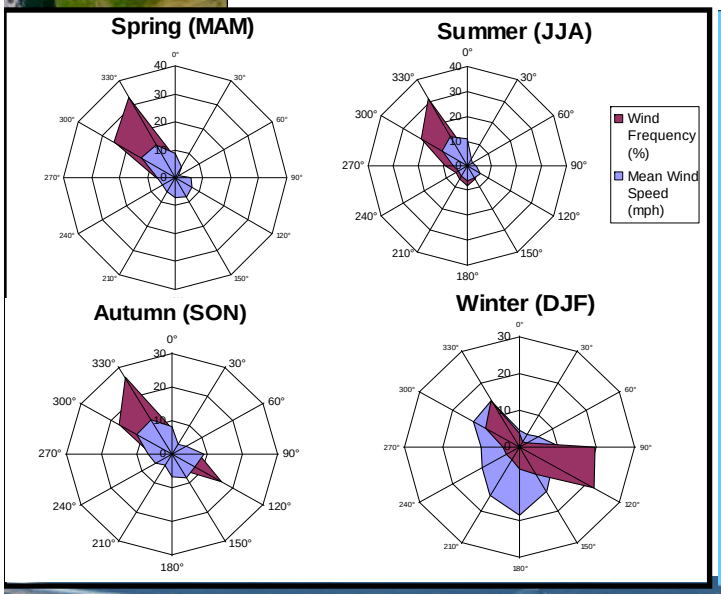
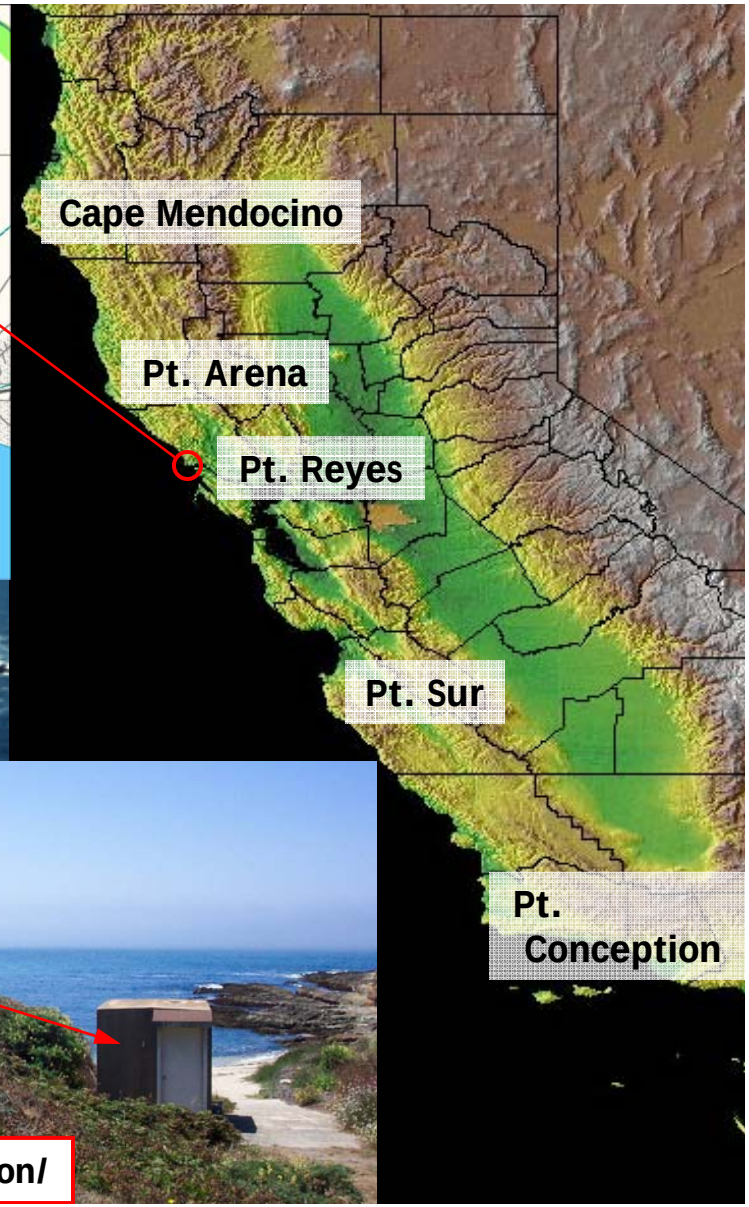
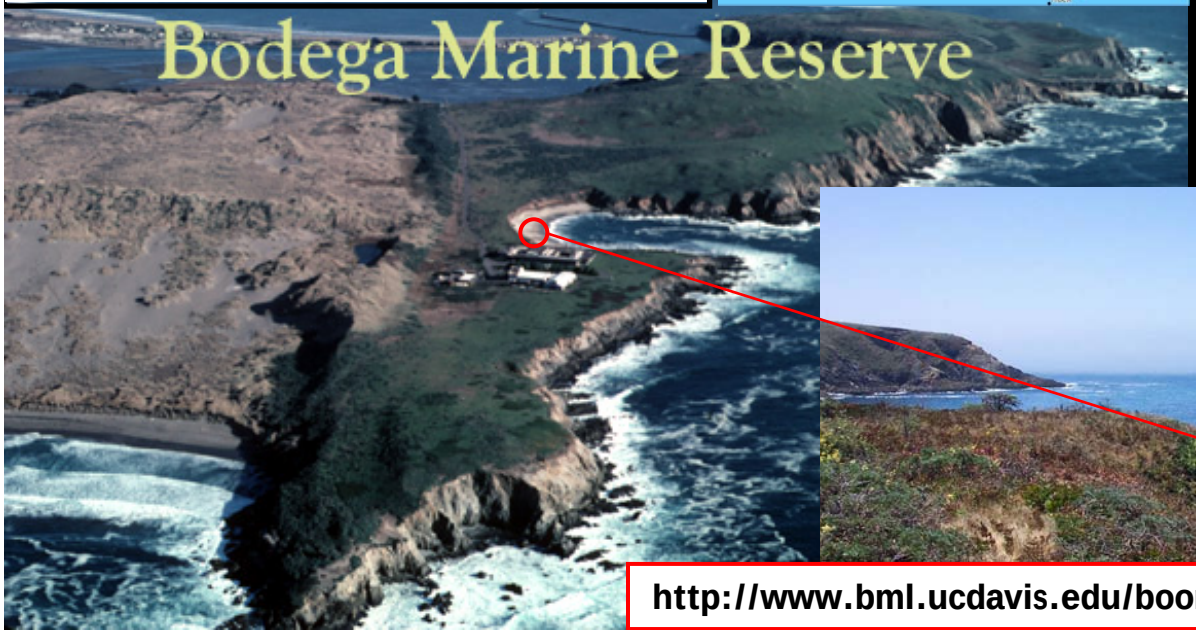
O_3 and CO from Bodega Bay and aloft: The photochemical boundary conditions of California

Bodega Marine Lab

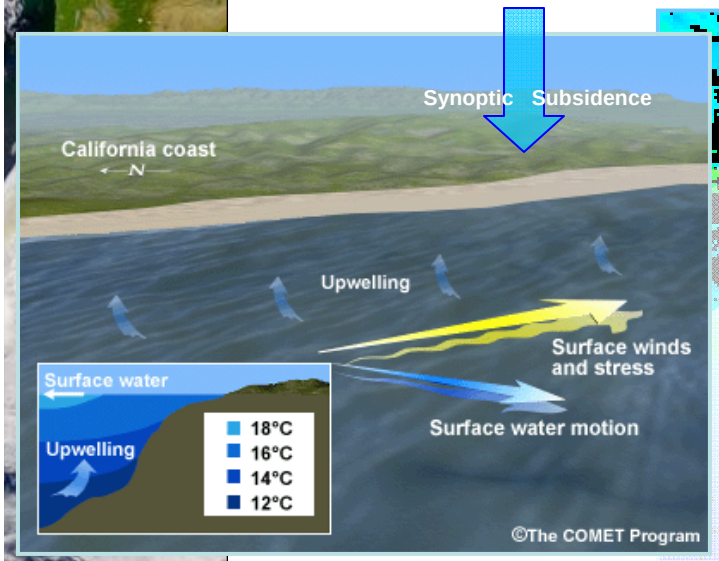


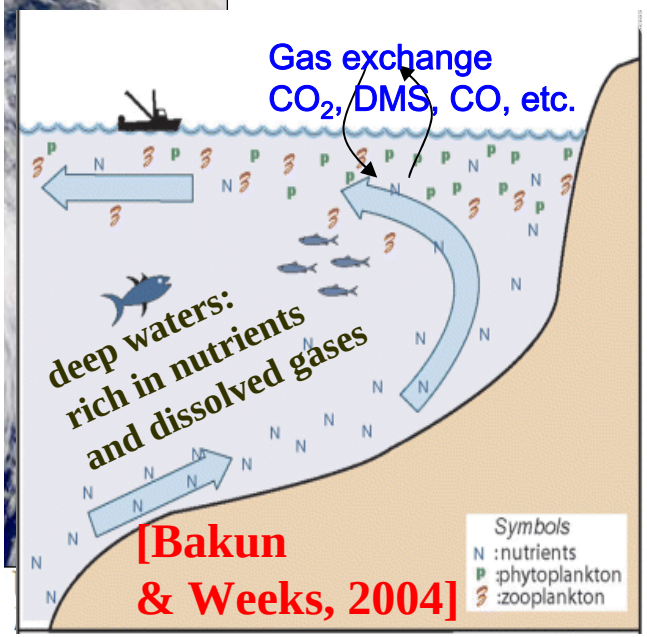




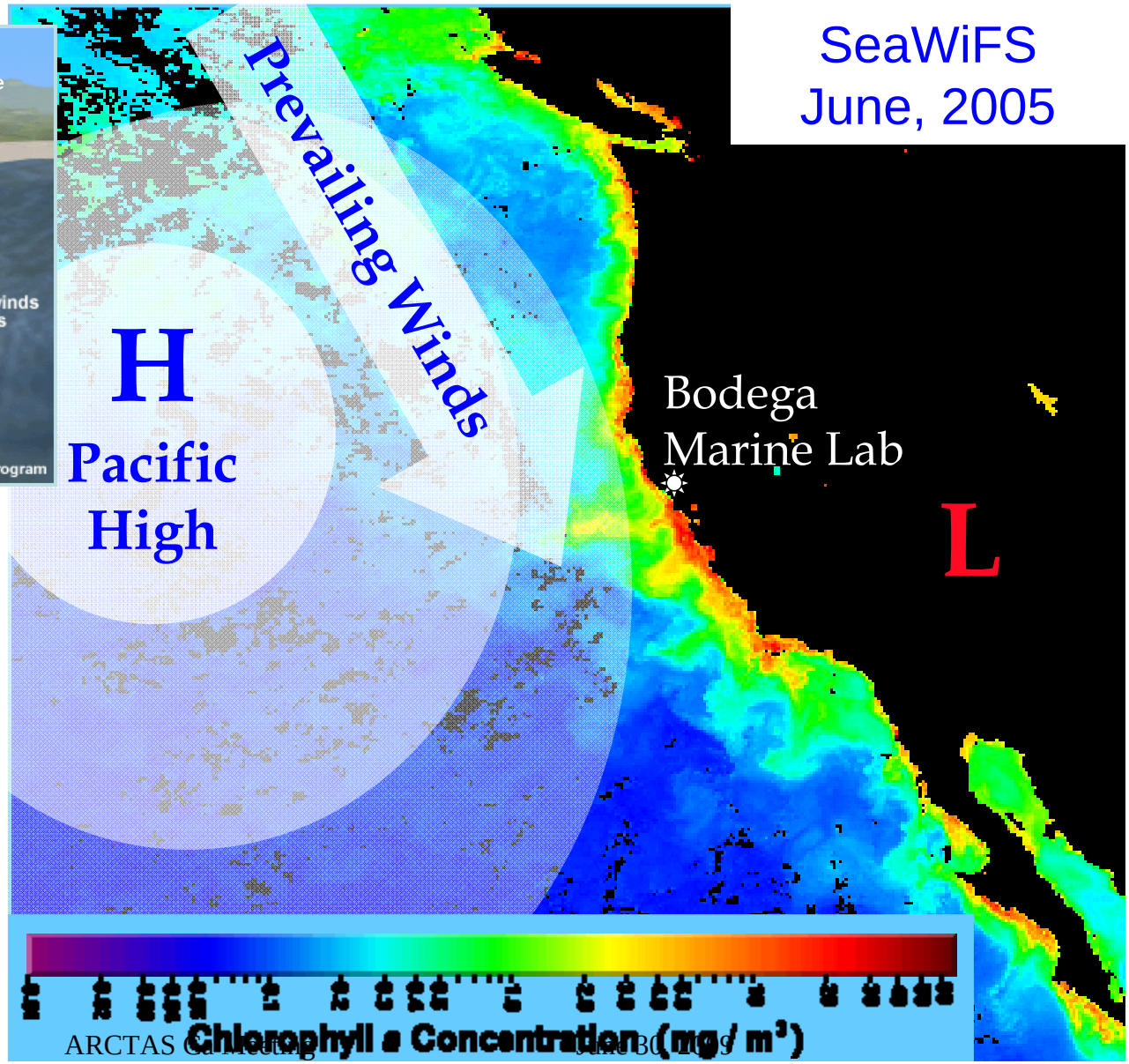
http://www.bml.ucdavis.edu/boon/

Coastal Biometeorology

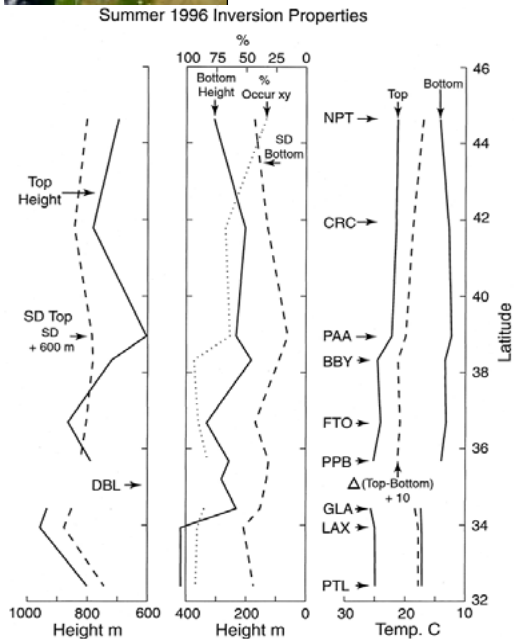




[Bakun & Weeks, 2004]

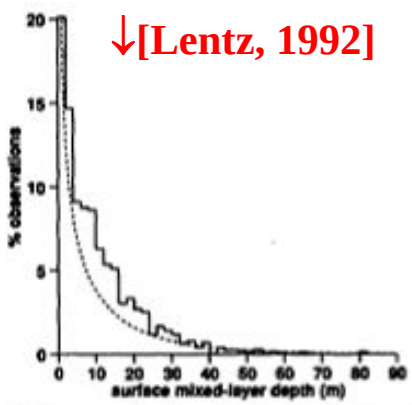


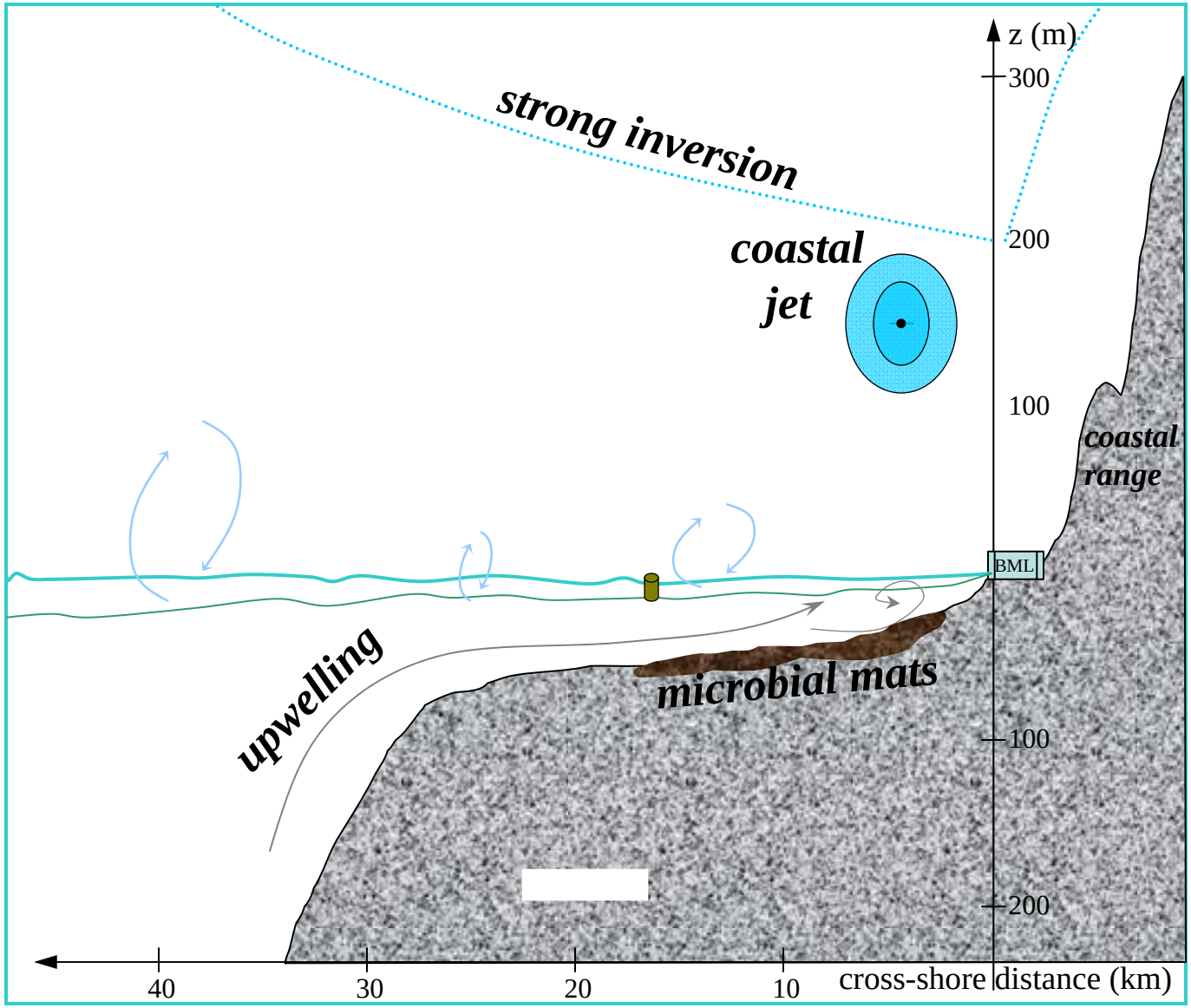
Strongly-Coupled, Shallow PBLs



↑[Dorman *et al.*, 2000]

↓[Lentz, 1992]





CO Monitoring

•Technique

VUV Resonance Fluorescence, Single Photon Detection

•Performance

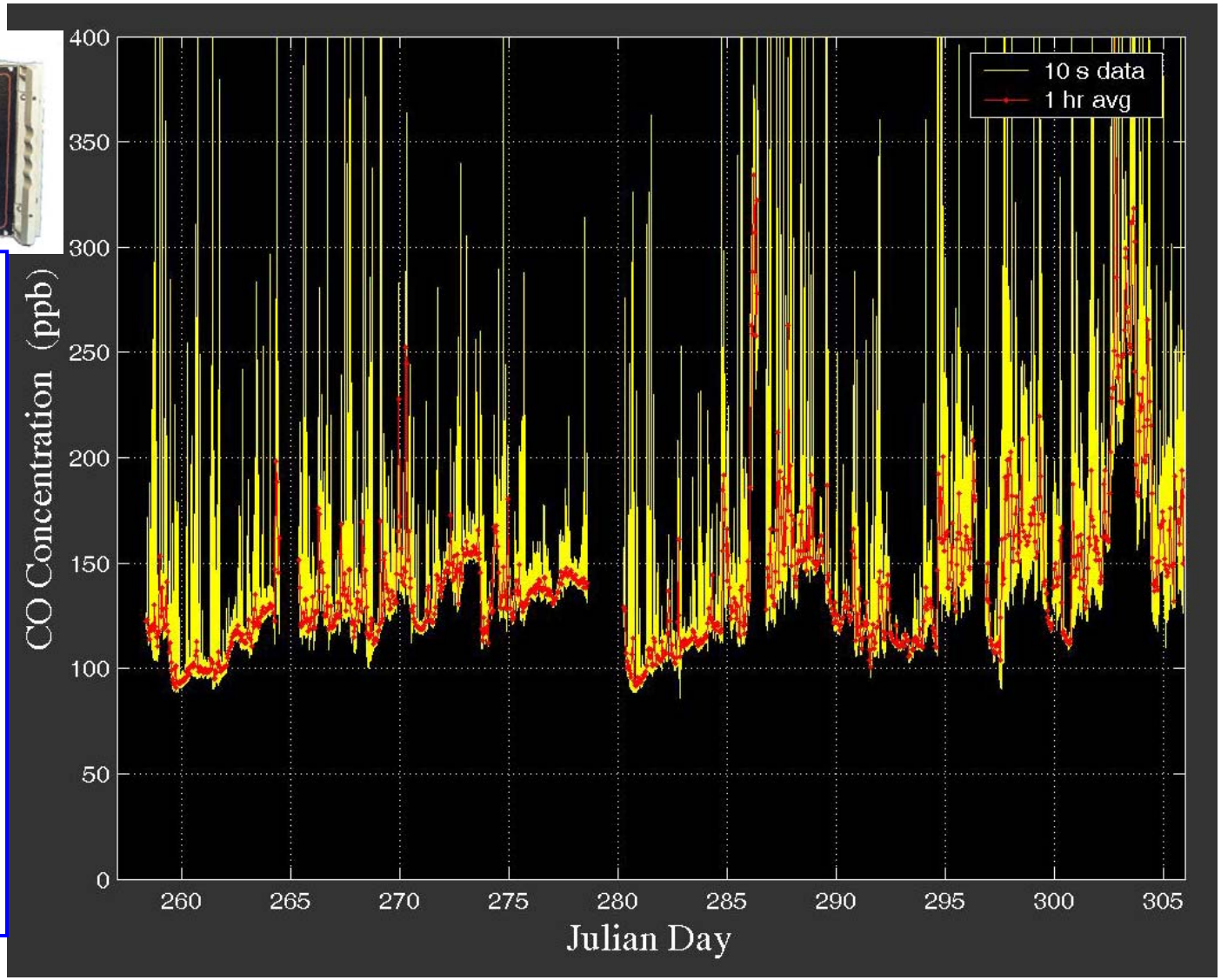
•Freq. Response: >1 Hz

•Precision (@ 1s & 100 ppb CO): ± 1.4 ppb

•Accuracy: ± 2%

•Detection Limit: < 1.5 ppb

[Gerbig *et al.*, 1999]



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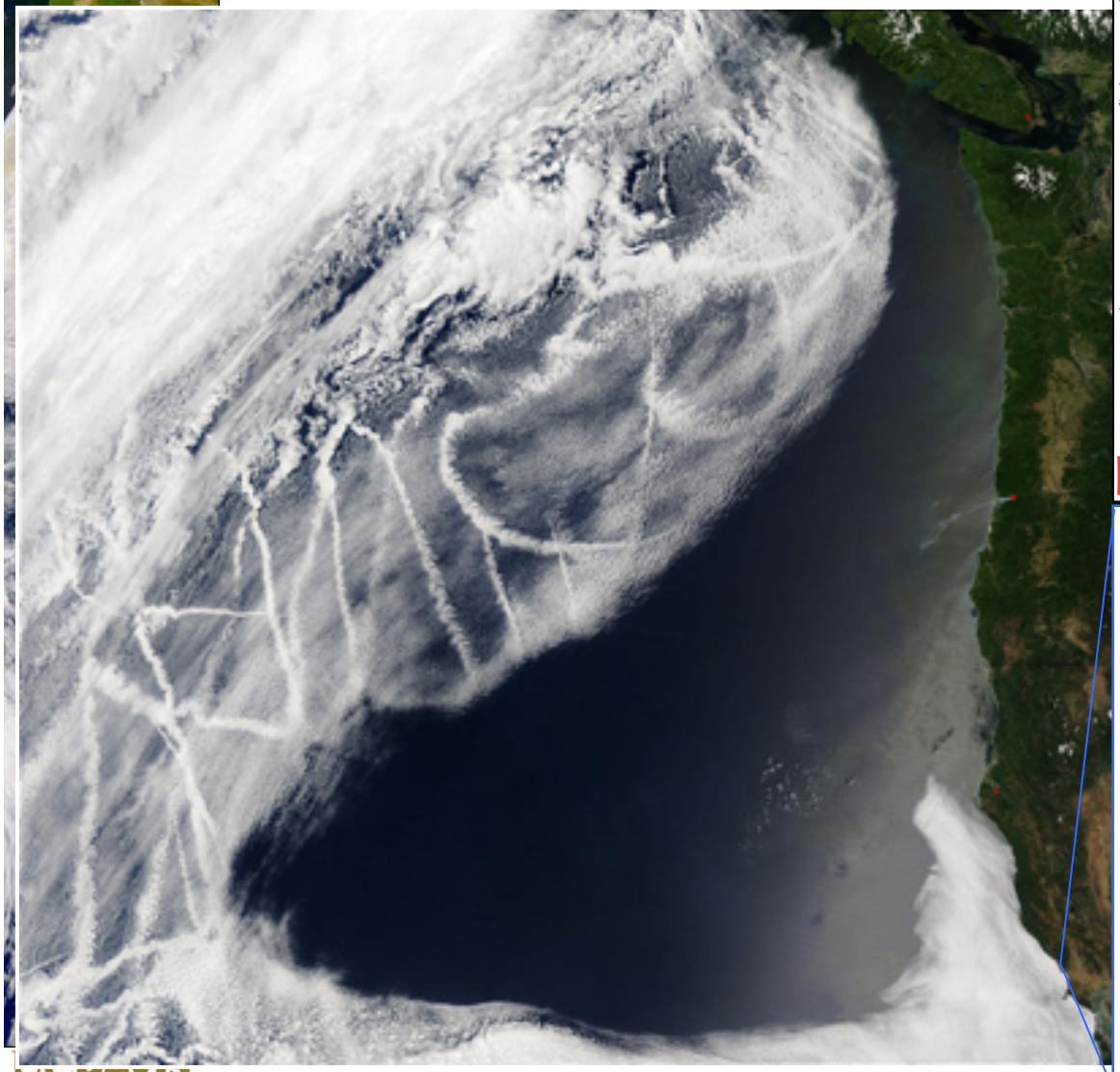
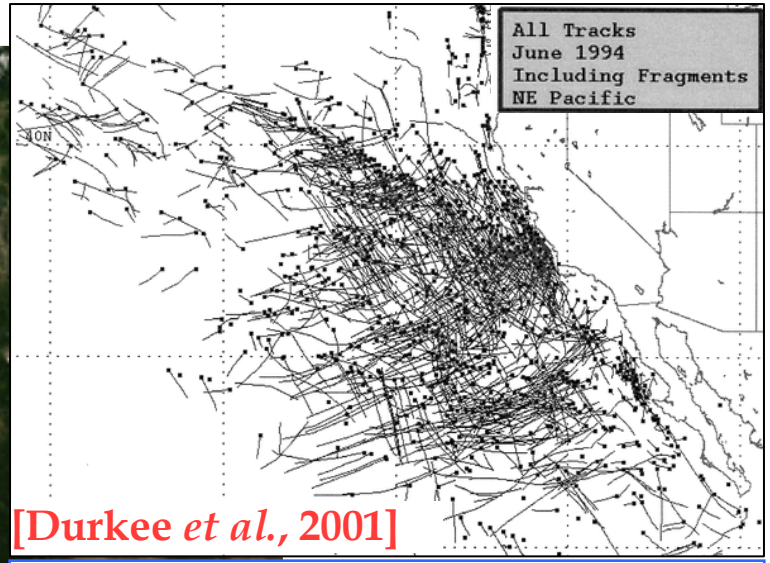
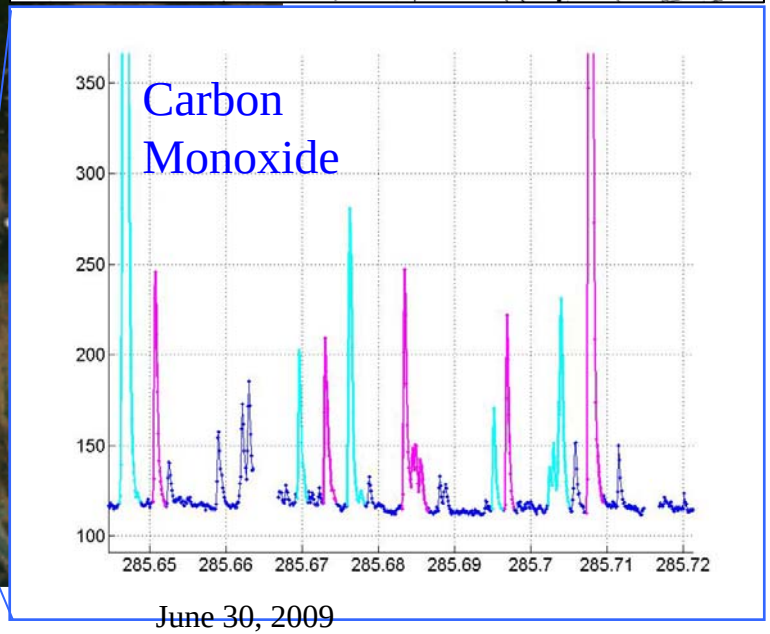
CO Spikes ⇒ Ship Emissions

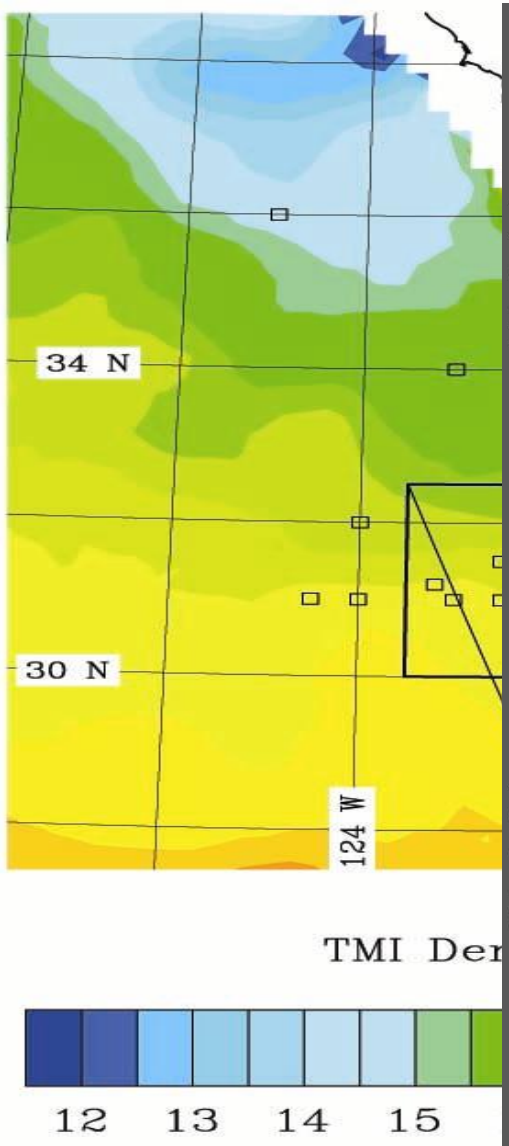


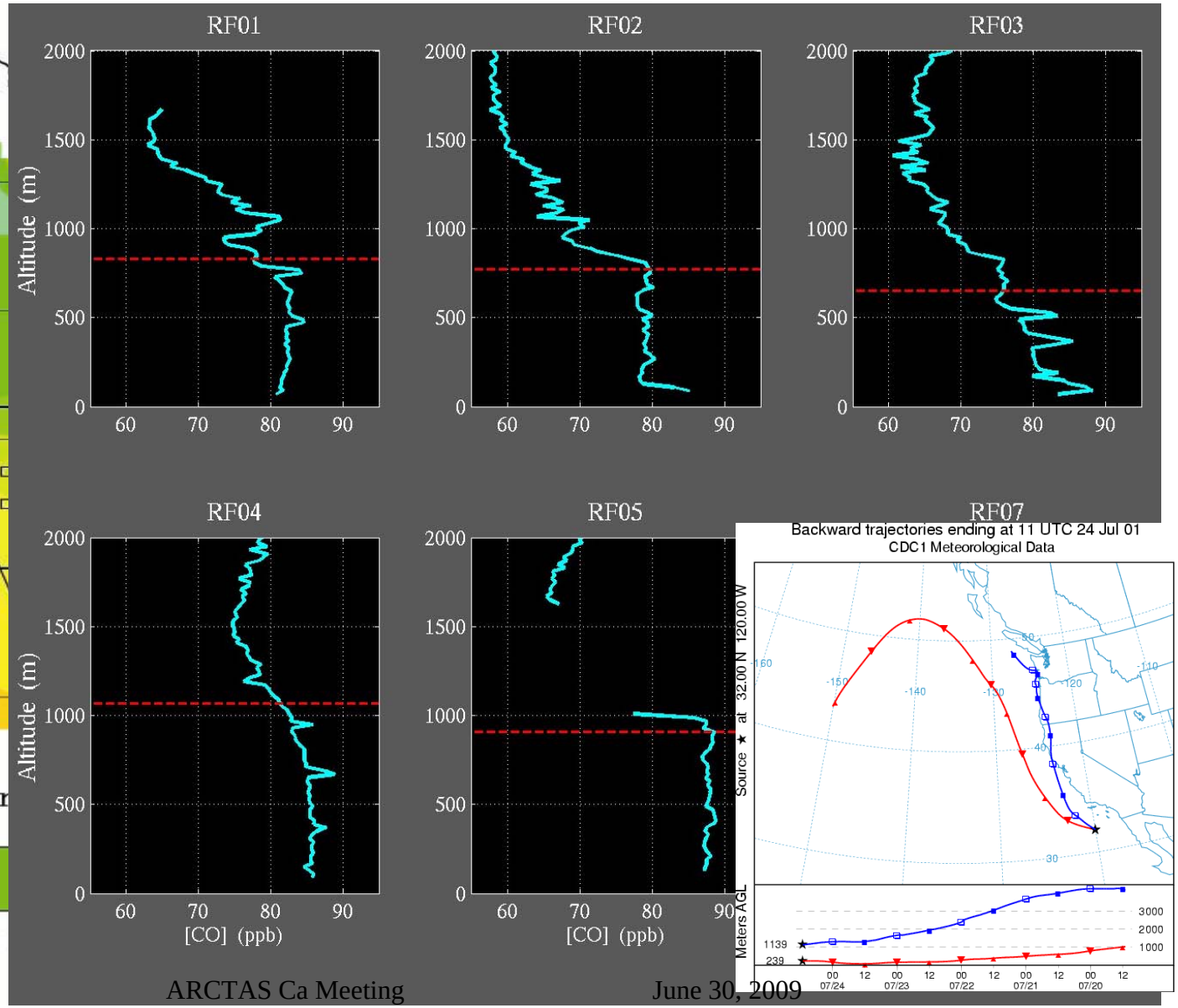


[Durkee *et al.*, 2001]

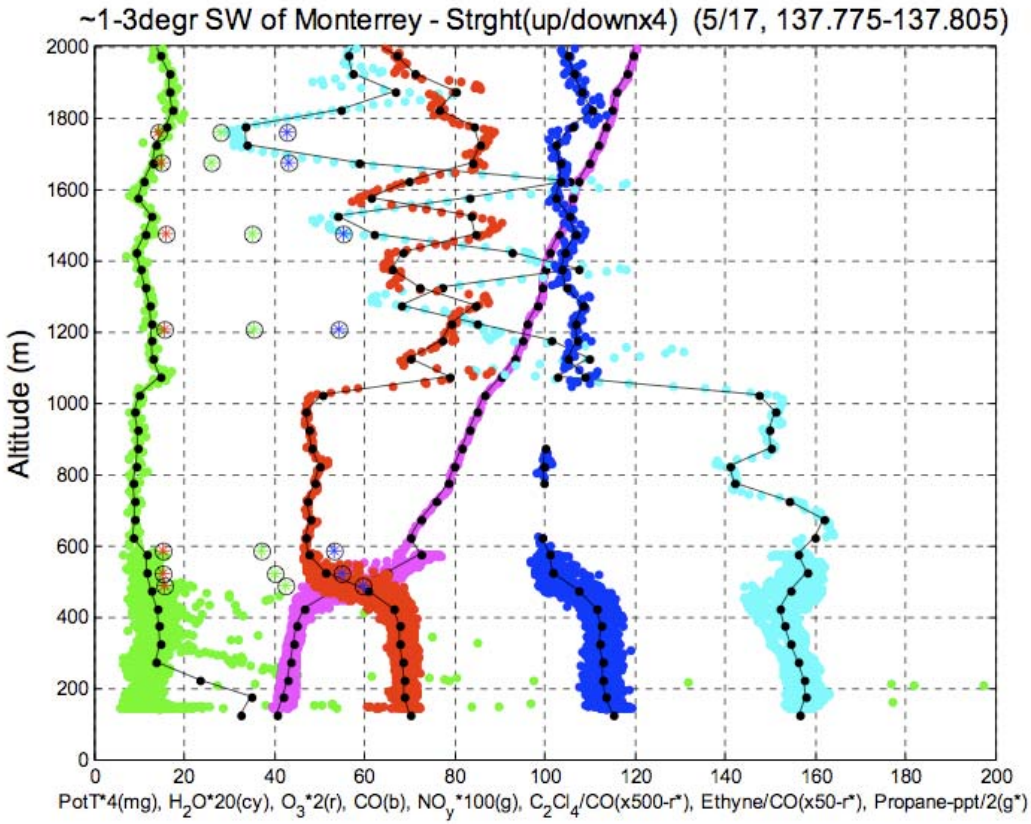


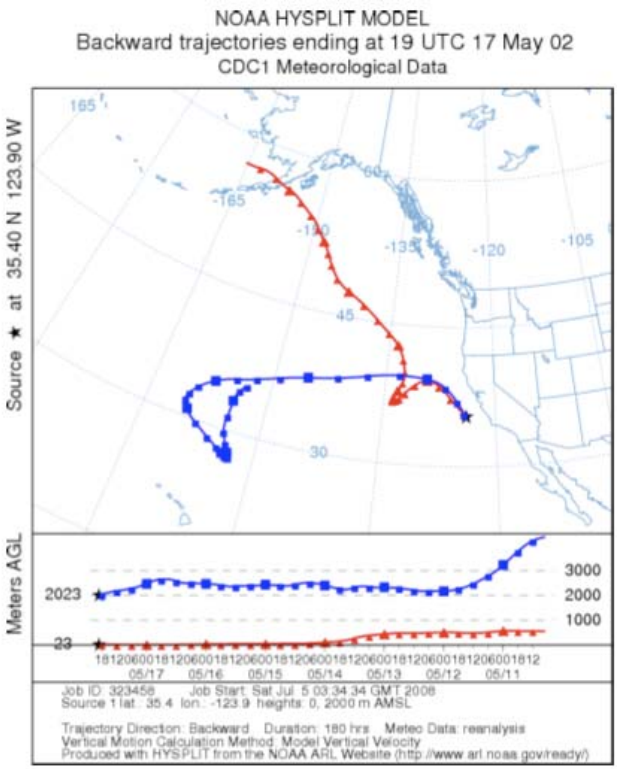
DYCOMS-II: MBL CO



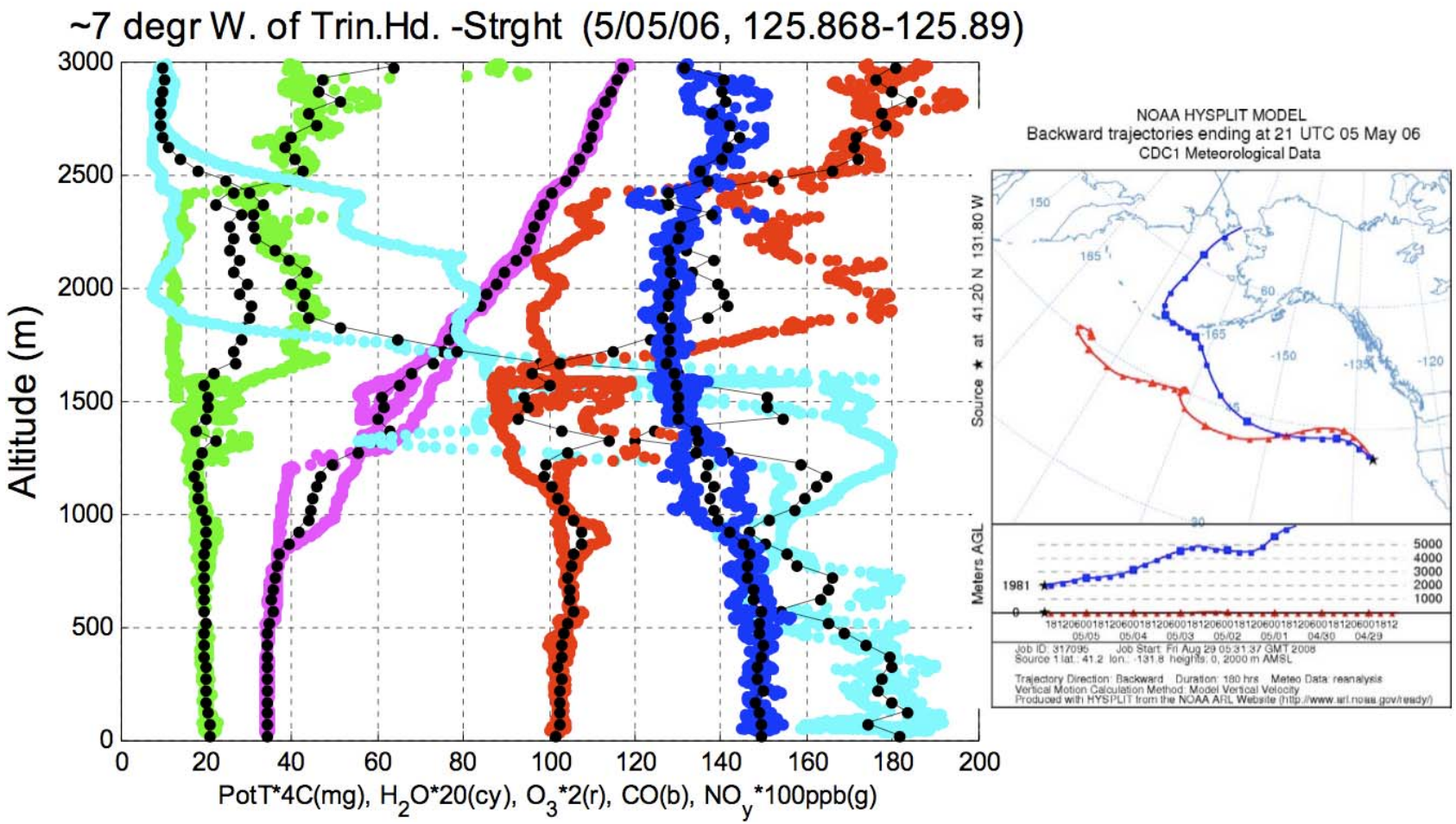


Aircraft Profiles: ITCT

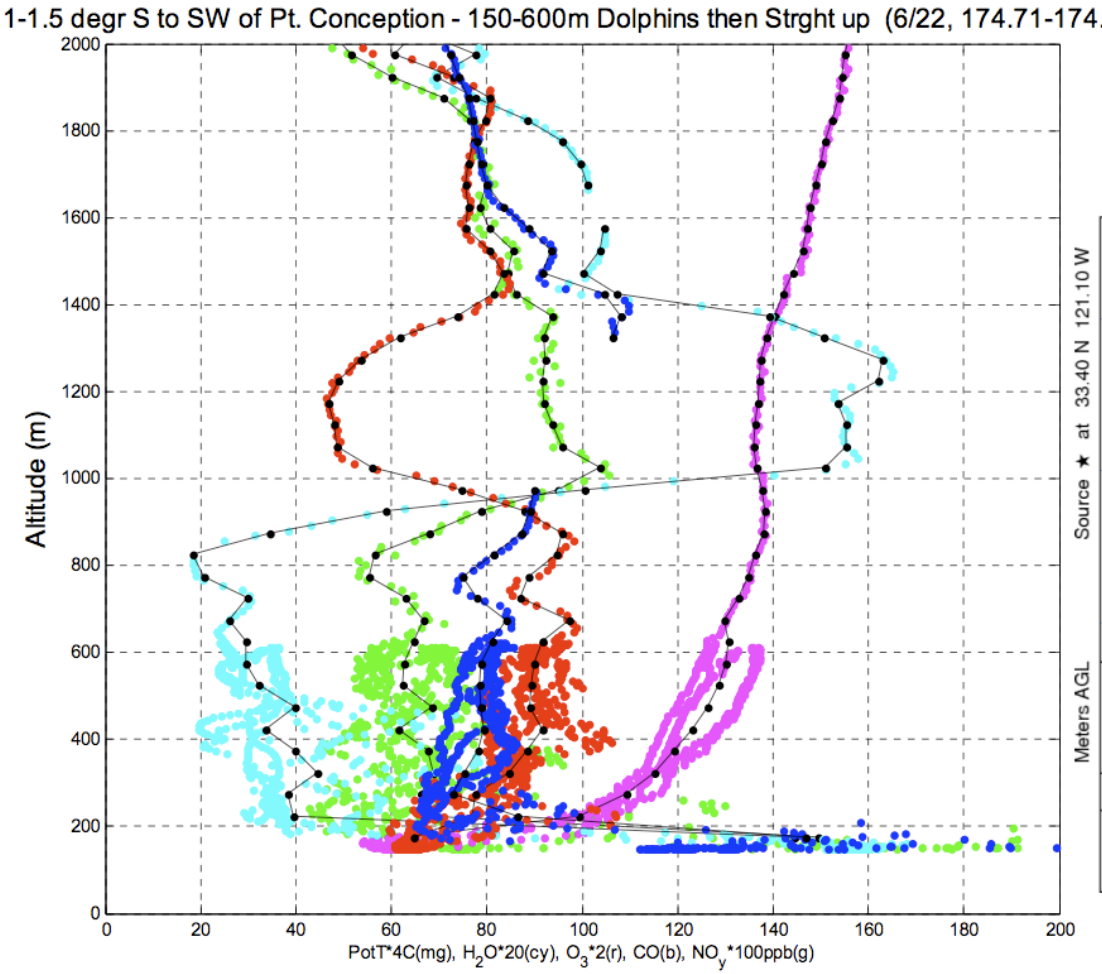


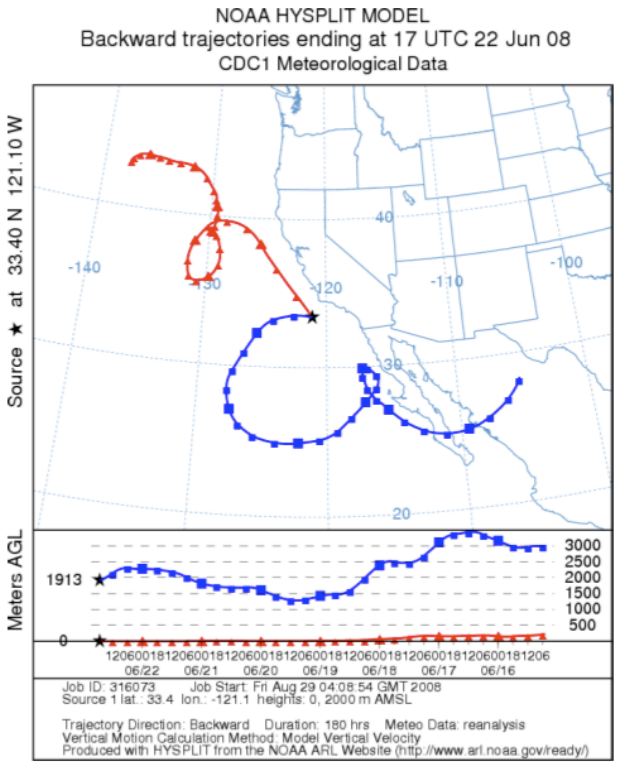


INTEX B:

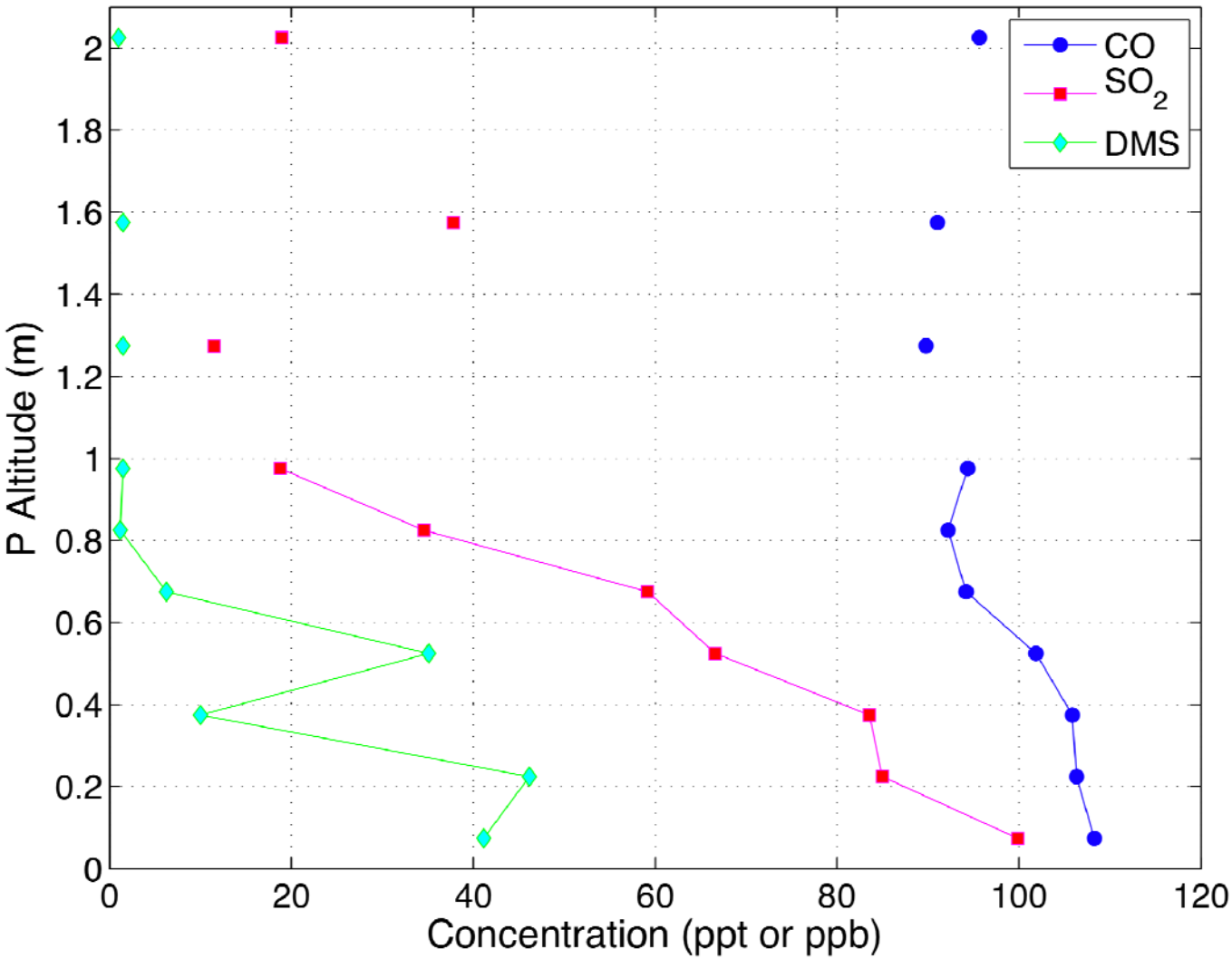

~7 degr W. of Trin.Hd. -Strght (5/05/06, 125.868-125.89)
Altitude (m)
3000
2500
2000
1500
1000
500
0
0 20 40 60 80 100 120 140 160 180 200
PotT*4C(mg), H2O*20(cy), O3*2(r), CO(b), NOy*100ppb(g)
NOAA HYSPLIT MODEL
Backward trajectories ending at 21 UTC 05 May 06
CDC1 Meteorological Data
Source ★ at 41.20 N 131.80 W
Meters AGL
5000
4000
3000
2000
1000
1981
05/05 05/04 05/03 05/02 05/01 04/30 04/29
Job ID: 317095 Job Start: Fri Aug 29 05:31:37 GMT 2008
Source 1 lat.: 41.2 lon.: -131.8 heights: 0, 2000 m AMSL
Trajectory Direction: Backward Duration: 180 hrs Meteo Data: reanalysis
Vertical Motion Calculation Method: Model Vertical Velocity
Produced with HYSPLIT from the NOAA ARL Website (http://www.arl.noaa.gov/ready/)

Aircraft Profiles: ARCTAS CA





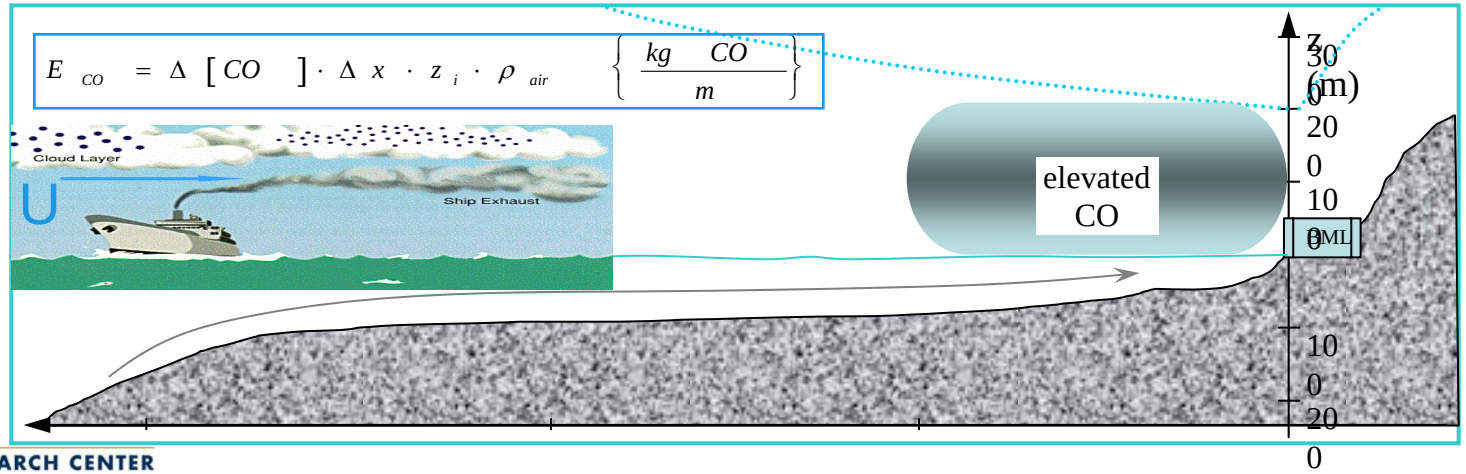
Compiled Offshore (>36 N)



Offshore CO Emission Estimates

ITCT boundary MBL-FT Gradients													
				Concentrations are for MBL and "jumps" are change moving from free trop to MBL									Entrainmen
					(m)	(ppb)	(ppb)	(ppb)	(ppb)	(ppt)	(ppt)	(ppt)	micromoles
Date	"Julian Time" (UTC)	Lat	Lon	Back Trajectory	MBL height	CO jump	CO conc	O3 jump	O3 conc	NOy jump	NOy conc	propane	CO flux (MI
	MEANS				**608.6**	**6.2**	**133.7**	**-5.4**	**40.8**	**-85.9**	**336.2**	**190.2**	**118**
DYCOMS-II profiles		Concentrations are for MBL and "jumps" are change moving from free trop to MBL											
2001													
					(m)	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)	(ppt)	**(micromol**
Flight:	"julian time"	Lat	Lon	Back Trajectory	MBL Ht.	CO jump	CO MBL	O3 jump	O3 MBL	NOy jump	NOy MBL	propane	**MBL CO Fl**
	MEANS					**8**	**83**	**-21**	**24**				**159**
					809								
ARCTAS boundary MBL-FT Gradients					(m)	(ppb)	(ppb)	(ppb)	(ppb)	(ppt)	(ppt)	(ppt)	micromoles
Date	"Julian Time" (UTC)	Lat	Lon	Back Trajectory	MBL height	CO jump	CO conc	O3 jump	O3 conc	NOy jump	NOy conc	propane	CO flux (MI
'6/18'	170.757	34.38	-121.18	Continental	550	15	87	8	44	250	650	nan	nan
'6/22'	174.716	33.44	-121.06	Marine	200	75	75	-12.5	33	-100	550	nan	1533
'6/22'	174.7535	34.85	-124.95	Marine	400	-15	93	-22.5	24	-150	250	nan	-307
'6/22'	174.7845	35.82	-126.78	Marine	600	-15	89	-25	25	200	500	nan	-307
'6/22'	174.8455	40.57	-125.66	Marine	600	-12	93	-20	25	0	220	nan	-245
'6/22'	174.94465	36.28	-121.98	Marine	300	-9	94	-28	25	-150	220	nan	-184
'6/22'	174.969	35.39	-121.32	Marine	250	30	110	-6	32			nan	613
	MEANS				**391.7**	**9.0**	**92.3**	**-19.0**	**27.3**	**-40.0**	**348.0**	**#DIV/0!**	**184**
INTEX-B boundary MBL-FT Gradients													
C-130 Profiles					(m)	(ppb)	(ppb)	(ppb)	(ppb)	(ppt)	(ppt)	(ppt)	micromoles
Date	"Julian Time" (UTC)	Lat	Lon	Back Trajectory	MBL height	CO jump	CO conc	O3 jump	O3 conc	NOy jump	NOy conc	propane	CO flux (MI
DC-8 Profiles	(INTEX-B)				(m)	(ppb)	(ppb)	(ppb)	(ppb)	(ppt)	(ppt)	(ppt)	micromoles
Flight Data (2006	Average Time	Latitude	Longitude	Back Trajectory	MBL height	CO jump	CO conc	O3 jump	O3 conc	NOy jump	NOy conc	propane	CO flux (MI
All Intex-B	**MEANS**				**880.6**	**2.1**	**145.9**	**-10.3**	**47.8**	**-95.3**	**225.6**	**#DIV/0!**	**43**
	MEDIANS				**1000.0**	**4.0**	**147.0**	**-10.0**	**49.0**	**-70.0**	**240.0**	**#DIV/0!**	**61**

$$E_{CO} = \Delta [CO] \cdot \Delta x \cdot z_i \cdot \rho_{air} \left\{ \frac{kg\ CO}{m} \right\}$$



➔220 $\mu molm^{-2}d^{-1}$

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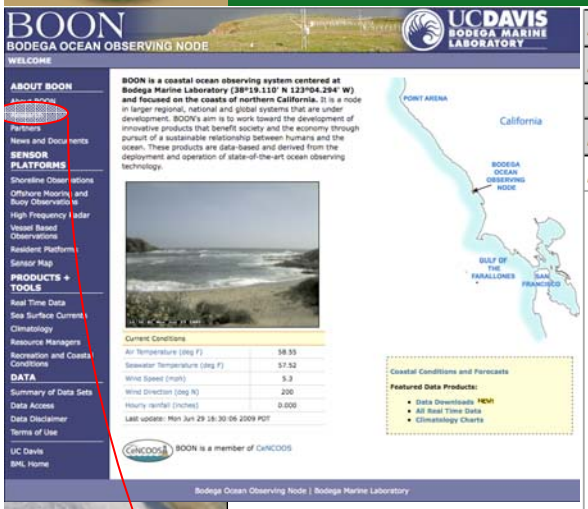
http://www.bml.ucdavis.edu/boon



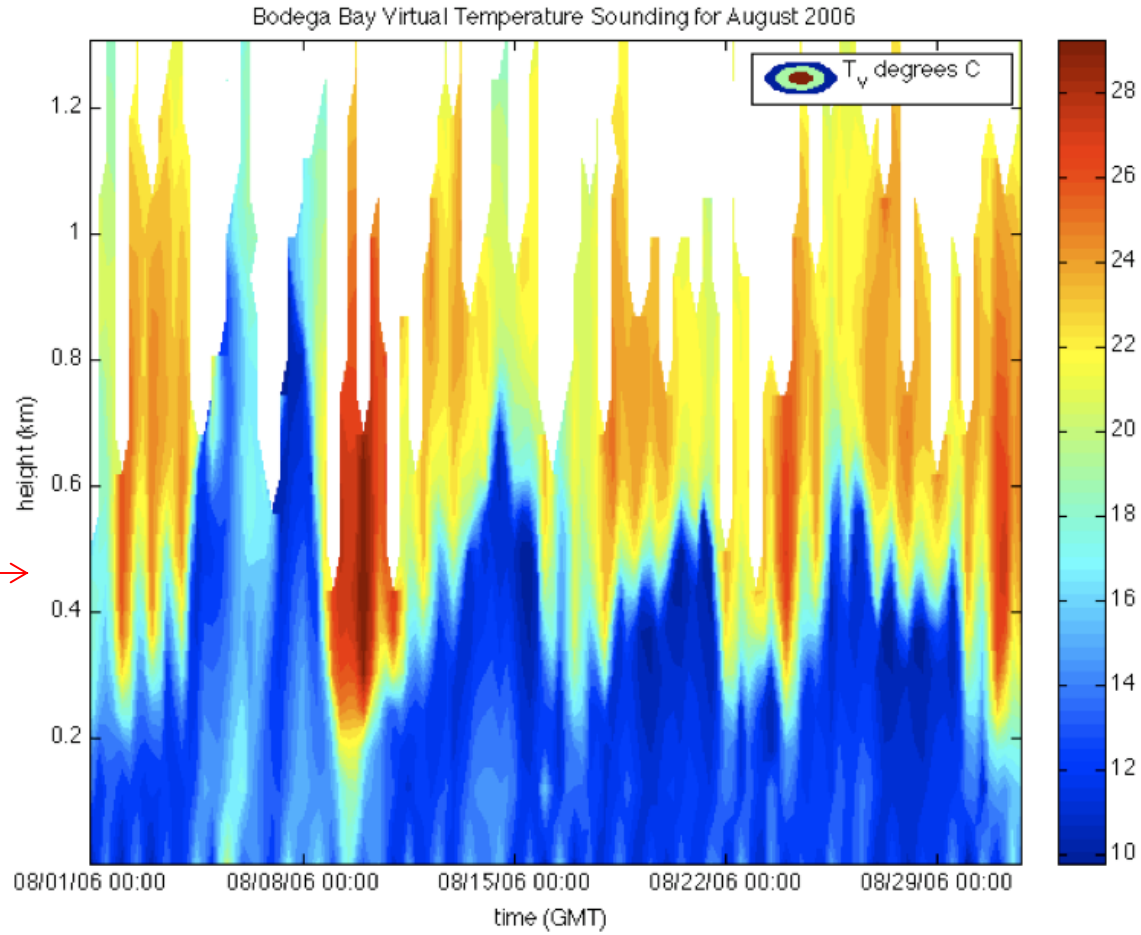
July 2007

June 2007

May 2007

April 2007

August 2006



July 2006

June 2006

May 2006

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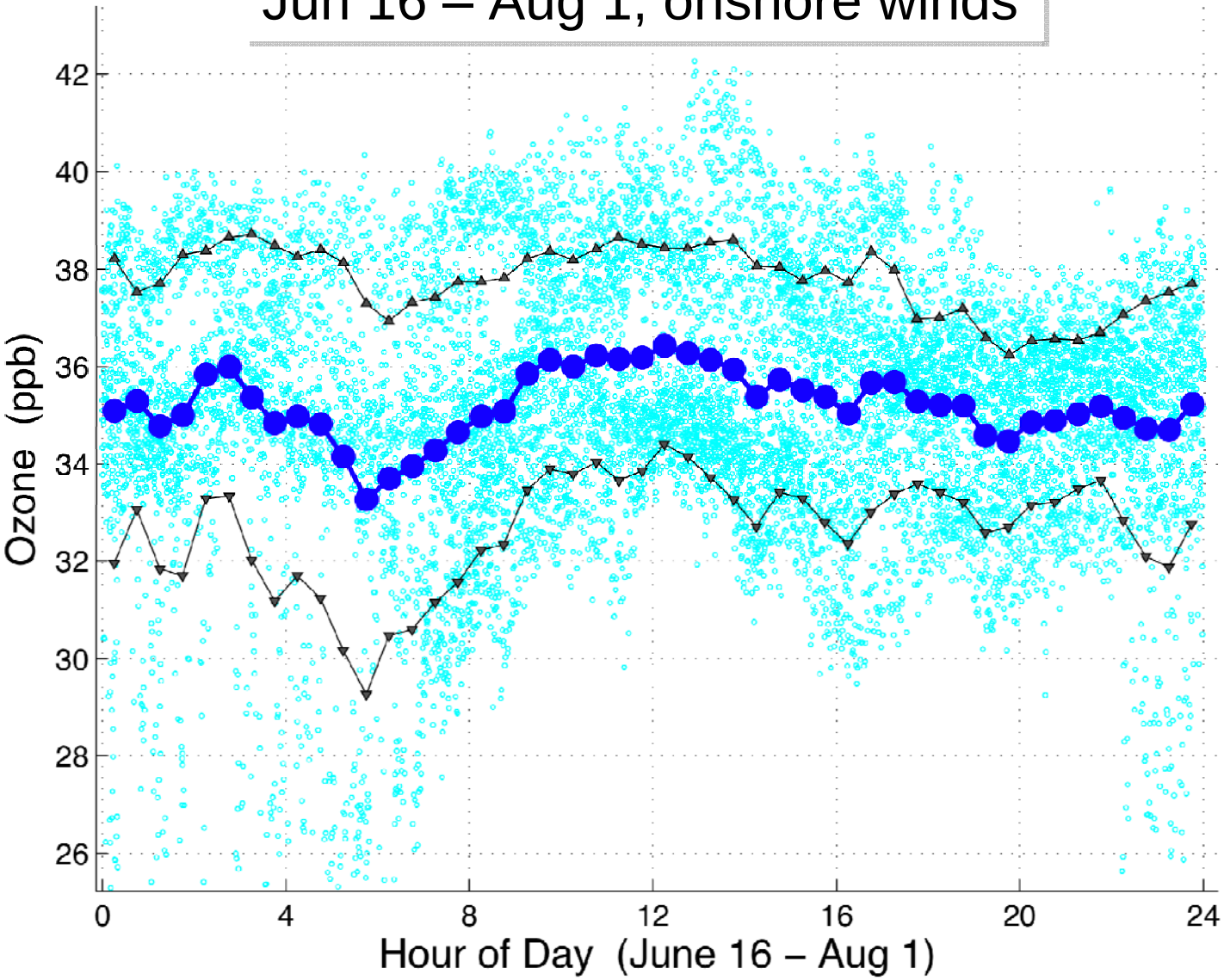
Ozone Monitored (Jun-Dec 2008)

Jun 16 – Aug 1, onshore winds



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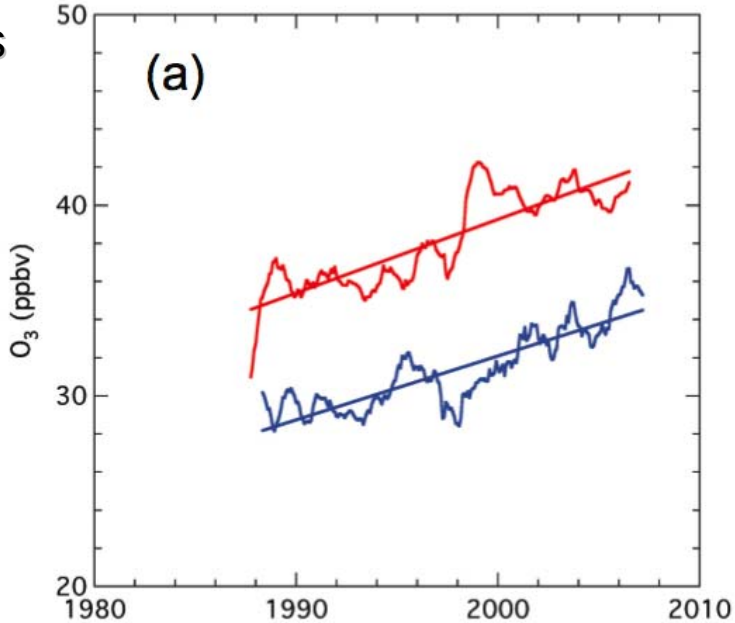
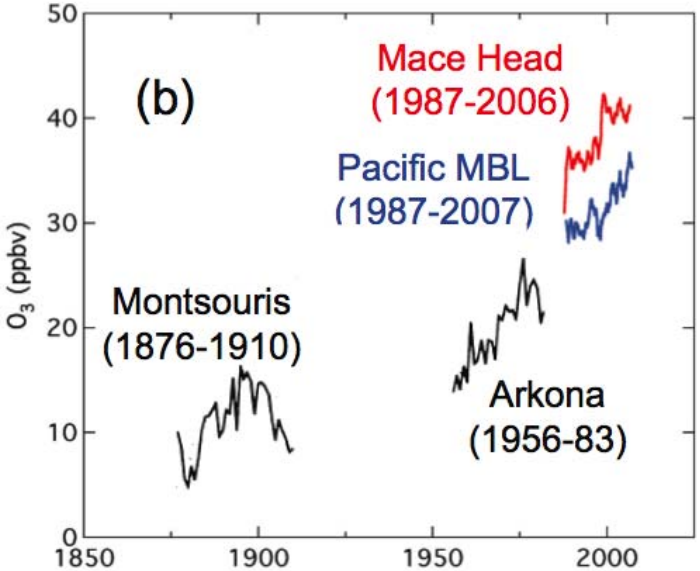
Parrish et al. – background O_3 ↑

Trinidad Head (near Eureka, CA) has a long time series of ozone blowing in off the ocean (blue line ➔)





Take Home Message:
Air pollution, like climate change, is finally being recognized as a GLOBAL ISSUE.

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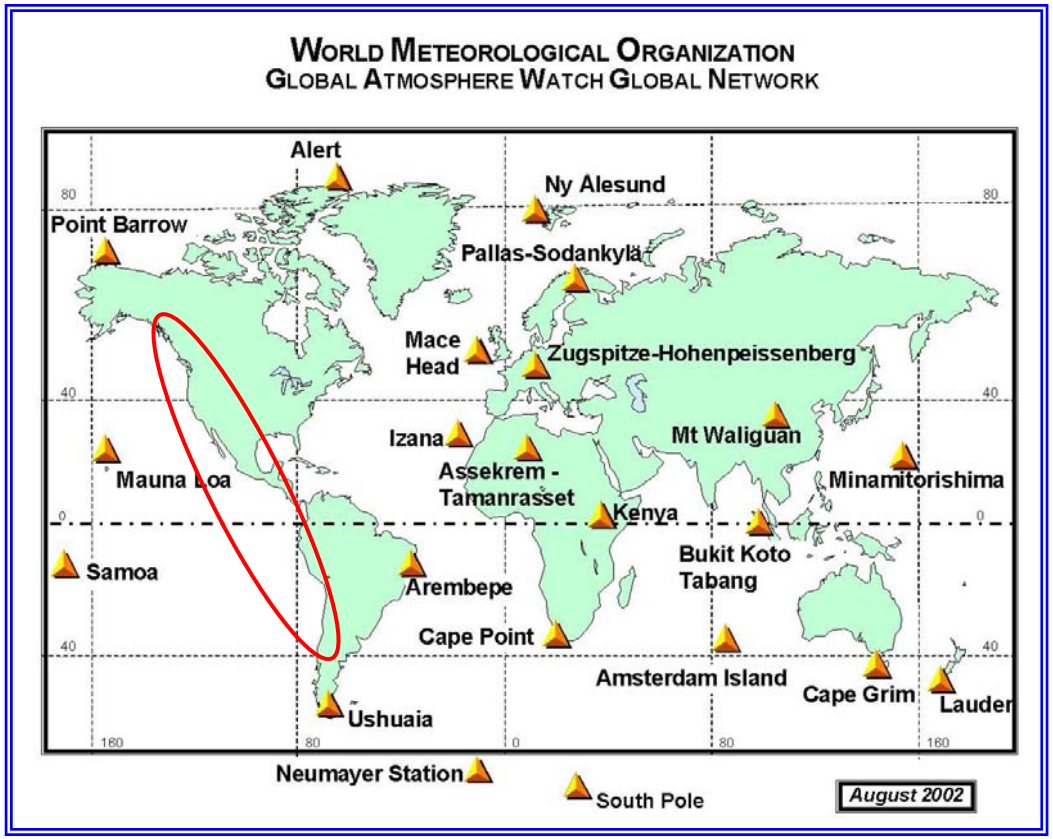
Concluding Remarks

- HCHO plays a central role in the atmospheric processing of natural/biogenic VOCs
- Observations of HCHO in the pine forests of the Sierras, indicates an unidentified source
- Daytime levels during the warmest part of the summer may exceed the NIOSH recommended exposure limit
- Where there is smoke there is probably fire – high levels of HCHO are most likely accompanied by elevated rates of ozone and aerosol production (important for regional air quality and climate)

Importance of Climate Monitoring