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# The impacts on air quality of wildland-urban interface (WUI) fires versus wildland fires

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# What is WUI?

**The wildland-urban interface (WUI) is the geographic area where anthropogenic urban land use and wildland vegetation come into contact.**

**USA Federal Register definition (USDA and USDI, 2001) is a widely used WUI definition.**

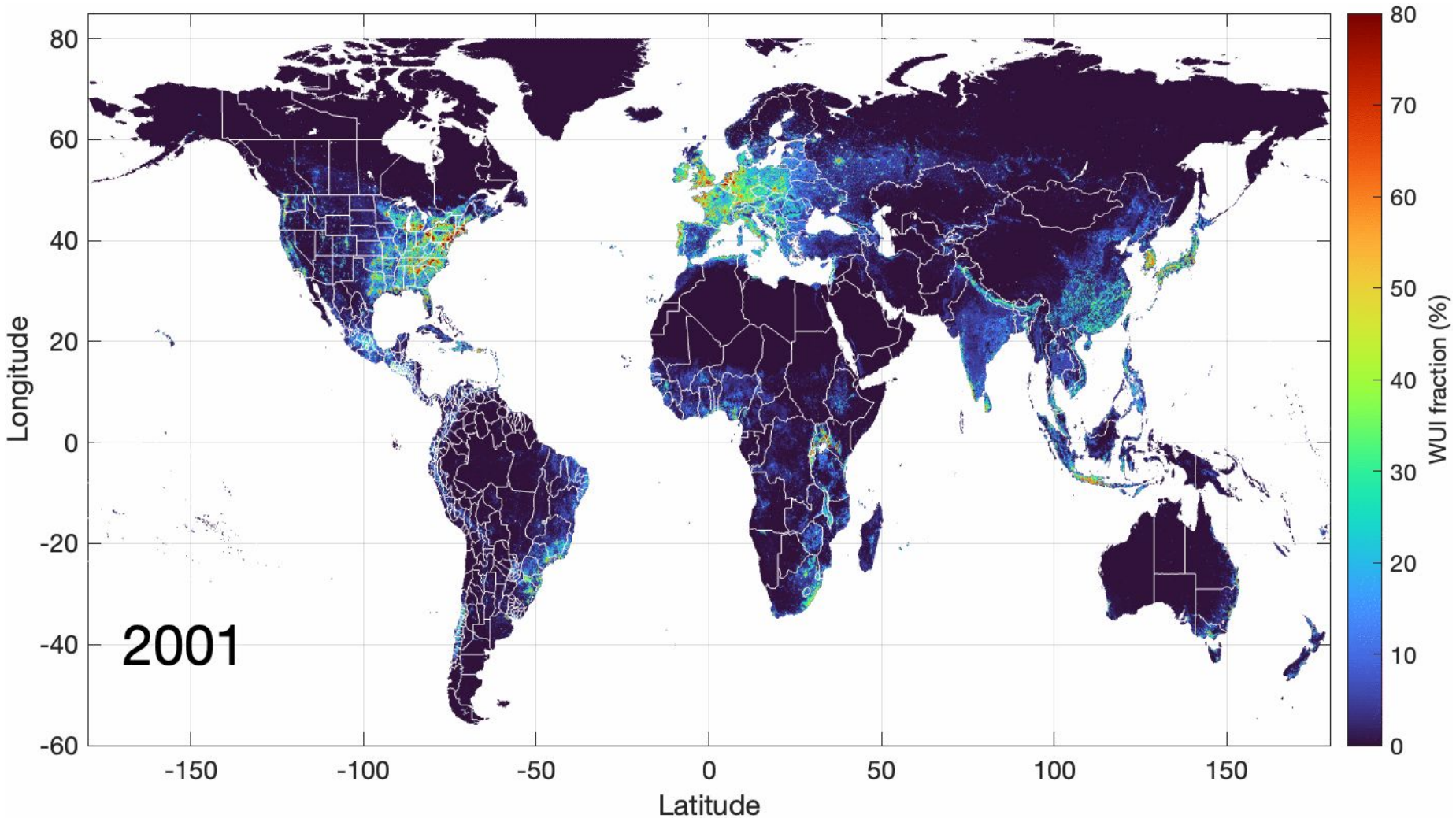
| **WUI** Definition | |
|---|---|
| Intermix | Areas with ≥6.18 houses per km² and ≥50 percent cover of wildland vegetation |
| Interface | Areas with ≥6.18 houses per km² and <50 percent cover of vegetation located <2.4 km of an area ≥5 km² in size that is ≥75 percent vegetated |

# Fires in WUI

## Fires in WUI are an important issue and require more research and better understanding.

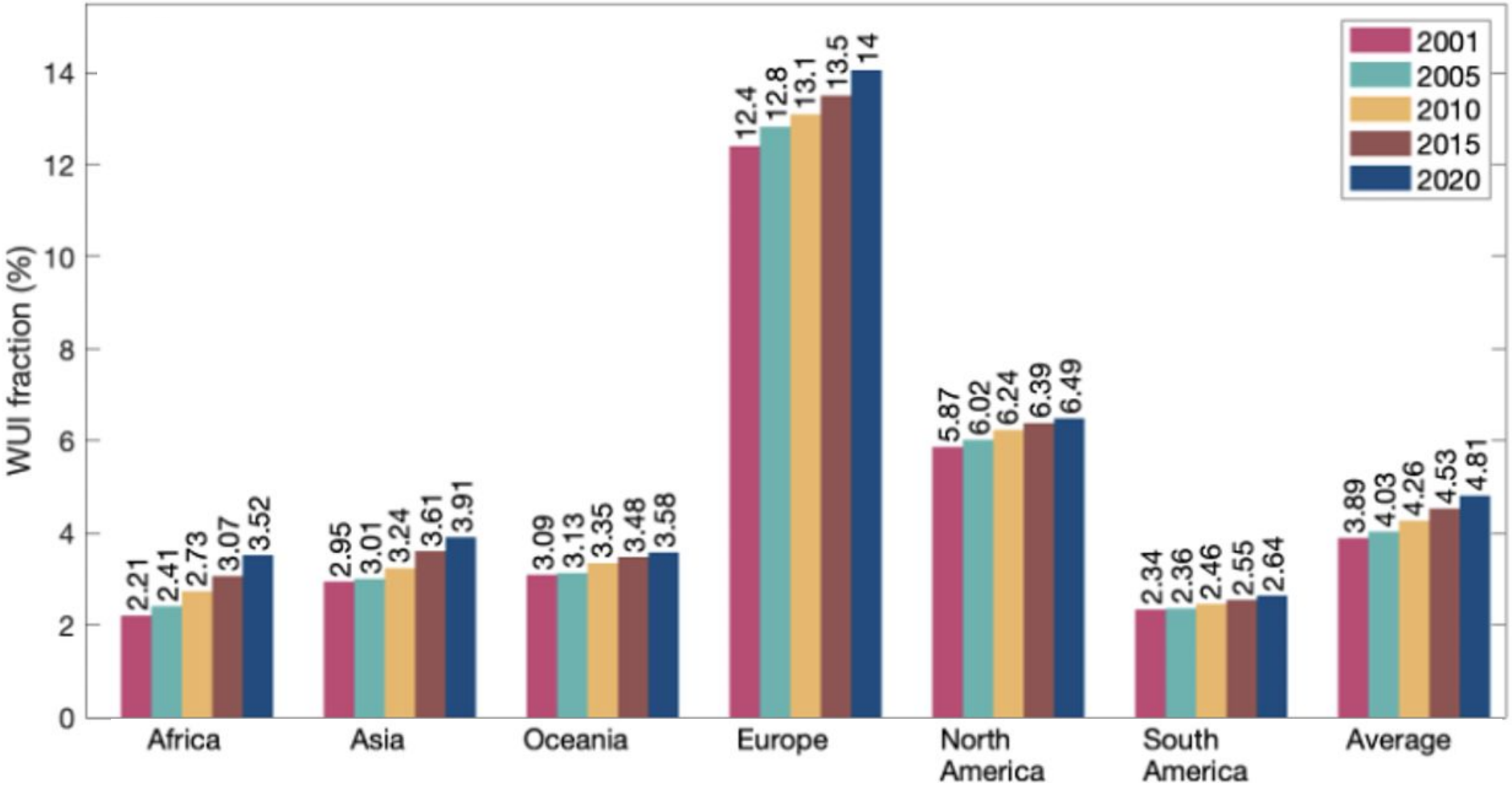
- In WUI, fire risk is relatively high
- WUI fires are closer to humans and properties
- Fire emissions from WUI fires can be more harmful
- WUI fires will become even more important in the future

# Worldwide Unified Wildland-Urban Interface (WUWUI)




We train a series of random forest models to predict WUI globally for past 20 years.
The outcome database is called Worldwide Unified Wildland-Urban Interface (WUWUI) database.

# Trend in fraction of land in WUIs

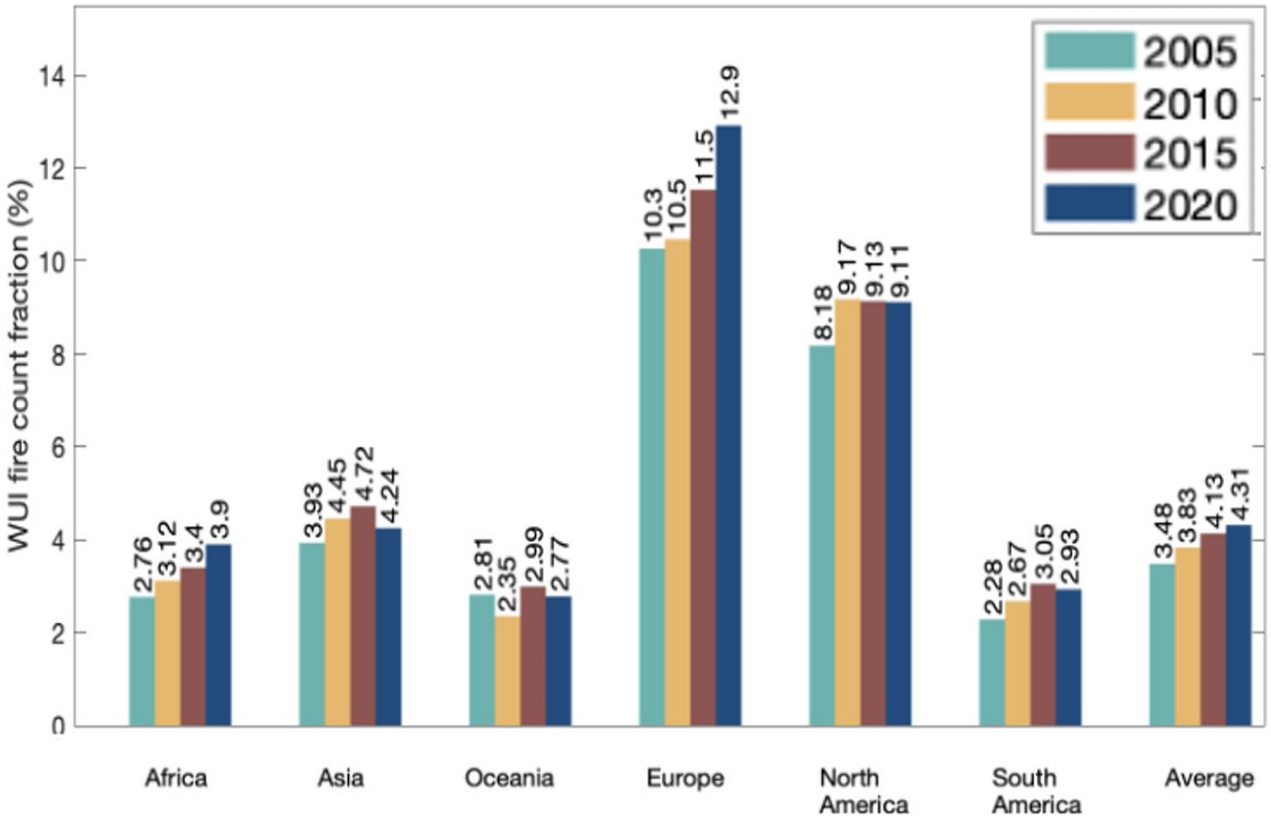



The global average fraction of land that is in WUIs (excluding Antarctica and oceans) is 4–5% during 2001-2020.

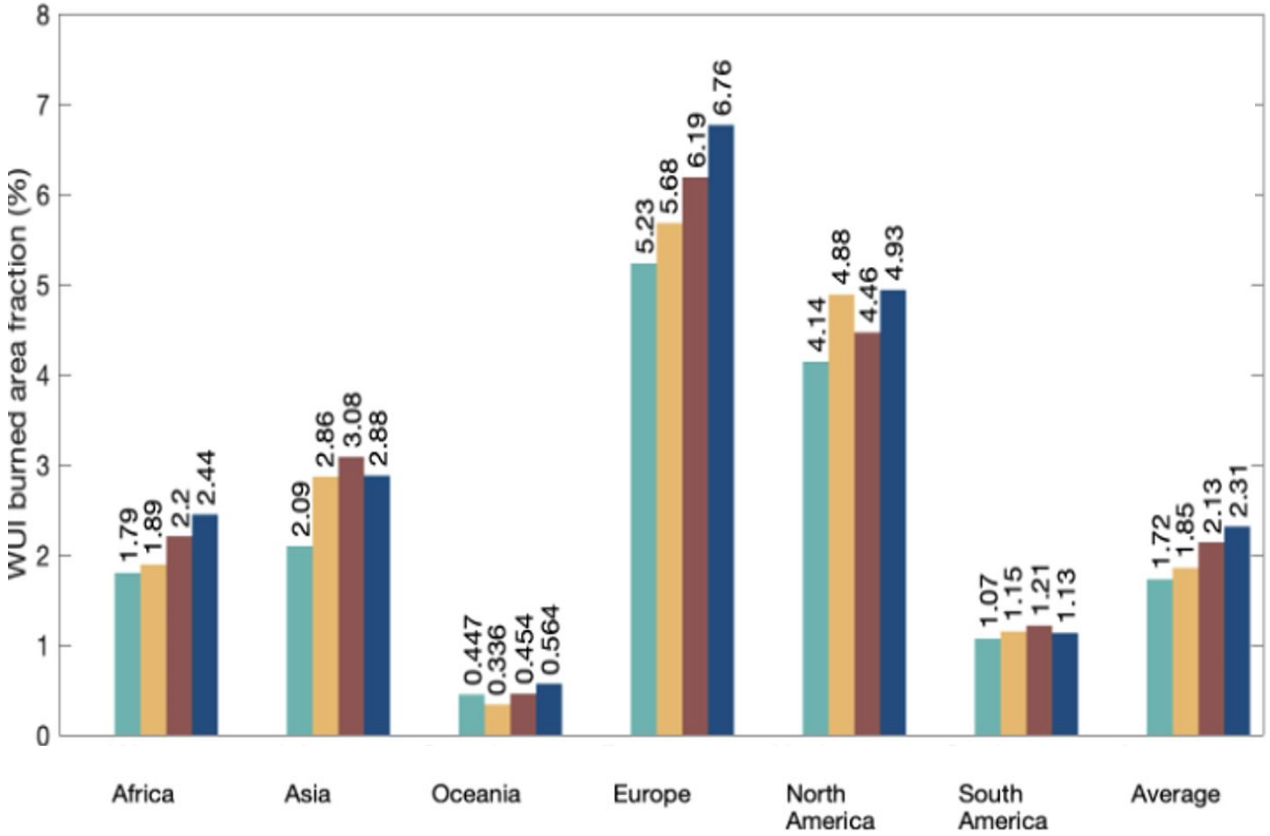
WUI has been increasing in all continents from 2001 to 2020.

# Trend in fraction of fires in WUIs

Fire count fraction in WUI




Burned area fraction in WUI

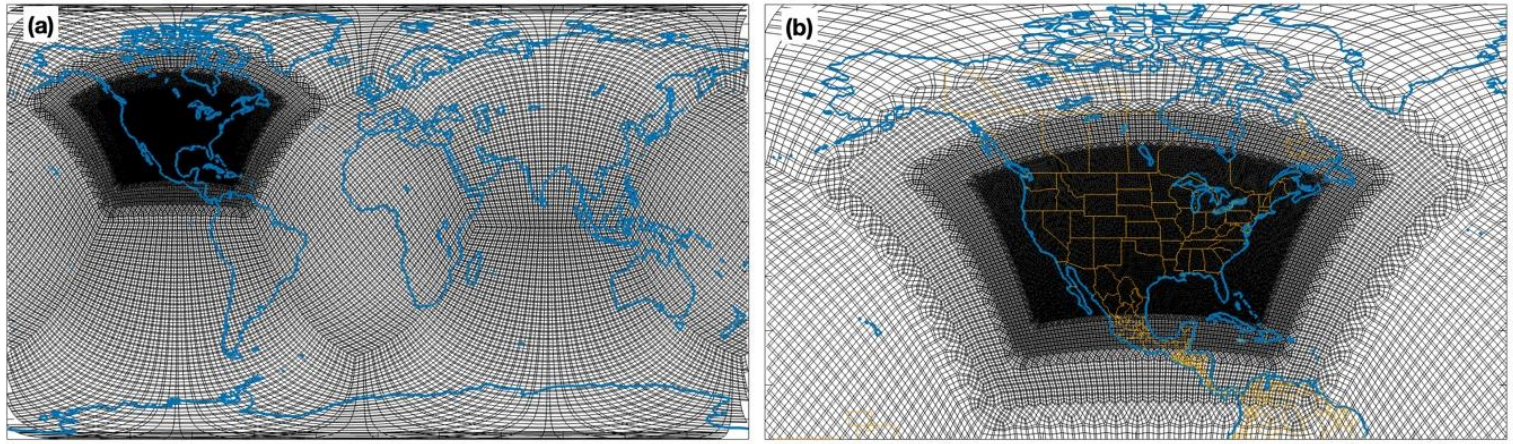



Global total fire counts and burned area (from MODIS) decreased from 2005 to 2020 whereas the WUI fraction of fire counts and burned area from 2005 to 2020 increases.

# MUSICAv0 simulations of WUI fire impacts

We run 4 MUSICAv0 simulations using the CONUS grid:

- No fire
- Wildland fire only
- WUI fire only
- All fires




**Disproportionally large impact of wildland-urban interface fire emissions on global air quality and human health**

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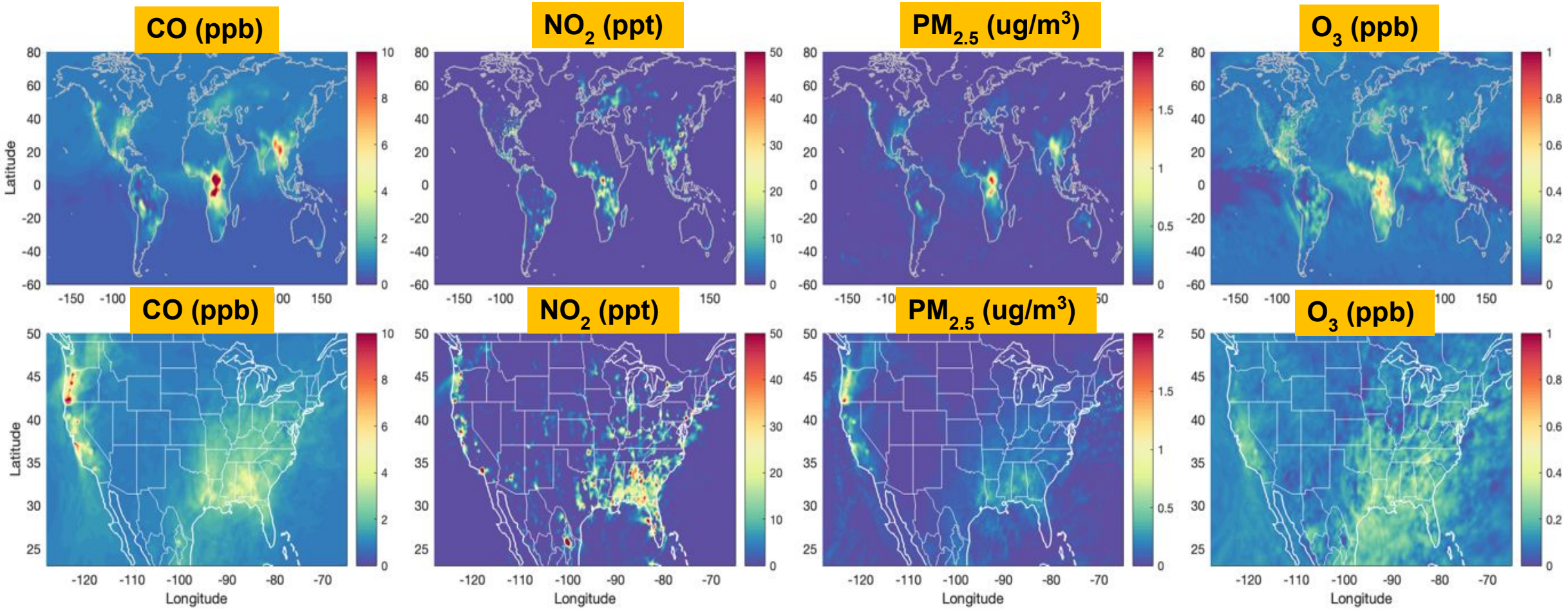
# WUI fire impacts on air quality

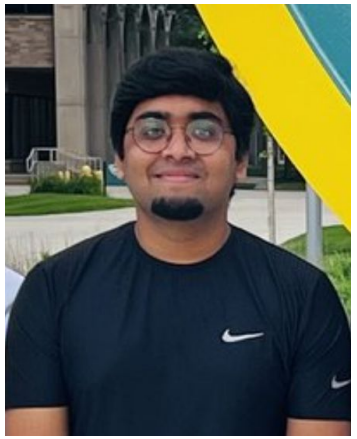
**WUI fires have notable impact on surface concentrations of key air pollutants (e.g., CO, $NO_2$, PM2.5, and $O_3$).**




*Annual average of global CO, $NO_2$, PM2.5, and $O_3$ at the surface due to WUI fires in 2020. The amounts due to WUI fires are from the difference of All-fires minus Wildland-fires-only. Lower panels are the same as upper panels but zoomed in to the conterminous U.S.*

# WUI fire impacts on health

**We calculate the annual total premature deaths (APDs) attributable to $PM_{2.5}$ and $O_3$ exposure.**



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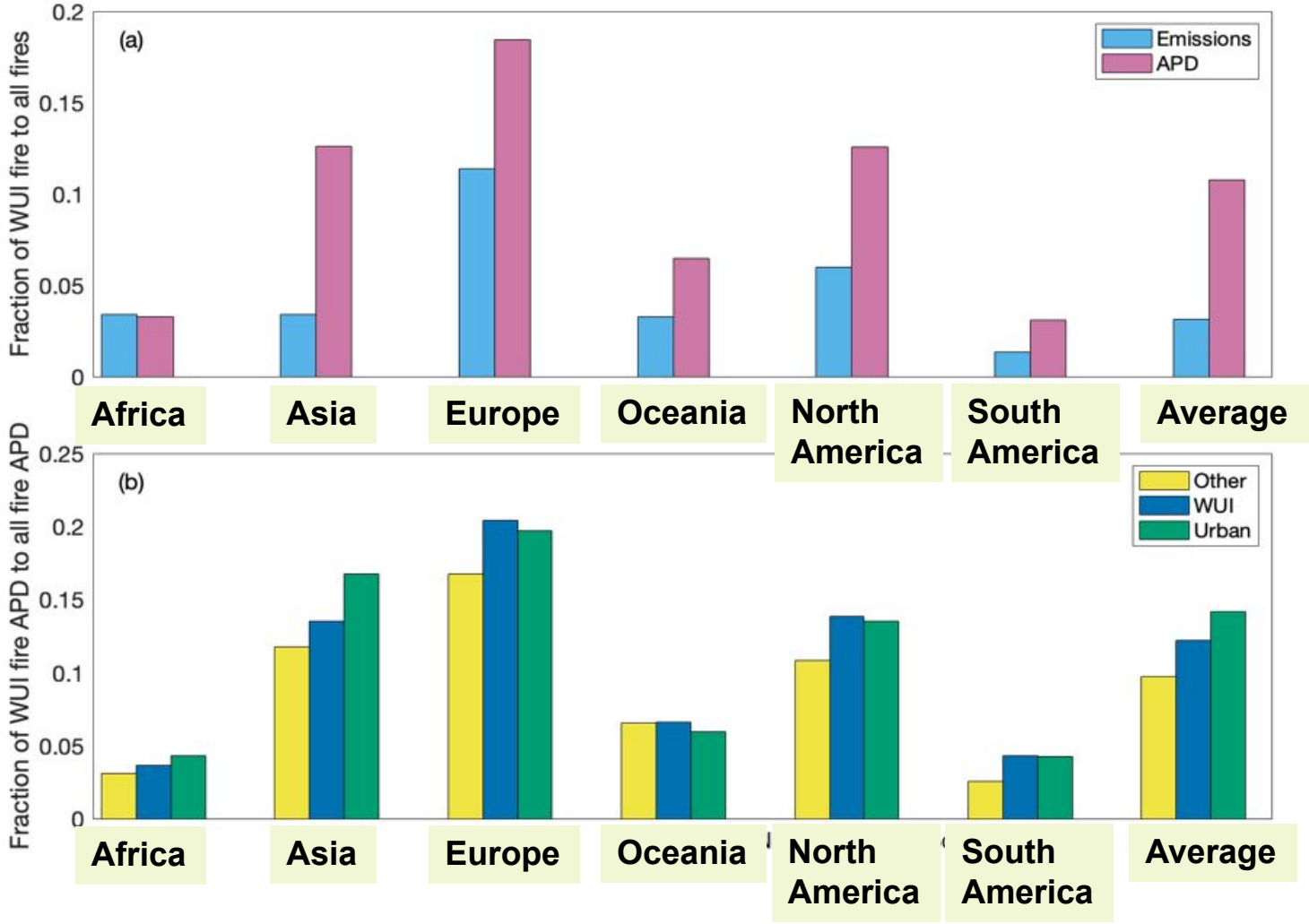
For $PM_{2.5}$, we calculate APDs due to lower respiratory infections (LRIs) and four non-communicable diseases (NCDs), namely chronic obstructive pulmonary disease (COPD), ischemic heart disease (IHD), stroke, and lung cancer.

For $O_3$, we quantify the APDs attributable to COPD.

# WUI fire impacts on health




The global health impact of WUI fire emission is disproportionally large compared to wildland fires primarily because WUI fires are closer to human settlement.

**At the global scale, the fraction of WUI fire-caused annual premature deaths (APD) to all fire-caused APD is about 3.5 times of the fraction of WUI fire emissions to all fire emissions.**

*(a) Fraction of WUI fire $CO_2$ emissions to all fire $CO_2$ emissions (blue) and fraction of APD due to WUI fires to APD due to all fires (pink). (b) Fraction of APD due to WUI fires to APD due to all wildfires over WUI (blue), urban (green), and other land type (yellow).*

# Take-home messages

- **Fires in the wildland-urban interface (WUI) are a global issue with growing importance.**
- **We developed a global WUI dataset called WUWUI to show increasing trend of WUI and WUI fires in the past 20 years.** (available at https://zenodo.org/records/10703310)
- **We run MUSICAv0 model to show the significant impacts of WUI fire on air quality and health.**
- **Thank you!**

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