Resource and Environment Group

Volume 1, Issue 4

June 2011

NEWSLETTER

INSIDE THIS ISSUE:

Please contact us:

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- If you have any suggestions for articles for future newsletters
- If you would like to offer to help
- If you have any comments on any matter related to resource and environment

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RESOURCE AND ENVIRONMENT GROUP—2011 PLANS

Since our March newsletter there have been a number of exciting developments:

- REG has regular items in The Actuary magazine
- We are staging a networking evening at Staple Inn on 13 September when a number of speakers will talk about the opportunities to work on environmental issues. Watch out for the official notification.
- Our second review of literature relating to resource and environmental issues is underway, leading up to a presentation in October. If you would like to help in the review please get in contact.
- A major research project has been agreed.

REG IS ONE OF THE LARGEST ACTUARIAL MEMBER INTEREST GROUPS AND ALSO INCLUDES MANY NON-ACTUARIES FROM ACADEMIA, OTHER PROFESSIONS AND NGOS.

CLIMATE SCIENCE AND SENSITIVITY

As actuaries, we do not need to understand climate science in order to carry out a work, but we do need to understand its implications, and have an appreciation of the uncertainties. In case you missed it, a useful summary of climate change science was published by The Royal Society last September: http://royalsociety.org/climate-change-summary-of-science/ It is a masterpiece of measured language, summarising the complexities and uncertainties in this subject in just 19 pages.

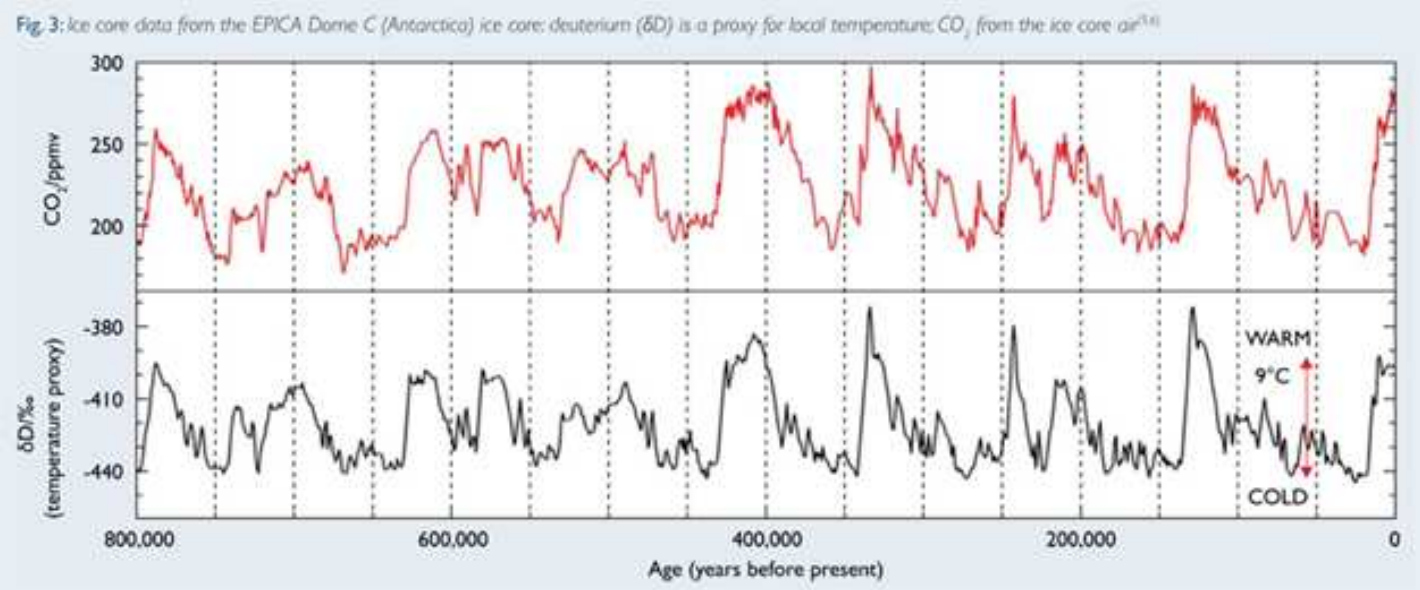
The aim of this document is to summarise the current scientific evidence on climate change and its drivers.

The Royal Society
September 2010

One of the concepts mentioned in the Royal Society document is “climate sensitivity”: defined there as the increase in average global surface temperature likely to ultimately result from a doubling in CO_2 in the atmosphere from pre-industrial levels. The level of CO_2 can be measured accurately from ice core data going back over 800,000 years. In the early part of the 19th century CO_2 was 280 ppm (parts per million), it is now around 390 ppm. 2007. Interestingly, the IPCC report stated that the best estimate for climate sensitivity is 3^0C, but this is not mentioned in the Royal Society document.

Paragraph 36 in the Royal Society document states that, "climate models indicate that the overall climate sensitivity (for a hypothetical doubling of CO_2 in the atmosphere) is likely to lie in the range 2^0C to 4.5^0C". As it says in the beginning of the document, this is partly based on results contained in the IPCC 4th assessment report published in 2007. Interestingly, the IPCC report stated that the best estimate for climate sensitivity is 3^0C, but this is not mentioned in the Royal Society document.

It's interesting to look at the actual record of temperature and CO2 over the available 800,000 years, taken from the British Antarctic Survey:



It does not need an actuary to see that they are closely correlated. The temperature change near the South Pole has moved within about a 9^0C band as CO_2 has varied between about 180 and 300 ppm. The relationship is also roughly the same over this period, i.e. the same rise in CO_2 is associated with roughly the same temperature change. It should be noted that there is a complex relationship between the polar temperature change and the global average temperature change, but the latter is apparently roughly half of the former.

Of course correlation does not necessarily mean causation. Temperature might cause the CO_2 to rise rather than the other way around. Alternatively there could be other factors that cause both temperature and CO_2 to rise together. This is referred to in paragraph 11 of the Royal Society paper. Scientists are reasonably sure that the ultimate cause are the Milankovitch cycles, which are oscillations in the Earth's orbit. These cycles just cause small regional changes in isolation, with the biggest effect at the polar regions. So the small regional radiative forcings caused by these cycles are somehow enough to trigger other mechanisms which eventually result in the switch between glacial and interglacial i.e. melt mile deep ice sheets and cause a 5^0 global average temperature change. This seems to indicate that the system is quite sensitive to small forcings.

The mechanism appears to be that there is an initial small temperature rise which causes water vapour and CO_2 levels to rise, possibly as a result of the ocean warming, currents changing and dissolved CO_2 being released. Rising CO_2 levels warm the planet, causing CO_2 and methane levels to rise further in a positive feedback. Also there is a positive feedback as ice sheets melt as dark earth and sea absorb more heat than white ice. There has obviously been a natural limit to this positive feedback in the past, as can be seen from the graph. But it is not clear how such constraints will work when the CO_2 level is at a much higher starting level – already well over 300 ppm - or the time period over which their beneficial restraining influence may be seen. Geological or millennial timeframes are not relevant to our current potential problems! These adverse feedbacks are also now amplified by black carbon and ozone emissions (recently studied in a UNEP report: http://www.unep.org/publications/contents/pub_details_search.asp?ID=6201)

Geological or millennial timeframes are not relevant to our current potential problems

The Royal Society paper does not define what it means by "likely". Presumably it is following the IPCC definition where it means > 66% probability (that climate sensitivity lies in the range 2^{0}C to 4.5^{0}C). This is not of course a random event: there will be only one answer, we will not be able to repeat the experiment! It is just that we do not know what that answer will be, but scientists think it likely that it will be in that range, based on "expert judgment and analysis of a body of evidence", to quote from the IPCC. The IPCC 2007 report contains an assessment of the impact of various increases in global temperature and clearly the upper end of the Royal Society range would cause global disasters. As risk managers, actuaries will also recognise that there is significant uncertainty ("16%" risk) that actual climate sensitivity could exceed 4.5^{0}C.

To reiterate, climate sensitivity as defined is one indicator of the sensitivity of the climate to a doubling in CO_2. The level of CO_2 has already increased by almost 40% and is continuing to increase rapidly. The IPCC's 2007 best estimate was that globally averaged surface temperatures would be between 2.5^0 - 4.7^{0}C higher by 2100 compared to pre-industrial levels. We await their next temperature report in 2013.

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Making a point? This is a picture of the South Pole, summer 2009, hopefully not a future holiday destination....

Visit the webpage:

http://www.actuaries.org.uk/members/pages/resource-and-environment-member-interest-group