Geophysical Research Abstracts
Vol. 16, EGU2014-13647, 2014
EGU General Assembly 2014

Isotopic metrics for structure, connectivity, and residence time in urban water supply systems

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Public water supply systems are the life-blood of urban areas, accessing, managing, and distributing water from an often complex array of sources to provide on-demand access to safe, potable water at the point-of-use. Water managers are faced with a wide range of potential threats, ranging from climate change to infrastructure failure to supply contamination. Information on the structure of supply and conveyance systems, connectivity within these systems, and links between the point-of-use and environmental water sources are thus critical to assessing the stability of water supplies and responding efficiently and effectively to water supply threats. We report datasets documenting stable hydrogen and oxygen isotope ratios of public supply water in cities of the United States across a range of scales. The data show a wide range of spatial and temporal variability that can be attributed to a combination of regional hydroclimate and water supply characteristics. Comparisons of public supply waters with model-based estimates of the isotopic composition of regional water sources suggests that major factors reflected in the tap water data include the degree of fragmentation of natural and man-made storage and conveyance systems, inter-basinal transfer of water, evaporative losses, and the total residence time of the natural and artificial systems being exploited. Because each of these factors contributes to determining the sustainability of water supply systems and their sensitivity to environmental disturbance, we propose a set of isotope-based metrics that can be used to efficiently assess and monitor the characteristics of public-supply systems in water security assessments and in support of management, planning, and outreach activities.