
# Fire drives change in the Arctic

**By Josh McDaniel**

**March 31, 2011** -- The 2007 Anaktuvuk River Fire burned more than 1,000 square kilometers of tundra on Alaska's North Slope. Fires in this region are a rarity and the fire doubled the area burned in that region since record keeping began in 1950. The fire was the largest of a series of large fires that burned on the North Slope during the 2000s. Scientists believe that the dramatic shift in frequency and size of fire in the Arctic has important implications for arctic ecosystems, and potentially for the global climate.

Anaktuvuk River fire on Alaska's North Slope. Credit: BLM

Anaktuvuk River fire on Alaska's North Slope. Credit: BLMThe burn scar for the Anaktuvuk River Fire is positioned just 24 miles north of the Toolik Arctic Biology Field Station, a world renowned climate change research station. After the fire, scientists from the station rushed in to record the immediate impact of the fire and also to begin assessing some of the long-term consequences.

Most importantly, scientists were eager to know how much carbon was released in the fire. They found that 1.9 million metric tons of carbon were released in the fire, the amount equal to what some small nations release annually from the burning of fossil fuels. (On a positive note, a recently released study shows that the Anaktuvuk River Fire only burned the top layer of organic soil, representing decomposition over the past 35 years, rather than deeper layers that would have represented much older carbon stores. It even suggests that the tundra could replace those carbon stores over the next few decades.)

A huge resevoir of the earth’s carbon is locked in the permafrost of northern latitudes–an amount that dwarfs the total amount of carbon released since humans began burning fossil fuels. Since the industrial revolution began, we have increased the carbon content of the atmosphere from 560 to 760 gigatons. The permafrost holds an estimated 1,400 gigatons of carbon. If the Arctic began to burn more frequently and intensively, that would mean huge releases of carbon to the atmosphere, and possibly create positive feedback with the climate that could result in more warming.

A number of important studies have begun to emerge from the work on the Anaktvuk River Fire as well as in Arctic studies in general. Scientists have known for years that climate change is leading to the loss of tundra, a cold, dry treeless ecosystem of grasses, sedges, mosses, lichens, and berry plants with a short growing season, and underlying layer of frozen soil, or permafrost. With the warming temperatures (3–5 degrees in the past 50 years), the tundra is rapidly being replaced by shrubland and even boreal forests.

Large, unprecedented fires like the Anaktuvuk River Fire are speeding up the transformation. The blackened area covered by the burn scar absorbs more solar radiation, speeding up the melting of the permafrost and favoring the establishment of shrubs, which shade out the normal grasses and lichens that make up the tundra ecosystem. On the Anaktuvuk River Fire site, lichens had not returned two years after the fire, while willows have begun resprouting dramatically. While the shrubbier ecosystems hold more carbon aboveground, they store less belowground. Studies are showing that two years after the fire, burned areas of the tundra released twice as much carbon as unburned tundra absorbed.

The increase in Arctic fires is also resulting in another phenomenon termed 'thermokarst failures.' When ice in the permafrost melts, from either fire or warming temperatures, the ground collapses, creating huge gullies hundreds of feet wide and long and tens of feet deep. The scars, called thermokarsts, have been increasing throughout the Arctic, and they can lead to huge releases of carbon dioxide and methane from the newly exposed and thawing soil. The formation of thermokarsts results in a positive feedback loop; release of greenhouse gasses, warming of soils, and shrubbier vegetation, which in turn result in more thermokarst failures and the release of more greenhouse gasses-–creating another positive feedback loop.

In subsequent posts, I will begin laying out some of the important findings that are emerging regarding the relationship between fire in boreal and tundra ecosystems. I will also begin conversations with fire management officials in Alaska and Canada on the changes they are seeing (or not seeing) in fire frequency, intensity and behavior.

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