# Decadal-Scale Variations in El-Niño Intensity

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## 1. Increase in El Niño intensity in recent decades?

Since 1976, El Niño episodes have been more frequent and stronger than in previous decades and La Niñas have become rare exceptions **(Trenberth and Hurrell, 1994)**. Sea surface temperatures in the central and equatorial Pacific have remained anomalously high and precipitation has been low in areas where dry conditions usually accompany El Niño events as in Indonesia and north-east Australia. Especially the consistently negative Southern Oscillation Index (SOI) since 1989 seems to be unusual when compared with observations in previous decades. Trenberth and Hoar (1996) state that there has been no period in the last 120 years with such high El Niño intensity. They conclude from a statistical model fitted to the 1882 to 1981 data that the 1990 to 1995 spell of El Niño activity had a probability of natural occurrence of about one in 2000 years. As could be expected, they intimate that man-made global warming is to blame.

An analysis of historical data going back to the 16th century shows that this judgement is not tenable. Quinn, Neal, and Atunez de Máyolo **(1987)** have published a historical chronology of El Nino events covering the period 1525 – 1987. It is essentially based on records of anomalous rainfall in northern Peru. The data are in good agreement with documented historical records elaborated by Ortlieb **(2000)**. Five years after the first publication, Quinn **(1992)** published a slightly corrected chronology which is available on-line **(JISAO, 2003)**. This investigation is based on it.

The Quinn Index 1525 to 1987 assigns to each year of the list a value taken from seven categories ranging from 0 (neutral or cold) to 6 (very strong). I transformed the observed data after 1987 to extend the index to the year 2000. I made use of the data only from 1530 onwards to get 47 complete decades. For each of these decades I computed the mean of the 10 Quinn values to measure the frequency and severity of the El Niño episodes within the respective decade. Figure 1 shows the result.

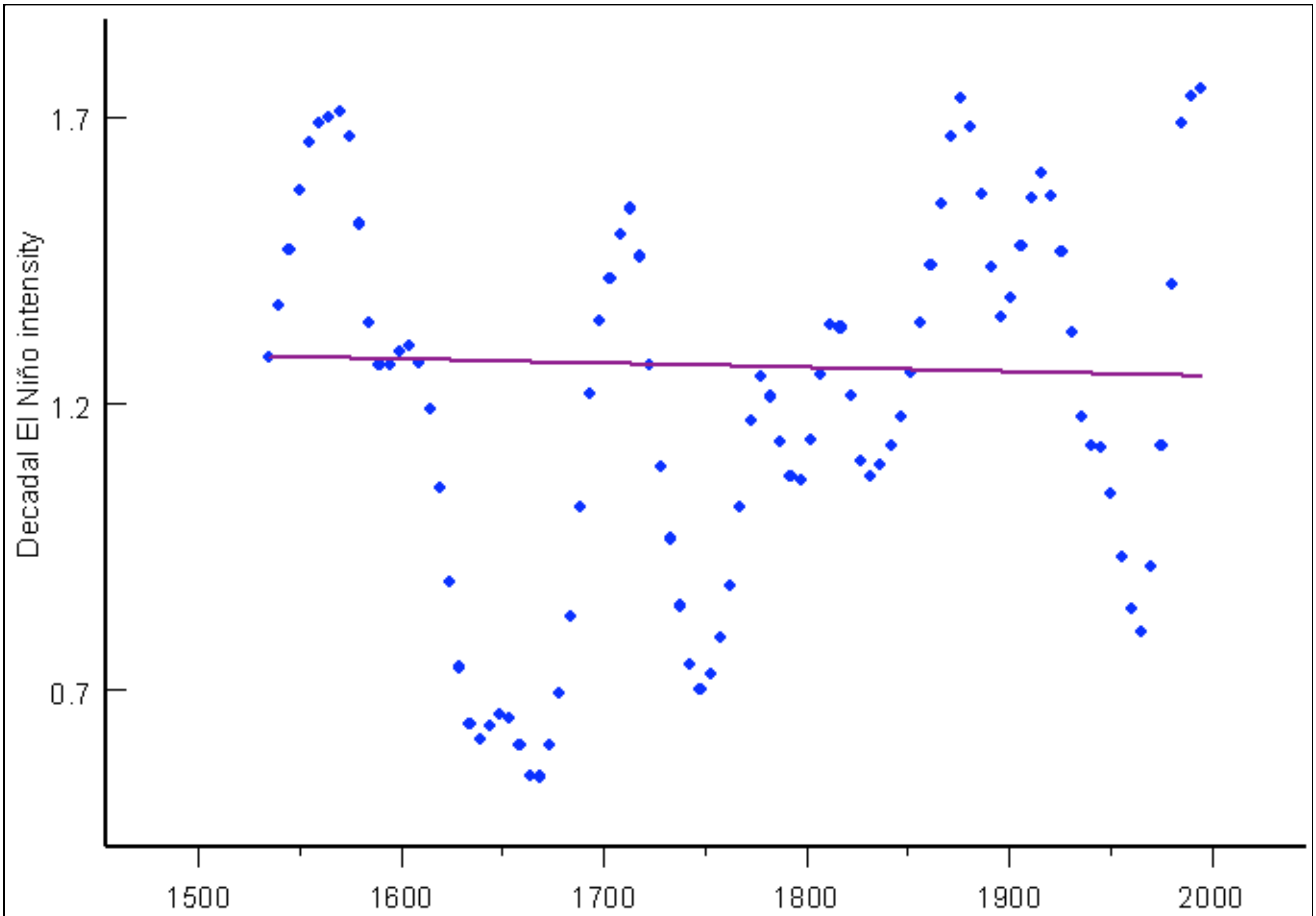

Figure 1

The data were subjected to 3-point Gaussian kernel smoothing. The data points fall at the middle of the respective decade. It can be seen that the peak in recent years is not higher than the previous outstanding peaks around 1570 and 1880. A least squares straight line fit yields a slightly ascending trend that is nearly horizontal. This kind of fit, however, is not robust with regard to errors. The trend line plotted in Figure 1 is robust as it is based on least trimmed squares. It shows a slightly descending trend. In both cases, the respective trend is far from being statistically significant. The El Niño variations of recent decades do not go beyond the natural level observed in the last five hundred years. Accordingly, even the IPCC author Schönwiese **(1994)** did not find a rising trend in the El Niño data.

## 2. Solar motion cycle of 179 years and clusters of outstanding El Niño episodes

The intensity data in Fig. 2 were subjected to moving window Gaussian kernel smoothing (Lorczak) of bandwidth 60. The wide intervals between high peaks and deep troughs point to a cyclic pattern on the intercentennial scale. If it were possible to find a predictable cycle, closely linked to this pattern, this would be a stride ahead as it is very important to know when to expect accumulations of strong El Niños or La Niñas covering two decades or more.

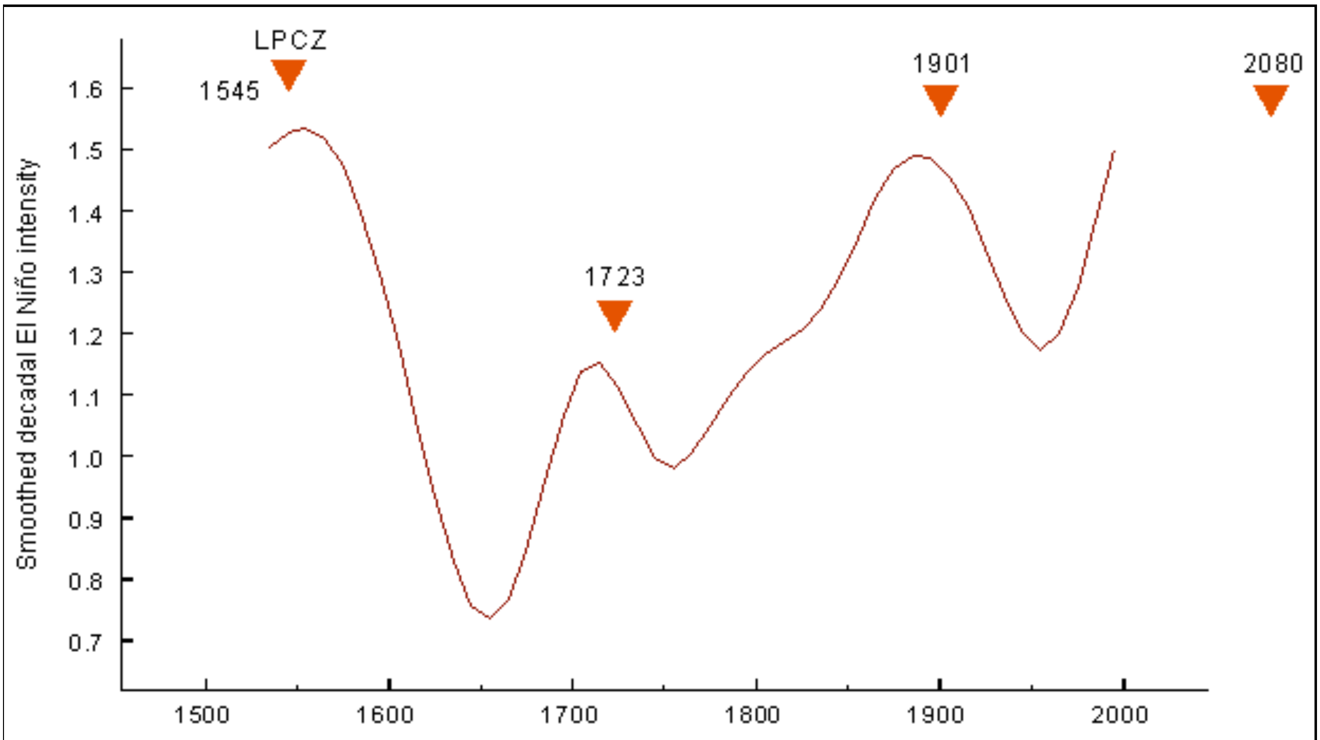


Figure 2

A closer look shows that the 179-year cycle in the Sun's motion about the center of mass of the solar system fits the cyclic distribution. Jose **(1965)** has found patterns in the rate of change of the Sun's orbital angular momentum that repeat at intervals of 178.8 years. In his pioneering computer analysis of the Sun's motion he discovered that sunspots, too, follow a cycle of this length. According to Dansgaard et al. **(1973)**, a period of 181 years, rather close to 179 years, is the paramount cyclic feature of the oxygen isotope profile of the Camp Century ice core. This indicates a connection with climate I have dealt with in several papers **(Landscheidt, 1983-2003)**.

The Jose cycle could be shifted arbitrarily. I have shown, however, that it has well defined initial phases that fall, for instance, at 1545.1, 1723.1, 1901.8, and 2080.7. As to a plot of the 179-year cycle, I call long perturbation cycle (LPC), I refer to Figure 3 of my on-line paper "Trends in Pacific Decadal Oscillation (PDO) subjected to solar forcing " **(Landscheidt, 2001 b)**. This paper shows that the LPC plays an important role in the forecast of cool and warm PDO regimes.

In Figure 2 of the present paper the initial phases LPCZ are marked by triangles. The correlation with the three outstanding intensity peaks within an interval of nearly 500 years is so clear-cut that it justifies the forecast that the next accumulation of outstanding El Niños comparable with the decades of intense El Niño activity around LPCZs 1545, 1723, and 1901 is to be expected around 2080. As the peaks around the past LPCZs in Figure 2 are separated by deep valleys, future La Niña intensity should predominate over frequency and strength of El Niños up to about 2060. This will be shown in detail in the next chapter. As episodes of El Niños and La Niñas have a strong impact on global temperature, a trend towards global cooling instead of global warming should develop in the next five to six decades. This confirms the conclusions in my paper "New Little Ice Age instead of global warming?" **(Landscheidt, 2003 b)** based on a different approach.

## 3. Solar motion cycle of 36 years linked to decadal variations in El Niño intensity

I have shown that the North Atlantic Oscillation (NAO), the Pacific Decadal Oscillation (PDO), El Niño and La Niña, extrema in global temperature anomalies, drought in Africa and U.S.A., as well as European floods are linked to cycles in the sun's orbital motion around the center of mass of the solar system **(Landscheidt, 1983-2003)**. The rate of change of the sun's orbital angular momentum $L$, the rotary force d$L$/d$t$ driving the sun's orbital motion (torque), forms a torque cycle with a mean length of 16 years **(Landscheidt, 2001 a,b)**. Perturbations in the sinusoidal course of this cycle recur at quasi-periodical intervals and mark zero phases of a perturbation cycle (PC) with a mean length of 35.8 years. As to details, I refer to Figure 2 in my on-line paper "Solar eruptions linked to North Atlantic Oscillation" **(Landscheidt, 2001 a)**. As to the details and physical implications of the Sun's irregular orbital motion I refer to my papers "New Little Ice Age instead of global warming?" **(Landscheidt, 2003)** and "Extrema in sunspot cycle linked to Sun's motion **(Landscheidt, 1999)**.

The phases of greatest perturbation (GP) and least perturbation (LP) in the torque cycle (TC) are the main phases in the 36-year perturbation cycle. They play an important role in the long-range forecast of diverse climate phenomena. They indicate, for instance, the peaks of warm PDO regimes and the coolest phases of cold PDO regimes **(Landscheidt, 2001 b)** and are closely linked to extended dry and wet spells measured by the U.S. drought index **(Landscheidt, 2003 a)**. Diaz and Pulwarty **(1994)** have found that the Quinn El Niño record exhibits significant spectral power over frequencies equivalent to wavelengths of 35 to 45 years. This is just the range of variations in the length of the PC with a mean length of 36 years. So I looked for connections between the Quinn data and the PC.

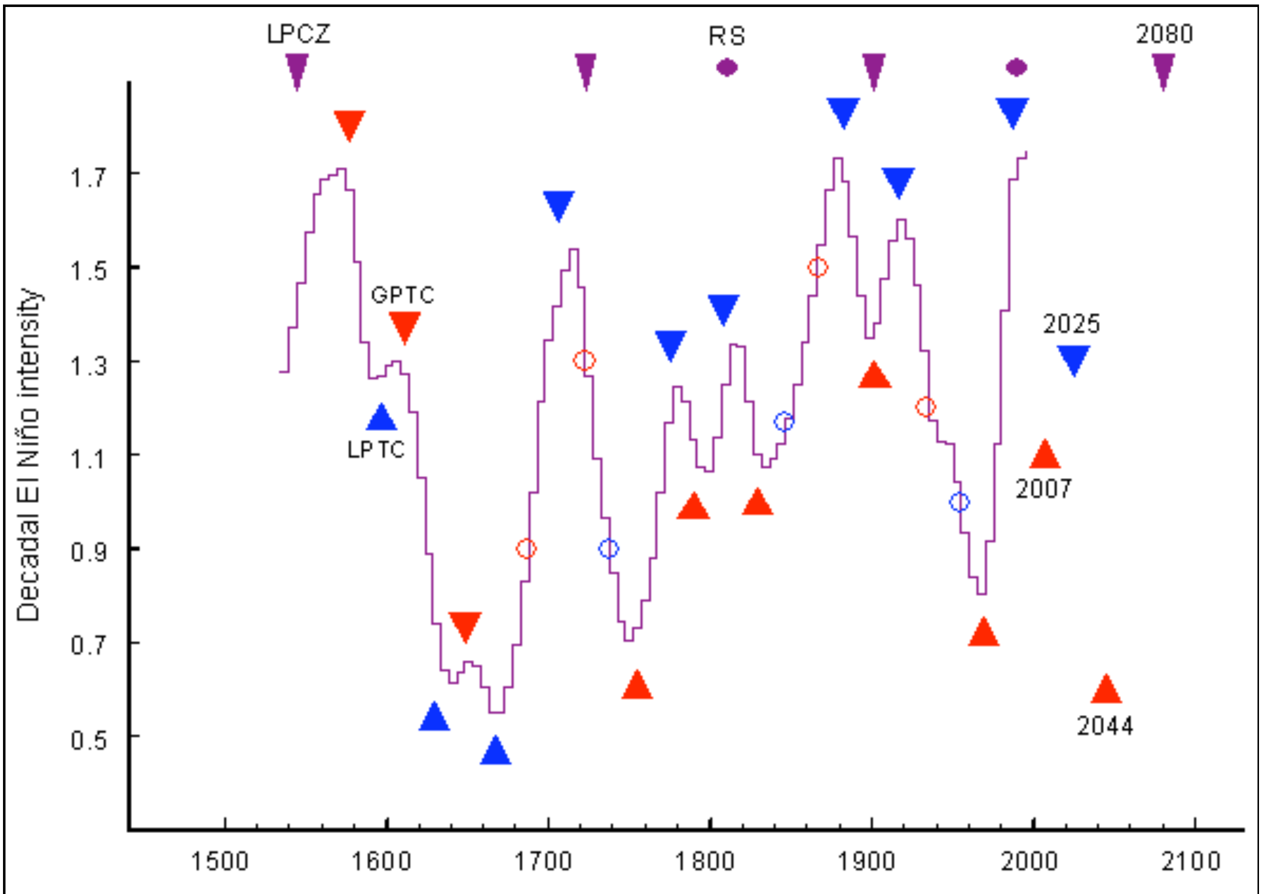

Figure 3

Figure 3 shows the result. GPTC phases are indicated by red triangles and LPTC phases by blue ones. The marked phases are consistently coeval with more detailed extrema of the slightly smoothed distribution of the decadal El Niño intensity. As I have shown in nearly all of my papers, phase reversals around initial phases of solar motion cycles are a normal phenomenon in solar-terrestrial relations. As the respective zero phases can be computed, this opens up a possibility to take the possibility of phase reversals into account. In Figure 3 the initial phases of the 179-year cycle (LPCZ) are indicated by arrowheads. So it is easy to see that there is a phase reversal linked to the LPCZ in 1723. Before this initial phase all maxima of El Niño intensity were linked to GPTCs (red triangles) and after it all minima. With LPTCs (blue triangles) the order is reversed.

A few main phases in the 36-year cycle, indicated by red and blue open circles, show no distinct connection with extrema in the smoothed curve. They match, however, more detailed datasets and fit in with the ordered sequence of red and blue triangles marking the respective PC phases. Such exceptions only occur around dominant LPCZs.

The next LPCZ in 2080 is sufficiently far away. In the next few decades the pattern shown in Figure 3 should be free of instabilities of any kind. So I expect a decadal minimum in El Niño intensity around 2007 (GPTC), a maximum around 2025 (LPTC), and further minimum around 2044 (GPTC). As can be read from Figure 3, these phases help to fix the timing, not the amplitude of the respective extremum.

Here the LPCZs come in and a new factor marked in Figure 3 by filled circles at the top. They indicate rare retrograde phases in the Sun's motion (RS) going along with negative orbital angular momentum. In my paper "Extrema in sunspot cycle linked to Sun's motion" **(Landscheidt, 1999)** I have shown that they go along with accumulations of extreme eruptional activity on the Sun. This is important as the effect of the set of solar motion cycles of different length is not based on relatively weak variations in solar irradiance, but on the Sun's energetic eruptional activity which has a strong impact on climate. As to details I refer to chapter 4 of my paper "Long-range forecast of U.S. drought based on solar activity **(Landscheidt, 2003 a)**.

It is easy to see from Figure 3 that all instances of peak intensity are grouped around LPCZ and RS epochs. All periods of protracted weak intensity fall in between these epochs. So the PC phases in 2007 and 2025 should go along with amplitudes as indicated by the respective triangles, and the minimum intensity around 2044 should have a large negative amplitude. Overall, up to about 2060, strong El Niños like in 1982/1983 and 1997/1998 should not occur, but strong La Niñas are to be expected. Only after 2060 and with the highest probability around 2080 accumulations of strong El Niños should emerge again.

## 4. Outlook

Contrary to the vague "storylines" the IPCC publicizes to speculate about man-made global warming as high as 5.8° C by 2100, the forecast presented here is based on data covering half a millenium. There is a theoretical background, but the forecast does not rely on it. The reliability of the involved solar motion cycles has been checked by 13 well-documented long-range forecasts of diverse climate phenomena that turned out correct without exception **(Landscheidt, 1983-2003)**.

Pertinently, this includes the last three El Niños. I have been told by IPCC adherents that there is nothing special about correctly forecasting El Niño events. They cited the report of Kerr **(1998)** in *Science* entitled "Models win big in forecasting El Niño." Landsea and Knaff **(2000)**, who employed a statistical tool to evaluate the skill of twelve state-of-the-art climate models in real-time predictions of the development of the 1997-1998 El Niño, found however that the models exhibited essentially no skill in forecasting the event at lead times ranging from 0 to 8 months. It should be noted that my last rather precise El Niño forecast, exclusively based on solar activity, was made more than three years before the event **(Landscheidt, 2002)**.

When dealing with an utterly complex system like climate, there is no other way to check hypotheses than by non-trivial forecast experiments. So this further long-range climate forecast solely based on solar activity may serve as a touchstone of the IPCC's claim that since 1950 or at least in recent decades the Sun's variable activity has practically had no effect on climate change.

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