## Information visualization for participatory multi-isoscape mapping

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Sustainable environmental monitoring in a region necessarily requires that researchers collaborate with societal actors such as governmental agencies, non-profit organizations, and residents. Such collaboration requires a boundary object as a shared upper-level goal, because different actors may have different motivation, values, beliefs, and incentive.

In water quality monitoring, the co-creation of a map, indicating the location of water sources or springs for instance, can be a boundary object between researchers and civil members. Researchers may input novel scientific knowledge, such as multi-isoscapes to the map and compare the visualized information with the local traditional knowledge, such as characteristics of groundwater in the study area. Mutual learning enables the formation of a community for continuous monitoring by civil members. In our view, researchers can visualize the vocabulary systems using ontological engineering and can provide participatory GIS (geographical information systems) in order to promote such a participatory citizen science. This study validates the usability of these tools by applying the ontological engineering technique to the researchers' talk on multi-isoscapes and water quality monitoring in public lectures for analyzing their knowledge systems and by applying the spatial principal component analysis to multiple chemical elements of the underground water in Ohno City (Fukui Prefecture, Japan).

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