Addendum to Letter of 01-09-2009
Responses to Donna Deneen comments on exceptional events request

1) Define what is meant by "unusually strong winds" and demonstrate the exceptionality of the event.

Among all strong winds, we defined "unusually strong wind" to be those with gust speed of ≥40 mph. Gusts of this speed occurred on just 0.87% of all days during the 2002-2007 period examined (Figure 1). It should be pointed out that the exceptionality of the wind storm of Dec 2, 2007 was due not only to its ≥40-mph gust, but also the unusual environmental factors that accompanied this gust.

In Eagle River and surrounding area, nearly all gusts of ≥40 mph have been observed between November and March when the ground is generally covered with snow, or the gusts have been accompanied by precipitation. A gust of ≥40 mph combined with an absence of snow cover and/or precipitation is extremely rare. Although gusts ≥40 mph were observed on 19 days during the 6-year period 2002-2007, only 6 of these days had no snow cover or coincident precipitation. These conditions occurred on less than 0.3% of the days during the period.* Exceedances of the PM_{10} NAAQS at Eagle River since 2002 have been strictly associated with this rare combination of high winds, lack of precipitation and absence of snow cover. Evidence suggests that exceedances do not occur in Eagle River except under these rare conditions or other natural events such as volcanic ash fall.

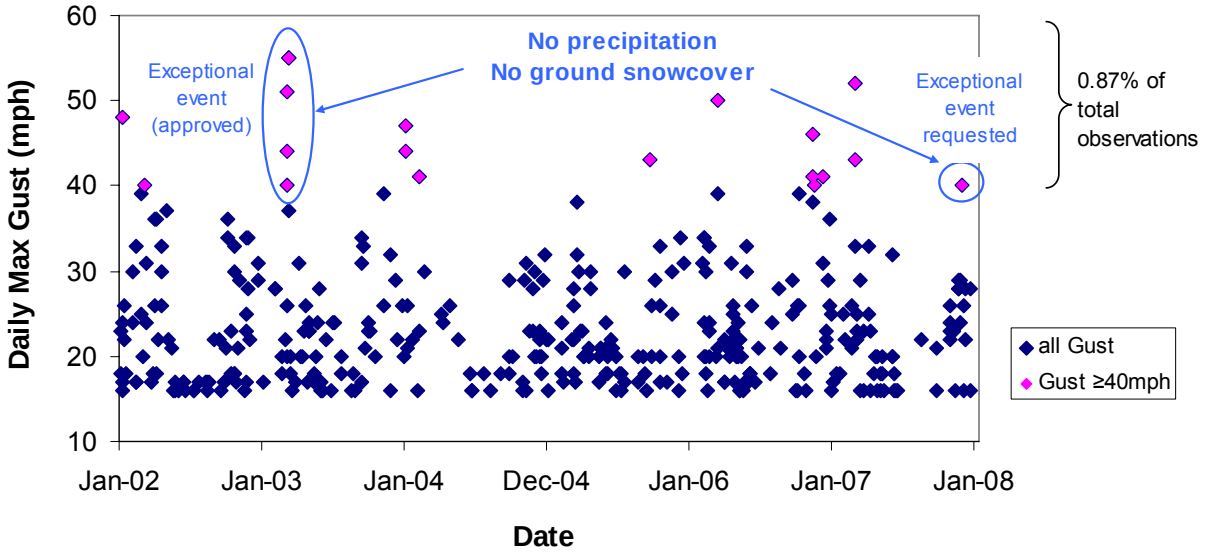

Figure 1. Daily maximum gust speed at Birchwood, approximately 6 miles NE of Eagle River. Snow cover and precipitation data were collected at Anchorage International Airport (PANC) site, approximately 30 miles SW of Eagle River, and matched with the gust data. We assumed that snow cover and precipitation conditions were similar within the PANC - Eagle River - Birchwood area. Gust data at Birchwood were obtained from Weather Underground (www.wunderground.com).

* Two of these days were exceedances (March 12, 2003 and December 2, 2007). PM-10 concentrations on the other four days are not known because these days did not coincide with the one-in-six day sampling schedule at the Parkgate site.

2) The frequency analysis should include all PM_{10} measurements including those that have been flagged (March 2003 and December 2007 events).

The empirical frequency distribution of all data including the flagged data points of March 12, 2003 and December 2, 2007 is shown in Figure 2. This figure clearly shows that these measured concentrations (590 and 223 µg m^{-3}, respectively) were unusual and beyond typical fluctuations. The absence of a well-fitted frequency distribution model with the flagged measurements but without these measurements indicates that process(es) that caused these two exceedances is absent during normal times. Combined with lack of significant temporary sources of PM_{10} at a local scale, such as fire, this abnormality supports the idea that the exceedance events were the result of PM_{10} emissions transported from remote areas.

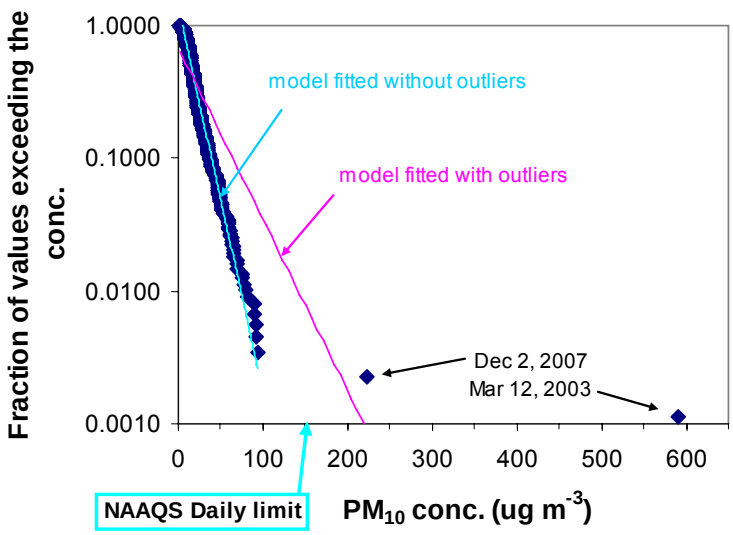

Figure 2. Frequency distribution of PM_{10} concentrations measured at the Parkgate Site, Eagle River. Note that model fitting is not possible with flagged data points of Mar 12, 2003 and Dec 2, 2007.

3) Justify that there would have been no exceedance or violation but for the event

The exceedance of Dec 2, 2007 would not have occurred without the wind storm, and the exceedance at the Parkgate site was almost certainly caused by windblown dust originated in upwind area (Palmer/Butte). Although no hourly PM_{10} data are available for Parkgate site or nearby town of Birchwood, hourly visibility data are available at both places. During clear weather condition, extremely high PM_{10} concentrations should be reflected by lower observed visibility.

In Figure 3, hourly visibility observations and speed of gust measurements at Birchwood are compared with those at Palmer/Butte area along with hourly PM_{10} data for the period November 30-December 4, 2007. During this period, no fog, rain, or snow that would reduce visibility were recorded except in Palmer on December 4. On the morning of December 2, visibility at Palmer declined quickly from ≥10 miles to 5 miles upon the onset of a gust >30 mph and reached as low as 0.8 miles (Figure 3-A). Hourly PM_{10} concentrations measured at Butte (~4 mile SE of Palmer) are roughly synchronized with the

changes in visibility and onset of gusts in Palmer, indicating the windblown dust is a source of PM_{10}.

Shortly after the decline in visibility and increase in PM_{10} observed in Palmer/Butte area, gust speeds peaked and visibility started to decline at Birchwood (Figure 3-B). During the 5-day period, visibility was less than 10 miles only on Dec 2 when the highest gust for the storm was recorded. Combined with the observations at Palmer/Butte sites, our data strongly suggest that strong winds caused the exceedance of the PM_{10} NAAQS on Dec 2 and that a significant portion of PM_{10} measured at the Parkgate site was transported from areas upwind. As noted in our letter of Jan 9, 2008 to ADEC, these upwind areas include the highly erodible glacial river floodplain of the Matanuska River which is almost certainly the source of a large portion of the PM_{10} transported into Eagle River.

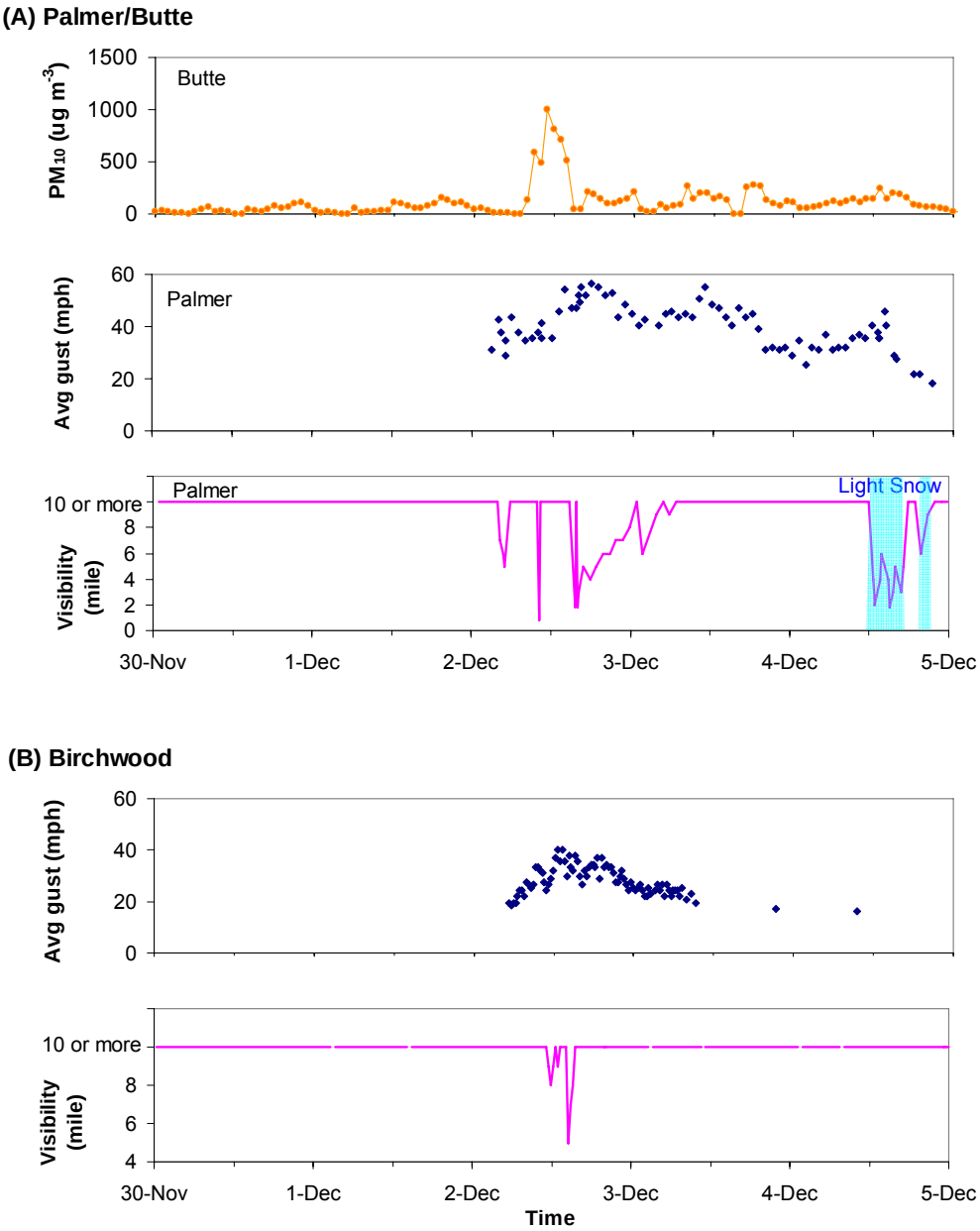

Figure 3. Comparison of gust, visibility, and PM_{10} concentrations observed in Palmer/Butte area and at Birchwood during Nov 30-Dec 4, 2007.