THE MIXING OF RAIN WITH NEAR-SURFACE WATER

DENNIS F. HOUK, University of Wisconsin.

ABSTRACT

Rain experiments were run with various temperature differences between the warm rain and the cool receiving water. The rain intensities were uniform and the raindrop sizes were usually uniform (2.2 mm, 3.6 mm, and 5.5 mm diameter drops). Two drop size distributions were also used.

The depth of mixing varies from 8 cm for raindrops less than 1.5 mm in diameter at an intensity of .9 cm/hr to 42 cm for drops 5.5 mm in diameter at 2.3 cm/hr. The mixed layer depth was found to be directly proportional to the rain's kinetic energy, to the 1/3 power of time, and inversely proportional to the rain-induced heat transfer through the water surface. The proportionality constants vary with raindrop size. Large raindrops strongly affect the depth of mixing even though they are a small fraction (2 - 4%) of the total rain volume. For natural rain, which consists of a broad spectrum of drop sizes, the constant representative of the largest few percent of the drop sizes should be used to predict the mixed layer depth. Maximum errors using the equations developed for predicting the depth of mixing were found to be 24% of the observed depth.

The rain dilution of the near-surface water may be estimated (to 24%) when the depth of mixing is known. If rain is acidic then the pH of unbuffered surface waters will be lowered depending on the mixed layer depth (dilution). The pH values of unbuffered surface waters could be estimated.