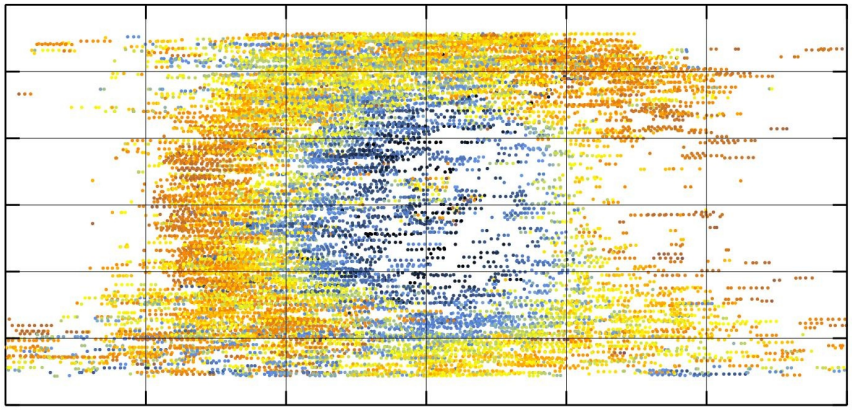
Assessing the quality of GNSS orbit models using SLR



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Solar radiation pressure (SRP)

= most important non-graviational force acting on a GNSS satellite

Extended CODE Orbit Model (Beutler et al., 1994)

→ acceleration due to SRP

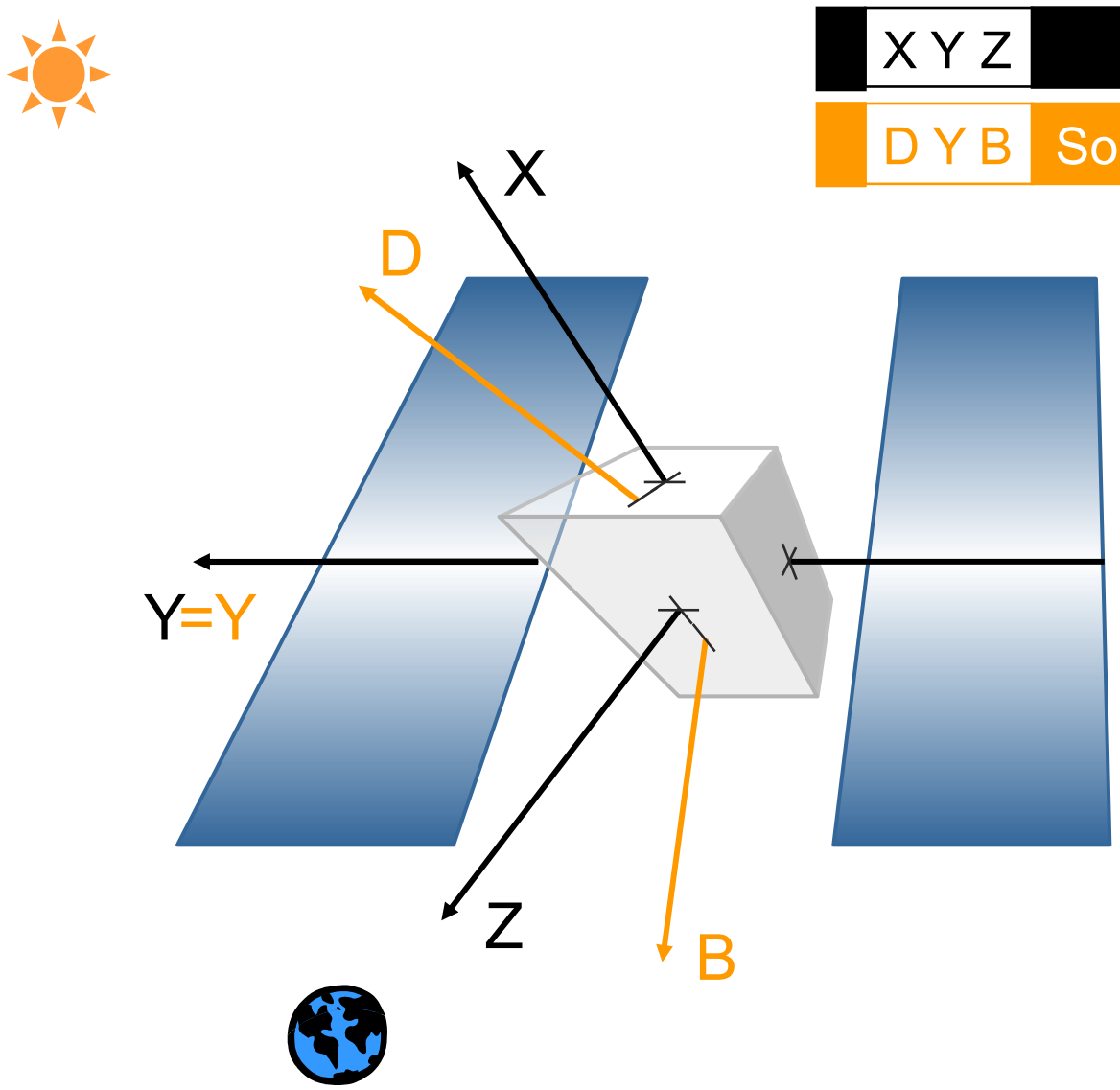
$$\mathbf{a}_{SRP} = \mathbf{a}_0 + D(u_{Sat})\,\mathbf{e}_D + Y(u_{Sat})\,\mathbf{e}_Y + B(u_{Sat})\,\mathbf{e}_B$$

$$D(u_{Sat}) = D0 + DC\cos(u_{Sat}) + DS\sin(u_{Sat})$$
$$Y(u_{Sat}) = Y0 + YC\cos(u_{Sat}) + YS\sin(u_{Sat})$$
$$B(u_{Sat}) = B0 + BC\cos(u_{Sat}) + BS\sin(u_{Sat})$$

A priori SRP model

Estimated parameters

Satellite coordinate systems



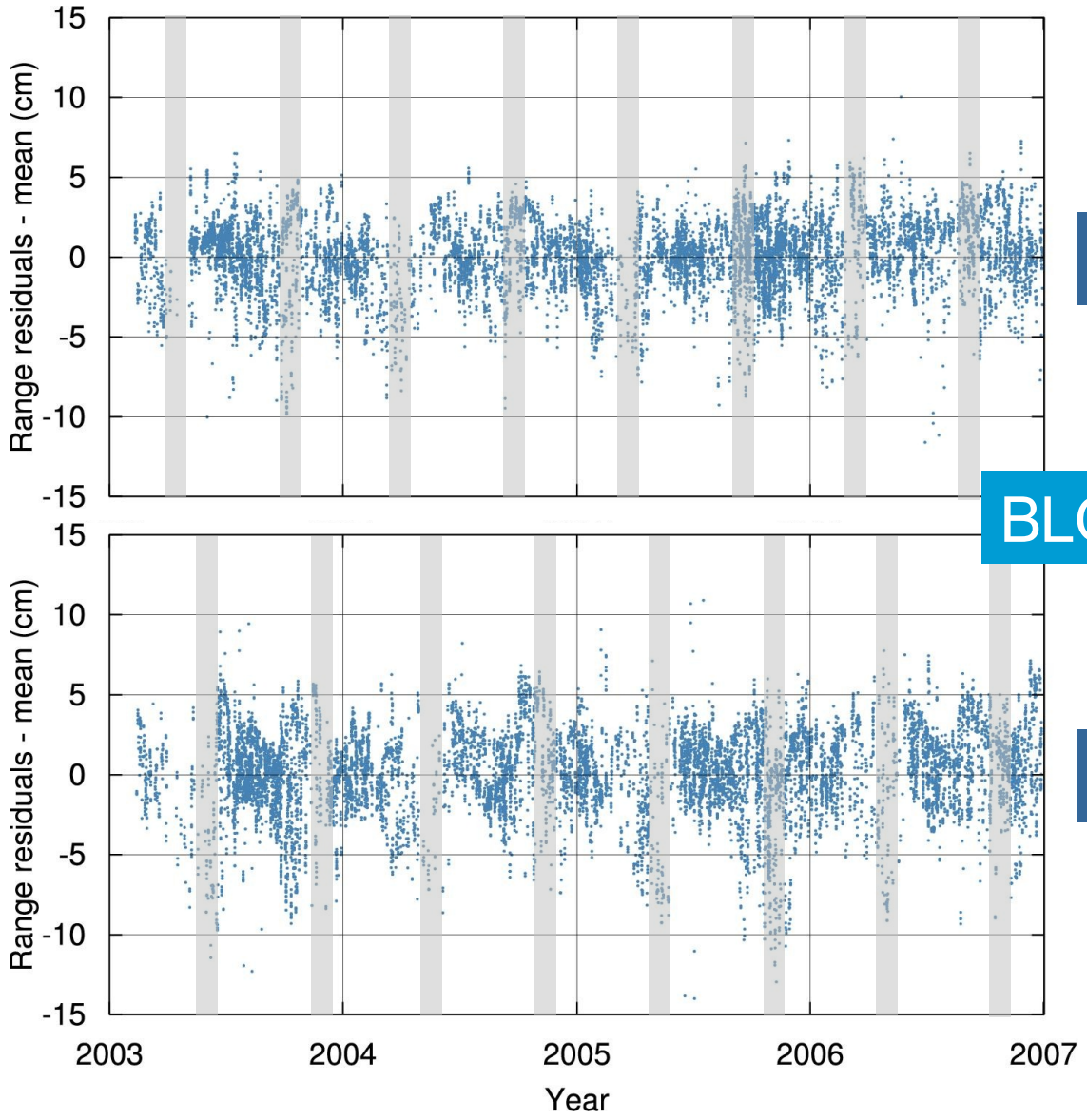
A priori SRP models

$$a_{SRP} = a_0 + D(u_{Sat})\, e_D + Y(u_{Sat})\, e_Y + B(u_{Sat})\, e_B$$

1. a_0 = **ROCK**
   - → based on a physical model
   - → periodic terms in X, Z
2. a_0 = **CODE´07**
   - → based on empirical parameters
   - → periodic terms in D, Y, B, Z
3. a_0 = **NONE**

SLR residuals for orbits using: ROCK

Eclipsing seasons



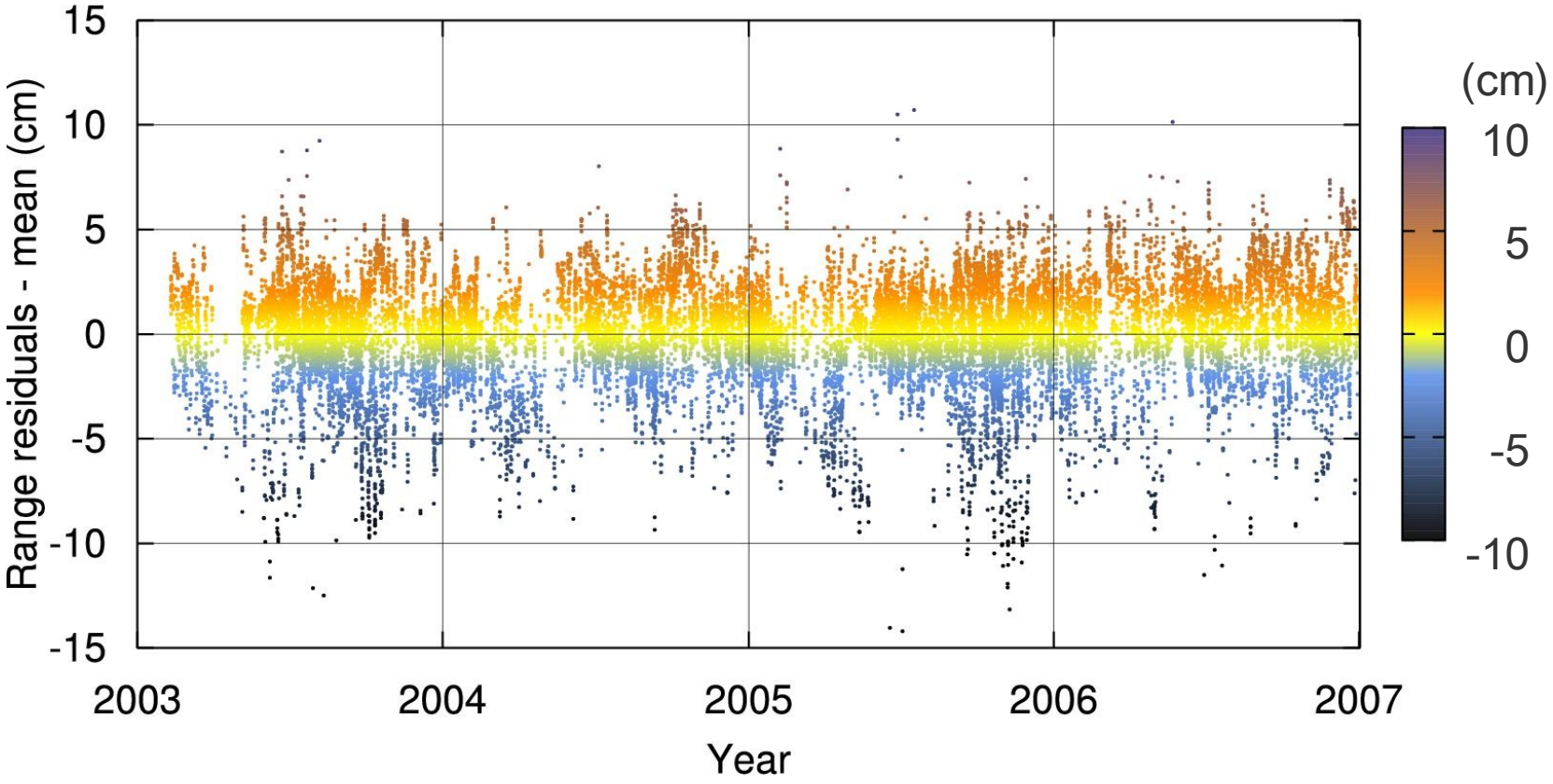
G05

BLOCK II

G06

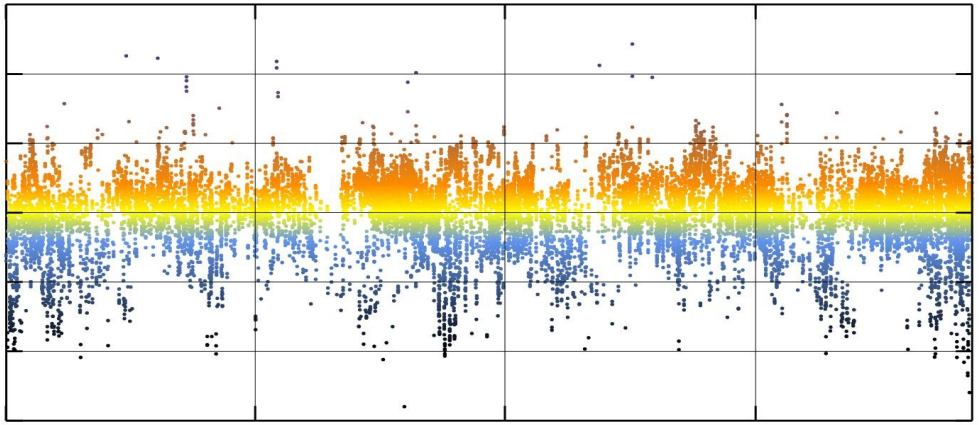
SLR residuals for orbits using: ROCK

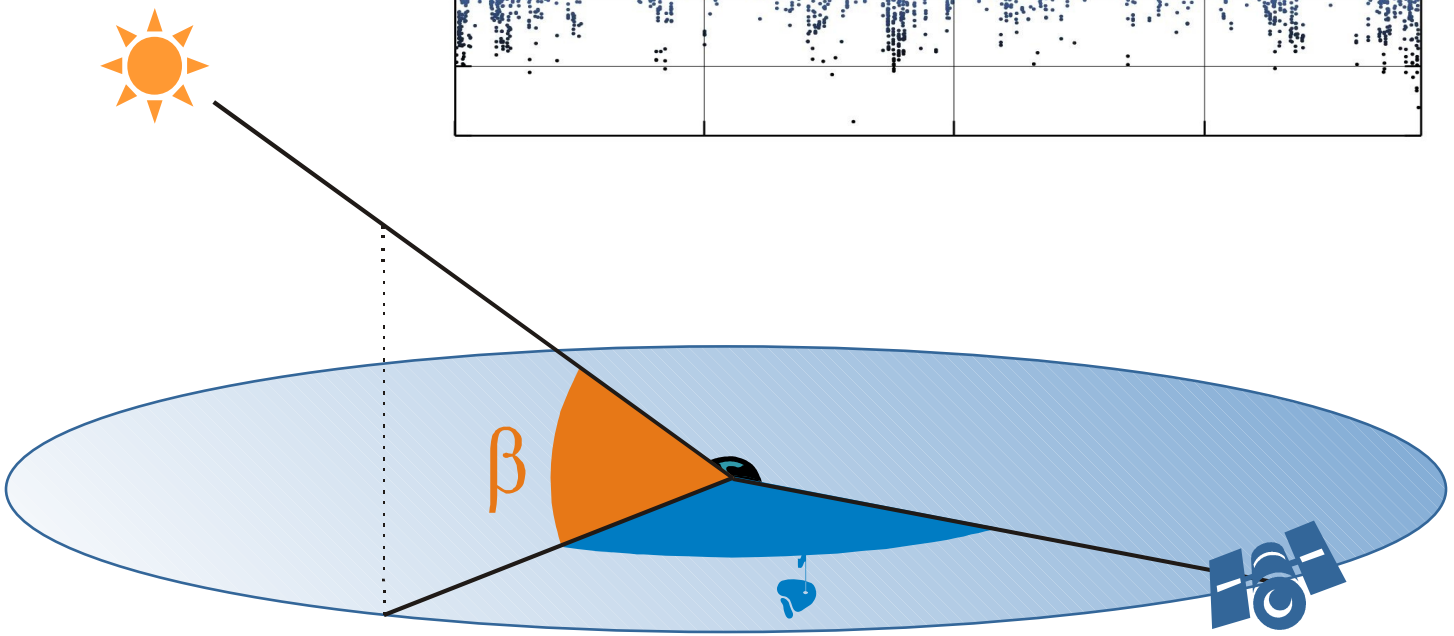
G05 + G06



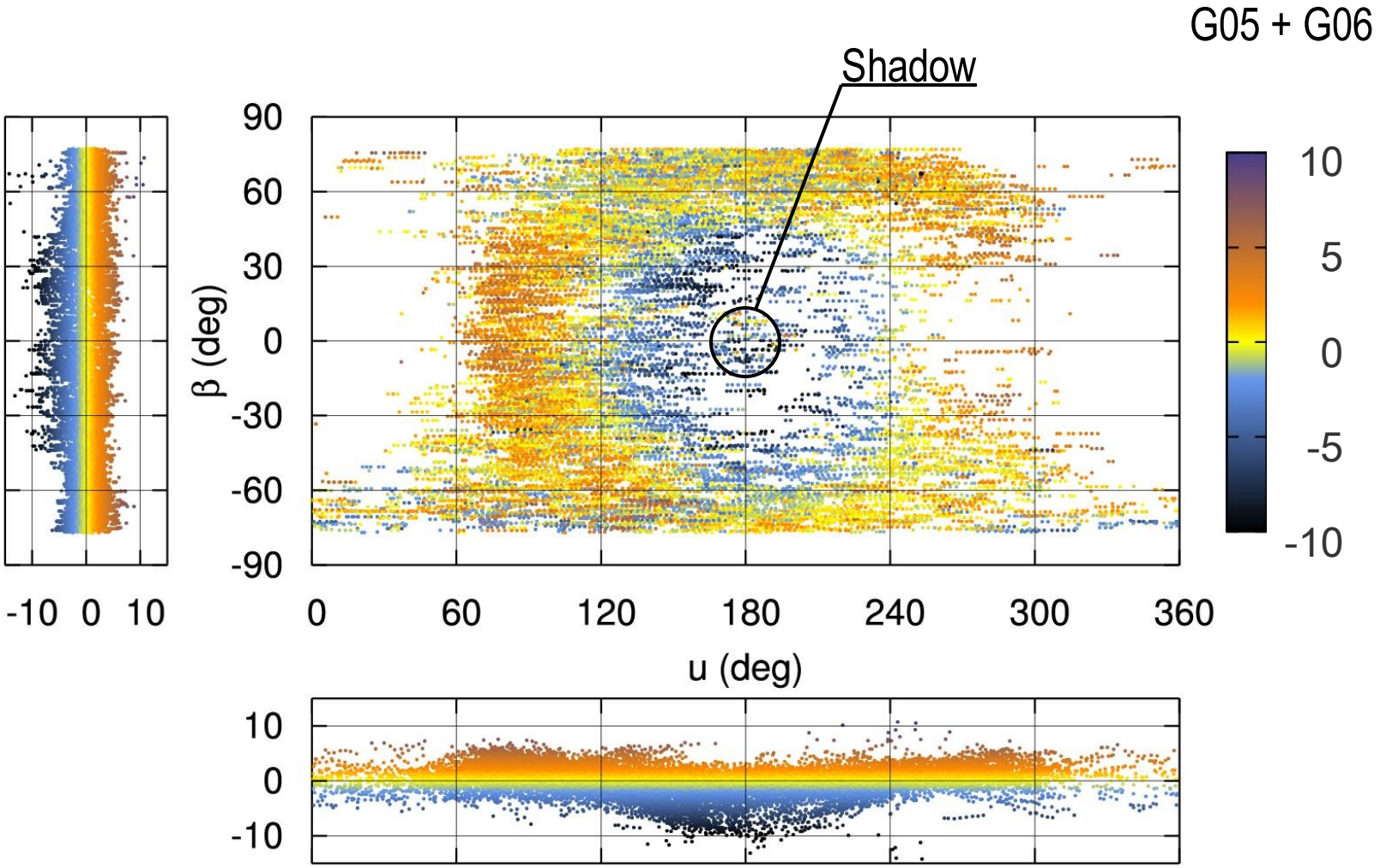
Coordinate system β-u

Satellite‘s position w.r.t. the Sun



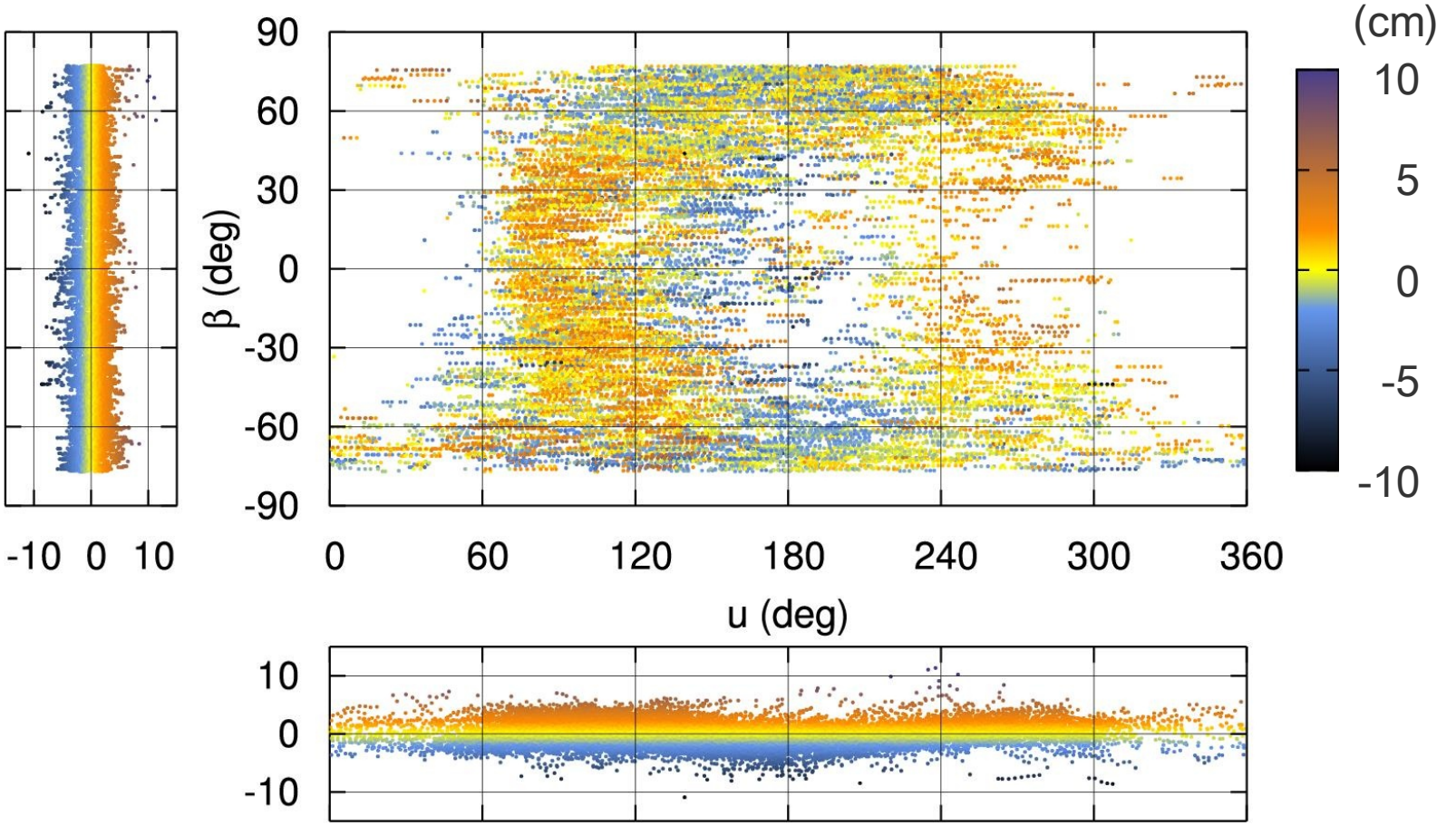


SLR residuals for orbits using: ROCK



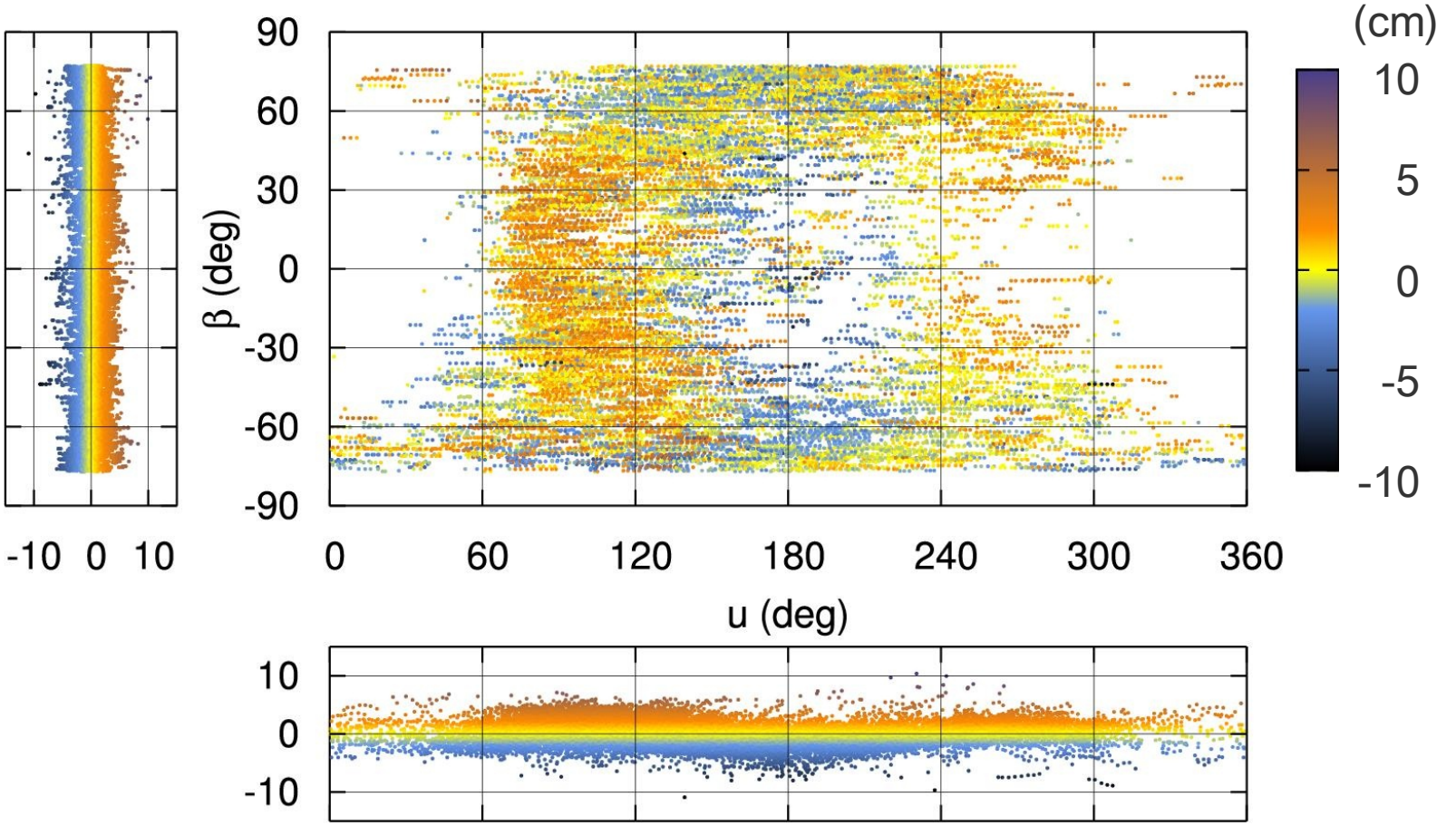
SLR residuals for orbits using: CODE´07

G05 + G06

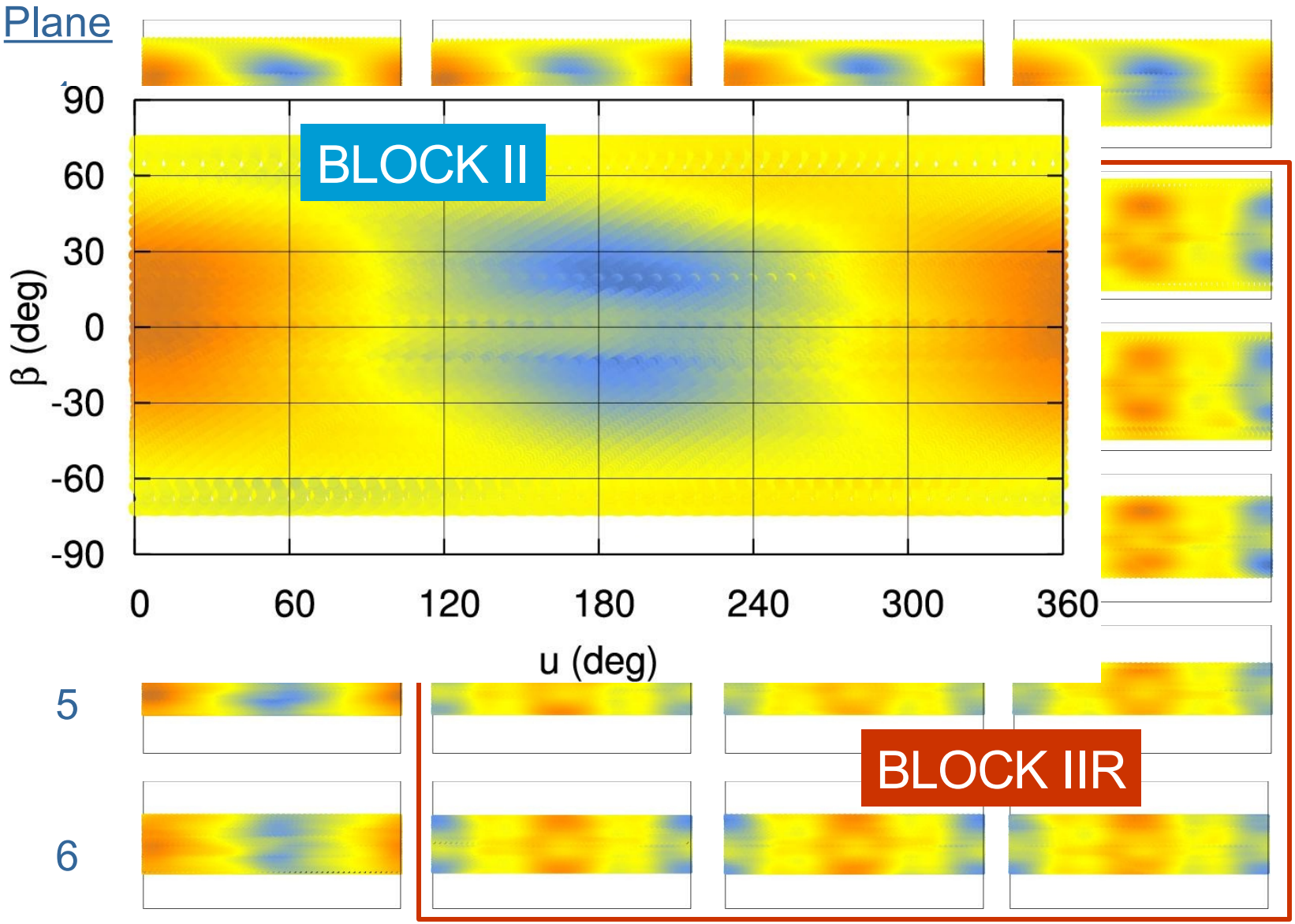


SLR residuals for orbits using: NONE

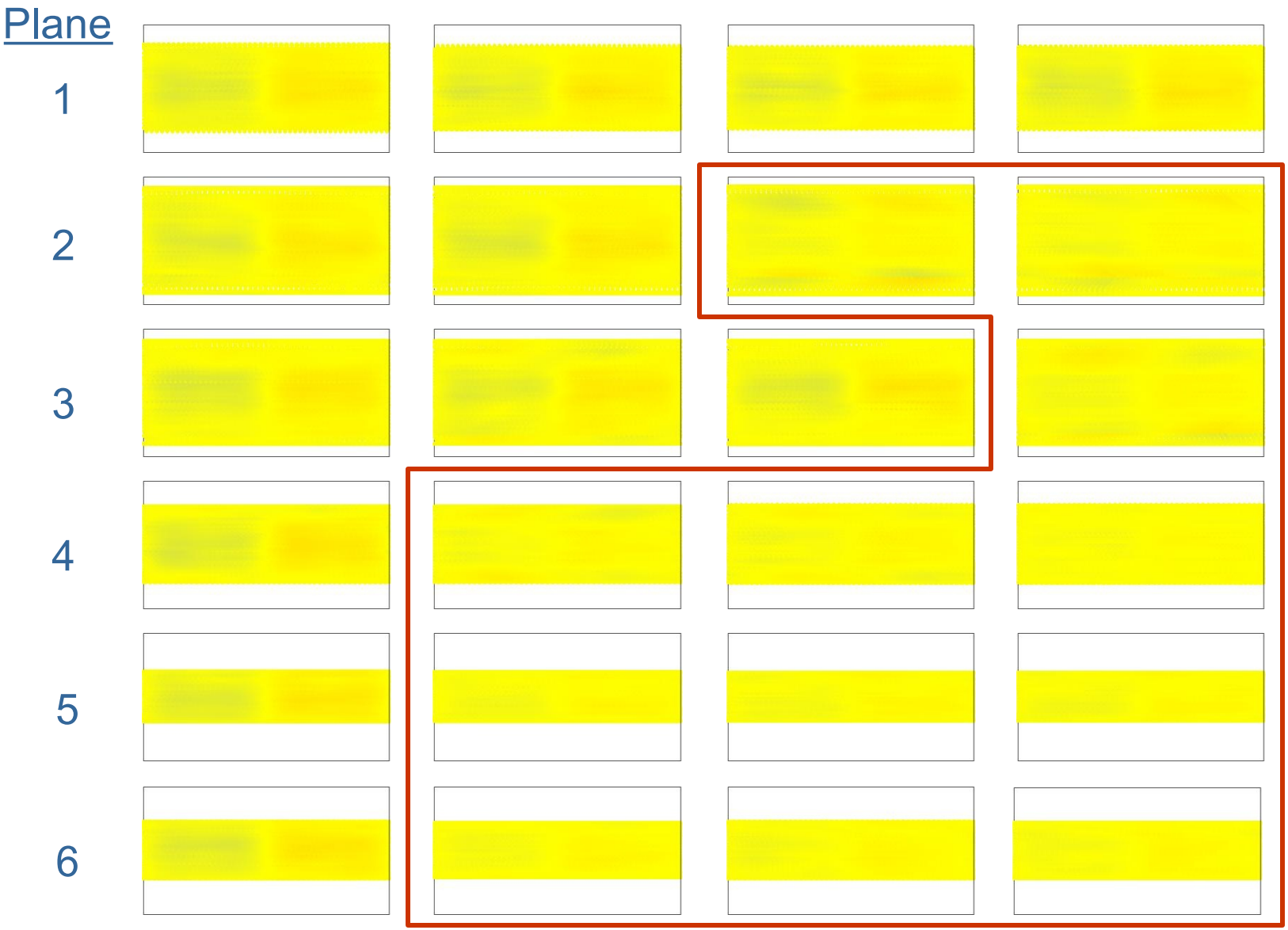
G05 + G06



Radial orbit differences: ROCK – CODE

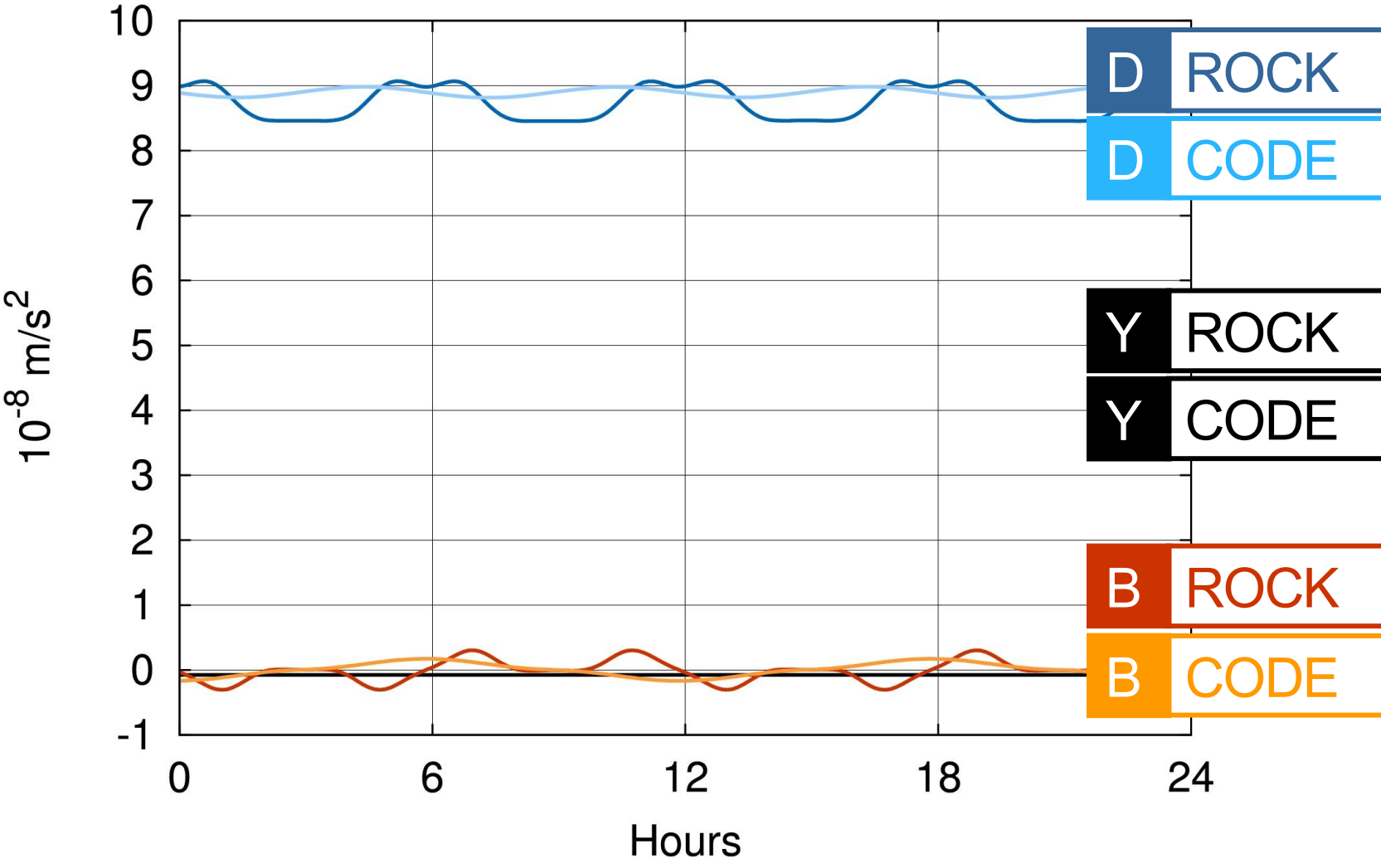


Radial orbit differences: CODE – NONE

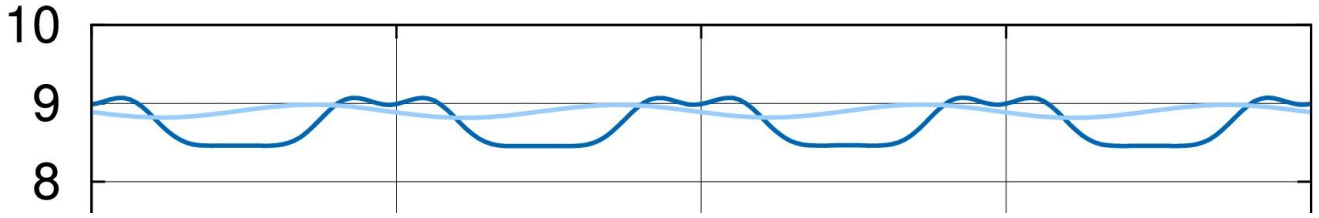


Solar radiation pressure

G05, β = 15°



Estimation of 2/rev parameter in D

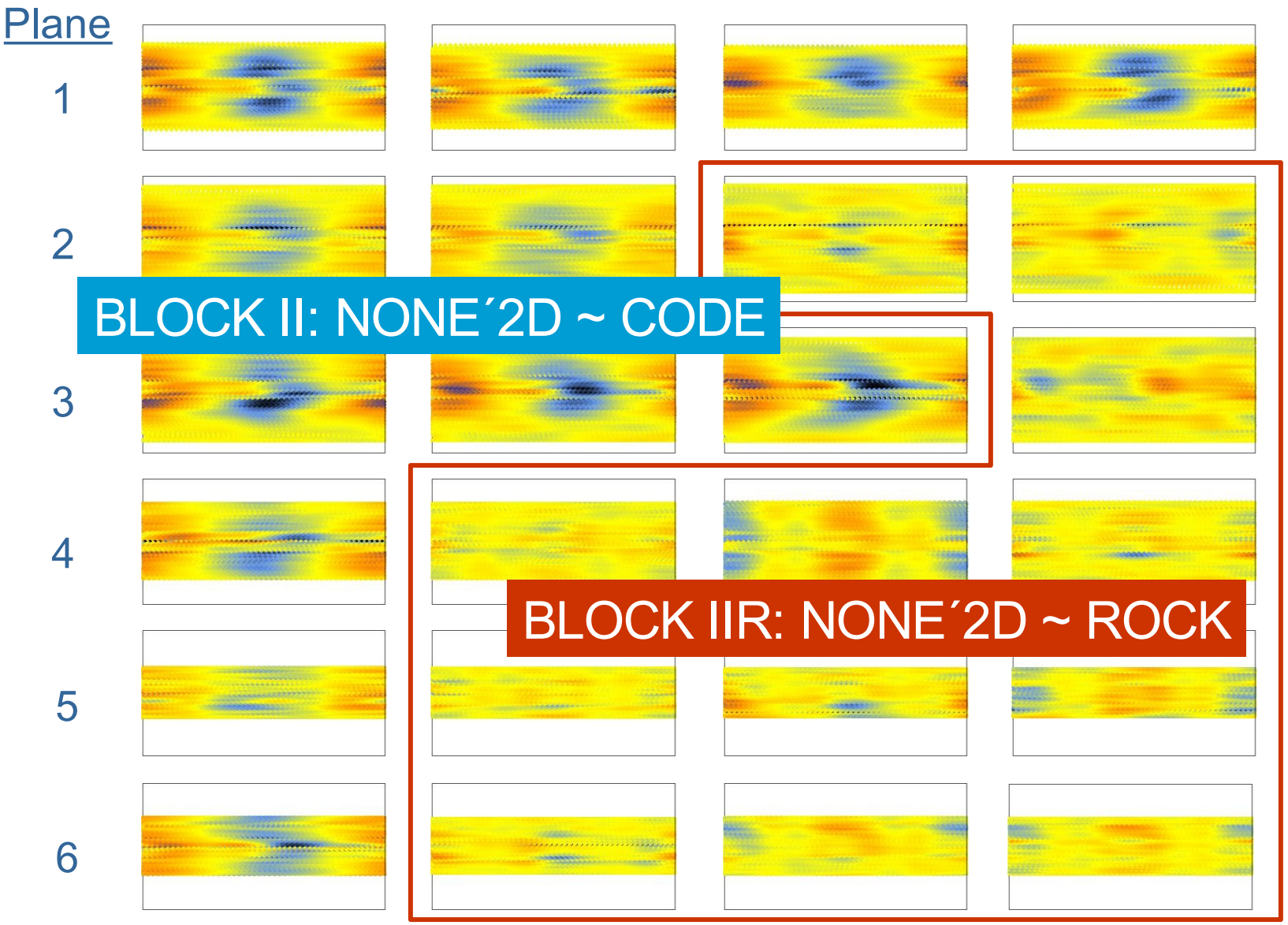


$$D(u_{Sat}) = D0 + DC \cos(2u_{Sat}) + DS \sin(2u_{Sat})$$

- no a priori SRP model: $\mathbf{a_0}$ = **NONE**
- Extended CODE orbit model + 2/revolution parameter in D

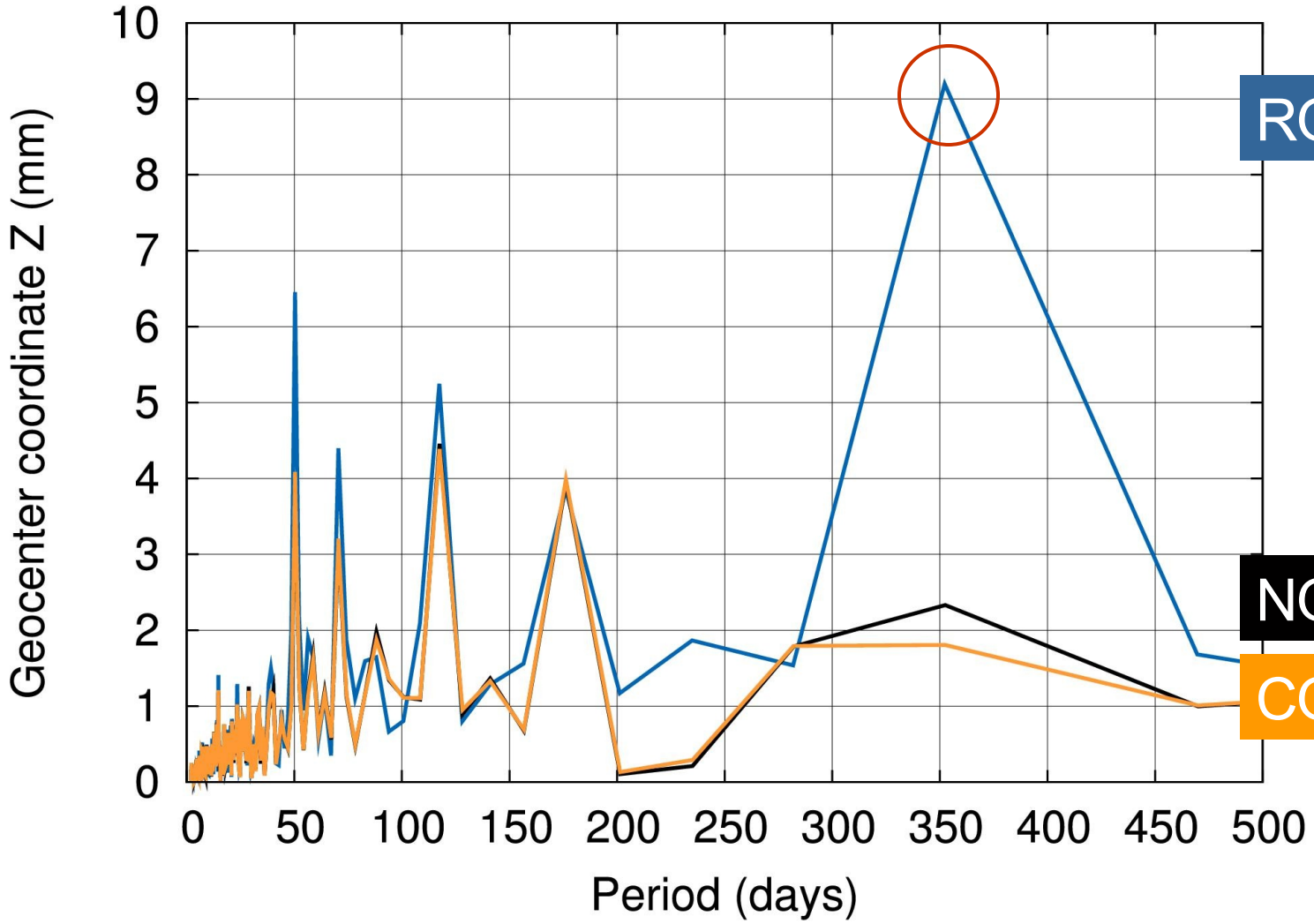
→ **NONE´2D**

Radial orbit differences: ROCK – NONE´2D



Impact of SRP models on Geocenter

352 days → draconitic GPS year



Conclusions

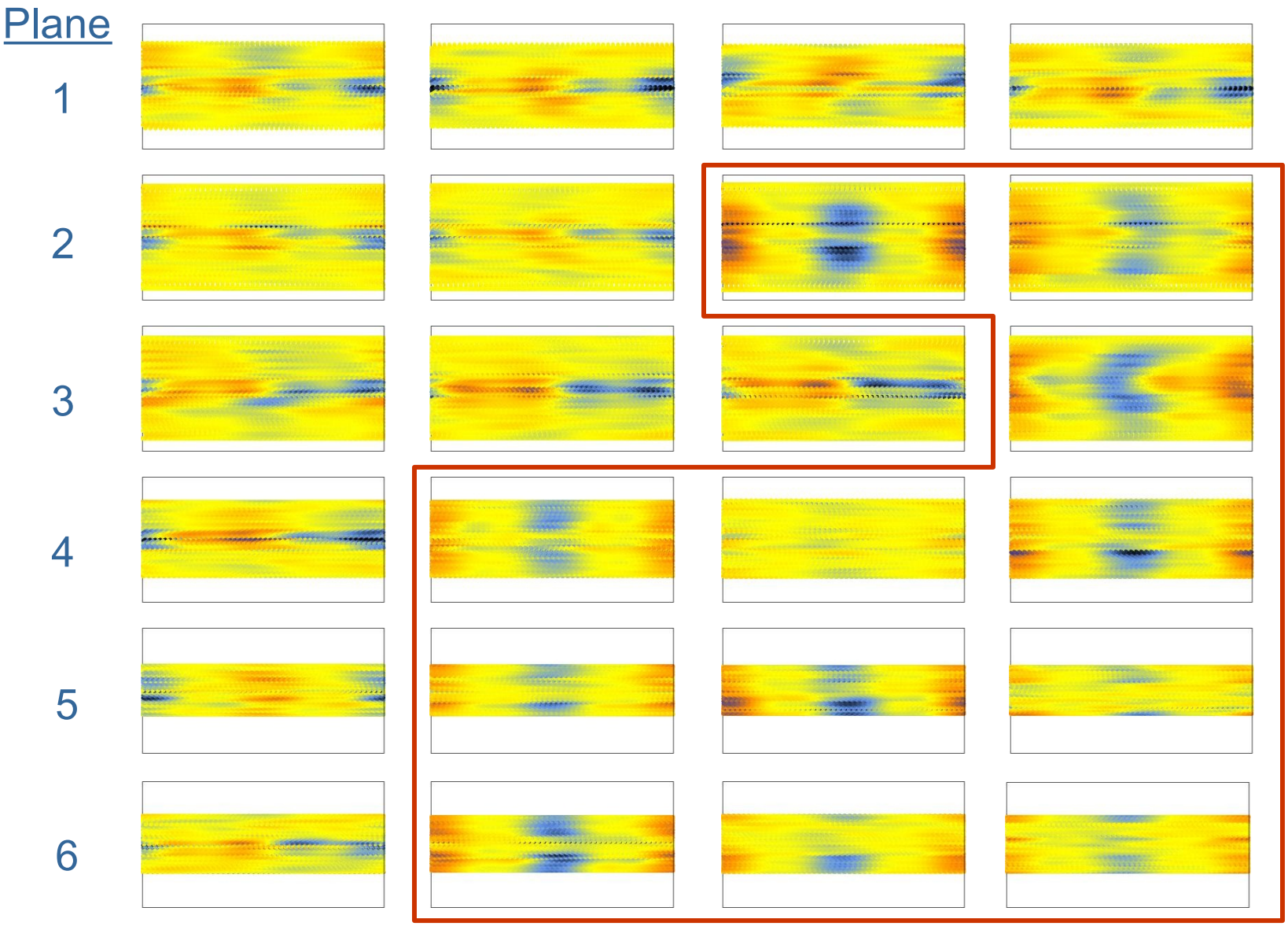
- Impact of SRP model on orbit quality
  - CODE ~ NONE
  - for BLOCK II: CODE superior to ROCK
  - for BLOCK IIR: no absolute assessment of orbit quality possible

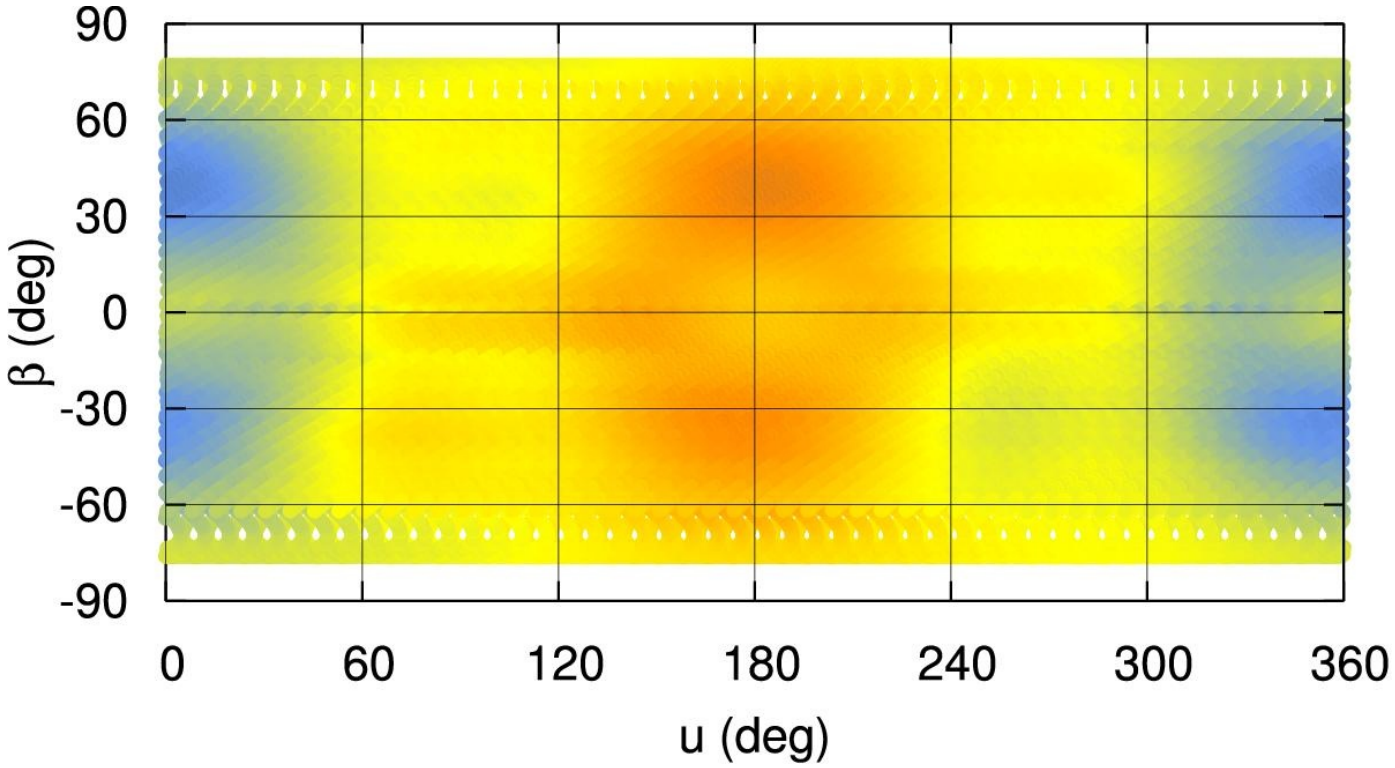
SLR retroreflectors are needed

- Still small systematic pattern in SLR residuals for CODE → demands further investigation
  - 2/rev, Boxwing SRP model
- Impact of SRP model on Geocenter Z-coord.
  - CODE superior to ROCK

Poster G1-1TU5P-0315 (L. Ostini et al.)
"Near-seasonal periods in GNSS station time series"

Radial orbit differences: NONE – NONE´2D




90
60
30
0
-30
-60
-90
β (deg)
0
60
120
180
240
300
360
u (deg)