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Improving the statistical correlations between low seismic events and CO₂ variations subtracting the rain contribution

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A correlation between low seismic activity and CO₂ measurements variations was observed at the Galliciano thermomineral spring, Tuscany, Italy, where an automatic monitoring multiparametric geochemical station is operative since 2003 (Pierotti et al., 2015). The above-mentioned correlation reported a time delay of about 2 days of small earthquakes with respect to CO₂ anomalies. Starting from this correlation a conditional probability of earthquake occurrence given the CO₂ anomaly detection was calculated, with a probability gain near 4 (Pierotti et al., 2022). A statistical correlation was also calculated between rain events and CO₂ anomalies which was observed for rain vents ahead CO₂ anomalies of one days. This permitted to distinguish CO₂ anomalies due to meteorological versus tectonic activities. Following this distinction, and subtracting the rain contribution to the CO₂ variations, a new correlation was observed between small earthquakes and CO₂ anomalies which confirmed the past results with a better performance. The new correlation peak is better defined and concentrated in the time lag of 2 days. The p-values of both earthquake and rain to CO₂ correlations were calculated. The correspondent probability gain in an earthquake forecasting experiment, taking into account the rain events, increased from less than 4 to 4.5.

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