Summer 2007 Ozone, PBL and AOD Verification in NAM-CMAQ AQ System

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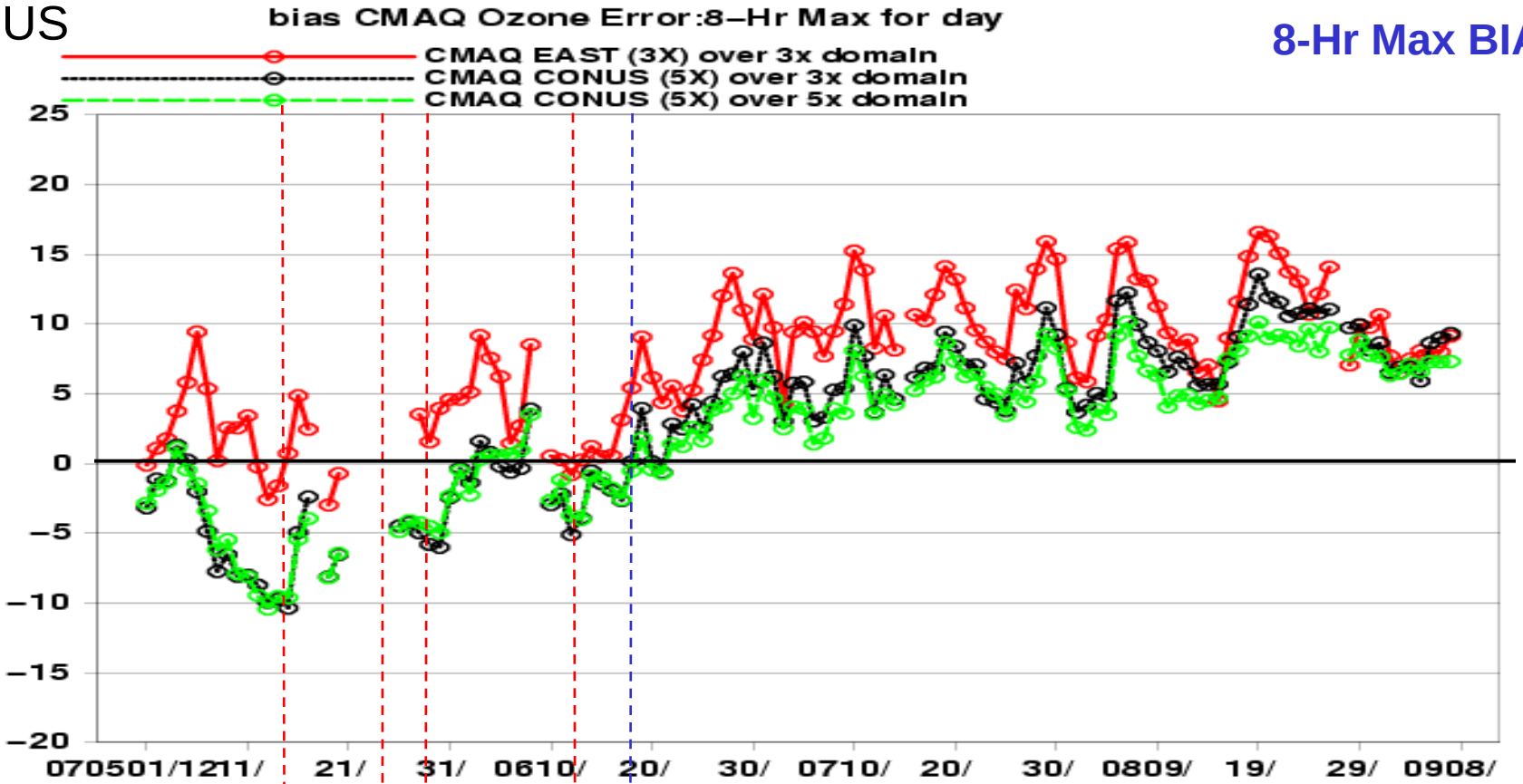
NOAA/NCEP/EMC

18 September, 2007

CONUS

8-Hr Max BIAS



May 1

Sep 8

May 16:
Correct Mobile Emissions

May 25:
Kz(min) = 0.1 m²/s

May 29:
Photolysis attenuation

June 12:
TKE->ACM2

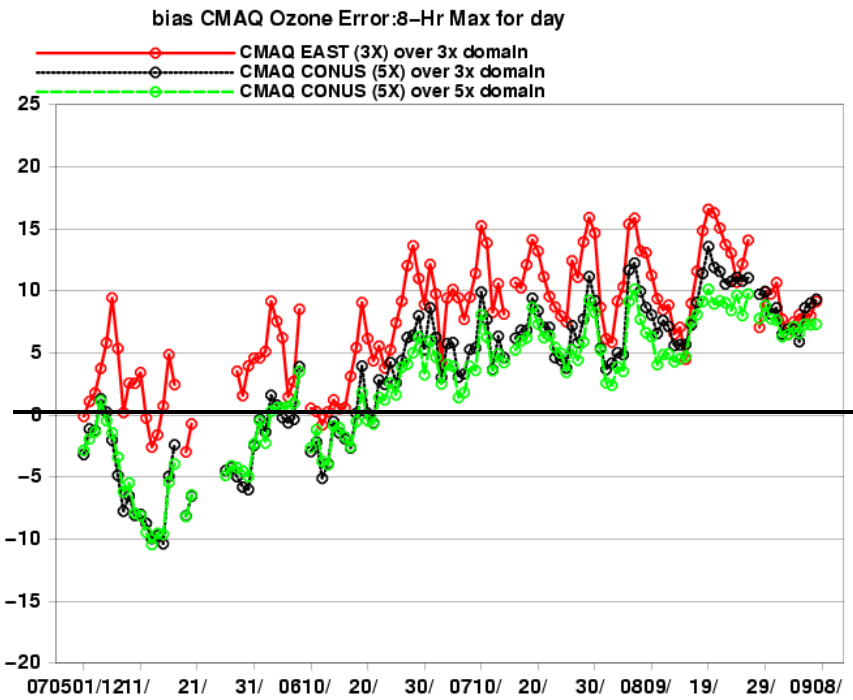
June 19:
- Remove dependance of z0 on sfc elevation
- Min canopy resistance:
  evergreen forest 125->250
  mixed forest 125->150

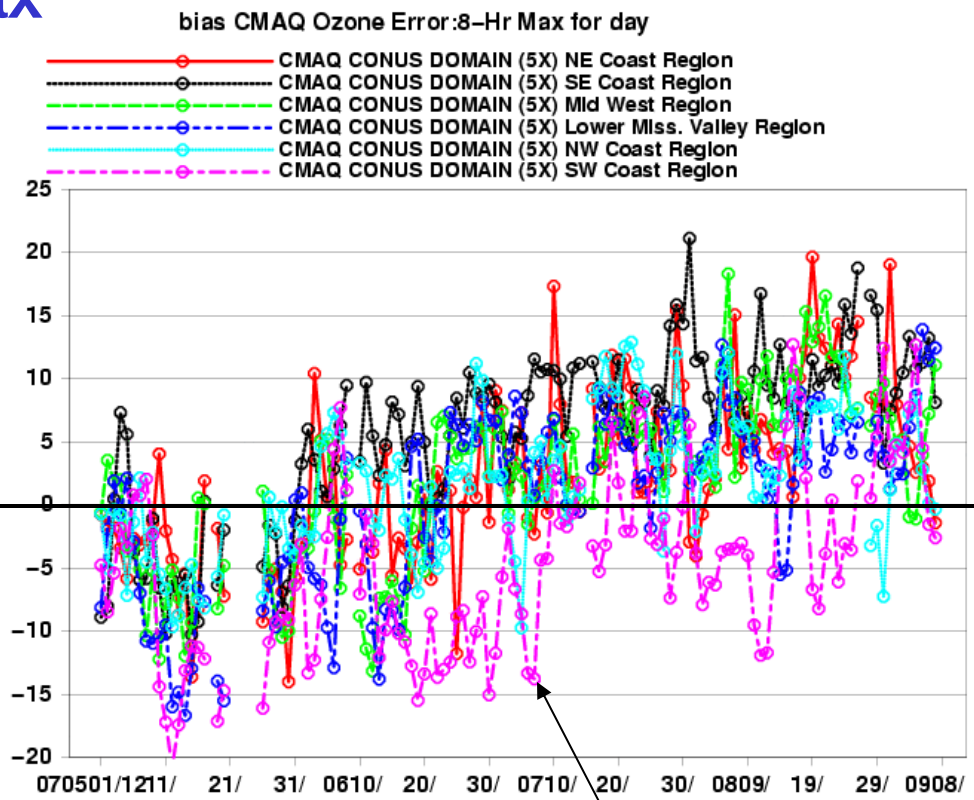
CMAQ and NAM Changes Summer 2007

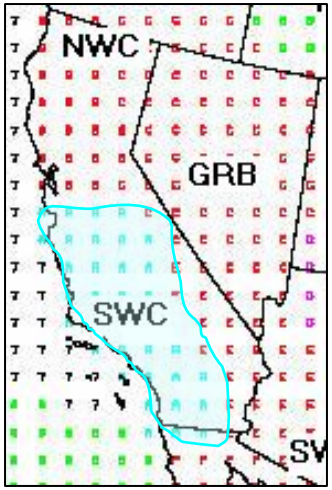
CONUS

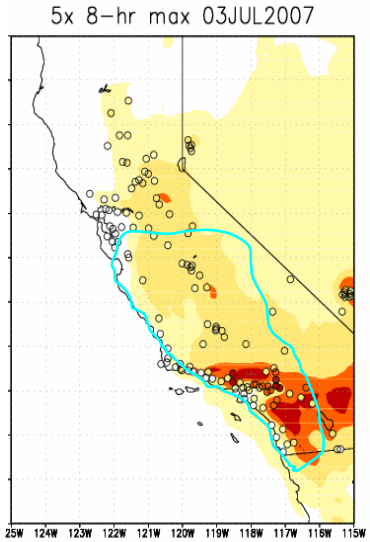
8-Hr Max

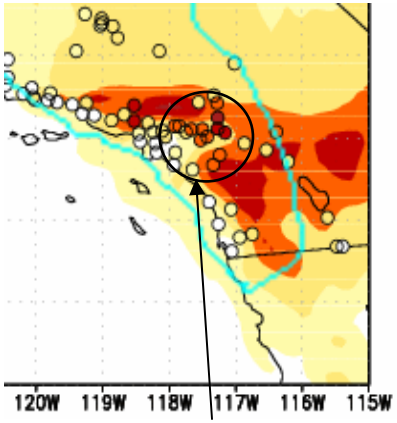
5X Sub-Regions











LA under-prediction

BIAS

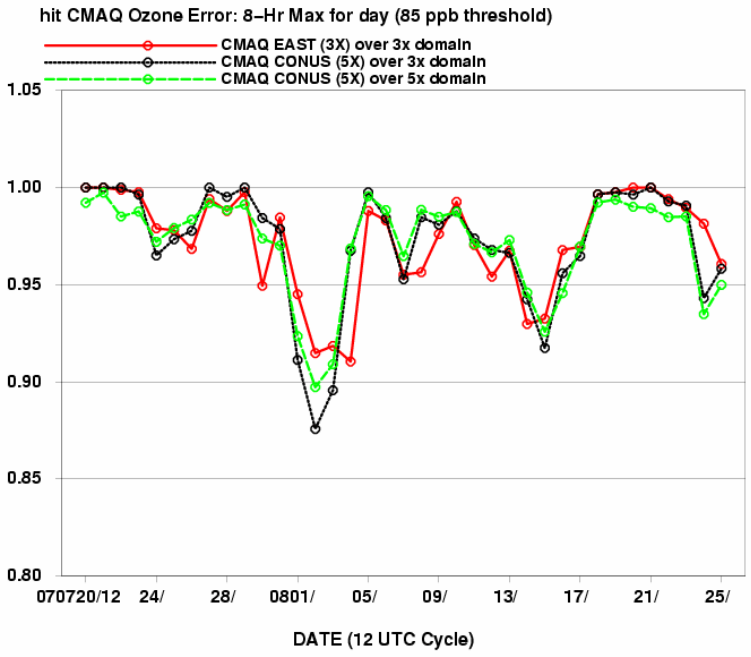
CONUS

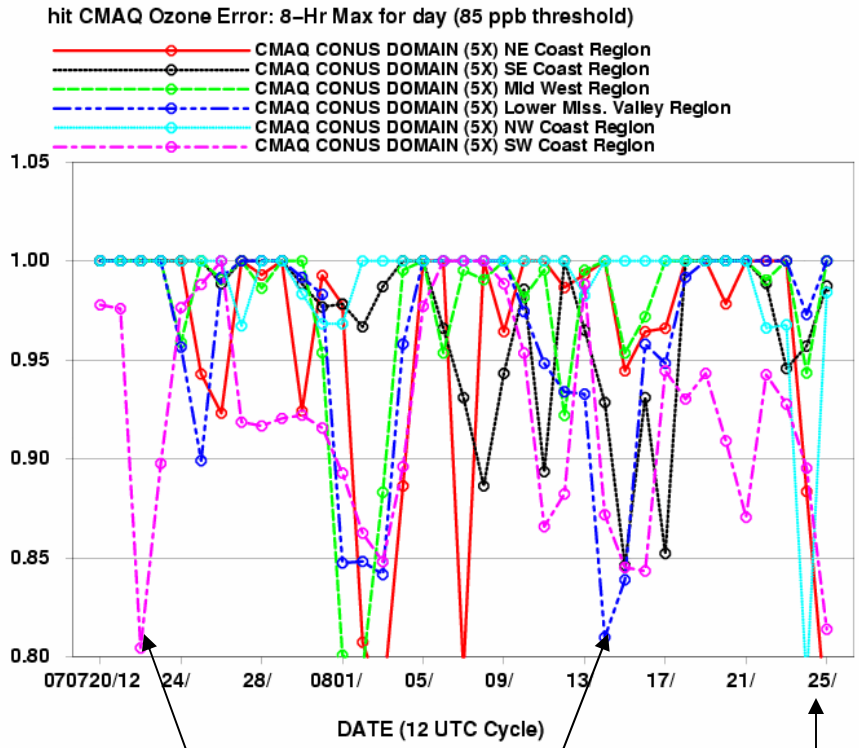
FHO Ozone statistics

5X Sub-Regions

8-Hr Max

July 20 – Aug 25



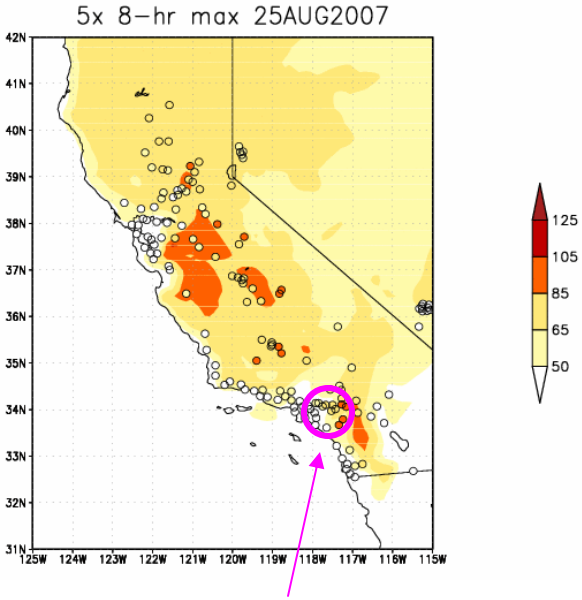


South-West

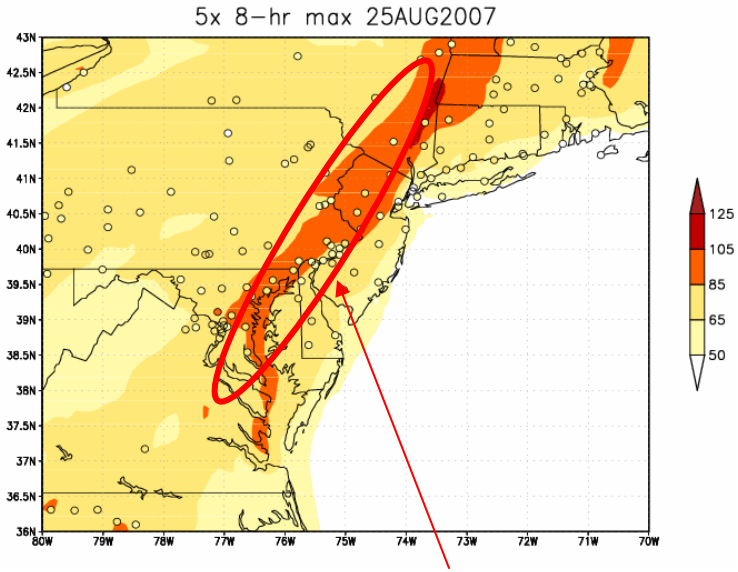
North-East

Lower Miss Valley

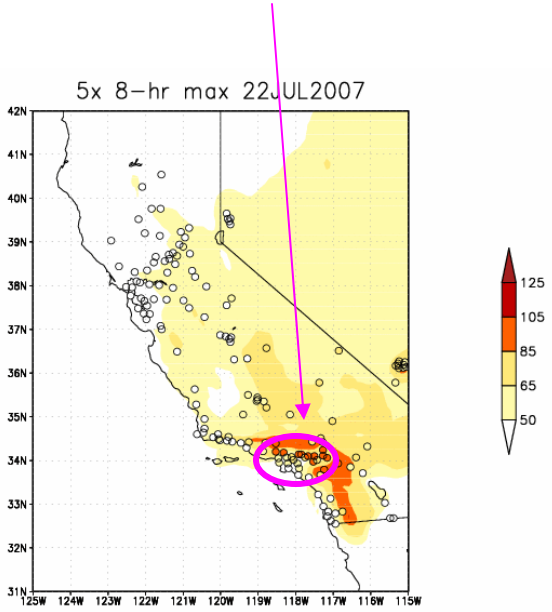
HIT Rate

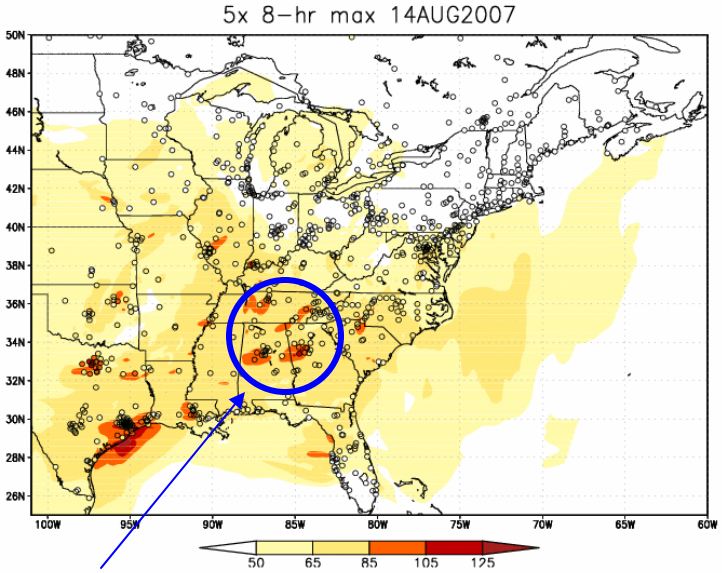


LA Under-prediction



NE Over-prediction



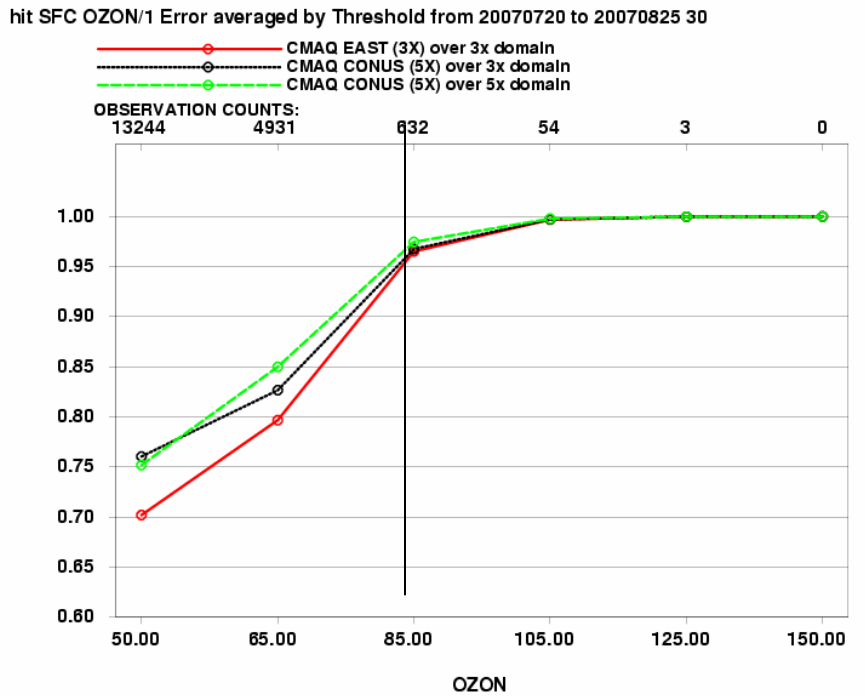


Lower Miss Valley Over-prediction

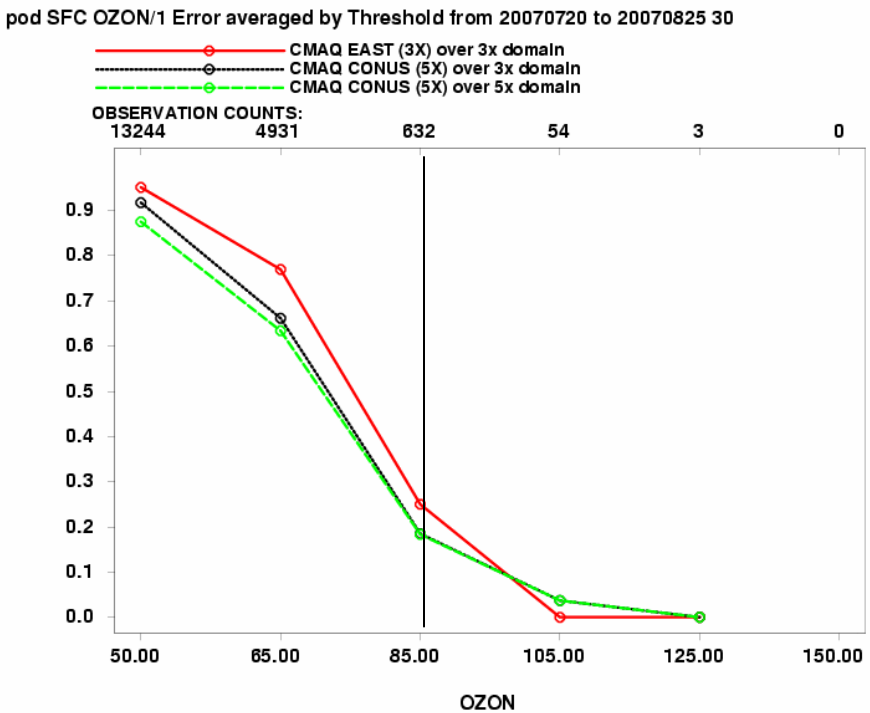
CONUS

FHO Ozone statistics

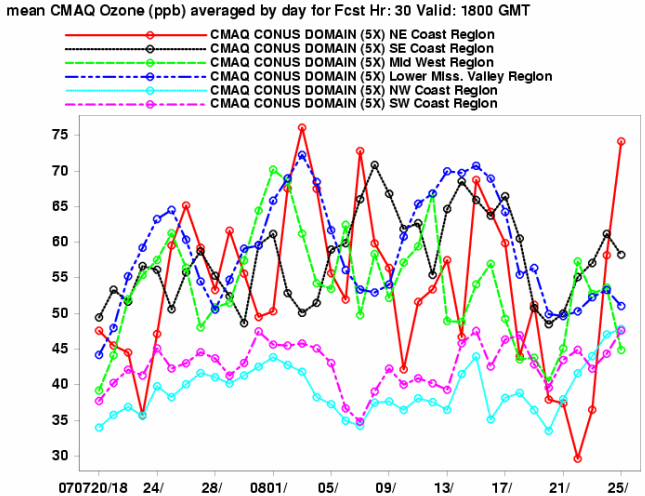
July 20 – Aug 25: 1-Hr Ave, 30 hr forecast



Hit Rate



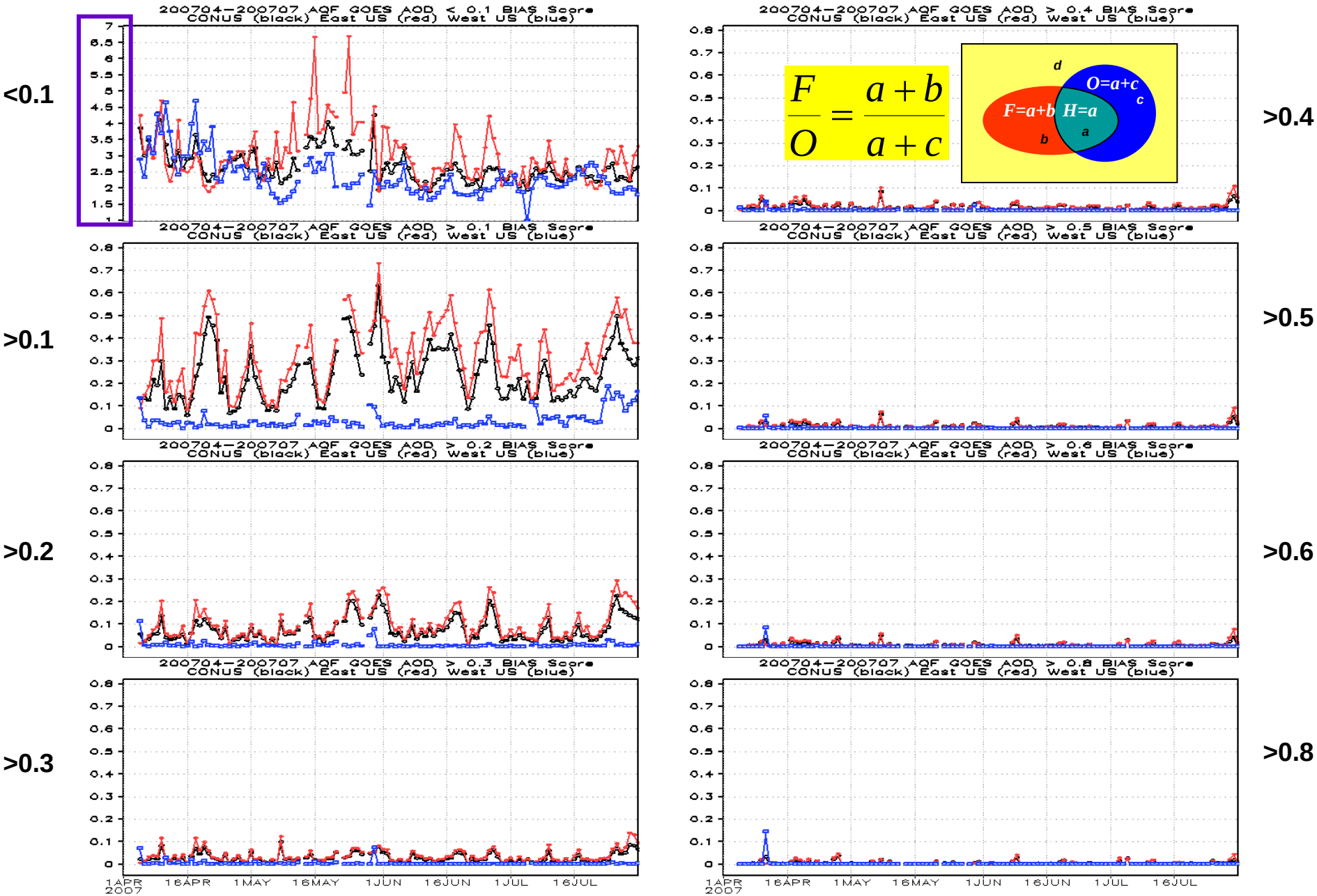
POD



Mean PBL

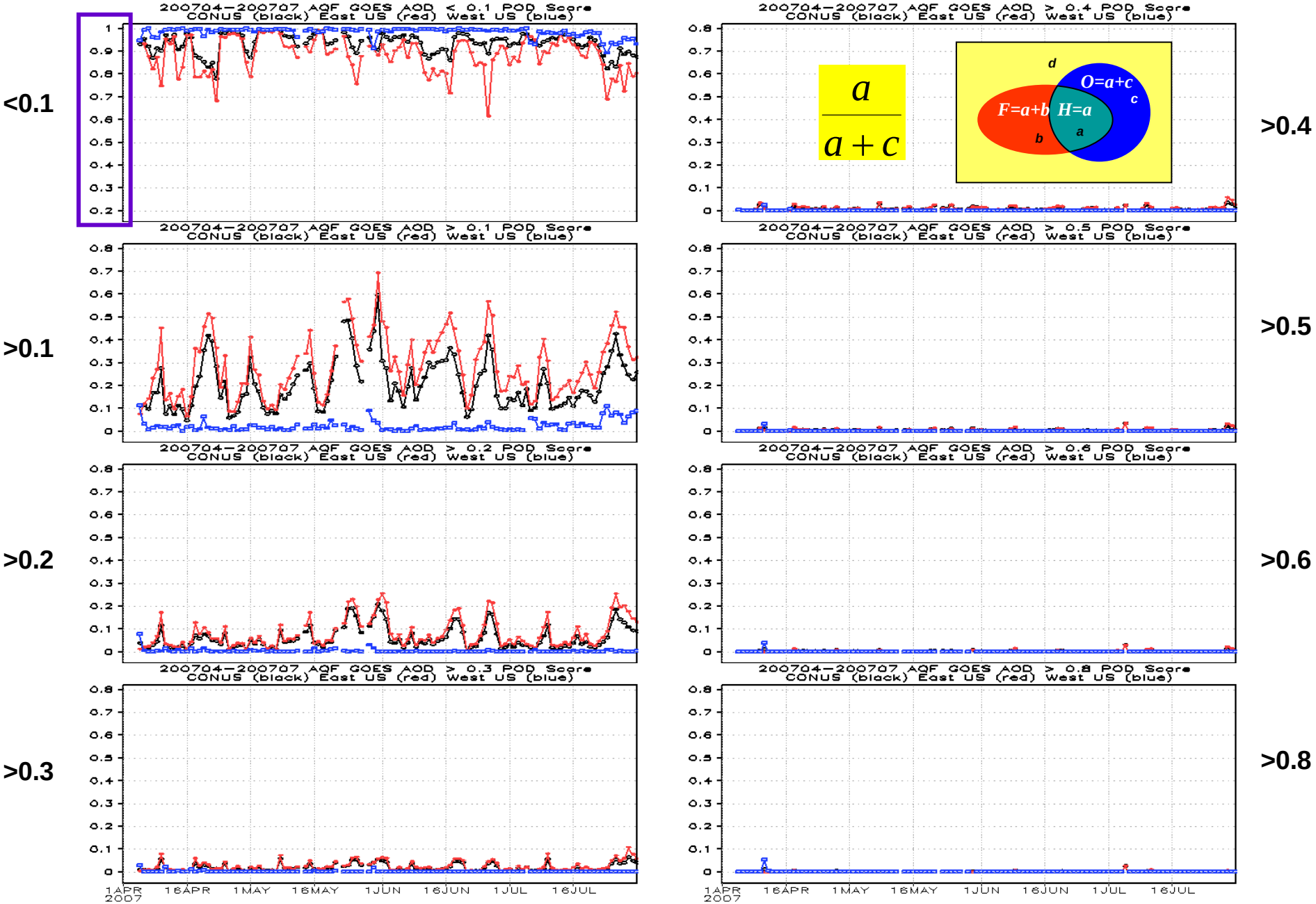
FHO AOD statistics: Apr – Jul 2007

BIAS

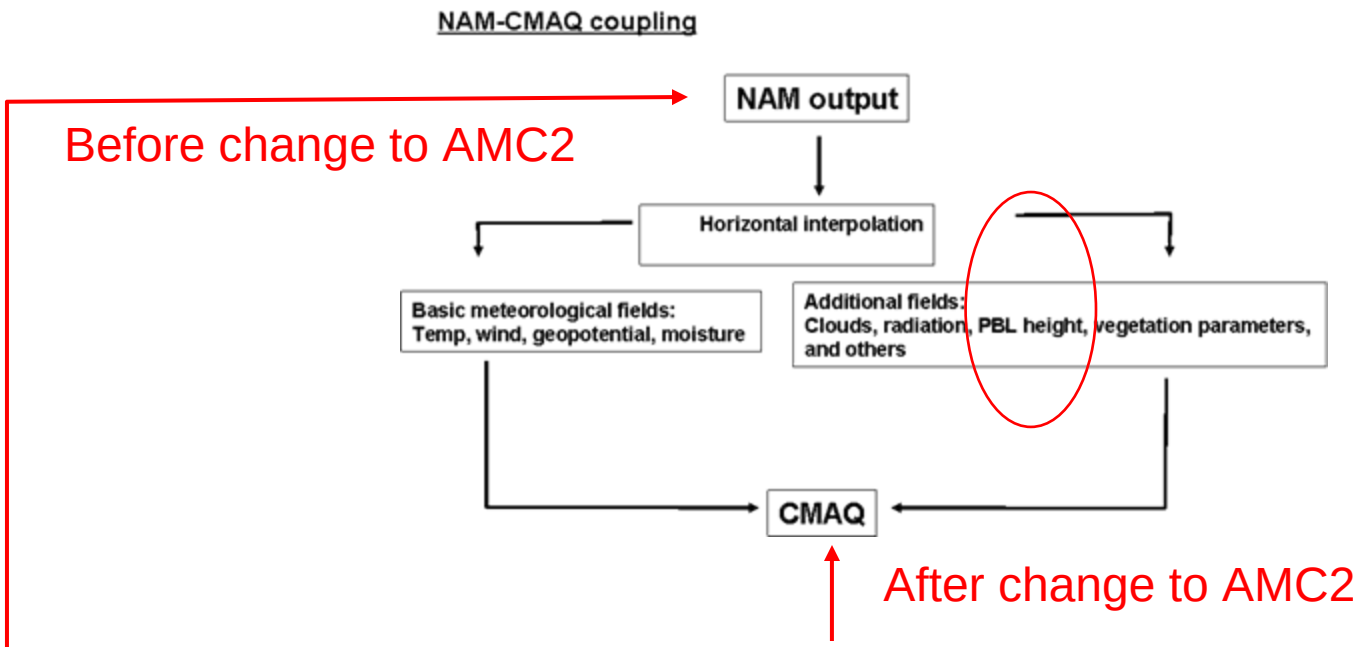


FHO AOD statistics: Apr – Jul 2007

POD



PBL HEIGHT ESTIMATION IN MODELS AND OBSERVATIONS



NAM:
TKE scheme

Post

+
Ri Number
(no fluxes)

CMAQ:
Critical Richardson
Number (with fluxes)

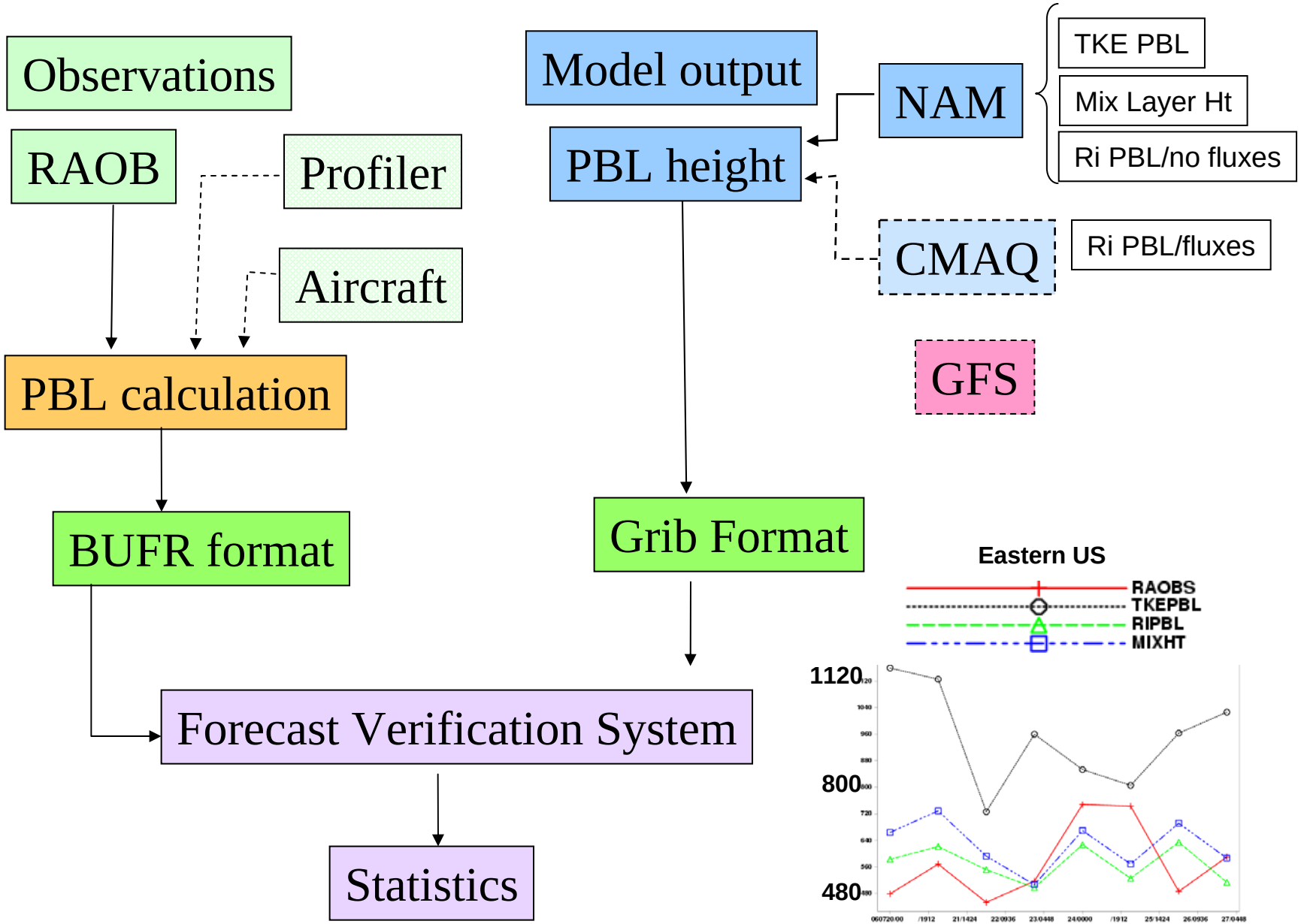
RADIOSONDES:
Critical Richardson
number (surface fluxes set to zero)

$$Ri_B = \frac{gz(\theta(z)-\theta(s))}{\theta(s)\left[(u(z)-u(s))^2+(v(z)-v(s))^2+bu_*^2\right]}$$

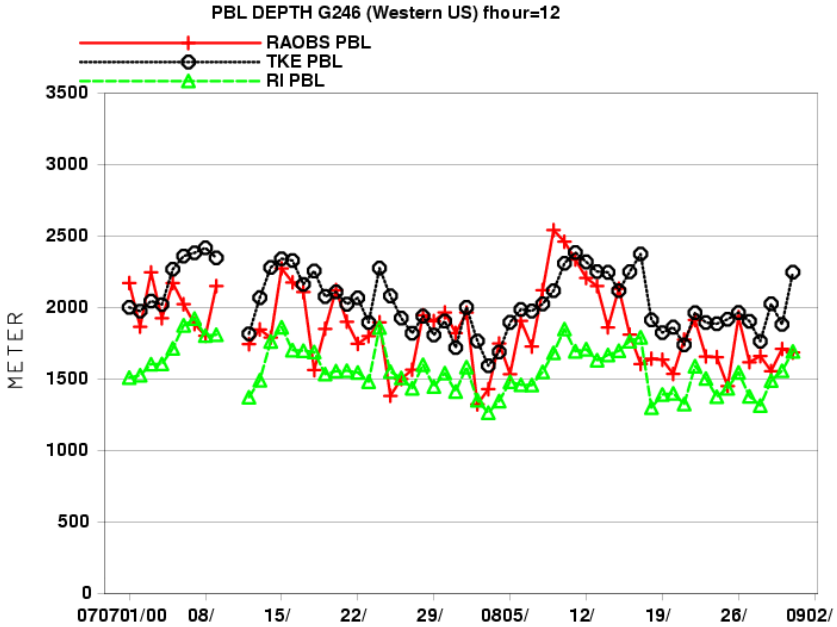
$$Ri_{CR} = 0.25$$

(Vogelezang and Holtslag, 1996)

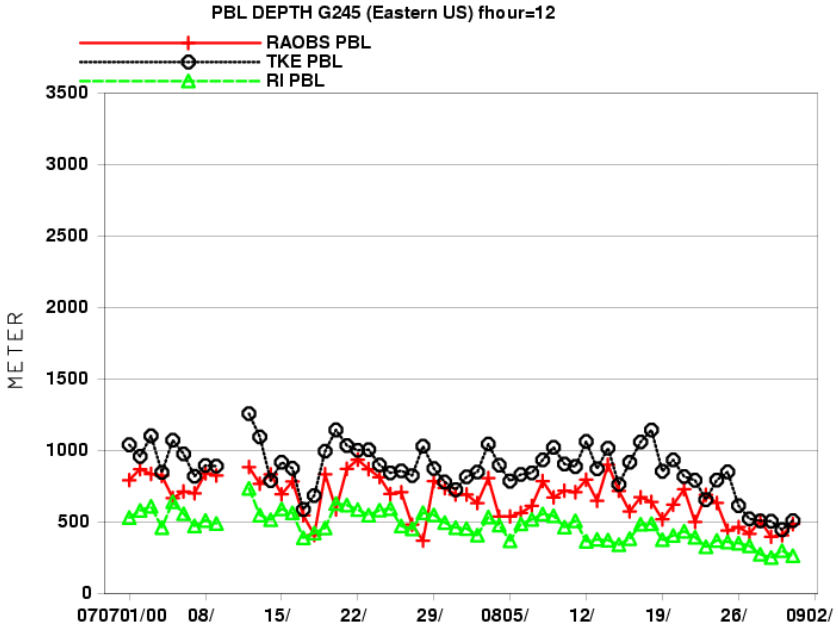
PBL Verification System



PBL Depth July 1 – Sep 2, 2007



Western US

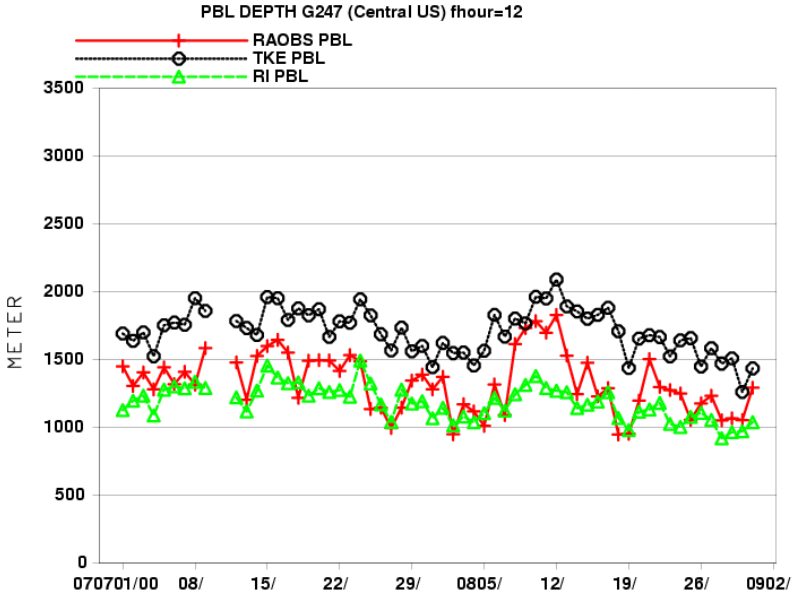


Eastern US

TKE PBL

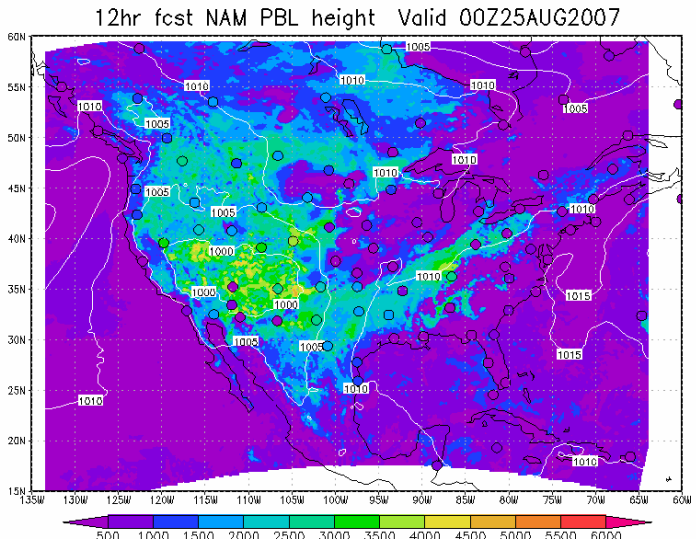
RI PBL

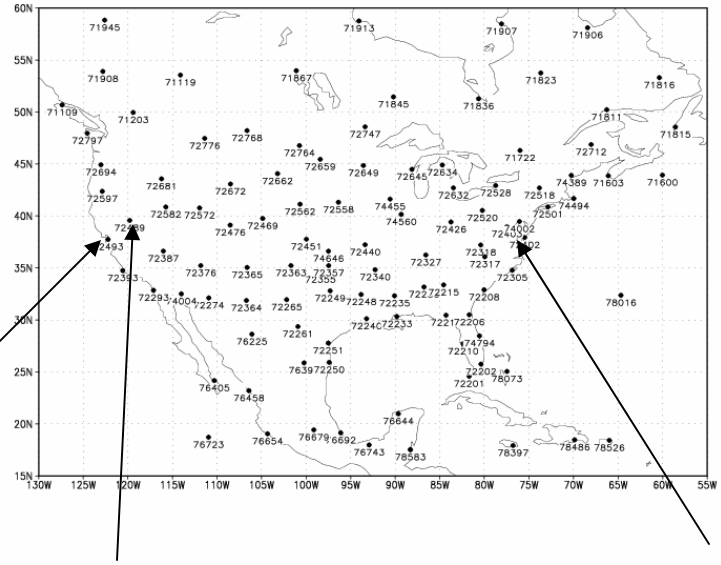
RAOBS

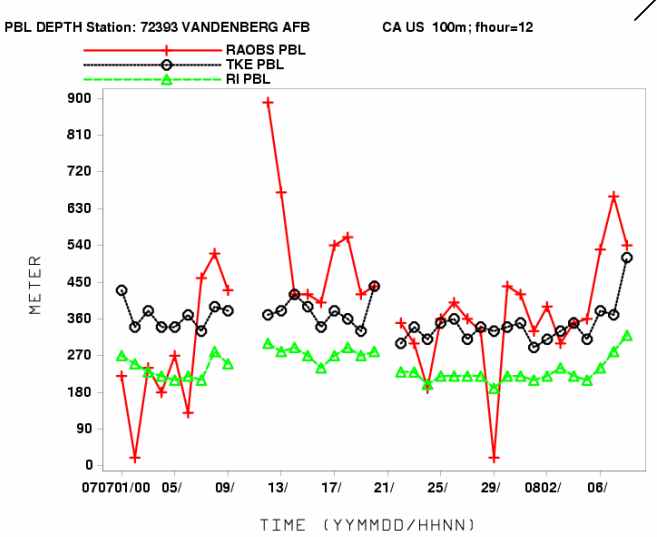


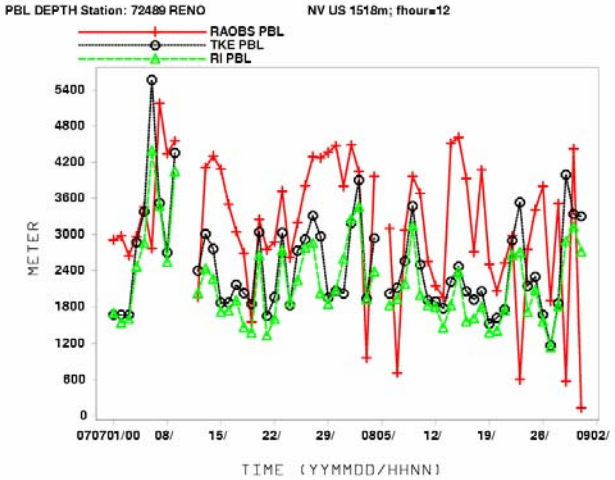
Central US

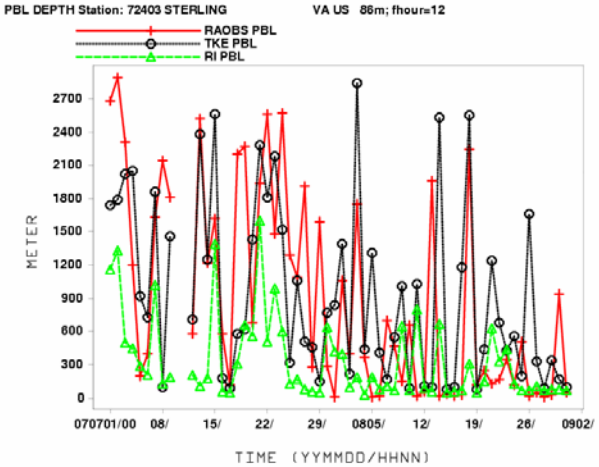
TKE PBL and RI PBL Verification





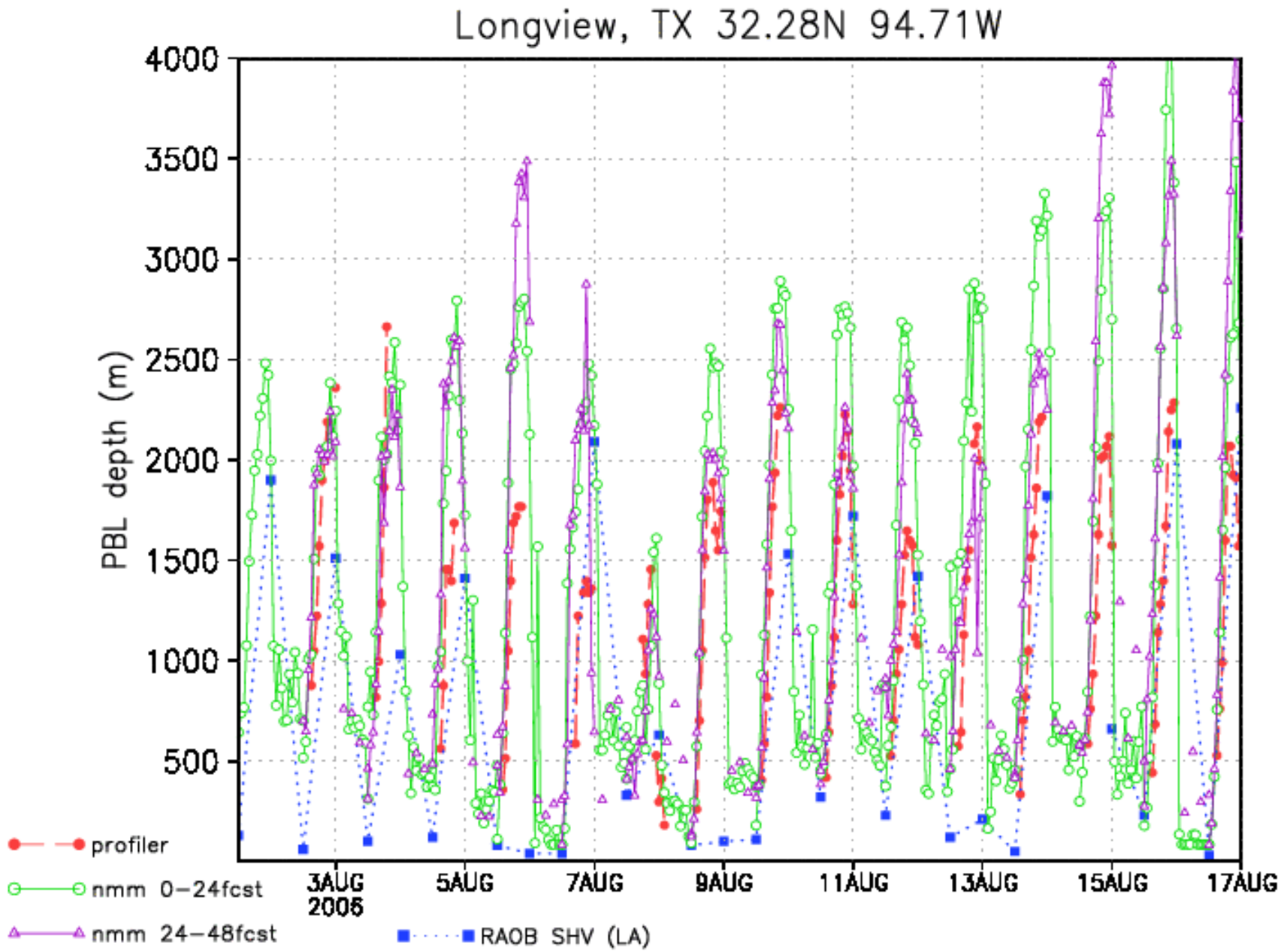




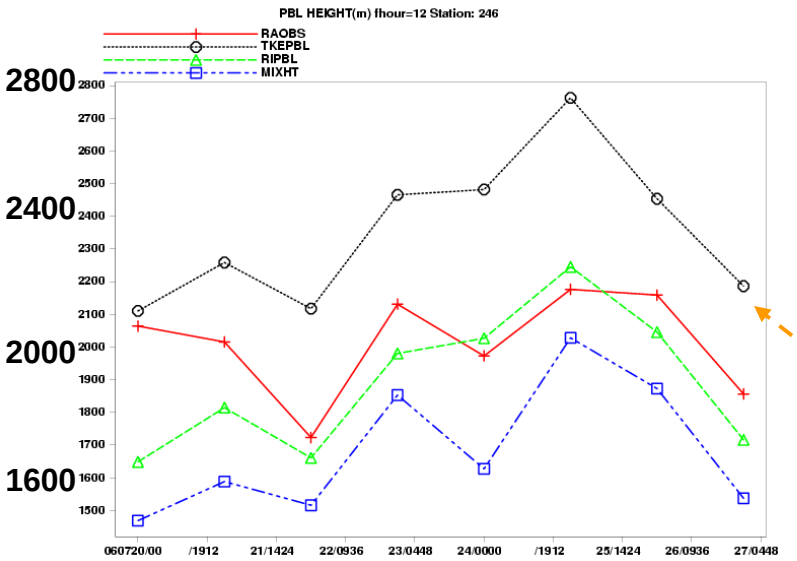


TKE PBL RI PBL RAOBS

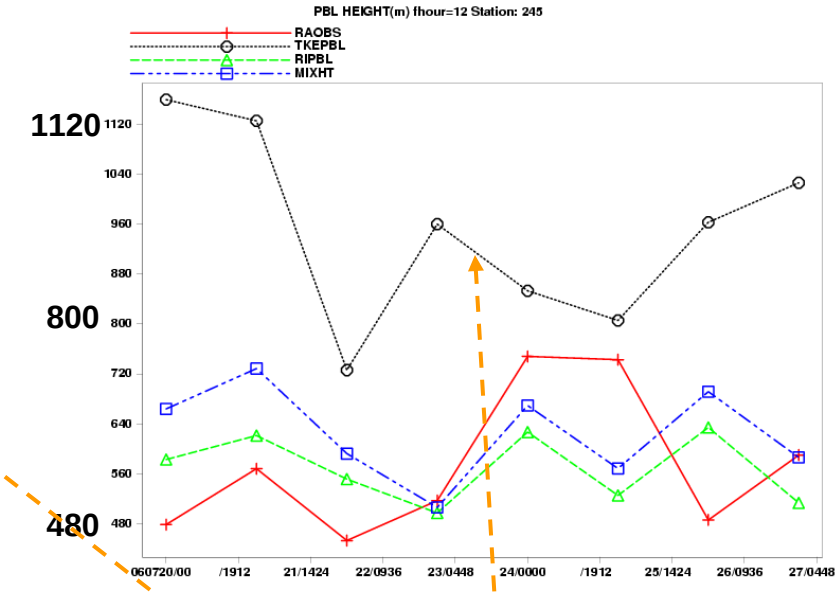
TexAQS 2006


Longview, TX 32.28N 94.71W
PBL depth (m)
4000
3500
3000
2500
2000
1500
1000
500
3AUG 2006
5AUG
7AUG
9AUG
11AUG
13AUG
15AUG
17AUG
profiler
nmm 0–24fcst
nmm 24–48fcst
RAOB SHV (LA)

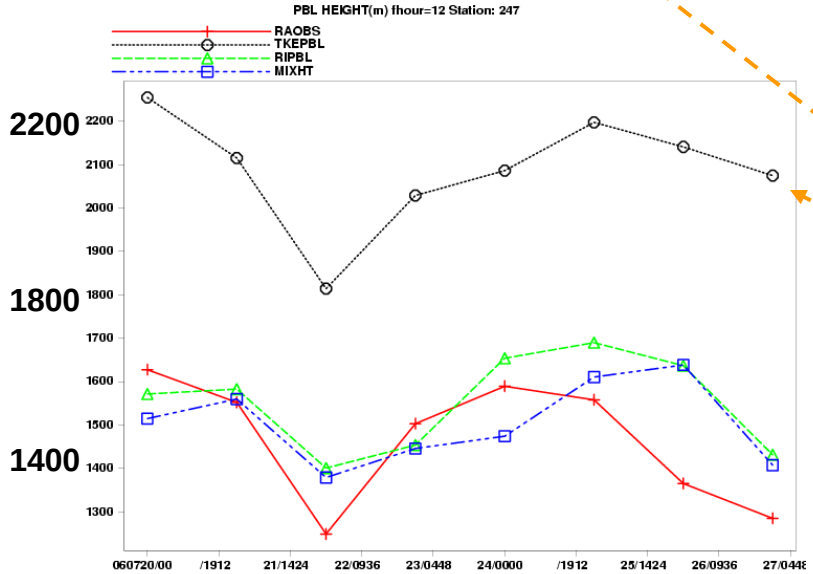
PBL Verification for retrospective tests: June 20-27, 2006



Western US



Eastern US



Central US

TKE PBL overprediction

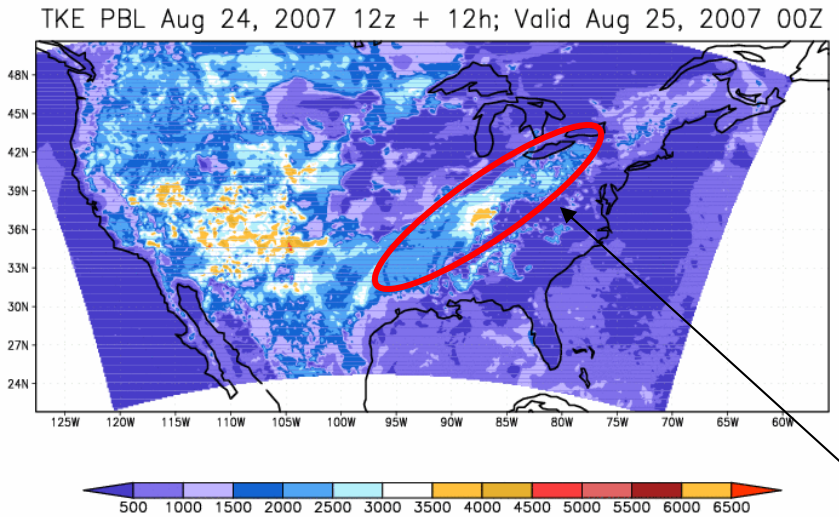
MX Height

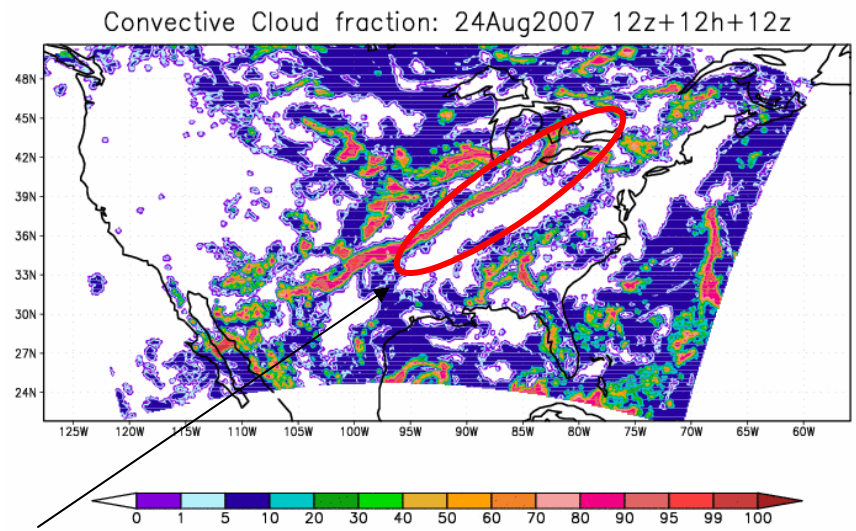
TKE PBL

RI PBL

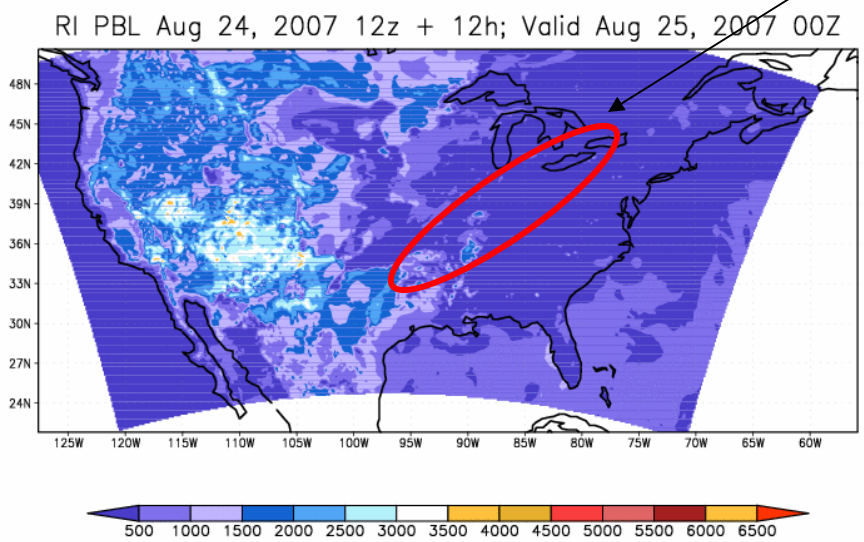
RAOBS

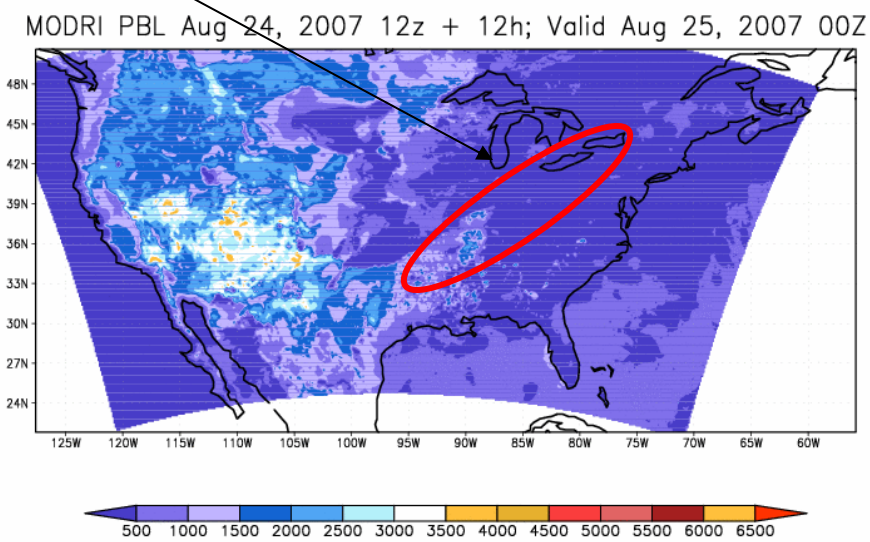
TKE, RI and MODRI PBL depth



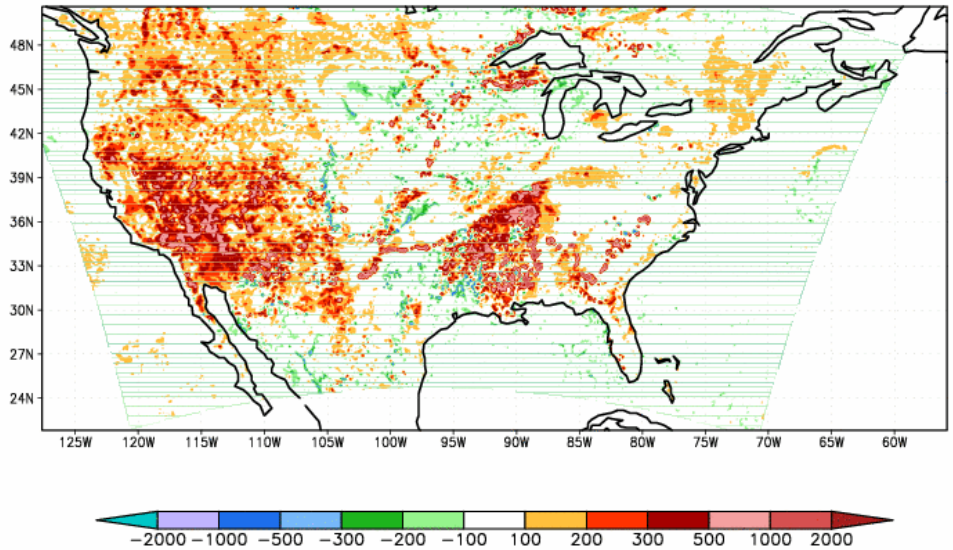


clouds

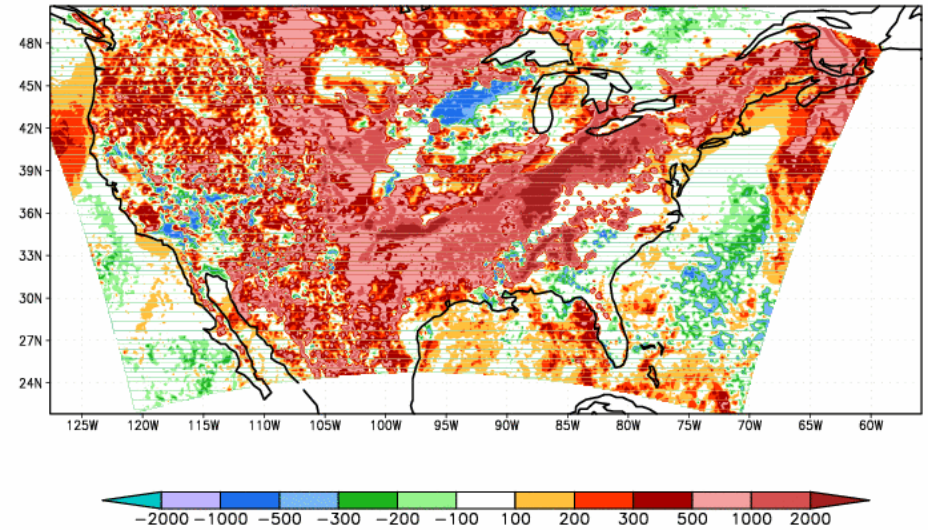




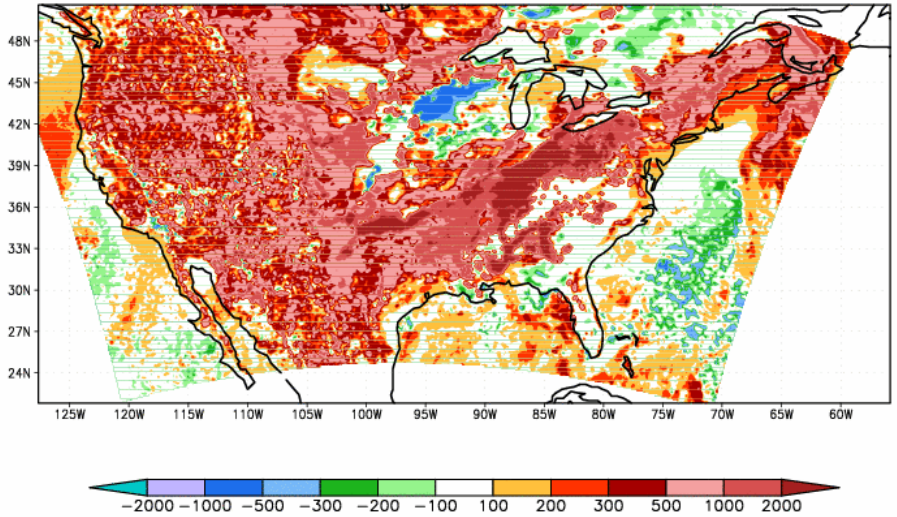
MODRI−RI PBL Aug 24, 2007 12z + 12h; Valid Aug 25, 2007 00Z

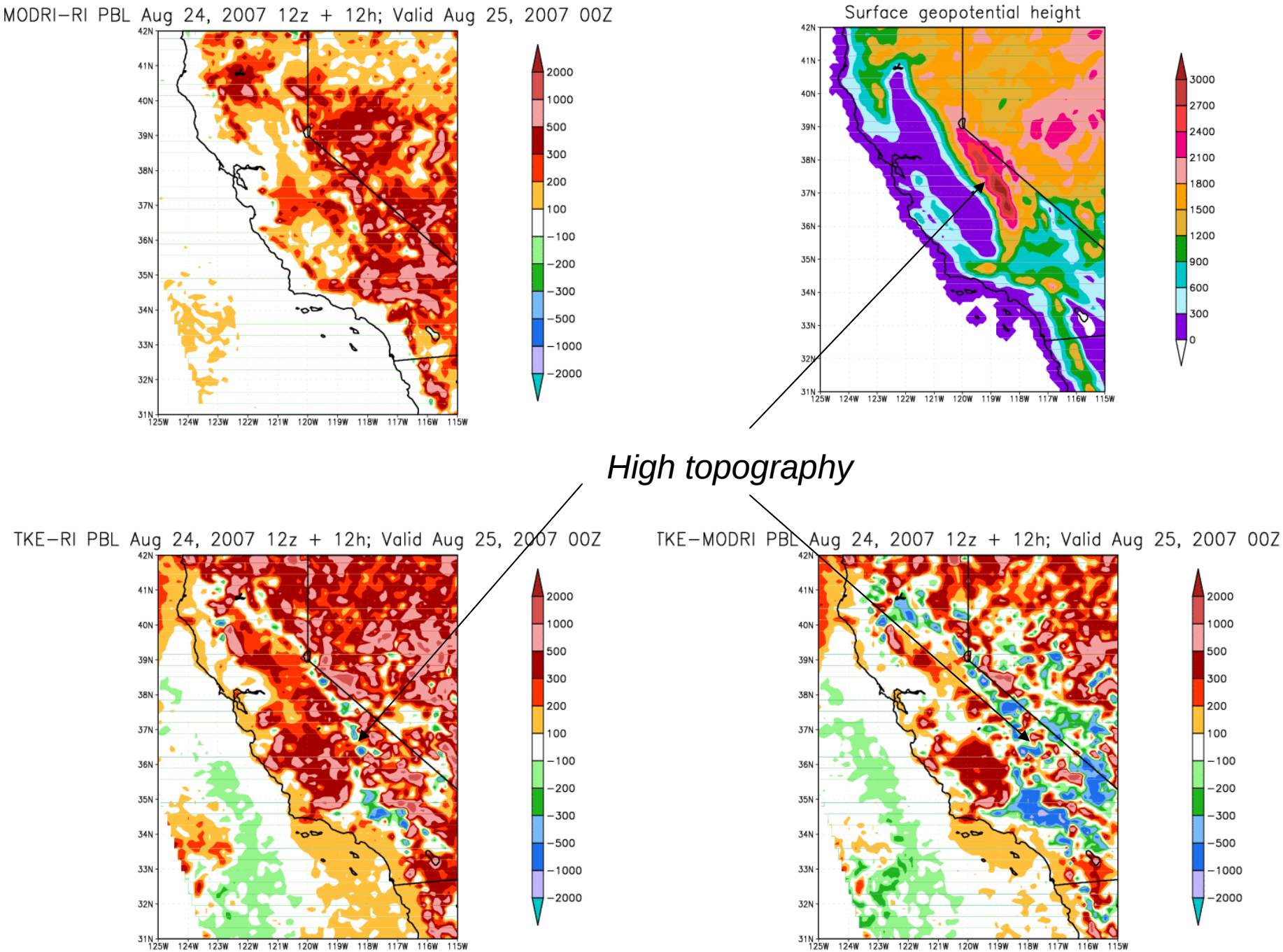


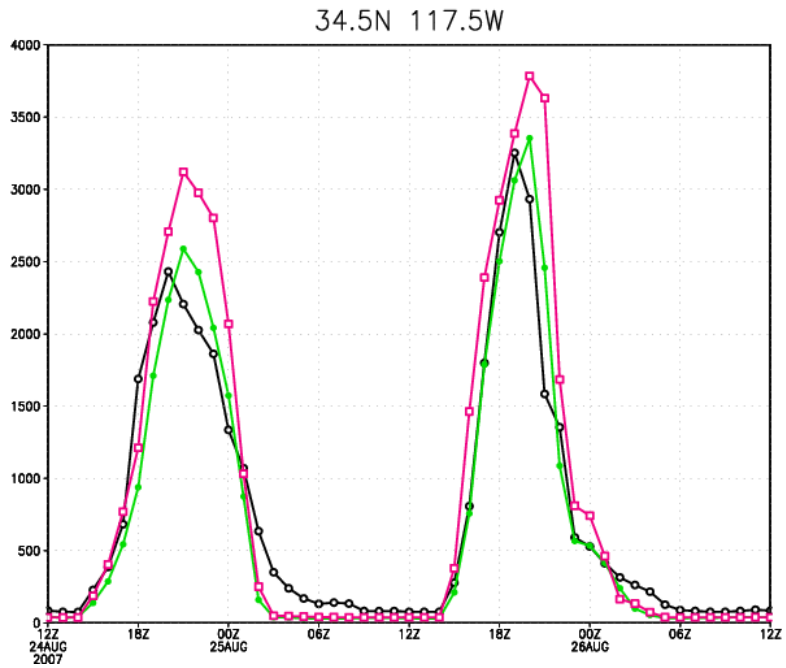
TKE−MODRI PBL Aug 24, 2007 12z + 12h; Valid Aug 25, 2007 0(

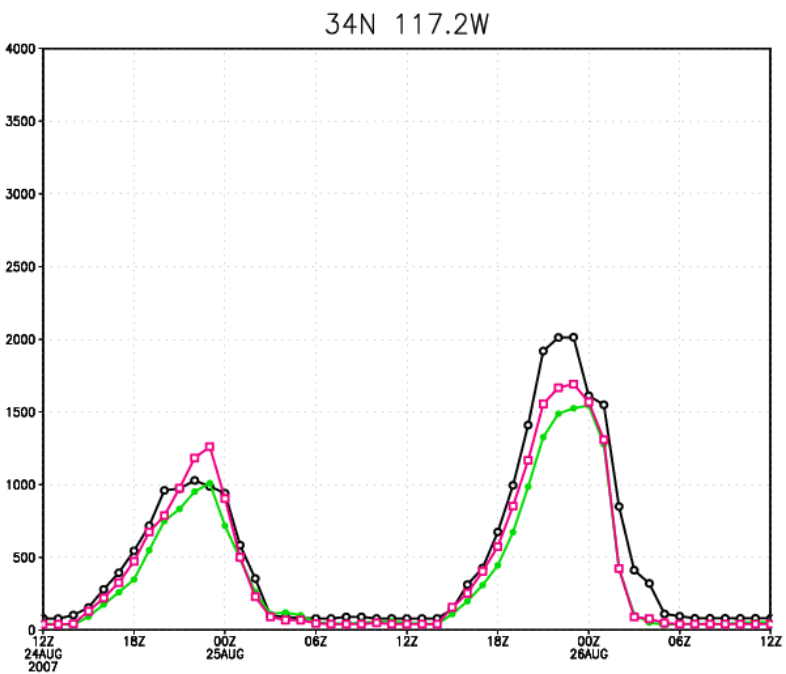


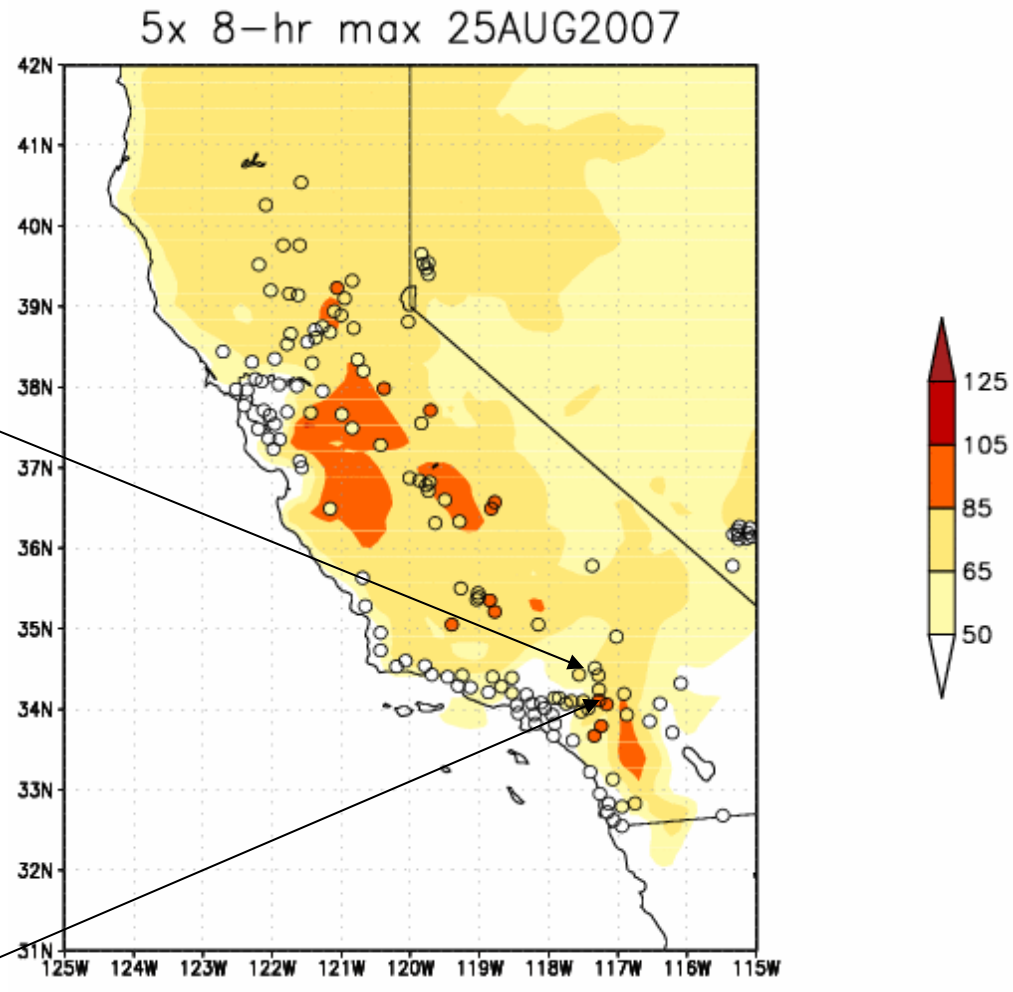
TKE−RI PBL Aug 24, 2007 12z + 12h; Valid Aug 25, 2007 00Z




MODRI−RI PBL Aug 24, 2007 12z + 12h; Valid Aug 25, 2007 00Z
Surface geopotential height
High topography
TKE−RI PBL Aug 24, 2007 12z + 12h; Valid Aug 25, 2007 00Z
TKE−MODRI PBL Aug 24, 2007 12z + 12h; Valid Aug 25, 2007 00Z
42N 41N 40N 39N 38N 37N 36N 35N 34N 33N 32N 31N
125W 124W 123W 122W 121W 120W 119W 118W 117W 116W 115W
2000 1000 500 300 200 100 −100 −200 −300 −500 −1000 −2000
3000 2700 2400 2100 1800 1500 1200 900 600 300 0



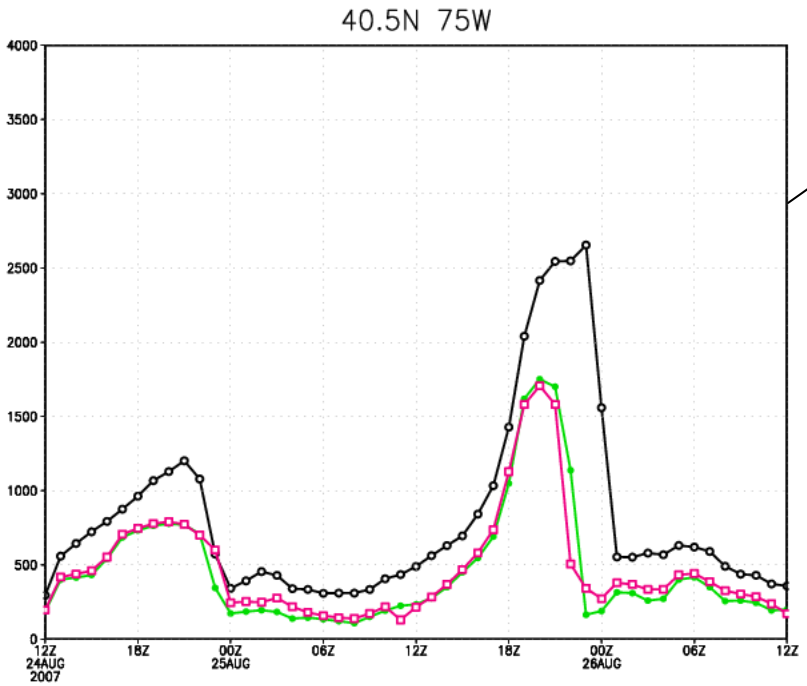


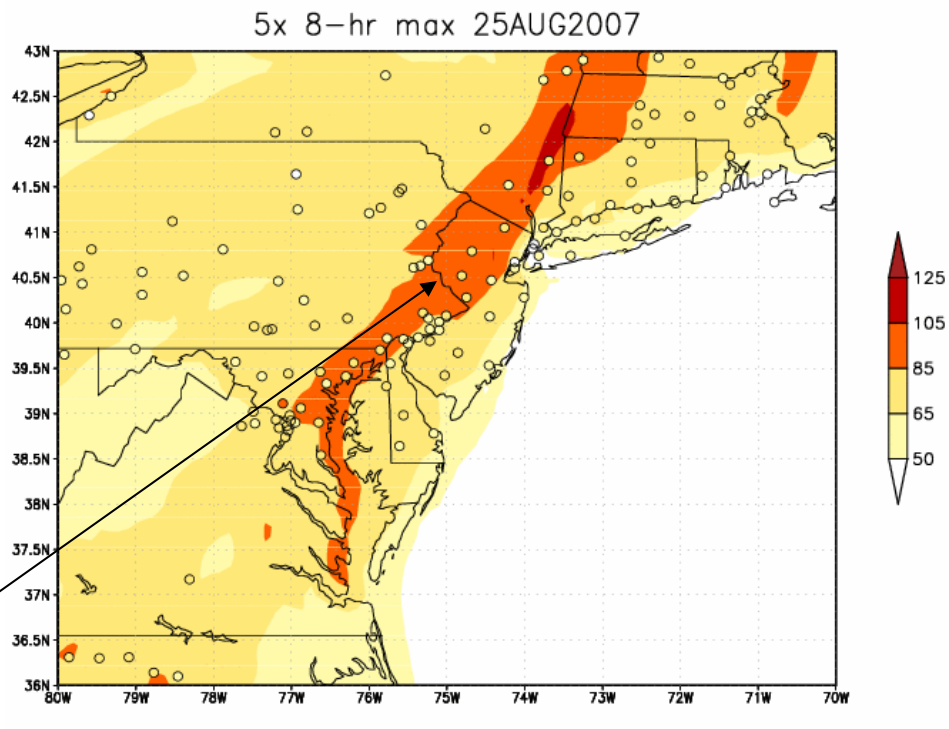


TKE PBL

RI PBL

MODRI PBL





TKE PBL

RI PBL

MODRI PBL

Summary and Future Work

OZONE:

- **Ozone bias improved in experimental 5x CMAQ**
- **CMAQ has negative bias over SW sub-domain, especially LA**

AOD:

- **AOD is added to Verification System at NCEP**

PBL:

- **Ri number based PBL is added to Verification System at NCEP**

PLANS:

- **Add Aircraft (ACARS) data to PBL Verification (much more frequent than twice/day RAOBS data)**
- **Add Mixed Layer Height and ModRi based PBL to Verification**
- **Add PM 2.5 to Verification**