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Dynamical constraints and their impact on the mean levelling of GOCE precise orbit determination solutions

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The Gravity and Ocean Circulation Explorer (GOCE) mission of the European Space Agency (ESA) provides a unique testbed for assessing the quality of GPS precise orbit determination solutions and the impact of different processing concepts. The spacecraft is equipped with a 12 channel GPS receiver that is able to track an average of 9-10 satellites on the L1 and L2 frequency and provides measurements at a comparatively high update rate of 1 Hz. In our poster, we compare the Precise Science Orbit (PSO) product generated at AIUB with the BERNESE software with independent solutions obtained with DLR's GHOST s/w. Both tool chains support the generation of reduced dynamic and purely kinematic solutions, but differ in their modeling of non-gravitational forces. A cross-comparison of the various orbit results indicates 2-3 cm 3D rms accuracy of the two reduced dynamics solution but likewise reveals small systematic biases that are particularly obvious in the radial direction. From a supplementary comparison with kinematic solutions, it can be concluded that the weak dynamical constraints applied in the BERNESE s/w result in a precise reconstruction of the antenna (phase center) motion, whereas the GHOST solution is effectively constrained to the center-of-mass (CoM) motion. Overall, it can be inferred that the adopted offset between the antenna phase center and the CoM is in error by up to 1 cm. Satellite laser ranging measurements contributed by the International Satellite Laser Ranging Service are analyzed in an effort to attribute this bias to either the GPS antenna or the spacecraft center-of-mass.