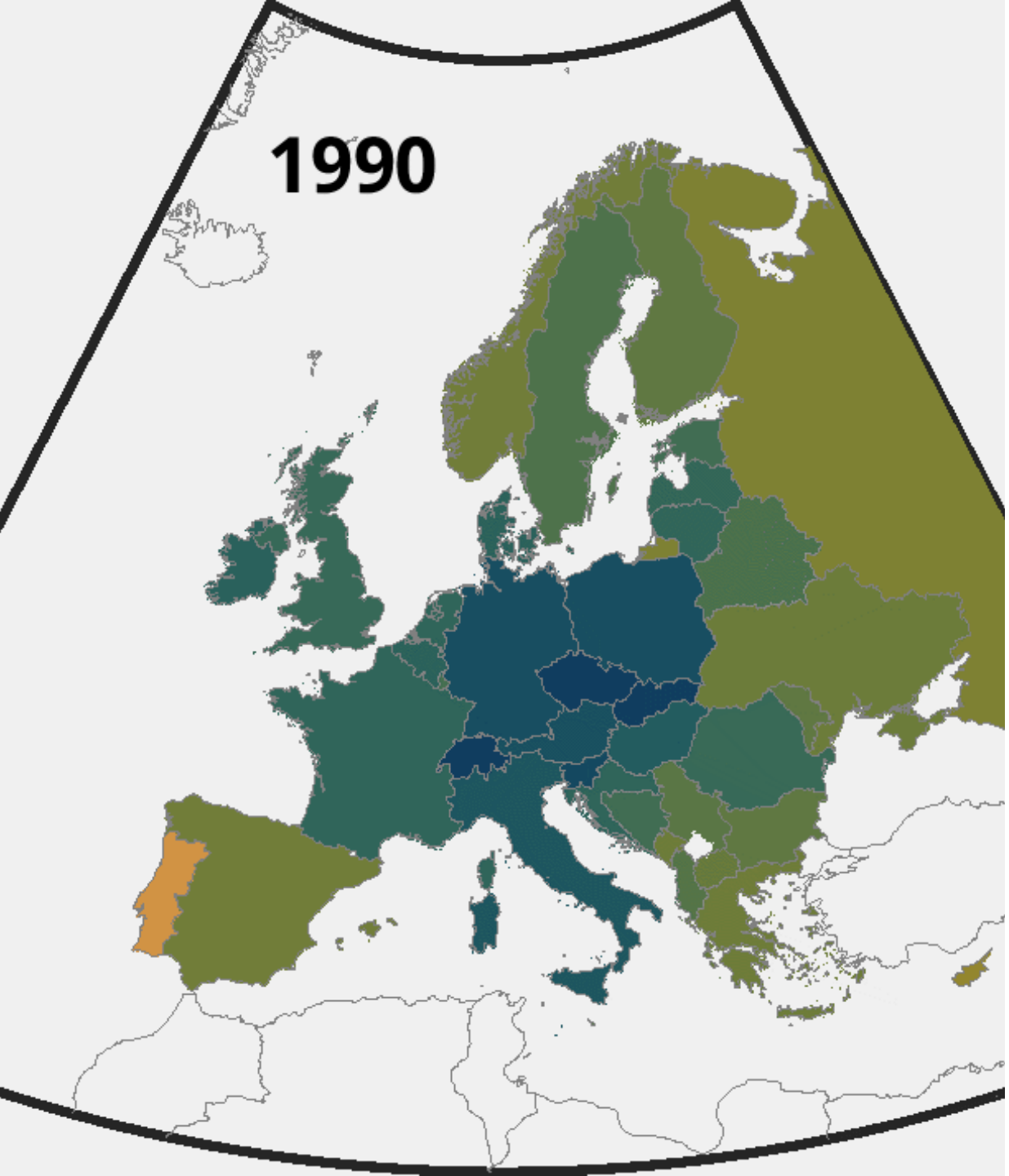


Contribution of forest fires to annual ambient air pollution and related excess deaths: Present status and future projections

Sourangsu Chowdhury, Kristin Aunan, Mikhail Sofiev, Risto Hanninen

EXHAUSTION

Introduction

- Climate change affects air pollution.
- The main effect of meteorological factors is on natural emissions and wildland fires.
- Over the past decade, there has been a surge in the incidence of large and uncontrolled fires on all vegetated continents
- Wildfires may exacerbate or result in a range of health issues, including respiratory and cardiovascular endpoints.
- Emissions from wildfires can be more toxic compared to other sources.

University of California Berkeley, Sept 2020 (10 am).

Picture courtesy- Josh Apte.

Objectives and Methods

The objective of this work is to quantify the contribution of forest fires on long-term air pollution exposure and chronic impacts on human health for the present and future scenarios.

Fire emissions are generated with a newly developed Fire Forecasting model which can produces fire emissions beyond the MODIS lifetime.

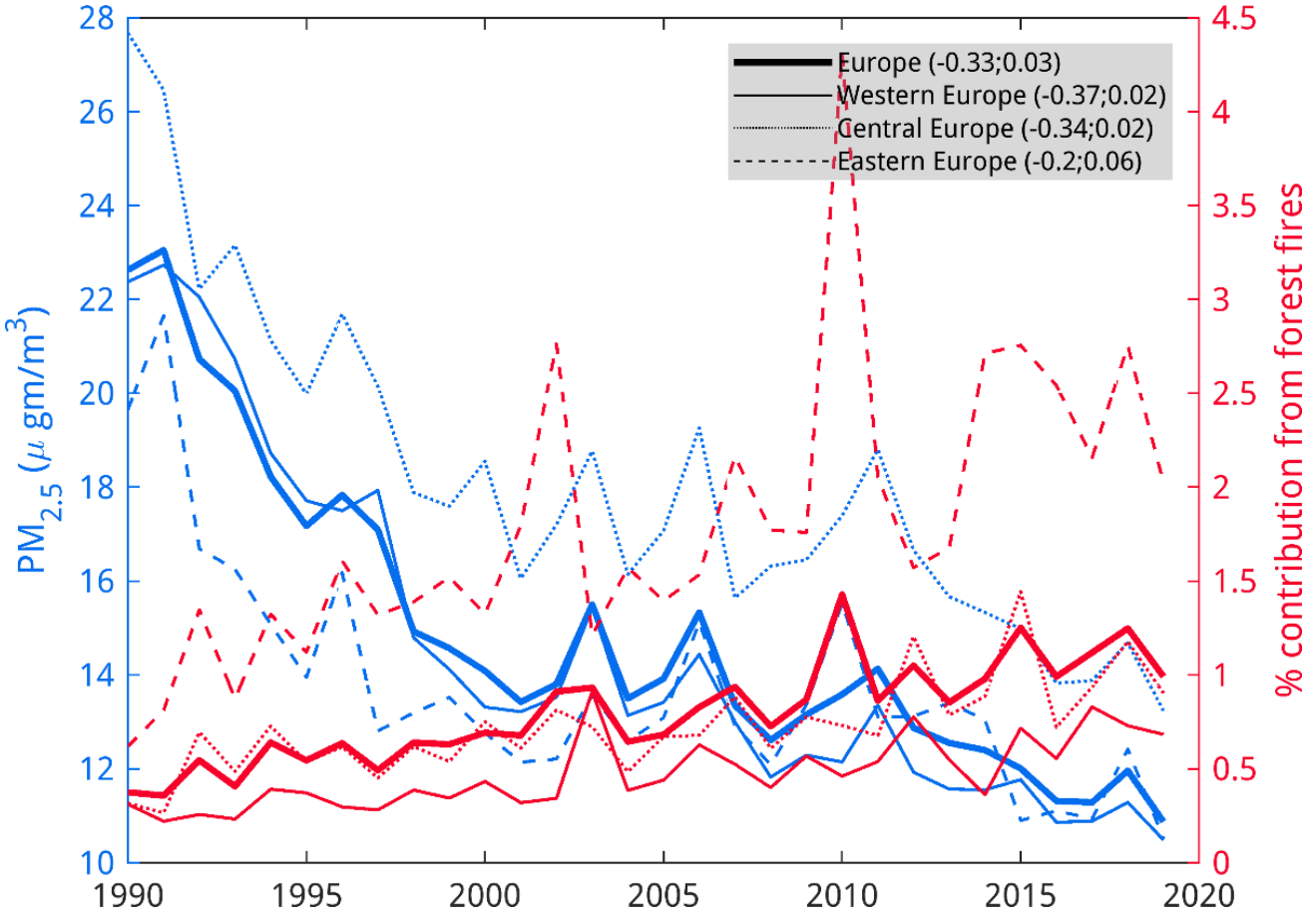
All anthropogenic sectors from CEDS- including industries, domestic, power generation, agricultural activities etc.

Emissions fed into a global chemical transport model.

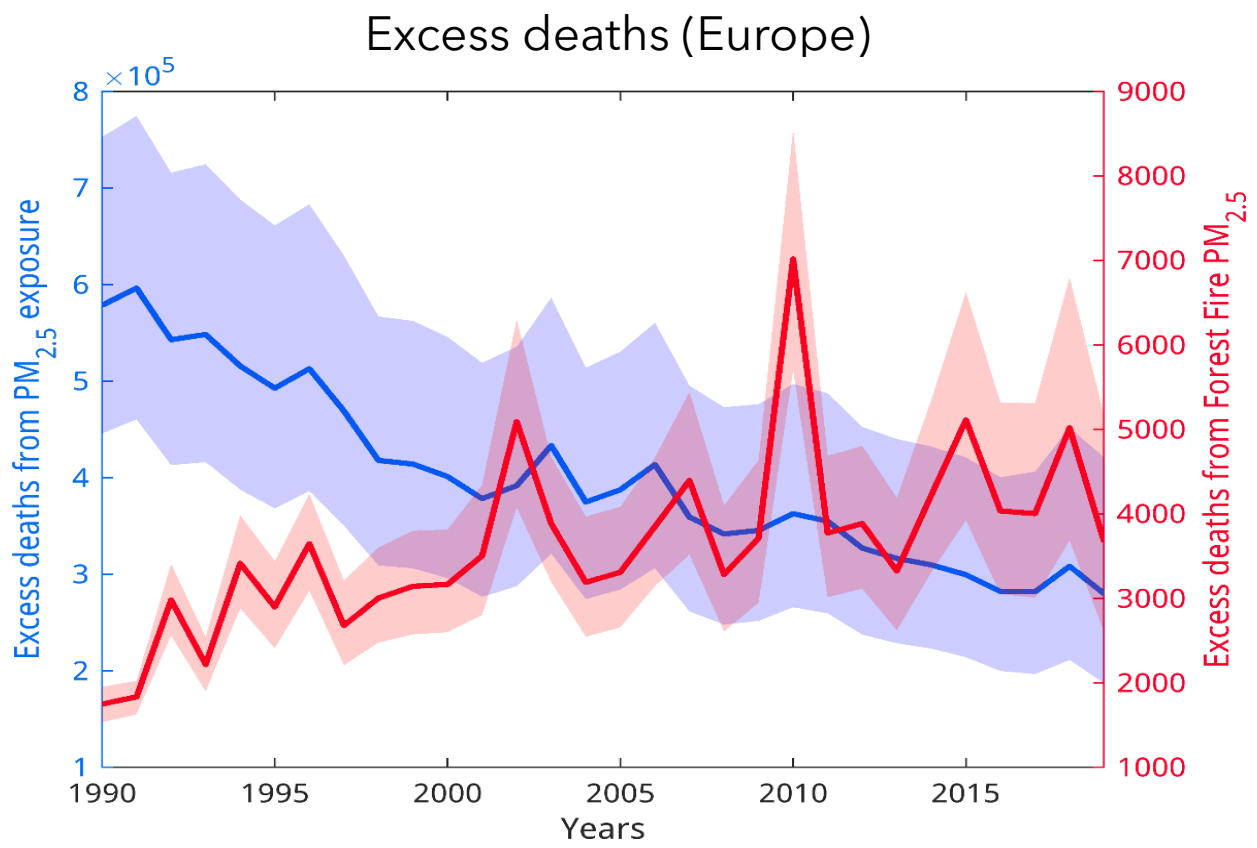
Resulting outputs at ~2°x 2° horizontal resolution globally (and at 20km over Europe) from 1990-2100 under 3 scenarios SSP126, SSP245 and SSP370, were used for health impact assessment.

Increasing importance of forest fires in Europe

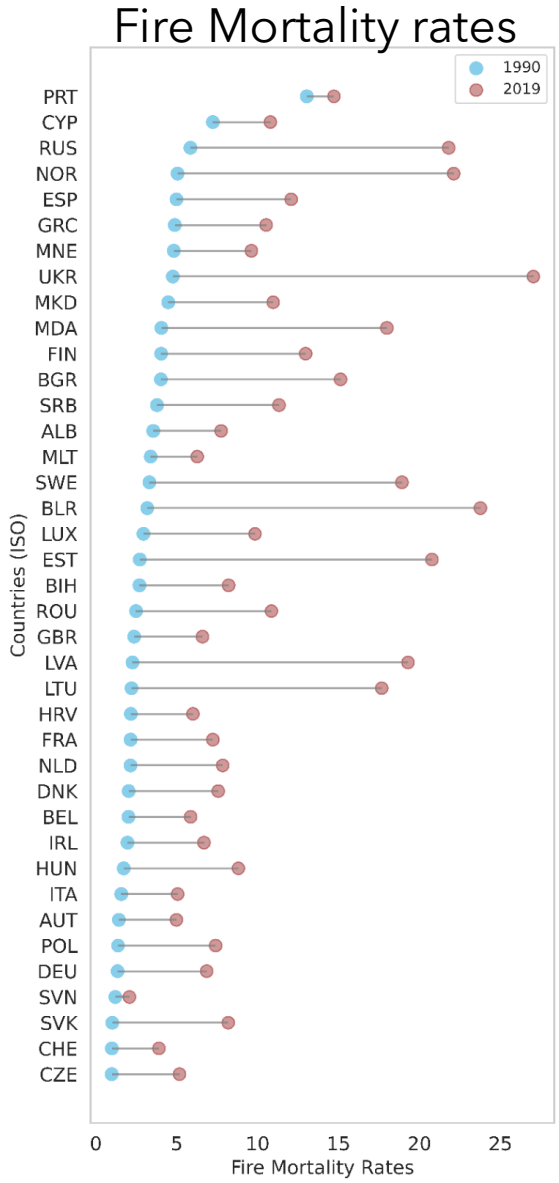
- Ambient air pollution - $PM_{2.5}$ exposure reduced by more than 50% in Europe in 2019 compared to 1990 levels.
- We observe a rising trend in the contributions of forest fires over the 30-year period, at a rate of more than 0.03% per year.
- The absolute exposure to forest fire $PM_{2.5}$ increased by more than 90% in the period.



Increasing importance of forest fires in Europe

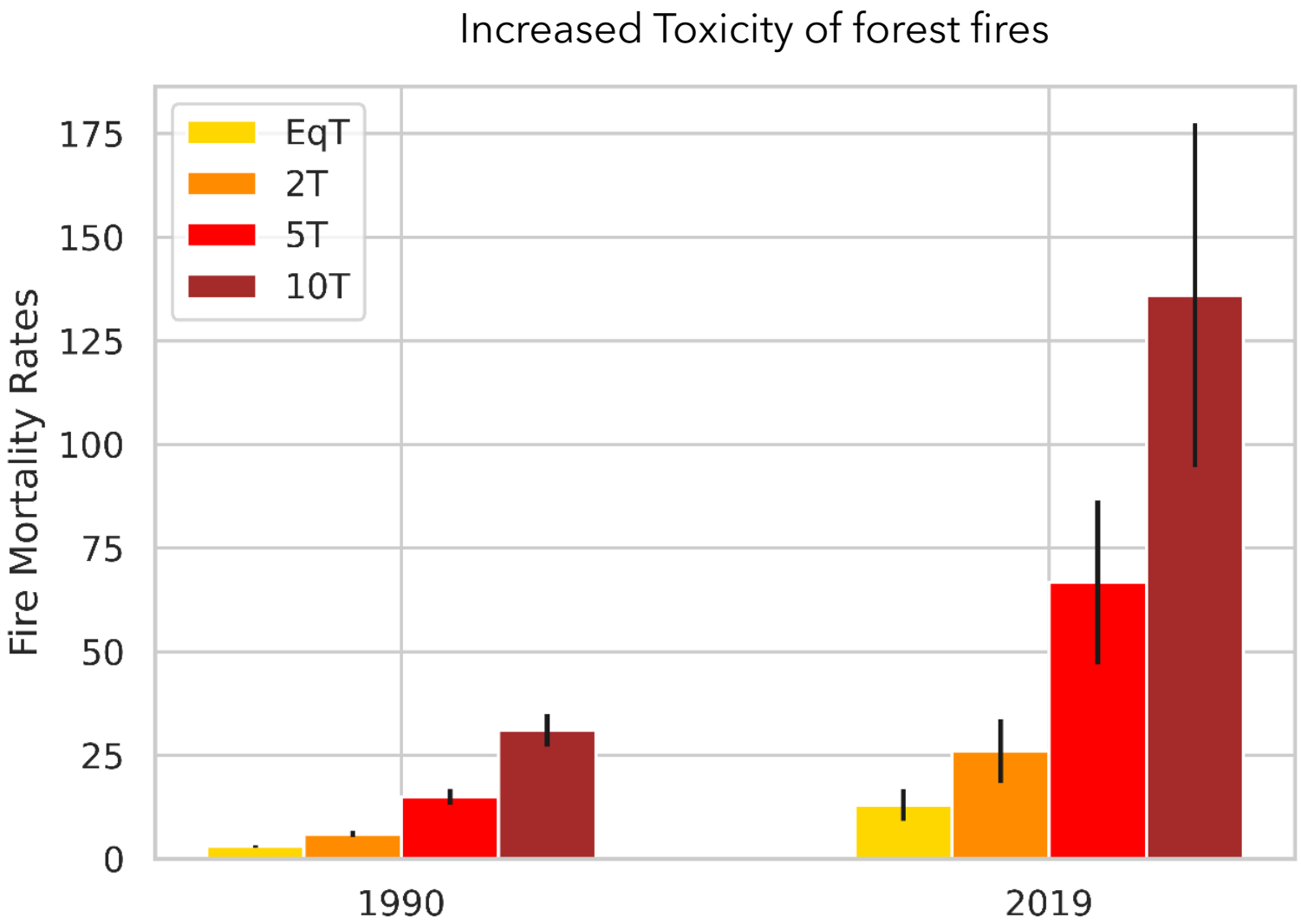


We estimate the excess deaths from exposure to ambient air pollution - $PM_{2.5}$ to decrease by more than 50% from 1990 to 2019, while the excess deaths attributable to forest fires were estimated to increase by more than 100%



Fire Mortality rates = Excess deaths from forest fires/1000 deaths from ambient PM2.5

Increasing importance of forest fires in Europe

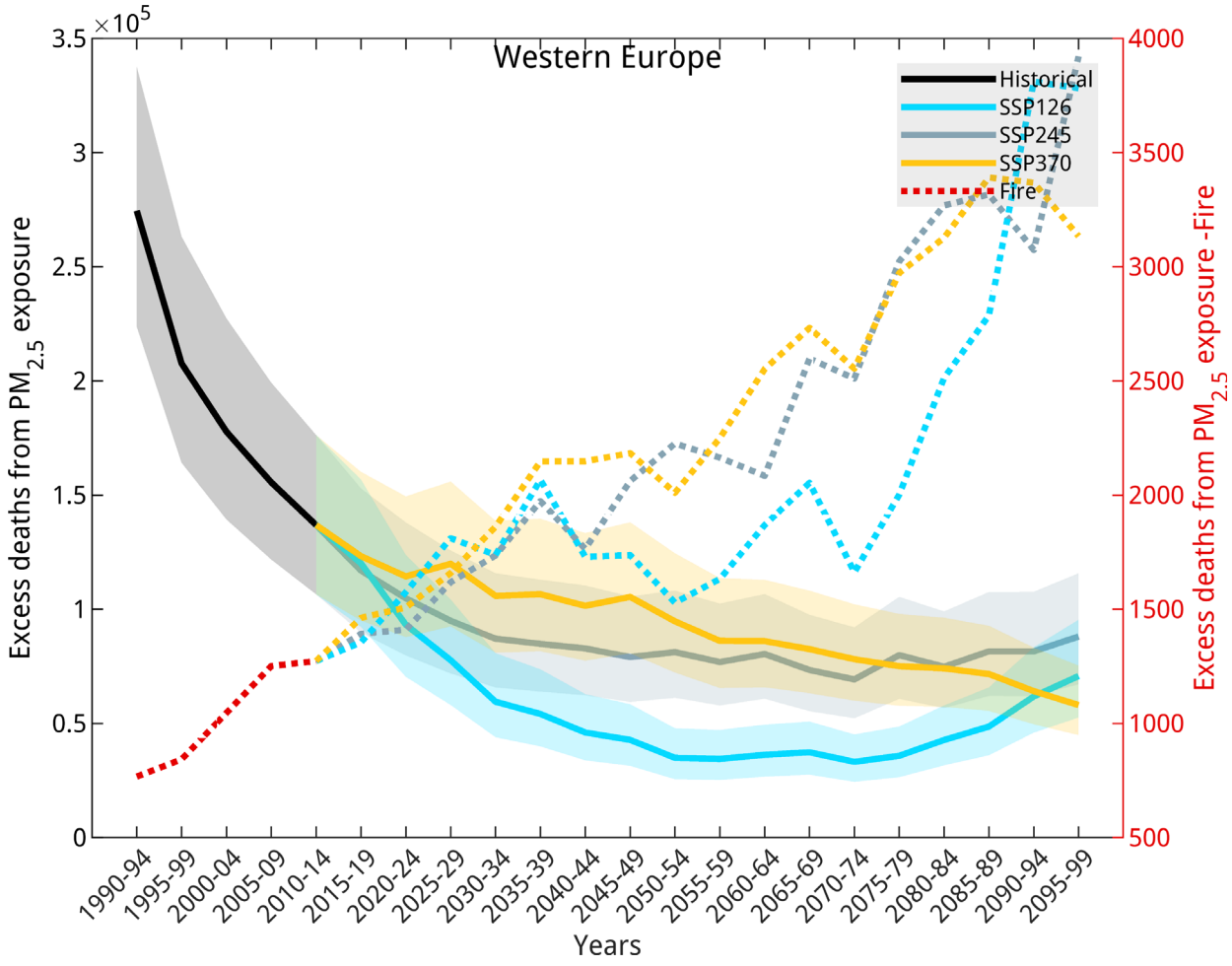


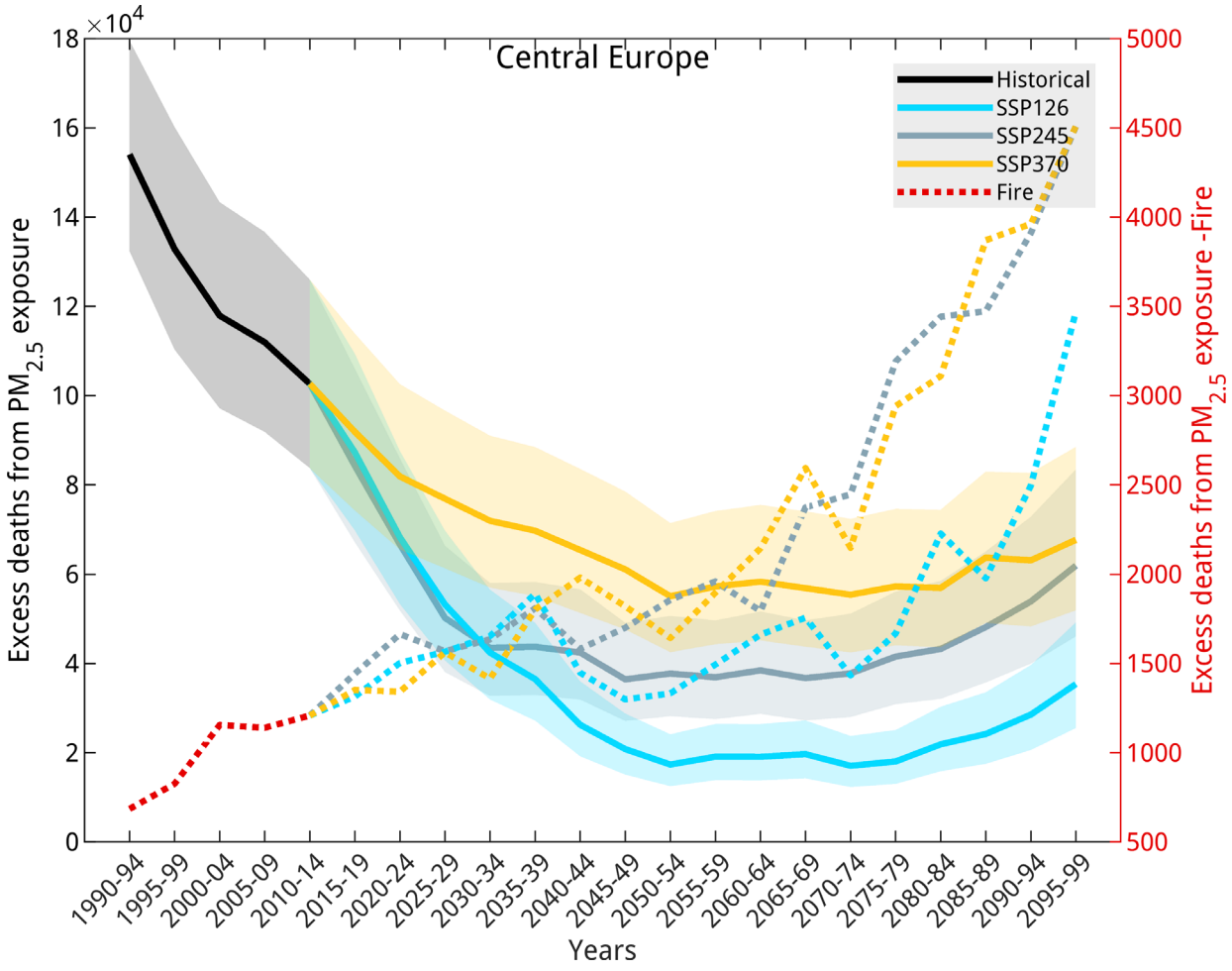
By considering forest fire emissions to be 10x more toxic, ~13.6% of total $PM_{2.5}$ related excess deaths in 2019 over Europe may be attributed to forest fires.

25% of the total excess deaths in Eastern Europe may be associated with forest fires in 2019.

10% and 7% deaths in Central and Western Europe can be associated with forest fires.

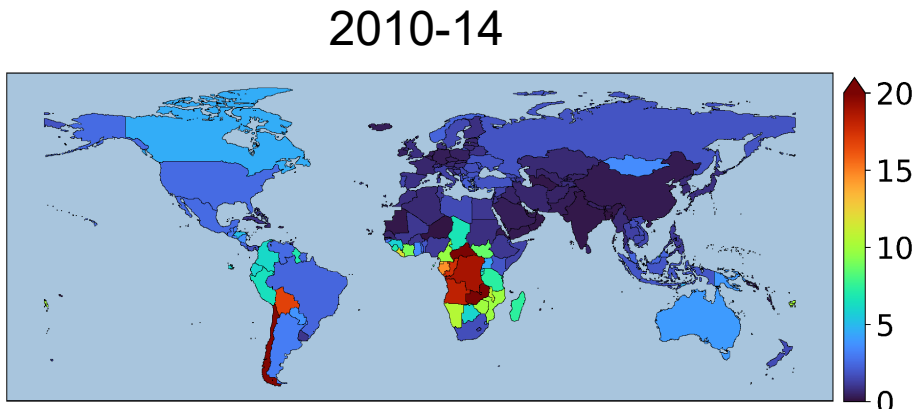
What the future holds?

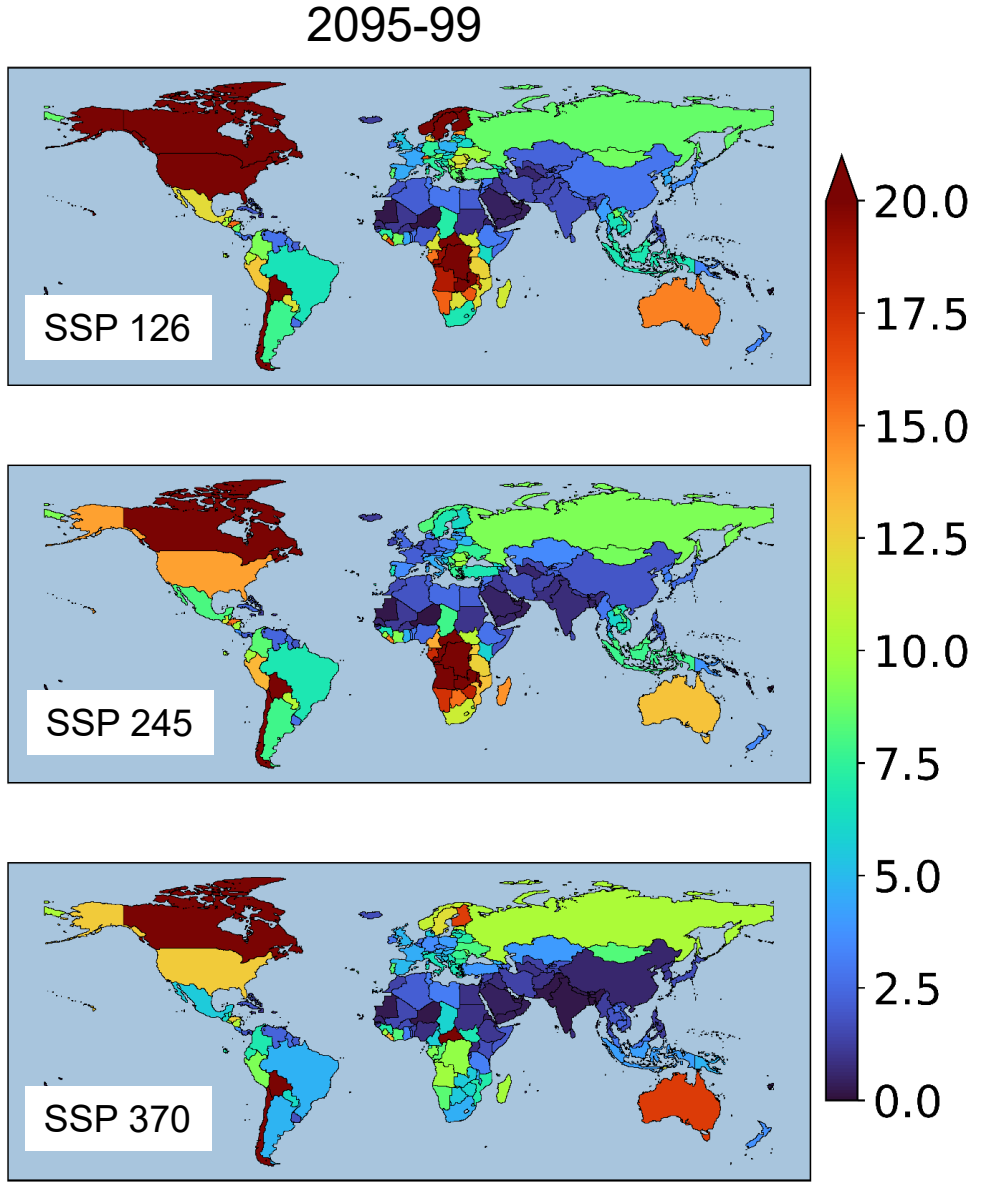




Excess deaths from forest fires are projected to increase by ~6x in 2095-2100 as compared to 2014 under the most optimistic scenario in Europe and even larger increase in the least optimistic scenario

% contribution of Forest fires to excess deaths in future





Forest fires are expected to become a significant source by end of the century in SSP126, majorly due to stricter air pollution control resulting in significantly lower contribution of anthropogenic sources.

°CICERO

Conclusions

- Forest fires are increasingly becoming an important source of PM2.5 related mortality in Europe, counteracting the improvements in air quality.

- If these emissions are more toxic compared to other sources, they may result in 13% of all excess deaths from air pollution in Europe

- It is expected to result in at least 6x more deaths in Europe compared to present day at end of the century under the most optimistic scenario

Athens, September 2022
Photo- Sourangsu Chowdhury

Recommendations

- Even in the most optimistic emission scenarios, it is anticipated that contributions from forest fires to ambient air pollution will increase in the future and make it difficult to meet the air quality guidelines. Consequently, robust adaptation measures, continued effective forest management and preparedness are essential to address these challenges.

- Episodes of heat waves are frequently accompanied by wildfires, potentially exacerbating health risks. Adequate health preparedness is essential in anticipation of such events expected in the future.

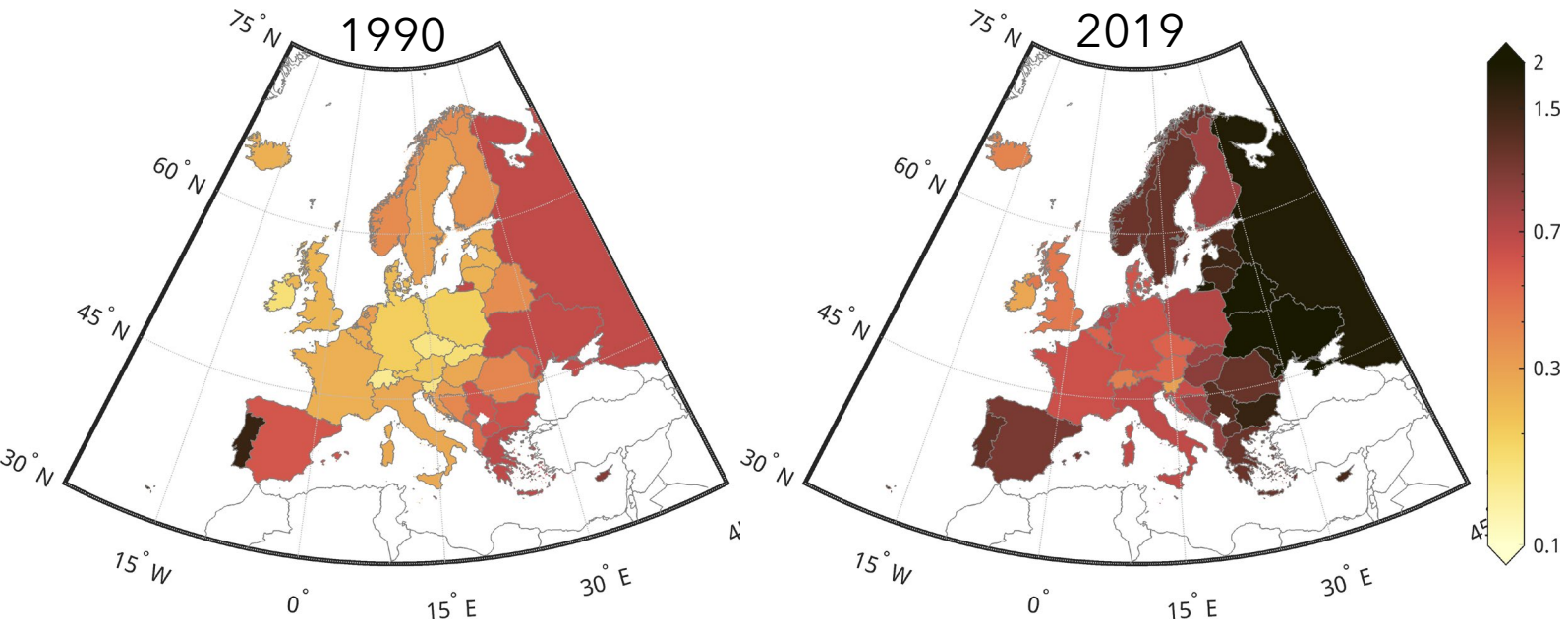
°CICERO

Thank you

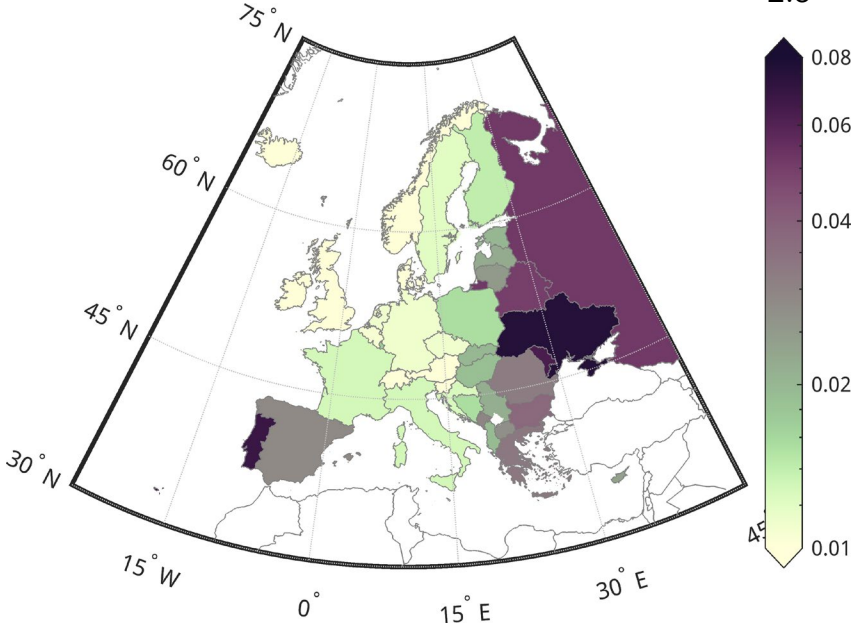
sourangsu.chowdhury@cicero.oslo.no

Increasing importance of forest fires in Europe

% contribution of forest fire to ambient PM2.5

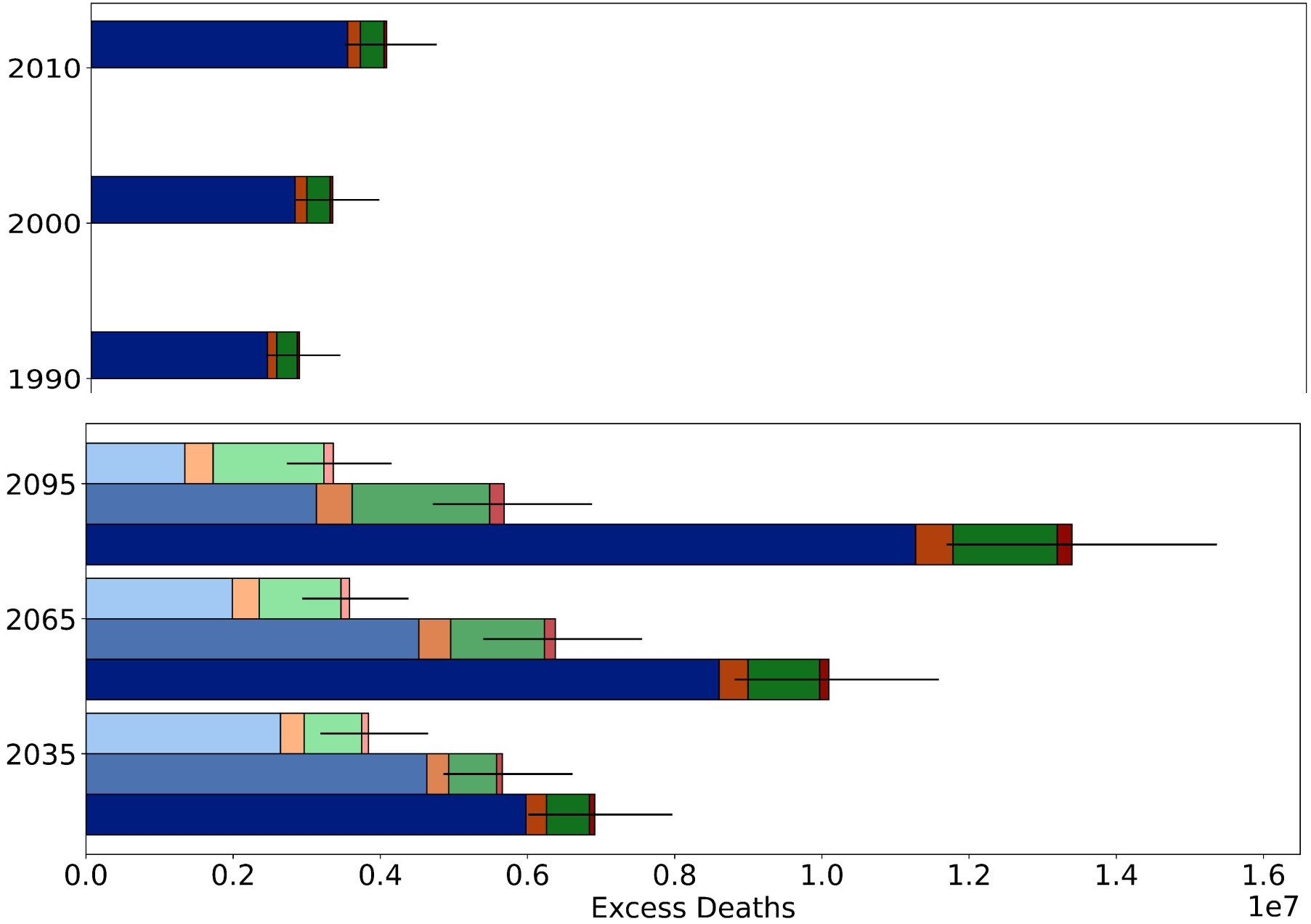


Rate of change (%/year) of forest fire's contribution to ambient $PM_{2.5}$



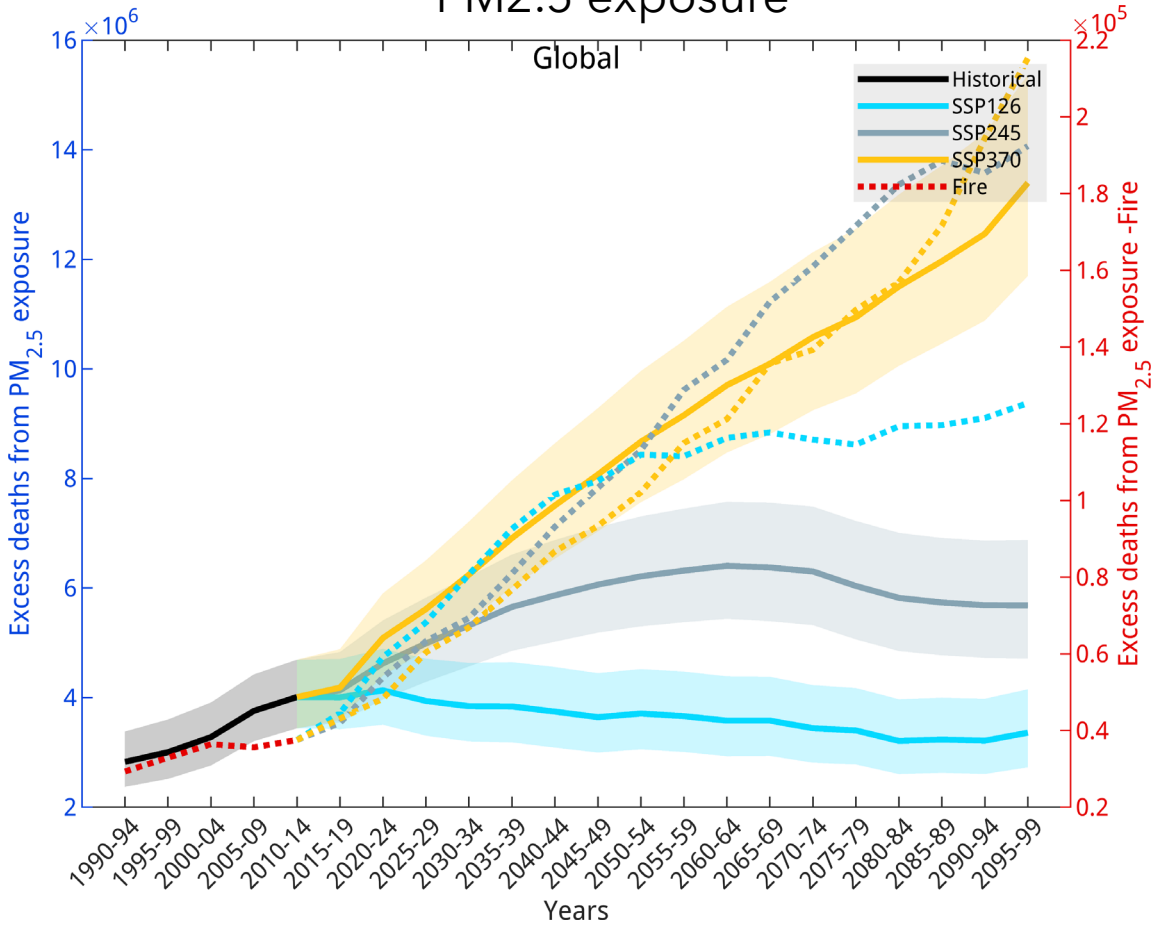
The trend of increasing contribution of forest fires to ambient PM2.5 is especially pronounced in Central , Eastern European and Mediterranean countries

Putting Forest Fires in light of other sources



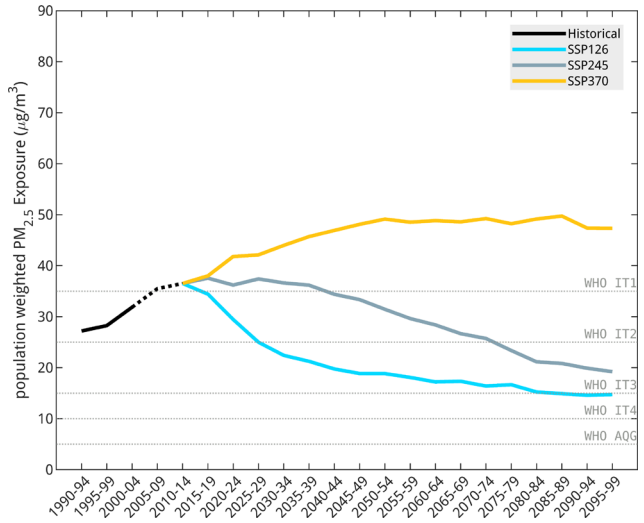
What the future holds?

Excess deaths from PM2.5 and forest fire PM2.5 exposure

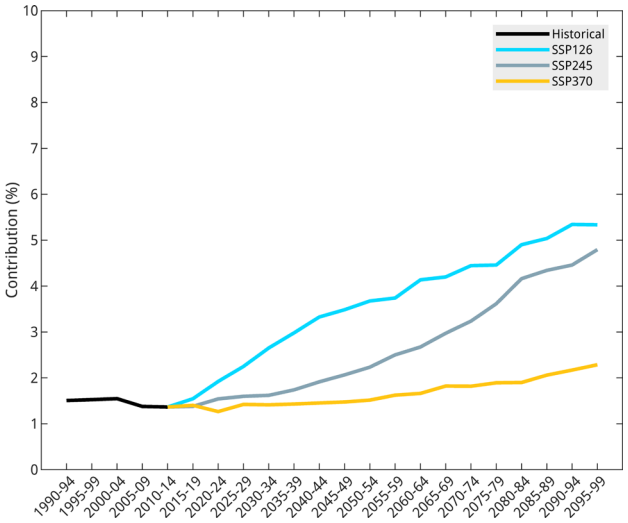


Excess deaths from forest fires are projected to increase by ~4x in 2095-2100 as compared to 2014 under the most optimistic scenario and by 7x under SSP370

Population weighted PM2.5

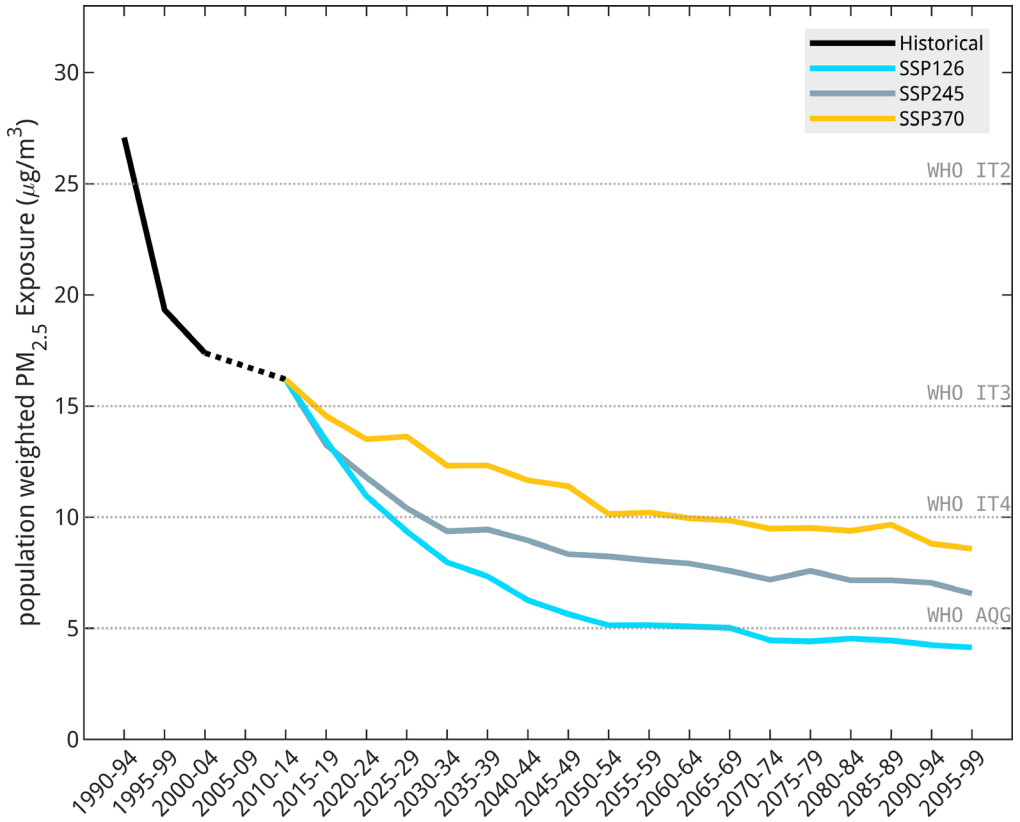


Contribution from fires

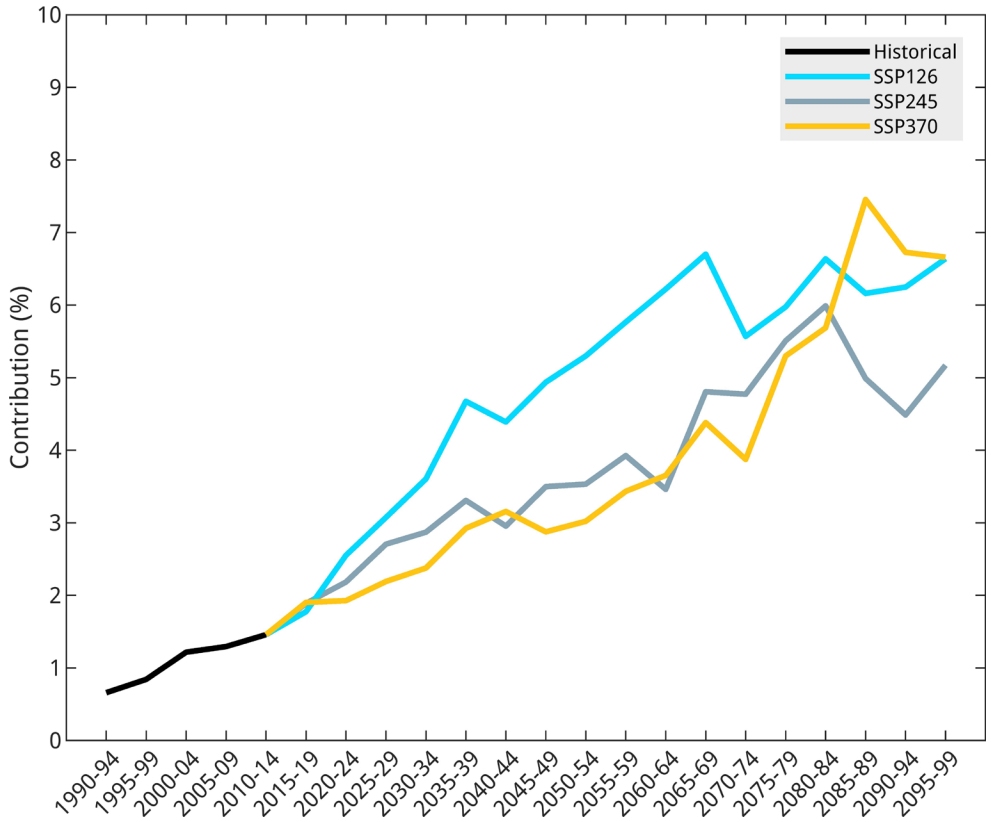


What the future holds?

Population weighted $PM_{2.5}$ exposure
Europe



% contribution from forest fires
Europe

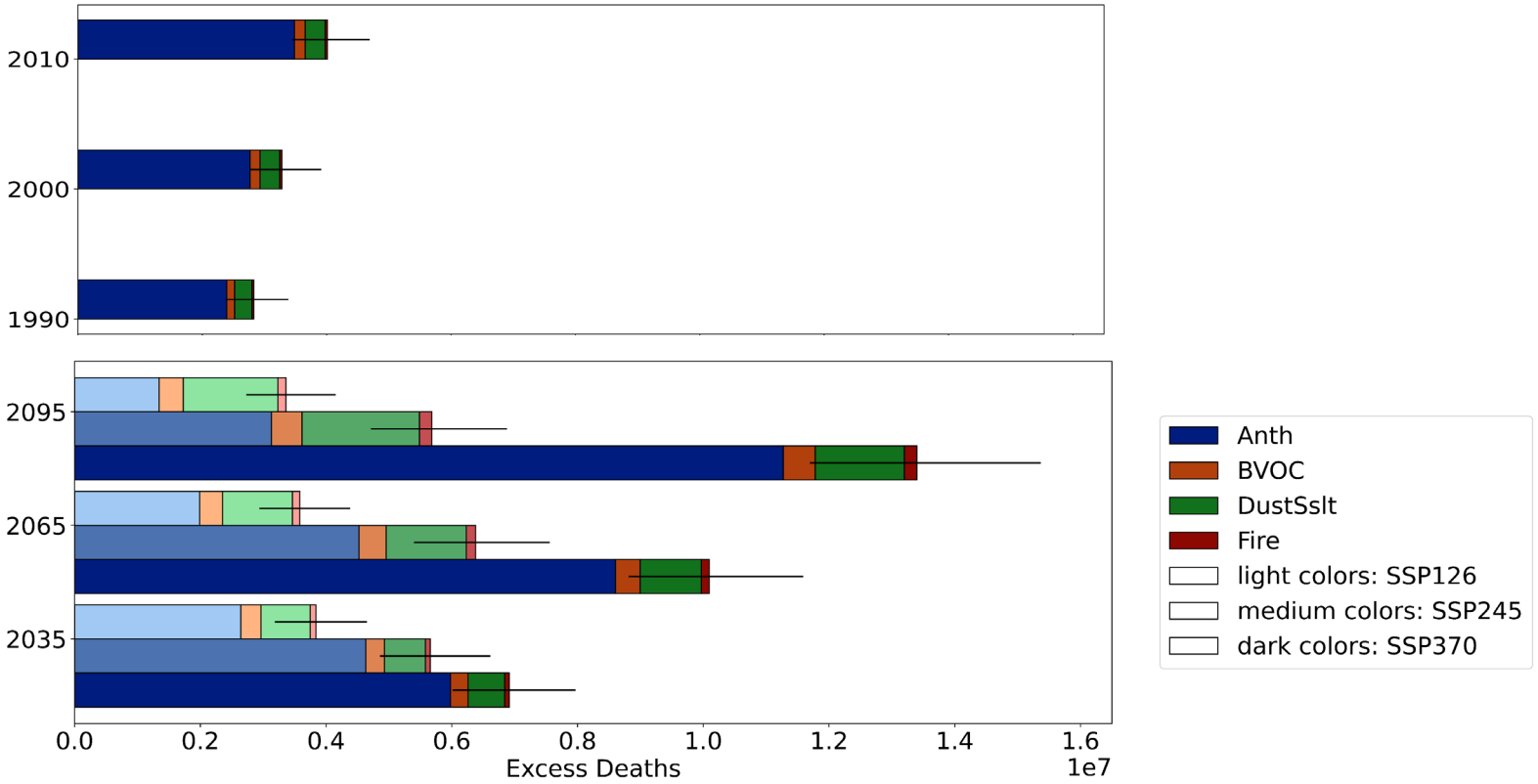


Conclusions

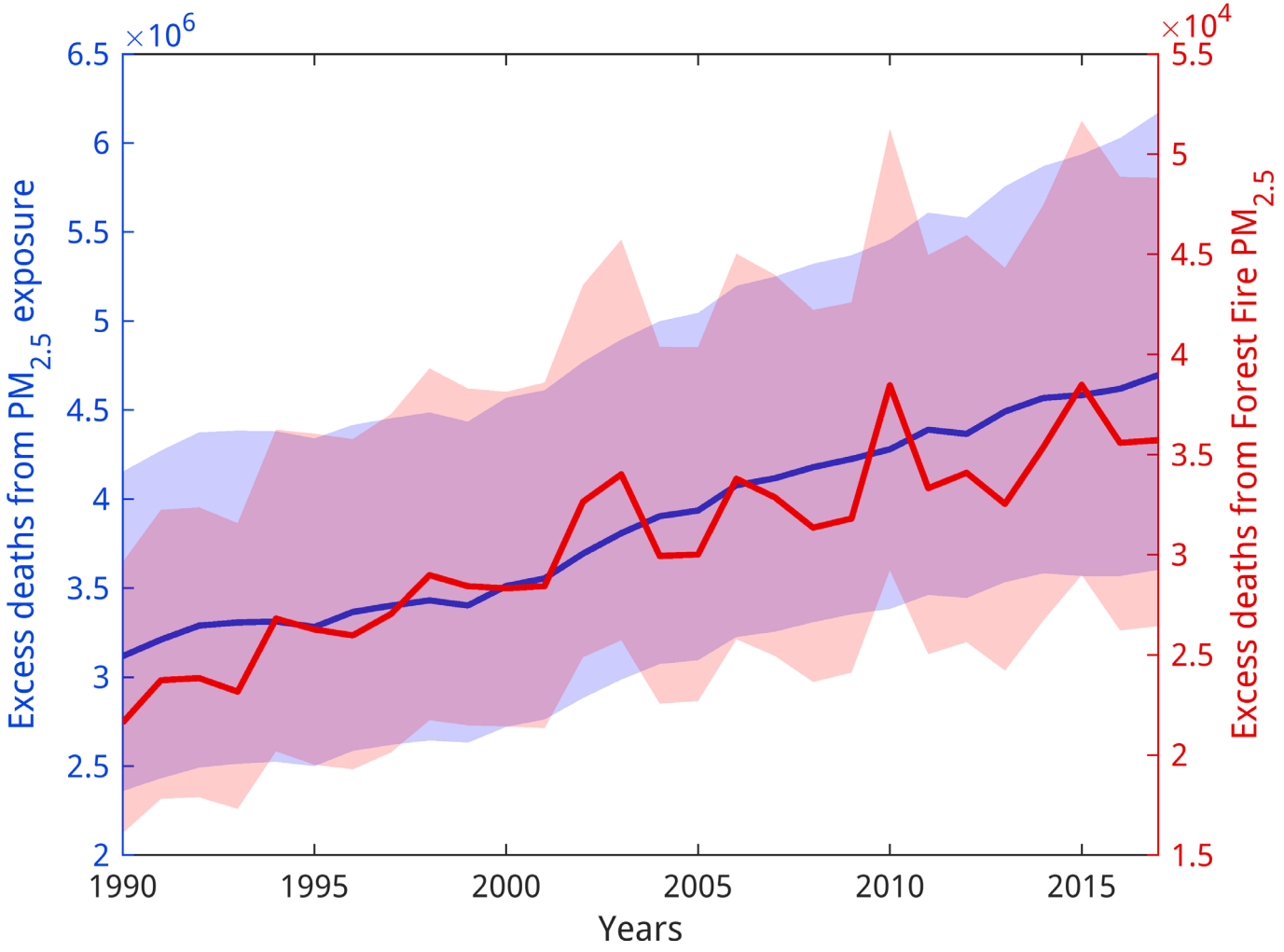
- Forest fire is an important source contributing between 36000-200000 excess deaths per year globally

- Forest fires are increasingly becoming an important source of PM2.5 related mortality in Europe, especially in Eastern and Central Europe

- It is expected to result in 7x more deaths compared to present day in the last pentad under one of the least optimistic scenarios



Increasing importance of forest fires globally

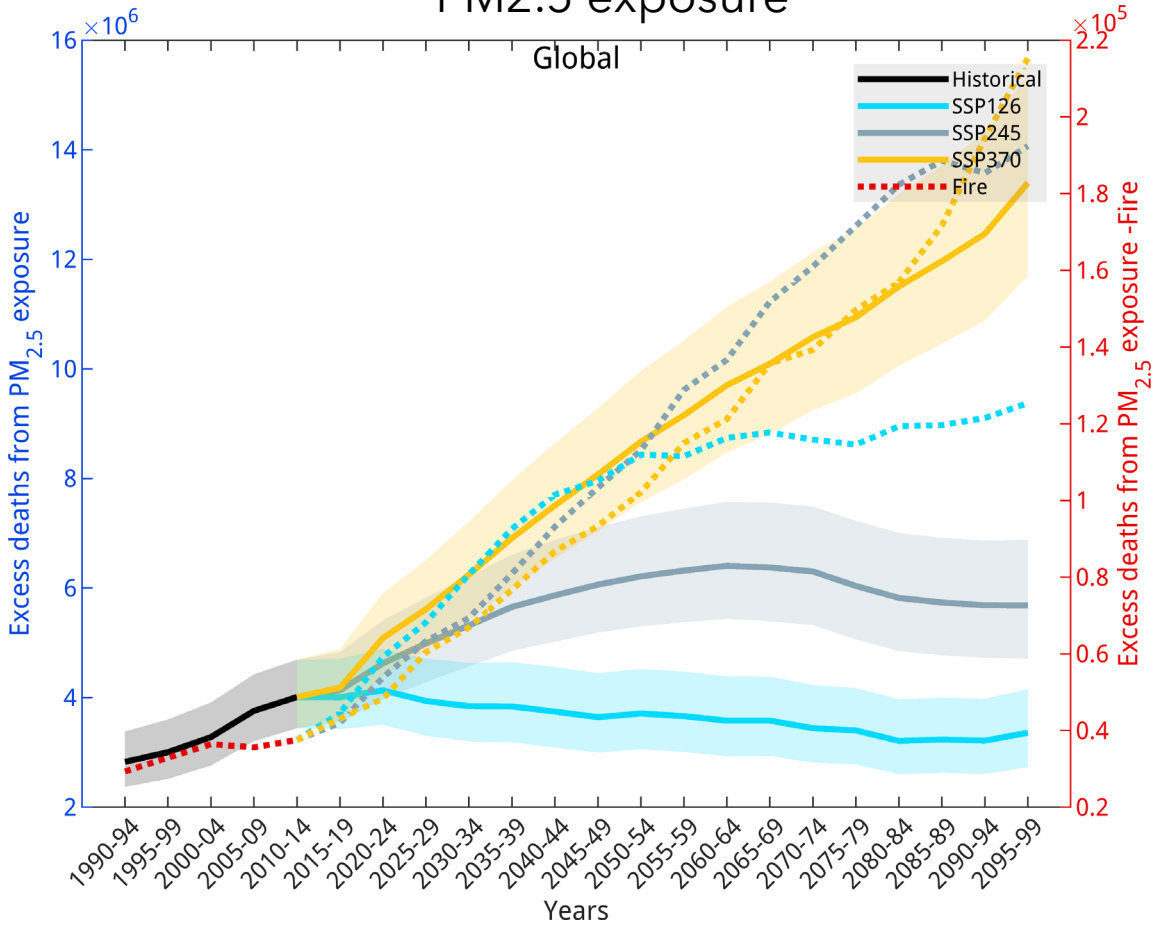


Globally Forest fires were found to contribute to ~36000(27000-48000) or <1% to the total excess deaths from $PM_{2.5}$ exposure in 2017.

In sub-Saharan Africa, North and South America, their contribution is substantially higher (10-15%).

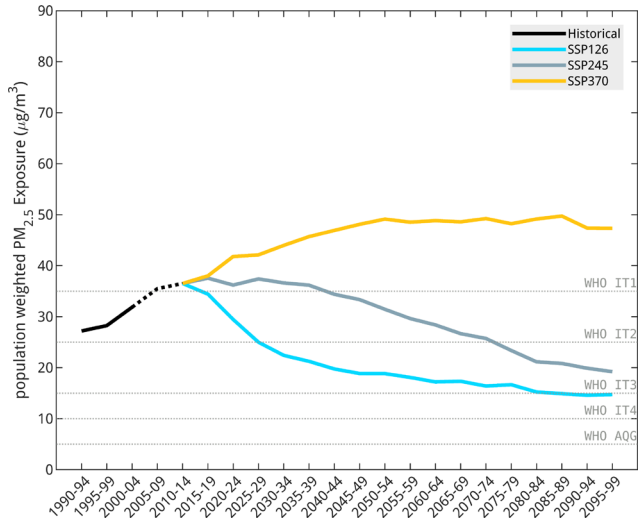
What the future holds?

Excess deaths from PM2.5 and forest fire PM2.5 exposure

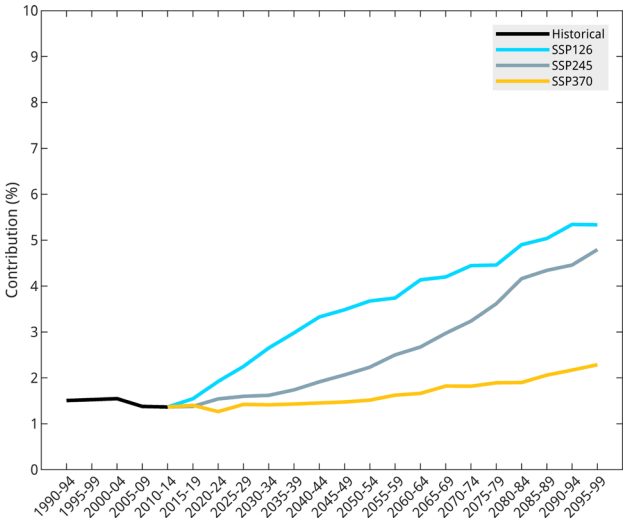


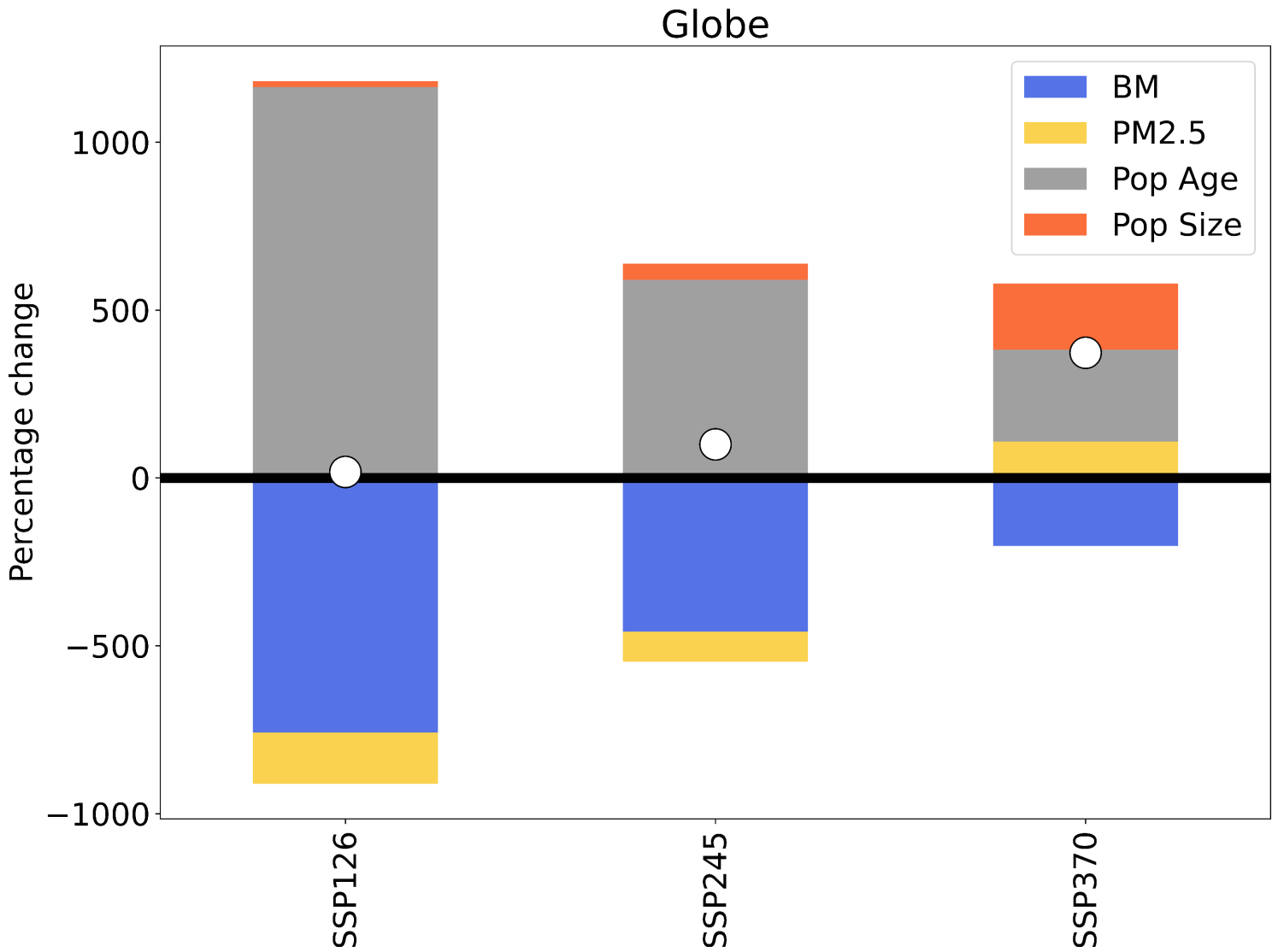
Excess deaths from forest fires are projected to increase by ~4x in 2095-2100 as compared to 2014 under the most optimistic scenario and by 7x under SSP370

Population weighted PM2.5



Contribution from fires




Globe
BM
PM2.5
Pop Age
Pop Size
Percentage change
1000
500
0
−500
−1000
SSP126
SSP245
SSP370