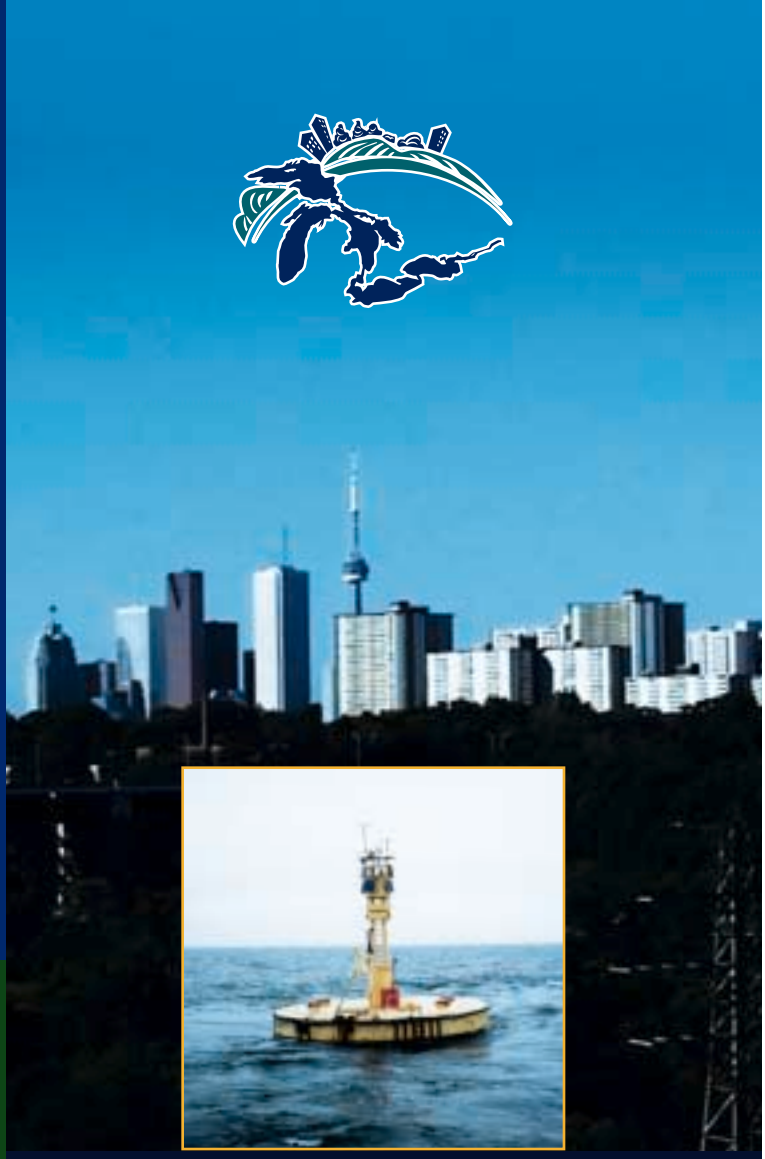


ATMOSPHERIC DEPOSITION IN THE GREAT LAKES:

There's Something in the Air

CANADA-ONTARIO AGREEMENT RESPECTING
THE GREAT LAKES BASIN ECOSYSTEM

Canada Ontario

Slam the door on one toxic chemical, and you are apt to find you have left the window open to another. Polluted air, much of it blowing north across the Canadian border, is emerging as a major pathway for sneaking harmful contaminants into the Great Lakes Basin. As much as 90 percent of certain persistent organic pollutants (POPs) are deposited into the lakes from the atmosphere. In turn, the Great Lakes may also be a reservoir of long-banned chemicals such as PCBs that are being released or "out-gassing" back into circulation.

Many of these contaminants are volatile and can evaporate if the weather conditions are right. They tend to build-up in the fatty tissues of the body. Remaining in the environment for years or decades, they pose a significant health threat to the people and wildlife that inhabit the basin. Reducing the emissions of harmful pollutants will be a major focus under the new Canada-Ontario Agreement Respecting the Great Lakes Basin Ecosystem (COA).

Before the governments of Canada and Ontario can control them, the sources of these pollutants must first be identified. The Integrated Atmospheric Deposition Network (IADN) was established in 1992 by the governments of Canada and the United States, under the Great Lakes Water Quality Agreement to conduct air and precipitation monitoring in the basin. There is now an IADN master station on each of the Great Lakes, surrounded by a series of satellite stations. "The number depends on the scientific questions we are trying to answer and what other agencies are doing in the basin" says Dr. Keith Puckett, Environment Canada's Manager of the IADN. *(cont'd)*

Cover: Toronto, good air day
Cover inset: air monitoring buoy, Lake Ontario

1. IADN measures a number of combustion byproducts
2. Toronto, bad air day
3. air sampling equipment

"We are going to find out how far the city's air pollutants travel out over the water …"

IADN is currently tracking some 20 atmospheric pollutants or classes of pollutants, including a variety of PCBs, a selection of polycyclic aromatic hydrocarbons (PAHs) and other combustion products, and about a dozen priority pesticides, such as DDT, hexachlorobenzene and toxaphene. This year, IADN will be expanding its monitoring network to include mercury.

"Basically, we want to know how much of each chemical is dropping into each of the Great Lakes," explains Dr. Puckett. "We also want to determine how much is coming from local sources within the Great Lakes Basin and how much is coming from continental or global sources outside the basin." This breakdown is going to vary for each chemical and for each lake. For example, about 30 to 40 percent of the dioxins and furans falling into the Great Lakes are emitted by local sources. On the other hand, almost all the toxaphene, a now-banned pesticide that was widely used on cotton fields throughout the southern United States, is blown in from outside the region.

But until the analysis is completed, it is difficult to put exact numbers on relative contributions, says Dr. Puckett. "We do know that, for the most part, atmospheric deposition dominates the pollutant loadings (of the persistent organic pollutants) from both point sources and non-point sources." This is especially true in the upper Great Lakes. By the time you get to the watersheds of Lake Erie and Lake Ontario, with their intensive agriculture and heavy urban concentrations, "other factors become more significant," says Puckett.

In the toxic shadow of the city

Cities can be tough on lakes. A lot of effort has been put into controlling sewage, industrial effluents and urban run-off. Now it is time to pay closer attention to the air pollution pumped out by powerplant smokestacks, factory boilers, household furnaces and fireplaces, and the million smoking tailpipes on the ends of cars, trucks and buses. Each one contributes its share of fine particulates and ash, acid gases, unburned hydrocarbons and smog-forming compounds to the atmosphere. And some of this pollution ends up in the Great Lakes.

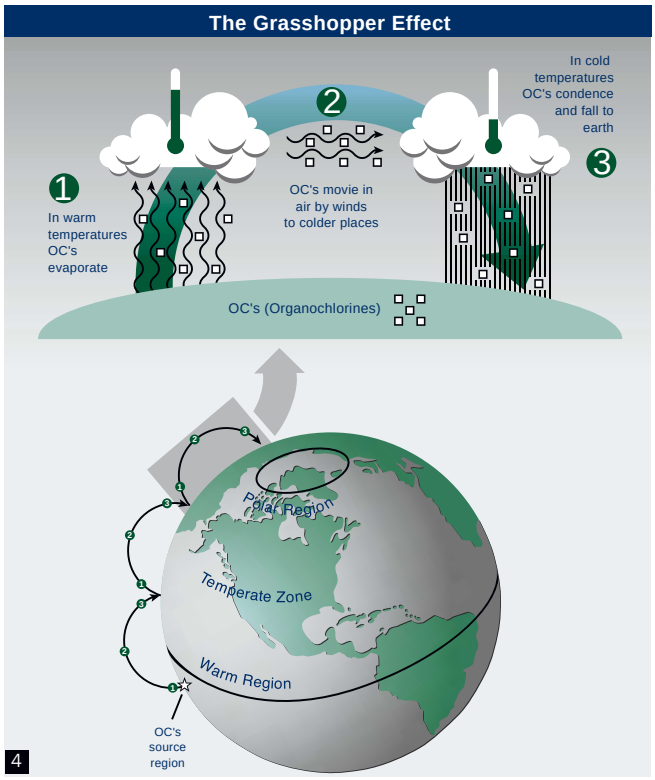
The United States has conducted an in-depth monitoring and air modelling study of the impact that Chicago's air pollution has had on the Great Lakes. "They found that the city made a significant contribution to contamination in the southern end of Lake Michigan," says Dr. Puckett. "We are hoping to do the same thing in Toronto." As part of the Government of Canada's Toxic Substances Research Initiative, the pesticides, PCBs and combustion products from Toronto and the surrounding region will be tracked out into Lake Ontario.

Sampling stations have been set up in, over and in the shadow of the city. A laboratory on the University of Toronto campus bristles with air sampling equipment and other monitoring instruments to give the ground-level perspective on pollution. The side of the massive CN Tower sports a row of passive samplers that provide a snapshot of the contaminant profile as one travels up through the atmosphere. And out in the middle of Lake Ontario bobs a 12-metre buoy measuring the same chemicals in the air. "We are going to find out how far the city's air pollutants travel out over the water," says Dr. Puckett. "We'll soon know how much of Lake Ontario lies in the shadow of Toronto's air pollution."

The grasshopper effect

Not all our air-borne pollution originates so close to home. Despite decisive action to ban many of the most persistent pesticides back in the 1970s and 1980s, a number of these toxic chemicals have been hiding out in the tropics. In many Central and South American countries, some pesticides such as DDT are still routinely used.

These volatile compounds can evaporate into the air and are carried off on the wind, travelling a couple of hundred kilometres north before being washed from the sky in a rainstorm. As the sun dries them up they are on their way again – in a series of mid-range puddle jumps – before falling somewhere in the Great Lakes Basin on another stop-over. It has been called the "grasshopper effect" and it is one reason why the dangerous chemicals Canada banned more than 20 years ago continue to turn up in the Great Lakes.



4. The Grasshopper Effect

Some of the contaminant load is "lost" along the way, deposited in sediment, absorbed into vegetation, or taken up by algae at the bottom of the aquatic food chain. The contaminant then begins another long journey, bioaccumulating up through zooplankton and small invertebrates, bait fish and larger game fish, and eventually into the bodies of eagles, bears, beluga whales and other mammals, including *Homo sapiens*.

Lead, cadmium and some other contaminants are one-hop pollutants. Once deposited in a lake, they tend to stay put in that particular ecosystem. The volatile organics, such as DDT, are multi-hop chemicals and like to hitchhike on the north-bound air currents during the summer months. They continue to travel north until cold temperatures disrupt the evaporative cycle and they are trapped in the far north.

Exporting home-grown pollution

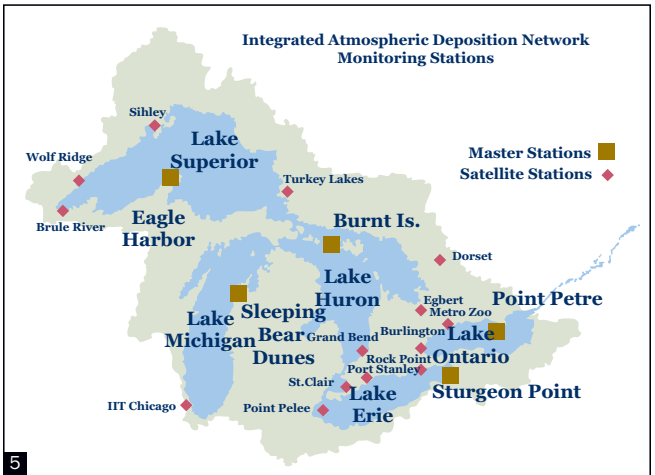
There are three primary mechanisms for transforming air pollution into water pollution: wet deposition, dry deposition and gas exchange. Certain contaminants are readily washed from the sky by rain, fog and snow. Through the process of dry deposition, little airborne particles drift towards the surface of the lake and deposit their pollutants. Finally, high levels of pollutant gases in the atmosphere follow the concentration gradient downwards to dissolve in the water.

The final mechanism, gas exchange, is a reversible process, Dr. Puckett cautions. Depending on the atmospheric conditions, PCBs and other pollutants can and will "outgas" from the lake. "Think of a lake as a giant lung that's been sucking in polluted air for the last 50 years," says Puckett. Now that atmospheric levels of many of these pollutants have dropped below a certain equilibrium point, "it's starting to exhale," he says.

Not all of the banned pesticides in our airshed are imported from the south. These persistent chemicals were licensed for use in Canada for many years and their toxic residues linger still. Disturb the soil on many orchards and farms in the Great Lakes Basin and – if the moisture and temperature conditions are right – you can measure the out-gassing of DDT, chlordane and the other toxic ghosts of the past. Volatile organics are also escaping from abandoned landfills and the dumping grounds around former factories.

Further study may show that the lakes are an important toxic reservoir for the pesticides, PCBs and methyl mercury on their way to the Arctic to build-up in the fatty tissues of polar bears, seals, fish and the Inuit that rely on them.

"…we want to know how much of each chemical is dropping into each of the Great Lakes."



The data compiled by the Canada-U.S. Integrated Atmospheric Deposition Network was crucial in building support for the Stockholm Convention on persistent organic pollutants (POPs) signed in May 2001. The global agreement will reduce or eliminate the "dirty dozen," a group of toxic substances that includes PCBs, DDT, dioxins and furans.

Clearing the air under COA

The governments of Canada and Ontario will continue the research, monitoring and modelling work needed to better understand the short and long-range transport of air pollutants into and out of the Great Lakes Basin. Under the new COA, a collaborative approach will be used in addressing atmospheric pollutants and achieving significant reductions in the use, generation and emission of these contaminants.

Government of Canada's Clean Air Action Plan

A series of new regulatory measures will mean tougher pollution control standards for cars and trucks and will reduce contaminant levels in fuel. New measures will also be taken to reduce smog causing pollutants from industrial sources, improve the network of national pollution monitoring stations, and expand the public reporting by industry on air pollutant releases. These measures will complement earlier Canada-wide initiatives to better control ozone, fine particulates, volatile organics and other key components of smog. The Government of Canada has led the international drive to reduce the release of persistent organic pollutants (POPs) that culminated in the signing of the Stockholm Convention in May 2001. All of these initiatives will help advance the goals of COA by cutting loadings of harmful pollutants to the lakes. For more information on Government of Canada efforts to provide cleaner air, visit the Environment Canada website at **www.ec.gc.ca/air/introduction_e.cfm.**

Government of Ontario's Drive Clean Program Fights Smog

Through wear, poor maintenance or deliberate tampering an engine can start to run dirtier once it has been on the road awhile. Ontario's Drive Clean is a mandatory inspection and maintenance program designed to identify vehicles that no longer meet acceptable emission standards and ensure that proper corrective action is taken. Cars and light trucks must be tested in an accredited facility every two years, while heavy trucks and buses must be tested annually. In addition, Ontario mobile Smog Patrol conducts random roadside tests of suspected polluting vehicles. Any vehicle with excessive visible emissions can be ticketed. When fully operational, Drive Clean will cut smog-related pollution from cars and trucks by an estimated 22 percent, while reducing fine particulate and trace contaminant emissions. These reductions will contribute to the goals of COA by cutting the loadings of harmful pollutants to the lakes. For more information on Drive Clean and other provincial clean air programs, visit the Ministry of the Environment website at **www.ene.gov.on.ca.**

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Canada-Ontario Agreement
Respecting the Great Lakes Basin Ecosystem

To learn more about COA and atmospheric deposition in the Great Lakes, contact:

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