Fire Severity and Smoke Impacts of 2004 Fire Season in Alaska

R.R. Jandt and J. Hroback (POSTER) Mixed-Severity Fire Regimes Conference, Spokane, WA Nov. 17-19, 2004

A Year For the Record Books:

Wildfires burned 6.7 million acres in interior Alaska boreal forests and tundra from June-September 2004. This is the largest single-year acreage on record, surpassing 1957 when 5 million acres burned. Season predictions based on snowpack and other season indicators did not suggest that 2004 would be a “big” fire year. The spring was actually moderate, with heavy spring rains in May, and the snowpack was average or slightly above average (Fig. 1). The weather pattern in June, however set up hot and dry over the entire state.

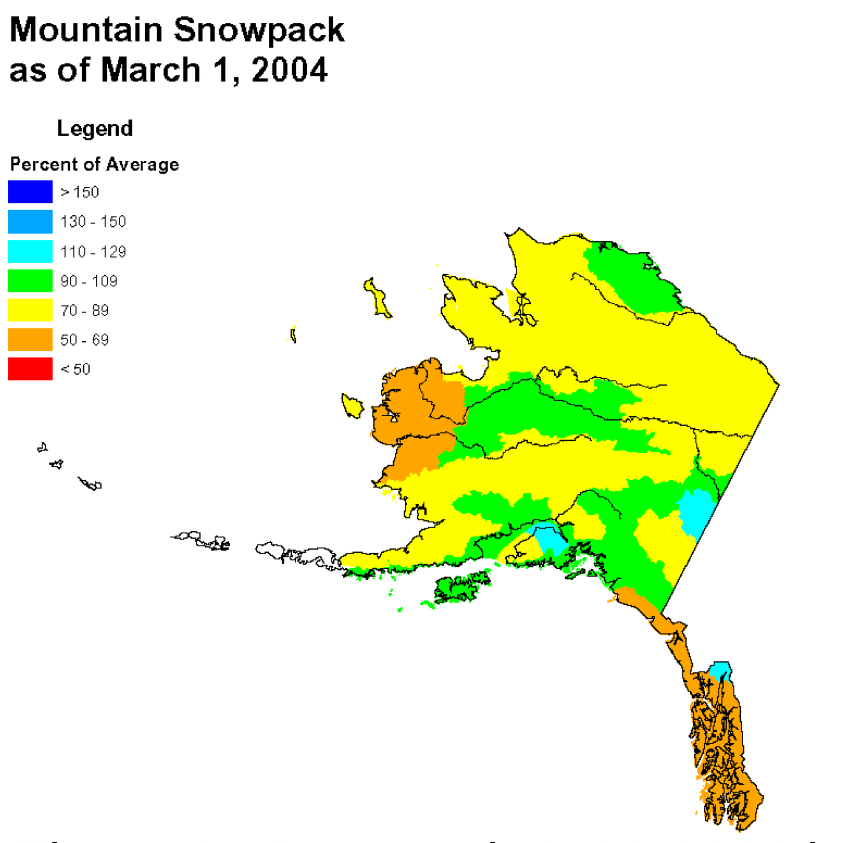


Figure 1. Snowpack 2003-2004 in Alaska.

Impacts of the Fire Season:

The fires also caused tremendous smoke impact Alaskan cities and towns. Air quality in interior and northeast Alaska was considered unhealthy or hazardous for 52 days this season. Fairbanksans were exposed to extreme levels of carbon monoxide (as high as 10 ppm) and smoke particulates (PM2.5) in excess of 1000 mcg/m^3, over eight times the previously recorded high from wildfire. Even indoors, borough air quality specialists observed “hazardous” levels of smoke particulates at >300 mcg/m^3 over a 24 hour period. Low visibility grounded air tankers and helicopters, closed airports, restricted grocery and medical services to many Alaskan towns, and all but shut down such tourism industries as flightseeing, fly-in fishing, and remote lodges.

On the other hand, in hard-hit areas almost anyone who wanted a job could get work supporting the firefighting effort. At one point during the summer, over 2,700 personnel were assigned to fires in Alaska. Firefighting resources from 46 states and 3 Canadian provinces worked in Alaska this summer including 44 hotshot crews from the continental United States. It is a credit to everyone in the firefighting effort that only 17 residential structures were lost and there were no fatalities or critical injuries.

Weather Phenomenon:

In fact, record warm and dry weather prevailed statewide from June through August. It was the warmest summer on record for Nome, Fairbanks, Anchorage, Valdez, Juneau and King Salmon. Heat often brings convection – lightning!—and record lightning days were recorded in June, July and August. June 14-15 combined saw 17,000 lightning strikes, which started 47 fires. The number of lightning strikes was phenomenal, 147,600 strikes was three times the previous record (Fig. 2). Having a number of fires burning in June, however, is a normal condition in Alaska boreal forests. What was different is that the usual mid-July through August rains did not come (Fig. 3). As live moss and duff continued to dry under the midnight sun, fires grew larger and larger (Fig. 4 and 5). Strong winds combined with drought conditions caused fires, like the Boundary Fire, to gain almost 200,000 acres in just a few days.

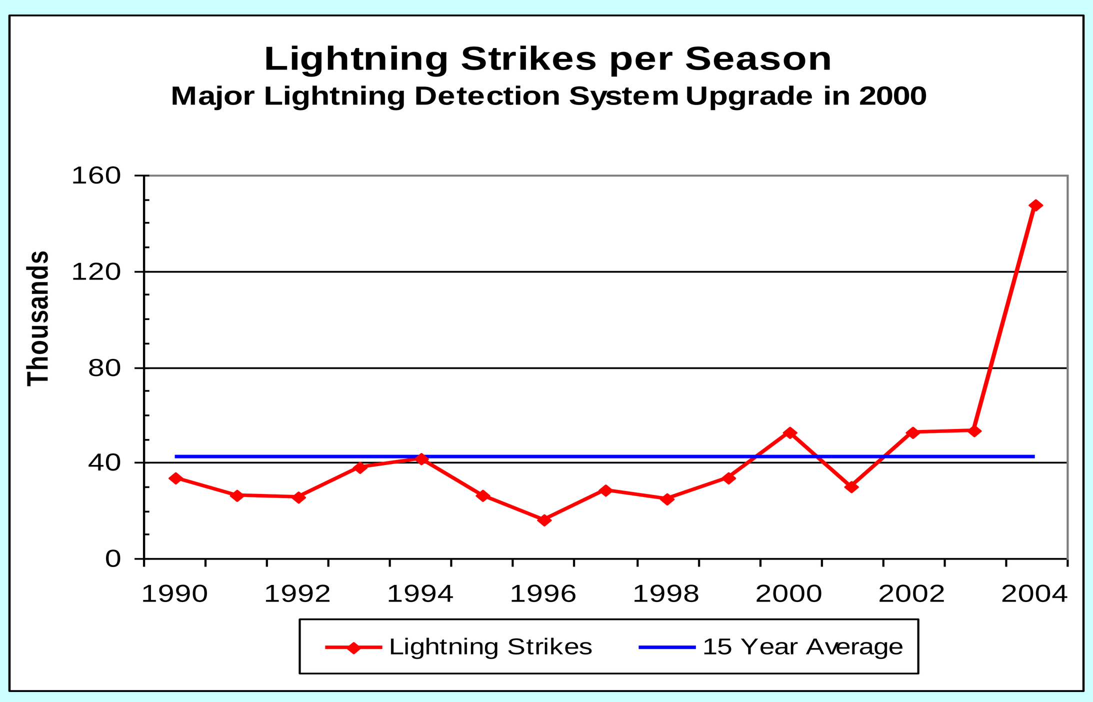


Figure 2: Highest number of lightning strikes recorded in 2004.

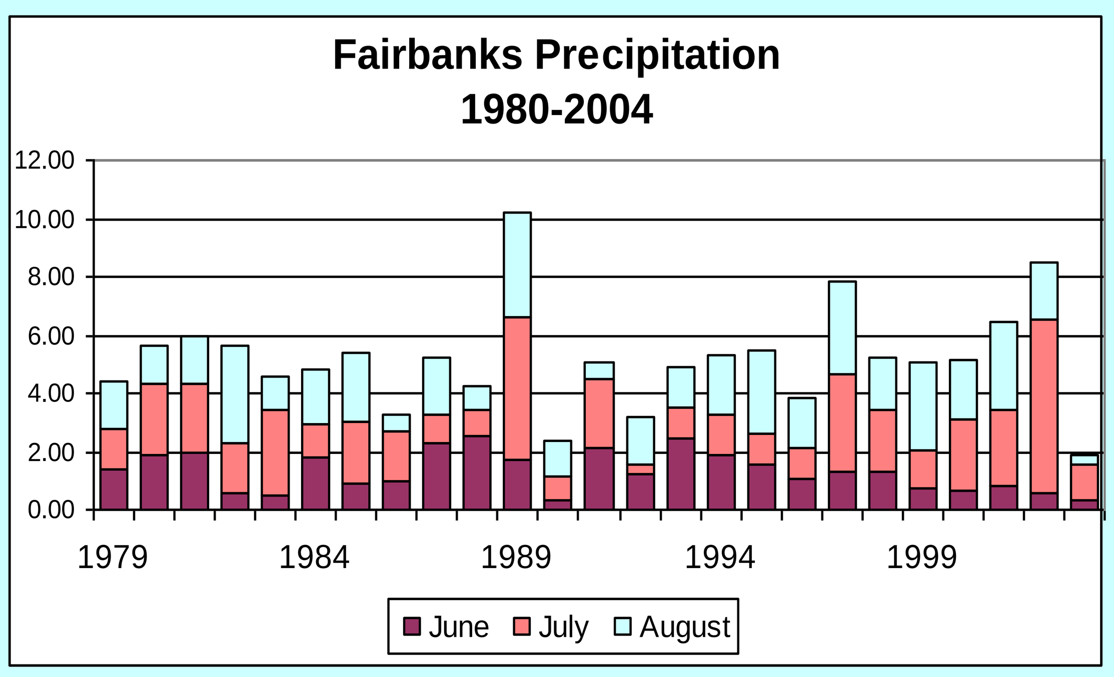


Figure 3. Driest summer in over 25 years.

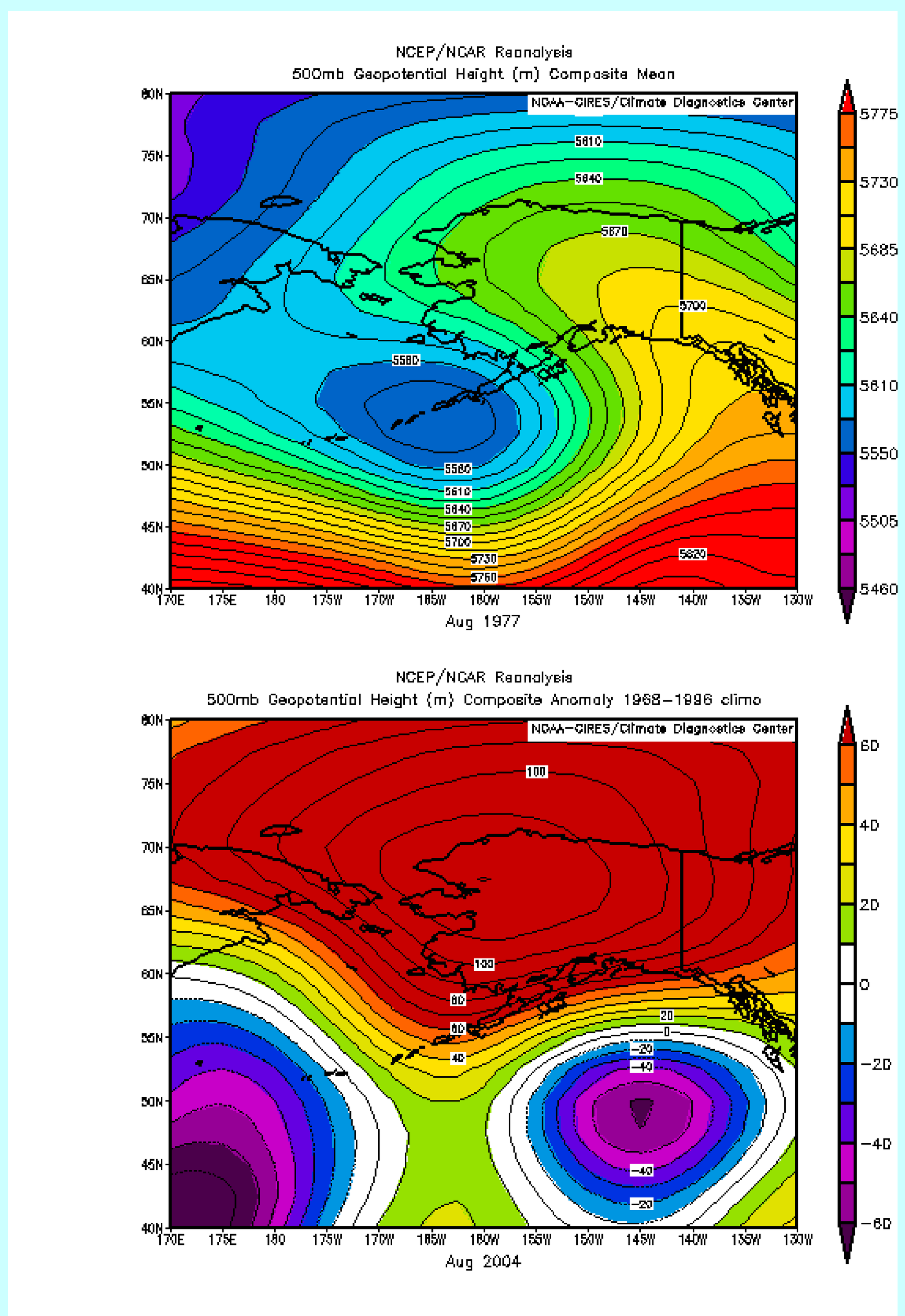


Figure 4 and 5: August—normally cool and rainy (Above, 1977) but sweltering under a high pressure anomaly in 2004.

The Alaska Fire Service

Figures 6 and 7: Research was conducted on actively burning fires in Alaska in 2004 by the Pacific Wildland Fire Sciences Laboratory, Rocky Mountain Research Lab, Yale University, Colorado State University, and University of Alaska-Fairbanks.

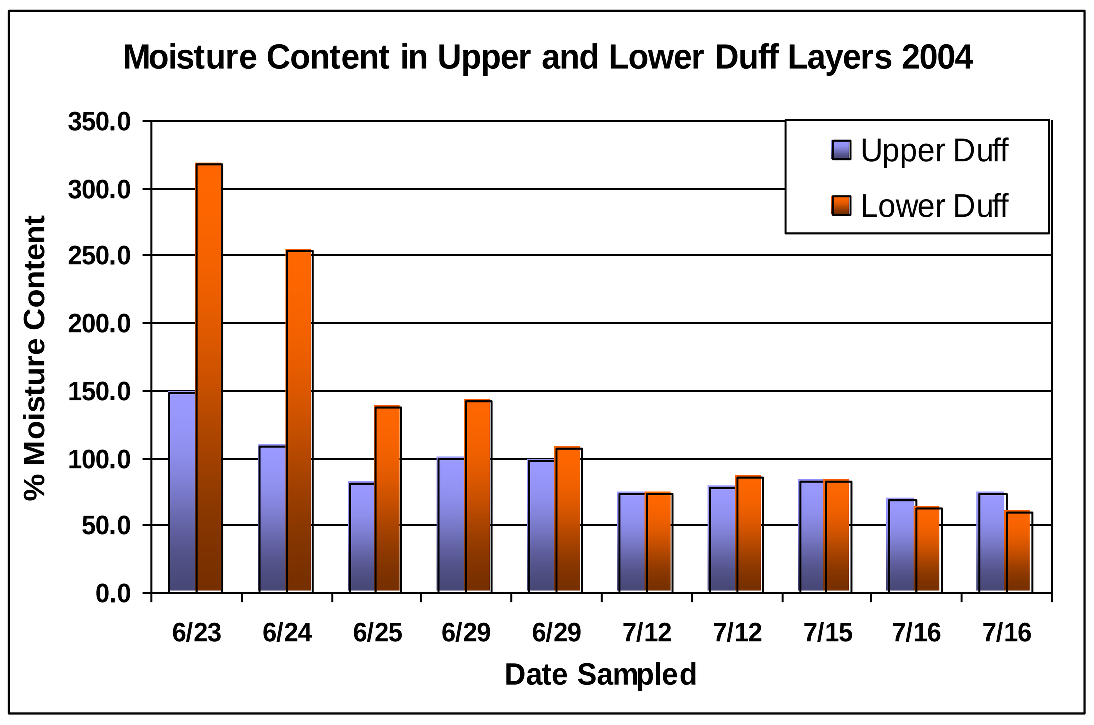
Photo by Kato Howard

Research:

Roger Ottmar of the USFS PNW Research Station led a rapid response effort to assess forest floor consumption and smoke emissions (Fig. 6 and 7). The team managed to place 18 plots in 2004 that later burned, yielding important data on depth of consumption and smoldering combustion in the forest floor. Black spruce forest is underlain by thick organic layers of feather mosses, from live to decomposed, that may be over 30 cm thick (Fig. 8). This is by far the largest source of burnable biomass for emission production—up to 75 tons/acre—accounting for 50-75% of the total biomass including trees, understory, and dead wood.

In mid-June, frost was still close to the surface and both moss layers and organic duff were wet. Many of the forest floor consumption measurements showed only a “skiff” of forest floor reduction. As the seasonal frost layer began to melt, moisture was allowed to drain from the forest floor layers into the mineral soil layers at an accelerated rate. This, in combination with warmer and drier conditions, allowed the forest floor to dry into deeper organic layers (Fig. 9 and 10). By late July many fire plots were burning to mineral soil (Fig. 11). Thus, although the flaming front was burning roughly the same mass of vegetation, subsequent smoldering vented millions of tons of smoke particulates and combustion by-products into the atmosphere (Fig. 12 and 13).

Figure 8: Characteristics of the boreal forest floor may double the emissions during drought summers (like 2004).



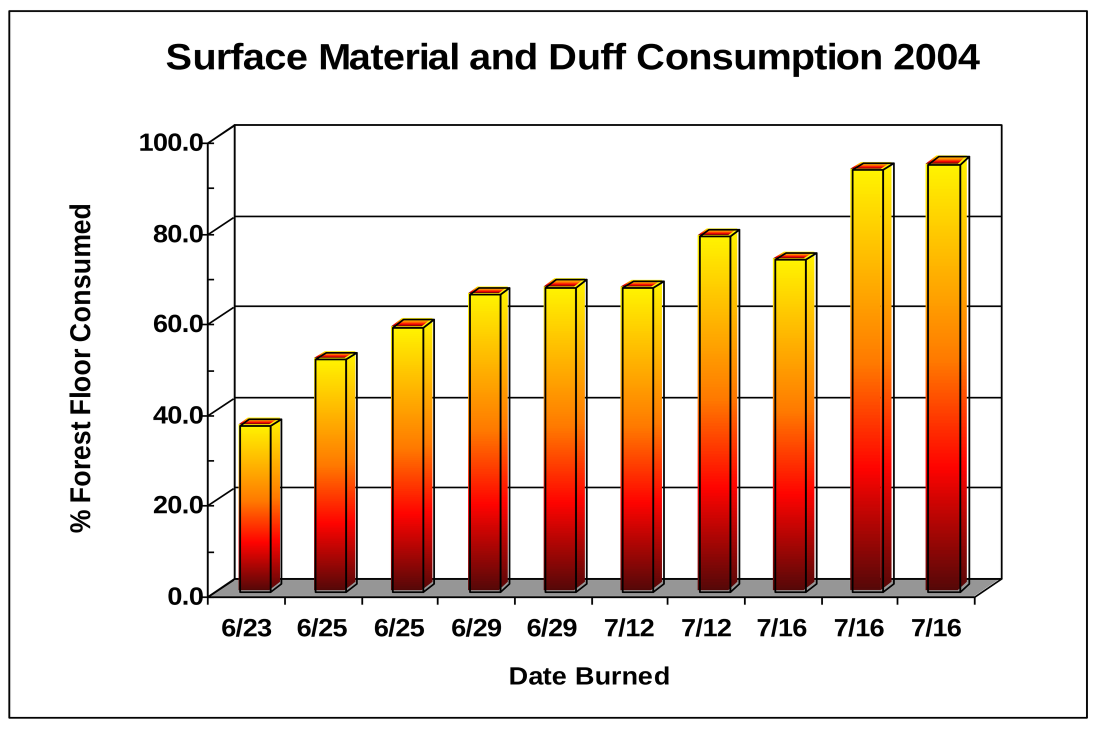


Figure 9 and 10: Deep organic duff progressively dried throughout the season leading to almost 100% consumption of the forest floor (Preliminary data, PNW).

Figure 12: Smoldering duff after fire front has passed.

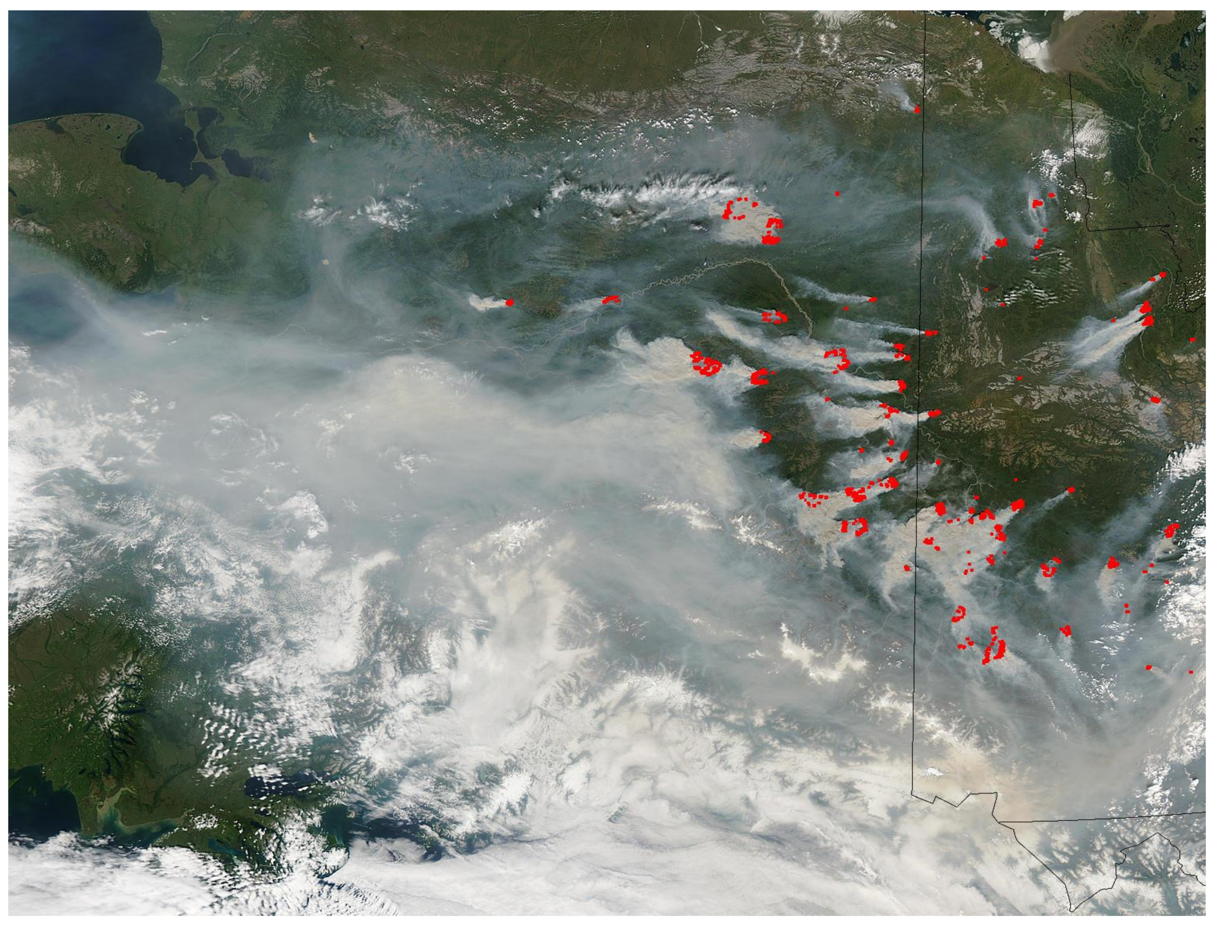


Figure 13: Modis smoke image of interior Alaska.

Photo by Cyle Wold

Figure 11: Severe burn with consumption of the forest floor.

Photo by Rob Allen, July 1 Taylor Complex

Environmental concerns:

There are fewer environmental concerns than might be expected from the extent of acreage burned this year. A BAER team was mobilized in Alaska (another first) but came up with a relatively short list of issues requiring immediate attention. The thickness of the organic forest floor in boreal systems tends to protect soils and erosion problems are infrequently encountered after typical fires. More problems are often created by firefighting efforts (bulldozer lines, spread of invasive species by personnel and equipment) than by the burning *per se*. However, the fact that 2004 fires burned deeply, especially late in the summer, and tended to leave fewer green islands in their wake may add up to notable landscape changes in the next few years. It is expected that thermokarsting (melting of underground ice to form sinkholes and ponds) (Fig. 14) and subsidence or slumping of hillsides will be observed in ice-rich soils.

Photo by Clinton Northway

Figure 14: Small pond possibly created from melting permafrost one year after fire.

Long-term Change:

Perhaps the most interesting question is the cumulative impact of climate change on boreal forest and tundra. Summer temperature (and precipitation) are the largest factors leading to large wildfires in Alaska (Duffy, in press)—as the 2004 season clearly indicates. Because summers are getting warmer (Fig. 15) at an accelerating rate in interior Alaska (and in other parts of the far north) should we be getting ready for more frequent big fire seasons? What effect will more fire have on Alaska's wildlife and fish resources? More frequent fire may benefit moose, which thrive on regenerating shrub vegetation. Species which depend on the mature forest or tundra, such as caribou, spruce grouse, or crossbills may not fare as well.

Studies underway by Drs. Scott Rupp and Dan Mann at UAF, along with cooperators at BLM, USGS, and Alaska Department of Fish and Game (with assistance from the Joint Fire Science Program) are attempting to model the landscape changes and habitat changes we may expect under a changing fire regime and what this means for wildlife management in Alaska.

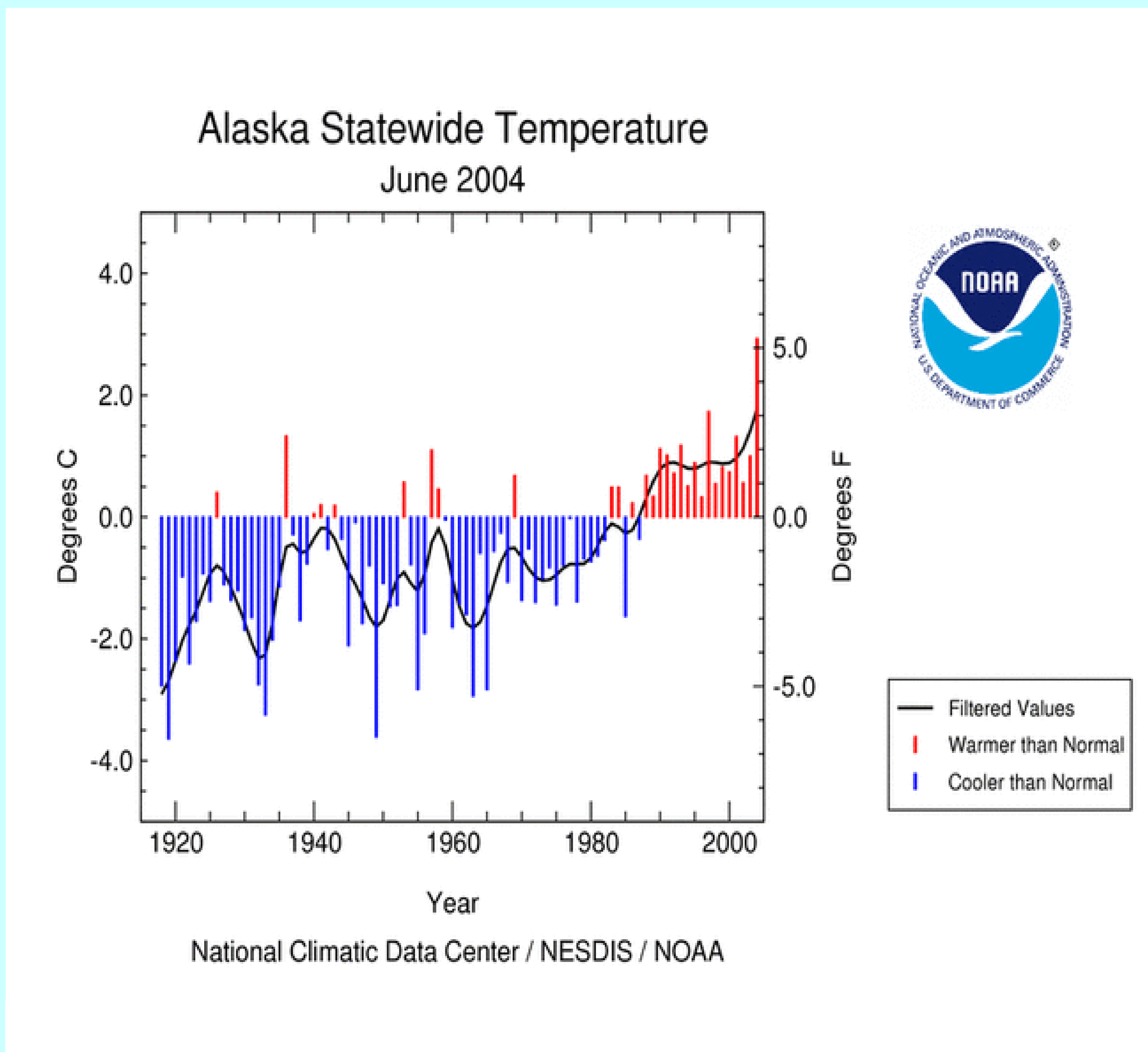


Figure 15. Climate warming we are now experiencing in interior Alaska is producing warmer June weather which may lead to more frequent large fires.

Photo by Jim Cronan, June 25, 2004

Acknowledgements

For data and graphs: Sharon Alden, NPS Meteorologist; Roger Ottmar, USFS-PNW Research Forester; David Wright, USFS-PNW Forester