Determining factors of the spatial distribution of the streamwater chemistry in headwater catchments

Nobuhito Ohte[1]

[1] Environ. Sci. and Tech., Kyoto Univ.

http://www.bluemoon.kais.kyoto-u.ac.jp/peopl-jp.html

In order to clarify the mechanisms of the spatial distributions of streamwater chemistry in montane headwater catchment, a conceptual model was proposed. The model assumes that the stream solute concentration is controlled by mixing ratio of subsurface and groundwaters, and simulates the relationship between spatial variability of geochemical solute concentration among the streams and subsurface-groundwater mixing in each subcatchment. The variability of solute concentration among subcatchments is potentially generated by difference in the ratio of catchment size of subsurface and groundwaters. The model was applied to the field data taken from two watershed having different geologic settings (granitic and sedimentary bedrock) in central Japan. Variability in geochemical solute concentrations was largest among smallest subcatchments in the most headwaters, and decreased with increasing of subcatchment size. Subsequently the solute concentrations converged into a constant value at the specific catchment scale. Two watersheds have a different converging subcatchment scale. Simulations based on these two field cases suggest that the size of geomorphologically minimum subcatchments (zero-order catchments) at the most headwaters and the variability of solute concentrations among these subcatchments are key parameters determining the size of the converging catchments. Both tow key parameters were larger in the sedimentary rock watershed than the granitic rock watershed, and the size of converging subcatchment was also larger in the sedimentary watershed. It is considered that the difference in geological setting affects the difference originally in the geomorphological characteristics such as valley shape and size of minimum subcatchments at the most headwaters. Consequently, this difference causes the variation in the size of converging subcatchments. The size of converging subcatchment can be treated as an expression of the representative elementary area (REA). The field data suggest the possibility for identifying REA by measuring the geochemical solute concentrations along the stream orders. Moreover, the model approach in this study imply that the determining mechanisms of REA can be generalized by the size of minimum subcatchments at the most headwaters, and the variability of geochemical solute concentration among minimum subcatchments.