

## **Photochemical alterations in gas phase and surface water ethanol concentrations in southeastern North Carolina, USA**

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Renewable fuels have been identified as an alternative to petroleum based fuels in the everchanging energy landscape. Recently, ethanol production has dramatically increased to provide a renewable fuel for the transportation sector however there are fundamental questions regarding the occurrence and fate of the biofuel. Diurnal variations in gas phase and surface water concentrations of ethanol and acetaldehyde were investigated at several locations near the University of North Carolina Wilmington, USA campus. There were distinct diurnal oscillations in gas phase concentrations with maxima occurring in late afternoon near the period of peak solar intensity suggesting that photochemical production is an important process in the cycling of these analytes in the troposphere. The rapid decrease in concentrations after the mid day maximum suggests that there is also an atmospheric photochemical sink for both analytes most likely involving photo produced hydroxyl radicals. Ethanol concentrations in the surface microlayer taken at the same time as gas phase samples had a very similar diurnal profile with time suggesting radical mediated photochemical processes, in addition to atmospheric deposition, play a role in the aqueous phase cycling of both analytes. In controlled laboratory experiments, the concentration of ethanol and acetaldehyde increased significantly in flasks containing fresh surface water exposed to simulated sunlight for 6 hours underscoring the importance of in situ photochemical production. Results of this study are significant because they represent the first simultaneous analyses of the temporal variability of ethanol and acetaldehyde concentrations in the gas and aqueous phases and their potential impact on radical chemistry both in the atmosphere and in surface waters. These measurements are essential in order to better define the impact of ethanol on the oxidizing capacity of the troposphere both now and in the future as our use of this biofuel continues to grow.