

Non-point Source Emissions Overview

Presented to: **CASA Non-Point Source Workshop**

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Agenda

- 1 Source Types
- 2 Background Contributions
- 3 Air Quality Issues
- 4 Assessment Tools
- 5 Management
- 6 Conclusions

1 Source Types

Based on geometry:

- Point
- Area
- Line
- Volume

Point Sources - Characteristics

- Specific to industry
- Highly regulated
- Can obtain measurements
- Well established emission controls



Point Sources - Characteristics

- Location
- Base Elevation
- Stack Height
- Stack Diameter
- Building Dimensions
- Stack Gas Exit Velocity
- Stack Gas Exit Temperature
- Substance Emission Rate (g/s)
- Temporal Variability



Area Sources - Characteristics

- Treat numerous, small point sources collectively as area sources for convenience
- Grid Cells
- Grid cell area
- Location
- Base Elevation
- Substance Emission Rate ($\text{g}/\text{m}^2/\text{s}$)
- Temporal Variability



Area Sources - Characteristics

- Homogenous Area
 - Pond
 - Mine
 - Plant Area
- Define Polygon
- Area
- Base Elevation
- Substance Emission Rate (g/m²/s)
- Temporal Variability



Line Sources - Characteristics

- Examples
 - Highway
 - Mine Haul Road
 - Conveyer
- Define segment
- Base Elevation
- Average Release Height
- Substance Emission Rate (g/m/s)
- Temporal Variability



Volume Sources - Characteristics

- An area Source with a third dimension
 - Storage piles
 - Fugitive refinery
 - Conveyer
- Define Area
- Base Elevation
- Average Release Height
- Substance Emission Rate ($\text{g}/\text{m}^2/\text{s}$)
- Temporal Variability



2 Background Contributions

Contributions outside study area:

- Long-range transport
- Natural sources

Forest (wild) Fires



Volcanoes



Intercontinental PM Transport

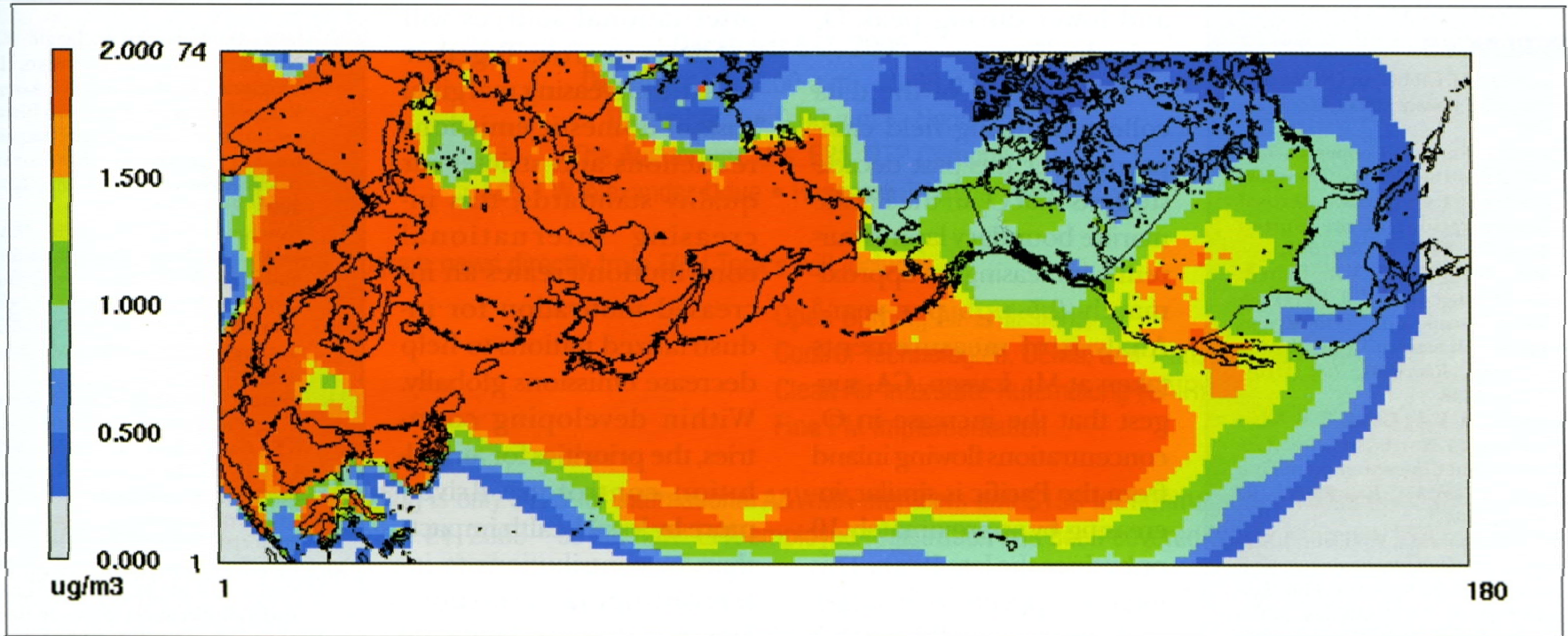
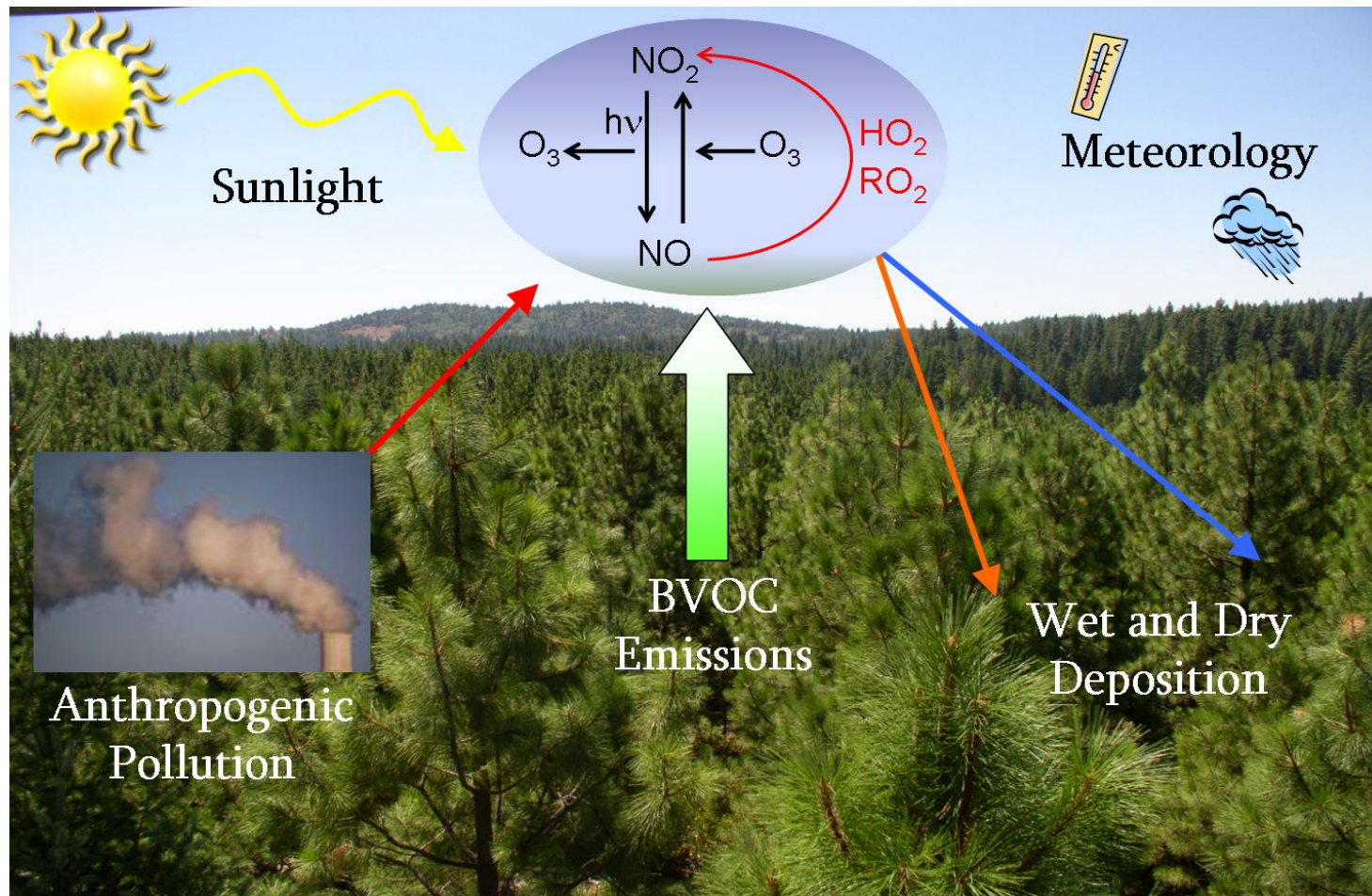


Figure 1. Modeled monthly average concentration of PM_{2.5} crossing the Pacific Ocean due to anthropogenic Asian emissions in April 2001, calculated using CMAQ as the difference between a base-case simulation and a simulation with anthropogenic Asian emissions removed. Courtesy of Carey Jang, EPA.

Large Asian dust transport events in western US occur once every 3 to 5 year

Biogenic VOC



3 Air Quality Issues

Issues determined by:

- Spatial scales
- Temporal scales

Spatial Scales

Local (~ 1 km)

- Nearby residents
- Typically odour concerns
- Dusting

Mesoscale (~1 to 10 km)

- General air quality (e.g., NO₂)
- Deposition in rural areas

Regional (10 to 100 km)

- Secondary PM_{2.5} and/or O₃ formation
- Downwind of large urban/industrial areas

Spatial Scales

Local (~ 1 km)

- May have to separate a single facility into multiple area sources
- For example, a single facility could be subdivided into different process areas, tank farm, construction areas

Regional (10 to 100 km)

- Area sources can be combined
- For example: individual urban grid cells could be combined for the entire urban area, and medium point sources could be treated as an area source

Temporal Scales

Emissions

- Hourly variation (e.g., traffic)
- Workday vs. weekend
- Seasonal

Meteorology

- Wind speed
- Temperature
- Precipitation

Temporal Scales

Receptors

- Minutes - odours
- Human health – Acute (1-h to 24 h exposures)
 - Chronic (annual to lifetime exposures)

General

- Magnitude
- Frequency
- Duration

Issues

PM (PM_{2.5} and PM₁₀)

- Road dust, construction, agriculture
- Primary and secondary
- Human health and visibility
- Dust involves larger PM

NO_x

- Industry and transportation
- NO₂ formation
- Human health, vegetation and PM and O₃ precursor

Issues

SO₂

- Industry
- Related fugitive TRS = odours

O₃

- Not directly emitted
- Secondary formation via NO_x and VOC
- Human health and vegetation

CO

- Transportation and industry
- Human health
- If we meet NO₂ standards, CO is not an issue

Issues

NH₃

- Agriculture and Industrial
- Odours
- Contributes to secondary PM

VOC

- Industry, transportation, agriculture and biogenic
- Multiple chemicals, grouping is for convenience
- Human health and odours

Visibility

- Enhanced fog formation
- Wind blown dust
- Plume blight, Haze formation

4 Assessment Tools

Three assessment tools:

- Emission Inventory
- Ambient Monitoring
- Simulation Modelling

Emission Inventory

Emission Rates

- Typically not measured
- Reliance on facility/activity specific emission factors
- US based emission factors may have limitations for the Alberta context
- Provincial estimations spatially allocated according to a surrogate
- NPRI database has limitations

Source Locations

- Typically not well defined

Ambient Monitoring

Locations

- May not be able to separate point source and non-point source contributions
- May not be able to separate local from long range/natural source contributions
- Need to be mindful of all potential contributions

Interpretation

- Typically not in the hot spots
- For example, we do not have a $PM_{2.5}$ or O_3 monitor downwind of Calgary where these effects are expected

Simulation Modelling

Model Selection

- Local scale = AERMOD or CALPUFF
- Regional scale = CALPUFF or CMAQ
- Secondary ozone = CMAQ

Model Input

- Emission inventory is the biggest road block
- When available, model performance should be gauged with measurements

4 Management Tools

- National
- Provincial
- Municipal
- Mitigation

National Tools

Focus on Industry

- NPRI reporting
- Emission Standards
- National Ambient Air Quality Standards
- Canada Wide Standards

Non-industry

- Emission standards (e.g., transportation)
- Fuel standards (e.g., gasoline)

Comprehensive Air Management System (CAMS)

- Canadian Ambient Air Quality Standards
- Place-based air quality management
- Base-Level Industrial Emissions Requirements

Provincial Tools

Focus on Industry

- EPEA, AER and NRCB
- Approval process
- Emission standards
- Monitoring
- Ambient air quality objectives and guidelines
- Provincial management plans

Non-industry

- Land Use Planning Zones
- Management Plans
- Airsheds
- CASA Process

Municipal Tools

Land Use Planning

- Designating industrial, residential zones
- Traffic corridors

Complaint

- Nuisances

Mitigation

Best Practices

- Emission reduction is often effected by other motivations

Examples

- Building design to reduce heating/cooling costs
- More fuel efficient vehicles to reduce energy demands
- Alternate commuting to reduce traffic congestion
- Dust management to improve safety
- Tilling practices to reduce loss of topsoil
- Wildfire management to prevent loss of a resource

6 Conclusions

- Non-point source types are varied
- Associated emissions are difficult to quantify
- Non-point source emissions can be substantive
- Multiple temporal and spatial scales
- Multiple air quality issues

⇒ **Multiple management approaches are required**

Questions?

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