FAIRMODE Technical Meeting
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OZONE-RELATED KEY CHALLENGES - HOW TO DESIGN MEASURES TO REDUCE O3 CONCENTRATIONS

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INTRODUCTION - Status quo of ozone in Europe

Emission reductions of O_3 precursors were achieved in Europe (EEA-33 countries) in the period 2000-2018 with a reduction in photochemical production.

Studies have identified a decreasing trend of main pollutants such as NOX, VOCs and an increasing trend for O_3

A differentiation is seen between rural and traffic stations, with a negative trend at rural stations.

The hemispheric background O_3 is increasing due to increase in VOCs and NOX emissions from Asia.

Close to traffic, the destruction of O_3 by titration is decreasing due to NOx decrease.

INTRODUCTION – Important parameters

VOC/NOx ratio: If ratio is low, reduction of NOx may cause O_3 concentration increase (titration effect).

NOx emission control of traffic at urban areas needs to be counterbalanced by sufficient VOCs emission control.

VOCs/NOX ratios vary both spatially and diurnally in a given city and from one episode to the next for the same city.

Formation through transport and solar radiation, from urban to rural areas. Vertical transport of O_3 from high altitude atmospheric layers and hemispheric & regional transport dominate.

Climate change might affect production of O_3: higher temperatures, biogenic VOCs, increase in stratospheric O3 intrusion, higher CH4 emissions and lightning NOX emissions

MEASURES

- Spatial and temporal mapping of emissions per sector including land use
- Spatial and temporal mapping of O3 concentrations (human health and vegetation protection) from monitoring networks
- Estimation of the NOX/VOC ratio of the area of interest
- Differentiate between urban/rural areas or areas with common source or/and exceedance characteristics
- Test (via modeling) several scenarios for the areas identified above including: emission reductions per sector, land use changes, technological advancements (electric cars, biofuels, etc)
- Cost / benefit estimations of the proposed measures should be made
- Communicate with policy makers and competent authorities the proposed scenarios

Ozone control strategies targeted by sector type

Road transport: The withdrawal of old passenger cars, replacement of old buses, introduction of electric cars (CO and NOx decreased by 38.45 % and 7.79%).

Design of effective road network on which the actual vehicles' velocities are increased will affected the emissions positively since engines consume less fuel at higher velocities.

Factories and power plants: Reduction of NOx emissions from alternative sources of energy, nuclear energy, cleaner fuels, filters and improved combustion technologies.

Residential heating sector: Energy efficiency of buildings, type of fuel/energy source used for heating/cooling. Scenarios of emissions estimation should include realistic/feasible use of alternative fuels, reduction in consumption of petroleum products order to reduce NOX emissions. For instance in Greece due to the financial crisis the heating oil consumption decreased by 66.81% (83.29 PJ) resulting in a drop of 67.35 % of NOX emissions (Fameli et al. 2021).

UNCERTAINTIES

- Socio-economic conditions (energy poverty, income, etc) affect the choice of energy type, consumption patterns and type of appliance.
- Future climatic conditions/climate change effects.
- Willingness of authorities/policy makers to promote and finance the energy upgrade of buildings.
- Timing of the implementation of measures.

In case of forecasting high O3 concentrations, suggested measures should be implemented before the expected pollution peak. The recorded O3 concentrations could provide evidence of the effectiveness of the measures.