Tracing the upper ocean's 'missing heat'

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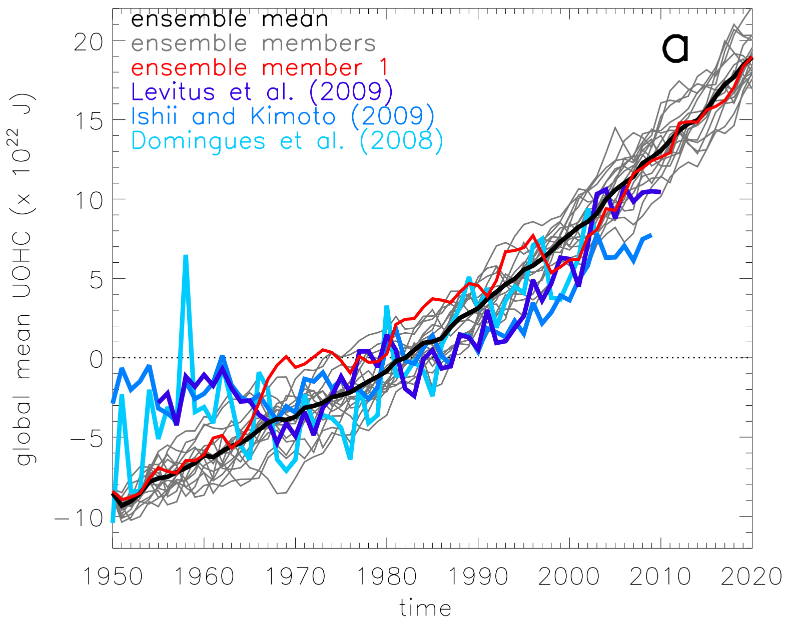
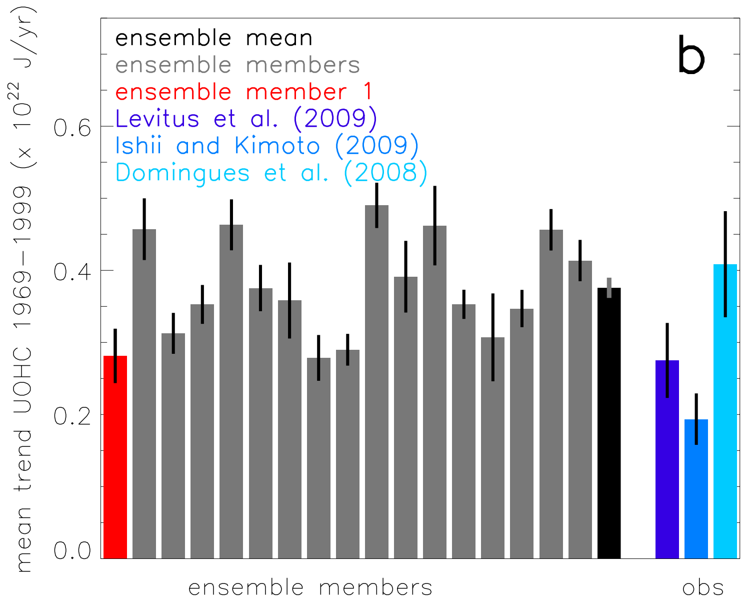
- Introduction
- Observations, model
- Natural variability
- Radiation effects
- Deep ocean
- Conslusions

Katsman, Caroline and G. J. van Oldenborgh, *Tracing the upper ocean's 'missing heat'*, GRL, accepted.

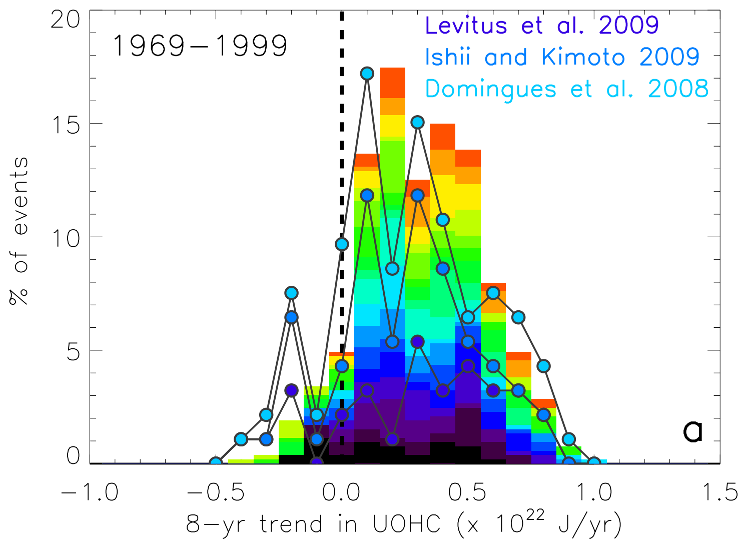
Observed and modelled UOHC (0-700m)

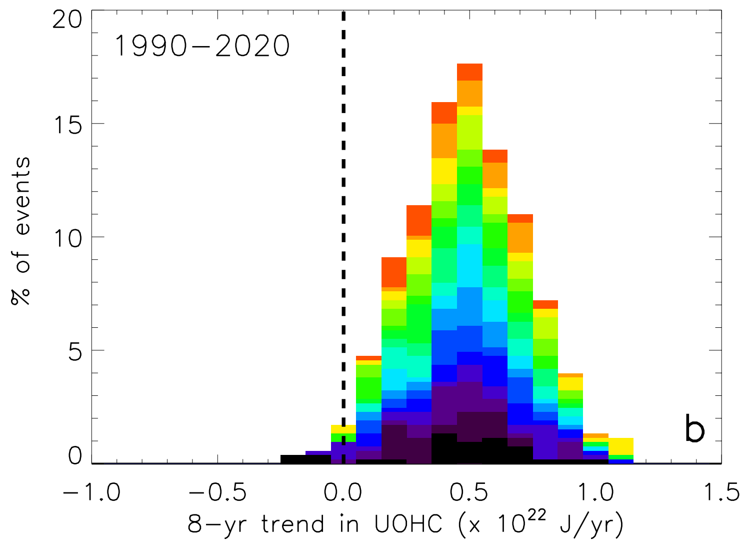




Model 17 runs 1950–2100 with ECHAM5/MPI-OM, 20c3m+sresa1b, no volcanoes

Observed and modelled PDFs of 8-yr trends





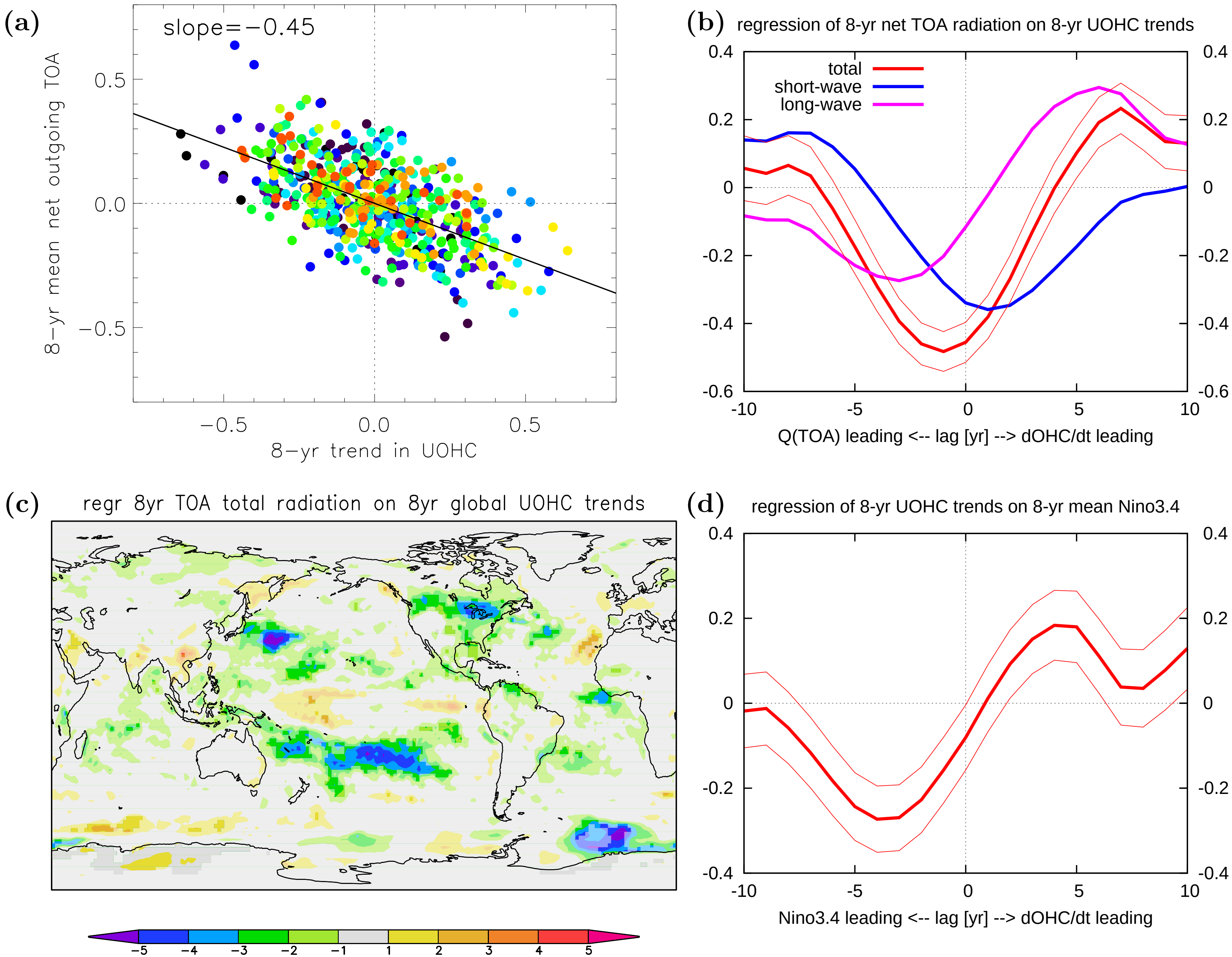
1990–2020: 3% of overlapping 8-yr trends are negative, so 57% chance of at least one negative in 31 years

Where did the heat go?

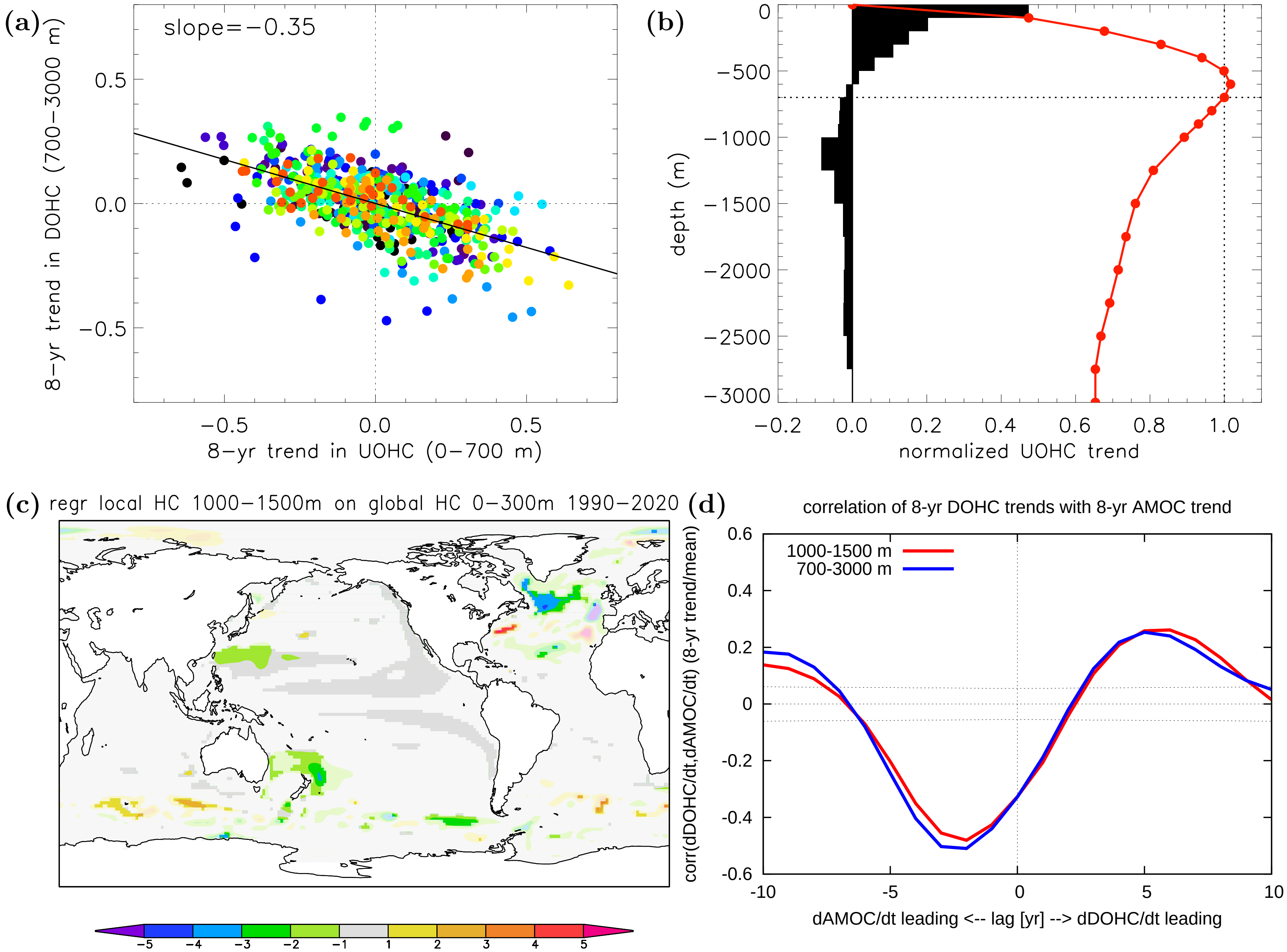
We're missing $\mathcal{O}(2\,10^{22})$ J. What would have happened if it were put it in the

- upper ocean: 0.02 K temperature rise: not observed
- Atmosphere: 5 K temperature rise: not observed
- lithosphere: 1.2 K temperature rise: not observed
- cryosphere: 7.5 K temperature rise: not observed
- land ice: 2 cm sea level rise: not observed
- sea ice: melted all sea ice: not observed
- radiated to space: 0.2 W/m2: smaller than accuracy
- deep ocean: no observations

Radiation to space



Heat transfer to the deeper ocean



Conclsuions

- An 8-yr period without rise in UOHC is well within natural variability
- In our model, on average 45% of the ‘missing heat’ is radiated to space, 35% into the deep ocean
- The radiation is largely due to decadal ENSO (with lag)
- The deep ocean heating is partly due to AMOC variability (with lag)
- Recent behaviour of ENSO and deep convection support this hypothesis and point to an upcoming resumption of rise of UOHC