Application of Elementary Circulation Mechanisms According to Dzerdzeevskii in Studies of Stable Isotopic Composition of Precipitation

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Abstract

Precipitation generating processes depend on atmospheric circulation patterns and consequently it is expected that its water stable isotopic composition of hydrogen and oxygen (δ^2H and δ^{18}O) is related to them. Precipitation generated at similar atmospheric circulation patterns should have similar empirical distribution of δ^2H and δ^{18}O. From that point Elementary Circulation Mechanisms (ECM) defined by Dzerdzeevskii are possible candidates for the determination of relation between air circulation and precipitation generating processes and their stable isotopic composition.

In the paper two possible models for coupling ECM and δ^2H and δ^{18}O are represented. First is based on the linear combination of δ^2H and δ^{18}O values and on precipitation amount weighted average related to elementary air circulation mechanisms – ECM (Brenčič et al., 2015). The second (new) one is based on the multiple linear regression approach where in the system of over-determined linear equations optimal fit and consequently parameters of the model are calculated. In the latter parameters are representing estimates of δ^2H and δ^{18}O for each ECM.

Proposed models open new opportunities for the application of stable isotopes in climatic studies. The model can be starting point for simulation of longer stable isotopic time series applicable in paleoclimate studies. With the proposed approach in combination with higher number of meteorological stations where isotopes in precipitation are observed it is possible to generate geospatial distribution maps of isotopes for each separate elementary circulation mechanism. Proposed ECM-isotope model gives us opportunity to improve our understanding of global air circulation and generation of precipitation on a wider scale. (Brenčič et al., 2015)

Literature:

Brenčič, M., Kononova, N.K., Vreča, P., 2015: Relation between isotopic composition of precipitation and atmospheric circulation patterns. Journal of Hydrology 529, 1422-1432: doi: 10.1016/j.jhydrol.2015.08.040