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Scavenging of ice-nucleating microorganisms from the atmosphere by artificial rain events

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Little is known about how microorganisms are scavenged from the atmosphere during rainfall. Microorganisms are abundant and diverse in rain (precipitation) collected near the surface of the earth. Some of these rain-associated microorganisms produce proteins that catalyze the nucleation of ice crystals at significantly warmer temperatures than would normally be required for ice formation, suggesting that they may play important roles in weather, including the onset of precipitation. We conducted a series of field experiments to test the hypothesis that ice-nucleating microorganisms are scavenged from the atmosphere by rainfall. Thirteen artificial rain events were conducted off the side of the Smart Road Bridge in Blacksburg, VA, USA. In each event, sterile water was dispensed over the side of the bridge (simulated rainfall), and recovered in sterile containers following gravitational settling from the side of the bridge to an open fallow agricultural field below (a distance of $\sim$55m from the release site to the collection site). Microbes scavenged from the artificial rain events were cultured on six different types of agar media (R2A, TSA, CA; +/- cycloheximide) and the ice nucleation activity was examined for colonies cultured from the different media types. Mean CFUs scavenged by artificial rain ranged from 83 to 196 CFUs/mL across all six media types. Ice-nucleating microorganisms were recovered from 85% (11/13) of the simulated rain events, and represented about 1% of the total number of colonies assayed from each event. Strikingly, this percentage is nearly identical to the percentage of culturable ice-nucleating microorganisms occurring in about half of the natural rain events studied to date in Blacksburg, Virginia. This work expands our knowledge of the scavenging properties of rain, and suggests that at least some ice nucleators in natural precipitation events may have been stripped from the atmosphere during rainfall, thus negating their potential role in the onset of precipitation.