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Wind erosion of microplastics from soils: implications for microplastic dispersal and distribution

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Microplastics have potentially deleterious effects on environments and ecosystems. The main research focus for translocation of microplastics has been via water, however recent studies of soils in the Alps and Middle East indicate airborne transport following wind erosion may also be significant. This paper reports wind tunnel studies to determine the extent to which two types of low density microplastic (microbeads and fibres) may be preferentially transported from different substrates – a well-sorted quartz sand and a poorly-sorted soil containing 13% organics. The polyethylene microbeads had a size range of 212-250 microns and density of 1.2 g cm^3. The polyester fibres were 5000 microns long and 500-1000 microns in width with a density of 1.38 g cm^3. Concentrations of microplastics in the initial wind tunnel bed ranged from 40-1040 mg kg^{-1} and the wind tunnel was used to determine the wind speeds at which intermittent and continuous saltation occurred using 0.25 m s^{-1} increments. Microplastics were entrained for all experiments regardless of the type of microplastic or substrate but the threshold for entrainment was higher for soils (>10.8 m s^{-1}) than for the sand bed (>6.9 m s^{-1}). The lowest enrichment ratios (ER) for microplastics were associated with the entrainment of beads from the soil bed (ER = 0.5-7) whilst the highest ERs were found for fibres entrained from the soil bed (ER 100 - >1000). Overall fibres were more likely to be entrained by wind than beads. The data will subsequently be used to explore the microplastic concentrations and emissions at source required to account for reported microplastic deposition at sink locations.