

*Figure S1: Vertical levels in MERRA2, WACCM on MERRA2 levels with 16 free-running levels above MERRA2's lid, and WACCM on native levels, assuming a 1000 hPa surface pressure.*

## Vertical resolution in MERRA2 and WACCM

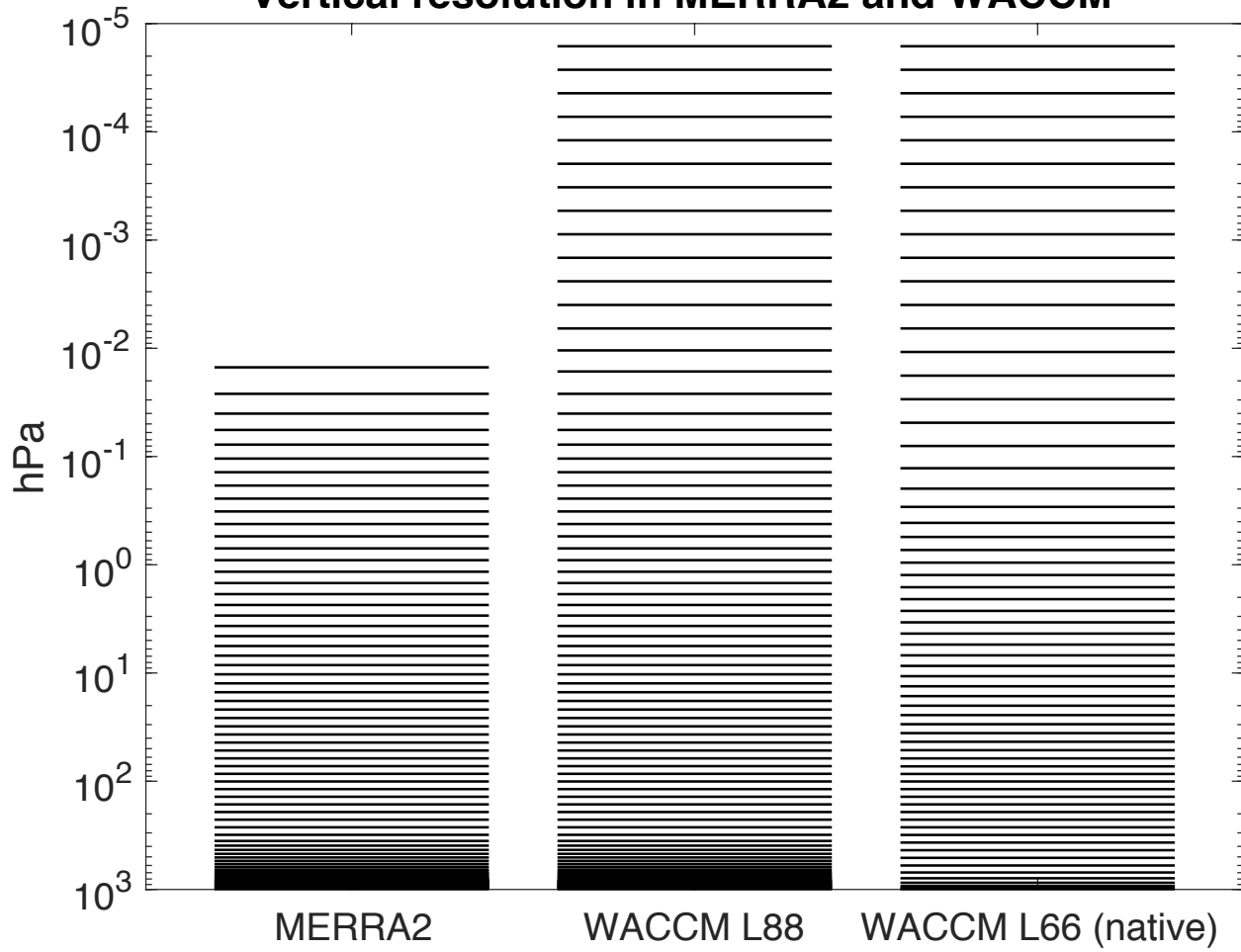


Figure S2: As in Fig. S1, but on a logarithmic pressure grid.

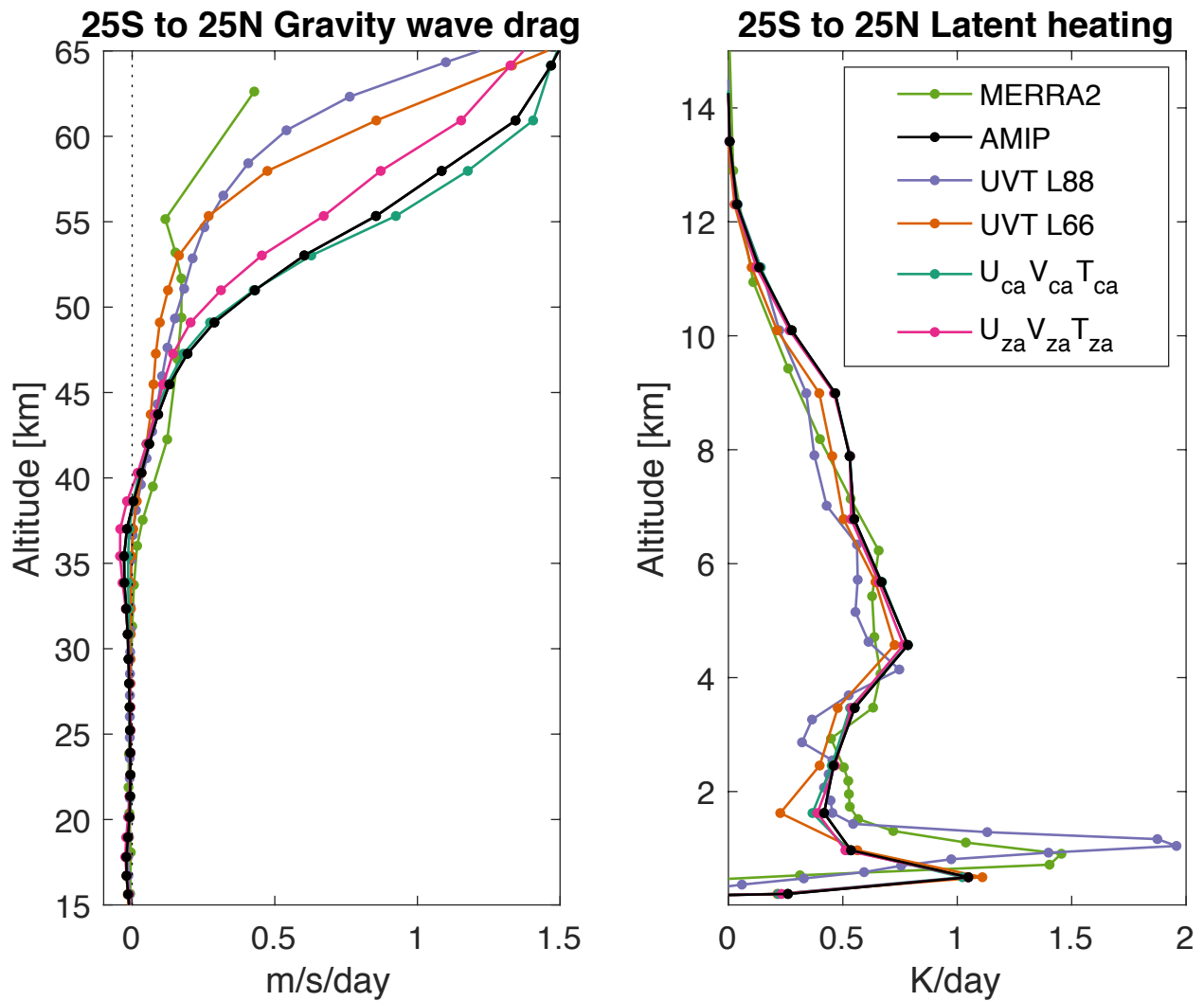


Figure S3: Climatological (left) gravity wave drag and (right) latent heating averaged between 25S and 25N for selected runs. Behavior of UV nudging simulations is quantitatively similar to their UVT counterparts. Gravity wave drag is the sum of the output variables *UTGWSPEC*, *BUTGWSPEC*, and *UTGWORO*.

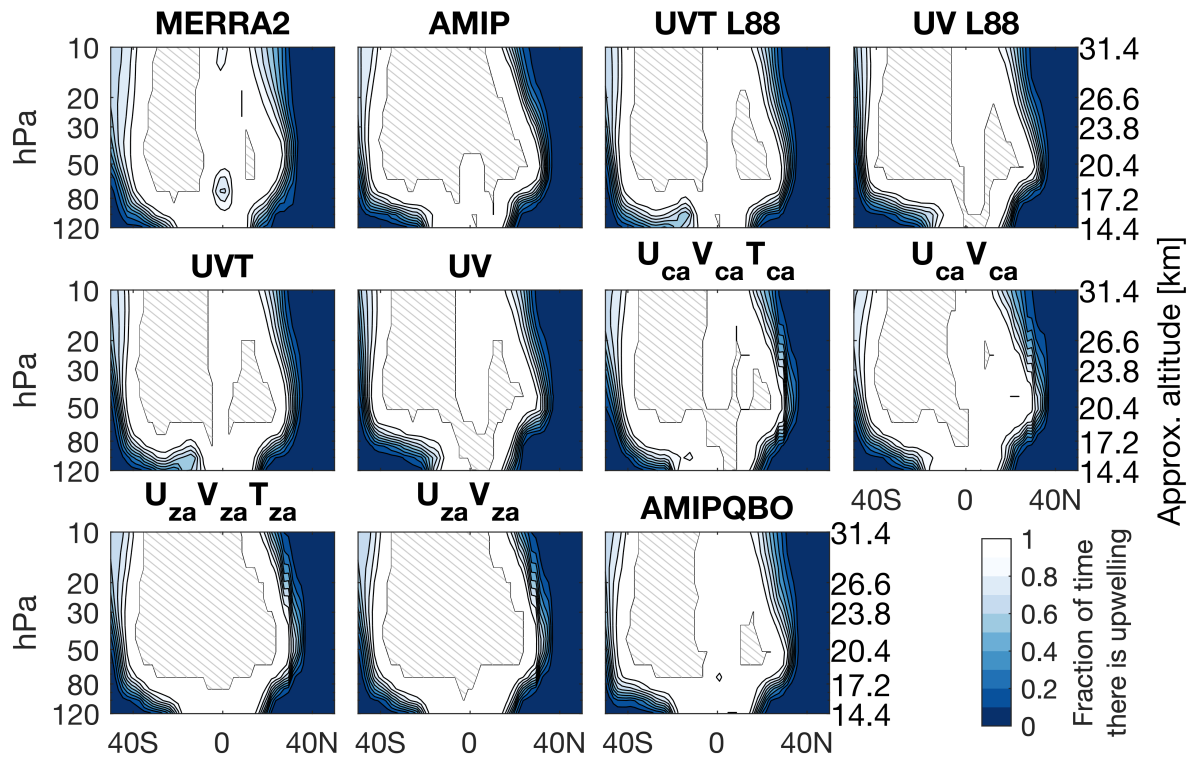


Figure S4: Frequency of upwelling based on the streamfunction definition of the residual circulation for each model simulation for December-January-February only. Hatching indicates there is upwelling 100% of the time.

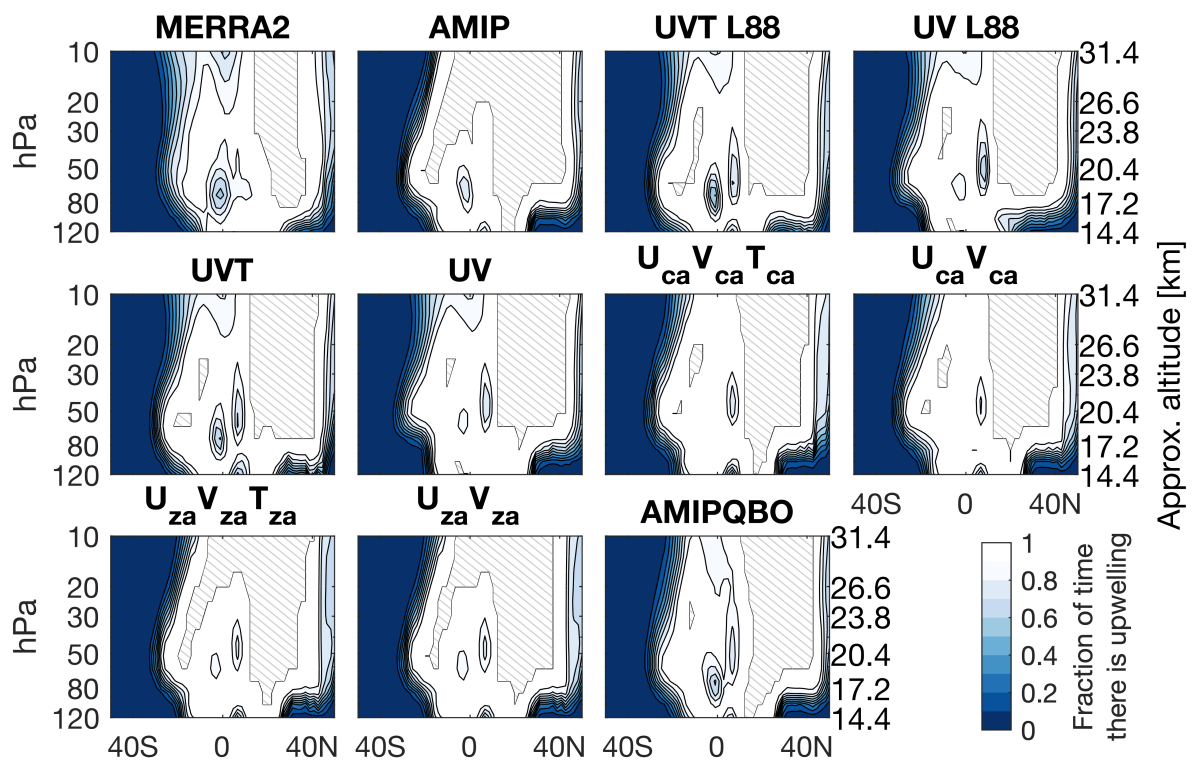


Figure S5: As in Fig. S4, but for June-July-August only.