List of Acronyms

AAE	Absorption Angstrom Exponent
AAOD	Aerosol Absorption Optical Depth
ABC	Atmospheric Brown Cloud
ACIA	Arctic Climate Impact Assessment
ACS	American Cancer Society
AERONET	Aerosol Robotic (Measurement) Network
AIE	Aerosol Indirect Effect
AMAP	Arctic Monitoring and Assessment Program
AOD	Aerosol Optical Depth
AP-42	Compilation of Air Pollutant Emission Factors (EPA)
APU	Auxiliary Power Unit
AQS	Air Quality System (EPA)
AR5	Fifth Assessment Report of the Intergovernmental Panel on Climate Change
ARIES	Aerosol Research Inhalation Epidemiology Study
BB	Biomass Burning
BC	Black Carbon
BCa	Apparent Black Carbon
BF	Biofuel
BrC	Brown Carbon
BS	Black Smoke
BSG	Biofuel Soot and Gases
C1	Commercial Marine Engines less than 5 liters/cylinder
C2	Commercial Marine Engines between 5-30 liters/cylinder
C3	Commercial Marine Engines greater than 30 liters/cylinder
CAA	Clean Air Act
CALIPSO	Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation
CAPMoN	Canadian Air and Precipitation Monitoring Network
CARB	California Air Resources Board
CAWNET	China Atmosphere Watch Network
CCN	Cloud Condensation Nuclei
CCVS	Closed Crankcase Ventilation System
CF_4	Carbon Tetrafluoride
CH_4	Methane
CI	Compression Ignition
CLRTAP	Convention on Long-Range Transboundary Air Pollution
CMAQ	Congestion Mitigation and Air Quality
CNG	Compressed Natural Gas
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COH	Coefficient of Haze

CRF	Concentration-Response Function
CSN	Chemical Speciation Network
DALYs	Disability Adjusted Life Years
DERA	Diesel Emissions Reduction Act
DOC	Diesel Oxidation Catalyst
DPF	Diesel Particulate Filter
EC	Elemental Carbon
ECa	Apparent Elemental Carbon
ECA	Emissions Control Area
EDX	Energy Dispersive X-ray Spectroscopy
EF	Emission Factor
EI	Emission Index
EMEP	European Monitoring and Evaluation Programme
EPA	Environmental Protection Agency
ER	Emission Reduction Factor
ERT	Emission Reduction Technique
ESP	Electrostatic Precipitator
ESRL/GMD	Earth System Research Laboratory/Global Monitoring Division (NOAA)
EU	European Union
EURO	European Emissions Standards
EUSAAR	European Supersites for Atmospheric Aerosol Research
FAO	Food and Agriculture Organization
FF	Fossil Fuel
FHWA	Federal Highway Administration
FRM	Federal Reference Method
g/bhp-hr	Grams per Break Horsepower-Hour
GACC	Global Alliance for Clean Cookstoves
GAW Aerosol	Global Atmospheric Watch Aerosol Program
GCP	Global Cost Potential
GDI	Gasoline Direct Injection
GDP	Global Damage Potential
GSFC	Goddard Space Flight Center
Gg	Gigagram (10^9 g = 1 kilotonne)
GHG	Greenhouse Gas
GIZ	German Agency for International Development (Deutsche Gesellschaft für Internationale Zusammenarbeit)
GLAS	Geoscience Laser Altimeter System (NASA)
GTP	Global Temperature Potential
GWP	Global Warming Potential
H_2O	Water
HAP	Hazardous Air Pollutant
HC	Hydrocarbon
HFC	Hydrofluorocarbon
HHK	Hybrid Hoffman Kiln
HKHT	Hindu-Kush Himalayan Tibetan Region
HULIS	Humic-Like Substances
hPa	Hectopascal (a unit of barometric pressure)
IAM	Integrated Assessment Model
ICI	Industrial, Commercial and Institutional (Boilers)
IEA	International Energy Agency

IGAC	International Global Atmospheric Chemistry Project
IIASA	International Institute for Applied Systems Analysis
IMPROVE	Interagency Monitoring of Protected Visual Environments
IPCC	Intergovernmental Panel on Climate Change
IR	Infrared
ISA	Integrated Science Assessment
LAC	Light-Absorbing Carbon
LDGV	Light Duty Gasoline Vehicle
LEV	Low Emissions Vehicle
LII	Laser Induced Incandescence
LNG	Liquefied Natural Gas
LPG	Liquid Petroleum Gas
LPM	Liters per Minute
LTO	Landing and Take-Off
MAC	Mass Absorption Coefficients
MACT	Maximum Achievable Control Technology
MANE-VU	Mid-Atlantic/Northeast Visibility Union
MARAMA	Mid-Atlantic Regional Air Management Association
MARPOL	International Convention on the Prevention of Pollution from Ships
MI	Myocardial Infarction
MISR	Multi-angle Imaging Spectroradiometer
Mm	Millimeter
MODIS	Moderate Resolution Imaging Spectroradiometer
MOVES	Mobile Vehicle Emission Simulator Model (EPA)
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standard
NAPS	National Air Pollution Surveillance Network
NATA	National Air Toxics Assessment
NCDC	National Clean Diesel Campaign
NCO-P	Nepal Climate Observatory Pyramid
NEI	National Emissions Inventory (EPA)
NESCAUM	Northeast States for Coordinated Air Use Management
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NGO	Non-Governmental Organization
NIOSH	National Institute for Occupational Safety and Health
NMIM	National Mobile Inventory Model
NOAA	National Oceanic and Atmospheric Administration
NO_x	Nitrogen Oxides
NRC	National Research Council
NSPS	New Source Performance Standard
Nss-S	Non-Sea-Salt Sulfur
O_3	Ozone
OC	Organic Carbon
OCa	Apparent Organic Carbon
OC/BC	Organic Carbon to Black Carbon Ratio (also OC:BC)

OECD	Organisation for Economic Co-operation and Development
OM	Organic Matter
OMI	Ozone Monitoring Instrument
PAH	Polycyclic Aromatic Hydrocarbon
PBL	Planetary Boundary Layer
PCFV	Partnership for Clean Fuels and Vehicles
PCIA	Partnership for Clean Indoor Air
PDPF	Partial Diesel Particulate Filters
PIC	Product of Incomplete Combustion
PM	Particulate Matter (for related terms, such as $PM_{2.5}$ and PM_{10}; see Glossary)
POM	Polycyclic Organic Matter
RCP	Representative Concentration Pathway
RHR	Regional Haze Rule
RICE	Reciprocating Internal Combustion Engine
RM	Raman Microspectroscopy
RPO	Regional Planning Organization
RWC	Residential Wood Combustion
SAGE	System for Assessing Aviation's Global Emissions (FAA)
SCC	Social Cost of Carbon
SCR	Selective Catalytic Reduction
SEARCH	SouthEastern Aerosol Research and Characterization
SEM	Scanning Electron Microscopy
SFP	Specific Forcing Pulse
SLCF	Short-Lived Climate Forcer
SNV	Netherlands Development Organization
SO_2	Sulfur Dioxide
SOA	Secondary Organic Aerosols
SPARC	Stratospheric Processes and their Role in Climate (World Climate Research Programme)
SRES	Special Report on Emissions Scenarios (IPCC)
STN	Speciation Trends Network
STRE	Surface Temperature Response per unit continuous Emission
TEM	Transmission Electron Microscopy
TERP	Texas Emissions Reduction Plan
TF HTAP	Task Force on Hemispheric Transport of Air Pollution
Tg	Teragram (10^{12} g = 1 megatonne)
TOA	Top of the Atmosphere
TOMS	Total Ozone Mapping Spectrometer
TOR	Thermal/Optical Reflectance
TOT	Thermal/Optical Transmittance
$\mu g/m^3$	Micrograms per cubic meter
ULSD	Ultra-Low-Sulfur Diesel
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USDA	United States Department of Agriculture
USGCRP	United States Global Climate Change Research Program

UV	Ultraviolet
VA	Vanillic Acid
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compound
VSBK	Vertical Shaft Brick Kiln
VSL	Value of a Statistical Life
W m^{-2}	Watts per square meter (also W/m^2)
WAIS	West Antarctic Ice Sheet
WHO	World Health Organization
WMO	World Meteorological Organization
WRAP	Western Regional Air Partnership
WTP	Willingness to Pay

Glossary

Aerosol
A mixture of gases and suspended solid and/or liquid particles, with a typical size between 0.01 and 10 micrometers and residing in the atmosphere for at least several hours. Aerosols may be of either natural or anthropogenic origin. Often the term is used interchangeably with "particle" or "particulate matter."

Aerosol Absorption Optical Depth
A quantitative measure of light extinction within a vertical column of atmosphere due to absorption by aerosols.

Aerosol Optical Depth
A quantitative measure of light extinction within a vertical column of atmosphere due to aerosol absorption or scattering. Pollution and cloud-free portions of the atmosphere have a low aerosol optical depth, while highly polluted or densely cloudy skies have a high optical depth.

Aging
The changes that occur to a particle over the course of its atmospheric lifetime, including changes in size or chemical composition.

Agricultural Burning
The planned burning of vegetative debris from agricultural operations; or, the use of fire as a method of clearing land for agricultural use or pastureland.

Albedo
The fraction of solar radiation reflected by a surface or object, often expressed as a percentage. Light-colored surfaces (such as those covered by snow and ice) have a high albedo; dark surfaces (such as dark soils, vegetation and oceans) have a low albedo.

Arctic Haze
A persistent reddish-brown haze visible in the atmosphere at high latitudes in the Arctic due to air pollution, including black carbon, organic carbon, and sulfate particles.

Atmospheric Brown Clouds
Pollution clouds consisting of combinations of black carbon, brown carbon, sulfates, organics, dust, and other components. Atmospheric brown clouds are more common in Asia, southern Africa, and the Amazon Basin. They have been linked to surface dimming and a decrease in vertical mixing (which exacerbates air pollution episodes), and they contribute to changes in the pattern and intensity of rainfall (particularly with respect to monsoon circulation in South Asia).

Atmospheric Lifetime
The approximate amount of time it would take for the atmospheric concentration of a pollutant to return to its natural level (assuming emissions cease) as a result of either being converted to another chemical compound or being taken out of the atmosphere via a sink. This time depends on the pollutant's sources and sinks as well as its reactivity. Average lifetimes for air pollutants can vary from days to weeks (black carbon and ozone) to more than a century (e.g., chlorofluorocarbons and carbon dioxide).

Atmospheric Residence Time
See *atmospheric lifetime*.

Atmospheric Transport
The movement of chemical species through the atmosphere as a result of large-scale atmospheric motions. Transport distances are a function of atmospheric lifetimes, emission location, and overall meteorological activity.

Baghouse
See *fabric filter*.

Biofuels
Biofuels are non-fossil carbon-based fuels derived from organic materials (biomass), including plant materials and animal waste.

Biomass
In the context of energy, the term biomass is often used to refer to organic materials, such as wood and agricultural wastes, which can be burned to produce energy or converted into a gas and used for fuel.

Black Carbon
A solid form of mostly pure carbon that absorbs solar radiation (light) at all wavelengths. Black carbon is the most effective form of particulate matter, by mass, at absorbing solar energy, and is produced by incomplete combustion.

Black Smoke
The term used since the 1950s to describe carbon-containing particulate matter resulting from incomplete combustion (e.g., from coal); also refers to a measurement that quantified the concentration of ambient particulate matter. Term has been used as a synonym for *soot*.

Bottom-Up Inventory
Emissions inventory based on emissions as measured or computed directly by concentration, mass flow, or stream velocity observations at the source, or calculated (using specific emission factors and activity levels) on a source-by-source basis.

Boundary Layer
The bottom layer of the atmosphere that is directly influenced by contact with the surface of the Earth.

Brown Carbon
A class of particulate organic carbon compounds that absorb ultraviolet and visible solar radiation. BrC can be directly emitted as a product of incomplete combustion, or it can be formed in the atmosphere as pollutants age.

Carbon Dioxide
A naturally occurring gas which arises from a variety of human activities such as burning fossil fuels and biomass, land-use changes and other industrial processes. Carbon dioxide is the principal anthropogenic greenhouse gas that affects the Earth's radiative balance. It is used as the reference gas against which other greenhouse gases are measured. See also *climate change*, *global warming, and global warming potential*.

Carbon Dioxide Equivalent
A metric used to compare the emissions from various greenhouse gases based upon their global warming potential. It is the calculated equivalent amount of carbon dioxide emissions that would result in the same radiative effect as a pulse of emissions of another greenhouse gas. Carbon dioxide equivalents are commonly expressed as "million metric tons of carbon dioxide equivalents" ($MMTCO_2eq$).

Carbon Mass Ratio
The ratio of the mass of different components of carbonaceous particles (e.g., the ratio of organic carbon to black carbon, or the ratio of black carbon to total particulate matter).

Carbonaceous Particulate Matter
A general term for carbon-based compounds found in particles, including black carbon and organic carbon. Primary combustion particles are largely composed of carbonaceous particulate matter.

Climate Change
Climate change refers to any significant change in measures of climate (such as temperature, precipitation, or wind) lasting for an extended period (decades or longer). Climate change may result from natural factors, such as changes in the Sun's intensity or slow changes in the Earth's orbit around the Sun; natural processes within the climate system (e.g., changes in ocean circulation); and human activities that change the atmosphere's composition (e.g., through burning fossil fuels) and the land surface (e.g., deforestation, reforestation, urbanization, desertification, etc.).

Cloud Albedo Effect
The process by which aerosols increase the reflectivity of clouds, leading to negative radiative forcing.

Cloud Brightening
See *cloud albedo effect*.

Cloud Burn-off
A subset of the *semi-direct effect*, related specifically to absorbing aerosols being embedded within a cloud and resulting in decreased cloud cover.

Cloud Lifetime Effect
The process by which aerosols reduce the size of cloud droplets, resulting in changes to precipitation patterns and increases in cloud lifetime that lead to cooling.

Coating
Atmospheric process by which a particle can become encased by a shell of a different substance; this often alters the particle's light absorption qualities.

Co-Emitted Pollutants
Gases and particles that are emitted with black carbon, such as organic carbon, sulfates, nitrates, sulfur dioxide and nitrogen oxides.

Co-Pollutants
See *co-emitted pollutants*.

Condensable Particulate Matter
Particles formed as an emissions plume cools in the atmosphere.

Contained Combustion
Closed combustion including internal combustion, reciprocating diesel engines, closed burning. Differentiated from open burning and open combustion.

Deposition
The transfer of atmospheric gases and particles to the Earth's surface. Wet deposition refers to deposition that occurs as a result of precipitation. Dry deposition occurs in the absence of precipitation.

Diesel Particulate Filter
Exhaust emissions control device used to reduce diesel particulate matter; also called a diesel particulate trap. The diesel particulate filter consists of a porous honeycomb structure that physically captures and oxidizes the diesel particulate matter.

Diesel Particulate Matter
The particulate component of diesel exhaust, which includes a mixture of black carbon, organic carbon, sulfates, metals, and trace elements. Black carbon is a major constituent of diesel particulate matter.

Diesel Retrofit
Any technology or system that achieves emissions reductions beyond those required by new engine regulations, including the replacement of high-emitting vehicles/equipment with cleaner vehicles/equipment, repowering or engine replacement, rebuilding the engine to a cleaner standard, installation of advanced emissions control after-treatment technologies such as DPFs, or the use of a cleaner fuel.

Direct Effect
The direct scattering or absorption of solar and terrestrial radiation by atmospheric particles.

Direct Forcing
The change in incoming and outgoing solar and terrestrial radiation due to the *direct effect* of atmospheric pollutants.

Disability Adjusted Life Years
A measure of overall disease burden, expressed as the number of life years lost due to ill-health, disability or early death.

Elemental Carbon
A descriptive term for carbonaceous particles that is based on chemical composition rather than light-absorbing characteristics. Often used as a synonym for *black carbon*.

Externally Mixed
When each particle in a collection of atmospheric particles is assumed to be composed of only one chemical compound for purposes of modeling and study.

Fabric Filters
Fabric filters are one of the most widely used devices for controlling emissions of particulate matter. A fabric filter system typically consists of multiple filter elements (bags) enclosed in a compartment (housing). When the process stream enters the housing and passes through the filter elements, particulate matter accumulates as a dust cake on the surface of the bag.

Filter-Based Techniques
One of several ways to quantify the amount of particulate matter in ambient (outdoor) air. Filter-based measurement methods use samplers that consist of a vacuum pump calibrated to draw in a fixed volume of air per minute through a filter that captures particles. The average concentration of particulate matter in the air can be calculated by weighing the filter before and after the run, and correlating the particulate weight to the volume of air drawn through the pump.

First Indirect Effect
See *cloud albedo effect*.

Flaming
The stage of combustion when fuel gases are rapidly oxidized. Under oxygen-limited and relatively low-temperature conditions, soot is emitted.

Fossil Fuels
Fuels derived from coal, oil, and natural gas.

Gasoline Direct Injection
A fuel injection system for gasoline vehicles which introduces fuel directly into each cylinder, which results in improved fuel economy with higher engine compression rations. Gasoline direct injection is projected to be used on almost all new model year vehicles starting in 2016.

Glaciation Indirect Effect
A warming effect which occurs in certain mixed-phase clouds when black carbon aerosols (and some other particles such as mineral dust) serve as ice nuclei in a super-cooled liquid water cloud, thereby enabling precipitation rather than delaying it.

Global Cost Potential
A metric that compares the relative marginal abatement costs for two climate forcers when a given climate change target is achieved at least cost.

Global Damage Potential
A metric that compares the relative damage resulting from an equal mass of emissions of two climate forcers.

Global Temperature Potential
A physical metric that compares the global average temperature change at a given point in time resulting from equal mass of emissions of two climate forcers.

Global Warming Potential
An index, based upon radiative properties of well-mixed greenhouse gases, measuring the radiative forcing of a unit mass of a given pollutant in the present-day atmosphere integrated over a chosen time horizon (often 100 years, or GWP100), relative to that of carbon dioxide (CO_2 always has a global warming potential of 1). The global warming potential represents the combined effect of the differing times these pollutants remain in the atmosphere and their relative effectiveness in absorbing radiation.

Greenhouse Gas
Any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to, water vapor, carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, hydrochlorofluorocarbons, ozone, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

Hazardous Air Pollutant
Pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects.

Incomplete Combustion
Combustion where only a partial burning of a fuel occurs. Combustion in practice is almost always incomplete due to insufficient oxygen or low temperature during the combustion process preventing the complete oxidation of the fuel to CO_2.

Indirect Effects
The various types of absorption or scattering of solar or terrestrial radiation that occur as a result of anthropogenic aerosol interaction with clouds. These include changes in cloud lifetime, reflectivity, and composition.

Indirect Forcing
The change in incoming and outgoing solar and terrestrial radiation due to the various *indirect effects* resulting from impacts on clouds, including changes in cloud lifetime, reflectivity, and composition. This forcing can be either positive (warming) or negative (cooling), depending on the specific cloud interaction.

Infrared Radiation
Radiation emitted by the Earth's surface, the atmosphere, and the clouds. It is also known as terrestrial or long-wave radiation.

Instantaneous Radiative Forcing
The difference between the amount of radiation coming into the Earth's system and leaving the system, as measured at the tropopause at a specific instant, due to a change in atmospheric concentrations. Unlike other *radiative forcing* measures, instantaneous radiative forcing calculations do not allow any part of the system to adjust prior to estimating net forcing.

Intergovernmental Panel on Climate Change
Established in 1988 by the World Meteorological Organization and the United Nations Environment Programme, the Intergovernmental Panel on Climate Change is responsible for providing the scientific and technical foundation for the United Nations Framework Convention on Climate Change, primarily through the publication of periodic assessment reports.

Internally Mixed
When individual atmospheric particles are treated as mixtures of chemical components for purposes of modeling and study.

Kyoto Basket
The set of greenhouse gases covered under the Kyoto Protocol: carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, and perfluorocarbons.

Laser Induced Incandescence
A technique in which a high-energy laser is used to heat soot particles to high temperatures; measurement of the resulting incandescent light emitted by the soot particles indicates the amount of soot (soot volume fraction) and its location within the combustion event.

Light-Absorbing Carbon
Carbonaceous particles that absorb light, including black carbon plus brown carbon.

Light-Absorbing Particulate Matter
Refers to particles that tend to absorb light, which represents energy added to the Earth's system and leads to climate warming.

Light-Scattering Particulate Matter
Refers to particles that tend to reflect or scatter light, which generally leads to increased reflection of light back to space, causing climate cooling.

Long-Lived Climate Forcer
A pollutant like CO_2 that has a positive radiative forcing effect on climate and a long atmospheric lifetime (decades to centuries).

Maximum Achievable Control Technology (MACT) Standards
U.S. federal emissions standards for stationary sources of hazardous air pollutants requiring the maximum emissions reductions, taking cost and feasibility into account. Under the Clean Air Act Amendments of 1990, the MACT must not be less than the average emission level achieved by controls on the best performing 12 percent of existing sources, by category of industrial and utility sources. See also *National Emissions Standards for Hazardous Air Pollutants (NESHAP)*.

Metric
An analytical measurement intended to quantify the state of a system. In climate assessments, metrics are used to quantify the impact of a pollutant relative to a common baseline.

Mixed-Phase Clouds
Clouds with both ice and water.

Mixing
The movement of pollutants through the atmosphere that often leads to chemical and physical transformations of the pollutants.

National Ambient Air Quality Standards (NAAQS)
Standards required under the Clean Air Act for widespread pollutants from numerous and diverse sources considered harmful to public health and the environment. Primary standards are designed to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards are designed to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings. EPA has set NAAQS for six principal pollutants, which are called "criteria" pollutants: particulate matter, ozone, lead, oxides of nitrogen, oxides of sulfur, and carbon monoxide.

National Emissions Inventory
EPA's national emissions database containing information about sources that emit criteria air pollutants and their precursors, and hazardous air pollutants. The database includes estimates of annual air pollutant emissions from point, nonpoint, and mobile sources in the 50 states, the District of Columbia, and Puerto Rico.

National Emissions Standards for Hazardous Air Pollutants (NESHAP)
Stationary source standards for hazardous air pollutants. The NESHAPs promulgated after the 1990 Clean Air Act Amendments require application of technology-based emissions standards referred to as *Maximum Achievable Control Technology (MACT)* standards. Consequently, these post-1990 NESHAPs are also referred to as MACT standards.

Net Radiative Forcing
The total *radiative forcing* due to the presence of a pollutant in the atmosphere, accounting for both the positive (warming) and negative (cooling) forcing associated with different radiative effects of the pollutant. For particles, this includes accounting for direct, indirect (cloud), and snow/ice albedo effects.

New Source Performance Standards (NSPS)
U.S. federal emissions standards for certain air pollutants that are emitted from new, modified, or reconstructed stationary emissions sources which reflect the use of best available control technology.

Nitrogen Oxides
A generic term for a group of highly reactive gases, including nitrogen oxide (NO) and nitrogen dioxide (NO_2). Nitrogen oxides result from combustion of fossil or biofuels, especially at high temperatures.

Open Biomass Burning
Open burning of vegetative material; includes agricultural burning, prescribed burning, and wildfires.

Organic Carbon
The mix of compounds containing carbon bound with other elements; e.g., hydrogen and oxygen. Organic carbon may be a product of incomplete combustion, or formed through the oxidation of VOCs in the atmosphere. Both primary and secondary organic carbon possess radiative properties that fall along a continuum from light-absorbing to light-scattering.

Organic Carbon to Black Carbon Ratio
See c*arbon mass ratios.*

Organic Matter
The total mass of organic material in a compound.

Oxidation
The chemical reaction of a substance with oxygen or a reaction in which the atoms in an element lose electrons and its valence is correspondingly increased.

Particle Coagulation
The process by which particles collide and stick together. Part of the internal mixing process, coagulation reduces the overall particle number and reduces the differences in chemical composition among the individual particles in the emissions plume.

Particulate Matter
A complex mixture of extremely small particles and liquid droplets suspended in the atmosphere. Particulate matter (PM) is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles. For purposes of air quality and health studies, PM is typically measured in two size ranges: PM_{10} and $PM_{2.5}$.

PM_{10}
Particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers. PM_{10} includes $PM_{2.5}$.

$PM_{2.5}$
Fine particulate matter with an aerodynamic diameter less than or equal to 2.5 micrometers.

Photoacoustic
A black carbon measurement technique where light from a source is absorbed by the aerosol resulting in the heating and subsequent expansion of the surrounding air. The expansion results in a sound wave which is then detected with a microphone.

Polycyclic Aromatic Hydrocarbon
A group of organic contaminants formed from incomplete combustion. These aromatic compounds comprise two or more benzene rings arranged in various configurations (polycyclic). Many polycyclic aromatic hydrocarbons (PAHs) are known to be toxic to humans and ecosystems, and EPA has classified seven PAH compounds as probable human carcinogens: benzo[a]pyrene, benz[a] anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, dibenz[a,h]anthracene, and indeno[1,2,3cd]pyrene). PAHs are precursors (building blocks) in the formation of black carbon and brown carbon.

Prescribed Fire
Any fire intentionally ignited by management under an approved plan to meet specific objectives.

Primary Particle
A particle that is emitted directly from a source.

Pulse
See *specific forcing pulse*.

Pyrolysis
The heating of solid fuels in the absence of oxygen. Pyrolysis induces the evaporation of volatile gases from the solid fuel needed to support combustion. Thermal breakdown of portions of the solid fuel provide additional fuel gases. Pyrolysis is used to produce charcoal and biochar, a residual form of carbon in solid form.

Radiation
Energy in the form of electromagnetic waves (or photons). Photons absorbed by solid materials, such as light-absorbing particles, are transformed into other forms of energy. Most notably, solar radiation absorbed by a particle converts, in part, into heat energy that warms the surrounding atmosphere or the surfaces upon which the particles are deposited (e.g., snow and ice).

Radiative Forcing
The change in the energy balance between incoming solar radiation and exiting infrared radiation, typically measured in watts per square meter (W m-2), due to a change in concentration (generally the change since preindustrial conditions in 1750). Positive radiative forcing tends to warm the surface of the Earth, while negative forcing generally leads to cooling. A pollutant that increases the amount of energy in the Earth's climate system is said to exert "positive radiative forcing," which leads to warming. In contrast, a pollutant that exerts "negative radiative forcing" reduces the amount of energy in the Earth's system and leads to cooling.

Second Indirect Effect
See *cloud lifetime effect*.

Secondary Organic Aerosols
Carbonaceous aerosols that are produced in the atmosphere rather than being directly emitted. Precursor gases (such as aromatic hydrocarbons, monoterpenes) undergo chemical reactions and condensation to form secondary organic aerosols.

Secondary Particle
A particle (e.g., sulfate or nitrate) that is formed in the atmosphere from the oxidation of gaseous precursors like sulfur dioxide, nitrogen oxides, and volatile organic compounds or through the transformation of directly emitted particles. The acids resulting from the oxidation of these compounds attract water vapor to form tiny droplets (fine particles).

Semi-Direct Effect
Localized heating of the atmosphere by absorbing aerosol particles, affecting the relative humidity and stability of the troposphere, which in turn affect cloud formation and lifetime.

Short-Lived Climate Forcer
A pollutant, such as black carbon, ozone, or methane, that has a positive radiative forcing effect on climate but a relatively short atmospheric lifetime (days to years).

Single-Scattering Albedo
The ratio of scattering optical depth to the total optical depth (scattering plus absorption) of the atmosphere; indicates how much of the light extinction in the atmosphere is due to scattering vs. absorption. If single-scattering albedo equals 1, all particle extinction is due to scattering; if single-scattering albedo equals 0, all extinction is due to absorption.

Smoldering
A non-flaming phase of the combustion process that involves a slower, cooler form of combustion which occurs as oxygen attacks the surface of heated solid fuel directly.

Snow/Ice Albedo Effect
Decrease in reflectivity (and increase in absorption) of solar radiation that occurs as a result of the darkening of snow and ice through aerosol deposition.

Snow/Ice Albedo Forcing
Positive radiative forcing resulting from the deposition of black carbon on snow and ice, which darkens the surface and decreases reflectivity (albedo), thereby increasing absorption of *solar radiation* and accelerating melting.

Social Cost of Carbon
An estimate of the monetized damages resulting from an incremental increase in CO_2 emissions in a given year. It can be thought of as the monetized benefit to society of reducing one ton of CO_2.

Solar Radiation
Radiation emitted by the Sun. It is also referred to as short-wave radiation. Solar radiation has a distinctive range of wavelengths (spectrum) determined by the temperature of the Sun. In the context of this report, the term refers to the portions of the solar spectrum which reach the lower atmosphere, including the ultraviolet (>280 nm), visible and infrared.

Solar Zenith Angle
The angle between a point directly above any location on the Earth's surface (the zenith) and the Sun, as measured at the location. These angles relate to the elevation of the Sun above the horizon (in degrees).

Soot
A complex mixture of mostly black and organic carbon that is the primary light-absorbing pollutant emitted by the incomplete combustion of fossil fuels, biofuels, and biomass.

Source Apportionment
The use of ambient and/or emissions data along with statistical modeling to determine the contribution of a specific emissions source category to measured ambient concentrations of air pollutants like $PM_{2.5}$.

SPECIATE database
EPA's repository of speciation profiles characterizing the composition of emissions from specific air pollution sources.

Specific Forcing Pulse
A metric based on the amount of energy added to the Earth's system due to the radiative forcing caused by a given mass of a pollutant.

Surface Dimming Effect
The reduction of solar radiation at Earth's surface due to high concentrations of particles, especially light absorbing particles, in the atmosphere, above. This results in cooling at the Earth's surface (even though net forcing measured at the top of the atmosphere might be positive).

Surface Temperature Response per Unit Continuous Emission
A metric that compares the change in surface temperature due to an assumed continuous emission of equal masses a climate forcer and CO_2.

Tar Balls
Liquid aerosol droplets observed in biomass burning plumes that appear to be formed entirely from brown carbon.

Thermal Techniques
A variety of approaches used for the measurement of organic and elemental carbon. The techniques involve the heating of particulate matter with the subsequent detection of the evolved carbon with a variety of techniques.

Thermal-Optical Techniques
A variety of approaches used for the measurement of organic and elemental carbon. These techniques are similar to the thermal techniques defined above, with the addition of an optical measurement to improve the separation of elemental carbon from organic carbon.

Thermodynamic Effect
The process by which freezing of droplets in mixed-phase clouds is delayed because droplet size is reduced. This effect ultimately changes the characteristics of the cloud, but whether it leads to warming or cooling is unclear.

Third Pole
Refers to the Hindu Kush-Himalayan-Tibetan region.

Tier 2 Standards
U.S. EPA emissions standards for emissions of hydrocarbons, carbon monoxide, oxides of nitrogen, and PM from light-duty vehicles (automobiles and light-duty trucks) phased in with the 2004 through 2006 model years. Standards represent roughly 99% emissions reduction compared to pre-control (pre-1968 model year) vehicles.

Top-Down Inventory
Emissions inventory based on ambient air quality data. Individual emissions source estimates are based upon the relative magnitude of tracer compounds in the ambient air.

Top of the Atmosphere
The location between the troposphere and the stratosphere. Measuring radiative forcing at this altitude is best for determining net energy balance.

Top of the Atmosphere Radiative Forcing
Net radiative forcing measured (or modeled) at the top of the atmosphere to capture the total change in incoming and outgoing radiation due to the presence of atmospheric pollutants.

Transport
See *atmospheric transport*.

Troposphere
The lowest part of the atmosphere from the Earth's surface (ranging from 9 km in high latitudes to 16 km in the tropics on average) where clouds and "weather" phenomena occur. In the troposphere, temperatures generally decrease with height.

Ultra-Low Sulfur Diesel Fuel
Diesel fuel that has a maximum of 15 parts per million of sulfur content. Ultra-low sulfur diesel enables advanced pollution control technologies such as *diesel particulate filters* and urea selective catalytic reduction systems for NO_x.

Ultraviolet Radiation
The energy range just beyond the violet end of the visible spectrum, with wavelengths between 10-400 nm. Ultraviolet radiation constitutes only about 5 percent of the total energy emitted from the Sun, and most ultraviolet radiation is blocked by Earth's atmosphere. The ultraviolet radiation that does reach the Earth aids in plant photosynthesis and helps produce vitamin D in humans. Too much ultraviolet radiation can burn the skin, cause skin cancer and cataracts, and damage vegetation.

Value of a Statistical Life
A summary measure for the dollar value of small changes in mortality risk experienced by a large number of people. The total estimated value of a statistical life is derived from aggregated estimates of individual values for small changes in mortality risks.

Volatile Organic Compounds
Organic chemical compounds whose composition makes it possible for them to evaporate under normal atmospheric conditions of temperature and pressure. These carbonaceous pollutant gases are emitted by both anthropogenic and natural processes and often serve as precursors for the formation of aerosol particles and ozone. Examples of volatile organic compounds include benzene, toluene, methylene chloride, and methyl chloroform.

Wildfire
An unplanned ignition caused by lightning, volcanoes, unauthorized activity, accidental human actions, and escaped prescribed fires.

Willingness to Pay
The maximum amount a person would be willing to pay, sacrifice, or exchange in order to receive a good or to avoid something undesired, such as pollution.