AMBIENT AIR QUALITY

By CHIRAG BHIMANI,

Dy. Environmental Engineer,

GUJARAT POLLUTION CONTROL BOARD,

GANDHINAGAR

AMBIENT AIR QUALITY

Definition:

am·bi·ent

–adjective

1. of the surrounding area or environment:

2. completely surrounding; encompassing:

AMBIENT AIR QUALITY

Definition:

air

-noun

a. A colorless, odorless, tasteless, gaseous mixture, mainly nitrogen (approximately 78 percent) and oxygen (approximately 21 percent) with lesser amounts of argon, carbon dioxide, hydrogen, neon, helium, and other gases.

b. This mixture with varying amounts of moisture and particulate matter, enveloping the earth; the atmosphere.

AMBIENT AIR QUALITY

What Is Ambient Air?

Defined as any unconfined part of the Earth's atmosphere, ambient air is the outdoor air in which humans and other organisms live and breathe. The content and quality of ambient air is directly affected by the day-to-day activities of humans. In turn, ambient air quality has a direct effect on both public health and the welfare of the Earth's ecosystems.

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About Ambient Air

Air normally has no color, odor, or taste. It is a mixture of gases, primarily nitrogen, at about 78%, and oxygen, at about 21%, with the remaining 1% composed of carbon dioxide, methane, hydrogen, argon, and helium. Anthropogenic Sources (Human activities), such as manufacturing and the burning of fossil fuels, cause changes in the chemical composition of ambient air through the release of chemical and industrial pollutants into the atmosphere.

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About Ambient Air Pollutants

Ambient air pollutants may include gases or particulate matter, which are small particles of dust, smoke, ash, pollen, or other substances. Many air pollutants have been found to be harmful to both the environment and human health. Pollutants known to have adverse health effects are called criteria pollutants. Criteria pollutants include ozone, lead, carbon monoxide, nitrogen dioxide, sulfur dioxide, and particulate matter.

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Ambient Air Pollutants

Ambient air pollutants are :

1. Natural sources

Dust from natural sources,
Methane, emitted by the digestion of food by animals,
Radon gas from radioactive decay within the Earth's crust,
Smoke and carbon monoxide from wildfires

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Ambient Air Pollutants

Ambient air pollutants are :

1. Natural sources (Continued)

Vegetation, in some regions, emits environmentally significant amounts of VOCs on warmer days which react with primary anthropogenic pollutants—specifically, NOx, SO2, and anthropogenic organic carbon compounds—to produce a seasonal haze of secondary pollutants

Volcanic activity, which produce sulfur, chlorine, and ash particulates

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Ambient Air Pollutants

Anthropogenic sources (Human Activity) are :

"Stationary Sources" include smoke stacks of power plants, manufacturing facilities (factories) and waste incinerators, as well as furnaces and other types of fuel-burning heating devices

"Mobile Sources" include motor vehicles, marine vessels, aircraft and the effect of sound etc.

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Ambient Air Pollutants

Anthropogenic sources (Human Activity) (Continued):

Chemicals, dust and controlled burn practices in agriculture and forestry management.

Fumes from paint, hair spray, varnish, aerosol sprays and other solvents,

Waste deposition in landfills, which generate methane.

Military, such as nuclear weapons, toxic gases, germ warfare and rocketry

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Importance of Ambient Air

Certain populations are most likely to be adversely affected by criteria pollutants in ambient air. These include infants, children, the elderly, and people with cardiopulmonary conditions. In children, criteria pollutants have been shown to increase the risk of respiratory tract infections and worsen the severity of asthma attacks. In adults, exposure to particulate matter is associated with an increased risk of hospitalization and death due to cardiovascular disease.

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Importance of Ambient Air

In the environment, changes in ambient air contribute to the development of acid rain and the greenhouse effect, the trapping of solar radiation in the Earth's atmosphere due to the presence of carbon dioxide, methane, and other gases. Ambient air pollution also contributes to depletion of the ozone layer, the region of the atmosphere that protects the Earth from harmful types of ultraviolet radiation.

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Importance of Ambient Air

HISTORICAL INCIDENCES OF POOR AMBIENT AIR QUALITY

1. **The Great Smog of '52 or Big Smoke was a severe air pollution event that affected London, England, during December 1952. A period of cold weather, combined with an anticyclone and windless conditions, collected airborne pollutants mostly from the use of coal to form a thick layer of smog over the city. It endured from Friday 5 to Tuesday, 9 December 1952, and then dispersed quickly after a change of weather.**

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Importance of Ambient Air

Although it caused major disruption due to the effect on visibility, and even penetrated indoor areas, it was not thought to be a significant event at the time, with London having experienced many smog events during the past. During the succeeding weeks however, medical reports estimated that 4,000 had died prematurely and 100,000 more were made ill because of the smog's effects on the human respiratory tract. More recent research suggests that the number of fatalities was considerably greater at about 12,000.

It is considered the worst air pollution event of the history of the United Kingdom and the most significant in terms of its effect on environmental research, government regulation, and public awareness of the relationship between air quality and health.

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Importance of Ambient Air

IMPACT ON LONDON

Although London was accustomed to thick fogs, this one was denser and longer-lasting than any previous fog. Visibility was reduced to a few yards making driving difficult or impossible.

Public transport ceased, apart from the London Underground; and the ambulance service stopped functioning, forcing sick people to transport themselves to hospital. The smog even seeped indoors, resulting in the cancellation or abandonment of concerts and film screenings as visibility decreased in large enclosed spaces, and stages and screens became harder to see from the seats. Outdoor sports events were also affected.

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Combating Ambient Air Pollution

To combat the detrimental effects of ambient air pollution, air quality standards have been established throughout the industrialized world. In, India The Air (Prevention and Control of Pollution) Act was enacted in 1981 wherein Ambient Air Quality Standards are prescribed and amended from time to time. These standards are designed to safeguard the public health, ensure the welfare of animals and crops, and protect the health of the ecosystems.

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Ambient Air Standards in INDIA

NATIONAL AMBIENT AIR QUALITY STANDARDS

S. No.	Pollutant	Time Weighted Average	Concentration in Ambient Air		
			Industrial, Residential, Rural and Other Area	Ecologically Sensitive Area (notified by Central Government)	Methods of Measurement
(1)	(2)	(3)	(4)	(5)	(6)
1	Sulphur Dioxide (SO_2), µg/m³	Annual*	50	20	- Improved West and Gaeke
		24 hours**	80	80	-Ultraviolet fluorescence
2	Nitrogen Dioxide (NO_2), µg/m³	Annual*	40	30	- Modified Jacob & Hochheiser (Na-Arsenite)
		24 hours**	80	80	- Chemiluminescence
3	Particulate Matter (size less than 10µm) or PM_{10} µg/m³	Annual*	60	60	- Gravimetric - TOEM
		24 hours**	100	100	- Beta attenuation
4	Particulate Matter (size less than 2.5µm) or $PM_{2.5}$ µg/m³	Annual*	40	40	- Gravimetric - TOEM
		24 hours**	60	60	- Beta attenuation
5	Ozone (O_3) µg/m³	8 hours**	100	100	- UV photometric - Chemilminescence
		1 hour**	180	180	- Chemical Method
6	Lead (Pb) µg/m³	Annual*	0.50	0.50	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper
		24 hours**	1.0	1.0	- ED-XRF using Teflon filter
7	Carbon Monoxide (CO) mg/m³	8 hours**	02	02	- Non Dispersive Infra Red (NDIR) spectroscopy
		1 hour**	04	04	
8	Ammonia (NH_3) µg/m³	Annual*	100	100	-Chemiluminescence
		24 hours**	400	400	-Indophenol blue method

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Ambient Air Standards in INDIA

(1)	(2)	(3)	(4)	(5)	(6)
9	Benzene (C_6H_6) $\mu g/m^3$	Annual*	05	05	- Gas chromatography based continuous analyzer - Adsorption and Desorption followed by GC analysis
10	Benzo(a)Pyrene (BaP) - particulate phase only, ng/m^3	Annual*	01	01	- Solvent extraction followed by HPLC/GC analysis
11	Arsenic (As), ng/m^3	Annual*	06	06	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni), ng/m^3	Annual*	20	20	- AAS /ICP method after sampling on EPM 2000 or equivalent filter paper

* Annual arithmetic mean of minimum 104 measurements in a year at a particular site taken twice a week 24 hourly at uniform intervals.

** 24 hourly or 08 hourly or 01 hourly monitored values, as applicable, shall be complied with 98% of the time in a year. 2% of the time, they may exceed the limits but not on two consecutive days of monitoring.

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Monitoring Ambient Air Pollution

Now that we know the detrimental effects of Ambient Air Pollution and also have Norms or Standards for Ambient Air Quality, measuring and monitoring the same is equally and of utmost important.

There are various methods of Ambient Air Quality Monitoring.

Some of them are :

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Ambient Air Quality Monitoring

Based on frequency of Monitoring

1. **Batch Monitoring**
2. **Continuous Monitoring**

Based on pollutants monitored

1. **High Volume Sampler**
2. **AAQM – PM_{10} _ Respirable Dust Sampler**
3. **AAQM – $PM_{2.5}$ Sampler**

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Ambient Air Quality Monitoring

High Volume Sampler

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Ambient Air Quality Monitoring

AAQM – PM_{10} Respirable Dust Sampler

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What Next ???

We have set of standards for Ambient Air Quality so that the pollutants released due to Anthropogenic Acitivities is not detrimental to Human Health and the Environment.

But is that enough? Does our obligation end there? What more can be done?

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Introduction to Air Modelling:

Atmospheric dispersion modeling is the mathematical simulation of how air pollutants disperse in the ambient atmosphere. It is performed with computer programs that solve the mathematical equations and algorithms which simulate the pollutant dispersion. The dispersion models are used to estimate or to predict the downwind concentration of air pollutants or toxins emitted from sources such as industrial plants, vehicular traffic or accidental chemical releases.

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Introduction to Air Modelling:

Such models are important to governmental agencies tasked with protecting and managing the ambient air quality. The models are typically employed to determine whether existing or proposed new industrial facilities are or will be in compliance with the National Ambient Air Quality Standards (NAAQS). The models also serve to assist in the design of effective control strategies to reduce emissions of harmful air pollutants.

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Introduction to Air Modelling:

Air dispersion models are also used by public safety responders and emergency management personnel for emergency planning of accidental chemical releases. Models are used to determine the consequences of accidental releases of hazardous or toxic materials, Accidental releases may result fires, spills or explosions that involve hazardous materials, such as chemicals or radionuclides.

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Introduction to Air Modelling:

The results of dispersion modeling, using worst case accidental release source terms and meteorological conditions, can provide an estimate of location impacted areas, ambient concentrations, and be used to determine protective actions appropriate in the event a release occurs. Appropriate protective actions may include evacuation or shelter-in-place for persons in the downwind direction.

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About Air Model:

The dispersion models vary depending on the mathematics used to develop the model, but all require the input of data that may include:

- Meteorological conditions such as wind speed and direction, the amount of atmospheric turbulence (as characterized by what is called the "stability class"), the ambient air temperature, the height to the bottom of any inversion aloft that may be present, cloud cover and solar radiation.

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About Air Model:

- Source term (the concentration or quantity of toxins in emission or accidental release source terms) and temperature of the material

- Emissions or release parameters such as source location and height, type of source (i.e., fire, pool or vent stack)and exit velocity, exit temperature and mass flow rate or release rate.

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About Air Model:

- Terrain elevations at the source location and at the receptor location(s), such as nearby homes, schools, businesses etc.

- The location, height and width of any obstructions (such as buildings or other structures) in the path of the emitted gaseous plume, surface roughness or the use of a more generic parameter “rural” or “city” terrain.

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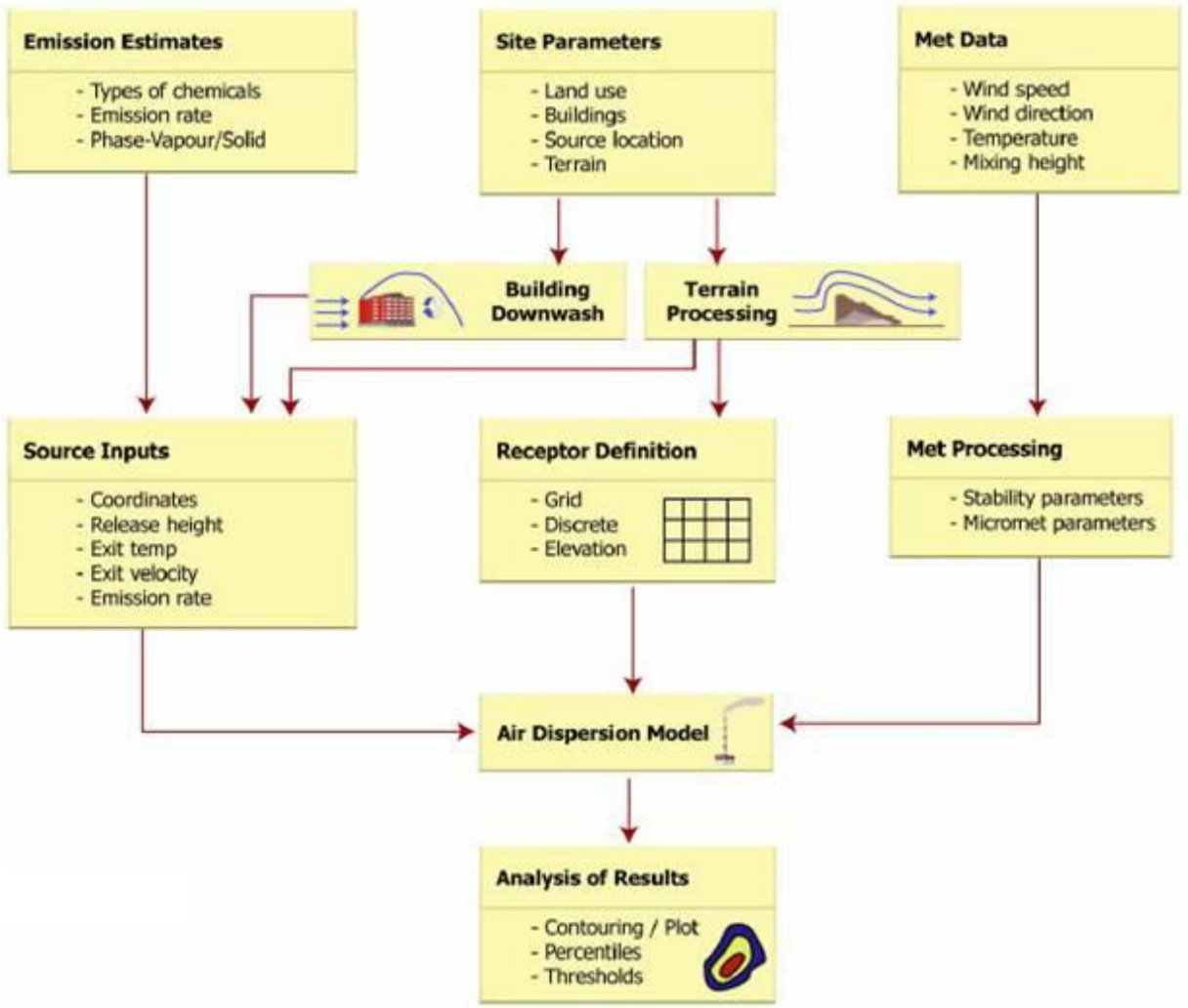

Generalized process for performing an air dispersion modelling assessment.

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Types of Air Models:

AERMOD - An atmospheric dispersion model based on atmospheric boundary layer turbulence structure and scaling concepts, including treatment of multiple ground-level and elevated point, area and volume sources. This model was in development for approximately 14 years before being officially accepted by the U.S. EPA.

CALPUFF - A non-steady-state puff dispersion model that simulates the effects of time- and space-varying meteorological conditions on pollution transport, transformation, and removal. CALPUFF can be applied for long-range transport and for complex terrain.

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Types of Air Models:

BLP - A Gaussian plume dispersion model designed to handle unique modelling problems associated with industrial sources where plume rise and downwash effects from stationary line sources are important.

CALINE3 - A steady-state Gaussian dispersion model designed to determine pollution concentrations at receptor locations downwind of highways located in relatively uncomplicated terrain.

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Types of Air Models:

CTDMPLUS - A Complex Terrain Dispersion Model (CTDM) plus algorithms for unstable situations (i.e., highly turbulent atmospheric conditions). It is a refined point source Gaussian air quality model for use in all stability conditions (i.e., all conditions of atmospheric turbulence) for complex terrain.

OCD - Offshore and Coastal Dispersion Model (OCD) is a Gaussian model developed to determine the impact of offshore emissions from point, area or line sources on the air quality of coastal regions. It incorporates overwater plume transport and dispersion as well as changes that occur as the plume crosses the shoreline.

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About AERMOD:

The AERMOD atmospheric dispersion modeling system is an integrated system that includes three modules:

A steady-state dispersion model designed for short-range (up to 50 kilometers) dispersion of air pollutant emissions from stationary industrial sources.

A meteorological data preprocessor (AERMET) that accepts surface meteorological data, upper air soundings, and optionally, data from on-site instrument towers. It then calculates atmospheric parameters needed by the dispersion model, such as atmospheric turbulence characteristics, mixing heights, friction velocity, Monin-Obukov length and surface heat flux.

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About AERMOD:

A terrain preprocessor (AERMAP) whose main purpose is to provide a physical relationship between terrain features and the behavior of air pollution plumes. It generates location and height data for each receptor location. It also provides information that allows the dispersion model to simulate the effects of air flowing over hills or splitting to flow around hills.

AERMOD also includes PRIME (Plume Rise Model Enhancements) which is an algorithm for modeling the effects of downwash created by the pollution plume flowing over nearby buildings.

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Output from AERMOD:

These softwares and models can give a variety of outputs right from numerical tables to coloured graphs and 3 D representations. They can also generate wind roses and pollution roses for the given condition and location. Thus with the advancement in technolodies it has become possible to predict the ambient air quality upto a certain extent for an environmentalist.

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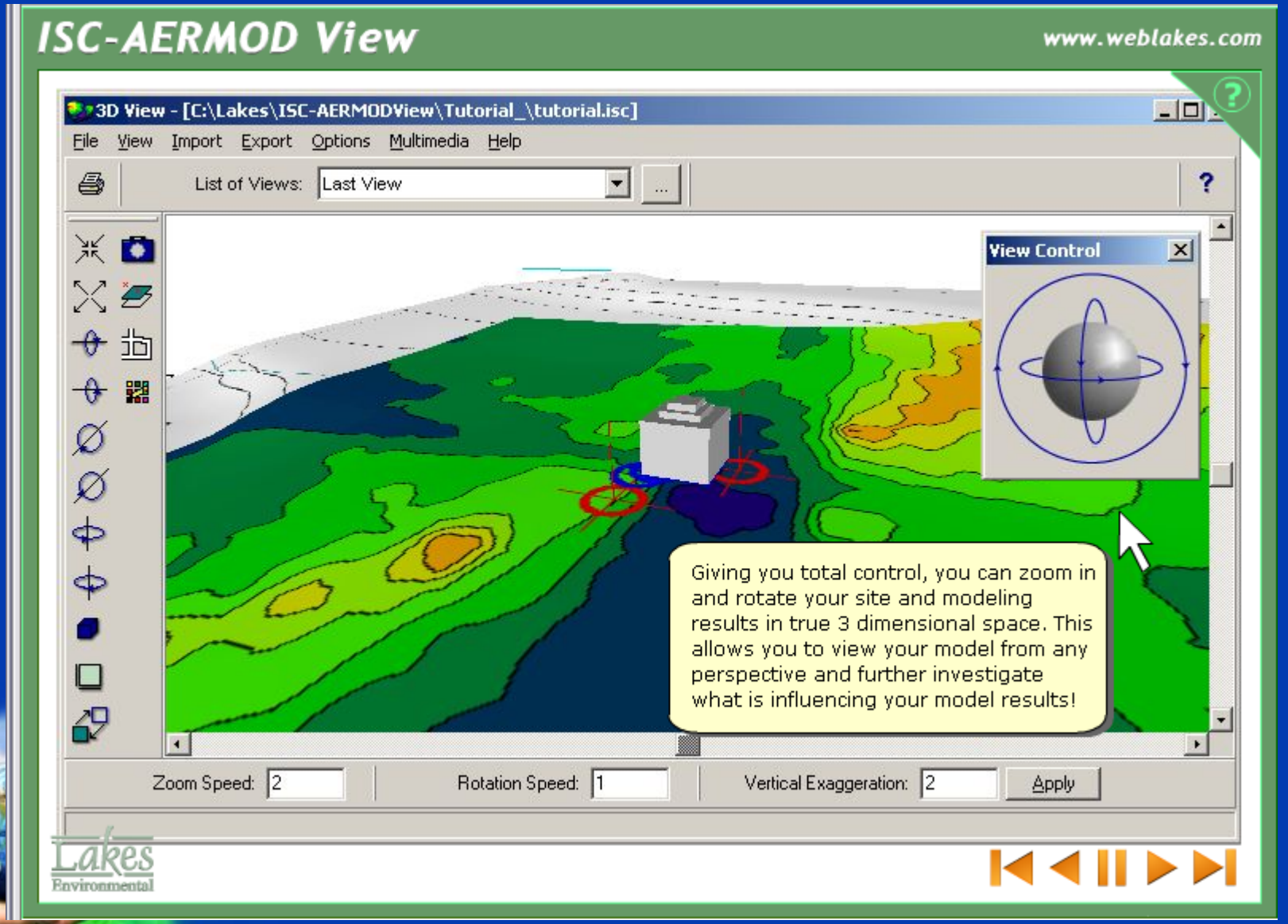

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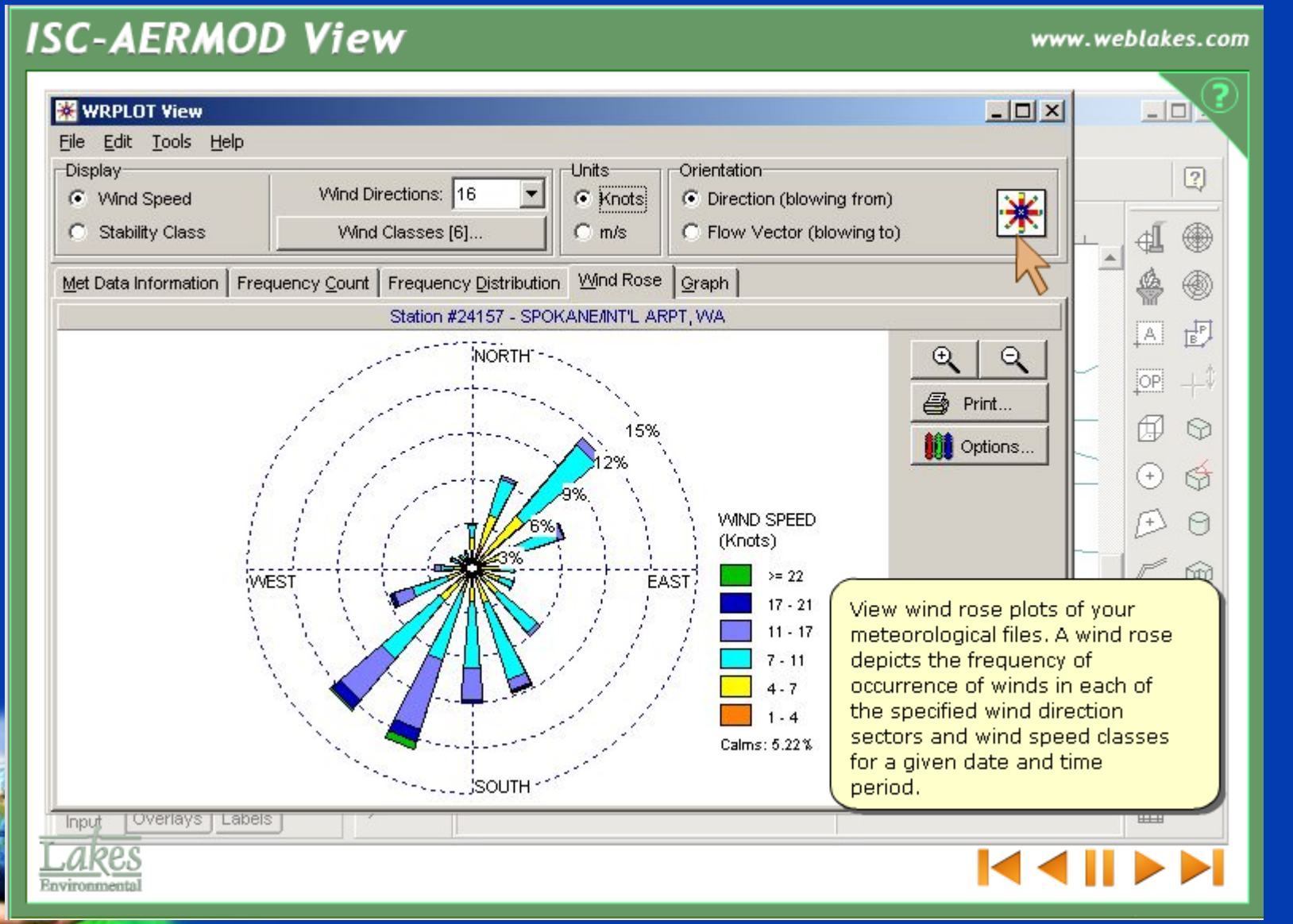

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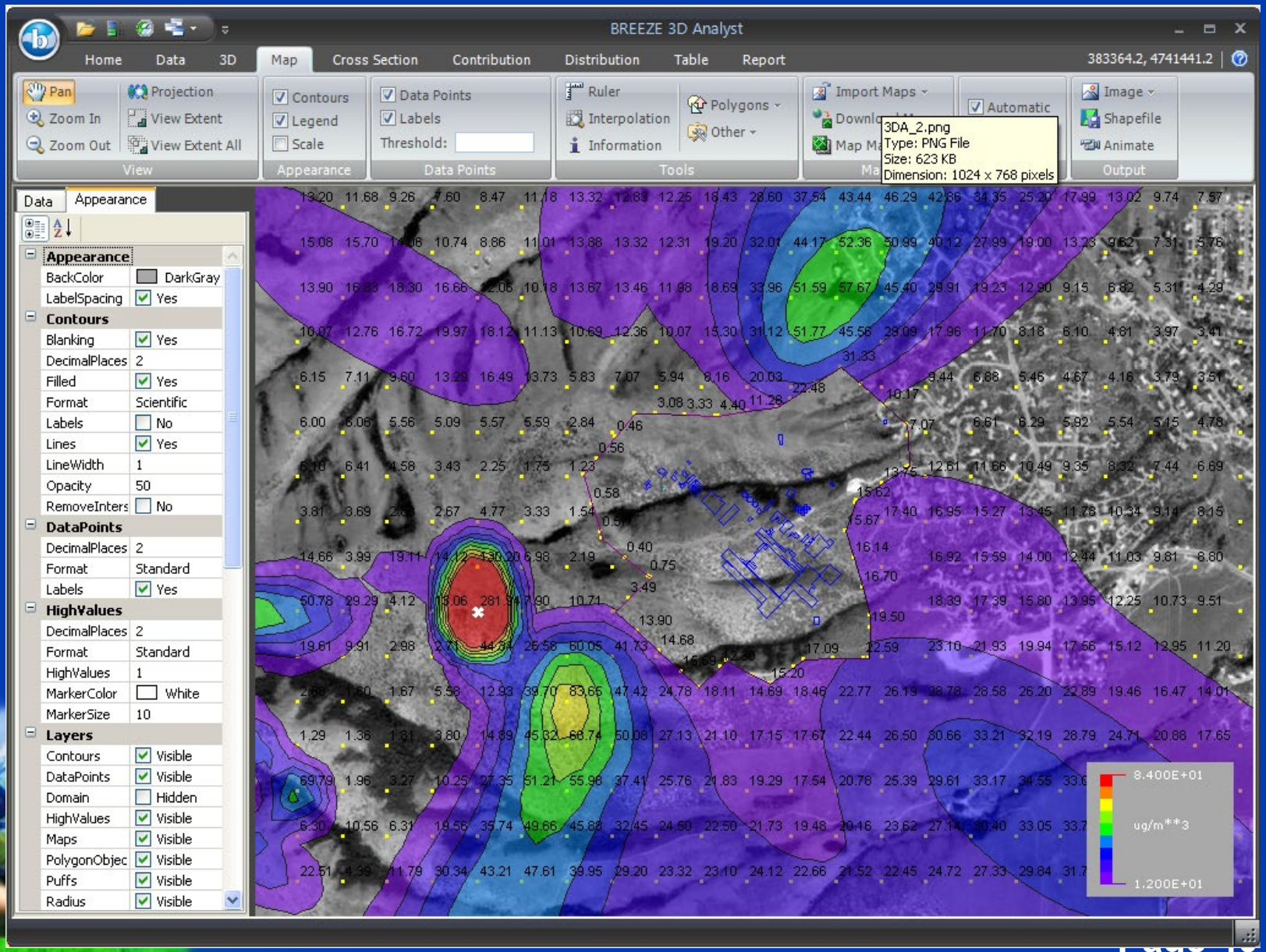

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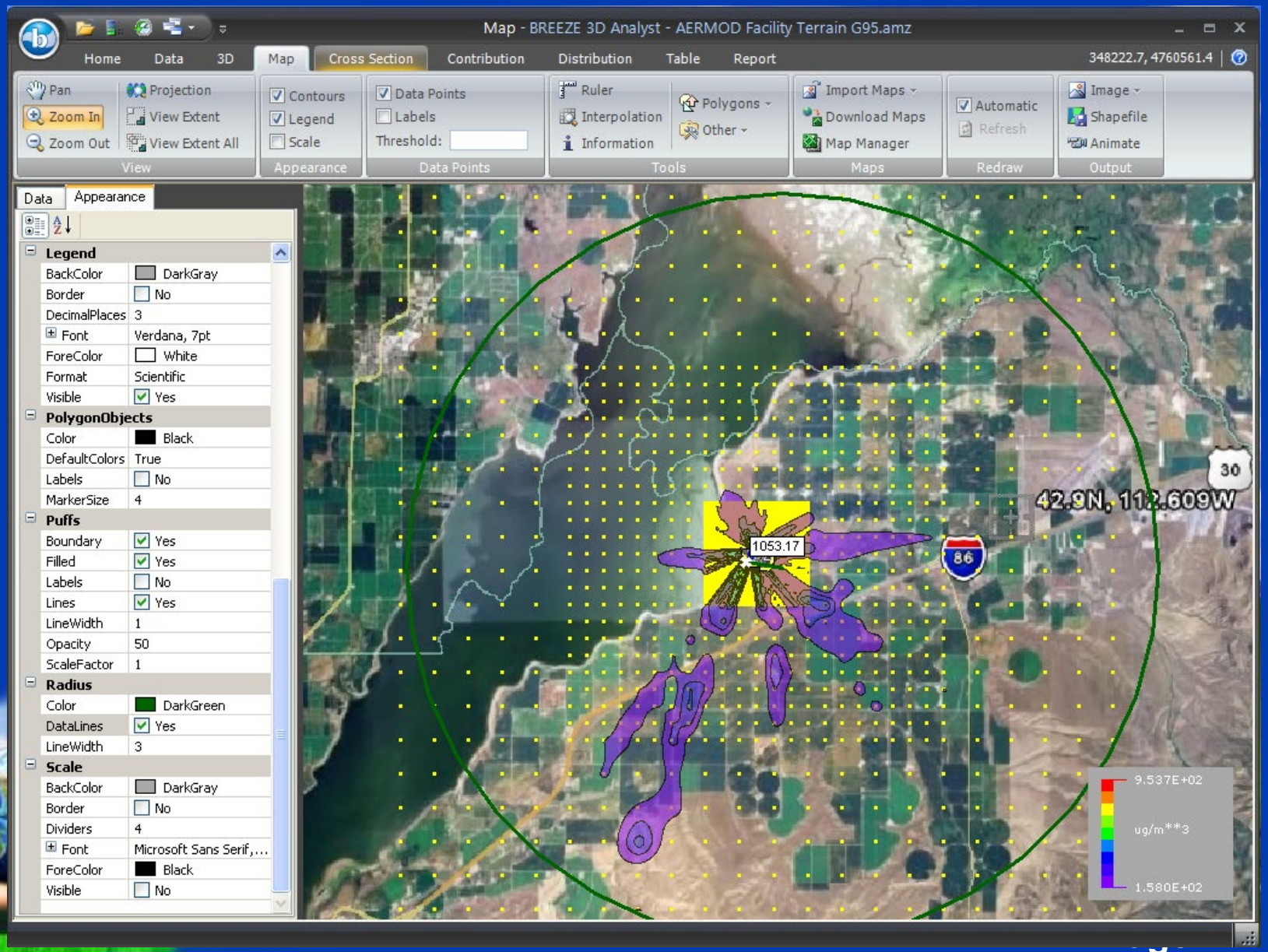


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