The Effect of Easterly Winds on Ceiling Heights at Unalakleet, Alaska During the Winter Months

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Easterly winds are very common at Unalakleet, AK, especially during the winter months. Through direct observation and discussions with forecasters, it was determined that any easterly component tends to be steered and funneled down the Unalakleet River and North River Valleys. As a result, east winds occur frequently at Unalakleet. Drainage flow can also be a significant factor during extreme cold events in the Interior. Figure 1 illustrates this east wind bias during the winter months.

Motivation

After understanding the cause of the easterly wind bias, I realized that it might have an effect on the Unalakleet (PAUN) ceiling heights. Studying this could be valuable, mainly because the Fairbanks WFO composes a routine TAF for the Unalakleet airfield.

Geography

Unalakleet is located on the eastern Norton Sound coast at the mouth of the Unalakleet River, as shown in Figure 2. Wind is funneled down the Unalakleet and North River Valleys, which converge about 10 miles east of town. Twenty-five miles to the east of PAUN, the ridge elevation of the Nulato Hills is between 2000 and 3000 ft.

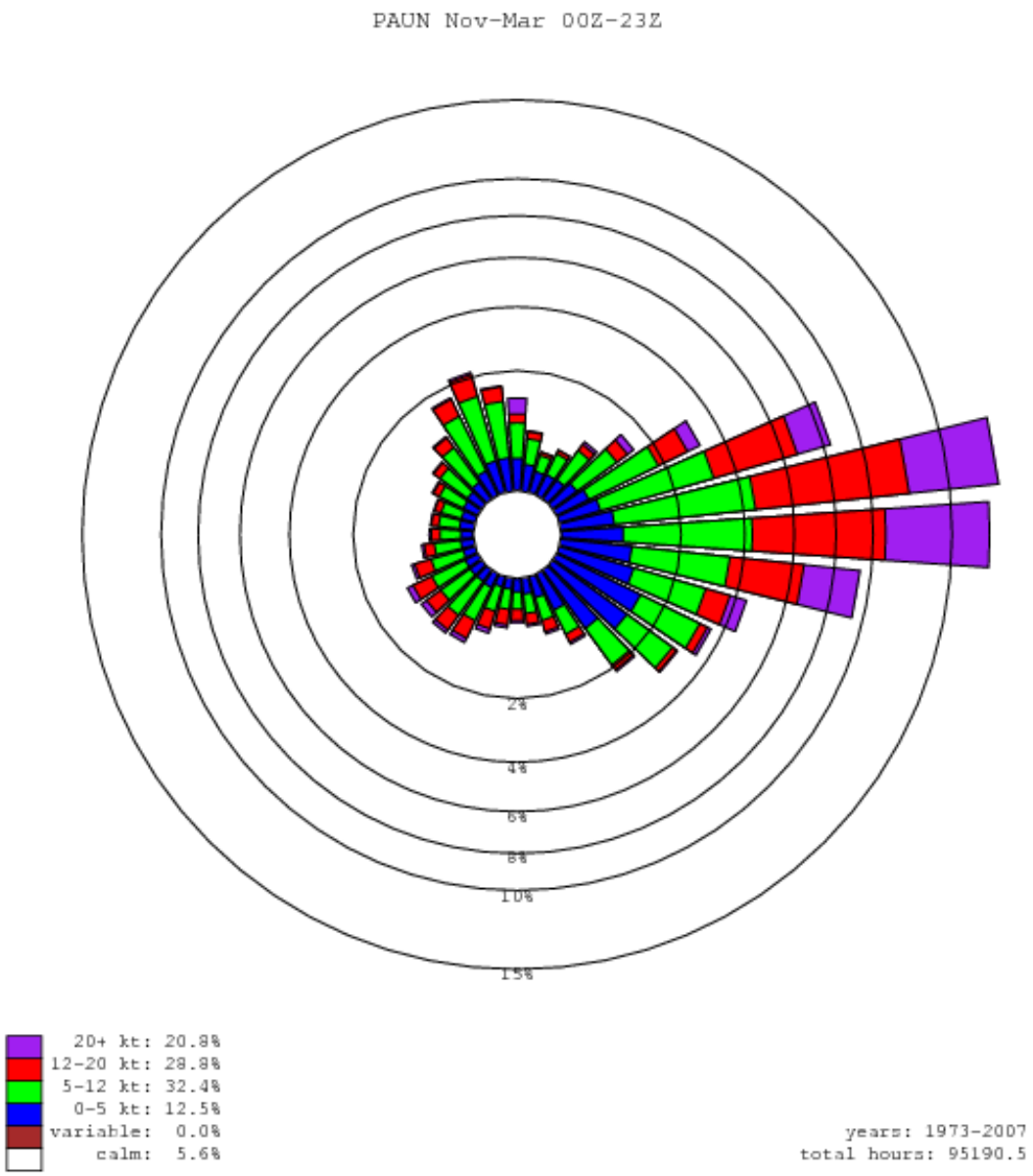

Figure 1. PAUN Wind Rose. Data are from Nov-March of 1973-2007.
Source: AvnFPS Wind Rose GUI on AWIPS.

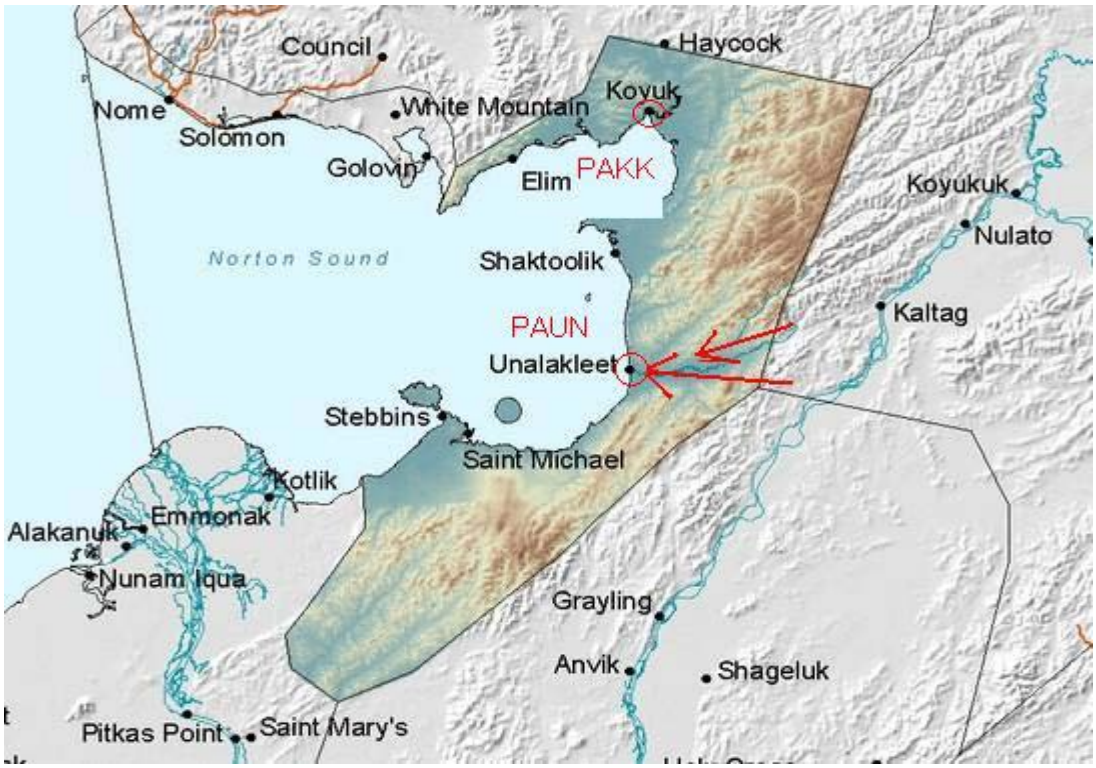

Figure 2: Zone 212 – Eastern Norton Sound & Nulato Hills…Including Unalakleet…Koyuk…Saint Michael

Hypothesis

When PAUN reports easterly winds, IFR ceilings (BKN or OVC < 1000ft) occur much less than when winds are from any other direction, due to down-sloping effects from the Nulato Hills.

Analysis

Since this is primarily a winter project, only the winter months from the past three years were analyzed. Observations were gathered from November through March of 2007-2008, 2008-2009, and from November through February of 2009-2010. March of 2010 is omitted because the month was incomplete at the time of analysis.

Sky condition, wind speed, and wind direction observations from the indicated time periods were obtained from PAUN. Observations from Koyuk (PAKK) were also analyzed in order to have comparative data in the same zone. Only wind speeds greater than 10kts were used in order to look at the sustained wind effect. East winds were defined as Azimuth degrees 70-110. Sky condition observations were analyzed

and grouped into the traditional ceiling categories of VFR, MVFR, and IFR. For PAUN, an additional category is shown for when the ceiling is at or below the airfield minimum of 600 ft. The number of times each ceiling category occurred were counted, and then converted into percentages of the total number of observations used.

Results

Figures 3a-4a show that MVFR ceilings occur much less at PAUN during easterly winds than during winds from any other direction. Surprisingly, there was no discernable difference between IFR ceiling occurrences, which shows the rarity of such events at this station during the winter. On a side note, ceilings were below airfield minimums less than one percent of the time when easterly winds occurred. However, the wind speeds during these events were generally 20-40kts. This indicates the possibility of a deep surface low over the Bering Sea in conjunction with strong winter storms.

Figures 3b-4b show surprisingly similar results during the winter months at PAKK. However, the difference in MVFR ceiling occurrences is less dramatic than the difference at PAUN. These figures also show that the winds at PAKK may have the same effect on ceiling heights, especially since a northerly component would also result in down-sloping.

Conclusion

This information is valuable to forecasters when composing and/or monitoring the TAF for PAUN. Further studies could be done on the effects of visibility, as well as occurrences during the summer months, when fog and stratus are prevalent on the Norton Sound coast. Additionally, a study could be done to look at pressure gradients between Unalakleet and Kaltag, which is 70 miles to the east, and on the other side of the Nulato Hills.

Unalakleet Analysis

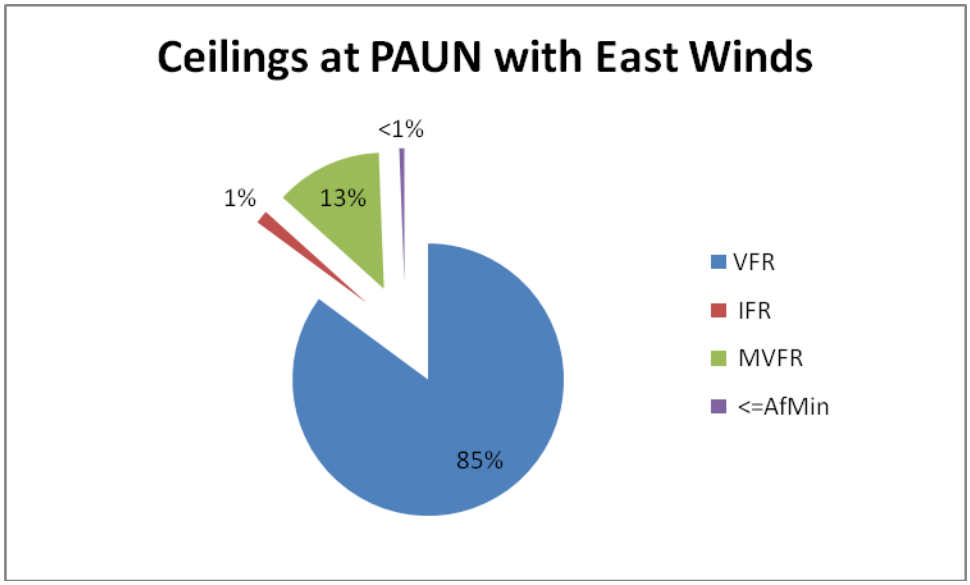

Figure 3a

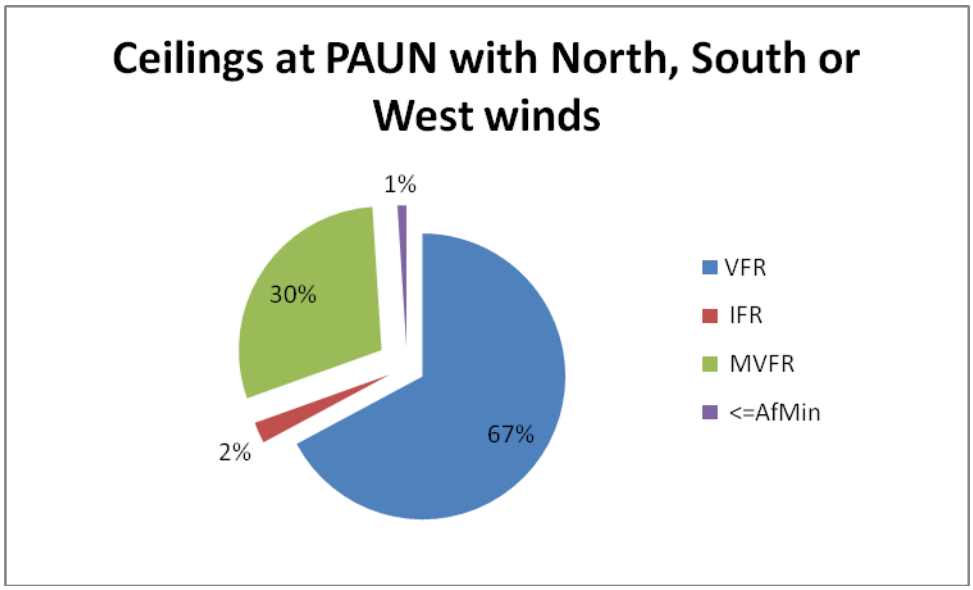

Figure 4a

Koyuk Analysis

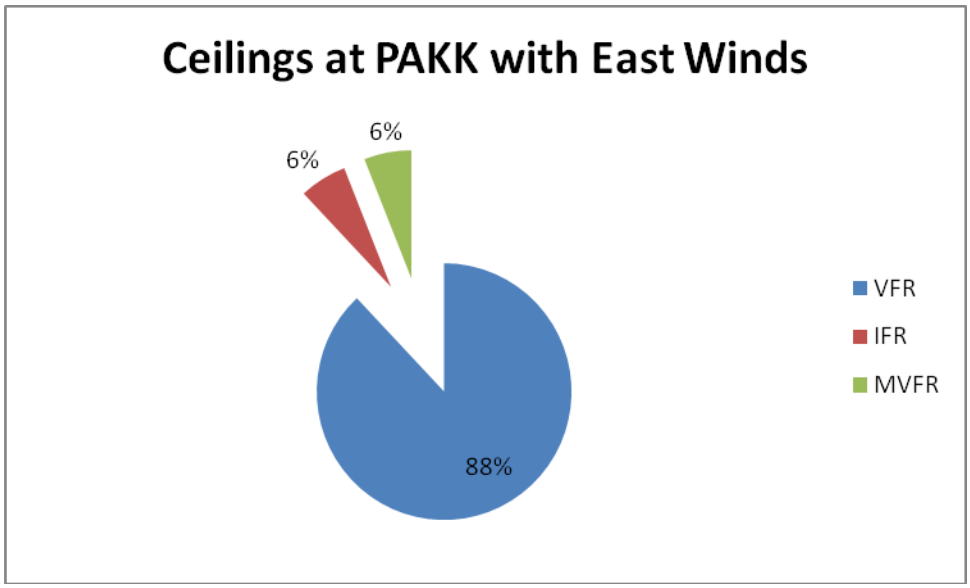

Figure 3b

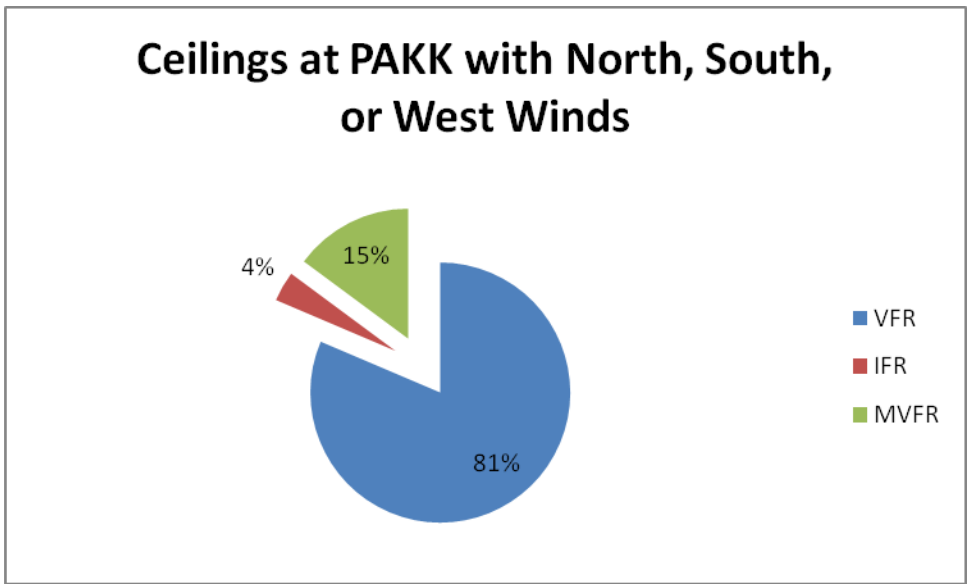

Figure 4b