# Supplementary Data for Stronger Arctic Amplification Produced by Decreasing, not increasing, CO2 Concentrations

**Shih-Ni Zhou[1], Yu-Chiao Liang[1,2*], Ivan Mitevski[3], and Lorenzo M. Polvani[2,3,4]**

[1]Department of Atmospheric Sciences, National Taiwan University, Taipei, Taiwan
[2]Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY, USA
[3]Department of Applied Physics and Applied Mathematics, Columbia University, New York, NY, USA
[4]Department of Earth and Environmental Sciences, Columbia University, New York, NY, USA

E-mail: pamip.yuchiao@gmail.com; yuchiaoliang@ntu.edu.tw

*Keywords*: Cold Arctic amplification; Seasonality changes

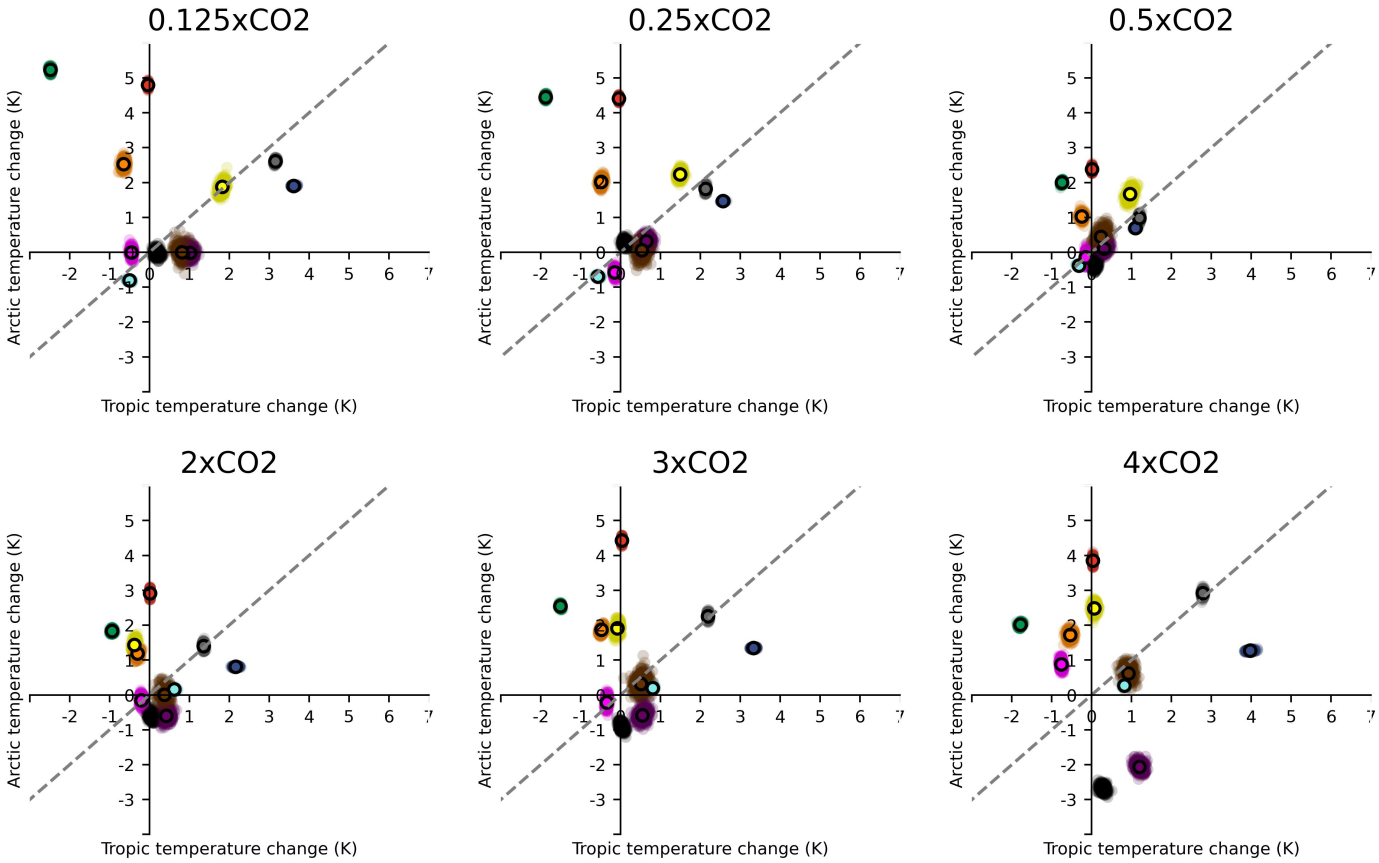


**Figure 1.** Contributions of feedbacks and meridional heat transports to the Arctic against tropical SATs under a wide range of abrupt CO2 forcings (from 0.125xCO2 to 4xCO2). The line with slope one (i.e., the one-to-one line) is plotted as a grey dashed line, and small dots are generated with 10,000 time random sampling for each feedback.

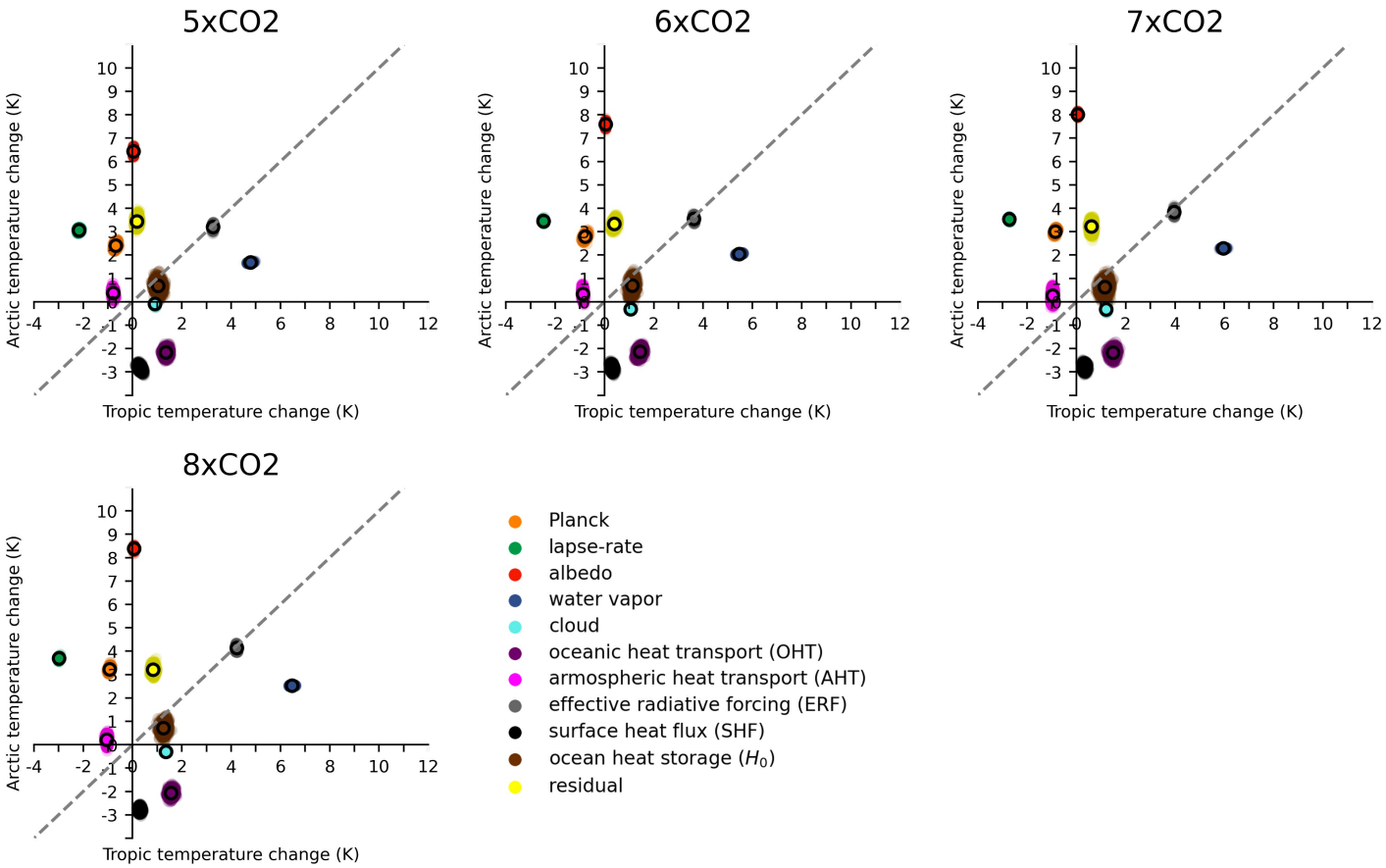


**Figure 2.** The same as Figure 1, but for 5xCO2 to 8xCO4 forcings.

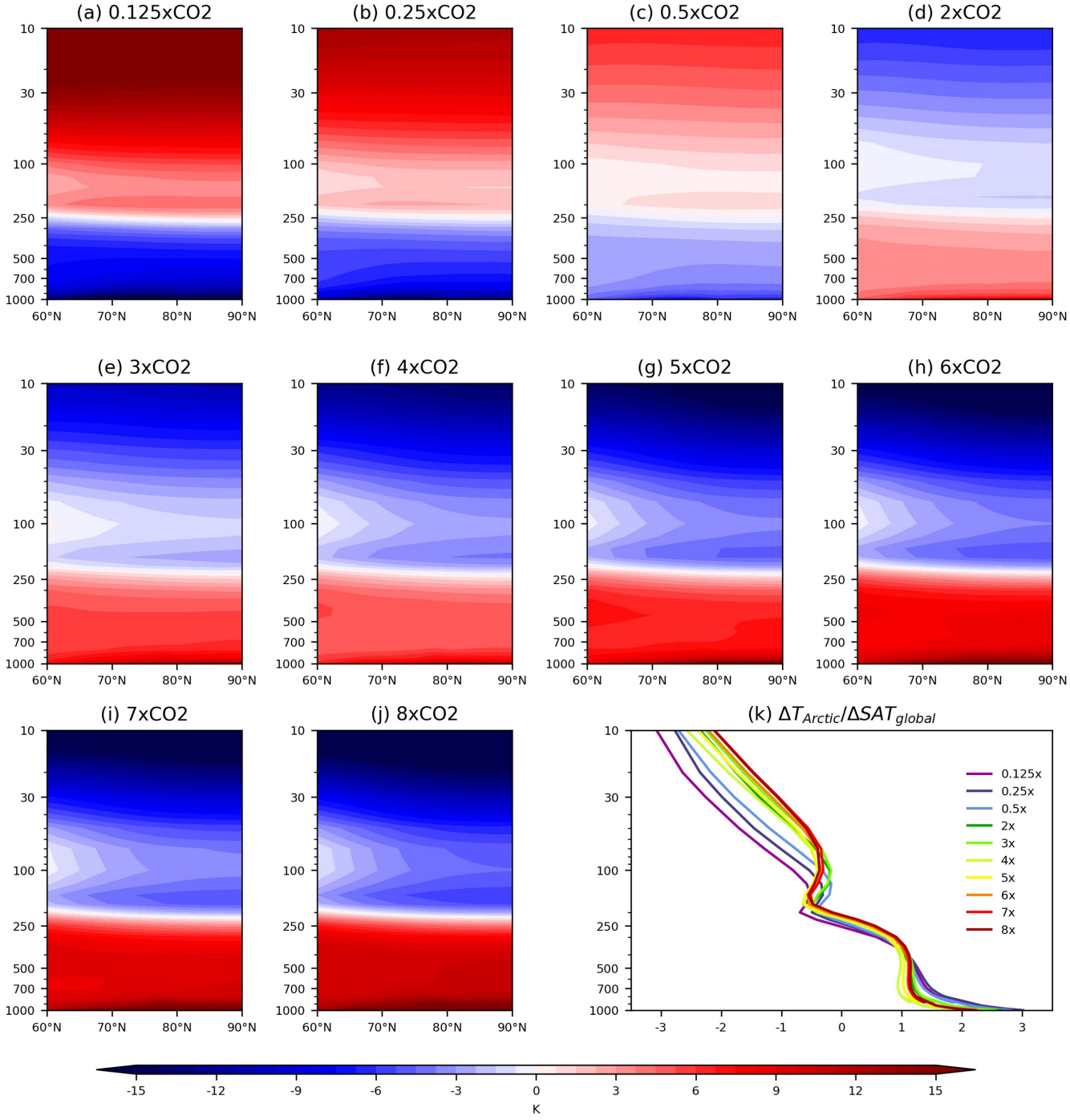


**Figure 3.** (a-j) Atmospheric vertical temperature responses and (k) the polar-cap-average temperature vertical changes with respect to global SAT changes in the polar-cap region in the cooling experiments.

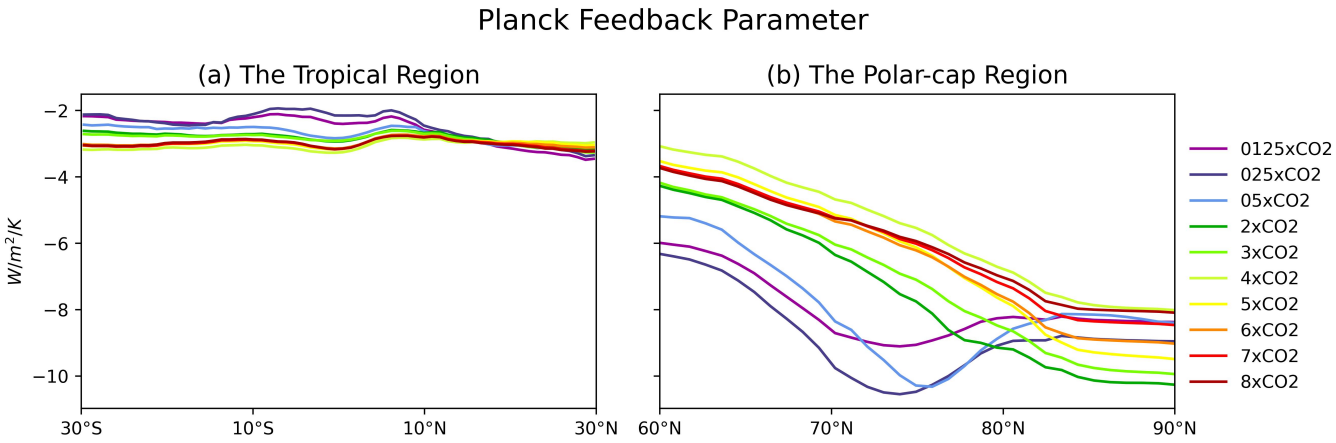


**Figure 4.** The latitudinal distribution of the Planck feedback parameter in (a) the tropical region and (b) the polar-cap region.

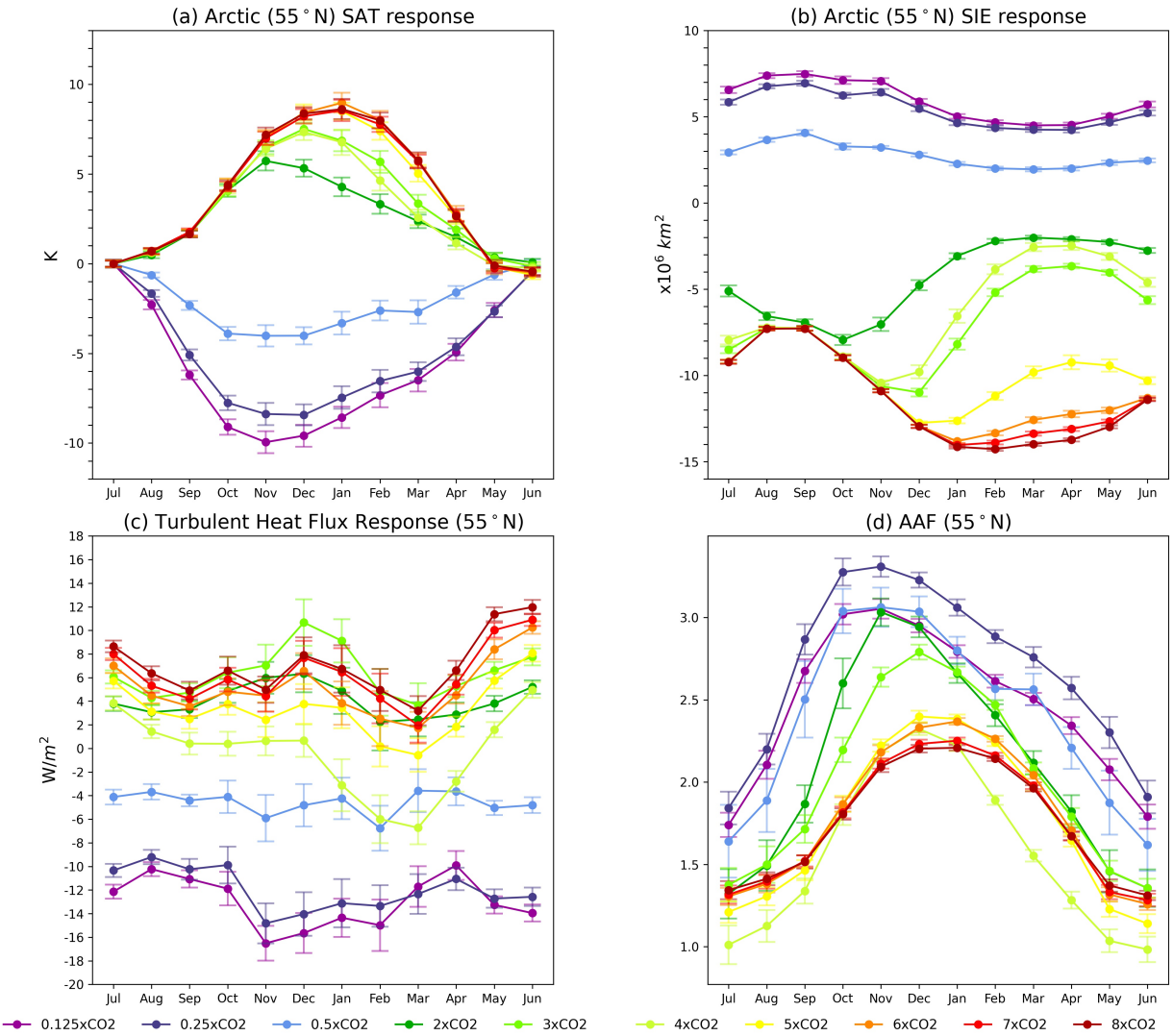


**Figure 5.** Seasonal migrations of (a) Arctic (55°N-90°N) SAT response, (b) Arctic SIE response, (c) turbulent heat flux response, and (d) AAF. The error bars denote 95% confidence intervals calculated using Student's t-distribution.

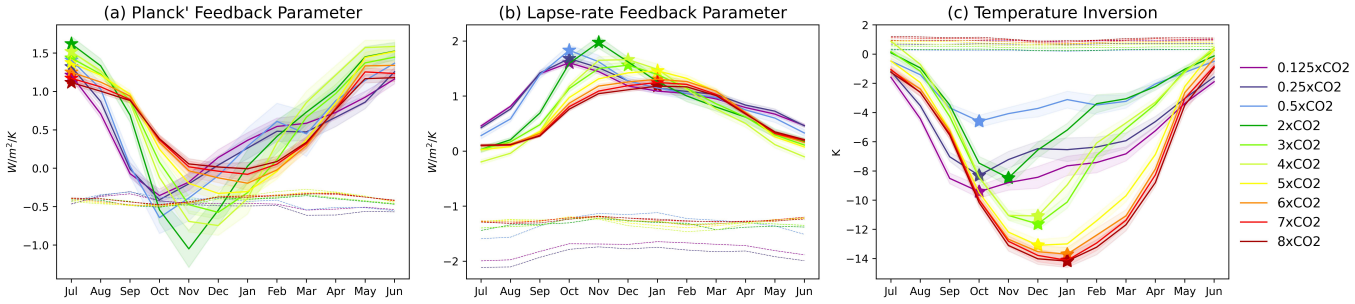


**Figure 6.** Seasonal migrations of (a) Planck feedback parameter, (b) lapse-rate feedback parameter, and (c) temperature inversion over the Arctic domain. Temperature inversion is estimated as the difference between the air temperature at 850 hPa and 1,000 hPa ($T_{850hPa}$-$\mathrm{T}_{1000hPa}$). The color shadings denote 95% confidence intervals calculated using Student's t-distribution. The results averaged over the tropical domain are plotted as dashed lines. The largest values over the 12 months are marked as stars.