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Ocean Science Discussions

Interactive comment on "Sea surface temperature anomalies, seasonal cycle and trend regimes in the eastern Pacific coast" *by* A. Ramos-Rodríguez et al.

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Answers to reviewer's comments:

The paper needs a thorough editing for English usage.

The paper was sent to an English language editor to improve the readability of the text.

Page 1218 line 12. I wonder if the 2 ERSST dataset is too coarse for studying coastal processes?.

Coastal processes are usually defined as "the set of mechanisms that operate along a coastline", and such a term is commonly related to tides, waves, wind and currents that are constantly working in the coastal zone and produce coastal erosion, sediment transport and accretion. In the present paper, there was more interest in meso-scale processes, particularly sea surface temperature (SST) over the continental shelf and the role of oceanic currents on the distribution of SST, reason for which, a 2-degree resolution was used. Although, as mentioned, a finer resolution could be used (up to 1 km), we wanted to remove those coastal processes that provide other kind of information.

Page 1217 lines 21-24. "The spatial and temporal variation in solar radiation due to solar altitude, changes in Earth's orbital eccentricity and the tilt of planet's rotational axis produces seasonal variation in temperatures, precipitation and many other aspects of the atmospheric environment". I think these changes in the Earth's rotation affect much longer time scales (i.e. tens of thousands of years), not seasons.

The whole sentence was changed because it, effectively, causes some confusion. It now reads:
"The spatial and temporal variation in solar radiation due to solar altitude produces seasonal variation in temperatures, precipitation and many other aspects of the atmospheric environment (Moran and Morgan, 1997). Seasonality even changes on longer time scales, mainly due to alterations in Earth's orbital eccentricity and the tilt of planet's rotational axis, varying on recognized cycles of approximately 41 k.y and 100 k.y. respectively, and known as Milankovitch cycles (Milankovitch, 1941; Bennett, 1990)."

Page 1219. Line 7. Section 2.2. Please mention that this analysis was applied to Sea Surface Temperature data.

The first sentence in the paragraph now reads:
"For the SST data, the monthly anomalies for each 2 by 2 coastal pixel were calculated by obtaining a mean of all months in the database resulting in an annual mean time series per pixel."

Page 1219. Lines 22-page 1220 line 4. Even with the expanded description given in the reply to the Reviewer, this section 2.3 is still unclear. For example " . . .we computed . . .the annual mean solar irradiance. The latter is a function of the . . .day of year." The annual mean is NOT a function of the day of year. Aside from this problem of English grammar, the final few lines of this section are extremely unclear and I do not know what was regressed against what. i.e. Carefully define the phrases "theoretical latitudinal solar irradiance amplitude series" (is this a time series?), "mean SST seasonal amplitude" and "latitudinal SST amplitude".

The paragraphs were rewritten and now they read:
"Changes in the seasonal cycle are studied from yearly amplitudes obtained for each pixel and every year in the data base. To calculate the deviations from the amplitude of seasonal cycle we computed for every pixel the annual mean solar irradiance. The latter is a function of the latitude and the movement of the sun throughout the sky during a year. We used equations based on the spherical law of cosines and equations modified from Spencer (1971) and Jacobs et al. (2004). First, we obtain the solar declination for a given year using,...."

"....The amplitude of the solar irradiance for each pixel (latitude) was obtained calculating the statistical range. This results in a theoretical latitudinal solar irradiance

amplitude series (the amplitude value of solar irradiance for every pixel), which was used to compute regressions against their corresponding latitudinal mean SST seasonal amplitude series, which was calculated averaging the 61-year SST amplitude series for each pixel (see section 2.2), resulting in one mean SST amplitude value for every pixel (latitude) used in this study. The regression was carried out in two steps: 1) from equator to 60N and, 2) from equator to 60S, resulting in a theoretical curve of latitudinal SST amplitude based on solar radiation (amplitude of the solar irradiance, red line in figure 1a)."

Regarding Figure 2 and associated discussion. It is suggested that the amount of solar irradiance integrated in time over whole solar cycles governs SST regimes. How does this relate to the findings of e.g. Meehl et al. 2009 that actual peaks in solar cycles correspond to cool SST in the eastern Pacific (Meehl et al. Fig. 1), which eventually switches to warm SST a couple of years later via air-sea coupling? Clearly Meehl et al are referring to different time scales (inter-annual) compared to your "decadal" processes, but I would like a discussion on how they are related.

The paragraph was rewritten and now it reads:
"...with an associated increase in trade wind strength capable of increasing the strength of equatorial ocean upwelling and of lowering equatorial SSTs (Meehl et al., 2009). A consequence of this lowering of SSTs and increased upwelling is a positive feedback due to enhanced subsidence producing fewer clouds in the eastern Pacific that allow even more solar radiation to reach the ocean surface. Therefore, during shorter sunspot cycles (increased solar activity), there is an increase in SSTs in the tropics and subtropics that can help explain the higher temperatures observed during regime 2. This statement can be corroborated when observing Cold Tongue Index, which usually increases during higher temperatures of positive ENSO events or positive phases of Pacific Decadal Oscillation (Mantua et al; 1997)"

Also, you find regime changes in the late 1970s and the late 1990s. There are a lot of papers in the literature that discuss these well-known regime shifts and analyse the relationship to the Pacific Decadal Oscillation, air-sea coupling, etc. I think you should relate your findings much more carefully to previous literature on this subject.

A paragraph was added in section 3.2:
"Pacific Decadal Oscillation (PDO) is a basin-wide phenomenon which occurs in eastern Pacific coast. It was initially described for the North Pacific, and its effects resemble to those of a weak, long-lasting ENSO event; with the positive phase similar to an El Niño and negative phase to La Niña (Trenberth, 1990; Mantua et al; 1997; Mantua, 2002). In last century, two positive PDO regimes prevailed from 1890-1924 and again from 1947-1976, while warm PDO regimes dominated from 1925-1946 and from 1977 to mid-2000s (Minobe, 1997; Mantua, 2002). PDO regimes and regime shifts detected seem to be in synchrony, i.e.the regime shift in PDO of late 1970's towards a positive phase agrees with the first regime shift detected in the present work which switched the whole basin to warm conditions. As pointed out by Mantua (2002) and Gershunov and Barnett (1998), some studies suggest that ENSO influences on climate are strongly dependent on the phase of the PDO, such that the canonical El Niño and La Niña patterns of climate anomalies are most likely to occur during years in which ENSO and PDO extremes are in phase (i.e., with warm PDO coincident with El Niño, and cool PDO coincident with La Niña). During second regime (warm), the strongest ENSO events of the series were recorded, which is another resemblance between PDO and the present work. It is worth noting the synchrony of regime shifts in this work and PDO phases, which indicates a deep coupling of the climatic system in the whole basin."