Supplement of Biogeosciences, 14, 5343–5357, 2017
https://doi.org/10.5194/bg-14-5343-2017-supplement

Biogeosciences Open Access EGU

Supplement of

Technical note: Application of geophysical tools for tree root studies in forest ecosystems in complex soils

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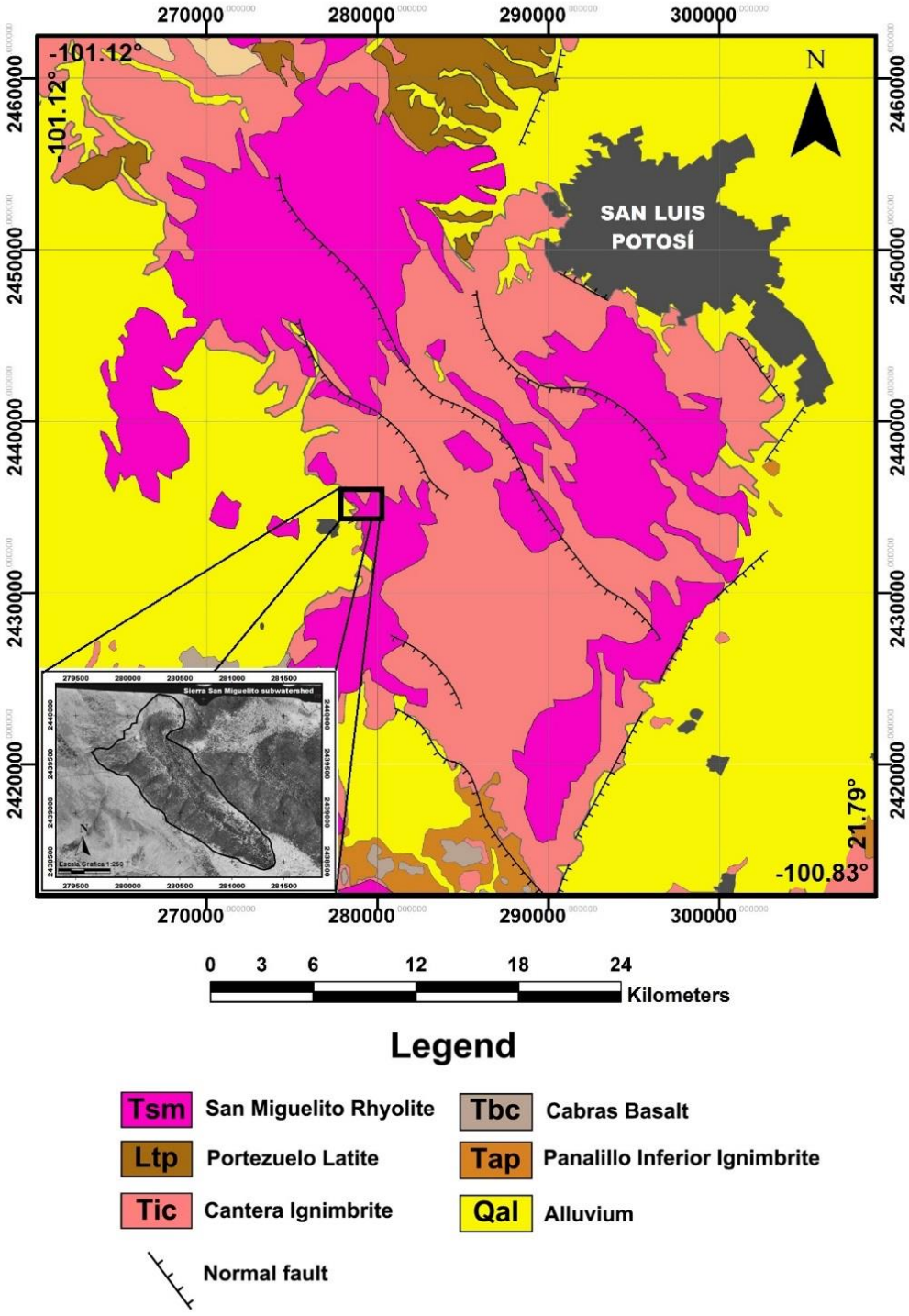

Figure S1. Geologic map of SSMVC showing the study area, San Miguelito rhyolite outcropping and structural features

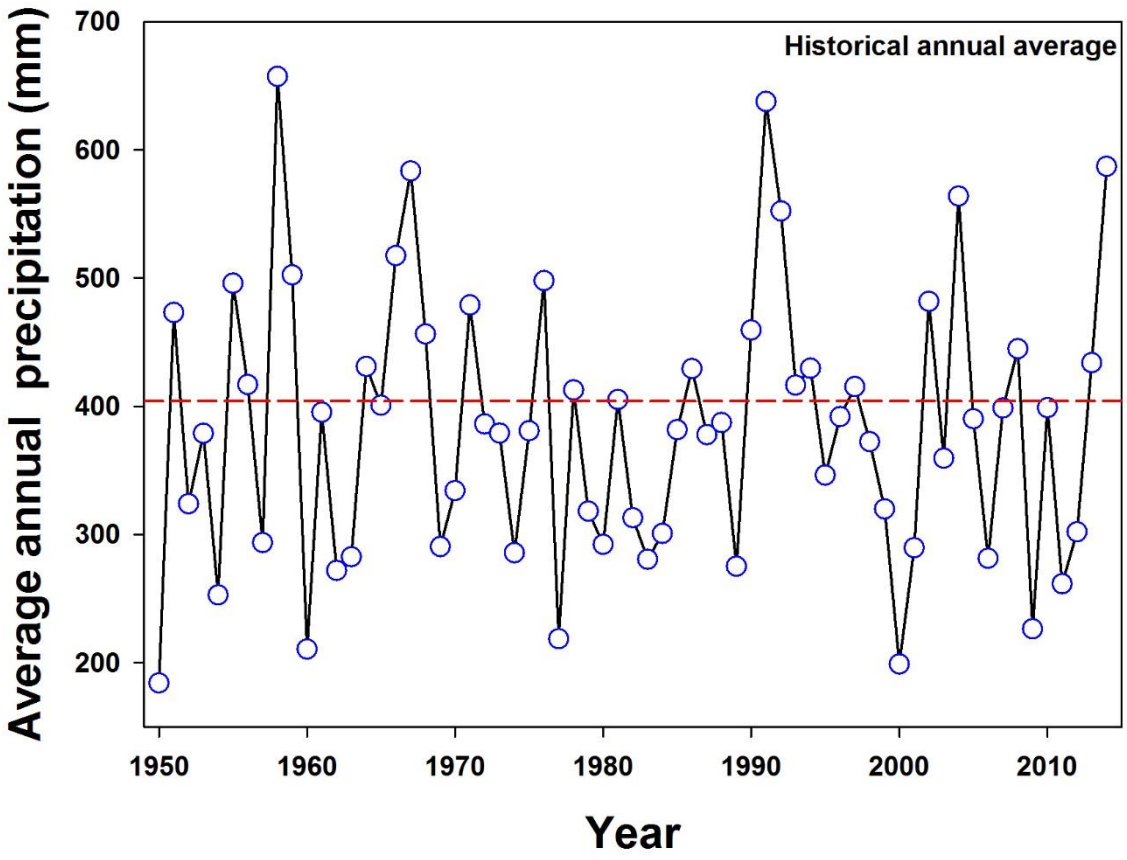

Figure S2. Historical mean annual precipitation for a period of 65 years in Sierra San Miguelito. Dashed line indicates the historical annual precipitation (averaged 408 mm). Weather station "La Purisima", 22° 5' 22.4", 101° 12' 28.9"

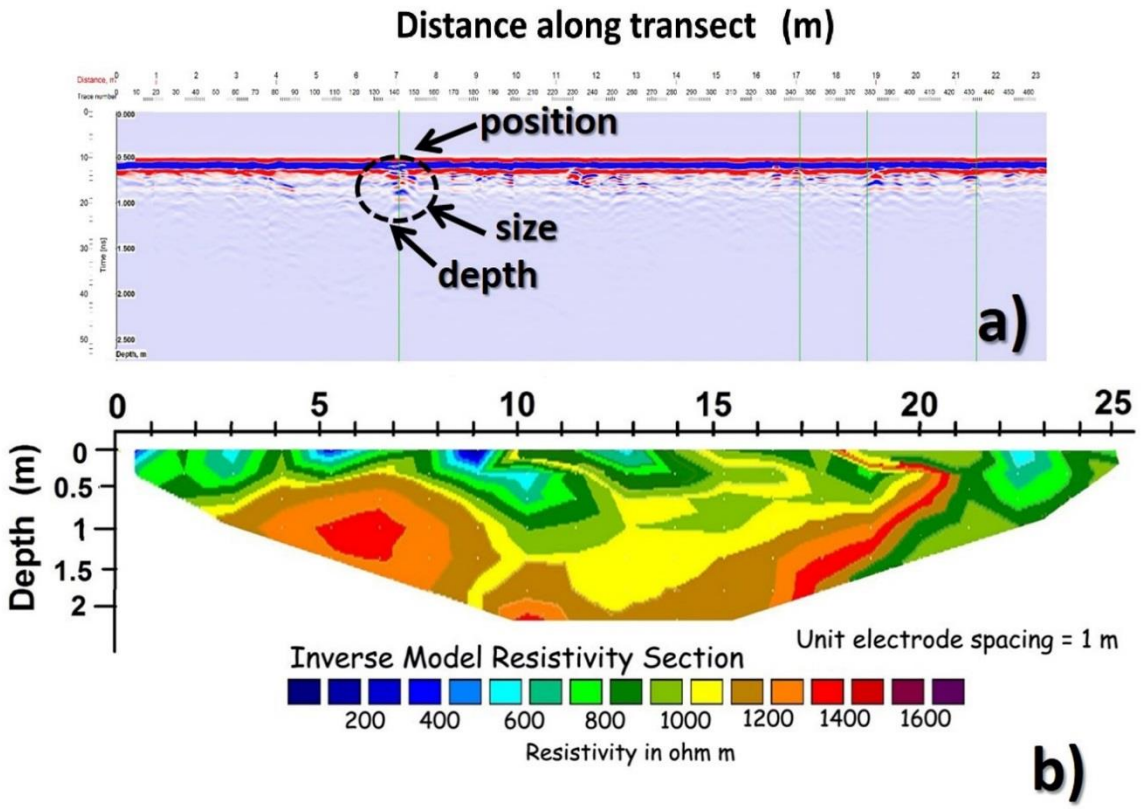

Figure S3. Interpretation of geophysical images. (a) Root identification as hyperbolic reflections obtained by ground penetrating radar (GPR). Estimation of the size, position and depth of roots with 2 to 6 cm diameter with 500 MHz shielded antenna. The dotted circle marks a root, whose existence was validated in the field. (b) ERT tomogram using a 24-electrode Wenner-type array with 1m electrode spacing. The electrical resistivity image shows areas of high soil water drainage (0 – 14 m and 22 -23 m, blue zone) and high frequency of rock fractures (at 0 – 0.5 m depth).

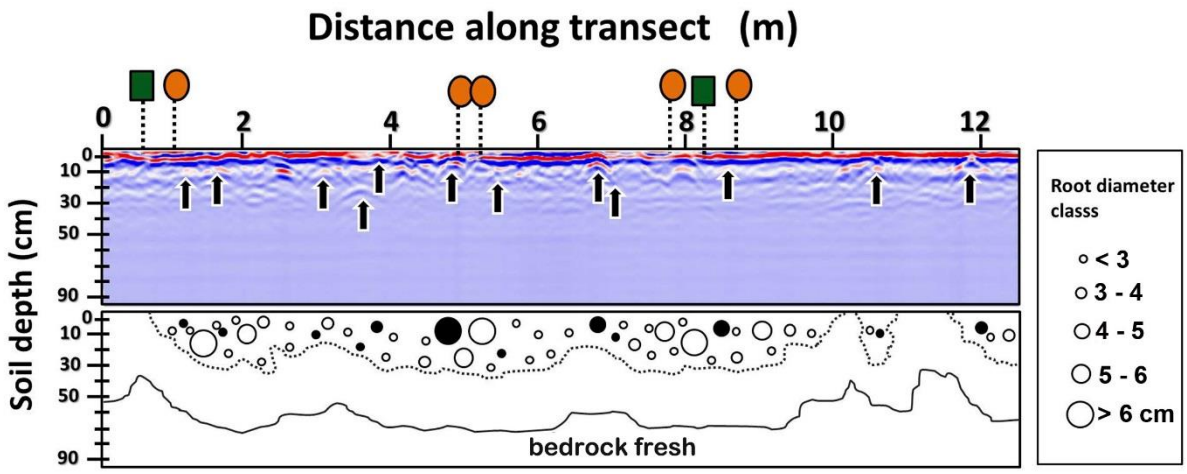

Figure S4. Spatial distribution (cross-section of roots) of individual roots of *Pinus cembroides* (green squares) and *Quercus potosina* (orange circles) in soil profiles at 12 m distance along a monitoring transect. GPR radargram was generated with a 500 MHz shielded antenna and band pass filters (both high-pass and low-pass filter) to eliminate both low and high frequency noise. Hyperbolically shaped reflections represent root reflectors. Black circles in the lower panel and arrows in the upper panel indicate roots that were excavated for GPR calibration. In the lower panel, the top layer corresponds to the soil horizon, pockets of soil and fractures, in which trees spread their roots; the intermediate layer corresponds to weathered bedrock; and the bottom layer represents fresh bedrock.

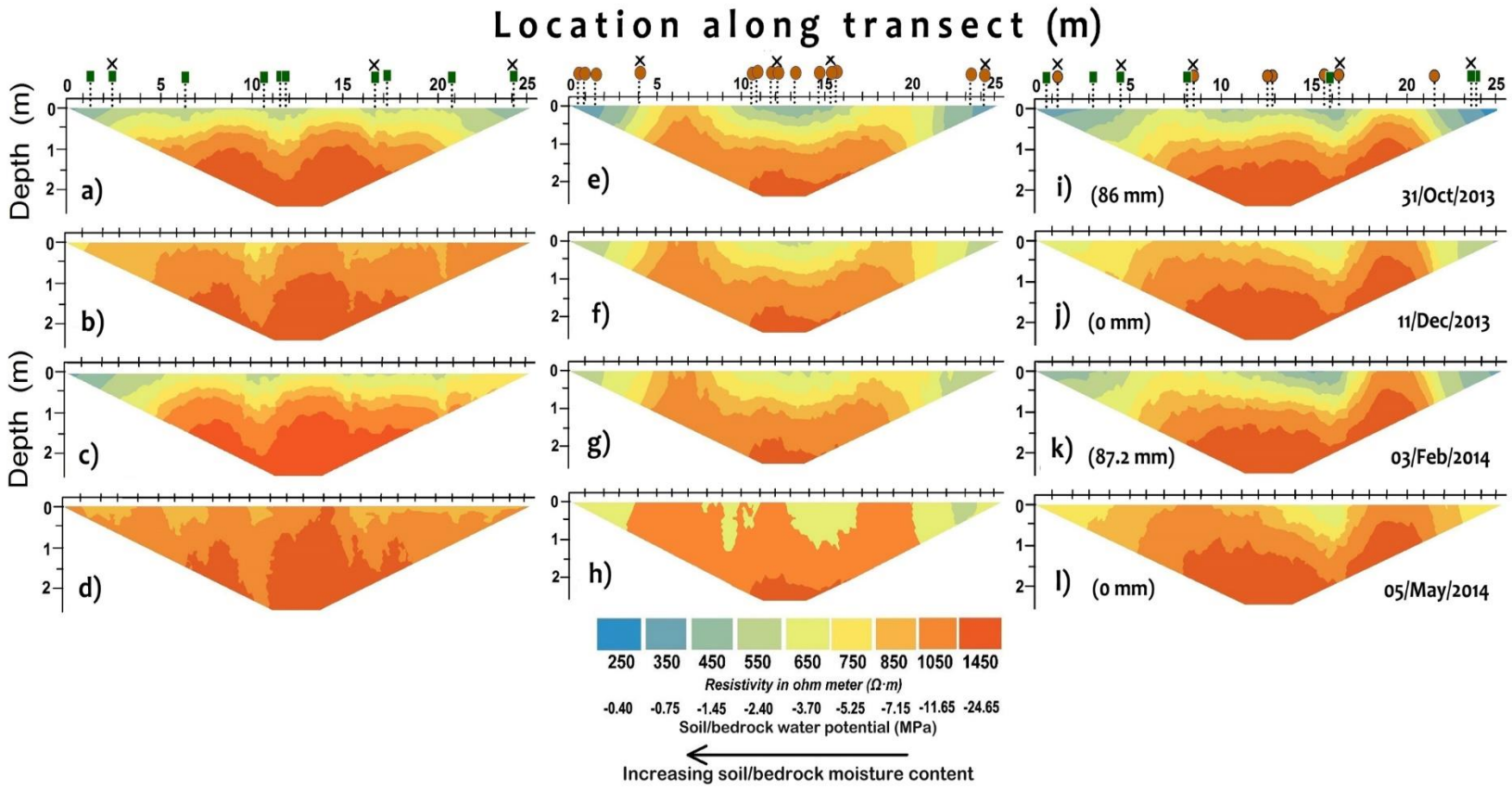

Figure S5. ETR tomograms in *Pinus cembroides*, *Quercus potosina* and Pine-Oak forest stands for different dates and accumulated precipitation: (a, e, i) October 2013, 86 mm; (b, f, j) December 2013, 0 mm; (c, g, k) February 2014, 87.2 mm; (d, h, l) May 2014, 0 mm rainfall. Squares mark pine tree positions, whereas circles mark oak tree positions. Trees marked with an X indicate the presence of soil psychrometers. Prediction error (average standard error): (a) 0.18, (b) 0.21, (c) 0.22, (d) 0.18, (e) 0.19, (f) 0.21, (g) 0.20, (h) 0.17, (i) 0.18, (j) 0.20, (k) 0.20, (l) 0.18, respectively.

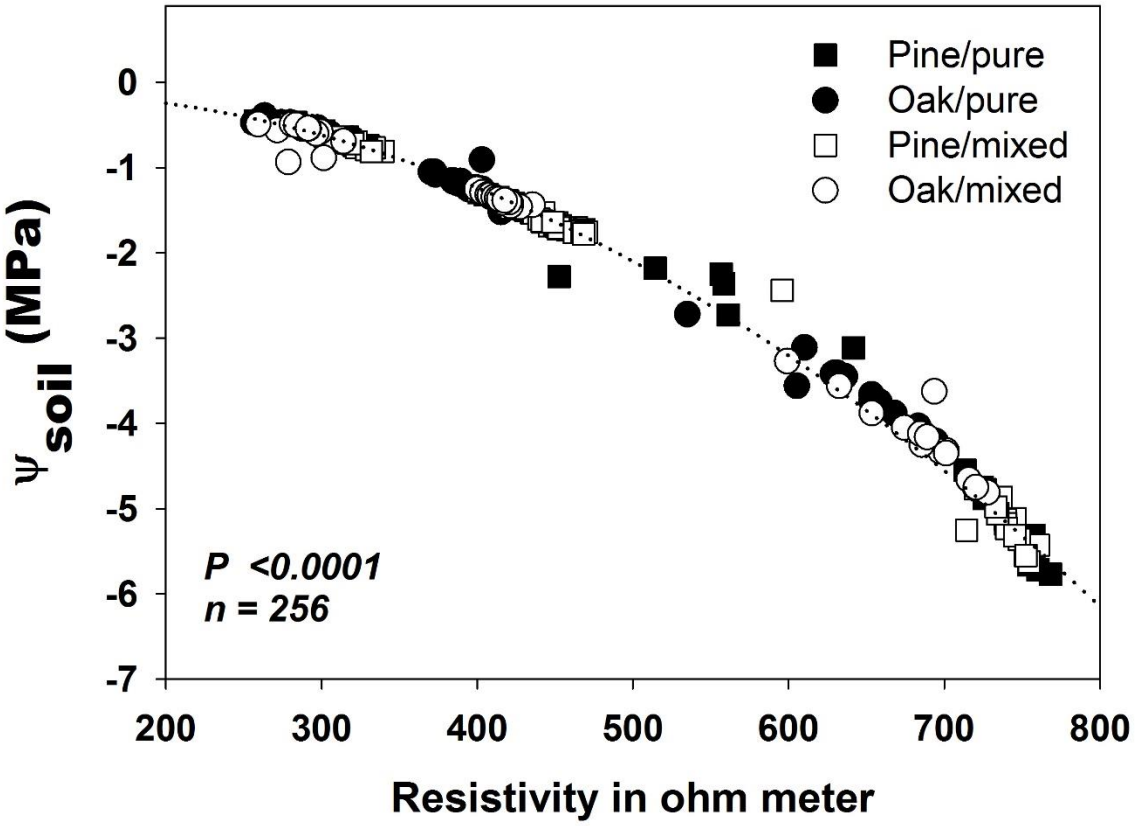

Figure S6. Relationship between soil water potential and soil resistivity for pine, oak and mixed stands. Global relation corresponds to the four periods defined in the study (October 2013, December 2013, February 2014 and May 2014) for both the spatial and temporal dynamics of soil resistivity.