Timing Comparisons for

- WACCM3
- WACCM3-GHG
- CAM3

by S. Waters (27 Sep 2006)

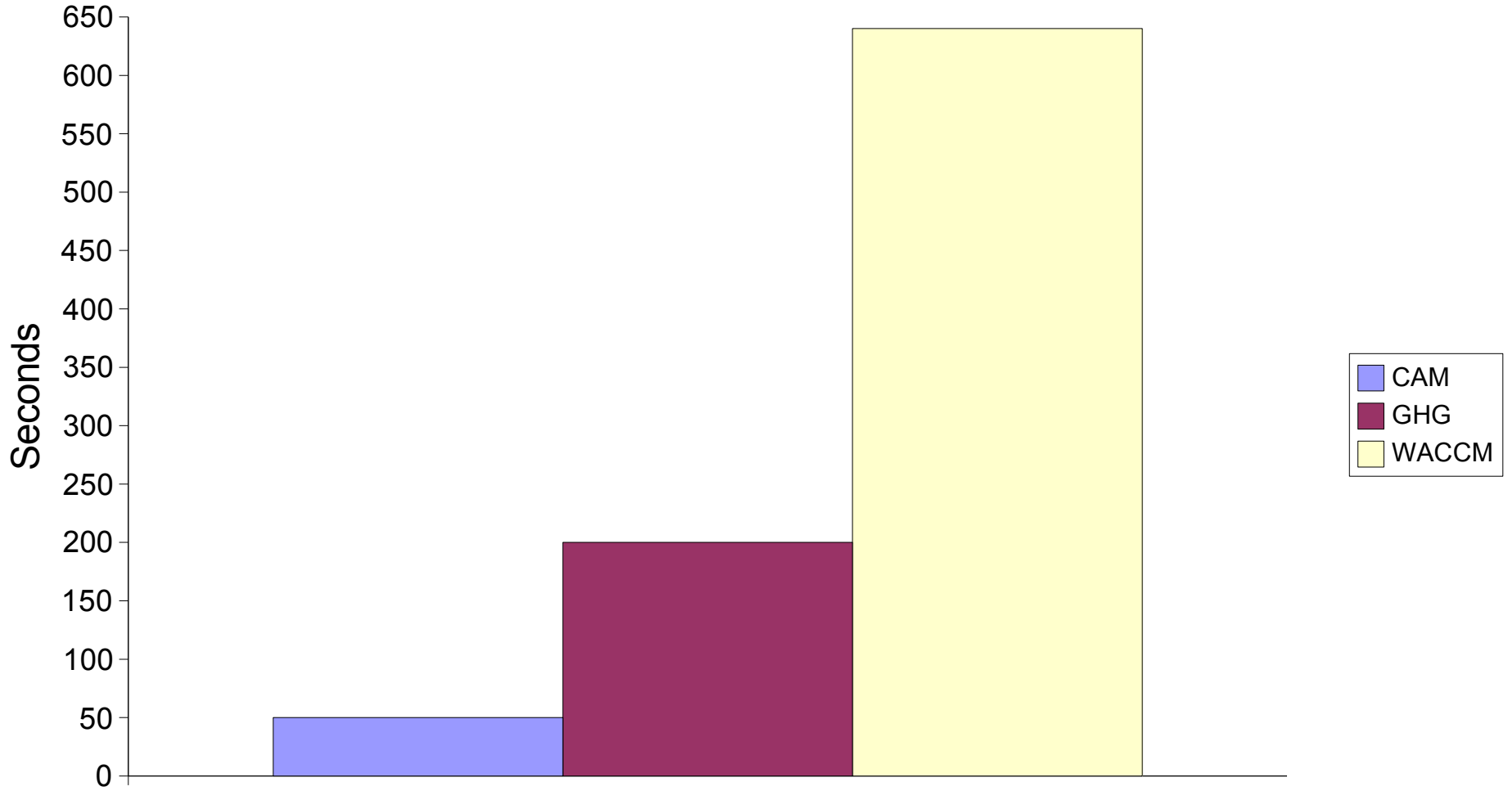
In Common ...

- One day simulation starting Jan 1
- 144 x 96 horizontal resolution
- 1d domain decomposition
- 16 mpi processes; 2 threads per process
- Dynamic sub time step = 3.75 min (nsplit=8)
- Solar min
- Load balanced (day/night)
- Run on single 32 cpu bluesky node

Differences ...

Model	Levels	Adv Species	Chm Species
CAM	26	3	0
GHG	66	11	4
WACCM	66	63	57

Overall Timing

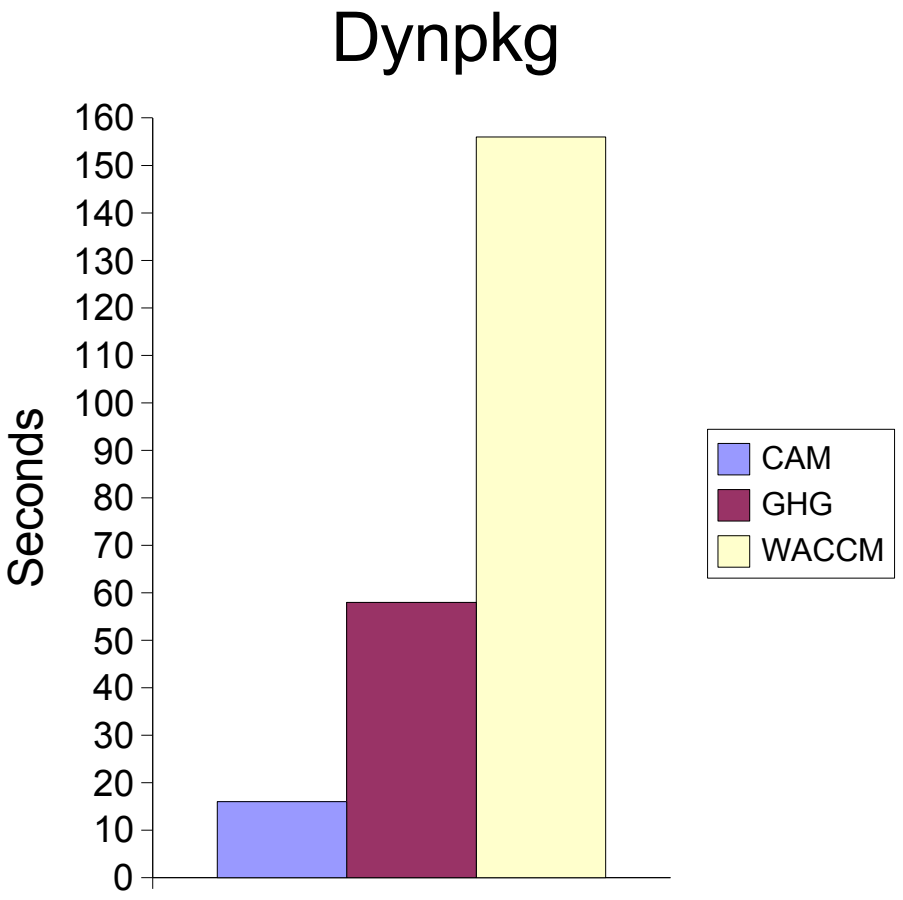


Main Timing Components

- Dynamics
- Heating rates
- Chemistry

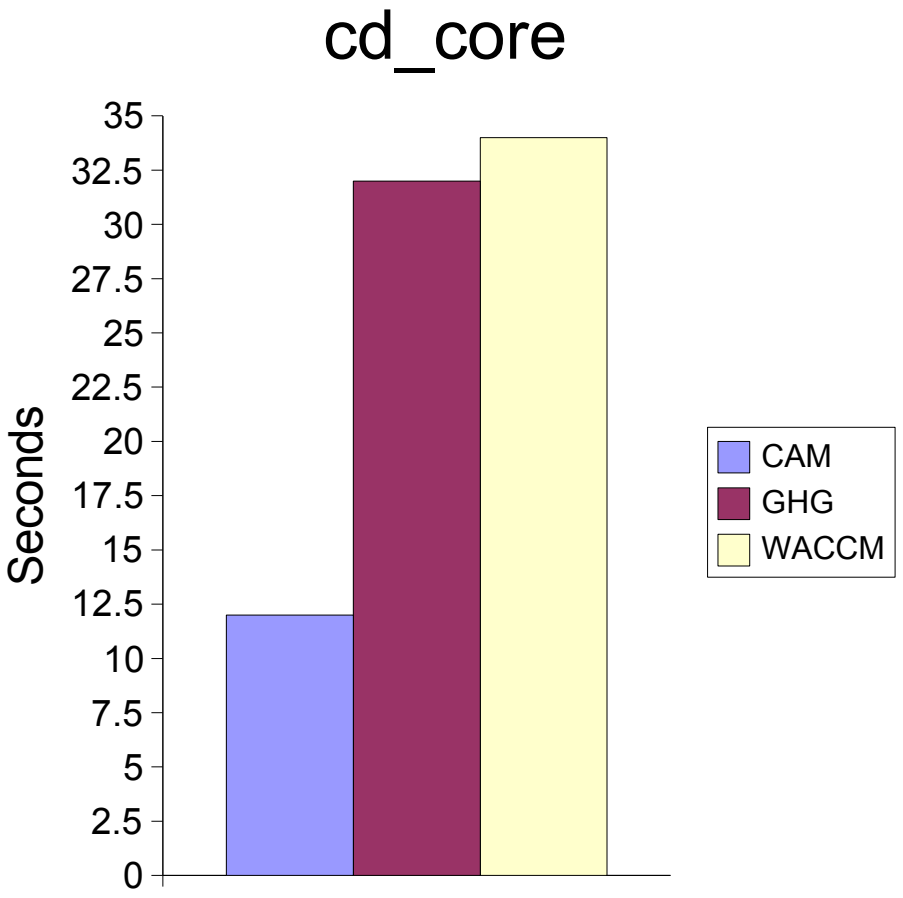
Dynamics timing

- Dynpkg has ...
  - cd_core
  - trac2d



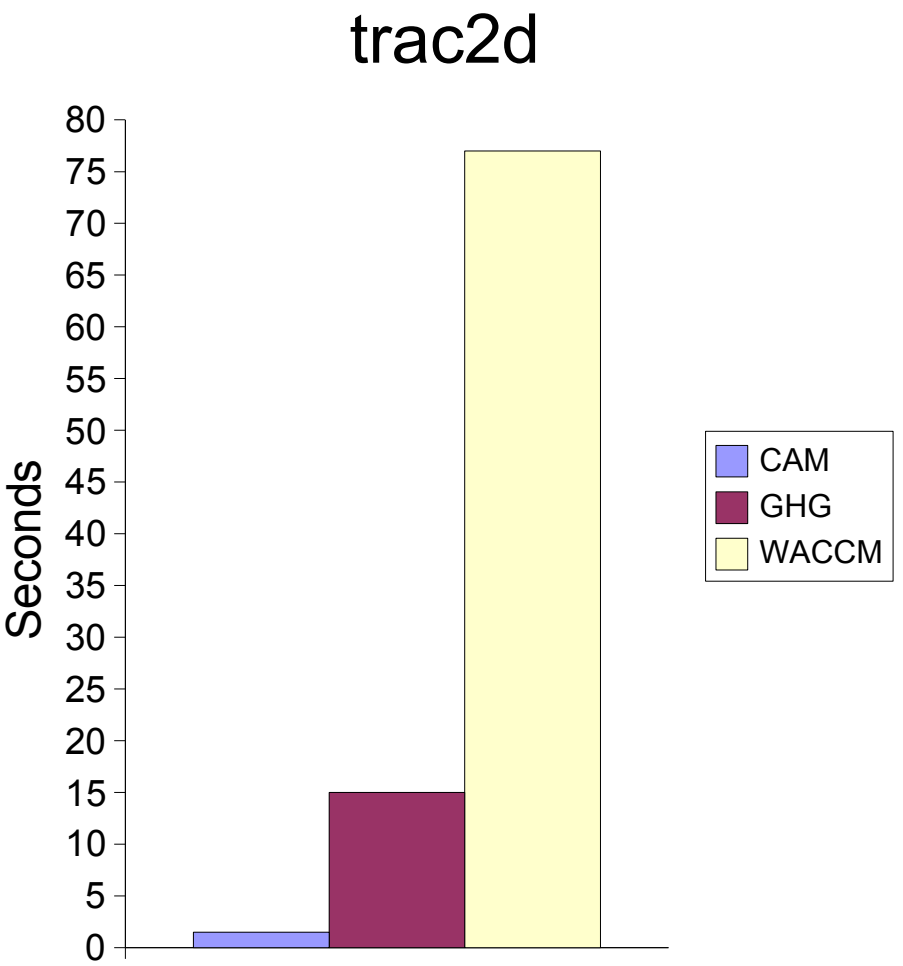
Dynamical core (u,v,p)

- Scales by vert levels
- GHG,WACCM similar
- WACCM/CAM ~ 2.6 (66/26 = 2.54)



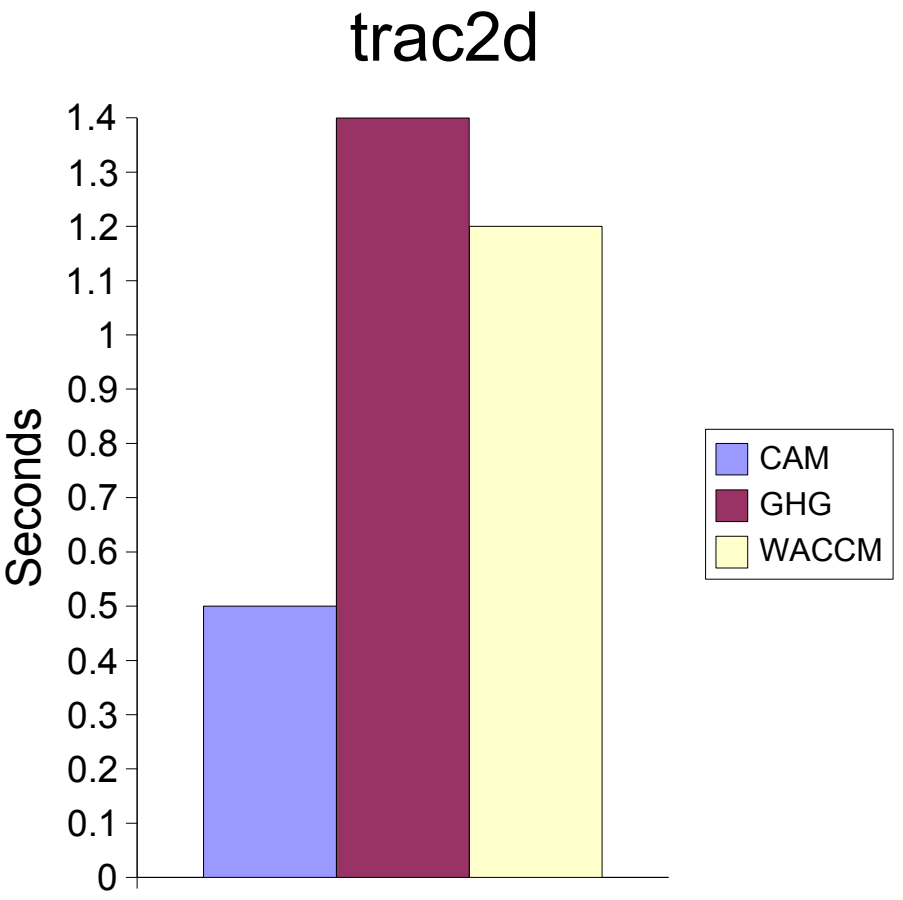
Advection

- Scales by product
  - Species count
  - Vert level count



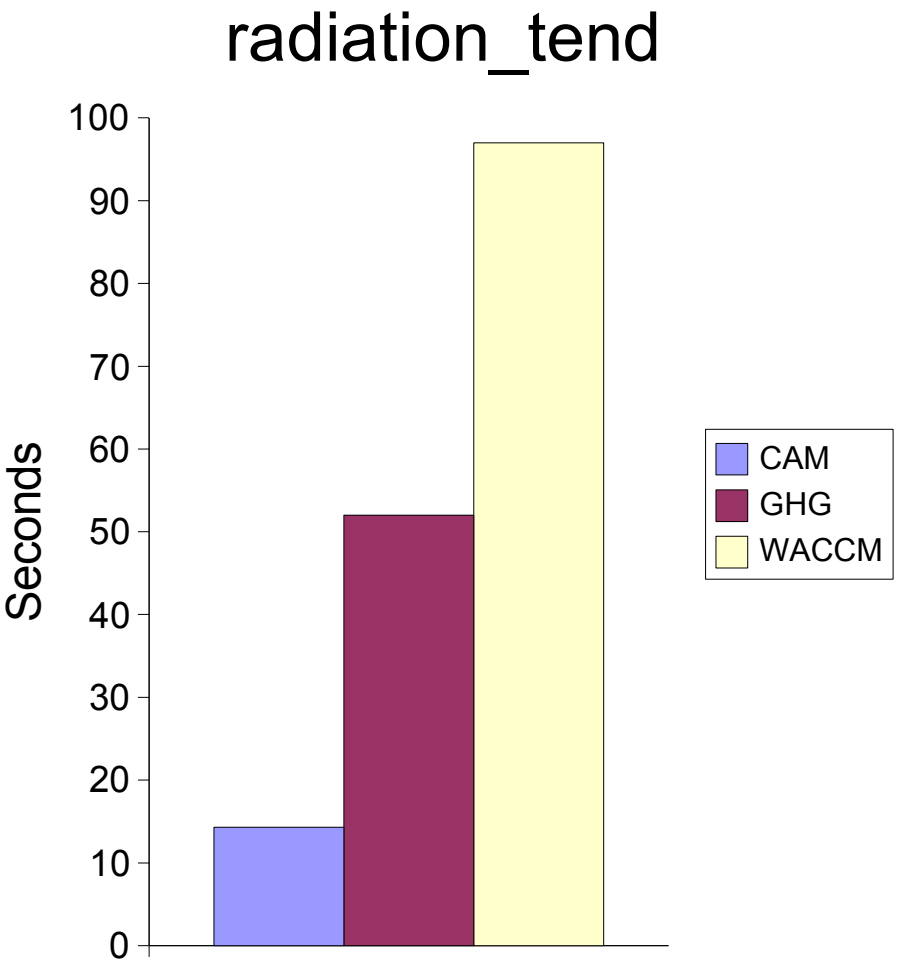
Advection per species

- Differences due to vert level count
- GHG,WACCM similar
- WACCM/CAM ~ 2.7 (66/26 = 2.54)



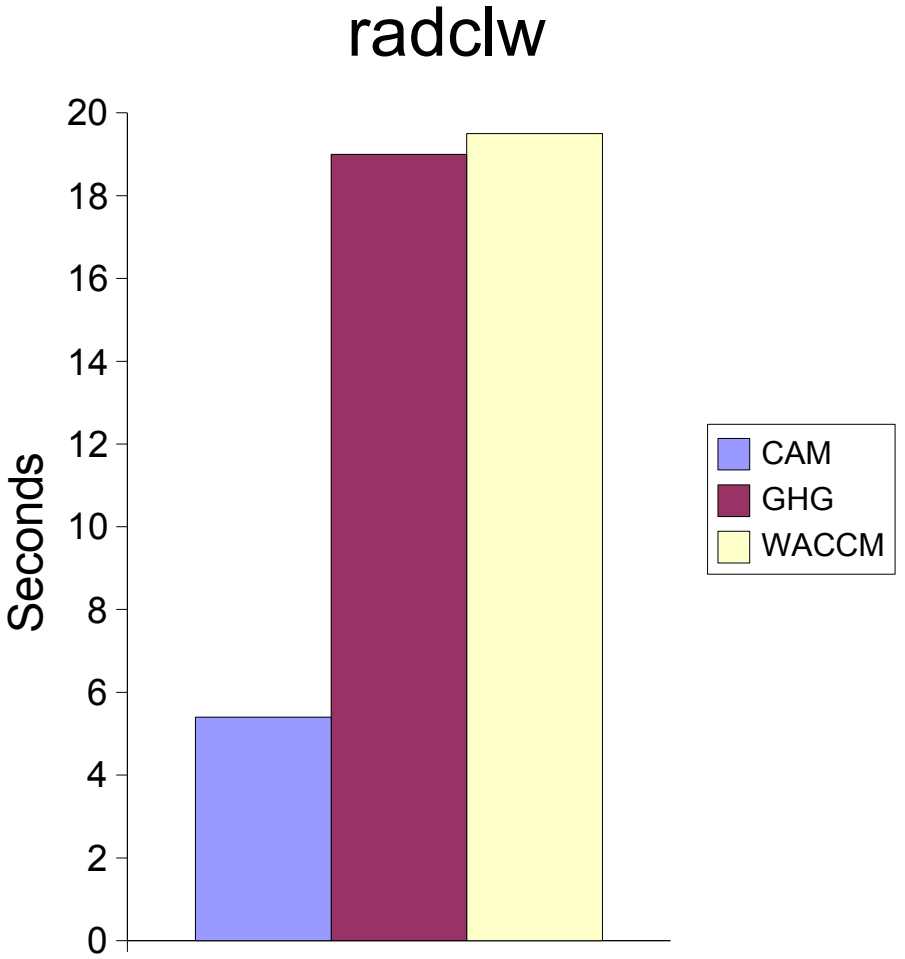
Heating timing

- All models have ...
  - radcsw
  - radclw
- GHG, WACCM have .
  - nlte
- WACCM has ...
  - hrates



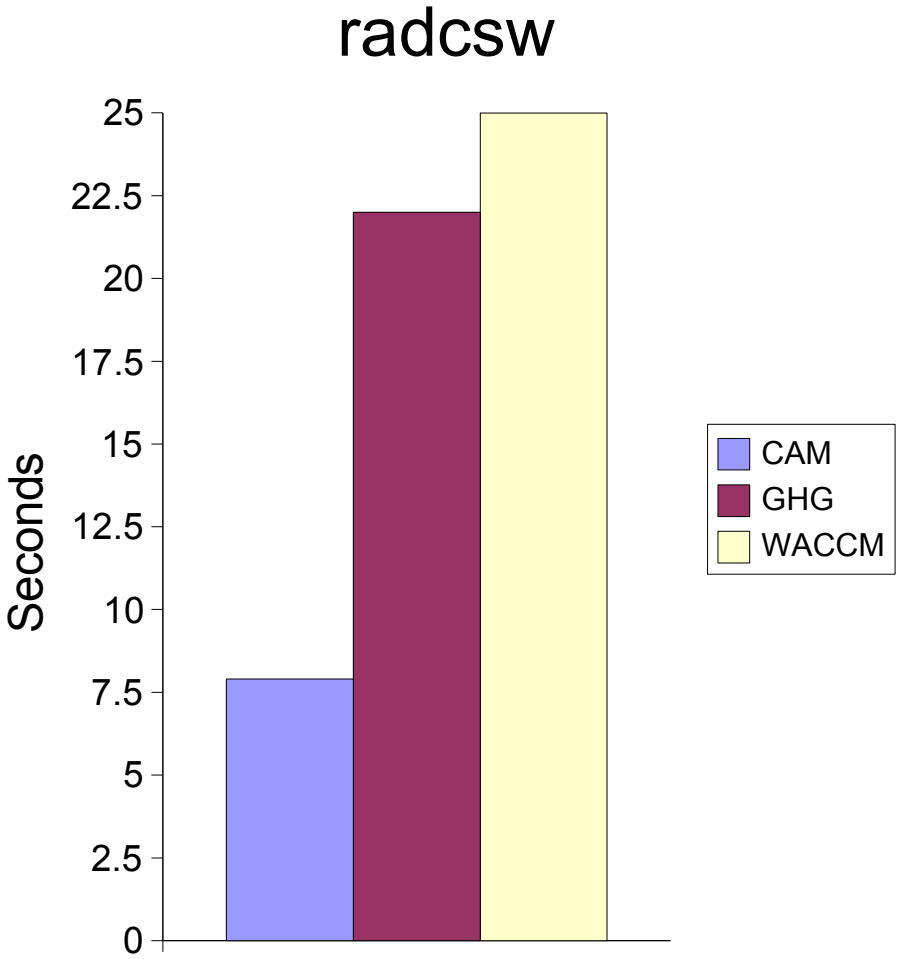
Long wave radiation

- GHG,WACCM similar
- Not linear with vertical levels
- WACCM/CAM ~ 3.55
- ~ (vert levs) ** 2



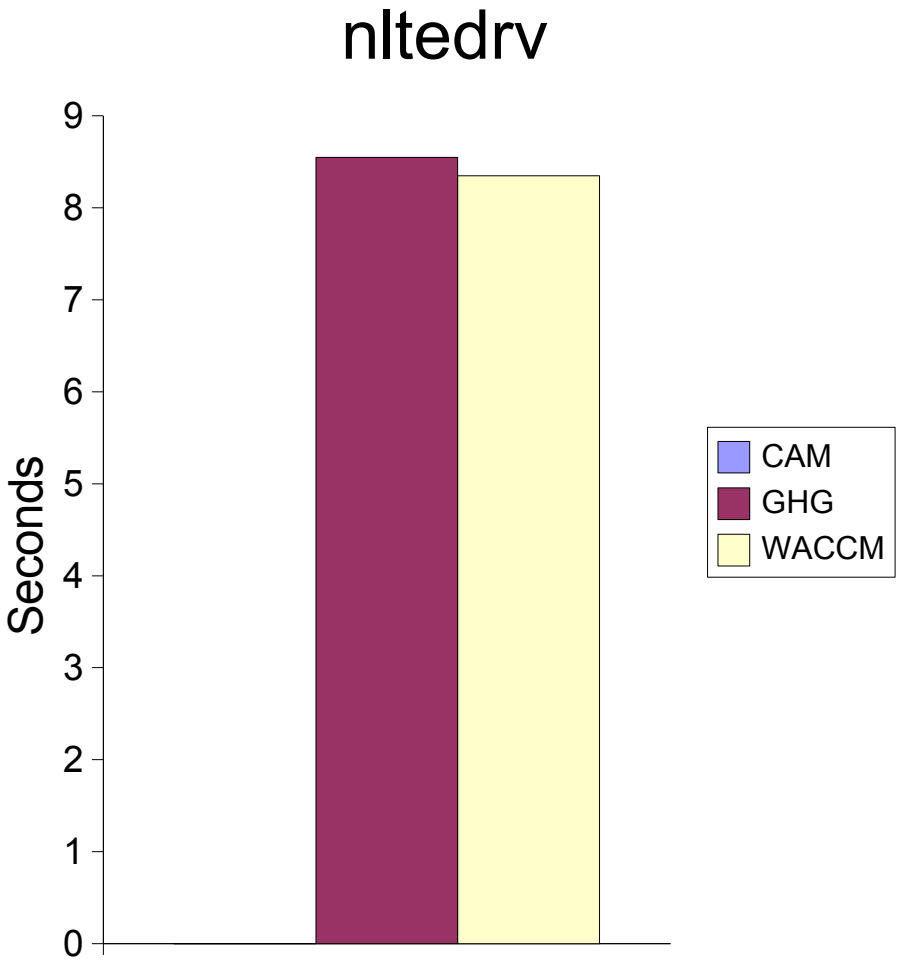
Short wave radiation

- GHG,WACCM similar
- WACCM/CAM ~ 3



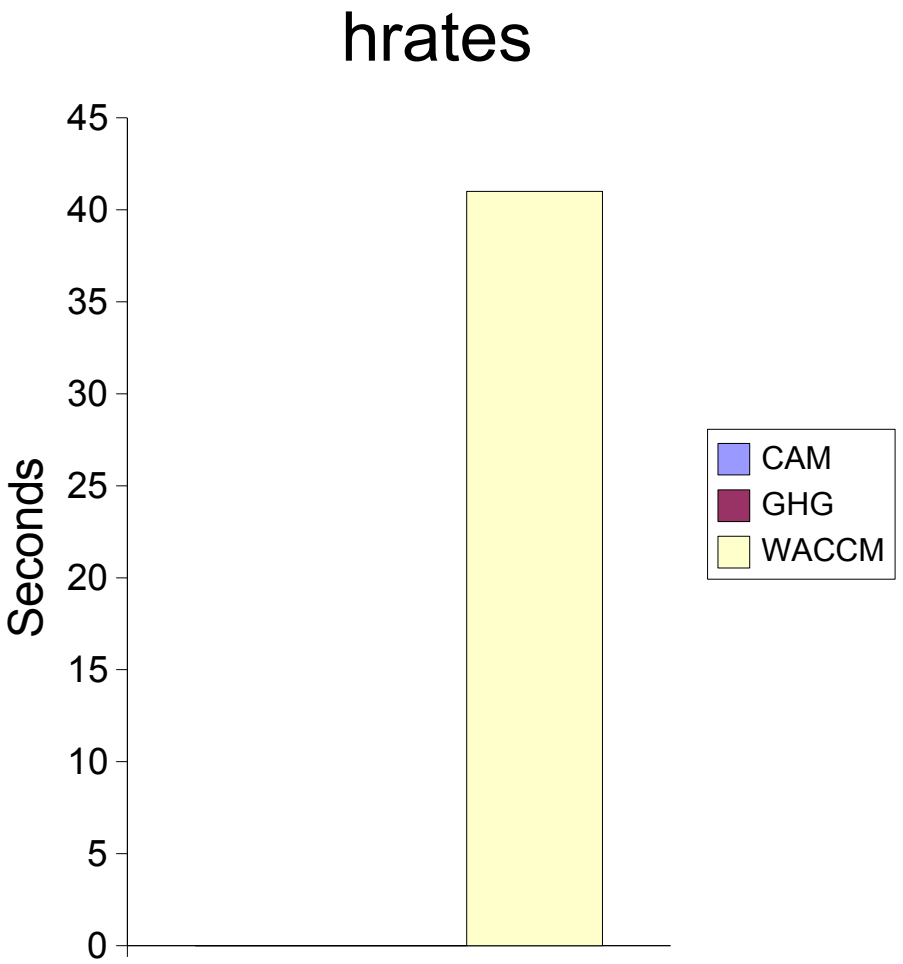
NLTE

- GHG,WACCM similar



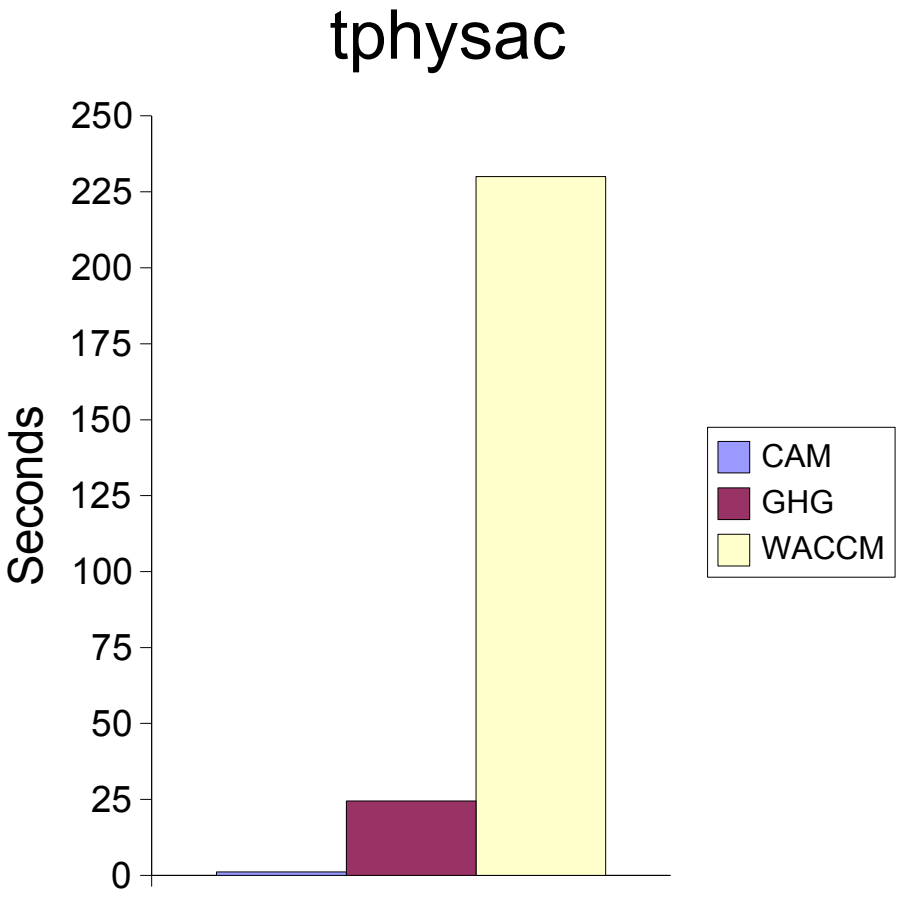
Chem Heating

- Only for WACCM



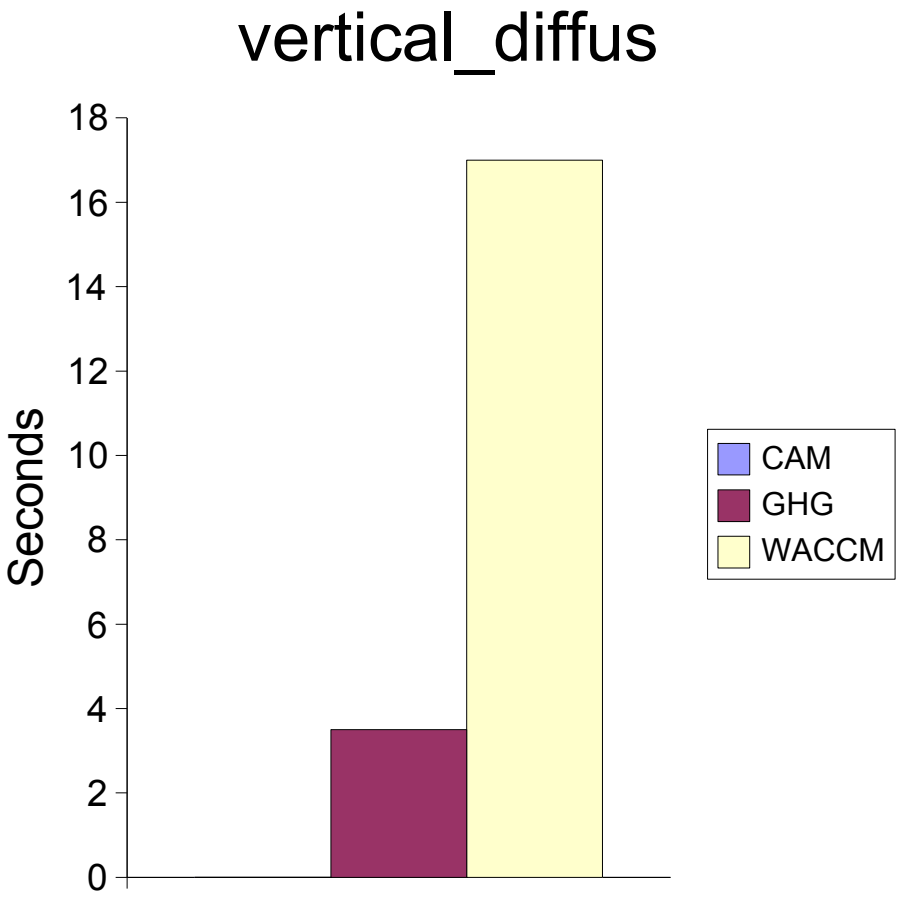
Vert xport, Chemistry timing

- tphysac has ...
  - vert diffusion
  - gravity waves
  - chemistry



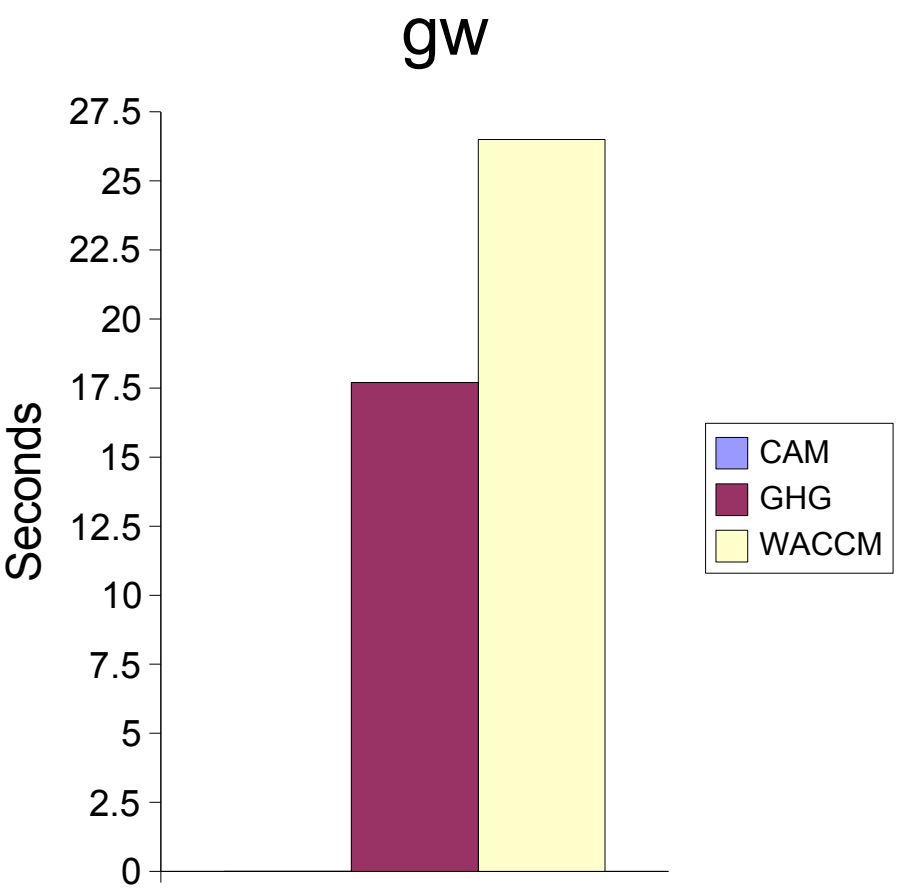
Vertical diffusion

- Scales with species count
- WACCM/GHG ~ 4.9 (63/11 = 5.7)



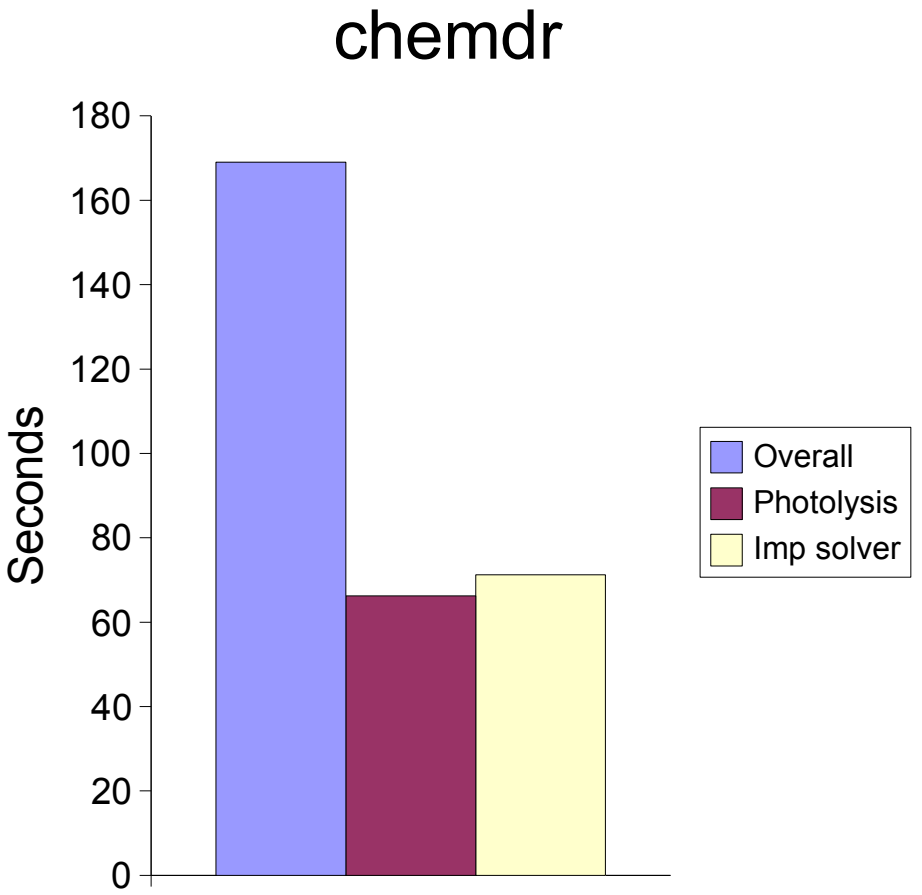
Gravity wave transport

- Scaling
  - Part with vert levels
  - Part with vert levels x species count
- WACCM/GHG ~ 1.5

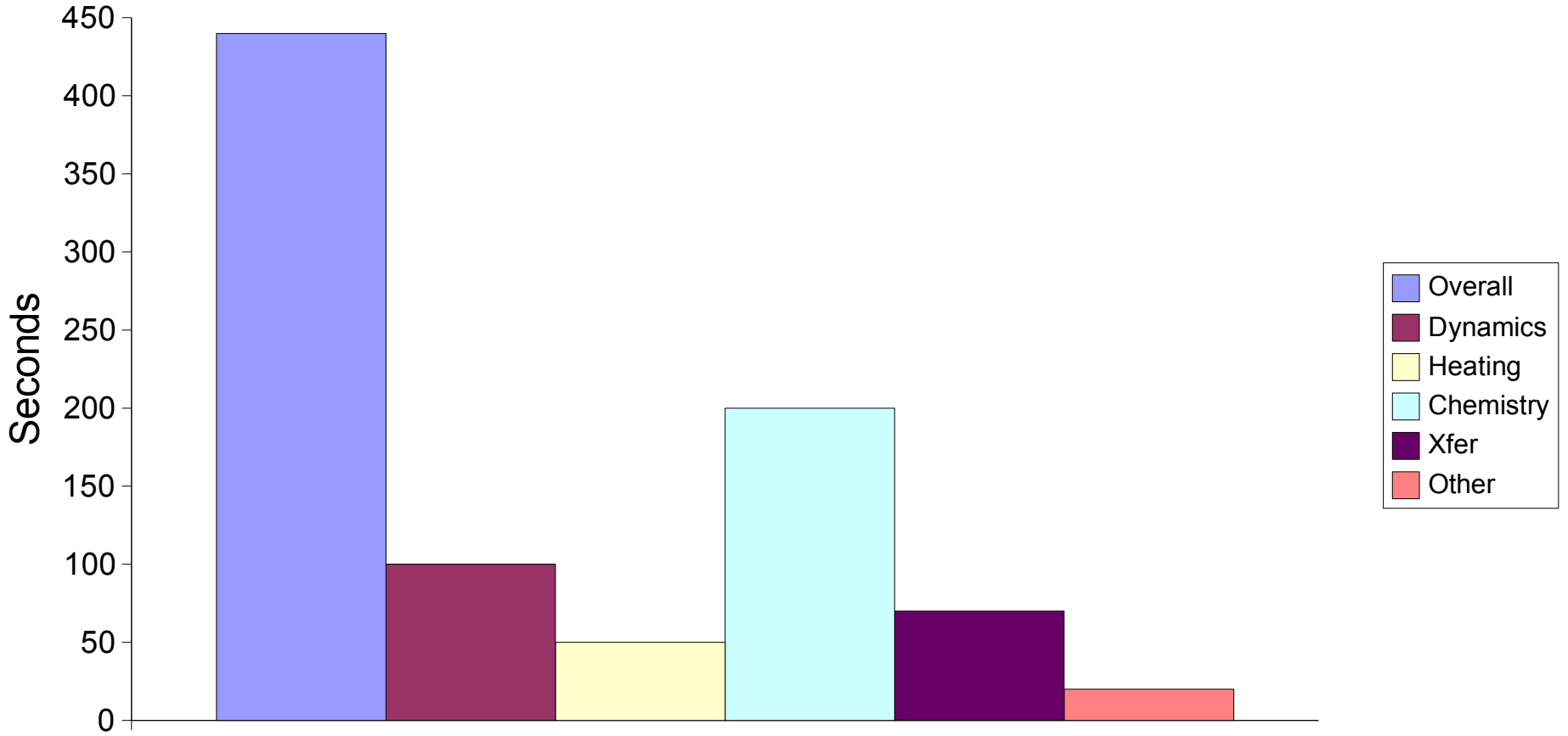


Chemistry in WACCM

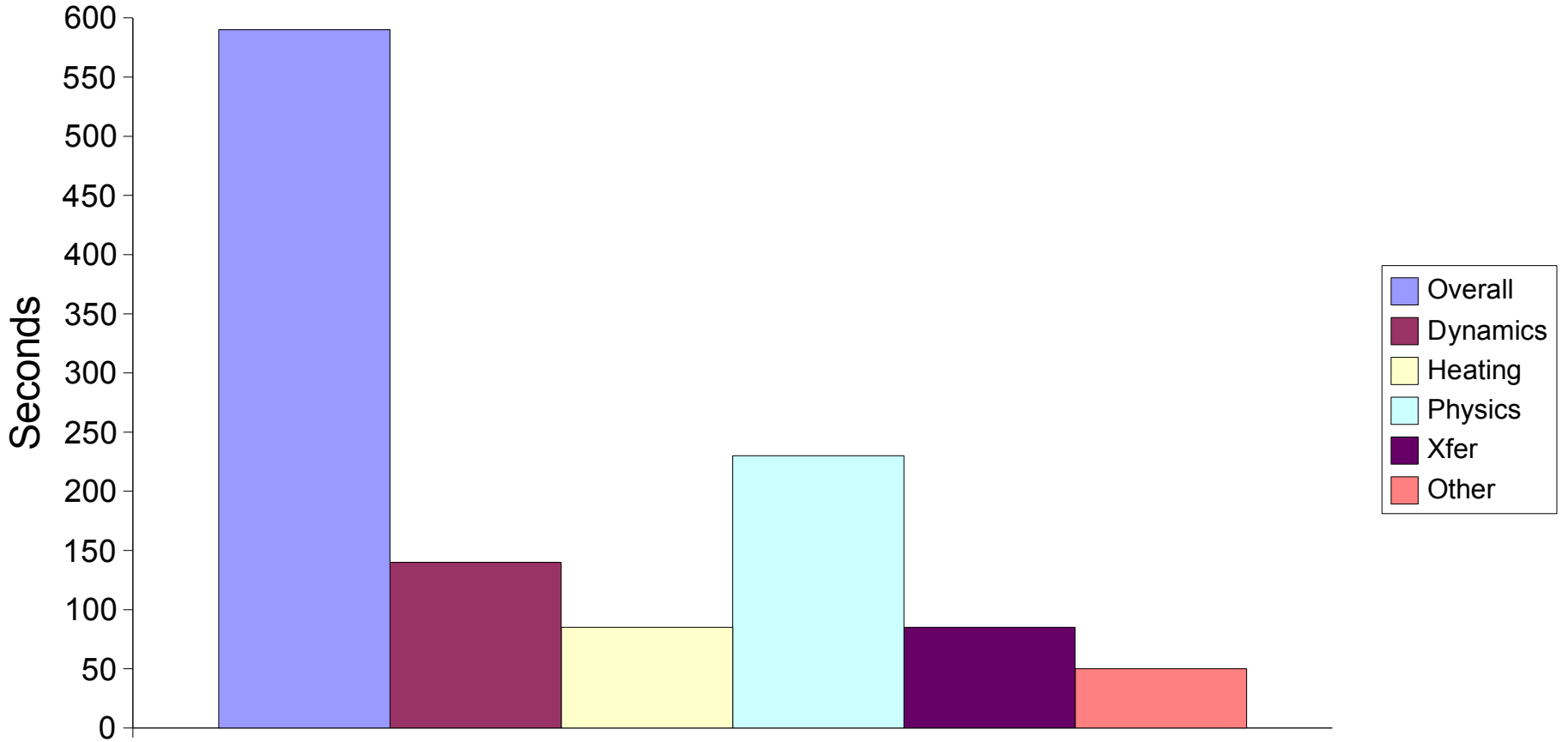
- CAM non-existent
- GHG negligible



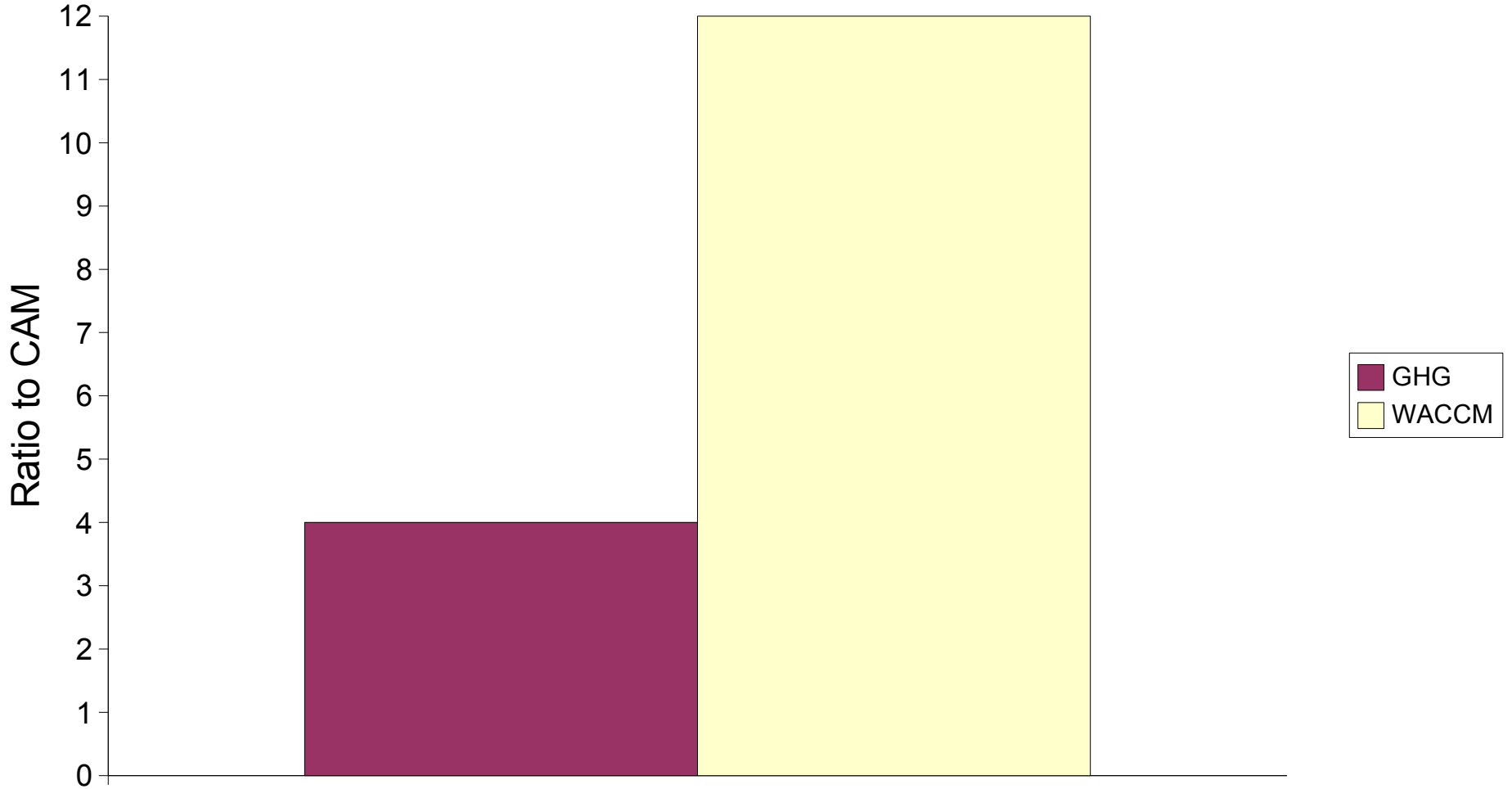
(WACCM – GHG) Differential



(WACCM – CAM) Differential



Overall Timing



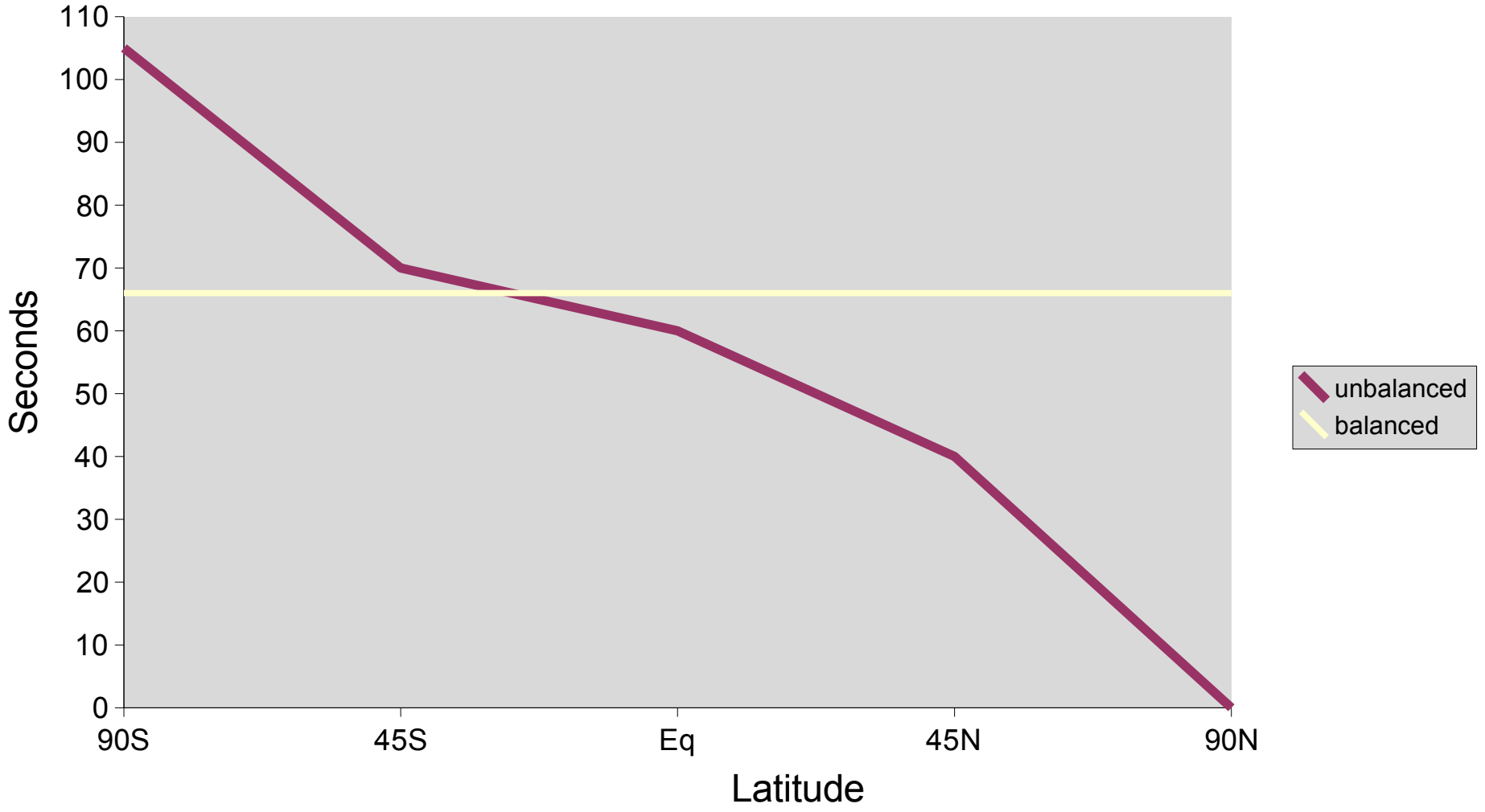
Model Timings
(seconds)

Process	*Cam*	*Ghg*	*Waccm*
Dynamics	**16**	**58**	**156**
Core	12	32	34
Advection	1.5	15	77
Heating	**14.3**	**52**	**97**
Long wave	5.4	19	19.5
Short wave	7.9	22	25
Nlte	0	8.6	8.4
Chm	0	0	41
Tphysac	**1**	**24.5**	**230**
Vdiff	0	3.5	17
Grav Waves	0	18	26.5
Chemistry	0	0	169

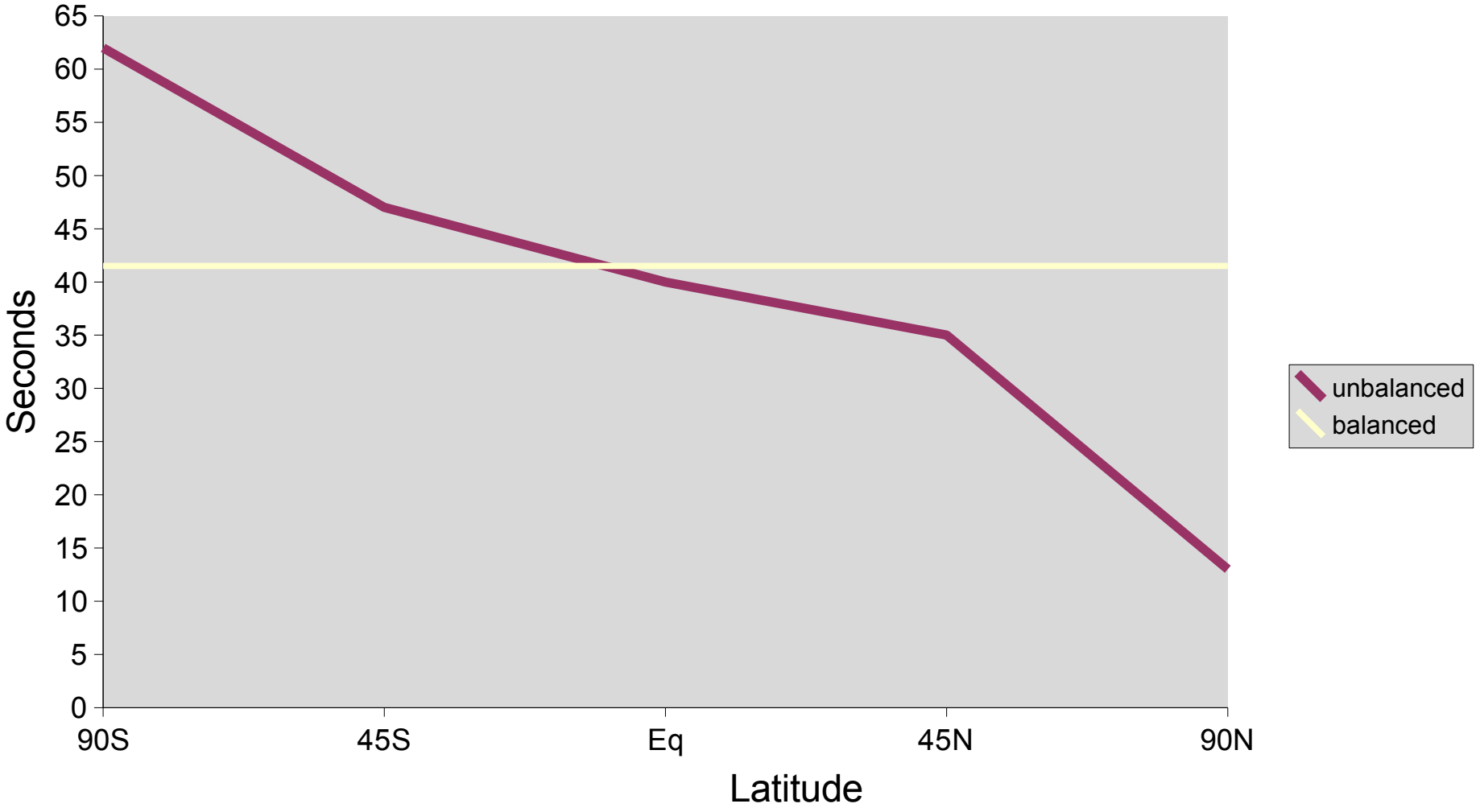
A matter of Balance ... (*without load balancing*)

- **Balanced**
  - dyn core, advection
  - long wave rad, nlte
- **Reasonably balanced**
  - implicit solver
- **Unbalanced**
  - photolysis, chem heating, short wave heating

Photolysis


110
100
90
80
70
60
50
40
30
20
10
0
Seconds
90S
45S
Eq
45N
90N
Latitude
unbalanced
balanced

Chem heating



What else ?

- Test 2d decomposition
- Explore increasing cpu counts
- Suggestions