

GLOSSARY & ACRONYMS

(Note: EPA Definitions can be found at: <http://www.epa.gov/climatechange/glossary.html>)

Aerosol (EPA Definition)

A collection of airborne solid or liquid particles, with a typical size between 0.01 and 10 micrometers (μm) and residing in the atmosphere for at least several hours. Aerosols may be of either natural or anthropogenic origin. Aerosols may influence climate in two ways: directly through scattering and absorbing radiation, and indirectly through acting as condensation nuclei for cloud formation or modifying the optical properties and lifetime of clouds. (The term has also come to be associated, erroneously, with the propellant used in "aerosol sprays.")

Anthropogenic (EPA Definition)

Made by people or resulting from human activities. Usually used in the context of emissions that are produced as a result of human activities.

Atmosphere (EPA Definition)

The gaseous envelope surrounding the Earth. The dry atmosphere consists almost entirely of nitrogen (78.1% volume mixing ratio) and oxygen (20.9% volume mixing ratio), together with a number of trace gases, such as argon (0.93% volume mixing ratio), helium, radiatively active greenhouse gases such as carbon dioxide (0.035% volume mixing ratio), and ozone. In addition the atmosphere contains water vapor, whose amount is highly variable but typically 1% volume mixing ratio. The atmosphere also contains clouds and aerosols.

Atmospheric Lifetime (EPA Definition)

The lifetime of a greenhouse gas refers to the approximate amount of time it would take for the anthropogenic increment to an atmospheric pollutant concentration 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. The lifetime of a pollutant is often considered in conjunction with the mixing of pollutants in the atmosphere; a long lifetime will allow the pollutant to mix throughout the atmosphere. **Average lifetimes can vary from about a week (sulfate aerosols)** to more than a century (chlorofluorocarbons (CFCs), carbon dioxide). See greenhouse gas and residence time.

Black Carbon (EPA Definition)

Operationally defined species based on measurement of light absorption and chemical reactivity and/or thermal stability; consists of soot, charcoal, and/or possible light-absorbing refractory organic matter. (Source: Charlson and Heintzenberg, 1995, p. 401.)

Carbon Sequestration (EPA Definition)

The uptake and storage of carbon. Trees and plants, for example, absorb carbon dioxide, release the oxygen and store the carbon. Fossil fuels were at one time biomass and continue to store the carbon until burned. See sinks.

CHAFF (U.S. Air Force)

A radar countermeasure in which aircraft or other targets spread a cloud of small, thin pieces of aluminum, metallized glass fibre or plastic, which either appears as a cluster of secondary targets on radar screens or swamps the screen with multiple returns. (CHAFF = Aluminum Coated Fiberglass Particulates)

"...Chaff and flares are defensive counter measures used on aircraft to confuse radar and heat seeking missiles. Chaff is used as a decoy for radar seeking missiles and is made of glass silicate fibers with an aluminum coating. The fibers are approximately 60% glass fiber and 40% aluminum by weight. The typical Air

Force RR-188 chaff bundle contains about 150 g of chaff or about 5 million fibers. The fibers are 25 microns in diameter and typically 1 to 2 cm in length. In 1997, the Air Force used about 1.8 million bundles worldwide. **The amount of chaff released worldwide by all of the services is approximately 500 tons per year.** Chaff falls to the earth at a settling velocity of approximately 30 cm per second. Atmospheric residence times range from 10 minutes for the majority of chaff released at 100 m to approximately 10 hours for chaff released at 10,000 feet. Chaff fibers experience little breakup before reaching the ground...”

Climate (EPA Definition)

Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands of years. The classical period is 3 decades, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. See weather.

Climate Change (EPA Definition)

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:

- 1) natural factors, such as changes in the sun's intensity or slow changes in the Earth's orbit around the sun;
- 2) natural processes within the climate system (e.g. changes in ocean circulation);
- 3) 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.)

Climate Mitigation

Reducing emissions of carbon dioxide (CO₂), the most prevalent greenhouse gas produced by human activity (according to some scientists), as a risk-management strategy to help reduce or limit the negative effects of climate change according to GAO report – Climate Change – A coordinated Strategy Could Focus Federal Geoengineering Research and Inform Governance Efforts, September, 2010.

Climate Remediation

Techniques intended to counteract or mask the climate effects of past greenhouse gas emissions to the atmosphere, and does not assume anything about the efficacy, feasibility, or desirability of those schemes according to Bipartisan Policy Center's Task Force on Climate Remediation Research.

Climate System (or Earth System – EPA Definition)

The five physical components that are responsible for the climate and its variations:

- 1) **atmosphere,**
- 2) **hydrosphere,**
- 3) **cryosphere,**
- 4) **lithosphere, and**
- 5) **biosphere)**

EPA Clean Air Act: SUBCHAPTER I > Part C > subpart i > § 7470

Congressional Declaration of Purpose: The purposes of this part are as follows:

- 1) to protect public health and welfare from any actual or potential adverse effect which in the Administrator's judgment may reasonably be anticipated
 - A) to occur from air pollution or from exposures to pollutants in other media, which pollutants originate as emissions to the ambient air)
 - B) notwithstanding attainment and maintenance of all national ambient air quality standards;
- (2) to preserve, protect, and enhance the air quality in national parks, national wilderness areas, national monuments, national seashores, and other areas of special national or regional natural, recreational, scenic, or historic value;
- (3) to insure that economic growth will occur in a manner consistent with the preservation of existing clean air resources;
- (4) to assure that emissions from any source in any State will not interfere with any portion of the applicable implementation plan to prevent significant deterioration of air quality for any other State; and
- (5) to assure that any decision to permit increased air pollution in any area to which this section applies is made only after careful evaluation of all the consequences of such a decision and after adequate procedural opportunities for informed public participation in the decision making process.

Emissions (EPA Definition)

The release of a substance (usually a gas when referring to the subject of climate change) into the atmosphere.

Geoengineering - (also referred to as climate engineering, climate remediation and climate intervention)

Deliberate large-scale interventions in the earth's climate system to diminish climate change or its impacts according to GAO Report – Climate Change – A Coordinated Strategy could Focus Federal Geoengineering Research and Inform Governance Efforts, September, 2101.

A FEW TYPES OF “Risky” GEOENGINEERING (Climate Remediation) SCHEMES

- *Solar Radiation Management
- *Carbon Capture & Sequestration
- *Sunscreens / Solar Umbrellas / Sunshades
- *Space Mirrors / Solar Sails / Self-Lofting CHAFF Balloons
- *Cloud Whitening Experiments (Using Salt)
- *Ocean Iron or Lime Fertilization
- *Weather Modification & Mitigation
- *Using Aircraft or Rockets to Produce:
 - 1) Man-Made Clouds and haze (also particulates causing Global Dimming)

- 2) Increase Water Vapor in the atmosphere via Jets or Rockets - Part of Geoengineering Schemes necessary to deliver sulfur, alumina, or other compounds into the atmosphere.
- 3) Aviation and rockets are responsible for exacerbating global warming, changing the climate and negatively impacting natural resources.
- 4) Other Schemes – All Risky and May Have Unintended Consequences

Global Change (EPA Definition)

A broad term that refers to changes in the global environment, including climate change, ozone depletion, and land use change.

Global Warming (EPA Definition)

Global warming is an average increase in the temperature of the atmosphere near the Earth's surface and in the troposphere, which can contribute to changes in global climate patterns. Global warming can occur from a variety of causes, both natural and human induced. In common usage, "global warming" often refers to the warming that can occur as a result of increased emissions of greenhouse gases from human activities. See climate change, greenhouse effect, enhanced greenhouse effect, radiative forcing, troposphere.

Honey Bees (Nature 2007) <http://www.nature.ca/notebooks/english/bees.htm>

Apiidae “Bees belong to the third largest insect order which also includes wasps and ants. Together, these creatures pollinate crops, turn over the soil more effectively than earthworms, and, in the case of the bee, furnish food in the form of honey. Even more importantly, some members of this order prey on other insects -- the single most important factor in keeping the Earth's insect population in check.

The bee's eyes, like those of other insects, differ greatly from human eyes. They consist of a pair of compound eyes made up of numerous six-sided facets (28,000 in some dragonflies, 4,000 in house flies) plus three simple eyes. Despite this, their vision is believed to be sharp only for a distance of about 1 m. Bees, however, are capable of seeing **ultraviolet light**, which is invisible to humans. The bee is capable of navigating, even on a cloudy day, by **cloud-penetrating ultraviolet light**. Honey bees also use the sun as a reference point to communicate to other bees the angle of flight to be followed to arrive at newly discovered nectar-bearing flowers. Could Honey & Bumble Bee decline be traced to **Ultraviolet Radiation** increases and changes?

Infrared Radiation (EPA Definition)

Radiation emitted by the Earth's surface, the atmosphere and the clouds. It is also known as terrestrial or long-wave radiation. Infrared radiation has a distinctive range of wavelengths ("spectrum") longer than the wavelength of the red color in the visible part of the spectrum. The spectrum of infrared radiation is practically distinct from that of solar or short-wave radiation because of the difference in temperature between the Sun and the Earth-atmosphere system.

MASK OR MASKING EFFECT

“...scattering of sunlight by aerosols masks as much as 50% of the present warming effect of greenhouse gases [Ramanathan et al., 2001].

http://www.arb.ca.gov/research/calnex2010/calnexus_white_paper_01_09.pdf

Megaton - megaton (mg-tn) n. Abbr. MT

A unit of explosive force equal to that of one million metric tons of TNT.

Megaton = One Million Tons

(Note: David Keith & Others promoting Geoengineering Schemes speak about introducing and keeping 1-4 Megatons of particles (sulfur, aluminum oxide, other compounds), in the atmosphere each year. These particles must be renewed each year as particles only remain in the atmosphere a certain amount of time before returning to Earth. When these particles return to Earth they pollute the air, water, soils, and may cause acid rains and other environmental problems. No one knows what the unintended consequences from “risky”, the multiple Geoengineering schemes planned nor the cumulative or synergistic effects.)

Ozone (O3) (EPA Definition)

Ozone, the triatomic form of oxygen (O₃), is a gaseous atmospheric constituent. In the troposphere, it is created both naturally and by photochemical reactions involving gases resulting from human activities (photochemical smog). In high concentrations, tropospheric ozone can be harmful to a wide range of living organisms. Tropospheric ozone acts as a greenhouse gas. In the stratosphere, ozone is created by the interaction between solar ultraviolet radiation and molecular oxygen (O₂). Stratospheric ozone plays a decisive role in the stratospheric radiative balance. Depletion of stratospheric ozone, due to chemical reactions that may be enhanced by climate change, results in an increased ground-level flux of ultraviolet (UV-) B radiation. See atmosphere, ultraviolet radiation.

Ozone Layer (EPA Definition)

The layer of ozone that begins approximately 15 km above Earth and thins to an almost negligible amount at about 50 km, shields the Earth from harmful ultraviolet radiation from the sun. The highest natural concentration of ozone (approximately 10 parts per million by volume) occurs in the stratosphere at approximately 25 km above Earth. The stratospheric ozone concentration changes throughout the year as stratospheric circulation changes with the seasons. Natural events such as volcanoes and solar flares can produce changes in ozone concentration, but man-made changes are of the greatest concern. See stratosphere, ultraviolet radiation.⁶

Particulate Matter (PM) (EPA Definition) <http://www.arb.ca.gov/html/brochure/pm10.htm>

Very small pieces of solid or liquid matter such as particles of soot, dust, fumes, mists or aerosols. The physical characteristics of particles, and how they combine with other particles, are part of the feedback mechanisms of the atmosphere. See aerosol, sulfate aerosols.

(NOTE: In Solar Radiation Management Schemes where particles are artificially formed in the atmosphere there is no doubt that these particles return to Earth as air pollutants. The size of these particles could impair public health due to the size, type of particulate, and the number of particles that return to Earth.)

What is Particulate Matter (PM₁₀)?

Particulate matter (PM₁₀) pollution consists of very small liquid and solid particles floating in the air. Of greatest concern to public health are the particles small enough to be inhaled into the deepest parts of the lung. These particles are less than 10 microns in diameter - about 1/7th the thickness of the a human hair - and are known as PM₁₀. **This includes fine particulate matter known as PM_{2.5}.**

PM₁₀ is a major component of air pollution that threatens both our health and our environment.

Where does PM₁₀ come from? In the western United States, there are sources of PM₁₀ in both urban and rural areas.

PM₁₀ is a mixture of materials that can include smoke, soot, dust, salt, acids, and metals. Particulate matter also forms when gases emitted from motor vehicles and industry undergo chemical reactions in

the atmosphere. PM10 is among the most harmful of all air pollutants. When inhaled these particles evade the respiratory system's natural defenses and lodge deep in the lungs. Health problems begin as the body reacts to these foreign particles. PM10 can increase the number and severity of asthma attacks, cause or aggravate bronchitis and other lung diseases, and reduce the body's ability to fight infections.

Although particulate matter can cause health problems for everyone, certain people are especially vulnerable to PM10's adverse health effects. These "sensitive populations" include children, the elderly, exercising adults, and those suffering from asthma or bronchitis. Of greatest concern are recent studies that link PM10 exposure to the premature death of people who already have heart and lung disease, especially the elderly. PM10 is often responsible for much of the haze that we think of as smog. This is a problem in our cities, rural areas and pristine areas - such as national parks and forests. The United States Environmental Protection Agency has set air quality standards for PM10. Based on health research, these identify acceptable levels of PM10. Currently, these standards are violated in many parts of the western United States. Air quality agencies in several states have developed, or are now developing, air quality plans to bring PM10 concentrations down to healthful levels.

Pollution (State of New York)

State of New York Laws: Article 1 - Title 3 - § 1-0303. General definitions. "19. "Pollution" shall mean the presence in the environment of conditions and or contaminants in quantities of characteristics which are or may be injurious to human, plant or animal life or to property or which unreasonably interfere with the comfortable enjoyment of life and property throughout such areas of the state as shall be affected thereby."

Photosynthesis (EPA Definition)

The process by which plants take CO₂ from the air (or bicarbonate in water) to build carbohydrates, releasing O₂ in the process. There are several pathways of photosynthesis with different responses to atmospheric CO₂ concentrations.

Solar Radiation Management (SRM) Geoengineering Techniques

Strategies to counteract or mask the effect of rising greenhouse gas concentrations in the atmosphere by increasing the amount of solar energy that is reflected back into space. Although SRM may be able to mask some impacts of greenhouse gases on the climate system, it would do nothing to deal with the chemical consequences of increased CO₂ concentrations in the atmosphere, including ocean acidification—a phenomenon that poses significant risks, particularly for marine life according to The Task Force on Climate Remediation Research, Bipartisan Policy Task Force October 4, 2011 Report. This category of climate remediation options includes a range of ideas, but most current research is focused on two distinct concepts:

1. Introducing very fine particles or liquid droplets—known as aerosols—into the stratosphere to deflect incoming solar radiation.
2. Altering the reflectivity of clouds by means such as spraying droplets of seawater into the atmosphere to make cloud droplets more numerous and smaller and to make the clouds more reflective (i.e., brighter).

Stratosphere (EPA Definition)

Region of the atmosphere between the troposphere and mesosphere, having a lower boundary of approximately 8 km at the poles to 15 km at the equator and an upper boundary of approximately 50 km. Depending upon latitude and season, the temperature in the lower stratosphere can increase, be isothermal, or

even decrease with altitude, but the temperature in the upper stratosphere generally increases with height due to absorption of solar radiation by ozone.⁶

Sulfur Hexafluoride (SF₆)

A colorless gas soluble in alcohol and ether, slightly soluble in water. **A very powerful greenhouse gas** used primarily in electrical transmission and distribution systems and as a dielectric in electronics. The global warming potential of SF₆ is 22,200. This GWP is from the IPCC's Third Assessment Report (TAR). See Global Warming Potential.

Trace Gas (EPA Definition)

Any one of the less common gases found in the Earth's atmosphere. Nitrogen, oxygen, and argon make up more than 99 percent of the Earth's atmosphere. Other gases, such as carbon dioxide, water vapor, methane, oxides of nitrogen, ozone, and ammonia, are considered trace gases. Although relatively unimportant in terms of their absolute volume, they have significant effects on the Earth's weather and climate.

Ultraviolet Radiation (UV) (EPA Definition)

The energy range just beyond the violet end of the visible spectrum. Although ultraviolet radiation constitutes only about 5 percent of the total energy emitted from the sun, it is the major energy source for the stratosphere and mesosphere, playing a dominant role in both energy balance and chemical composition.

Most ultraviolet radiation is blocked by Earth's atmosphere, but some solar ultraviolet penetrates and 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.

Water Vapor (EPA Definition)

"The most abundant greenhouse gas, it is the water present in the atmosphere in gaseous form. Water vapor is an important part of the natural greenhouse effect. While humans are not significantly increasing its concentration, it contributes to the enhanced greenhouse effect because the warming influence of greenhouse gases leads to a positive water vapor feedback. In addition to its role as a natural greenhouse gas, water vapor plays an important role in regulating the temperature of the planet because clouds form when excess water vapor in the atmosphere condenses to form ice and water droplets and precipitation. See greenhouse gas..."

Water Vapor – Positive Feedback Loop (EPA Definition)

"Water Vapor: It's a Gas! Water can take the form of an invisible gas called water vapor. Water vapor is naturally present in the atmosphere and has a strong effect on weather and climate. As the planet gets warmer, more water evaporates from the Earth's surface and becomes vapor in the atmosphere. Water vapor is a greenhouse gas, so more water vapor in the atmosphere leads to even more warming. This is an example of a positive feedback loop, which happens when warming causes changes that lead to even more warming.

Weather (EPA Definition)

"Atmospheric condition at any given time or place. It is measured in terms of such things as wind, temperature, humidity, atmospheric pressure, cloudiness, and precipitation. In most places, weather can change from hour-to-hour, day-to-day, and season-to-season. Climate in a narrow sense is usually defined as the "average weather", or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including

a statistical description, of the climate system. A simple way of remembering the difference is that climate is what you expect (e.g. cold winters) and 'weather' is what you get (e.g. a blizzard)..."

HISTORY & REFERENCES

- 1) "Global Warming and Ice Ages" by Edward Teller, L. Wood, R. Hyde, August 15, 1997 "...It may well be feasible to transport and disperse enough SO₂ (or SO₃ or H₂SO₄) into the stratosphere to produce the desired insolation modulation effect 28,29 – and even to do so partly on the basis of existing experience, as well as much prior analysis. It has also been suggested that alumina injected into the stratosphere by the exhaust of solid-rocket motors might scatter non-negligible amounts of sunlight. We expect that introduction of scattering-optimized alumina particles into the Stratosphere may well be overall competitive with use of sulfur oxides; alumina particles offer a distinctly different environmental impact profile..." (Reference 30 "...A mean stratospheric lifetime of each scattering particle of 5 years would imply a required injection rate of 2x10⁶ tons annually, or a time-averaged injection rate of 60 kg/second, which is feasible to maintain e.g., with highly parallel exercising of existing fine-aerosol-dispersion technology...")

2) "Active Climate Stabilization: Practical Physics-Based Approaches to Prevention of Climate Change" by Edward Teller, L. Wood, R. Hyde - April 18, 2002 – Lawrence Livermore Laboratory-CA

"...Abstract - Introduction. **It's not generally realized that the Earth's seasonally-averaged climate is colder now than it's been 99% of the time since complex life on Earth got seriously underway with the Cambrian Explosion, 545 million years ago.** Similarly, it's not widely appreciated that atmospheric concentrations of carbon dioxide – CO₂ – are only very loosely correlated with average climatic conditions over this extended interval of geologic time, in that it's been much colder with substantially higher air concentrations of CO₂ and also much warmer with substantially lower atmospheric levels of CO₂ than at present; indeed, the CO₂ level in the air is observed in the geologic record to be one of the weaker determinants of globally- and season-averaged temperature..." 2002 Report

- 2) The Royal Society Report: "The Environmental Effects of Civil Aircraft in Flight Special Report"
<http://adg.stanford.edu/aa241/supplement/av12-txt.pdf> November 2, 2002

- 3) Aviation and the Global Atmosphere – IPCC 2001
http://www.grida.no/publications/other/ipcc_sr/?src=/climate/ipcc/aviation/034.htm

<http://www.ipcc.ch/pdf/special-reports/spm/av-en.pdf>

4.4 Water Vapour

"Most subsonic aircraft water vapour emissions are released in the troposphere where they are rapidly removed by precipitation within 1 to 2 weeks. A smaller fraction of water vapour emissions is released in the lower stratosphere where it can build up to larger concentrations. **Because water vapor is a greenhouse gas, these increases tend to warm the Earth's surface, though for subsonic aircraft this effect is smaller than those of other aircraft emissions such as carbon dioxide and NO_x.**

4.5 Contrails

In 1992, aircraft line-shaped contrails are estimated to cover about 0.1% of the Earth's surface on an annually averaged basis with larger regional values. **Contrails tend to warm the Earth's surface, similar to thin high clouds.** The contrail cover is projected to grow to 0.5% by 2050 in the reference scenario (Fa1), at a rate which is faster than the rate of growth in aviation fuel consumption. This faster growth in contrail cover is expected because air traffic will increase mainly in the upper troposphere where contrails form preferentially, and may also occur as a result of improvements in aircraft fuel efficiency.

Contrails are triggered from the water vapour emitted by aircraft and their optical properties depend on the particles emitted or formed in the aircraft plume and on the ambient atmospheric conditions. The radiative effect of contrails depends on their optical properties and global cover, both of which are uncertain. Contrails have been observed as line-shaped clouds by satellites over heavy air traffic areas and covered on average about 0.5% of the area over Central Europe in 1996 and 1997.

4.6 Cirrus Clouds

Extensive cirrus clouds have been observed to develop after the formation of persistent contrails. Increases in cirrus cloud cover (beyond those identified as line-shaped contrails) are found to be positively correlated with aircraft emissions in a limited number of studies. About 30% of the Earth is covered with cirrus cloud. On average an increase in cirrus cloud cover tends to warm the surface of the Earth..."

<http://enrin.grida.no/htmls/bosnia/bosnia2002/energymore.html>

"...Background - The most important problem caused by energy production and use is climate change. The climate change problem is related to changes in the concentration of the greenhouse gases (**water vapor**, CO₂, CH₄, N₂O, and CFCs), which trap infrared radiation from the Earth's surface and thus cause the greenhouse effect..."

4) <http://www.stormingmedia.us/53/5383/A538373.html?searchTerms=Jet%7EEmissions>

Aviation and the Environment: Aviation's Effects on the Global Atmosphere Are Potentially Significant and Expected to Grow = Authors: GENERAL ACCOUNTING OFFICE WASHINGTON DC RESOURCES COMMUNITY AND ECONOMIC DEVELOPMENT DIVISION "...Abstract: Concerns about global warming are focusing increasingly on the contribution of human activities, including aviation. Jet aircraft are among many sources of greenhouse gases-gases that can trap heat, potentially increasing the temperature of the earth's surface and leading to changes in climate..."

5) **U.S. EPA Report** <http://www.epa.gov/oms/regs/nonroad/aviation/r99013.pdf>

ENVIRONMENTAL PROTECTION AGENCY PA420-R-99-013 - Final Report "Evaluation of Air Pollutant Emissions from Subsonic Commercial Jet Aircraft", U.S. Environmental Protection Agency April 1999. Excerpts from this report are reprinted below (includes both human and environmental impacts):

"Public Health and Aircraft Emissions": "Ultimately, EPA's principal concern in evaluating and controlling (jet fuel) emissions is the preservation of human health and, secondarily, the protection of public welfare (including protection against damage to crops, vegetation, animals, and buildings)...In particular, they have significant concerns regarding the effect of NO_x on local and regional environments. Tropospheric NO_x has multiple environmental quality impacts...contributing to ground-level O₃ and PM, but also air toxic concentrations, excess nitrogen loads to sensitive water bodies, and acidification of sensitive ecosystems (EPA 1997a)." (PM = Particulate Matter)..."

Note: Geoengineering Solar Radiation Management Schemes involve adding water vapor, a greenhouse gas, and injecting sulfur or aluminum oxide particles into the atmosphere. This will increase aviation emissions, water vapor, and toxic particulates into the atmosphere.