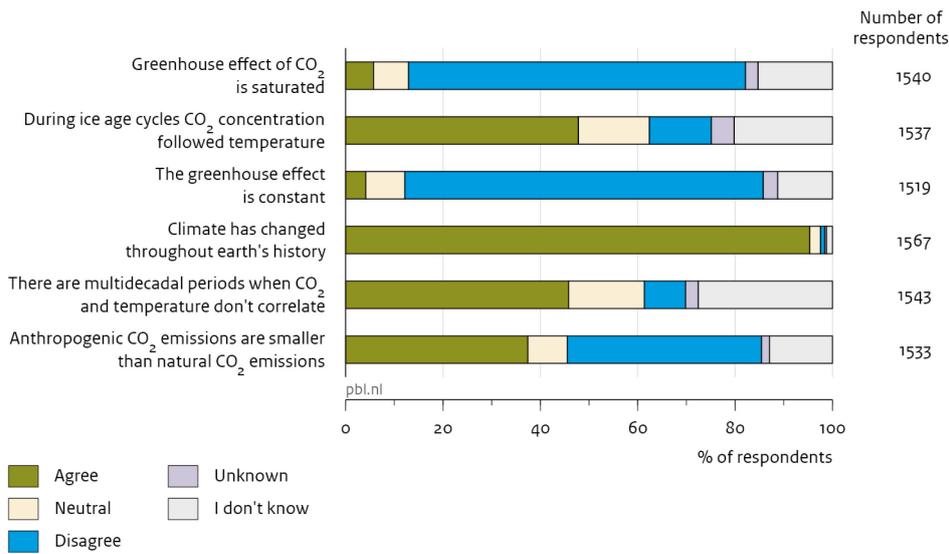


Figure 18a Responses to Question 18a.

The last statement (‘Anthropogenic CO₂ emissions are lower than natural CO₂ emissions to the atmosphere ’) was deemed unclear by many respondents (gross versus net emissions), as is evident from the responses given.

18b Reasons for agreeing with statements related to attribution

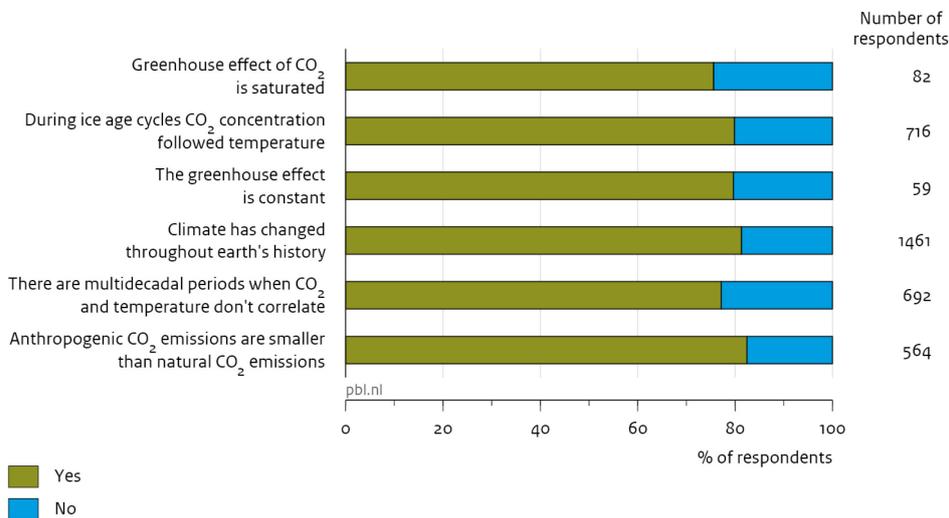
The following questions were only addressed to respondent who agreed with the corresponding statement in Question 18a. These follow-up questions could be answered with a ‘yes’ or ‘no’.

- You indicated that the greenhouse effect of CO₂ is saturated. Can this be reconciled with a dominant anthropogenic cause of global warming since pre-industrial times?
- You indicated that during the ice age cycles CO₂ followed temperature. Can this be reconciled with a dominant anthropogenic cause of global warming since pre-industrial times?
- You indicated that the greenhouse effect is constant. Can this be reconciled with a dominant anthropogenic cause of global warming since pre-industrial times?
- You indicated that climate has changed throughout the Earth's history. Can this be reconciled with a dominant anthropogenic cause of global warming since pre-industrial times?
- You indicated that there have been multidecadal periods when CO₂ and temperature do not correlate. Can this be reconciled with a dominant anthropogenic cause of global warming since pre-industrial times?

- You indicated that anthropogenic CO₂ emissions are lower than natural CO₂ emissions to the atmosphere. Can this be reconciled with a dominant anthropogenic cause of global warming since pre-industrial times?

Question 18b

Can the following statements be reconciled with a dominant anthropogenic cause of global warming since pre-industrial times?



Source: PBL

Figure 18b Responses to question 18b.

III.4 Statements on climate models

19a Agreement with statements on climate models

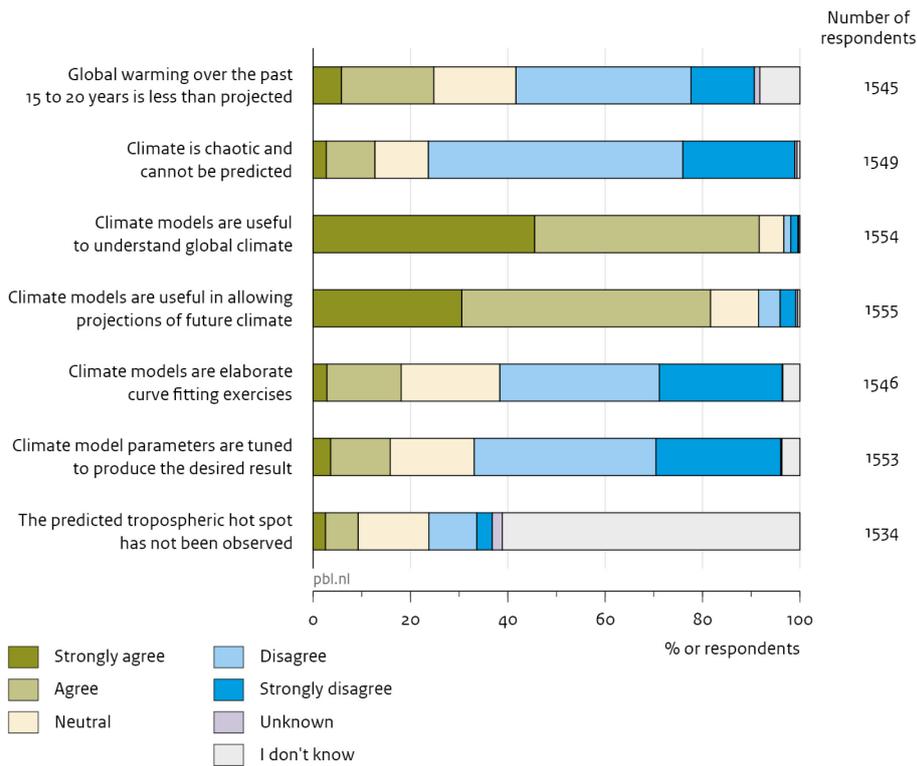
This question asked about the respondents' agreement with statements regularly used in the public debate on global climate models:

To what extent do you agree with the following statements?

- Global warming over the past 15 to 20 years is less than projected*
- Climate is chaotic and cannot be predicted*
- Climate models are useful in aiding our understanding of global climate*
- Climate models are useful in allowing projections of future climate*
- Climate models are elaborate curve fitting exercises*
- Climate model parameters are tuned to produce the desired result*
- The predicted tropospheric hot spot has not been observed*

Question 19a

To what extent do you agree with the following statements?



Source: PBL

Figure 19a Responses to Question 19a.

19b Reasons for agreement with statements on climate models

These follow-up questions were only addressed to respondents who agreed with the corresponding statement in Question 19a.

You indicated that climate model parameters are tuned to produce the desired result. What is/are the most important parameter(s) for model tuning?

- [Open answer]

These open answers have not yet been analysed.

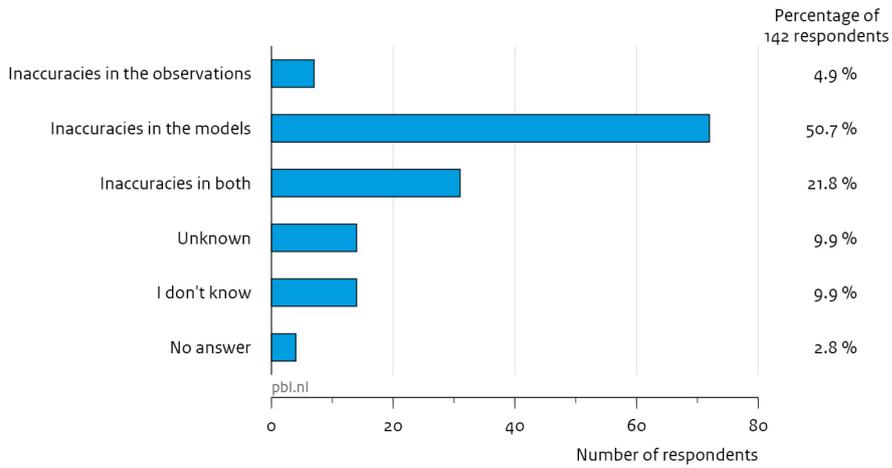
You indicated that the predicted tropospheric hot spot has not been observed. Is this discrepancy primarily due to inaccuracies in the observations or in the models?

- Inaccuracies in the observations
- Inaccuracies in the models
- Inaccuracies in both
- Unknown due to lack of knowledge
- I do not know
- Other (please specify)

Question 19b

You indicated that the predicted tropospheric hot spot has not been observed.

Is this discrepancy primarily due to inaccuracies in the observations or in the models?



Source: PBL

Figure 19b Responses to the second part of question 19b.