Abstract: X-ray tomography is a technique that allows for three-dimensional observation and measurement of variables internal to an otherwise opaque object. Detail resolution ranges from 100s of microns for cm-sized samples, 1-5 microns for mm-sized objects, and 100s of nm for micron-sized objects. Contrast depends on density and atomic number of the imaged object and creative use of contrast agents can thus help delineate otherwise difficult to identify features. The technique has advanced to the point where detailed probing and quantitative analysis of processes and mechanisms at the pore-scale is possible. Among the variables of relevance to multi-phase systems, we are able to measure porosity, saturation, fluid-fluid interfacial area and curvatures and characterize the wettability state of a porous medium. Multi-phase fluid can be classified as connected vs. disconnected, and morphological and topological measures such as Betti and Euler numbers can be measured and used to describe fluid connectivity.

This presentation will provide an overview over the current state of imaging of earth science processes using x-ray tomography, and examples of application to relevant environmental engineering problems such as groundwater remediation and geologic storage of CO₂.