



24 September 2013

Dear Mr. Lewis,

I would like to follow up on a few key points in the ongoing discussion around the interplay between models and observations, so that we can provide greater clarity on the science behind estimating climate sensitivity, aerosol forcing and the relationship between them.

As a physicist who has worked extensively on using observations to understand climate processes and natural climate variability, and subsequently to model them, I would like to understand in more detail how you estimate equilibrium climate sensitivity (ECS) and aerosol radiative forcing from the observational base.

Specifically:

(i) How do you extract the radiative forcing from CO₂ alone from observations of changes in total radiative forcing that are a complex mix of the effects of greenhouse gases, anthropogenic and natural aerosols, solar variability and so on? In particular, when you estimate aerosol radiative forcing how do you go from observations of aerosol concentrations and characteristics (optical depth primarily) to their effects on the radiation field? How do you deal with the distribution of aerosols both horizontally and vertically both of which have fundamental effects?

(ii) Estimating the ocean heat uptake from observations is extremely challenging because of the difficulty in observing the three dimensional ocean and its evolution in time. How do you handle that in your estimation? If you rely on global ocean analyses then they are fundamentally model-based through the data assimilation process.

(iii) Natural decadal variability needs to be factored in and I wonder how you deal with that because of the shortness of the observational record and the critical role that the oceans play on these timescales.

(iv) In considering the relationship between ECS and aerosol radiative forcing how do you reconcile the fact that the 3-dimensional and temporal signatures of aerosol versus greenhouse gas forcing within the climate system are very different?

I hope you agree that there is some serious science to discuss here and I would like to invite you to visit us in Exeter to work through these together.

Yours sincerely,

Professor Julia Slingo OBE DSc