Mapping and kinematic history of active landslides in Panachaikon Mountain, Achaia (Peloponnese, Greece) by InSAR Time Series analysis and its relationship to rainfall patterns

EGU22-5958

Short Oral Presentation

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We investigate the kinematic behaviour of active landslides at several well-known locations around the Panachaikon Mountain, Achaia (Peloponnese, Greece), using space geodetic data (InSAR/GNSS). We process LiCSAR interferograms produced by Sentinel-1 (C-band) acquisitions using the open-source software LiCSBAS and we obtain average displacement maps for the period 2016-2021. The maximum displacement rate of each landslide is located at about the centre of each landslide. The average E-W velocity of the Krini landslide is 4 cm/yr (towards east) and 1 cm/yr downwards. The line-of-sight (LOS) velocity of this landslide compares well to a co-located GNSS station within (±) 3 mm/yr (25mm/yr for InSAR and 28mm/yr for GNSS for the descending orbit). Our results also suggest that there is a correlation between rainfall and landslide motion. A cross-correlation analysis of our data suggests that the mean time lag was 13.5 days between the maximum seasonal rainfall and the change of LOS displacement rate. Also, it seems that the amount of total seasonal rainfall controls the increase of displacement rate as 40-550% changes of the displacement rate of the Krini landslide were detected, following a seasonal maximum of rainfall values at the nearby meteorological station. A large part of this mountainous region of Achaia suffers from slope instability that is manifested in various degrees of ground displacement (detectable using space geodesy) affecting greatly its morphological features and inhabited areas.

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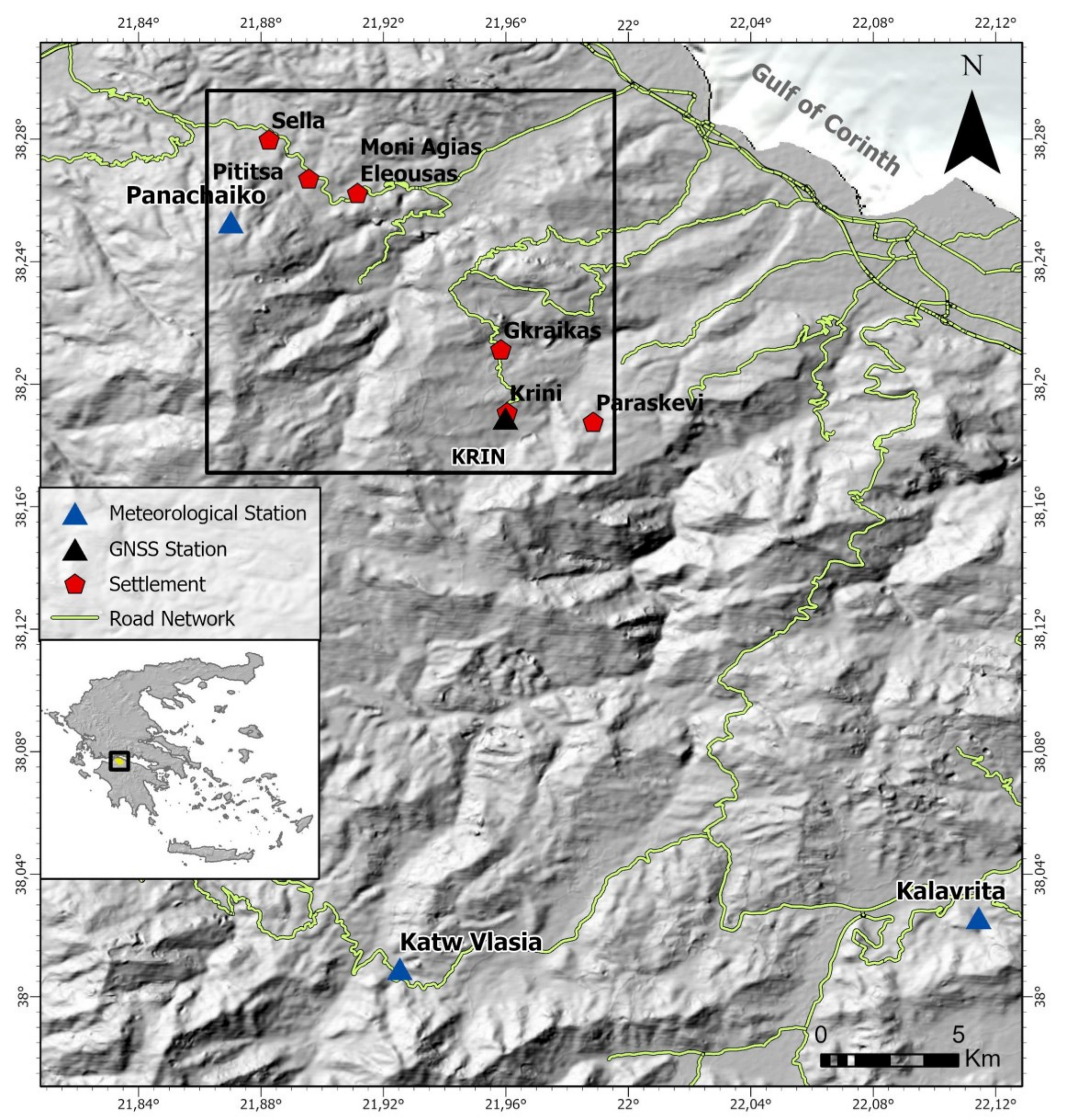
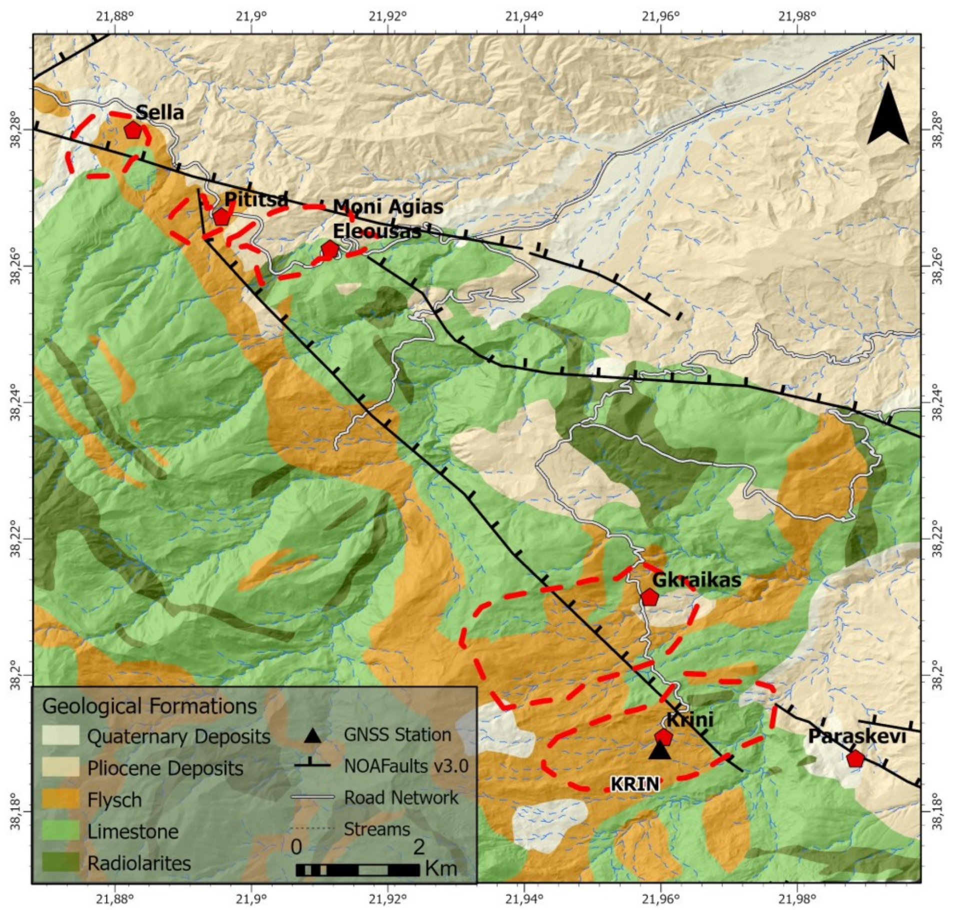
Study Area-Landslide



Krini, Pititsa -Sella -Agia Eleousa Landslides are active. We study the area with space-geodetic techniques in order to understand their kinematic behavior.



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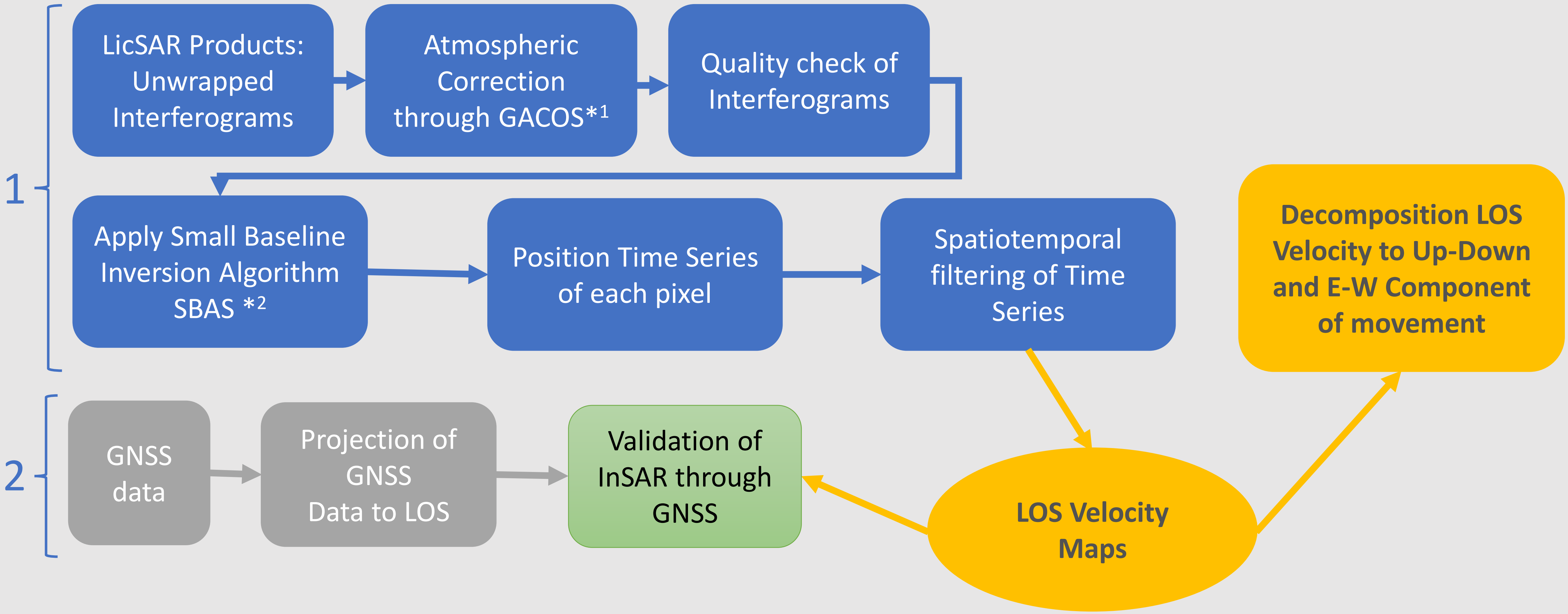


*[2]López-Quiroz et al., 2009

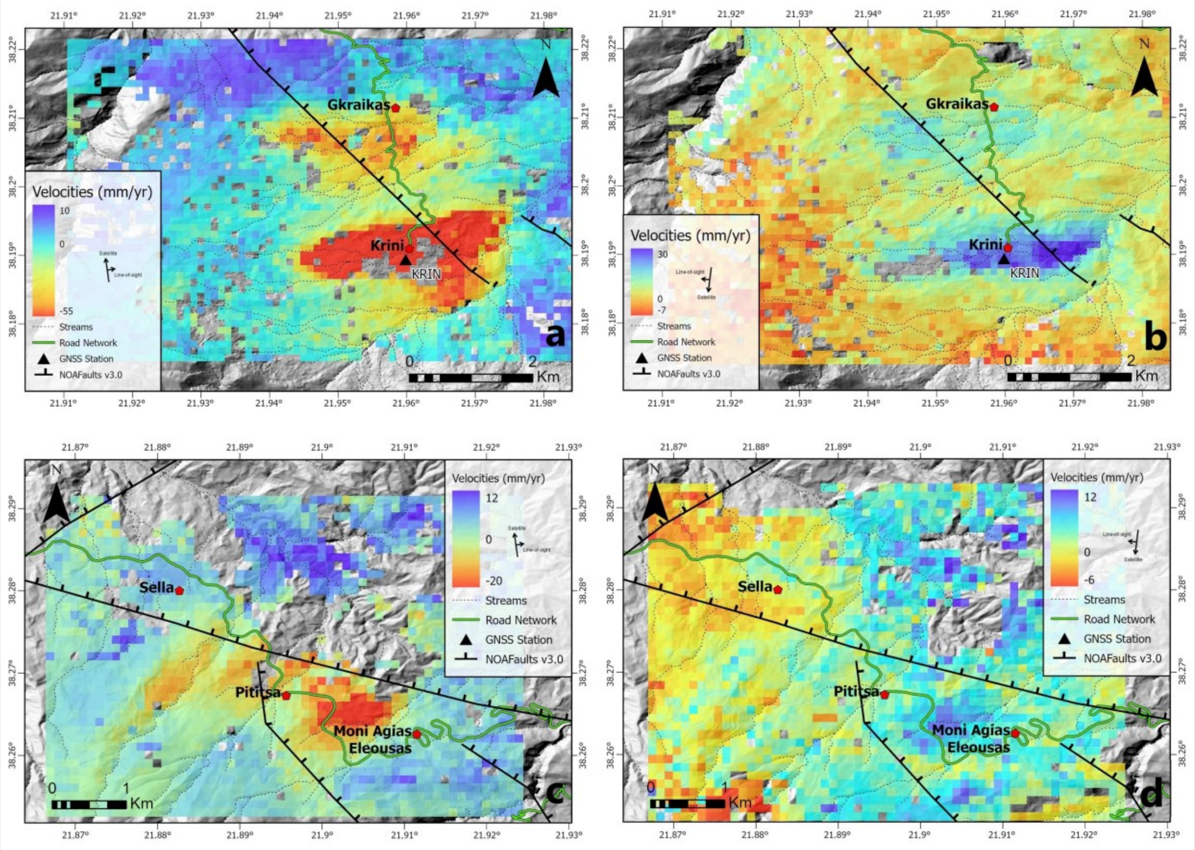
*[1]Yu et al., 2018

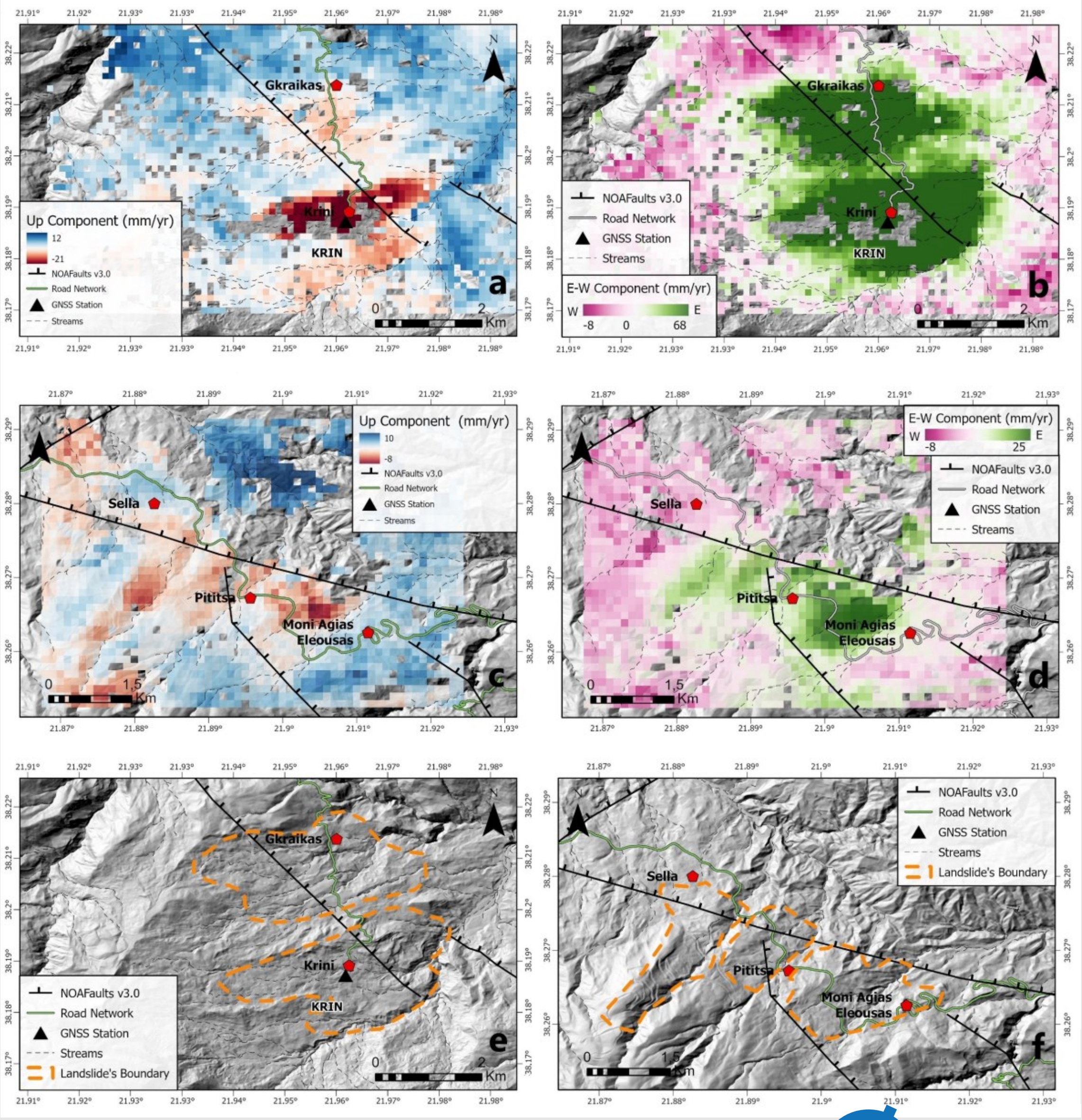
InSAR Time Series Analysis

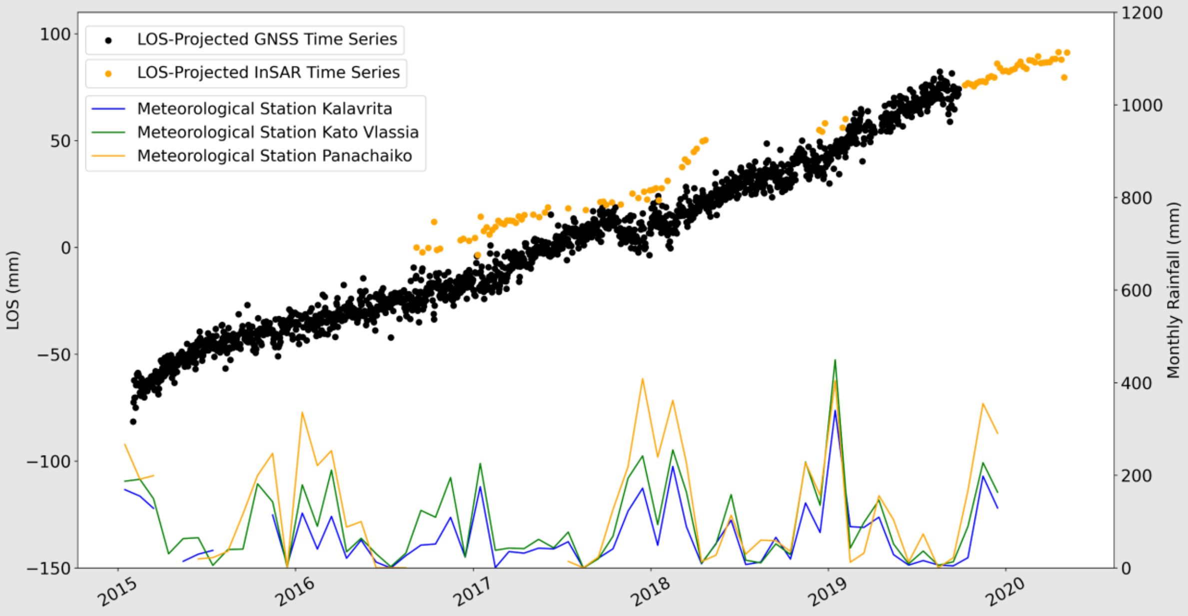
Up and East-West Component of Velocity ➔

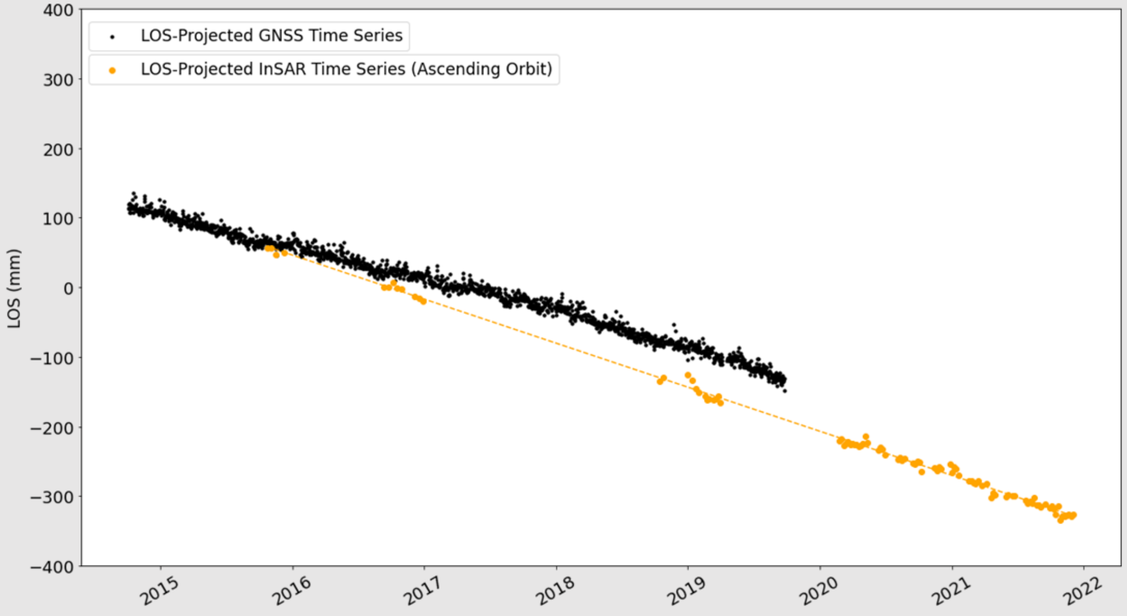
LOS Velocities (Ascending and Descending)

➔







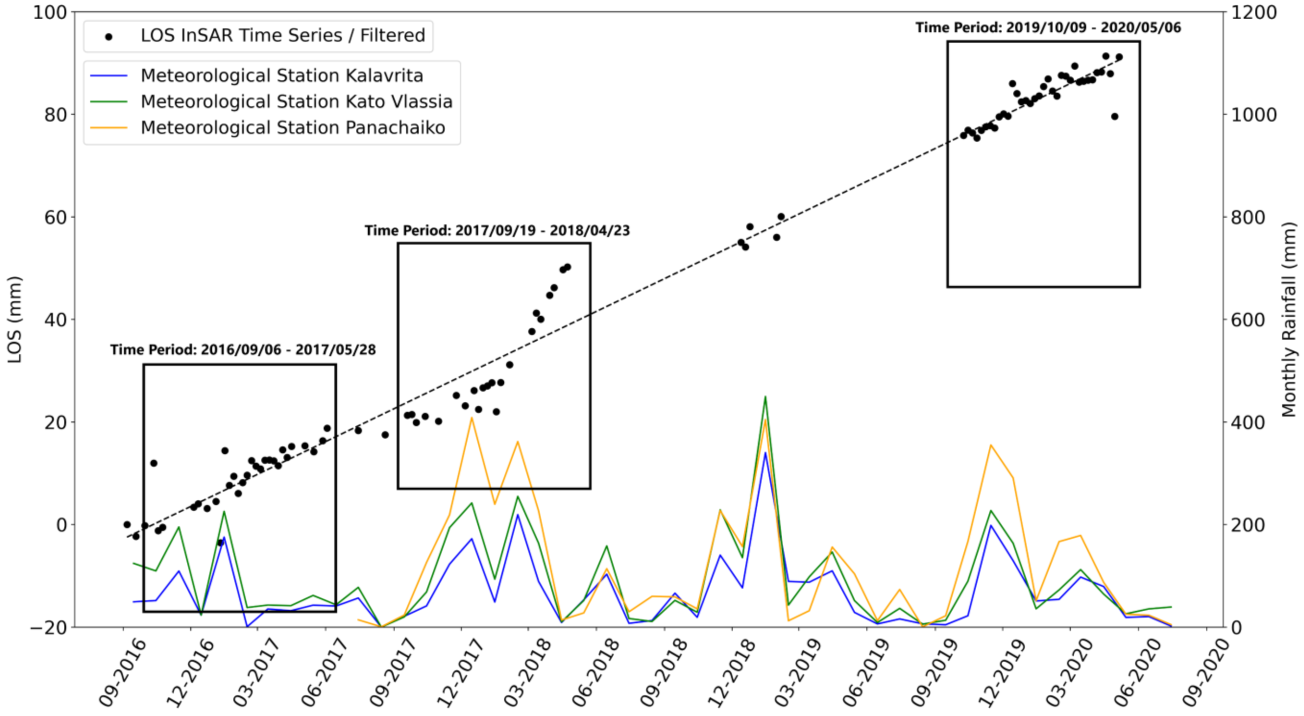


Validate InSAR Time Series Analysis through GNSS

LOS-Projected GNSS Time series (KRIN station; black points) and InSAR position time series (orange points, ascending orbit)

LOS-Projected GNSS Time series (KRIN station; black points) and InSAR position time series (orange points, descending orbit)

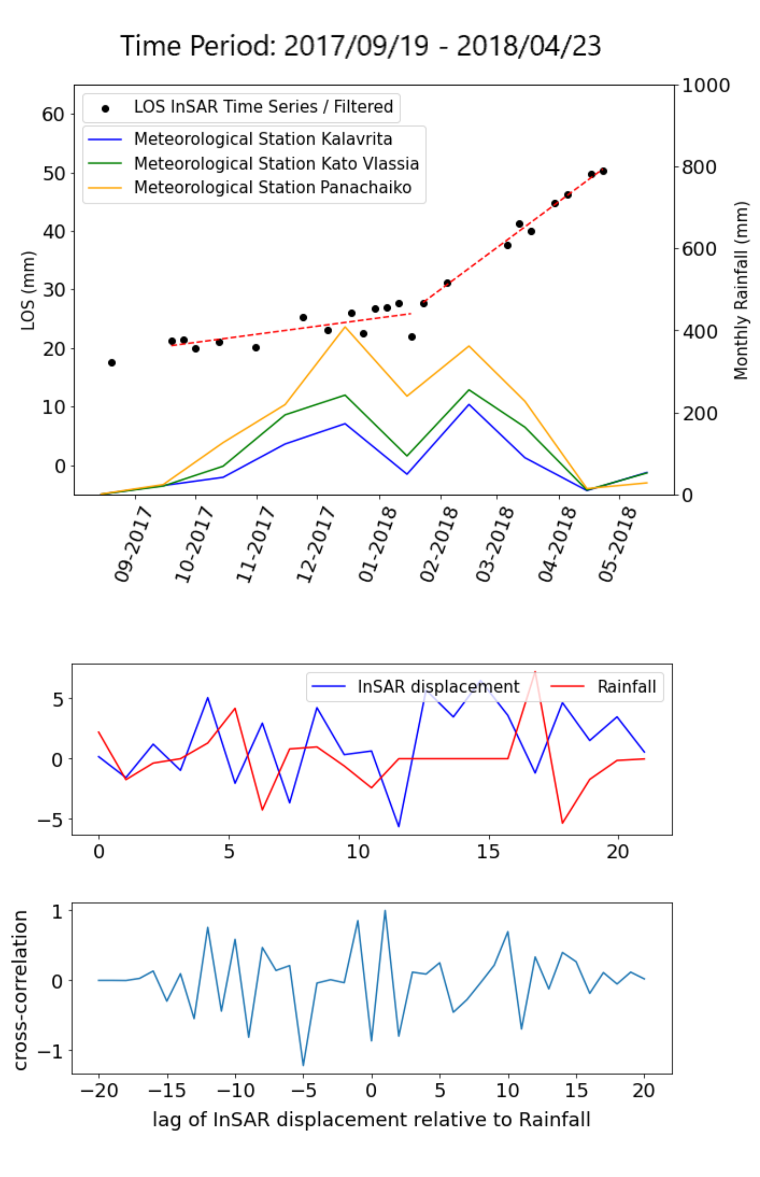
LOS Velocity Maps / Timeseries of each pixel



Daily Rainfall data

Cross Correlation Between InSAR and Rainfall

Time Lag Between InSAR and Rainfall



Two of the three time periods show an increase of displacement rate about 40%. The period September 2017-April 2018 shows an increase of the displacement rate about 550%. This result is accompanied by a large amount of total rainfall.

Correlation between the amount of total rainfall with the positive displacement rate (increase) of an active landslide.

Through the cross-correlation, we were able to compute the time lag between the maximum peaks of InSAR and rainfall. The mean time lag was 13.5 days.

The **main findings** of this research are:

i. The Krini, Agia Eleoussa monastery and Pititsa landslides **are active landslides whose motion was measured by InSAR** (C-band) time series analysis for the period 2016–2021.

ii. The maximum displacement rate of each landslide is located at about the center of each landslide.

iii. Our results point that there is **a correlation between rainfall and landslide motion**. For the Krini landslide, we found the **mean time lag to be 13.5 days** between the maximum rainfall and the maximum of LOS displacement (descending orbit data).

iv. The displacement rates of the Krini active landslide increase after a period of rainfall. Two of the three time periods examined showed an increase in the displacement rate by about 40% when the total rainfall was quite similar (~700 mm). The period September 2017–April 2018 showed an increase in the displacement rate by about 550%. This result was accompanied by a large amount of total rainfall (~1000 mm).

v. Our findings suggest that **the amount of total rainfall could control the amount of increase of the displacement rate of an active landslide**.

Thank you!

You can find this research published:

Tsironi, V., Ganas, A., Karamitros, I., Efstathiou, E., Koukouvelas, I., & Sokos, E. (2022). Kinematics of active landslides in Achaia (Peloponnese, Greece) through InSAR Time Series analysis and relation to rainfall patterns. Remote Sensing, 14(4), 844.

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Funding by the project PROION "Multiparametric microsensor monitoring platform of the Enceladus Hellenic Supersite" co-financed by Greece and the European Union