P3.24 AN EXTRAORDINARY SUMMER IN THE INTERIOR OF ALASKA

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1. INTRODUCTION

A late spring/early summer of intense convection and locally record-breaking rainfall in interior Alaska was followed by drought, record warmth, and record-breaking wildland fire acreage. This paper will examine the events of May through August, 2004, describing the meteorological features causing them, and documenting the magnitude of the anomalous weather for the period which led to the record-breaking 6.5 million acres burned in the 2004 season.

2. MONTHLY SUMMARIES

2.1 May

For the month of May, 2004, interior Alaska as a whole reported 100 to 300 percent above normal precipitation (Fairbanks measured 2.01", 300 percent of normal), and monthly average temperatures of +4 to +8 degrees above the 1971-2000 normals. Much of this came from convection between the 25th and 31st of the month. In fact, on the 31st, the Alaska Lightning Detection System recorded 7876 lightning strikes, the largest total ever measured in May in over 25 years of records. Figure 1 shows the 500 millibar height analysis for that day. As was typical during that period of late May, extending to the middle of June, a deep nearly cut-off upper low remained in the Gulf of Alaska, while a strong ridge with positive height anomalies covered northern Alaska, northwest Canada, and the Beaufort Sea. This left the Alaska interior under a prevailing easterly low to mid level flow. Moisture and weak short-wave disturbances, the remnants of long-dissipated occluded Pacific frontal systems, provided the focus for organized convection. Some of the thunderstorms associated with these disturbances were surprisingly strong by Alaska standards, approaching (and even exceeding in a few cases) the NWS definition of severe (¾" hail and/or 50 kt. winds). Some fire starts were observed in late May, but most of the thunderstorms produced .10 or more rainfall, and it was likely that many of them held over into June, when warmer, drier conditions, with lower daytime RH's and fuel moistures caused them to grow more quickly and enable them to be detected. Figure 2 shows the 24 hour lightning accumulation from the BLM detection network on May 31, an amazing, by Alaska standards, 7876 strikes.

2.2 June

June saw a dramatic upsurge in fire activity and growth over the Alaska interior due to very warm, dry weather the latter half of the month, preceded by abundant lightning during the first half. Fairbanks only received a trace of precipitation from the 12th to the end of the month. Temperatures over the interior as a whole were 6 to 10 degrees above normals for the month (Fairbanks had the 2nd warmest June in 100 years of records), while precipitation for most of the region was only 25 to 50 percent of normal.

Of special note was the anomalously strong upper-ridge that built in over northern, and then northwestern Alaska during the last week of the month. 500 millibar heights of 580 dekameters were observed at 70 degrees N, and 570 dm at 80 N. This large mass of anomalously warm air brought unprecedented warmth to many areas of the state. Kivalina, on the Chukchi Sea Coast at 68 degrees N, recorded a high temperature of 96 degrees on the 29th, shattering the old all-time high by more than 15 degrees. The following morning the low there was a balmy 68. Average high and low temperatures for this area in late June would be a high in the low 50s with a low near 40. Figure 3 shows the anomalously strong upper ridge on June 29. With the upper ridge

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in this position, a corresponding surface high developed over northern and northeastern Alaska during this time, from about 6/27 to 7/03. This brought an unusually long five day period of warm, dry downsloping winds to the lower elevations of the Alaska Interior, blowing from the Brooks Range and uplands on both sides of the Yukon River, southeast to the broad lower and middle Tanana Valley. The multitude of wildfires which had been ignited by lightning earlier in late May to mid-June, then allowed to grow further (because they were in wilderness/designated non-suppression areas) the rest of the month, were fanned into conflagrations. Two of these, the Boundary and Wolf Creek wildfires, threatened homes and a hot springs on the outskirts of Fairbanks at this time. The Boundary Fire spread westward about 30 miles during this period. All of these fires throughout the interior grew explosively during this time and cast a thick pall of smoke which grew to cover the entire interior and then extended well west to Siberia.

2.3 July

Temperatures during the month of July over the interior were only slightly above normal during the month for most of the interior. This is misleading though, as heavy smoke from the large wildfires over the Yukon Flats, and uplands north and east of Fairbanks shrouded the entire area in thick smoke cover much of the time. This reduced solar insolation to the point that high temperatures were often 10 to 20 degrees (F) cooler than they would have been under clear sky conditions. Figure 4 is a MODIS image from July 1, showing the thick smoke shrouding much of the interior. Precipitation during the month was below average for much of the interior except over the uplands around the Yukon River, thunderstorms on many days in this area brought more rainfall to this area. As a general rule though, during this month, strong high pressure ridging over the region kept a warm, often unstable airmass in place. A typical example is shown in figure 5, the 500 millibar analysis from July 15. On this day, 9022 lightning strikes were recorded in Alaska, possibly the greatest daily accumulation since the lightning detection network was initiated 25 years ago (possibly, because the sensitivity of the network has increased over the last few years with better sensors and increased areal coverage). On days like this, the airmass over much of the state, especially the interior, was highly convectively unstable, with values of CAPE approaching 800-1000 J/Kg (values of that magnitude are fairly rare in Alaska). What was most atypical for the month as a whole, is that no low pressure systems were able to penetrate the prevailing ridge pattern from the southwest, or west. Typically, by mid to late July, low pressure systems from the North Pacific and Bering Sea move over the interior as the summer-time polar jet begins to strengthen slightly. The passage of these lows brings widespread wetting rains (.10 or more) to the interior and usually slows, or even ends, large-scale active fire growth. That did not occur in July, 2004. By the end of the month, acreage burned by wildfires across the state (almost entirely in the interior) had reached 4.37 million acres, approaching the old record of 5.0 million, which occurred in 1957.

2.4 August

August was another warm month in the interior of Alaska, with most recording sites measuring temperatures 3 to 7 degrees above normal. More remarkable was the drought. Most of the interior saw less than 50 percent of normal rainfall, and the central and eastern portions, less than 25 percent. Fairbanks had it's driest August in 101 years of records. August is usually the wettest month of the year for much of the interior. This is typically when low pressure systems from the North Pacific and Bering Sea move inland more frequently, and bring cooler, wet weather for a few days or a week at a time. Only one system of this kind occurred early in the month, Fairbanks picked up .34 on the 1st. Remarkably, there were only three days the rest of the month where .01 occurred there, it was an essentially rainless month except for the first day. Figure 6 shows why the month was so warm and dry overall. The 500 mb analysis for August 18 shows a strong blocking ridge in place extending north along the West Coast north and west to the Alaska interior. This pattern, with minor variations, was in place for much of the summer. By the end of the month, wildfire acreage had increased to 6.2 million acres, far surpassing the old 1957 record. Figure 7 is a MODIS image of many of the fire scars in the interior, on a rare, relatively smoke-free day in early August.

3. Summary

The summer of 2004 will be most remembered in the Alaska interior for the record-breaking wildfire acreage and resultant smoke accumulations and unhealthy conditions. The weather patterns that led to this were much above normal temperatures from May through August, much below normal precipitation accumulations from June through August, and abundant lightning from late May through Mid July. A pattern of strong upper-level ridging extending north along the West Coast into the Alaska interior was responsible for warm, dry weather from June through August. Usually this pattern is transitory, occurring for a week or two at a time, each summer, through June and into July. What was remarkable in 2004 was the persistence of this pattern, and the extreme magnitude of the late June/early July ridging event that brought the strong subsident north to east winds over the interior.

4. References

Alaska Climate Research Center, 2004: Monthly Statewide Summaries, June, July, August. http://climate.gi.alaska.edu/Fairbanks/2004

Bureau of Land Management – Alaska Fire Service, 2004: Alaska Interagency Coordination Center Situation Reports. http://www.fire.ak.blm.gov.

Grice, G.K., 1976: Thunderstorm Climatology of Alaska. *NOAA Technical Memorandum NWS AR-14.*

Paylor, T., 1998: Using Eta-Model Gridded CAPE as a Thunderstorm Predictor in Alaska. *NOAA-NWS-Alaska Region Technical Attachment T-98-10.*

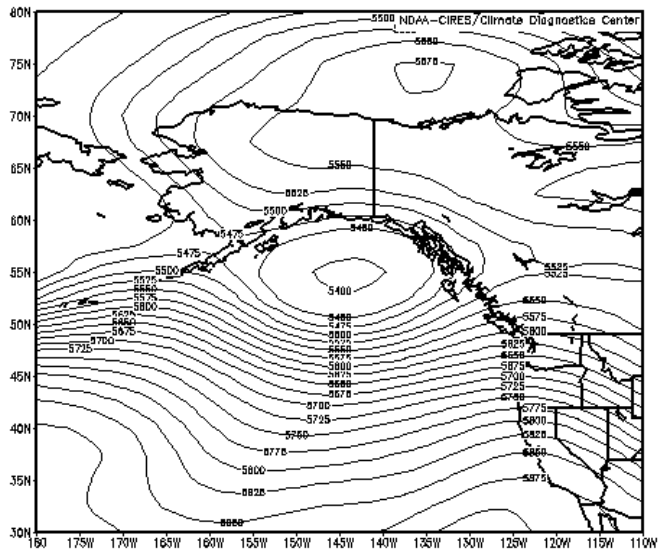

Fig. 1: May 31, 2004 500 millibar height analysis. Note deep low in the Gulf of Alaska with strong ridge over northern AK/NW Canada and Beaufort sea, leading to easterly 500 mb flow over interior AK.

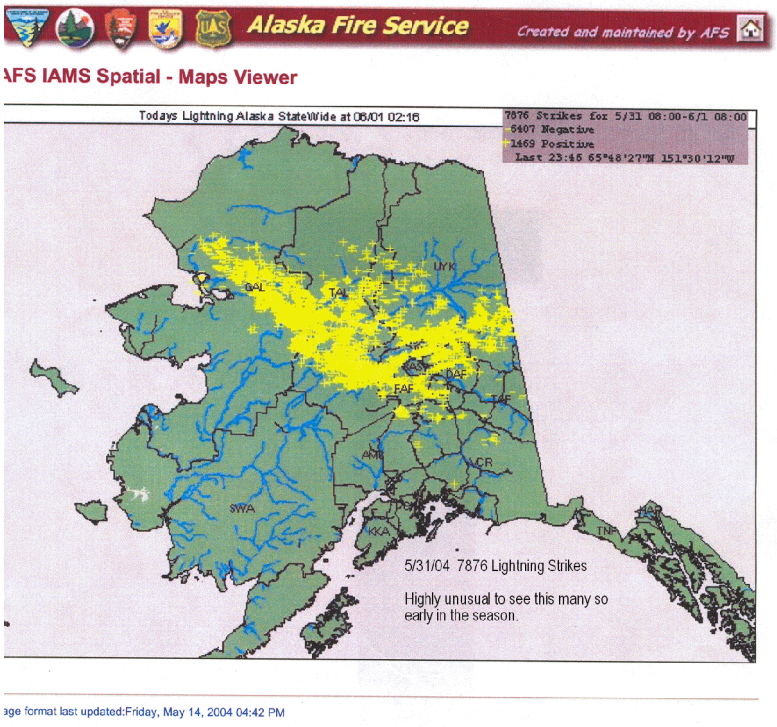

Figure 2. 24 hour lightning accumulation for May 31, 2004.

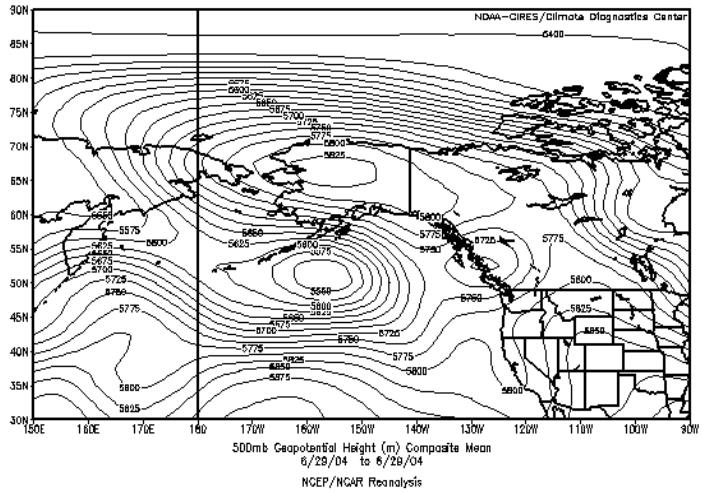

Figure 3: 500 millibar analysis, June 29, 2004.

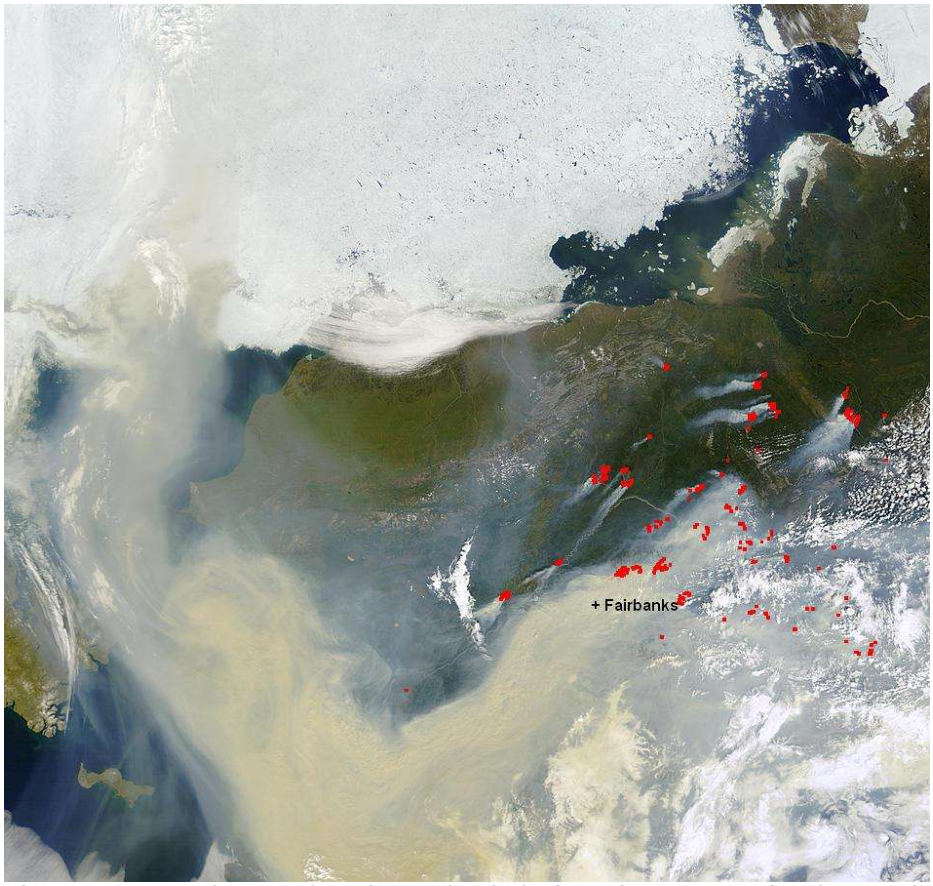

Figure 4. MODIS image of northern 2/3 of Alaska July 01, 2004 showing smoke and active fires.

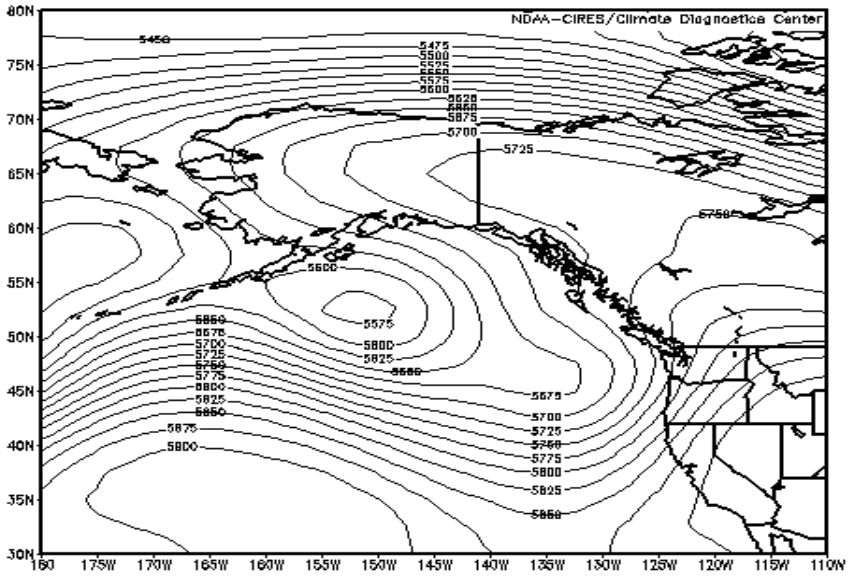

Figure 5. 500 millibar analysis July 15, 2004. Southeast low-mid level flow with embedded short-waves provided ample moisture and instability for widespread convection.

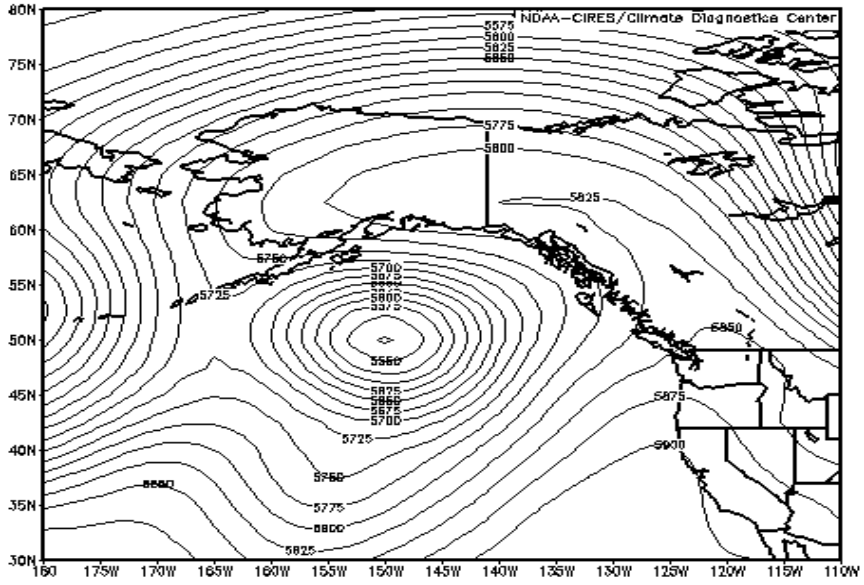

Figure 6. 500 millibar analysis August 18, 2004. Very strong ridge with high heights suppresses convection and will bring temperatures in the 80s or even 90s in extreme cases when skies are clear. (the high in Fairbanks this day was 81. Smoke kept temperatures down 5-10 degrees that day).

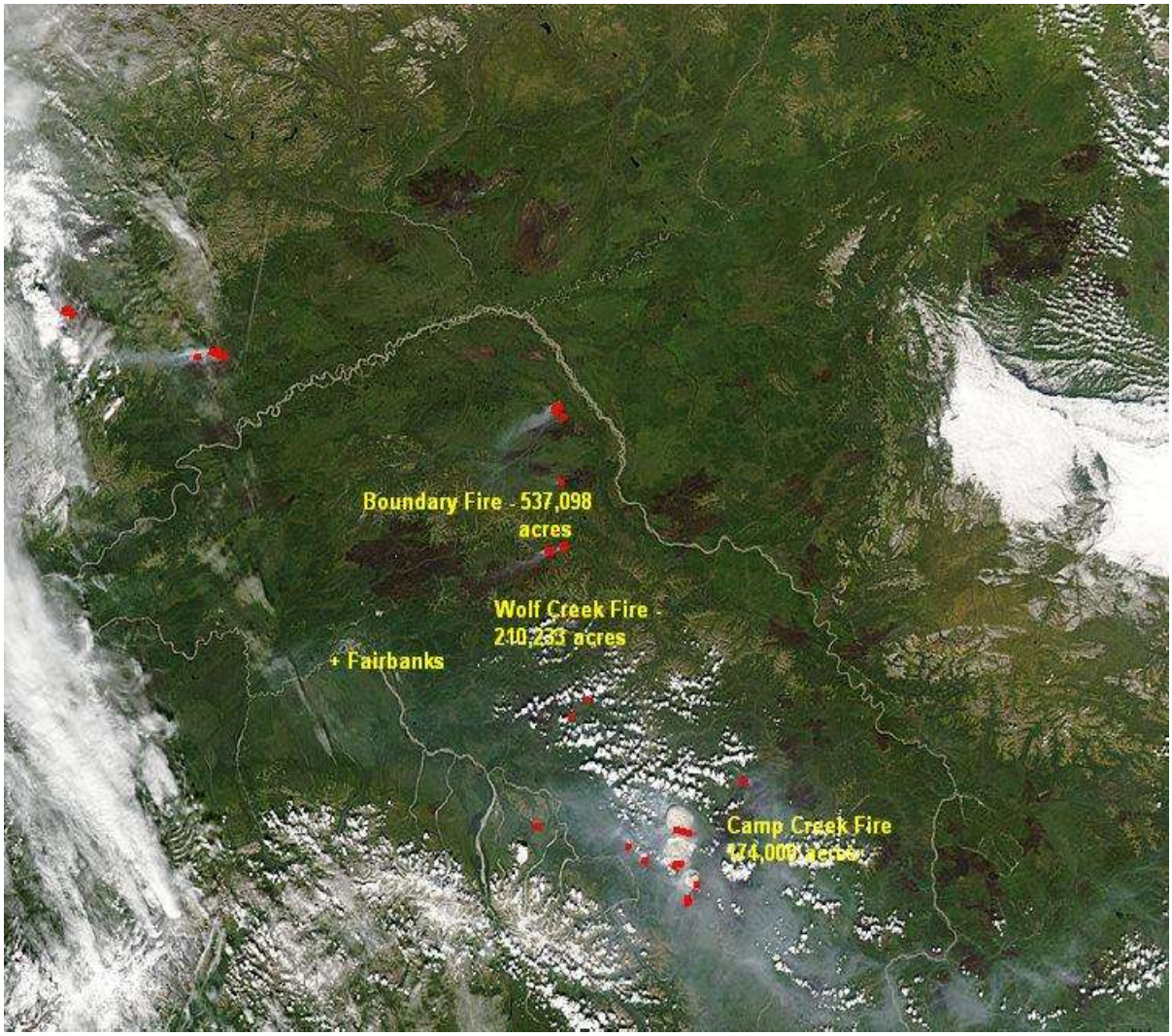

Figure 7. MODIS image of burn scars over the Alaska interior, August 05, 2004.