

Satellite Interferometric Investigations of Subsidence Events Associated with Groundwater Extraction in Sao Paulo, Brazil

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Abstract : The Metropolitan Region of Sao Paulo (MRSP) has suffered from serious water scarcity. Consequently, the most convenient solution has been building wells to extract groundwater from local aquifers. However, it requires constant vigilance to prevent over extraction and future events that can pose serious threat to the population, such as subsidence. Radar imaging techniques (InSAR) have allowed continuous investigation of such phenomena. The analysis of data in the present study consists of 23 SAR images dated from October 2007 to March 2011, obtained by the ALOS-1 spacecraft. Data processing was made with the software GMTSAR, by using the InSAR technique to create pairs of interferograms with ground displacement during different time spans. First results show a correlation between the location of 102 wells registered in 2009 and signals of ground displacement equal or lower than -90 millimeters (mm) in the region. The longest time span interferogram obtained dates from October 2007 to March 2010. As a result, from that interferogram, it was possible to detect the average velocity of displacement in millimeters per year (mm/y), and which areas strong signals have persisted in the MRSP. Four specific areas with signals of subsidence of 28 mm/y to 40 mm/y were chosen to investigate the phenomenon: Guarulhos (Sao Paulo International Airport), the Greater Sao Paulo, Itaquera and Sao Caetano do Sul. The coverage area of the signals was between 0.6 km and 1.65 km of length. All areas are located above a sedimentary type of aquifer. Itaquera and Sao Caetano do Sul showed signals varying from 28 mm/y to 32 mm/y. On the other hand, the places most likely to be suffering from stronger subsidence are the ones in the Greater Sao Paulo and Guarulhos, right beside the International Airport of Sao Paulo. The rate of displacement observed in both regions goes from 35 mm/y to 40 mm/y. Previous investigations of the water use at the International Airport highlight the risks of excessive water extraction that was being done through 9 deep wells. Therefore, it is affirmed that subsidence events are likely to occur and to cause serious damage in the area. This study could show a situation that has not been explored with proper importance in the city, given its social and economic consequences. Since the data were only available until 2011, the question that remains is if the situation still persists. It could be reaffirmed, however, a scenario of risk at the International Airport of Sao Paulo that needs further investigation.

Keywords : ground subsidence, Interferometric Satellite Aperture Radar (InSAR), metropolitan region of Sao Paulo, water extraction

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