Diagnostic Evaluation of Current and Future Operational NWP Models During NEHRTP 2002, 2003, and 2004

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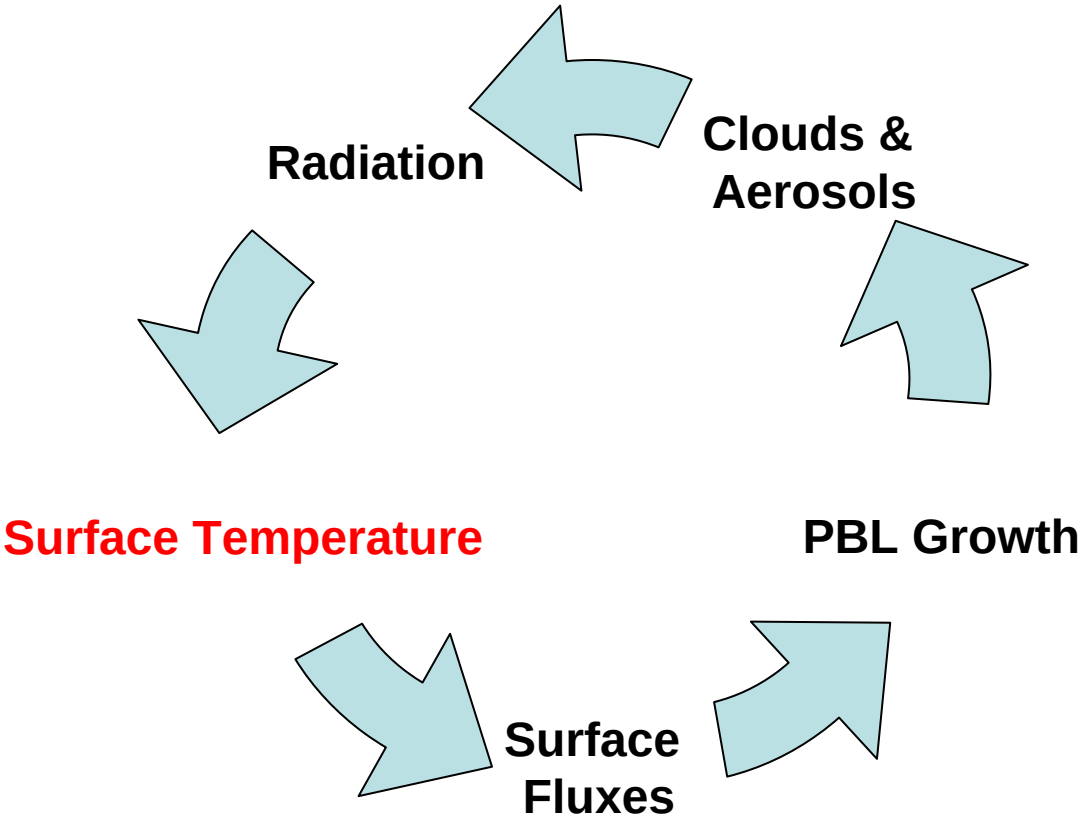
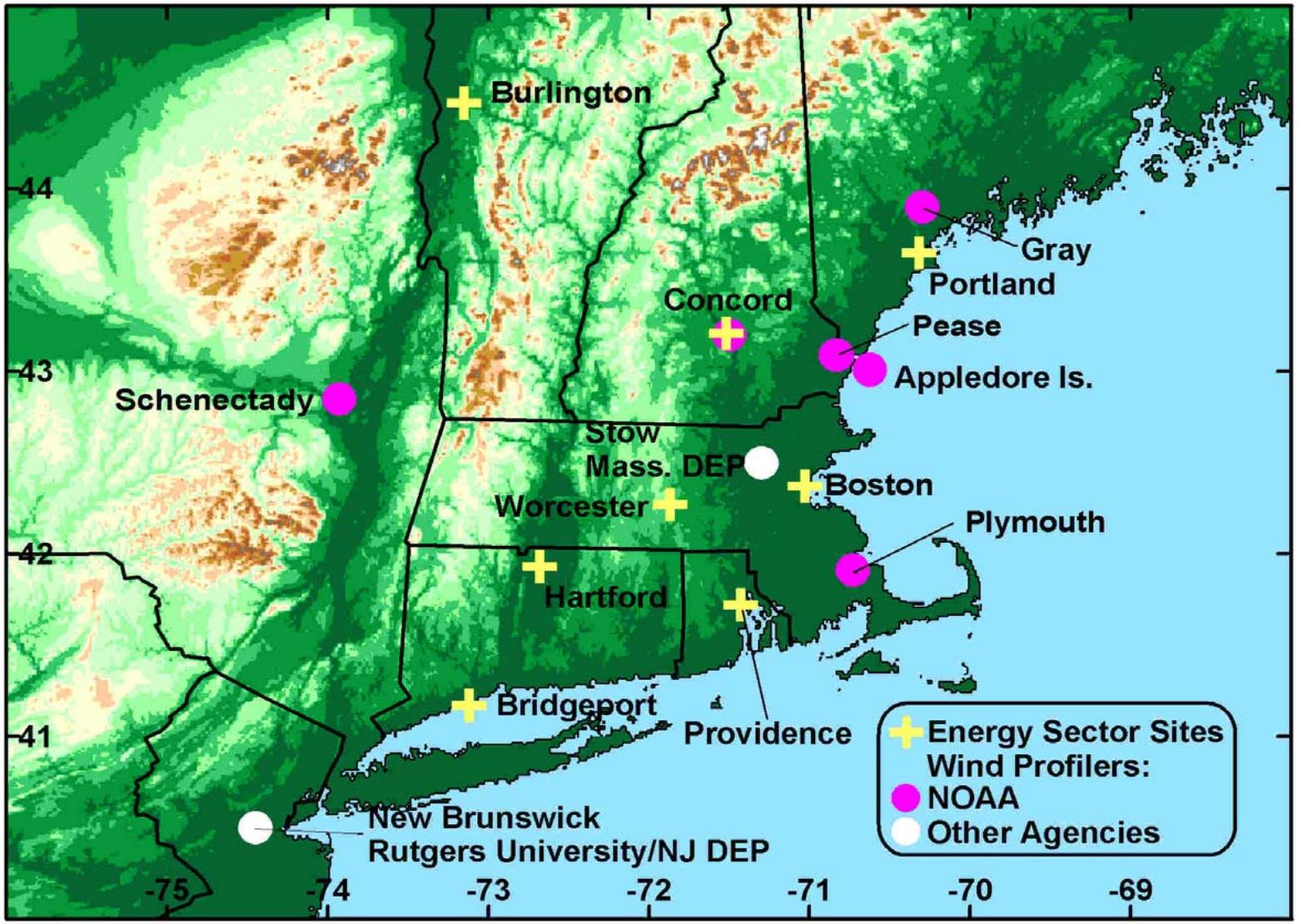
Environmental Technology Laboratory – Model Assessment Team

Collaborations: NCEP, FSL, NSSL



2002	2003	2004
Eta-12	Eta-12, V, Y	Eta-12
RUC-20/10	RUC-20/10	RUC-13
WRF-27	WRF-20/10	WRF-27,13
MM5-27/9/3		
NSSL BCE	NSSL BCE	NSSL BCE
NGM-MOS	NGM-MOS Eta-MOS GFS-MOS	NMG-MOS Eta-MOS GFS-MOS
	GFS	GFS
	NMM-8	NMM-8
	SREF	SREF
		+ NEAQS Models



Summer 2003 wind profiler and Energy Site locations

NOAA Environmental Technology Laboratory

ETL

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PROGRAM LINKS

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MODEL CYCLE

Select the model cycle initialization:
Tue, 19 Aug 2003 12:00:00 UTC

00Z Aug 19
12Z Aug 19

SITES

Select site type:

(•) Profiler ( ) Energy

Concord, NH

DATA ARCHIVE

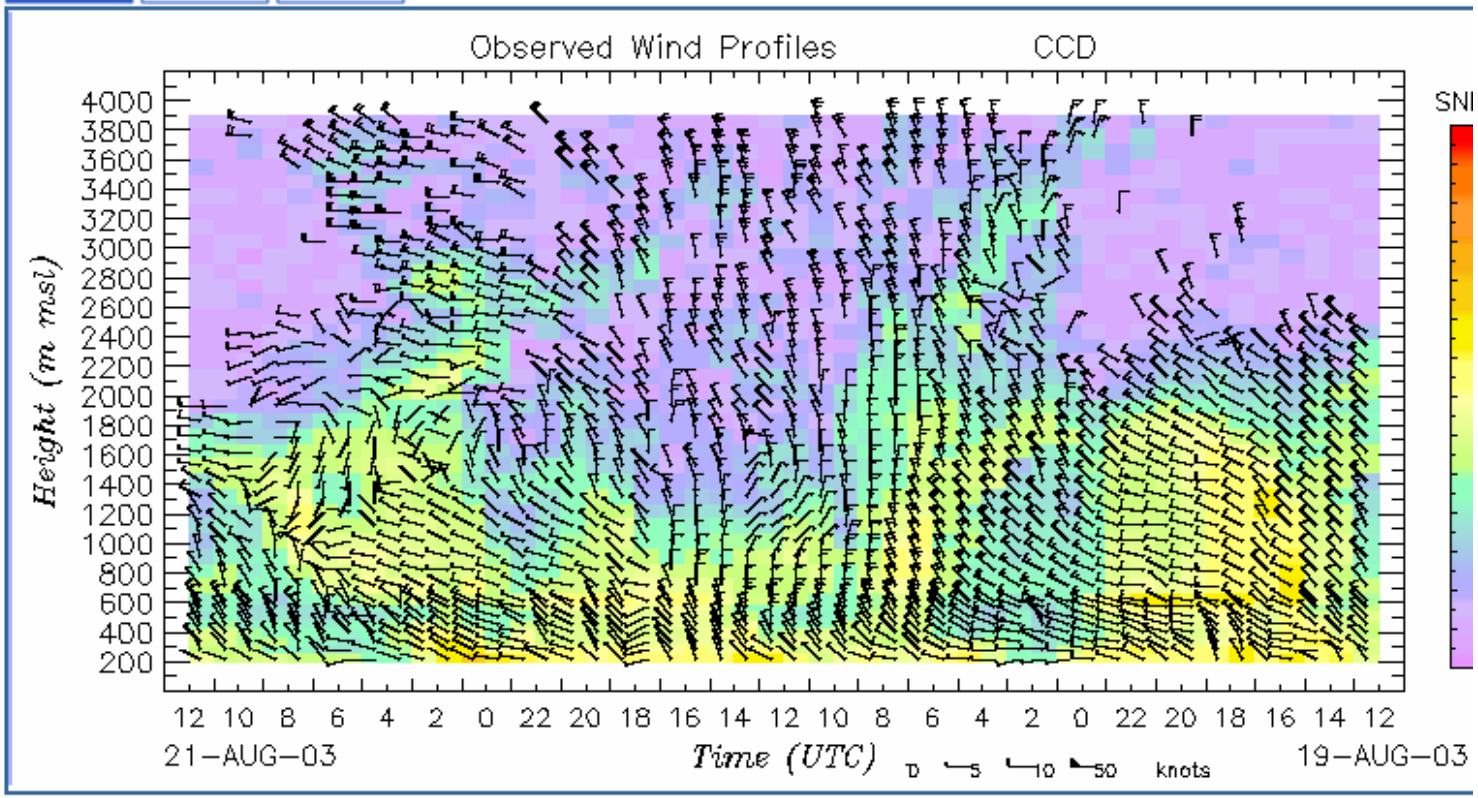
Select a date:

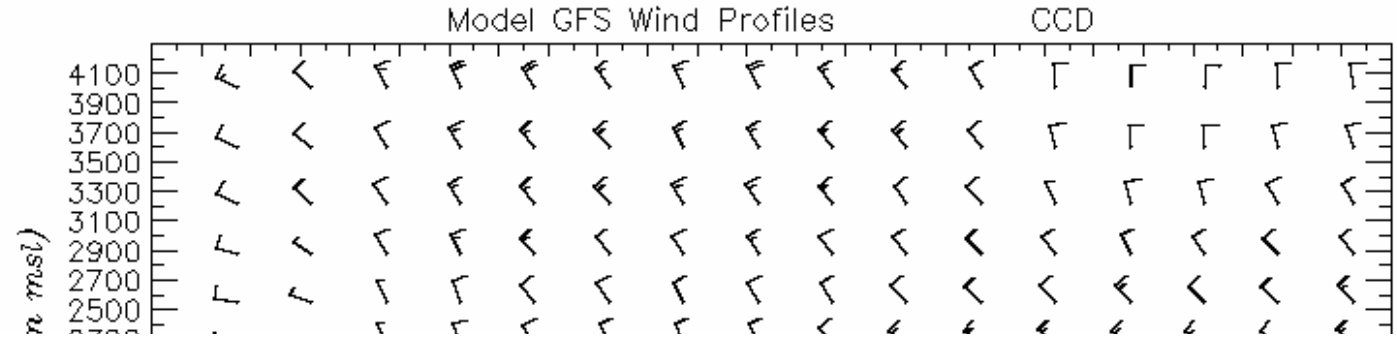
< August 2003 >

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	**19**	20	21	22	23
24	25	26	27	28	29	30
31						

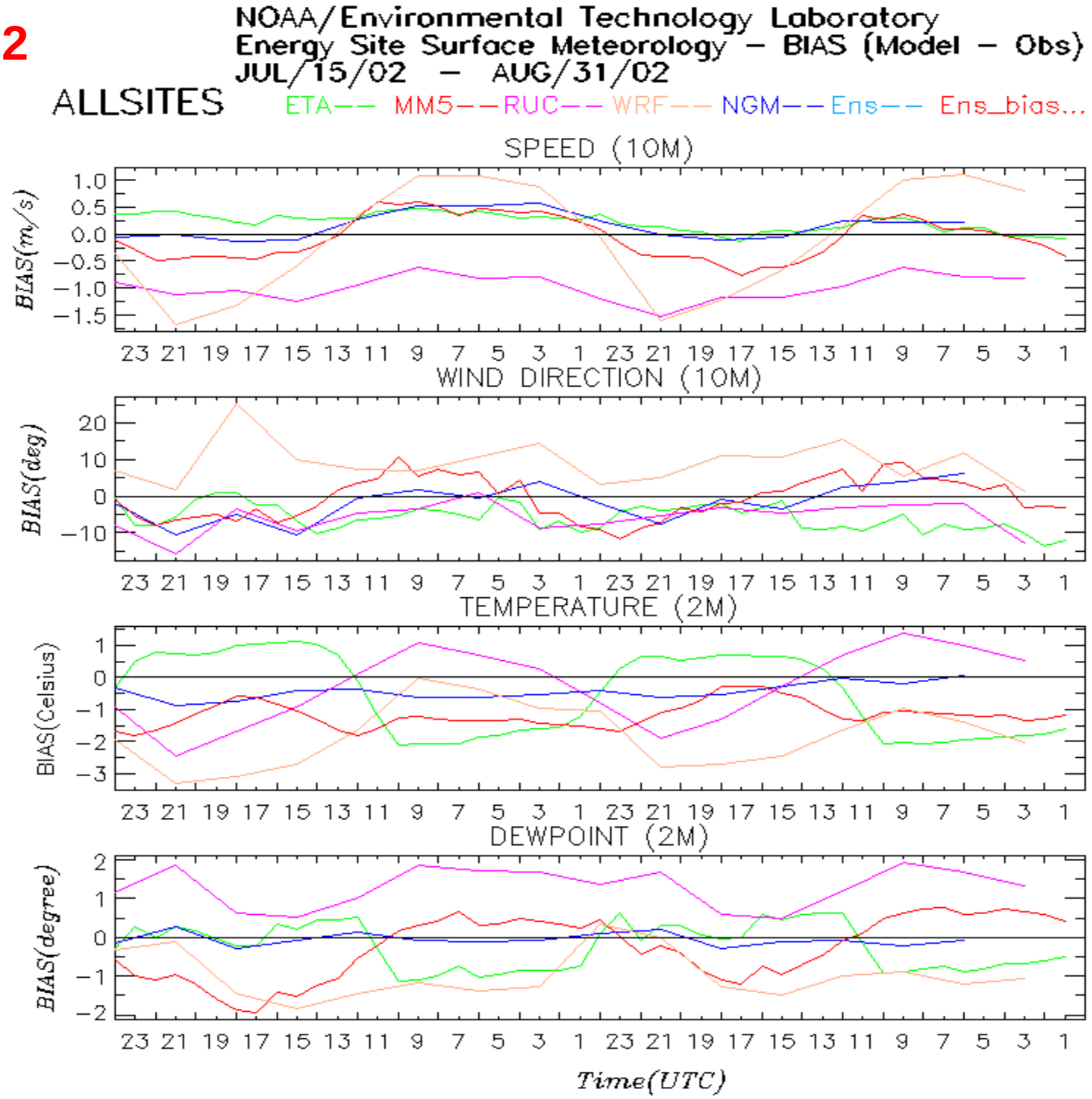
GFS | ETA-12 | NMM-8 | RUC-10 | RUC-20 | WRF-10 | WRF-20 | ETA-V | ETA-Y | SREF-1 | SREF-2 | SREF-3

SNR/Winds | RASS/Winds | Sfc Met

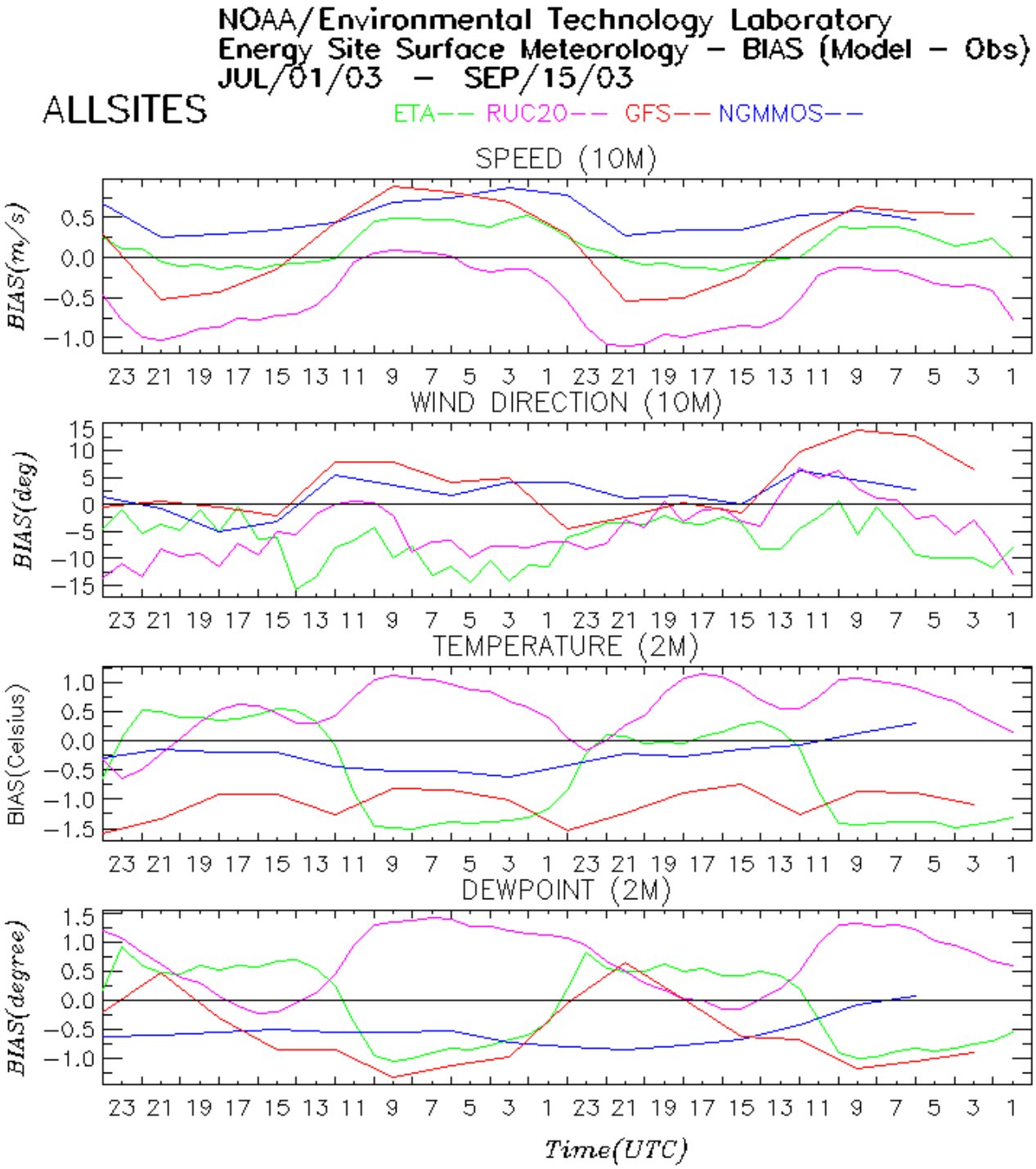


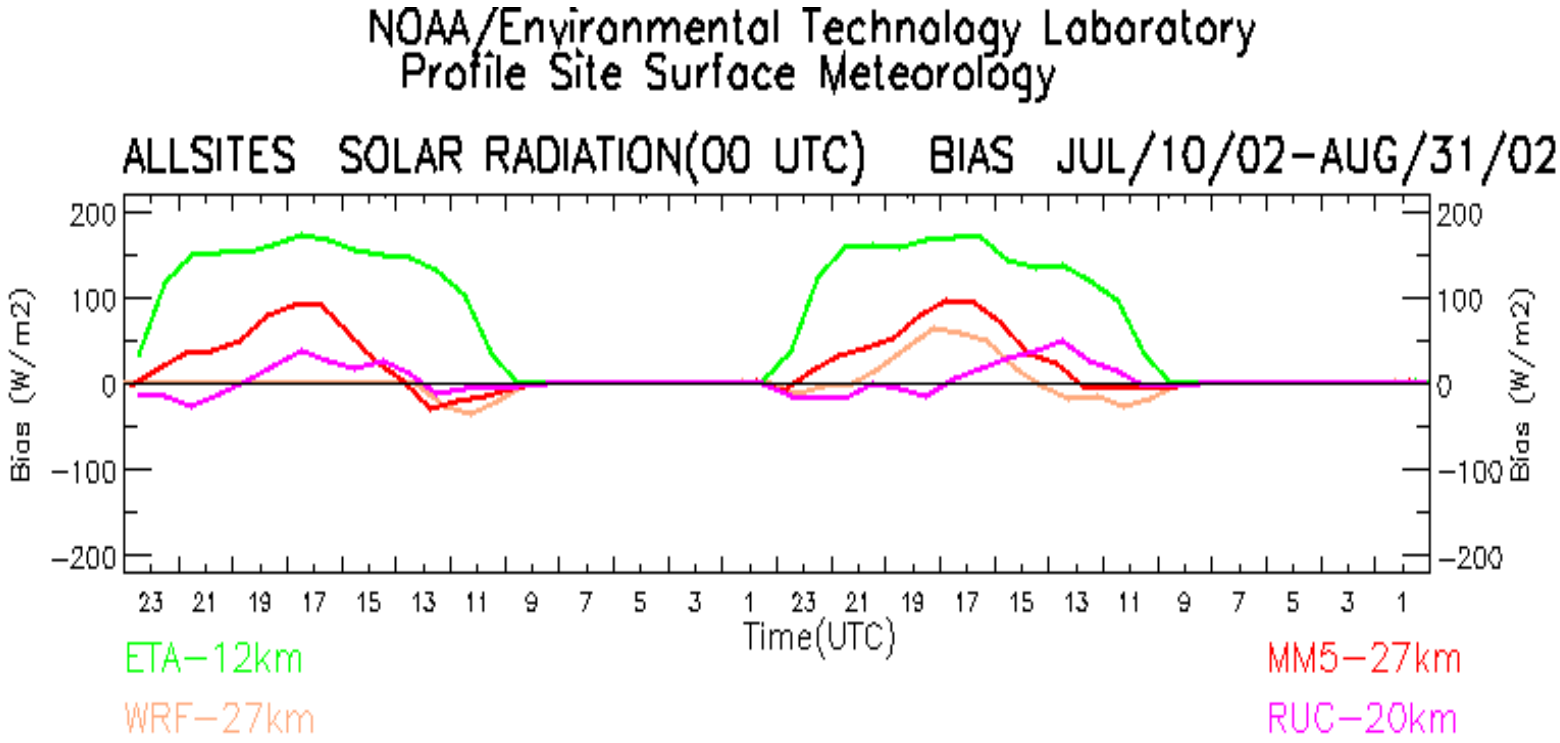


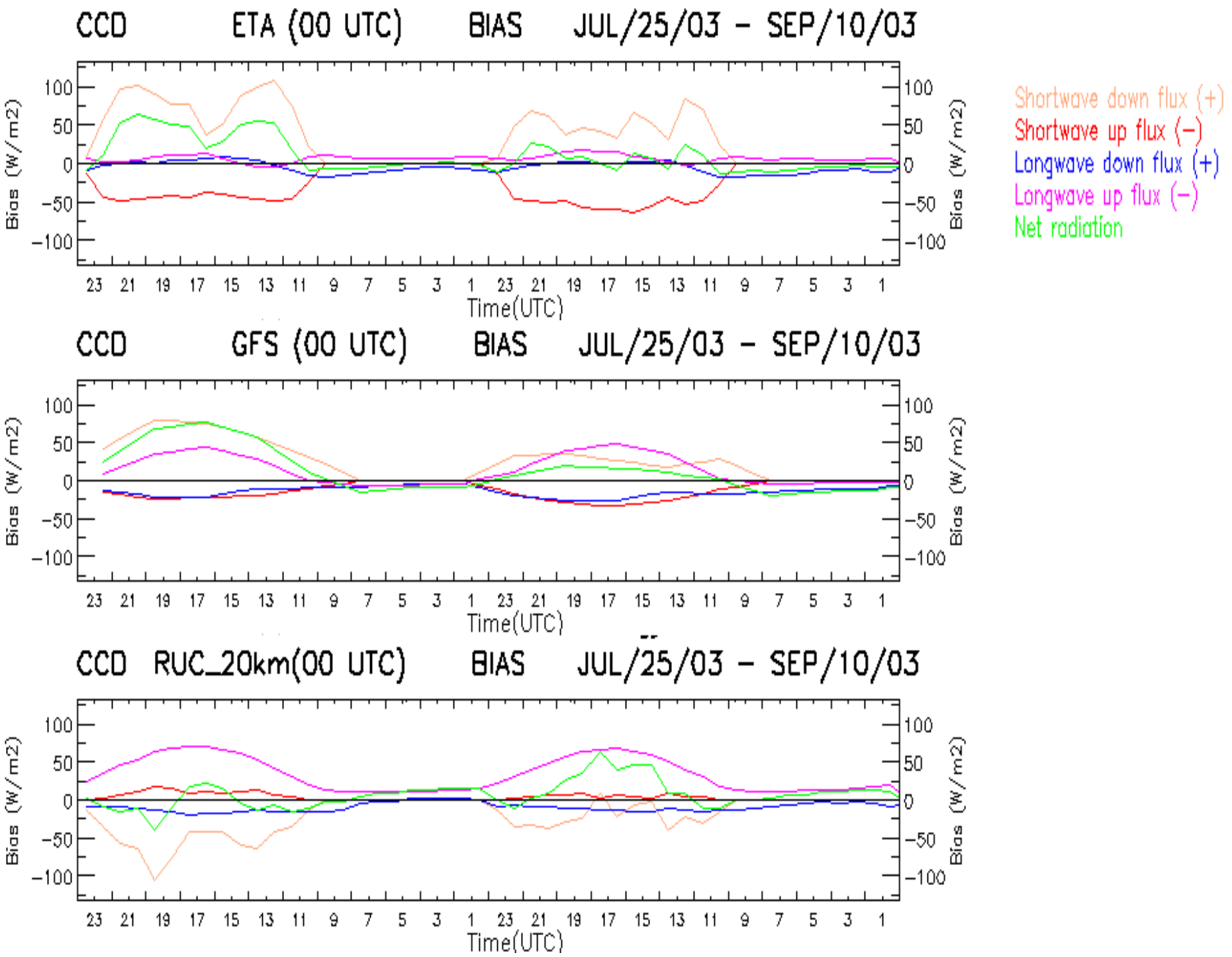
2002


NOAA/Environmental Technology Laboratory
Energy Site Surface Meteorology – BIAS (Model – Obs)
JUL/15/02 – AUG/31/02
ALLSITES
ETA MM5 RUC WRF NGM Ens Ens_bias...
SPEED (10M)
BIAS(m/s)
WIND DIRECTION (10M)
BIAS(deg)
TEMPERATURE (2M)
BIAS(Celsius)
DEWPOINT (2M)
BIAS(degree)
Time(UTC)

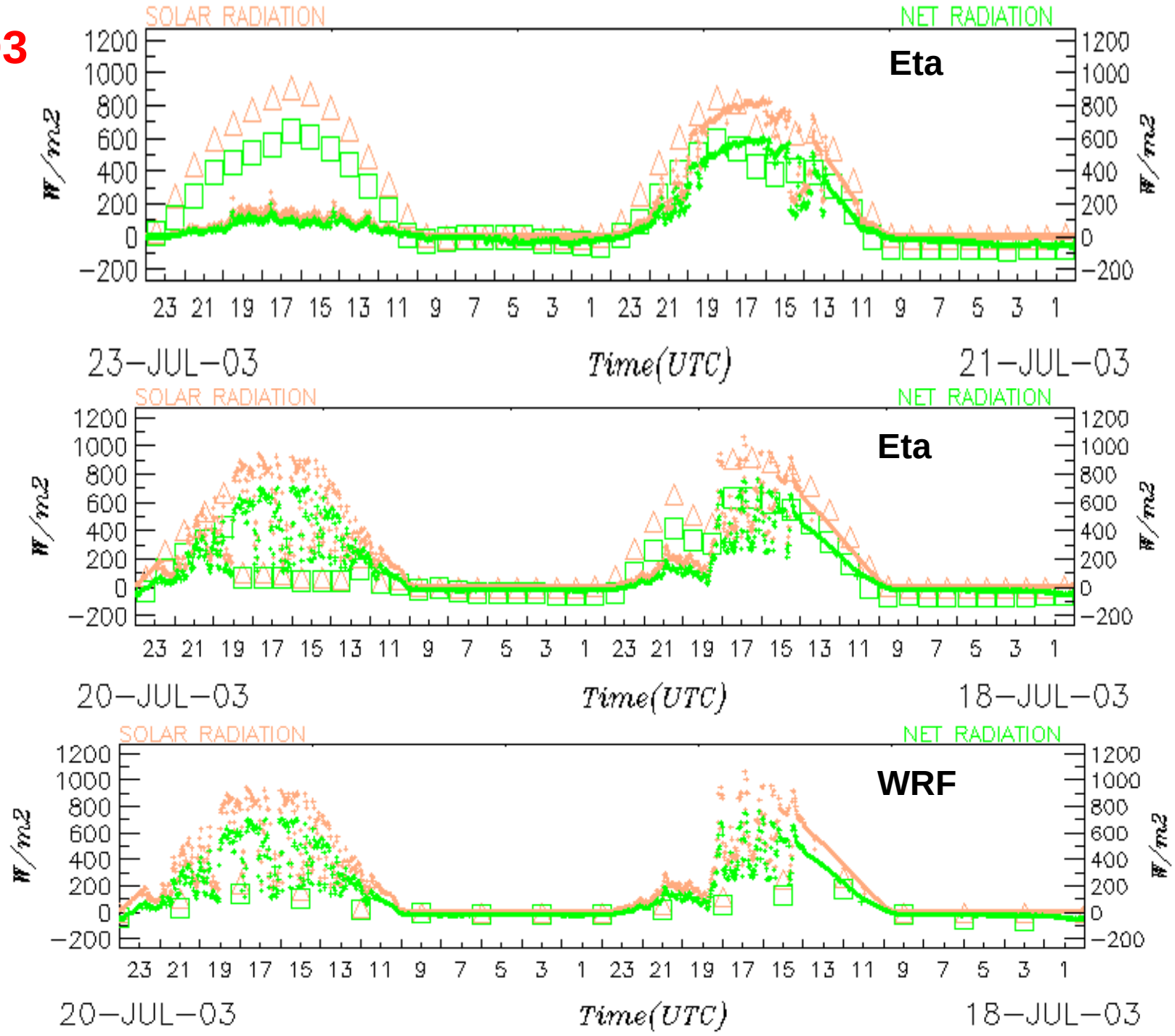
2003


NOAA/Environmental Technology Laboratory
Energy Site Surface Meteorology – BIAS (Model – Obs)
JUL/01/03 – SEP/15/03
ALLSITES
ETA-- RUC20-- GFS-- NGMMOS--
SPEED (10M)
BIAS(m/s)
WIND DIRECTION (10M)
BIAS(deg)
TEMPERATURE (2M)
BIAS(Celsius)
DEWPOINT (2M)
BIAS(degree)
Time(UTC)

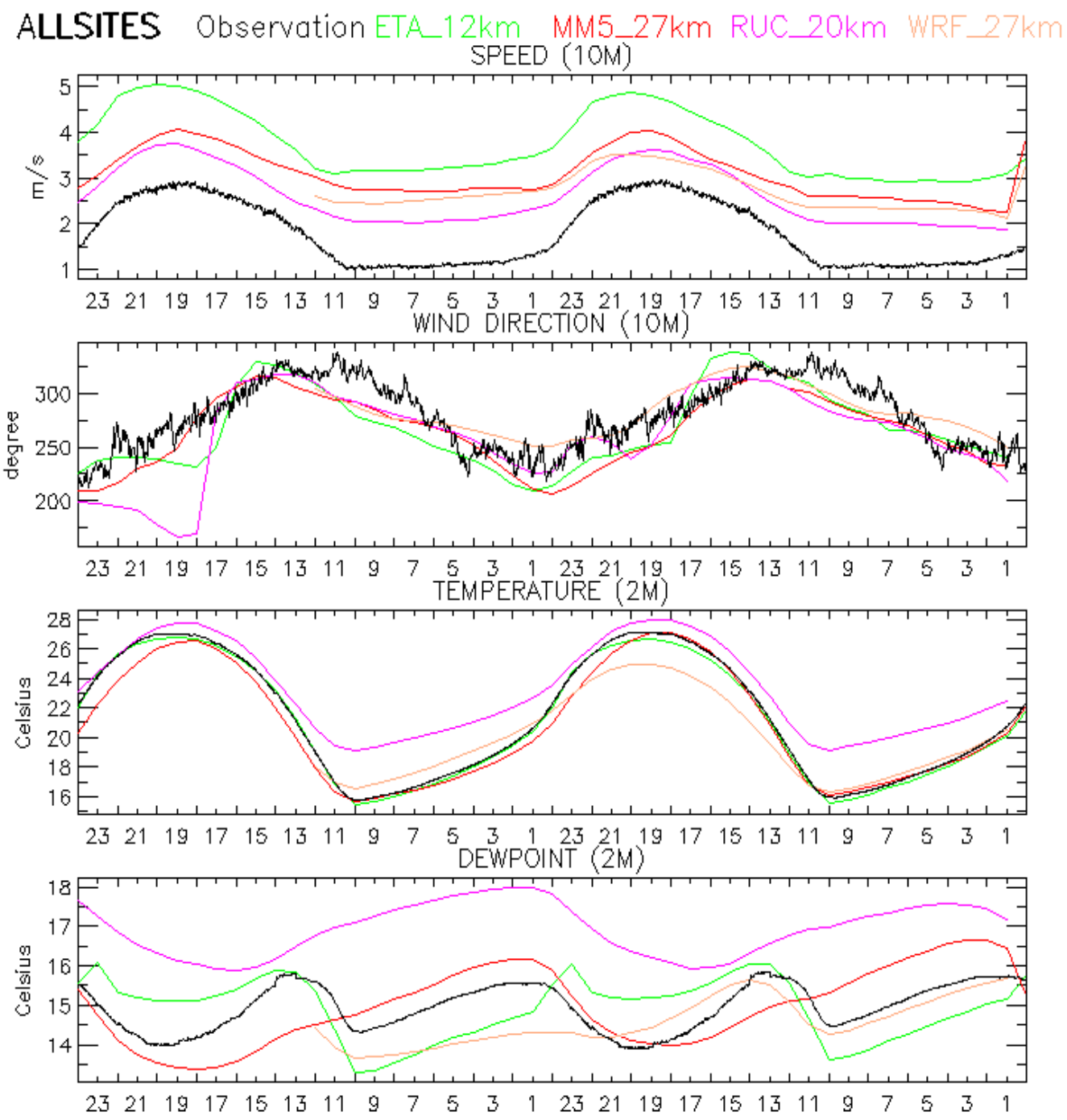

NOAA/Environmental Technology Laboratory
Profile Site Surface Meteorology
ALLSITES SOLAR RADIATION(00 UTC) BIAS JUL/10/02-AUG/31/02
Bias (W/m2)
200
100
0
-100
-200
23 21 19 17 15 13 11 9 7 5 3 1 23 21 19 17 15 13 11 9 7 5 3 1
Time(UTC)
ETA-12km
MM5-27km
WRF-27km
RUC-20km

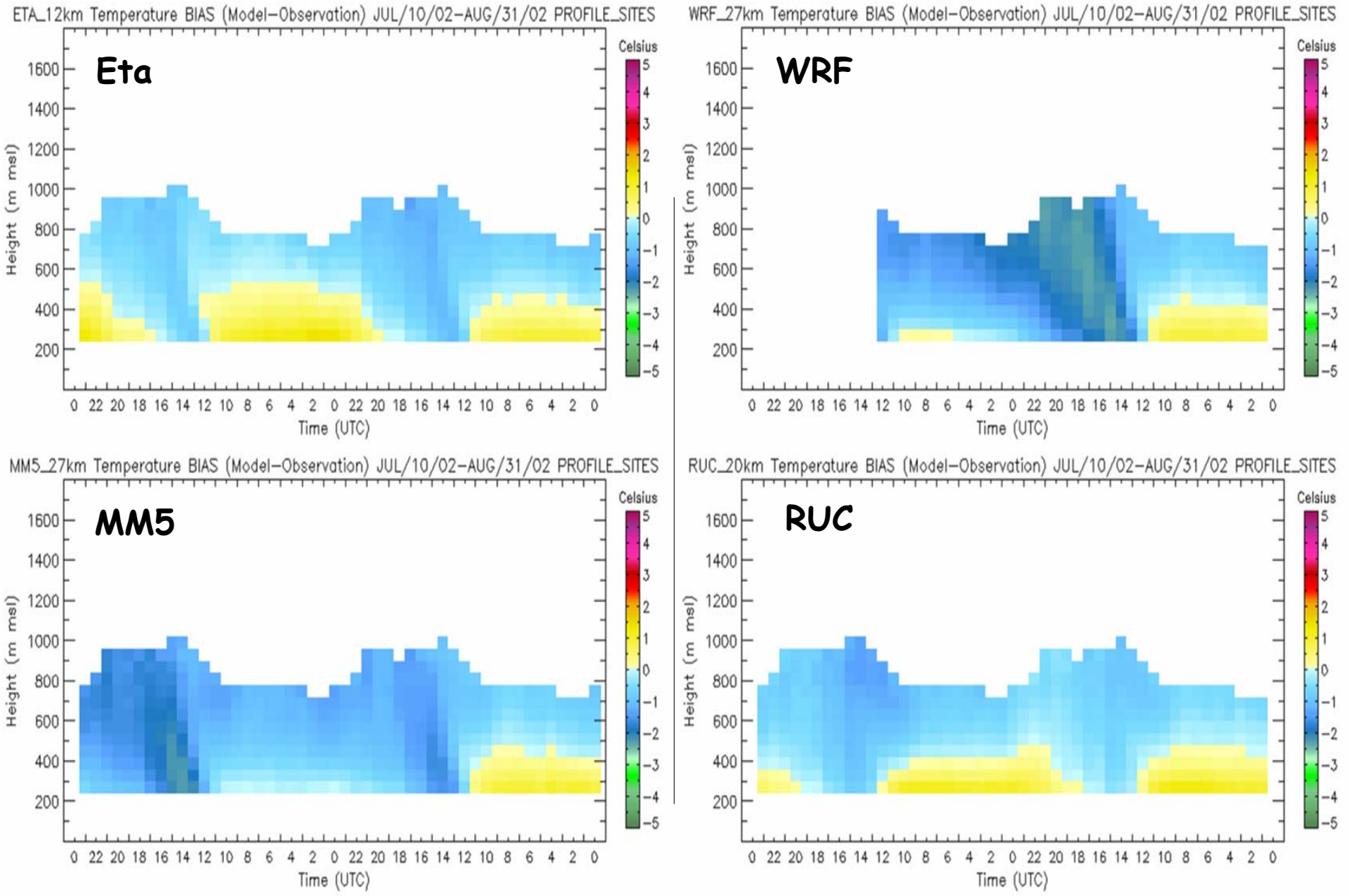

CCD ETA (00 UTC) BIAS JUL/25/03 - SEP/10/03
CCD GFS (00 UTC) BIAS JUL/25/03 - SEP/10/03
CCD RUC_20km(00 UTC) BIAS JUL/25/03 - SEP/10/03
Bias (W/m2)
Time(UTC)
Shortwave down flux (+)
Shortwave up flux (-)
Longwave down flux (+)
Longwave up flux (-)
Net radiation

2003

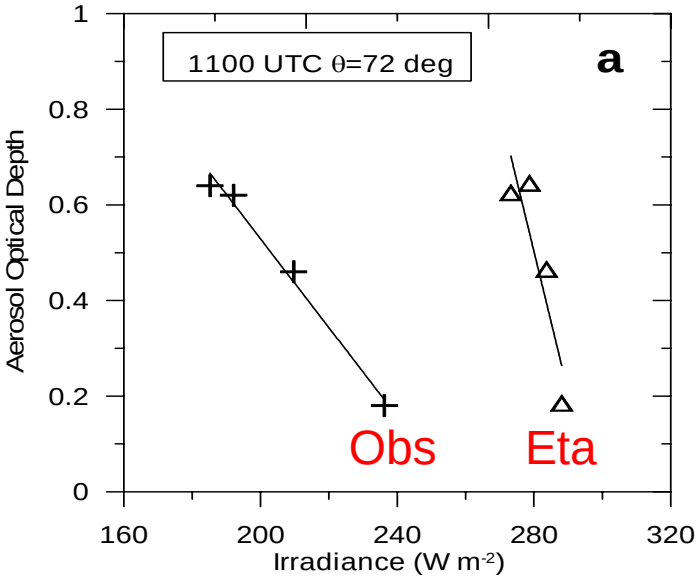

SOLAR RADIATION
NET RADIATION
Eta
W/m2
1200
1000
800
600
400
200
0
−200
23 21 19 17 15 13 11 9 7 5 3 1 23 21 19 17 15 13 11 9 7 5 3 1
23−JUL−03
Time(UTC)
21−JUL−03
SOLAR RADIATION
NET RADIATION
Eta
20−JUL−03
Time(UTC)
18−JUL−03
SOLAR RADIATION
NET RADIATION
WRF
20−JUL−03
Time(UTC)
18−JUL−03

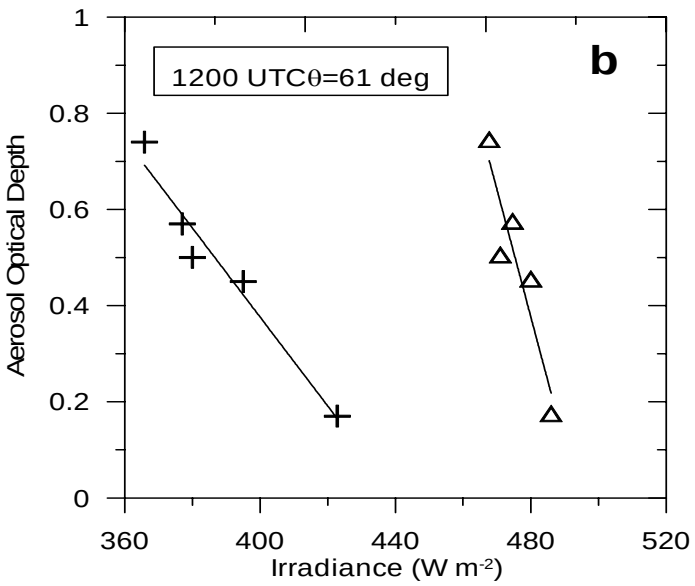
2002

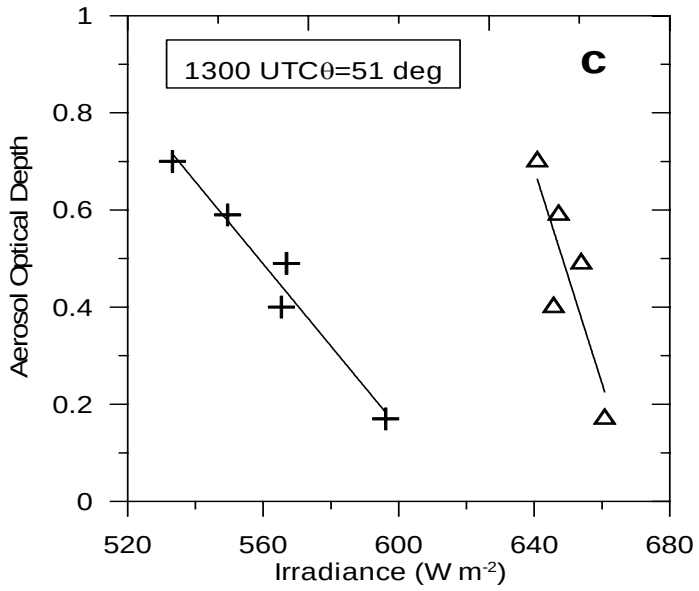

ALLSITES Observation ETA_12km MM5_27km RUC_20km WRF_27km
SPEED (10M)
m/s
WIND DIRECTION (10M)
degree
TEMPERATURE (2M)
Celsius
DEWPOINT (2M)
Celsius
23 21 19 17 15 13 11 9 7 5 3 1 23 21 19 17 15 13 11 9 7 5 3 1

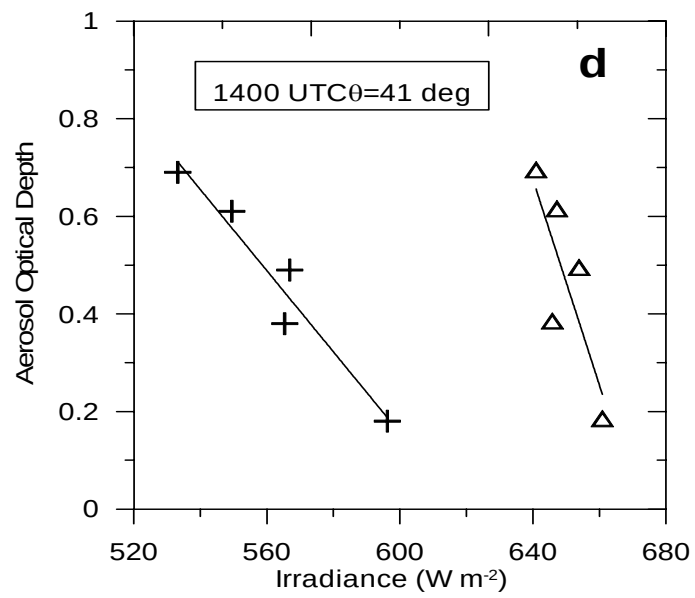


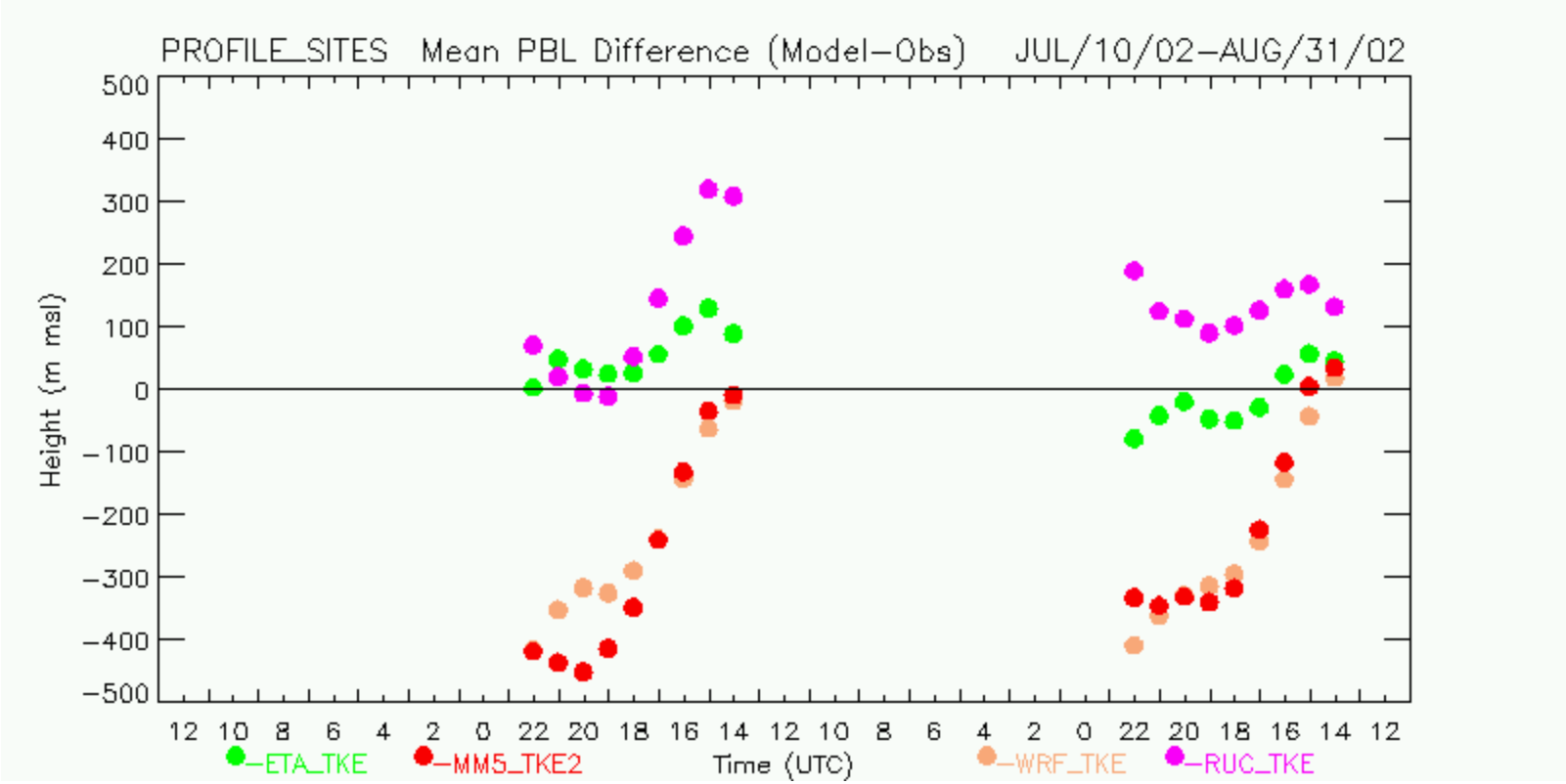
2002 **RASS-derived model virtual temperature bias**

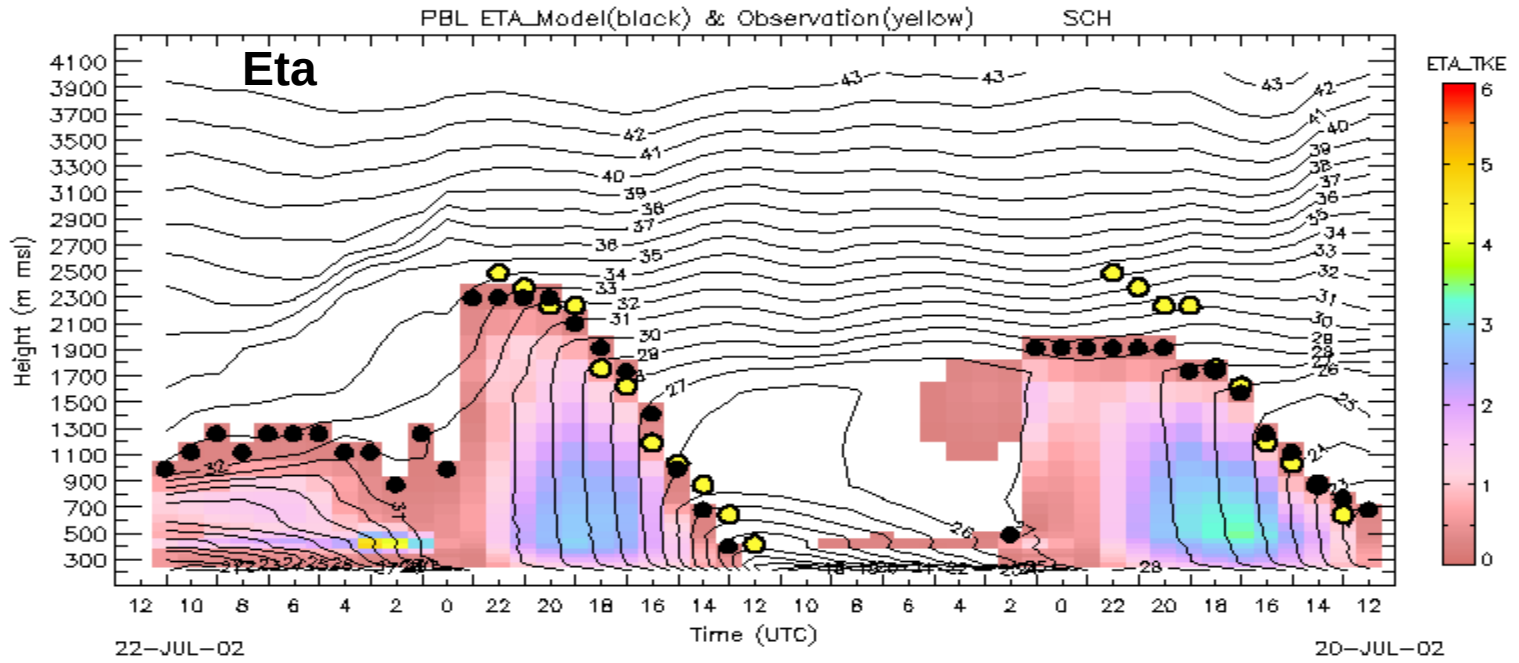

1100 UTC θ=72 deg
a
Obs
Eta
Aerosol Optical Depth
Irradiance (W m-2)
0
0.2
0.4
0.6
0.8
1
160
200
240
280
320

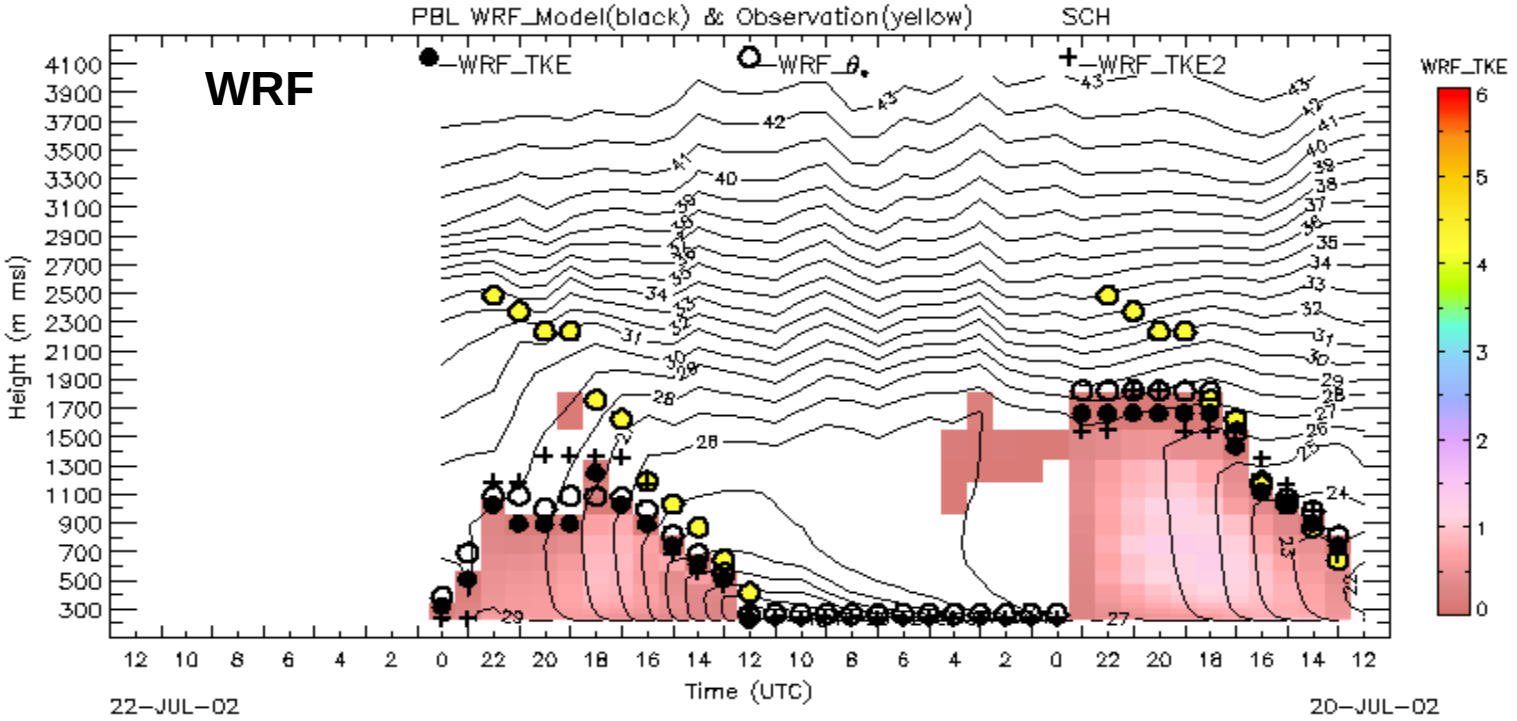

1200 UTCθ=61 deg
b
Aerosol Optical Depth
Irradiance (W m-2)
0
0.2
0.4
0.6
0.8
1
360
400
440
480
520

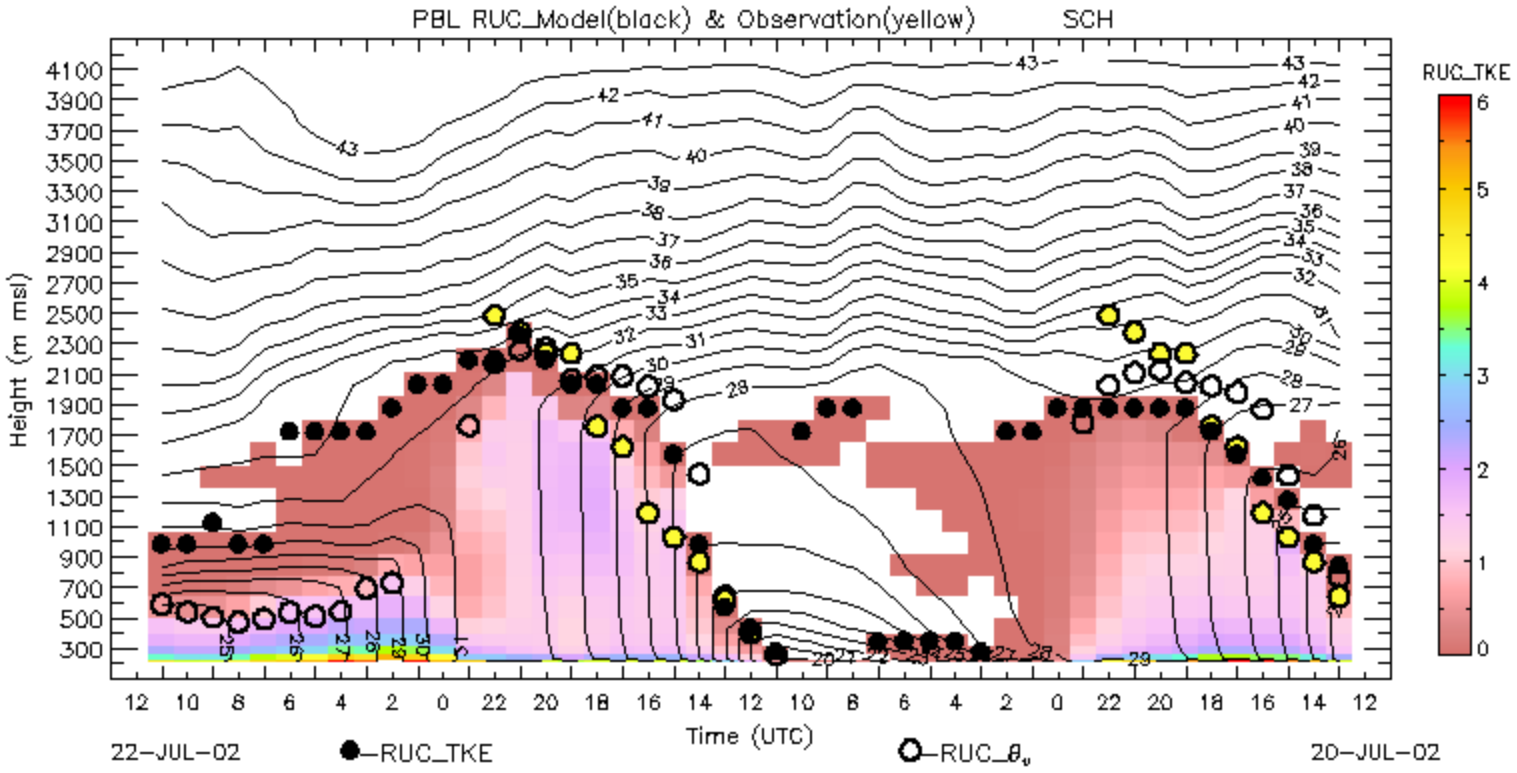

1300 UTCθ=51 deg
c
Aerosol Optical Depth
Irradiance (W m-2)
0
0.2
0.4
0.6
0.8
1
520
560
600
640
680

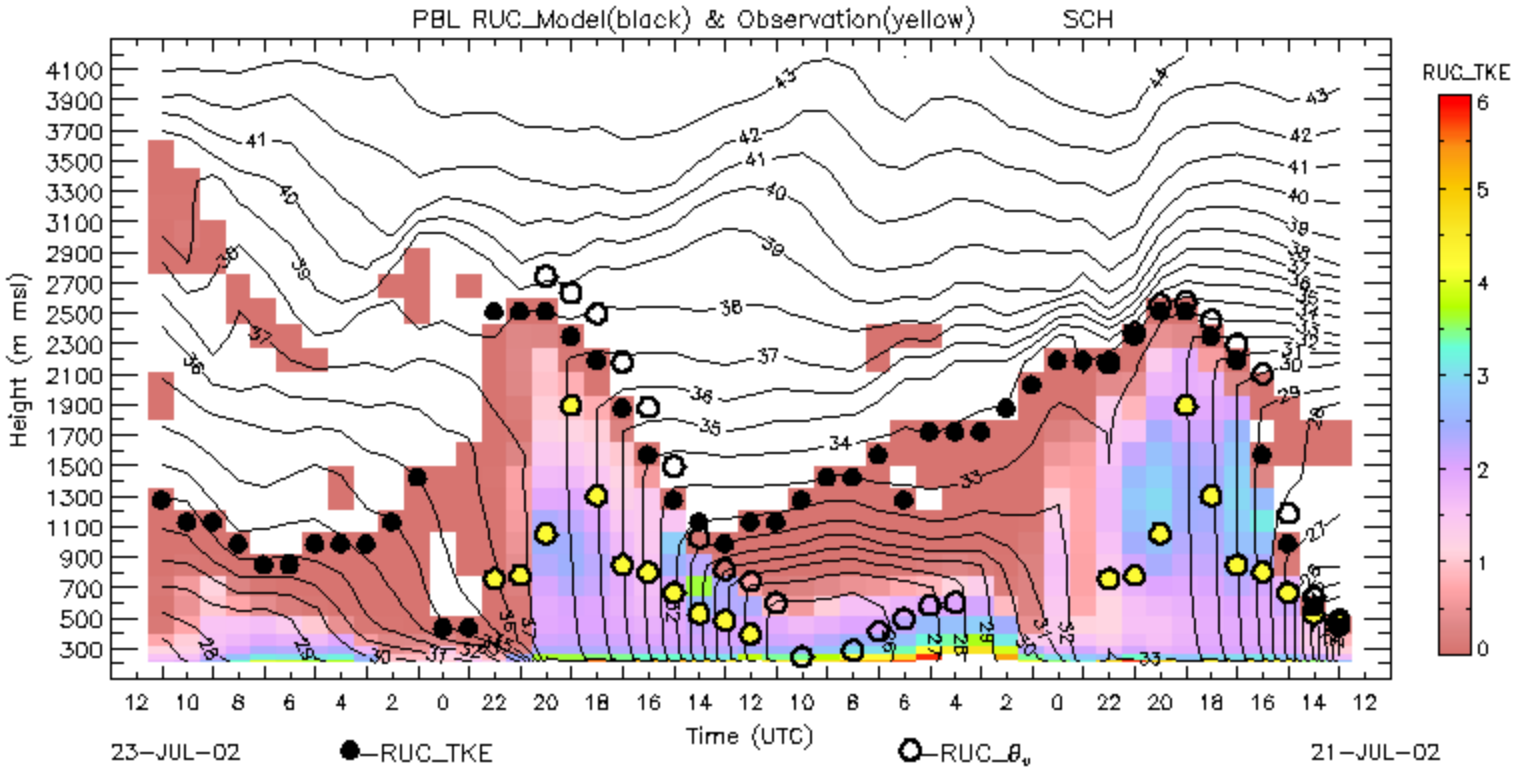

1400 UTCθ=41 deg
d
Aerosol Optical Depth
Irradiance (W m-2)
0
0.2
0.4
0.6
0.8
1
520
560
600
640
680


PROFILE_SITES Mean PBL Difference (Model−Obs) JUL/10/02−AUG/31/02
Height (m msl)
500
400
300
200
100
0
−100
−200
−300
−400
−500
12 10 8 6 4 2 0 22 20 18 16 14 12 10 8 6 4 2 0 22 20 18 16 14 12
Time (UTC)
−ETA_TKE
−MM5_TKE2
−WRF_TKE
−RUC_TKE


PBL ETA_Model(black) & Observation(yellow) SCH
Eta
ETA_TKE
Height (m msl)
Time (UTC)
22-JUL-02
20-JUL-02


PBL WRF_Model(black) & Observation(yellow) SCH
WRF
WRF_TKE
WRF_θe
WRF_TKE2
WRF_TKE
Height (m msl)
Time (UTC)
22-JUL-02
20-JUL-02


PBL RUC_Model(black) & Observation(yellow) SCH
Height (m msl)
4100
3900
3700
3500
3300
3100
2900
2700
2500
2300
2100
1900
1700
1500
1300
1100
900
700
500
300
12 10 8 6 4 2 0 22 20 18 16 14 12 10 8 6 4 2 0 22 20 18 16 14 12
Time (UTC)
22-JUL-02
RUC_TKE
RUC_θ_v
20-JUL-02
RUC_TKE
6
5
4
3
2
1
0

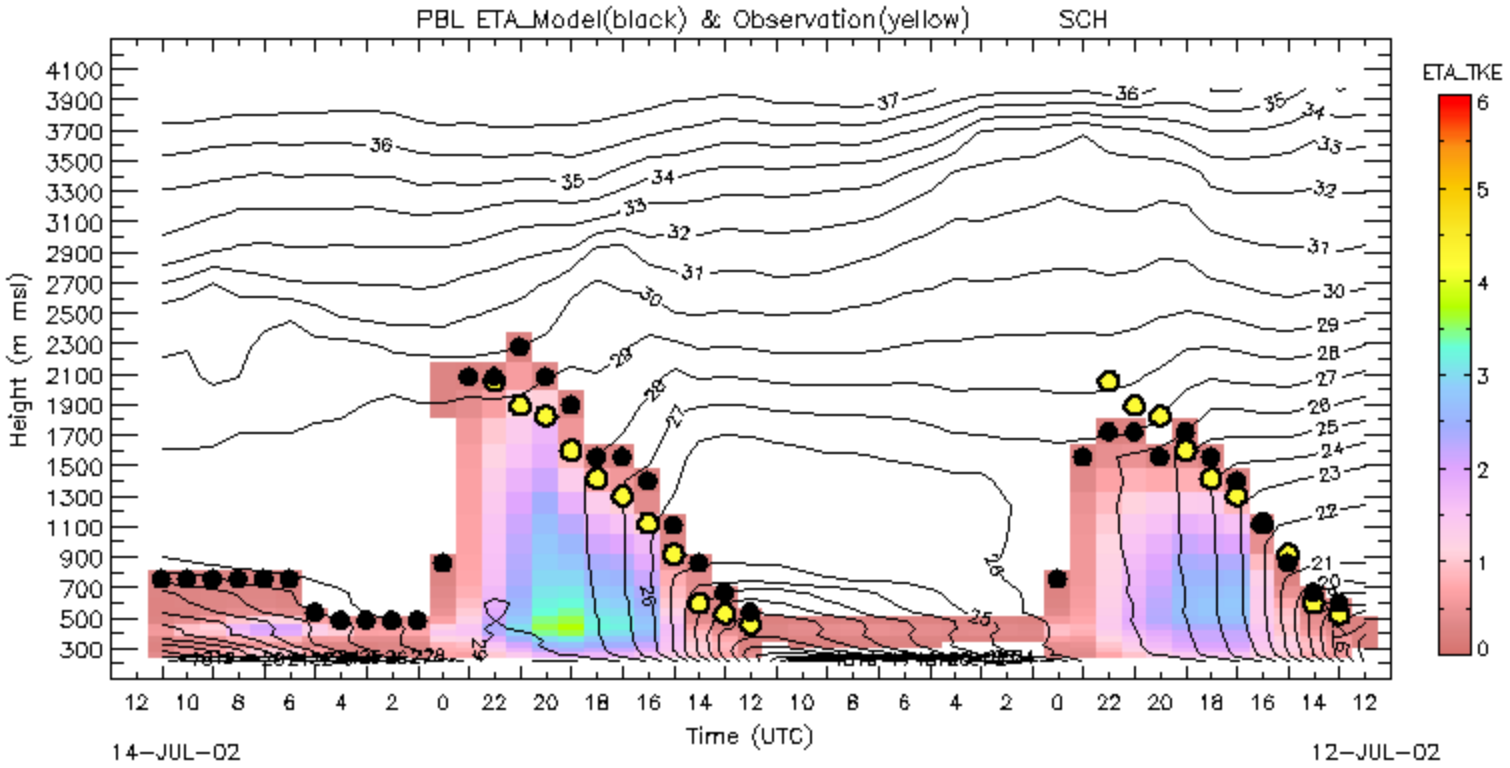

PBL RUC_Model(black) & Observation(yellow)
SCH
Height (m msl)
4100
3900
3700
3500
3300
3100
2900
2700
2500
2300
2100
1900
1700
1500
1300
1100
900
700
500
300
12 10 8 6 4 2 0 22 20 18 16 14 12 10 8 6 4 2 0 22 20 18 16 14 12
Time (UTC)
23-JUL-02
21-JUL-02
RUC_TKE
RUC_θv
RUC_TKE
6
5
4
3
2
1
0

2004 Goals

- Use New England Super-Site (Plymouth MA) to quantify model errors of physical processes affecting surface temperature
- Run single column versions of Eta and GFS driven by observed forcing
- Calculate model statistics in real-time and display on web site
- Evaluate high-impact days: large forecast errors or high maximum temperatures

2004 New England Super-Site

- S-band cloud radar
- 3 channel radiometer (ILW)
- Ceilometer
- Aerosol optical depth
- 915 MHz Wind Profiler/RASS
- High-res sodar
- Surface turbulent fluxes
- 4 stream radiation with direct & diffuse solar
- Soil moisture/heat flux
- Airborne ozone lidar overpasses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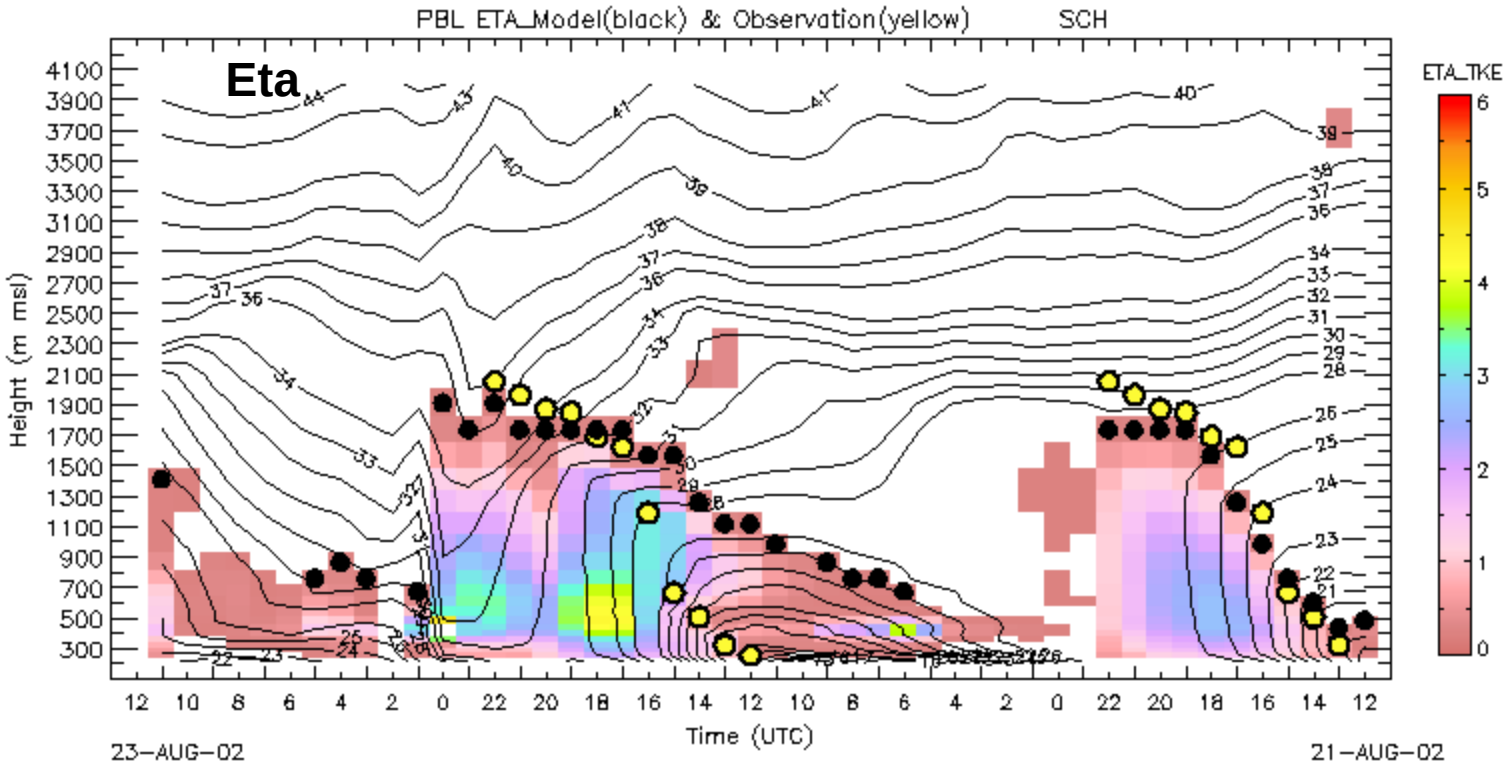
SCH
ETA_TKE
Height (m msl)
Time (UTC)
14-JUL-02
12-JUL-02


PBL ETA_Model(black) & Observation(yellow)
SCH
Eta
Height (m msl)
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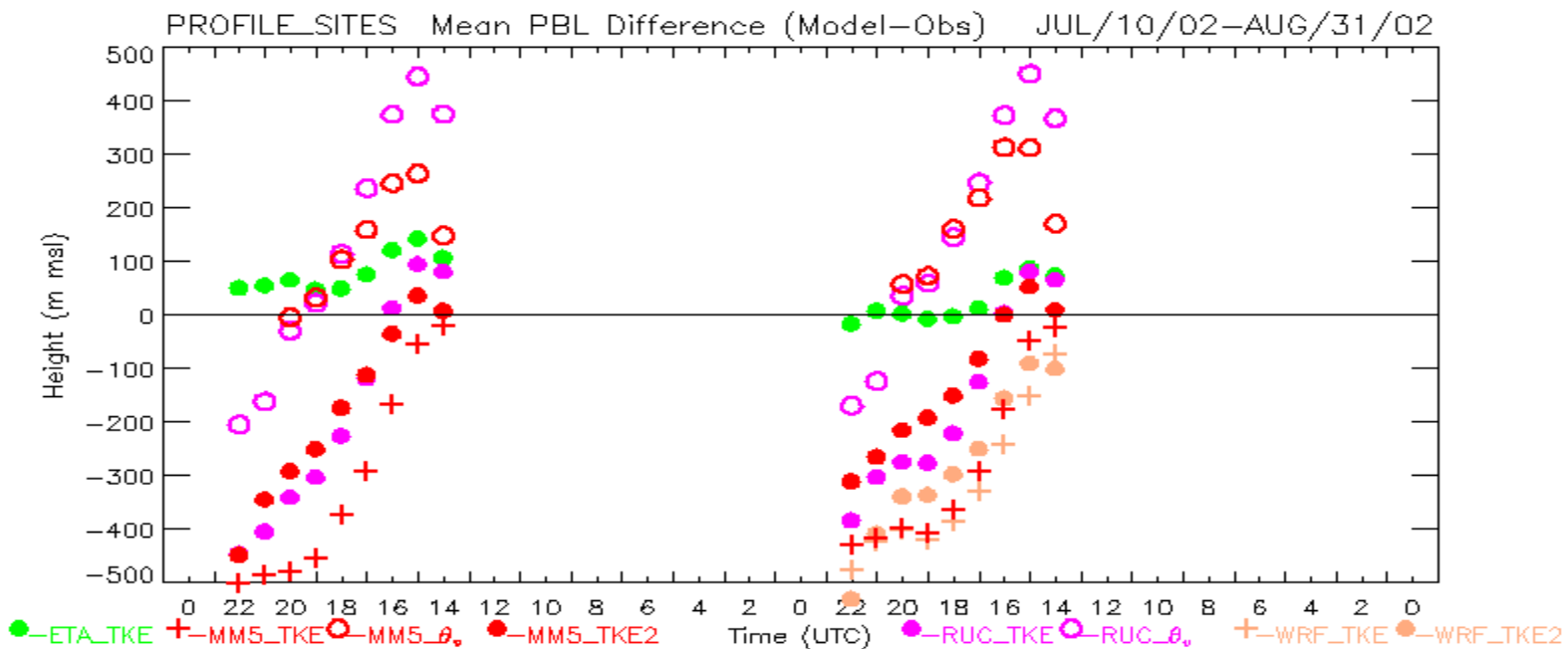
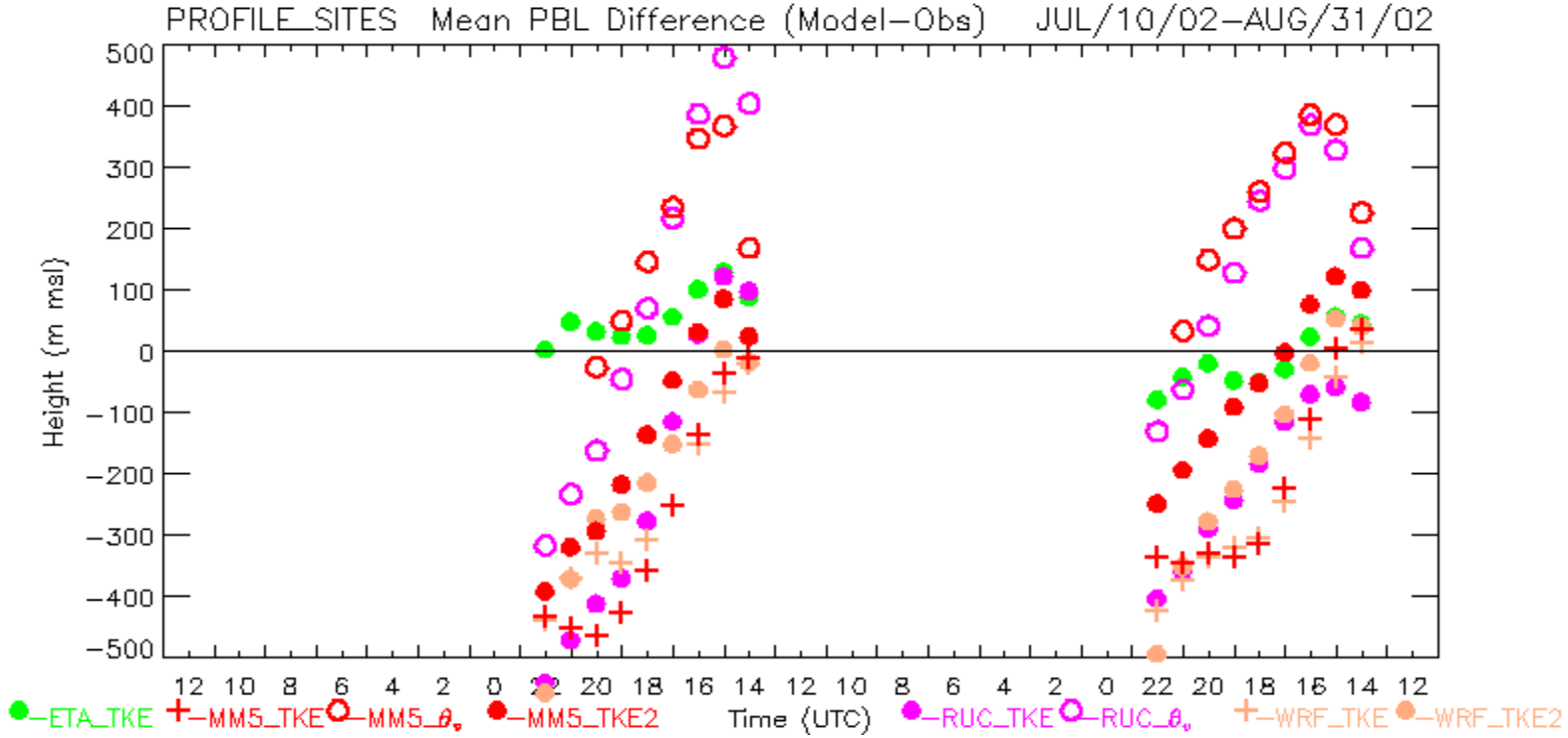
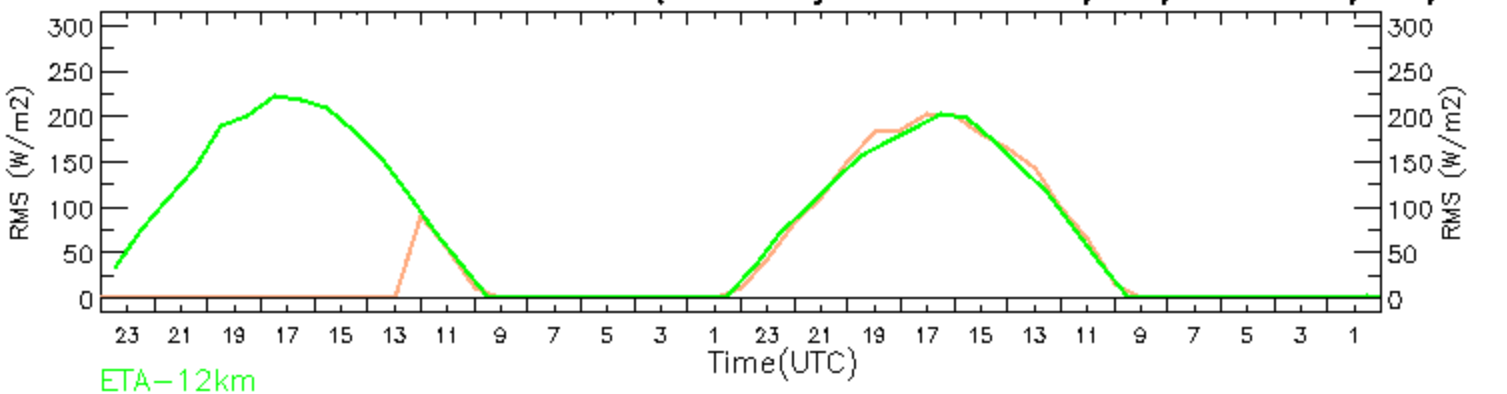
3900
3700
3500
3300
3100
2900
2700
2500
2300
2100
1900
1700
1500
1300
1100
900
700
500
300
12 10 8 6 4 2 0 22 20 18 16 14 12 10 8 6 4 2 0 22 20 18 16 14 12
Time (UTC)
23-AUG-02
21-AUG-02
ETA_TKE
6
5
4
3
2
1
0


PROFILE_SITES Mean PBL Difference (Model–Obs) JUL/10/02–AUG/31/02
Height (m msl)
500
400
300
200
100
0
−100
−200
−300
−400
−500
0 22 20 18 16 14 12 10 8 6 4 2 0 22 20 18 16 14 12 10 8 6 4 2 0
Time (UTC)
–ETA_TKE
–MM5_TKE
–MM5_θv
–MM5_TKE2
–RUC_TKE
–RUC_θv
–WRF_TKE
–WRF_TKE2


PROFILE_SITES Mean PBL Difference (Model–Obs) JUL/10/02–AUG/31/02
Height (m msl)
500
400
300
200
100
0
−100
−200
−300
−400
−500
12 10 8 6 4 2 0 22 20 18 16 14 12 10 8 6 4 2 0 22 20 18 16 14 12
Time (UTC)
–ETA_TKE
–MM5_TKE
–MM5_θv
–MM5_TKE2
–RUC_TKE
–RUC_θv
–WRF_TKE
–WRF_TKE2

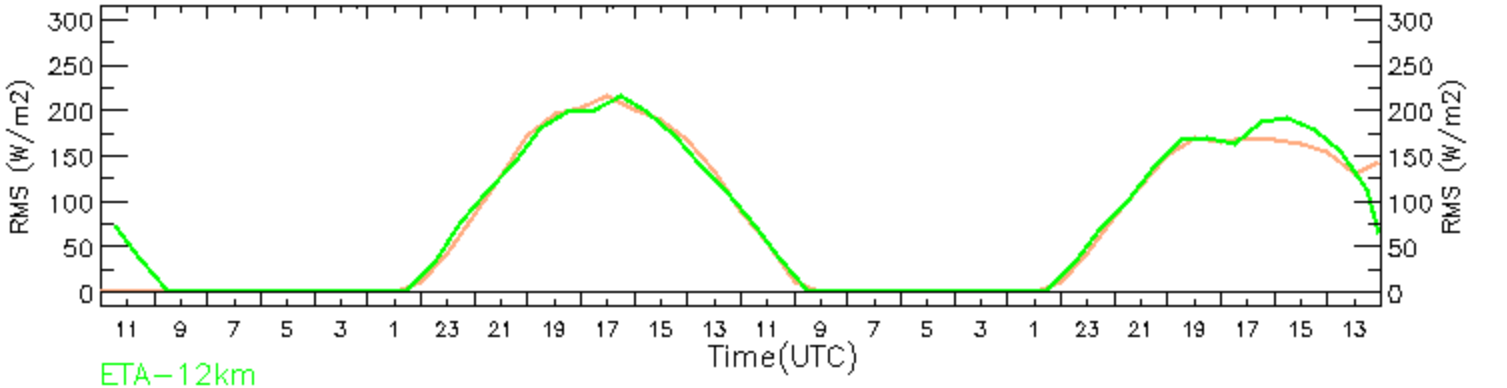
NOAA/Environmental Technology Laboratory
Profile Site Surface Meteorology

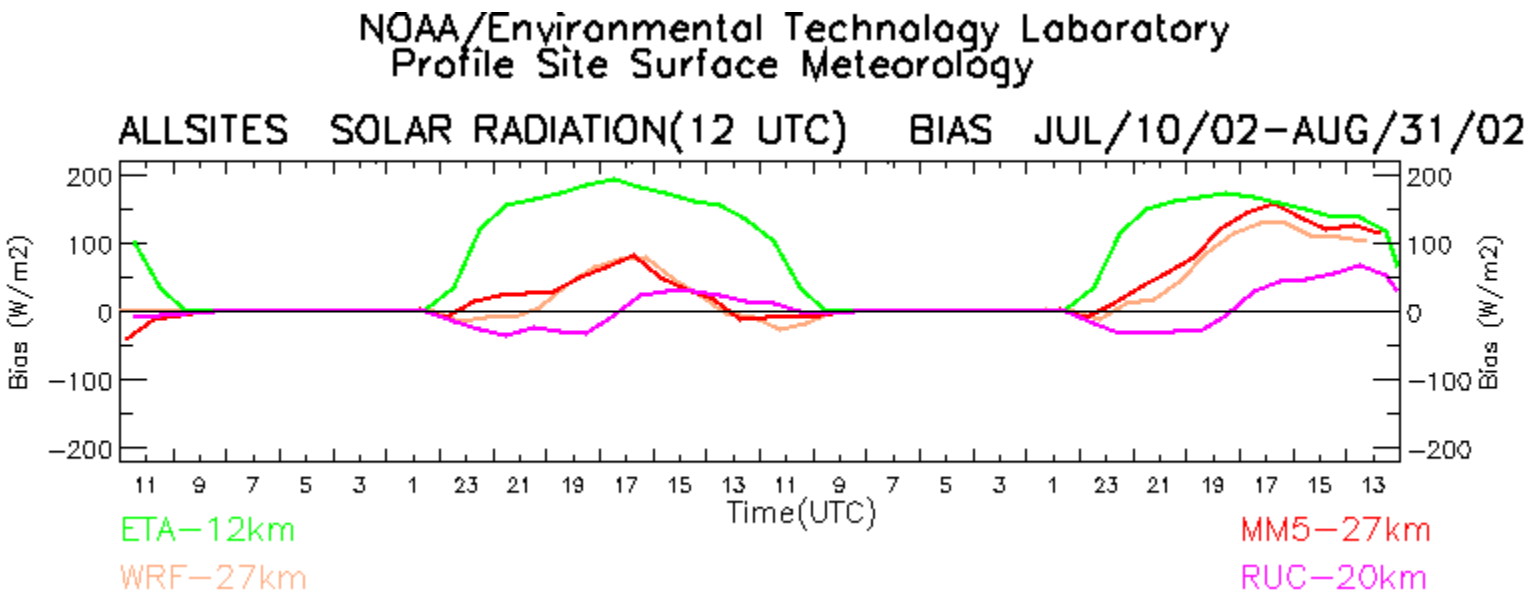
ALLSITES SOLAR RADIATION(00 UTC) RMS JUL/10/02-AUG/31/02

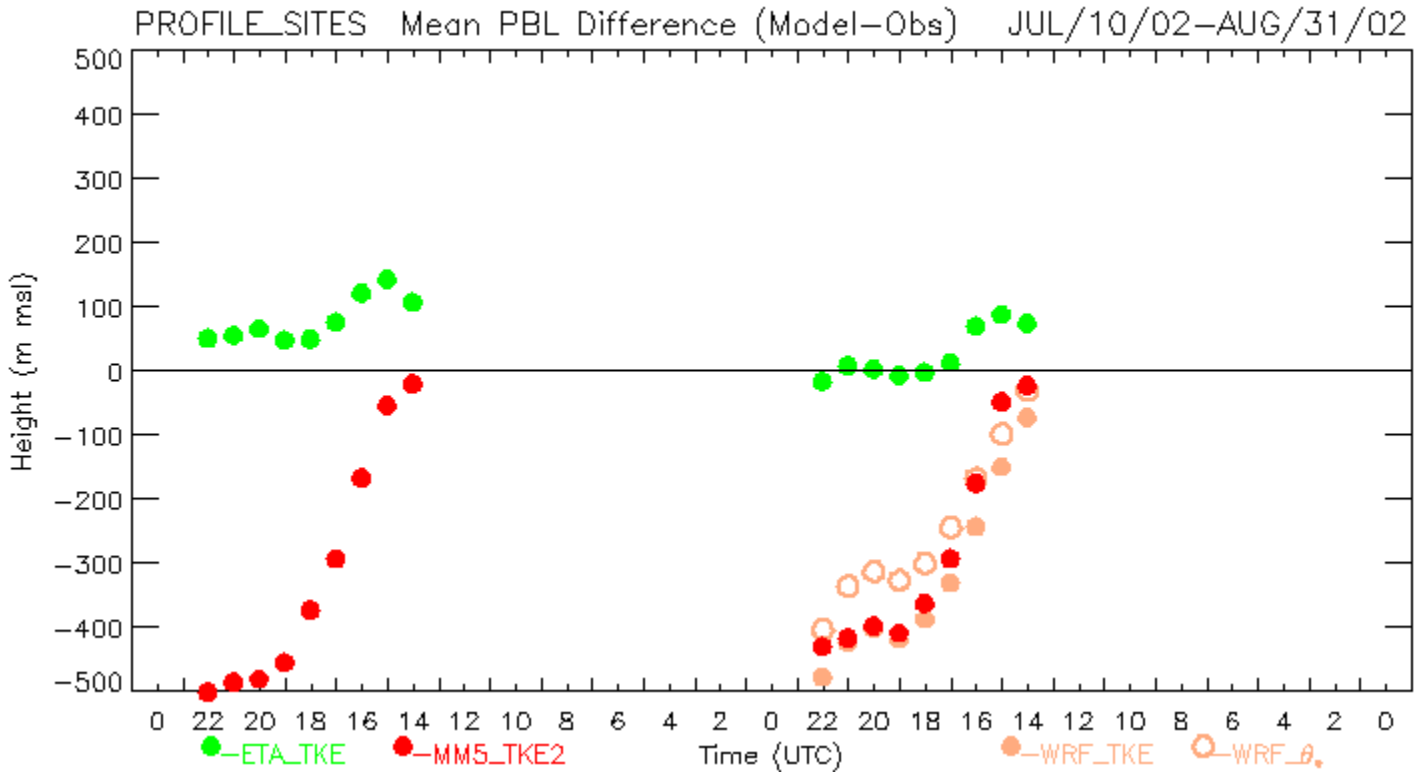


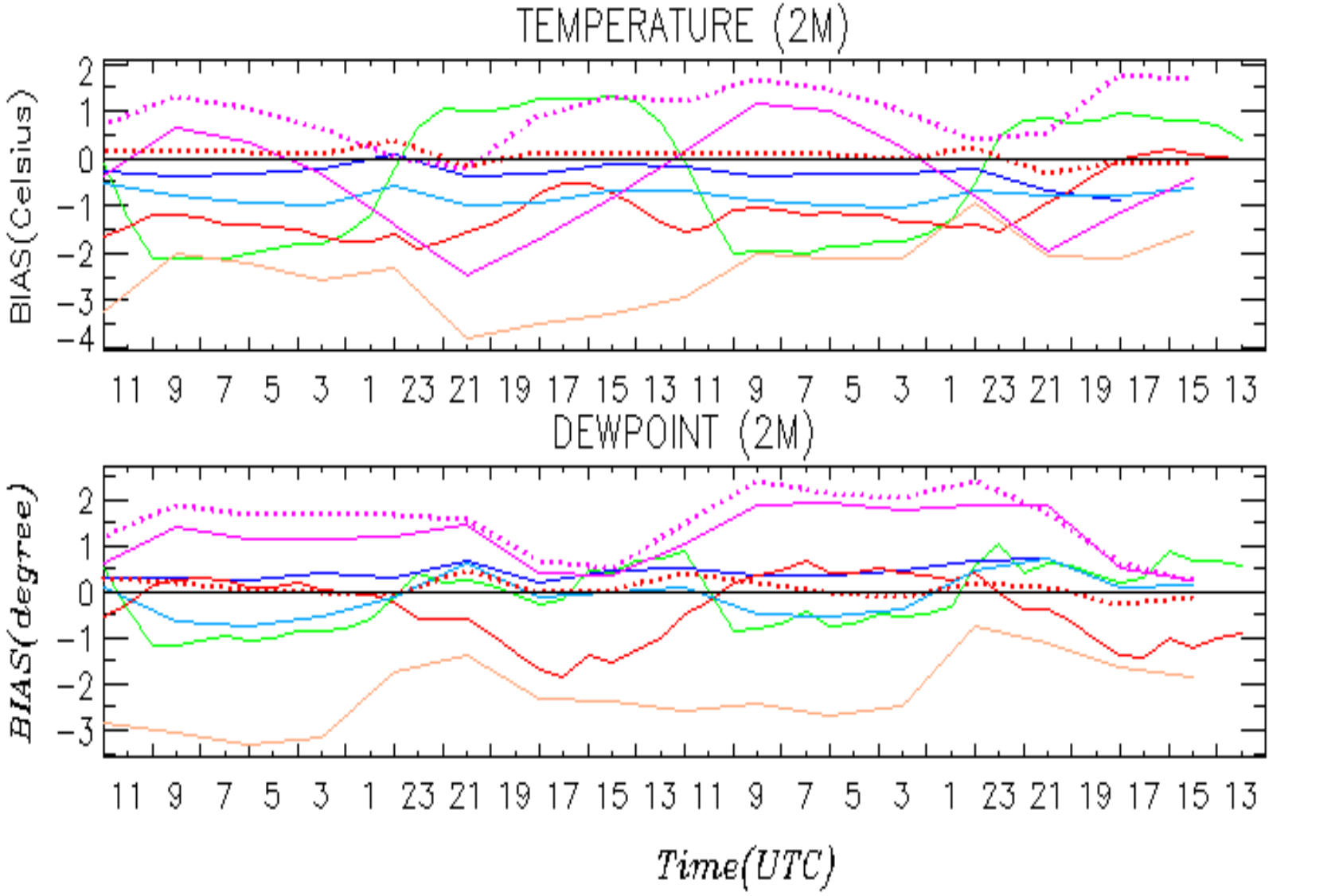
NOAA/Environmental Technology Laboratory
Profile Site Surface Meteorology

ALLSITES SOLAR RADIATION(12 UTC) RMS JUL/10/02-AUG/31/02



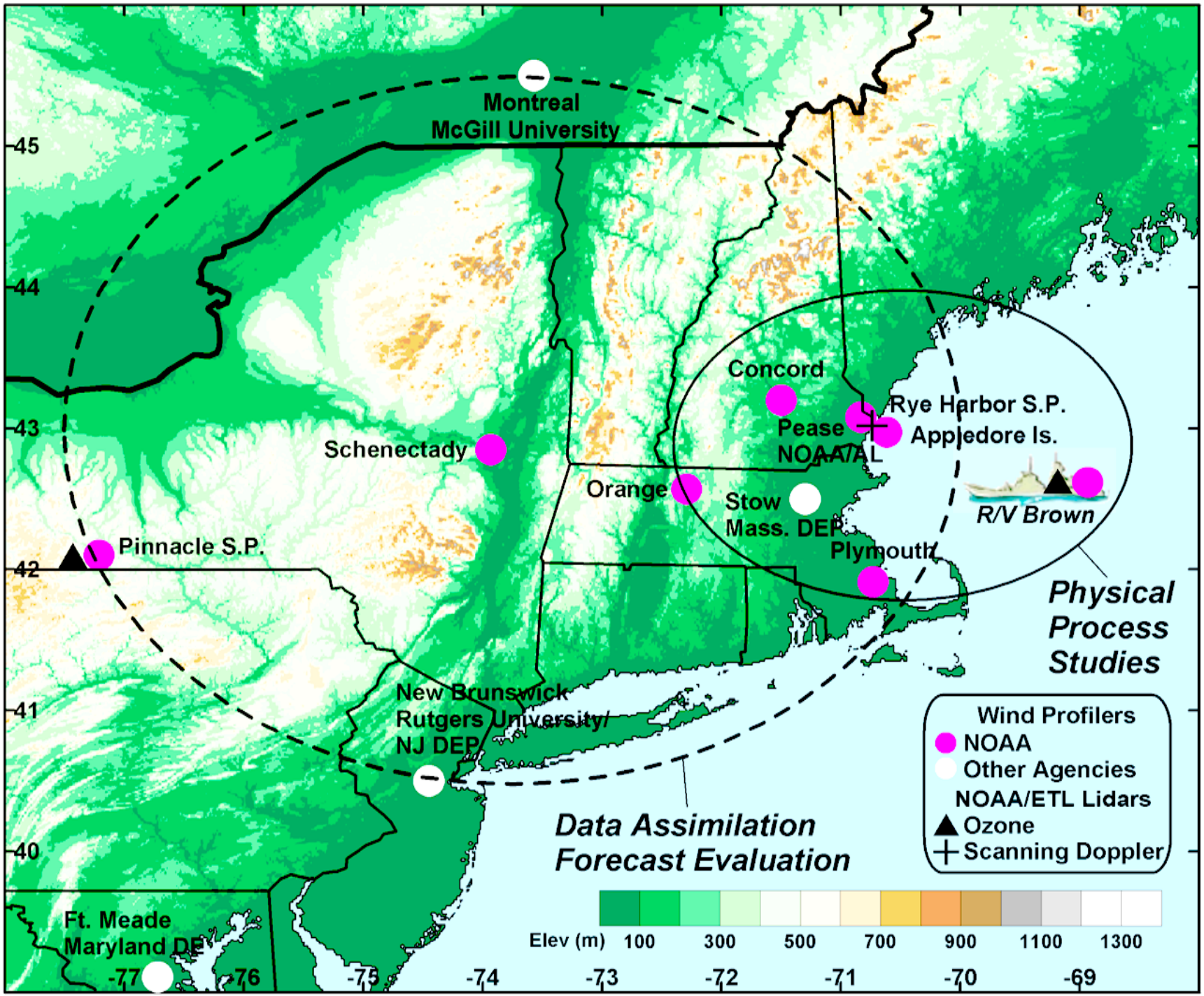

NOAA/Environmental Technology Laboratory
Profile Site Surface Meteorology
ALLSITES SOLAR RADIATION(12 UTC) BIAS JUL/10/02-AUG/31/02
Bias (W/m2)
200
100
0
-100
-200
11 9 7 5 3 1 23 21 19 17 15 13 11 9 7 5 3 1 23 21 19 17 15 13
Time(UTC)
ETA-12km
WRF-27km
MM5-27km
RUC-20km


PROFILE_SITES Mean PBL Difference (Model−Obs) JUL/10/02−AUG/31/02
Height (m msl)
500
400
300
200
100
0
−100
−200
−300
−400
−500
0 22 20 18 16 14 12 10 8 6 4 2 0 22 20 18 16 14 12 10 8 6 4 2 0
Time (UTC)
ETA_TKE
MM5_TKE2
WRF_TKE
WRF_θv



NOAA/Environmental Technology Laboratory
Energy Site Surface Meteorology – BIAS (Model – Obs)
JUL/15/02 – AUG/31/02

ALLSITES ETA-- MM5--RUC--RUC20... WRF--NGM--Ens-- Ens_bias...


Montreal
McGill University
Concord
Rye Harbor S.P.
Pease
NOAA/AL
Appledore Is.
Schenectady
Orange
Stow
Mass. DEP
R/V Brown
Pinnacle S.P.
Plymouth
Physical
Process
Studies
New Brunswick
Rutgers University/
NJ DEP
Data Assimilation
Forecast Evaluation
Wind Profilers
NOAA
Other Agencies
NOAA/ETL Lidars
Ozone
Scanning Doppler
Ft. Meade
Maryland DE
Elev (m) 100 300 500 700 900 1100 1300
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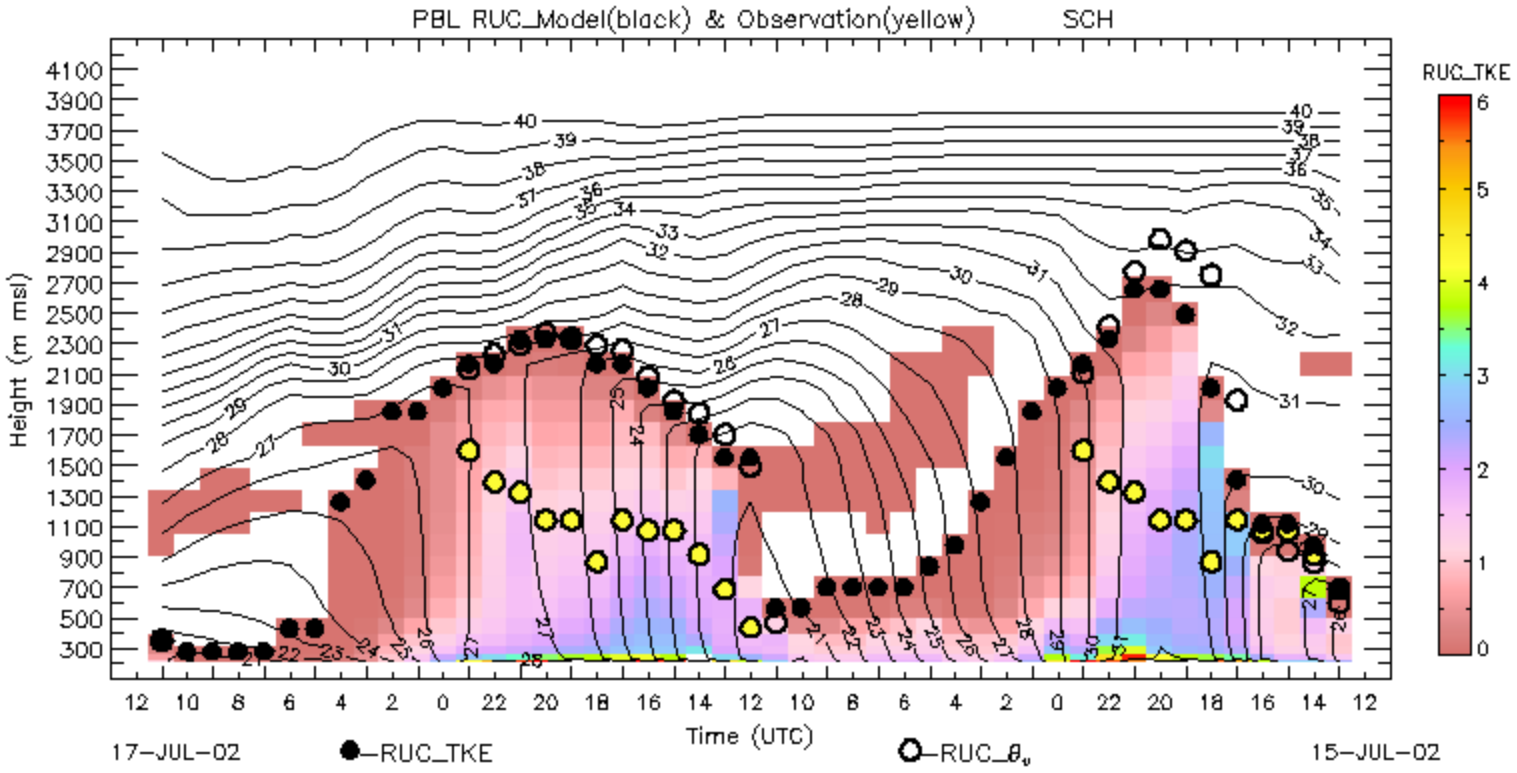
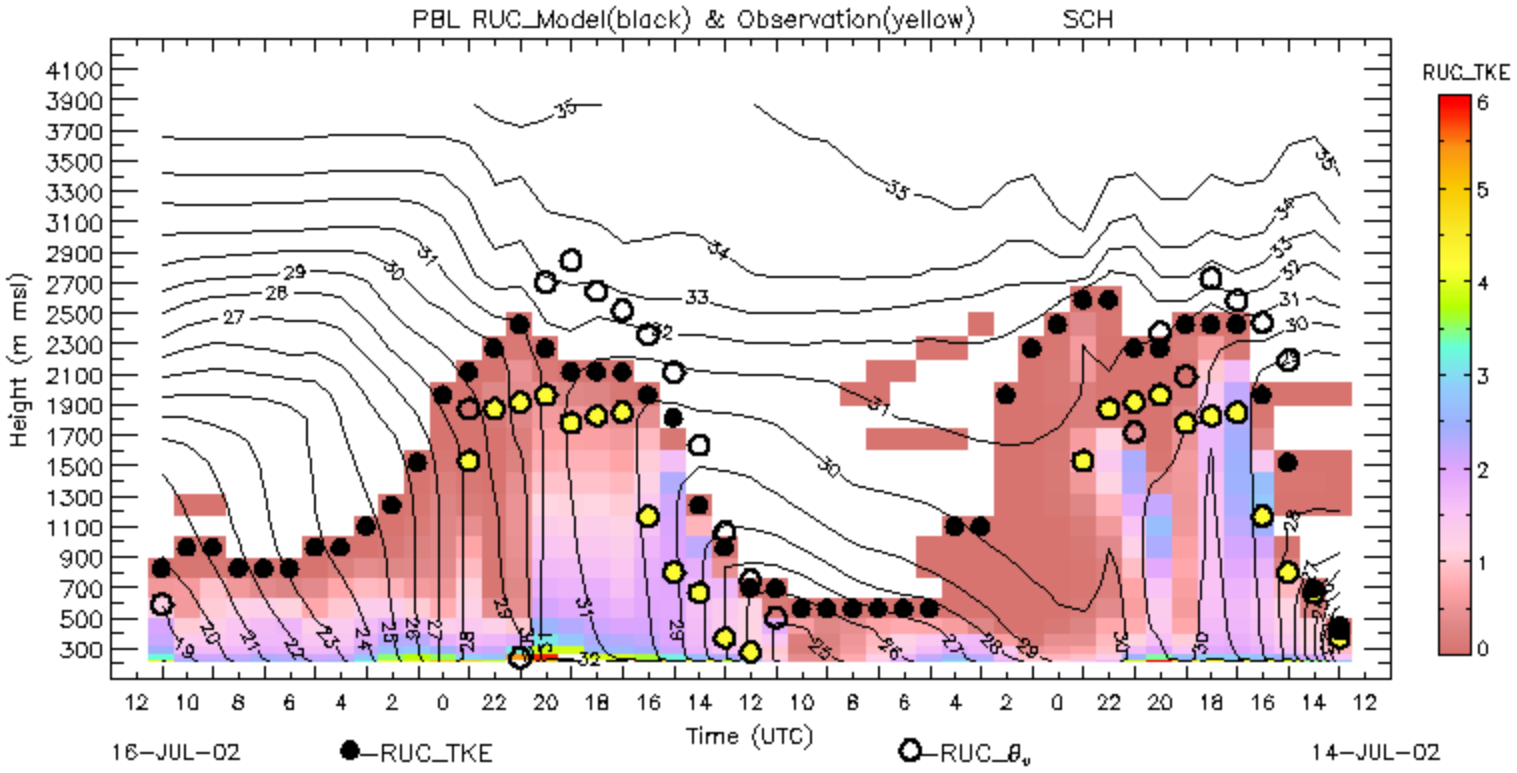
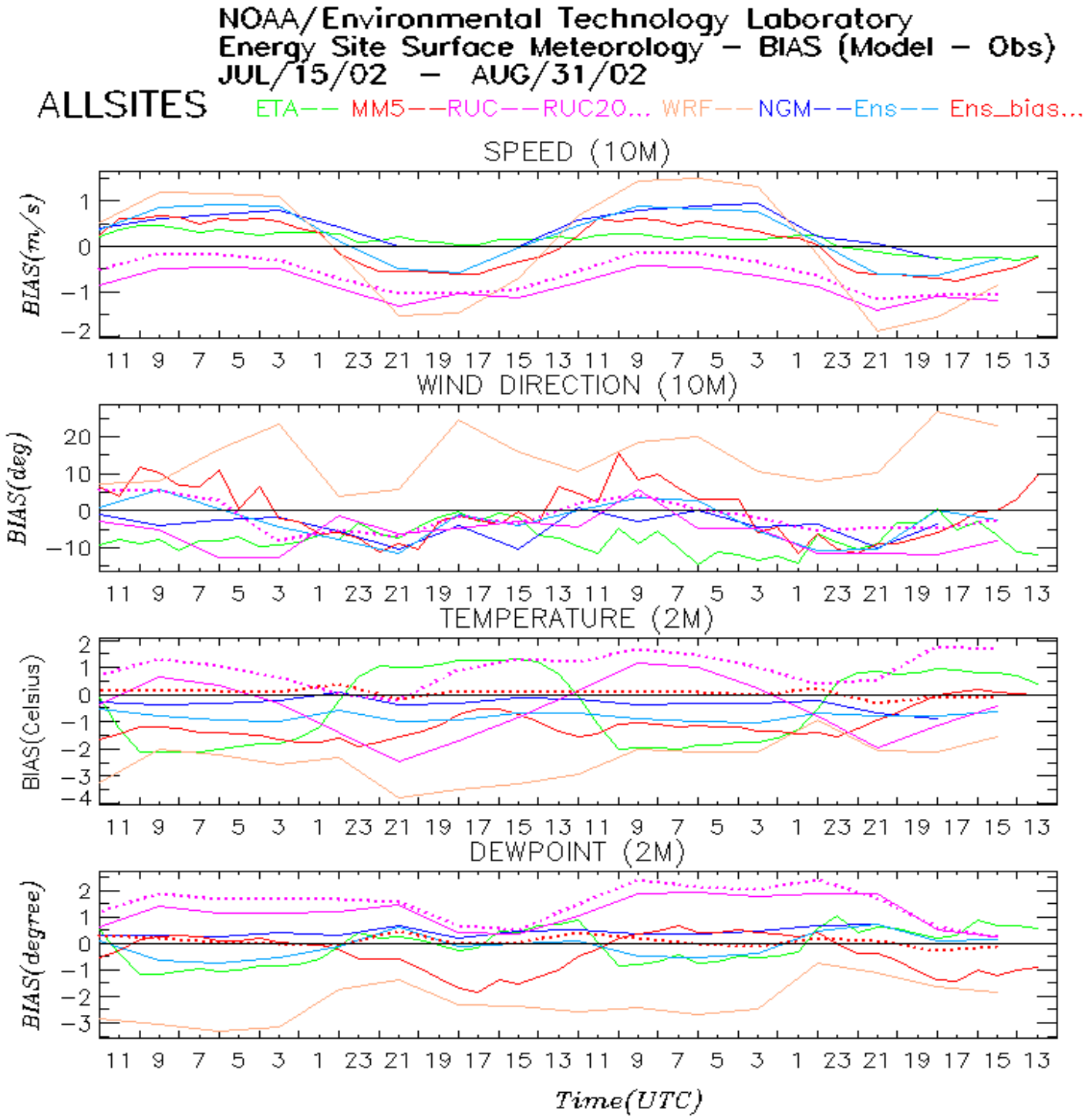
-75
-74
-73
-72
-71
-70
-69


PBL RUC_Model(black) & Observation(yellow) SCH
Height (m msl)
4100
3900
3700
3500
3300
3100
2900
2700
2500
2300
2100
1900
1700
1500
1300
1100
900
700
500
300
12 10 8 6 4 2 0 22 20 18 16 14 12 10 8 6 4 2 0 22 20 18 16 14 12
Time (UTC)
17-JUL-02
RUC_TKE
RUC_θ_v
15-JUL-02
RUC_TKE
6
5
4
3
2
1
0


PBL RUC_Model(black) & Observation(yellow) SCH
Height (m msl)
4100
3900
3700
3500
3300
3100
2900
2700
2500
2300
2100
1900
1700
1500
1300
1100
900
700
500
300
12 10 8 6 4 2 0 22 20 18 16 14 12 10 8 6 4 2 0 22 20 18 16 14 12
Time (UTC)
16-JUL-02
RUC_TKE
RUC_θ_v
14-JUL-02
RUC_TKE
6
5
4
3
2
1
0

	Eta	WRF	MM5	RUC
Land-surf	Noah	OSU	Smirnova	Smirnova
Surf-layer	MO	MO (Eta)	MO (Hi-res PBL)	MO (Pan 94)
PBL	MY 2.5	MY 2.5 (Eta)	MY 2.5	MY 2.5 (BT)
Shortwave	Lacis&Hansen (modified)	Dudhia	Dudhia	Dudhia
Longwave	GFDL	RRTM	RRTM	Dudhia
Microphys	Ferrier	NCEP 3-class	Reisner 5 class	Reisner 5 class
Cum precip	BMJ	BMJ	Grell-Dev. Ens	Grell-Dev. Ens
Initial cond	EDAS	RUC (OI)	RUC (OI)	RUC (OI)
Bound cond	GFS	Eta	Eta	Eta
Horiz grid	12km	27km	27km	20km
Vert levels	60	25	30	50
Lvls <1km/2km	20/26 at sea level	12/16	11/14	10/17


NOAA/Environmental Technology Laboratory
Energy Site Surface Meteorology – BIAS (Model – Obs)
JUL/15/02 – AUG/31/02
ALLSITES
ETA-- MM5--RUC--RUC20... WRF--NGM--Ens-- Ens_bias...
SPEED (10M)
BIAS(m/s)
WIND DIRECTION (10M)
BIAS(deg)
TEMPERATURE (2M)
BIAS(Celsius)
DEWPOINT (2M)
BIAS(degree)
11 9 7 5 3 1 23 21 19 17 15 13 11 9 7 5 3 1 23 21 19 17 15 13
Time(UTC)