# Fine-Resolution Air Quality Modeling for the NW

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**Center for Climate and Aerosol Research (CCAR)**
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# Objective

To develop a multi grid, high-resolution air quality modeling framework to support activities at PSU-CCAR

# Why?

- Studies dedicated to investigate the health effects from acute and chronic  exposure to air pollutants require reliable air quality simulations.

- Increasing horizontal resolution of chemical transport models can result in improved simulations of pollutants concentrations.

- Improved simulations at higher resolution can reveal high spatial variability of air pollutants, potentially leading to gradients in health impacts.

# Requirements for Hi-Res Air Quality Modeling

- Hi-Res:
  - Emission Files
  - Meteorological Simulations
  - Biogenic Emissions
  - Measurements

WRF
12 km

WRF
4 km

WRF
1 km

MEGAN

EPA-NEI2011v2

SMOKE

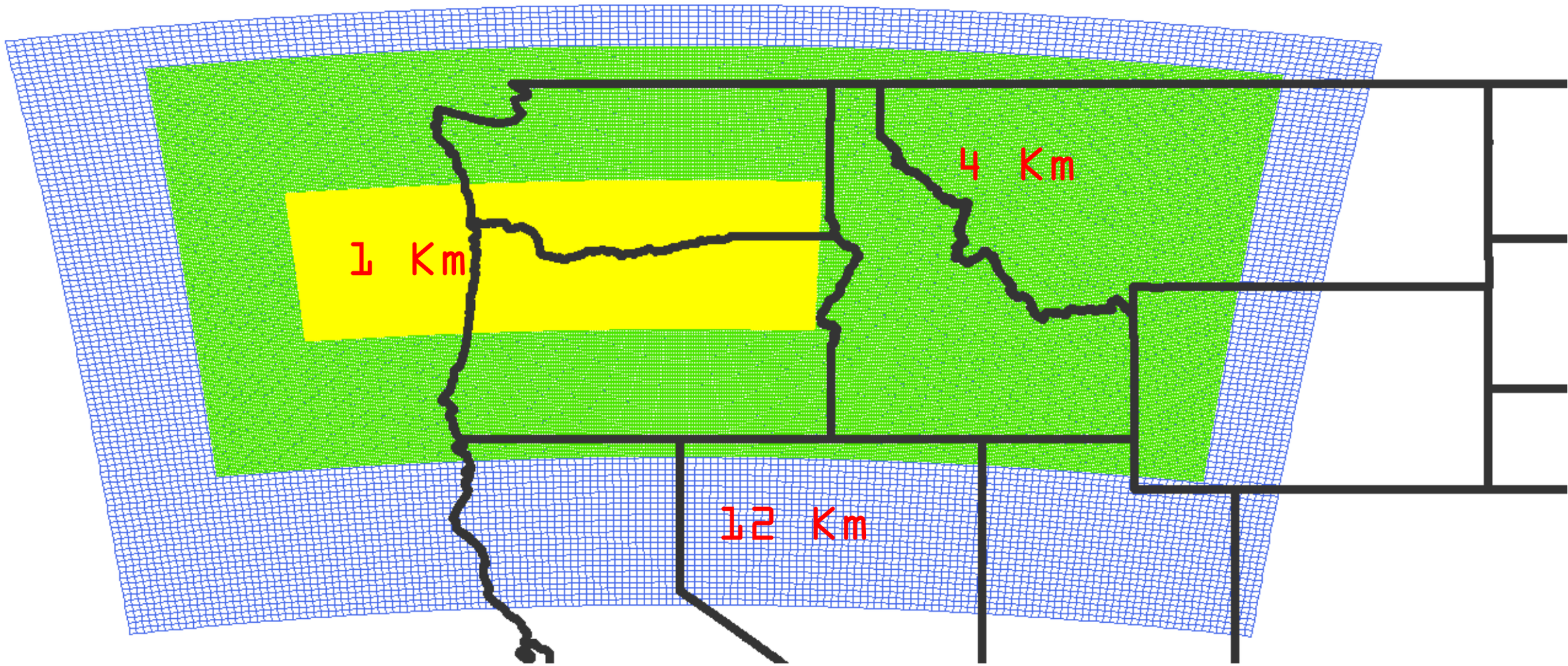
v5.0.2
CMAQ
12 km

CMAQ 4
km

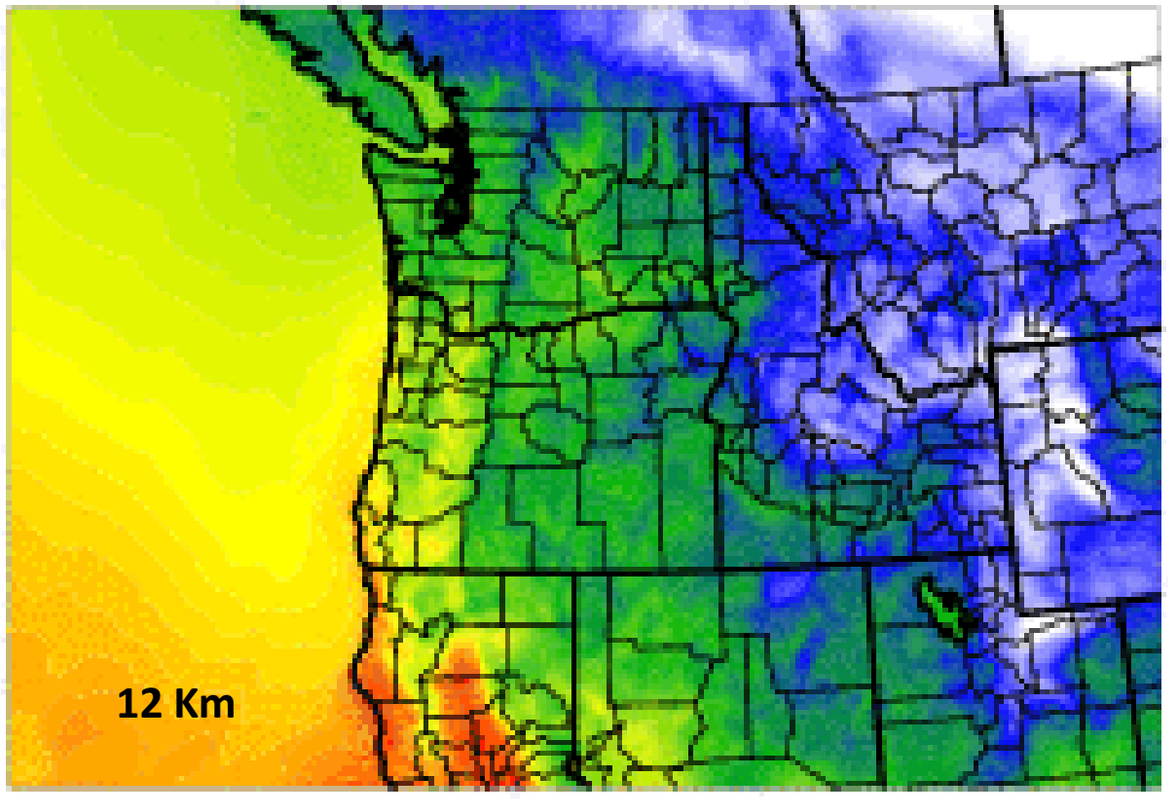
CMAQ 1
km

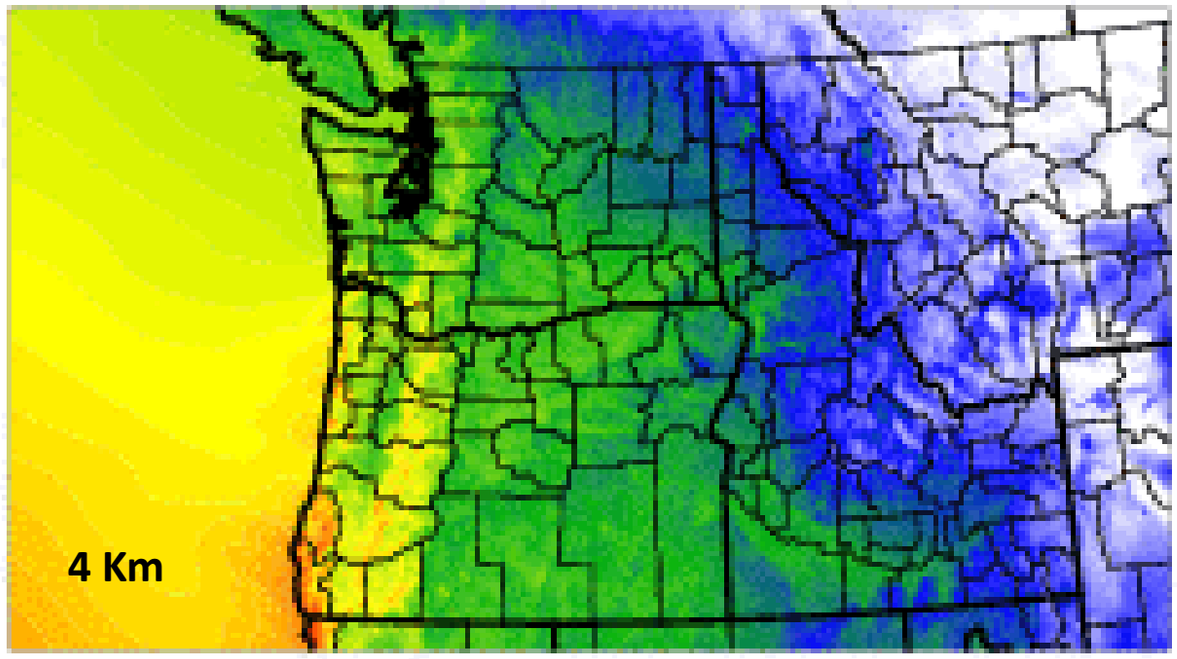
BENMAP
Mortality,
Morbidity

# 3 Nested Domains

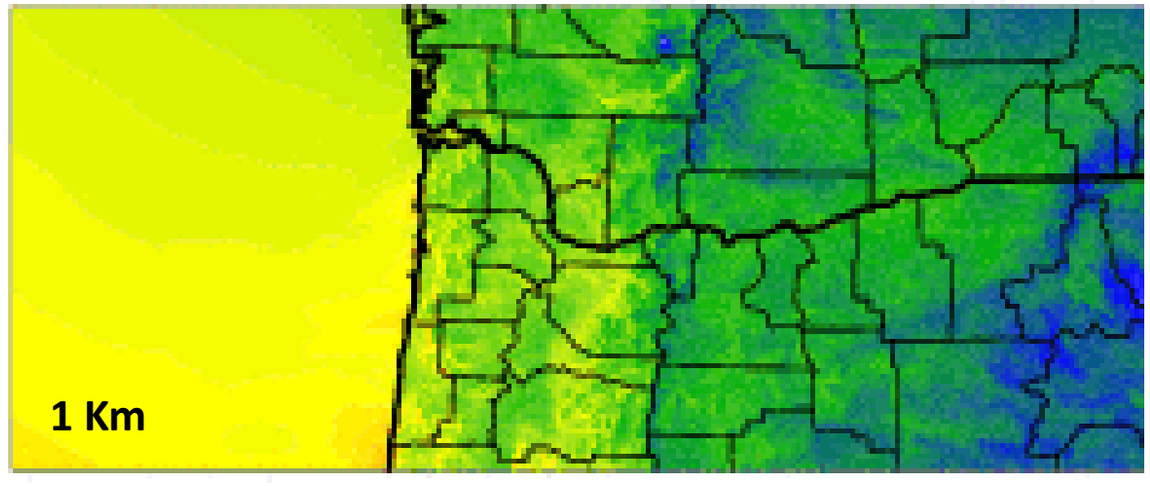


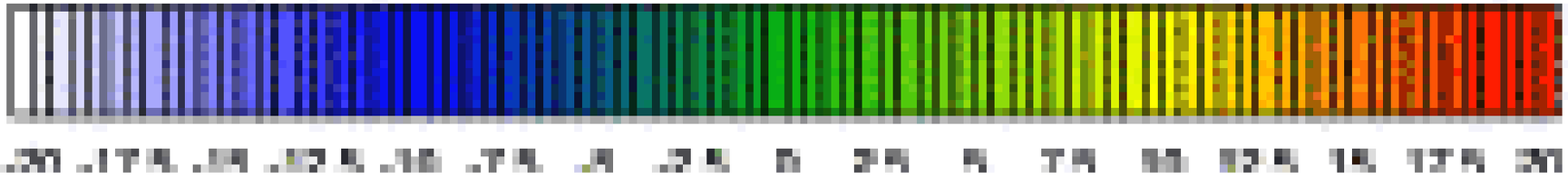
# Temperature




Only 7 days of simulations →



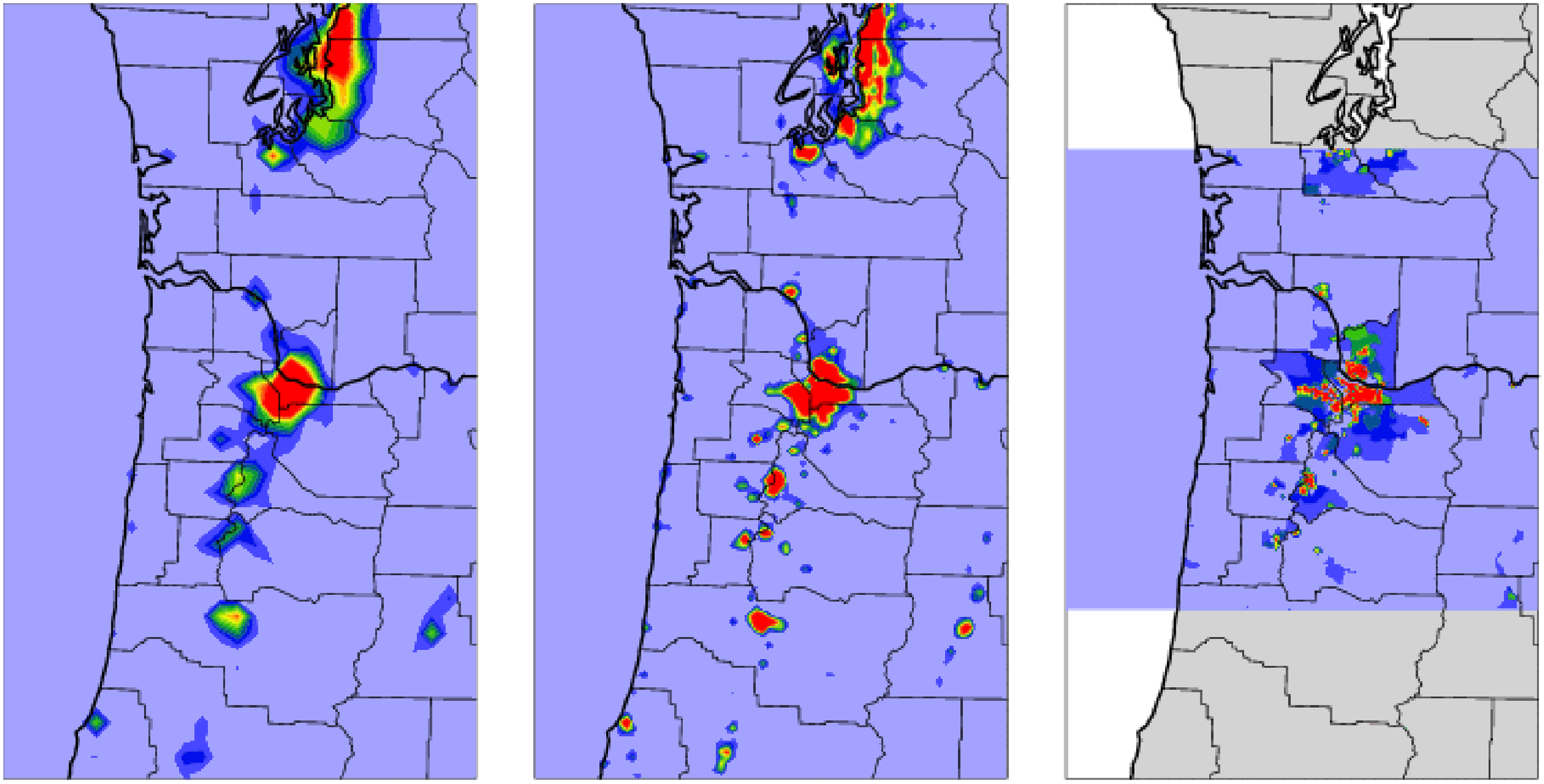



°C

12 Km

4 Km

1 Km



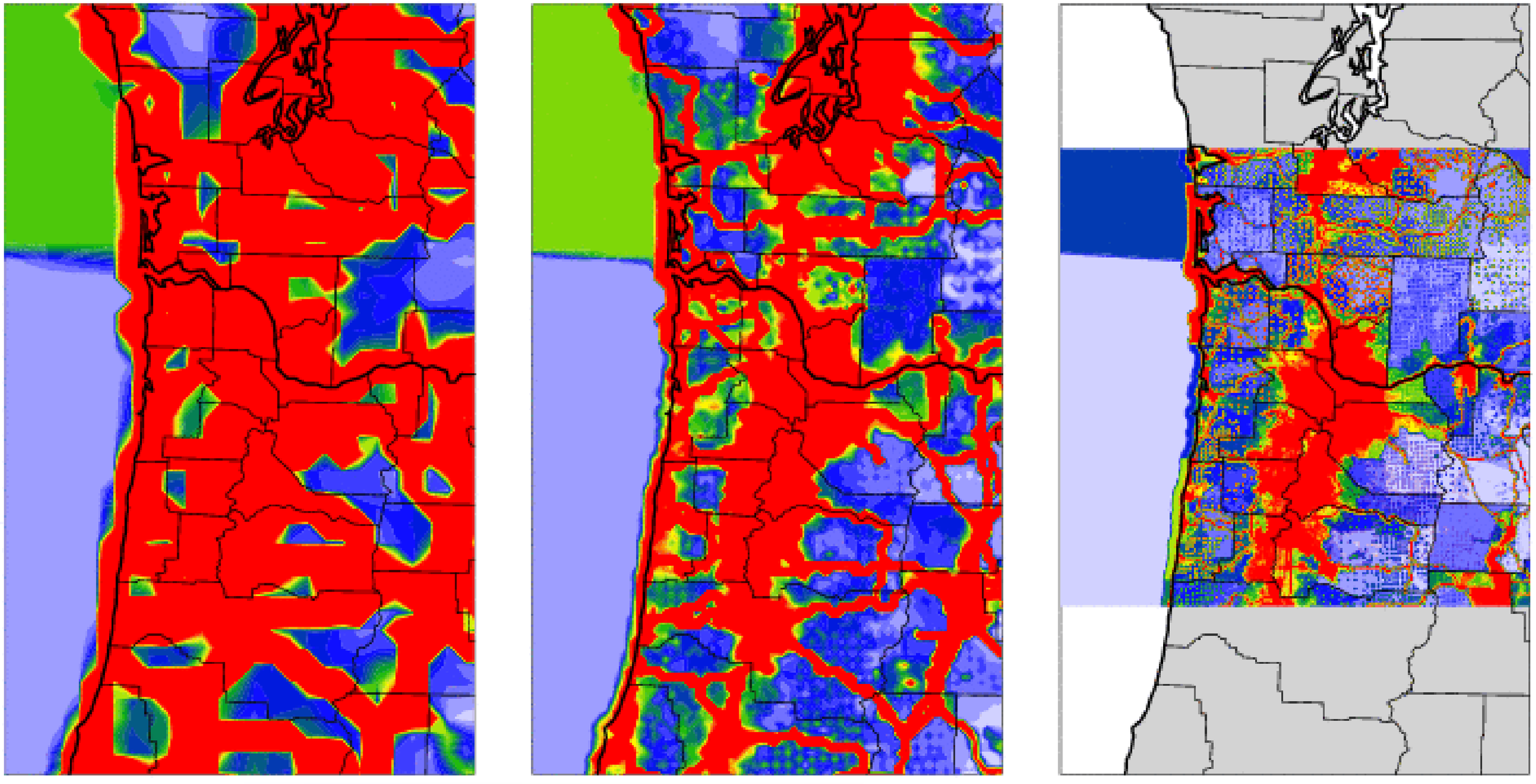
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1

EC ($g\ s^{-1}\ km^{-2}$)

12 Km

4 Km

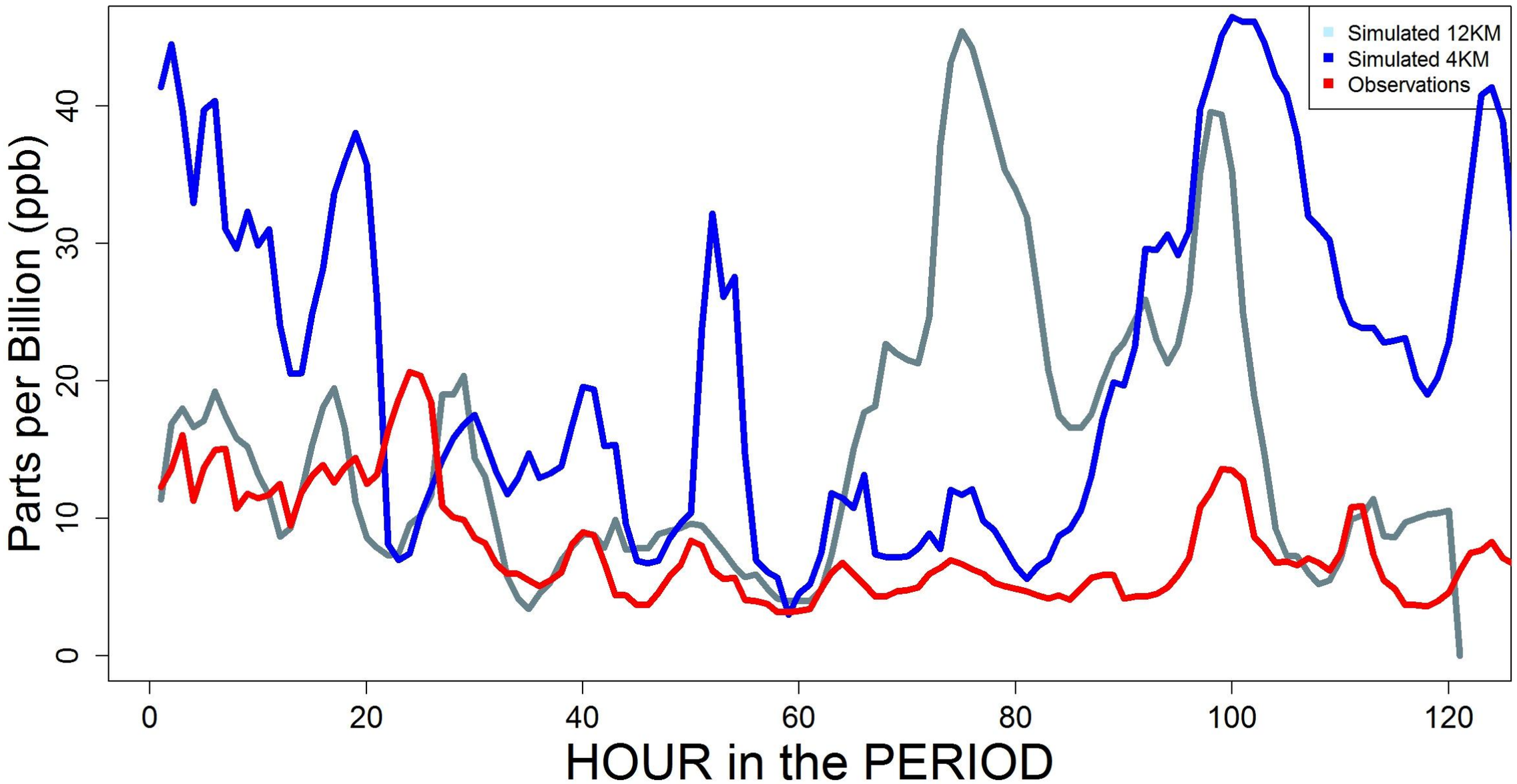
1 Km



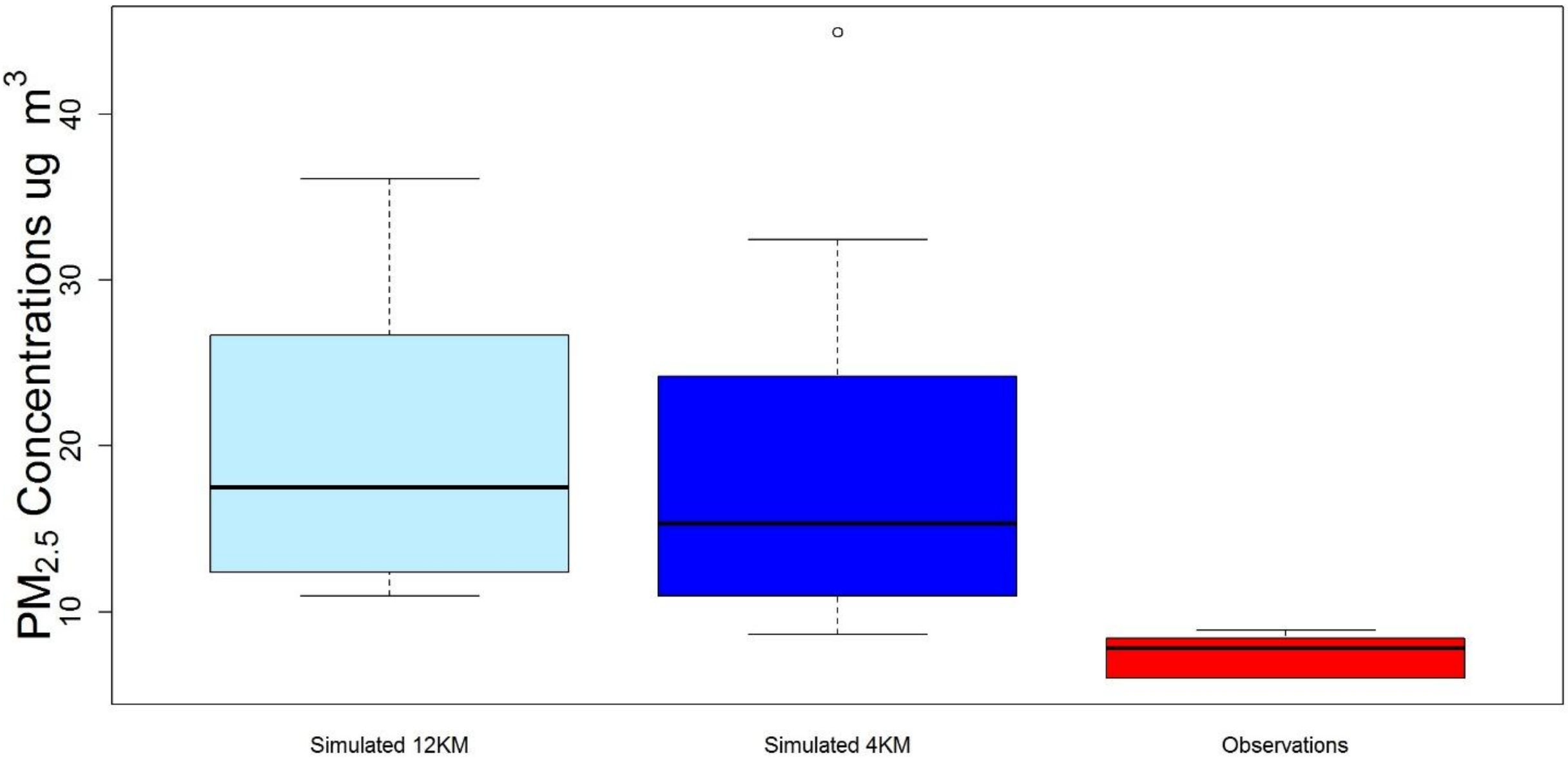
0 0.5 1 1.5 2

NOx (g $s^{-1}$ $km^{-2}$)

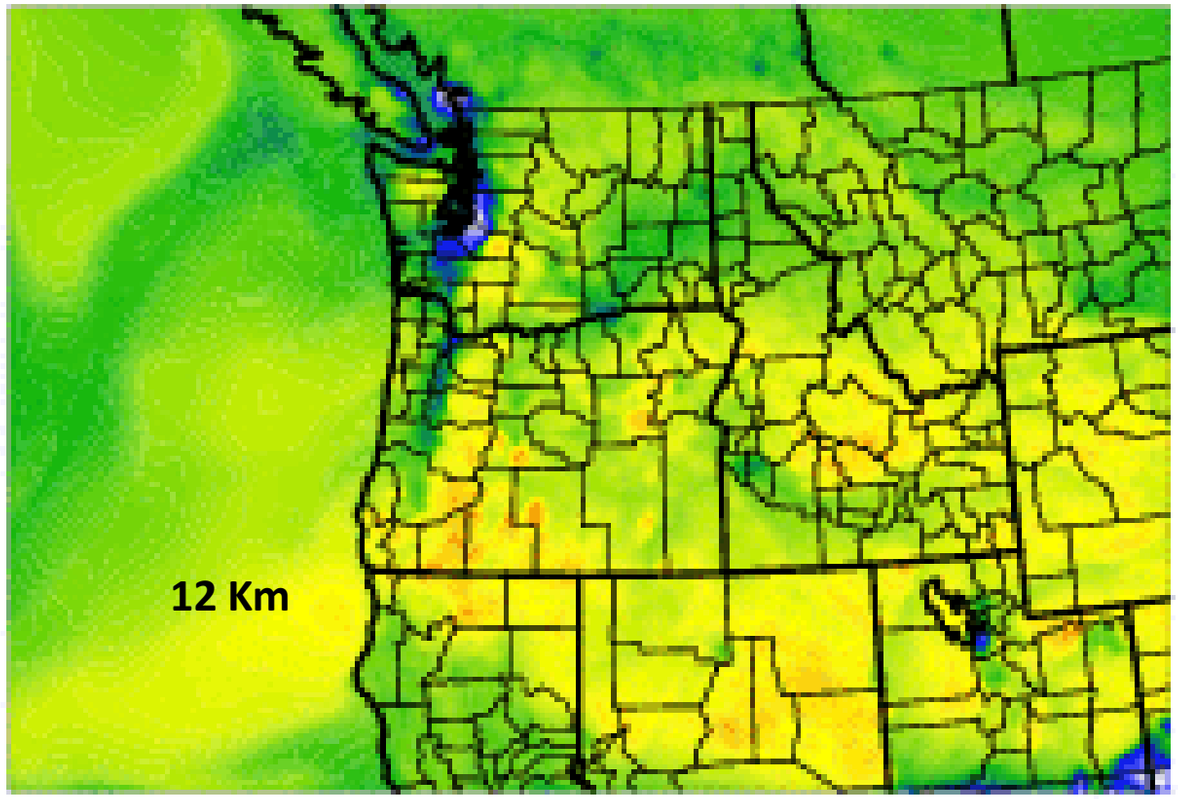
# Concentrations vs observations ($NO_2$)

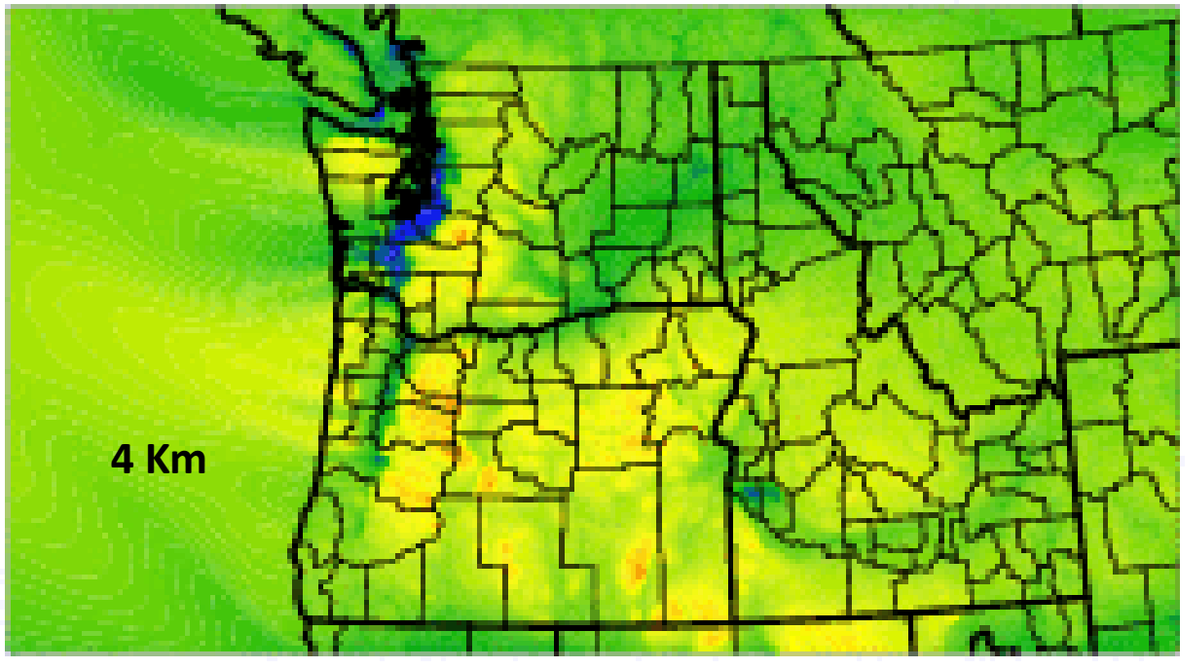


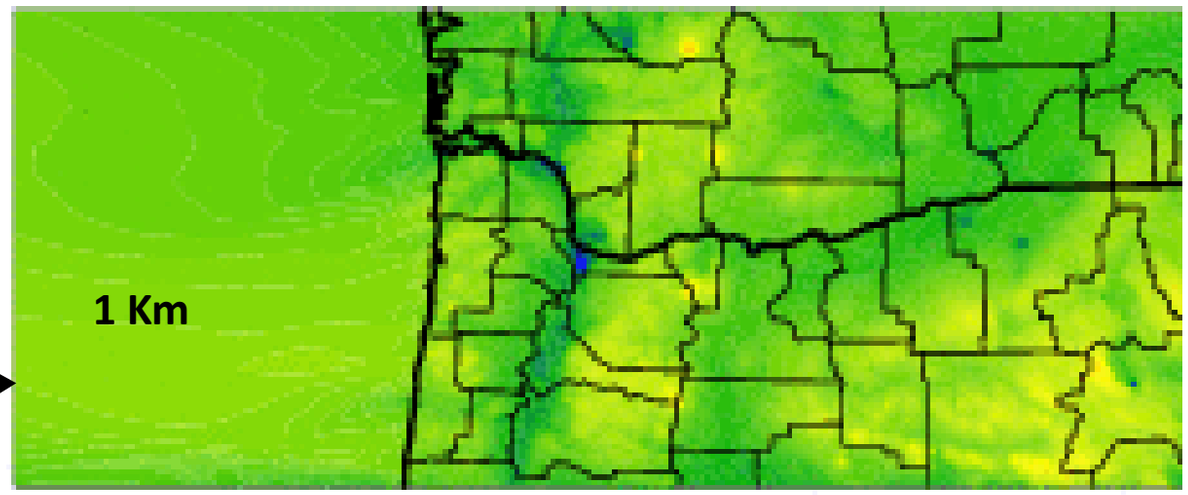
# Concentrations vs observations ($PM_{2.5}$)



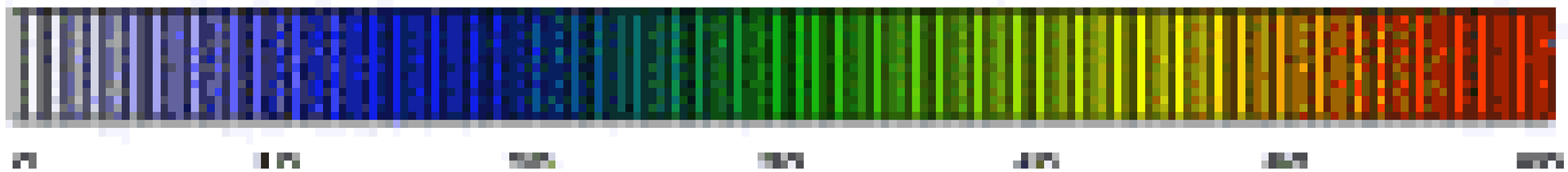
# CONCENTRATIONS ($O_3$)



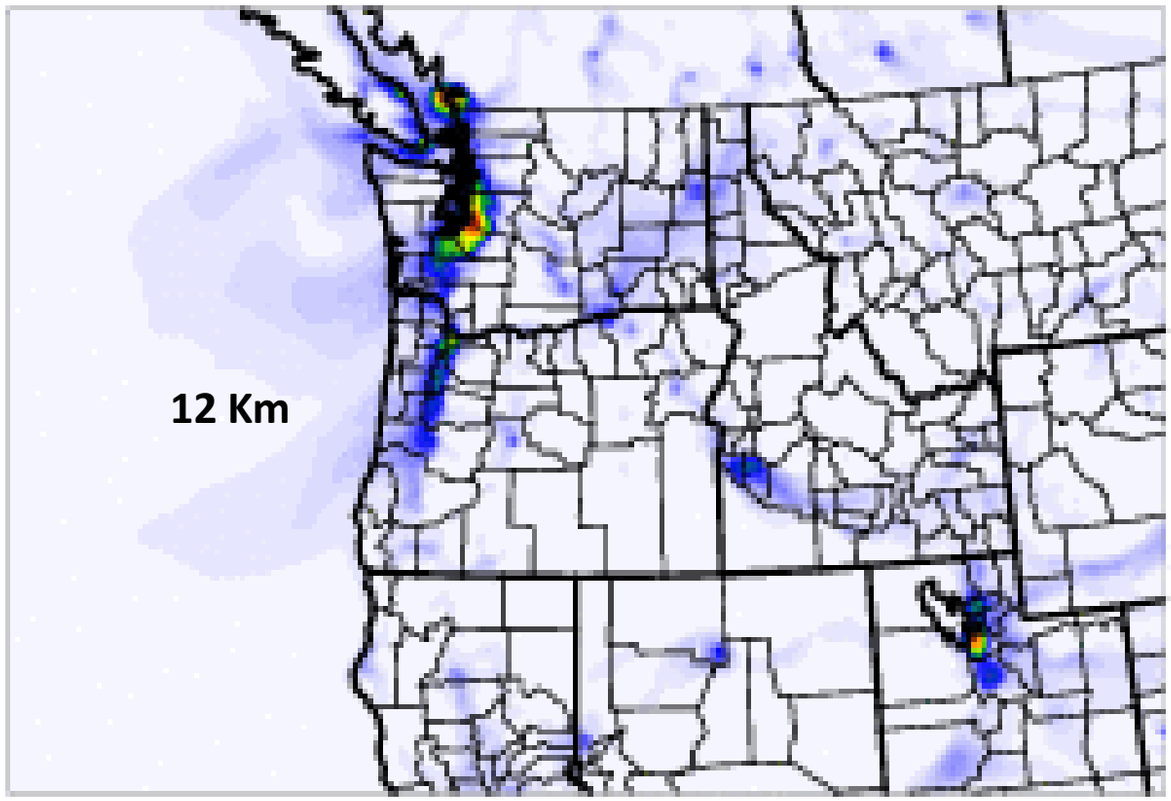



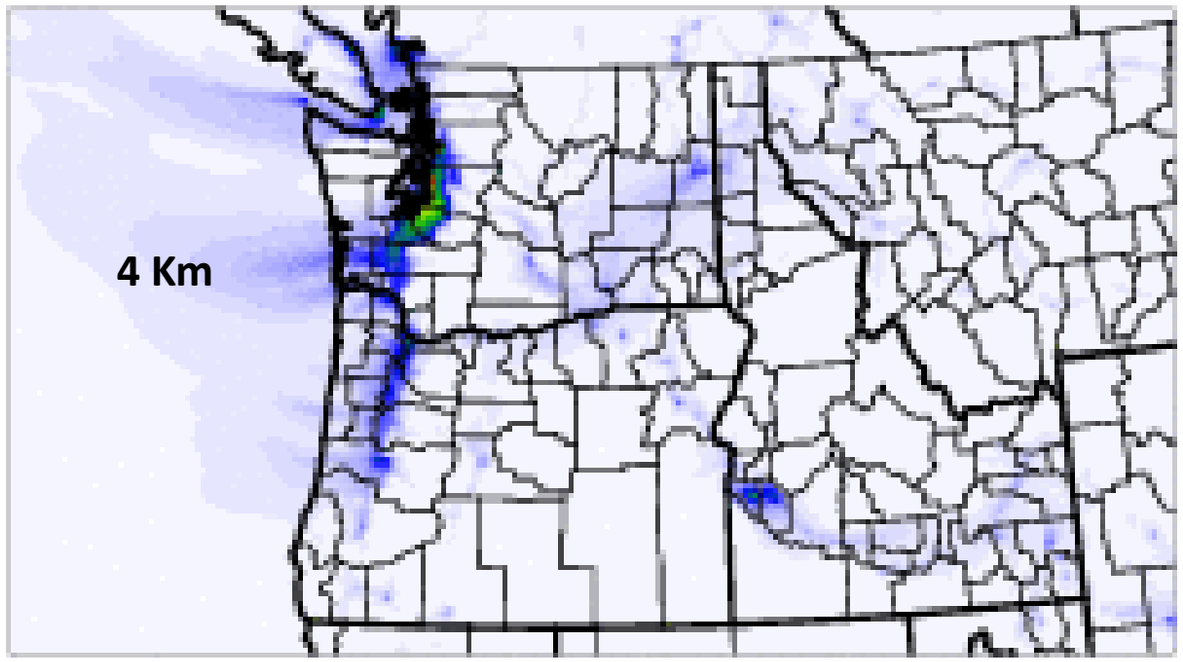

Only 7 days of simulations →



ppbV

# CONCENTRATIONS ($NO_2$)

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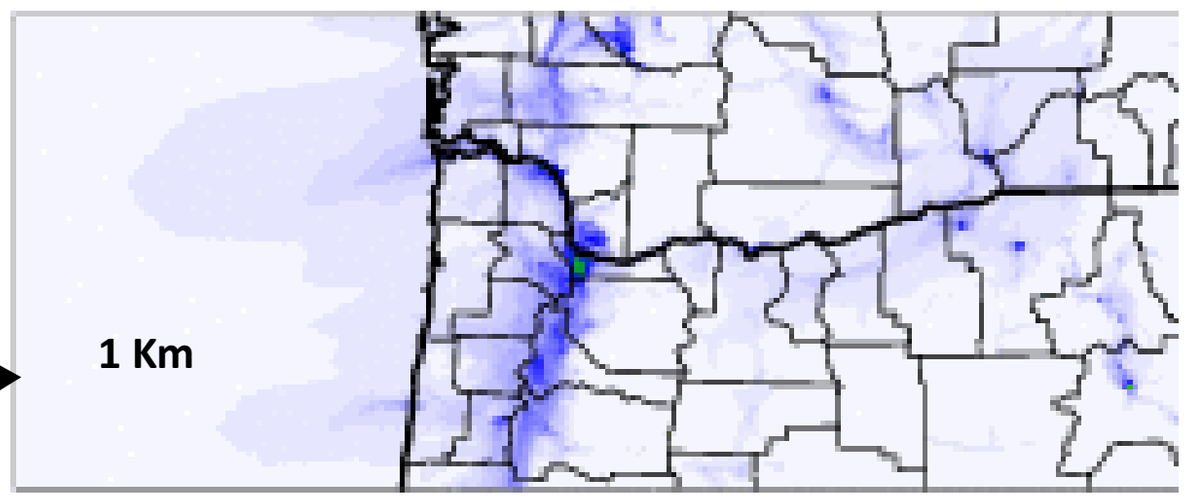
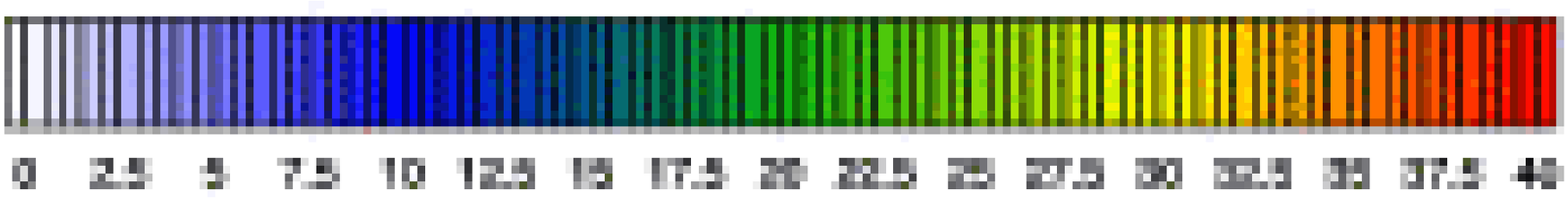
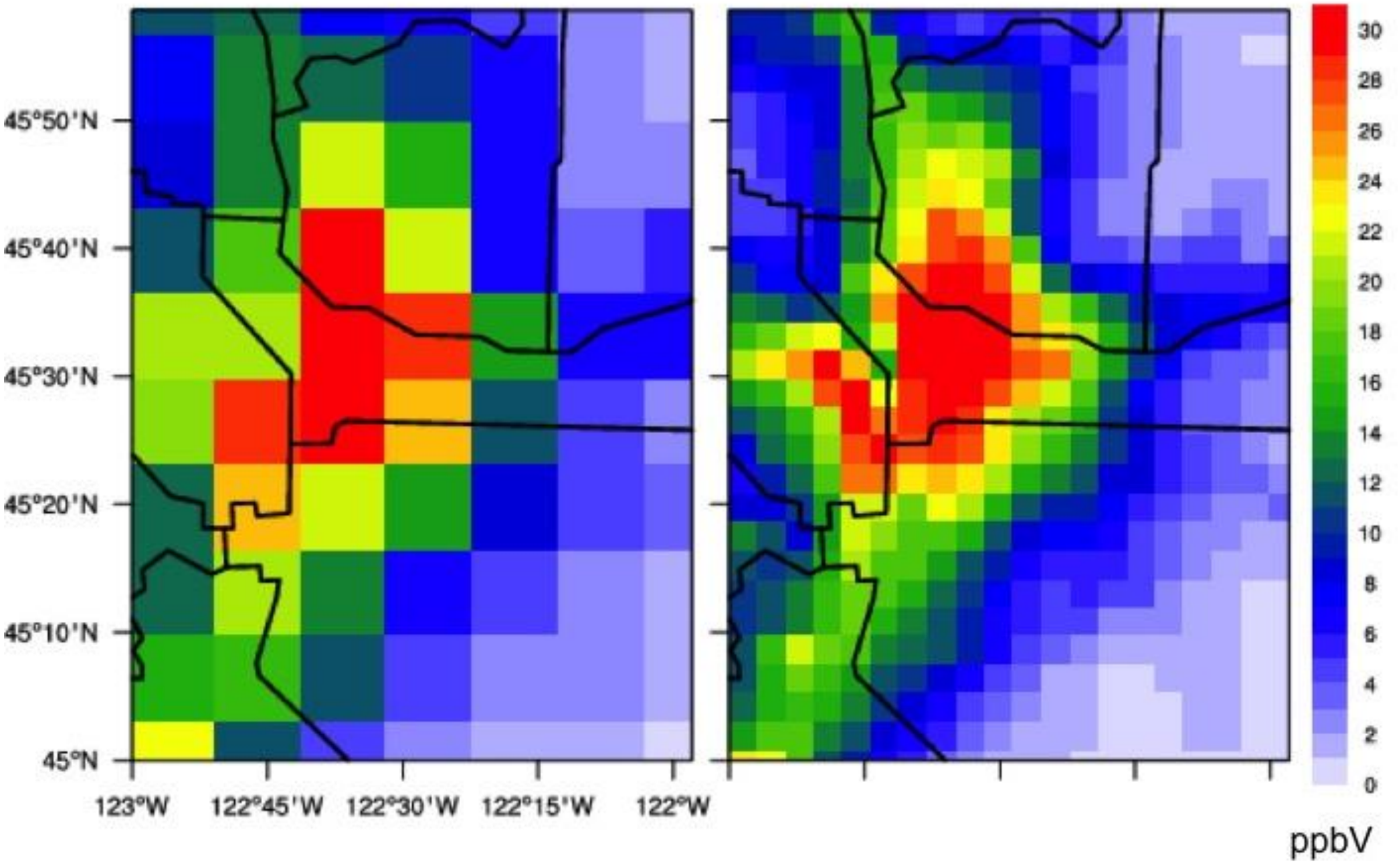


# CONCENTRATIONS ($NO_2$) cont.



# BenMAP Differences

| Endpoint | Incidence (4km) | Incidence (12 km) | % difference |
|---|---|---|---|
| Asthma Exacerbation, One or More Symptoms (4 to 12 years) | 167,335 | 139,123 | 17 |
| Cough ( 7 to 14 years) | 76,537 | 64,738 | 15 |
| Asthma Exacerbation, Missed school days (4 to 12 years) | 108,481 | 91,290 | 16 |
| Emergency Room Visits, Asthma (all ages) | 870 | 720 | 17 |
| HA, All Respiratory (65 years and older) | 1,070 | 867 | 19 |
| HA, Asthma (0 to 29 years) | 18 | 15 | 17 |
| HA, Asthma (30 years and older) | 22 | 18 | 18 |
| HA, Chronic Lung Disease (65 years and older) | 73 | 59 | 19 |

# Next Step

- Estimate Incidence for 1 km resolution
- What is the effect of model resolution in the estimation of exposure from sensible populations, minorities and socio economic status?