

Determination of Geoid in The Kingdom of Saudi Arabia Using Global Gravity Model and GPS/Benchmark Data: A Case Study.

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SUMMARY

SUMMARY A Vertical Reference Frame forms the basis for all development projects in which heights are used. Heights are generally considered to refer to mean sea level (MSL) and most vertical reference frame attempt to approximate MSL as the datum for heights. In principle the geoid is the ideal datum. In practice both the geoid and MSL are approximated by taking tide gauge measurements at one or more sites over a limited time period. Nowadays most control survey are established using Global Navigation Satellite System (GNSS). The reference frame for GNSS is the WGS84 where heights are referred to GWS84 ellipsoid, not to MSL. Consequently, in order to reference GPS – derived heights to the geoid, the geoid – ellipsoid separation (N) must be known. Two models for this separation has been implemented using GNSS/Benchmark data for Saudi Arabia. Vertical reference frame of Saudi Arabia, established in early 1970's as first order vertical control network by spirit leveling based on tidal gauges along the Red Sea and Arabian Gulf, is analyzed for determination of GPS/Benchmark geoid of the Kingdom. The analysis is based on existing benchmarks and newly created benchmarks essential to places where there are no benchmarks. Thin Plate Surface Fitting using Least Squares Collocation and Surface Fitting based on Kriging Algorithm was used to derive the conversion surface throughout Saudi Arabia by differencing ellipsoidal heights and orthometric heights on leveled benchmarks occupied by GPS and geoid undulation of Global Gravity Field Model, EGM96 ($\Delta N = NMSL - NEGM96$) The accuracy analysis is based on comparisons of both cases of geoid (NMSL) and residual geoid () using two algorithms mentioned above. The RMS of surfaces determined by geoid fitting was found 0.123 and 0.088 meter respectively where as the RMS of differences of surfaces determined by residual geoid fitting was found 0.075 m. This results may indicates that refinement of undulation of Global Gravity Field Model with GPS/Benchmark data gave the preliminary values of geoid undulations acceptable for practice purposes for The Kingdom.