Figure S1: Orthographic view from a northern mid-latitude vantage point of the simulation at the same instance shown in Fig. 2 of the main paper.
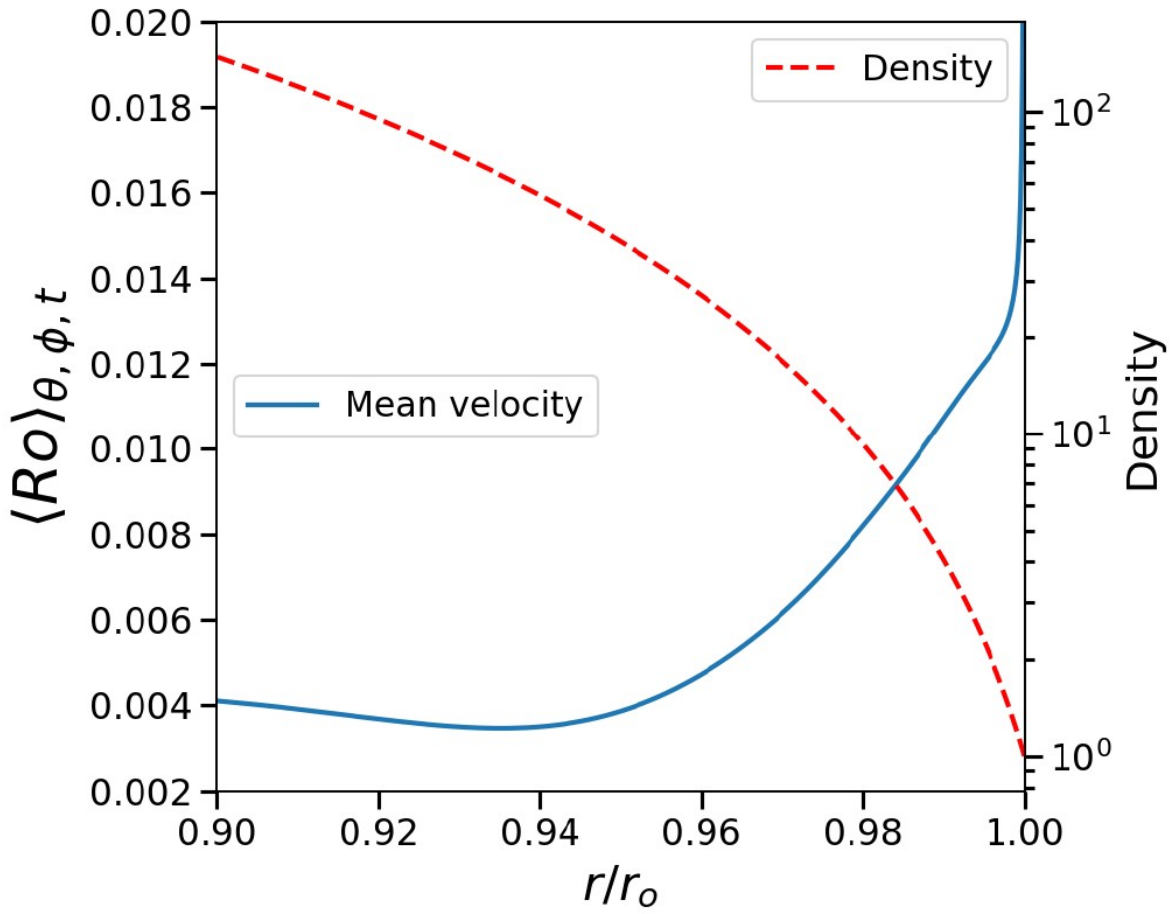
Figure S2: Variation of the mean velocity (left axis) expressed in terms of the Rossby number and the normalized fluid density (right axis) as a function of the normalized radius.
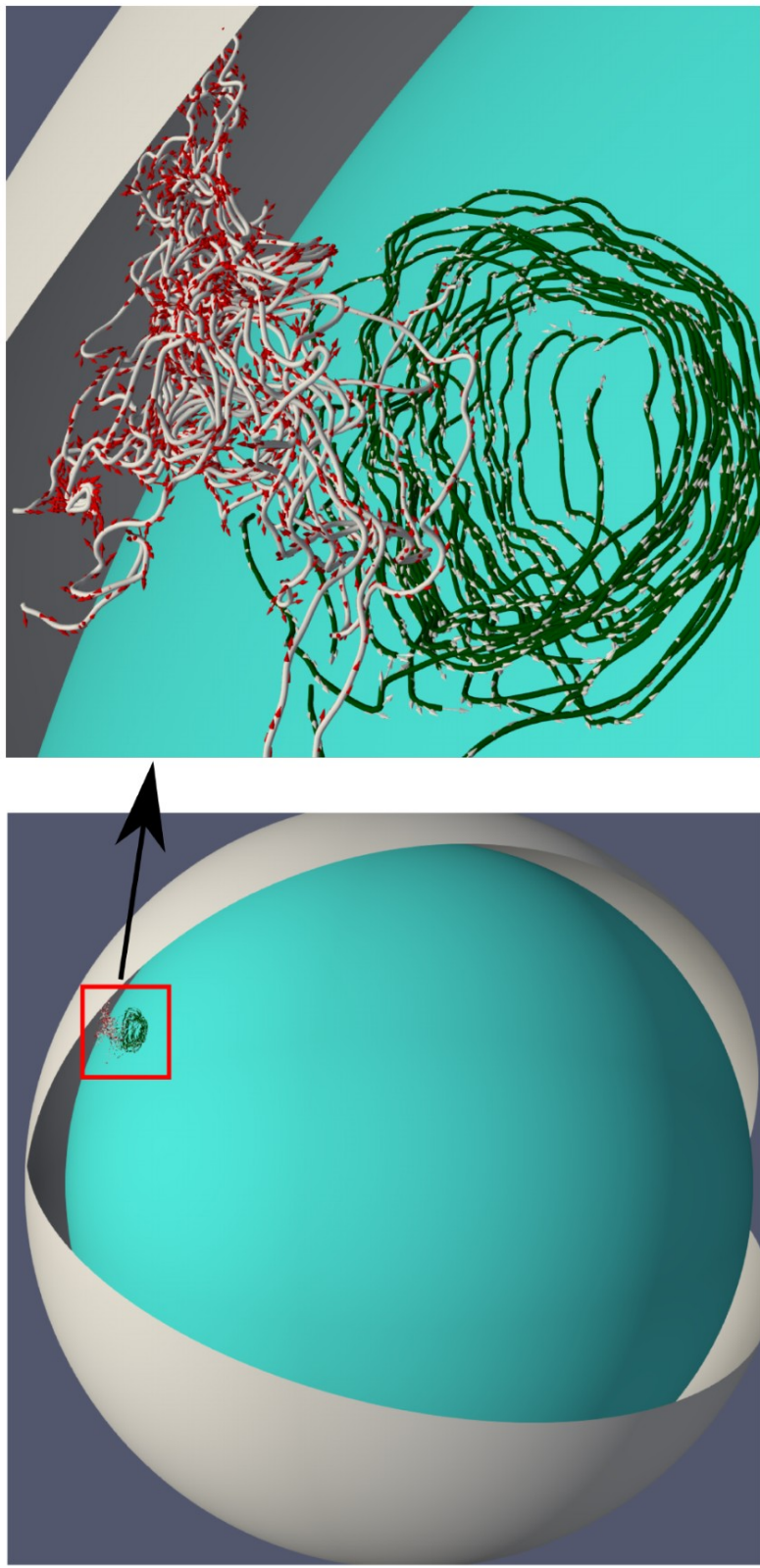
Figure S3: Orthographic plot showing gray colored stream lines with red flow vectors for the shallow flow and green colored stream lines with gray flow vectors for deeper flow in a large vortex. The concentric shells show the simulation boundaries.
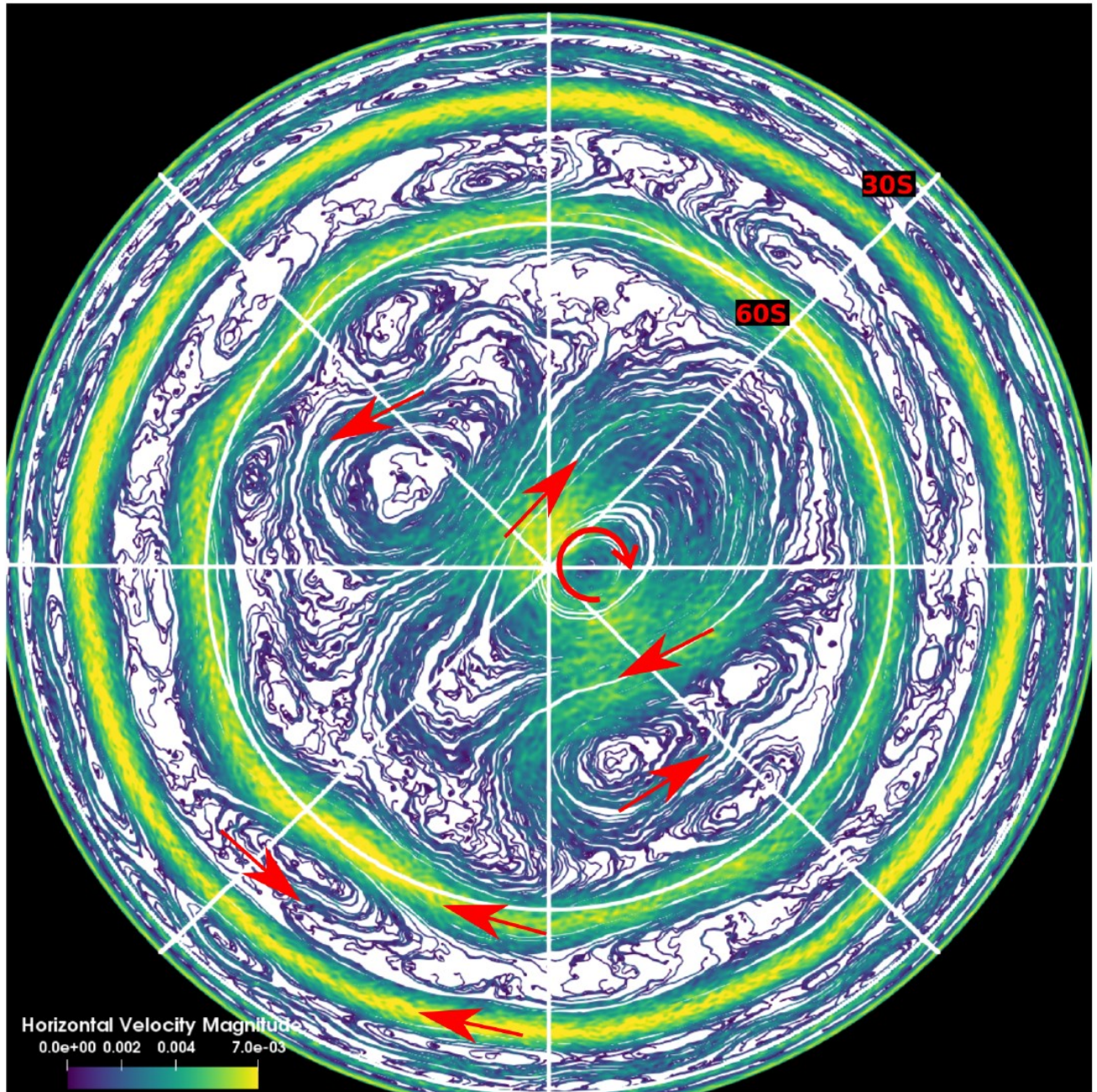
Figure S4: Orthographic view from the south pole vantage point of the simulation at the same instance shown in Fig. 2 of the main paper.
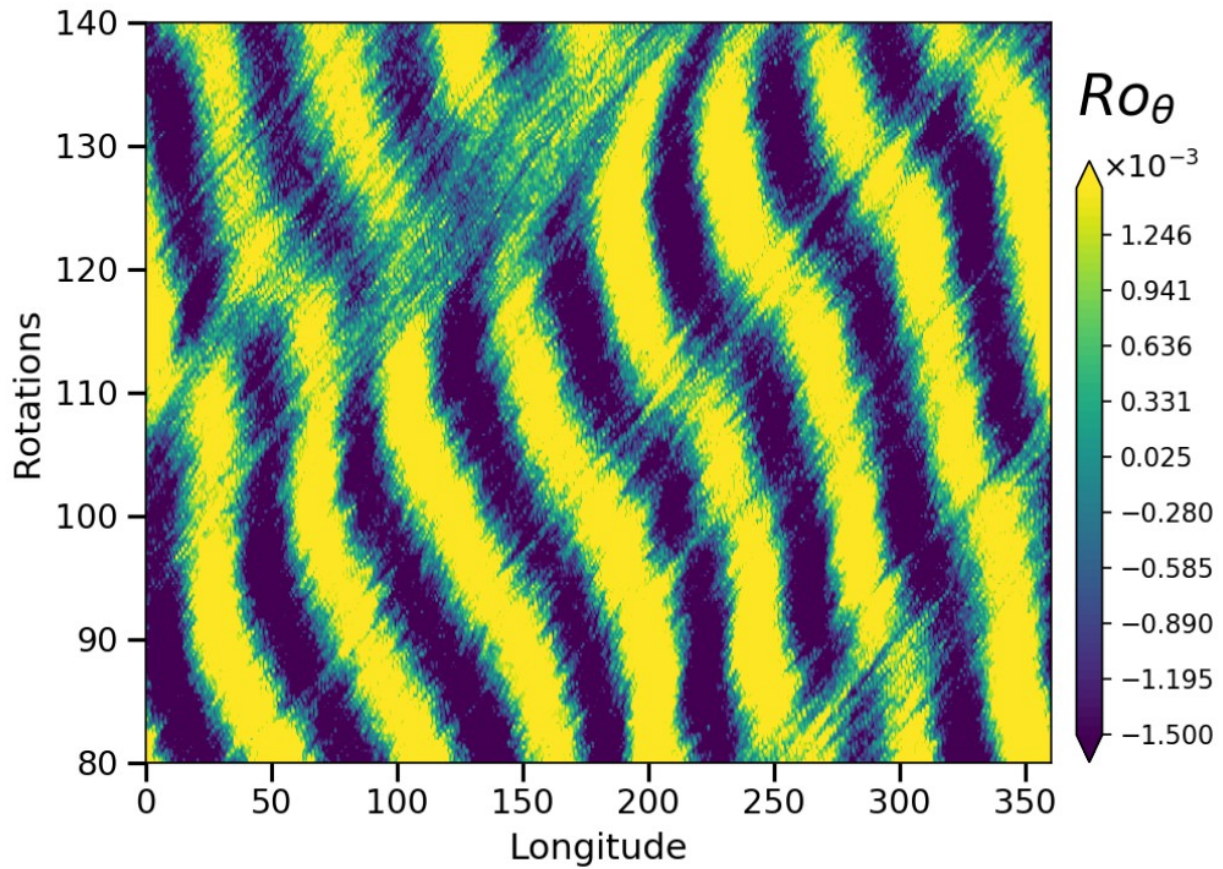
Figure S5: The latitudinal velocity for higher Rayleigh number of 4.5×10^8 at 60 degrees south of the equator as a function of time. Note that due to the highly demanding nature of this case, we simulated only about 140 rotations.

Animation M1: The animation "SI_Animation_M1.mp4" shows the time evolution of flow streamlines viewed from a northern vantage point. About 90 rotations of the simulation are shown. A thumbnail of the animation is shown below.