EPSC Abstracts
Vol. 6, EPSC-DPS2011-252, 2011
EPSC-DPS Joint Meeting 2011

Previous studies showed a close relationship between regional flushing dust storms and near surface atmospheric wave activities in the northern mid / high latitudes. Both flushing dust storms and near surface transient eddy temperatures were minimal during the winter solstice period. During active flushing dust storm periods in mid fall and mid winter, the 2 to 3 sol zonal wave number m = 3 eastward traveling waves were especially strong and usually dominate the power spectra of temperature near the surface. As a result, the dominant wave mode in near surface temperature exhibited a transition from m = 2 to m = 3 in early / mid fall and from m = 3 to m = 2 in mid / late winter. Above the lowest 2 or 3 scale heights, the m = 1 and m = 2 waves were the most important modes. They tended to be stronger when the atmosphere is dustier in general. When a planet-encircling major dust storm fully developed, there were substantial suppression of near surface transient eddies and amplification of upper level eddies.

To investigate the behavior of transient eddies and their relationship with atmospheric dust loadings, we have performed general circulation model (MarsWRF) simulations under different dust conditions. For the control run using the Mars Climate Database MGS background dust scenario, the model simulates well the general seasonality and vertical structure of traveling waves. Specifically, model results show strong near surface temperature variations before and after the winter solstice period and strong surface pressure variations throughout the fall and winter, which indicates that the solstice m = 1 and 2 modes are more barotropic than the m = 3 mode. However, the 2 – 3 sol m = 3 waves in the simulation appear to be not strong and persistent enough. We have experimented with different horizontal and vertical dust distributions, traveling dust forcing, and interactive dust simulations. Some simulations show greatly enhanced m = 3 wave modes. We will present the favorable conditions for m = 3 wave excitation, the seasonal evolution of wave modes in the simulations and discuss the implications for the development of flushing dust storms.