A Systematic Experimental Investigation of Micro- and Nanoplastics Aerosolization by Oceanic Breaking Waves

Nishan Pokhrel*[1], Charbel Harb[1], and Hosein Foroutan†[1]

[1]The Charles E. Via, Jr. Department of Civil Environmental Engineering – 417 Durham Hall Virginia Tech, Blacksburg, VA 24061, United States

Abstract

Marine environments are often considered to be the ultimate sink of plastic pollutants. Recent investigations, however, have suggested that micro- and nanoplastics (MNPs, plastic particles less than 5 mm in size) can potentially aerosolize from the ocean into the atmosphere through sea spray aerosols (SSA) generated via breaking waves and bubble bursting. Limited number of studies have explored the contribution of oceans to atmospheric MNPs, and experimental studies of water-air transfer of MNPs is still in its infancy. The goal of this study is to conduct systematic laboratory experiments to investigate MNPs aerosolization in a wave-breaking analogue tank containing synthetic seawater and MNPs of various properties. Specifically, experiments are conducted with two different types of MNPs, namely polystyrene (PS) and polyethylene (PE), with the former being uniformly suspended in the in the bulk water due to its density, while the latter distributed on the surface. Size, concentration in water, as well as surface characteristics (pristine vs UV-aged) of each of the MNP types are systematically varied to investigate the effect of those parameters onto the aerosolization rate. MNP filter samples collected during the experiments are analyzed using Fluorescence and Raman Microscopy techniques. Preliminary results show that subsurface distributed particles are aerosolized at water concentrations much smaller than those floating on the surface. The findings of the study further constrain the MNP aerosolization flux from oceans and support atmospheric modeling endeavors.

Keywords: microplastics, nanoplastics, MNPs, aerosolization, breaking waves, SSA

*Speaker

†Corresponding author: hosein@vt.edu