Orbital Mechanics and the Chandler Wobble

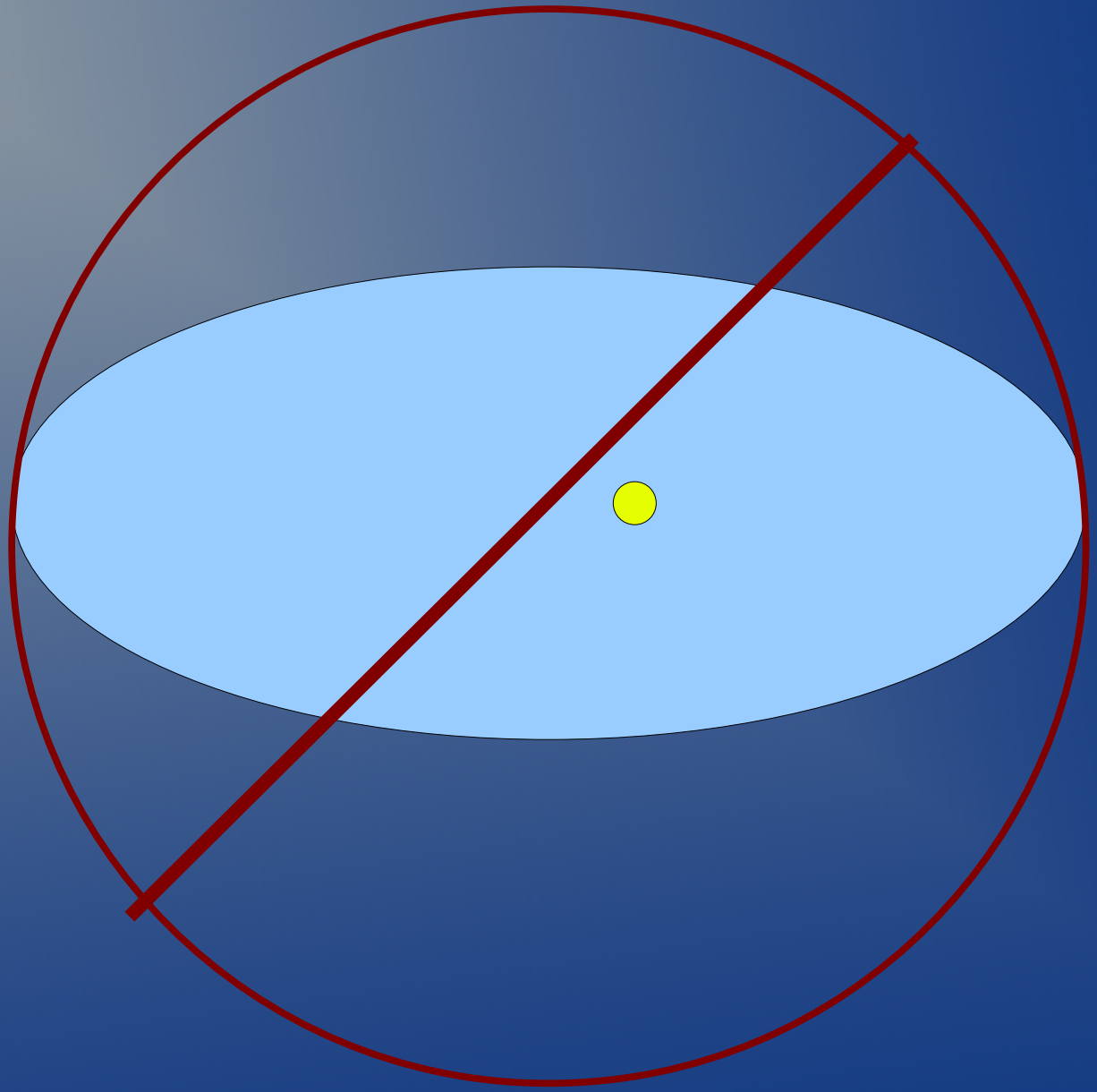
Robert.Grumbine@gmail.com

- History
- Orbital mechanics
- Earth orientation and rotation
- Meteorology/oceanography
- Interconnections
- Conclusions
- Future

History

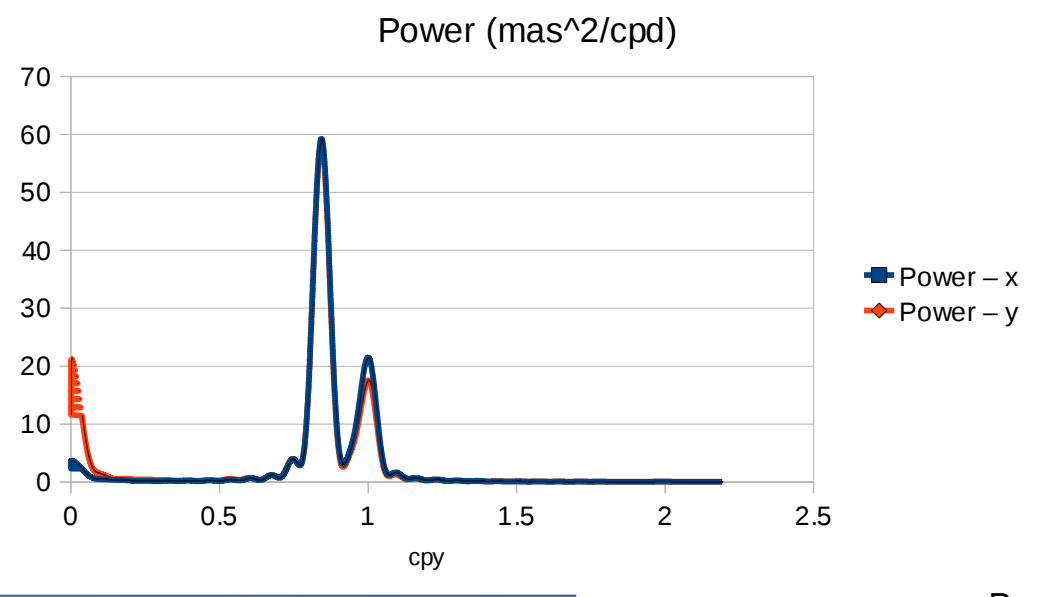
- Euler 1755
- Bessel, Peters 1840s
- Chandler 1891
- Newcomb 1892
- ... Munk and MacDonald, 1960; Lambeck, 1980
- Gross, 2000; O’Connor, 2000

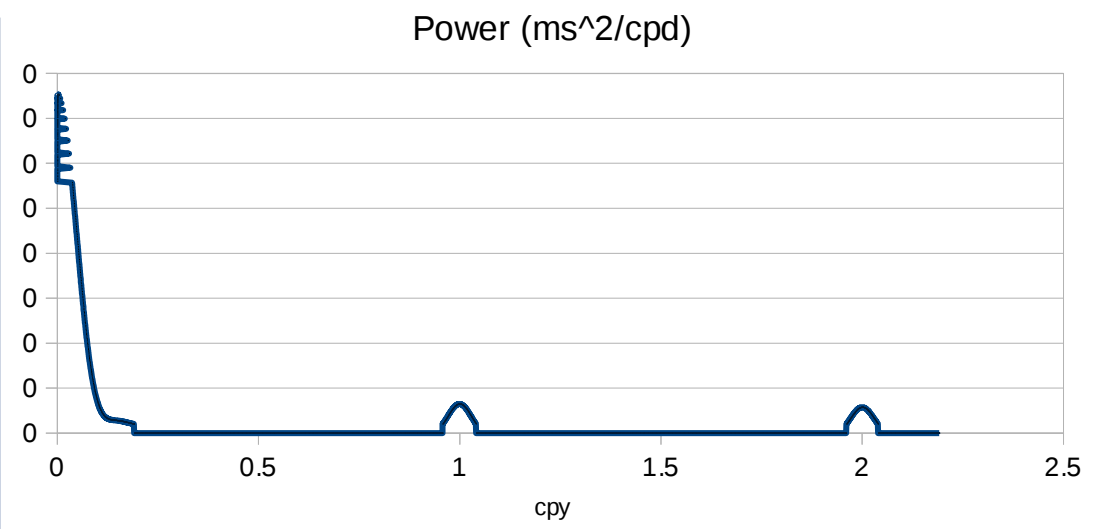
Orbital Mechanics



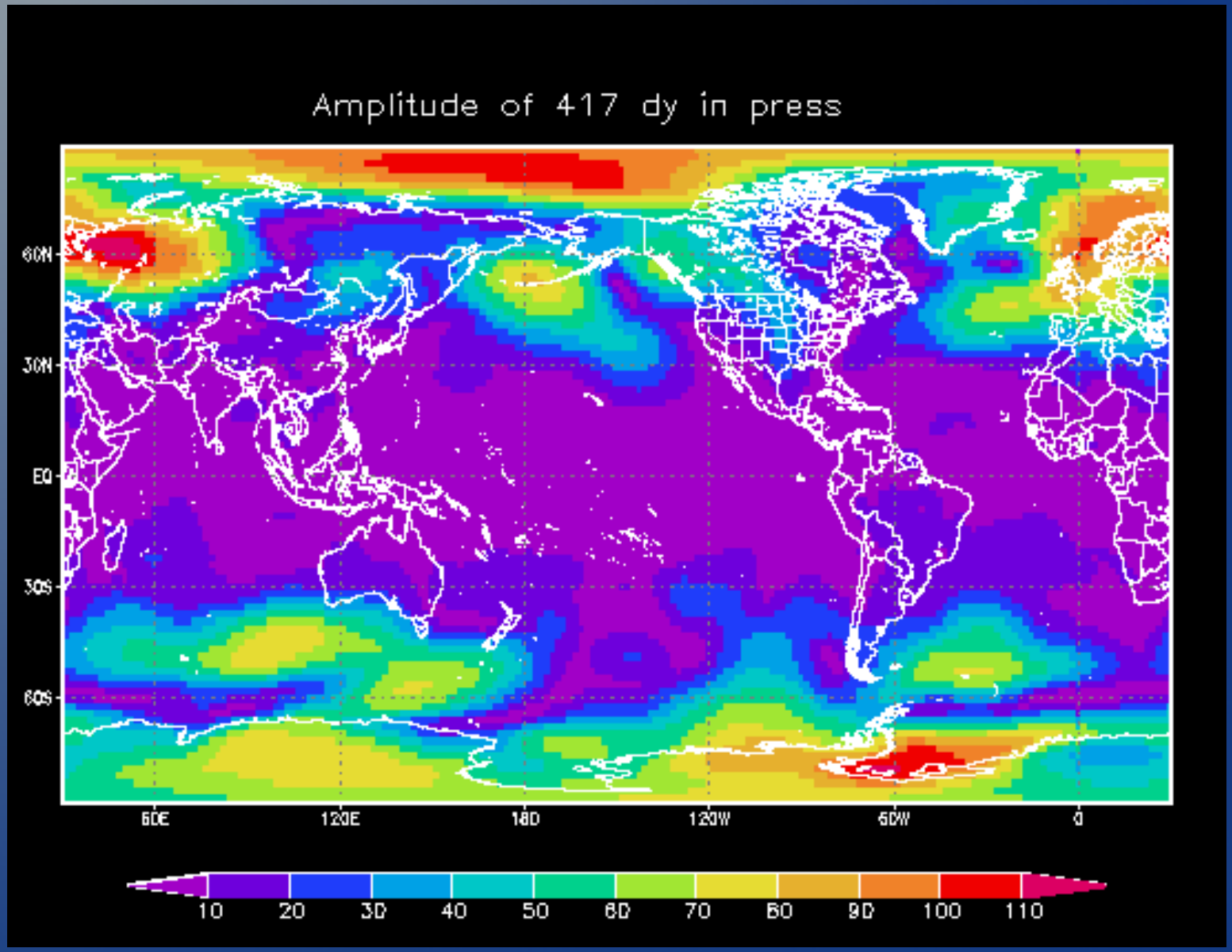
Frequency (cpd)	Amplitude (10^{-6} AU)	Phase	Period (dy)	Code M	T	A	V	J
0.002737778	16713.64	-177.7	365.26	0	0	1	0	0
0.005475557	139.66	-175.5	182.63	0	0	2	0	0
0.033863141	30.83	-29.1	29.53	1	-1	0	0	0
0.003425111	16.57	-147.0	291.96	0	-2	0	2	0
0.002506994	16.14	141.0	398.88	0	1	0	0	-1
0.005013988	9.46	140.5	199.44	0	2	0	0	-2
0.001712556	5.16	99.0	583.92	0	-1	0	1	0
0.002276185	4.14	65.7	439.33	0	1	0	0	-2
0.002399864	3.69	12.4	416.69	0	-4	0	3	0
0.000687308	3.17	44.2	1454.95	0	-3	0	2	0
0.005137667	2.61	133.2	194.64	0	-3	0	3	0
0.008213335	1.76	-174.1	121.75	0	0	3	0	0
0.004799727	1.66	85.0	208.35	0	-8	0	6	0
0.002045376	0.89	-7.7	488.91	0	1	0	0	-3
0.036600944	0.57	154.1	27.32	1	0	0	0	0
0.031125338	0.55	-32.7	32.13	1	0	-2	0	0

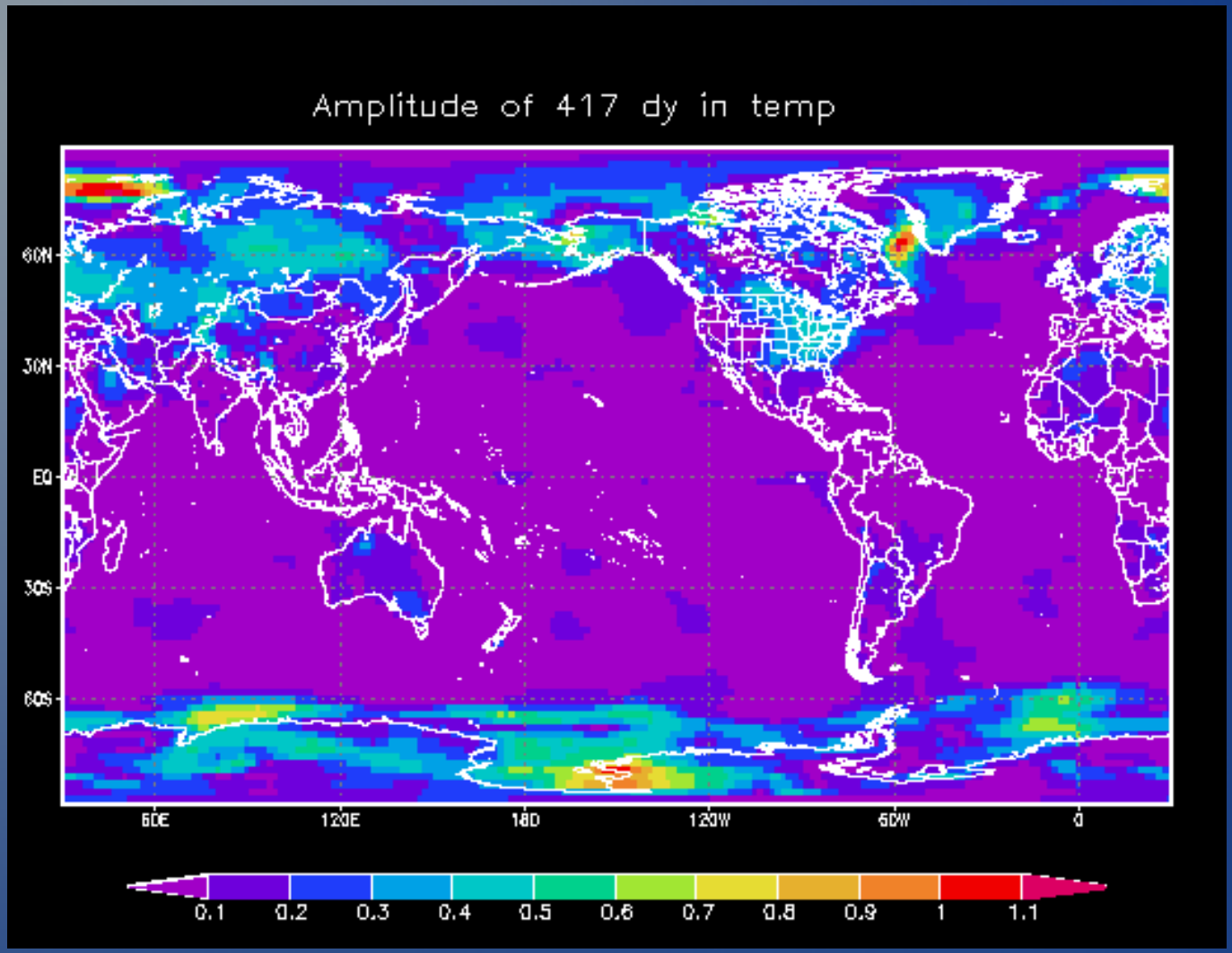
Earth Orientation and Rotation

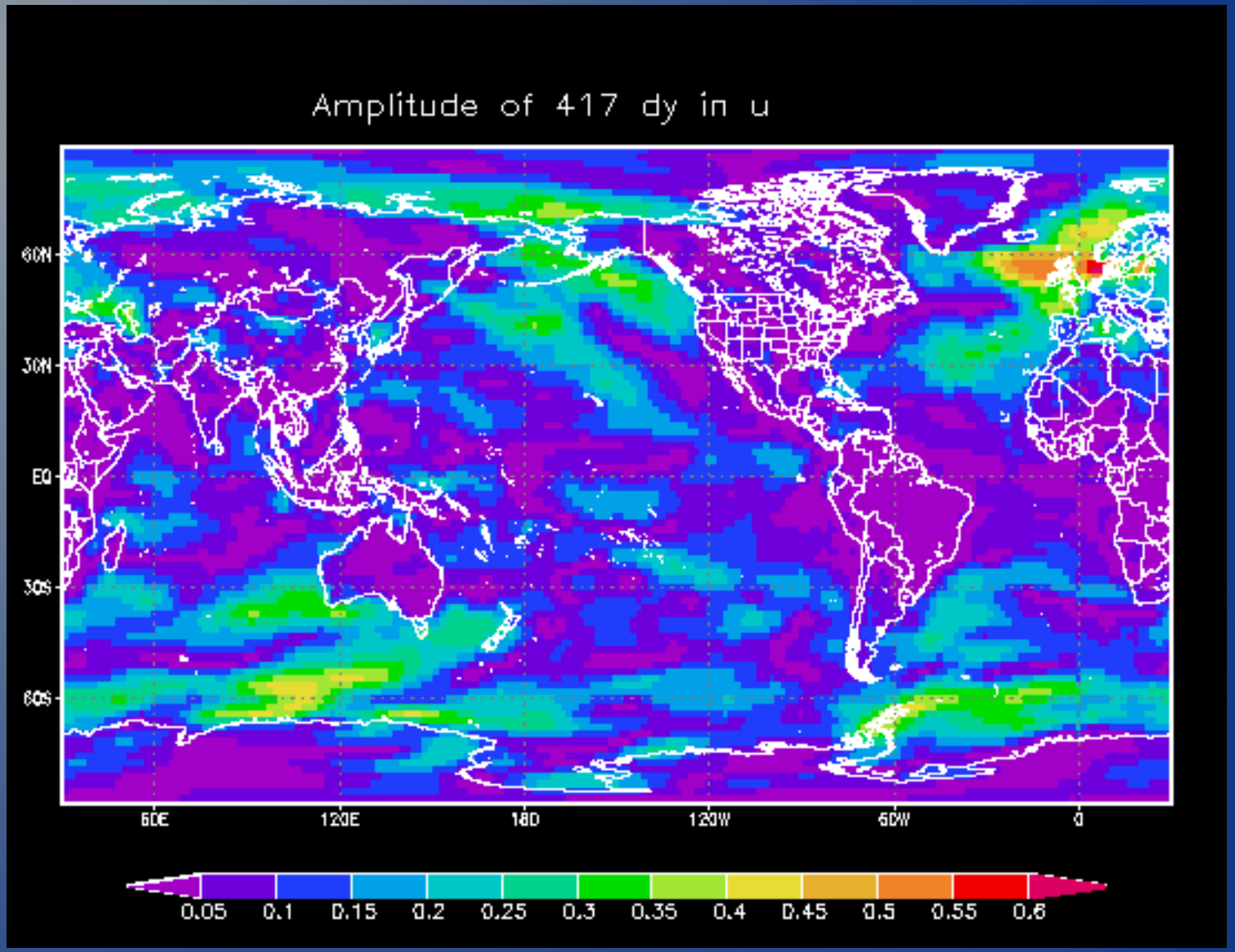


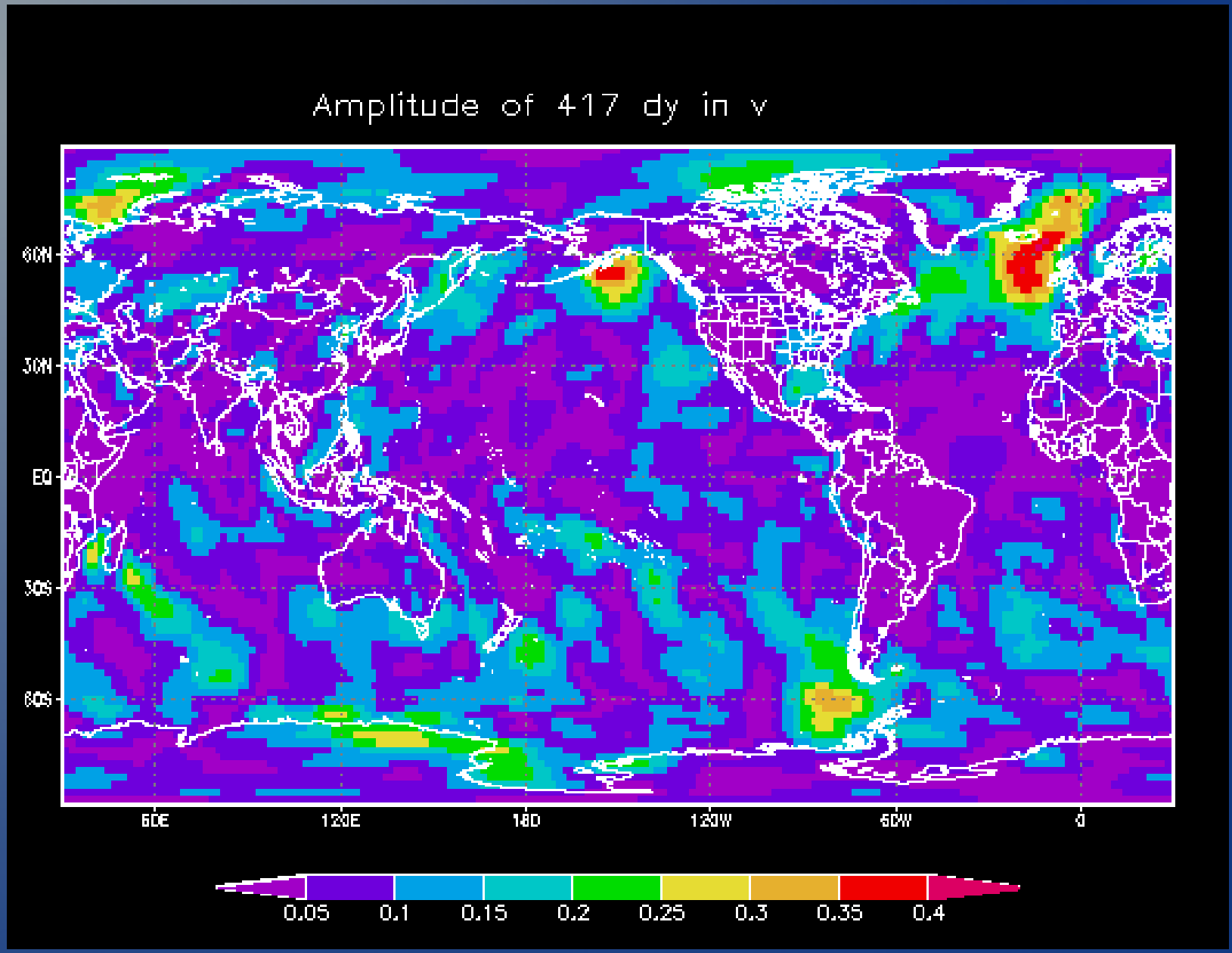


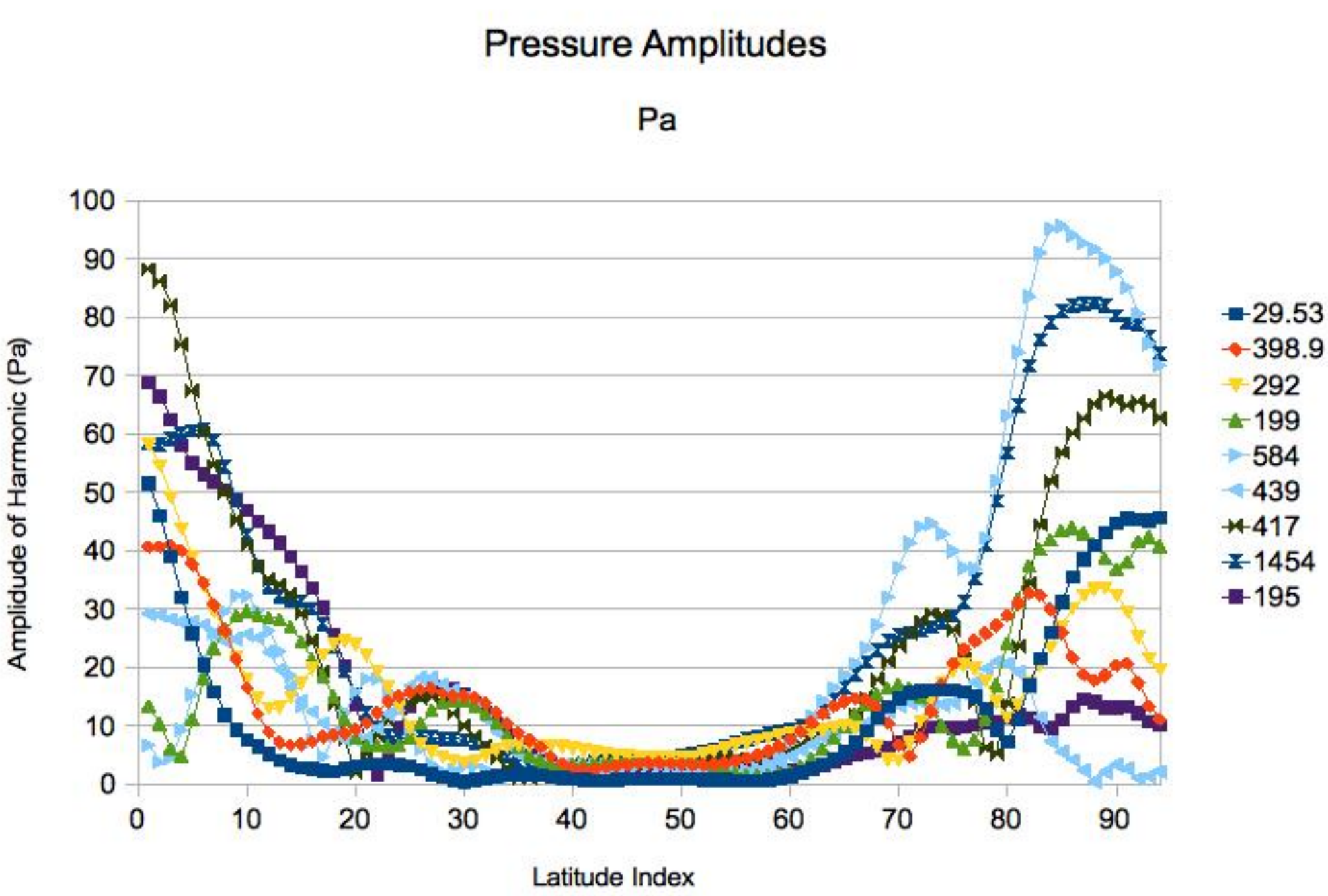
Meteorology/Oceanography



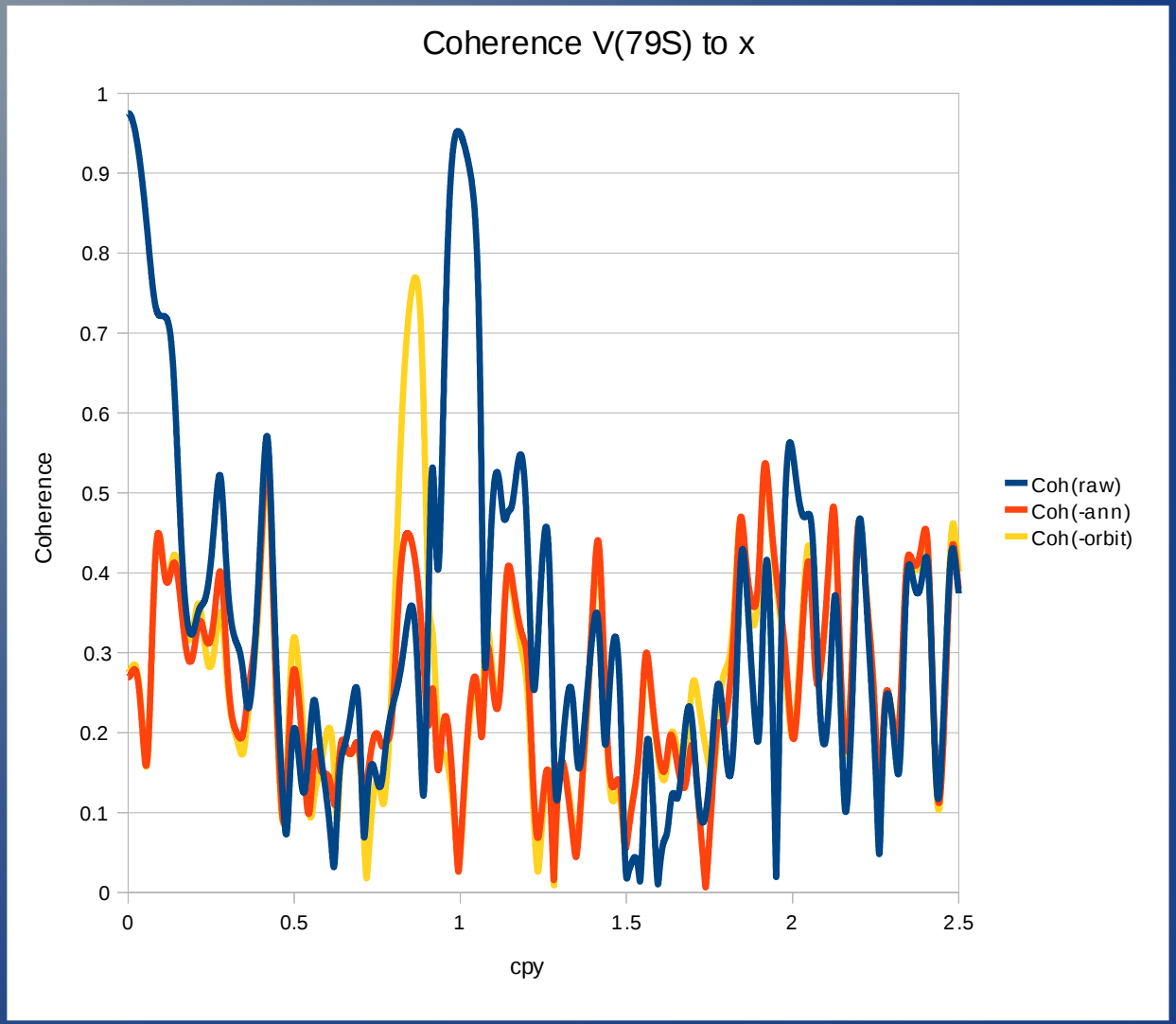

Amplitude of 417 dy in temp
60N
30N
EQ
30S
60S
60E
120E
180
120W
60W
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1

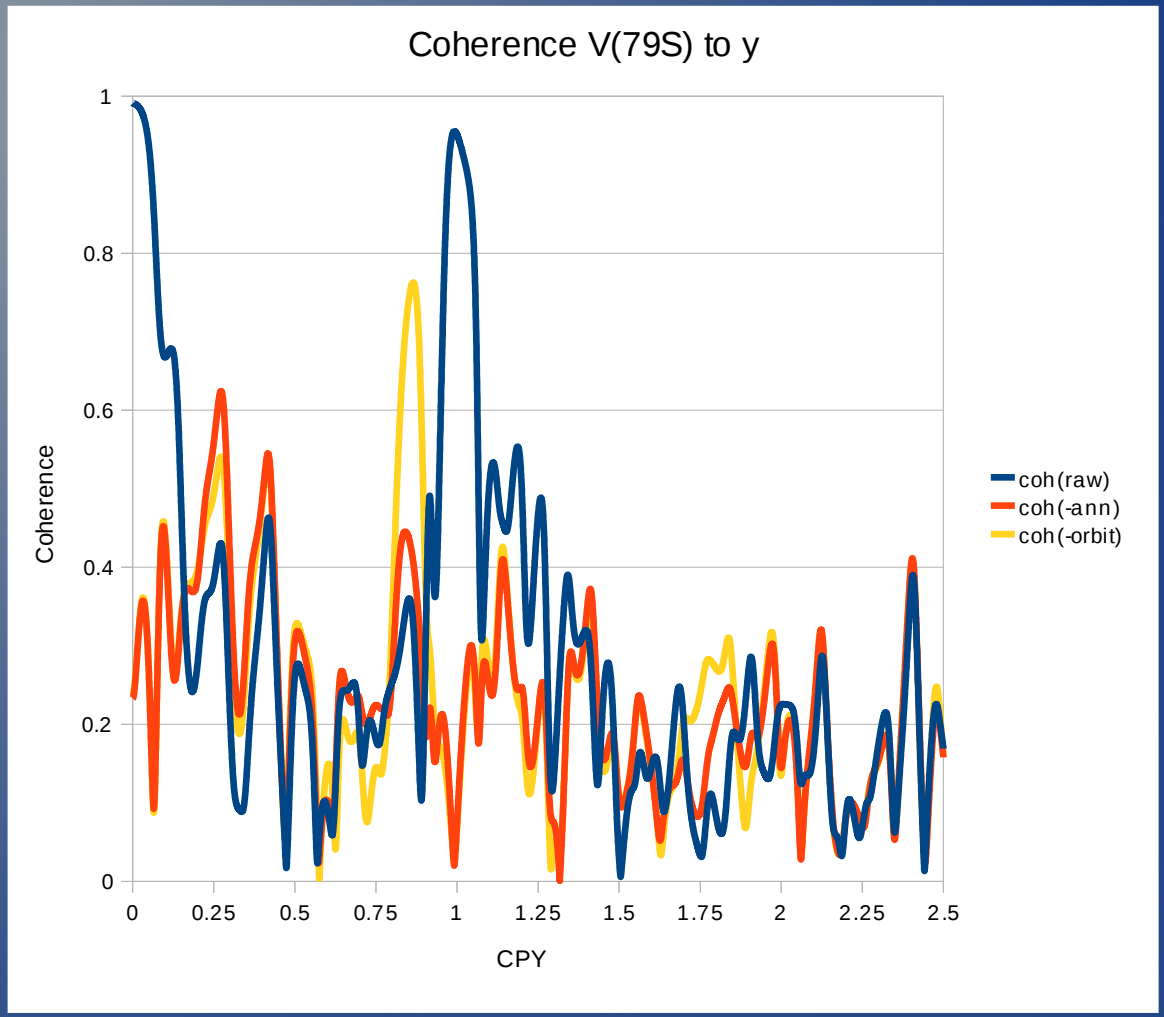

Amplitude of 417 dy in u
60N
30N
EQ
30S
60S
60E
120E
180
120W
60W
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
0.55
0.6

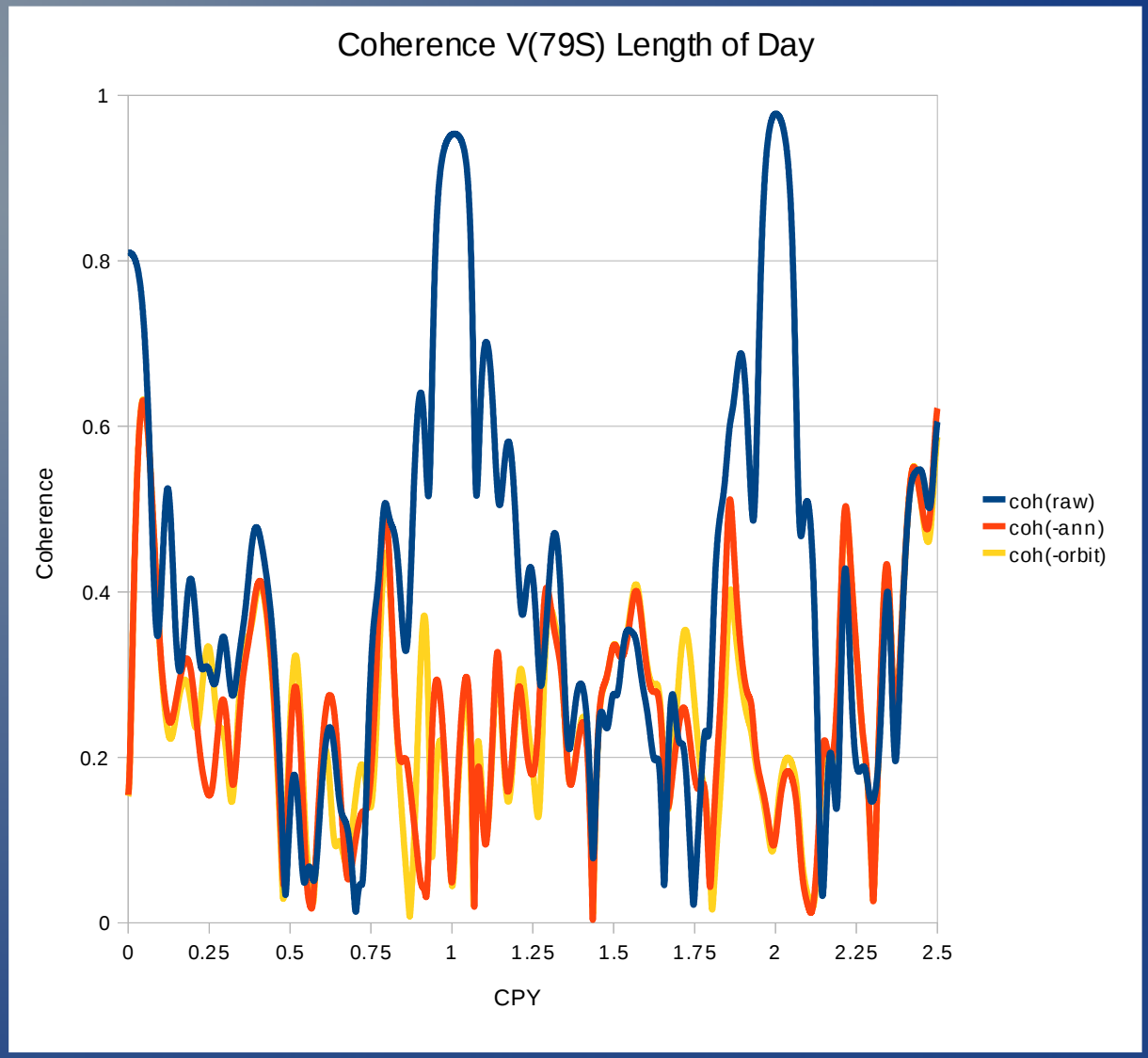

Amplitude of 417 dy in v
60N
30N
EQ
30S
60S
60E
120E
180
120W
60W
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4


Pressure Amplitudes
Pa
Amplidude of Harmonic (Pa)
Latitude Index
0
10
20
30
40
50
60
70
80
90
100
29.53
398.9
292
199
584
439
417
1454
195

Interconnections




Coherence V(79S) to y
Coherence
1
0.8
0.6
0.4
0.2
0
0
0.25
0.5
0.75
1
1.25
1.5
1.75
2
2.25
2.5
CPY
coh(raw)
coh(-ann)
coh(-orbit)


Coherence V(79S) Length of Day
Coherence
1
0.8
0.6
0.4
0.2
0
0
0.25
0.5
0.75
1
1.25
1.5
1.75
2
2.25
2.5
CPY
coh(raw)
coh(-ann)
coh(-orbit)

Interconnections

- SST
- Sea Ice
- MSU T

Conclusions

- Earth-sun distance for Chandler Wobble
- General mechanism
- Shows up elsewhere too

Future

- Single versus Multiple
- Markowitz wobble
- Other reanalyses
- Force a climate model with orbital harmonics
- How and why do these signals appear at all?

  (stochastic resonance? Squids?)
- Variation through time of wobble response/character? (+paleowobble)