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Verification of SPCZ and ENSO dynamics in the extended reanalysis period using the South Pacific Rainfall Atlas

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Ground-based rainfall observations during the pre-satellite era in the South West Pacific were examined for an extreme La Niña event that occurred in 1955-56. The rainfall observations were derived from the South Pacific Rainfall Atlas (SPRAT), a data compilation contributed by the regional meteorological services. The influence of tropical cyclone activity on both monthly and warm season rainfall anomalies were also accounted for using the International Best Tracks Archive for Climate Stewardship (IBTrACS) tropical cyclone database.

The rainfall anomalies from more than 60 southwest Pacific Island stations showed a region of enhanced rainfall in the southwest half of the south Pacific encompassing the Southern Cook Islands, Tonga, Fiji, New Caledonia, and Vanuatu. Suppressed rainfall was observed in the northeast corner of the region over the Marquesas, the Northern Cook Islands, Tokelau, and Tuvalu. This pattern is similar to what is expected for La Nina events that occurred during the classic re-analysis period (1958 onward). Elimination of anomalously high historical rainfall totals for individual islands using the IBTrACS data allowed a 'best guess' of the past SPCZ position, suggesting it was probably southwest of the its normal climatological position during the 1955-56 La Nina.

A comparison of the 'best guess' SPCZ position fit derived from the rainfall anomalies to the omega velocity furnished by the NOAA-CIRES reanalysis show a remarkably similar position of the SPCZ during the 1955-56 ENSO event. Ground-based rainfall observations that support SPRAT (which extend into the early 1900s and beyond) can therefore confirm the fidelity of the NOAA-CIRES extended 20th century reanalysis and can help to reveal past ENSO and SPCZ dynamics. In addition, the high-resolution daily reanalysis data and IBTrACS information indicate a unique SPCZ control on regional tropical cyclone trajectories into the Southern Hemisphere mid-latitudes during ex-tropical transition. Additional data contributions (both rainfall and surface pressure) from the late 19th century that are developed through SPRAT in the near future will help to supplement the NOAA-CIRES reanalysis through time, and also provide a ground-based test of reanalysis-based SPCZ and ENSO reconstructions. This effort is complementary to and integrated with the present global effort underway through the ACRE project.