

Critical Zone System Science (EH 6XX)

Open system framework and introduction to Critical Zone,

Components of Critical Zones : Introduction to climate, landforms, soil, water and biota components.

Multiscale Geophysical and geochemical imaging of the Critical Zone structure: Magnetic, Electrical, Electromagnetic, GPR, NMR and Seismic methods for subsurface imaging. Chemical analysis of soil, surface water and groundwater.

Process models in Critical Zone:

Radiative energy and mass balance on the Earth's surface,

Thermodynamics of solutions and mixtures, Rate of entropy production, Geochemical kinetics: rate models, Chemical reactions in soil-water interaction,

Conservation laws and constitutive relationships for porous media, Richard's and Boussinesq equations for unsaturated and saturated media. Heat conduction and advection, Thermal convection, Mass and energy transport in river and landform evolution.

Ecosystem processes: Growth and decay and Advection-diffusion-reaction models

Process - structure integration in the Critical zone: Geological and climatic drivers of critical zone processes, Modifications by anthropogenic forcing.

References:

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- Giardino, J.R. and Houser, C., 2015. Principles and dynamics of the Critical Zone. In (Shroder Jr, J.F. - eds.) Developments in Earth Surface Processes, Vol 19. Elsevier.
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- Anderson, R.S. and Anderson, S.P., 2010, Geomorphology: The Mechanics and Chemistry of Landscapes.
- Butler, D.K., Near Surface Geophysics. Society of Exploration Geophysics, Series of Investigation in Geophysics, Vol. 13.
- Everett, M.E., 2013. Near-Surface Applied Geophysics. Cambridge University Press.
- Reynolds, J. M., 2011. An Introduction to Applied and Environmental Geophysics. Wiley-Blackwell.
- Turcotte, D. and Schubert, G., 2014, Geodynamics, Third edition, Cambridge Univ Press.
- Ganguly, J., 2008, Thermodynamics in Earth and Planetary Sciences. Springer