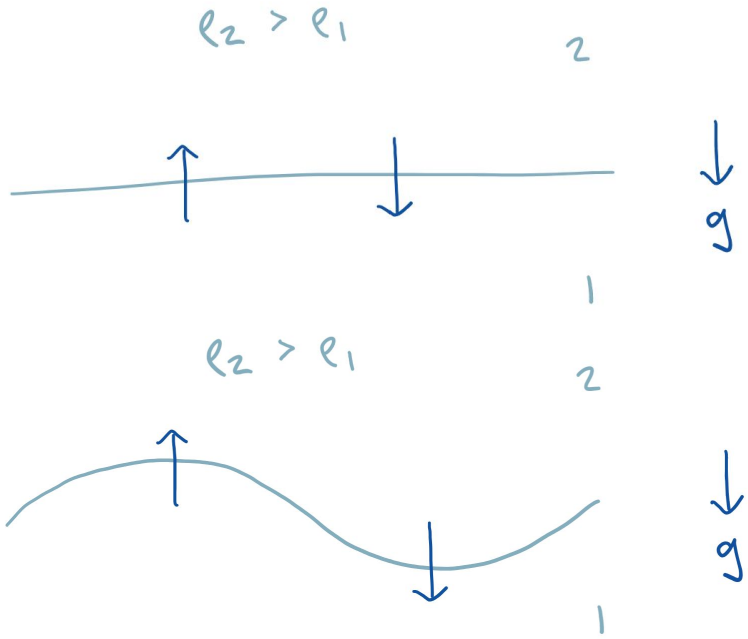
AOS 180

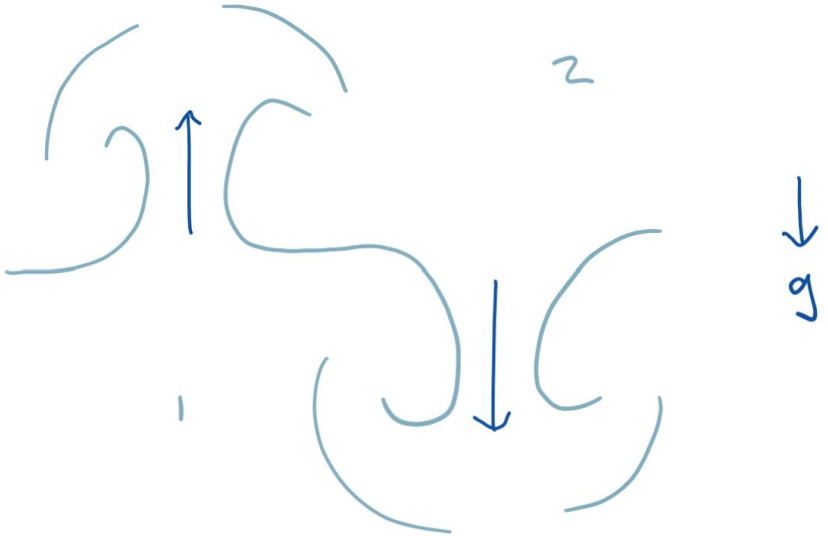
RAYLEIGH-TAYLOR INSTABILITY

HANNAH LE

WHAT IS IT?

instability between two fluids of different densities





MY SETUP

spatial derivatives

- second-order centered finite differences

time advancement

- advection/buoyancy: leapfrog scheme
- diffusion: euler-forward

poisson solver

- SOR with estimated optimal α and tol = 1e^-8

parameters

- Lx = 800m, Lz = 2000m
- initial temperature = 300 K
- dtemp = 1 K
- total time = 500 s
- dt = 0.05s

REFERENCE :D

Late-time quadratic growth in single-mode Rayleigh-Taylor instability

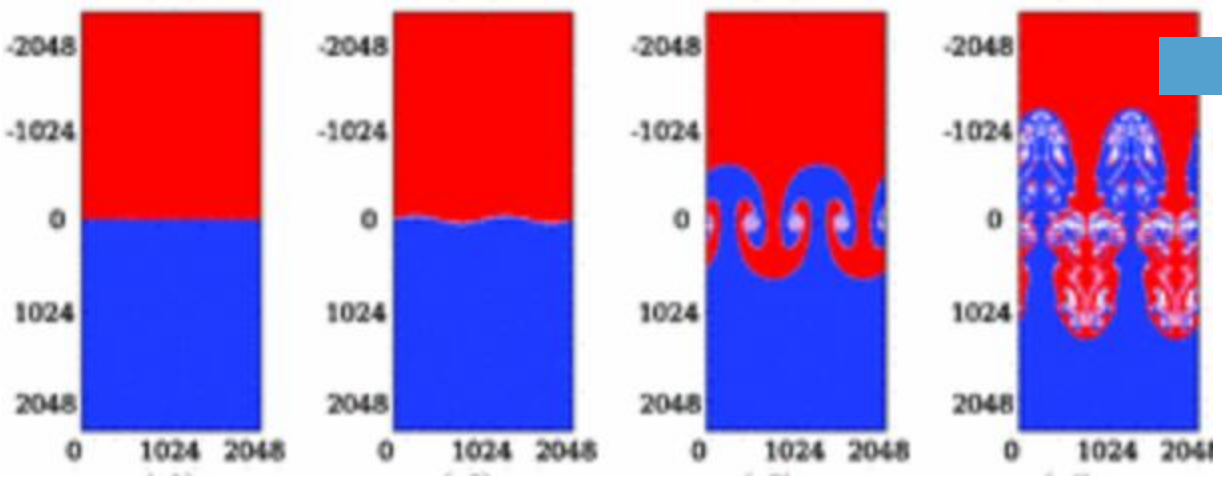
by Tie Wei and Daniel Livescu

spatial derivatives

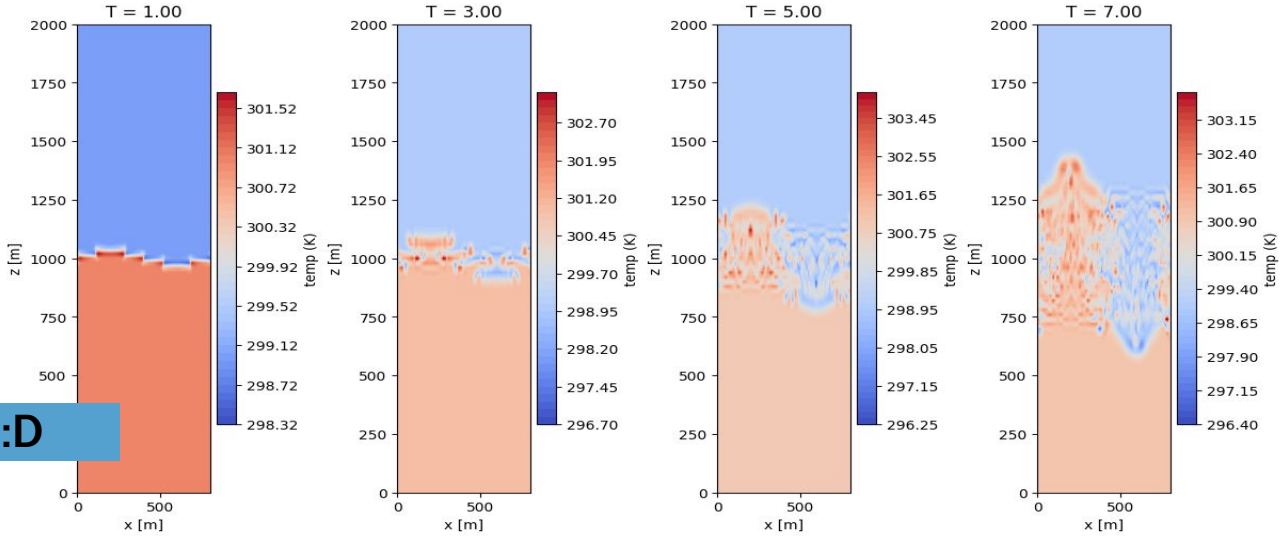
- sixth-order compact finite differences (vertical) and spectral differences (horizontal)

time advancement

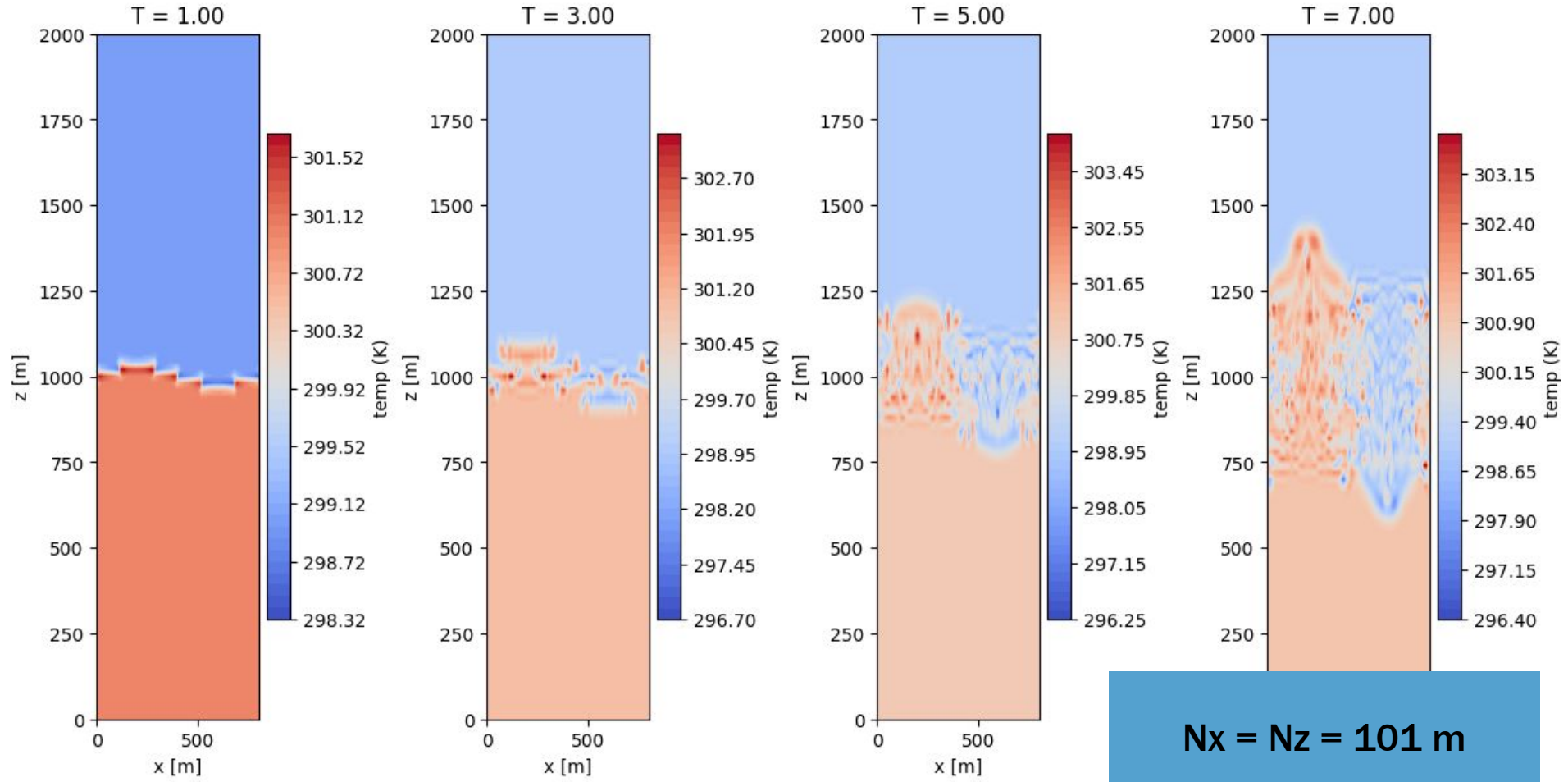
- third-order predictor corrector adams-bashforth-moulton



theirs



mine :D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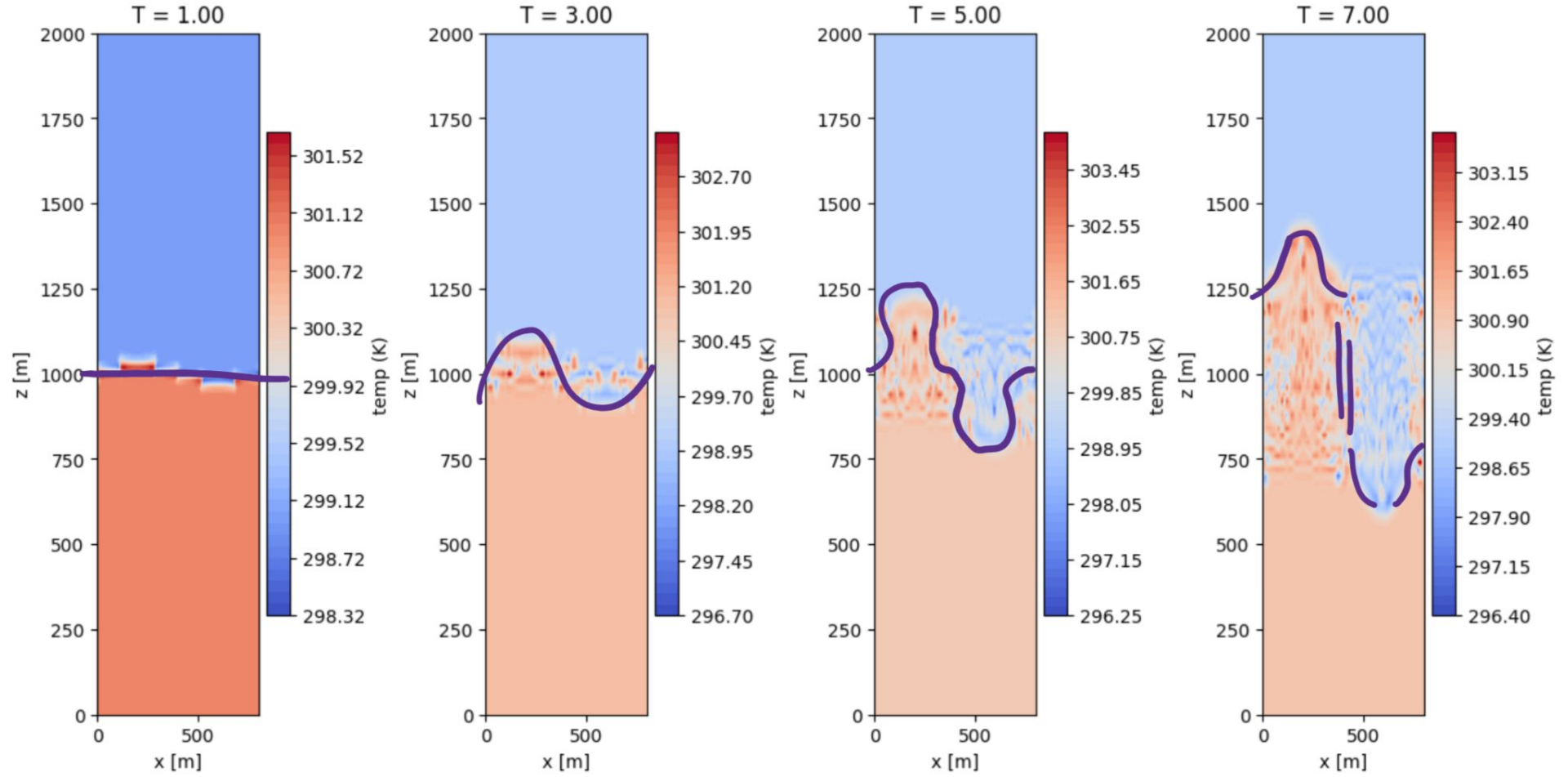
T = 3.00
T = 5.00
T = 7.00
z [m]
x [m]
temp (K)
2000
1750
1500
1250
1000
750
500
250
0
500
301.52
301.12
300.72
300.32
299.92
299.52
299.12
298.72
298.32
302.70
301.95
301.20
300.45
299.70
298.95
298.20
297.45
296.70
303.45
302.55
301.65
300.75
299.85
298.95
298.05
297.15
296.25
303.15
302.40
301.65
300.90
300.15
299.40
298.65
297.90
297.15
296.40

Nx = Nz = 101 m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T = 3.00
T = 5.00
T = 7.00
z [m]
x [m]
temp (K)
2000
1750
1500
1250
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0
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301.52
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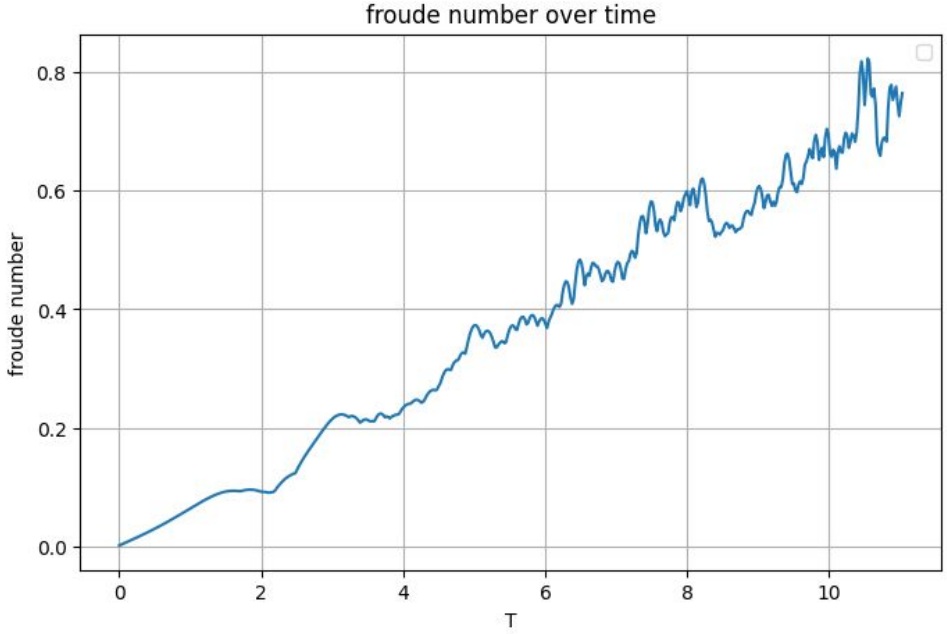
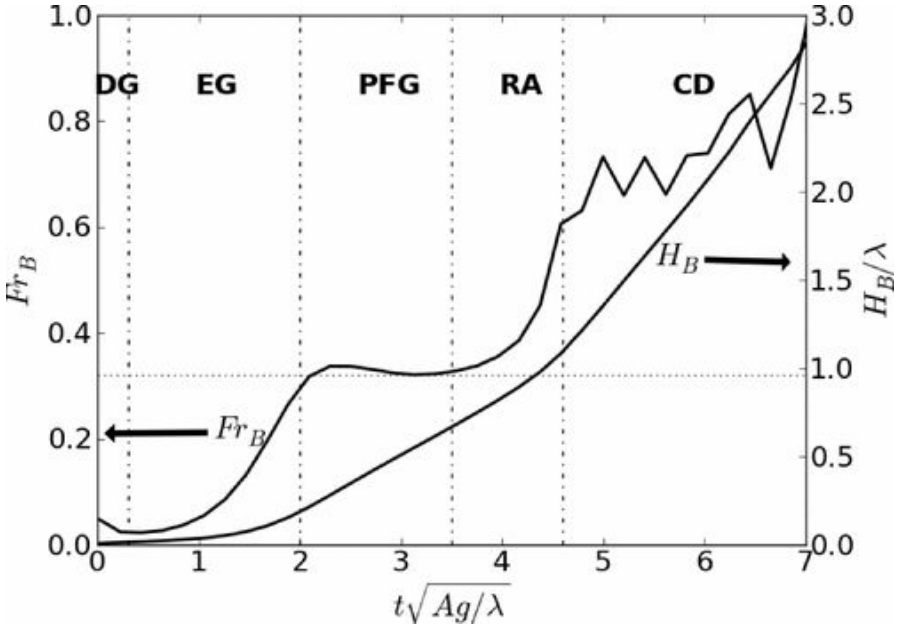
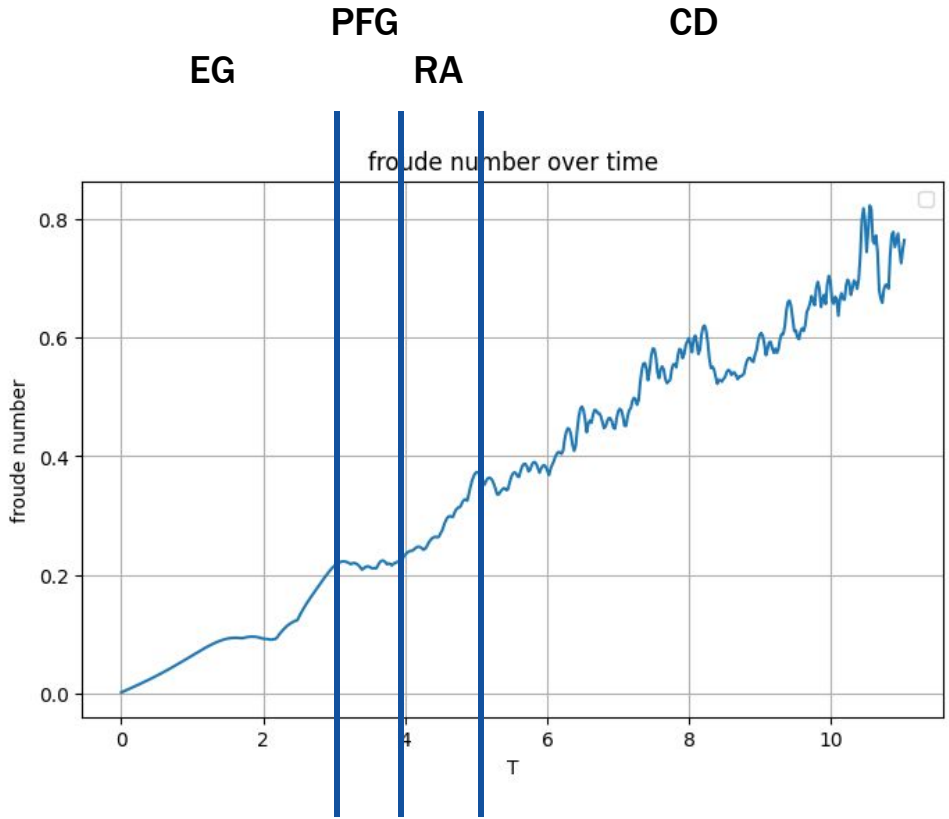
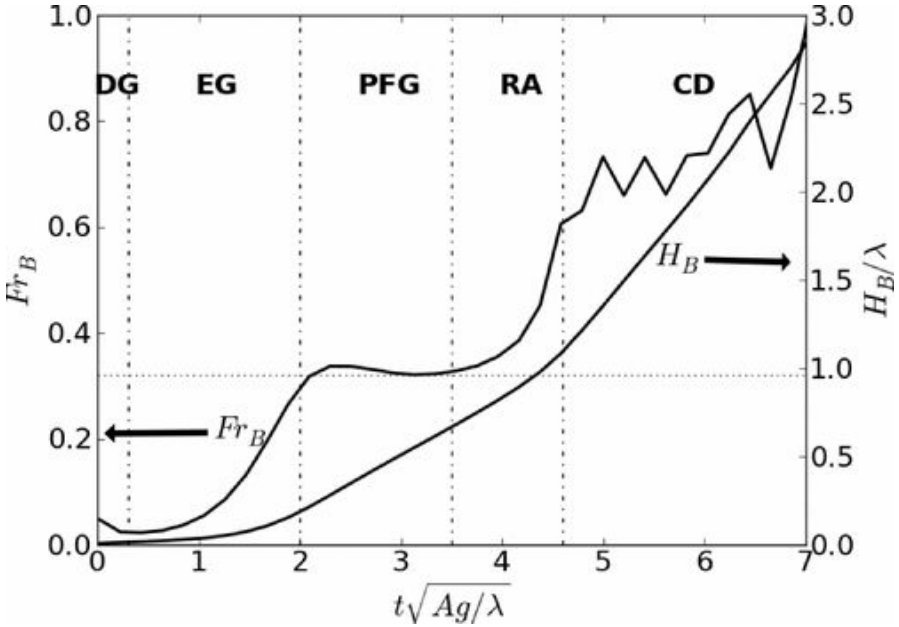

froude number over time
froude number
T
0.0
0.2
0.4
0.6
0.8
0
2
4
6
8
10


DG
EG
PFG
RA
CD
Fr_B
H_B
H_B/λ
$t\sqrt{Ag/\lambda}$
0.0
0.2
0.4
0.6
0.8
1.0
0.5
1.5
2.0
2.5
3.0
0
1
2
3
4
5
6
7


PFG
CD
EG
RA
froude number over time
froude number
T
0.0
0.2
0.4
0.6
0.8
0
2
4
6
8
10


DG
EG
PFG
RA
CD
Fr_B
H_B
H_B/λ
$t\sqrt{Ag/\lambda}$
0.0
0.2
0.4
0.6
0.8
1.0
0.5
1.5
2.0
2.5
3.0
0
1
2
3
4
5
6
7

LIMITATIONS

- my poisson solver sucks
- only able to run on coarse grid, finer grid took too much time (also blew up)
- wasn’t able to experiment much with artificial diffusion, etc. (it blew up)

THANK YOU!