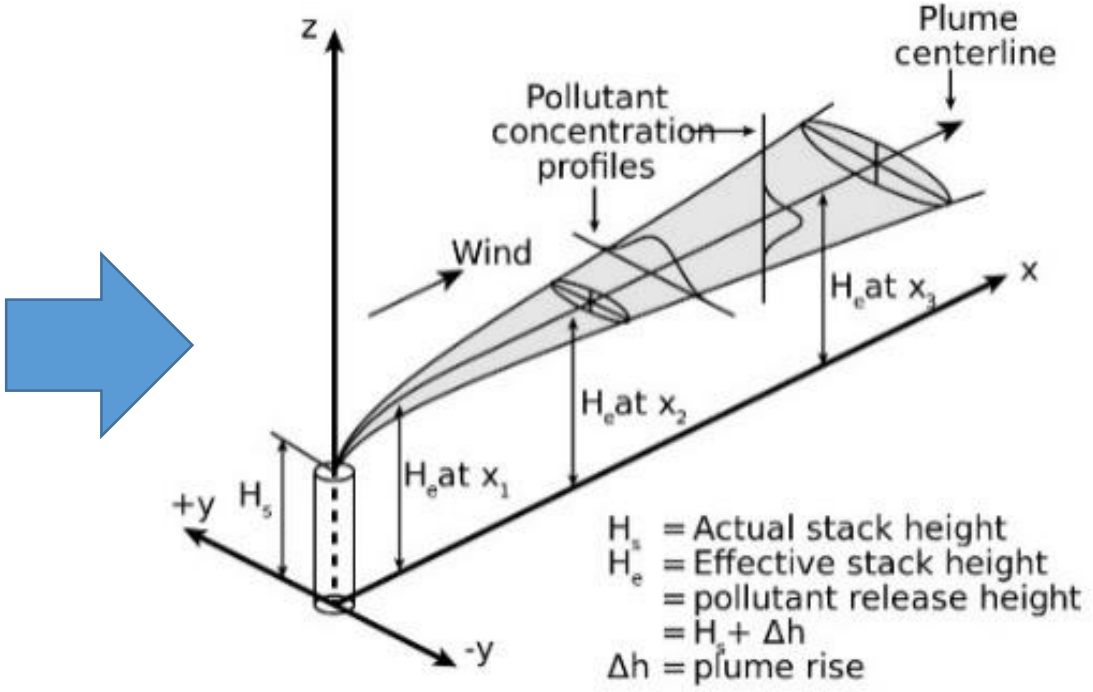
Iowa Department of Natural Resources

Leading Iowans in caring for our natural resources

Dispersion Modeling
June 8, 2023

What is Dispersion Modeling?

- A tool used to approximate the concentration of pollutants in the air

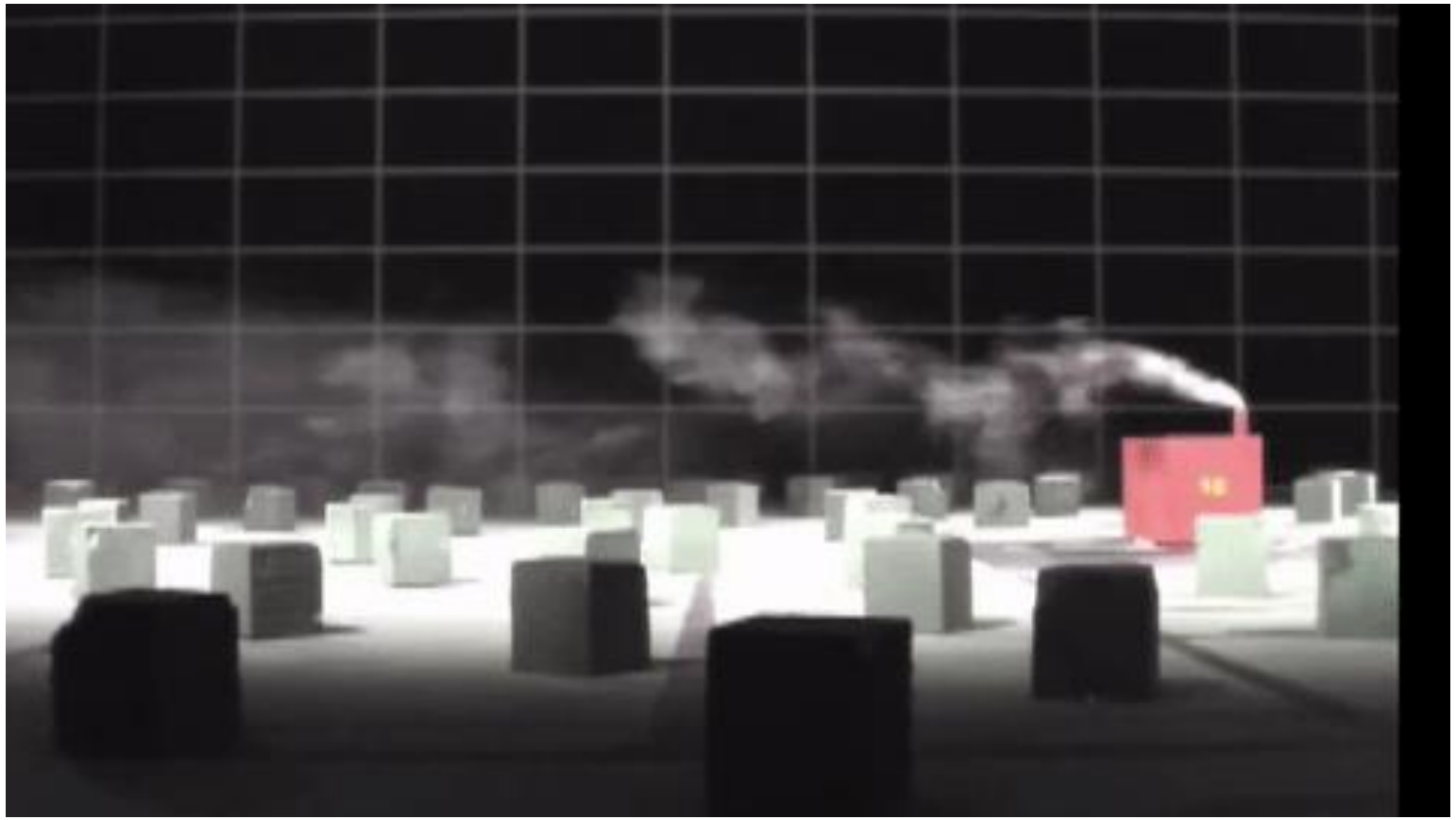


What is Dispersion Modeling?

- A tool used to…
  - Design projects so they comply with public air quality health standards
  - Help prevent modifications after construction is complete
  - Plan for future expansion
  - Evaluate possible sites for new construction

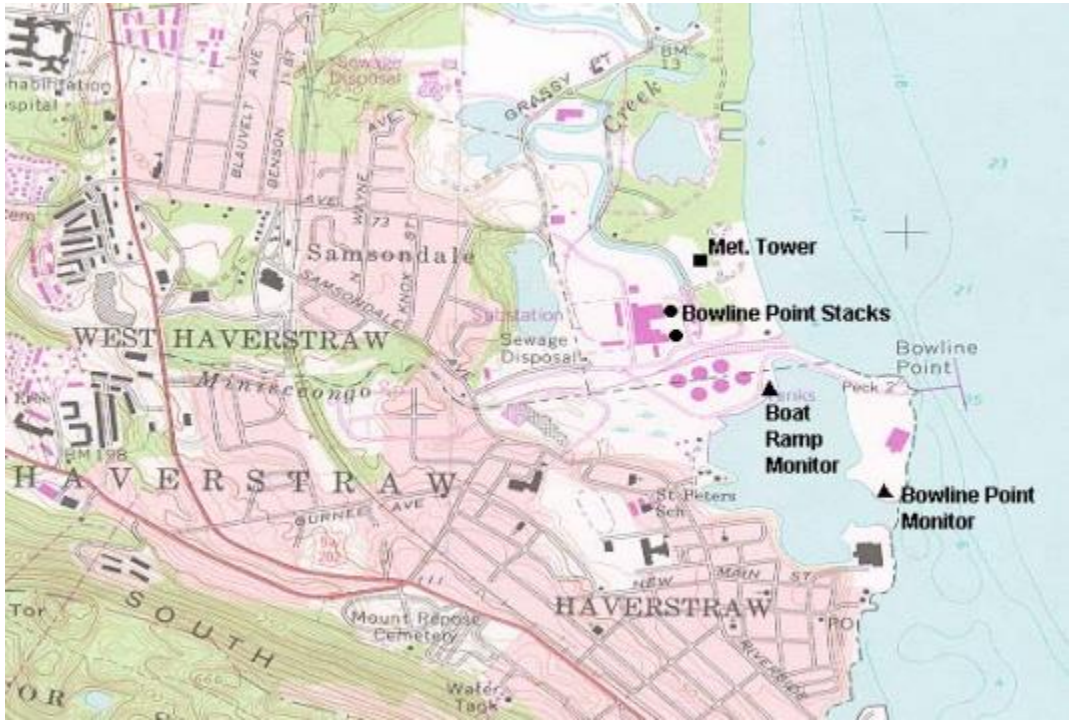
What is Dispersion Modeling?

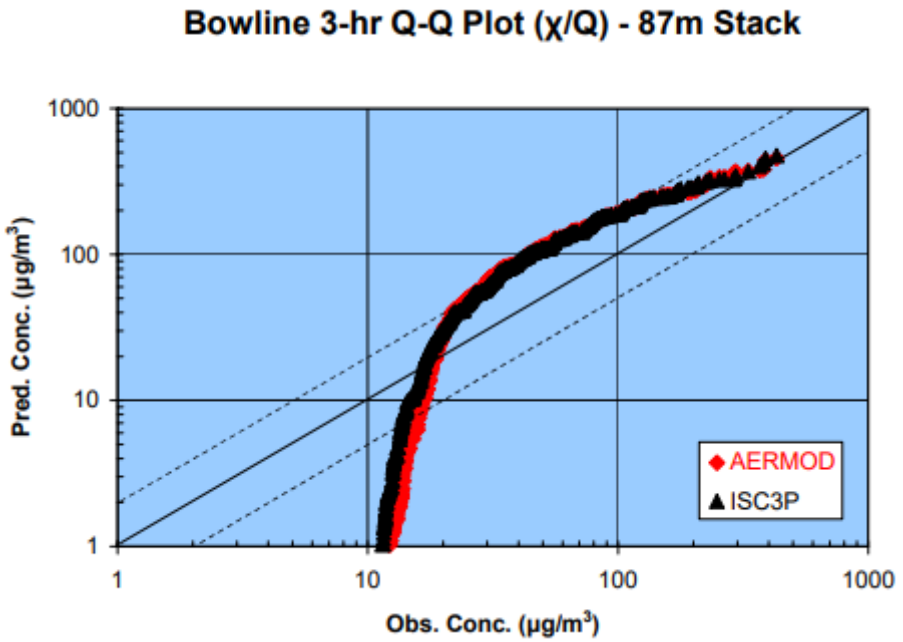
- Derived from physical models, but faster and less expensive



What is Dispersion Modeling?

- Tuned based on real-world observations to be most accurate for peak concentrations





Why Do We Model?

- Proactive protection of public health (NAAQS)
- The impact of sources that have not yet been constructed can only be determined through modeling
- Predict effect of modifying existing sources
- Planning

NAAQS

The National Ambient Air Quality Standards are Public health standards set by EPA

When Do We Model?

- Prior to issuance of a construction permit for air emissions
- Approximately 10% of applications are modeled
  - Project exceeds specific emission levels
    - If the project is at a “major” source → PSD
  - Projects in an area that may already be close to the NAAQS
  - SIP areas
  - Case-by-case

PSD

“Prevention of Significant Deterioration”
1977 Clean Air Act Amendment

SIP

“State Implementation Plan”
Used to attain/maintain NAAQS

When Do We Model?

Non-PSD

- Project emission levels
- Availability of air resources (AAR)
- See Form MD (also available in EASY Air)

FORM MD: NON-PSD MODELING DETERMINATION FORM

Please see instructions on page three (3) of this form.

Company Name: _____

SECTION 1: PROJECT EMISSIONS					
1. Pollutant	2. Total Net Change in Emissions from Project			3. Significant Emission Rate (SER)	4. Check box if net change is ≥ corresponding SER (Modeling is required)
	2a. Total Increase	2b. Total Decrease	2c. Net Change		
PM_{10}	_____ lb/hr	- _____ lb/hr	= _____ lb/hr	3.42 lb/hr	☐
$PM_{2.5}$	_____ lb/hr	- _____ lb/hr	= _____ lb/hr	2.28 lb/hr	☐
NO_X Non-intermittent sources only:	_____ lb/hr	- _____ lb/hr	= _____ lb/hr	9.13 lb/hr	☐
NO_X All sources combined:	_____ ton/yr	- _____ ton/yr	= _____ ton/yr	40 ton/yr	
SO_2	_____ lb/hr	- _____ lb/hr	= _____ lb/hr	9.13 lb/hr	☐
CO	_____ lb/hr	- _____ lb/hr	= _____ lb/hr	22.8 lb/hr	☐

SECTION 2: AVAILABILITY OF AIR RESOURCES

Only complete this section for pollutants with a net change (2c) greater than zero. Skip this section if the project is for a new facility or a portable plant.

5. Pollutant	6. Averaging Period	7. Air Resources Currently Being Used (Visit http://www.iowadnr.gov/AAR if unknown)			8. Modeling Determination Threshold (MDT) (NAAQS – SIL)	9. Check if total is ≥ corresponding MDT (Modeling is required)
		7a. Modeled Concentration ($\mu g/m^3$)	7b. Current Background ($\mu g/m^3$)	7c. Total ($\mu g/m^3$)		
PM_{10}	24-hour	_____ +	_____ =	_____	145	☐
$PM_{2.5}$	24-hour	_____ +	_____ =	_____	33.8	☐
	Annual	_____ +	_____ =	_____	11.7	
NO_2	1-hour*	_____ +	_____ =	_____	180.5	☐
	Annual	_____ +	_____ =	_____	99	
SO_2	1-hour*	_____ +	_____ =	_____	188.1	☐
	3-hour	_____ +	_____ =	_____	1,275	
CO	1-hour	_____ +	_____ =	_____	38,000	☐
	8-hour	_____ +	_____ =	_____	9,500	

*Leave the 1-hour NO_2 and 1-hour SO_2 lines blank if this project consists of only intermittent sources as defined in Item 1 of the instructions.

When Do We Model?

PSD

- Prevention of Significant Deterioration
- Applies only to large projects at major facilities (criteria set be federal government)
- Additional level of scrutiny
- PSD Increments provide additional protection to pristine areas and limit how much all areas of the country can be degraded

Increment

Maximum allowable increase in concentration...may limit an area to a lower level of pollution than the NAAQS would otherwise allow.

When Do We Model?

SIP Areas

- State Implementation Plans
- Areas of specific concern
- Monitored high concentrations or exceedances of NAAQS
- Model every change at any facility in the SIP

When Do We Model?

Case-by-case

- All projects are unique, some reasons for case-by-case modeling include:
  - New facility locating in an already industrialized area where a majority of the air quality resource is already being utilized
  - New or modified portable plants
  - New sources with lead emissions, or increases in lead emissions from existing sources
  - Relaxation of permit limits or requirements originally established to protect the NAAQS
  - Changes to source location, stack design or facility layout
  - Direct ozone emissions
- DNR management reviews the need for all case-by-case modeling requests

Who Conducts the Modeling?

- PSD:
  - Applicant or their consultant
  - Project-specific modeling protocol proposed by applicant and agreed upon by DNR
  - DNR reviews modeling
- All other:
  - DNR will conduct the modeling analysis if the applicant requests it
    - This typically means project design work is already complete
    - If modeling indicates changes are necessary, the design may need to be reworked
  - Applicants may conduct their own modeling
    - Allows dispersion modeling to be considered as part of the design process
    - Follow DNR modeling guidelines (currently being updated)
    - DNR reviews modeling

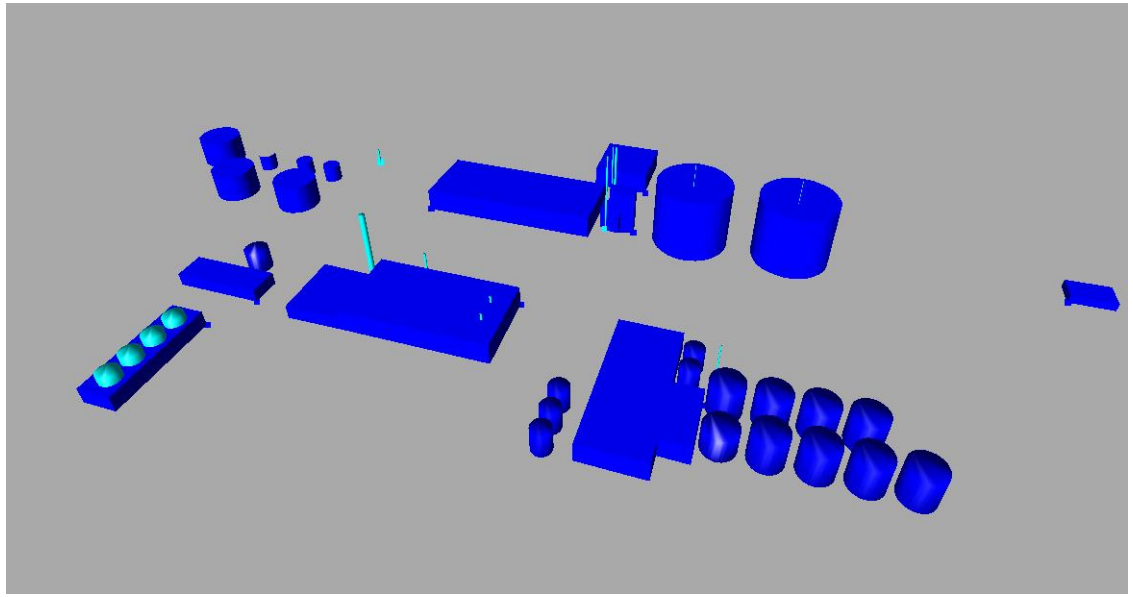
Modeling Procedure

- Create a 3D model of a facility and its surroundings in the computer
- Three main components
  - Source data
  - Terrain elevations
  - Atmospheric conditions
- AERMOD (EPA’s preferred regulatory model)

Modeling Procedure

Source Data

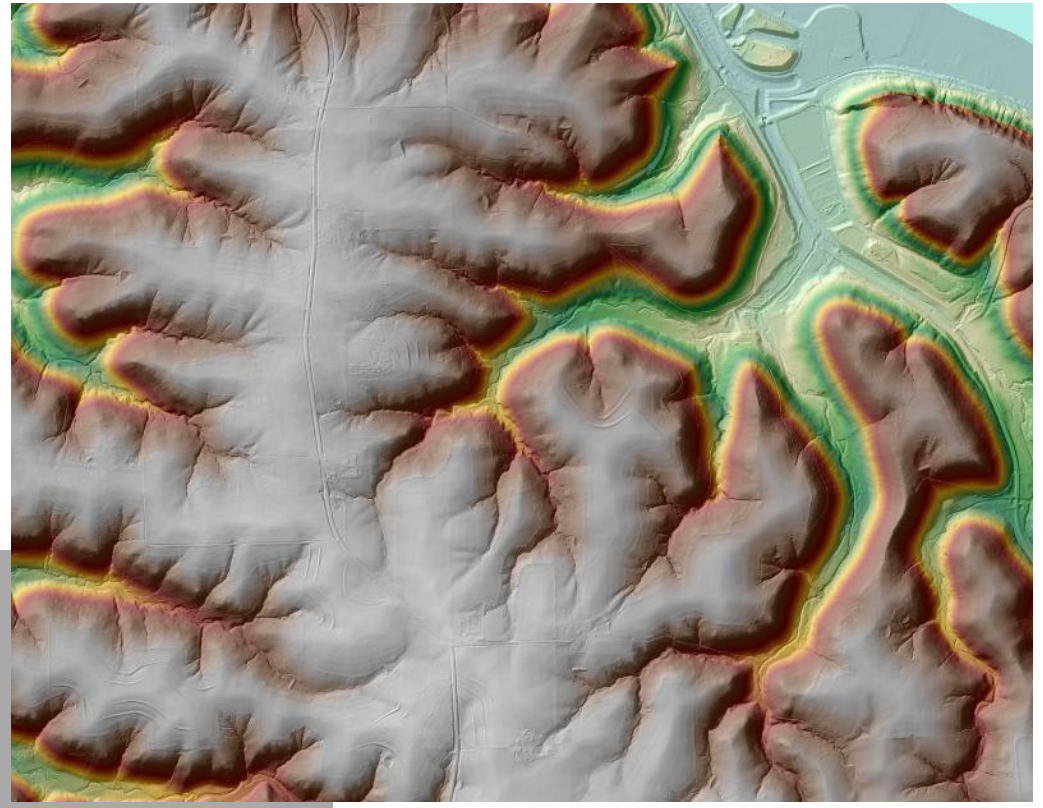
- Create a 3D representation of the facility and associated emission sources

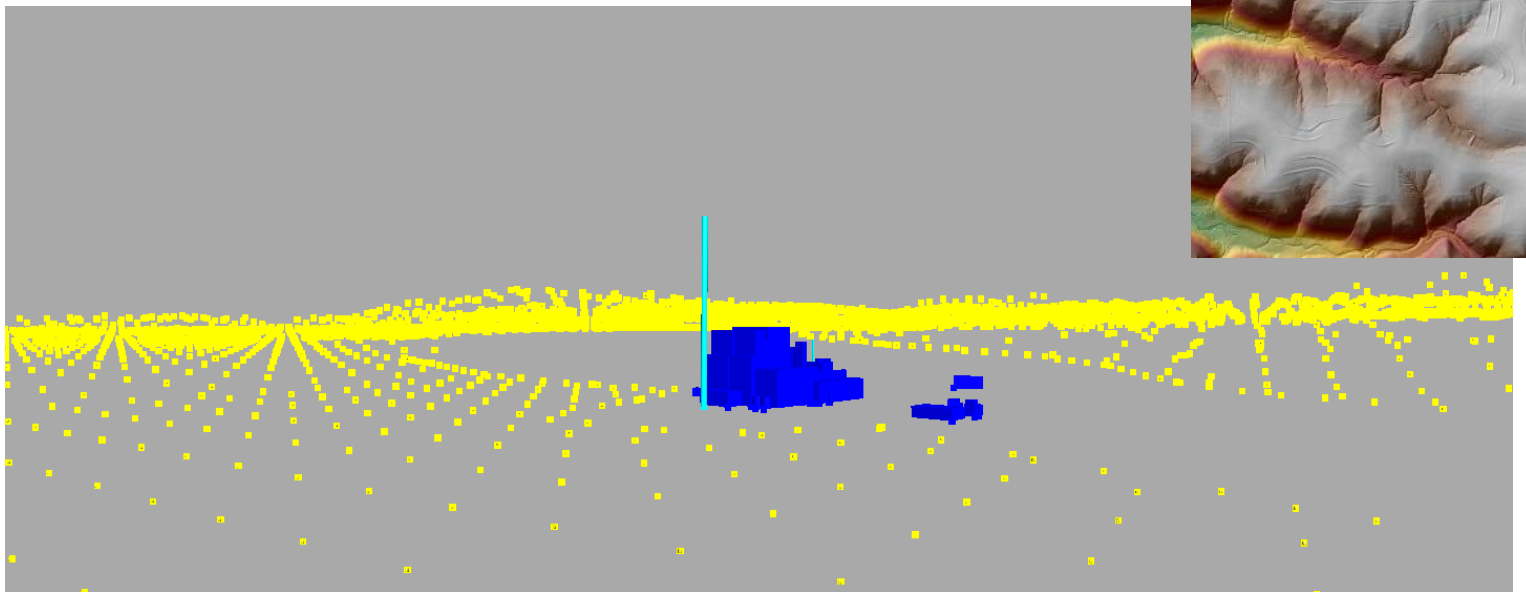


Modeling Procedure

Terrain Data

- Add elevation data to the 3D model
- Especially important in valleys and hilly areas

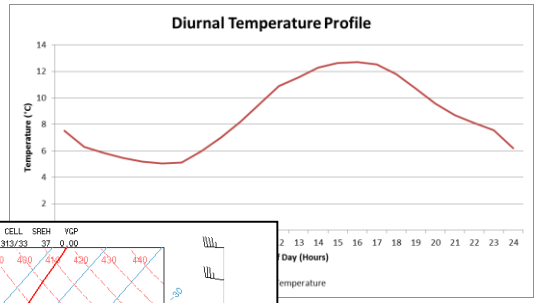


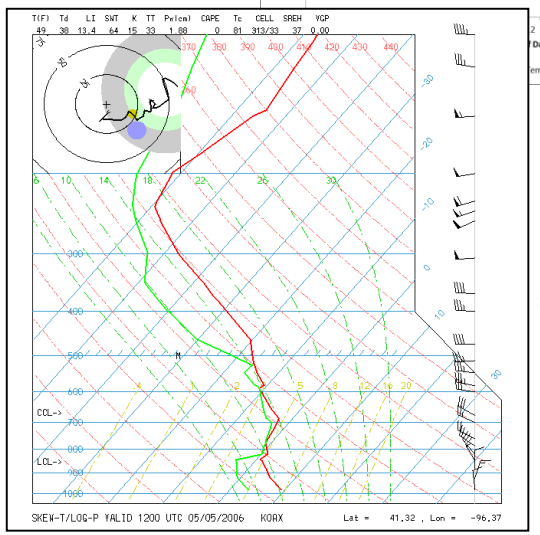


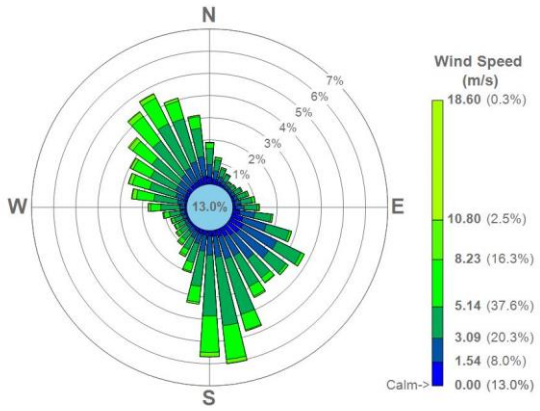
Modeling Procedure

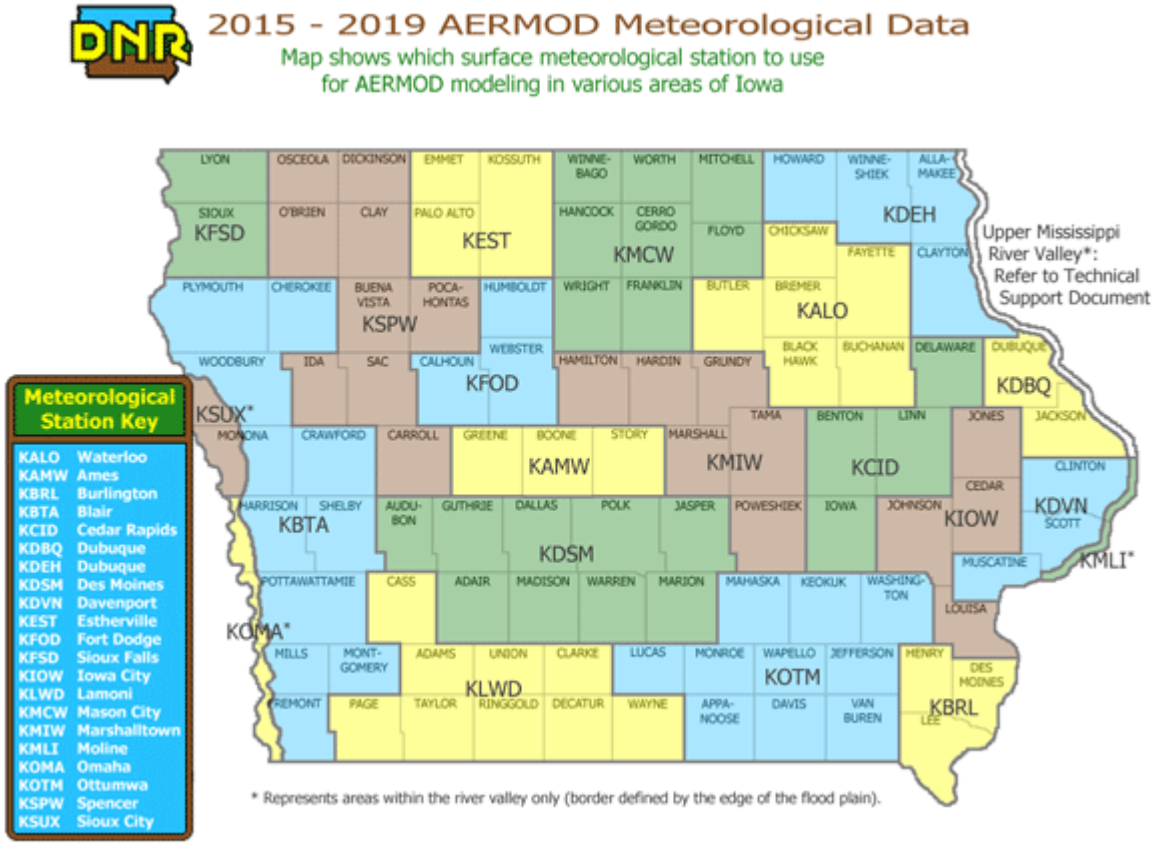
Meteorological Data

- Define atmospheric conditions









Modeling Procedure

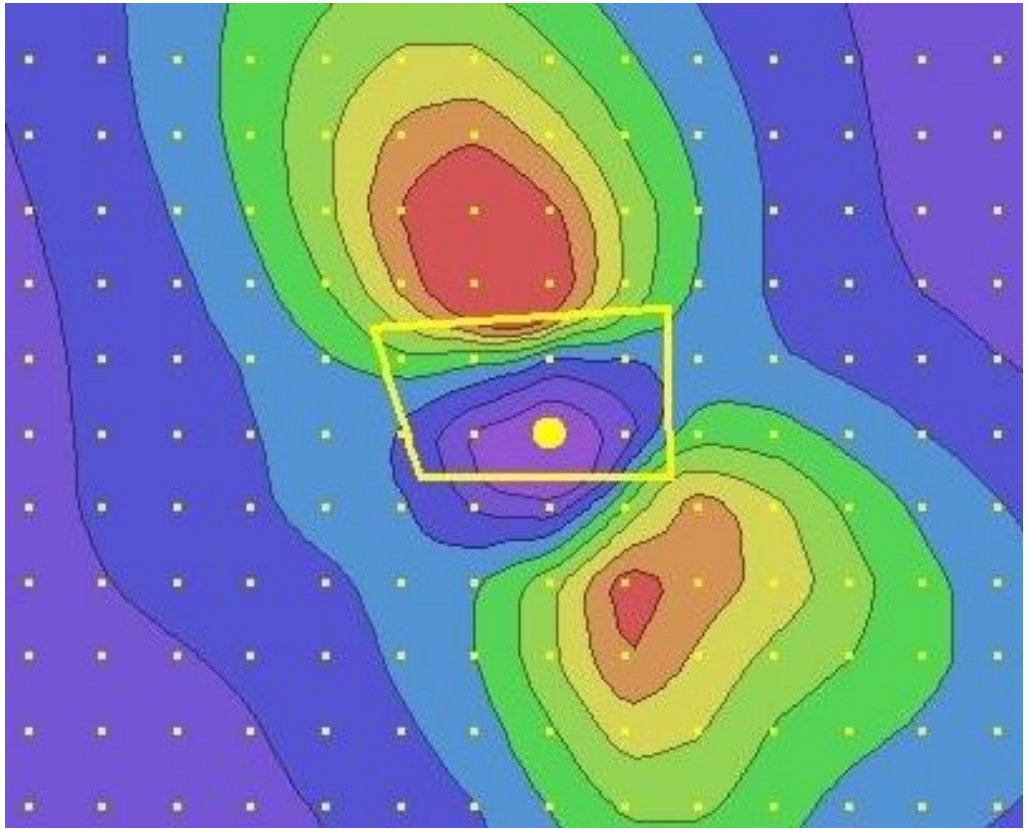
Run the Model

- Can take a few minutes for simple models
- Can take several days if more complex

Modeling Procedure

Review Results

- Incorporate existing pollutant levels (background)
- Compare results to standards
- Mitigate exceedances, if any are predicted
  - First, remove conservative assumptions from the analysis
  - If permit modifications are necessary the DNR modeler, permit engineer, applicant, and consultant discuss options



Modeling Procedure

- Final modeling report included in permit record
- AAR Summary provided to applicant with permit

Questions?

Brad Ashton – Lead Dispersion Modeler

Brad.Ashton@dnr.iowa.gov

(515) 725-9527