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Discussions

Interactive comment on "Spatial distribution of oxygen-18 and deuterium in stream waters across the Japanese archipelago" *by* M. Katsuyama et al.

Anonymous Referee #2

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General comments: Katsuyama et al. present a huge dataset (almost 1,300 records) of oxygen-18 and deuterium in Japanese stream headwaters, grouped into a number of regions representing the main climatic characteristics of the country and derived regression lines as well as multiple regression equations based on commonly known corollary parameters. In addition to that, Katsuyama et al. also collected precipitation oxygen-18 and deuterium data from existing published and unpublished sources. In total, Katsuyama et al. report to present the most comprehensive isoscape of oxygen-18 and deuterium in Japanese streamwaters.

Unfortunately, the presentation of the work is not fully stringent; a one-time streamwater sampling campaign is compared with precipitation isotopic data patchy in both space and time. Hence, the conclusions Katsuyama et al. draw deem to be made with cau-

tion. The collection methods (for samples as well as supporting data) lack a thorough description. Occasionally, there is vagueness in statements which may be read as obfuscation. After all, the authors however do not succeed to meet objective of presenting an isoscape (gridded data at high spatial resolution) and present small-scale contour maps instead. For details see the specific comments below.

A generic issue (though that's not a mistake of the authors) is that a number of key publications the authors refer to has been published in a local language and is hence often out of reach of the international scientific community. Finally, the authors are strongly encouraged to publish their data and/or gridded data files at an appropriate resolution as supplementary material, last but not least as an important step towards leveraging this (known) issue.

Specific comments: Introduction (chapter 1): The relationship between precipitation isotopic values (with its pronounced seasonality) and streamwaters (which may include substantial peak flow and groundwater components) is complex; this should be borne in mind when using one-time samplings of streamwater for generic statements (cf. e.g. Lachniet and Patterson, 2002; shallow groundwaters are less prone to the abovementioned effects, cf. the summary of Wassenaar et al. 2009 and their references), especially with few studies on this conducted previously (as mentioned by the authors). The superiority of streamwater over precipitation isoscapes may be given as per their applications (e.g. for migratory or forensic studies in areas where surface waters play an important role), however it is hard to see such a generic statement justified (p. 10906 lines 9-11).

Methods (2): While some of the data show remarkable evaporative tendencies, the authors unfortunately do not address some questions: Which definition of 'headwater catchment' is applied (given the broad range of catchment sizes)? How were catchments featuring lakes, swaps or geothermally altered spring waters dealt with? How are 'baseflow conditions' defined? It seems that many samples were taken during the precipitation-rich summer or during the tail of the annual rainfall peak. Furthermore, the explanations should include which sample containers were used (despite freezing), a short statement on the measurement calibration and uncertainty, and how much time passed between sampling and analysis (sampling: 2003, publication: 2014). Similar efforts should be made for the collected precipitation data; for synthetic collection this is known to be difficult and may presented in an annexed table rather than listing the method for only a few of the stations in the text. As for geographical parameters, it is not quite clear whether the elevation of the site has been used for further calculations, or the mean catchment elevation. The spatial resolution of the mesh climatic data could not be read from the manuscript. The generation of small-scale contour plots, based on the IDW method, does hardly match the definitions of a state-of-the-art 'isoscape' (cf. Bowen 2010 for a detailed history of isoscape generation); there are a number of reliable, open-source GIS and geostatistical tools available (QuantumGIS, R with 'gstat' extension etc.) to perform more robust calculations at higher spatial resolution.

Regression lines (3.1): While there seems to be a disagreement among the cited references over the linear relationship between oxygen-18 and deuterium (and it is hence a difficulty to establish a general baseline), the authors present highly disperse regression lines for the individual regions. The usage of phrases like 'relatively similar (about 6-8)' (p. 10909, l. 22f.) is to be questioned since the slopes and intercepts deviate substantially from the GMWL (not only in regions F and G), some of which suggest clear evaporative trends (or other alterations). A 'generally similar appearance' (p. 10910, l. 2) and a resulting validity as a proxy for precipitation isoscape data on a nationwide scale, with the small concession to evaporative processes during infiltration, looks a bit far-fetched. (A streamwater isoscape as such is a valuable achievement, but questions concerning seasonal or hydrographic biases need to be addressed.) The authors' comment on the need for further precipitation isotope data is fully supported, however that would be a precondition for using a streamwater isoscape as a proxy. In absence of appropriate precipitation isotope data, shallow groundwater isotopic records, as suggested by Wassenaar et al. (2009) may serve as a better means for cross-validating the streamwater isoscape. To this end, the authors should consider mining some of

their source publications for shallow groundwater data, and comparing them region by region with (a) existing precipitation records and (b) the collected streamwater data.

Spatial and seasonal distribution of d excess (3.2 and 3.3): A topographic map, based open-access data (DEM, e.g. ETOPO) and software should be included in the paper instead of a mere web URL. References should be given to d excess and its meanings (e.g. Dansgaard 1964 in general and references for the specific situation of the dual moisture source regime of Japan). The authors may consider explaining specific spatial patterns of d excess (e.g. areas with low d excess) instead of merely listing them (e.g. p. 10910 l.25 vs. p. 10911 l. 4). As for seasonality, they authors should consider showing typical plots of monthly average isotope values instead of picking specific 'typical' years for a few stations.

Correlations (4.1): Which definition of 'elevation' is used? (Elevation of the sampling point vs. mean catchment elevation) Consider showing a covariance matrix for the corollary variables. A minor glitch is that the lapse rate is -0.27/100m in p. 10912 l. 16 and -0.28 in l. 18. It should be considered that altitude lapse rates are not globally uniform, and the authors should use caution to interpret conformity with the global lapse rate as a criterion for proxy suitability. The criteria for the choice of a multiple regression is not clear (consider showing a covariance matrix or use of the Akaike Information Criterion [AIC], cf. Wassenaar et al. 2009). Finally, the authors should consider a combined multiple regression / interpolation approach (cf. Bowen 2010 for examples) to further refine resulting gridded data and to use subsequent interpolation to account for the residuals and to derive a state-of-the-art isoscape.

D excess in streamwater vs. precipitation (4.2): For comments on the precipitation data considered, see 'figures and tables'. Notwithstanding the efforts undertaken by the authors, but considering the number of unexplained anomalies in their dataset, the claim for presenting a spatially AND temporally integrated isocape should be used with care, given the spatial and temporal heterogeneity of comparison datasets. The authors should consider cross-checking their future gridded data product with established precipitation isoscapes, e.g. by Bowen & Revenaugh (2003) or van der Veer et al. (2009) which used precipitation isotope datasets whose hetereogeneity issues were analysed and discussed (cf. e.g. Bowen 2010).

Figures & tables: It would be good to incorporate record length information into table 1. The comment concerning ‘arbitrary reading d excess from original papers’ bears some explanation. The authors could consider constraining the map extent to the prefectures sampled; leaving out Okinawa prefecture would give approx. 4 times as much map space. Standard map elements (grid mesh, frame, legend) should be included. The region map could be transformed into a combined region and topography map. The authors may consider colour-coding the sampling locations in Fig. 1 according to their oxygen-18 or deuterium value, and presenting the gridded data products instead of the contour maps (Figs. 4 and 5). Finally, the panel Figure 6 does not show whether the isotopic values of one year (as suggested in the text) or multi-year averages are presented. Overall, it is suggested to present the seasonality patterns of several stations well-distributed over Japan.

Summary of comments: Katsuyama et al. present a huge dataset with a big potential for generating gridded isoscape products. Some conceptual aspects (linking of streamwater to precipitation etc.) and methodological (data selection and discussion) need to be elaborated more profoundly. Finally, an improved method for generating the graphic output should be sought. These revisions will help to exploit the full potential of the dataset collected. Finally, my sincere thanks for the interesting read.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 11, 10903, 2014.