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Terrestrial Systems Research: Monitoring, Prediction & High Performance Computing

<u>Oral</u> presentation in **Session**:
Monitoring of terrestrial systems

Ground-based quantitative electromagnetic induction measurements and inversions show that patterns in airborne hyperspectral data are caused by subsoil structures

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Non-invasive geophysical fixed-boom multi-coil electromagnetic induction (EMI) instruments return apparent electrical conductivity (ECa) values that depend on subsurface soil properties. Using different transmitter-receiver coil separations and orientations, ECa values of different depths of investigation (DOI) are obtained. After calibration, the quantitative EMI data are inverted to obtain electrical conductivity (σ) changes over depth assuming a layered subsurface model. Airborne hyperspectral measurements are used to estimate plant performance and growth, however, the top- and subsoil structural changes influencing plant performance and growth is often ignored. Here, we have investigated the origin of observed patterns in sun-induced fluorescence data by performing quantitative large-scale EMI measurements and quantitative inversions. The fixed-boom multi-coil EMI ECa data of nine coil configurations indicated spatial patterns due to buried paleo-river channels. After inversion, the obtained layered quasi-3D electrical conductivity model showed a relatively homogeneous ploughing layer and the presence of the paleo-river channels at > 1 m depth. Contrary to often used assumptions, σ of the ploughing layer only showed minor correlation to fluorescence data (r ~ 0.35), while the subsoil returned a significant correlation (r ~ 0.65) indicating a substantial influence of the subsoil on the plant performance, especially during dry periods which is probably due to differences in soil water holding capacity. For the first time, we have related soil-depth

specific 3D subsurface information obtained by quantitative multi-coil EMI data inversions with sun-induced fluorescence data and have shown that above surface plant performance is caused by subsoil structural changes. Consequently, the subsurface structures should be incorporated in plant modeling as well as in terrestrial system modeling tools to improve the understanding of soil-vegetation-atmosphere exchange processes.