

## **“Biogeoeengineering Solutions to Climate Change. What are they? Do they work and are they ethical?”**

Professor Paul Valdes University of Bristol.

Professor Valdes reviewed the current knowledge on climate change in terms of what we know, what we don't know and the uncertainties of predicting the future. There is little argument that over the past 150 years the levels of CO<sub>2</sub> have risen and continue to rise faster than for millennia and that multiple lines of evidence suggest that it is human activity that has caused this. CO<sub>2</sub> are still following the worst case scenario despite the many reduction strategies adopted by many of the developed countries. Promoting the need to reduce emissions has not been helped by recent media coverage of inconsistencies in data presented to the public.

Increasing levels of CO<sub>2</sub> contribute not only to global warming (2010 proved to be equal to the warmest average global temperature on record), but also result in an increase in the acidity of the oceans.

Uncertainties arise from the interpretation of data from a range of sources, particularly those from the distant past, but if the levels of CO<sub>2</sub> continue to rise, the predictions show a worst case scenario of a 6°C rise in global average temperature. However regional predictions are even more uncertain and there is growing pressure to give answers.

Climate change and its effect on natural resources such as food, water etc. together with the growing world population will create potential trouble for governments. As long ago as 2004 a Pentagon report claimed that the threat to global stability arising from availability of natural resources will vastly eclipse that of terrorism.

Geo-bioengineering is the deliberate modification of the earth system to mitigate the effects of global warming. There are basically two types (a) attempts to reduce solar radiation thereby reducing the effect and (b) CO<sub>2</sub> removal to minimise the effect.

It has been suggested that solar radiation could be reduced by the use of mirrors in space but this is probably impracticable since they would need to be several kilometres across. Land based mirrors or making land surface more reflective are possible and it has also been found that some plants, including varieties of wheat, are more reflective to sunlight. The use of aerosols or particles in the stratosphere to block the sun's radiation is a real possibility and the UK is piloting methods of achieving this.

There have been many suggestions for carbon capture or removal of CO<sub>2</sub>: e.g. artificial trees that absorb CO<sub>2</sub>, iron fertilisation of the oceans to stimulate plankton growth, ocean pumps to bring high nutrient deep water to the surface and even liming the ocean to reduce acidity. However of the various methods proposed, Professor Valdes thought that the liquefaction of CO<sub>2</sub> and pumping it into the spaces resulting from oil and gas extraction to be the most practical. Norway has already adopted this approach, albeit mainly to improve the flow of oil from wells as the natural gas pressure drops. He ended with a comparison of a range of indicators such as population growth, water use, global GDP, biodiversity loss all of which show very similar change rates to that of CO<sub>2</sub>.

There are no perfect solutions and it is therefore imperative that every effort be made to reduce or at worst stabilise emissions but that approaches such as geo-bioengineering should also be developed.

*Given on Wednesday 12 January at the Royal Agricultural College*