CENTRE NATIONAL D'ÉTUDES SPATIALES

Impact of long-term gravity field variations on Jason-1 and Jason-2 GDR orbits

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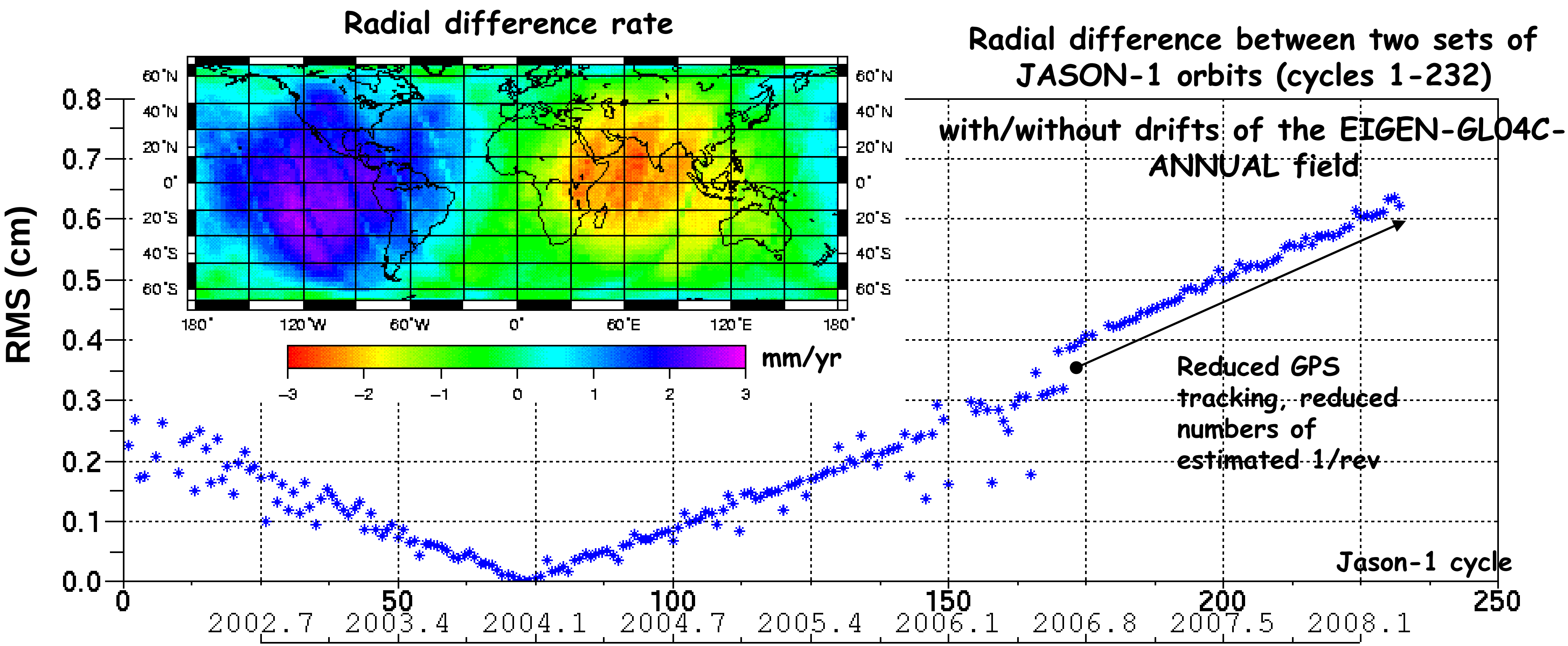
Introduction

- Conclusions from last meeting (Nice ’08):
  - Geographically correlated error from the static part of the gravity field is now below 1 mm
  - Below 1 cm, the gravity field cannot considered to be static
- Current standards include drifts for the zonal terms up to degree 4, annual and semiannual variations from the EIGEN-GL04S-ANNUAL field
- What is the impact of long term variations of the gravity field on GDR orbits?
  - Compare GDR-C orbit with one obtained using a GRACE-derived time series of gravity fields

Introduction

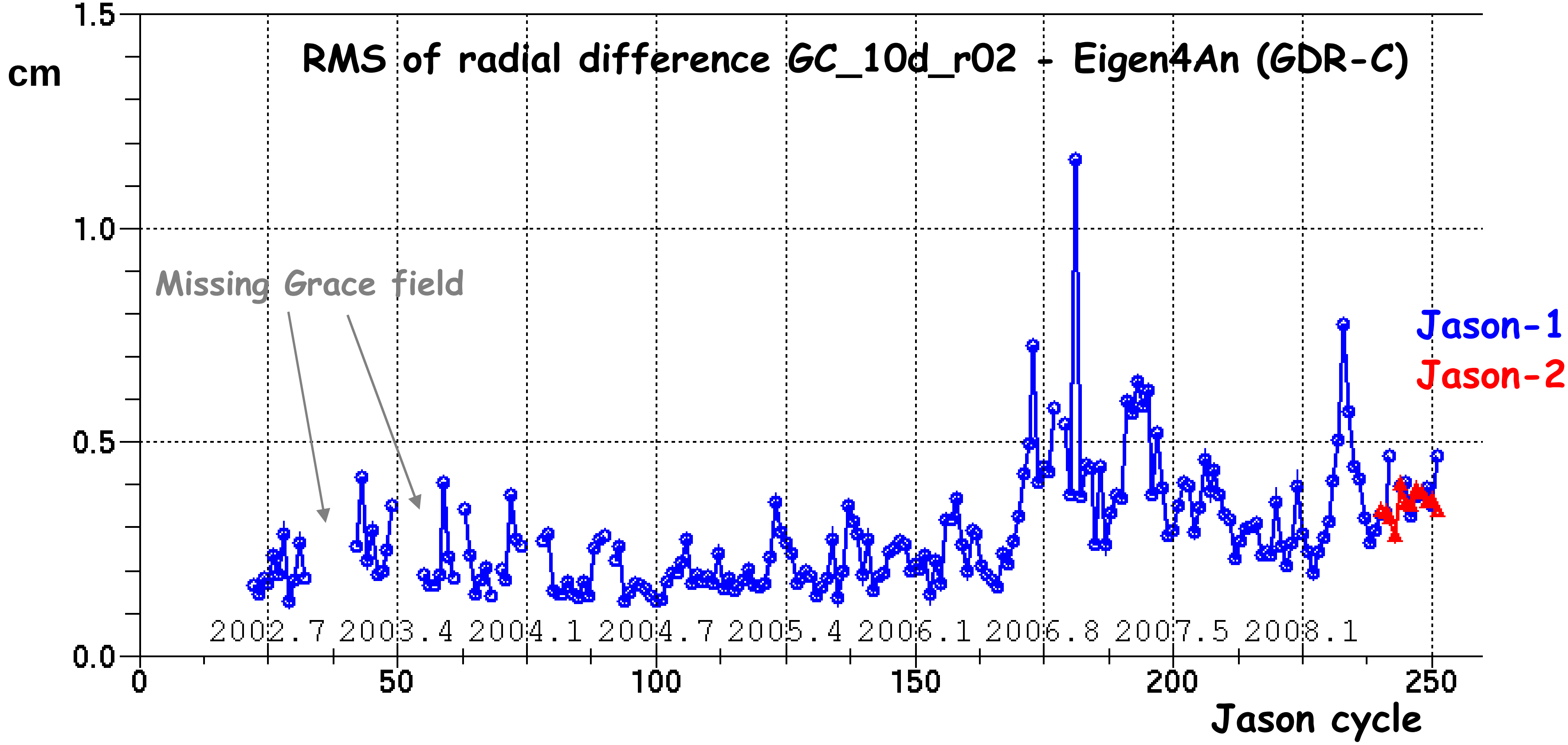
- **From last meeting (Nice ’08): impact of the drifts included in EIGEN-GL04S-ANNUAL**



![cnes logo]

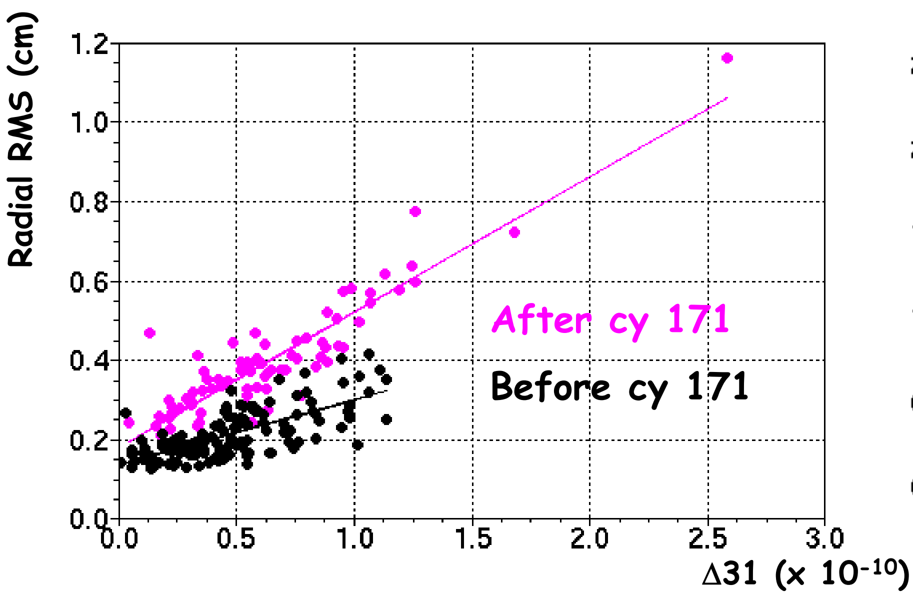
Orbit difference Radial RMS per cycle

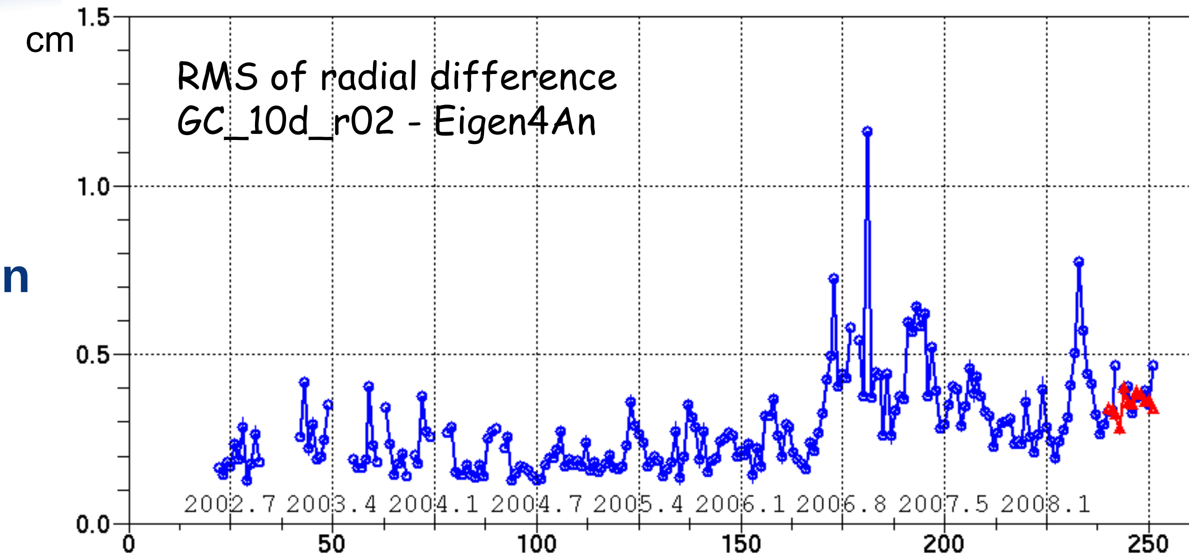
- CNES-GRGS GRACE-derived 10-day gravity fields (Release 02) now available, tested over Jason1 series 22→251 and Jason2 001→012

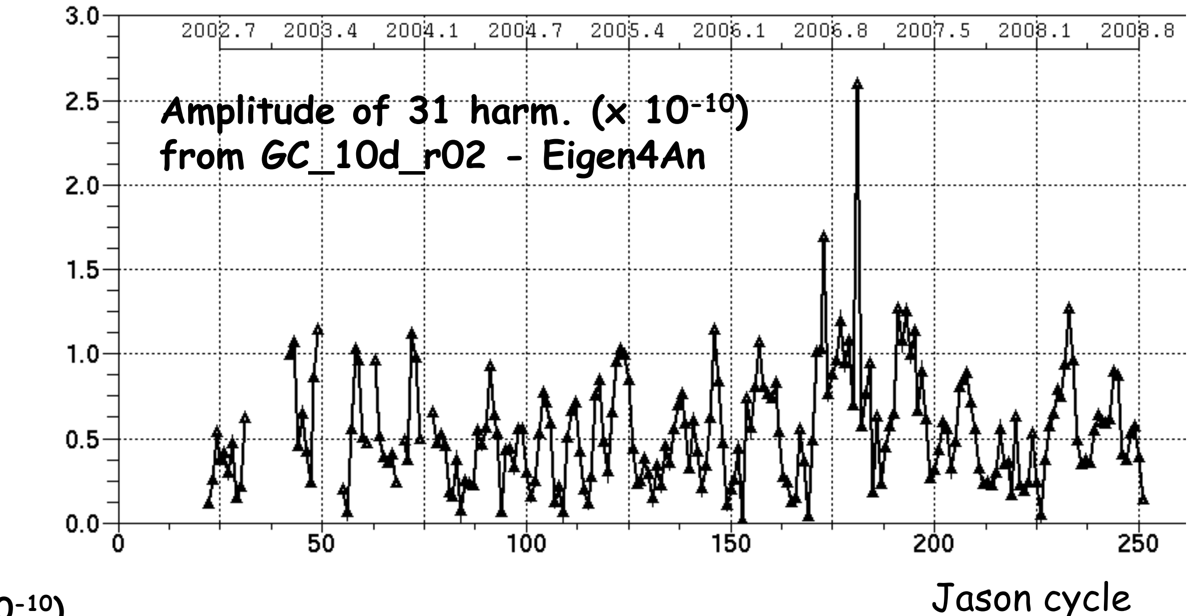


Orbit difference
deg. 3/ord. 1 harmonic

- **Noticeable correlation between variations of the 31 harmonic and the radial orbit difference**
  - Stronger effect with D+L configuration (1/rev every 24 hr)

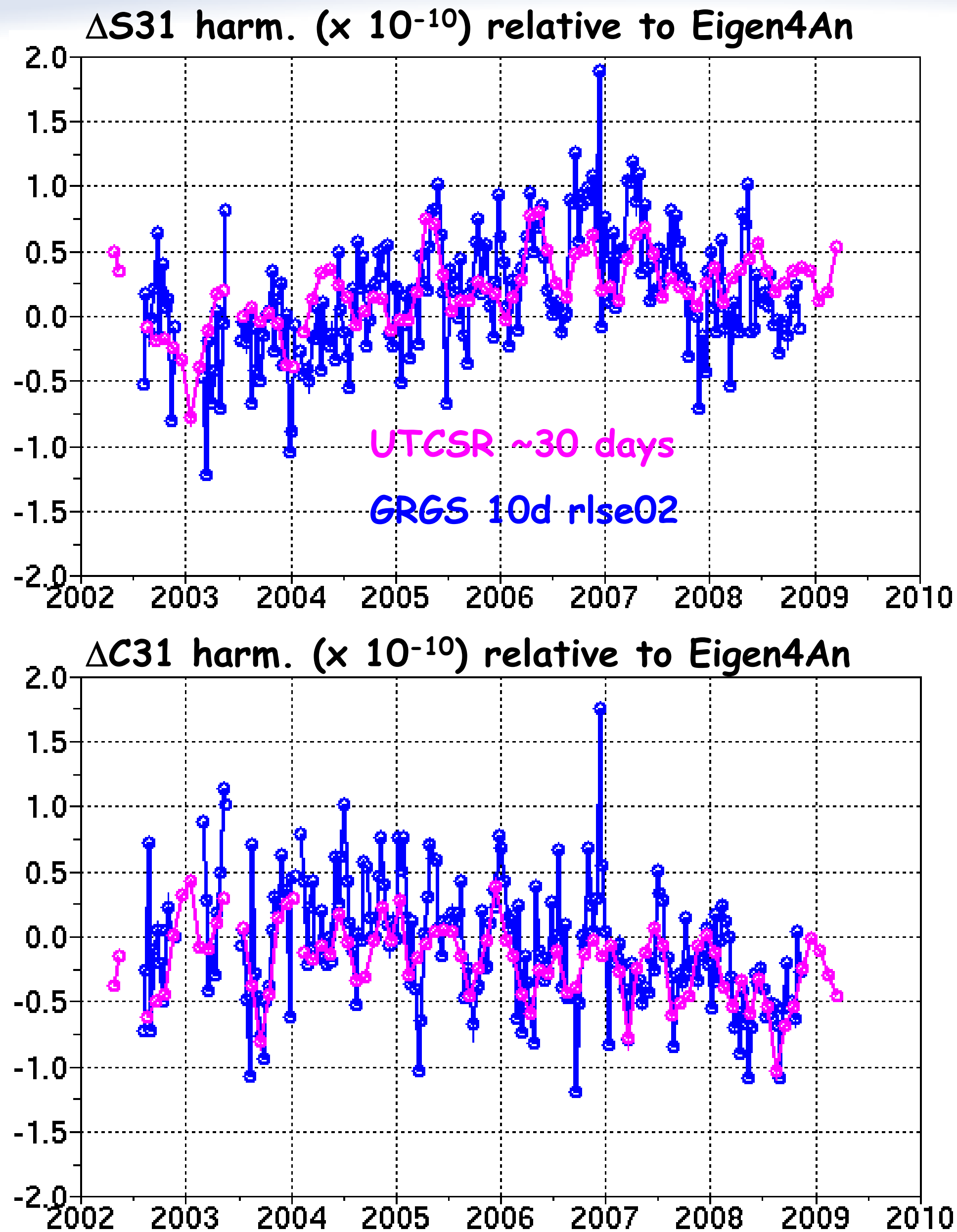






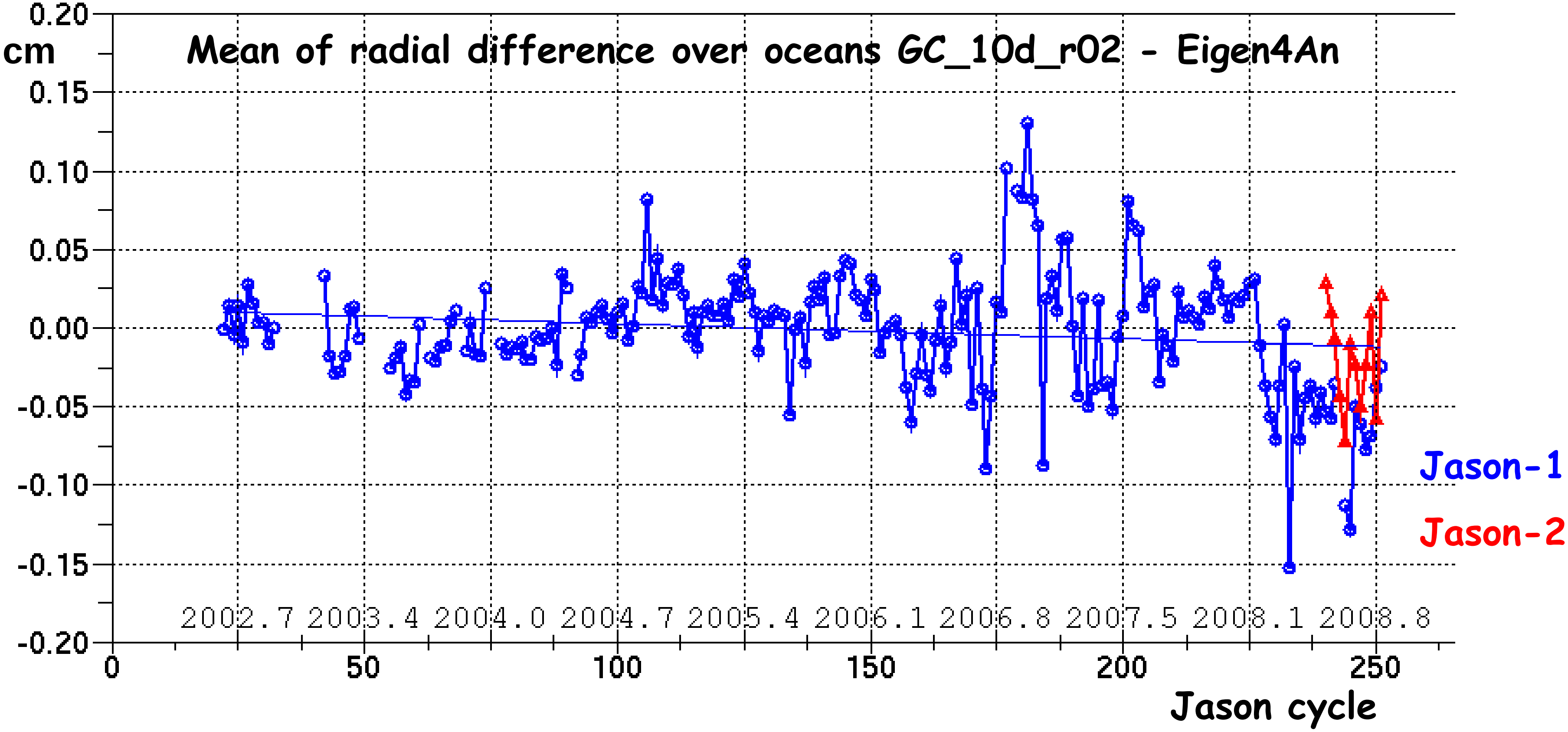
deg. 3/ord. 1 harmonic

- 10-day fields are noisier, each individual solution doesn't necessarily represent the best available gravity model
- Long term behavior is consistent between different series of GRACE fields, and not modeled in current POE standards



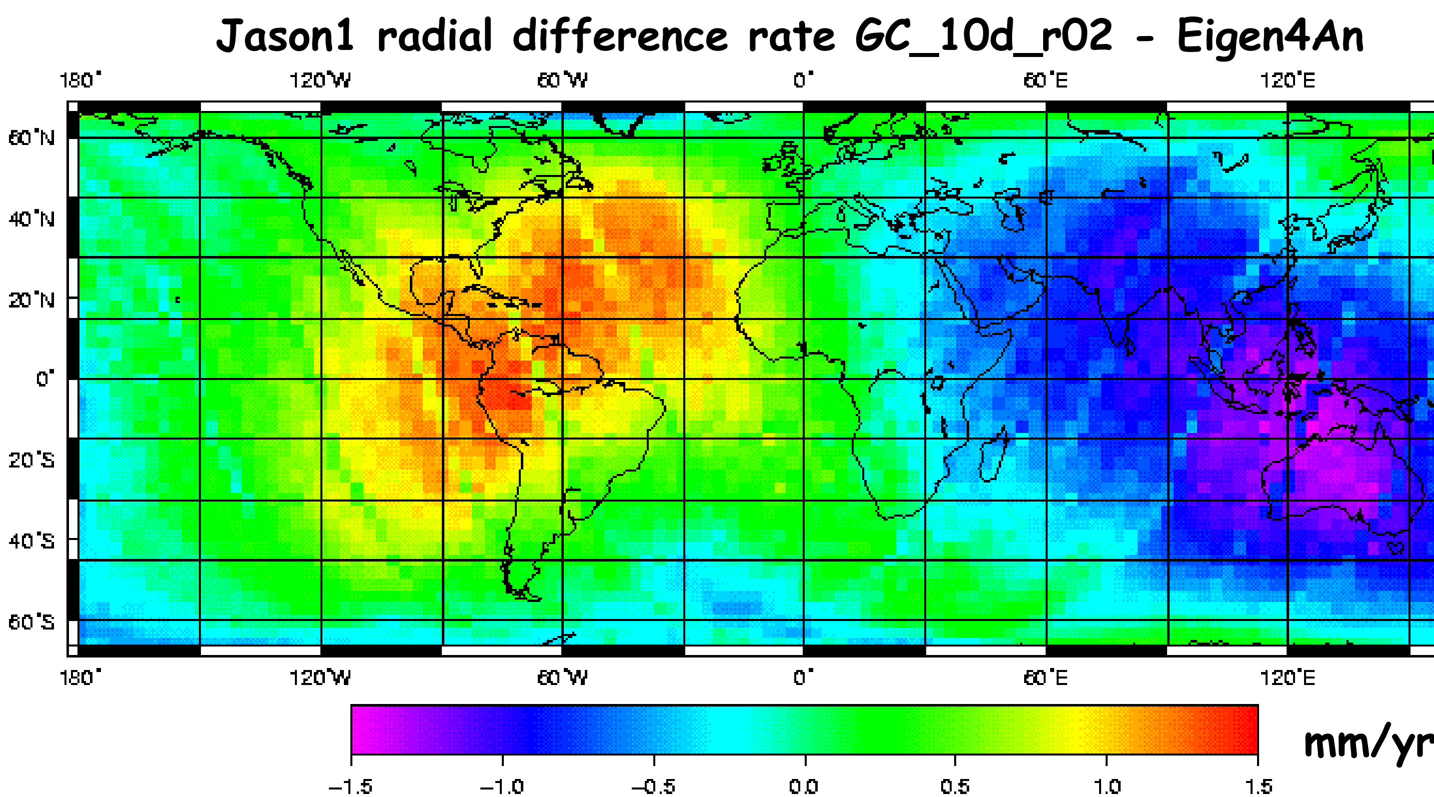
Orbit difference – Radial mean over oceans

- Trend of mean radial difference over ocean below 0.05 mm/yr



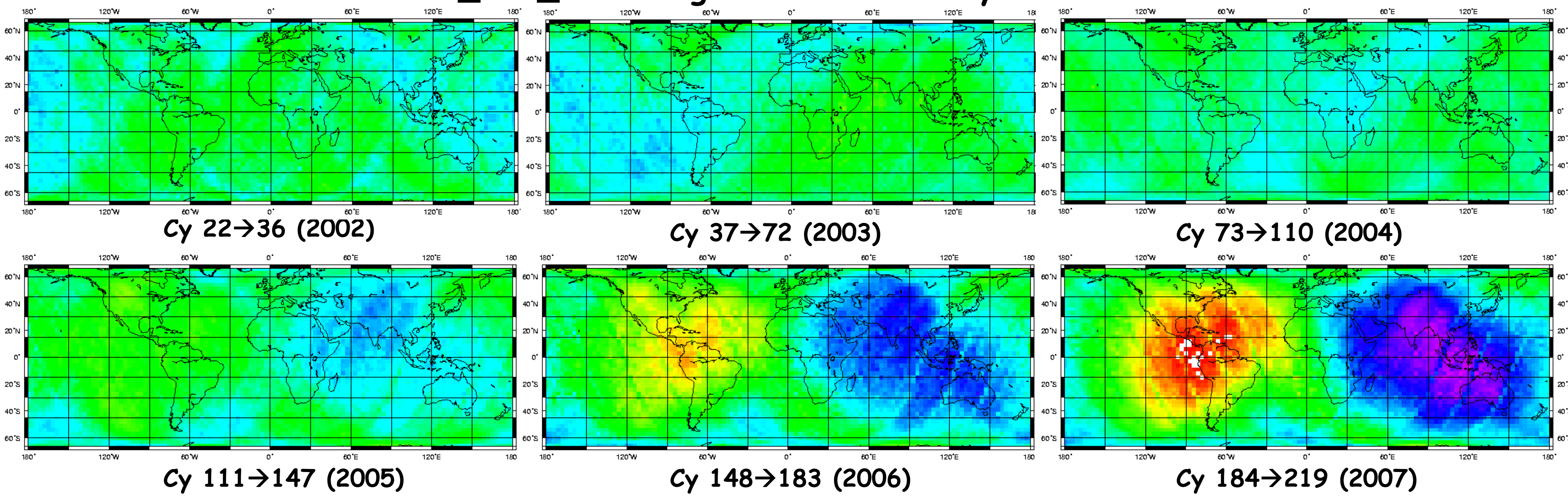
Orbit difference – Radial mean over oceans

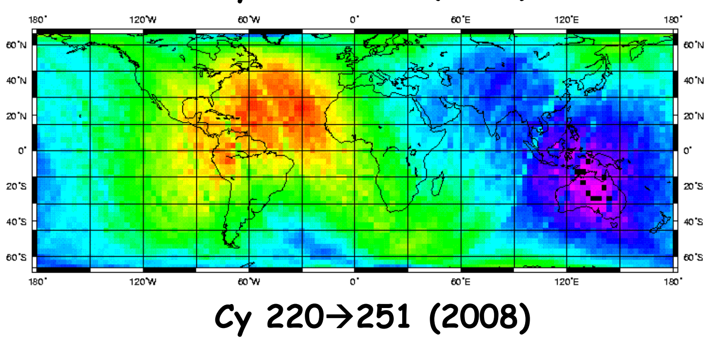
- significant mean differences exist on smaller scale

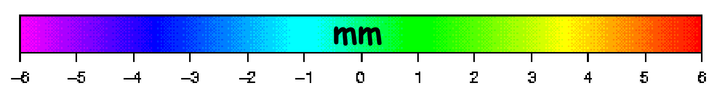


Orbit difference – Geographically correlated difference

GC_10d_r02 - Eigen4An Jason-1 cy 22→251



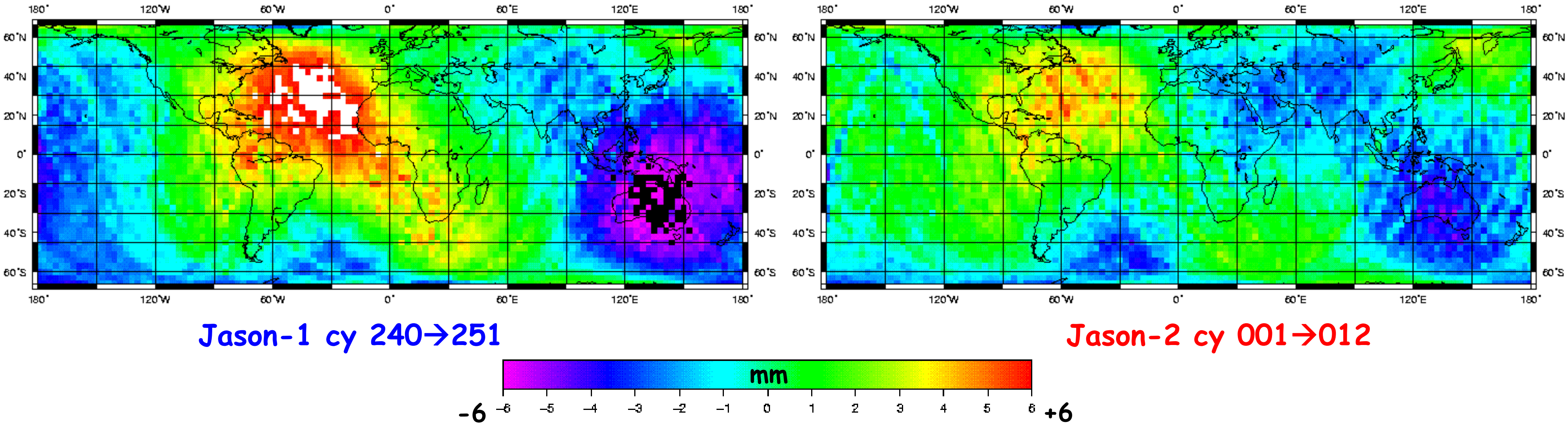




- Non-linear variation of the geographically correlated difference with time

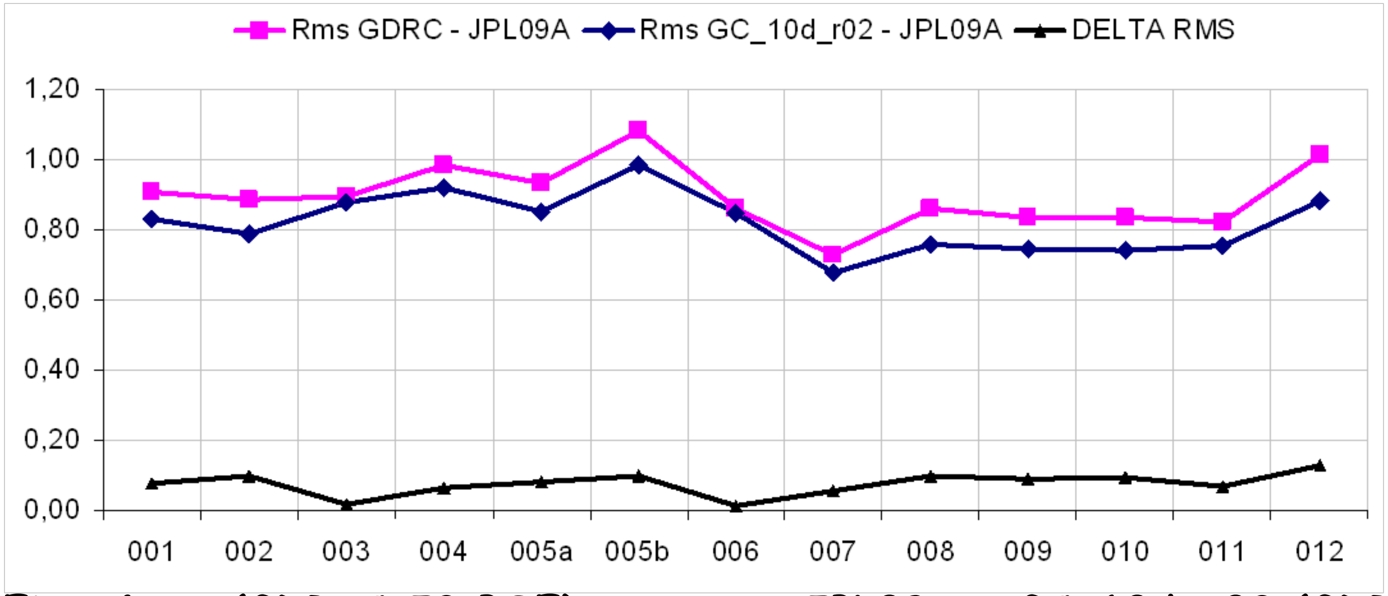
Orbit difference – Geographically correlated difference

GC_10d_r02 - Eigen4An

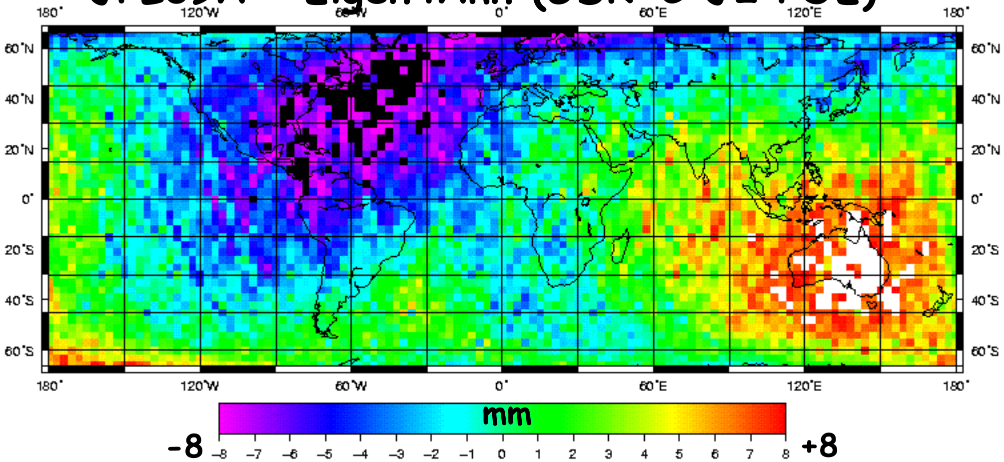


■ **Lower impact of errors in the gravity field on Jason-2 POE (higher number of 1/rev allowed by GPS)**

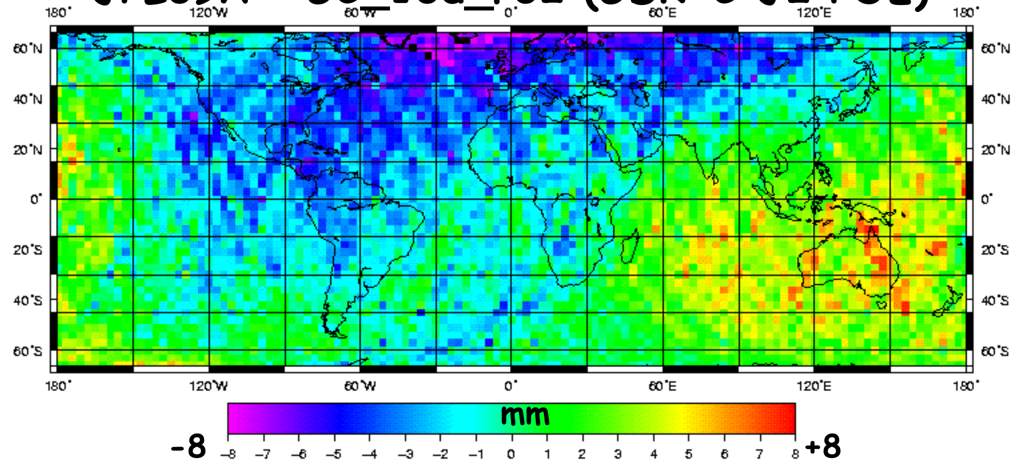
Closer to Jason-2 reduced dynamic orbits (JPL09a)



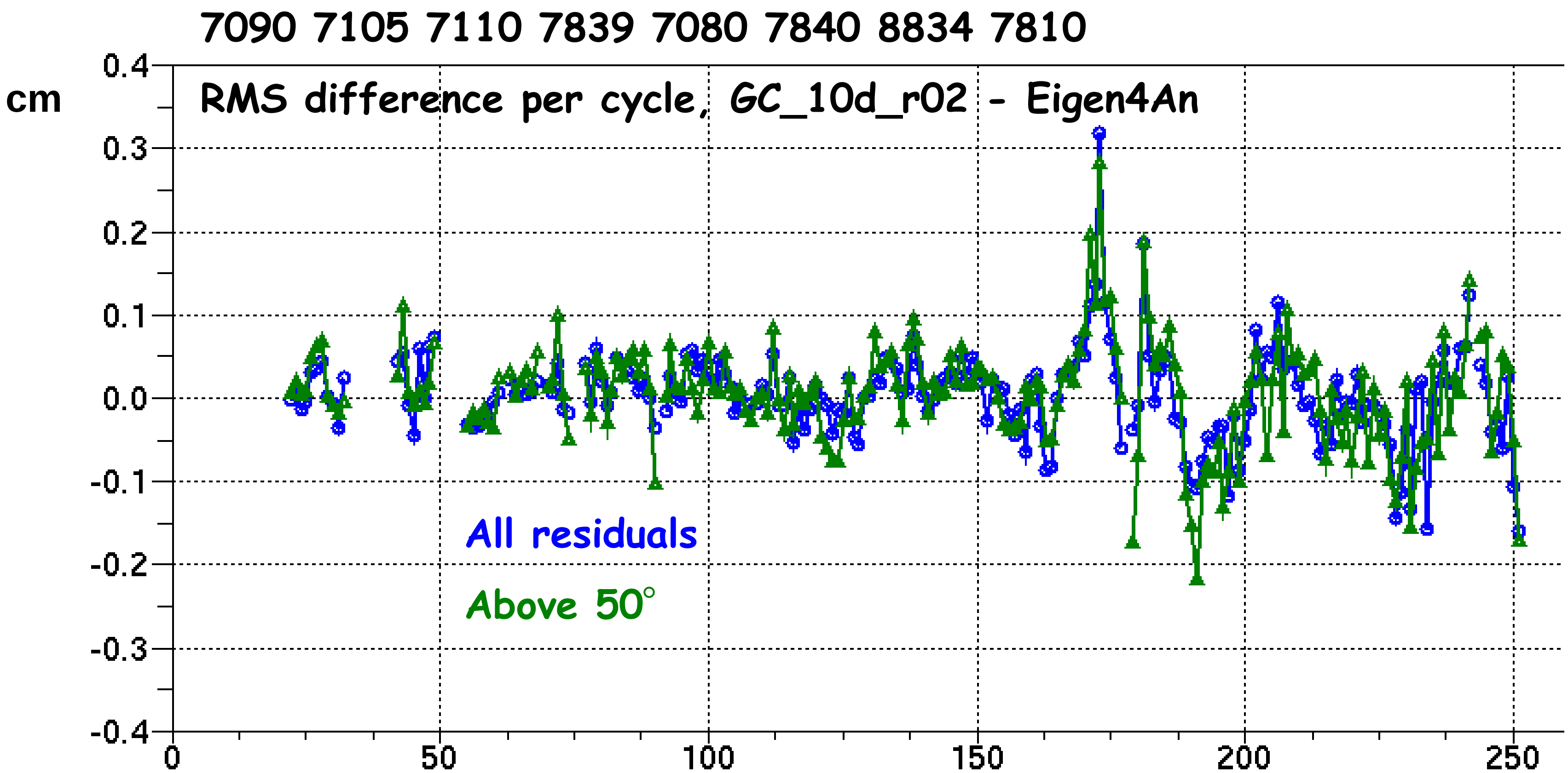
JPL09A – Eigen4Ann (GDR-C J2 POE)



JPL09A – GC_10d_r02 (GDR-C J2 POE)

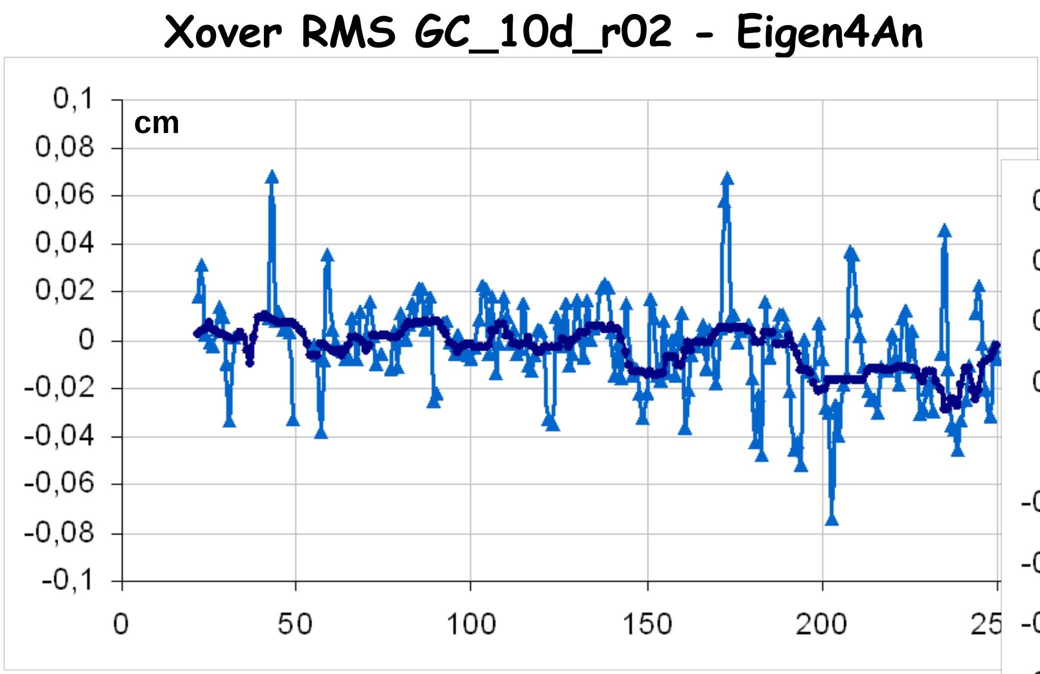


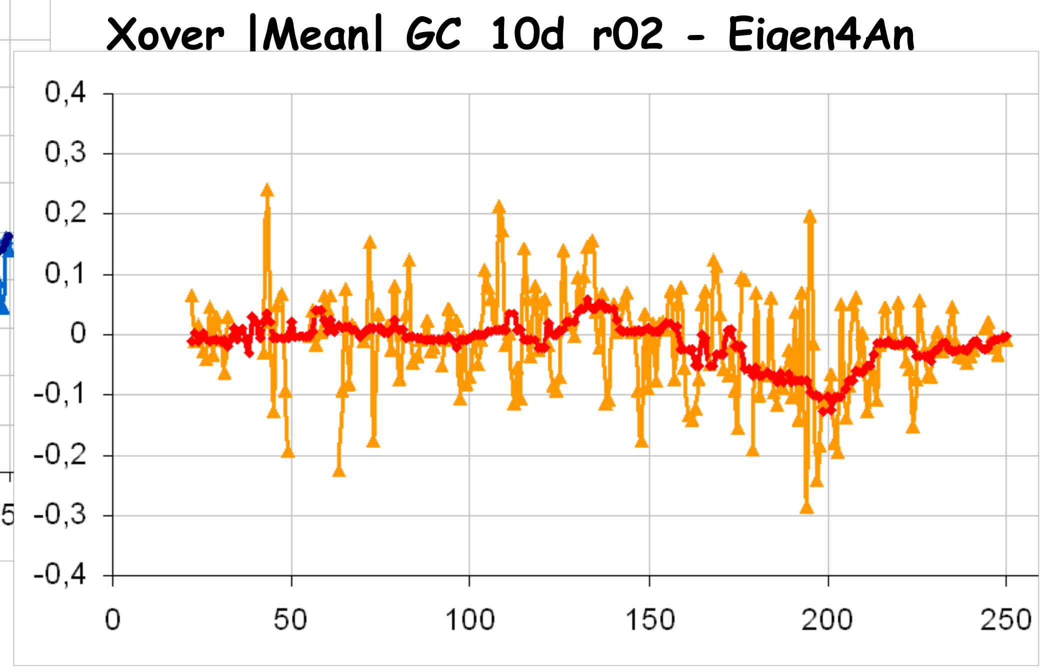
Performance – Post-Fit SLR Residuals



Performance – Crossover Residuals

- Small but noticeable improvement in RMS and Mean of crossover residuals





Conclusions

- **The omission of long term variations of gravity field in the current standards leads to ~1.5 mm/yr differences on a basin scale, and to less then 0.1 mm/yr differences over the whole ocean**
- **These variations are non-linear, and the yearly average of geographically correlated difference reaches peaks of 6 mm (2007)**
- **The impact on the orbit can be attenuated by**
  - **Improving current models?**
  - **Improving the orbit parameterization**
    - Optimize management of 1/rev empiricals
    - Reduced dynamic orbits
    - Differences are strongly correlated with deg.3/ord.1 harmonic: try solving for C31/S31?