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Improving microbial quality assessment for irrigation water in ponds using the Environmental Fluid Dynamic Code

Seongyun Kim, Matthew Stocker, Manan Sharma, and Yakov Pachepsky
Environmental Microbial and Food Safety Laboratory, USDA-ARS, Beltsville, MD, USA

Microbial quality of irrigation water is a public health concern. Management decisions are routinely based on concentrations of fecal indicator bacteria like *Escherichia coli* (*E. coli*) in water sources. In the case of irrigation ponds, water samples are often collected near the banks and at shallow depths due to convenient access. However, we hypothesized that water is drawn from locations far from the shoreline and far below the water surface during irrigation events. We used the Environmental Fluid Dynamic Code (EFDC) water quality model to test this hypothesis by simulating water and tracer movement in a working irrigation pond. The initial condition datasets included (1) setting the tracer concentration to zero at the shoreline and to unity in the interior and (2) setting the tracer concentration to zero at the surface water layer and to unity in the deeper layers. Tracer transport to the intake location was simulated with and without wind effect. The simulated concentrations at the intake were close to unity, indicating an insignificant contribution of the near-surface and nearshore layers to the intake concentrations. Four years of biweekly sampling of nearshore and interior locations in two irrigation ponds revealed statistically different average *E. coli* concentrations between nearshore and interior locations under various environmental conditions. Additionally, when three-dimensional monitoring was conducted, significantly different *E. coli* concentrations between water depth layers (e.g., 0 m to 0.5 m, 0.5 m to 1 m, 1 m to 1.5 m, etc.) were frequently observed. Mixing water from different depths or locations in the same water body in response to the initiation of irrigation did not homogenize the tracer in the pond. Hydrodynamic modeling showed that the *E. coli* concentration at the intake changed over the course of the irrigation event in response to the 3D spatial heterogeneity of concentrations measured in the pond water. The results of this work show that 1) water samples should be collected from the pond interior at depths close to the irrigation water intake, and 2) water must be sampled several times during irrigation events if samples are taken at the irrigated fields rather than in ponds.