Temporal variation estimates of apparent resistivities (AR) associated with ocurrence of seismic activity around Bogotá – Colombia using MT records from the RSUNAL seismic network

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Introduction - Justification

Rock's responses
before/during/after earthquakes
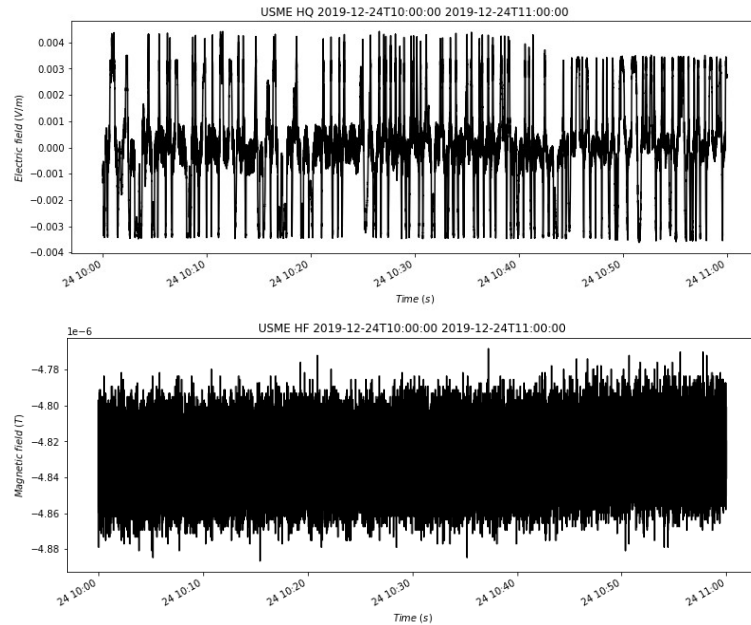(Physical parameters)

⬇

Fluid's migration

How do we measure fluids
(changes of fluids) in a rock?

⬇

Subsurface electrical
conductivity/resistivity (indirect
measure) – Magnetotellluric
method

Method

Input records (HQ, HF)

Apparent resistivity (AR) curve (using equations from Simpson & Bahr, 2005)
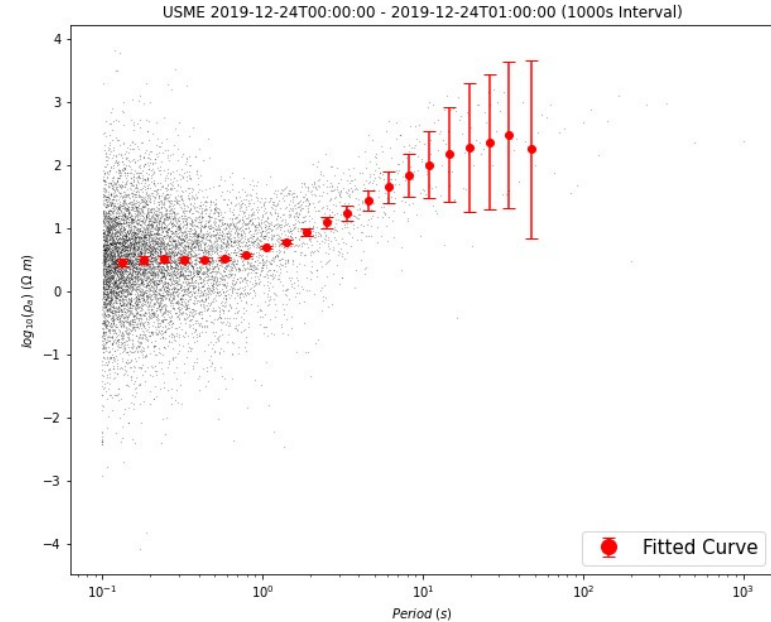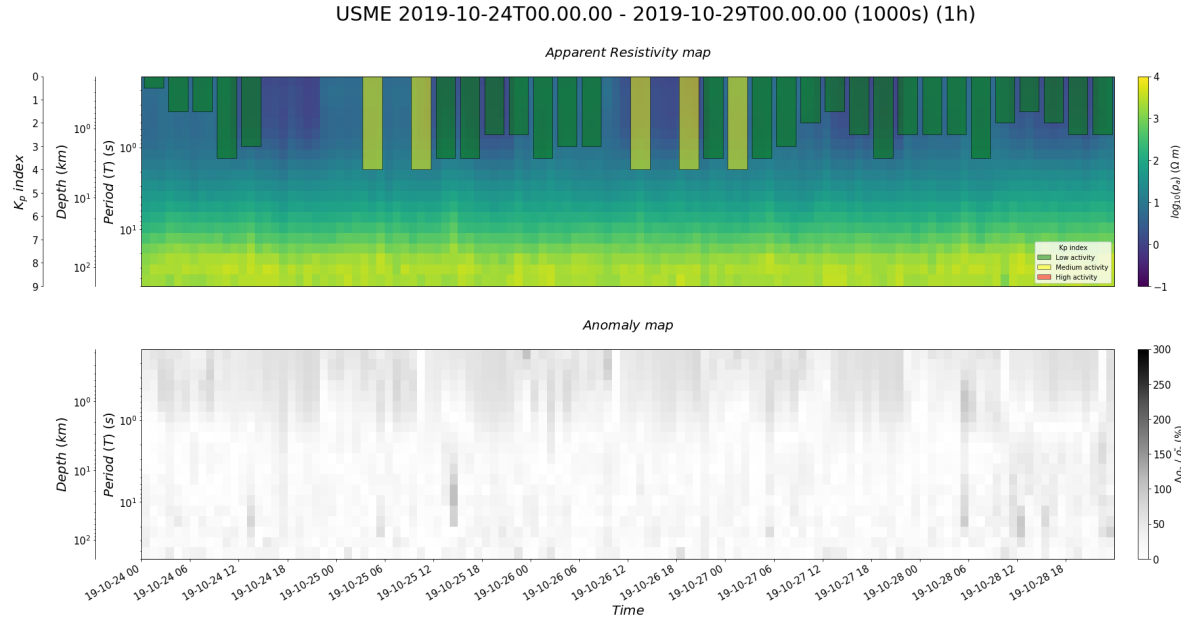

Figure 1. Input records of Electric and Magnetic fields from de USME station (RSUNAL Seismic Network) (left). Corresponding AR curve obtained from operating the input signals (right).

Method

Figure 2. Apparent resistivity (up) and Anomaly (down) maps which contains information about temporal variations of subsurface's resistivity.

$$\begin{pmatrix} \rho_{a_{0,0}} & \rho_{a_{0,1}} & \cdots & \rho_{a_{0,M}} \\ \rho_{a_{1,0}} & \rho_{a_{1,1}} & \cdots & \rho_{a_{1,M}} \\ \vdots & \vdots & & \vdots \\ \rho_{a_{N,0}} & \rho_{a_{N,1}} & \cdots & \rho_{a_{N,M}} \end{pmatrix} \implies \begin{pmatrix} (\sum_{i=0}^{M} \rho_{a_{0,i}})/M \\ (\sum_{i=0}^{M} \rho_{a_{1,i}})/M \\ \vdots \\ (\sum_{i=0}^{M} \rho_{a_{N,i}})/M \end{pmatrix} = \begin{pmatrix} \overline{\rho_{a_0}} \\ \overline{\rho_{a_1}} \\ \vdots \\ \overline{\rho_{a_N}} \end{pmatrix}$$

$$Anomaly_{i,j} = A_{i,j} = \frac{\rho_{a_{i,j}} - \overline{\rho_{a_i}}}{\overline{\rho_{a_i}}} \cdot 100$$

$$\begin{pmatrix} A_{0,0} & A_{0,1} & \cdots & A_{0,M} \\ A_{1,0} & A_{1,1} & \cdots & A_{1,M} \\ \vdots & \vdots & & \vdots \\ A_{N,0} & A_{N,1} & \cdots & A_{N,M} \end{pmatrix}$$

Results - Discussion

USME 2019-12-23T00.00.00 - 2019-12-28T00.00.00 (1000s) (1h)
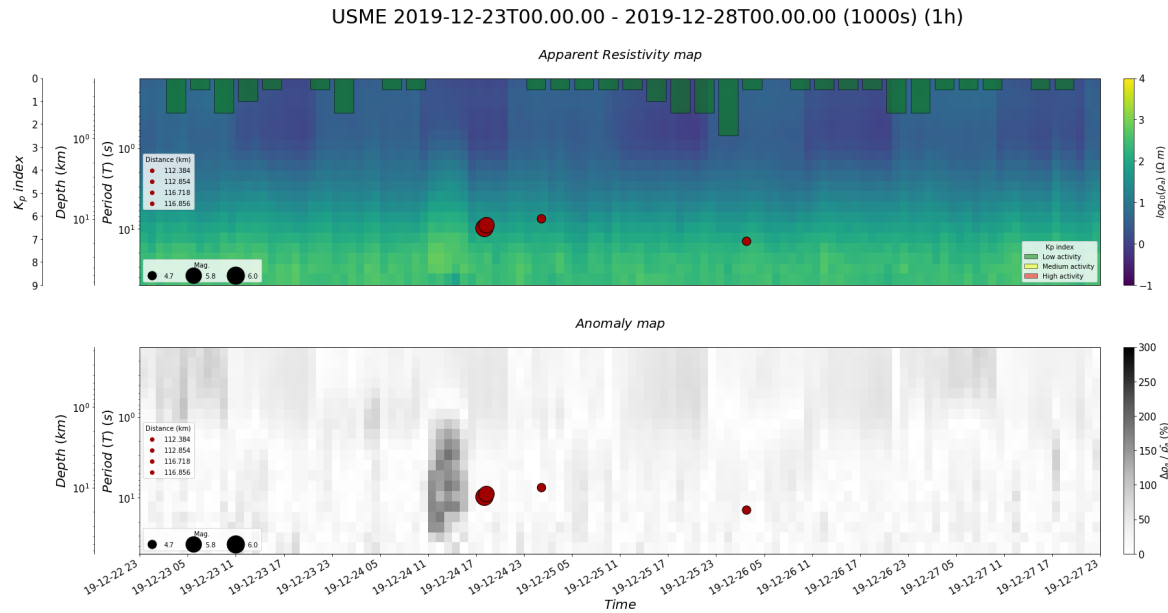
Apparent Resistivity map

Anomaly map

Figure 3. Apparent resistivity (up) and Anomaly (down) maps with the 6,0 Mesetas – Meta earthquake mainshock and some aftershocks associated.
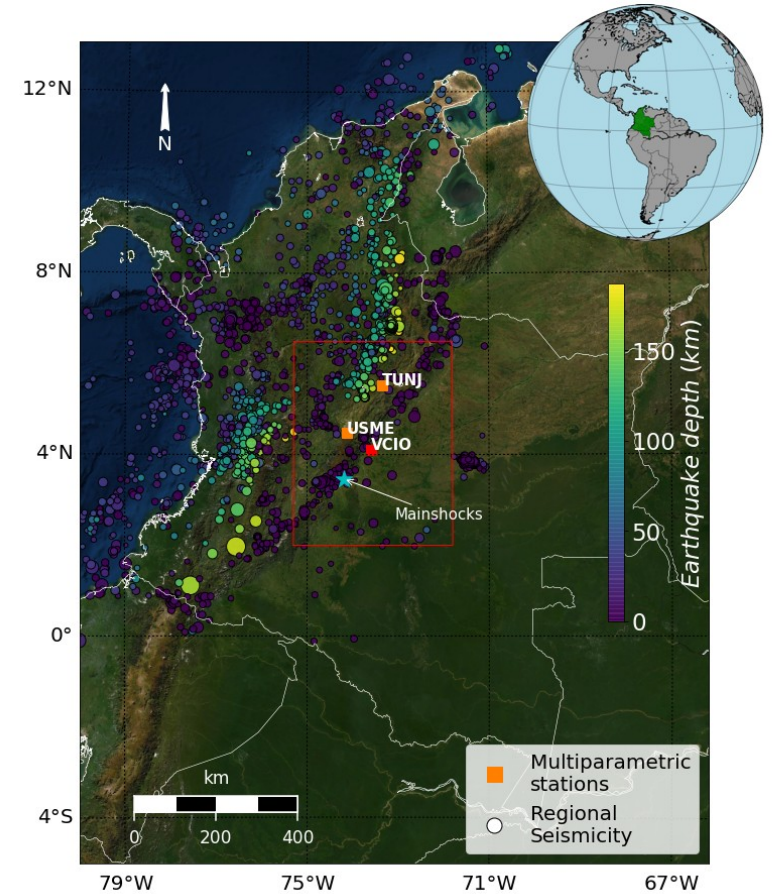

Figure 4. RSUNAL and mainshock locations. Besides, some information about regional seismicity in Colombia.

Concluding remarks – Future work

The 6.0 Mesetas – Meta earthquake suggest an AR anomaly 8 hours before the mainshock. Its duration was about 4 – 5 hours within a period of 1 – 30 s (~1,5 – ~40 km depth (?)).

The main limitation of this research, the database.

Althought this study was "succesful" in just 1 case, we insist that the results are clearly visible.
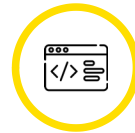
Let's connect!

Thank you!

Questions?

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