

National Air Quality Forecast Capability: Developmental expansion to Hawaii and Alaska

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NOAA/NCEP/EMC support, SAIC

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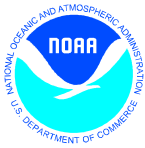


Co-Authors

- Paula Davidson and Ivanka Stajner (NWS Managers, the National Air Quality Forecast Capability).
- ARL for leading the developmental expansion and providing PreMAQ, CMAQ and emission files: Daewon Byun (team leader), Pius Lee, Rick Saylor, Daniel Tong, Hyun-Cheol Kim, BinYu Wang, Hsin-Mu Lin, Fantine Ngan, and Tianfeng Chai.
- NCEP colleagues: Jeff McQueen (team leader), Youhua Tang, Marina Tsidulko, Bill Lapenta, Geoff DiMego.

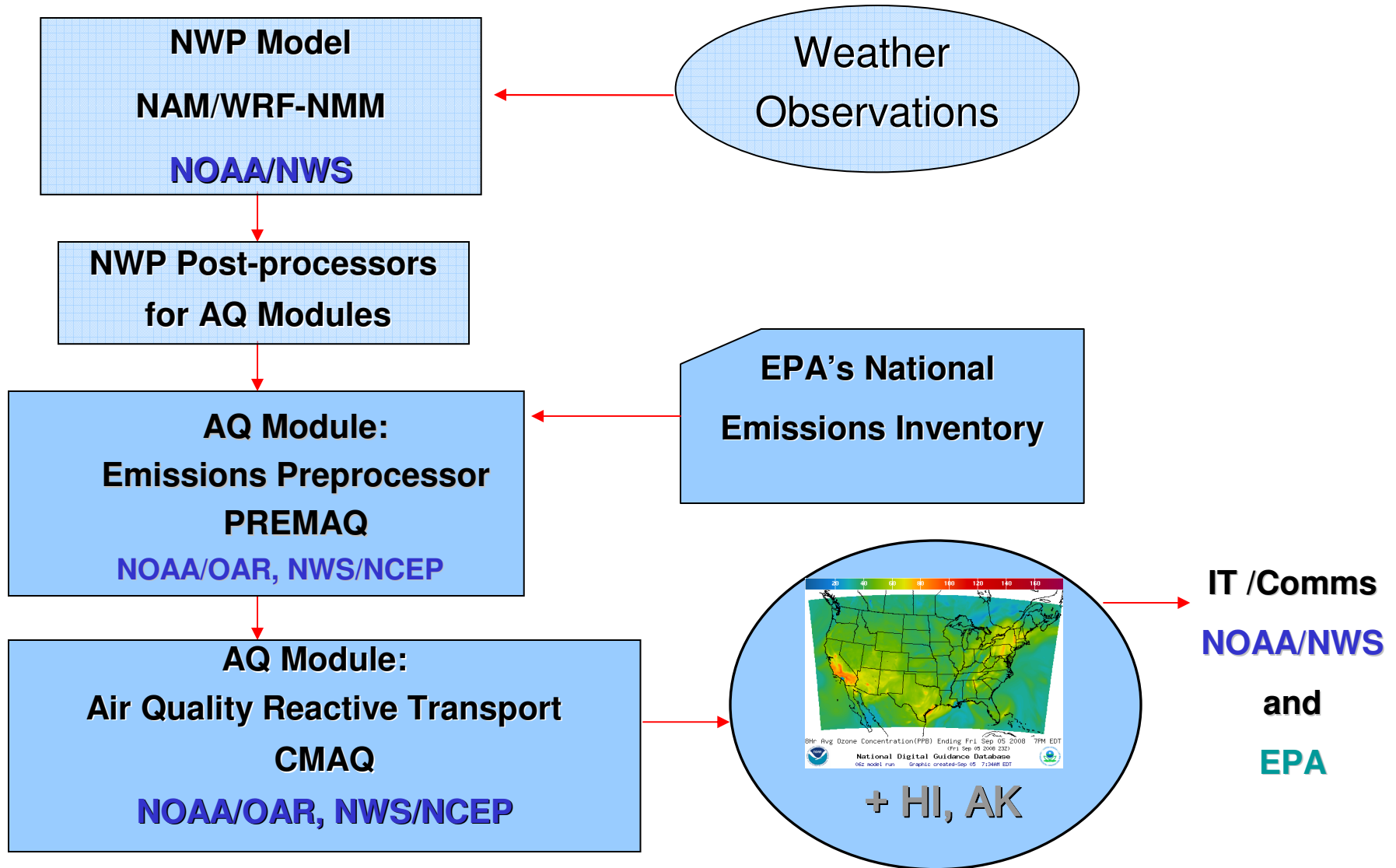
Outline

- The National Air Quality Forecast Capability
- Model configurations, emissions and lateral boundary conditions (LBCs)
- Influence of LBCs on surface O₃ (1-hr, 8-hr max) predictions for HI and AK
- Verification of Met, 1-hr and 8-hr max O₃ predictions for HI and AK
- Summary



National Air Quality Forecast Capability

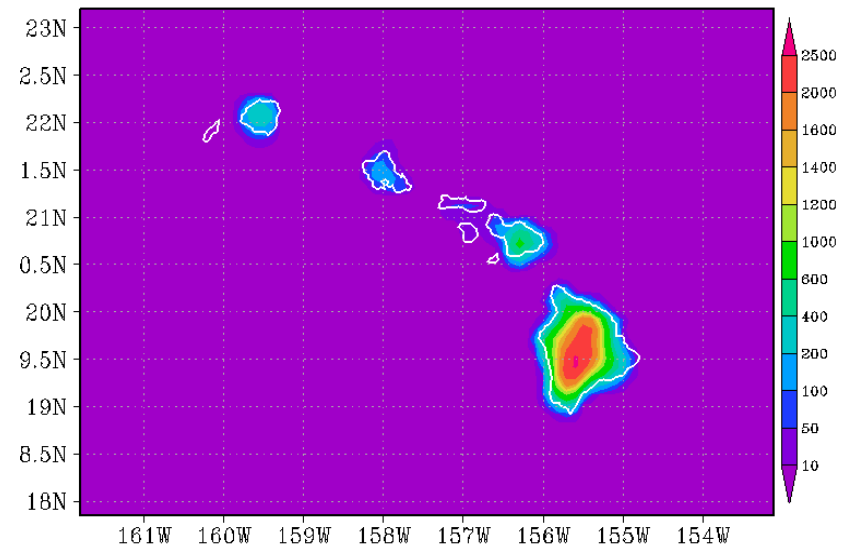
Major Model Components: Ozone Predictions



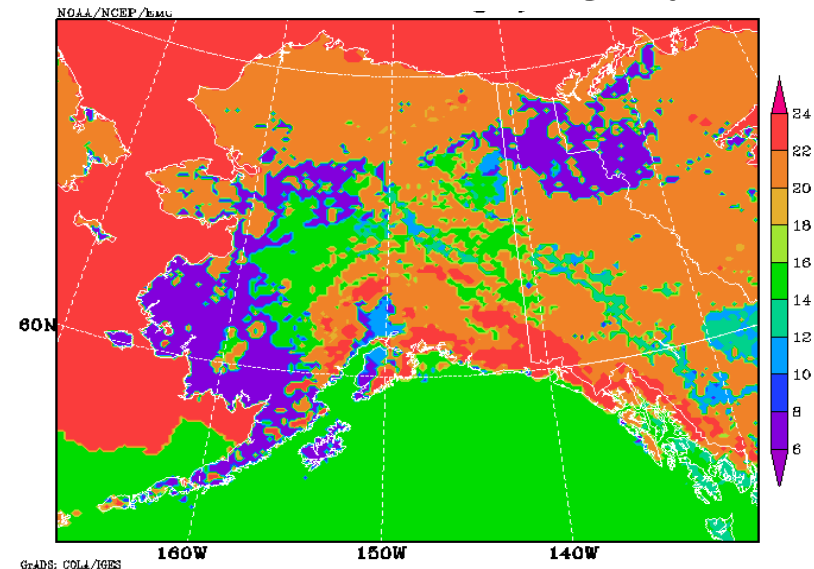
Model Configurations

- **CMAQ**
 - CB05 gas-phase
 - Aero-4 aerosol chemistry
- **Domains**
 - HI: 80 x 52 grid cells
 - AK: 199 x 163 grid cells
- **Horizontal resolution: 12 km**
- **Vertical level: 22 layers**
- **Meteorological inputs**
 - NAM WRF- NMM 12 km
- **Emissions**
 - NEI 2005
 - BEIS V3.3
 - LULC
- **Lateral boundary conditions**
 - GEOS-Chem precursors
 - HI: Hilo monthly mean ozonesonde

Terrain height (m)

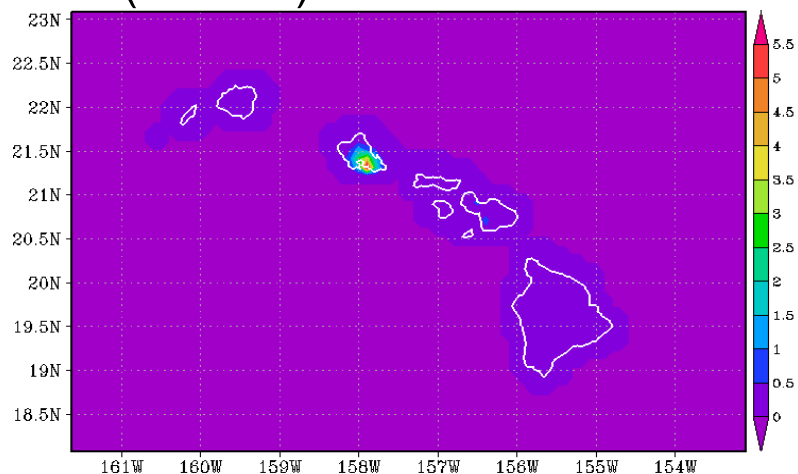


Land-use category

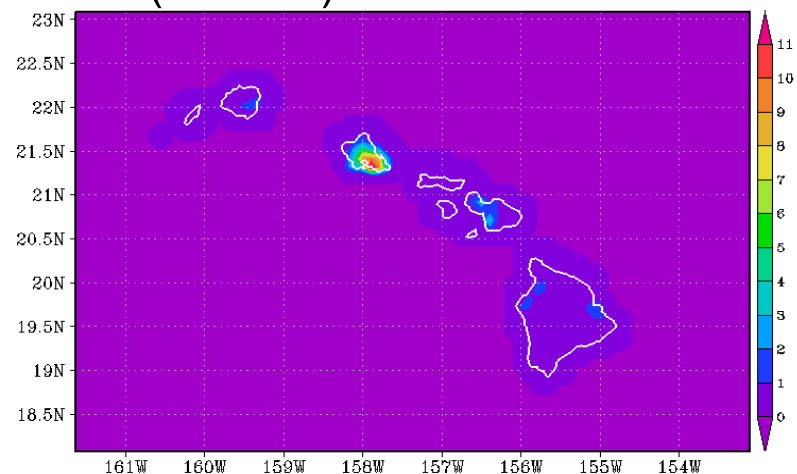


NO and VOC emission rates

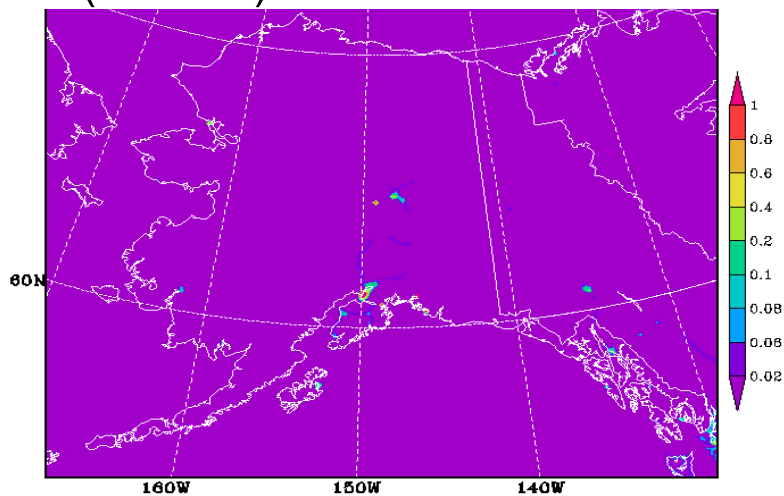
NO (mole/s) at 01 UTC 02/27/2010



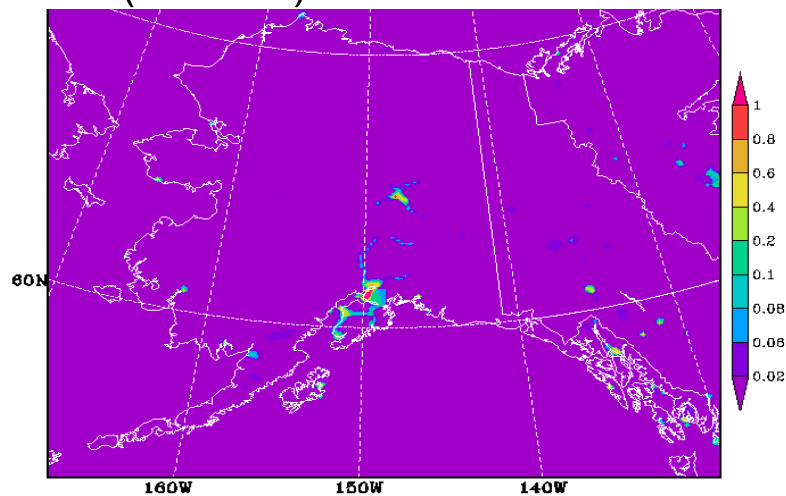
VOC (mole/s) at 01 UTC 02/27/2010



NO (mole/s) at 01 UTC 03/08/2010



VOC (mole/s) at 01 UTC 03/08/2010



Lateral boundary conditions

1) Monthly ozone **sonde** climatology computed for 1982-2007.
Data from: ftp://ftp.cmdl.noaa.gov/ozwv/ozone/hilo/hilosum_lvl/
(for HI only)

GEOS-Chem: a global 3-D atmospheric chemistry model driven by assimilated meteorology from the Goddard Earth Observing System Version 4 (GEOS-4) (Bey et al., 2001; <http://acmg.seas.harvard.edu/geos/index.html>).

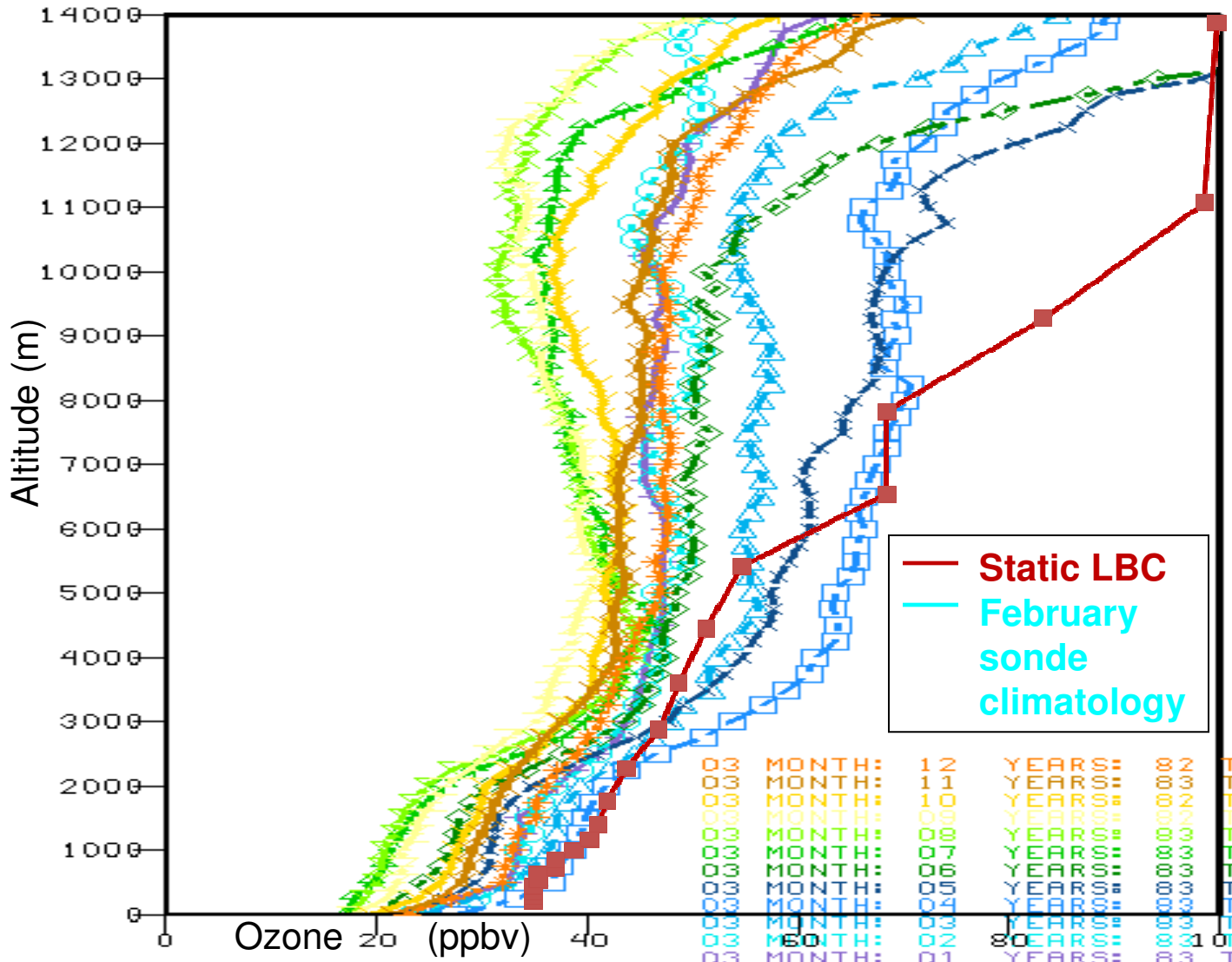
- 2.0° latitude x 2.5° longitude resolution with 50 levels.

LBCs for 41 chemical species including:

NO₂, O₃ (for AK), ISOP, ASO4J, ANO3J, AORGBJ.

2) **Static** climatological LBCs

O₃ lateral boundary conditions: HI

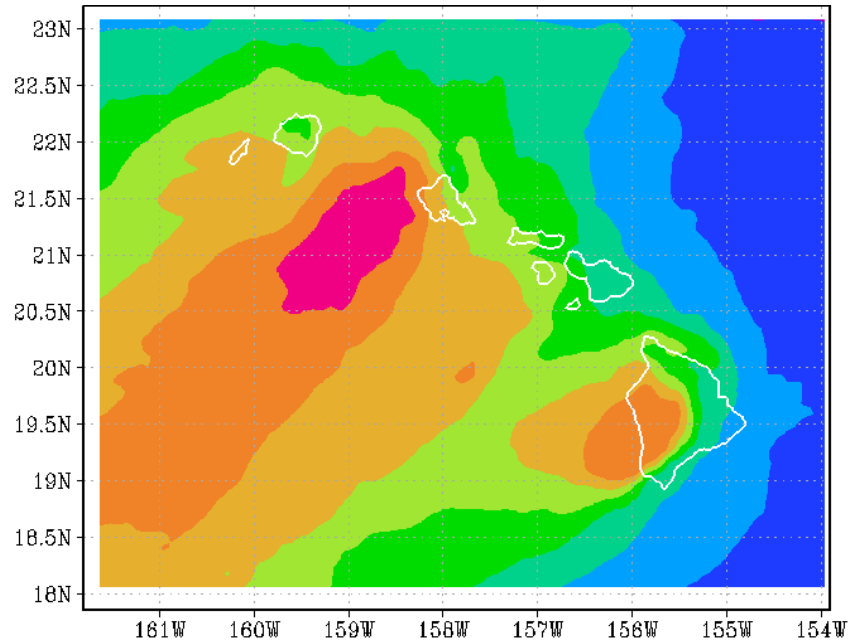


Comparison of ozone LBCs from ozone sonde climatology with static ozone LBC

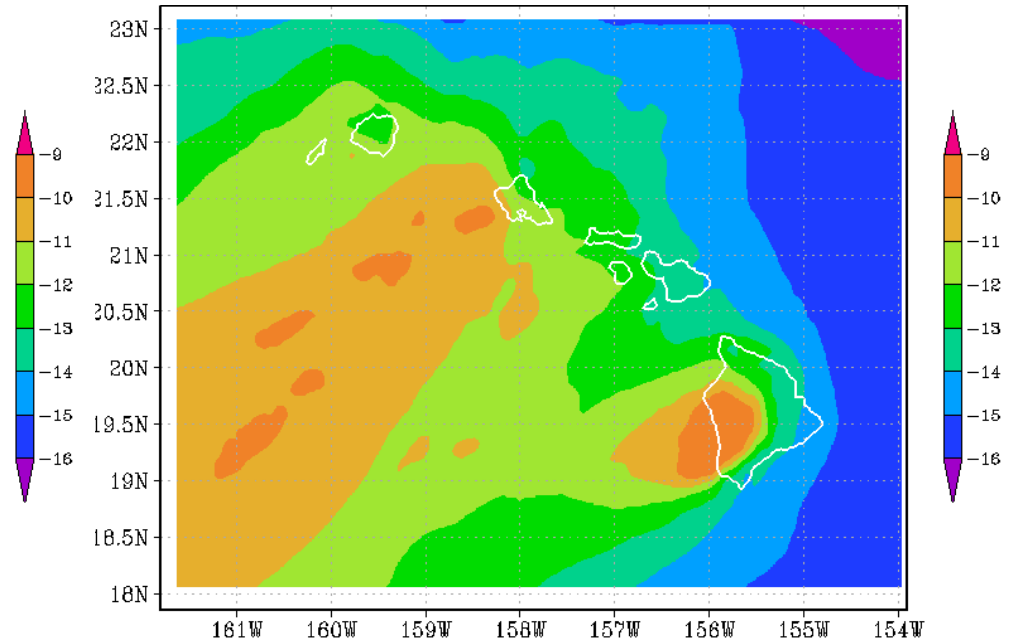
Influence of LBCs on ozone predictions: HI

Monthly mean for Feb 2010

1-hr max O₃ percent. diff (%)

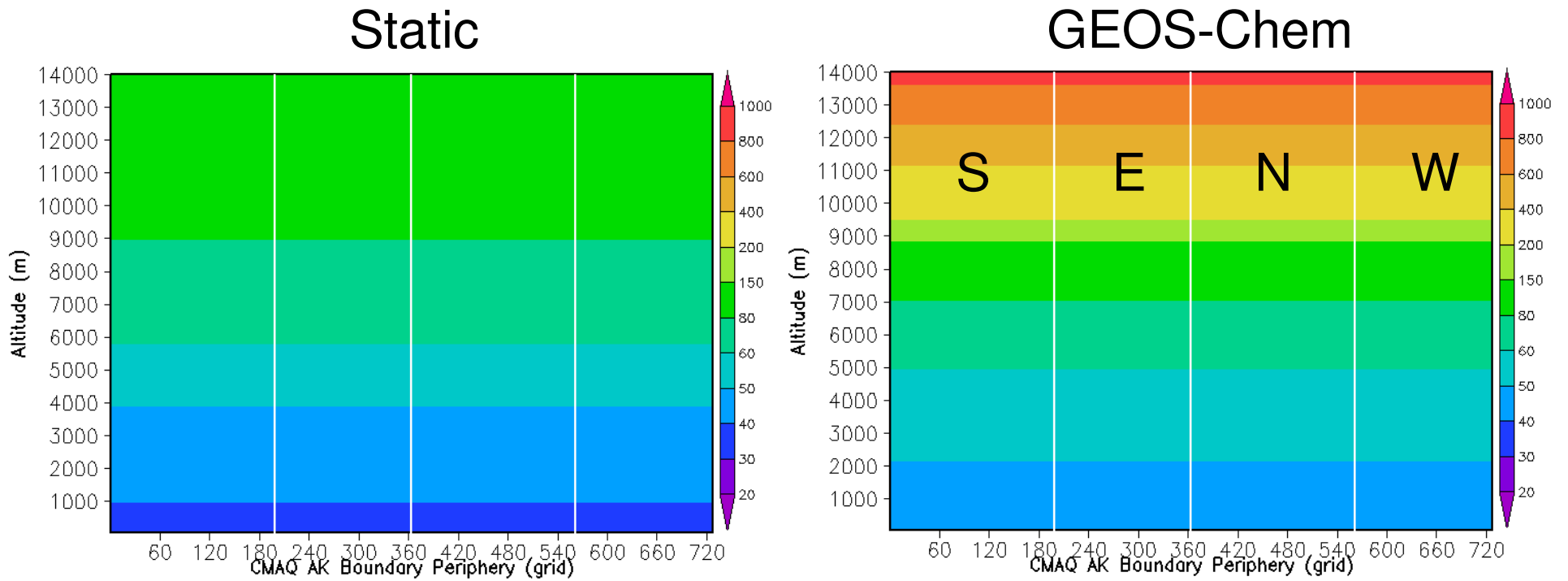


8-hr max O₃ percent. diff (%)



$(\text{sonde} - \text{static}) / \text{static} * 100\%$

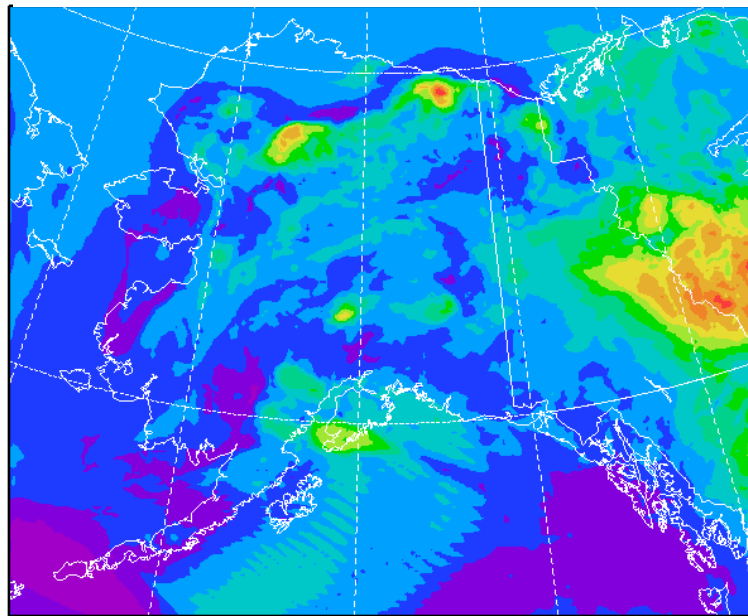
Ozone LBCs for **AK** (March)



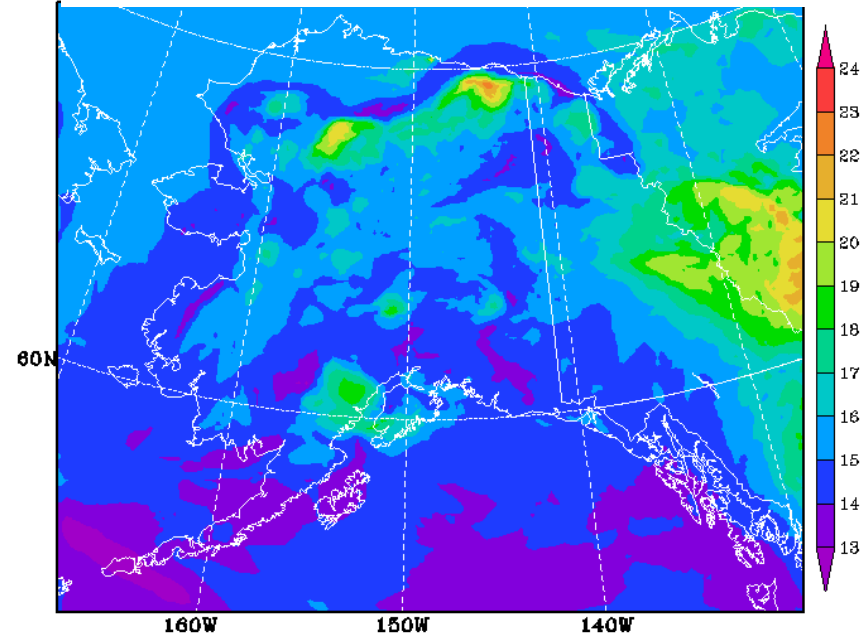
Influence of LBCs on ozone predictions: **AK**

Averaged over Mar 1-8, 2010

1-hr max O₃ percent. diff (%)



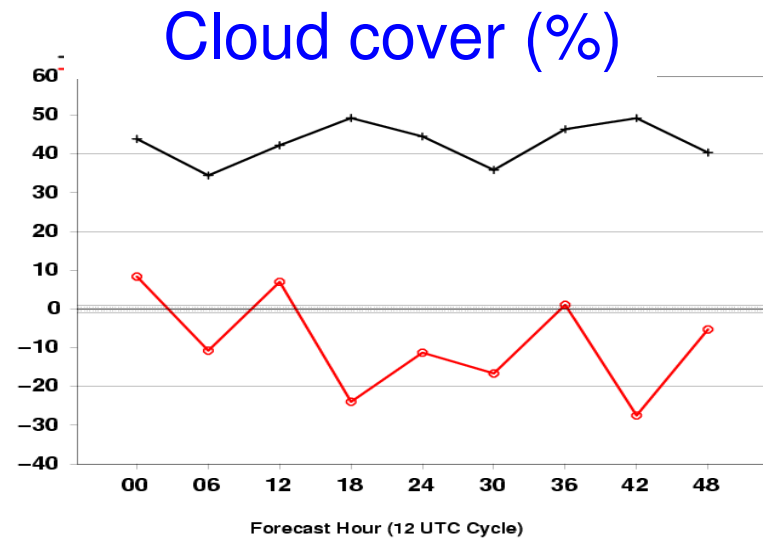
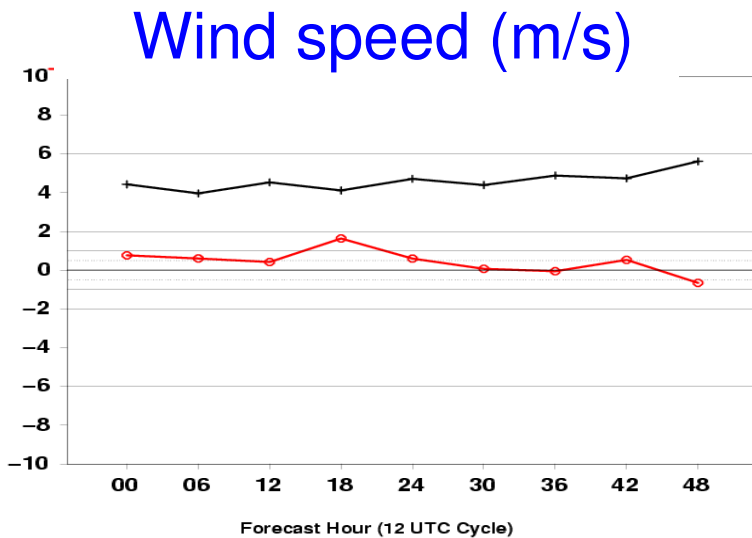
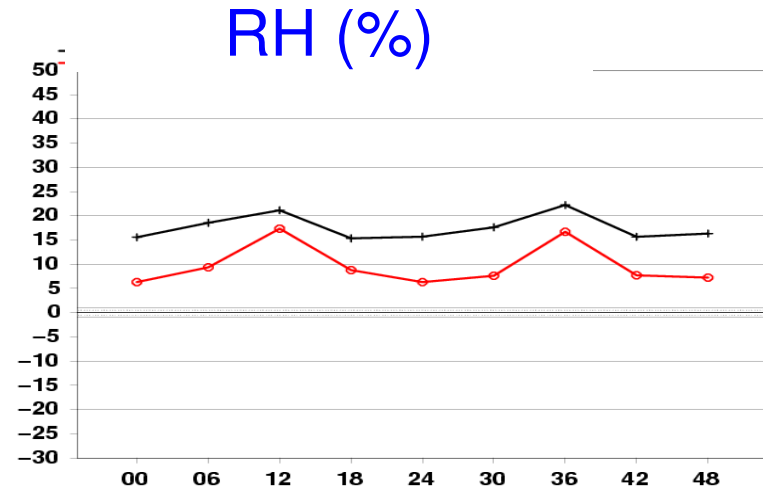
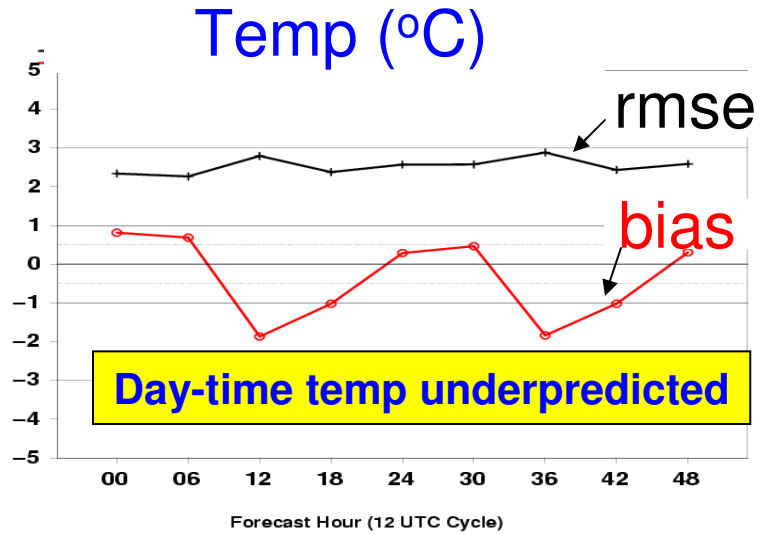
8-hr max O₃ percent. diff (%)



$(\text{GEOS-Chem} - \text{static}) / \text{static} * 100\%$

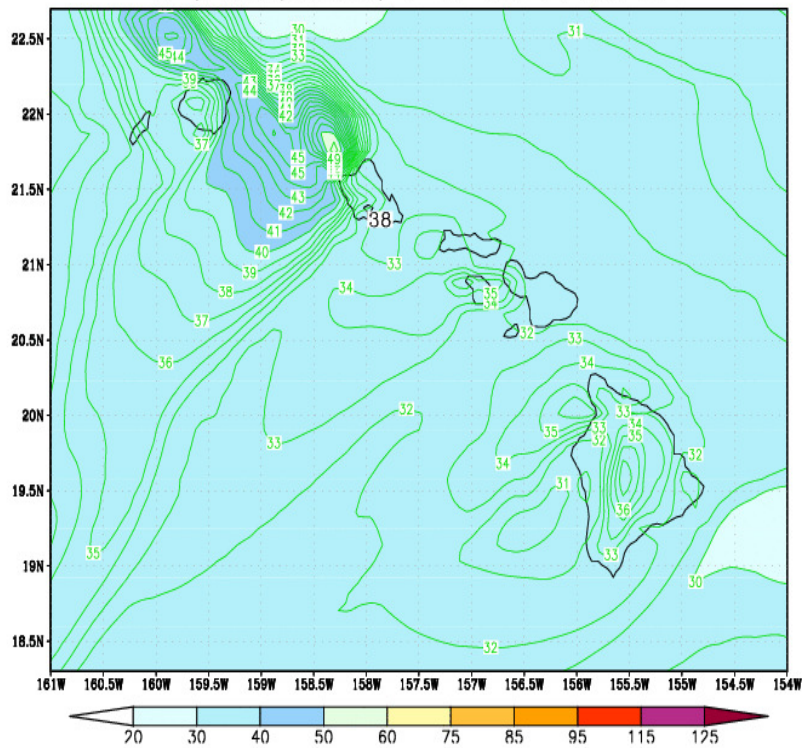
Verification of Hawaii region met fields: HI

Monthly mean for Feb 2010

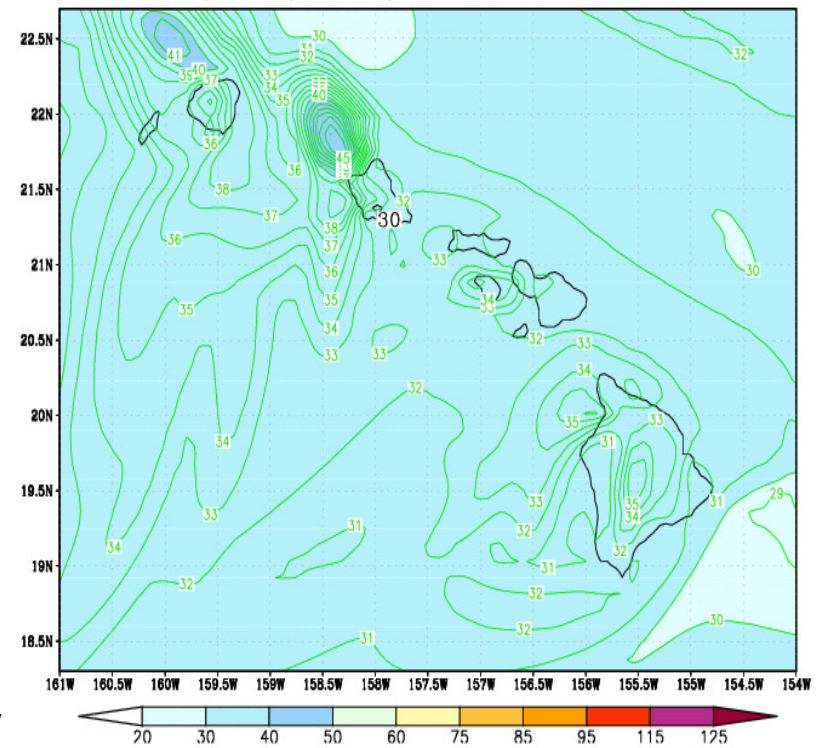


1-hr and 8-hr max ozone spatial patterns

1-hr max 27Feb2010



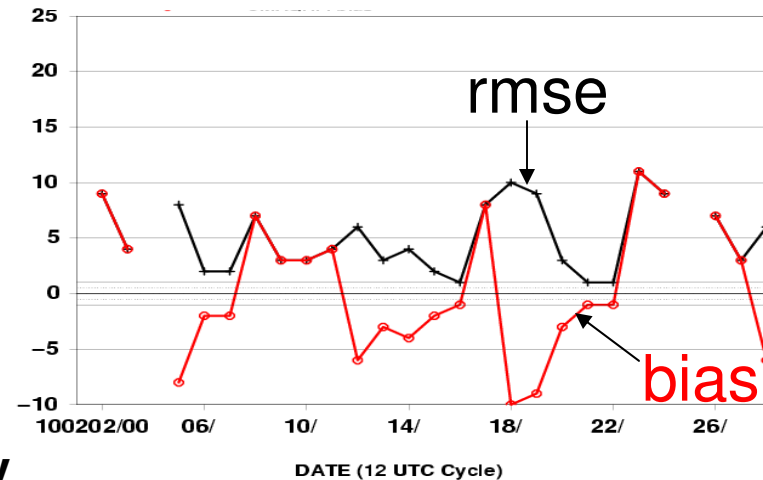
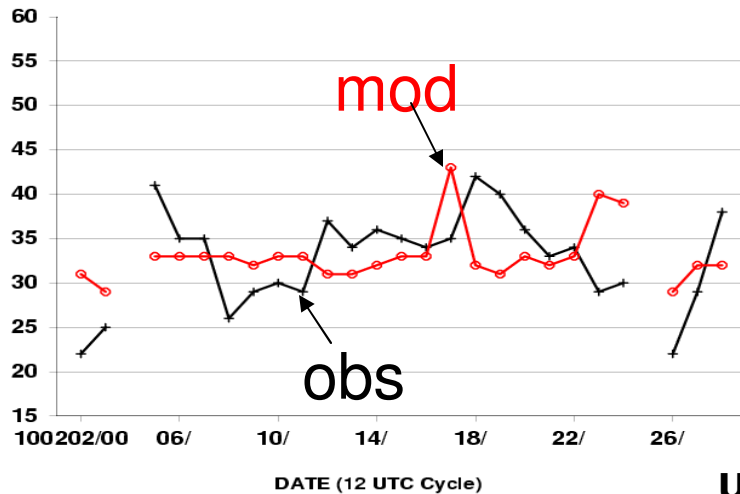
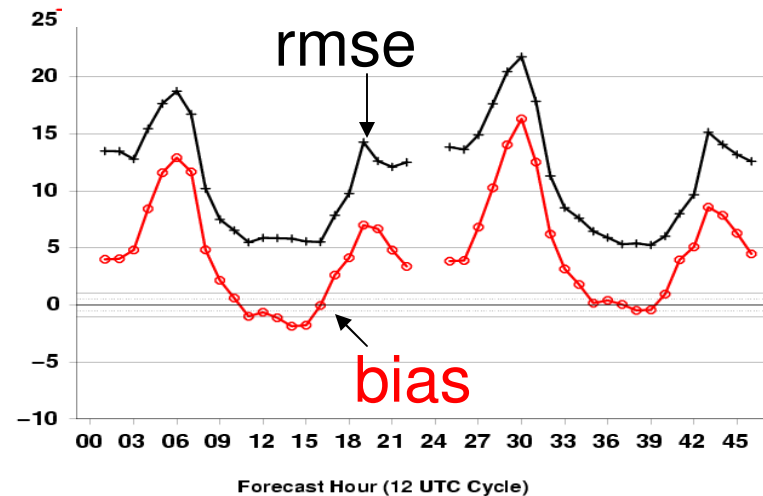
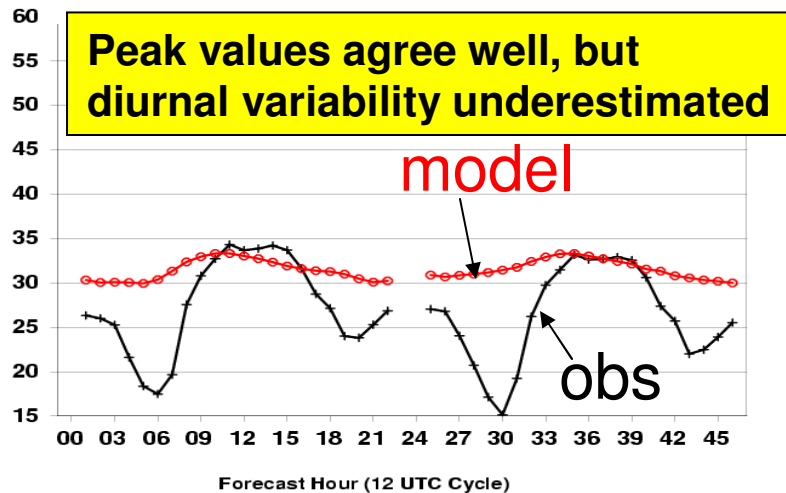
8-hr max 27Feb2010



Ozone well predicted for Honolulu

Verification of 1-hr average ozone: HI

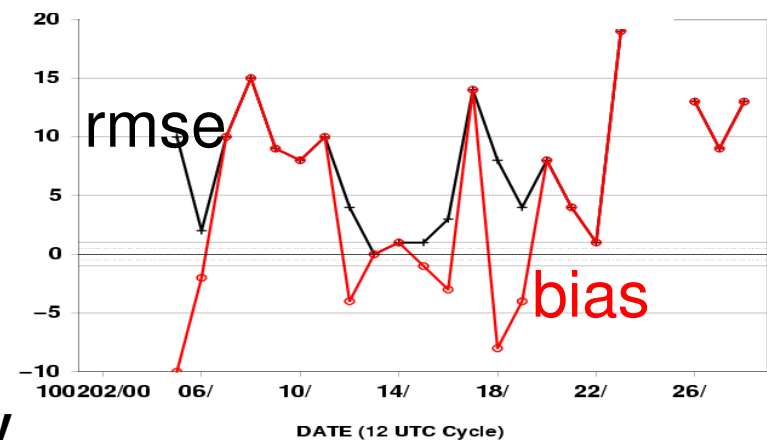
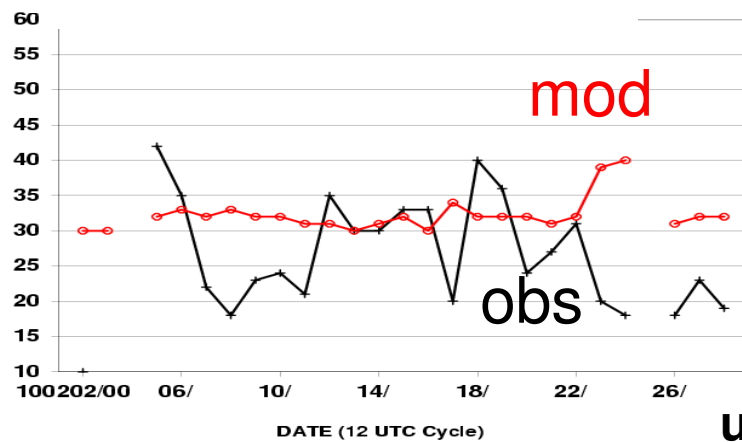
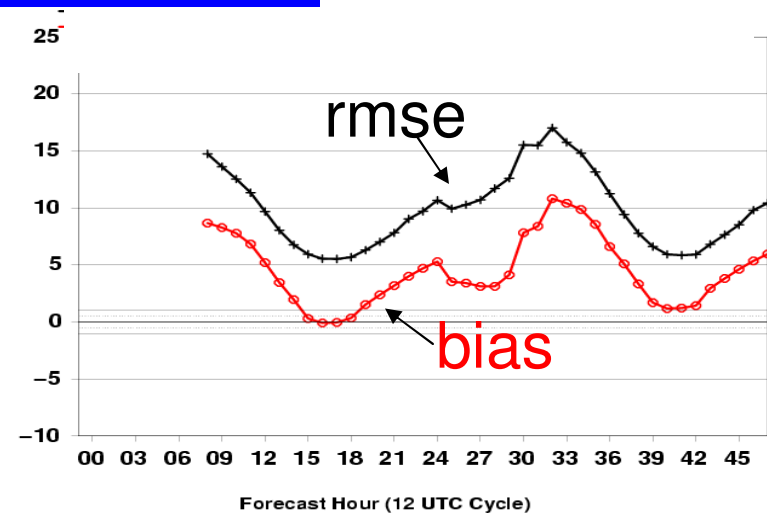
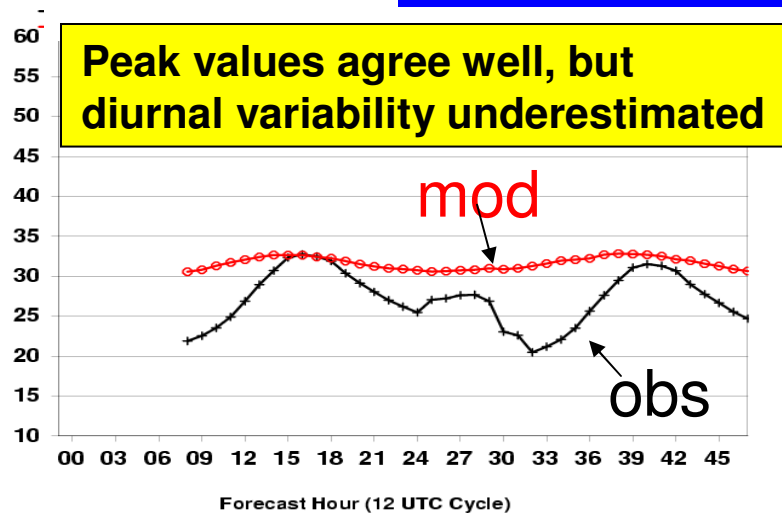
Monthly mean for Feb 2010



unit: ppbv

Verification of 8-hr average ozone: HI

Monthly mean for Feb 2010

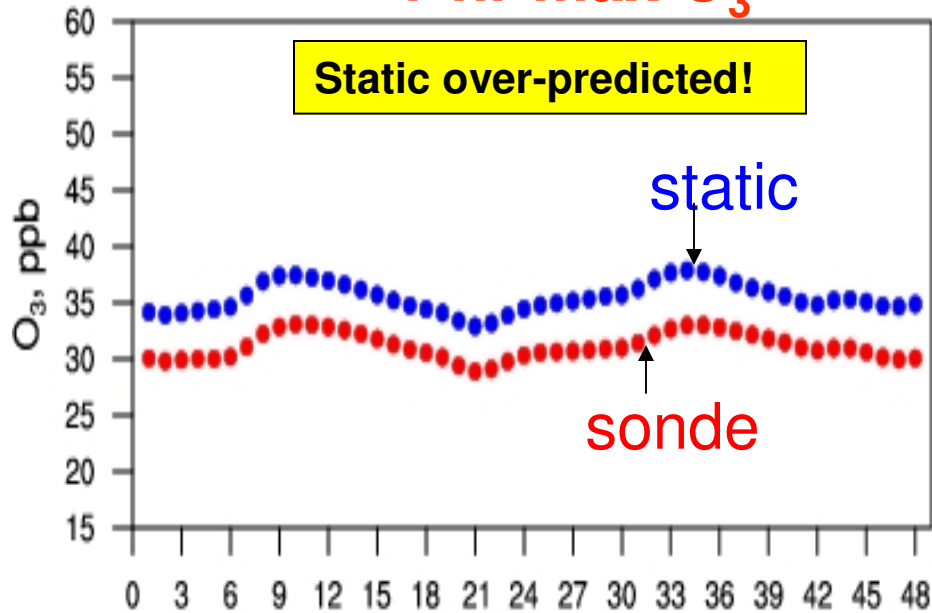


unit: ppbv

Sonde LBC vs. Static LBC: HI

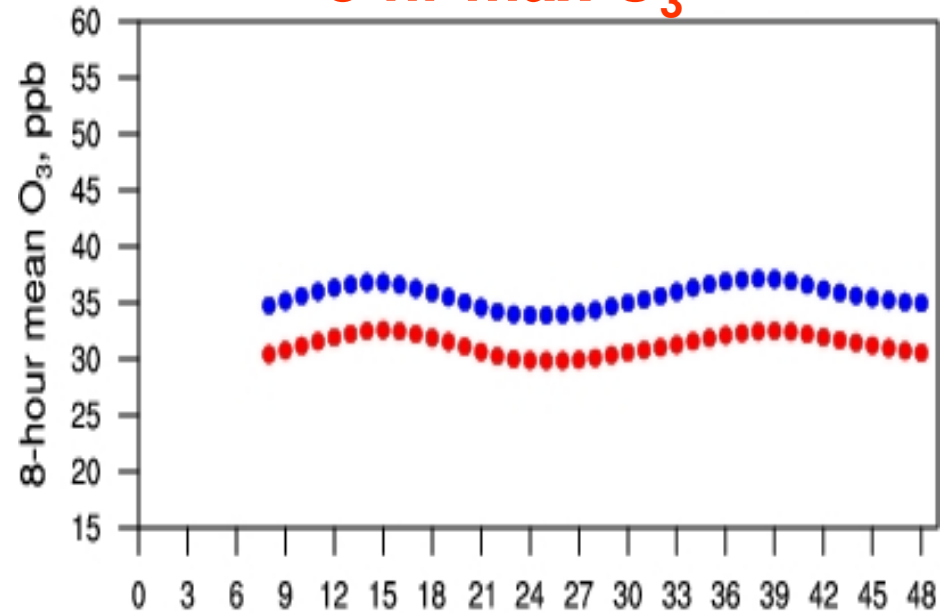
Monthly mean for Feb 2010

1-hr max O₃



Forecast Hour (12 UTC Cycle)

8-hr max O₃



Forecast Hour (12 UTC Cycle)

Summary

- **The National Air Quality Forecast Capability is being extended to provide numerical guidance for HI and AK ozone predictions.**
- **Implementation of experimental ozone predictions is targeted for HI in March 2010 and for AK in May 2010.**
- **HI 1hr and 8hr max ozone predictions have been improved with the new LBCs from GEOS-Chem and ozone sonde data.**
- **HI 1hr and 8hr average ozone predictions capture observed daily maximum well, but not the observed diurnal variability. The comparison is limited to a single available ozone site.**

Acknowledgement

- Prof. Daniel Jacob (Harvard Univ.) for providing the GEOS-Chem simulation results.