Anchorage snowfall 2011-2012: White Gold or Nuisance?

John Papineau, NWS, Anchorage

Unless you have been out of town for an extended period of time or locked in the house, you will have noticed that a lot of snow has fallen this winter. As of April 1 we have received 129.4" of snow making it the second snowiest winter, and the season is not over yet. Blowing snow and icy roads at times have made for some challenging driving, not to mention obstructing snow berms that have limited vision and narrow snow choked side streets. Nevertheless it has been a boom season for snow removal contractors and auto body repair shops. Skiers enjoyed the white stuff when it was not windy, rainy, or sub-zero temperatures.

Figure 1 shows Anchorage seasonal snowfalls that have exceeded one hundred inches. You should note that these observations have been taken at a number of different locations throughout the years. From 1998 to the present snowfall and snow depth are measured at the Weather Service Office, located just south of the airport. From 1953 through 1998 snow measurements were taken at Pt. Campbell which was located on a knoll adjacent to the east-west runways at the airport. Prior to 1953 observations were taken at Merrill Field and various spots in the downtown area. Some of these locations are windier than others during the winter months, so hence there is some geographic variability, but the current location and Pt. Campbell are close enough for one continuous record. The current 30 year mean Anchorage snowfall is 74.5" while the period of record mean (81 years) is 68.7"; prior to 1953 seasonal snowfall for some reason was less than in recent decades. Whether this difference is due to the location of where the observations were taken (wind), or represent an actual change in snowfall, remains unknown. Nevertheless, no matter how you look at it this winter was white, not only in Anchorage but over much of Southcentral as well. Although the 'official' snowfall measurement is taken in west Anchorage, snowfall and snow depth varies greatly across town. On the upper Hillside for example several locations have measured over 200" of snow this season which either breaks existing records or is close to the record.

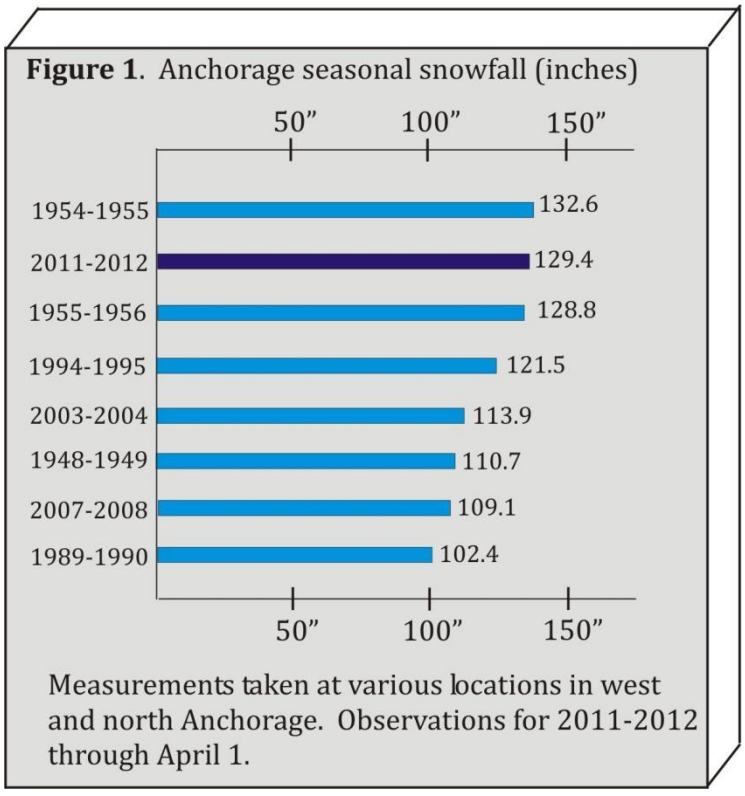


Figure 1. Anchorage seasonal snowfall (inches)

Measurements taken at various locations in west and north Anchorage. Observations for 2011-2012 through April 1.

It began on October 30th when the snow season got off to a humble start with 1.1" at the NWS forecast office. Snowfall has been pretty consistent through the season; there were several dry periods the longest in mid-winter was during the mid-January cold spell where we had a 10 day stretch without fresh snow. Currently we are in a 21 day drought at the Forecast Office. The greatest depth this season was 36" which occurred in late February and early March, which is not a record…on December 31, 1955 the depth was 47", in February 1956 and again in mid-March 2002 a depth of 39" was recorded.

Figure 2 shows the month-to-month 'path' that the record snowfall took in comparison with the previous record of 1954-1955. Snow started later this current season but quickly outpaced the old record by early November and only since mid-February have the two been close. Note that 18+ inches of snow fell in April of 1955 to set the local record for snowfall. The average snowfall for the month of April is around four inches but ranges from zero to 30 inches.

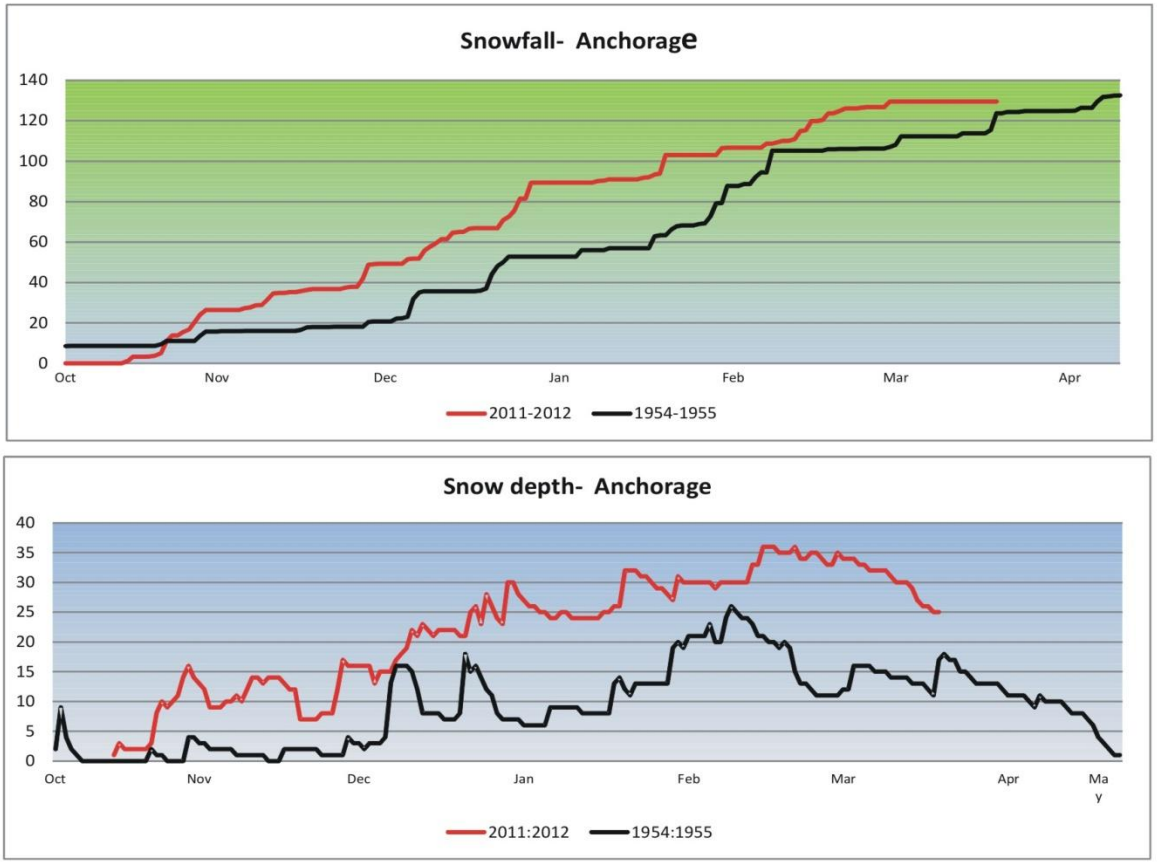


Figure 2. Comparison of snowfall and snow depth for current season and the record setting snowfall of 1954-1955.

One of the unique aspects of this season's snow is the amount that has fallen in conjunction with cooler temperatures. A general rule-of-thumb is that warm air, for example when the air temperature near the ground is in the 20's to lower 30's, is more favorable for the production of snow than colder temperatures. If we look at the amount of snow that has fallen when the daily mean air temperature was 10^{o} F or colder from previous heavy snow years we find: 16.5" fell in 1954-1955, down to 11.5" in the 1955-1956 season with a modest 12.8" in 2007-2008. However this season 31.1" of snow fell on cold days. Why this occurred is a mystery at this point- but considering that the weather this winter over most of Alaska has been one of extremes, we should not be too surprised.

Table One shows a comparison of the number of snow days, defined as any day with at least 0.1" of snowfall, and the number of days where 6.0" of more snow was observed. It is apparent that the current snowy season has similar characteristics as previous big snow years; that is the most of the snow

comes in small increments rather than in large doses, as seen in the relatively few number of events with 6" or more snowfall.

Table 1: Anchorage snow data			
Season	# snow days	>= 6.0"	Melt out
2011-2012	71	4	???
1954-1955	62	7	May 7
1955-1956	64	4	April 28
1994-1995	56	5	April 17
2003-2004	55	3	April 23
1948-1949	59	2	n/a
2007-2008	54	3	April 19,30*
1989-1990	65	1	April 12

Astute readers will have noticed that three of the highest snowfall totals shown in Figure 1 have occurred in the last nine seasons. This begs the question whether we are experiencing an increase in snowfall or precipitation. There does not appear to be any trend in the data at this point but it's worth monitoring closely. As noted above the 'official' site where snow has been measured has moved around town over the years…some are windier then others, so a certain amount of uncertainty is added by this as well.

The historical data indicates that there is no correlation between the occurrence of an El Nino or La Nina and the amount of snowfall in the greater Anchorage area. It is noteworthy that both the heavy snow seasons of 1954-1955 and 1955-1956 were La Nina winters. However, since the North Pacific climate shift of 1977, there has been 10 La Nina's with an average snowfall of approximately 78". There have been 11 El Nino events since 1977 producing an average of 74" of snow. Weather patterns during a given El Nino or La Nina in the greater Alaska region are less predictable than they are in the mid-latitudes due to the highly unstable positioning of the storm track across the southern Bering Sea and Gulf of Alaska. In fact for the ten wettest winters since 1977 in Anchorage (snow + rain), three occurred during La Nina winters, three during El Niño's winters and four during ENSO neutral winters. The primary difference between La Nina's and El Niño's is that there is a higher probability that a La Nina winter will be cooler than an El Nino winter.

Figure 3 shows snowfall observations from around the region; virtually all locations south of the Alaska Range have received well above normal amount s of snowfall. Kodiak is close to setting a new snowfall record while Valdez is well behind its record of 550.7" set in 1989-1990. Although snowfall in Yakutat has also been well above normal, it is still some distance behind its record of 403.2" set in 1975-1976.

The Future: The snow season is not over yet, so who knows how much more we could receive over the next several weeks. What many residents are now wondering is how long will it take for this snow to melt? Although snowmelt began in earnest this past week, with 25-50"of snow on the ground this could take a while. The most significant factor in determining the melt process is the speed at which air temperatures warm in April, and secondly the amount of sunshine (or lack of cloud cover). Sometimes the warming is abrupt and the snow melts rapidly (as in late March 1995), and other years it is slow and the snowpack bleeds off (as in April 2002). One advantage to the abundant snowfall in November is that it insulated the ground, in other words despite the deep snowpack, once this snow melts, the frost depth should be less deep that in many years- meaning that the ground should warm fairly rapidly. The current estimate of frost depth in Anchorage is around 15 inches; although frost depth data is very limited, this is indeed much shallower than what we would measure in a typical winter.

If we look at the melt out dates (trace of snow at the Forecast Office) several of the previous big snow years as seen in the last column of Table 1, we see a wide range of dates. The advantage of an abrupt warming trend in the spring is that the snow melts sooner and the frozen ground can begin to thaw.

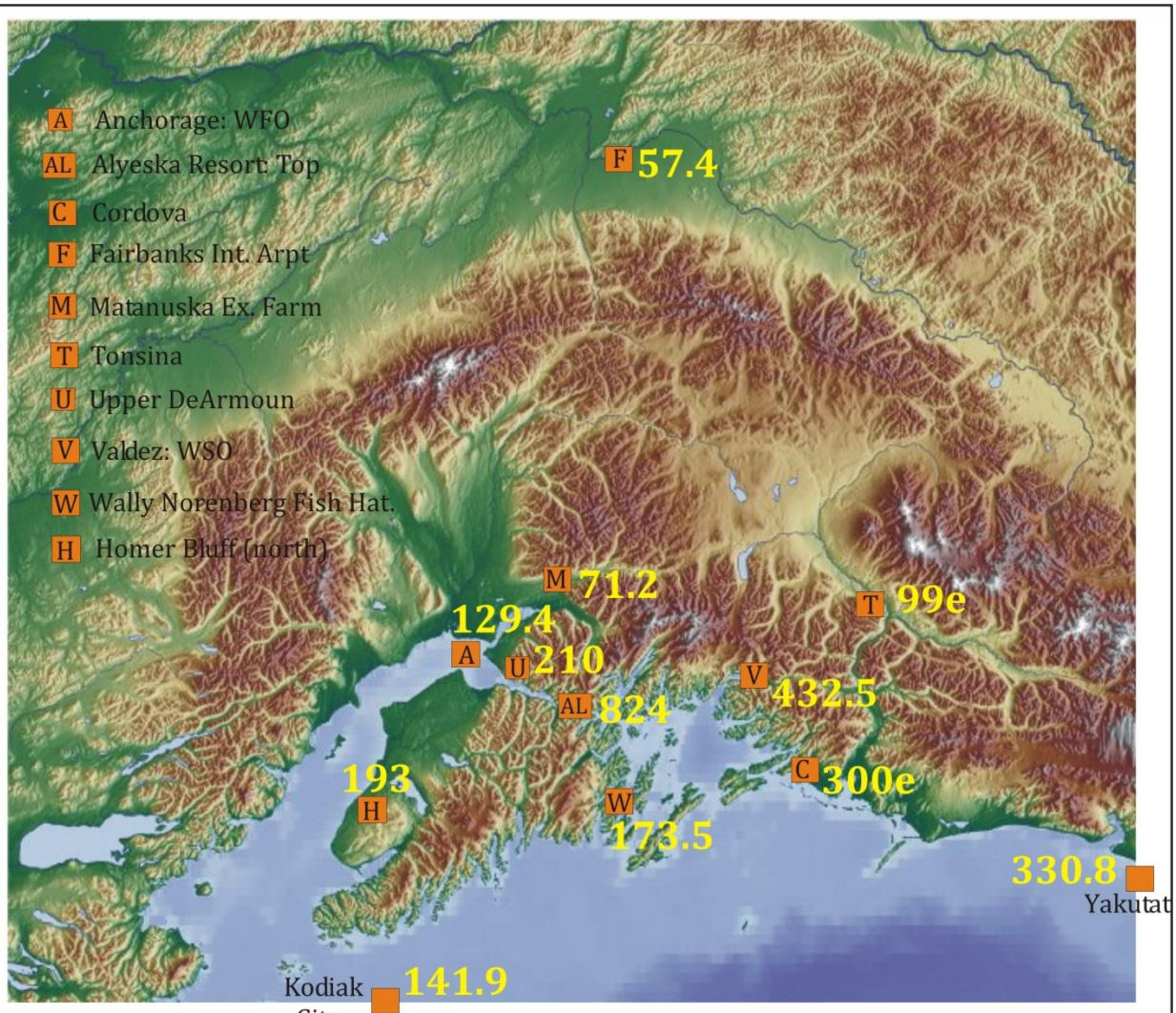
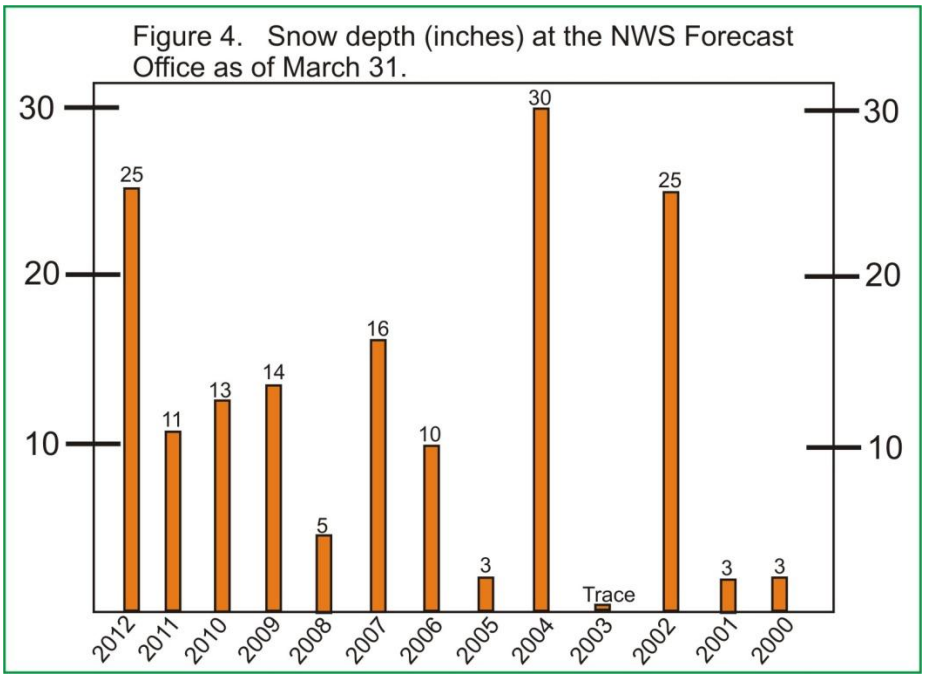


Figure 3. Regional snowfall (inches) observations through April 1. Estimated values are indicated with an "e".

The disadvantage to a rapid melt is that all the water makes its way to low-lying areas including dips in roads and forms ponds. This makes for continued fun driving…some of these melt ponds refreeze at night making for even more fun the next morning! Note that in April of 2008 the snow in west Anchorage had melted out but on the 25th a major snow storm produced another 15-22" across town. This pushed the ultimate melt out back to April 30th.

Figure 4 shows the snowdepth as of March 31st for the previous 12 years. Note that the current snowdepth of 25" contains 6.4" inches of water, which means that if this amount of snow was suddenly melted it would release this much water. The range is from zero to 30" so our current value is on the high side but not extreme.

So what produced all of the snow across the region? Inspection of the weather maps over the course of the winter indicates that the storm track across the eastern North Pacific was shifted further north than



in most winters. We do not know ultimately why this occurred; nevertheless the end result was a high frequency of storms in the Gulf of Alaska and with fewer storms reaching the western USA. The number of days of rain or snow along Gulf Coast was well above normal. For example, at Yakutat the number of days of precipitation (rain or snow) from the December through February period typically averages around 59 days (out of a possible 90 for non-leap years), this past season had 78 days with measureable precipitation. The number of snow days during this three month period averages 38 days, this past season had 61 days. During years of heavy snowfall it is typically for the increase in snow to be due to an increase in the number of storms rather than larger amounts of snowfall from the same number of storms.

The current long-range temperature forecast from the Climate Prediction Center is for a cool spring across most of Southcentral and southwest Alaska…which if this forecast is correct would hint at a slow bleeding of the snowpack. This would mean less melt problems but we would have snow on the ground well into….. This week it looks as if night time lows will be in the 20s and day time highs in the 40s with a chance of rain or snow on Wednesday and again on Sunday.

Acknowledgment: As always thanks to our many cooperative weather observers who fill in the data voids with their tireless collection of weather data.

John Papineau, Ph.D
Climate Focal Point
National Weather Service, Anchorage
john.papineau@noaa.gov