Multi-model assessment of surface O_3 at regional CASTNet sites in the U.S.

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Task Force on Hemispheric Transport of Air Pollution

LRTAP
Long-range Transboundary Air Pollution

Petrified Forest, AZ site

Objectives

- Provide results directly relevant to NAS report

- Assess model ensemble skill in reproducing observed policy-relevant O_3 statistics

- Determine the contribution from inter-continental sources to surface O_3

Proposed Methodology

1. Select regionally-representative CASTNet sites

2. Calculate the # of exceedance days (MDA8 > 75 ppbv) for each year in CASTNet database

3. Compare multi-model results of exceedance days in 2001 with observations from CASTNet

4. Quantify differences between multi-model and CASTNet MDA8 statistic (seasonal differences?)

5. Use SR6 simulations to calculate foreign contribution to the range of MDA8 values by region (as in Tracey Holloway's poster)

Other aspects to be pursued

- Compare:

  1) West coast CASTNet obs

  2) THD O_3-sonde

  3) PHOBEA (2001) campaign aircraft data

  4) Multi-model simulations

  to determine monthly mean inter-continental contribution *in the vertical* on W. coast

- Perform same comparison *but hourly* for PHOBEA aircraft and MOZART

CASTNet
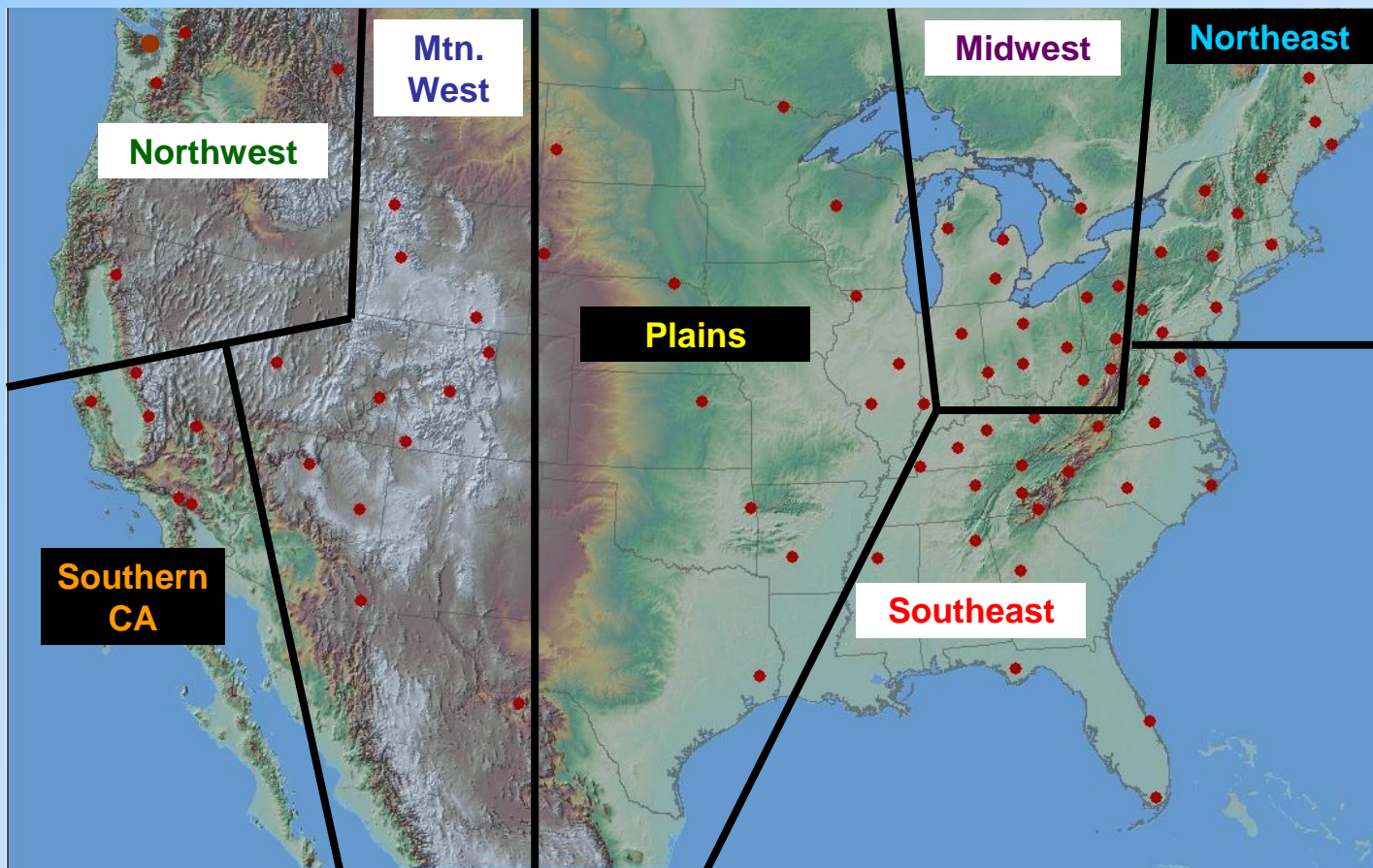
- 86 sites established as part of CAAA of 1990

- Strict citing criteria to avoid influence from local sources

- Nation's primary monitoring network for measuring background O_3 levels

- 8 sites w/ elev. > 2 km; 12 sites > 1.5 km

Previous Work (Fiore et al., submitted)
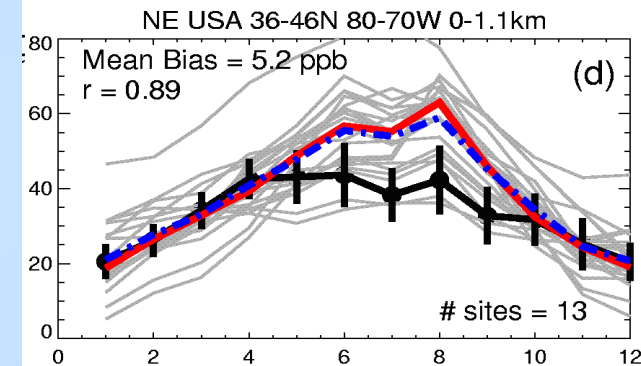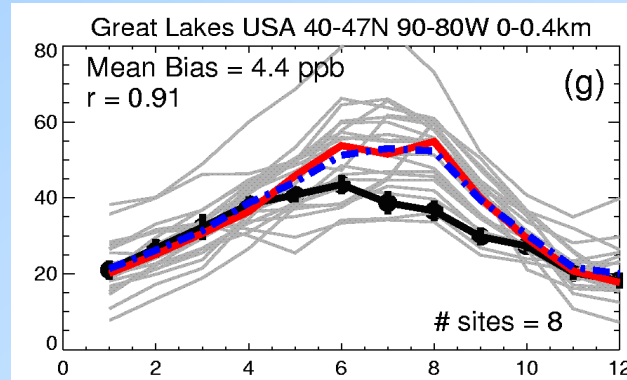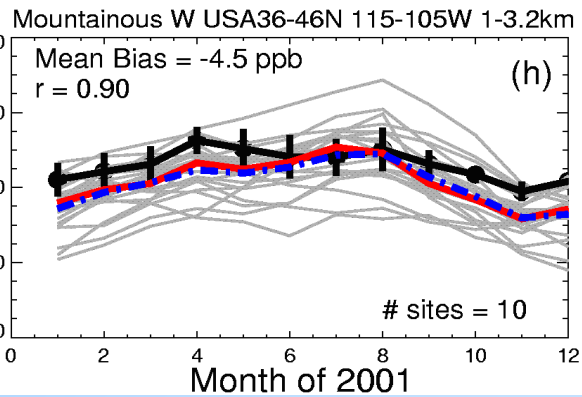
Regional monthly mean O_3 from CASTNet (black) and SR1 simulations in models (red = median; blue = mean)
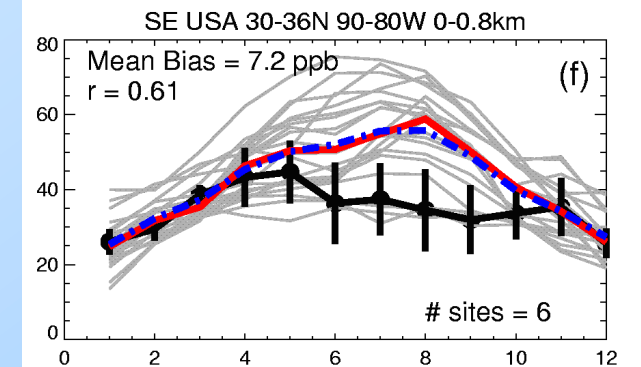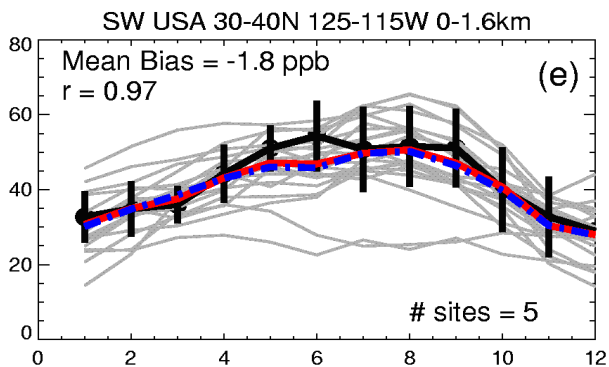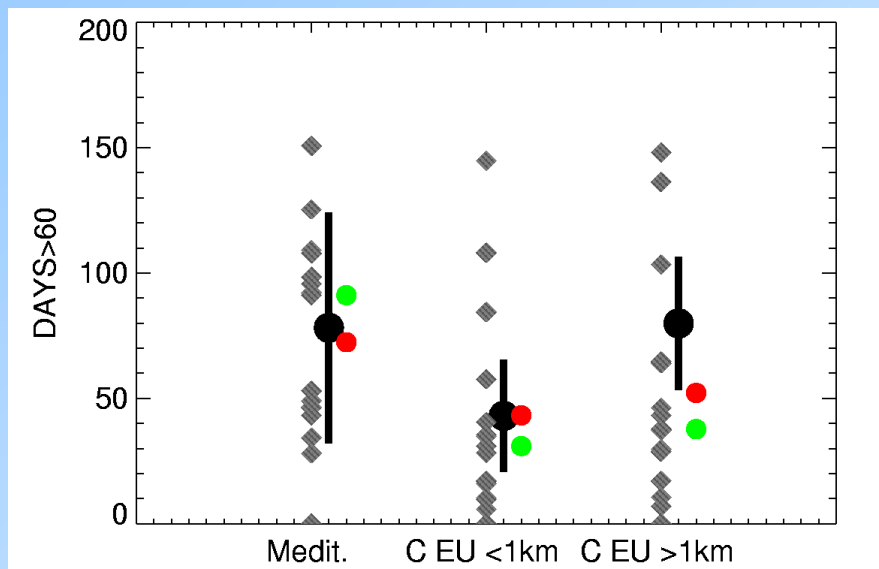
→ Ensemble mean overestimates summer O_3 in Great Lakes, SE and NE, but does well in other seasons

→ Ensemble mean generally underestimates Mountainous West and summer in the SW

# Previous Work (Fiore et al., submitted): O₃ statistics: DAYS > 60

- Observed (**black**) and simulated (**gray**) annual days w/ max daily 8-hr avg $[O_3] > 60$ ppb (DAYS>60)

- 18-model ensemble mean (**red**) and median (**green**) for SR1 case

- Contribution of 3 foreign source regions to ΔDAYS>60 over N. Amer.

- Combined 20% decreases in all anthropogenic O_3 precursors (SR6-SR1)
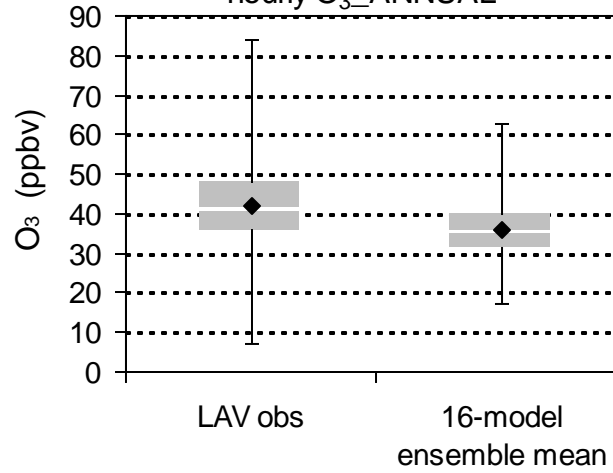
- Right axis shows base case (SR1) DAYS>60
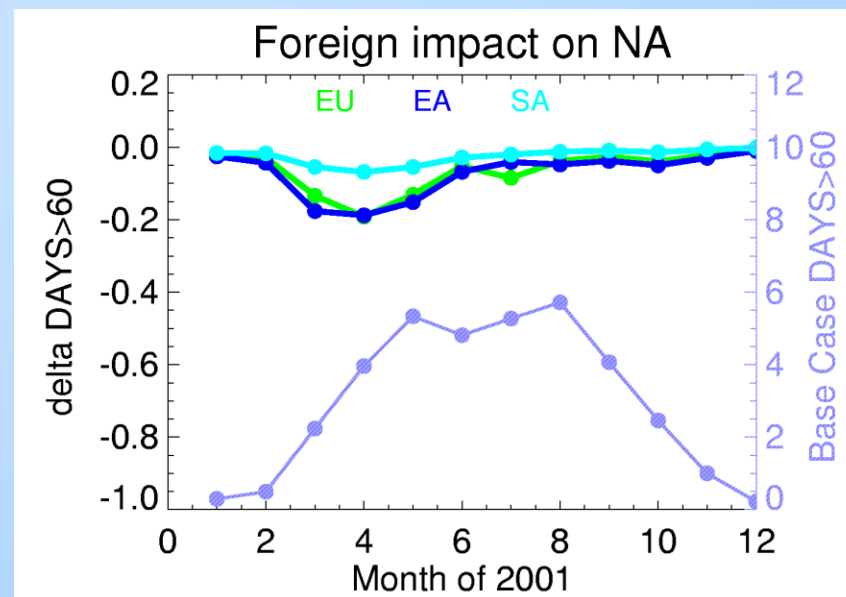
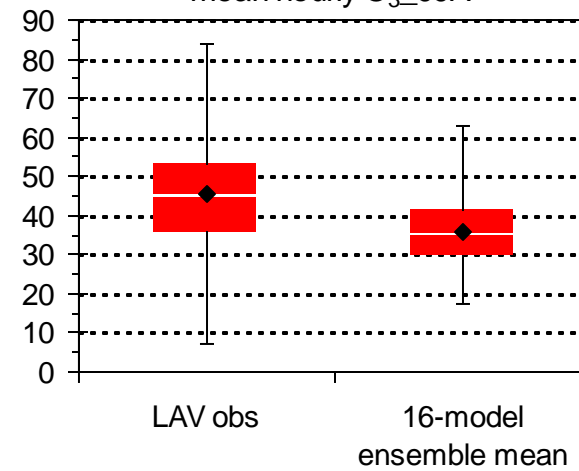# Annual & seasonal means at LAV
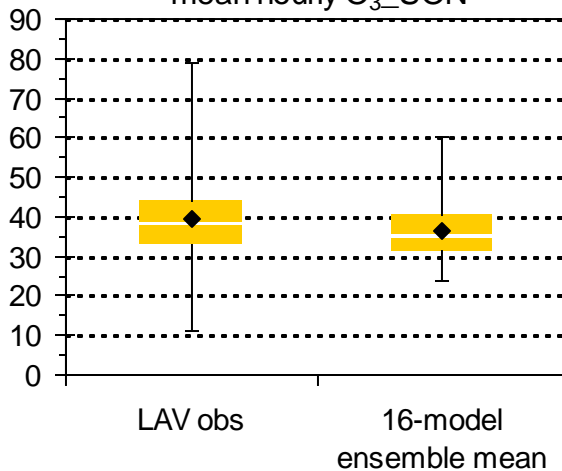

LAV vs. 16-model ensemsble mean hourly O_3_MAM
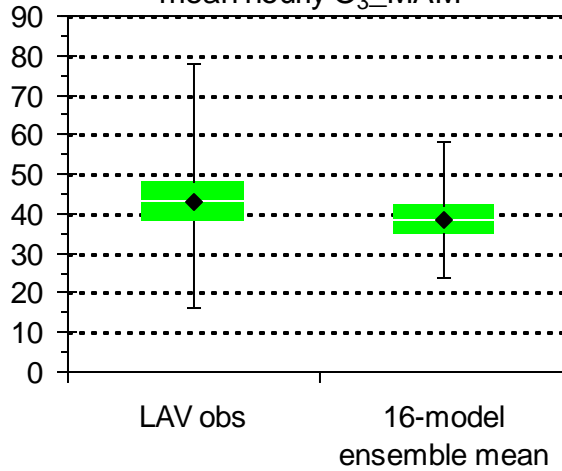
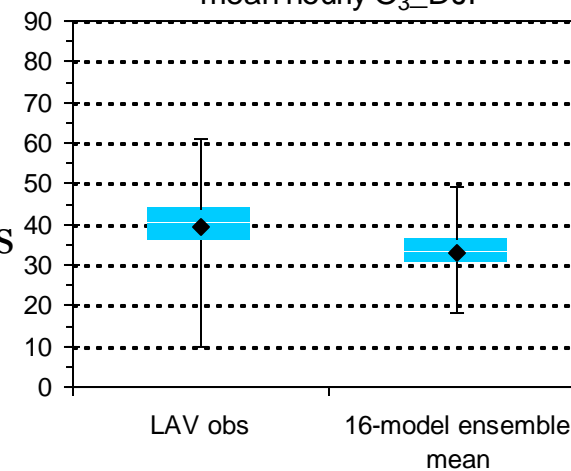LAV vs. 16-model ensemble mean hourly O_3_ANNUAL

LAV vs. 16-model ensemble mean hourly O_3_JJA

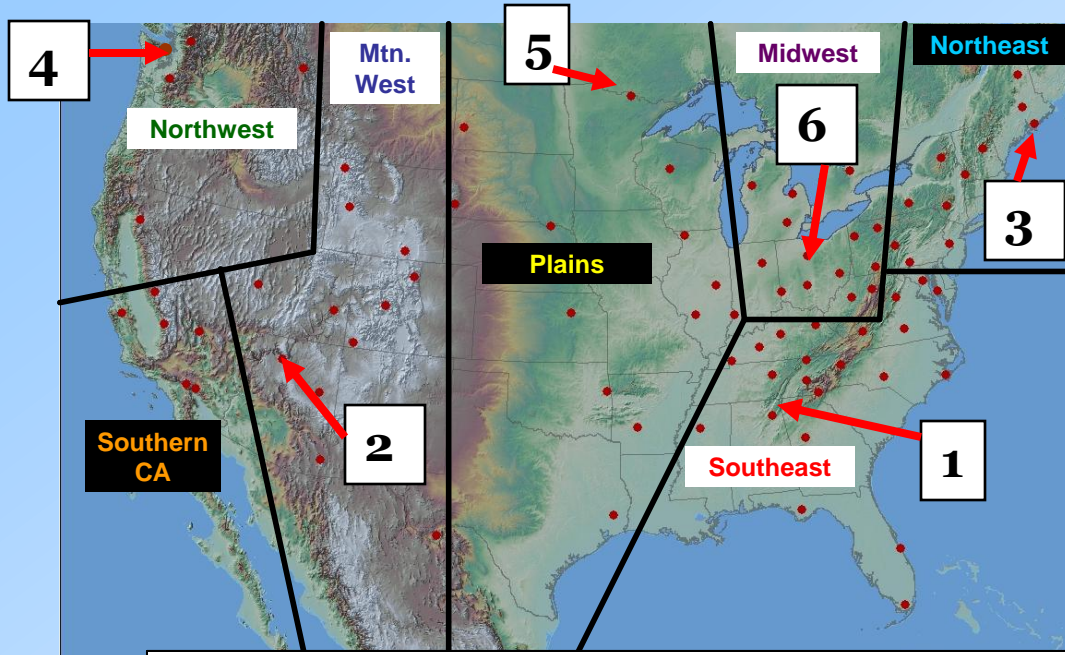LAV vs. 16-model ensemble mean hourly O_3_SON

LAV vs. 16-model ensemble mean hourly O_3_DJF

- Need to understand basic ensemble skill before assessing LRT

- Models underestimate O_3 year-round

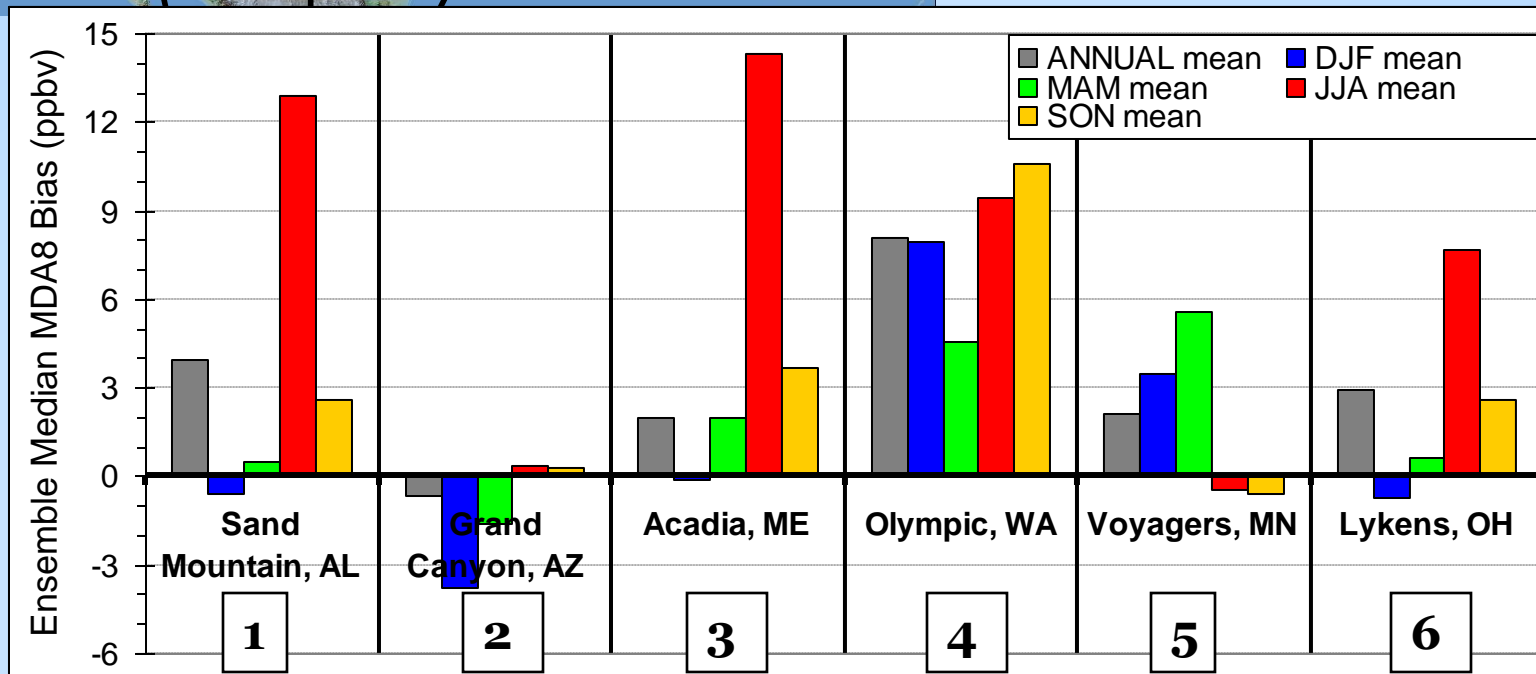- Models do not capture extremes (esp. in summer & fall)

→ Could be due to vertical resolution issues, given complex terrain around LAV

16-model ensemble bias in MDA8

MDA8 = max daily 8-hr avg

• In contrast to LAV seasonal and annual means, model ensemble *over*estimates in almost all seasons in all regions for MDA8 statistic

End

Issues, Questions, etc.

- Hourly model output for surface level only, so is high-altitude site focus a good idea?

- Individual sites vs. regional mean? If regional "mean", include all sites equally? Definition of regions: stay consistent with Holloway and/or others?

- Varying model resolution: 4° x 5 ° → 1 ° x 1 ° … segregate models by resolution?

- ???

Diurnal cycles (by season) at LAV