

AAAS AMA: Hi, we're scientists from NOAA and research universities who analyze the sources of pollution and recently published a study in Science Magazine. Ask us anything!

AAAS-AMA¹ and r/Science AMAs¹

¹Affiliation not available

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Abstract

As transportation emissions of volatile organic compounds (VOCs) have decreased due to stricter controls on air pollution, the relative importance of chemical products such as pesticides, coatings, printing inks, adhesives, cleaning agents, and personal care products has increased correspondingly. In a recent study we published in Science Magazine, we show that these volatile chemical products now contribute fully one half of emitted VOCs from petrochemical sources in Los Angeles. We hope these results will spur additional research and inform decisions about mitigating sources of ground-level ozone, fine particulate pollution, and air toxics. If you want to know more about how paints, pesticides, and perfumes contribute to pollution - ask us anything! Dr. Brian McDonald is an atmospheric scientist at the University of Colorado Boulder who works at the National Oceanic and Atmospheric Administration, and whose expertise is on air quality models and emission inventories Dr. Chris Cappa is a professor at the University of California, Davis in the Dept. of Civil and Environmental Engineering, whose work centers on the sources, fate and impacts of small particles in the atmosphere Dr. Jessica Gilman is a Research Chemist at NOAA and specializes in the measurement and chemistry of volatile organic compounds (VOCs) in the atmosphere. Dr. Joost de Gouw is a senior research scientist at the Cooperative Institute for Research in Environmental Sciences at the University of Colorado Boulder. His expertise is in the sources and transformations of organic compounds in the atmosphere.

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If you were able to instantly ban a single process or chemical from being used in order to improve air quality which would it be a why?

[wilkins1952](#)

(CC): That's difficult to answer, since we know that there are many different sources of pollution to the atmosphere. We know that combustion is a major source of pollution to the atmosphere, both of chemicals that are important to urban air quality and of chemicals like CO₂ that are contributing to modern climate change. But there are also lots of small sources of pollutants that, when added together, contribute greatly to air pollution. So, it's really difficult to pick just one.

Are all perfumes and scented body products the same with regards to environmental impact? If I wanted to be more environmentally ethical in my personal scent choices, is there something I should look for?

[firedrops](#)

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(CC) What we know is that each chemical product (including perfumes and scented body products) will have a unique fingerprint, i.e. a mix of specific chemicals. The environmental impacts will depend on what that exact mix is. It is difficult at this point to point towards something specific to look for. So, one might just think about minimizing the amount of these types of products that you use rather than trying to choose between products. Beyond impacts of these emissions on air quality, there are also considerations associated with people who have particular sensitivities to scented products. So, limiting use can have multiple benefits.

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JdG: There are likely differences as different chemical compounds in these products react differently in the atmosphere. For you as a consumer, the information to make informed decisions between products is not there at the moment.

What not insignificant source of ground-level pollution do you think would most surprise your average person?

[adenovato](#)

BM: It was surprising to us that VOCs emitted from the use of personal care products (e.g., hair spray, shampoos, deodorants, creams, lotions, etc.) were similar to the amount from cars in Los Angeles. VOCs contribute to a variety of air quality issues, including the two main building blocks of smog: ground-level ozone and fine particles.

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Jessica Gilman (JG-NOAA) here. I am always surprised by the complexity of different emission sources. In addition to personal care products, another urban source that many people may not realize is a significant source of both volatile organic compounds (VOCs) and nitrogen oxides (NOx) is from small two-stroke engines such as a lawnmower. These often do not have the emission control technologies that modern vehicles do. Also, the cut-grass smell (which I really like) is also composed of VOCs.

As someone who is launching an environmentally-responsible printing company, what are some key things I can do to reduce my footprint? We're using as much 100% PCW stock as possible and are switching to vegetable-based inks - we also plant a tree for every order placed. I'm not interested in offsetting our footprint alone, but more so in reducing the impact of it as much as possible - am I simply in the wrong industry or is having mindsets like mine important to encouraging a paradigm shift in mentality across the industry?

Thank you in advance! My mother works with Universities across the world in the fields of waste management and environmental impact but her expertise doesn't cover inks, solvents and coatings - mainly heavy metals and biowaste.

[thereluctantpoet](#)

BM: First, I want to commend you for thinking about how to reduce the environmental impact of your company. Using printing inks with less VOCs could be one possible way to reduce air quality impacts. Other possibilities include the use emissions control devices, such as catalytic converters, to remove the VOCs before they enter the outdoor environment.

Hi, thanks for doing this AMA! My question is: How did you all come to work for NOAA? Any tips for a recent college grad hoping to work there some day? :P

[PhrosstBite](#)

(CC): Good question. All of us answering these questions first received our PhD degrees before working at NOAA, and during our graduate studies focused on atmospheric chemistry and air pollution engineering. So, that's of course one path, albeit a long one. But there are lots of other pathways, including things like [NRC fellowships](#).

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JG-NOAA here. This is a great question that I wanted to add to. Probably the best way is to directly contact the scientist or office that you are interested in joining. For undergraduates, I would also highly recommend applying for the [Hollings](#) Scholarship. Many of the NOAA labs have cooperative institutes such as [CIRES](#) and other [Cooperative Institutes](#) that offer graduate scholarships. Best of luck in your future endeavors.

Globally we flare and vent over 14 billion cubic feet of gas everyday. Have you looked at the pollution emitted from Gris poor practice to deal with waste gases in the oil and gas industry? VOC's, particulates, HAP's, methane, etc.

Industry is allowed to assume a flare combusts at 98% efficiency but any one that has looked at a black smoky flare would be hard pressed to find that assumption valid. Since methane comprises the majority of the waste gas and is 86x worse than CO2 from a GHG perspective, I believe this is the worlds greatest opportunity to reduce emissions and have a significant impact on air pollution.

[AMascarenhas1](#)

JdG: Yes, in fact we are doing a lot of work to quantify the emissions associated with oil and gas production as well. For example, in an earlier study in Colorado we reported that a large fraction of hydrocarbons came from oil and gas production: <https://pubs.acs.org/doi/abs/10.1021/es304119a> In Los Angeles, such emissions are relatively less important though not negligible.

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Hello, JG-NOAA here. We have been measuring the emissions from oil and natural gas development. We recently completed the NOAA Shale Oil and Natural Gas Nexus study [SONGNEX](#). In the McDonald et al. study, 30% of the fossil-VOCs were attributed to "upstream emissions" from the production of oil and gas, 20% was from gasoline and diesel fuel use and ~50% from the use of volatile chemical products. Methane was not included in this study, but it is an important greenhouse gas. Thank you for your question.

In the end, does it actually produce less pollution to drive an electric vehicle given the fossil fuel inputs to generate that electricity?

[benspaperclip](#)

(CC) Overall, yes. But the exact benefits today do depend on where you live because different regions have different mixes of energy sources: see the [Union of Concerned Scientists](#) for example. You can imagine that as energy production becomes even less carbon intensive over time that the benefits of EVs will grow.

Interested in conservation and environmental protection in the D.C. Area. Graduated with a degree in marine biology, and currently working as a long term substitute teacher. What's the best way to break into the field? I keep getting rejected from the jobs I'm really passionate about

[dromalio](#)

(CC) It's great to hear about your passion for the environment. Don't get discouraged! I often suggest that you ask friends/family to help with things like looking over resumes, mock interviews, etc. Otherwise, just keep at it...

Are there any pesticides in use that should currently be replaced by a less harmful one?

This is a little off-topic: What are some techniques that we could use for earth to absorb slightly less heat from the sun?

[StopHelpingMe](#)

(CC): I can't speak to your first question, but as to the second the key thing we can do is to reduce our emissions of greenhouse gases!

Is it true when tap water becomes airborne it creates VOCs? Thanks!

[city312](#)

JG-NOAA here. Yes, there are VOCs that are water soluble (dissolved in water) including oxygenated VOCs like ethanol. It's very difficult to get truly VOC-free water, but small amounts of VOCs in water are generally not harmful. When water is heated and/or aerosolized like it is in the shower, it is much easier for any dissolved VOCs to evaporate into the atmosphere. Thanks for your questions!

Do you view Bill Nye as a valid scientist?

[DontLetYourslefDolt](#)

JG here. I do view Nye as a scientist and a communicator. I'm currently listening to his book "Unstoppable" and like it so far. I think it is important to improve science communication and get information to wider audiences and Nye is doing just that.

Would you recommend not using cologne, hair spray, spray paint?

[japosey](#)

(CC) Our work definitely suggests that reducing the emissions from these types of sources would have tangible benefits for air quality. And certainly one way to reduce emissions is to reduce use.

Thank you for the AMA.

What effect, if any, does airborne pollution have on rain fall. Do pollutants contribute to or interfere with nucleation? Has there been any measurable increase or decrease in rain fall in areas with increasing pollution.

[lukevanin](#)

(CC) Every cloud droplet, which turn into rain drops, forms on a small, airborne particle. When there is more pollution, meaning more particles, around a cloud will typically end up with more cloud droplets that are smaller than if there were less particle pollution. Sometimes this can lead to more rainfall, but sometimes less. The exact behavior depends on the atmospheric conditions, and how many particles there are in the first place. And, to make things even more complicated, it can actually be very difficult for water to freeze in the atmosphere. Water can remain liquid to well below zero degrees C. But, very special particles--called ice nucleating particles--can help to make water freeze. Sometimes, freezing of water (aka snow!) can help to turn a cloud that wouldn't precipitate into one that will. So, overall the impact of particles on rainfall is variable and depends on lots of factors.

Thank you for doing an AMA!

Is there a significant difference in pollution amounts from paints applied via a sprayer versus a brush or roller? Are there types of paint that are safer to use than others? Painting is a significant part of my job, so I want to know how I can minimize my impact.

[ttypphoon](#)

BM: In general, an aerosolized application of paint will more efficiently spray VOCs into the air than brushing or rolling. This means that indoor levels of VOCs can reach high concentrations before dissipating. However, a high fraction of VOCs in non-aerosol paints also emits following paint application over hours to months, and will get into the outdoor air. Regulatory efforts have also tried to remove VOCs (e.g., low-VOC paints), so the paint formulations have been evolving. In short, atmospheric scientists still have a lot more to learn about the air quality impacts of different types of paint formulations, especially as it relates to the formation of fine particles that could impact human health.

