COMPOSITIONS, ORIGINS, EMISSION RATES AND ATMOSPHERIC IMPACTS OF VOLCANIC GASES pdf

1: Greenhouse gas - Wikipedia

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Methane , emitted by the digestion of food by animals , for example cattle. Radon is a colorless, odorless, naturally occurring, radioactive noble gas that is formed from the decay of radium. It is considered to be a health hazard. Radon gas from natural sources can accumulate in buildings, especially in confined areas such as the basement and it is the second most frequent cause of lung cancer, after cigarette smoking. Volcanic activity, which produce sulfur , chlorine , and ash particulates. Emission factors Main article: AP 42 Compilation of Air Pollutant Emission Factors Air pollutant emission factors are representative values that attempt to relate the quantity of a pollutant released to the ambient air with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant e. Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages. The United States Environmental Protection Agency has published a compilation of air pollutant emission factors for a multitude of industrial sources. Indoor air quality A lack of ventilation indoors concentrates air pollution where people often spend the majority of their time. Radon Rn gas, a carcinogen , is exuded from the Earth in certain locations and trapped inside houses. Building materials including carpeting and plywood emit formaldehyde H_2CO gas. Paint and solvents give off volatile organic compounds VOCs as they dry. Lead paint can degenerate into dust and be inhaled. Intentional air pollution is introduced with the use of air fresheners , incense , and other scented items. Controlled wood fires in stoves and fireplaces can add significant amounts of smoke particulates into the air, inside and out [10]. Indoor pollution fatalities may be caused by using pesticides and other chemical sprays indoors without proper ventilation. Carbon monoxide CO poisoning and fatalities are often caused by faulty vents and chimneys, or by the burning of charcoal indoors. Chronic carbon monoxide poisoning can result even from poorly adjusted pilot lights. Traps are built into all domestic plumbing to keep sewer gas, hydrogen sulfide , out of interiors. Clothing emits tetrachloroethylene , or other dry cleaning fluids, for days after dry cleaning. Though its use has now been banned in many countries, the extensive use of asbestos in industrial and domestic environments in the past has left a potentially very dangerous material in many localities. Asbestosis is a chronic inflammatory medical condition affecting the tissue of the lungs. It occurs after long-term, heavy exposure to asbestos from asbestos-containing materials in structures. Sufferers have severe dyspnea shortness of breath and are at an increased risk regarding several different types of lung cancer. As clear explanations are not always stressed in non-technical literature, care should be taken to distinguish between several forms of relevant diseases. According to the World Health Organisation WHO , these may defined as; asbestosis , lung cancer, and mesothelioma generally a very rare form of cancer, when more widespread it is almost always associated with prolonged exposure to asbestos. Biological sources of air pollution are also found indoors, as gases and airborne particulates. Indoors, the lack of air circulation allows these airborne pollutants to accumulate more than they would otherwise occur in nature. Health effects The World Health Organization states that 2. In six days more than 4, died, and 8, more died within the following months. These effects can result in increased medication use, increased doctor or emergency room visits, more hospital admissions and premature death. The number of annual premature deaths is considerably higher than the fatalities related to auto collisions in the same area, which average fewer than 2, per year [16]. Diesel exhaust DE is a major contributor to combustion derived particulate matter air pollution. In several human experimental studies, using a well validated exposure chamber setup, DE has been linked to acute vascular dysfunction and increased thrombus formation. Effects on cystic fibrosis Main article: Cystic fibrosis A study from to by the University of Washington showed that patients near and around particulate matter air pollution had an increased risk of pulmonary exacerbations and decrease in lung function. Participants involved in the study were located in the United States in close proximity to an Environmental Protection Agency. During the time of the study deaths were associated with air pollution. A trend was noticed that patients living closer or in large metropolitan areas to be close to medical help also had higher level of pollutants found in their system because of more emissions in larger cities. With cystic fibrosis patients already being born with decreased lung function everyday pollutants such as smoke emissions from automobiles, tobacco smoke and improper use of indoor heating devices could add to the disintegration of lung function. All subjects were male postal truck drivers aged 40 to Compared to the subjects from the outlying towns, the London subjects exhibited more severe respiratory symptoms including cough, phlegm, and dyspnea , reduced lung function FEV1 and peak flow rate , and increased sputum production and purulence. The differences were more pronounced for subjects aged 50 to The study controlled for age and smoking habits, so concluded that air pollution was the most likely cause of the observed differences. Studies have shown that in urban areas patients suffer mucus hypersecretion, lower levels of lung function, and more self diagnosis of chronic bronchitis and emphysema. Early in December , a cold fog descended upon London. Because of the cold, Londoners began to burn more coal than usual. The resulting air pollution was trapped by the inversion layer formed by the dense mass of cold air. Concentrations of pollutants, coal smoke in particular, built up dramatically. The "fog", or smog, was so thick that driving became difficult or impossible. The extreme reduction in visibility was accompanied by an increase in criminal activity as well as transportation delays and a virtual shut down of the city. During the 4 day period of fog, at least 4, people died as a direct result of the weather. Examples of these countries include Egypt , Sudan , Mongolia , and Indonesia. Because children are outdoors more and have higher minute ventilation they are more susceptible to the dangers of air pollution. Health effects in relatively "clean" areas Even in areas with relatively low levels of air pollution, public health effects can be substantial and costly. This is because effects can occur at very low levels and a large number of people can potentially breathe in such pollutants. This finding is based on health valuation of lethal mortality and sub-lethal morbidity effects. Reduction efforts There are various air pollution control technologies and land use planning strategies available to reduce air pollution. At its most basic level land use planning is likely to involve zoning and transport infrastructure planning. In most developed countries, land use planning is an important part of social policy, ensuring that land is used efficiently for the benefit of the wider economy and population as well as to protect the environment. Efforts to reduce pollution from mobile sources includes primary regulation many developing countries have permissive regulations ,[citation needed] expanding regulation to new sources such as cruise and transport ships, farm equipment, and small gas-powered equipment such as lawn trimmers, chainsaws , and snowmobiles , increased fuel efficiency such as through the use of hybrid vehicles , conversion to cleaner fuels such as bioethanol , biodiesel , or conversion to electric vehicles. Control devices The following items are commonly used as pollution control devices by industry or transportation devices. They can either destroy contaminants or remove them from an exhaust stream before it is emitted into the atmosphere. Mechanical collectors dust cyclones , multicyclones Electrostatic precipitators An electrostatic precipitator ESP , or electrostatic air cleaner is a particulate collection device that removes particles from a flowing gas such as air using the force of an induced electrostatic charge. Electrostatic precipitators are highly efficient filtration devices that minimally impede the flow of gases through the device, and can easily remove fine particulate matter such as dust and smoke from the air stream. Baghouses Designed to handle heavy dust loads, a dust collector consists of a blower, dust filter, a filter-cleaning system, and a dust receptacle or dust removal system distinguished from air cleaners which utilize disposable filters to remove the dust. Particulate scrubbers Wet scrubber is a form of pollution control technology. The term describes a variety of devices that use pollutants from a furnace flue gas or from other gas streams. In a wet scrubber, the polluted gas stream is brought into contact with the scrubbing liquid, by spraying it with the liquid, by forcing it through a pool of liquid, or by some other contact method, so as to remove the pollutants.

COMPOSITIONS, ORIGINS, EMISSION RATES AND ATMOSPHERIC IMPACTS OF VOLCANIC GASES pdf

2: Who monitors volcanic gases emitted by KÄ«lauea and how is it done??

This paper reviews recent research on the compositions, origins, emission rates, and atmospheric impacts of volcanic gases, and suggests possible avenues for future work. COMPOSITIONS AND ORIGINS OF VOLCANIC GASES.

Magma contains dissolved gases, which provide the driving force that causes most volcanic eruptions. As magma rises towards the surface and pressure decreases, gases are released from the liquid portion of the magma melt and continue to travel upward and are eventually released into the atmosphere. Large eruptions can release enormous amounts of gas in a short time. The eruption of Mt. Pinatubo is thought to have injected more than megatons of gas into the upper atmosphere on a single day. However, even if magma never reaches the surface, gases can often escape continuously into the atmosphere from the soil, volcanic vents , fumaroles , and hydrothermal systems. By far the most abundant volcanic gas is water vapor, which is harmless. However, significant amounts of carbon dioxide, sulfur dioxide, hydrogen sulfide and hydrogen halides can also be emitted from volcanoes. Depending on their concentrations, these gases are all potentially hazardous to people, animals, agriculture, and property. Carbon dioxide CO2 trapped in low-lying areas can be lethal to people and animals. Carbon dioxide constitutes approximately 0. In an average year, volcanoes release between about and million tonnes of carbon dioxide. When this colorless, odorless gas is emitted from volcanoes, it typically becomes diluted to low concentrations very quickly and is not life threatening. However, because cold carbon dioxide gas is heavier than air it can flow into in low-lying areas where it can reach much higher concentrations in certain, very stable atmospheric conditions. This can pose serious risks to people and animals. In volcanic or other areas where CO2 emissions occur, it is important to avoid small depressions and low areas that might be CO2 traps. The boundary between healthy air and lethal gas can be extremely sharp; even a single step upslope may be adequate to escape death. In , three ski patrol members were killed at Mammoth Mountain ski resort after falling into a snow depression surrounding a volcanic fumarole and filled with cool CO2 gas. High concentrations of CO2 gas in soils can also damage or destroy vegetation, as is visible in several areas on Mammoth Mountain. In addition to their direct hazard, volcanic CO2 emissions also have the capacity to affect the global climate , but scientific studies indicate that the average global volcanic output is insignificant when compared to emissions from human activity. Sulfur dioxide SO2 is irritating to eyes, skin and respiratory system. Sulfur dioxide is a colorless gas with a pungent odor that irritates skin and the tissues and mucous membranes of the eyes, nose, and throat. During very large eruptions, SO2 can be injected to altitudes of greater than 10km into the stratosphere. They also have a role in ozone depletion, as many of the reactions that destroy ozone occur on the surface of such aerosols. Please see our discussion of volcanic gases and climate change for additional information. Hydrogen sulfide H2S is very toxic in high concentrations. Hydrogen sulfide is a colorless, flammable gas with a strong, offensive odor. It is sometimes referred to as sewer gas. Interestingly, the human nose is more sensitive to H2S than any gas monitoring instrument we have today: Unfortunately, however, our sense of smell is not a reliable alarm - at mixing ratios above about 0. Exposure to ppm can cause a human to fall unconscious in 5 minutes and die in an hour or less. When magma ascends close to the surface, volcanoes can emit the halogens fluorine, chlorine and bromine in the form of hydrogen halides HF, HCl and HBr. These species are all strong acids and have high solubility; therefore they rapidly dissolve in water droplets within volcanic plumes or the atmosphere where they can potentially cause acid rain. In an ash -producing eruption, ash particles are also often coated with hydrogen halides. Once deposited, these coated ash particles can poison drinking water supplies, agricultural crops, and grazing land.

3: Scientists offer new theory for largest known mass extinction

Studies by scientists at the U.S. Geological Survey have revealed the compositions and amounts of gases released from many active volcanoes in the U.S. (California, Oregon, Washington, Wyoming, Alaska, and Hawaii).

Lardy1,2 Received 18 April ; revised 21 August ; accepted 19 September ; published 23 October But due We present here a series of SO2 flux measurements results, to its isolation in the south Pacific region, very little is obtained between April and November on Yasur known about its emission rates. We report here sulphur volcano using a DOAS instrument. We found an average flux of 7. Lardy [Louat et al. It covers km2 and is built up by , Sulphur dioxide emission rates from Yasur volcano, Pliocene to recent subaerial and subaqueous basaltic and Vanuatu archipelago, Geophys. Introduction upper Pleistocene to Recent Siwi group in the easternmost [2] SO2 emission rates are important indicators of volca- part within a 24 km2 caldera [Carney and Macfarlane, nic activity and are routinely measured at a number of ; Coulon and Maury, ; Robin et al. The volcanoes in support of hazard assessment. These emissions Green Hill Group and Tukosmeru group are predominantly can also have important impacts on the atmosphere and basaltic or basaltic andesite in composition while Siwi climate at various temporal and spatial scales. For instance, group are basaltic andesite to andesite in composition. An volcanic sulphur emissions have been implicated in tropo- uplift of more than m has occurred in the eastern spheric cooling, stratospheric heating, stratospheric ozone portion of Siwi group forming the Yenkahe Horst [Chen depletion, and alteration in stratospheric global circulation et al. Yasur, a small scoria cone volcano m patters, due to radiative and chemical interactions [Robock above sea level which occupies the western part of the and Oppenheimer,]. Volcanic SO2 clouds are mea- Yenkahe Horts, is characterised by a sustained degassing sured from above by spaceborne instruments, and from with a continuous strombolian to vulcanian type activity. Methodology [Stoiber et al. The product of these flux estimates and mass ratios spectrometer which spanned the spectral interval â€” of other plume species to SO2 i. Exposure time fluxes of other components e. This device [Andres and Kasgnoc,], Yasur volcano in Vanuatu was coupled to a vertically pointing telescope of 8 mrad archipelago appears in the top ten of a list of forty-nine field of view with an optic fibre bundle. However, until this work, connected the spectrometer to a laptop computer, providing the flux estimates for Yasur were based on comparisons of power and data transfer. The only field SO2 flux measurements were [Kraus,] to save and analyse spectra, providing real performed in July with a correlation spectrometer but time concentration readings. The position of each UV constrained to weather condition [Gauthier,]. Thus spectrum was determined from a continuously recording GPS unit. These spectrometers have also been used for measurements of volcanic BrO [Bobrowski et al. Fluxes were Copyright by the American Geophysical Union. Note that on the 10th January the plume dispersion was to the south due to the presence of cyclone Kerry located km southwest of Vanuatu at that time. Results and Discussion estimated plume speed. For Yasur the traverses were per- formed on the ash plain Figure 1 and plume speeds were [6] From April to November a total of 86 obtained either from a hand held anemometer on top of traverses were accomplished under the plume less than 2 km Yasur, or from simultaneously recording overhead SO2 time series from underneath the plume, using 2 and 3 spectro- meters Table 1. These devices are situated between 0. Peaks and troughs obtained from the series, corresponding to overhead transit of plume structure, have been cross-correlated, using methods described by Table 1. Yasur plume in July Correlation between seismic counts and SO2 fluxes; volcanic events with seismograph displacements greater than The SO2 flux for each measurement period P is represented by circles. The average fluxes from these 7. Apparent SO2 fluxes from volcanoes can, shown in Table 1. Figure 2 shows a representative plot of and do, vary considerably, even on short timescales, so no concentration versus distance-traversed perpendicular to the direct agreement between these estimates made at different plume transport direction. The profiles of the column times is expected. However, the general flux fluctuation amounts recorded on Yasur present frequently three maxi- from P1 through P8 tend to be consistent with the volcanic ma, and indicate the dispersion and overlap of individual behaviour of Yasur recorded by a permanent seismic mon- plumes emitted from the three active vents within the crater. Correlation plot between seismic events and SO2 emission rates. Emissions rate which correspond to P5 and P7 were omitted because of high gas discharge which occurred with no significant seismic events and lack of seismic data respectively. Maury , Petrology of tholeiitic lavas from cesse in island arc magmatism, Bull. An exception in this general â€" Edmonds, with no sustained explosions which probably due to higher and L. A new tool for volcano surveillance, J. The lowest gas Gauthier, P. Graf , The annual t. This A global data set for the last years, J. Marty , Incandescent tephra ejection; small lava lakes; strong SO2 emission, Bull. Global Volcanism Network, 15, Mulargia , Cross-correlation between]. Thus during low activity phases Yasur SO2 emission volcanic tremor and SO2 flux data from Mount Etna volcano, â€" rates can be reduced to around t. Earth Part A, 25 9 â€" 11 , â€" Monzier , Shallow and intermedi- ate depth seismicity in the New Hebrides Arc: Constraints on subduction thousand tons per day. Pyle , Walking traverse and scanning DOAS measurements of [7] Our results confirm that Yasur is one of the largest volcanic gas emission rates, Geophys. Oppenheimer global time-integrated volcanic emissions to the whole , Plume velocity determination for volcanic SO2 flux measure- atmosphere â€" kg. Event Alert Network, 13, Sweeney , Mt Erebus, the largest point source of with a miniature ultraviolet spectrometer for Yasur volcano NO2 in Antarctica, Atmos. We obtained fluxes between 2. Such volcanic emissions merit greater attention in 70, â€" We gratefully acknowledge the support of the Robock, A. Kasgnoc , A time-average inventory of Tabbagh, J. Charley , Mild eruption subaerial volcanic sulphur emissions, J. Global Volcanism Network, 27, Platt , Detection of Watson, I. Platt , Reactive halogen chemistry in volcanic Harris, A. Elias , Accurately measuring volcanic plumes, J. Implications for volcanic, landslide and tsunami hazards, M.

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4: Air pollution - Wikipedia

Vog (volcanic smog) is a visible haze comprised of gas and an aerosol of tiny particles and acidic droplets created when sulfur dioxide (SO2) and other gases emitted from a volcano chemically interact with sunlight and atmospheric oxygen, moisture, and dust.

One model, involving mid-tropospheric heating, did result in a weakening of the trade winds. This change was consistent with observed surface winds north of the Equator in the eastern Pacific Ocean. He sorted the volcanoes by latitude. Low latitude 20 N to 20 S eruptions are associated with an increase in sea surface temperatures in the eastern tropical Pacific Ocean see above figure , the area where El Nino events begin. The warmer temperatures last up to three seasons after the eruptions. Handler called for further theoretical work on these observations. Ozone destruction Ozone is a gas made of three oxygen atoms. Ozone is bluish in color and harmful to breathe. The stratosphere is a layer in the atmosphere from about 10km to about 50km in altitude. Ozone is important because it absorbs specific wavelengths of ultraviolet radiation that are particularly harmful to living organisms. The ozone layer prevents most of this harmful radiation from reaching the ground. As concern grew over depletion of ozone in the stratosphere scientists examined the role of volcanoes. They noted that the gases emitted by most eruptions never leave the troposphere, the layer in the atmosphere from the surface to about 10km. Hydrogen chloride released by volcanoes can cause drastic reductions in ozone if concentrations reach high levels about ppb by volume Prather and others, Other large eruptions Tambora, Krakatau, and Agung may have released almost ten-times more HCl into the stratosphere than the amount of chlorine commonly present in the stratosphere Pinto and others, At least two factors reduce the impact of HCl, chlorine appears to be preferentially released during low-levels of volcanic activity and thus may be limited to the troposphere, where it can be scrubbed by rain. Hydrogen chloride may also condense in the rising volcanic plume, again to be scrubbed out by rain or ice. Lack of HCl in ice cores with high amounts of H2SO4 from large eruptions may indicate ambient stratospheric conditions are extremely efficient at removing HCl. Thus, most HCl never has the opportunity to react with ozone. No increase in stratospheric chlorine was observed during the eruption of Mt. Although volcanic gases do not play a direct role in destroying ozone they may play a harmful indirect role. Scientists have found that particles, or aerosols, produced by major volcanic eruptions accelerate ozone destruction. The particles themselves do not directly destroy ozone but they do provide a surface upon which chemical reactions can take place. This enhances chlorine-driven ozone depletion. Fortunately, the effects from volcanoes are short lived and after two or three years, the volcanic particles settle out of the atmosphere. Study of ozone amounts before and after the eruption of Mt. Pinatubo show that there were significant decreases in lower stratospheric ozone Grant and others, A similar reduced amount of ozone was measured in the summer of Man Versus the Volcano Do humans add more gases to the atmosphere or do volcanoes? Reaching a good estimate is important in guiding global policy for standards to reduce emissions from man-made sources of gases. Carbon Dioxide Present-day carbon dioxide CO2 emissions from subaerial and submarine volcanoes are uncertain at the present time. While this is a conservative estimate, man-made anthropogenic CO2 emissions overwhelm this estimate by at least times. Sulfur Emissions Andres and Kasgnoc estimated the time-averaged inventory of subaerial volcanic sulfur emissions. There inventory was based upon the 25 year history of making sulfur measurements, primarily sulfur dioxide SO2 , at volcanoes. About 4 Tg come from explosive eruptions and 9 Tg is released by passivedegassing, in an average year. When considering the other sulfur species also present in volcanic emissions, a time-averaged inventory of subaerial volcanic sulfur emissions is Volcanoes and other natural processes release approximately 24 Tg of sulfur to the atmosphere each year. Andres and Kasgnoc noted that the bulk of the anthropogenic flux is located in the northern hemisphere while volcanic fluxes occur in much more focused belts around the world. Gases from Kilauea provides a comparison of a man-made sulfur dioxide gas leaked at a refinery to the gas released by a volcano.

COMPOSITIONS, ORIGINS, EMISSION RATES AND ATMOSPHERIC IMPACTS OF VOLCANIC GASES pdf

5: Overview of Greenhouse Gases | Greenhouse Gas (GHG) Emissions | US EPA

The volcanic gases that pose the greatest potential hazard to people, animals, agriculture, and property are sulfur dioxide, carbon dioxide, and hydrogen fluoride. Locally, sulfur dioxide gas can lead to acid rain and air pollution downwind from a volcano.

Scientists offer new theory for largest known mass extinction March 30, Hypothetically speaking, large areas of the hyper saline Zechstein Sea and its direct environment could have looked like this, which in the Permian Age was situated about where present day Central Europe is. At the end of the Permian Age the Zechstein Sea was irrevocably disconnected from the open sea and the remaining sections of sea soon dried out after that. As a result the microbial-limited halogenated gases from the Zechstein Sea stopped and vegetation was able to regenerate again. The pink colour of the Zechstein Sea was probably brought about by microbes with an extreme preference for salt, as is the case with salt lakes today. In the background sand dunes can be recognised from a landscape with hardly any water. At least that is what an international team of scientists have reported in the most recent edition of the "Proceedings of the Russian Academy of Sciences" Dokladi Earth Sciences. Previously it was thought that volcanic eruptions , the impacts of asteroids, or methane hydrate were instigating causes. Forecasts predict an increase in the surface areas of deserts and salt lakes due to climate change. That is why the researchers expect that the effects of these halogenated gases will equally increase. The team of researchers from Russia, Austria, South Africa and Germany investigated whether a process that has been taking place since primordial times on earth could have led to global mass extinctions, particularly at the end of the Permian. The starting point for this theory was their discovery in the south of Russia and South Africa that microbial processes in present-day salt lakes naturally produce and emit highly volatile halocarbons such as chloroform, trichloroethene, and tetrachloroethene. They transcribed these findings to the Zechstein Sea, which about million years ago in the Permian Age, was situated about where present day Central Europe is. The Zechstein Sea with a total surface area of around In their current publication the authors explain the similarities between the complex processes of the CO2-cycle in the Permian Age as well as between global warming from that time and at present. Based on comparable calculations from halogenated gas emissions in the atmosphere from present-day salt seas in the south of Russia, the scientists calculated that from the Zechstein Sea alone an annual VHC emissions rate of at least 1. By comparison, the annual global industrial emissions of trichloroethene and tetrachloroethene amount to only about 20 percent of that respectively, and only about 5 percent of the chloroform from the emissions calculated for the Zechstein Sea by the scientists. Incidentally, the industrial production of methyl chloroform, which depletes the ozone layer, has been banned since by regulation of the Montreal Protocol. Karsten Kotte from the University of Heidelberg explained. Based on both of these findings the researchers were able to form their new hypothesis: According to the forecast from the International Panel on Climate Change IPCC , increasing temperatures and aridity due to climate change will also speed up desertification, increasing with it the number and surface area of salt seas, salt lagoons and salt marshlands. Moreover, this will then lead to an increase in naturally formed halogenated gases. The phytotoxic effects of these substances become intensified in conjunction with other atmospheric pollutants and at the same time increasing dryness and exponentiate the eco-toxicological consequences of climate change. The new theory could be like a jigsaw piece that contributes to solving the puzzle of the largest mass extinction in the history of the earth. What is fact however is that the effects of salt seas were previously underestimated. In their publication the researchers working with Dr. The new findings on the effects of these halogenated gases are important for revising climate models, which form the basis for climate forecasts. Dokladi Earth Sciences, Vol.

6: How are volcanic gases measured?

[1] Yasur volcano has long been suspected as one of the volcanic emission sources responsible for a significant contribution of sulphur dioxide to the atmosphere. But due to its isolation in the south Pacific region, very little is known about its emission rates.

Pollutant and Greenhouse gas An air pollutant is a material in the air that can have adverse effects on humans and the ecosystem. The substance can be solid particles, liquid droplets, or gases. A pollutant can be of natural origin or man-made. Pollutants are classified as primary or secondary. Primary pollutants are usually produced by processes such as ash from a volcanic eruption. Other examples include carbon monoxide gas from motor vehicle exhausts or sulphur dioxide released from the factories. Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. Ground level ozone is a prominent example of secondary pollutants. Some pollutants may be both primary and secondary: Before flue-gas desulphurization was installed, the emissions from this power plant in New Mexico contained excessive amounts of sulphur dioxide. Schematic drawing, causes and effects of air pollution: Thermal oxidisers are air pollution abatement options for hazardous air pollutants HAPs , volatile organic compounds VOCs , and odorous emissions. Substances emitted into the atmosphere by human activity include: Carbon dioxide CO2 â€” Because of its role as a greenhouse gas it has been described as "the leading pollutant" [5] and "the worst climate pollution". Clean Air Act is deemed to regulate CO2 emissions. SO2 is produced by volcanoes and in various industrial processes. Coal and petroleum often contain sulphur compounds, and their combustion generates sulphur dioxide. Nitrogen oxides NOx â€” Nitrogen oxides, particularly nitrogen dioxide , are expelled from high temperature combustion, and are also produced during thunderstorms by electric discharge. They can be seen as a brown haze dome above or a plume downwind of cities. Nitrogen dioxide is a chemical compound with the formula NO2. It is one of several nitrogen oxides. One of the most prominent air pollutants, this reddish-brown toxic gas has a characteristic sharp, biting odor. Carbon monoxide CO â€” CO is a colorless, odorless, toxic yet non-irritating gas. It is a product of combustion of fuel such as natural gas, coal or wood. Vehicular exhaust contributes to the majority of carbon monoxide let into our atmosphere. It creates a smog type formation in the air that has been linked to many lung diseases and disruptions to the natural environment and animals. In , more than half of the carbon monoxide emitted into our atmosphere was from vehicle traffic and burning one gallon of gas will often emit over 20 pounds of carbon monoxide into the air. Methane is an extremely efficient greenhouse gas which contributes to enhanced global warming. Other hydrocarbon VOCs are also significant greenhouse gases because of their role in creating ozone and prolonging the life of methane in the atmosphere. This effect varies depending on local air quality. The aromatic NMVOCs benzene, toluene and xylene are suspected carcinogens and may lead to leukemia with prolonged exposure. Particulates , alternatively referred to as particulate matter PM , atmospheric particulate matter, or fine particles, are tiny particles of solid or liquid suspended in a gas. In contrast, aerosol refers to combined particles and gas. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols. Averaged worldwide, anthropogenic aerosolsâ€"those made by human activitiesâ€"currently account for approximately 10 percent of our atmosphere. Increased levels of fine particles in the air are linked to health hazards such as heart disease, [13] altered lung function and lung cancer. Particulates are related to respiratory infections and can be particularly harmful to those already suffering from conditions like asthma. Chlorofluorocarbons CFCs â€" harmful to the ozone layer ; emitted from products are currently banned from use. These are gases which are released from air conditioners, refrigerators, aerosol sprays, etc. On release into the air, CFCs rise to the stratosphere. Here they come in contact with other gases and damage the ozone layer. This can lead to skin cancer, eye disease and can even cause damage to plants. Ammonia NH3 â€" emitted from agricultural processes. Ammonia is a compound with the formula NH3. It is normally encountered as a gas with a characteristic pungent odor. Ammonia contributes significantly to the nutritional needs of terrestrial organisms by serving as a precursor to foodstuffs and fertilizers. Ammonia, either directly or indirectly, is also a building block for the synthesis of many pharmaceuticals. Although in wide use, ammonia is both caustic and hazardous. In the atmosphere, ammonia reacts with oxides of nitrogen and sulphur to form secondary particles. Particulates created from gaseous primary pollutants and compounds in photochemical smog. Smog is a kind of air pollution. Classic smog results from large amounts of coal burning in an area caused by a mixture of smoke and sulphur dioxide. Modern smog does not usually come from coal but from vehicular and industrial emissions that are acted on in the atmosphere by ultraviolet light from the sun to form secondary pollutants that also combine with the primary emissions to form photochemical smog. Ozone O3 is a key constituent of the troposphere. It is also an important constituent of certain regions of the stratosphere commonly known as the Ozone layer. Photochemical and chemical reactions involving it drive many of the chemical processes that occur in the atmosphere by day and by night. At abnormally high concentrations brought about by human activities largely the combustion of fossil fuel , it is a pollutant and a constituent of smog. Minor air pollutants include: A large number of minor hazardous air pollutants. Some of these are regulated in USA under the Clean Air Act and in Europe under the Air Framework Directive A variety of persistent organic pollutants , which can attach to particulates Persistent organic pollutants POPs are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes. Because of this, they have been observed to persist in the environment, to be capable of long-range transport, bioaccumulate in human and animal tissue, biomagnify in food chains, and to have potentially significant impacts on human health and the environment. There are various locations, activities or factors which are responsible for releasing pollutants into the atmosphere. These sources can be classified into two major categories. Anthropogenic man-made sources Controlled burning of a field outside of Statesboro , Georgia in preparation for spring planting. These are mostly related to the burning of multiple types of fuel. Stationary sources include smoke stacks of fossil fuel power stations see for example environmental impact of the coal industry , manufacturing facilities factories and waste incinerators, as well as furnaces and other types of fuel-burning heating devices. In developing and poor countries, traditional biomass burning is the major source of air pollutants; traditional biomass includes wood, crop waste and dung. Controlled burn practices in agriculture and forest management. Controlled or prescribed burning is a technique sometimes used in forest management, farming, prairie restoration or greenhouse gas abatement. Fire is a natural part of both forest and grassland ecology and controlled fire can be a tool for foresters. Controlled burning stimulates the germination of some desirable forest trees, thus renewing the forest. Fumes from paint , hair spray , varnish , aerosol sprays and other solvents. These can be substantial; emissions from these sources was estimated to account for almost half of pollution from volatile organic compounds in the Los Angeles basin in the s. Methane is highly flammable and may form explosive mixtures with air. Methane is also an asphyxiant and may displace oxygen in an enclosed space. Asphyxia or suffocation may result if the oxygen concentration is reduced to below Fertilized farmland may be a major source of nitrogen oxides. Radon is a colorless, odorless, naturally occurring, radioactive noble gas that is formed from the decay of radium. It is considered to be a health hazard. Radon gas from natural sources can accumulate in buildings, especially in confined areas such as the basement and it is the second most frequent cause of lung cancer, after cigarette smoking. Smoke and carbon monoxide from wildfires Vegetation, in some regions, emits environmentally significant amounts of Volatile organic compounds VOCs on warmer days. These VOCs react with primary anthropogenic pollutantsâ€"specifically, NOx, SO2, and anthropogenic organic carbon compounds â€" to produce a seasonal haze of secondary pollutants. The VOC production from these species result in ozone levels up to eight times higher than the low-impact tree species. AP 42 Compilation of Air Pollutant Emission Factors Beijing air on a day after rain left and a smoggy day right Air pollutant emission factors are reported representative values that attempt to relate the quantity of a pollutant released to the ambient air with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of pollutant divided by a unit weight, volume, distance, or duration of the activity emitting the pollutant e. Such factors facilitate estimation of emissions from various sources of air pollution. In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages. There are 12 compounds in the list of persistent organic pollutants. Dioxins and furans are two of them and intentionally created by combustion of organics, like open burning of plastics. These compounds are also endocrine disruptors and can mutate the human genes. The United States Environmental Protection Agency has published a compilation of air pollutant emission factors for a wide range of industrial sources. Air pollution exposure can be expressed for an individual, for certain groups e. For example, one may want to calculate the exposure to a hazardous air pollutant for a geographic area, which includes the various microenvironments and age groups. This can be calculated [29] as an inhalation exposure. This would account for daily exposure in various settings e. The exposure needs to include different age and other demographic groups, especially infants, children, pregnant women and other sensitive subpopulations. The exposure to an air pollutant must integrate the concentrations of the air pollutant with respect to the time spent in each setting and the respective inhalation rates for each subgroup for each specific time that the subgroup is in the setting and engaged in particular activities playing, cooking, reading, working, spending time in traffic, etc.

COMPOSITIONS, ORIGINS, EMISSION RATES AND ATMOSPHERIC IMPACTS OF VOLCANIC GASES pdf

7: USGS: Volcano Hazards Program

Impacts of volcanic gases on climate, the environment, and people Gases from volcanoes give rise to numerous impacts on climate, the environment, and people. U.S. Geological Survey (USGS) scientists are inventorying gas emissions at many of the almost 70 active volcanoes in the United States.

Documentation Key Points Global atmospheric concentrations of carbon dioxide, methane, nitrous oxide, and certain manufactured greenhouse gases have all risen significantly over the last few hundred years see Figures 1, 2, 3, and 4. Historical measurements show that the current global atmospheric concentrations of carbon dioxide, methane, and nitrous oxide are unprecedented compared with the past , years see Figures 1, 2, and 3. Carbon dioxide concentrations have increased substantially since the beginning of the industrial era, rising from an annual average of ppm in the late s to ppm as measured at Mauna Loa in â€"a 43 percent increase see Figure 1. Almost all of this increase is due to human activities. This increase is predominantly due to agriculture and fossil fuel use. Levels have risen since the s, however, reaching a new high of ppb in average of three sites in Figure 3. This increase is primarily due to agriculture. As a result, concentrations of many major ozone-depleting gases have begun to stabilize or decline see Figure 4, left panel. Concentrations of other halogenated gases have continued to rise, however, especially where the gases have emerged as substitutes for ozone-depleting chemicals see Figure 4, right panel. Overall, the total amount of ozone in the atmosphere decreased by about 3 percent between and see Figure 5. All of the decrease happened in the stratosphere, with most of the decrease occurring between and Changes in stratospheric ozone reflect the effect of ozone-depleting substances. These chemicals have been released into the air for many years, but recently, international efforts have reduced emissions and phased out their use. Globally, the amount of ozone in the troposphere increased by about 3 percent between and see Figure 5. Human activities have only a small direct influence on atmospheric concentrations of water vapor, primarily through irrigation and deforestation, so it is not included in this indicator. Background Since the Industrial Revolution began in the s, people have added a substantial amount of greenhouse gases into the atmosphere by burning fossil fuels, cutting down forests, and conducting other activities see the U. When greenhouse gases are emitted into the atmosphere, many remain there for long time periods ranging from a decade to many millennia. Over time, these gases are removed from the atmosphere by chemical reactions or by emissions sinks, such as the oceans and vegetation, which absorb greenhouse gases from the atmosphere. As a result of human activities, however, these gases are entering the atmosphere more quickly than they are being removed, and thus their concentrations are increasing. Carbon dioxide, methane, nitrous oxide, and certain manufactured gases called halogenated gases gases that contain chlorine, fluorine, or bromine become well mixed throughout the global atmosphere because of their relatively long lifetimes and because of transport by winds. Concentrations of these greenhouse gases are measured in parts per million ppm , parts per billion ppb , or parts per trillion ppt by volume. In other words, a concentration of 1 ppb for a given gas means there is one molecule of that gas in every 1 billion molecules of air. Some halogenated gases are considered major greenhouse gases due to their very high global warming potentials and long atmospheric lifetimes even if they only exist at a few ppt see table. This indicator looks at global average levels of ozone in both the stratosphere and troposphere. Ozone is also a greenhouse gas, but it differs from other greenhouse gases in several ways. The effects of ozone depend on its altitude, or where the gas is located vertically in the atmosphere. In the troposphereâ€"the layer of the atmosphere near ground levelâ€"ozone is an air pollutant that is harmful to breathe, a main ingredient of urban smog, and an important greenhouse gas that contributes to climate change see the Climate Forcing indicator. Unlike the other major greenhouse gases, tropospheric ozone only lasts for days to weeks, so levels often vary by location and by season. About the Indicator This indicator describes concentrations of greenhouse gases in the atmosphere. It focuses on the major greenhouse gases that result from human activities. For carbon dioxide, methane, nitrous oxide, and halogenated gases, recent measurements come from monitoring stations around the world, while measurements of older air come from air bubbles trapped in layers of ice from Antarctica and Greenland. By determining the age of the ice layers and the concentrations of gases trapped inside, scientists can learn what the atmosphere was like thousands of years ago. These satellite data are routinely compared with ground-based instruments to confirm their accuracy. Ozone data have been averaged worldwide for each year to smooth out the regional and seasonal variations. Indicator Notes This indicator includes several of the most important halogenated gases, but some others are not shown. Many other halogenated gases are also greenhouse gases, but Figure 4 is limited to a set of common examples that represent most of the major types of these gases. The indicator also does not address certain other pollutants that can affect climate by either reflecting or absorbing energy. For example, sulfate particles can reflect sunlight away from the Earth, while black carbon aerosols soot absorb energy. Data for nitrogen trifluoride Figure 4 reflect modeled averages based on measurements made in the Northern Hemisphere and some locations in the Southern Hemisphere, to represent global average concentrations over time. Data Sources Global atmospheric concentration measurements for carbon dioxide Figure 1 , methane Figure 2 , and nitrous oxide Figure 3 come from a variety of monitoring programs and studies published in peer-reviewed literature. Global atmospheric concentration data for selected halogenated gases Figure 4 were compiled by the Advanced Global Atmospheric Gases Experiment, the National Oceanic and Atmospheric Administration, and a peer-reviewed study on nitrogen trifluoride. The physical science basis. Nitrogen trifluoride global emissions estimated from updated atmospheric measurements. Data updated July Atmospheric Concentrations of Greenhouse Gases: High-resolution carbon dioxide concentration record ‚â€”, years before present. 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8: Hawaiian Volcano Observatory

Volcanic emission of halogens to the atmosphere leads to long- and short-term impacts on atmospheric chemistry that range from global perturbation of the stratospheric O3 budget to more localized.

Potential effects of volcanic gases The volcanic gases that pose the greatest potential hazard to people, animals, agriculture, and property are sulfur dioxide , carbon dioxide , and hydrogen fluoride. Locally, sulfur dioxide gas can lead to acid rain and air pollution downwind from a volcano. Because carbon dioxide gas is heavier than air, the gas may flow into in low-lying areas and collect in the soil. The concentration of carbon dioxide gas in these areas can be lethal to people, animals, and vegetation. A few historic eruptions have released sufficient fluorine-compounds to deform or kill animals that grazed on vegetation coated with volcanic ash; fluorine compounds tend to become concentrated on fine-grained ash particles, which can be ingested by animals. Sulfur dioxide SO2 The effects of SO2 on people and the environment vary widely depending on 1 the amount of gas a volcano emits into the atmosphere; 2 whether the gas is injected into the troposphere or stratosphere; and 3 the regional or global wind and weather pattern that disperses the gas. Sulfur dioxide SO2 is a colorless gas with a pungent odor that irritates skin and the tissues and mucous membranes of the eyes, nose, and throat. Sulfur dioxide chiefly affects upper respiratory tract and bronchi. The World Health Organization recommends a concentration of no greater than 0. A concentration of ppm can cause immediate irritation of the nose and throat; 20 ppm can cause eye irritation; 10, ppm will irritate moist skin within minutes. For example, the large explosive eruption of Mount Pinatubo on 15 June expelled km 3 of dacite magma and injected about 17 million tonnes of SO2 into the stratosphere. The sulfur aerosols resulted in a 0. The sulfate aerosols also accelerated chemical reactions that, together with the increased stratospheric chlorine levels from human-made chlorofluorocarbon CFC pollution, destroyed ozone and led to some of the lowest ozone levels ever observed in the atmosphere. At Kilauea Volcano, the recent effusive eruption of about 0. Downwind from the vent, acid rain and air pollution is a persistent health problem when the volcano is erupting. Sulfur dioxide gas reacts chemically with sunlight, oxygen, dust particles, and water to form volcanic smog known as vog. Helens, Washington , El Chichon, Mexico , and Mount Pinatubo, Philippines , clearly show the importance of sulfur aerosols in modifying climate, warming the stratosphere, and cooling the troposphere. Hydrogen sulfide H2S Hydrogen sulfide H2S is a colorless, flammable gas with a strong offensive odor. It is sometimes referred to as sewer gas. At low concentrations it can irritate the eyes and acts as a depressant; at high concentrations it can cause irritation of the upper respiratory tract and, during long exposure, pulmonary edema. A minute exposure to ppm results in headache, dizziness, excitement, staggering gait, and diarrhea, followed sometimes by bronchitis or bronchopneumonia. Carbon dioxide CO2 Volcanoes release more than million tonnes of CO2 into the atmosphere every year. This colorless, odorless gas usually does not pose a direct hazard to life because it typically becomes diluted to low concentrations very quickly whether it is released continuously from the ground or during episodic eruptions. But in certain circumstances, CO2 may become concentrated at levels lethal to people and animals. In volcanic or other areas where CO2 emissions occur, it is important to avoid small depressions and low areas that might be CO2 traps. The boundary between air and lethal gas can be extremely sharp; even a single step upslope may be adequate to escape death. When a burning piece of wood is lowered into a hole that has a high concentration of CO2, the fire goes out. Such a condition can be lethal to people and animals. Comparison of CO2 emissions from volcanoes vs. Scientists have calculated that volcanoes emit between about million tonnes million tons of CO2 into the atmosphere every year Gerlach, , This estimate includes both subaerial and submarine volcanoes, about in equal amounts. Emissions of CO2 by human activities, including fossil fuel burning, cement production, and gas flaring, amount to about 22 billion tonnes per year 24 billion tons. Human activities release more than times the amount of CO2 emitted by volcanoes--the equivalent of nearly 17, additional volcanoes like Kilauea Kilauea emits about Historical examples of the effects of carbon dioxide gas Hydrogen Chloride HCl Chlorine gas is emitted from volcanoes in the form of hydrochloric acid HCl. Exposure to the gas irritates mucous membranes of the eyes and respiratory tract. Hydrogen Fluoride HF Fluorine is a pale yellow gas that attaches to fine ash particles, coats grass, and pollutes streams and lakes. Exposure to this powerful caustic irritant can cause conjunctivitis, skin irritation, bone degeneration and mottling of teeth. Excess fluorine results in a significant cause of death and injury in livestock during ash eruptions. Even in areas that receive just a millimeter of ash, poisoning can occur where the fluorine content of dried grass exceeds ppm. Animals that eat grass coated with fluorine-tainted ash are poisoned. Small amounts of fluorine can be beneficial, but excess fluorine causes fluorisis, an affliction that eventually kills animals by destroying their bones. It also promotes acid rain effects downwind of volcanoes, like HCl. Secondary Gas Emissions Another type of gas release occurs when lava flows reach the ocean. Extreme heat from molten lava boils and vaporizes seawater, leading to a series of chemical reactions. The boiling and reactions produce a large white plume, locally known as lava haze or laze, containing a mixture of hydrochloric acid and concentrated seawater. Acid-rich plumes Lava haze or laze Hydrochloric acid forms when lava enters the ocean boiling and vaporizing the sea water. Chloride in the sea salt combines with hydrogen in the water to form hydrochloric acid in the plume. This is a short-lived local phenomenon that only affects people or vegetation directly under the plume. Academic Press, Australia, p. Van Nostraud Reinhold, New York, 3rd ed. Eruptions and lahars of Mt. Geological Survey Earthquakes and Volcanoes, v. Mineralogical Society of America Reviews in Mineralogy, v. Department of the Interior, U.

9: The Impact of Rates of CO2 Emissions

Assuming a steady volcanic emissions rate of km 3 /yr, the average volcanic gas composition would evolve from 75% to less than 10% H 2 O within million years of degassing activity, the latter being 3 to 6 times less H 2 O-rich than non-subduction related volcanic gases emitted today on Earth (Symonds et al.,).

Global Warming Potential year: Greenhouse Gas Emissions and Sinks: Larger image to save or print. The main human activity that emits CO2 is the combustion of fossil fuels coal, natural gas, and oil for energy and transportation, although certain industrial processes and land-use changes also emit CO2. The main sources of CO2 emissions in the United States are described below. Electricity is a significant source of energy in the United States and is used to power homes, business, and industry. The type of fossil fuel used to generate electricity will emit different amounts of CO2. This category includes transportation sources such as highway vehicles, air travel, marine transportation, and rail. Note that many industrial processes also use electricity and therefore indirectly cause the emissions from the electricity production. However, emissions and removal of CO2 by these natural processes tend to balance. Since the Industrial Revolution began around , human activities have contributed substantially to climate change by adding CO2 and other heat-trapping gases to the atmosphere. In the United States, since , the management of forests and other land has acted as a net sink of CO2, which means that more CO2 is removed from the atmosphere, and stored in plants and trees, than is emitted. Since the combustion of fossil fuel is the largest source of greenhouse gas emissions in the United States, changes in emissions from fossil fuel combustion have historically been the dominant factor affecting total U. Changes in CO2 emissions from fossil fuel combustion are influenced by many long-term and short-term factors, including population growth, economic growth, changing energy prices, new technologies, changing behavior, and seasonal temperatures. Between and , the increase in CO2 emissions corresponded with increased energy use by an expanding economy and population, an overall growth in emissions from electricity generation, and increased demand for travel. Reducing Carbon Dioxide Emissions The most effective way to reduce CO2 emissions is to reduce fossil fuel consumption. Many strategies for reducing CO2 emissions from energy are cross-cutting and apply to homes, businesses, industry, and transportation. EPA is taking common sense regulatory actions to reduce greenhouse gas emissions. Examples of Reduction Opportunities for Carbon Dioxide Strategy Examples of How Emissions Can be Reduced Energy Efficiency Improving the insulation of buildings, traveling in more fuel-efficient vehicles, and using more efficient electrical appliances are all ways to reduce energy consumption, and thus CO2 emissions. Energy Conservation Reducing personal energy use by turning off lights and electronics when not in use reduces electricity demand. Reducing distance traveled in vehicles reduces petroleum consumption. Both are ways to reduce energy CO2 emissions through conservation. Fuel Switching Producing more energy from renewable sources and using fuels with lower carbon contents are ways to reduce carbon emissions. Carbon Capture and Sequestration Carbon dioxide capture and sequestration is a set of technologies that can potentially greatly reduce CO2 emissions from new and existing coal- and gas-fired power plants, industrial processes, and other stationary sources of CO2. Some of the excess carbon dioxide will be absorbed quickly for example, by the ocean surface , but some will remain in the atmosphere for thousands of years, due in part to the very slow process by which carbon is transferred to ocean sediments.

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