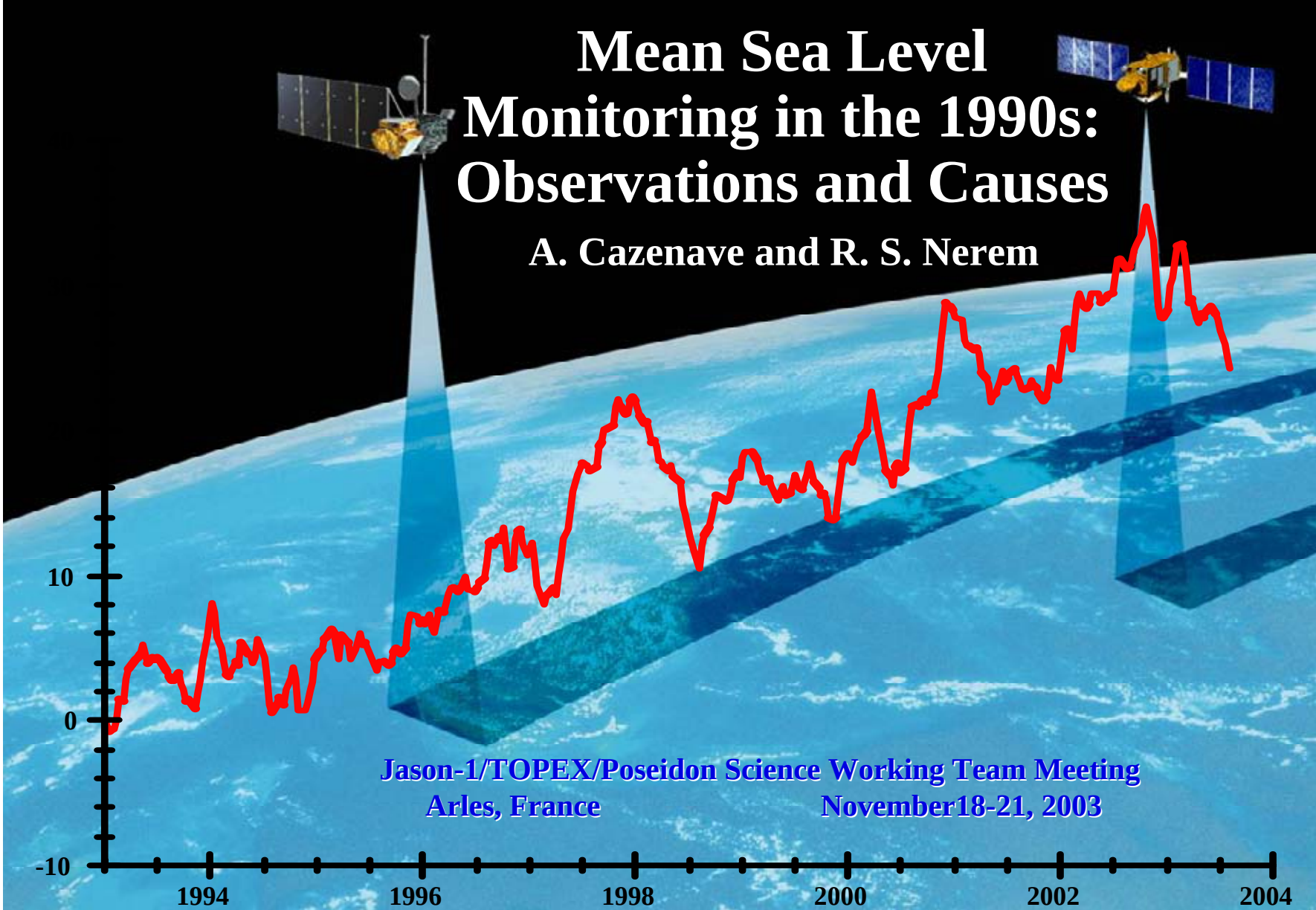
Mean Sea Level Monitoring in the 1990s: Observations and Causes

A. Cazenave and R. S. Nerem



Jason-1/TOPEX/Poseidon Science Working Team Meeting
Arles, France November18-21, 2003

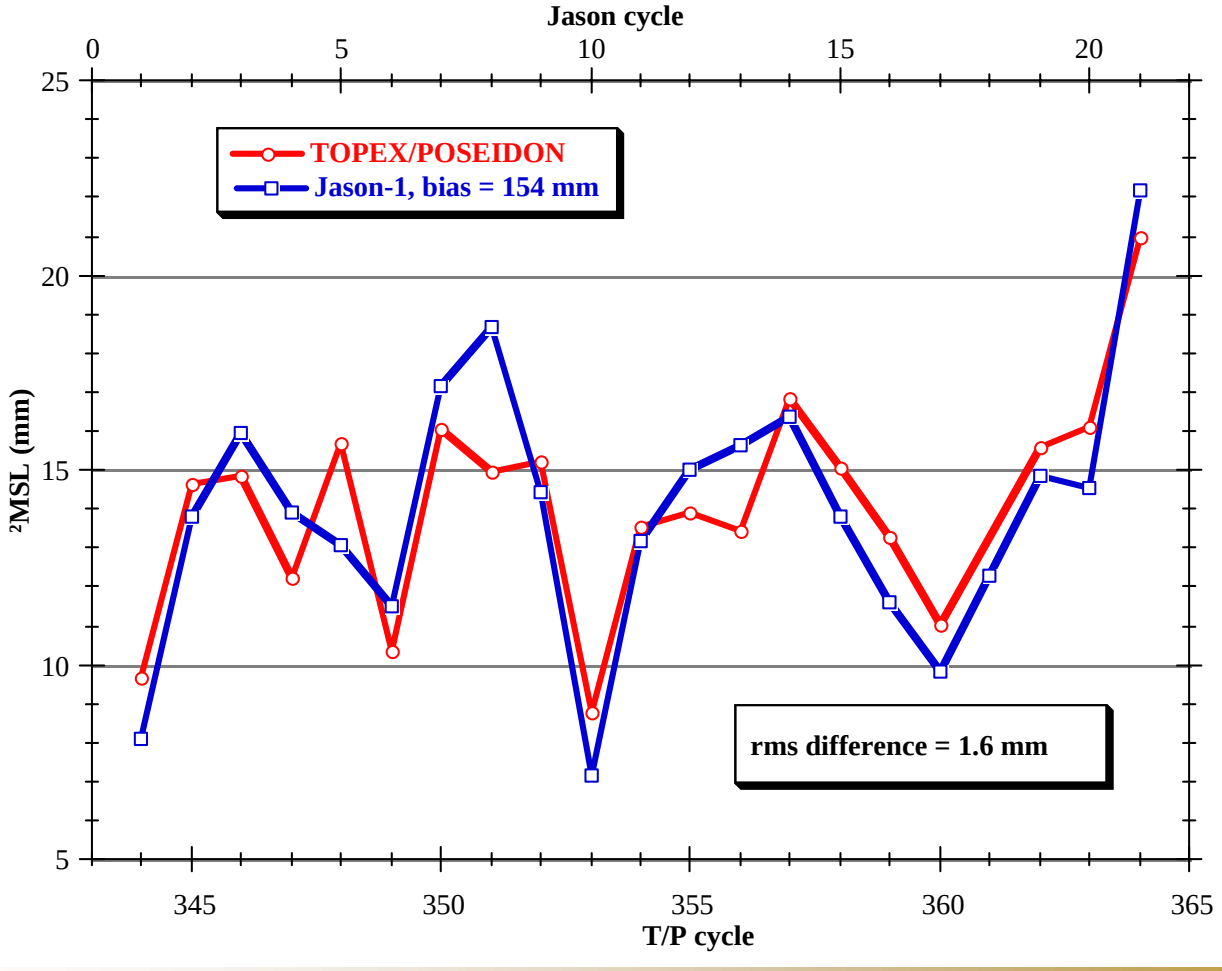
Questions to be Addressed

- What have we learned from a decade of precision altimetry?
- How well are the instruments calibrated?
- Can we see climate variations in the altimeter record?
- What does the tide gauge record tell us?
- Has there been a recent acceleration in sea level rise?
- What evidence is there to differentiate contributions to sea level rise?

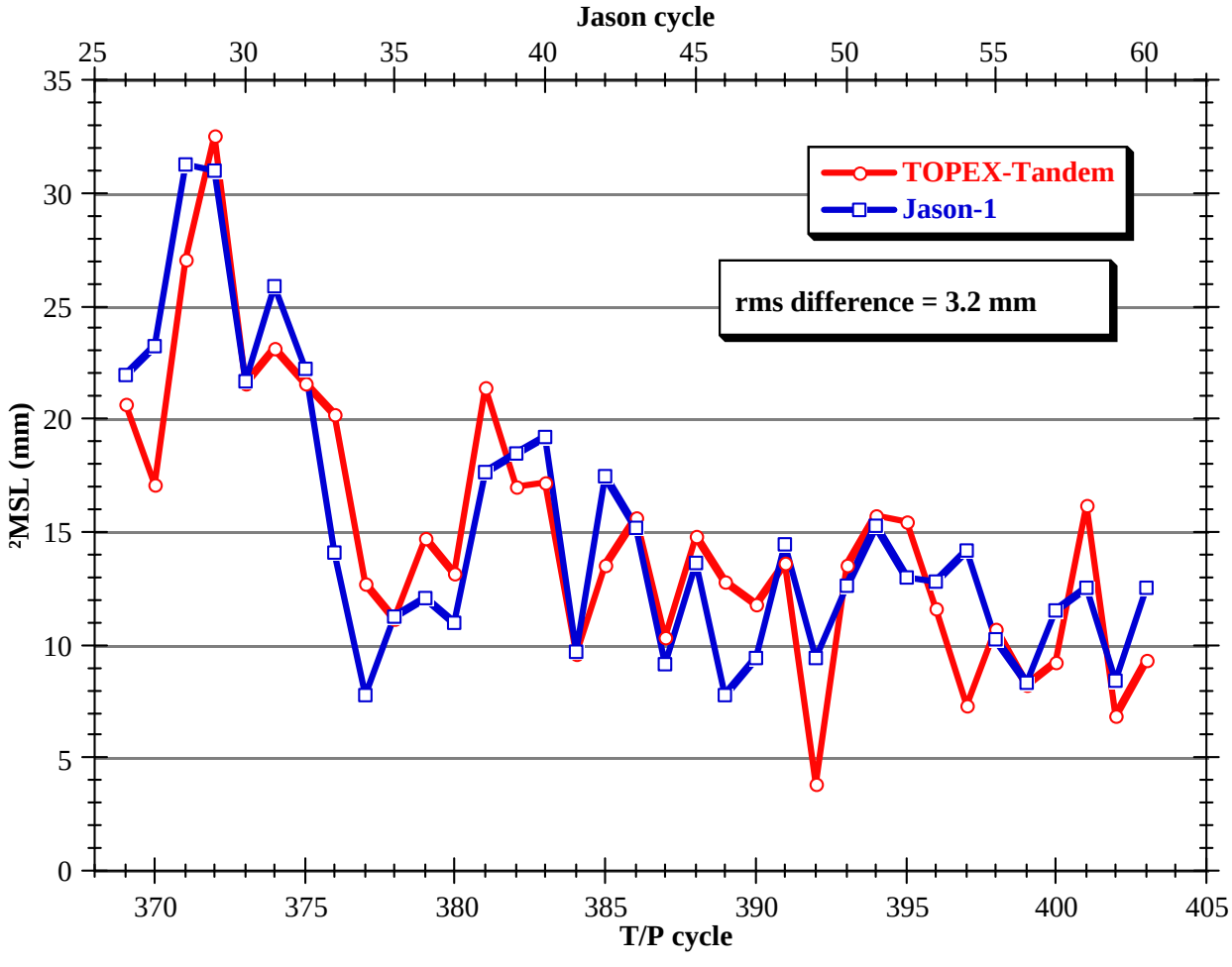
Altimeter Data Processing

- TOPEX “Classic”
  - MGDRs with GCP-C
  - TMR drift
  - GCP-C yaw correction
  - GOT99b tides
  - Chambers SSB
  - 1.4 mm A/B bias
- TOPEX Tandem
  - Same as TOPEX, but uses its own along-track mean (adjusted to Jason)
- Jason
  - GDRs
  - 154 mm bias with respect to TOPEX
  - Experiments with different orbits, SSB corrections

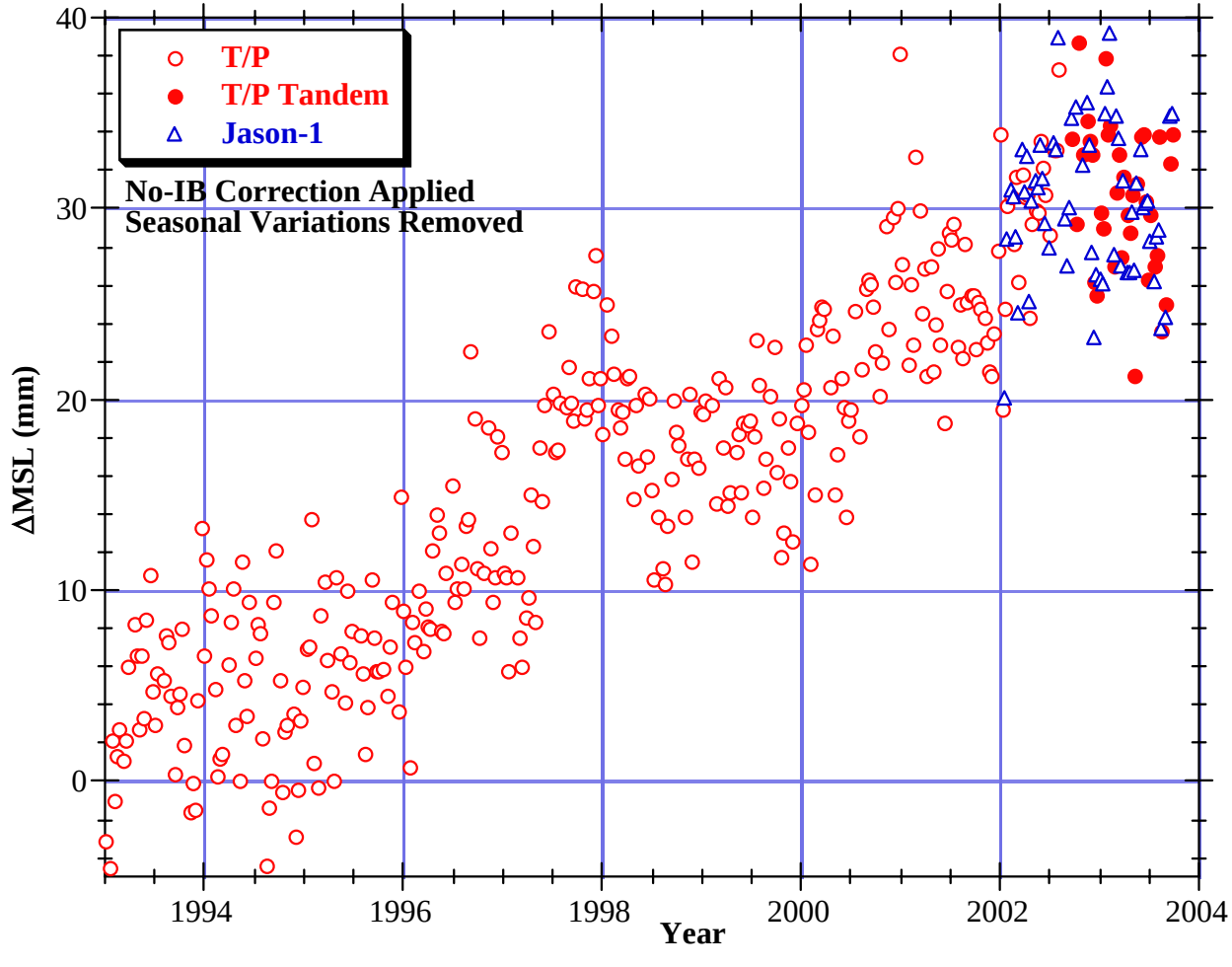
Jason vs T/P MSL: Calibration Phase



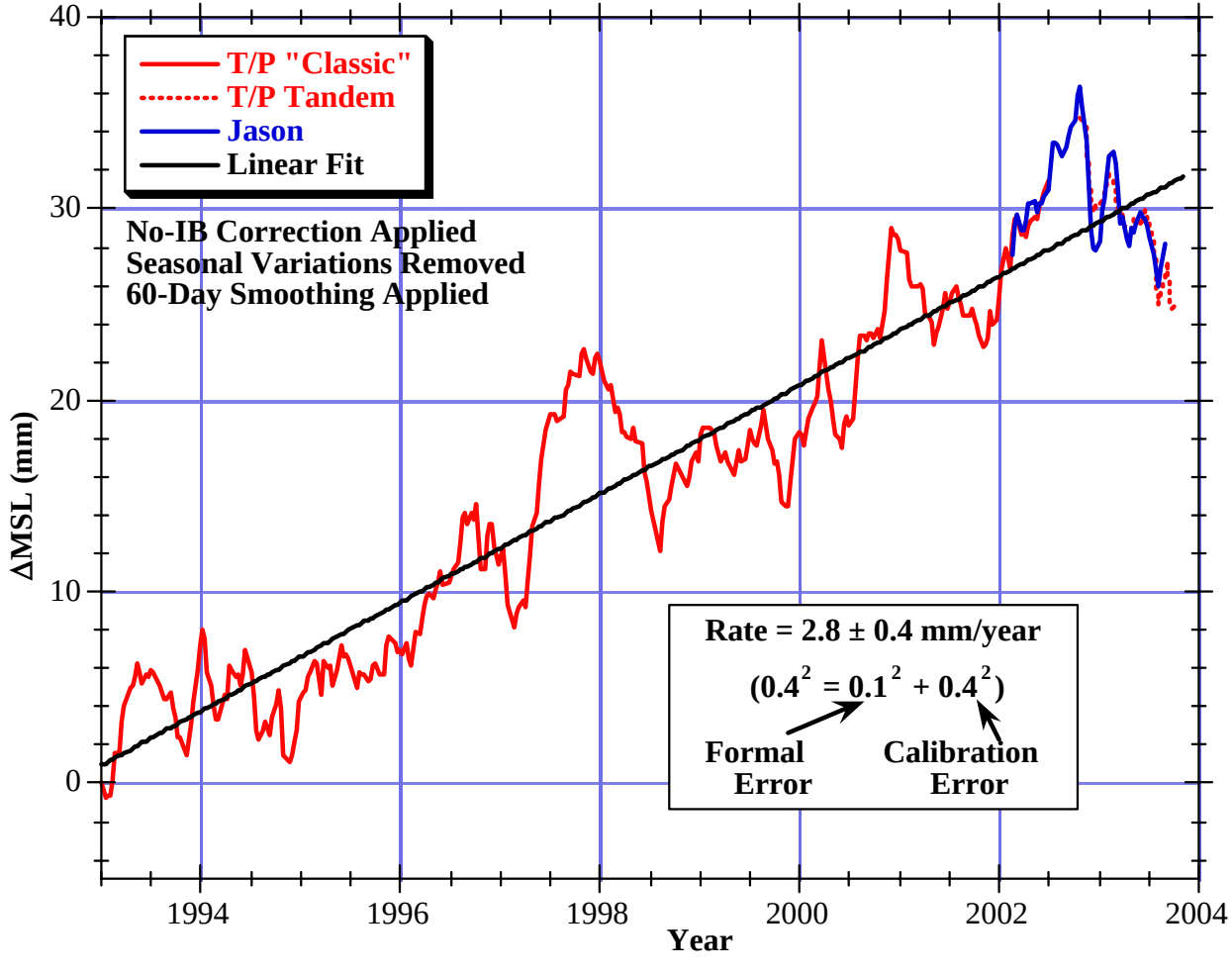
Jason vs T/P MSL: Tandem Phase



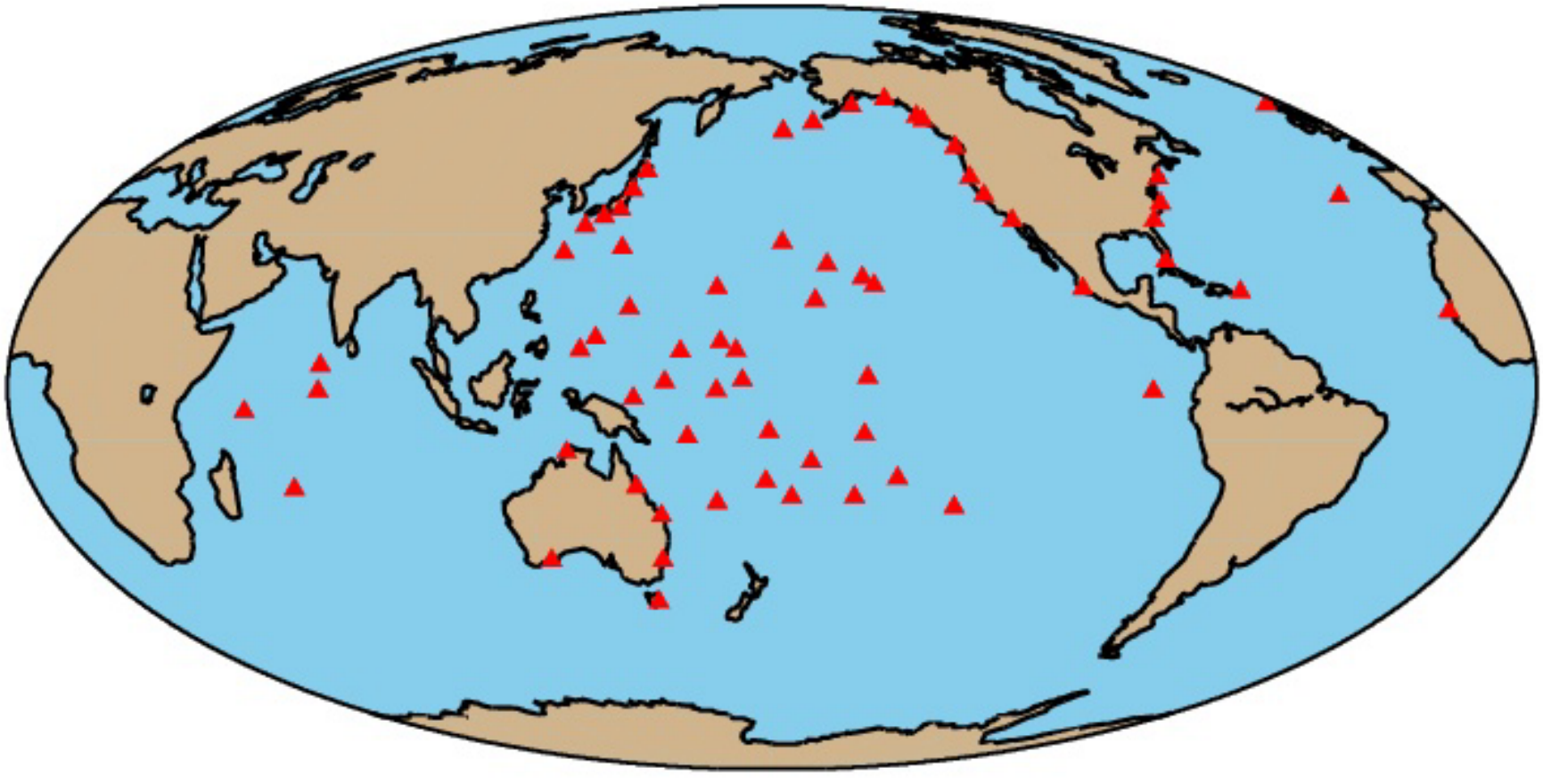
Global Mean Sea Level from T/P



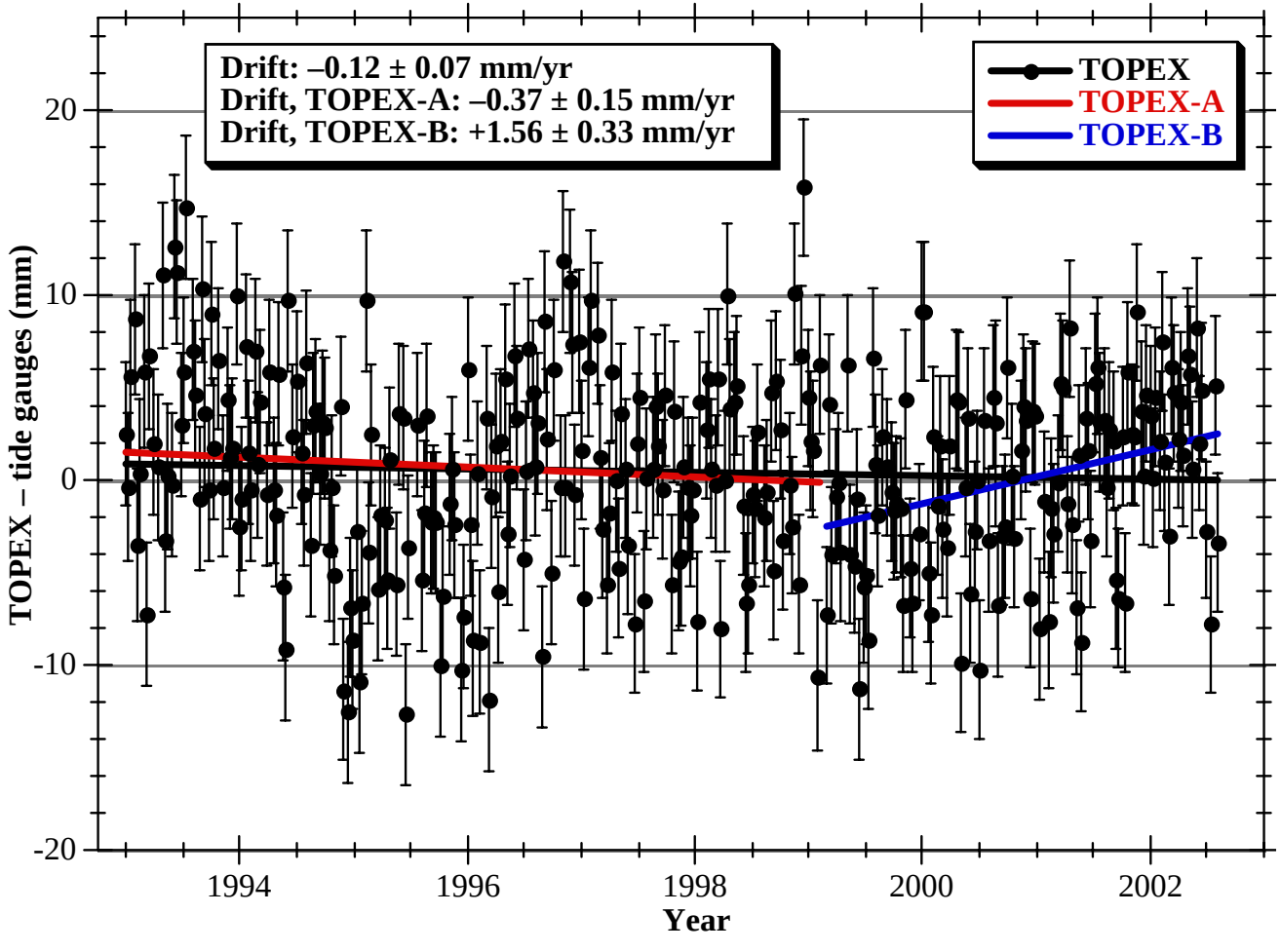
GMSL Variations from T/P and Jason-1



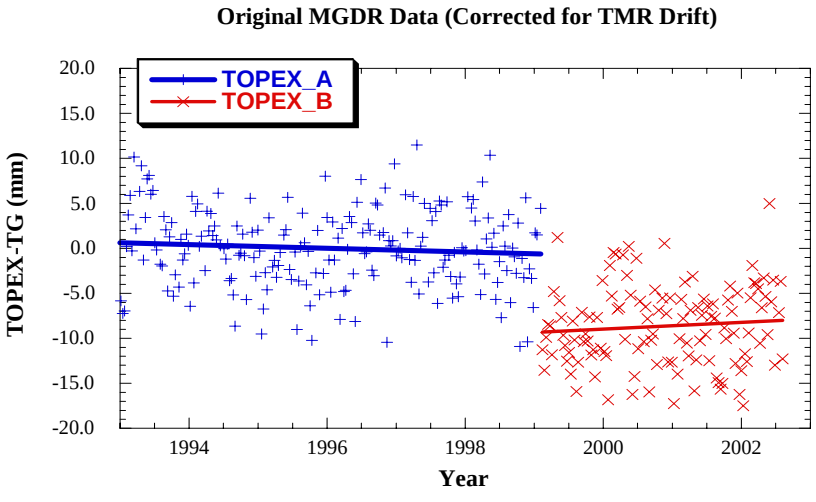
Tide Gauge Calibration Sites

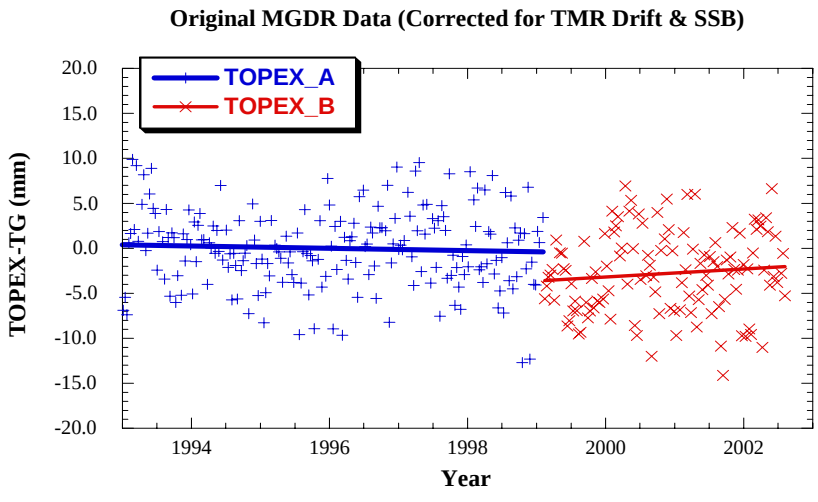


TOPEX Tide Gauge Calibration



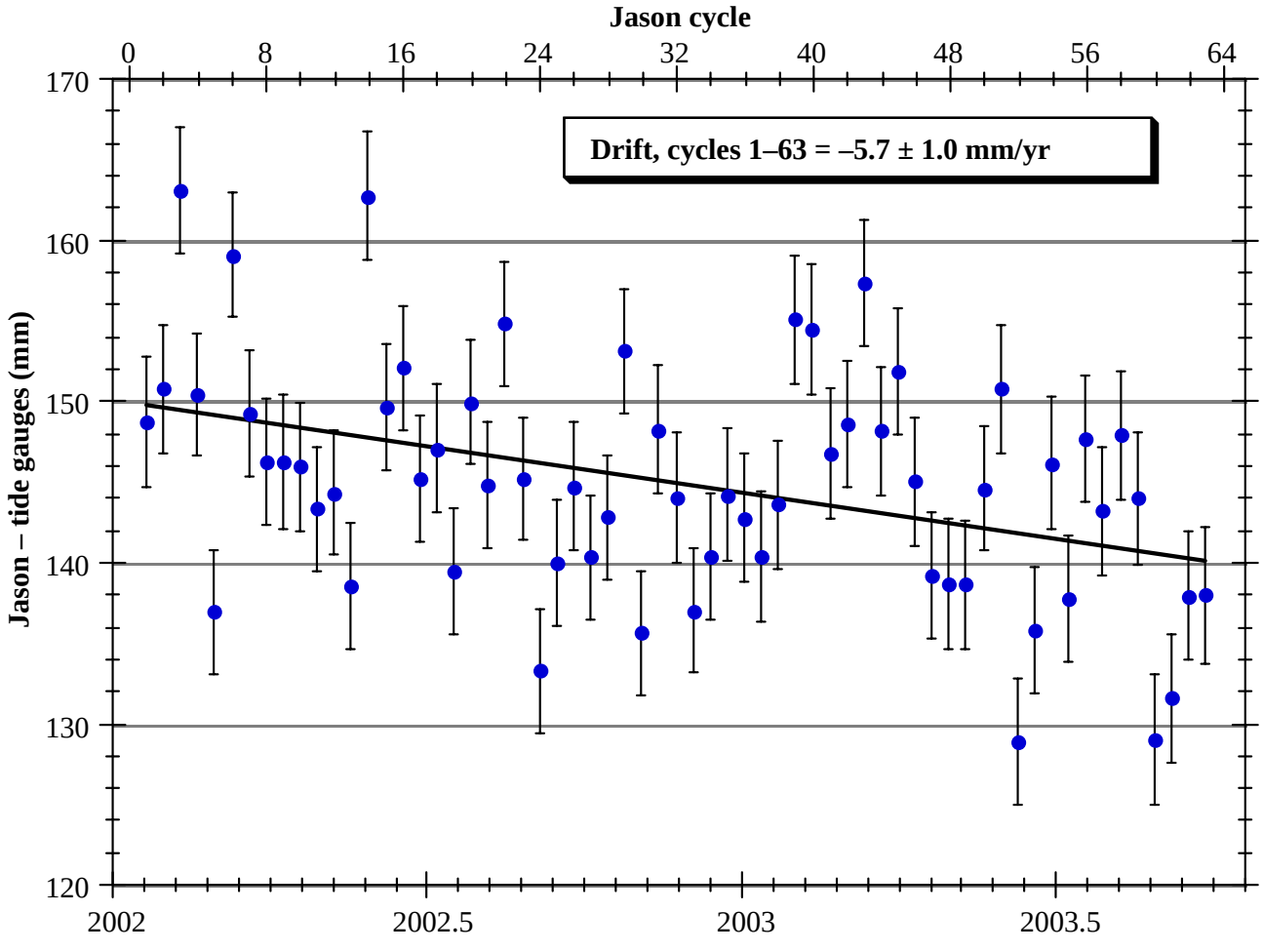
TOPEX-B Calibration



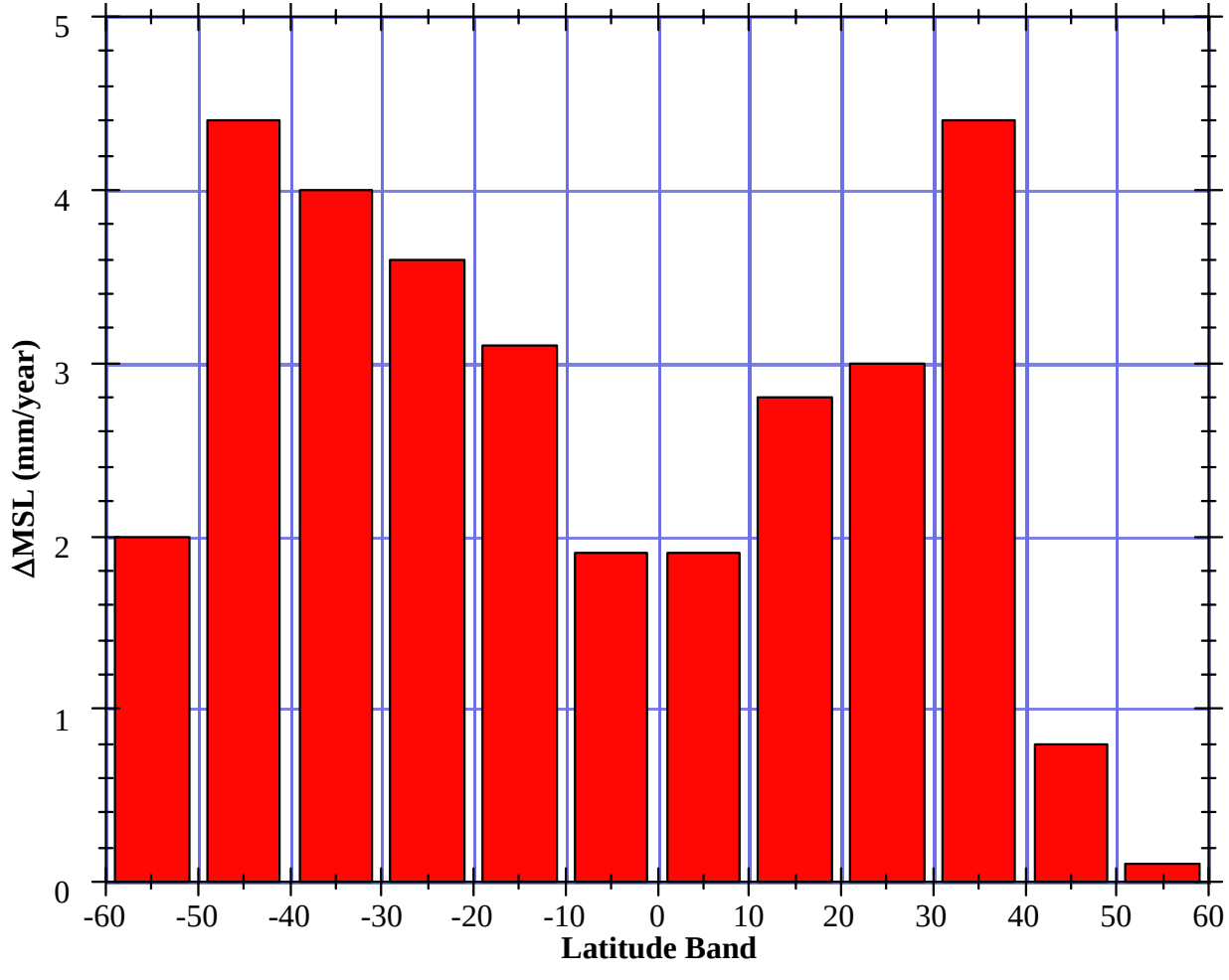


***Chambers et al.*, New TOPEX Sea State Bias Models and Their Effect on Global Mean Sea Level, *J. Geophys. Res.*, *108* (C10), 3305, 10.1029/2003JC001839, 2003**

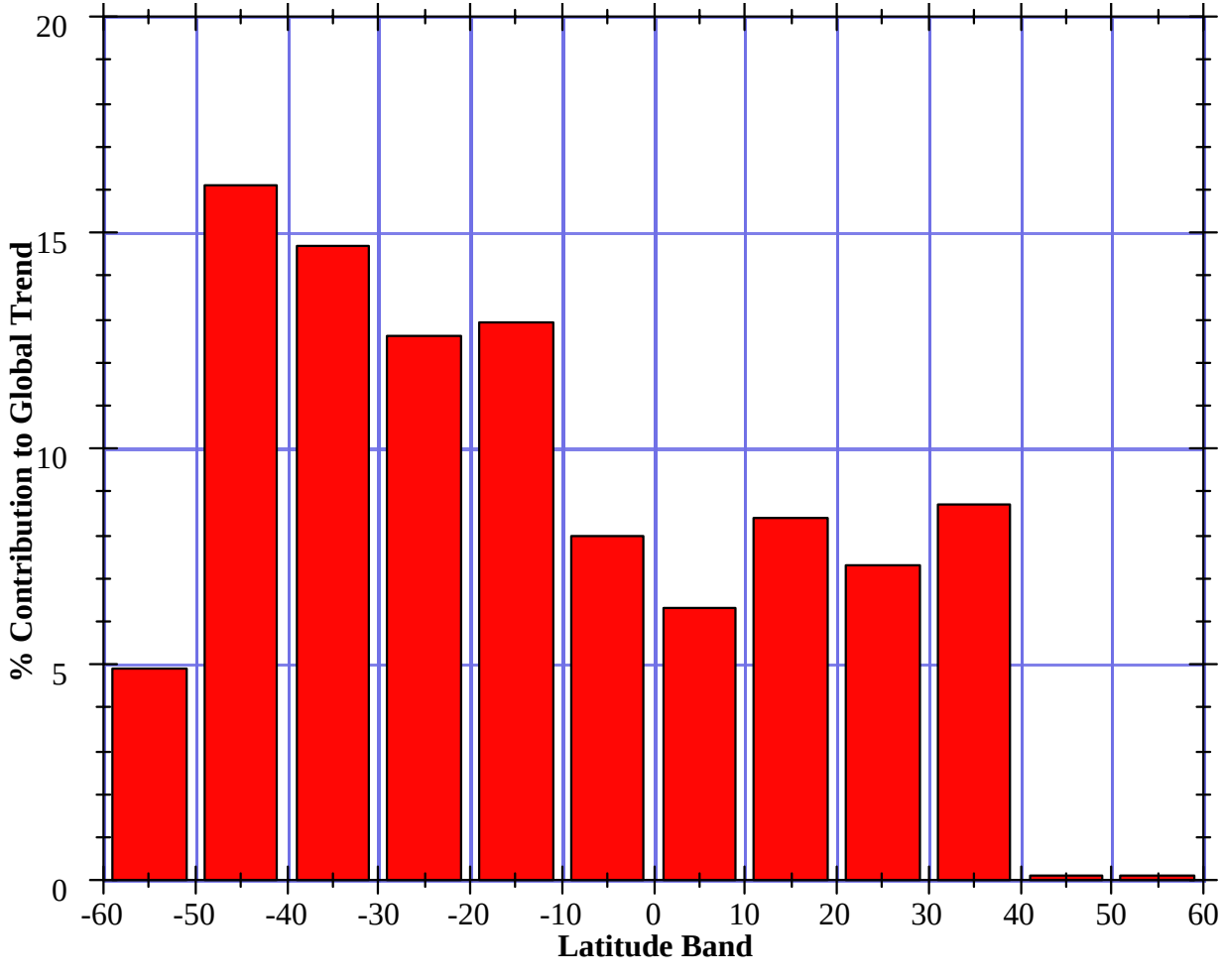
Jason Tide Gauge Calibration



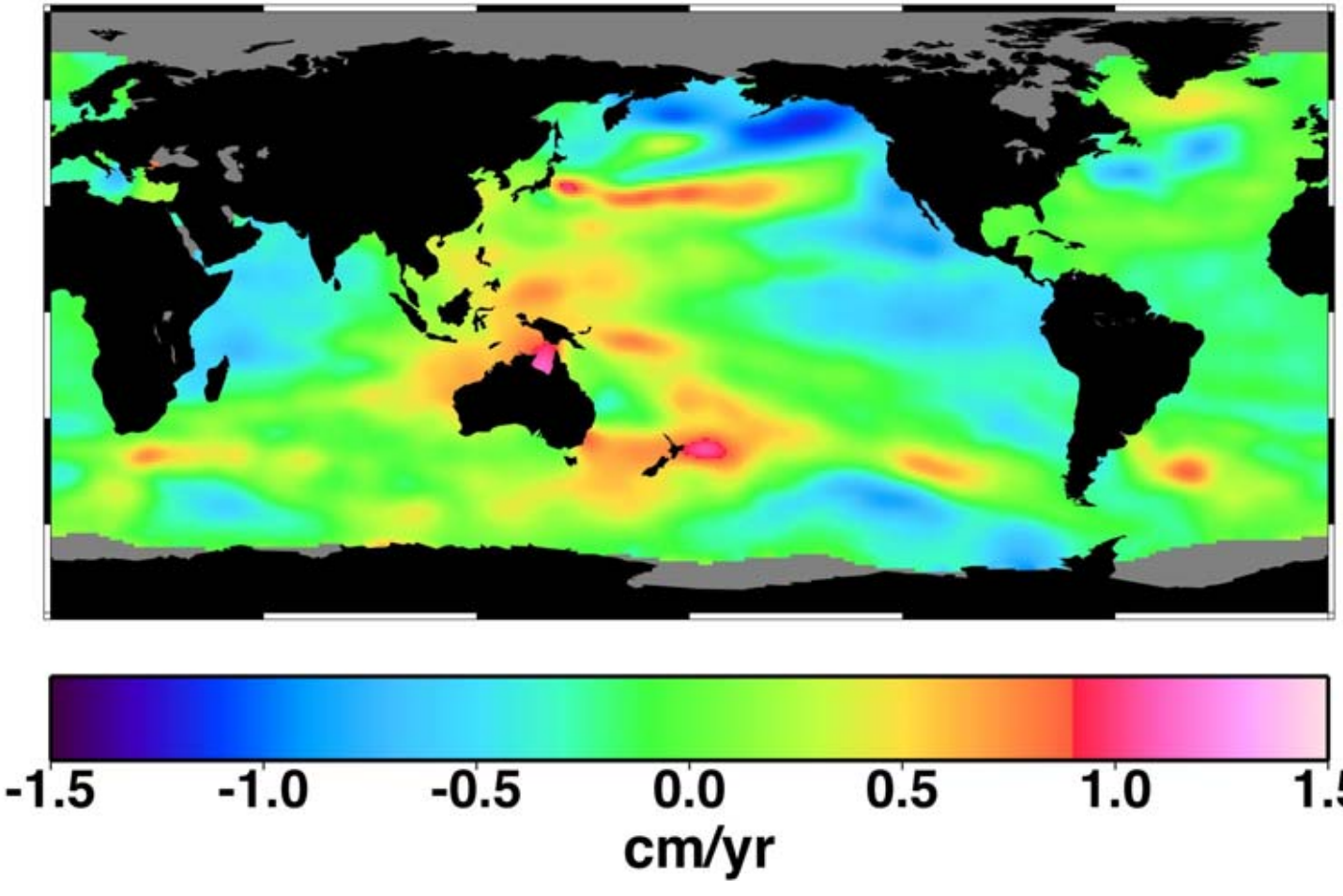
Sea Level Rise Versus Latitude



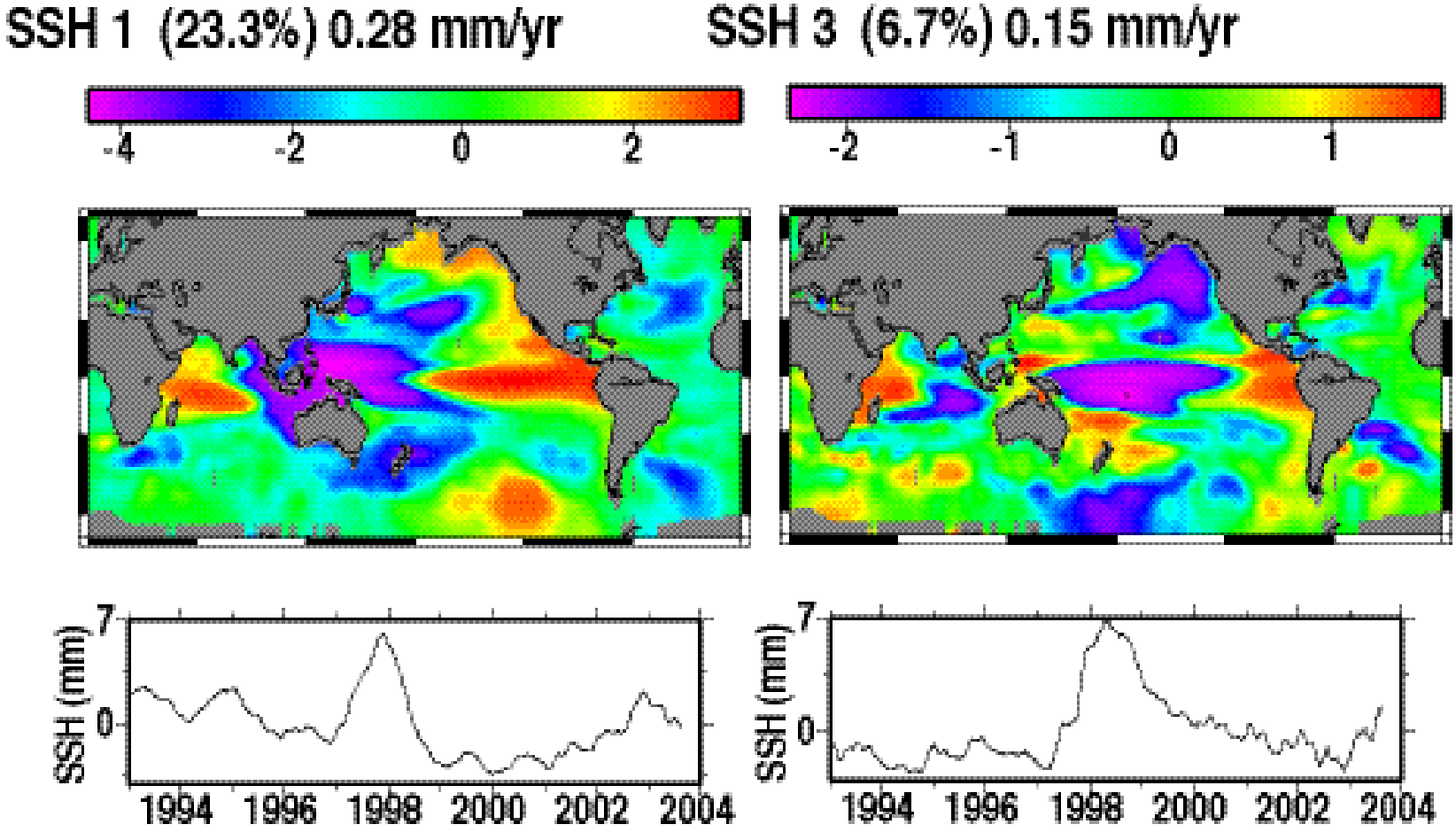
Percent Contribution to Global Trend



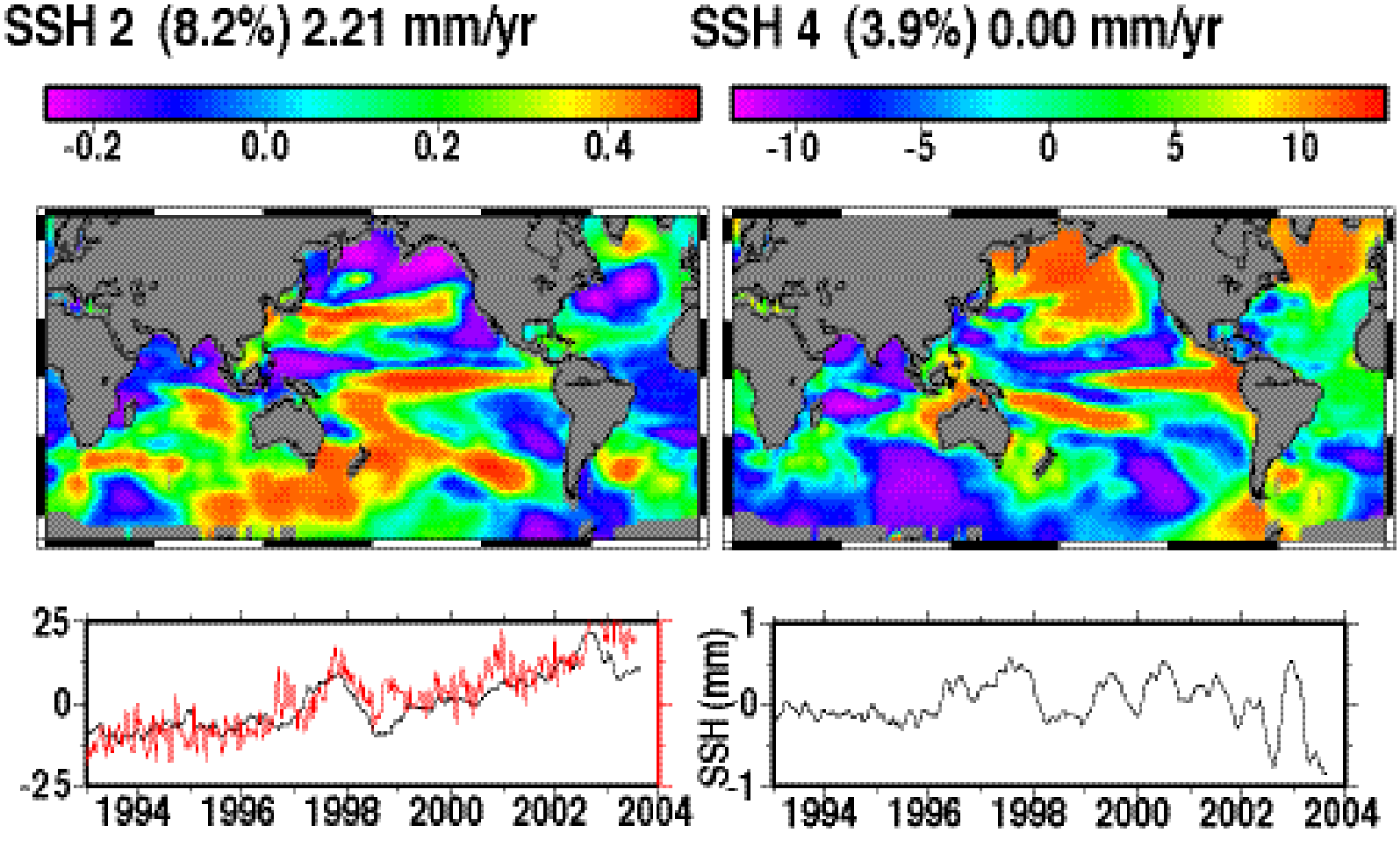
Sea Level Trends: 1993-2003



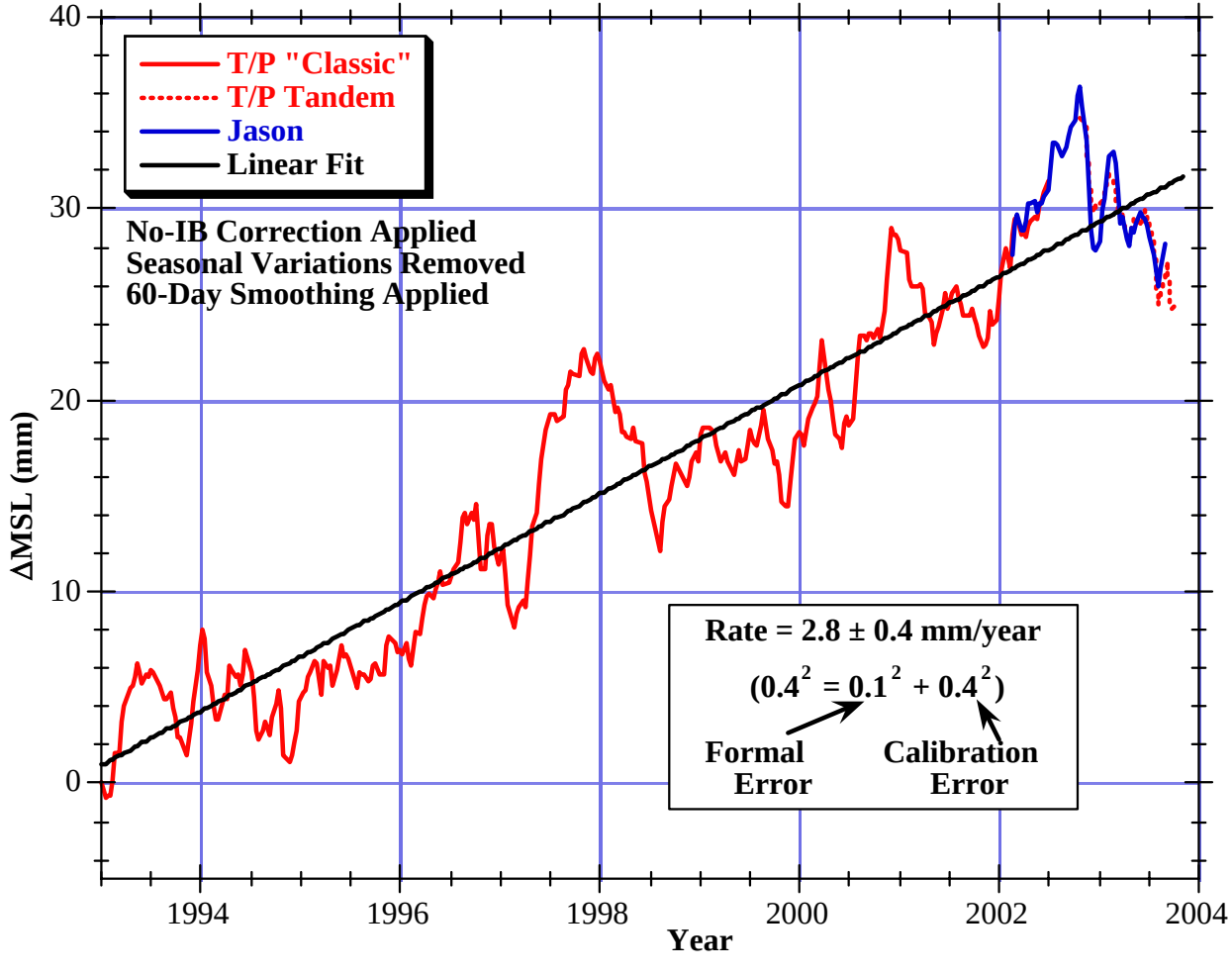
EOF Modes 1 and 3



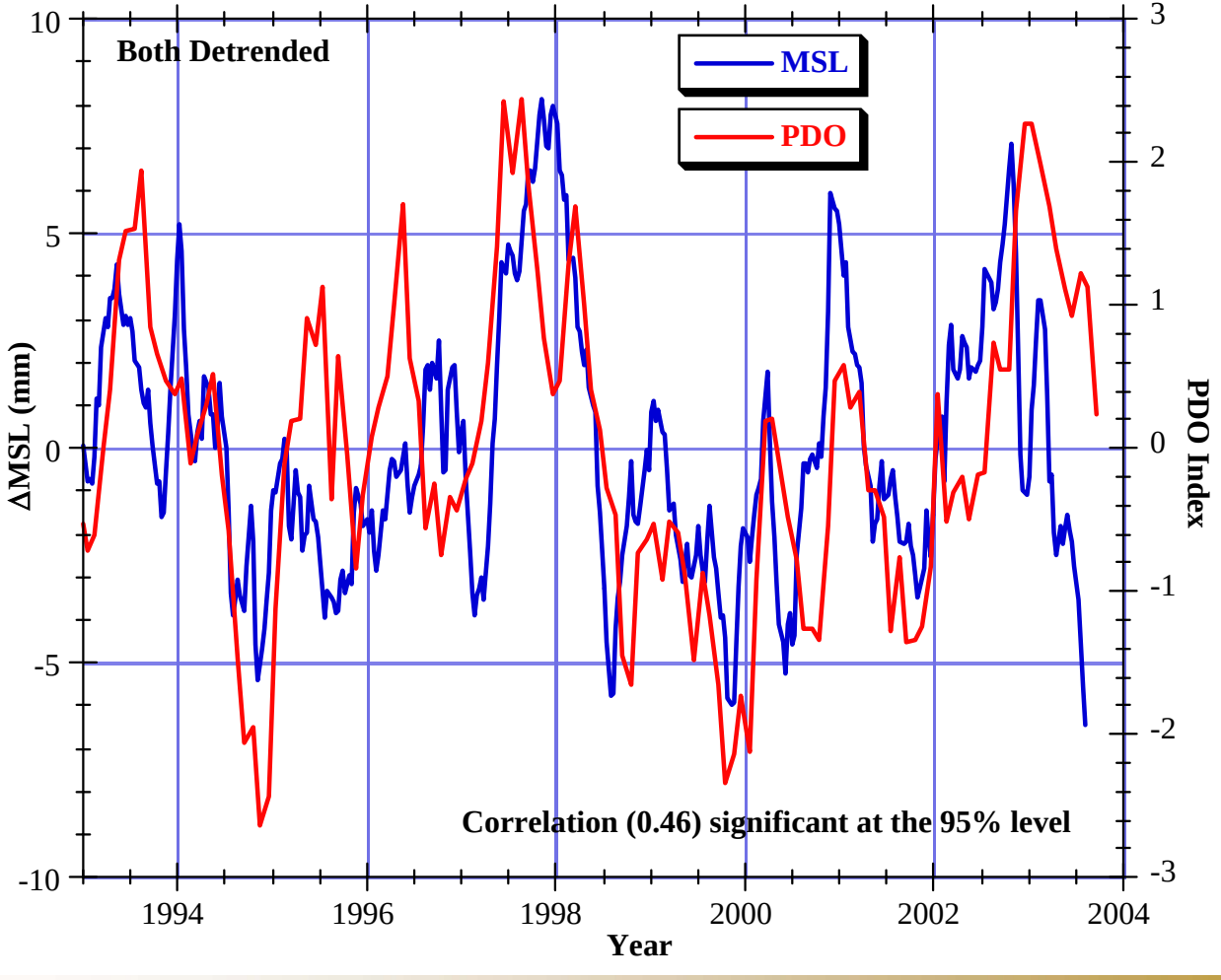
EOF Modes 2 and 4



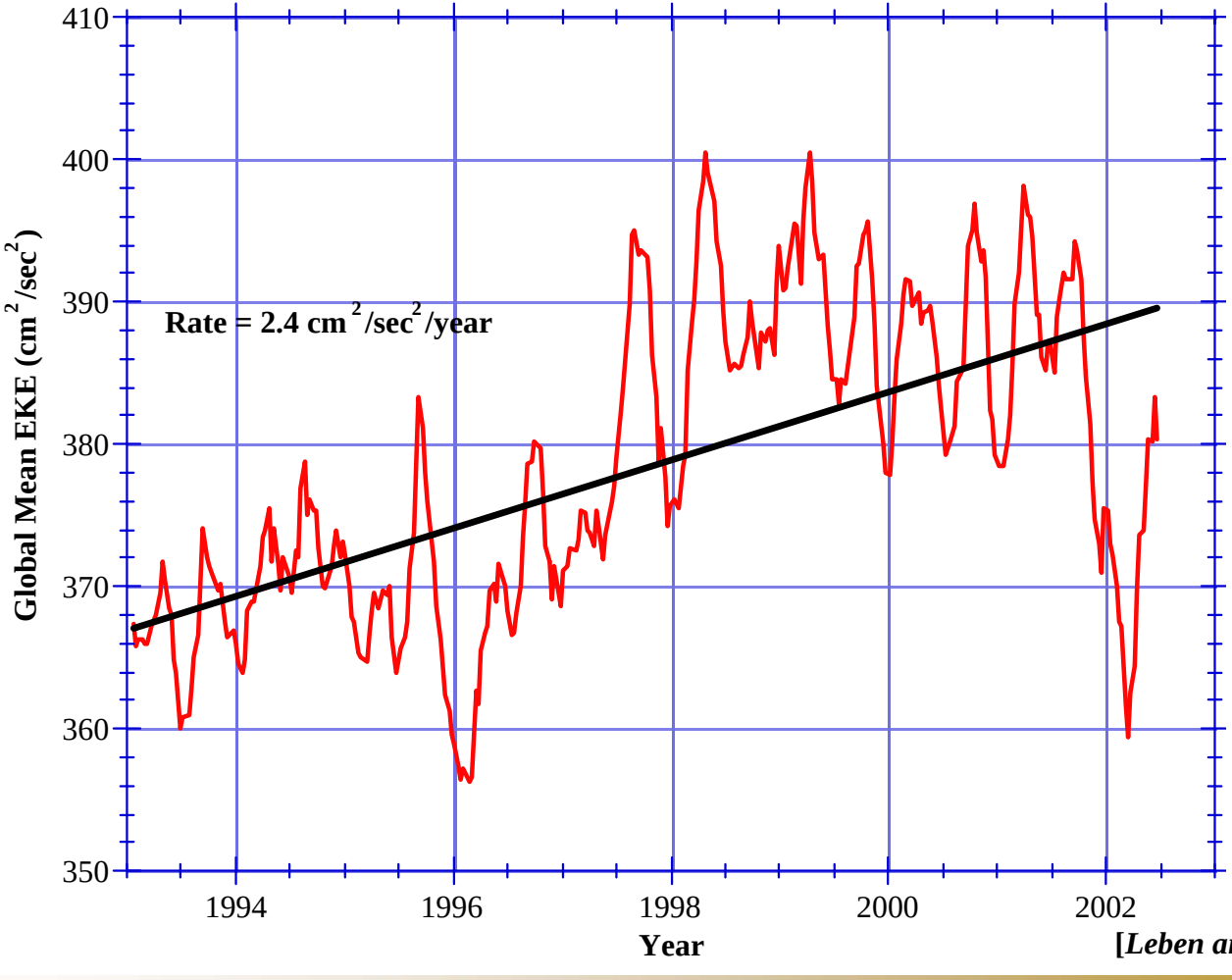
GMSL Variations from T/P and Jason-1



Detrended PDO vs MSL

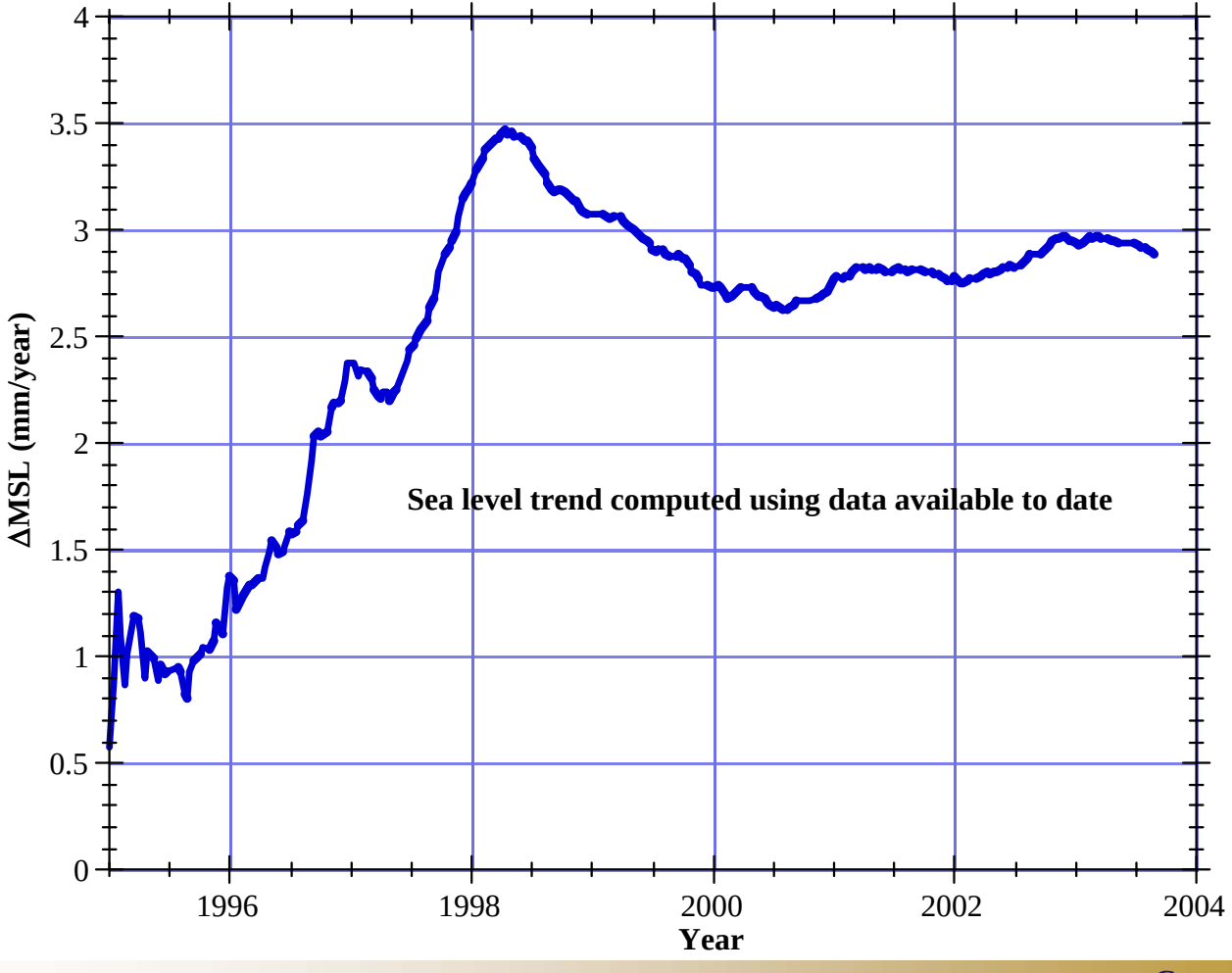


Global EKE Variations from TOPEX



[*Leben and Powell*, 2003]

Sea Level Rise Estimates Over Time

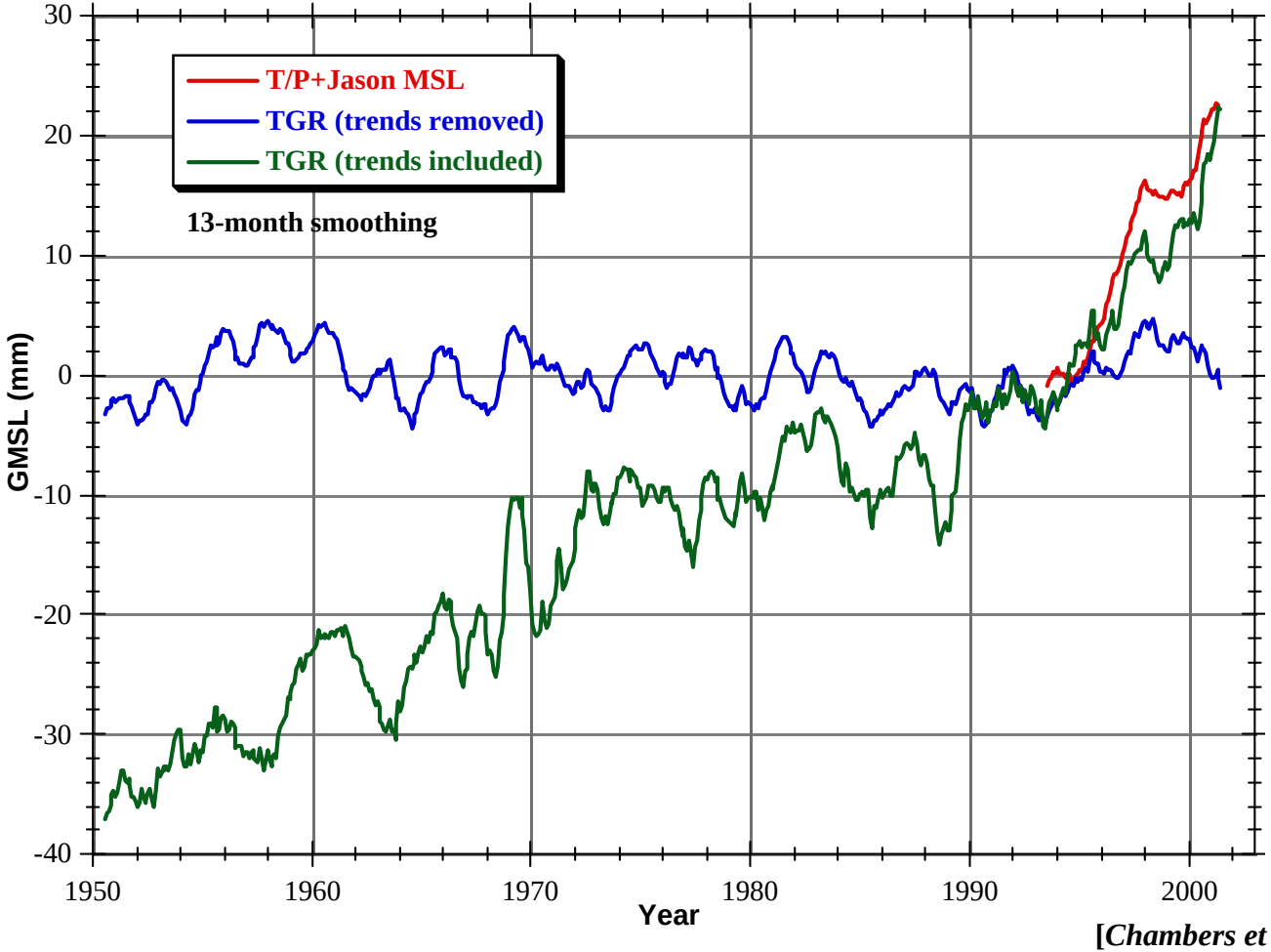


The Detection Problem

- ***Question:*** **How long of an altimetric GMSL series do we need to have good confidence that the sea level rise we are observing is related to climate variations?**
- **Tests using different proxies for sea level variability (SOI, SST, PDO, tide gauge sea level reconstructions) all suggest about a decade of averaging is needed to have confidence in the rate at the 0.5 mm/year level.**
- **Tests using AOGCMs reach similar conclusions [*Lowe & Gregory*, 2003].**
- ***Answer:*** **We are close, but…….**
- ***Next Question:*** ***If*** **we have confidence in the altimetric rate, does it represent a recent acceleration relative to historical sea level rise estimates?**

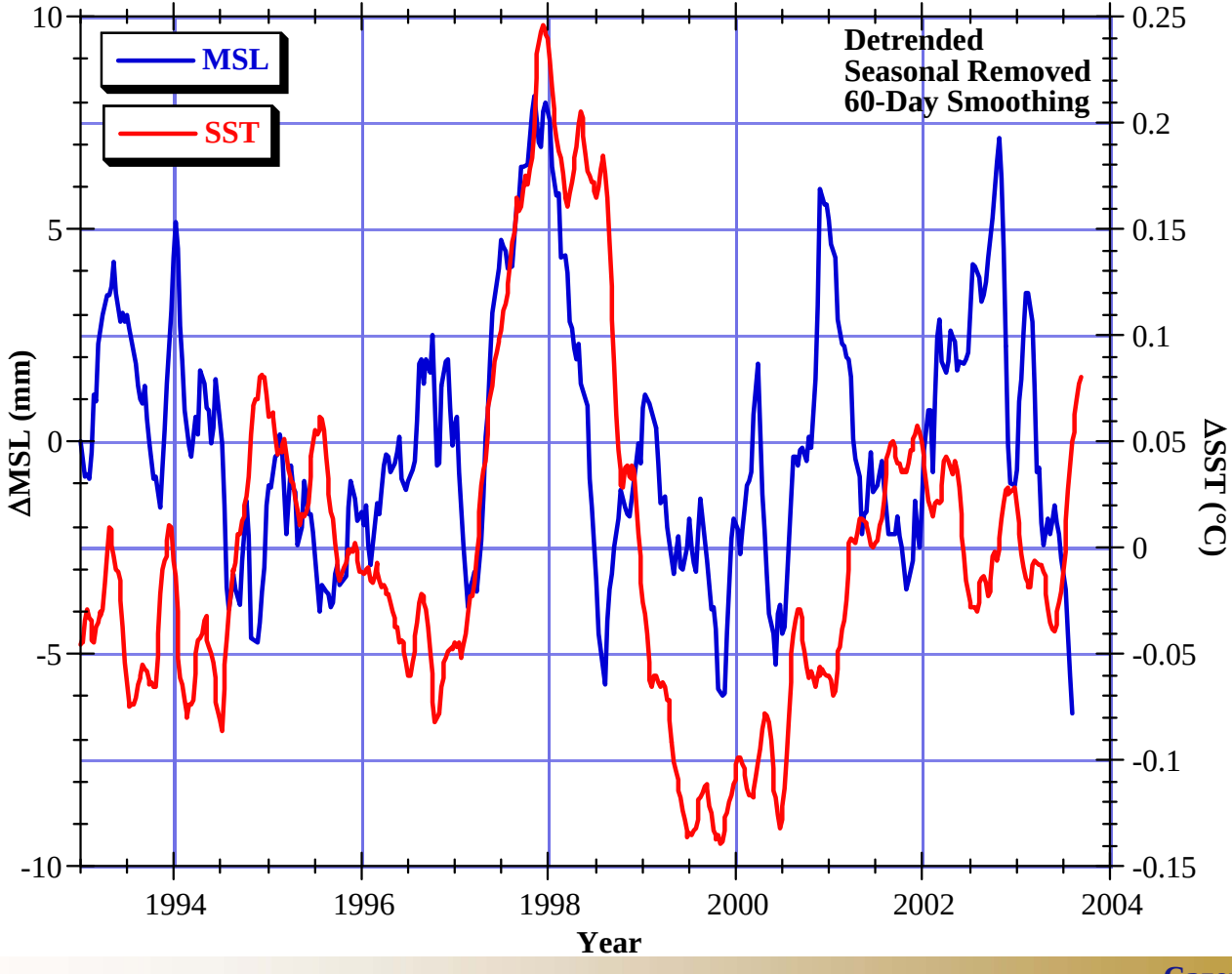
➡ **Next IPCC Assessment**

Tide Gauge Sea Level Reconstruction



[*Chambers et al.*, 2002]

Detrended Mean SST vs MSL



Detrended SOI vs MSL