Investigation on Formosat-3 /COSMIC retrieval data quality

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Motivation

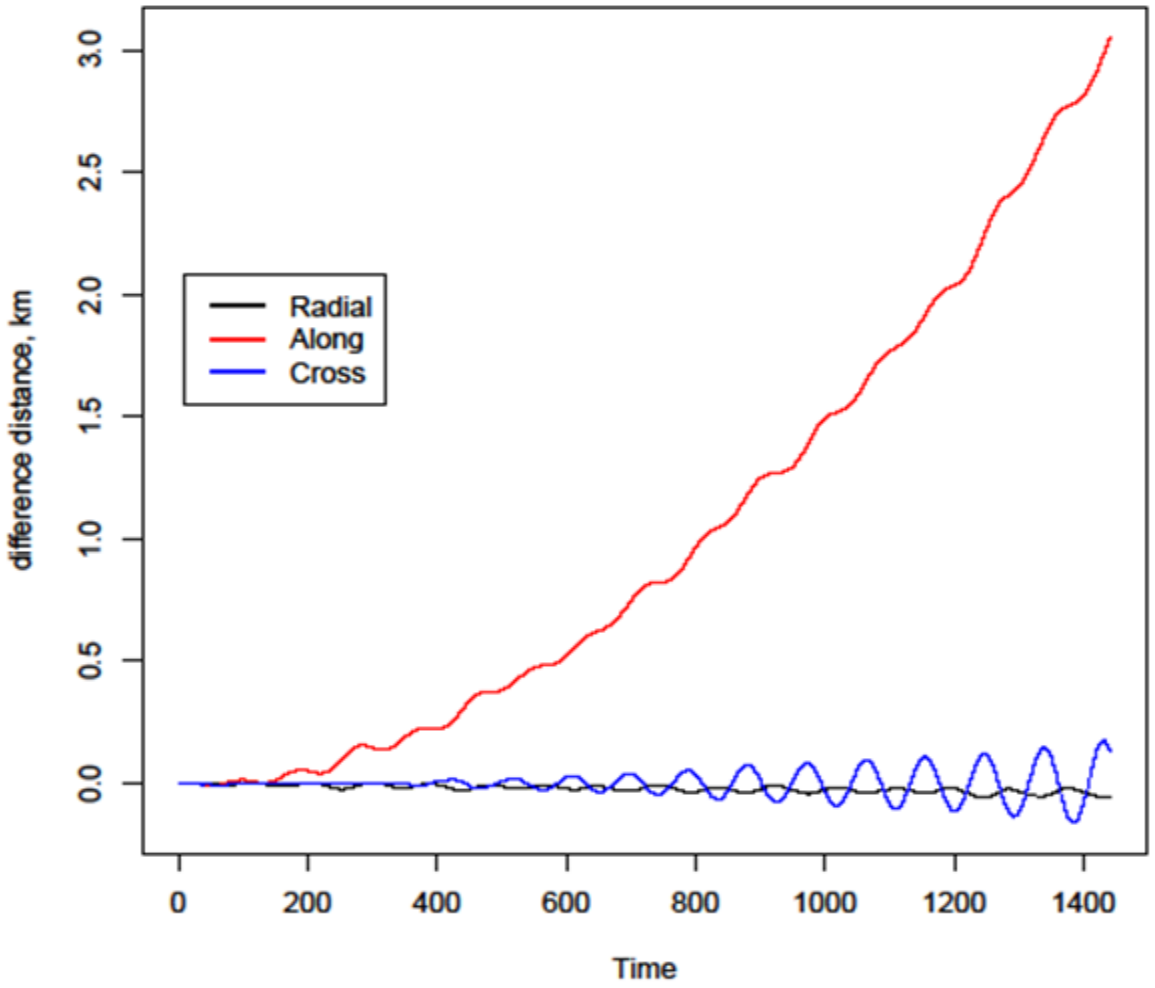
- Initial purpose:
  - Calculate neutral density (ρC_D) from FS3/COSMIC orbital change while the altitude park around 500 km.
  - N-body and Solar radiation pressure(specular reflection) are considered
  - Albedo, IR, Solid Tide, Ocean Tide, Lift and Side are not considered.
- The drag just could be get while the resolution duration is longer than 3 or even more orbits.
- GOAL: get the higher time resolution for scientific research.

Orbital difference (SP3-Ref orbit)

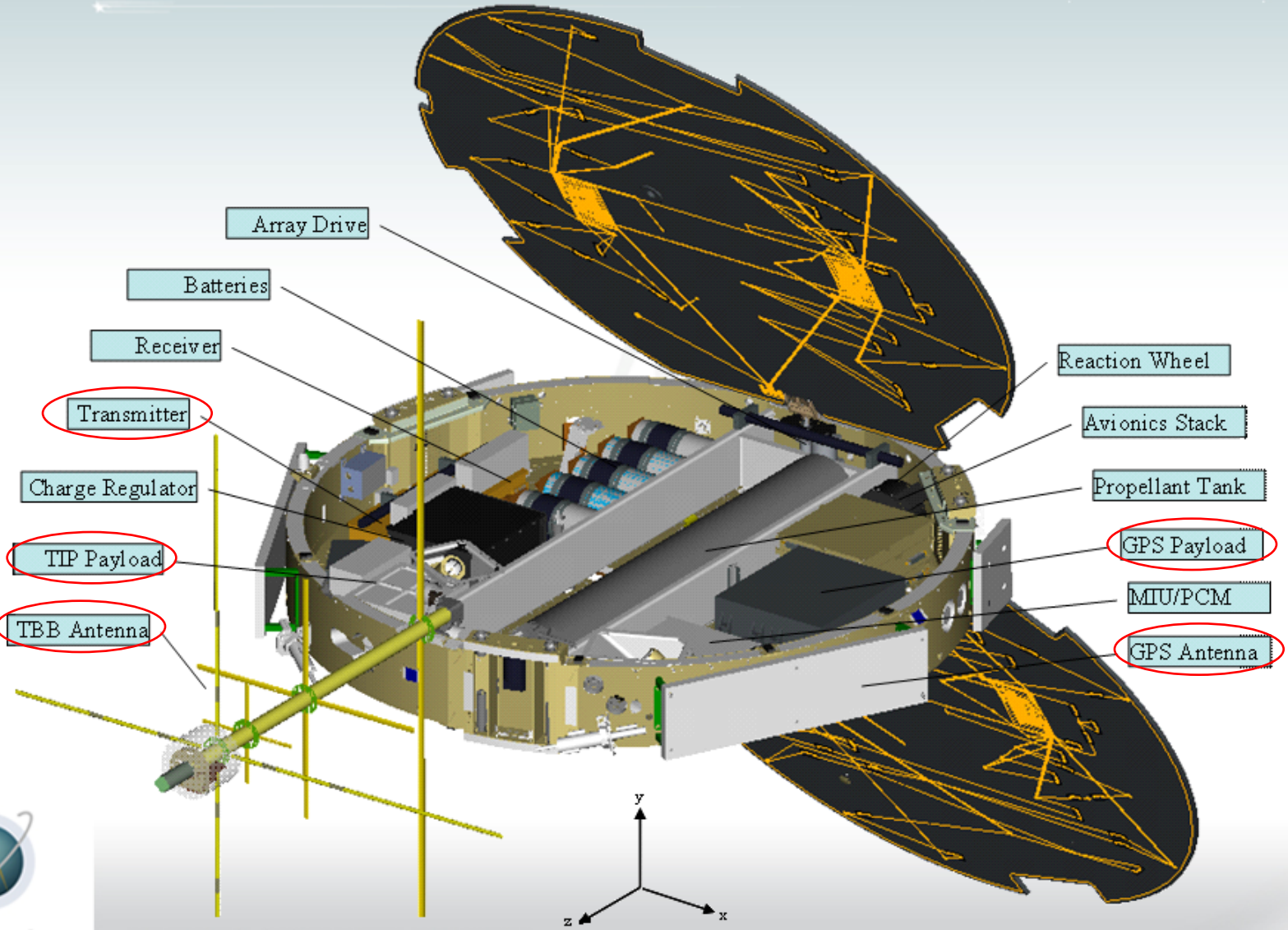
Ref orbit :

gravity (ICGEM 70order),

DE405 (Sun and moon and 8 planets)



Spacecraft Overview



Solar radiation pressure (David A. Vallado, 2007)

Solar Radiation Pressure

$$\mathbf{a}_{SR} = -\sum_{i=1} \frac{P_{SR} A_{\Theta} \cos(\phi_{inc})}{mc} \left\{ 2\left(\frac{C_{Rd_i}}{3} + C_{Rs_i} \cos(\phi_{inc})\right)\mathbf{n} + (1 - C_{Rs_i})\mathbf{s} \right\}$$

C_{Ra} : absortion
C_{Rs} : specular reflection
C_{Rd} : diffuse reflection
$C_{Ra}+C_{Rs}+C_{Rd}=1$
P_{SR} = 1367 W/m² = 4.57E+6 N/m²

Atmospheric Drag

$$\mathbf{a}_{drag} = -\frac{1}{2}\frac{C_D A}{m}\rho v_{rel}^2 \frac{\mathbf{v}_{rel}}{|\mathbf{v}_{rel}|}$$

C_D : drag coefficient

Albedo and IR is similar to Solar Radiation.

Parameters

- Orbital data : LeoOrb
- Satellite attitude : LeoAtt
- Neutral Density: JB2008 (Developed by Air Force)
- Solar panel

$C_{Ra} = 0$
$C_{Rs} = 0.5$
$C_{Rd} = 0.5$
$C_{Rd} = 2.2$
$C_{Lift} = 2.2$
$C_{Side} = 2.2$

$P_{SR} = 1367\ W/m^2 = 4.57E{+}6\ N/m^2$

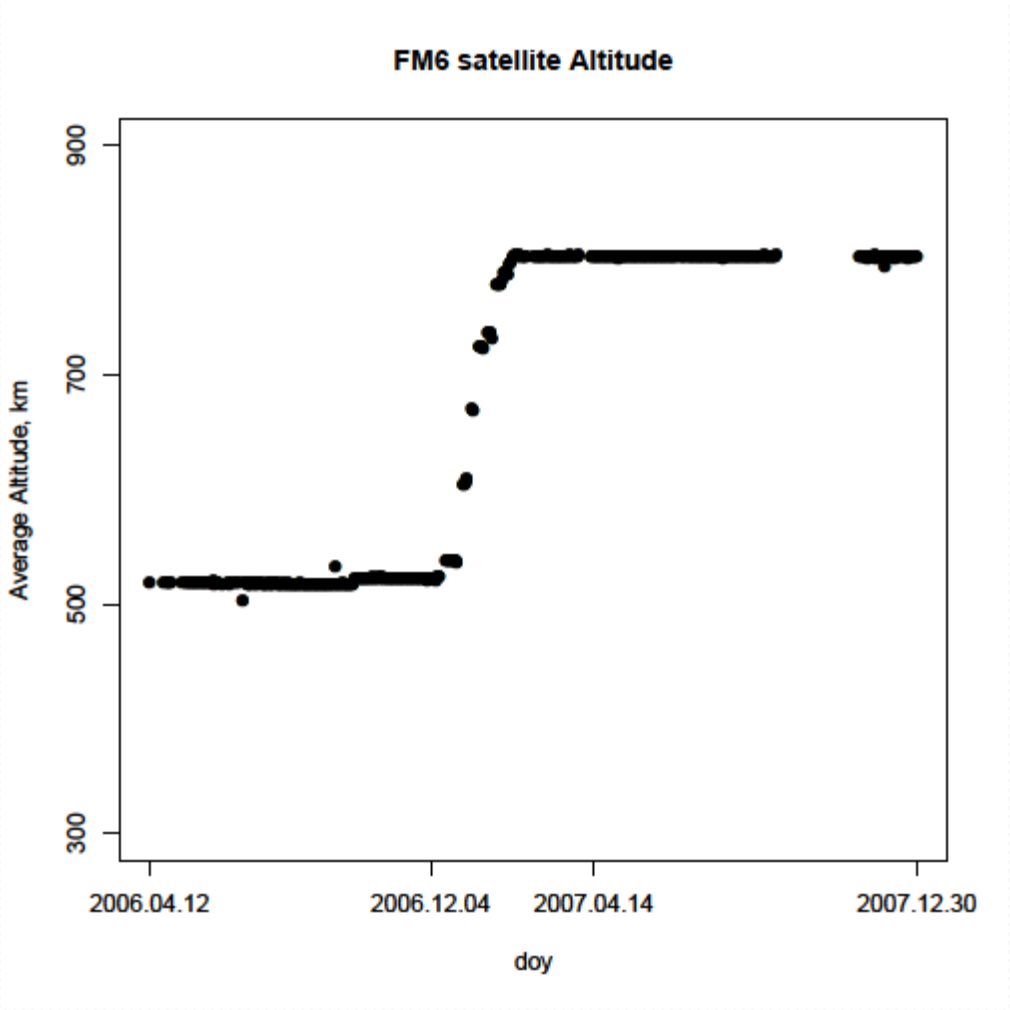
$P_{Albedo} = 0.3P_{SR} = 410\ W/m^2$

$P_{IR} = 237\ W/m^2$

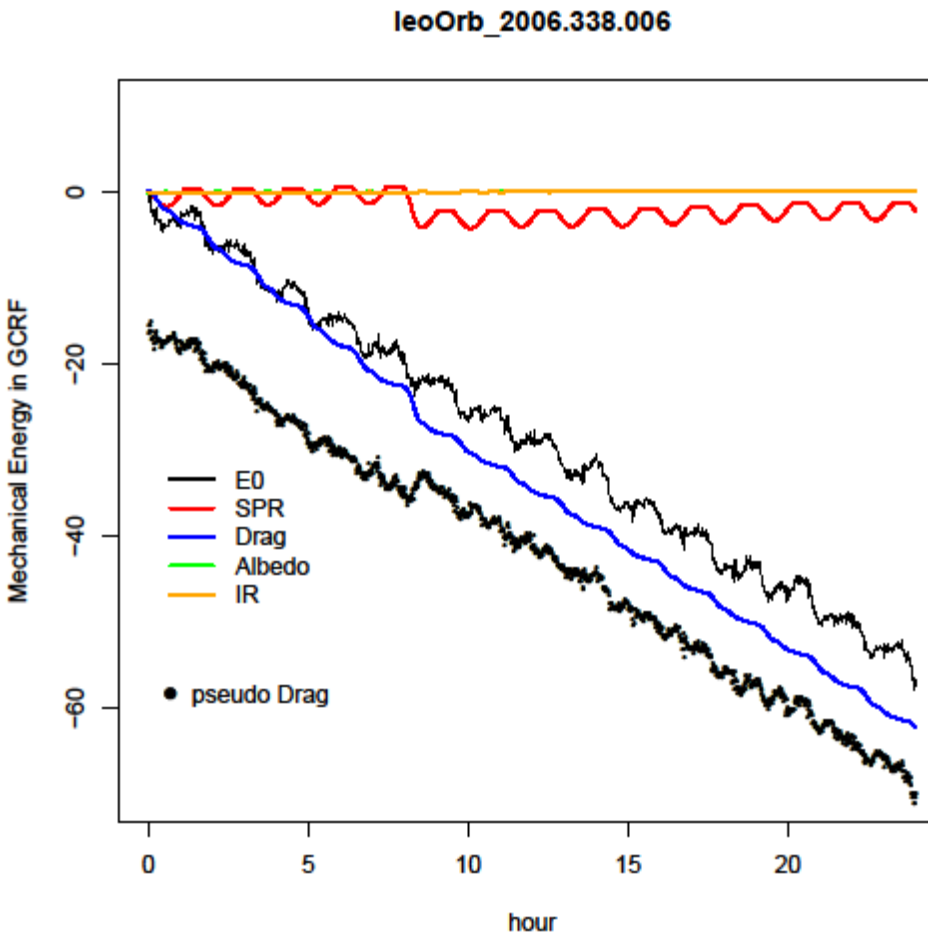
- Cylinder body

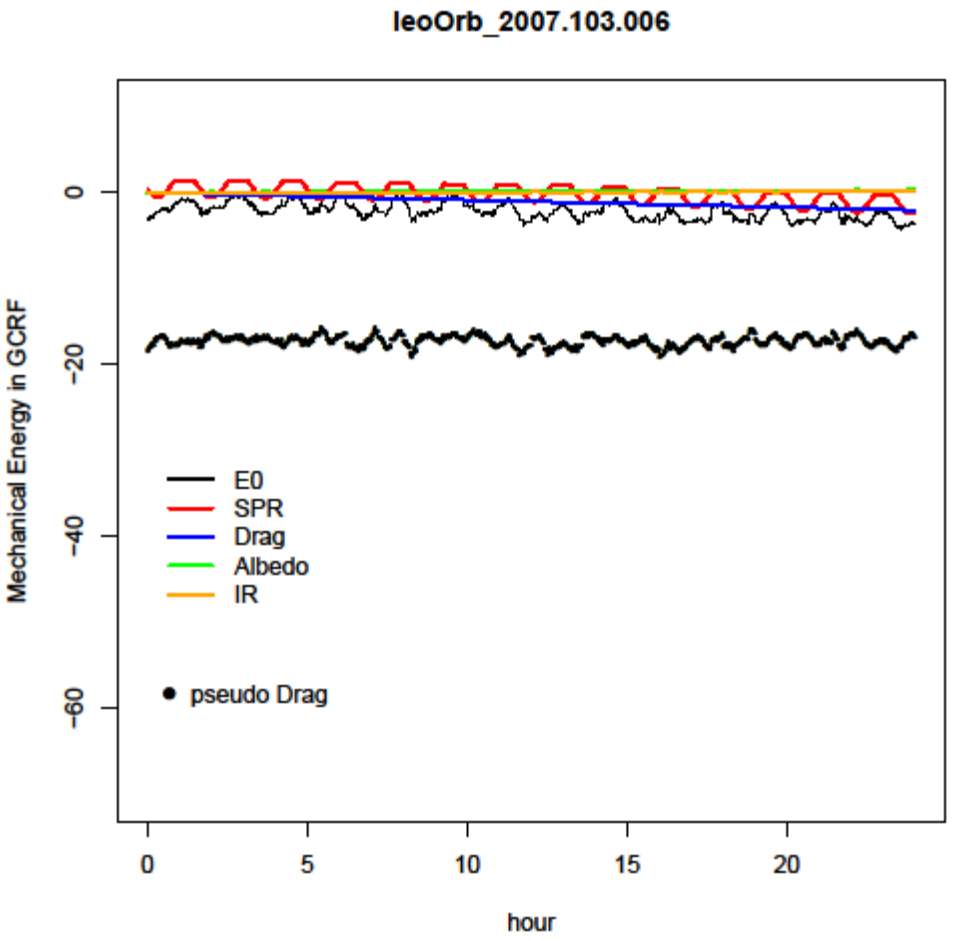
$C_{Rd} = 1.17$

FM6 Altitude

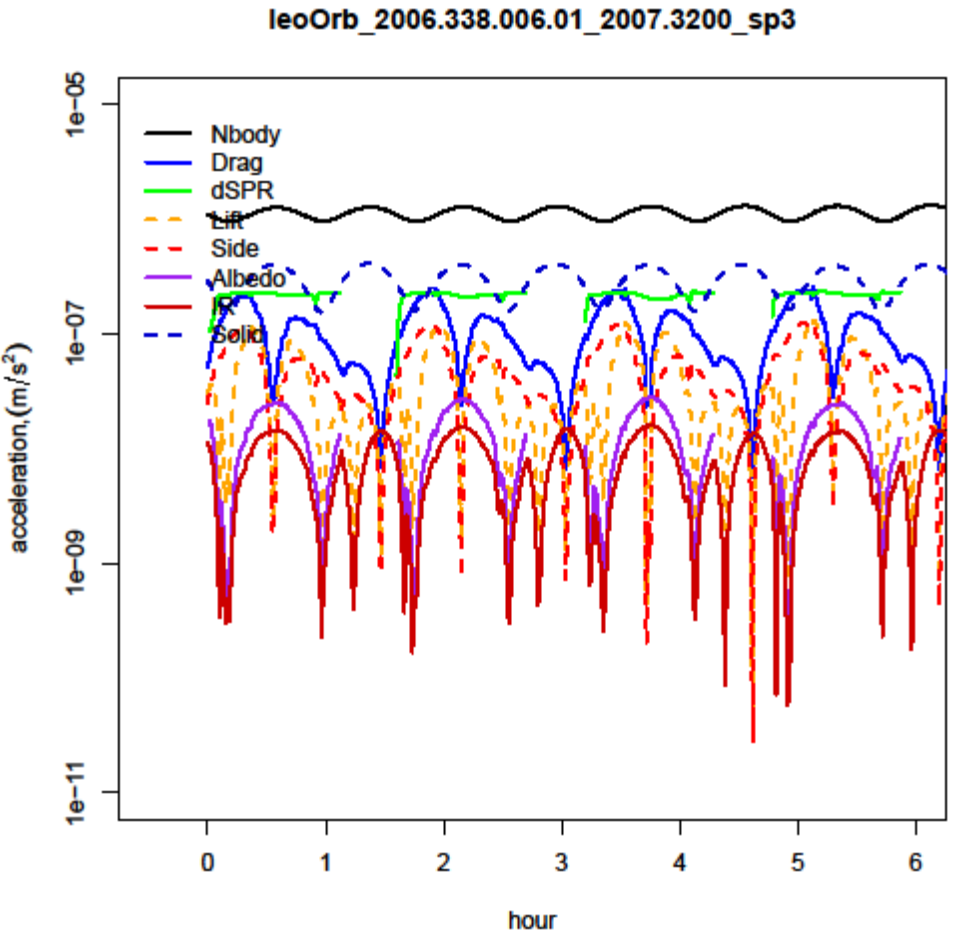


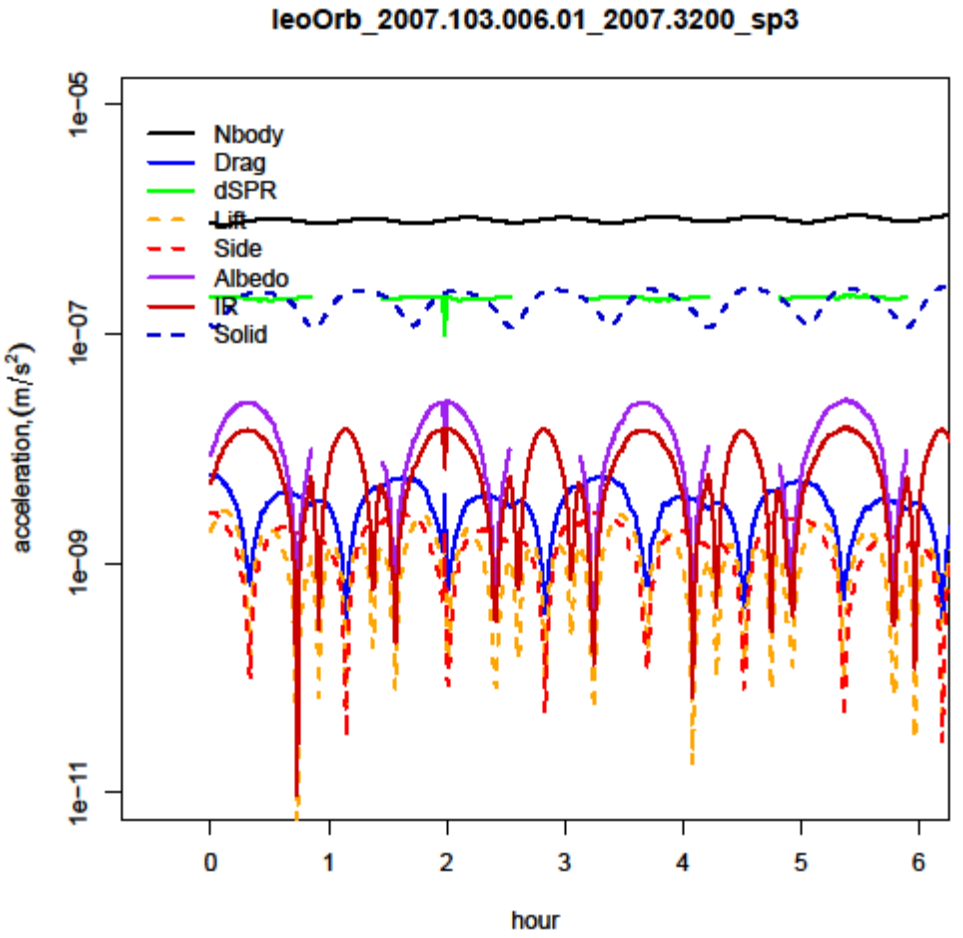
$$E = -\frac{\mu}{2a}$$


leoOrb_2006.338.006
Mechanical Energy in GCRF
0
-20
-40
-60
E0
SPR
Drag
Albedo
IR
pseudo Drag
0
5
10
15
20
hour

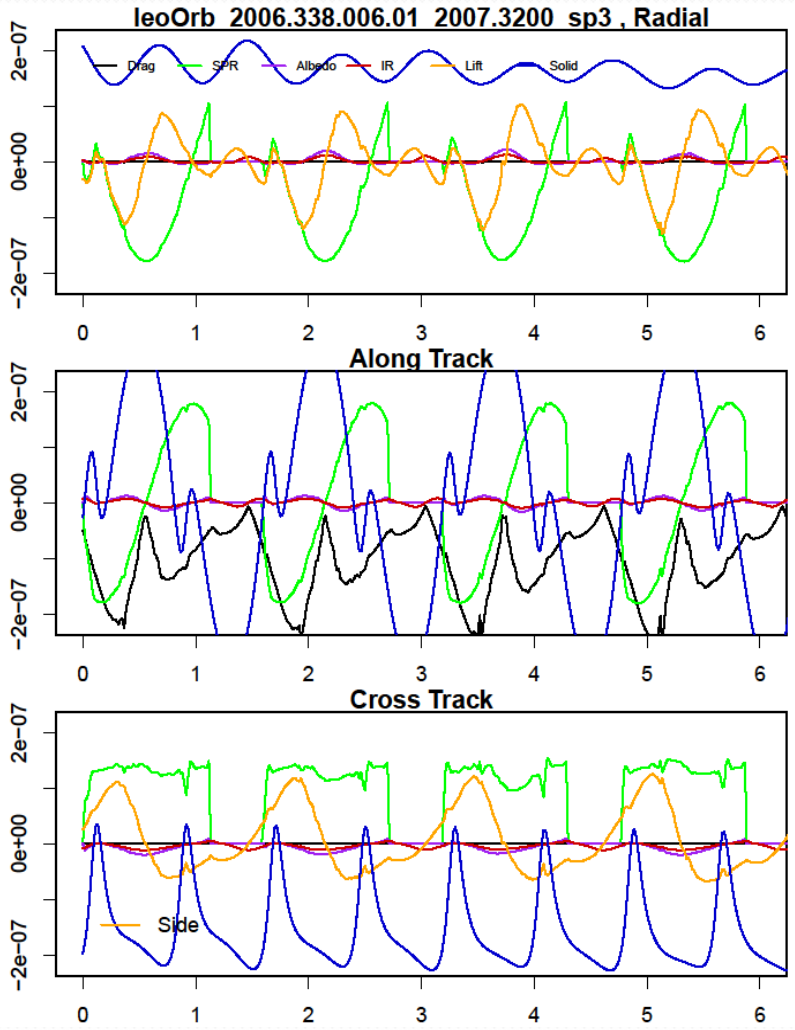

leoOrb_2007.103.006
Mechanical Energy in GCRF
0
-20
-40
-60
E0
SPR
Drag
Albedo
IR
pseudo Drag
0
5
10
15
20
hour

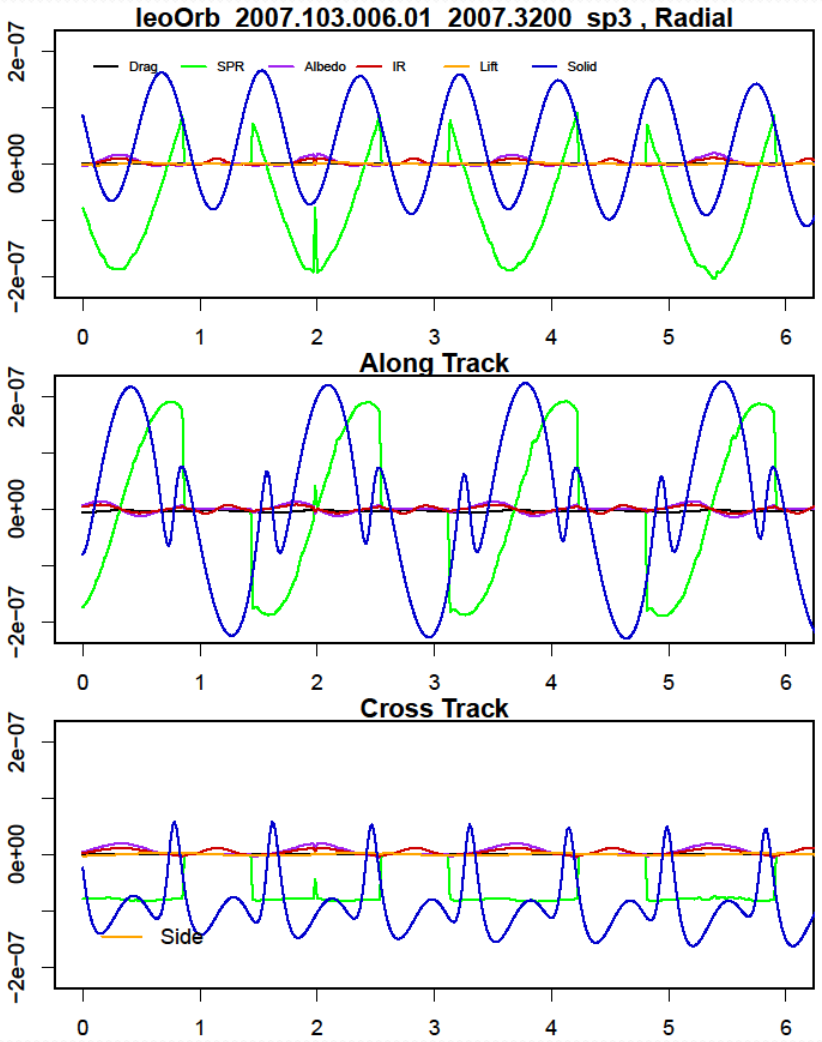
Accerleration analysis

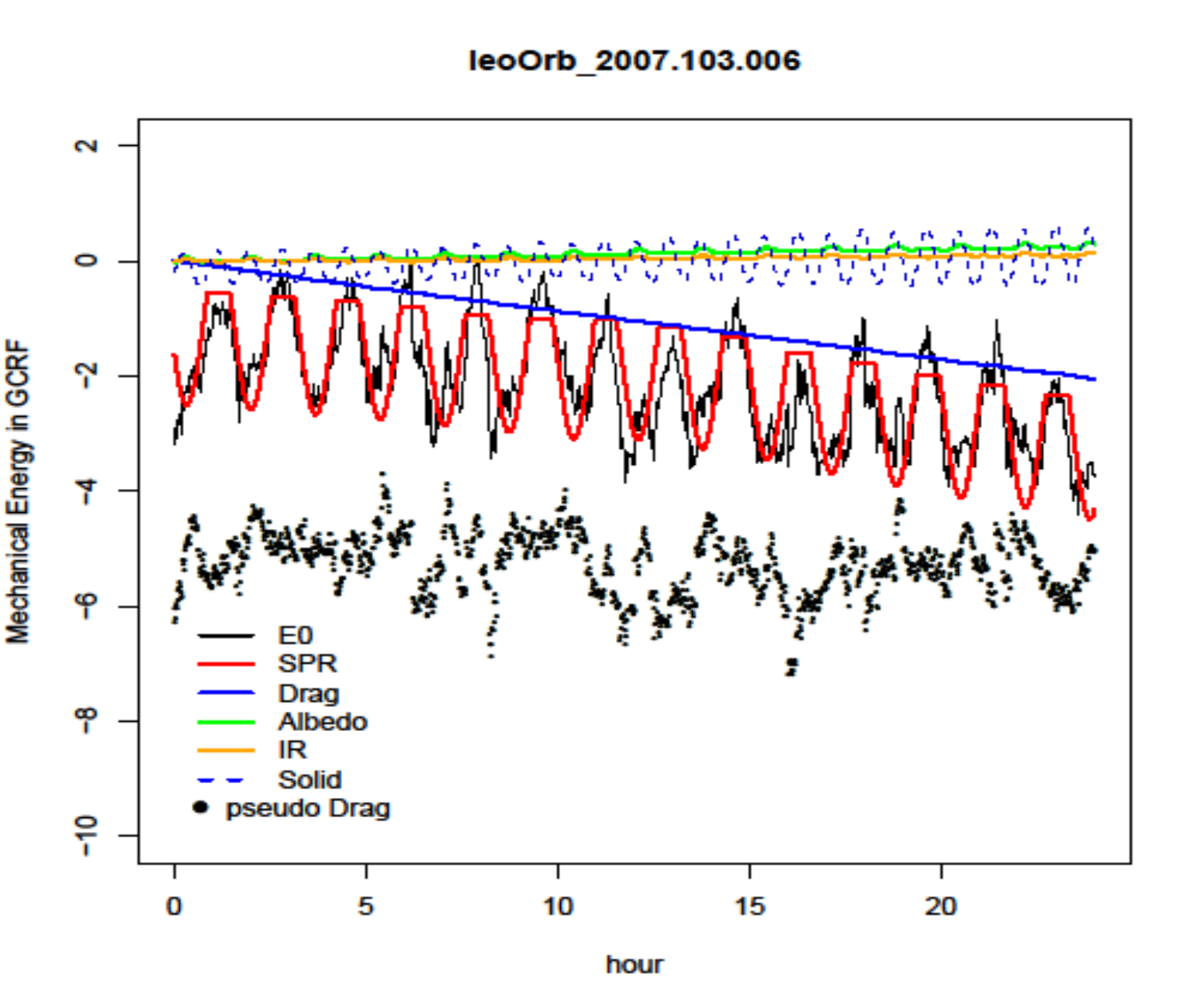


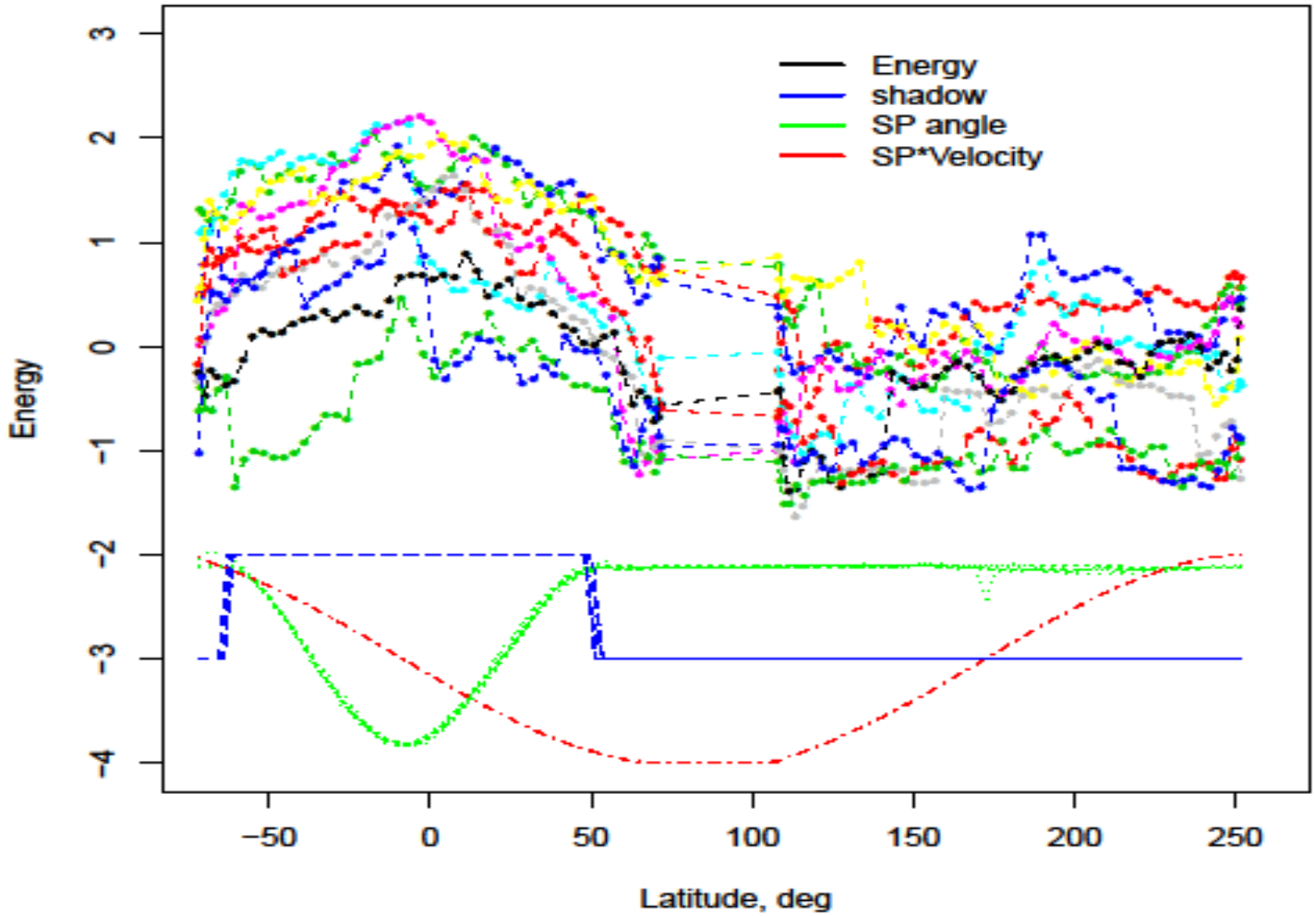


Accerleration analysis in RSW

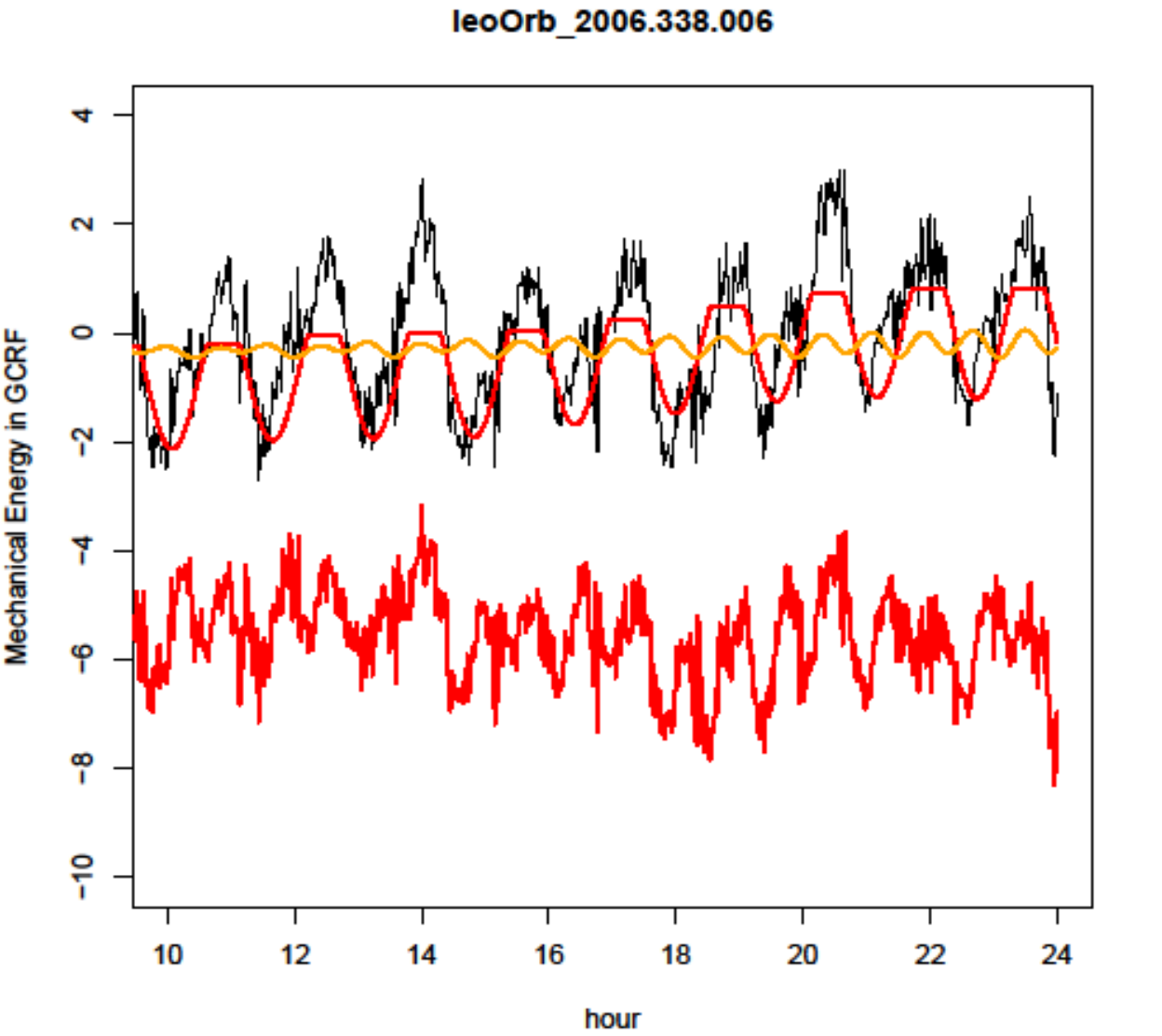




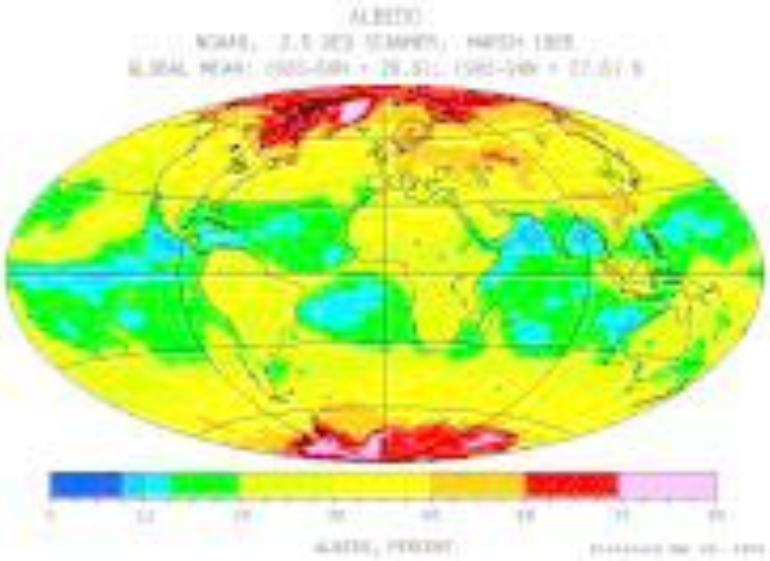

leoOrb_2007.103.006
Mechanical Energy in GCRF
2
0
-2
-4
-6
-8
-10
0
5
10
15
20
hour
E0
SPR
Drag
Albedo
IR
Solid
pseudo Drag


Energy
shadow
SP angle
SP*Velocity
Energy
3
2
1
0
−1
−2
−3
−4
−50
0
50
100
150
200
250
Latitude, deg

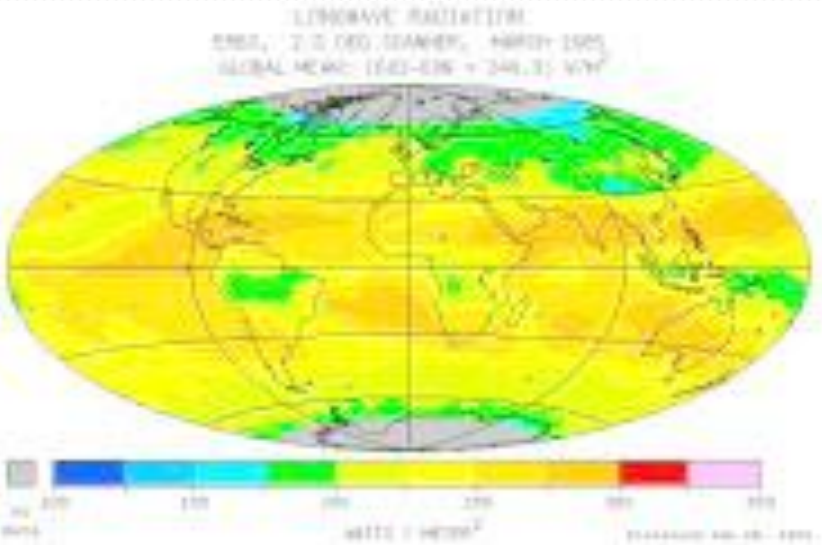
Orbit analysis around 500 km



Albedo and IR emmision



Planetary albedo map composed from NOAA-9 data
(based on observations in March 1985)



Earth IR re-radiation map composed from ERBE data
(based on observations in March 1985)

H. Klinkrad and B. Fritsche,

Conclusions

➔Bigger Amplitude fluctuation seem could be removed by finding the correct solar panel reflection, diffuse and absorption coefficients from orbit data around 800 km .

➔ What we will do in future

1. Observed IR and Albedo data should be used,
2. Higher resolution orbital data maybe used,
3. Ocean Tide.

➔Challenge

1. Small amplitude fluctuation
2. Where Error might come from:
    i. Integrator,
    ii. SP3 orbit,
    iii. Wind around 500 km.
3. Unconsidered perturbation,