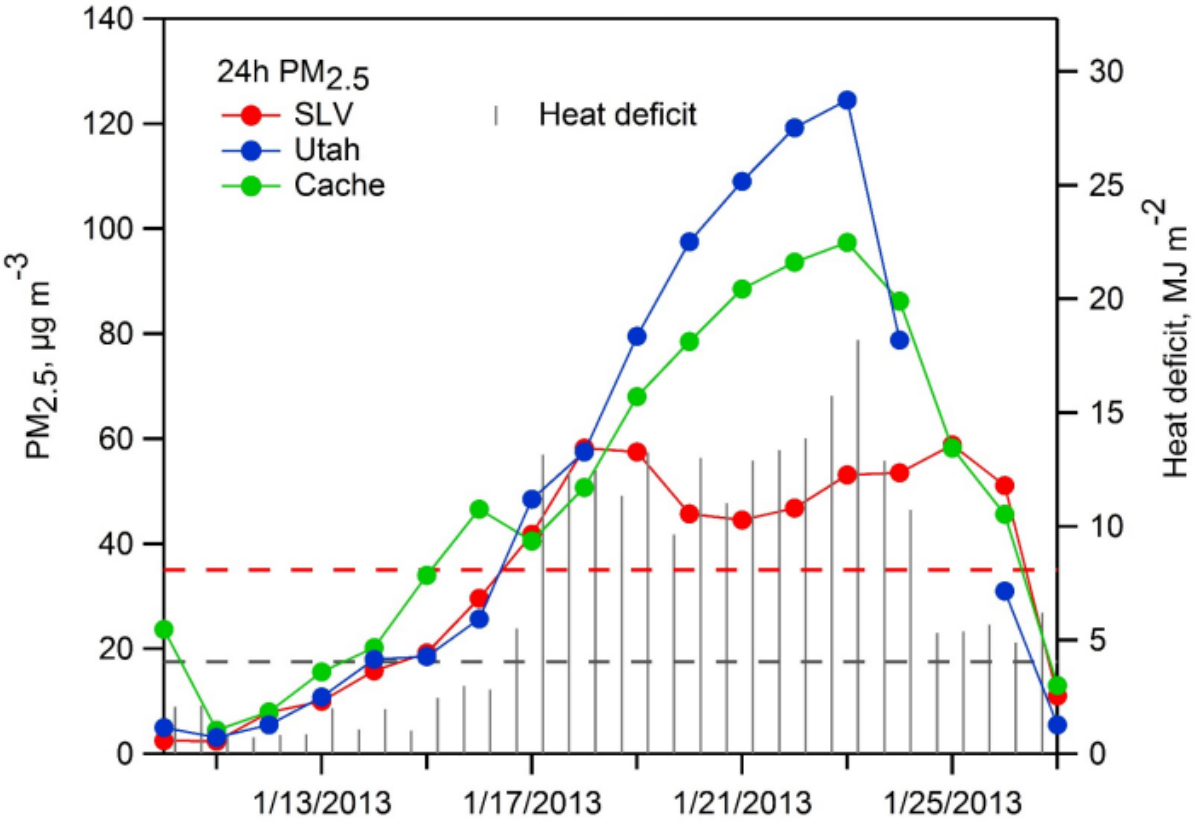
Vertical and spatial distribution of Aerosol and Gases during the UWFPS

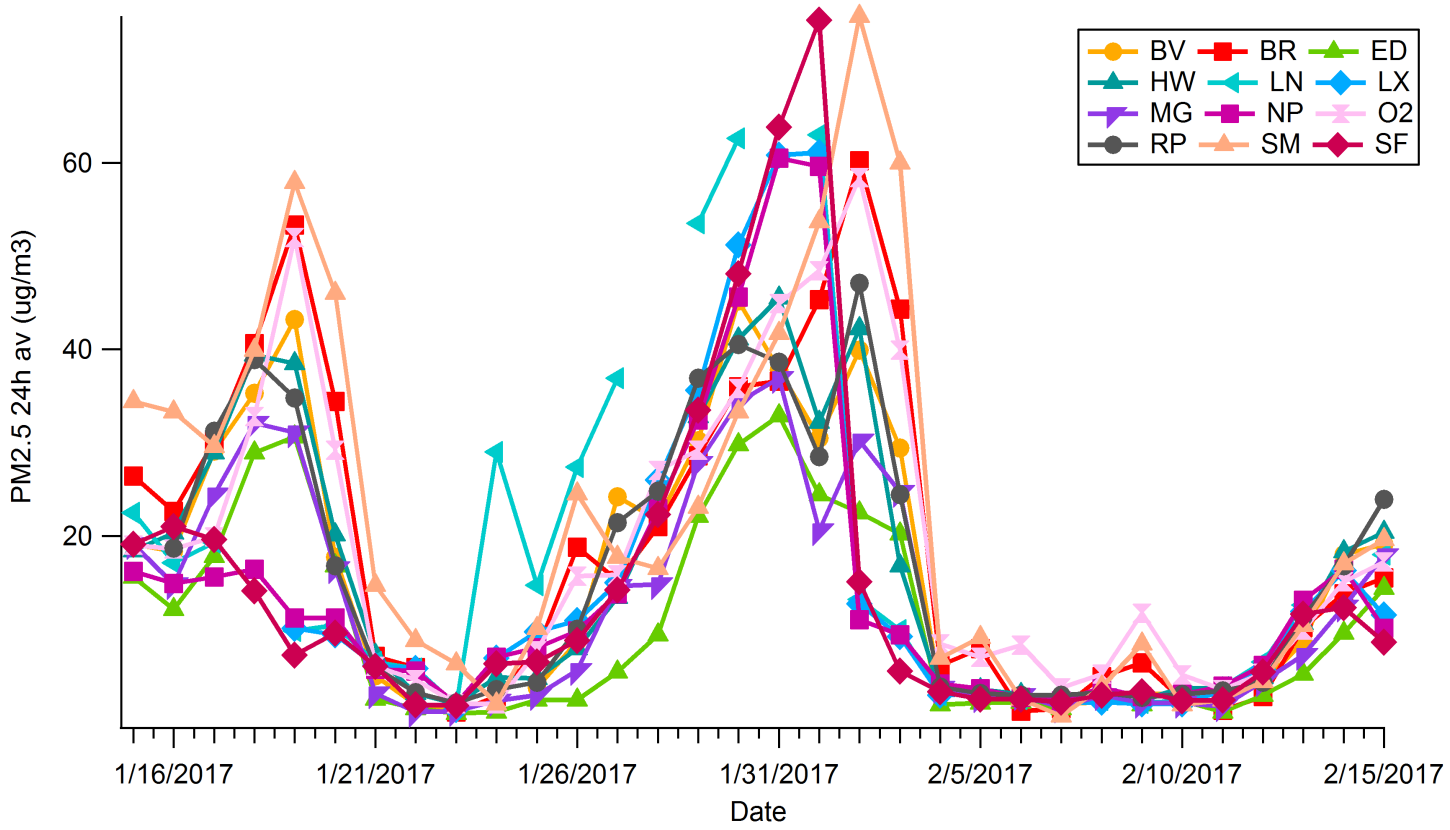
Alessandro Franchin

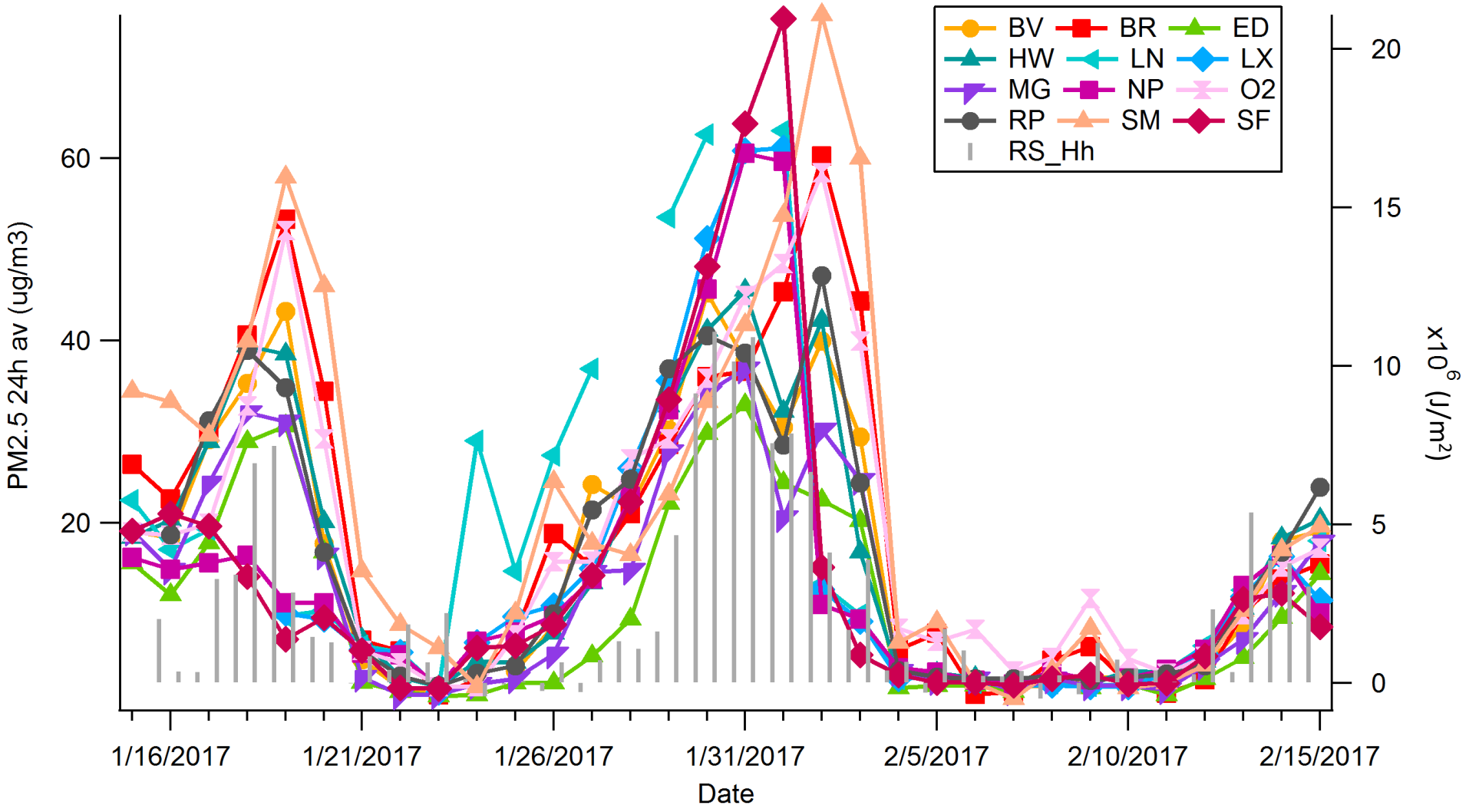
June, 29th 2017

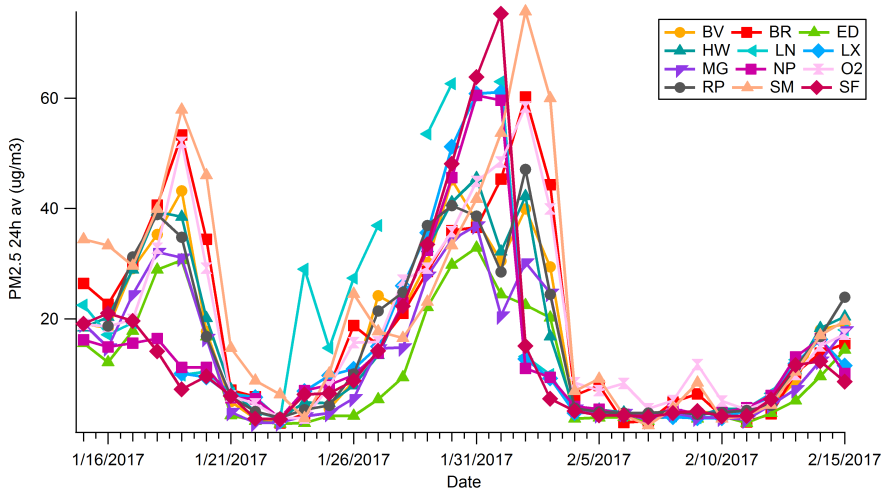
Pollution during winter inversion, a 2013 example

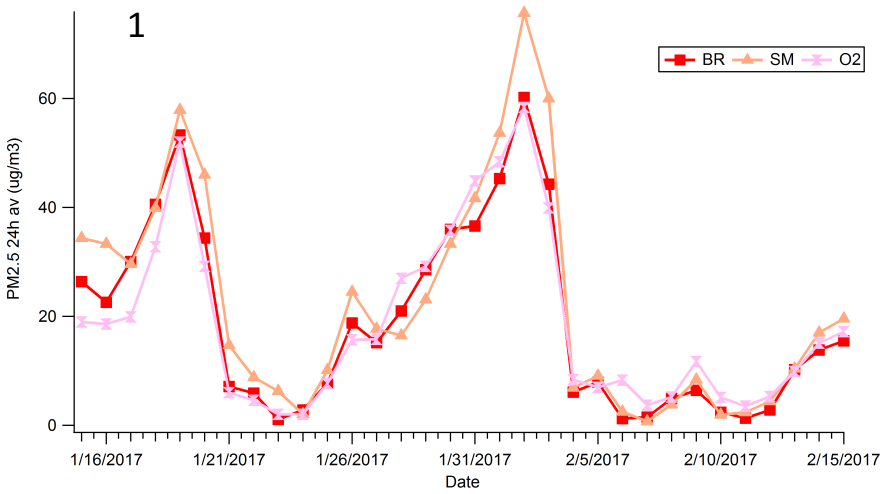


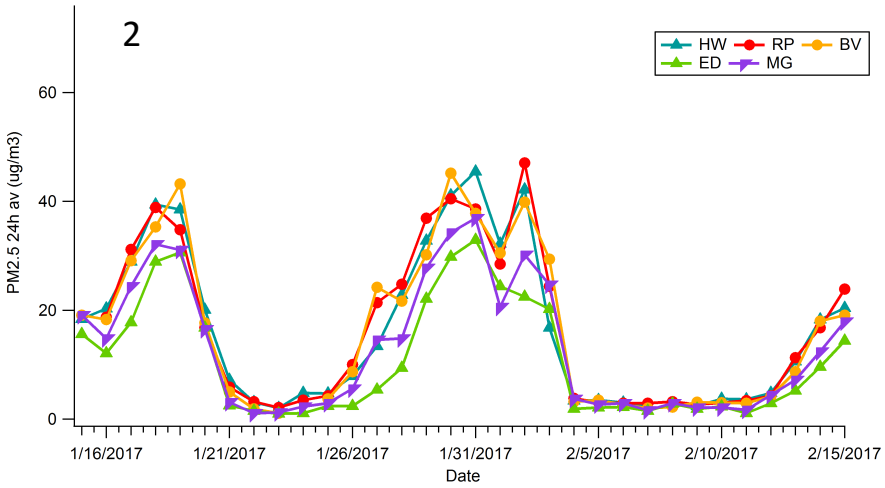
Pollution during winter inversion, a 2017 example

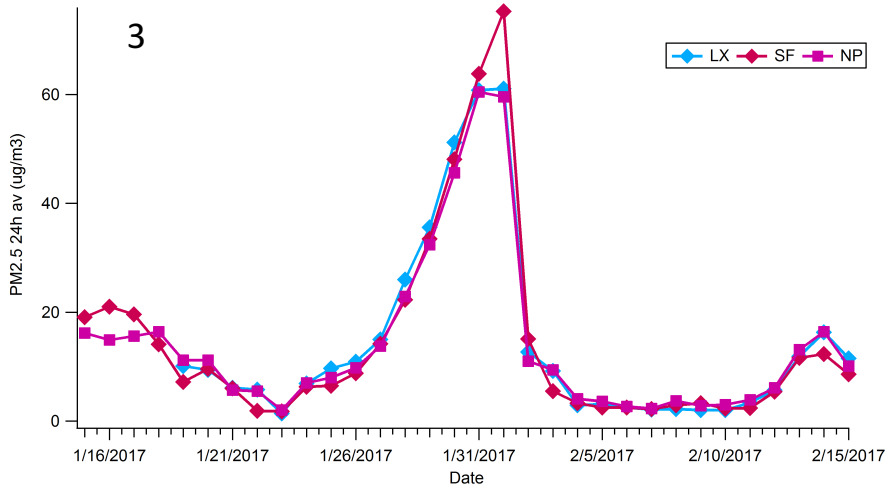


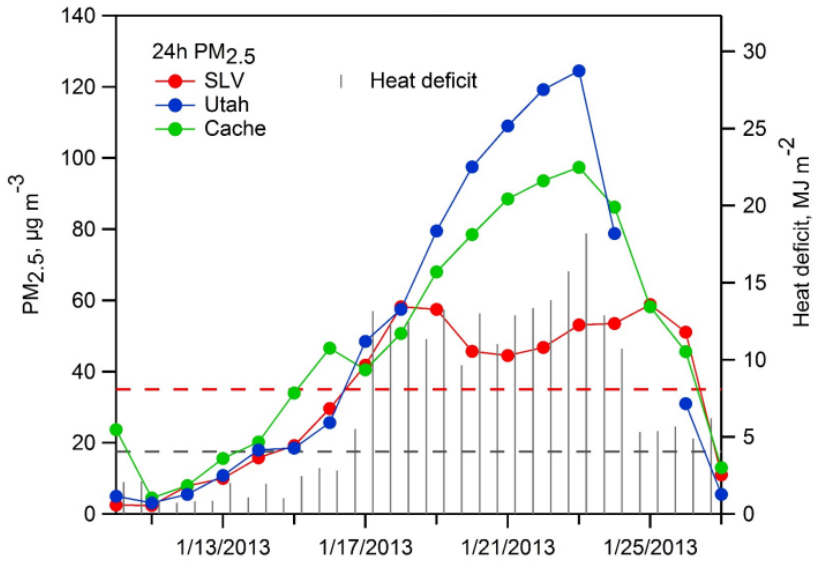

BV
BR
ED
HW
LN
LX
MG
NP
O2
RP
SM
SF
RS_Hh
PM2.5 24h av (ug/m3)
60
40
20
x10^6 (J/m^2)
20
15
10
5
0
1/16/2017
1/21/2017
1/26/2017
1/31/2017
2/5/2017
2/10/2017
2/15/2017
Date

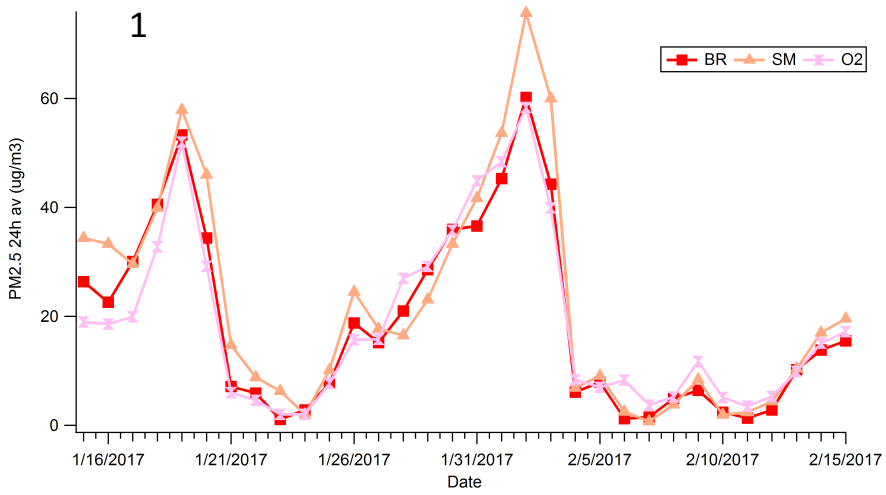

BV
BR
ED
HW
LN
LX
MG
NP
O2
RP
SM
SF
PM2.5 24h av (ug/m3)
0
20
40
60
1/16/2017
1/21/2017
1/26/2017
1/31/2017
2/5/2017
2/10/2017
2/15/2017
Date

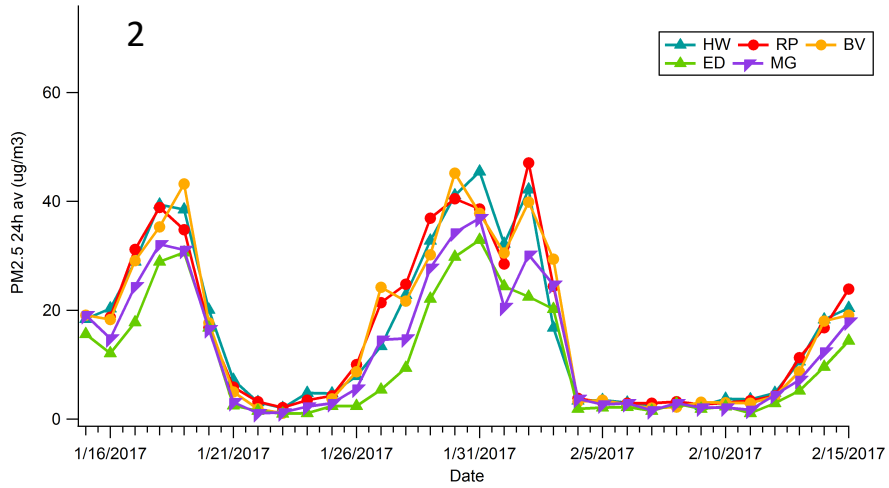

1
BR
SM
O2
PM2.5 24h av (ug/m3)
0
20
40
60
1/16/2017
1/21/2017
1/26/2017
1/31/2017
2/5/2017
2/10/2017
2/15/2017
Date

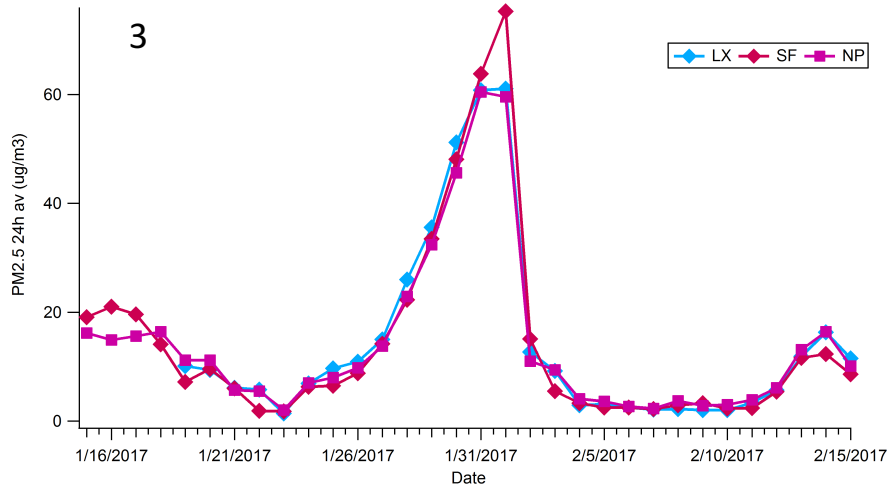

2
HW
RP
BV
ED
MG
PM2.5 24h av (ug/m3)
0
20
40
60
1/16/2017
1/21/2017
1/26/2017
1/31/2017
2/5/2017
2/10/2017
2/15/2017
Date

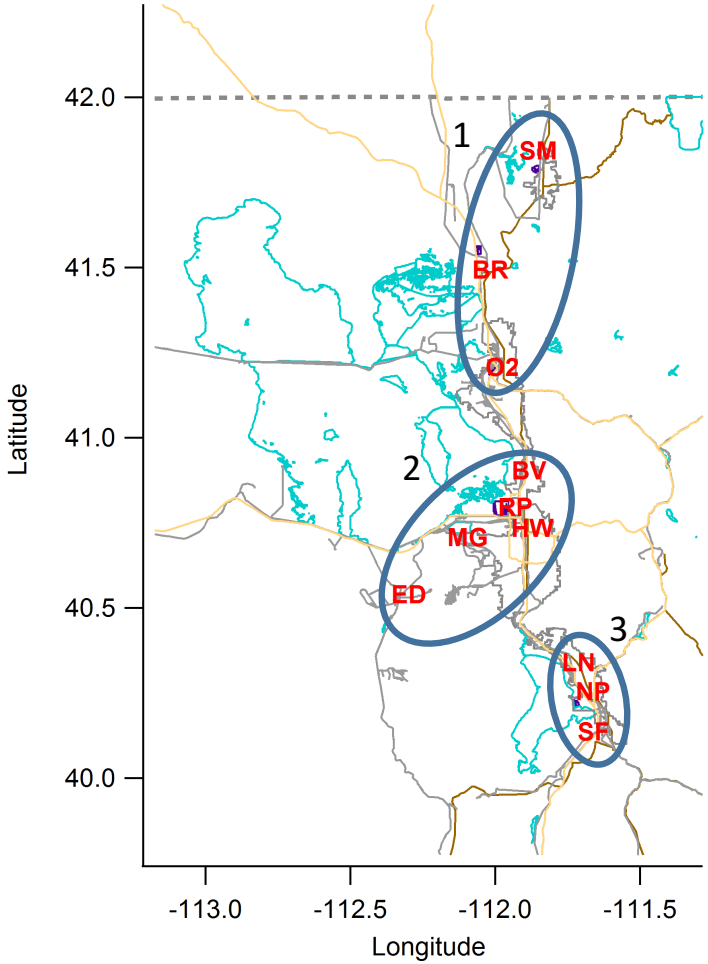

3
LX
SF
NP
PM2.5 24h av (ug/m3)
0
20
40
60
1/16/2017
1/21/2017
1/26/2017
1/31/2017
2/5/2017
2/10/2017
2/15/2017
Date

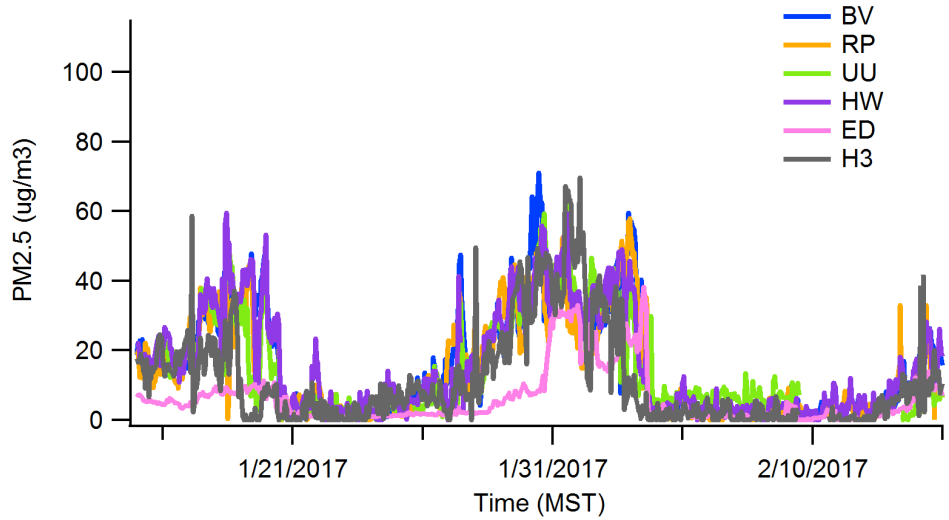

24h PM2.5
SLV
Utah
Cache
Heat deficit
PM2.5, µg m-3
Heat deficit, MJ m-2
1/13/2013
1/17/2013
1/21/2013
1/25/2013

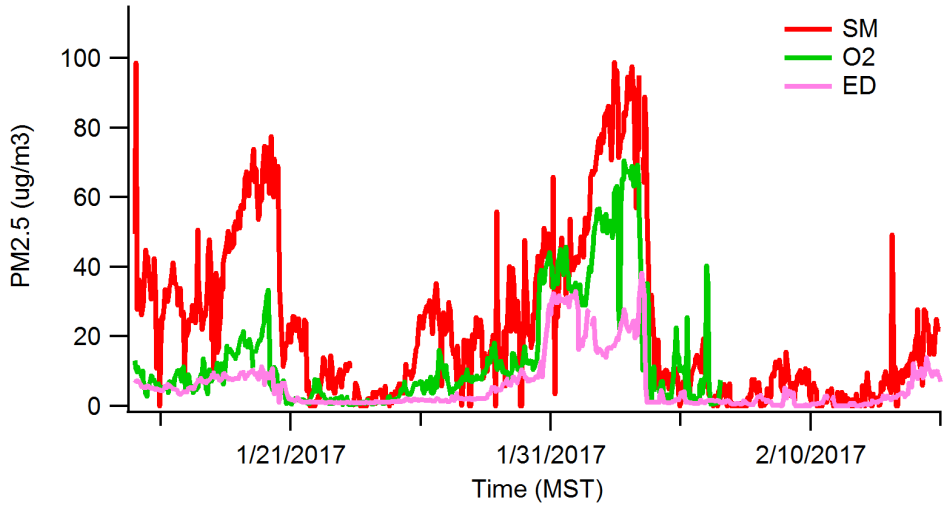

1
BR
SM
O2
PM2.5 24h av (ug/m3)
Date
1/16/2017
1/21/2017
1/26/2017
1/31/2017
2/5/2017
2/10/2017
2/15/2017

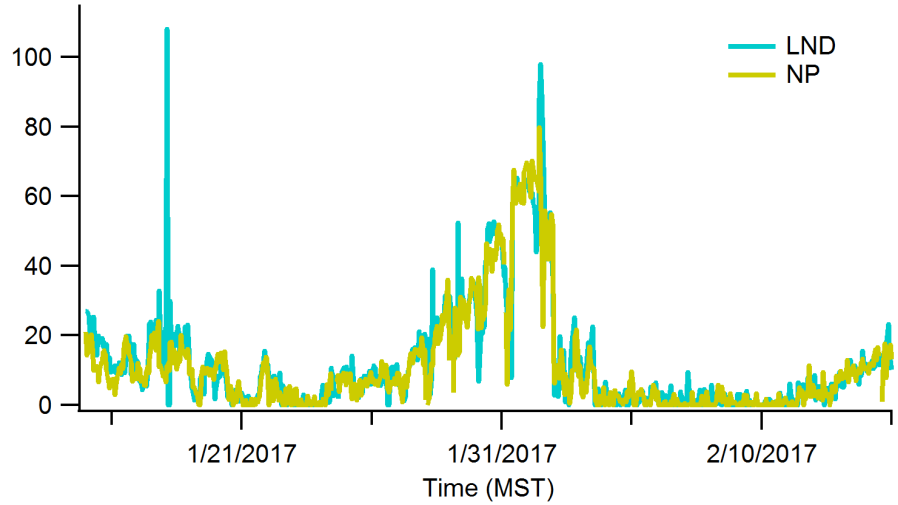

2
HW
RP
BV
ED
MG
PM2.5 24h av (ug/m3)
Date
1/16/2017
1/21/2017
1/26/2017
1/31/2017
2/5/2017
2/10/2017
2/15/2017

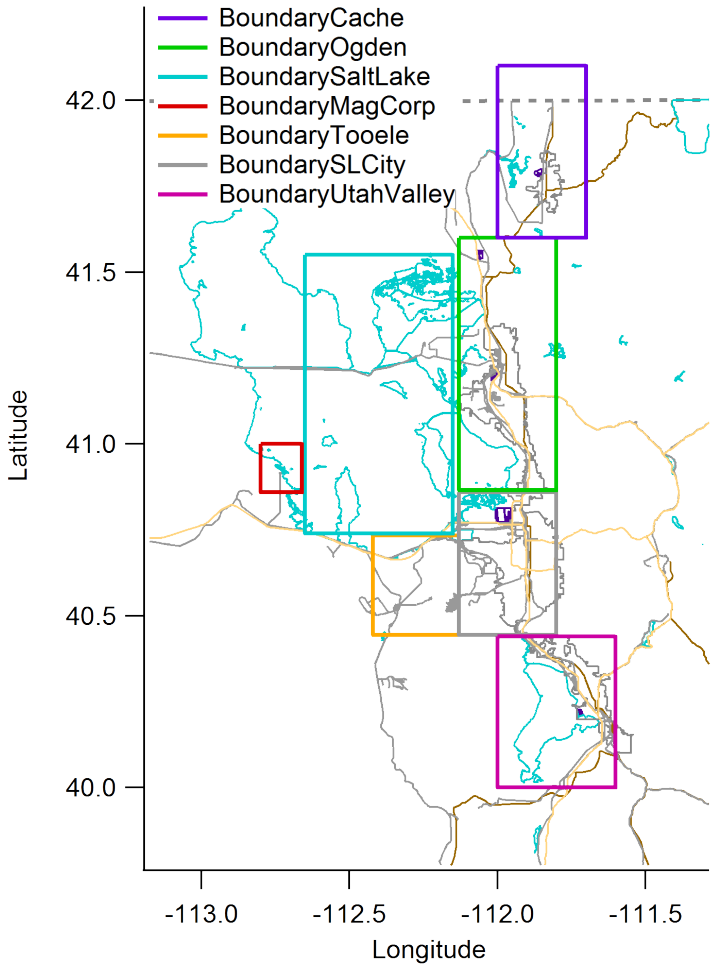

3
LX
SF
NP
PM2.5 24h av (ug/m3)
Date
1/16/2017
1/21/2017
1/26/2017
1/31/2017
2/5/2017
2/10/2017
2/15/2017

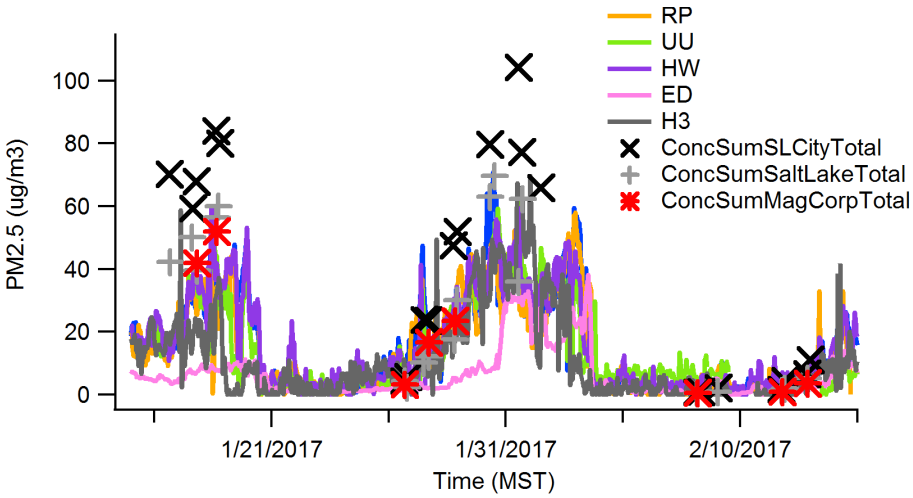

42.0
41.5
41.0
40.5
40.0
Latitude
-113.0
-112.5
-112.0
-111.5
Longitude
1
2
3
SM
BR
O2
BV
RP
HW
MG
ED
LN
NP
SF

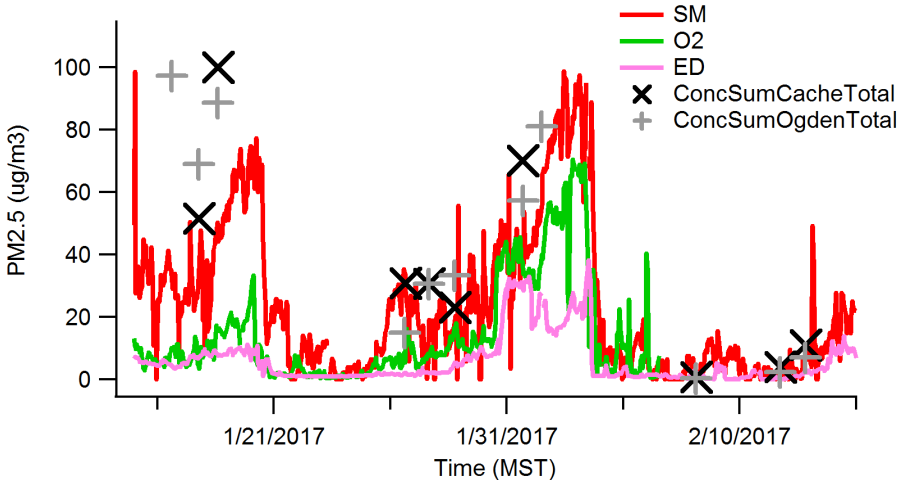

BV
RP
UU
HW
ED
H3
PM2.5 (ug/m3)
0
20
40
60
80
100
1/21/2017
1/31/2017
2/10/2017
Time (MST)

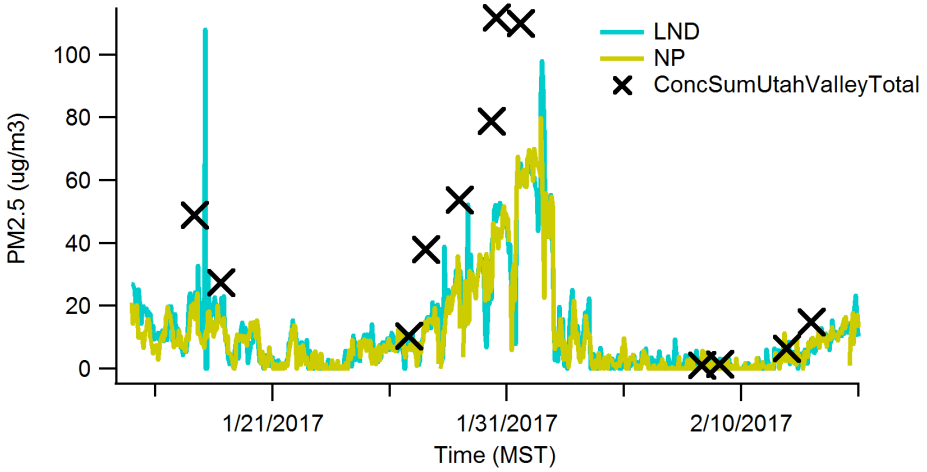

SM
O2
ED
PM2.5 (ug/m3)
0
20
40
60
80
100
1/21/2017
1/31/2017
2/10/2017
Time (MST)

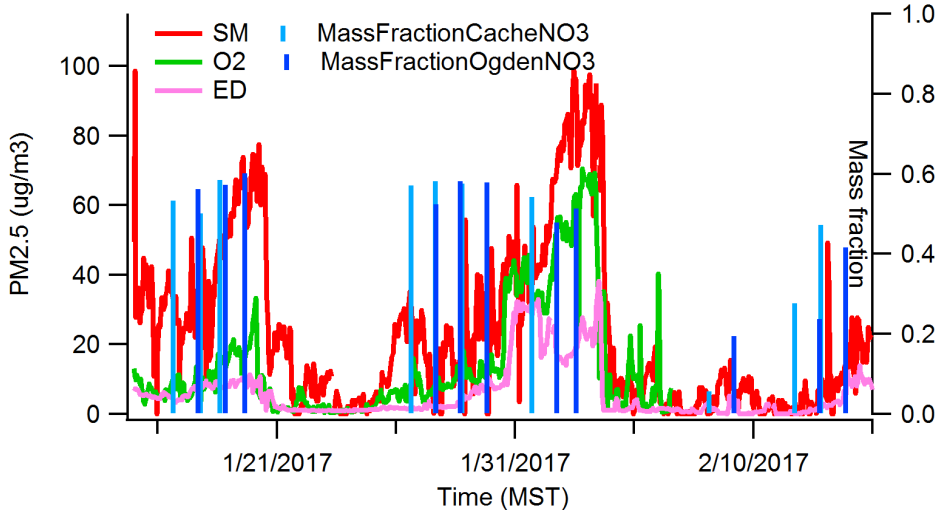

LND
NP
0
20
40
60
80
100
1/21/2017
1/31/2017
2/10/2017
Time (MST)

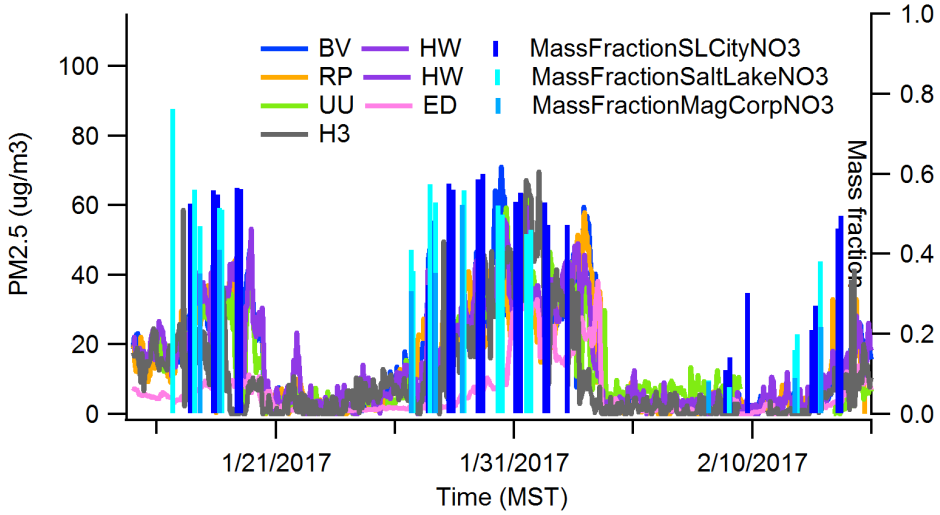

BoundaryCache
BoundaryOgden
BoundarySaltLake
BoundaryMagCorp
BoundaryTooele
BoundarySLCity
BoundaryUtahValley
42.0
41.5
41.0
40.5
40.0
Latitude
-113.0
-112.5
-112.0
-111.5
Longitude

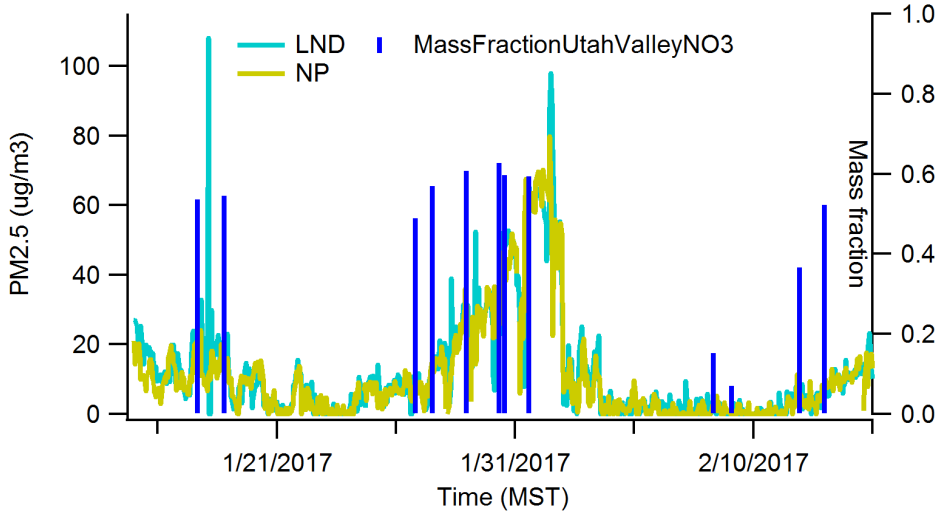

RP
UU
HW
ED
H3
ConcSumSLCityTotal
ConcSumSaltLakeTotal
ConcSumMagCorpTotal
PM2.5 (ug/m3)
0
20
40
60
80
100
1/21/2017
1/31/2017
2/10/2017
Time (MST)

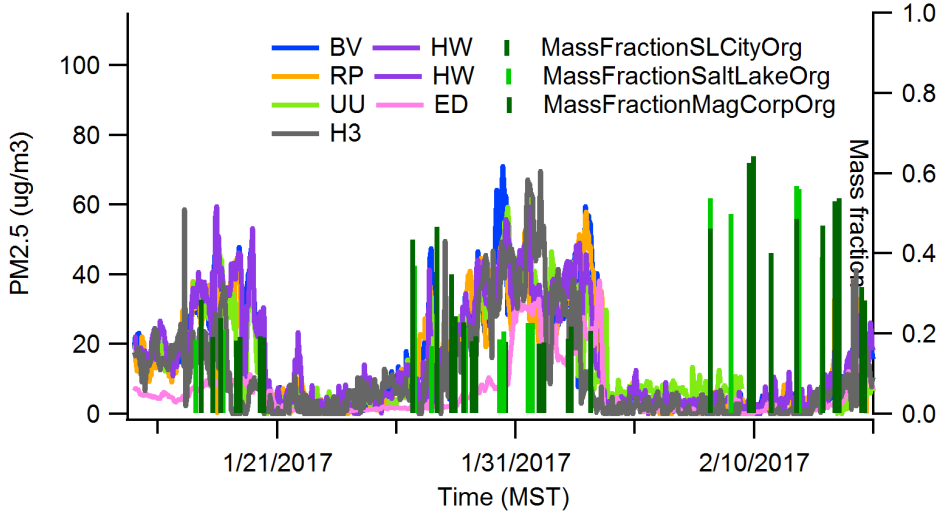

SM
O2
ED
ConcSumCacheTotal
ConcSumOgdenTotal
PM2.5 (ug/m3)
0
20
40
60
80
100
1/21/2017
1/31/2017
2/10/2017
Time (MST)

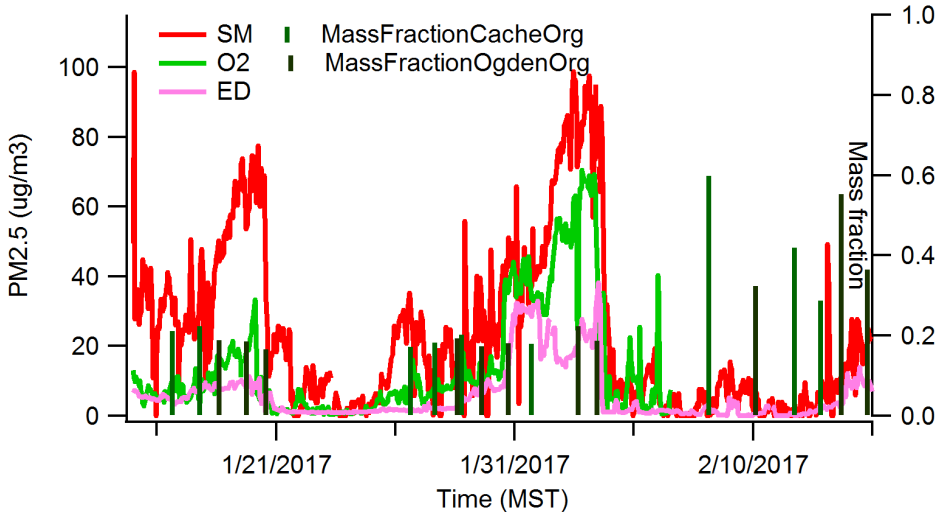

LND
NP
ConcSumUtahValleyTotal
PM2.5 (ug/m3)
0
20
40
60
80
100
1/21/2017
1/31/2017
2/10/2017
Time (MST)

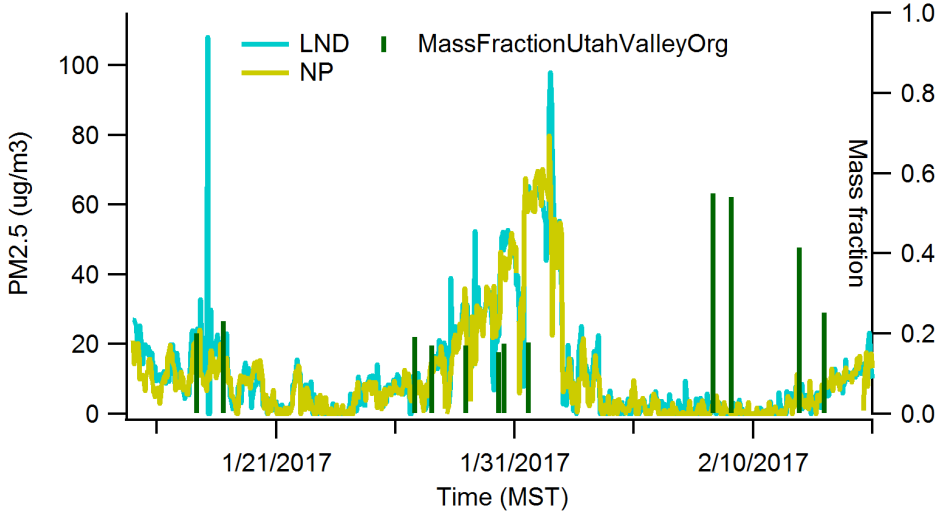

SM
O2
ED
MassFractionCacheNO3
MassFractionOgdenNO3
PM2.5 (ug/m3)
Mass fraction
0
20
40
60
80
100
0.0
0.2
0.4
0.6
0.8
1.0
1/21/2017
1/31/2017
2/10/2017
Time (MST)


BV
RP
UU
H3
HW
HW
ED
MassFractionSLCityNO3
MassFractionSaltLakeNO3
MassFractionMagCorpNO3
PM2.5 (ug/m3)
Mass fraction
0
20
40
60
80
100
0.0
0.2
0.4
0.6
0.8
1.0
1/21/2017
1/31/2017
2/10/2017
Time (MST)

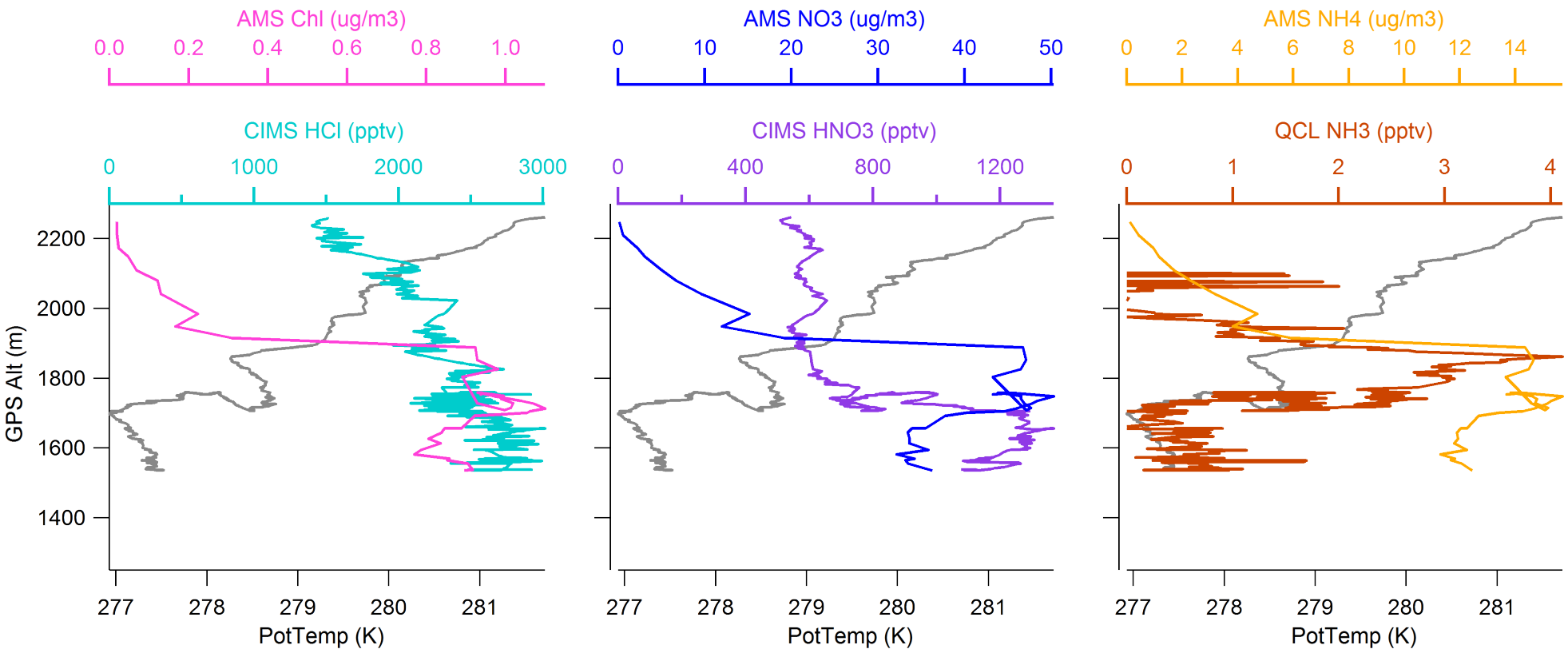

LND
NP
MassFractionUtahValleyNO3
PM2.5 (ug/m3)
Mass fraction
0
20
40
60
80
100
0.0
0.2
0.4
0.6
0.8
1.0
1/21/2017
1/31/2017
2/10/2017
Time (MST)


BV
RP
UU
H3
HW
HW
ED
MassFractionSLCityOrg
MassFractionSaltLakeOrg
MassFractionMagCorpOrg
PM2.5 (ug/m3)
Mass fraction
0
20
40
60
80
100
0.0
0.2
0.4
0.6
0.8
1.0
1/21/2017
1/31/2017
2/10/2017
Time (MST)

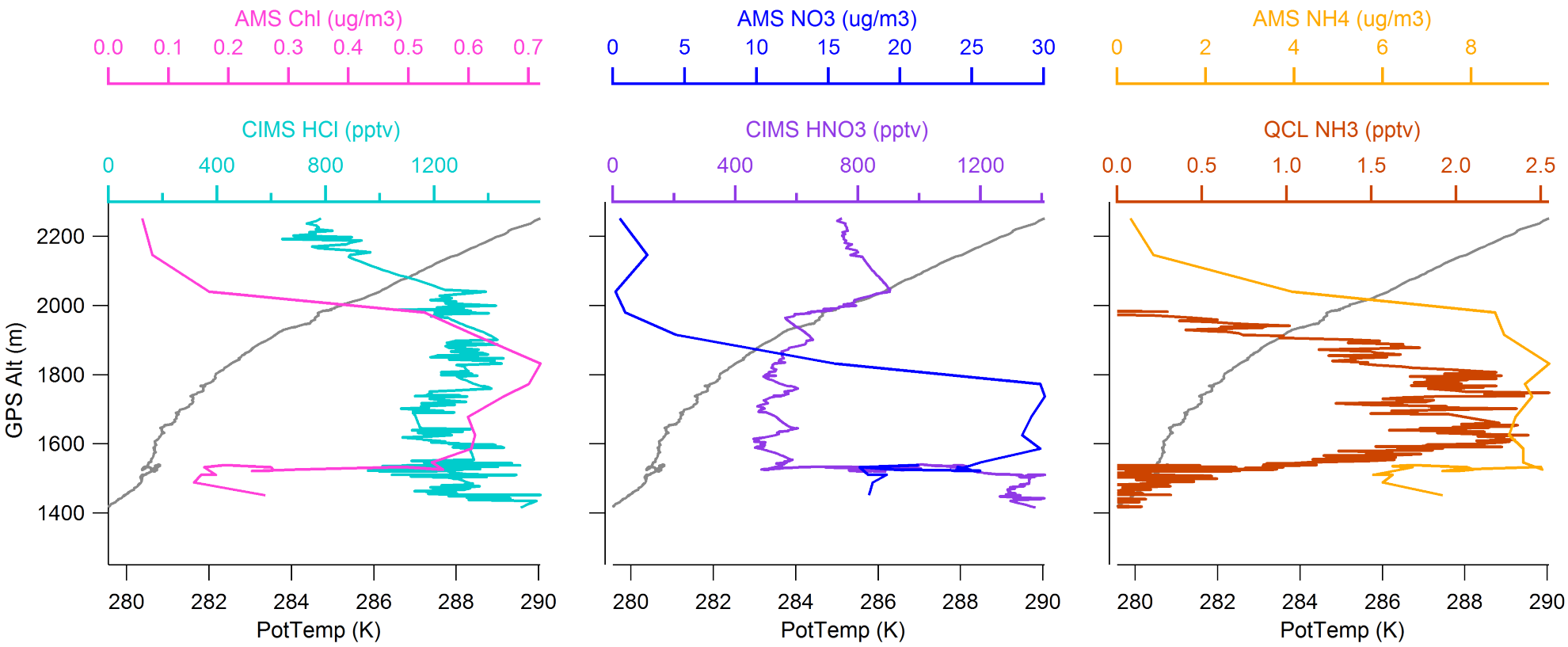

SM
O2
ED
MassFractionCacheOrg
MassFractionOgdenOrg
PM2.5 (ug/m3)
Mass fraction
0
20
40
60
80
100
0.0
0.2
0.4
0.6
0.8
1.0
1/21/2017
1/31/2017
2/10/2017
Time (MST)


LND
NP
MassFractionUtahValleyOrg
PM2.5 (ug/m3)
Mass fraction
0
20
40
60
80
100
0.0
0.2
0.4
0.6
0.8
1.0
1/21/2017
1/31/2017
2/10/2017
Time (MST)

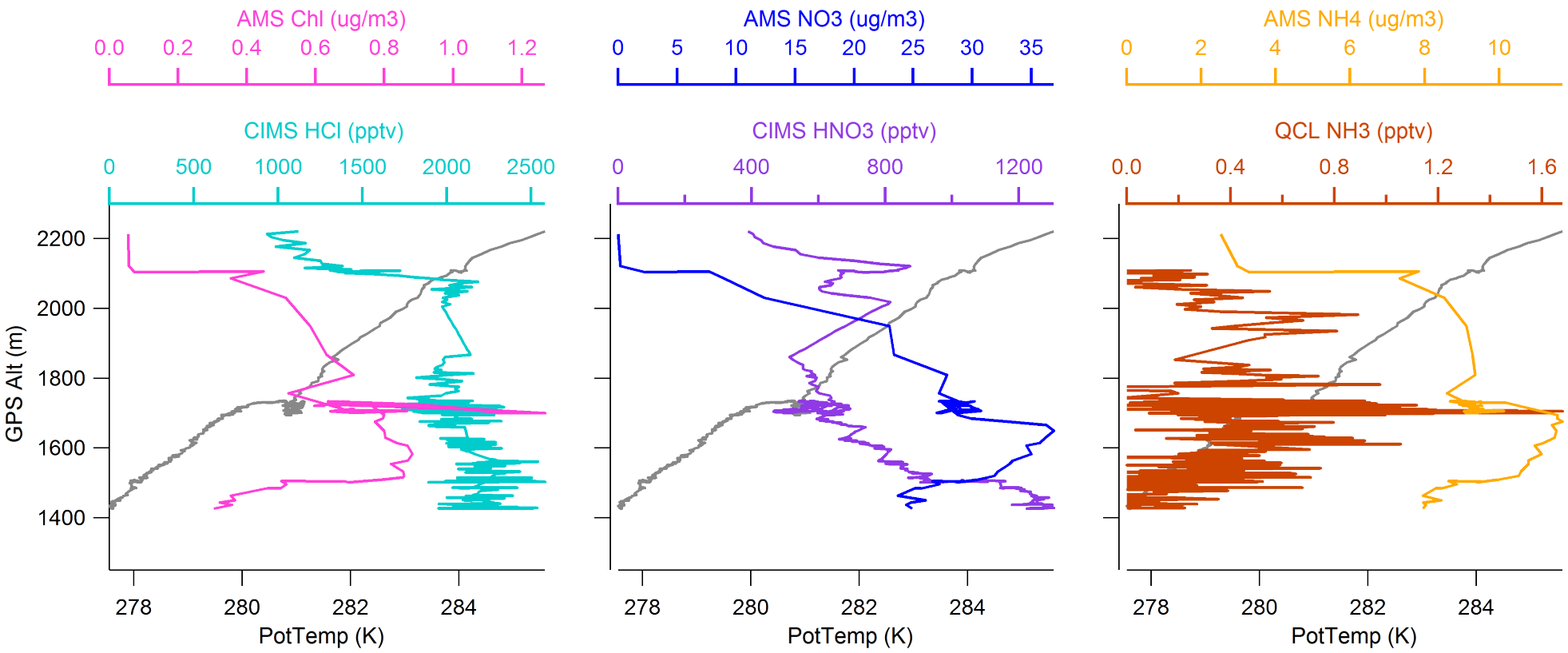
South Leg



RF05	Start Lat, Start Lon	Stop Lat, Stop Lon	Mean Lat, Mean Lon	Start Pt, Stop Pt
	40.716, -112.12	40.495, -112.03	40.594, -112.06	1240, 1710

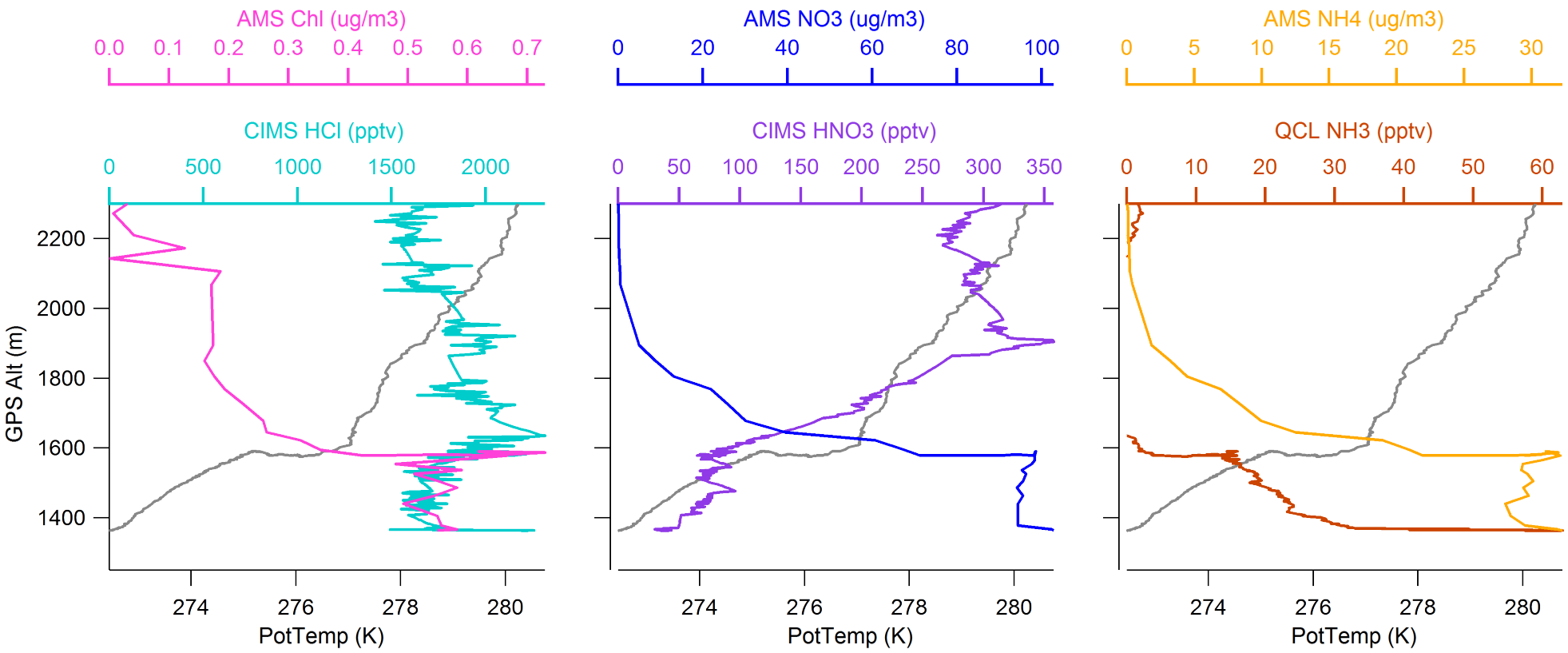


RF02	Start Lat, Start Lon	Stop Lat, Stop Lon	Mean Lat, Mean Lon	Start Pt, Stop Pt
	40.405, -111.79	40.235, -111.74	40.334, -111.79	5010, 5499

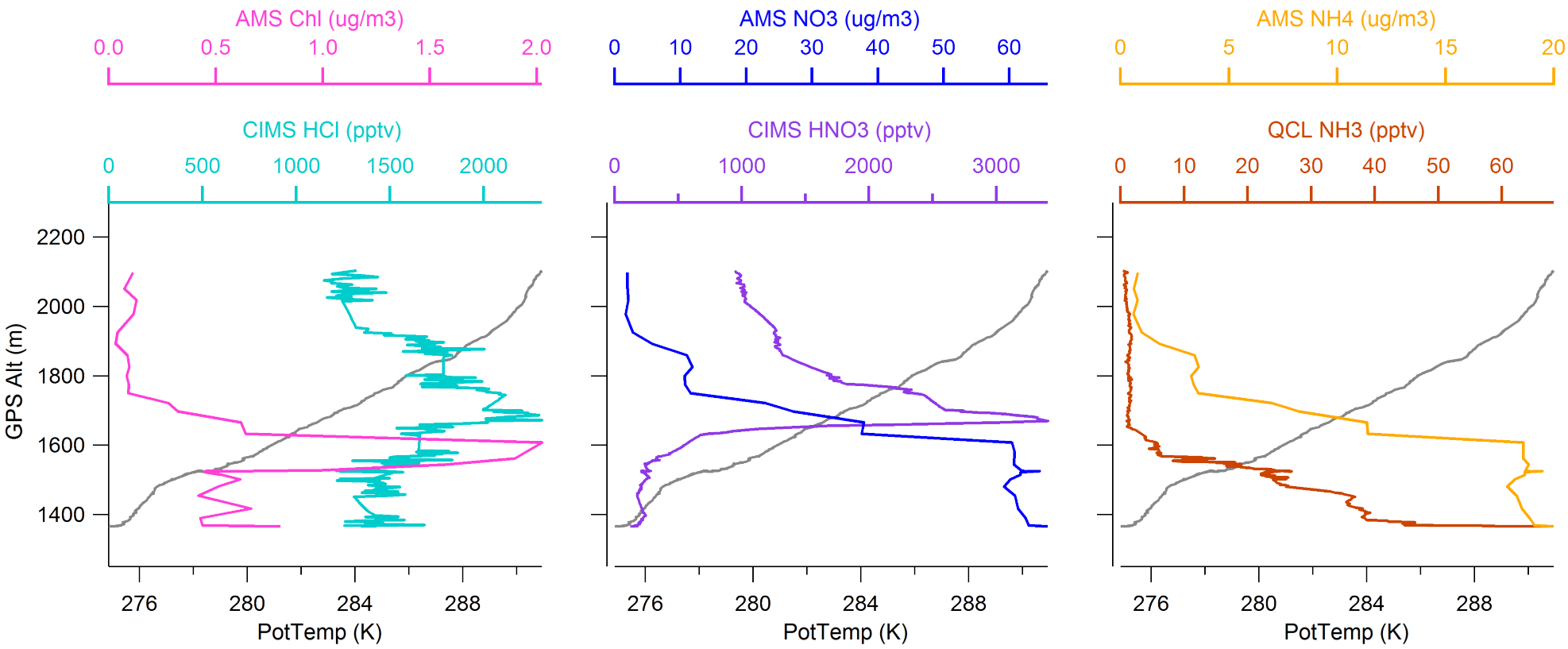


RF02	Start Lat, Start Lon	Stop Lat, Stop Lon	Mean Lat, Mean Lon	Start Pt, Stop Pt
	40.771, -112.18	40.496, -112.04	40.624, -112.07	1468, 2114

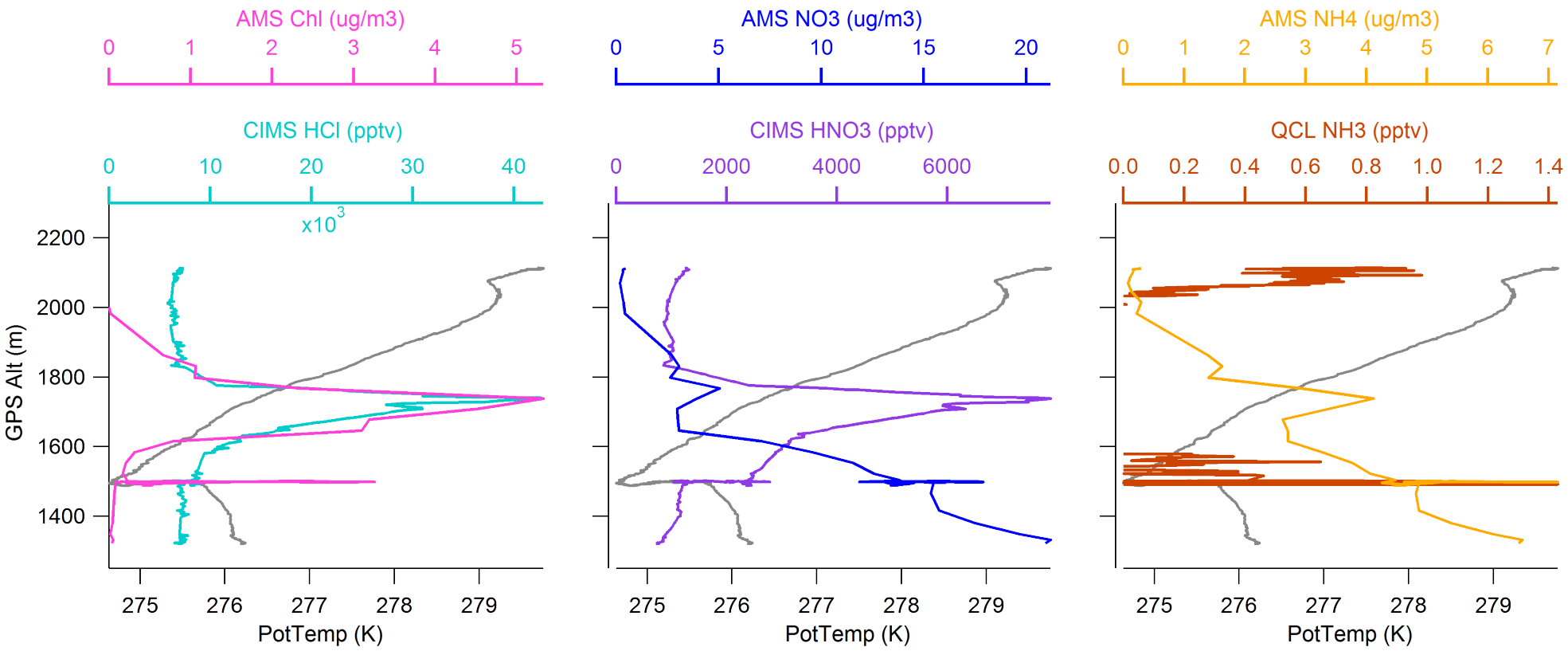
North Leg



RF01	Start Lat, Start Lon	Stop Lat, Stop Lon	Mean Lat, Mean Lon	Start Pt, Stop Pt
	41.57, -111.88	41.792, -111.85	41.653, -111.85	2512, 3008

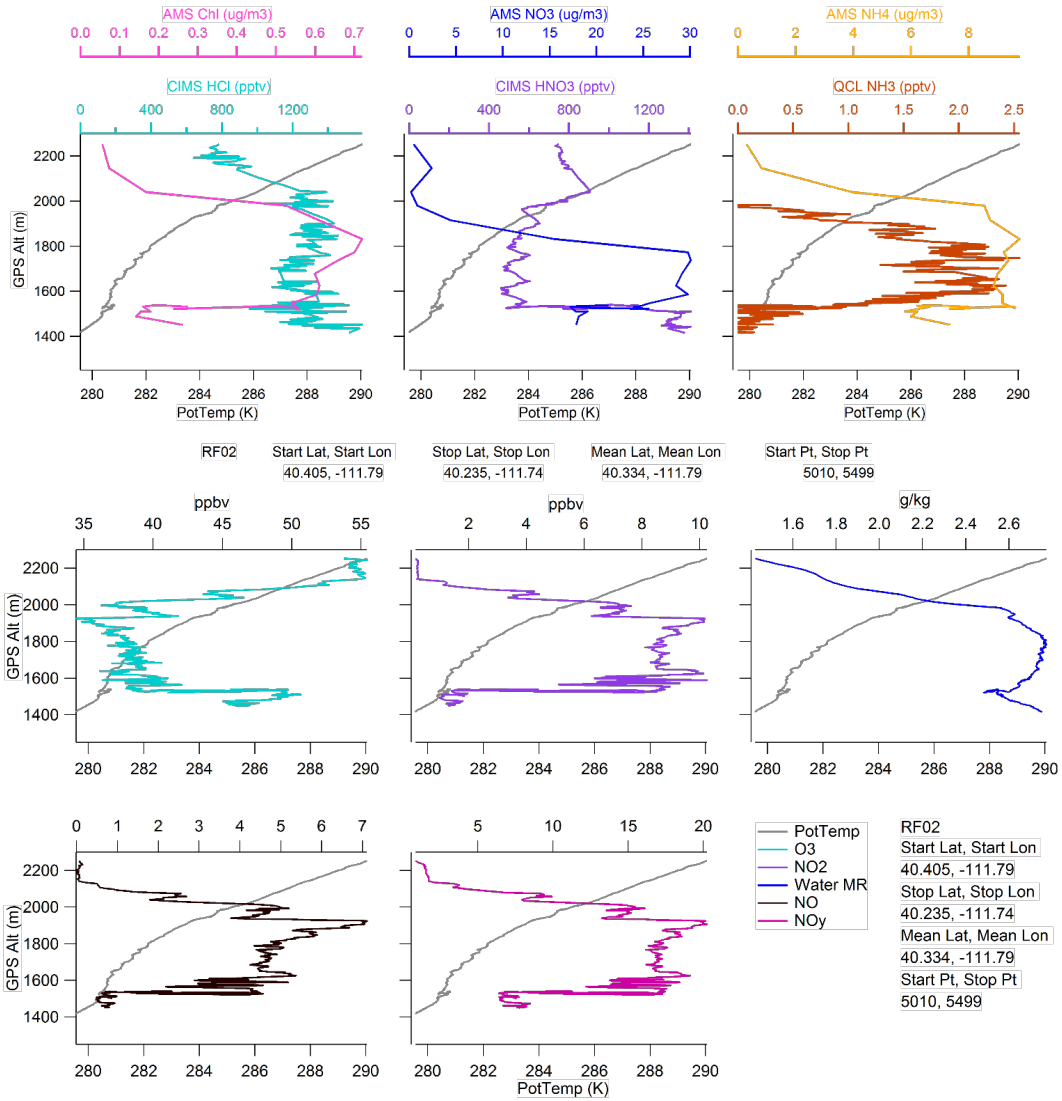


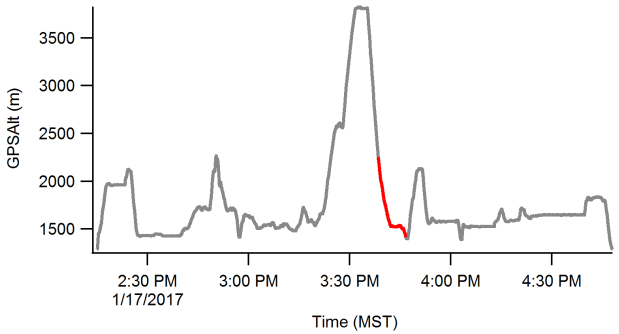
RF04	Start Lat, Start Lon	Stop Lat, Stop Lon	Mean Lat, Mean Lon	Start Pt, Stop Pt
	41.604, -111.85	41.79, -111.85	41.699, -111.85	2556, 2874

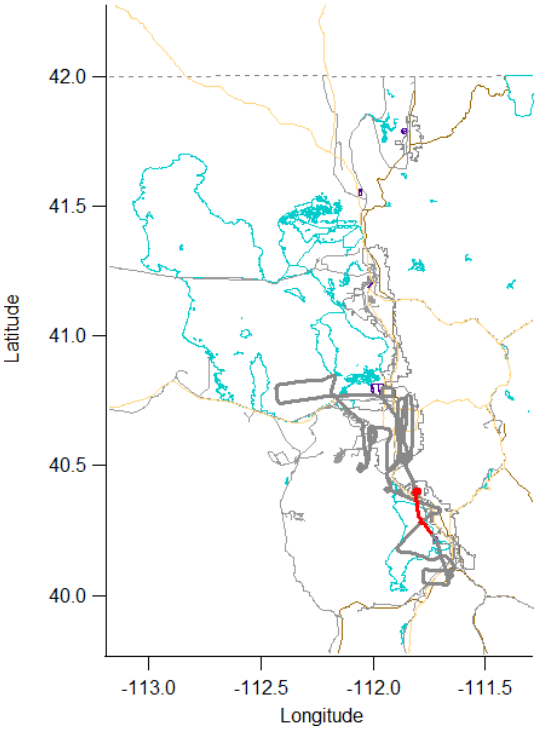


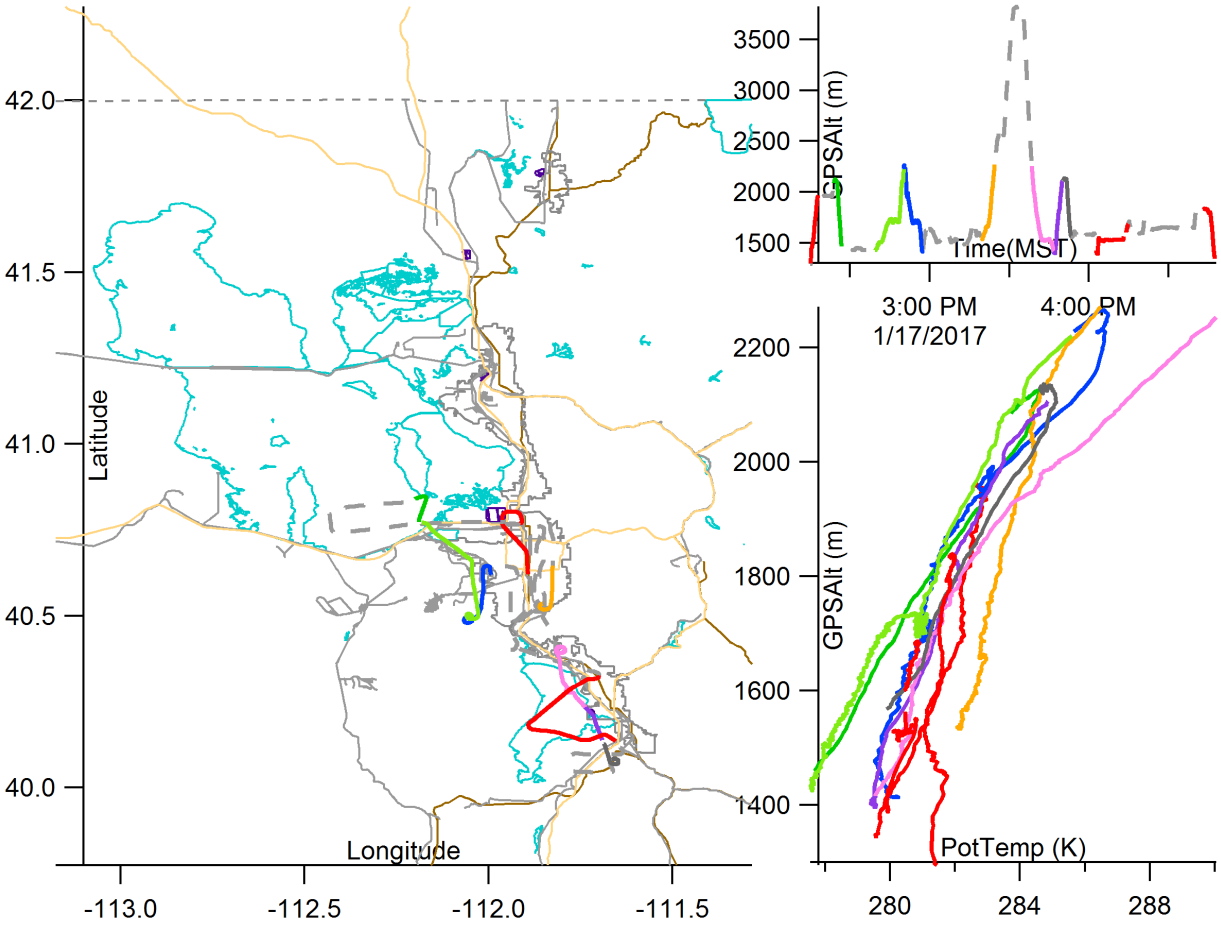
RF10	Start Lat, Start Lon	Stop Lat, Stop Lon	Mean Lat, Mean Lon	Start Pt, Stop Pt
	40.912, -112.75	40.624, -112.35	40.763, -112.54	8247, 9045

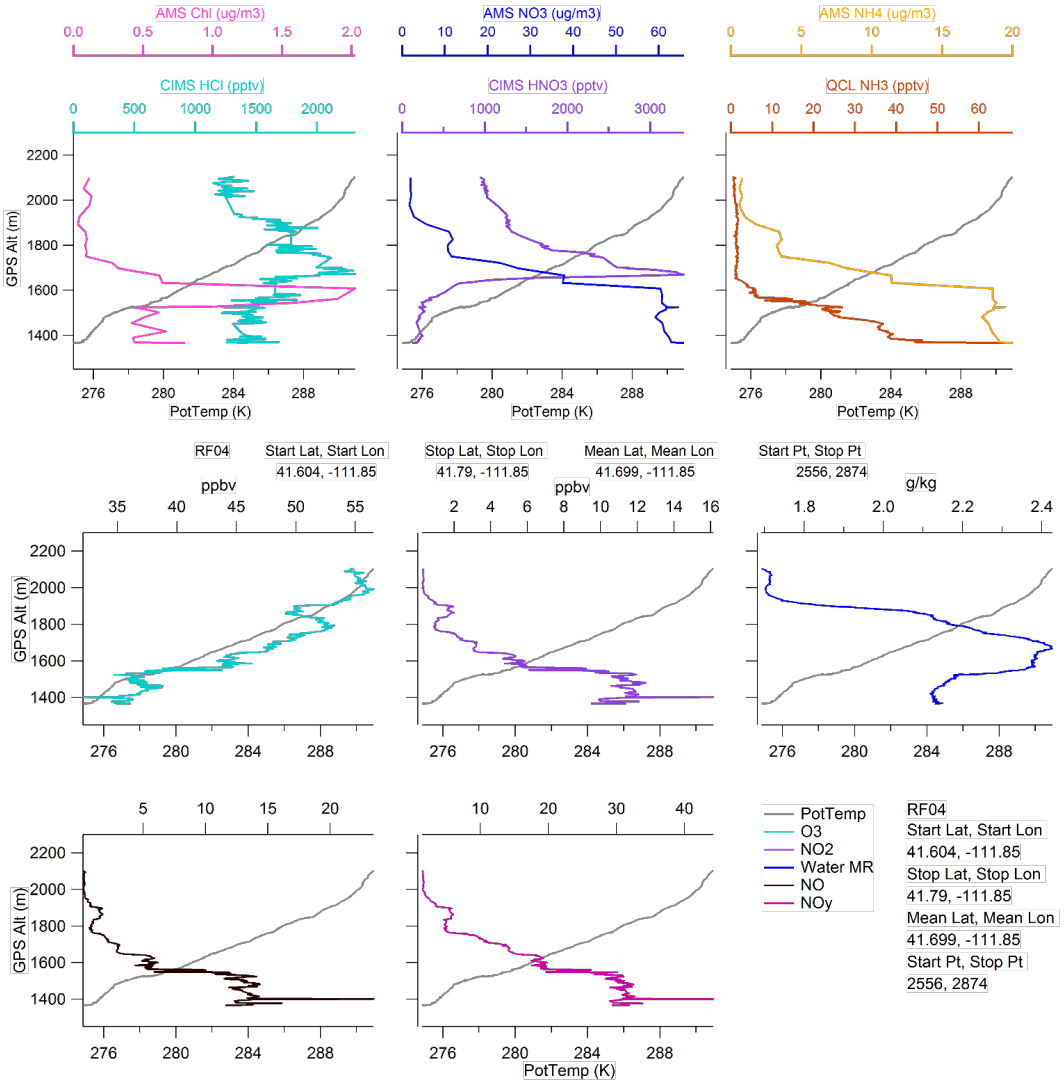
A more comprehensive look at vertical profiles

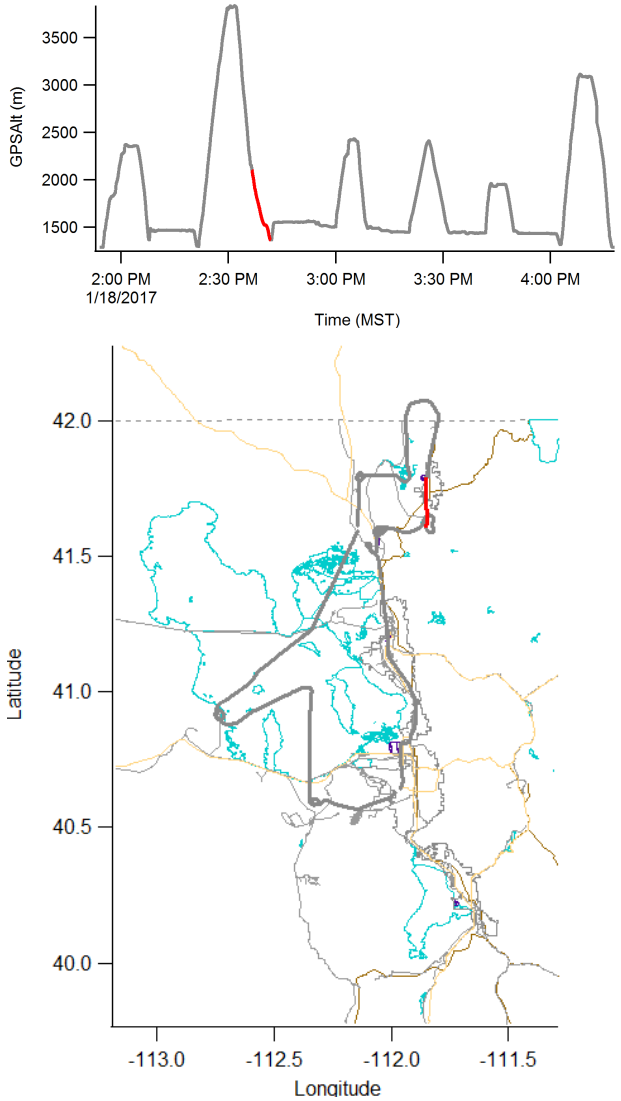

AMS Chl (ug/m3)
AMS NO3 (ug/m3)
AMS NH4 (ug/m3)
CIMS HCl (pptv)
CIMS HNO3 (pptv)
QCL NH3 (pptv)
GPS Alt (m)
PotTemp (K)
RF02
Start Lat, Start Lon
40.405, -111.79
Stop Lat, Stop Lon
40.235, -111.74
Mean Lat, Mean Lon
40.334, -111.79
Start Pt, Stop Pt
5010, 5499
ppbv
g/kg
PotTemp
O3
NO2
Water MR
NO
NOy

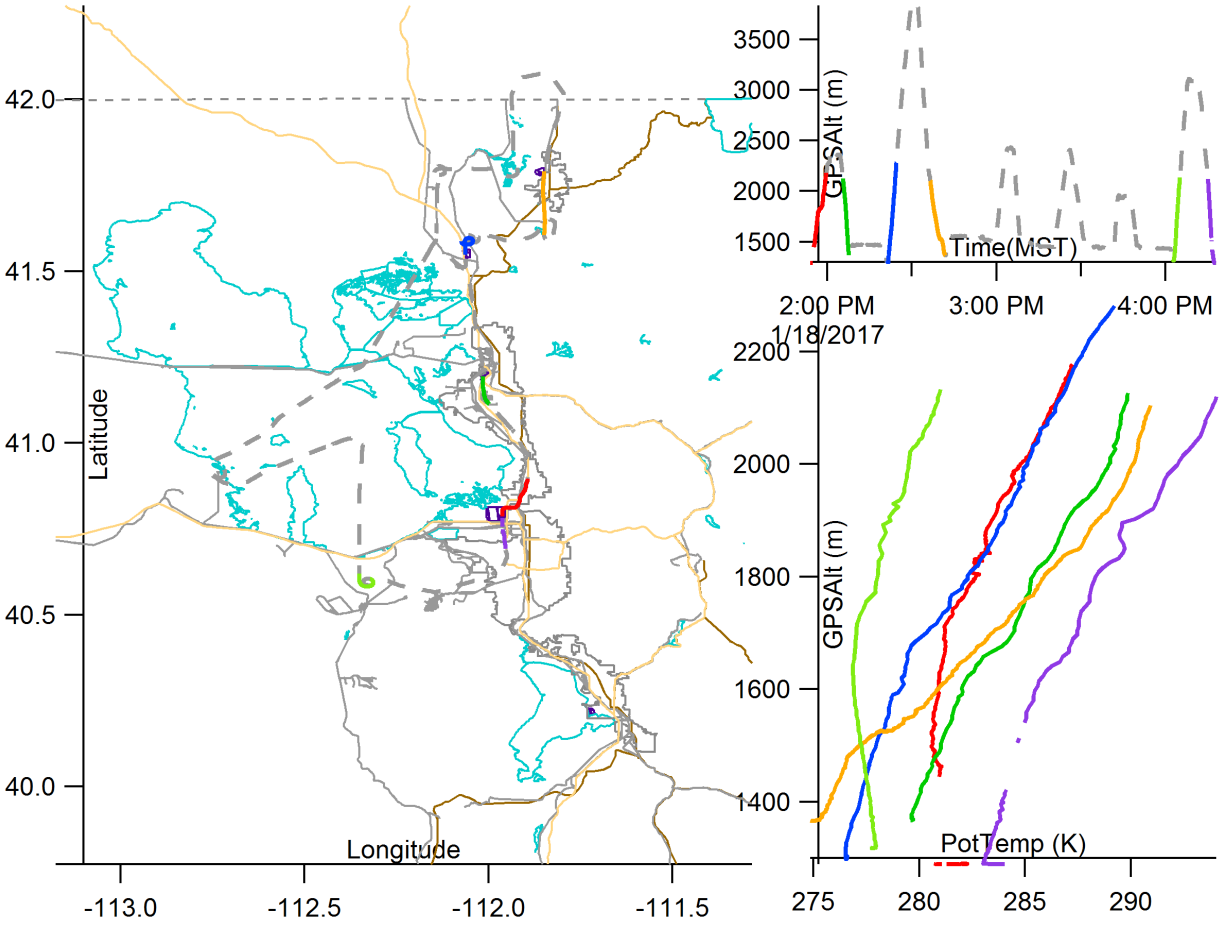

GPSAlt (m)
2:30 PM
1/17/2017
3:00 PM
3:30 PM
4:00 PM
4:30 PM
Time (MST)


Latitude
Longitude


42.0
41.5
41.0
40.5
40.0
Latitude
-113.0
-112.5
-112.0
-111.5
Longitude
3500
3000
2500
2000
1500
GPSAlt (m)
Time(MST)
3:00 PM
1/17/2017
4:00 PM
2200
2000
1800
1600
1400
GPSAlt (m)
280
284
288
PotTemp (K)


AMS Chl (ug/m3)
AMS NO3 (ug/m3)
AMS NH4 (ug/m3)
CIMS HCl (pptv)
CIMS HNO3 (pptv)
QCL NH3 (pptv)
GPS Alt (m)
PotTemp (K)
RF04
Start Lat, Start Lon
41.604, -111.85
Stop Lat, Stop Lon
41.79, -111.85
Mean Lat, Mean Lon
41.699, -111.85
Start Pt, Stop Pt
2556, 2874
ppbv
g/kg
PotTemp
O3
NO2
Water MR
NO
NOy
RF04
Start Lat, Start Lon
41.604, -111.85
Stop Lat, Stop Lon
41.79, -111.85
Mean Lat, Mean Lon
41.699, -111.85
Start Pt, Stop Pt
2556, 2874


GPSAlt (m)
2:00 PM
1/18/2017
2:30 PM
3:00 PM
3:30 PM
4:00 PM
Time (MST)
Latitude
Longitude


42.0
41.5
41.0
40.5
40.0
Latitude
-113.0
-112.5
-112.0
-111.5
Longitude
3500
3000
2500
2000
1500
GPSAlt (m)
Time(MST)
2:00 PM
3:00 PM
4:00 PM
1/18/2017
2200
2000
1800
1600
1400
GPSAlt (m)
275
280
285
290
PotTemp (K)

Modelling the results with ISORROPIA

- Assumes thermodynamic Equilibrium

INPUT

Input units (0=umol/m3, 1=ug/m3) ;
1
Problem type (**0=forward**, 1=reverse); Phase state (0=solid+liquid, 1=metastable)

0, 1

NH4-SO4 system case

Na	SO4	NH3	NO3	Cl	RH	TEMP
0	6.38441	14.3126	41.0481	2.52149	0.654	271.95
0	6.04943	12.4858	39.9676	2.2952	0.668	271.53
0	6.88014	15.2628	45.1649	2.50698	0.751	269.49

OUTPUT

Gas phase: NH_3, HNO_3, HCl,H_2O

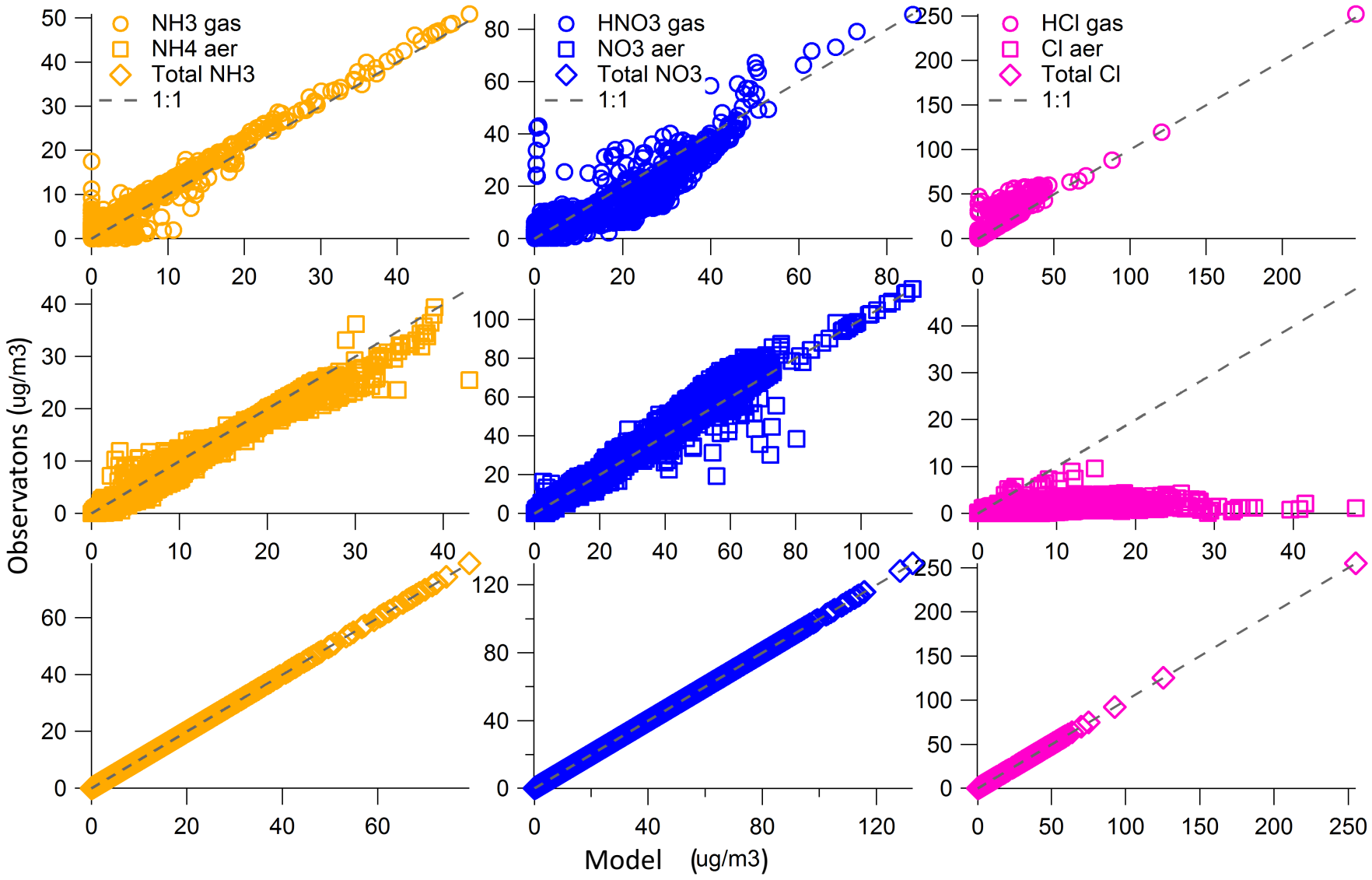
Liquid phase: NH_4^+, Na^+,H^+,Cl^-, NO_3^- , SO_4^{2-} , HSO_4^- ,

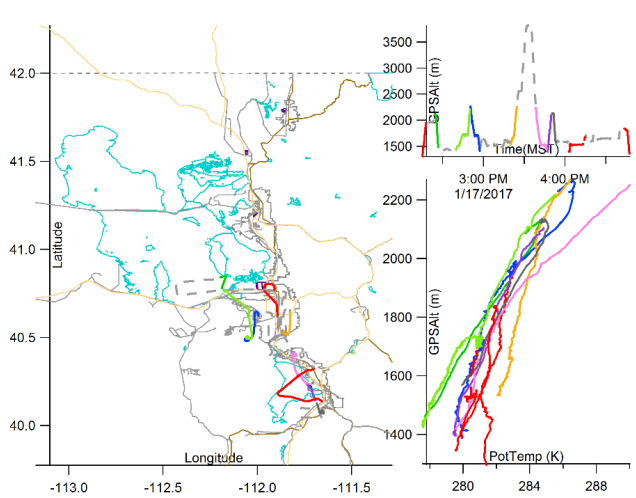
OH^- , H_2O

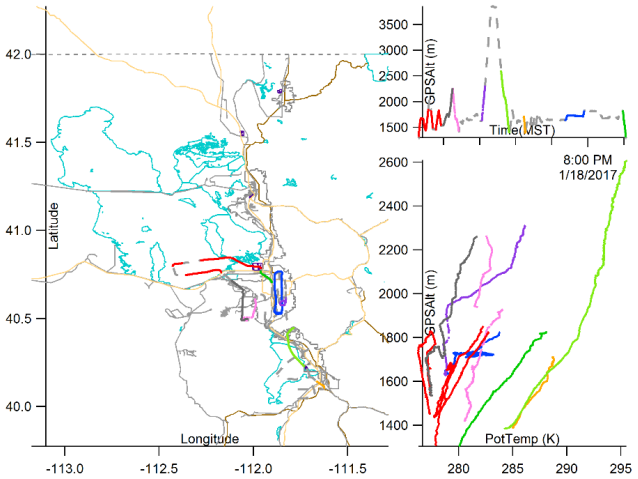
Solid phase: $(NH_4)_2SO_4$,NH_4HSO_4 , $(NH_4)_3H(SO_4)_2$,

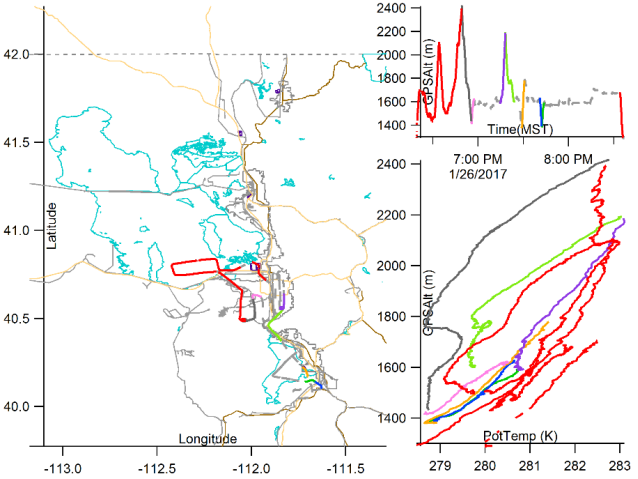
NH_4NO_3 , NH_4Cl, NaCl, $NaNO_3$, $NaHSO_4$,

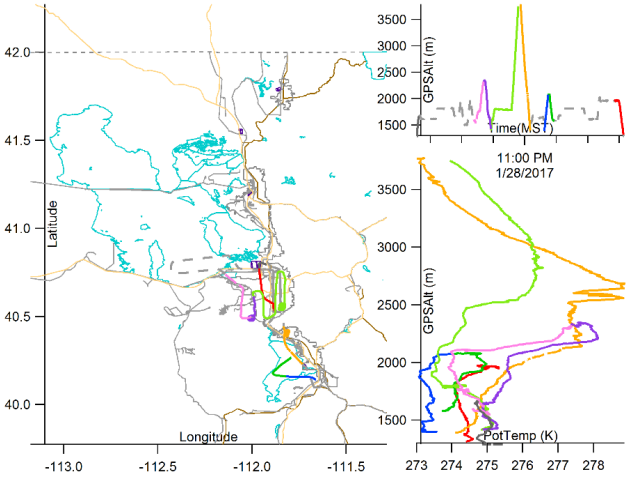
H_2SO_4

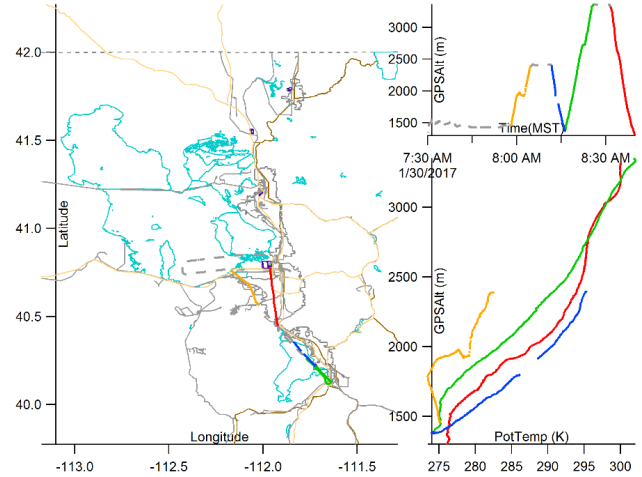

NH3 gas
NH4 aer
Total NH3
1:1
HNO3 gas
NO3 aer
Total NO3
1:1
HCl gas
Cl aer
Total Cl
1:1
Observatons (ug/m3)
Model (ug/m3)

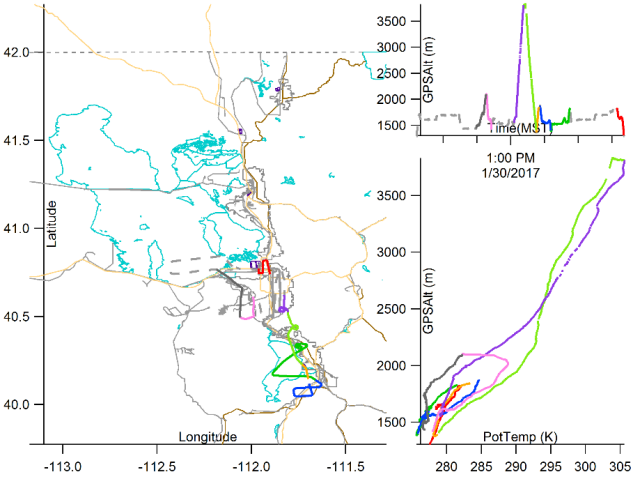

Latitude
Longitude
GPSAlt (m)
Time(MST)
3:00 PM
1/17/2017
4:00 PM
PotTemp (K)

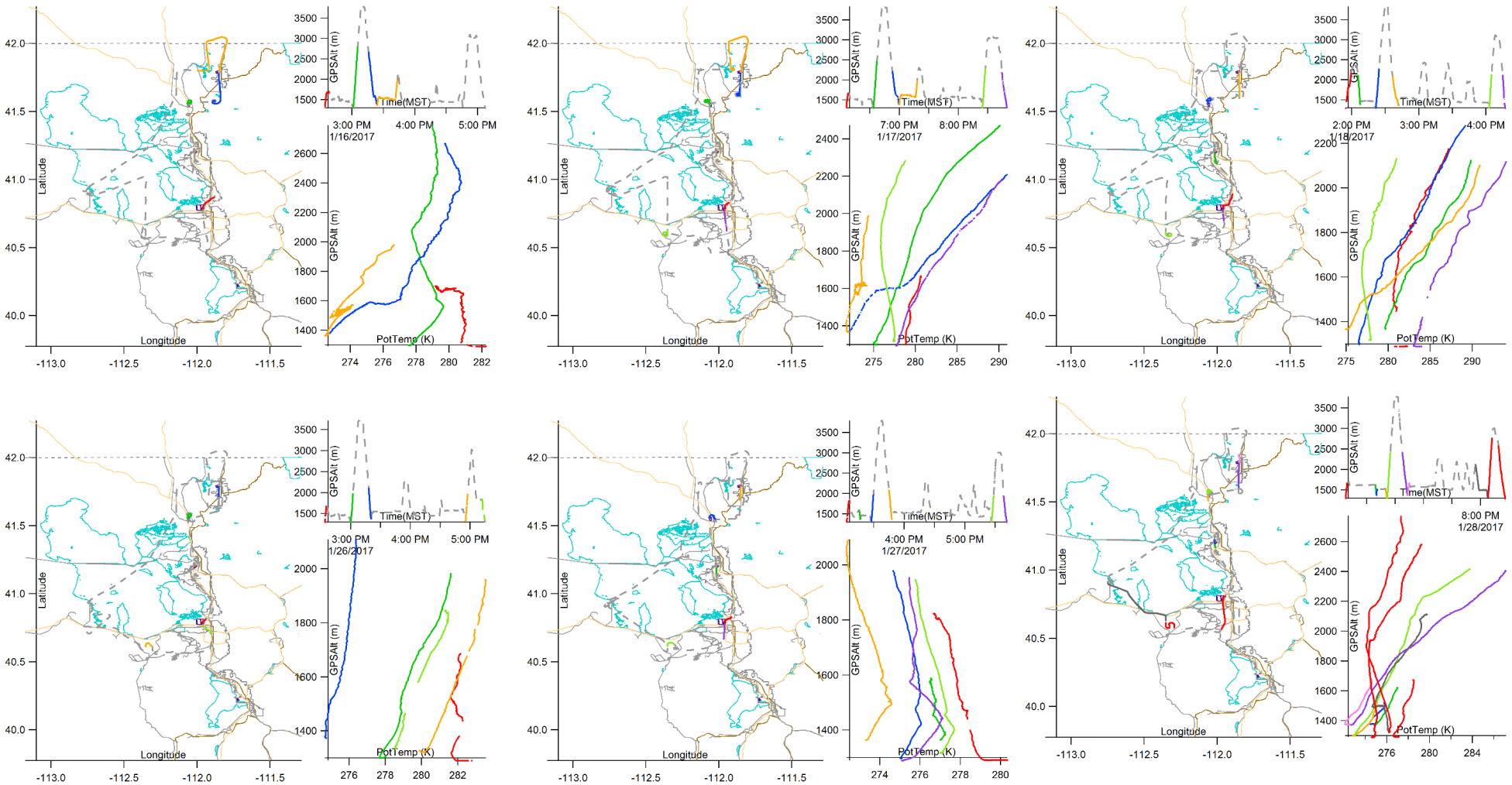

Latitude
Longitude
GPSAlt (m)
Time(MST)
8:00 PM
1/18/2017
PotTemp (K)


Latitude
Longitude
GPSAlt (m)
Time(MST)
7:00 PM
1/26/2017
8:00 PM
PotTemp (K)


Latitude
Longitude
GPSAlt (m)
Time(MST)
11:00 PM
1/28/2017
PotTemp (K)


Latitude
Longitude
GPSAlt (m)
Time(MST)
7:30 AM
1/30/2017
8:00 AM
8:30 AM
PotTemp (K)


Latitude
Longitude
GPSAlt (m)
Time(MST)
1:00 PM
1/30/2017
PotTemp (K)


Latitude
Longitude
GPSAlt (m)
Time(MST)
PotTemp (K)
3:00 PM
1/16/2017
4:00 PM
5:00 PM
7:00 PM
1/17/2017
8:00 PM
2:00 PM
1/18/2017
3:00 PM
4:00 PM
3:00 PM
1/26/2017
4:00 PM
5:00 PM
4:00 PM
1/27/2017
5:00 PM
8:00 PM
1/28/2017

Questions

- Are these coordinates correct?

Station Name	Station Lat	Station Lon
BR	41.4929	-112.018
BV	40.9029	-111.884
ED	40.5394	-112.3
HW	40.7344	-111.872
LN	40.3396	-111.713
MG	40.7068	-112.095
NP	40.2538	-111.663
O2	41.2069	-111.975
RP	40.7956	-111.931
SF	40.1363	-111.66
SM	41.8428	-111.852
H3	40.49641	-112.036
UU	40.73943	-111.979

What is a good indicator of inversion strength?