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**Plain Language Summary:** Gravity waves (GWs) significantly contribute to driving the meridional circulation in the entire middle atmosphere and equatorial large-scale oscillations by transporting momentum in the vertical. In this study, GW characteristics and background wind fields in the troposphere and lower stratosphere at high latitudes in the Southern Hemisphere, which is a key region of GW activity, were revealed by statistical analysis based on 7-year continuous PANSY radar observations at Syowa Station (69.0°S, 39.6°E).

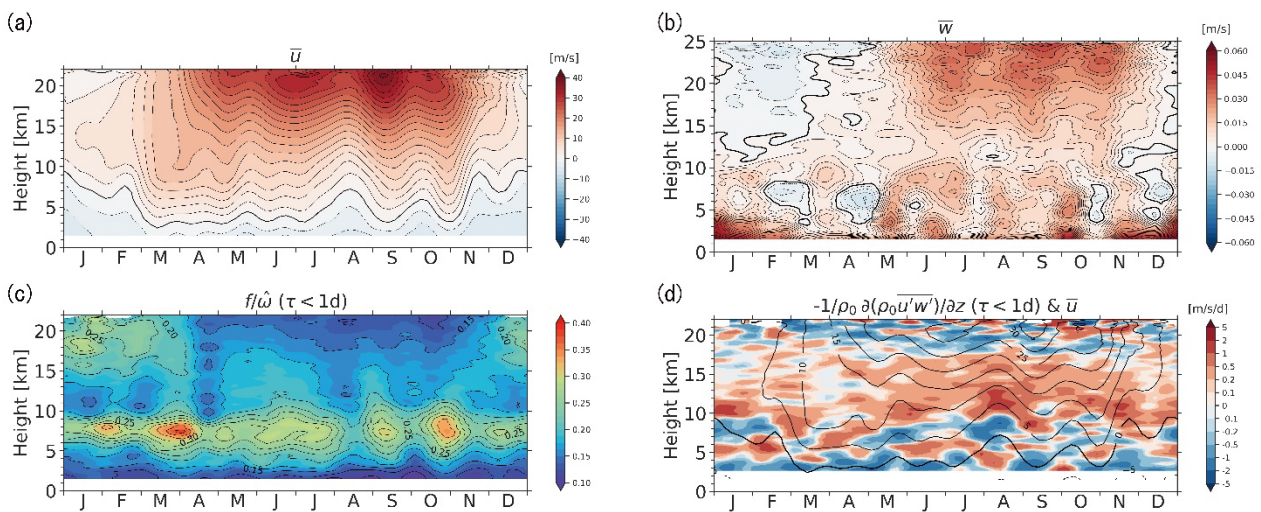


Figure 1. Time-height sections of climatological mean of background field of (a) zonal wind  $\bar{u}$  and (b) vertical wind  $\bar{w}$ . Time-height sections of climatology of (c) the ratio of the Coriolis parameter to the intrinsic frequency  $f/\hat{\omega}$  and (d) the divergence of the vertical flux of zonal momentum  $-\frac{1}{\rho_0} \frac{\partial \rho_0 \bar{u} \bar{w}}{\partial z}$  of GWs with period shorter than 1 day. The contour in (d) shows the background zonal wind  $\bar{u}$ . The contour intervals of (a–d) are  $2 \text{ m s}^{-1}$ ,  $0.003 \text{ m s}^{-1}$ ,  $0.025$ , and  $5 \text{ m s}^{-1}$ , respectively.

- Taking an advantage of the PANSY radar to observe the vertical wind directly, the climatology of the vertical wind  $\bar{w}$  is given and a method to estimate the ratio of the Coriolis parameter to the intrinsic frequency  $f/\hat{\omega}$  is proposed.
- In the lower stratosphere, the vertical wind climatology is upward from May to November, with a maximum value of  $\bar{w} \sim 43 \text{ mm s}^{-1}$ , and downward from January to March, with a minimum value of  $\bar{w} \sim -11 \text{ mm s}^{-1}$ .
- The  $f/\hat{\omega}$  has a maximum in the vertical slightly below the tropopause throughout the year and decreases with height in the lower stratosphere from May to November.
- In the height range of 9–17 km, the GW forcing is eastward with a mean value of  $\sim 0.37 \text{ m s}^{-1} \text{ day}^{-1}$  from May to November, which can be explained by the critical level filtering of upward GWs.