Special Issue

Freeze-Thaw Cycles of Rock and Soil in the Sustainable Ecological Environment and Engineering Safety

Message from the Guest Editor

Freeze-thaw (F-T) cycles significantly impact both ecological stability and engineering safety, especially in cold and high-altitude regions. Under climate change, intensified F-T cycles exacerbate soil erosion, rock weathering, infrastructure degradation, and ecosystem vulnerability. For instance, F-T cycles alter soil structure and induce salt frost heaving in saline soils, threatening road durability and slope stability. Simultaneously, they regulate physiological responses of desert mosses and soil greenhouse gas emissions, influencing carbon sequestration and biodiversity. Understanding these dual impacts is critical for achieving sustainability goals, balancing ecological resilience with engineering reliability. This special issue aims to explore the mechanisms, mitigation strategies, and sustainable solutions for F-T cycle impacts on ecosystems and engineered systems. Topics span material science, geotechnical engineering, and ecosystem dynamics. Contributions will advance knowledge on climate-adaptive materials, low-carbon technologies, and ecosystem-based engineering practices.

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