Dirty Air Brings Rain – Then Again, Maybe Not: Scientists Reconcile Contradictory Effects

ScienceDaily (Sep. 11, 2008) — An international team of scientists, headed by Prof. Daniel Rosenfeld of the Institute of Earth Sciences at the Hebrew University of Jerusalem, has come up with a surprising finding to the disputed issue of whether air pollution increases or decreases rainfall. The conclusion: both can be true, depending on local environmental conditions.

The determination of this issue is one with significant consequences in an era of climate change and specifically in areas suffering from manmade pollution and water shortages, including Israel.

In an article appearing in the Sept 5 issue of the journal Science, the scientific team, which included researchers from Germany, has published the results of its research untangling the contradictions surrounding the conundrum. They do this by following the energy flow through the atmosphere and the ways it is influenced by aerosol (airborne) particles. This allows the development of more exact predictions of how air pollution affects weather, water resources and future climates.

Mankind releases huge amounts of particles into the air that are so tiny that they float. Before being influenced by man, air above land contained up to twice as many of these so called aerosol particles as air above oceans. Nowadays, this ratio has increased to as much as a hundredfold.

Natural and manmade aerosols influence our climate – that much is agreed. But which way do they push it? They produce more clouds and more rain, some say. They produce fewer clouds and less rain, say others. This disputed role of aerosols has been the greatest source of uncertainties in our understanding of the climate system, including the question of global warming.

"Both camps are right", says Prof. Meinrat O. Andreae, director of the Max Planck Institute for Chemistry in Germany, a coauthor of the publication. "But you have to consider how many aerosol particles there are." The lead author, Prof. Rosenfeld of the Hebrew University, adds: "The amount of aerosol is the critical factor controlling how the energy is distributed in the atmosphere." Clouds, and therefore precipitation, come about when moist, warm air rises from ground level and water condenses or freezes on the aerosols aloft. The energy responsible for evaporating the water from the earth's surface and lifting the air is provided by the sun.

Aerosols act twofold: On the one hand, they act like a sunscreen reducing the amount of sun energy reaching the ground. Accordingly, less water evaporates and the air at ground level stays cooler and drier, with less of a tendency to rise and form clouds.

On the other hand, there would be no cloud droplets without aerosols. Some of them act as gathering points for air humidity, so called condensation nuclei. On these tiny particles with diameters of less than a thousandth of a millimeter the water condenses – similar to dew on cold ground – releasing energy.
But if there is a surplus of these gathering points, the droplets never reach the critical mass needed to fall to earth as rain – there just is not enough water to share between all the aerosol particles. Also, with a rising number of droplets their overall surface increases, which increases the amount of sunlight reflected back to space and thus cooling and drying the earth.

In a nutshell, then, the study results show the following: With rising pollution, the amount of precipitation at first rises, then maxes out and finally falls off sharply at very high aerosol concentrations. The practical result is that in relatively clean air, adding aerosols up to the amount that releases the maximum of available energy increases precipitation. Beyond that point, increasing the aerosol load even further lessens precipitation. Therefore, in areas with high atmospheric aerosol content, due to natural or manmade conditions, the continuation or even aggravation of those conditions can lead to lower than normal rainfall or even drought.

Prof. Rosenfeld states: “These results have great significance for countries like Israel where rainfall is scarce and can be easily affected by over-production of aerosols. Our study should act as a red light to all of those responsible for controlling the amounts of pollution we release into the atmosphere.”

“With these results we can finally improve our understanding of aerosol effects on precipitation and climate,” summarizes Andreae, “since the direct contradiction of the different aerosol effects has seriously hindered us from giving more accurate predictions for the future of our climate, and especially for the availability of water.”

Email or share this story: | More

Story Source:
Adapted from materials provided by Hebrew University of Jerusalem.

---

Rainy Summer Days In The Southeast US (Feb. 7, 2008) — Rainfall data from a NASA satellite show that summertime storms in the southeastern United States shed more rainfall midweek than on weekends. Scientists say air pollution from humans is likely ... > read more

Air Pollution Linked To Premature Birth In Pregnant Women (Aug. 27, 2007) — Women who lived in regions with high carbon monoxide or fine-particle levels -- pollution caused mainly by vehicle traffic -- were approximately 10 to 25 percent more likely to have a preterm baby ... > read more

Beijing Game For Clean Air Challenge (May 13, 2008) — With the Olympic Games in sight, the Chinese Government is committed to improving the air quality in Beijing and has made measures in place since 1998 which have already made a difference. However, ... > read more

Dirty Windows In Urban Areas May Be Hidden Contributors To Air Pollution (May 14, 2007) — The grime that accumulates on windows, buildings, roads, and other surfaces in urban areas could be an important source of nitrogen oxide air pollutants, scientists in Canada conclude in a new ... > read more

Air Dispersion Modeling
Easy to use software from industry leader with 20 years of experience.
www.Breeze-Software.com

Stop Stormwater Trash
The TrashScreen and SNOT from BMP Inc. traps trash in stormwater.
www.Bmpinc.com

Clean stack for less
Smoke toxic particles removal save with custom built systems
www.enviroenergytek.com

Canada Tar Sands
Current News & Events To Ponder On. Forum To Discuss All Your Questions
www.CanadasOilsands.ca

---

About This Site | Editorial Staff | Awards & Reviews | Contribute News | Advertise With Us | Privacy Policy | Terms of Use
Copyright © 1995-2009 ScienceDaily LLC — All rights reserved — Contact: editor@sciencedaily.com
Part of the iVillage Your Total Health Network