**Title**

Detection strategies for impending sinkholes based on InSAR data

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**Abstract**

Undiscovered underground cavities might exist in the subsurface. A catastrophic ground failure event follows when such a cavity starts to migrate upwards and finally intersects with the surface, resulting in a sinkhole. Catastrophic collapse events are usually preceded by precursory subsidence. An upward migrating cavity causes the development of a (subsidence) trough at the surface. The trough deepens as the cavity nears the surface, changing its surface expression. With the technique called InSAR, displacements over a large area can be measured. Literature shows that precursory subsidence is measurable using InSAR. However, automatically detecting impending sinkholes from InSAR displacements has not yet been researched in depth. This study shows that the developed novel arc-based temporal strategy can early detect an impending sinkhole. The kinematic model is adequate to model the surface expression of an impending sinkhole. The results are used to implement an artificial sinkhole based on the kinematic model into a subset to test the developed strategies. The first strategy was based on spatio-temporal characteristics of a sinkhole. This strategy can locate the subsiding area and indicate a surface expression size range. However, during this study, a second strategy was developed to identify anomalous behavior quicker and more reliable than the spatio-temporal strategy. The second strategy is arc-based and marks point measurements behaving anomalously. The result demonstrates a potential automated early warning system based on the InSAR displacement time series. The developed strategies harbor the potential of monitoring for impending sinkholes on a large scale. This study is anticipated to be a starting point for more development in early warning systems for impending sinkholes. Future research could entail verifying the strategies in regions with collapsed sinkholes.