

Improving raster map of precipitation isotopes over the Japanese Alps region

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Isotopic compositions of precipitation are important information for tracing catchment hydrological cycle. Although recent progress in establishing isotopic monitoring network over the Japanese Alps region provides observed isotope data set, it is difficult to estimate those for non-observation sites. This study aims at creating raster map of precipitation isotope and examines optimal strategy for interpolation/extrapolation. We used precipitation isotope data obtained at 13 sites for the period from June 2010 to November 2011 for simple/multiple correlation analyses. As the results, altitude was the most important parameter with highest correlation with isotopic data. In addition, a multiple regression model (MRM) including altitude, precipitation amount, maximum snow depths, slope, slope aspect and slope curvature (but longitude for hydrogen) showed highest performance. The RMSE (root mean square error) in cross-validation for the MRM is 0.427 permil for oxygen and 2.96 permil for hydrogen; these values are about 60% of those for simple regression model and better than those for geostatistical (i.e., inverse distance weighted) model. The precipitation amount and maximum snow depth are related to the distance from water vapor source, suggesting inland effect as well as altitude effect is important in controlling spatial distribution pattern of precipitation isotope. Comparison between catchment-mean precipitation-isotope calculated from the MRM-based isotope map and river water isotope measured at 24 locations within Chikuma River and Fuji River basins clarified that the both are in generally in good agreement, while the measured river water delta values were slightly higher than the catchment-mean precipitation delta values. This is likely to be due to isotopic enrichment during soil evaporation, indicating a possibility for evaluating proportion of water that can be used neither for human activity nor ecosystems (i.e., white water). Thus, we concluded raster map of precipitation isotope based on the MRM has sufficient accuracy and useful for analyzing catchment hydrology.

Keywords: isotope, mapping, precipitation, river water, Japanese Alps region