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Continuous monitoring of physical parameters (temperature, electrical conductivity, water pressure) in a karst aquifer of central Italy (Venafro Mts., Molise): first results in a seismically active region

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The involvement of fluids in the earthquake cycle is a still open debate in the scientific community (e.g. Gratier et al., 2002). In the last years, new data from laboratory experiments and on-field discrete and continuous monitoring of soil gas, springs and gas vents were gathered worldwide (e.g. Martinelli, 2015; Nielsen et al., 2016). The aim of these studies was to better define the role of the observed fluid changes either as a trigger of earthquakes or as the co and post-seismic response to the transient (dynamic) and permanent (static) stress changes. This subject is particularly attractive in central and southern Apennines (Italy), where both huge water and CO_2 circulation at depth, occur (e.g Frondini et al., 2018). In this respect, the three long-lasting earthquake sequences that hit central Apennine in the last decades (1997, 2009 and 2016-2017, M_w up to 6.5) were accompanied by hydrological (increase or decrease in the spring discharges) and hydrochemical (variations in chemical composition, physico-chemical parameters) anomalies (e.g. Carro et al., 2005; Barberio et al., 2017; Petitta et al., 2018). Changes were observed mainly in the co and post-seismic phase and only a few pre-seismic signals were recorded. Temporal monitoring ranged from weeks to months, but higher sampling rates are needed to study crustal deformation processes (stress and volumetric strain) during the earthquake cycle. For example, since 2015 De Luca et al. (2016, 2018) are been performing high frequency (up to 20 samples/second) continuous monitoring of temperature, hydraulic pressure, and electrical conductivity in the Gran Sasso aquifer. They recorded unambiguous long-term (days to months) pre-Amatrice earthquake anomalies in both hydraulic pressure and electrical conductivity, related to its preparation stage.

In the light of the above, we decided to duplicate the equipment presently working in the Gran Sasso aquifer in a site with similar hydrological setting: the Venafro carbonate hydrostructure (Molise, Saroli et al., 2019). The site we chose is located in one of the most seismically active

sectors of central-southern Apenninic belt, repeatedly hit in the past by large magnitude earthquakes and crossed by up to 20 km-long extensional fault systems (e.g. Galli & Naso, 2009). The main goals of our research are: i) measuring and understanding the dynamics of the carbonate aquifer, also through the analysis of rainfall, ii) deepening the relationships between aquifer behavior and earthquakes as well as to iii) widen the monitored areas.

Our experimental equipment includes a 3-channels 24-bit ADC set up for continuous local recording in groundwater (De Luca et al., 2016, 2018) in a horizontal borehole located in the drainage gallery “San Bartolomeo”, managed by Campania Aqueduct company. We started data acquisition in May 2019 by high-frequency continuous sampling (20 Hz for each channel) of physical parameters such as groundwater hydraulic pressure, temperature and electrical conductivity. We present some preliminary results (elaborated through a statistical approach) and possible explanations regarding the hydraulic pressure signals recorded before and during nearby (Mw 4.4, distance ~ 45 km) and regional (Albania, Mw 6.2, distance ~ 400 km) earthquakes, both occurred in November 2019.