陸別・信楽の大気光画像を用いた中間圏重力波・TIDの水平位相速度分布：成層圏突然昇温・地方時依存性

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Phase velocity distribution of mesospheric and ionospheric waves in airglow images at Japan: Local time variation and SSW

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Atmospheric gravity waves (AGWs) transport momentum from the troposphere into the mesosphere and the lower thermosphere (MLT). The momentum deposit through wave breaking causes the large-scale pole-to-pole circulation. The vertical propagation of AGWs depends on the horizontal phase velocity. Thus, investigation of the horizontal phase-velocity characteristics of AGWs is essential for understanding the dynamical variation of middle and upper atmosphere. The propagation direction of medium-scale traveling ionospheric disturbances (MSTIDs) seems to be different at different latitudes. However, the cause which determines their propagation direction has not been sufficiently understood.

A new spectral analysis technique has been developed to obtain power spectra in the horizontal phase velocity by using the 3-D FFT technique [Matsuda et al., JGR, 2014]. Takeo et al. (JGR, 2017) studied horizontal parameters of AGWs and MSTIDs over 16 years by using airglow images at wavelengths of 557.7 nm (emission altitude: 90-100 km) and 630.0 nm (200-300 km) obtained at Shigaraki, Japan (34.8^{o}N, 136.1^{o}E) which is located at the middle part of Japan.

In this study, we have applied the same spectral analysis technique to the 557.7 nm and 630.0-nm airglow images obtained at Rikubetsu (43.5^{o}N, 143.8^{o}E), which is at the northern edge of Japan, for 16 years from 1999 to 2014. We compared features of horizontal wave spectra at Shigaraki and Rikubetsu over 16 years. We focus their dependence on local time and stratospheric sudden warming (SSW).

In summer, the propagation direction of AGWs seen in the 557.7-nm images is northeastward regardless of local time at both Shigaraki and Rikubetsu. However, in winter, the propagation direction is changed from southwestward to northwestward as time progresses from evening to morning at both stations. The meridional wind measured by the meteor radar mode of the MU radar at Shigaraki changes from northward to southward at altitudes around 95 km from evening to morning in winter. This suggests that the wind filtering by the mesospheric jet causes the observed local time dependence of AGW propagation directions. On the other hand, the propagation direction of MSTIDs in 630.0-nm images is southwestward regardless of the local time.

There is almost no change in the propagation direction of AGWs at both Shigaraki and Rikubetsu before and after the day of SSW defined by the peak stratospheric temperature in polar cap (60-90^{o}N). However, the propagation direction of AGWs is changed from southwestward to northeastward at Rikubetsu on the day of the reversal of eastward zonal wind at 60^{o}N and 10 hPa (about 35 km in altitude) by the SSW. This propagation direction change was not observed at Shigaraki. The propagation direction of AGWs is generally northeastward in summer and southwestward in winter. Thus the present observation suggests that the zonal wind reversal in the high-latitude stratosphere at SSW causes the seasonal variation of the propagation direction of AGWs in the mesopause region at middle latitudes at ˜43.5^o. For MSTIDs, propagation direction is not changed before and after the days with the peak temperature and the reversal of wind by the SSWs.