

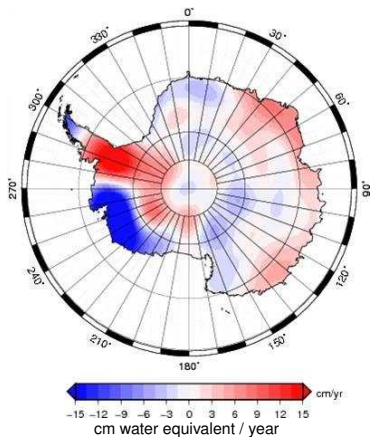
# High-resolution Analysis of GRACE Sensor Data and Lessons for Follow-on Satellite Gravity Missions

Jakob Flury

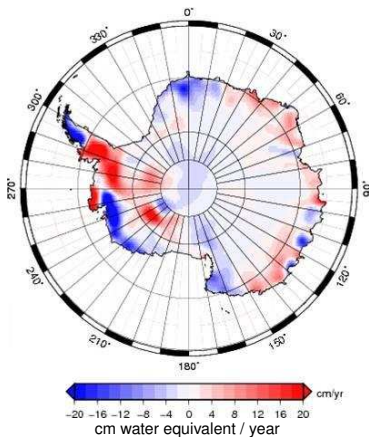
University of Texas at Austin Center for Space Research

## Antarctica: ice mass change 2003 – 2006

GRACE (gravity)

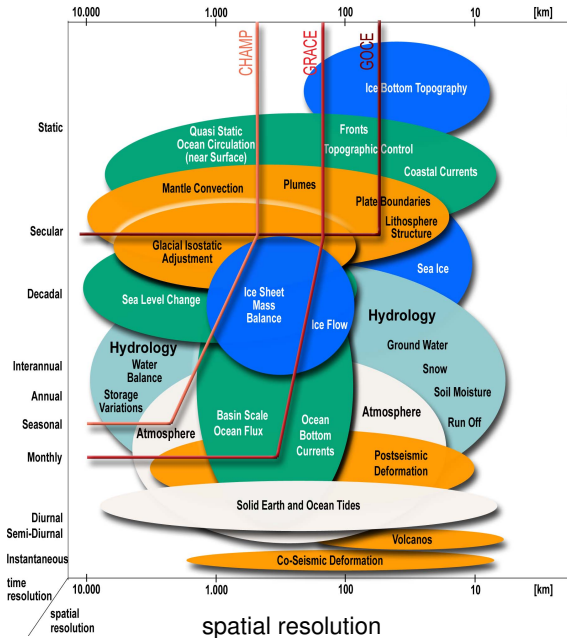


ICESat (laser altimetry)



Gunter et al (2008)

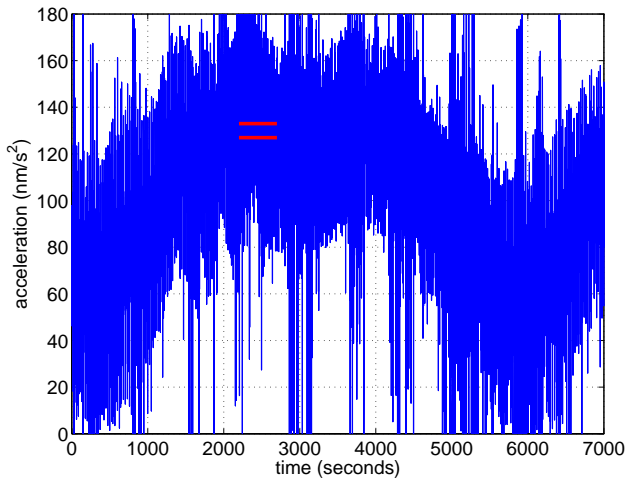
temporal resolution



# Limiting factors for GRACE gravity field determination

- ▶ sensor accuracy
- ▶ disturbances
- ▶ spatial-temporal sampling
- ▶ parameterization, modeling, representation

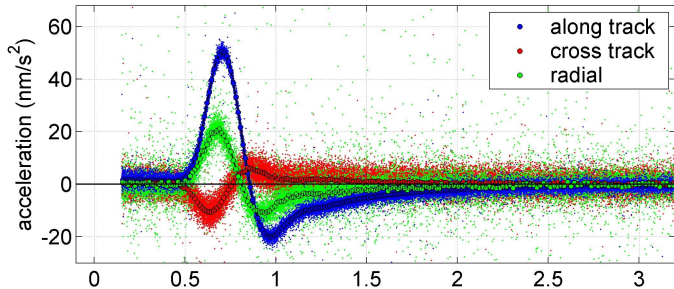
# Disturbances in accelerometer observations



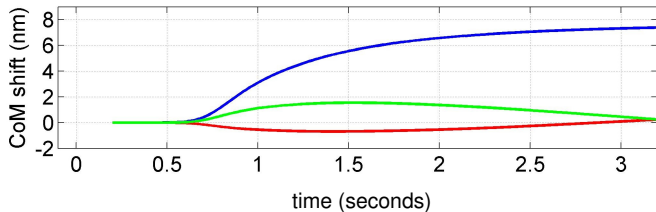
Level 1a data, along track axis, 10 Hz sampling

# Heater switching spikes

Heater THHA0113 switch off spike

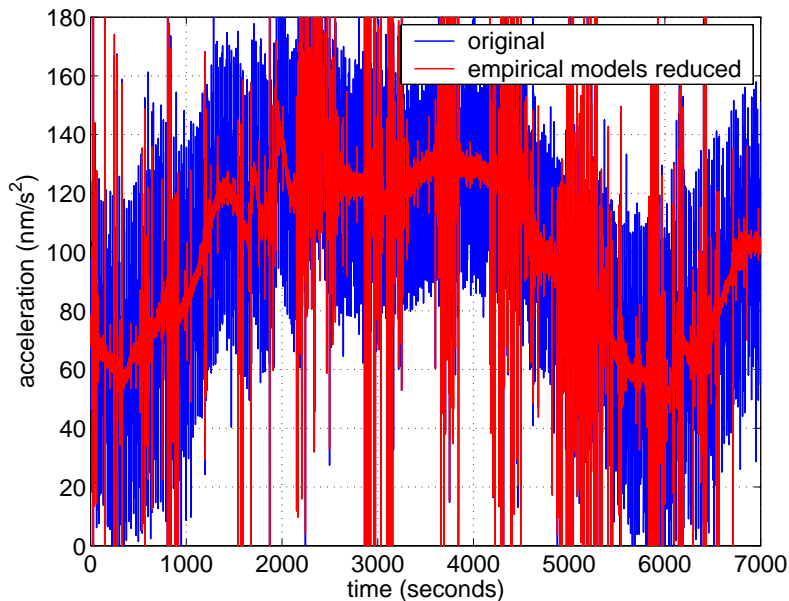


70 heaters

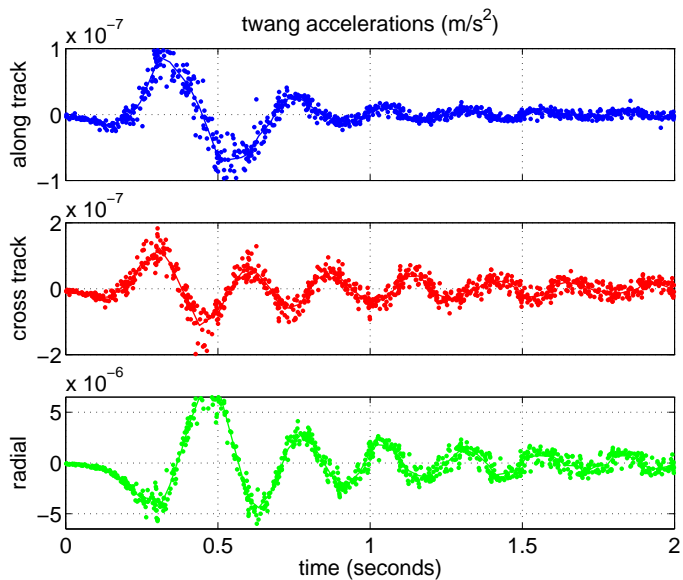


Flury et al,  
Adv Space Res (2008)

# Modeling and reduction



# 'Twangs'

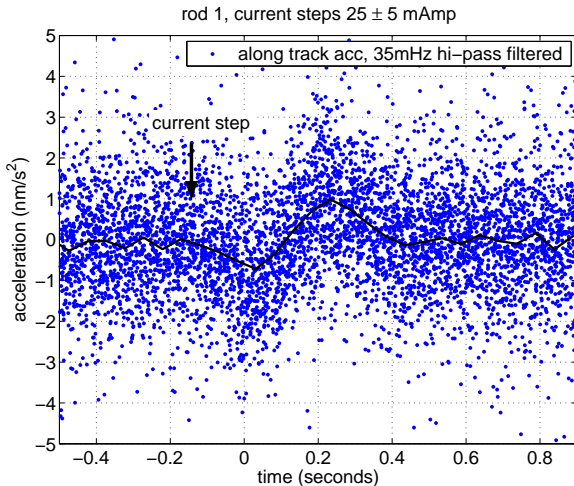




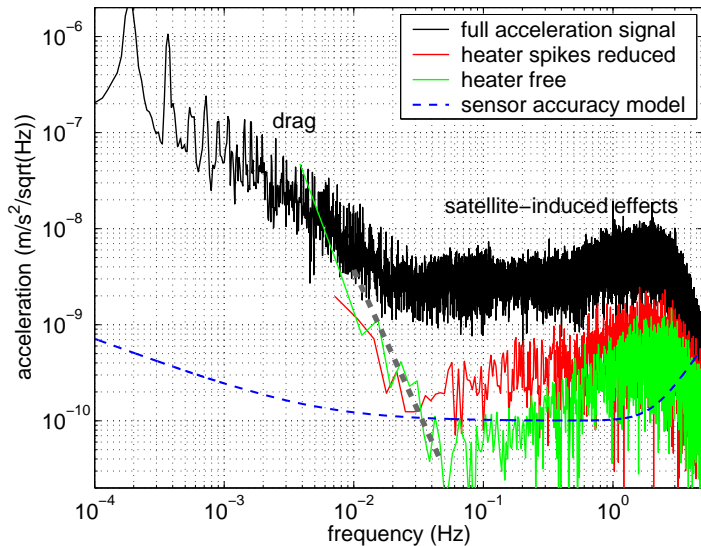
# Magnetic torquer spikes



torquer rod

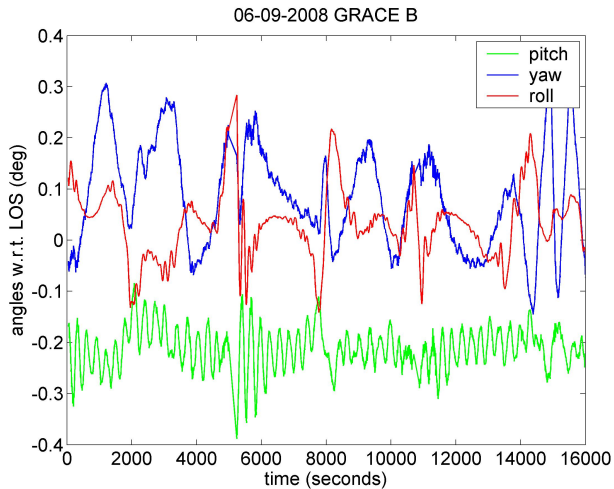


# Signal contributions: PSD analysis

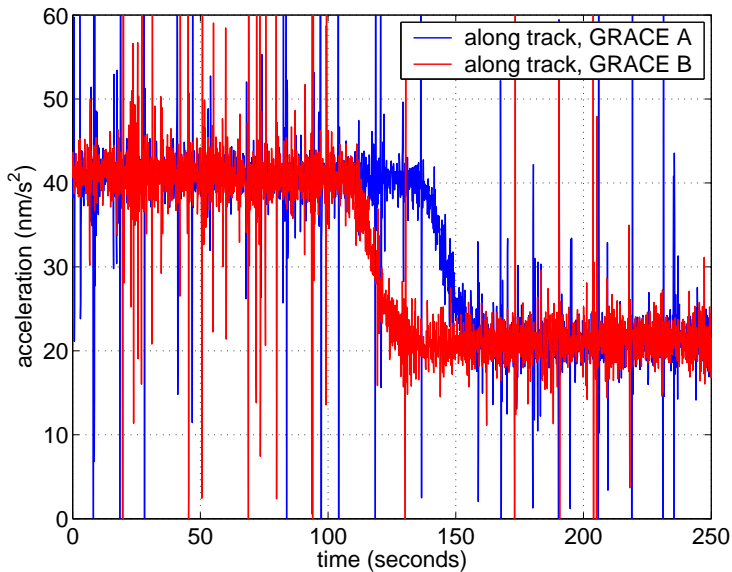


along track accelerometer axis

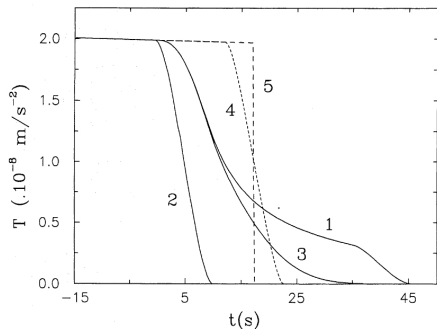
# Rotational movement



# Penumbra transitions



# Penumbra transitions

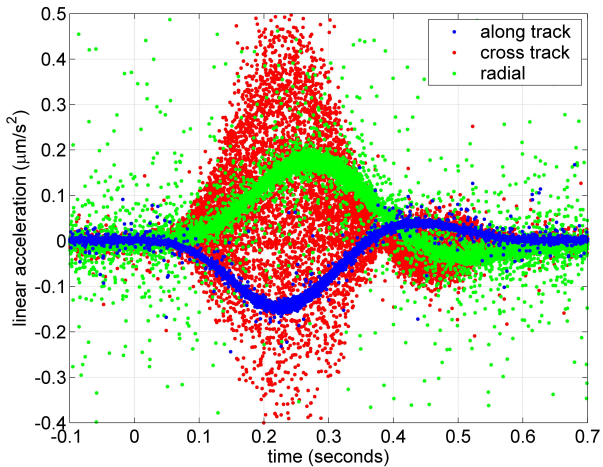
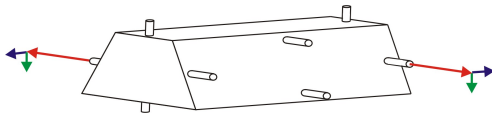


penumbra accelerations  
(Vokrouhlicky et al. 1993)



compression of solar disk, seen from a  
space shuttle

# Thruster accelerations



# More approaches for sensor time series validation

- ▶ accelerometers: difference GRACE A - B
- ▶ mutual validation GPS - K-band ranging
- ▶ rotational movements

# Gravity field missions as precision test laboratories (1)

- ▶ novel sensor accuracies
- ▶ excellent sensor performance and robustness
- ▶ disturbances
- ▶ identification, modeling, separation
- ▶ monitor, understand and control laboratory conditions
  - material properties
  - environment
  - satellite dynamics
  - control system

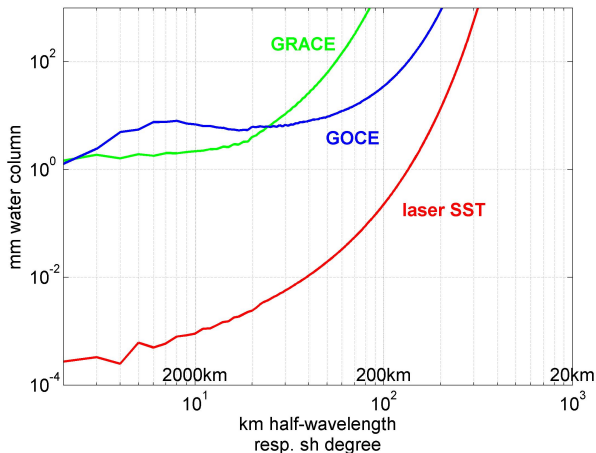


## Gravity field missions as precision test laboratories (2)

- ▶ calibration / validation
  - noise levels
  - test signals
  - sensor combinations
  - sensor-satellite interaction
- ▶ spatial-temporal sampling, aliasing due to short period mass changes

# The path to follow-on gravity missions

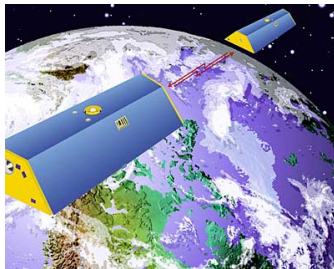
- ▶ sensor accuracy
- ▶ disturbances
- ▶ spatial-temporal sampling
- ▶ parameterization, modeling, representation



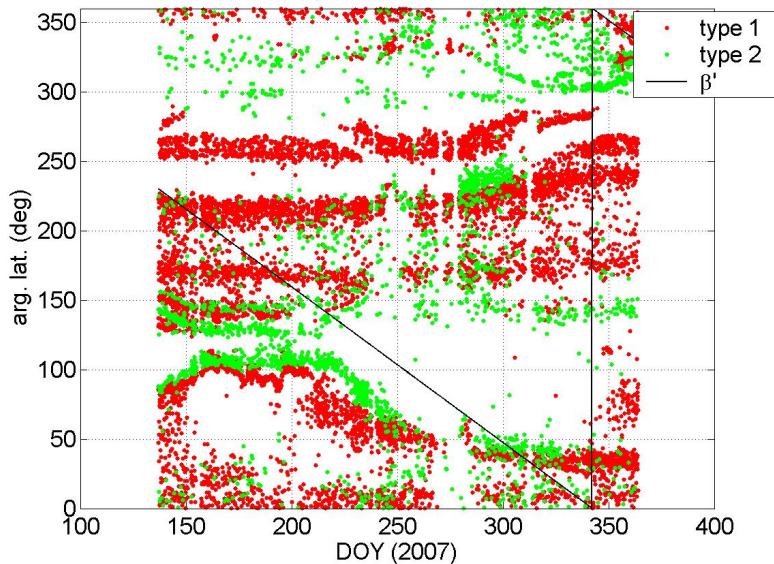
# The path to follow-on gravity missions

- ▶ continuation of GRACE time series ASAP
- ▶ new sensor technologies (inter-satellite laser interferometry)
- ▶ improvement of “laboratory conditions”
- ▶ sensor combinations for redundancy, validation
- ▶ satellite constellations for improved sampling

# Thank you!



# distribution of twangs



# accelerometer scale factors

