Plain Language Summary: We show a simple conceptual model of the resonant interaction in a typhoon-like vortex between vortex Rossby waves (VRWs) and gravity waves (GWs), which are caused by the VRWs. The proposed conceptual model is based on the buoyancy-vorticity formulation (BV-thinking), and is different from that for the barotropic and baroclinic instabilities based on PV interactions (PV-thinking).
  We consider disturbances of the first baroclinic mode on a basic barotropic vortex. The disturbance vertical vorticity ζ of the VRW in the central region has a large amplitude on the upper and lower levels. The disturbance buoyancy b and radial vorticity η of the GW in the outer region have a large amplitude on the middle level.
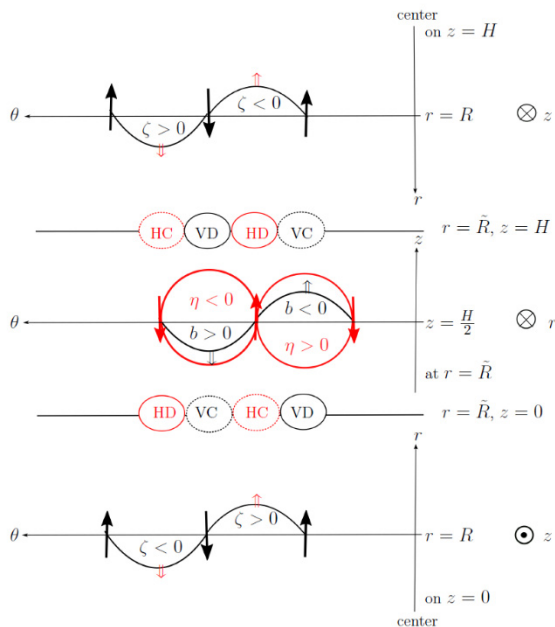

Figure.1 shows the conceptual model of the interaction between the near-central VRW and the outer GW. The circulation around ζ of the VRW enhances b of the GW, which in turn enhances η. At the same time, the circulation around η of the GW enhances ζ of the VRW. As a result, the VRW and GW grow simultaneously.
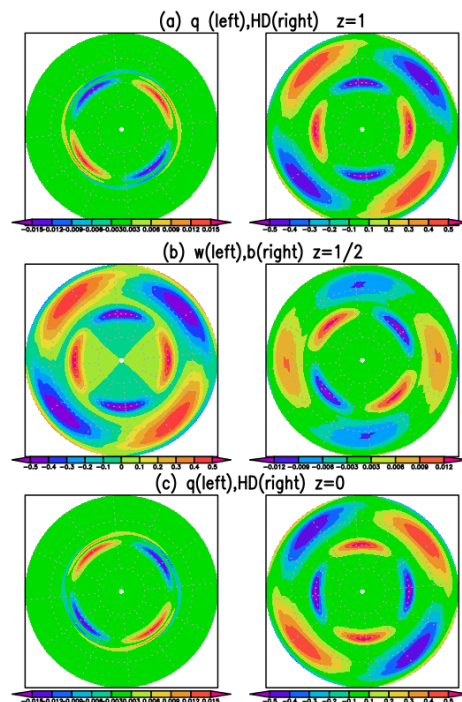

Figure.2 shows the results of the numerical calculation of the proposed model. We can see the same growing structure as shown in figure.1 .

- We propose the VRW-GW resonant growth mechanism in a three dimensional model not in a two dimensional model.
- The VRW-GW resonant growth occurs in a three dimensional system. This is because the growth is caused by the interaction between the horizontal circulation of VRW and the vertical circulation of GW.
- We also show the numerical calculation of the proposed model.