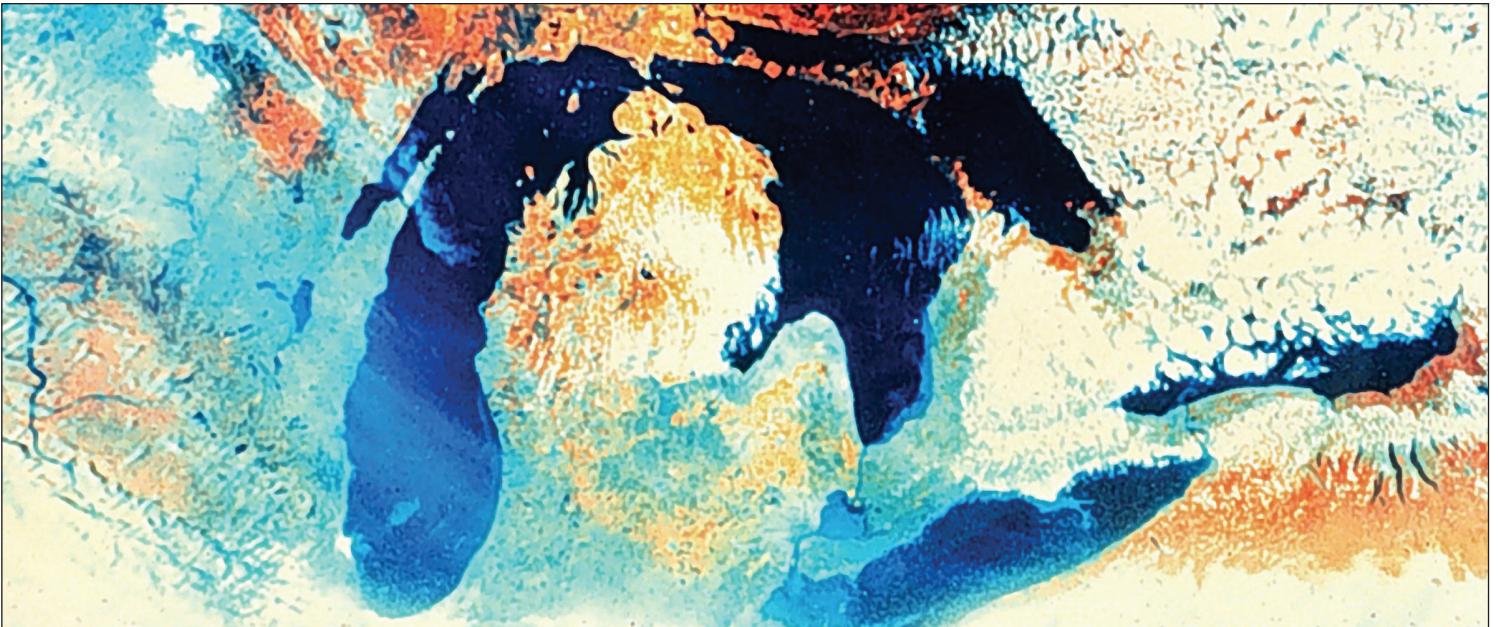


GLOBAL CHANGE **LOCAL IMPACT**

OSU Climate Change Webinar Series



Studying World Climate to Help Ohio

by Christina Dierkes

Did you know that almost all US states have a state climatologist? These researchers, in addition to duties within universities or governmental agencies, manage networks of volunteer weather observers across their state, compile and verify weather data, and make it available to interested parties. The climatologists' knowledge of their state's climate and weather patterns makes them an invaluable resource not only for those concerned about the impacts of today's weather, but also for those responsible for adapting to new weather scenarios in a world affected by climate change.

The state climatologist for Ohio is Dr. Jeffrey Rogers, Professor in the Department of Geography at Ohio State University. Rogers studies climate variability in the United States and North America, and often

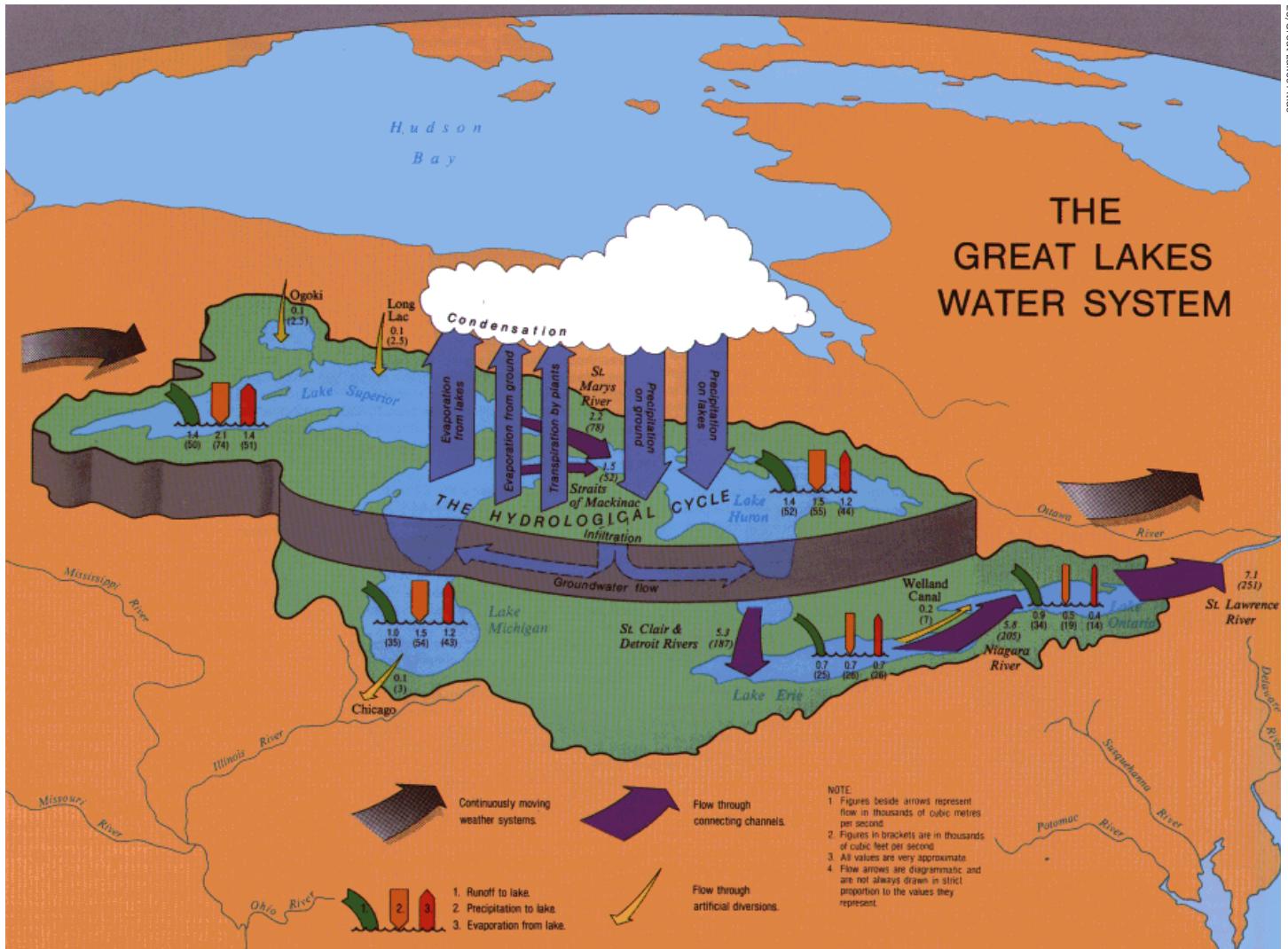
focuses his research on the weather patterns of Ohio and the Southeastern United States. Recently, his research has included analyses of how atmospheric circulation can create different types of regional weather – how changes in a circulation pattern called the Pacific North American Pattern can cause milder but wetter winters in the Ohio River Valley, for example.

Rogers suggests that the climate in Ohio has been getting steadily warmer over the years, and will likely continue to do so in the future. While the warmest summers on record are still those of the 1930s Dust Bowl, recent summers like 2002, 2005 and 2010 will be very high on that list, according to Rogers. But greenhouse gases in the atmosphere are not the only reason why summers are getting hotter across the Great Lakes region.

"I see it continuing also because in Ohio, there's a very strong link between humidity and moisture, which will ensure that temperatures will keep going up," Rogers explains. "Humidity traps more heat, air then retains more humidity, and so on. I think the temperature changes are here to stay," he adds.

The effect of humidity on Ohio's climate is especially visible when looking at nighttime temperatures in the state. The diurnal temperature range – the difference between daytime highs and nighttime lows – for Columbus has steadily decreased over the past 60 years, a phenomenon which some climate scientists suggest could be one of the first indicators of a warming climate.

"Increased cloud cover acts like a blanket and traps heat that would otherwise escape into the atmosphere," Rogers suggests,



The Great Lakes water cycle is driven by a number of climatological factors. Air temperature and wind control evaporation (red arrows) that removes water from the lakes' surface. Flow out to other bodies of water and to the Atlantic (purple arrows) removes additional water from the Lakes. At the same time, water is added from precipitation (tan arrows) in the form of rain and snow, as well as through inflow from basin streams (green arrows), upstream lakes (purple arrows) and ground water.

adding that additional humidity in the air is a likely factor in explaining the changing cloud cover.

Increased humidity as part of a changing climate in Ohio also goes along with another weather phenomenon: precipitation extremes – very large or very small amounts of rain or snowfall in a given time period – have become much larger. Especially in the summer, the state goes without rainfall for long periods of time, followed by heavy rainstorms (or “extreme precipitation events,” as they’re known in meteorologist circles). “We keep going back and forth like this; a couple of days of heavy rain, then things

dry out quite a bit,” Rogers says. “According to numerical models of the atmosphere, this is what we expect with a planet that is undergoing greenhouse warming.”

To understand how global warming and pollution affect the earth’s climate, one first has to understand how the planet’s temperature is regulated. Radiant energy from the sun strikes the earth’s surface and warms it up. Naturally occurring Greenhouse gases such as carbon dioxide (CO₂) and water vapor absorb radiation coming from the earth that would potentially go to space and allow the planet to cool. This interplay regulates

the overall average temperature on earth at around 59 degrees Fahrenheit – 60 degrees warmer than on an earth without greenhouse gases – and thereby makes life on the planet possible.

The current problem with climate change is related to an increase in temperature beyond the 59 degree average, which is caused by an excess of greenhouse gases produced by burning fossil fuels like coal or oil. Burning these fossil fuels also produces sulfates and other aerosols that would contribute to “global dimming,” or a cooling effect. Human produced aerosols like sulfates scatter solar radiation, making

it less able to warm the planet's surface. "When you fly across the world at 30-some thousand feet, you can look out the window and see that the air down below is somewhat brown and murky, and the air that's up higher is usually very blue and crystal clear," Rogers explains, adding "that's because we don't have a sizeable impact on the visibility in the stratosphere, but the murky layer below is sulfate and pollutants from fossil fuels that keep sunlight from reaching the surface."

However, studies have shown that the net effect of carbon dioxide and sulfates is still one of warming temperatures overall. According to Rogers, one study showed that greenhouse gases caused an increase in temperature of about 0.7 degrees Celsius, while sulfates and aerosols were responsible for global cooling of about 0.3 degrees Celsius – resulting in a net warming of 0.4 degrees Celsius. These higher temperatures caused by additional CO2 trapping more heat close to the earth's surface can result in both droughts and increased precipitation due to higher evaporation of surface waters.

While the term "precipitation" includes both rain and snow, Rogers also explains that Ohio winters are likely to include more rainfall and less snowfall as climate change continues. In the Great Lakes region, scientists are seeing a delicate balancing act between precipitation and evaporation, which

both influence the Great Lakes' hydrologic cycle, or how water travels between the atmosphere and the ground.

"As temperatures increase due to global warming, the lakes will tend to evaporate, but there is also a tendency towards heavier precipitation," Rogers says, adding that in the worst case scenario the Great Lakes probably won't experience enough precipitation increases to offset the evaporation from higher temperatures. Water levels would tend to go down in this scenario, causing problems not only for recreational areas on the shore, but also because some of the drinking water supply in the region comes from the Great Lakes.

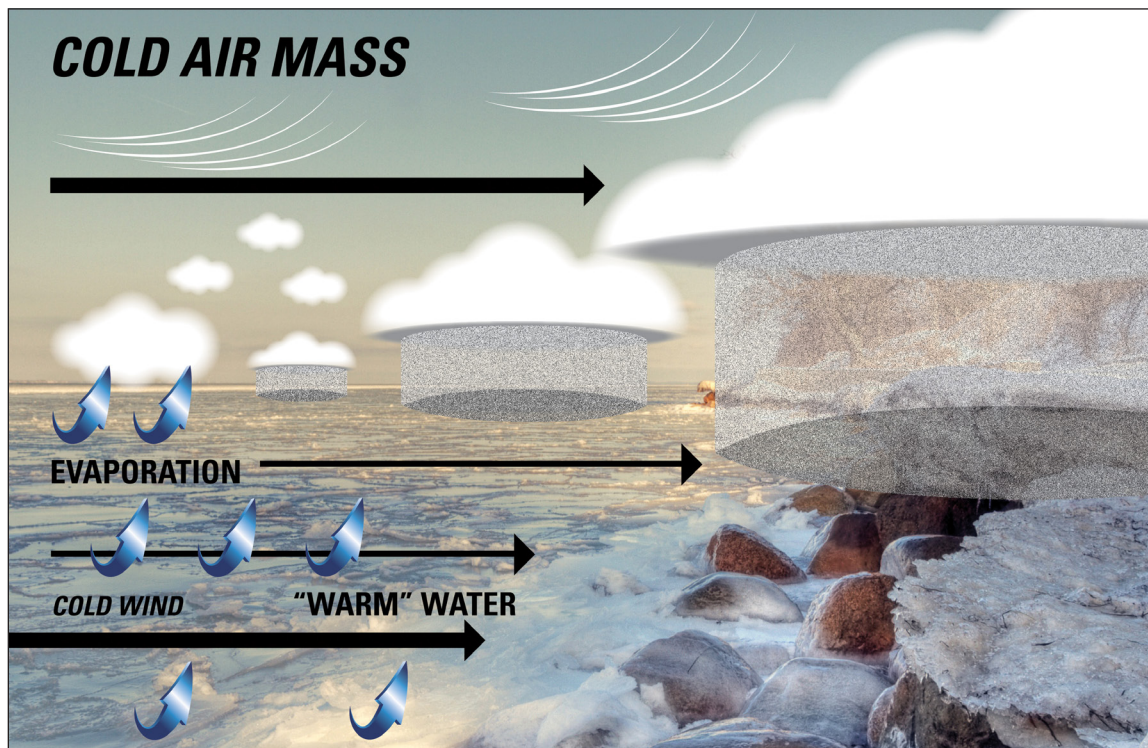
"There are many factors in these situations, but basically, it's something we need to keep looking at," Rogers says. In the meantime, Cleveland may appreciate the break from lake effect snow, reduced by more prevalent winter rain.

More information about Rogers' research, as well as the upcoming webinars on climate change impacts in the Great Lakes region, is available at ChangingClimate.osu.edu.

The Global Change, Local Impact Webinar Series is a multi-departmental effort within Ohio State University, led by OSU Extension, Ohio Sea Grant, and Byrd Polar Research Center, to help localize the climate change issue for Ohioans and Great Lakes residents.



Jeffrey Rogers is a Professor in the Geography Department and the Atmospheric Sciences Program at Ohio State University. He is the State Climatologist for Ohio and performs research on the causes of short-term climate variability around the United States.



Lake effect snow is caused when cold winter air flows over the warmer waters of a large lake. Heavy evaporation from the lake surface forms clouds that cannot contain the evaporated water, and some of it comes back down as snow. This is especially common in cities like Buffalo, NY, or Cleveland, OH. In a climate change setting, the flowing air is not as cold, and the water contained in the forming clouds does not freeze into snow before it comes back down. This leads to an increase in rainfall and a reduction in snowfall in areas normally affected by lake effect snow, especially on the southern Great Lakes.