Trees and VOCs:
Measuring volatile organic compounds from urban forests

Why are plastic bags on the trees?

Romain Baghi

Scientists from the Institute of Arctic and Alpine Research, University of Colorado, are studying the volatile organic compounds (VOCs) that trees give off into the air. **CreekSide Tree Nursery** is a partner in this experiment, allowing us to sample emissions from many species in a stable, secure environment.

We know a lot about how trees protect air quality by capturing carbon dioxide and pollutants like ozone, carbon monoxide, and particulates. But we know less about the more subtle effects of VOCs acting on the chemistry of the atmosphere.

What are VOCs anyway?

VOCs are naturally formed chemicals that easily turn into vapor. The sharp scents of pines and eucalyptus, for instance, are examples of biogenic VOCs. Trees use VOCs to attract pollinators, repel harmful insects and animals, and respond to stress.

In the air, some types of VOCs interact with nitrogen oxides and sunlight to make ozone. So, while all trees improve air quality, some have a greater net effect than others. Therefore, planting properly chosen types of trees in our yards and on City property can help remove pollutants from the air while minimizing effects on ozone.

The **City of Boulder**, another partner in this research, will consider information about the VOC emissions of different species when choosing trees to plant on City property.
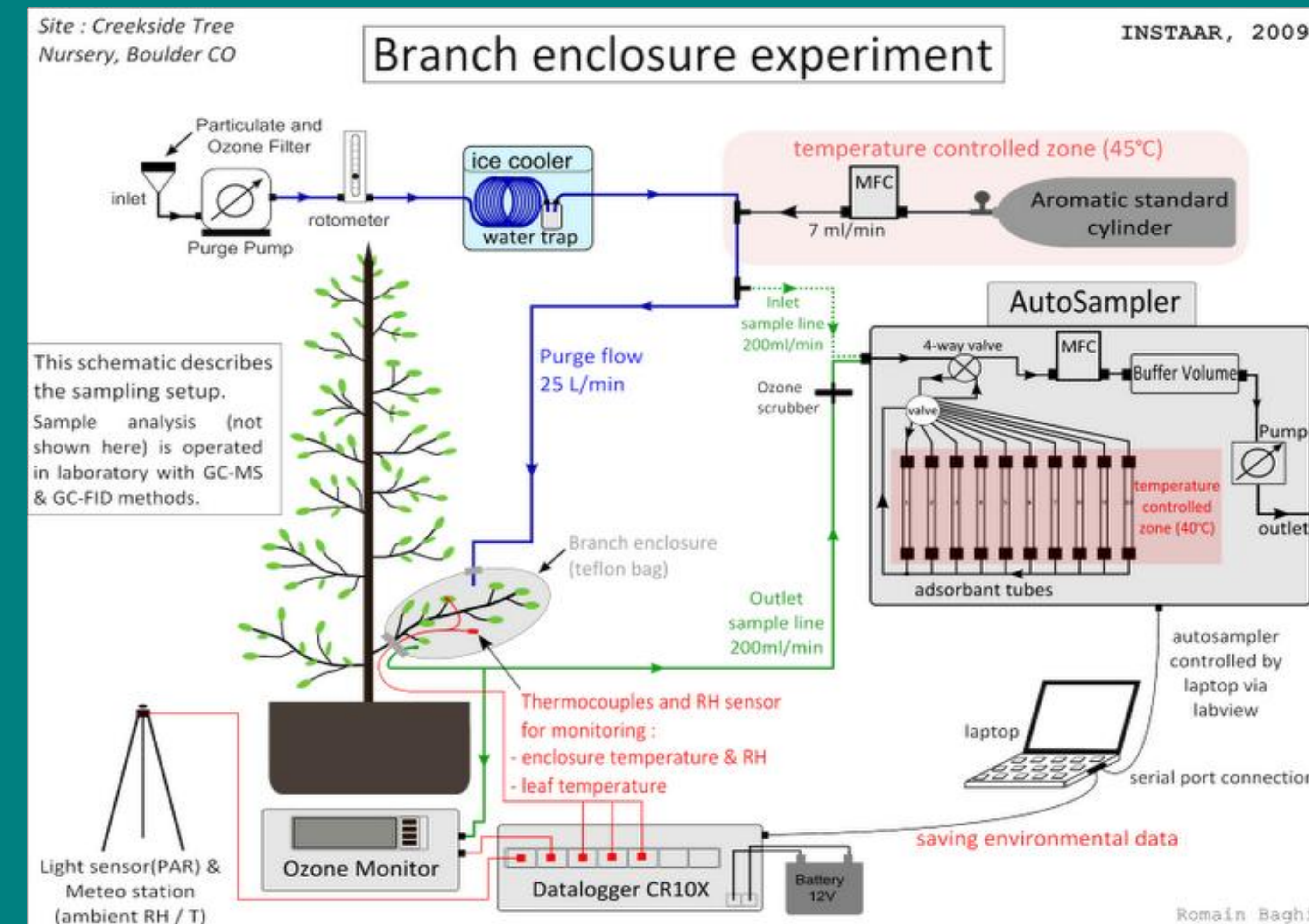
How does the experiment work?

To measure VOC emissions, a researcher ties a Teflon bag around a tree branch. An instrument pumps clean air into the bag and routes outgoing air through another, highly sensitive analytical monitor that measures emissions from the leaves. Instruments also keep track of temperature and sunlight. Once

Site : Creekside Tree Nursery, Boulder CO   INSTAAR, 2009
Branch enclosure experiment

This schematic describes the sampling setup. Sample analysis (not shown here) is operated in laboratory with GC-MS & GC-FID methods.

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enough data has been collected, the team cuts off the branch and weighs the leaves.

At the end of the experiments, the team will know how many VOCs a particular tree branch emitted. They can extrapolate from that branch how much the whole tree or an entire forest of those trees would emit. They will also know more about how local conditions, like day or night, or cloudy vs. sunny days, affect emissions from different species.

Inside the trailer that houses our instruments is this sampler, used to measure VOC emissions from tree leaves.

Visiting graduate student Romain Baghi sets up an empty enclosure as a test to make sure the system is working accurately.

What will this experiment do?

The team is focusing on sesquiterpene compounds (SQT), a kind of VOC that may be especially important in atmospheric chemistry. The team wants to collect data on SQT emission rates from different species of trees, and find out how those rates depend on local environmental conditions like time of day, temperature, and cloudiness.

The scientists will use that data to contribute to models of how the world's atmosphere works, fine-tuning information about how trees in urban areas affect the chemical balance of the air. They also hope to provide suggestions to urban planners and foresters about tree species that best offset air pollution.

VOCs are just one in an array of factors to consider when choosing a tree. Others include suitability for the site (height, canopy shape), drought tolerance, disease resistance, fruiting behavior, etc. The arborists at CreekSide Nursery can help take all these factors into account for a particular planting.

Find out more on our outreach web site http://instaar.colorado.edu/outreach/trees-and-vocs and on the City of Boulder web site http://www.bouldercolorado.gov.

Graduate student Ryan Daly attaches Teflon enclosures to a flowering crabapple branch at CreekSide.