**Title**

Evaluating the value of Integrated Geodetic Reference Stations: Assessment of the InSAR and GNSS observations

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**Abstract**

Interferometric Synthetic Aperture Radar (InSAR) and Global Navigation Satellite Systems (GNSS) are widely used to monitor the dynamic behavior of the Earth. InSAR is a geodetic technique that estimates millimeter-level relative displacement time-series in an opportunistic network of a multitude of coherent points on the Earth’s surface, in a local datum. GNSS uses ground-based instrumentation to acquire time-series data over a limited number of specific and well-defined points in a known geodetic datum.The Integrated Geodetic Reference Station (IGRS) is designed to combine these (and other) techniques into one common instrument, establishing an integrated benchmark, i.e., a GNSS antenna and two radar corner reflectors, ensuring an identical kinematic behavior. This enables a geodetic datum connection, effectively enabling the InSAR results to be represented in a common geodetic datum, instead of a free network.However, the efficacy of the IGRS has not yet been proven, i.e., a thorough analysis of the first empirical results of an IGRS network has not yet been performed.Here we show that by using three years of data from a spatio-temporal network of 29 IGRS stations in an area of 60×60 km, and 742 independent Synthetic Aperture Radar (SAR) acquisitions, we reach a high level of agreement, demonstrating that IGRS can be used to connect InSAR information products to a well-defined geodetic datum.By using an Overall Model Test with a significance level of 5% we found that 96% of the double-difference arcs in time and space, sustain the null hypothesis that both the InSAR and the GNSS results stem from the same distribution. We found that the main reason for rejecting the null hypothesis for the remaining 4% of the double-difference arcs is that the results of both the InSAR and the GNSS are affected by a leakage of signal from the functional to the stochastic model. For the InSAR observations there is inadequately modeled atmosphere leaking into the stochastic model, while for the GNSS it appears that the precision estimate of the periodically moving stations is worse than the non-periodically moving stations, which suggests that the stochastic model is influenced by the the functional model.In the end, this study proved the efficacy of the IGRS to connect different geodetic datums, and this enables the InSAR results to be integrated in a well-defined geodetic datum.