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Unification of global vertical height system using precise frequency signal links

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The realization of International Height Reference System (IHRS) is one of the major tasks of the International Association of Geodesy (IAG). Here we formulate a framework for connecting two local VHSs using ultra-precise frequency signal transmission links between satellites and ground stations, which is referred to as satellite frequency signal transmission (SFST) approach. The SFST approach can directly determine the geopotential difference between two ground datum stations without location restrictions, and consequently determine the height difference of the two VHSs. Simulation results show that the China's VHS and the US's VHS can be unified at the accuracy of several centimeters, provided that the stability of atomic clocks used on board the satellite and on ground datum stations reach the highest level of current technology, about 4.8×10^{-18} in 100 s. The SFST approach is promising to unify the global vertical height datum in centimeter level in future, providing a new way for the IHRS realization. This study is supported by NSFCs (grant Nos. 41721003, 41631072, 41874023, 41804012, 41429401, 41574007) and Natural Science Foundation of Hubei Province of China (grant No. 2019CFB611).