EXHAUSTION

Historical and future air pollution over Europe and the Nordic region

WEBINAR - Heat and air pollution in a Nordic context
December 16th, 2022

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OUTLOOK

- Downscaling experiments in H2020 EXHAUSTION
- Model description
- How good are the models?
- European ozone (O_3) and fine particulate matter ($PM_{2.5}$) projections
- Nordic O_3 and $PM_{2.5}$ projections

EXHAUSTION OBJECTIVES

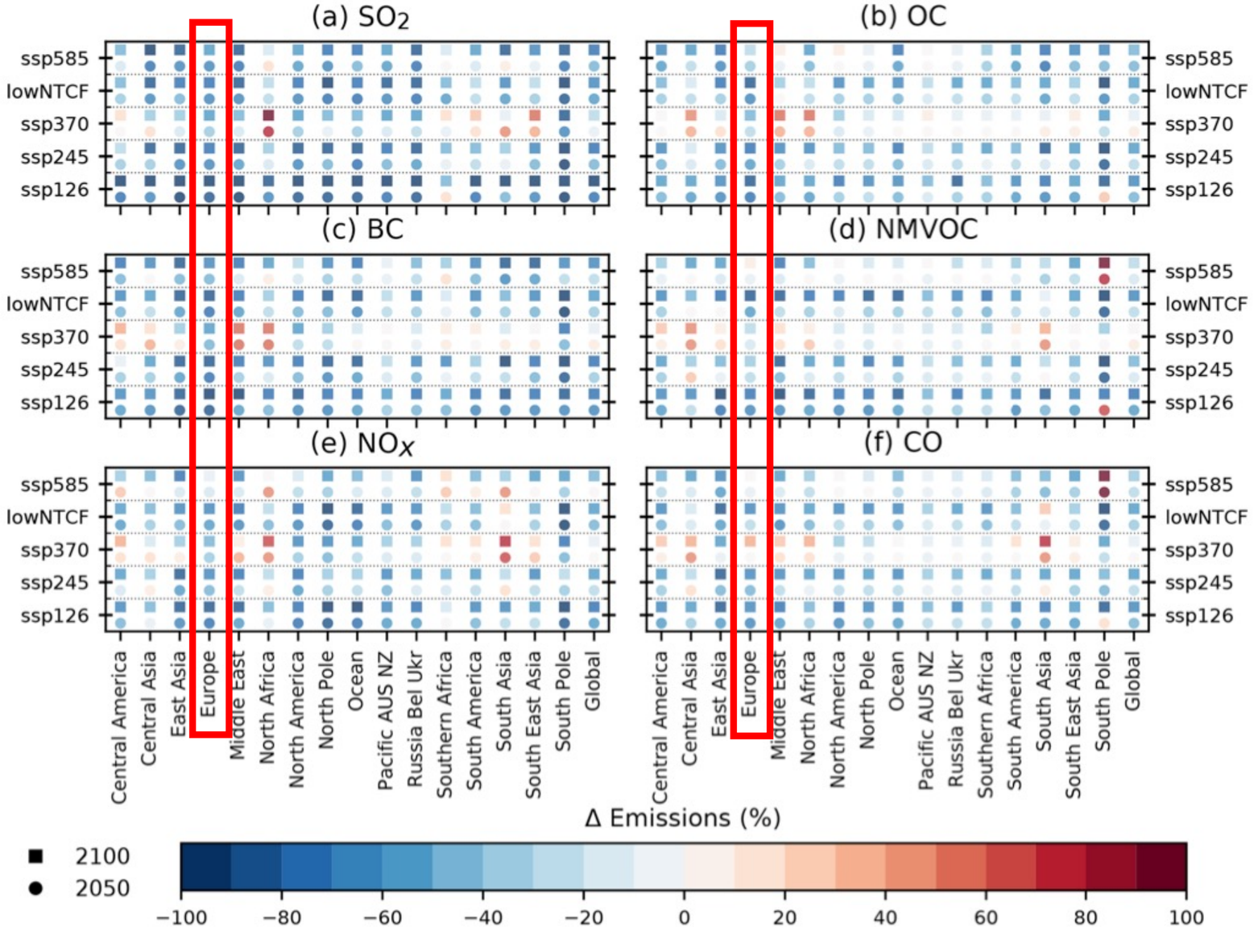
- ***Impacts of extreme heat and air pollution on cardiovascular diseases and premature mortality in Europe***

- Projections of wildland fires in Europe
- Climate projections using Community Earth System Model version 2 (CESM2): Climate model
- *Multi-model* downscaling of projections of climate & air pollution in Europe until 2050
- Why multi-model?: Models have different complexitiy of physics, dynamics and chemistry, different assumptions and processes

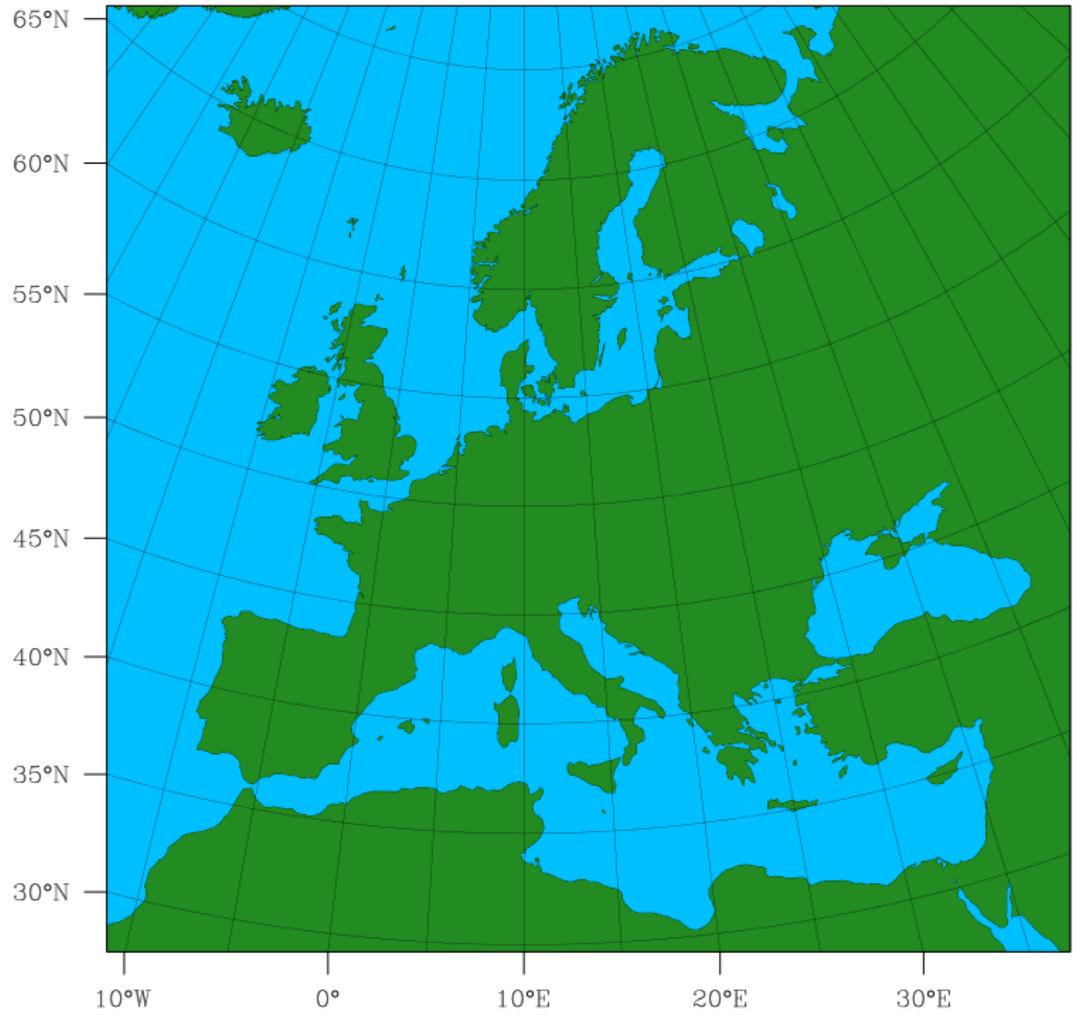
FUTURE EMISSIONS

- Emissions in Europe decrease in all future scenarios

Turnock et al., ACP, 2021

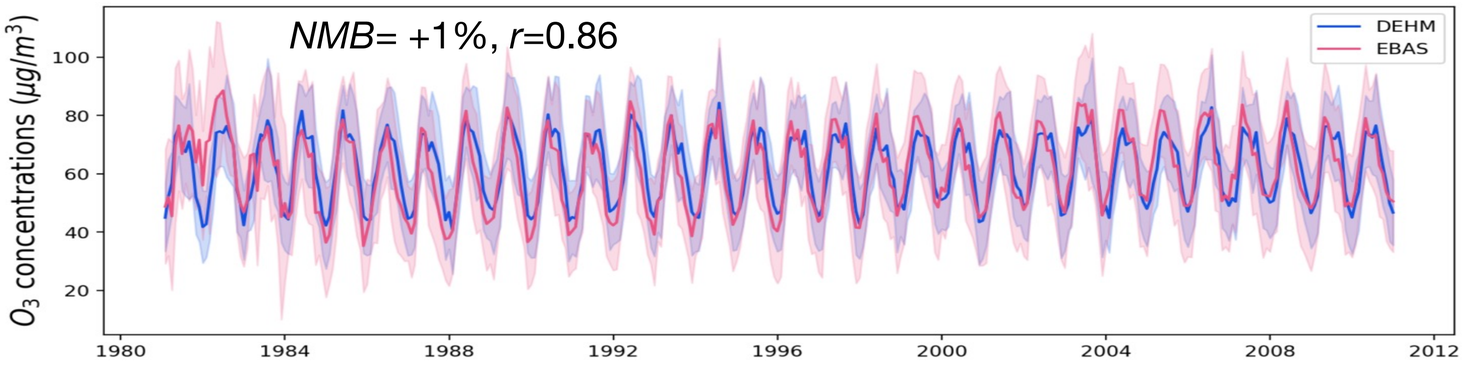


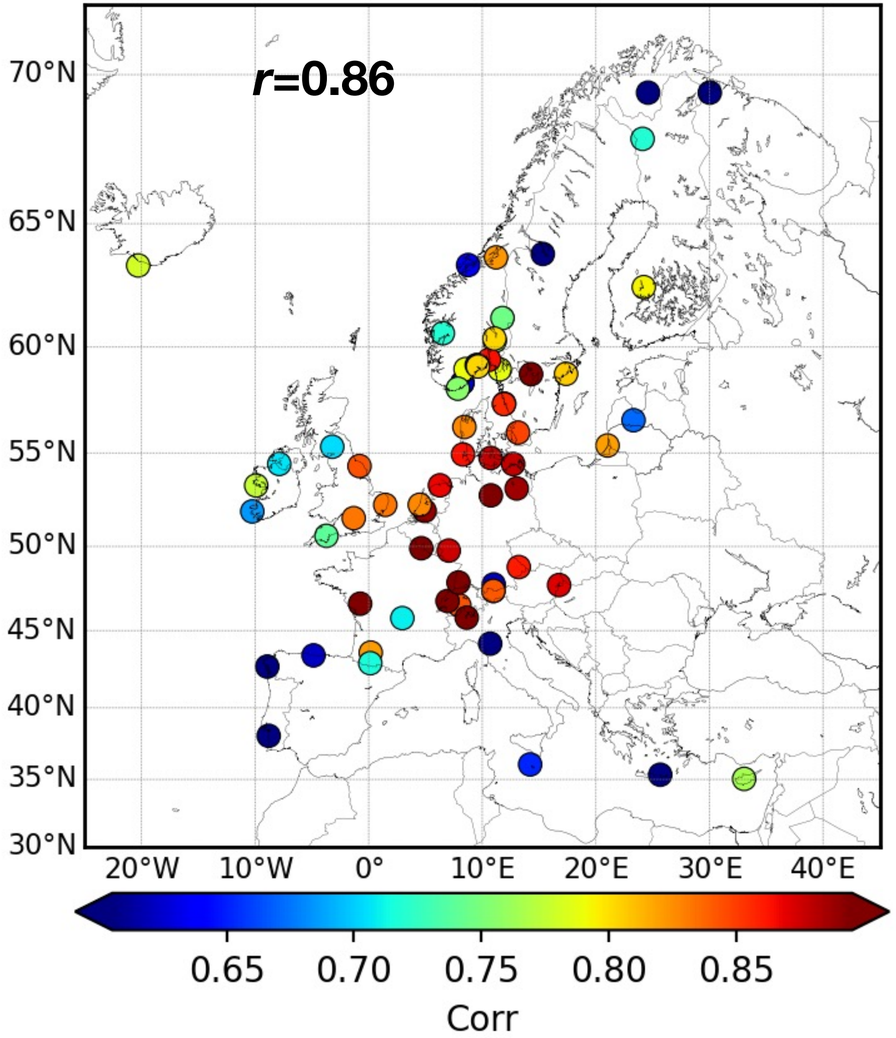
Danish Eulerian Hemispheric Model (DEHM)

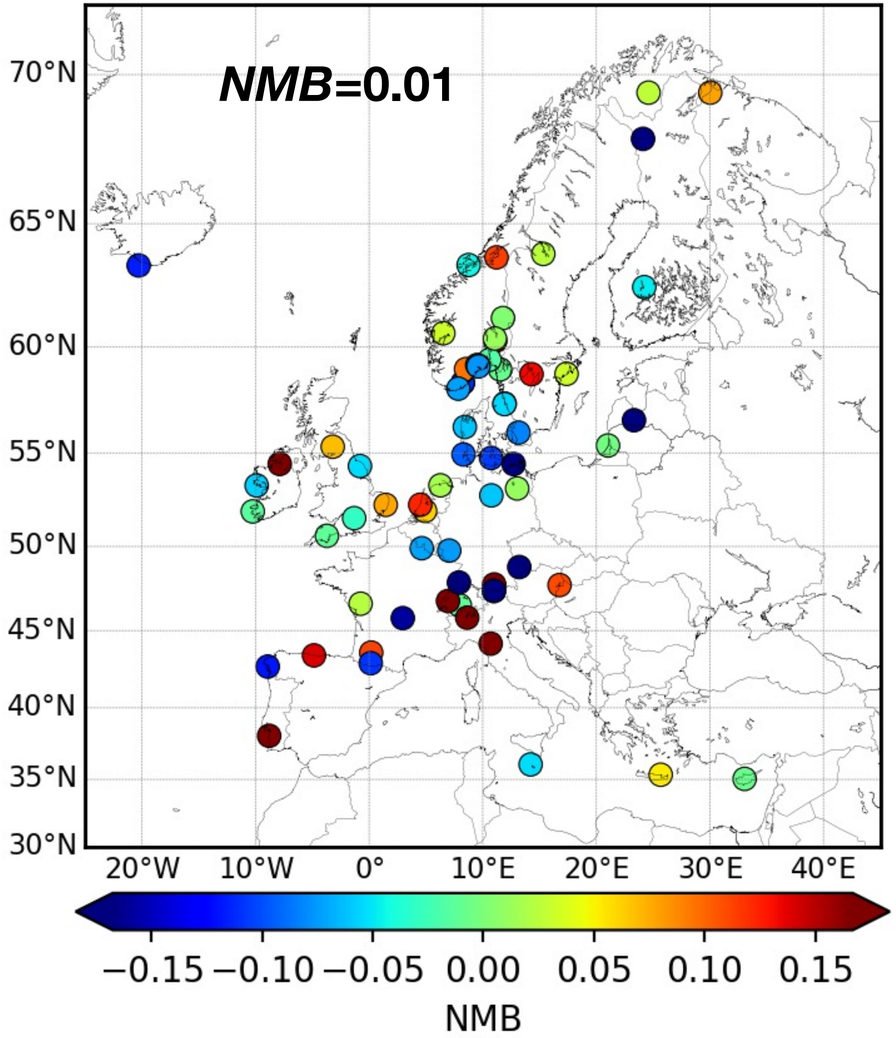


- Aarhus University, Denmark
- 3 future scenarios (2015-2050):
  - High, medium, low mitigation
- 20 km & 1-hour resolution
- IS4FIRES wildland emissions
- Boundary conditions from global SILAM

Ozone (O_3) Evaluation

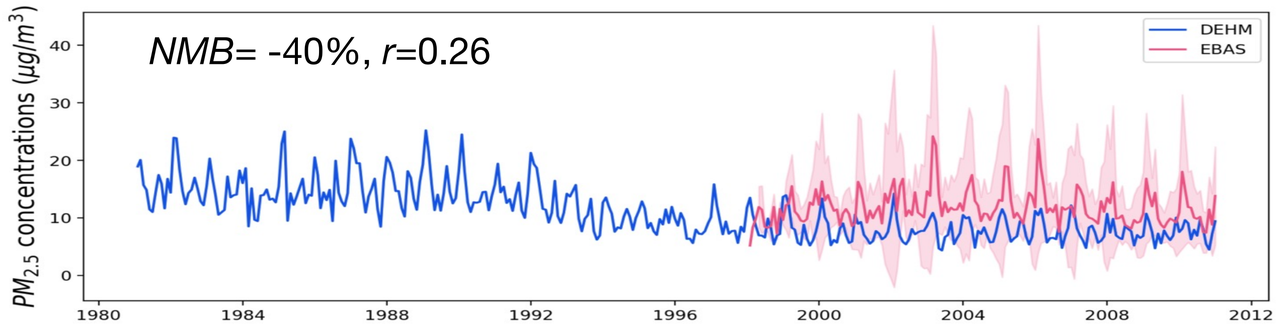


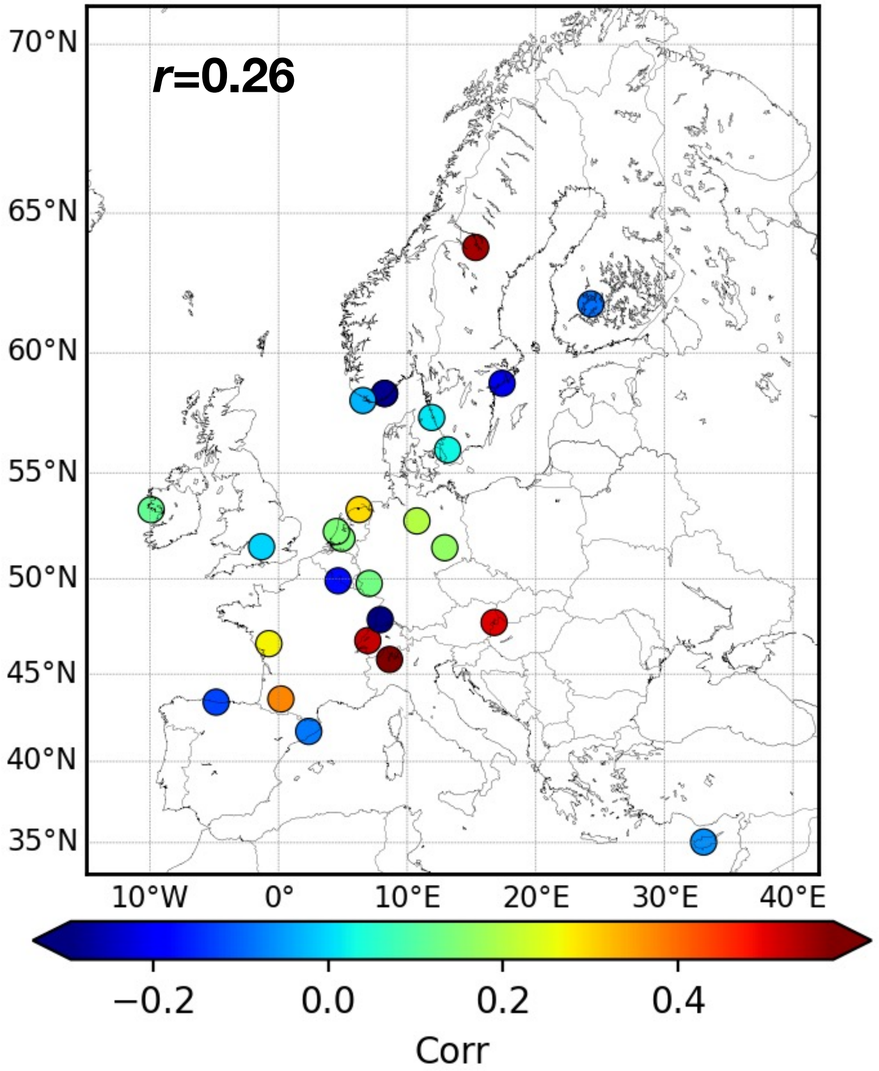


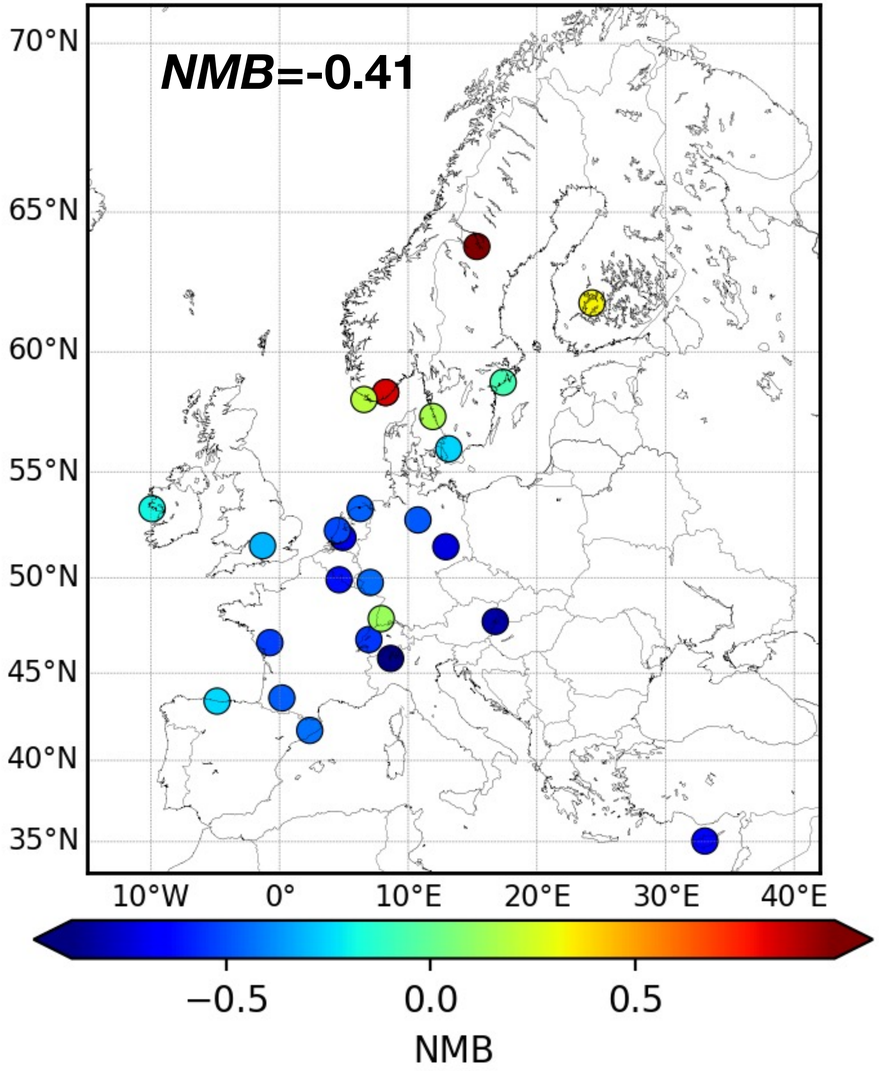


EXHAUST

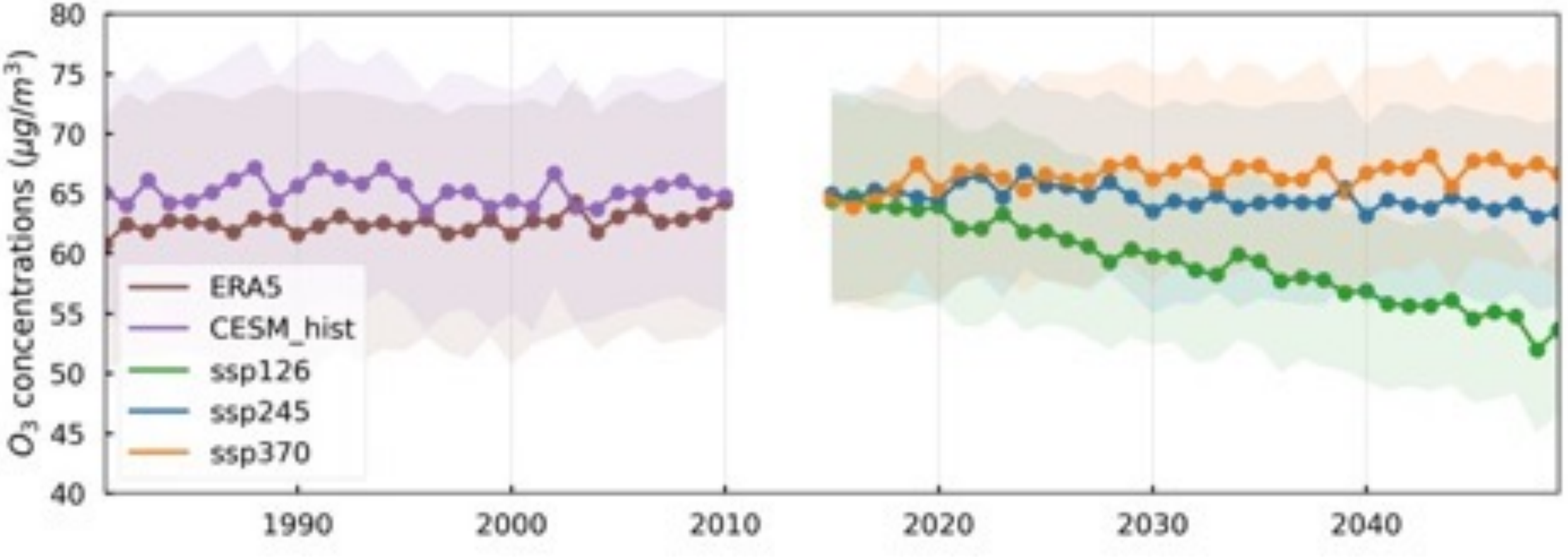
Particulate Matter ($PM_{2.5}$) Evaluation



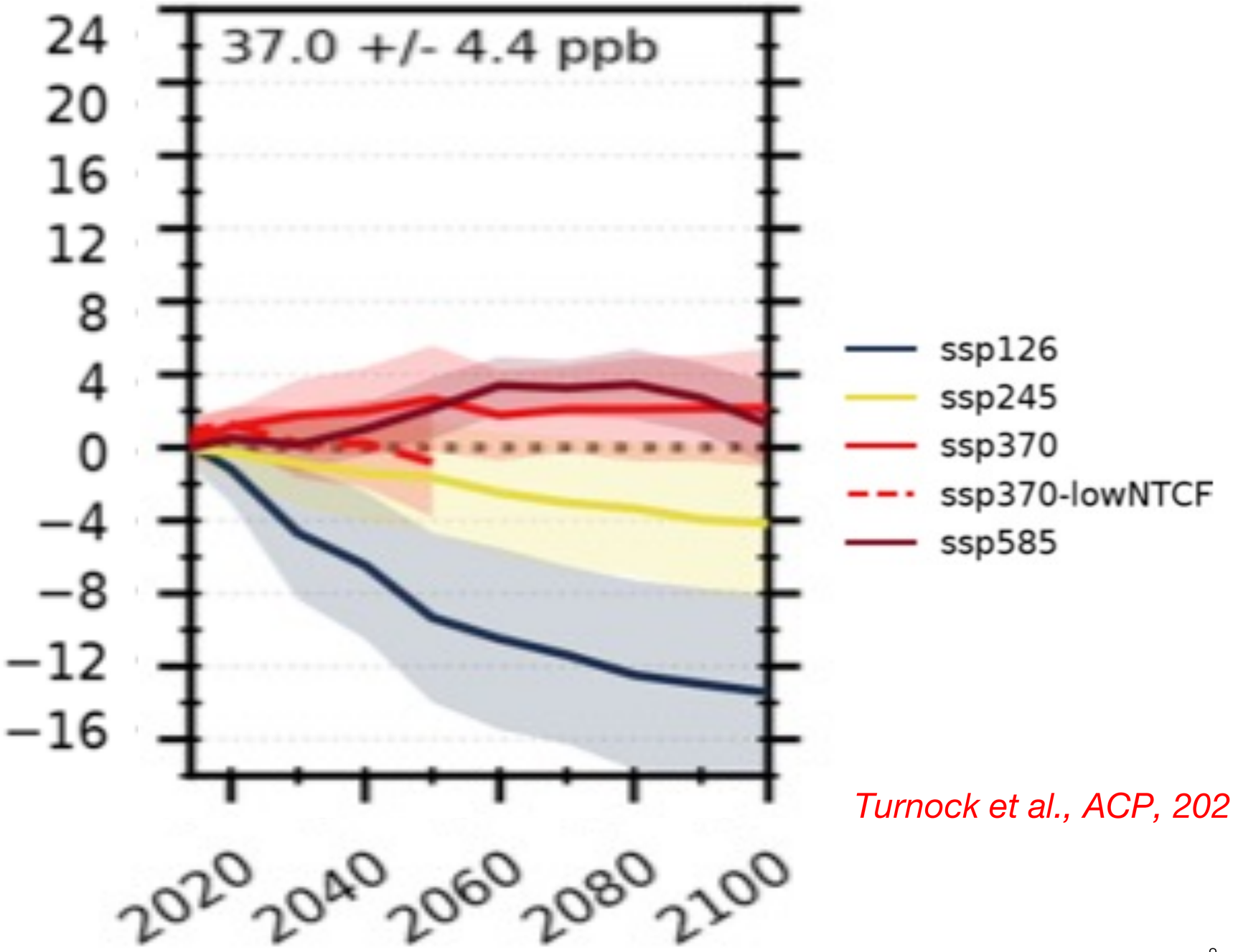




O_3 Projections



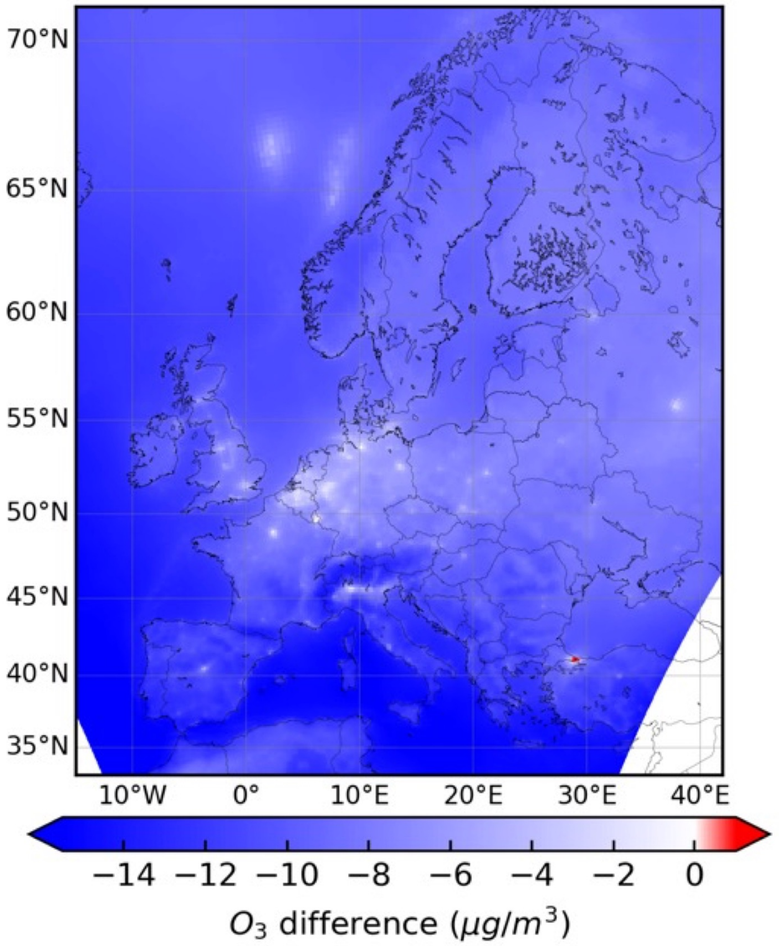
IPCC O_3 EUROPE



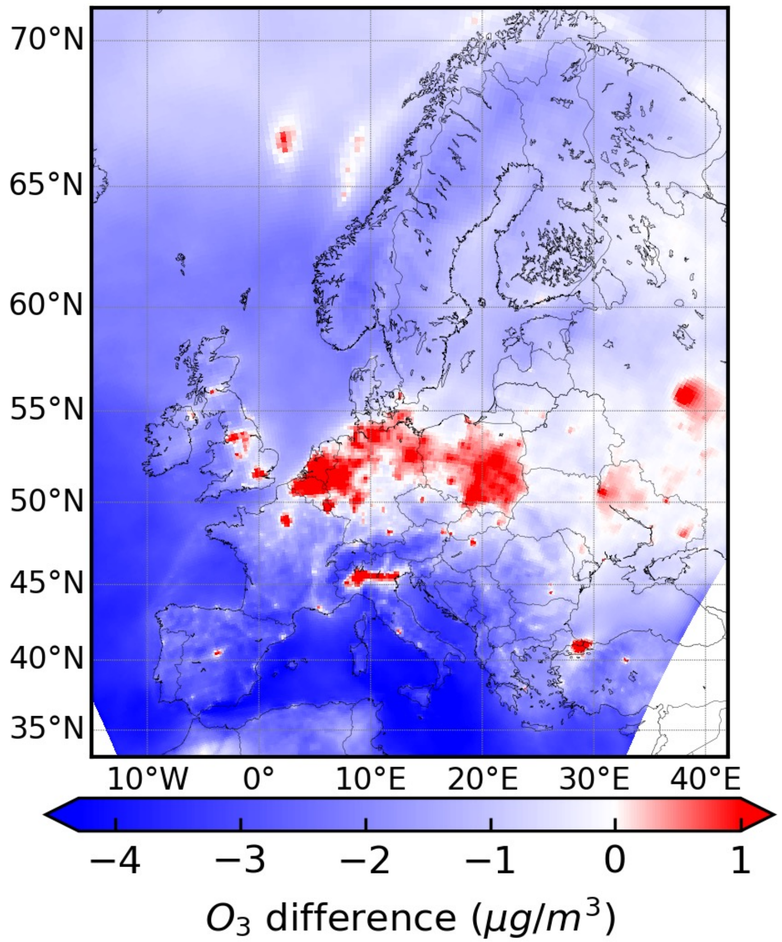
Turnock et al., ACP, 2021

O_3 Projections (2040-2050 vs 2015-2020)

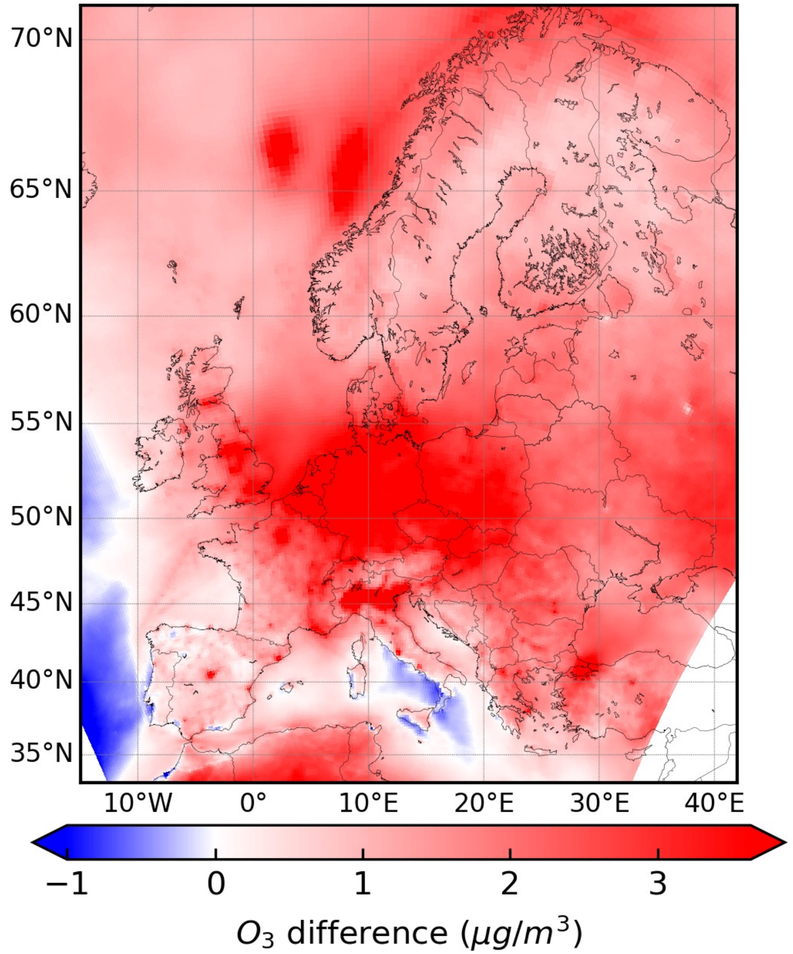
High Mitigation



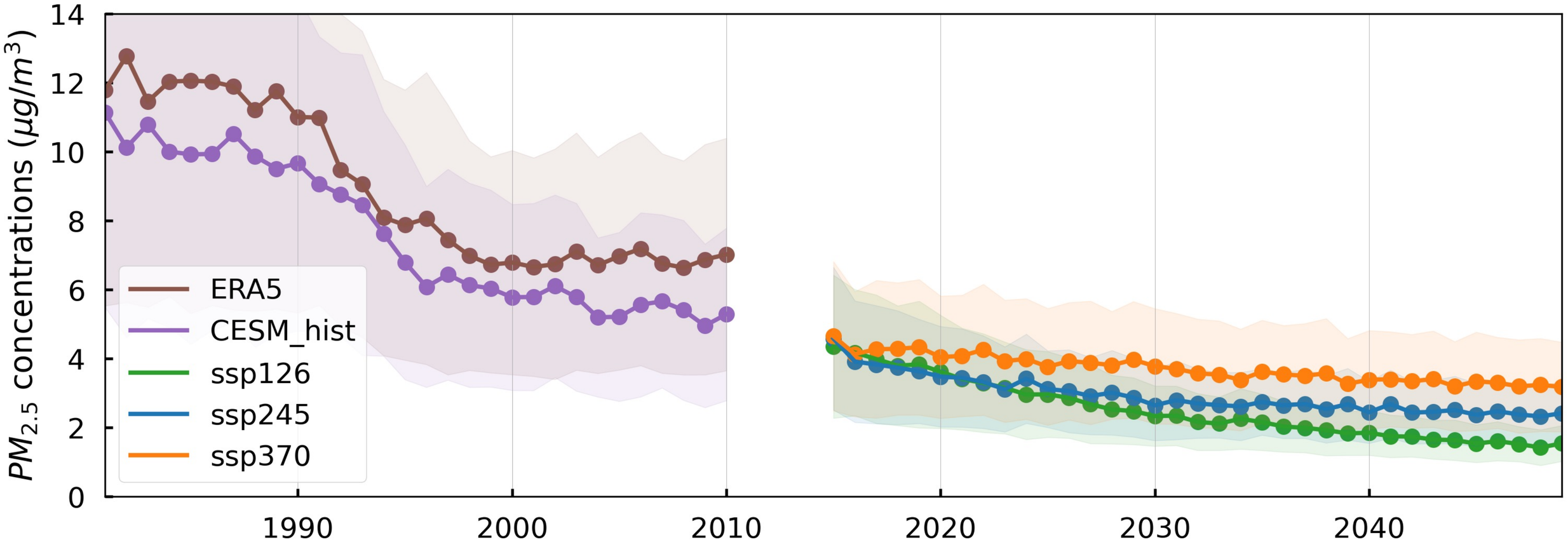
Medium Mitigation



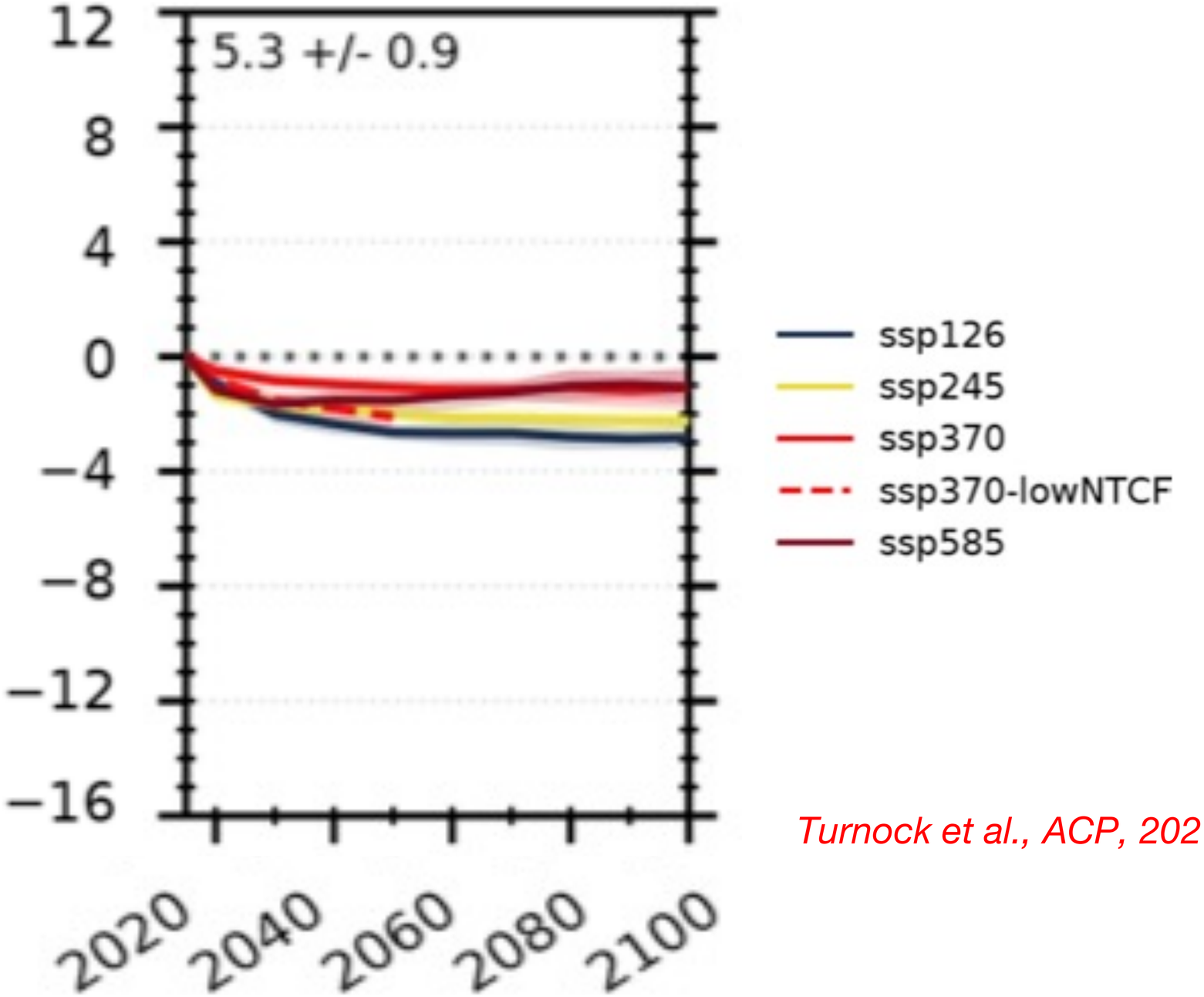
Low Mitigation



$PM_{2.5}$ Projections



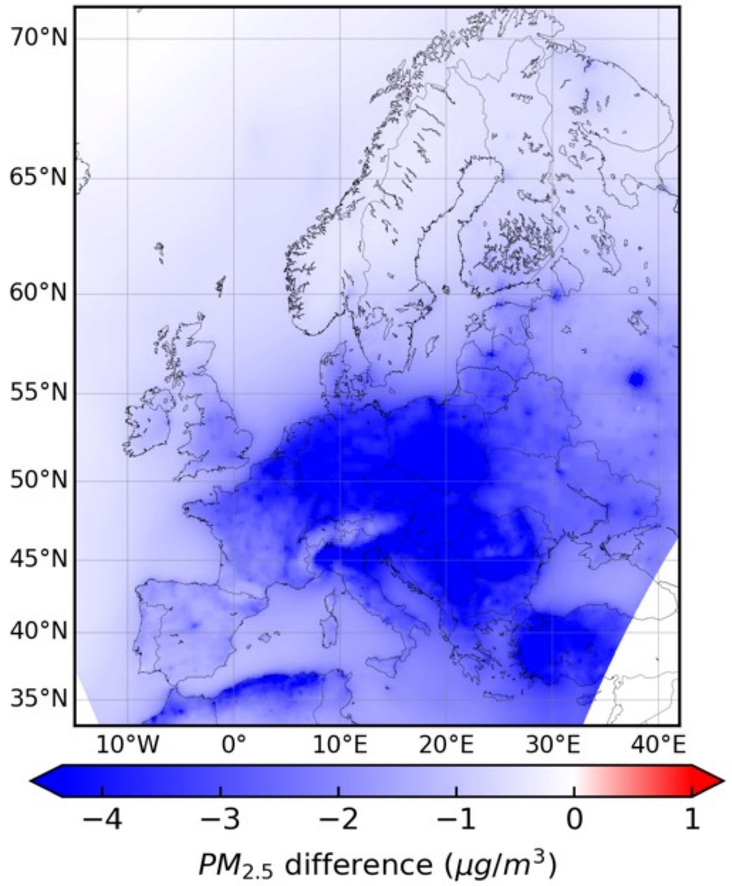
IPCC $PM_{2.5}$ EUROPE



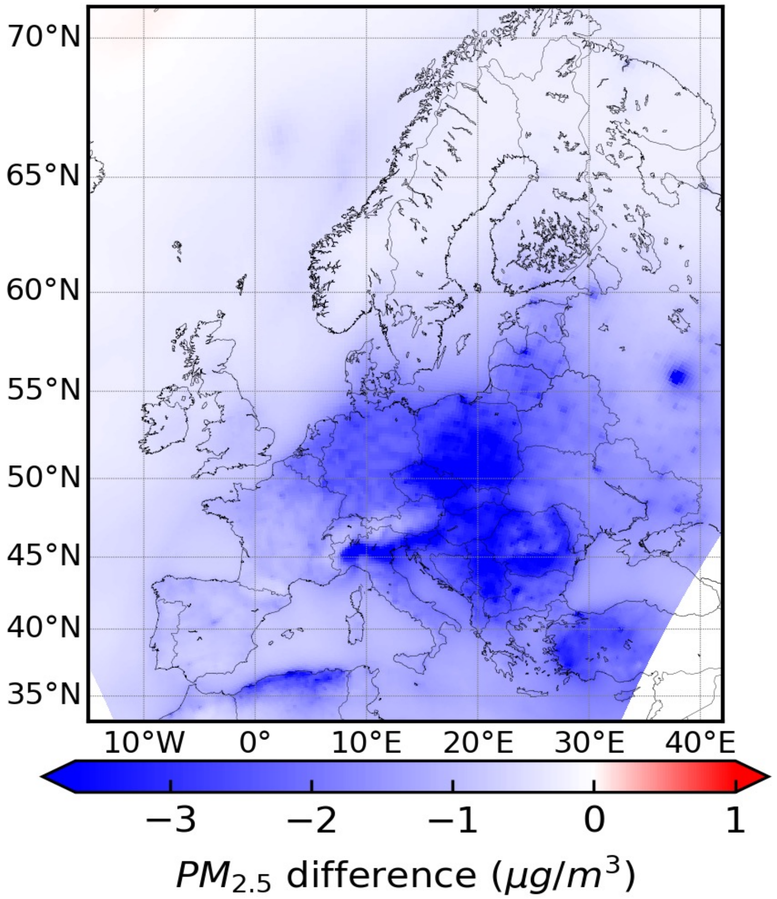
Turnock et al., ACP, 2021

$PM_{2.5}$ Projections (2040-2050 vs 2015-2020)

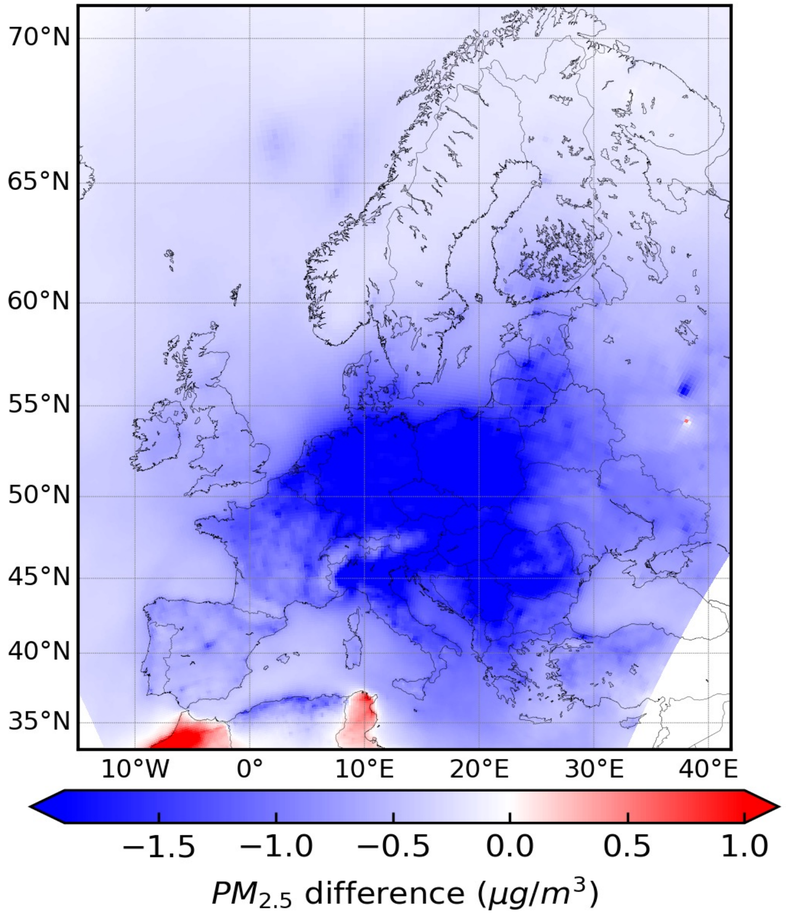
High Mitigation



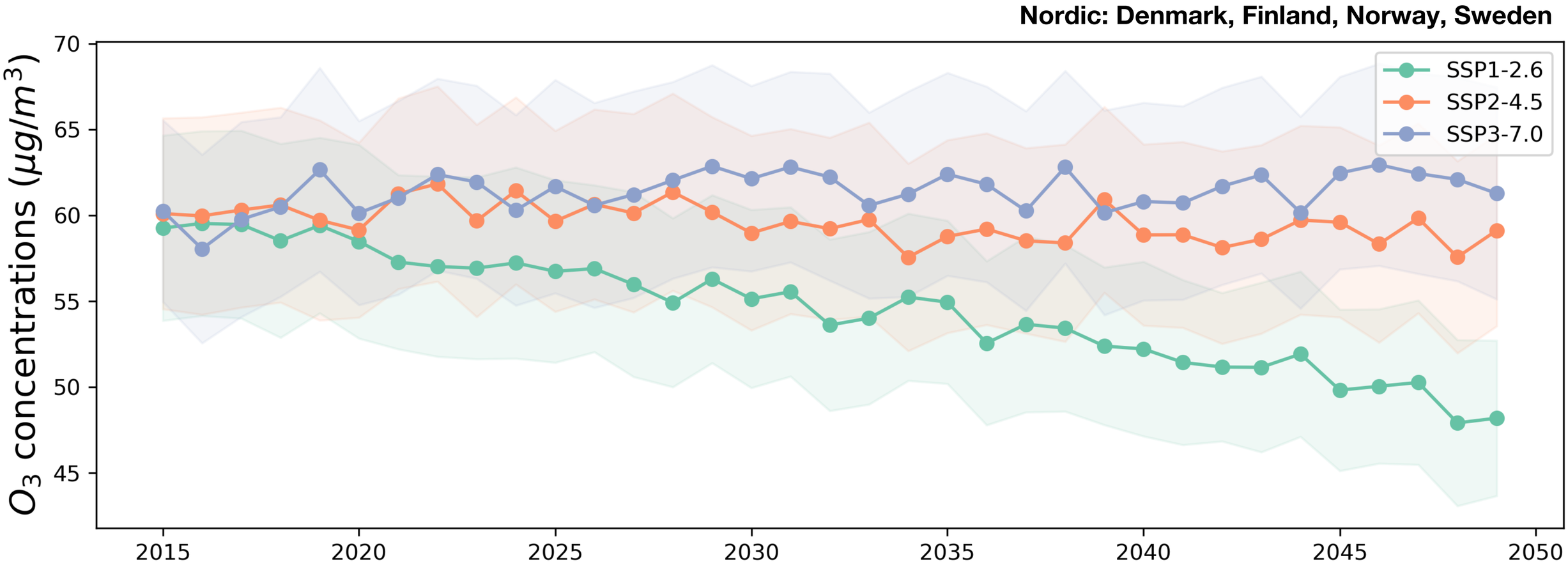
Medium Mitigation



Low Mitigation

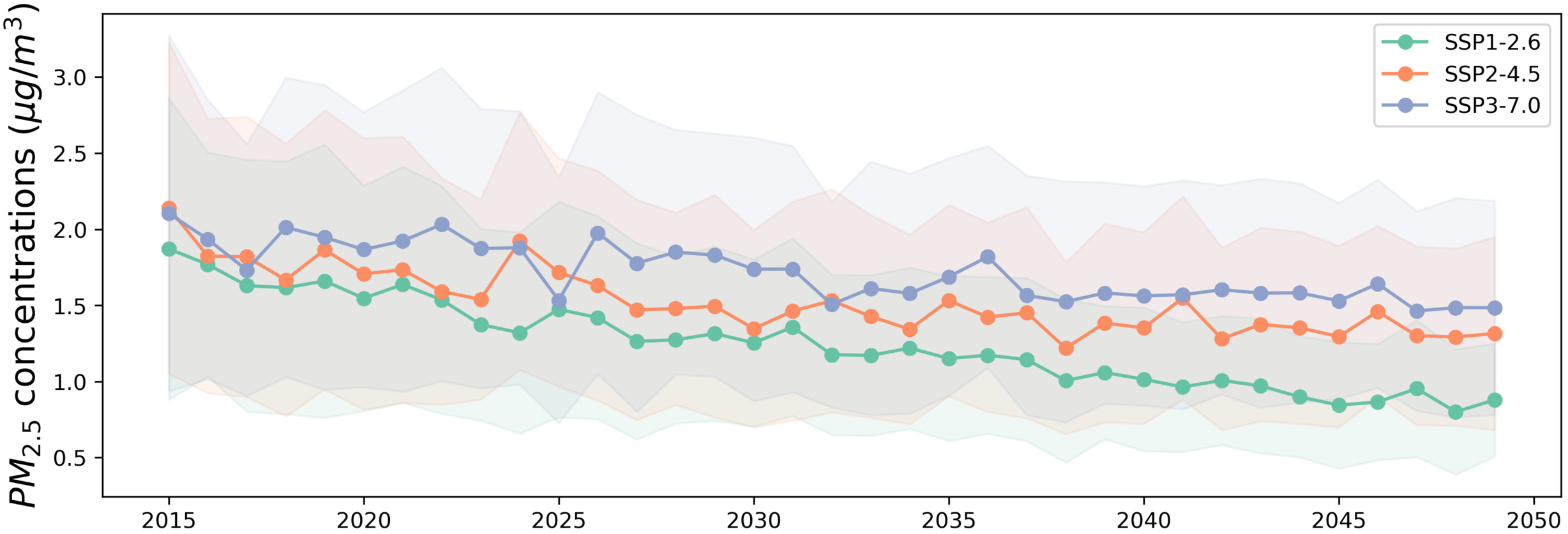


Nordic Projections – O_3



Nordic Projections – $PM_{2.5}$

Nordic: Denmark, Finland, Norway, Sweden



CONCLUSIONS

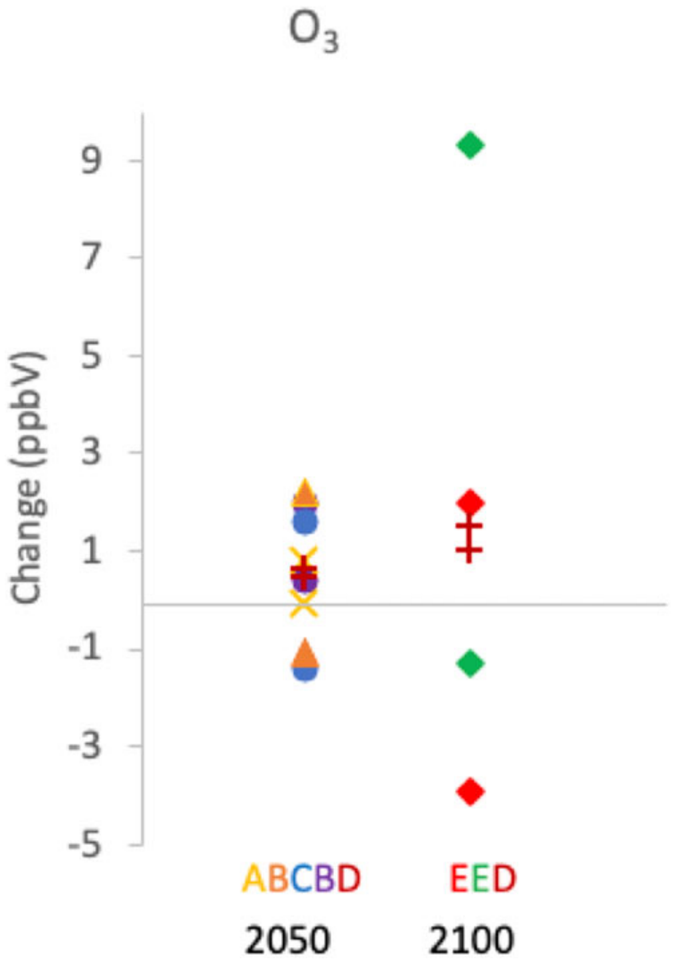
- Emissions over Europe are projected to decrease
- O_3 and $PM_{2.5}$ surface concentrations are expected to decrease in most scenarios
  - Scenarios with limited mitigation lead to unchanged levels over Europe
- O_3 levels are expected to increase mainly over the southern Europe in all scenarios
- $PM_{2.5}$ levels are expected to decrease in high mitigation scenarios, in particular over central Europe
- O_3 and $PM_{2.5}$ over the Nordic region decreases slightly in all scenarios

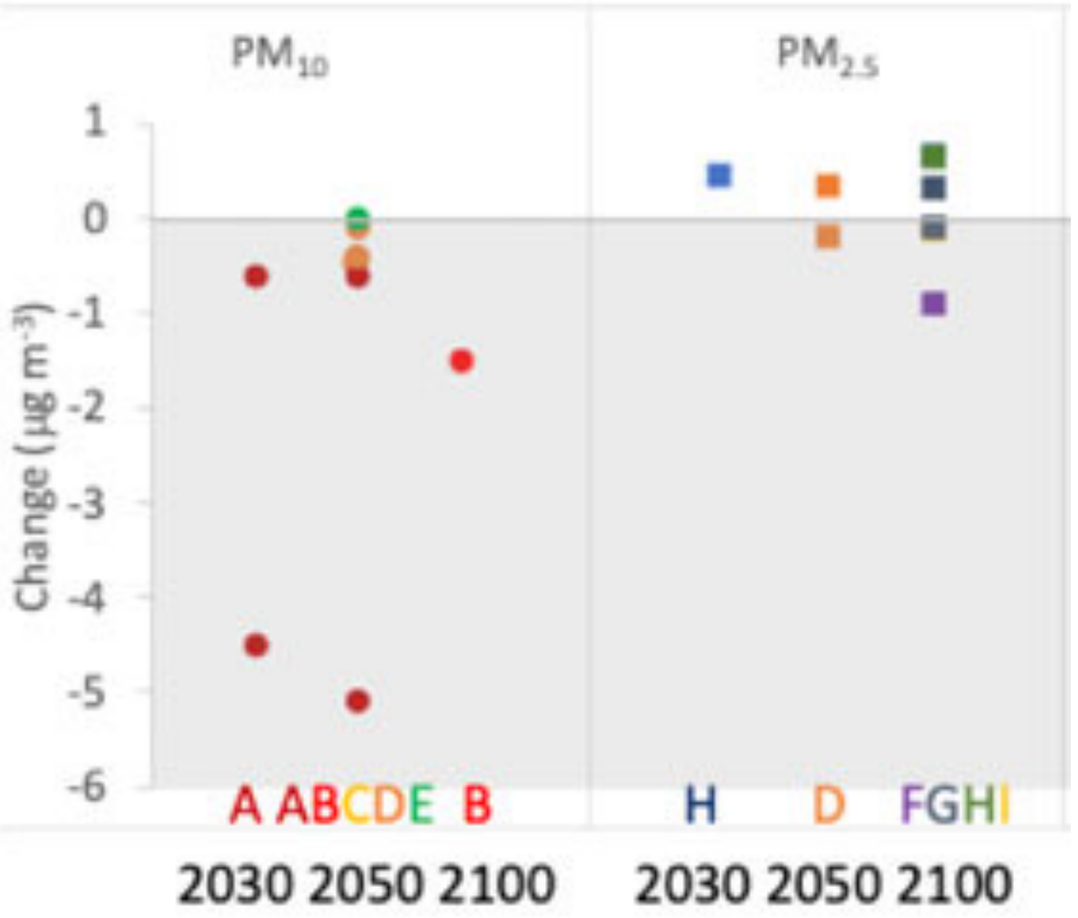
THANK YOU

Contact: ulas@envs.au.dk

UNCERTANTIES

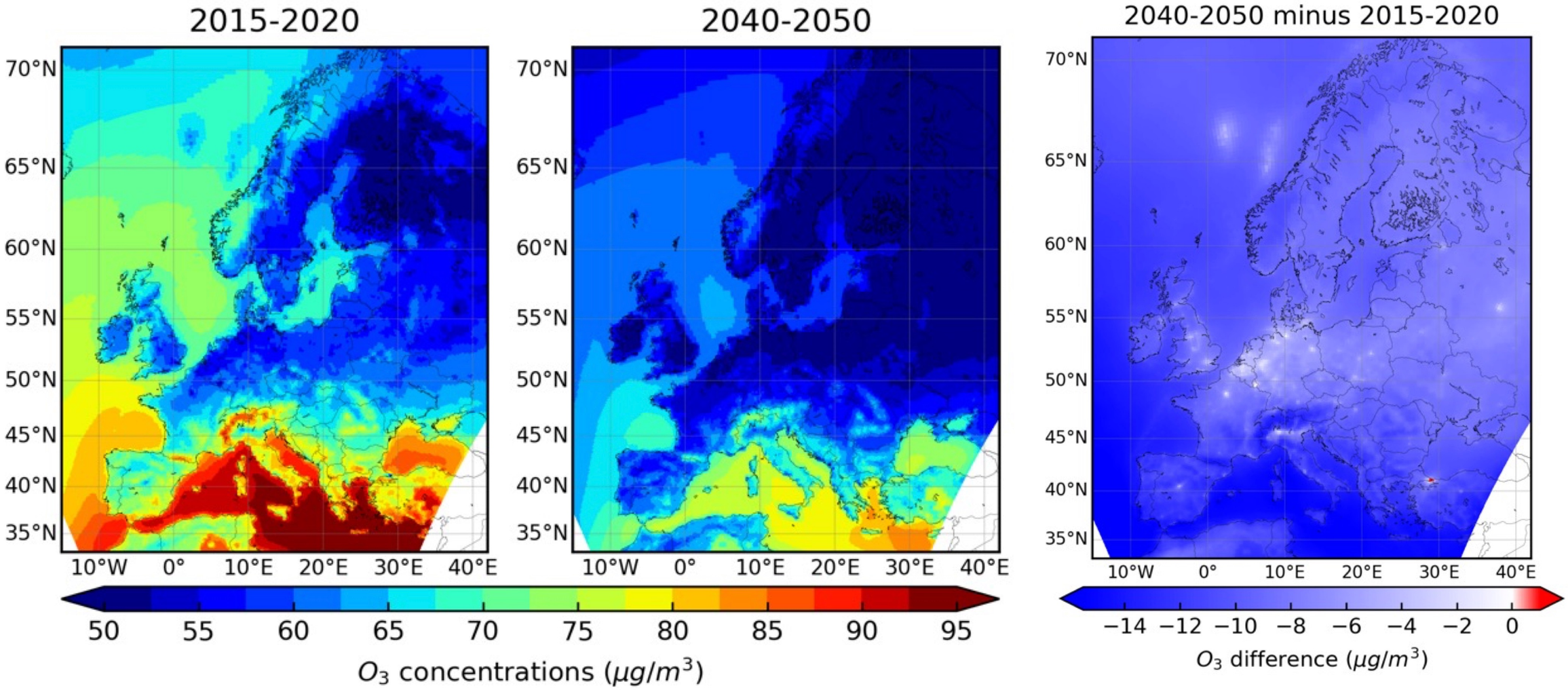
- Meteorology
- Emissions
- Model:
  - Chemistry
  - Aerosols
  - Resolution
- Scenaria



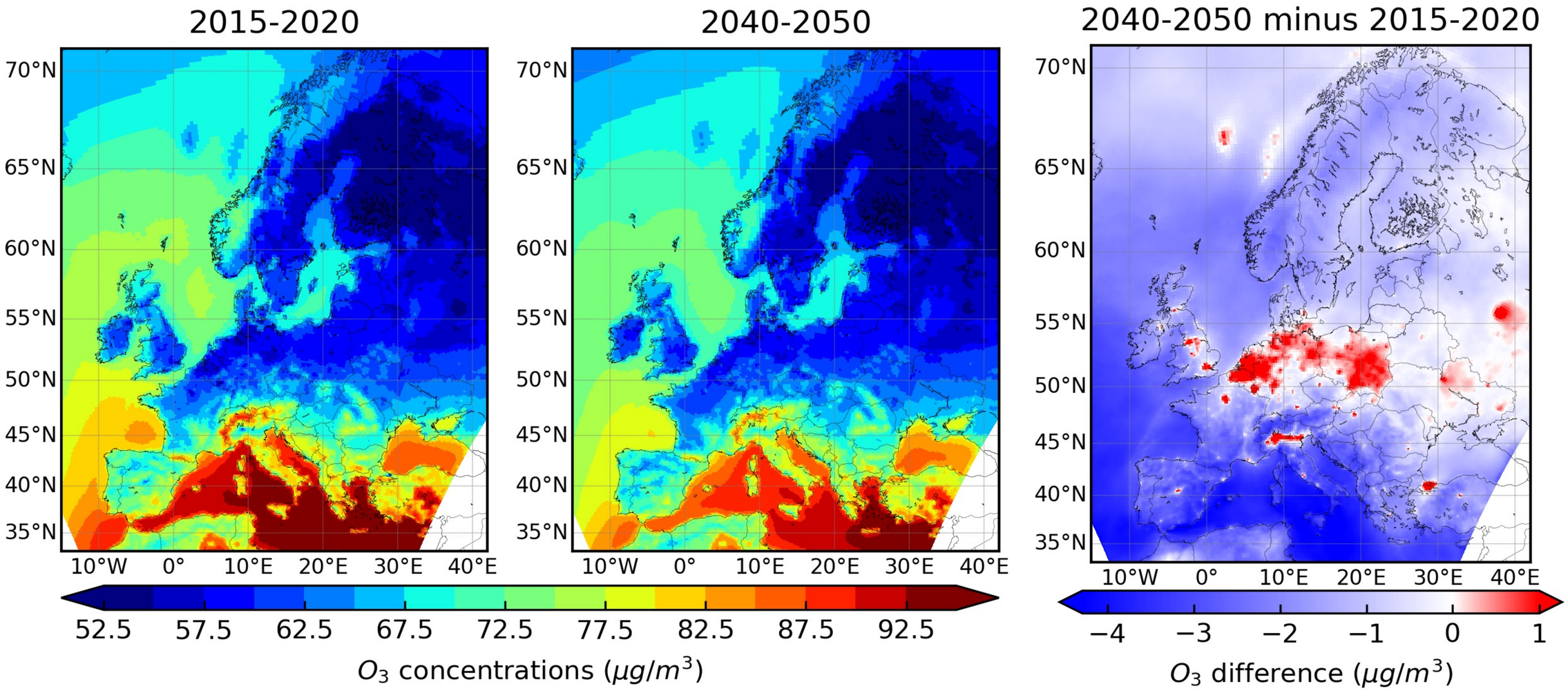


Im et al., Frontiers, 2022

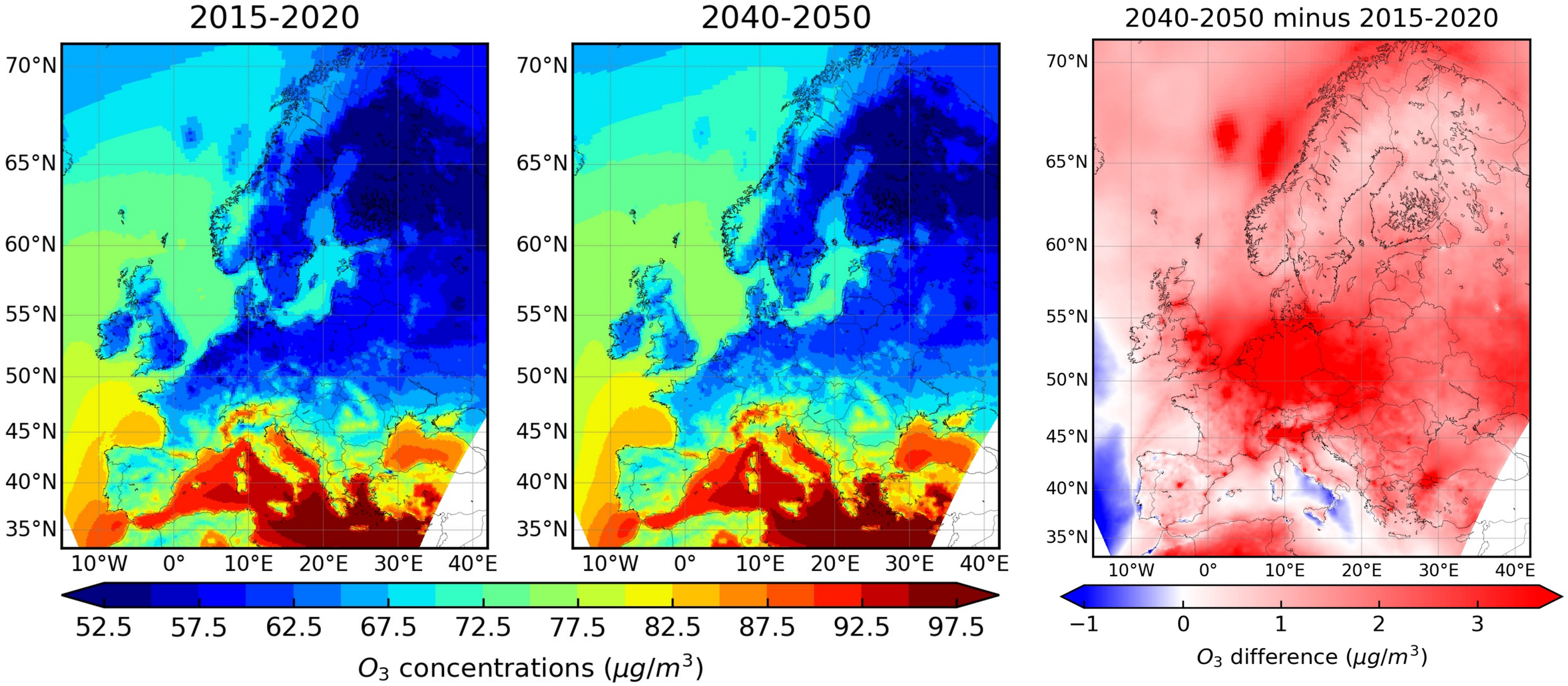
O_3 Projections – High Mitigation (SSP1-2.6)



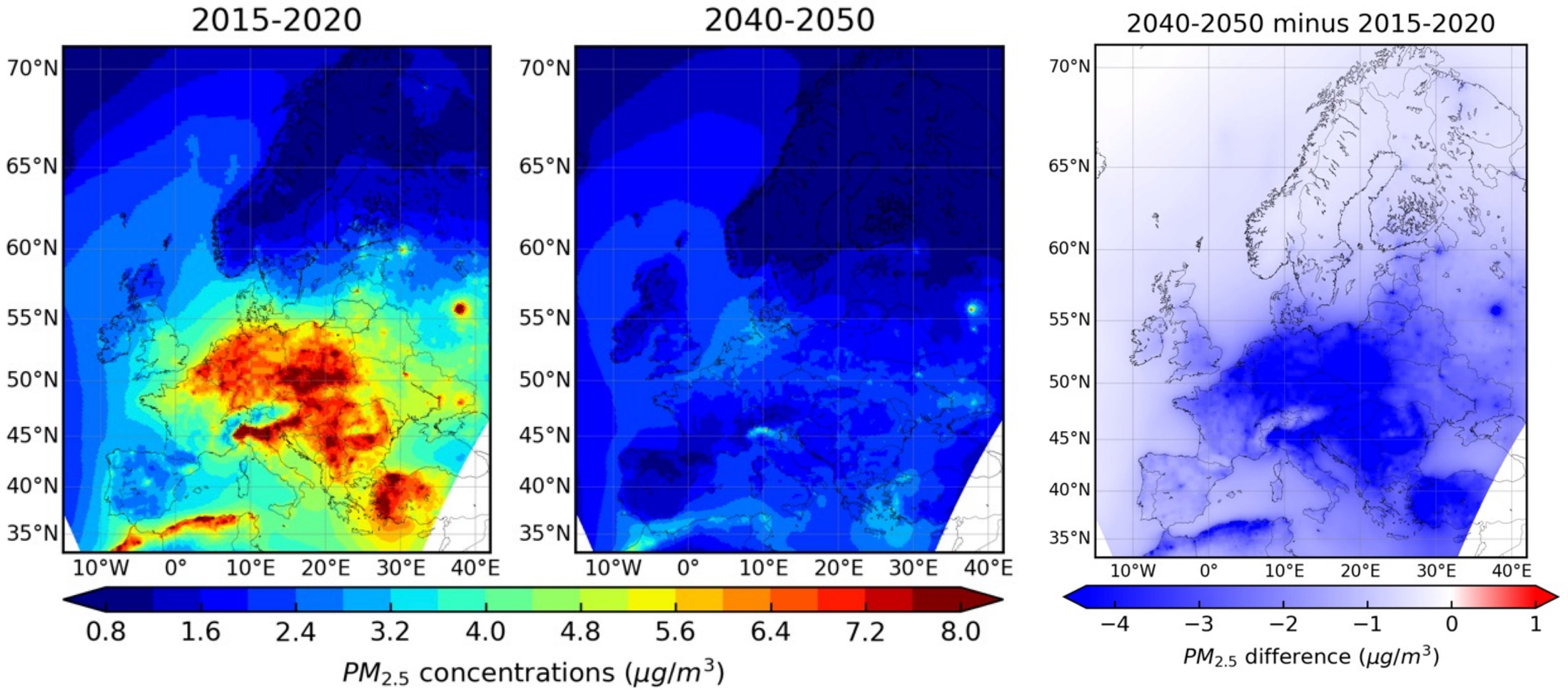
O_3 Projections – Medium Mitigation (SSP2-4.5)



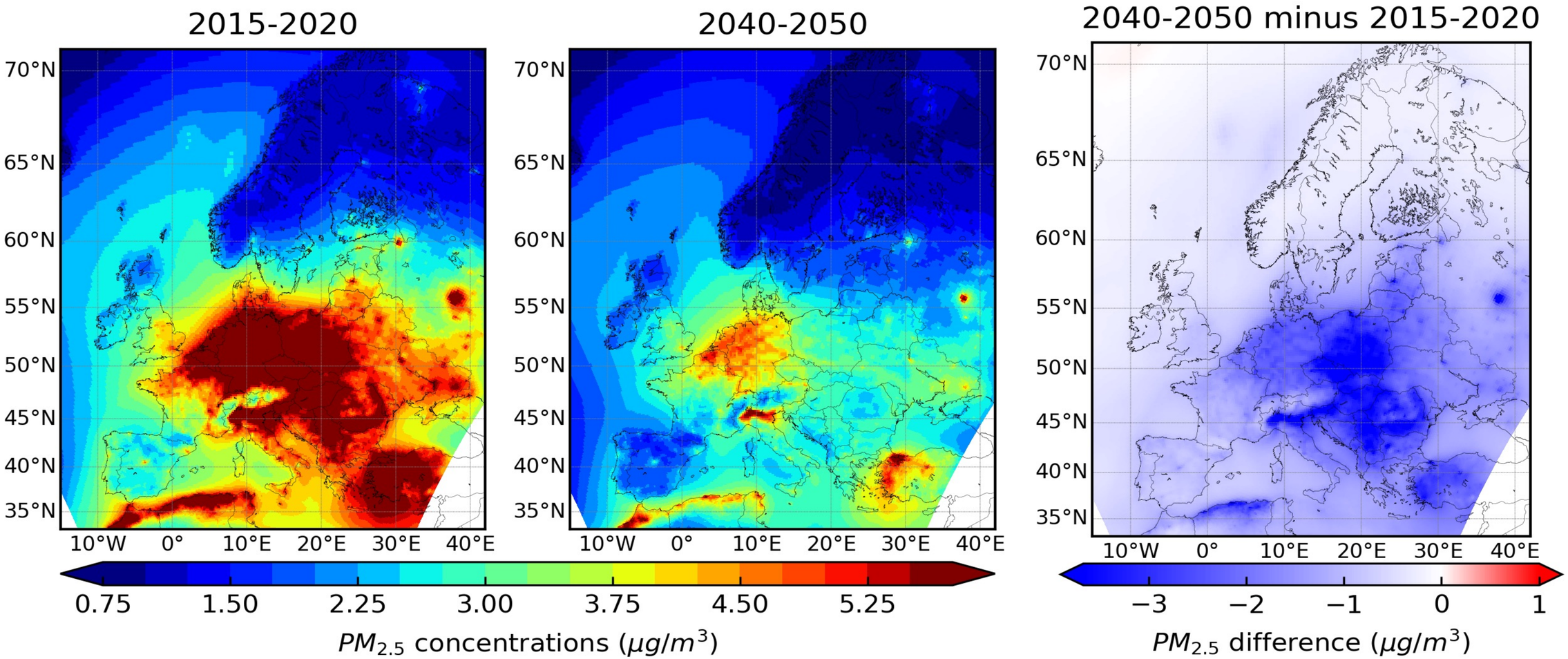
O_3 Projections – Low Mitigation (SSP3-7.0)



$PM_{2.5}$ Projections – High Mitigation (SSP1-2.6)



$PM_{2.5}$ Projections – Medium Mitigation (SSP2-4.5)



$PM_{2.5}$ Projections – Low Mitigation (SSP3-7.0)