Data Collection & Modeling to Support Air Pollution Analysis in the Balkan Cities

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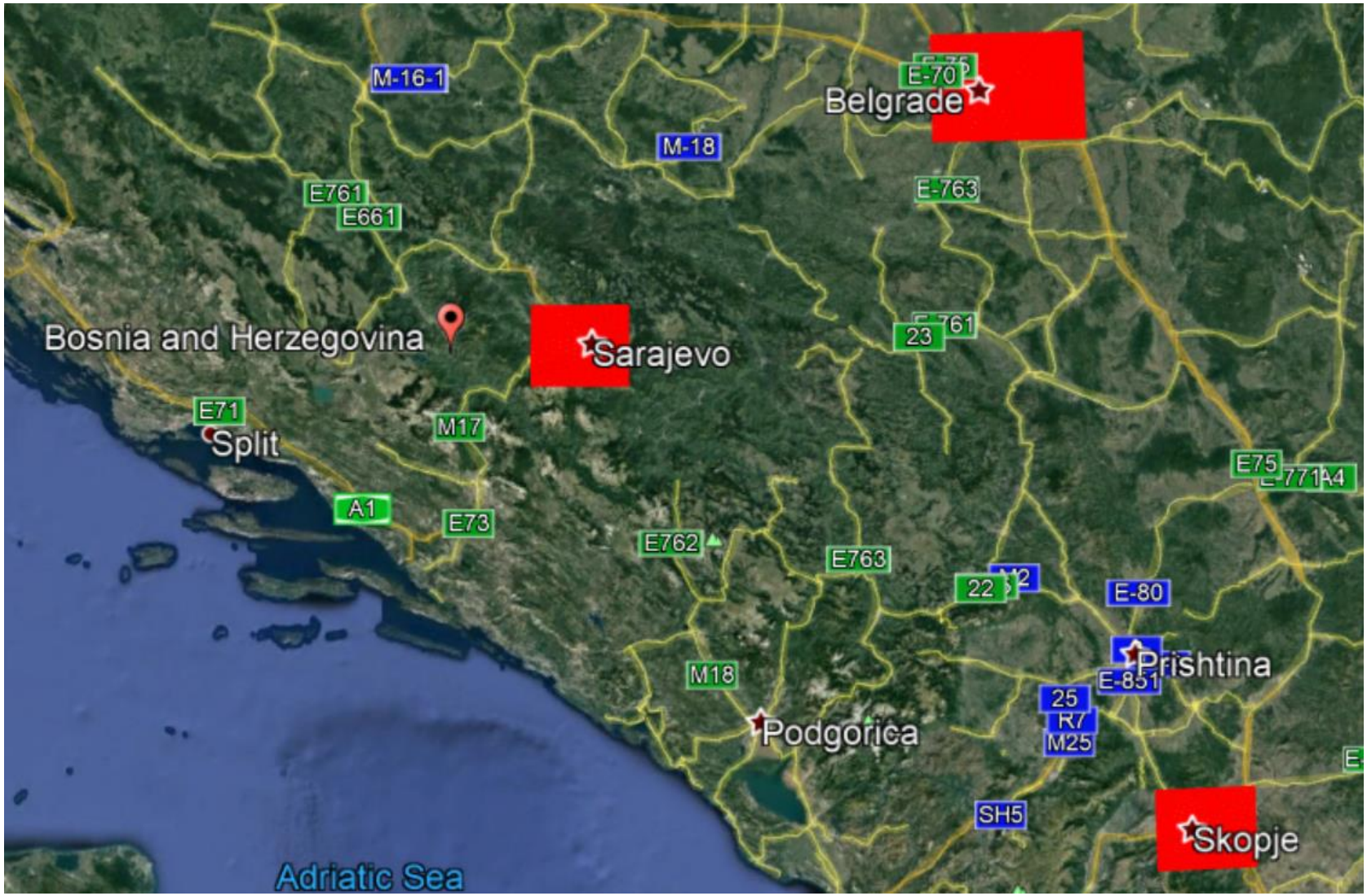
URBAN emissions .info

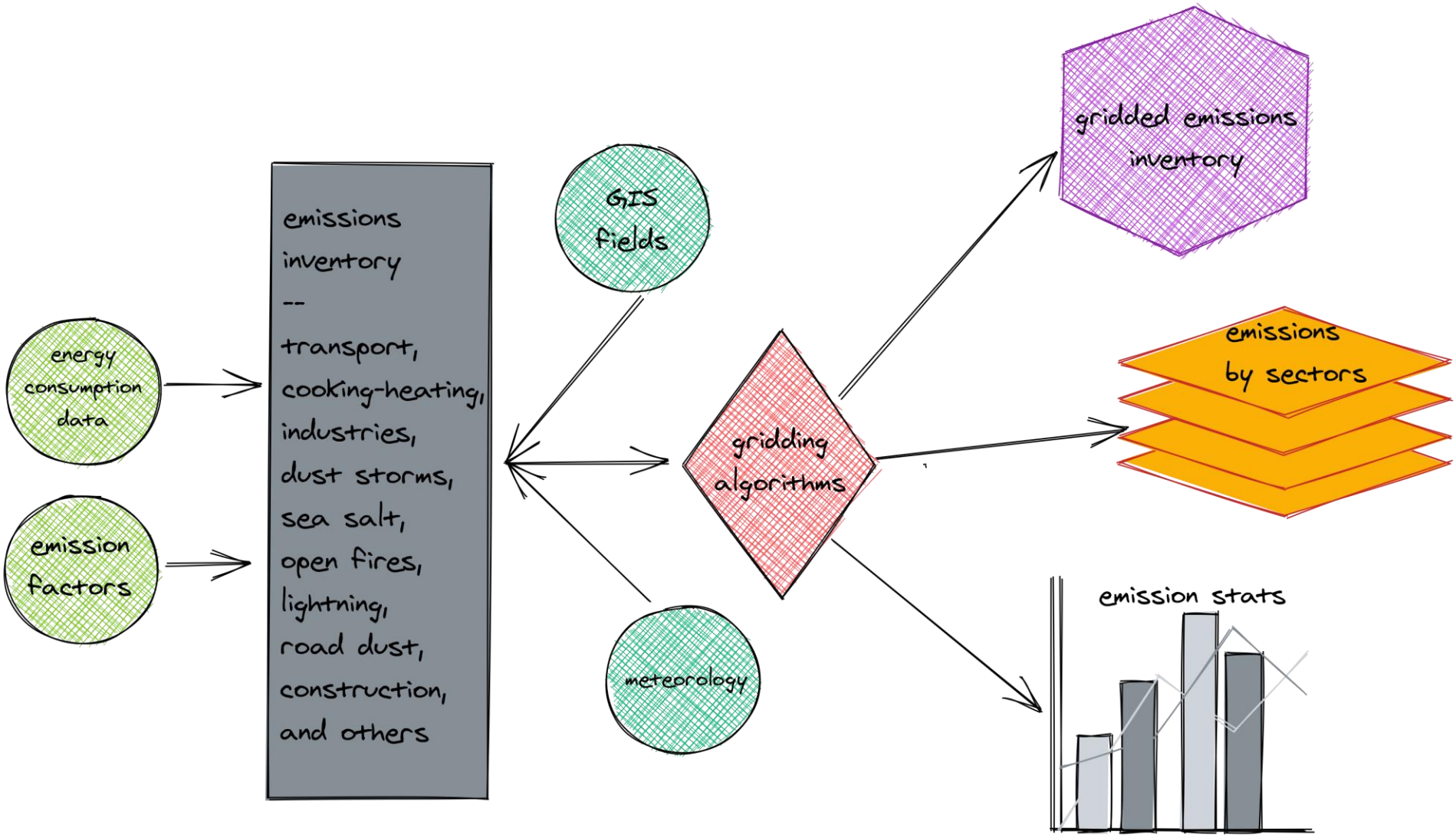
THE WORLD BANK

Clean Air Regions Initiative Boot Camp
09-Sep-2021

Air quality analysis for Balkan cities



General Schematic of Emissions Modeling



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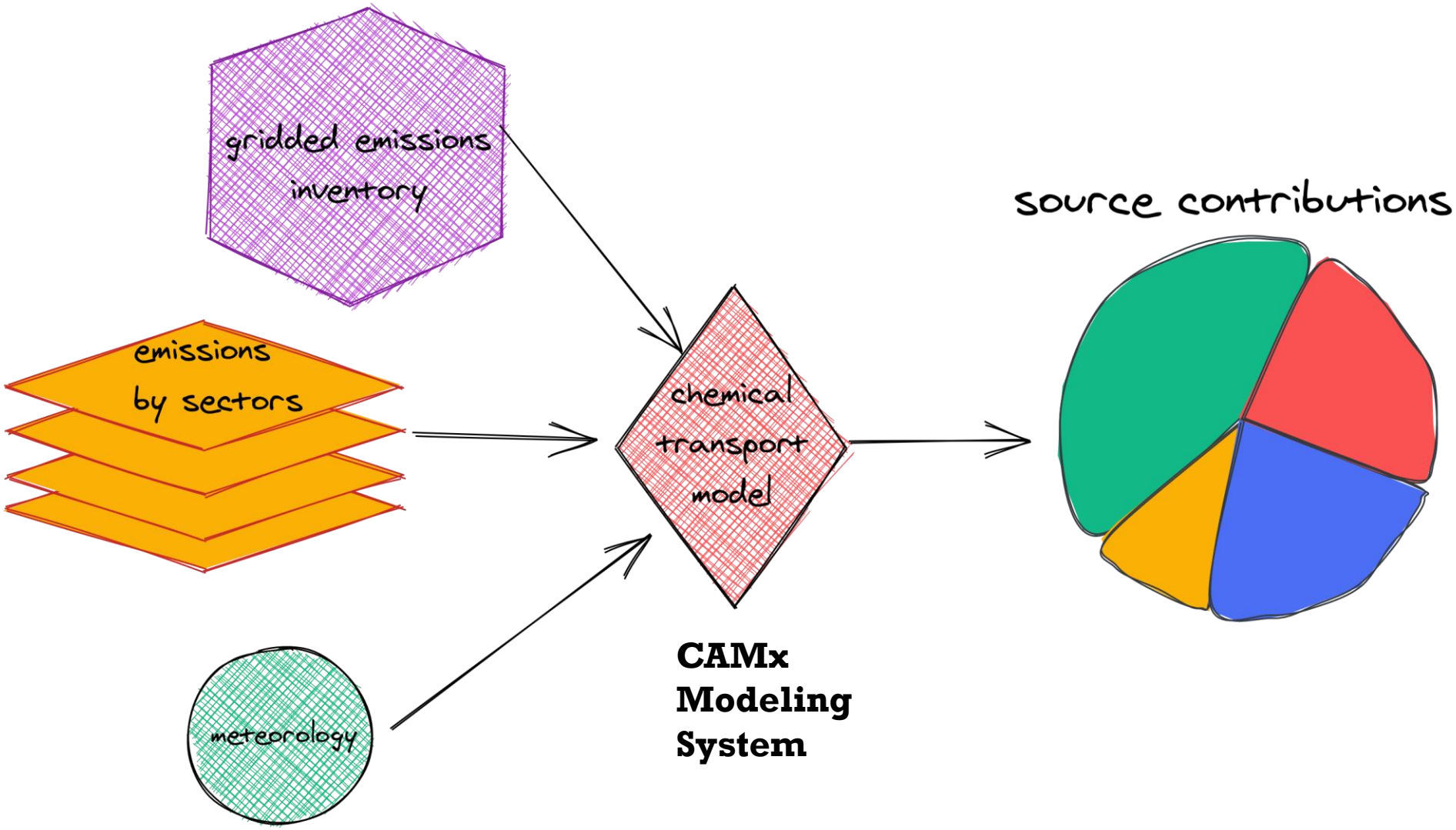
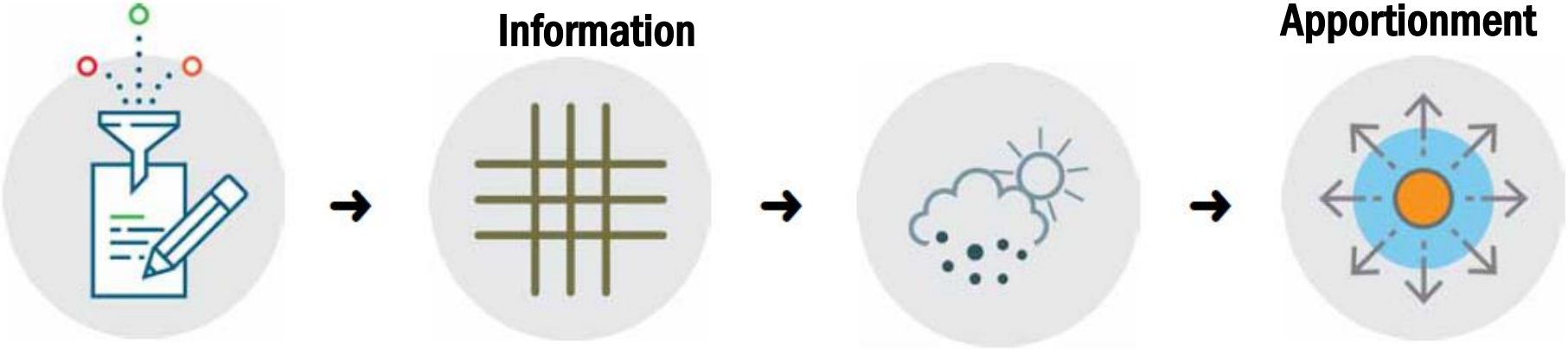
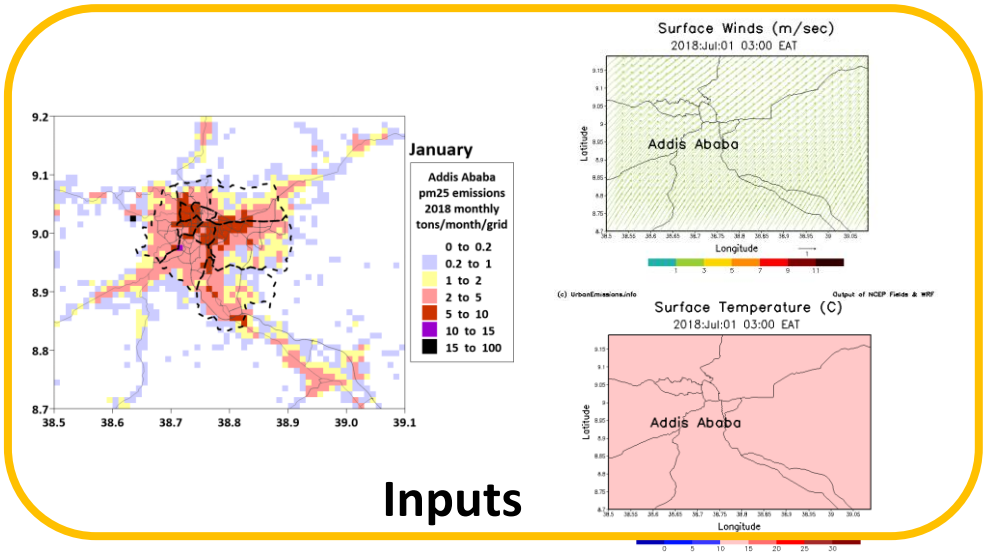


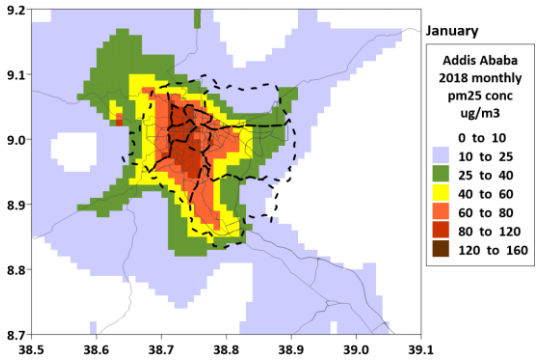
data integration for AQ modelling

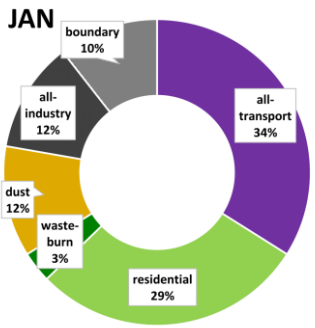


Data collection

Met & Pollution Modeling







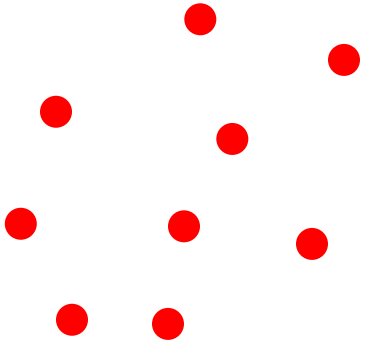
2-sides of air quality data

monitoring

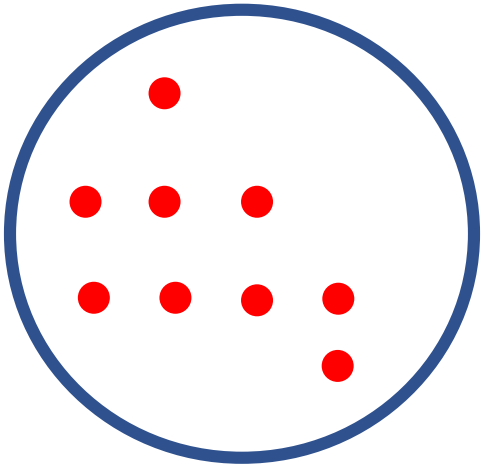
modeling

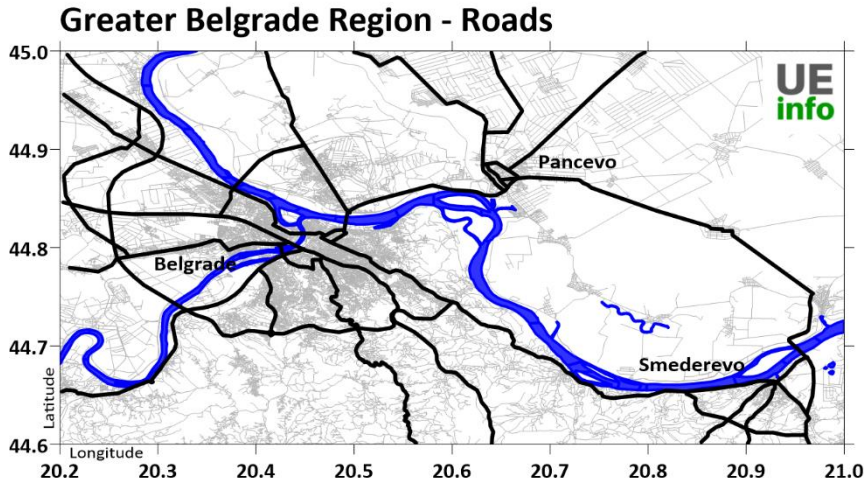
2-sides of air quality data

snippets

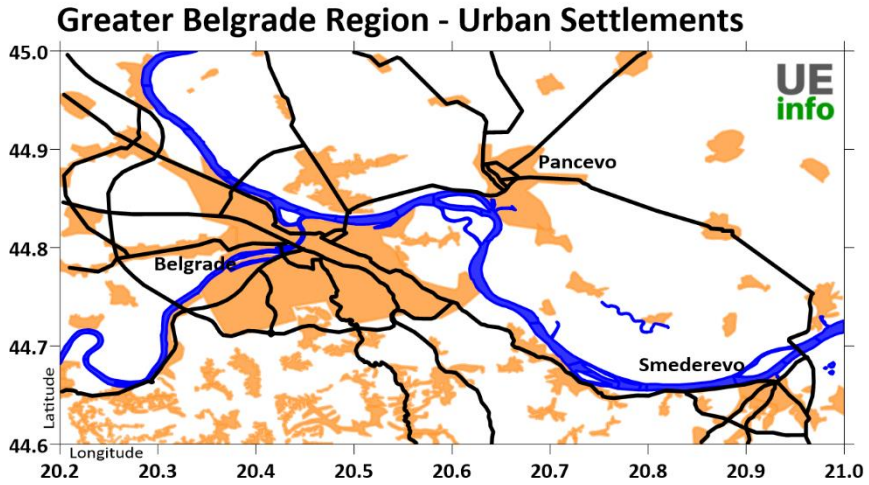


big-data

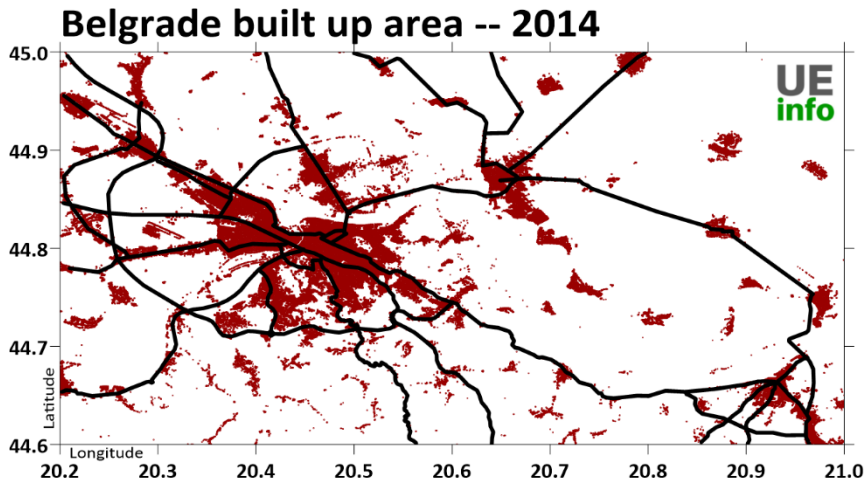




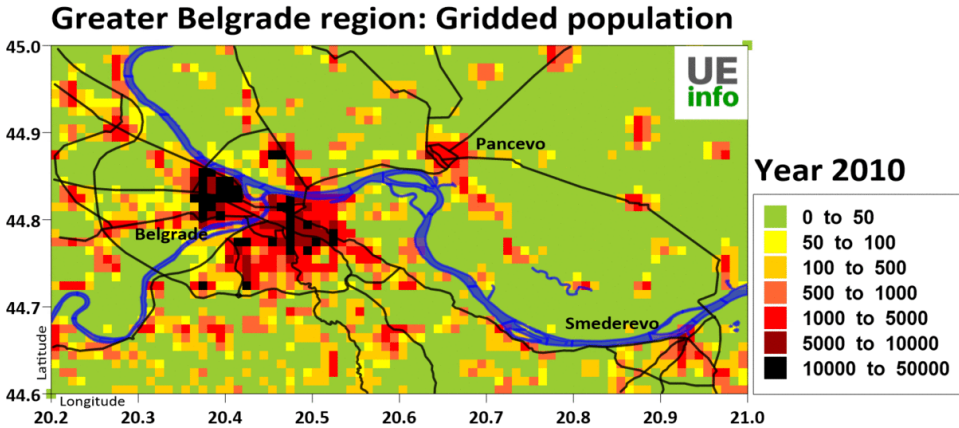
Open Street Maps



GHS and Google Earth



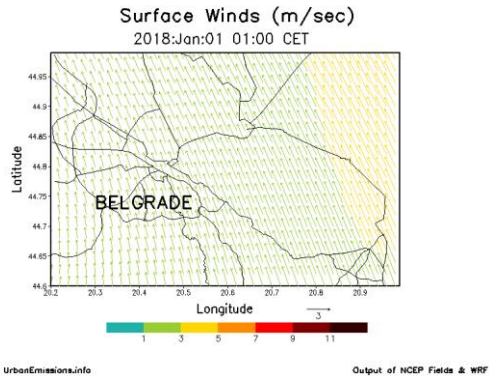
ESA's Global Human Settlements Project

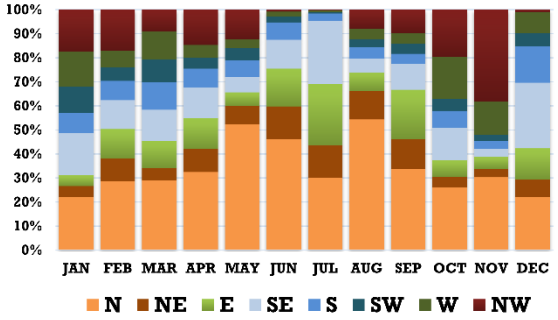


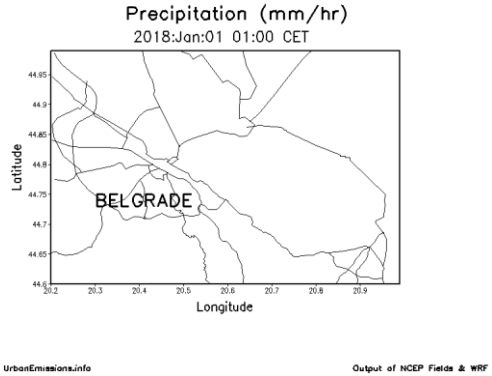
78-82% urban; 18-22% rural

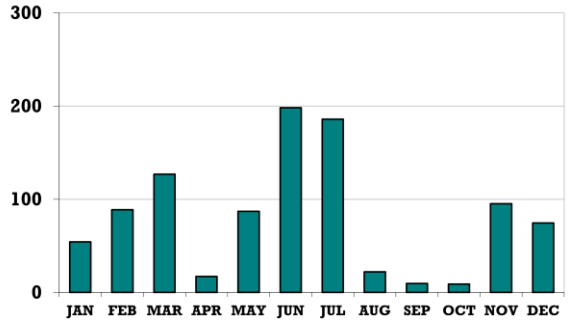
Meteorology over Belgrade

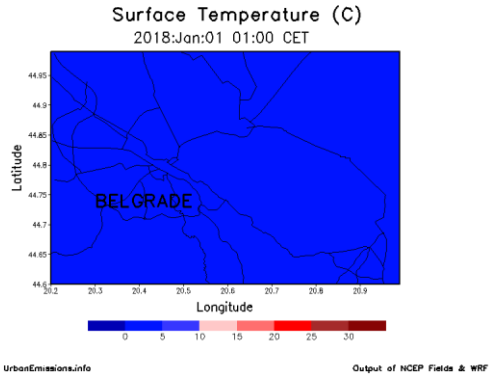
- Data is processed using WRF4.1 meteorological model with inputs from NCEP reanalysis for year 2018
- Hourly and monthly profiles are included in the following slides, along with 24-hour animations of hourly snapshots from January and July

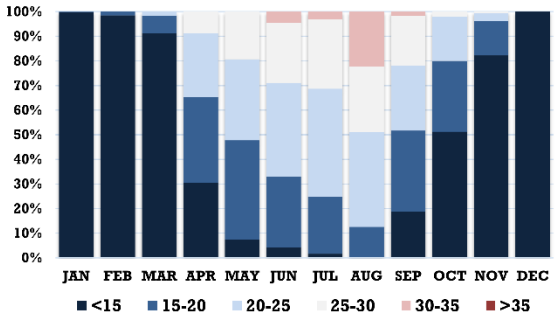


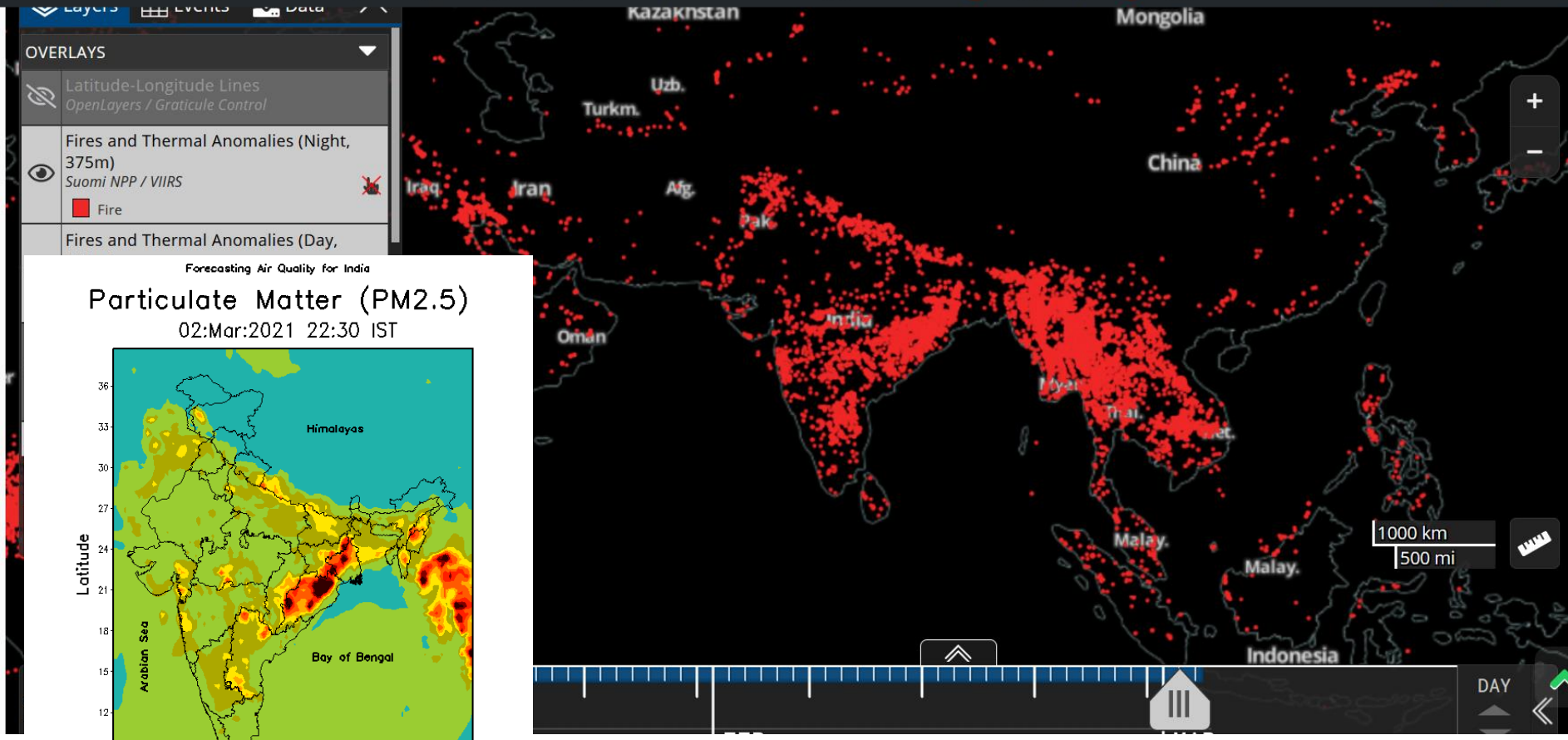












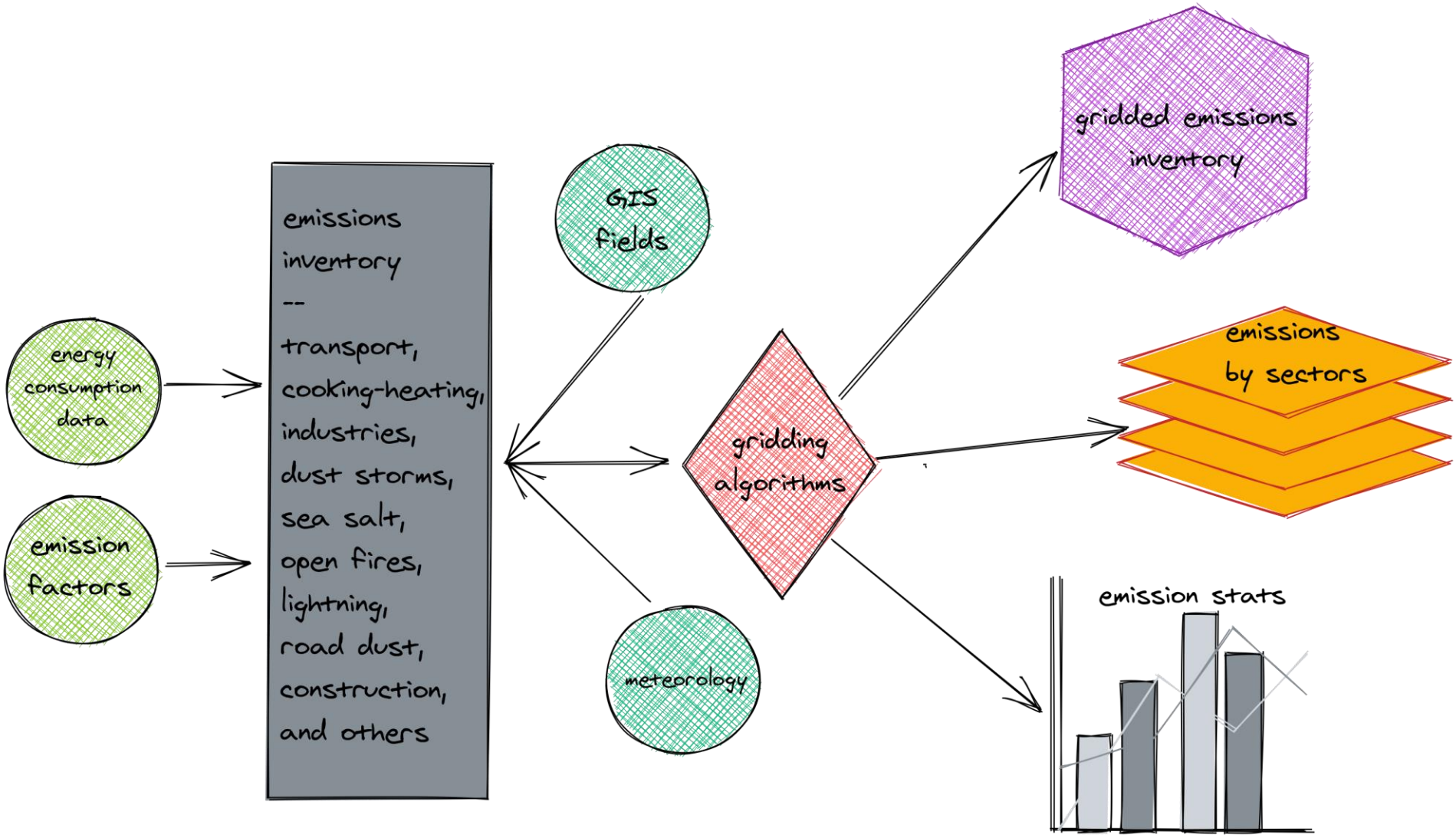
Vinca landfill (3000 tpd and 0.8 km2)

Pancevo refinery (4.8 Mta crude)

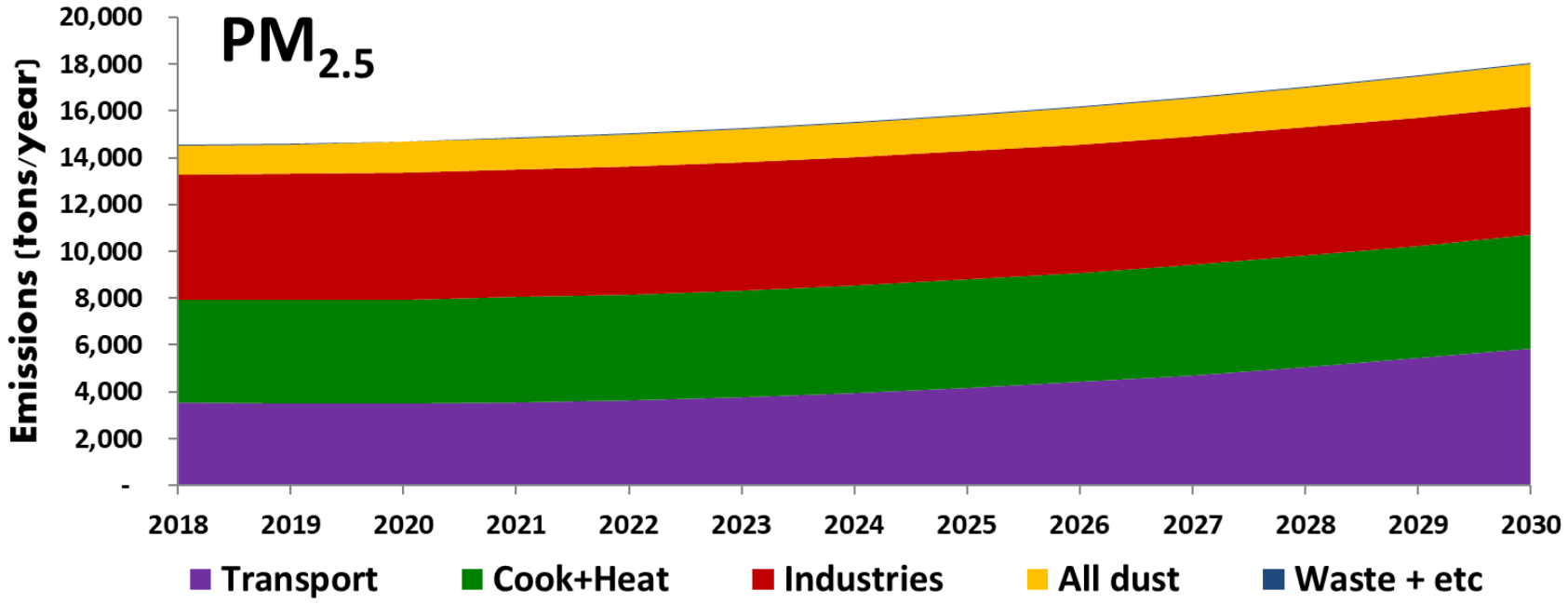
Construction debris collection

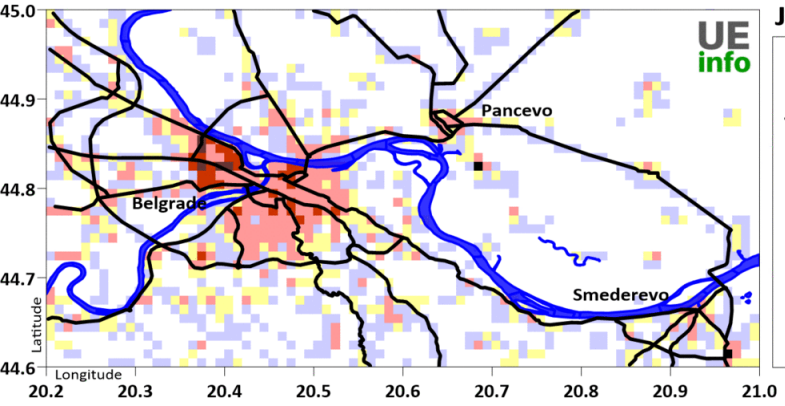
Smederevo steel plant (2 Mt/yr)

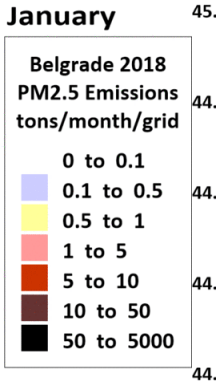
General Schematic of Emissions Modeling

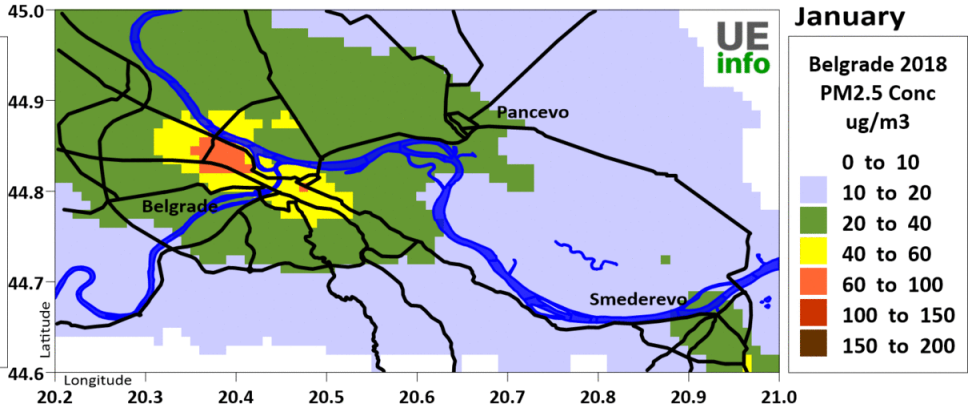


Multi-Pollutant Emissions with Projections

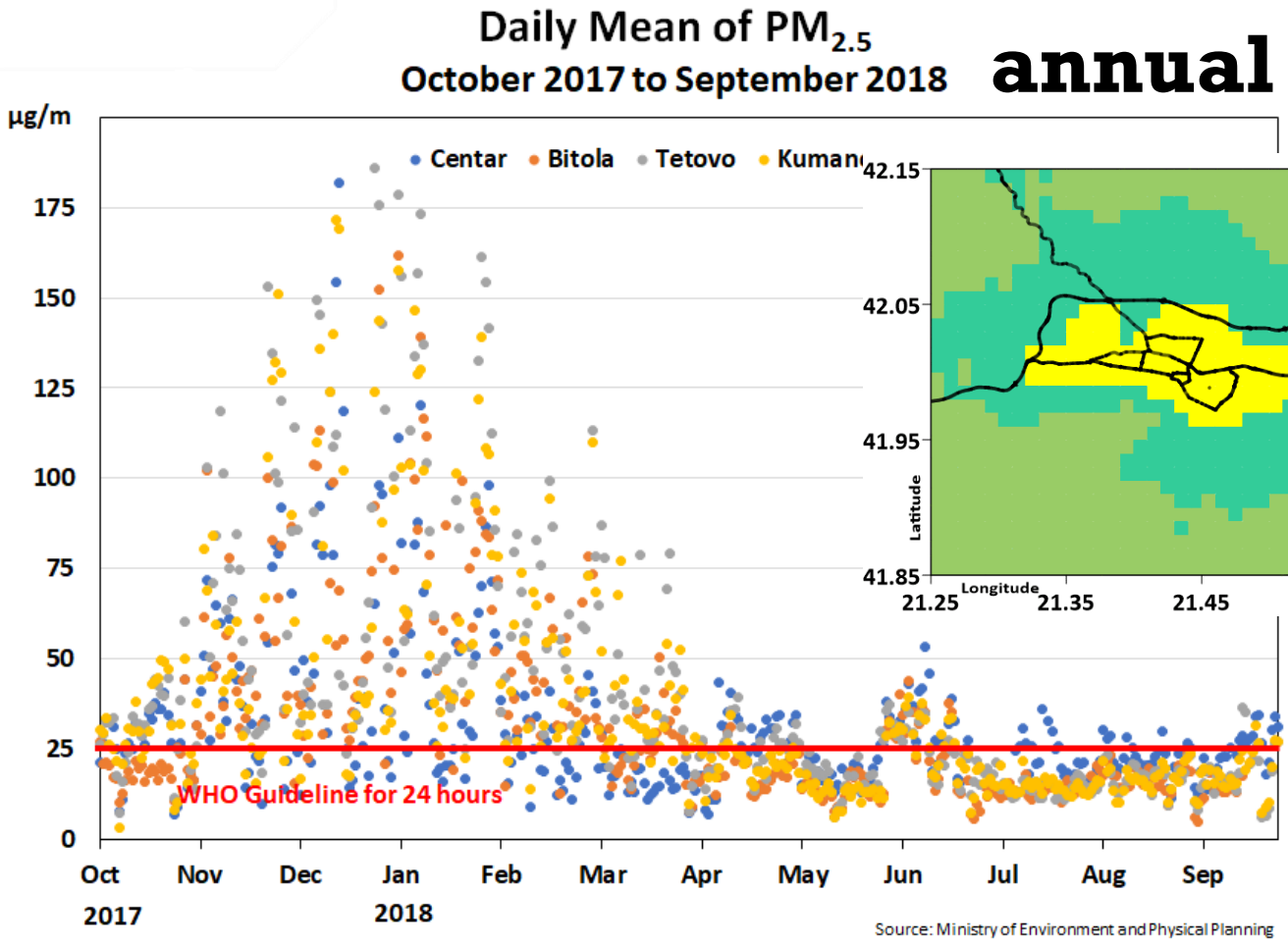




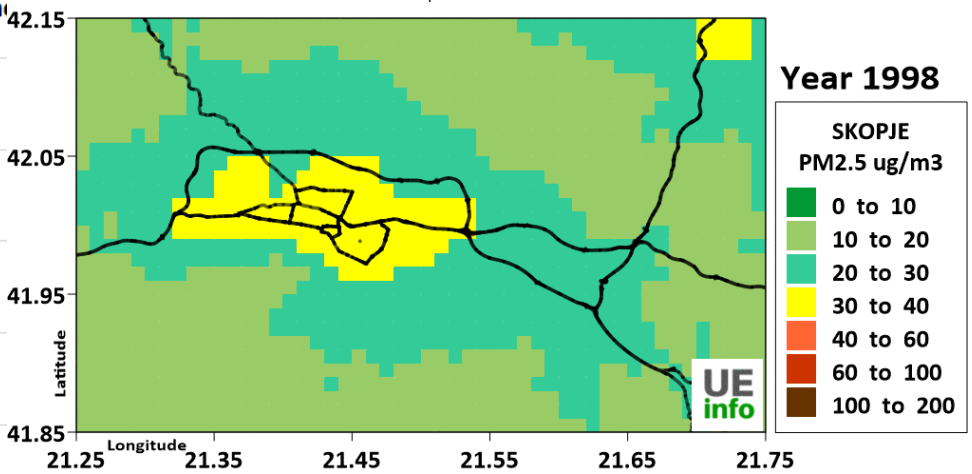




monitoring profiles - Skopje



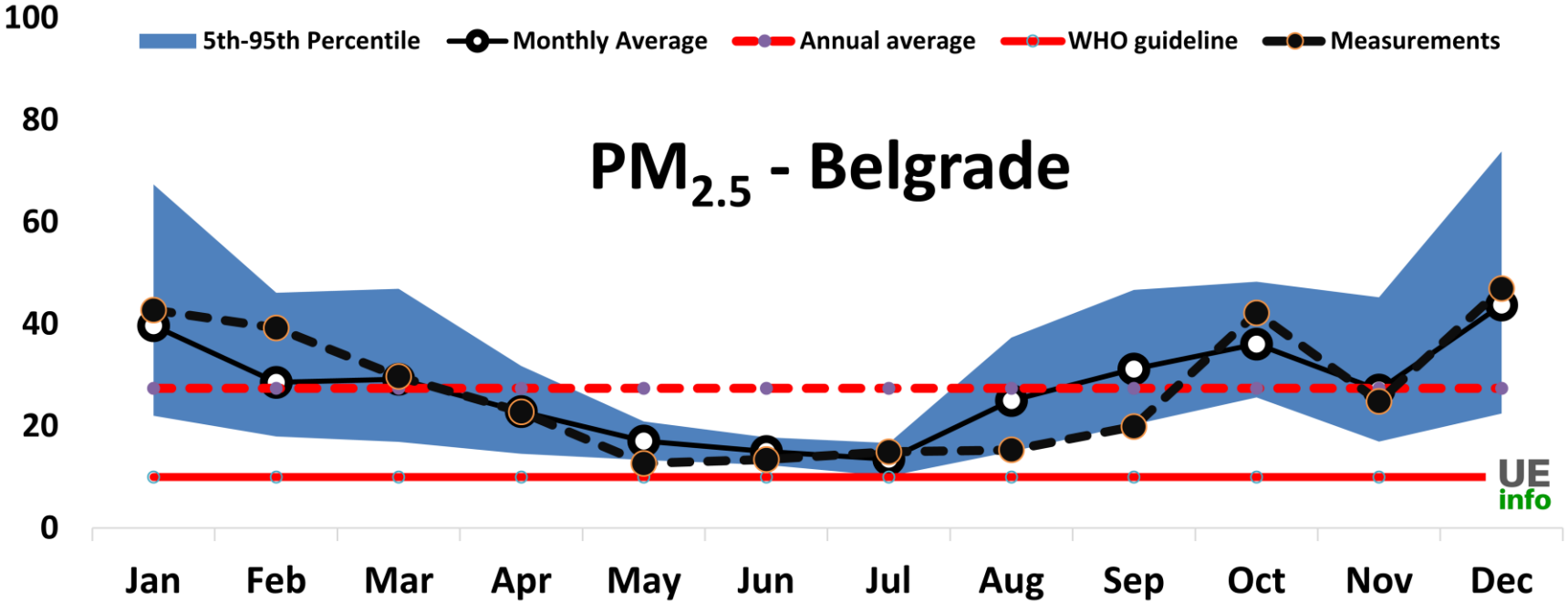
annual avg 50 µg/m³

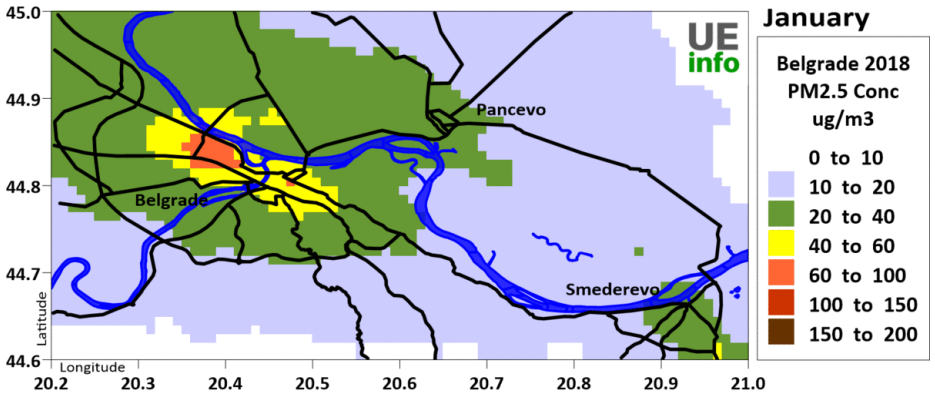


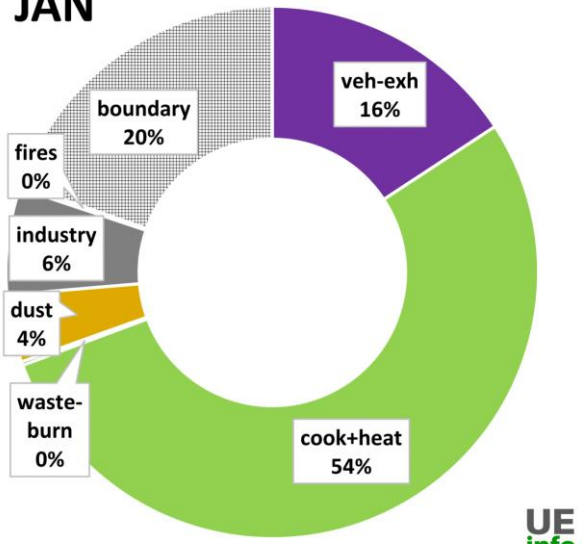
Global model simulations with satellite feeds http://fizz.phys.dal.ca/~atmos/martin/?page_id=140

https://www.macedonia2025.com/activities/single/air-pollution-in-macedonia-killing-people-and-decreasing-economic-growth/#_ftnref1

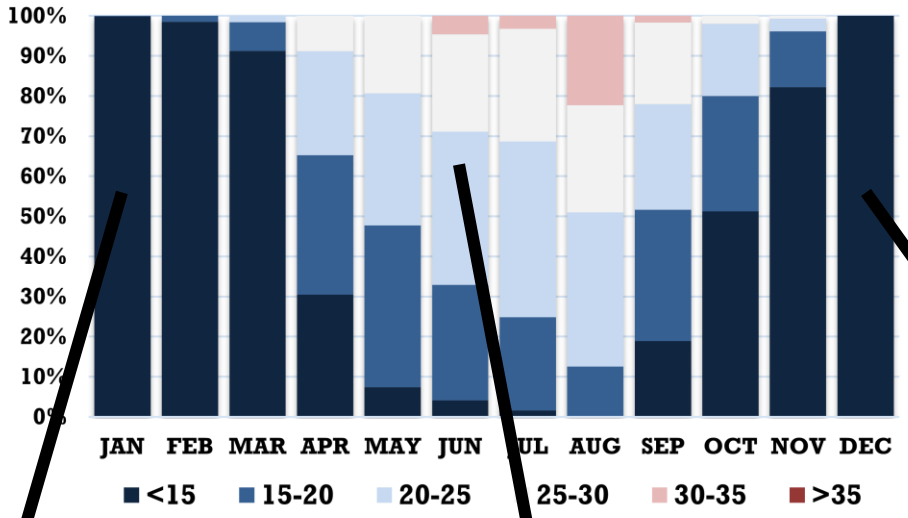
Modeled $PM_{2.5}$ Source Apportionment

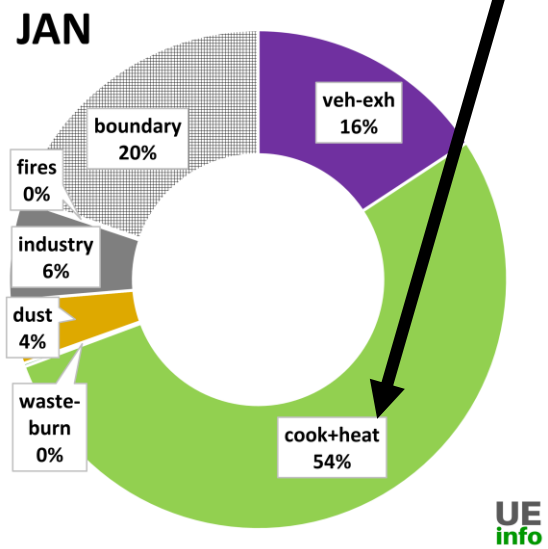


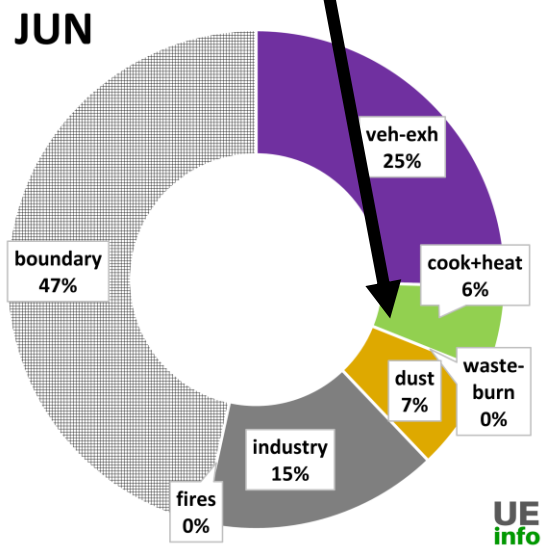


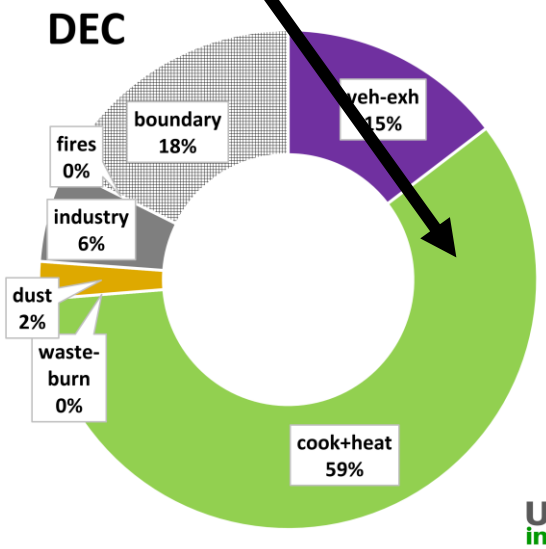


Heating needs : Winter vs. Summer months

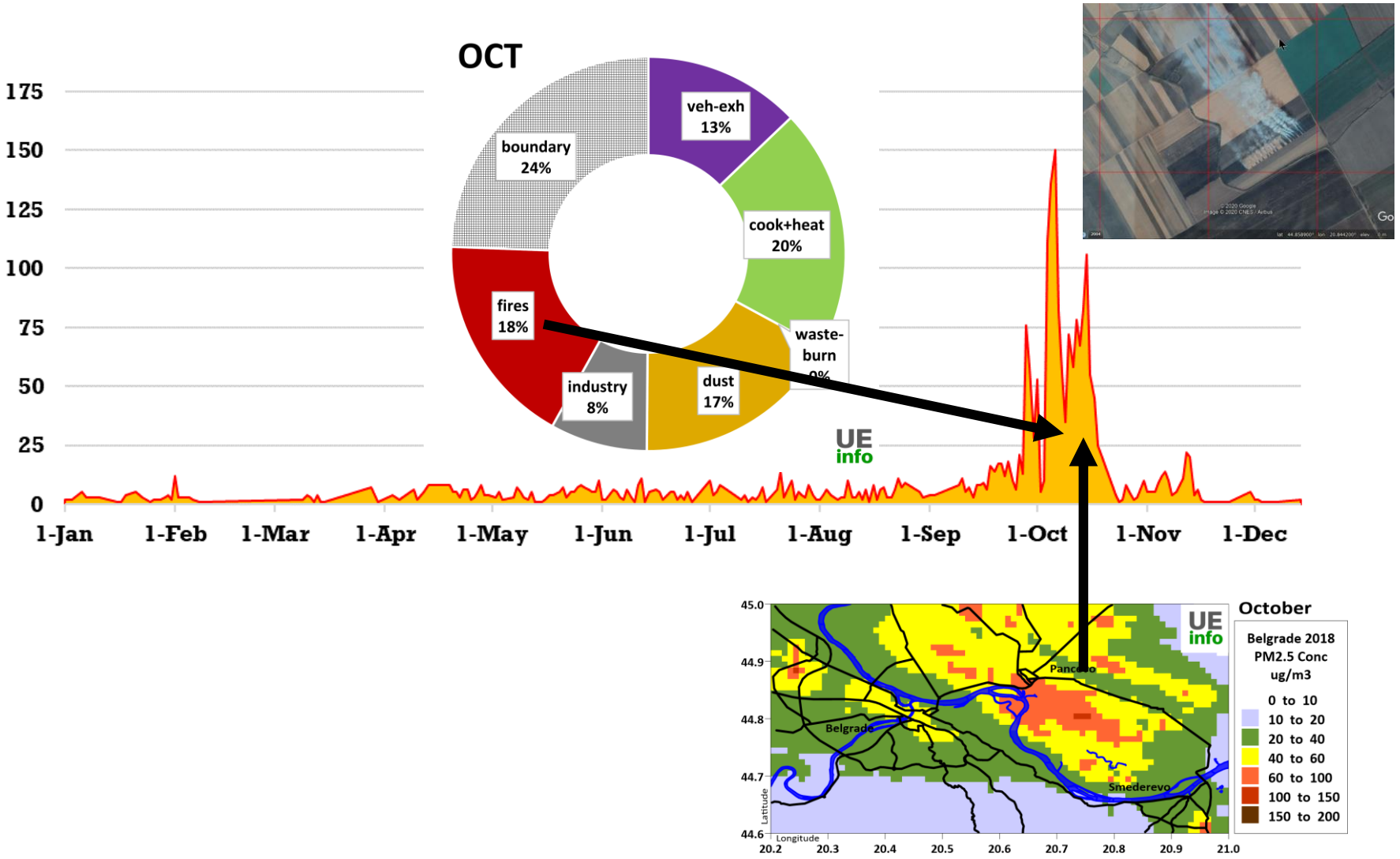








Peak open fire contribution in October



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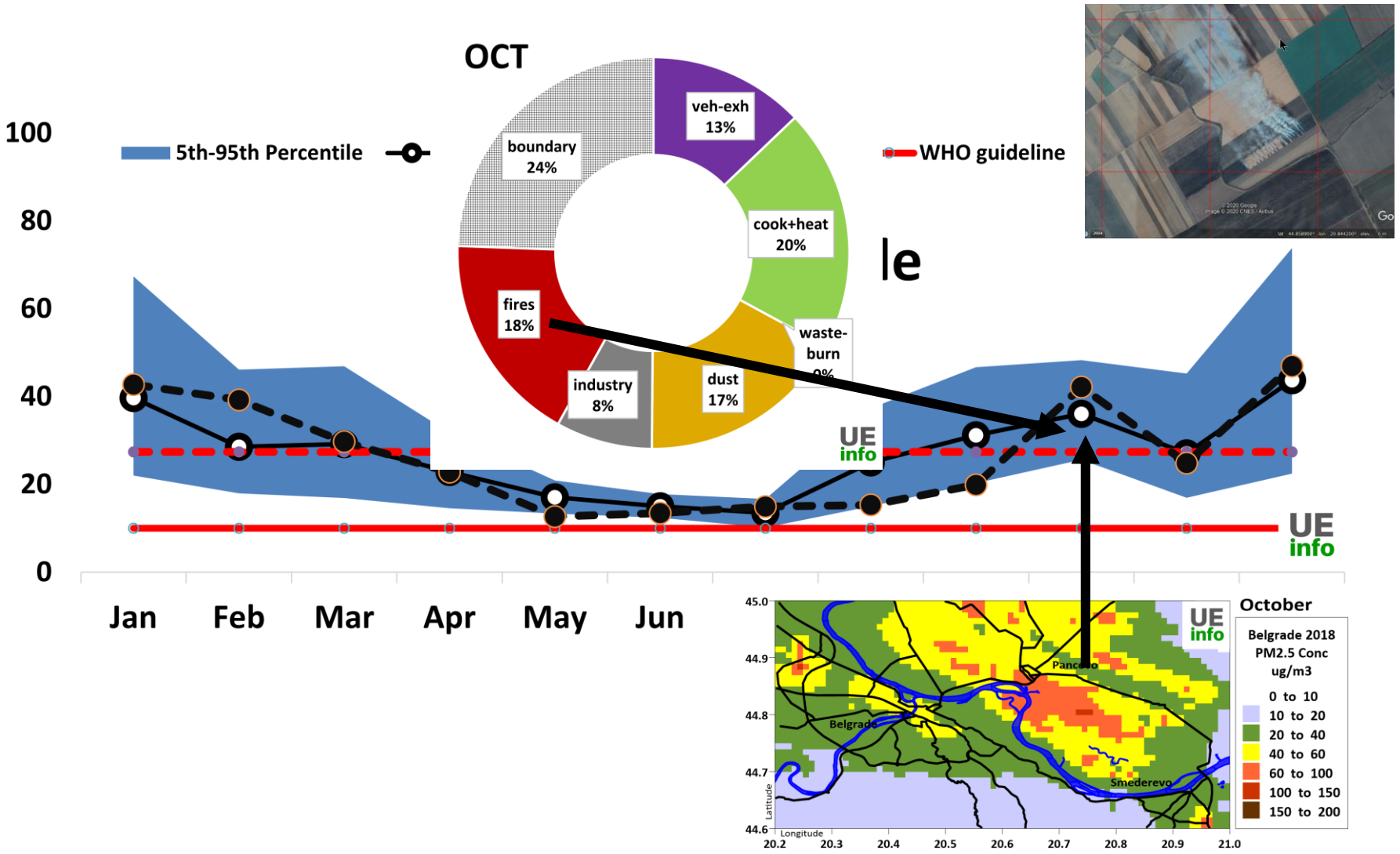
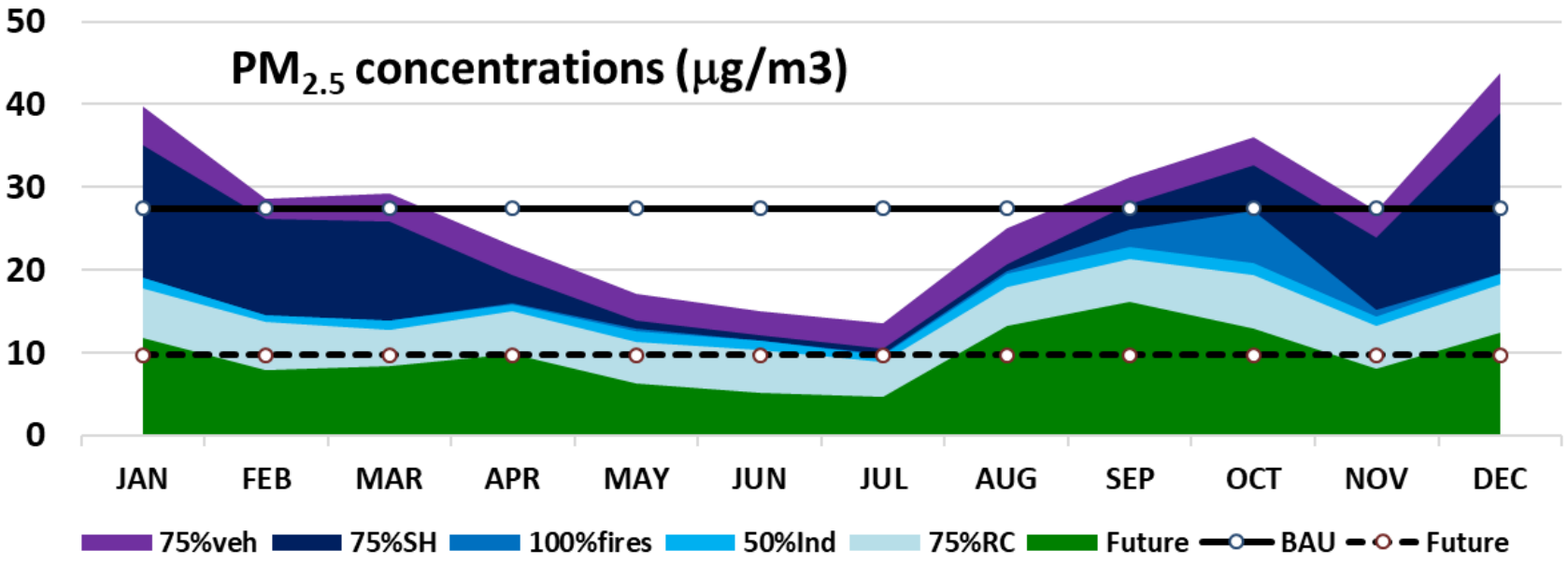


"what-if" simulations: Reductions needed to reach WHO guideline



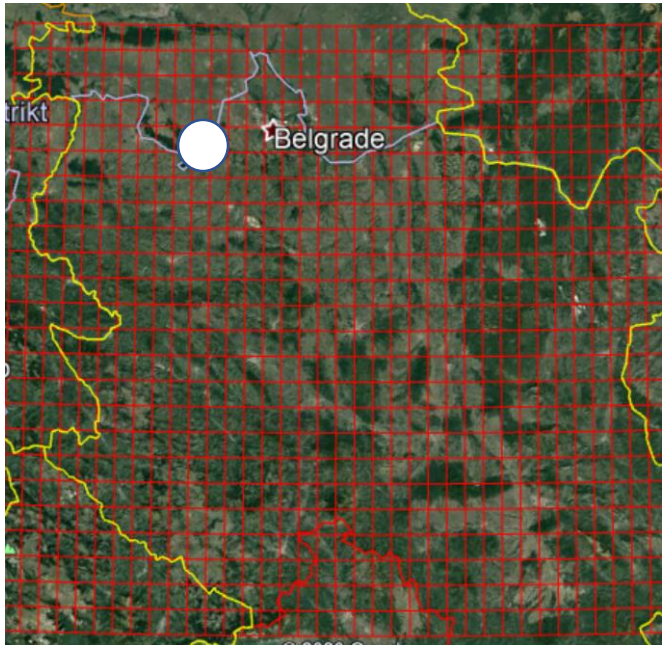
Reductions of 75% vehicle exhaust emissions; 75% of space heating emissions; 100% open fires; 50% of industrial emissions; 75% of regional contribution

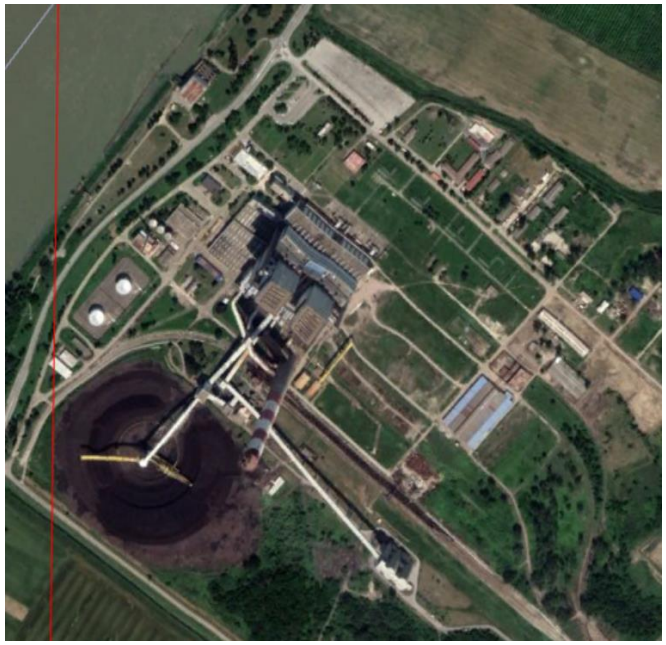
Urban annual average (BAU) = 27.4 µg/m^3 and (Future) = 9.7 µg/m^3

Specific interventions for SO_2 emissions in Serbia

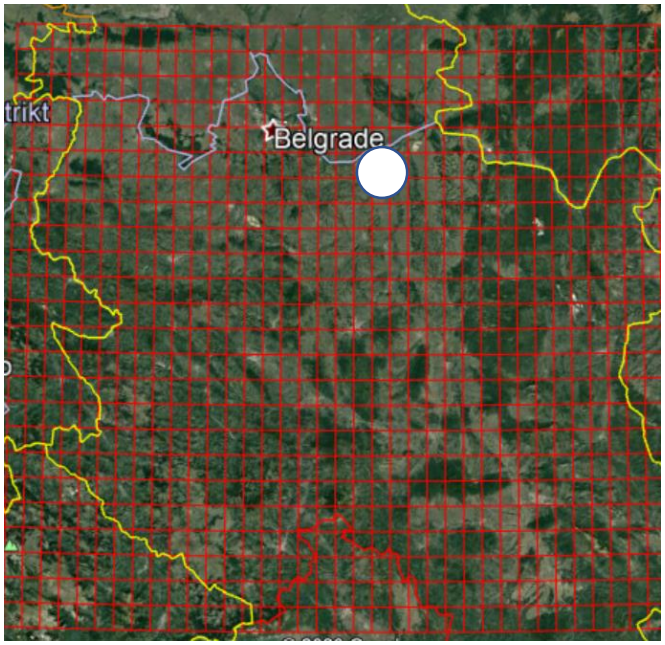
1. Control case 1 (C1) – shift from 3% to 1% in the sulfur content of heavy fuel oil used for residential heating

2. Control case 2 (C2) – reduction in the overall SO2 emissions at the lignite coal power plants - Nikola Tesla (A/B) and Kostalac (A/B). For this case, we capped the total emissions to maximum allowed, as specified in national emissions reductions plan.





Nikola Tesla A & B



Kostolac A & B

Average benefits of Specific interventions for SO_2 emissions in Serbia

2021 control case	Change from business as usual
C1 - Annual SO_2 emissions	8.4 to 4.9 ktons (41.6% reduction)
C2 - Annual SO_2 emissions	304 to 50.3 ktons (83.5% reduction)

urban vs. rural benefits under C1

C1 – Annual SO_2 emissions (all grids designated as urban – 116 grids of the modeling domain)	3.3 to 1.4 ktons (57.6% reduction)
C1 – Annual SO_2 emissions (all grids designated as rural – 784 grids of the modeling domain)	5.1 to 3.6 ktons (29.4% reduction)

Model grids for Serbia were designated as urban and rural, using the built-up area information from ESA's Global Human Settlements program @ https://ghsl.jrc.ec.europa.eu/datasets.php

Average benefits of Specific interventions for SO_2 emissions in Serbia

	2021C1	2021C2
All urban cells - average SO2 concentration	-9.2%	-26.2%
All urban cells - average SO4 concentration	-2.0%	-30.8%
Belgrade city cells - average SO2 concentration	-17.6%	-21.9%
Belgrade city cells - average SO4 concentration	-3.0%	-33.3%

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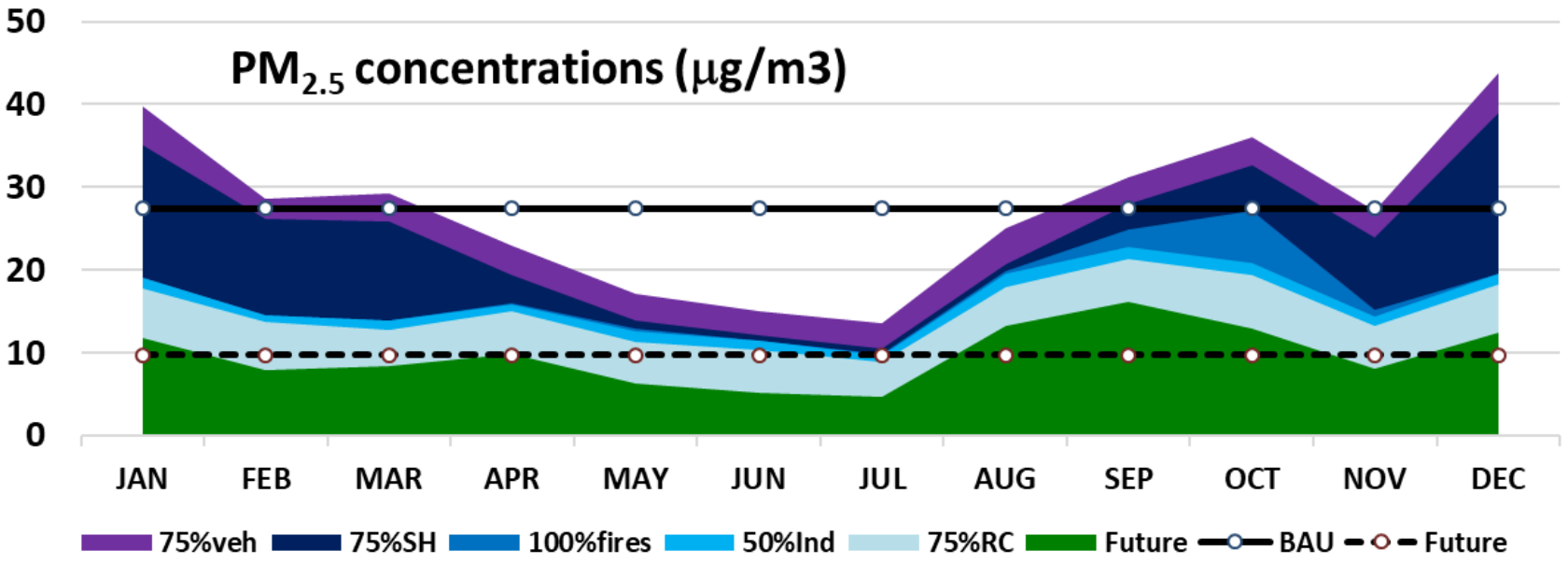

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This work was commissioned by the World Bank as part of a rapid diagnostic study to understand the air quality situation in the greater Belgrade area and Serbia.

The analysis undertaken was based on publicly available sources of data, except for air quality monitoring data that was kindly made available by SEPA.

The results have not been reviewed and endorsed by the management of the World Bank.

Key lessons from modeling exercise

1. Address winter peaks which seem to come mostly from domestic heating / cooking sources

2. Control agricultural burning in the autumn months

3. Implement the Rulebook on reducing Sulphur in HFO from 3% to 1% from 1st Jan 2021 , as planned

4. Implement NERP that is already adopted to address emissions from large combustion plants

Policy Recommendations

1. more granular analysis based on locally collected emissions data would help refine the results presented - not change their overall direction

2. preparation / review of air quality management plan for the Belgrade airshed and for all of Serbia, taking account of transboundary contributions - may call for greater regional cooperation with neighboring countries

3. prioritization of interventions (policies and measures) based on analysis of their costs and benefits – ensuring potential climate mitigation benefits

4. implementation of prioritized policies and measures in line with EU directives – with potential support of development partners

5. Strengthen monitoring of emissions and ambient air quality – to better track and report impacts