LATE SPRING TO MID-SUMMER EASTERLY WAVES OVER THE CENTRAL AND EASTERN INTERIOR – AND THEIR SIGNIFICANCE TO FIRE WEATHER

Overview: Easterly waves are remnants of dissipated occluded frontal systems that circulate around a closed upper-level low centered in the Gulf of Alaska. They can bring significant amounts of precipitation to much of the interior, especially the east/southeast and central portions, in any season. This could be in the form of over-running snow in fall/winter, and either moderate to heavy stratiform rain or organized widespread showers/thunderstorms, depending on when in the warm season they occur.

Their significance to fire weather over the central and eastern interior, especially, is that they can be a focusing mechanism for organized convection, providing moisture, and dynamical lift/forcing which can be augmented by the usual warm-season daytime surface heating/boundary layer instability. Thunderstorms associated with these can be stronger (and actually severe) than the typical summer air-mass types over the interior, and have produced large hail and strong damaging winds. Widespread lightning outbreaks can be produced, with thousands of strikes, which often serve as the main mechanism for fire starts, especially in the early and middle part of the fire season, late May through mid-July. Although organized convection and lightning outbreaks with these are typically accompanied by wetting rains (.10" or more), there often are so many fire starts that as soon as weather and fuel conditions allow, new fires spring to life. Thus, although they wouldn't likely be a red flag warning-type event, forecasting the widespread lightning outbreaks likely with these, and the areas expected, will be of great benefit to Alaska Fire Service. They can pre-position resources for scouting of and initial-attack suppression on the new fire starts.

Synoptic-Scale Ingredients: A closed upper-level low in the Gulf of Alaska with east to southeast circulation at 700 and 500 mb levels over the Interior is the primary ingredient. Satellite imagery will show the areas of moisture that are the remnants of old Pacific frontal systems (see figure 1), and the forecast models will typically show them as minor troughs and vorticity maxima (see figures 2 and 3). Convection is especially favored if these features arrive over previously clear areas of the central/eastern interior during maximum daytime heating, in afternoon or evening. Surface-based CAPE values of 800-1200 J/Kg can occur at these times, allowing the convection to be much deeper/stronger than what is usually expected over the AK Interior. Look at satellite imagery to first assess if any are waves moving north and west from the Gulf of AK/Southeast AK, and toward the interior. Model output usually will also show them at least minimally; and also look at the Meso-Eta CAPEs and 700mb vertical velocity forecasts, to get an indication of the model-forecasted strength of these. If/when the wave moves over a previously clear area of the central/eastern interior, the organized convection can be in the form of a squall line, with embedded thunderstorms capable of producing NWS-defined large hail (3/4" or greater) and strong winds (50 kt or greater), along with frequent lightning and locally heavy rain. Pre-existing instability derived from the appropriate sounding(s), combined with model forecasts (especially Meso-Eta) of CAPE or model-forecast soundings during the time of wave passage can help in the forecasting of the strength of these convective outbreaks. When one is approaching Fairbanks, radar interpretation is vital, due to the potential of severe thunderstorms. Figures 4 and 5 show a typical 24 hour lightning accumulation over the interior on a day when organized convection from an easterly wave occurred.

Two specific cases: The first case is from 31 May, 2004. This wave produced a squall line which moved over the Middle Tanana Valley in the late afternoon, over skies that had been sunny previously all day. One-inch hail and strong winds were observed in the Goldstream Valley, and more importantly, thousands of lightning strikes over the interior. This outbreak started many of the fires which grew to epic proportions later in the record-breaking 2004 fire season, although the thunderstorms with it were quite wet, producing in some cases over .50" of rainfall. Note how there are more lightning strikes over the uplands north and east of Fairbanks, than over the flats (fig. 4). **Thunderstorms with these waves tend to weaken as they move off the uplands and over the flats, hence there is a focusing of lightning and strong/severe winds and hail with these over the upland areas.** Note the deep upper-low present in the Gulf of Alaska with central height less than 540 dm (fig. 2), combined with a short-wave trough over the eastern interior. Satellite imagery at this time showed the wave over southeast Alaska, moving slowly west in the prevailing mid/upper-level circulation. Figure 6 shows the FAI skew-T just before the squall-line moved through. Note the high values of CAPE (817 J/Kg), low lifted index from cooling aloft with the approaching short-wave combined with strong daytime surface heating, and moist easterly flow from 800 mb through 200 mb.

The second case is from 13 June, 2005. Figure 5 shows the thousands of lightning strikes that occurred over the uplands from Nenana east to Fairbanks, as well as along the south slopes of the Brooks Range. **Particularly striking with this (no pun intended), is the lack of strikes indicated over the Middle Tanana Valley, implying a definite orographic focusing of the convection.** The accompanying 500 mb analysis (fig. 3) is not as clear-cut, but does show a hint of an upper-trough. These systems are most easily identified using mid-level height and vorticity analysis from the models, and IR imagery. The accompanying FAI skew-T (fig. 7) again shows the great instability present, along with the deep, relatively moist easterly flow.

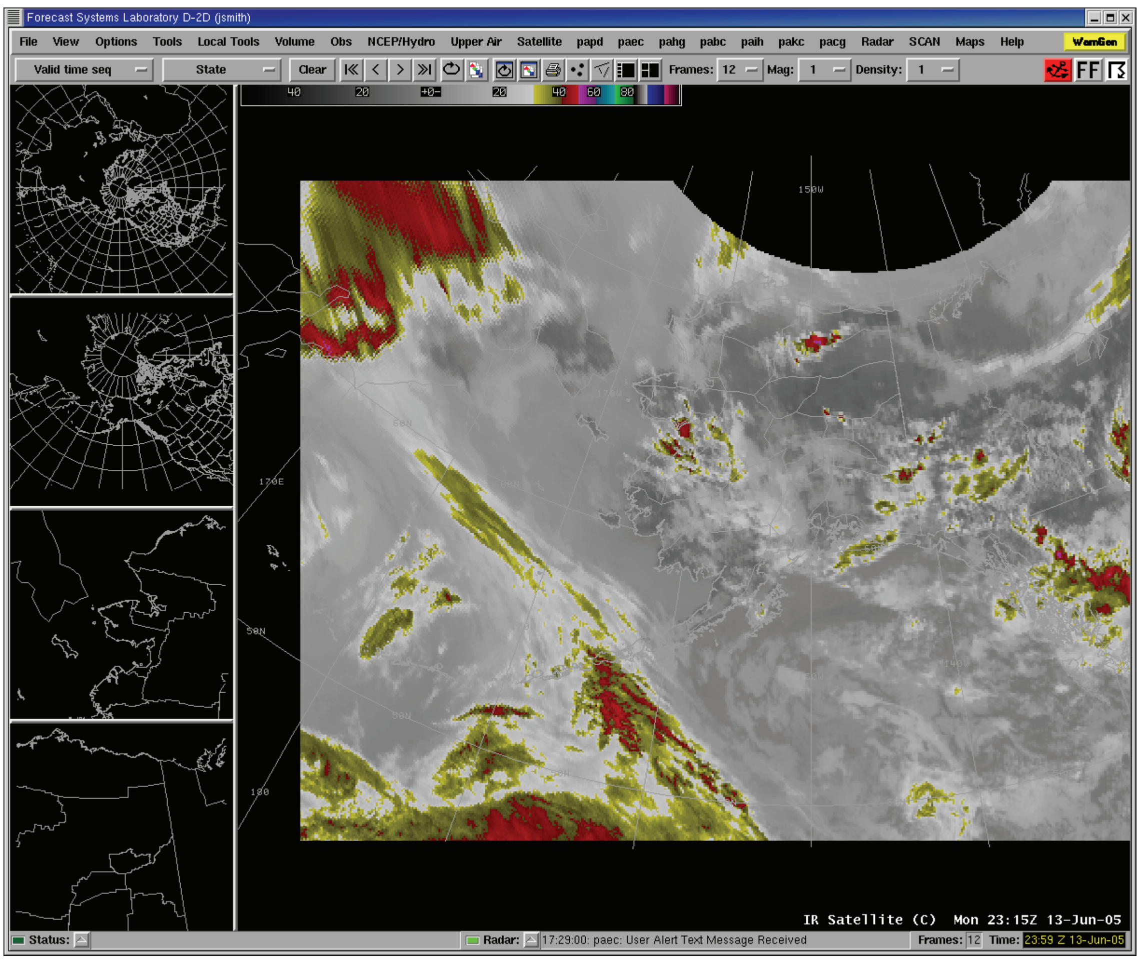

Figure 1 – GOES IR image of a typical easterly wave moving toward the interior from SE Alaska and the Yukon.

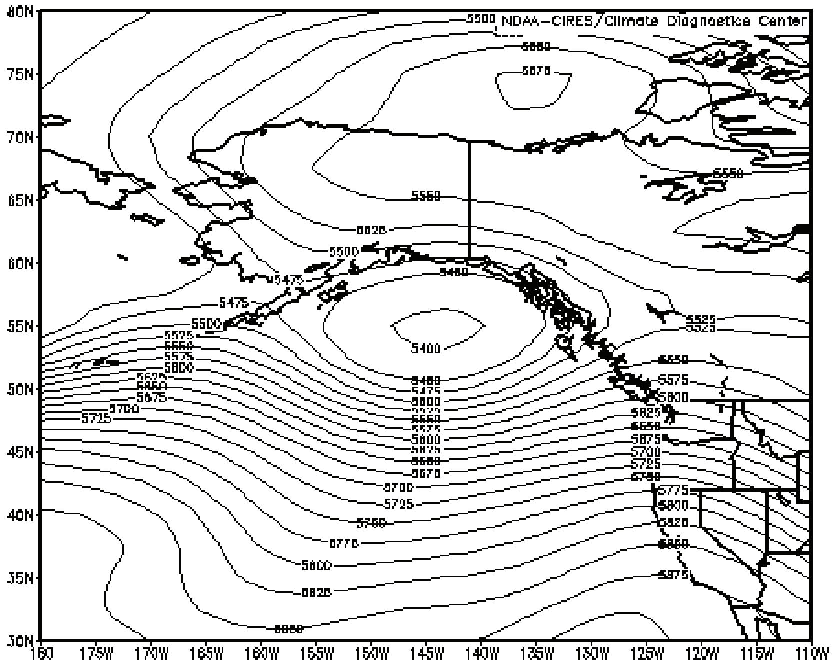

Figure 2 – 500 mb analysis from 12z 31 May, 2004.

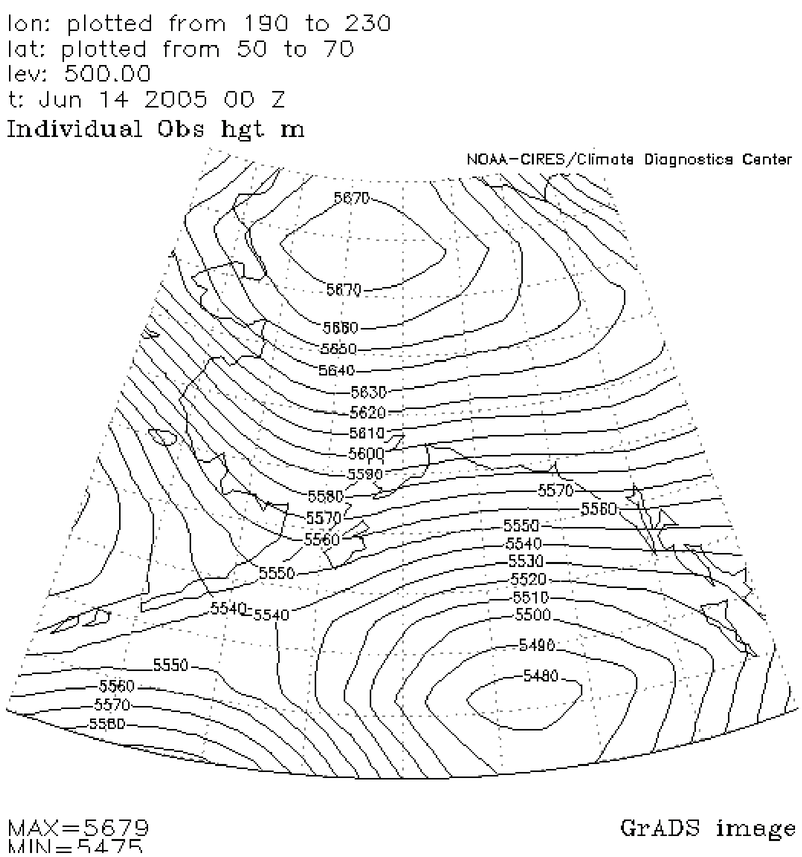

Figure 3 – 500 mb analysis from 00z 14 June, 2005.

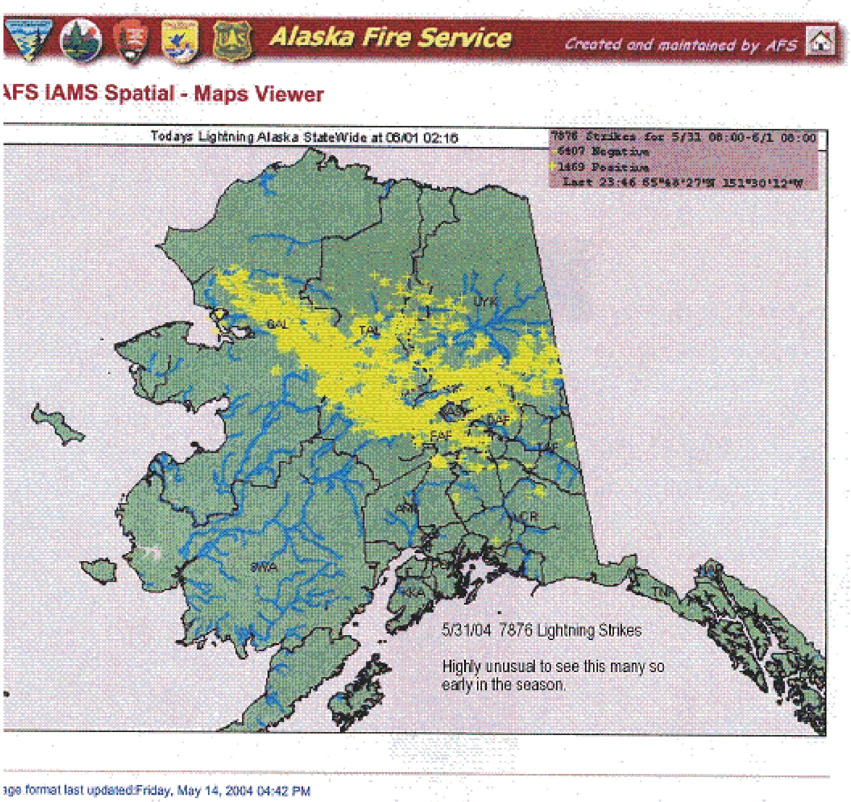

Figure 4 – 24 hour lightning accumulation, 31 May, 2004.

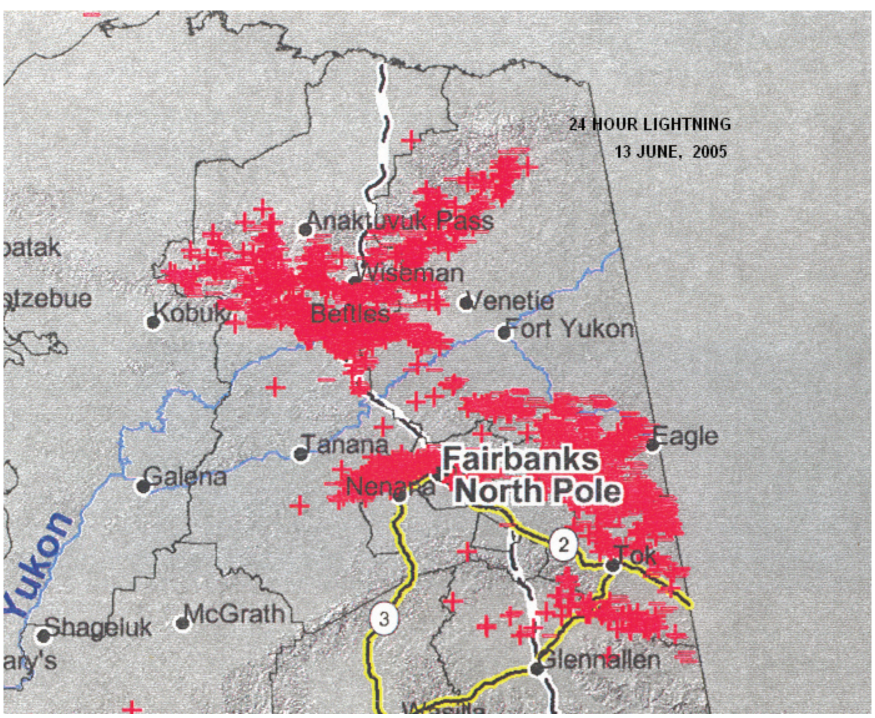

Figure 5 – 24 hour lightning accumulation, 13 June, 2005.

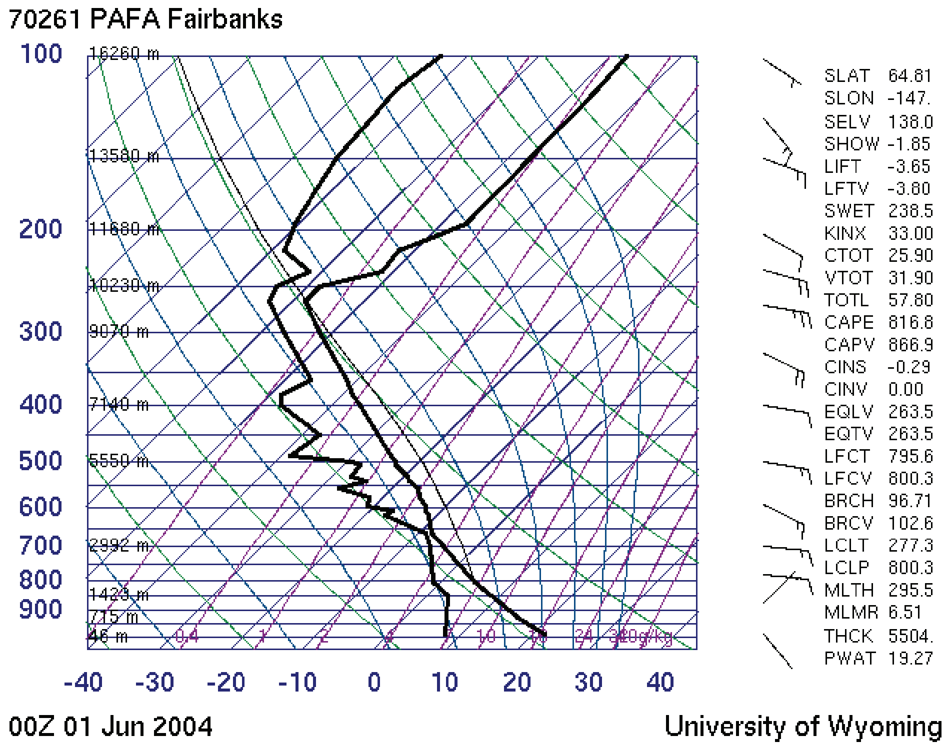

Figure 6 – FAI Skew-T afternoon of 5/31/04.

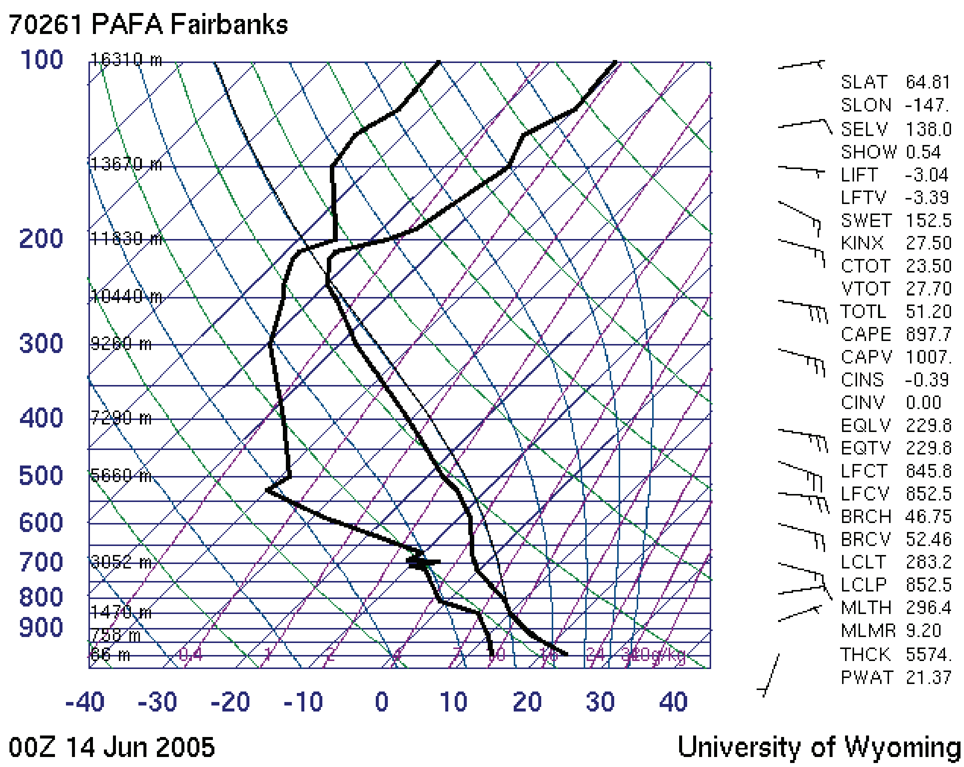

Figure 7 – FAI Skew-T afternoon of 6/13/05.