



A destructive wildfire burned through Canada's Northern Alberta region, razing neighborhoods in Fort McMurray and displacing tens of thousands of residents.

Image: NASA Earth Observatory

FULL SCREEN

Climate models may be overestimating the cooling effect of wildfire aerosols

Study finds accounting for year-to-year variability enables more accurate projections of climate change and its impacts.

Mark Dwortzan | MIT Joint Program on the Science and Policy of Global Change

November 29, 2016

Whether intentionally set to consume agricultural waste or naturally ignited in forests or carbon dioxide emissions, which drive up the average global surface temperature. On the other hand, they produce atmospheric aerosols, organic carbon, black carbon, and sulfate-bearing particulates that can lower that temperature either directly, by reflecting sunlight skyward, or indirectly, by increasing the reflectivity of clouds. Because wildfire aerosols play a key role in determining the future of the planet's temperature and precipitation patterns, it's crucial that today's climate models — upon which energy and climate policymaking depend — accurately represent their impact on the climate system.

But a [new study](#) in *Atmospheric Chemistry and Physics* by researchers at the MIT Joint Program on the Science and Policy of Global Change shows that at least one widely-used climate model is overestimating the cooling effect of these aerosol emissions by as much as 23 percent.

"This overestimation could lead to errors in projections of surface temperature and rainfall, both globally and regionally," says [Chien Wang](#), a senior research scientist at MIT's Department of Earth, Atmospheric and Planetary Sciences and the Joint Program, who co-authored the paper with two members of his group: lead author and research scientist [Benjamin S. Grandey](#) and postdoc Hsiang-He Lee of the Center for Environmental Sensing and Modeling at the Singapore-MIT Alliance for Research and Technology. "We hope our findings will reduce such errors in climate modeling."

To make long-term global projections, most climate models represent atmospheric wildfire aerosol emissions by using monthly measures of emissions at different locations around the globe, and then averaging those emissions over multiple years — before estimating their effect on solar radiation at each location over the multi-year period. Questioning the accuracy of this conventional approach, the researchers proposed a revised representation of wildfire aerosol emissions in which the radiative effect associated with each monthly measure of emissions is first calculated, before averaging over the multi-year period. The revised approach would account for year-to-year variability in the aerosols' radiative effect, which is missing in the conventional representation.

Using a global aerosol-climate model — the Community Earth System Model (CESM) — and the Global Fire Emissions Database (GFED4.0s), the researchers compared both modeling approaches over a 10-year period. The comparison showed that wildfire emissions are responsible for a global mean net radiative effect of about -1.26 watts per square meter for the conventional approach, and about -1.02 watts per square meter for the revised approach. The conventional climate modeling approach systematically overestimated the strength of the net radiative effect of wildfire aerosols — by 23 percent globally and by higher levels (58 percent over Australia and New Zealand; 43 percent over Boreal Asia, where wildfires are commonplace) regionally.

The researchers attribute this systematic overestimation to the non-linear influence of the aerosols on clouds, due largely to interactions between organic carbon aerosols and clouds. Organic carbon aerosols initially boost the reflectivity (and thus cooling effect) of clouds, but as concentrations increase over a particular geographic location, the rate of increase in cloud reflectivity (and cooling effect) slows down considerably. By incorrectly assuming that the indirect cooling effect of aerosol emissions increases linearly with their concentration, conventional approaches overestimate that effect in climate models.

Representing the year-to-year variability in the cooling effect of wildfire aerosols in climate models could improve our understanding of the climate system and the overall accuracy of global and regional climate projections.

"Hopefully what we've found here will be taken into account in future climate modeling studies, which could help improve decision-making regarding climate mitigation and adaptation," says Grandey.

The research team recommends further research to test the robustness of their method by using different climate models and wildfire emissions data sets, improve the scientific understanding of the mechanisms behind the results, and explore in greater depth the impact of year-to-year variation in aerosol emissions on different aspects of climate change.

The research was funded by the Singapore National Research Foundation through the Singapore-MIT Alliance for Research and Technology's Center for Environmental Sensing and Modeling, as well as by grants from the National Science Foundation, the Department of Energy, and the Environmental Protection Agency.

Topics:

Research

Pollution

Greenhouse gases

Climate

Climate change

School of Science

EAPS

Environment

National Science Foundation (NSF)

Department of Energy (DoE)

Joint Program on the Science and Policy of Global Change

Global

Singapore-MIT Alliance for Research and Technology (SMART)

Press Inquiries

RELATED

Paper: "Radiative effects of interannually varying vs. interannually invariant aerosol emissions"

Chien Wang

Benjamin Grandey

Joint Program on the Science and Policy of Global Change

Department of Earth, Atmospheric and Planetary Sciences

School of Science

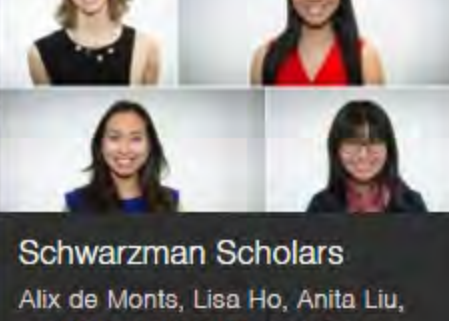
MIT NEWS

December 5, 2016



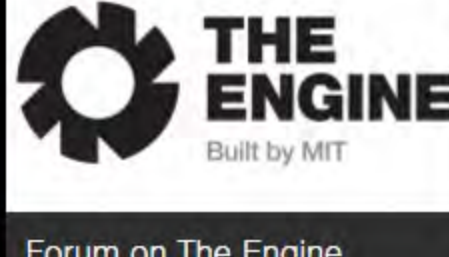
Recognizing sounds

Machine-learning system doesn't require costly hand-annotated data.



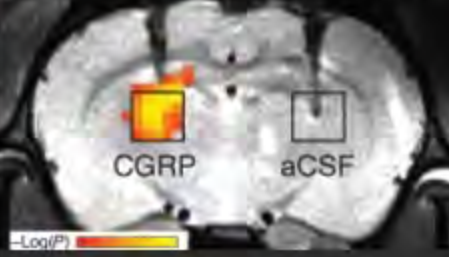
Schwarzman Scholars

Alix de Monts, Lisa Ho, Anita Liu, and Melody Liu will study for one year at Tsinghua University in China.



Forum on The Engine

MIT leadership answers questions about the mission and features of the new accelerator.



Imaging brain molecules

New probe induces blood flow changes that can be seen by MRI.

During *The Economist's* weekly podcast, Kenneth Cukier and Paul Markillie discuss how the MIT researchers behind LiquiGlide, a non-stick coating, have developed a way to precisely steer fluid droplets. The new technique could be used in microfluidic devices, in deicing techniques and to increase the efficiency of condensers.

The Economist

LATEST MIT NEWS



Letter to the community reaffirming MIT's support for students



How the brain recognizes faces

Machine-learning system spontaneously reproduces aspects of human neurology.



Bold research visions recognized and rewarded

Four proposals from six MIT faculty members to receive Professor Amar G. Bose Research Grants.



Steppe by steppe

Mongolian anthropologist Manduhai Buyandelger studies a society in transition.



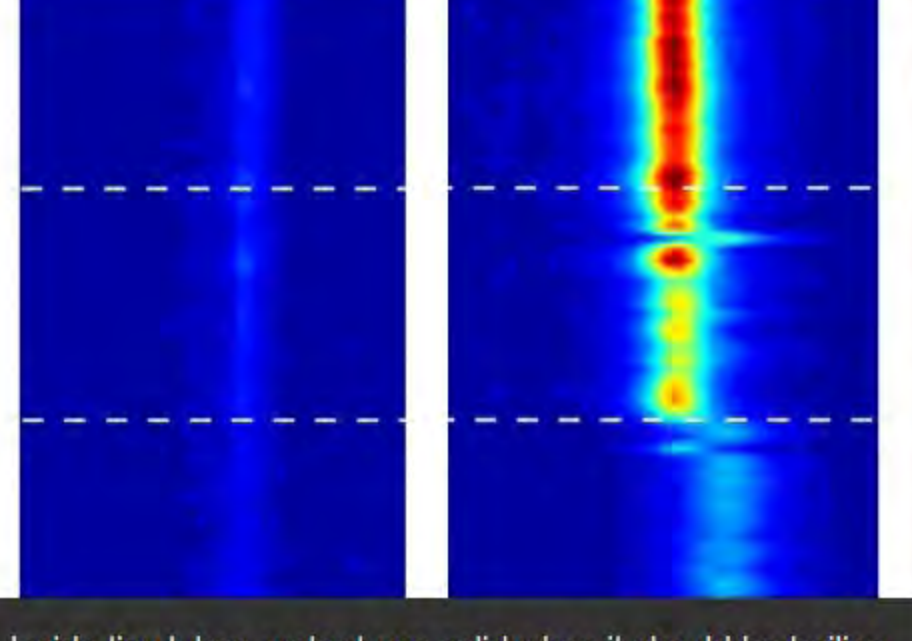
LIGO back online, ready for more discoveries

Upgrades make detectors more sensitive to gravitational waves.



3Q: Dennis Frenchman on the rise of innovation districts in Cambridge and beyond

MIT professor explains how "productive neighborhoods" can remake cities.



Inside tiny tubes, water turns solid when it should be boiling

MIT researchers discover astonishing behavior of water confined in carbon nanotubes.



New Kendall Wi-Fi supports Kendall Square and nearby residential areas

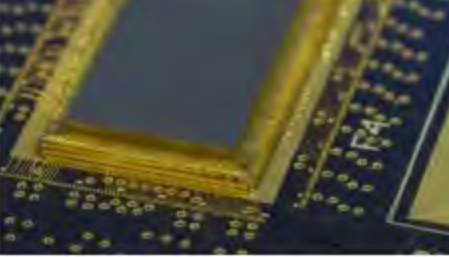
Free high-speed outdoor internet service implemented by MIT and partners.

AROUND CAMPUS



Face to face with "The Enemy"

Face to face with "The Enemy"



Lincoln Laboratory is honored with the Herschel Award



Li-Huei Tsai receives Society for Neuroscience Mika Salpeter Lifetime Achievement Award



A community of making



Lincoln Laboratory's supercomputing system ranked most powerful in New England



Commercializing integrated photonics



Wiesner Gallery relaunched



School of Architecture and Planning receives \$1.5 million grant from Mellon Foundation

IN THE MEDIA

Boston-area museums swapped Instagram accounts this week to promote and share the plethora of cultural offerings available, reports Steve Annear for *The Boston Globe*. The Peabody Essex Museum visited the MIT Museum and shared images of Kismet, "art from the Hart Nautical Collection; and Harold Edgerton's stop-motion photograph the 'milk-drop coronet.'"

The Boston Globe

In an article for the *Financial Times*, Jayesh Kannan, a graduate student in the Sloan School of Management, discusses how a "beer game" exercise during orientation provided valuable lessons on supply chains and management. The game exemplifies "MIT's emphasis on education for practical application," Kannan explains.

FINANCIAL TIMES

New York Times reporter Paul Vitello writes that Prof. Emeritus Bruce Mazlish, a historian known for his psychoanalytical biographies of world leaders, died at age 93. Mazlish's history to young scientists and engineers inspired a lifelong interest in understanding the divide between science and the humanities."

The New York Times

Stephanie Mlot reports for FOX News that MIT researchers have developed a new portable system that can monitor energy usage, and could be useful for both residential and military applications. The system could "not only generate major savings in fuel or power," Mlot writes, "but it may also safeguard soldiers responsible for base resupply."

FOX NEWS

In an article for *The Boston Globe Magazine* about how the 2016 presidential election has been a source of anxiety for people around the country, James Sullivan highlights graduate student Maimuna Majumder's research on post-election stress. "What we're finding is that stress is not just limited to people that are liberal," says Majumder, "it is all-encompassing."

The Boston Globe

MIT researchers have created a self-driving scooter that can be used both indoors and outdoors, reports Siyi Chen for *Quartz*. The scooter will "slow down or stop in order to calibrate a new route" when faced with an obstacle, explains Chen.

QUARTZ

New Scientist reporter Victoria Turk writes that MIT researchers have developed a system that can predict the future based off of a still image. Turk writes that the system could enable "an AI assistant to recognize when someone is about to fall, or help a self-driving car foresee an accident."

NewScientist

READ MORE

About This Website

This Website is maintained by the MIT News Office, part of the Office of Communications.

About the MIT News Office

MIT News Press Center

Press Inquiries

Filing Guidelines

Office of Communications

Contact Us

Terms of Use

RSS

Twitter

Facebook

Google+

Instagram

Flickr

YouTube

MIT Homepage

MIT Video

MIT Connect

MIT Resources

Events Calendar

About MIT

Admissions

Alumni

Education

Labs and Centers

Resources

Submit Campus News

Pitch a Story

Sign Up for Newsletter

Subscribe to Press Releases

Terms of Use



MIT News Office • Building 11-400
Massachusetts Institute of Technology • Cambridge, MA 02139-4307

GIVE TO MIT