Imaging the Critical Zone Using Ground Penetrating Radar and Electric Resistivity. Initial Results From the Boulder Creek Critical Zone Observatory

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The Critical Zone (CZ) became a major focus of Geoscience within the last years. Its interdisciplinary approach offers great opportunities to achieve data of the CZ which is defined as the thin, porous covering of the earth, within which rocks, soil, gases and water interact. Information about the vertical and lateral alteration of the CZ are indispensable for many geomorphological, hydrological, biological and pedological studies. Geophysical methods possess a great value to acquire data of the CZ as the methods are mainly non-invasive and they can explore large areas within a short time. Here, we present initial data from the NSF-funded Boulder Creek Critical Zone Observatory (BC-CZO) in the Front Range of the Rocky Mountains in Colorado, USA. Ground Penetrating Radar (GPR) and Electric Resistivity Tomography (ERT) were applied at three different catchments to achieve subsurface information of the structure, the thickness and the layering of the CZ. The three catchments represent different landscape types. Green Lakes Valley is a typical alpine tundra area at around to 3600 m.a.s.l., whereas Gordon Gulch (2700 m.a.s.l.) represents a sub alpine area. The lower montane area is represented by the watershed of Betasso (1900 m.a.s.l.). These three study sites enormously differ in their requirements for geophysical studies as vegetation, slopes, moisture due to precipitation, rockiness etc. vary a lot. A certain scheme of data collection was developed to counteract the different environments. The presented results include data about glacier ice mass balance, determination of ice within rock glaciers, periglacial slope deposits (active and inactive), depth to bedrock and zones of saprolite weathering. Drillings and natural sections provide the necessary ground truth. Data aggregation within the next years will allow a three dimensional model of the CZ for each of the three catchments with their characteristic composition of the CZ.