Standardization and Integration of InSAR and other Geodetic Data for Deformation Analysis

van Leijen, Freek; van der Marel, Hans; Samiei Esfahany, Sami; Hanssen, Ramon

Publication date
2017

Document Version
Final published version

Citation (APA)
van Leijen, F., van der Marel, H., Samiei Esfahany, S., & Hanssen, R. (2017). *Standardization and Integration of InSAR and other Geodetic Data for Deformation Analysis*. 89. Abstract from Fringe 10th International Workshop on , Helsinki, Finland.

Terrain subsidence and landslides I and II

Standardization and Integration of InSAR and other Geodetic Data for Deformation Analysis

van Leijen, Freek; van der Marel, Hans; Samiei-Esfahany, Sami; Hanssen, Ramon
Delft University of Technology, Netherlands, The

Geodetic techniques for deformation monitoring such as InSAR, levelling, and GNSS are complementary in spatial density and coverage, temporal density and coverage, 3D (GNSS) or 3D-to-1D projection (levelling and InSAR), precision and datum. However, this complementarity also poses challenges in the integration of the various datasets. When the integration is not performed properly, data analysis, model selection, and predictions, will be sub-optimal.

In this study, we develop a standardized way to convert the original observations to a generic set of double-difference deformations. Combined with a description of its stochastic properties, the format can be used as a standard in the analysis or data inversion. The approach is based on a two-step procedure: 1) generation of standardized datasets, and 2) application of a tool to generate the optimal set of double-difference observations, together with their corresponding covariance matrix.

In the first step, the original multi-format geodetic datasets are converted to a common NetCDF format. Depending on the nature of the original observations, the data is stored in undifferenced (ZD), single difference (SD) or double difference (DD) form. Apart from the observations, also the associated covariance matrix describing the measurement noise is inserted.

Second, a tool is used to generate the optimal set of double-difference observations for the user-defined area of interest and period of interest. The advantage of using double-differences is that the effect of different reference points and datums is eliminated, whereas for deformation analysis, the relative (spatial and temporal) motion is of importance anyway. The tool, known as CUPiDO (Connecting Undifferenced Points in Deformation Observations), will be made publicly available. CUPiDO maximizes the number of double-difference observations, and generates a single vector of multi-technique observations, together with the associated covariance matrix. This covariance matrix not only contains the measurement noise, but can also contain additional (co)variance factors describing the idealization precision. This idealization precision can be both temporally correlated (for instance describing benchmark instability) as well as spatio-temporally correlated (e.g., to account for shallow compaction). The idealization precision parameters can be specified by the user.

The approach is applied to both an illustrative simulated dataset, and on real data acquired in The Netherlands. The dataset consists of optical levelling, hydrostatic levelling, continuous and campaign-based GNSS data, as well as InSAR PSI data.