GOCE will allow the determination of geoid heights with an accuracy of 1-2 cm and spatial resolution of about 100 km. An important application that will benefit from this is the global unification of the (over 100) existing height systems. GOCE will provide three important components of height unification: highly accurate potential differences (geopotential numbers), a global geoid- or quasi-geoid-based reference surface for elevations that will be independent of inaccuracies and inconsistencies of local and regional data, and a consistent way to refer to the same datum all the relevant gravimetric, topographic and oceanographic data.

The paper summarizes the theory of vertical datum definition and unification over continents and oceanic areas, as well as over the whole Earth, and presents the methodology that should be applied in order to define and establish a World Height System. The determination of an appropriate \( \mathcal{W}_0 \) value using real data will be discussed, and the roles and requirements of the various data sets and in particular of the mean sea surface will be analyzed. The available GOCE-derived satellite-only geopotential models, and their combination with terrestrial data, will be tested in order to select the optimal (quasi-)geoid model to serve as the reference surface for elevations. Preliminary results obtained for the establishment of the European, North American and oceanic datums, as well as their temporal variations, will be presented, together with a road map for the realization of a globally unified height system and its integration with the International Terrestrial Reference Frame.