The GOCE gradiometer - instrument status, data processing and product performance

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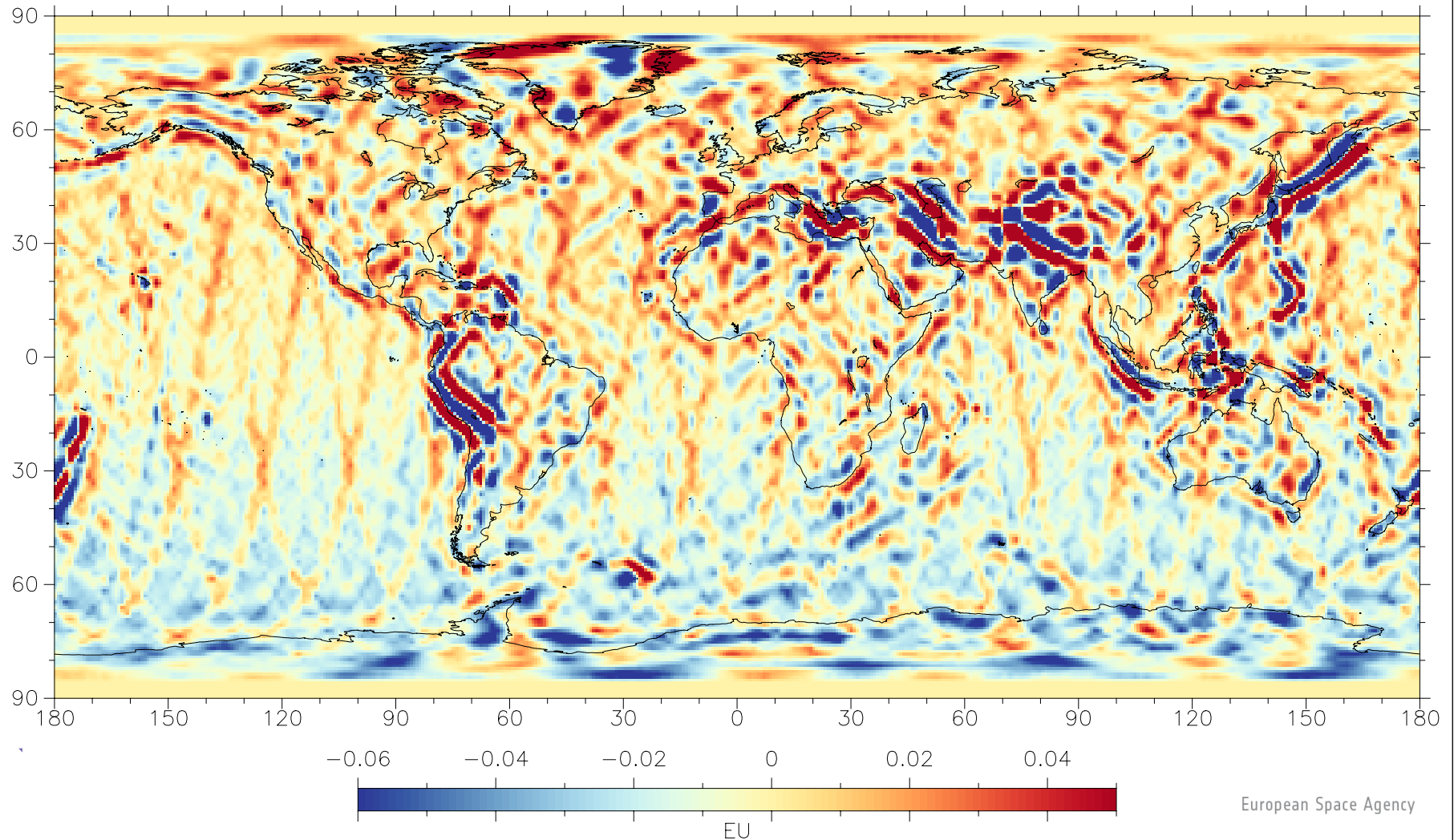
European Space Agency

Observed gravity gradients

- The following plots show gradiometer Level 1b data products from 30 September to 16 November 2009

- Sinc filtered and Hanning windowed to emphasise measurement band (high-pass)

- Gradients are:

  – given in instrument reference frame

  – internally calibrated (i.e. no confrontation with pre-GOCE gravity field information to determine scales, biases, n cprs, etc.)
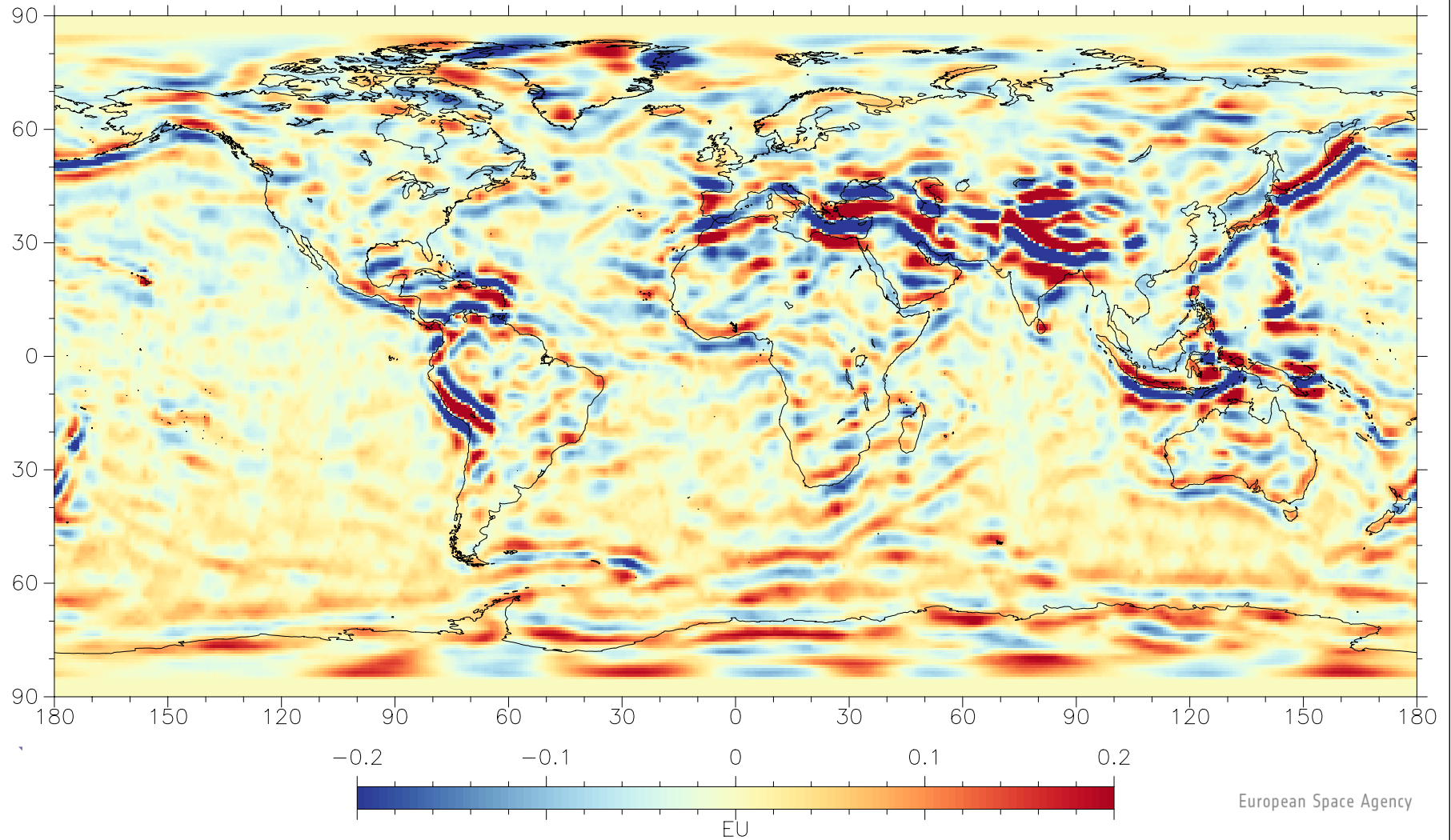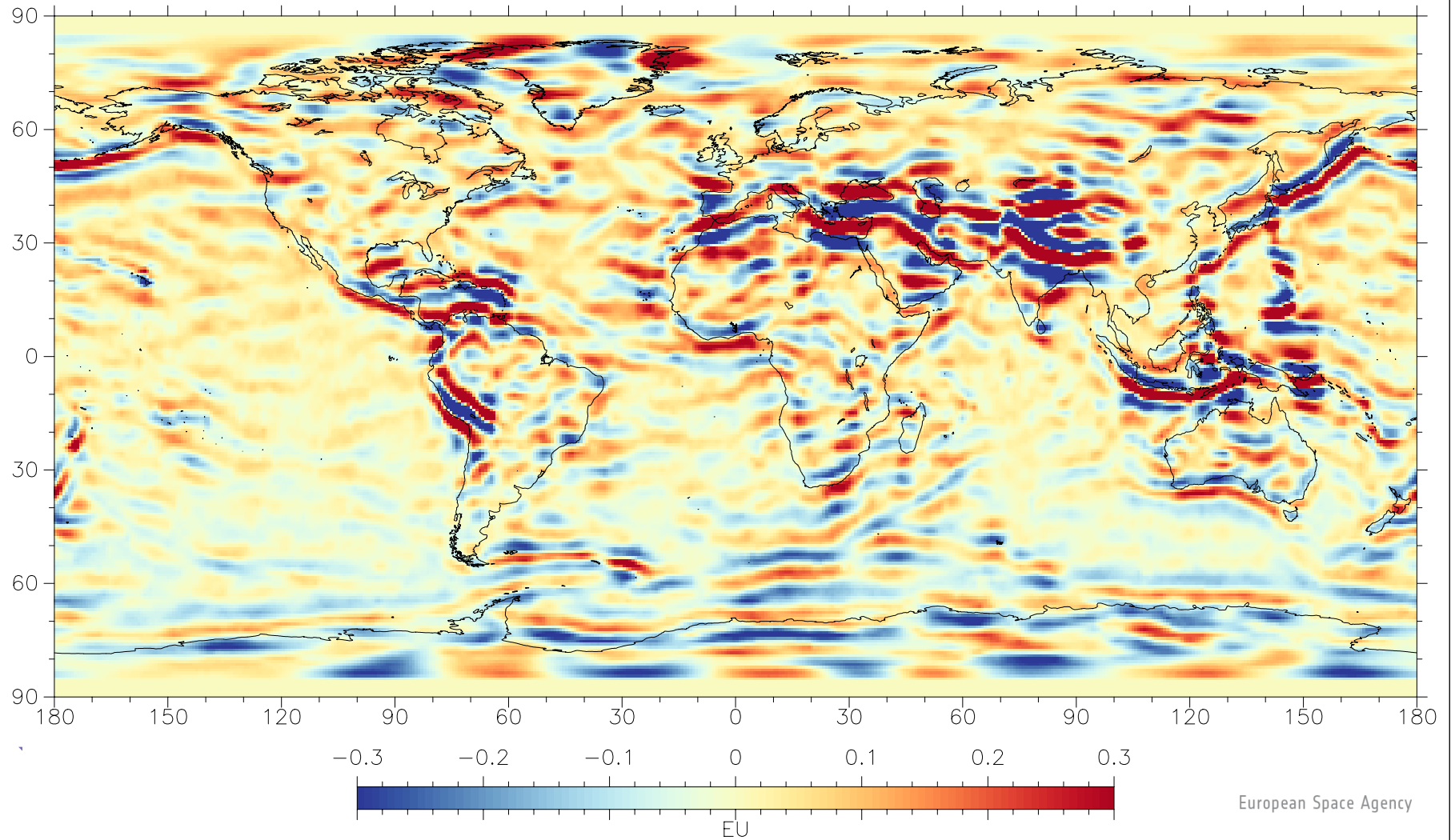
Observed gravity gradients: U$_{xx}$

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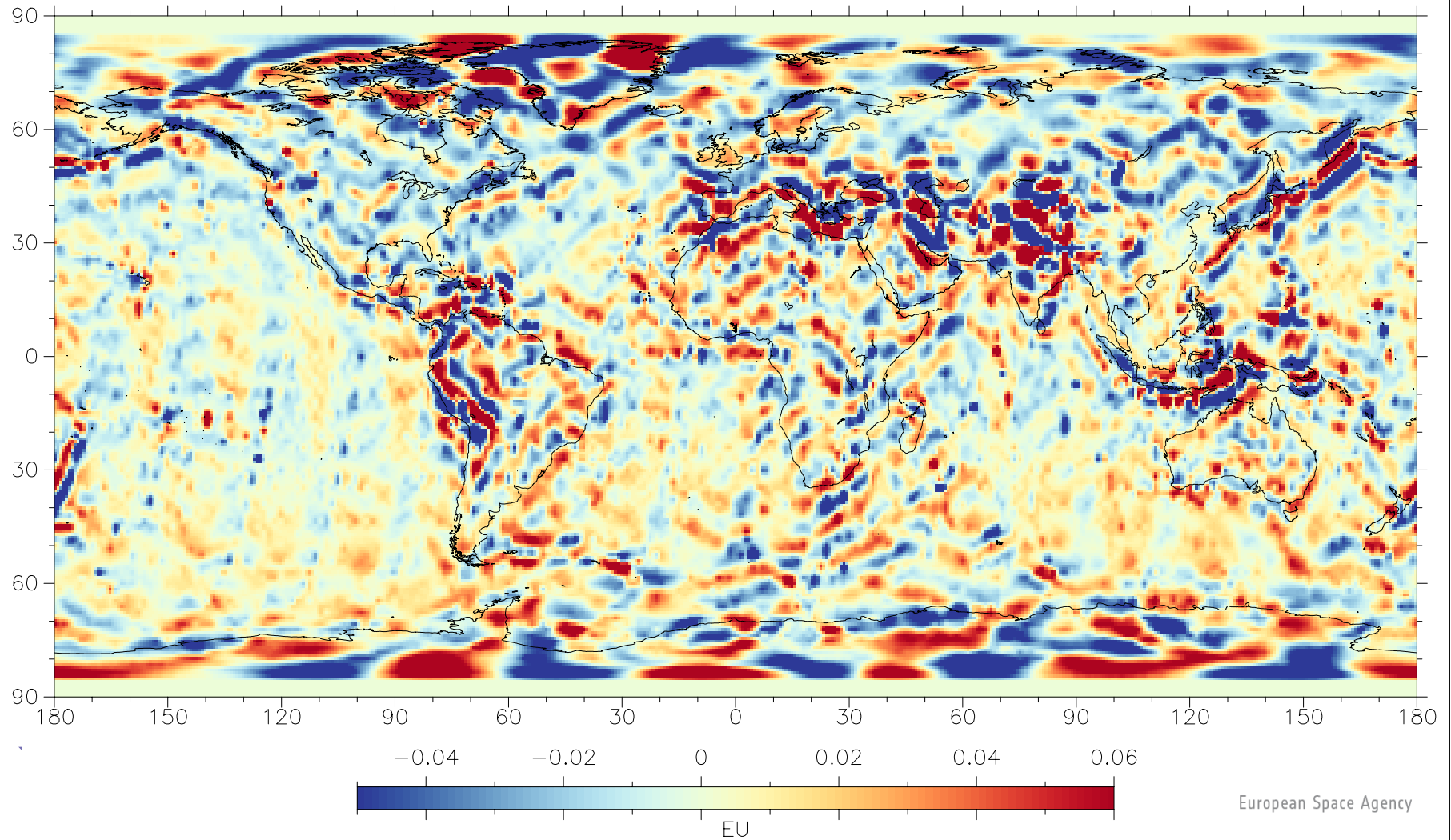
Observed gravity gradients: U$_{yy}$

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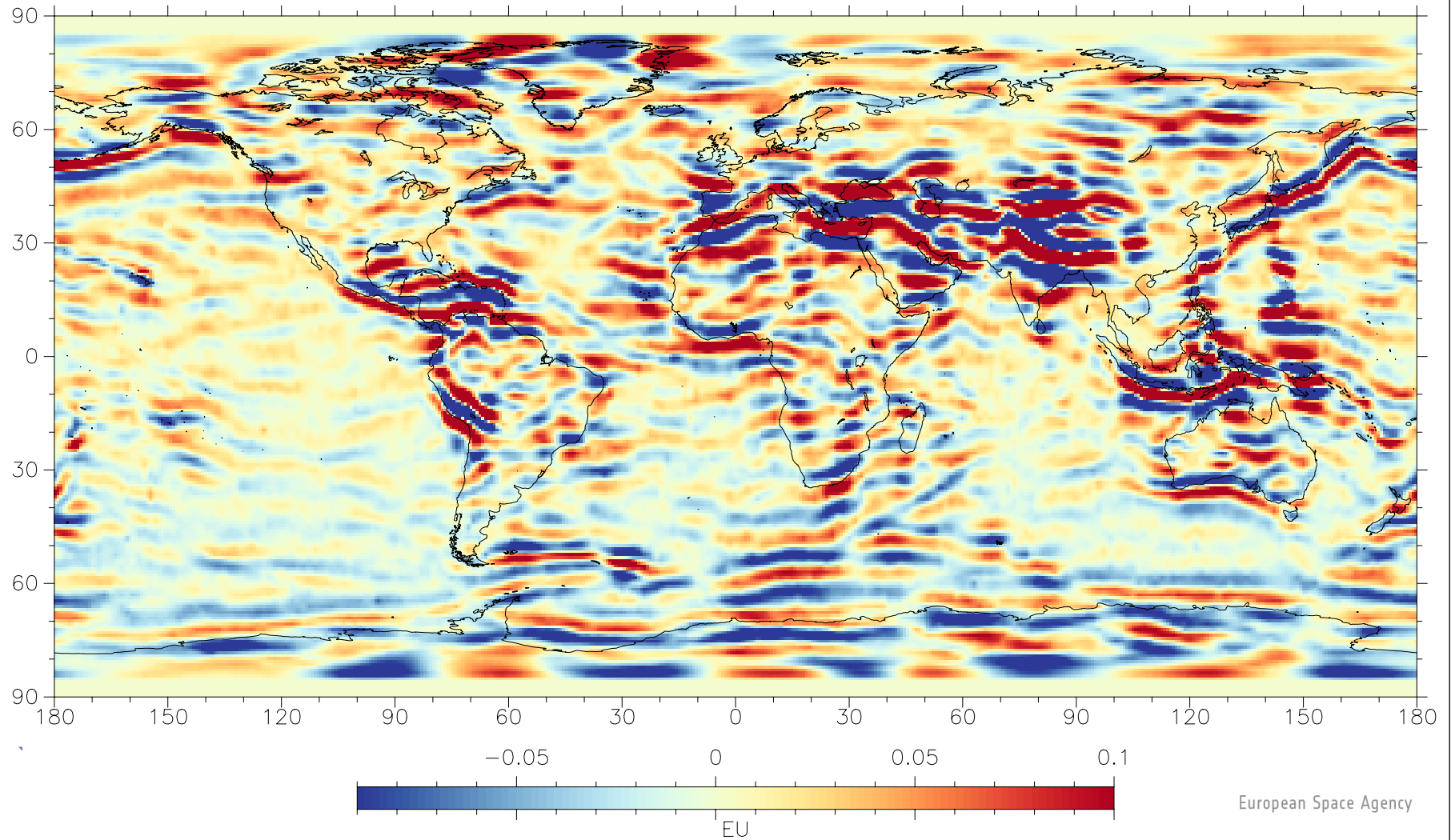
Observed gravity gradients: U_{zz}

Observed gravity gradients: $U_{xx} - U_{zz}$

Observed gravity gradients: U$_{xz}$

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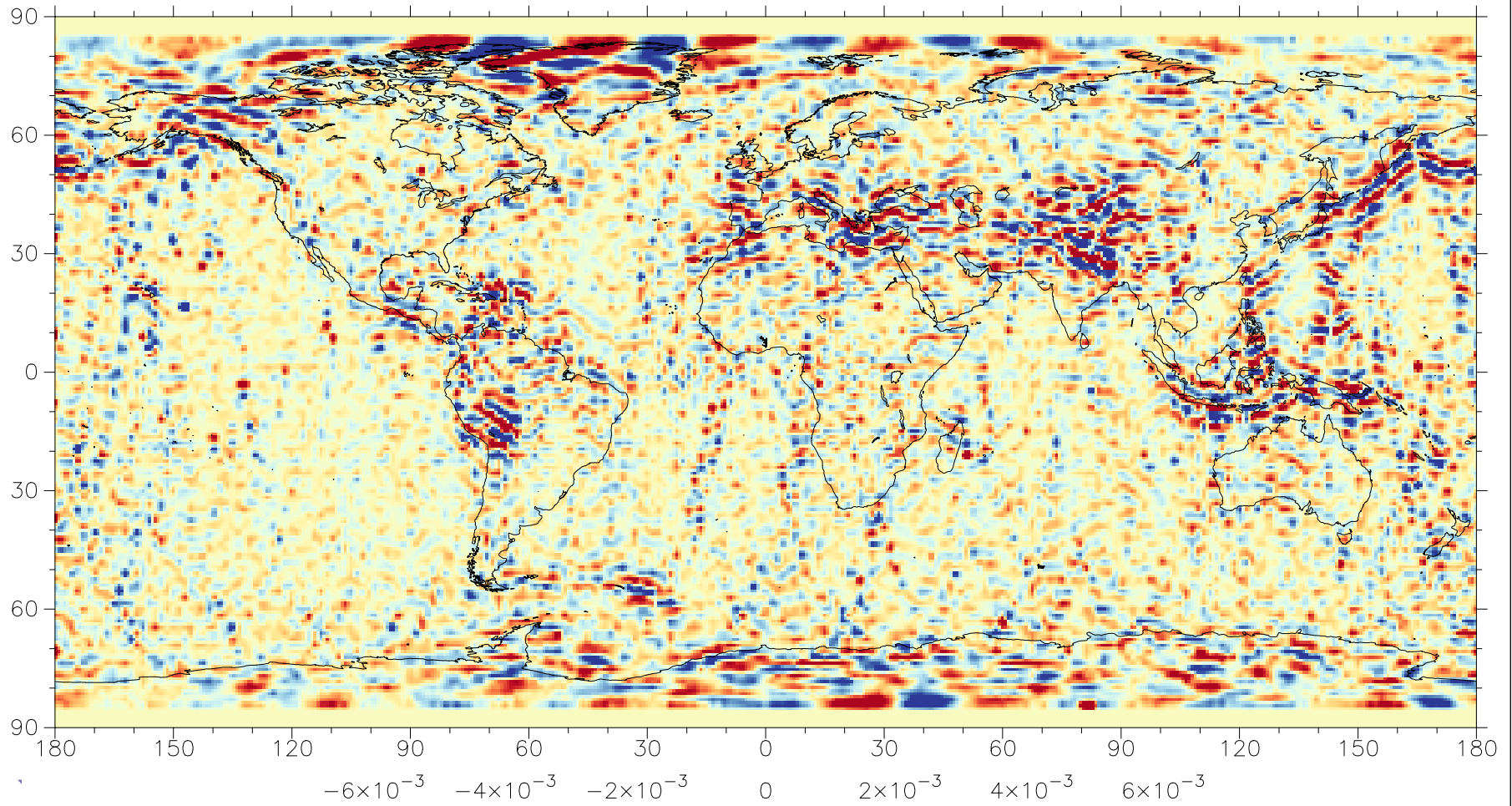
Observed gravity gradients: U_{xy} and U_{yz}
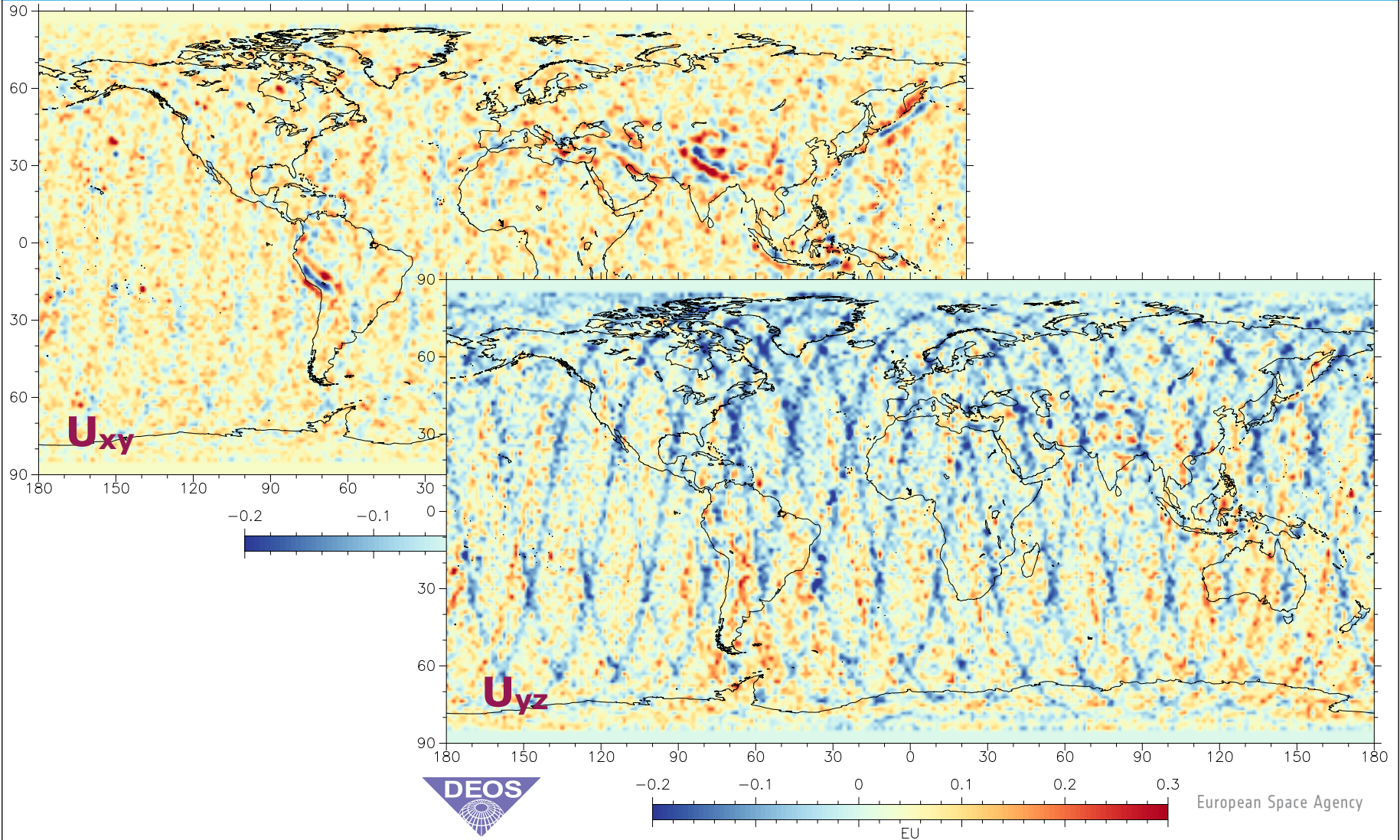
Differences w.r.t. EIGEN5C: U_{xx}
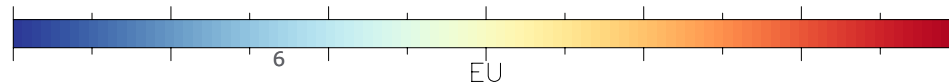
Differences w.r.t. EIGEN5C: U_{yy}
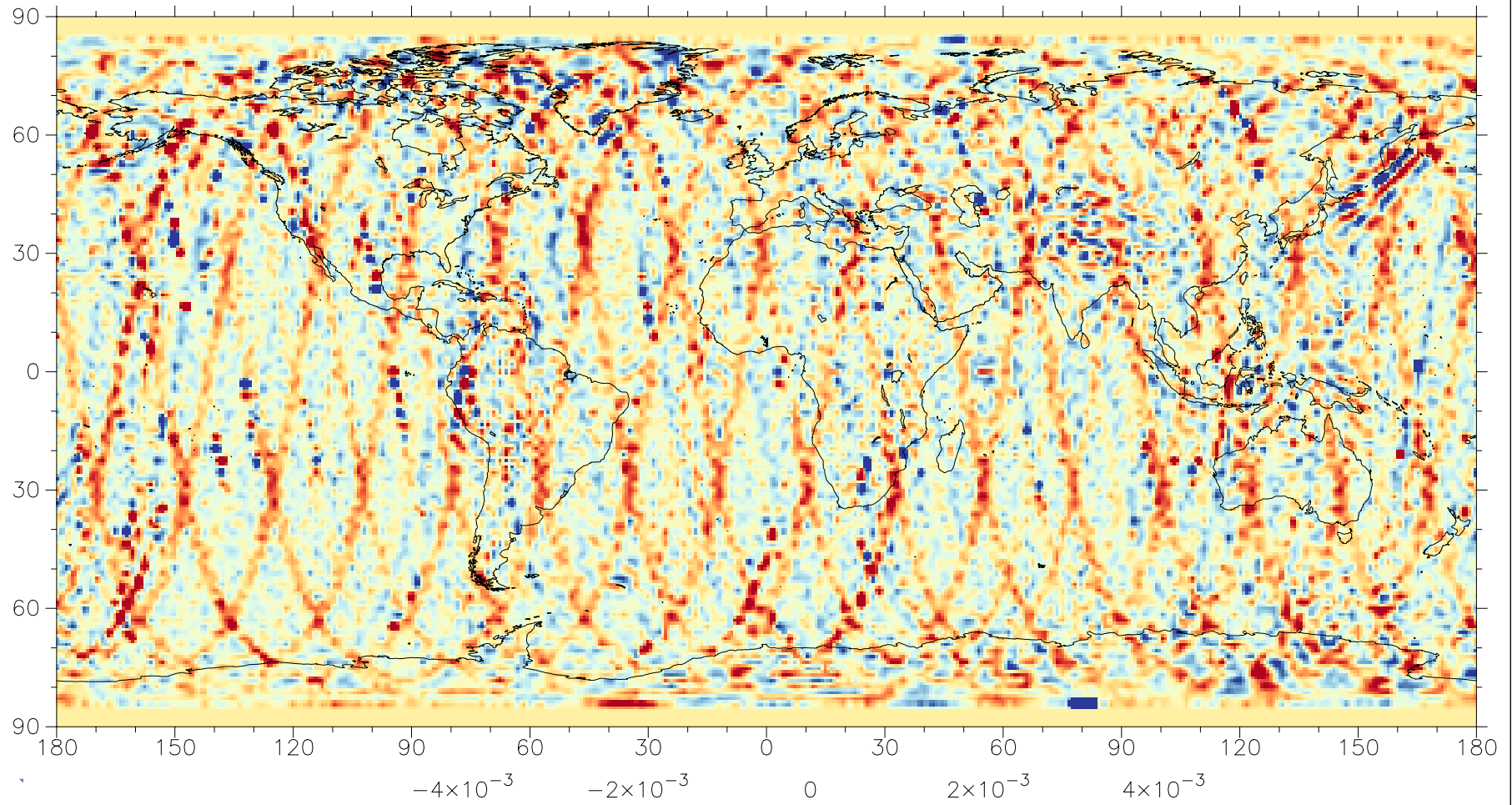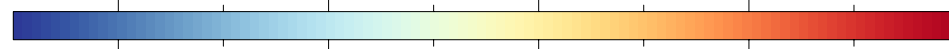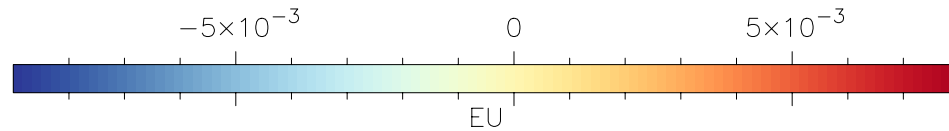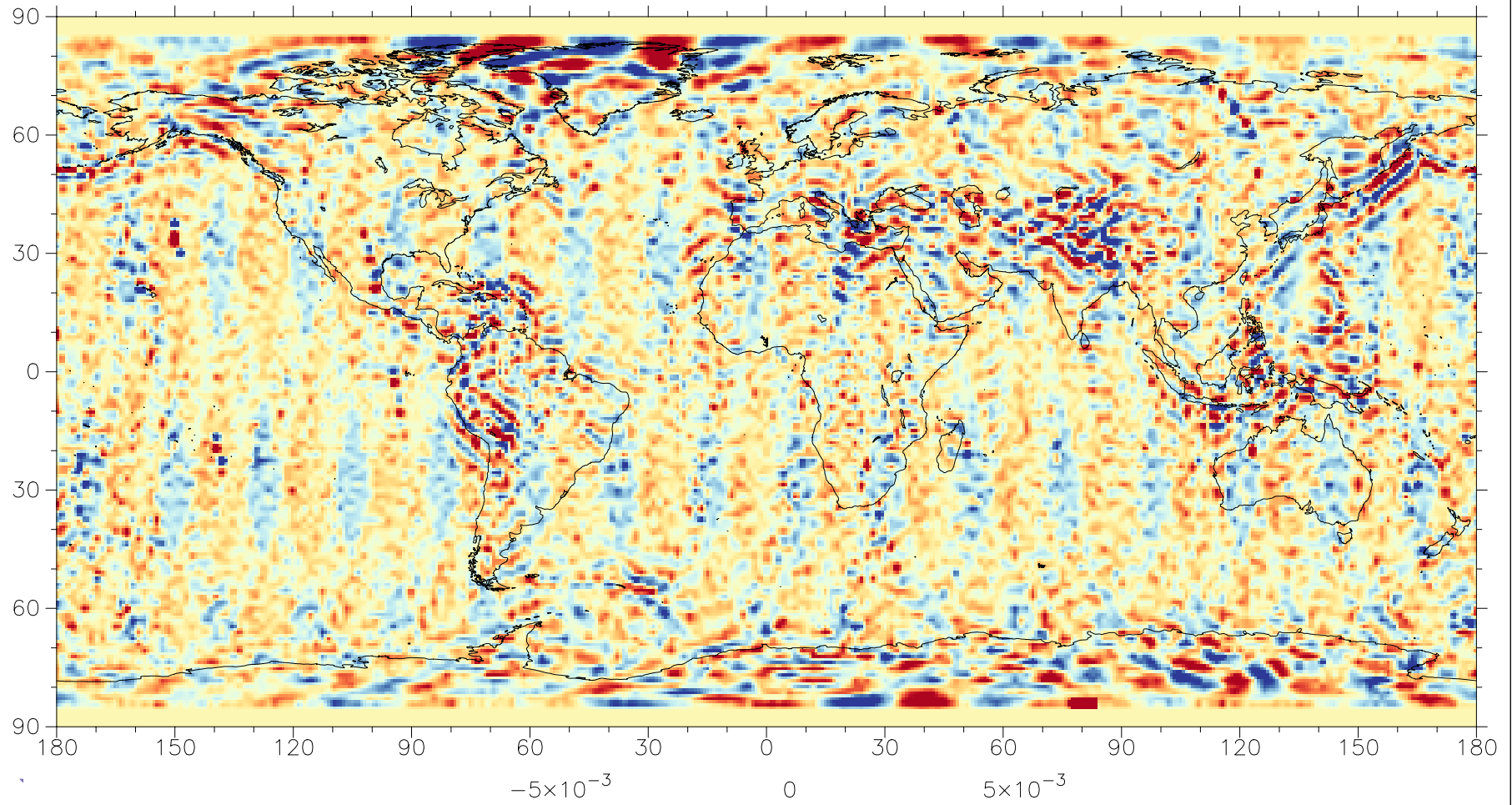
Differences w.r.t. EIGEN5C: U_{zz}

-5×10^{-3} 0 5×10^{-3}

EU

Differences w.r.t. EIGEN5C: $U_{xx} - U_{zz}$
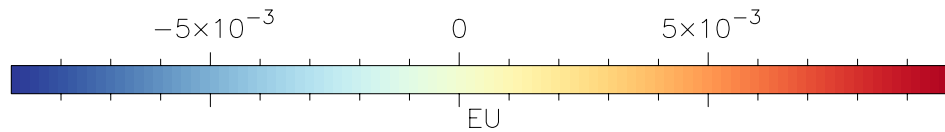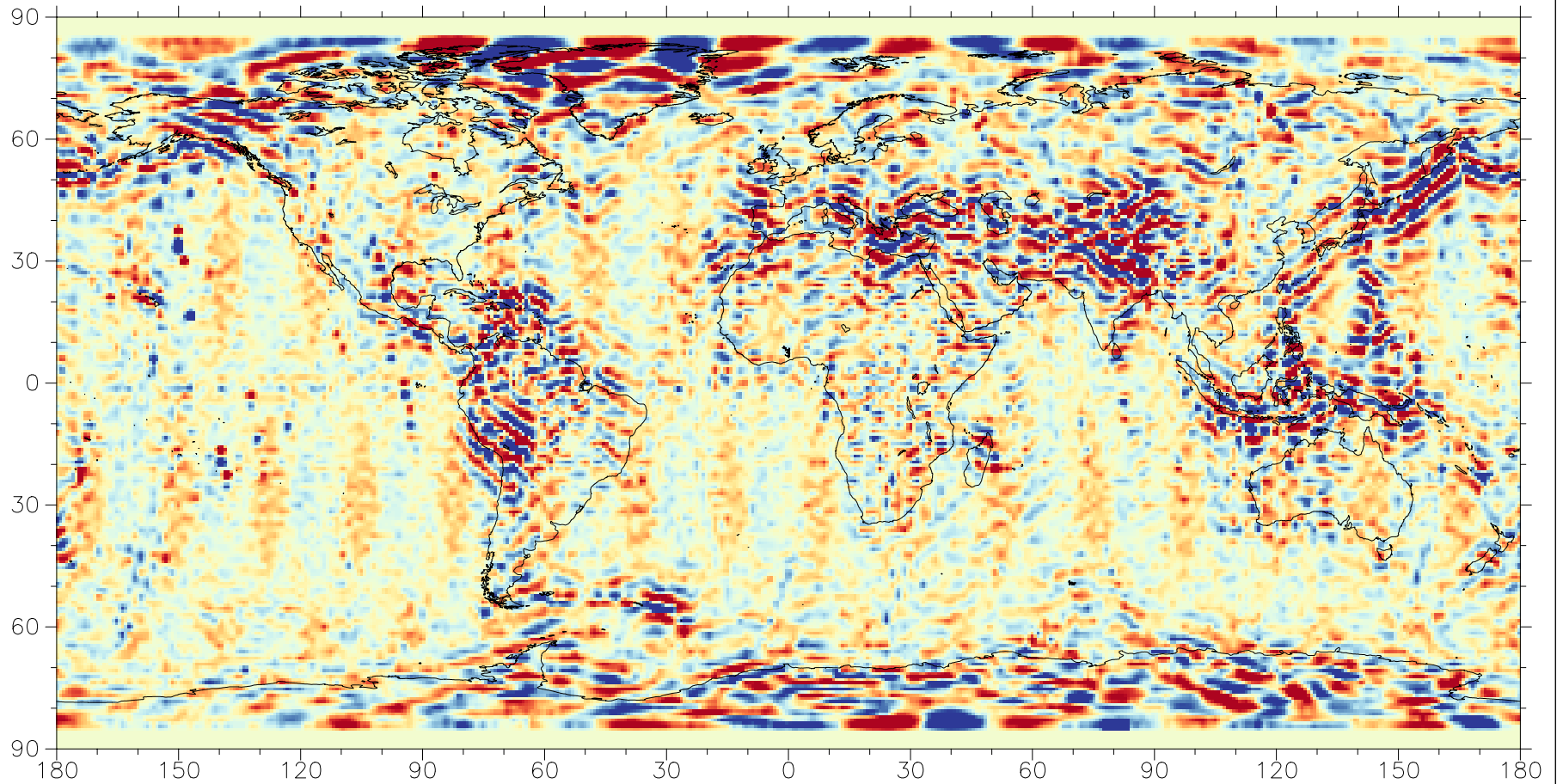
Differences w.r.t. EIGEN5C: U_{xy} and U_{yz}

Filtered V_{zz} (Pre-whitening fi lter), epoch 0:53:50.73, 5/11/2009

correlation coeff. is 0.99503

Residual

o-c histogram

12

Improvements during commissioning phase
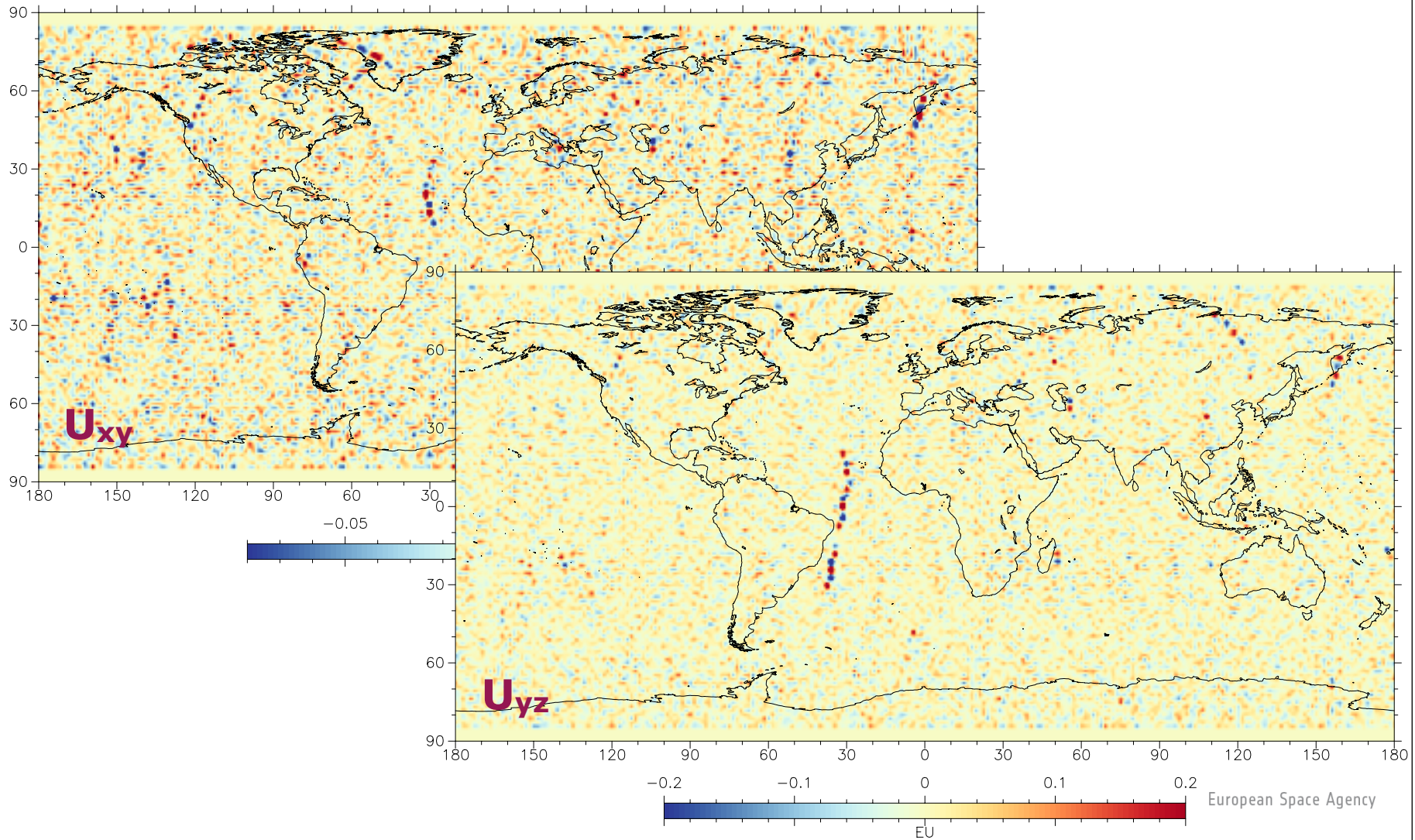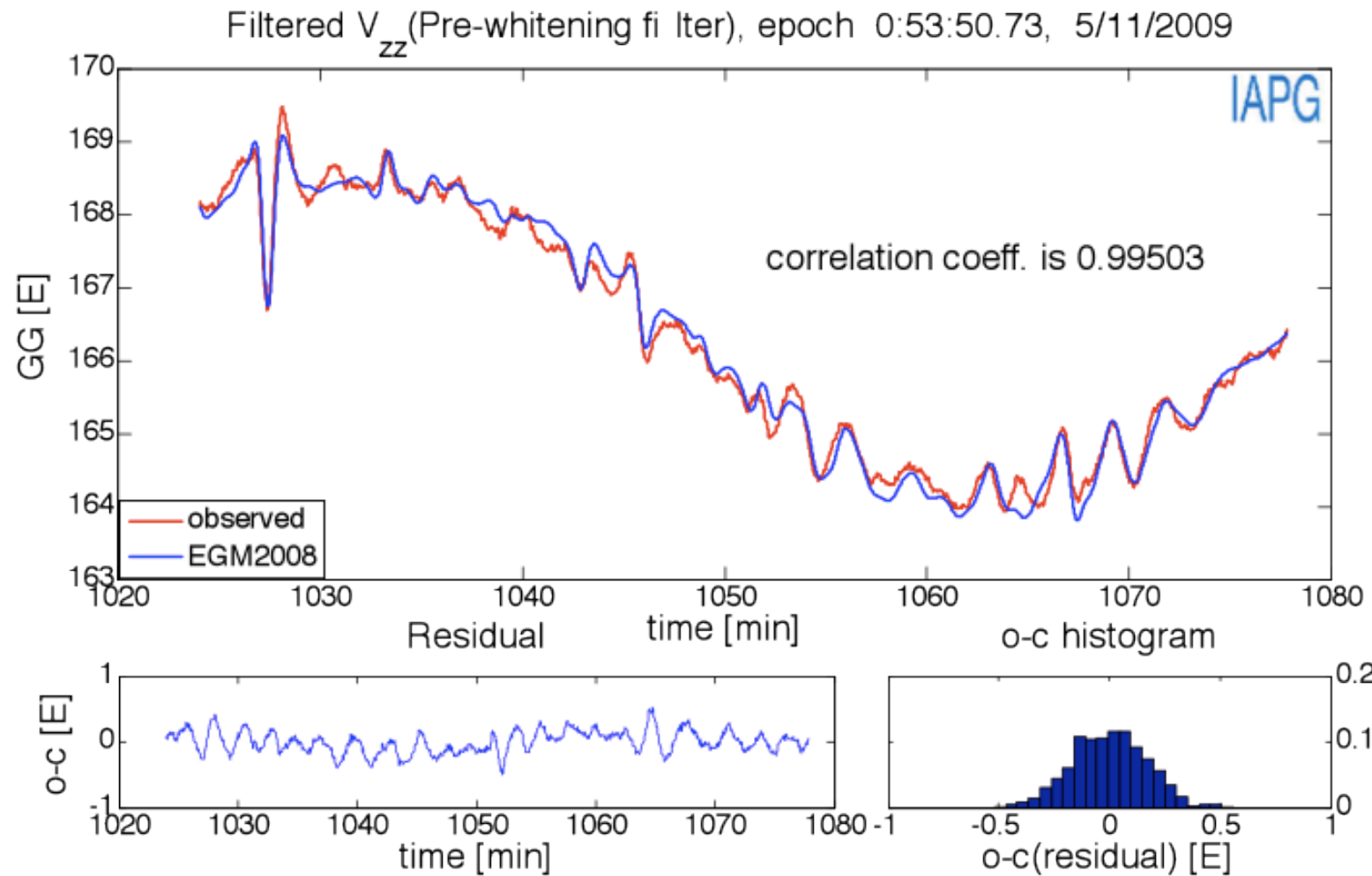
Change of proof mass angular control about less-sensitive axis

- A very significant 30% improvement has been achieved by not using electrode pairs along the directions of individual gradiometer arms in proof mass angular control
- Conclusion: there was a "noise" introduced using in-line electrodes for angular control; remaining error now in transversal axis

Parameter update for determination of centrifugal accelerations
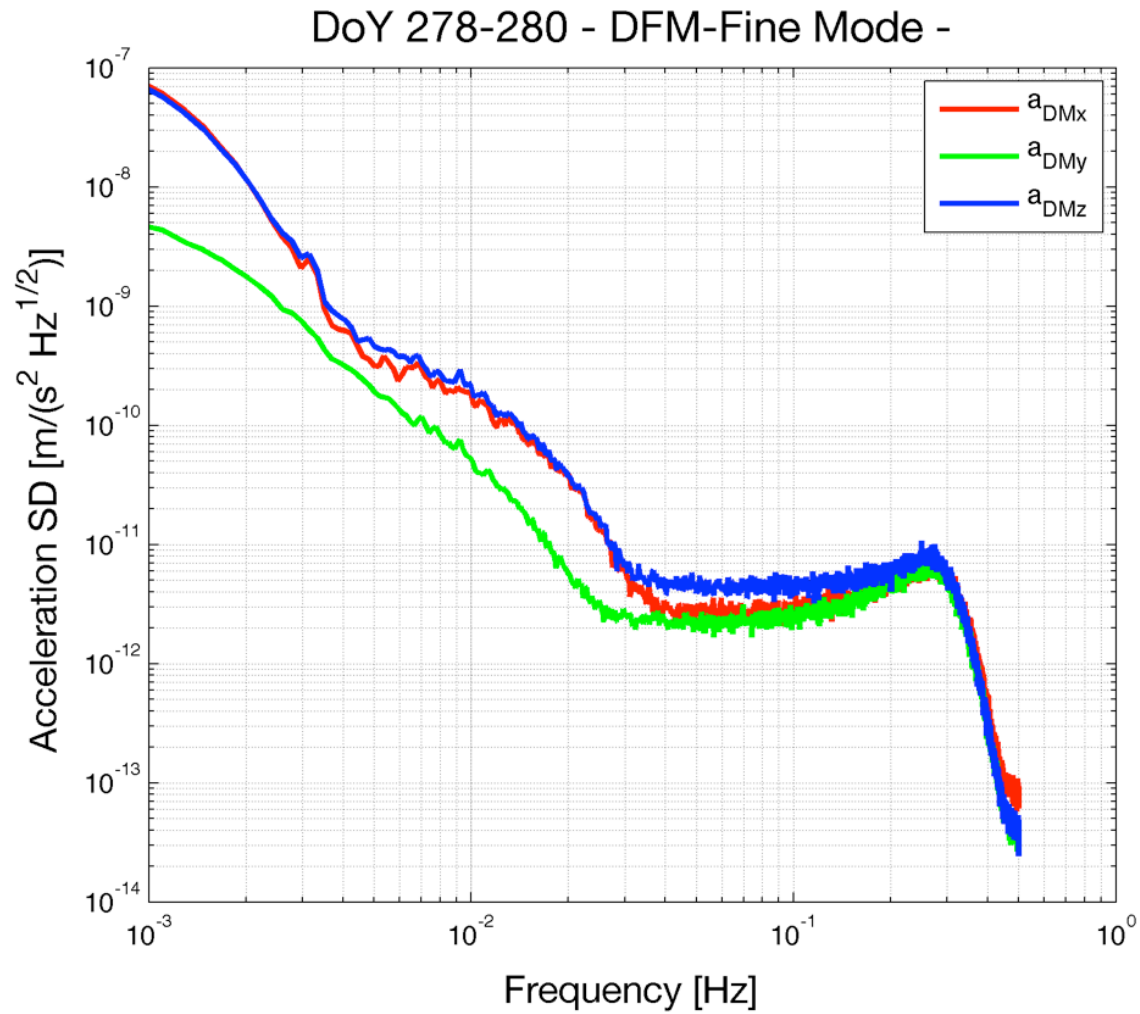
- Affects the mix of star camera and gradiometer observations
- Implemented in dedicated Kalman filter as part of Level 1 processing

- Trace of gradient tensor in upper measurement band now ~ 20 mE/$\sqrt{Hz}$

Differential accelerations
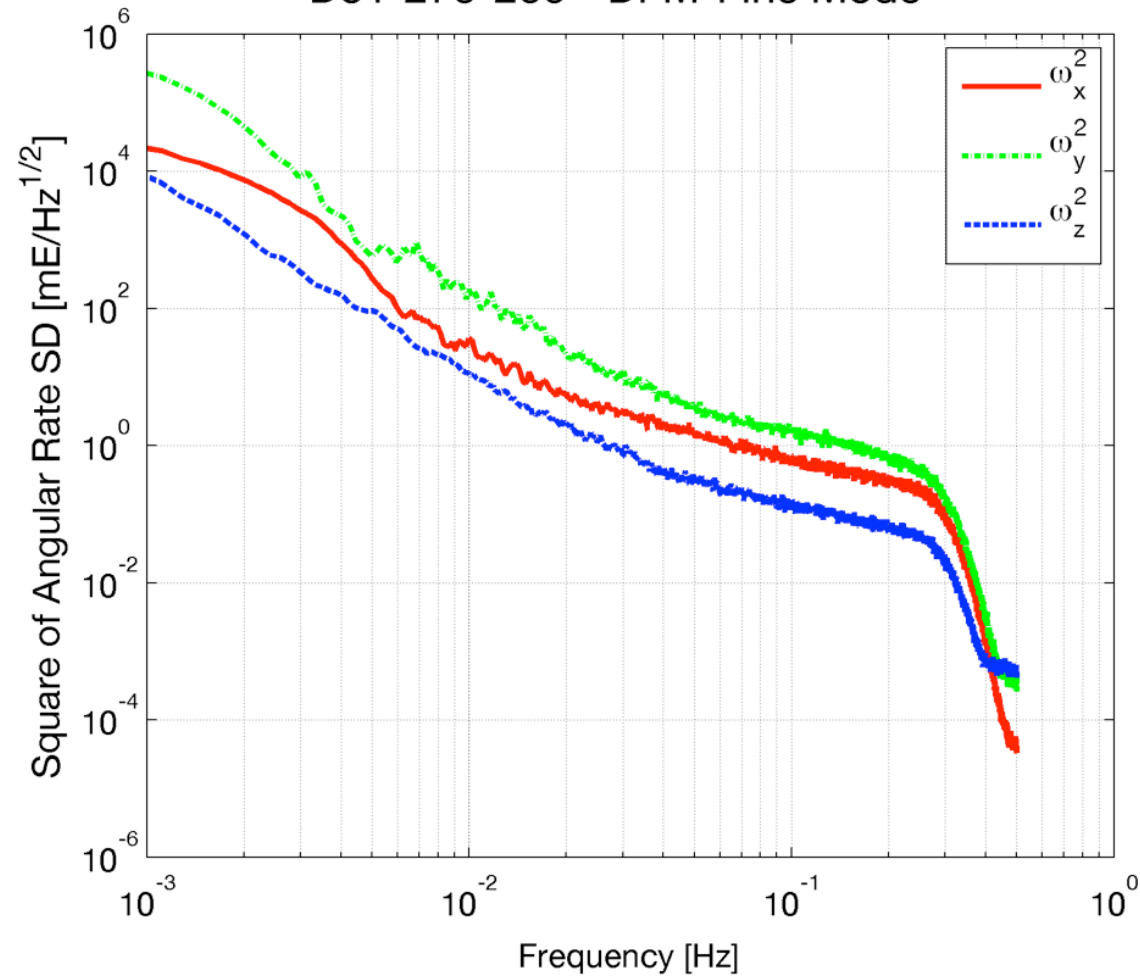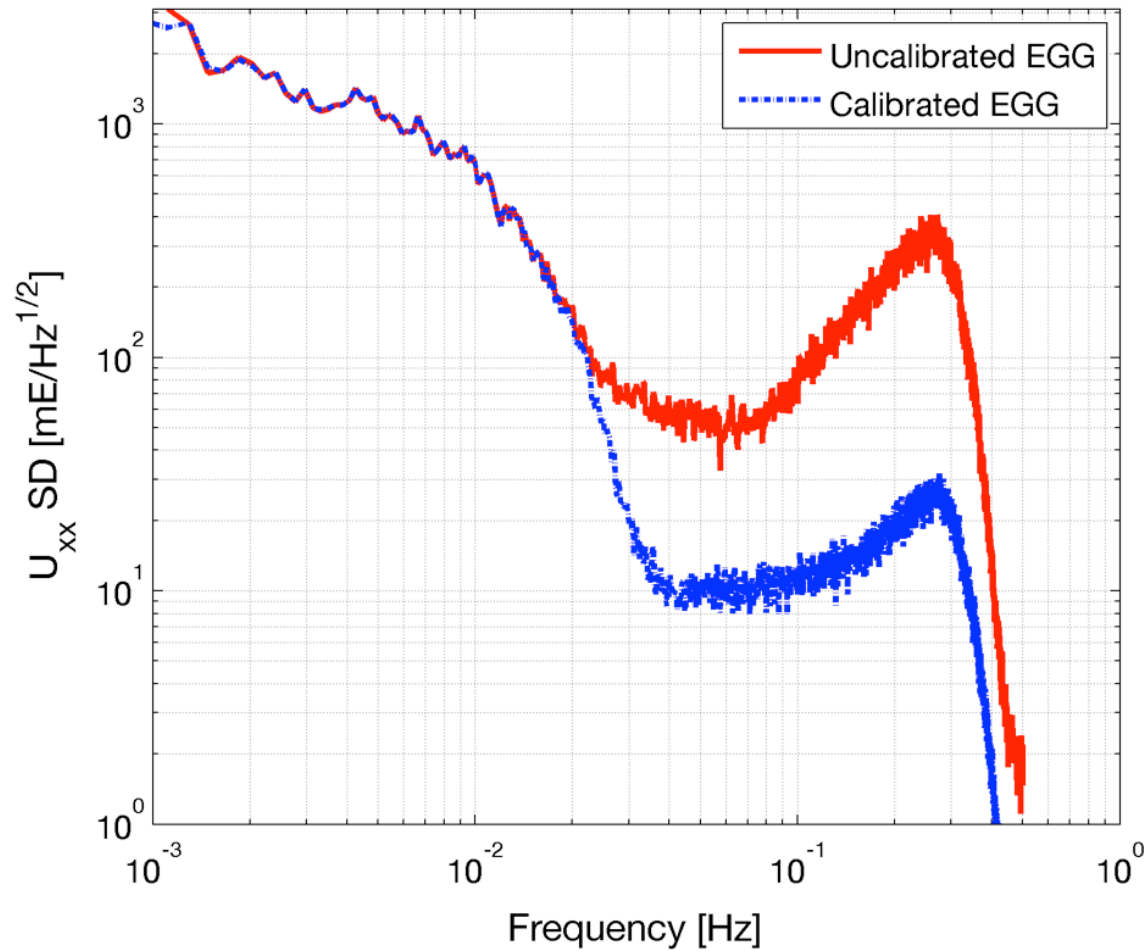

DoY 278-280 - DFM-Fine Mode -

Centrifugal accelerations

DoY 278-280 - DFM-Fine Mode -

Along-track gradients (GRF)

DoY 278-280 - DFM-Fine Mode -

Cross-track gradients (GRF)
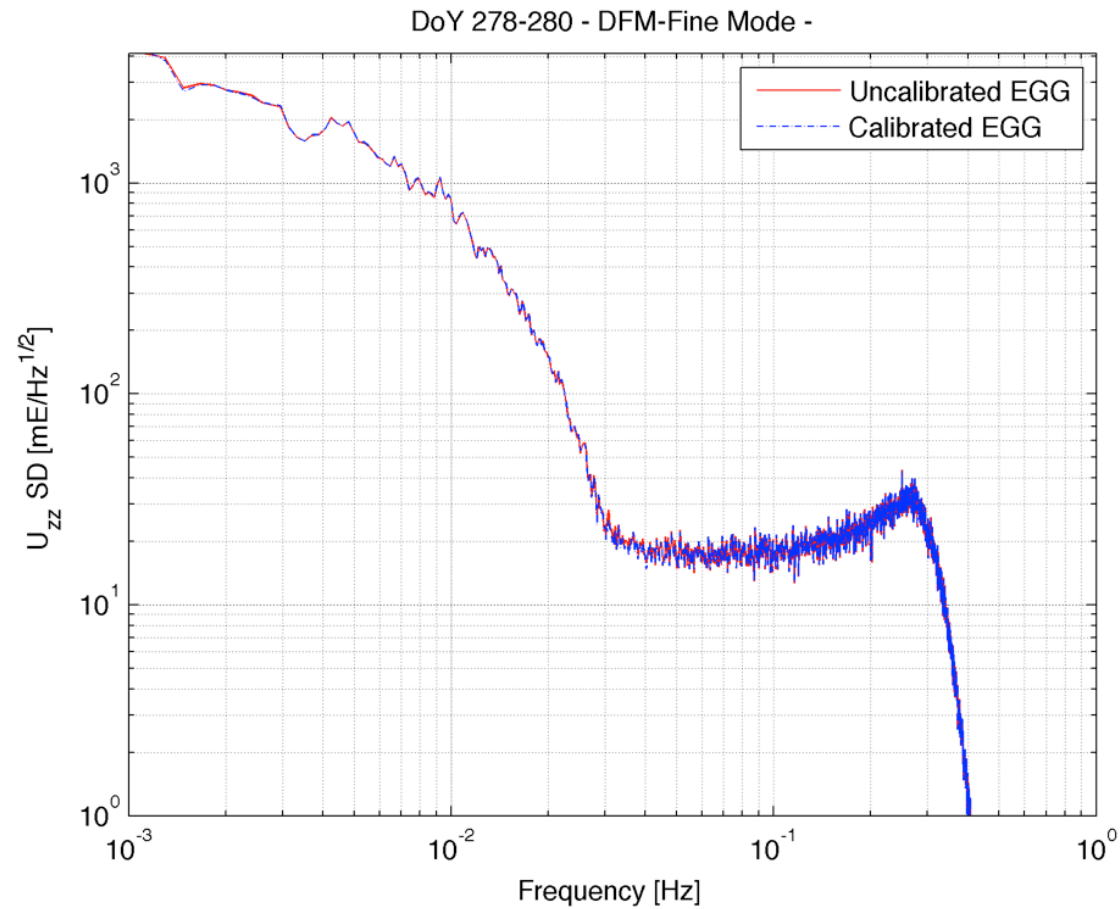

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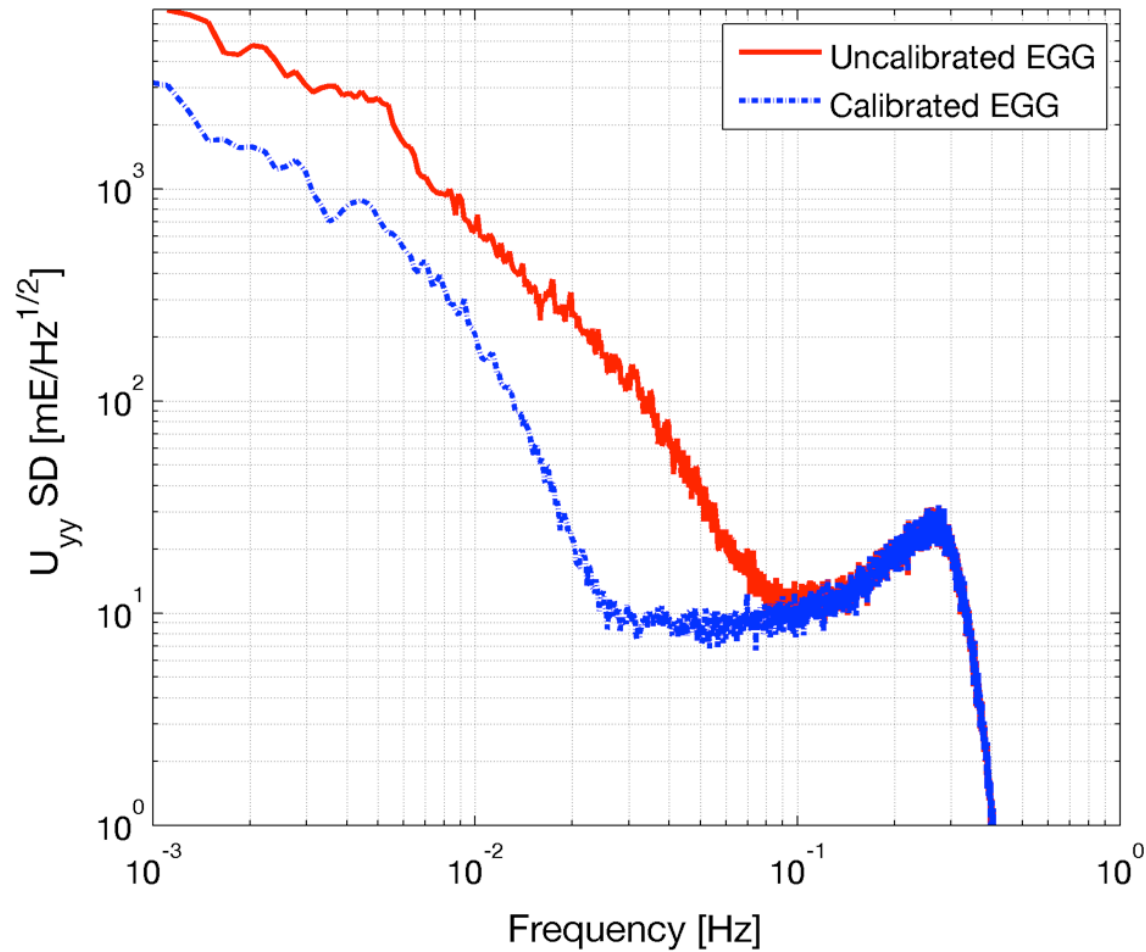
Radial gradients (GRF)


DoY 278-280 - DFM-Fine Mode -

Satellite-to-Satellite Tracking Instrument
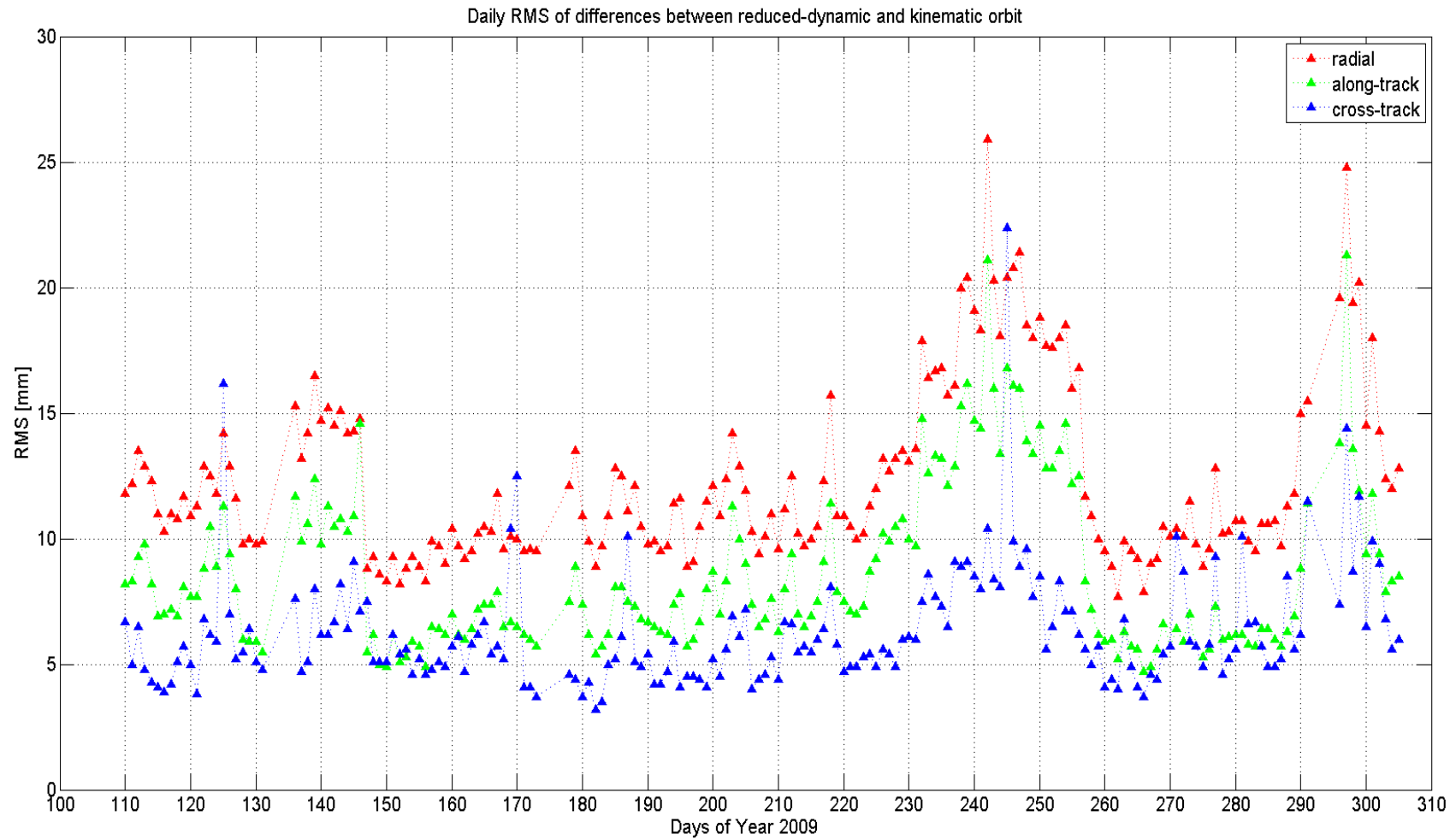
- Top class orbits: **current POD accuracy is at 1-2 cm level** in each of the three orthogonal directions

- In most cases better than 2 cm 3D RMS

- Rapid science orbits (<1 day latency) are at 3-4 cm accuracy

- Validated by Satellite Laser Ranging to within absolute differences of approximately 2.5 cm

Orbit overlaps
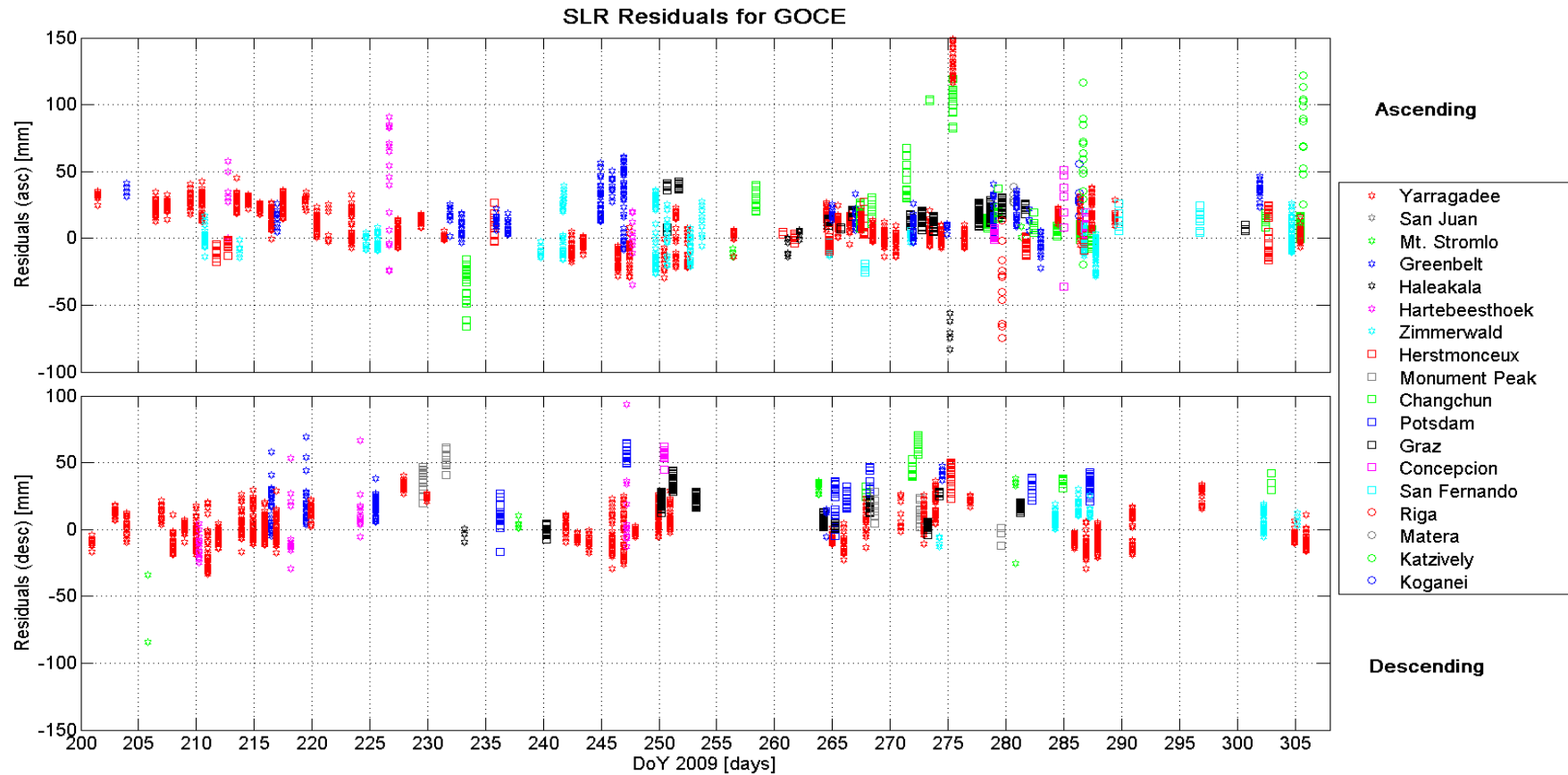

Daily RMS of overlaps of consecutive orbits (6h each day)
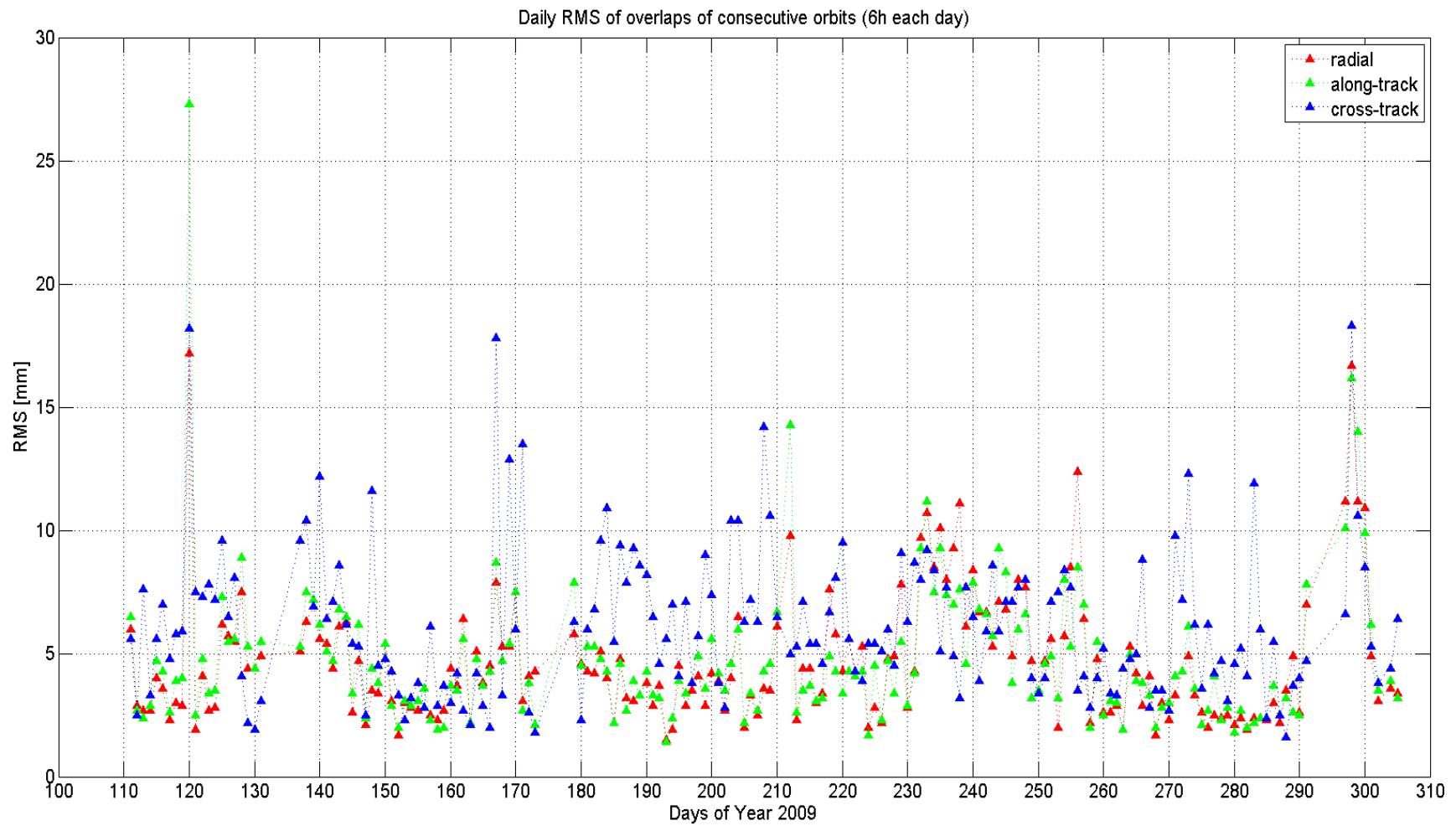
Reduced-dynamic vs. kinematic orbits

Daily RMS of differences between reduced-dynamic and kinematic orbit

POD validation by Satellite Laser Ranging

SLR Residuals for GOCE

CONCLUSIONS

- Science data are continuously delivered to ground (1 Hz data rate); no gaps in gradiometer data stream

- Gradiometric observing system (satellite + instrument) performs excellently

- Precise orbit product is top-notch

- Analysis of gradiometer data quality indicates that all mission objectives will be met

- Data from non drag-free periods (commissioning phase, April - September) will also be made available (use with care!)