# Exploring Artificial Intelligence (AI) driven approaches to enhance land subsidence modelling and management

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## Project description

Land subsidence presents a significant challenge to the Netherlands, threatening millions of people by damaging the existing rural and urban infrastructure while climate change and sea level rise exert additional pressure. While physical models provide valuable insights, there's potential to enhance their predictive capabilities through artificial intelligence which includes machine learning (ML) techniques like neural networks, i.e. computer models that mimic human brain, to learn from data and make predictions. This exploratory research aims to investigate how AI techniques can complement existing physical models, addressing challenges in uncertainty quantification and potentially improve subsidence predictions.

Objectives:

1. Investigate an integration of machine learning with a process-based subsidence model
2. Explore uncertainty quantification methods in the context of subsidence prediction for enhancing decision support.

Methodology:

1. Data preparation: Preprocess environmental and subsidence data for machine learning applications.
2. Basic hybrid model: Implement a machine learning model (e.g. Random Forest) to work alongside the existing physical subsidence model. Train the AI model on historical data to predict land subsidence.
3. Uncertainty exploration: Apply uncertainty quantification methods, such as bootstrap sampling, to provide initial insights into prediction reliability.
4. Interpretability investigation: Utilize simple explainable AI techniques (e.g. feature importance in Random Forests) to interpret model decisions.
5. Comparative analysis: Compare hybrid model's predictions with those of physical model alone, analyzing differences in accuracy and interpretability.

This project will provide preliminary insights into integrating AI with physical subsidence models, addressing aspects of prediction accuracy, uncertainty quantification, and interpretability. It will deliver a pre-processed dataset for AI applications, a hybrid model combining ML and physical models, and initial uncertainty estimates, visualizations for subsidence predictions. While limited in scope, it will lay groundwork for future, more advanced AI applications in subsidence modelling. The work will contribute initial findings towards broader research questions and give the student valuable experience applying AI to environmental challenges.

## Job requirements

Candidates preferably have a background in Geosciences with a strong interest in programming (mainly python and linux) and numerical modelling.