Background

The 2002 World Summit on Sustainable Development (WSSD) adopted the Johannesburg Plan of Implementation wherein international efforts to improve the scientific understanding of the earth's water cycle was recognized as one of several steps needed for reaching the goal of sustainable management of water resources. The International Atomic Energy Agency (IAEA) long has operated the Global Network of Isotopes in Precipitation (GNIP), which has provided global data to understand and simulate the water cycle under present and past climates. In order to supplement GNIP data and integrate isotope applications in hydrological and climate research, the IAEA has initiated efforts to improve the availability of isotope data for other water cycle components.

To this end, a Moisture Isotopes in the Biosphere and Atmosphere group (MIBA) has been constituted which includes a group of scientists with diverse research interests ranging from the ecosystem to global scales (see partial list below of participants and supporters). The motivation for this effort stems from the scarcity of experimental data on stable isotopes in biospheric and atmospheric moisture. Routine measurements of stable oxygen and hydrogen isotopes are crucial to the advancement of hydrological and climate research at the ecosystem, regional and global scales.

Scientific questions

The Moisture Isotopes in the Biosphere and Atmosphere group (MIBA) invites you to participate in its worldwide network of moisture sampling. The product of this effort will help provide an alternative to our present dependency on model output for some key variables, and further advance our understanding of:

- **Regional scale hydrological budgets:** partitioning evapotranspiration fluxes into surface evaporation and vegetation transpiration; distinguishing evapotranspiration vs advection; quantifying local and regional water re-cycling; improving closure of continental, regional and watershed isotope mass balance.
- **The partitioning of annual carbon fluxes:** the measured variables in the MIBA network drive the ^{18}O composition of atmospheric CO_2. The measurement of ^{18}O in CO_2 offers both an additional constraint and smaller uncertainties for CO_2 flux partitioning between the ocean and the terrestrial biosphere at the global scale; and between assimilation and respiration in land ecosystems.

- **The development of new global change indicators:** ^{18}O and ^{2}H in atmospheric vapor can be used as indicators for regional to global-scale reductions in evaporation.
- **Ecosystem functioning:** distinguishing productivity responses due to soil moisture stress vs. atmospheric humidity stress; ecosystem-specific effects on the ^{18}O of atmospheric CO_2; ecosystem-specific patterns of water use (melt water, permafrost), and allowing the combined use of oxygen and carbon isotopes.
- **Interpretations of ^{13}C and ^{18}O analyses in organic matter:** Improvement of tree-ring-based climate reconstructions; explaining the cause of genetic variation in C_i/C_a (net photosynthesis vs. stomatal conductance).
- **The validation of general circulation models:** Particularly those weather prediction models that aim to couple carbon and water fluxes using stable isotopes to improve simulations of the water and carbon cycles.
- **Past global responses to climate change:** biospheric productivity forces a difference between the oxygen isotopes of ocean water and atmospheric O_2 (the Dole effect). The MIBA network will further elucidate the current Dole effect, and allow us to constrain estimates of past global productivity using H_2O and O_2 trapped in ice cores.

Samples needed

To advance in these issues, samples of ^{18}O in moisture from various compartments of terrestrial ecosystems are needed.

Stem water is representative of the source water, to which the plants have access. This data allows for the assessment of the primary water pools used, and hence water use strategies, by plants.

Leaf water represents a measure for the evaporative processes as influenced by leaf response to the environment (RH, temperature). This data is needed for paleo-climatic reconstructions, based on organic matter (tree rings) and for understanding O-isotopes in CO_2 (for the partitioning photosynthesis and respiration on the ecosystem level) and Oxygen (for understanding the ratio between terrestrial and marine productivity). Furthermore, organic leaf material can provide information on the environmental impact during the development of the leaves. This material will be preserved and archived for further studies.

Soil water represents the non-biological component of evapotranspiration and knowledge of the $\delta^{18}O$ and δD of leaf, stem and **soil** water, in conjunction with water vapor measurements, allows for the partitioning of soil evaporation and transpiration from plant canopies.

Organization

The IAEA isotope laboratory and that of several group members will provide isotopic analyses for those participants who do not have the availability or capacity to perform the required analysis. The IAEA will provide the secretariat for the work of MIBA group and may provide modest financial support for facilitating sampling, particularly in the developing countries. Together, the group will also assist in providing training and logistics according to needs.

As a participating member of this network, you, in turn, would provide stem, leaf and soil water samples (and eventually atmospheric water vapor) twice a month, totaling 12-16 samples per month. Sampling should, ideally, be coordinated with other climatic and flux measurements and would require no more than half an hour of time to complete. At the end of the sampling season or earlier, we would ask you to ship the samples to a domestic isotope lab for analysis (shipping costs would be approximately 10 USD). Results of all analysis will be immediately made available in a restricted IAEA web page to all participants and you will be given priority in any public dissemination of data related to your sampling site. Products of this network will lead to periodic meetings (organized by the IAEA) where participants will be invited to discuss results of their efforts.

IAEA and Advisory board for the Network:

P. Aggarwal, Head, Isotope Hydrology Section IAEA

D. Yakir (Israel; Chair), G. Farquhar (Australia), L. Flanagan (Canada), F. Longstaffe (Canada), R. Siegwolf (Switzerland), G. Hoffman (France), H. Meijer (the Netherlands), H. Griffiths (UK), J. Berry (USA), P. Tans (USA), P. Ciais(France), N. Buchmann (Switzerland), L. Sternberg (USA), T. Dawson (USA), G. Lin (China), W. Stichler (Germany), J. White (USA), and J. Santrucek (Czech Republic), Brent Helliker (USA).

Contact information

If you have any questions concerning the MIBA network, please contact as your regional representative:

Alexander Knohl
University of California
ESPM Dept., Ecosystem Science Div.
151 Hilgard Hall #3110
Berkeley, CA 94720-3110
phone: ++1 (510) 642 2421
fax: ++1 (510) 643 5098
e-mail: aknohl@nature.berkeley.edu