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MCTA Air Conference Modeling 101

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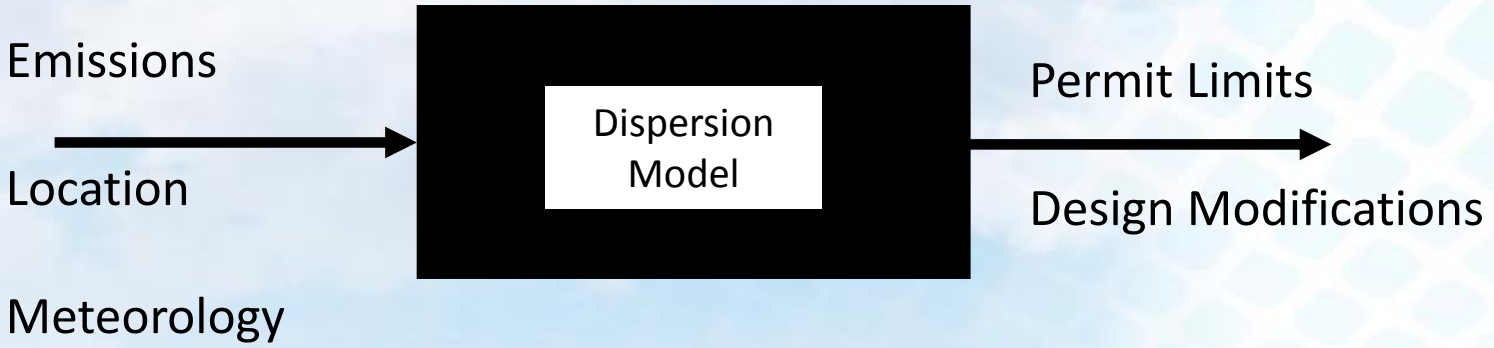
Boston, MA

Presentation Goal

Develop basic understanding of modeling concepts to reduce “black box” of modeling



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Discussion Points

- When is modeling needed?
- What do some of the acronyms mean?
- What are the critical inputs to the models?
- What do you do if you do not "pass" the modeling?

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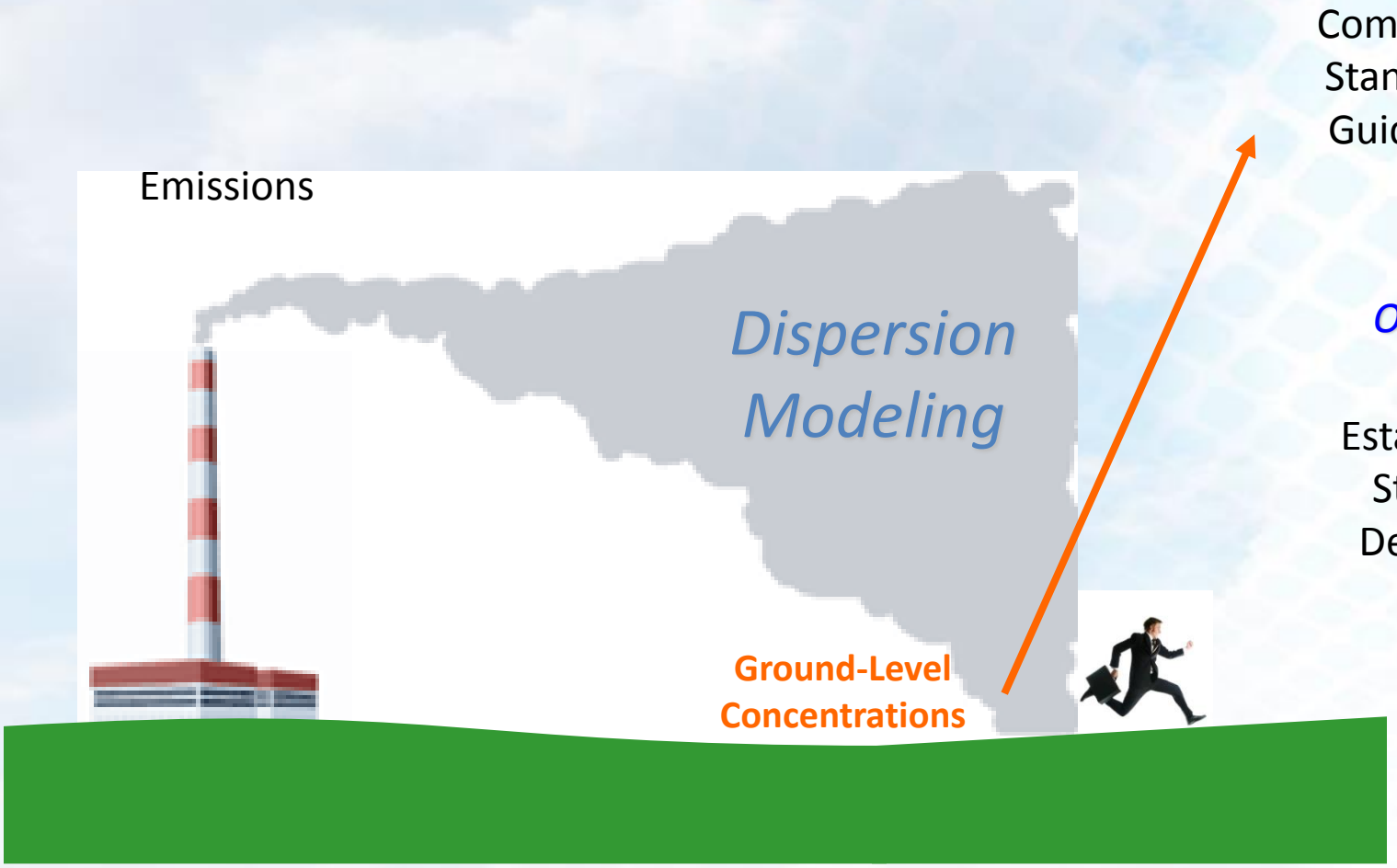
Purpose of Dispersion Modeling



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When is Modeling Needed?

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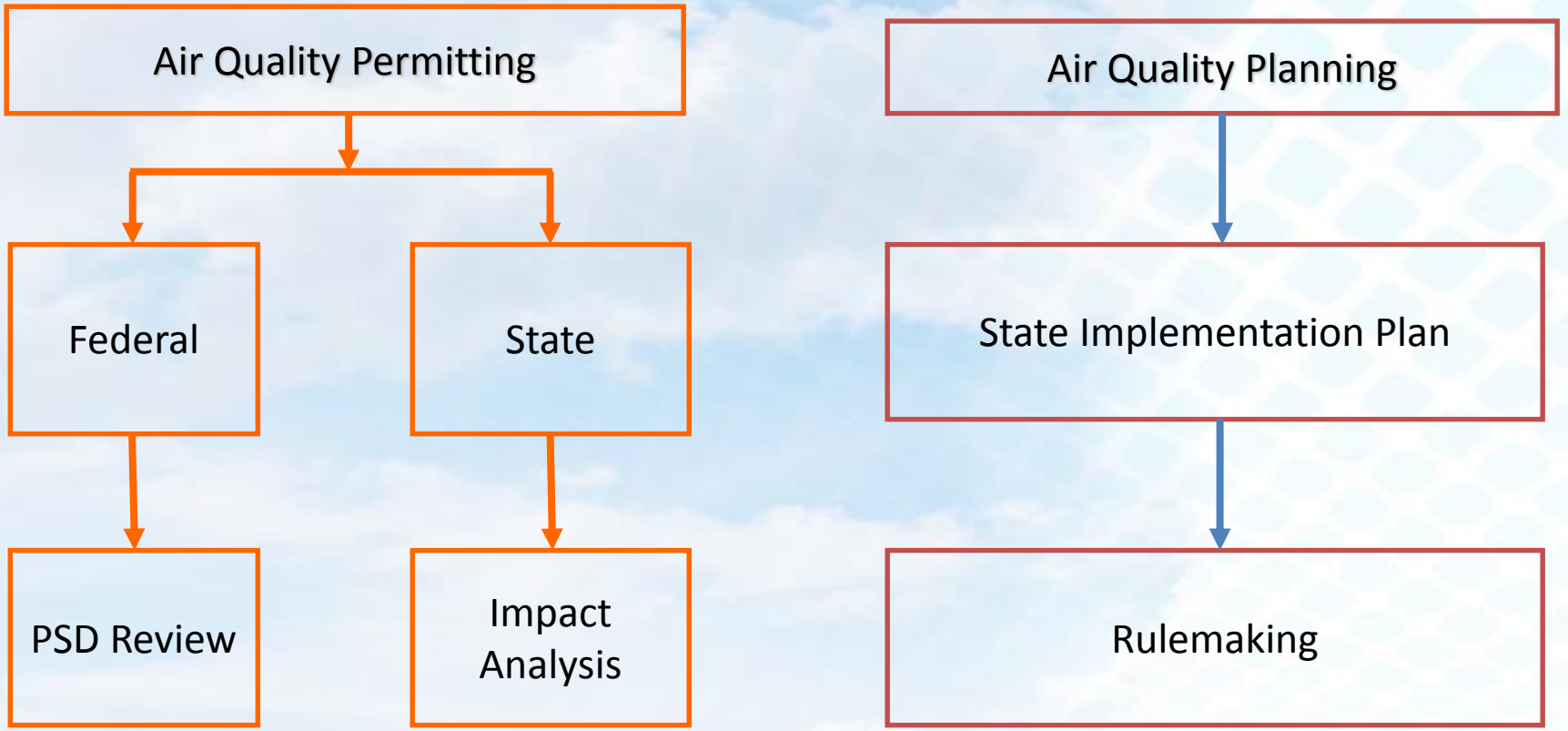
When is Modeling Required?



** For projects that do not trigger a Federal review, modeling for criteria pollutants (NAAQS) may be requested by state agency*

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Dispersion Models

- For most applications:
  - SCREEN Models
    - AERSCREEN, CALPUFF Screen
    - Models that give worst-case first-cut concentration
  - Refined Models
    - AERMOD
    - CALPUFF
  - Special Case Models
    - CTDM – Complex Terrain Dispersion Model
    - SCICHEM – Second Order Closure Integrated Puff Model with Chemistry
    - SDM – Shoreline Fumigation
    - DEGADIS – Dense Gas Model
    - OCD – Offshore and Coastal Dispersion Mode

How Do We Choose a Modeling Methodology?

- Federal & State Guidance
  - Guideline On Air Quality Models
  - New Source Review Workshop Manual
  - AERMOD Implementation Guidance
  - State Guidance
  - Regulatory Specific Guidance (SIP, PSD, toxics, etc.)
  - FLAG, VISTAS, MOG
  - Support Center for Regulatory Air Models (SCRAM)

What Do Some of The Acronyms Mean?

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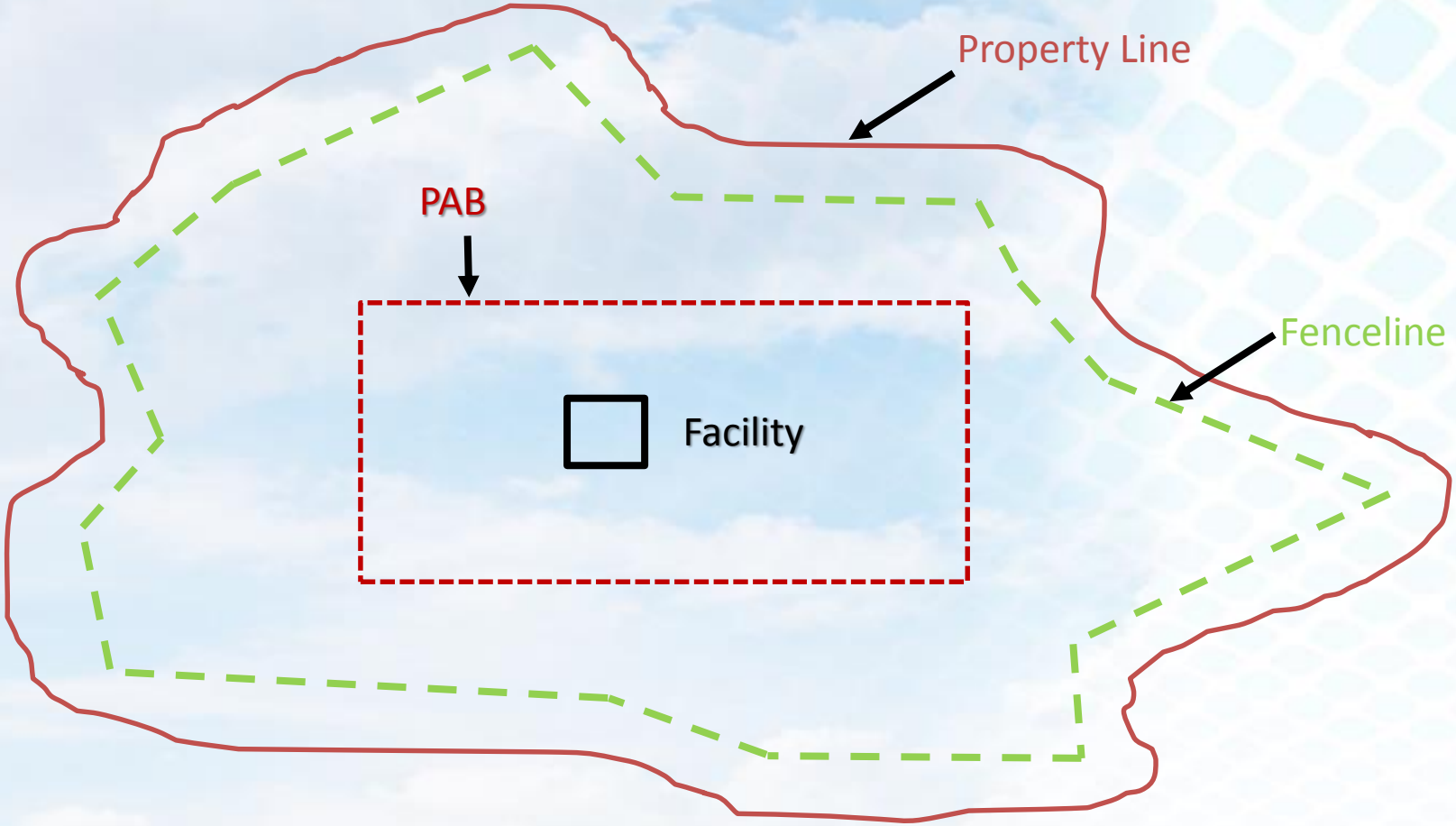
Modeling Definitions – Ambient Air

(1 of 6)

- *Ambient Air*
- The portion of the atmosphere, external to buildings, to which the general public has access
  [40 CFR Part 50.1 (e)) (7-A)]
  - In general, ambient air is defined as any location at or beyond the fence line of the facility. The fence line must restrict public access by a continuous physical barrier, such as a fence or a wall. If plant property is accessible to the public or if any residence is located within the restricted area, receptors should be located on-property.
  - Be aware of local agency modeling department's likes and dislikes

Modeling Definitions

(2 of 6)



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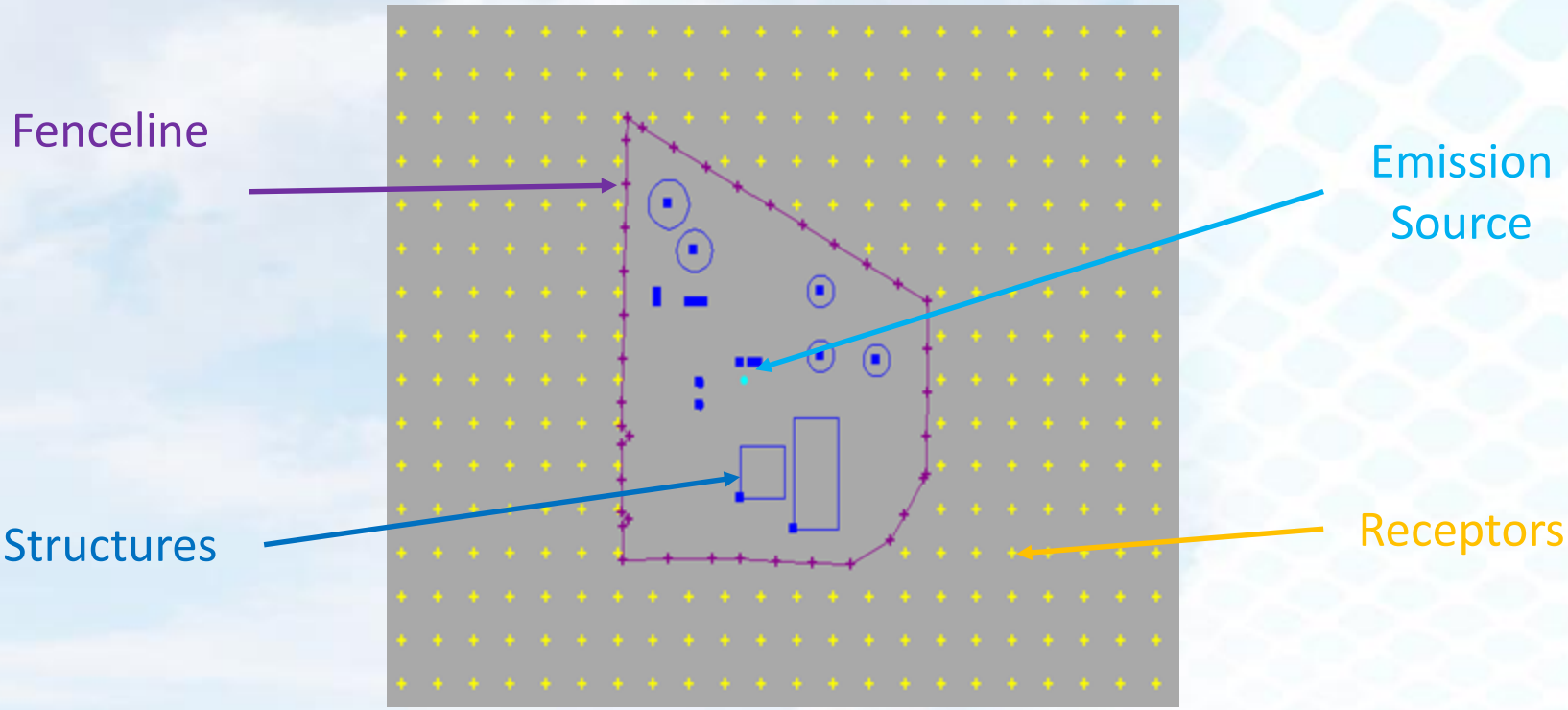
Modeling Definitions - General

(3 of 6)



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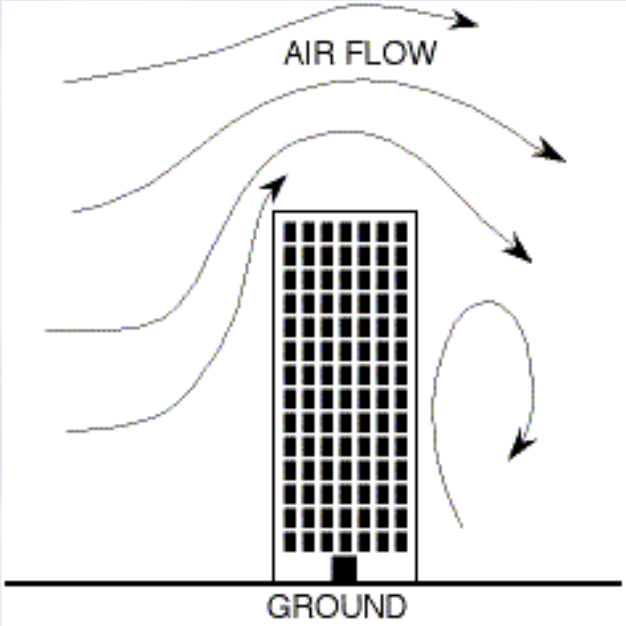
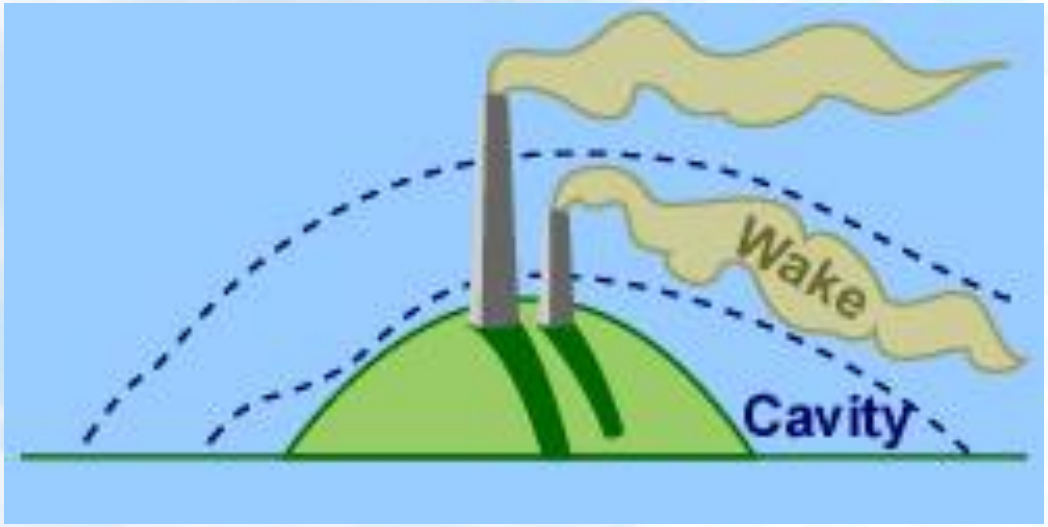
Modeling Definitions-Downwash

(4 of 6)





In about 80% of all modeling cases, maximum concentrations occur at receptors affected by downwash

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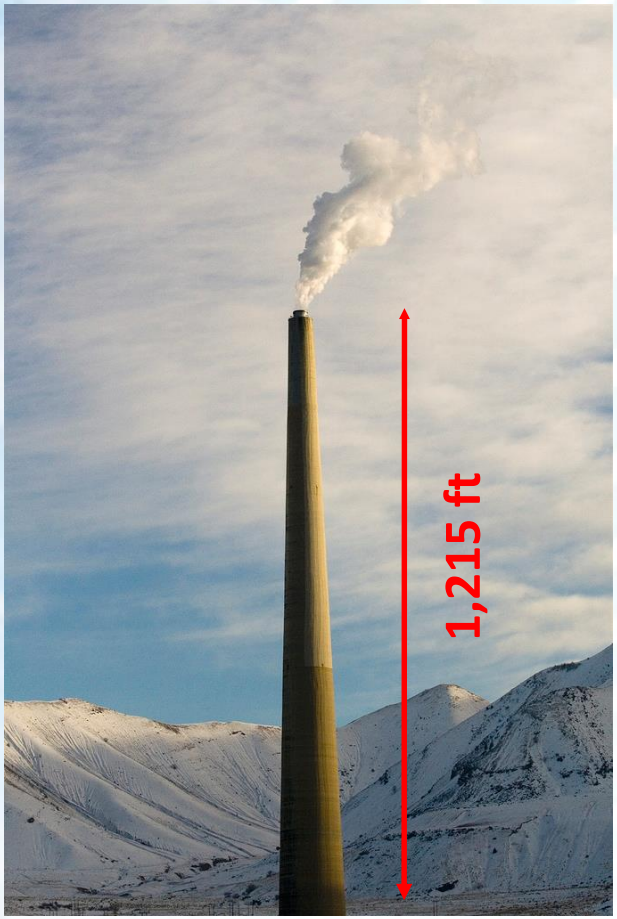
Modeling Definitions-Good Engineering Practice Stack Height (GEP)

(5 of 6)

- GEP – The stack height at which building downwash no longer occurs
- GEP = Maximum of 65 meters or Hb + 1.5L
  - Hb = height of building
  - MPW = Maximum projected width of building
  - L is the lesser of Hb and MPW

  Cannot model a stack higher than GEP



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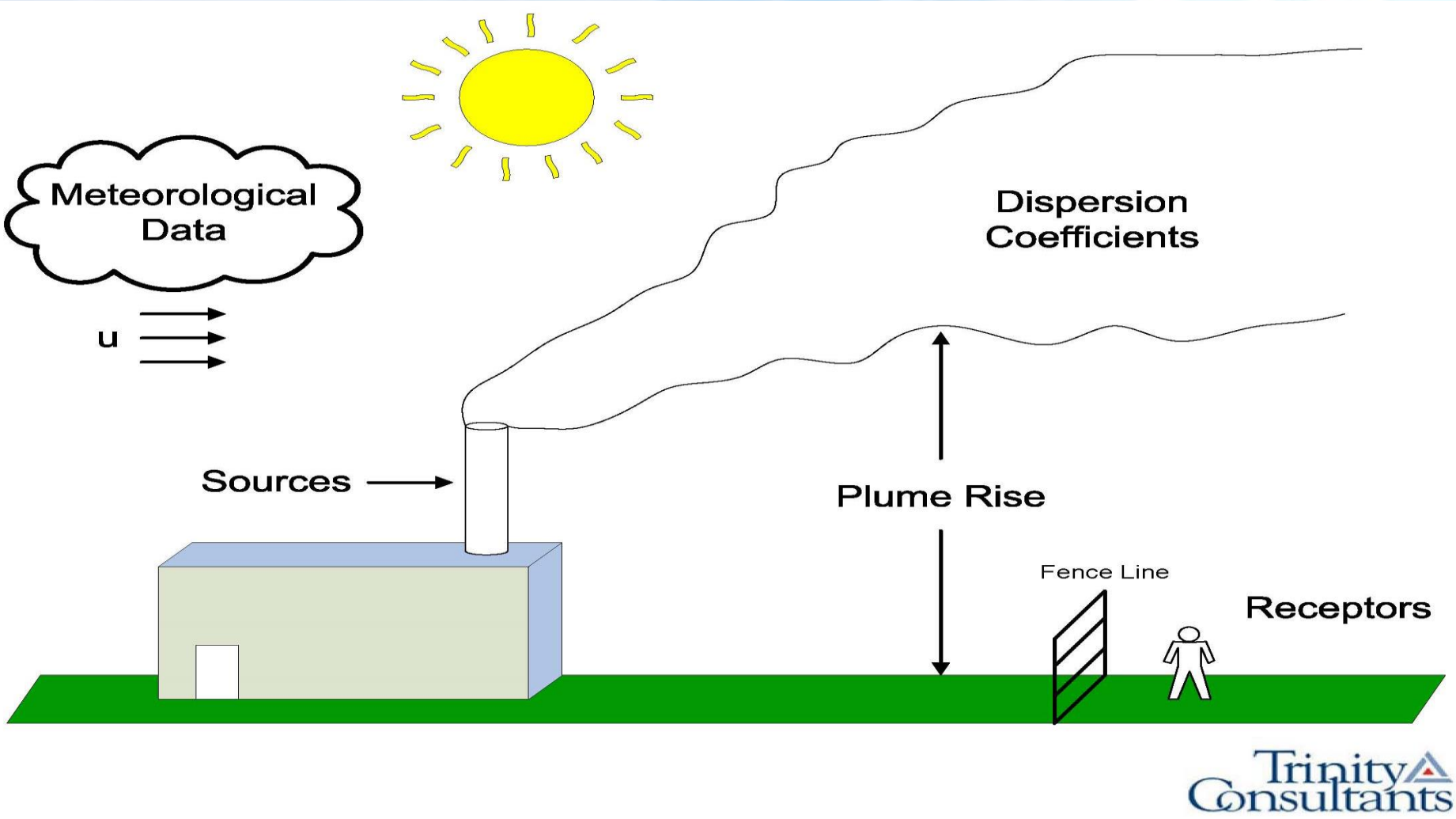
Modeling Definitions – Other Parameters

(6 of 6)



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What are the Critical Inputs to the Models?

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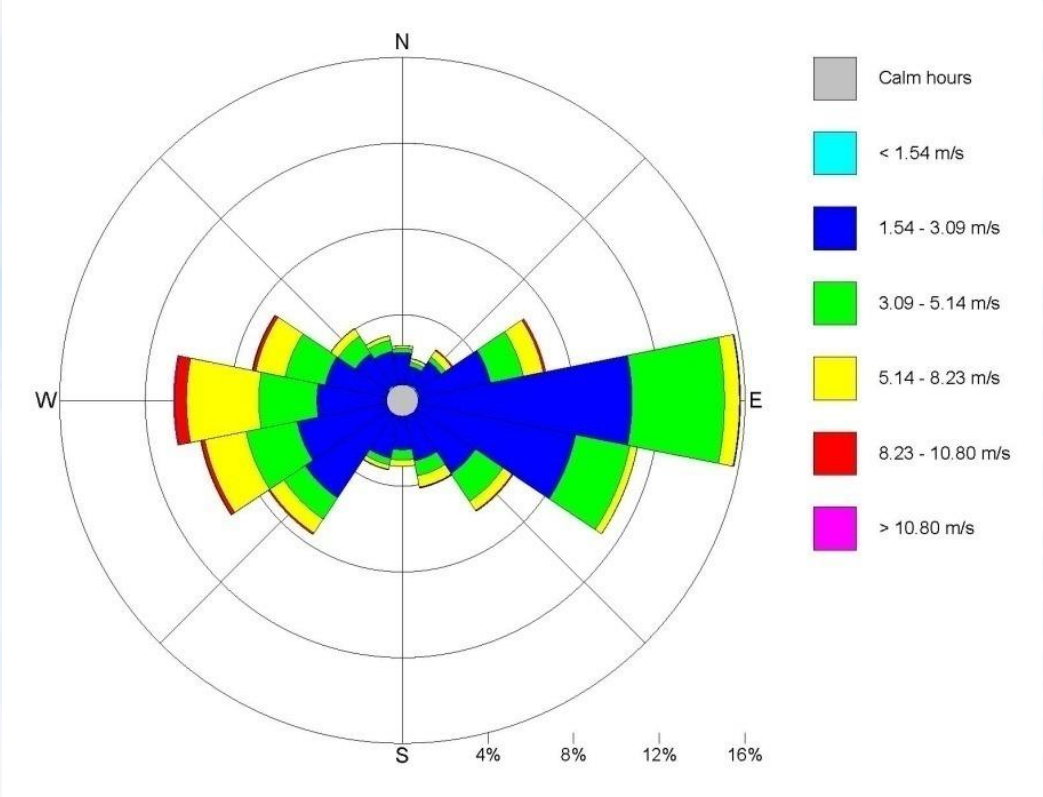
Critical Inputs - Meteorology

(1 of 7)

- Wind speed and direction



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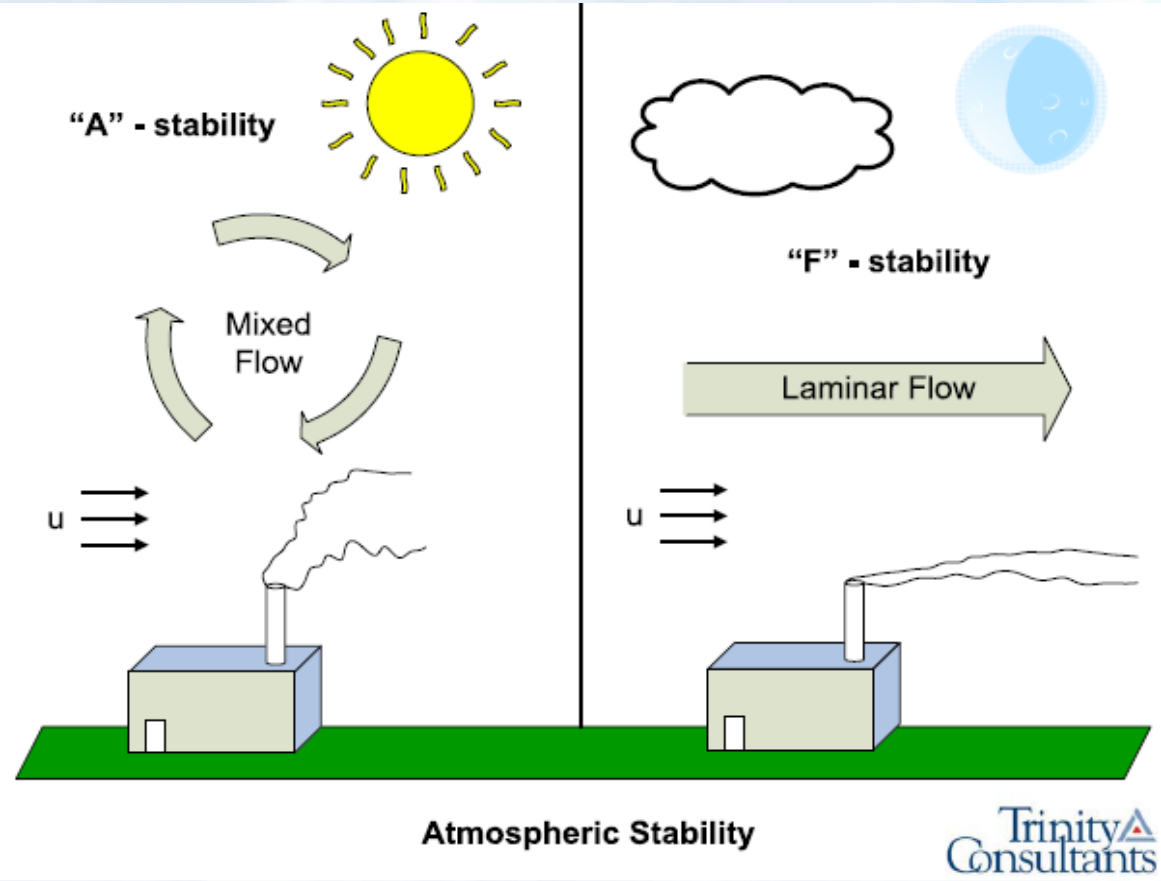
Critical Inputs - Meteorology

(2 of 7)

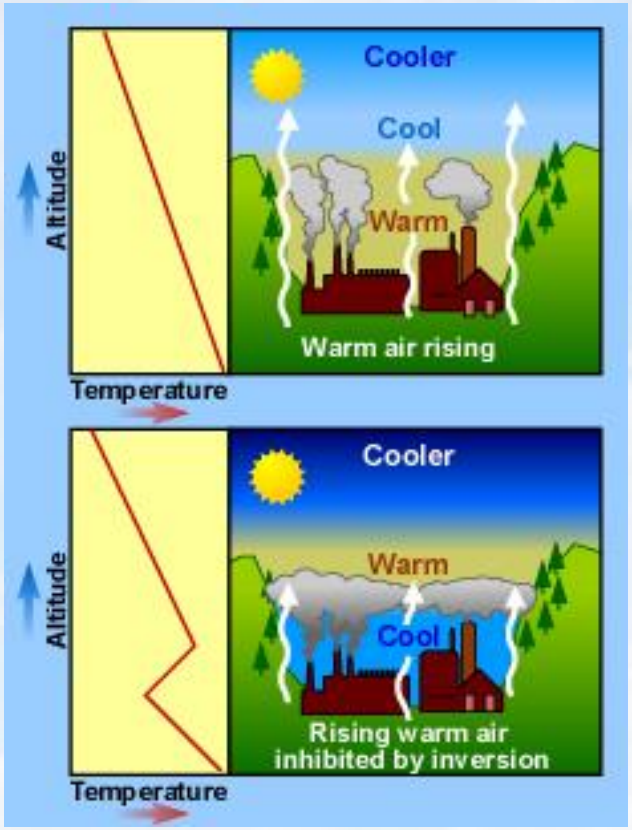
- Turbulence and stability

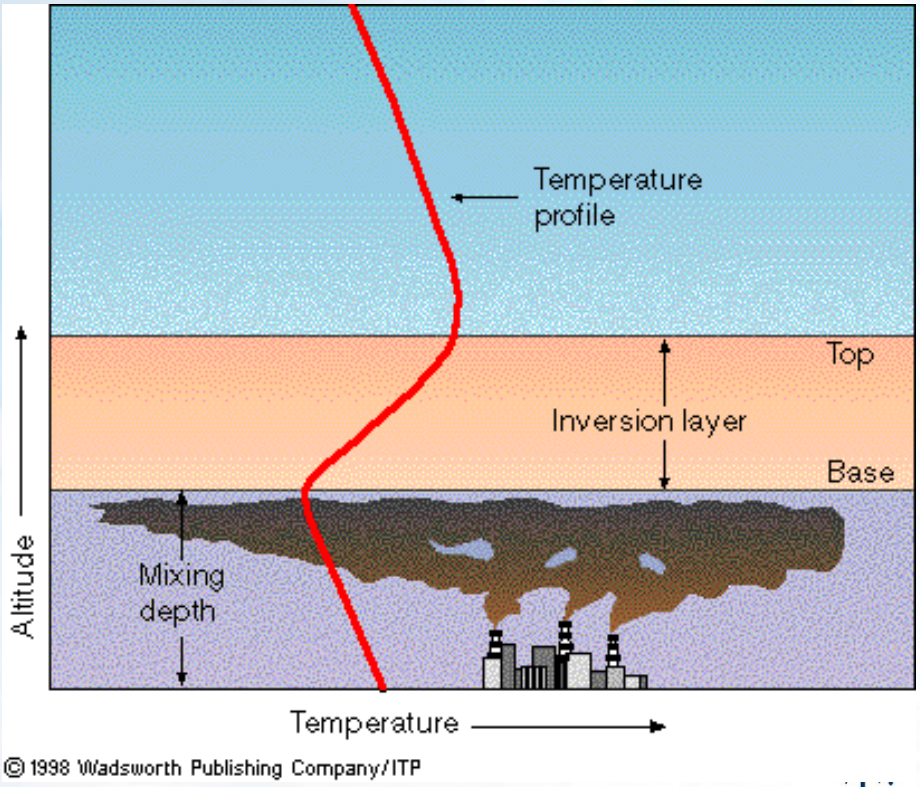


Critical Inputs - Meteorology

(3 of 7)

- Mixing height





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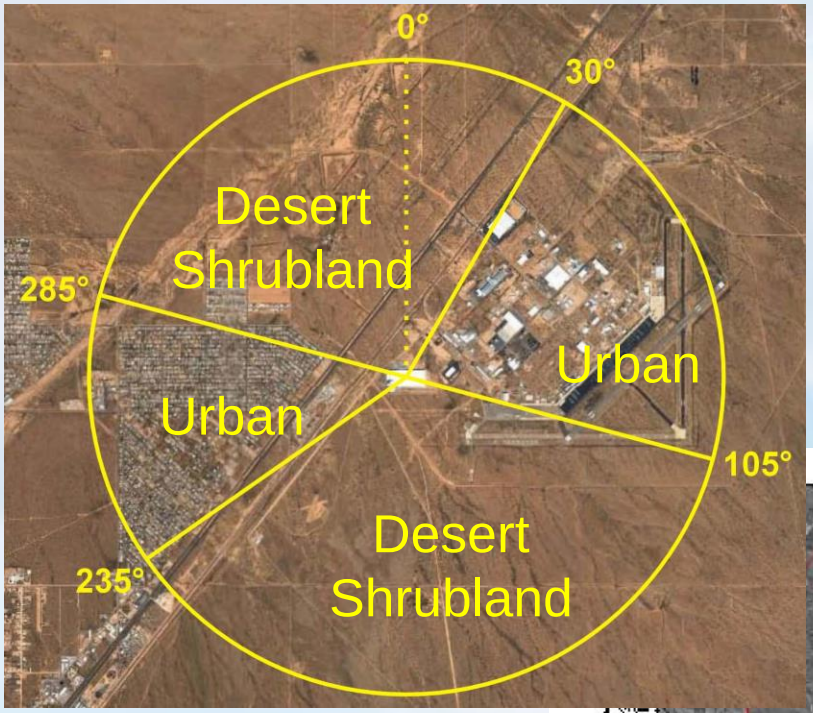
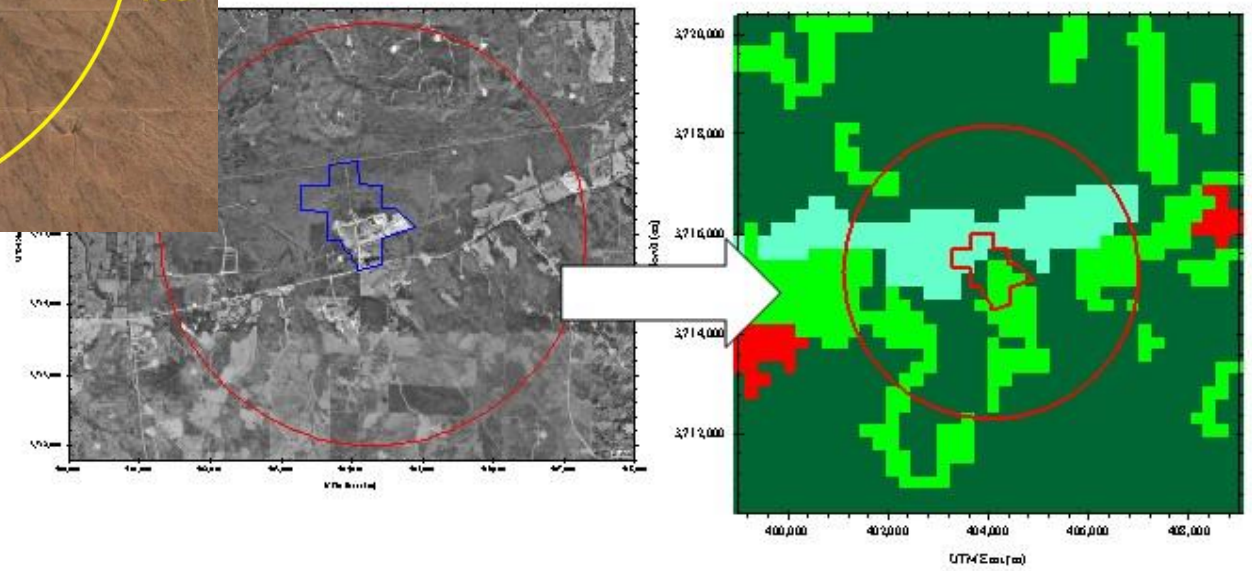
Critical Inputs - Landuse

(4 of 7)

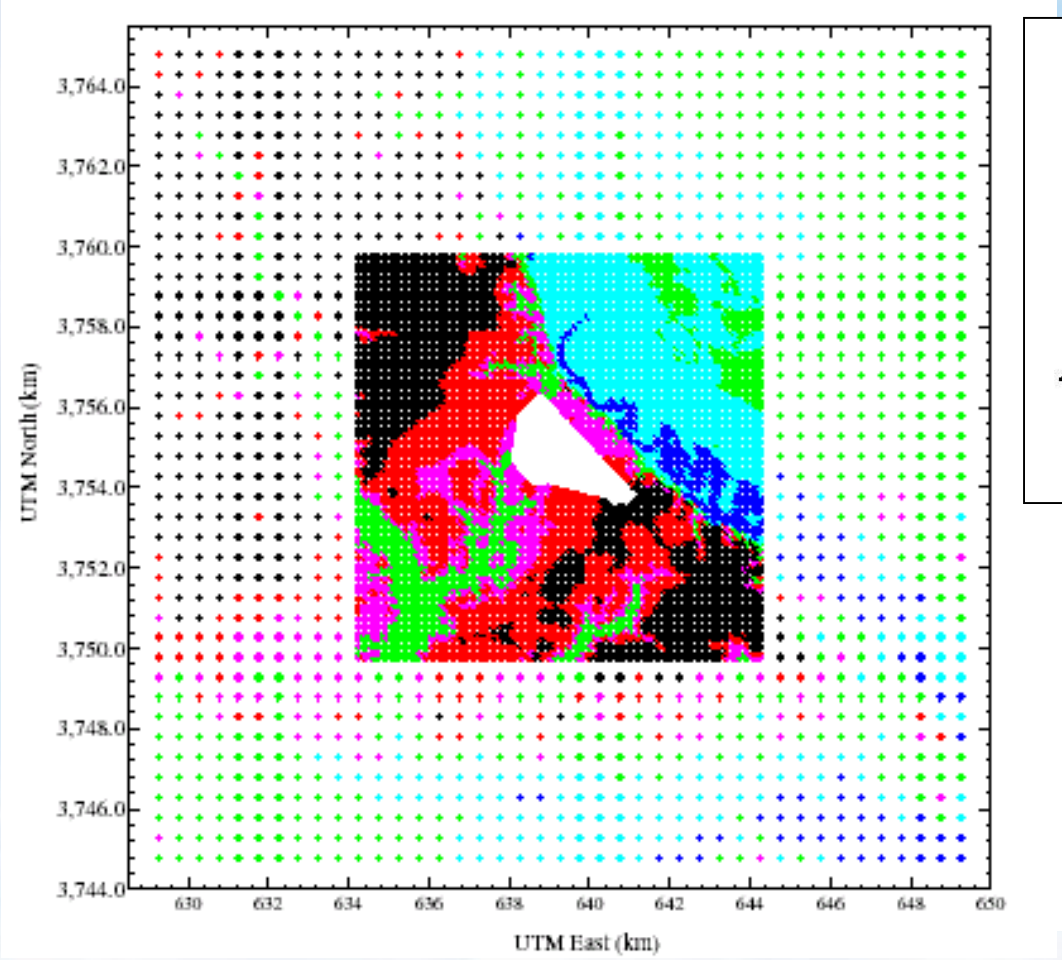


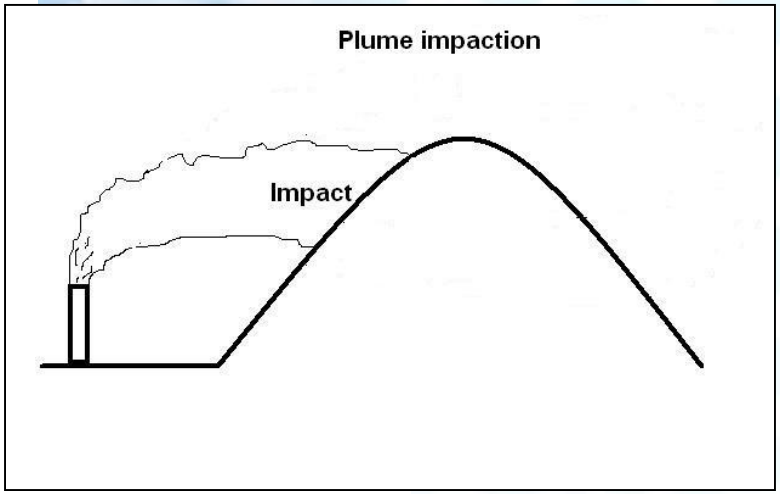
- Used to be performed manually
- Now performed using AERSURFACE

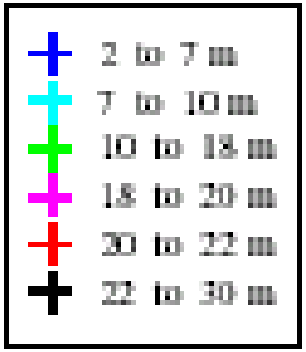


Critical Inputs - Elevations

(5 of 7)







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Critical Inputs - Source Characterization

(6 of 7)

- Common
  - Point
  - Area
  - Volume
- Special
  - Line
  - Buoyant line
  - Open pit

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Critical Inputs - Source Examples

(7 of 7)

Source	Example
Point	- Smoke stacks - Vents
Line	- Haul road emissions – paved or unpaved - Emissions vented through a gable of a building
Area	- Haul road emissions – paved or unpaved (MO preference) - Emissions from a waste water treatment lagoon - Gaseous Landfill Emissions - Wind-blown emissions of PM10 from a large pile
Volume	- Haul road emissions – paved or unpaved (KS, NE, IA preference) - Emissions from eaves, windows, and doors of a building - Conveying system transfer points - Wind-blown emissions of PM10 from a large pile - Other fugitive emissions

Typical Modeling Procedures

- Obtain and process representative *meteorological data*
- Develop or obtain a site plan (*sources, structures, boundary*)
- Characterize emission sources (*area, volume, point, etc.*)
- Define *modeling domain, receptor locations*, and obtain/process terrain *elevation data*
- Input building data and obtain downwash information
- Develop model input files and select processing options
- Run model and analyze results

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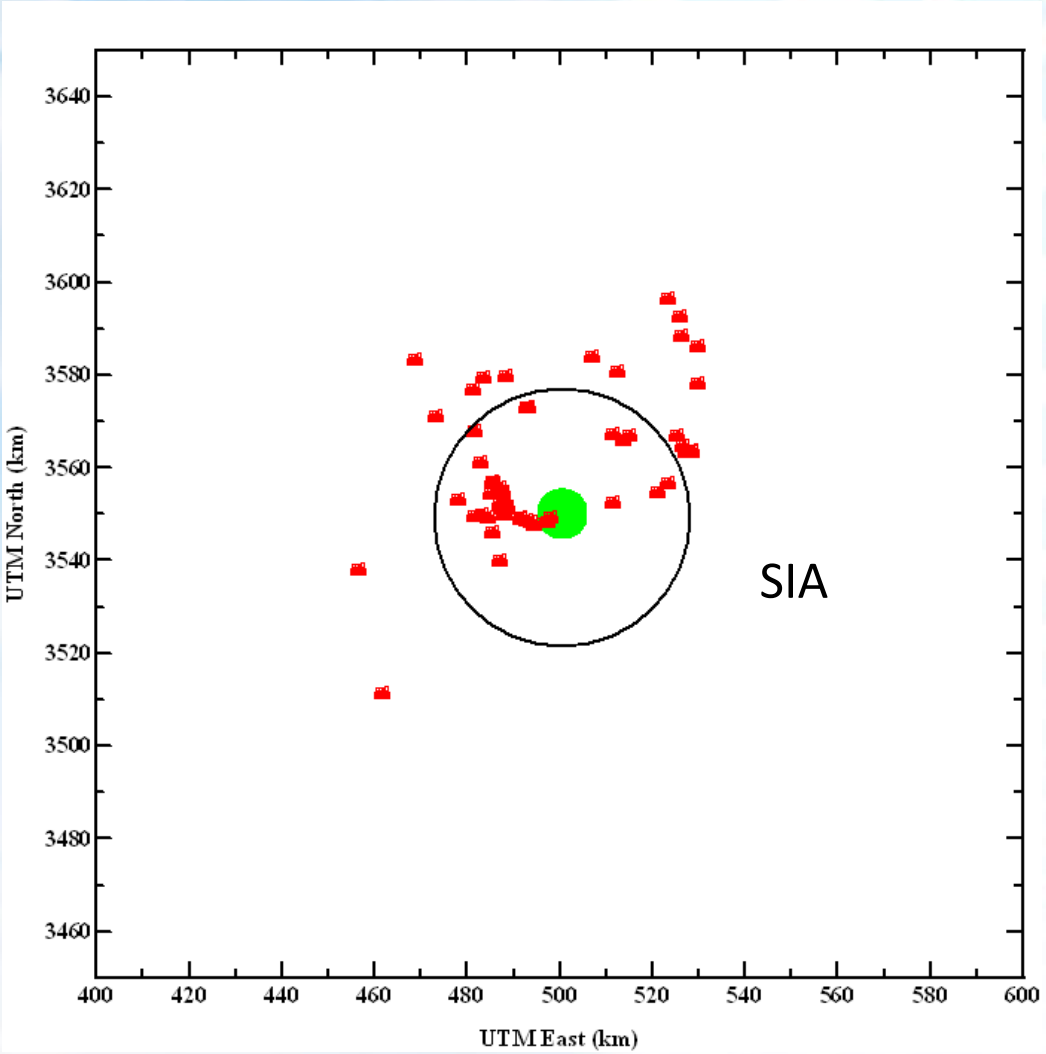
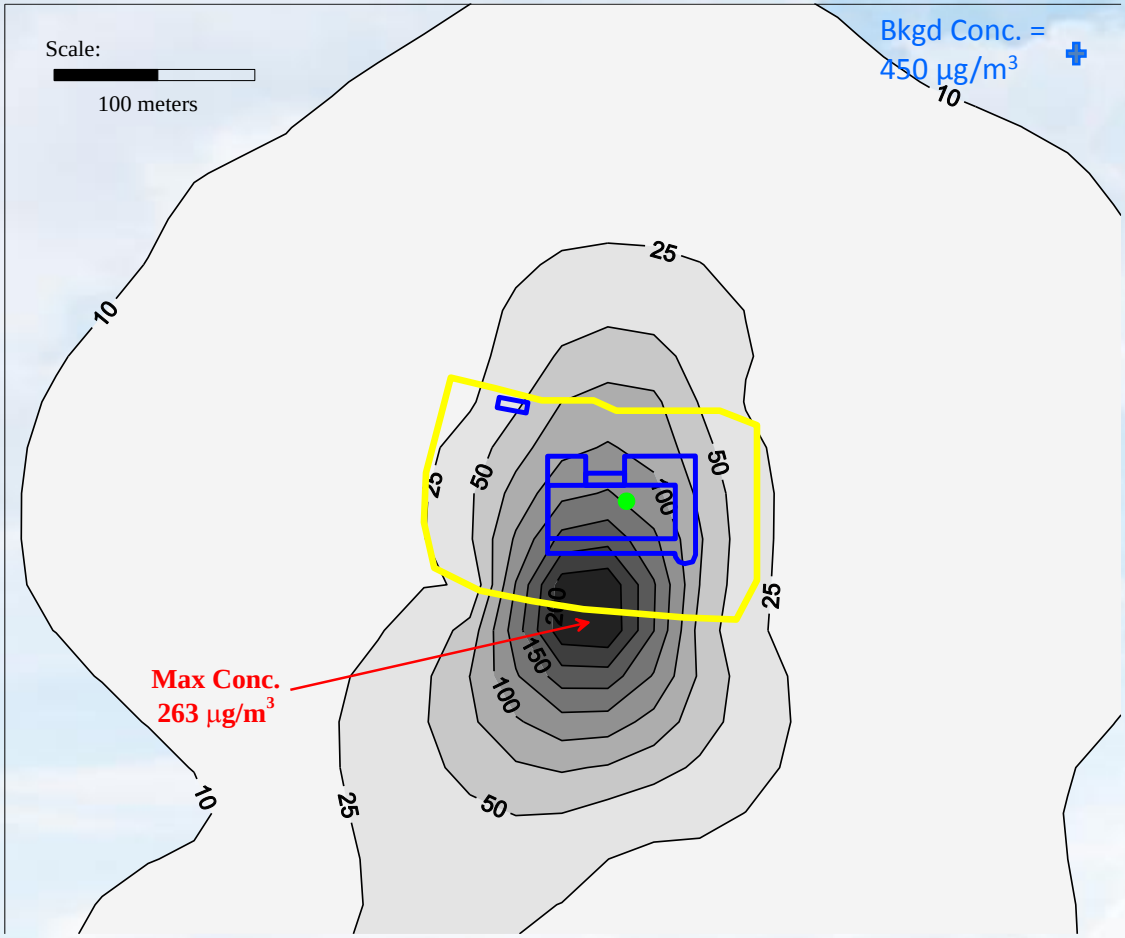
NAAQS Modeling

- Significance Analysis
  - Determine if new project has a "significant impact"
- SIL = Significant Impact Level
- ROI = Radius of Impact
- SIA = Significant Impact Area = ROI + 50 km
- Regional Source Inventory
- Model New Project + Regional Source Inventory
- Impact + Background should be < NAAQS



NAAQS Analysis Example



Max. Modeled Conc. = 263 µg/m³

Bkgd. Conc. = 450 µg/m³

Total Conc. = 713 µg/m³

NAAQS = 1,300 µg/m³

Total Conc. < NAAQS

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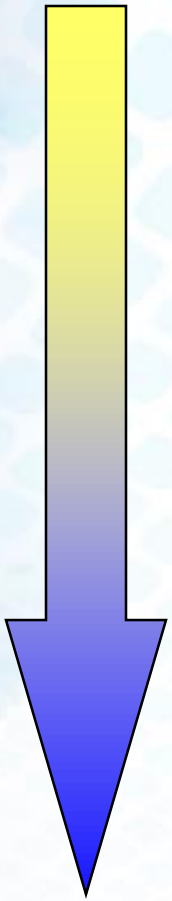
40 CFR Part 51 Appendix W Models

- AERSCREEN
  - Fast, conservative “screening model”
  - Typically used for small projects
- AERMOD
  - Short and long range regulatory model
  - Run by applicant
- CALPUFF
  - For visibility and long-range impacts
  - Run by applicant
  - Usually for Federal projects only



Complexity

Cost

Time

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What do you do if you do not “pass" the modeling?

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What do you do if you do not "pass"?

(1 of 2)

- Determine if project "causes or contributes" to exceedance
- If exceedance occurs when project is significant, review ***inventory sources***
- Review background NAAQS concentrations
- If exceedance is from your project
  - Isolate problem sources
  - Review/revise modeling parameters and assumptions

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What do you do if you do not "pass"?

(2 of 2)

- Use multi-tiered approach or deposition and plume depletion
- Batch versus continuous sources
- Different short term vs. long term emission rates
- Source changes to reduce impacts

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What are the Constraints to Expect Due to Modeling?

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Constraints Due to Modeling
(1 of 2)

- Permit limits taken for model to "pass"
  - Pollutants with different short and long term standards
  - Reduced number of hours/day or hours/year
  - Further restrictions on production
  - Monitoring (e.g., RTO temp to obtain 98% control)
  - Recordkeeping (e.g., hours of operation)

Constraints Due to Modeling

(2 of 2)

- Modeling may be the controlling factor for project
  - Too close to a Class I area
  - Ambient monitors already near NAAQS
  - Nearby sources consuming PSD Increment or NAAQS
  - Time of day operation (e.g. operating from 8 AM to 5 PM)

Importance of Modeling

- Can be the ***critical path*** item in a large or small permitting project timeline
- May ultimately determine ***emission limits*** or ***controls*** beyond BACT required for a new project or facility
- Members of the ***public*** may be concerned about modeling results

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Summary

- Dispersion modeling is a well-established and acceptable technique for estimating ambient air impacts
- Dispersion modeling has been built on sound science from the past and present
- Review model inputs and assumptions
- Refinements may be necessary
- Modeling is a critical component of permit analyses, litigation, and agency SIP requirements and planning

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Questions?

Thank You !!

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