NAQFC Upgrades

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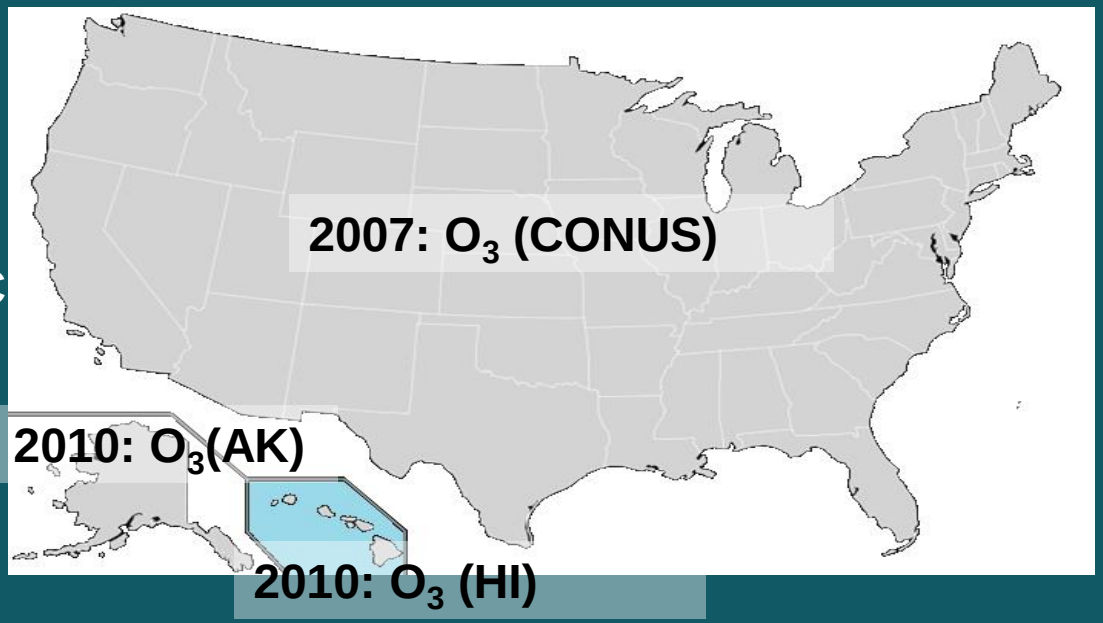
Current NAQFC: ops

Chemical Transport Model:

- **CMAQ4.5.2** for **CONUS**
  - CBIV gas chemistry
  - LBC: Static EPA 2001 annual
  - **O_3 product dissemination: TOC**
- **CMAQ4.6.2** for **AK & HI**
  - CB05 gas chemistry
  - Aero4 aerosol chemistry
  - LBC: Static from GEOS-CHEM
  - **O_3 product dissemination: TOC**



O_3 Performance (FVS by NCO):

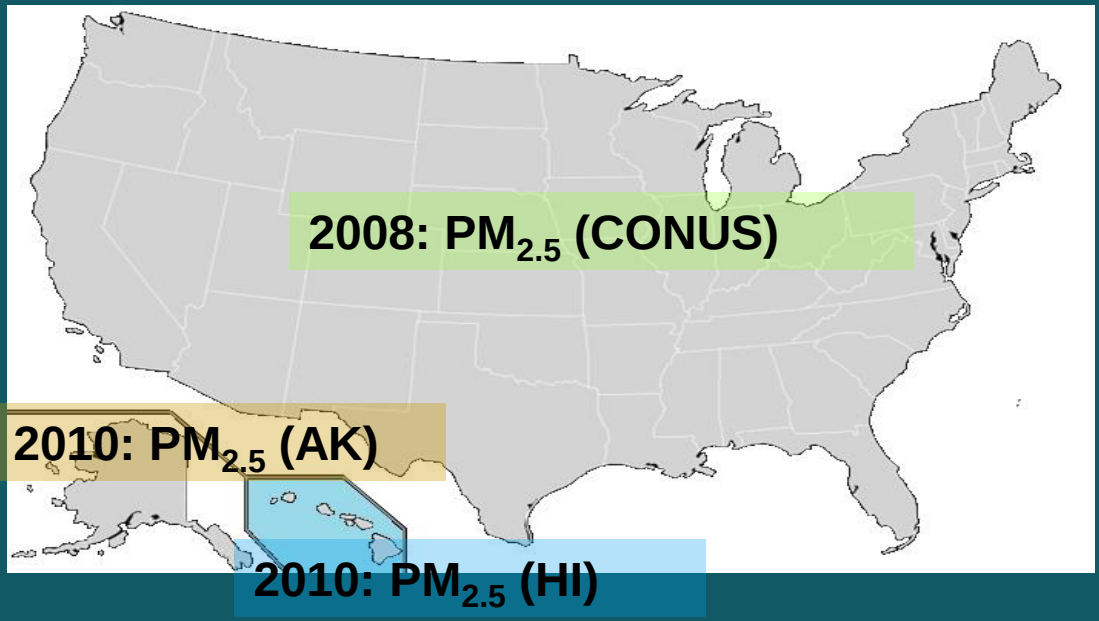
Max Daily 8h O_3 for domains above: Bias, RMSE, and % Hit Rate

Feed of EPA AIRNow O_3 and $PM_{2.5}$ in Bufr format

Current NAQFC: expr/dev

Chemical Transport Model:

- **CMAQ4.6.2** for **CONUS, AK & HI**
  - CB05 gas chemistry
  - Aero4 aerosol chemistry
  - LBC: Static from GEOS-CHEM
  - PBL Min-value constraint
  - Vdry-dep update
  - **PM2.5 product dissemination: Graphics on web**



$PM_{2.5}$ Performance (Exceedance w.r.t 35 µg/m^3 by MDL & EMC):
24 h averaged $PM_{2.5}$ for the above domains: Bias, RMSE, and % Hit Rate

Q1-FY15 NAQFC Upgrades

Significant impact on O_3 forecast –CMAQ4.6.3

- Gas-phase chemistry: Carbon Bond 4 (CBIV) ⟹ CB05 for CONUS
- Faster removal of organic nitrate -- NTR (Saylor and Stein, GMD 2012)

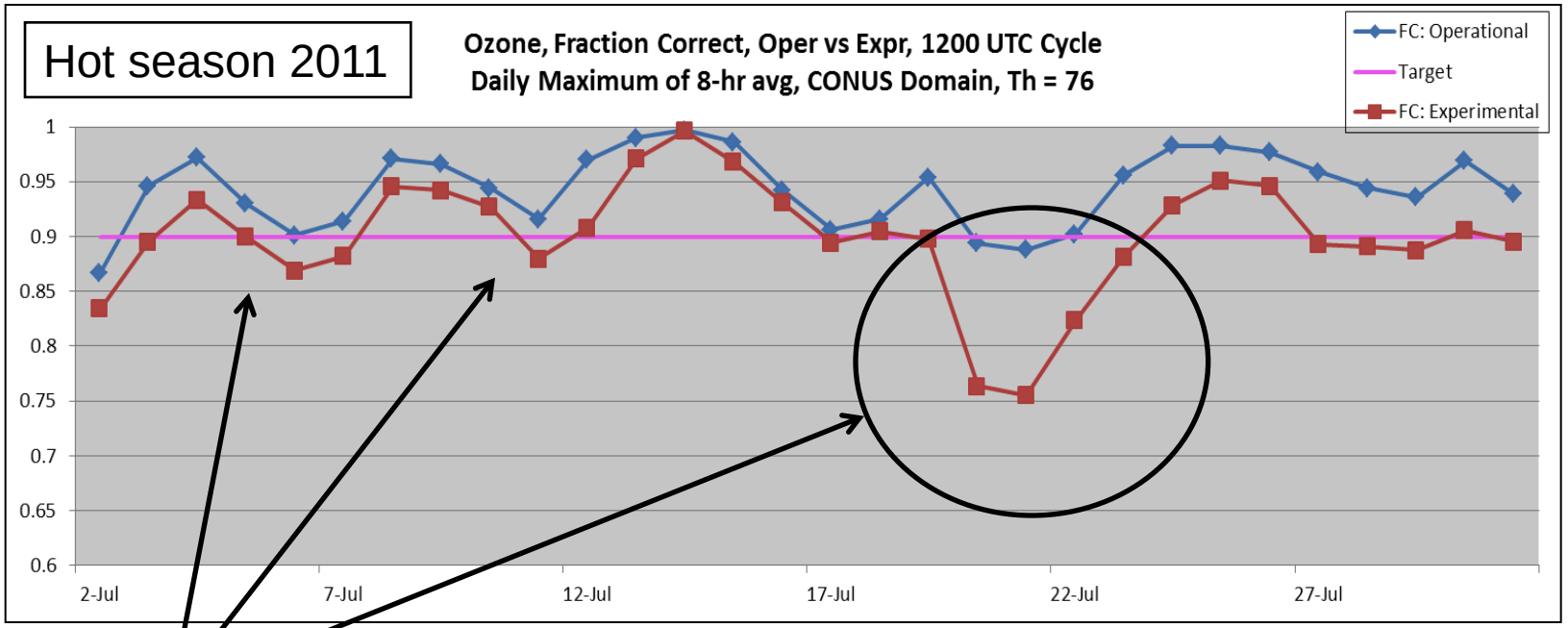
Significant impact on $PM_{2.5}$ forecast – CMAQ4.6.3

- Implement AERO-4 for CONUS
- Fugitive dust emissions modulated by snow – emission off if snow cover
- NESDIS Hazard Mapping System wild fires and fuel from USFS BlueSky
- Dynamic emission fluxes for windblown dust (Tong and Lee et al., ACP 2012,AE2015)

Q1 FY15 NAQFC-O_3 Upgrades

Significant impact on O_3 forecast –CMAQ4.6.3

➢**Gas-phase chemistry: Carbon Bond 4 (CBIV)** ➡ **CB05 for CONUS**



Courtesy: Ivanka Stajner

CB05 over-predicts surface O3 considerably due to over-recycling of NTR (Saylor and Stein, GMD 2012)

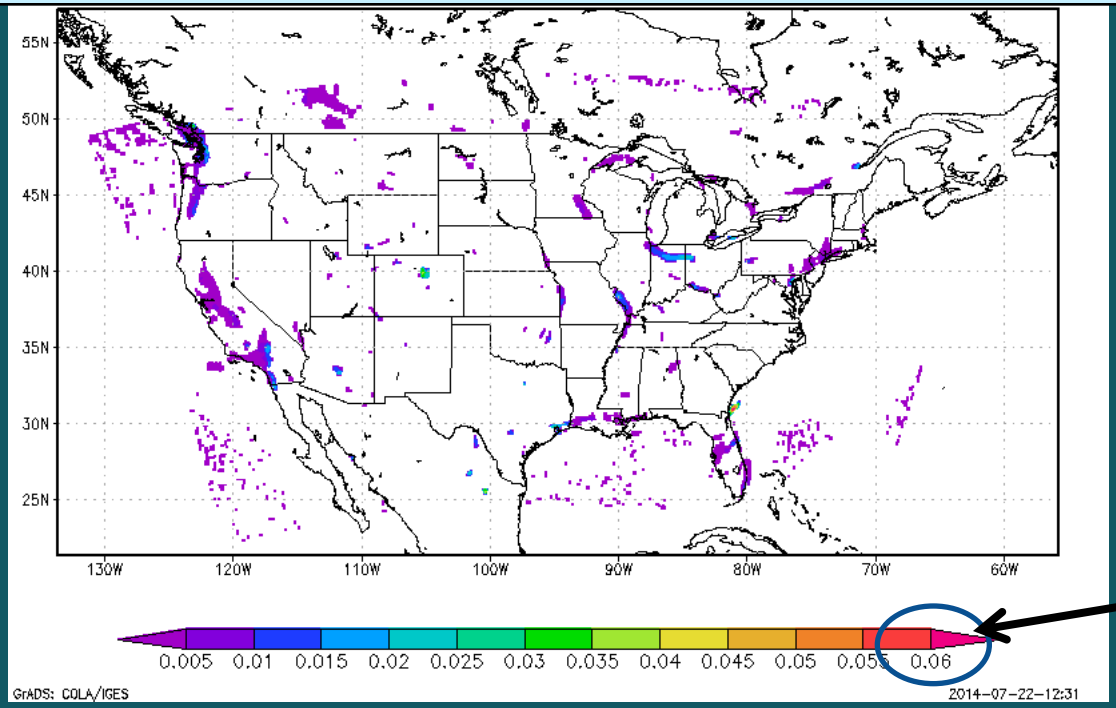
Q1 FY15 NAQFC-O_3 Upgrades

Significant impact on O_3 forecast –CMAQ4.6.3

- Gas-phase chemistry: Carbon Bond 4 (CBIV) ➡ CB05 for CONUS
- **Faster removal of organic nitrate -- NTR**

Hot season sensitivity cases: Same NMMB, initializations,

NTR modified (CMAQ4.6.3) minus Original NTR (CMAQ4.6.2)



12UTC cycle simulation +6h Valid at 18UTC July 15 2014

0.06ppb (small)

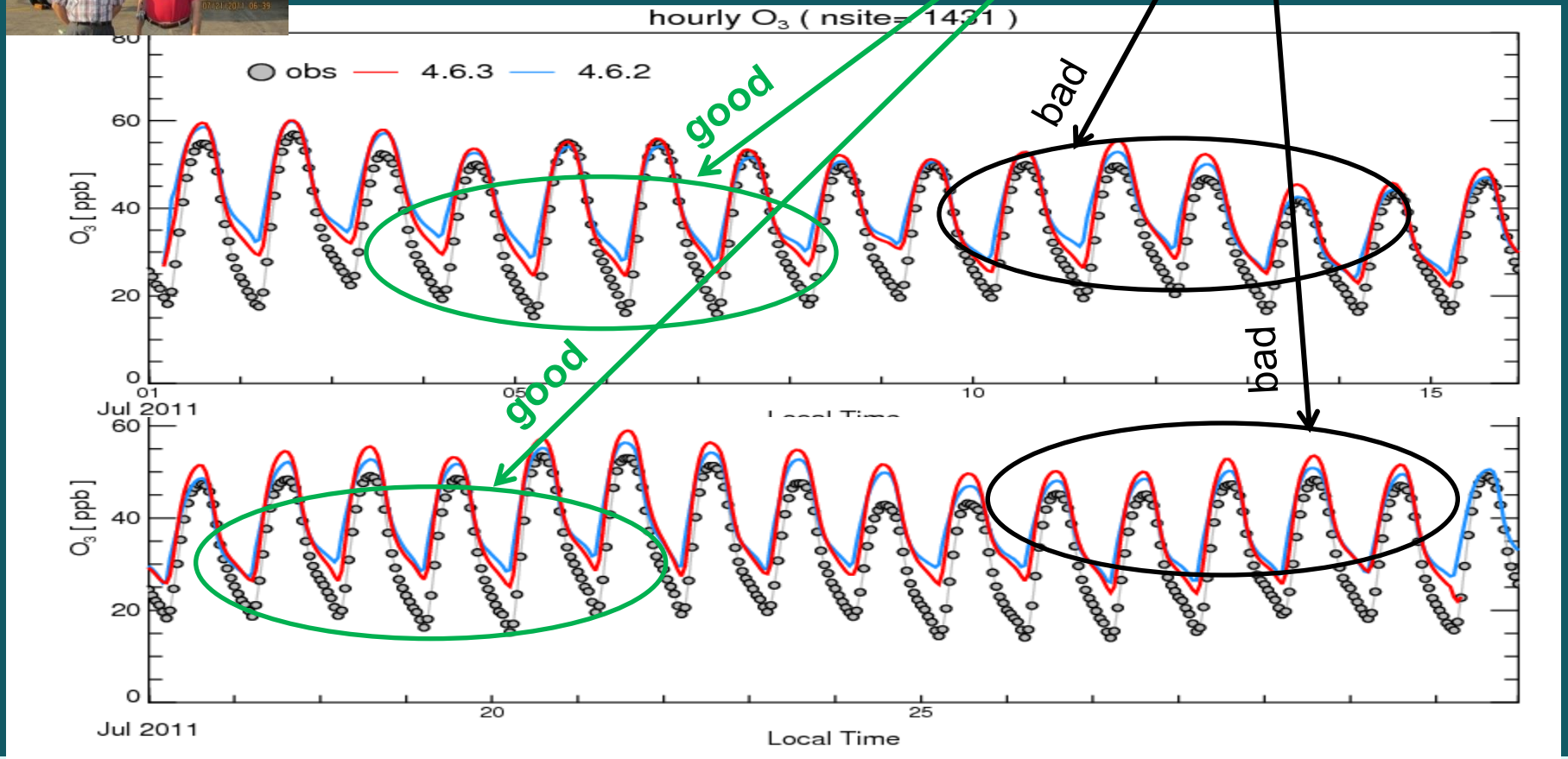
Q1 FY15 NAQFC-O_3 Upgrades

Significant impact on O_3 forecast –CMAQ4.6.3

➢**Faster removal of organic nitrate -- NTR**

Mixed results over CONUS

DISCOVER-AQ (hot seaon July 2011): NMMB, one cycle/day,



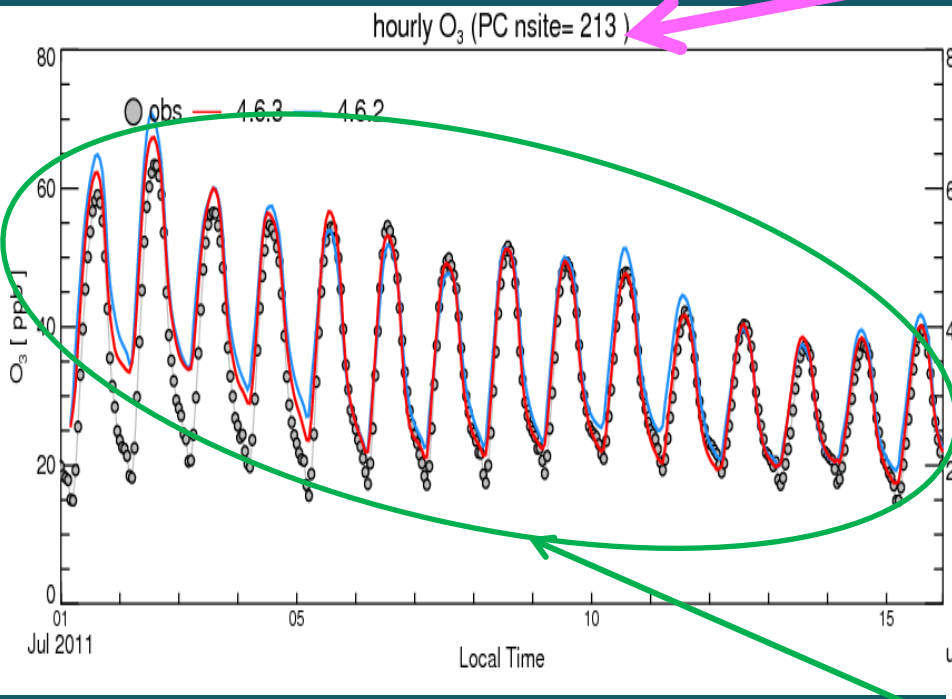
Emission: Li & Tong et al. AE 2014)

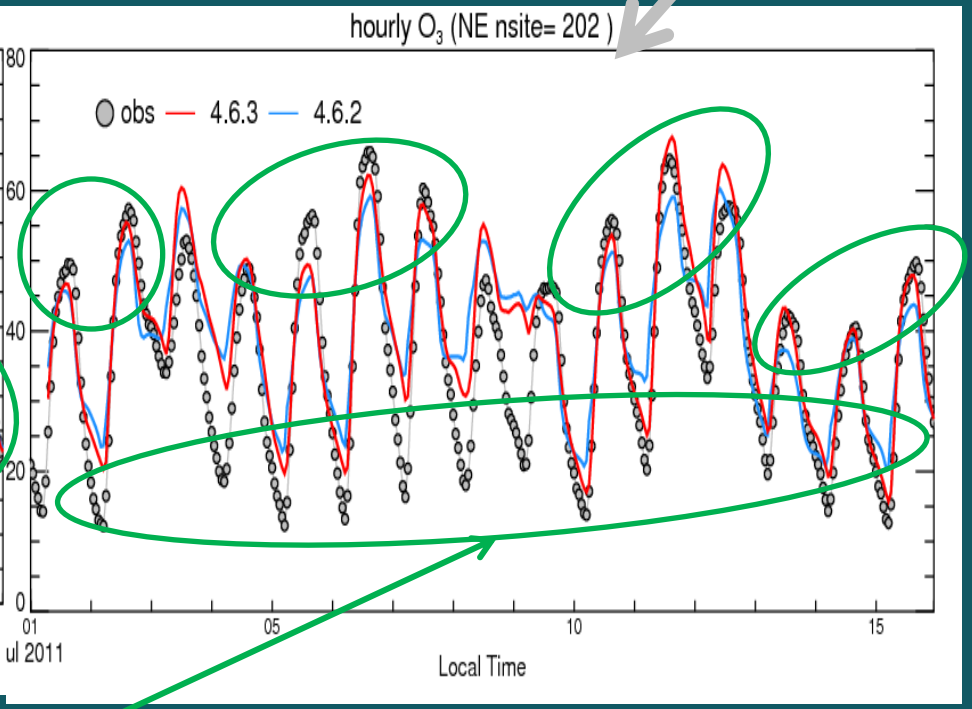
Q1 FY15 NAQFC-O_3 Upgrades

Significant impact on O_3 forecast –CMAQ4.6.3

➢**Faster removal of organic nitrate -- NTR**

Hot season sensitivity cases (July 2011): NMMB, one cycle/day;



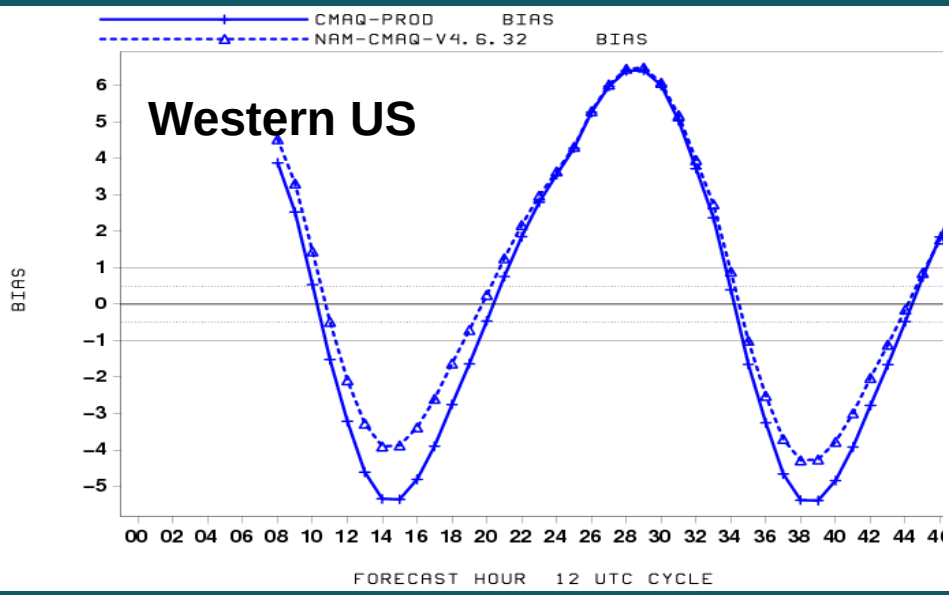


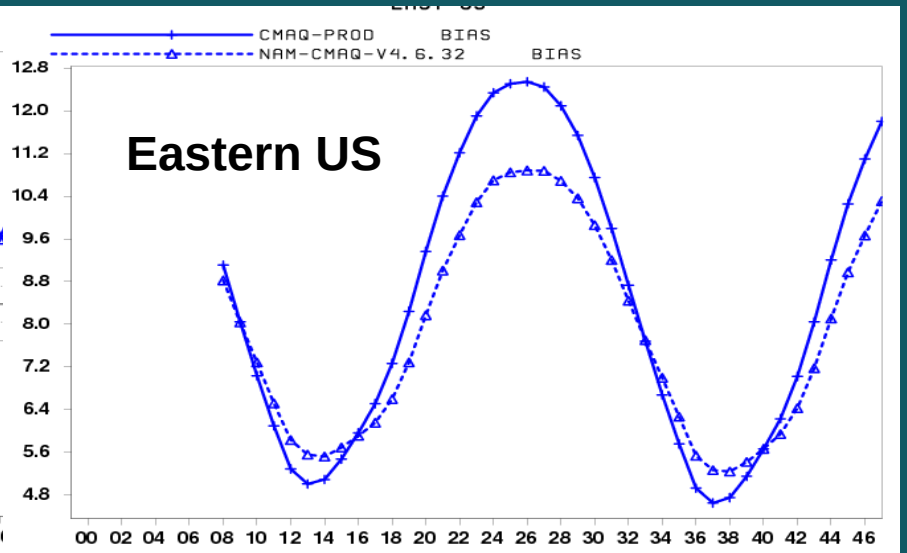
Improvement in PC and NE as monitors are predominantly over urban sites

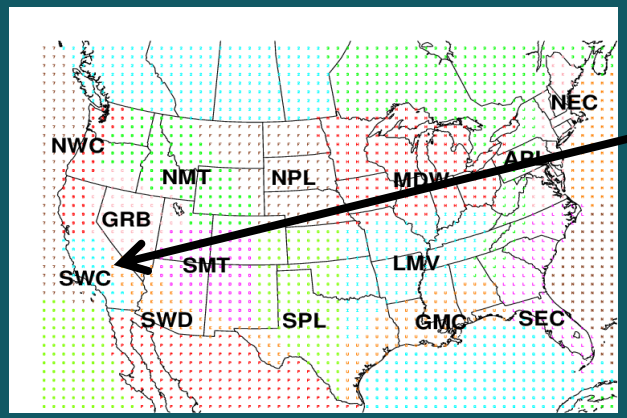
Impact: O_3 performance: Upgraded v. ops

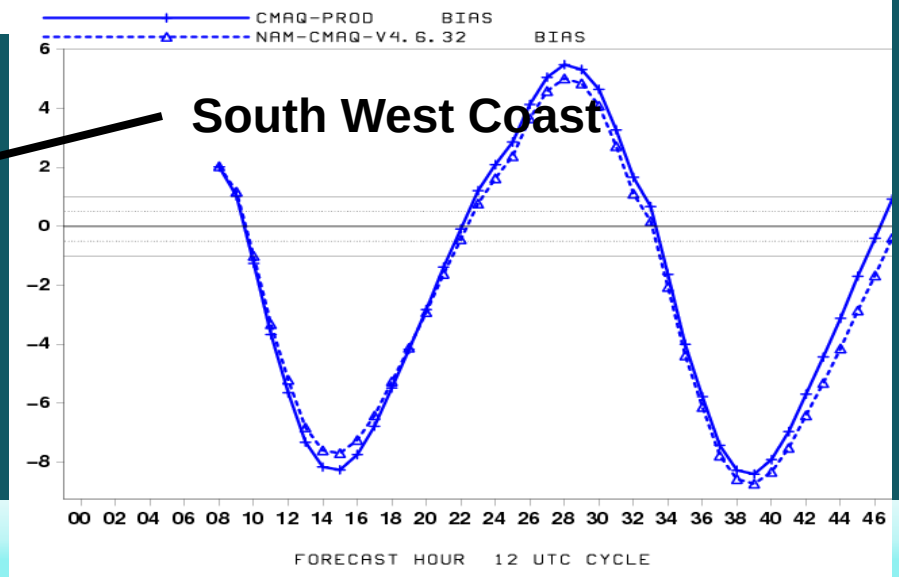
FVS: Between July 15 – August 30, 2014 ~ 45 days

O_3 over-prediction in Operational sys reduced









Q1 FY15 NAQFC-PM Upgrades (2)

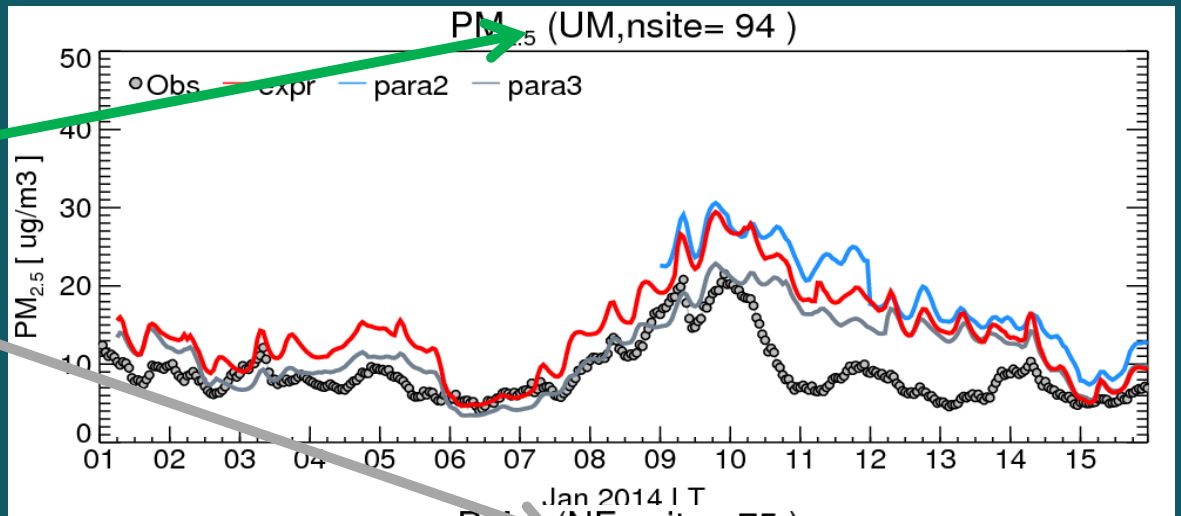
Significant impact on $PM_{2.5}$ forecast – CMAQ4.6.3

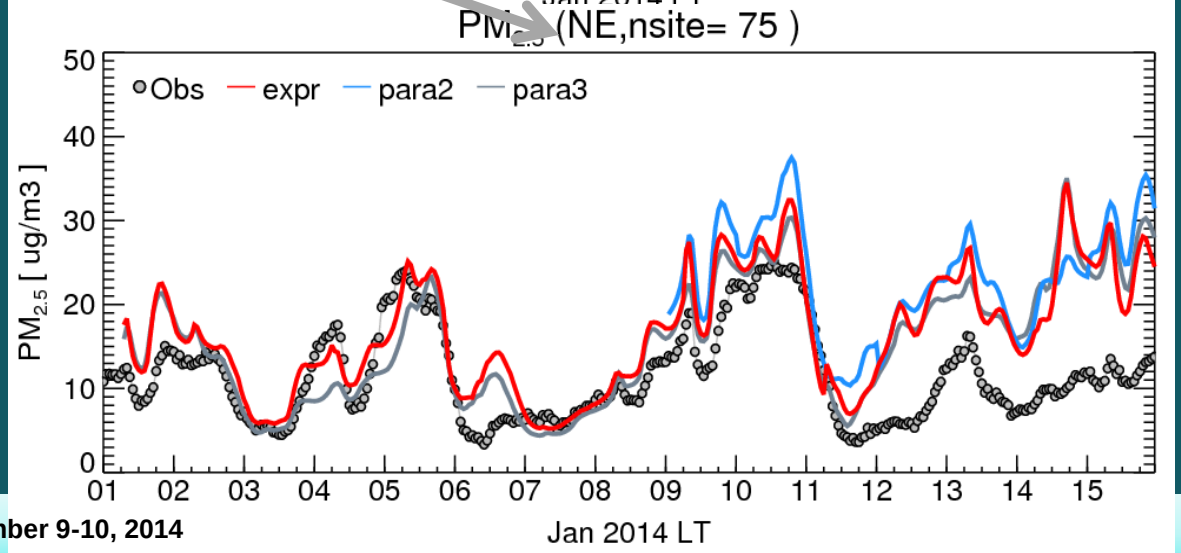
- Implement AERO-4 for CONUS
- **Fugitive dust emissions modulated by snow** – emission off if snow cover

Test Jan 2014

Sensitivity nomenclature

- **expr = cmaq4.6.2**
- **para2 = expr + new NMMB**
- **para3 = para2 +ice/snow-modulation**



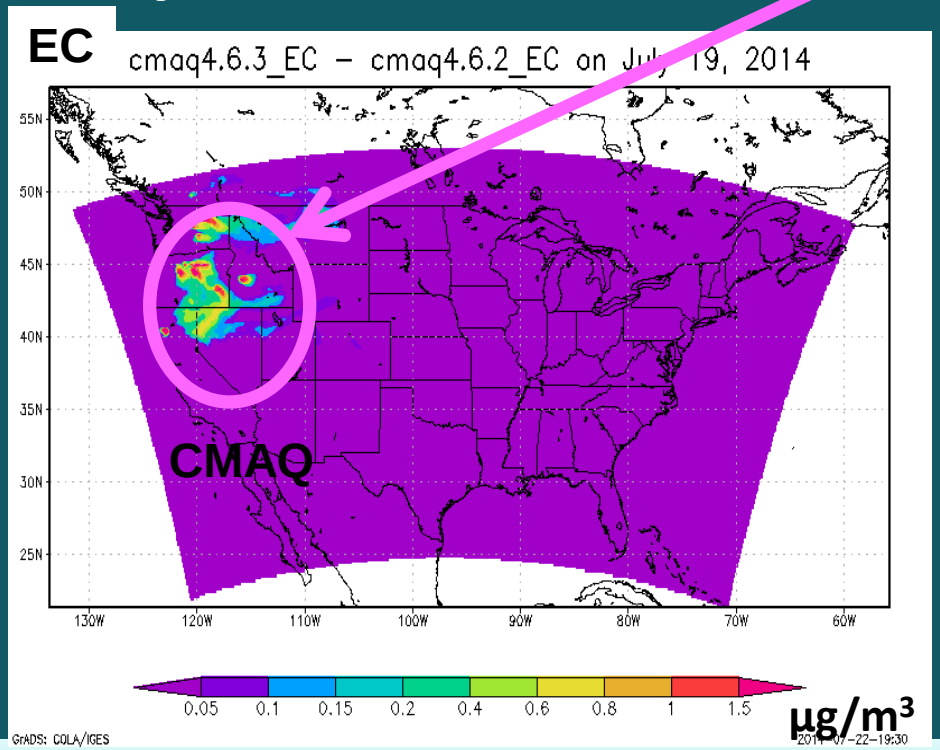


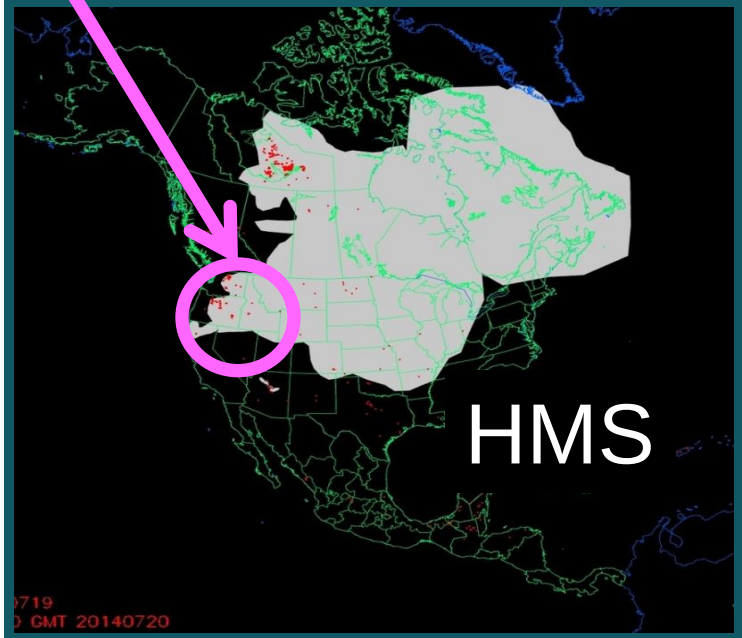
Q1 FY15 NAQFC-PM Upgrades (3)

Significant impact on $PM_{2.5}$ forecast – CMAQ4.6.3

- **NESDIS Hazard Mapping System** wild fires and fuel from USFS BlueSky

NESDIS TEXT on smoke plumes from wild fires on **July 19, 2014**
Smoke is visible … Northwest Territories, northern Saskatchewan, Washington, and Oregon. .. much of central Canada recorded wildfire smoke plumes. In **U.S. wildfires in Washington/Oregon** are combining throughout northwestern and north-central U.S.





Q1 FY15 NAQFC-PM Upgrades (3)

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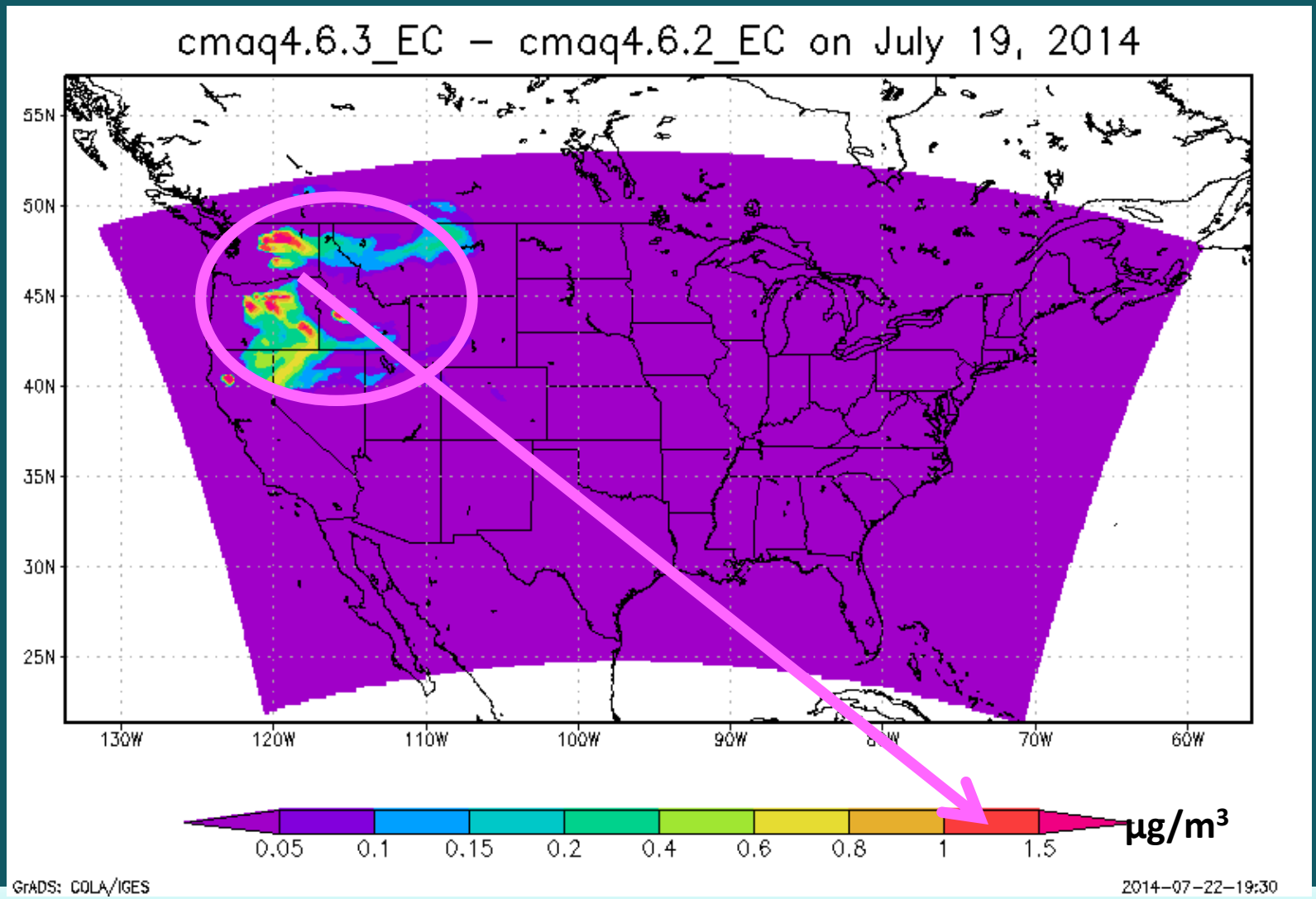
- NESDIS Hazard Mapping System wild fires and fuel from **USFS BlueSky**

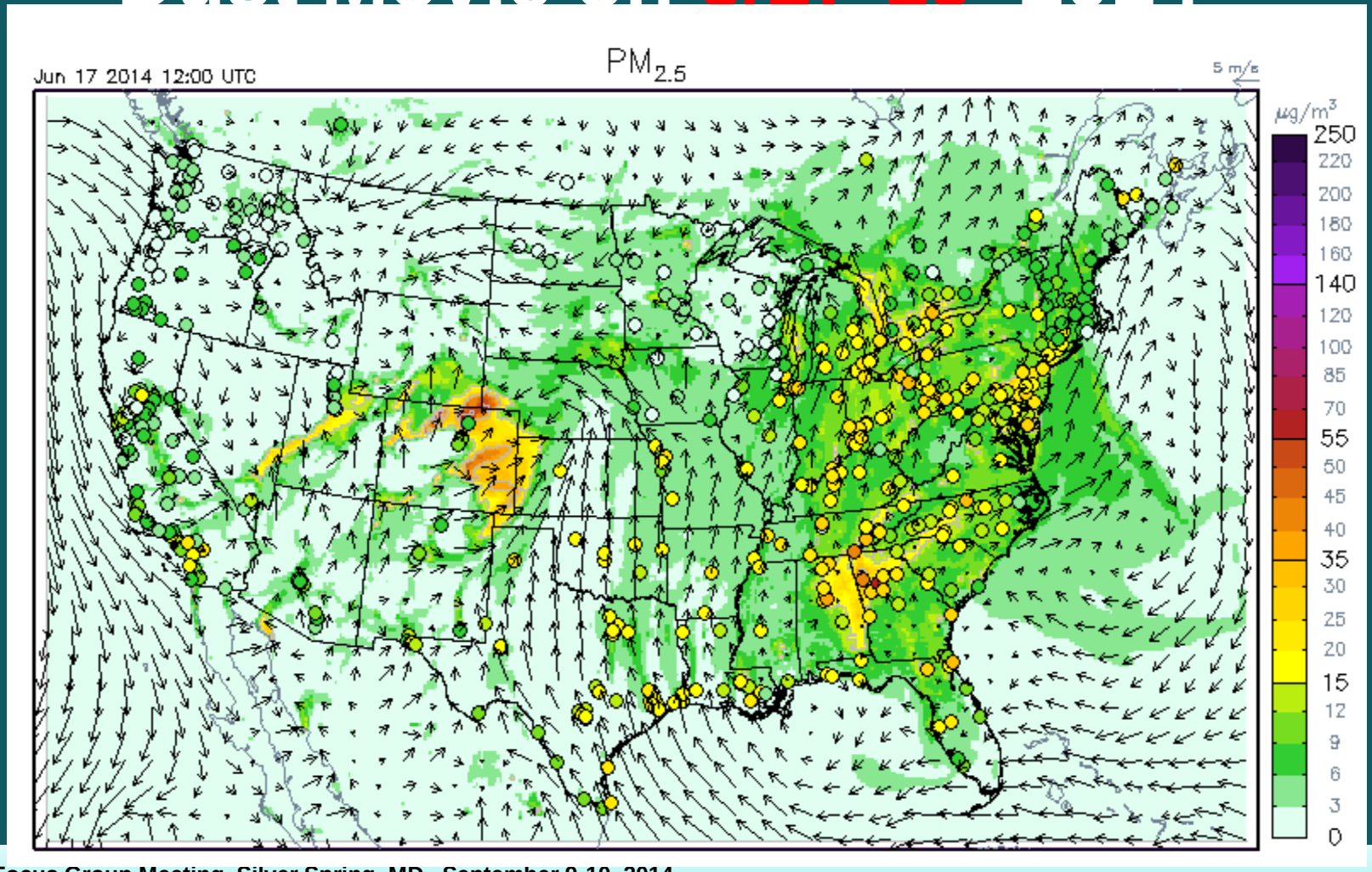


Q1 FY15 NAQFC-PM Upgrades (4)

Significant impact on $PM_{2.5}$ forecast – CMAQ4.6.3

- **Dynamic windblown dust emission** (Tong and Lee et al., ACP 2012, AE2015)

Dust Movie on 6/17-19 2014



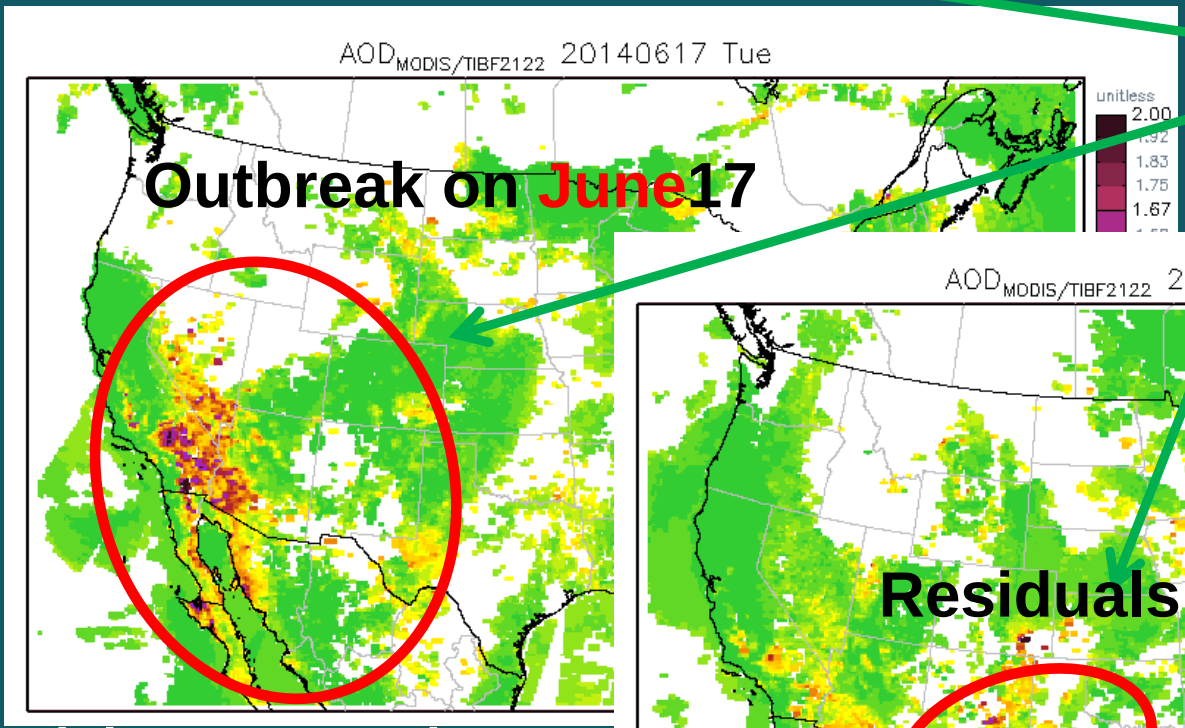
Q1 FY15 NAQFC-PM Upgrades (4)

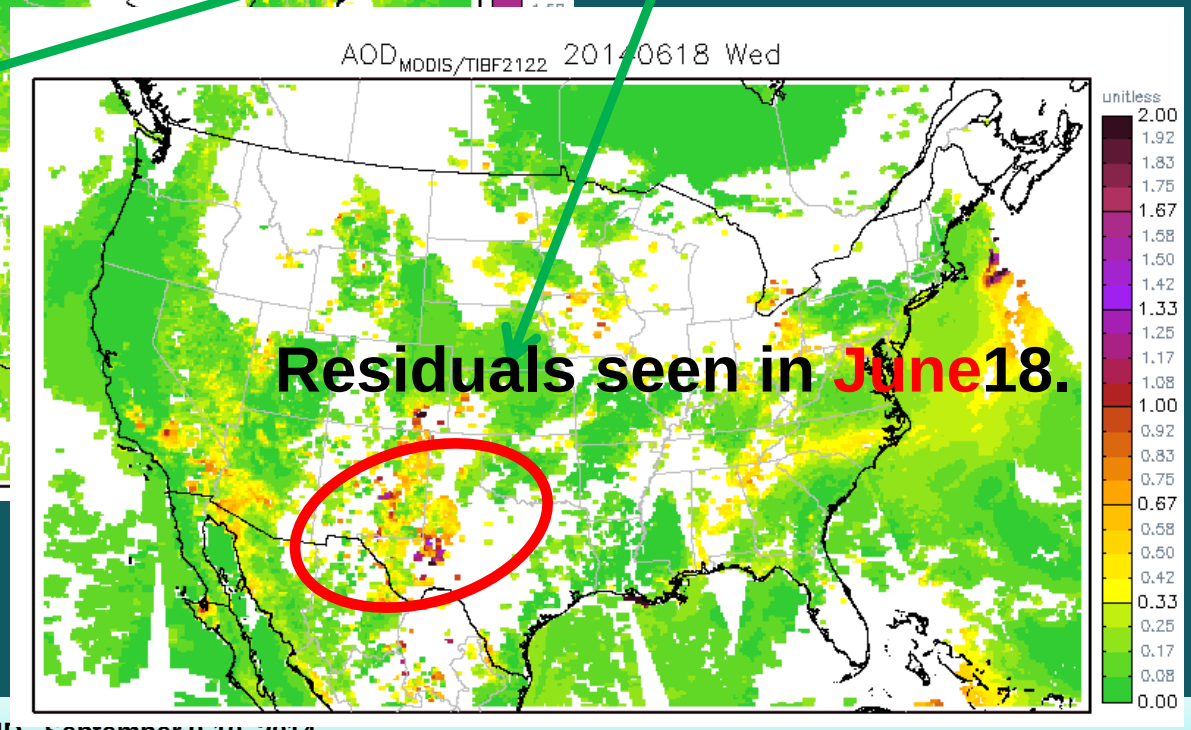
Significant impact on $PM_{2.5}$ forecast – CMAQ4.6.3

- **Dynamic windblown dust emission**

NESDIS TEXT: **June 19 2014**: A large cyclone ..thin dust and sand covers much of AZ into SE UT, W CO and far NW NM.

MODIS imageries Confirmed dust event

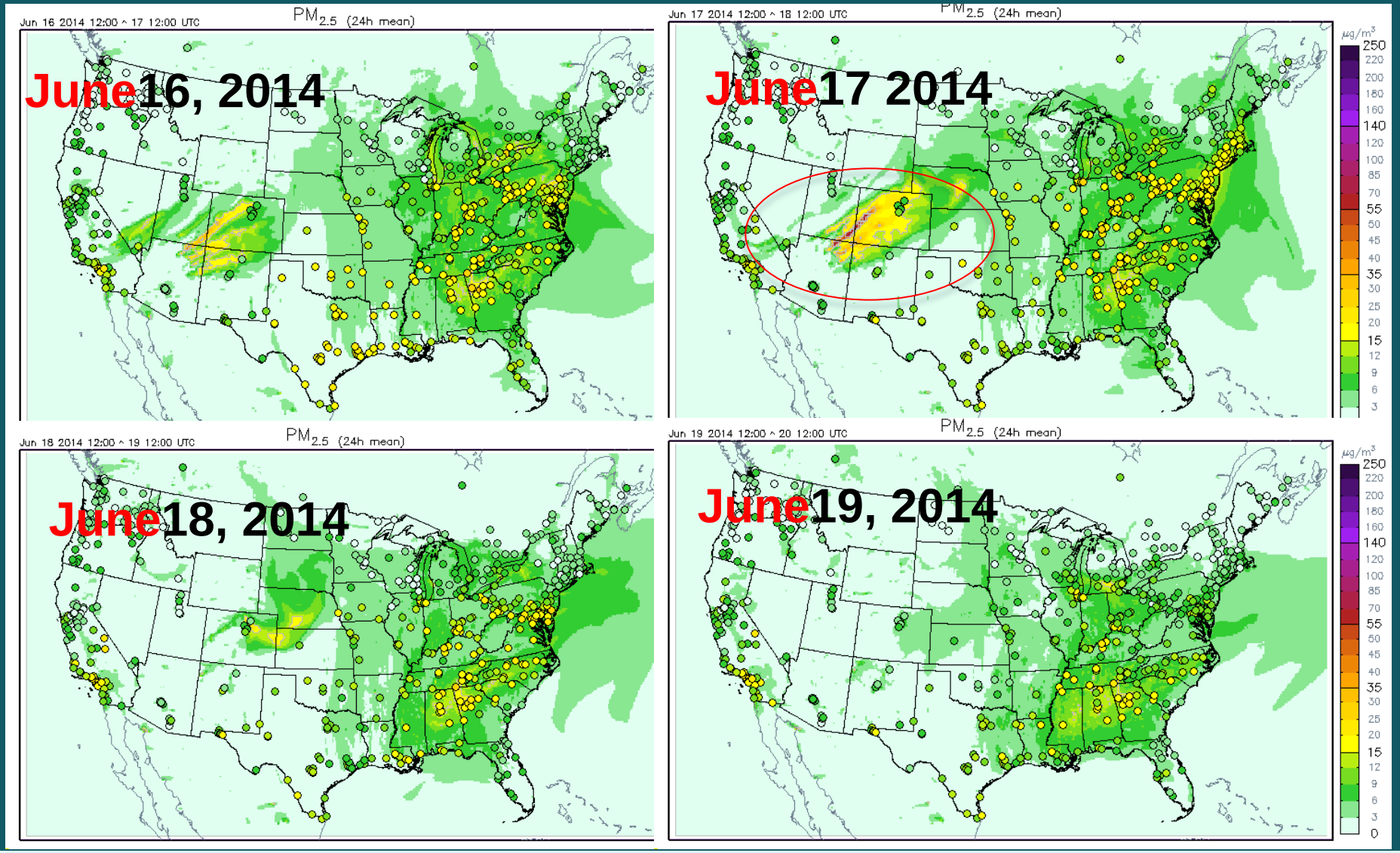




High AOD over desert regions, thin and wide plume over the SW.

Q1 FY15 NAQFC-PM Upgrades (4)

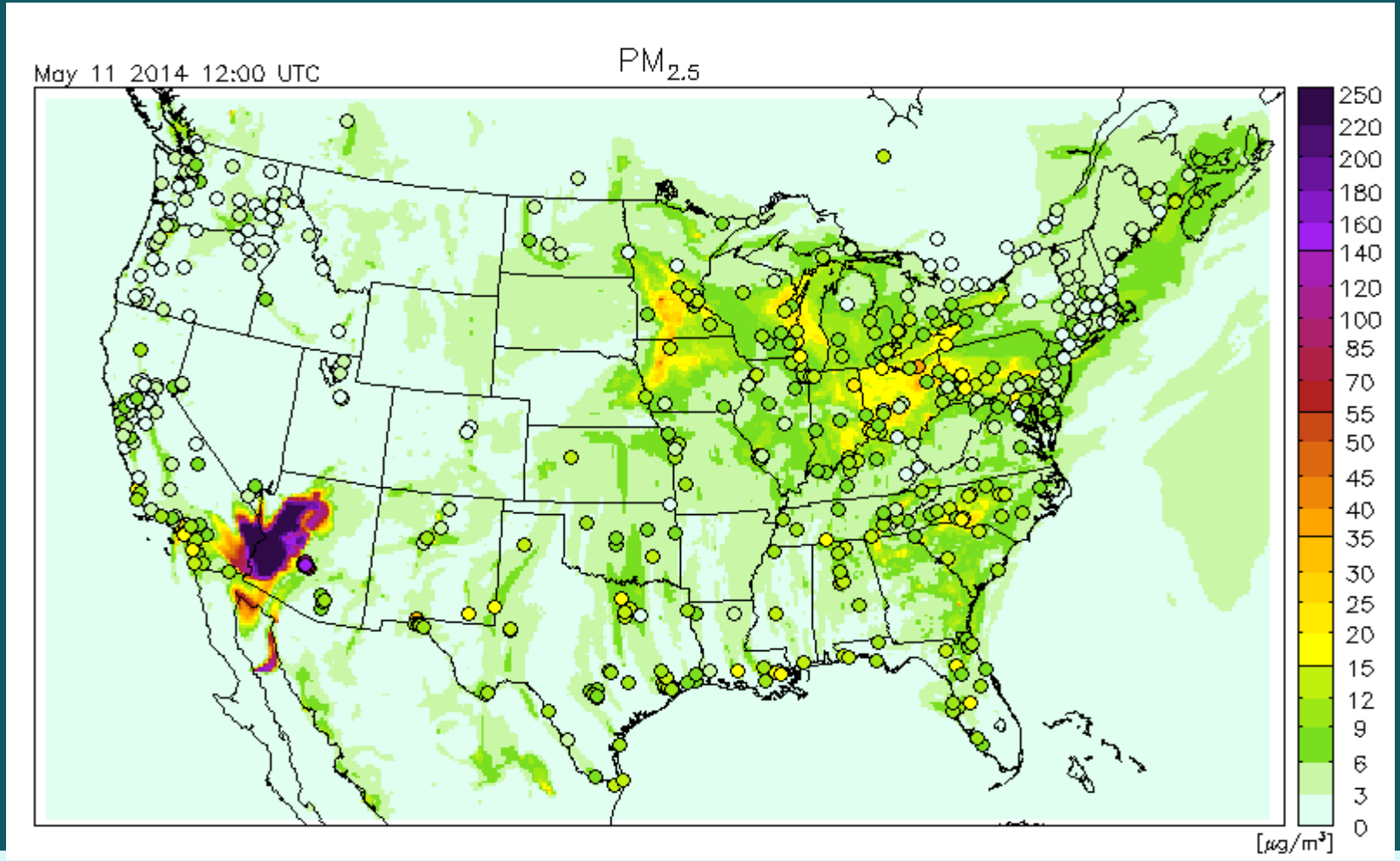
- **Dynamic windblown dust emission: Outbreak captured**



Q1 FY15 NAQFC-PM Upgrades (4)

- **Real-time testing: May 11 2014**: Event was near monitors

NESDIS TEXT May 11 2014: Moderate windblown dust was visible across Northern Baja (CA & AZ) into Western NM.

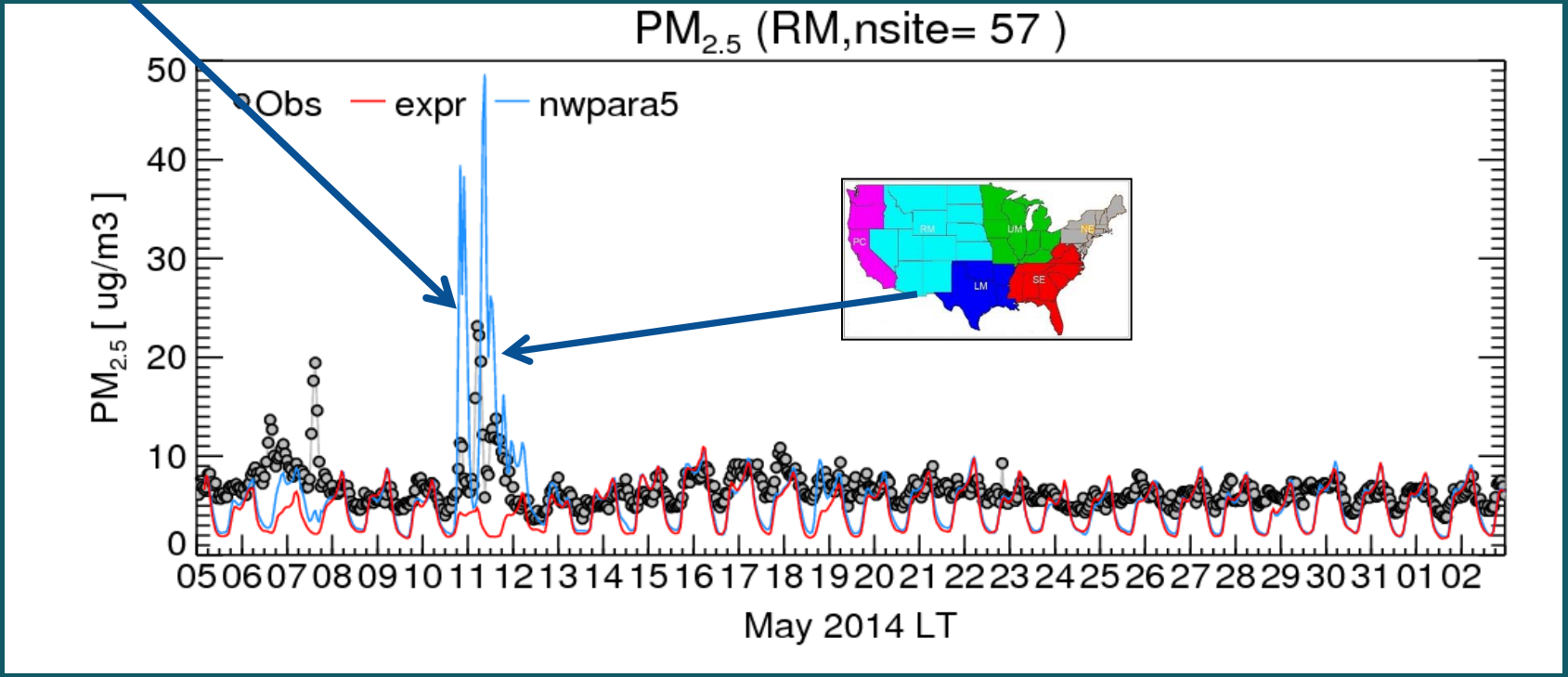


Q1 FY15 NAQFC-PM Upgrades (4)

- **Real-time testing: May 11 2014**: Event was near monitors

NESDIS TEXT May 11 2014: Moderate windblown dust was visible across Northern Baja (CA & AZ) into Western NM.

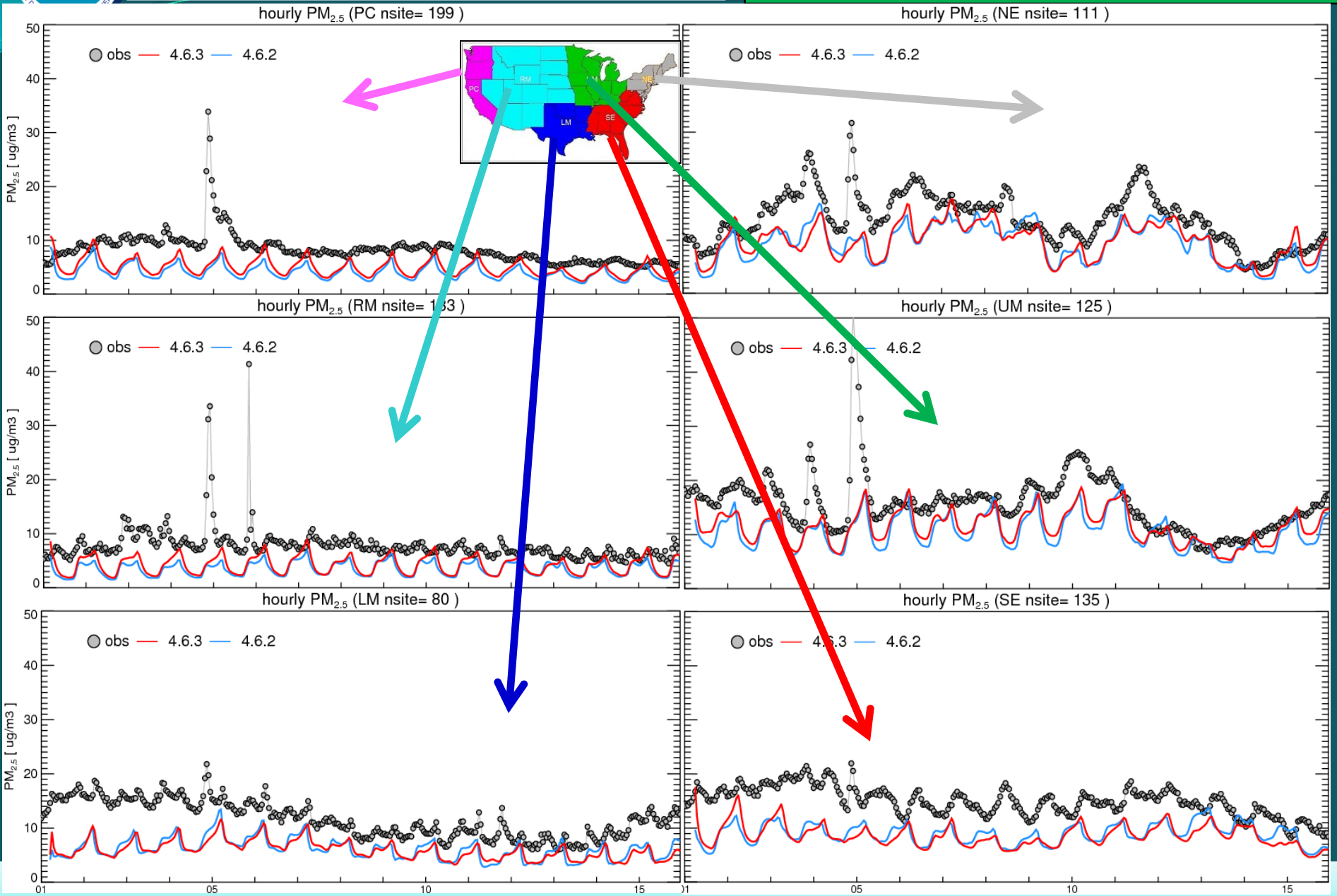
The real-time run better captured May11-12 dust in Rocky Mountains



Impact: $PM_{2.5}$ performance: upgraded vs. current expr

metrics: Between July 1 – 15, 2011

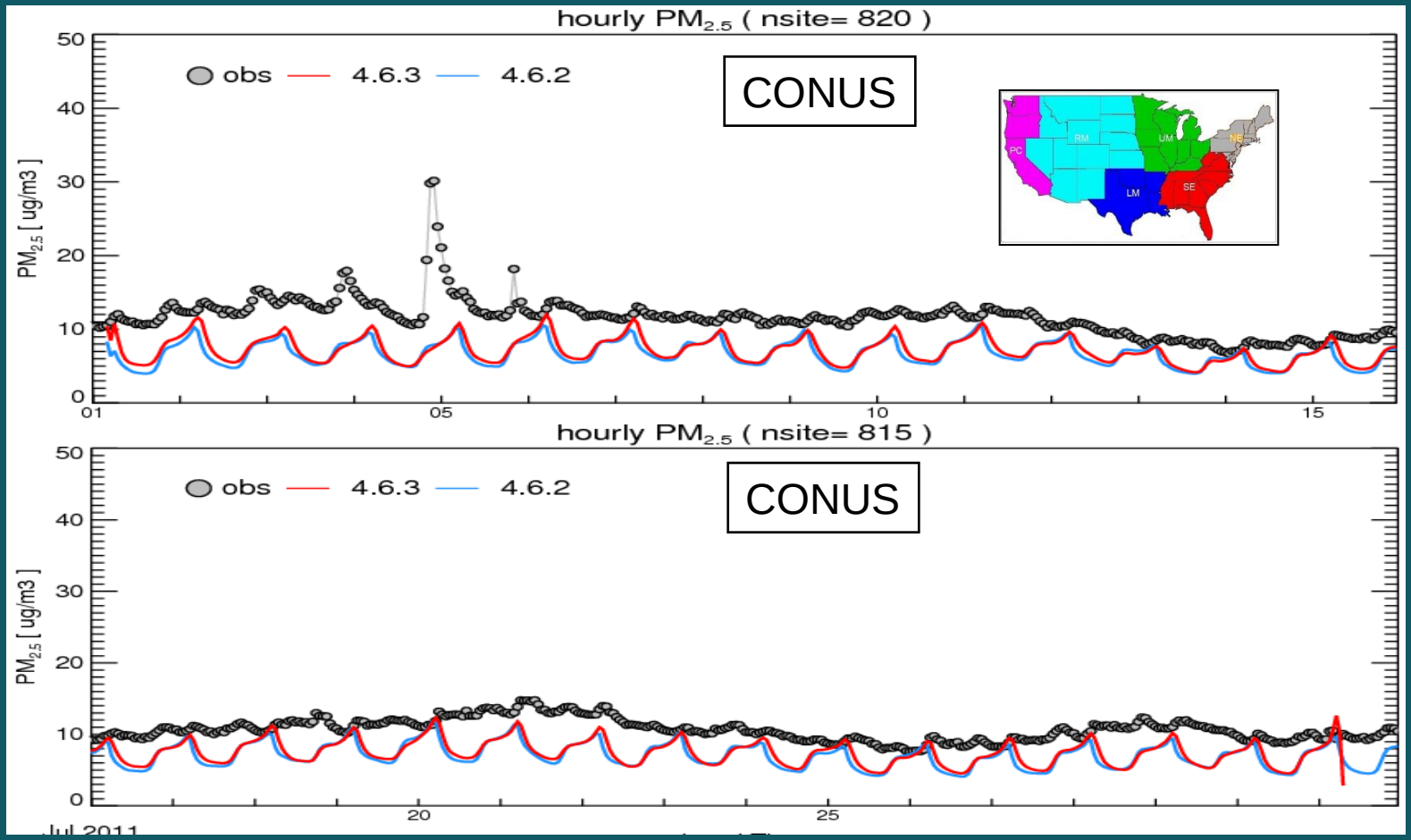
$PM_{2.5}$ performance improved



Impact: $PM_{2.5}$ performance: upgraded vs. current expr

metrics: Between July 1 – 31, 2011

$PM_{2.5}$ performance improved



Summary

- **Q1 FY15 NAQFC upgrades**
  - **Include 6 science upgrades: with 2 deal with O_3, 4 deal with $PM_{2.5}$**

Significant impact on O_3 forecast guidance

- **Gas-phase chemistry: Carbon Bond 4 (CBIV) ➡ CB05 for CONUS**
- **Faster removal of organic nitrate (NTR)**
- **PBL Min-value constraint**
- **Vdry-dep update**

Significant impact on $PM_{2.5}$ forecast guidance

- **Implement AERO-4**
- **Fugitive dust emissions modulated by snow – emission off if snow cover**
- **NESDIS HMS wild fires emission and fuel loading from USFS BlueSky**
- **Dynamic windblown dust emission**

O_3 ops-forecast guidance: improved

$PM_{2.5}$ dev-forecast guidance: modeled & disseminated reliably