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1. ABSTRACT

We present growth rates, Sr/Ca, and U/Ca ratios of the coral colony (*Siderastrea stellata*) sampled at Rocas Atoll, off the Brazilian coast. These variables are primarily affected by sea surface temperature (SST) at seasonal scale, and by wind stress at interannual scale. **The reliance from wind stress represents a broad new finding.** A lower significance at the interannual time scale between Sr/Ca and U/Ca with respect to SST is attributed to the low SST amplitude closed to Equator. An investigation on the dependence of coral growth rates with respect to the "cloud shading effect" promoted by the Intertropical Convergence Zone (ITCZ) does not show significant influence. Additionally, rain seems to act on local geochemistry of Sr/Ca ratios and growth rate at the decadal scale.

2. MATERIAL AND METHODS

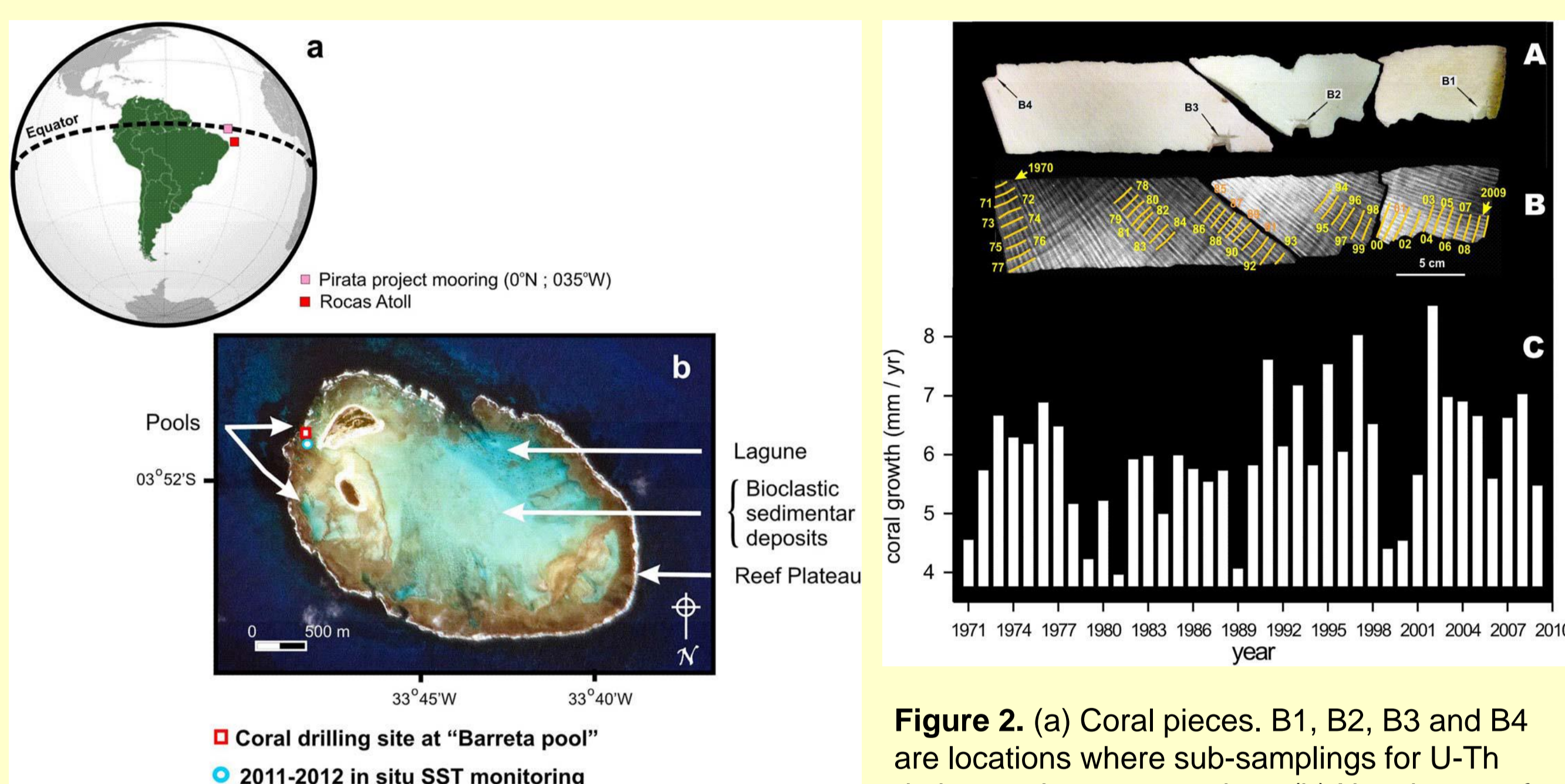


Figure 1. (a) Location of Rocas Atoll and the PIRATA mooring where SST were measured in the West-Equatorial Atlantic; (b) the atoll main features, the coral drilling site and the location of in situ SST monitoring during 2011–2012.

Figure 2. (a) Coral pieces. B1, B2, B3 and B4 are locations where sub-samplings for U-Th dating analyses were taken; (b) X-ray image of *Siderastrea stellata* core with annual growth bands defined. Chronology was taken from the year of sampling (2009); (c) coral growth rate variability.

3. SST, WIND, ITCZ MEASUREMENTS

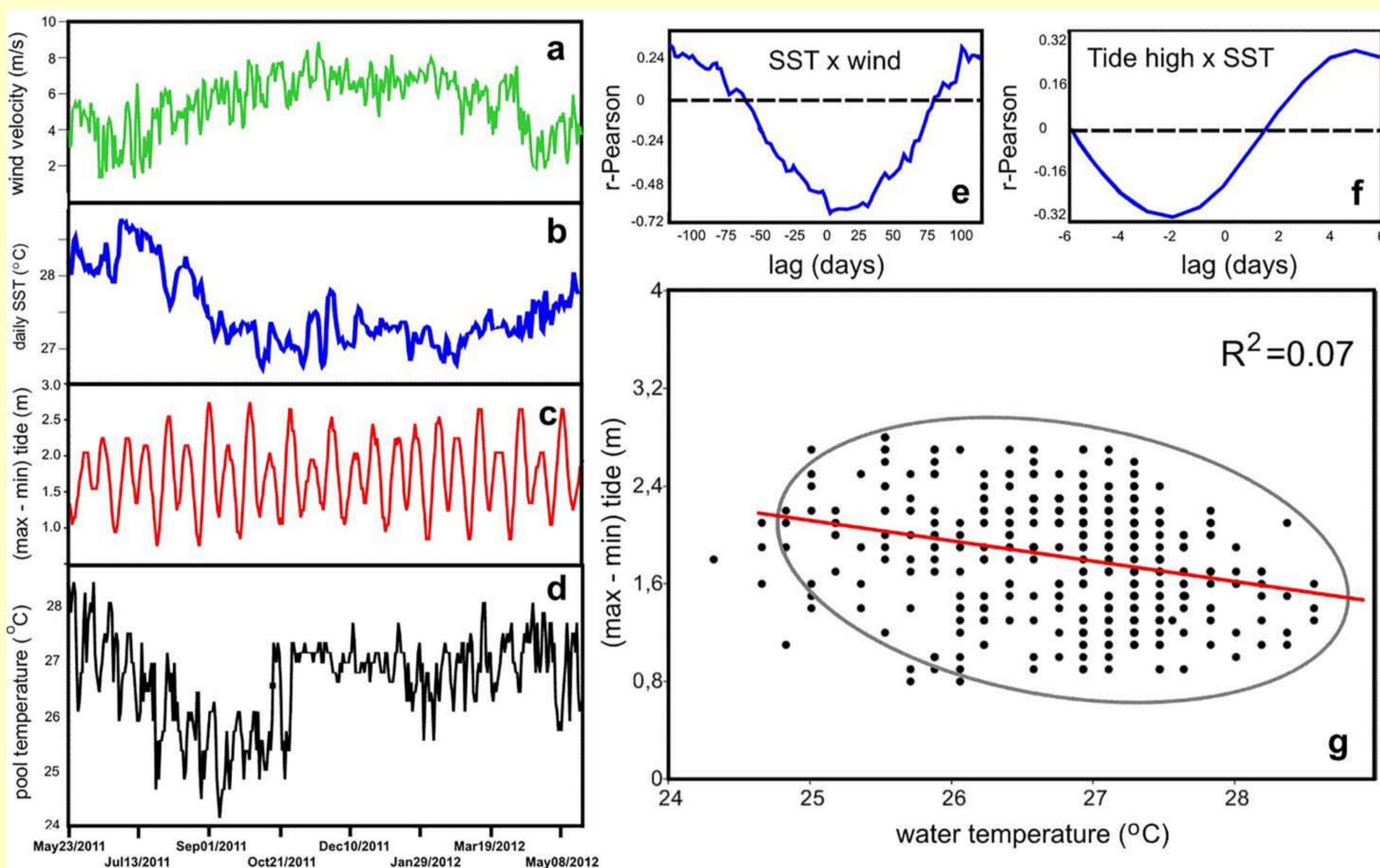


Figure 3. Daily record from May 23, 2011 to May 22, 2012 of: (a) wind velocity (m s⁻¹) and (b) SST (8C) at 08N-0358W both from the PIRATA Project; (c) tide amplitude (m) from Tide Station at Fernando de Noronha Is. (38510S, 0328250W); (d) water temperature at the pool where the coral core was sampled in Rocas Atoll; (e) lag correlation (days) between SST and wind; (f) lag correlation (days) between tide amplitude and water temperature (in situ); (g) correlation between in situ water pool temperature and tide amplitude. 95% confidence ellipse and regression curve are shown.

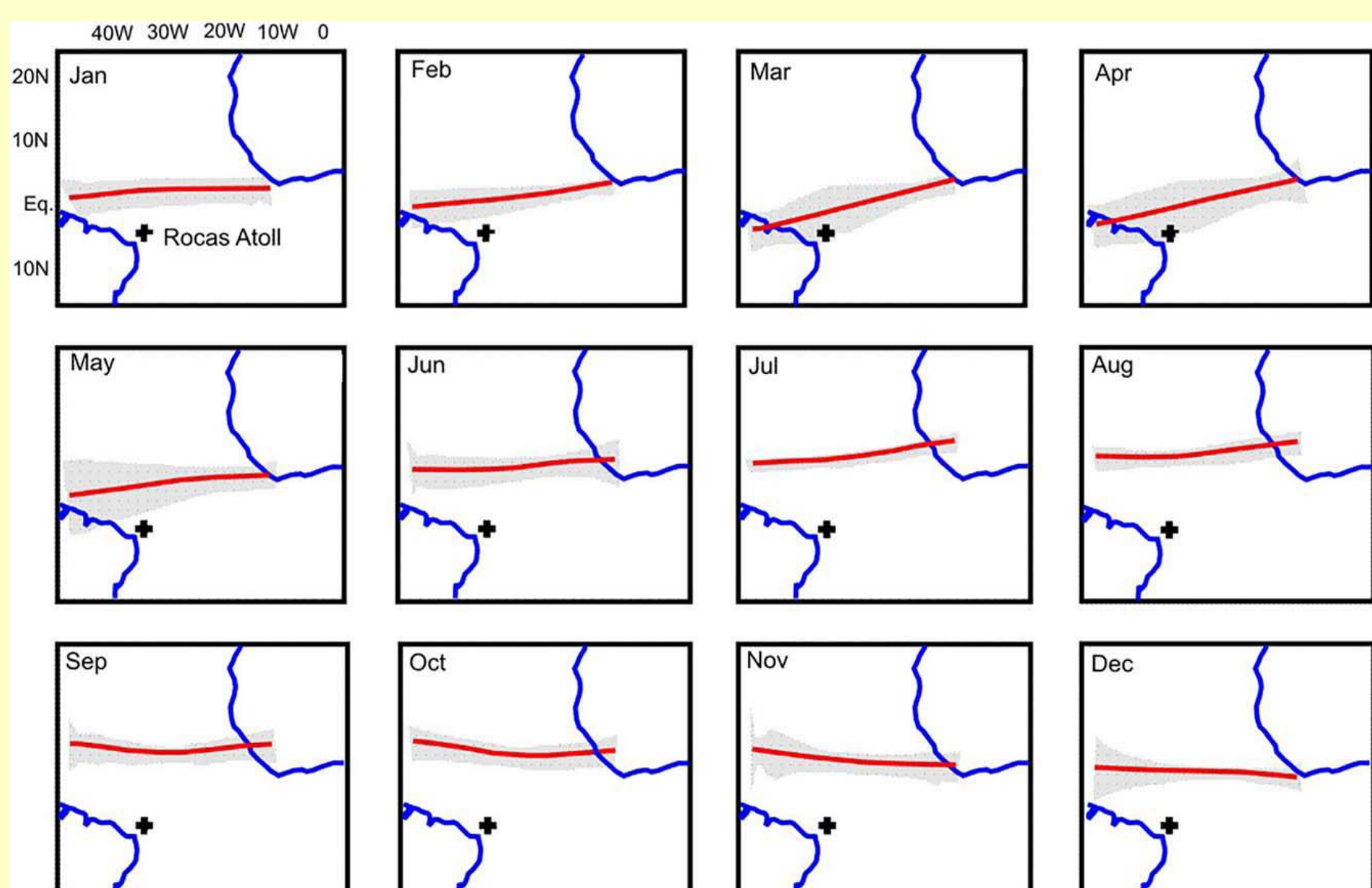


Figure 4. Monthly ITCZ displacements relative to Rocas Atoll (indicated by a cross) based on OLR method. Shaded areas are 95% confidence interval. The analyzed period spanned the period 1975–2013.

4. REGRESSIONS Sr/Ca AND U/Ca vs. SST

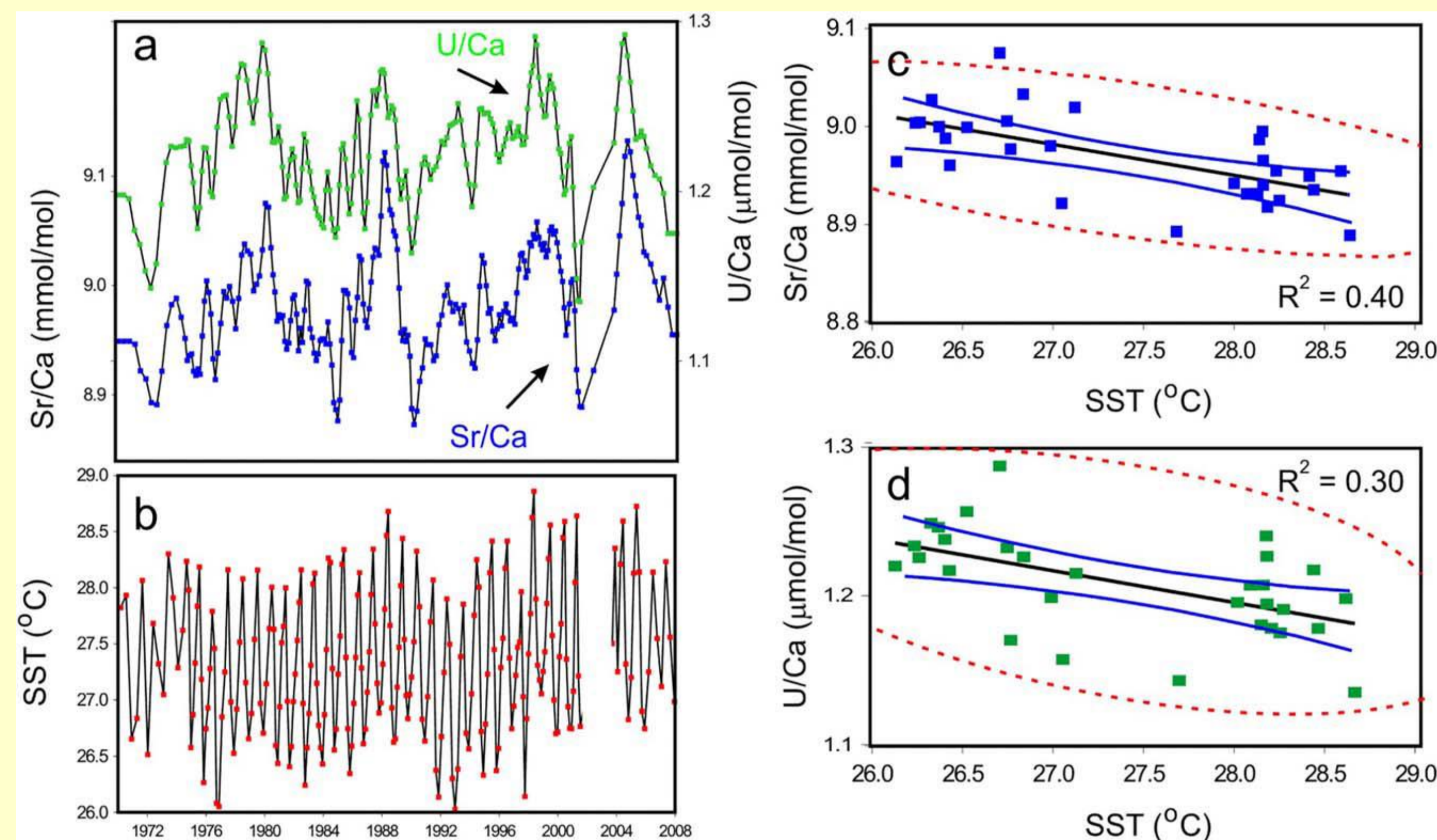


Figure 5. (a) Sr/Ca and U/Ca variability along the coral core of Rocas Atoll; (b) bi-monthly SST (SERV monthly database); (c) Regression, corresponding confidence interval, and 95% confidence ellipse for Sr/Ca; (d) the same for U/Ca (n515).

5. REGRESSIONS Sr/Ca AND GROWTH vs. WIND STRESS

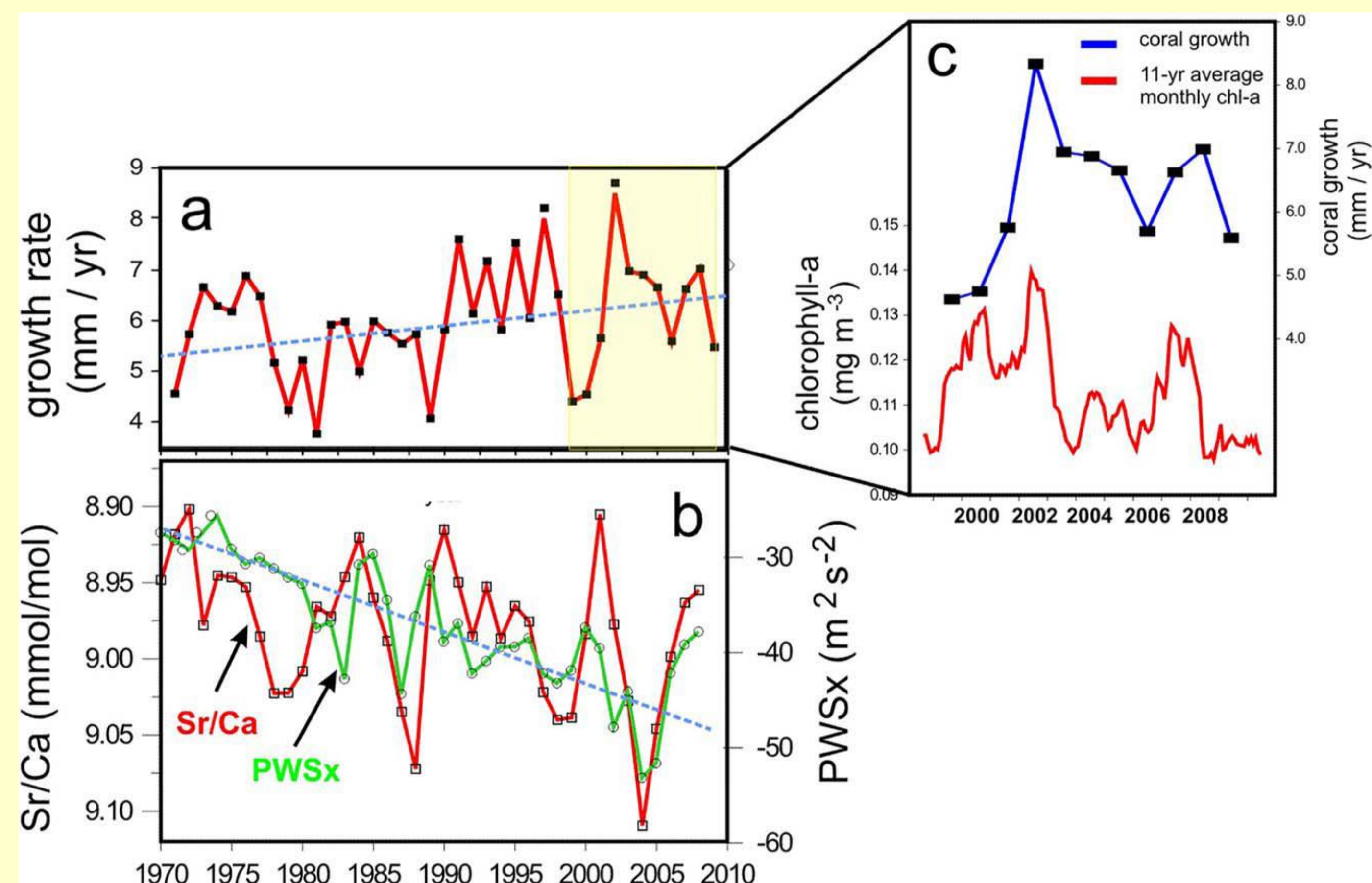


Figure 6. (a) Coral growth time series; (b) Sr/Ca and pseudo wind stress; (c) coral growth and Chlorophyll-a inferred from SeaWiF. Dotted lines are linear trends for growth rate in Figure 6a and PWSx in Figure 6b

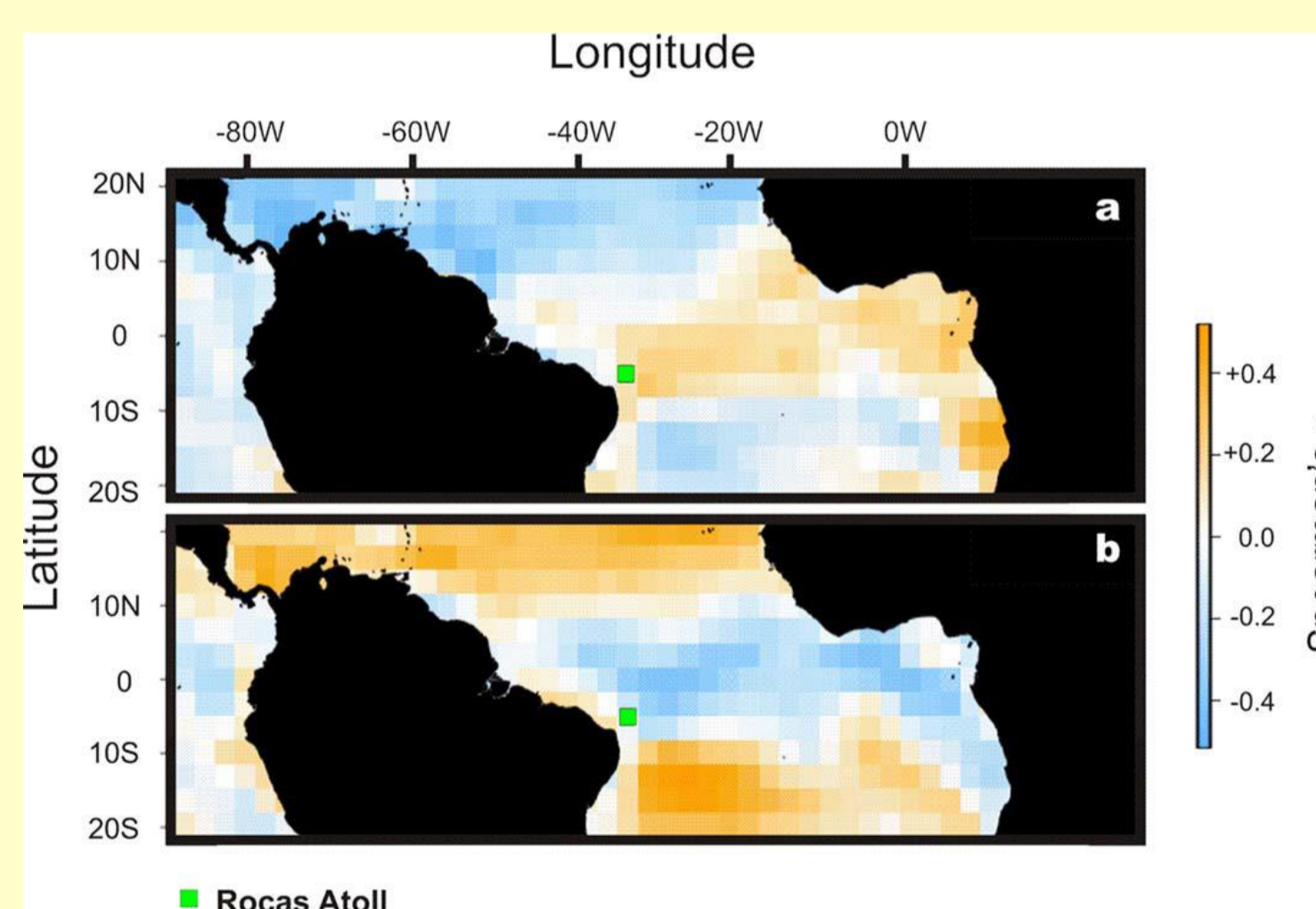


Figure 7. Spearman's q correlation maps for (a) coral growth rate and PWSx; (b) for coral Sr/Ca and PWSx. (PWSx data from NCEP/NCAR reanalysis. Time series were detrended).

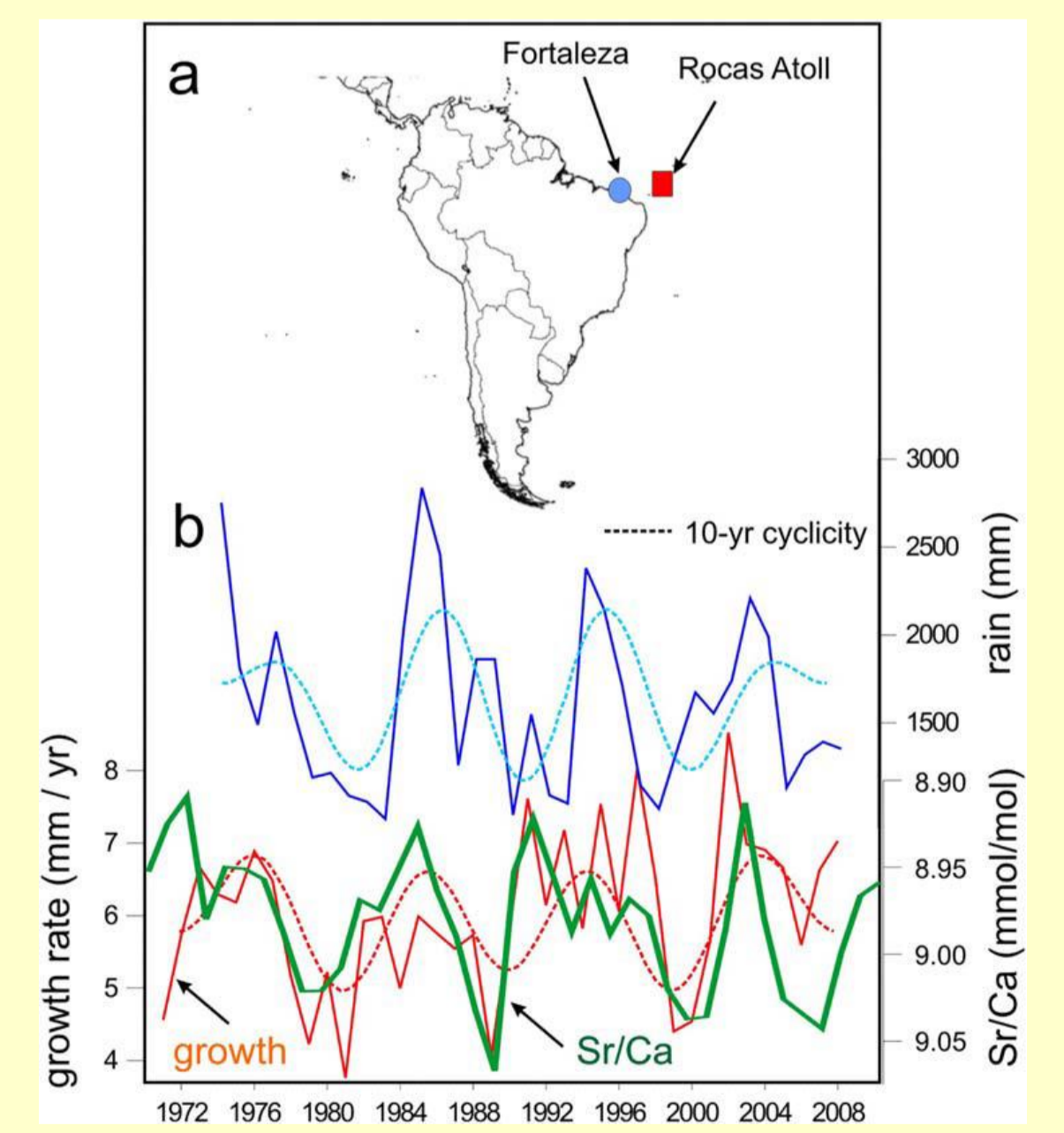


Figure 8. (a) Rocas Atoll site and Fortaleza Meteorological Station at the Brazilian coast; (b) rain data from Fortaleza-FUNCEME station, coral growth and Sr/Ca annual data. Dotted curves are 10-yr phase extracted from rain and growth data.

6. CONCLUSIONS

At seasonal time scale, linear regression between Sr/Ca, U/Ca, and SST present slopes values comparable to previously published. At the interannual scale, Sr/Ca, U/Ca and growth rate are all significantly correlated to each other, but not correlated with SST. This lack of relationship might be due to the small SST inter-annual variability, whose amplitude does not exceed 1.58 °C. Conversely Sr/Ca is significantly correlated with the surface wind, more specifically the zonal pseudo wind stress (PWSx), a variable that presents greater regional mode of variability. Over the last decades, a positive trend in growth rate was accompanied by an increase in the wind stress.