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.

\[ T + c = E_{\text{kin}} - U - Z - \int \left( f + \sum g_k \right) dx \]

- \( T \) = disturbing potential
- \( c \) = integration constant
- \( E_{\text{kin}} \) = kinetic energy
- \( U \) = normal gravitational potential
- \( Z \) = centrifugal potential
- \( \int fdx \) = dissipative energy
- \( \int \sum g_k dx \) = 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:
• Converging groundtracks yield better data coverage at high-latitude areas
→ localized solution is expected to be more accurate than the global solution

Expected improvement for high-latitude areas:

Contribution to Earth Monitoring:

Partner:
National Resources Canada
Geodetic Survey Division, Canada

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