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While disinfection byproducts (DBPs) are typically measured at drinking water treatment plants, levels can change dramatically within the distribution system before reaching the consumer. In this study, the spatio-temporal trends of 66 DBPs across 9 different classes were examined in two drinking water distribution systems with similar source waters, but different pretreatments and residual disinfectants. One system uses residual chlorine in the distribution system, the other chloramine, allowing for examination of how DBP concentrations change over time in distribution systems with different residual disinfectants. Four routes were sampled for each system with six time points over three days travel time, collected at increasing distance from the treatment plant to “chase” the same packet of water. Generally, DBP levels increased over time in the chlorinated system, but decreased in the chloraminated system, indicating that DBP formation in the pipes outpaced DBP degradation in the chlorinated system. Among emerging DBP classes, haloacetamides and iodo-DBPs decreased by 57% and 64% (dichloroiodomethane maintained steady levels), respectively, in the chlorinated distribution system, while haloacetic acids and haloacetaldehydes reached maximum concentrations in the middle of the chloraminated distribution system before decreasing by an average of 29% and 54%, respectively, by the end of the system.