

# PBL Dynamics and Transport

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# Meteorological Components of TERC Science Synthesis Report

- 3.2 Planetary Boundary Layer Dynamics
  - 3.2.1 Vertical Mixing in the PBL
  - 3.2.2 The Sea Breeze
  - 3.2.3 Stationary Fronts
  - 3.2.4 Nocturnal Transport
- 3.4 Background Ozone and Long-Range Transport
  - 3.4.1 Statistical Studies
  - 3.4.2 Aircraft Studies (need input)
  - 3.4.3 Ozonesonde and Satellite Studies

## 3.2.1 Vertical Mixing in the PBL

- Good, complementary MH data sets
  - Radar Wind Profilers (STI and NOAA)
  - NASA Airborne Lidar (Hostetler)
  - Rawinsondes (Univ. of Houston)
  - Ship-based Rawinsonde and Lidar (NOAA; Angevine et al. submitted)
- Model output comparison and improvement
  - Angevine et al. – more needed
  - H96 (research scientist Xiaoming Hu)

## 3.2.2 The Sea Breeze

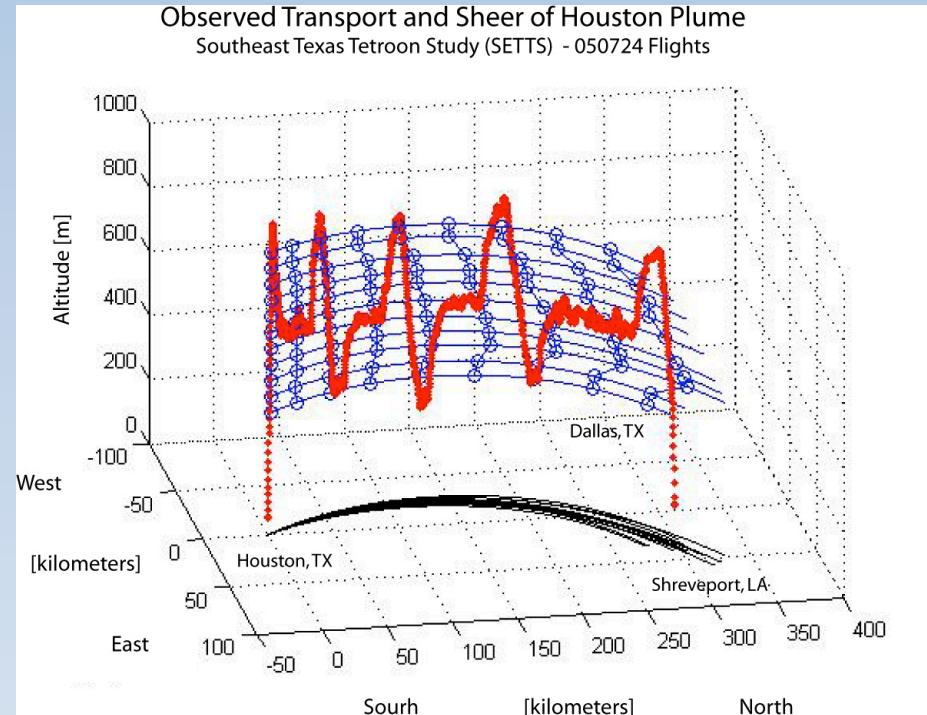
- Ordinary Sea Breeze and Coastal Oscillation
- Characteristics of Coastal Oscillation
  - Rightward curvature of trajectories in aftn/eve
  - Horizontal recirculation when winds < threshold
  - Different winds in morning and afternoon
  - Timing of ozone depends on wind direction
- Importance confirmed by statistical analyses (H107, etc.) and cluster analyses (Darby 2006)

## 3.2.3 Stationary Fronts

- August 21-22 flight, Dallas area
- Observed characteristics
  - Highest ozone north of front at low levels
  - Winds squirrely
- Analysis and comparison with model simulations ongoing

## 3.2.4 Nocturnal Transport

- Best information still 2005 coordinated balloon/aircraft flights
- Near-uniform transport contrasts with TexAQS 2000 lesson of strong nighttime wind shear: meteorological sensitivity
- Sea-breeze low-level jet: more work needed



## 3.4.1 B/T: Statistical Studies

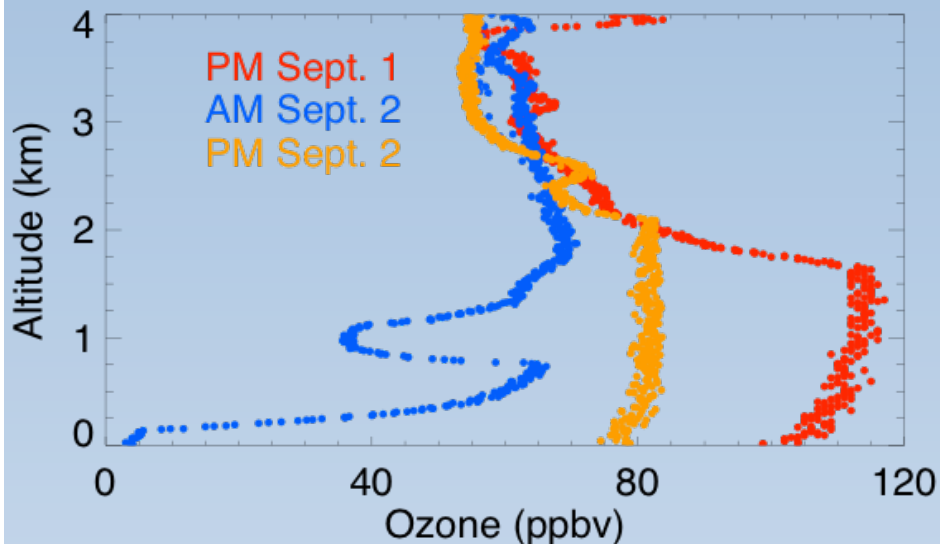
- H107: refinement and updating of Conceptual Model work
- Sullivan: associating ozone exceedances throughout Texas to back-trajectories

Average pct of "high" sites by factor and year										
	year (Aug.-Sept.)									
Factor	1997	1999	2000	2001	2002	2003	2004	2005	2006	Avg by factor
1 = "short fetch"	16.98	23.61	33.33	5.30	23.15	12.37	27.78	11.52	5.21	17.69
2 = E-SE	1.19	6.25	10.87	4.17	1.82	2.08	0.00	3.79	4.63	3.87
3 = S-SE	2.08	1.39	1.67	0.88	0.00	0.00	0.00	1.04	0.60	0.85
4 = NE	23.48	48.48	47.62	19.23	28.24	14.81	18.21	19.10	12.50	25.74
5 = North	16.67	19.44	12.50	0.00	8.33	1.67	2.78	8.33	6.11	8.43
Max	23.48	48.48	47.62	19.23	28.24	14.81	27.78	19.10	12.50	25.74
Count of trajs by factor and year										
	year (Aug.-Sept.)									
Factor	1997	1999	2000	2001	2002	2003	2004	2005	2006	Count by factor
0 = no cluster	2	3	5	1	1	3	1	1	3	20
1 = "short fetch"	27	18	13	11	9	31	6	25	8	148
2 = E-SE	7	8	23	12	15	4	12	11	9	101
3 = S-SE	8	6	5	19	8	7	7	8	14	82
4 = NE	11	11	7	13	22	9	27	14	12	126
5 = North	2	9	4	3	4	5	6	2	15	50
Num trajs	57	55	57	59	59	59	59	61	61	527

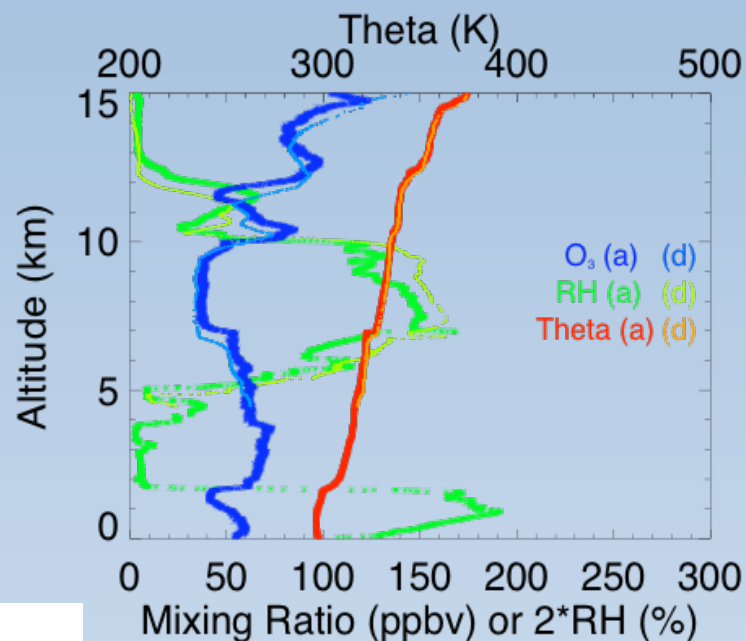
### 3.4.3: B/T Ozonesonde and Satellite Studies

- Pierce et al. (2008): Transport is not just transport – ozone production rates of 15 ppb/day in air arriving from Midwest, modified a bit by deposition and mixing
- Rappenglueck et al. (2008): Typical arrival of high ozone in Houston area two days after frontal passage

### Case Study 2: Ozone Profiles

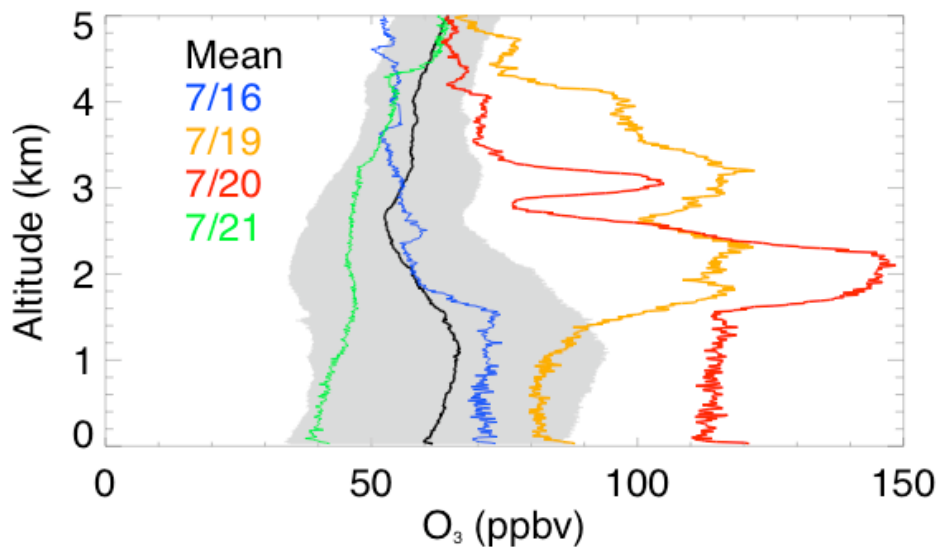


### Houston, TX - 2008042018



### Influence of Remote Biomass Burning on Ozone

July 19 - 20, 2004 Over Houston, TX



# Transport: Work Needing to be Done

- Integration of “anecdotal” and statistical studies
- Multi-day comparison of photochemical model simulations with observations, both above the PBL and along lateral boundaries
- Evaluation of local vs. background consequences of new 75 ppb standard