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Hemispheric imprints on the relationship between surface warming and cumulative emissions

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Studies on the empirical relationship between surface warming and cumulative carbon emissions (also known as the Transient Climate Response to Emissions, or TCRE) have found a near-constant proportionality, which arises from a global compensation between ocean heat and carbon uptake [1,2,3]. While this relationship is defined globally, the patterns of radiative forcing, heat, and carbon uptake may vary regionally. In this study, we examine the hemispheric contributions to the TCRE using an intermediate-complexity Earth system model. We use an ocean-centred framework [4] to compare terms relating temperature changes to radiative forcing and CO_2 radiative forcing to cumulative emissions. We find that the hemispheric contributions to the TCRE terms are two-fold. First, the relationship between CO_2 radiative forcing and cumulative emissions is highly symmetric across the equator, arising from the chemical control of ocean carbon uptake. Second, there is a marked asymmetry in the relationship between surface temperature changes and radiative forcing. The model shows a preindustrial northward equatorial heat transport, and this transport is enhanced in the RCP scenarios by non-uniform sulphate aerosol forcing, resulting in changes to hemispheric heat convergence and climate sensitivity. These regional considerations may be used in conjunction with global sensitivity studies to better understand the current uncertainties in the TCRE, both between models and with observational data.

Citations:
1. Matthews, H.D., et al. (2009), The proportionality of global warming to cumulative carbon emissions. *Nature* **459**, 829-832.
2. Goodwin, P., et al. (2015), Sensitivity of climate to cumulative carbon emissions due to compensation of ocean heat and carbon uptake. *Nature Geosciences* **8**, 29-34.
3. MacDougall, A.H. (2017), The oceanic origin of path-independent carbon budgets. *Scientific Reports* **7**, 2045-2322.
4. Williams, R.G., et al. (2016), A framework to understand the transient climate response to emissions. *Environmental Research Letters* **11**.