Seismic velocity variations & precipitation in Greece

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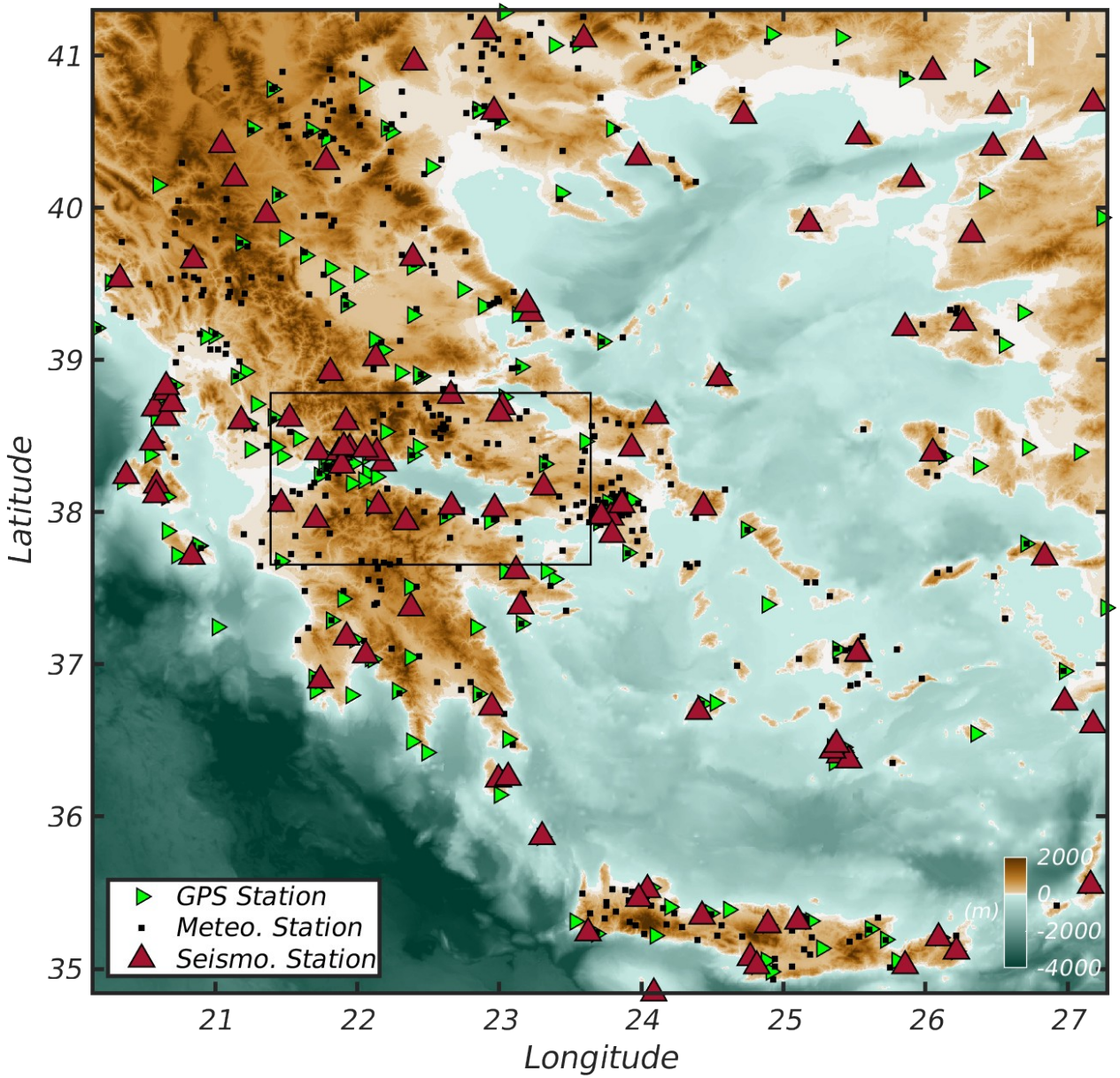
Data

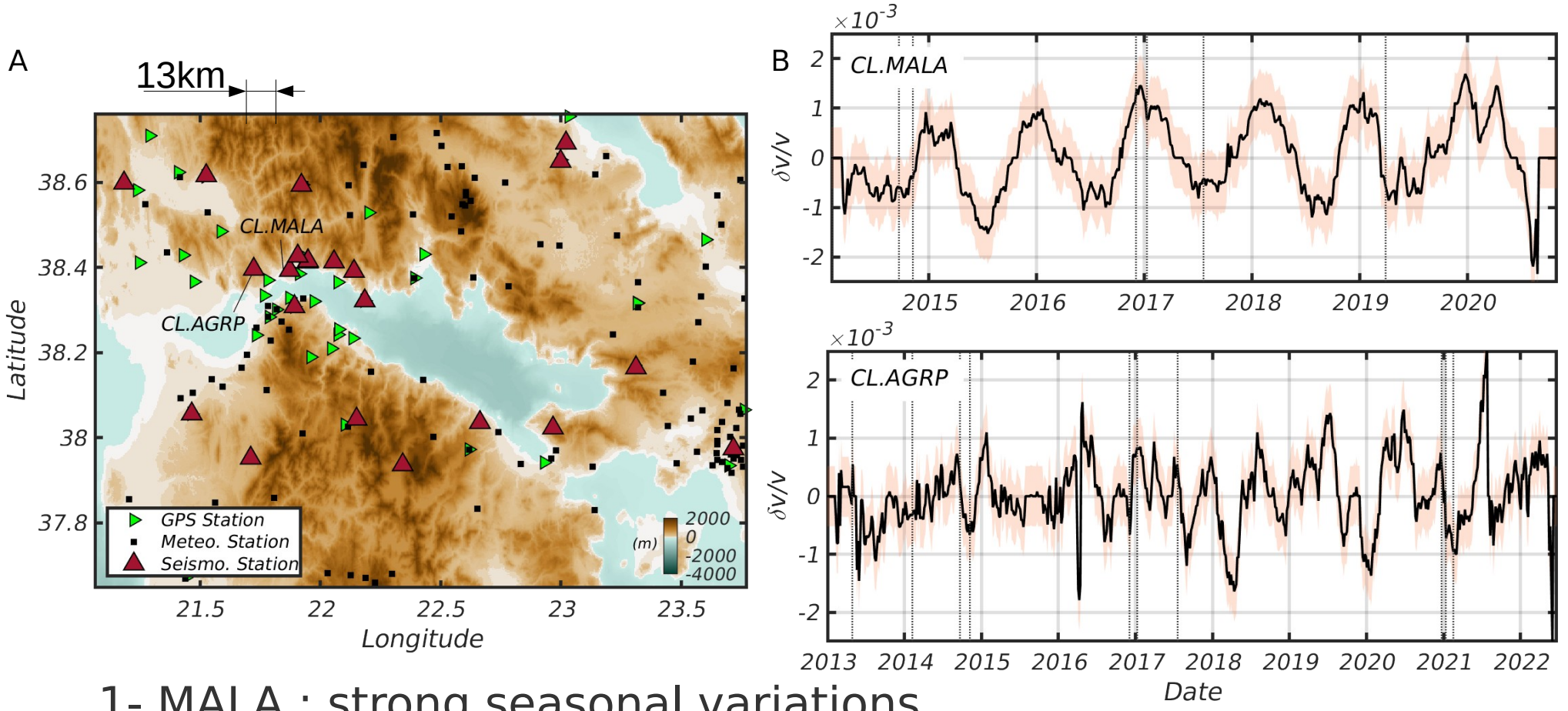


→ We use 12 years (2010-2022) of continuous vertical noise record at 142 stations

→ We measure the temporal evolution of the seismic velocity (dv/v) on the coda waves of auto-correlations

Temporal evolution of the seismic velocity in the Gulf of Corinth

- Sliding window of 2 months
- dv/v computed between [1-3]s ~ 1/2km depth



1- MALA : strong seasonal variations

2- AGRP : no seasonal variation

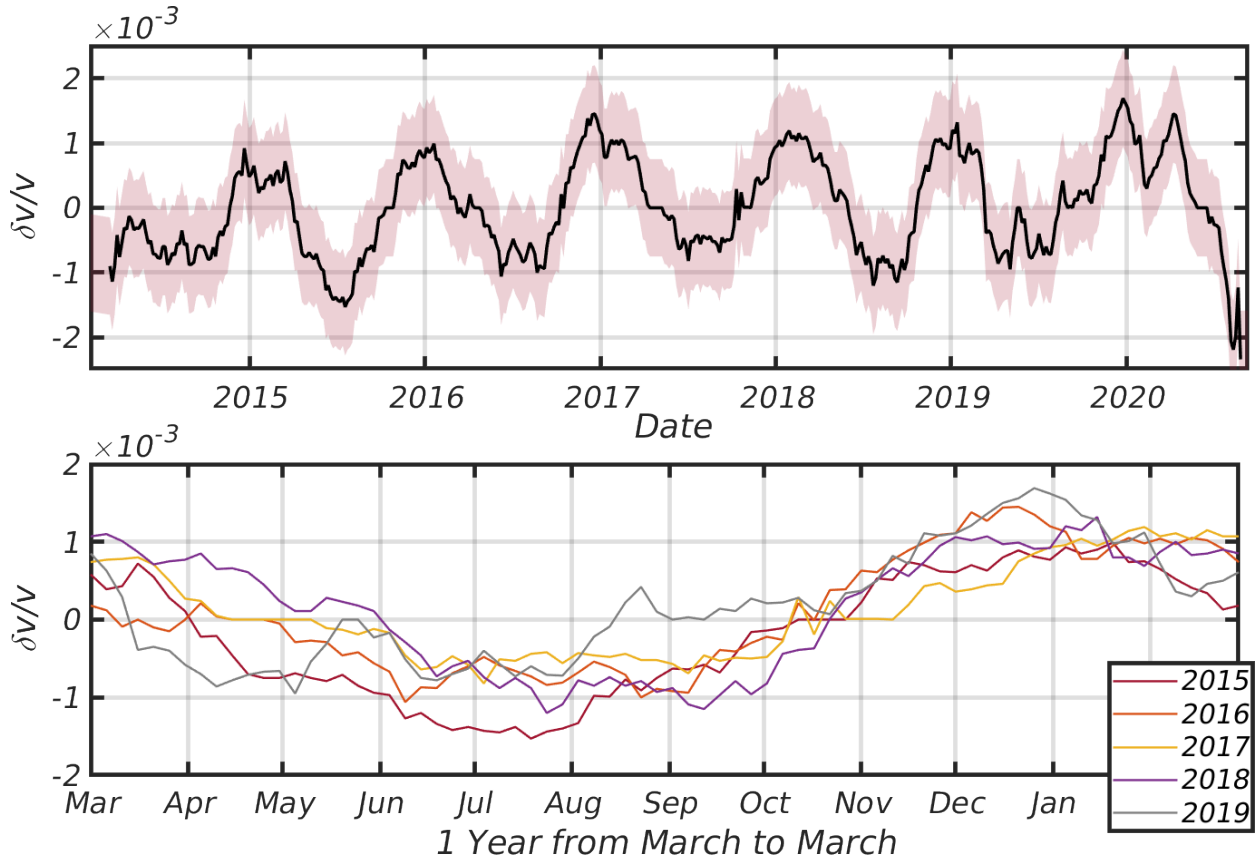
Which regions exhibit seasonal variations ?

Seasonality coefficient
Example with 1 station

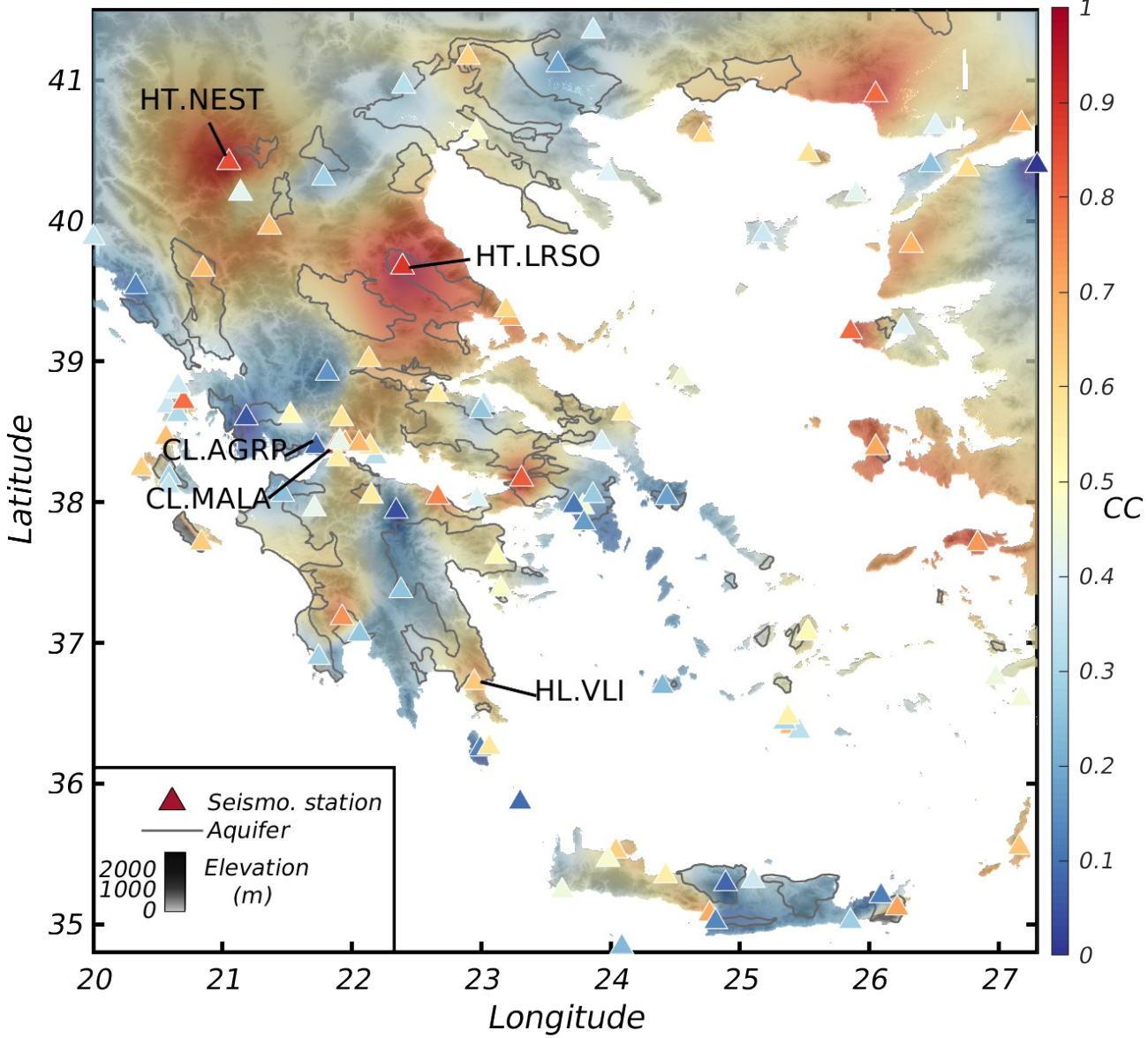
For each station we compute the correlation coefficient between the dv/v computed each year

$$CC(y_1, y_2) = \frac{\mathrm{cov}(y_1, y_2)}{\sigma_{y_1}\sigma_{y_2}}$$

CC value ~ 1 → the dv/v are similar ~ seasonal variations
CC value ~ 0 → the dv/v are different from year to year



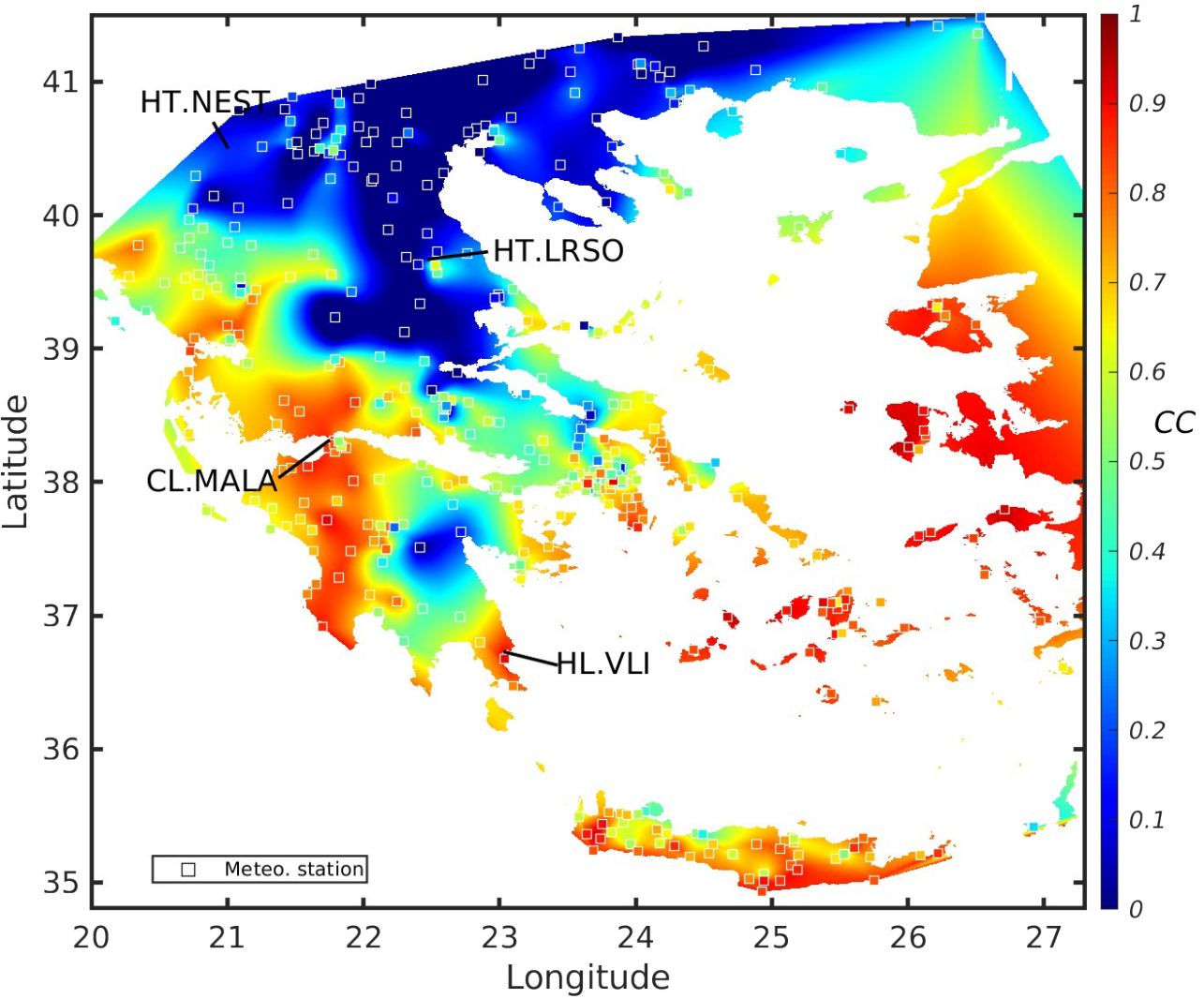
Generalization at all stations → dv/v seasonality map



seasonal variations

no seasonal variations

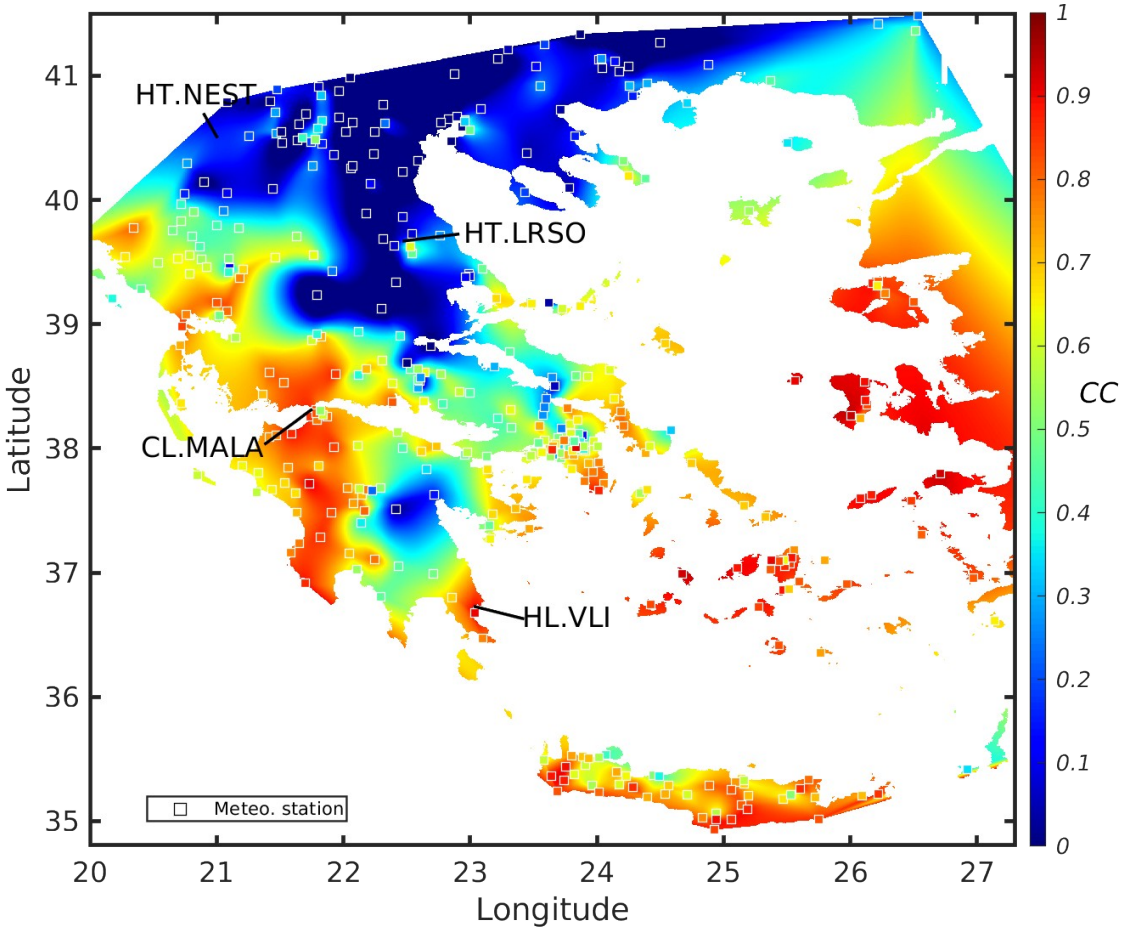
Precipitation seasonality map

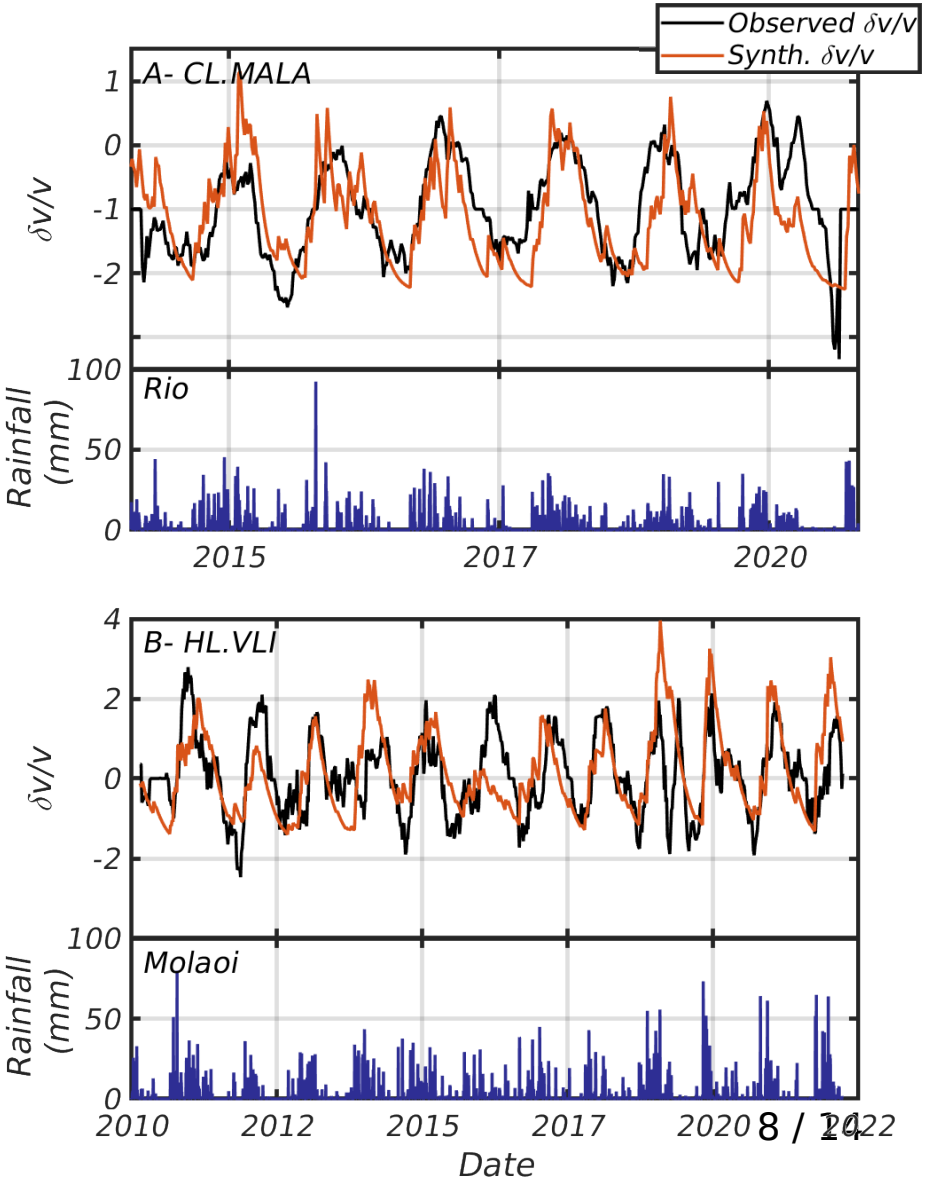


Precipitations have seasonal variations mostly in the **western part** of Greece

Is it possible to predict the dv/v using from precipitations data ?

Using a simple linear reservoir model to predict dv/v from precipitation

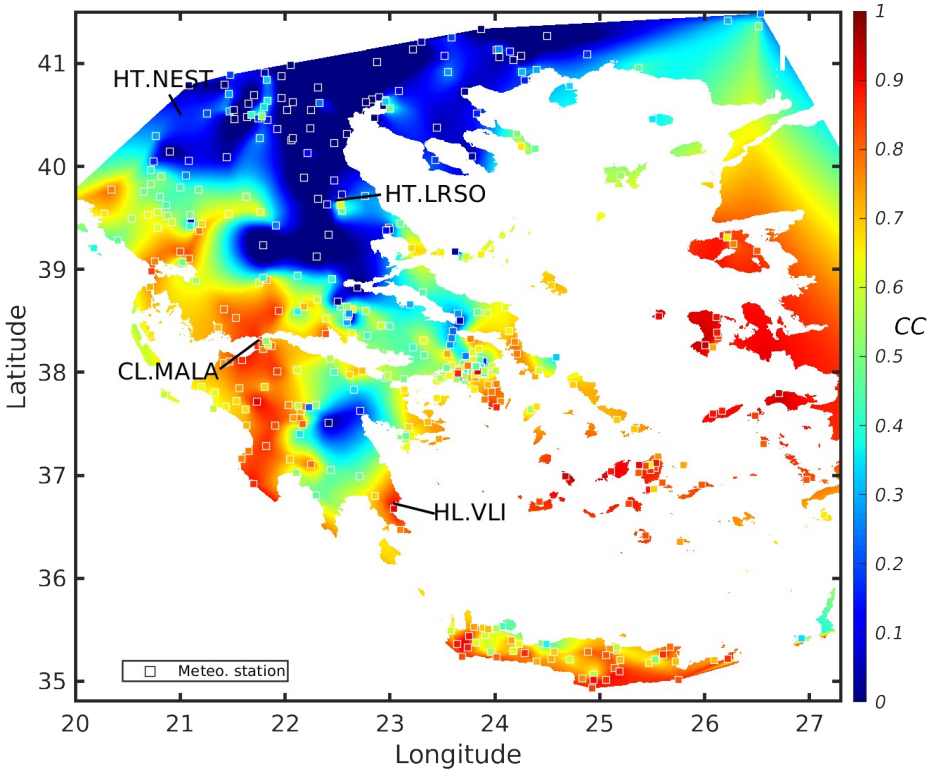


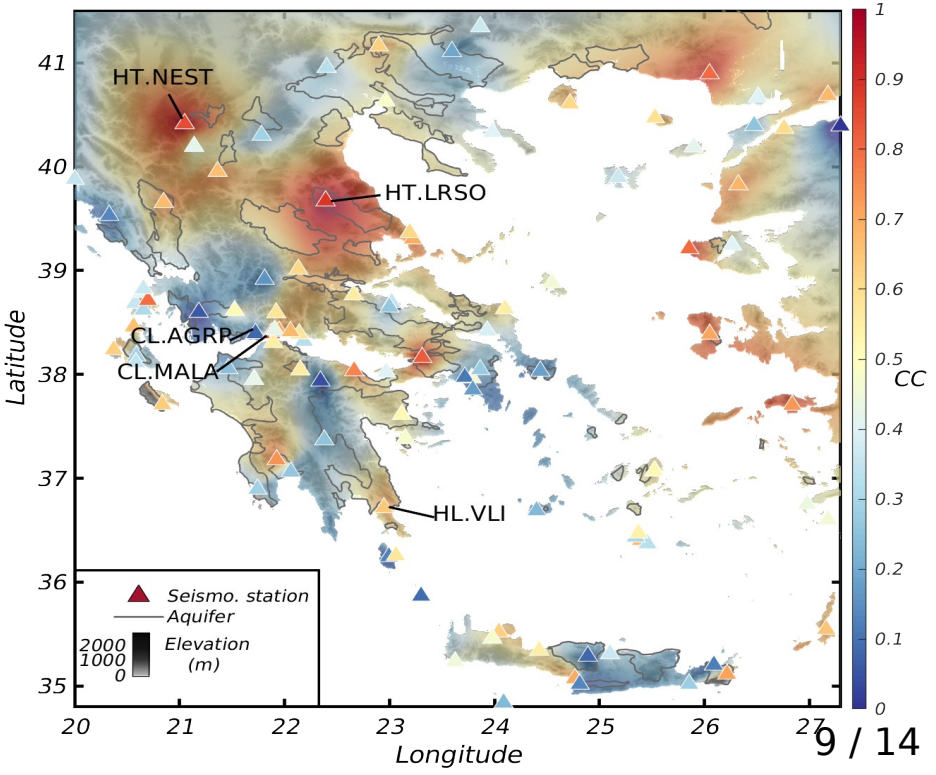


$$\frac{\delta v}{v}_{syn}(t) = \left\langle \frac{\delta v}{v}(t) \right\rangle + \left(\frac{\mathrm{cov}\left(\frac{\delta v}{v}(t), h(t)\right)}{\mathrm{var}(h(t))} \right) \cdot h(t)$$

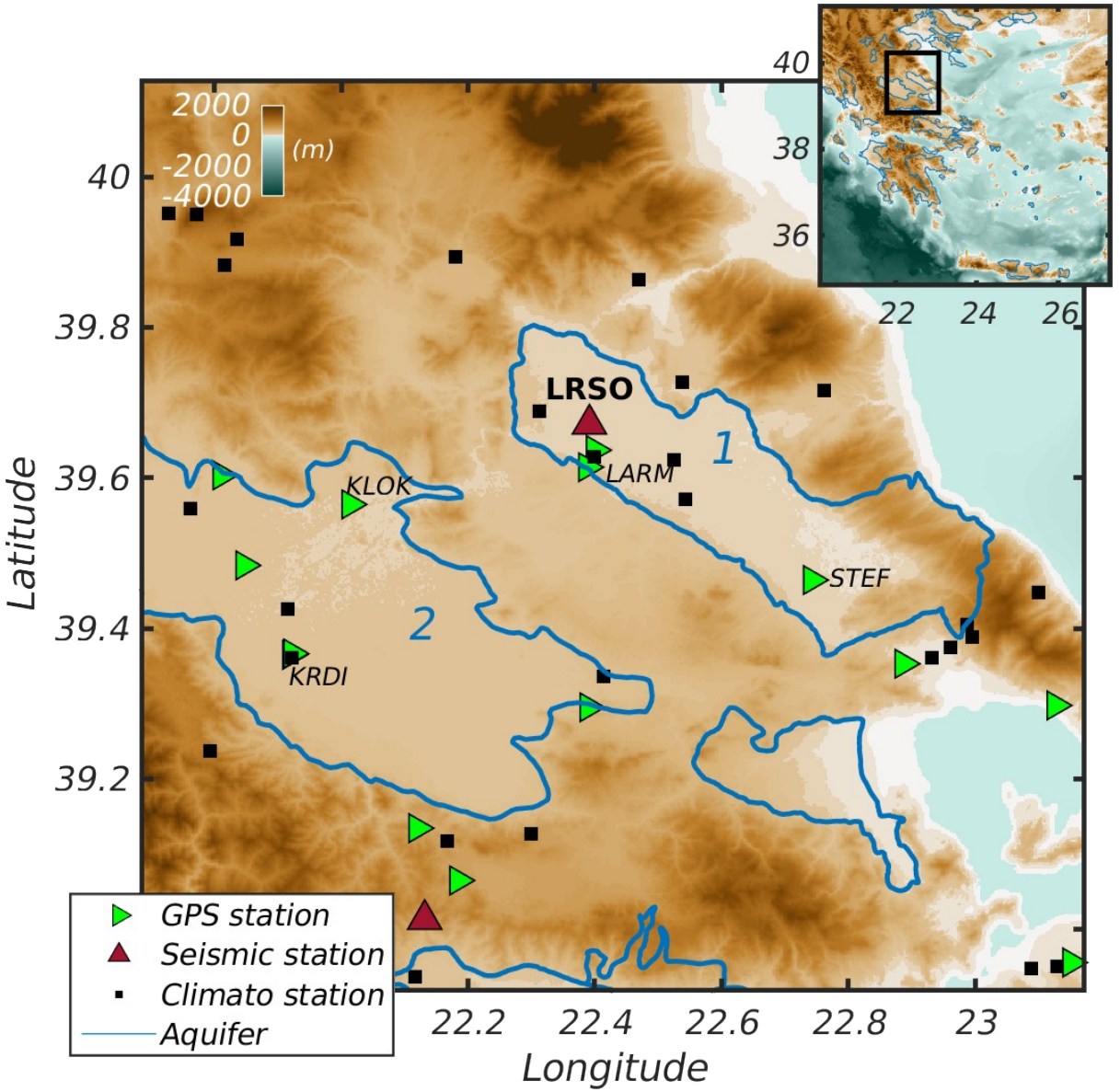
In the east and north of Greece the seismic velocity have seasonal variations, wheras the precipitation are not seasonal.

Why is seismic velocity seasonal in this case ?





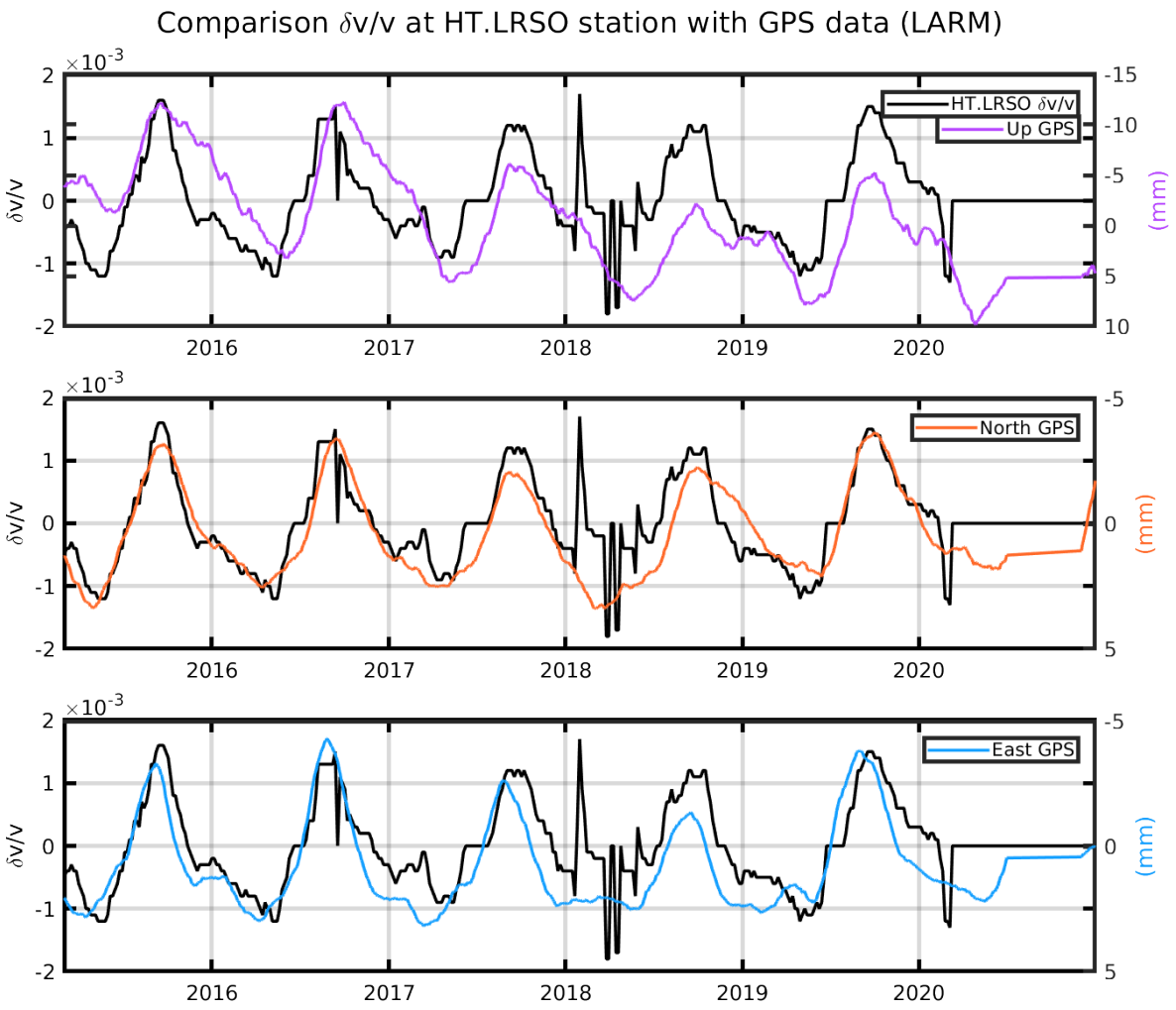
Example on Larissa region

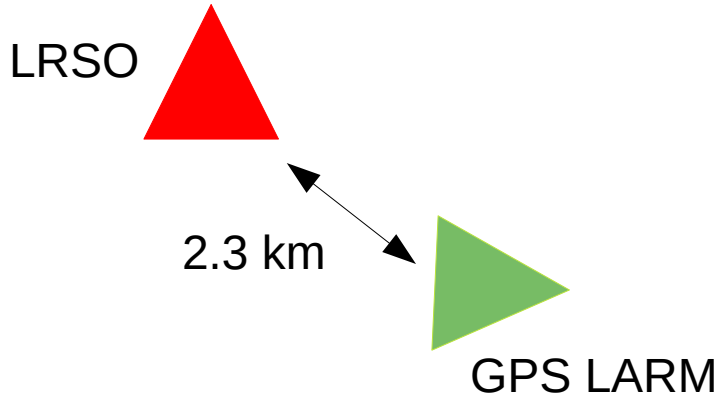


Seismological station located right above aquifers

Comparison with
GPS data
to analyze hydrological processes
inside aquifers
[Cheloni et al. 2017]

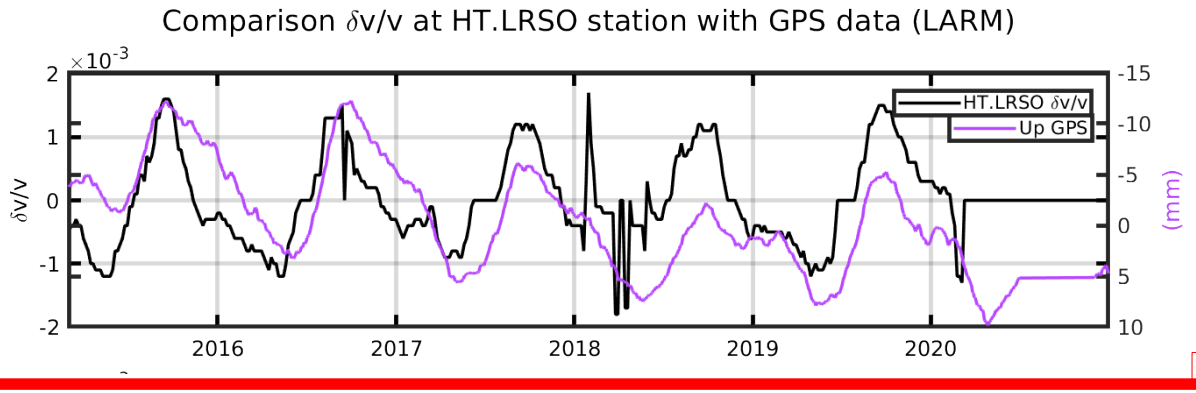
Industrial pumping for agriculture

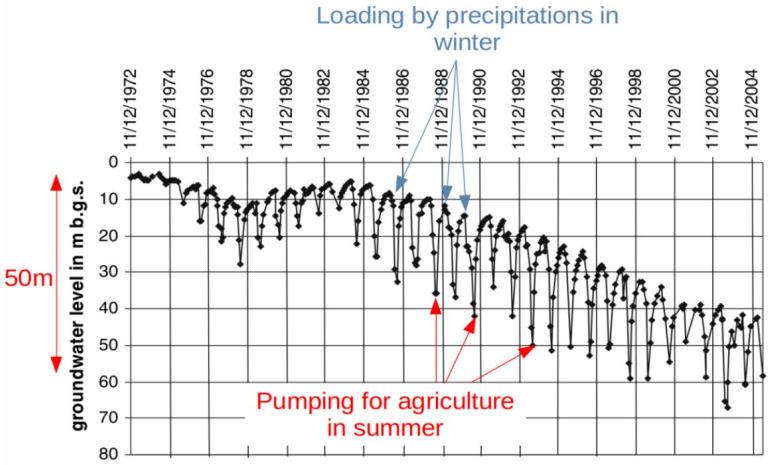




INCREASE of DV/V
=
DECREASE OF DISPLACEMENT

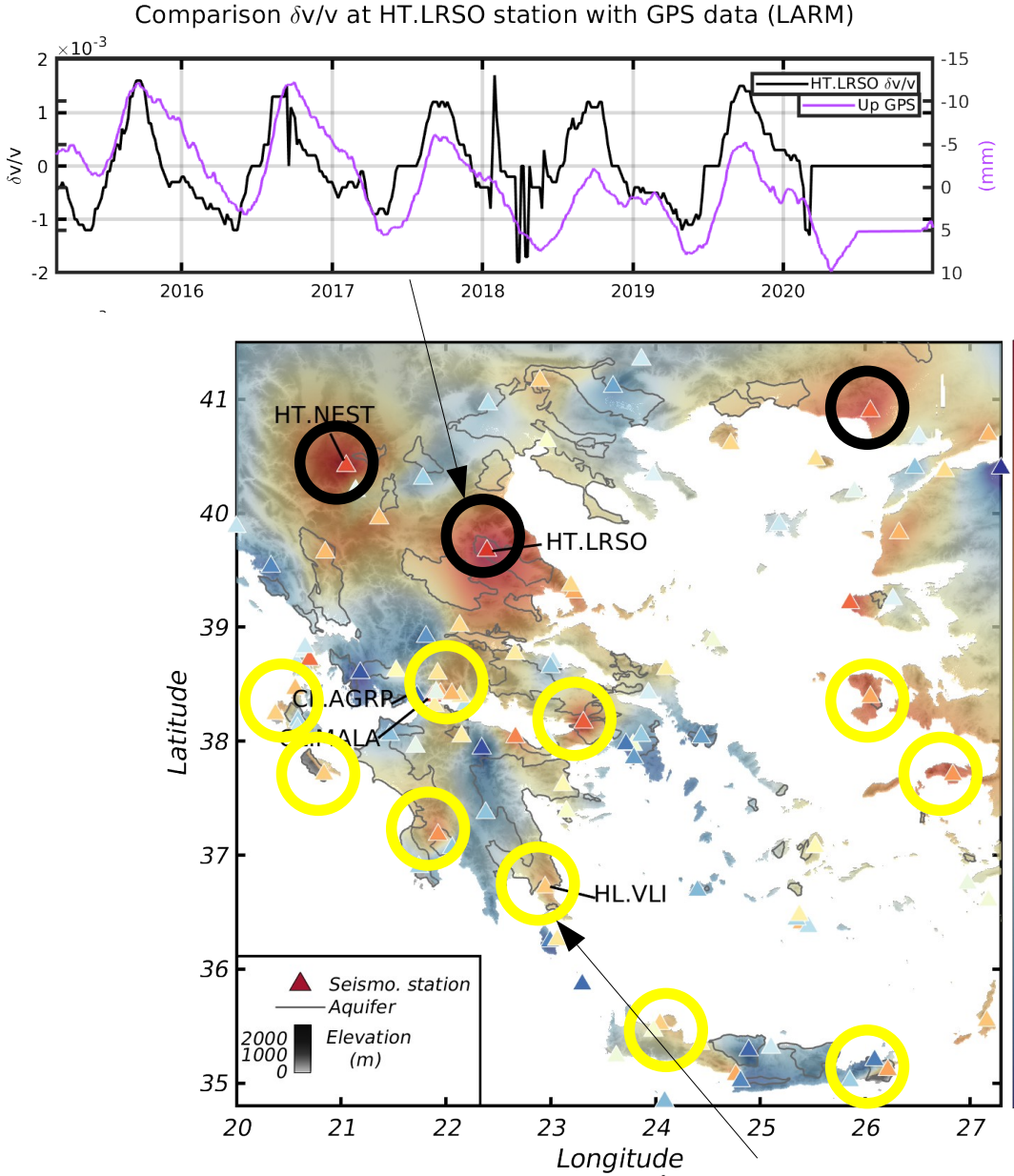
Industrial pumping for agriculture





INCREASE of DV/V
=
DECREASE OF DISPLACEMENT
=
LESS WATER IN THE SOIL

Daskalaki et al., (2008) modified



CONCLUSION

EXPLANATIONS SEASONALITY ON DV/V

= precipitations

= water pumping for agriculture

Any questions?

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