Centrifugal

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1 Mathematical Model

2 Centrifugal Force Only

2.1 Aspect Ratio = 0.1

The $E = 10^{-5}$ case may be under resolved. May need to increase gridpoint resolution.

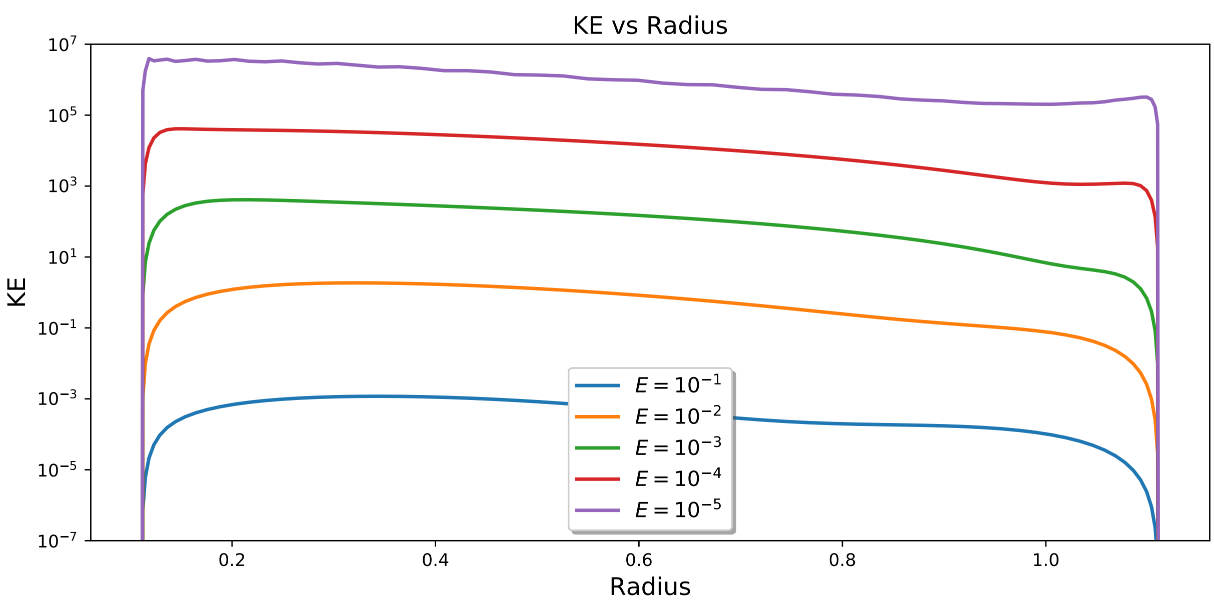

Figure 1: Kinetic energy shell average as a function of radius during equilibrated phase for a range of Ekman numbers.

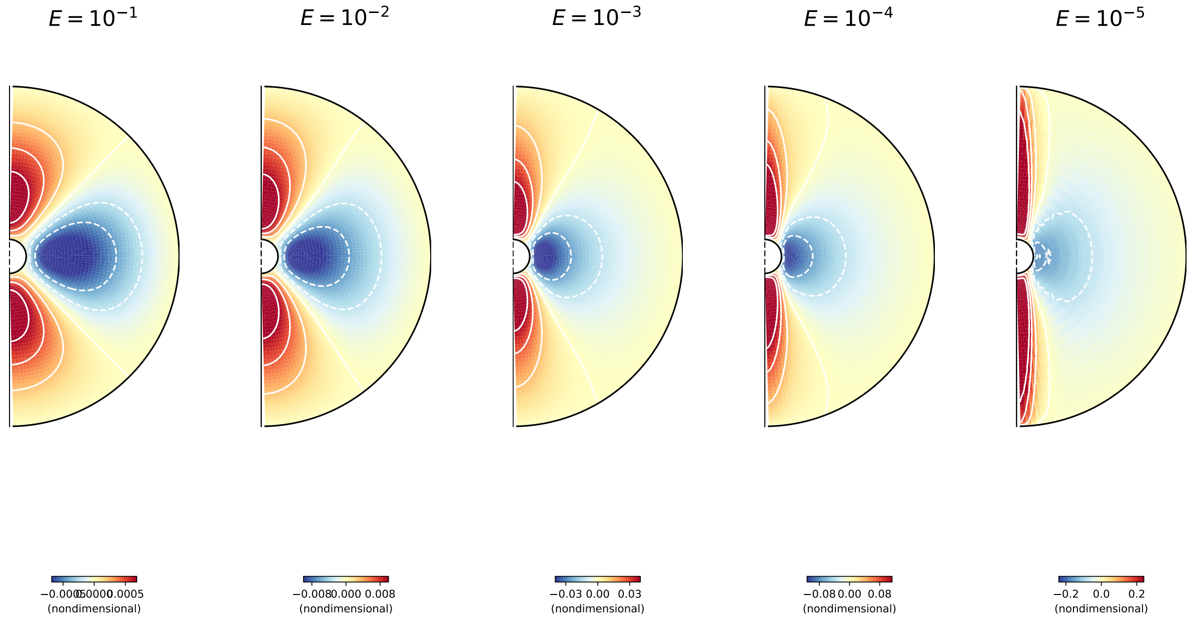

Figure 2: Temperature azimuthal average during equilibrated phase for a range of Ekman numbers.

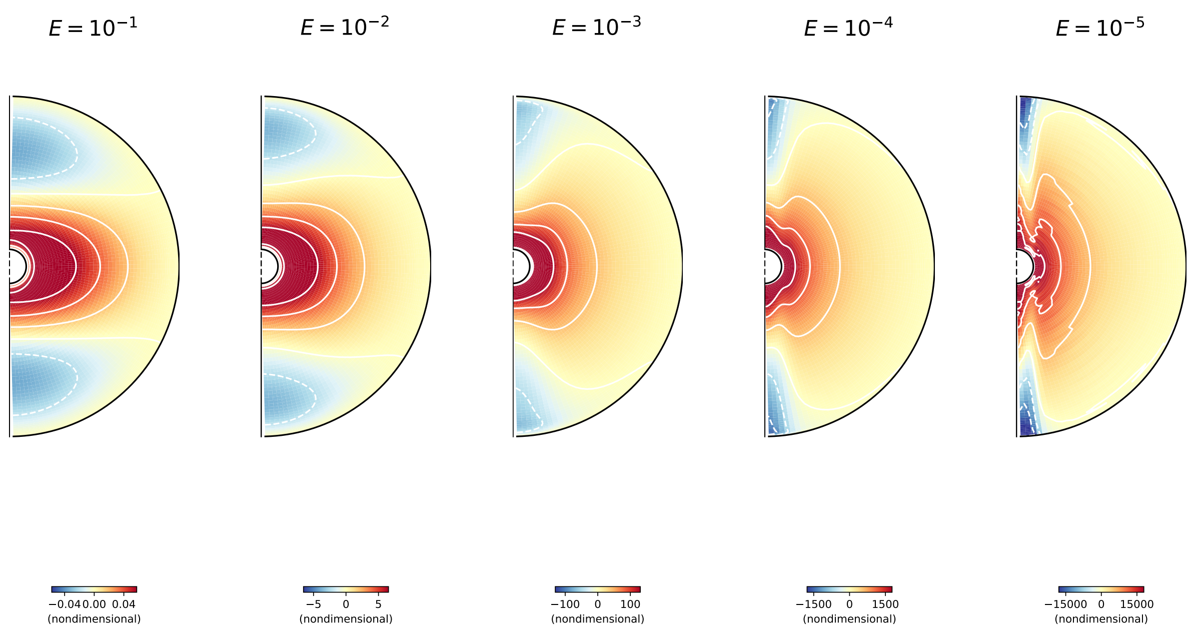

Figure 3: Angular velocity azimuthal average during equilibrated phase for a range of Ekman numbers.

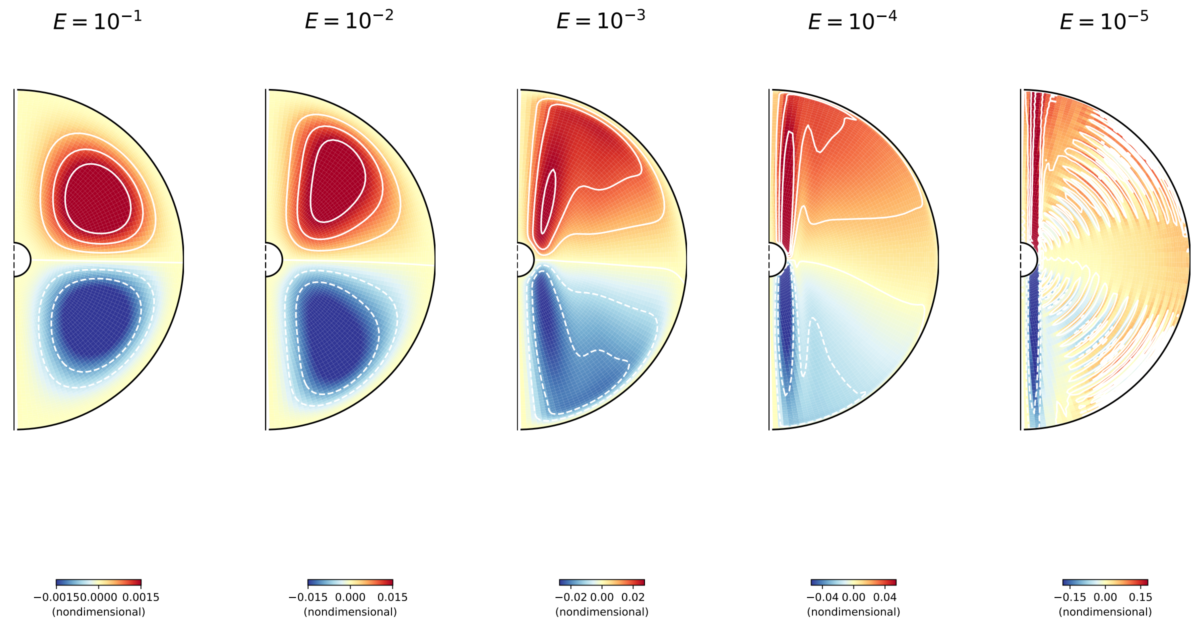

Figure 4: Mass flux azimuthal average during equilibrated phase for a range of Ekman numbers.

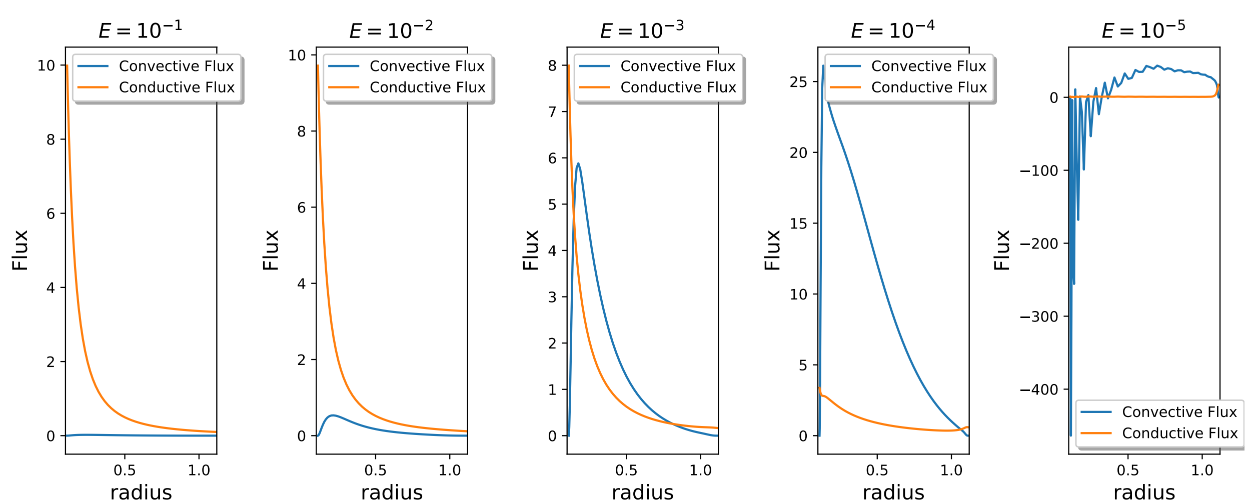

Figure 5: Azimuthal average of convective and conductive heat flux at the pole for a range of Ekman numbers.

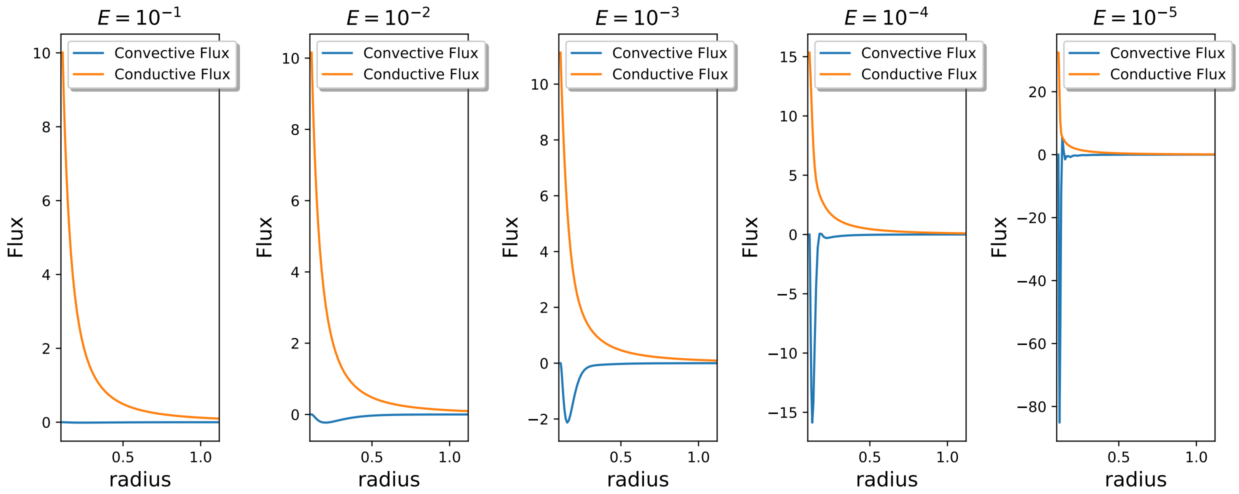

Figure 6: Azimuthal average of convective and conductive heat flux at the equator for a range of Ekman numbers.

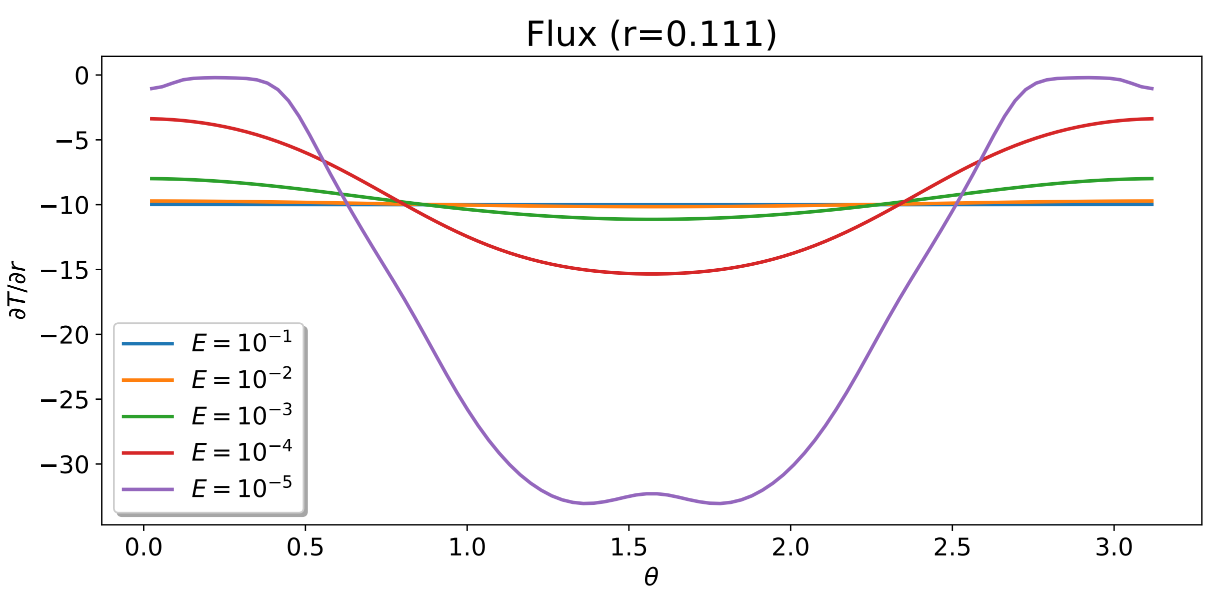

Figure 7: Conductive flux azimuthal average as a function of θ at the inner radius for a range of Ekman numbers.

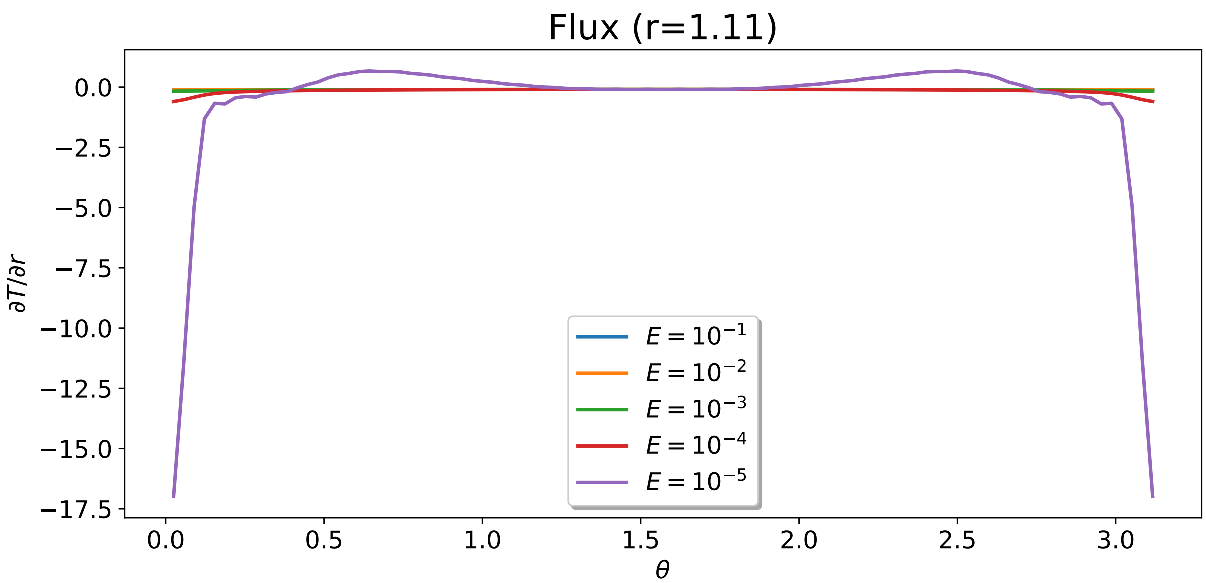

Figure 8: Conductive flux azimuthal average as a function of θ at the outer radius for a range of Ekman numbers.

Aspect Ratio	E	Δt	N_r x N_θ x N_ϕ	KE	KE$_r$	KE$_\theta$	KE$_\phi$	ℓ degree	Wavenumber m	P_ℓ
0.1	10^{-1}	10^{-4}	64x96x192	2.72×10^{-4}	1.33×10^{-4}	9.82×10^{-5}	4.00×10^{-5}	6	4	376
0.1	10^{-2}	10^{-4}	64x96x192	3.71×10^{-1}	1.98×10^{-2}	1.08×10^{-2}	3.4×10^{-1}	6	4	376
0.1	10^{-3}	5×10^{-5}	64x96x192	67.23	2.12×10^{-1}	1.01×10^{-1}	66.92	6	4	376
0.1	10^{-4}	10^{-5}	64x96x192	9.77×10^{3}	3.511	2.016	9.76×10^{3}	6	4	376
0.1	10^{-5}	10^{-6}	64x96x192	9.59×10^{5}	85.2	251.36	9.76×10^{3}	6	4	376

Table 1: Details of numerical simulations performed for the incompressible model in this section. The following are specified, aspect ratio of the sphere, the Ekman number (E), the luminosity, the Rayleigh number (Ra), the Prandtl number (Pr), the time-step size (Δt), the spatial resolution (N_r x N_θ x N_ϕ), and the spherical harmonic degree ℓ with corresponding wavenumber m. The power and growth rate are also recorded alongside each respective ℓ degree.

2.2 Aspect Ratio = 0.5

Working currently on getting $E = 10^{-4}$ to run on Summit. Leaving plots here as place holders.

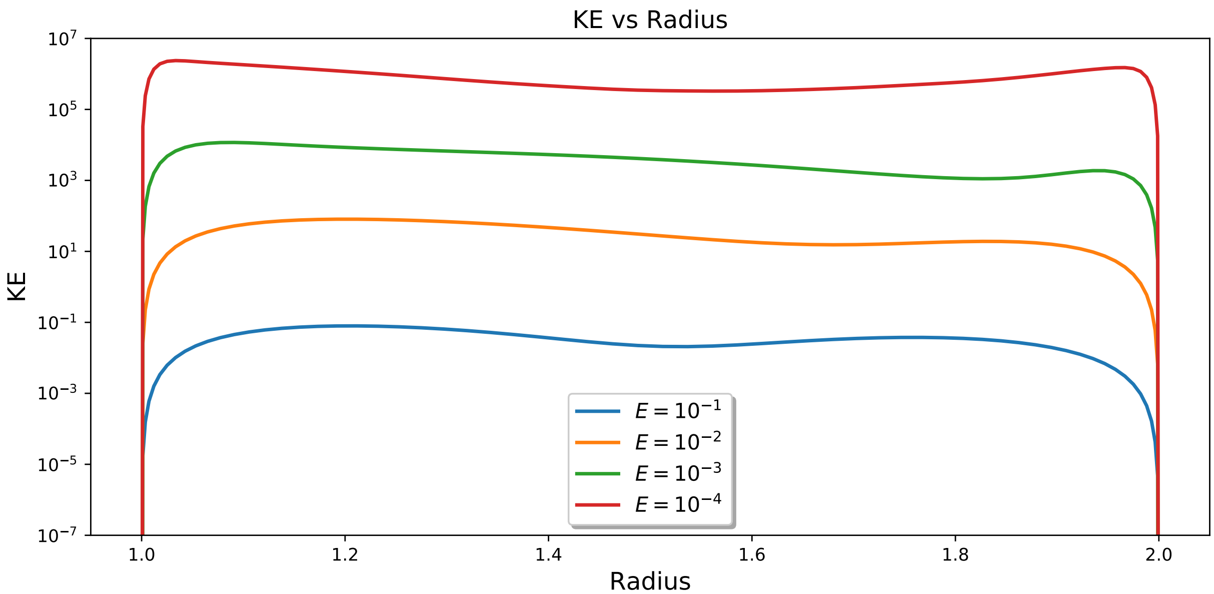

Figure 9: Kinetic energy shell average as a function of radius during equilibrated phase for a range of Ekman numbers with aspect ratio set to 0.5.

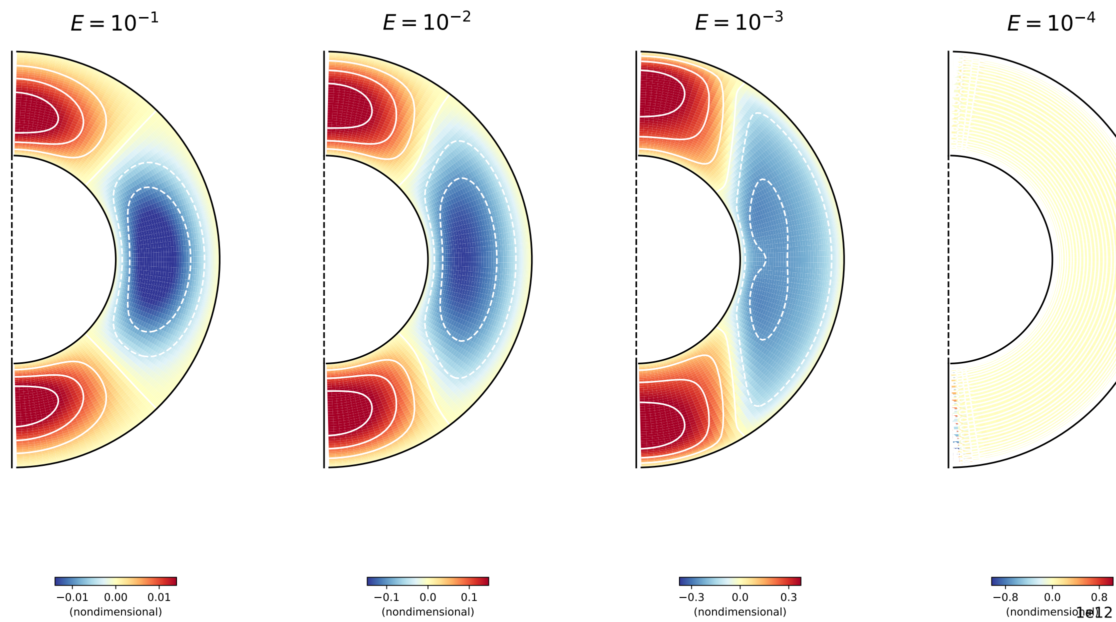

Figure 10: Temperature azimuthal average during equilibrated phase for a range of Ekman numbers.

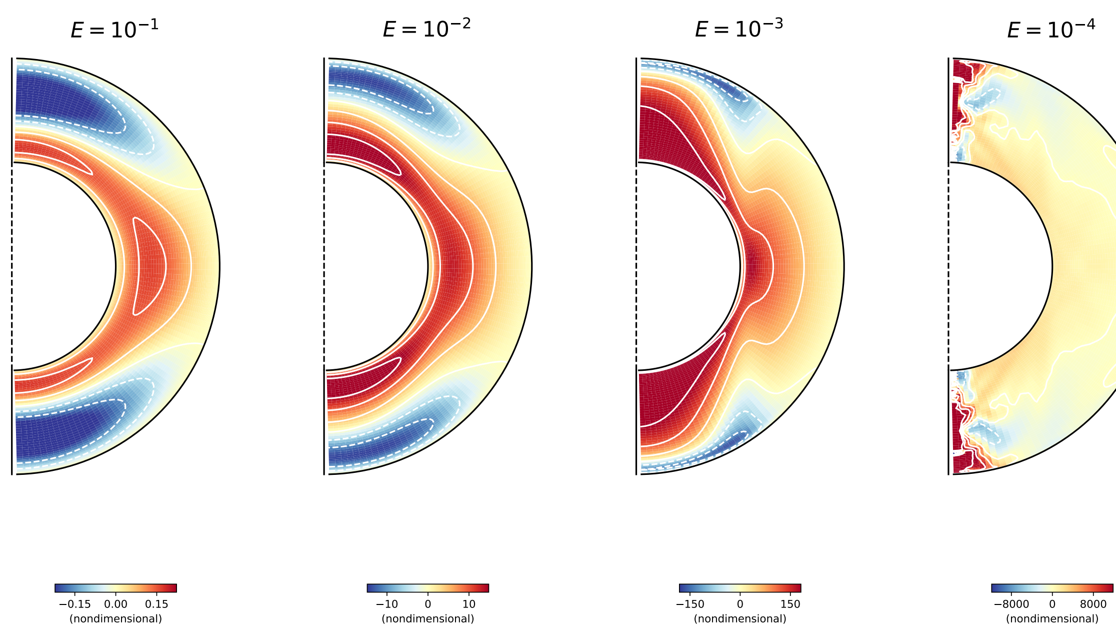

Figure 11: Angular velocity azimuthal average during equilibrated phase for a range of Ekman numbers.

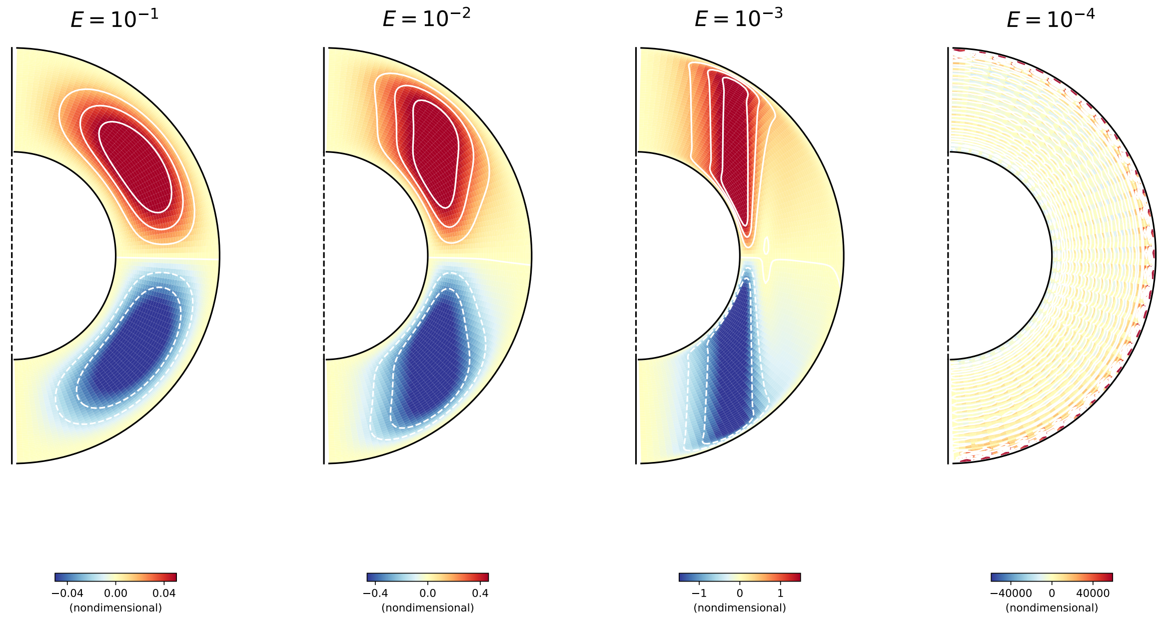

Figure 12: Mass flux azimuthal average during equilibrated phase for a range of Ekman numbers.

Aspect Ratio	E	Δt	N_r x N_θ x N_ϕ	KE	KE$_r$	KE$_\theta$	KE$_\phi$	ℓ degree	Wavenumber m	P_ℓ
0.5	10^{-1}	10^{-3}	64x96x192	2.72×10^{-4}	1.33×10^{-4}	9.82×10^{-5}	4.00×10^{-5}	6	4	376
0.5	10^{-2}	10^{-4}	64x96x192	3.71×10^{-1}	1.98×10^{-2}	1.08×10^{-2}	3.4×10^{-1}	6	4	376
0.5	10^{-3}	5×10^{-5}	64x96x192	67.23	2.12×10^{-1}	1.01×10^{-1}	66.92	6	4	376
0.5	10^{-4}	10^{-5}	64x96x192	9.77×10^{3}	3.511	2.016	9.76×10^{3}	6	4	376

Table 2: Details of numerical simulations performed for the incompressible model in this section. The following are specified, aspect ratio of the sphere, the Ekman number (E), the luminosity, the Rayleigh number (Ra), the Prandtl number (Pr), the time-step size (Δt), the spatial resolution (N_r x N_θ x N_ϕ), and the spherical harmonic degree ℓ with corresponding wavenumber m. The power and growth rate are also recorded alongside each respective ℓ degree.