Accurate orthometric heights in a national vertical datum can be determined economically using GPS heights and gravimetrically computed geoid undulations. If this national vertical datum should be tied to a global geoid, then both the datum offset as well as the difference between the GPS ellipsoid and the globally best-fitting ellipsoid should be known. This paper elaborates on the theory and procedures to obtain the datum offset for South Korea’s national vertical datum on the basis of the global model, EGM08. Among several GPS/leveling data sets the best obtained estimate is 22.2+/-0.27 cm (above the global zero-tide geoid), where the uncertainty is a level of precision, not absolute accuracy. An alternative procedure to determine orthometric heights using the modern principles is also proposed that makes the vertical datum completely independent of the global geoid in the traditional way and obviates the estimation of these offsets.