Dynamic orbit analysis is based on a known geopotential model and the numerical methods used for the actual orbit integration. The contribution of the geopotential model can be performed in a degree-wise cumulative sense, thus quantifying the band-limited performance of the individual models at satellite altitude. We demonstrate this orbit analysis procedure to selected arcs of the GRACE satellite mission. For the contribution of the gravitational component we use models EGM2008, EIGEN-5C, GGM03S, ITG-Grace2010s, AIUB-CHAMP03S and GOCO01S. Additional gravitational effects are also taken into consideration, i.e. tidal effects and third-body perturbations according to the planetary and lunar orbits available by JPL (DE ephemerides). The accelerometry data enter also the computational scheme, expressing the non-gravitational contributions to the computed orbit. The resulting orbits of the two GRACE satellites are compared with the corresponding k-band ranging (KBR) measurements. The obtained orbit residuals offer an independent assessment tool of the gravity models at satellite altitude. In addition, an external comparison is performed using GRACE precise orbit data. The orbit comparison is implemented into the orbital frame and the differences are obtained along the three orbital components (radial, along-track and cross-track). The orbit numerical integration is based on various multistep methods (Adams-Bashforth-Moulton, Gauss-Jackson, Stoermer-Cowell) and Runge-Kutta-Nyström (RKN7(6)-8, RKN6(4)-6FD). The proposed analysis leads to an external validation procedure of the different Earth gravity models providing an insight into the amplitude of the different geopotential coefficients in dynamic orbit computations.