Emissions of organic compounds from produced water ponds in the Uinta Basin, Utah and the Upper Green River Basin, Wyoming

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When crude oil and raw natural gas are extracted from the Earth’s crust, large amounts of water, known as “produced water,” are also brought to the surface. This water phase is often saline, and also contains dissolved and suspended hydrocarbons, so without treatment, its release into the hydrosphere is unacceptable. About 95% of the water produced in the Uinta Basin is reinjected into spent oil or gas wells, while the remainder is discharged into open-air impoundment ponds, or “produced water ponds,” for evaporation. Water intended for reinjection is also often stored in open-air ponds. Before our study, very few measurements of VOC emissions from these ponds had been performed, and because no measurements existed, these ponds were routinely overlooked in emissions inventories. Over the past several years, we have performed extensive flux chamber and inverse modeling measurements of VOC emissions from ponds in the Uinta Basin and the Upper Green River Basin. Co-located measurements of organics in the ponds have allowed us to study correlations between water-phase concentrations and air-phase fluxes. These correlations are consistent with the WATER9 semi-empirical model to within about an order of magnitude. Newer water is an important source of hydrocarbon emissions, while water that has been in long storage is an important CO2 source. 1-D models suggest that this temporal cross over from hydrocarbon to CO2 emissions is the result of poor vertical mixing in the ponds. Methanol emissions can also be important. We have scaled our measurements up to the basin level, and estimate that the Uinta Basin ponds emit about 700 t/y CH4; 18,000 t/y CO2; 2,000 t/y non-methane hydrocarbons; and 5,000 t/y alcohols (mostly methanol). The omission of these emissions from inventories is a serious oversight.