North American isoprene influence on intercontinental ozone pollution

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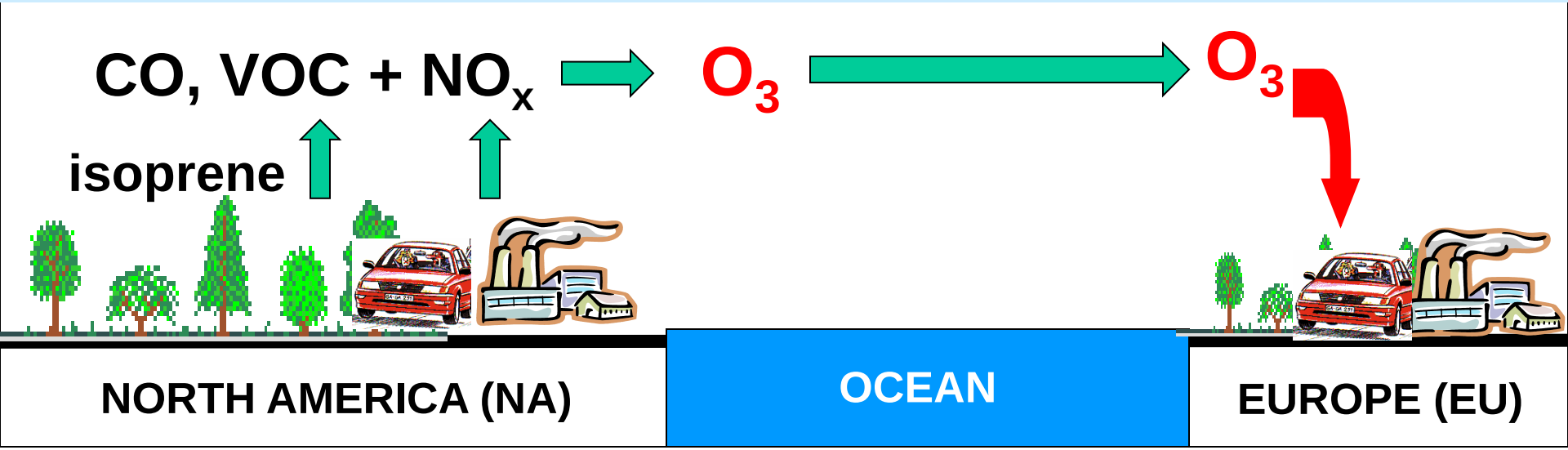
What role does isoprene play in intercontinental O_3 transport?

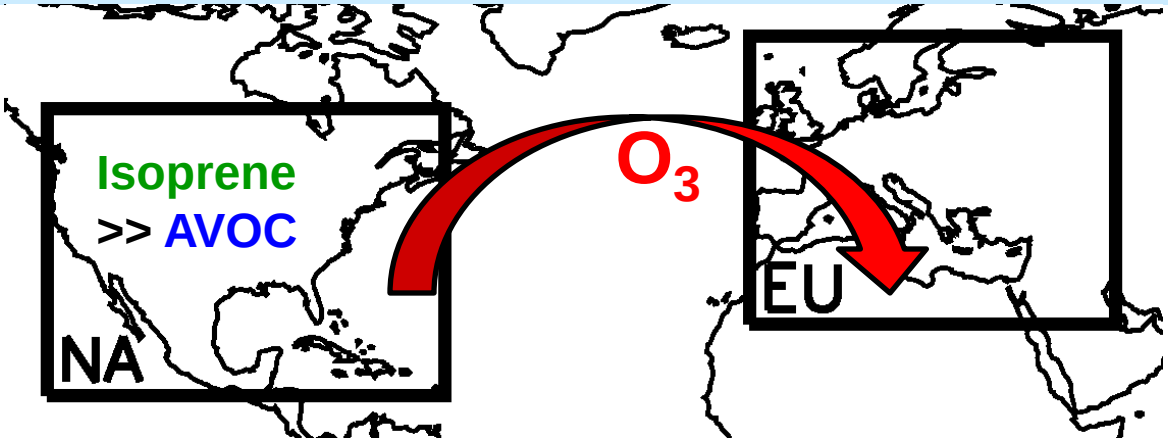


KEY FINDINGS (MOZART-2 global model)

EU surface O_3 decrease from -20% NA anthrop. emissions:

1. **could be offset by increases in isoprene (warmer climate, land-use)**
2. **shows little sensitivity to uncertain isoprene source magnitude or isoprene nitrate recycling**

Approach: Sensitivity simulations in MOZART-2 global CTM, expanding on TF HTAP multi-model studies



www.htap.org
TF HTAP, 2007, 2010;
Sanderson et al., GRL, 2008;
Shindell et al., ACP, 2008;
Fiore et al., JGR, 2009,
Reidmiller et al. ACP, 2009;
Anenberg et al., ES&T, 2009;
Jonson et al., ACPD,2010

1. Base Simulation in MOZART-2 global CTM:

→ 1.9 x1.9°; 2001 NCEP meteorology
→ Anthropogenic emissions as in Horowitz et al. [2003]
→GFED v2 for biomass burning [van der Werf et al.; 2006]

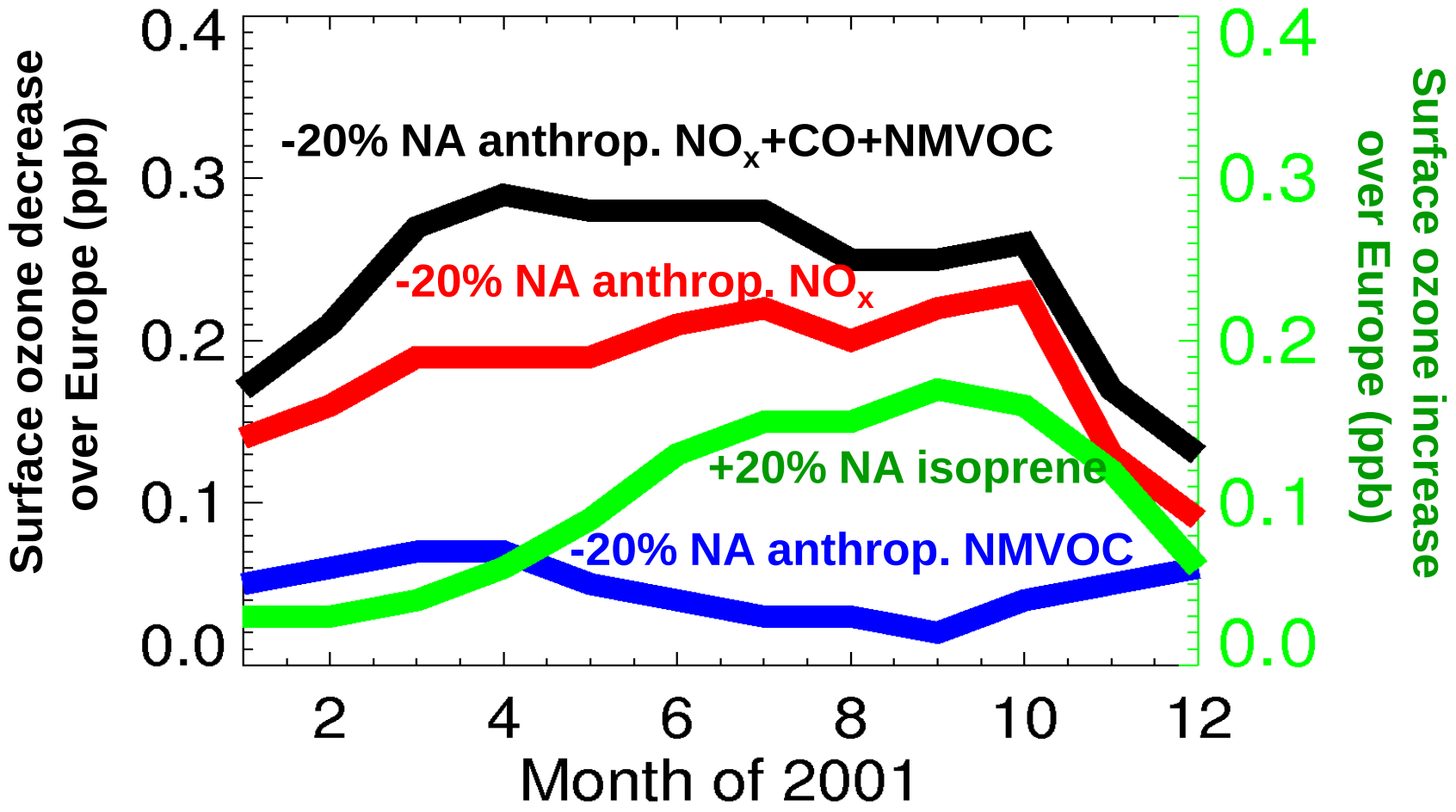
2. Suite of simulations changing NA emissions by:

→ **-20% anthrop. NO_x, NMVOC, separately**
→ **-20% all anthrop. (NO_x+CO+NMVOC+aerosol)**
→ **+20% isoprene**
→ **+20% isoprene and -20% all anthropogenic**

3. Different baselines to estimate all NA anthrop. influence on EU O_3

→ **isoprene nitrate recycling (100% vs 40%)**
→ **+20% isoprene emissions**

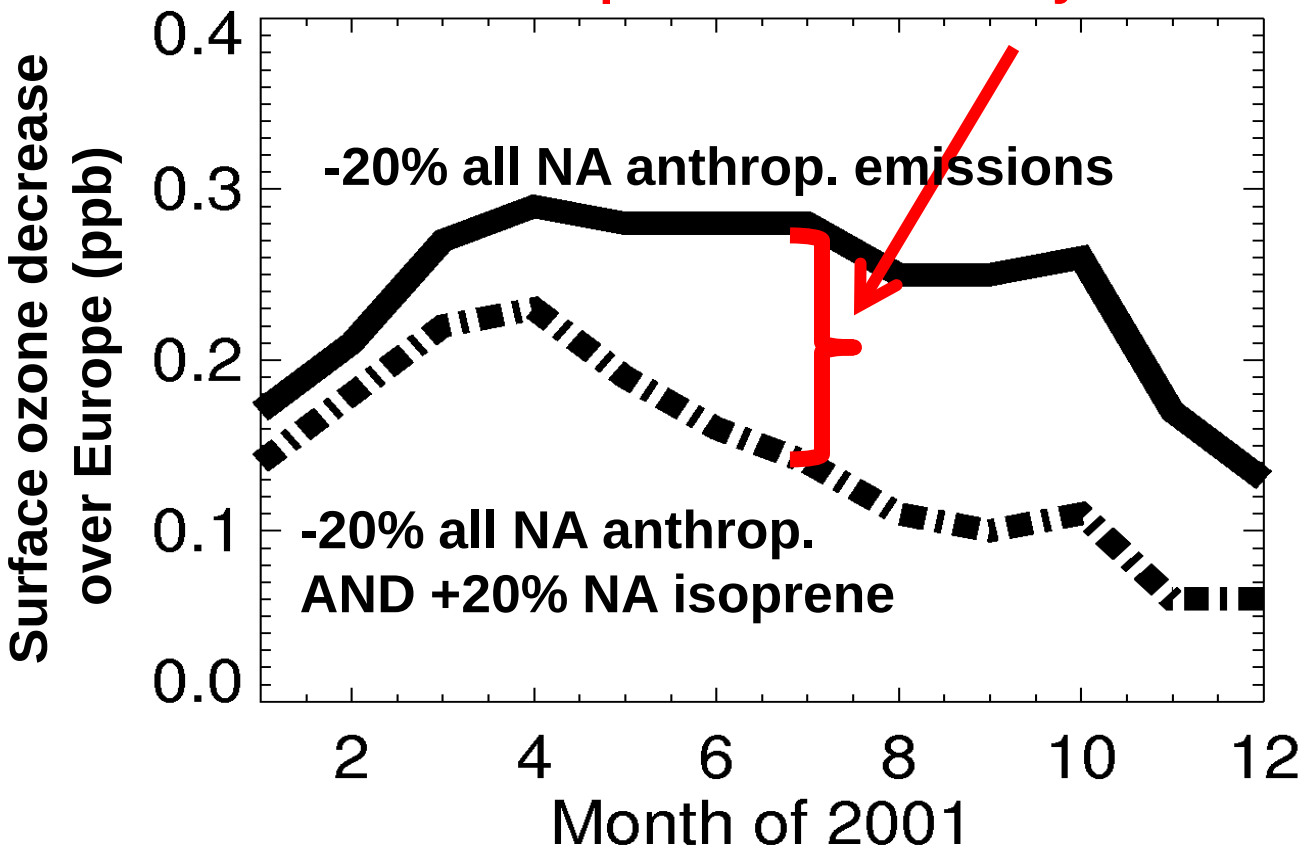
Surface O_3 response over Europe (spatial average) to North American (NA) emission perturbations



EU O_3 response to NA isoprene comparable to anthrop. NO_x in summer/fall; larger than anthrop. NMVOC

Surface O_3 over Europe (spatial average) to -20% North American emission perturbations

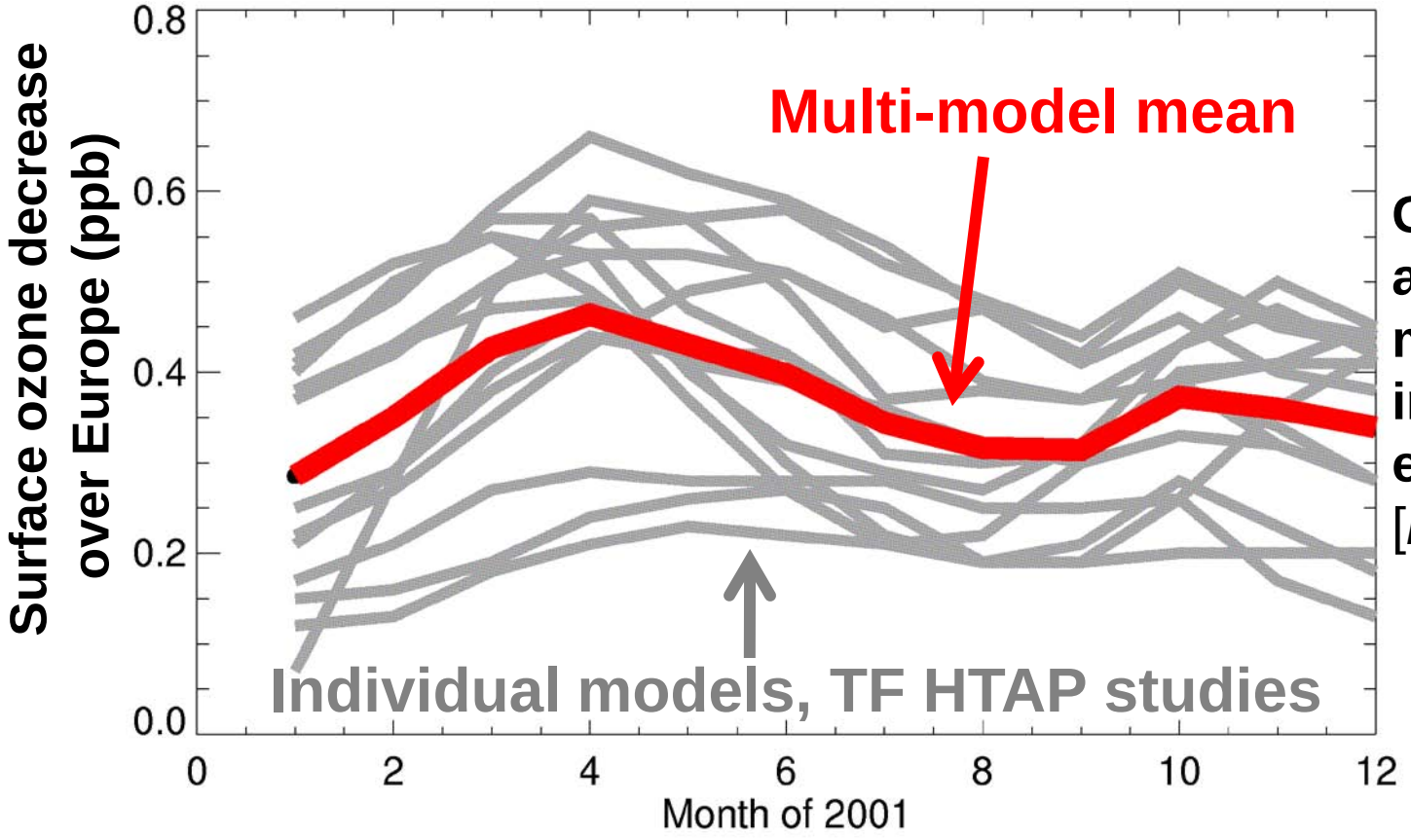
EU O_3 decrease is smaller by ~50% when NA isoprene increases by 20%



Interannual variations in NA isoprene emissions ~ 20-30%
[Palmer et al. 2006]

Consider potential changes in isoprene (climate, land-use) in future scenarios for emission controls to lower hemispheric O_3

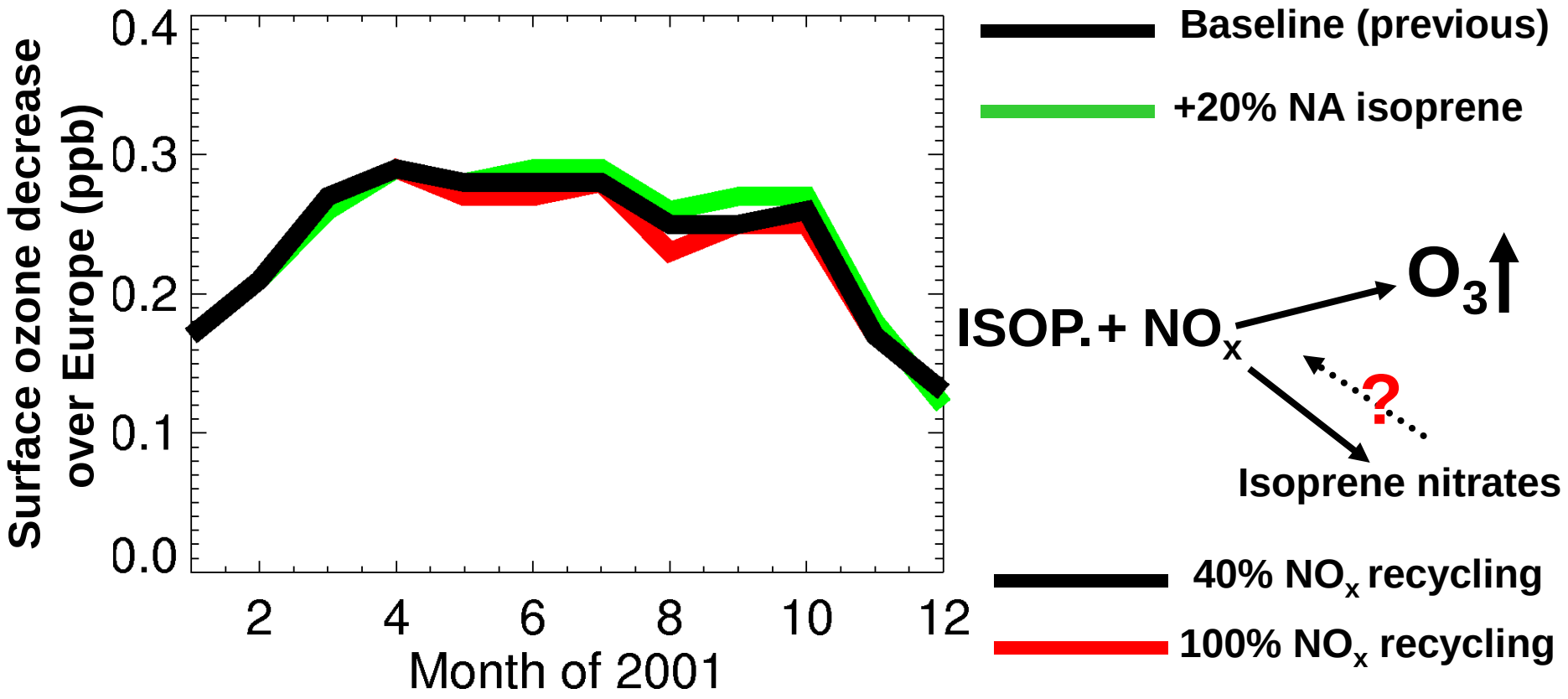
Prior studies show a wide range in model estimates of EU surface O_3 response to NA anthrop. emissions



Generally not associated with model differences in anthropogenic emissions
[*Fiore et al., 2009*]

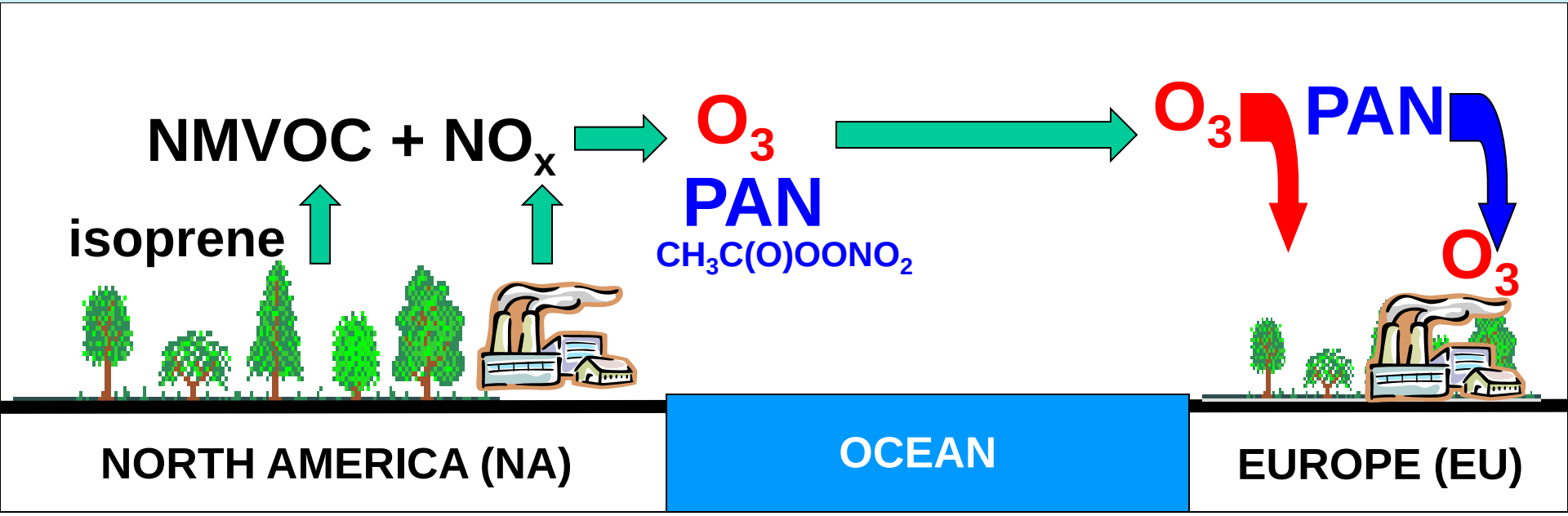
Does the range reflect model differences in size of isoprene source and/or isoprene nitrate chemistry?

Surface O_3 response over Europe (spatial average) to -20% all North American anthropogenic emissions



Cross-model differences not explained by different treatments of isoprene emission magnitude or isoprene nitrate recycling

PAN: A pathway (and a proxy ?) for source regions to influence foreign O_3



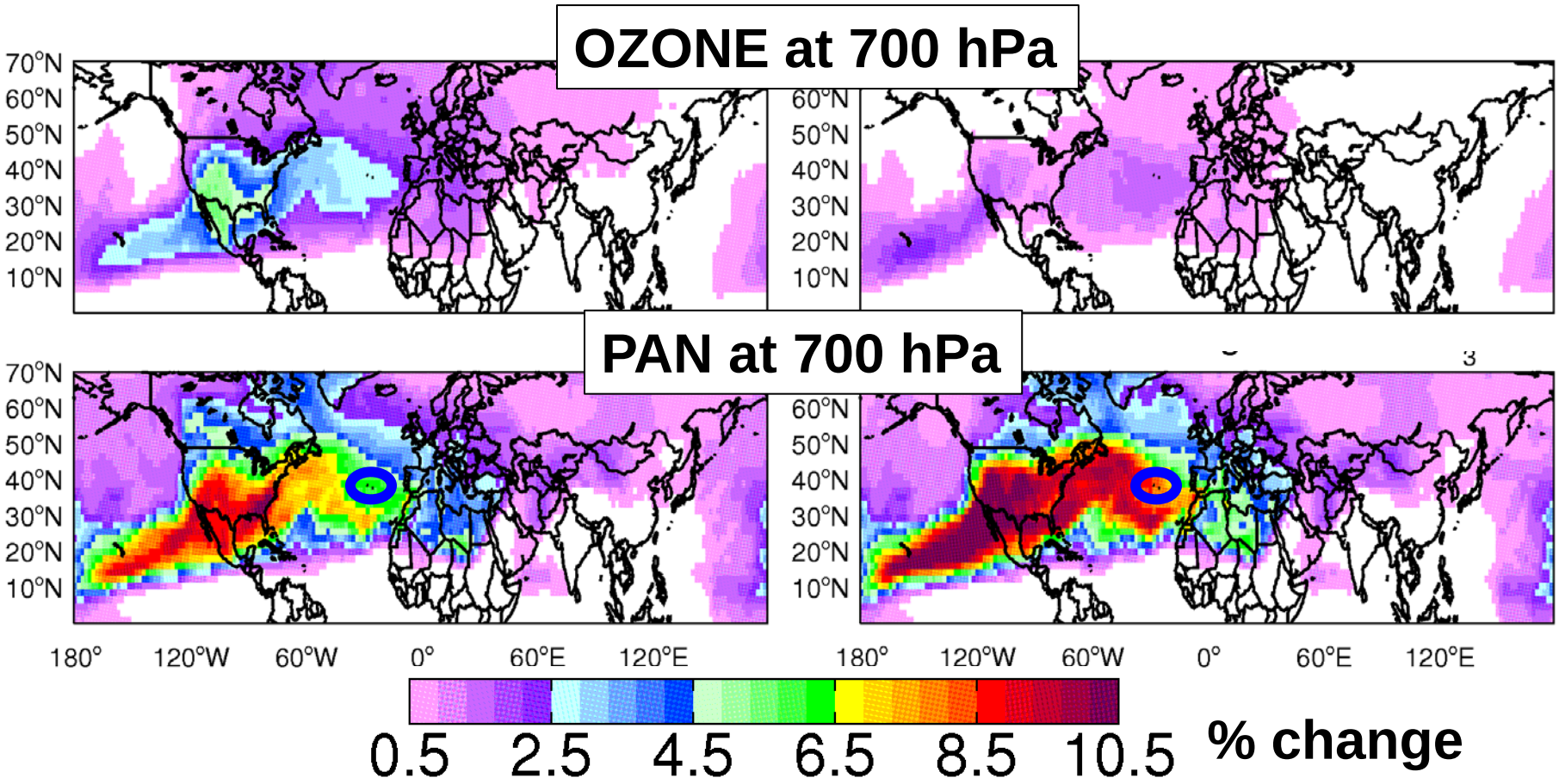
PAN as a PATHWAY: contributes to O_3 far downwind

[*e.g., Moxim et al*., 1996; *Heald et al.,2003; Hudman et al., 2004; Zhang et al., 2008; Fischer et al., 2010; Lin et al., 2010*]

PAN as a PROXY: may reflect changes in O_3 precursor sources better than O_3 itself [*Jaffe et al*., 2007; *Fischer et al*., 2010]

PAN is relatively more sensitive than O_3 to anthropogenic and isoprene emission changes (August)

-20% ALL NA anthrop. emissions **+20% NA isoprene emissions**



PICO-NARE site well-positioned for sampling N. American outflow
[*e.g., Honrath et al., JGR*, 2004; *val Martin et al., JGR*, 2008.]

North American isoprene vs. anthropogenic influence on intercontinental O_3 pollution: Conclusions and *implications*

EU surface O_3 decrease from -20% NA anthrop. emissions:

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Include biogenics when assessing impacts of human activities (& consider as anthropogenic, e.g. land-use)?

PAN may be a proxy for regional emission changes

Establish long-term PAN observing sites in the lower free troposphere in key locations?

For more info or to join the discussion (open at ACPD through 12/20/10):
http://www.atmos-chem-phys-discuss.net/10/24821/2010/acpd-10-24821-2010-discussion.html