Physical Heights from GNSS-Derived Geometric Coordinates and a Geophysical Model

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SUMMARY

The U.S. will be implementing new geometric and vertical reference frames in 2022 to replace the North American Datum of 1983 (NAD 83) and North American Vertical Datum of 1988 (NAVD 88), respectively. NAD 83 and NAVD 88 are mandated by legislation to be the official definitions of the National Spatial Reference System (NSRS) for the United States. The National Geodetic Survey (NGS) has primary responsibility for implementing the new reference frames that will update the NSRS as well as providing access to the updated NSRS. This paper focuses on the use of an existing tool, OPUS Projects (OP), for determining geometric coordinates and a developing geopotential model as a means of determining physical heights. It has long been a practice to use geometric coordinates and geoid height model to derive orthometric heights. This approach works within the accuracy of both the GNSS-derived geometric coordinates and the geoid height model to predict orthometric heights using the simple linear relationship between ellipsoidal heights (h), orthometric heights (H) and geoid heights (N): $h = H + N$. This paper focuses on the derivation and quality of the geometric coordinates and the derived physical heights by comparisons with other, external data sets such ass tidal bench marks and very accurately surveyed profiles such as from the Geoid Slope Validation Studies of 2011 and 2014 (e.g., GSVS 11 and GSVS 14). Derivation of Geometric coordinates using OP is a step away from the current technique, which using adjustment software (PAGES-NT) applied to GPS/GNSS observations. OP uses a different adjustment technique and must be demonstrated as a valid means of positioning before it can be adopted for the new means of determining coordinates. Similarly, physical heights are currently adjusted from spirit level observations. Use of a geoid height or other geophysical model to derive equivalent physical heights must be similarly analyzed to demonstrate the validity of determining heights of a sufficient accuracy for existing applications. This paper will cover both the analysis of geometric coordinates and derived physical heights and discuss some of the existing models and results. The expectation is that this process or one similar to it will be adopted in 2022 for the U.S. as the legislated means for

accessing the NSRS.