Man-made disaster on urban area: subsidence and underground salt dissolution in Maceio (Brazil) revealed by remote sensing and numerical modelling

Magdalena Vassileva\textsuperscript{1,2}, Djamil Al-Halbouni\textsuperscript{1}, Mahdi Motagh\textsuperscript{1,2}, Thomas R. Walter\textsuperscript{1}, Torsten Dahm\textsuperscript{1,3}, and Hans-Ulrich Wetzel\textsuperscript{1}

\textsuperscript{1}GFZ German Research Centre for Geosciences, Telegrafenberg, 14473 Potsdam, Germany, (magda88@gfz-potsdam.de)
\textsuperscript{2}Leibniz University Hannover, Institut für Photogrammetrie und Geoinformation (IPF), Hannover, Germany
\textsuperscript{3}University of Potsdam, Institute of Geosciences, Karl-Liebknecht-Str. 24-25, 14476 Potsdam-Golm, Germany

Land subsidence hazard affects many highly populated urban areas of the world as a consequence of natural and/or anthropogenic derived geomechanical rock alterations. Here we exploit the full archive of Synthetic Aperture Radar (SAR data) and present a 16-years history (2004-2020) of surface displacement affecting the federal capital of Maceió (Alagoas, Brazil), where sinkhole formation and fractures on infrastructures have been intensified since early 2018, forcing authorities to relocate the affected residence and pose the building under demolition. The geodetic result shows that precursory deformations were already visible in early 2000’s, reaching in November 2020 a maximum cumulative subsidence of approximately 2 m near the Mundaú lagoon coast. The maximum rate of subsidence is estimated at 27 cm/year. Numerical elastic source modelling proves that the subsidence is associated with localized, deep seated material removal at the location and depth where salt mining is performed. More sophisticated 2D distinct element method highlights the formation of cracks in sedimentary layers that eventually enables strong water percolation from rather superficial aquifers into the deeper underground, with potential increase of material dissolution and erosion. We discuss the accelerating subsidence rates, the influence of severe precipitation events to the aforementioned geological instability and the related dynamic evolution of the subsidence hazard by generating dynamic geohazard maps valuable for further infrastructure risk assessment.