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Assessment of the Mars Express orbit determination for the improvement of Mars' gravity field.

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The Mars Express (MEX) radio science experiment (MaRS) offers the opportunity to improve Mars' gravity field determined from the Mars Global Surveyor Spacecraft (MGS) because the MEX orbit is quite different. The MEX eccentricity is 0.6 compared to 0.01 for MGS. With low MEX pericenter altitude (250 km), the spatial resolution of the gravity anomalies at several surface features of geophysical interest can be increased. Moreover, the joint use of MEX and MGS tracking data could improve the precision on the determination of the seasonal variations of the low-degree zonal coefficients of the gravity field related to the global CO2 mass cycle. The MEX orbit will be reconstructed from the Doppler (2-way) and ranging tracking data provided by the Mars Radio Science experiment (MaRS). The results on gravity anomalies and the temporal behavior of the low order gravity field depend on the accuracy of the orbit solution.

In this paper, we first estimate the effect of the expected gravity signal on the MEX orbit. Then we assess the quality of the MEX orbit, by studying the non-gravitational

components of the force budget acting on the spacecraft. We adjust the model of the atmospheric drag and radiation pressure forces as well as some bias on radio measurements and residual accelerations associated with desaturation maneuvers when they occur. From such a precise orbit, we then compute the errors on the local gravity anomalies and on the time-variable zonal coefficients. We use the GINS (Géodésie par Intégration Numériques Simultanées) software primarily developed by the French space agency (CNES).