Forced vorticity waves on super-rotation flow: (Planetary vorticity: ζ. Primes: deviations from zonal base state. Damping: r. Forcing: S_{ext}.)

$$\frac{d\zeta'}{dt} = -\nabla \bullet (v\zeta' + \zeta v') - r\zeta' + S_{ext}$$

Case 1: $v = \hat{\mathbf{i}}(u_o + u_s)\Omega a \cos\theta, \quad r = r_o = 0.25\ d^{-1}$

Case 2: $r = (r_o + r_s),\ v = \hat{\mathbf{i}} u_o \Omega a \cos\theta$

Cast equation in terms of streamfunction ($\zeta = \nabla^2 \Psi$) and project onto spherical harmonics.

$$\frac{d}{dt}\begin{pmatrix} \Psi_{nr}^m \\ \Psi_{ni}^m \end{pmatrix} = \begin{pmatrix} -r & -mD_n \\ mD_n & -r \end{pmatrix}\begin{pmatrix} \Psi_{nr}^m \\ \Psi_{ni}^m \end{pmatrix} + \begin{pmatrix} S_{nr}^m \\ S_{ni}^m \end{pmatrix}$$

$$D_n = \left\{ \frac{2}{n(n+1)} + d_n u \right\} \Omega$$

where $u_o \Omega a = 15$ m/s

$$d_n = \frac{2}{n(n+1)} - 1$$

and $u = u_o + u_s$ (Case 1) or $u = u_o$ (Case 2).