

Global perspective of local meteoric water lines based on daily and monthly data: a consideration of climate types

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Abstract

The stable hydrogen and oxygen isotopes as well as their correlation in precipitation have been widely investigated for the understanding of various hydrological processes. Monthly precipitation data were usually recommended in order to establish a linear relationship between the stable hydrogen and oxygen isotope ratios (also known as local meteoric water lines or LMWL for a specific location); however, the LMWL based on daily (or event-based) precipitation data is usually different from that using monthly data. Based on 83 sampling stations across the world from 2000 to 2017, local meteoric water lines were calculated using daily (or event-based) precipitation data (n=9354) and corresponding monthly data (n=1895), respectively; multiple regression methods were used, including ordinary least squares, reduced major axis and major axis regressions as well as their precipitation-weighted counterparts. The global meteoric water line from daily data is $\delta^2\text{H} = (7.72 \pm 0.02) \delta^{18}\text{O} + (6.84 \pm 0.15)$ (n=9354, r²=0.96) and from monthly data is $\delta^2\text{H} = (7.81 \pm 0.04) \delta^{18}\text{O} + (7.61 \pm 0.32)$ (n=1895, r²=0.96). The stations used in this study were grouped into five climate types, according to the Köppen Climate classification. The precipitation-weighted regression may increase the long-term receptiveness of LMWL using daily-based (or event-based) samples, not only for arid regions, but also for cold regions. When only relatively short-term isotopic records in event-based precipitation samples are available, which is usual in modern hydrological studies, the weighted regression (especially precipitation weighted ordinary least squares regression, PWLSR) is helpful to create a respective local meteoric water line.

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