

Movie 1. Numerical simulations showing the time evolution of the vorticity field $\zeta(x, y, t)$ with initial conditions

$$\zeta(x, y, 0) = \zeta_0 [J_0(\chi) - J_0(j_{1,1})] + \zeta_1 J_1(\chi) \sin(\theta), \quad \chi \leq j_{1,1}.$$

Note $j_{1,1} = 3.8317\dots$. The vorticity amplitudes are $\zeta_0 = 0.5$ and $\zeta_1 = 1$. The numerical domain is a square with a side length $L = 10\pi$, discretized in 1024^2 grid points. Time step $\delta t = 0.01$ and time save $\Delta t = 1$. The movie comprises only the time interval $t = [300, 500]$ and a reduced area of the numerical domain. Vorticity contour interval $\Delta\zeta = 0.05$. The red contour corresponds to $\zeta = 0$.