

# **Soil Settlement and Uplift Damage to Architectural Heritage Structures in Belgium: Country-Scale Results from an InSAR-Based Analysis**

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## **ABSTRACT**

Soil movement may be induced by a wide variety of natural and anthropogenic causes, which are detectable in the local scale, but may influence the movement of the soil over vast geographical expanses. Space borne interferometric synthetic aperture radar (InSAR) measurements of ground movement provide a method for the remote sensing of soil settlement and uplift over wide geographic areas. Based on this settlement and uplift evaluation, the assessment of the potential damage to architectural heritage structures is possible.

In this paper an interdisciplinary monitoring and analysis method is presented that processes satellite, cadastral, patrimonial and building geometry data, used for the calculation of settlement and uplift damage to architectural heritage structures in Belgium. It uses processed InSAR data for the determination of the soil movement profile around each case study, of which the typology is determined from patrimonial information databases and the geometry is calculated from digital elevation models.

The impact on the historic structures is calculated from the determined soil movement profile based on various soil-structure interaction models for buildings. The resulting damage is presented in terms of a numerical index illustrating its severity according to different criteria. In this way the potential soil movement damage is quantified in a large number of buildings in an easily interpretable and user friendly fashion.

The processing of InSAR data collected over the previous 3 decades allows the determination of the progress of settlement- and uplift-induced damage in this time period. With the integration of newly acquired and more accurate data, the methodology will continue to produce results in the coming years, both for the evaluation of soil settlement and uplift in Belgium as for introducing related damage risk data for existing architectural heritage buildings.

Results of the analysis chain are presented in terms of soil movement exceeding a prescribed threshold indicating significant magnitude and in potential current damage for selected areas and buildings.