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South Pacific's Non-Seasonal SSTs

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Abstract

In the western tropical South Pacific are found the highest SSTs of the year according to a classical world atlas. These temperatures are essentially no higher in the southern summer than in winter. Consequently an efficient heat balance mechanism for the surface layer occurs at all times: heat from absorbed solar radiation must be exported out. Between winter and summer, the area of highest SSTs more than doubles as indicated by the 80 F and 82.5 F contours moving south. When the areas decrease again it is proposed that a surge of warm surface layer water has exited the tropics by southward horizontal advection and is heading to mid and higher latitudes. This surge should take place to the west of a permanent wide warm surface current connecting the western tropics to the coast of South America that was proposed earlier based on two winter east/west hydrographic vertical sections at mid-latitudes. More observations are needed to confirm the conjectures.

Keywords

South Pacific, Non-Seasonal SSTs

1. Introduction

Based mainly on two vertical east/west hydrographic sections at mid-latitudes, the conjecture has been made that there exists a wide warm surface current moving diagonally southeast through the center of the South Pacific, at least during two different southern hemisphere winters [1].

What is attempted below is to try to find the relation between this circulation concept and SSTs from a classical world atlas, derived from ship-injection temperatures, covering the tropics of the South Pacific for all twelve months. That such a comparison is possible comes from the primary focus on surface flows, so that only the top 100 m of the vertical sections, extending from the surface to the bottom, are of interest here. Extrapolation from what has been discovered in a more data rich ocean, the North Pacific, provides guidance as well.

Explored for the first time, probably, is the prime oceanographic feature, already known from the North Pacific and the North Atlantic, that the warmest temperatures of the year are to be found in the western tropics and that they have the unusual property of being at most only 1 C warmer in the southern summer than in winter, *i.e.* their magnitudes are essentially non-seasonal. Also it is found that the surface area between the 80 F contour and the equator dramatically swells (more than doubles in size) in the southern spring and summer compared to the lowest values of the fall and winter.

A straightforward consequence of these powerful observations for the ocean's surface and near surface heat balance should apply just as well to the South Pacific as it has been suggested to do to the other oceans [2]. At all times the amount of solar heat absorbed through the sea surface in the tropics must equal that exported out of the surface layer region. Available data and a few assumptions indicate that the excess spring and summer heat accumulated in the surface layer is carried south (poleward) by advection during those seasons.

One refreshing characteristic of the classical temperature atlas [3] is: it is totally independent of the strongly held and theoretically conceived notions about the movement of ocean currents in relation to the winds above them that was put firmly in place just a few years after the publication of the atlas.

2. From the Atlas

Each monthly mean chart in the H. O. 225 atlas is provided with a grid of one degree latitude/longitude squares as a background. Areas are easily computed by counting these squares. In that manner the areas between the equator and the 80 and 82.5 F contours were found for the 12 sheets of the western South Pacific. Convenient east and west boundaries of all total areas were selected to be 150 E and 130 W.

Results of the area computations are presented in **Figure 1**. Both area curves in **Figure 1** are similar in their overall shape in that they have a marked seasonal variation: large values in the southern summer and low values in the winter. That these curves are not completely smooth may indicate that the underlying data base was relatively small. But the doubling and almost tripling of the largest areas over the smallest ones cannot be dismissed as being fictional. The way that the areas expand in the southern summer, without the temperatures within the areas changing significantly, is by the southward movement of the contours. For example, the maximum latitude of the 80 F contour ranges from 16 S in winter to 25 S in summer (not shown). Confirmation that the north/south movement of the temperature contours is due mainly to the movement of the surface water is likely to be true in the tropics but direct observations are needed to be sure.

In this connection, bringing up ship drift data, with mean values of the order of 10 cm/sec, causes considerable hesitancy due to the largely unknown quality and usefulness of such data. If it were not for the fact that over 40 years ago it had been noticed that "there is flow away from the equator in both hemispheres" [4], which statement

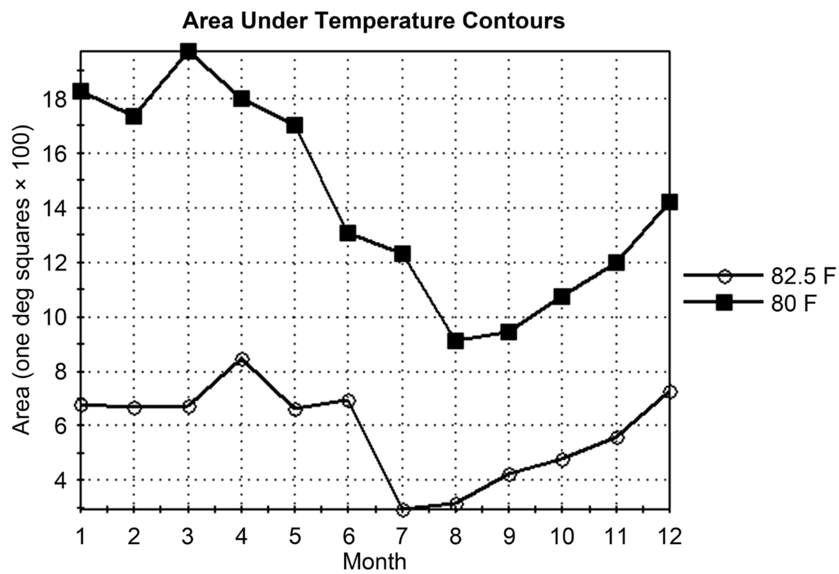

Figure 1. Area (units of one degree square × 100) between the 80 F contour (upper curve) and the equator and area between the 82.5 F contour (lower curve) and the equator as functions of month (1 = January, etc.).

was deduced from ship drift measurements and it applies to the Pacific in particular and to all four seasons, no mention of the subject would have been made.

3. Discussion

Interpretation of the summer's horizontal bulging of the area of the tropical surface layer containing the highest temperatures in the South Pacific proceeds in the same way as was done in the North Pacific, the only difference being the 180 degree phase shift in the seasonal signal of the areas shape, which is expected because of the sun's movement across the oceans throughout the year plus the assumption that north/south flow crossing the equator can be neglected. Compare the present **Figure 1** with Figure 1 in Reference [2] to see the contrast in phase between the two hemispheres. The magnitudes of the maximum and minimum areas for the 80 F contours, for example, are very nearly the same in the two figures but the phase difference between the approximately sinusoidal curves is off by about 180 degrees.

Two vertical sections at mid-latitudes in two different southern hemisphere winters, with densely spaced (horizontally and vertically) very accurately measured temperature and salinity values, have documented the reality of what has been proposed to be the analogue of the wide warm surface current of the North Pacific flowing northeast off California. The only difference is that in the South Pacific the flow is southeastward heading toward South America. However, there are not sufficient data to prove the permanence of this southeastward surface flow of warm water, although the expectation is high that this will eventually turn out to be the case.

Massive amounts of ship-injection temperatures in the North Pacific have allowed the conjecture to be put forward that in summer a separate wide warm "surge" of surface water leaves the western tropics for mid to higher latitudes to the west of the permanent northeastward flow. Now the classical SST atlas suggests, by a single realization, that the southward bulging of the area of highest temperatures in the western tropics of the South Pacific, in the southern spring and summer, will lead to a separate surge of warm surface layer water that will move southward, at the end of summer, to the west of the permanent southeastward flow.

Evidently there is plenty of room for more experimental work in order to try to clear up all these conjectures. For example, no single hydrographic vertical section has yet captured both the permanent flow and the separate summer surge in either hemisphere of the Pacific.

4. Conclusion

Predictions are made for two wide warm surface flows moving southward in the South Pacific occurring in the southern hemisphere summer. First, the diagonal southeast flow between the western tropics and the west coast of South America should be found at all times of the year, including summer, at about the same location indicated by the winter hydrographic sections made earlier. Second, west of the permanent southeast flow will be found a surge of warm surface water exiting the tropics every summer for mid to higher southern latitudes, based on SSTs from a classical atlas and analogous developments from the more data rich North pacific. New measurements are required to establish the correctness of the predictions.

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