Reproducing the Profile of the Coriolis number of the Sun

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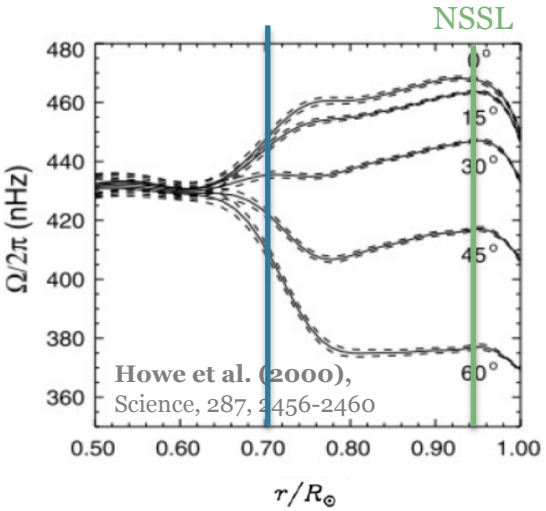
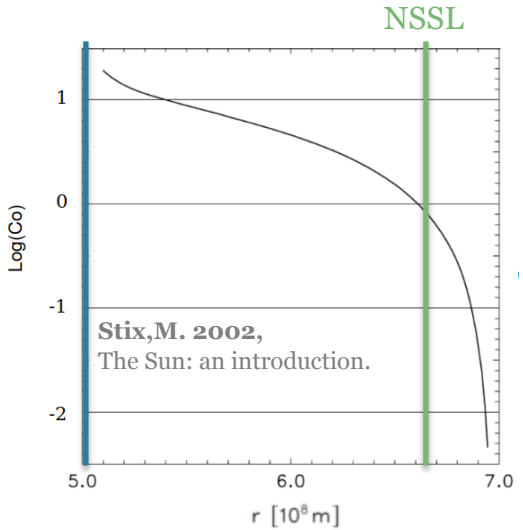
Introduction

- Layers of the Sun
  - Core
  - Radiative zone
  - Convection zone
- Sun's radius- 700 Mm
  - Convection zone- 200 Mm
  - NSSL- 35Mm

$$10^{-3} \leq Co(NSSL) \leq 1 \leq Co(CZ) \leq 10$$

$$\mathrm{Co} = 2\tau\Omega$$





Simulation Setup

$$\frac{D\ln\rho}{Dt} = -\boldsymbol{\nabla}\cdot\boldsymbol{U},$$
$$\frac{D\boldsymbol{U}}{Dt} = \boldsymbol{g} - c_s^2\boldsymbol{\nabla}\ln\rho + \boldsymbol{F}^{\rm visc} + \boldsymbol{F}^{\rm Coriolis} + \boldsymbol{F}$$

Pencil Code

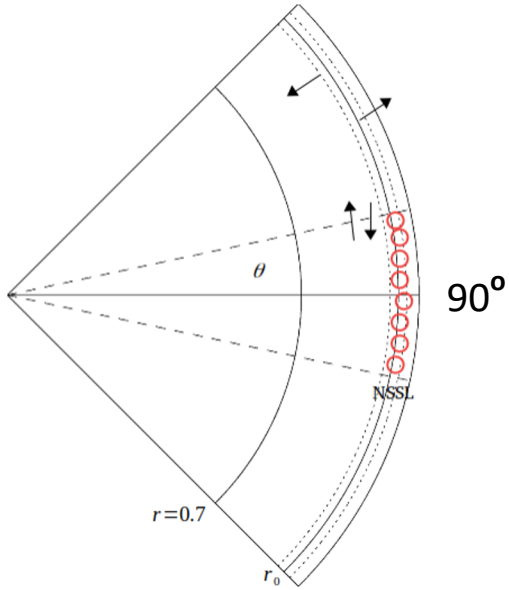
Table 1: Simulation parameters and their units set in the code. n_i is the number of mesh points.

parameter	value
n_r	128 $(0.7 \le r \le 1)$
n_θ	256 $(72° \le \theta \le 108°)$
n_ϕ	64 $(0° \le \phi \le 15°)$
ν	10^{-5}
c_s	1
f_0	0.02
g	3

Radius= 1.00

Width=0.02

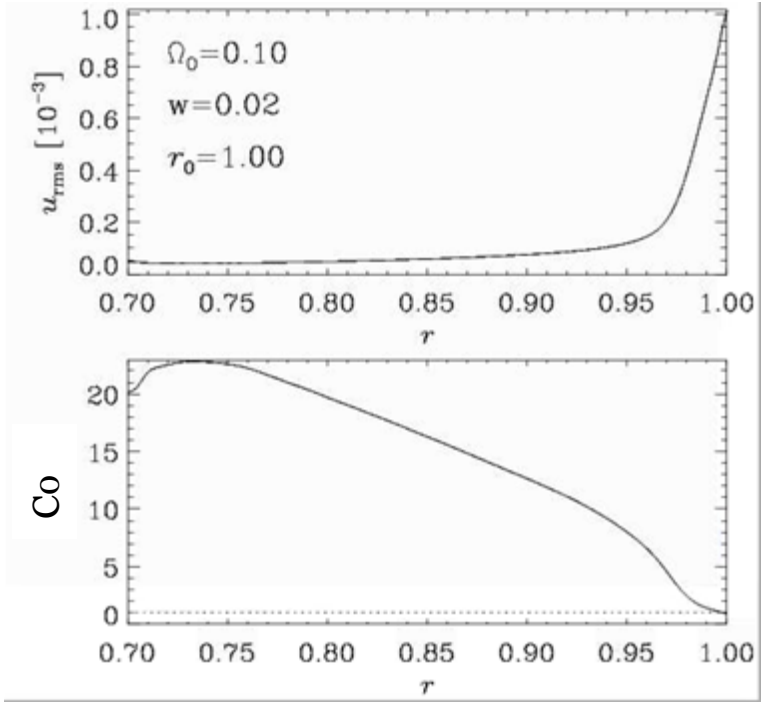
Forcing=0.10



Results

$$10^{-3} \leq Co(NSSL) \leq 1 \leq Co(CZ) \leq 10$$

- With my simulation setup, I was able reproduce the radial dependence of the Coriolis number.
- The trend is correct, but the values are larger than what was expected.



Conclusion and Future Work

- The radial dependency of the Coriolis number can be achieved with this simple set up

- For future work, I plan to continue with parameter studies allow for individual variables to be differed to obtain the expected Coriolis number profile
  - Parameters that I plan to study:
    - Forcing Width
    - Forcing Strength
    - Forcing Location
    - Rotation Rate

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