Speaker: Dr. Hung-I Lee(Postdoctoral Scholar, Department of Geophysical Sciences, The University of Chicago)
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Title: Nonquasigeostrophic and Nonadiabatic sources of upper tropospheric Rossby wave activity
Host: Yun-Yuan Chang / Assistant Research Fellow

<Abstract>

The budget of Rossby wave activity in the quasigeostrophic (QG) limit is largely governed by the convergence of wave activity fluxes: the zonal advective flux by geostrophic flow and the Eliassen-Palm (EP) flux, i.e. radiation stress associated with baroclinic wave packets traveling through an inhomogeneous jet stream. The residual of the budget presumably accounts for nonadiabatic and non-QG sources and sinks of wave activity. Here, we analyze ERA5 data to evaluate non-QG wave sources in the upper troposphere associated with local diabatic heating and advection of potential vorticity by ageostrophic flow driven by remote heat sources.

Climatological mean distribution of the upper-tropospheric wave activity sources in the Northern Hemisphere reveals that the upgradient eddy PV flux comes mainly from the non-QG component, suggesting that diabatic sources of wave activity generate a significant positive ageosstrophic eddy PV flux in the midlatitudes. In the East China Sea and the Sea of Japan, up-gradient PV fluxes occur where divergent winds cross subtropical jets. Meridional divergent winds match eddy PV fluxes outside the western Pacific, indicating that the non-QG PV fluxes match the meridional overturning circulations (Hadley and Ferrel cells).

Previously it has been recognized that the climatological-mean wave activity is enhanced on the eastern side of the column water vapor maximum (quasi-stationary atmospheric river or QSAR) at 30°N during the cold season but on both sides during summer (Lee and Mitchell 2021). The present study suggests that the eastward enhancement of wave activity is the result of the production of wave activity by the local diabatic sources at QSAR and the subsequent downstream advection by the jet stream. The enhancement of wave activity west of QSAR during summer on the other hand arises from the combination of diabatic heating and ageostrophic advection of potential vorticity, both enhanced by the Asian summer monsoon in the subtropics of the Eurasian continent.