

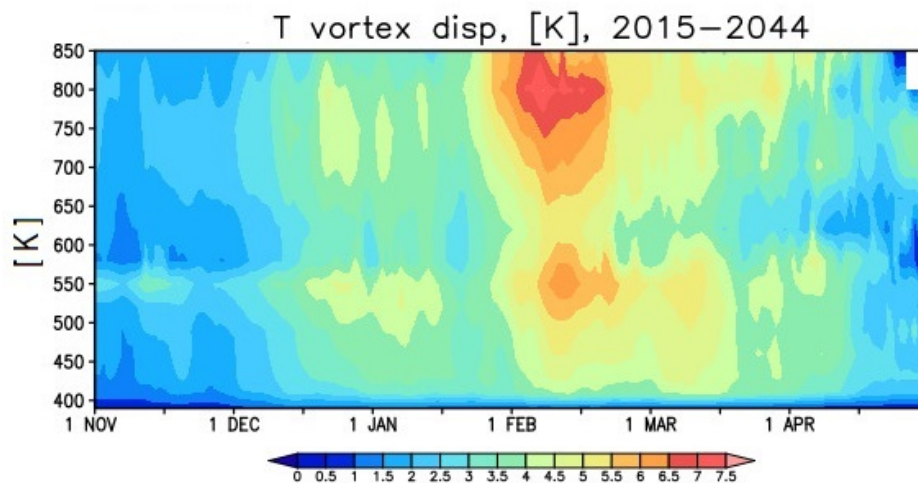
Arctic Stratosphere Circulation Changes in 21st Century in Simulations of INM CM5

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S1. Three-dimensional Plumb flux vectors were calculated according to [35]:

$$F = (F_x, F_y, F_z) = \frac{p}{p_s} \cos y \cdot \begin{pmatrix} V^{*2} - \frac{1}{2\Omega a \cdot \sin 2y} \frac{\partial(V^* \Phi^*)}{\partial x} \\ -U^* V^* + \frac{1}{2\Omega a \cdot \sin 2y} \frac{\partial(U^* \Phi^*)}{\partial x} \\ \frac{2\Omega \cdot \sin y}{S} \left[V^* T^* - \frac{1}{2\Omega a \cdot \sin 2y} \frac{\partial}{\partial x} (T^* \Phi^*) \right] \end{pmatrix} \quad (1)$$

where F_x , F_y , F_z are the longitudinal, latitudinal and vertical components of the Plumb flux vector, with x – longitude, y – latitude, z – altitude, U , V are zonal and meridional velocity, Φ is geopotential, T – temperature, p – pressure, and p_s – pressure at Earth surface, a stands for Earth's radius, Ω for Earth's angular velocity, with $S = \frac{\partial \bar{T}}{\partial z} + \frac{\kappa \bar{T}}{H}$ is static stability, $\kappa = R/c_p \approx 0.286$ and H represents scale height; a star indicates the deviation from the zonal average and a bar the zonal mean.



a

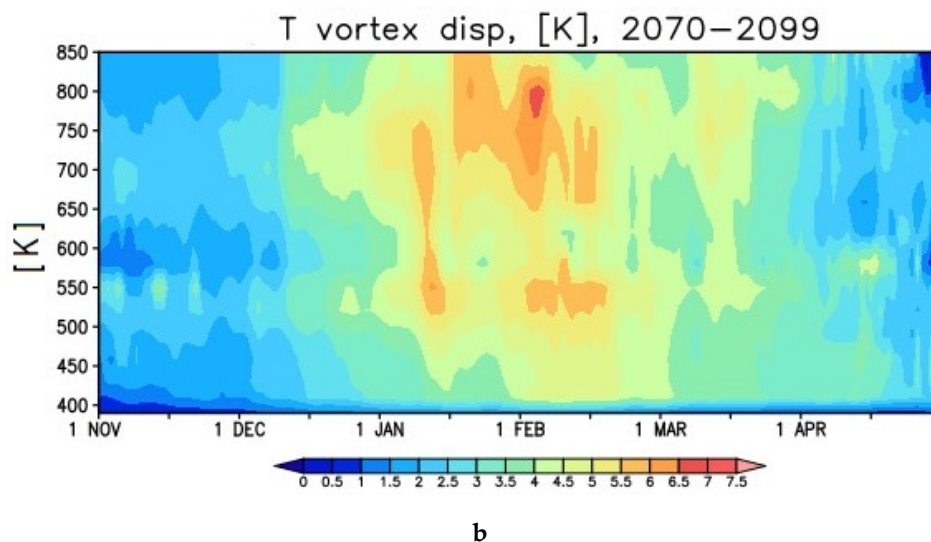


Figure S2. Seasonal cycle of dispersion of daily average mean air temperature (K) inside Arctic stratospheric polar vortex in experiment SSP5-8.5: for the period 2015-2044 (a), for the period 2070-2099 (b).

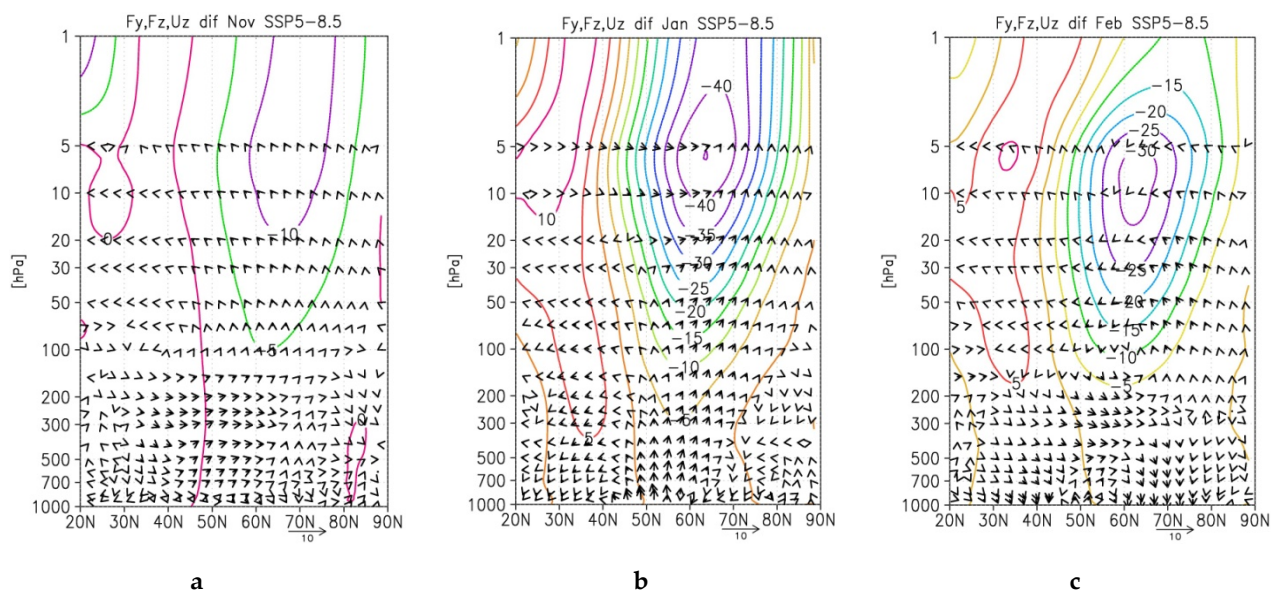


Figure S3. Altitude-latitude cross section of Plumb vectors F_y , F_z (m^2/s^2) and zonal mean zonal wind difference between "warm" and "cold" winters in November (a), January (b), and February (c).

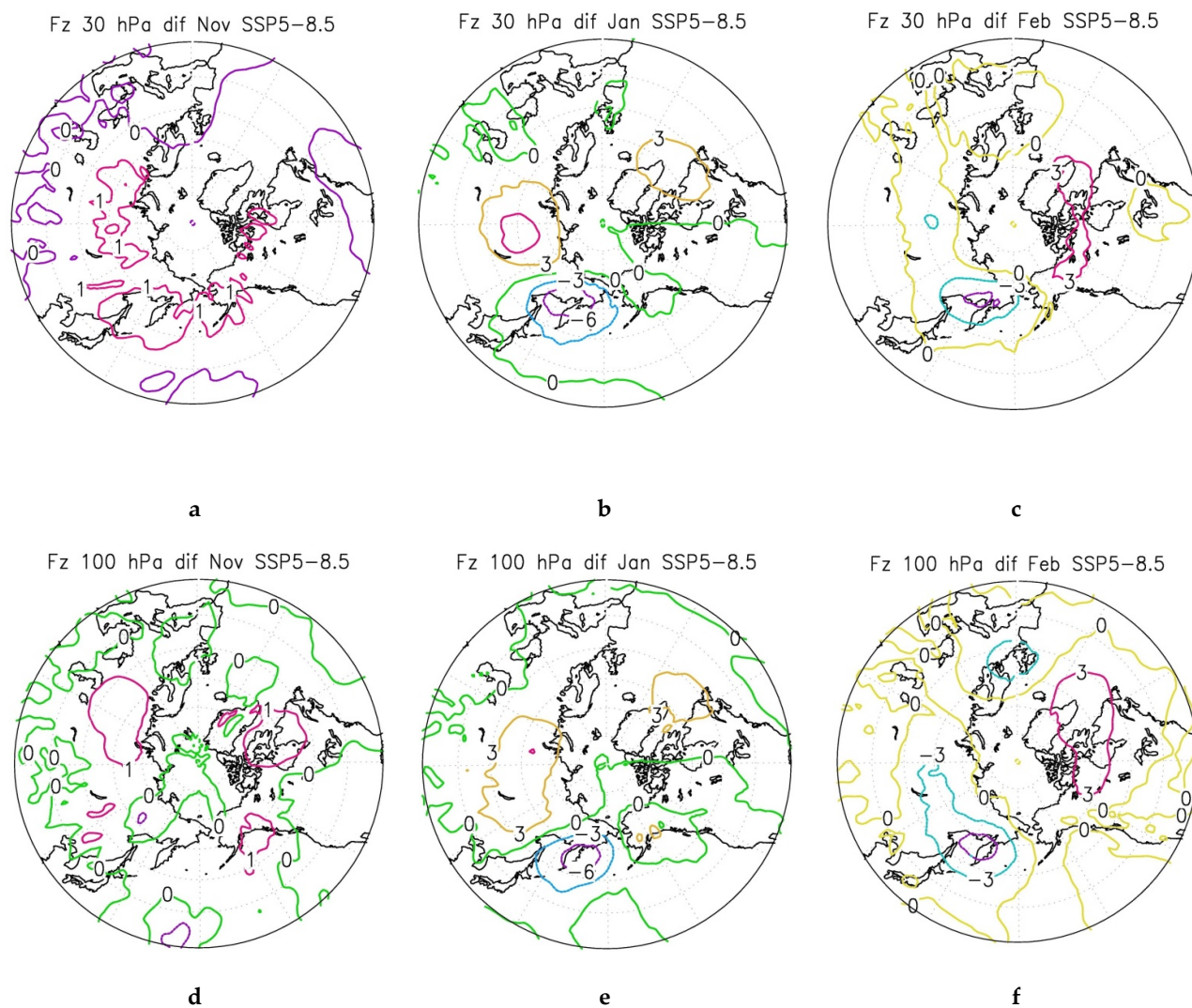


Figure S4. Vertical component of Plumb vectors F_z (m^2/s^2) difference between "warm" and "cold" winters at pressure level 30 hPa and 100 hPa in November (a,d), January (b,e), and February (c,f) respectively. Contour intervals are 1 for November and 3 for January and February. .