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The Earth's atmosphere

…as conduit

How are energy and chemicals such as pesticides, carbon dioxide, and water transported from one region of the environment to another?

"The chemical and biological processes that take place on the Earth's surfaces are intimately coupled with the overlying air," explains Judith Perlinger. "An intense and complex exchange takes place when atmospheric chemicals, heat, and momentum interact with land and water surfaces."

Perlinger conducts micrometeorological air-water exchange flux measurement above Lake Superior onboard Michigan Tech's *R/V Agassiz* and the US Environmental Protection Agency's research vessel, the *R/V Lake Guardian,* using the measurements to better understand environmental processes. She and her team have designed, fabricated, and tested multicapillary collection devices (MCCDs) which they use to collect semivolatile organic compounds (SOCs) present in trace concentrations in the atmosphere. The devices provide rapid, low-cost, and low-impact means to collect the compounds, and can be re-used.

This new technology has also enabled the first air-water exchange flux measurements of trace persistent organic pollutants (POPs) to be made in locations in and around Lake Superior. "Although gaseous concentrations of POPs such as PCBs and pesticides are extremely low in the remote regions, the air is, nevertheless, their primary source to the lake, and thus to the lake's foodweb," notes Perlinger. For example, concentrations of dieldrin, toxaphene, polychlorinated biphenyls (PCBs), and dichlorodiphenyl-trichloroethane (DDT) in Lake Superior's water currently exceed the State of Michigan's water quality guidelines by factors of 19, 15, 2.3, and 1.3, respectively.

Perhaps counterintuitively, the air is also the primary avenue for removing POPs from the lake once emissions have been reduced sufficiently to maintain gas-phase concentrations at low values. "Air-water exchange is an important pathway," says Perlinger. "Because of this, national and international government policies that reduce atmospheric POPs not only help clean the air we breathe—they help clean up the waters of Lake Superior as well."

The same micrometeorological techniques being applied to trace organics can also be applied to more abundant substances. Perlinger is applying micrometeorological techniques to study water evaporation rates and the biogeochemistry of carbon in the Great Lakes region, as well.