THE IMPACT OF SEDIMENT AND FRESHWATER RUNOFF ON THE GROWTH OF *PORITES* CORALS

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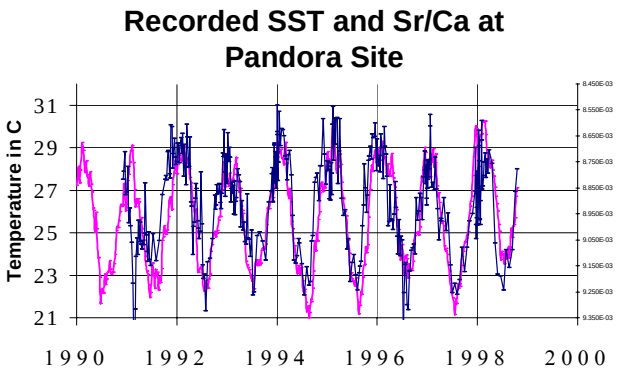
This work studies the relationship between growth rate in flood and non-flood years in *Porites* coral

- Collecting coral cores on the Great Barrier Reef, Australia



- Elements and fluorescent bands are used to analyze coral and surrounding environment

- Effects of Burdekin River flood on coral including sediment exposure

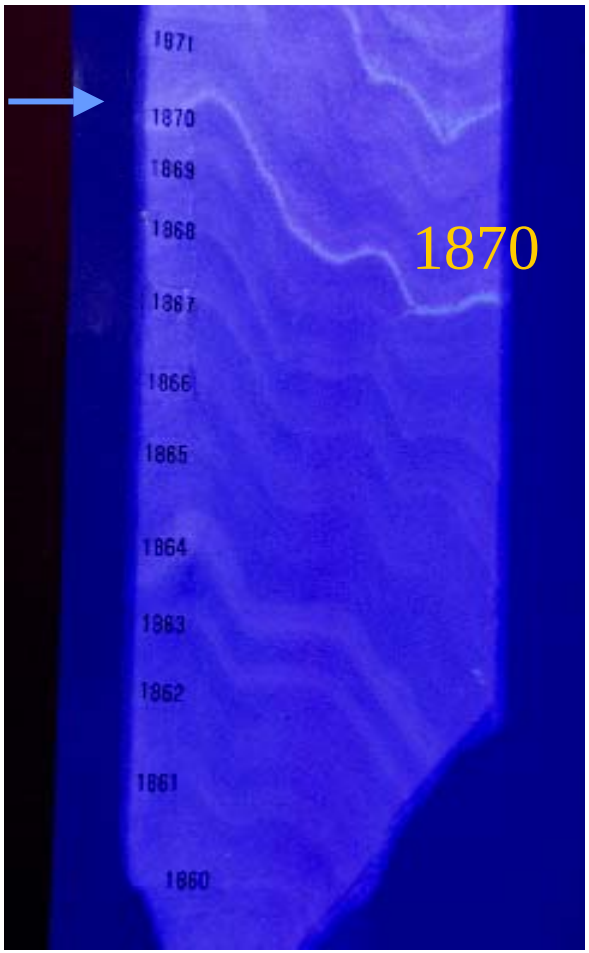
Coral Drilling and Analyzing

- Coral cores were obtained from two *Porites* corals (Pandora and Havannah site) in Australia's Great Barrier Reef
- The cores were analyzed using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) to decipher the element abundances

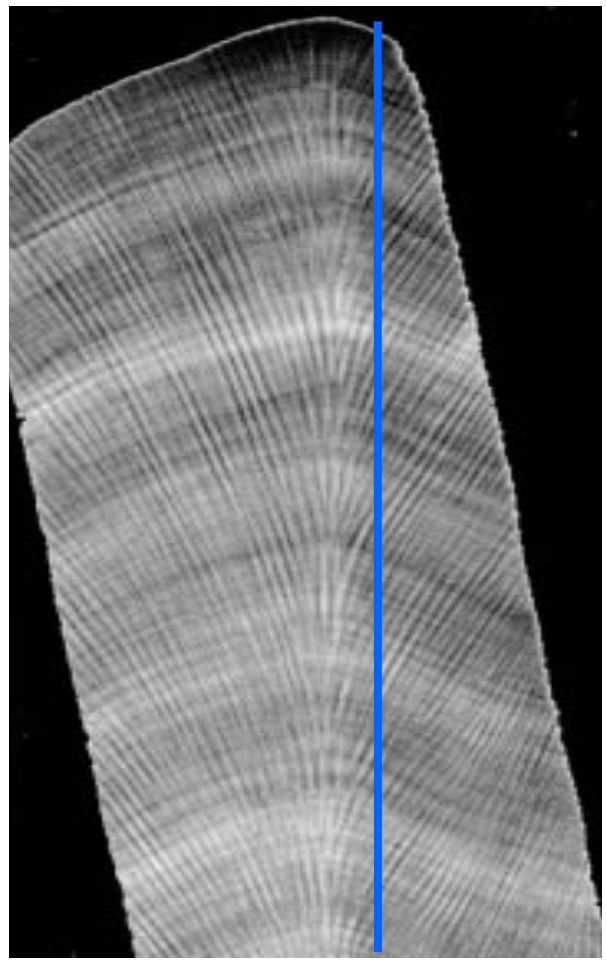
Fluorescents and Coral Bands

UV light photo of coral showing runoff band (luminescent line)

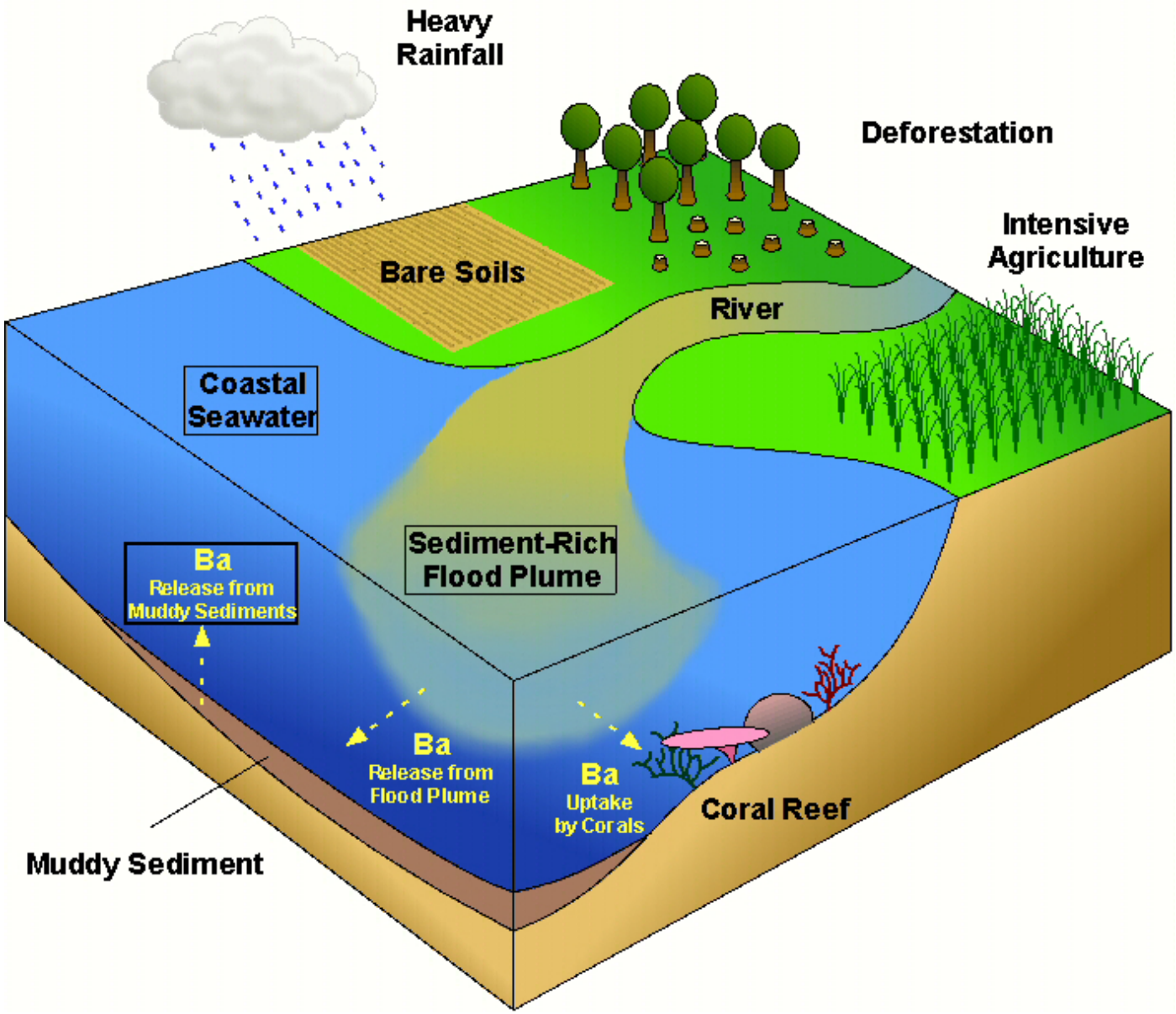
A x-ray of a coral slice revealing high density and low density



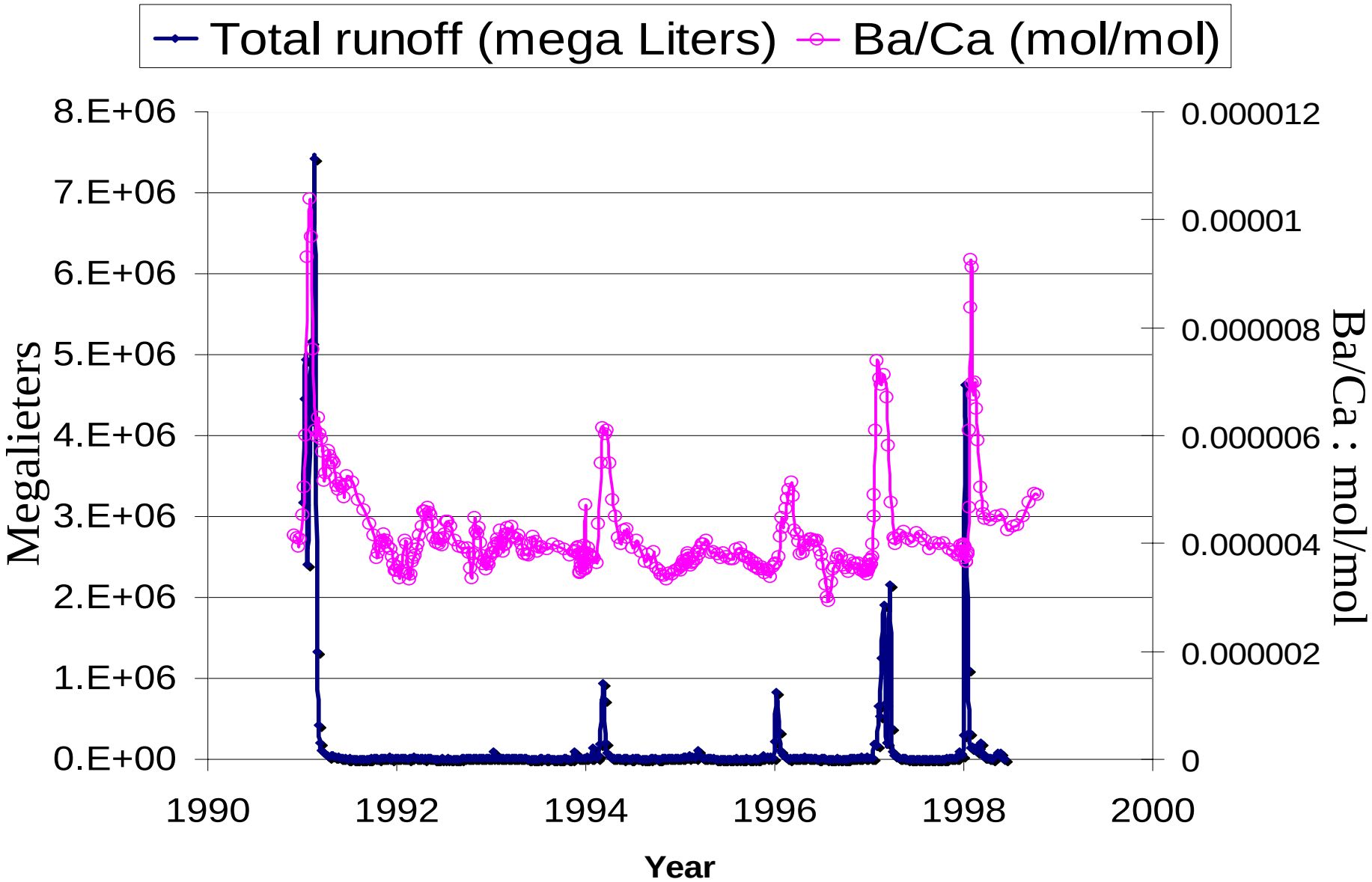
- The luminescent line is one way to see the effects of river runoff on coral
- One hi/low couplet on the x-ray is equivalent to one years growth (similar to tree rings)
- The strong relationship b/w Sr/Ca-SST is used to develop accurate time series for growth rate determination during flood and non-flood years



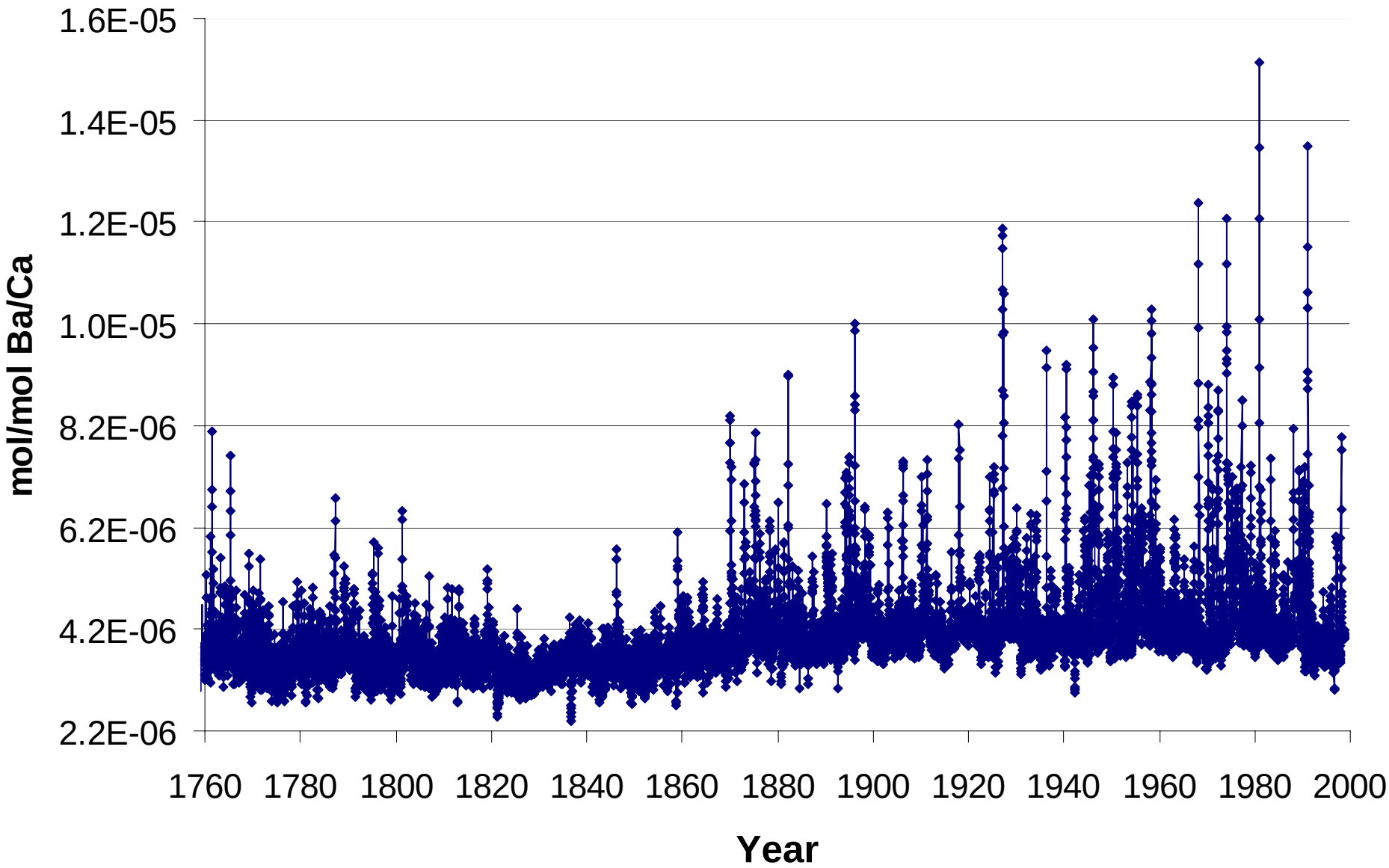
Freshwater Flood Cycle



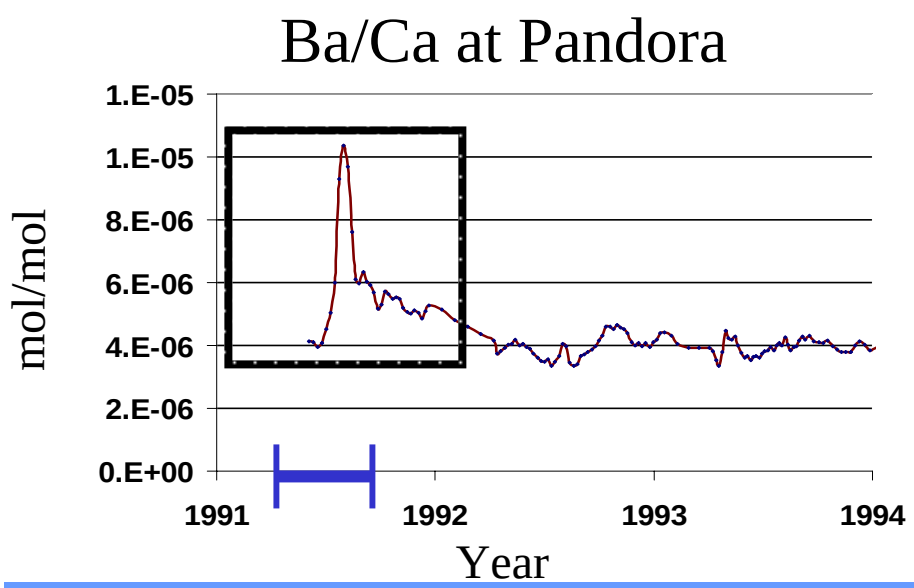
Burdekin River Runoff and Ba/Ca in Coral

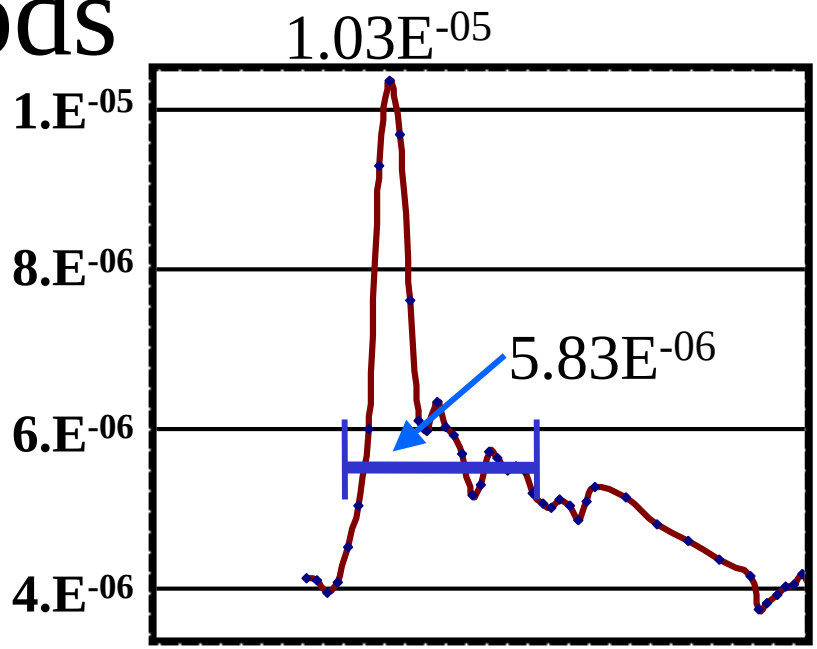


Ba/Ca in Havannah Coral



Methods



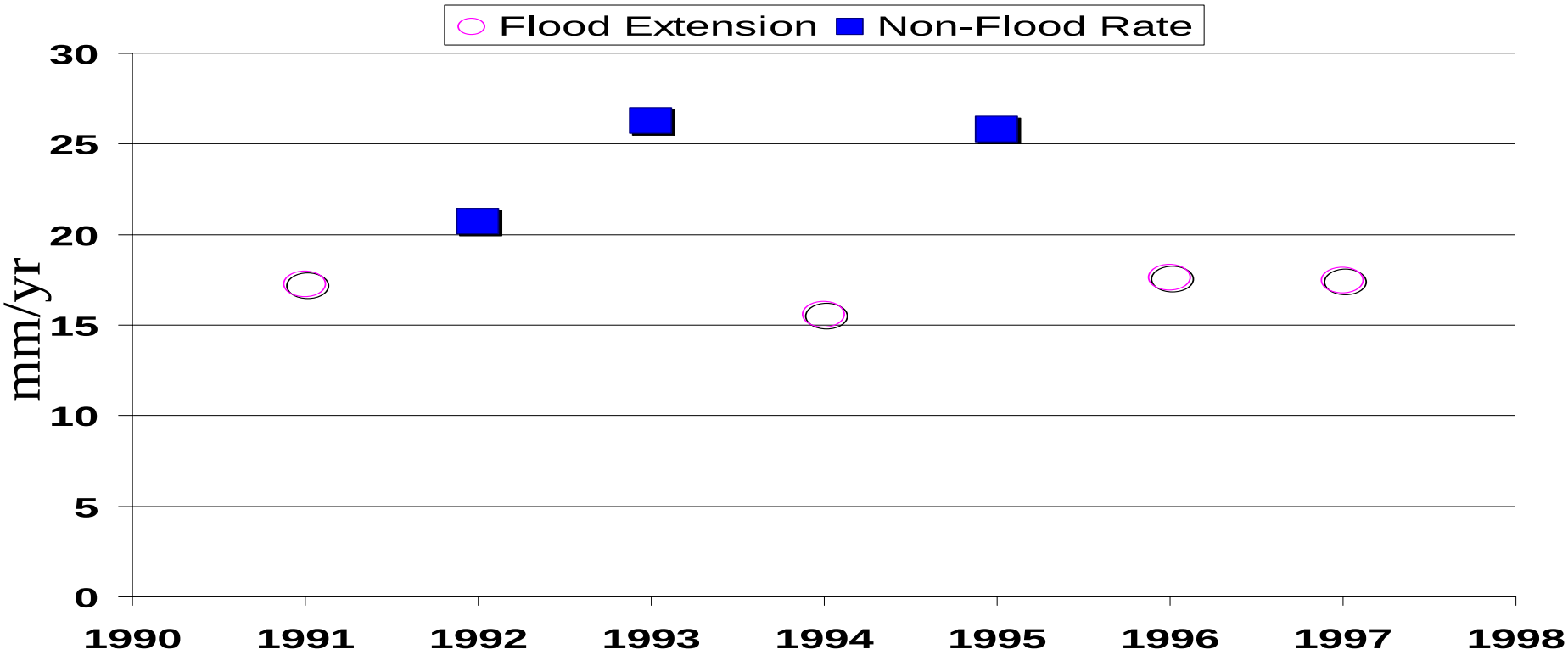


((Peak Height-4E^{-06})/2)+4E^{-06}) = Half Peak

((1.03E-05-4E^{-06})/2)+4E^{-06}) = 5.83E^{-06}

1. Peak heights greater than 5.0E^{-06} is interpreted as a flood
2. A half peak height is calculated from each flood peak
3. The length of the flood is determined by the half peak points from the start of flood to the end of flood
4. The rate is determined by the extension during the flood / the duration of the flood
5. To account for annual growth variability extension rates were normalized (flood rate / yearly extension rate)

Pandora Flood and Non-Flood Extensions



Z test: **1.96**

Degree of Freedom: **5**

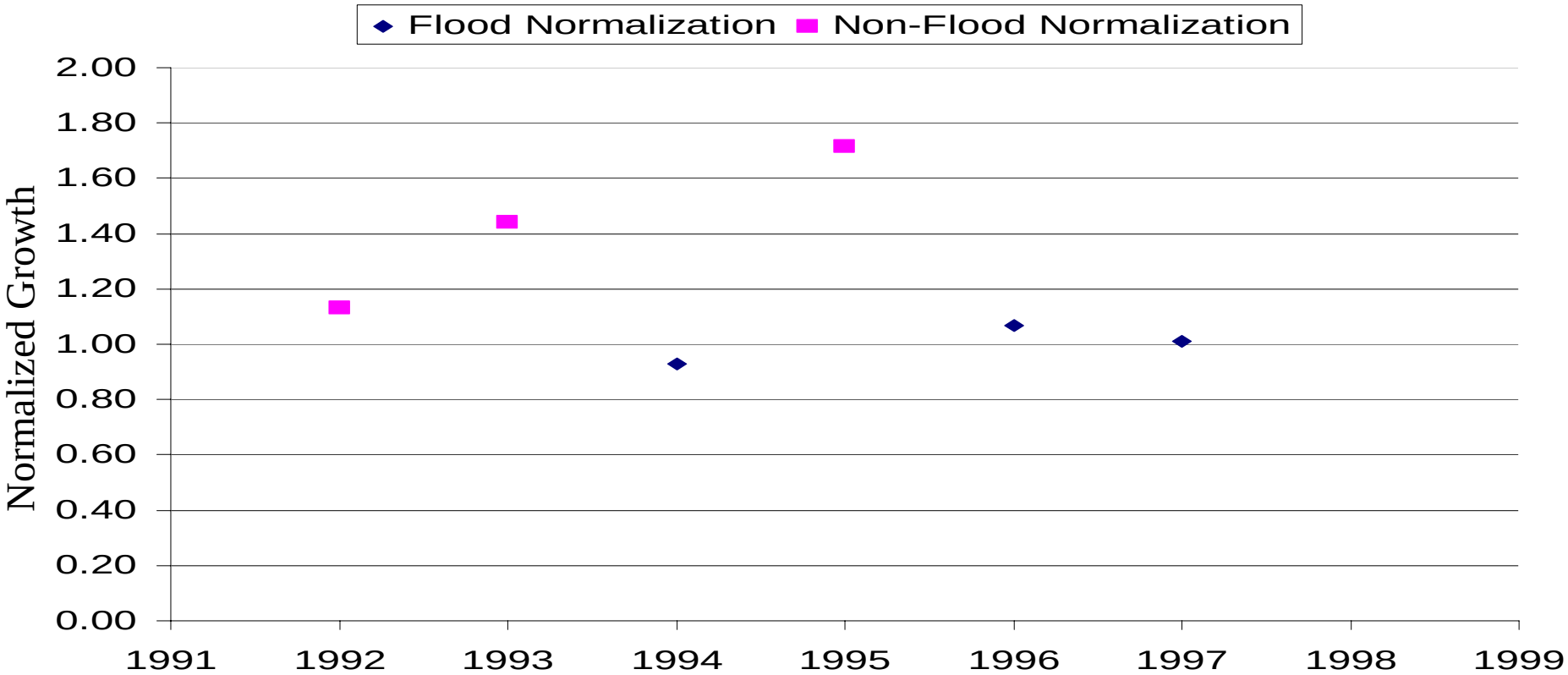
Significant **95%> Z > 90%**
2.02> Z >1.48

<u>Average Extension Rate</u>

Flood: 17.0 mm/yr

Non-Flood: 24.3 mm/yr

Pandora Normalization Rate



Z test: **1.96**

Degree of Freedom: **4**

Significant at a 95%> Z >90%

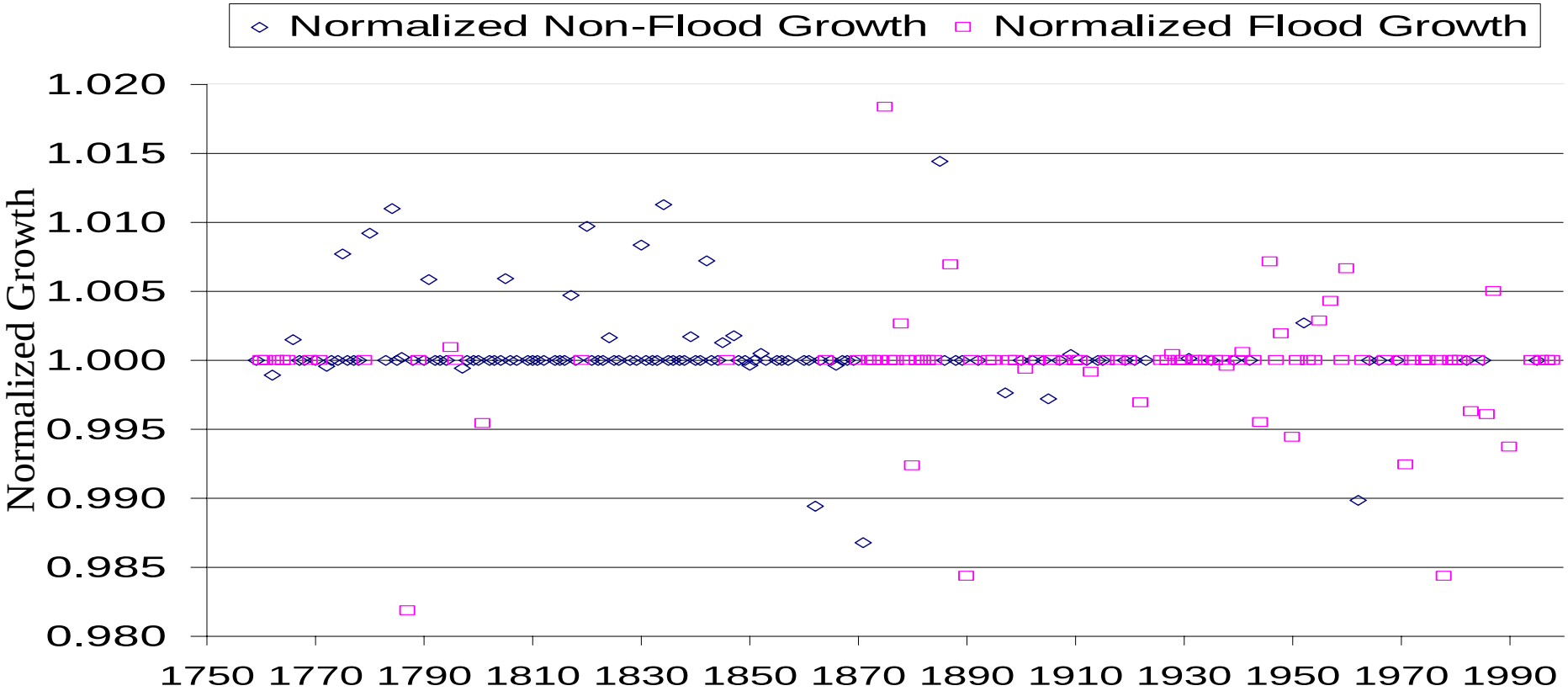
2.13 > Z > 1.53

Normalized Average Rate

Flood: 1.00294

Non-Flood: 1.42987

Havannah Flood and Non-Flood Normalized Rates



Z test: **1.96**

Degree of Freedom: **238**

Significant at a **97.5%** level

Z = 1.96

<u>Normalized Average Rate</u>

Flood: 0.99277

Non-Flood: 0.99553

Conclusion: How do floods and sediments impact *Porites* coral growth rate?

- The Pandora site revealed a difference showing the floods ***decreased*** the coral growth rate as well did the normalization calculations
- The Havannah site normalization calculations also supported a ***decreased*** coral growth rate during the flood years
- Both sites had significant data proving a difference in growth rates between flood and non-flood years

Continued Research…

A continued project could entail a concentration on years previous to settlement (1759-1860) to be able to compare freshwater floods with increased sediment in the floods (1860-2000).

Acknowledgements

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Tom Guilderson, CAMS, LLNL

References

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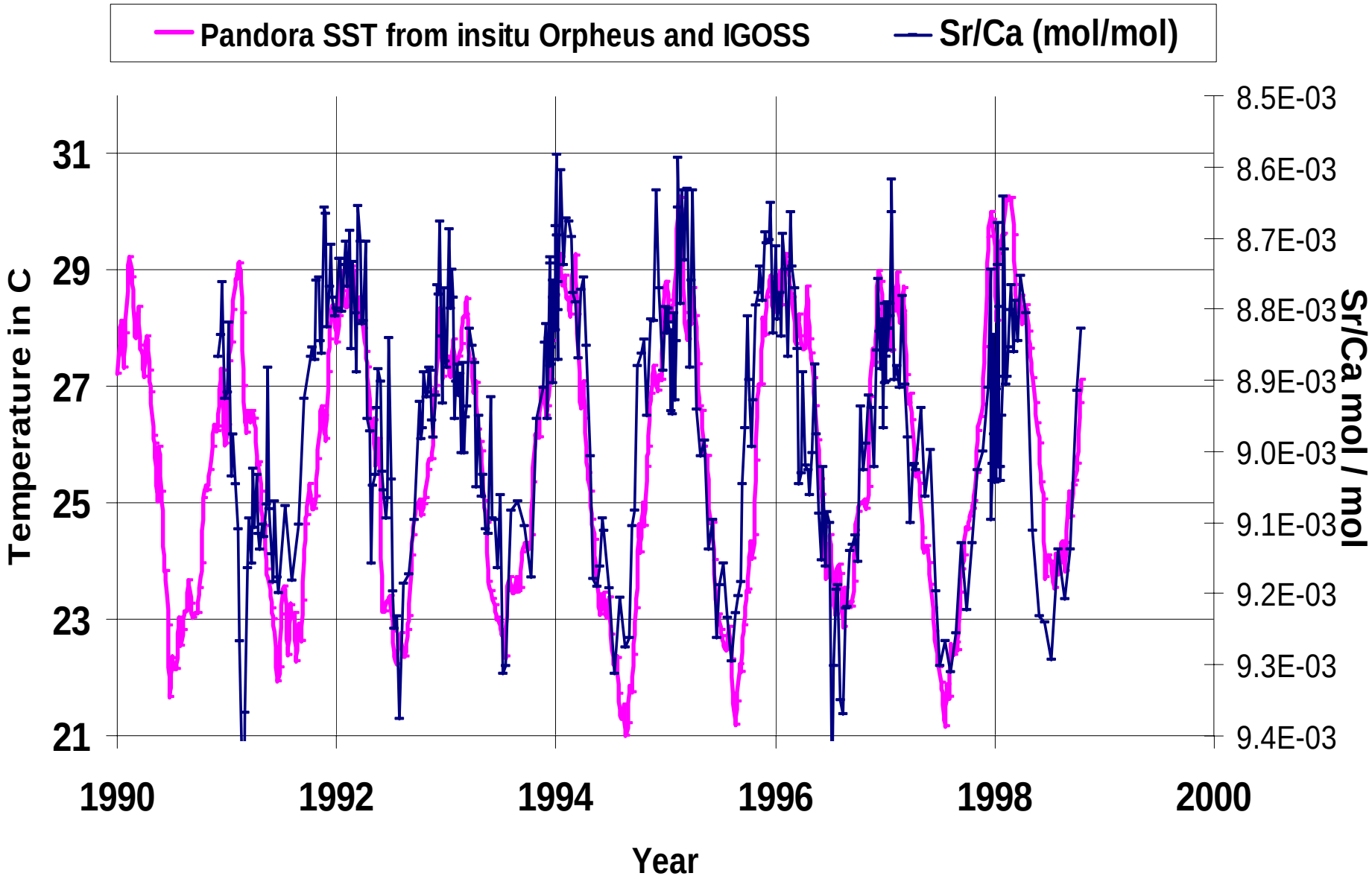
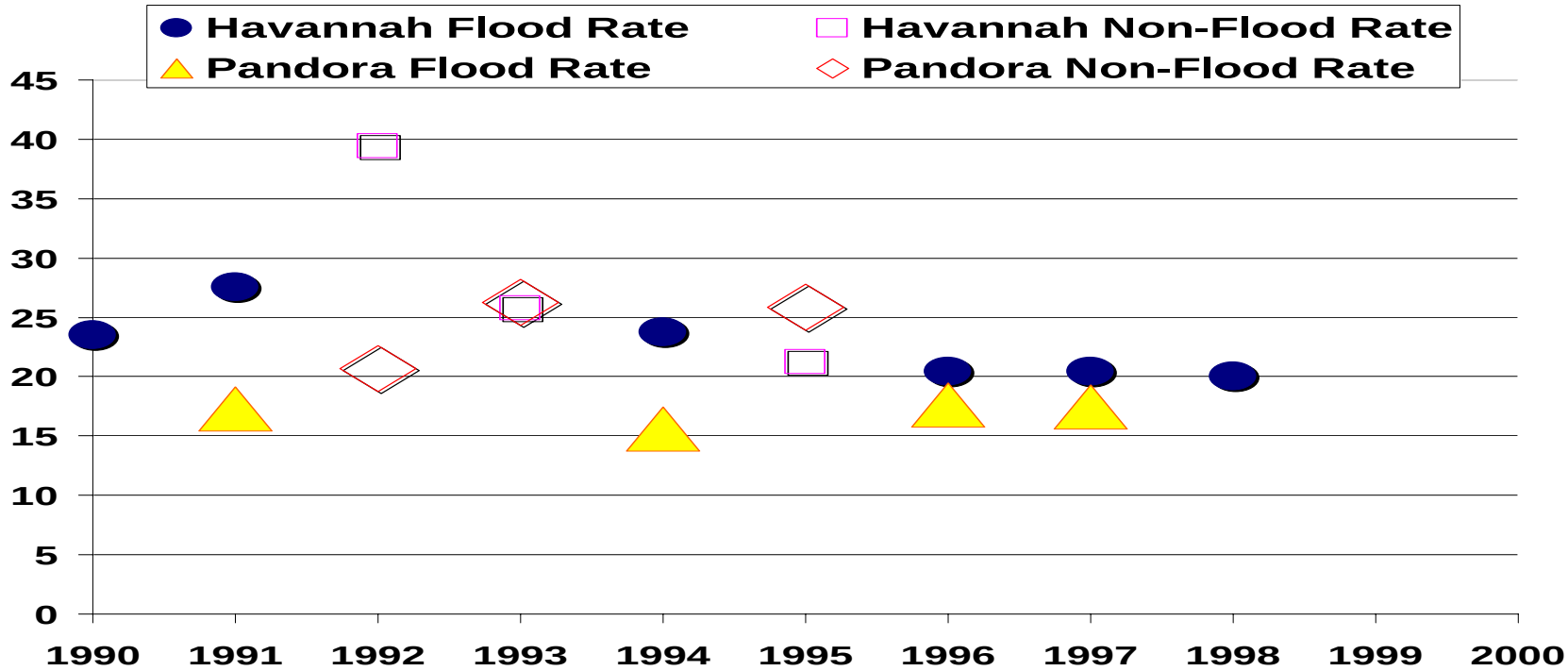
Fallon SJ, McCulloch MT, Alibert C (2003) Examining water temperature proxies in *Porites* corals from the Great Barrier Reef: a cross-shelf comparison. Coral Reefs 22:389-404.

McCulloch MT, Fallon SJ, Wyndham T, Hendy E, Lough J, Barnes D (2003) Coral record of increased sediment flux to the inner Great Barrier Reef since European settlement. Nature 421:727-730.

Recorded SST and Sr/Ca at the Pandora Site



Havannah and Pandora *Porites* Growth Rates



Havannah

Average Extension Rate

Flood: 22.6 mm/yr

Non-Flood: 28.8 mm/yr

Z test: **1.96**

Degree of Freedome: **6**

Significant **97.5%> Z >95%** **2.45> Z >1.94**

Pandora

Average Extension Rate

Flood: 17.0 mm/yr

Non-Flood: 24.3 mm/yr

Z test: **1.96**

Degree of Freedom: **5**

Significant **95%> Z > 90%** **2.02> Z >1.48**

Potential Environmental Effects

- Changes in sea temperature
- Tropical storms
- Age of the coral and the stress during lifetime