Possible Lithosphere Atmosphere Ionosphere Coupling before 19 September 2021 La Palma volcano eruption

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La Palma volcano location

On 19 September 2021, an eruption of Volcano Explosive Index (VEI) 3 started at La Palma
Lithosphere investigation by analysing earthquakes’ space and time clustering

Earthquakes started from 40 km depth one year before the eruption, underling the uplift of magma and filling of two deeper and shallower magmatic chambers, months and days respectively before the eruption.
**Geomagnetic** field ground investigation of possible lithosphere activity

Several **disturbances** have been recorded only close to volcano and maybe induced by the magma uplift.

A decrease of vertical magnetization has also been recorded, and it could be due to demagnetization produced by the increase of lithospheric temperature.
A persistent anomaly appeared for 2 consecutive days 34 days before the eruption and it was located at the same location as the volcano.

Atmosphere investigation of SO$_2$ time series 6 months before the eruption.
**Ionospheric investigation of CSES electron density** night-time latitudinal profiles

**Method:**
Comparison of the same nighttime orbit (every 5 days) of CSES Ne. Only tracks in geomagnetic quiet time ($|\text{Dst}| \leq 20$ nT and $ap \leq 10$ nT) have been considered.

The track of 1 August 2021 presents a particularly high value of electron density. TEC data from GIM confirmed the measurements of CSES.
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The track of 1 August 2021 presents a particularly high value of electron density. TEC data from GIM confirmed the measurements of CSES. CSES electron density increase is also visible in TEC data with enhancement very localised above La Palma volcano, suggesting that it was a Lithosphere-atmosphere-ionosphere coupling induced by the volcano.
Ionosphere: cumulative number of Swarm magnetic anomalies above La Palma volcano

Acceleration of the Y anomalies 90 days before the eruption
Possible Lithosphere – Atmosphere – Ionosphere couplings - Summarised common view

Several couplings with different delays and mechanisms seem to occur!
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Lithosphere–atmosphere–ionosphere bottom-up coupling (LAIC) models

Different couplings can reflect several processes of the preparation of the volcano eruption driven by the magma uplift!
Graphical abstract

These results were published in Remote Sensing: www.mdpi.com/2072-4292/14/19/5001

Clues of Lithosphere, Atmosphere and Ionosphere variations possibly related to the preparation of La Palma 19 September 2021 volcano eruption
Thank you very much for your attention!

Invitation to submit papers on Lithosphere Atmosphere Ionosphere Coupling in the occasion of earthquakes:

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Invitation to read:
➢ Zhang Yiqun et al. Are There One or More Geophysical Coupling Mechanisms before Earthquakes? The Case Study of Lushan (China) 2013 published in this Special Issue of Remote Sensing on 10-03-2023

10 years of observations of earthquakes with Swarm satellites: results and open questions