

Earth rotation parameters from satellite techniques

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Overview

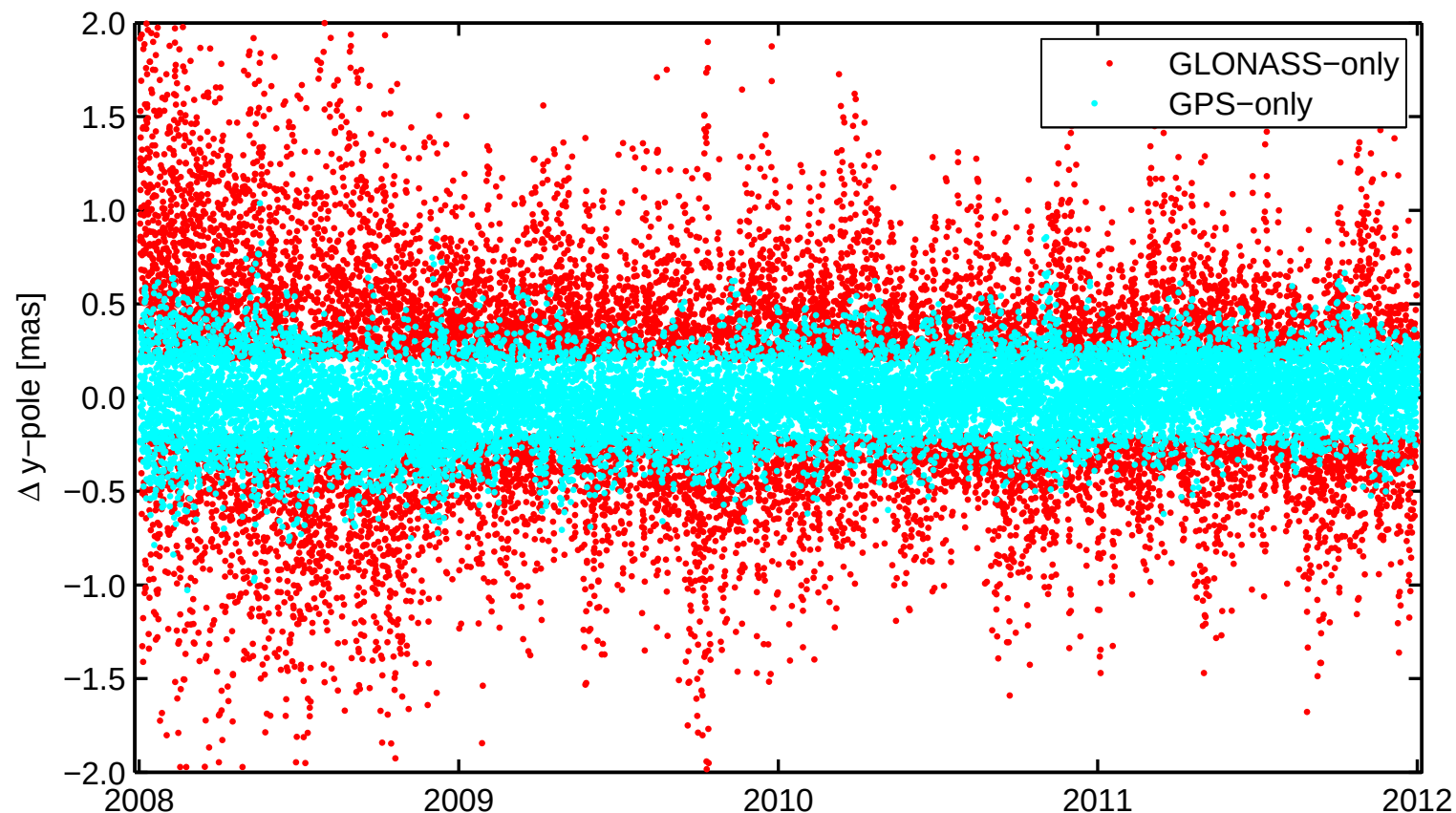
- Sub-daily Earth rotation:
 - GPS, GLONASS and SLR
 - Time-series (up to 1-hour resolution)
- Impact of gravity field variations on ERPs:
 - Estimation of low-degree gravity field coefficients together with ERPs
 - GNSS and SLR solutions

Sub-daily ERPs

Comparison of different satellite systems:

- **GPS-only:**
 - 2008 – 2011
 - Daily solutions
 - 1.5 hour temporal resolution
- **GLONASS-only:**
 - Settings / network identical to GPS-only solution
- **LAGEOS-only:**
 - 2001 – 2011
 - Weekly solutions
 - Testing different temporal resolutions (1 h, 2 h, 3 h)

Sub-daily ERPs: Time series PM

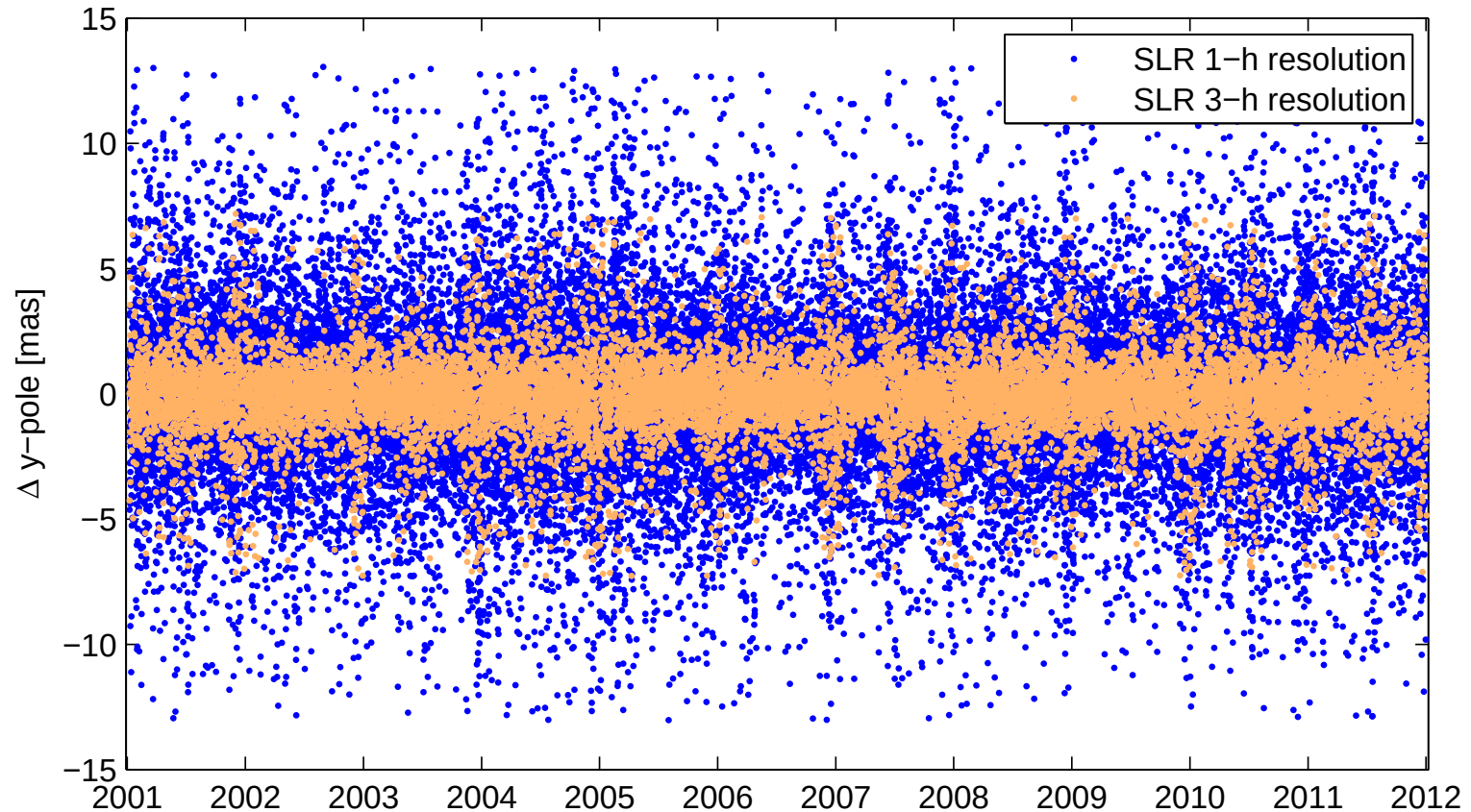


GLONASS: WRMS = 372.6 μs

GPS: WRMS = 162.2 μs

=> PM based on GLONASS
is clearly noisier than PM
based on GPS

Sub-daily ERPs: Time series PM



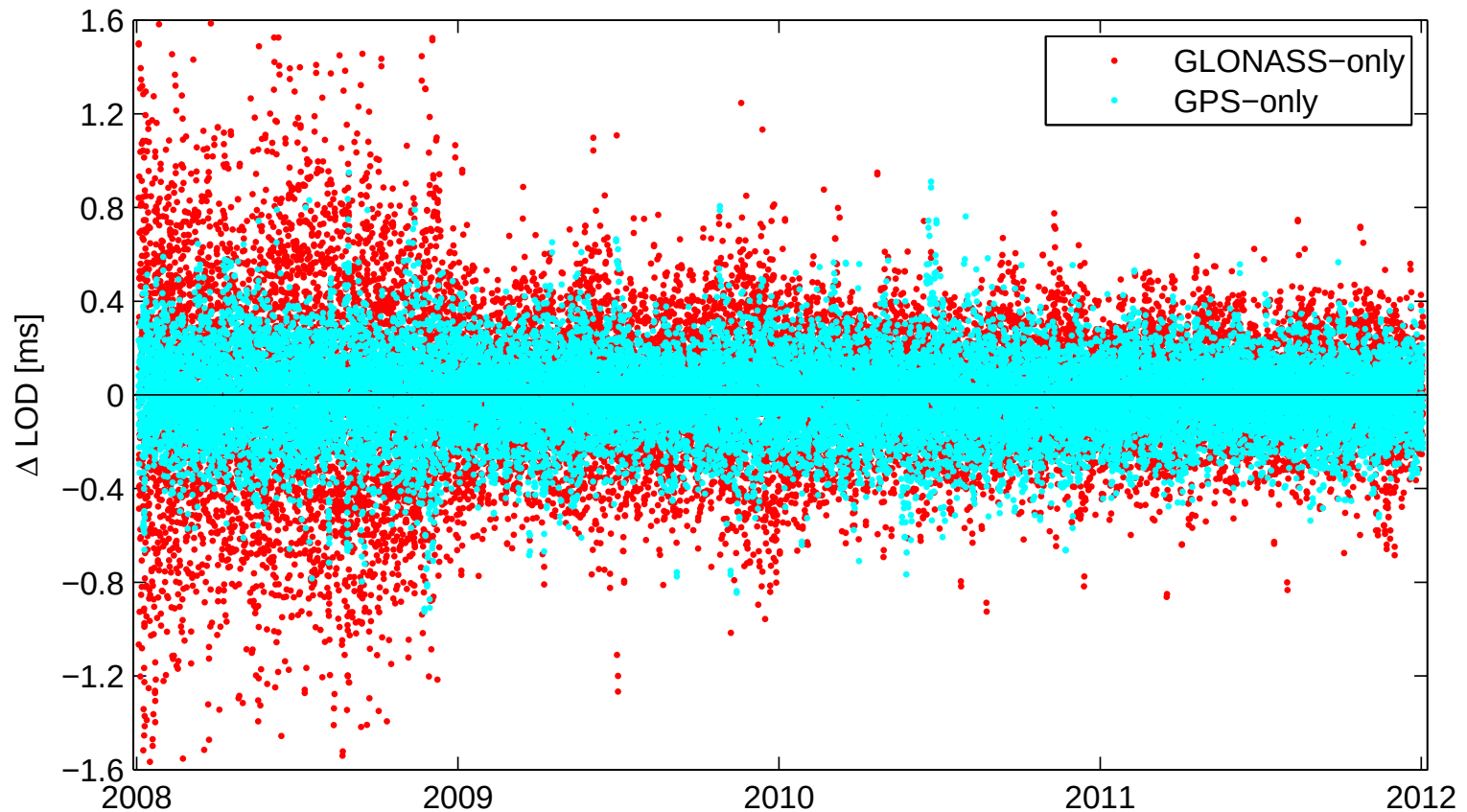
SLR 1-h: WRMS = 1648.6 μas

SLR 2-h: WRMS = 1213.1 μas (not shown)

SLR 3-h: WRMS = 1050.7 μas

=> 1-hour
resolution might be
too high for SLR

Sub-daily ERPs: Time series LOD

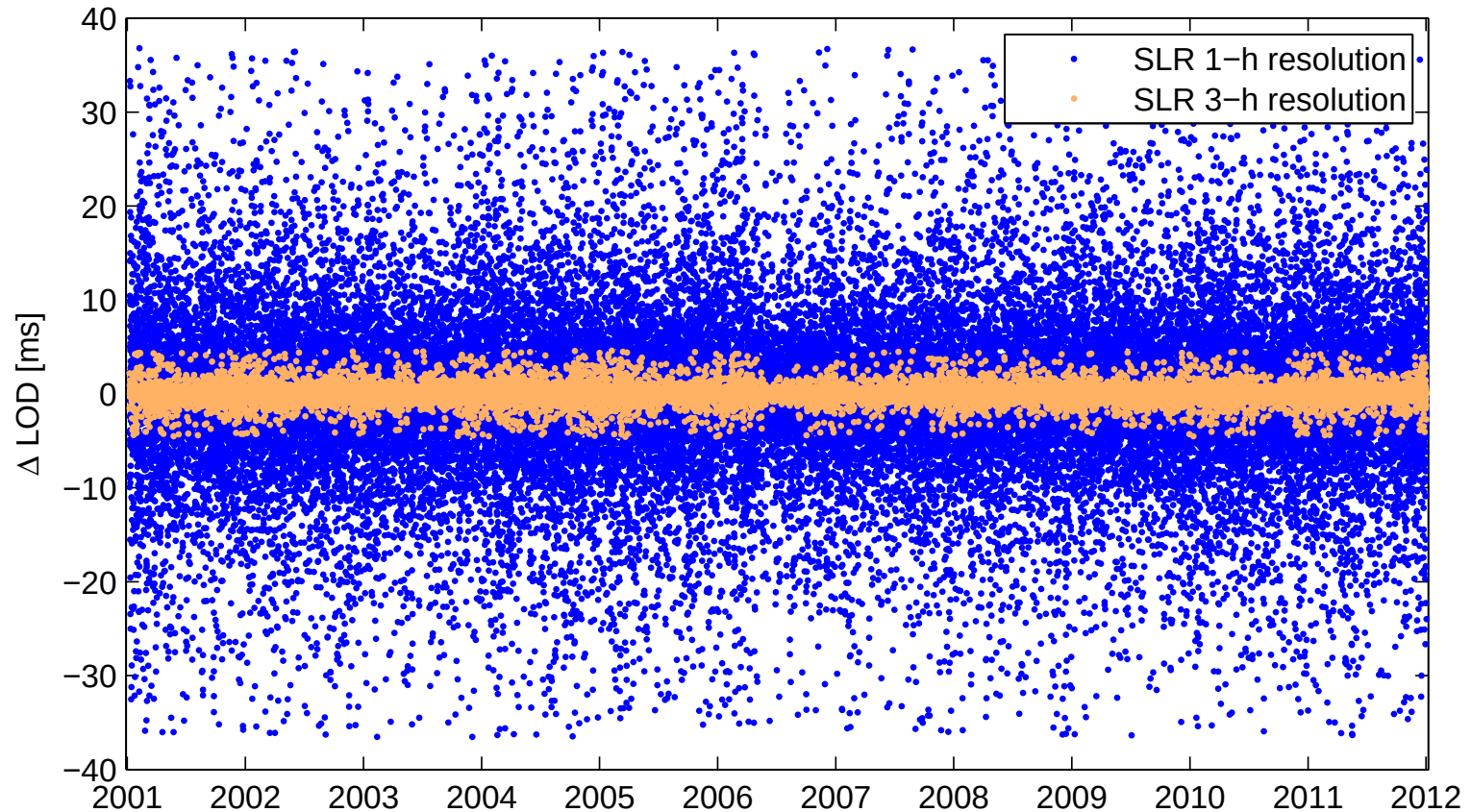


GLONASS: WRMS = $229.5 \mu\text{s}$

GPS: WRMS = $161.9 \mu\text{s}$

=> GLONASS has similar quality
as GPS if full satellite
constellation is available

Sub-daily ERPs: Time series LOD



SLR 1-h: WRMS = 4380.0 μs

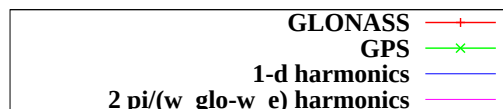
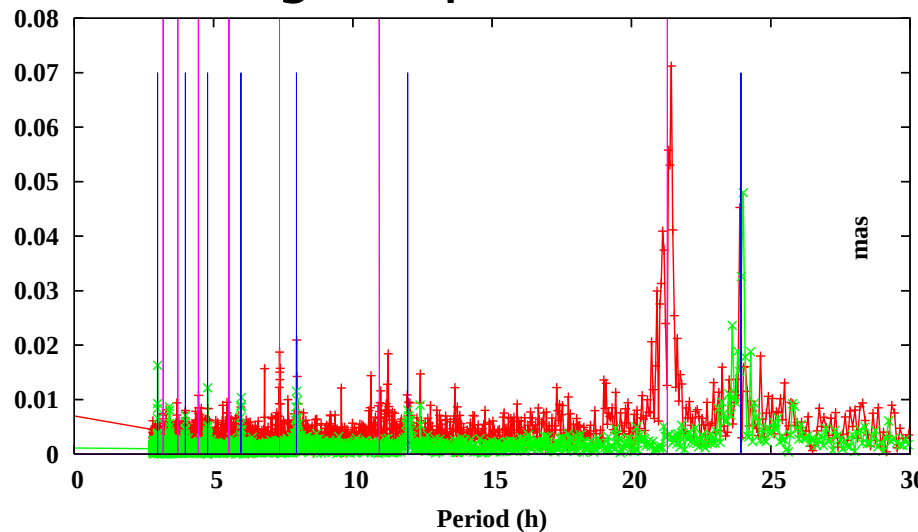
SLR 2-h: WRMS = 1171.3 μs

SLR 3-h: WRMS = 552.1 μs

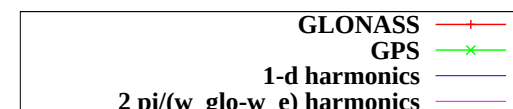
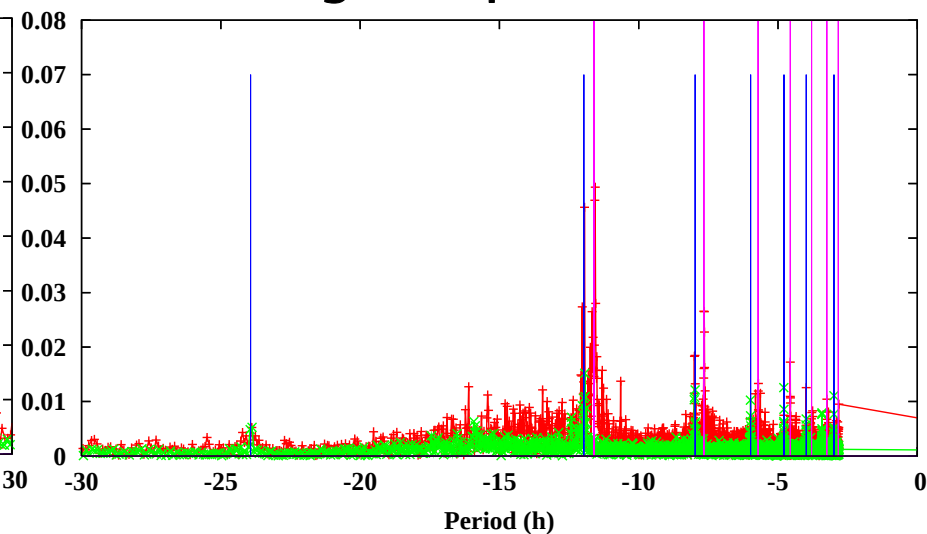
=> The temporal resolution has a bigger impact on LOD than on PM

Sub-daily ERPs: Spectra of PM time-series

Prograde polar motion

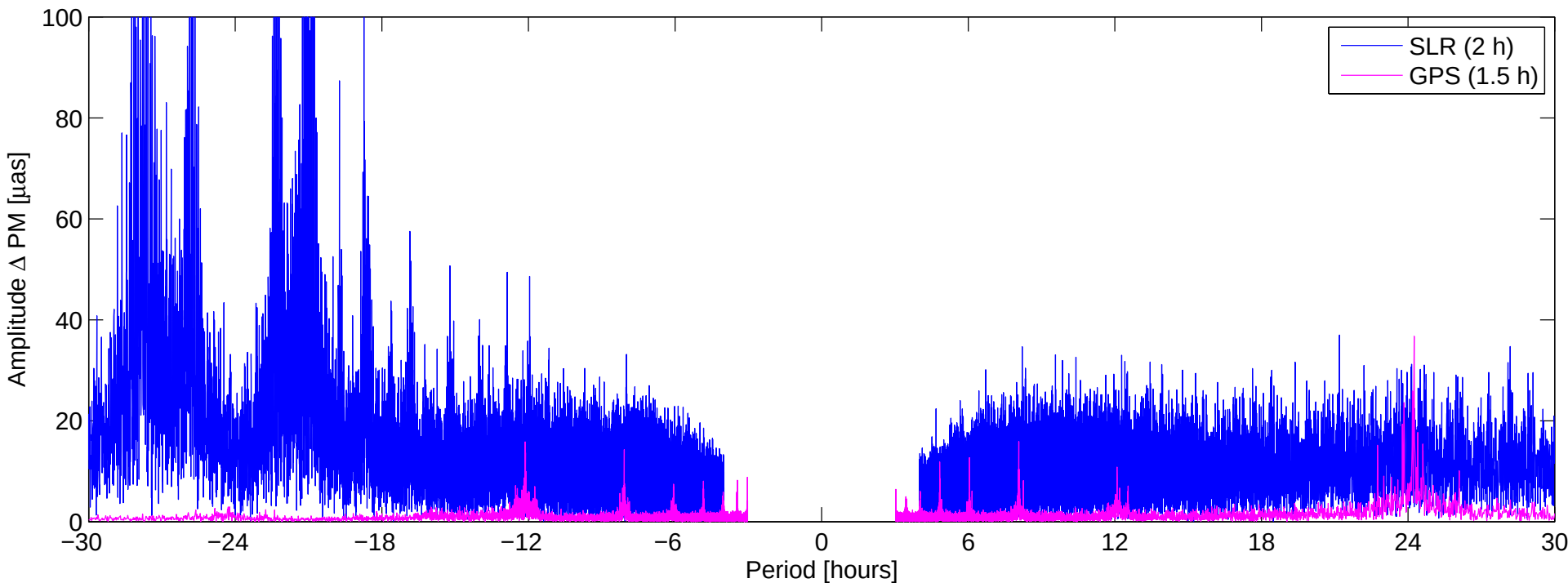


Retrograde polar motion



- **GPS**: many orbital artefacts
= harmonics of a **diurnal period**
- **GLONASS**: many orbital artefacts
= harmonics of **linear combination** of the **Earth's** and the **satellites' revolution periods**

Sub-daily ERPs: Spectra of PM time-series



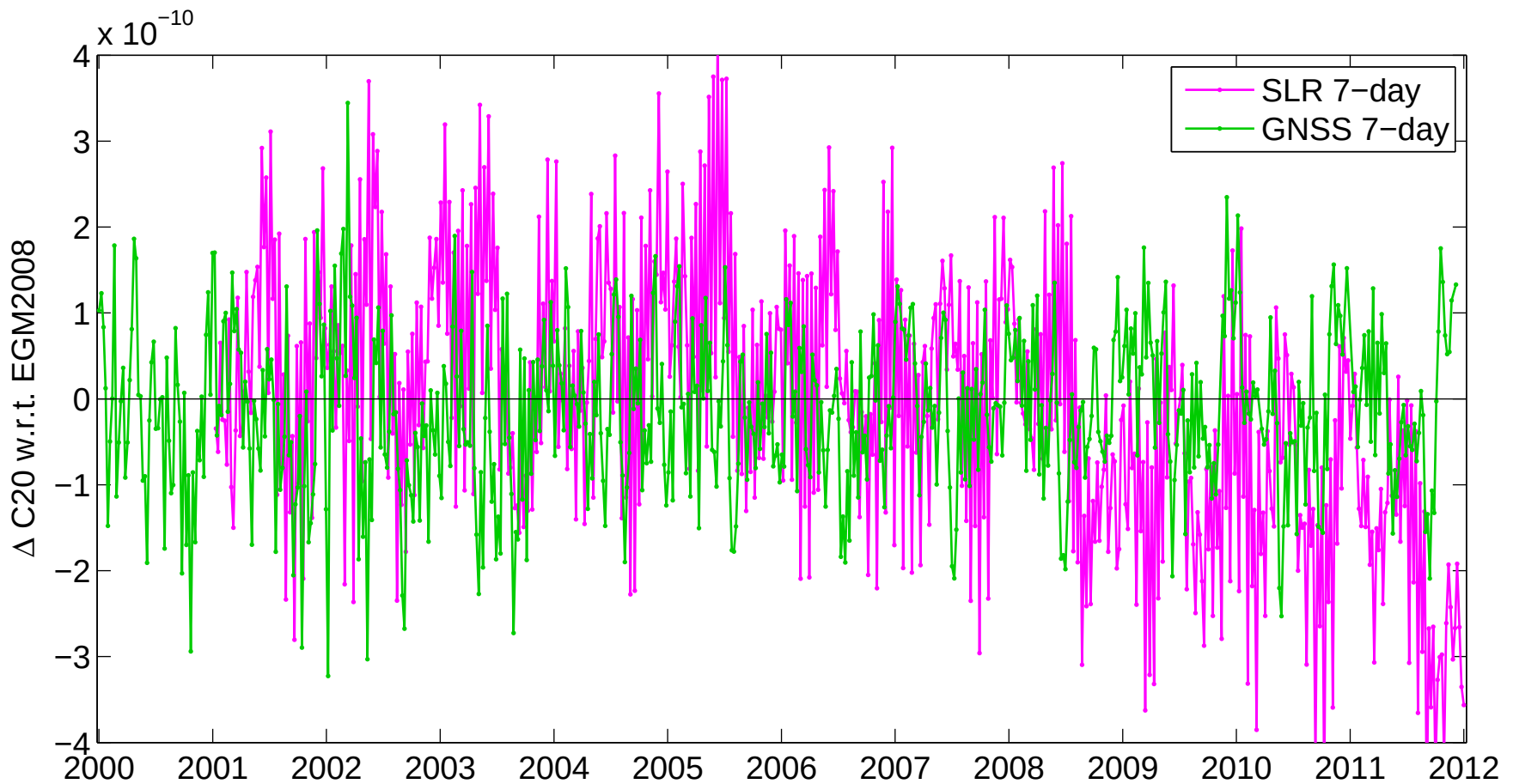
SLR-LAGEOS:

- Many artefacts in retrograde PM: **linear combinations** of **Earth's** and **satellites' revolution periods** (3.75 h)
- Prograde PM does not have artefacts (but much larger noise level than GNSS)

Impact of low-degree gravity

- **2 types of solution series** are computed:
 - **No** gravity field coefficients estimated
(= «Standard» solution)
 - **C20** estimated
- **GNSS**: weekly solutions, 2000 – 2011
- **SLR**: weekly solutions, 2001 – 2011

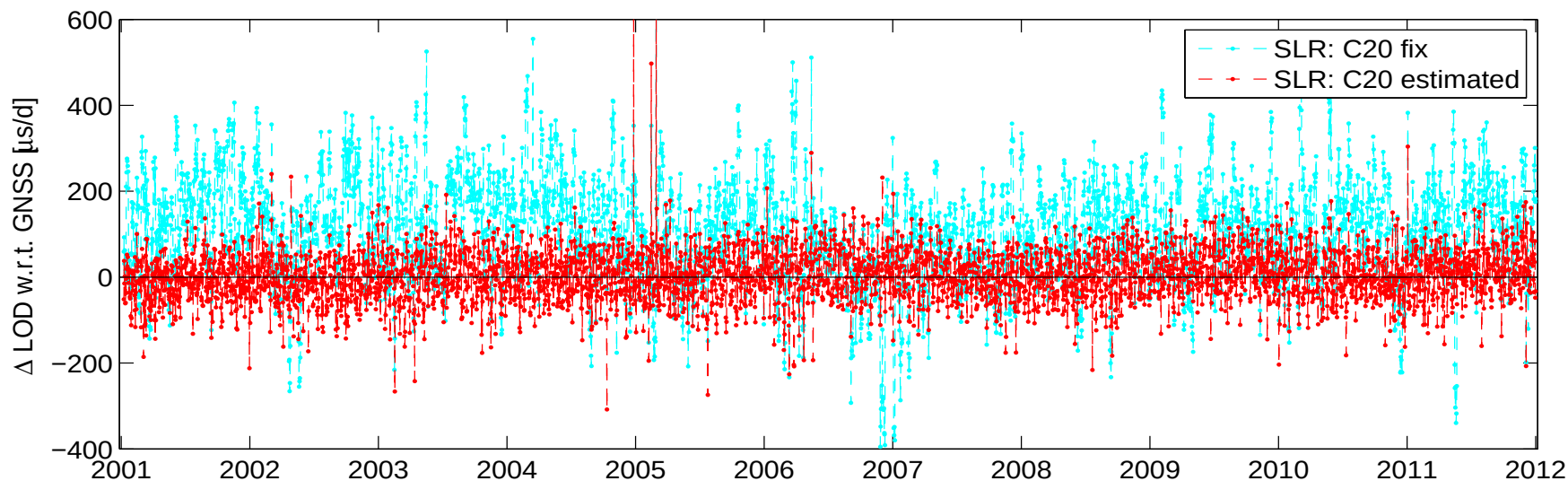
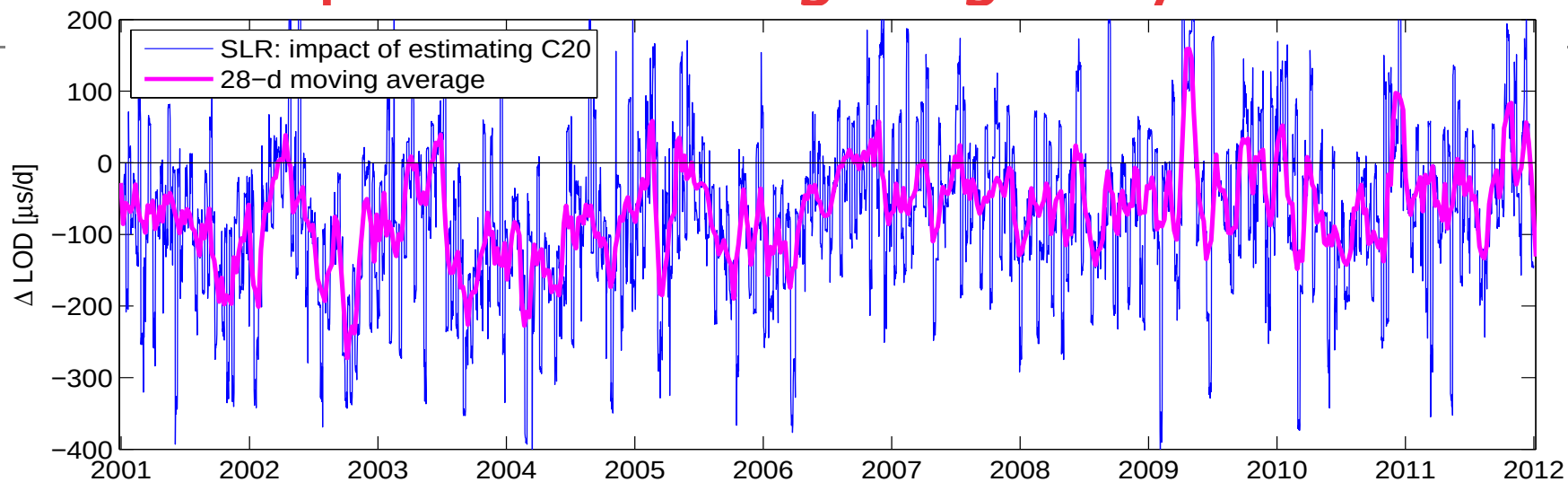
Impact of low-degree gravity: C20



Variations are not negligible

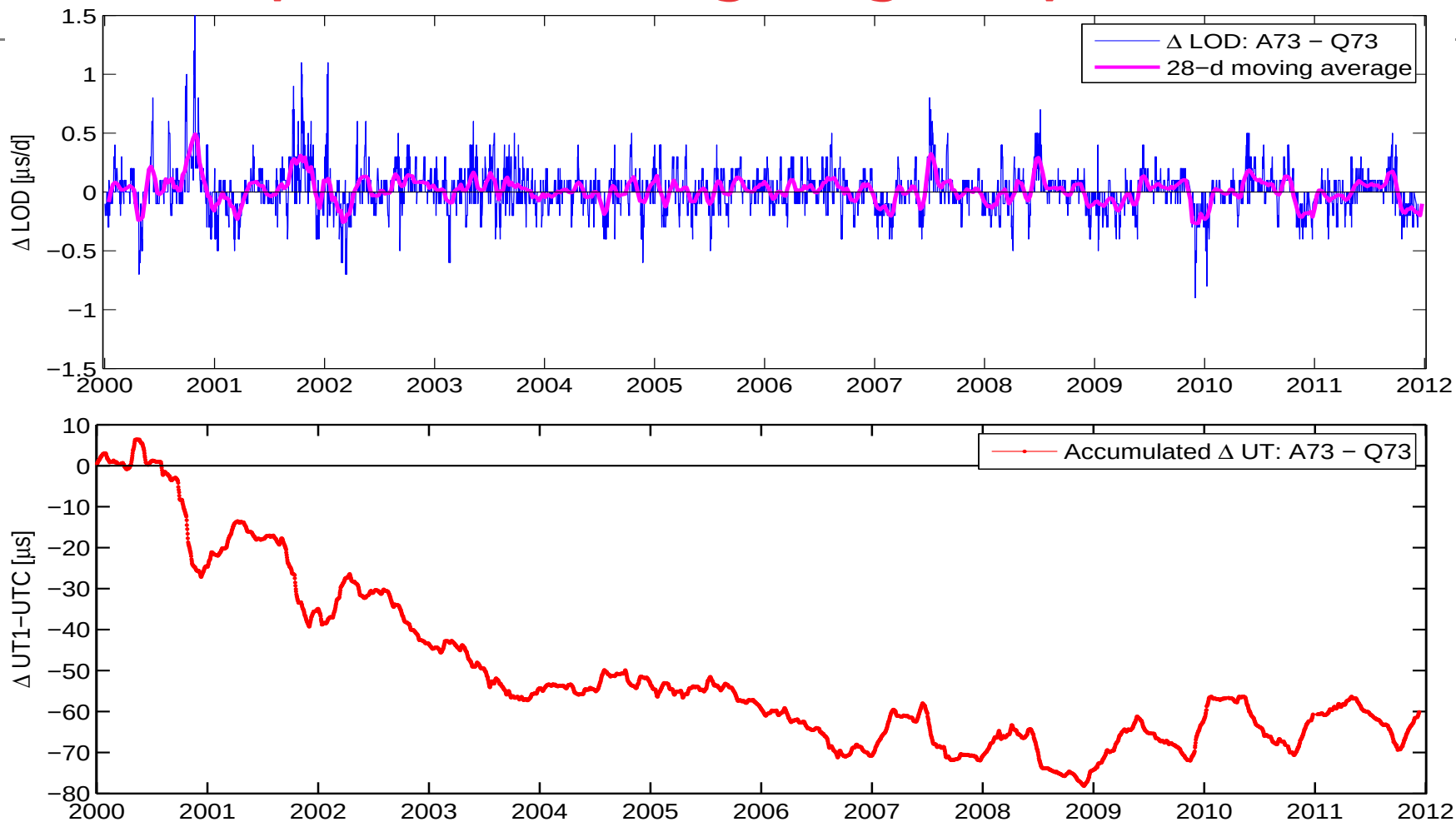
Formal errors: $\sim 1.e-12$

Impact of low-degree gravity: SLR



LOD is shifted if C20 is not estimated: $\sim 74 \mu\text{s}$

Impact of low-degree gravity: GNSS



Impact of estimating C20 on UT1–UTC / LOD seems to be small

BUT: Accumulated effect is not negligible

Conclusions

- **Sub-daily ERPs:**
 - Orbit-related artefacts in all satellite techniques
 - SLR capability is surprisingly good (considering the small amount of data)
 - 1-h resolution is too high for SLR, but 2-h resolution seems feasible
- **Impact of low-degree coefficients of the Earth's gravity field:**
 - Impact of C20 was studied
 - SLR: LOD is shifted by $\sim 74 \mu\text{s}$
 - GNSS: Accumulated effect reaches $\sim 70 \mu\text{s}$ after few years
 - Consequence: C20 should be estimated together with ERPs