Soil response and cracking failure induced by severe drought climate

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The formation of cracks on soil surface is a common natural phenomenon as the soil is subjected to drought climate. The presence of cracks can significantly affect soil performance in various geological, geotechnical, and environmental engineering applications, and decrease the stability of earth structures. With increasing frequency of severe drought climate, better understanding of soil response and cracking failure process is becoming an increasing significant issue. In this investigation, a series of desiccation tests were performed on soils by simulating long term drought climate. The soil water evaporation, volumetric shrinkage and surface cracking processes were monitored and their coupled mechanisms were thoroughly analysed. Moreover, the evolution of mechanical parameters that controlling soil cracking development was measured during drying. It is found that the evaporation process of soil is composited of three stages: Constant, falling and residual rate zones. The soil is saturated during constant rate period. The shrinkage process of soil is also composited of three stages: Normal, residual and zero shrinkage. The initiation and propagation of desiccation cracks show evident dynamic characteristics and significantly depend on soil water evaporation rate, stress state and shrinkage properties of soil. The cracks initiate as the tensile stress induced by suction exceeds soil tensile strength, and the corresponding evaporation rate lies in constant stage where the soil is still saturated. Most of the cracks develop during constant evaporation rate period and normal shrinkage stage. Intrinsically, the crack opening is the result of pore volume shrinkage, and the cracking curve presents the same physical significance with the shrinkage curve. Based on the obtained results, a tensile failure criterion is proposed for predicting soil cracking behaviour as the soil is subjected to drought climate.

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Correct atmosphere optics modelling: Theory and experiment

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Rapid evolution of computers in last decades provides complicating atmospheric models with detailing vertical profiles, accounting for irregular clouds in wide spectral ranges. Numerical algorithms for calculating radiative characteristics with maximal exactness and minimization of uncertainty are usually applied. There are many different computer codes including look-up tables with aerosols characteristics, water vapor, atmosphere conditions in different latitudes, continental and sea conditions, and seasons. Sophisticated approaches for calculating optical parameters are based on scattering and radiative transfer theories. It is very useful for applied problems. However the analysis of separate factors influence on atmospheric radiative characteristics without of considering all possible variations of the whole totality is often necessary for many research problems. For that case the simple models of homogeneous (for the clear atmosphere) and two or three layer atmosphere (for cloudy cases) allow operative varying considered atmospheric optical parameters and provide result that hardly contributes to complicate models and clearly elucidate an interactions between of key atmospheric parameters and radiative characteristics. Two-stream methods of radiative transfer theory ensure an acceptable exactness for calculating integral (over viewing directions) radiative characteristics (irradiance and radiative divergences). Asymptotic formulas are also effective for fast and transparent calculation in case of the cloud atmosphere. A simplest optical model is accepted of the homogeneous clear atmosphere including ozone absorption in UV ranges, molecular scattering, and four variants of the aerosol content at selected shortwave wavelength. In cloud case three variants of extended cloud layer are added. Radiative characteristics together with heating rate are calculated and presented in this study. Results of optical parameters retrieved from observation of solar radiation in the atmosphere and radiative characteristics are compared with simple modelling.

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