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Interactive comment on "Regional temperature change potentials for short lived climate forcers from multiple models" *by* Borgar Aamaas et al.

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The manuscript by Aamaas et al. (2017) evaluates the impact of emissions changes resolved across four latitudinal bands on temperature change. Overall, this is a very valuable work, and we appreciate several aspects of this paper, especially the multi-model efforts and exploration of the role of altitude for BC. However, discussion of the works cited in this comment and associated caveats on the use of regional temperature potentials should be included.

The use of latitudinal bands stems from the work of Shindell and Faluvegi (2009) and Shindell (2012), which evaluated climate response to radiative forcing in these bands. However, we take issue with the application of these bands for defining relationships between emissions and radiative forcing, which ignores previously published

work quantifying variability of radiative forcing efficiencies within these bands of more than an order of magnitude.

As noted by another reviewer, these regions are presented in Aamaas et al. (2017) arbitrarily in the context of relating emissions to radiative forcing, without consideration of more highly resolved regions, or – even more importantly – resolving emissions at scales other than latitudinal bands.

Further, we have in our own work explicitly shown that radiative forcing efficiencies of aerosol (Henze et al., 2012; Lacey et al., 2015) and ozone (Bowman and Henze, 2012) precursor emissions vary tremendously – more than 1000% – across latitudes. For aerosols, the key features modulating radiative forcing efficiency are related to aerosol lifetime over surfaces of varying albedo and the chemical environment for forming secondary PM from gas-phase precursors (such as the ratio of ammonia to sulfate and nitric acid). Latitude has little bearing on aerosol radiative forcing efficiency, although (the Himalayan region aside) it does impact the indirect effects of BC deposition on snow and ice (Lacey et al., 2015). For short term ozone direct radiative forcing (DRF) efficiency, latitude is a key variable, but also factors such as atmospheric chemistry, altitude, and the efficiency of vertical mixing play important roles. For example, Bowman and Henze (2012) find that "NOx emissions in Chicago would lead to 0.01 mW/m^2 change in DRF but the equivalent absolute reduction to emissions east of Atlanta would lead to a 0.035 mW/m^2 DRF reduction."

We hope that a revised manuscript from Aamass et al. will consider these important factors in their presentation and evaluation of regional temperature potentials, explicitly stating the uncertainties in application of their coefficients to evaluate temperature impacts of emissions changes at scales other than latitudinal bins. For example, while the latitudinal dependency of climate sensitivities imparts a strong-latitudinal dependence on the overall regional temperature potentials for emissions, the sub-latitudinal impact of emissions on radiative forcing can lead to important differences in the temperature impacts of equivalent changes to emissions in country-scale cookstove mitigation scenarios (Lacey and Henze, 2015; Lacey et al., 2017).

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Bowman, K. W., and D. K. Henze (2012), Attribution of direct ozone radiative forcing to spatially-resolved emissions, Geophys. Res. Lett., 39, L22704, doi:10.1029/2012GL053274.

Henze, D. K., D. T. Shindell, F. Akhtar, R. J. D. Spurr, R. W. Pinder, D. Loughlin, M. Kopacz, K. Singh, and C. Shim (2012), Spatially refined aerosol direct radiative forcing efficiencies, Environ. Sci. Technol., 46, 9511 - 9518, dx.doi.org/10.1021/es301993s.

Lacey, F., and D. K. Henze (2015), Global climate impacts of country-level primary carbonaceous aerosol from solid-fuel cookstove emissions, Environ. Res. Lett., 10, 114003, doi:10.1088/1748-9326/10/11/114003.

Lacey, F., D. K. Henze, C. Lee, A. van Donkelaar, R. V. Martin (2017), Transient climate and ambient health impacts due to national solid fuel cookstove emissions, Proc. Nat. Acad. Soc., doi:10.1073/pnas.1612430114.

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