Southern Hemisphere fronts and their role in changes in the Hadley Cell extent

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A notable feature of global circulation is the 'seamless' meridional transport of moist static energy towards the poles. In the tropics this transport is predominantly effected by the Hadley Circulation (HC), and by baroclinic transient eddies in the extratropics. The seamless character means that there is an intimate connection between variation in the HC and the midlatitude eddies. In recent times considerable focus has been placed on the expansion of the HC (e.g., Grise et al. (2019)) and we are exploring the involvement of SH fronts in that change.

Our analysis is based on the ERA-Interim reanalysis (Dee et al. 2011). The edge of the SH HC is taken to be the location of the subtropical ridge (STR), while frontal features are determined with the automated scheme described by Simmonds et al. (2012) and Rudeva and Simmonds (2015). Fig. 1 shows the strong geographical connections between the STR and front frequency.

In five key sectors of the SH (see Fig. 1) the lead/lag correlations between the daily counts of fronts lying in 20-40^{o}S and STR latitude (STRP) are calculated. (Similar calculations are performed for STR intensity (STRI).) In the annual case (Fig. 2) the STRP (significant) correlations peak when frontal counts lead STRP by about 1 day. A similar, but less clear, situation applies to STRI. The results suggest that in this context midlatitude changes *lead* those of the HC. Further details appear in Rudeva et al. (2019).

References

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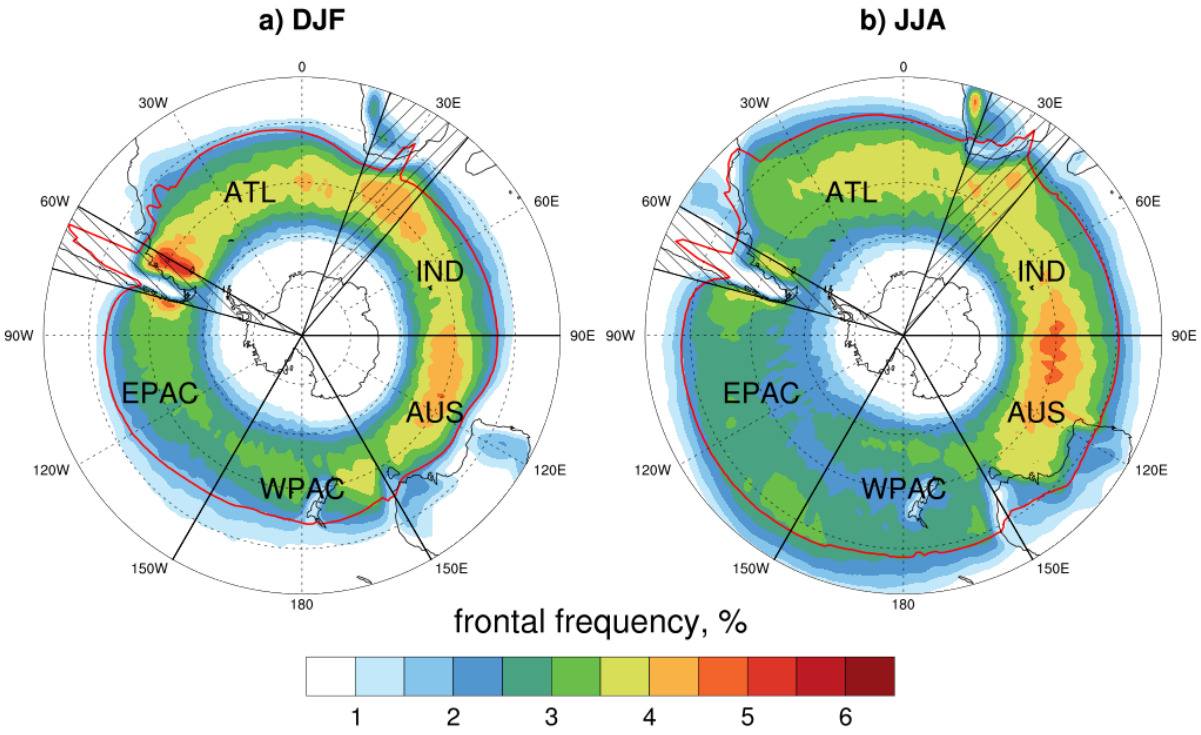

Fig. 1: Climatological frontal frequency (color; %) and the mean STR position (red line) in (a) DJF and (b) JJA averaged over a 30-year period (1980–2009 and 1979–2008, respectively).

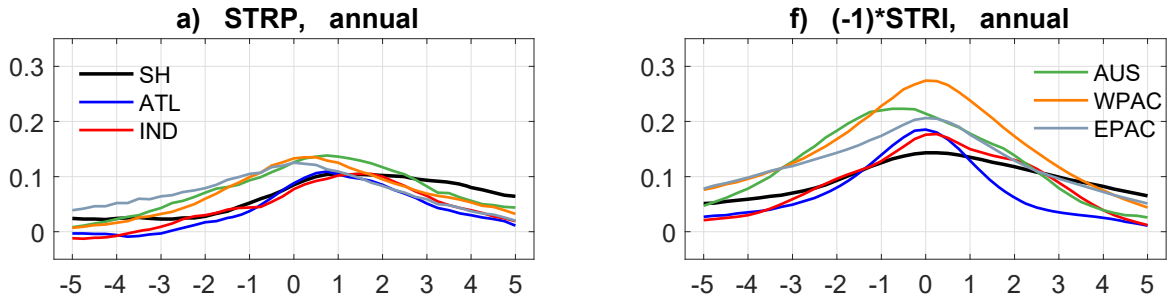

Fig. 2: Lag-correlation between the number of fronts in the SH and (left) STRP and (right) STRI. Positive lag times indicate that the number of fronts *leads* the changes in STR characteristics.