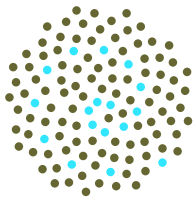

Ian Plimer's 'Heaven + Earth' — Checking the Claims

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Overview

Ian Plimer's book *Heaven + Earth — Global Warming: The Missing Science* claims to demolish the theory of human-induced global warming due to the release of CO_2 and other greenhouse gases.

Overall:

- it has numerous internal inconsistencies;
- it often misrepresents the operation of the IPCC and the content of IPCC reports;
- in spite of the extensive referencing, key data are unattributed and the content of references is often mis-quoted.

Most importantly, Ian Plimer fails to establish his claim that the human influence on climate can be ignored, relative to natural variations.

Breadth of Science

In Plimer's public appearances he has made the claim that climate scientists are ignoring geology. This is untrue. Some of the geologists who are important in developing understanding of climate and climate change have been:

- Hogbohm – who worked with Arrhenius;
- Eric Sundquist of the USGS (with Sarmiento, resolved carbon budget ambiguity);
- the many geologists who have contributed to the paleo-climate studies that Plimer misrepresents;
- Henry Pollack, a borehole specialist, who has published an excellent book, *Uncertain Science ... Uncertain World*, (CUP), pointing out that uncertainty about climate is much less than the uncertainty surrounding many other important decisions;
- and of course the American Geophysical Union which covers the gamut of Earth sciences – atmospheric, oceanic, solid earth and space sciences — has strongly endorsed the reality of human-induced global warming:
  http://www.agu.org/outreach/science_policy/positions/climate_change2008.shtml

Point by point

This list is evolving, in part due to input from colleagues. The items are listed in order of pages in *Heaven + Earth* and the page noted — the item numbering will almost certainly change as the document is extended. An index for various topics is given, identifying both the item number and the page in the present document. If you wish to quote items here, quote using the page number in *Heaven + Earth*. Better still, don't quote me at all — use this document as a guide to check it out for yourself, even if you have to resort to buying the book. Material that is underlined is presented as an exact quote from *Heaven + Earth*. If I am notified of errors in such quotes, I will make the correction.

1. p. 14: *Hypotheses are invalidated by just one piece of contrary evidence* ... yes but only once it has been ascertained that the contrary evidence is being correctly interpreted.

2. p. 15: *Studies of the earth's atmosphere tell us nothing about future climate* — so much for Plimer's claim that an inclusive approach is needed.

3. p. 15: *Collection of new scientific data by observation, measurement and experiment is now out of fashion* — patently ridiculous, given NASA budget, NOAA, CMAR, EU CarboEurope etc.

4. p. 15: Aristotle's principle quoted as *First we must seek the facts, then seek to explain* is one view — it contrasts to Charles Darwin's view that *a fact is of no value unless it is for or against some theory* [approximate wording].

5. p. 21–22: Fudged comparison of IPCC '**balance of evidence**' vs a survey that found only 10% of scientists **certain** that global warming is a process that is underway.

6. p. 22: Misrepresents IPCC treatment of Little Ice Age (LIA), Medieval Warm Period (MWP). (See later – item 12).

7. p. 25, figure 3: The graph has been distorted and misplotted. The line has the 1998 peak in about the right place relative to the scale, but the 1940 peak (labelled as such) appears in the 1950's and the 1975 trough is plotted nearer to 1979. (The Brave New Climate web site identifies this fabrication as coming from *The Great Global Warming Swindle*).

8. p. 25, footnote 25: Given Plimer's past interactions with religious groups, choosing the Washington Times as a source of his climate data seems strange.

9. p. 32: *within a glacial period that has already lasted tens of millions of years*, identified in footnote 38 as *Pleistocene glaciation, sometimes called Quaternary glaciation* — a duration for 'Pleistocene' and 'Quaternary' that might surprise Plimer's geological colleagues.

10. p. 33, figure 5: Caption reads: *The amount of temperature and temperature change ...*. This is two different things, but only one line is plotted.

11. p. 40, figure 8: lower part lacks numbers on horizontal axis.

12. p. 91: This makes a succession of claims about IPCC treatment of the Medieval Warm Period (MWP) , Little Ice Age (LIA) and hockey stick:
    i. *the 1996 IPCC report showed the Medieval Warm Period and the Little Ice Age*
    ii. *Mann's hockey stick was used in the IPCC's 2001 report and the Medieval Warm Period and the Little Ice Age were expunged*
    iii. *In the next IPCC report the Medieval Warm Period and the Little Ice Age mysteriously re-appeared* (i.e. the 2006 report).

    In reality, the only reconstruction in the 1996 report appears to be the Bradley estimates (figure 3.20, page 175 in WG1 SAR) which only went back to 1400 (i.e. after Plimer's definition of end of MWP). Thus the MWP was not in the 1996 report to be 'expunged' in 2001. The 'reappearance' in 2007 is to have multiple reconstructions, none of which show a MWP even 1°C warmer than the second half of the twentieth century, let alone the 2°C that Plimer claims. The LIA can be seen in all 3 reports, with most reconstructions suggesting about 0.5°C below mid 20th century levels. In the 2007 report, a small number of reconstructions suggest LIA temperatures nearer to 1°C cooler and MWP a few tenths of a degree cooler. (Note that all this refers to the northern hemisphere).

13. p110, figure 12: The lower plot on this figure has a label referring to late twentieth century warming, with a time line in 'years before present'. However the line ends at about 60 years ago. Maybe Plimer is anticipating the book being in print, without revision in 2060! However the real howler in this plot is that the temperature increase is shown as about 40°C. This is presumably carelessness. In addition, the relation between upper (10000 years of C-14) and lower (1100 years of temperature) parts of the figure is unclear.

14. p. 112: *IPCC computers don't do clouds* — totally unsurprising — IPCC computers don't do climate modelling — presumably they do things like e-mail, desktop publishing, accounting etc. The climate modelling used by the IPCC is done by major research groups using models that do include clouds.

15. p. 121: *The sun rotates around the centre of gravity of the solar system every 11.1 years*. Plimer is confusing rotation (about once every 25 days) with orbital motion around the center of gravity. According to Einstein's principle of general relativity, such orbital motion can have no detectable effect. There can be tidal effects, but these will have a frequency given by the difference: $1/25 - 1/(365 \times 11.1)$ per day, i.e. not much less than once every 25 days.

16. p. 217: *Mt Pinatubo released 20 millions tonnes of sulphur dioxide .... and very large quantities of chlorofluorocarbons*. The reference cited for this (footnote 1075) makes no such claims and is not reporting observations of anything. It is about a modelling study that compares the chemical effects of Pinatubo emissions to the effect of chlorofluorocarbons. [also in TL list]

17. p. 230: claims that climate models don't do seasonal variation of insolation, i.e. neglect the ellipticity of the Earth's orbit. *The mean figure of 1367 watts per square metre is used in climate models, thereby omitting the effects of orbit on the change in solar input.* This is untrue (personal communication from CSIRO climate modellers). An older, but

verifiable and more accessible reference is CSIRO Division of Atmospheric Research Technical Paper no. 26, available on-line from the CSIRO Marine and Atmospheric Research website.

18. p. 303: *In the three years before the flooding associated with hurricane Katrina devastated New Orleans in August 2005, the city and surrounding area had undergone rapid subsidence of about 1 metre*. There is no reference associated with this claim. However, when the claim is repeated on page 409 a reference is cited, but the subsidence reported in that reference represents an average of 16.8 ± 7.5 mm over the three years — see item 27.

19. p. 338: *There is no such thing as a "tipping point" (or even a "precautionary principle") in science*. The precautionary principle is proposed for the conduct of human affairs. No-one seriously proposes it as a scientific principle. (If it was a scientific principle there would be no need to argue for its use — it would just happen). There is such a thing as a "tipping" point in science, but the more technical name is "catastrophe". An accessible account is given in the book *Catastrophe Theory* by V.I. Arnold (Springer-Verlag, 1984, 1986). Since not all things that are catastrophes in the mathematical sense are catastrophic in the human sense, the use of a less ambiguous term such as "tipping point" seems desirable for public communication.

20. p. 350: *The El Niño most commonly occurs in late December, lasts for a month or so . . .* compared to p. 352 *El Niño lasts for one to two years.*

21. p. 365: *Clouds are not factored into climate models*. Untrue. See for example sections 12 and 13 of CSIRO Division of Atmospheric Research Technical Paper no. 26, available on-line from the CSIRO Marine and Atmospheric Research website.

22. p. 366: assertion of the 0.5°C climate sensitivity with no citation [TL].

23. p. 371: assertion of the 0.5°C climate sensitivity with no citation [TL].

24. p. 374: *Once there is 400 ppm of CO_2 in the atmosphere, the doubling or tripling of CO_2 has little effect on atmospheric temperature because CO_2 has adsorbed all the infra-red it can adsorb*. The term '**adsorb**' is defined (Macquarie Dictionary) as " *to gather a gas, liquid or dissolved substance) on the surface of a condensed layer . . .* ", c.f. '**absorb**' for which the same dictionary's definitions include **5**. *to take or receive in by chemical or molecular action* while Chambers Twentieth Century dictionary's definition of 'absorb' includes "*to suck in, to swallow up, ... to take up and transform (energy) instead or transmitting or reflecting*". An consistent failure [see item 32] to distinguish between 'adsorb' and 'absorb' does not inspire confidence.

25. p. 375, figure 50:[1] As with many of the graphics, this is poorly described with no attribution of the numbers. However above 100 ppm the values seem to be inversely proportional to concentration as expected for incremental change when temperature has a logarithmic dependence on concentration (which Plimer acknowledges on p. 338). Thus a better label for the vertical axis would be 'incremental warming'. This means that the claim in the

[1] Prior to version 1.4, this was incorrectly noted as fig 5.

caption *once the atmosphere is at its present 385 ppm a doubling or quadrupling will have very little effect on the atmospheric temperature* is untrue. (Note also similar statement on previous page — item 24). Each doubling will have the same effect on temperature until concentrations get so high that the logarithmic relation breaks down. The trend in Figure 50 shows no sign of this happening around 400 ppm. The bars would imply that the increments correspond to each additional 20 ppm of CO_2. This would imply a climate sensitivity of 0.35°C. While the origin of the numbers is not given, the discussion below notes that they can be explained by using 0.5°C for the climate sensitivity (the lower of Plimer's other values); then having a factor of 1.44 error through neglecting to consider the change of base of logarithms.

26. p. 407: *Actual measurements for 2007 show that it was one of the coldest years this century and the coldest since 1995.* Compare to figure 1 on page 11. The claim '*coldest since 1995*' is clearly untrue. '*one of the coldest this century*' is fairly insignificant with only 8 or 9 years (depending on whether you regard the century as beginning on 1/1/2000 or 1/1/2001).

27. p. 409: *New Orleans sunk rapidly by about 1 metre in the three years before Katrina struck.* This time (unlike page 303, item18) a reference is cited: by Dixon and others *Nature*, **441**, 587–588 (2006) from radar satellite altimetry. They report a three-year average of -5.6 ± 2.5 mm/year, with a maximum of -29 mm/year (negative values indicating subsidence). They note that if the motion is interpreted as purely vertical, the mean and maximum subsidence become 6.4 mm/year and 33 mm/year.

28. P. 417: *..the observatory was evacuated for a few months and there was a gap in the data record which represented a period of no measurements. There are now no gaps in the Mauna Loa data set.* To refer to **the** Mauna Loa (CO_2) data set, is misleading since there are three main records: The Scripps in-situ IRGA measurements established by C. D. Keeling; the NOAA in-situ IRGA measurements and the NOAA flask program which is part of a global network for which flasks of air are shipped back to the central NOAA laboratory in Boulder, Colorado. The main archive/access location for CO_2 data is the Carbon Dioxide Information and Analysis Center (CDIAC), in Oak Ridge, Tennessee. The graphic at:
http://cdiac.ornl.gov/trends/co2/graphics/Mauna_Loa_CO2.jpg shows extensive gaps in the early part of the Scripps record.

29. p. 417: *The annual mean CO_2 atmospheric content reported at Mauna Loa for 1959 was 315.93 ppmv. This was 15 ppmv lower than the 1959 measurements for measuring stations in northwestern Europe. Measured CO_2 at Mauna Loa increased steadily to 351.45 ppmv in early in 1989. The 1989 value is the same as the European measurements 35 years earlier by the Pettenkofer method....* Plimer's references for the European program are two papers by Bischof in 1960 and 1962 (footnotes 2094 and 2095 respectively). The 1960 paper quotes annual means of — 1955: 326 ppm; 1956: 321 ppm; 1957: 323 ppm; 1958: 315? ppm; 1959: 331 ppm. For such a short passage, Plimer is showing a remarkably high number of errors:
(i) 1959 to 1989 is 30 years, not 35 years;

(ii) 15 ppm above 315.9 ppm is 330.9 ppm, close to the annual mean reported for Mauna Loa for 1975, not 1989.
(iii) during 1959 the Swedish group switched to the more precise Infra-Red Gas Analyser (IRGA) with precision determined as ± 1 ppm, while they found the precision of the chemical method to be ± 3 ppm;
(iv) the whole comparison is biased by comparing a high altitude sight with surface data. The relevant comparison is with the data reported by Bischof 1962, sampling air during aircraft flights. The values for air from above about 1km are very close to 315 ppm.

30. p. 417–8: *Furthermore, the measurement at Mauna Loa is by infra-red analysis and some of the ice core measurements of CO_2 in trapped air were by gas chromatography*. Exactly. There are two techniques, IRGA and GC, with good precision and which agree with each other, and a third (chemical) technique with inherently lower precision which requires great experimental skill to achieve accuracy.

31. p. 419: *The lowest figure measured since 1812, the 270 ppm figure, is taken as the pre-industrialisation yardstick. The IPCC want it both ways. They are prepared to use the lowest determination by the Pettenkofer method as a yardstick yet do not acknowledge Pettenkofer method measurements showing CO_2 concentrations far higher than now many times since 1812*. The IPCC do not use 270 ppm as the pre-industrial CO_2 concentration. The value used is 280 ppm. In the various WG1 reports, see SPM table 1, in 1990, technical summary (TS) table 1 in SAR, TS table 1 in TAR. and page 2 in SPM of AR4. This number is based in measurements of air in ice bubbles (mainly using IR techniques) and excluding anomalously low values from the time of the Little Ice Age. In this case, the volume of air is too small to use the less precise chemical (Pettenkofer) method.

32. p. 421: *CO_2 molecules will be removed fast from the atmosphere to be adsorbed in another reservoir* — inability to distinguish 'adsorbed' from 'absorbed' yet again — see item 24.

33. p. 421: For CO_2, *The IPCC asserts that the lifetime is 50–200 years. The IPCC has been criticised because the lifetime is not defined.* In reality the IPCC (1990) says in the SPM *The way in which CO_2 is absorbed by the oceans and biosphere is not simple and a single number cannot be given* and in the footnote to table 1: *The "lifetime" of CO_2 is given in the table is a rough indication of the time it would take CO_2 concentrations to adjust to changes in emissions. (see section 1.2.1 for further details)*, with section 1.2.1 stating *The turnover time of CO_2 in the atmosphere, measured as the ratio of content to the fluxes through it is about 4 years. ... This short time scale must not be confused with the time it takes for the atmospheric CO_2 level to adjust to a new equilibrium of sources or sinks change.*

34. p. 425: *The IPCC 2007 report stated that the CO_2 radiative forcing had increased by 20% in the last 20 years. Radiative forcing puts a number on increases in radiative energy in the atmosphere and hence the temperature. In 1995, there was 360 ppmv of CO_2 whereas in 2005 it was 378 ppmv, some 5% higher, However each additional molecule of CO_2 in the atmosphere causes smaller radiative forcing than its predecessor and the real increase in radiative forcing was 1%. The IPCC have exaggerated the effect of CO_2*

20-fold. As Plimer notes, radiative forcing is about **increases**. The IPCC (see AR4 WG1 glossary) defines radiative forcing as the change relative to the year 1750. This is also noted in footnote 2 of the SPM when the concept of radiative forcing is introduced. Using the logarithmic formula to account for the diminishing effect of additional CO_2, =log(378/280)/log(360/280) in a spreadsheet, gives a 1.194 multiplier from 1995 to 2005, i.e. a 19.4% increase. This does not depend on the value of the climate sensitivity. The same result is obtained with any of Plimer's 3 values (0.35°C from figure 50, the 0.5°C that he asserts without citation, or the 1.5 to 1.6°C from the long-term historical data that he cites, e.g. item 35). (A value of 20% is obtained if the 1750 concentration is taken as 282 ppm.) [also in TL list]

35. p. 426: *The variation in CO_2 shows that a climate sensitivity of greater than 1.5°C has probably been a robust feature of the Earth's climate system for over 420 million years.* This contradicts his frequent assertion that the climate sensitivity is 0.5°C

36. p. 437: *If governments had read the fine print of the crucial chapter 5 of the IPCC AR4 Humans responsible for climate change they would have realised it was based on the opinions of just 5 independent scientists.* This implies that the chapter is called 'Humans responsible for climate change'. This is untrue. In the AR4 WG1 report chapter 5 is called 'Observations: Oceanic Climate Change and sea level'. The words 'Humans responsible for climate change' are not the title of any section or subsection of chapter 5 (nor the title of any other chapter in the AR4 WG1 report). The executive summary of chapter 5 does not include any discussion of attribution of responsibility for the changes that are described. The total number of authors is 13, coming from 9 different countries with Corrinne Le Quéré spending part of her time in a 10th country. Similarly, in the AR4 reports from working groups 2 and 3, neither chapter 5 nor any other chapter has the title 'Humans responsible for climate change'. [also in TL list].

37. P. 438: *The IPCC has essentially ignored the role of natural climate variability.* In reality the various IPCC WG1 reports have chapters entitled: *7: Observed Climate Variations and Change* (1990); *3: Observed Climate Variability and Change* (1996); *2: Observed Climate Variability and Change* (2001); *6: Paleoclimate* (2007).

38. p. 472: *Oceans, soils and plants already absorb at least half the human CO_2 emissions* This is the view of mainstream science. The reason to note it is that it is inconsistent with Plimer's claims about CO_2 lifetimes and large emissions from volcanoes.

39. p. 477–478. The discussion of Stern's work quotes a paper by Klyashtorin and Lubushin (footnote 2221) when referring to *data from many sources*, The Klyashtorin and Lubushin paper is often cited (and mis-quoted) by pseudo-sceptics/doubt-spreaders. It finds no correlation between detrended series for temperature and fuel use. It is not comparing temperature to fossil carbon emissions. It is comparing temperature to what the carbon emissions would have been if all energy use (including nuclear) had come from oil. As described in *Twisted* a number of aspects of the fit act to reduce the type of correlation that would be obtained. However, in *Heaven and Earth* the citation is essentially irrelevant.

40. p. 479. Footnote 2235 is a repeat citation of footnote 2221, the Klyashtorin and Lubushin paper (see item 39). Since its sole climate analysis is comparing temperature to energy use (and finding *no true linear correlation* in the detrended series), this citation provides no meaningful support for the statement that *the next major climate change will be cooling*.

41. p. 484: The 2007 IPCC SPM *showed cooling for 100 of the last 160 years, during which time greenhouse gases were increasing*. Possibly true but irrelevant — what matters is if net year-to-year increase is significantly positive. [also in TL list]

42. p. 485: *The Montreal Protocol used the precautionary principle to attempt to ban chlorofluorocarbons because these gases destroy ozone. However we use chlorine every day to make water fit to drink and yet chlorine also destroys ozone. There is no such thing as the precautionary principle in science.* This misrepresentation of the precautionary principle is discussed in item 19. The passage misrepresents the role of chlorine, in that reactive chlorine compounds are removed in the lower atmosphere (mostly ending up as water soluble compounds that dissolve in rainwater) while unreactive compounds such as CFCs are only destroyed in the stratosphere (by the higher UV levels) and where rain-out does not occur. It is the chlorine from CFC breakdown that destroys ozone — Plimer's use of the word 'also' suggests that he doesn't understand this. [also in TL list]

43. p. 488: another assertion of the 0.5°C climate sensitivity.

44. pp. 489–493: Choosing to end with a summary from someone (Viscount Monckton) who is not a scientist is a strange choice. Some of the points (item 45) are particularly questionable.

45. p491–492: *Sea level may rise by 1 foot to 2100, not 20ft as Gore claims*. Gore does not put a date on when a 20 foot rise would happen (nor specify what circumstances). In my view this is one of the serious omissions in Gore's book. My recollection is that a similar view of this omission was taken by the judge in the UK court case over Gore's film and book, a case in which Monckton was involved.

46. Plimer asserts that the world was only 7°C warmer with 20 times the amount of atmospheric CO_2. This give impression that the effect of CO_2 on climate is small, but ignores the logarithmic dependence (known since Arrhenius, acknowledged by Plimer on p. 338 and often cited by greenhouse sceptics such as Bob Carter as a reason for not worrying). If taken at face value, this assertion would imply a climate sensitivity of 1.6 degrees — just over half Hansen's estimate and below the lower end of the IPCC range, but still not insignificant. This can be easily checked by typing = 7.0*log(2.0)/log(20.0) into a spreadsheet.

Contributed comments

This document contains contributions from Tim Lambert from the list on his Deltoid blog [TL], Steven Sherwood [SS]. The source of each item is indicated by the author's initials. This section and the following section have comments in outline form. Where I have expanded this type of contribution to a more complete version it is in the main list.

47. Figs. 1, 3 and 4 are all very inconsistent, esp. 1 and 4 which purport to use the same dataset (HadCRU3). [SS]

48. p. 198: claims Arctic sea-ice is expanding [TL]

49. p. 113: claim that research shows cosmic rays are important for cloud formation are not supported by the cited studies; some of the studies (Udelhofen and Cess) claimed to support relationship between cloud and cosmic rays actually refute it. [SS]

50. p. 281: Misquotes cited source by claiming alpine glaciers not retreating.[TL]

51. p. 286: claims IPCC has no evidence to support statement that glaciers are retreating. [TL]

52. p. 316: claims that 1-m sea level rise would be consistent with post- glacial rise rate, but a few sentences later says that has been dropping for the last 3000 years not rising at all. In the next paragraph he claims that rates of change of several meters per century were common during the holocene, but the references quoted actually show that 1-m changes occurred in parts of Australia and that global sea level fell steadily over the last 6000 years by a total of 2m.[SS]

53. p. 235: says that even if we burn all fossil fuels we won't be able to double atmospheric CO_2.

54. p. 367: confused about how the earth warms. How does he think a blanket works? [TL].

55. p. 421: claims only 4% of CO_2 in atmosphere is from humans [TL]

56. p. 425: claims anthropogenic CO_2 produces only 1% of global warming. [TL] Appears inconsistent with his stated values of climate sensitivity.

57. p. 443: repeats Monckton's claims about *An Inconvenient Truth* without mentioning that most were rejected by the court. [TL]

58. p. 472: claims Pinatubo emitted as much CO_2 as humans in one year. no citation. Actual data shows CO_2 growth rate declined after Pinatubo eruption. [TL]

Some silly stuff

This section is split off in response to critics, who think that this sort of thing dilutes the arguments about science:

59. p. 83, footnote 345: Deducing climate trends from paintings of clouds is fraught with problems (and essentially restricted to Europe). Previous studies of cloud paintings have analysed fractal dimension to show bias in representation — painters choose 'interesting' clouds, reflecting what Plimer notes as the role of artistic licence. Also fashions change.

Turner's Val d'Aosta would probably not have been painted in an earlier time and prior to Mark Rothko and like-minded artists, a painting of marine stratus would be unlikely to have been regarded as art.

60. p. 467: *The environmental religion has no music ...* — Peter Garrett??

61. p. 468: *Self-denial and a return to the past led to the 600-year Dark Ages...* — a remarkable assertion of human influence on climate?

Other – may be expanded later

This section flags additional issues but with minimal detail. In many cases, some pre-existing knowledge of climate science will be required in order to understand these points.

- p. 86: 102 studies — no citation
- p. 99: 1934 (same old misrepresentation) [also in TL list]
- p. 132: GHG as amplifier of orbital effects — see also p. 277
- p. 277: Vostok timing/causality issue was identified in early publications
- p. 278: solubility as cause of lower glacial CO_2 — this was ruled out a long time ago as being sufficient to explain glacial-interglacial changes.
- p. 433: Lindzen's 'iris' theory has been tested and found wanting
- p. 423: not true that IRGA 'unvalidated'
- p. 413 *Animals produce 25 times as much CO_2 as cars and industry*. Irrelevant and untrue. A common irrelevant argument used by doubt-spreaders. Animal CO_2 production doesn't matter because it is putting back carbon taken out of the atmosphere by plants. However 25 by 7 GtC/year is exaggerated. Even if no plant material decayed directly to CO_2, or decomposed by bacteria or burnt by wild-fire, Plimer's figures would have animals chomping through plant material at least 2 or 3 times as the rate (the Global Net Primary Production of 50 to 100 GtC) at which plants remove the carbon from the atmosphere.
- p. 444: IPCC reports written by 35 authors — no way [also in TL list]

Other critiques

- The book review *No Science in Plimer's Primer* by Michael Ashley picks up on issues such as the temperature data, CO_2 measurements and in particular some of Plimer's weirder claims about the composition of the Sun, (page 116). I have noted some such issues on CO_2 measurements as items 28, 29, 30 and 31.

- From Tim Lambert: *I cross referenced Ian's list of 33 problems* [i.e. version 1 of the present document] *with my own list of 59 and there were only 5 things in common. So I can estimate the total number of errors if I assume that we have produced independent samples from the population of Plimer errors: (33x59)/5 = 390 problems. Almost one for every page!*. Blogged at:
  http://scienceblogs.com/deltoid/2009/05/ian_enting_is_checking_plimers.php

  As well as 5 being a small sample, there are a lot of reasons why the samples are **not** independent — some would lead to lower estimates, some to higher estimates. There are additional comments by Tim and myself on Tim's blog, but the bottom line is not to take the number seriously.

Climate sensitivity

The climate sensitivity is defined as the amount of equilibrium warming caused by a doubling of CO_2 (or equivalent change in radiative forcing). Over the concentration range of most interest, this relation can be approximated as a logarithmic function (as Plimer acknowledges on page 338) Thus about the same warming is expected for doubling from 200 ppm to 400 ppm as from 300 ppm to 600 ppm. Denoting the climate sensitivity as X, means that the temperature change as a function of concentration change from C_1 to C_2 can be written as:

$$\Delta T_{1,2} = T(C_2) - T(C_1) = X[\log_2(C_2) - \log_2(C_1)] = X \times \log_2(C_2/C_1)$$

This logarithmic relation has been known since the time of Arrhenius (1896) (who estimated X= 5°C). It can be written in terms of natural logarithms (logarithms to base e) as

$$\Delta T_{1,2} = X[\log_e(C_2) - \log_e(C_1)] \times \log_2 e \approx 1.44X \times \log_e(C_2/C_1) = 1.44X \times \ln(C_2/C_1)$$

The IPCC has given a range of 1.5°C to 4.5°C. James Hansen (e.g. Bjerknes lecture at AGU fall meeting) estimates $X = 3.0 \pm 0.5$°C. The logarithmic relation won't apply at low concentrations — a linear dependence is expected. The logarithmic dependence will also break down at sufficiently high concentrations.

Plimer's treatment of this lacks consistency. On a number of occasions he claims 0.5°C (e.g. page 488), while on page 426 (see item 35) he claims 1.5°C, and his example above (ee item 46) of 7°C for 20 times CO_2 implies 1.61°C. (Note that since a division of logarithms is involved, the result of the calculation $7 \times \log(2.0)/\log(20.0)$ does not depend on what base is used for the logarithms, as long as the same base is used in both cases).

For a fixed initial concentration C_1, one can look at how much the temperature increases for each unit increase in the concentration, C_2:

$$\frac{\partial}{\partial C_2} T_2 = \frac{1.44X}{C_2}$$

This will have units of degrees C per unit of CO_2. Plimer's plot in figure 50, page 375, seems to reflect this (remembering that the $\frac{\partial T}{\partial C} \propto 1/C$ relation won't apply at low concentrations) with:

- taking the CO_2 unit as 20 ppm jumps as implied by the bars (i.e. the plot is of temperature increase for each extra 20ppm CO_2);
- assuming that $X = 0.5$°C;
- omitting the factor of 1.44 (i.e. $\log_2 e$) that comes from going from base-2 to base-e logarithms.

Accuracy Precision and Standards

All scientific measurements are subject to error. Even when an instrument repeatedly measures the same object or sample, the results will not all be the same. For example Bischof (footnote 2094) reported a precision of ± 3 ppm for measurements of CO_2 made by the chemical method. In contrast using the Infra-Red Gas Analyser (IRGA), they found a precision of ± 1 ppm for measurements of CO_2.

While precision quantifies the measurement-to-measurement repeatability, a serious concern for any measurement is the question of 'accuracy'. Do all the measurements exhibit a systematic bias, such that the (average) measured value differs from the true value of what is meant to be measured?

Many measurements actually involve comparison of a sample to a standard. Consequently the accuracy of such a measurement is tied to the accuracy of the standard. Thus when Bischof switched to using the more accurate IRGA method, he could use standards calibrated by the chemical method. (Averaging multiple chemical measurements of the standard will overcome the inherently lower precision). Thus Bischof's agreement between chemical and IRGA measurements could be essentially guaranteed. The independent check on the accuracy is provided by the agreement of the Bischof's higher altitude results (see footnote 2095) and Keeling's results from Mauna Loa — both indicating about 315 ppm. Keeling prepared his standards using manometric techniques – mixing gases from precisely calibrated volumes.

Summing up

Ian Plimer's claim that the human influence on climate can be ignored, relative to natural variations seems to rest on three main strands of argument:

a the extent of natural variability is larger than considered in 'mainstream' analyses;

b the effects of changes in radiative forcing are smaller than values used in 'mainstream' analyses;

c the IPCC uses a range of misrepresentations to conceal points **a** and **b**.

The most obvious point to note is that if there was a valid case to be made for any of these claims, then there would have been no need for Plimer to resort to systematic misrepresentation.

The extent of natural variability is being misrepresented, through an exaggerated emphasis on the Medieval Warm Period.

The effect of radiative forcing is being misrepresented by repeated claims of a climate sensitivity of 0.5°C [item 43] even when Plimer's own examples show 1.5 to 1.6 °C [item 35], his denial of an effect beyond 400 ppm [item 24] even when he acknowledges the logarithmic relation (page 338) and presents a graph (figure 50) consistent with that relation (see item 25).

For the IPCC there is extensive misrepresentation of:
— the content of the IPCC reports [items 6, 12, 34, 36],
— the operation of the IPCC assessment process and the authorship of reports [items 14, 36],
— and the characteristics of climate models that form the basis of some of the science presented in the IPCC reports [item 17].

In support of these three main strands of argument are presented extensive references, many of which either fail to support the claims [item 16]; explicitly contradict the claims [item 27]; or are irrelevant to the claims.

In addition the various misrepresentations of the IPCC and the content of IPCC reports; the introduction above noted:

- it has numerous internal inconsistencies [item 20];
- in spite of the extensive referencing, key data are unattributed and the content of references is often mis-quoted [items 16, 27].

Acronyms and abbreviations

AR4 Fourth Assessment Report (of the IPCC).

CDIAC Carbon Dioxide Information and Analysis Center. (Oak Ridge, USA).

GISS Goddard Institute for Space Studies.

GC Gas chromatograph(y). An instrument/technique used to measure greenhouse gases (and many other things).

IPCC Intergovernmental Panel on Climate Change.

IRGA Infra-red gas analyser.

LIA Little Ice Age.

MWP Medieval Warm Period.

NASA National Aeronautics and Space Administration. (USA).

SAR Second Assessment Report (of the IPCC).

SPM Summary of Policy Makers, i.e. summary of an IPCC report.

TAR Third Assessment Report (of the IPCC).

WDCGG World Data Centre for Greenhouse Gases. (JMA¡ Japan).

WG1 Working Group 1 (of the IPCC).

Acknowledgements

This analysis draws on the work of various colleagues. Item 7 includes a comment from the *Brave New Climate* website. Useful feedback on version 1 came from Barry Brook, Barrie Pittock and Michael Ashley — my grateful thanks should not be taken as implying that they agree with every detail of what I say. Particular thanks are due to Richard Brak who organised a 're-direct' when *The Australian* inserted an extra dash in the URL that I sent them.

Version history

File: 0-denial/plimer/plimer.tex
Last change 14/5/09; typeset May 16, 2009

The intention is that the published URL shall always refer to the most recent version of this document.

The current version is:
Version 1.4, with my itemised and indexed discussion of 46 of items and a number of other contributed items giving a total of 58.

Previous versions are:

- Version 1.3, with itemised and indexed discussion of 40 of my items and 3 other contributions: 15/5/2009 (BNC site only).

- Version 1.2, with itemised and indexed discussion of 39 items: 14/5/2009.
  My letter about this document was published in *The Australian* on 1/5/2009 with a 'dash' added the the URL that I sent in my letter. A 're-direct' was established at the University of Melbourne so that the document could be accessed from the published address.

- Version 1.1, with itemised and indexed discussion of 34 items was uploaded for test purposes about 16:30 13/5/2009, unfortunately resulting in a failed test, with the URL not being preserved (but removing version 1).

- Version 1, with itemised and indexed discussion of 33 items, was submitted to the MASCOS website on 12/5/2009 and available from 13/5/2009.

Due to problems on the MASCOS site, various versions were mirrored on the Brave New Climate website.

- version 1.3 late on evening of 14/5/2009.

- version 1.2 on 14/5/2009.

- version 1.1 from about 21:00 13/5/2009.

Response to criticism

A number of these come from the letters blog of *The Australian*. Since *The Australian* is not accepting my posts of replies, even when I keep my comments separate from the URL issue, a few short comments are here:

Why didn't I attack Gore in the same way?

(i) I wasn't engaged in public debate until early 2007 when I started writing *Twisted: The Distorted Mathematics of Greenhouse Denial*

(ii) Plimer claims to be writing as a scientist and his op-ed challenges scientists to address the science. I am taking him at his word. Gore is a politician and *An Inconvenient Truth* is largely a political book.

(iii) Even if one thinks that Justice Burton was wrong and one accepts all the errors claimed in the UK court case, Gore's book has many fewer scientific errors than *Heaven + Earth*. (This assessment is based on my own notes. Earlier versions, 1 to 1.3, do not document enough of the errors to support that claim.)

Concentrating on Plimer's inconsistencies is nit-picking that doesn't address scientific issues

A theme that I tried to get across is *Twisted* is that for a scientific theory, a lack of internal consistency is even more fatal than discordant observations.

Disclaimer

This discussion, its contents and style, are the responsibility of the author and do not represent the views, policies or opinions of The University of Melbourne.

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