# Competing anthropogenic effects cause distinct regional impacts on extreme wildfire risk

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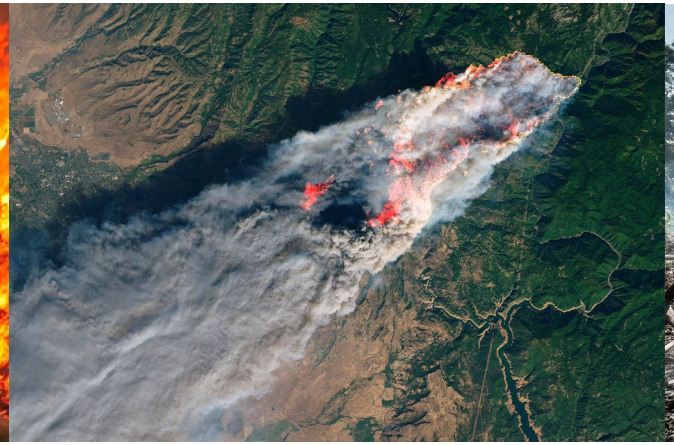
# Recent unprecedented global wildfire events

**2017**
**Thomas Fire**
2 fatalities
1000 buildings destroyed



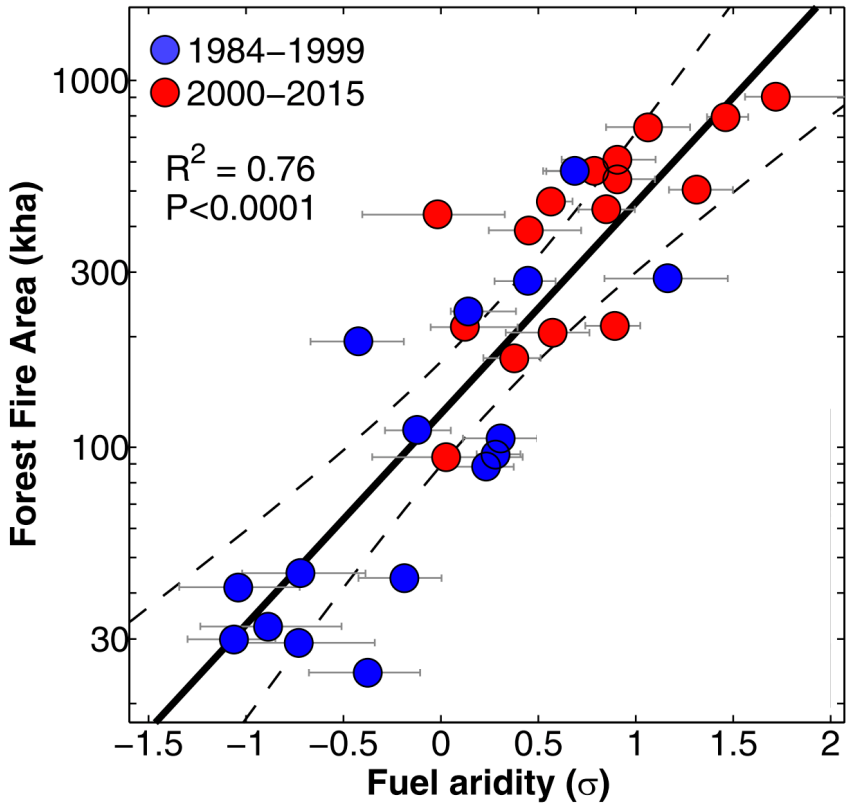
**2018**
**Camp Fire**
85 fatalities
$16.5 bn in losses

**2019**
**Amazon Fires**
3500 sq. miles
400 million tons of $CO_2$

**2019-2020**
**Australia Bushfires**
34 direct + 417 smoke-related fatalities

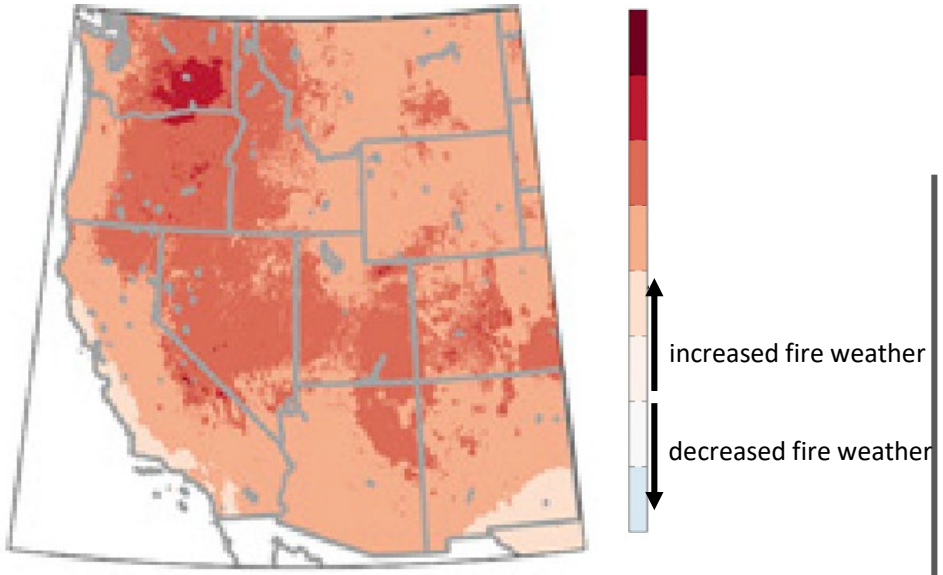
# Increases in fuel aridity cause larger and more severe fires

**Western US fire area and fuel aridity**




Recent years have drier fuels and larger fires

**2000-2015 anthropogenic impact on fire weather conditions**

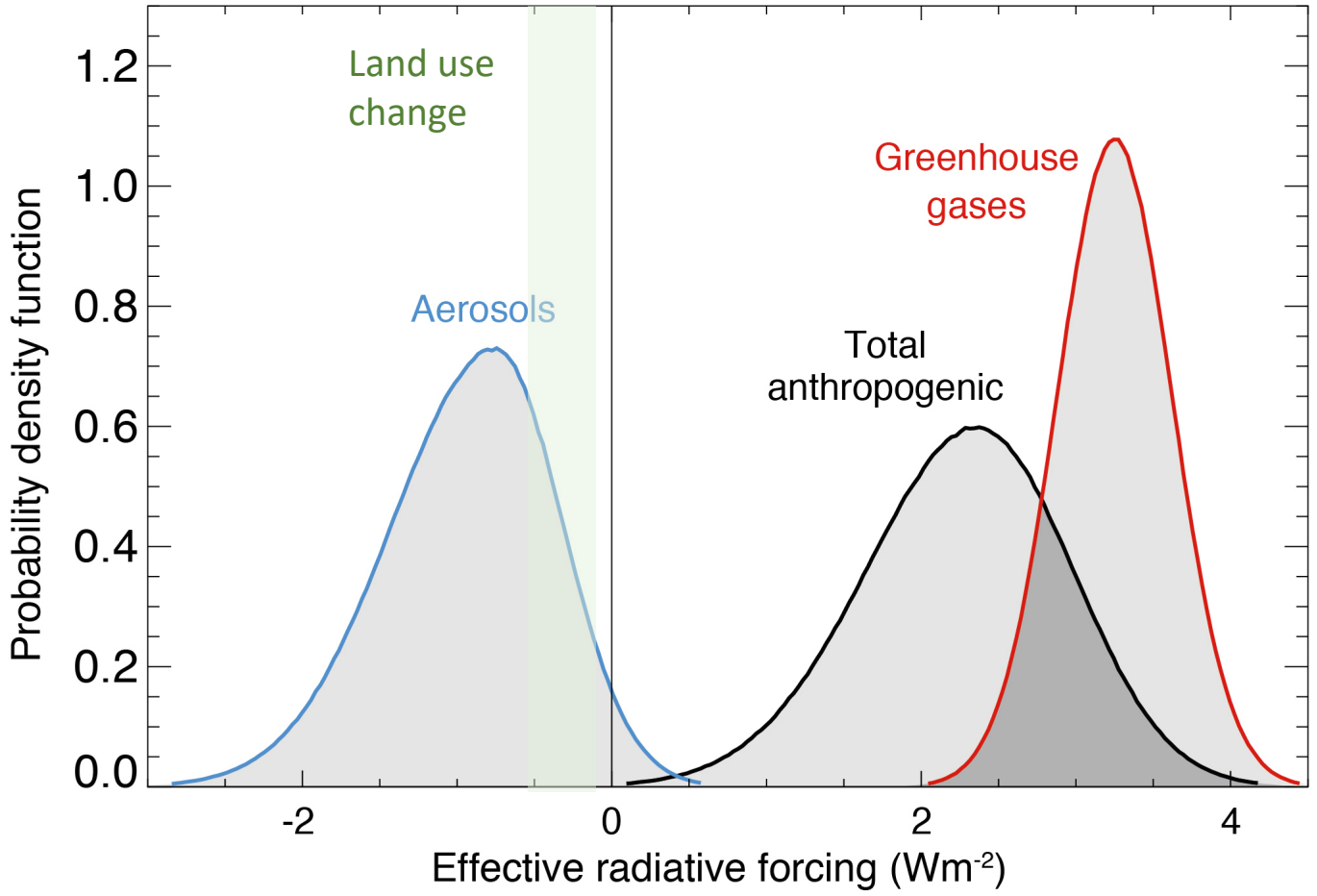



Increase in fire weather due to observed ACC

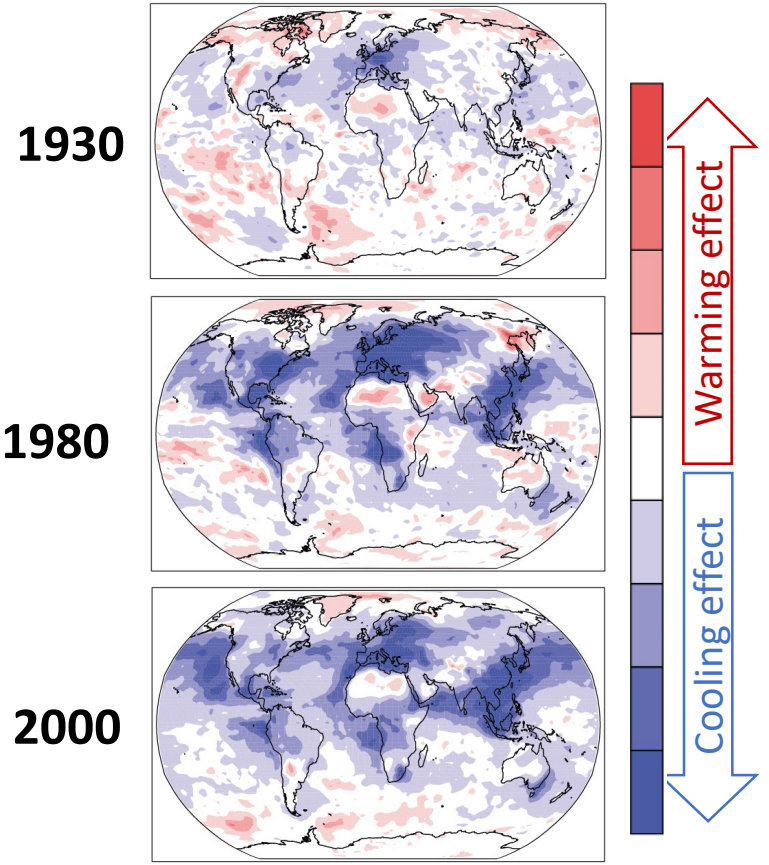
*Abatzoglou and Williams (2016)*

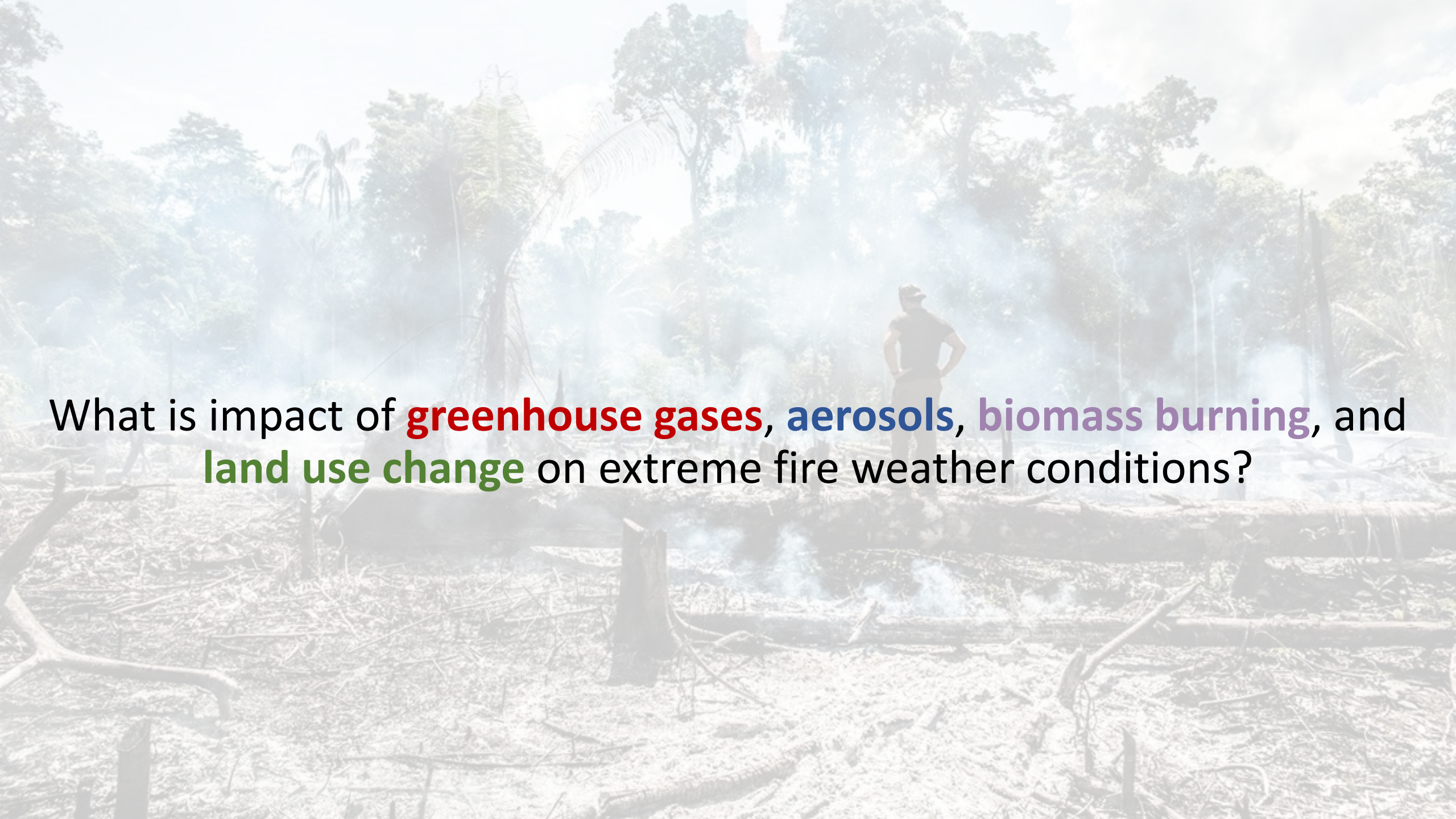
# Competing effects of anthropogenic forcing vary in space and time

Global effect of anthropogenic forcing (1750-2011)



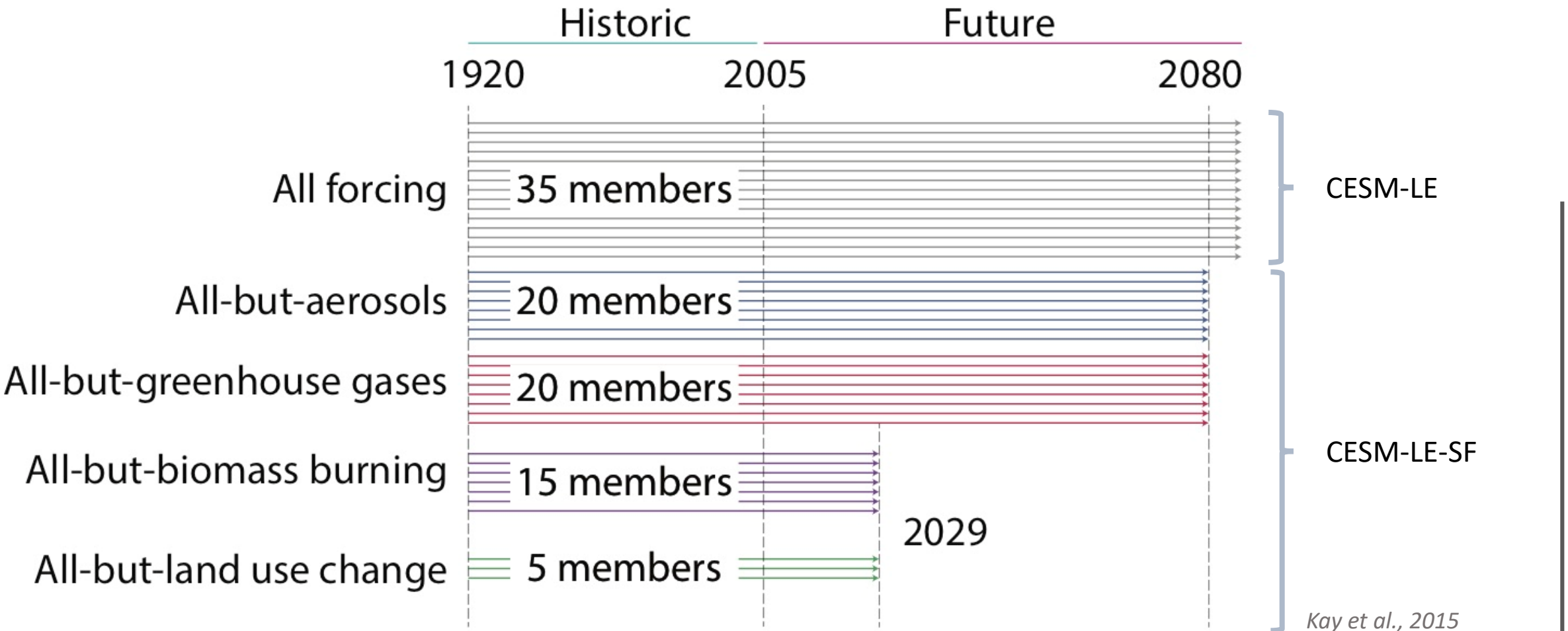

Aerosol Forcing Effect





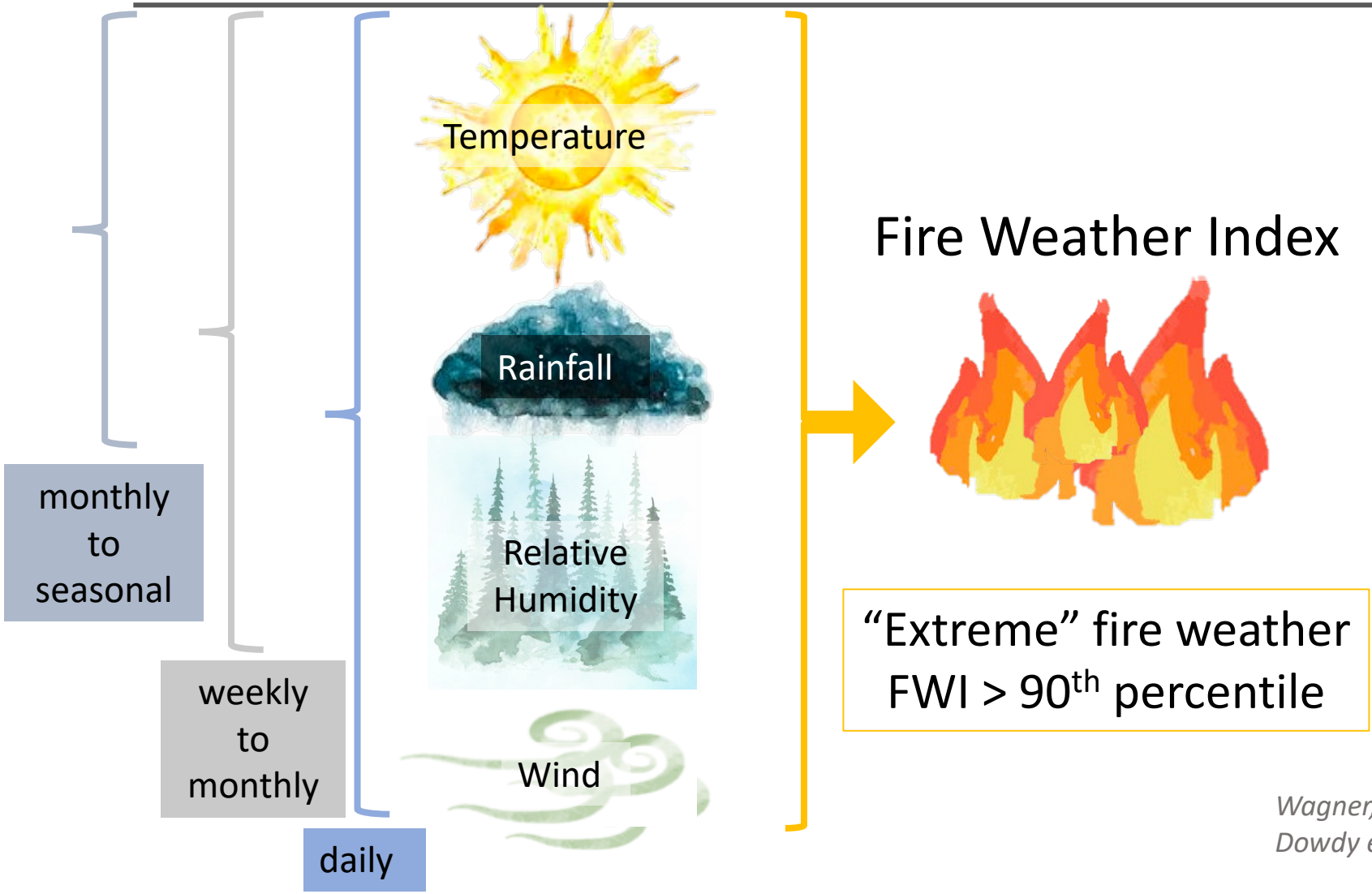
What is impact of **greenhouse gases**, **aerosols**, **biomass burning**, and **land use change** on extreme fire weather conditions?

# CESM-LE-SF experiments key for isolating anthropogenic impacts




*Kay et al., 2015*
*Pendergrass et al., 2019*
*Deser et al., in revision*

# Fire risk and spread depends on daily to seasonal climate conditions




*Wagner, 1974*
*Dowdy et al., 2009*

# How does anthropogenic forcing change the risk of extreme fire conditions?

**risk ratio (RR)**

**=**

probability of extreme fire weather with forcing

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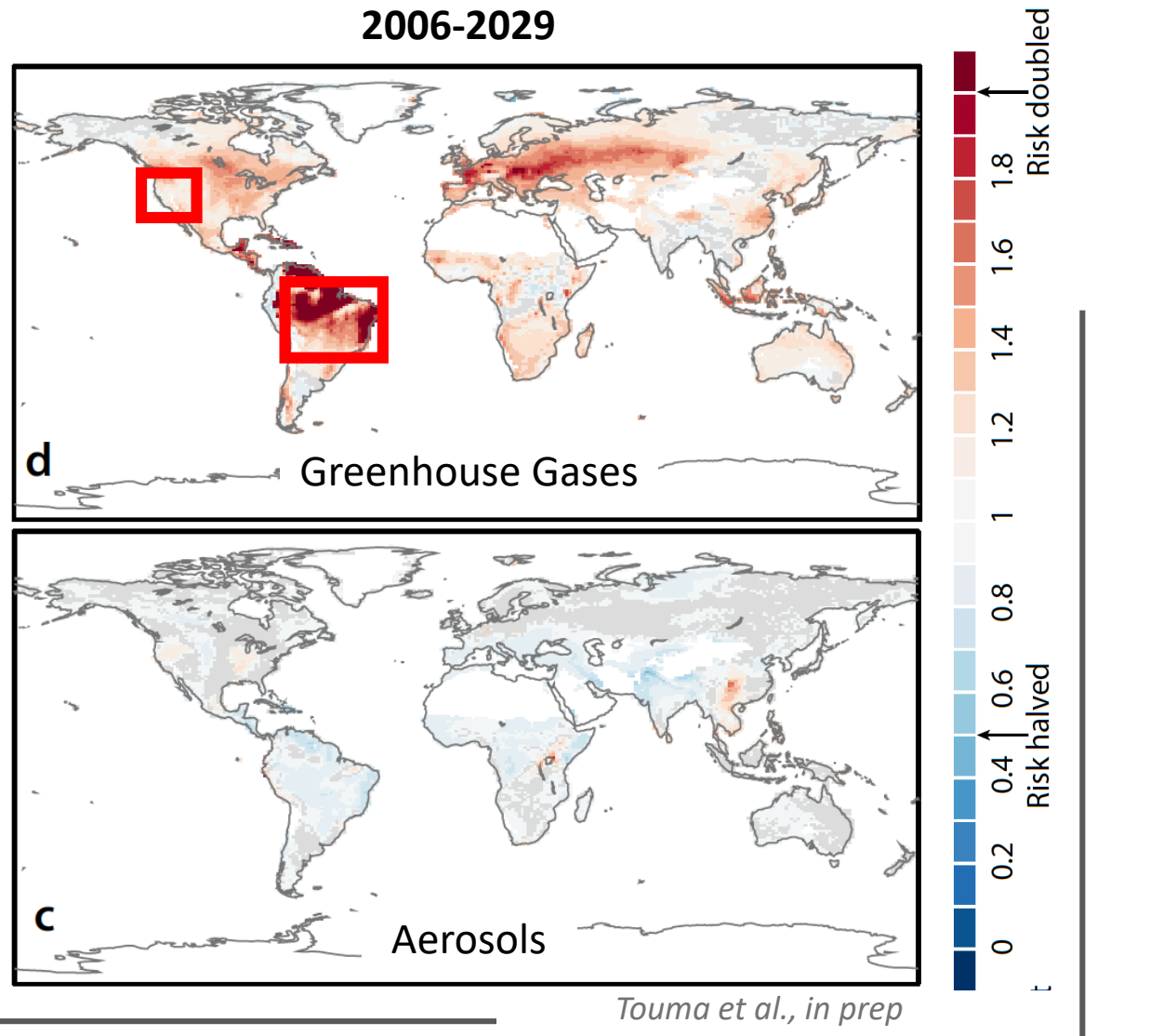
probability of extreme fire weather without forcing

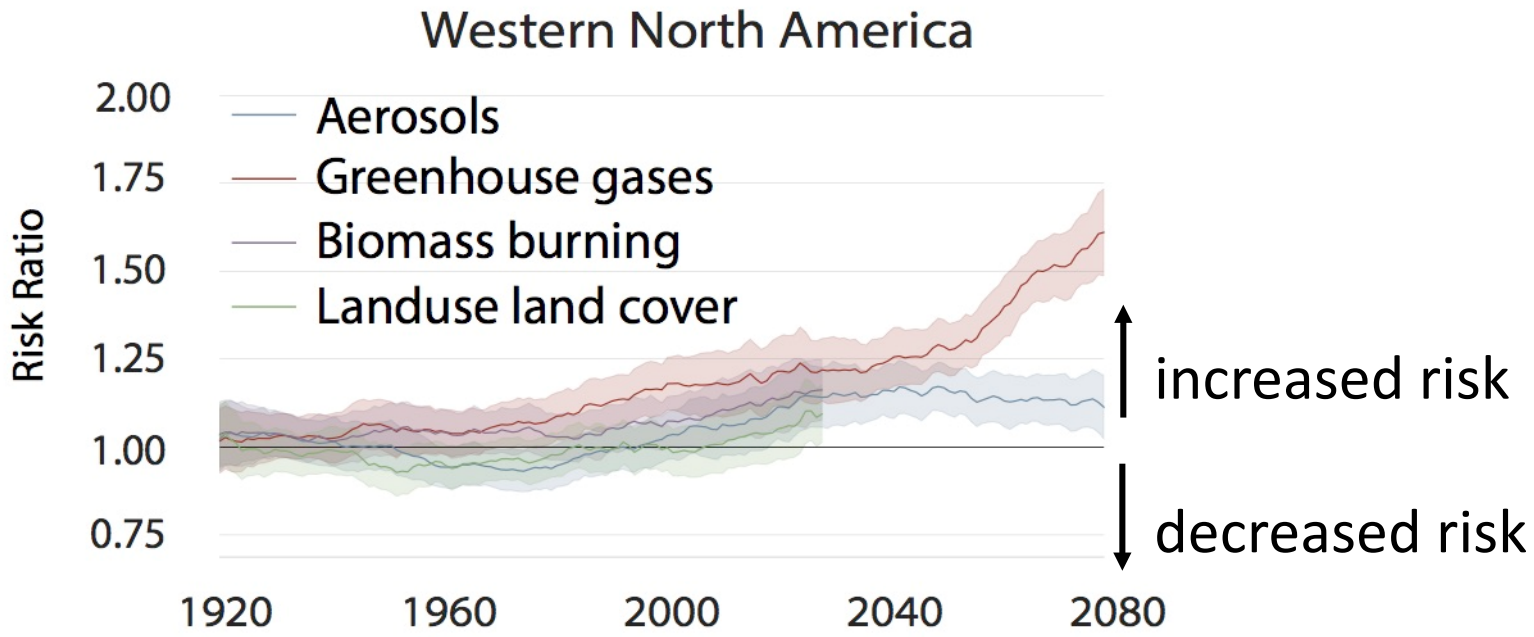
RR > 1 forcing increases risk

RR < 1 forcing decreases risk




*Touma et al., in prep*

# Regional and decadal variations in extreme fire weather risk ratio




*Touma et al., in prep*

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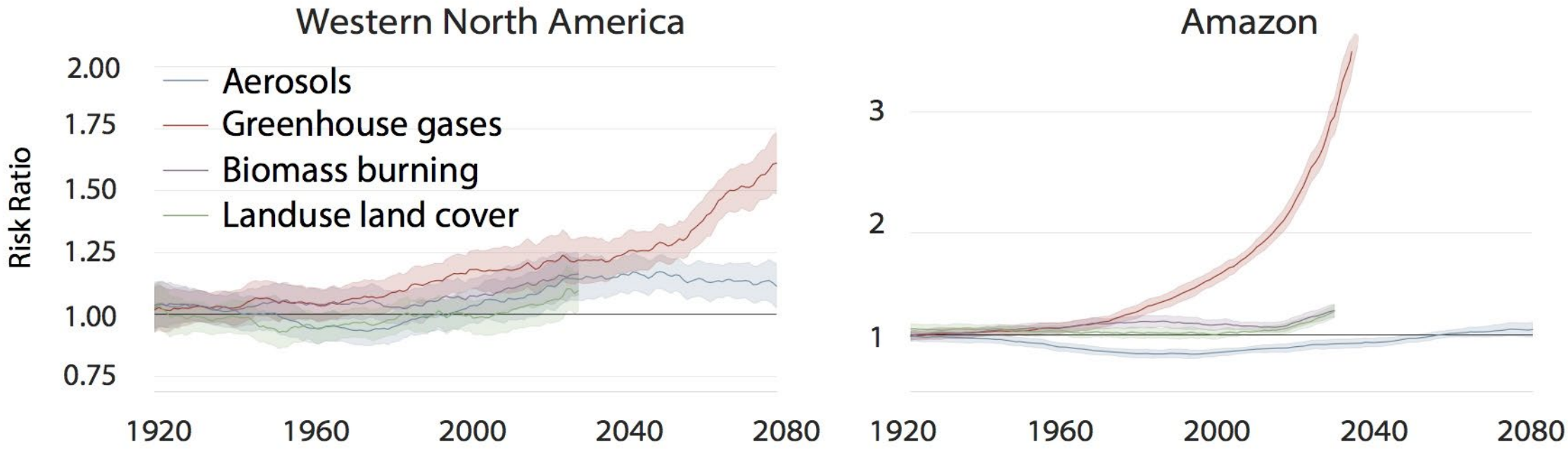
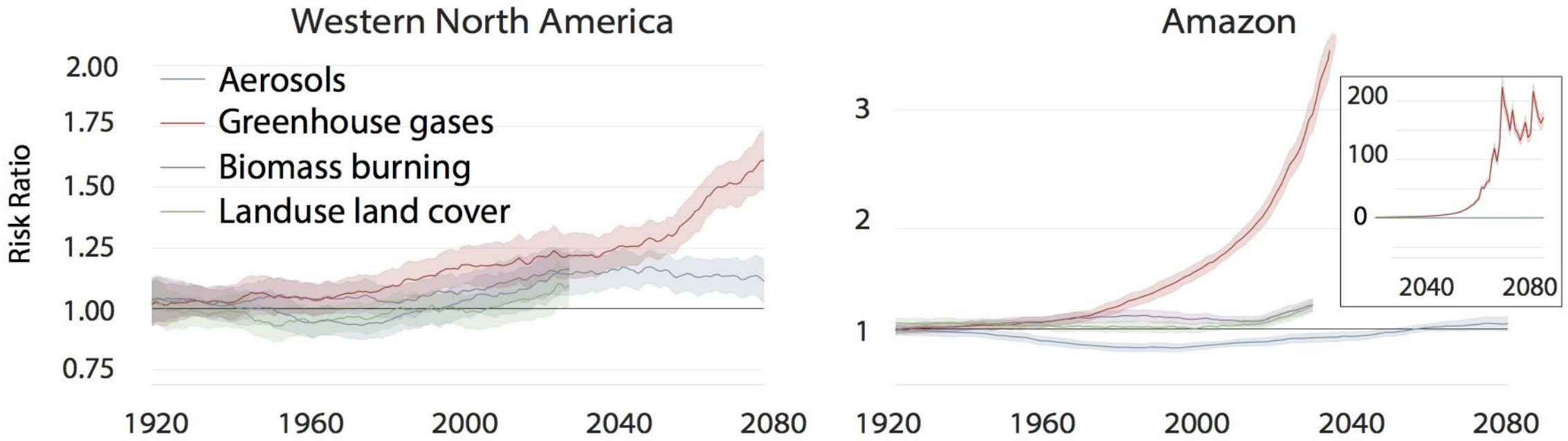



*Touma et al., in prep*

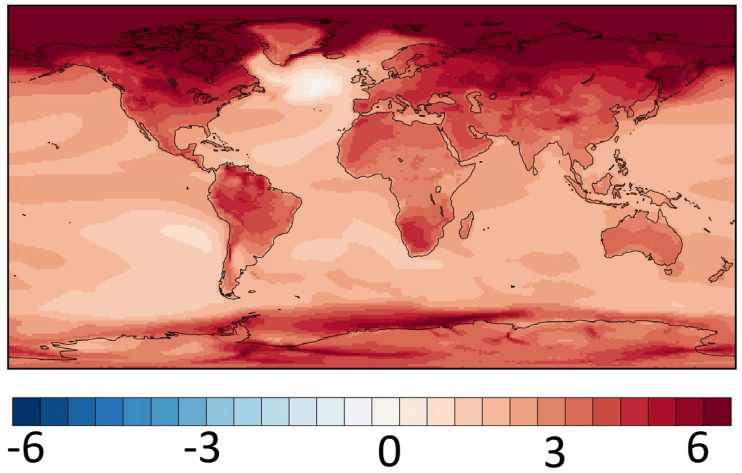
# Regional and decadal variations in extreme fire weather risk ratio

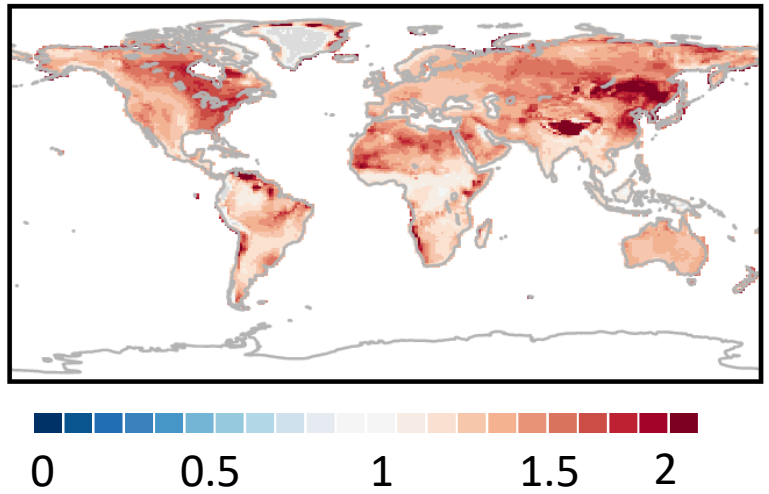



*Touma et al., in prep*

# Isolating the greenhouse-gas driven temperature effect

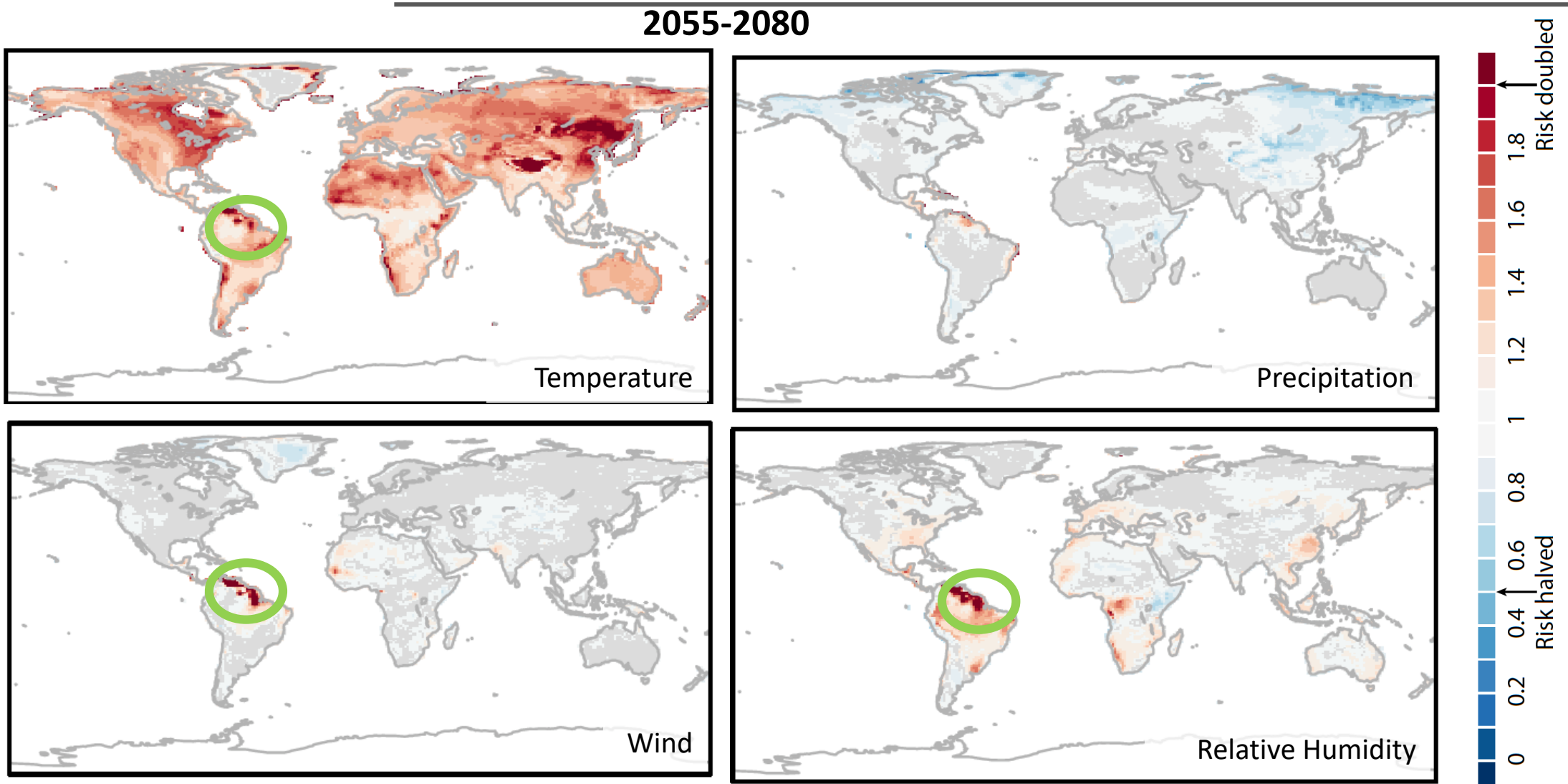
Greenhouse Gases




*Touma et al., in prep*

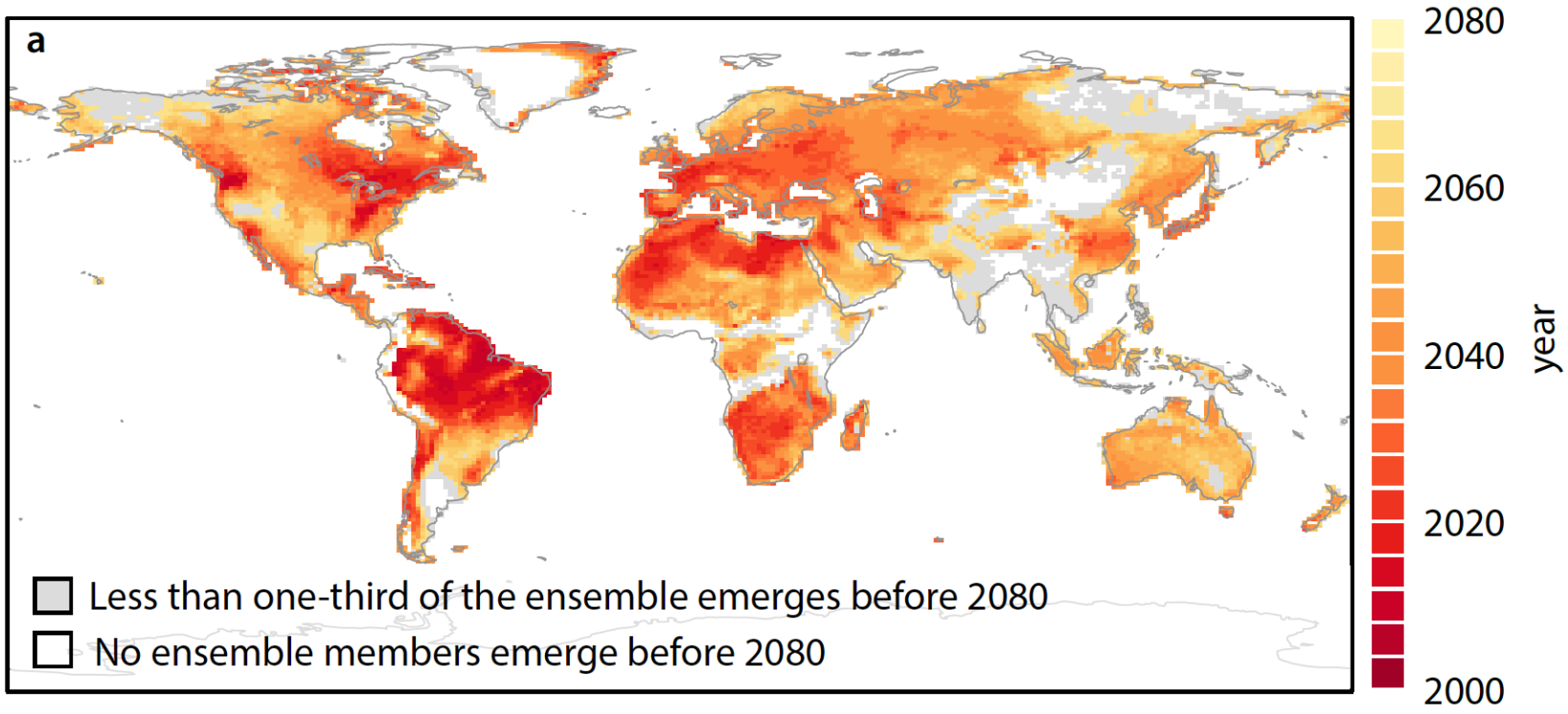
# Isolating greenhouse gas-driven effects



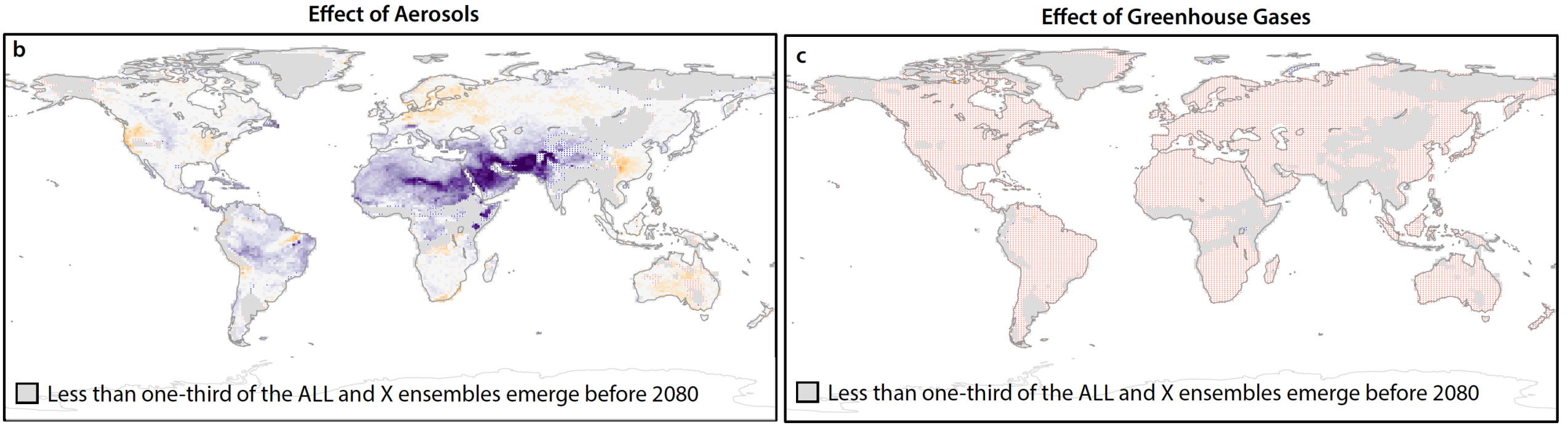

*Touma et al., in prep*

# Time of emergence occurs before 2080 in many regions

Year that frequency of extreme fire weather **permanently emerges** above the 1980-2005 natural variability



# Aerosols delay the time of emergence and greenhouse gases accelerate it




*Touma et al., in prep*

# Disentangling the anthropogenic impact on extreme wildfire conditions

Greenhouse gases increase the risk of extreme fire weather in the recent past and future periods, and accelerate the time that extreme fire weather becomes the new normal.

Aerosols reduce extreme fire weather risk in many regions in the recent past, but will have a smaller or opposite impact in the future.

**Thank you!**

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