Energy spectra of planetary-scale disturbances in the Martian atmosphere

Takeshi Imamura[1]; Hiroko Kobayashi[2]

[1] ISAS/JAXA; [2] none

Wavenumber spectra of the Martian atmosphere for stationary and transient components with zonal wavenumbers s=1-6 were obtained as a function of latitude, season and Martian year, using atmospheric temperature data obtained by TES onboard MGS spacecraft. The stationary component tends to peak at s=2 and drops rapidly at higher wavenumbers, while the transient component tends to peak at s=1 and shows much flatter spectral slopes. The dominance of s=2 for the stationary component will be partly due to the dominance of s=2 in topography. The spectral slope of the transient component ranges from 0 to -2; this indicates, based on the predictions from linear instability theories, that baroclinic energy injection occurs at borad wavenumbers greater than 2 and that upscale energy cascade occurs from the energy injection scale to s=1. Seasonal variation is prominent at high latitudes; the maximum power tends to occur in winter and the minimum occurs in summer, with an exception that the transient component is maximized in spring in the southern hemisphere. The winter maximum is attributed to the increase in the latitudinal temperature gradient which leads to stronger jet and baroclinic activity. The transient comopnent shows much higher power in the norhern winter than in the soughern winter at high latitudes; as a result, the s=1 transient wave is stonger than the stationary wave in the northern winter, while the former is weaker than the latter in the southern winter. This hemispheric asymmetry is attributed to the larger latitudinal temperature gradient in the north than in the south. Abrupt increases in the s=1 power are observed during the period Ls=180-240 especially in the low and middle latitude. This might be related to the increased dust loading in this period, although the specific mechanism is unclear. The height dependece is not prominent, except that the s=1 stationary waves reach heigher altitudes than the s=2 waves probably due to the Charney-Drazin filtering.

Ideas of future Martian atmosphere missions will be presented based on these results.