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The desaturation processes in the vadose zone

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When there is a rain, the rain water will infiltrate downwards and tend to saturate the soil on its way. If the rain continues and is heavy enough, the infiltrated water may percolate to deep depth. However, once the rain stops or its strength decreases, the downward percolation of the infiltrated water would become much slower because it lost the pushing forces from upper side, and be much retarded by factors as root uptake, capillary forces and the upward evaporation. Thus water redistribution occurs in the subsurface and the soil begins to experience desaturation process. Since the period without rainfall usually is much longer than the raining one, this desaturation process has great importance on the vegetation growth and in our understanding the whole water circulation process. In this study, based on field monitoring with high-density electrical resistivity tomography (ERT), this desaturation process was investigated. The monitoring was conducted in a 4.5 m x 4.5 m square located in Nanjing Botanical Garden Mem. Sun Yat-Sen, Nanjing, China. The site is surrounded by trees and two trees stand near the corners of the square. Upper part of the soil profile is a kind of clayey loam, while the lower part is sandy clay. Between them, there seems to be a very thin (about 5cm), discontinuous rock layer, the origin of which is still unidentified. Soil properties at the site are extremely heterogeneous and the groundwater level was not found up to 3.17m depth. At the ground surface, a total of 100 stainless steel electrodes were installed to a depth of 5 cm, with the horizontal and vertical electrode intervals approximately equal to 50 cm. By using a multi-channel dense electrode electrical prospecting system, the soil electrical resistances were measured every given time interval, and the corresponding three-dimensional electrical resistivity tomography was conducted. Other instruments installed in the site include soil moisture meter, tensiometer, rain gage, evaporation pan, earth and air temperature meters. The results from two drying period observation indicate that the desaturation

process occurred in the field is quite heterogeneous and behaves differently during the two drying periods. While some places in the site correspond to the continuing dry weather fast, the other places seem to correspond it slowly. Spatial distribution of the places liable to desaturate has a relatively stable structure. Both of the tree canopy and its root influenced the nearby soil water dynamics greatly. The soil under the tree shows the latest wetting and the fastest drying properties. While detail analysis about the interactions between tree and soil water is still on the way, the data show that the two trees probably are competing for the water from the central part of the square.