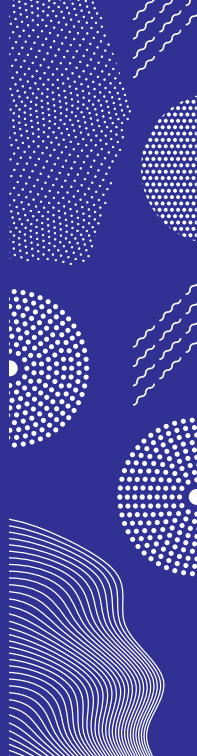# Air pollution at global scale

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Finnish Meteorological Institute

EXHAUSTION webinar: Heat and air pollution in a Nordic context,
December 16, 2022

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Outline

Introduction and model description

Model performance

Air pollution: historical and future predictions
  Real meteorology/weather (ERA5, 1980-2019)
 Climatological weather (CESM2, 1950-2099)

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Global simulations on air pollution: historical and future scenarios

- SILAM model (http://silam.fmi.fi/):
 - Input: emissions (athropogenic and natural), wind, temperature, humidity, rain, ...
  - Models transport of air pollutants
  - Chemistry transformation of chemicals
  - Stratosphere with halogens (e.g. CFCs)
  - New fire forcasting model
  - Global runs with 2 degree resolution
- Historical:
  - ERA5 meteorology (1980-2019, hourly)
  - CESM2 meteorology (1950-2014, hourly)
- Three CMIP6 future scenarios (2015-2099):
  - SSP126: Green pathway, 2.6 W/m^2 by 2100
  - SSP245: Middle of the road, 4.5 W/m^2
  - SSP370: Regional rivalry, 7.0 W/m^2
  - CESM2 meteo and CMIP6 emissions
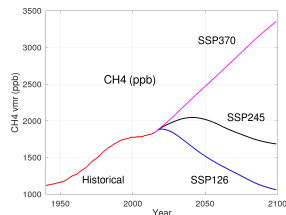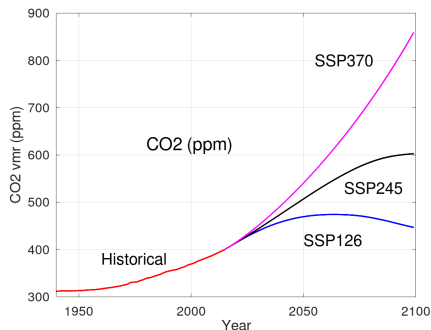
Model performance: Atomic optical depth (AOD)
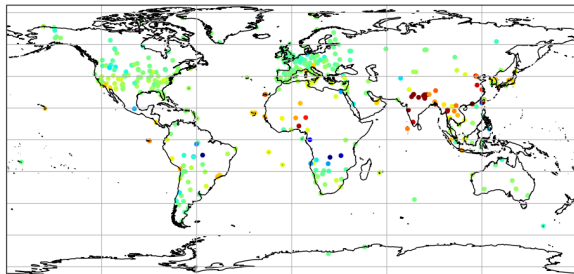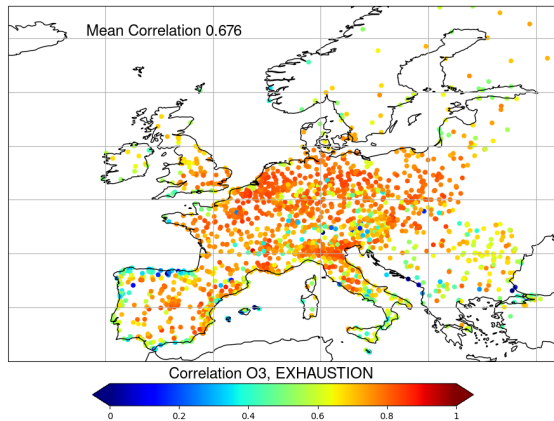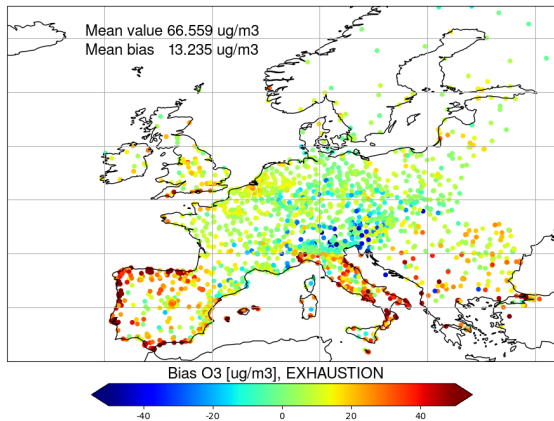

Bias AOD
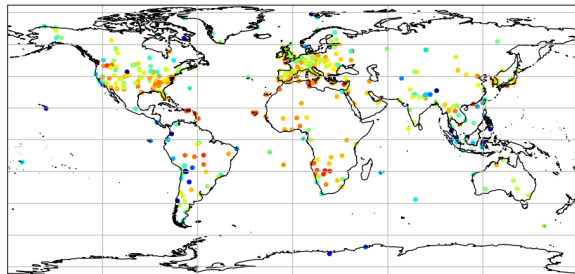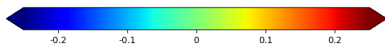
Correlation AOD

AOD is the measure of aerosols (e.g., urban haze, smoke. particles, desert dust, sea salt) in atmosphere. Clear sky value is 0.1, while 1 indicates very hazy conditions.
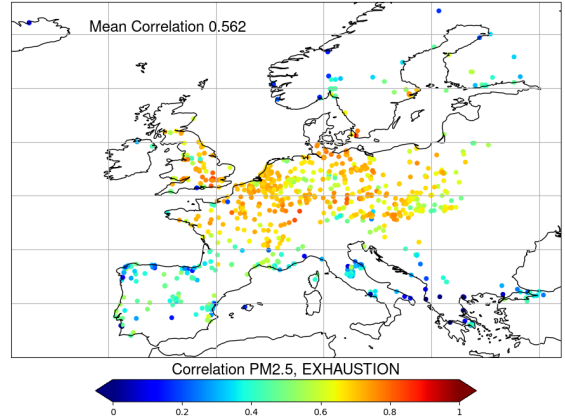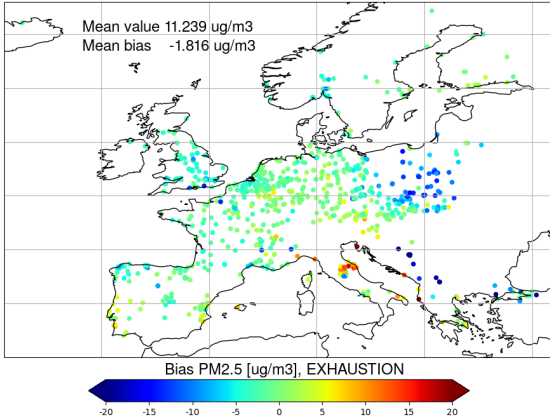Bias = mean difference from measurements.
Correllation = how well the model follows the measurements (1 = 100% agreement)
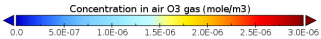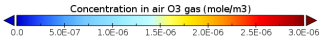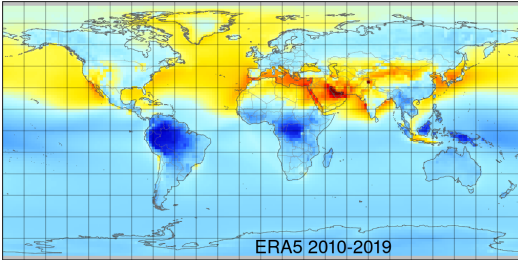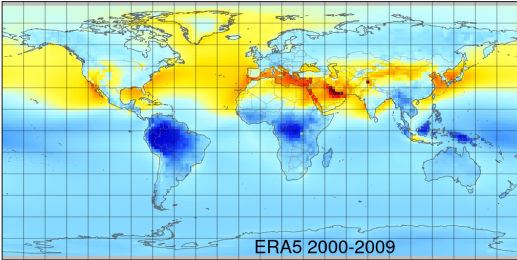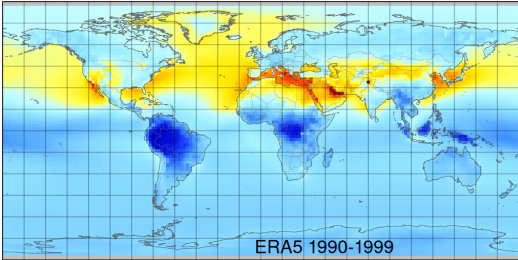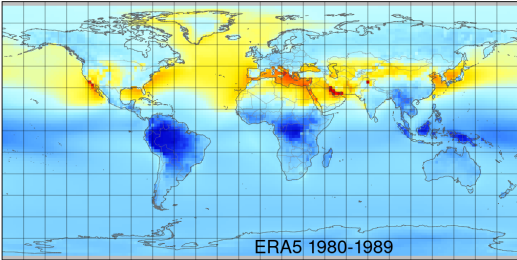
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Model performance: Ozone (O$_3$)

Mean value 66.559 ug/m3
Mean bias 13.235 ug/m3

Bias O3 [ug/m3], EXHAUSTION

-40   -20   0   20   40

Mean Correlation 0.676

Correlation O3, EXHAUSTION

0   0.2   0.4   0.6   0.8   1

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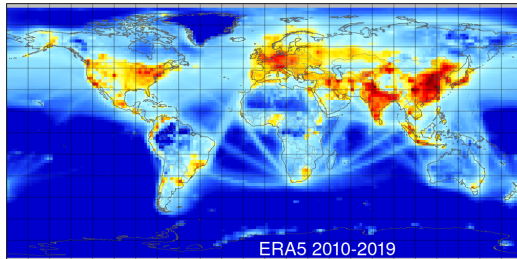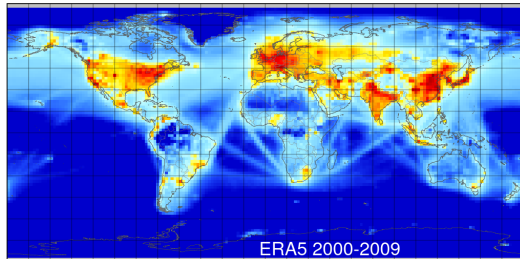METEOROLOGISKA INSTITUTET
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Model performance: fine particles (PM2.5)

Ozone (1980-2019): decadal means

Concentration in air O3 gas (mole/m3)
0.0   5.0E-07   1.0E-06   1.5E-06   2.0E-06   2.5E-06   3.0E-06

ERA5 1980-1989
ERA5 1990-1999
ERA5 2000-2009
ERA5 2010-2019

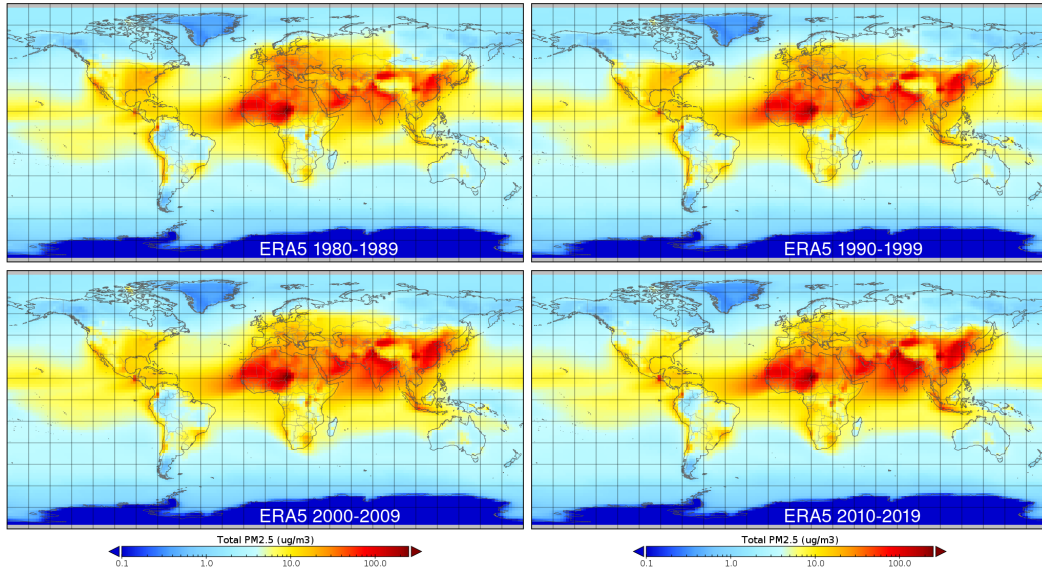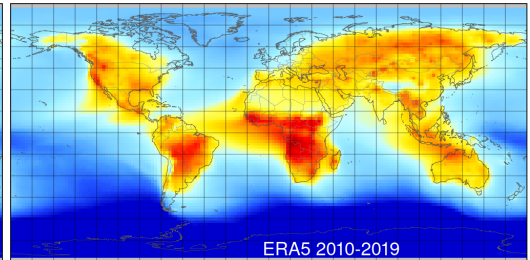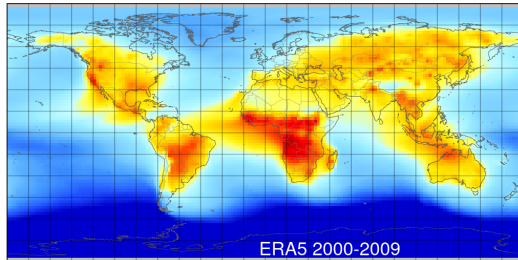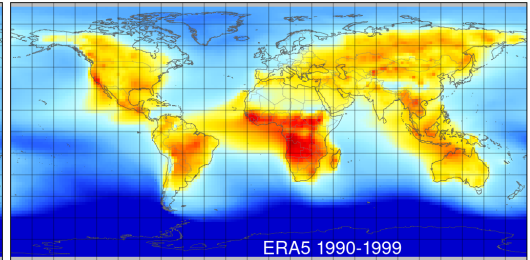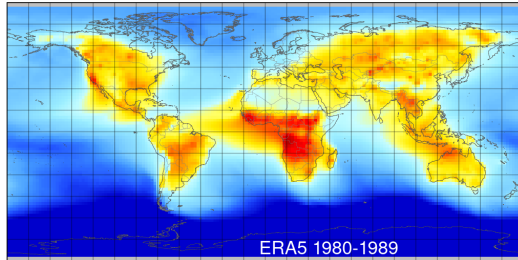ILMATIETEEN LAITOS
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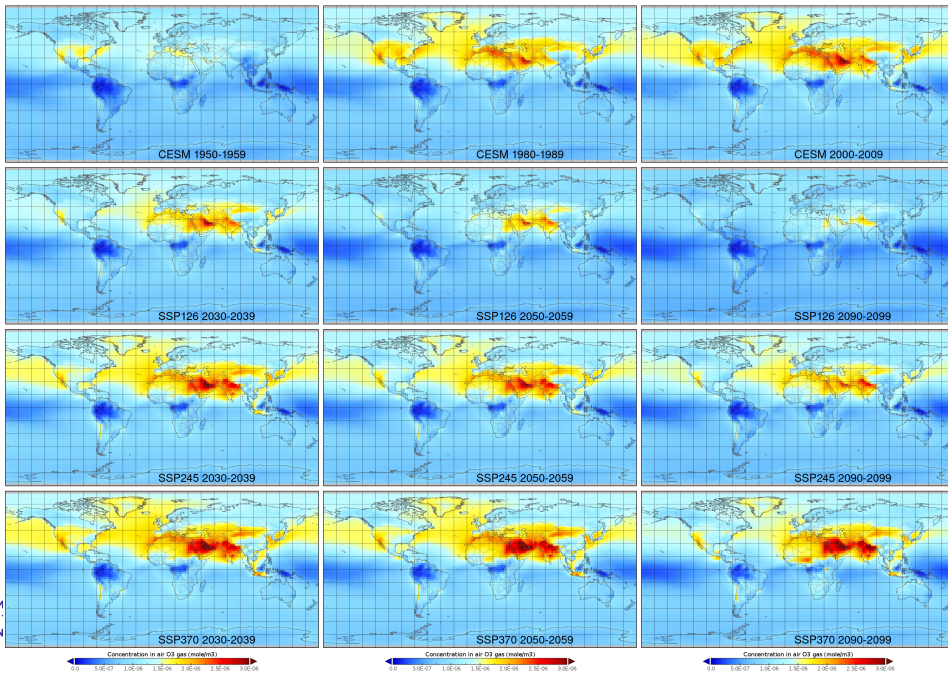# Nitrogen dioxide (1980-2019): decadal means
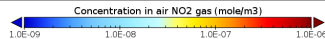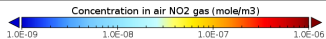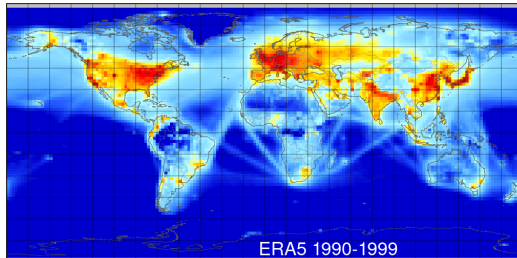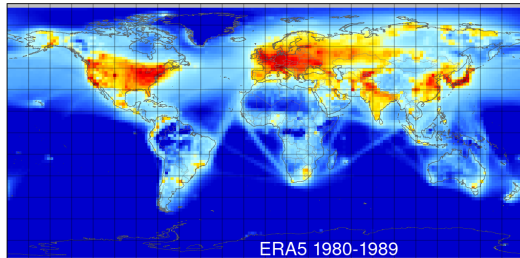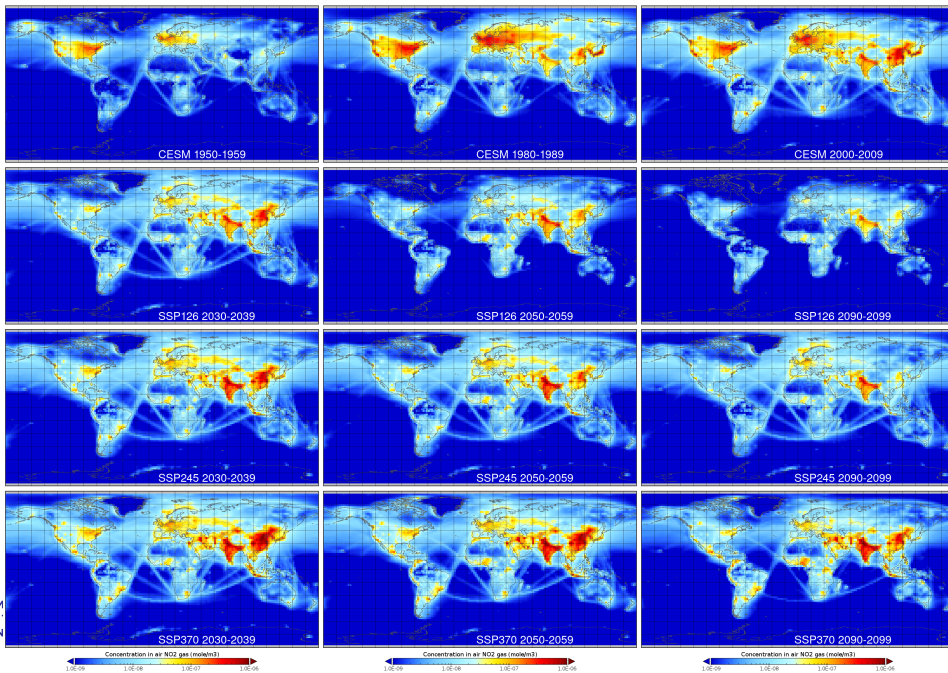
Fine particles (1980-2019): decadal means

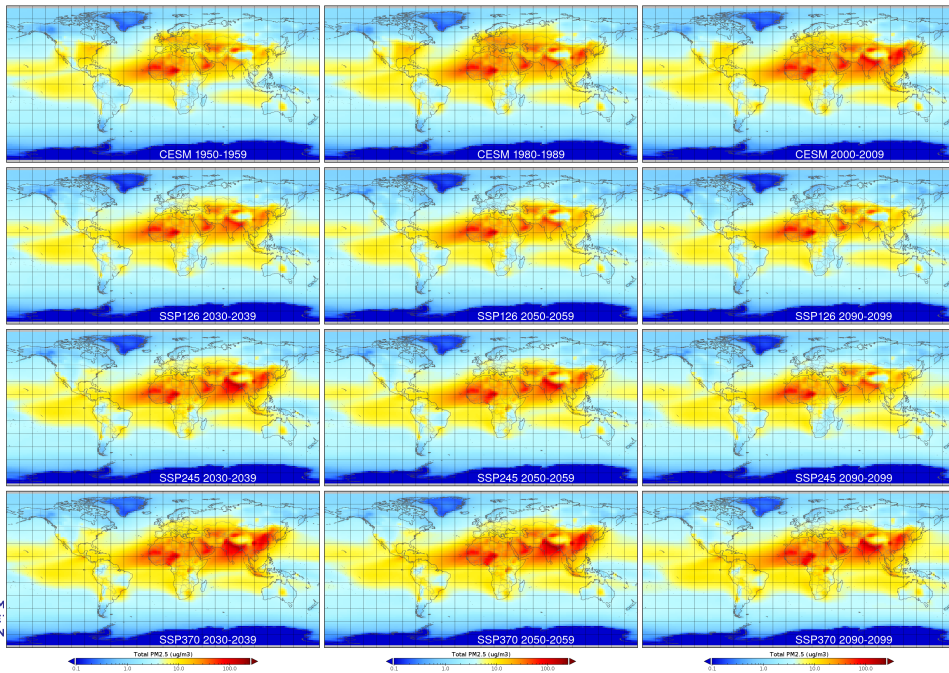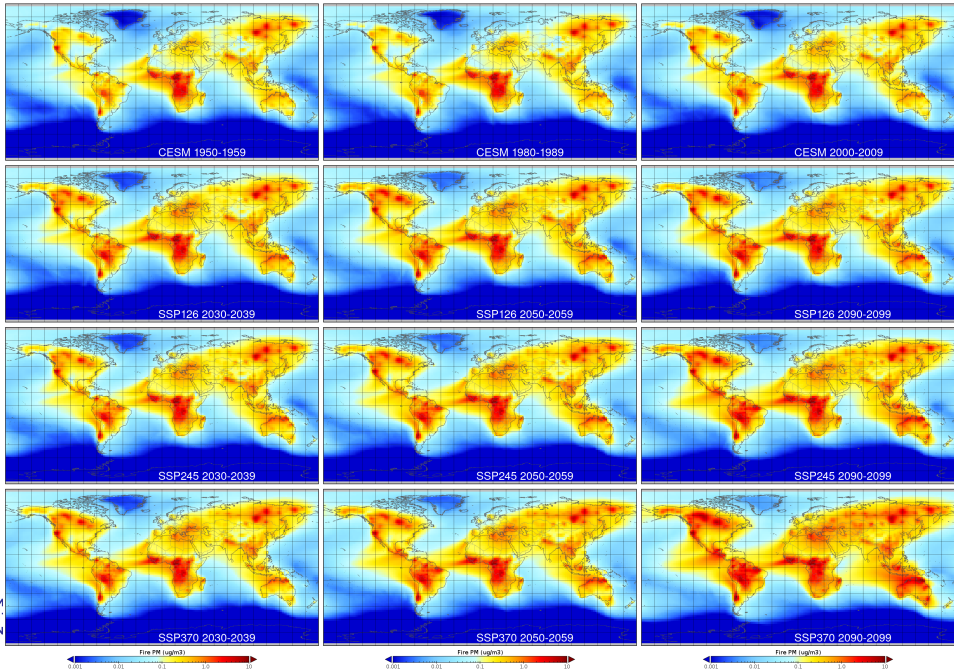# Fine particles from fires (1980-2019): decadal means
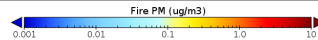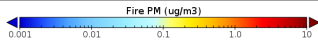
Ozone (1950-2099): decadal means
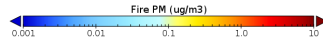
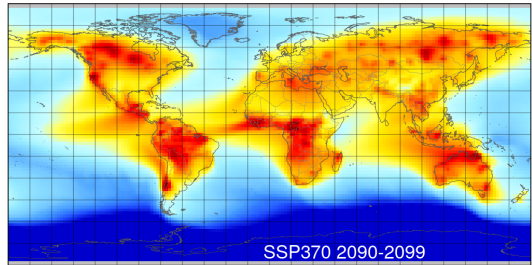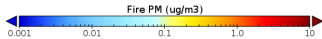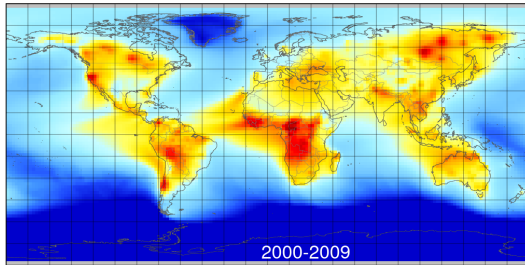# Nitrogen dioxide (1950-2099): decadal means

Fine particles, PM$_{2.5}$ (1950-2099): decadal means

Fine particles from fires (1950-2099): decadal means

Fine particles from fires

Begin and end of this century in the worst case scenario (SSP370).

Thank you!