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Kinematic versus highly reduced-dynamic LEO orbits for global gravity field recovery

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Kinematic positions of low Earth orbiting satellites (LEOs) equipped with on-board GPS receivers (CHAMP, GRACE, and upcoming GOCE) are nowadays widely used as input data for different gravity field recovery schemes, because they are completely independent from any a priori gravity field model. However, kinematic LEO positions are usually governed by rather large noise. As an alternative, we developed highly reduced-dynamic LEO orbit determination schemes based on pseudo-stochastic parameters, e.g., instantaneous velocity changes or piecewise constant accelerations, which allow for a reduction of the LEO position noise with almost no dependency on an a priori gravity field model.

We use simulated CHAMP GPS data to perform kinematic and highly reduced-dynamic precise orbit determination with a subsequent recovery of the gravity field coefficients by means of the short-arc method (arclength at maximum 24h) and analyze the quality of the recovered fields. We discuss the importance of the noise reduction in the LEO positions and determine the trade-off with the a priori field dependencies introduced by processing highly reduced-dynamic LEO positions.