Institut für Photogrammetrie
und GeoInformation

Leibniz Universität Hannover

Unsupervised time series clustering for InSAR-based Land subsidence analysis.

InSAR time series analysis has become a widely used tool for monitoring ground deformation worldwide. The availability of open-access satellite data, global coverage, and continuous advancements in InSAR time series algorithms make the technique suitable for a broad range of scientific applications. In the context of land subsidence driven by groundwater extraction, InSAR has proven particularly effective.

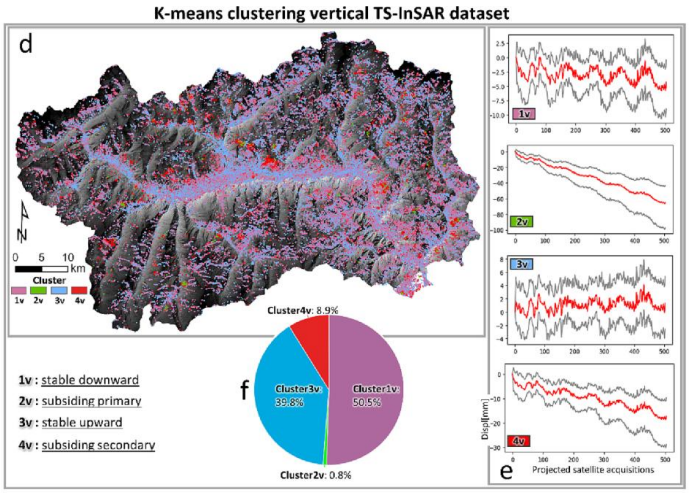
With the increasing volume of data collected by missions such as Sentinel-1, InSAR now allows the generation of long time series spanning more than a decade. This new era of “big InSAR data” brings important challenges. how can we translate massive amounts of spatial–temporal deformation time series into meaningful, interpretable products that accurately capture the characteristics of subsidence processes?

Land subsidence is influenced by various physical and anthropogenic factors, including sediment properties, geological structures, and groundwater extraction practices. These processes produce deformation signals with diverse spatial and temporal behaviors that go from small, localized patches to medium and large-scale patterns. Understanding these signals requires methods capable of grouping similar deformation behaviors.

This thesis aims to explore and evaluate unsupervised time series clustering algorithms such as Long Short-Term Memory (LSTM), HDBSCAN or K-means for the classification of InSAR time series. The goal is to investigate how different deformation patterns relate to underlying geological and hydrogeological conditions. The study area is the Taipei Basin, Taiwan, a region affected by significant land subsidence due to groundwater withdrawal. The student will investigate multiple clustering approaches, perform validation and comparison of the methods, and interpret the results in a geological context.

An ideal candidate should have a basic knowledge of InSAR and time series analysis, familiarity with clustering algorithms and basics in python programming language. Knowledge in Linux environments is an advantage. The student must be motivated to learn about advanced InSAR processing and conduct statistical analyses.

The thesis will be supervised by Erik Rivas, Msc



References:
Liang Y., Qiu H., Wang J., et al (2025). Automated identification of ground kinematic patterns based on InSAR time series displacement and K-SC clustering
Festa D., Novellino A., Hussain E., et. Al (2023). Unsupervised detection of InSAR time series patterns based on PCA and K-means clustering

Fakultät für Bauingenieurwesen und Geodäsie

Institut für Photogrammetrie und GeoInformation
Prof. Dr.-Ing. habil. Christian Heipke

Erik Rivas, Msc
Tel. +49 511 762 - 2566
E-Mail: rivas@ipi.uni-hannover.de

26.11.2025

Besucheradresse:
Nienburger Straße 1
30167 Hannover
www.ipi.uni-hannover.de

Zentrale: