MODEL VALIDATION PROJECT: OVERVIEW, DATA PROCESSING, AND SOME RESULTS

by

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MVP

- SPONSOR: USAF SPACE & MISSILE SYSTEMS CENTER

- JOINT EFFORT INVOLVING THE USAF, AEROSPACE CORP, NOAA/ARL, AND PRIVATE CONTRACTORS.

- COMPREHENSIVE DATA COLLECTION TO VALIDATE AND IMPROVE MODELS USED TO SUPPORT USAF RANGE SAFETY PREDICTIONS FOR ATMOSPHERIC DISPERSION OF ROCKET LAUNCH PLUMES AND TOXIC FUEL RELEASES.

- MODELS INCLUDE
REEDM: ROCKET EXHAUST EFFLUENT DIFFUSION MODEL
REEDPUFF, RAMS/HYPACT, TRIAD, LINCOM/RIMPUFF

- TOTAL 106 SF_6 PLUMES AND 247 PUFFS RELEASED DURING DIFFERENT SEASONS OF 1995-97 AT CAPE CANAVERAL AIR STATION (CCAS) AND VANDENBURG AIR FORCE BASE (VAFB)

- 56 PLUMES AND ALL PUFFS WERE WERE RELEASED FROM AN ELEVATED BLIMP

- RELEASE HEIGHTS: 1 - 1200 M

- RELEASE DURATIONS: 2 - 3 HR FOR PLUMES, 5 -15 SEC FOR PUFFS

FOUR FIELD STUDIES HAVE BEEN COMPLETED:

- MVP-1. CCAS. July 1995
- MVP-2. CCAS. November 1995
- MVP-3. CCAS. April-May, 1996
- MVP-4. VAFB. May 1997

All studies recorded both meteorological conditions and tracer concentrations, to allow comprehensive transport and dispersion modeling.

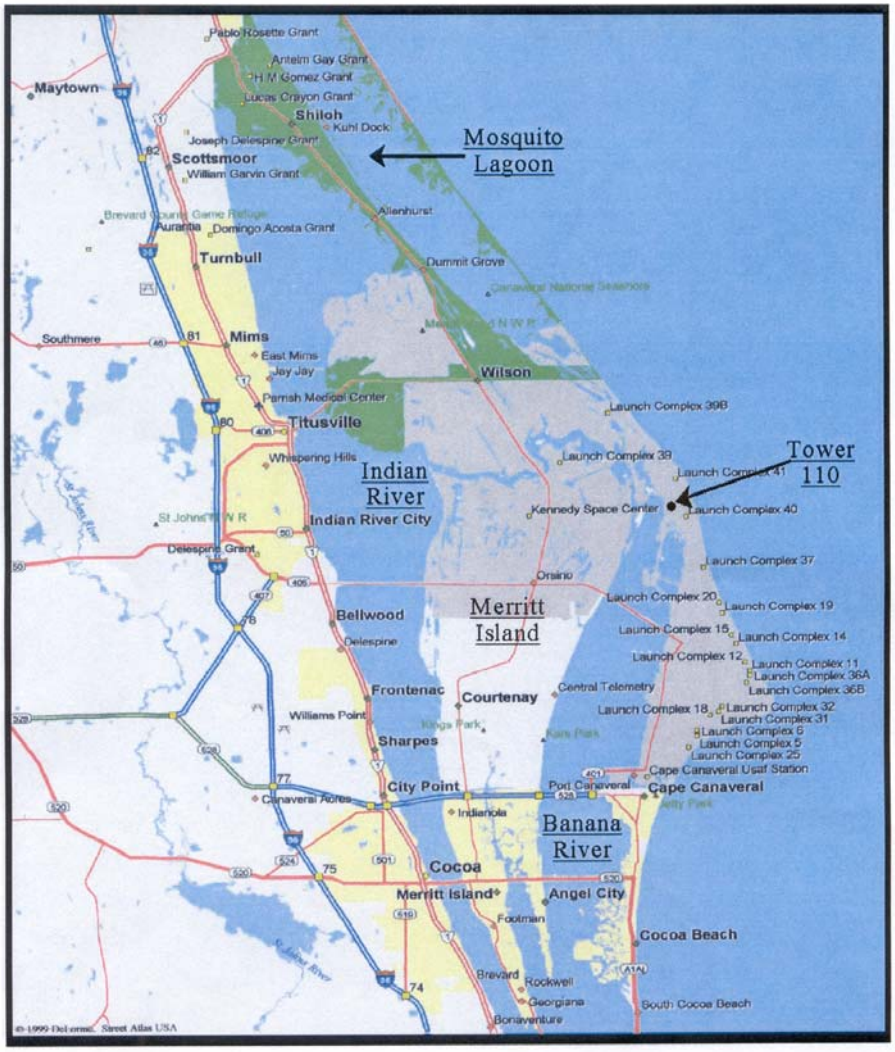


Figure 1. Cape Canveral and vicinity of interest for MVP tracer experiments. Merritt Island, and the local rivers and highways are shown. Tower 110 is used as reference point for analysis of tracer sampling data.

MAJOR DATA TYPES

- METEOROLOGY
  Towers, sodars, profilers, rawinsondes, NWS products (synoptic and upper air charts, satellite images), aircraft met obs (blimp and airplane), etc.
- SURFACE ENERGY BUDGETS AND TURBULENCE
  Supplementary towers and sensors
- AIRBORNE FLUXES AND TURBULENCE
  Long-EZ instrumented airplane
- TRACER SOURCE DATA
  Blimp and ground release positions, source flow rates, start and stop times, etc.
- TRACER CONCENTRATION DATA
  Concentrations and positions of van-based RT samplers, airborne RT samplers, integrated (bag) samplers (VAFB only)
- INFRARED IMAGERY
  IR images and data from tracer plumes and puffs, and from actual launch clouds
- SUPPORTING INFORMATION (METADATA)
  Instrument descriptions, site descriptions, maps, photos, procedures, etc.

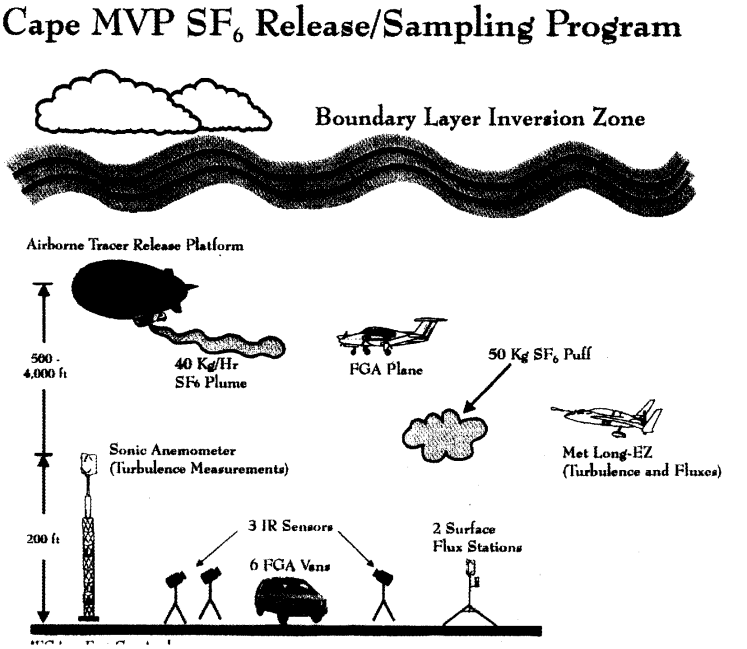


Figure 3.1 Platforms and resources supplementing existing range monitoring during the MVP field sessions.

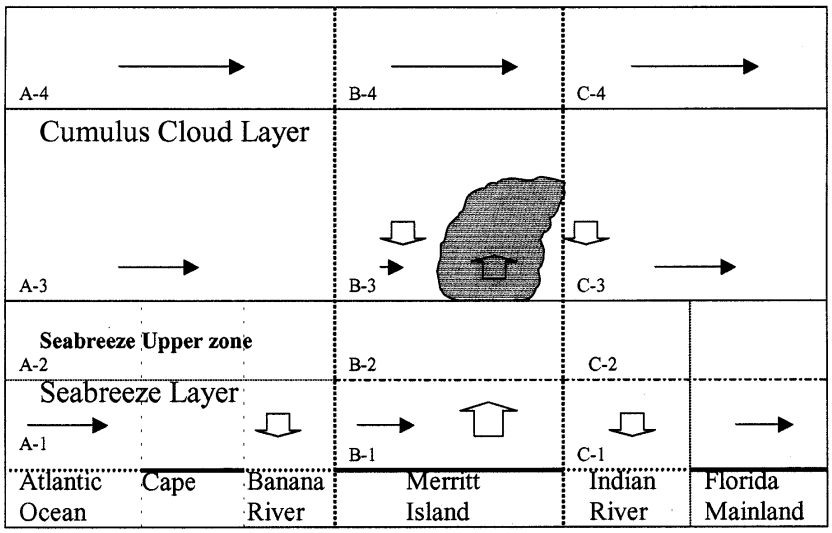
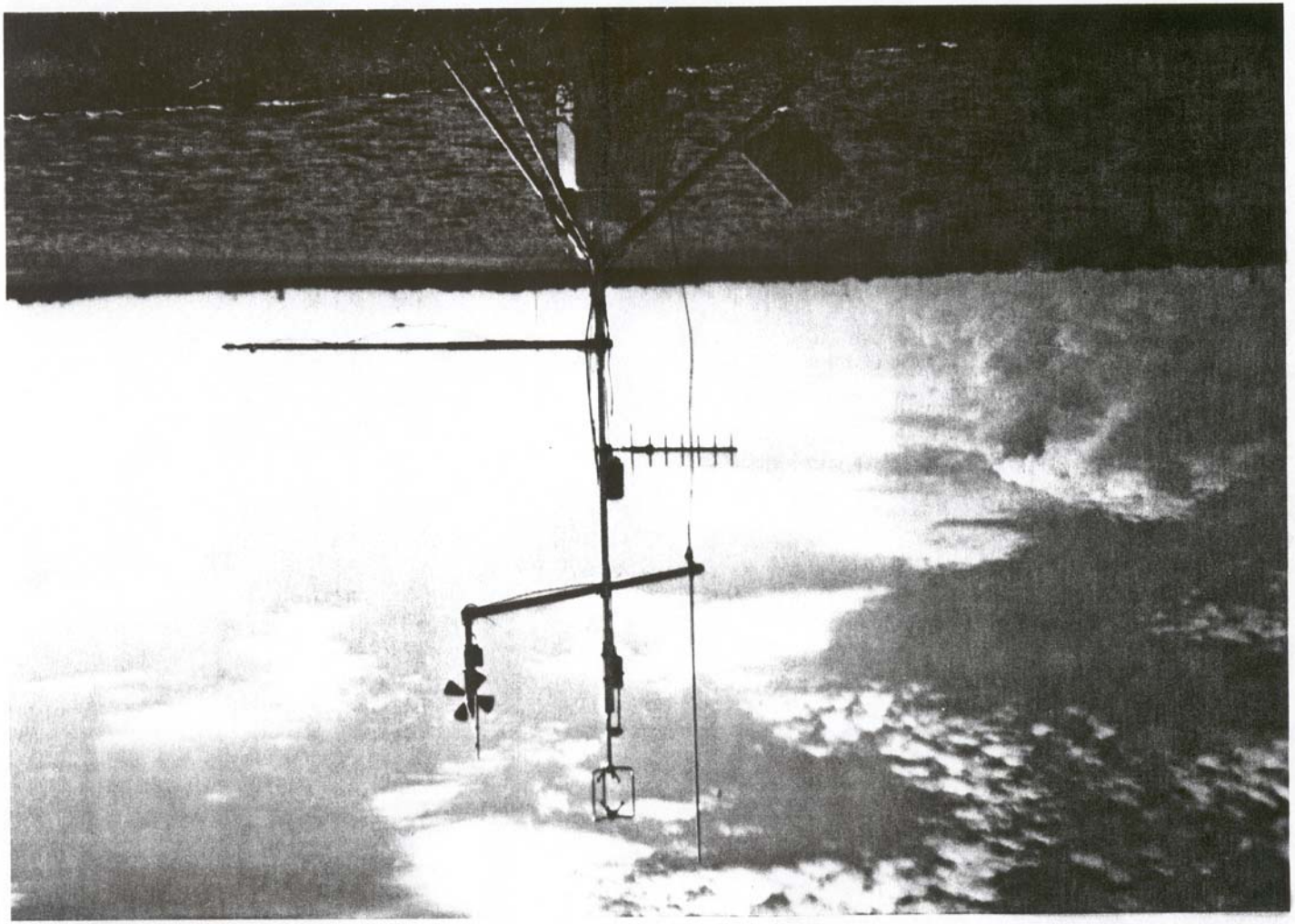


Figure 2.1 Schematic of layered airflows and varying surface features in the Cape Canaveral setting. West is to the right. The horizontal distance from the Atlantic Ocean shoreline to the Florida mainland is about 20 km.



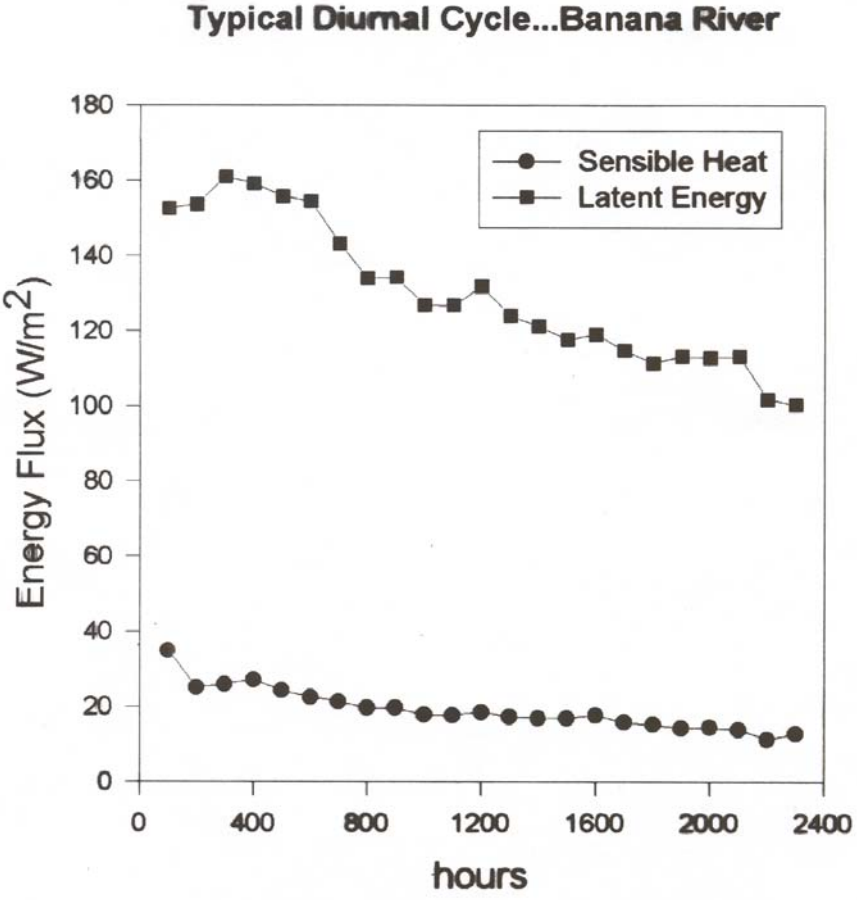

Typical Diurnal Cycle...Banana River
Sensible Heat
Latent Energy
Energy Flux (W/m2)
180
160
140
120
100
80
60
40
20
0
0
400
800
1200
1600
2000
2400
hours



Figure 4.12 Typical installation of a FGA unit in a van for mobile tracer measurements. The van GPS receiver and FGA sampling inlet were mounted (a) above the front roof. The FGA unit with recorder, computer, and cylinders of compressed air for calibrations and instrument operation were installed (b) below and to the side of the FGA.

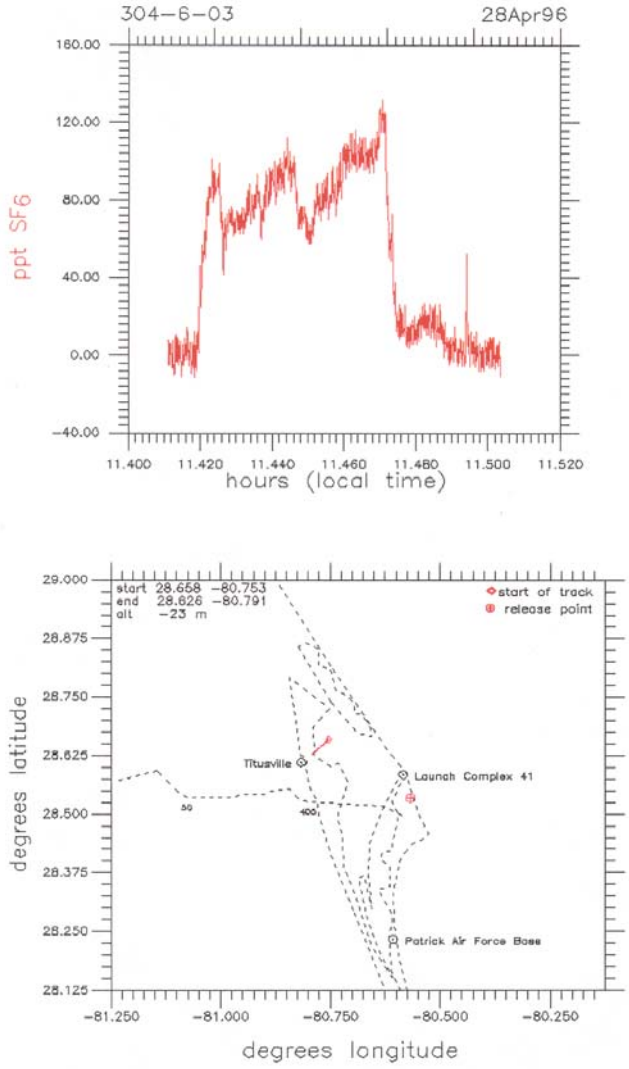
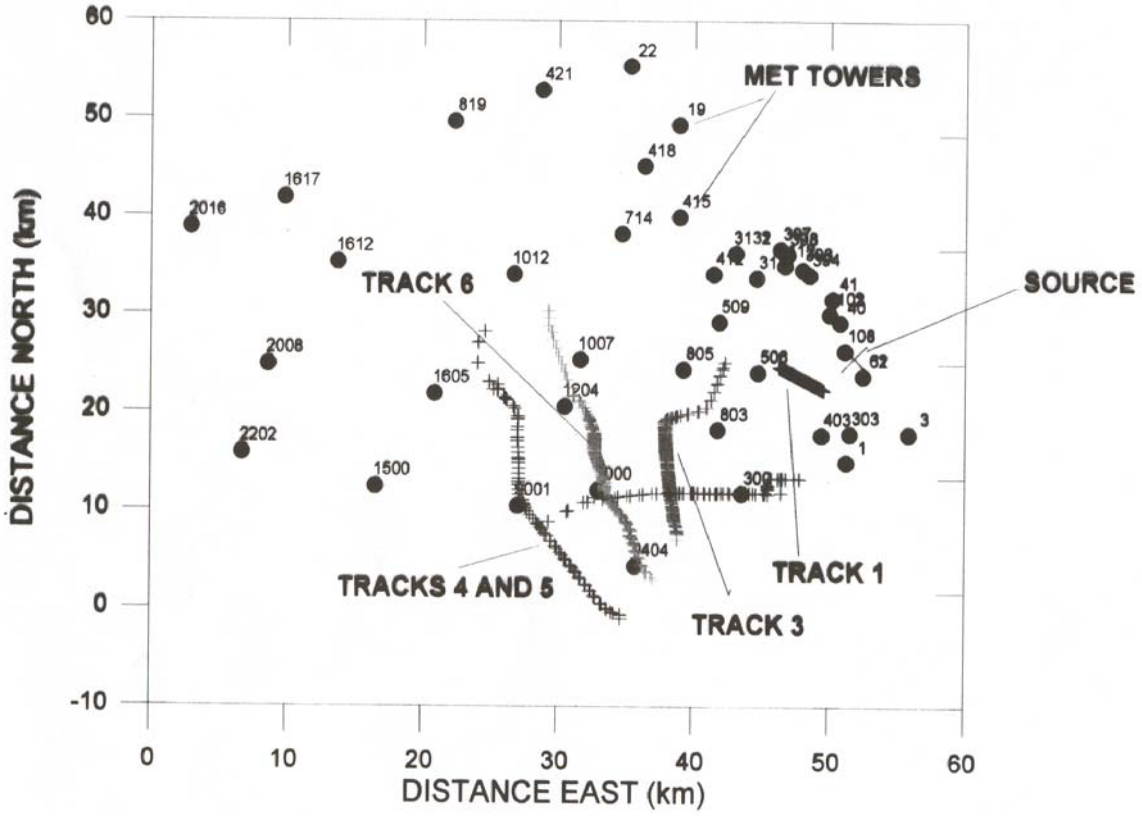


Figure 4.13 Time series of FGA sampling transect by Van 6, 25 km downwind of source during test 304. Upper panel shows concentration versus driving time. Lower panel shows the geographical location of the sampling path.

CAPE CANAVERAL MVP

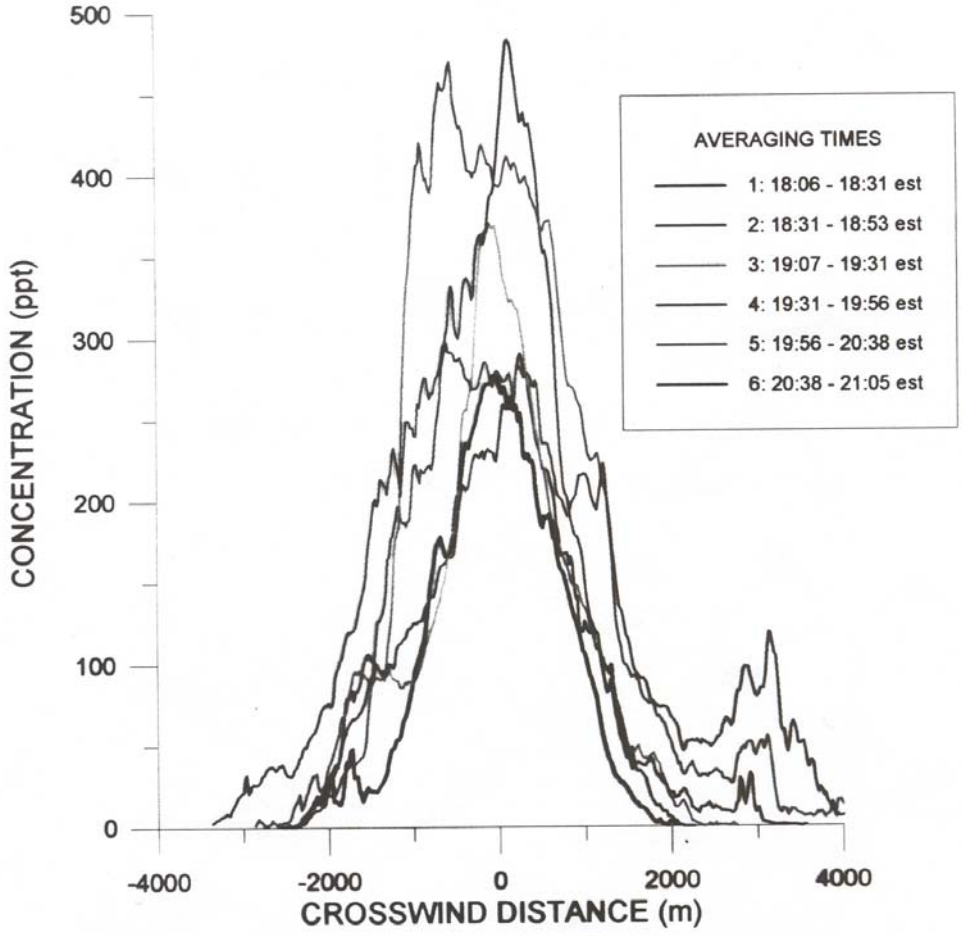
NOVEMBER 6, 1995

RELEASE TIME: 16:20 - 18:56: Q = 5.7 g/s: SOURCE HEIGHT = 30 m



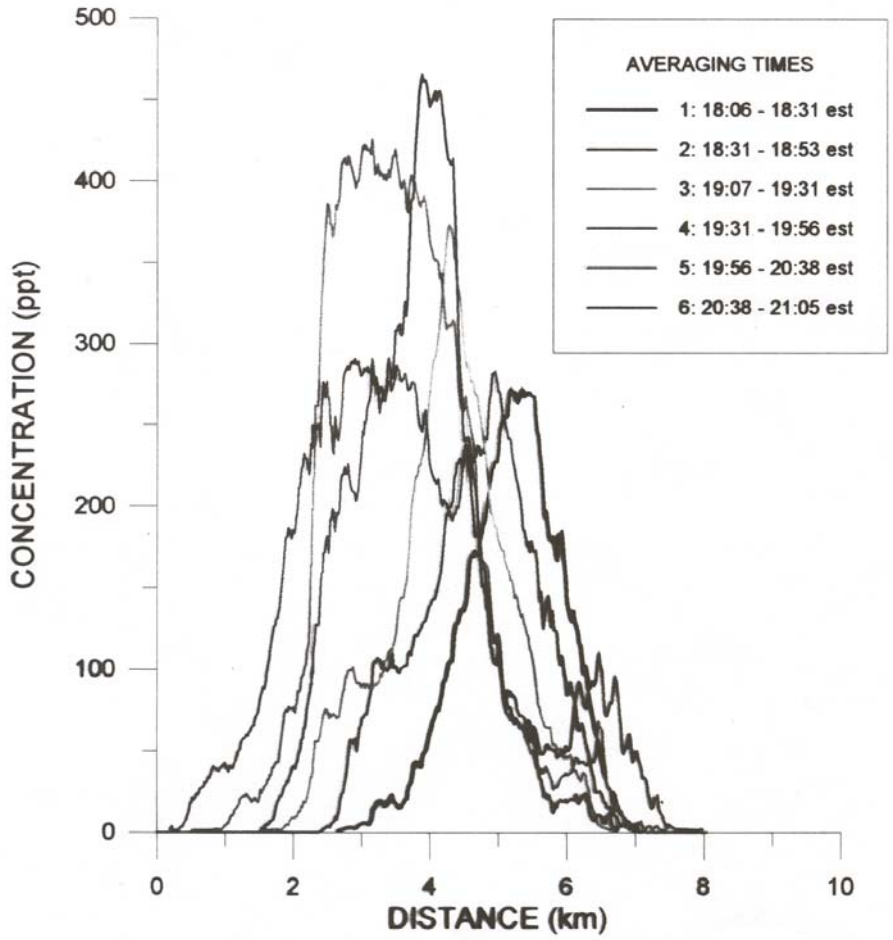
TEST 209 TRACK 3

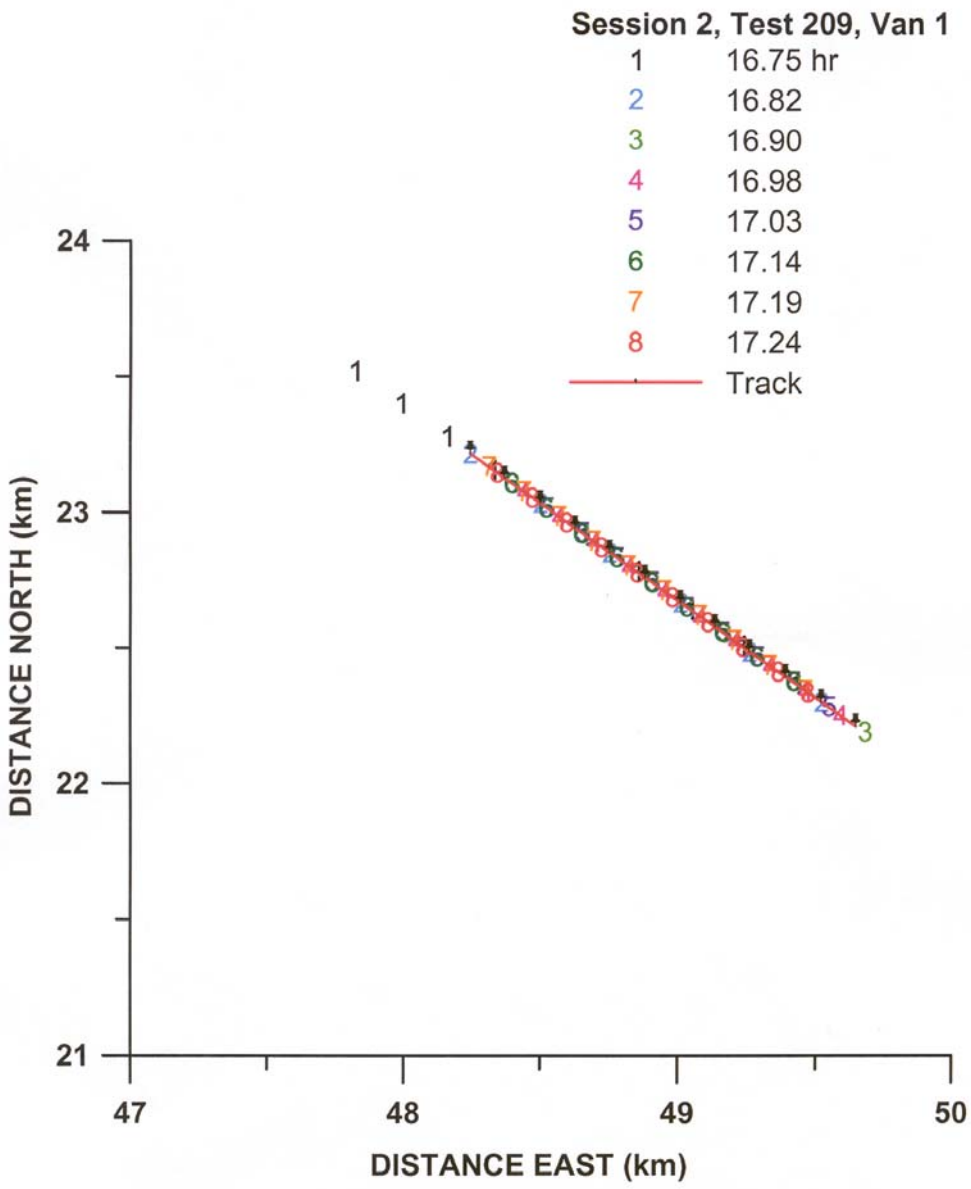
TIME - AVERAGED LAGRANGIAN PLUMES



TEST 209 TRACK 3

TIME - AVERAGED EULERIAN PLUMES




Session 2, Test 209, Van 1
1 16.75 hr
2 16.82
3 16.90
4 16.98
5 17.03
6 17.14
7 17.19
8 17.24
Track
DISTANCE NORTH (km)
24
23
22
21
47
48
49
50
DISTANCE EAST (km)

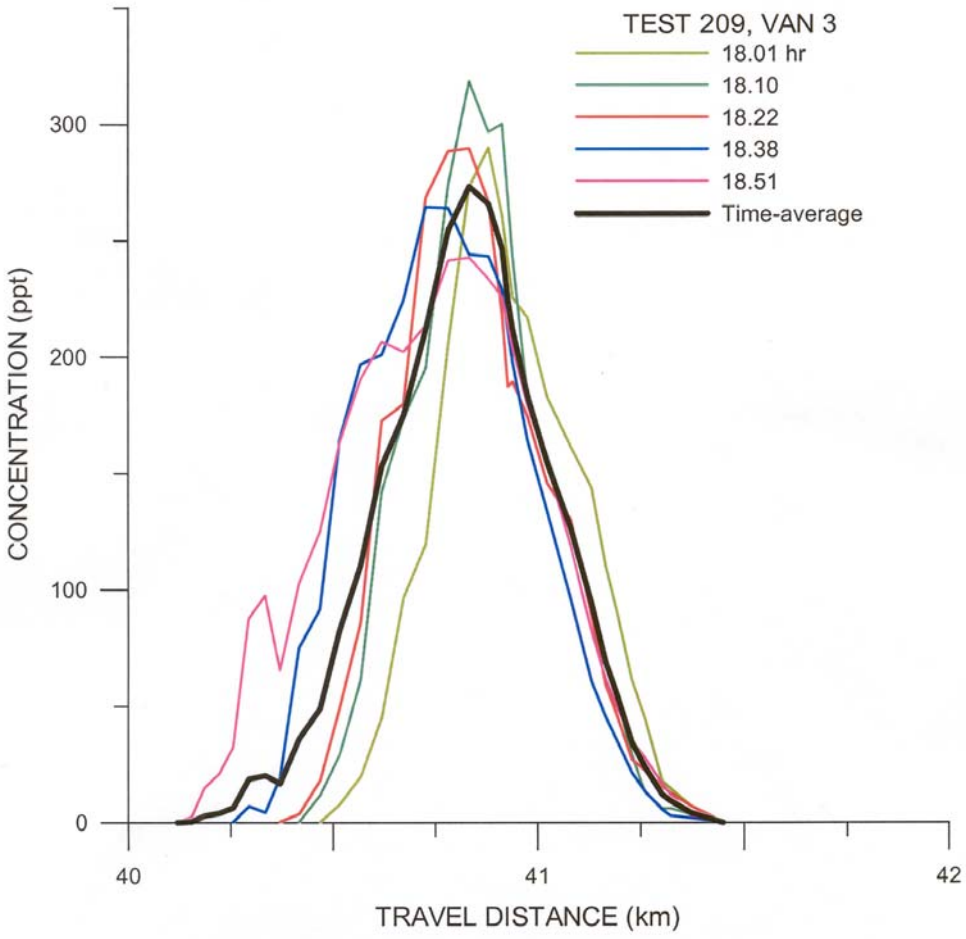

TEST 209, VAN 3
18.01 hr
18.10
18.22
18.38
18.51
Time-average
CONCENTRATION (ppt)
300
200
100
0
40
41
42
TRAVEL DISTANCE (km)

Table 1. Tracer Release Information for Selected MVP Tracer Tests.

Tracer Test Number	Julian Day Date	Release Time Period Local Time GMT	Source Location Lat/Lon (deg) Height (m MSL)
110	204 23 July 1995	13:30 - 14:57 EDT 17:30 - 18:57 GMT	SLC 37 28.5325, - 80.5665 1
117	208 27 July 1995	10:00 - 12:00 EDT 14:00 - 16:00 GMT	Tower 110 28.5675, - 80.5870 150
209	310 6 November 1995	16:22 - 18:56 EST 21:22 - 23:56 GMT	SLC 37 BH roof 28.5296, - 80.5679 20
216	314 10 November 1995	12:55 - 15:17 EST 17:55 - 20:17 GMT	300 m S of SLC 37 28.5270, - 80.5680 457
304	119 28 April 1996	10:00 - 12:00 EDT 14:00 - 16:00 GMT	SLC 37 28.5333, - 80.5668 305
306	120 29 April 1996	09:45 - 12:30 EDT 13:45 - 16:30 GMT	UCS 26 28.4600, - 80.5917 8

Table 2. Processed Tracer Concentration Data File 110C1ALL.DAT.

TEMPORAL & SPATIAL EVOLUTION OF CONCENTRATIONS (ppt):

6 TRACKS ARE PROCESSED.
SAMPLING TIMES (Hrs.): 14.21 14.79 14.88 15.00 15.28 15.38

XE(km)	YE(km)	14.21	14.79	14.88	15.00	15.28	15.38
43.394	31.256	0.7016E+03	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00
43.405	31.232	0.4413E+03	0.1646E+01	0.2444E+02	-0.1150E+01	0.0000E+00	0.0000E+00
43.404	31.167	0.4033E+03	-0.2085E+01	0.4975E+02	-0.4775E+01	0.0000E+00	0.0000E+00
43.410	31.072	0.3927E+03	-0.3709E+01	0.6045E+02	-0.1023E+02	0.0000E+00	0.0000E+00
43.410	30.983	0.4221E+03	-0.1370E+02	0.8466E+02	0.1540E+02	0.7043E+01	0.0000E+00
43.413	30.896	0.6621E+03	-0.1811E+02	0.1651E+03	-0.1045E+02	0.2037E+02	-0.3518E+01
43.415	30.806	0.1213E+04	-0.2752E+02	0.1870E+03	0.2757E+02	0.4055E+02	-0.3067E+01
43.417	30.717	0.1215E+04	-0.3417E+02	0.2088E+03	0.3593E+02	0.7517E+02	0.1209E+02
43.417	30.631	0.7696E+03	0.9268E+01	0.2477E+03	0.3335E+02	0.9200E+02	0.4326E+02
43.423	30.545	0.6754E+03	0.6402E+02	0.2728E+03	0.1627E+02	0.6692E+02	0.3653E+02
43.429	30.461	0.7427E+03	0.7789E+02	0.2649E+03	0.3353E+02	0.8918E+02	-0.3583E+01
43.435	30.379	0.5829E+03	0.8297E+02	0.2567E+03	0.3785E+02	0.1592E+03	0.7644E+01
43.448	30.302	0.4708E+03	0.8996E+02	0.2578E+03	0.6147E+02	0.1821E+03	0.3488E+02
43.448	30.231	0.7150E+03	0.7772E+02	0.2926E+03	0.1012E+03	0.1422E+03	0.9773E+02
43.450	30.167	0.1265E+04	0.2306E+03	0.3216E+03	0.1451E+03	0.1499E+03	0.8873E+02
43.448	30.107	0.1334E+04	0.2514E+03	0.3380E+03	0.1686E+03	0.1739E+03	0.7340E+02
43.448	30.044	0.1457E+04	0.2201E+03	0.3655E+03	0.2058E+03	0.2495E+03	0.6489E+02
43.448	29.978	0.1507E+04	0.3232E+03	0.4094E+03	0.2385E+03	0.5222E+03	0.6594E+02
43.448	29.911	0.1311E+04	0.3167E+03	0.3424E+03	0.3180E+03	0.6590E+03	-0.8931E+00
43.446	29.836	0.1053E+04	0.5147E+03	0.9251E+02	0.2301E+03	0.8325E+03	0.7107E+02
43.446	29.760	0.3746E+03	0.1930E+03	0.1344E+02	0.7497E+02	0.7702E+03	0.9519E+03
43.446	29.683	-0.9493E+02	0.4784E+02	0.3420E+02	0.2167E+01	0.3293E+03	0.1470E+04
43.444	29.616	0.1047E+02	-0.1285E+02	0.0000E+00	0.5167E+01	0.0000E+00	0.1452E+04
43.449	29.542	0.0000E+00	-0.8937E+01	0.0000E+00	0.2833E+01	0.0000E+00	0.4750E+03

Table 3. Time-Averaged Concentration Data File 110A1- 2.DAT

AVERAGE CONCENTRATION OF 4 TRACKS FROM 14.88 TO 15.38 Hrs.

XE(km)	YE(km)	CAVE (ppt)
43.394	31.256	0.0000E+00
43.405	31.232	0.5823E+01
43.404	31.167	0.1124E+02
43.410	31.072	0.1256E+02
43.410	30.983	0.2678E+02
43.413	30.896	0.4288E+02
43.415	30.806	0.6302E+02
43.417	30.717	0.8300E+02
43.417	30.631	0.1041E+03
43.423	30.545	0.9813E+02
43.429	30.461	0.9601E+02
43.435	30.379	0.1154E+03
43.448	30.302	0.1341E+03
43.448	30.231	0.1584E+03
43.450	30.167	0.1763E+03
43.448	30.107	0.1885E+03
43.448	30.044	0.2214E+03
43.448	29.978	0.3090E+03
43.448	29.911	0.3296E+03
43.446	29.836	0.3066E+03
43.446	29.760	0.4526E+03
43.446	29.683	0.4590E+03
43.444	29.616	0.3643E+03
43.449	29.542	0.1195E+03

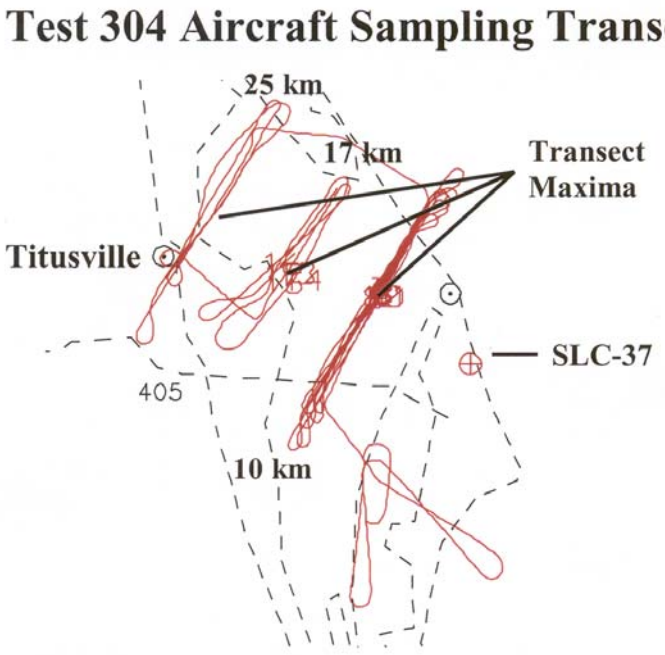


Figure 4.17 Enlarged view of aircraft sampling transects during test 304. The locations of concentration maxima are noted for each sampling arc.

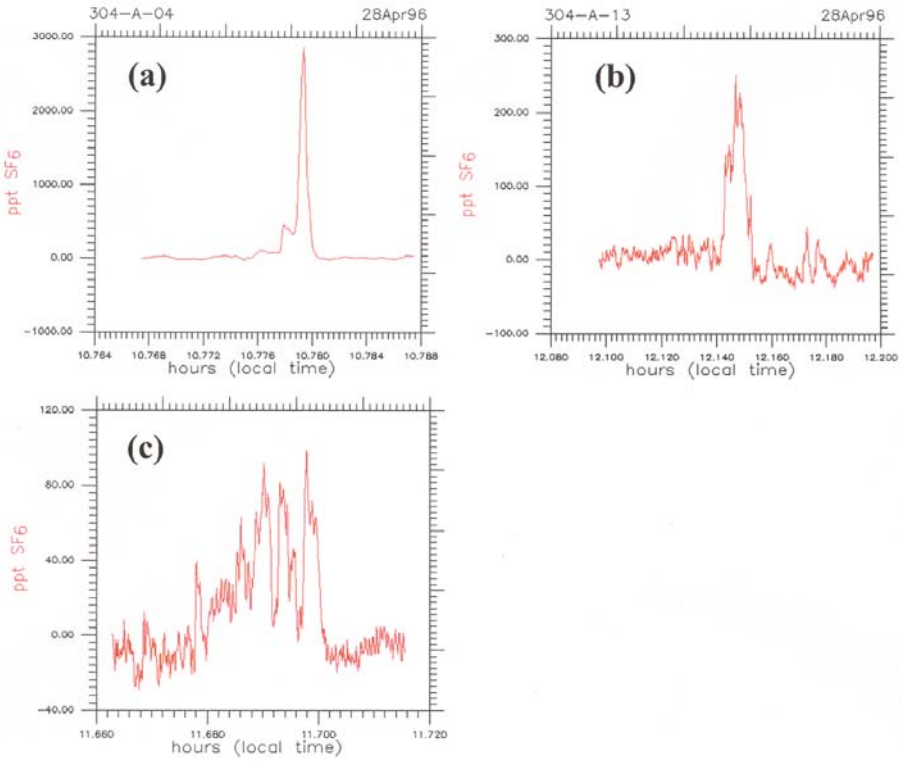


Figure 4.18 Aircraft FGA measured tracer concentrations at (a) 10 km, (b) 17 km, and (c) 25 km downwind of the release for test 304.

ORGANIZATION OF THE DATA

Organized by measurement platform or data source.
Then chronologically by MVP session number.

DIRECTORY	DATA TYPE
BLIMP	Blimp-borne met data
BUOY	Ocean buoy met data
CAPETWRS	Cape Canaveral tower met data
CLOUDSMP	Launch cloud sampler data
FLUXTWRS	Micromet flux and turbulence data
LONGEZ	Airborne flux and turbulence data
MODLDISP	Results of dispersion model calculations
NEXRAD	NEXRAD radar images
OPTICAL	Infrared data and other photos
PROFILER	B. layer profilers (50, 915, 449 MHz)
RAWIN	Rawinsonde profile data
SATIMAGE	Satellite images (IR, VIS, Landsat, etc.)
SFCOBS	Synoptic scale surface obs and charts
SODAR	Acoustic sounder data
TRACROBS	Tracer concentration and position data
TRACREL	Tracer release data
UPPERAIR	Synoptic scale upper air charts
VAFBTWRS	Vandenberg tower met data