Seasonal variation of mesospheric echoes observed with the MU radar in Japan and its relation to the thermosphere and ionosphere

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Seasonal variation of the plasma density in the ionosphere shows semiannual variation with maxima at around March and September equinoxes and minima at around June and December solstices. Asymmetry of the plasma density between March and September equinoxes is also well-known. The plasma density near and above the F2 peak altitude is larger in March equinox than in September equinox, whereas the plasma density at the bottomside F-region in September equinox exceeds that in March equinox. These seasonal variations in the ionosphere arise mainly from the corresponding asymmetries in the thermosphere, especially meridional neutral winds and neutral composition. However, the basic cause of the seasonal variation in the thermosphere remains a puzzle. Qian et al. [2009], who have performed numerical simulation, suggest that eddy diffusion in the mesopause region changes the neutral composition in the thermosphere, especially O/N2, which is proportional to the plasma density in the F region. The purpose of this study is to investigate whether the equinoctial asymmetry in the thermosphere and ionosphere can be explained in term of that of the eddy diffusion in the mesopause region. Observation of the eddy diffusion in the mesosphere is very limited. In this study, we have analyzed spectral width of radar echoes at altitudes of 70-80 km, observed in a mode of the mesospheric measurement carried out by the MU radar in Japan from April 1996 to May 2013 because the eddy diffusion can be estimated from the spectral width. We have found that average seasonal variation of the spectral width has a major peak at around June solstice with two minima at around March and September equinoxes. According to Qian et al. [2009], eddy mixing accelerates the downward transportation of atomic oxygen to lower altitudes, where it recombines into the molecular oxygen, decreasing O/N2 ratio. Consequently, seasonal variation of the eddy diffusion (spectral width) is probably responsible for that of the thermosphere. In the presentation, we will show seasonal variation of the eddy diffusion estimated from the spectral width and discuss its relation to the thermosphere and ionosphere.