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Supplement of

Observed long-term changes in global tropopause characteristics

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Example global frequency distributions of PTGT and LRT altitudes from a single month of GNSS-RO data (Fig. S1) and seasonal PTGT and LRT climatologies of each tropopause characteristic from the 23-year study period (Figs. S2–S7) are provided here for reference. Seasonal climatologies include primary tropopause altitude (Fig. S2) primary tropopause temperature (Fig. S3), primary tropopause sharpness (Fig. S4), tropical tropopause occurrence (Fig. S5), double tropopause occurrence (Fig. S6), and triple tropopause occurrence (Fig. S7).

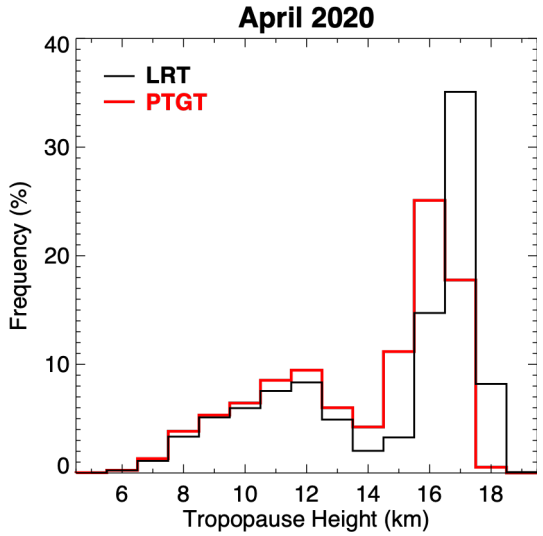


Figure S1. Frequency distributions of LRT (black line) and PTGT (red line) altitudes from a single month—April 2020—of global GNSS-RO data (161,421 profiles).

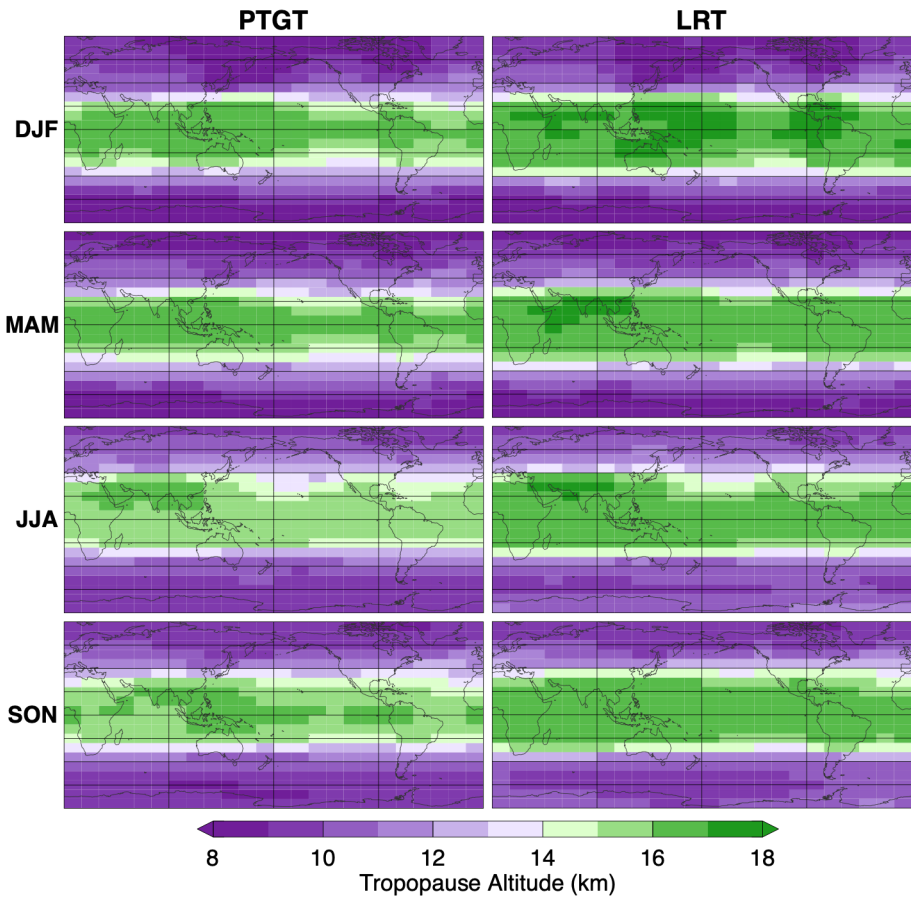


Figure S2. Maps of seasonal mean GNSS-RO primary tropopause altitude based on the (left) PTGT and (right) LRT tropopause definitions. From top to bottom, seasons are December-January-February (DJF), March-April-May (MAM), June-July-August (JJA), and September-October-November (SON).

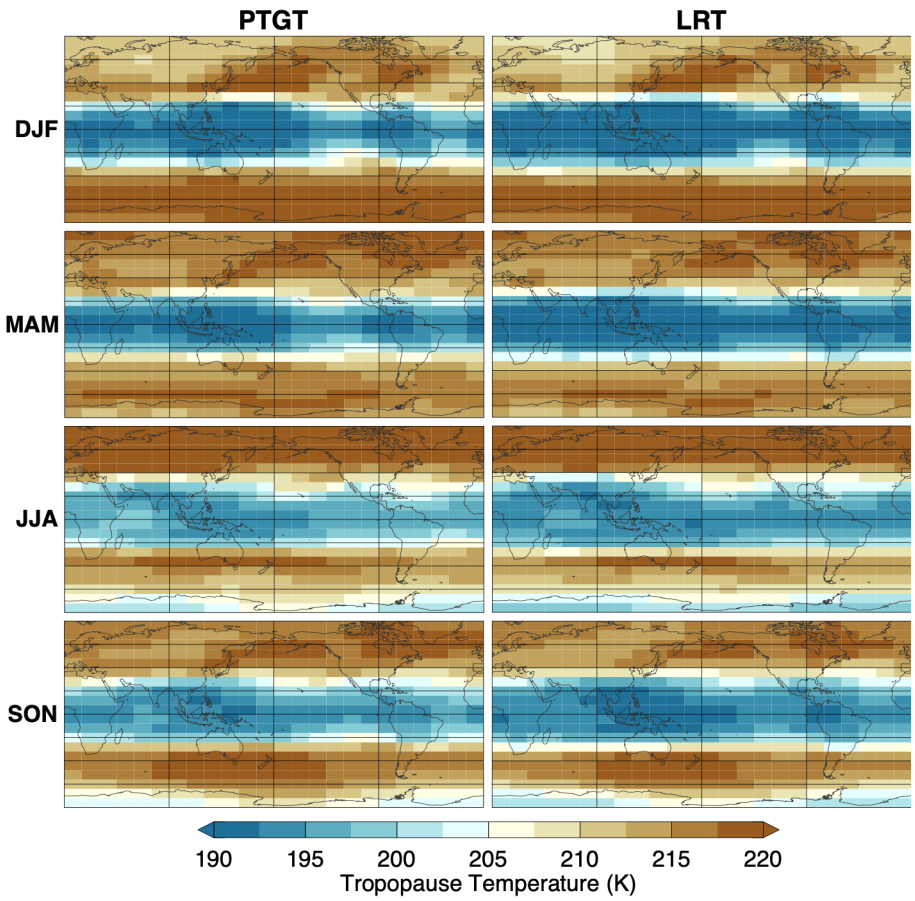


Figure S3. As in Fig. S2, but for primary tropopause temperature.

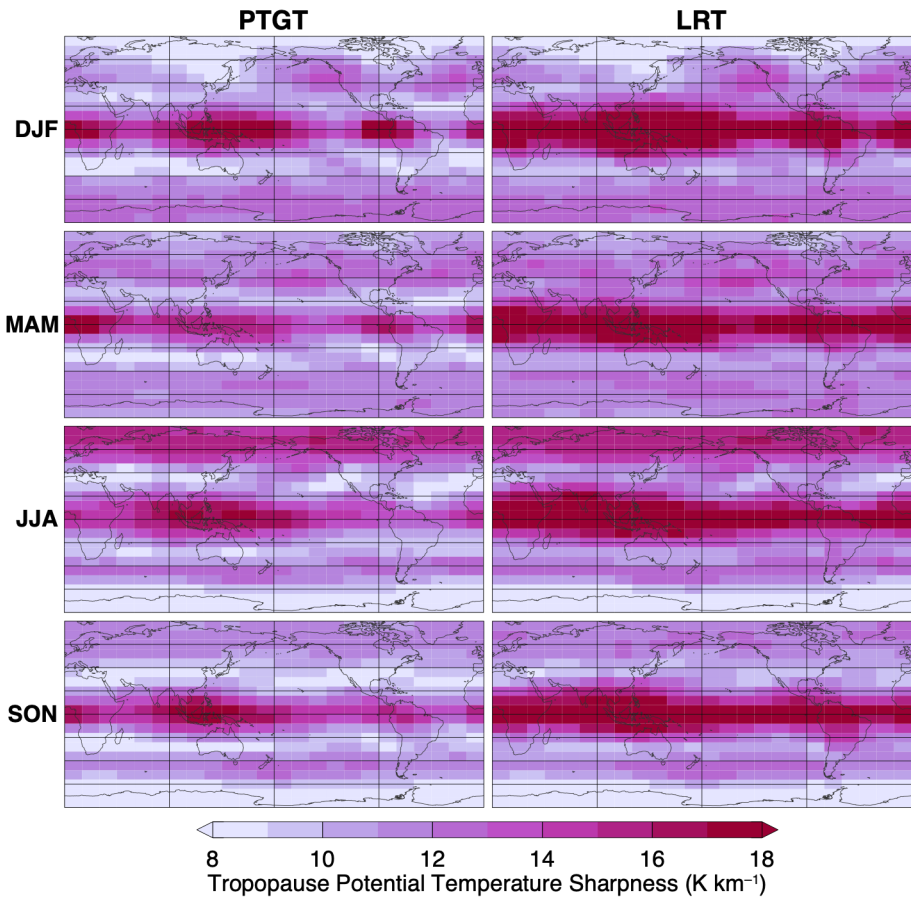


Figure S4. As in Fig. S2, but for primary tropopause sharpness.

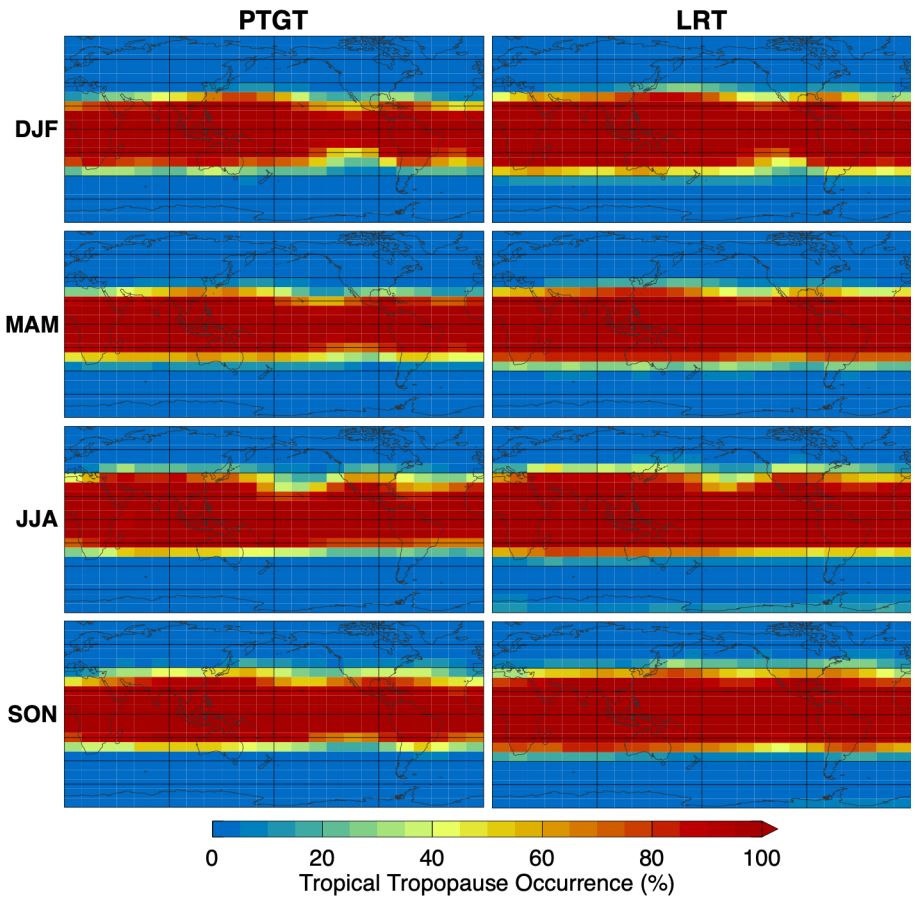


Figure S5. As in Fig. S2, but for tropical tropopause occurrence.

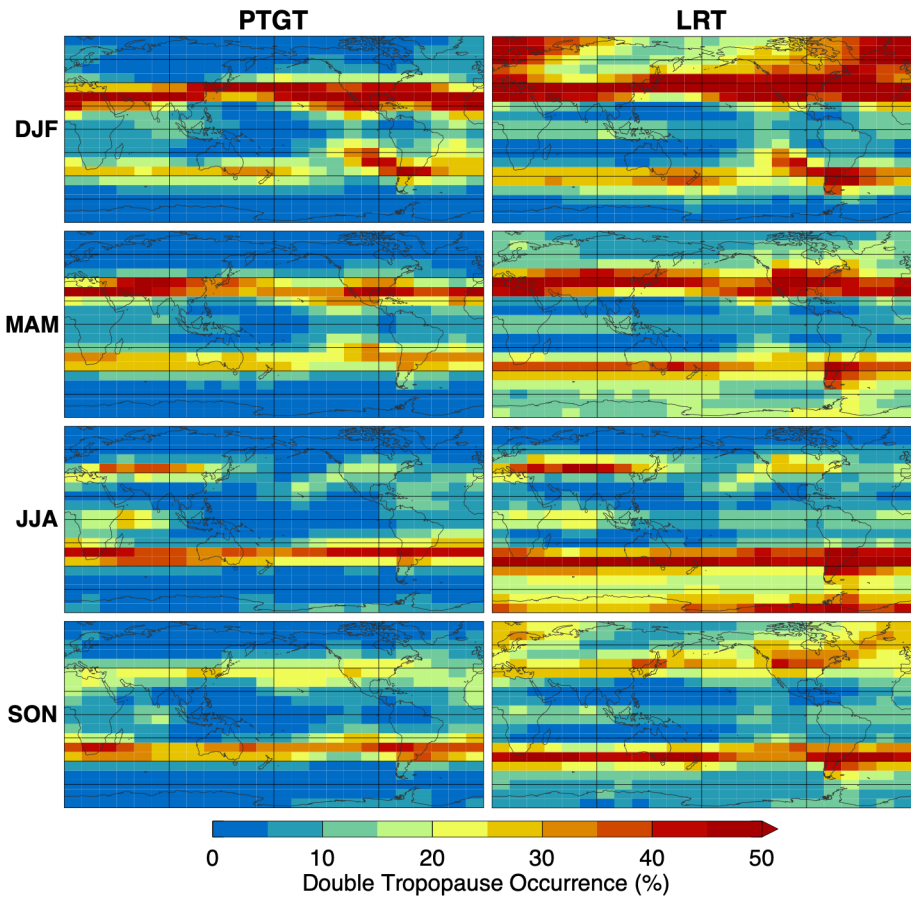


Figure S6. As in Fig. S2, but for double tropopause occurrence.

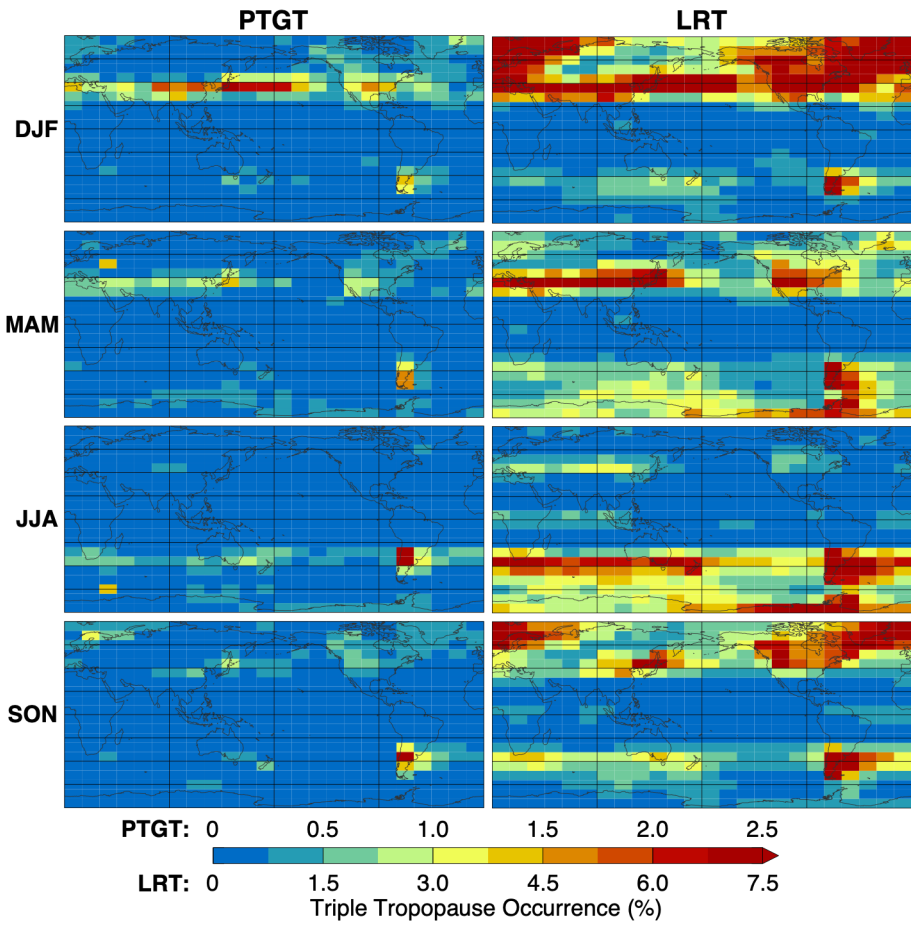


Figure S7. As in Fig. S2, but for double tropopause occurrence. Note that the scale for LRT occurrence is 3 times greater than that for PTGT occurrence.