Dust, vapour & cloud in greenhouse Earth

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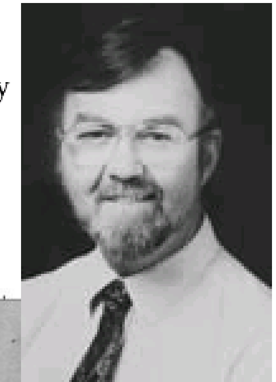
Homage to Harries event, Imperial College, 24th May 2017

Q. J. R. Meteorol. Soc. (1997), **123**, pp. 2173–2186

Atmospheric radiation and atmospheric humidity

By J. E. HARRIES*
Imperial College, UK

(Presidential address: delivered 19 June 1996)



Q. J. R. Meteorol. Soc. (1996), **122**, pp. 799–818

The greenhouse Earth: A view from space

By J. E. HARRIES*
Imperial College, UK

(Presidential address: delivered 21 June 1995

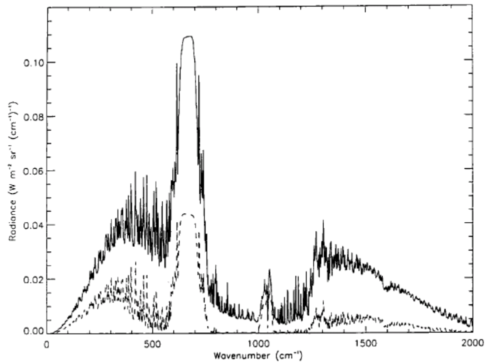
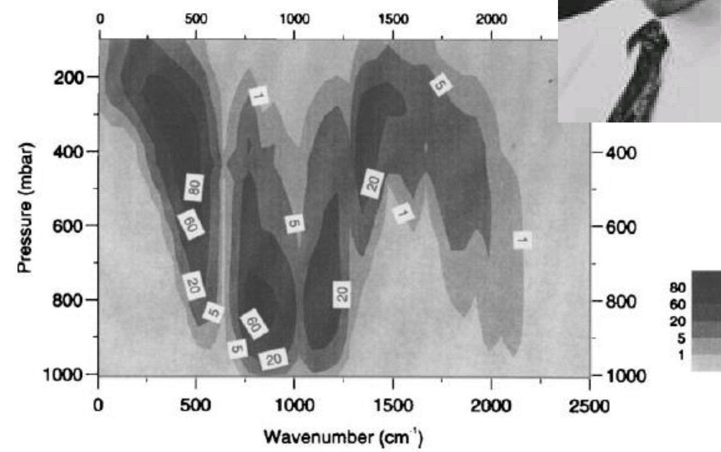


Figure 6. The greenhouse-effect parameter *G* (see text) for two atmospheres: solid curve, for the moist tropical case shown in Fig. 5; broken curve, for a cold sub-arctic standard atmosphere.



e 8. The outgoing long-wave radiation (OLR) calculated using the Shine (1992) model, by removing the vapour from 50 mb thick layers and noting the change in OLR. The units are mW m^{-2} per 10 cm^{-1} interval spectrum. Abscissa gives spectral wave number (= reciprocal of wavelength), and ordinate gives pressure in the atmosphere. Case of a moist tropical standard atmosphere. (Sinha and Harries 1995).

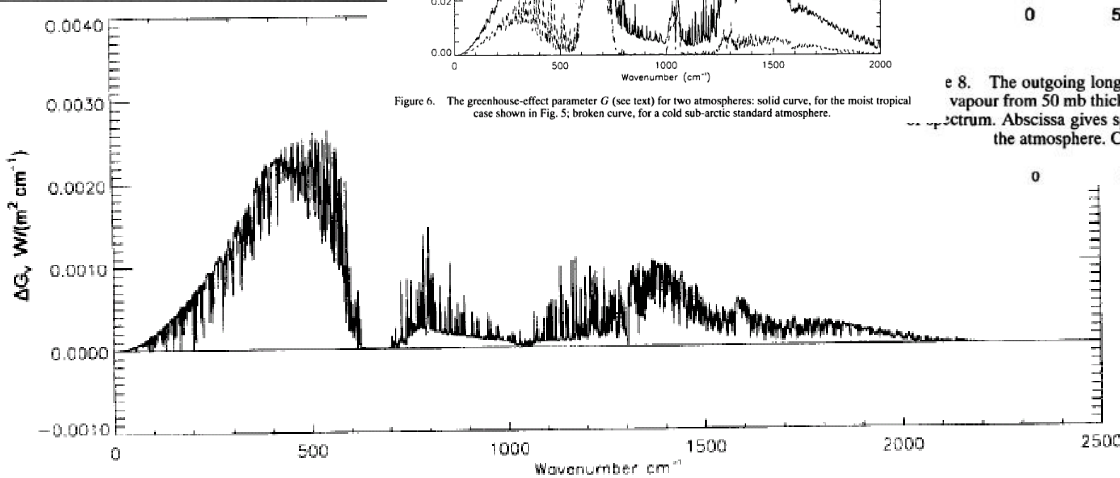
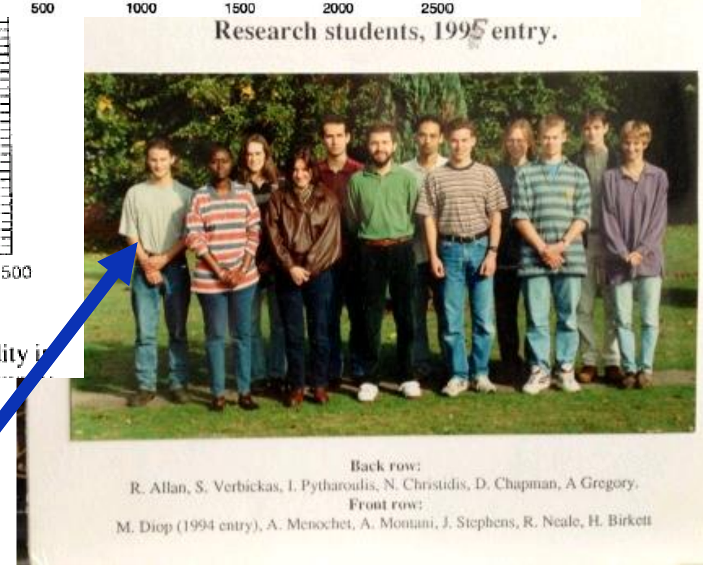
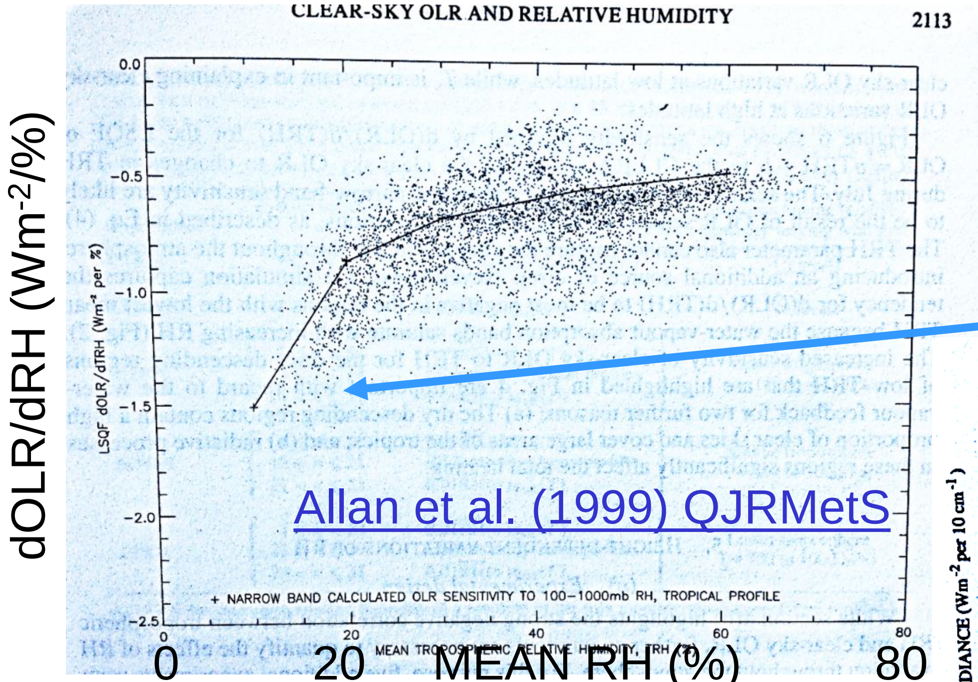


Figure 9. Change in calculated spectral greenhouse parameter, G_ν, due to a 12% increase in specific humidity i



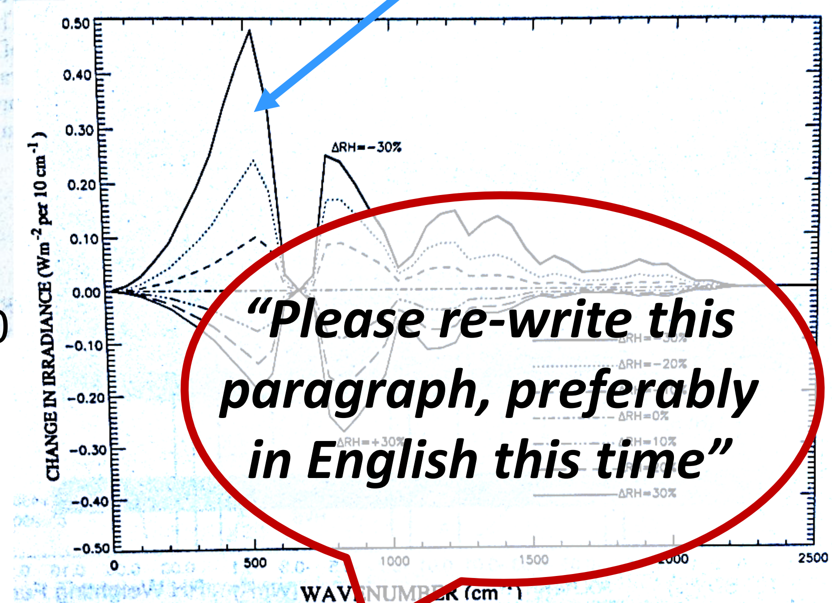
Readily gobbled up by a new PhD student working on Earth's energy balance!

Role of far infrared in controlling how much water vapour amplifies climate change



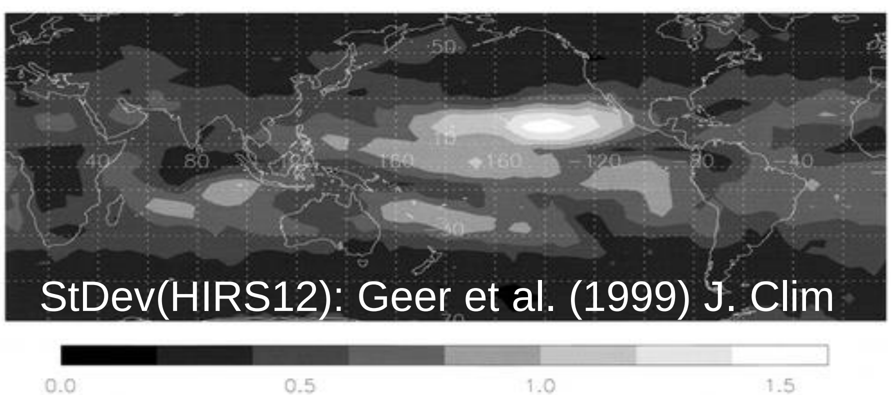
Allan et al. (1999) QJRMetS

Far infrared outgoing radiation highly sensitive to humidity changes in dry regions e.g. Sinha & Harries (1997)



"Please re-write this paragraph, preferably in English this time"

12/37 The referees and associate editor are thanked for their many helpful comments.

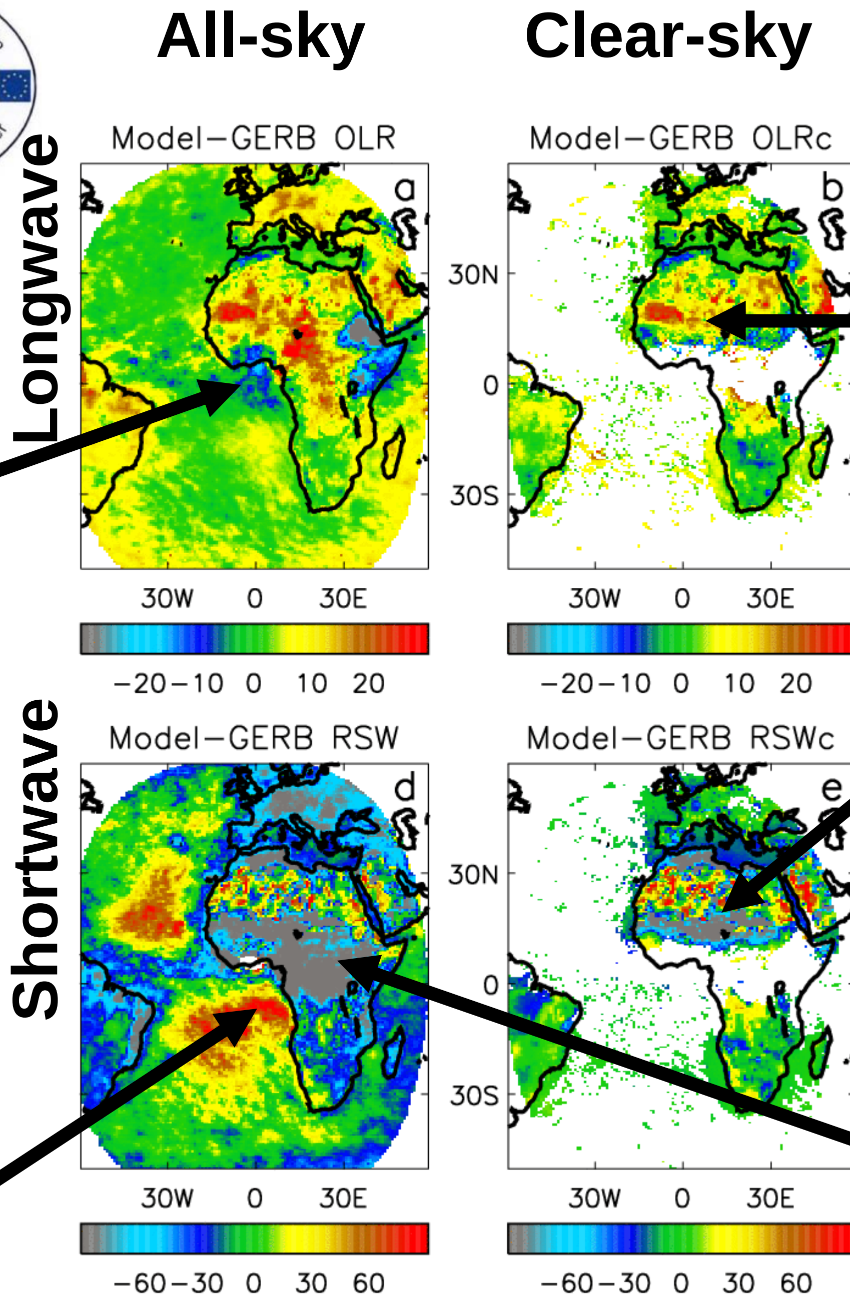


StDev(HIRS12): Geer et al. (1999) J. Clim

Convective outflow

Exploiting GERB to improve Met Office forecast model physics

Marine stratocumulus



Mineral dust

Surface albedo

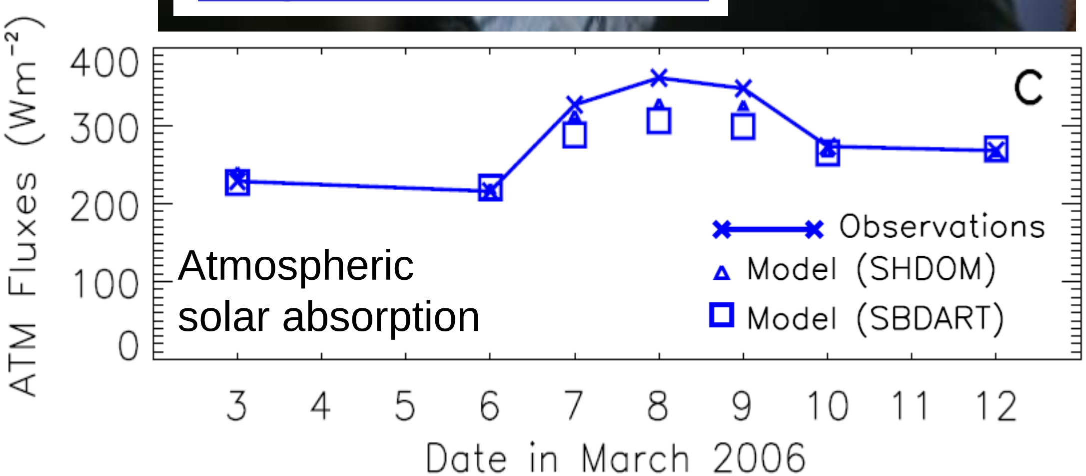
Convective cloud

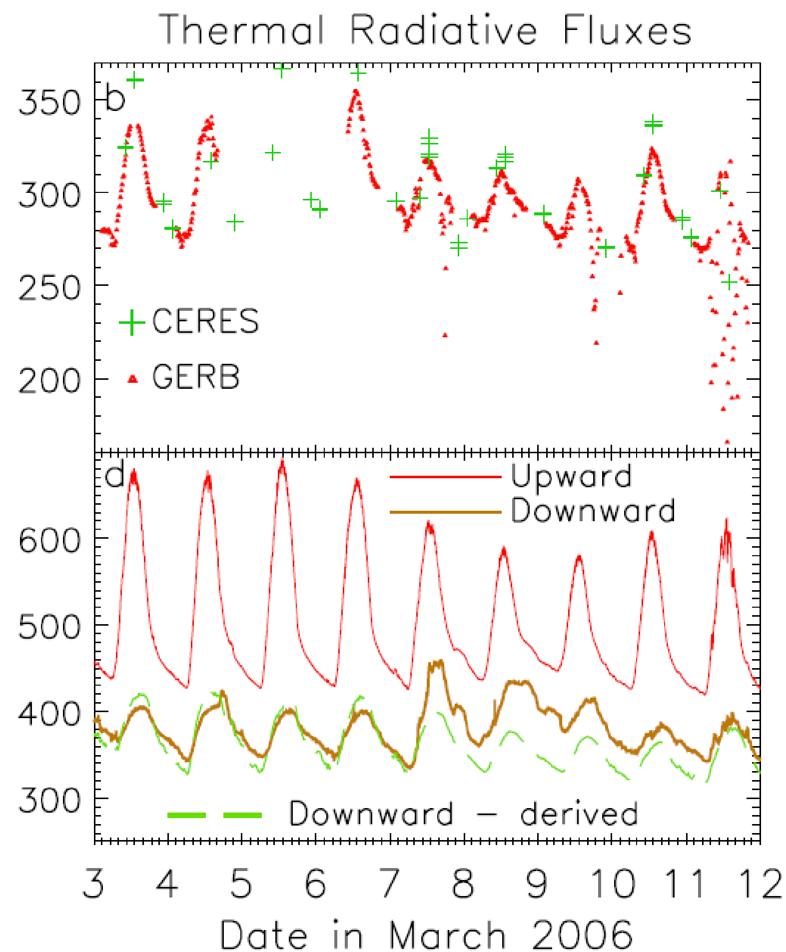
Futyan et al. (2004 J Clim, 2005 GRL); Harries et al. (2005) BAMS; Allan et al (2007) QJRMS

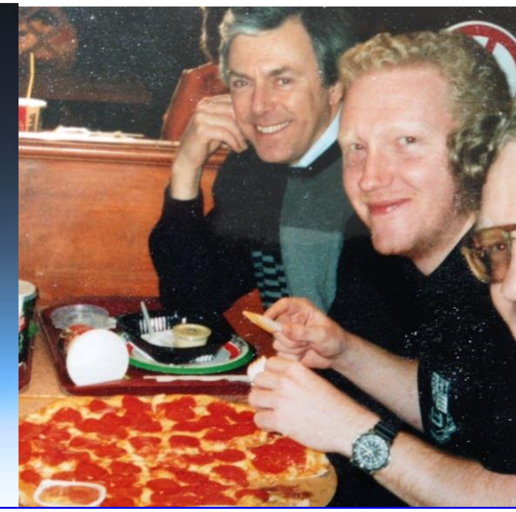
Combining surface data with GERB uncovers radiative impact of major Saharan dust storm

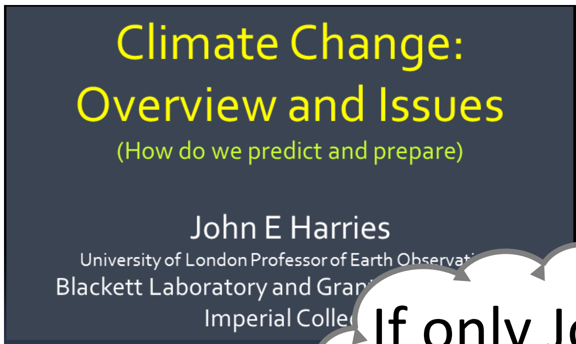
- Advances in understanding impact on LW and SW absorption by mineral dust

Slingo et al. (2006) GRL



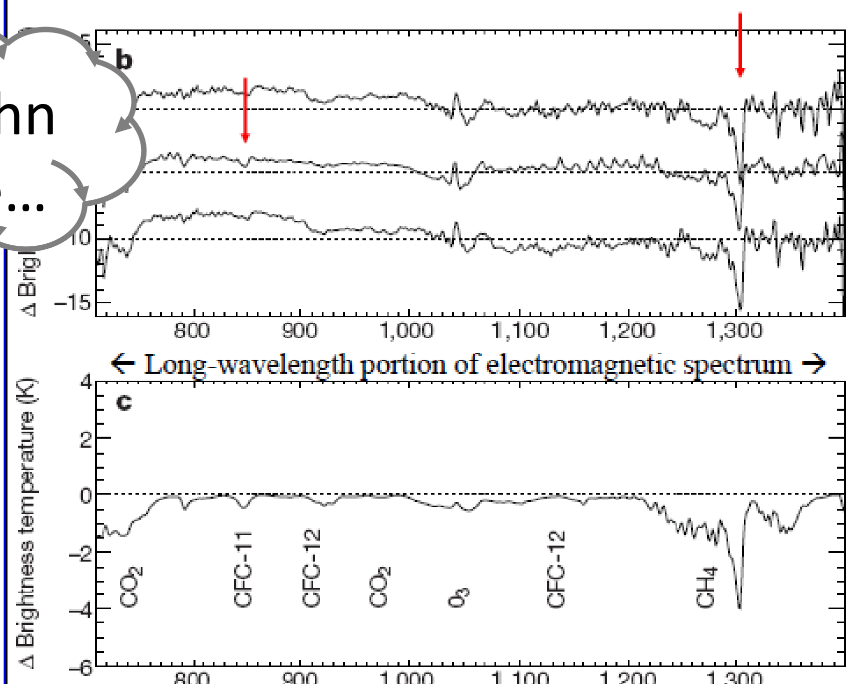






If only John was here…

Satellite observations detect enhanced greenhouse effect: 1997-1970 Harries et al. 2001, Nature

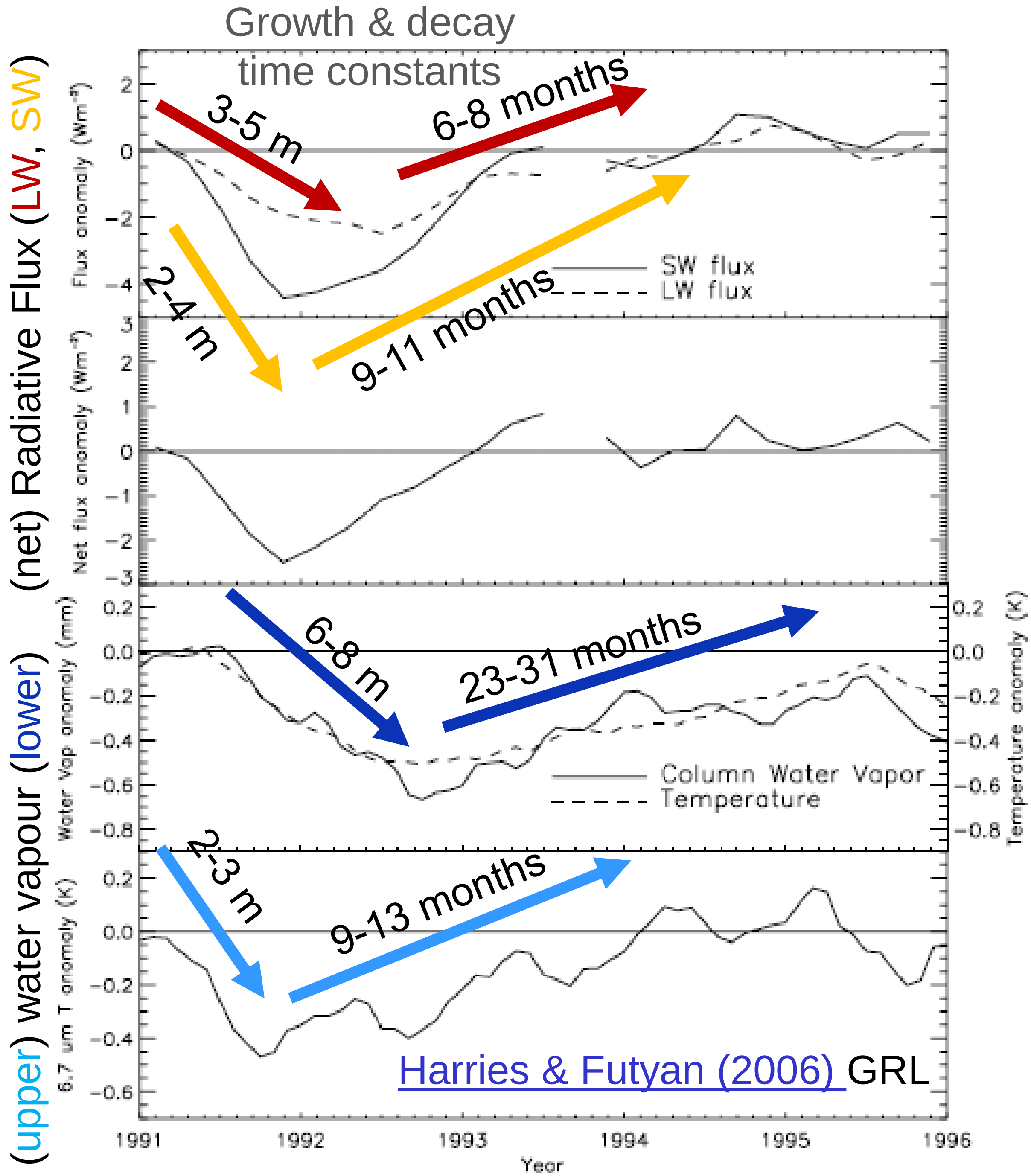


These results showed for the first time experimental confirmation of the significant increase in the greenhouse effect from trace gases such as carbon dioxide and methane

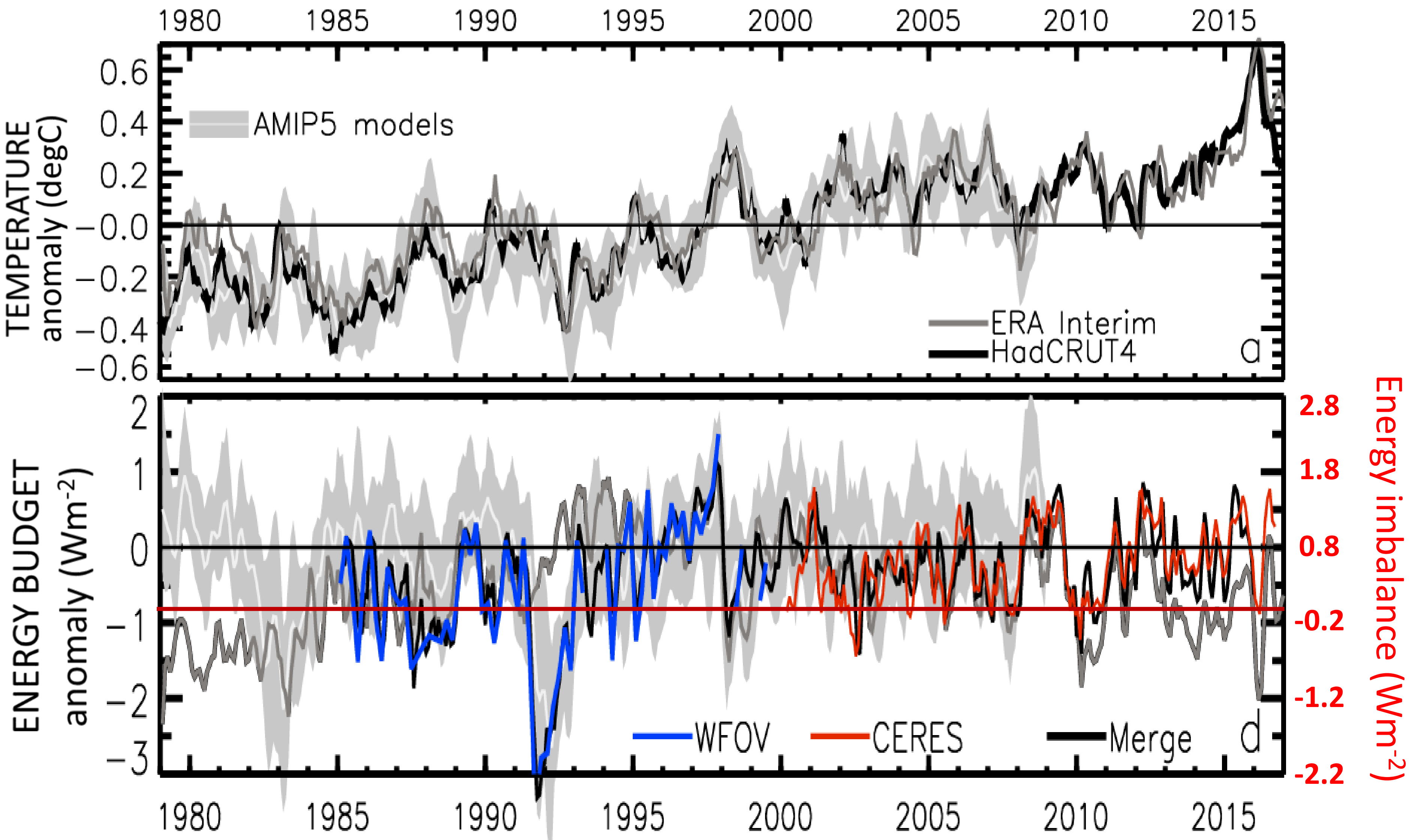
Fundamental timescales of Earth's energy budget

"Separating rapid adjustments to radiative forcings from the responses of the climate system involving fast and slow feedbacks is a powerful emerging diagnostic of the Earth system"

Quote by R. Allan, famous scientist, 24 May 2017



Earth's global surface temperature & energy imbalance variability since the 1980s



Based on Allan et al. 2014 GRL, after Harries & Belotti (2010) J. Clim

Outlook: and the work goes on…

- Timescales of climate response and change
  - What determines feedbacks on internal variability and are they distinct to forced response?
  - What are the fundamental time-scales of climate system components?
  - e.g. Harries & Futyan (2005) Stability of the Earth's radiative energy balance…, GRL, 33, doi:10.1029/2006GL027457.
- Energy budget and hydrological cycle
  - Can heterogeneous net zero radiative forcing cause responses in global temperature via atmosphere/ocean dynamical responses?
  - e.g. Sinha & Harries (1997) Possible change in climate parameters with zero net radiative forcing, GRL, **24**, doi:10.1029/95GL01891
- How does cirrus FIR effect influence climate feedbacks?
  - Cox, Harries, et al.(2010) Measurement/simulation of mid/far infrared spectra in the presence of cirrus, QJRMS, **136**, doi:10.1002/qj.596

Changes in global water cycle