Transboundary Air Pollution

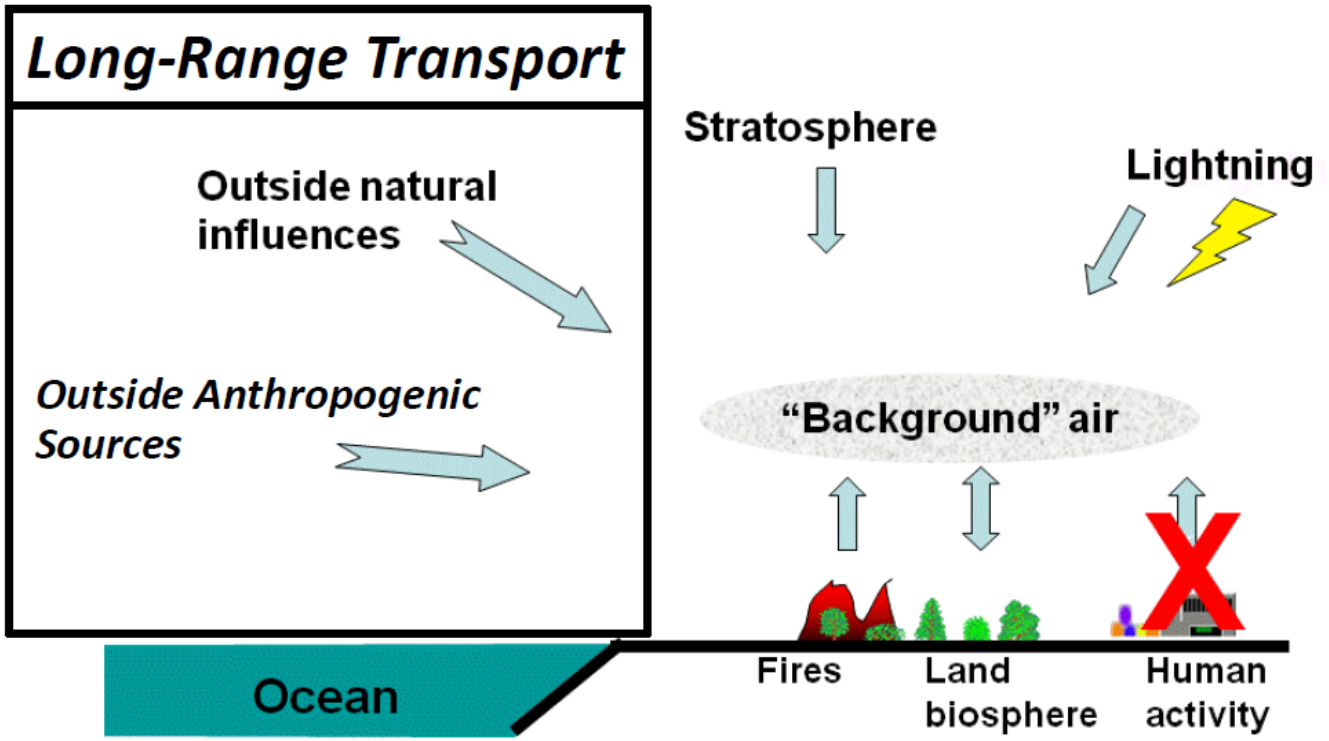
Briefing for Clean Air Act Advisory Committee
November 7, 2019

Purpose and Overview

- **Background impacts *ozone, PM, and regional haze* in the US**
  - Stakeholders have varying definitions; depends on the policy context
  - Background contributions are not directly measurable so we use photochemical model to provide estimates
- **PM:**
  - Predominantly a local issue, contribution from long range transport small (< 0.5 µg/m^3)
- **Ozone:**
  - Summer season average "US Background" in most places: 20-40 ppb
  - Few places/episodically, i.e., near borders or high elevation areas: 60-65 ppb
  - International transport in most places, most of the time: 1-10 ppb with near border areas up to 20 ppb of ozone
- **EPA is actively engaged with scientific community to update estimates and related guidance**

"International Transport" is One Part of Ozone Background

- Long range transport has natural and anthropogenic sources "outside" of the area of focus
- For the US, "International Transport" is reflected by outside anthropogenic sources
  - Most places, most of the time: 1-10 ppb
  - Near Mexican border or during transport events: up to 20 ppb episodically
- Natural: 15-30 ppb seasonal average, episodically larger e.g., from stratosphere
- We use photochemical models to estimate since even the most remote monitors include US anthropogenic contributions



Schematic of background O3 sources adapted from the most recent Integrated Science Assessment for the Ozone NAAQS Review

Mechanisms for long-range transport

- Different transport pathways
  - Low altitude are slower with more losses
  - High altitude are faster winds with fewer removal mechanism

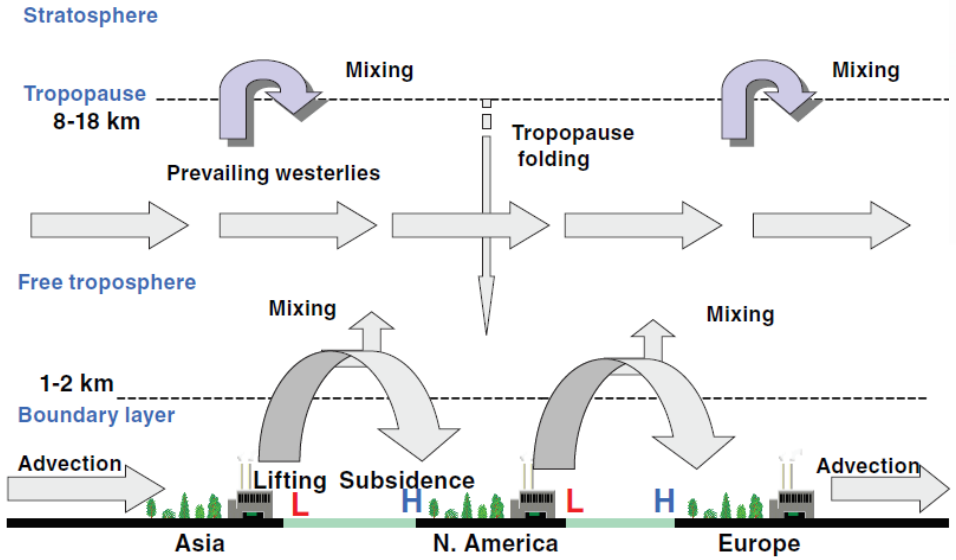


FIGURE 1.1 Schematic of the dominant dynamical processes involved in long-range midlatitude pollution transport. Ground level H and L symbols represent high- and low-pressure systems.

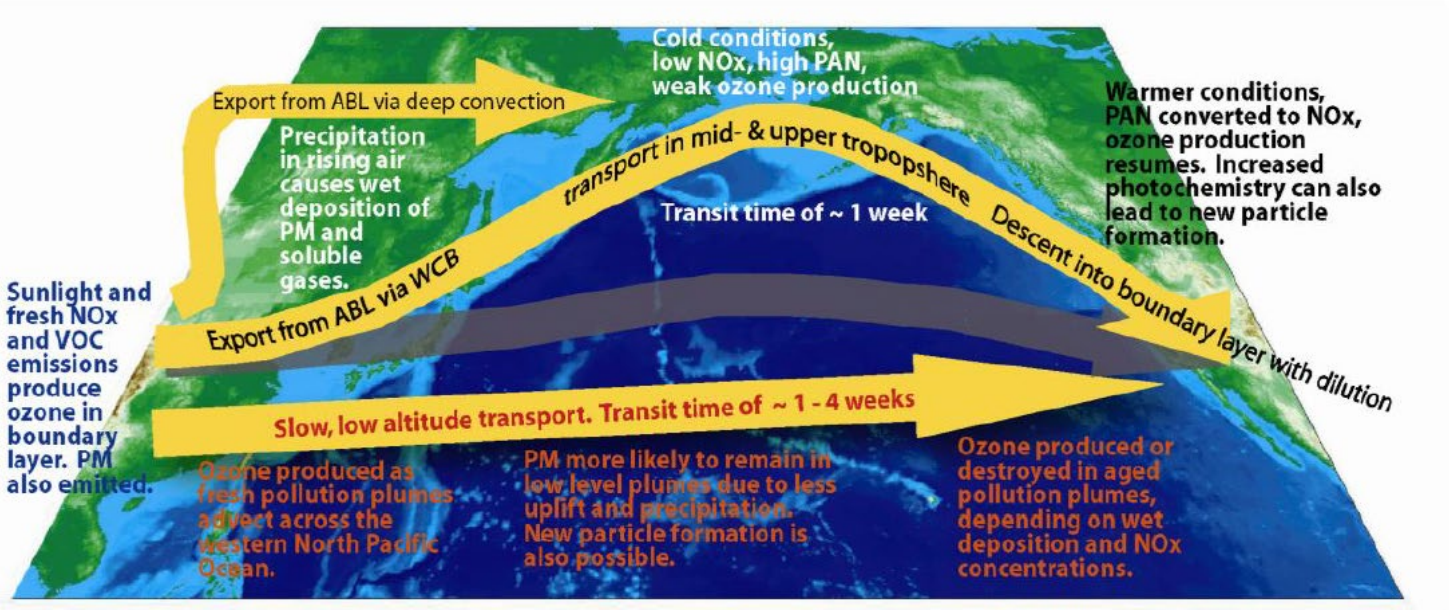
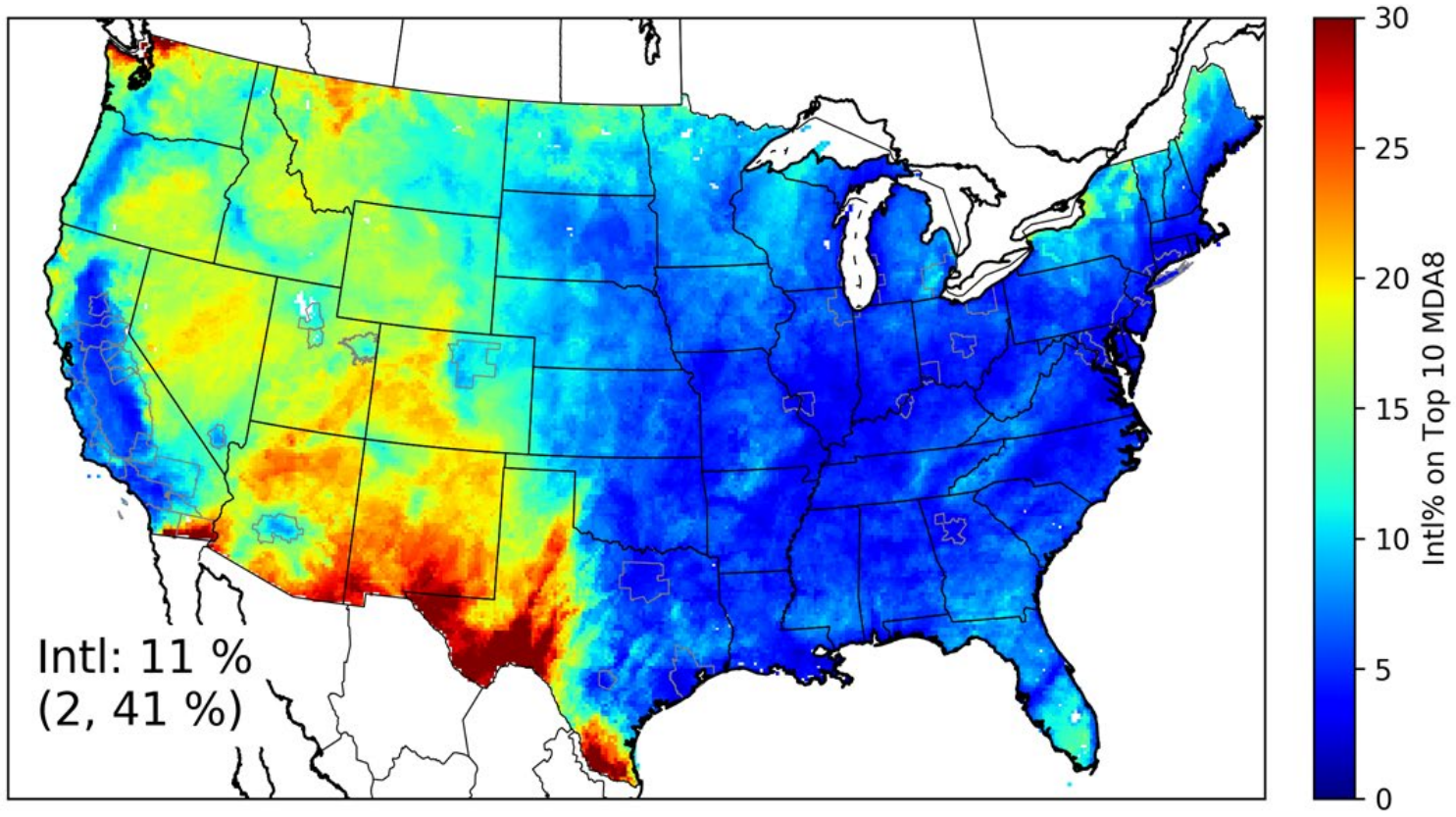


Figure 1.5. General intercontinental transport processes. Blue text on the left applies to continental boundary layer processes, red text apples to low level transport and black/white text applies to high altitude transport.

- Connection to the upper levels are controlled by convection

Figures: Global Sources of Local Pollution and HTAP Assessment Report

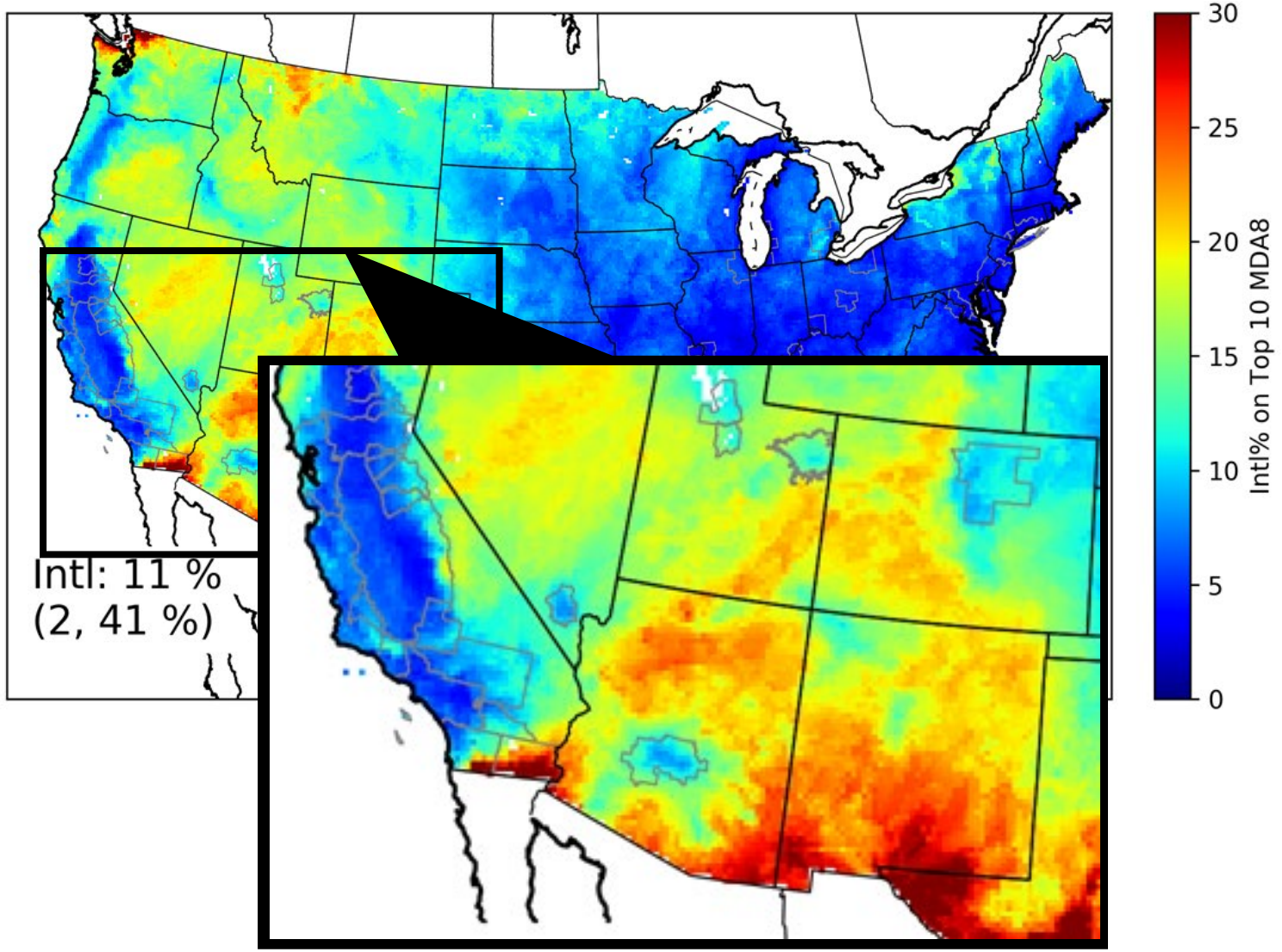
Contributions of International Anthropogenic Sources Over the US: 2016*



- Map of estimated International Transport fraction on top 10 total ozone modeled days.
- Grey lines outline 2015 Ozone NAAQS Designated Areas
- Domestic manmade emissions are the largest contributor to ozone design values at most locations in the Eastern US and most areas with ozone >70 ppb.
- Border areas and Intermountain West have more long range contributions (natural and anthropogenic).

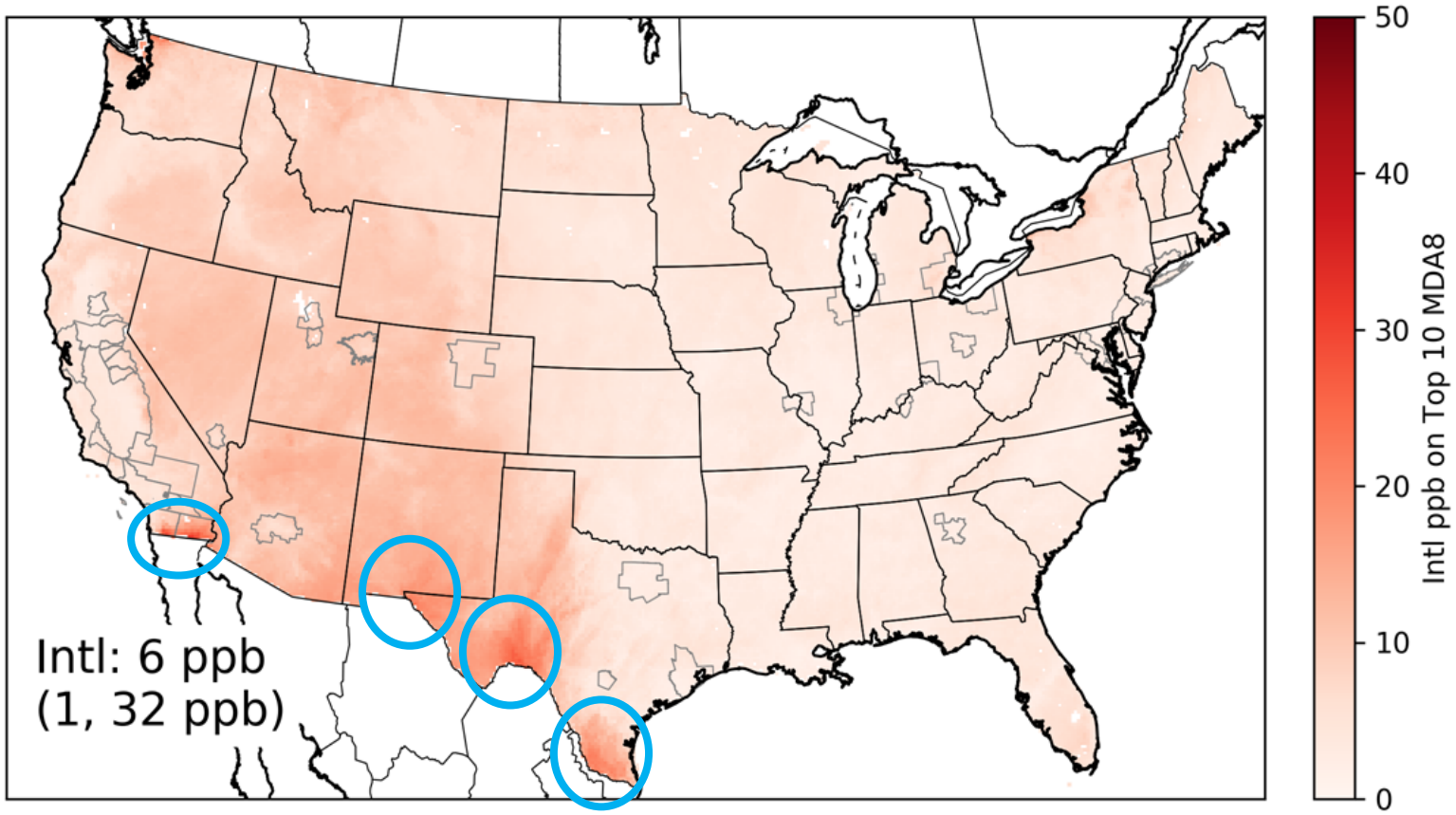
*2016 reflects zero-out modeling done for the 2018-2020 Ozone Policy Assessment.

Focus on Western Ozone Contributions in High Elevation & Border Areas



- Urban areas: have large impact from US manmade emissions. Similar to Eastern US sites. Local emissions contribute more during the typical ozone season.
- California non-urban: higher elevation sites, and near-border sites can be more affected by background.
- Intermountain western US: Sites can be strongly influenced by background near urban sites as well. Some rural, high-elevation areas can be near the NAAQS w/ low US anthropogenic contributions.

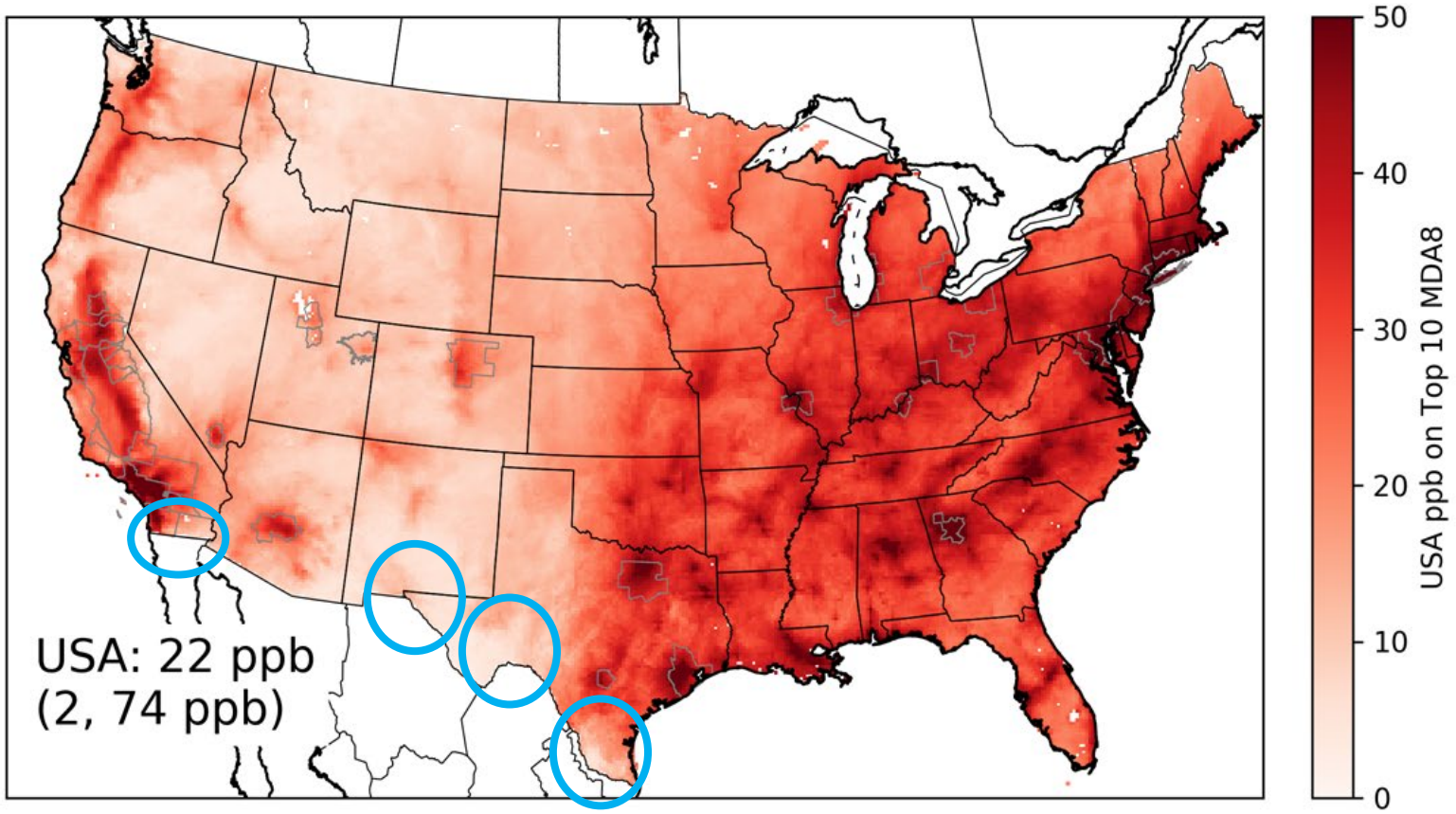
International Transport of Anthropogenic Ozone over US: 2016



- Map of estimated International contribution (ppb) on top 10 total ozone modeled days.
- Eastern US has little international contribution.
- Intermountain West has more “long-range” international transport.
- Select border areas have “short-range” transport.
- Largest international rarely coincides with ozone over the level of the standard.

*2016 reflects zero-out modeling done for the 2018-2020 Ozone Policy Assessment.

United State Anthropogenic Ozone over US: 2016



- Map of estimated USA contribution (ppb) to on top 10 total ozone modeled days.
- Largest USA contribution nearly always coincides with ozone over the level of the standard.
- Exceptions are very close to border areas, some of which do have international transport that is atypically large.

*2016 reflects zero-out modeling done for the 2018-2020 Ozone Policy Assessment.

For PM, background is local issue with small contributions from long range transport

- Short atmospheric lifetimes (~days to weeks) means PM pollution is more localized
- International transport is therefore primarily a concern for near-border areas
  - That said, small contributions can be important for visibility/Regional Haze (separate briefing on modeling for Regional Haze Roadmap)
- Background PM contributions for most of the US are mainly from natural sources
- Episodic natural contributions can be large, e.g. near fires or wind blown dust events
  - These extreme episodes occur mainly in remote areas and are routinely screened for subsequent use in regulatory applications



Image Sources: USFS/InciWeb; phys.org

Addressing "Background" in NAAQS Reviews and Implementation

- Current Ozone and PM NAAQS Reviews
  - Integrated Science Assessment and Policy Assessment for each review includes summary of latest literature on US background including international transport
  - Policy Assessment updating US Background including international transport for recent year
- NAAQS Implementation
  - Exceptional Events Rule allows for exclusion of episodic events (CAA §319)
    - natural events (e.g., fires or stratospheric intrusions)
    - anthropogenic activity that is unlikely to recur (e.g., facility explosion)
  - CAA § 179B:
    - Allows EPA to approve an attainment plan for a nonattainment area, if international transport of pollution is a significant impediment to meeting the standard on time, i.e., would have attained "but for" international emissions.

EPA Planned and Ongoing Technical Efforts

- Research and Assessments
  - Extending application of the EPA's Hemispheric-CMAQ system for more regulatory and policy purposes
  - EPA's 2016 modeling platform with characterization of international transport contributions for
    - O_3 : characterizing more specific sources,
    - $PM_{2.5}$: extending our methods to better quantify PM contributions, and
    - Regional Haze: proposing "international adjustments" for calculating the glidepath.
  - Updated modeling is consistent with previous results and expectations.

- Background and International Transport Implementation Supports
  - Exceptional Events: Technical guidance
    - Ozone/Wildfire Guidance (*public*, working on addendum for prescribed fires)
    - Interim High Winds Guidance (*public*)
    - Stratospheric Intrusion Guidance (*public*)
  - 179B technical guidance to inform states on providing approvable demonstration (*under development*)