GRACE: From Measurement to Gravity

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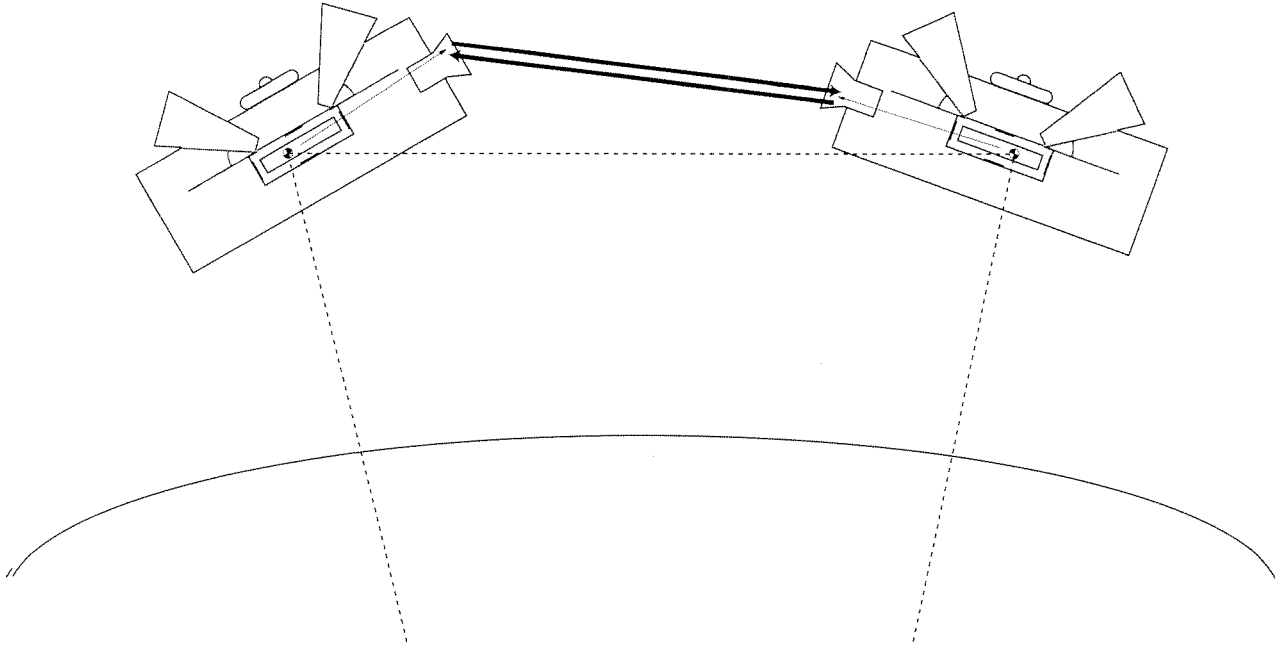
Overview

- **GRACE measurements**
- **Impact of measurements on gravity recovery**

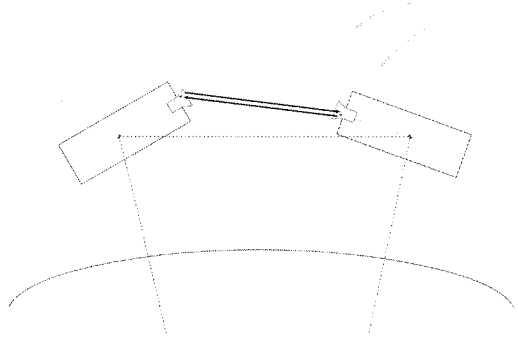
  (individual,ensemble)
- **Examples of possible scientific use of GRACE measurements**
- **Level-1 processing status**

GRACE measurements

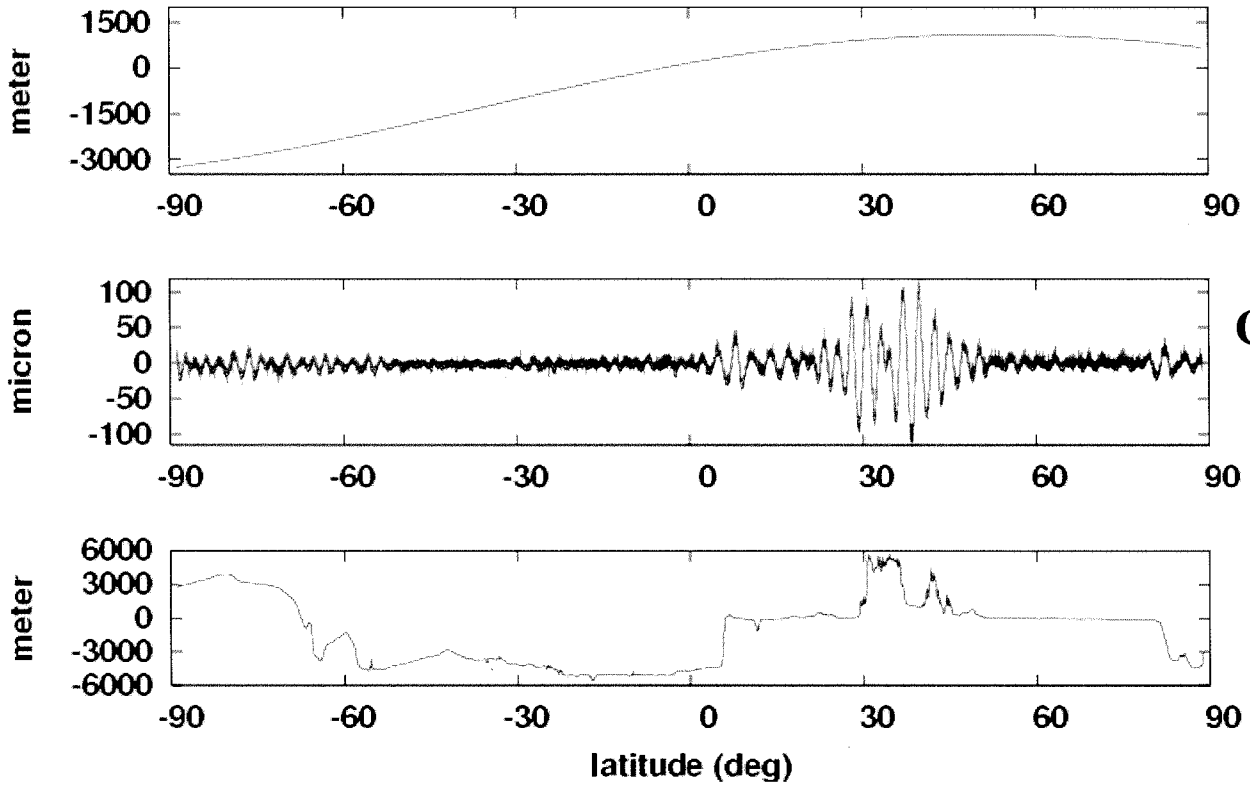


K-band ranging measurement

- **K-band ranging system measures range change due to:**
  - **Change in gravitational potential**
  - **Non conservative forces**
  - **Difference in orbital elements of both GRACE spacecraft**
  - **Attitude variations of both GRACE spacecraft**
- **Primary measurement biased dual one way range**



High Frequency Content of KBR Dual One Way Range Measurement

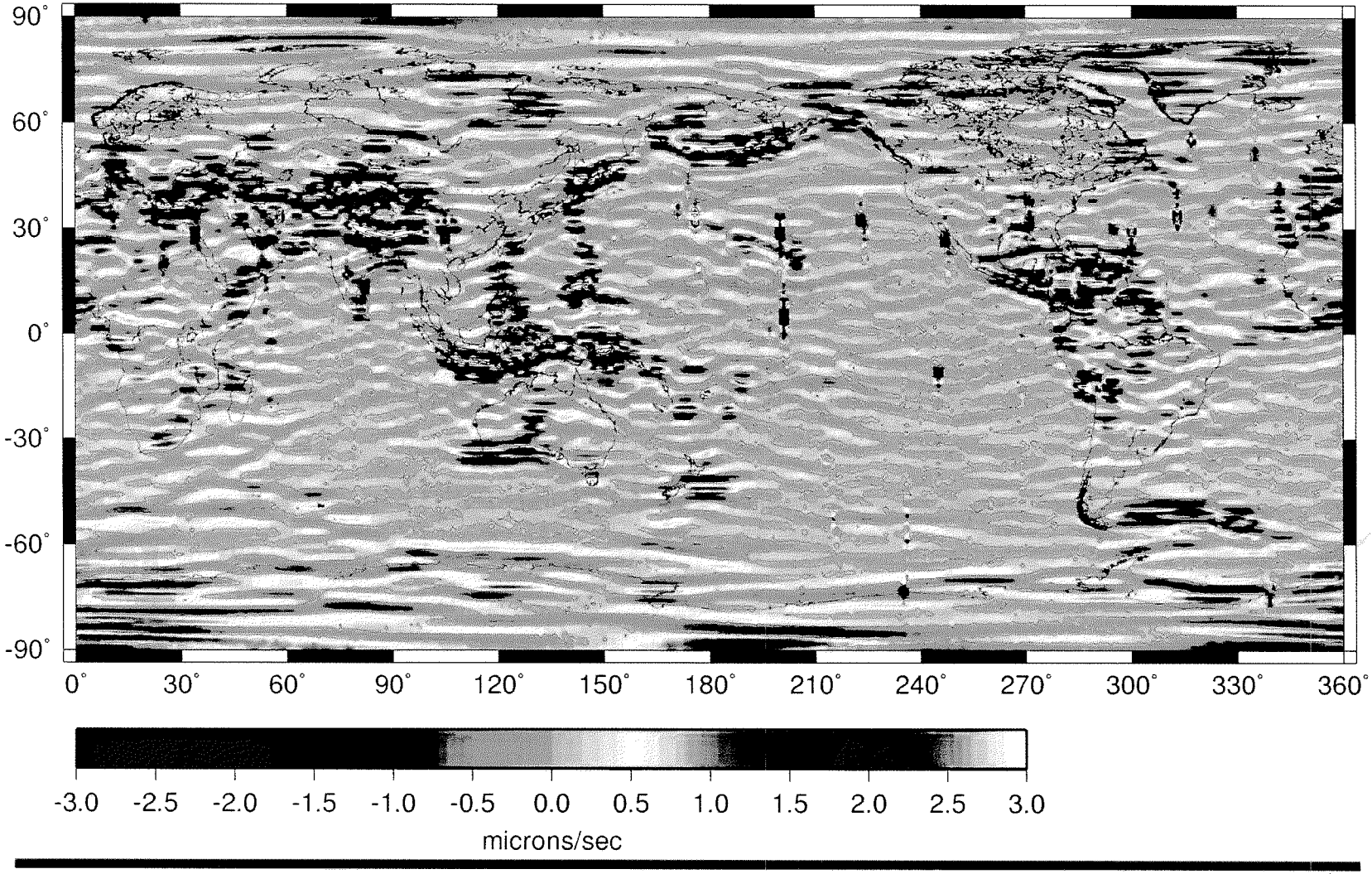


Full KBR Range - Bias

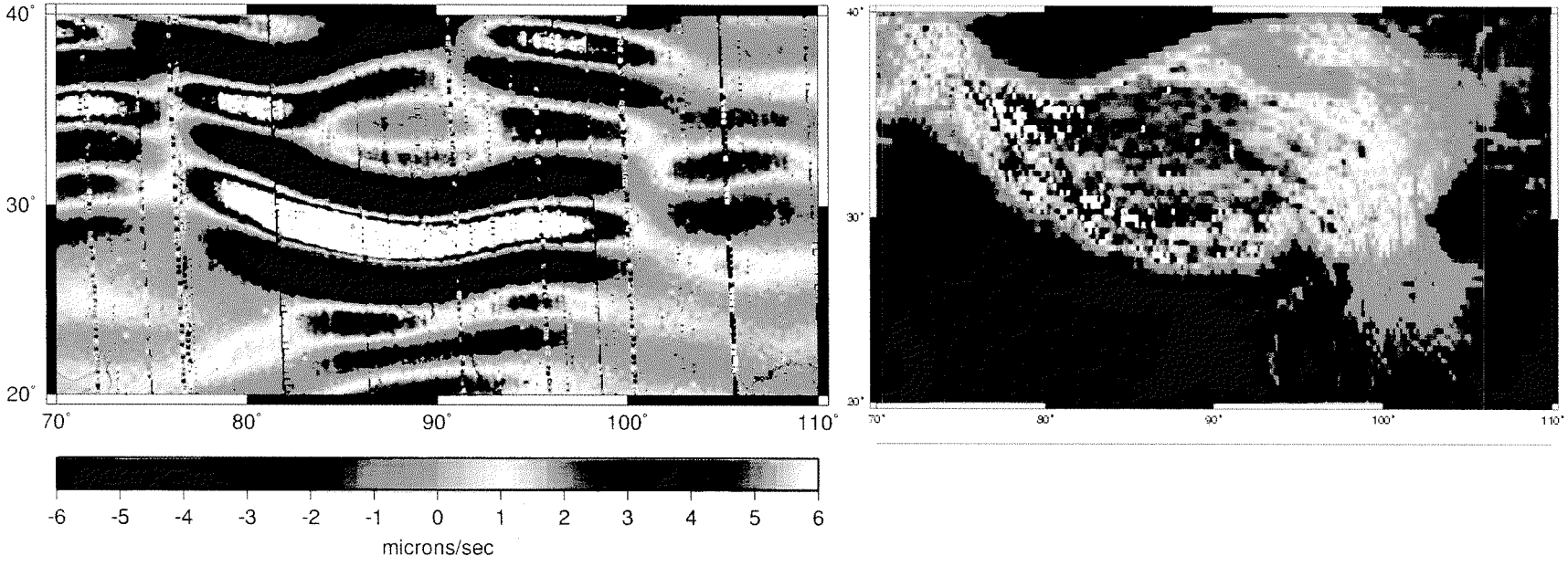
Cubic Spline Residual (30 second knots)

Topography Along Groundtrack

Global High-Frequency KBR measurement

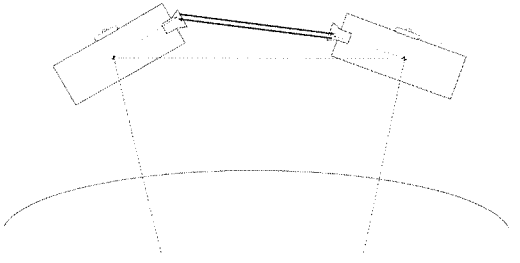


Himalaya - Detail



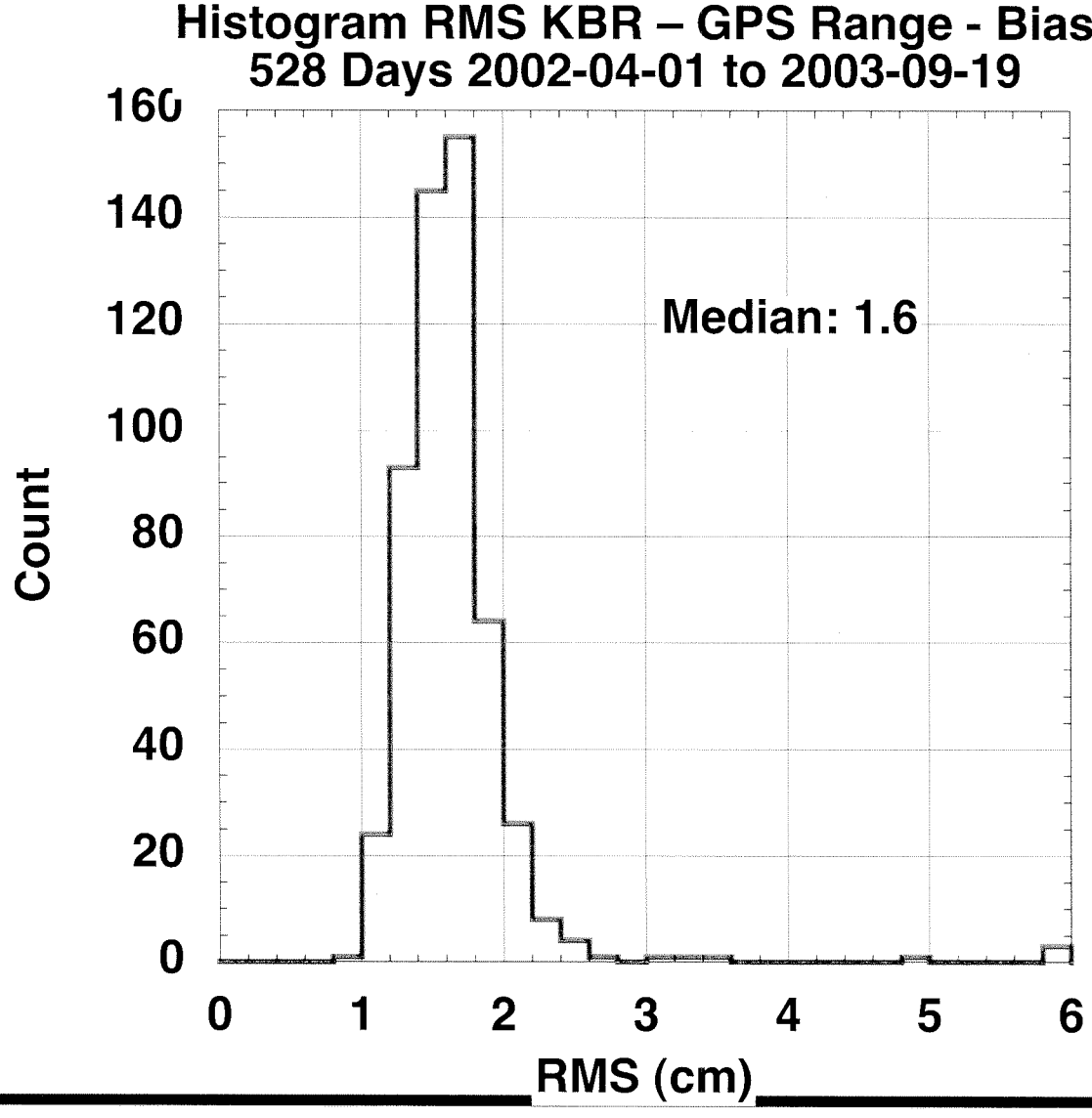
KBR range-rate residuals - correlations to topography

GPS measurements

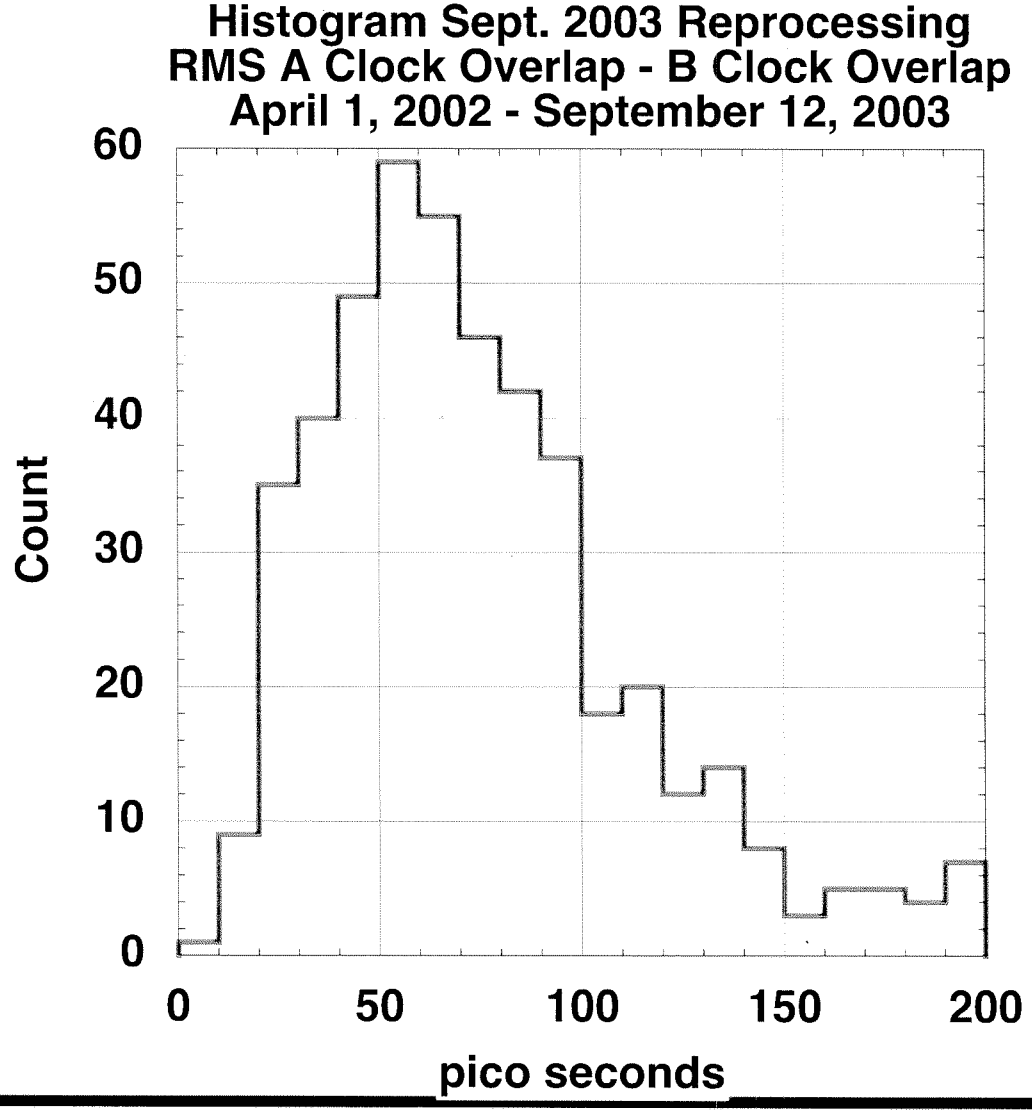


- GPS measurements provide:
  - Geo location of GRACE measurements
  - Alignment of both GRACE spacecraft clocks
  - Contributes to gravity field solution at long wavelengths
- Impact of measurement errors on gravity field
  - Clock alignment errors result in increased noise in KBR
  - Systematic errors in GPS system affect long wavelength features of the estimated gravity field

GRACE along track orbit accuracy



GRACE clock alignment

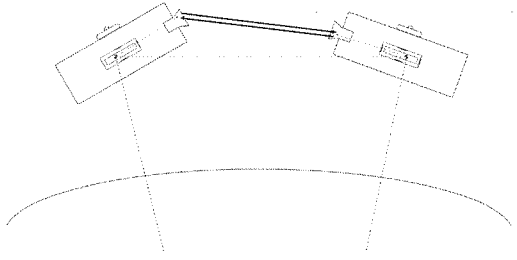


Median: 68 ps = 2 cm

469 Days

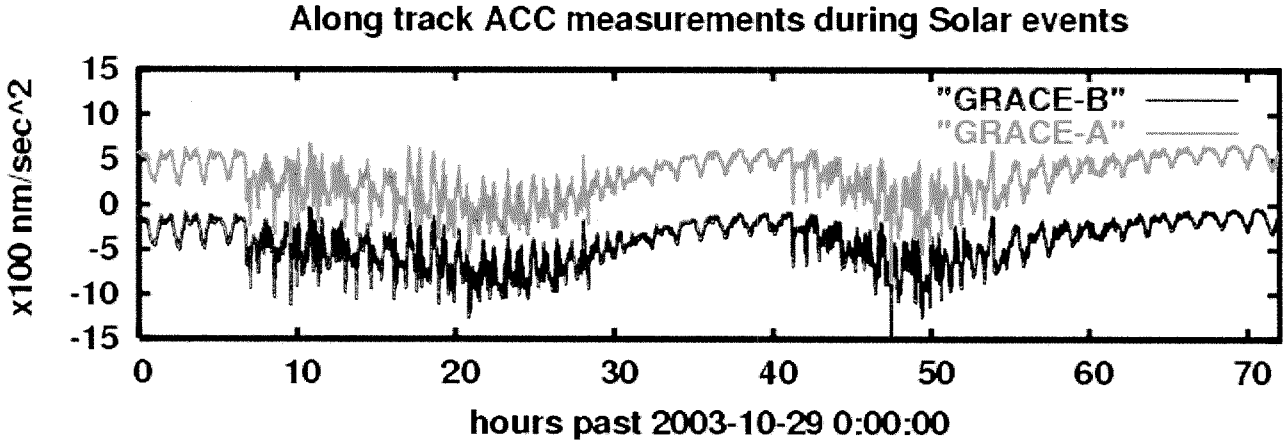
Accelerometer measurements

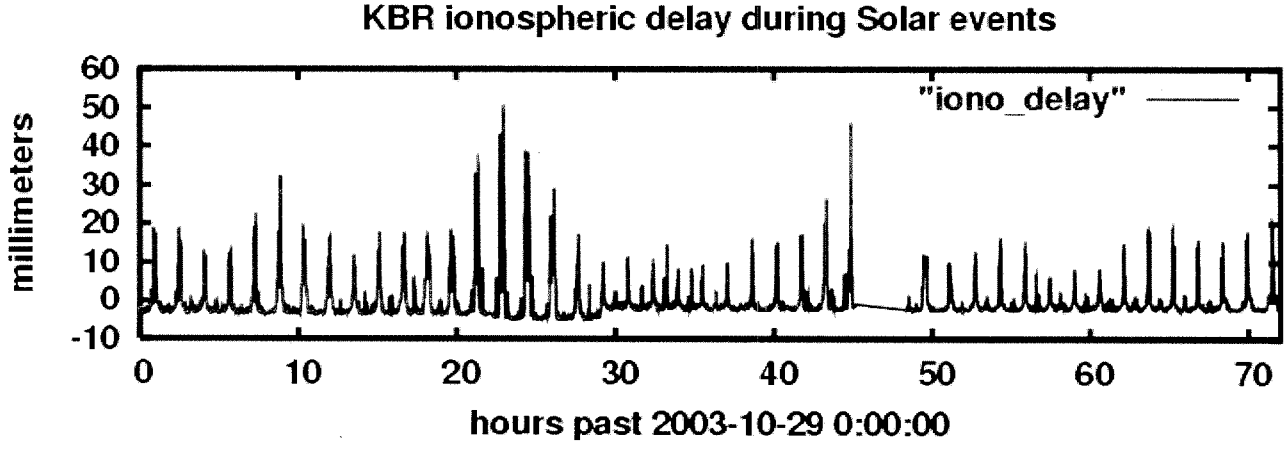
- **Accelerometer measurements provide:**
  - **Linear accelerations due to non conservative forces**
  - **Angular accelerations**
- **Impact of measurement errors on gravity field**



  - **Noise limits removal of integrated inter-satellite range changes due to non-conservative forces, which affects all wavelengths**
  - **Alignment and pointing errors introduce integrated inter-satellite range error which affects all wavelengths**

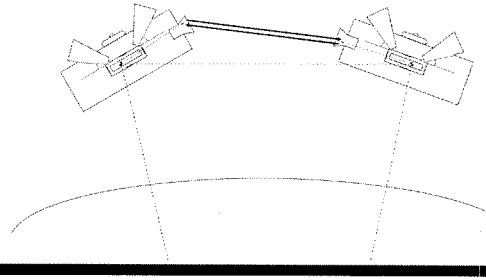
Accelerometer measurement and Ionospheric delay during Solar Events



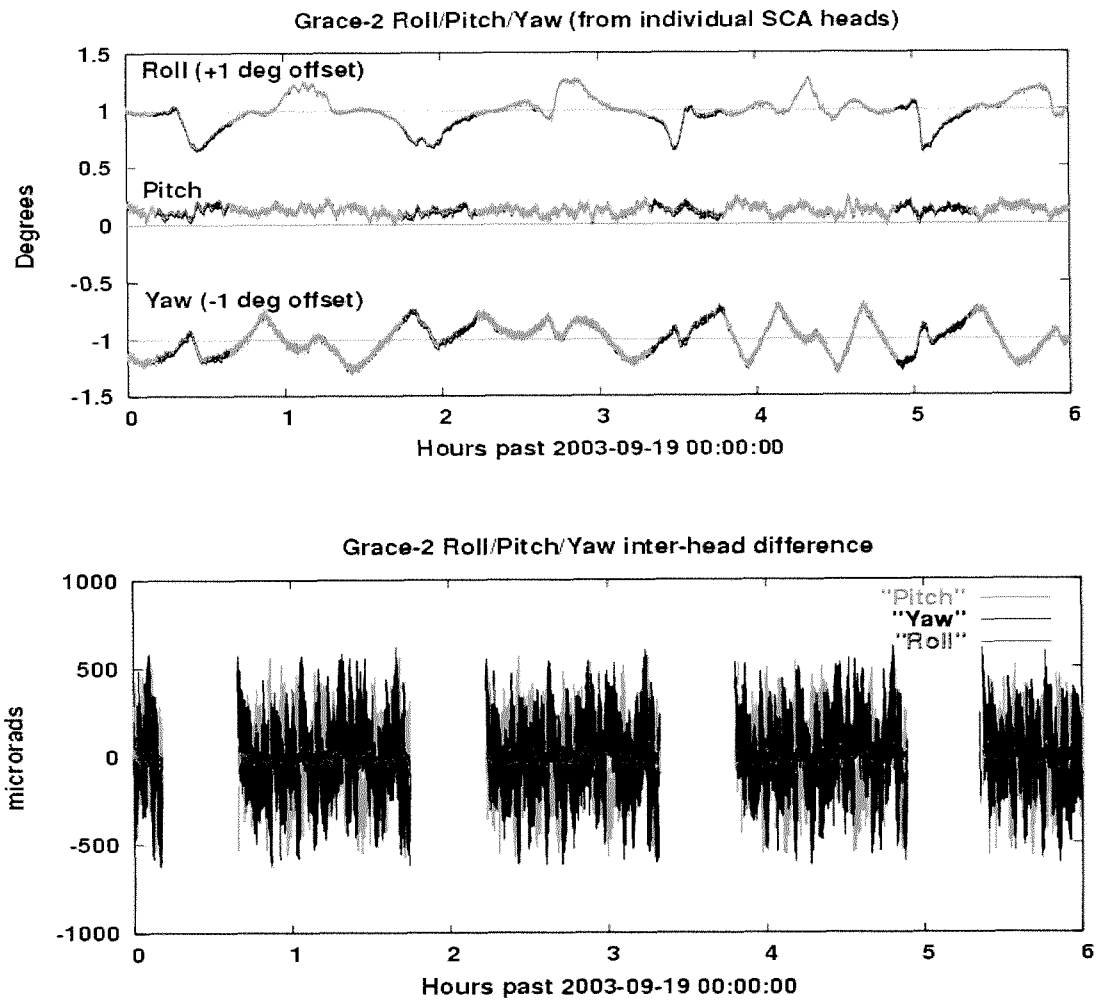


Star camera measurements

- **Star camera measurements provide:**
  - **Inertial satellite attitude**
- **Impact of measurement errors on gravity field**
  - **Alignment and pointing errors introduce integrated inter-satellite range error which affects all wavelengths**



Roll/Pitch/Yaw Each Camera Head



Data Flow Statistics as of 19 September 2003

- **99.8 % of raw data has been retrieved successfully and reformatted by the Science Data System (data latency < 1.0 hour)**
- **536 days of Level-1B data have been distributed to the level-2 centers (CSR, GFZ ,JPL) (data latency < 12 days)**
  - **517 days which passed KBR quality check**
  - **462 days all instruments available**

Postscript: Meaning of GRACE

A touch of truth, ...

That lets you see the world in a new way.

Source: Joan of Arcadia, CBS