Webex Agenda, 27 September 2012

1) California Logistics Update

2) Preliminary plans for Houston

3) Resolution of decision regarding deployment Colorado in 2014

4) Publication plans and any new analysis results team members would like to share

Site Survey Results

Updates to this summary table since the last telecon are in red

Site Name	Spiral Y/N	Pandora Y/N	Aeronet Y/N	Missed Approach?	other DISCOVER-AQ Augmentation
Fresno - Garland	Y	Y	Y	Maybe	AMS/SMPS (Zhang), Drum Sampler/Nephelometer (VanCuren), Aerosol Optical Properties (Cappa)
Madera City	N	Y	Y	N	
Madera - Pump Yard	N	N	N	N	
Fresno - Skypark	N	N	N	N	
Clovis - N. Villa	N	N	Y	N	
Fresno - Drummond	N	N	Y	N	
Parlier	N	Y	Y	N	
Tranquility	Y	Y	Y	N	
Huron	Y	Y	Y	N	Millersville
Hanford	Y	Y	Y	Y	
Corcoran	N	Y	Y	Y	
Visalia	N	N	N	N	
Visalia APT	N	Y	Y	Y	EPA (roadside proximity)
Porterville	Y	Y	Y	Y	NATIVE/UMBC/EPA, NOAA, Drum Sampler (VanCuren)
Bakersfield – Cal.	N	N	Y	Maybe	
Shafter	N	Y	Y	N	
Oildale	N	N	N	N	P-3B overflight, Mobile lab (Leifer)
Bakersfield Airport	Y	Y	Y	N	UCI (Kim)? Drum Sampler (Van Curen)?
Edison	N	N	N	N	
Arvin – Di Giorgio	N	Y	Y	N	P-3B overflight

Outstanding Logistics Issues

1. “Hold Harmless” Letters for after hours access to ARB sites:
   Received: UCSB (Oildale)
   Still waiting: UC-Davis (Fresno-Garland), UMBC (Shafter, Fresno-Garland)
   Negotiating: NASA (Shafter, Fresno-Garland, Bakersfield-Cal Ave)

2. Internet Access at monitoring sites:
   ARB sites: Still under discussion. May be able to use mobile hotspots in some locations (e.g., Shafter)
   SJV APCD sites – switches to be used to expand access (has Jay received switches yet?)
   Other sites: Mobile hotspots will be needed for Huron and Arvin (others?)

3. Porterville power and access:
   Adequate power is available, but need to arrange for hookup. Request dates for setup from Penn State and NOAA.
   Trent Procter still needs to contact landowner for NOAA. Penn State will be able to locate in parking lot adjacent to APCD trailer.

4. Visalia Airport (EPA site)
   Still waiting for airport contact. If permission is granted, will need to establish power (hopefully available from defunct DHL building)

Outstanding Logistics Issues (cont.)

5. Relocation of Millersville to Huron

Balloon operations at Porterville were denied, but Huron is feasible. Will likely locate on city property. This solves hosting issue for Pandora and Aeronet. Rich Clark to visit on November 7 to assess site and power requirements. He will address City Council on plans.

6. Pandora installation

Instruments will ship to APCD in Fresno in the next month (Aeronet plans?) and installations for many sites will take place in late October/early November (details to be worked out between Jay Herman and Nathan Trevino). Certain Pandora emplacements will have to wait until January (e.g., Arvin, Huron, Porterville, and Visalia Airport).

8. Mobile Lab at Oildale

Property owner is a local church. Contact has been made and material on our plans is being sent. High likelihood that permission to locate there will be granted.

9. Arvin-Digiorgio School

Last contact was for details on weight and duration of project. Need status update on this location, but feedback has been positive.

Outstanding Logistics Issues (cont.)

10. Wallops/Palmdale logistics:

    Instructions will be coming very shortly from Luci Crittenden. Please be prepared with to provide information to support the following:

    Badging (Wallops and Dryden) – Foreign Nationals must submit 45 days in advance for WFF and 70 days in advance for Palmdale

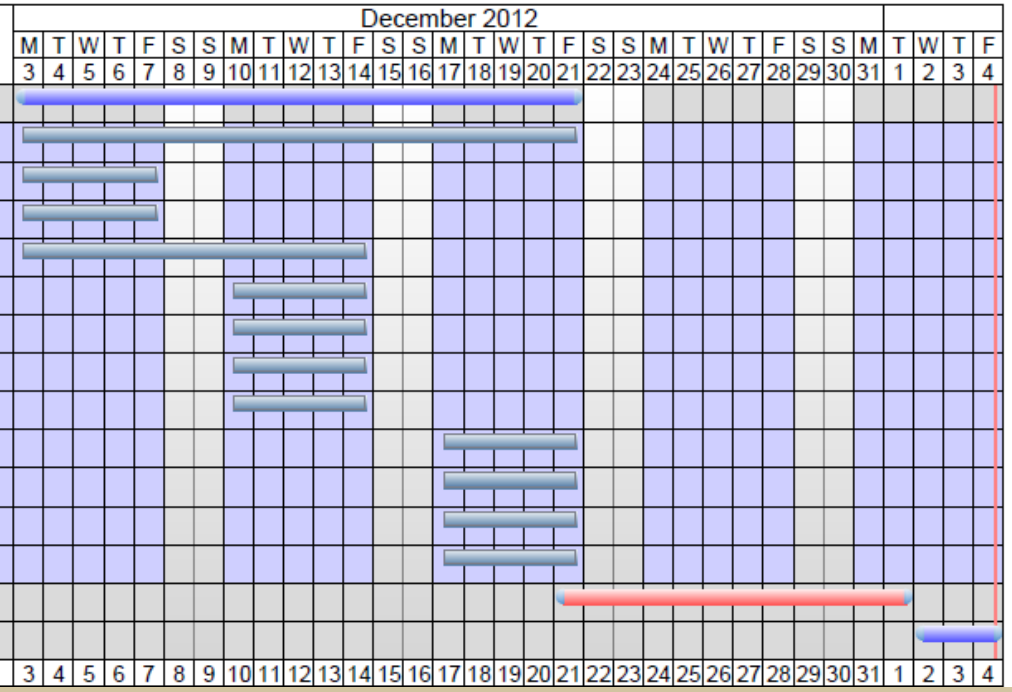
    Shipping requirements between integration sites and Palmdale

    Lodging: Choice of lodging at integration sites and for ground teams are left to the discretion of the investigators. Instructions for lodging at Palmdale will be available soon. For those needing to arrange integration travel, you can start contacting Diane Zeimet now.

P-3B Integration Schedule

	PI	Instrument	Installation Dates		Install Inlet Early?	Install Rack Early?
Week 1	Anderson	CAPS	12/2	12/21	N/A	N/A
		LARGE	12/2	12/7	N/A	N/A
	Wisthaler	PTR-MS	12/2	12/7	N/A	N/A
	Nowak	NH3	12/2	12/14	N/A	N/A
Week 2	Cohen	TD-LIF	12/10	12/14	Yes	Yes, don't bolt
	Fried	DFGAS	12/10	12/14	Yes	No
	Diskin	DACOM	12/10	12/14	Yes	Tom Slate will arrive as needed
		DLH	12/10	12/14	No	
Week 3	Weinheimer	NOXY	12/17	12/21	Yes	No
	Barrick	j(NO2)	12/17	12/21	Yes	Yes
	Yang	AVOCET	12/17	12/21	Yes	Yes, don't bolt
	NSERC	NSERC Data System	12/17	12/21	N/A	Yes

	Activity Name	Duration (Days)	Start Date	Finish Date
1	Upload	15.00	12/3/12	12/21/12
2	CAPS (Anderson)	15.00	12/3/12	12/21/12
3	LARGE (Anderson)	5.00	12/3/12	12/7/12
4	PTR-MS (Wisthaler)	5.00	12/3/12	12/7/12
5	NH3 (Nowak)	10.00	12/3/12	12/14/12
6	TD-LIF (Cohen)	5.00	12/10/12	12/14/12
7	DFGAS (Fried)	5.00	12/10/12	12/14/12
8	DACOM (Diskin)	5.00	12/10/12	12/14/12
9	DLH (Diskin)	5.00	12/10/12	12/14/12
10	NOXY (Weinheimer)	5.00	12/17/12	12/21/12
11	j(NO2) (Barrick)	5.00	12/17/12	12/21/12
12	AVOCET (Yang)	5.00	12/17/12	12/21/12
13	REVEAL (NSERC)	5.00	12/17/12	12/21/12
14	Holiday	8.00	12/21/12	1/1/13
15	Finishing Touches	3.00	1/2/13	1/4/13



P-3B Pre-Deployment Preparation

Updates will appear on the Airborne Science website

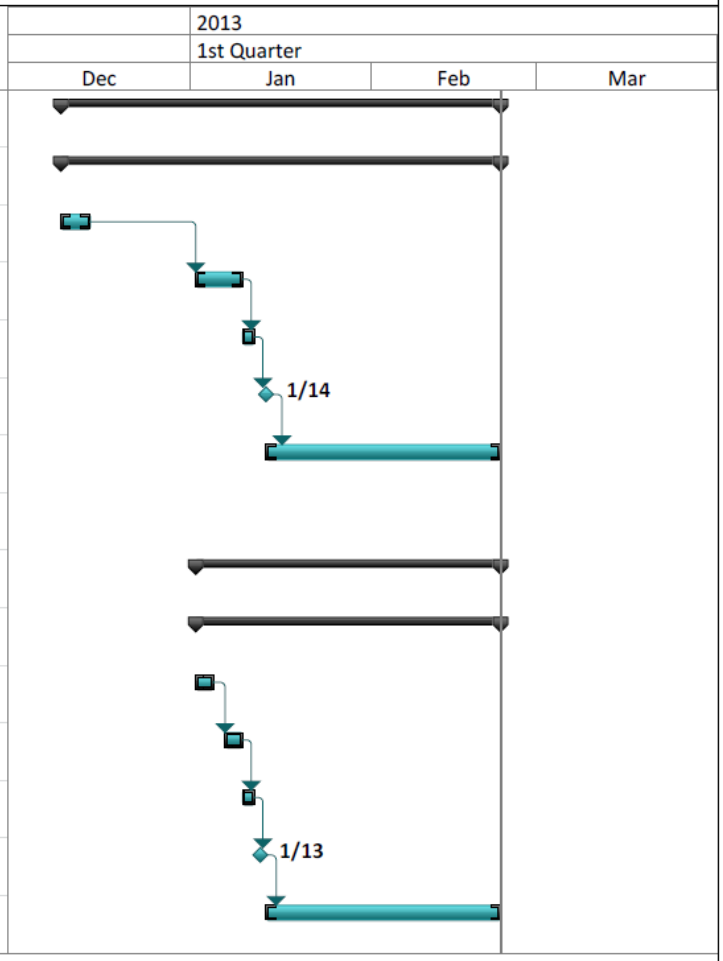
(http://airbornescience.nasa.gov/aircraft_detailed_cal/2013-01?aircraft_id=12)

B200 Integration and Deployment

Discover - AQ California 2013

B200

ID		Task Name	Duration	Start	Finish
1		**Option 1**	**55 d**	**12/10/12**	**2/22/13**
2		**Discover - AQ California**	**55 d**	**12/10/12**	**2/22/13**
3		Installation / Integration	5 d	12/10/12	12/14/12
4		Check-Out Flights	6 d	1/2/13	1/9/13
5		Pack-Out	2 d	1/10/13	1/11/13
6		Depart LaRC	0 d	1/14/13	1/14/13
7		Discover - AQ Ca. Mission	30 d	1/14/13	2/22/13
8					
9		**Option 2**	**38 d**	**1/2/13**	**2/22/13**
10		**Discover - AQ California**	**38 d**	**1/2/13**	**2/22/13**
11		Installation / Integration	3 d	1/2/13	1/4/13
12		Check-Out Flights	3 d	1/7/13	1/9/13
13		Pack-Out	2 d	1/10/13	1/11/13
14		Depart LaRC	0 d	1/13/13	1/13/13
15		Discover - AQ Ca. Mission	30 d	1/14/13	2/22/13



J.Cronauer
AMA

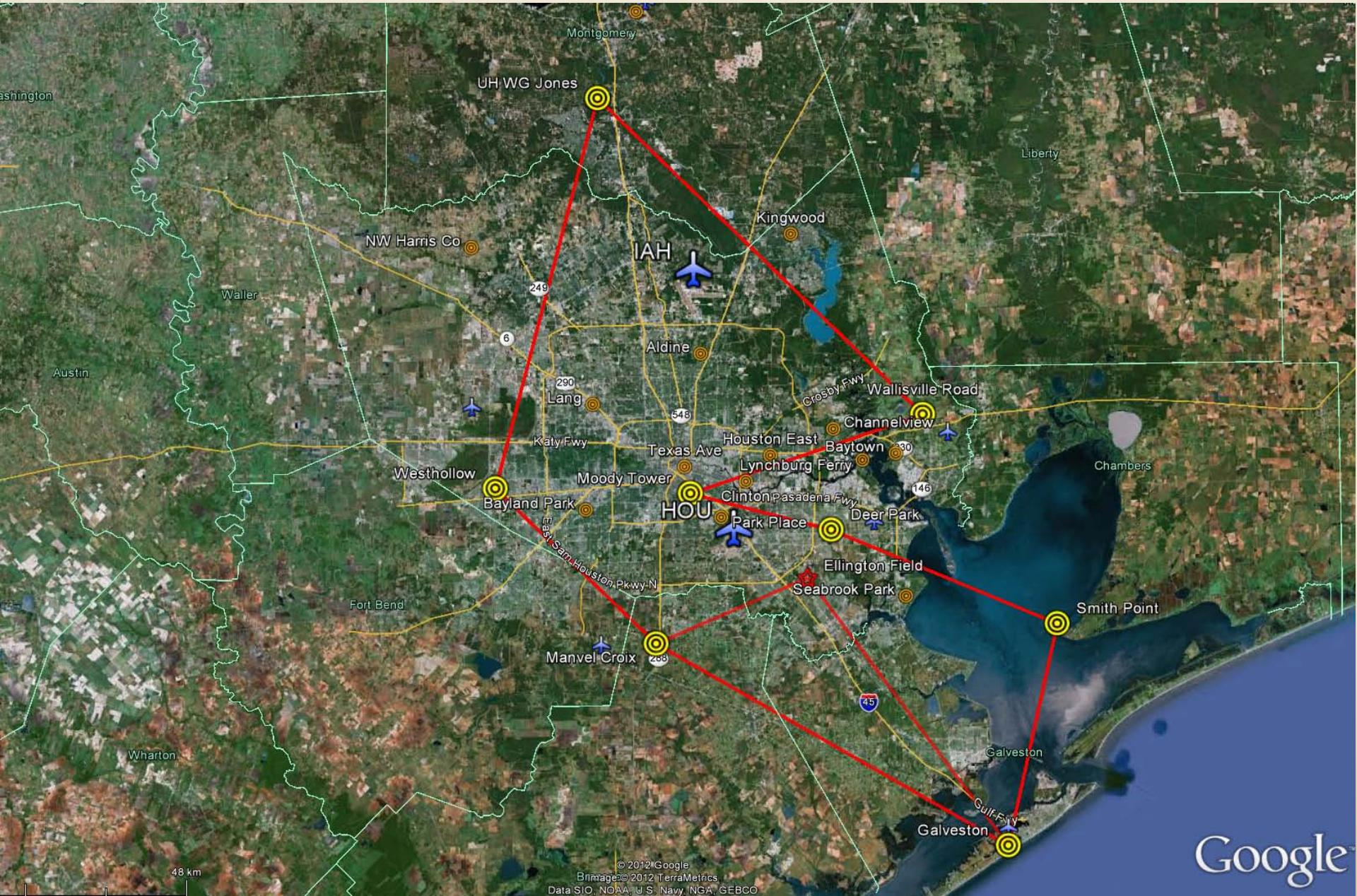
California EPO Opportunities

GLOBE (Global Learning and Observation to Benefit the Environment) Train the Trainer Planning in Progress-We're in the process of planning a train-the-trainer event through the GLOBE program, where we'll teach and train a small group of GLOBE partners from CA about DISCOVER-AQ and how to make atmospheric measurements using GLOBE protocols. The GLOBE partners will then be able to go back to CA and train teachers how to make those same measurements in their classrooms concurrent with the DISCOVER-AQ campaign in January. The train-the-trainer session will occur in Hampton, VA in mid/late November.

Visits to CA Schools during the Campaign-In addition, we're also planning site visits to 8 schools in CA that are directly in the flight path. Anyone interested in helping with those site visits to the schools to share about DISCOVER-AQ would be greatly appreciated!

Still looking for volunteers to help with outreach!

Houston Strawman
(iterate after feedback from Mike Singer)



Colorado 2014?

Pros

- Engaged and enthusiastic host agency and partners (numerous emails of interest have been received)
- High potential for strong augmentation of ground observations and remote sensing (time sensitive)
- Potential addition of C-130 aircraft (time sensitive, location dependent?)
- Sufficient density of FRM Ozone and PM monitors

Cons

- Cleaner than previously visited regions (especially for aerosol)
- Sparse FRM NO2 monitors

Decision is for NCAR collaborators to proceed with NSF proposal for C-130 and ground augmentation. Proposal will be submitted in January with feedback anticipated by summer 2013. If feedback is positive, then the final deployment will be to Colorado. If feedback is negative then there is plenty of time to reassess and adjust plans for summer 2014

Meetings and Presentations

Thanks to Ray Hoff for representing us at the following meetings over the past months:

- ACTRIS Meeting, La Stresa, Italy - 50/50 on aerosols and trace gases because of that audience
- International Laser Radar Conference, Porto Heli, Greece - 100% on lidar
- International Radiation Symposium, Berlin - mostly on AOD closure with relative humidity and PM2.5 at the surface. Also showed that the missing AOD from the bottom 1000' probably is less than a 3% error in AOD if we extend the lowest aircraft measurement to the surface.

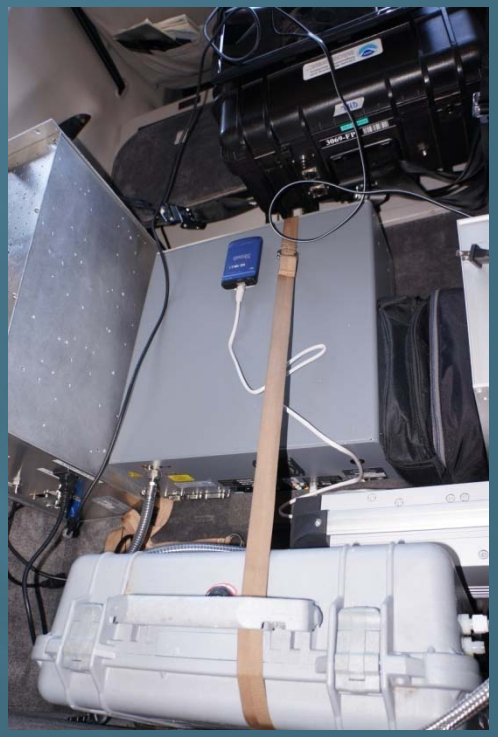
Upcoming opportunities:

- IGAC, 17-21 September, Beijing China (Crawford poster, others?)
- Aura Science Team, 1-3 October, Pasadena, CA
- CMAS, 15-17 October, Chapel Hill, NC
- **Fall AGU, 3-7 December, San Francisco (25 abstracts across 10 sessions)**
- AMS, 6-10 January, Austin, TX

AIRBORNE RESEARCH AT THE UNIVERSITY OF CALIFORNIA, DAVIS

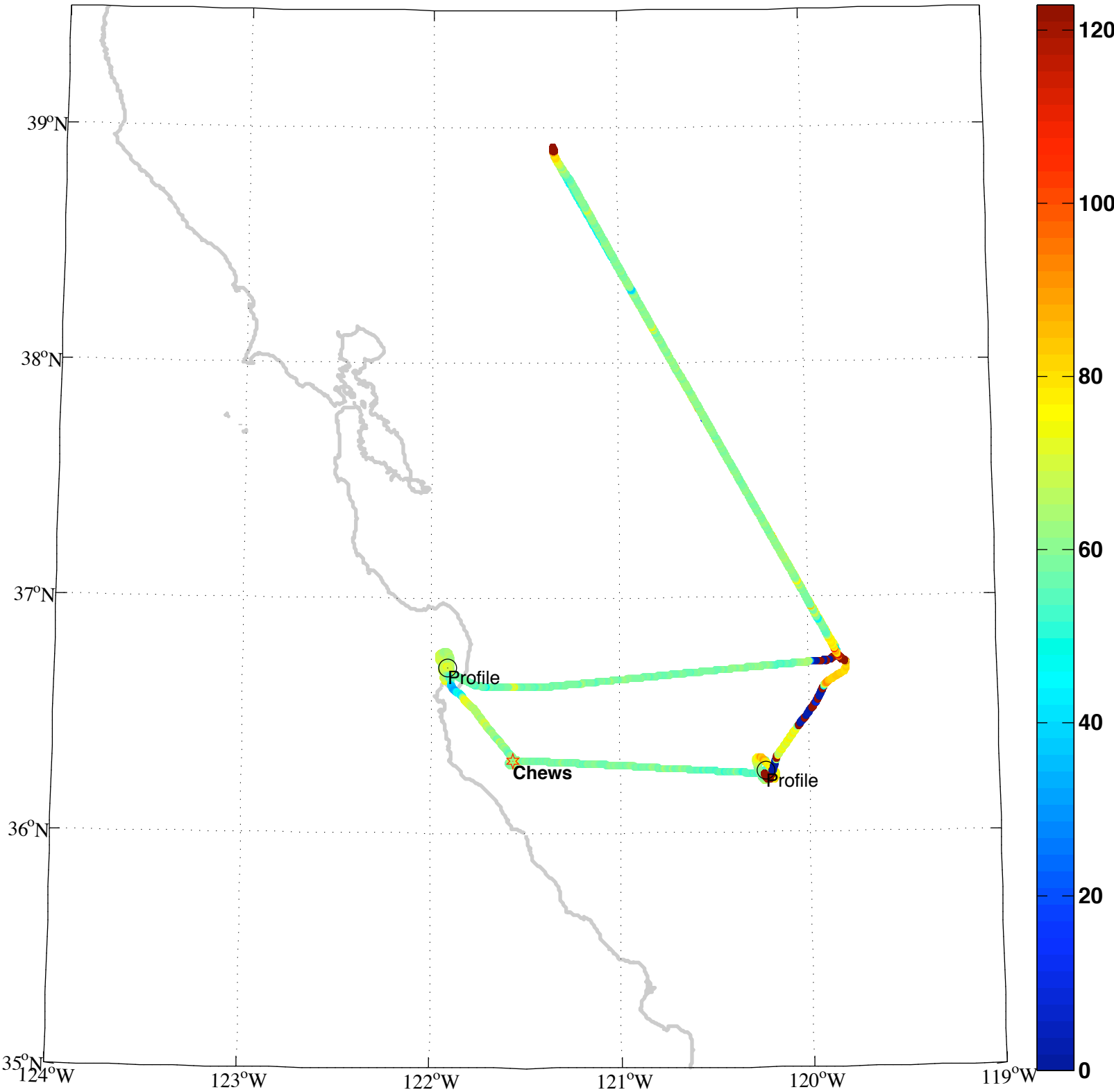
Description	
Make & Model	Mooney M20M TLS
Maximum Cruise Speed	200 kts @ 18 gallons/hr
Minimum Cruise Speed	100 kts @ 10 gallons/hr
Payload	925 pounds (including fuel)
Fuel Capacity	89 gallons
Payload with full fuel	407 pounds
110V A/C Power Available	500 Watts

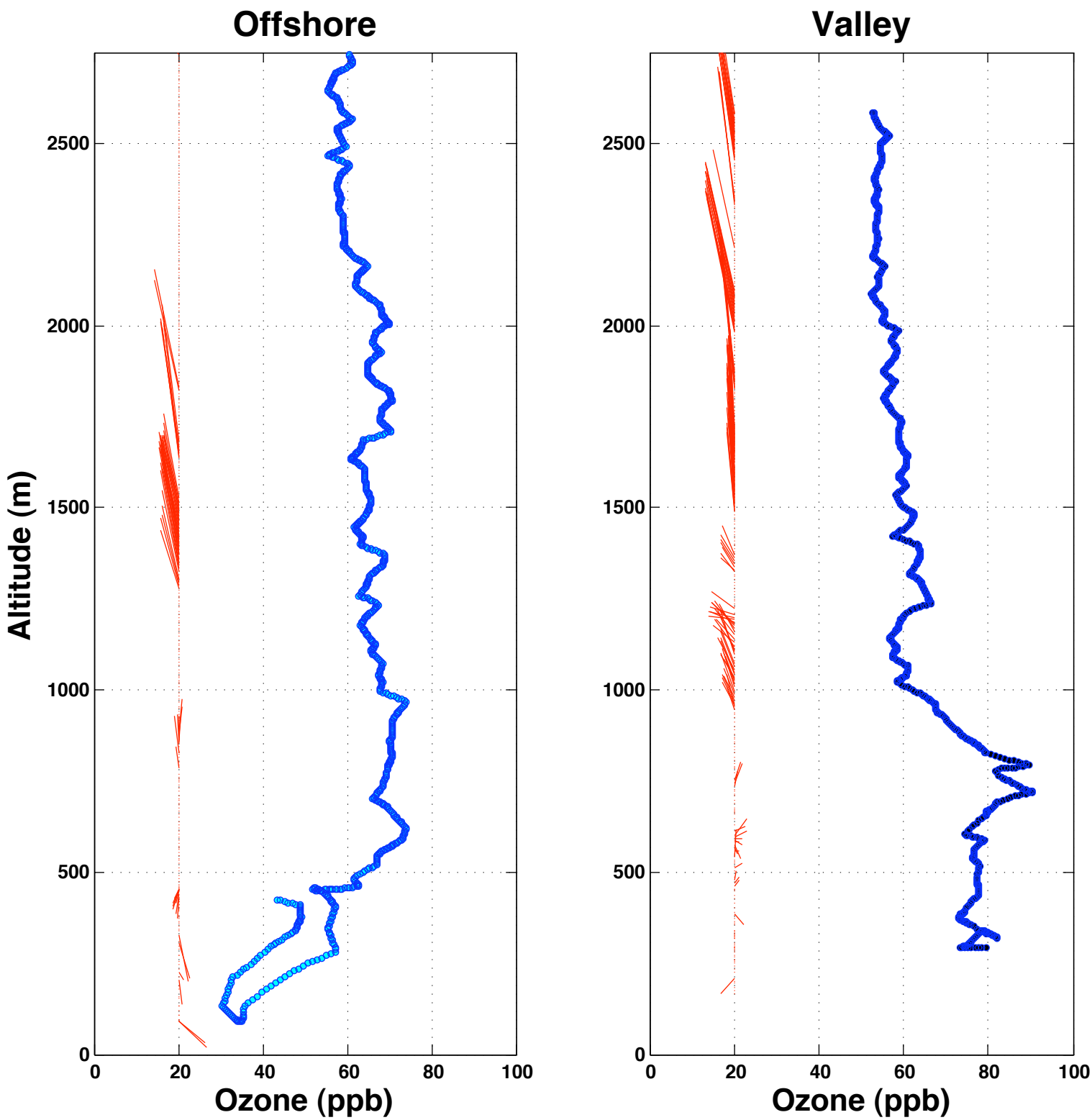
Measurements	Technique
Horizontal Winds	Differential GPS (1 second)
Methane, CO_2, H_2O	PICARRO CaRDS (10 Hz)
Temperature/Humidity	Vaisala Probe (wing mount)
Ozone	2B Model 205

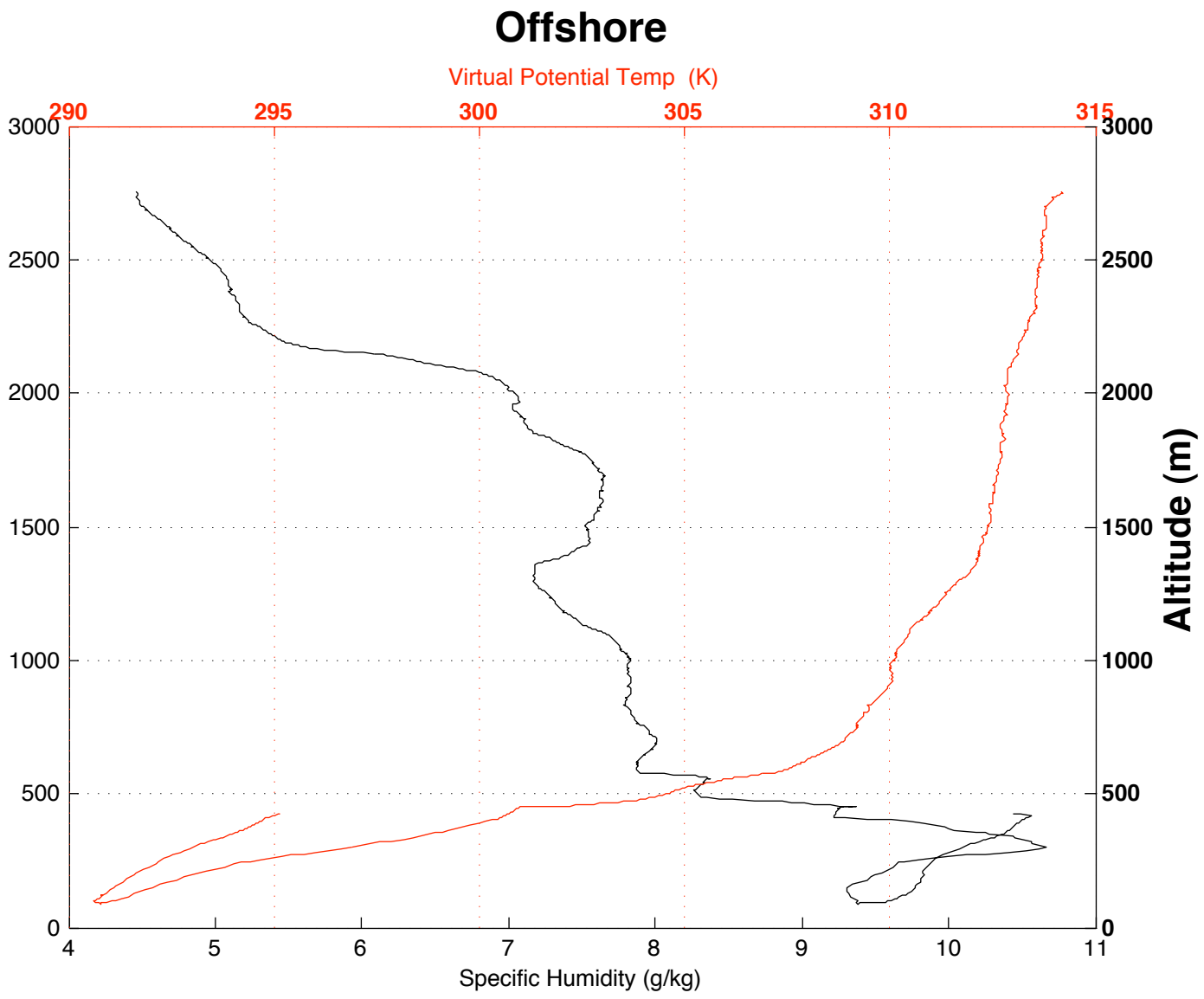


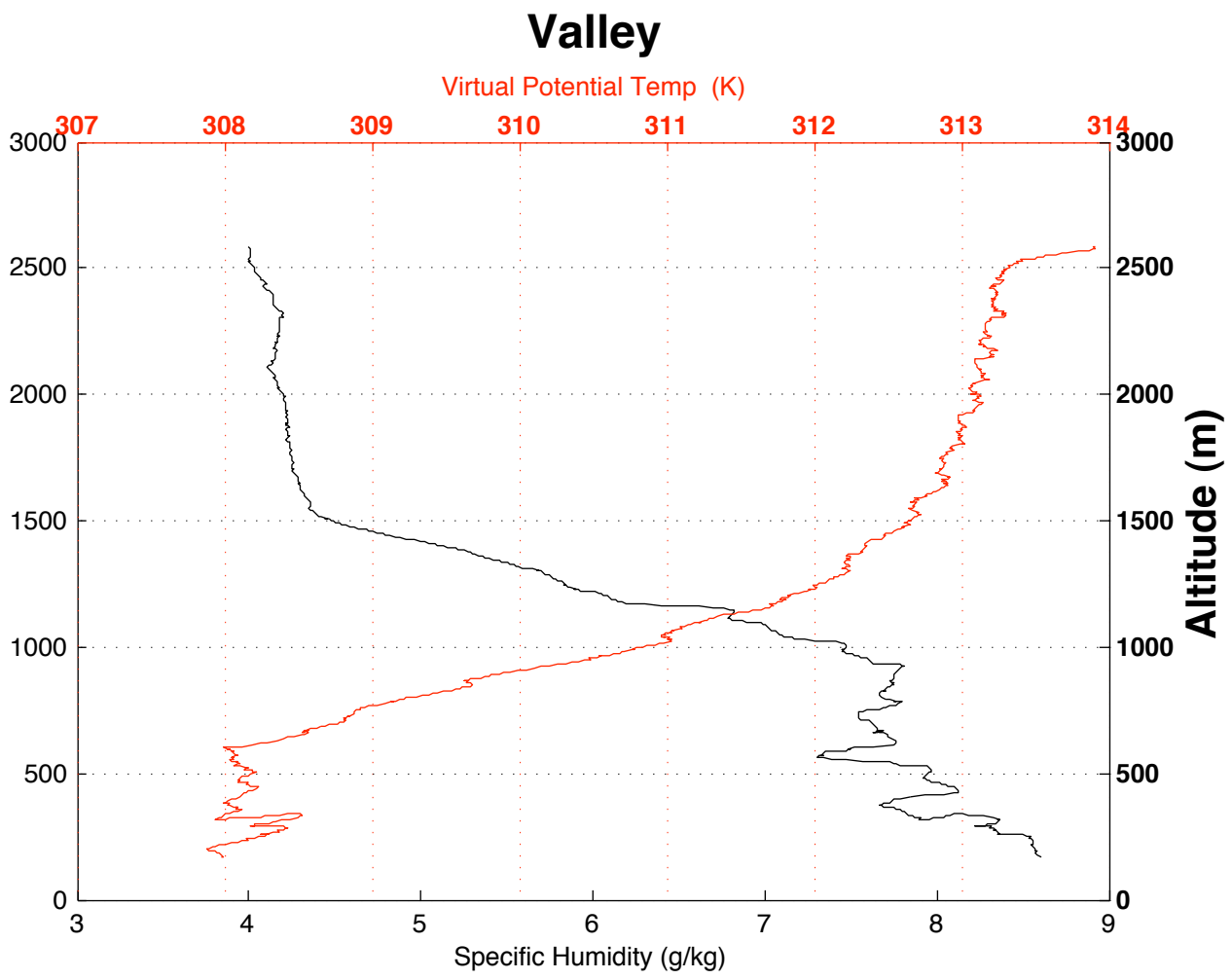
2B Ozone, Picarro (CH_4/CO_2), LGR NO_2, NOAA flask package

Scientific Aviation Flight 13–Sep–2012: O_3 (ppb)




Offshore
Valley
Altitude (m)
Ozone (ppb)
Ozone (ppb)
0
500
1000
1500
2000
2500
0
20
40
60
80
100


Offshore
Virtual Potential Temp (K)
290
295
300
305
310
315
3000
2500
2000
1500
1000
500
0
Altitude (m)
4
5
6
7
8
9
10
11
Specific Humidity (g/kg)


Valley
Virtual Potential Temp (K)
307
308
309
310
311
312
313
314
3000
2500
2000
1500
1000
500
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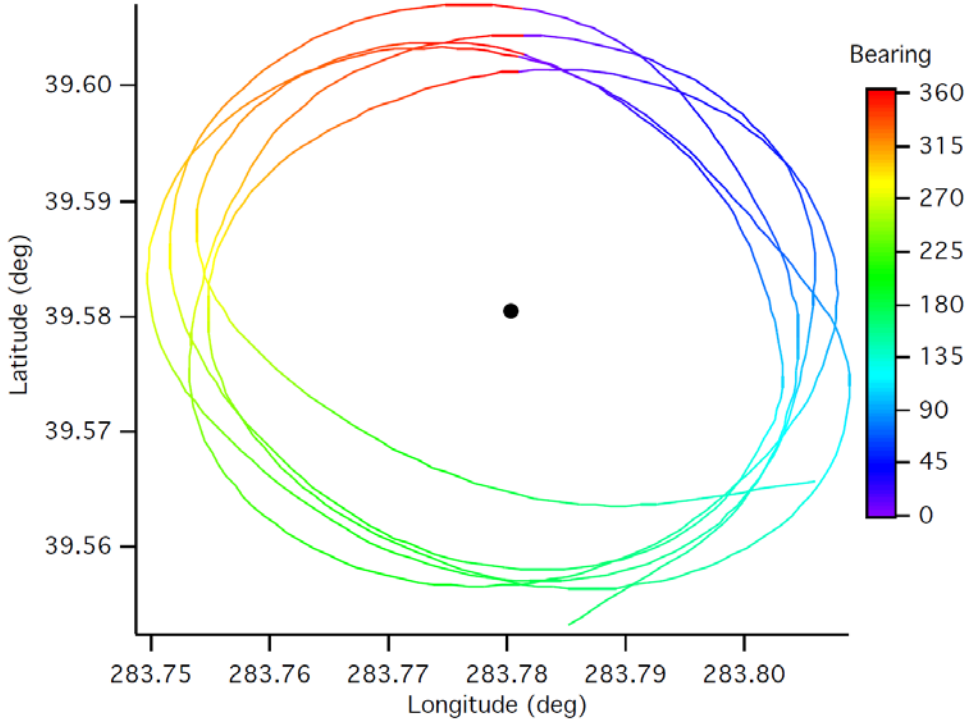
3
4
5
6
7
8
9
Specific Humidity (g/kg)
Altitude (m)

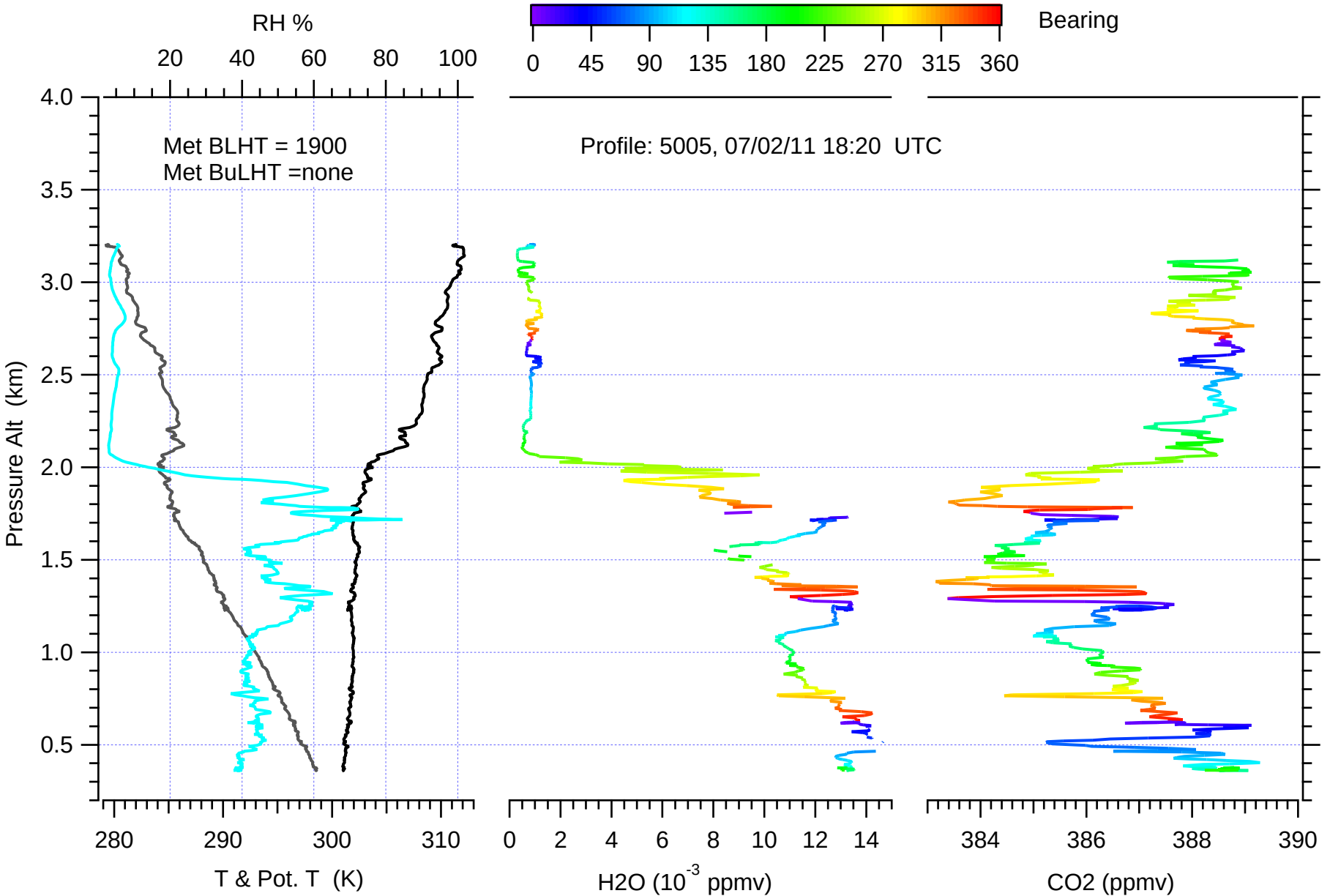


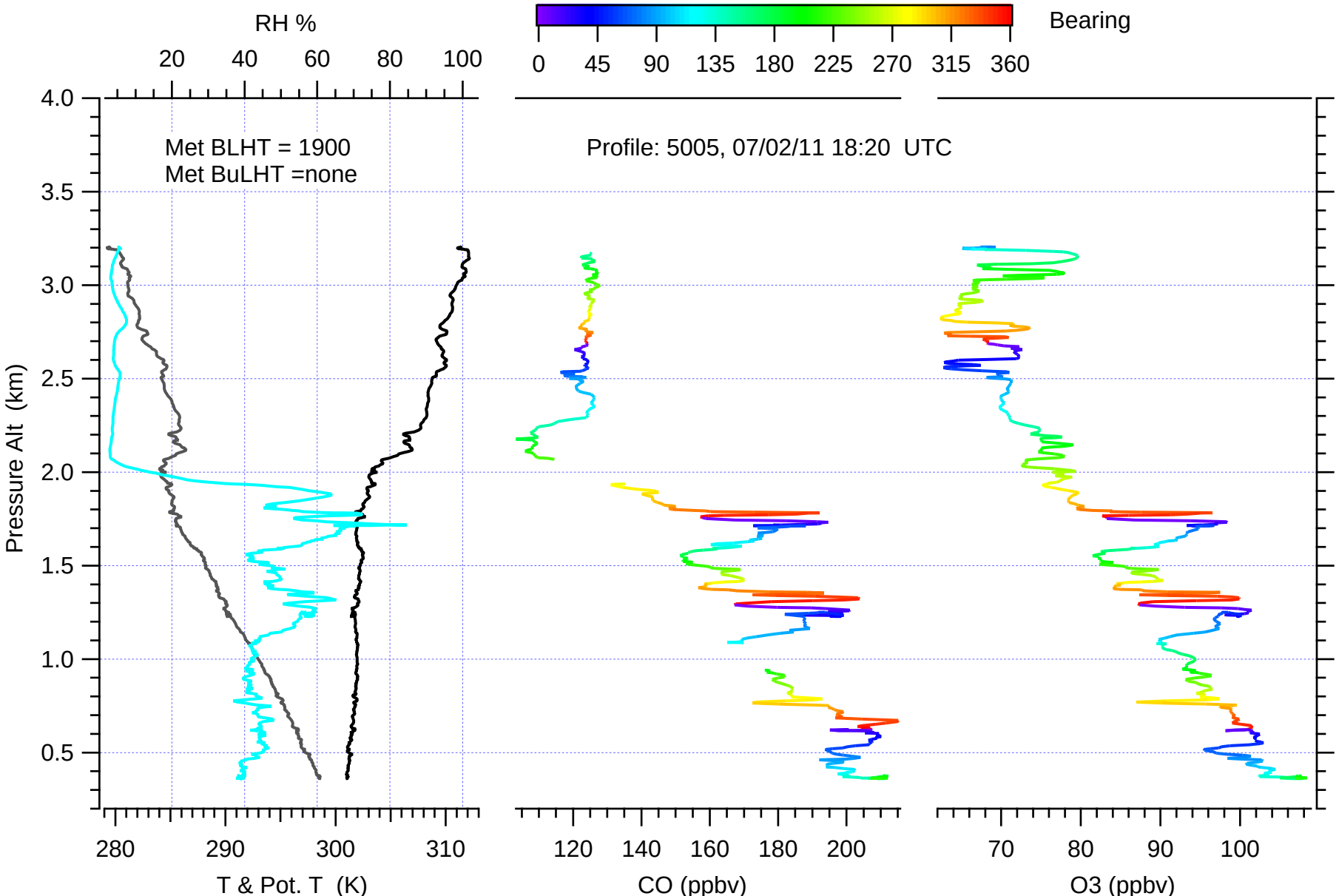
-Horizontal variability can be gauged by calculating the bearing angle from the geographic center of each spiral

-Vertical profiles can then be colored to show bearing at each altitude. Seeing enhancements at multiple altitudes and the same color helps separate horizontal from vertical gradients in a profile.

-The examples that follow represent two of the more obvious cases.

-Plots for all profiles have been placed on the DISCOVER-AQ archive and are undergoing further analysis.


RH %
20
40
60
80
100
Bearing
0
45
90
135
180
225
270
315
360
Met BLHT = 1900
Met BuLHT =none
Profile: 5005, 07/02/11 18:20 UTC
Pressure Alt (km)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
280
290
300
310
T & Pot. T (K)
0
2
4
6
8
10
12
14
H2O (10^-3 ppmv)
384
386
388
390
CO2 (ppmv)


RH %
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Bearing
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Met BLHT = 1900
Met BuLHT =none
Profile: 5005, 07/02/11 18:20 UTC
Pressure Alt (km)
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280
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T & Pot. T (K)
120
140
160
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CO (ppbv)
70
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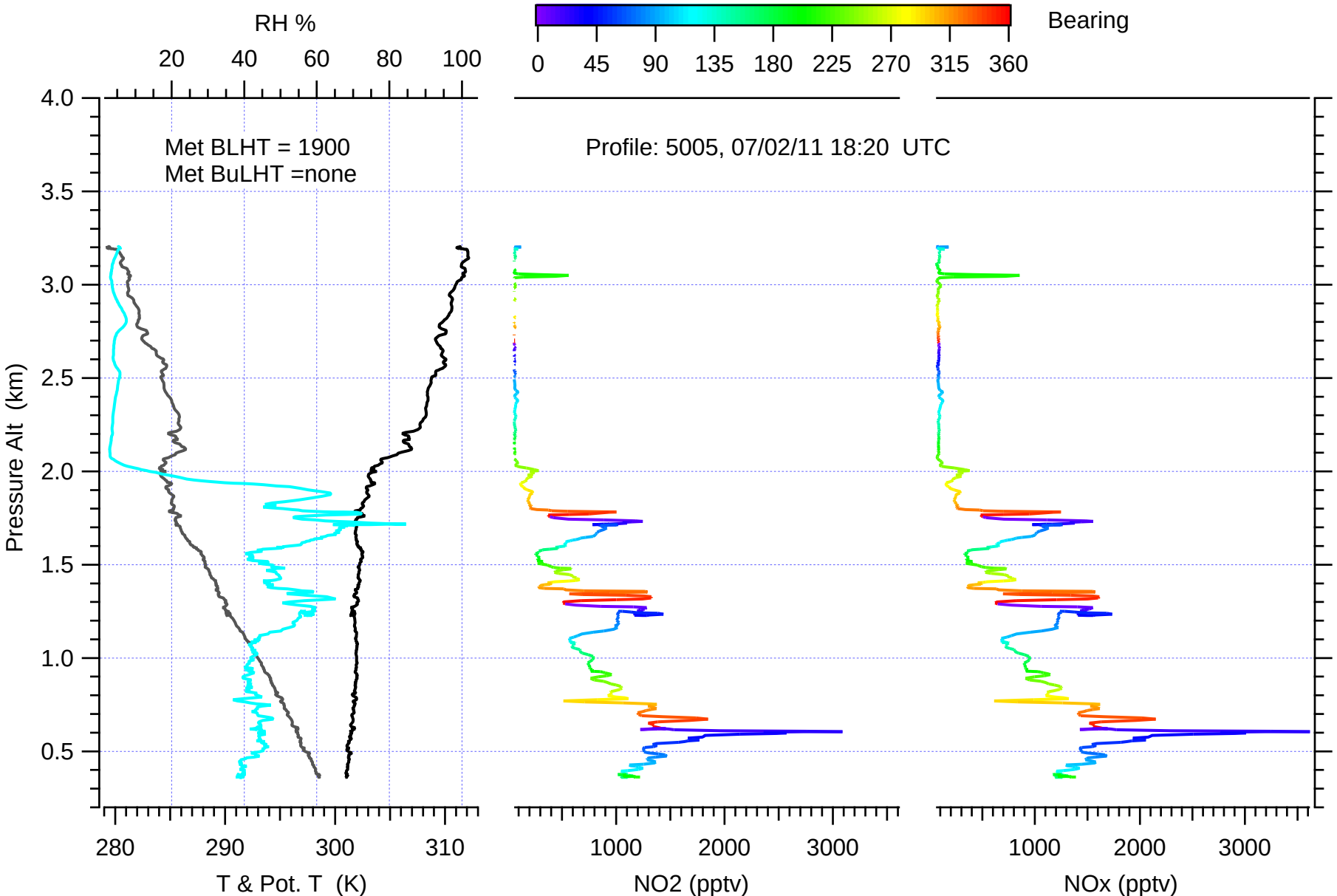
O3 (ppbv)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Bearing
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Met BLHT = 1900
Met BuLHT =none
Profile: 5005, 07/02/11 18:20 UTC
Pressure Alt (km)
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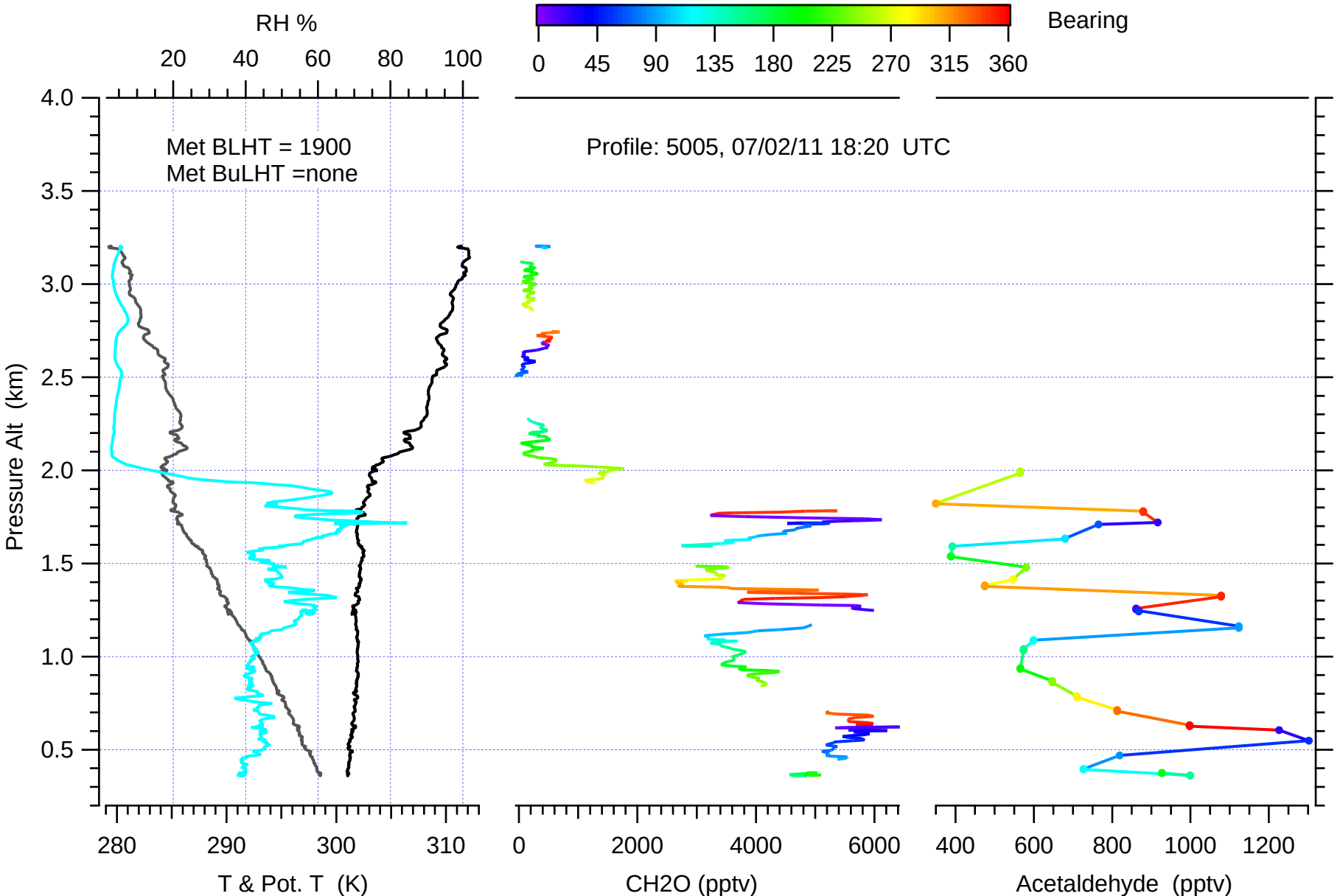
T & Pot. T (K)
1000
2000
3000
NO2 (pptv)
1000
2000
3000
NOx (pptv)


RH %
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Bearing
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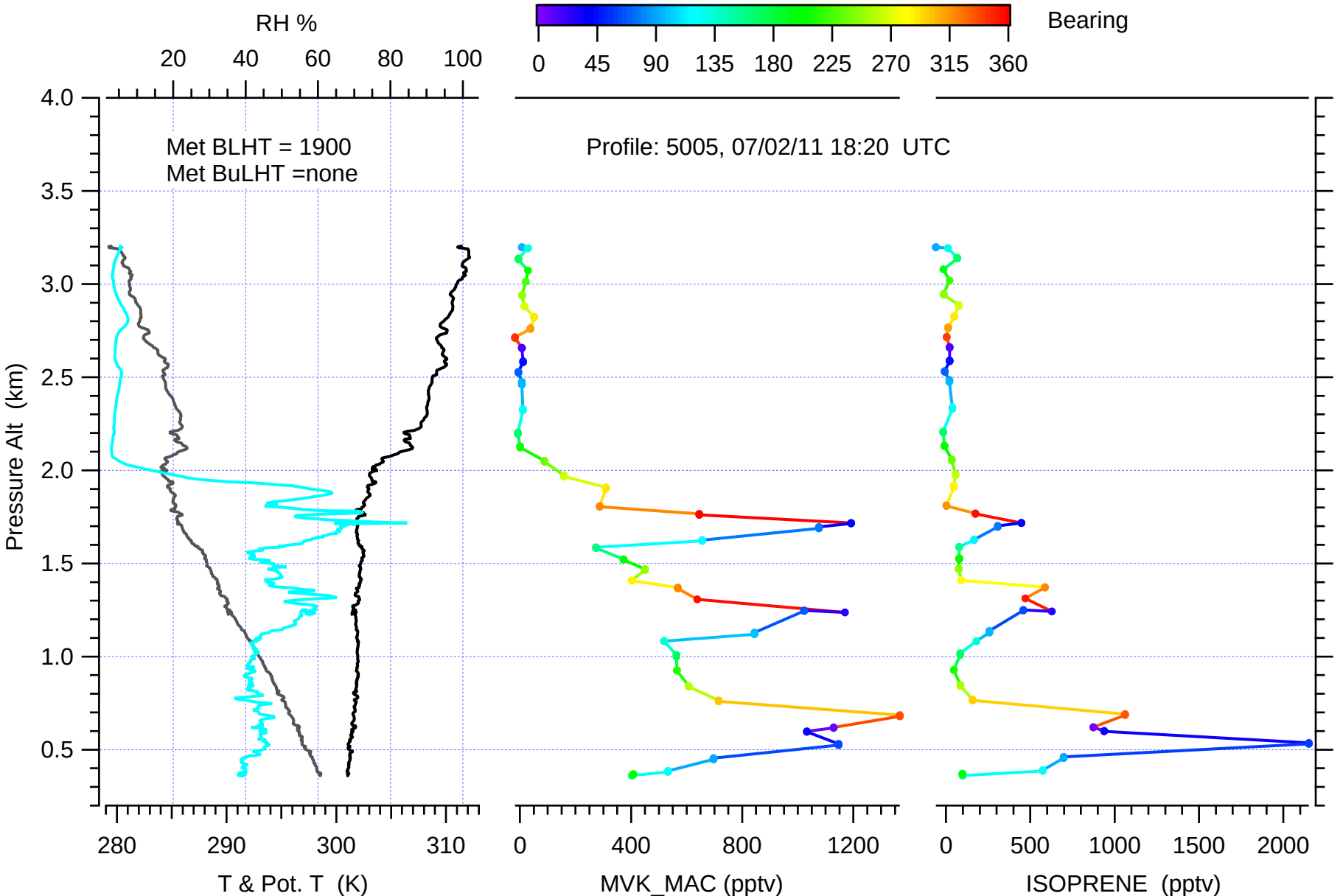
Met BLHT = 1900
Met BuLHT =none
Profile: 5005, 07/02/11 18:20 UTC
Pressure Alt (km)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
280
290
300
310
T & Pot. T (K)
0
2000
4000
6000
CH2O (pptv)
400
600
800
1000
1200
Acetaldehyde (pptv)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Met BuLHT =none
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Pressure Alt (km)
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280
290
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T & Pot. T (K)
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MVK_MAC (pptv)
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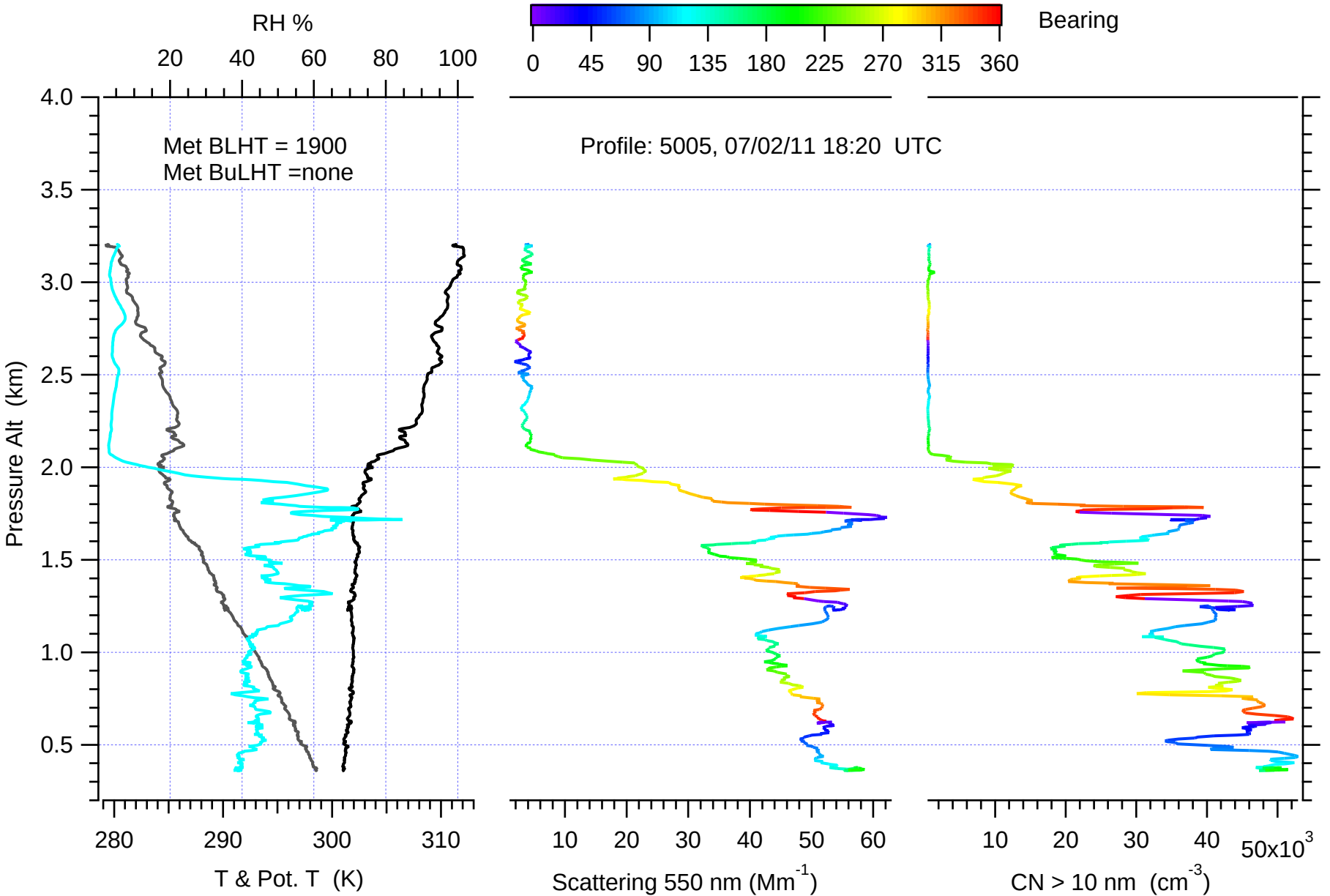
2000
ISOPRENE (pptv)


RH %
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Bearing
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Met BLHT = 1900
Met BuLHT =none
Profile: 5005, 07/02/11 18:20 UTC
Pressure Alt (km)
4.0
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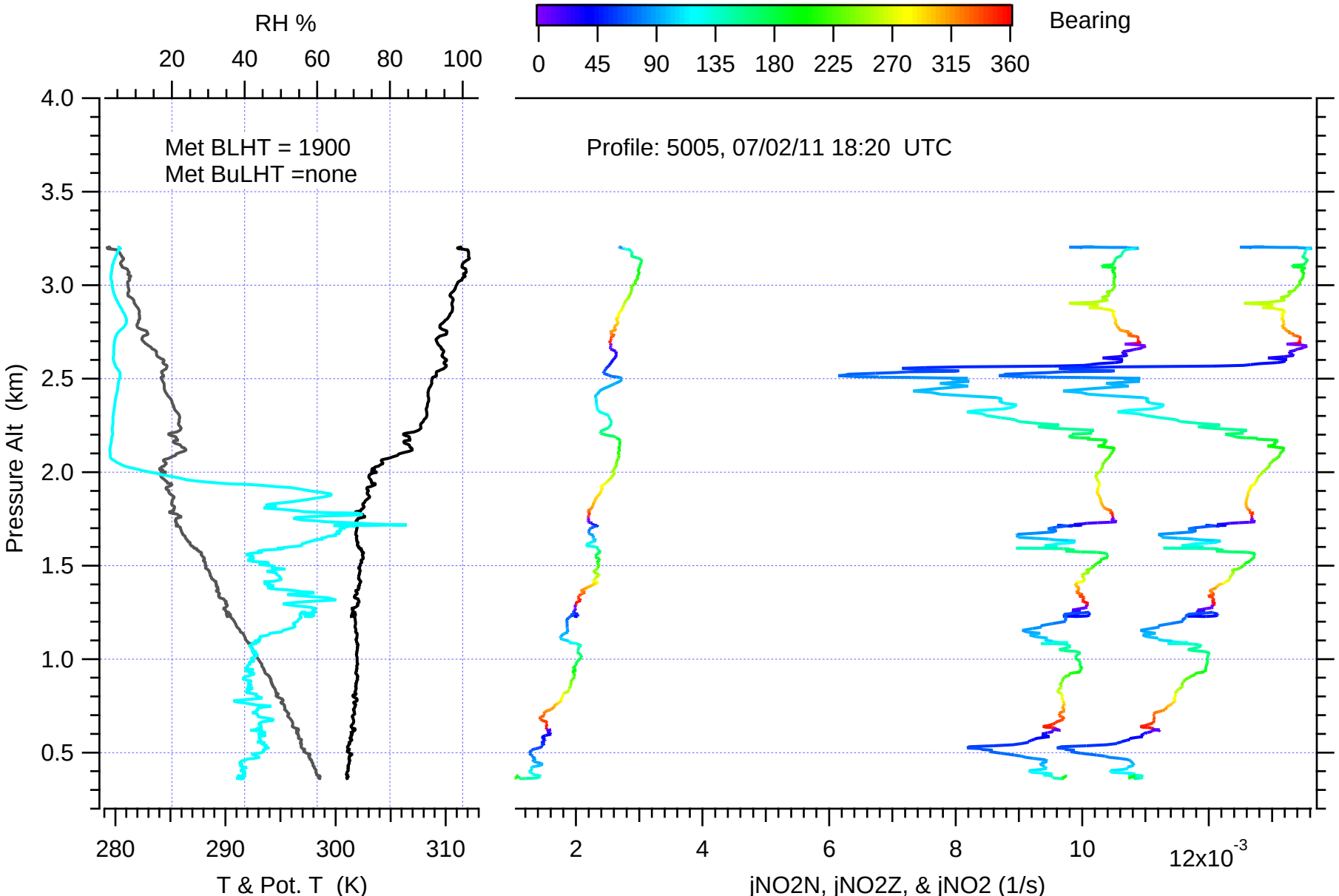
2.0
1.5
1.0
0.5
280
290
300
310
T & Pot. T (K)
10
20
30
40
50
60
Scattering 550 nm (Mm-1)
10
20
30
40
50x10^3
CN > 10 nm (cm-3)


RH %
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Met BLHT = 1900
Met BuLHT =none
Profile: 5005, 07/02/11 18:20 UTC
Pressure Alt (km)
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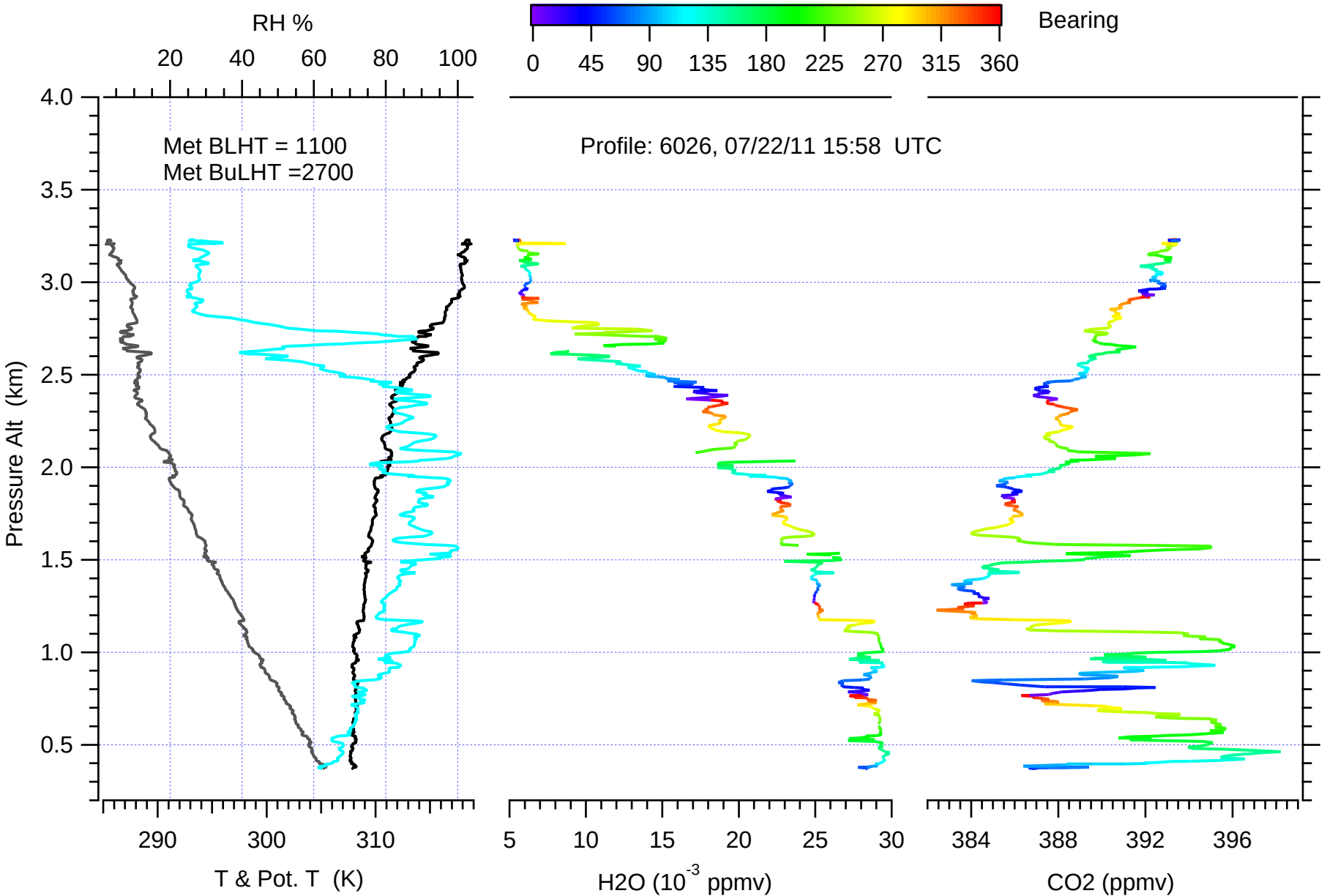
1.0
0.5
280
290
300
310
T & Pot. T (K)
2
4
6
8
10
12x10^-3
jNO2N, jNO2Z, & jNO2 (1/s)


RH %
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Bearing
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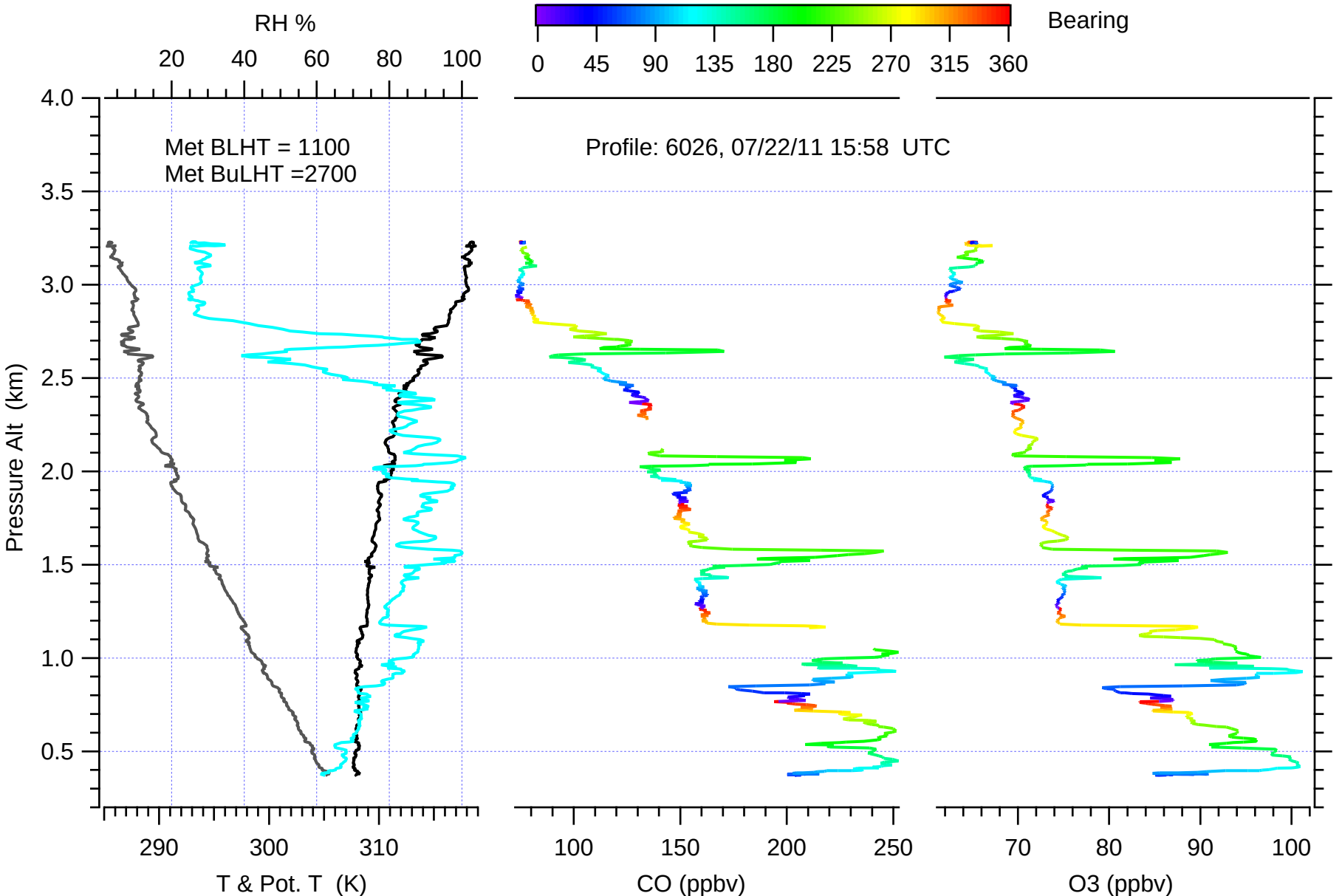
135
180
225
270
315
360
Met BLHT = 1100
Met BuLHT =2700
Profile: 6026, 07/22/11 15:58 UTC
Pressure Alt (km)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
290
300
310
T & Pot. T (K)
5
10
15
20
25
30
H2O (10^-3 ppmv)
384
388
392
396
CO2 (ppmv)


RH %
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80
100
Bearing
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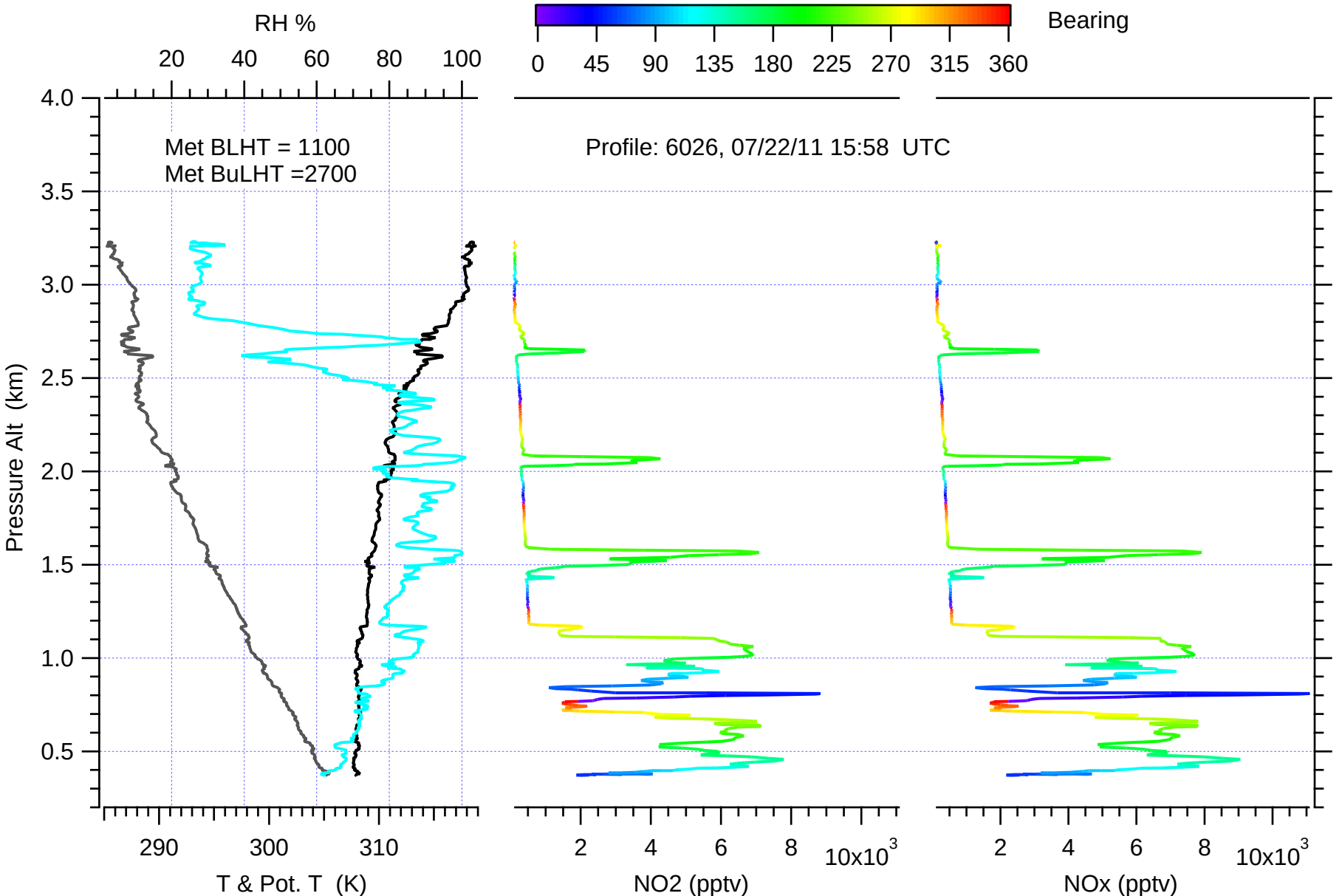
45
90
135
180
225
270
315
360
Met BLHT = 1100
Met BuLHT =2700
Profile: 6026, 07/22/11 15:58 UTC
Pressure Alt (km)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
290
300
310
T & Pot. T (K)
100
150
200
250
CO (ppbv)
70
80
90
100
O3 (ppbv)


RH %
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Bearing
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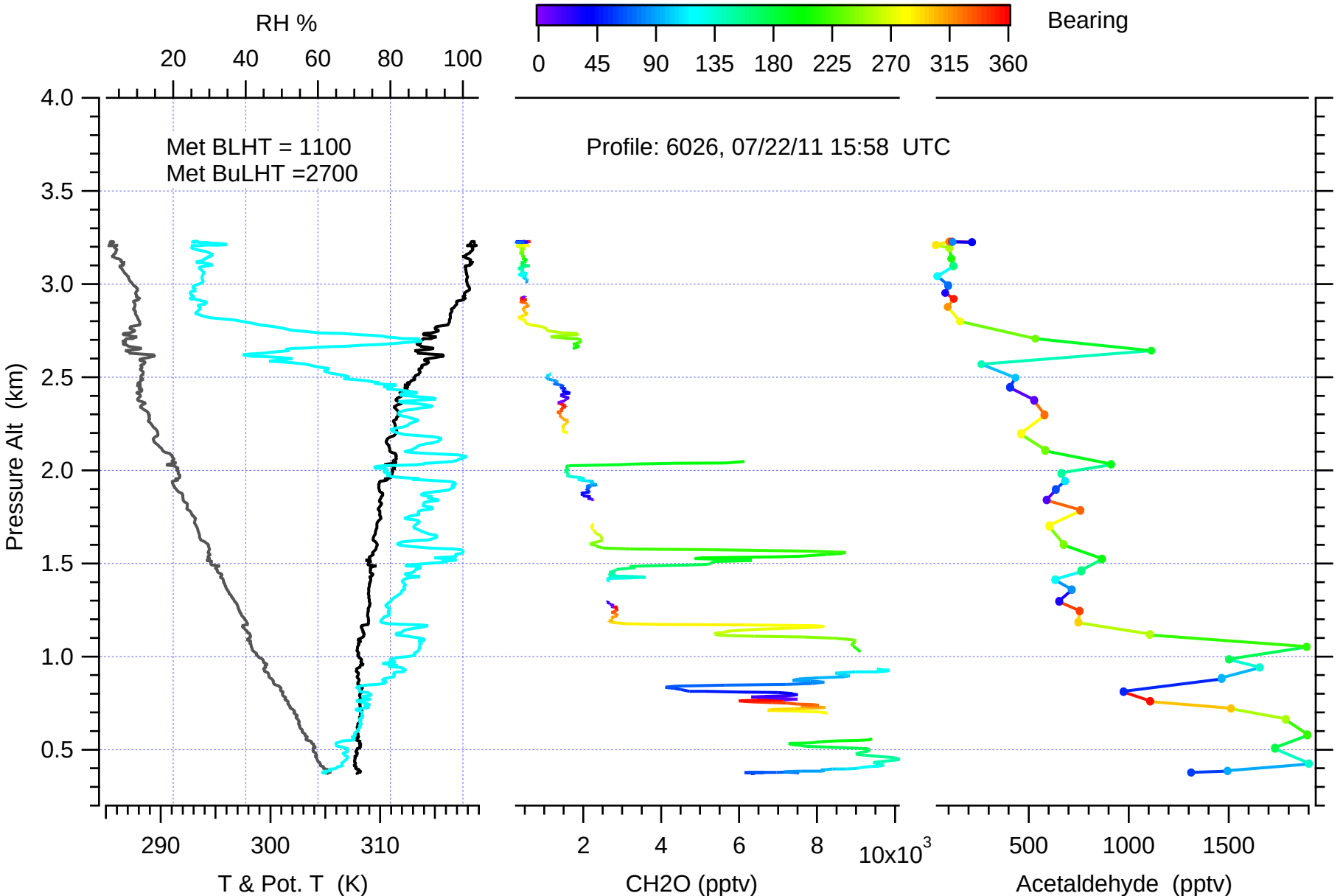
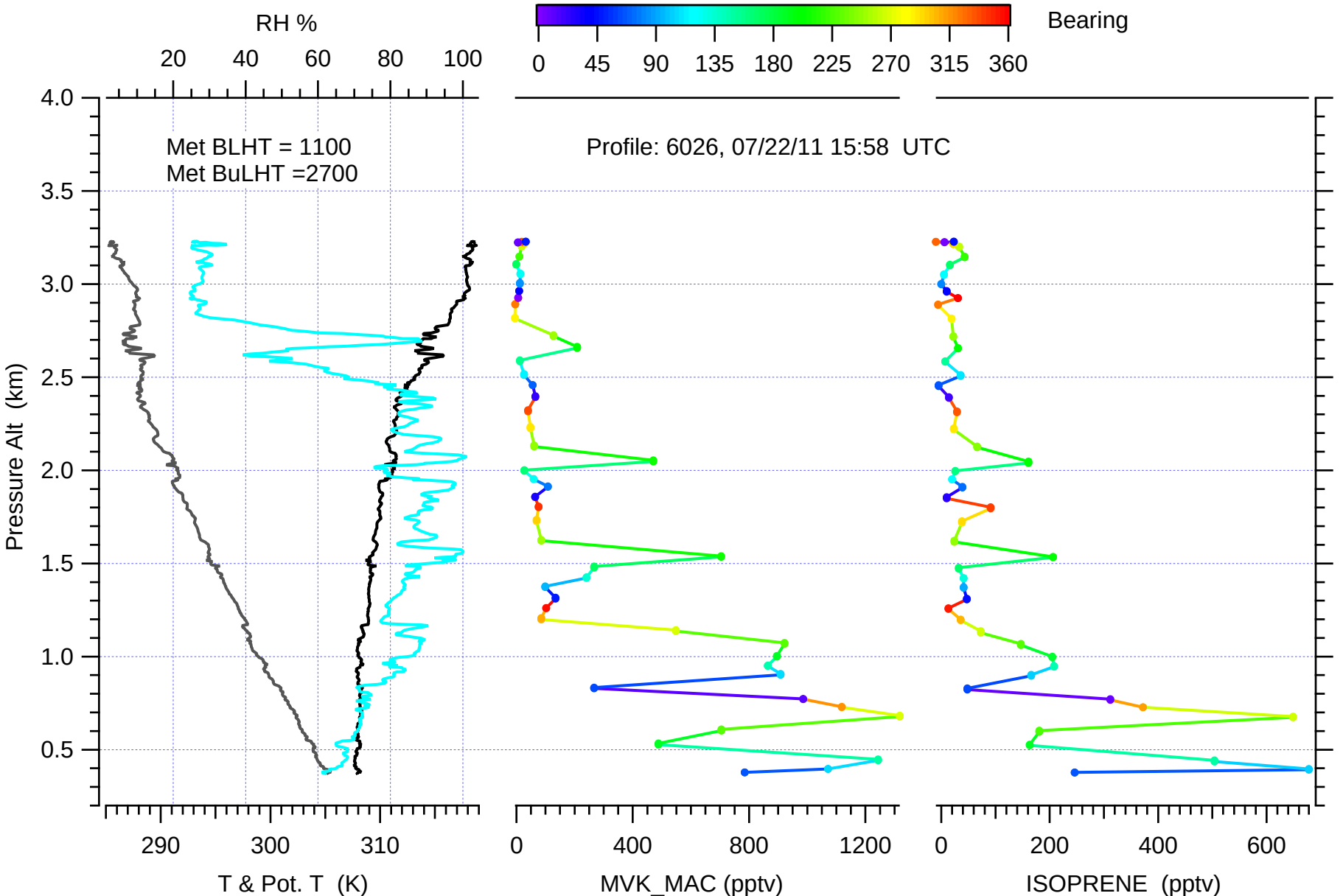
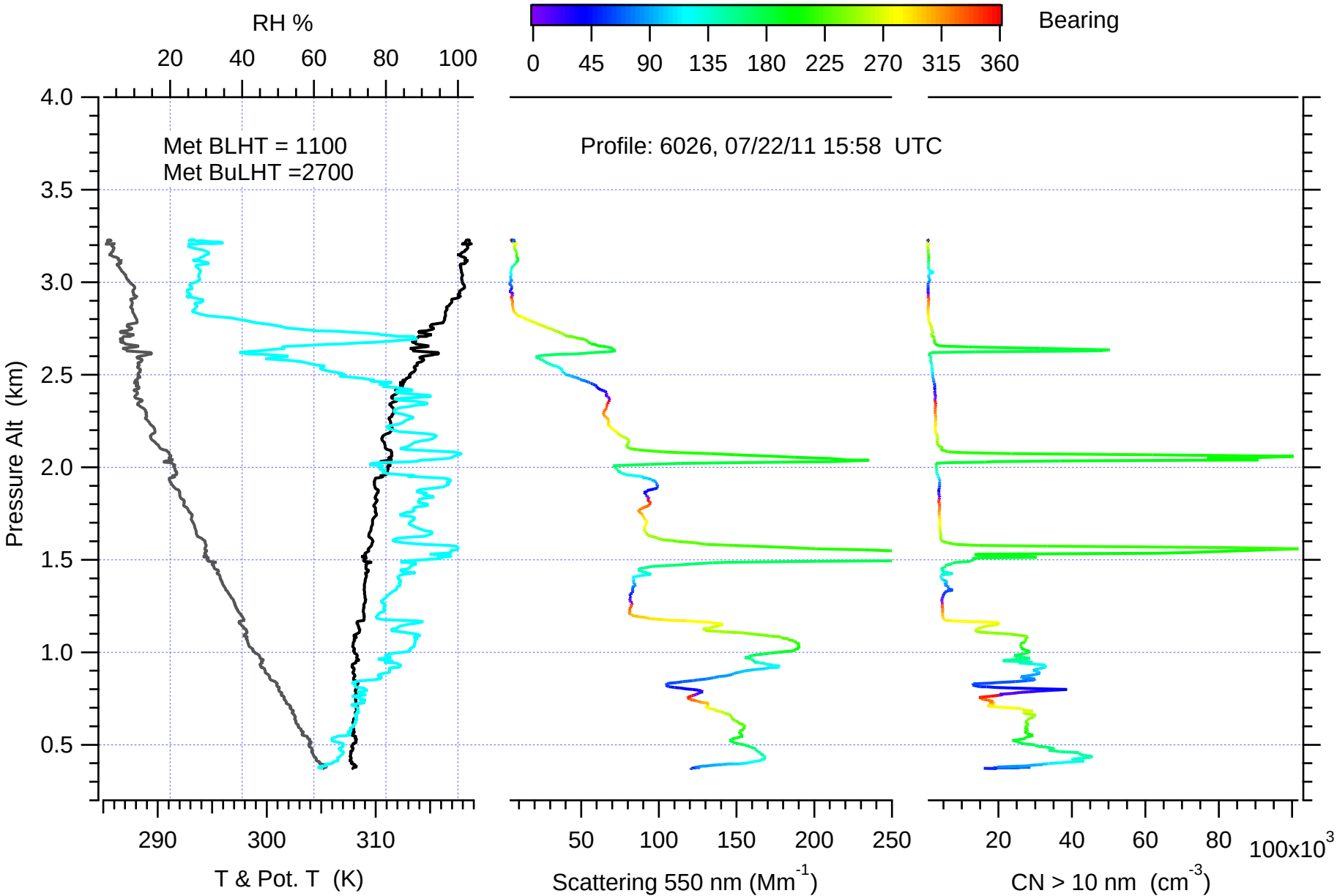
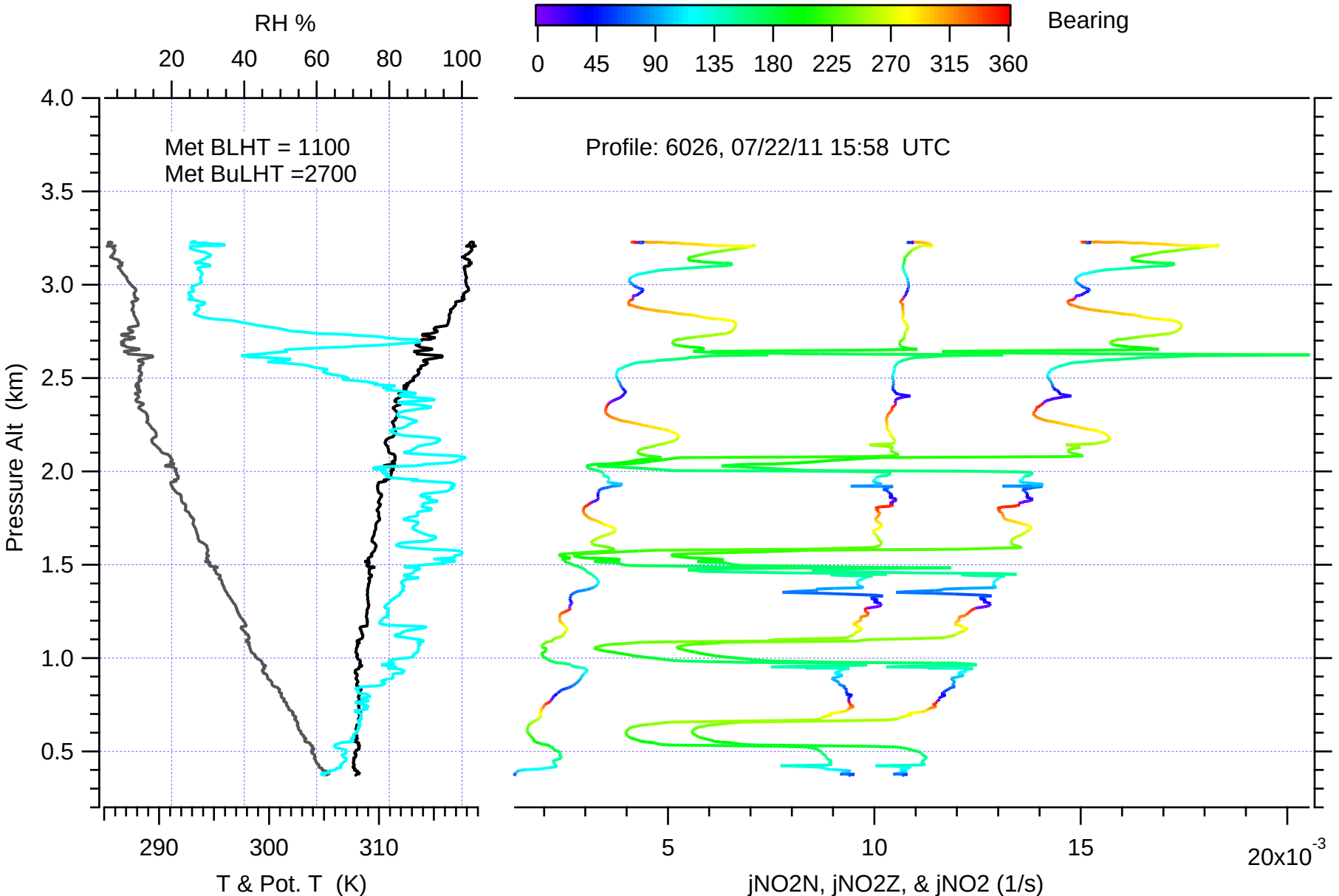
180
225
270
315
360
Met BLHT = 1100
Met BuLHT =2700
Profile: 6026, 07/22/11 15:58 UTC
Pressure Alt (km)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
290
300
310
T & Pot. T (K)
2
4
6
8
10x10^3
NO2 (pptv)
2
4
6
8
10x10^3
NOx (pptv)


RH %
20
40
60
80
100
Bearing
0
45
90
135
180
225
270
315
360
Met BLHT = 1100
Met BuLHT =2700
Profile: 6026, 07/22/11 15:58 UTC
Pressure Alt (km)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
290
300
310
T & Pot. T (K)
2
4
6
8
10x10^3
CH2O (pptv)
500
1000
1500
Acetaldehyde (pptv)


RH %
20
40
60
80
100
Bearing
0
45
90
135
180
225
270
315
360
Met BLHT = 1100
Met BuLHT =2700
Profile: 6026, 07/22/11 15:58 UTC
Pressure Alt (km)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
290
300
310
T & Pot. T (K)
0
400
800
1200
MVK_MAC (pptv)
0
200
400
600
ISOPRENE (pptv)


RH %
20
40
60
80
100
Bearing
0
45
90
135
180
225
270
315
360
Met BLHT = 1100
Met BuLHT =2700
Profile: 6026, 07/22/11 15:58 UTC
Pressure Alt (km)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
290
300
310
T & Pot. T (K)
50
100
150
200
250
Scattering 550 nm (Mm-1)
20
40
60
80
100x10^3
CN > 10 nm (cm-3)


RH %
20
40
60
80
100
Bearing
0
45
90
135
180
225
270
315
360
Met BLHT = 1100
Met BuLHT =2700
Profile: 6026, 07/22/11 15:58 UTC
Pressure Alt (km)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
290
300
310
T & Pot. T (K)
5
10
15
20x10^-3
jNO2N, jNO2Z, & jNO2 (1/s)

SUPPLEMENTAL WINTER AIRCRAFT PM MEASUREMENT PROJECT

(Draft, September 26, 2012)

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INTRODUCTION

The NASA DISCOVER-AQ team plans to conduct a comprehensive field program from January 15 to February 15, 2013 in the southern San Joaquin Valley measuring particulate matter (PM) from satellite, aircraft and ground-based stations. Their main goal is to calibrate satellite-based measurements against ground-based measurements to increase the accuracy of estimated ground level PM from satellite measurements. Even though their study will focus on the calibration of data in the southern San Joaquin Valley, findings of this study can be expanded to other regions in California as well as portions of the Western United States. The DISCOVER-AQ team has conducted similar studies in different regions of the country successfully.

The Bay Area Air Quality Management District (BAAQMD) plans to collaborate with the DISCOVER-AQ team in their effort. Research and Modeling Section staff of the BAAQMD has been extensively studying PM in the region. They have been analyzing aerometric data to identify meteorological conditions leading to elevated PM concentrations, preparing an emissions inventory for modeling, conducting meteorological and air quality simulations to estimate PM concentrations, investigating the effectiveness of proposed and adopted emissions controls through simulations to aid air quality planners, and estimating PM exposure and its human health impacts. The BAAQMD study domain covers all of central California and portions of northern California that includes the entire Central Valley and the San Francisco Bay Area.

The BAAQMD team has been evaluating models and improving their performance. Data are mainly available from routine surface-based measurements for model evaluation. In order to ensure the best model performance, it is necessary to evaluate the models in aloft layers. Therefore, the BAAQMD team collaborating with the DISCOVER-AQ team is proposing additional aircraft measurements for the purpose of model evaluation.

The results of the modeling work will also benefit the DISCOVER-AQ team. One way to calibrate satellite data for the DISCOVER-AQ team is to compare remotely sensed (satellite-based) columns of PM data against columns of PM measured from aircraft. Additional insight to the calibration effort may be gained by comparing columns of satellite data against columns of simulated data. If successful, the modeling information can significantly help the DISCOVER-AQ team in expanding their findings to other regions of California.

BACKGROUND

The BAAQMD has been applying both MM5 and WRF meteorological models with 4 km horizontal grid resolution, and 30 and 50 vertical layers in central California. The top of the modeling domain reaches 16 km. For PM simulations, the US EPA's CMAQ model was used. An extensive emissions inventory was developed for the San Francisco Bay Area. For the rest of the modeling domain, emission estimates were obtained from the California Air Resources Board.

The modeling system has been tested and evaluated for various winter weather conditions and an optimum model setup representative of the region has been selected. Meteorology and PM were simulated for three winters (2006-07, 2010-11 and 2011-12) for studying model performance, model response to changes in emissions, and regional transport of PM. In addition, detailed analyses of aerometric data have been conducted to identify meteorological conditions that lead to elevated PM concentrations.

Central California comprises three large air basins with complex and interconnected terrain: the San Joaquin Valley (SJV), the San Francisco Bay Area (SFBA), and the Sacramento area. Each region has distinct emissions patterns. Industrial and vehicular emissions dominate in the SFBA, household wood burning dominates the upper Sacramento Valley (SV), and agricultural emissions dominate in the SJV. Episodes of high PM levels develop over a few days to a week as winds shift typically from the north through the SV at the beginning of episodes to from the south through the SJV at the end of episodes. These shifting along-valley winds occur simultaneously with downslope motions along the elevated terrain surrounding Central Valley (CV), comprising the inland SJV and the SV. The combined effects tend to produce a large cold pool in the CV, which empties through the SFBA toward the Pacific Ocean. The mixing of the diverse emissions from the three regions over the course of an episode produces an inter-regional PM gradient with greater primary composition nearer the coast and greater secondary

composition further inland. Additionally, PM may be transported aloft, over the top of the cold pool of near-calm, often foggy air blanketing the valley floors. Thus, the evolution of a PM episode needs to be studied over the entire central California domain in order to better understand its PM problem.

Central California has an extensive surface monitoring network that characterizes the evolving gradient in PM composition as episodes progress. Limited column measurements were obtained at different locations on different days as part of the last major PM field study conducted in 1999-2001, the California Regional Particulate Air Quality Study (CRPAQS). These data did not, however, characterize the evolving aloft gradient at the inter-regional scale. Therefore, they are inadequate for model evaluation in aloft layers.

The DISCOVER-AQ program presents an opportunity to obtain the first inter-regional column measurements of PM over central California. These data would help both understanding of surface air quality and its calibration against remote sensing data. Understanding the horizontal spatial gradients for remotely sensed PM columns among the grid squares covering diverse sub-regions of central California is likely to considerably benefit the calibration of satellite-based measurements to explain regional surface air quality. A previous study conducted at the BAAQMD demonstrated that distinct gradients for NO_2 columns over the SFBA measured by OMI could be correlated with surface meteorology and air quality measurements.

SUPPLEMENTAL MEASUREMENT PROPOSAL

The NASA DISCOVER-AQ program currently plans to make aircraft measurements for about 10 days between January 15 and February 15, 2013 over the southern portions of the SJV, between the cities of Fresno and Bakersfield. Column measurements, most using lidars, will enable quantification of PM in aloft layers. Measurements will be conducted only for days with clear skies.

This proposal will expand the flight paths to include 2 additional days for the purpose of sampling wider regions of central California. These days should be forecasted to have region wide high PM levels. Days meeting this forecast will likely be foggy over the SJV, precluding the original flight path around Fresno and Bakersfield. The flights should be above the fog layer (400-800 m), as appropriate for meeting the FAA regulations and avoiding severe turbulance. The modified flight path is outlined below and shown in Figure 1.

- Start at Bakersfield and fly north along the Interstate 99 corridor.
- Pass over Sacramento from the east and continue north toward Yuba City.
- Pass Yuba City, then turn southwest flying over Woodland, Davis, Vacaville, Vallejo along the Interstate 80 corridor.

- Turn south at Fairfield along the 680 corridor into the Livermore Valley.
- Turn west at Livermore following the Interstate 580 corridor, exiting the Valley at Tracy.
- Turn south at Tracy toward Bakersfield and follow a path between Interstates 5 and 99.

Some surface air monitoring sites collect filter based PM data on one in three days. Others collect data every day. To maximize data for model evaluation, collaborating with neighboring districts, the BAAQMD will seek permission from the California Air Resources Board and the US EPA to alter the measurement schedule of those stations collecting data on one in three days so that they collect data on the day aircraft measurements are scheduled.

OUTCOMES AND BENEFITS

The proposed additional measurements will significantly contribute to the DISCOVER-AQ team's mission and the BAAQMD's effort. Neighboring districts will also significantly benefit from the outcome.

First the collected data will allow us to better understand the inter-regional spatial distribution of PM as episodes progress through central California. These data will likely reflect differences in primary-secondary split and elemental carbon (EC)-organic carbon (OC) composition associated with source-receptor relationships for the diverse emissions types occurring throughout central California. These data may also reflect different weather patterns under which inter-regional PM episodes initiate, persist, and terminate.

Second, the data will allow us to assess the model performance in aloft layers so that model findings and associated model response to changes in emissions and regional PM transport can be simulated and interpreted accurately. Models are used for a variety of other purposes including forecasting to issue alerts (BAAQMD and NOAA/ARL), permitting of large stationary sources, and developing clean air and land use plans.

Finally, the calibration of remotely sensed air quality against surface measurements will likely benefit greatly from expanded flight paths covering the entire central California domain.

ADDITIONAL CONSIDERATION

The estimated flight time to cover the outlined flight path is 4-5 hours. The estimated cost of each flight is $14,000-$17,500. This additional cost is not included in the DISCOVER-AQ team's budget. Therefore, the BAAQMD will cover the cost of supplemental measurements, not to exceed $29,000.

All data analysis and modeling related work will be conducted by staff of the BAAQMD. Results will be documented and shared with the members of the DISCOVER-AQ team. Experiments for expanding the calibration of satellite data will be designed jointly.

REFERENCES

Additional information can be found at BAAQMD's website:
http://www.baaqmd.gov/Divisions/Planning-and-Research/Research-and-Modeling/Publications.aspx

Figure 1. Proposed expanded flight path to obtain supplemental PM measurements over central California.