MLS intercomparisons with in situ water vapor measurements during AVE-WIIF

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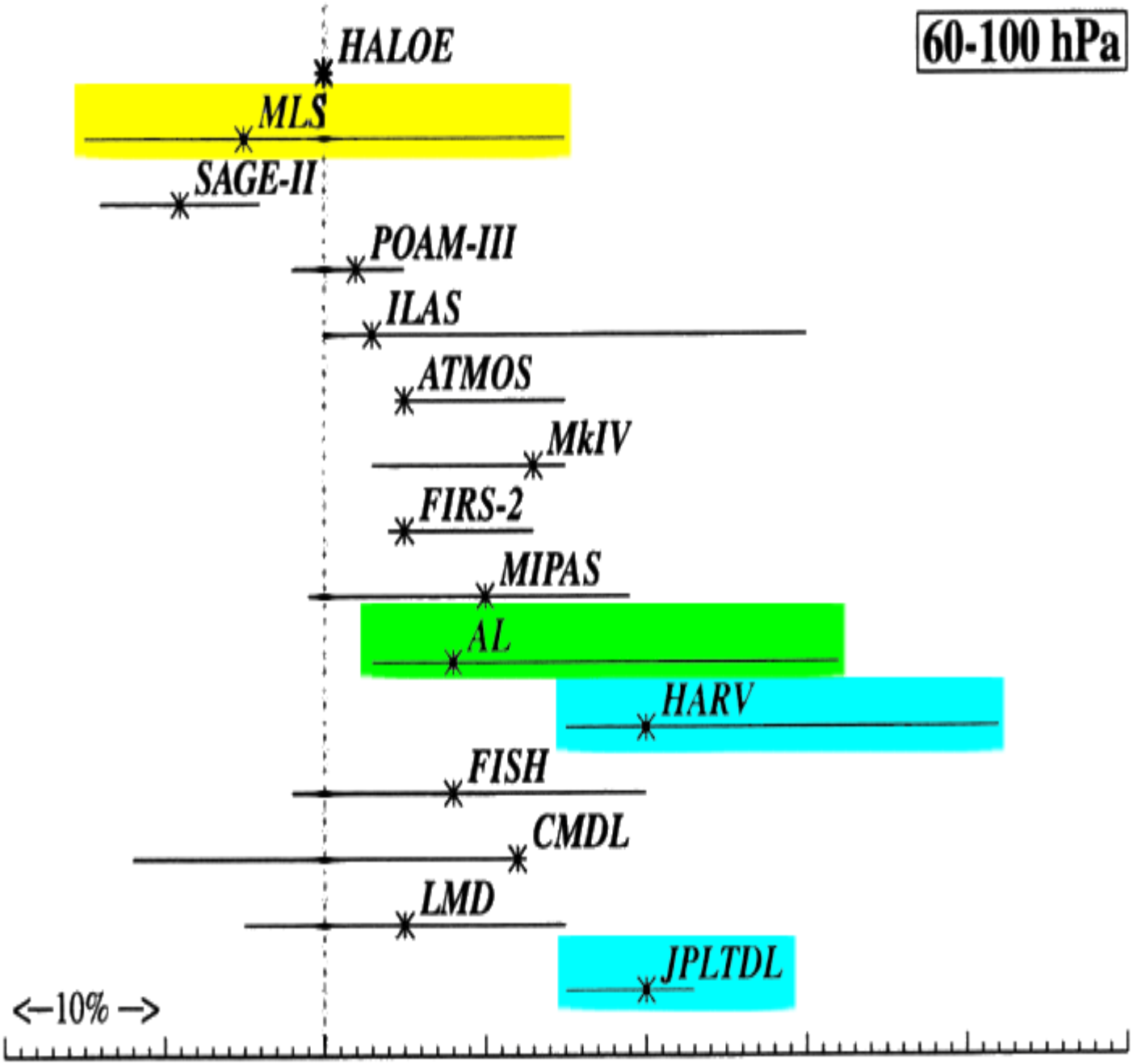
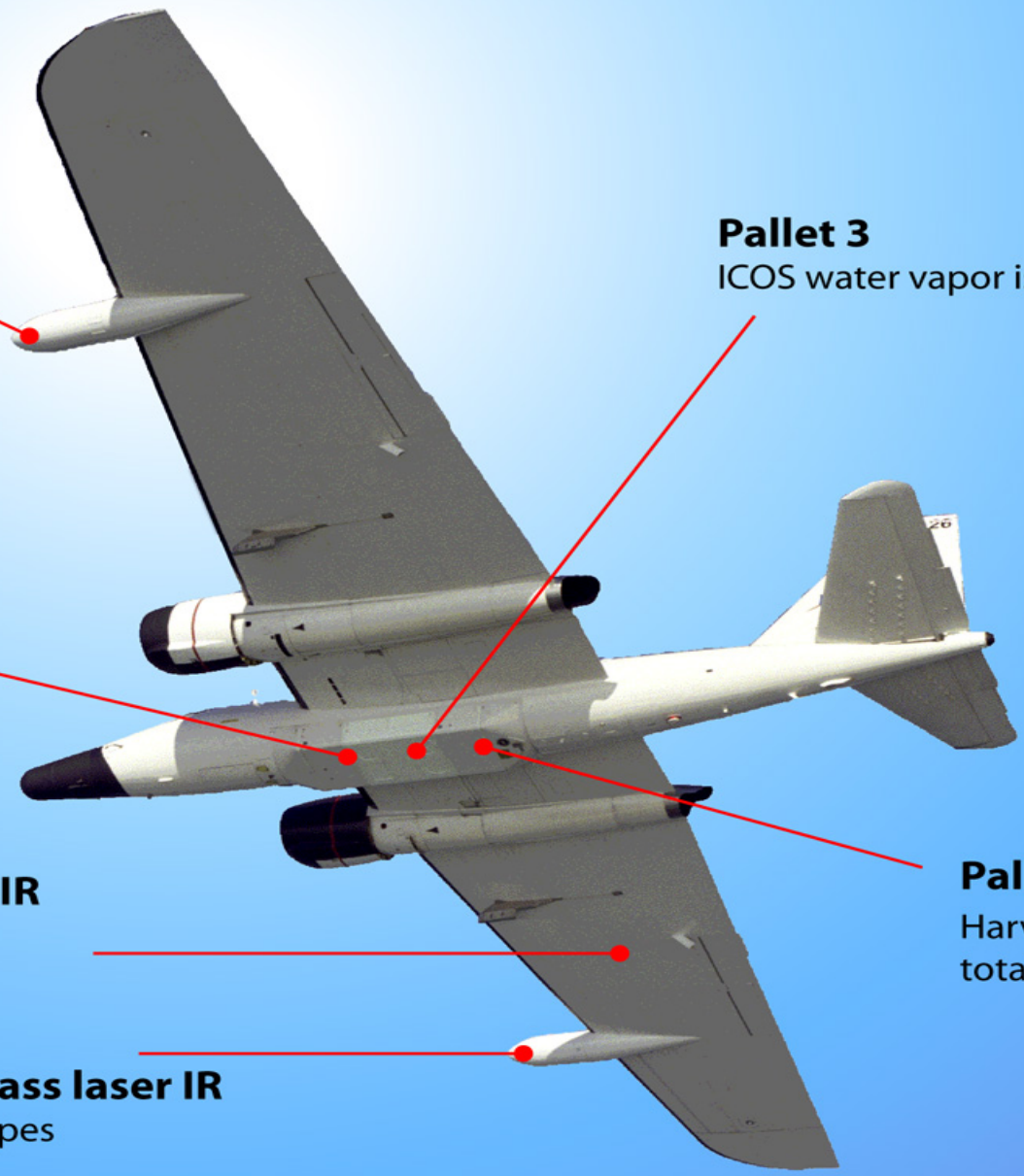
*With Acknowledgements and thanks to Bob Herman for the use of his data


60-100 hPa
HALOE
MLS
SAGE-II
POAM-III
ILAS
ATMOS
MkIV
FIRS-2
MIPAS
AL
HARV
FISH
CMDL
LMD
JPLTDL
<—10% —>

Water measurements during AVE-WIIF



Extensive and intensive laboratory calibrations
Using SI traceable standards

Lyman alpha water vapor and total water

ICOS

HOxotope

Water vapor partial pressure

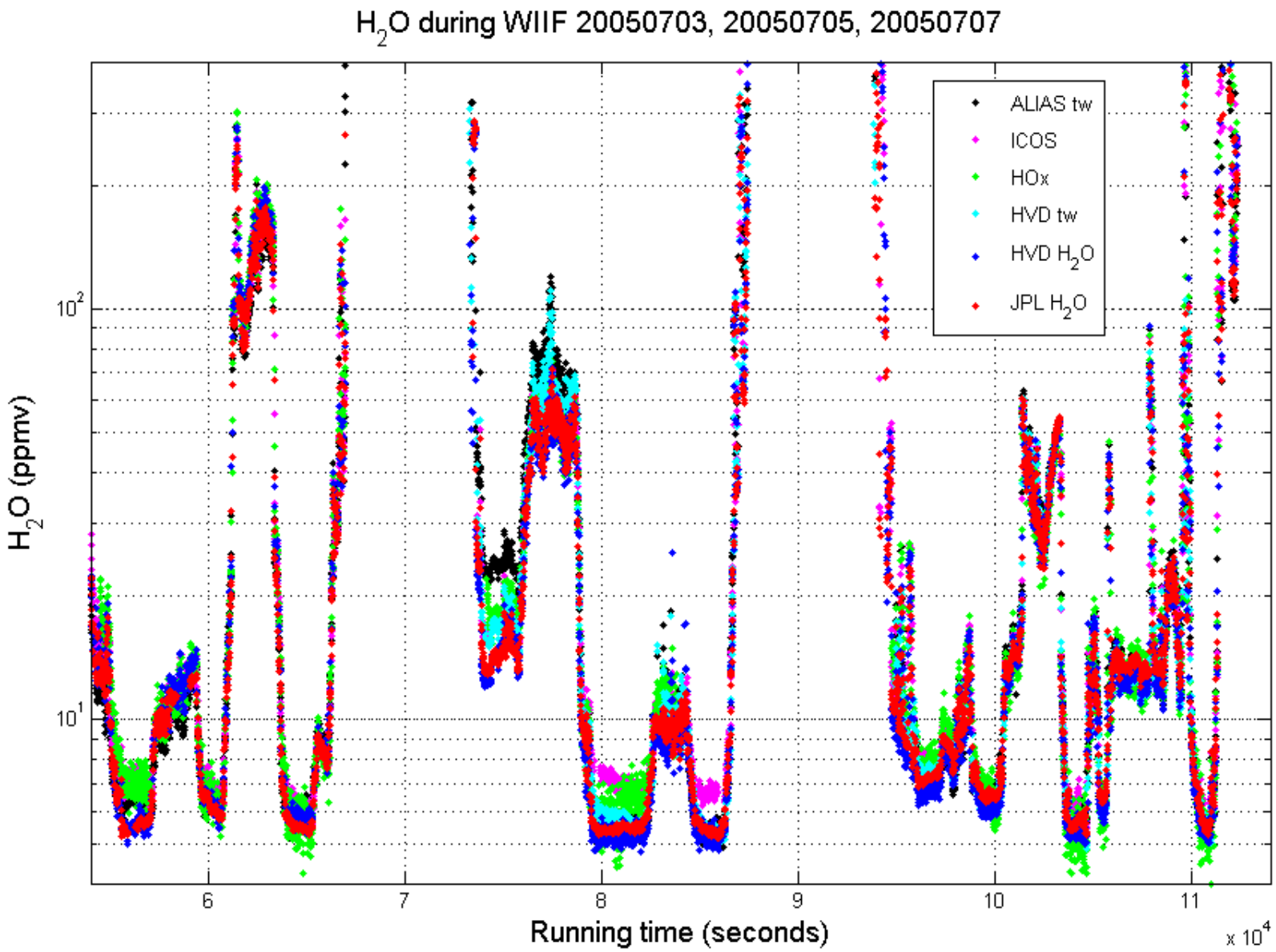
Lyman alpha

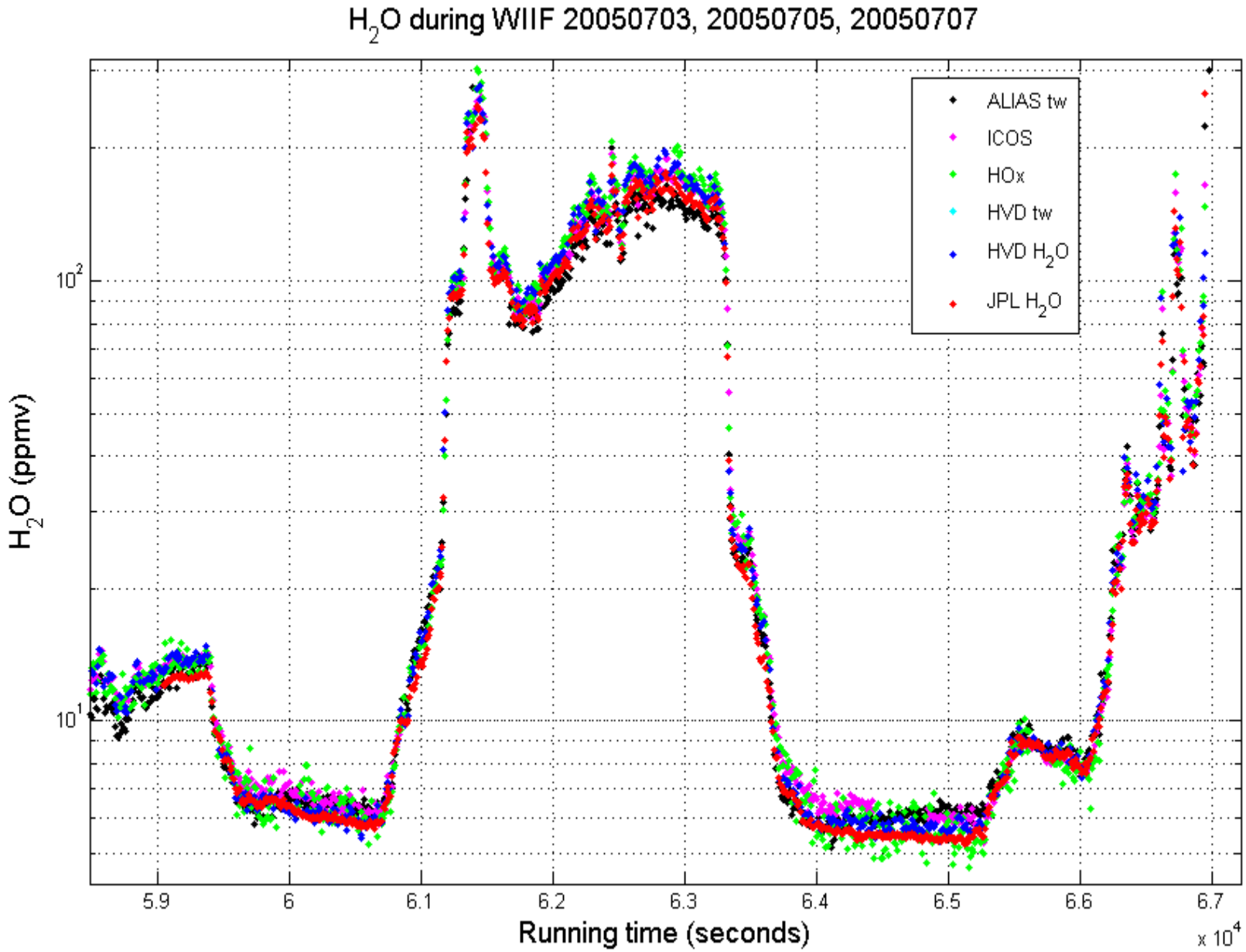
ICOS

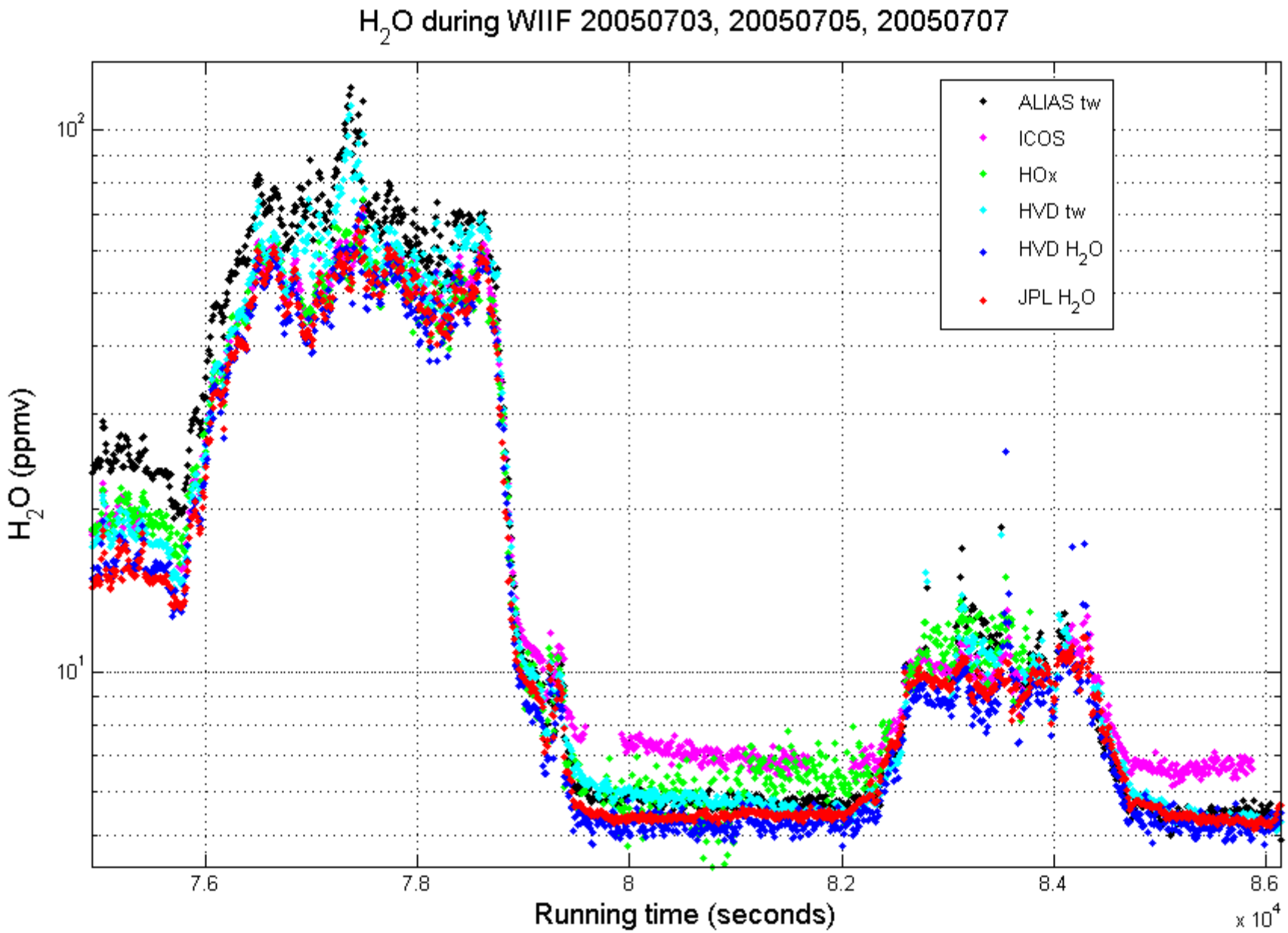
HOxotope

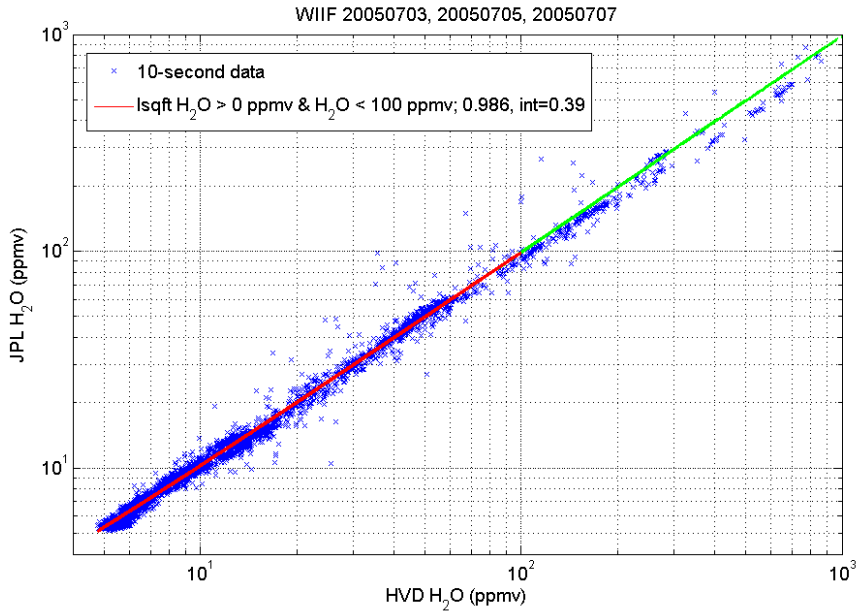
Axial and radial absorption at 121.6 nm

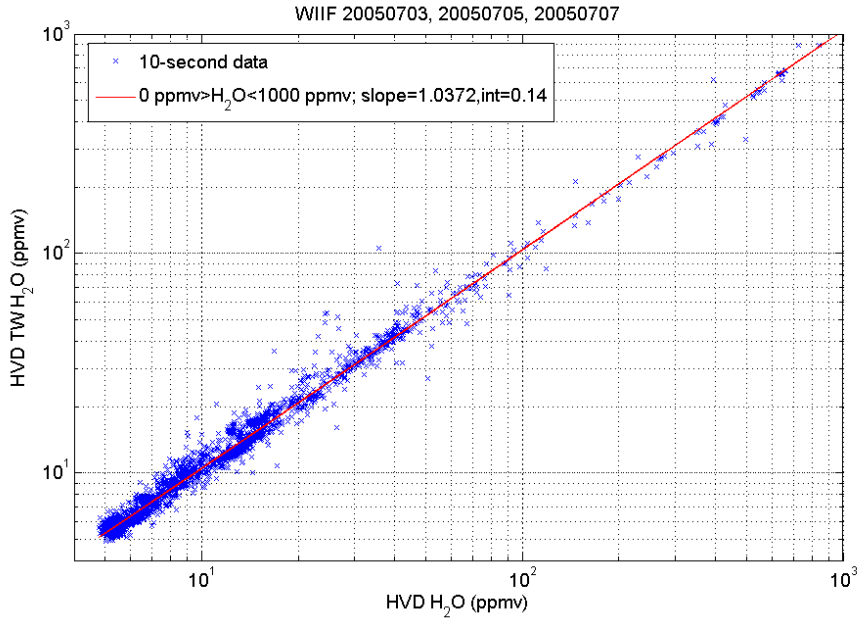
Droplet injection

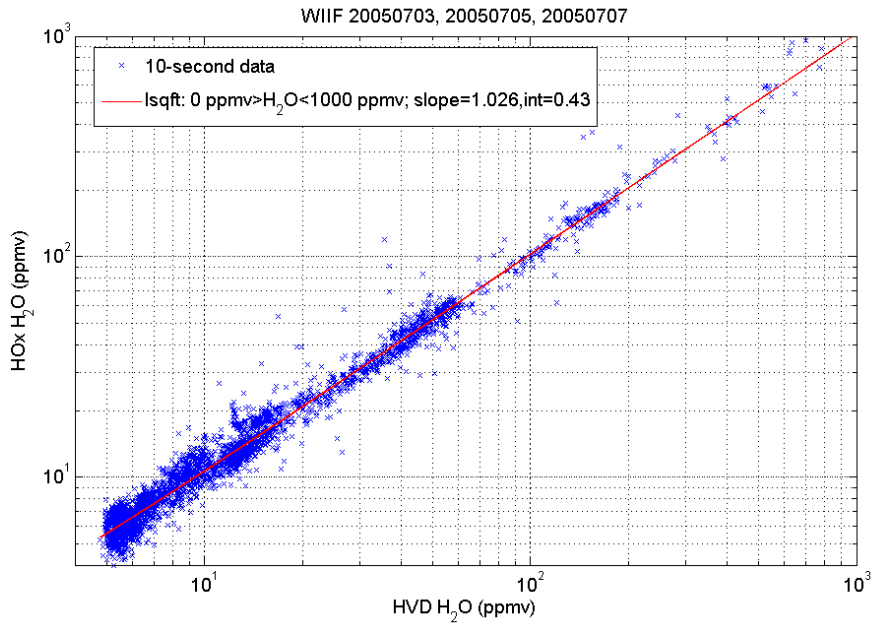

H2O during WIIF 20050703, 20050705, 20050707
ALIAS tw
ICOS
HOx
HVD tw
HVD H2O
JPL H2O
H2O (ppmv)
10^2
10^1
6
7
8
9
10
11
Running time (seconds)
x 10^4

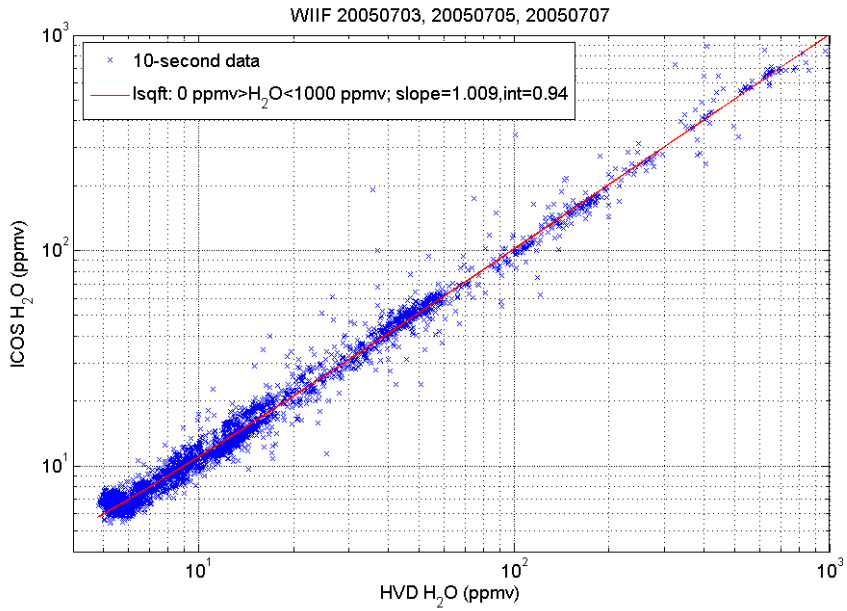

H2O during WIIF 20050703, 20050705, 20050707
ALIAS tw
ICOS
HOx
HVD tw
HVD H2O
JPL H2O
H2O (ppmv)
10^2
10^1
5.9
6
6.1
6.2
6.3
6.4
6.5
6.6
6.7
Running time (seconds)
x 10^4


H2O during WIIF 20050703, 20050705, 20050707
ALIAS tw
ICOS
HOx
HVD tw
HVD H2O
JPL H2O
H2O (ppmv)
10^2
10^1
7.6
7.8
8
8.2
8.4
8.6
Running time (seconds)
x 10^4


WIIF 20050703, 20050705, 20050707
10-second data
lsqft H_2O > 0 ppmv & H_2O < 100 ppmv; 0.986, int=0.39
JPL H_2O (ppmv)
HVD H_2O (ppmv)


WIIF 20050703, 20050705, 20050707
10-second data
0 ppmv>H_2O<1000 ppmv; slope=1.0372,int=0.14
HVD TW H_2O (ppmv)
HVD H_2O (ppmv)


WIIF 20050703, 20050705, 20050707
10-second data
lsqft: 0 ppmv>H_2O<1000 ppmv; slope=1.026,int=0.43
HOx H_2O (ppmv)
HVD H_2O (ppmv)

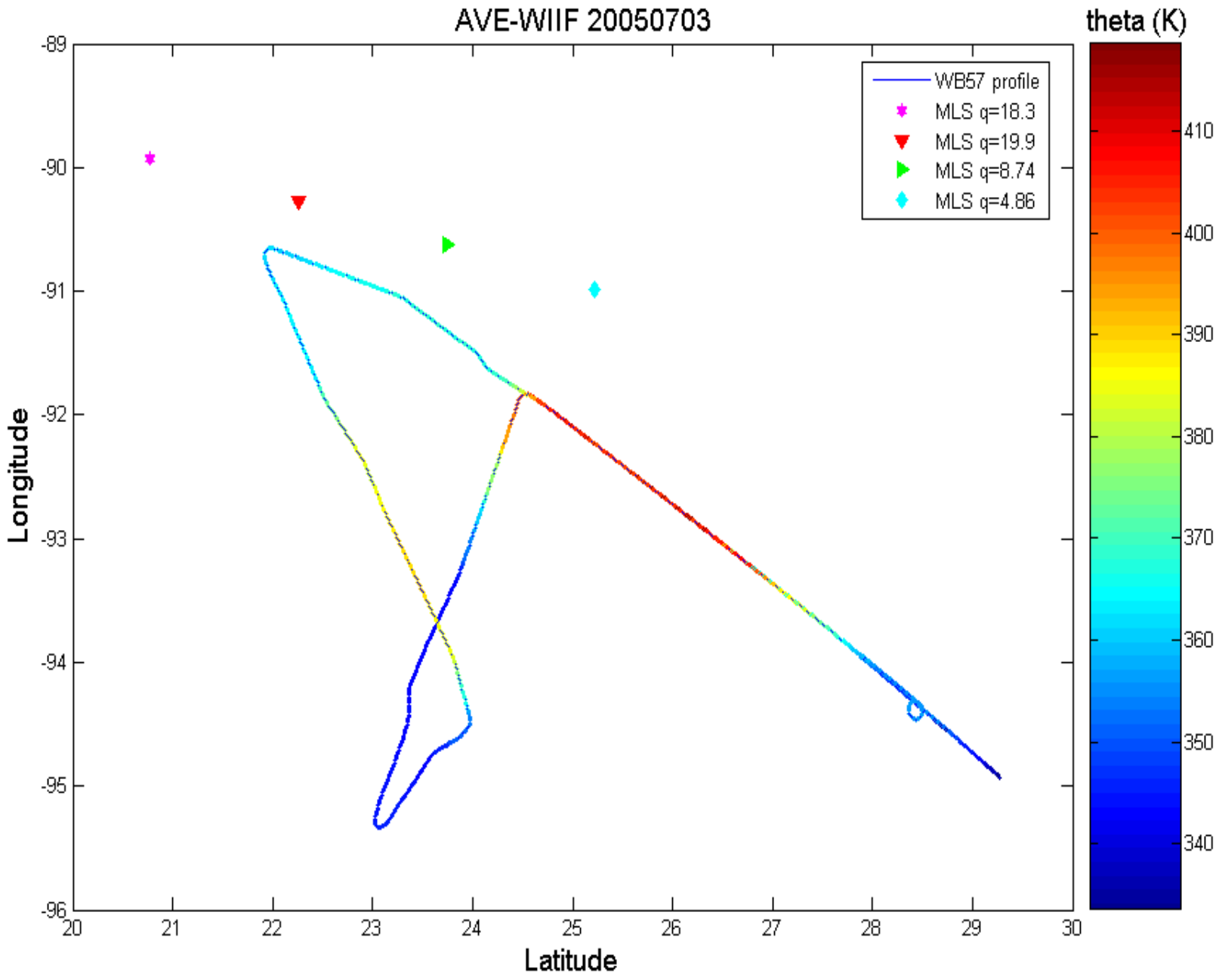

WIIF 20050703, 20050705, 20050707
10-second data
lsqft: 0 ppmv>H_2O<1000 ppmv; slope=1.009,int=0.94
ICOS H_2O (ppmv)
HVD H_2O (ppmv)

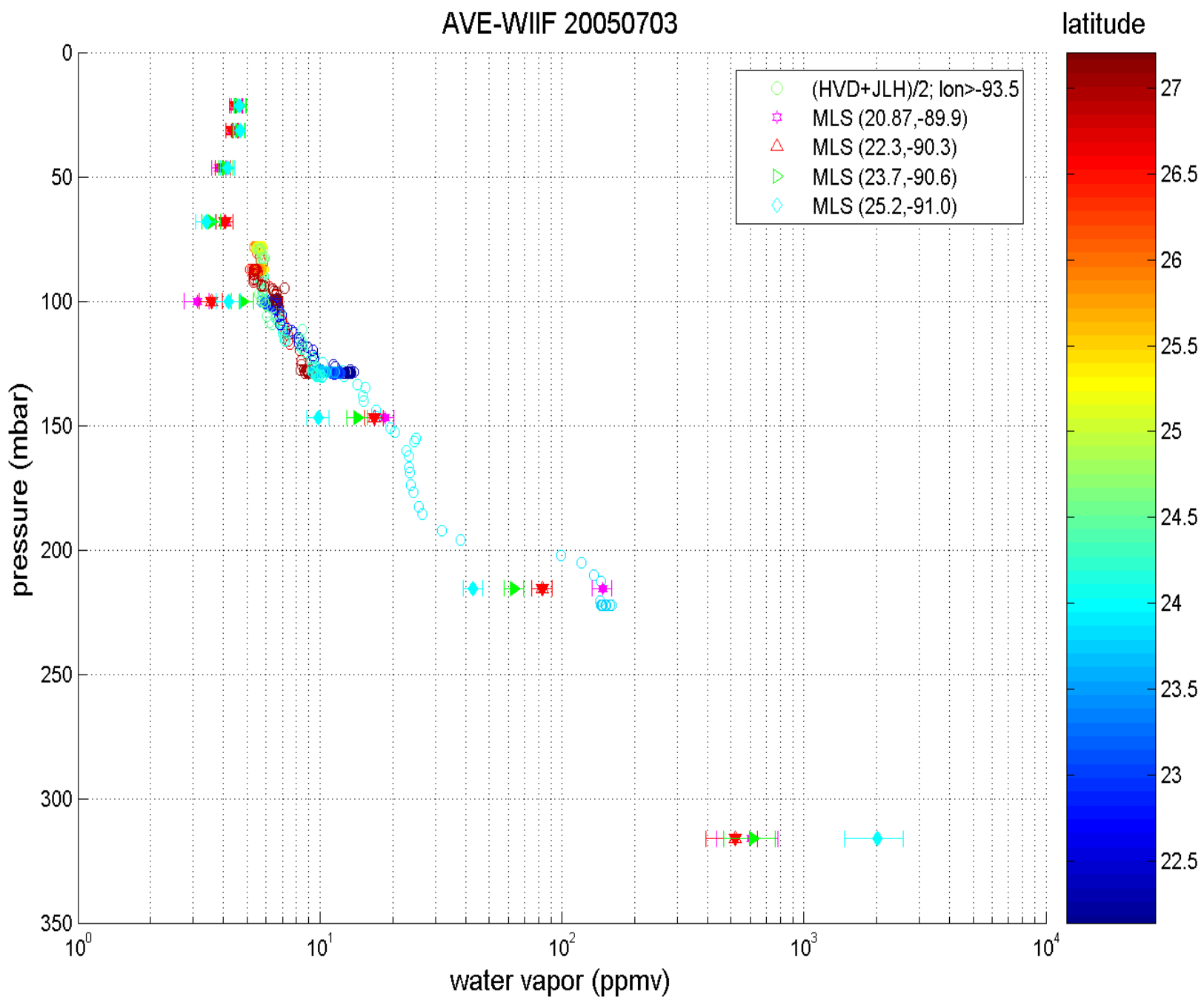
Take home messages from AVE-WIIF regarding water vapor measurements on the WB57

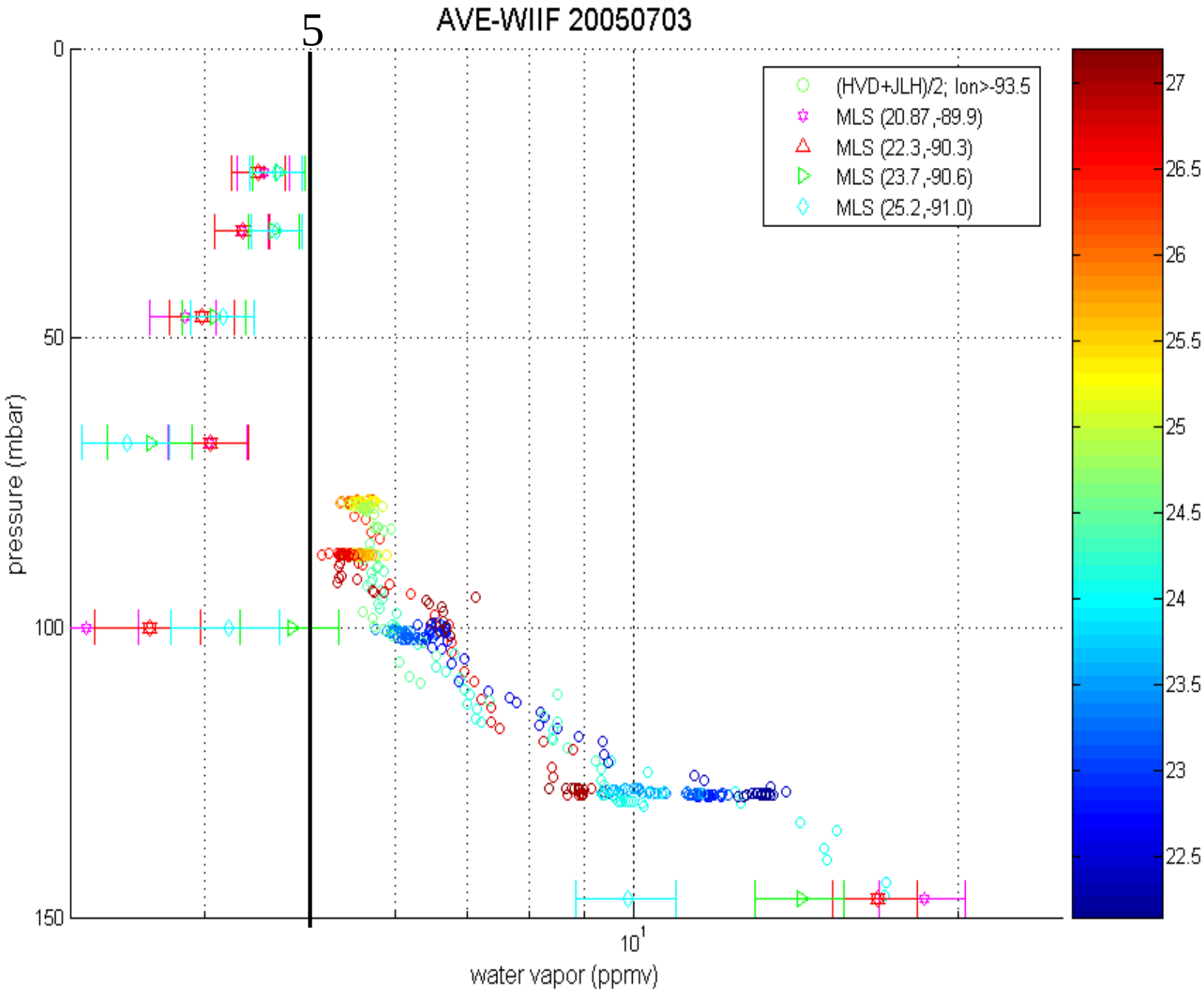
•Agreement among these in situ instruments corroborates their accuracy from the mid-troposphere to lower stratosphere.

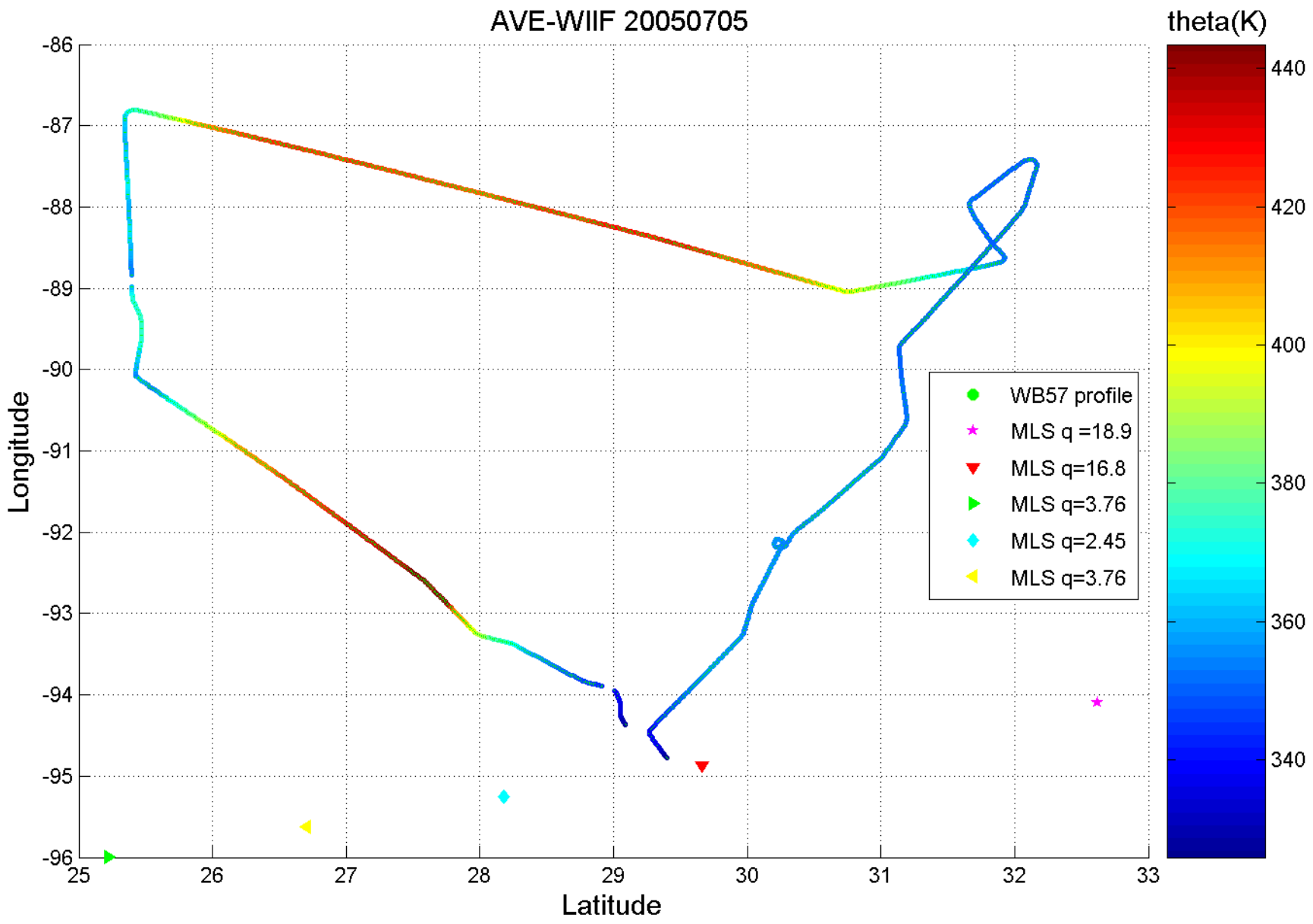
• Models that calculate stratospheric water vapor to evaluate dehydration mechanisms need to compare with data consistent with in situ data on the WB57 and past ER2 data.

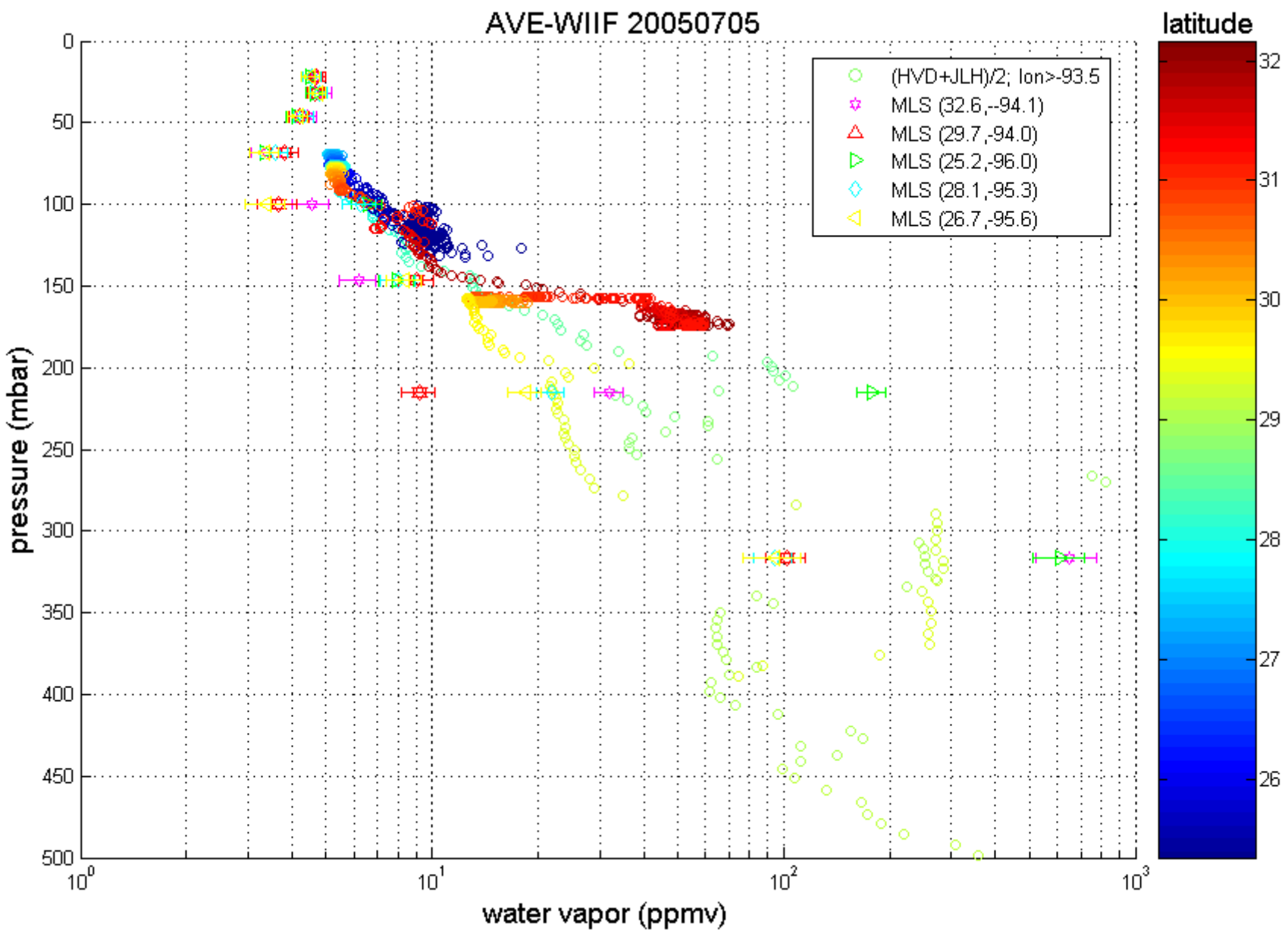
•These measurements provide the accuracy necessary for satellite validation.

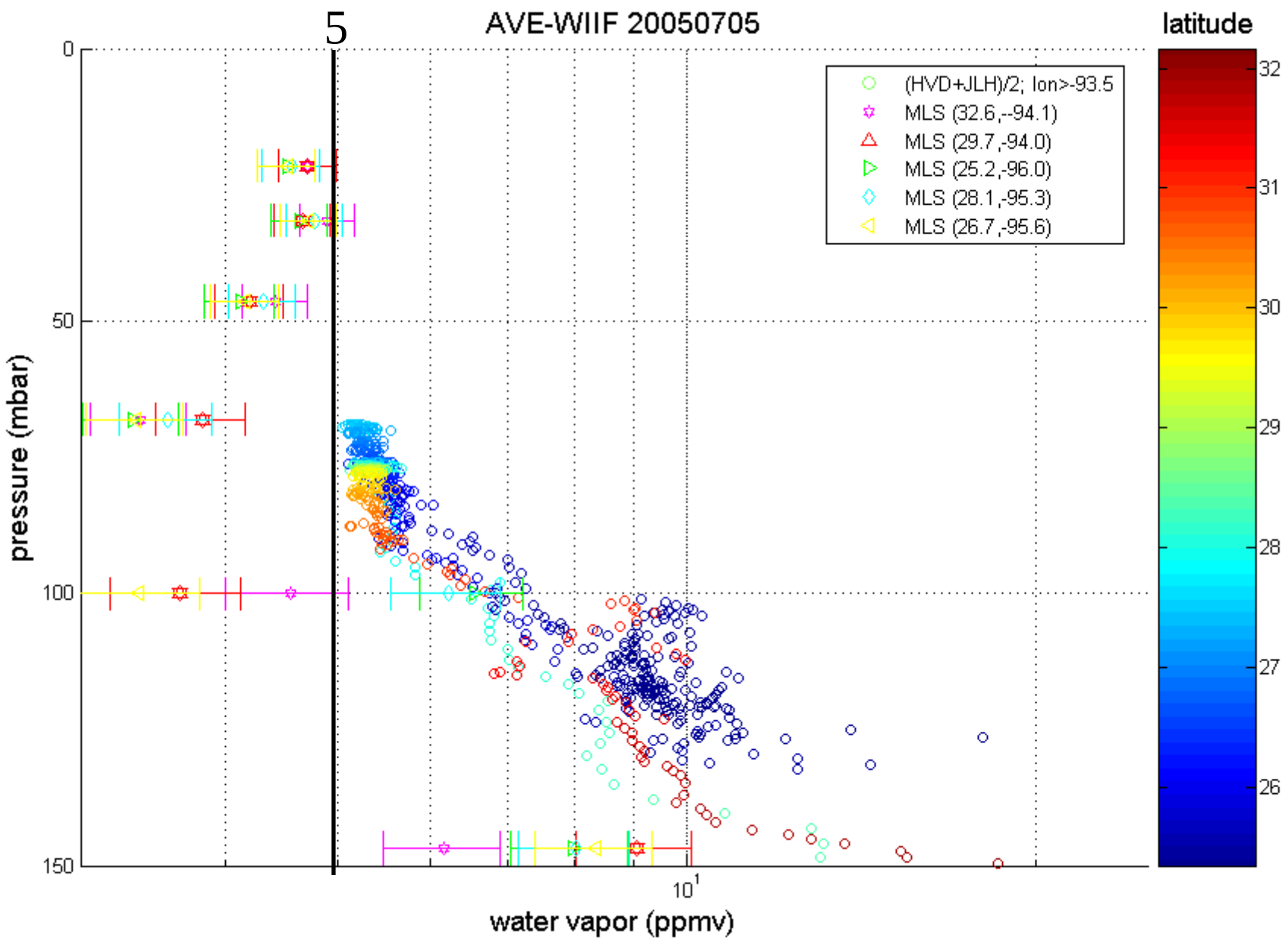

AVE-WIIF 20050703
theta (K)
WB57 profile
MLS q=18.3
MLS q=19.9
MLS q=8.74
MLS q=4.86
Longitude
Latitude
-89
-90
-91
-92
-93
-94
-95
-96
20
21
22
23
24
25
26
27
28
29
30
410
400
390
380
370
360
350
340

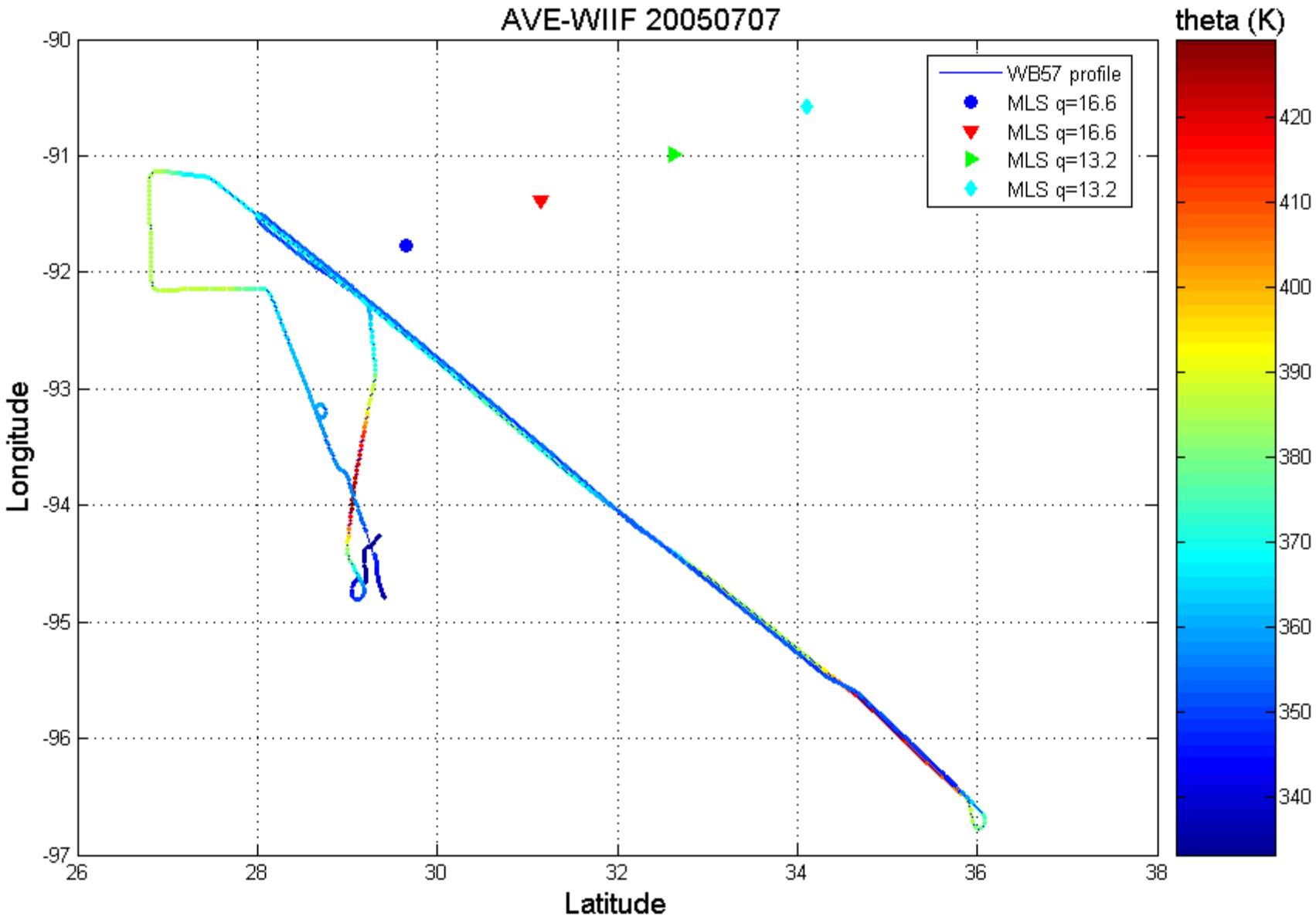

AVE-WIIF 20050703
latitude
(HVD+JLH)/2; lon>-93.5
MLS (20.87,-89.9)
MLS (22.3,-90.3)
MLS (23.7,-90.6)
MLS (25.2,-91.0)
pressure (mbar)
water vapor (ppmv)
0
50
100
150
200
250
300
350
10^0
10^1
10^2
10^3
10^4
27
26.5
26
25.5
25
24.5
24
23.5
23
22.5

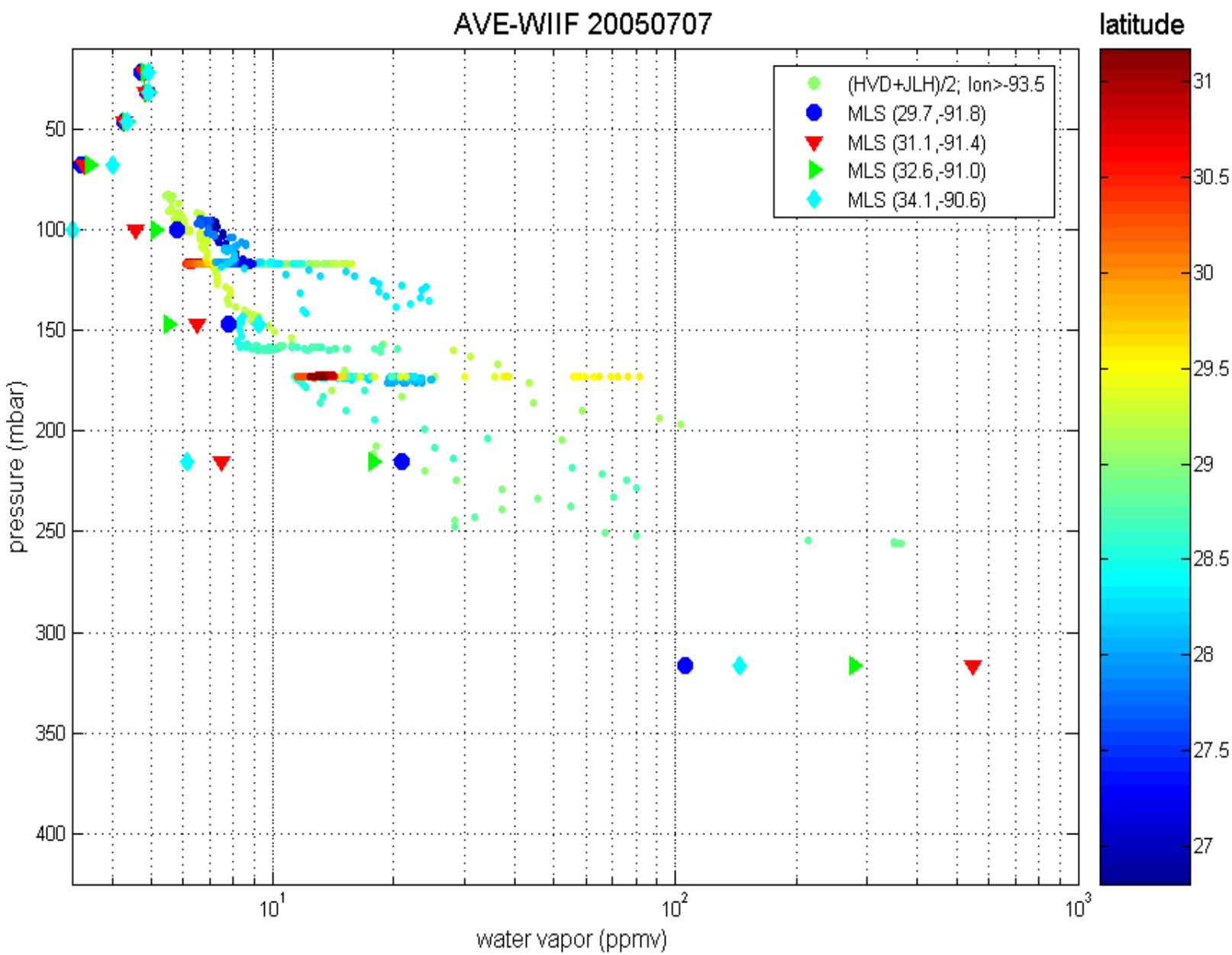

AVE-WIIF 20050703
(HVD+JLH)/2; lon>-93.5
MLS (20.87,-89.9)
MLS (22.3,-90.3)
MLS (23.7,-90.6)
MLS (25.2,-91.0)
pressure (mbar)
water vapor (ppmv)
0
50
100
150
10^1
27
26.5
26
25.5
25
24.5
24
23.5
23
22.5

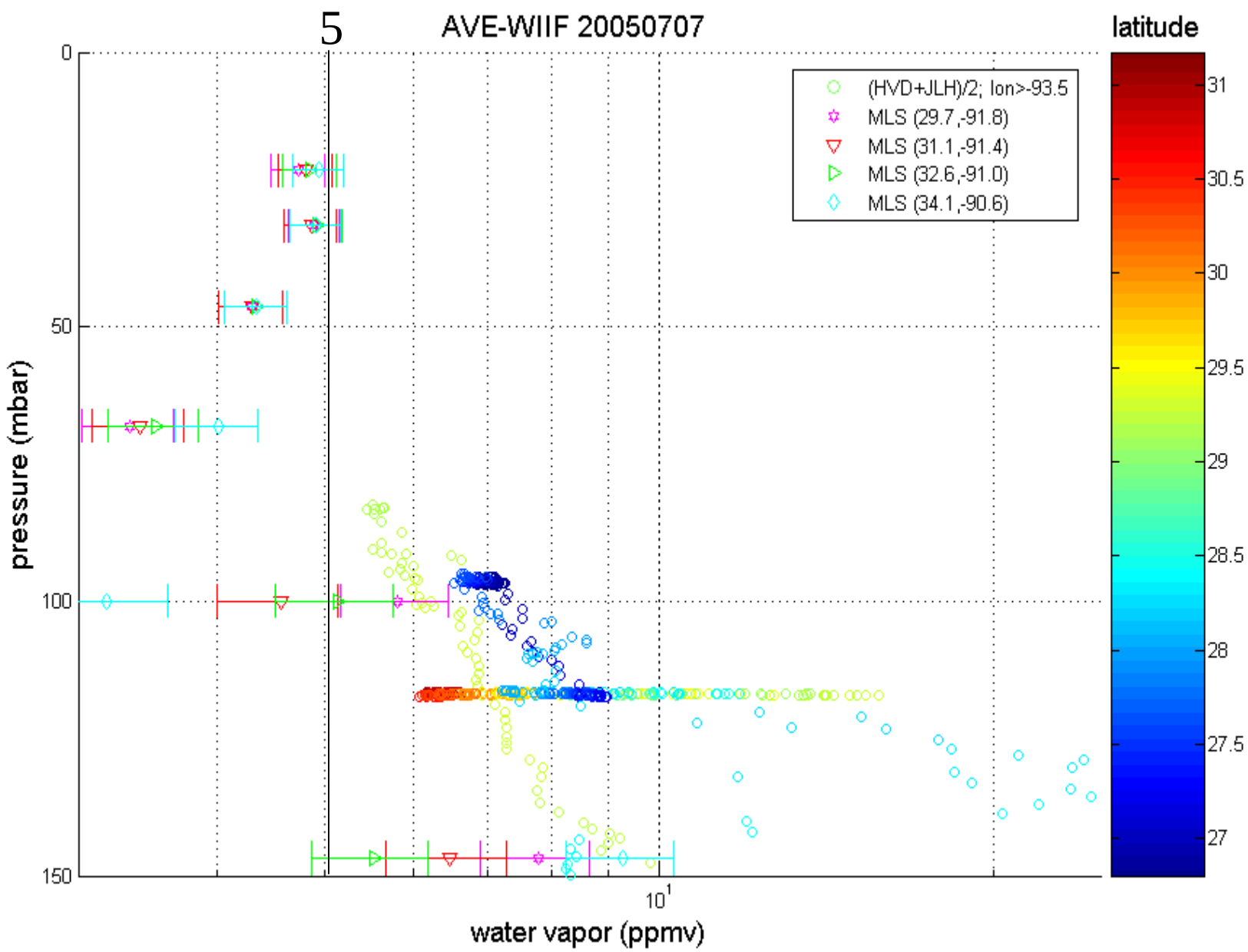

AVE-WIIF 20050705
theta(K)
440
420
400
380
360
340
Longitude
-86
-87
-88
-89
-90
-91
-92
-93
-94
-95
-96
Latitude
25
26
27
28
29
30
31
32
33
WB57 profile
MLS q =18.9
MLS q=16.8
MLS q=3.76
MLS q=2.45
MLS q=3.76

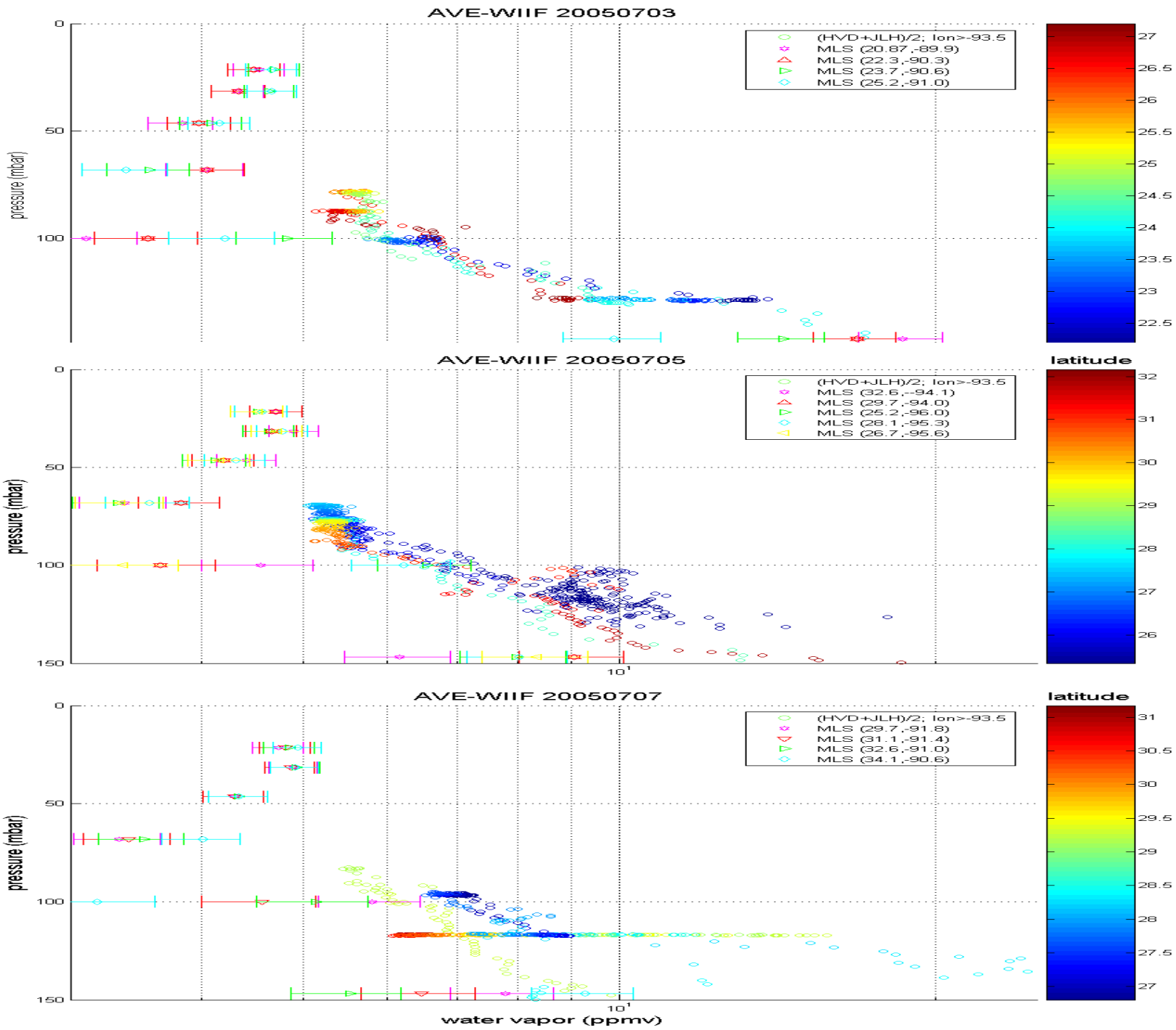

AVE-WIIF 20050705
latitude
(HVD+JLH)/2; lon>-93.5
MLS (32.6,--94.1)
MLS (29.7,-94.0)
MLS (25.2,-96.0)
MLS (28.1,-95.3)
MLS (26.7,-95.6)
pressure (mbar)
water vapor (ppmv)
0
50
100
150
200
250
300
350
400
450
500
10^0
10^1
10^2
10^3
32
31
30
29
28
27
26

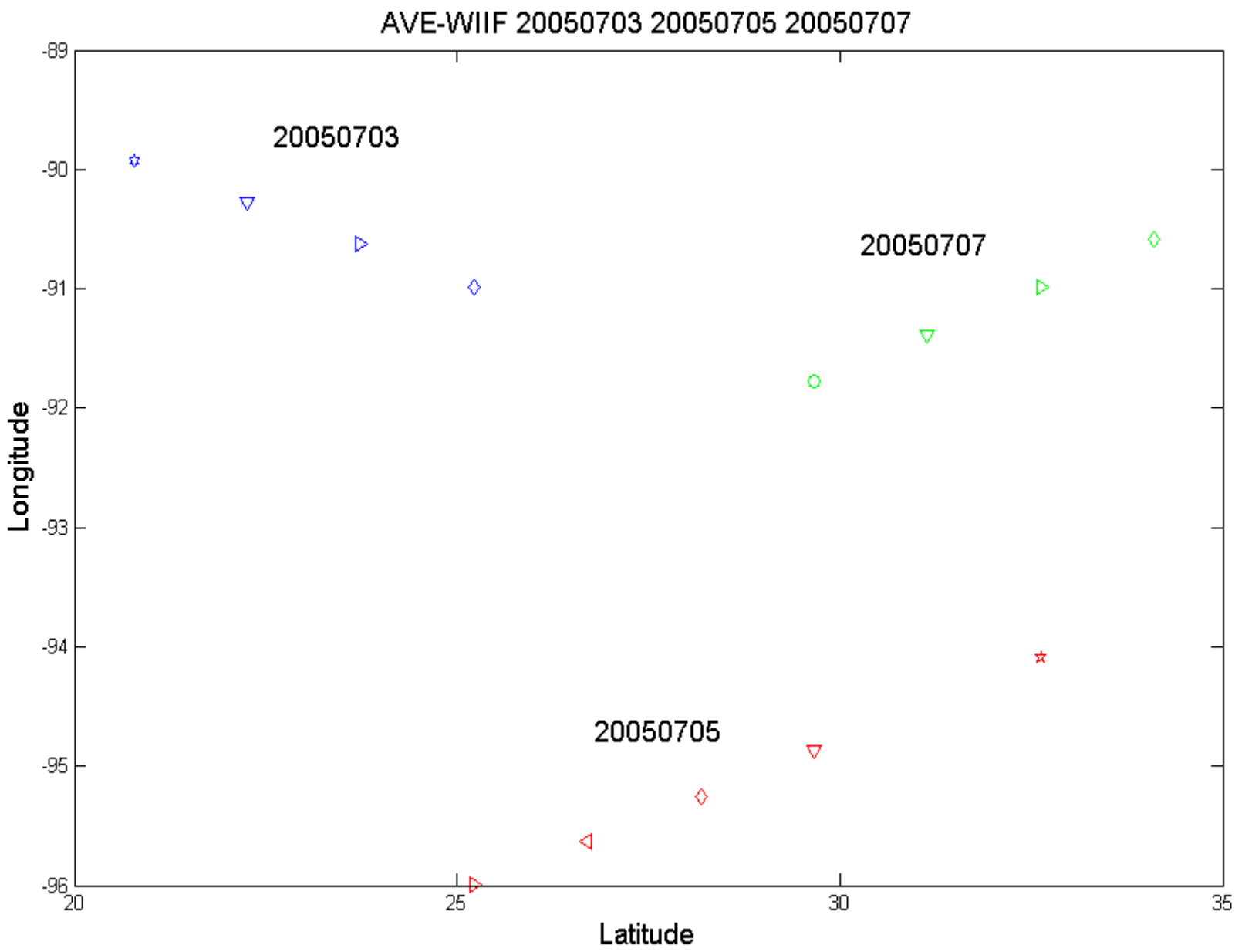

5
AVE-WIIF 20050705
latitude
(HVD+JLH)/2; lon>-93.5
MLS (32.6,--94.1)
MLS (29.7,-94.0)
MLS (25.2,-96.0)
MLS (28.1,-95.3)
MLS (26.7,-95.6)
pressure (mbar)
water vapor (ppmv)
0
50
100
150
10^1
32
31
30
29
28
27
26

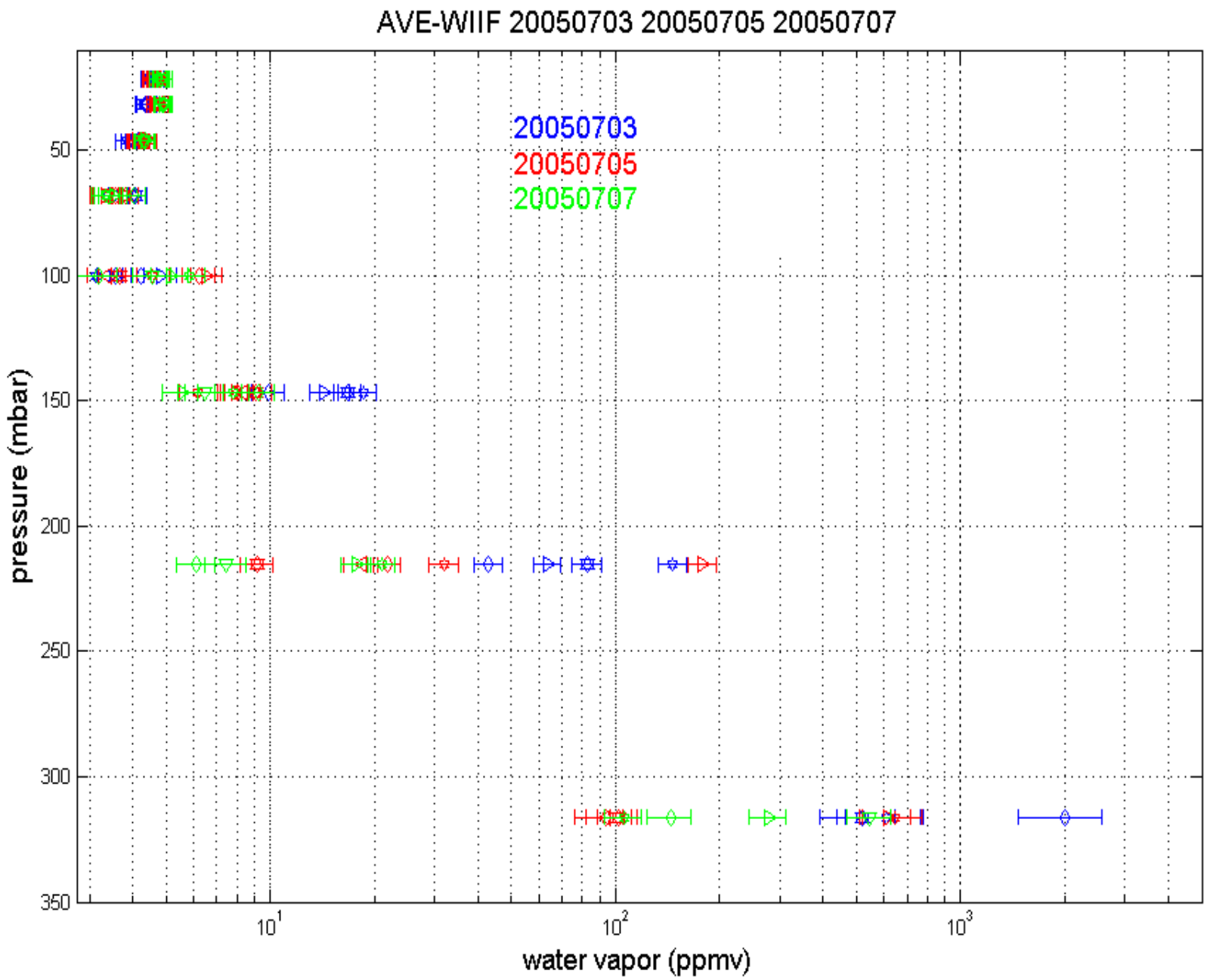

AVE-WIIF 20050707
theta (K)
WB57 profile
MLS q=16.6
MLS q=16.6
MLS q=13.2
MLS q=13.2
Longitude
Latitude
-90
-91
-92
-93
-94
-95
-96
-97
26
28
30
32
34
36
38
420
410
400
390
380
370
360
350
340


AVE-WIIF 20050707
latitude
(HVD+JLH)/2; lon>-93.5
MLS (29.7,-91.8)
MLS (31.1,-91.4)
MLS (32.6,-91.0)
MLS (34.1,-90.6)
pressure (mbar)
water vapor (ppmv)
50
100
150
200
250
300
350
400
10^1
10^2
10^3
31
30.5
30
29.5
29
28.5
28
27.5
27


AVE-WIIF 20050707
latitude
(HVD+JLH)/2; lon>-93.5
MLS (29.7,-91.8)
MLS (31.1,-91.4)
MLS (32.6,-91.0)
MLS (34.1,-90.6)
pressure (mbar)
water vapor (ppmv)
0
50
100
150
10^1
31
30.5
30
29.5
29
28.5
28
27.5
27


AVE-WIIF 20050703
(HVD+JLH)/2; lon>-93.5
MLS (20.87,-89.9)
MLS (22.3,-90.3)
MLS (23.7,-90.6)
MLS (25.2,-91.0)
pressure (mbar)
AVE-WIIF 20050705
(HVD+JLH)/2; lon>-93.5
MLS (32.6,--94.1)
MLS (29.7,-94.0)
MLS (25.2,-96.0)
MLS (28.1,-95.3)
MLS (26.7,-95.6)
latitude
AVE-WIIF 20050707
(HVD+JLH)/2; lon>-93.5
MLS (29.7,-91.8)
MLS (31.1,-91.4)
MLS (32.6,-91.0)
MLS (34.1,-90.6)
water vapor (ppmv)


AVE-WIIF 20050703 20050705 20050707
20050703
20050707
20050705
Longitude
Latitude
-89
-90
-91
-92
-93
-94
-95
-96
20
25
30
35


AVE-WIIF 20050703 20050705 20050707
20050703
20050705
20050707
pressure (mbar)
water vapor (ppmv)
50
100
150
200
250
300
350
10^1
10^2
10^3

Conclusions

•Intercomparisons between in situ and MLS water vapor data are self consistent for the three flights during AVE-WIIF.

•Only on the 20050705 flight does the WB57 reach the 68 mbar pressure level. For that flight the in situ instruments measure over 5 ppmv while MLS measures about 3.5 ppmv.

•For 150 mbar and below atmospheric structure and variability make quantitative intercomparisons difficult and more profiling is necessary down to lower pressures. This is logistically difficult for the WB57.