

The Limits of Livability

The emerging threat of smoke impacts on health from forest fires and climate change



CLIMATE AND
HEALTH
ALLIANCE



CAPE
Canadian Association
of Physicians
for the Environment
Association Canadienne
des Médecines
pour l'Environnement
ACME



THE GLOBAL
CLIMATE & HEALTH
ALLIANCE

Climate Change, wildfires and smoke pollution



Photo: BC Wildfires Service

Recent years have witnessed an increase in extreme wildfire events around the world with growing evidence that climate change is implicated.¹ The risk of wildfires is projected to increase in most areas of the world as climate change intensifies^{2,3} bringing more frequent heat waves of longer duration⁴ and changes in rainfall patterns which affect vegetation growth. Larger populations, including urban populations far from the forests, are being exposed to harmful and prolonged levels of wildfire smoke.

This country brief accompanies a report released by the Global Climate and Health Alliance (GCHA) in June 2021. The report highlights that government

response to wildfires has largely centered on emergency response to the immediate impacts of the fires themselves, with limited preparation and response to address either short- or long-term impacts of wildfire smoke exposure. Smoke from landscape fires causes an estimated 339,000 premature deaths per year worldwide, many more deaths than those lost directly⁵ yet receives relatively little attention.

Wildfire smoke and health impacts

Major wildfires impact health in a wide variety of ways, including, 'death, trauma, and major burns, anxiety during wildfire periods ... post-traumatic stress disorder, anxiety and depression related to evacuations',^{6,7} but the health impacts of wildfire smoke remain under-recognized.

Wildfires can cause episodes of extremely poor air quality that can affect very large populations. The smoke contains a range of pollutants including particulate matter, carbon dioxide, nitrogen oxides and volatile organic compounds.⁸ Wildfire particulate matter may be more harmful to health than urban particulate air pollution.¹

Smoke from wildfires has a wide range of impacts, as particulate pollution (PM_{2.5}) from the smoke can affect every organ in the body.¹ A recent study of exposure to particulate pollution during wildfire seasons in British Columbia indicated that impacts on respiratory and cardiovascular health were observable within one hour of exposure to PM_{2.5}.⁹ There is some evidence of a link between diabetes and particulate pollution.¹⁰⁻¹² In addition, during sustained wildfire events and smokey conditions, people with diabetes may not be able to

follow their usual self-care regimens for exercise and food choices.

In one Canadian study on the Yellowknife fires of 2014, asthma cases doubled during the fires and salbutamol prescriptions dispensations went up by about 50% in community pharmacies in areas impacted by the fires, compared to surrounding areas. For every $10\mu\text{g}/\text{m}^3$ increase in $\text{PM}_{2.5}$ there was an associated increase in Emergency Room (ER) visits of 11% for asthma, 6% for pneumonia, and an 11% increase in chronic obstructive pulmonary disease (COPD)-related hospital admissions. Land-based food gathering and grocery store supply chains were impacted, and community members described increases in mental health impacts from isolation, decreased physical activity and reduced connection to the land, particularly for Indigenous people.⁷

Children and adults over 65 and those with pre-existing conditions such as asthma, COPD and cardiovascular disease¹ are at higher risk from the health impacts of smoke. People spending

more time outdoors, such as outdoor workers or people who are homeless, are also vulnerable.¹

Females seem to be more sensitive to asthma related outcomes than males.¹³ Studies have linked adverse pregnancy outcomes with exposure to air pollutants including low birthweight,¹⁴ and there appears to be an association between low birth weight (LBW) and maternal exposure to air pollution ($\text{PM}_{2.5}$) and carbon monoxide (CO) from biomass burning during the second and third trimesters of pregnancy.¹⁵

The 2018 Wildfires

Polar regions are projected to warm faster due to climate change than areas towards the equator. Located near the Arctic, Canada is warming faster than many other parts of the world.¹⁶ Under the IPCC scenario where greenhouse emissions continue at a mid-range, it is projected that wildfires will increase in Canada by 75% by 2100.¹⁷ In the period 1980-2017, 448,444 Canadians were evacuated due to wildfires. Half of these

Photo: BC Wildfires Service



'Wildfires cause episodes of the worst air quality that most people living in high income countries are ever going to see.'¹⁸

Dr Sarah Henderson, Scientific Director, Environmental Health Services, British Columbia CDC.

evacuations took place in the last decade, reflecting a trend of increased impact.¹⁹ Wildfires were included as one of the key indicators of climate-related health impacts in the 2019 Lancet Countdown report from Canada.²⁰

In the Canadian provinces of British Columbia (BC) and Alberta, 2018 was the worst fire season on record, following record-breaking fires in 2017 when a 10 week state of emergency was declared.²¹ The fires were fuelled by changed weather patterns driven by climate change, combined with poor forest management. Wildfires caused severe smoke which forced the cancellation of flights and impacted tourism.²² Smoke from the fires spread across Canada and as far as Ireland.

The BC Wildfire Service reported that during 2018:²³

- 2,117 fires burnt more than 1.3 million hectares of land; in 2017, 1.2 million hectares were destroyed.
- 66 evacuations were ordered, affecting 2,211 properties.
- Wildfire suppression cost CA\$ 615 million (US\$ 491.5 million).

To fight the fires, 270 aircraft and 4,756 personnel were engaged. International assistance was provided by Washington State in the US, Mexico, New Zealand, and Australia.²³ In 2017, health services were impacted with more than 700 staff displaced and 880 patients evacuated at a cost of CA\$2.7 million (US\$ 2.2 million).^{BICHA, cited in 20}

Preparation and emergency planning

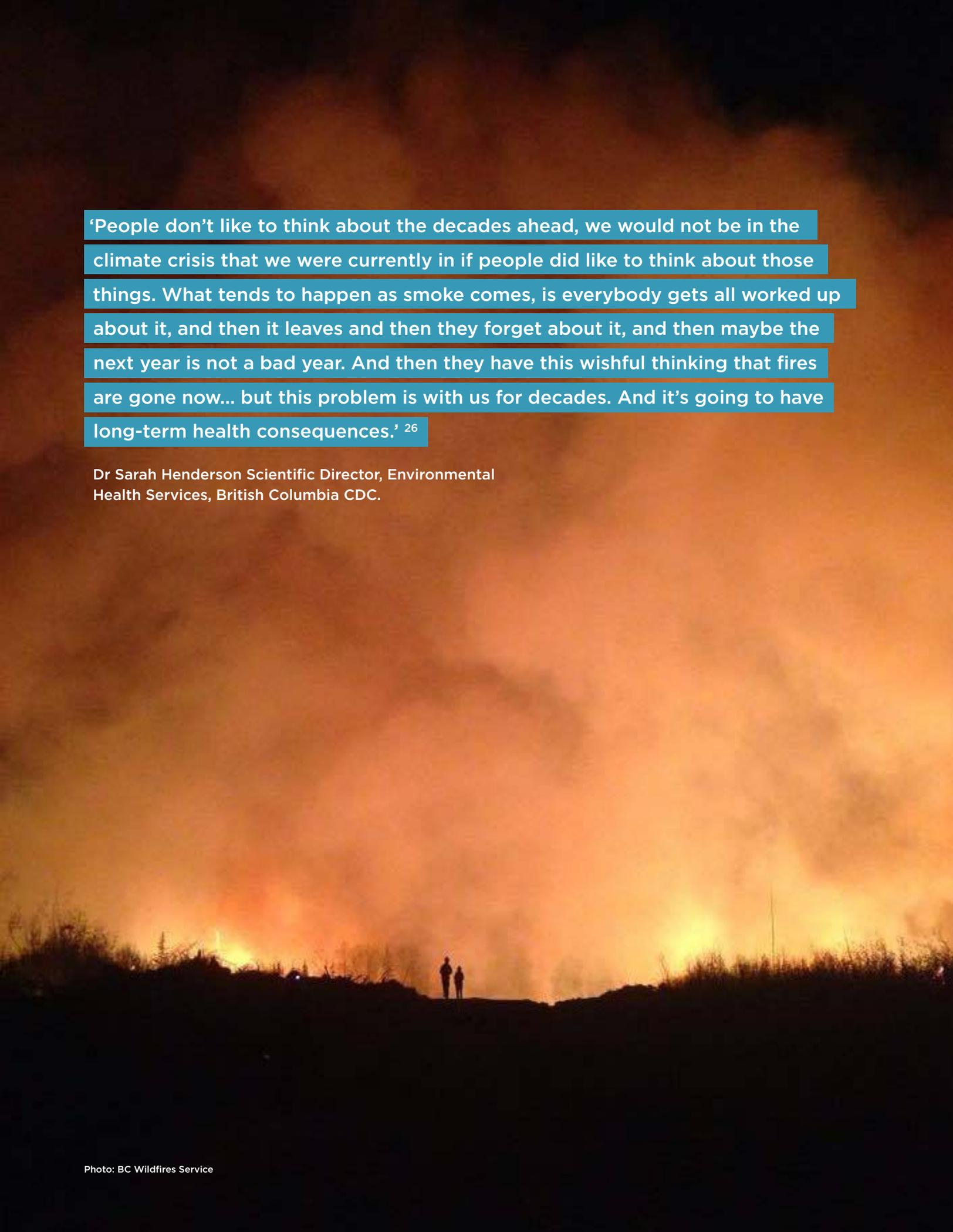
Public health systems are not currently equipped to deal with longer wildfire events. The findings of the GCHA report *The Limits of Livability* signal the need for significantly greater governmental action to protect public health from wildfire smoke. There is an urgent need to mitigate climate change, to address this underlying and major contributor to wildfire extremes whilst also strengthening public health messaging on preparing for wildfires and smoke pollution.

Current public health advice for wildfires is based on responding to shorter and less severe episodes. However, in 2014 fires burned for 2.5 months in Yellowknife.²⁴

Interviews from the Summer of Smoke²⁴ Yellowknife study demonstrated that advance preparation, including the development of evacuation plans and a strong community plan, were helpful in building individual and community resilience: community members who knew the evacuation plan and how to 'fire-smart' their homes were much more confident and positive in their tone.⁷ Planning authorities will need to future-proof hospital design and buildings in anticipation of a changing climate. During the Yellowknife fires, for example, smoke entered the hospital operating theatre which meant it could not be used for several days at a time.²⁵



Photo: BC Wildfires Service



‘People don’t like to think about the decades ahead, we would not be in the climate crisis that we were currently in if people did like to think about those things. What tends to happen as smoke comes, is everybody gets all worked up about it, and then it leaves and then they forget about it, and then maybe the next year is not a bad year. And then they have this wishful thinking that fires are gone now... but this problem is with us for decades. And it’s going to have long-term health consequences.’²⁶

Dr Sarah Henderson Scientific Director, Environmental Health Services, British Columbia CDC.

Conclusions and recommendations



Photo: BC Wildfires Service

Reducing smoke emissions from wildfires will benefit both human health and climate change since most of the air pollutants from fire smoke overlap with the pollutants that cause climate change. Reducing the incidence of major wildfires in Canada will result in fewer greenhouse gas emissions from forest carbon stores while also protecting communities and biodiversity.

To ensure better preparation and response to the wildfires that are anticipated, key recommendations include:

- Strengthen the pan-Canadian emergency response so that it is flexible enough to incorporate future climate change projections.
- Develop easy to use emergency plans for fire and smoke for residents and communities.

- Tackle inequalities in smoke exposure, including recognition of greater vulnerability of Indigenous people living in remote areas.

The Canadian federal government must also do its fair share and make greater progress on climate change than it has to date, aligning its climate mitigation commitments with the Paris Agreement target of well below 2°C and aiming for 1.5°C. Measures that strengthen health, wellbeing, and healthcare systems in the near term while meeting climate mitigation targets should be prioritized. An end to public subsidies for fossil fuels would signal the Canadian government's serious commitment to tackle global climate change and reduce national vulnerability and impacts such as wildfires.

References

1. Xu R, Yu P, Abramson MJ, Johnston FH, Samet JM, Bell ML, et al. Wildfires, Global Climate Change, and Human Health. *N Engl J Med*. 2020;383(22):2173-81.
2. Bowman DMJS, Kolden CA, Abatzoglou JT, Johnston FH, van der Werf GR, Flannigan M. Vegetation fires in the Anthropocene. *Nat Rev Earth Environ*. 2020 Oct 1;1(10):500-15.
3. Turco M, Rosa-Cánovas JJ, Bedia J, Jerez S, Montávez JP, Llasat MC, et al. Exacerbated fires in Mediterranean Europe due to anthropogenic warming projected with non-stationary climate-fire models. *Nat Commun*. 2018 Oct 2;9(1):3821.
4. Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.). *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva, Switzerland: IPCC; 2014 p. 151.
5. Johnston FH, Sarah B. Henderson, Yang Chen, James T. Randerson, Miriam Marlier, Ruth S. DeFries, et al. Estimated Global Mortality Attributable to Smoke from Landscape Fires. *Environ Health Perspect*. 2012;120(5):695-701.
6. Cameron PA, Mitra B, Fitzgerald M, Scheinkestel CD, Stripp A, Batey C, et al. Black Saturday: the immediate impact of the February 2009 bushfires in Victoria, Australia. *Med J Aust*. 2009 Jul 6;191(1):11-6.
7. Dodd W, Scott P, Howard C, Scott C, Rose C, Cunsolo A, et al. Lived experience of a record wildfire season in the Northwest Territories, Canada. *Can J Public Health*. 2018 Jun;109(3):327-37.
8. Urbanski SP, Hao WM, Baker S. Chemical composition of wildland fire emissions [Internet]. In: Bytnerowicz, A.; Arbaugh, M.; Riebau, A.; Andersen, C., eds. *Developments in environmental science, Volume 8: Wildland fires and air pollution*. The Netherlands: Elsevier: 79-107. 2009 p. 79-107. Available from: <https://www.fs.usda.gov/treesearch/pubs/33764>
9. Jiayun Yao, Michael Brauer, Julie Wei, Kimberlyn M. McGrail, Fay H. Johnston, Sarah B. Henderson. Sub-Daily Exposure to Fine Particulate Matter and Ambulance Dispatches during Wildfire Seasons: A Case-Crossover Study in British Columbia, Canada. *Environ Health Perspect*. 2020;128(6):067006.
10. Johnston FH, Salimi F, Williamson GJ, Henderson SB, Yao J, Dennekamp M, et al. Ambient Particulate Matter and Paramedic Assessments of Acute Diabetic, Cardiovascular, and Respiratory Conditions. *Epidemiol Camb Mass*. 2019 Jan;30(1):11-9.
11. Zanobetti A, Dominici F, Wang Y, Schwartz JD. A national case-crossover analysis of the short-term effect of PM_{2.5} on hospitalizations and mortality in subjects with diabetes and neurological disorders. *Environ Health Glob Access Sci Source*. 2014 May 22;13(1):38.
12. Bowe B, Xie Y, Li T, Yan Y, Xian H, Al-Aly Z. The 2016 global and national burden of diabetes mellitus attributable to PM_{2.5} air pollution. *Lancet Planet Health*. 2018 Jul;2(7):e301-12.
13. Borchers Arriagada N, Horsley JA, Palmer AJ, Morgan GG, Tham R, Johnston



Photo: BC Wildfires Service

- FH. Association between fire smoke fine particulate matter and asthma-related outcomes: Systematic review and meta-analysis. *Env Res.* 2019 Dec;179(Pt A):108777.
14. Melody SM, Johnston FH. Coal mine fires and human health: What do we know? *Int J Coal Geol.* 2015 Dec 1;152:1-14.
 15. Payam Dadvand, Jennifer Parker, Michelle L. Bell, Matteo Bonzini, Michael Brauer, Lyndsey A. Darrow, et al. Maternal Exposure to Particulate Air Pollution and Term Birth Weight: A Multi-Country Evaluation of Effect and Heterogeneity. *Environ Health Perspect.* 2013;121(3):267-373.
 16. Government of Canada. Canada's Changing Climate Ottawa, Ontario, 2019. 2019.
 17. Wotton M, Nock C, Flannigan M. Forest fire occurrence and climate change in Canada. *Int J Wildland Fire.* 2010 01;19:253-71.
 18. Hirschlag A. The long distance harm done by wildfires. 2020.
 19. Christianson A. Wildland Fire Evacuations in Canada. *Nat Resour Can.* 2017;
 20. Howard C, Buse C, Rose C, MacNeill A, Parkes M. The Lancet Countdown on Health and Climate Change Policy brief for Canada. 2019.
 21. B.C. year in review 2017: wildfires devastate the province like never before [Internet]. CKNW. [cited 2021 May 20]. Available from: <https://globalnews.ca/news/3921710/b-c-year-in-review-2017-wildfires/>
 22. Sep 30 DH· TCP· P, September 30 2018 1:09 PM PT | Last Updated:, 2018. Back-to-back summers of smoke and fire stoke B.C. tourism industry fears | CBC News [Internet]. CBC. 2018 [cited 2021 May 20]. Available from: <https://www.cbc.ca/news/canada/british-columbia/back-to-back-summer-of-smoke-and-fire-stoke-b-c-tourism-industry-fears-1.4844731>
 23. BC Wildfire Service. Wildfire Season Summary - Province of British Columbia [Internet]. British Columbia. Province of British Columbia; [cited 2021 Jun 11]. Available from: <https://www2.gov.bc.ca/gov/content/safety/wildfire-status/about-bcws/wildfire-history/wildfire-season-summary>
 24. Howard C, Rose C, Dodd W, Kohle K, Scott C, Scott P, et al. SOS! Summer of Smoke: a retrospective cohort study examining the cardiorespiratory impacts of a severe and prolonged wildfire season in Canada's high subarctic. *BMJ Open.* 2021 Feb 1;11(2):e037029.
 25. Howard C. Forest fire smoke and health [unpublished interview]. 2021.
 26. Henderson A. Forest fire smoke and health [unpublished interview]. 2020.

To read the full report, find supporting materials, and report details, go to:
<https://climateandhealthalliance.org/forest-fire-smoke-health-climate/>

About GCHA

The Global Climate and Health Alliance (GCHA) is the leading global convener of health professional and health civil society organizations addressing climate change. We are a consortium of health and development organisations from around the world united by a shared vision of an equitable, sustainable future, in which the health impacts of climate change are minimized, and the health benefits of climate solutions are maximised. GCHA works to elevate the influential voice of the health community in policy making to address the climate crisis.

Contact: info@climateandhealthalliance.org

 @GCHAlliance
 #LimitsofLivability

Authors: Frances MacGuire, Milena Sergeeva

Design: Russell Shaddox

Copyright © 2021 by the Global Climate and Health Alliance