UNIVERSITAT POLITÈCNICA DE VALÈNCIA

DEPARTAMENTO DE INGENIERÍA CARTOGRÁFICA, GEODESIA Y FOTOGRAMETRÍA

PROPUESTA DE TESIS DOCTORAL

Subsidence monitoring in “Los Bronces Mining District”, in the upper basin of the Mapocho River, Chile trough processing of a temporal series of images by differential interferometry techniques (DInSAR).

ABSTRACT

The subsidence of a mining district is defined as the sinking of the surface through the extraction of rocks or minerals from an underground mine (Ng, Ge, Du, Wang, & Ma, 2017). This phenomenon could cause damage to the mining infrastructure (Sarychikhina, Glowacka, Mellors, & Vidal, 2011) as well as to the environment.

In this sense, the detection of ground subsidence and its monitoring would allow us to detect temporary changes of the subsidence pattern and provide important information about the dynamics of this process. In addition, estimating where future subsidence would occur would facilitate decision making, avoiding damage to mining facilities and the environment (Sarychikhina et al., 2011).

In relation to the above, the main objective of this research is to monitor the possible subsidence that would occur in the Río Blanco-Los Bronces mining sector in the central zone of Chile using DInSAR (Differential SAR Interferometry) techniques in a time series with Sentinel-1 images. That mining area holds the greatest potential for mining development in the country and the world, where a volume of 200 million tons of copper is estimated (Mining Value, 2017).

The DInSAR, is a remote sensing technique based on synthetic aperture radar satellites, which can be used to measure the displacement of the surface in large regions with high spatial resolution. In good conditions, the displacements can be measured with centimeter to subcentimeter accuracy (Wempen & McCarter, 2017). A combination of the DInSAR technique and the *Multidimensional Small Baseline Subset* (MSBAS) *technique* (Samsonov & d'Oreye) will be used, allowing monitoring the movement of the surface and updating it as new images become available.

In this context, the DInSAR technique and the MSBAS technique have been widely used for this type of studies in different parts of the world (Bonì et al., 2015, Hanssen, 2005, Herrera et al., 2012, Liu et al. ., 2014; Moghaddam, Sahebi, Matkan, & Roostaei, 2013), because it has the ability to operate in diverse climatic conditions (Hay-Man Ng, 2017) and has also proved to be a more effective technology, in contrast to the traditional topography method (Moghaddam et al., 2013).

AVAILABLE RESOURCES: The thesis plan will be carried out in the context of the project *"Study of geology, geomorphology and natural hazards in the upper sector of the Mapocho River basin"* funded by the Angloamerican mining company from 2015 to 2018 Project Director: Waldo Pérez Martínez.

BIBLIOGRAPHY

Bonì, R., Herrera, G., Meisina, C., Notti, D., Béjar-Pizarro, M., Zucca, F., … Mora, O. (2015). Twenty-year advanced DInSAR analysis of severe land subsidence: The Alto Guadalentín Basin (Spain) case study. *Engineering Geology*, *198*, 40–52. https://doi.org/10.1016/j.enggeo.2015.08.014

Hanssen, R. F. (2005). Satellite radar interferometry for deformation monitoring: a priori assessment of feasibility and accuracy. *International Journal of Applied Earth Observation and Geoinformation*, *6*(3–4), 253–260. https://doi.org/10.1016/j.jag.2004.10.004

Herrera, G., Álvarez Fernández, M. I., Tomás, R., González-Nicieza, C., López-Sánchez, J. M., & Álvarez Vigil, A. E. (2012). Forensic analysis of buildings affected by mining subsidence based on Differential Interferometry (Part III). *Engineering Failure Analysis*, *24*(May 1998), 67–76. https://doi.org/10.1016/j.engfailanal.2012.03.003

Liu, Z. G., Bian, Z. F., Lei, S. G., Liu, D. L., & Sowter, A. (2014). Evaluation of PS-DInSAR technology for subsidence monitoring caused by repeated mining in mountainous area. *Transactions of Nonferrous Metals Society of China (English Edition)*, *24*(10), 3309–3315. https://doi.org/10.1016/S1003-6326(14)63471-3

Moghaddam, N. F., Sahebi, M. R., Matkan, a. a., & Roostaei, M. (2013). Subsidence rate monitoring of Aghajari oil field based on Differential SAR Interferometry. *Advances in Space Research*, *51*(12), 2285–2296. https://doi.org/10.1016/j.asr.2013.01.023

Ng, A. H.-M., Ge, L., Du, Z., Wang, S., & Ma, C. (2017). Satellite radar interferometry for monitoring subsidence induced by longwall mining activity using Radarsat-2, Sentinel-1 and ALOS-2 data. *International Journal of Applied Earth Observation and Geoinformation*, *61*(December 2016), 92–103. https://doi.org/10.1016/j.jag.2017.05.009

Sarychikhina, O., Glowacka, E., Mellors, R., & Vidal, F. S. (2011). Land subsidence in the Cerro Prieto Geothermal Field, Baja California, Mexico, from 1994 to 2005. An integrated analysis of DInSAR, leveling and geological data. *Journal of Volcanology and Geothermal Research*, *204*(1–4), 76–90. https://doi.org/10.1016/j.jvolgeores.2011.03.004

Wempen, J. M., & McCarter, M. K. (2017). Comparison of L-band and X-band differential interferometric synthetic aperture radar for mine subsidence monitoring in central Utah. *International Journal of Mining Science and Technology*, *27*(1), 159–163. https://doi.org/10.1016/j.ijmst.2016.11.012