Velocity Scaling in Stratocumulus Topped Marine Boundary Layer

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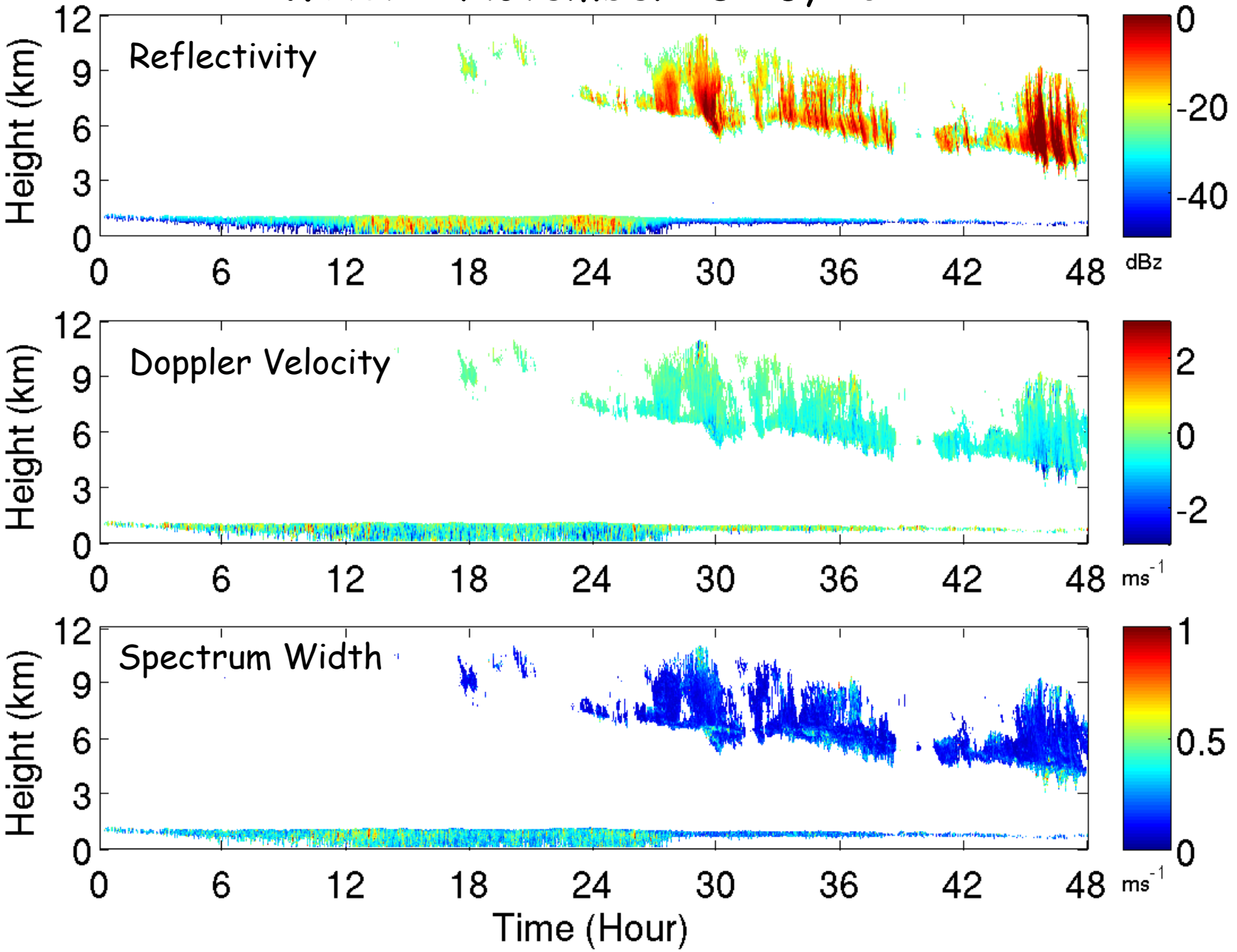
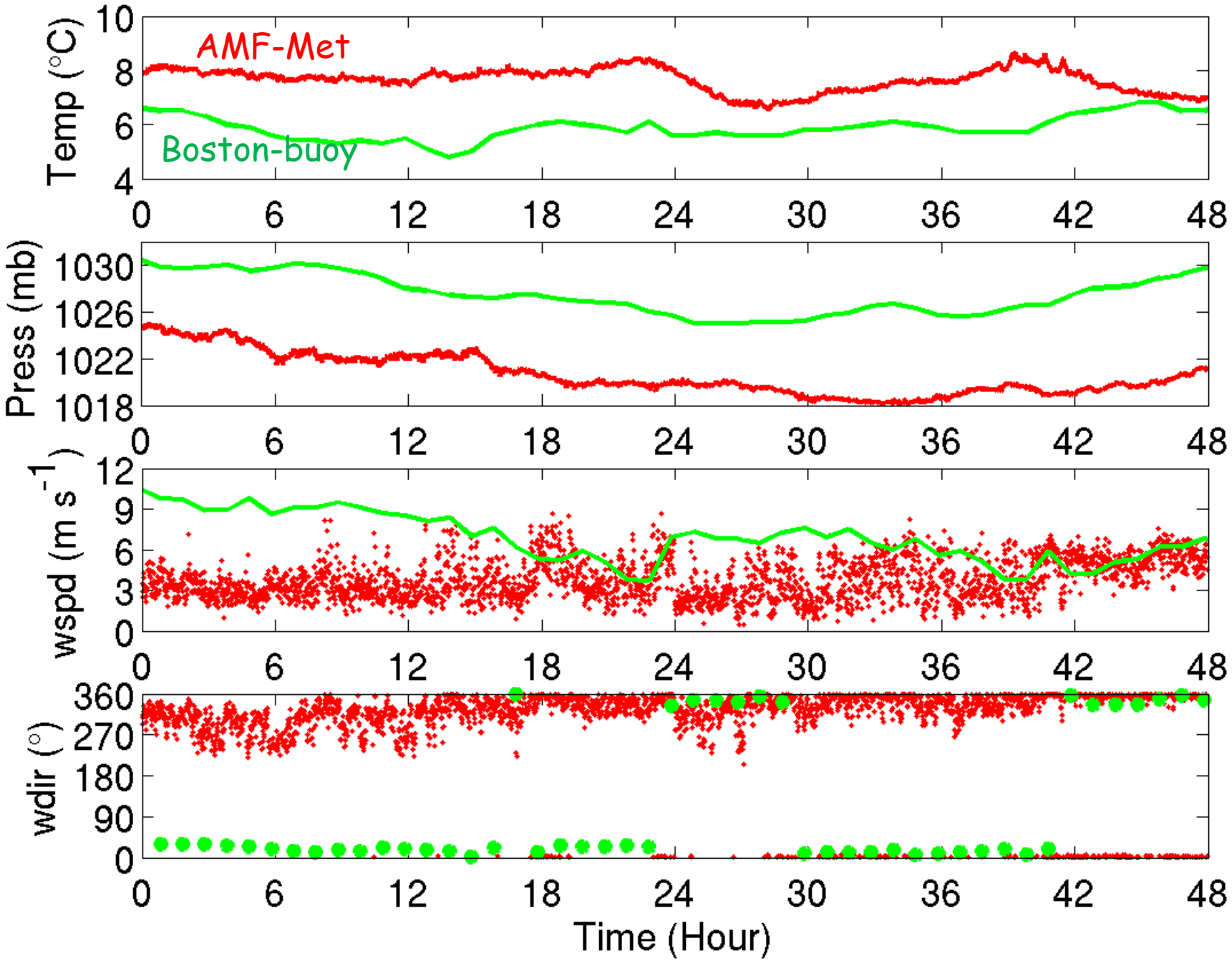
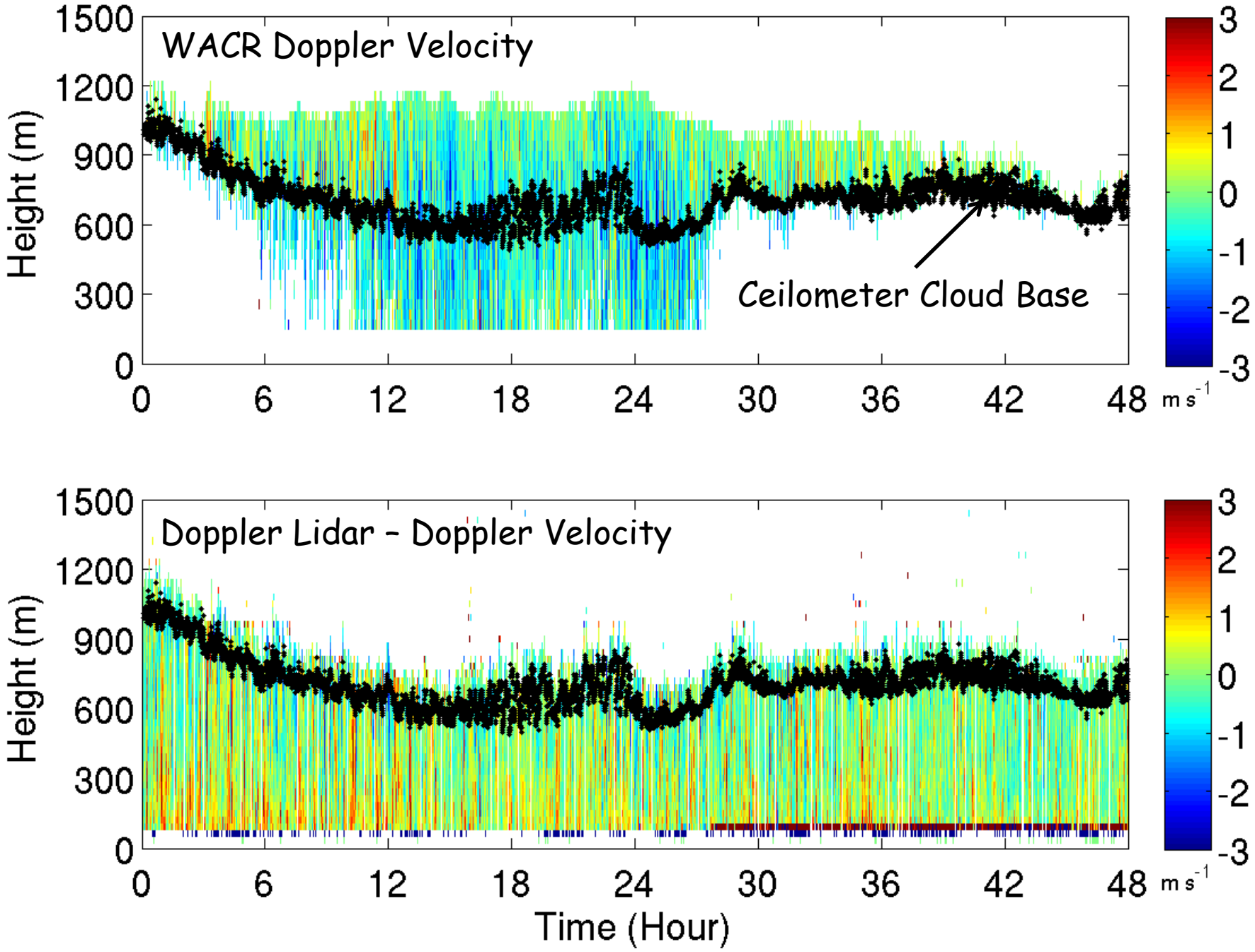
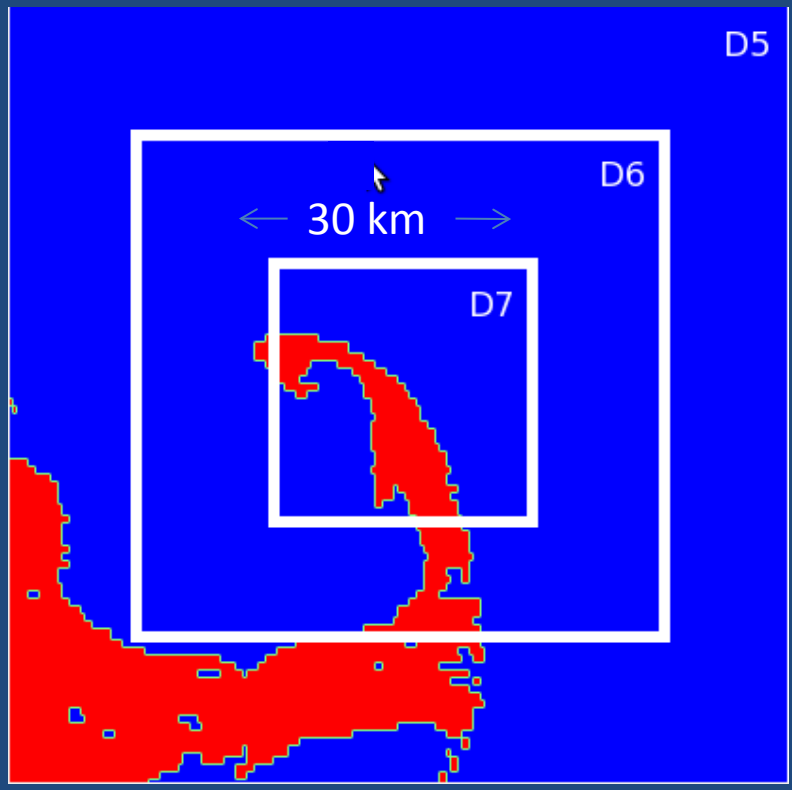

WACR - November 15-16, 2012
Reflectivity
Doppler Velocity
Spectrum Width
Height (km)
0
3
6
9
12
0
6
12
18
24
30
36
42
48
Time (Hour)
0
-20
-40
dBz
2
0
-2
ms-1
1
0.5
0
ms-1


November 15-16, 2012
Temp (°C)
AMF-Met
Boston-buoy
Press (mb)
wspd (m s-1)
wdir (°)
Time (Hour)


WACR Doppler Velocity
Ceilometer Cloud Base
Height (m)
1500
1200
900
600
300
0
0
6
12
18
24
30
36
42
48
3
2
1
0
-1
-2
-3
m s-1
Doppler Lidar – Doppler Velocity
Height (m)
Time (Hour)
m s-1

WRF-LES (3.4) Setup



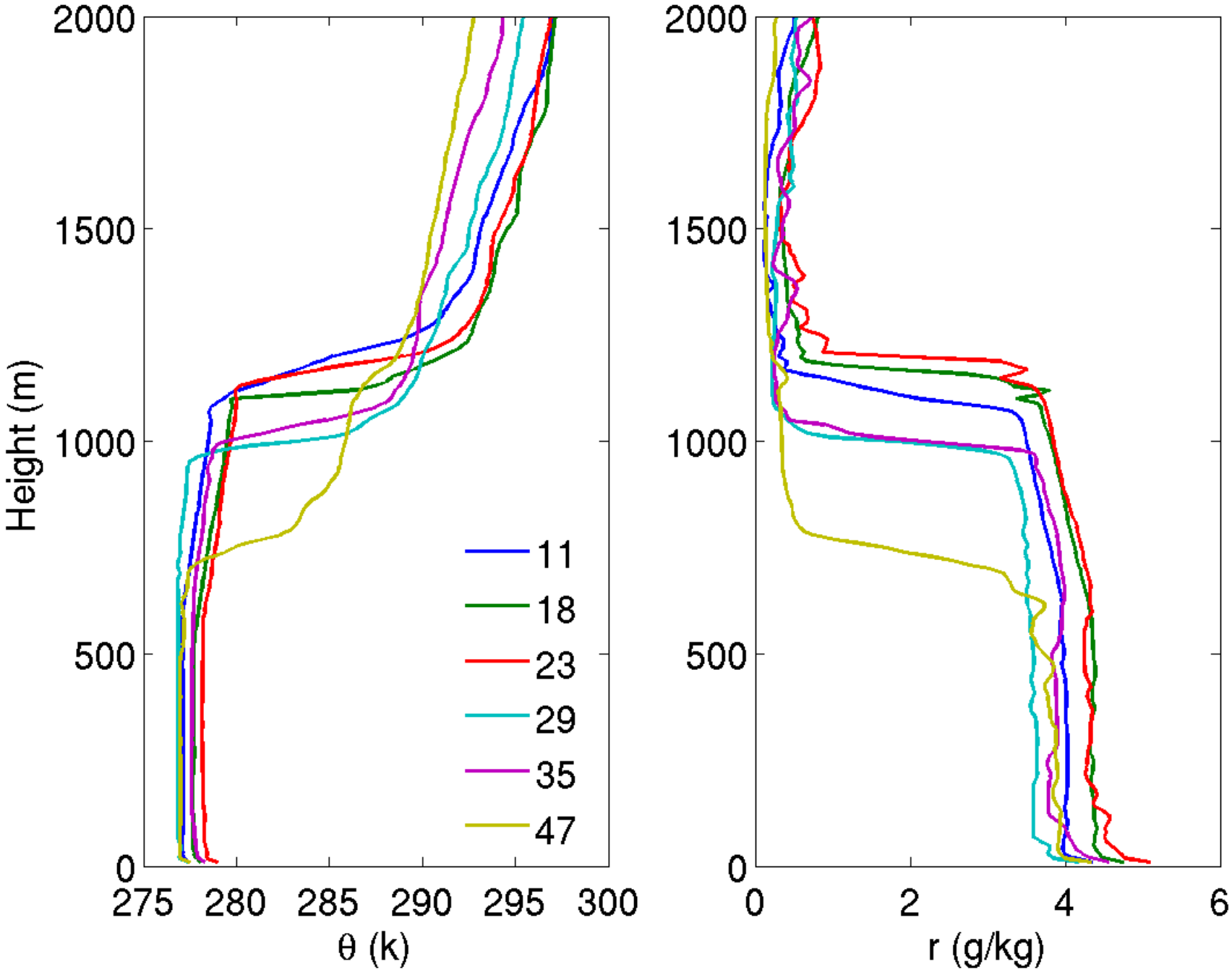
- Seven domains
  - 36.45 km to 50 m
  - 125 vertical levels (10 m to 500 m)
  - Dudhia shortwave / RRTM longwave
  - NOAH LSM
  - Jimenez surface layer
  - Two-way interactive (with exception)
- Outer four domains (≥ 1.35 km)
  - WSM6 microphysics
  - KF cumulus on two outermost domains
  - YSU PBL
- One-way nestdown to inner three LES domains (≤ 450 m)
  - Milbrandt-Yau 2-moment microphysics
  - NBA scheme with diagnostic stress and Smagorinsky eddy coeff. option

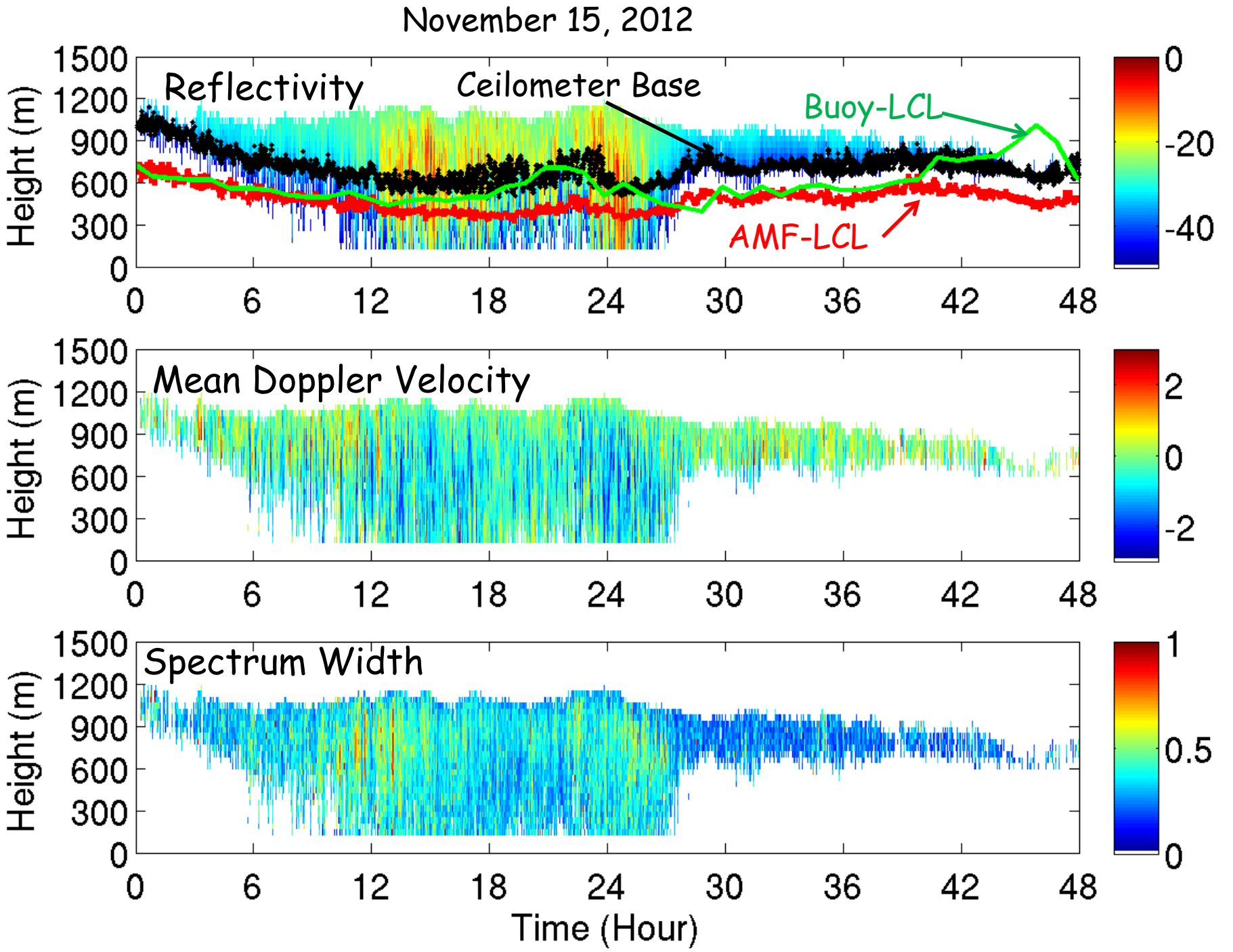
Future Plan

- Compare the LES simulated and observed vertical velocity PDF

- Explore various scaling arguments pertaining to velocity scale and entrainment. e.g. Lock et al. (2000)

$$w^* = w^*_{sfc} + w^*_{rad} + u^* + w^*_{BR}$$


2000
1500
1000
500
0
Height (m)
275
280
285
290
295
300
θ (k)
11
18
23
29
35
47
0
2
4
6
r (g/kg)


November 15, 2012
Reflectivity
Ceilometer Base
Buoy-LCL
AMF-LCL
Mean Doppler Velocity
Spectrum Width
Height (m)
Time (Hour)
1500
1200
900
600
300
0
0
6
12
18
24
30
36
42
48
0
-20
-40
2
-2
1
0.5

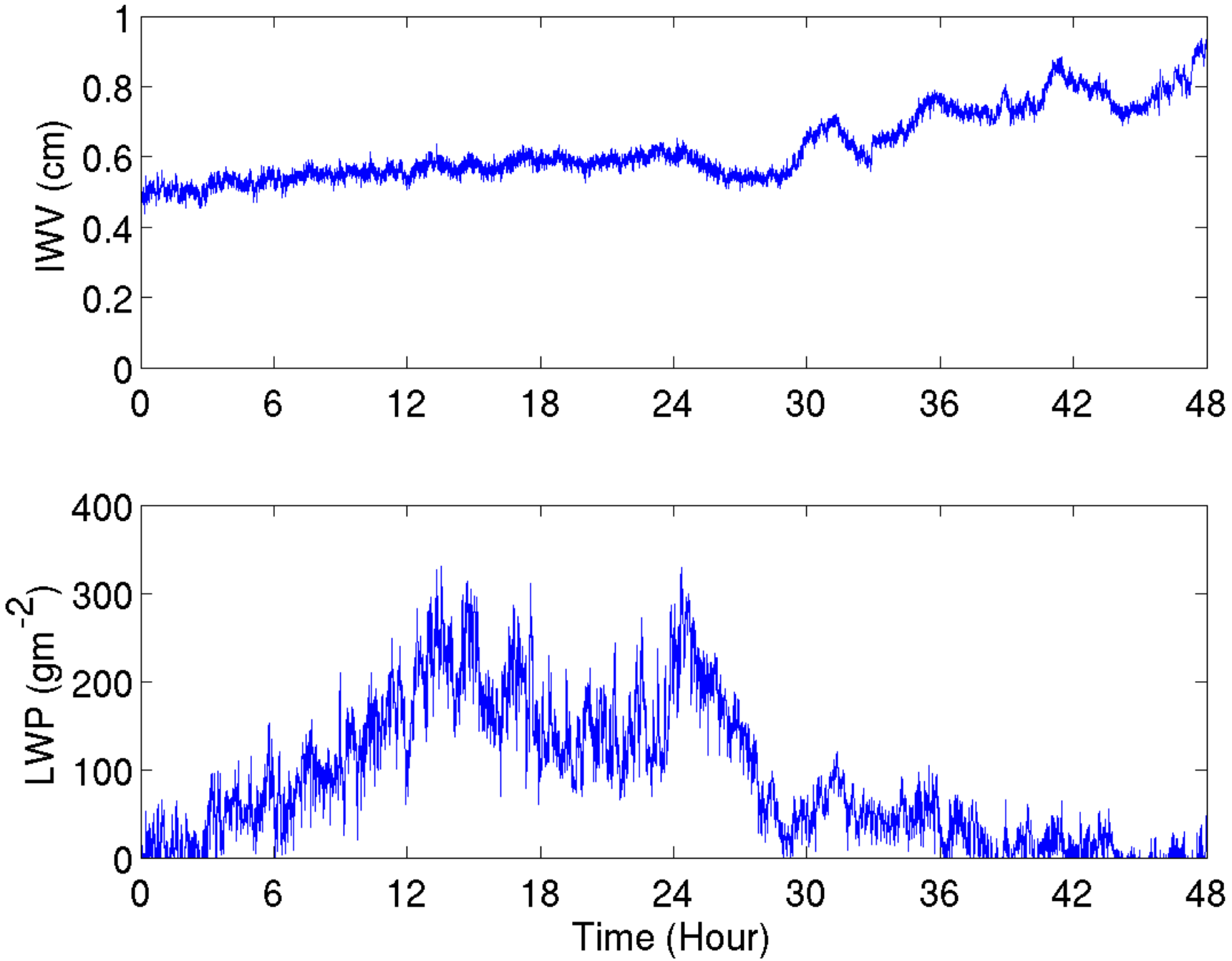
The Plan

Observations

$$w^*_{sfc} = \left(\frac{g \times Z_i}{\overline{\theta_v}} \times \left(\overline{w' \theta'_v} \right)_{sfc} \right)^{1/3}$$

$$w^*_{rad} = \left(\frac{g \times Z_i}{\rho \times c_p \times \overline{\theta}} \times \left(- \Delta F_{rad} \right) \right)^{1/3}$$

Model


IWV (cm)
0
0.2
0.4
0.6
0.8
1
0
6
12
18
24
30
36
42
48
LWP (gm-2)
0
100
200
300
400
0
6
12
18
24
30
36
42
48
Time (Hour)