Sekido, H., K. Sato, H. Okui, D. Koshin, and T. Hirooka, 2024: A study of zonal wavenumber 1 Rossby-gravity wave using long-term reanalysis data for the whole neutral atmosphere. *J. Meteor. Soc. Japan*, **102**, https://doi.org/10.2151/jmsj.2024-029

Plain Language Summary:

The dynamical characteristics of the zonal wavenumber 1 ($s = 1$) Rossby-gravity wave (RG1) are examined utilizing long-term reanalysis data which covers the entire neutral atmosphere up to 100 km altitude. This wave is identified as an distinct and isolated spectral peak at a wave period of 1.3-day in the zonal wavenumber-frequency spectra, which well accords with the theoretically-predicted $s = 1$ Rossby-gravity normal mode. The spatial phase structure of the detected RG1 wave is also consistent with the normal mode theory. The climatological distribution of RG1 is shown as a function of latitude at various heights. A detailed case study for a notable event suggests that the source of RG1 is situated not only in the troposphere but also in the middle atmosphere.

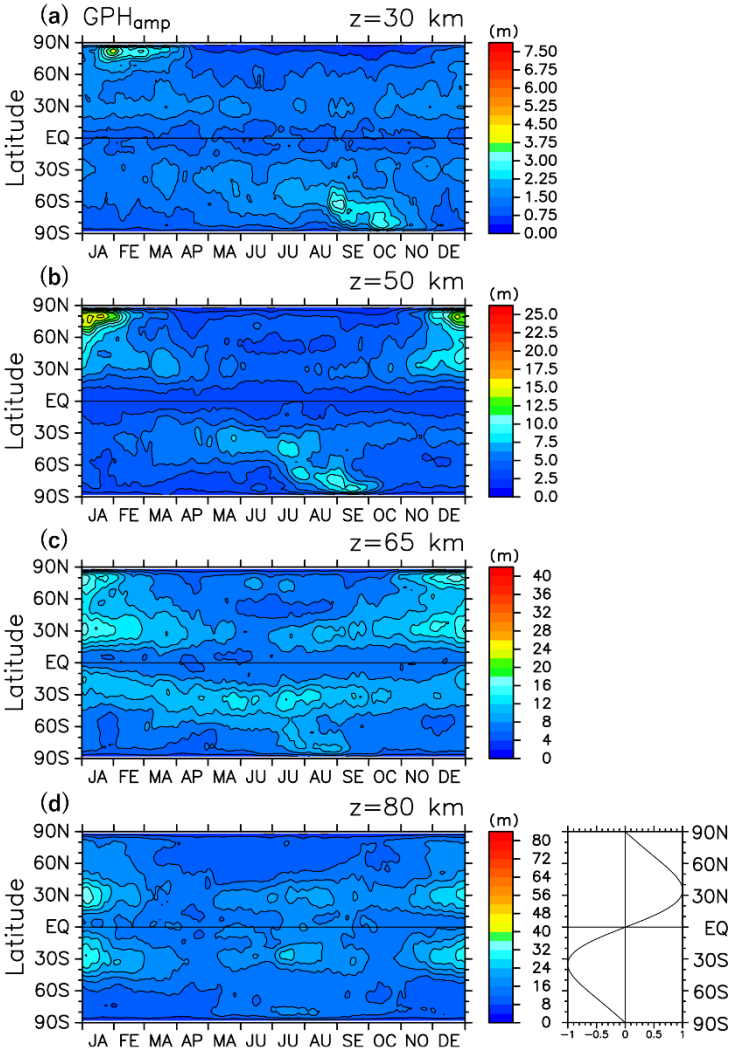

Figure 1. Time-latitude sections of the climatology of the GPH amplitude of RG1 at (a) $z = 30$, (b) 50, (c) 65, and (d) 80 km. A 15-day running mean is applied. The contour intervals are (a)0.375 m, (b) 1.25 m, (c) 2 m, and (d) 4 m. In the bottom right panel, the solid curve represents the latitudinal profile of the Hough function of the $s = 1$ RG mode.

- RG1 exhibits characteristic seasonal variation in the middle atmosphere: the amplitude is largest in the winter hemisphere in the stratosphere and lower mesosphere, while enhancement is observed in both winter and summer hemispheres in the upper mesosphere.
- The strong RG1 has horizontal and vertical structures consistent with the normal mode theory in the height range from upper stratosphere to lower thermosphere where the RG1 amplitude is large.
- Both the climatology of the geopotential height amplitude and the time evolution of the amplitude of a distinct case suggests the presence of RG1 source in the middle atmosphere.