Master of Science Project

Geoscience and Remote Sensing

Theme: InSAR data interpretation

On the hypothesis of overestimating subsidence due to hydro carbon extraction

Background information

During preparations for an arbitrage case a consultancy postulated that the Nederlandse Aardolie Maatschappij (NAM) is over-estimating subsidence due to hydrocarbon extraction over the Groningen area, because "all" buildings with levelling benchmarks are founded in the shallow Holocene layer. Also some Integrated Geodetic Reference Stations (IGRS) are founded in this layer that is known to compact and expand due to seasonal influences. Lowering ground water levels or settlement of buildings can cause compaction and consequently apparent subsidence in the measurements.

NAM's approach to quantify the contribution of gas production on subsidence is to base subsurface modelling on a subset of representative measurement points that are not affected by settlements or shallow compaction. The identification of this subset assumes that the displacement behaviour of most of the points is representative for the subsidence caused by deeper layers. This approach will not work if all points are affected to Holocene compaction.

Two possible routes are proposed to test the hypothesis if subsidence due to hydrocarbon extraction is overestimated.

Description tasks

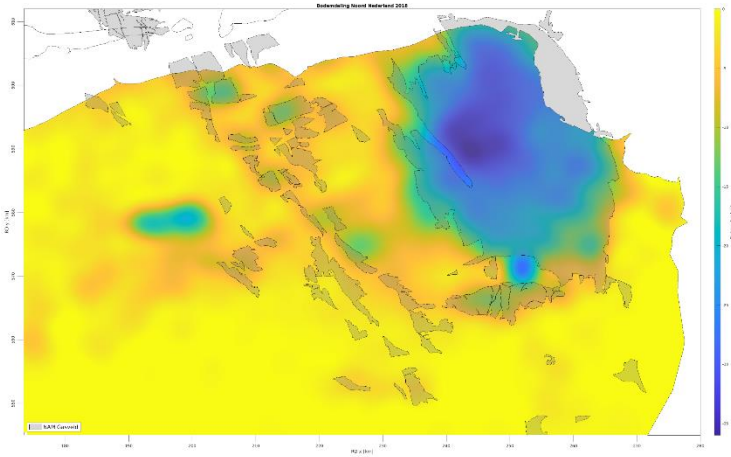
The candidate will firstly perform a literature review of current practices to separate subsidence due to hydrocarbon extraction from other causes. The research could then cover two tasks:

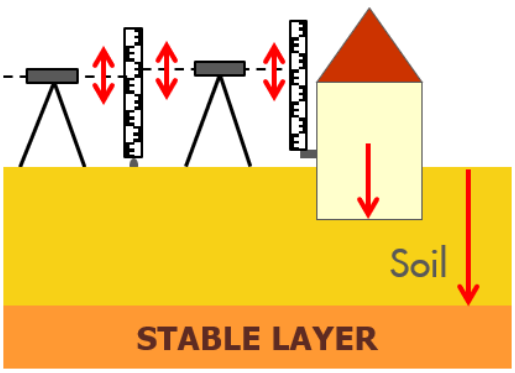
In the 1990's many "underground benchmarks" have been placed in the Groningen and Lauwersmeer area. Geotechnical investigation proves these benchmarks are indeed founded on the Pleistocene. Double differences between these benchmarks can be compared with double differences computed from a geodetic subsidence model originating from spatio-temporal analysis of levelling data. If both agree within noise levels, the hypothesis can be rejected.

Secondly, TerraSAR-X InSAR data can be related to cadastral building data (BAG), linking the reflection of a building to a year of construction. Under the assumption that newly constructed buildings are founded on a stable layer, only these reflections could be compared against the geodetic subsidence model. It both agree within noise levels, the hypothesis can be rejected.

Requirements

The candidate shall have good data handling and programming skills (MATLAB or Python), a sound understanding of statistics (hypothesis testing) and InSAR.





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