Sixty-Four Years a Weather Observer

Yesterdays rain is history tomorrows only an illusion.

Jim Goodridge 11/18/14

My first day on the job as weather observer started on November 18, 1950. This was a day a bridge washed out on the Merced River on the road to Yosemite. The observer's duty included reading the rain gage on the roof of the Post Office building at 8:00 AM. Sacramento had one hundred years of historic rain record in 1950.

I had assumed that the forces causing rain would reset to zero with each summer drought. Not so, there were runs of wet and dry years embedded in the record. Runs indicated longer forces were acting on the rainfall patterns. The search for these forces have inspired years of research and wonder.

Great ocean currents were apparently influencing our yearly rainfall totals. For a current to flow there needs to be a pump. That pump is apparently the thermally induced shrinkage of the Arctic Ocean. This pump ties together the Atlantic Gulf Stream and the Great North Pacific Upwelling.

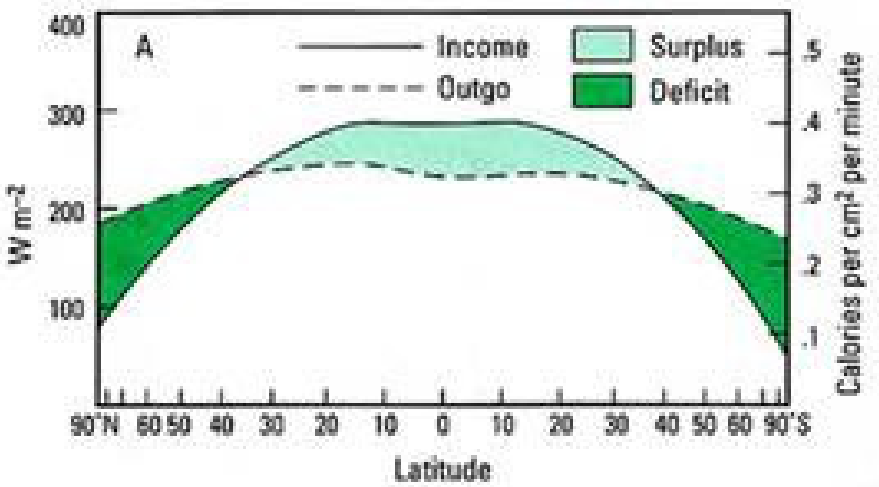
That upwelling keeps shifting between the California and the Japanese Coasts. The Pacific Decadal Oscillation Index expresses the East-west temperature differences and suggests witch side of the North Pacific Ocean is upwelling. A major climate change occurs frequency with the PDO changes.

A big question remains; what drives the apparent decadal variation in flood and drought with wind persistence that drives coastal ocean upwelling?

Many Thanks to Wally Broecker of Columbia University and Nate Mantua the University of Washington for their insights and to the Weather Bureau and Corps of Engineers and California Department of Water Resources for the inspiration regarding climate fluxuation.

Why Weather

Seasons vary, as Earth is inclined 23 degrees from the plane of the annual solar orbit. This causes the summer and winter and drives the annual bird migrations. It was assumed that the solar out put was a constant 1.952 Langleys or 1.381 kW/M^2. The solar constant was measured from satellites since 1978 and found changes with sunspots. The solar constant was at one time thought to vary by 1.0% but was found to vary closer to 0.1%.



Global annual heat balance of Earth is shown above with thanks to Anthony Watts with WUWT (WattsUpWithThat blog). All objects radiate energy according to the fourth power of their absolute temperature. Earths out going radiation equals the incoming radiation. The temperature is in a delicate balance.

The imbalance of Solar vs. Earth radiation balance calls for vast flows of heat to the polls. Radiation balance is achieved by equal polar cold exchanged with topical heat. The junction of migration cold and moist air masses are the storm fronts that being rain. Weather is basically solar driven, as is most life on Earth.

The polar to equator heat exchange is with water as well as he atmosphere

California's Great Storms

Great storms and flood protection have been obsessions. There are the runs of flood and drought years that mimic the tidal variation. There is similarity between a 9-year average rainfall and 9-year average of the detrended San Francisco sea levels.

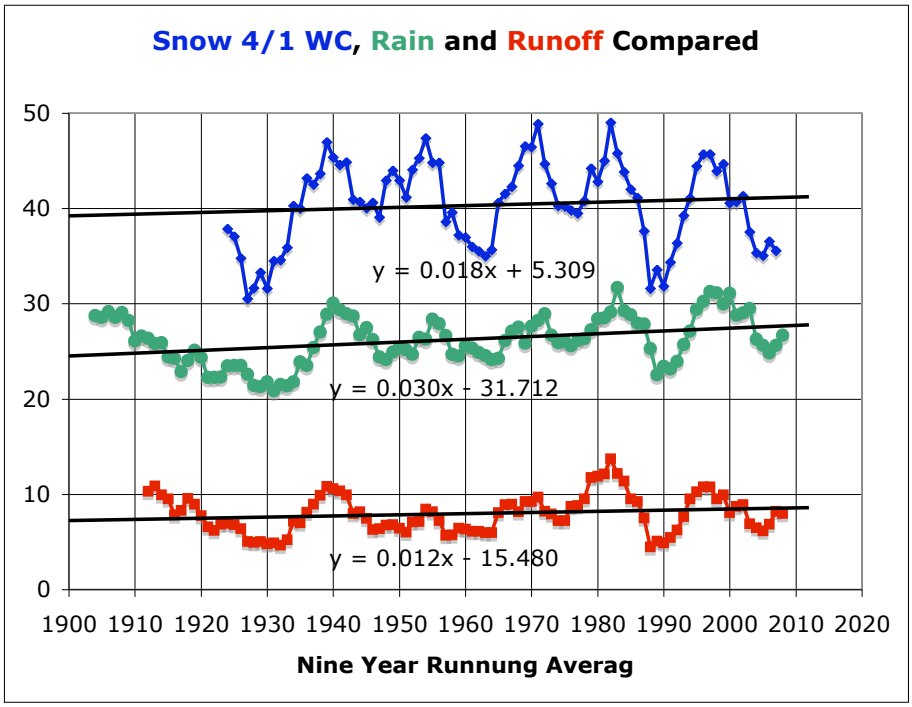
Wet year cycles occur when Coriolis force acts on moist south winds and suppress cold water upwelling. North winds have an offshore component with cold dry off shore winds that lower tides low tides and induce cold water upwelling. The tides are obviously sensitive to winds an well as lunar attraction.

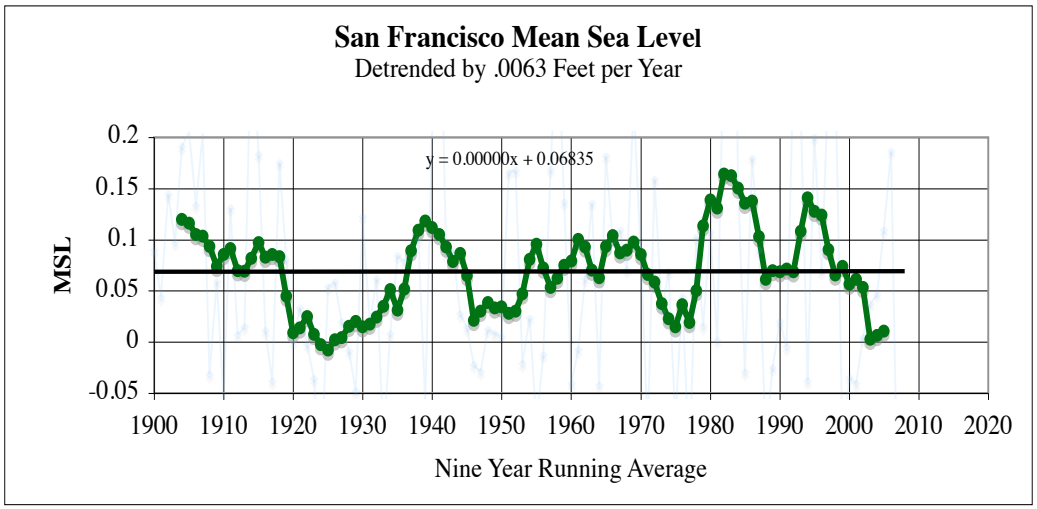
The one world ocean strives for hydrostatic balance. A major driving force for ocean currents is water shrinkage in the Artic Ocean.
When the Gulf Stream enters the 3.4 billion acres of the Artic Ocean and shrinks by 0.2%. An annual 6.5-foot difference in water surface results from this shrinkage. The total water volume of the shrinkage is estimated to be 22.5 billion-acre feet per year. This is 62 million acre-feet per day equaling to 31 million cubic feet per second.

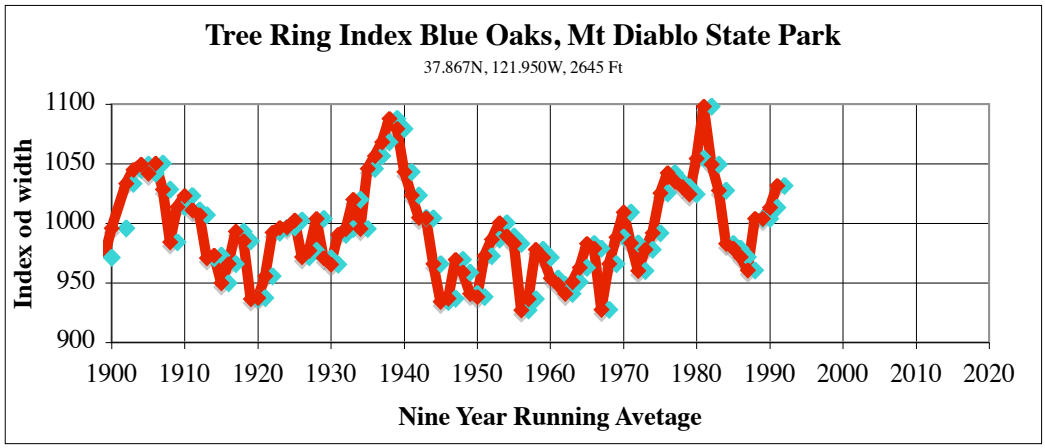
The Artic Ocean component of the Gulf Stream is 9 times the average annual flow of the Amazon River. The inflow and out flow of the Artic Ocean must balance. This is ignoring the outflow from the Bering Straits or inflow of North flowing rivers. The out flow of dense cold water cascades over the Straights of Denmark, located between Greenland and Iceland and cascades to the ocean bottom.

Wally Boecker describes a Great Ocean Conveyor with upwelling in the North Pacific. The Pacific Decadal Oscillation Index suggests where that upwelling occurs. PDO is a measure of the east-west water temperature difference of the North Pacific. California weather events fluctuate in a rich synchronization with PDO and even more with the tides at San Francisco.

The 15-20 years fluxuation in San Francisco mean sea level,
Matched our rainfall, stream-flow, snow-pack and tree-rings widths.
Flooding occurs mainly during periods of high tide and drought with low tides. The similarity with tides and PDO are there but a more complicated relationship. The climate indicators between California and Japan are of opposite sign. This is evident in barometric pressure and mean sea levels.

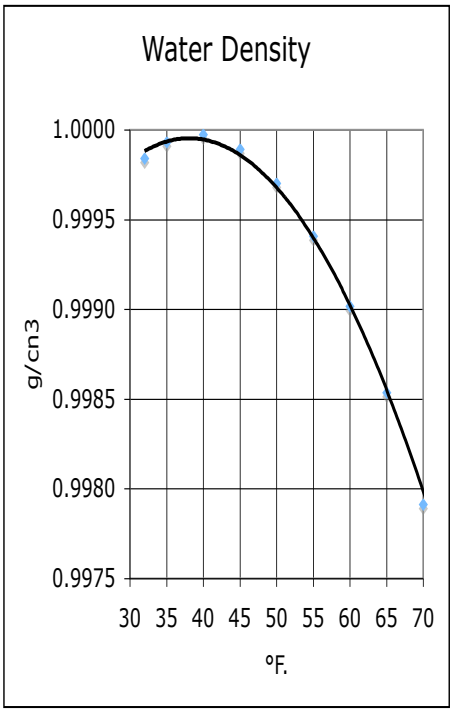

Snow 4/1 WC, Rain and Runoff Compared
50
40
30
20
10
0
y = 0.018x + 5.309
y = 0.030x - 31.712
y = 0.012x - 15.480
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010 2020
Nine Year Runnung Averag


San Francisco Mean Sea Level
Detrended by .0063 Feet per Year
MSL
0.2
0.15
0.1
0.05
0
-0.05
y = 0.00000x + 0.06835
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010 2020
Nine Year Running Average


Tree Ring Index Blue Oaks, Mt Diablo State Park
37.867N, 121.950W, 2645 Ft
Index od width
1100
1050
1000
950
900
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010 2020
Nine Year Running Avetage

Artic Ocean

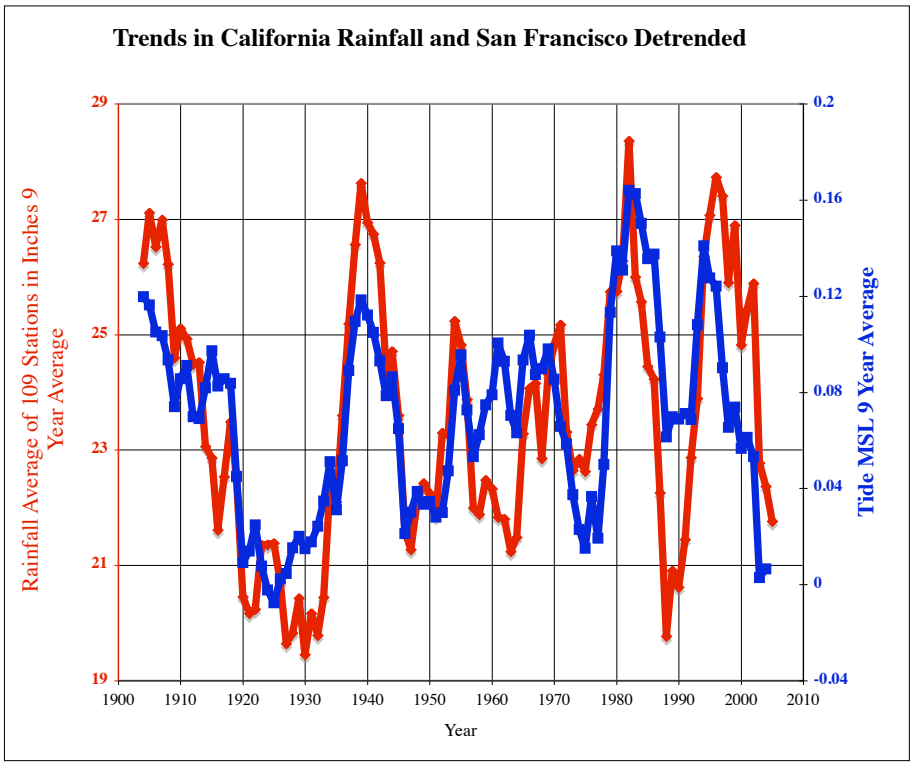
The Artic Ocean area is 5,427,000 square miles or 3,472,000,000 acres.
The Average depth is 3240 feet.
Inflow density assumed to be .998
Outflow water density is assumed to be 1.000
Shrinkage ratio is assumed to be .002
Total shrinkage 6.48 feet per year
Shrinkage per year is 22.5 billion acre-feet
Shrinkage per day 61.7 million acre-feet
One Acre-foot per day = .504 cubic feet per second (cfs)
Daily out flow of Artic Ocean = 31 million cubic feet per second (cfs)
Out flow of Amazon River 3.5 million cubic feet per second (cfs)
Ratio Amazon to Artic out flow 9



Weather Cycles

The history of flooding and drought are seen in the rain records. Biblical legends of lean and abundant years appear in the rain records. Six peaks and lows in 110 years of record suggest an 18.3-year periodicity. This looked a lot like the 18.6 years attributed to the precession of the Lunar Orbit. The lacks of good fit with the 18.6-year pattern suggest there are other factors as well.

A surprise was when the long-term fluctuations in annual rainfall resembled that of the San Francisco tides. The mean sea level at San Francisco varied as the rainfall. The sea level record was de-trended by 0.006 feet per year. The problem of sea level or tectonic change was not addressed. This similarity was not intuitive until the Coriolis effects were considered. Coriolis effect is where the Earth turning under the atmosphere induces a west wind. This induced moist southerly onshore winds that suppressed upwelling



Most flooding generally occurs during the time of high tides. The biggest rainfalls come with humid southerly on-shore winds. The drought times are clearly the low tide periods. North wind times bring cold dry air with offshore winds that induce low tides. Offshore winds are those inducing cold-water upwelling on our west coast. The results in the runs of wet and dry years in California rainfall records.

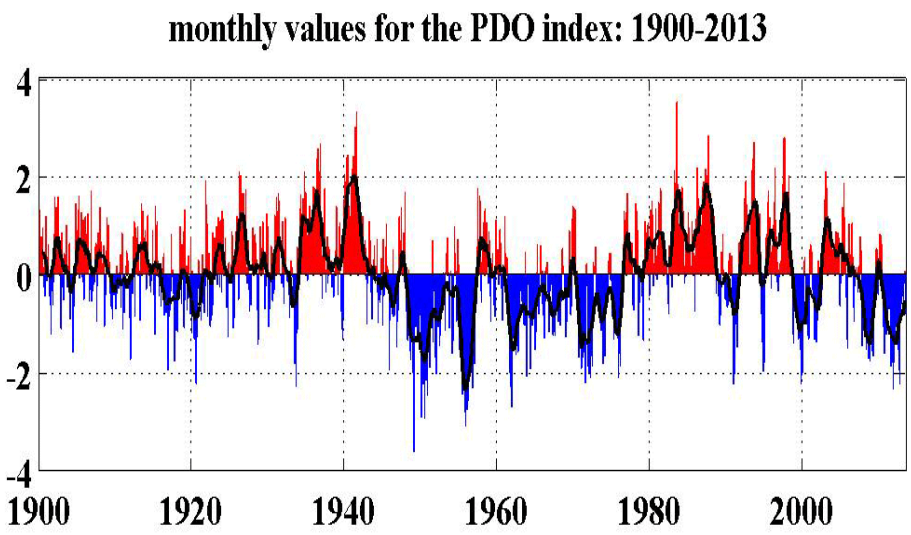
Seawater cooling causes several feet of shrinkage of the Artic Ocean. The lower water levels draw the warm Gulf Steam into the Artic. Outflow cascades at over the Straits of Denmark between Iceland and Greenland. The cold dense water flows to the bottom of the world ocean.

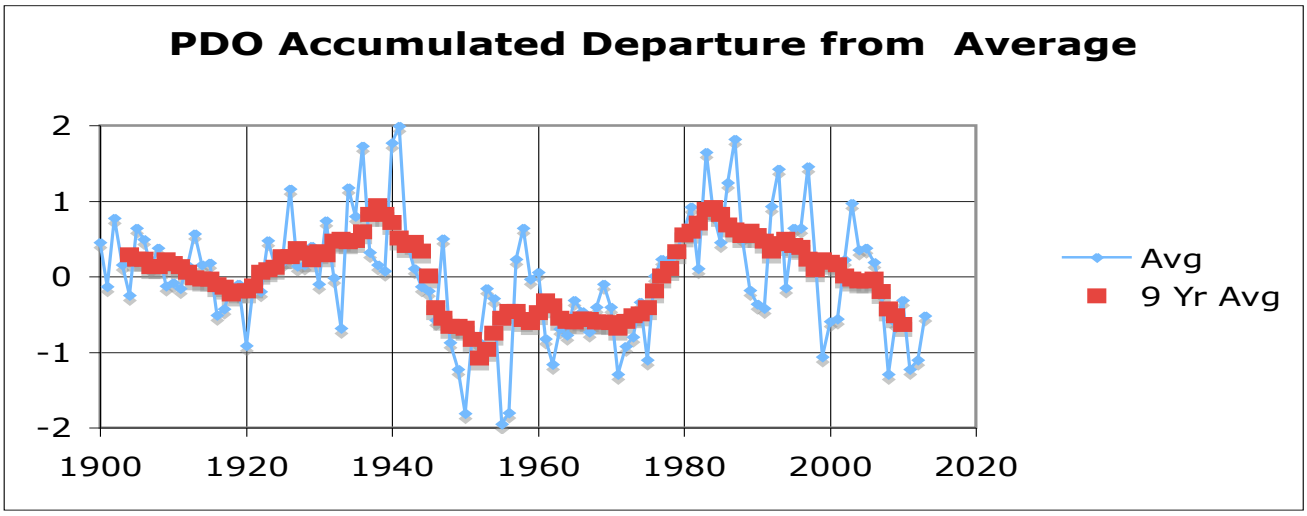
The resulting hydrostatic forces must upwell somewhere to maintain balance. The North Pacific Ocean is a site of much of the cold-water upwelling.

Pacific Decadal Oscillation Index

The PDO index is Sea Surface Temperature difference east or west of the International Date Line. The PDO index indicates upwelling occurs either in the East or West of the North Pacific Ocean.

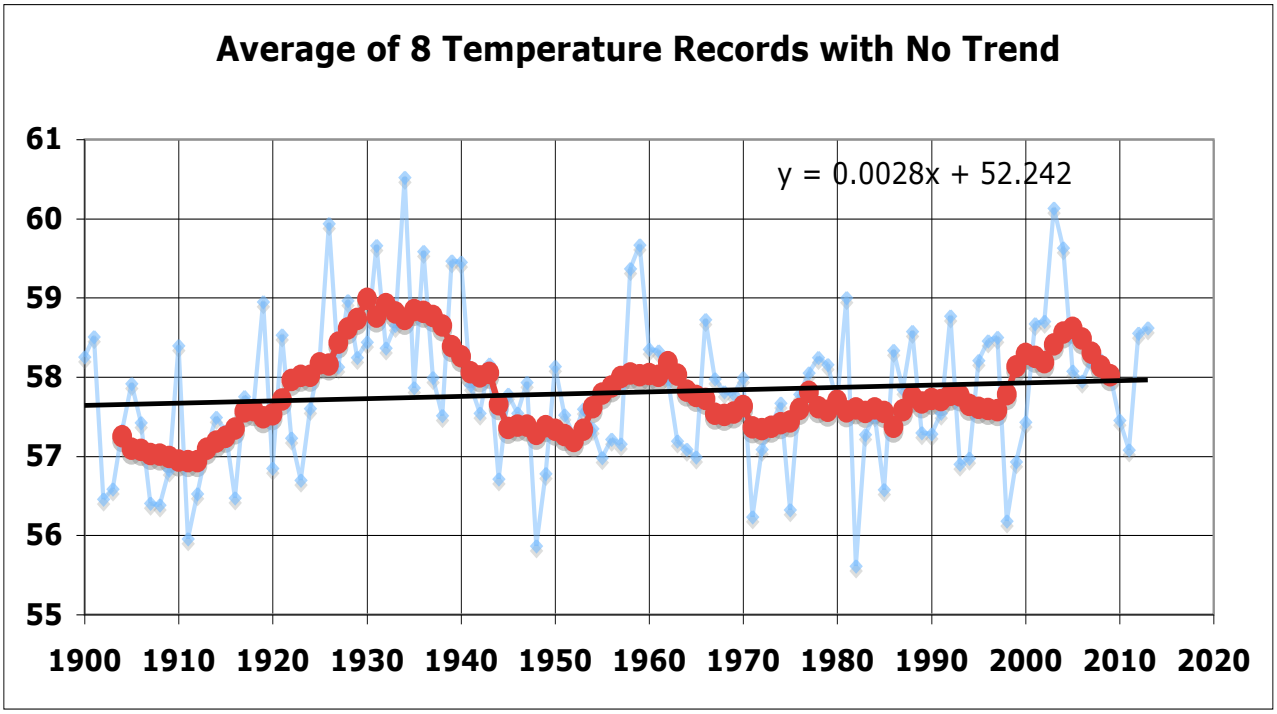
With warm south winds SST in Eastern Pacific moist tropical air is lifted by the Coriolis effect. This warm moist air being lifted over the mountain reduces water-holding capacity. Dry North winds cause off shore winds, low tides and upwelling. His accounts for the similarity in California Rainfall and San Francisco tide trends





Temperature

There are eight air temperature records in California that are in rural areas and do not reflect urban influence. These 8 records ard fairly complete since 1900. These are averaged below:

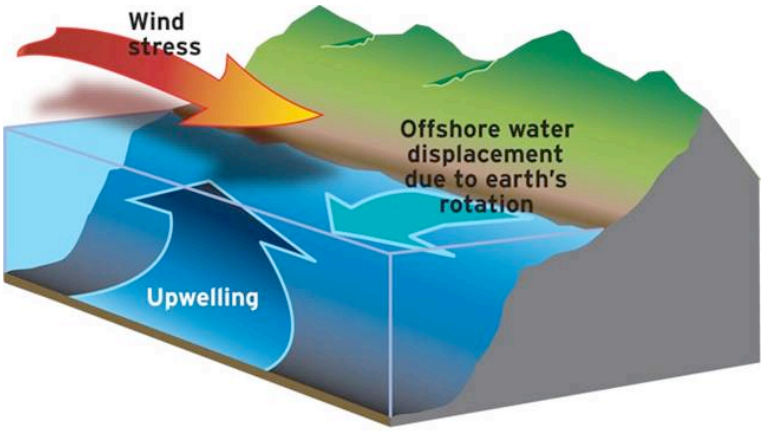


These records range from Cedarville in the north to Cuyamaca in the south. The warmest period was from 1928 to 1937. The great climate shift starting in 1975 is not as duminate as the 1910 to 1930 shift.

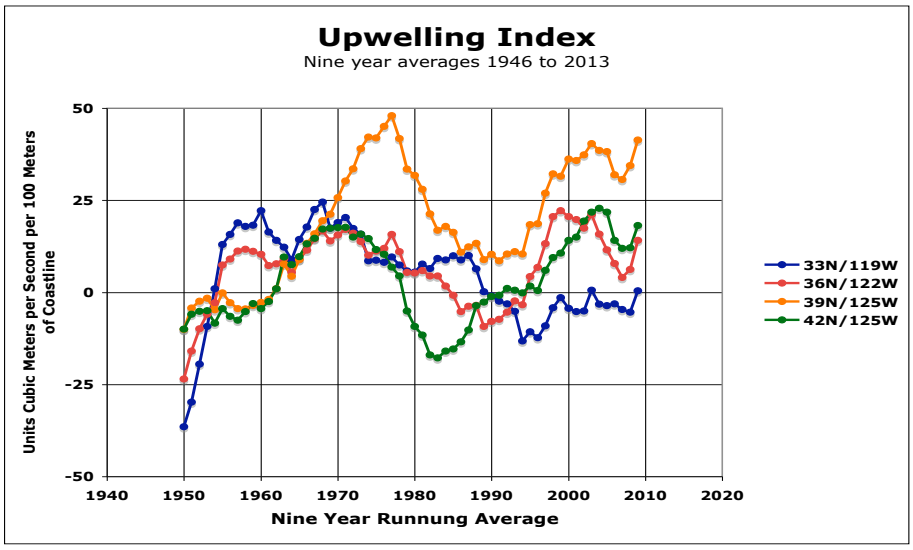
Other temperature records would have been used but they would need detrending to compensate for land use changes in the vicinity of more urban measuring sites.

Upwelling

Upwelling of cold water happens with predominate cold dry North winds. Corilous effect induces off shore winds pushing ocean surface away from shore and inducing cold sea surface temperatures. These are the times of dry weather on our Pacific Coast.



An Upwelling Index is calculated by NOAA Marine Fisheries in Monterey, CA to suggest where fish can be found, as fish follow zones of equal water temperature in the ocean. The upwelling index is based on prevailing winds.



This was based on monthly averages of the upwelling index from: ftp://orpheus.pfeg.noaa.gov/outgoing/upwell/monthly/upanoms.mon. Persistant prevailing winds appear to determine where upwelling occurs. Runs of the persistant Atmospheric Angular Momentum and Length Of Day reflect variation in the world persistant wind patterns.

Storm Frequency

The frequency of extreme rainfalls in California was calculated for 4201 daily records as of September 2014. These consisted of 150,900 station years of daily data at 13 storm intervals consisting if annual series data for 1, 2, 3, 4, 5, 6, 8, 10, 15, 20, 30 and 60 consecutive days and the annual total.

The dimensionless coefficients of variation (CV) and skew (SK) were found to be geographically distributed and were averaged for each one square degree. These one-degree regional values were used rather than the measured sample values. This avoided the problem of large variation in design rainfalls due to short records. Averages of Sk and CV need to be weighted by length of years of record in future studies.

An index of 356 storm events was compiled where the return period exceeded 1000 years. The number of these averages events per decade peaked in the decade of 1960 to 1969. Half of those were from the Columbus Day storm of 1962, a typhoon from the orient. This storm came across the North Pacific and first devastated Washington then Oregon. This storm came at the end of our summer, on dry soil, and avoided sever flooding.

The few 1000-year storms before 1950 may have resulted in under design of Folsom Dam on the American River. The adjacent Cosumnes River had one 2-inch per day stream flow before 1950 and seven after 1950. A big question; is the frequency of 1000-year events reflect a recent decline the number of rain records sampled?

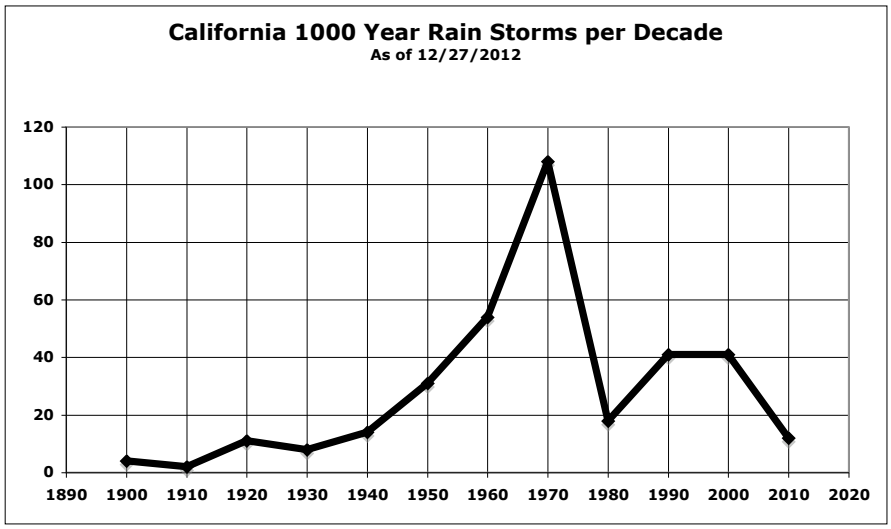
It is noted that rain records published in Climatological Data also peaked in 1950 to 1970 and DWR climate volunteer observation program declined about 1980. Could 1000-year storm frequency reflect a decline in rain gage network density?

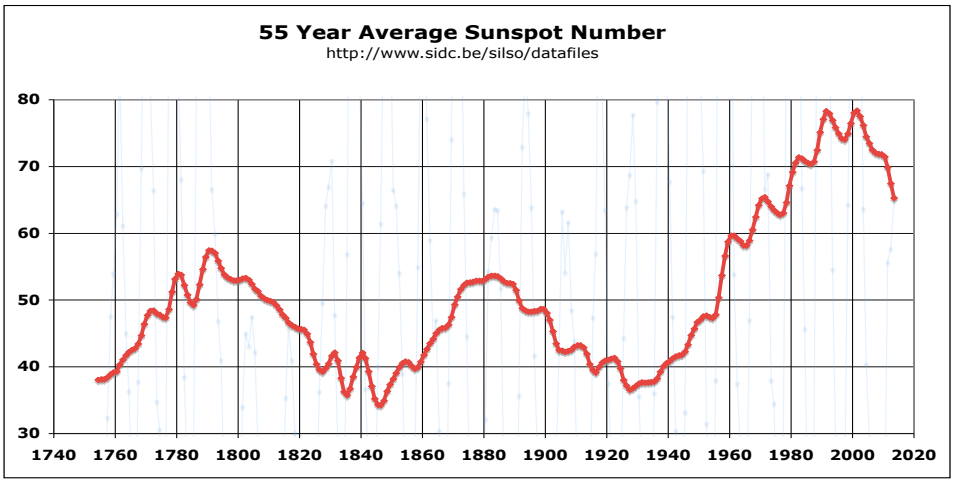
An average of 426 station-years record for each 1000-year storm seems less than expected. Intuition suggests 1000 station-years of record for each 1000-year storm. Perhaps a 1000-year storm should be more than 5 standard deviations above the mean? This study included storms of durations from one to 60 days and the 426 years ignored the 2 to 60 day storms. Since 13 storm durations were studied the sample size would be 13 times the 150,900 station years. Could some multi-day rains have been recorded as one-day events? The total number of 1000-year storms included many 2 to 60 day storms.

Many short duration records have been added our data base from data loggers. These are records of short length where as some of the volenteer

observer records include some of considerable length provided inter yearly continuity. Was the high number of 1000-year storms a reflection of a wet episode 1950 to 2000?

All of life's existence is related to solar radiation from our food supply to weather. The occurrence extreme rainstorms peaked with the highest sunspot numbers in 300 years. All weather is related to solar activity as the change of seasons and rainfall occurrence. The variation in the numbers of 1000-year storms in California might be solar related.



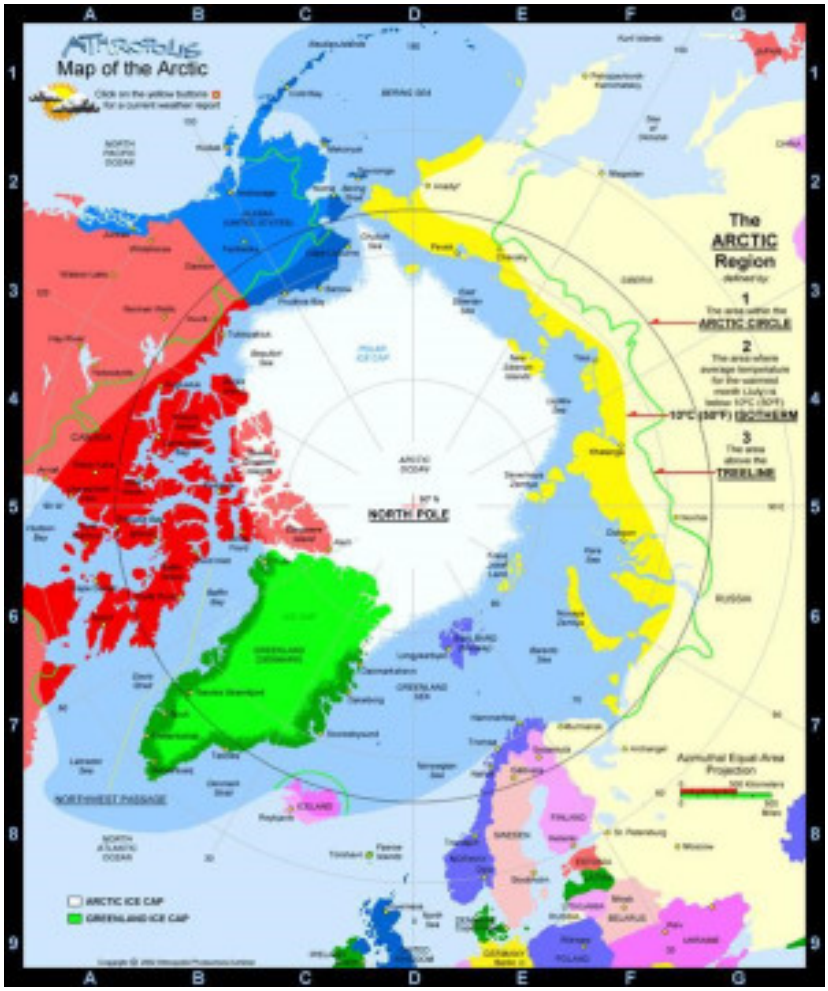


The highest sunspot numbers since the little ice age coincided with occurrence of peak storms frequency in California. These peak storms are those where the return periods were estimated to be 1000 years or more.

Franklin's Lament

Poor John Franklin (1786-1847} if only he would have selected a Northeast Passage. The Northwest is where Artic ice accumulates. The relatively warm buoyant water is drawn into the Artic Ocean. The drawing force is water shrinkage due to cooling. The 3000 feet depth of the Artic suggests shrinkage could be 6 feet per year.

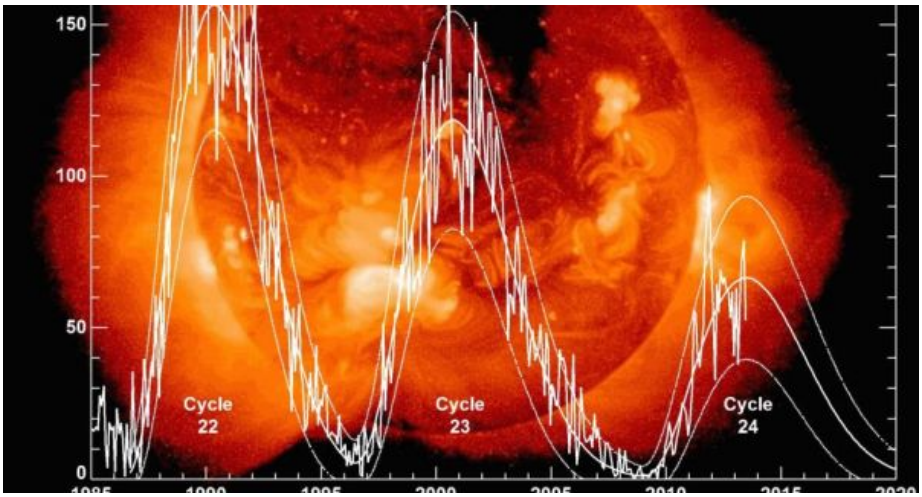
Coriolis effect turns north flowing warm water to the east. The Emerald Isle in perpetually green and Northwest Russia ice free all year. Caribbean water flows into the Artic Ocean generating the Gulf Stream.



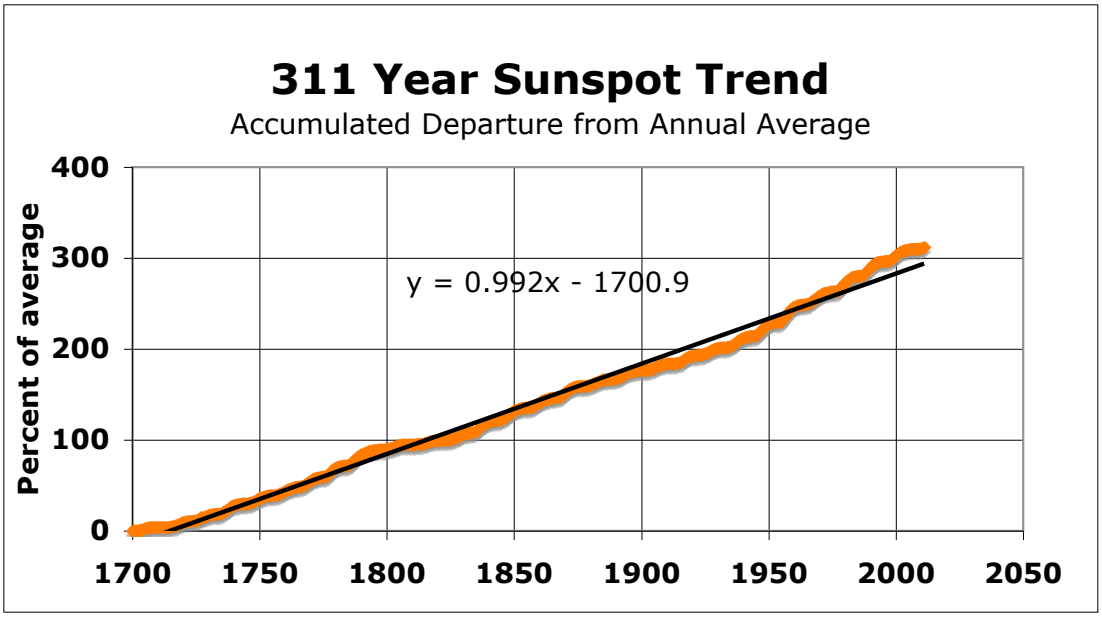
Warm water flowing into the Artic is driving the World Ocean circulation. Cold Artic water cascades over the Denmark Straits to the ocean bottom. Hydrostatics prevails, Artic outflow up-wells in the North Pacific.

Warming The World

There is a large interest in sunspot numbers and climate cycles. The 11-year pattern obscures the 300-year trend sunspot numbers.

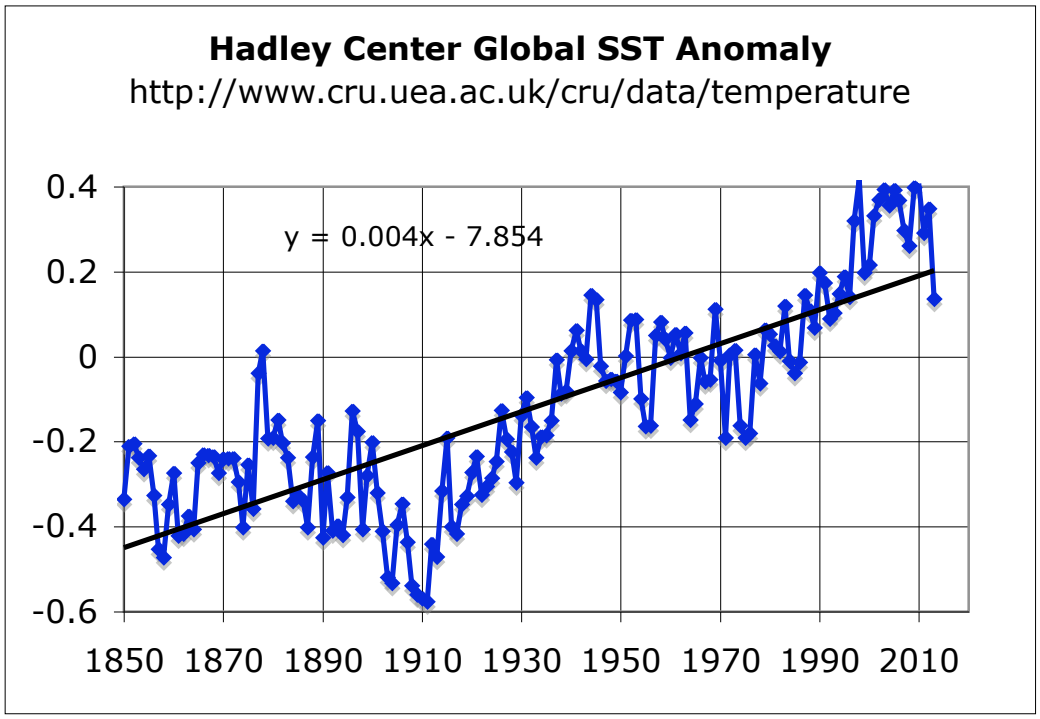


The mounds of record hide a long tern trend that may be related with world temperatures. The recent down turn in temperatures may be associated with the reduced sunspot activity of cycle 24 sunspots.



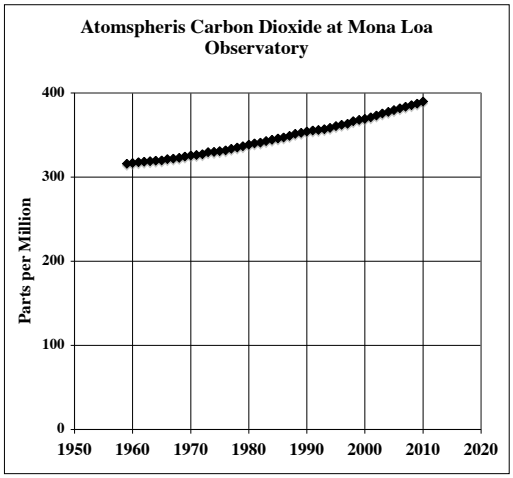
Heating with 300 years of increased sunspot numbers is reflected recovery from the Little Ice Age. There are some including Lief Svalgaard of Stanford University who feel that the sunspot numbers are not a homogenous data set and the recent records are kept by different standards than the earlier record. There is evidence that the polar ice caps of Mars as well as Earth are shrinking

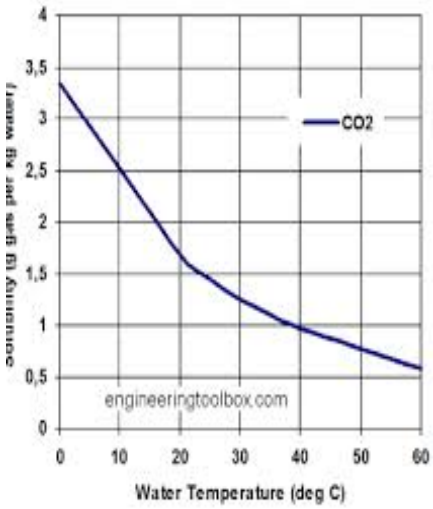
Sea Surface Temperature



Atmospheric Carbon Dioxide

The increase in atmospheric CO2 is consistent with the decreasing solubility with increasing water temperature.





The increased CO2 could reflect the reduced solubility in water with higher sea surface temperature.

Further studies.

There was a profound climate change starting in 1975 when world temperature tends changed from cooling to warming. The change was very strongly noted in the barometric pressure at Darwin in northern Australia. This suggests a global event that may be worthy of further study