

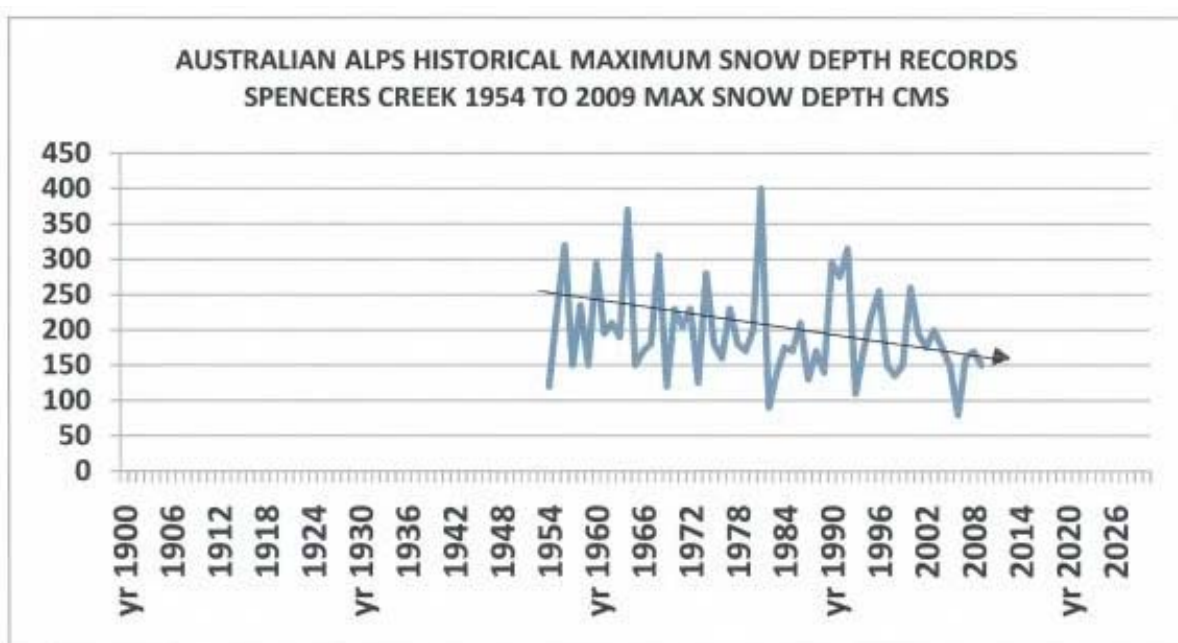
WHAT IS CONTROLLING SNOW LEVELS IN THE AUSTRALIAN ALPS?: HOW HAVE SNOW LEVELS CHANGED FROM 1927 TO 2009?...AND, WHAT ARE THE EXPECTED AUSTRALIAN ALPS SNOW LEVEL GENERAL TREND FORECASTS FROM 2010 TO 2030?

Ian Holton, Holton Weather Forecasting Pty Ltd: Friday 26th March 2010

INTRODUCTION:

Maximum Snow Depth Levels in the Australian Alps have been noticed tending towards lower and lower levels over the past 10 to 20 years. Many snow enthusiasts and others have become concerned that Global Warming will continue this downwards trend, and we will eventually lose our Australian Winter-Spring Snow Season almost altogether! This would have a devastating effect on our Snow Tourist Industry in Australia, not to mention the lack of snowmelt going into our rivers, lakes, dams and hydro-electricity power stations.

Snow Depth records in Australia are generally quoted as running from 1954 onwards. Using the well known & well presented Snow Depth Data from the Snowy Hydro Limited [On their [website](#)] it is graphs plotted using this Snow Depth data that appear quite convincing in showing a steady downward trend in Mean Yearly Snow Depths since 1954 ([See Graph below](#)).



Nicholls <http://www.bom.gov.au/amm/docs/2005/nicholls1.pdf> used this data (& other extra data) to arrive at the following conclusion in his comprehensive 2005 paper, " *The fact that the decline in maximum snow depth is much weaker than would be expected if this decline is being controlled by temperature, suggests that maximum snow depth is strongly affected by the occasional large 'dumps' of snow. On the other hand, the larger decline in*

spring snow depth which is clearly related to the strong warming, suggests that the main factor leading to this decline is the melting of the snow once it has fallen, rather than the amount of snow falling during the season. The warming observed at Cabramurra in winter and early spring reflects the regional and continental-scale warming (of).....the past 50 years or so (Nicholls 2003, 2004), and is most likely, at least partly due to the enhanced greenhouse effect. The results of this study, in turn, suggest that the impacts of the enhanced greenhouse effect are already being observed in the Australian alpine region. It seems likely, therefore, that as predicted by various authors (e.g. Hennessy et al. 2003), the duration of snow cover will decrease as the warming effect of the enhanced greenhouse effect".

There is, however, extra lesser known Snow Depth Data available for two other sites in the Australian Alps going back to 1927. These, I have attempted to adjust and add onto the Spencers Creek Snow Depth Data Set....This new longer set tends to show that warming and snow depth levels are not diminishing as fast as indicated by Nicholls in his paper. And the two Holton Weather Articles previous to this one, in the March 2010 set, show fairly clearly that CO2 level are not of as much concern as stated, and that cooling and higher snow levels are likely in the next 20 to 30 years ahead at least.

METHODOLOGY OF FORMULATING A NEW EXTENDED AUSTRALIAN ALPS MAXIMUM SNOW DEPTH SERIES:

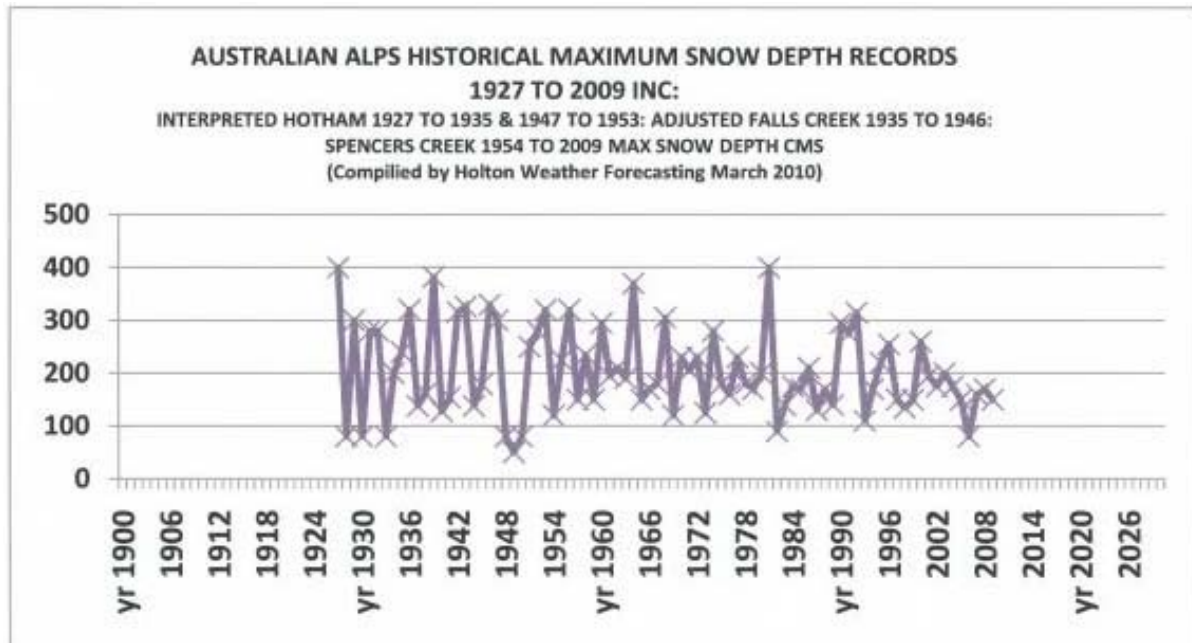
Now, the first data that I have added onto the Spencers Creek Maximum Snow Depth data series, is an excellent Maximum Snow Depth series that is found at http://wikiski.com/wiki/index.php/Snow_depth_records. Here are found a series of photocopied yearly Snow Depth records completed at Falls Creek by "Average Snow depth based on 102 snow poles 100ft apart on the Rocky Valley Gauging line from Wallace's Hut to Rocky Valley Camp". The data found here is in inches, but can easily be converted to cm's of snow depth. The data runs from 1935 to 1946.

There is also similarly measured (less snow poles-same site position) Falls Creek Snow Depth Series from 1954 to 1984. It is from this later series, when compared to the Spencers Creek maximum Snow Depth Data, that a conversion factor of Falls Creek Maximum Snow Depth multiplied by two, can be used to gain an approximate Spencers Creek Yearly Maximum Snow Depth Proxy from 1935 to 1946 inclusive. This 1935 to 1946 Proxy Series was then added to the 1954 to 2009 Spencers Creek Data Series.

We are still left with a data gap between 1947 to 1953 to fill in somehow! However, there are some written descriptive records that are on the same web-site mentioned above, and also found in "Snow on St. Bernard: Wangartta Ski Club 1930 - 1980. W.S.C. '980. p. 170", from Mt Hotham which runs yearly from 1927 to 1979. Now one may have some disdain at using such seemingly "primitive" written descriptive records to add to the series. However, again, by using the overlap years where this written descriptive record occurs concurrent with Falls Creek measured Snow Depth data & Spencers Creek measured Snow Depth data, one can get a reasonable idea as to what "Very Light, Light, Good, Heavy, Very Heavy, etc", would correspond to in cm's of Maximum Snow Depth at Falls Creek...And, hence the required Proxy Maximum Snow Depth Yearly Data we need to be added to the Spencers

Creek maximum Snow Depth Series during the gap from 1947 to 1953. Indeed, using this latter Hotham written data, the Spencers Creek proxy Series can also be extended back from 1945 to 1927 as well.

This then completed a reasonably accurate new extended "Proxy Spencers Creek Maximum Snow Depth Series from 1927 to 1945", attached to the widely used "Actual Spencers Creek Maximum Snow Depth Series" from 1954 to 2009.....Therefore we now have a much longer, more complete, and very useful Australian Alps Maximum Snow Depth Series from 1927 to 2009 (See Graph 2 below).



COMMENTS ON THE NEW EXTENDED AUSTRALIAN ALPS MAXIMUM SNOW DEPTH SERIES:

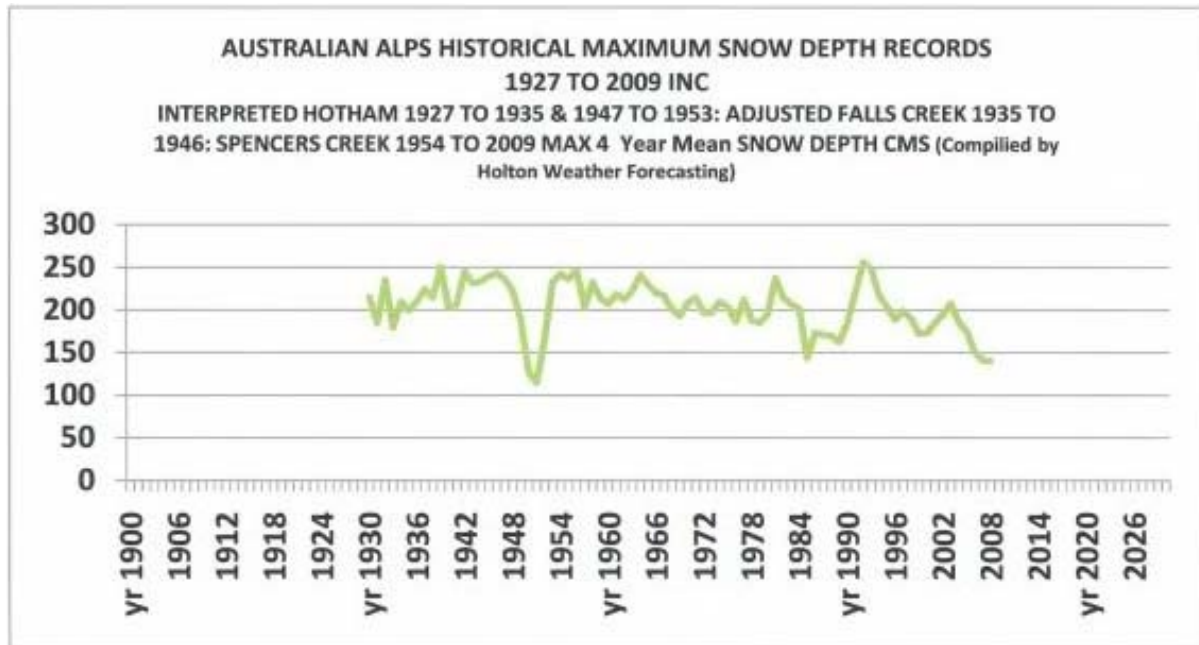
The first factor that appears, as one looks at the new longer series, is that previously shown on the shorter series, steady fall away in Snow Depth levels from 1954 to 2009 visually does not seem quite as significant. In fact, visually, from 1927 to around 1984, there does not seem to be any real significant general Snow Depth trend at all!

The second factor that appears, as one looks at this longer series, is that several (in fact, 6) years appear to be equally as low as the recent very low 2006 Maximum Snow Depth level...And three of these years occur in a row from 1948 to 1950!...Here, the Hotham Written Records show, "1948 "Very Light", 1949 "Extreme Light" & 1950 "Very Light and Short" Snow Depths.

The third factor that appears noteworthy is that the four Highest Maximum Snow Depth Years appear all before 1982, IE. 1927, 1939, 1964 and 1981 (1946 is quoted as being in the top 4 years on the Hotham Written Record, but it is NOT shown as high in the Falls Creek measured data). The graph series fairly clearly shows that from 1982 onwards we have not had any really extreme high Snow Depth years in the Australian Alps...But, having said that, there does appear a noteworthy three year cluster of high Snow Depth years from 1990 to

1992 in recent times...The highest number of high Snow Depth years in a row for the whole series!

The "1927 to 2009 Australian Alps Maximum Snow Depth Yearly Series" can also be converted to a "1927 to 2009 Australian Alps Maximum Snow Depth 4 Yearly Mean Series" (See graph 3 below). From this new "1927 to 2009 Australian Alps Maximum Snow Depth 4 Yearly Mean Series" we can then more clearly view the main trends of the total Maximum Snow Depth Series.



And, from graph 3 above, using the new 4 year Mean Maximum Snow Depth Trend data, we can detect (1) A rise in levels from 1930 to 1946, (2) A dramatic fall trough from around 1949 to around 1952, (3) A very slow fall in levels from 1954 to 1984, (4) Another significant fall trough from 1985 to 1990, (5) A dramatic rise peak from 1991 to 1994, and, (6) A final erratic fall from 1995 to 2009.

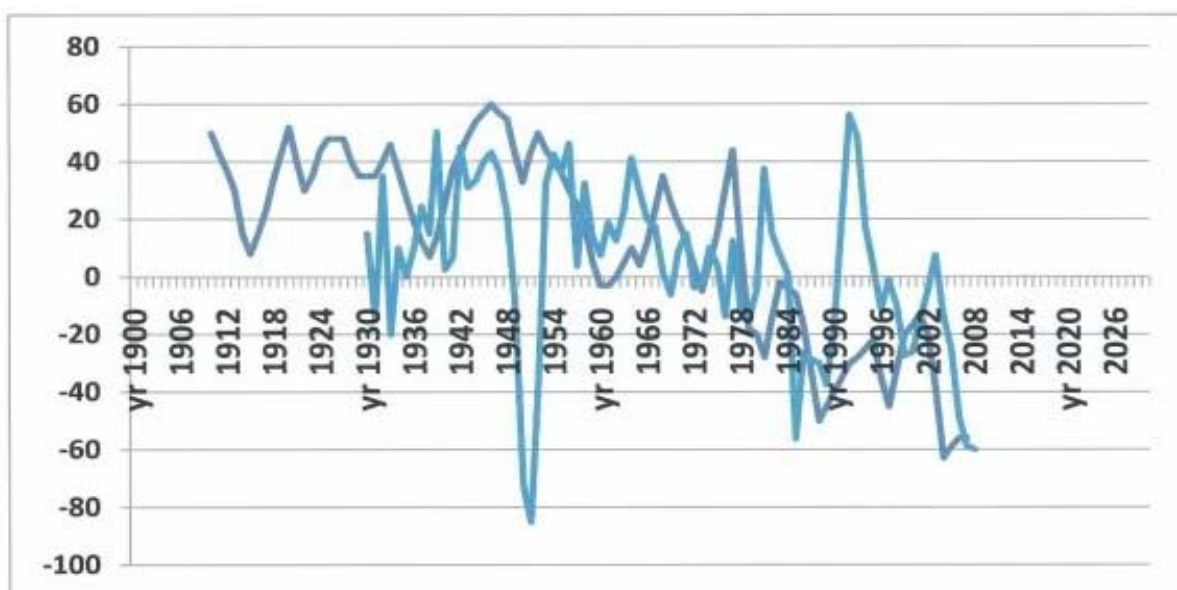
AUSTRALIAN ALPS MAXIMUM SNOW DEPTH-TEMPERATURE-HTFM MODEL LINKAGES:

The most obvious link to Maximum Snow Depths each year is Mean Temperature, as Nicholls 2005 has suggested, "the larger decline in spring snow depth which is clearly related to the strong warming".

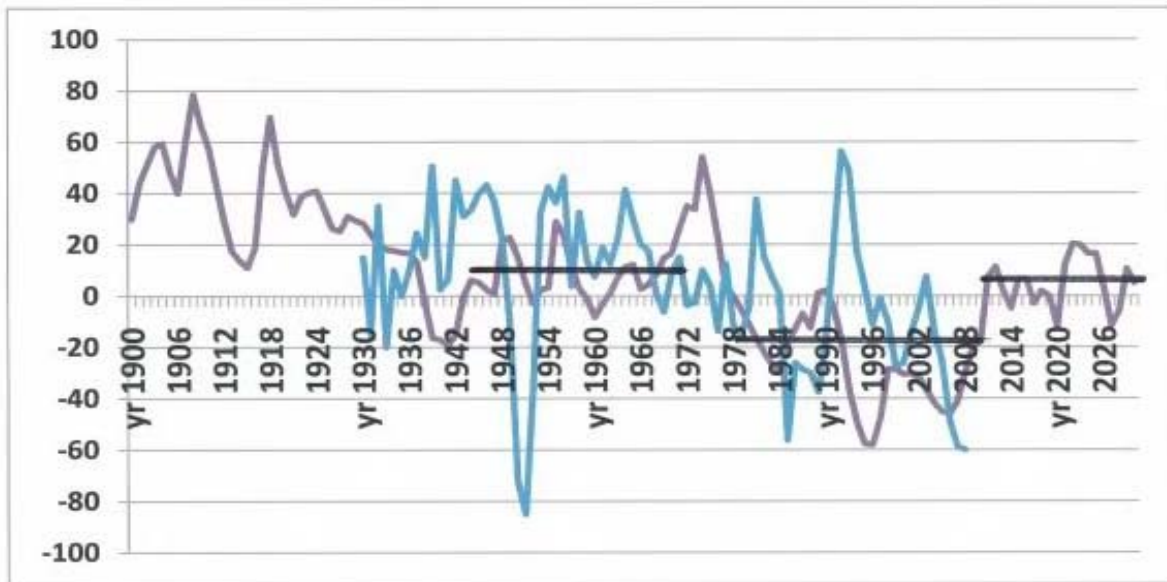
Therefore, we will first compare the "1927 to 2009 Australian Alps Maximum Snow Depth 4 Yearly Mean Series" to use the negative, or the minus "1900 to 2009 Australian 4 Yearly Mean Temperature Series" (*All Temperature values sourced from <http://www.bom.gov.au/climate/change/>). Here noting, that to compare the two series, we need to invert the Mean Temperature Series to gain a comparison, as Mean Temperature will be expected to vary the exact opposite to Mean Maximum Snow Depth.

And, from this comparison of the two series, it can be clearly seen that, in general, Australian Alps Maximum Snow Depth (Light Blue Line) does indeed correlate quite well with the Inverted (*Minus*) Australian Mean Temperatures from 1930 to 2009 (Dark Blue Line) (See Graph 4 below).

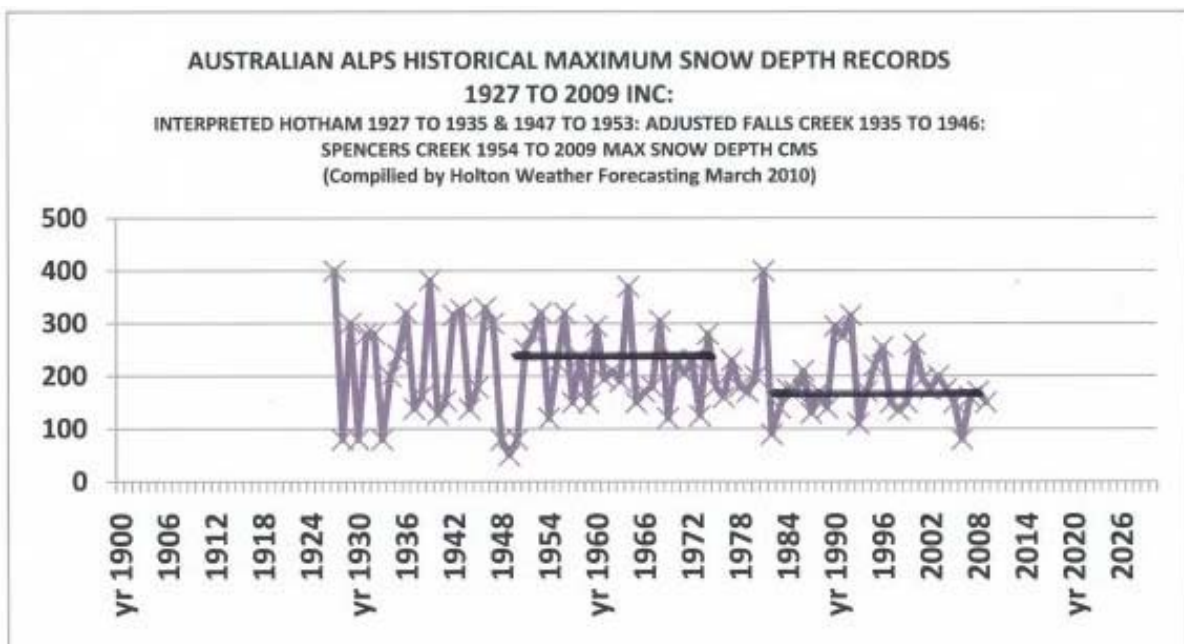
There are 2 notable exceptions (1) In the 1949 to 1952 sharp fall trough, and, (2) In the 1991 to 1994 sharp rise peak. In these two short time periods, the Snow Depths are quite a bit lower and quite a bit higher respectively, than that anticipated from temperature variations alone... However, we must not lose sight of the fact that Snow Depths will also respond to other meteorological variables, as well as to temperature... And some isolated significant variations in the two traces would be expected to occur because of these other meteorological factors (e.g. wind direction, low or high pressure dominance, etc, etc).



Now, if we then compare (See Graph 5 below) the "1927 to 2009 Australian Alps Maximum Snow Depth 4 Yearly Mean Series" (Blue Line) to the "1900 to 2030 Holton Temperature Forecasting Model (HTFM) Series" (Purple Line) ([HTFM details are Found in the following Holton Weather Article, WHAT IS CONTROLLING GLOBAL, SOUTHERN HEMISPHERE, AUSTRALIAN & AUSTRALIAN SOUTHERN OCEAN TEMPERATURES?: WHAT TEMPERATURE CHANGES HAVE OCCURRED FROM 1900 TO 2009?...AND, WHAT ARE THE GLOBAL & AUSTRALIAN TEMPERATURE FORECASTS FOR THE FUTURE PERIOD 2010 TO 2030? Ian Holton, Holton Weather Forecasting Pty Ltd : Friday 19th March 2010](#)), we also gain a reasonably good correlation, similar to that found in the just compared Australian Alps Maximum Snow Depth to Australian Mean Temperatures in Graph 4. Here noting once again, that to compare the two series we need to invert the HTFM Series to gain a comparison, as HTFM will be expected to vary the exact opposite to Mean Maximum Snow Depth.



Now on Graph 5 Above, the HFTM Model forecasts a Maximum Snow Depth Trend Rise from current well negative Maximum Snow Depth Levels, back to Positive Maximum Snow Depth Levels, commencing in the near future 2010 to 2012 period.....With the HFTM Model suggesting, by the comparison of its' Actual past Levels(1946 to 1972 Approximate Period: Black horizontal Mean Line)& Forecast levels(/span>2010 to 2030 Approximate Period: Black horizontal Mean Line)), that Snow Depth levels will return soon to similar MEAN values to that of the 1945 to 1972 period



Following on from the last paragraph and moving back to Graph 2(Re-done Above as Graph 6), we can see that the approximate Mean Maximum Australian Alps Snow Depth has dropped from around a Mean value of 240cms at Spencers Creek in the 1950 to 1974

Period, to a new lower approximate Mean Maximum Snow Depth of around 170cms in the current 1982 to 2009 Period (If we ignore the odd higher 1991-1993 short spell).

Therefore, using the forecast HFTM values, on the previously shown Graph 5, we would anticipate Spencers Creek Maximum Mean Snow Depth Trend values increasing shortly to back to somewhere close to the 1950 to 1974 Mean value of around 240cms.

SUMMARY & CONCLUSIONS:

Maximum Snow Depth levels have been decreasing at Spencers Creek in the Australian Alps steadily from 1954 onwards. However, new Proxy Maximum Snow Depth Data compiled by Holton Weather from 1927 to 1953, suggests that Maximum Snow Depth Levels have been as low as the current levels back in the 1927 to 1953 period.

The new more complete Australian Alps Maximum Snow Depth Series, comprises, (a) The often quoted well compiled Snowy Hydro series going back to 1954, (b) The Falls Creek well measured series from 1935 to 1946 (Adjusted to Spencers Creek levels), and, (c) The Mt Hotham written descriptive record series from 1927 to 1934, & from 1947 to 1953 (Interpreted & adjusted to Spencers Creek levels). This new longer period Snow Depth Series, does, in the author's opinion, give a much better overall balanced view of the history of Australian Alps Maximum Snow Levels.

Mean Yearly maximum Snow Depth Levels would be expected to follow Mean Temperature Levels fairly closely...And this new Yearly Australian Alps Maximum Snow Depth Series has been found to have a high correlation with the Yearly General Australian Mean Temperature Series. Now, although Mean temperature is obviously not the only influence on Yearly Snow Depth Records (As shown by the 2 significant diversions of Snow Depth & Temperature records on graph 4, in the 1949 to 1952 sharp fall trough, and in the 1991 to 1994 sharp rise peak, where the Snow Depths are quite a bit lower and quite a bit higher than expected from Temperature influence alone), Mean temperature is by far the most dominant climatic influence.

By making use of this Mean Temperature to Maximum Snow Depth high correlation, the Holton Forecast Temperature Model (HFTM) was then used to calculate an Australian Alps Maximum Snow Depth General Trend Forecast from 2010 to 2030. This HFTM Model Australian Alps Maximum Snow Depth General Trend Forecast predicts that levels will change from current Mean Trend of 170cms, back to a value nearer the Mean Trend of 1950 to 1974, which was 240cms (*Values are all relative to Spencers Creek Hydro Data*).

It should be stressed that this does NOT, of course, infer that every year from 2010 to 2030 is forecast to be at that 240cms Trend Level.....Only that Yearly Maximum Snow Depth Levels will be expected to increase to vary up and down around that new 240cms Mean Maximum Snow Depth Trend Forecast.

This third study, in conjunction with the two other studies in this March 2010 series, show that Australian Alps Snow Fields are likely to continue to exist in a "fairly robust healthy state" in the future from period from 2010 to 2030...And likely for many more years after that!

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