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DISCUSSION

Nunn, Patrick D., 1998. Sea-Level Changes over the Past 1,000 Years in the Pacific. *Journal of Coastal Research*, 14(1), 23–30.

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Based on data from American Samoa, Fiji, the Gambier Islands, Guam, Kosrae, New Zealand, Rota and the Tuamotus, NUNN (1998) presented a sea-level envelope for the southern Pacific basin covering the past 1200 years. He identified: (1) a slow sea-level rise between ~1000 BP and ~700 BP from close to present sea level to ~0.9 m above present sea level; (2) a rapid fall of sea level around ~700–650 BP of ~1.4 m; (3) stable sea level between ~650 BP and ~450 BP; (4) a rise to 'a little above present sea level' around 430 BP; (5) slowly falling sea level to 0.9 m below present sea level between 430 BP and 200 BP; and (6) rapid sea-level rise in the past 150–200 years. Episodes 1 and 3–5 were associated with the Little Climatic Optimum and the Little Ice Age, respectively. It may be argued that sea-level data from such a wide geographical area should not be presented in the same diagram, even when selected data are from presumed 'stable' coastlines, because true isostatic stability does not exist (MITROVICA and PELTIER, 1991). However, the sole purpose of this discussion is to demonstrate that the proposed relationships between climate and sea level are not supported by the data if all height uncertainties and, particularly, age uncertainties are considered.

The most important noncounting error in ^{14}C age determination results from variations in the atmospheric concentration of ^{14}C through time. This error is taken into account by calibration of ^{14}C ages, yet NUNN (1998) based his conclu-

Table 1. *Sea-level index points from the Pacific presented by Nunn (1998) with calibrated radiocarbon ages. For original sources and localities see Nunn (1998).*

Data point (Nunn, 1998)	Laboratory no.	Emergence magnitude (Nunn, 1998)	Measured ^{14}C age	Calibrated ^{14}C age (Stuiver et al., 1998) 2σ cal AD calibrated range(s)	Material dated
2	Hv-12996	0.45 ± 0.2	1,080 ± 55	790–1033	*Porites* coral
3	Hv-12265	≥0.6[1]	950 ± 70	908–1127	coral
4	?	≥−0.66 ± 0.03	940 ± 120	803–1297	unspecified reef material
5	NZ-6485	0.02 ± 0.9	907 ± 62	1002–1011 1016–1263	shell
6	?	≥−0.72 ± 0.03	900 ± 140	803–1337	unspecified reef material
7	?	0.745	740 ± 60	1162–1337	unspecified reef material
8	?	0.6	720 ± 80	1190–1203 1206–1413	peat
9	Hv-12282	≥0.6[1]	705 ± 65	1184–1403	reef conglomerate
10	Hv-13017	0.25 ± 0.1	700 ± 60	1199–1400	*Porites* coral
11	?	0.89	690 ± 70	1190–1416	unspecified reef material
12	NZ-1962	0.12 ± 0.23	670 ± 50	1266–1401	shell
15	NZ-1965	0.0 ± 0.24	470 ± 50	1404–1479	shell
16	NZ-5270	0.0 ± 0.5	413 ± 30	1434–1514 1600–1615	shell
17	NZ-6519	−0.46 ± 0.24	395 ± 34	1437–1523 1563–1628	shell
19	NZ-6462	−0.23 ± 0.22	365 ± 30	1444–1533 1539–1636	shell
22	?	≥−1.06 ± 0.04	260 ± 135	1426–1950	unspecified reef material
24	?	−0.77 ± 0.02	115 ± 160	1476–1950	unspecified reef material

[1] Given by Nunn (1998) as exactly 0.6 m.

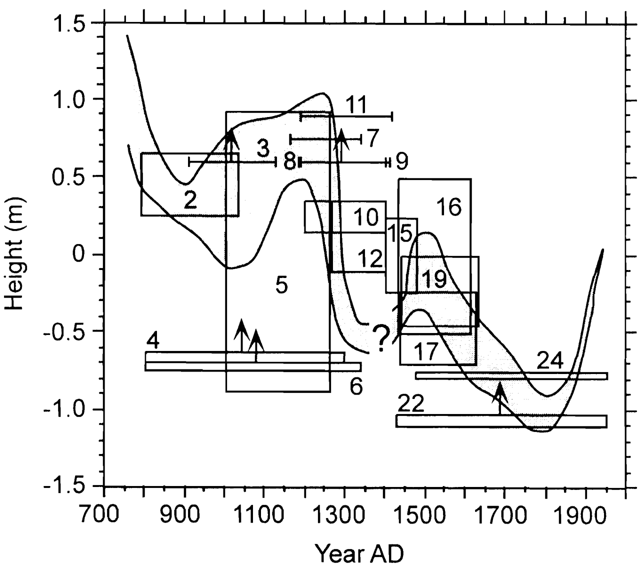

Figure 1. The sea-level envelope for southern Pacific basin proposed by NUNN (1998) compared with the data points on which the envelope is based. The data are presented as boxes that represent uncertainties in age (2σ calibrated ranges) and height. From the figure it can be seen that the sea-level envelope is too narrowly drawn.

sions on uncalibrated radiocarbon ages. Table 1 includes calibrated ages according to the INTCAL dataset of STUIVER *et al.* (1998), not provided by NUNN (1998).

From Nunn's Table 1 and from the text of his paper it is not always possible to determine the nature of the dated material and whether a reservoir correction is included for marine samples. In most of the original sources a standard correction of 400 ^{14}C years appears to have been applied, but this could not be verified for data points 4, 6, 22 and 24. For terrestrial sample 8 the calibration takes into account an average offset in the southern hemispheric radiocarbon time scale of 24 ± 3 ^{14}C year (STUIVER *et al.*, 1998, MCCORMAC *et al.*, 1998a). PIRAZZOLI *et al.* (1988) argue that for lagoonal samples a reservoir correction is not always necessary as the samples may be assumed to have been in equilibrium with atmospheric ^{14}C. For these samples, the southern hemispheric offset should be applied. Unfortunately, it was not always possible to verify the original setting of the dated sample.

The calibrated data are plotted in Figure 1 and include the vertical errors presented by NUNN (1998). For five samples vertical uncertainties of sea-level index points were not given. Two of these (3 and 9) represent minimum sea-level positions, rather than the exact positions given by NUNN (1998). Whether or not all calibrations are accurate is open to question—for example, the interhemispheric ^{14}C offset may be temporally variable (MCCORMAC *et al.*, 1998b)—but it is clear that uncertainties in height and age do not justify the detailed trends postulated by NUNN (1998).

In conclusion, studies of the relationship between climatic change and sea-surface change should rely on the calendar time scale. Authors should provide complete information of dated samples when presenting ^{14}C data. Analyses of radiocarbon-dated records showing short-lived climatic and sea-level fluctuations should always include an assessment of the vertical errors and age uncertainties.

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