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257 - Ground Surface Subsidence in Córdoba, Argentina, revealed by multitemporal SAR interferometry

Romina Solorza [1], Claudio Carignano [2], Marcela Cioccale [3], Claudia Notarnicola [4]

[1] Gerencia de Observación de la Tierra, Comisión Nacional de Actividades Espaciales (CONAE).
Centro Espacial Teófilo Tabanera, Falda de Cañete, Córdoba, Argentina. rsolorza@conae.gov.ar
[2] Instituto de Estudios Avanzados en Ingeniería y Tecnología (IDIT). CONICET.
Facultad de Ciencias Exactas Físicas y Naturales, Universidad Nacional de Córdoba, Argentina. ccarignano@unc.edu.ar
[3] Escuela de Geología, Facultad de Ciencias Exactas Físicas y Naturales, Universidad Nacional de Córdoba, Argentina. a.cioccale@unc.edu.ar
[4] Institute for Earth Observation, EURAC Research. Bolzano, Italia. claudia.notarnicola@eurac.edu

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Introduction and goals

Population growth in metropolitan areas and the need for infrastructure leads to a rapid and unplanned urbanization process.

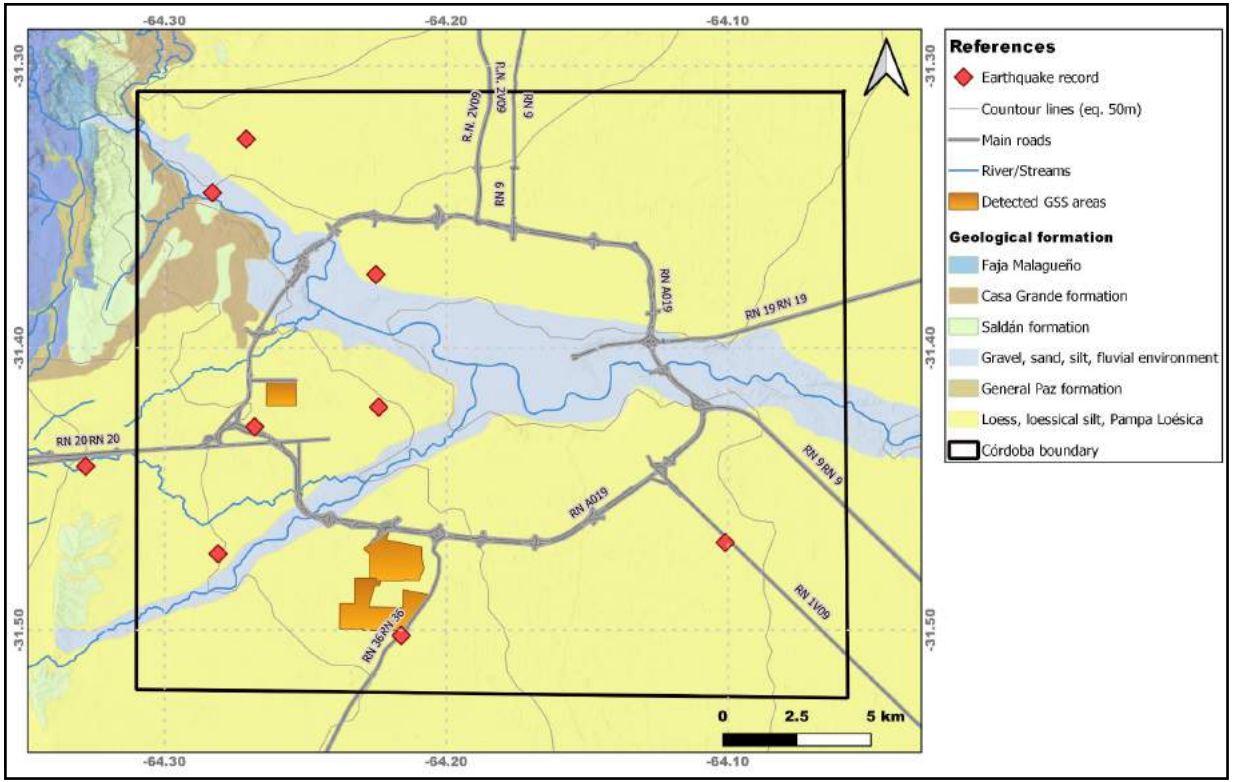
Wall cracks and roof collapse reported in Villa Libertador in February and August 2021. Neighbours demand geological studies and infrastructure to deal with the problem of urban liquid rise and collapse. In this neighbourhood, an emergency area has been declared in 2019 that includes more than 200 houses considered at risk.
Source: La Voz del Interior Journal.

Very-slow movements are affecting homes and infrastructure in peripheral neighborhoods of Córdoba city.

Main Goal: to discover active subsidences for the first time, in places where deformations have already been detected only by cracking and rupture of infrastructure.

¿How satellite data can assess the Ground Surface Subsidence (GSS) detected in Córdoba?

Study area



Geologic domains of the study area. Red points are earthquake records located nearby GSS detected areas.

Data used

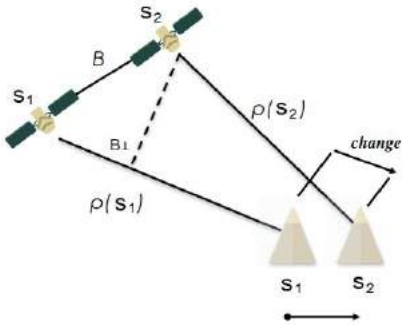
Sentinel 1 SAR satellites (5.405 GHz centre frequency). Acquisition over Argentina every 12 days, in the TopSAR Interferometric Wide Swath (IW) mode.

Name	Images	Temporal span	Orbit	Track
A	34	14/1/2015 - 9/12/2017	Asc	76
B	20	26/1/2016 - 8/3/2018	Asc	149
C	34	8/5/2020 - 17/12/2021	Desc	112

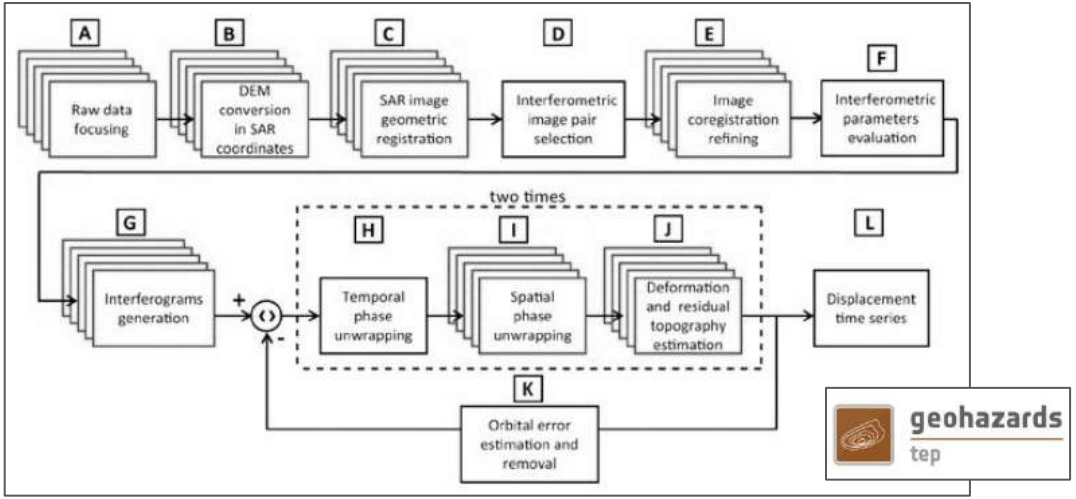
CHARACTERISTICS OF THE DATASETS.

Methodology

Quantification of Ground Surface Subsidence can be approached by using Differential SAR Interferometry (DInSAR)

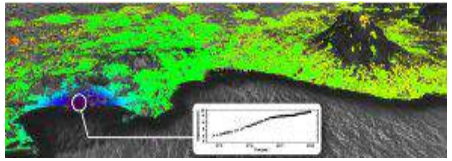


Repeat pass Interferometry geometry (https://arset.gsfc.nasa.gov/).

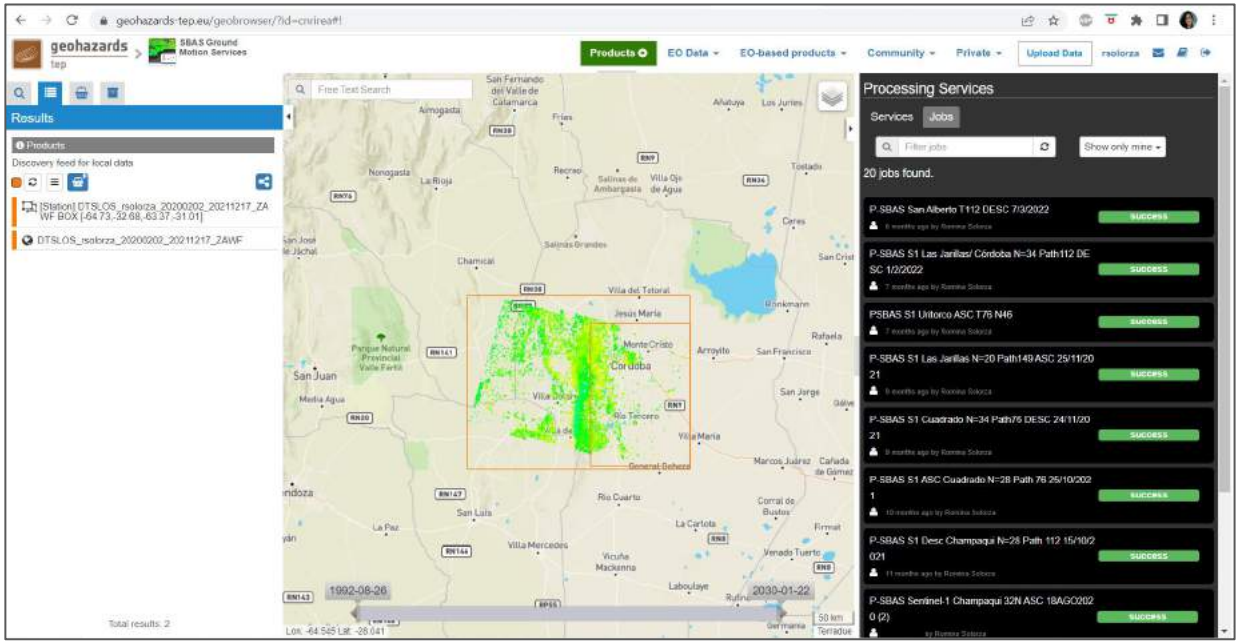


P-SBAS (Parallel Small BAseline Subset) algorithm steps processed in https://geohazards-tep.eu. From Casu et al (2014.)

Methodology



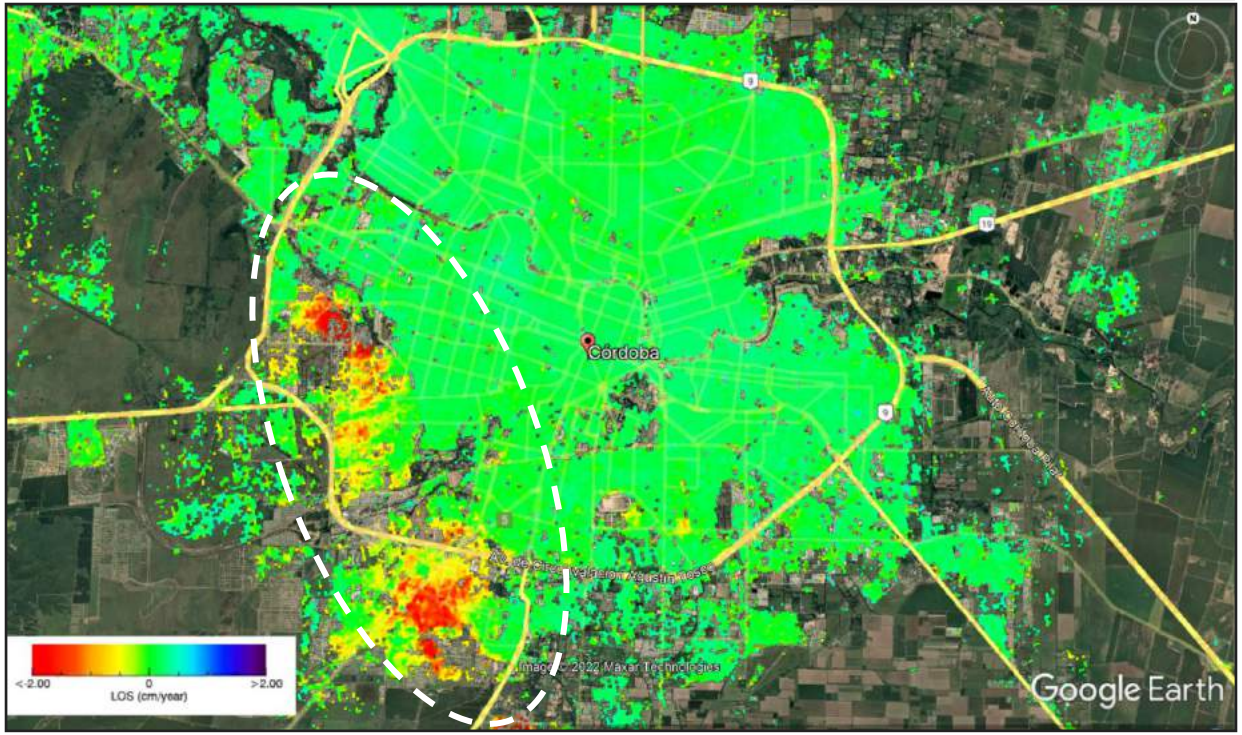
SBAS Ground Motion Services
by **CNR IREA**



Geohazards Exploitation Platform (GEP): https://geohazardstep.eo.esa.int/#!

Results

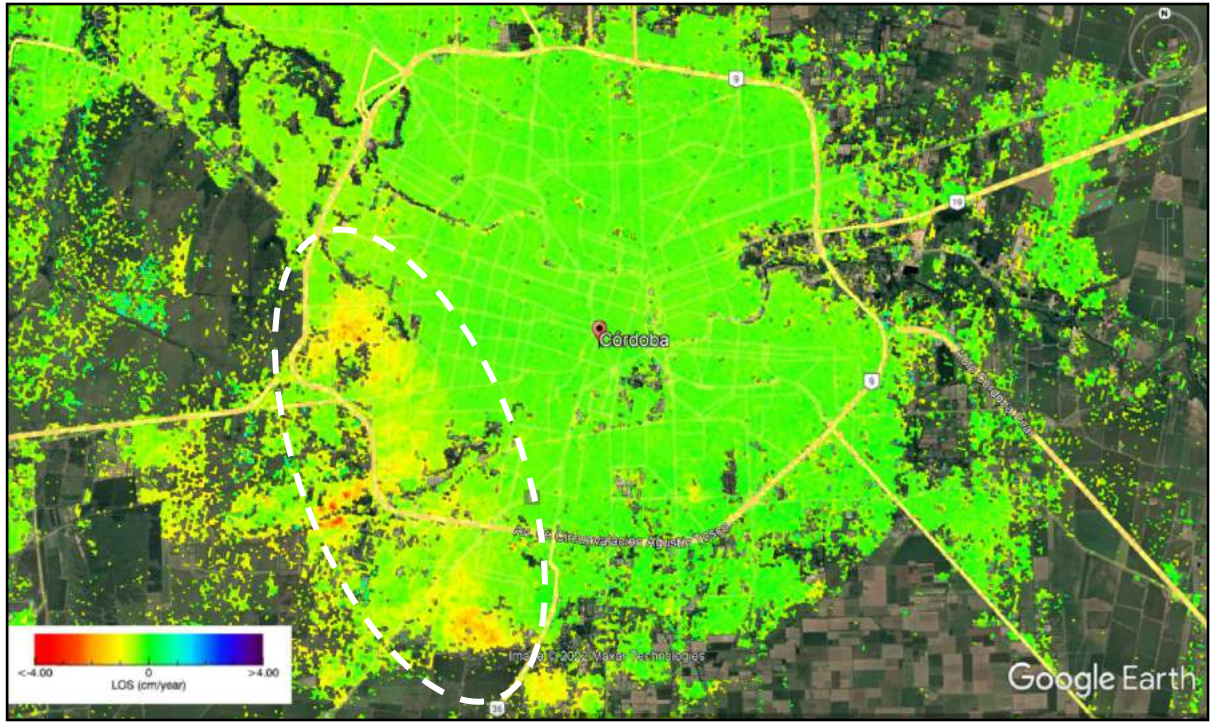
14/1/2015 - 9/12/2017 (A)



Velocity maps in Line Of Sight (LOS): Negative values: the target moves away; positive values: the target approaches.

Results

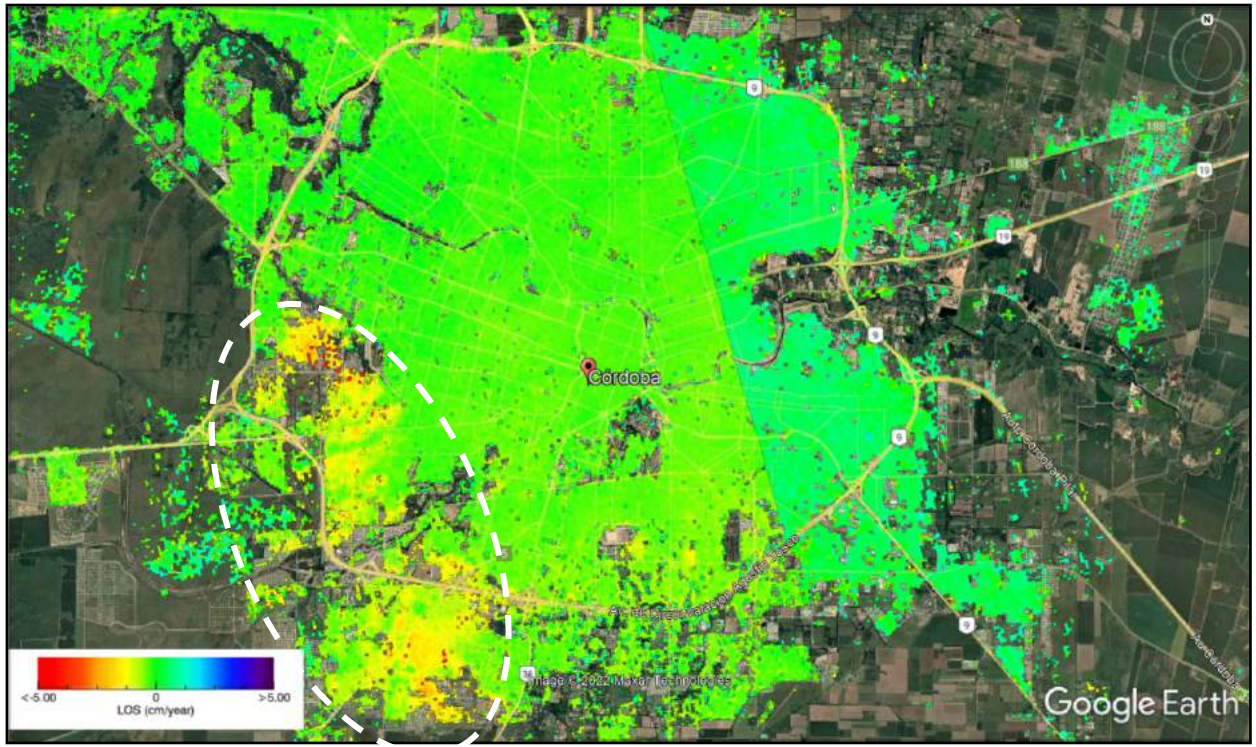
8/5/2020 - 7/12/2021 (C)



Velocity maps in Line Of Sight (LOS): Negative values: the target moves away; positive values: the target approaches.

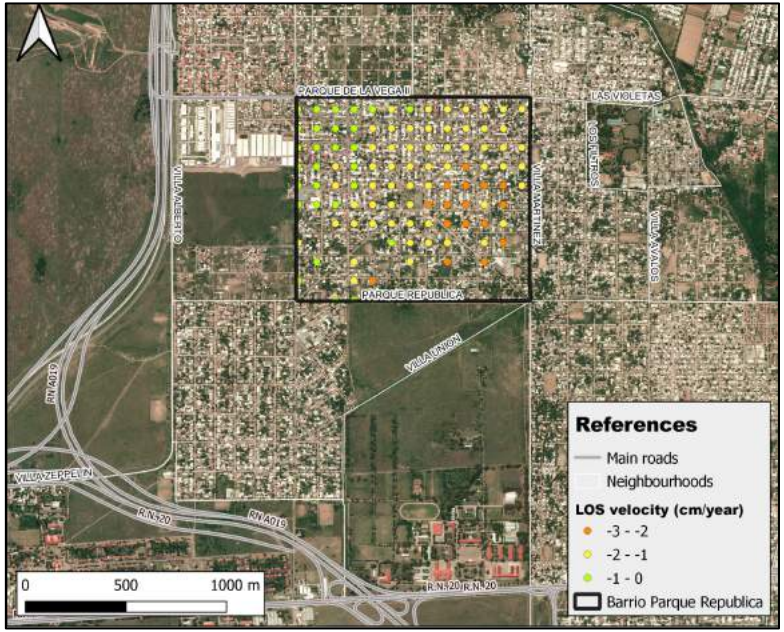
Results

26/1/2016 - 8/3/2018 (B)

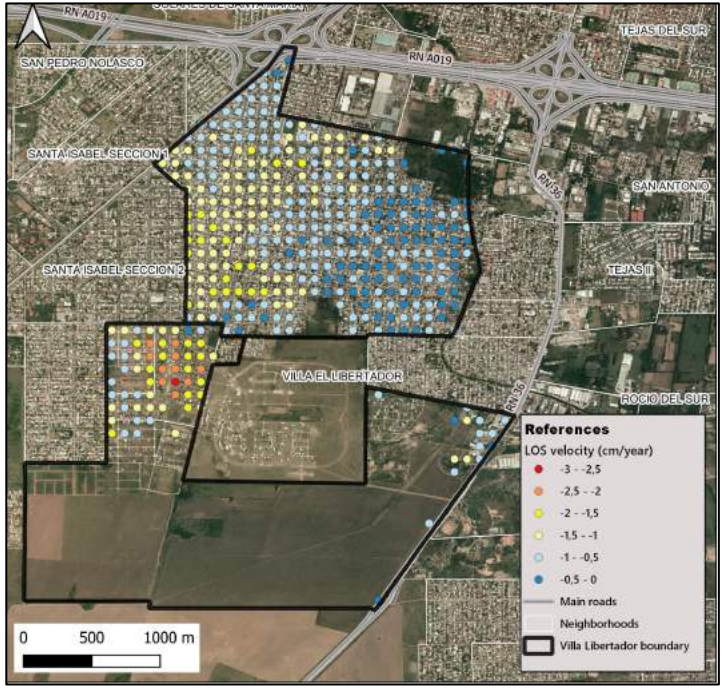


Velocity maps in Line Of Sight (LOS): Negative values: the target moves away; positive values: the target approaches.

Results

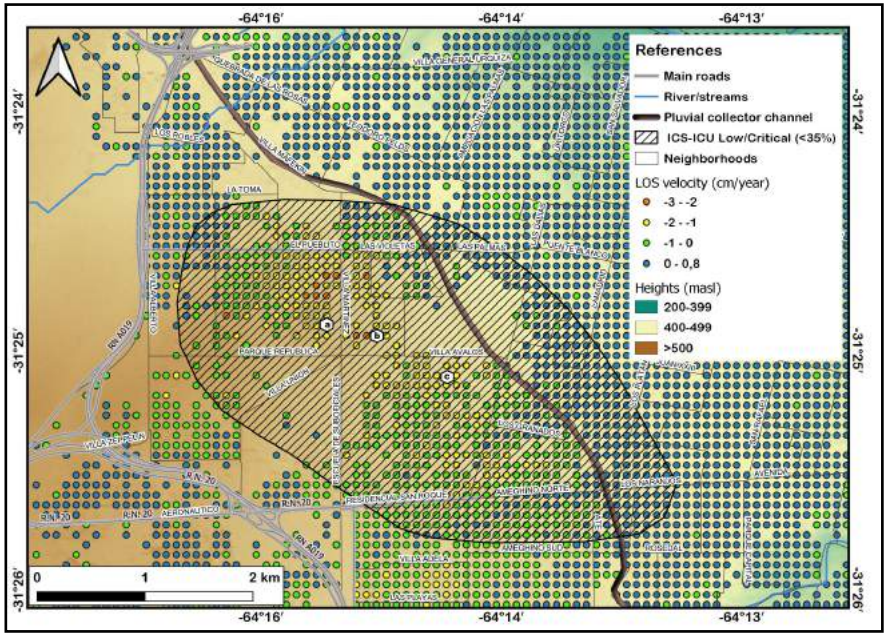


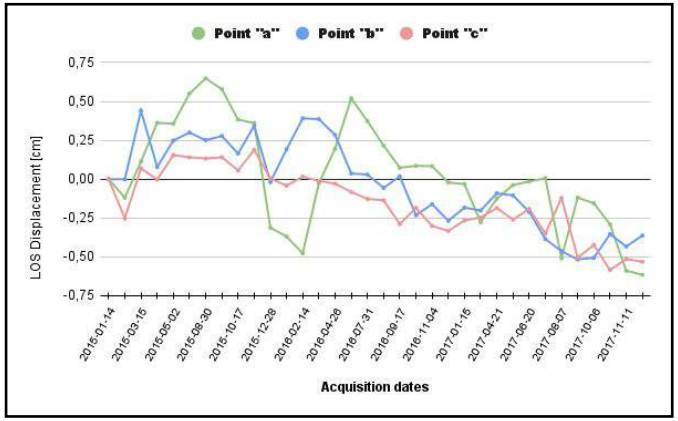
LOS velocity map (cm/year) of Parque República. Stack acquired in 2016–2018 in ascending mode.



Villa Libertador LOS velocity (cm/year) map. Stack acquired between 2016–2018 in ascending mode.

Results





Displacement history of three points located in Parque República.

Conclusions and highlights

- This is the first study carried out in the province of Córdoba to detect ground subsidence in loessic sediment environments.
- Results detected by DinSAR technique match with field surveys and geotechnical studies.
- Through the use of multi-temporal DINSAR techniques, it is possible to detect new subsidence processes.
- The need of powerful enough hardware to process large volumes of data is overcome by the GEP platform.
- This technique can be applied to detect serious geotechnical problems in a province where loessic sediments occupy more than 70% of its surface, for planning and territorial ordering.
- We are currently working in the detection of water leaks combining SAOCOM data with traditional geological studies.

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¿Questions?

Romina Solorza

Comisión Nacional de Actividades Espaciales. Ruta C45 Km 8, Falda de Cañete, Córdoba, Argentina.

Claudio Carignano

Instituto de Estudios Avanzados en Ingeniería y Tecnología (IDIT). CONICET, Facultad de Ciencias Exactas Físicas y Naturales, Universidad Nacional de Córdoba, Argentina

Marcela Cioccale

Escuela de Geología. Facultad de Ciencias Exactas Físicas y Naturales, Universidad Nacional de Córdoba, Argentina.

Claudia Notarnicola

Institute for Earth Observation. EURAC Research. Bolzano, Italia.

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