Greenhouse Gas Emission Research at Lake Lacawac

By: Jenna Robinson

Did you know that lakes are biochemical hotspots on Earth? What exactly does it mean to be a biochemical hotspot? Consider this, lake's make up less than 1% of Earth's entire surface. Yet, lakes emit substantial amounts of carbon dioxide (CO_2) and methane (CH_4), so much so that it is comparable to the amount of carbon that all the world's oceans naturally uptake from the atmosphere. Lakes are located across the globe, and they are acting like chimneys, or hotspots, funneling greenhouse gases into the atmosphere. But how? How could lakes, which make up such a small portion of Earth's surface, release such large amounts of these potent greenhouse gases? This is where the biochemical part comes in.

Lakes sit at the bottom of their watershed, so as rain and stream water run through the surrounding forest, farmland, and/or urban development, large amounts of organic material (like leaves and sticks) is picked up and carried downstream until it ends up in the lake. These large amounts of organic matter that end up in lakes act as fuel for microbial life. These microbes consume the organic matter and biochemically convert it into inorganic forms like carbon dioxide and methane.

The Global Water Lab at Rensselaer Polytechnic Institute (RPI) of New York has been conducting research at Lacawac Sanctuary for several years to understand the effects of climate change on the lake's ecology, including how carbon is cycled through the lake and converted into carbon dioxide and methane. Due to climate change, the Pocono Lakes region has been seeing increases in extreme storm events and precipitation, which affects the quality and quantity of organic matter in Lake Lacawac, as well as the resulting greenhouse gas emissions. Jenna Robinson, a graduate student at RPI, has been working at Lake Lacawac to better understand how changes in climate may affect the timing and magnitude of these lake greenhouse gas emissions.

Jenna and a team of researchers from RPI visit Lake Lacawac year-round to collect measurements of organic matter and dissolved greenhouse gases from different depths within the lake. These researchers also maintain a suit of underwater sensors that measure temperature, oxygen, organic matter (among other parameters) every 15 minutes, to help understand the biochemical processes that are happening both through the water column and through time. Jenna's research has found that Lake Lacawac has two distinct periods of dissolved greenhouse gas build-up when the lake is stratified, or separated into thermal layers, both in the summertime and in the wintertime, under-ice. This build-up of greenhouse gases in the bottom layer of the lake in the summertime has exceeded 10x the normal atmospheric concentration of carbon dioxide and over 500x the normal atmospheric concentration of methane.

In the wintertime, under-ice, Jenna has found deep water carbon dioxide levels of over 7x the normal atmospheric concentration and methane levels exceeding 200x normal atmospheric concentrations. During stratification or when the lake is covered in ice, these gases are trapped within Lake Lacawac. However, when the ice melts and/or the lake turns over (when stratification ends) the surface water mixes with the deep water again and these dissolved gases are released into the atmosphere.

Jenna hopes to expand her research at Lake Lacawac to further understand what drives seasonal and inter-annual variability in greenhouse gas emissions in lakes.