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High-frequency measurements of atmospheric stable water vapor isotopes in the tropics (Sulawesi, Indonesia)

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Recent advances in cavity ring-down spectroscopy have enabled the continuous long-term measurement of atmospheric stable water vapor isotopes, which represent a powerful tool to investigate transport processes and sources of atmospheric water vapor. Here, we present continuous measurements of δ2H and δ18O of atmospheric water vapor made with a Picarro water vapor isotope analyzer (L2120-I, Picarro Inc.) from the roof top of our laboratory in Palu, Sulawesi, Indonesia. These are among the first known continuous high-frequency measurements made in the tropics, where water vapor plays a central role in the energy and water balance and where climate change is expected to significantly alter patterns of evapotranspiration and precipitation. We first characterize the accuracy and performance of the analyzer in terms of precision, memory effects and concentration dependency and assess its suitability for continuous remote long-term measurements. We then attempt to determine the source of atmospheric water vapor in Palu using measurements of δ2H and δ18O from precipitation and surface air, and explore the influence of wind speed, wind direction, atmospheric humidity and air temperature on variations in isotope ratios.

The isotope analyzer was calibrated periodically using a standards delivery module in combination with a vaporizer included with the analyzer. From March to August 2011 the analyzer drift was <5.0 ‰ for δ2H and <1.2 ‰ for δ18O. Precision (one standard deviation) at a 60 s averaging time was 0.06 ‰ for δ2H and 0.03 ‰ for δ18O. From mid-April to late-June, 1-hour averages of surface air δ2H and δ18O ranged from -70 to -210 ‰ and from -15 to -35 ‰ respectively.