High-latitude gravity field recovery from CHAMP and its contribution to Earth monitoring

Introduction:

- Concept of energy balance is applied for gravity field recovery.
- The basic characteristic is the use of GPS derived position and velocity data and the correction for non-gravitational forces.
- Purely kinematic CHAMP orbits avoid the contamination with a priori gravity field information but velocities have to be derived numerically.
- Time-wise spherical harmonic analysis on a global scale.
- Expected improvement for local gravity field recovery
- Application in geodesy, geodynamics, geology, hydrology, glaciology, sea level, geophysical prospecting

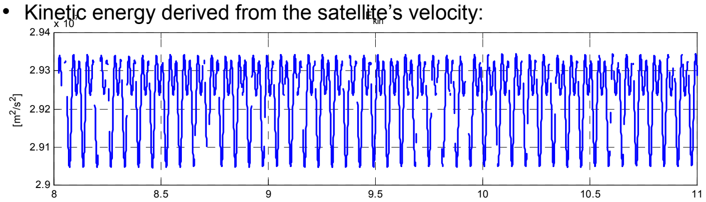
Method:

- The energy integral approach is connecting position, velocity and accelerometry to the disturbing potential.

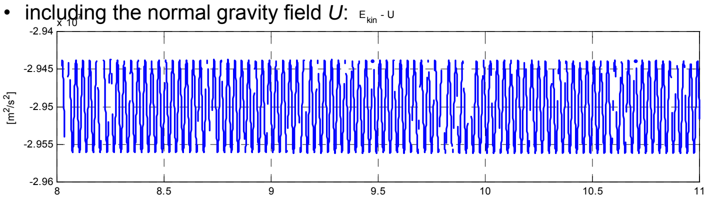
$$T + c = E_{kin} - U - Z - \int \left(f + \sum_k g_k \right) dx$$

T	$=$	disturbing potential
c	$=$	integration constant
E_{kin}	$=$	kinetic energy
U	$=$	normal gravitational potential
Z	$=$	centrifugal potential
$\int f dx$	$=$	dissipative energy
$\int \sum_k g_k dx$	$=$	time variable changes

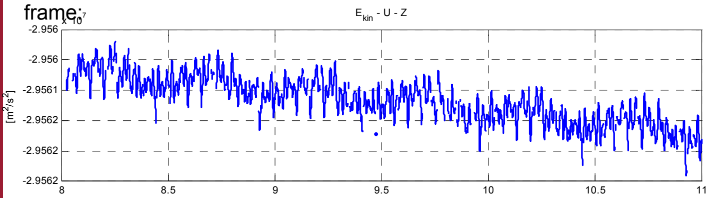
- Kinetic energy derived from the satellite's velocity:



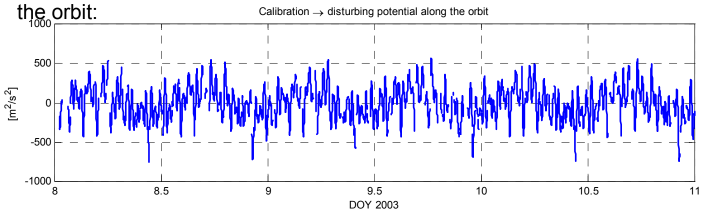
- including the normal gravity field U:



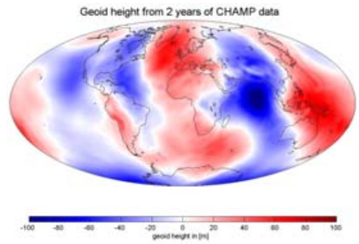
- including centrifugal forces Z since the measurement is done in a rotating frame:

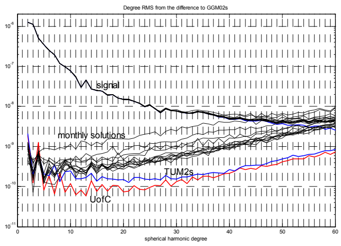


- including accelerometry and calibration yields the disturbing potential along the orbit:



Global solution:

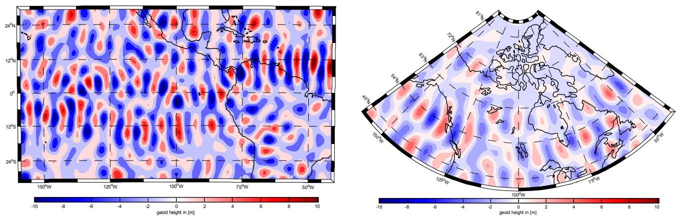




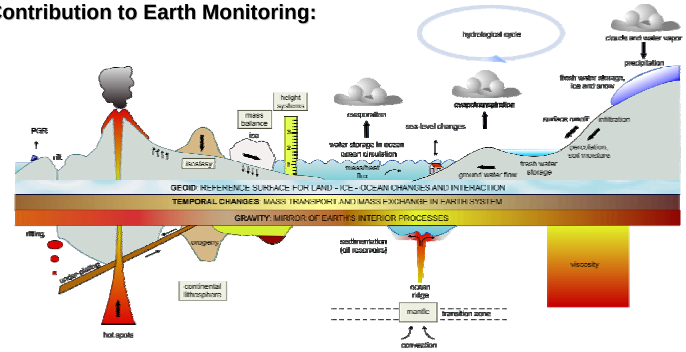
Expected improvement for high-latitude areas:

- Converging groundtracks yield better data coverage at high-latitude areas

  → localized solution is expected to be more accurate than the global solution



Contribution to Earth Monitoring:



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