

Statistical Methods for Environmental Sciences and Engineering

Lecture 1

Introduction to the Course

Data, plotting data

Why statistics matter: some examples

Scripps Pier: an ongoing climate record



Scripps Pier: Sample ocean temperature records

Center for Operational Oceanographic Products and Services Data Disclaimer
These raw data have not been subjected to the National Ocean Service's quality control or
quality assurance procedures and do not meet the criteria and standards of official National
Ocean Service data. They are released for limited public use as preliminary
data to be used only with appropriate caution.

Water Temperature (E1)

- Station -- Unique seven character identifier for the station
- D -- A one character identifier for the data collection platform (DCP) at a station
- SE -- A two character identifier for the data sensor
- Date Time -- Date and time the data were collected by the DCP
- WT -- Water Temperature in degrees Centigrade
- X -- A flag that when set to 1 indicates that the maximum expected water temperature was exceeded
- N -- A flag that when set to 1 indicates that the minimum expected water temperature was exceeded
- R -- A flag that when set to 1 indicates that the rate of change tolerance limit was exceeded

Times are on UTC (GMT)

9410230-LaJolla,CA from 20050217 to 20050217

Station	D	SE	Date	Time	WT	X	N	R
9410230	1	E1	2005/02/17	00:00	15.8	0	0	0
9410230	1	E1	2005/02/17	01:00	15.9	0	0	0
9410230	1	E1	2005/02/17	02:00	15.9	0	0	0
9410230	1	E1	2005/02/17	03:00	15.9	0	0	0
9410230	1	E1	2005/02/17	04:00	15.4	0	0	0
9410230	1	E1	2005/02/17	05:00	15.3	0	0	0

Scripps Pier: Sample ocean temperature records

Station	D	SE	Date	Time	WT	X	N	R
9410230	1	E1	2005/02/17	00:00	15.8	0	0	0
9410230	1	E1	2005/02/17	01:00	15.9	0	0	0
9410230	1	E1	2005/02/17	02:00	15.9	0	0	0
9410230	1	E1	2005/02/17	03:00	15.9	0	0	0
9410230	1	E1	2005/02/17	04:00	15.4	0	0	0
9410230	1	E1	2005/02/17	05:00	15.3	0	0	0
9410230	1	E1	2005/02/17	06:00	15.6	0	0	0
9410230	1	E1	2005/02/17	07:00	15.4	0	0	0
9410230	1	E1	2005/02/17	08:00	15.5	0	0	0
9410230	1	E1	2005/02/17	09:00	15.5	0	0	0
9410230	1	E1	2005/02/17	10:00	15.4	0	0	0
9410230	1	E1	2005/02/17	11:00	15.4	0	0	0
9410230	1	E1	2005/02/17	12:00	15.4	0	0	0
9410230	1	E1	2005/02/17	13:00	15.4	0	0	0
9410230	1	E1	2005/02/17	14:00	15.3	0	0	0
9410230	1	E1	2005/02/17	15:00	15.3	0	0	0
9410230	1	E1	2005/02/17	16:00	15.4	0	0	0
9410230	1	E1	2005/02/17	17:00	15.4	0	0	0
9410230	1	E1	2005/02/17	18:00	15.2	0	0	0
9410230	1	E1	2005/02/17	19:00	15.4	0	0	0



NOAA Satellites and Information



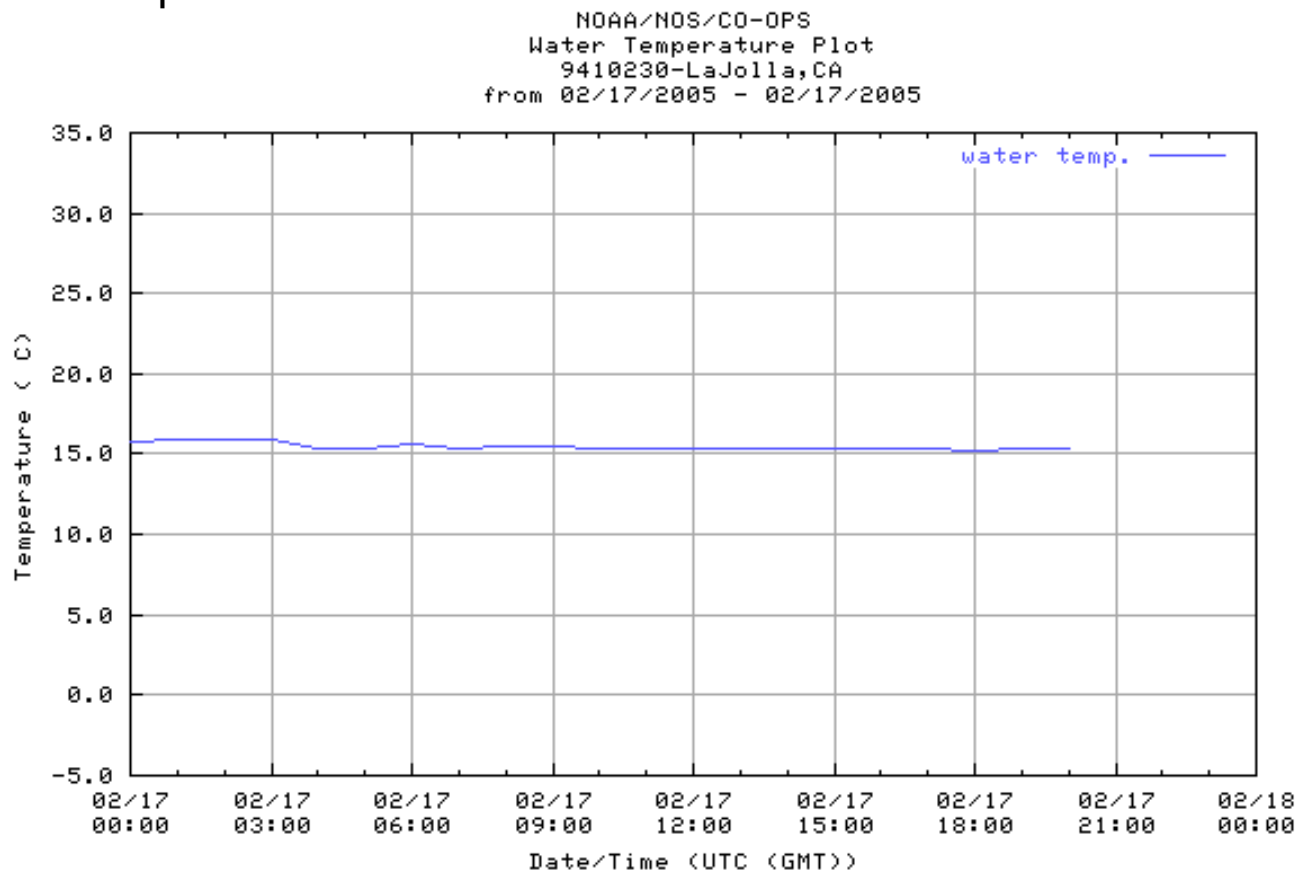
National Oceanographic Data Center



<http://www.nodc.noaa.gov/dsdt/cwtg/spac.html>

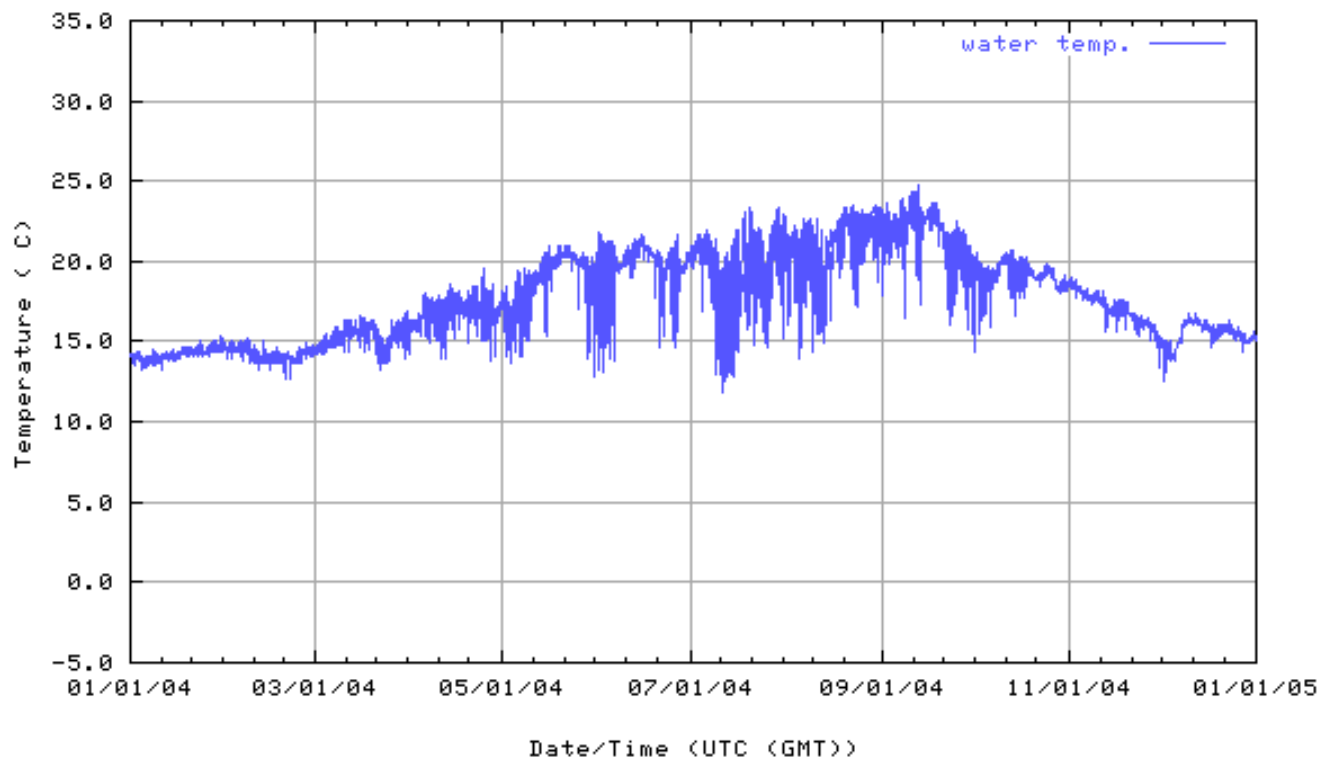
Scripps Pier: What do we do with the data?

Time series plot:

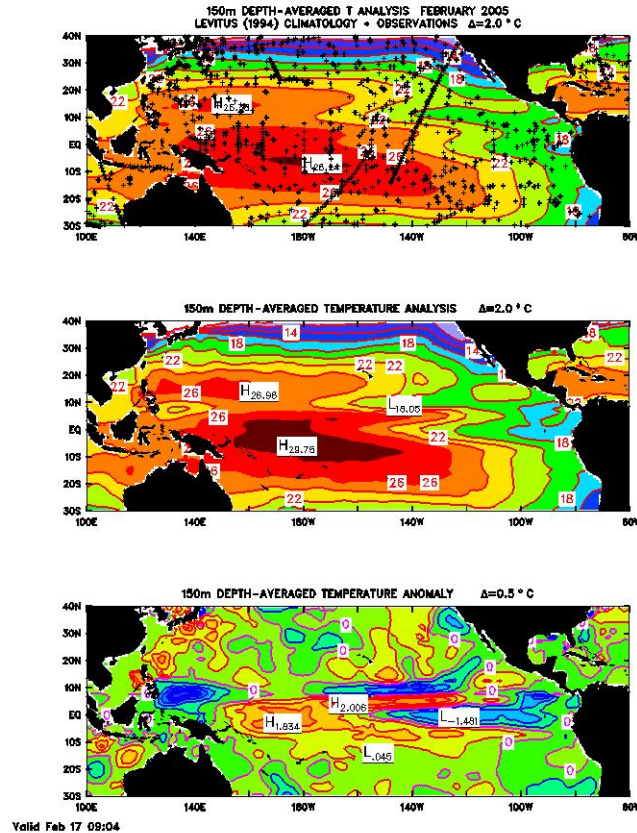


Scripps Pier: Year-long time series

NOAA/NOS/CO-OPS
Water Temperature Plot
9410230-LaJolla, CA
from 01/01/2004 - 12/31/2004

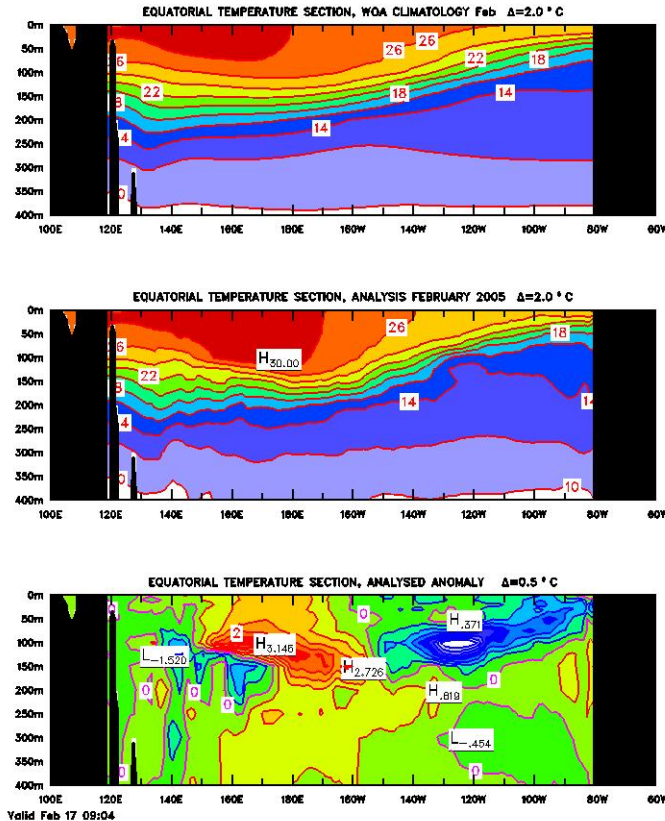


Pacific Ocean Temperature averaged over top 150 m



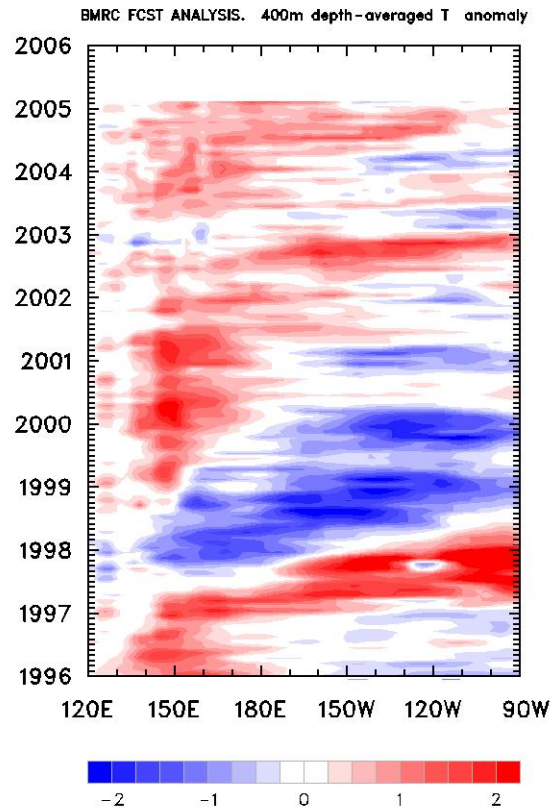
<http://www.bom.gov.au/bmrc/ocean/results/climocan.htm>

Equatorial Pacific vertical section



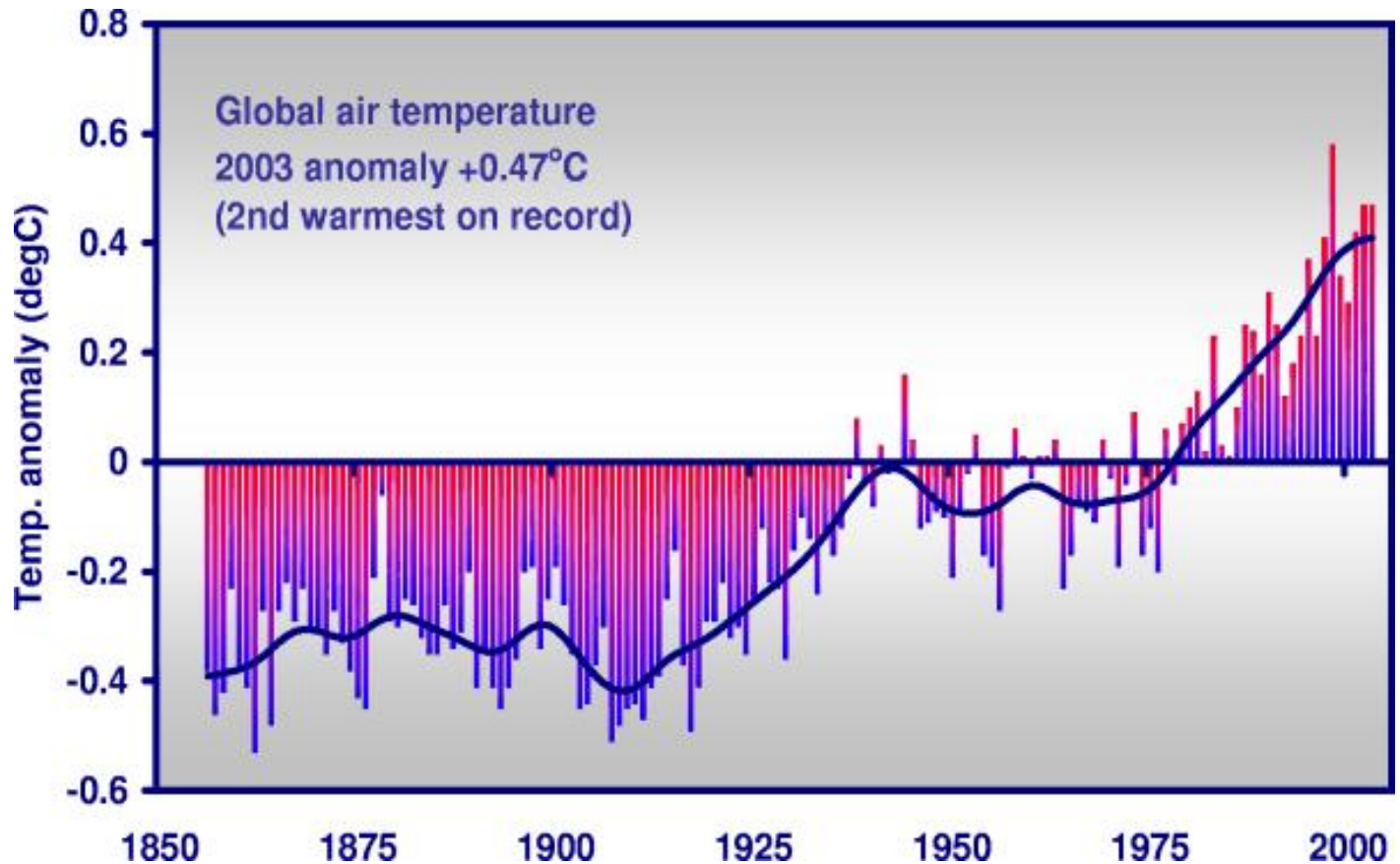
<http://www.bom.gov.au/bmrc/ocean/results/climocan.htm>

Equatorial Pacific Hovmoller diagram



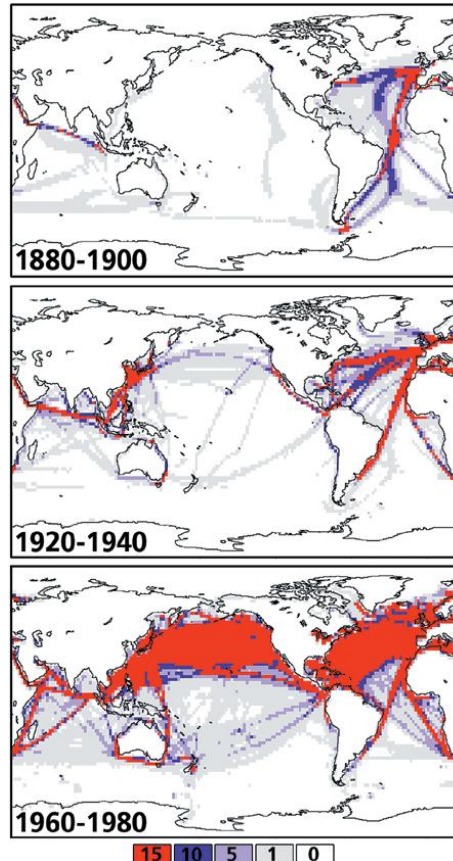
<http://www.bom.gov.au/bmrc/ocean/results/climocan.htm>

Example 1: Identifying Climate Change



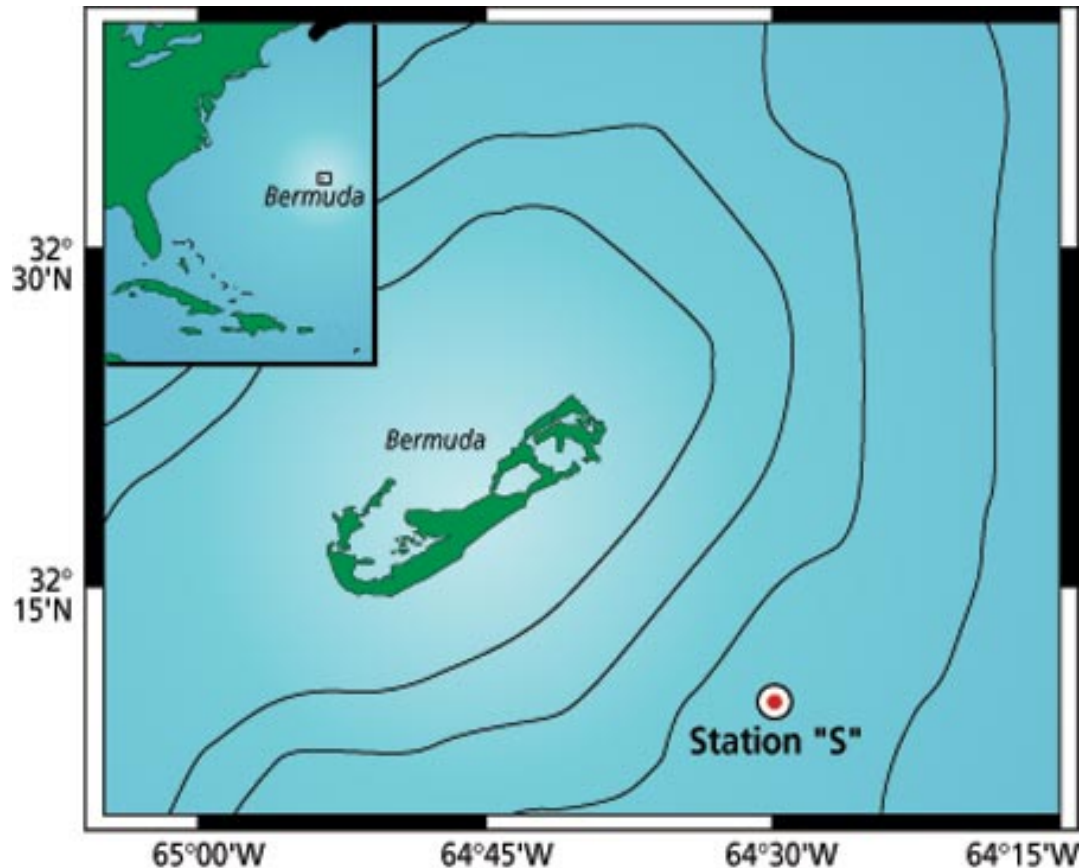
<http://www.cru.uea.ac.uk/cru/info/warming/>

Data isn't uniform in space or time



<http://www.oceanusmag.whoi.edu/v39n2/deser.html>

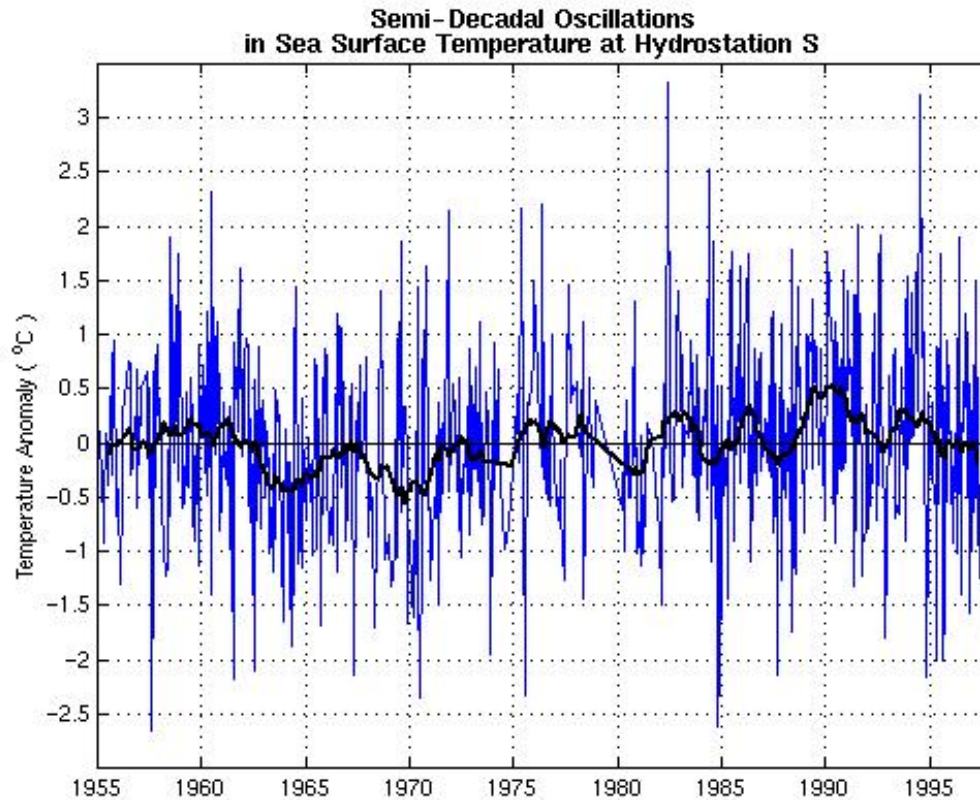
A single longterm record: Bermuda Station S



bi-weekly records since 1954.

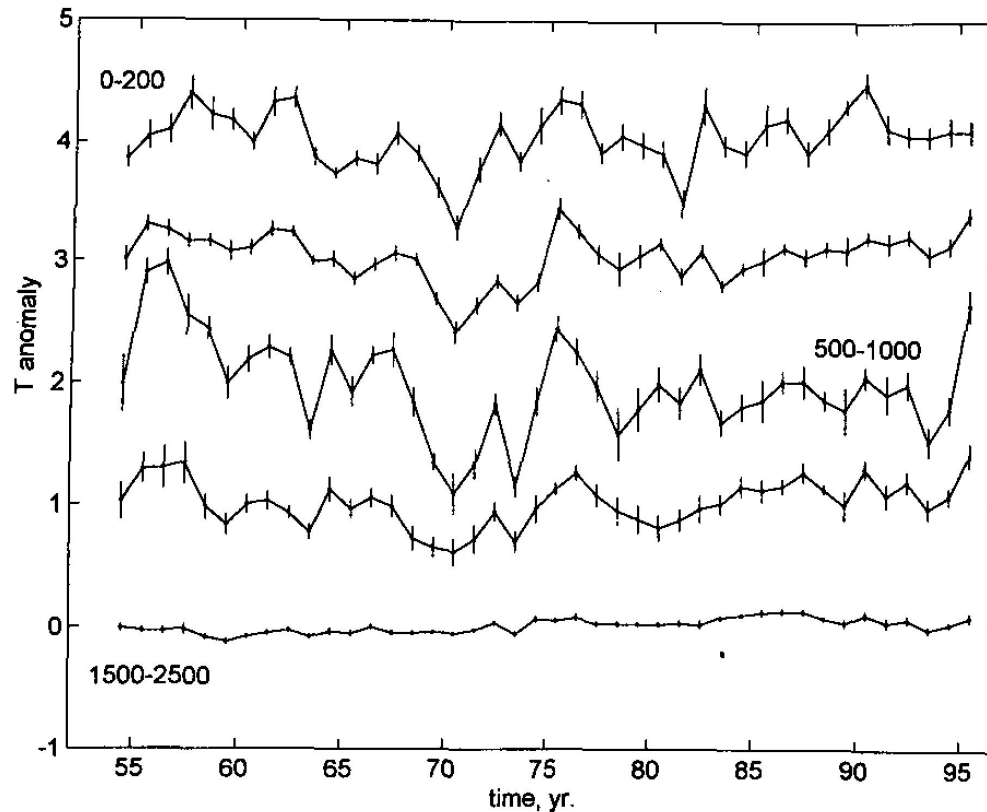
<http://www.oceanusmag.whoi.edu/v39n2/joyce.html>

Bermuda Atlantic Time-series: Is there a trend?



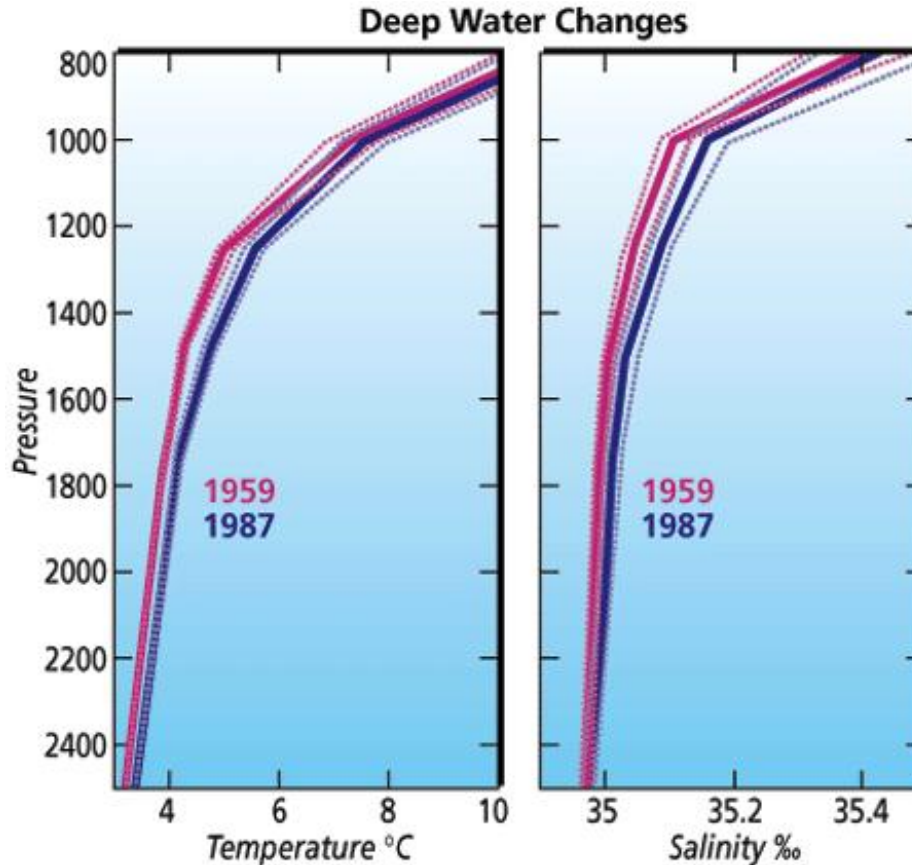
<http://www.bbsr.edu/cintoo/bats/bats.html>

Bermuda Atlantic Time-series: Is there a trend? (2)



Joyce and Robbins, J. Climate, 1996, vol. 9, 3121-3131.

Bermuda Atlantic Time-series: Is there a trend? (3)



<http://www.oceanusmag.whoi.edu/v39n2/joyce.html>

Example 2: Tracking Air Quality



<http://www.epa.gov/ttn/chief/index.html> <http://www.sdapcd.co.san-diego.ca.us/air/maps/today.html>

Example 2: Tracking Air Quality (San Diego County)

Ozone

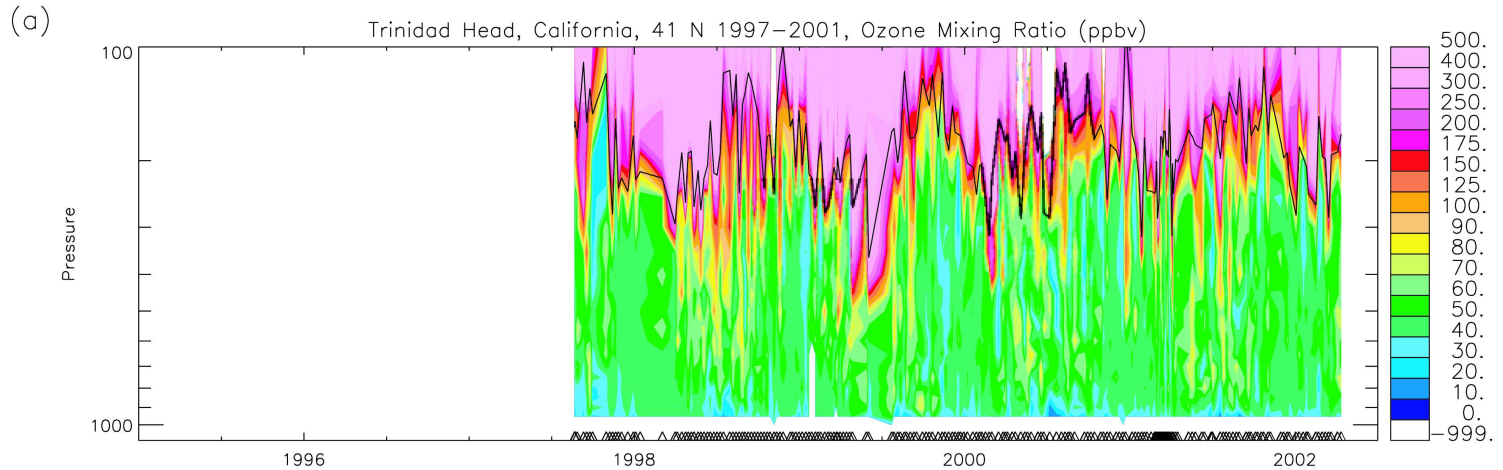
Number of Days Exceeding Federal and State Standards
San Diego County 1999-2003

Station	Number of Days Exceeding Federal 1-Hour Standard Concentration > 12 pphm					Number of Days Exceeding State 1-Hour Standard Concentration > 9 pphm					Maximum 1-Hour Concentration (pphm)					Date of Maximum 1-Hour Concentration				
	03	02	01	00	99	03	02	01	00	99	03	02	01	00	99	03	02	01	00	99
Chula Vista	0	0	0	0	0	0	1	2	0	4	8	12	10	9	11	10/28	9/1	9/30	4/30	4/19
El Cajon	0	0	0	0	0	1	2	3	5	3	10	10	12	11	10	9/21	8/9	5/8	4/25	2/28
Kearny Mesa	0	0	1	0	0	2	3	9	5	3	11	11	14	12	10	10/19	9/21	9/30	9/12	3/1
Del Mar	0	0	0	0	0	0	1	0	0	1	9	10	9	9	11	10/17	9/21	9/30	3/14	9/30
Escondido	0	0	1	0	0	3	2	4	6	1	11	10	14	12	10	9/21	9/1	9/30	9/16	8/25
Alpine	1	0	1	0	0	17	13	22	19	21	13	12	14	12	12	9/21	6/6	5/8	4/26	6/13
Downtown San Diego	0	0	0	0	0	0	0	1	1	0	8	9	10	12	9	4/9	9/21	9/30	9/12	2/28
Camp Pendleton	0	0	0	0	0	4	0	2	0	1	10	9	11	11	10	10/16	5/12	9/29	4/26	10/10
Otay Mesa	0	0	0	0	0	1	2	0	2	1	10	11	9	8	10	10/13	9/1	9/30	3/14	4/15
Basinwide	1	0	2	0	0	23	15	29	24	27	13	12	14	12	12	9/21	6/6	9/30	9/16	6/13

<http://www.sdapcd.co.san-diego.ca.us/air/reports/reports.html>

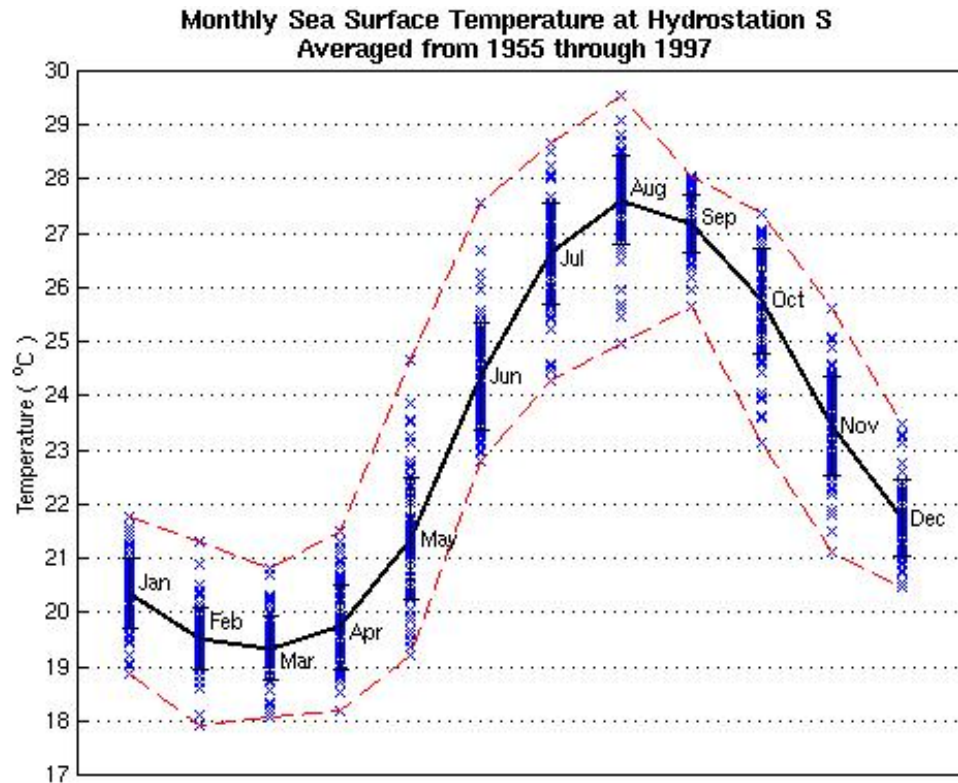
Example 3: Determining Annual Variability

Ozone in the troposphere

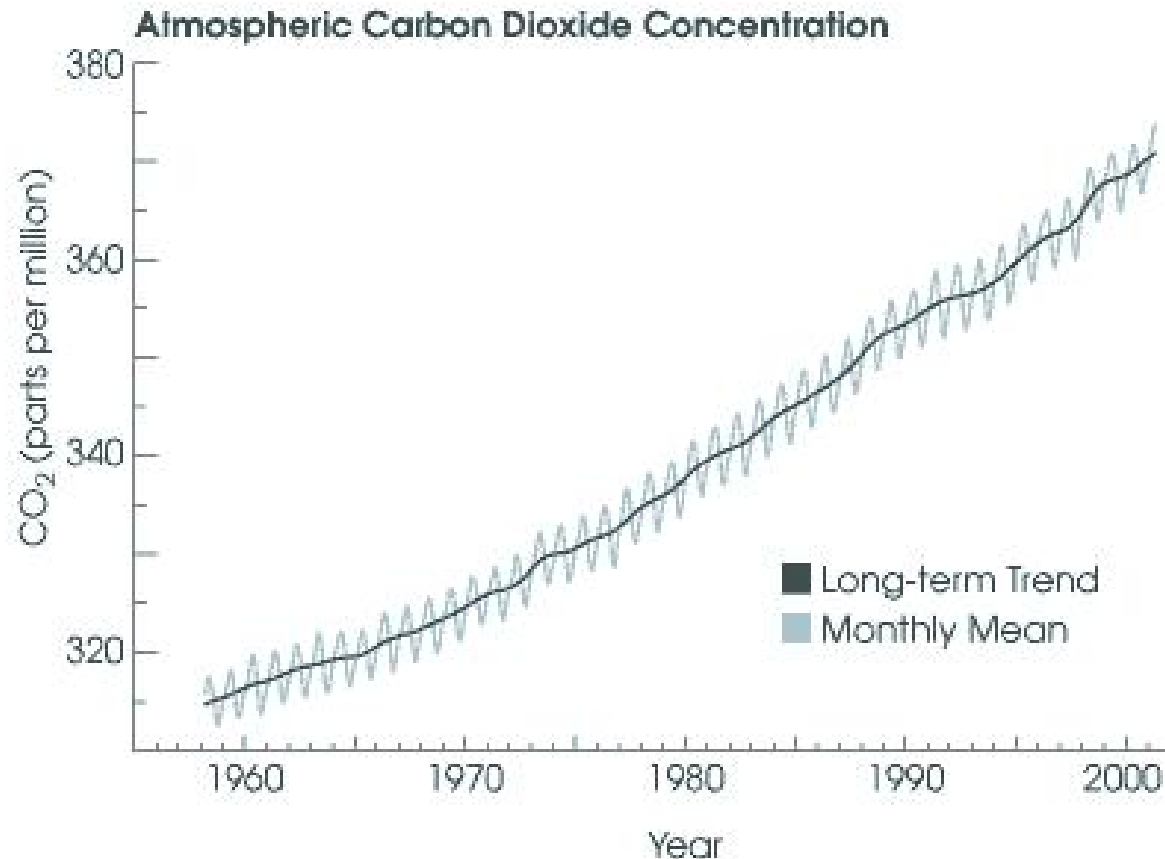


Newchurch et al., 2003: J. Geophys. Res., vol 108, D1, 4031.

Example 3: Determining Annual Variability (2)



Example 3: Determining Annual Variability (3)



http://www.visionlearning.com/library/module_viewer.php?mid=109&l=&c3=