Supplementary material for 'Introducing Ice Nucleating Particles functionality into the Unified Model and its impact on the Southern Ocean short-wave radiation biases'

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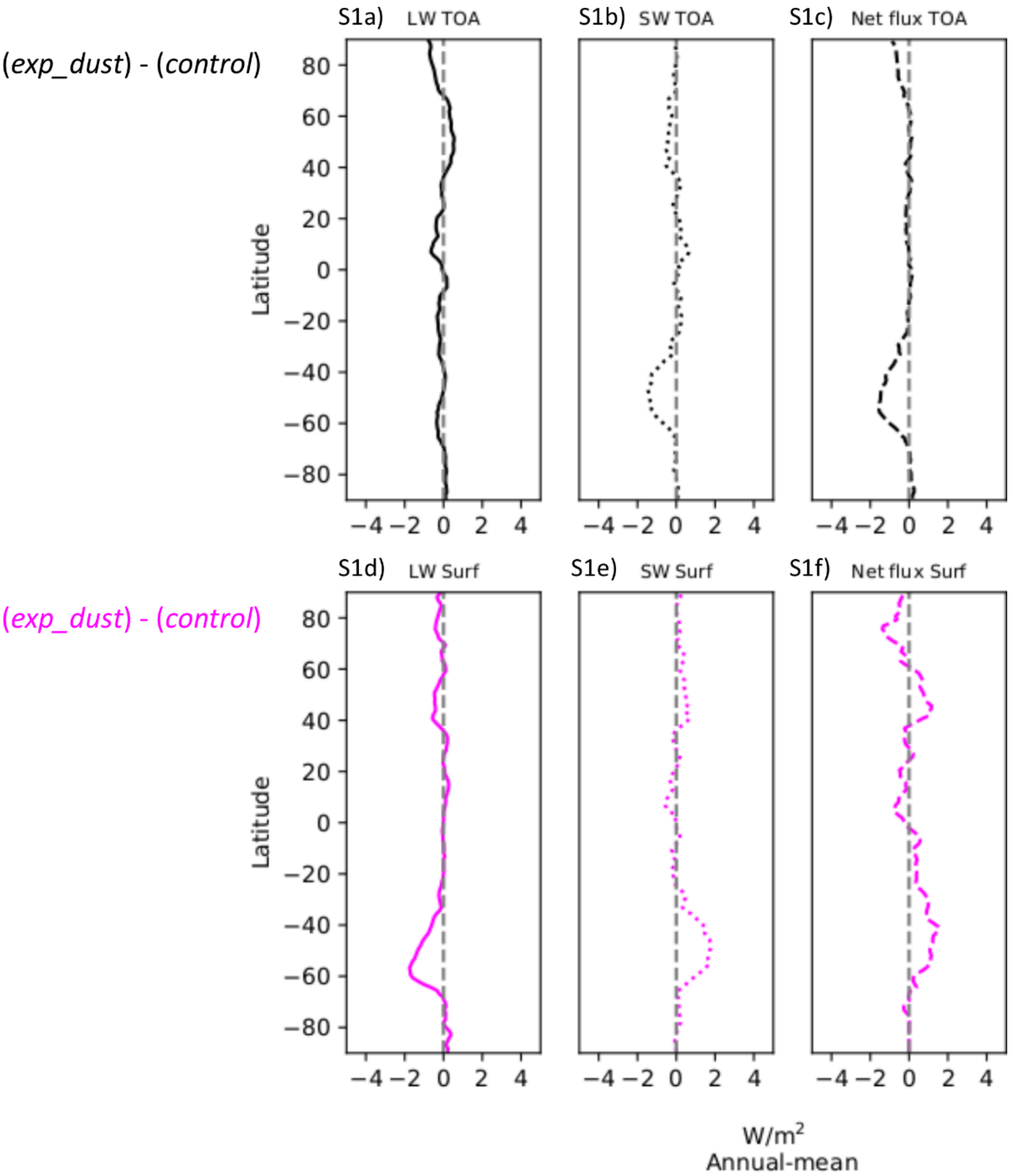

Figure S1: Distribution of zonally averaged annual-mean radiative flux anomalies in *exp_dust* with respect to *control*. (S1a) to (S1c) represent the TOA (upward) radiative flux anomalies and (S1d) to (S1f) represent the surface (downward) flux anomalies. (S1a) = LW at TOA (S1b)

= SW at TOA (S1c) = net flux at TOA (i.e. LW +SW at TOA). Similarly, (S1d) = LW at surface (S1e) = SW at surface (S1f) = net radiative heat flux at surface (i.e. incoming LW + SW at surface) - (sensible heat + latent heat). Annual-mean values are calculated from daily-mean model output over 20 years.

As shown in Figs. S1a to S1c, for the TOA fluxes, most response over SO is for SW (Fig. S1b), where it shows a decrease in *exp_dust* compared to *control*. This is due to the additional feedbacks from convection scheme as mentioned in the main material (e.g. Fig. 6). This decrease in SW TOA is also reflected in the net flux at TOA where there is a decrease over the SO region (Fig. S1c). The response of TOA fluxes over NH is less pronounced compared to the SH.

For the incoming surface radiation, the LW shows a decrease and SW shows a corresponding increase in *exp_dust* compared to *control*. Subsequently, the net flux at surface is showing an increase over the SO region.

The noticeable factor is that the response of fluxes in *exp_dust* is mostly targeting SO region as anticipated which is beneficial to the prognostic-dust parametrisation.