19.1 TRENDS AND VARIATIONS IN SOUTH PACIFIC ISLAND AND OCEAN SURFACE TEMPERATURES

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1. INTRODUCTION

We analyse temperature variability and trends in the South Pacific using 40 island stations and optimally interpolated sea surface (SST) and night marine air temperature (NMAT) data. The data generally end in 1998. The SST data come from the HadISST1 data set while NMAT data derive from the HadMAT1 data set. Here, revised corrections have been applied for changing thermometer screen heights above the sea surface as ships have become larger (Rayner et al, 2003). We also analyse composite island and collocated SST and NMAT time series for four large regions, T1-T4, (Fig. 1). These regions were chosen by Salinger et al (1995) to have homogeneous island temperature trends in the period 1951-1990.

Composite island air temperature and marine temperature time series for regions T1-T4 have been corrected for artificial changes in variance due to changes in the availability of constituent island stations. Folland et al (2003) discuss the mathematical method for achieving this as the intrinsic variance of the stations changes over these relatively large regions.

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2. RESULTS

A key finding is that annual collocated NMAT and SST show a striking pattern of correlations, with a minimum correlation near the northern border of region T1, surrounded by areas of high correlation. We call this line of minimum correlation the MCSTMAT. The MCSTMAT also reflects a minimum line of interannual standard deviation in SST, NMAT and in island maximum and minimum temperature. The minimum is also seen seasonally. The MCSTMAT is strongly related to the mean position of the South Pacific Convergence Zone, almost identically in spring and summer, but somewhat displaced southwest in the other seasons. The MCSTMAT is also close to where seasonal or interannual correlations of the Southern Oscillation with island air temperature, SST and NMAT change sign. Correlation analyses for both 1871-1948 or 1949-1998 give similar geographical locations for

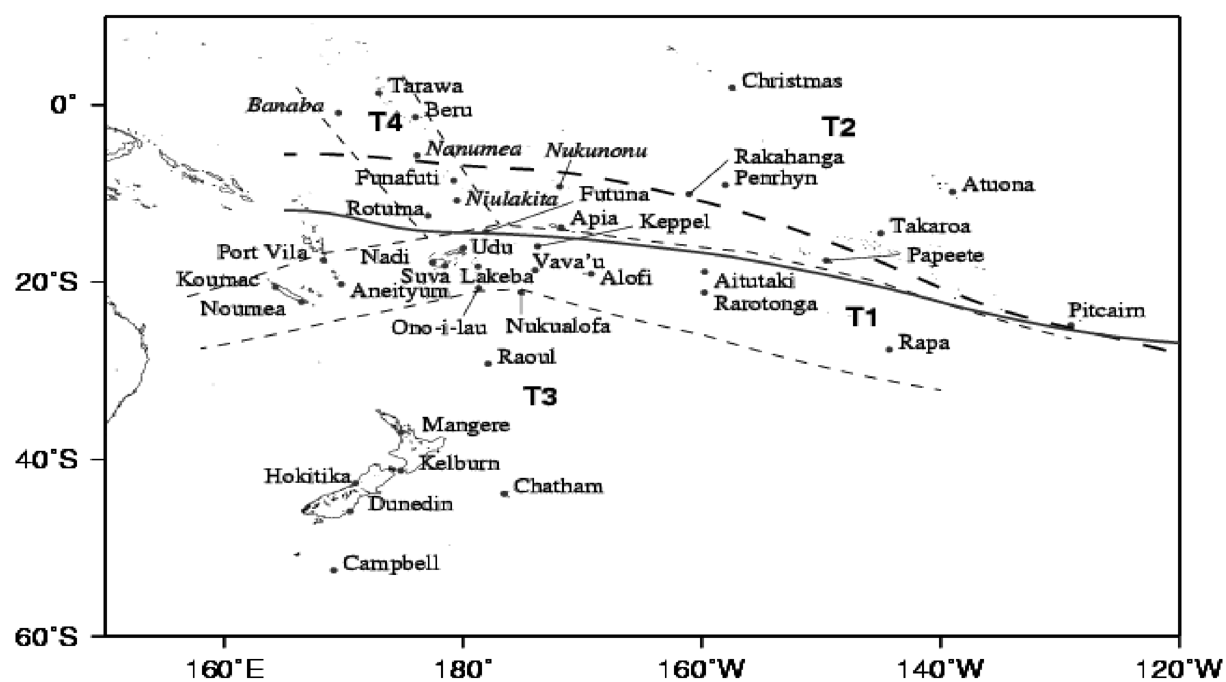

Figure 1. South Pacific stations and regions T1-T4. The austral winter position of the South Pacific Convergence Zone is shown as the heavy dashed line and the summer position as the full line. Both are based on the position of mean maximum convergence of NCEP Reanalysis 10m winds over 1958-1998.

this change of sign for SST and NMAT, there being too few early island data to test this temporal stability.

Long time series of regional temperature data of all the variables are generally quite consistent, especially on interannual time scales, adding confidence to the overall veracity of the data. The general consistency of the often sparse marine data, especially of NMAT, owes much to the use of a form of optimum interpolation that allows for non-stationarity of these data (Rayner et al, 2003). Annual low frequency temperature variations in the four regions are shown in Figs 2a-2d. Regions T2 and T3 are generally internally consistent, the latter back to 1871. However, warming in T4 since about 1985 is not reflected in NMAT. This is part of a larger area noted by Christy et al (2001) where NMAT has failed to warm recently, whereas SST has warmed. In region T1, the marine data do not show the strong recent warming seen in the island air temperature data. The shaded area show the assessed uncertainty in the SST data; uncertainties in other data cannot yet be estimated. Assessed SST uncertainties are due to random errors, representativity errors due to sparse data in grid boxes, and uncertainties in SST bias corrections before 1942.

These much expanded temperature data generally confirm the results of Salinger et al (1995). Thus T1 shows an unsteady warming in the island data while T2 shows slight cooling from about 1940 to 1970, then warming. Region T3 shows most warming between 1900 and 1960 with slow or little warming since then. Region T4 has some of the characteristics of T1 but with a more muted recent warming.

2.1 References

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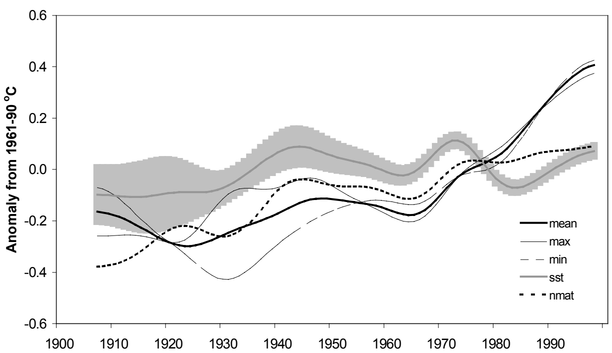

Figure 2a. Annual marine and surface air temperatures for region T1, 1907-1998, using a low pass filter with a half amplitude of 25 years. SST data include a shaded 2 standard error range.

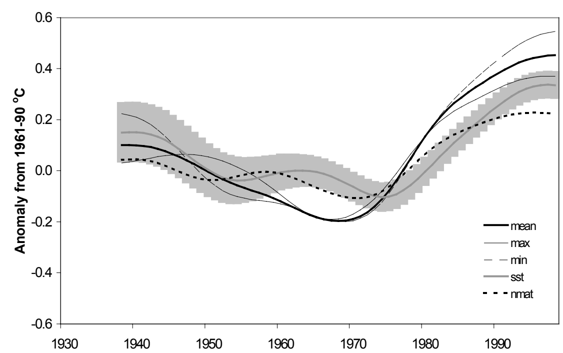

Figure 2b. Filtered (as in Fig. 2a) composite annual marine and surface area temperatures for region T2, 1938-1998.

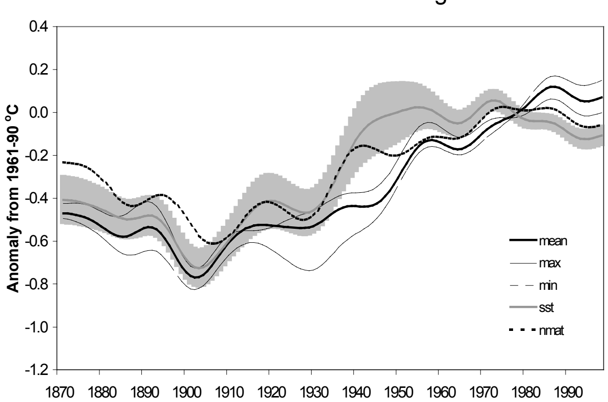

Figure 2c. Filtered (as in Fig. 2a) composite annual marine and surface air temperatures for region T3, 1871-1998.

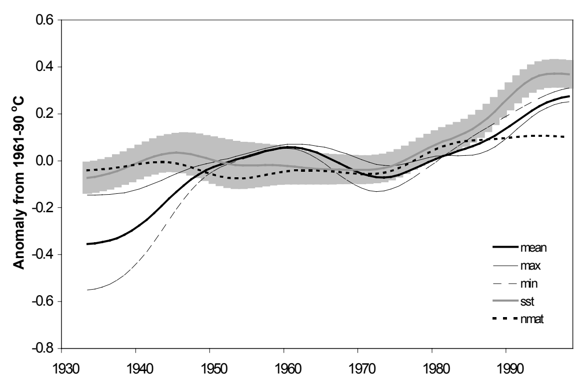

Figure 2d. Filtered (as in Fig. 2a) composite marine and surface air temperatures for region T4, 1933-1998.