From the Chief Scientific Adviser to HM Government
and Head of the Government Office for Science
Sir John Beddington CMG FRS

Government Office for Science

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By email: jn@cloudworld.co.uk

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Dear John

To follow up my note of 27 April, I enclose a fuller response to your letter of 26 March and enclosed *Arctic Methane Alert* report. While the general premise of the arguments presented in the report, that sea ice melt and methane release could both act to amplify climatic changes through feedback effects, is scientifically valid; I do have a number of concerns about the way in which the scientific evidence has been presented.

There is a significant amount of uncertainty associated with current scientific understanding of climatic feedbacks which is not adequately communicated in the document. Some of the very significant risks and uncertainties associated with some geoengineering techniques are also not addressed.

In your letter you call for a rapid reappraisal of the Arctic situation from the government's chief scientific advisers. Under the DECC and Defra funded Climate Programme the Met Office Hadley Centre has produced an assessment of current scientific understanding of the state of the Arctic, including the possibility of rapid change in Arctic sea ice and its potential impacts. This assessment was completed earlier this year and is expected to be published in the next few months.

The Hadley Centre assessment concludes that the Arctic is likely to become ice-free during summer at some point this century, and that it is the climate models which predict this happening earlier rather than later which most closely replicate the observed long-term rate of decline in sea ice extent and volume. However, the earliest that models predict this

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happening is around 2030. As such I was concerned to see your prediction of a seasonally ice-free Arctic by 2015.

This prediction appears to have been reached by fitting PIOMAS Arctic sea ice volume estimates with an exponential curve and extrapolating this trend into the future. The reason for the choice of fitting an exponential trend to this data is not clear. The University of Washington, who developed PIOMAS, illustrate the declining trend by fitting a linear trend-line through the data[1]. Aside from the fact that extrapolation of any trend-line is obviously subject to significant uncertainty, extrapolating an exponential trend into the future leads to a much more dramatic conclusion than if a linear trend were extrapolated, and I am not convinced there is scientific justification for it.

On-going research programmes will improve scientific understanding of climate change in the Arctic, through better monitoring and better modelling. Direct estimates of ice volume from the CryoSat satellite which are now becoming available will be an important source of data to help monitor changes throughout the year across this data-sparse region.

The potential impacts of methane release from permafrost and hydrates is highly uncertain but is clearly an important area of active scientific research. Scientists are working to improve our understanding of how much methane is stored in permafrost and hydrates, and the regional and global impacts of its release; which will depend on whether it is released slowly or quickly, and for that stored in hydrates whether it actually escapes to the atmosphere.

The issues which are the subject of your report, decline of Arctic sea ice, both in extent and volume, and the issue of rapid methane release from thawing ground and warming shelf areas in the Arctic is obviously of concern. This issue will be addressed in the next assessment report of the Inter-Governmental Panel on Climate Change (IPCC) Working Group One. The IPCC, and the peer reviewed literature, are manifestly credible sources of climate science and are likely to remain as the basis of decision-making regarding action on climate change.

It is clear that the scientific evidence for climate change leaves no room for complacency. It may be possible that geoengineering technologies have a role to play in future in supplementing our efforts to mitigate climate change, however, for most techniques current

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[1] See Polar Science Center » Arctic Sea Ice Volume Anomaly, version 2 and also Schweiger et al (2011) *Uncertainty in Modeled Sea Ice Volume* Journal of Geophysical Research **116** doi:10.1029/2011JC007084

understanding of the suitability, impacts and efficacy is limited. Clearly, more work is needed, but in the absence of a robust knowledge base I believe it is imprudent to advocate deployment of these technologies.

Sir John Beddington