

Status meeting

Tudat radiation pressure models
21 July 2023

Agenda

Validation

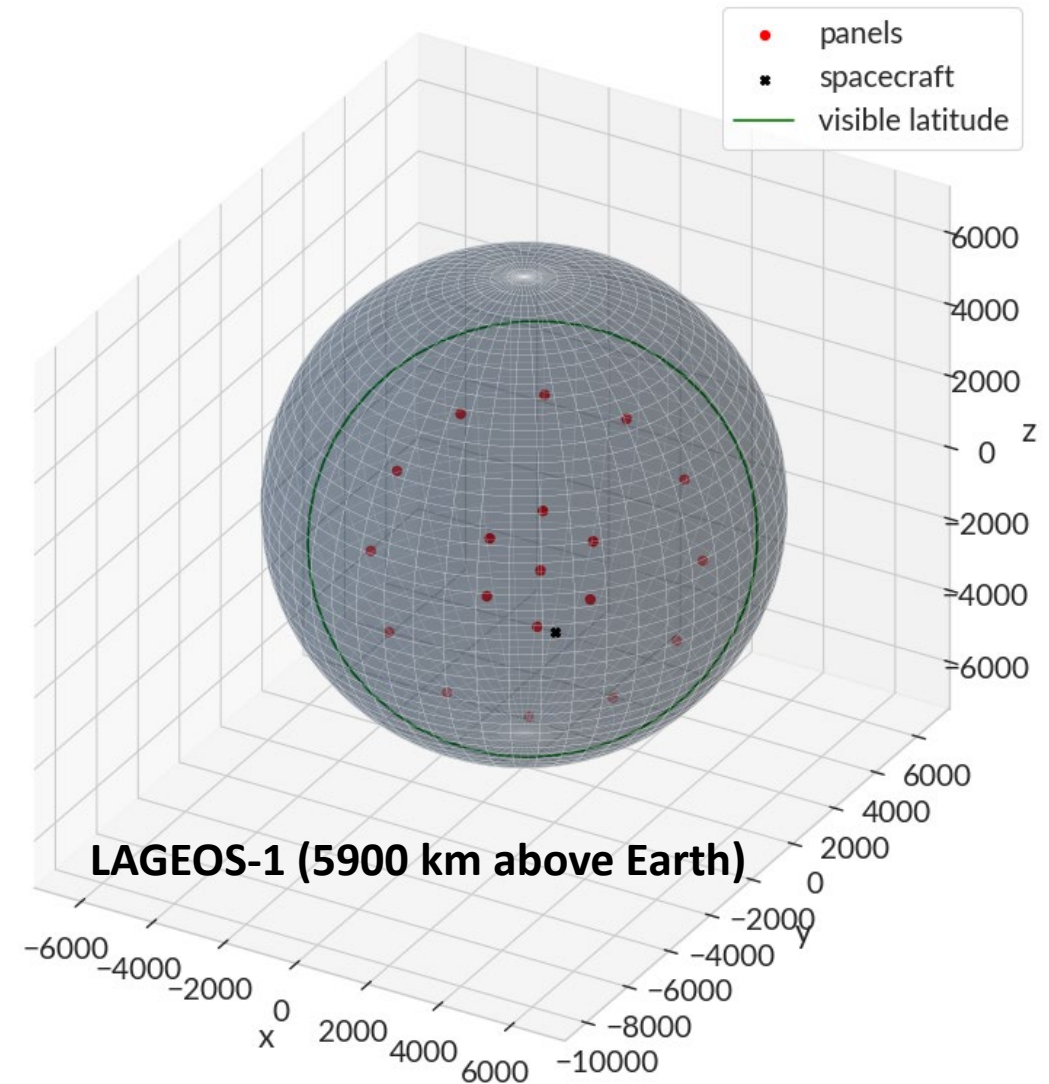
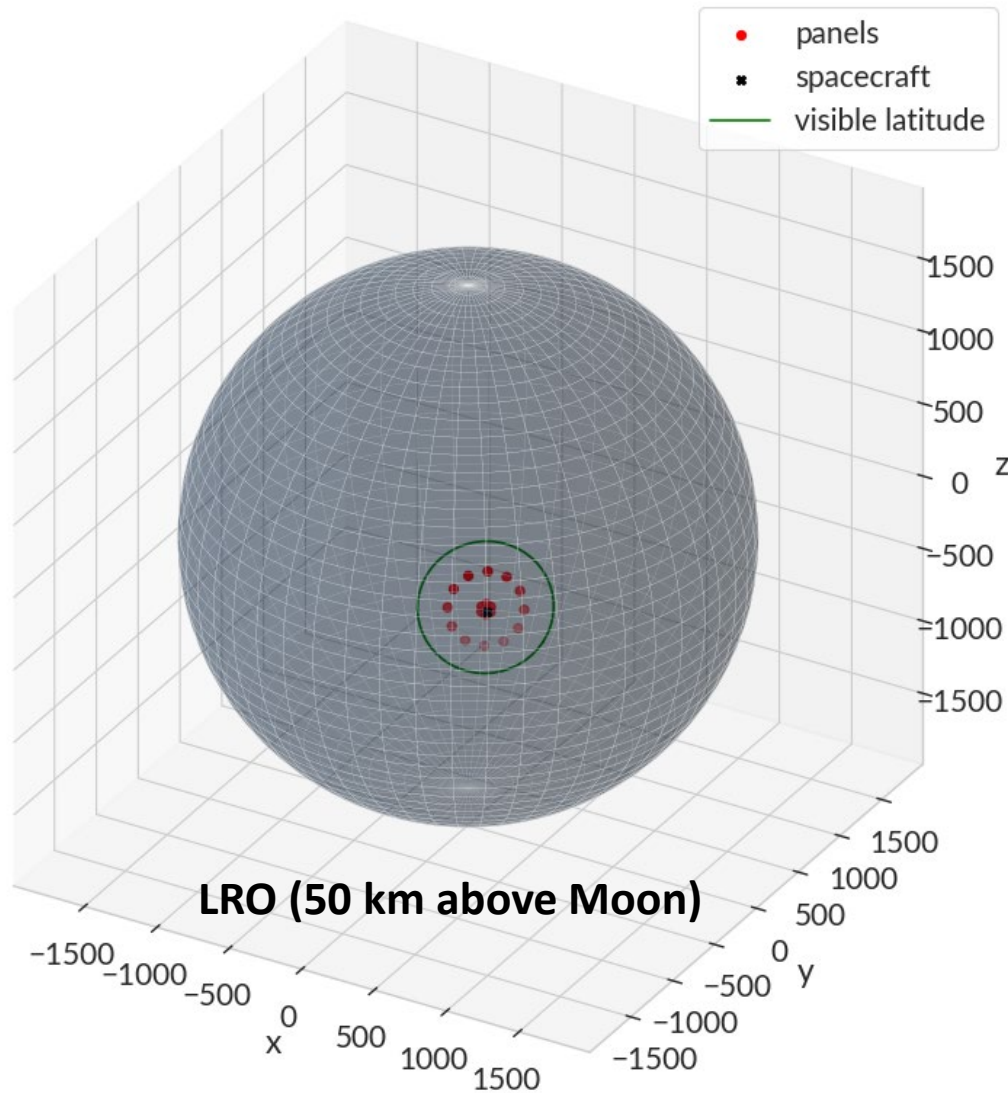
- Visualization of Knocke's paneling algorithm
- Comparison with Knocke's accelerations for LAGEOS-1
- Comparison with Orekit accelerations for LAGEOS-1
- Comparison with Smith's accelerations for LRO
- Convergence for increasing number of panels

Science results

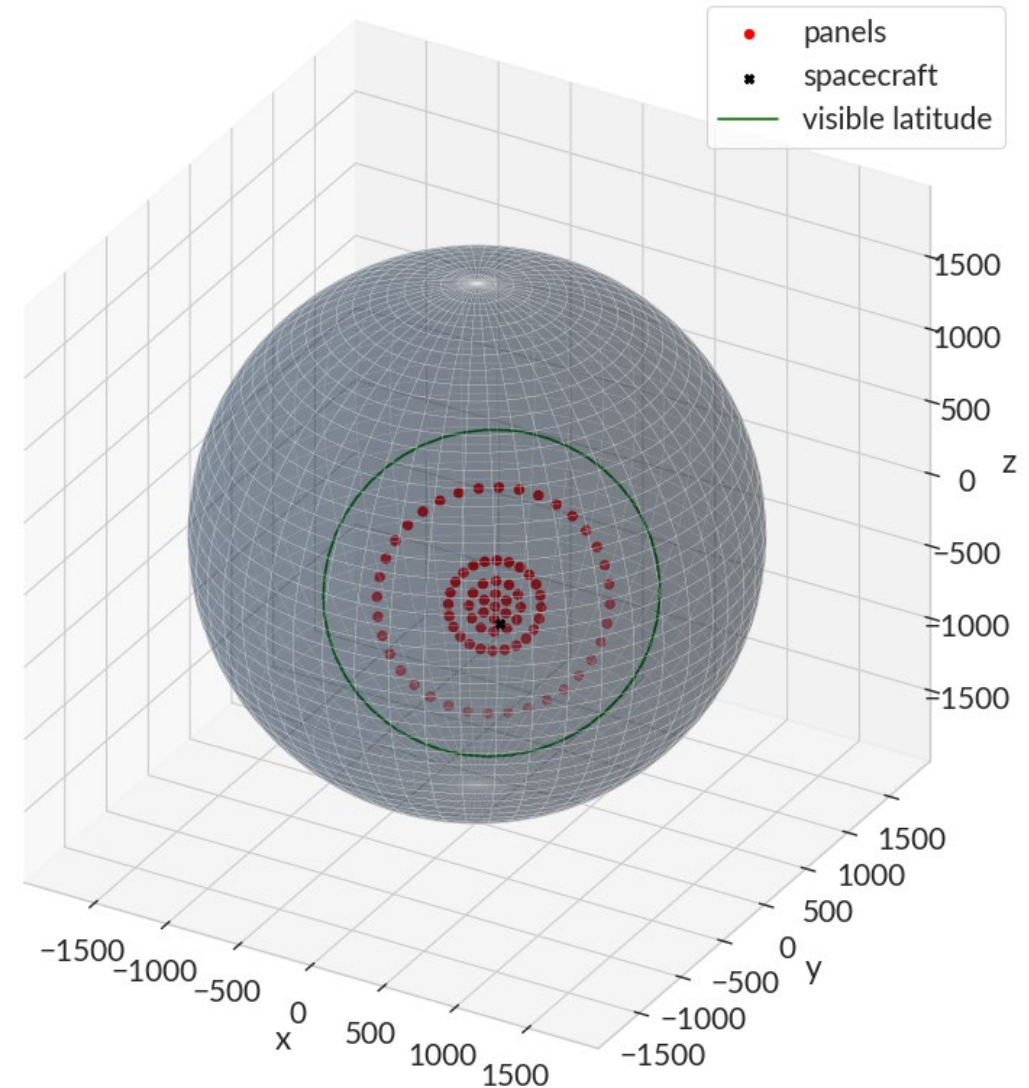
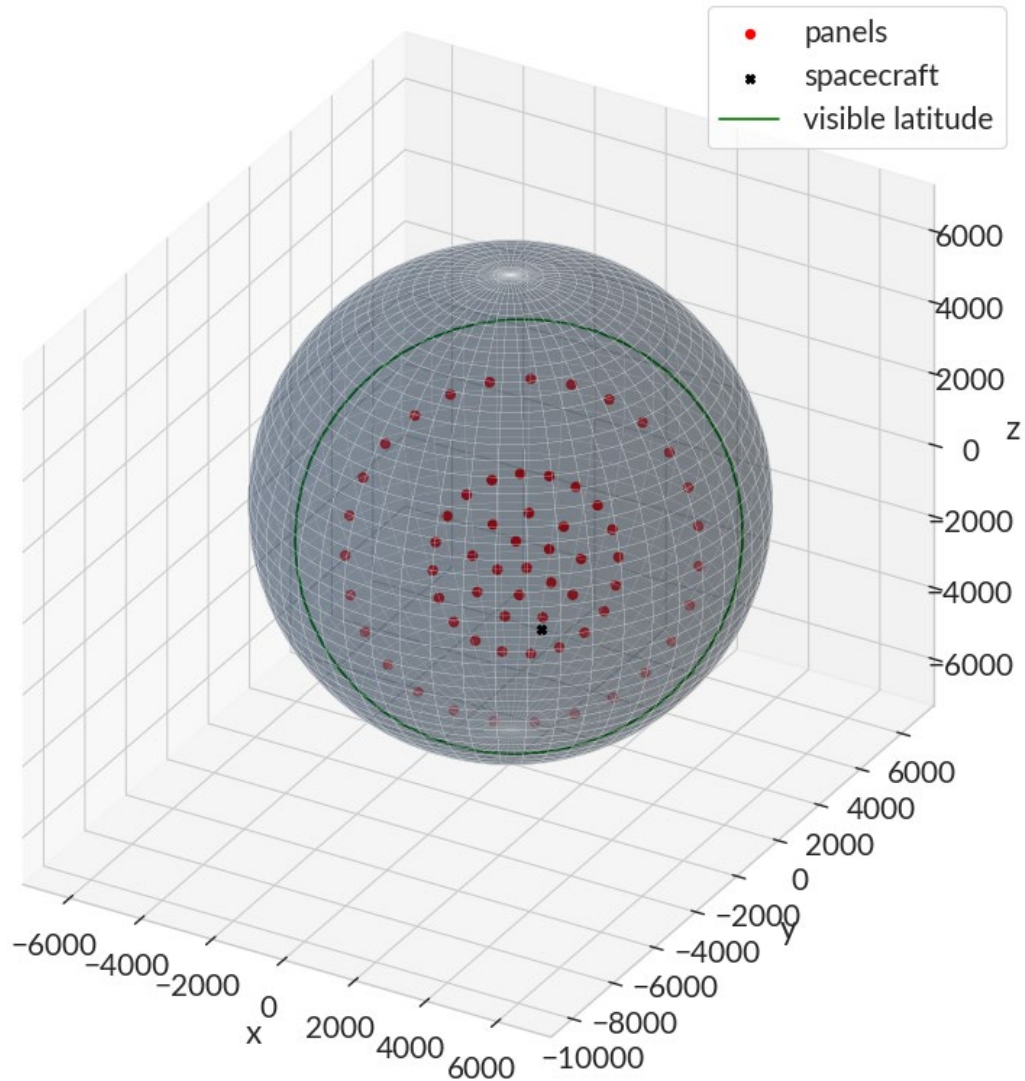
- RP accelerations of LRO

Visualization of Knocke's paneling algorithm

Knocke's paneling algorithm: LAGEOS and LRO

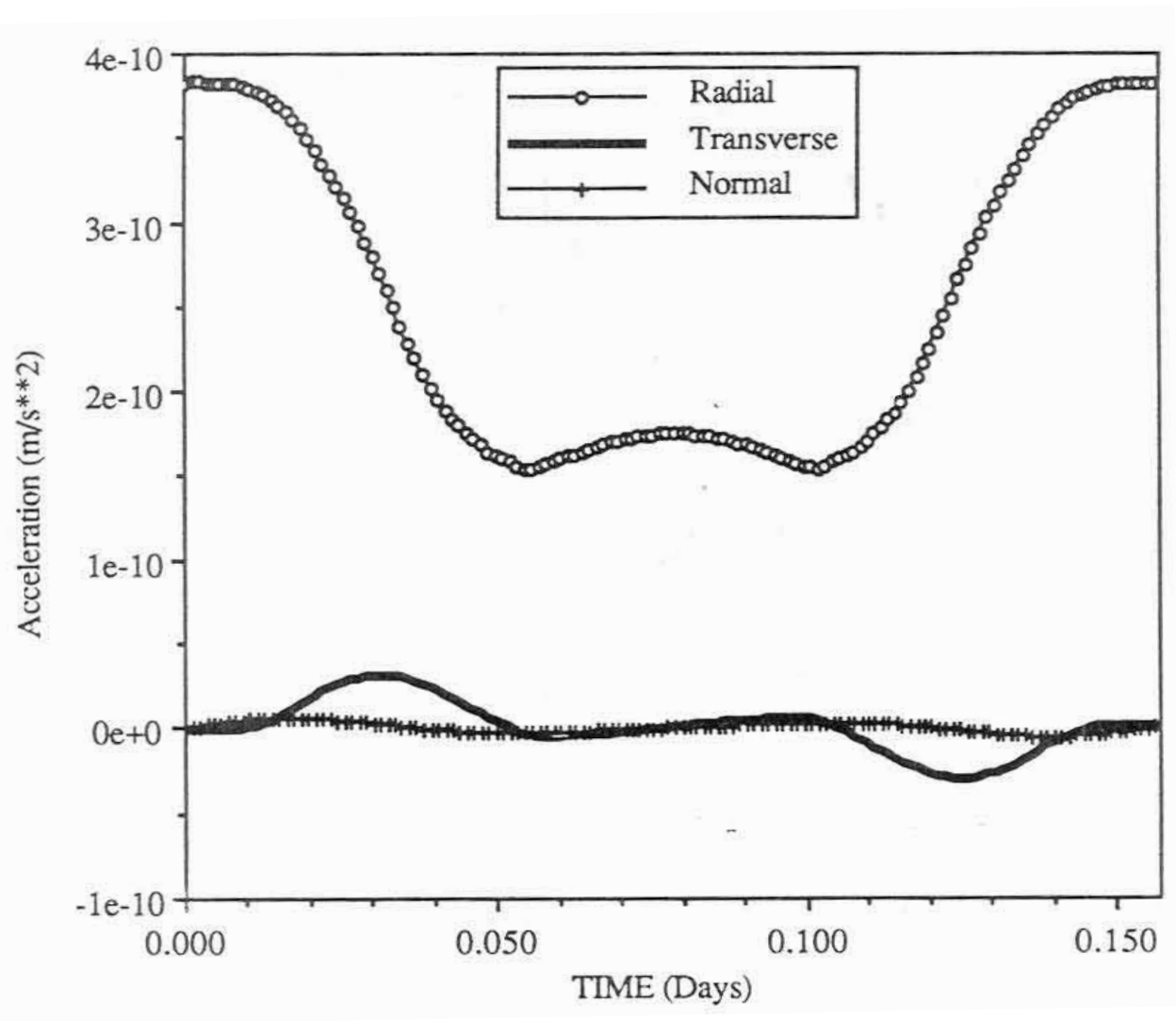


Knocke's paneling algorithm: Flexible panels

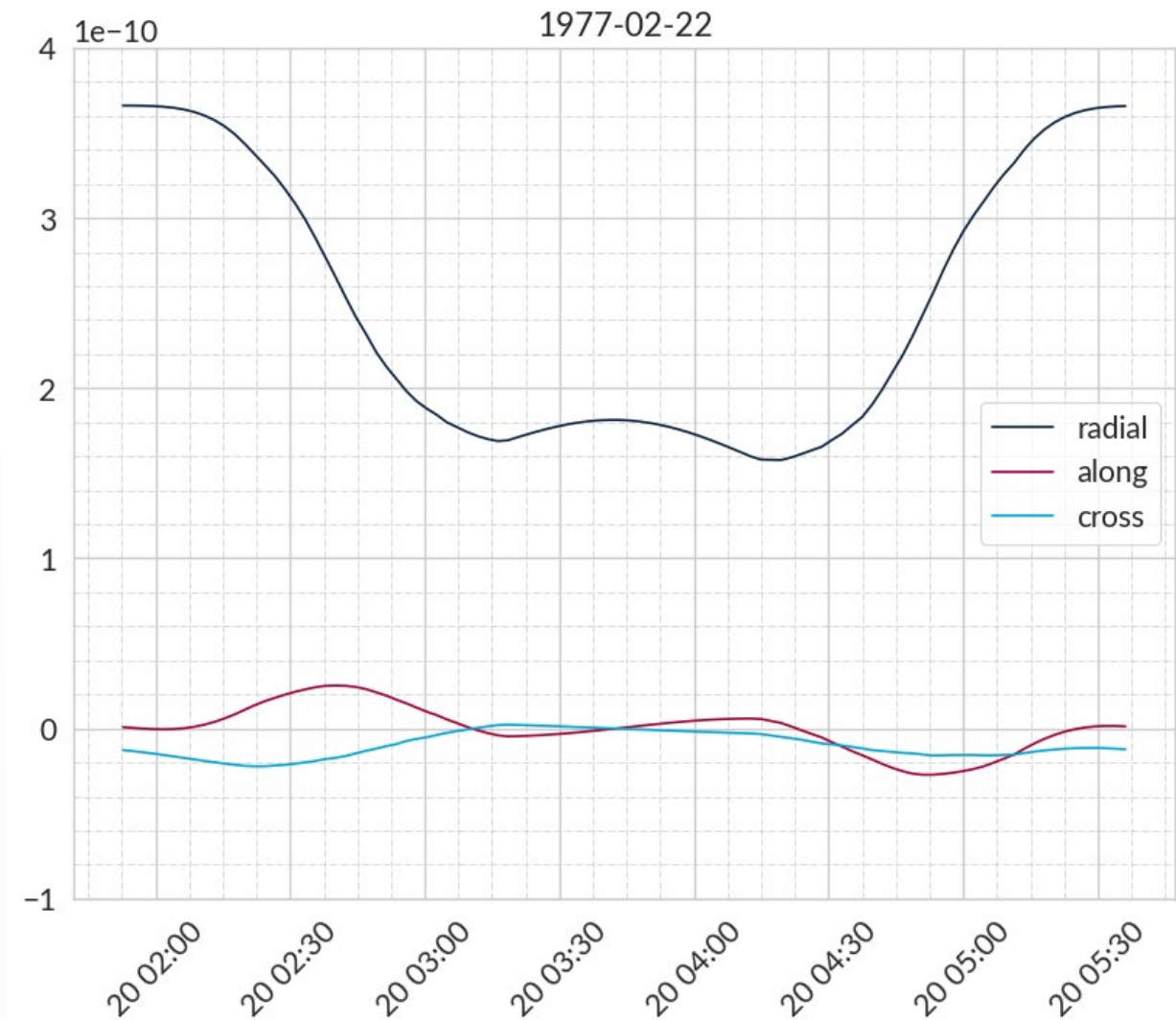
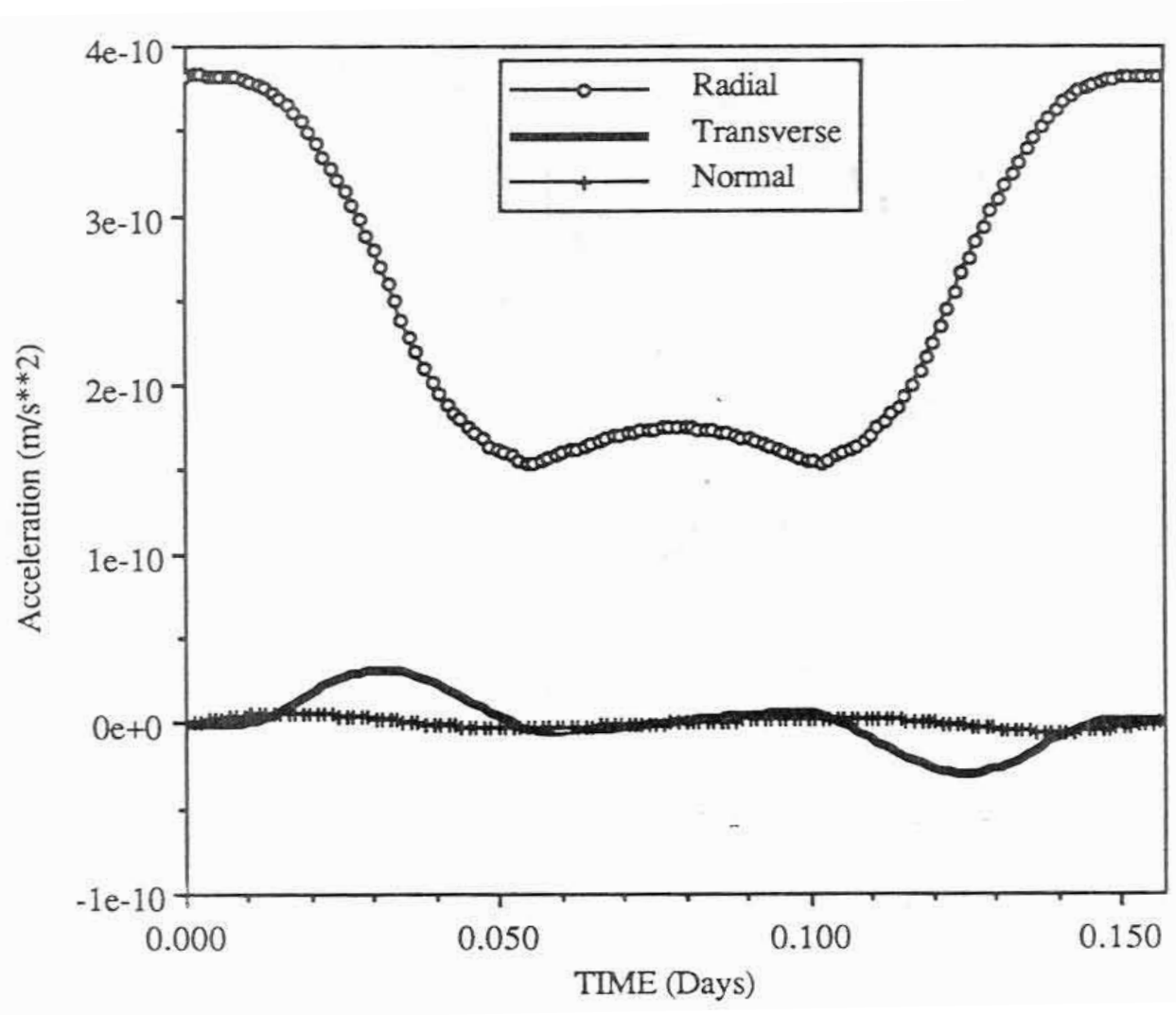


Comparison with Knocke for LAGEOS-1

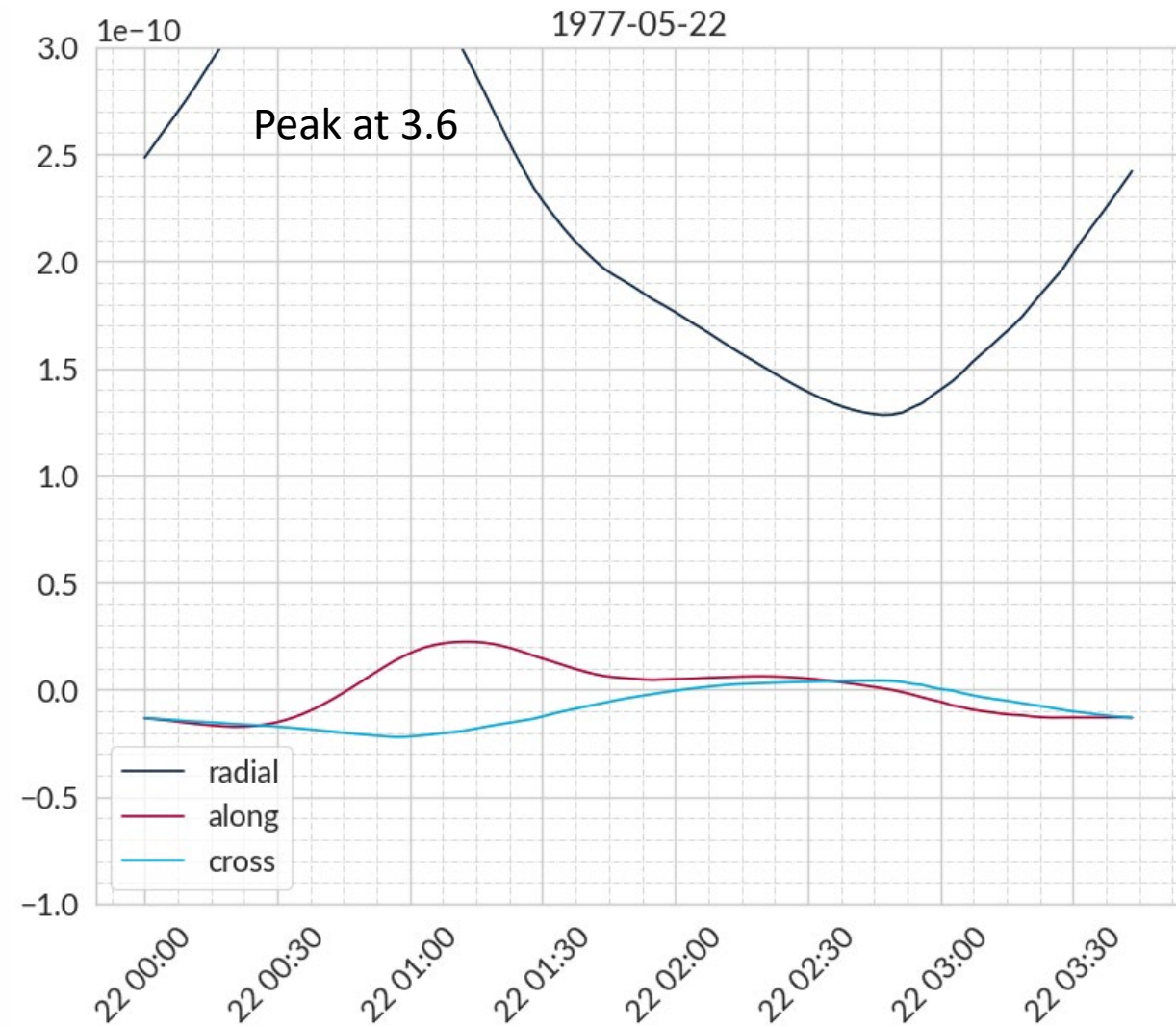
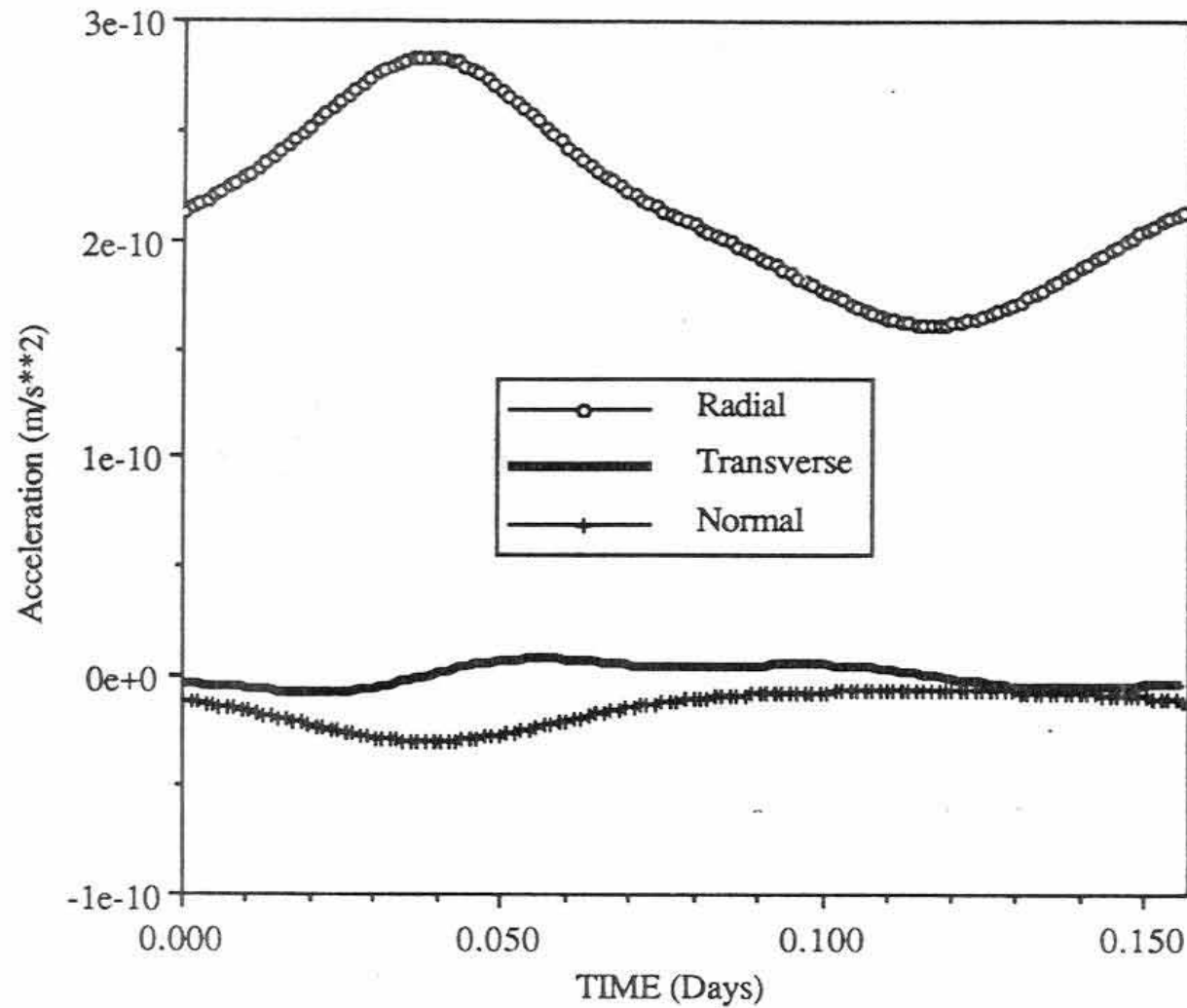
Comparison with Knocke: $\beta = 0^\circ$



Comparison with Knocke: $\beta = 0^\circ$

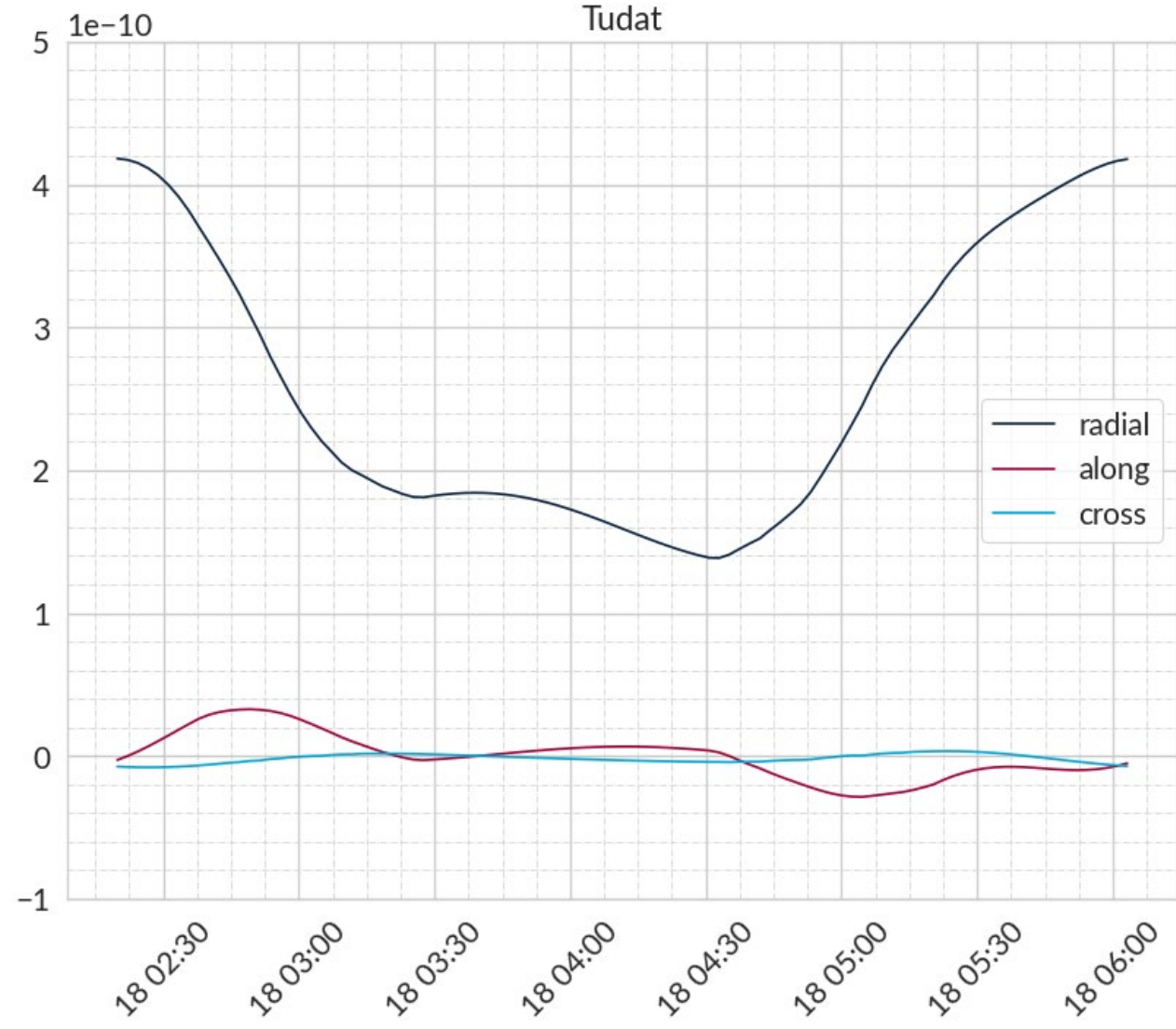
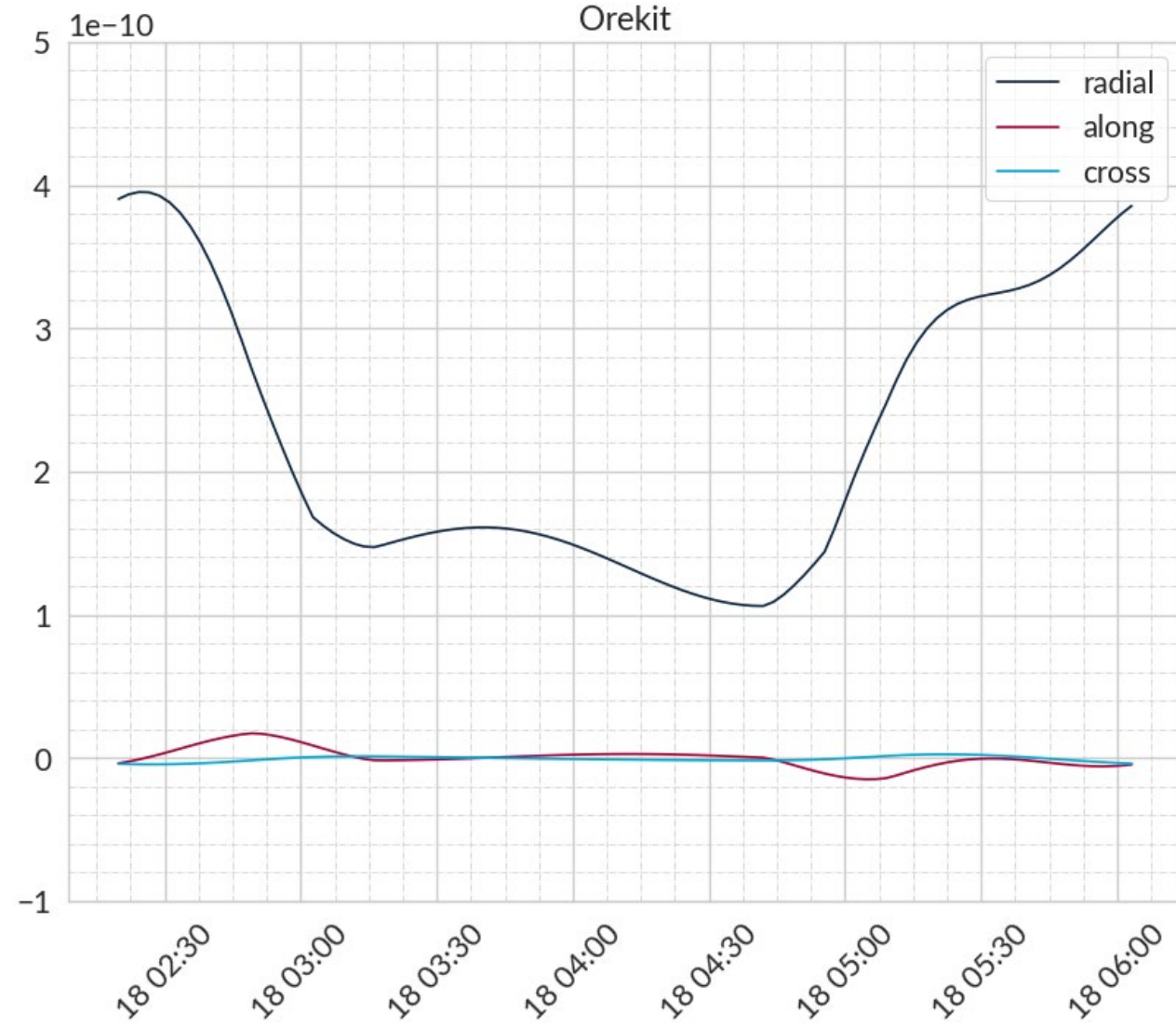


Comparison with Knocke: $\beta = 90^\circ$

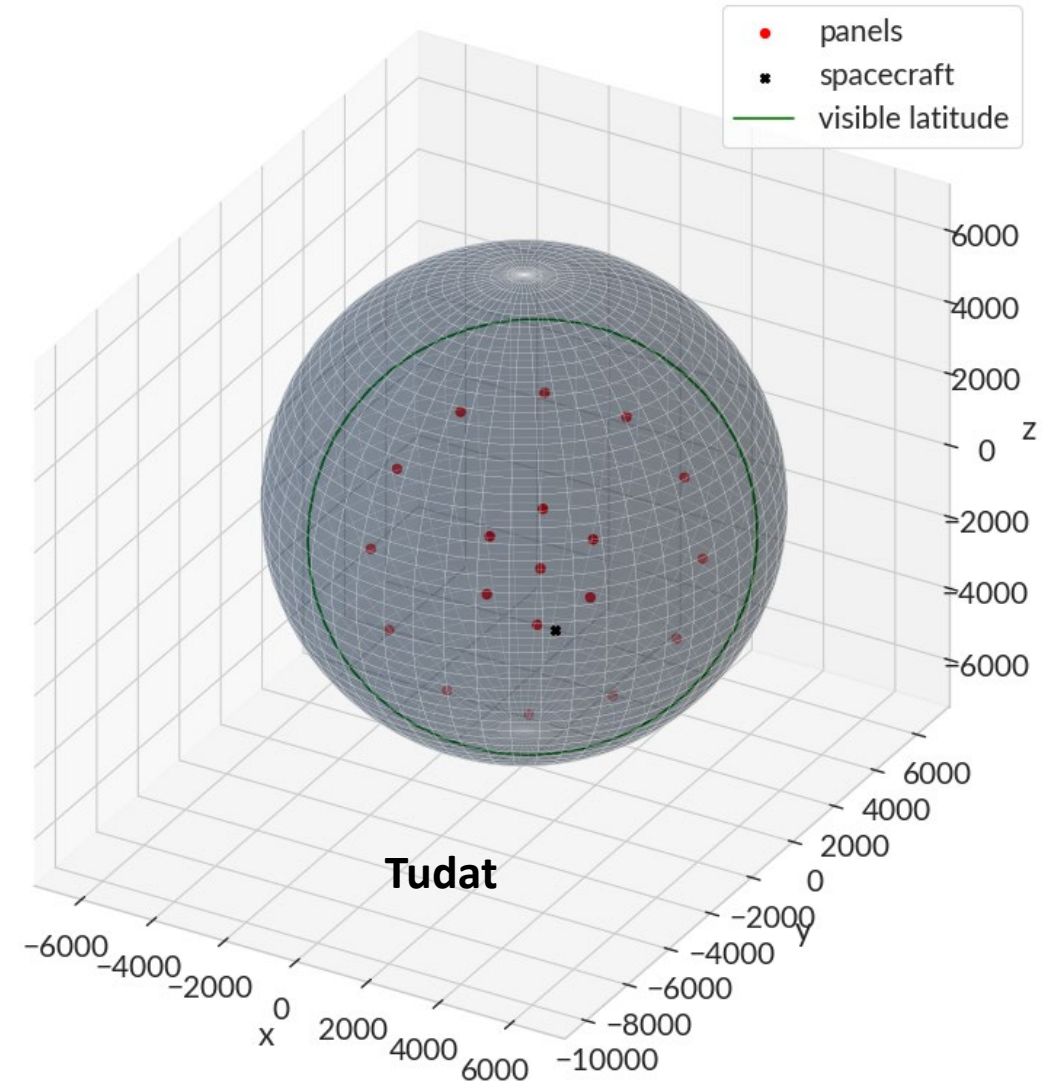
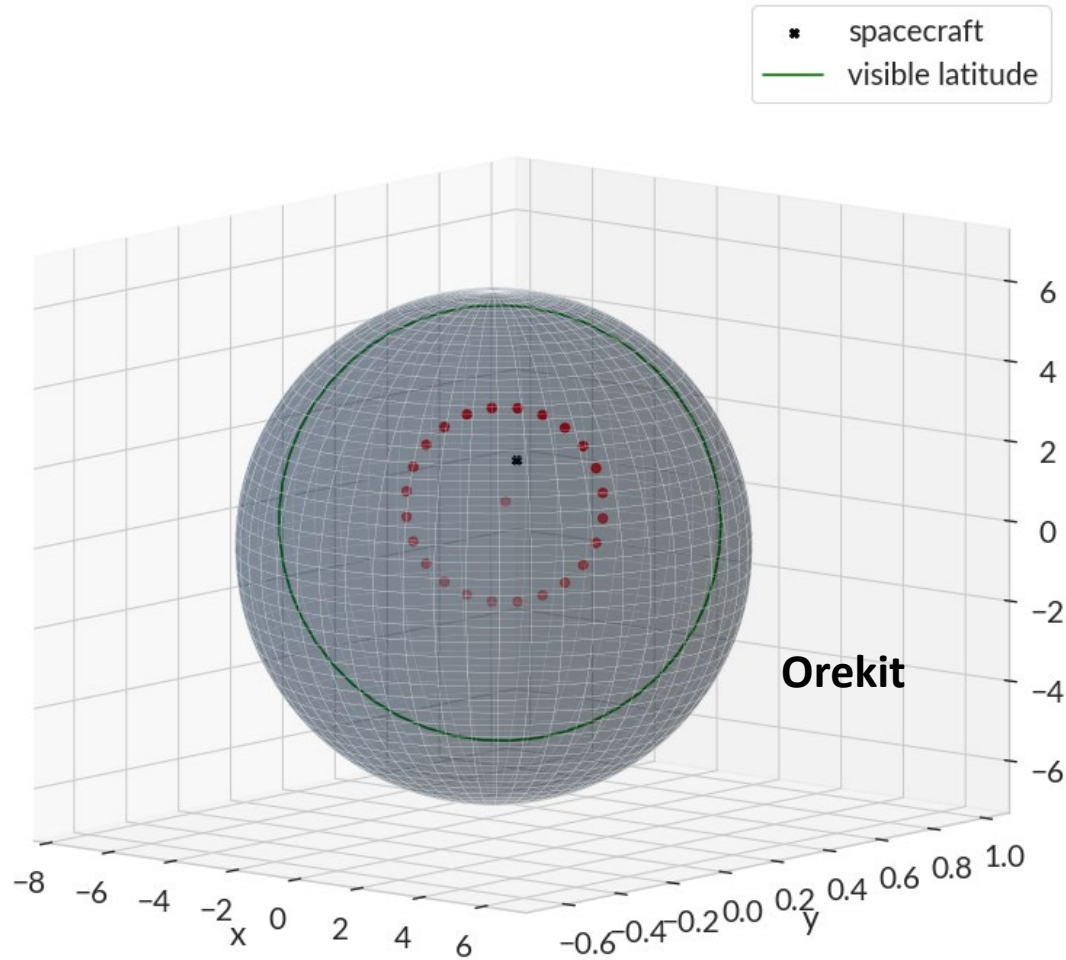


Comparison with Orekit for LAGEOS-1

Comparison with Orekit

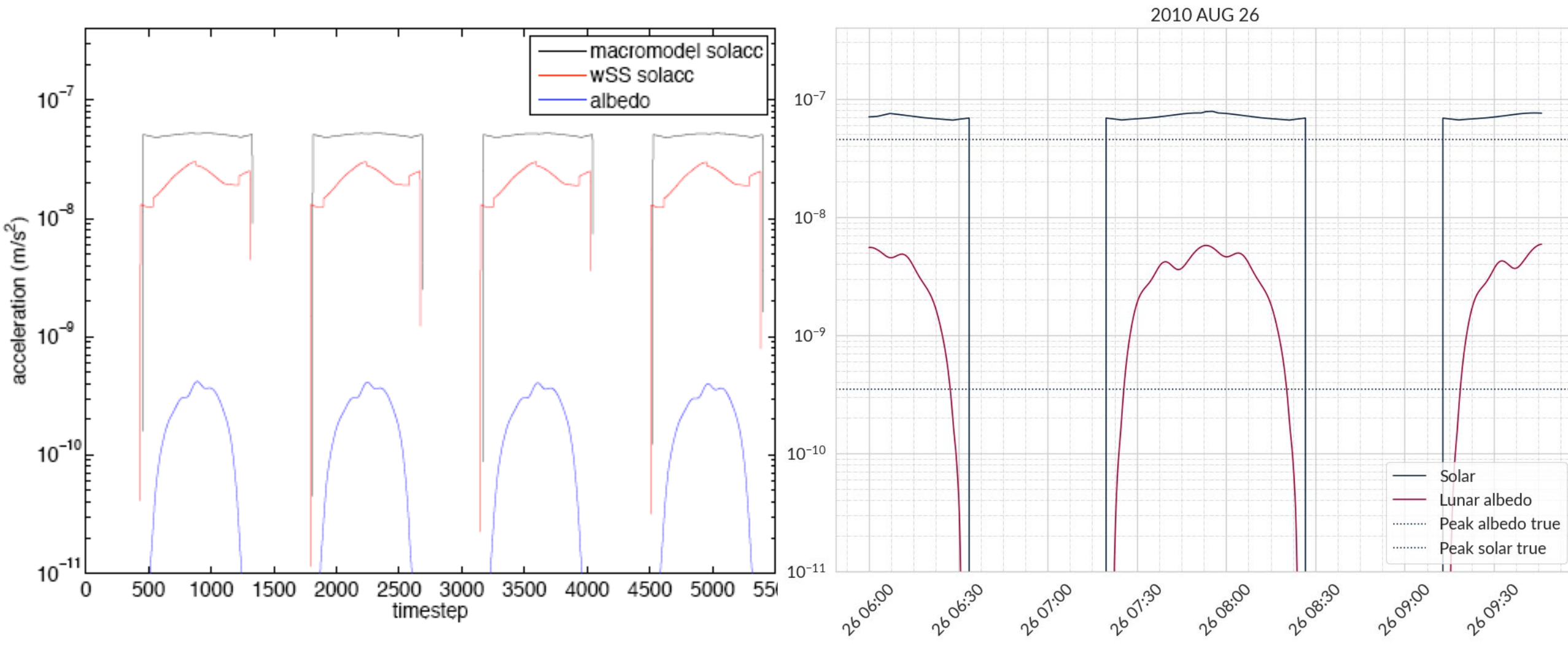


Comparison with Orekit

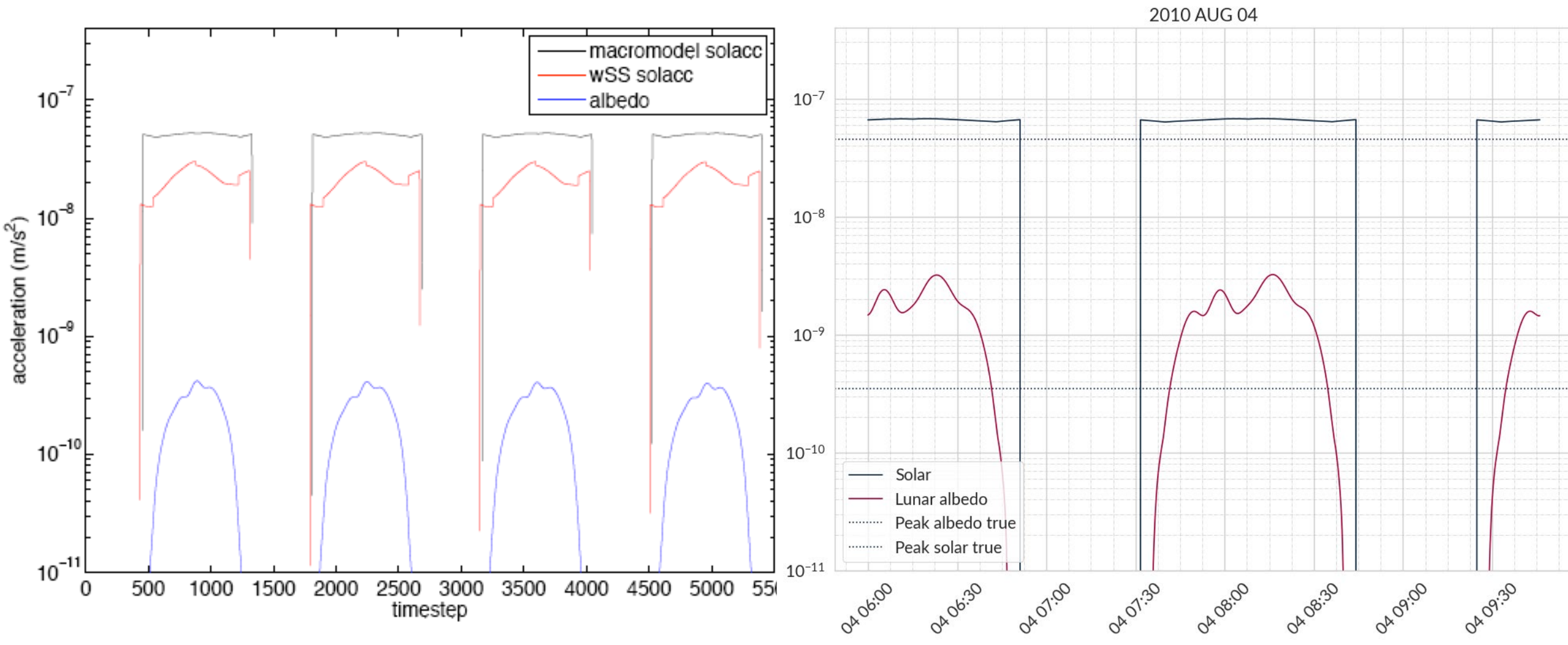


Comparison with Smith for LRO

Comparison with Smith: $\beta = 35^\circ$

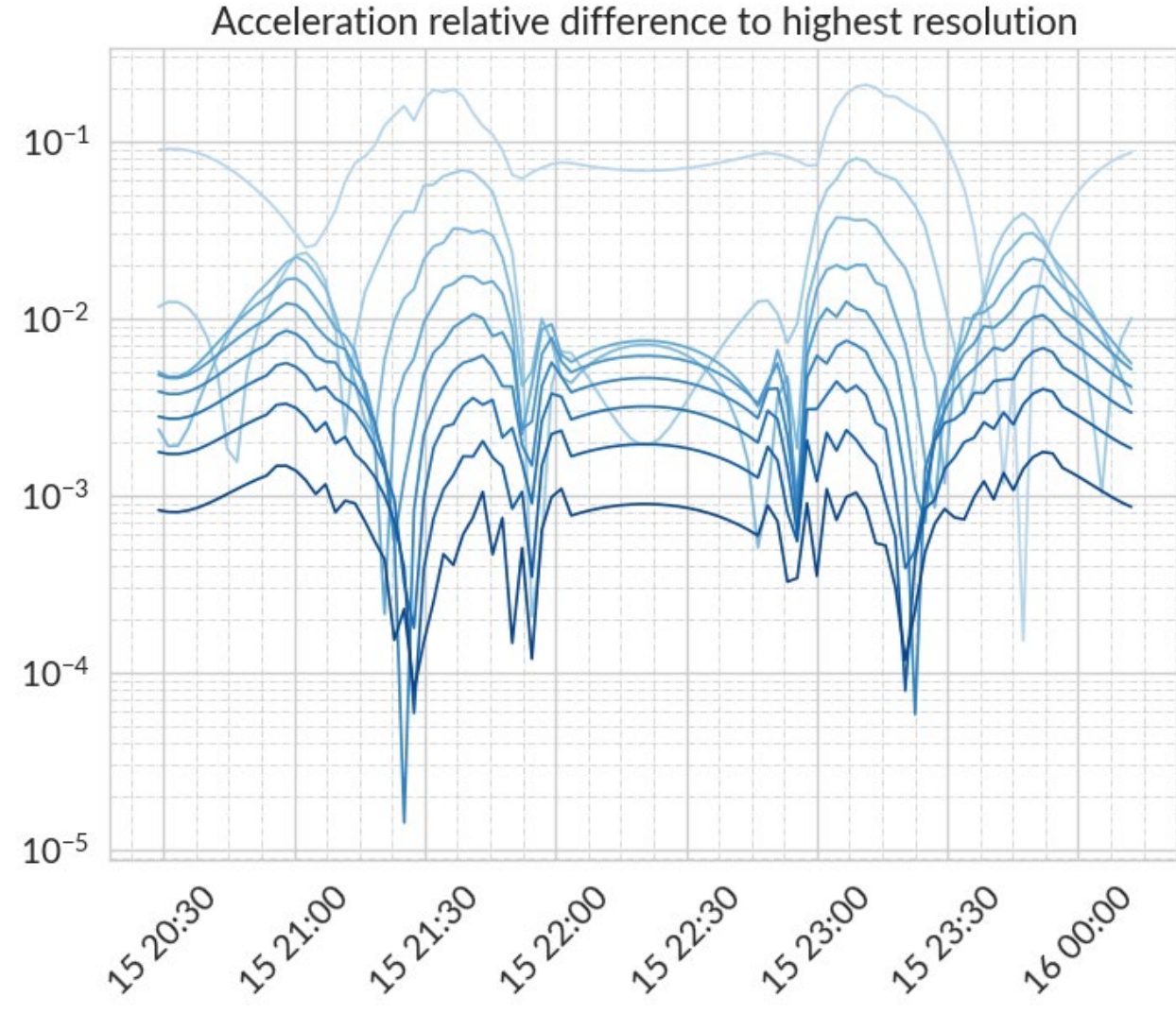
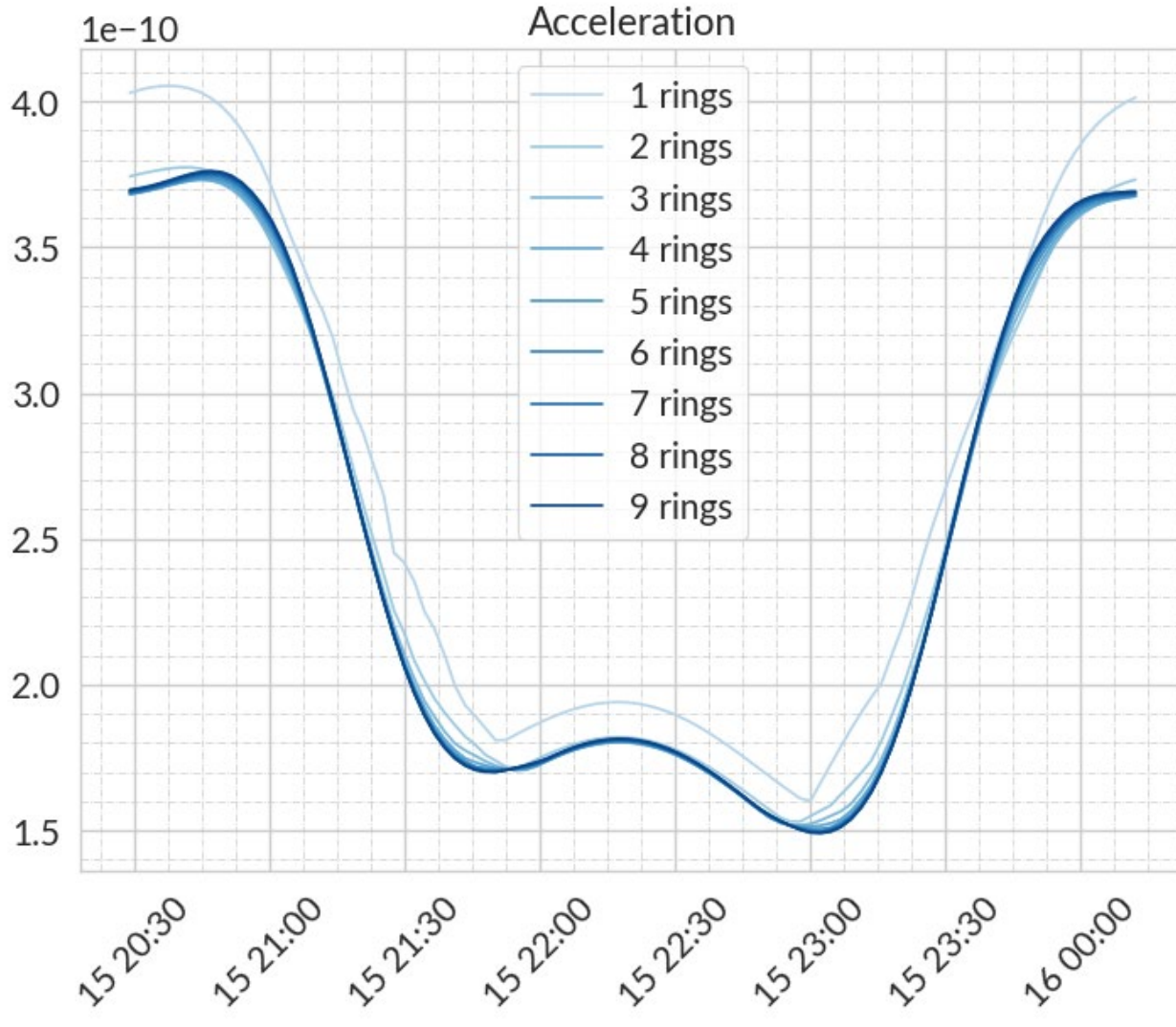


Comparison with Smith: $\beta = 56^\circ$

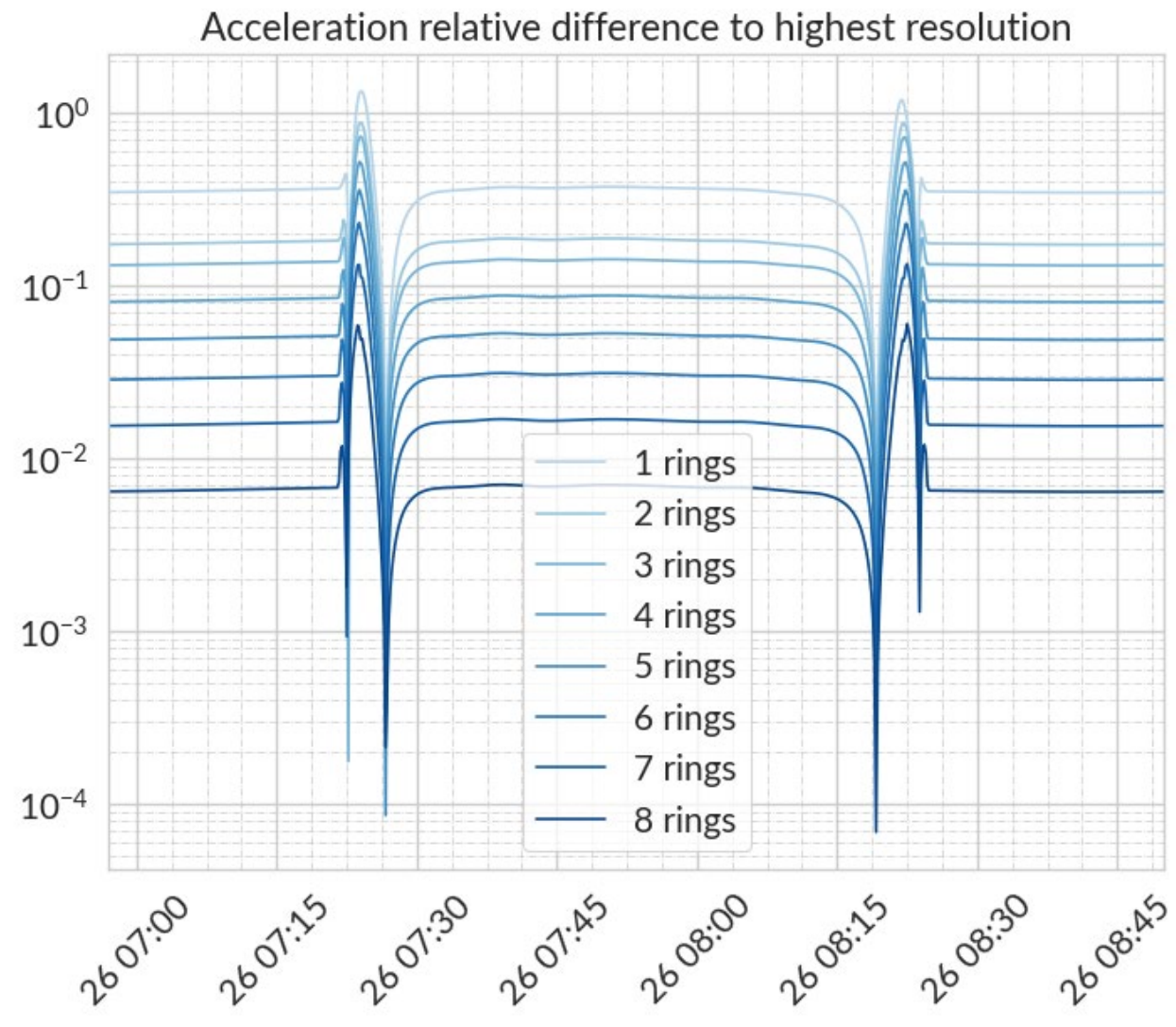
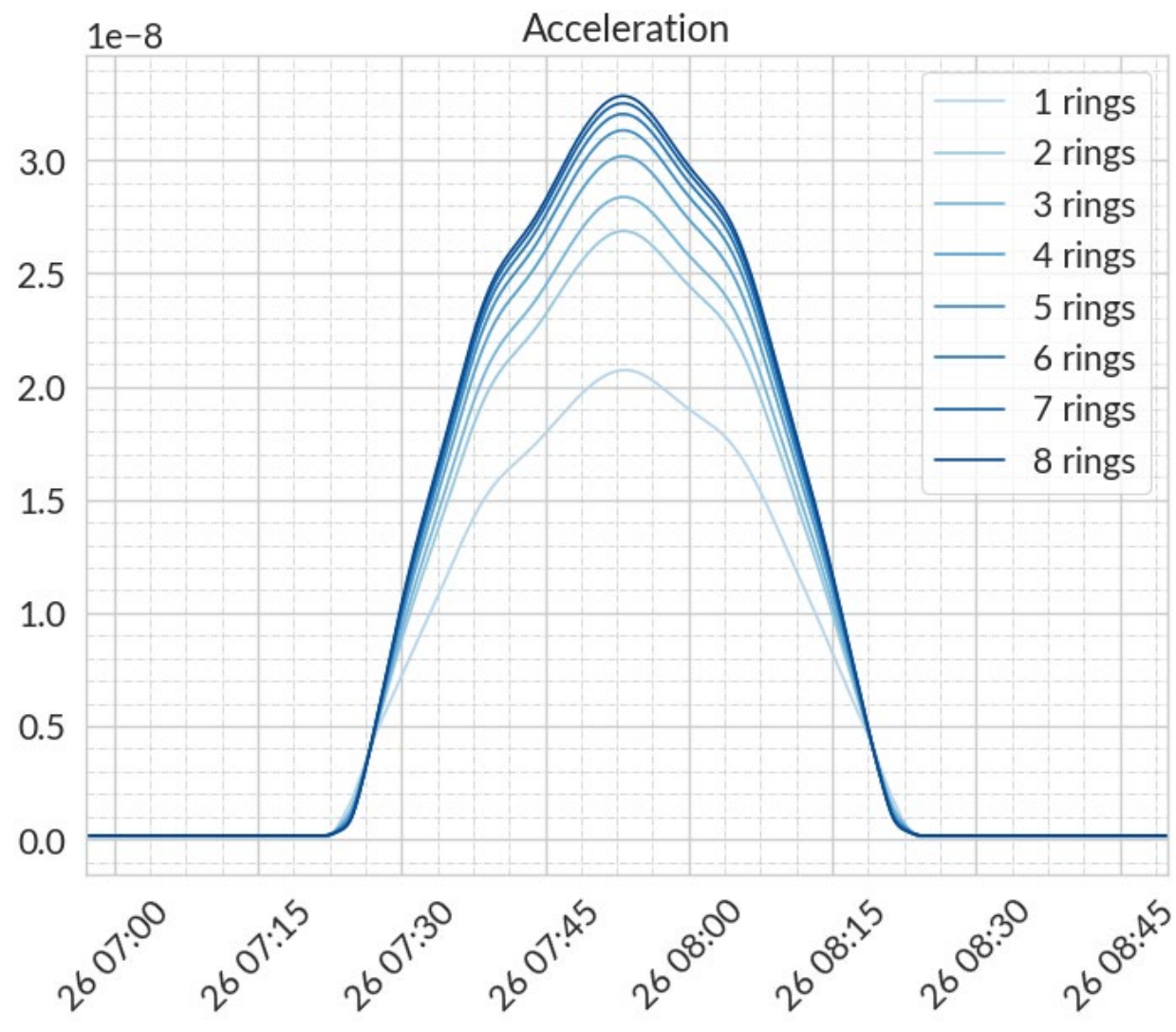


Convergence for
increasing number of panels

Convergence for LAGEOS-1



Convergence for LRO



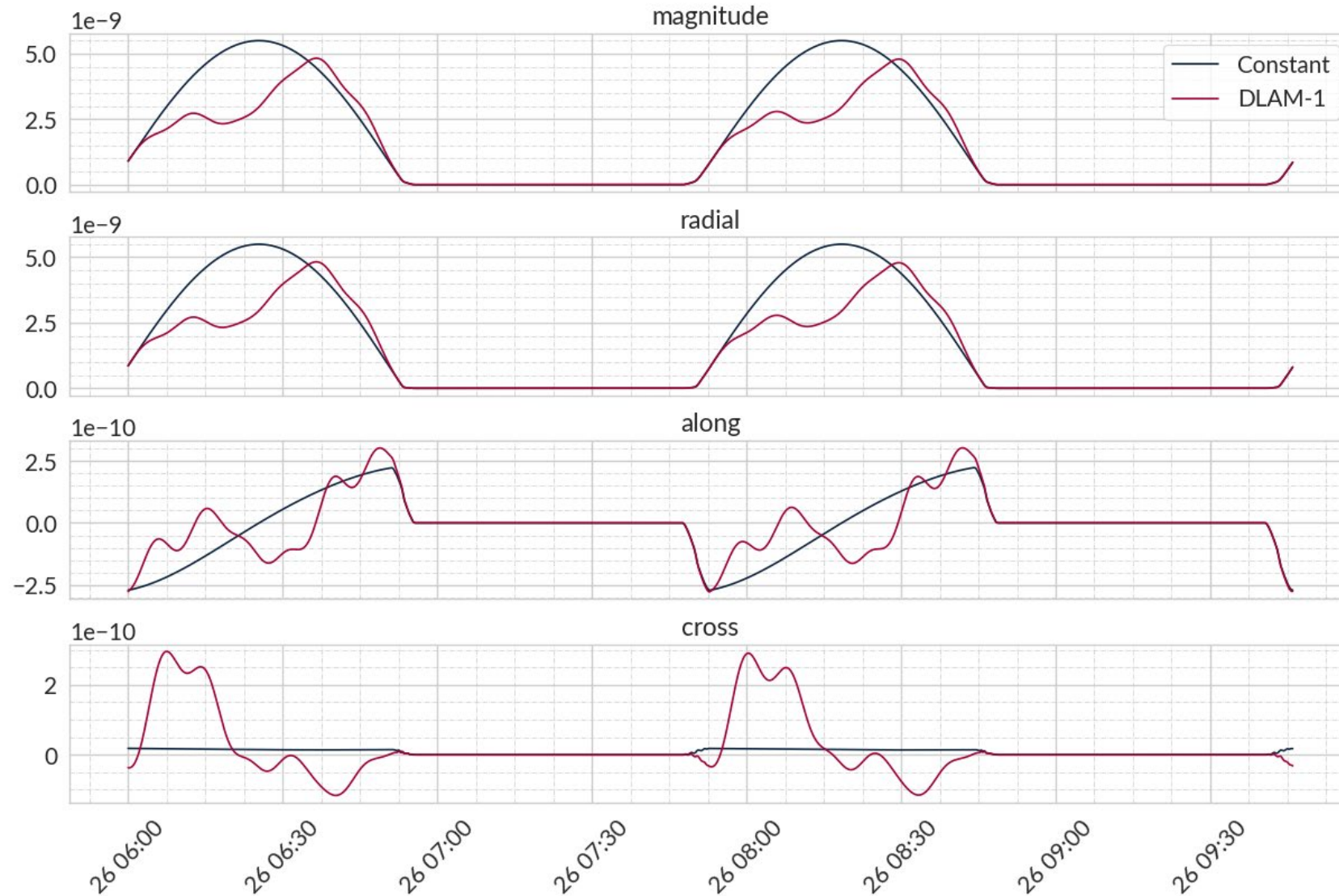
Validation summary

- Cannonball and paneled target for solar RP agree with existing implementation
 - Cannonball 4% slower, paneled 6% faster
- Accelerations agree with Knocke for LAGEOS-1
 - General shape agrees well
 - Magnitude can be over/underestimated by up to 15%
 - Possible reason: wrong arc
- Accelerations agree with Orekit for LAGEOS-1
 - General shape agrees well
 - Magnitude can be off by up to 30%
 - Orekit defines panels wrong
- Accelerations do NOT agree with Smith
 - Order of magnitude discrepancy for albedo
- Accelerations converge for increasing number of panels

→ Sufficiently validated?

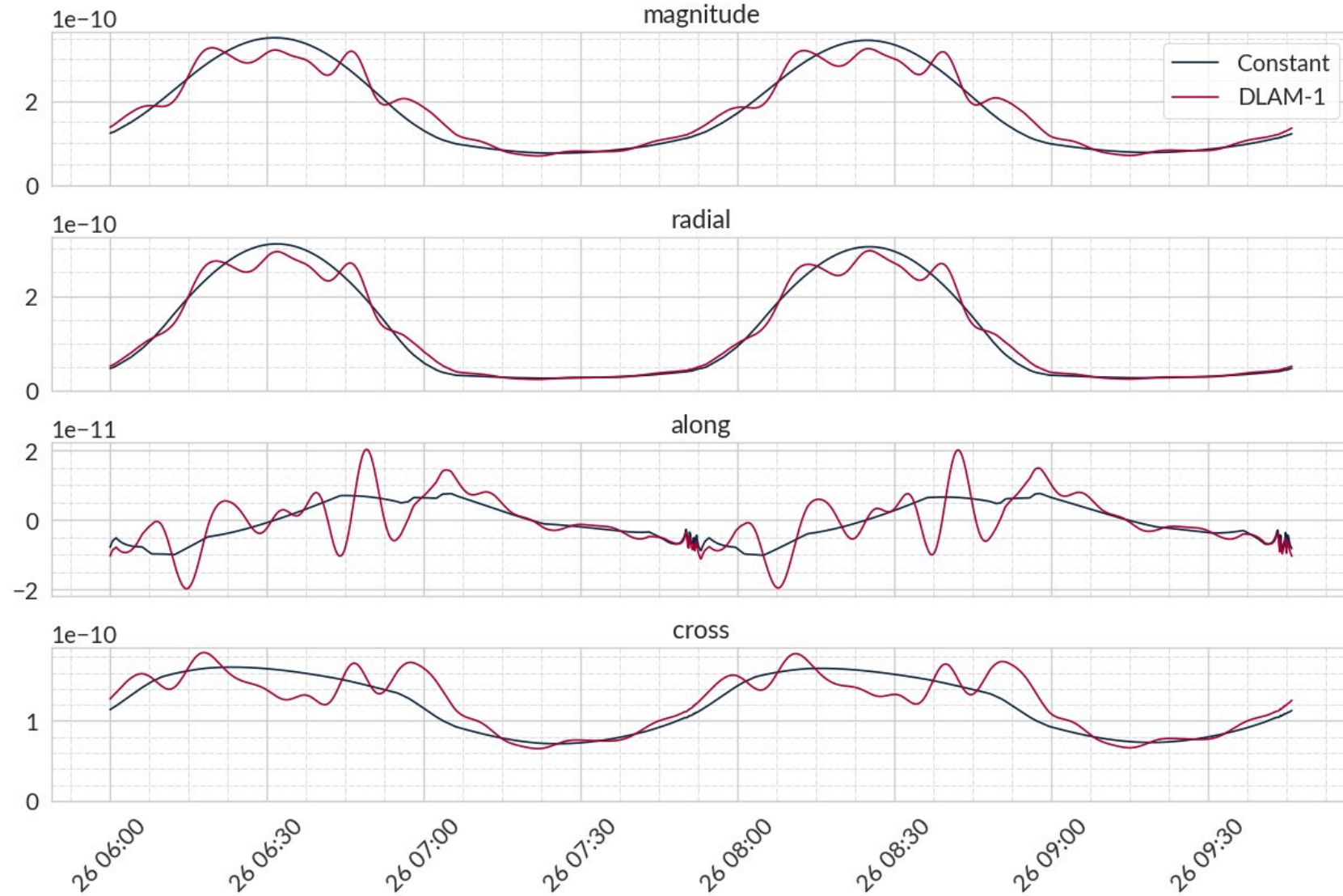
Radiation pressure accelerations of LRO

Constant vs SH albedo: $\beta = 0^\circ$



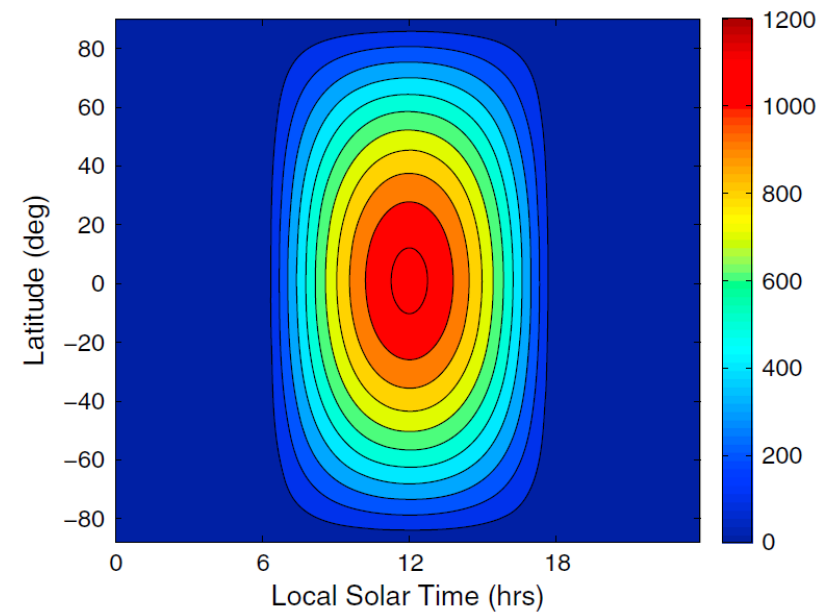
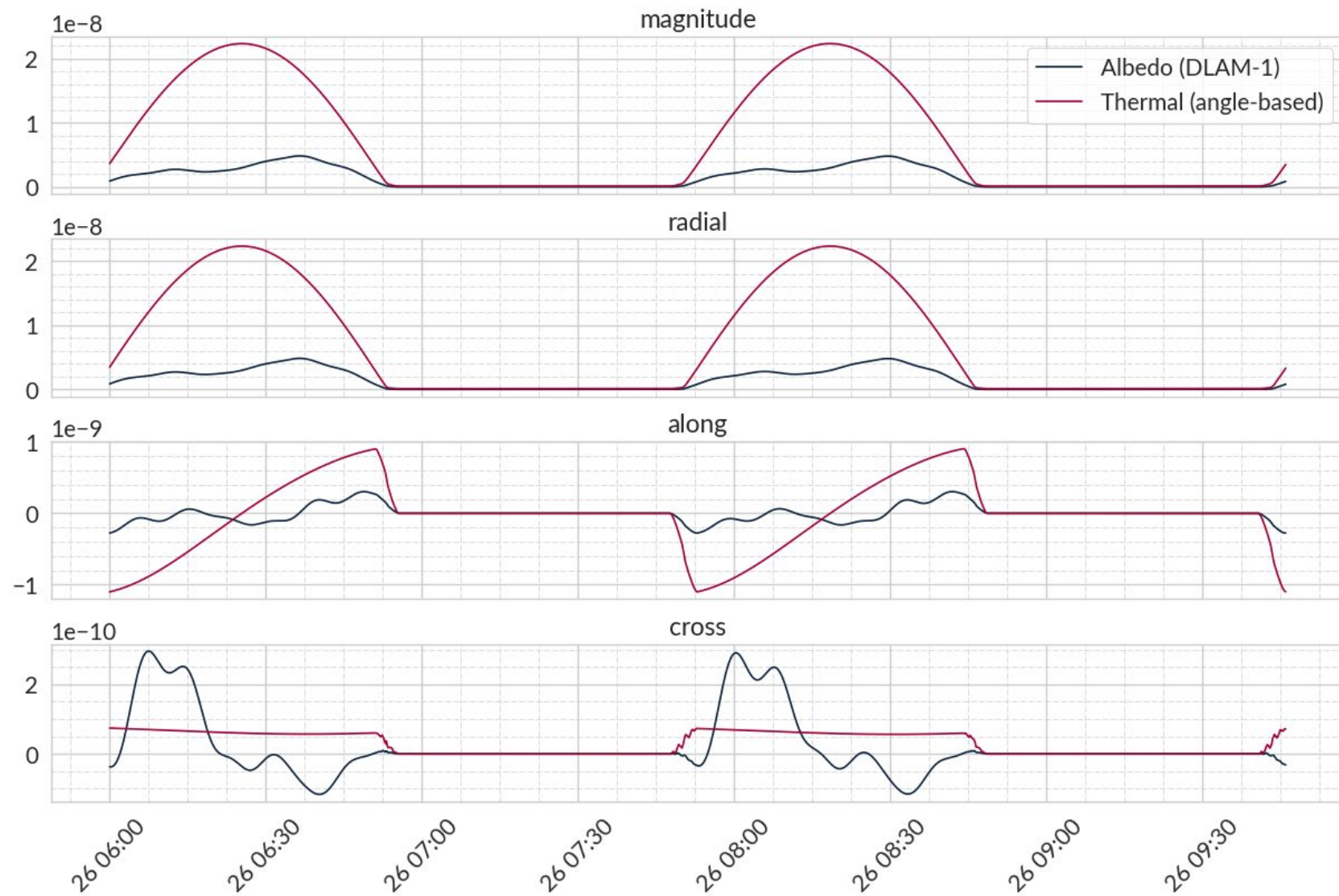
Constant albedo = 0.19

Constant vs SH albedo: $\beta = 90^\circ$



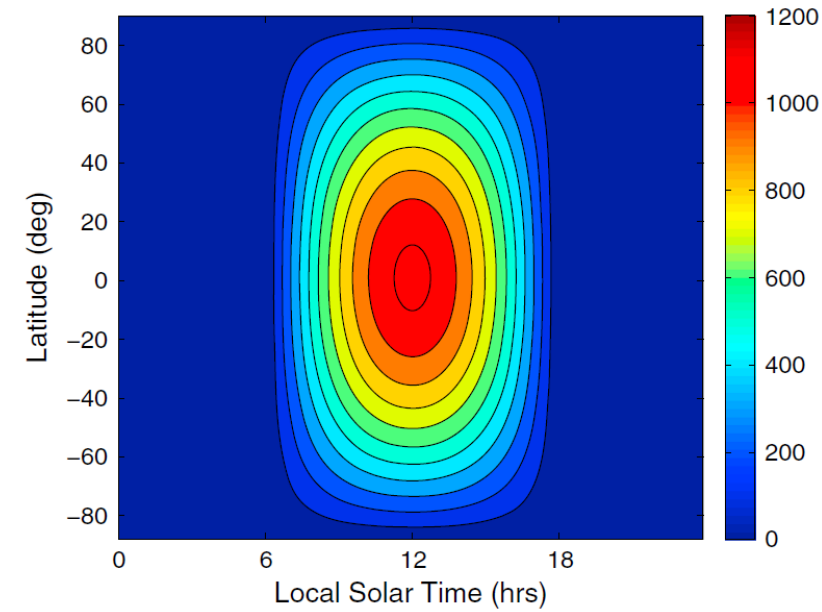
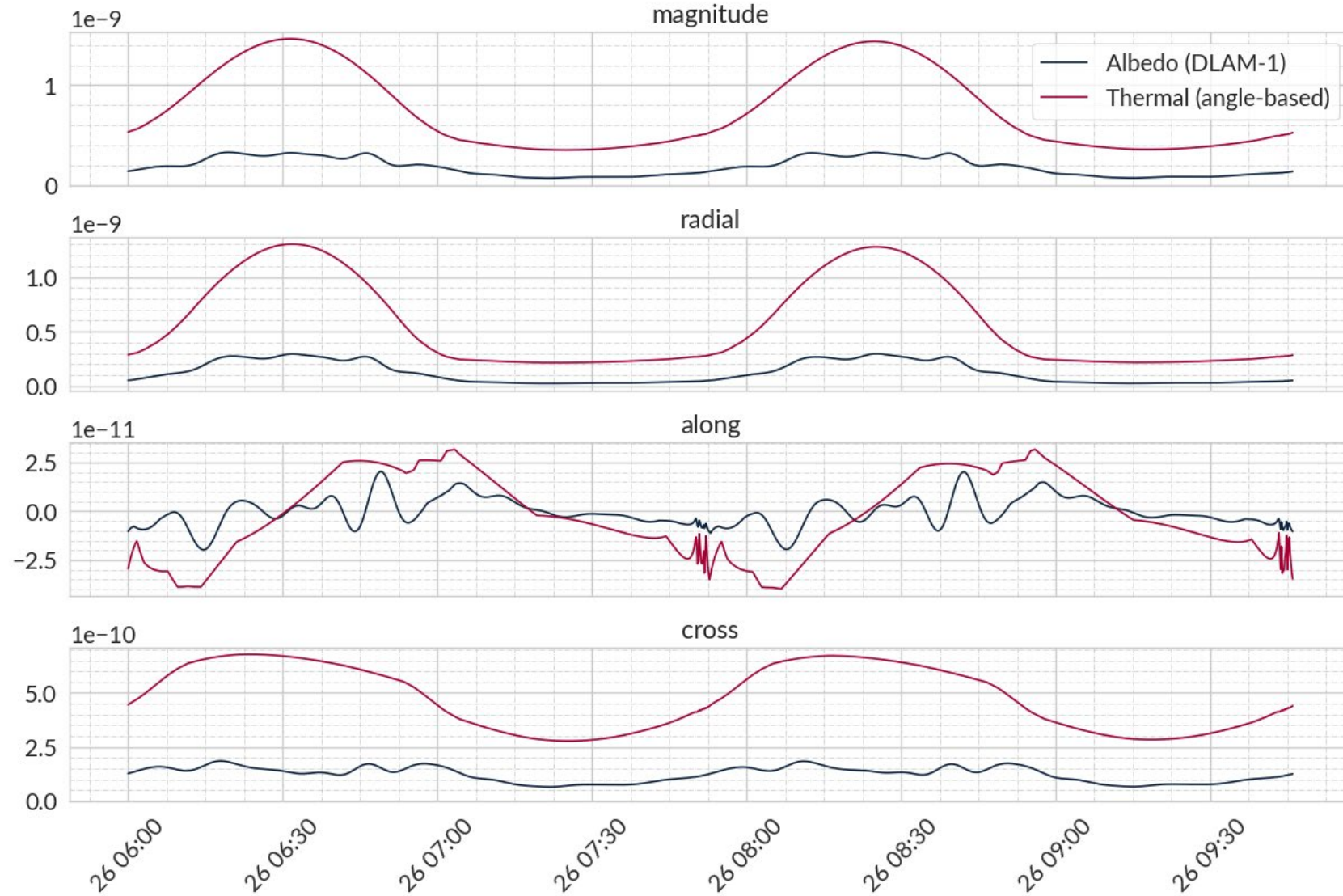
Constant albedo = 0.19

Albedo vs thermal: $\beta = 0^\circ$

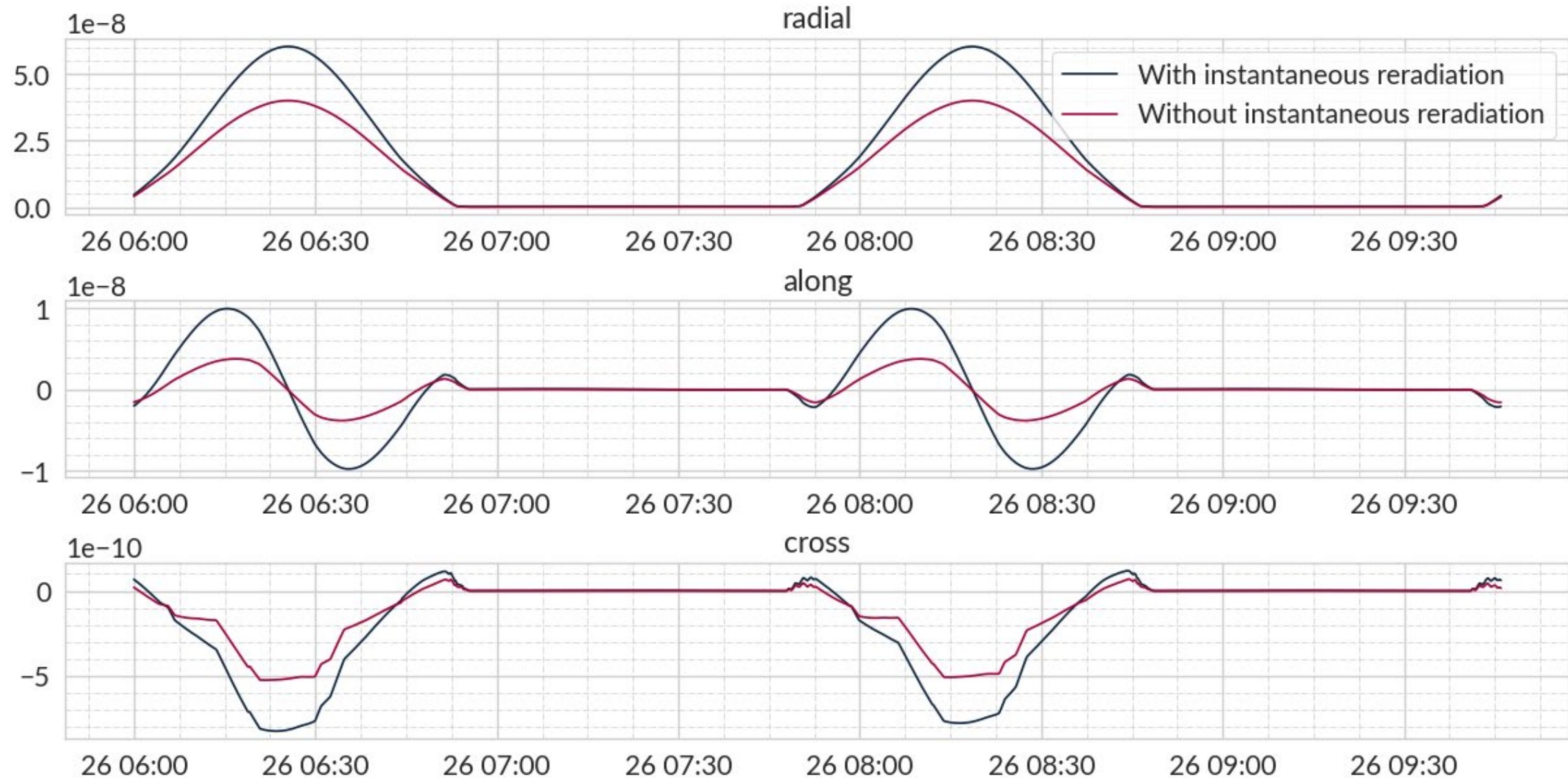


Angle-based emissions in W/m^2

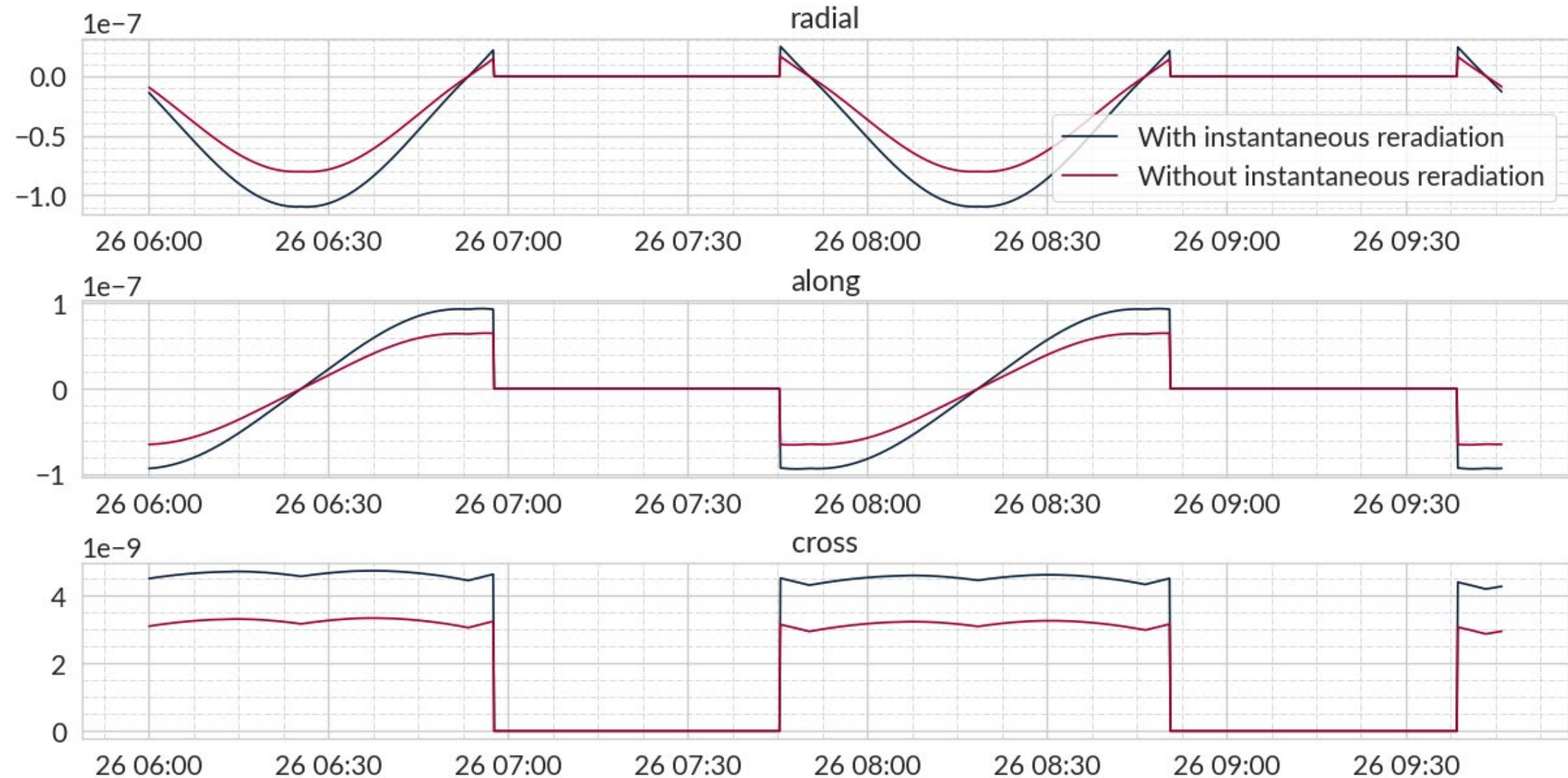
Albedo vs thermal: $\beta = 90^\circ$



Instantaneous reradiation of lunar radiation



Instantaneous reradiation of solar radiation



Next steps

For paper

- Complete validation
 - Investigate oscillation above south pole
 - Investigate mismatch in magnitude of albedo radiation pressure
- Generate results with different models
 - Accelerations for $\beta = 0^\circ$ and $\beta = 90^\circ$
 - Effect on orbital elements
 - Performance impact (wall time, ...?)

For Tudat

- Write documentation
- Switch to new RP models but remain backwards-compatible
- Profile to find bottlenecks