A Winter for the Record Books

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The snow 'drought' of late March and early April ended on April 6th when 0.8" of wet snow was observed but the decisive blow was on the 7th when 4.3" fell at the Forecast Office breaking the old record set during the 1954-1955 season. So far this season we have recorded 134.5" of snow in west Anchorage with an estimated 215"-225" on the Upper Hillside.

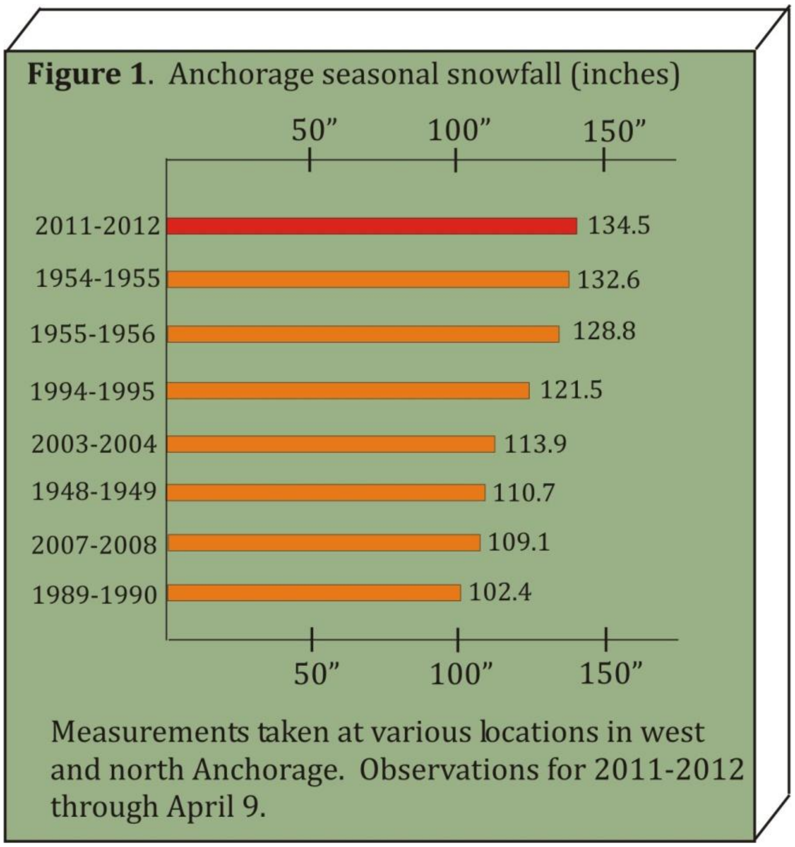


Figure 1 shows Anchorage seasonal snowfalls that have exceeded one hundred inches. You should note that these observations have been taken at a number of different locations throughout the years. From 1998 to the present snowfall and snow depth are measured at the Weather Service Office, located just 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 were snowfall ranges from 130-150% of normal. 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 well over 200" of snow this season which either breaks existing records or is close to the record.

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. We had a 21 day 'drought' at the Forecast Office until the recent snowfall in early April. 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: Monthly distribution of snowfall for 2011-2012 season

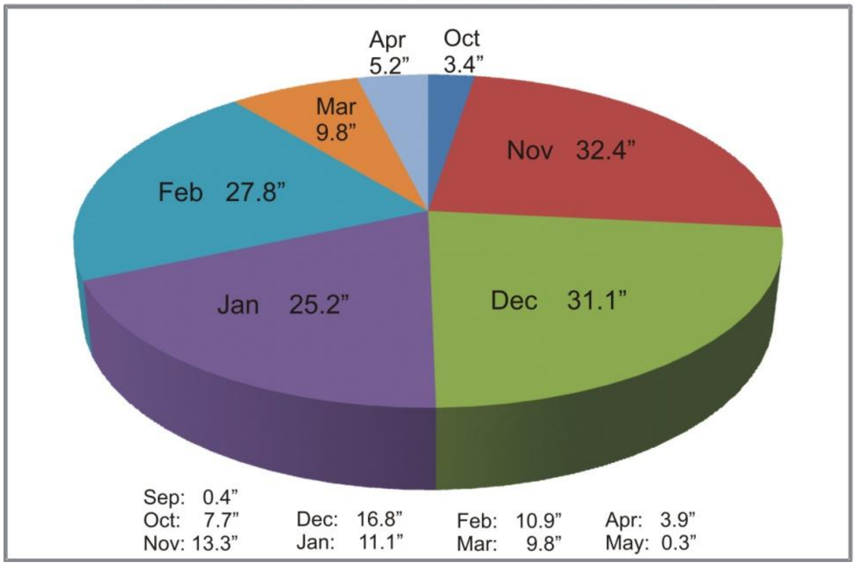


Figure 2 shows the month-to-month snowfall totals for this current season with the 30 year normal at the bottom. Snowfall was distributed quite uniformly through the core of the winter. One of the unique aspects of this season's snow is the amount that has fallen in conjunction with cooler temperatures. 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; in that 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	73	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.

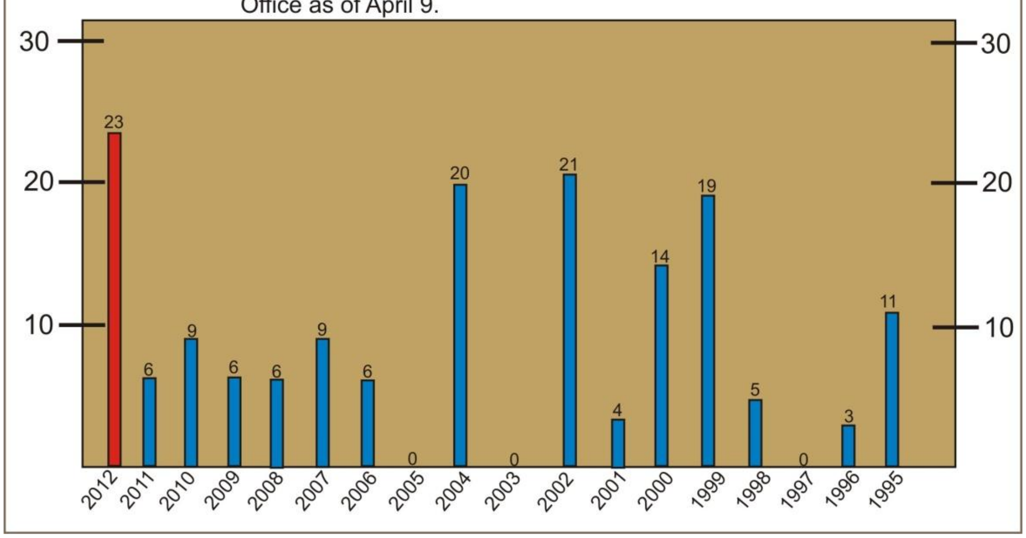
The historical data indicates that there is no correlation between the occurrence of an El Nino or La Nina and the amount of snowfall in the greater Anchorage area. It is noteworthy that both the heavy snow seasons of 1954-1955 and 1955-1956 were La Nina winters. However, since the North Pacific climate 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.

What lies in 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 23-40"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 on the ground 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. 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 3 shows the snowdepth as of April 9th for the previous 17 years. Note that the current snowdepth of 23" contains 6.4" inches of water, which means that if this amount of snow was suddenly melted it would release this much water.

Figure 3. Snow depth (inches) at the NWS Forecast Office as of April 9.



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 typical 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. Over the next 10 days it would appear that night time low temperatures will be in the 25-30^{o} range with daytime highs in the mid-40s. A rough estimate of melt would be about one inch per day in an uncompacted snowpack; hence the melt-out at the Forecast office barring any additional snow or unseasonably cold temperatures would be around the end of April or the first few days of May. Areas of substantially deeper snow will probably melt out around the second week of May.

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