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Effects of microplastics on temperature profiles inside porous media during evaporation

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The increase in plastic production is expected to exacerbate plastic waste disposal in terrestrial ecosystems. Soil represents a large reservoir for plastic wastes. Once disposed into the soil, plastic wastes interact with soil particles and biota and affect chemical, physical, and biological processes in soil (Jannesarahmadi et al., 2023). Microplastics (MPs) with distinct thermal and radiative properties and filling characteristics can alter energy partitioning over the surface of drying porous media and thus subsurface thermal regimes. The present study aims to quantify impacts of MPs on latent heat loss and temperature dynamics in drying sandy media. We conducted a series of evaporation experiments on sand columns (height: 20 cm –diameter: 8 cm) with grain size ranging from 0.4 to 0.8 mm and density of 2.65 g/cm³. Two types of microplastics with different characteristics and concentrations were used: Polyethylene (PE) with 34 to 50 µm particles and density of 0.94 g/cm³ and Polyvinylchloride (PVC) with particles ranging from 80 to 200 µm and density of 1.4 g/cm³. Mass loss rates from sand samples with different concentrations of MPs (i.e., 0.5, 2, and 5%) were compared with drying rates of the sand column without MPs serving as a reference. An array of thermocouples continuously measured vertical temperature profile in drying sand columns subjected to different wind and radiative boundary conditions. Airflow was generated by an adjustable fan and shortwave radiation flux was mimicked using halogen lamps with different intensities. Our preliminary results show that the presence of MPs with different characteristics alter evaporative loss and vertical temperature profiles in drying sand samples with the surface accumulation of PE particles (with lower density relative to water) influencing the thermal and radiative properties at the surface of drying porous media. The study provides new insights into the impact of MPs on energy partitioning dynamics over drying terrestrial surfaces and subsurface thermal regimes that could potentially affect various hydrological and biological processes in soil.

Participation

Online

References

Jannesarahmadi, S., Aminzadeh, M., Raga, R., Shokri, N. (2023), Effects of microplastics on evaporation dynamics in porous media, Chemosphere, 311, 137023.

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