Surface Radiocarbon Variability off the Coast of Kenya During the Last 50 Years

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ARTS Open Science Meeting 2001
Noumea, New Caledonia

1997-98 Climate Disasters

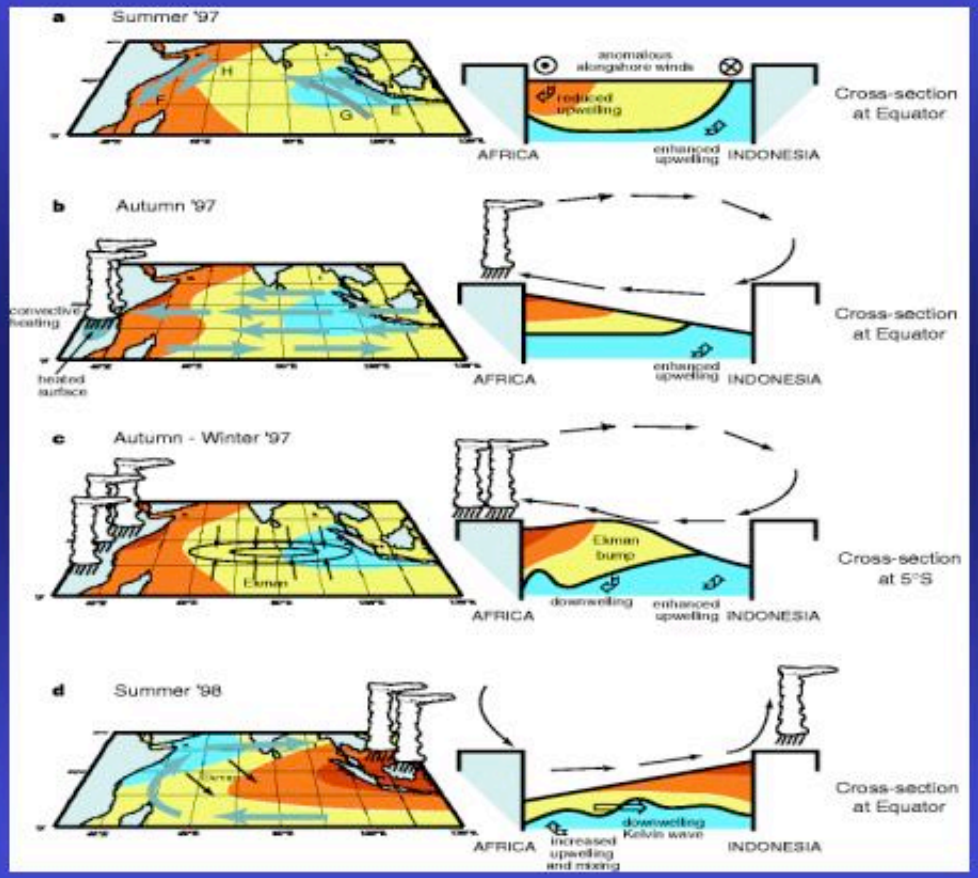
Indonesian Forest Fires
rubber and palm plantation

Photo by David Portnoy

East African Floods
torrential rain

Photographs taken by the Red Cross

Indian Ocean Dipole

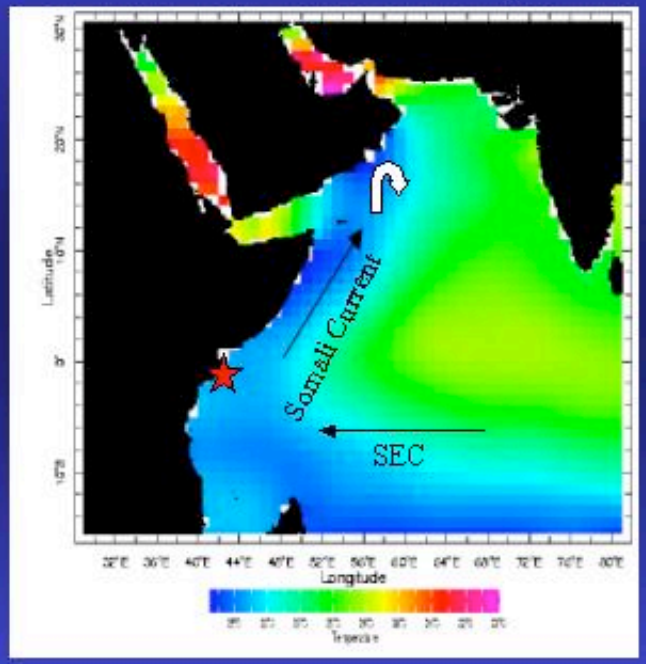


Webster et al., 1999

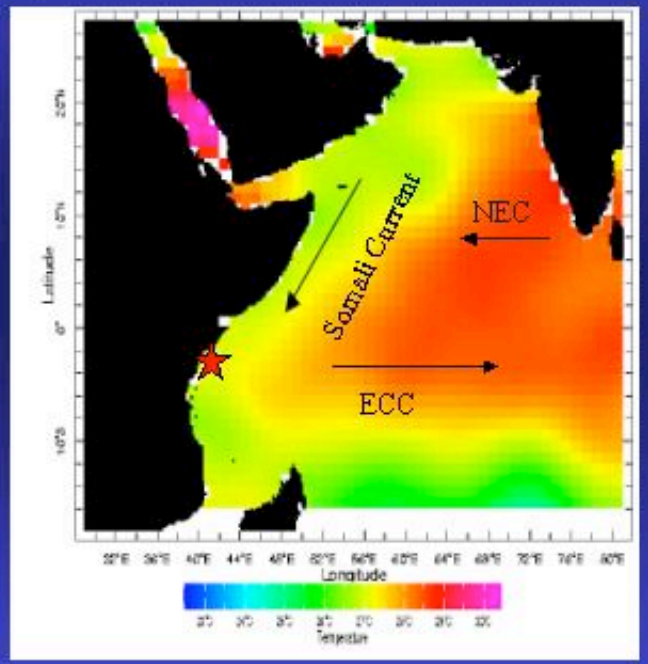
East African Coral Site

★ **Watamu**

(3°23'S, 39°52'E)



SW Monsoon



NE Monsoon

Photo by Maris Kazmers

Coral Radiocarbon

$^{14}CO_2$

air-sea exchange

$\Sigma^{14}CO_2$

precipitation

$$Ca^{2+} + H_2{}^{14}CO_3^- = H_2O + Ca^{14}CO_3 + CO_2$$

*Coral skeletal ^{14}C = Water ^{14}C

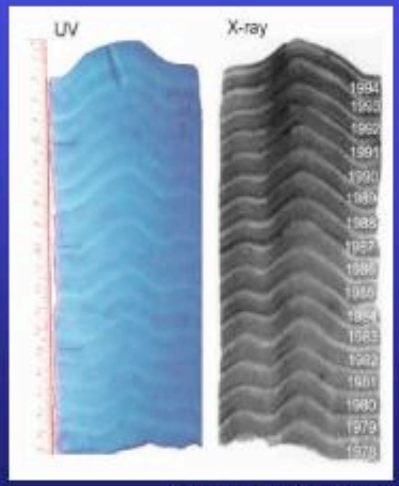
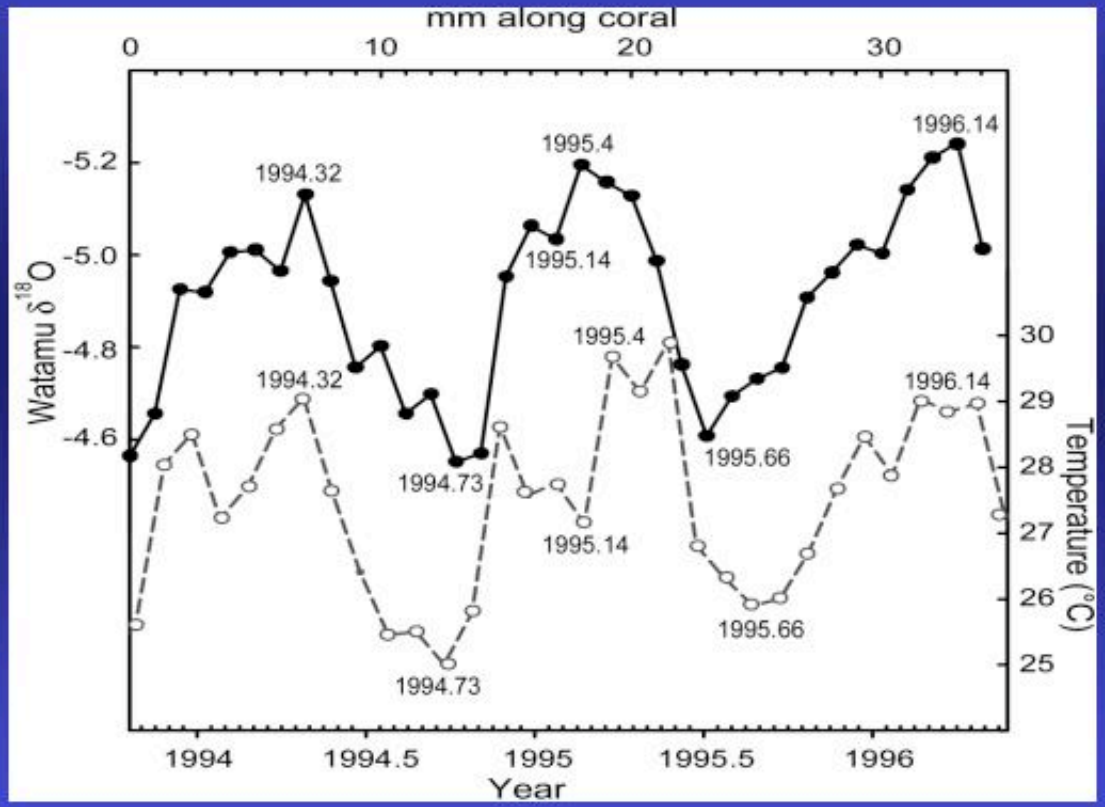


Image by Dr. Robert Dunbar

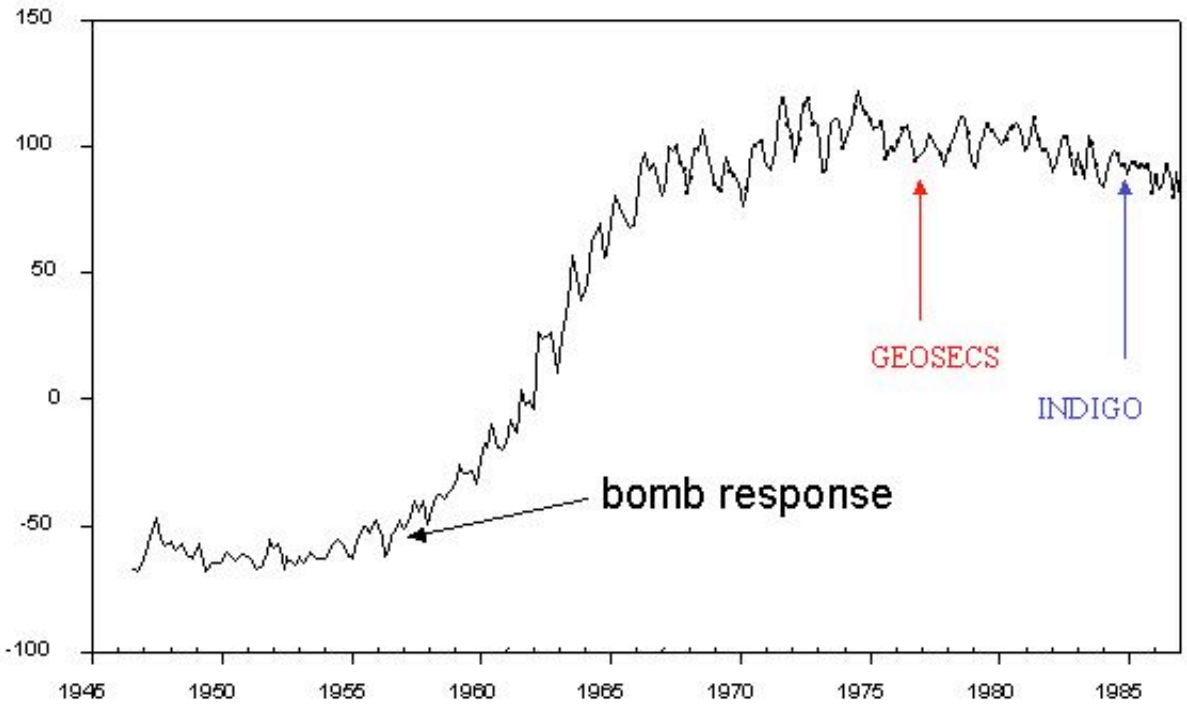
Center for Accelerator Mass Spectrometry (CAMS) at LLNL

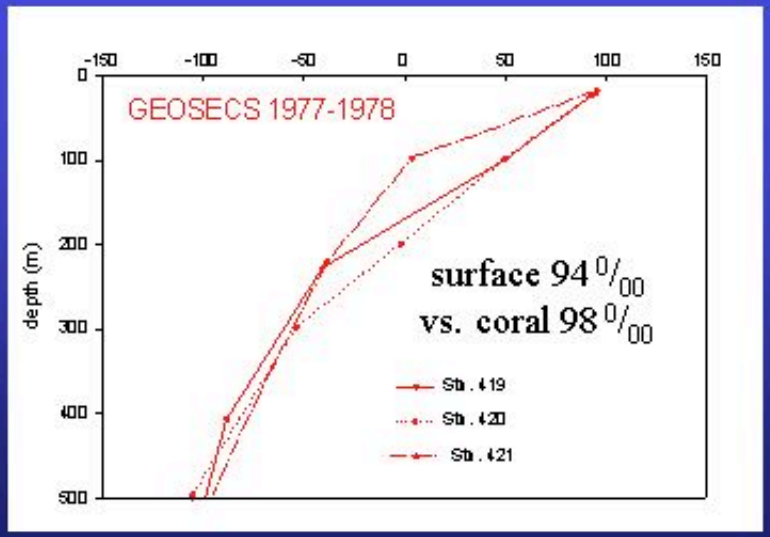
Coral Chronology

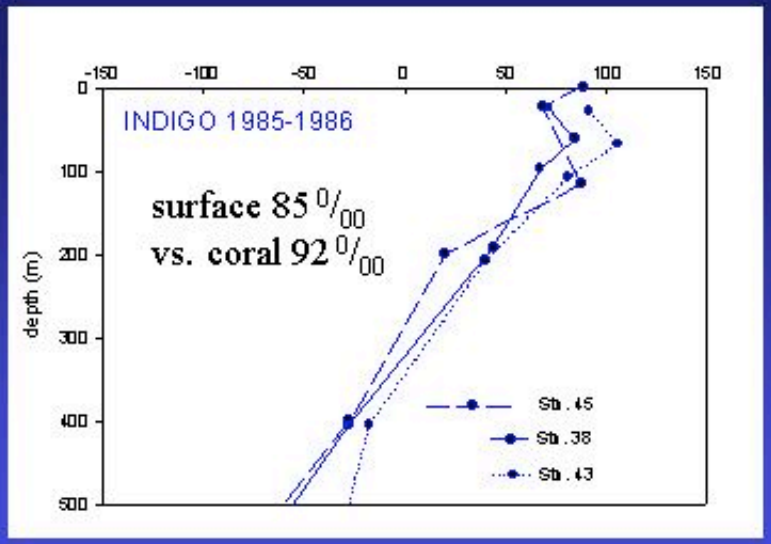


Grumet et al., in press

Watamu Coral Radiocarbon

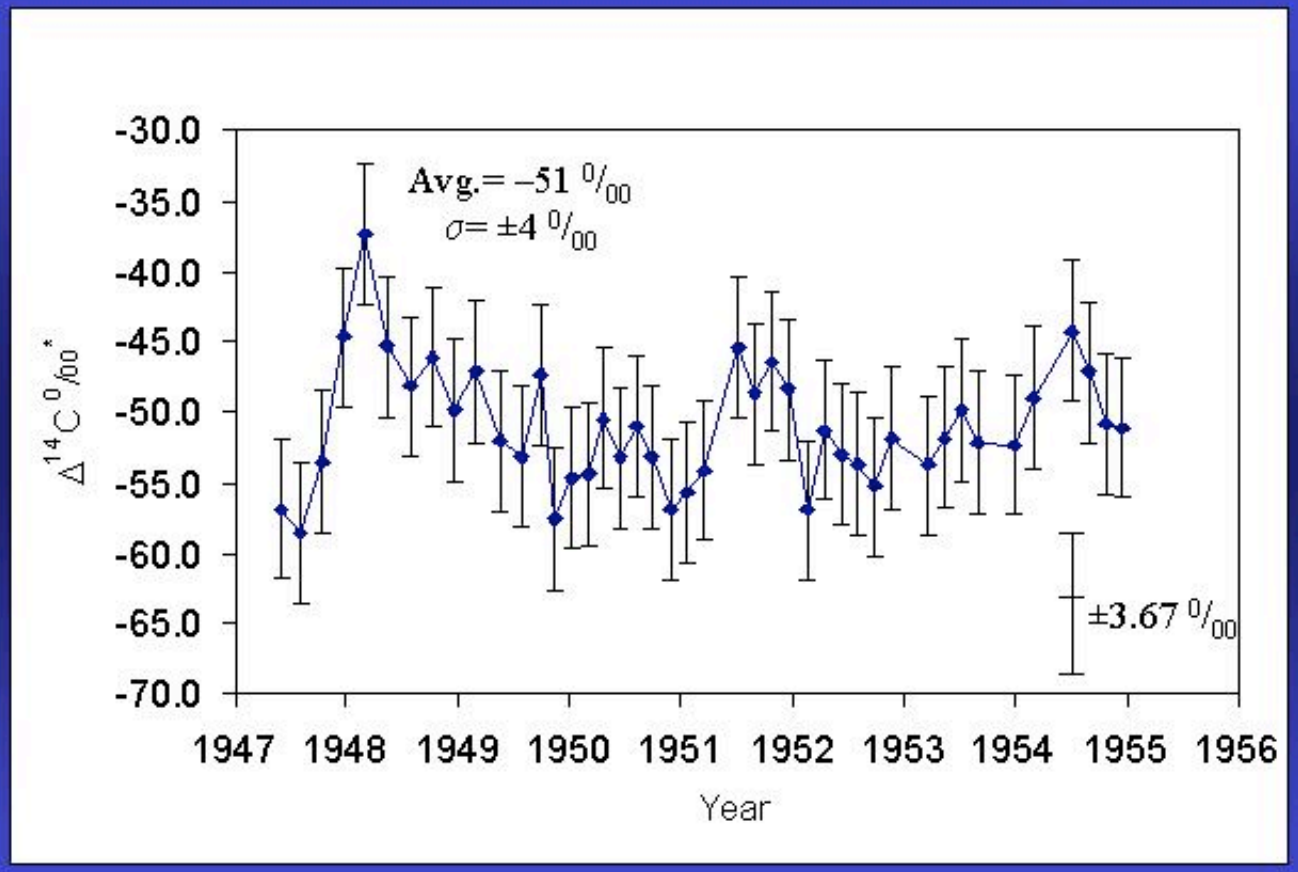






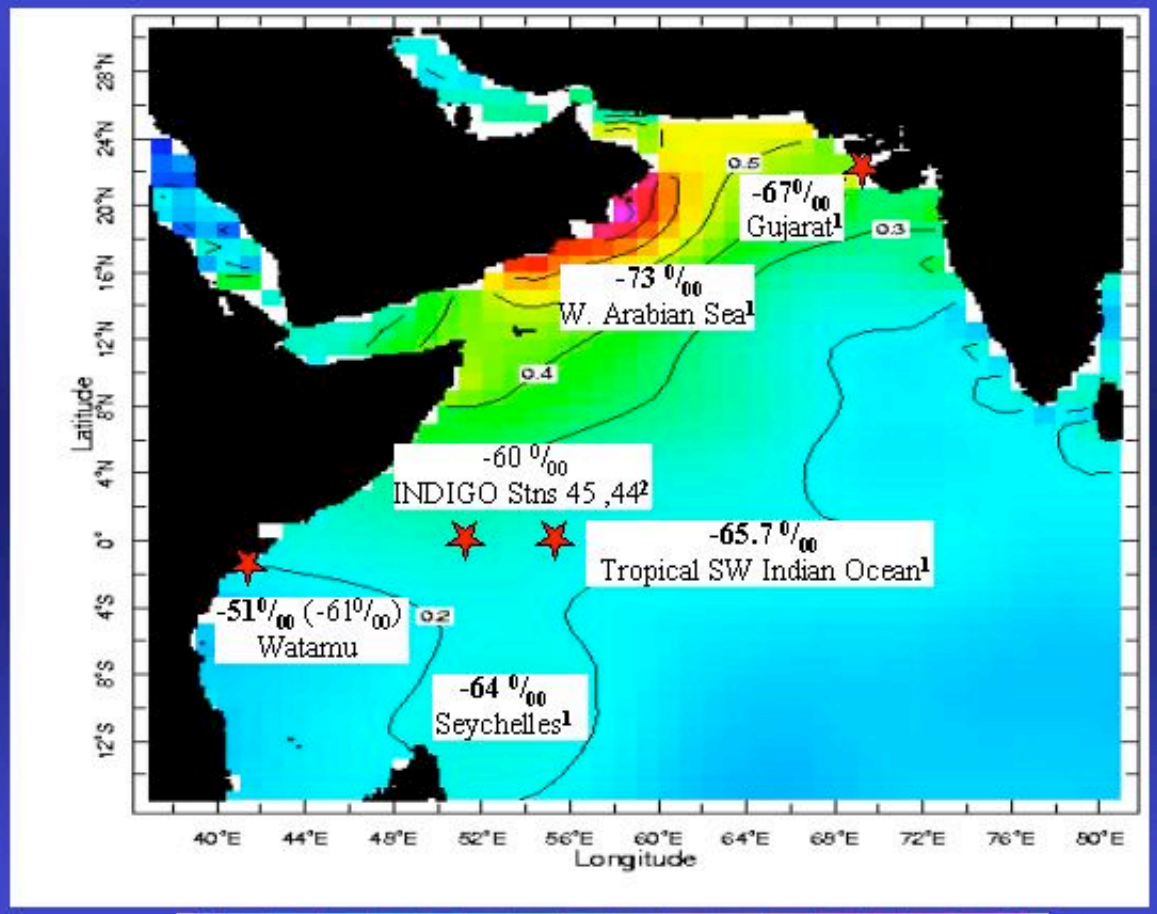
*cruise data at 10-20 m

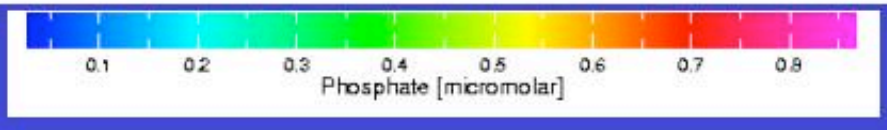
Pre-Bomb Watamu $\Delta^{14}C$ Seasonal Variability



*Suess corrected ~ -10$^0/_{00}$

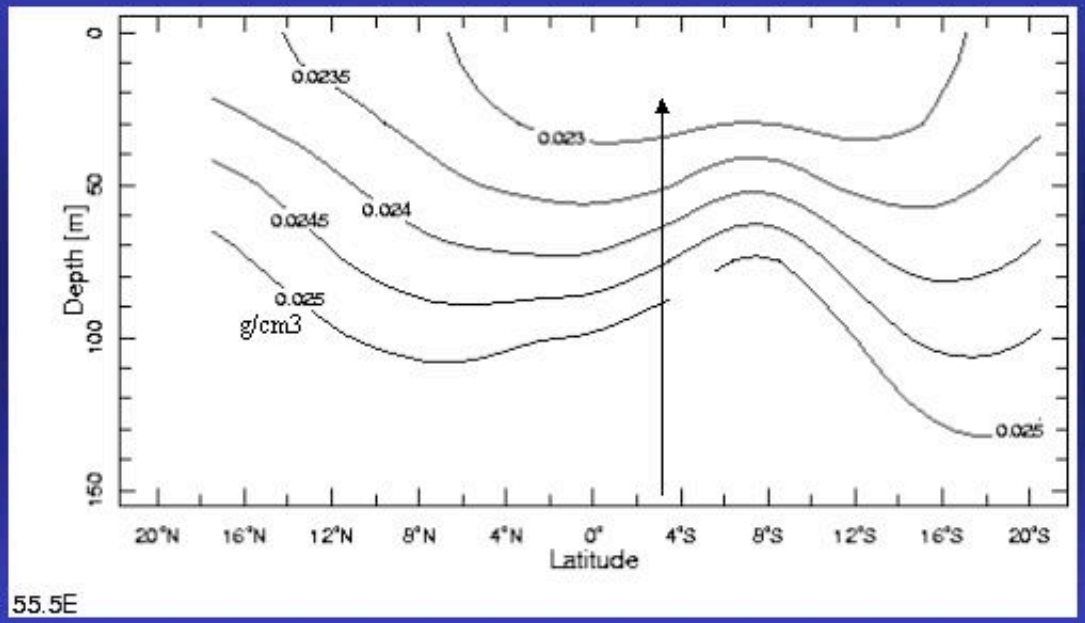
Pre-bomb $\Delta^{14}C$ and annual surface PO_4^- concentrations





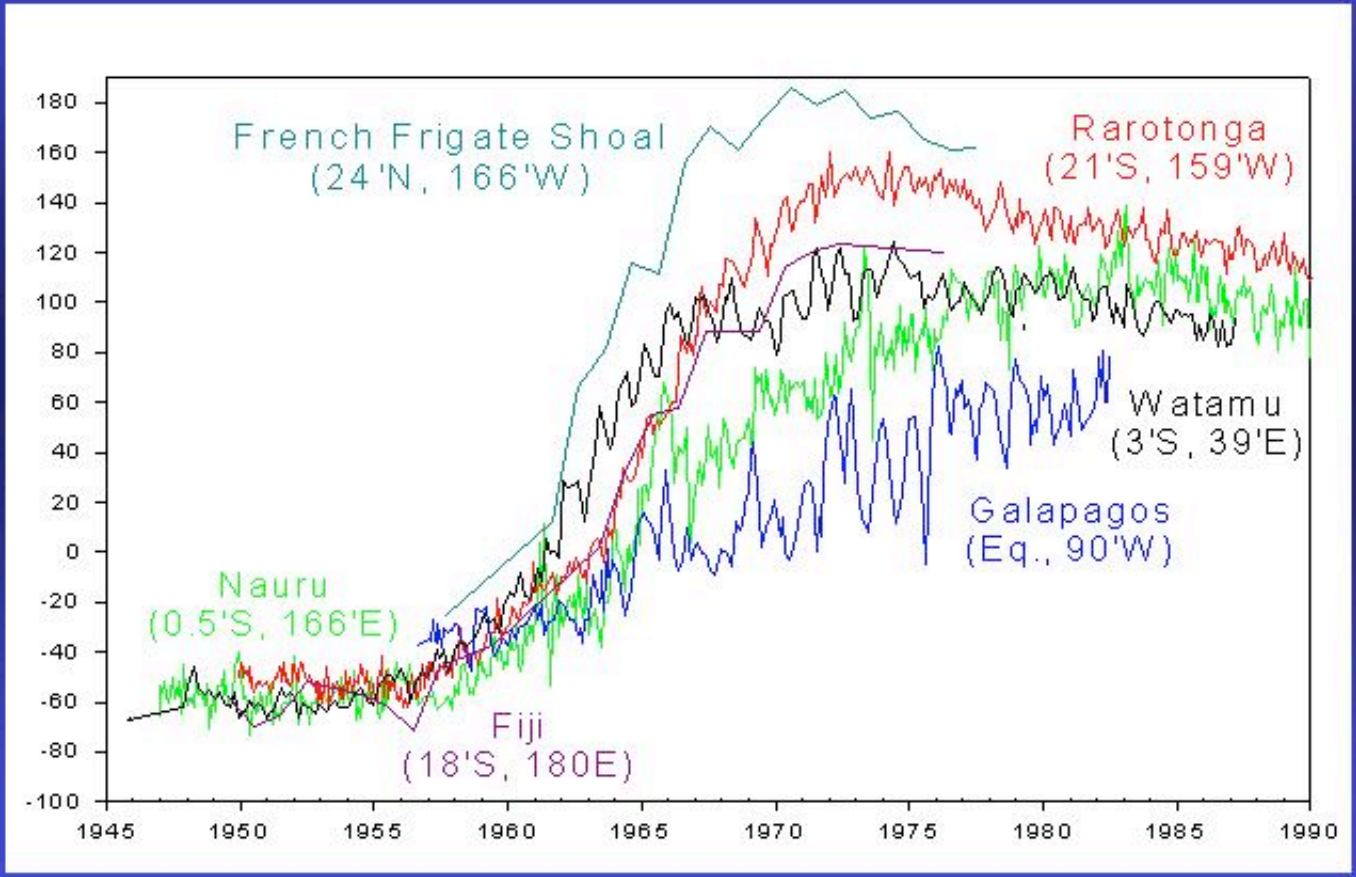
[2]Southon et al. (in press)
[1] Bard et al. (1988)

Isopycnal Meridional-Depth Profile



LEVITUS94, World Ocean Atlas 1994

Coral Radiocarbon
Indian Ocean and Pacific Ocean



Comparison of Coral Radiocarbon Records

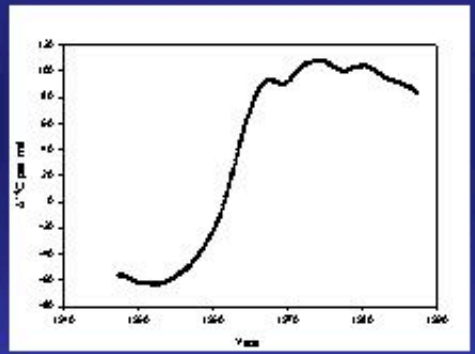
	Fr.Frigate Shoals[1] (24'N, 166'W)	**Galapagos[2]** (Eq., 90'W)	**Nauru[3]** (0.5'S, 166E)	**Fiji[4]** (18'S, 180'E)	**Rarotonga[5]** (21'S, 159'W)	**Watamu[6]** (3'S, 39'E)
Pre-bomb Avg.+	-50 ‰	-80 ‰	-58 ‰	-60 ‰	-52 ‰	-61 ‰
Maximum+ /Year	189 ‰ 1971	60 ‰ 1982	137 ‰ 1983	138 ‰ 1973-4	153 ‰ 1972	121 ‰ 1974
		* 70‰ 1993				

[1]Druffel, 1987, [2]Guilderson and Schrag, 1998, [3]Guilderson et al., 1998, [4]Toggweiler et al., 1991, [5]Guilderson et al., 2000, [6]Grumet-Prouty et al., in prep.

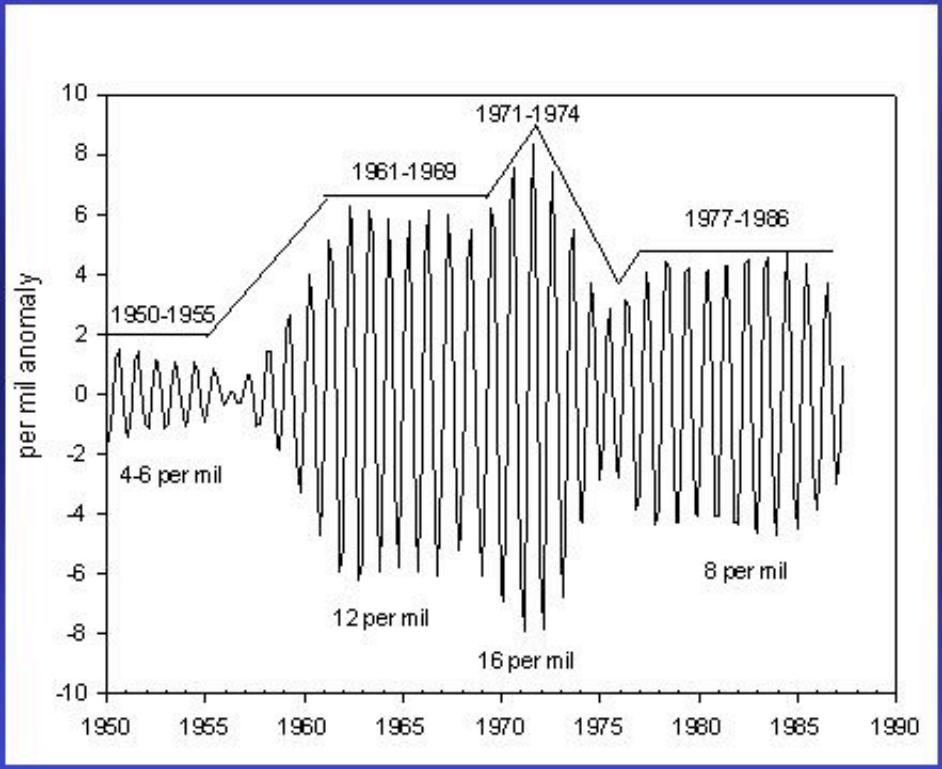
*WOCE cruise data

+uncorrected for fossil fuel effect

Subannual Variability



Long Term Trend



Conclusions and Interpretation

Seasonal Signal:

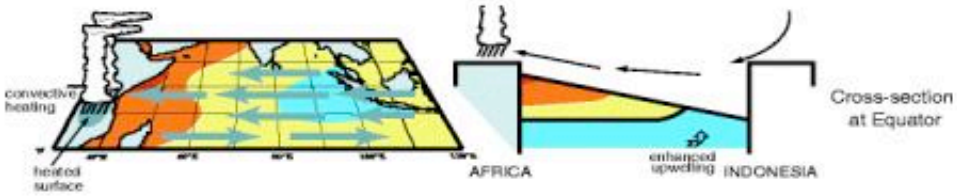
A. Absence of distinct annual signal during the pre-bomb
B. Local upwelling is negligible
C. Horizontal advection likely mechanism

Long Term Trend:

A. 1957-58 Watamu $\Delta^{14}C$ rise consistent with other reports documenting influx of radiocarbon into tropics
B. 1974 $\Delta^{14}C$ peak ~10 yrs after atmospheric peak
C. Overall trend behaves more like subtropical site

Watamu $\Delta^{14}C$ Coral Signal:
Tracer for Meridional Transport in the Western Indian Ocean

Revisit the Dipole….



Warmer SST in Western Indian Ocean

↓

Stronger NE Monsoon

↓

Greater Equatorward Transport

↓

More Depleted $\Delta^{14}C$ in Watamu Coral Record

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