Cirrus Flux Closure Validation Study

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Motivation:

- Aircraft validation is insufficient to establish the validity of cirrus retrievals in a statistically significant sense.

Purpose:

- Explore a new approach that exploits the continuous character of ARM data and addresses a fundamental ARM issue – Radiative Forcing

Approach:

•Use the software infrastructure developed for CRF study (Mace et al., 2006) to conduct comparisons to TOA and surface fluxes.

•For specific cirrus cases, developers produced input files according to specifications.

•Retrieved microphysics used to calculate cirrus radiative properties

•Radiative properties then used to calculate solar and IR flux

•Flux then converted to CRF and compared to observations.

Status of the study:

•We are able to ingest, run, and evaluate candidate algorithms and compare to fluxes

•Evaluated year 2000 cases and have preliminary results

Early results:

•All algorithms appear to diagnose too little forcing in cases where the forcing is small

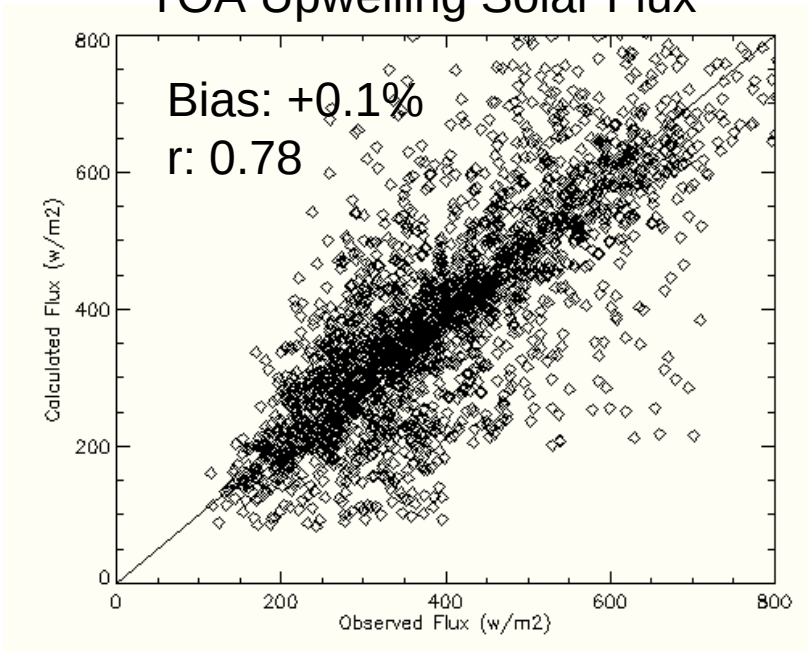
•Better agreement is found in situations where the forcing is large

•Interalgorithm differences and agreements bear further examination

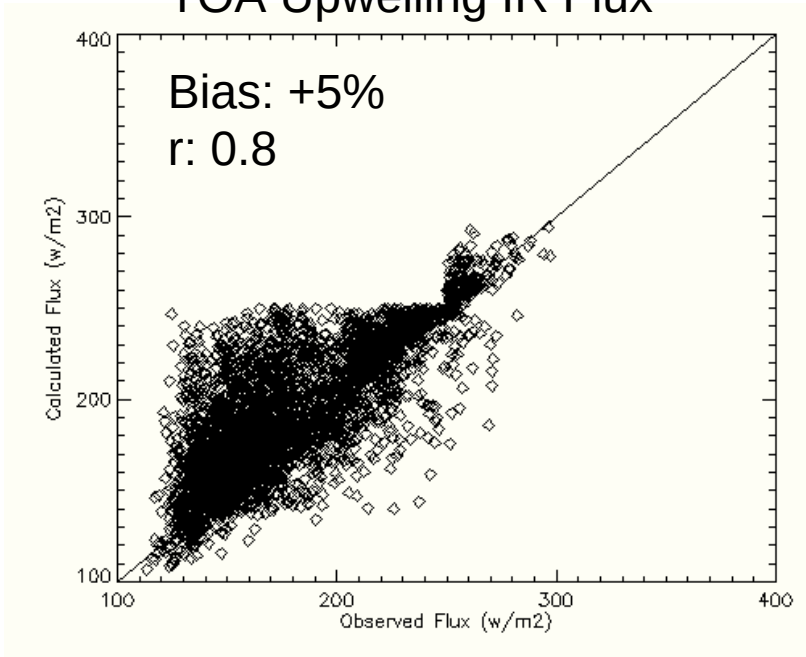
•Particle size sensitivity ongoing

•Need more cases now to extend statistical significance

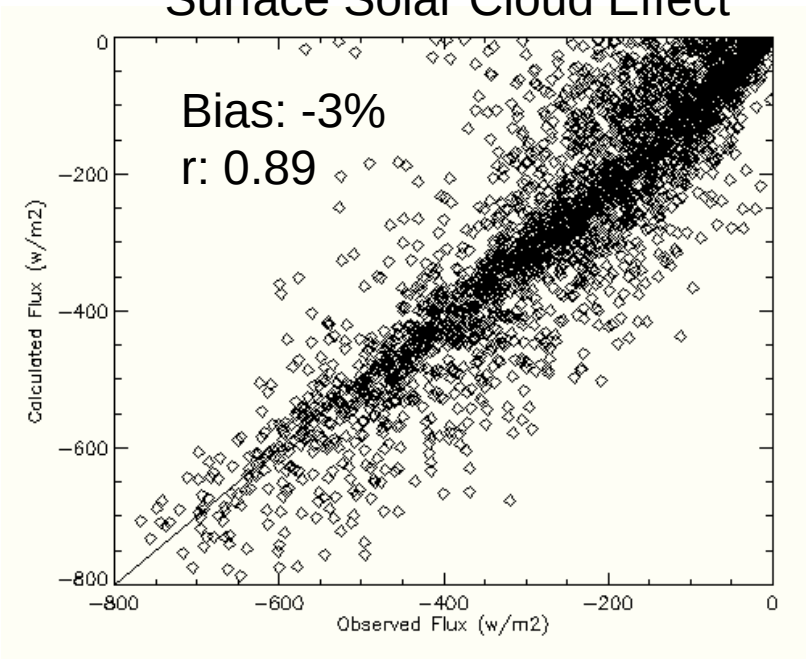
TOA Upwelling Solar Flux



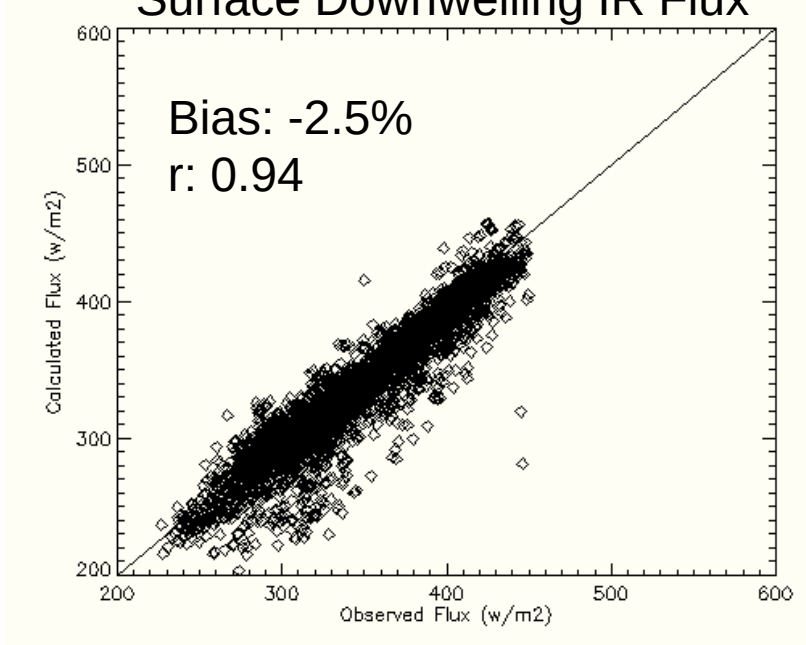
TOA Upwelling IR Flux

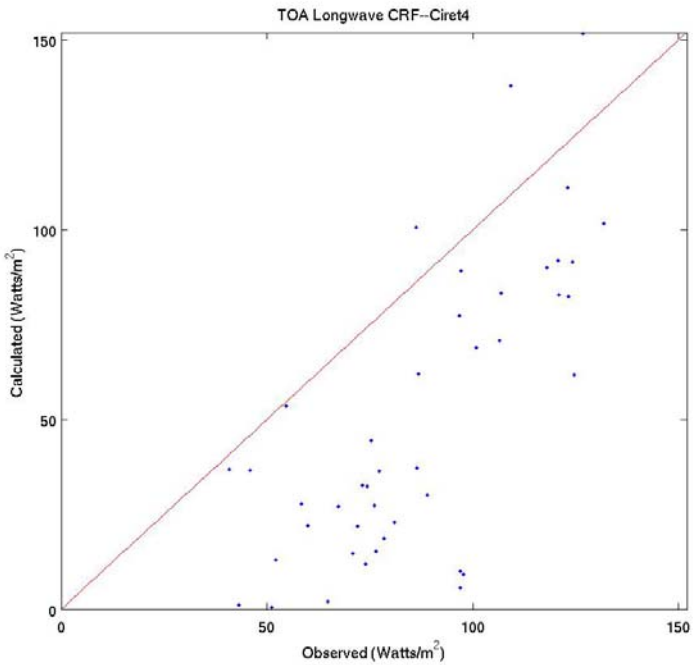


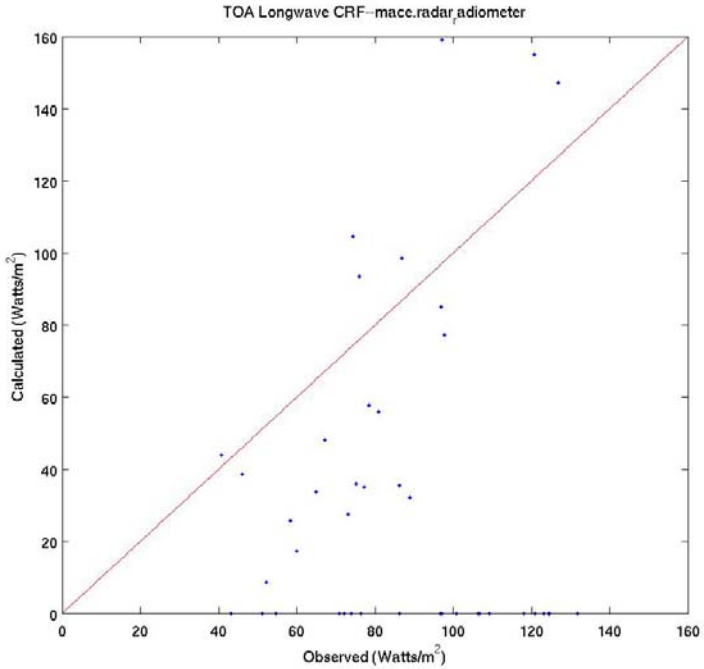
Surface Solar Cloud Effect



Surface Downwelling IR Flux




TOA Longwave CRF--Ciret4
Calculated (Watts/m^2)
Observed (Watts/m^2)
0
50
100
150


TOA Longwave CRF--mace.radar_radiometer
Calculated (Watts/m^2)
Observed (Watts/m^2)
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40
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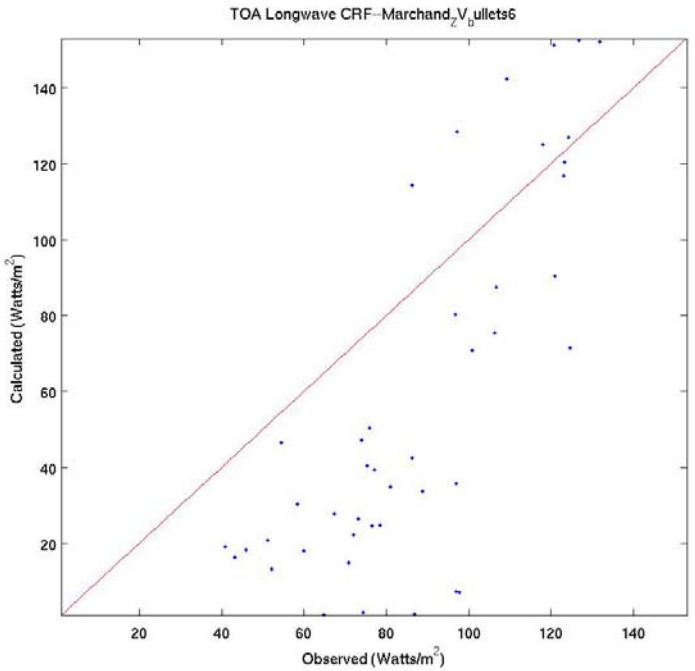
80
100
120
140
160


TOA Longwave CRF--Marchand_2V_bullets6
Calculated (Watts/m^2)
Observed (Watts/m^2)
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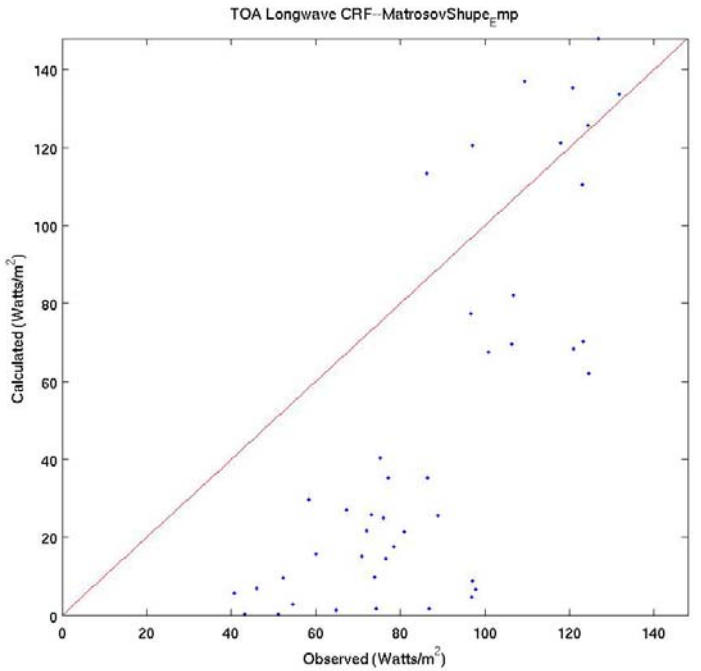
40
60
80
100
120
140


TOA Longwave CRF--MatrosovShupe_Emp
Calculated (Watts/m^2)
Observed (Watts/m^2)
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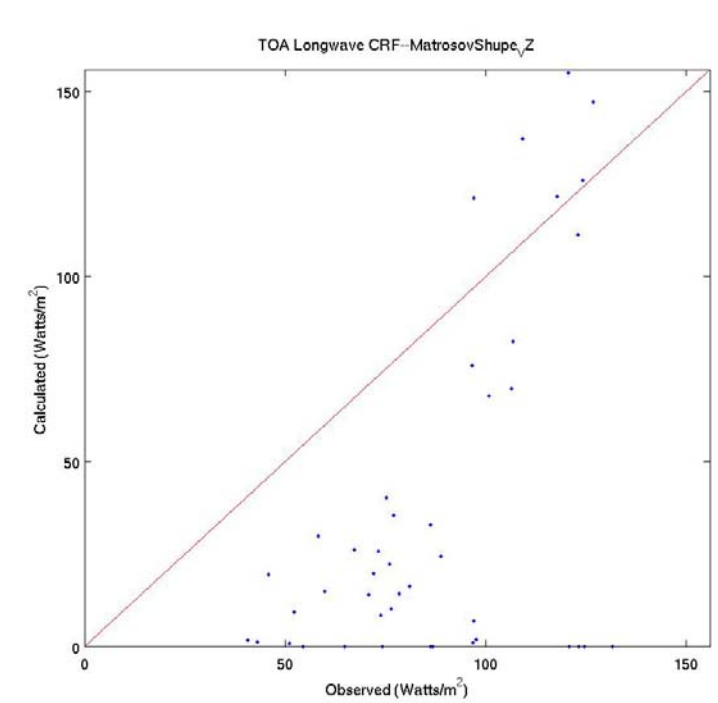
20
40
60
80
100
120
140


TOA Longwave CRF--MatrosovShape_VZ
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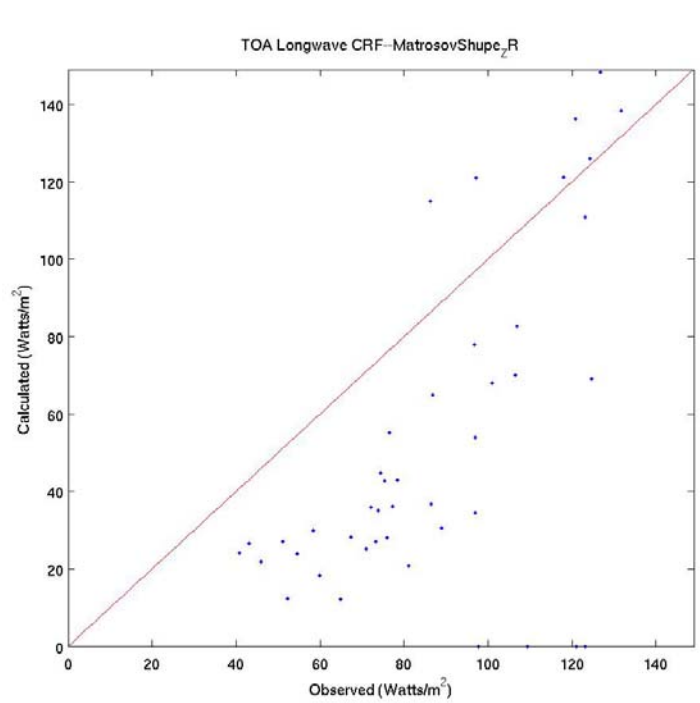
Observed (Watts/m^2)
0
50
100
150


TOA Longwave CRF--MatrosovShape_ZR
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Observed (Watts/m^2)
0
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80
100
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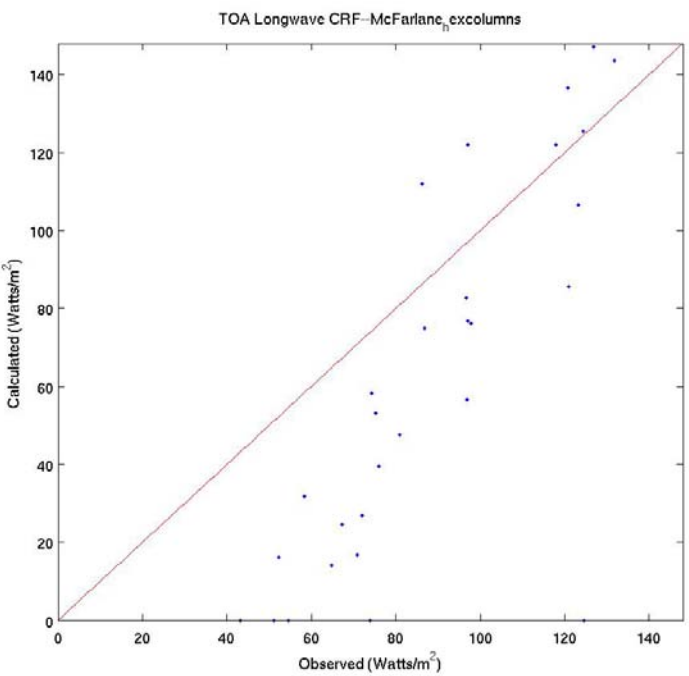
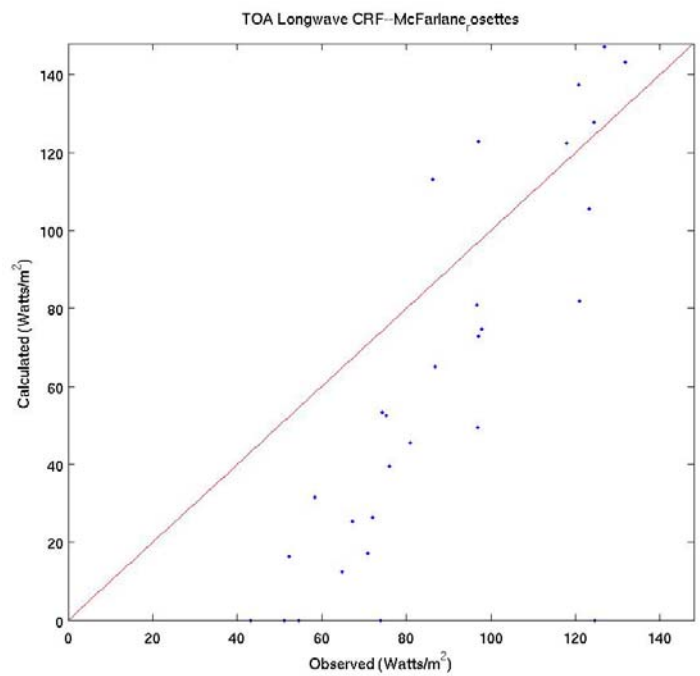
140


TOA Longwave CRF--McFarlane_hexcolumns
Calculated (Watts/m^2)
Observed (Watts/m^2)
0
20
40
60
80
100
120
140


TOA Longwave CRF--McFarlane_rosettes
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Observed (Watts/m^2)
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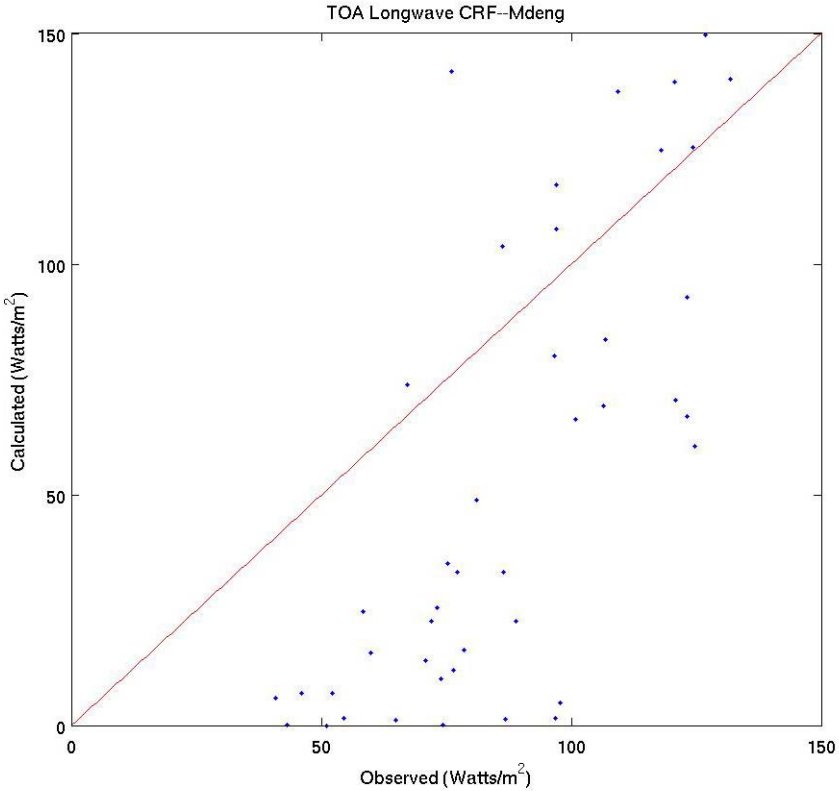
TOA Longwave CRF--Mdeng
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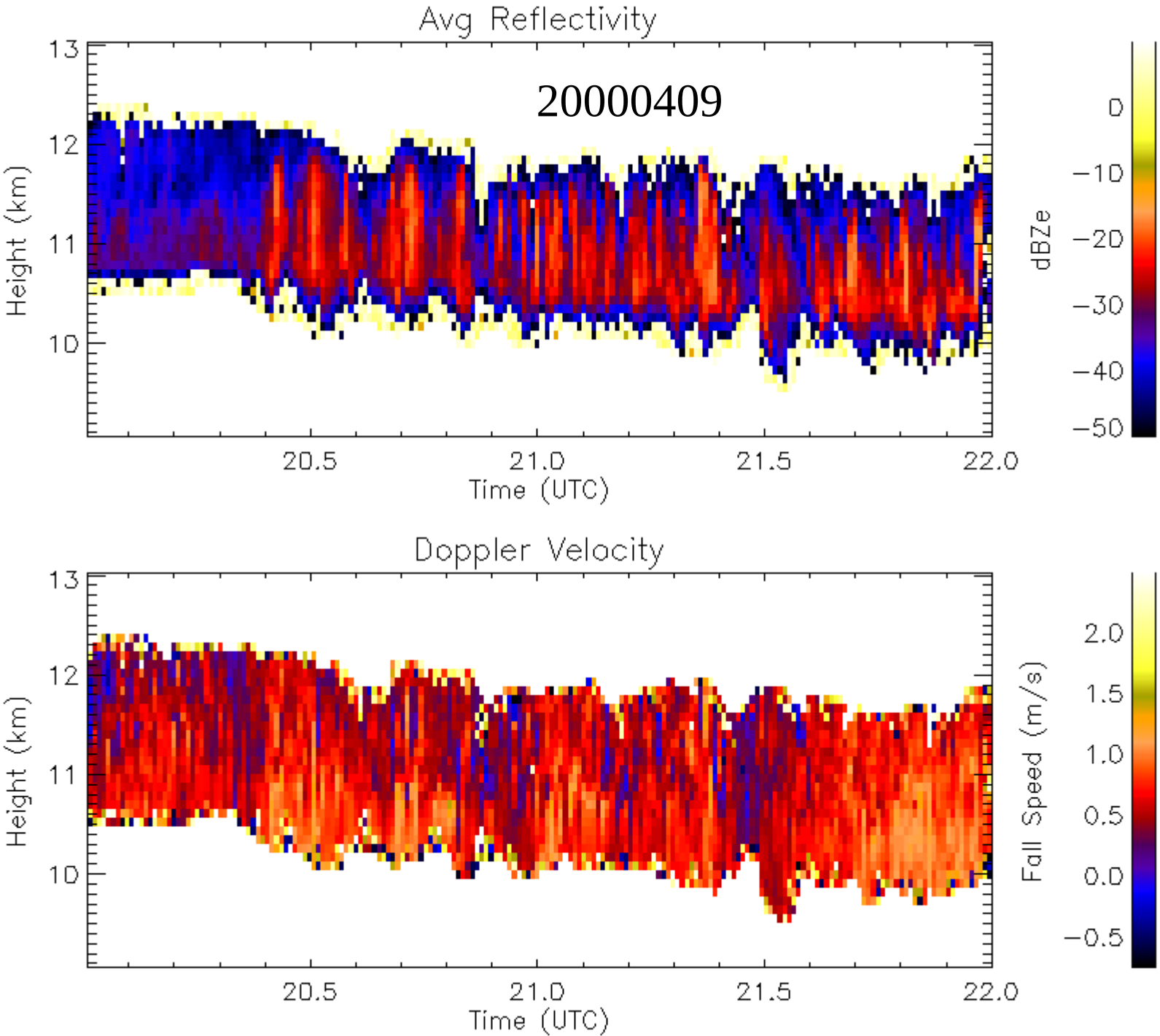
0
50
100
150
Calculated (Watts/m2)
Observed (Watts/m2)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Height (km)
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12
11
10
20.5
21.0
21.5
22.0
Time (UTC)
dBZe
0
−10
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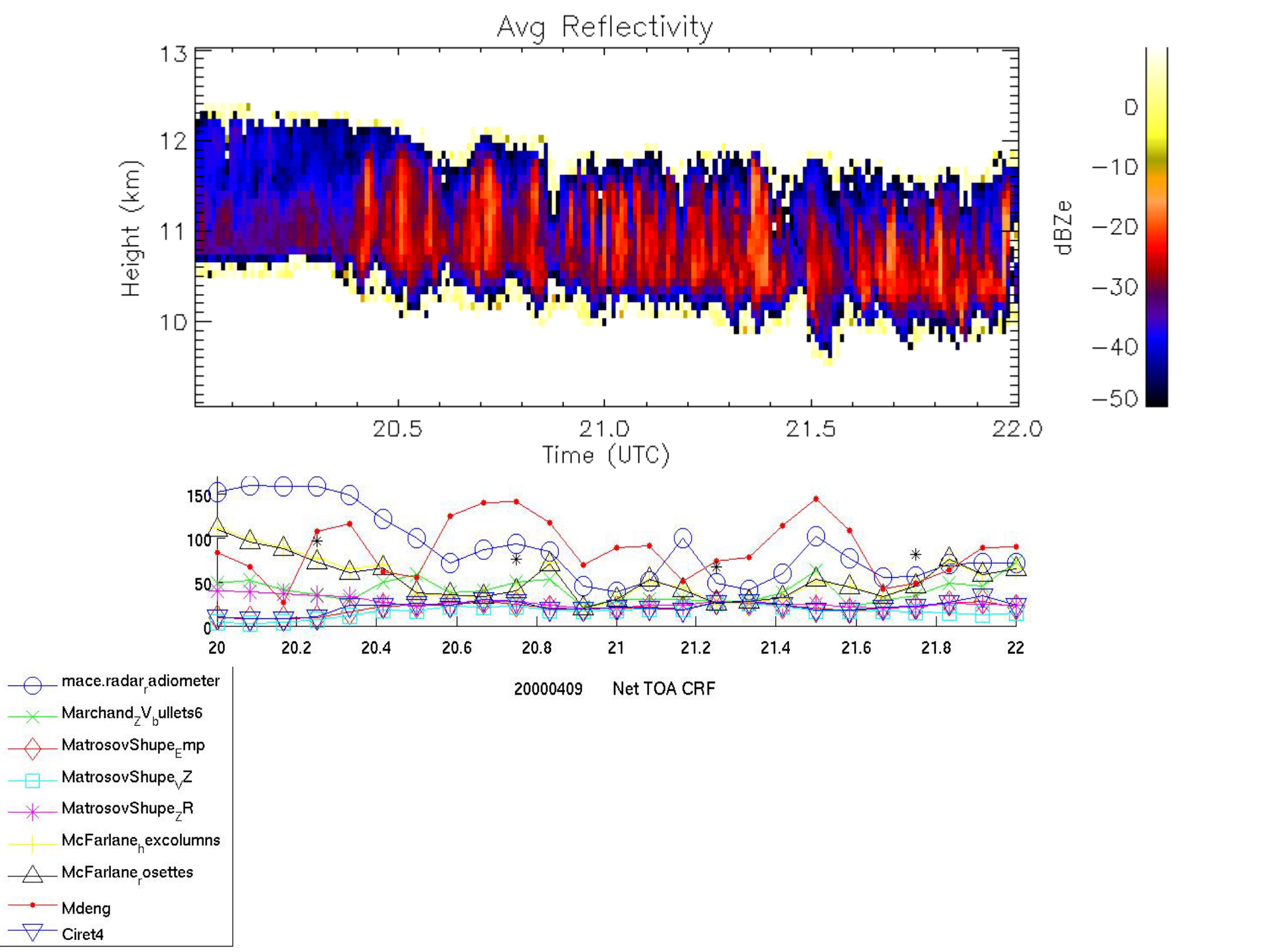
−30
−40
−50
Doppler Velocity
Height (km)
13
12
11
10
20.5
21.0
21.5
22.0
Time (UTC)
Fall Speed (m/s)
2.0
1.5
1.0
0.5
0.0
−0.5


Avg Reflectivity
Height (km)
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Time (UTC)
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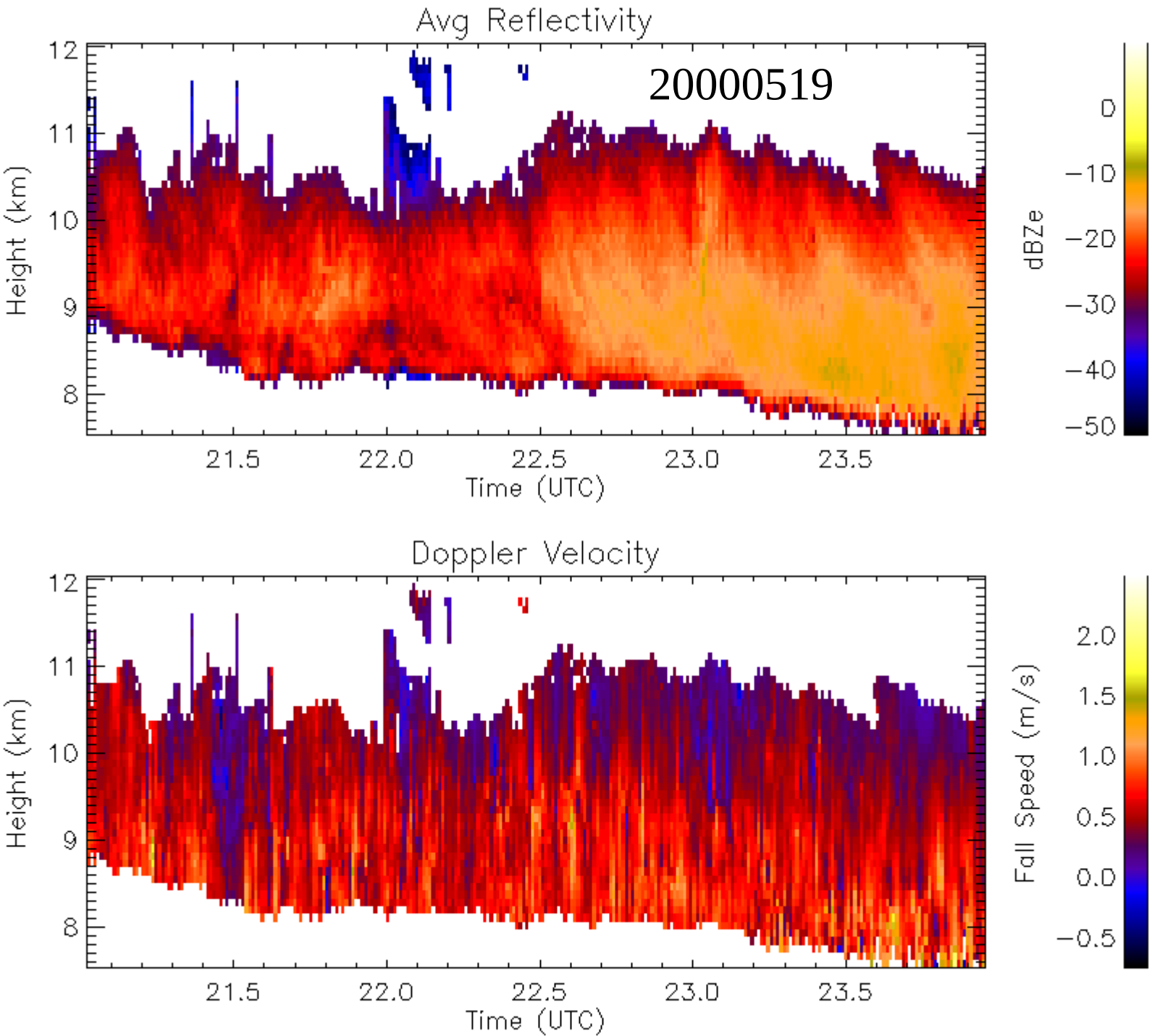
20000409 Net TOA CRF
mace.radar_radiometer
Marchand_ZV_bullets6
MatrosovShupe_Emp
MatrosovShupe_VZ
MatrosovShupe_ZR
McFarlane_hexcolumns
McFarlane_rosettes
Mdeng
Ciret4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22.5
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23.5
Time (UTC)
dBZe
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−50
Doppler Velocity
Height (km)
12
11
10
9
8
21.5
22.0
22.5
23.0
23.5
Time (UTC)
Fall Speed (m/s)
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1.5
1.0
0.5
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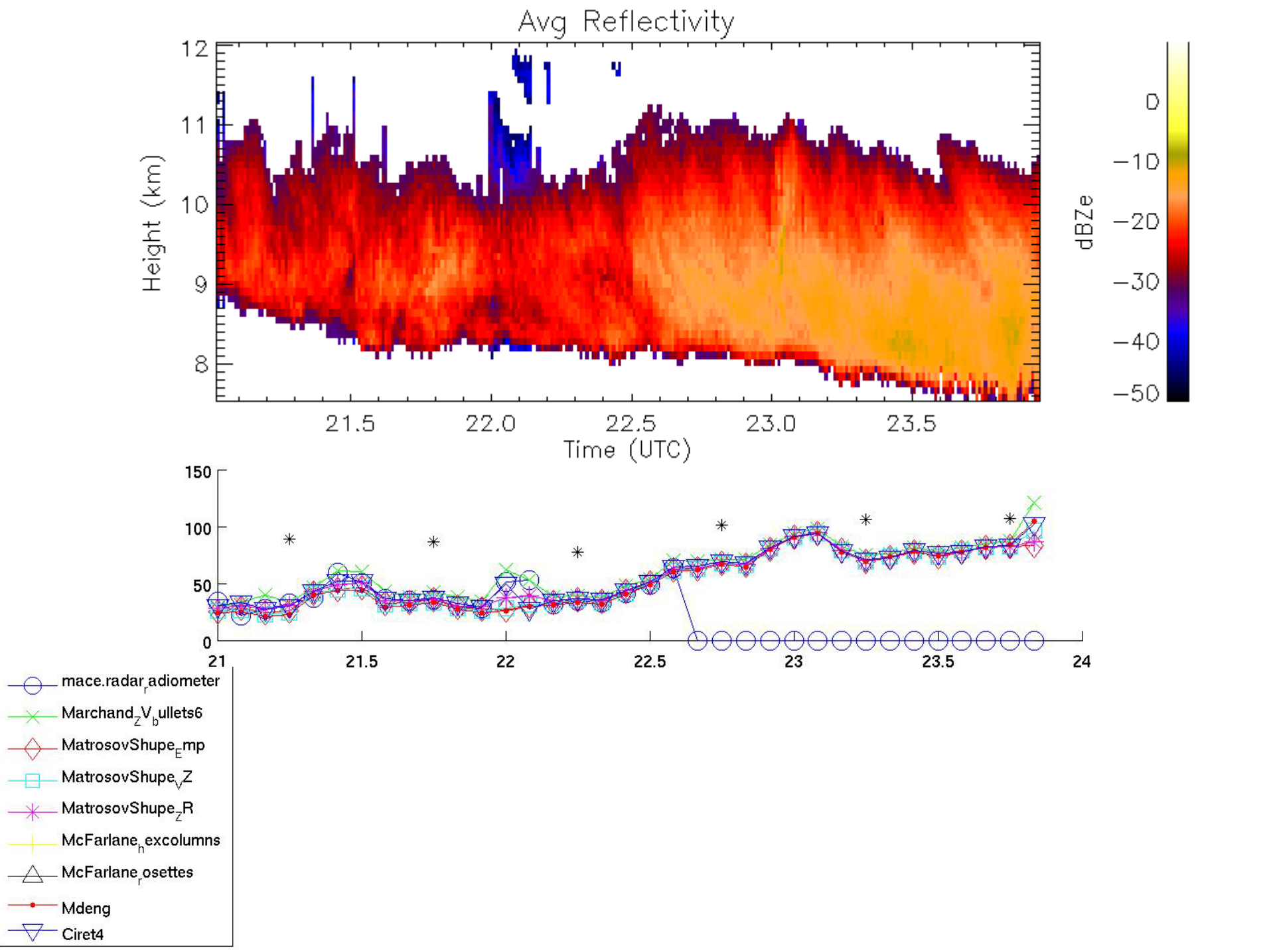
−0.5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Height (km)
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Time (UTC)
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mace.radar_radiometer
Marchand_ZV_bullets6
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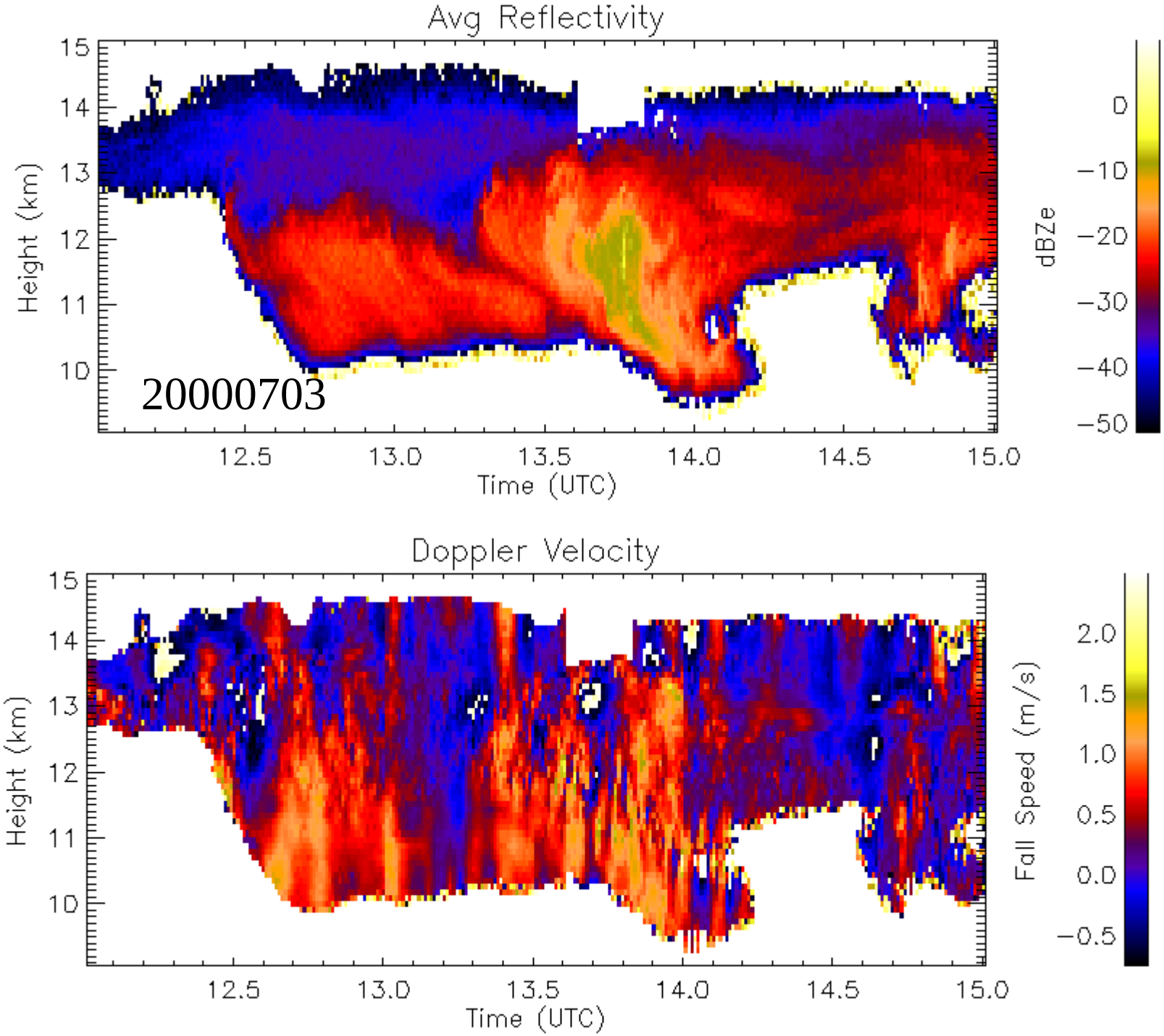
McFarlane_hexcolumns
McFarlane_rosettes
Mdeng
Ciret4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12
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10
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15.0
Time (UTC)
dBZe
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−20
−30
−40
−50
Doppler Velocity
Height (km)
15
14
13
12
11
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12.5
13.0
13.5
14.0
14.5
15.0
Time (UTC)
Fall Speed (m/s)
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1.5
1.0
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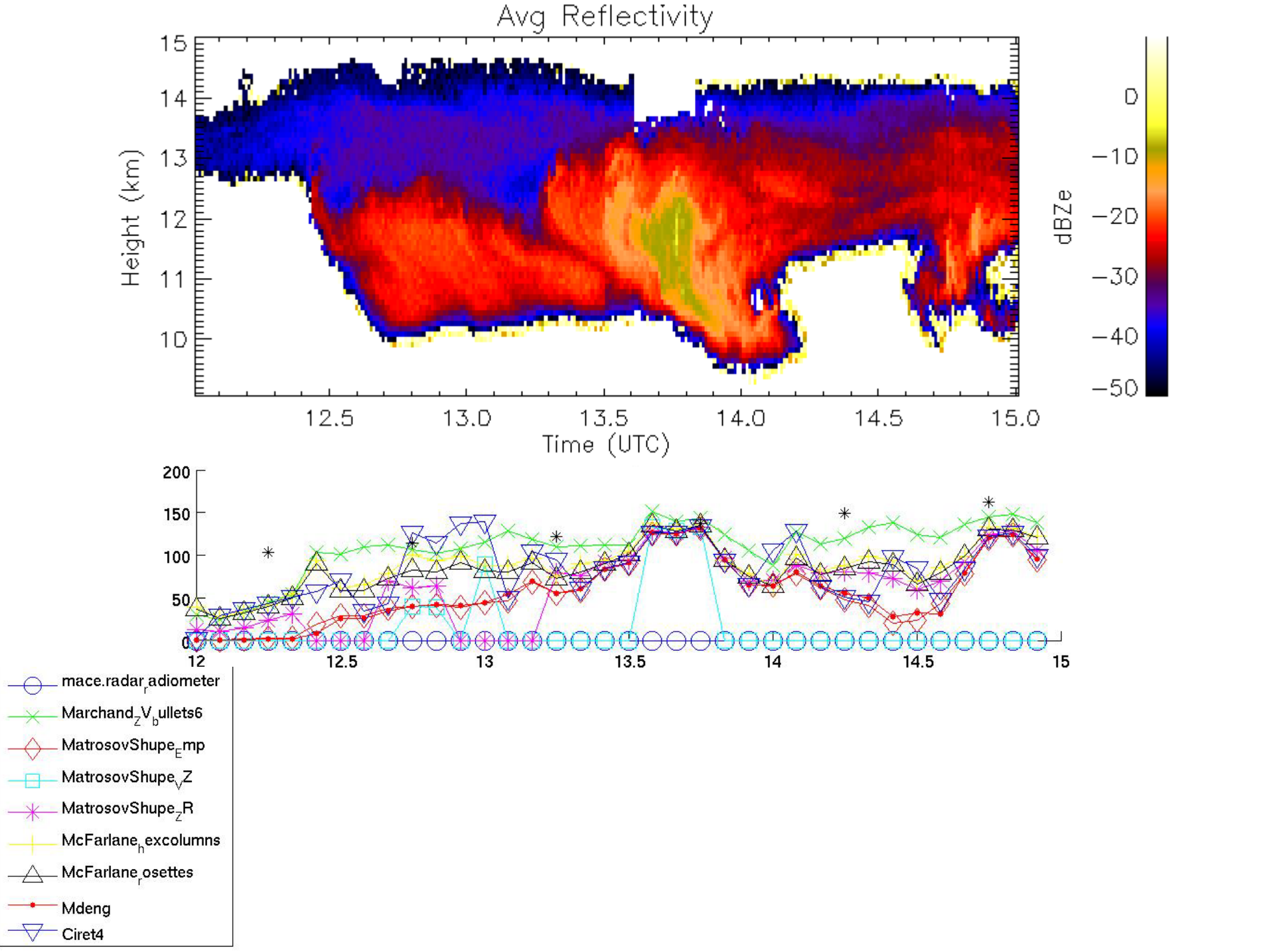
Avg Reflectivity
Height (km)
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Time (UTC)
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mace.radar_radiometer
Marchand_ZV_bullets6
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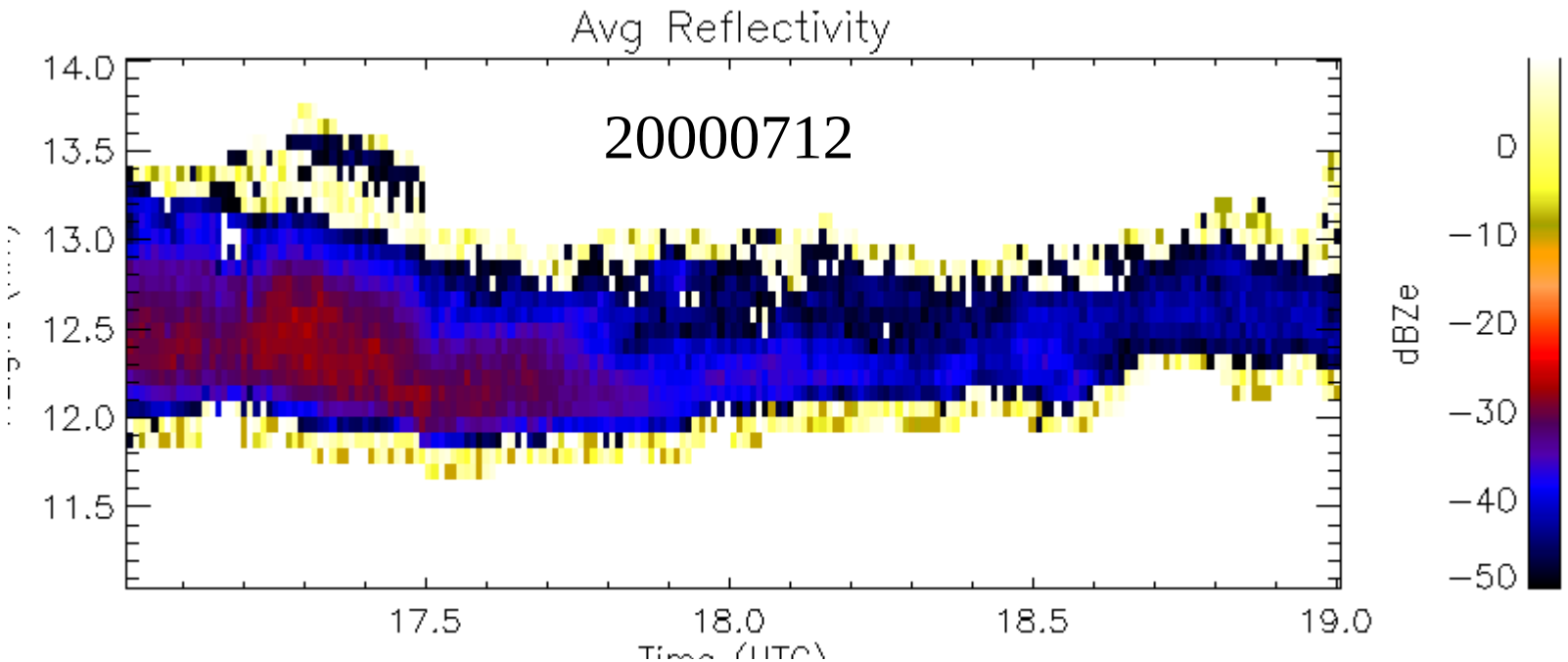
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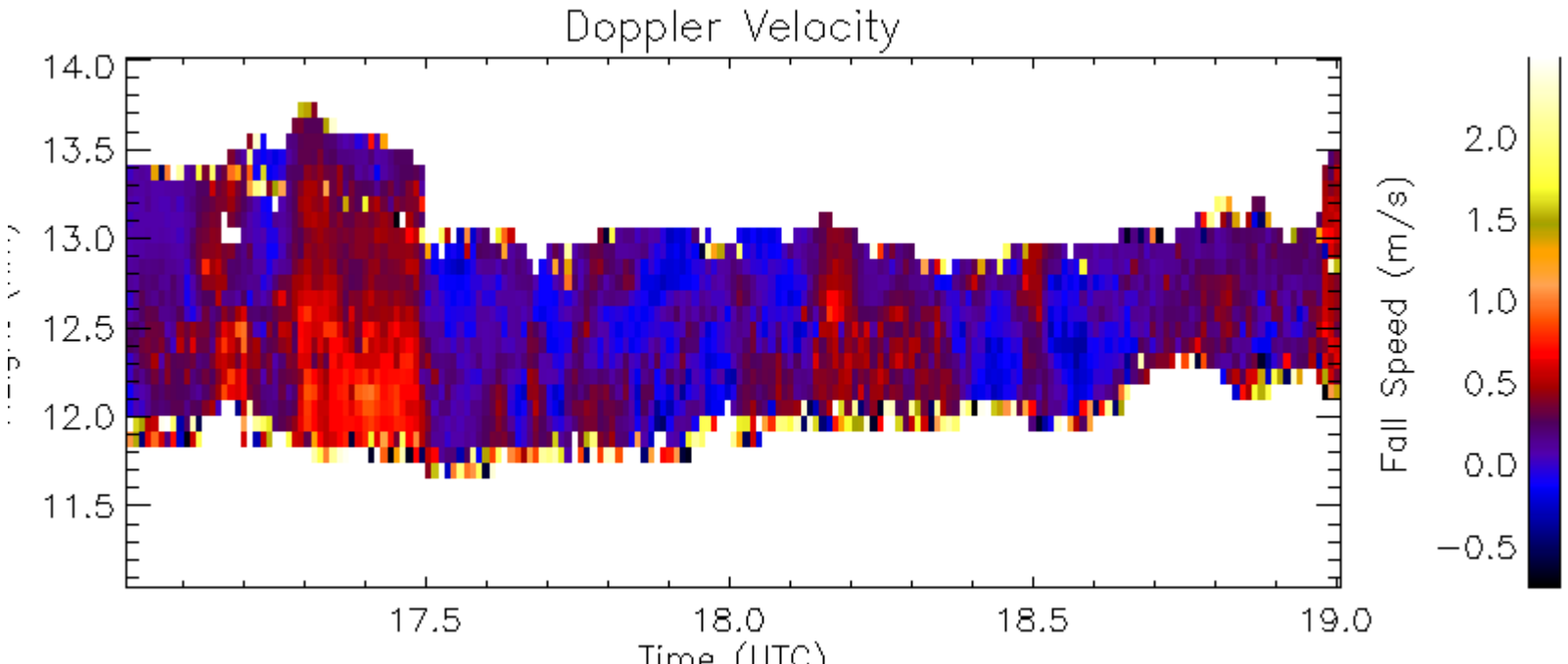
dBZe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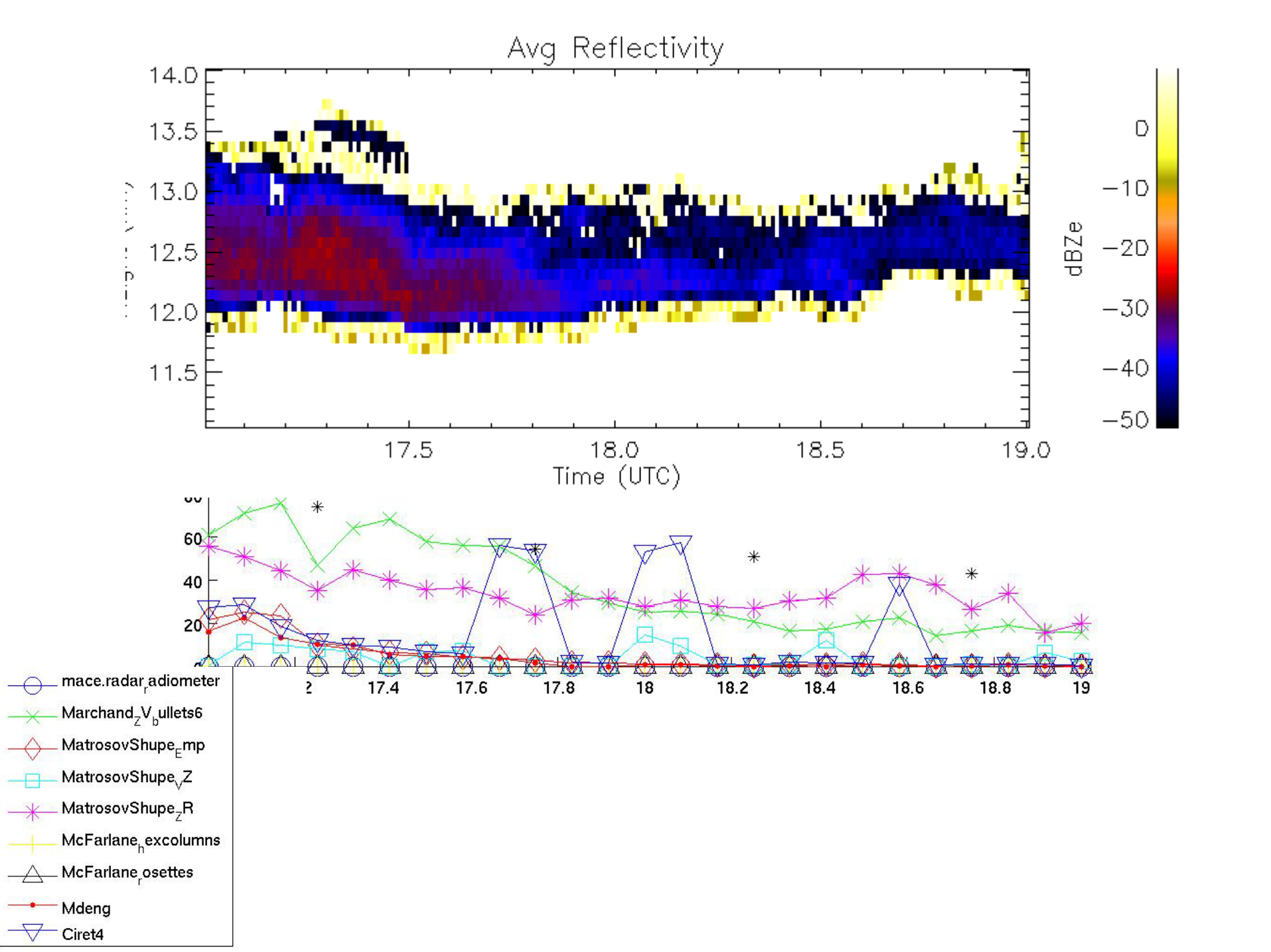
−0.5
Fall Speed (m/s)


Avg Reflectivity
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Time (UTC)
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19
mace.radar_radiometer
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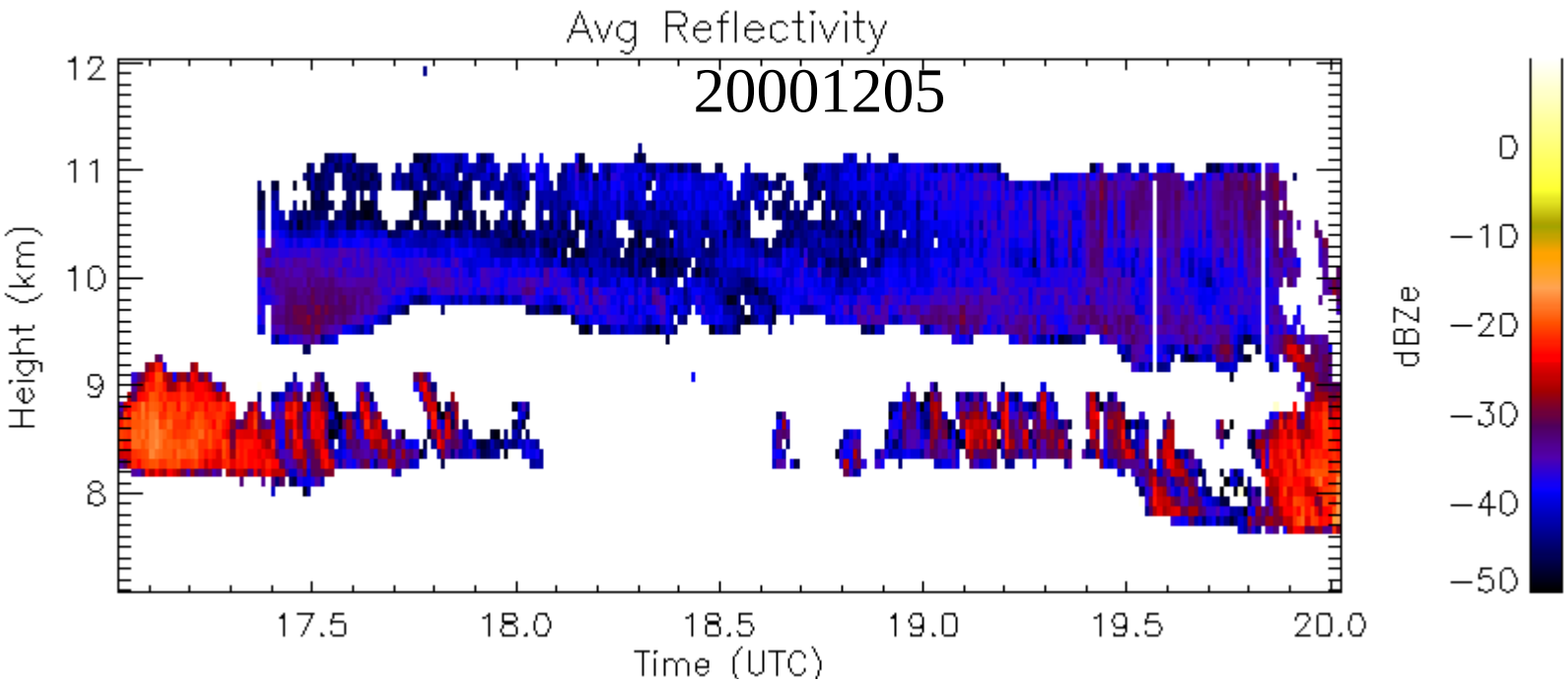
McFarlane_rosettes
Mdeng
Ciret4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Height (km)
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Time (UTC)
dBZe
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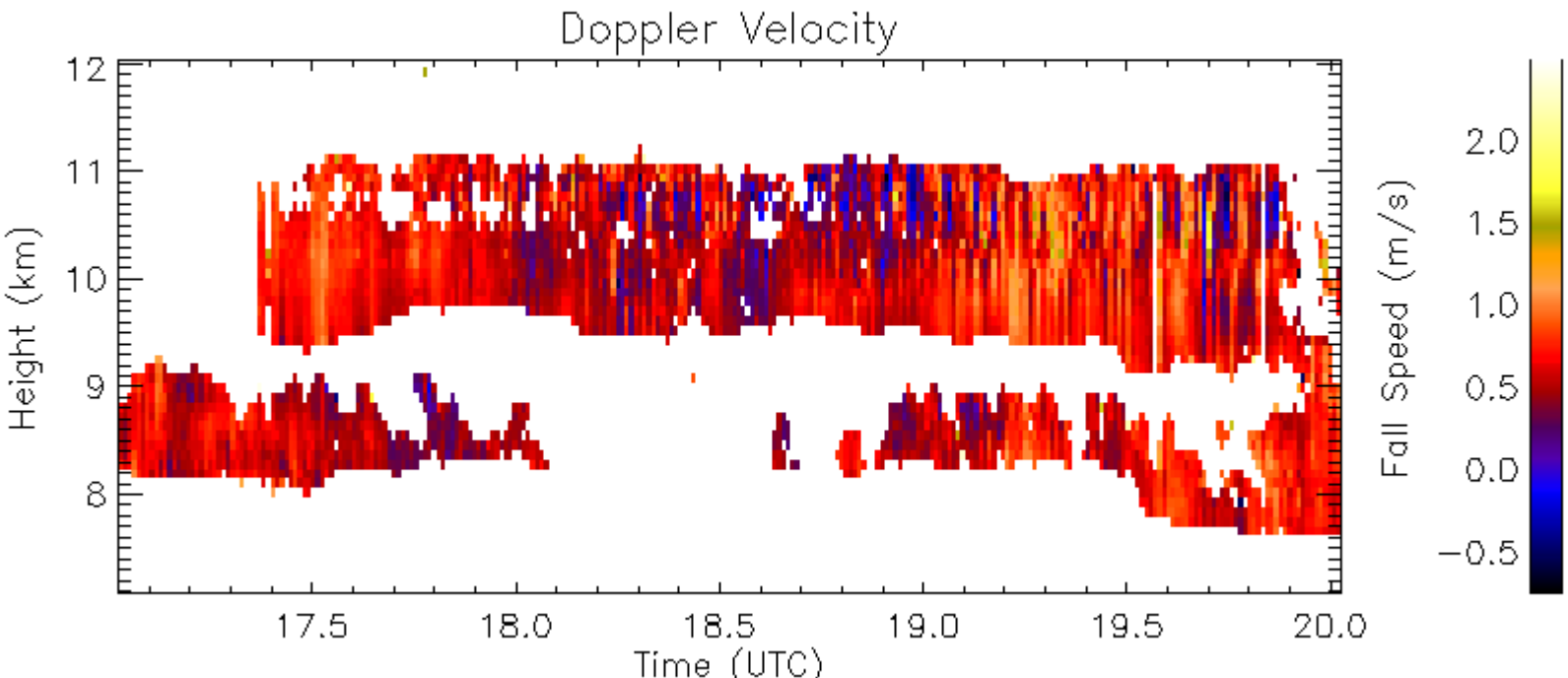
Doppler Velocity
Height (km)
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Time (UTC)
Fall Speed (m/s)
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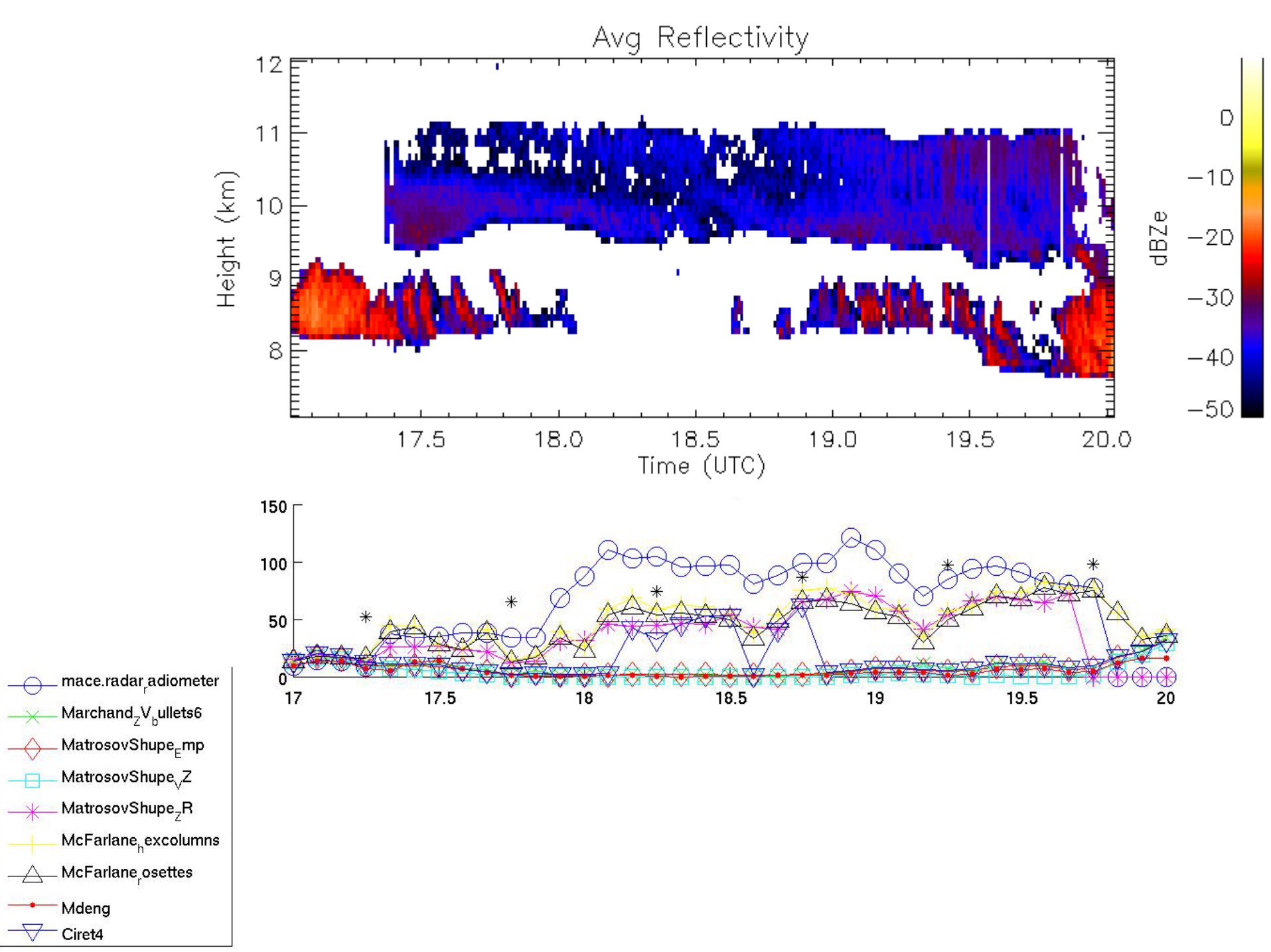
Avg Reflectivity
Height (km)
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Time (UTC)
dBZe
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mace.radar_radiometer
Marchand_ZV_bullets6
MatrosovShupe_Emp
MatrosovShupe_VZ
MatrosovShupe_ZR
McFarlane_hexcolumns
McFarlane_rosettes
Mdeng
Ciret4

Summary:

There seems to be a general bias in the forcing at small values of forcing – Why?

Bimodal size distributions and inability of single mode PSD's to characterize optical depth

Particle size characterization?

Next steps:

Extend the data set

Focus on representative case studies and understand differences and similarities