

California Shore Station Program and Global Warming

Headwaters to Oceans Conference

28 October 2004

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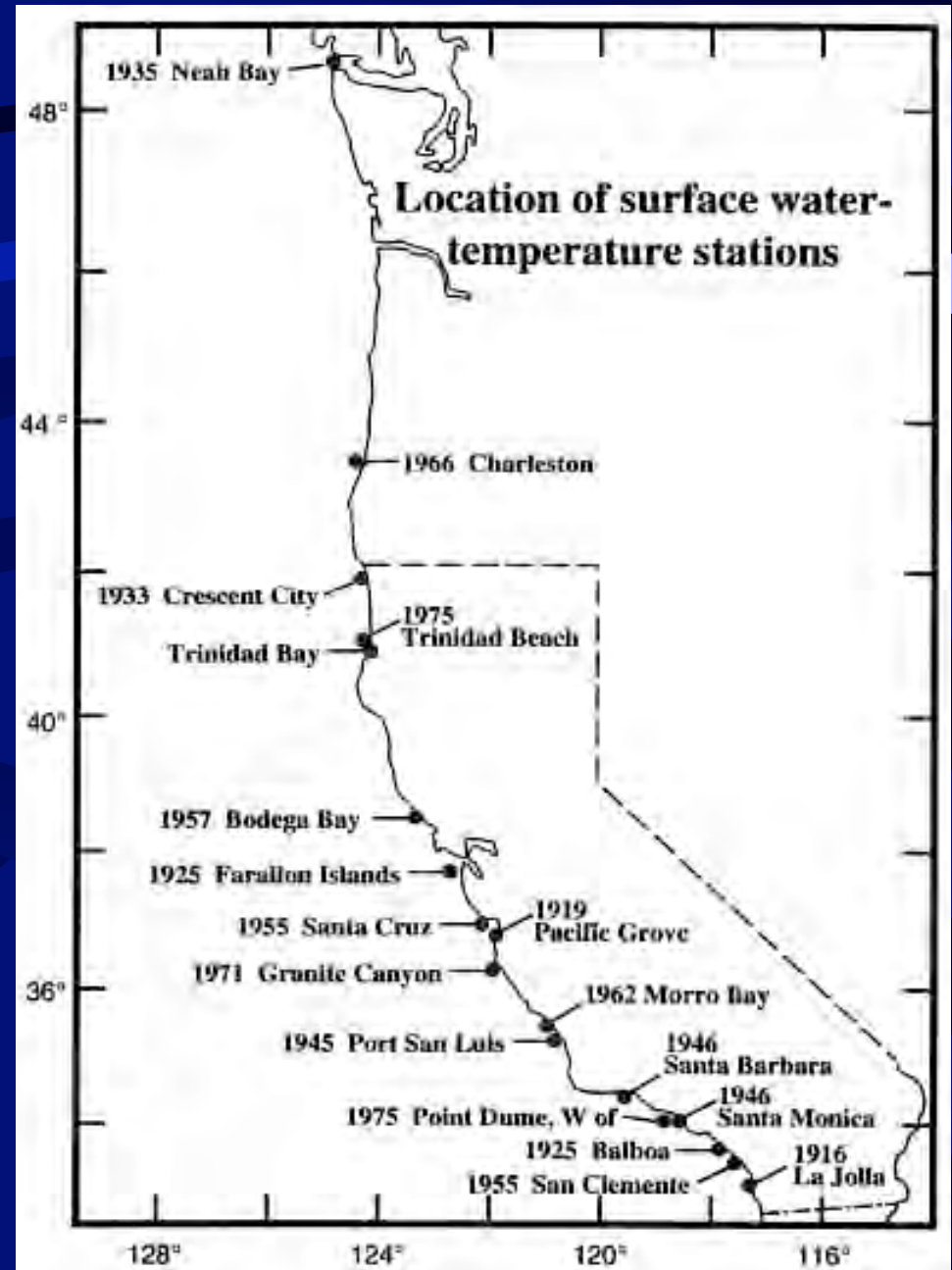
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California Shore Station Program

- 18 Stations – CA, OR, WA
- Volunteers
- Temperature
- Salinity
- Once-per-day



Shore Station Data Sheets

Week 34

DATA SHEET FOR OCEAN OBSERVATIONS

Station Seaside Pier Observer _____ Page 1

Sample No. Date Time	Latitude Longitude Section	Ther. No. Reading Loc. Temp.	Haul No. Appended Depth	Date Det. Weight Det. Temp. Latitude	Base No. Rider Printer	Sp. Gr. Sal. Pk.	REMARKS
9						34	

DATA SHEET FOR OCEAN OBSERVATIONS

Station Seaside Pier Observer Austrian Page 149

Sample No. Date Time	Latitude Longitude Section	Ther. No. Reading Loc. Temp.	Haul No. Appended Depth	Date Det. Weight Det. Temp. Latitude	Base No. Rider Printer	Sp. Gr. Sal. Pk.	REMARKS
31		19.5					
32		19.9					
32A		19.7					
33		19.7					
33A		19.7					
38		19.5					
38A		19.5					

88-year data record
extraordinarily valuable

SCRIPPS INSTITUTION OF OCEANOGRAPHY / UCSD

Station Seaside Pier Observer Austrian Page 149

Month Sept. Year '84 Time Zone PST (8+) Sheet No. 1 of 2

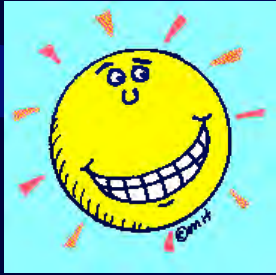
Latitude 32° 52' N Longitude 117° 15' W

Initials	Time of Obs.	Date	Air Temp °F			Water Temperature °C			Therm. Number	WIND		Weather	CLOUDS		Visi- bility	SEA	SWELL			Sample Numbers
			Max	Min	Procs	Surf	Bot.	Dir		Spd.	Typ		Amt	Dir			Per	Ht.		
RL	0900	1	70	64	68	22.4	21.8	7775			44	L6	8	92	01	280	7	1	31628 28331	
VL	1730	2	75	66	70	24.0	23.5	7775	260	10	02	L6	2	98	01	260	7	1	31625 28332	
UM	1155	3	71	66	68	22.6	22.5	7775	190	15	01	L6	8	98	02	240	8	2-3	31630 28333	
UL	1130	4	69	65	69	22.7	22.3	7775	310	3	02	L1	1	98	01	260	12	2	31631 28334	
UM	1100	5	80	60	78	22.6	22.3	7775			01	L1	2-3	08	02	280	12	3	31632 28335	
FP	1045	6	84	60	78	22.6	20.6	7775	250	10	02	-	0	99	01	280	10	2	31633 28336	
UL	1120	7	80	68	78	23.7	22.3	7775			44	L6	8	94	01	280	12	2	31634 28337	
UL	1000	8	80	65	72	22.8	22.4	7775	300	2	02	L6	2	98	01	280	10	2	31635 28338	
VL	1000	9	78	70	72	23.0	22.8	7775	320	4	02	L6	3	98	01	280	10	2	31636 28339	
UL	1000	10	78	72	74	24.2	22.6	7775	300	2	02	L1	2	98	01	280	8	2	31637 28340	
UM			80	70	75	24.9	23.9	7775	300	1	02	L4	3	97	01	270	8	2	31638 28341	
FN	1335	12	80	71	72	24.7	23.9	7775	285	7	02	L1	2	98	01	285	8	2	31639 28342	
FP	1015	13	74	67	70	23.1	23.2	7775	180	10	01	L6	3	97	02	280	6	3	31640 28343	
FN	1450	14	70	68	68		23.0	7775	200	18	00	-	-	99	02	285	7	2-3	31641 28344	
MA	1130	15	71	68	71	22.7	22.8	7775	250	15	02	-	0	99	02	270	07	03	31642 28345	
MA	1130	16	71	69	71	23.0	22.9	7775	290	15	01	L6	07	97	02	280	06	02	31643 28346	
UL	700	17	74	70	71	23.3	23.3	7775	295	12	01	L6	09	97	02	280	07	02	31644 28347	

** Please note any change in thermometer or thermometer calibrations.
If you need supplies or experience any problems preventing the collection of data, please contact shorestation@ucsd.edu or call (658) 534-6304.

Limitations of Shore Station Data

- Once-per-day sampling causes aliasing
- Seasonal and interannual fluctuations may disguise long-term trends
- Logistics, calibration tedious and error-prone



“Global Warming”

Interannual & Long-Term Climate Change

How do we determine & explain trends?

- Observational records over last 100 yrs



- Global & regional atmosphere & ocean models



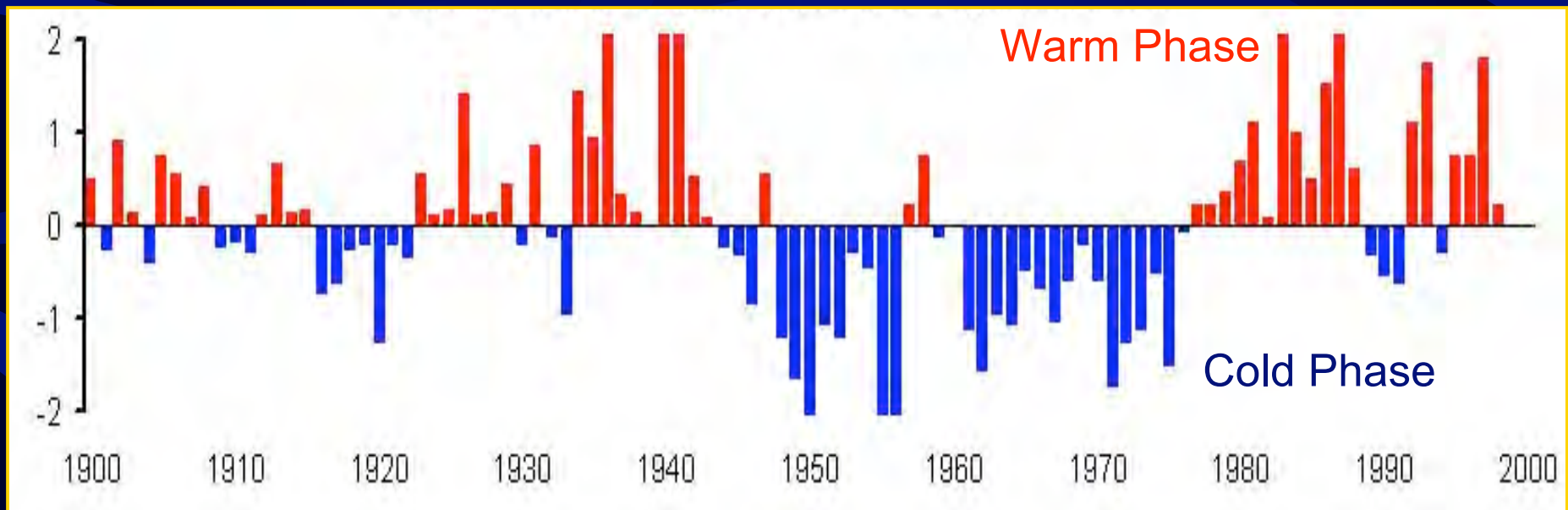
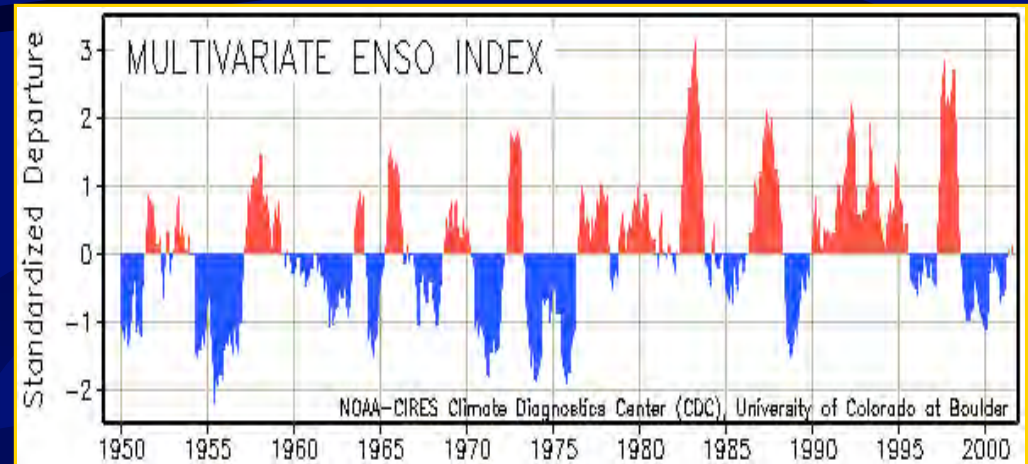
- Proxy records over centuries and millennia



Interannual and Inter-decadal Change

Pacific Ocean conditions drive temperature & storminess

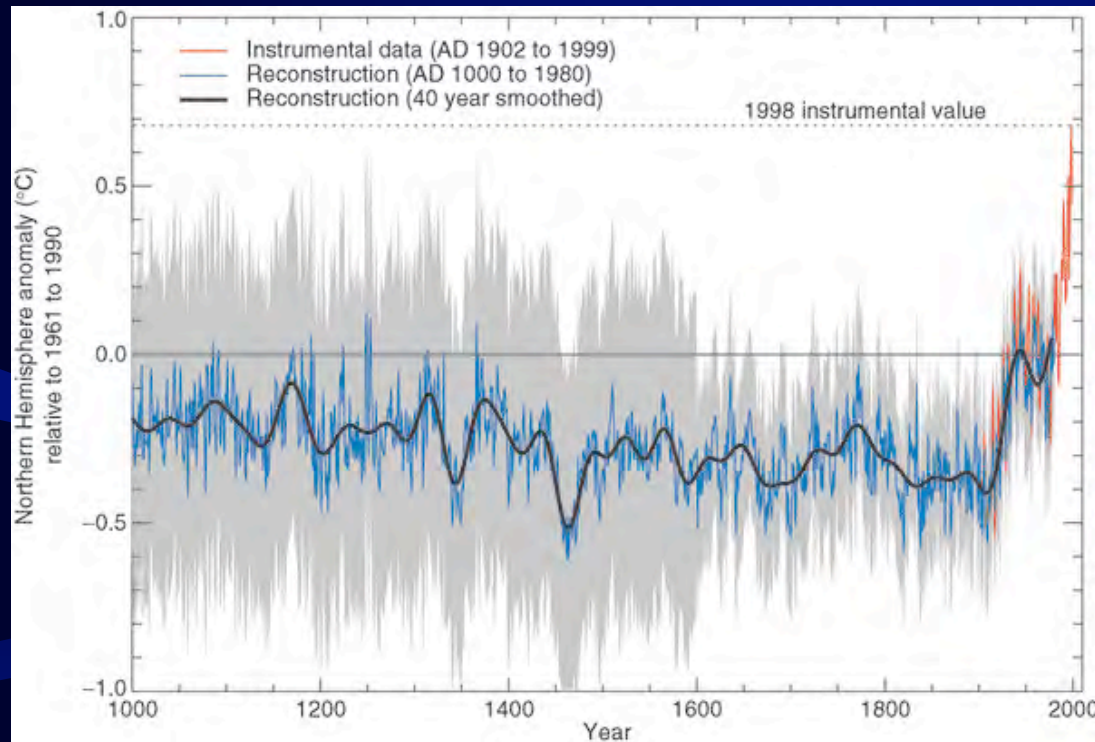
El Niño



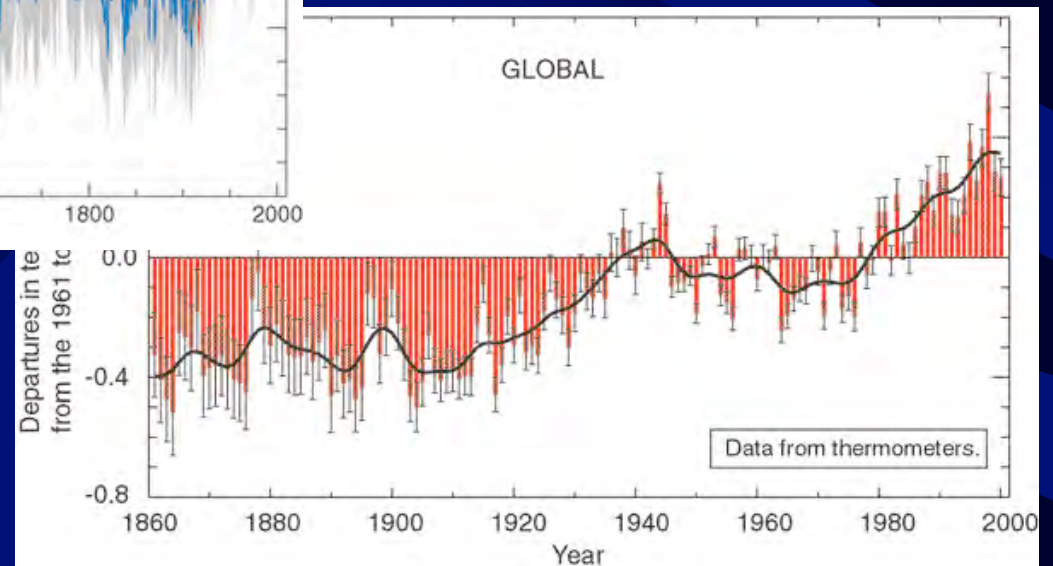
Pacific Decadal Oscillation

Global Warming

Solar cycles & greenhouse gases drive temperature & sea level



Increase of $0.6^{\circ} \pm 0.2^{\circ} \text{C}$
over last 100 yrs
“Greenhouse effect”?

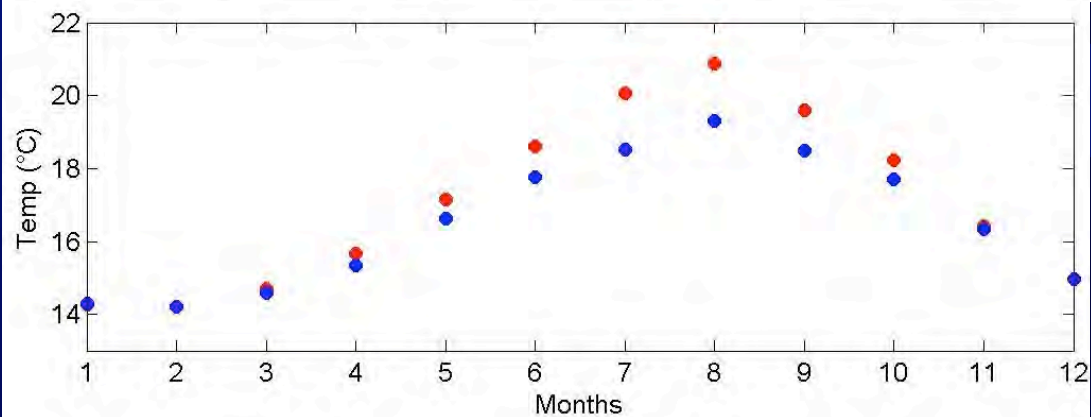
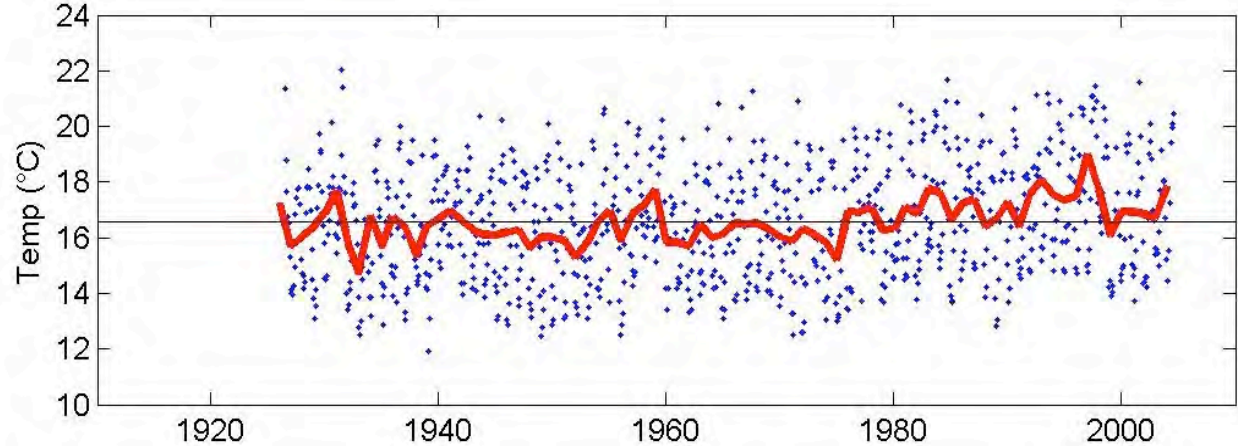
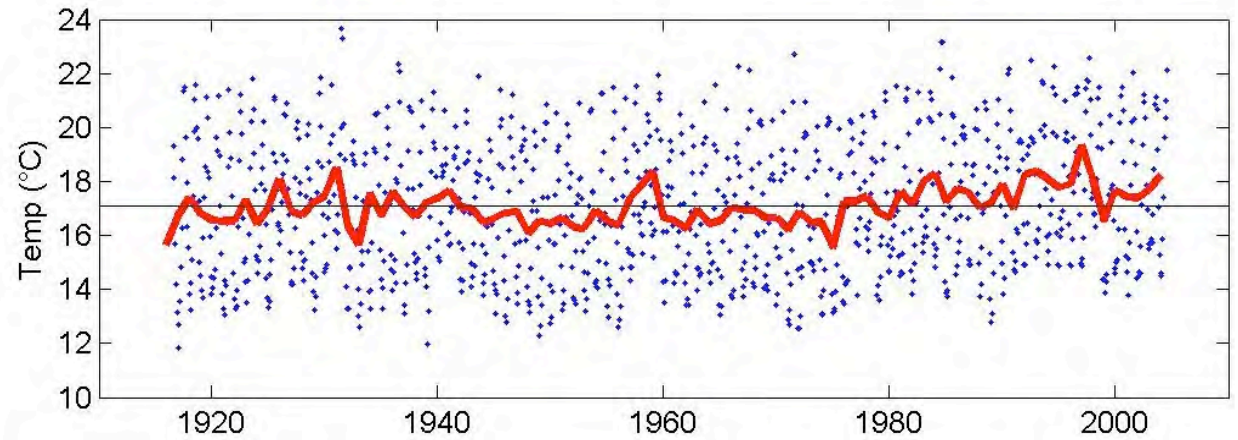


Combined air and sea surface temperature

Source: IPCC *Climate Change*
2001 http://www.grida.no/climate/ipcc_tar/wg1/012.htm#figTechSum2

SIO Pier Temperature

- Surface
- Bottom
- Seasonal

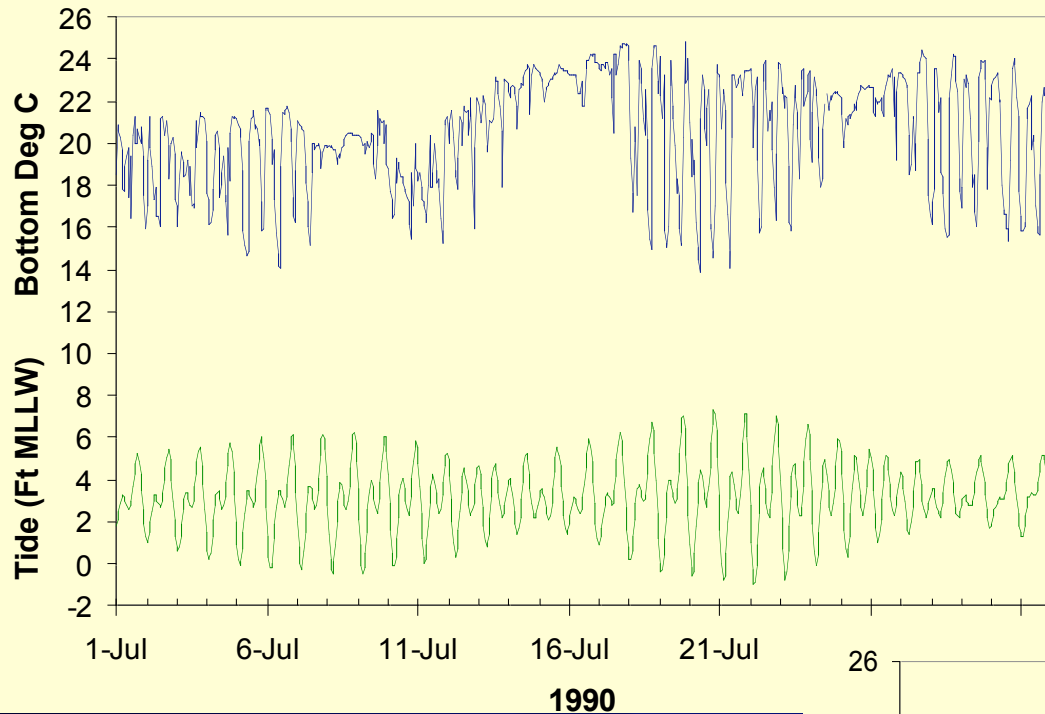


Additional Pier Data

Rapid 1-5 min electronic sampling, recording & dissemination

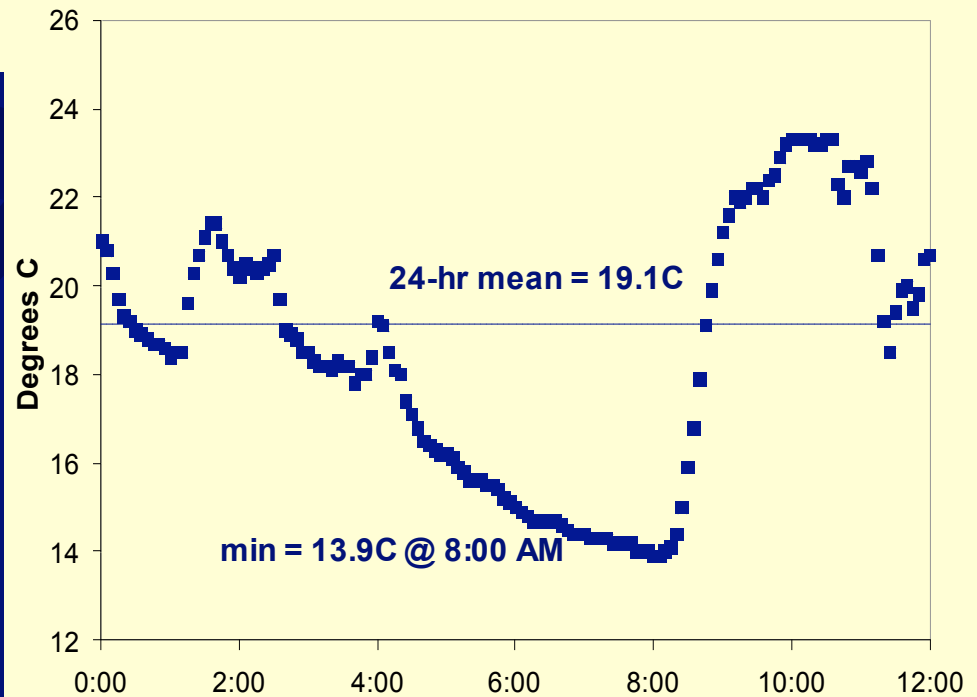
- SIO thermistors (1989 - 1995)
- Sea Grant thermistors (2001 - 2003)
- NEOCO moored CTD's (2002 - ongoing)

Internal Tides & Cold Surges Bias Daily Readings



Summer cold surges preferentially appear in the AM with spring tides

Average July 8 AM bottom temperature bias -0.5 C



Use and Abuse of Long-term Once-per-day Shore Station Data

- Evaluation & comparisons of data sets
- Account for biases in trend calculations
- Need for long-term data sets
- Keep Shore Station Program alive