Dear authors,

Thank you very much for an interesting study. This comment is motivated by your discussion of the possible influence of the vertical shift of the circulation (isentropes in this case) on the trends of the overturning circulation. (P5aroundL30 and P12L11-12).

I am just submitting a study (Šácha et al., 2018) concerning the effect of the vertical shift of pressure levels (shrinkage) on AoA trends in REFC2 CCMI-1 simulations and so, it was easy for me to have a quick look on the vertical shift of isentropes. Fig. 1 shows a trend (geopotential meters/decade) of isentropic levels in a Ref (1960-2000), NF (2000-2050) and F (2050-2100) period in a CMAM REFC2 simulation. The method is based on interpolation of the standard geopotential height output to predefined isentropic levels using the collocated potential temperature. The isentropes rise quite uniformly at a rate of about 50 meters/decade. However the rise relative to pressure levels will be more rapid higher in the stratosphere, because from about 35km the pressure levels shift downward instead of upward (stratospheric shrinkage). The shift of pressure levels is not shown, because it is included in Šácha et al. (2018) and I am not sure if I can actually show the figure also here.

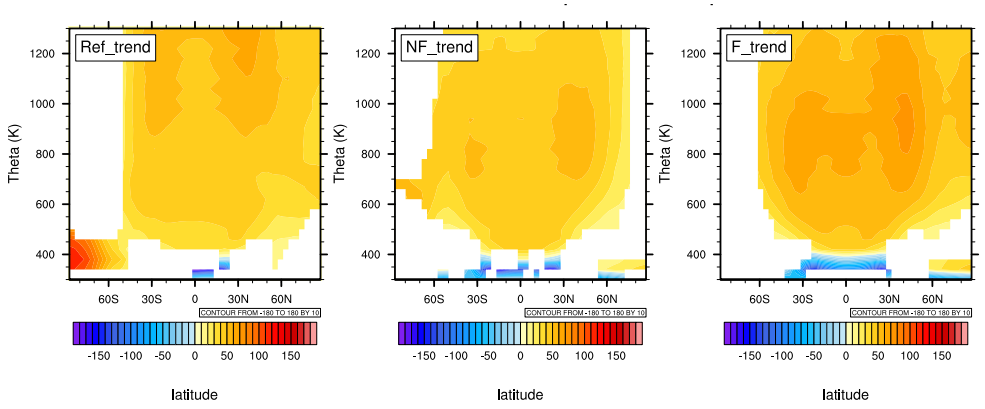

Figure 1. CMAM trend of geopotential height of isentropic level [gpm/decade]. Only the trends in the regions where they exceed the statistical significance of 95% confidence level are plotted.

Of course, the seasonal trends are different, which further complicates things. For example in DJF (Fig. 2) we have strong significant trends of isentropic levels also in polar regions (interesting for you can be the strong and negative trend a the SH polar region in the Ref period).

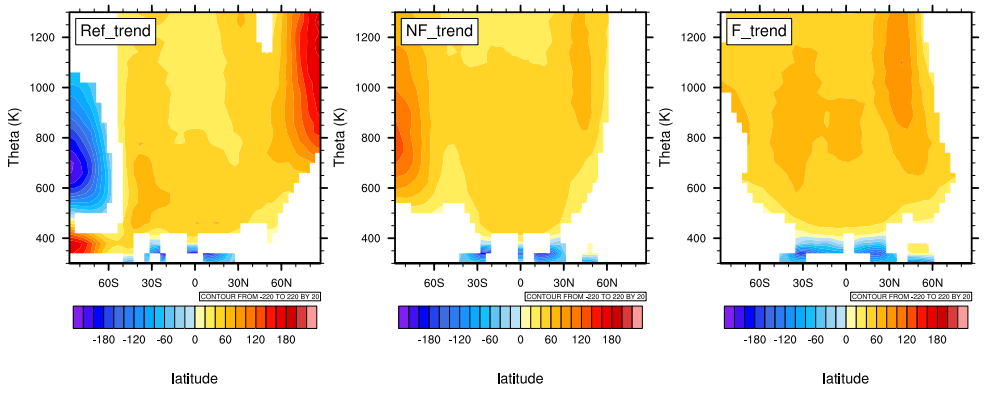

Figure 2. The same as Fig. 1 but for DJF.

I am fully aware that your study is based on different dataset and scenario, but I hope that you will find this SC usefull. Please apologize the late submission in the final day of the discussion.

Best regards,

Petr Šácha.

Reference:

Petr Šácha, Roland Eichinger, Hella Garny, Petr Pišoft, Simone Dietmüller, Laura de la Torre, David Plummer, Patrick Jöckel, Olaf Morgenstern, Guang Zeng, Neal Butchart, and Juan Añel: Extratropical Age of Air trends and causative factors in climate projection simulations, ACPD - CCMI special issue.