

UKMO FEEDBACK OMISSIONS - EAC Enquiry; the validity of Carbon Budgets in Climate Act

GCI welcomes this new EAC enquiry into the adequacy of the carbon-budgets in the UK Climate Act. In the previous enquiry in 2009, the UKMO gave misleading information to the EAC claiming that all relevant feedback effects were in the climate-model underpinning the Climate Act. They were not.

From the outset, GCI has constantly warned of feedback effects being omitted from climate-models. Starting in 1989, GCI proposed the thesis of "Equity & Survival" to the UN 1990-92. Through 1993-94 we countered its 'economic' antithesis of 'Efficiency with No-Regrets' as the 'Economics of Genocide'. In a document requested of GCI by IPCC in 1993 for the Second Assessment Report [SAR], GCI warned about the possibility and the dangers of positive feedback effects: - http://www.gci.org.uk/Documents/Nairobi3b_.pdf

THE "CONSTANT AIRBORNE FRACTION" (CAF)

"During the period 1860 to 1990 a constant fraction of CO2 emissions to the atmosphere in the order of 50% remained 'airborne'. However, given the possibility of enhanced positive feedback in the future, the fraction may not remain constant. In the face of continued industrial emissions and declining terrestrial sink-capacity, it will probably increase."

At the 2nd 'Conference of Parties' [COP-2] to the UN Framework Convention on Climate Change 1996, GCI tabled the Contraction and Convergence (C&C) model for achieving UNFCCC-compliance. At COP-2, GCI defended C&C at rates consistent with a 350 ppmv atmospheric stabilisation target. Again, we warned about the possibility of positive feedback: - http://www.gci.org.uk/Documents/ZEW_CONTRACTION_&_CONVERGENCE.pdf

WHICH CONTRACTION BUDGET? WHICH CONVERGENCE DATE?

"These are the two main questions that arise once the twin-policy approach is accepted in principle. We will address 'which budget?' first, as the imperative of convergence only arises as a derivative of the imperative of contraction even if in turn, contraction is only practically achievable once global convergence has been accepted, agreed and configured."

Also, most known feedback mechanisms are not modelled into these runs. And while their interactive effects on climate forcing are still too complex to simulate in the models, the feedback signs are predominantly assumed positive - i.e. giving increased warming."

The Paper was presented to the ZEW conference in Mannheim Germany in June 1997. We continued the defence of 350 ppmv and the paper was ultimately published by ZEW through Springer Verlag in an updated form but where this defence was edited out: - <http://www.gci.org.uk/papers/zew.pdf>

From 1995 onwards GCI has advocated the synthesis of 'Contraction & Convergence' [C&C] at the UN, continuously making the case for realistic feedback-averse rates of C&C to be adopted: - <http://www.gci.org.uk/rates.html>

Since that time C&C has become the most widely internationally recognized, cited and arguably the most widely supported methodology in the process: - <http://www.gci.org.uk/news.html>
<http://www.gci.org.uk/endorsements.html>

C&C has also had considerable cross-party political support in the UK: - http://www.gci.org.uk/Full_House.html

A campaign summary is here: - http://www.gci.org.uk/Documents/Campaign_Summary_.pdf

In 2008, Adair Turner, Chairman of the UK Climate Change Committee, recognized C&C as the basis of the UK Climate Act: - <http://www.youtube.com/watch?v=M1ampl1XAzs>

"In the UK Climate Act we have endorsed the C&C principle. It is pretty strong support for what Aubrey Meyer has said."

However, throughout and concomitant with all this, the UKMO has routinely excluded these feedback effects from the Climate Model underpinning the UK Climate Act. Indeed, in the EAC Enquiry in 2004, the UKMO made these inaccurate and misleading remarks about C&C and the Brazilian Proposal in their evidence about "Responsibility for mitigation": -

"The Brazilian proposal and other similar mechanisms provide frameworks that could be used to assign future responsibility for mitigation to those with greatest responsibility for past climate change. The Hadley Centre and other scientists around the world are working together to come up with a robust methodology to quantitatively estimate how future emissions reductions might be divided between nations in an equitable way, should such approaches be adopted by the international community. This information will underpin negotiations post Kyoto, and inform negotiations on contraction and convergence."

The problem with this as a statement about C&C was that from a policy perspective, there is no meaningful feedback measurement in the Brazilian Proposal whatsoever. When IA for that reason, GCI lodged a complaint about these remarks, the EAC chair accepted GCI's C&C definition statement and the UKMO told us to, **"get a trademark"**. We did and two years later they agreed to respect it.

On June 23 2009, UKMO claimed to the EAC Enquiry that all relevant feedbacks were in the climate modelling behind the UK Climate Act: -

"The models will take into account all the feedbacks we are aware of that we think are important."

This was and remains an ambiguous and misleading statement and the carbon budget in the UK Climate Act is a product of it. In November 2010 the UKMO put an admission of this on its website: - <http://www.metoffice.gov.uk/climate-change/guide/science/explained/feedbacks>

At that time, UKMO claimed in the EAC 2009 Enquiry to have included coupled-carbon cycling [as in IPCC AR4] in the model used for the Act. However, what they actually introduced in the carbon-cycle was the first projection of **negative** – not **positive** – feedback in the twenty year history of climate-modelling in the IPCC's record. This claimed more than 100% 'Carbon-Sink-Efficiency' by 2050 in the carbon 'Contraction:Concentrations' budget [2016 4% Low] in the UK Climate Act. The UKMO ignored challenge on this but especially in the light of feedback omission, this projection remains and untrustworthy basis for policy development. This is analysed in some detail in this evidence.

Overall, the 'science/policy-hybrid' created by the UKMO and the CCC renders the Act itself opaque and falsely reassuring. Moreover, the problem remains as the UKMO are **still** omitting feedback effects from their model, having aligned it with the RCP projections in IPCC AR5, despite comments from other eminent sources. As UNEP said in **"Policy Implications of Warming Permafrost"** [2012]: -

"All climate projections in the IPCC 5th Assessment, due for release in 2013-14, are likely to be biased on the low side relative to global temperature because the models did not include Permafrost carbon feedback. So targets based on these projections would be biased high."

Nicholas Stern told the IMF last month, **"Feedbacks and tipping points such as Permafrost melt are omitted in the scientific models. We need a new approach."**

Because of RIAFE, dealing with this 'modelling challenge' is intractable, but in this evidence, GCI also offers a draft suggestion of what this new approach needs and might begin to look like: -

<http://www.gci.org.uk/CBAT/cbat-domains/Domains.swf>

THE UKMO ADMIT FEEDBACKS ARE OMITTED FROM THEIR MODEL

In June 23 2009 Professor Mitchell of the UKMO claimed to the EAC Enquiry that all relevant feedbacks were in the climate models behind the UK Climate Act: -

"The models will take into account all the feedbacks we are aware of that we think are important, then we can quantify that we understand, and to that extent the Climate Change Committee has obviously done that.

Science being science, we uncover new feedbacks and there is a delay in being able to incorporate those in the complex models.

One can use simple models to get, if you like, a fast-track estimate of what the effect would be, but one would have to refer to the more complex models to make sure that when you add that additional feedback you are actually taking into account all the processes that are important."

This was an incorrect and misleading statement. The UK Climate Act is a product of this and in November 2010 the UKMO put the following admission on its website: -

<http://www.metoffice.gov.uk/climate-change/guide/science/explained/feedbacks>

Are there feedbacks that *aren't* included in the models?

"There are some feedbacks we have recognised but remain big uncertainties. We don't know enough about them to include their effects in climate models. However, they are potentially very serious so there is still a lot of work going on to try to understand them and get them into our projections."

Methane hydrates (positive feedback)

"These are potentially a very big deal which could change our whole understanding of climate change, but it's very uncertain.

There are very large stores of methane locked away at depth in the ocean. We know the stability of these stores is dependent on temperature. As the oceans get warmer it's possible this balance could be upset and the stores released — which would be very serious. Methane is more than 20 times as potent as CO2 as a greenhouse gas.

There's some evidence to suggest that going back over a very long historical period (more than millions of years), the release of these methane stores may have played a big role in abrupt and severe changes to past climate. How close we are to any possible threshold is very much an open question."

Permafrost methane (positive feedback)

"This is a big question mark but also potentially a very big deal. There are very organic rich soils in certain parts of the world. At higher latitudes, these are frozen over by permafrost, and those greenhouse gases are effectively locked away. When the soil thaws due to rising temperatures, these gases could become unlocked and be released as CO2 or methane. At the moment we don't know how much of the CO2 is stored away or to what extent it would be released when the soil thaws.

These are two key questions, and we need to figure out how to resolve them on a global scale in a climate model before this effect can be included in our projections. Within the next five years we hope to know enough about this process to start including its effects."

Could there be other feedbacks that you don't yet know about?

"Yes, we assume there are hidden feedbacks in the system, but as long as we keep climate change relatively small we can be confident these unknown issues won't come in to play.

However, as we move further away from the present climate, we are exposing ourselves to more risk about these unknowns. Even only taking into account the climate feedbacks we are aware of now, they pose a great incentive for us to quickly reduce our greenhouse gas emissions to keep global temperature rises to a minimum."

Last Updated: 29 November 2010

Aligning itself with the RCP scenarios apparently now the base of IPCC AR5, UKMO published the 'Advance Paper' in 2010 last updated 29/04/2013: -

<http://www.gci.org.uk/Documents/advance.pdf>

The climate-modelling in this paper continues to omit the feedbacks listed on page 18 of the 'Advance' document, as do the RCP scenarios with which UKMO aligned itself

"We will continue to improve the representation of processes included in our model.

There are also a number of processes not currently included that could potentially have a major impact on the degree of warming for a given emissions scenario, quite apart from their impact on local and regional climate. Some of these processes have been discussed here and we are actively working on including them in the model: -

- The impact of ozone on plants reduces their ability to take up carbon. Given their major implications for international technology and economic development, policy decisions on climate change must be underpinned by the best possible evidence.*
- The deposition of black carbon on snow changes the reflectivity of the surface leading to more warming at high latitudes. Other processes are less well understood but are actively being researched with a view to including them in future models.*
- The ability of plants to take up carbon may be limited by the supply of nitrogen available naturally, but may be enhanced by man-made sources of nitrogen. Climate change itself may also increase available nitrogen and stimulate plant growth.*
- The thawing of permafrost may lead to large amounts of carbon release, but these processes are not well understood.*
- Dynamic ice processes could speed up freshwater supply from glaciers into the ocean.*
- The processes that affect methane in the Arctic Ocean could lead to increased methane release (the science is poorly understood so may take longer to include in models).*

The international science community is working hard to understand and narrow the uncertainties in future climate projections — and it is doing this primarily through model inter-comparison projects, comparison with observations, and the synthesis of results by the next IPCC report.

Understanding the interactions within the Earth system is critical."

"All climate projections in the IPCC Fifth Assessment Report, due for release in 2013-14, are likely to be biased on the low side relative to global temperature because the models did not include the permafrost carbon feedback."

In 2012, UNEP published *"The Policy Implications of Warming Permafrost."*

In the executive summary it made the following statements about IPCC AR5 and the omission of carbon feedback in the climate models that under-pin AR5.

"All climate projections in the IPCC Fifth Assessment Report, due for release in 2013-14, are likely to be biased on the low side relative to global temperature because the models did not include the permafrost carbon feedback."

Consequently, targets for anthropogenic greenhouse gas emissions based on these climate projections would be biased high.

The treaty in negotiation sets a global target warming of 2°C above pre-industrial temperatures by 2100.

If anthropogenic greenhouse gas emissions targets do not account for CO₂ and methane emissions from thawing permafrost, the world may overshoot this target."

UNEP [2012]

"Policy Implications of Warming Permafrost."

<http://www.gci.org.uk/Documents/permafrost.pdf>

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As things stand, this message from UNEP confirms the danger, indeed the likelihood that IPCC AR-5 will continue the pattern established over the past twenty years of under-estimating and under-representing the real risks we face.

Sir Robert Watson [a former Chairman of the IPCC at the time of the IPCC Third Assessment Report] said in a public session in San Francisco in December 2012: -

*"We were careful and conservative. If we had a strong statement subsequently proved wrong, we would lose all credibility as a scientific community. I thought we should always be slightly on the side of conservative. Otherwise we were going to get ripped apart by climate-deniers even for the simplest mistake."*

This is not just erring towards 'conservatism'. That suggests we face merely the inconvenience of 'control-curves' – or *deceleration* curves. Feedbacks mean what we face is the potentially catastrophic consequences of 'loss-of-control-curves' – or *acceleration* curves.

James Hansen has already

This is why we make the assertion that omitting feedbacks from the models: -

*" . . . unintentionally provides assistance to 'climate-deniers' against whom James Hansen has already and rightly levelled the charge of crimes against humanity for willing dangerous rates of climate-change upon the future."*

Nicholas Stern, author of the 2006 Stern Report, made a presentation in DAVOS in January this year saying: -

*"I got it so wrong on climate change, its far, far worse."*

<http://www.guardian.co.uk/environment/2013/jan/27/nicholas-stern-climate-change-davos>

Who advised him at the time of the original report?

Who advises him now when tells the IMF: -

***"The scientific models mostly leave out dangerous feedbacks/tipping points. We need new generation of models."***

In May 2013, the IMF published slides from a presentation there by Nicholas Stern.

On slide 9 and 10 Stern also points to the omission of melting Permafrost feedbacks and tipping points: -

*"The scientific models mostly leave out dangerous feedbacks/tipping points.*

*At 6°, 5°, 4° C or below, the probability of passing some tipping points, such as melting of permafrost, may be high. If modellers cannot capture or model effects 'sufficiently clearly' they are omitted. But best guess surely not zero.*

*The models are not built in a way that help us describe the impacts on people:*

*At sea level (SL) 2m higher a few hundred million might have to move (Nicholls, et al., 2011);*

*-At 3-4-5°C may see radical monsoon changes in India and substantial changes in flows of major rivers off the Himalayas (a billion plus people depend on them). Desertification of southern Europe?*

*Models should focus on understanding probabilities of events with severe consequences for people rather than on those bits which (on narrow assumptions) seem more tractable, such as change in agricultural output, relative to those effects that can be modelled more easily.*

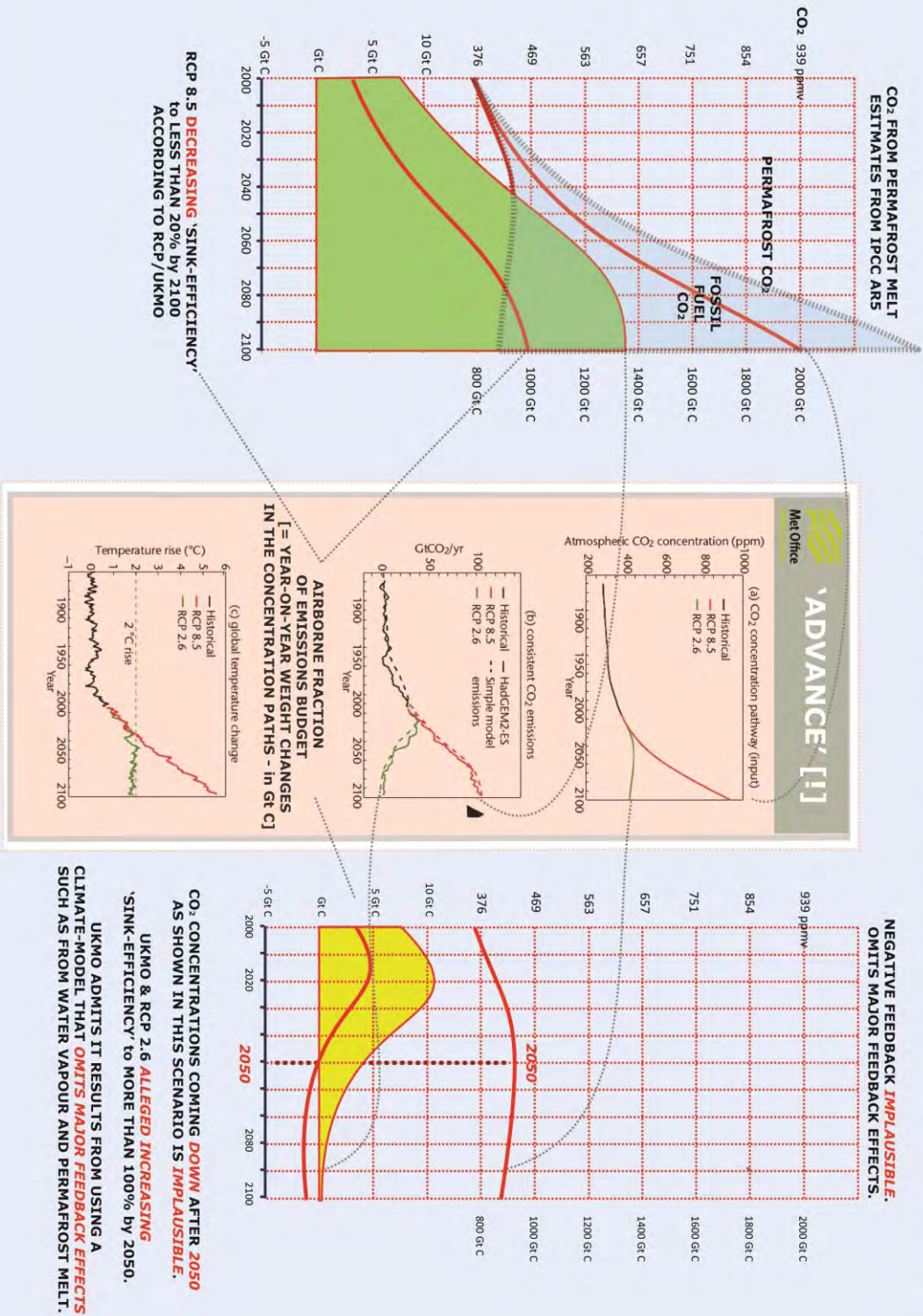
*We need new generation of models."*

### **Nicholas Stern to IMF May 2013**

[http://www.gci.org.uk/Documents/Stern\\_IMF.pdf](http://www.gci.org.uk/Documents/Stern_IMF.pdf)



UKMO'S 'ADVANCE' PAPER ALIGNS 'HADGEM' CLIMATE MODEL WITH THE RCP SCENARIOS IN IPCC AR5. SO ALL THESE RCP SCENARIOS OMIT MAJOR FEEDBACK EFFECTS TOO. ADDING JUST THE EXTRA CO<sub>2</sub> FROM MELTING PERMAFROST AS PPMV [AS ESTIMATED IN IPCC AR5 TEXT ONLY] IS ADDED IN BLUE



**In 'ADVANCE', UKMO's comment on feedback omission reads: -**

*We will continue to improve the representation of processes included in our model.*

*There are also a number of processes not currently included that could potentially have a major impact on the degree of warming for a given emissions scenario, quite apart from their impact on local and regional climate. Some of these processes have been discussed here and we are actively working on including them in the model: -*

- The impact of ozone on plants reduces their ability to take up carbon. Given their major implications for international technology and economic development, policy decisions on climate change must be underpinned by the best possible evidence.*
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*The international science community is working hard to understand and narrow the uncertainties in future climate projections — and it is doing this primarily through model inter-comparison projects, comparison with observations, and the synthesis of results by the next IPCC report.*

*Understanding the interactions within the Earth system is critical."*

**Yet, aligning itself with the RCP scenarios now at the base of IPCC AR5, UKMO again publishes negative feedback in the 'Advance Paper' of 2010.**

The paper set out the alignment of UKMO HADGEM2-ES with the RCP scenarios that have replaced the SRES scenarios in previous IPCC Assessment Reports.

An analysis of the RCP 8.5 & 2.6 scenarios for airborne fractions of emissions shows the same rate of reabsorption as increasing to more than 100% of the budget by 2050 in the case of RCP 2.6 and decreasing to around 20% of the CO<sub>2</sub> budget by 2100 for RCP 8.5.

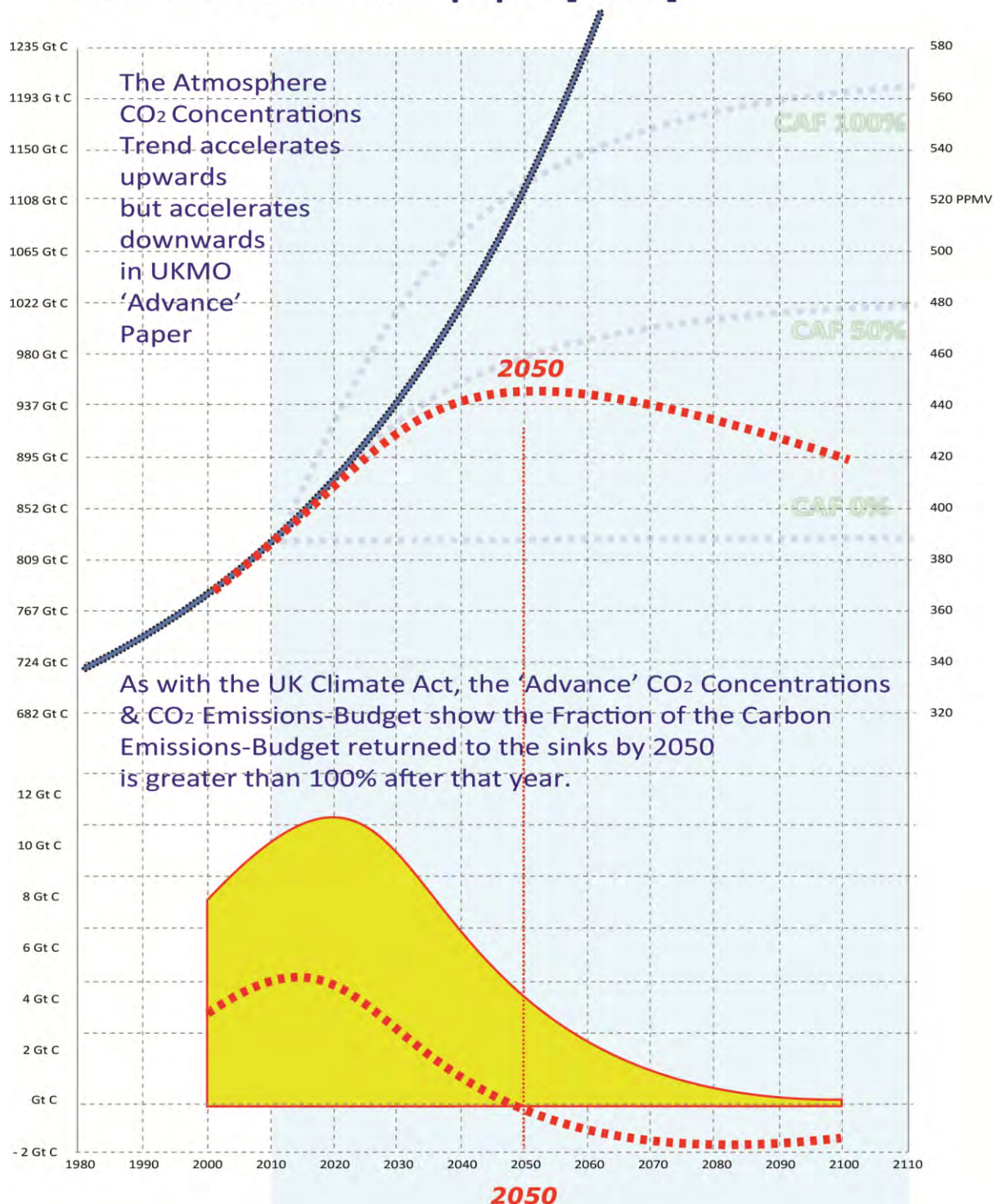
This is therefore true of the HADGEM2-ES runs as well and that the projections continue to be made on the basis of the continuing omission of major feedback effects in RCPs, currently drafted to inform IPCC AR5.

**It was updated by UKMO April 29<sup>th</sup> 2013: -**

<http://www.gci.org.uk/Documents/advance.pdf>



**Despite this & the CO<sub>2</sub> trend acceleration in PPMV, UKMO continues to model growing 'Sink-Efficiency, as in their 'Advance' paper [2010].**



In fact UKMO formally aligned itself with the RCP scenarios in 2010, shows the same feedback omissions are in the RCP scenarios [see next slide].

It is understood that these RCP scenarios are being made the basis of the drafts of the forthcoming IPCC AR5 [due 2014/15]. If so, it suggests that these feedback omissions could inform AR5 on publication.

## **UKMO's Feedback Omissions are in 'NATURE CLIMATE', February 2013**

"A global assessment of the effects of climate policy on the impacts of climate change"

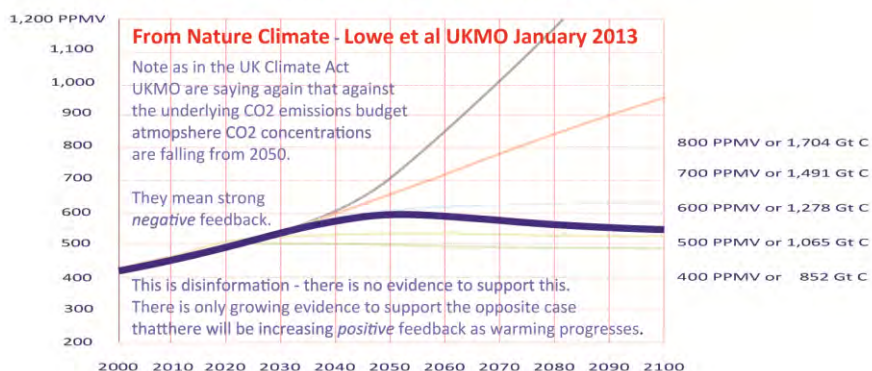
By UKMO's J. A. Lowe and other authors from the UKMO-led AVOID project, a global carbon budget weighing around 90 Gt C [or about twice the weight of the budget in the UK Climate Act] projects carbon emission, concentrations and temperature from 200 to 2100.

While temperature is projected to rise throughout to approaching 3 degrees above pre-industrial, and emissions fall in this case from 2030 onwards, CO<sub>2</sub> concentrations peak at 600 PPMV and then fall from 2050 onwards to around 550 PPMV by 2100.

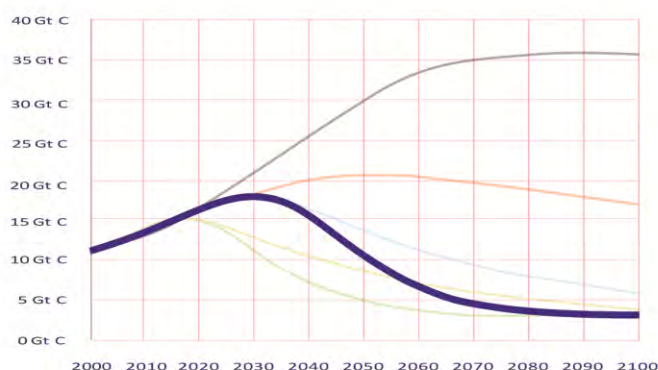
This projects yet again that according to the UKMO, CO<sub>2</sub> sinks are greater than Budget CO<sub>2</sub> sources [or more than 100% 'sink-efficiency' is projected] by 2050. This is yet further evidence of the fact that UKMO continues to use a climate-model that omits major feedback effects.

The conclusion that has to be drawn from all this is that use of this model as it is, results in unrealistic and misleading results.

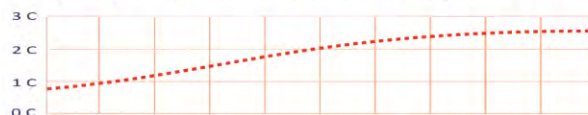
## UKMO Atmosphere CO<sub>2</sub> Concentrations



## UKMO Emissions CO<sub>2</sub>



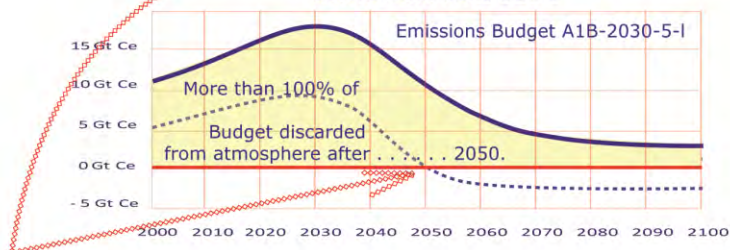
## UKMO Temperature Increase above pre-Industrial



## UKMO Atmosphere CO<sub>2</sub>-e Concentrations



## UKMO Emissions CO<sub>2</sub>-e



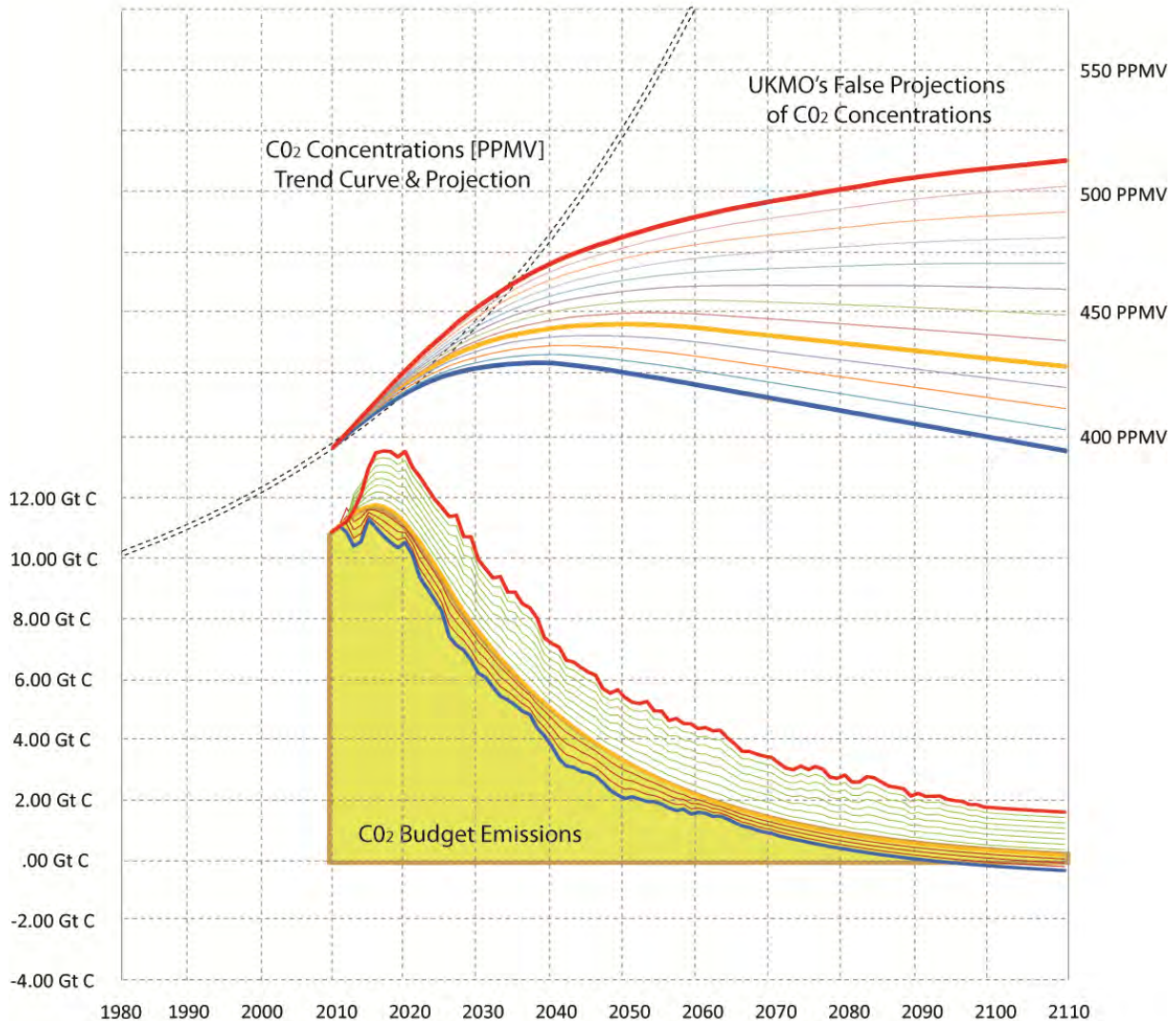
Once again in NATURE CLIMATE [January 2013] UKMO authors assert 'Negative Feedback' in the carbon cycle at the Budget volume/velocity i.e. the emissions rates of UK Climate Act. This means repeating the fallacy of achieving greater than 100% 'sink-efficiency' by 2050. and aligning the repeat of '**Feedback Omissions**' with the RCP scenarios in IPCC AR-5 drafts.



# ***"Keeping Control Curves?"***

## **FALSE EQUILIBRIUM BEHAVIOUR**

**By omitting CLIMATE FEEDBACK EFFECTS from the Climate Act  
UKMO falsely project only 'Keeping Control Curves'**



*"The scientific models mostly leave out dangerous feedbacks/tipping points. At 6°, 5°, 4° or below, the probability of passing some tipping points, such as Permafrost melt may be high. If modellers cannot capture of model effects 'sufficiently clearly', they are omitted, but best guess is surely not zero. We need a new approach."*

**Nicholas Stern to IMF, May 2013**

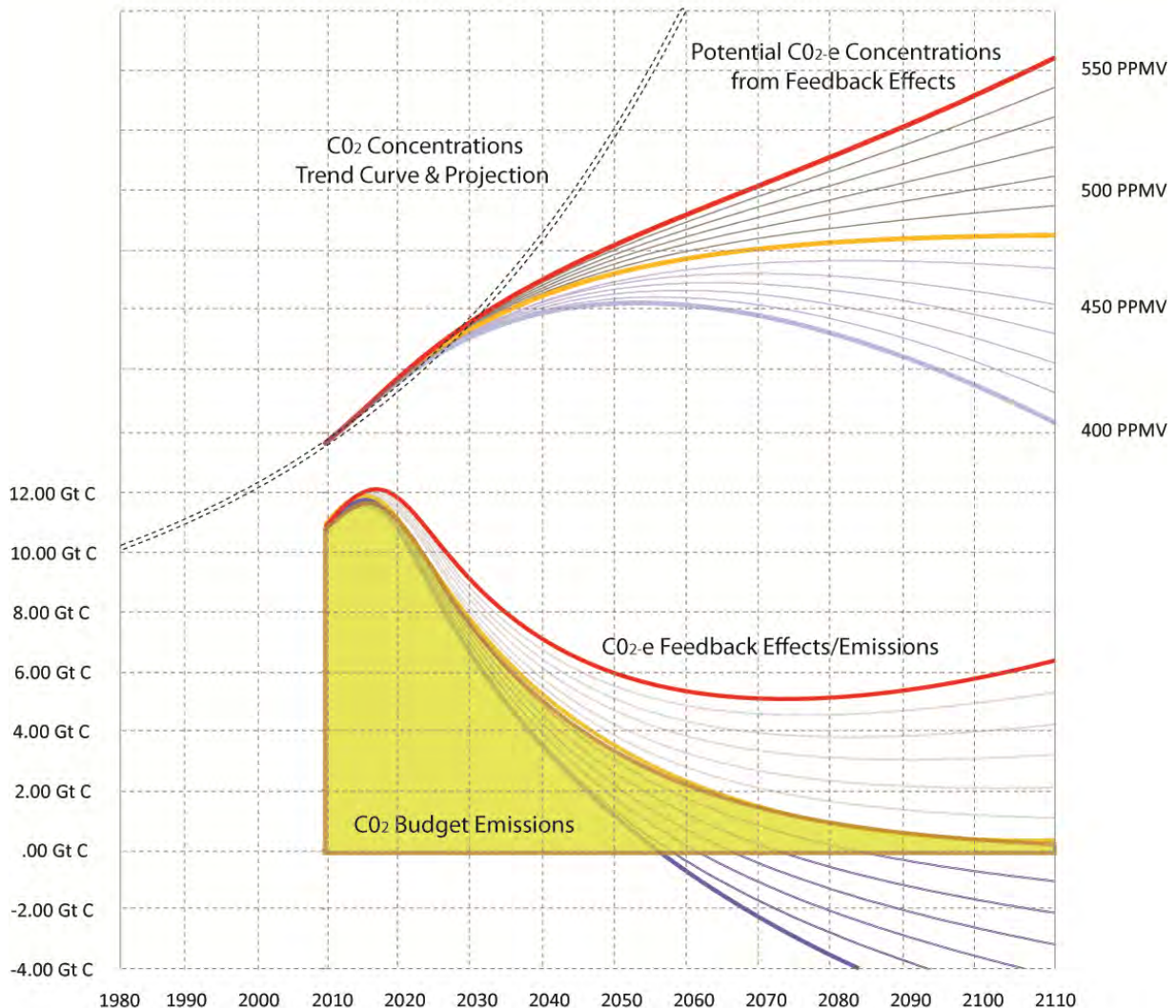
*"All climate projections in the IPCC 5th Assessment, due for release in 2013-14, are likely to be biased on the low side relative to global temperature because the models did not include Permafrost carbon feedback. So target based on these climate projections would be biased high."*

**Policy Implications of Warming Permafrost, UNEP 2012**

# ***"Loss of Control Curves?"***

## **POTENTIAL RUNAWAY BEHAVIOUR**

**By admitting CLIMATE FEEDBACK EFFECTS to the Climate Act  
Trend-Logic augurs the potential for *'Loss of Control Curves'***



*"The UKMO/CCC scenarios mimic a conceptual shortcoming in models over the last 17 years. Tipping points and the most important feedback effects leading to these, are still not in the climate-models being used."*

**GCI to EAC Enquiry, June 2009**

*"We must be precautionary and not run risks we cannot afford to run. The rates of CO<sub>2</sub>-emissions & concentrations considered in this study recognize that a steady rate of feedback acceleration in the years ahead, makes it possible to contemplate a scenario where positive feedback, for example from Permafrost melt, is driving the system as a whole from a point after which 'human-budget emission-control' becomes irrelevant. In 2013 it is of great concern that these feedback effects continue to be absent from UKMO's Climate-Models and the RCP scenarios being fed into IPCC AR5."*

**GCI to EAC Enquiry, May 2013**