Exposure in West Balkan and EECCA states

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Overview

- Calculations for 2018 with EMEP 0.1º data (EMEP report 2020)
  - TNO emission for residential combustion used (with condensables, Ref2)
  - Concentrate on $PM_{2.5}$ calculations

- uEMEP applied at 250 m on annual mean data with downscaling of
  - Residential combustion (population density)
  - Shipping (AIS)
  - Traffic (Open Street Maps)
  - Downscaling area ±0.1º

- Aggregated into EU+EFTA, Western Balkan and EECCA countries
  - Concentration maps of all countries
  - Population weighted concentrations for EMEP and uEMEP
  - Population exposed above threshold for EMEP and uEMEP

- Uncertainties
  - uEMEP calculations have a bias of -10% in EU, varying from -30 to +30% per country
  - No measurement data readily available for West Balkan and EECCA countries
  - Emissions for EECCA countries should be considered very uncertain

Western Balkan

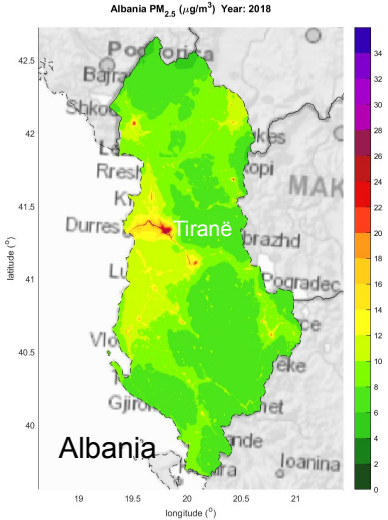
https://publications.parliament.uk/pa/ld201719/ldselect/ldintrel/53/5304.htm

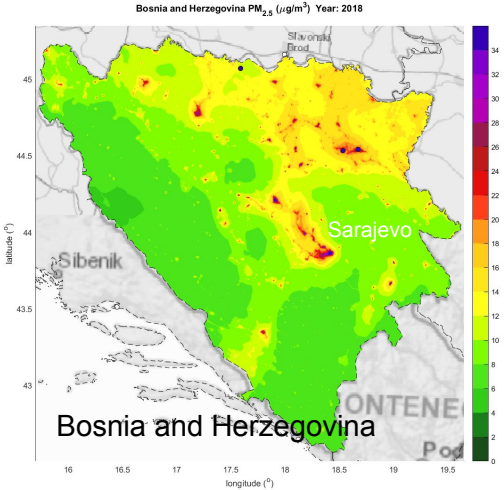
EECCA

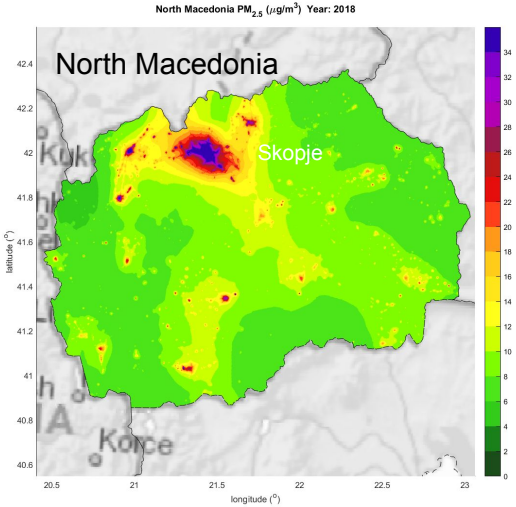
https://www.bilaterals.org/?empirical-data-on-isds-in-the-cis&lang=fr

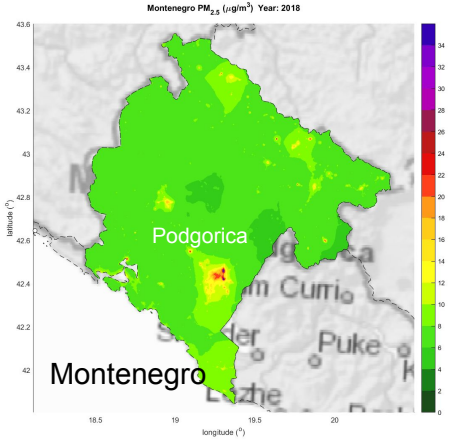
Example maps and exposure

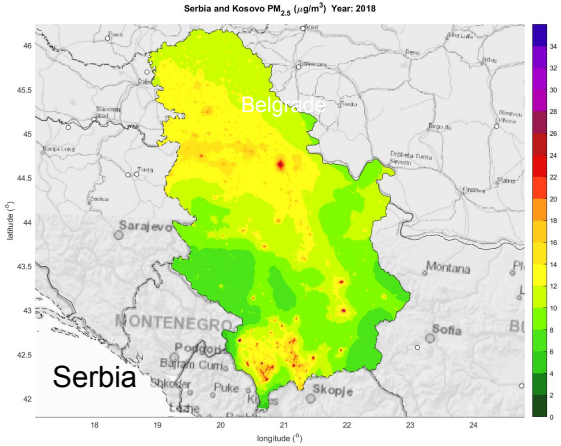
Western Balkan

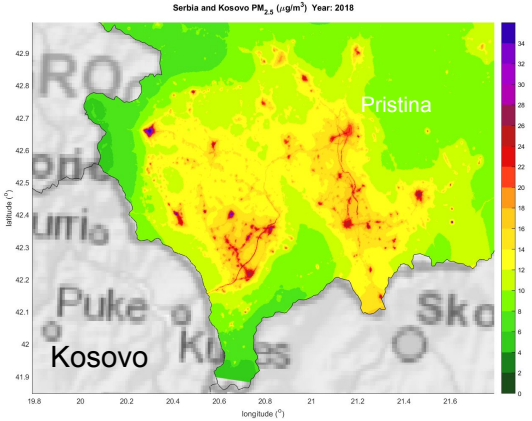




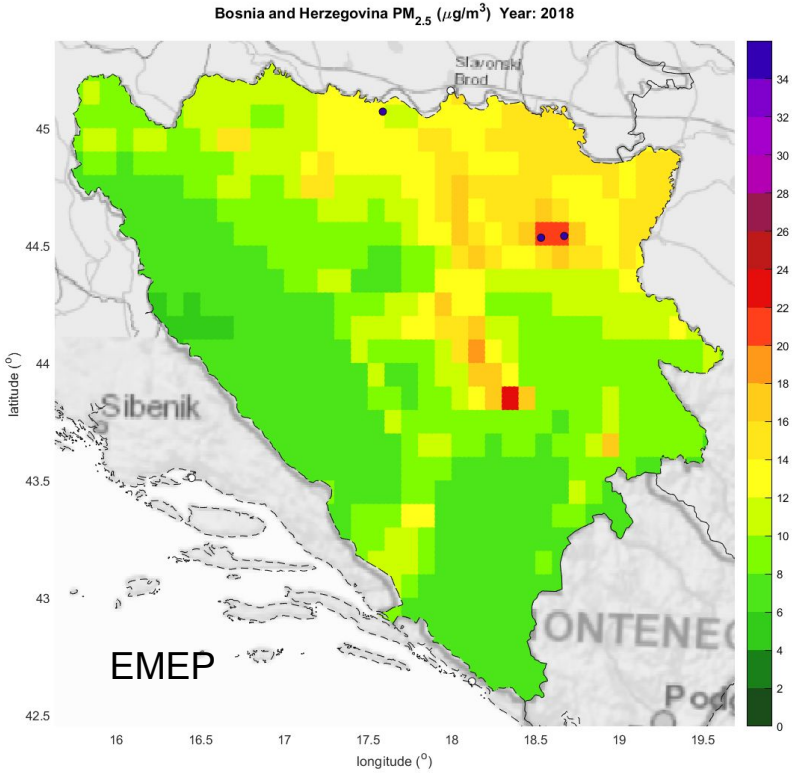


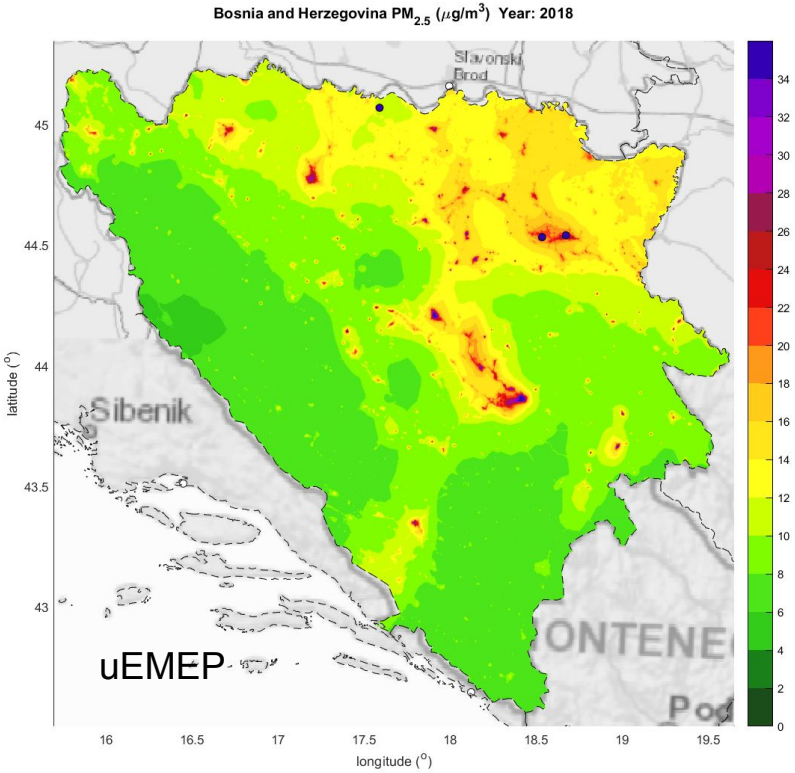




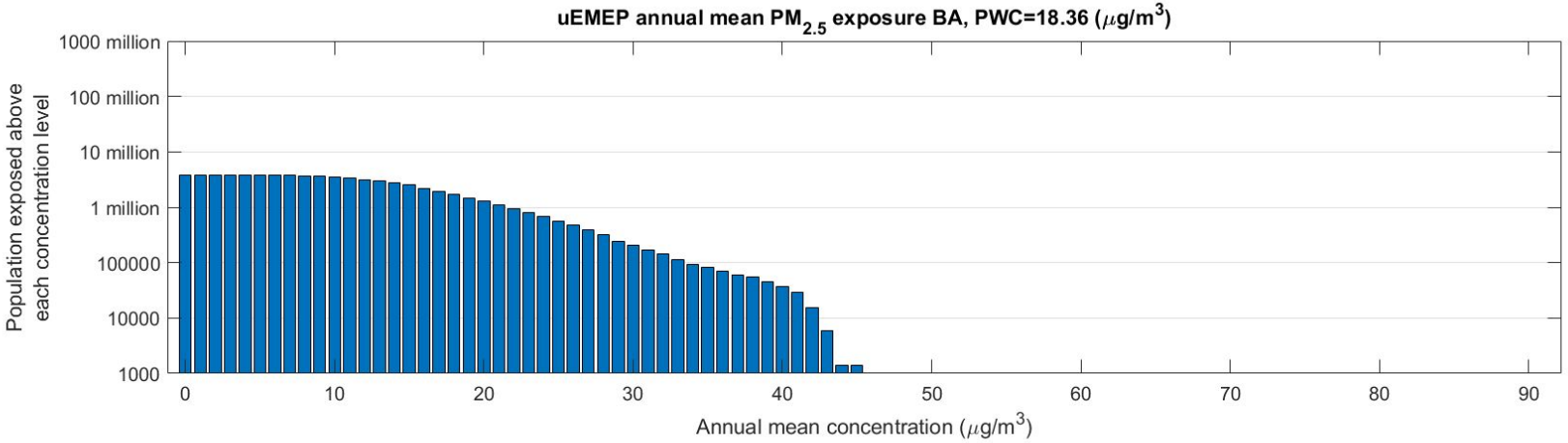


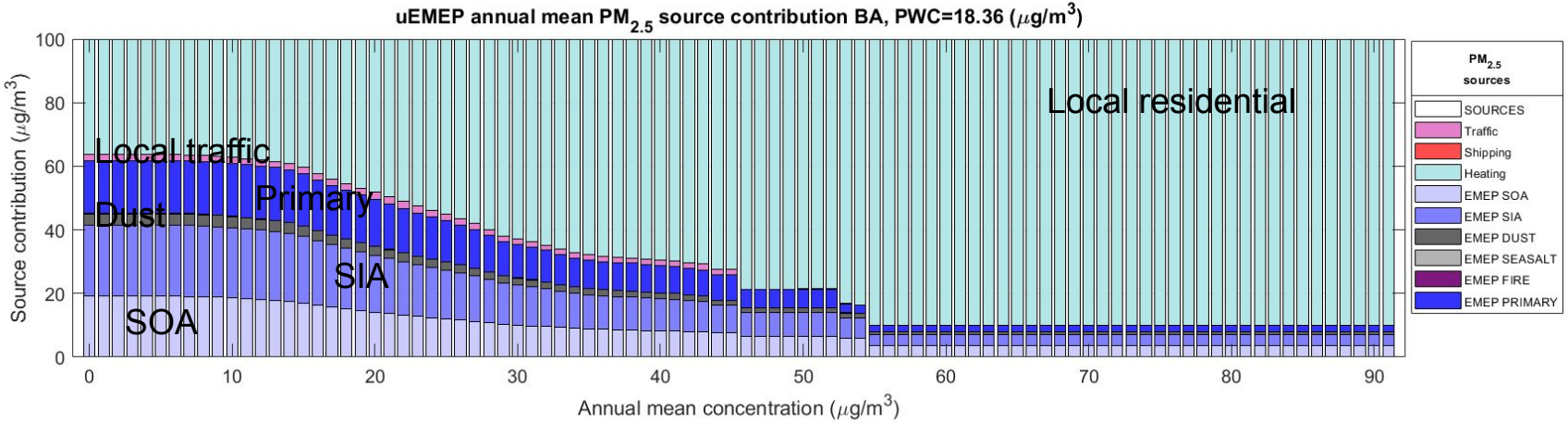
Bosnia and Herzegovina

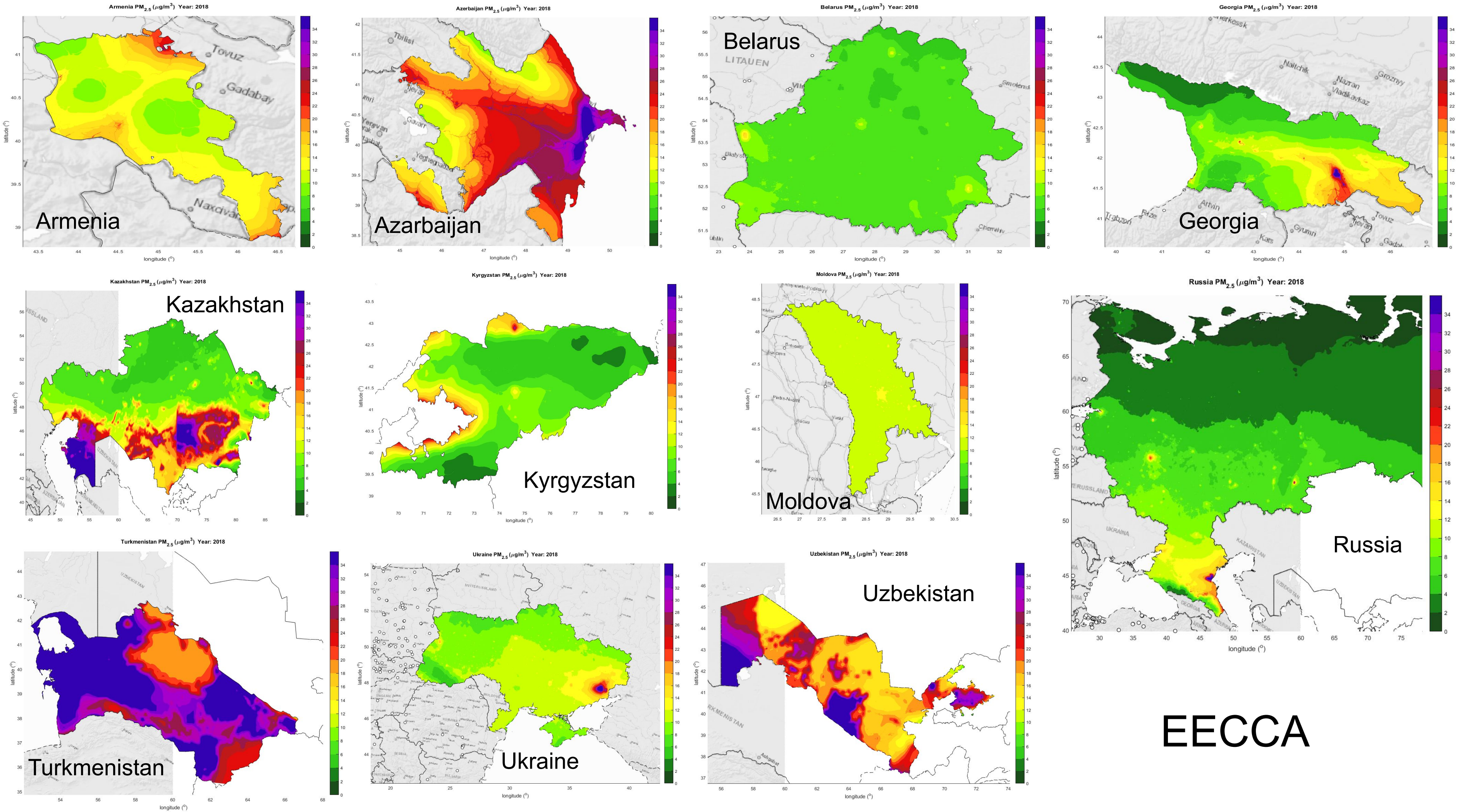




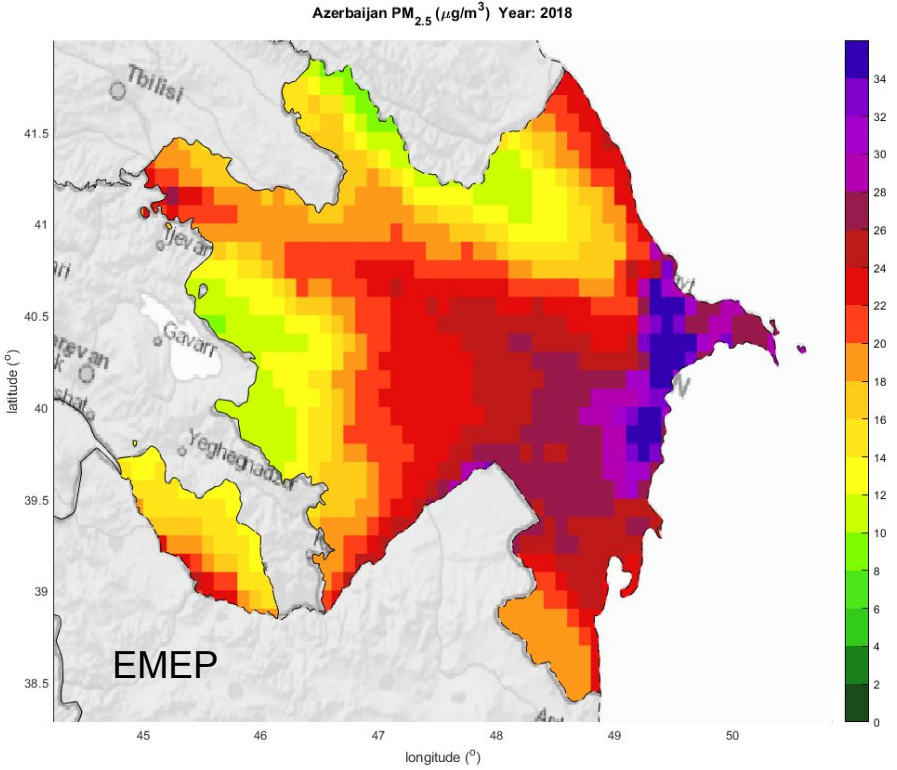
Bosnia and Herzegovina

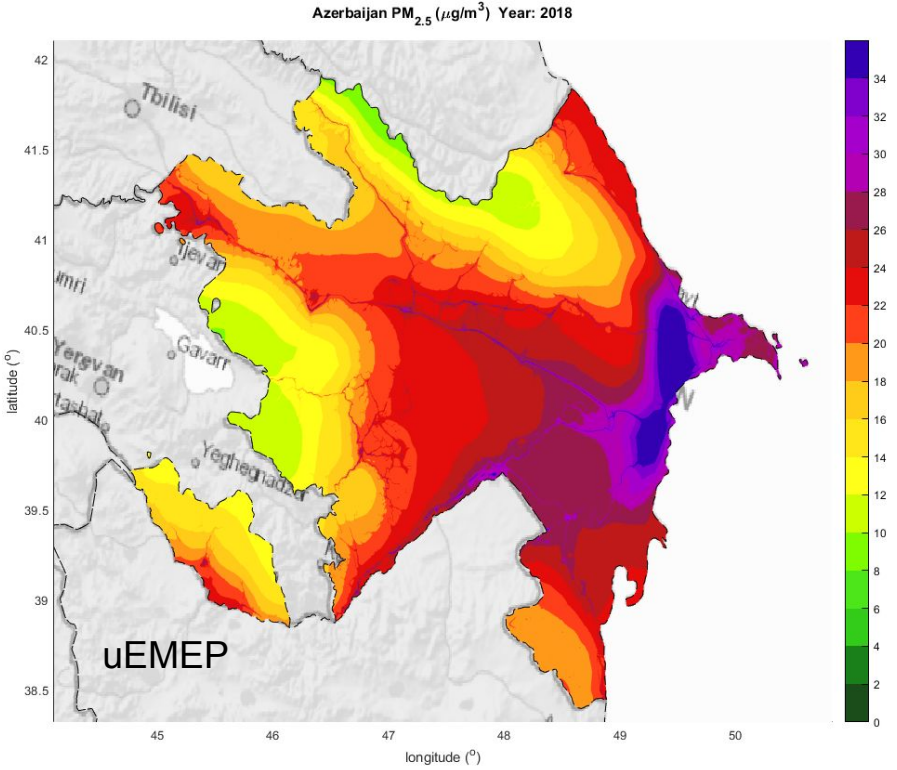




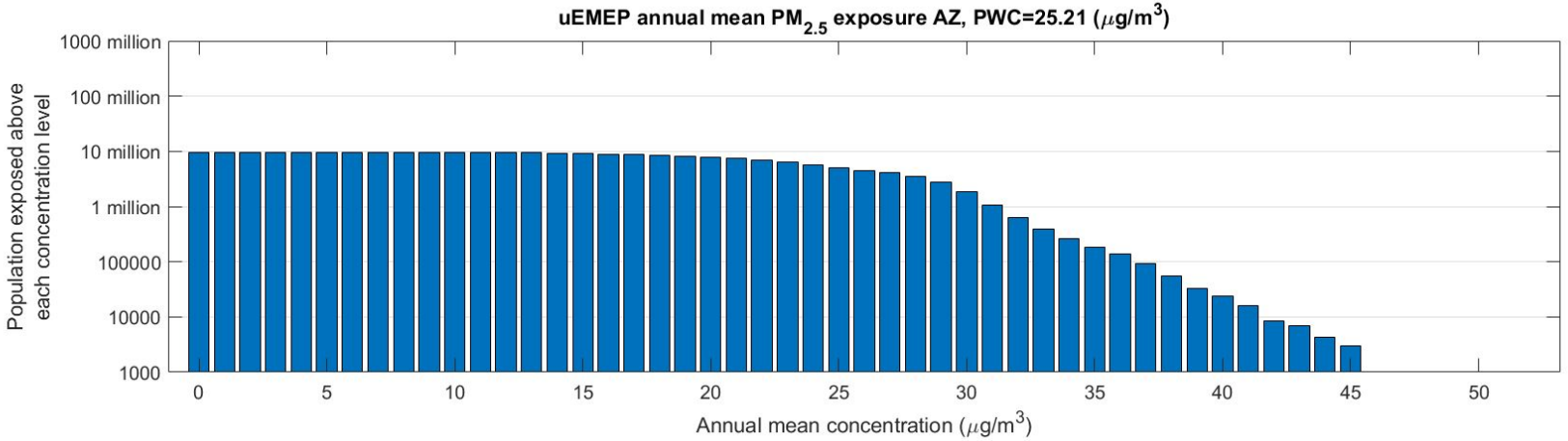

Armenia PM2.5 (μg/m3) Year: 2018
Armenia
Azarbaijan PM2.5 (μg/m3) Year: 2018
Azarbaijan
Belarus PM2.5 (μg/m3) Year: 2018
Belarus
Georgia PM2.5 (μg/m3) Year: 2018
Georgia
Kazakhstan PM2.5 (μg/m3) Year: 2018
Kazakhstan
Kyrgyzstan PM2.5 (μg/m3) Year: 2018
Kyrgyzstan
Moldova PM2.5 (μg/m3) Year: 2018
Moldova
Russia PM2.5 (μg/m3) Year: 2018
Russia
Turkmenistan PM2.5 (μg/m3) Year: 2018
Turkmenistan
Ukraine PM2.5 (μg/m3) Year: 2018
Ukraine
Uzbekistan PM2.5 (μg/m3) Year: 2018
Uzbekistan
latitude (°)
longitude (°)
EECCA

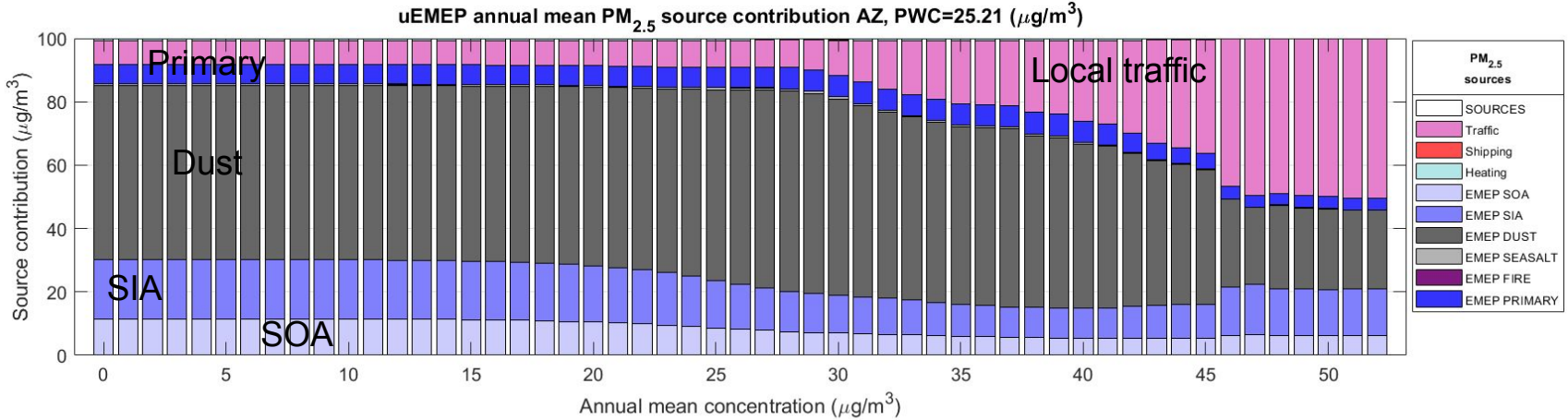
Azerbaijan


Azerbaijan PM2.5 (μg/m3) Year: 2018
Tbilisi
Gavarr
Yeghegnadzor
EMEP
latitude (°)
longitude (°)
41.5
41
40.5
40
39.5
39
38.5
45
46
47
48
49
50
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0


Azerbaijan PM2.5 (μg/m3) Year: 2018
Tbilisi
Gavarr
Yeghegnadzor
uEMEP
latitude (°)
longitude (°)
42
41.5
41
40.5
40
39.5
39
38.5
45
46
47
48
49
50
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0

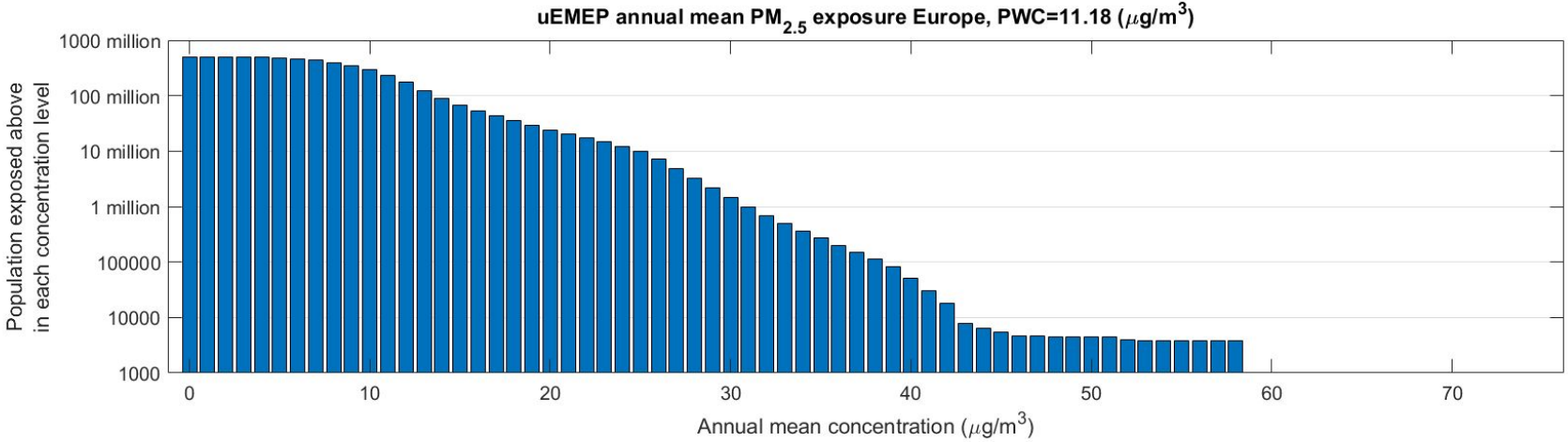
Azerbaijan

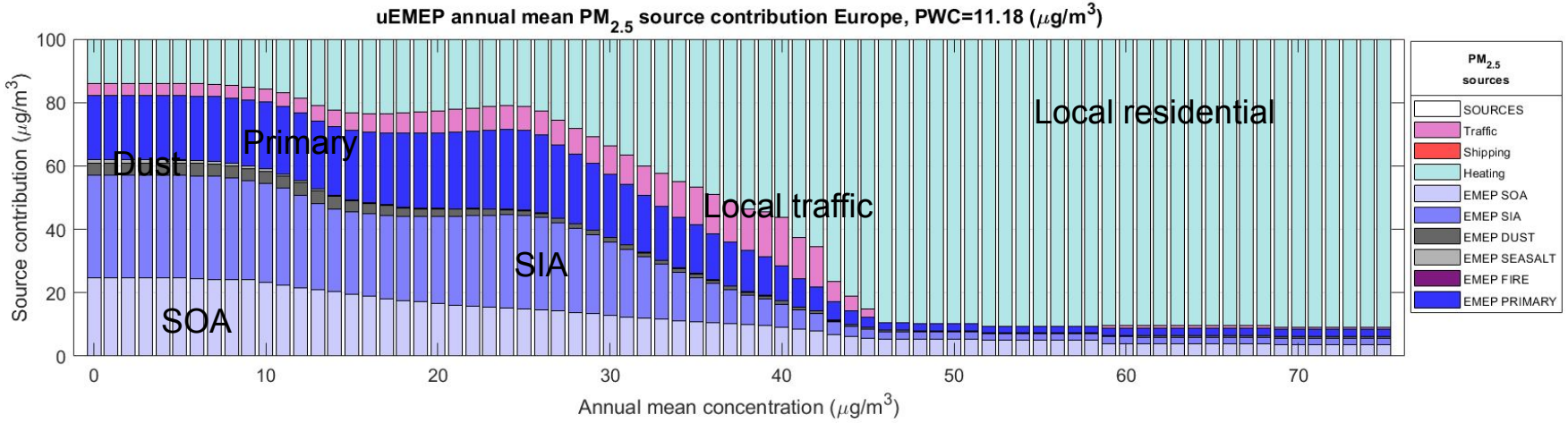

uEMEP annual mean PM2.5 exposure AZ, PWC=25.21 (μg/m3)
Population exposed above each concentration level
1000 million
100 million
10 million
1 million
100000
10000
1000
0
5
10
15
20
25
30
35
40
45
50
Annual mean concentration (μg/m3)


uEMEP annual mean PM2.5 source contribution AZ, PWC=25.21 (μg/m3)
Source contribution (μg/m3)
Primary
Dust
SIA
SOA
Local traffic
PM2.5 sources
SOURCES
Traffic
Shipping
Heating
EMEP SOA
EMEP SIA
EMEP DUST
EMEP SEASALT
EMEP FIRE
EMEP PRIMARY
Annual mean concentration (μg/m3)

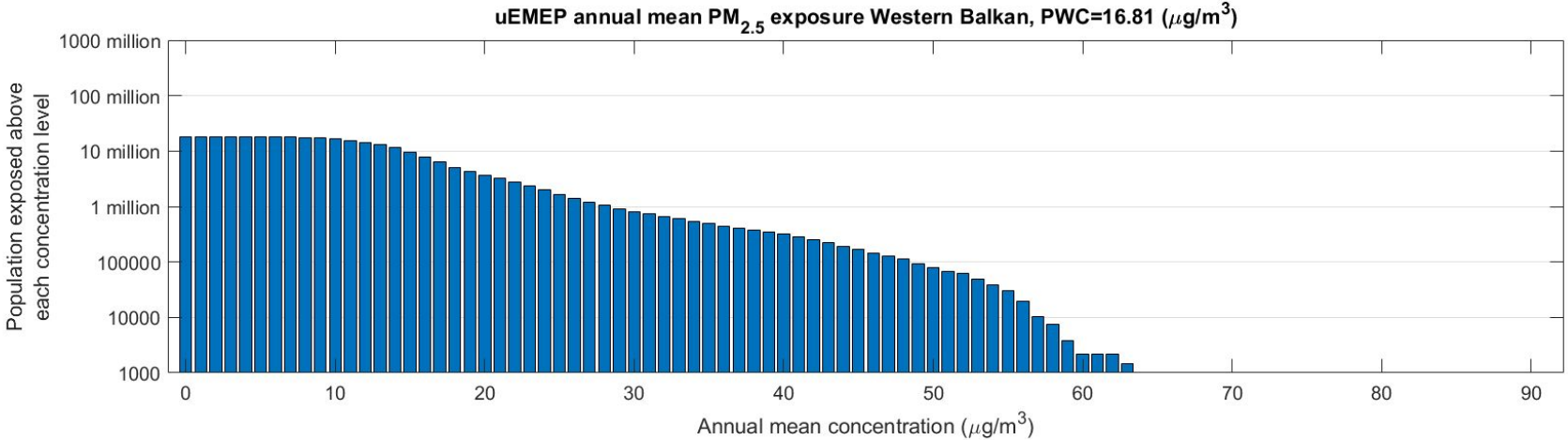
Regional exposure (uEMEP)

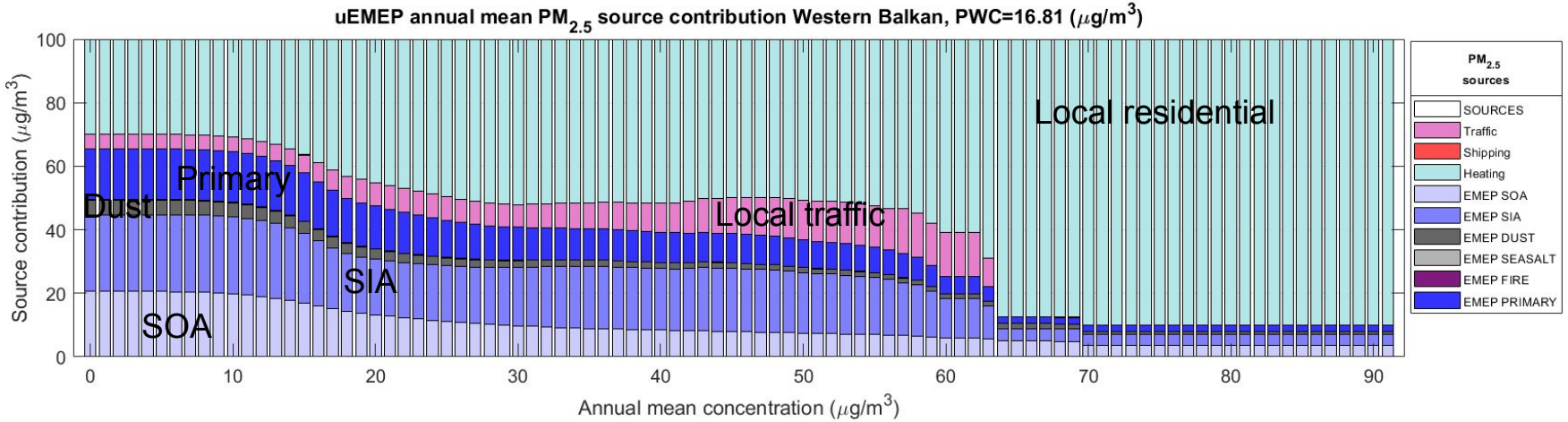
EU+EFTA


uEMEP annual mean PM2.5 exposure Europe, PWC=11.18 (μg/m3)
Population exposed above in each concentration level
1000 million
100 million
10 million
1 million
100000
10000
1000
0
10
20
30
40
50
60
70
Annual mean concentration (μg/m3)

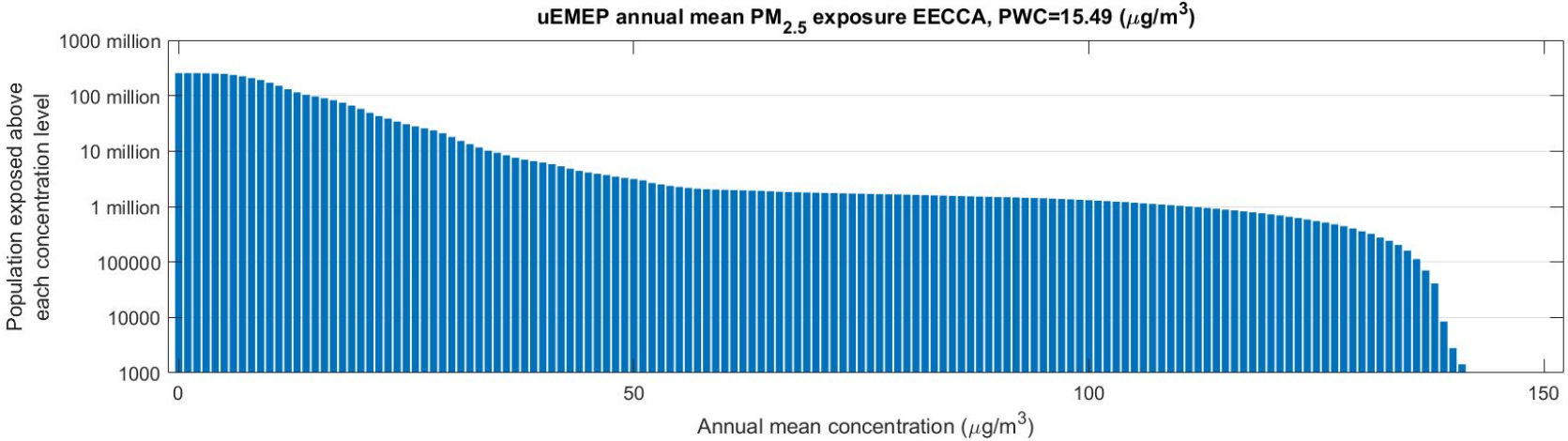

uEMEP annual mean PM2.5 source contribution Europe, PWC=11.18 (μg/m3)
Source contribution (μg/m3)
100
80
60
40
20
0
Dust
Primary
SOA
SIA
Local traffic
Local residential
0
10
20
30
40
50
60
70
Annual mean concentration (μg/m3)
PM2.5 sources
SOURCES
Traffic
Shipping
Heating
EMEP SOA
EMEP SIA
EMEP DUST
EMEP SEASALT
EMEP FIRE
EMEP PRIMARY

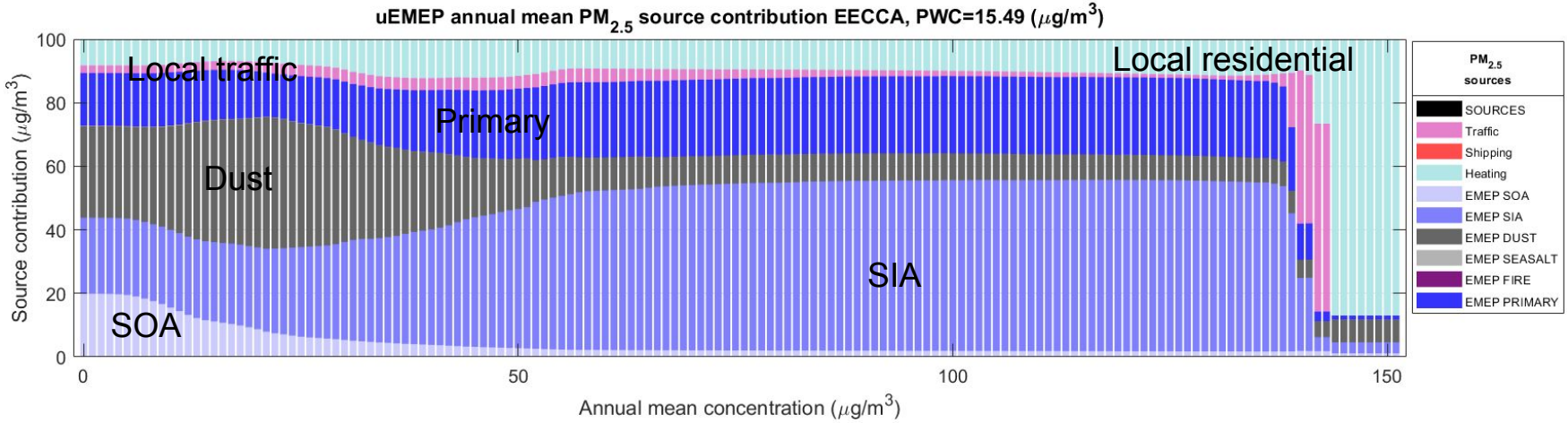
Western Balkan





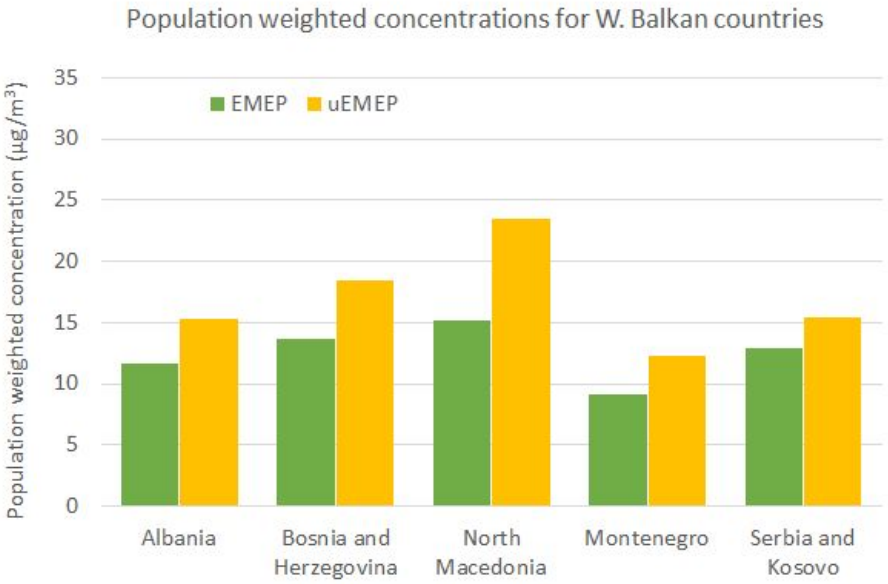
EECCA

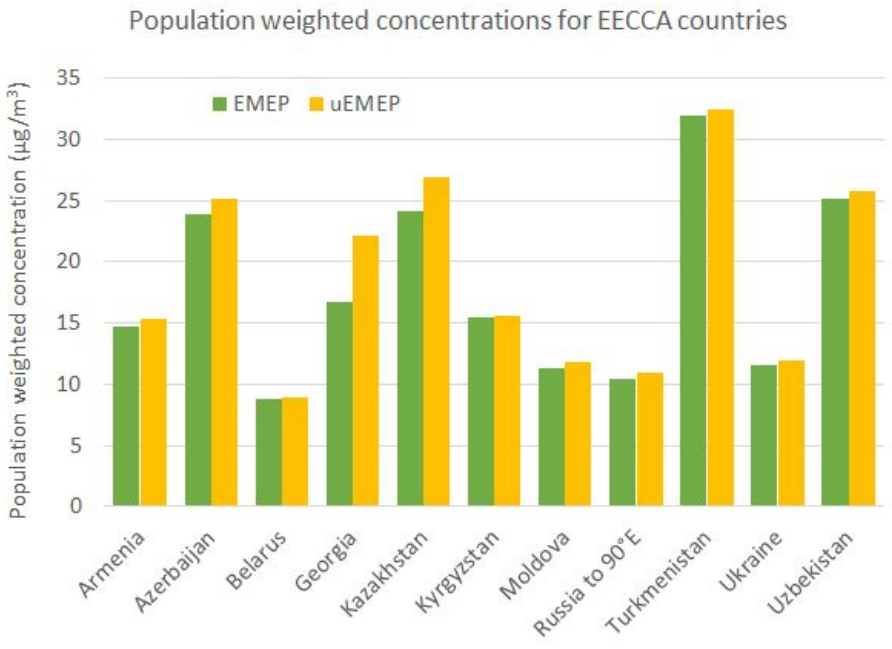

uEMEP annual mean PM2.5 exposure EECCA, PWC=15.49 (μg/m3)
Population exposed above each concentration level
1000 million
100 million
10 million
1 million
100000
10000
1000
0
50
100
150
Annual mean concentration (μg/m3)


uEMEP annual mean PM2.5 source contribution EECCA, PWC=15.49 (μg/m3)
Source contribution (μg/m3)
100
80
60
40
20
0
Local traffic
Primary
Dust
SOA
SIA
Local residential
0
50
100
150
Annual mean concentration (μg/m3)
PM2.5 sources
SOURCES
Traffic
Shipping
Heating
EMEP SOA
EMEP SIA
EMEP DUST
EMEP SEASALT
EMEP FIRE
EMEP PRIMARY

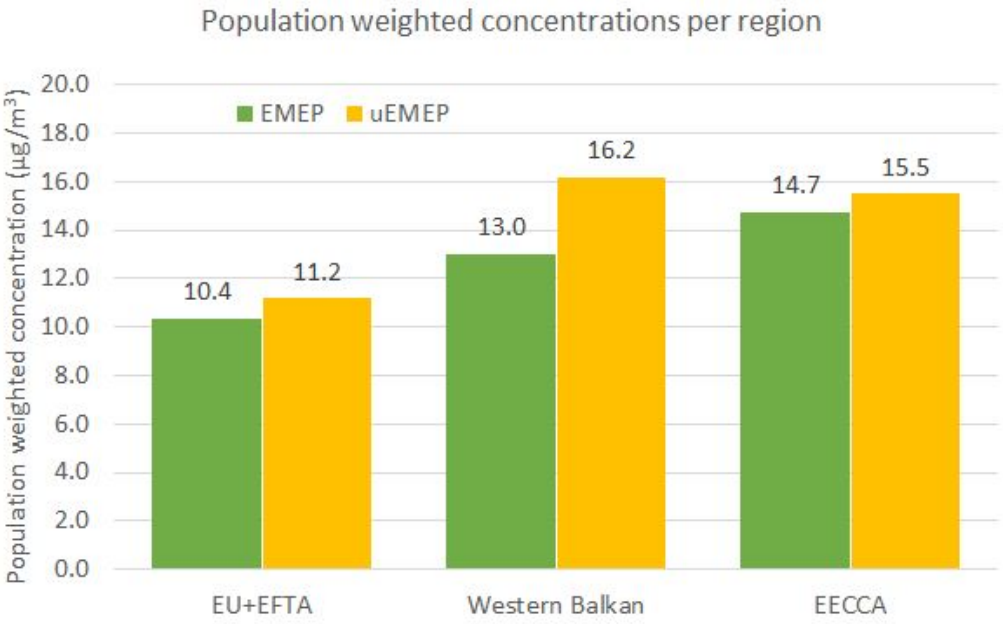
Regional exposure: population weighted concentrations

Western Balkan and EECCA per country



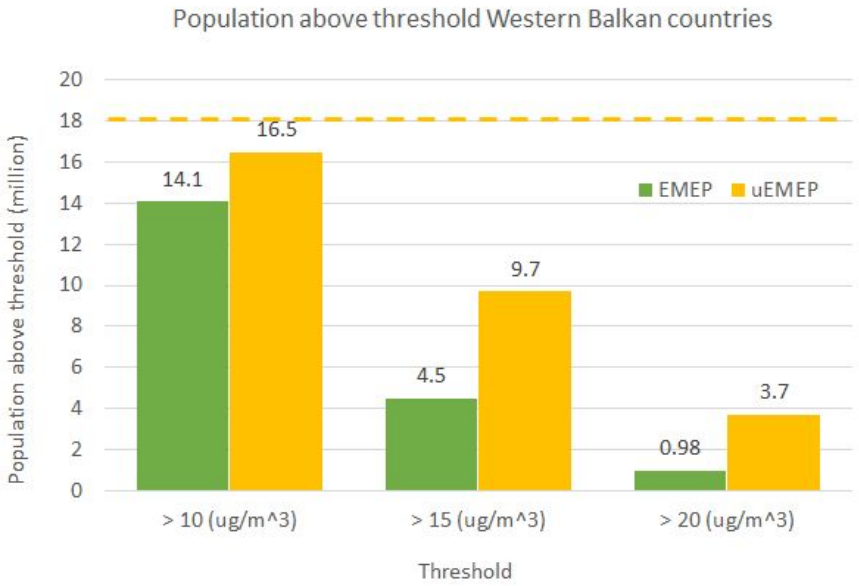


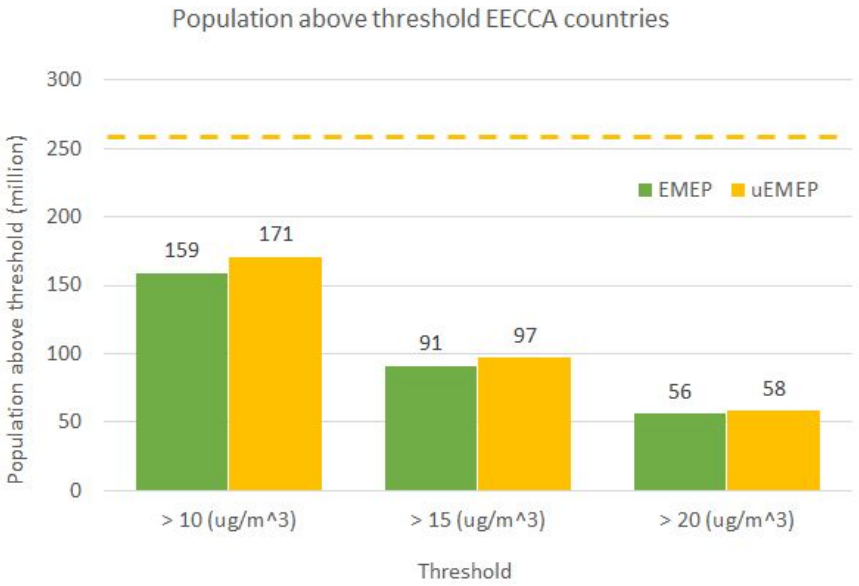
Population weighted concentration per regional



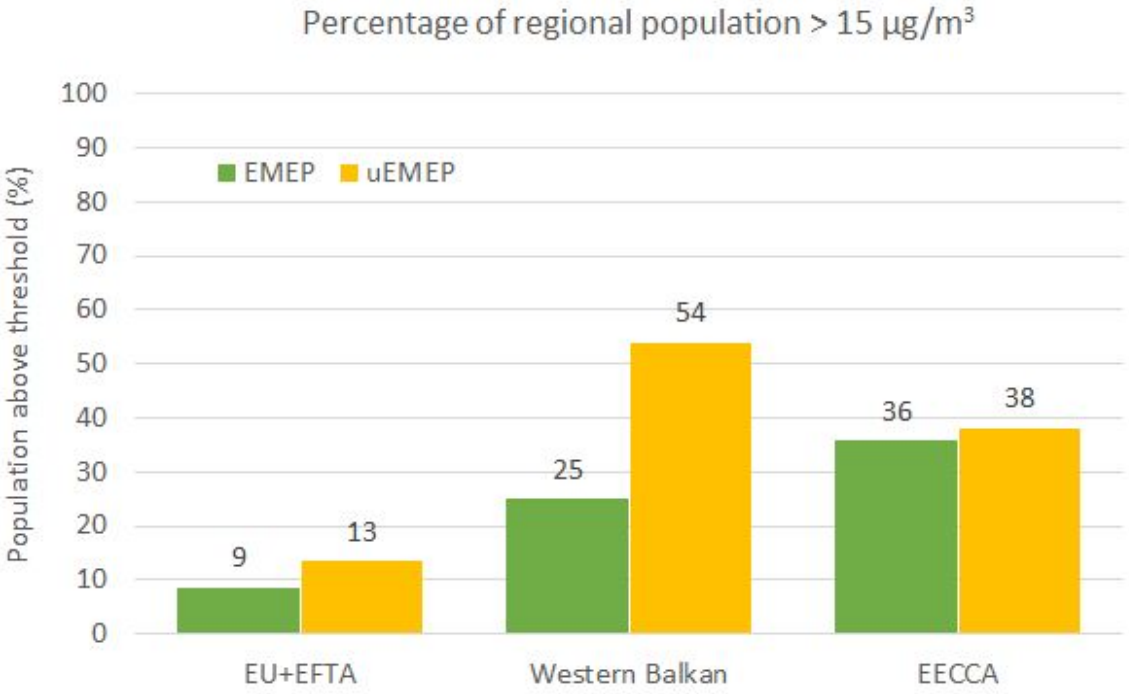
Regional exposure: population above threshold

Western Balkan and EECCA per threshold





Regional exposure percentage of population



Concluding

- Population weighted concentration (uEMEP) and change with implementation of uEMEP
  - EEU+EFTA 11.2 μg/m^3 uEMEP change +8%
  - Western Balkan 16.2 μg/m^3 uEMEP change +24%
  - EECCA 15.5 μg/m^3 uEMEP change +5%

- Percentage of population exposed > 15 μg/m^3 and change with implementation of uEMEP
  - EEU+EFTA 13% uEMEP change +54%
  - Western Balkan 54% uEMEP change +115%
  - EECCA 38% uEMEP change +6%

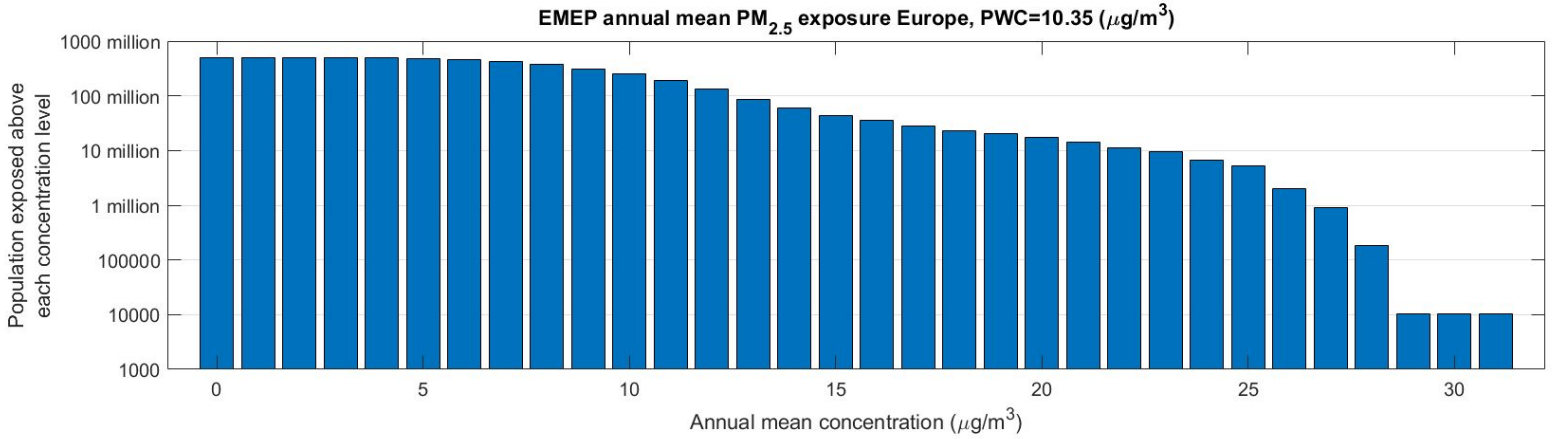
- Contribution of local residential combustion ($\pm 0.1^{o}$) to $PM_{2.5}$
  - EEU+EFTA +14%
  - Western Balkan +30%
  - EECCA +8%

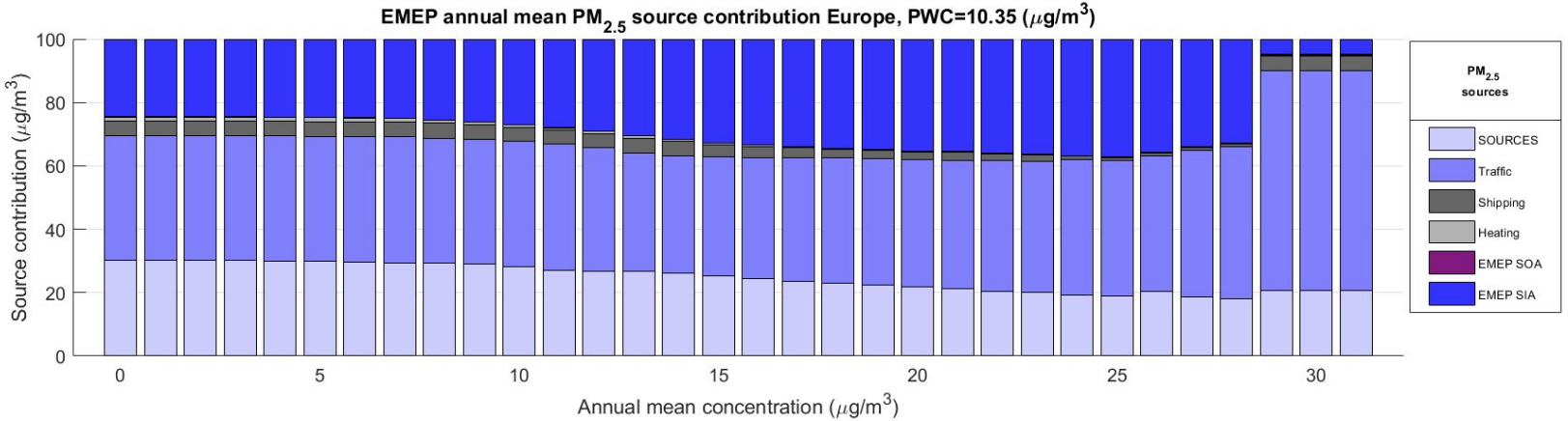
- Uncertainties
  - EEU+EFTA Significant variability in bias between countries in Europe
  - Western Balkan Similar results to EU+EFTA but higher contributions from residential combustion
  - EECCA Some extremely divergent and unrealistic emissions in some countries

The end

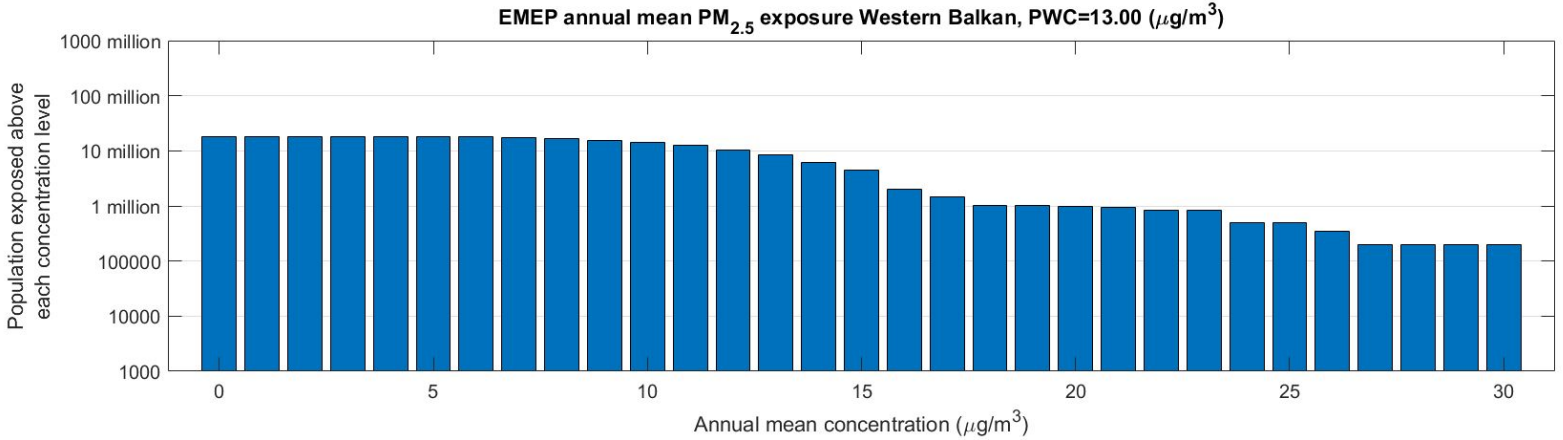
Additional slides

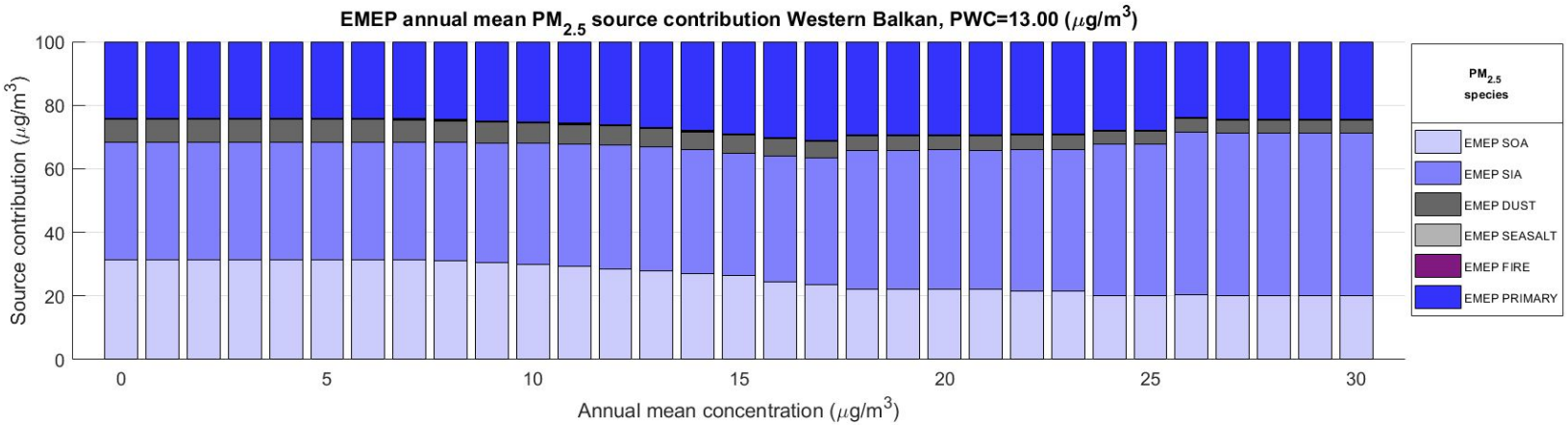
EMEP results $PM_{2.5}$ annual mean exposure for EU+EFTA



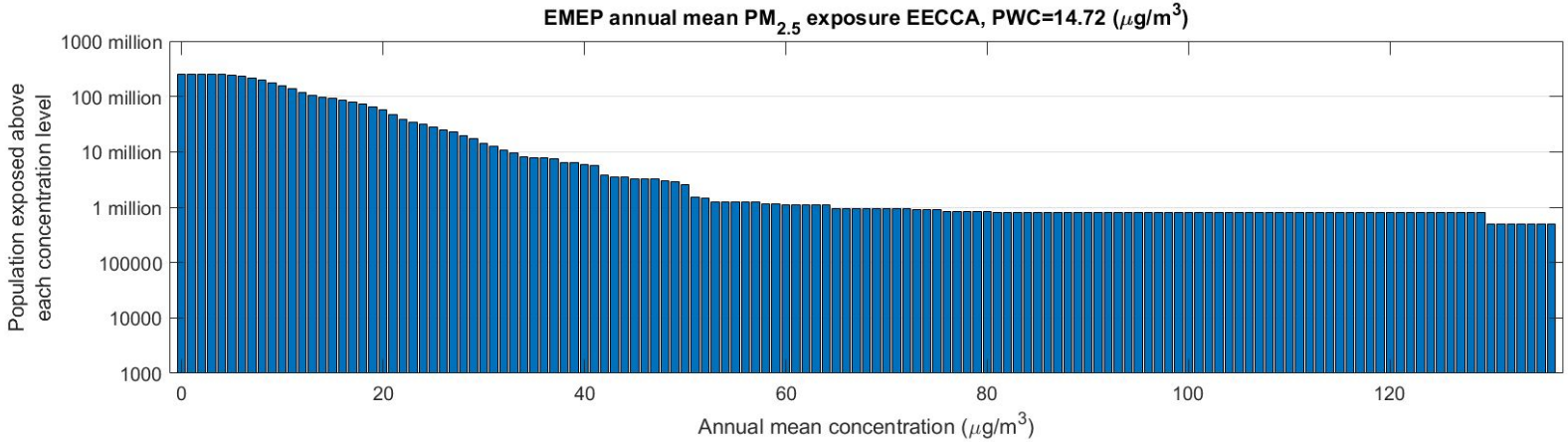


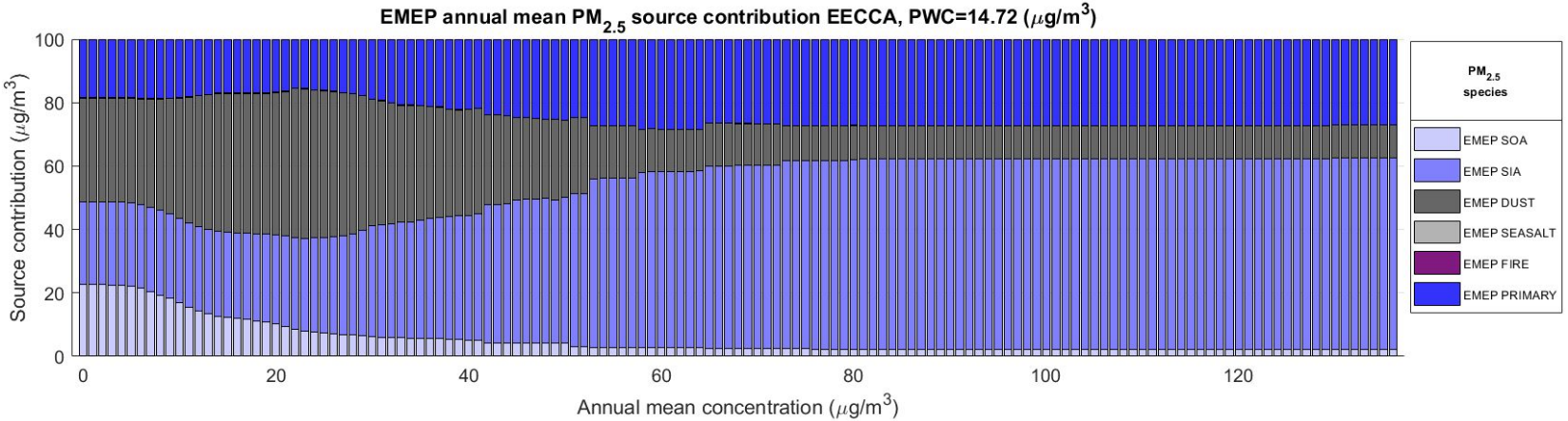
EMEP results $PM_{2.5}$ annual mean exposure for W. Balkan





EMEP results $PM_{2.5}$ annual mean exposure for EECCA





Summary uEMEP results $PM_{2.5}$ annual mean exposure

EU+EFTA EMEP heating emissions

> 10 ug/m3 = 211 million

> 15 ug/m3 = 40 million

> 20 ug/m3 = 17 million

EECCA EMEP heating emissions

> 10 ug/m3 = 138 million

> 15 ug/m3 = 87 million

> 20 ug/m3 = 52 million

Western Balkan EMEP heating emissions

> 10 ug/m3 = 16.4 million

> 15 ug/m3 = 9.5 million

> 20 ug/m3 = 4.0 million

EU+EFTA TNO heating emissions

> 10 ug/m3 = 296 million

> 15 ug/m3 = 68 million

> 20 ug/m3 = 24 million

EECCA TNO heating emissions

> 10 ug/m3 = 171 million

> 15 ug/m3 = 97 million

> 20 ug/m3 = 58 million

Western Balkan TNO heating emissions

> 10 ug/m3 = 16.5 million

> 15 ug/m3 = 9.7 million

> 20 ug/m3 = 3.7 million

EU+EFTA

Total population = 506 million

List of countries:
'AT','BE','BG','CH','DK','ES','EE','EL','CY','CZ','DE','FO','FR','FI','HR','HU','IE','IM','IS','IT','LT','LU','LV','MC','MT','ME','NL','NO','RO','PL','PT','SE','SI','SK','UK'

EECCA

Total population = 255 million

List of countries:
'AM','AZ','BY','GE','KZ','KG','MD','RU','TJ','TM','UA','UZ'

Western Balkan

Total population = 18 million

List of countries: 'AL','BA','MK','ME','RS' *

*Kosovo included in Serbia (RS)

Summary EMEP results $PM_{2.5}$ annual mean exposure

EU+EFTA EMEP heating emissions

> 10 ug/m3 = 178 million

> 15 ug/m3 = 28 million

> 20 ug/m3 = 12 million

EECCA EMEP heating emissions

Western Balkan EMEP heating emissions

EU+EFTA TNO heating emissions

> 10 ug/m3 = 255 million

> 15 ug/m3 = 44 million

> 20 ug/m3 = 17 million

EECCA TNO heating emissions

> 10 ug/m3 =159 million

> 15 ug/m3 = 91 million

> 20 ug/m3 = 56 million

Western Balkan TNO heating emissions

> 10 ug/m3 = 14.1 million

> 15 ug/m3 = 4.5 million

> 20 ug/m3 = 0.98 million

EU+EFTA

Total population = 506 million

List of countries:
'AT','BE','BG','CH','DK','ES','EE','EL','CY','CZ','DE','FO','FR','FI','HR','HU','IE','IM','IS','IT','LT','LU','LV','MC','MT','ME','NL','NO','RO','PL','PT','SE','SI','SK','UK'

EECCA

Total population = 255 million

List of countries:
'AM','AZ','BY','GE','KZ','KG','MD','RU','TJ','TM','UA','UZ'

Western Balkan

Total population = 18 million

List of countries: 'AL','BA','MK','ME','RS' *

*Kosovo included in Serbia (RS)

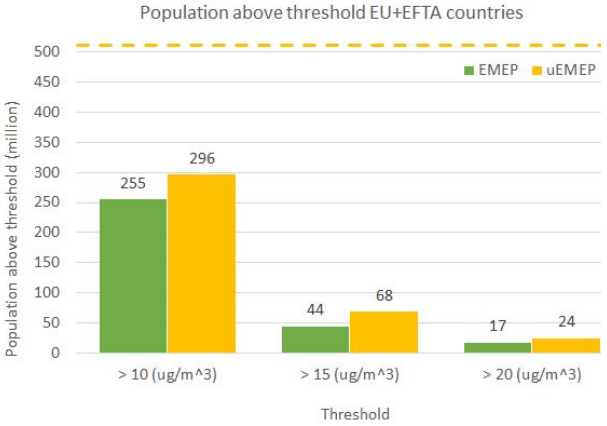
Summary table EECCA countries

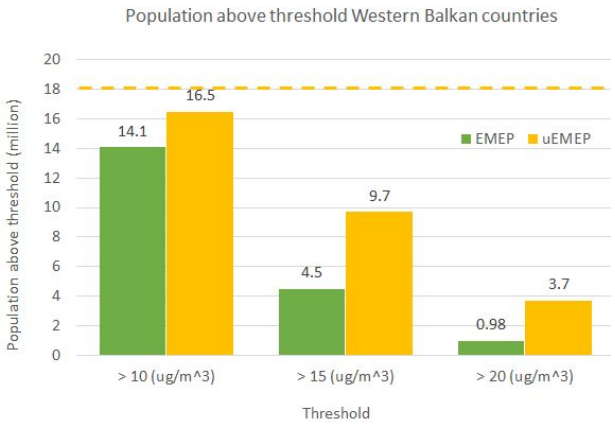
Country	Comments	PWC $PM_{2.5}$ (ug/m3) EMEP/uEMEP
Armenia	High traffic contributions with uEMEP gives around 50 000 people exposed to > 25 ug/m3 that is not calculated using just EMEP. Small contribution from residential combustion.	14.7/15.4
Azerbaijan	Almost no contribution from residential heating but significant from traffic.	23.9/25.2
Belarus	Low concentration levels. Little contribution from traffic.	8.8/8.9
Georgia	Extremely high traffic contribution in and around the capital Tbilisi (with NO2 concentrations above 200 ug/m3)	16.7/22.1
Kazakhstan	More than 50% SIA in EMEP. Peculiar spatial distribution.	24.2/26.9
Kyrgyzstan	Large concentration gradient going from Uzbekistan to Kyrgyzstan. Only significant concentrations are in the capital Bishkek (population 1 million).	15.5/15.6
Moldova	Reasonable results though very low emission within the country	11.3/11.8
Russia - out to 90°E	Reasonable results. High emissions in south should be checked.	10.4/10.9
Turkmenistan	Wind blown dust accounts for 80% of all exposure to PM2.5	32.0/32.4
Ukraine	Large primary emission 47.5N 37.5E, nearest town Volnovakha. Cause of all concentrations over 20 ug/m3.	11.6/12.0
Uzbekistan	Significant wind blown dust. Reasonable results. Highest contributions, apart from dust, in the capital Tashkent (population 2.4 million).	25.1/25.8

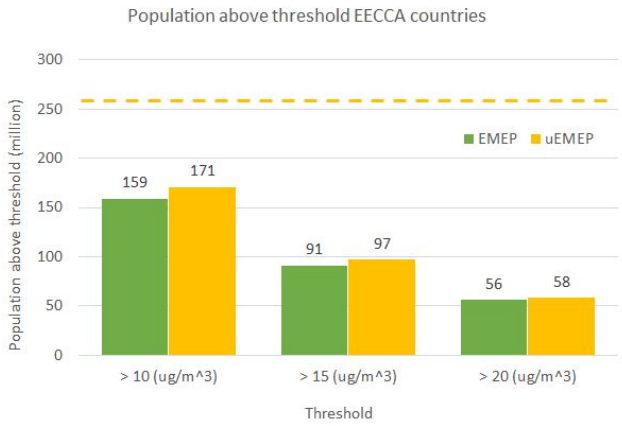
Summary table Western Balkan countries

Country	**Comments**	**PWC $PM_{2.5}$ (ug/m3) EMEP/uEMEP**
Albania	Reasonable results. Large increase in PWC with downscaling, both traffic and residential contribute. Traffic seems too high in regard to other countries	11.7/15.3
Bosnia and Herzegovina	Large local contribution of residential, 35% when downscaled. 3 Airbase measurements available. -60% bias in EMEP, -50% uEMEP	13.7/18.4
North Macedonia	Large local contribution of residential, 45% when downscaled. Large increase in PWC with downscaling due to residential	15.2/23.5
Montenegro	Large local contribution of residential, 35% when downscaled.	9.1/12.3
Serbia and Kosovo	Results seem reasonable	12.9/15.4

Regional exposure







Validation of uEMEP for $PM_{2.5}$ 2018