Sustained Satellite Missions for Climate Data Records

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Climate Data Record (CDR)

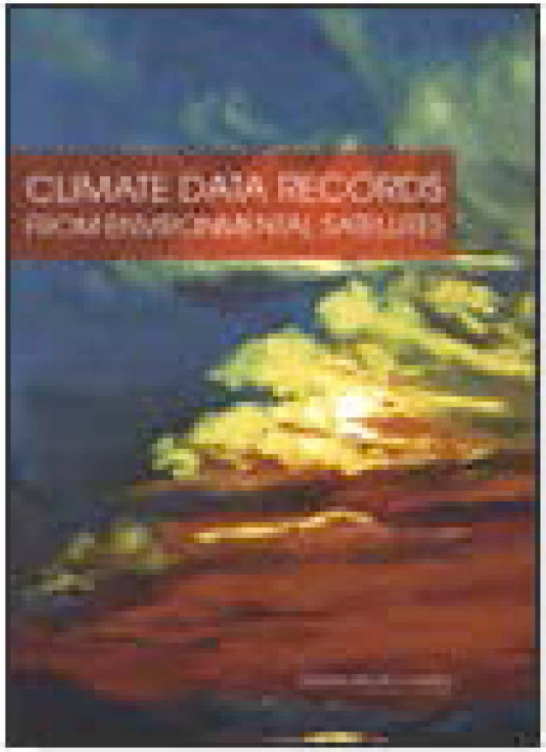
- A measurement time series of sufficient length, consistency, accuracy, precision, and continuity to determine climate variability and change

Summary

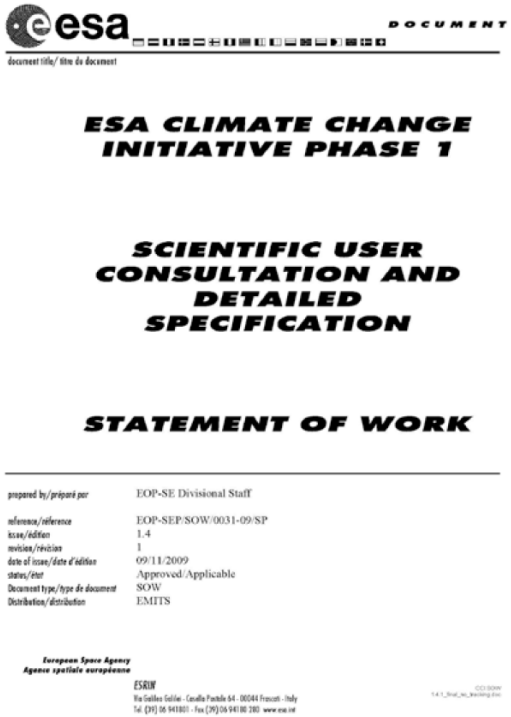
- Satellite CDRs possess the accuracy, longevity, and stability for sustained monitoring of critical variables to enhance understanding of the global integrated Earth system and predict future conditions.
- Satellite CDRs are a critical element of a global climate observing system.
- Satellite CDRs are a difficult challenge and require high-level managerial commitment, extensive intellectual capital, and adequate funding.

CDR

- Long-term data record involving a series of platforms, such as satellite and in-situ instruments each with different performance characteristics, usually with different space and time sampling, time extent, and stability
- Overlaps and calibrations sufficient for generation of homogeneous and well-characterized global data products that are stable for climate monitoring
- Includes metadata used for calibration



National Research Council (2004)



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ESA CLIMATE CHANGE INITIATIVE PHASE 1

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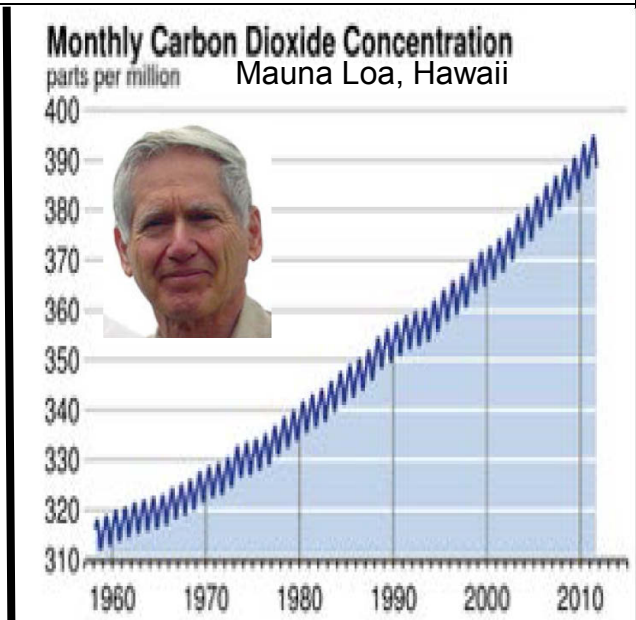
ESRIN

CDR Requirements

- Accuracy
- Precision
- Uncertainty
- Error characteristics
- Timeliness
- Reliability
- Completeness
- Relevancy
- Utility
- Objectivity
- Reproducibility
- Reprocessing
- Documentation
- Calibration
- Interoperability
- Accessibility

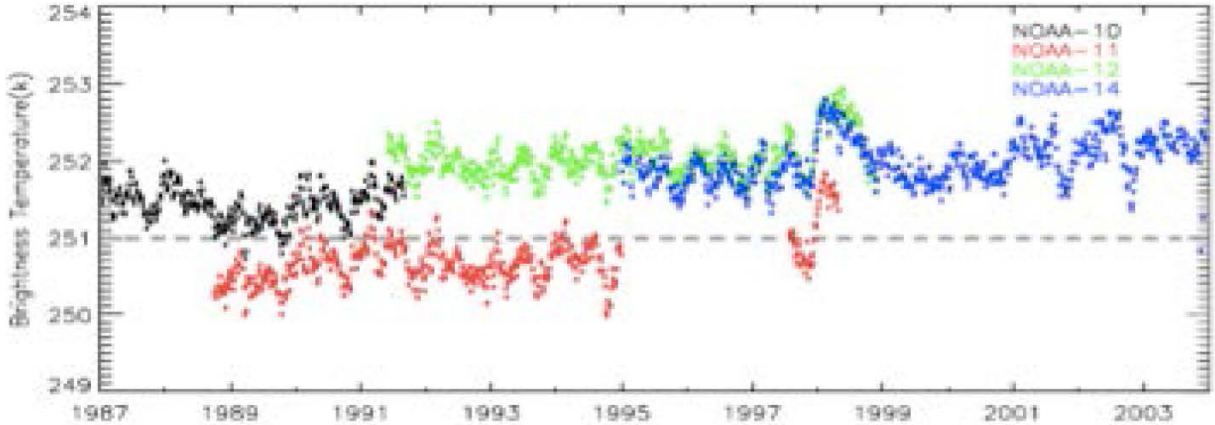


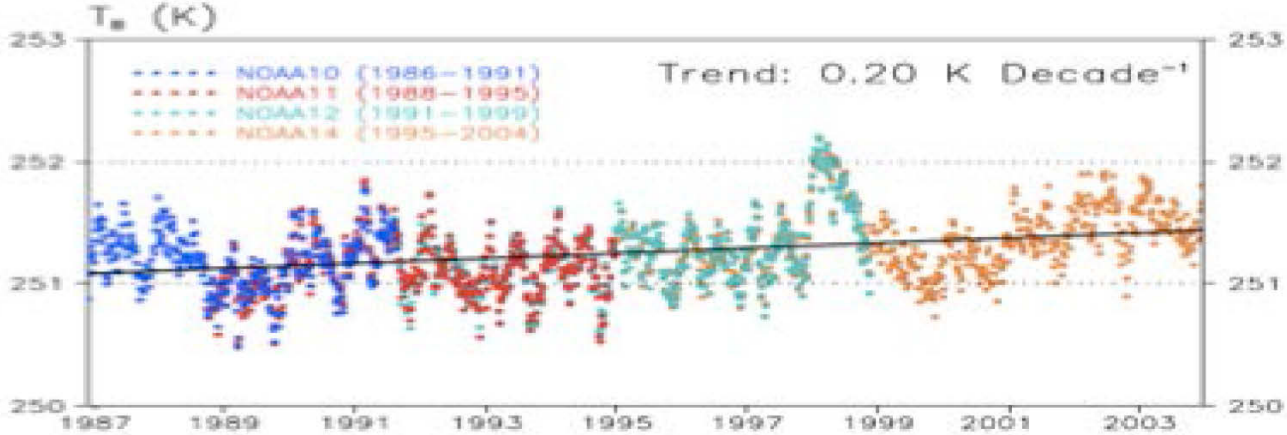
http://scrippsco2.ucsd.edu/home/index.php

- Champion with perseverance
- Agency/country champion with perseverance
- Open and transparent peer-review process
- Stability traceable to international standards
- Internationalization (a good CDR produced anywhere is good for global integrated Earth system science everywhere)
- GEO data policy of free and open data exchange with minimum time delay and minimum cost for distribution

Climate Data Record (CDR): Fundamental

Fundamental (satellite) CDR (FDCR): Calibrated and quality-controlled sensor data set that has been improved over time

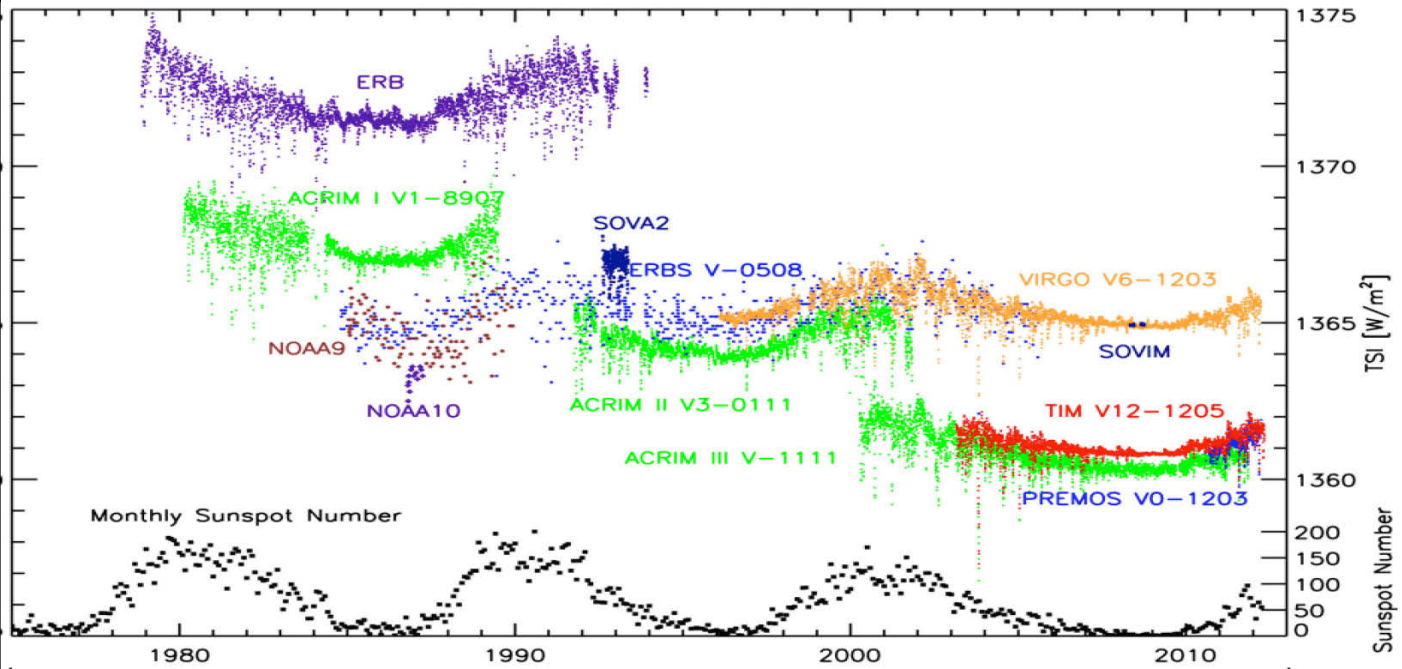




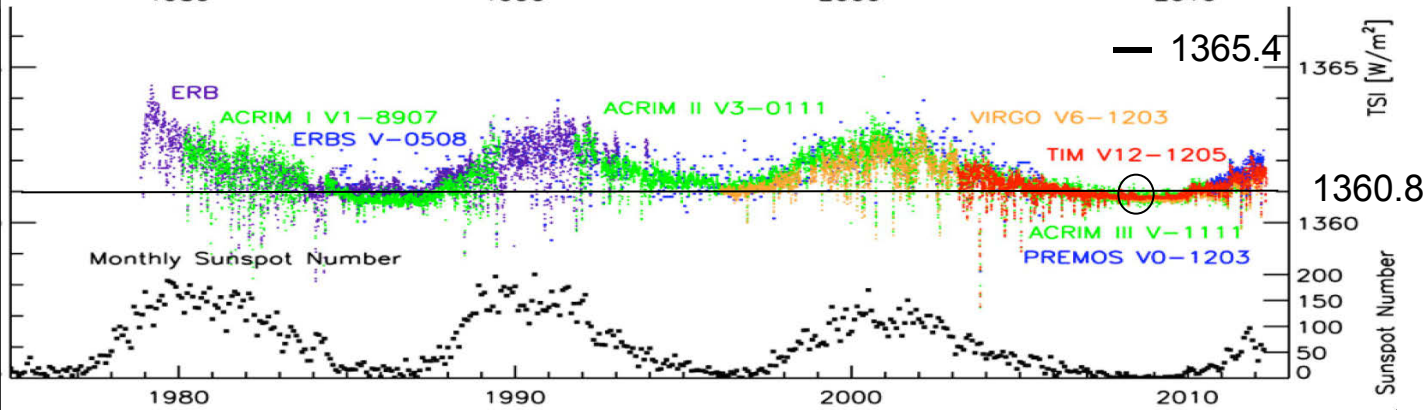
Iacovazzi and Sullivan (2007) *CSICS Quarterly*

TCDR: Total Solar Irradiance

Thematic (satellite) CDR (TCDR): Time series of geophysical variable derived from FCDR, such as total solar irradiance



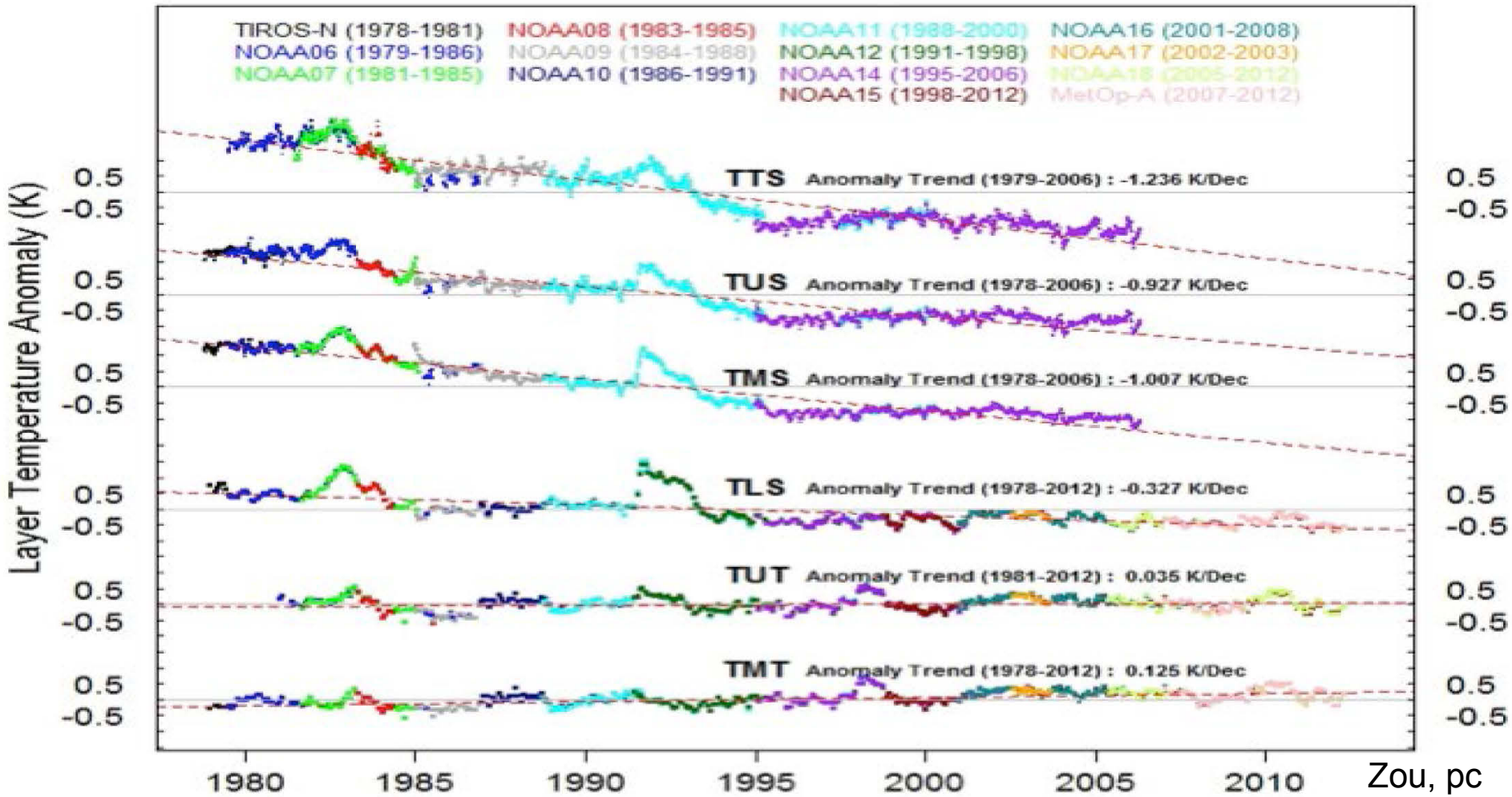
spot.colorado.edu/~koppg/TSI/TSI.jpg



spot.colorado.edu/~koppg/TSI/TSI_Composite.jpg

Kopp and McLean (2011) *GRL*, *38*,doi:10.1029/2010GL045777

TCDR: Atmospheric Temperature



Zou, pc

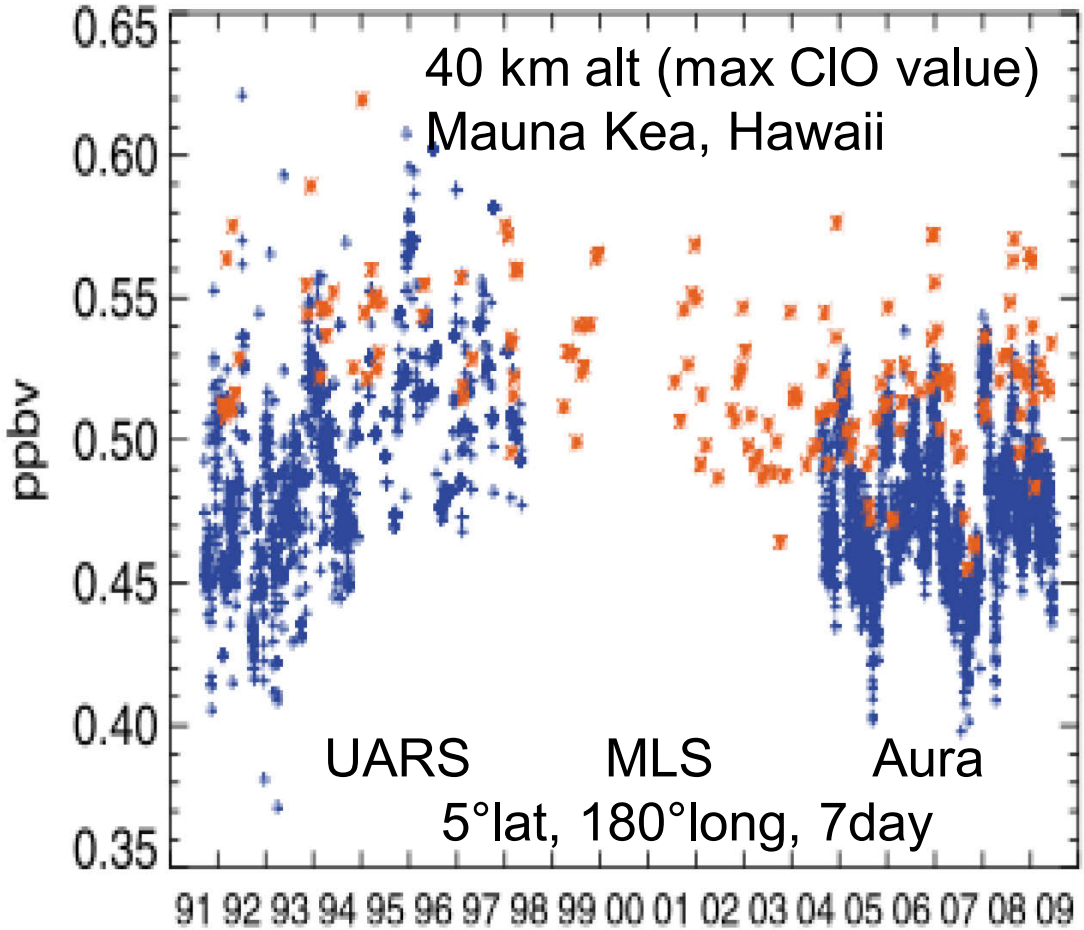
TTS, TUS, and TMS: Temperature of top stratosphere, upper-stratosphere, and mid-stratosphere
TLS, TUT, and TMT: Temperature of lower-stratosphere, upper-troposphere, and mid-troposphere

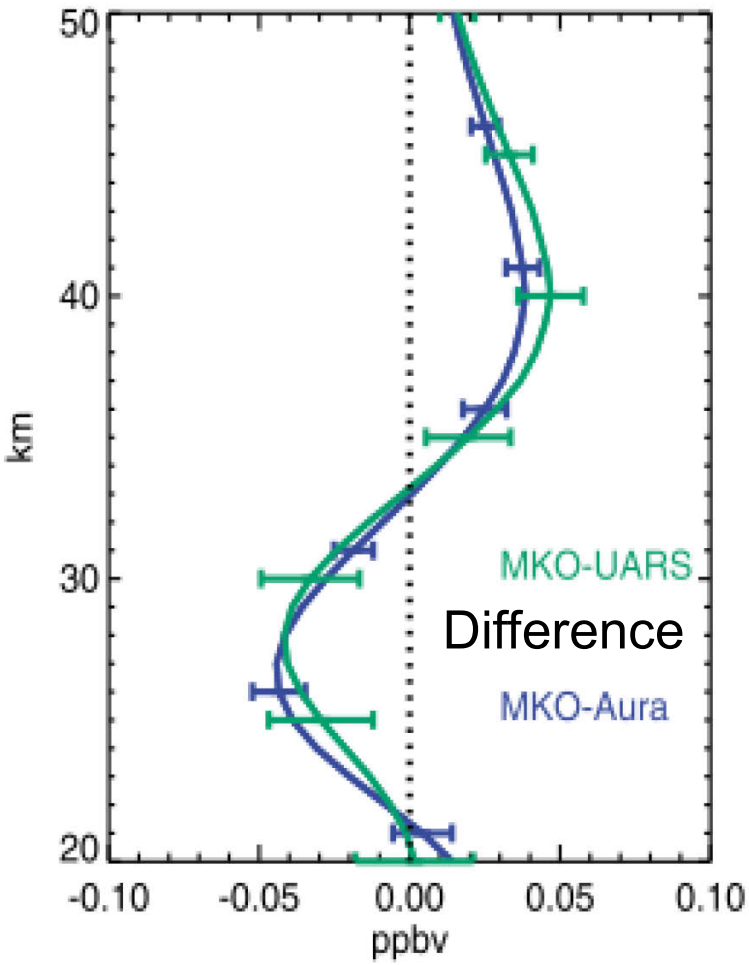
Zou and Wang (2011) *JGR*, *116*, doi: 10.1029/2011JD016205.
Wang et al. (2012) *J. Clim.*, *25*, 2931-2946.

TCDR: Chlorine Monoxide (ClO)

Chlorine atom (Cl·) reacts with ozone molecule to deplete ozone.

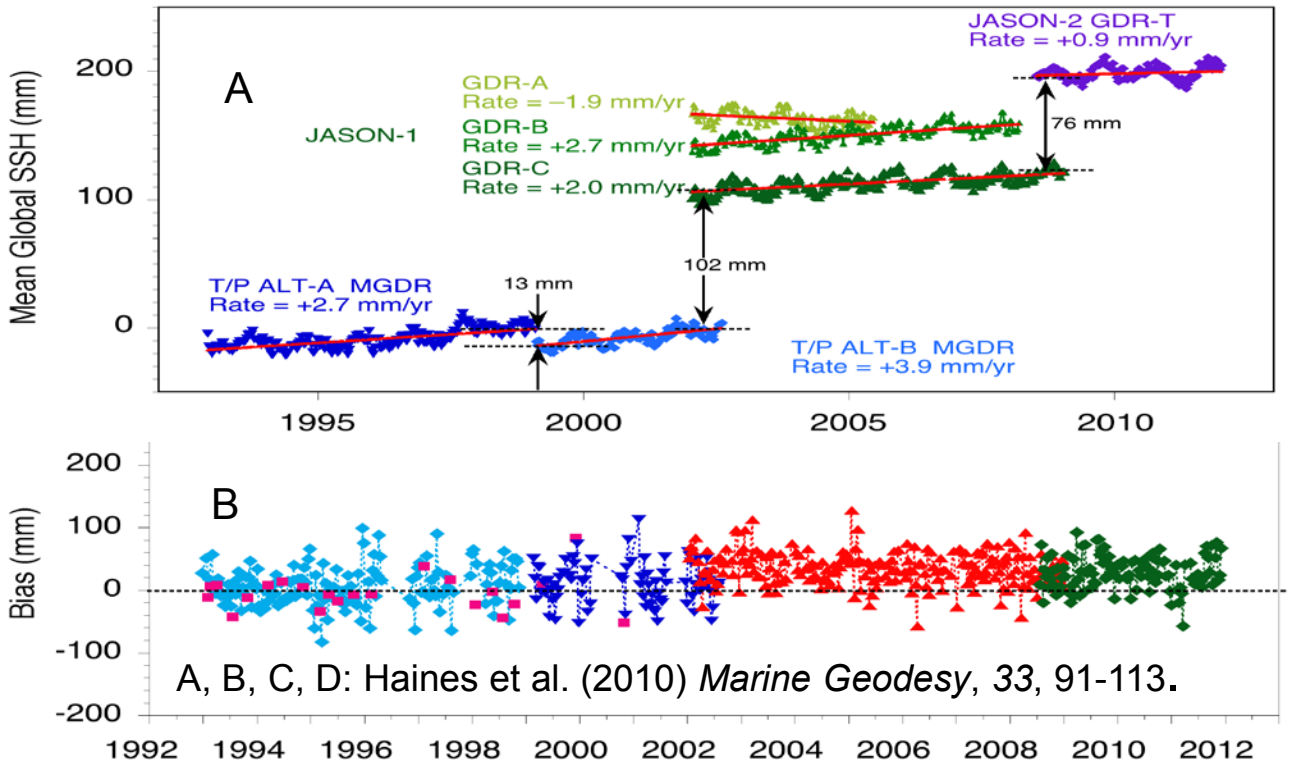
$Cl\cdot + O_3 = ClO + O_2$



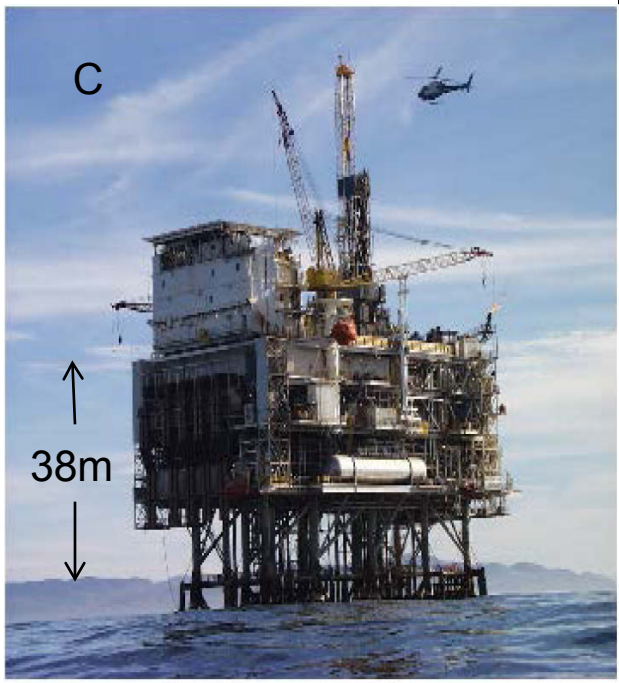


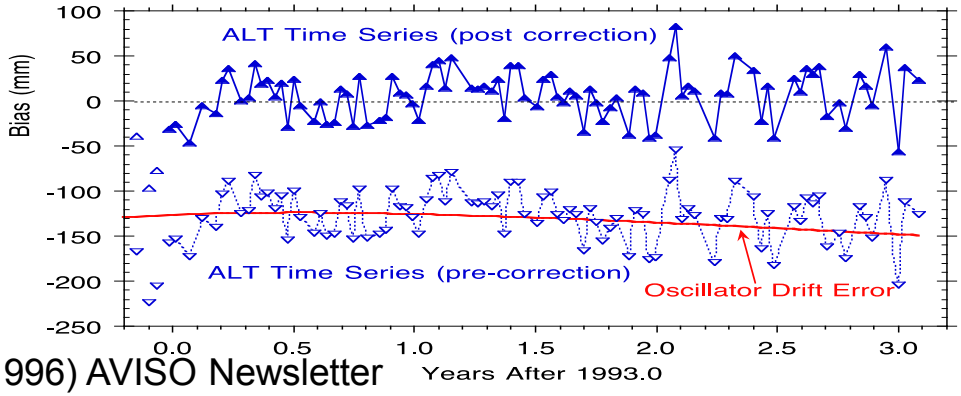
Nedoluha et al. (2011) J. Geophysical Res., doi: 10.1029/2010JD014732.

TCDR: Sea Level (1)

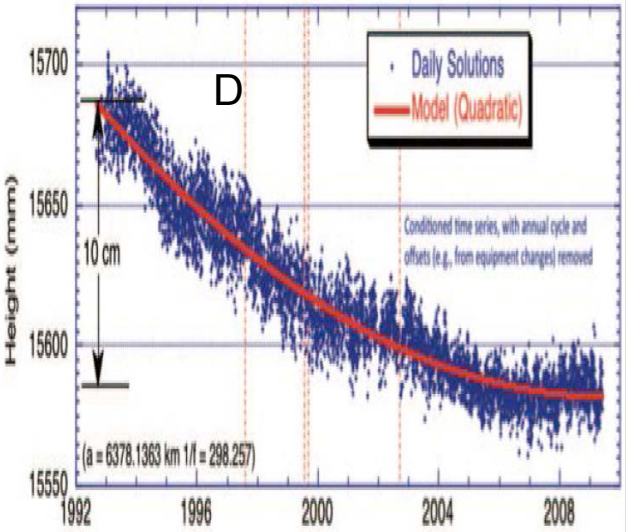


A, B, C, D: Haines et al. (2010) *Marine Geodesy*, *33*, 91-113.

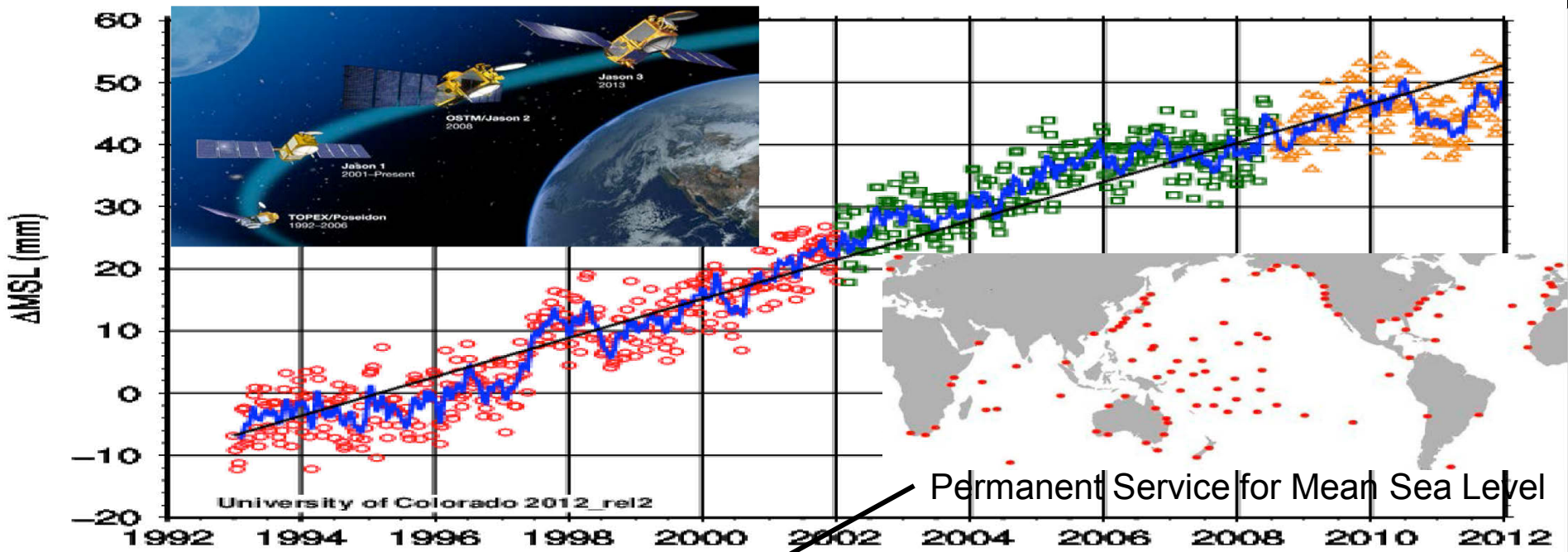


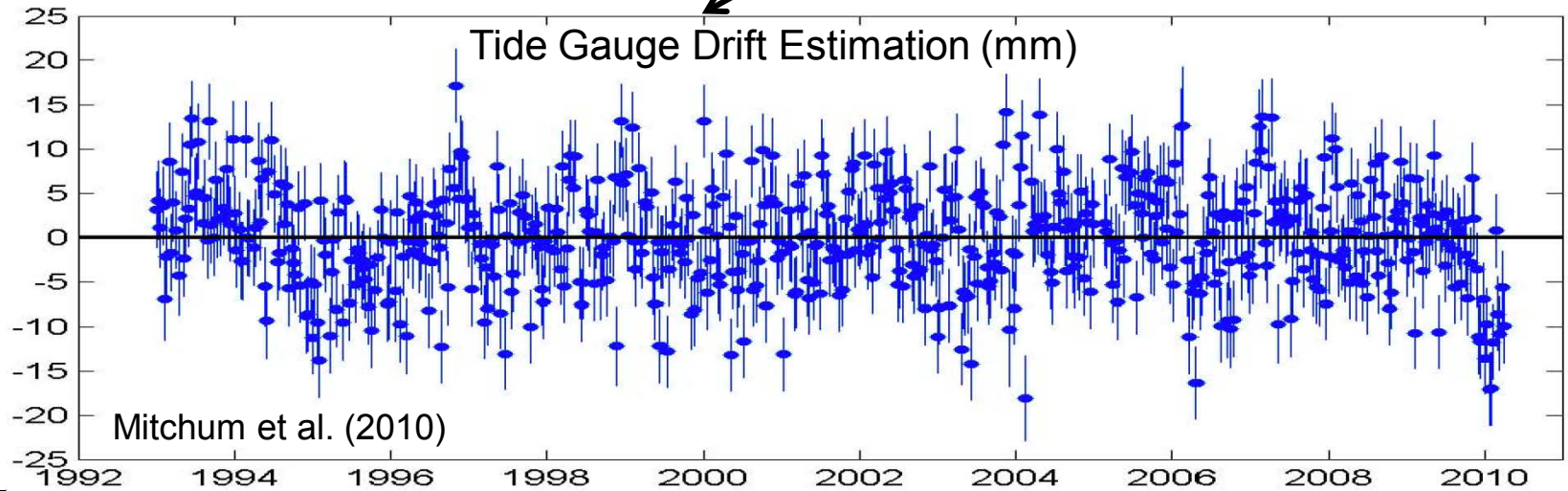


Zanife et al. (1996) AVISO Newsletter

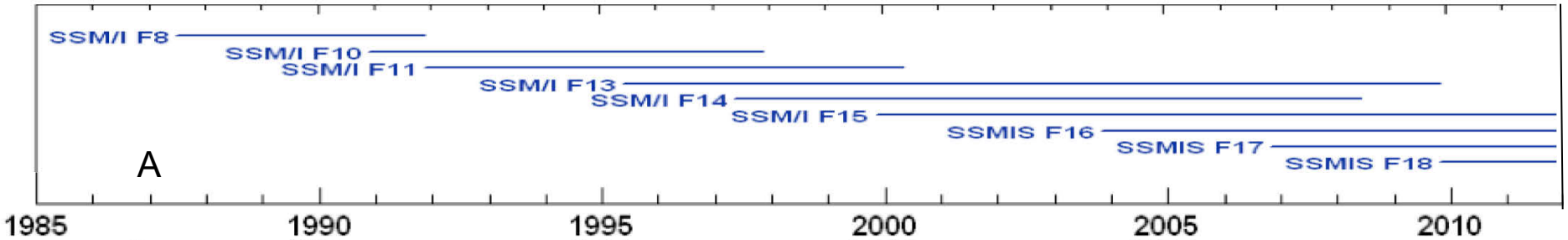


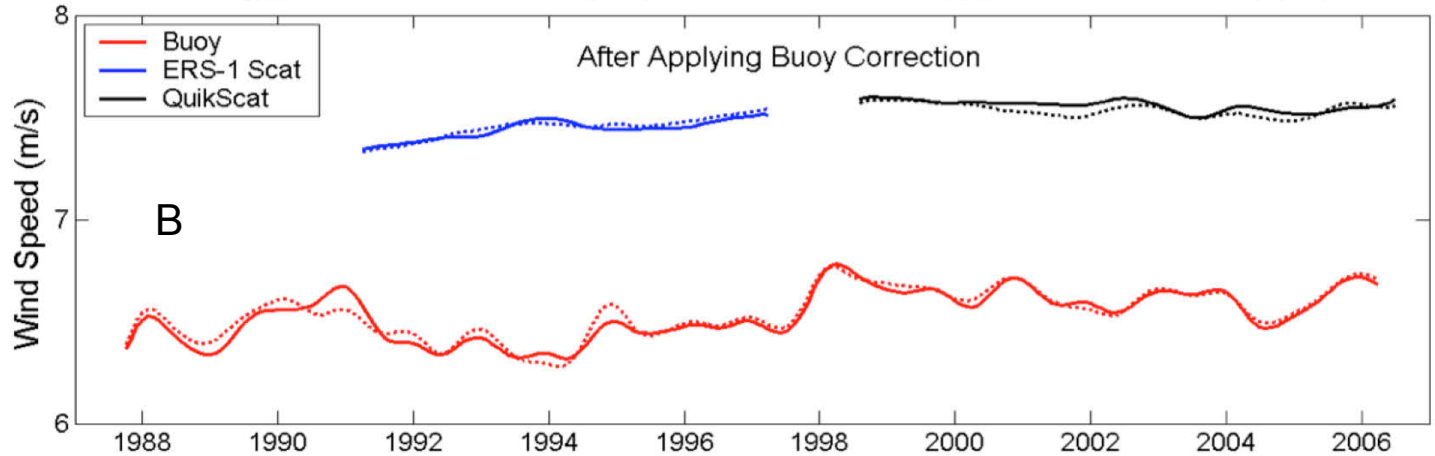
TCDR: Sea Level (2)





TCDR: Surface Wind Speed





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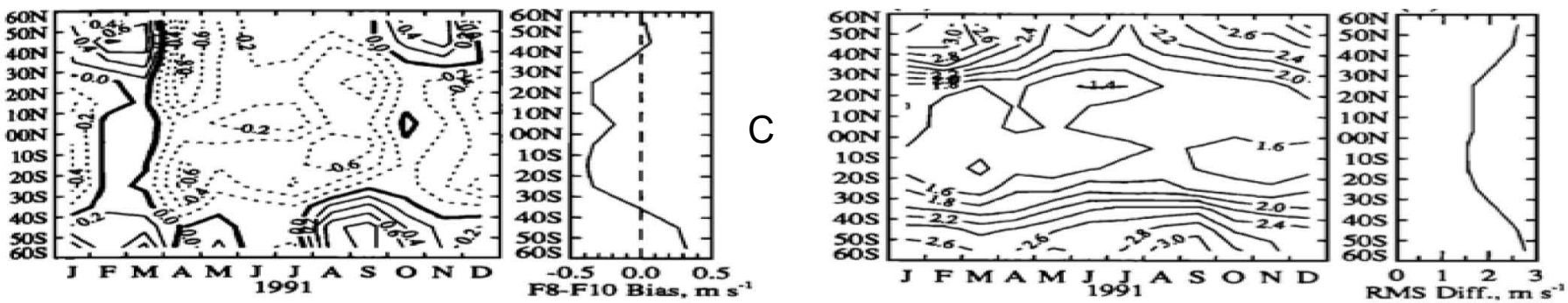


A, B: Wentz et al. (2007) *Science*, *317*, 233-235.
C: Halpern and Wentz (1994) *Geophysical Research Letters, 21*, 193-196.

SSMI positions on F8 and F10 spacecraft were different.

Summary of Critical CDR Attributes

- Multiple instruments characterization
- Integration of in-situ and satellite measurements
- Data reprocessing and product generation
- Extensive interaction with scientific community
- Continuous vigilance
- Expert scientific staff
- Open and transparent data processing information
- International collaborative effort

Concluding Remarks

Satellite CDRs are a recent phenomenon.
Number of CDRs will increase.
Each CDR enables GEOSS SBA "Climate."

GEOSS Climate Vision

Achieve effective and sustained operation of the global climate observing system and reliable delivery of climate information of a quality needed for predicting, mitigating and adapting to climate variability and change, including for better understanding of the global carbon cycle

GEOSS intends to:

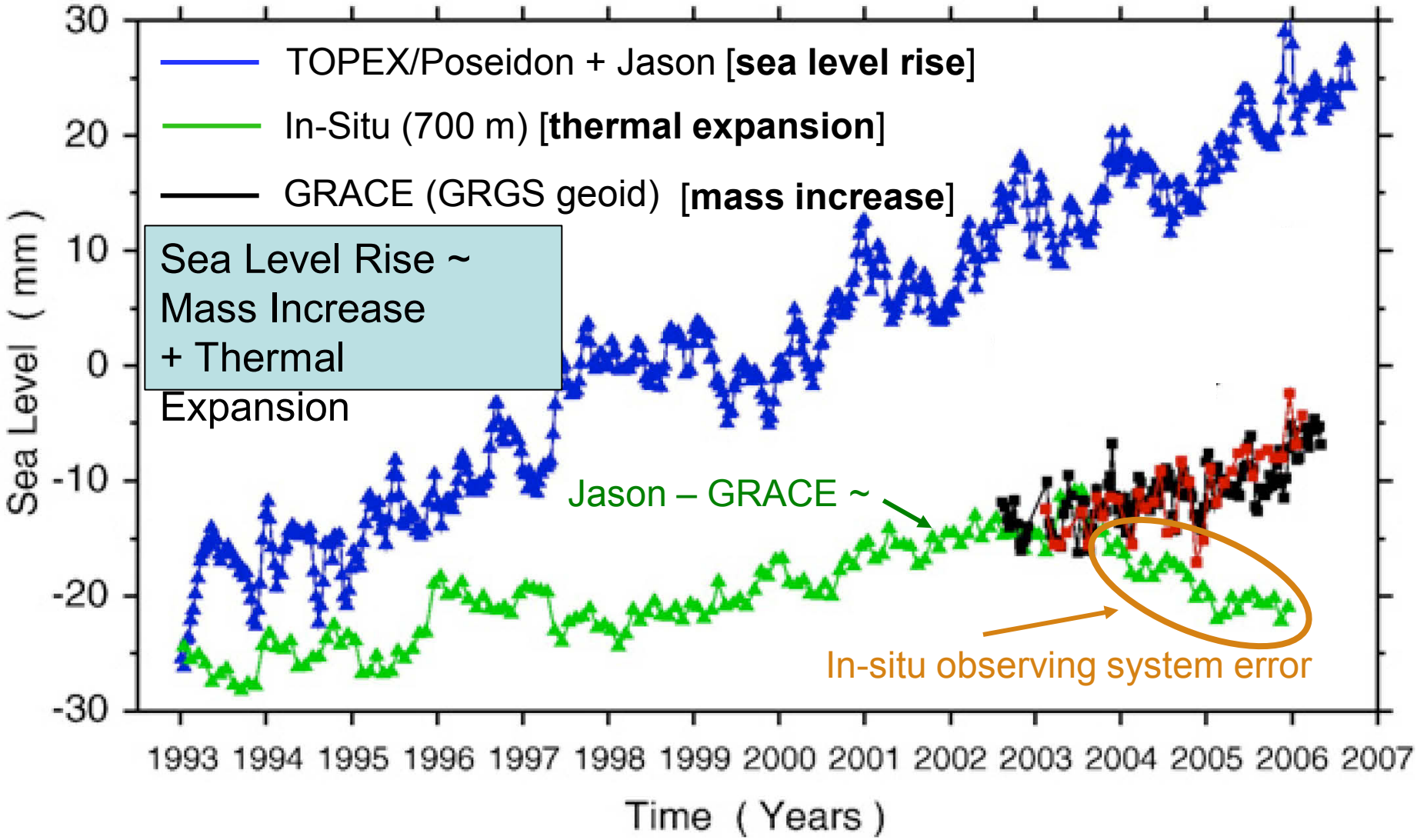
- Contribute to major advances in the monitoring of climate on seasonal, inter-annual and decadal time scales
- Provide all 50 GCOS Essential Climate Variables

GEO cultivates CDR development through many Tasks

Addendum: In-situ CDR

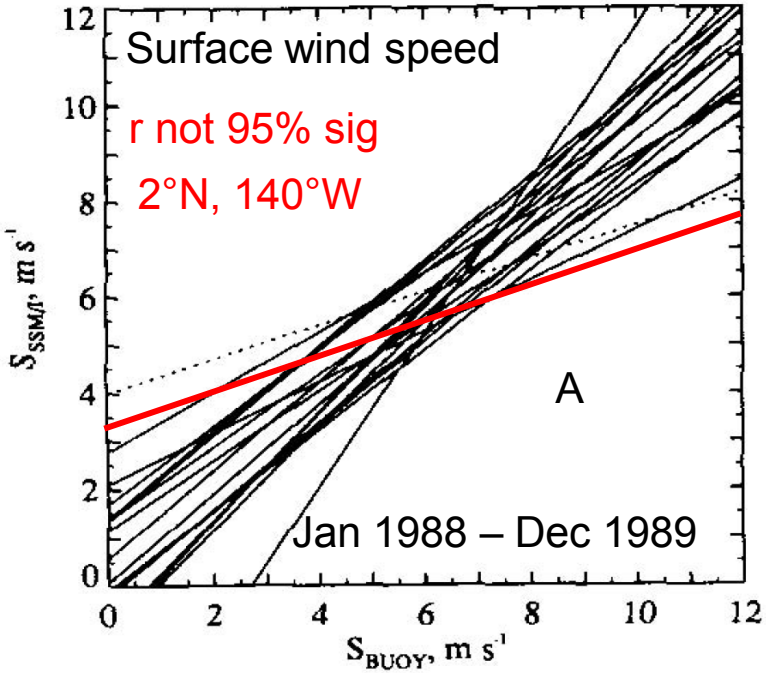
Satellite Data Calibrate In-situ Data

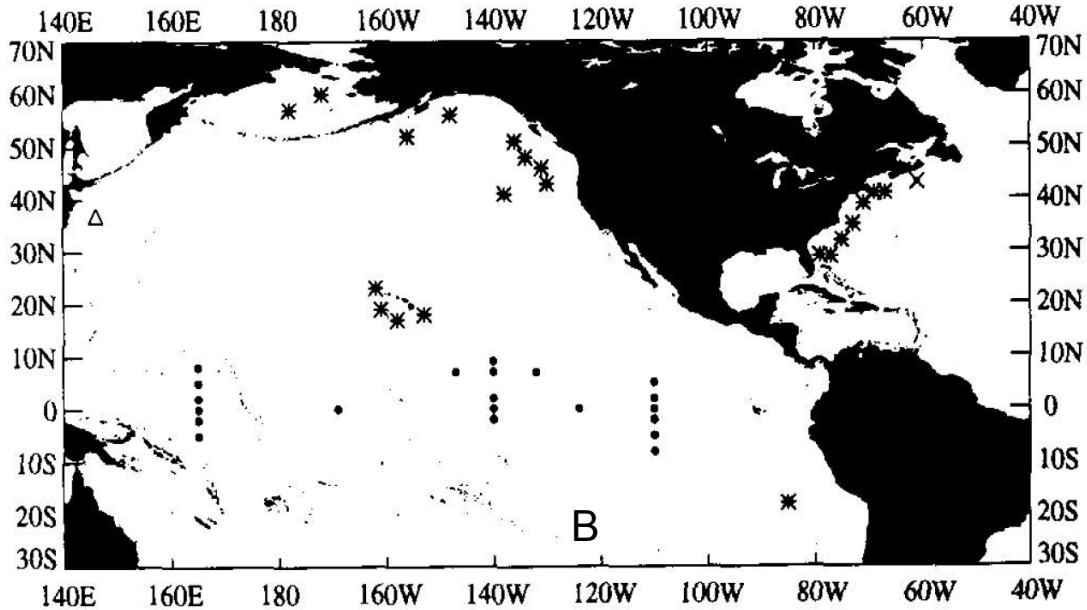
In-situ CDR (1)



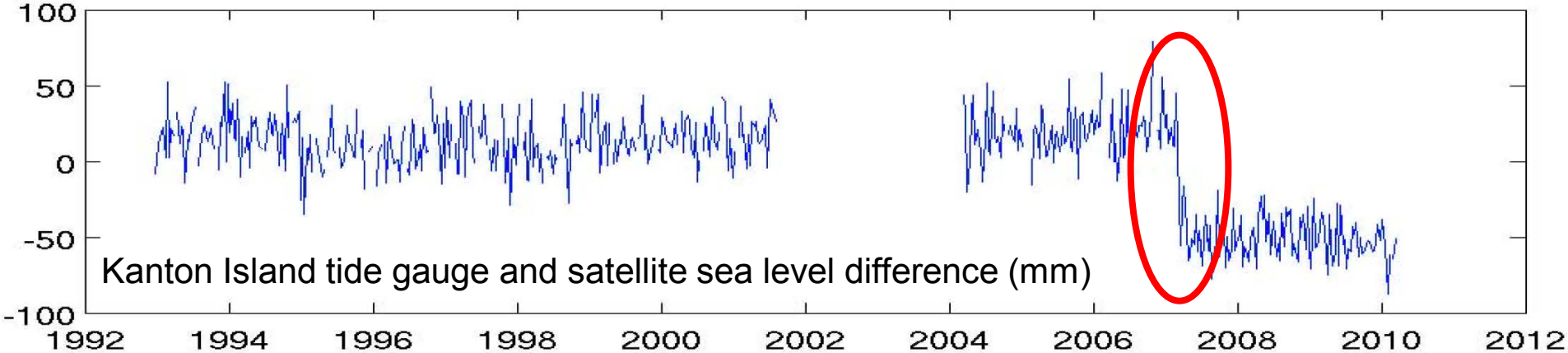
Lombard et al. (2007) *Earth and Planetary Sciences*, 194-202.

In-situ CDR (2)





A, B: Halpern (1993)



Mitchum (2011)

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Thank you