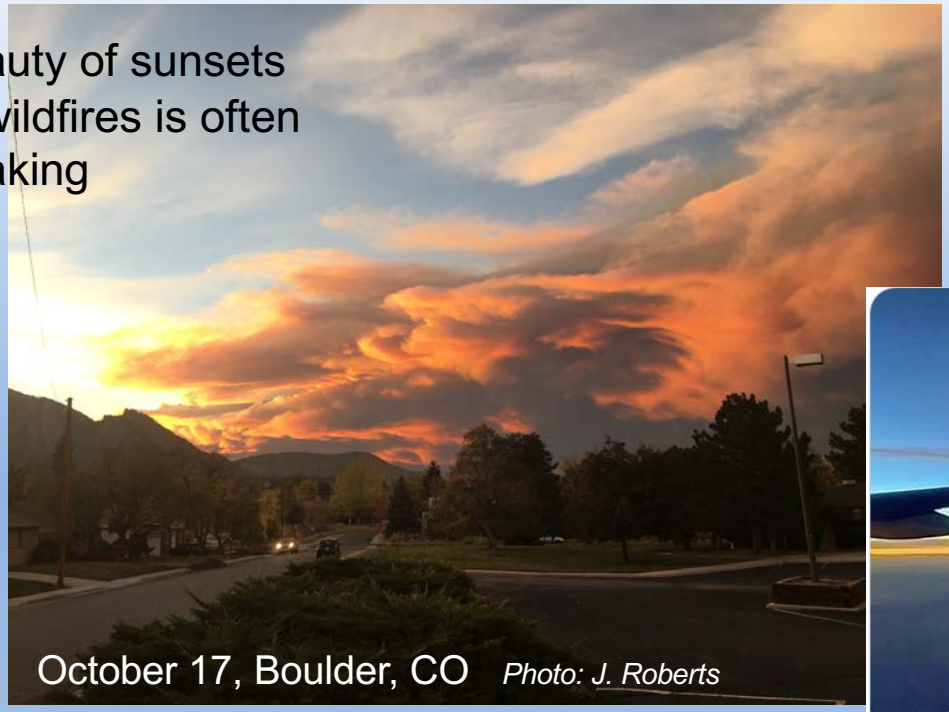
The beauty of sunsets during wildfires is often breathtaking



October 17, Boulder, CO *Photo: J. Roberts*

East Troublesome Fire, Colorado
October 2020

October 17, from above *Photo: G.M. Kuzma*

…and there are more reasons to study wildfire!

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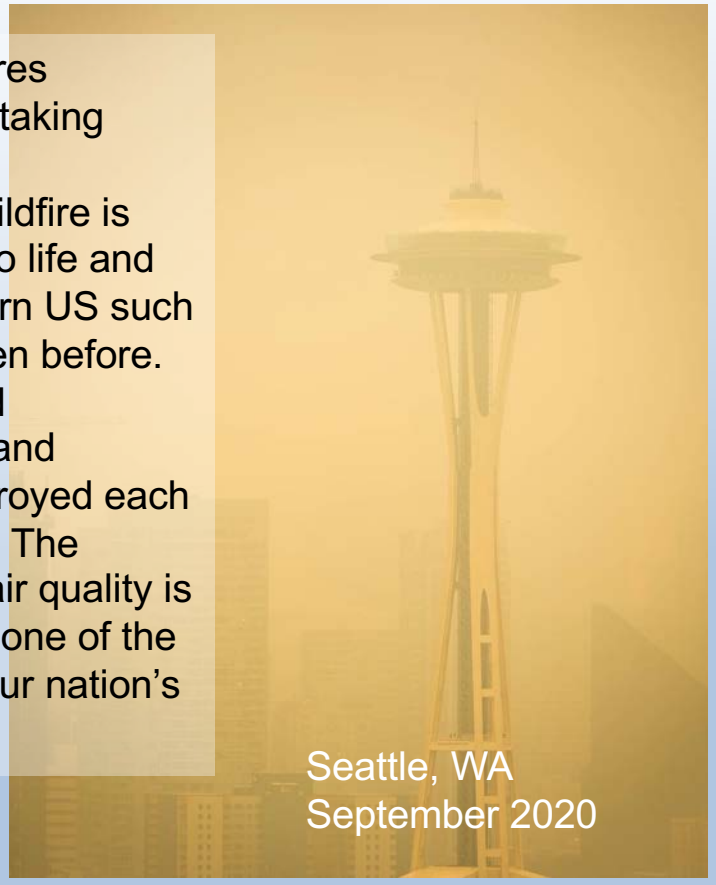
Emissions from wildfires can be literally breathtaking

Sadly, uncontrolled wildfire is causing devastation to life and property in the Western US such as we have never seen before. Hundreds of lives and thousands of homes and buildings can be destroyed each year by “Mega-Fires”. The impact of wildfire on air quality is also profound, and is one of the major challenges to our nation’s air quality.



Seattle, WA
September 2020

Santa Rosa, CA
October 2017

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One of the driving factors in the increases in wildfire in the Western US is the fact that we have fought fire for much of the 20th century, and now we have unhealthy forests in which substantial quantities of fuel have built up and are available to drive wildfires of unprecedented ferocity.

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Another major factor in the increasing importance of wildfire in the Western US is climate change. One of the most robust relationships we have for predicting fire area is “fuel aridity”; a combination of metrics that quantify how combustible a forest will be.

These metrics have been increasing in the Western US on decadal timescales, and these increases are correlated with yearly Forest Fire Area as shown in this figure.

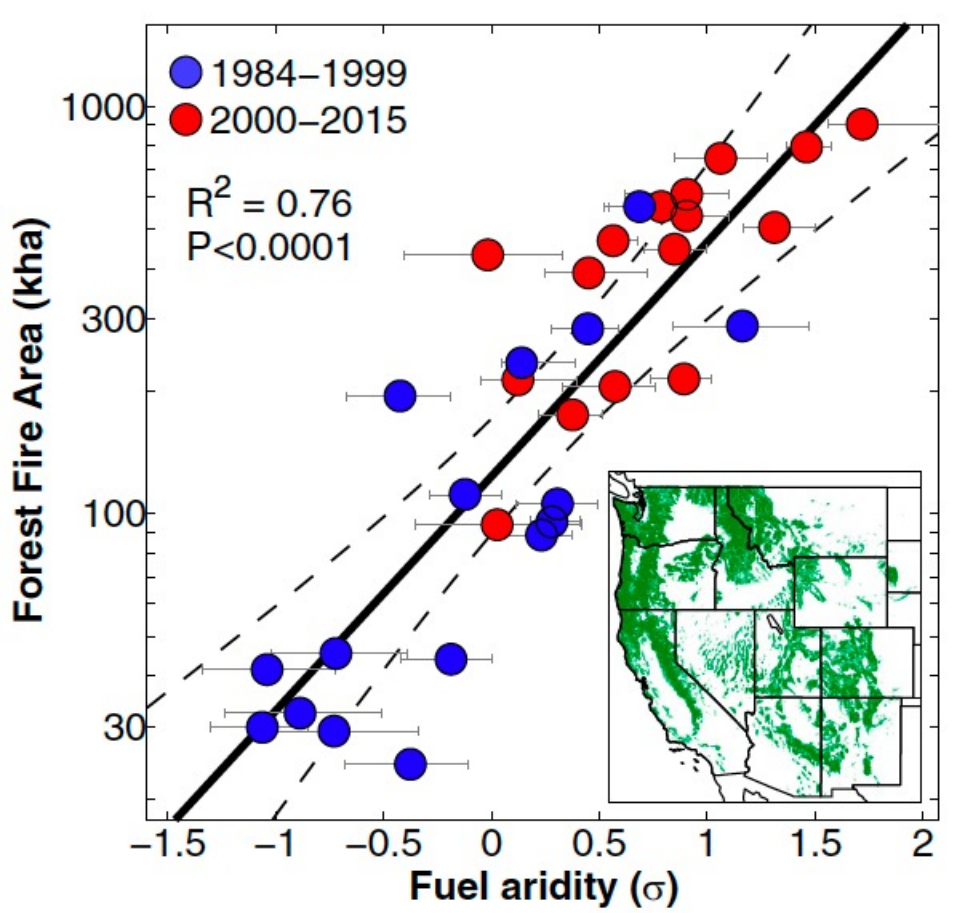

Fig. 1. Annual western continental US forest fire area versus fuel aridity: 1984–2015. Regression of burned area on the mean of eight fuel aridity metrics. Gray bars bound interquartile values among the metrics.

Abatzoglou and Williams, *PNAS*, 2016.

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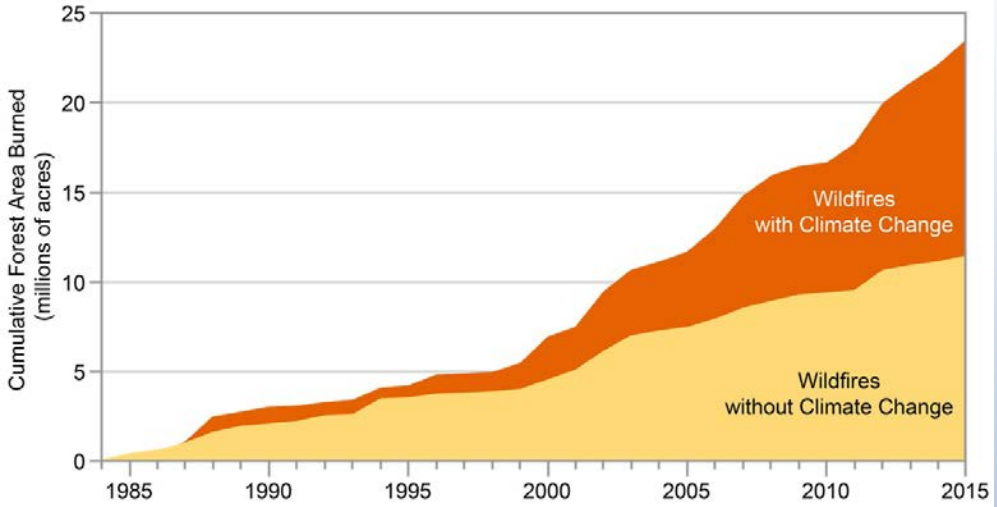
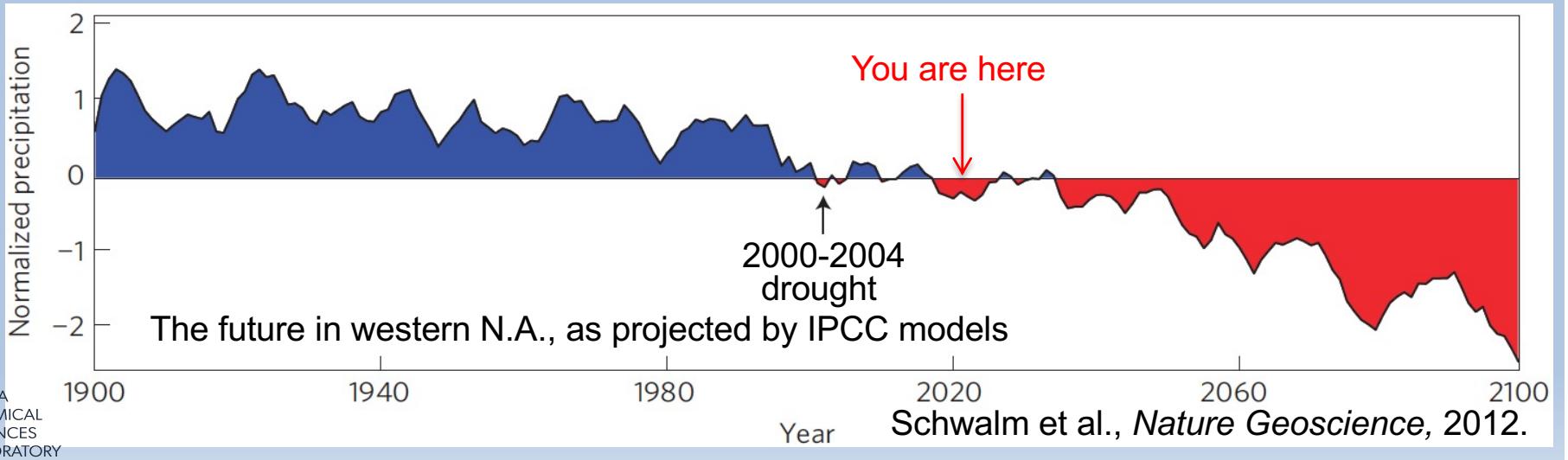
This figure from the USGCRP 4th National Climate Assessment illustrates an estimate of how climate has impacted Western wildfire.



The cumulative forest area burned by wildfires has greatly increased between 1984 and 2015, with analyses estimating that the area burned by wildfire across the western United States over that period was twice what would have burned had climate change not occurred. USGCRP, NCA4, Vol. 2

Long-term model projections point towards continuing drought conditions in the Western US for the remainder of the century, further exacerbating this driver of increased fire and smoke.



The future in western N.A., as projected by IPCC models

Schwalm et al., *Nature Geoscience,* 2012.

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The impact of wildfire on air quality has also been increasing:

The changing risk and burden of wildfire in the United States

Marshall Burke[a,b,c,1], Anne Driscoll[b], Sam Heft-Neal[b], Jiani Xue[b], Jennifer Burney[d], and Michael Wara[e]

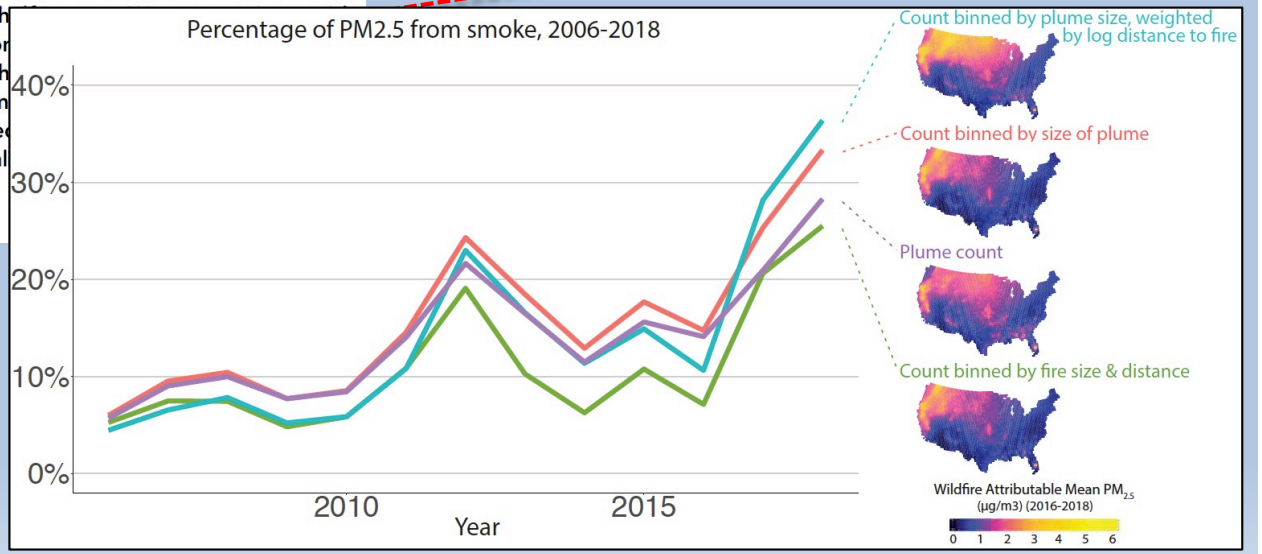
Edited by B. L. Turner, Arizona State University, Tempe, AZ, and approved November 24, 2020 (received for review June 30, 2020)

...we estimate that wildfires have accounted for up to 25% of $PM_{2.5}$ (particulate matter with diameter <2.5 μm) in recent years across the United States, and up to half in some Western regions...

houses every 3 y. To illustrate how changes in wildfire activity might affect air pollution and related health outcomes, and how these linkages might guide future science and policy, we develop a statistical model that relates satellite-based fire and smoke data to information from pollution monitoring stations. Using the model, we estimate that wildfires have accounted for up to 25% of $PM_{2.5}$ (particulate matter with diameter <2.5 μm) in recent years across the United States, and up to h
spatial patterns in ambient smoke exposure that do not follow traditio
sure gradients. We combine the model with stylized scenarios to show th
could have large health benefits and that future health impacts from
smoke could approach projected overall increases in temperature-relate
but that both estimates remain uncertain. We use model results to highl
search and to draw lessons for policy.

wildfire | air pollution | climate change | health impacts

PNAS 2021 Vol. 118 No. 2 e2011048118



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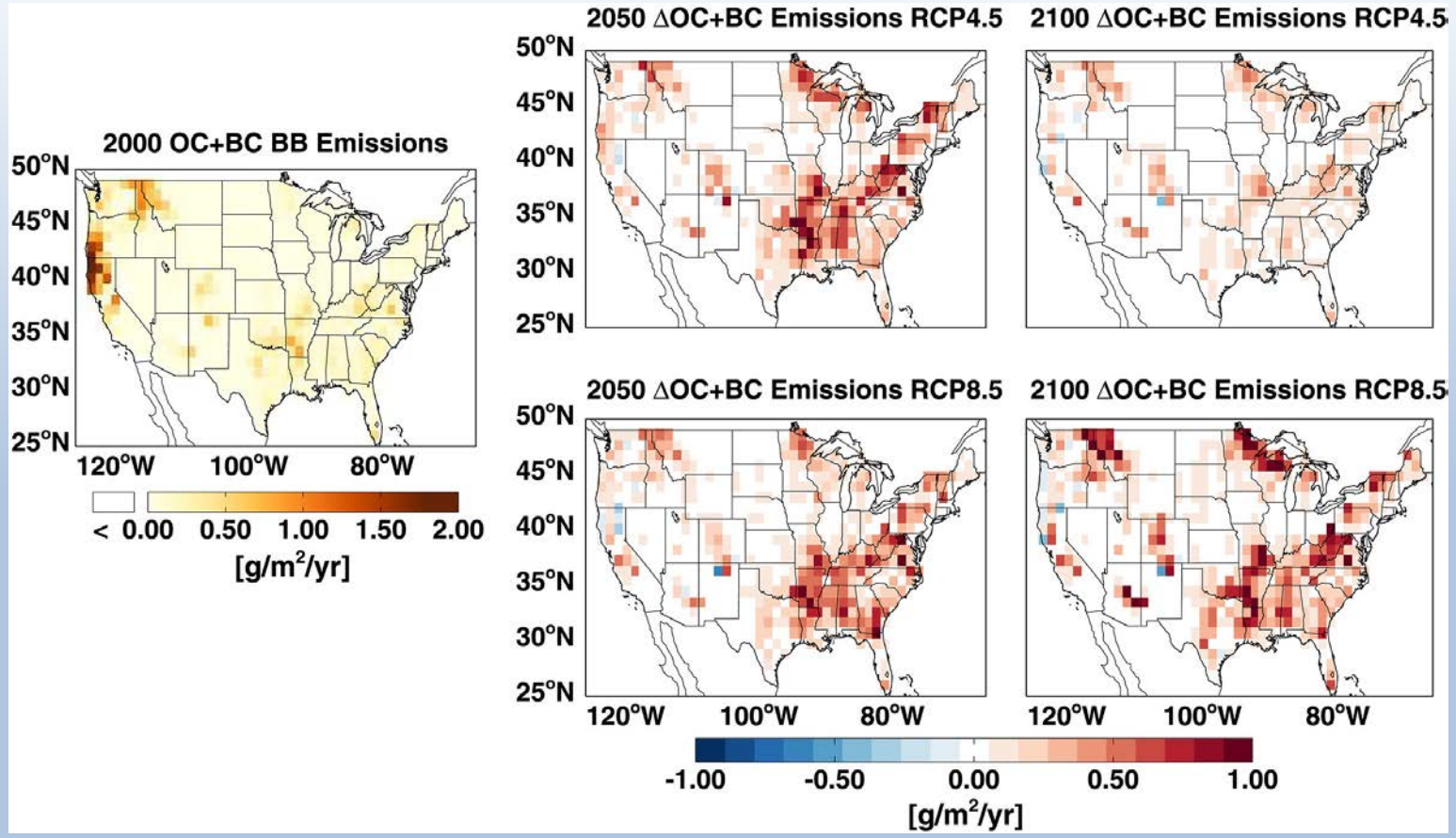
And these impacts are expected to increase in the future with increased fires:



Ford, B., M. Val Martin, S. Zelasky, E. V. Fischer, S. Anenberg, C. Heald, and J. R. Pierce (2018), Future fire impacts on smoke concentrations, visibility, and health in the contiguous United States, *Geohealth*, 2, https://doi.org/10.1029/2018GH000144

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The global impact of biomass burning is apparent in recent CSL measurements in the global atmosphere from the ATom project:

ARTICLES
https://doi.org/10.1038/s41561-020-0586-1
nature geoscience
Check for updates

Widespread biomass burning smoke throughout the remote troposphere

G. P. Schill[1,2], K. D. Froyd[1,2], H. Bian[3,4], A. Kupc[1,2,5], C. Williamson[1,2], C. A. Brock[1], E. Ray[1,2], R. S. Hornbrook[6], A. J. Hills[6], E. C. Apel[6], M. Chin[4], P. R. Colarco[4] and D. M. Murphy[1]

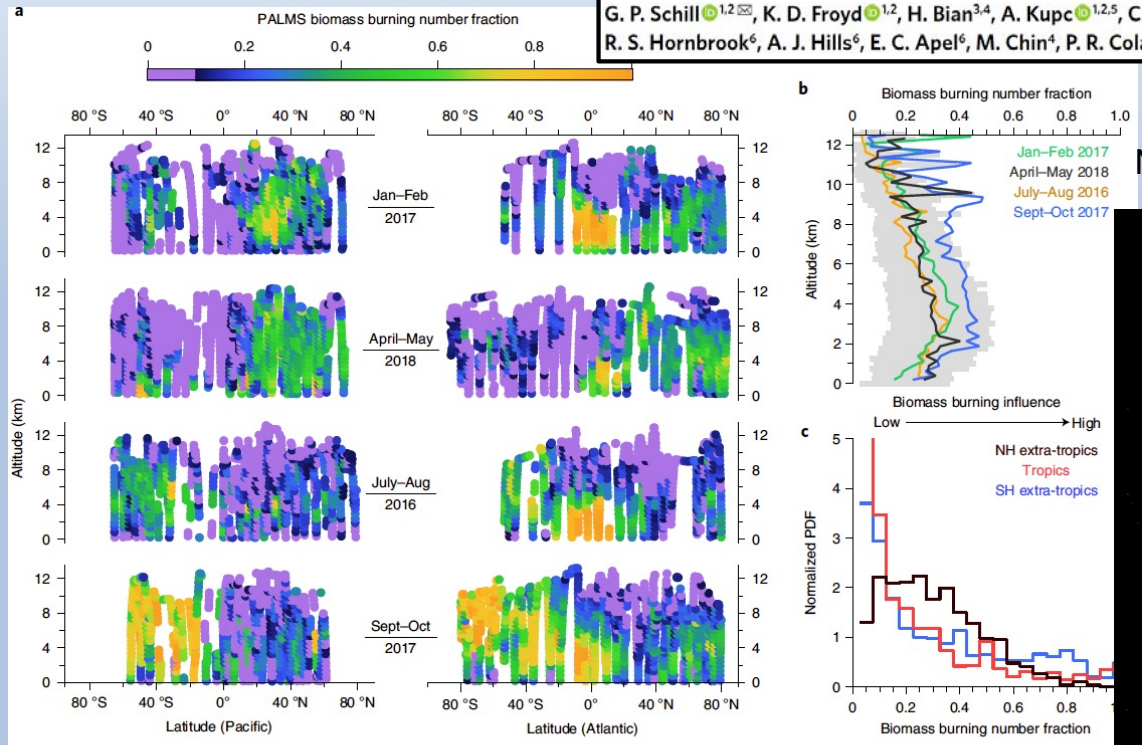
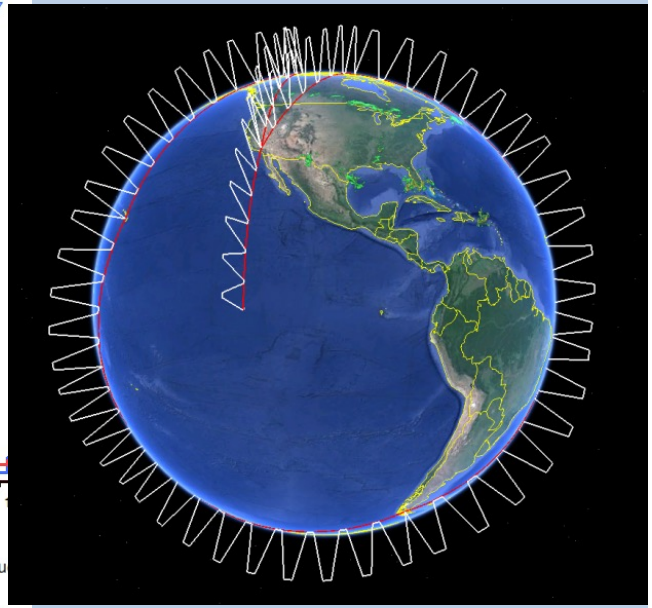


Fig. 1 | The influence of biomass burning on aerosol in the remote troposphere. a–c, PALMS biomass burning number fractions shown as altitude/latitu curtain plots, split by season and ocean basin (**a**), seasonal average vertical profiles (coloured lines) and mission-wide IQRs (grey boxes) (**b**) and mission-wide normalized probability density functions (PDFs), split into three latitude bins (**c**). See Supplementary Table 1 for region definitions. NH, Northern Hemisphere; SH, Southern Hemisphere.

NASA Atmospheric Tomography mission



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In Summary

Wildfire management requires understanding of fundamental aspects of biomass burning in general and wildfire in particular:

Emissions, transport and processing, and impacts

CSL science is being used to improve the tools needed to predict and manage the impacts of wildfire on the atmosphere.

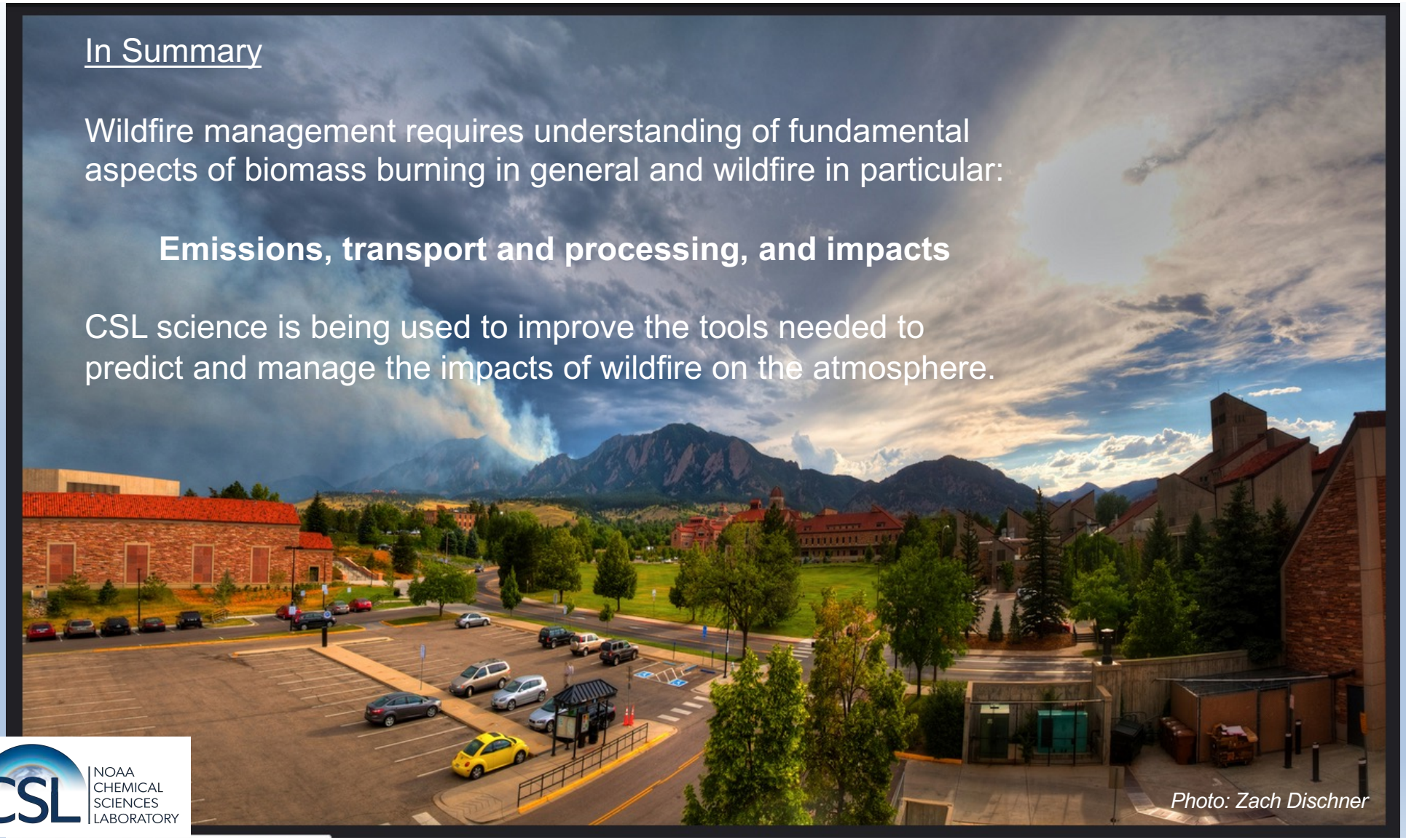

Photo: Zach Dischner

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