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El Ninos: Their magnitudes and durations

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Abstract

Between 1900 and 2022, there have been 35 El Nino warming events recorded. An examination of the temperature rise caused by those events has shown that they occurred within the range of 0.029 – 0.54 Deg. C, with those of longer duration generally having the higher temperatures. Their median maximum temperature value was 0.29 Deg. C, and their average value was 0.26 Deg. C.

In all but four instances, they were ended because of the injection of cooling volcanic Sulfur Dioxide (SO2) aerosols into the stratosphere by a VEI4, or larger, volcanic eruption. The exceptions were due to increased levels of industrial SO2 aerosol emissions.

This information can be used to judge whether future El Ninos fall within the normal range, or not, etc.

Keywords: El Ninos; Volcanic effects; Climate Change; SO_2 aerosols

1. Introduction

El Ninos are classified as being Weak (W), Moderate (M), Strong (S), or Very Strong (VS), and it appeared that the maximum temperatures and durations associated with each one could be helpful in determining whether a future El Nino lies within the normal range. Since adverse weather conditions (droughts, floods, fires, hot waves, cold waves, stormy weather, etc.) are associated with El Ninos, this information could be helpful in understanding our weather.

2. Methods

A print-out of the Hadcrut5 average anomalous land/ocean global temperatures [1] was obtained, and the Start and End dates of each El Nino between 1900 and 2022 was marked on the print-out, using data from the National Weather Service Climate Prediction Center [2]. The start and end dates were recorded, along with the highest temperature within that interval, and its date.

3. Discussion

The data obtained is shown in the following Table 1.

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Table 1 Maximum El Nino Temperatures, Deg. C.

Maximum El Nino Temperatures, Deg. C.									
						Max Temp	Cause of		
		Date, if not	Maximum	Hadcrut5 Temps		Increase*	El Nino		Published
El Ninos		at end	Temp.	Start	End	Deg. C.	Ending		Rating
1899 Dec-1900 Oct			-0.065	-0.406	-0.065	0.341	Dona Juana1899Nov		
1902 Apr-1903 Apr		1903 Feb	-0.24	-0.431	-0.588	0.407	Pele 1902 May		
1904 Oct-1906 Apr			-0.104	-0.553	-0.104	0.449	Lolobau 1904 Aug		
1911 Oct-1912 May			-0.335	-0.345	-0.335	0.1	Ksudach 1907 Apr		
1913 Oct-1914 Apr				-0.438	-0.409	0.029	Novarupta 1912 Jun		
1914 Nov-1915 Apr			-0.083	-0.19	-0.083	0.107	Colima 1913 Jun		
1918 Aug-1919 Jul		1918 Oct	-0.119	-0.438	-0.3	0.319	Arigan 1917 Apr		
1923 Aug-1924 Mar		1923 Nov	-0.034	-0.324	-0.176	0.29	Manam 1919 Aug		
1925 Jul-1926 Aug		1926 Jan	0.088	-0.331	-0.1	0.243	Raikoke 1924 Feb		
1930 Jul-1931 Jul		1930 Nov	-0.088	-0.188	-0.088	0.1	KamagaTake '29 Jun		
1939 Nov-1940 Jun		1939 Dec	0.334	0.021	0.045	0.313	(-)13Mt SO2 1939-40		
1940 Oct-1942 Mar		1942 Jan	0.258	0.096	-0.042	0.162	Rabaul 1937 May		
1951 Jun-1952 Feb		1951 Sep	0.132	0.06	0.068	0.072	Ambrym 1950 Dec		W
1953 Jan 1954 Mar		1953 Apr	0.225	-0.009	-0.183	0.234	Bagama 1952 Mar		W
1957 Mar-1958 Aug		1958 Jan	0.225	-0.198	-0.019	0.423	Las Venados 1955Jul		S
1958 Oct-1959 Apr			0.026	-0.019	0.026	0.045	Bezymianny '56 Mar		M
1963 May-1964 Mar		1963 Sep	0.122	-0.147	-0.383	0.269	Agung1963 Mar VEI6		M
1965 Apr-1966 May		1965 Oct	-0.106	-0.229	-0.218	0.123	Shiveluch 1964 Jan		S
1968 Sep-1969 Apr			0.049	-0.226	0.049	0.275	Awu 1966 Aug		M
1969 Jul-1970 Feb			0.064	-0.189	0.064	0.253	Fernandina1968 Jun		W
1972 Apr-1973 Apr			0.199	-0.128	0.199	0.327	(-) 6 Mt SO2 1972-73		S
1976 Aug-1977 Mar			0.075	-0.242	0.075	0.317	Tolbachik 1975 Jul		W
1977 Aug-1978 Feb		1977 Nov	0.121	0.13	0.074	0.066	Augustine 1976 Jan		W
1979 Sep-1980 Mar				0.171	0.217	0.46	SierraNegra '79 Nov		W
1982 Mar-1983 Jul		1983 Jan	0.358	-0.187	0.115	0.545	Pagan 1981 May		VS
1986 Aug-1988 Mar		1988 Jan	0.459	0.088	0.385	0.371	Chikurachki '86 Nov		S
1991 Apr-1992 Jul		1992 Jul	0.467	0.436	0.005	0.031	Kelut 1990 Feb		S
1994 Aug-1995 Apr		1995 Feb	0.64	0.173	0.427	0.467	Lascar 1993 Apr		M
1997 Apr-1998 Jun			0.668	0.378	0.668	0.29	(-) 5 Mt SO2 1997-98		VS
2002 May-2003 Mar		2003 Jan	0.654	0.503	0.484	0.151	Shiveluch 2001 May		M
2004 Jun-2005 May		2004 Dec	0.651	0.311	0.553	0.34	Reventador '02 Nov		W
2005 Aug-2007 Feb		2007 Jan	0.893	0.581	0.64	0.312	Sierra Negra '05 Oct		W
2009 Jun-2010 Apr			0.834	0.623	0.834	0.211	Chaiten 2008 May		M
2014-Sep-2016 May		2016 Feb	1.224	0.757	0.88	0.467	(-)23Mt SO2 2014-16		VS
2018 Aug-2019 Jul		2019 Mar	1.076	0.735	0.857	0.341	Bogoslof 2017 May		W
					Range:	(+) .029-0.545 Deg. C.			
*Highest Average Anomalous Global Temp.					Median	0.29	Deg. C.		
During the El Nino					Average	0.26	Deg. C.		
					Durations:	6-23 Months , Average 10.5 Months			

The Hadcrut5.0 data set was used, since it has fewer upward temperature adjustments than NASA/GISS, hopefully giving a more accurate range of El Nino temperatures.

The Table includes the names of the volcanoes that terminated the El Ninos, and the dates of their eruptions, which occurred, on average, 16 months earlier.

The actual cause of all El Nino events was addressed in an earlier article "The Definitive Cause of La Nina and El Nino Events" [3], which found that they formed when there was a decrease of about 2 Megatons in the amount of SO2 aerosols in the atmosphere, either from a volcanic-induced El Nino, or from global "Clean Air" efforts.

It was suggested that their effects could be minimized by the careful injection of SO_2 into the atmosphere.

4. Conclusion

The maximum temperatures recorded for all El Ninos within the past 122 years were within the range of 0.03-0.5 Deg. C, with a median of 0.3 Deg. C. Their durations were within the range of 6- 23 months (average 10.5), with most being ended by a volcanic eruption.

If longer intervals between eruptions should occur, it would be expected that higher El Nino temperatures would be experienced, as happened during the Medieval Warm Period (MWP) (circa 950 AD-1250 AD, for example, when there were very few volcanic eruptions.

References

[1] Hadcrut5.0 1880-present https://uea.uk/cru/data/temperature/HadCRUT5.0Analysis_gl.txt

[2] Cold and Warm Episodes by Season www.nws.noaa.gov

[3] The Definitive Cause of La Nina and El Nino Events https://doi.org/10.30574/wjarr.2022.17.1.0124

[4] Volcanoes of the World, 3rd edition (2020, Smithsonian Institution, Siebert, et al.