From: Charles Miller
To: SENR Exhibits
Subject: More about SB1007
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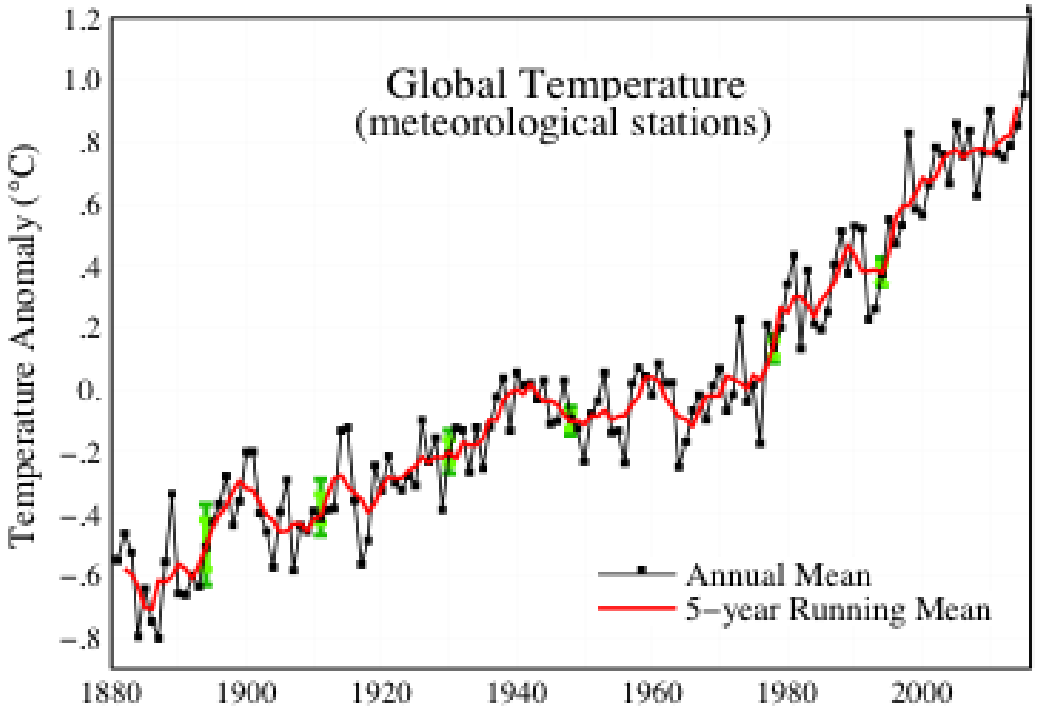
Attachments: ATT00001.png

Senator Dembrow, asked, during testimony on 12 April regarding SB 1007, where global average temperatures are in a progression toward a hoped for 2° Celsius (C) limit to the ongoing increase.

The baseline is somewhat vague, which is why I hoped Trish Webber would know exactly what the Paris accords were based upon. The verbiage goes that the intent (e.g., from Paris) is to limit the increase to "2° C above pre-industrial levels."

Pre-industrial is usually put at about 1750 or 1770 CE. However, the distribution of recorded thermometers did not reach sufficient global density and distribution for averaging until about 1880. NASA, NOAA, the British Hadley Centre and others (with almost identical results) have maintained for some years graphs based on the data since 1880. The result through 2016 is below. It is a plot of the global average Temperature Anomaly, relative to the roughly unchanging interval from 1950 to 1980 (plotted at zero, Y-axis), versus years (X-axis). The zero anomaly is a global average of about 15°C.

The overall shift is (0.6+1.2) = 1.8°C, if the shocking 0.2°C increase for the annual average of 2016 is included. Yes, the 2016 annual average was above the graph's scale limit at 1.2°C, a one-year jump of by 10% of the way to the hoped-for limit. Note that there are other jumps as great along the time series, so the anomaly could come down some in 2017; in fact that is probably the best prediction: a drop back to the general trend since 1976, the year of the strong inflection in the trend. However, if the present general trend persists, and all indications are that it will, we are only a few years from passing 2°C and staying above that. Some details of the calculations follow below.



Exactly what is this graph? Approximately 10,000 meteorological stations all over the land masses of the Earth record land-surface temperature on a frequent basis, at least hourly since about 1950. The data are gathered by the World Meteorological Organization (WMO) for distribution to laboratories for analysis. The time series for each station is averaged for the year, and that average is subtracted from each of its individual measurements, producing a time-series of *anomalies* (averaging zero) from the site's mean. Those time series are suitable for averaging between places with different climates, say Nome in Alaska versus Timbuktu in Mali. Next, all of the array of time series are averaged time-point-by-time-point, and all of those averages are again averaged for each year. Finally, the average over all years of the

annual averages is subtracted from that time series of annual averages, producing the anomaly time series plotted above.

Yes, that's complex, but it is also carefully considered, and it is definitely the best way to see the overall trend. The graph key explains the black points and red smoothing line. The green bars are statistical confidence limits for selected points on the red line - it is quite unlikely the real mean at those points is above or below the ends of the green bars.

The additional heating is warming the oceans, generating more evaporation into warmer air that will hold more water vapor, that in recent years comes down in torrents. Last week's floods in the American Southeast are an example. The warm, wet winds from the Gulf of Mexico met the colder air to the northeast at the time, producing winter tornadoes from Alabama to Georgia, flooding in Georgia and the Carolinas. The global water cycle has become more intense, because the oceans are warmer and warmer air can transport more vapor. Torrential rains are causing flash floods across the whole northern hemisphere. Climate change is turning out to include radically enhanced storm activity from greater hurricanes and typhoons to rains filling California's drought-emptied reservoirs in just a few months.

Thanks to the Senate Environment and Resources Committee for all you are trying to do about this crisis situation. It is obvious that you "get it" and that you care.

Charles Miller, Ph.D.
Corvallis, Oregon