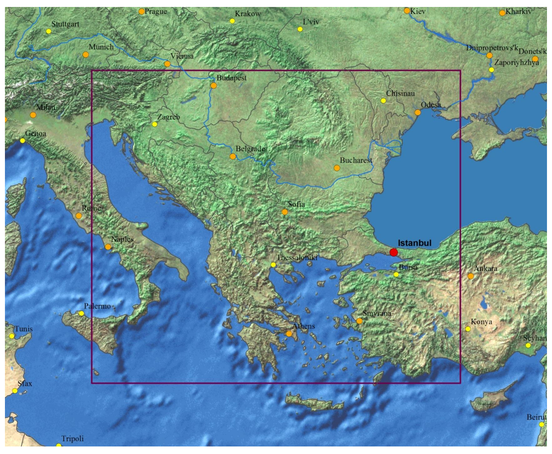

DIFFERENT SNAP CATEGORIES CONTRIBUTION TO THE AIR POLLUTION

EVALUATION OF THE CONTRIBUTION OF DIFERENT SNAP CATEGORIES TO THE AIR POLLUTION OVER THE BALKAN PENNINSULA

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SUMMARY

OBJECTIVE:

The impact of the different SNAP categories to the air pollution of the Balkan Peninsula as a whole had never been comprehensively studied. The aim of the present work is to carry out high resolution studies with different scenarios, with up-to-date modelling tools, detailed and reliable input data for long enough simulation period

MODELS:

The simulations are based on US EPA Models-3 System – MM5, SMOKE and CMAQ. The emission input is from GEMS 0.25º inventory (TNO, The Netherlands).

METHODOLOGY:

TNO emissions are distributed over 10 SNAPs (Selected Nomenclature for Air Pollution) classifying pollution sources according the processes leading to release in the atmosphere. The inventory contains 8 pollutants: CH4, CO, NH3, nmVOC, NOx, SOx, PM10 and PM2.5.

The different scenarios are created using emission reduction factor α=0.8 for SNAP 1 – energy combustion and SNAP 7 – road transport.

The relative contribution (φ_m) for every SNAP to the characteristic φ is given by the formula:

$$\varphi_m = \frac{1}{1-\alpha}\frac{(\varphi-\varphi_m)}{\varphi}.100$$

RESULTS:

Averaging the fields over the whole ensemble of results (from 2003 till 2006) for the respective month produces a diurnal behaviour of given pollution characteristic, which can be interpreted as “typical” for the month/season. The characteristics, which will be demonstrated as an example further are the surface concentration and relative contribution of SNAP1 and SNAP7, for typical winter and summer months - January and July. Analysing the results one should keep in mind that the contribution of a SNAP category in a given point (or sub-domain) reflects the respective SNAP sources in the whole integration domain.

CONCLUSIONS:

Studying the air pollution fields response to emission changes (model sensitivity to emission input) is obviously a task of great practical importance, connected with formulating strategies for short and long-term pollution management.

The obtained ensemble of numerical simulation results is extensive enough to allow statistical treatment – calculating not only the mean concentrations and different SNAP categories contribution mean fields, but also standard deviations, skewness, etc. with their seasonal and diurnal variations.

SIMULATION DOMAINS

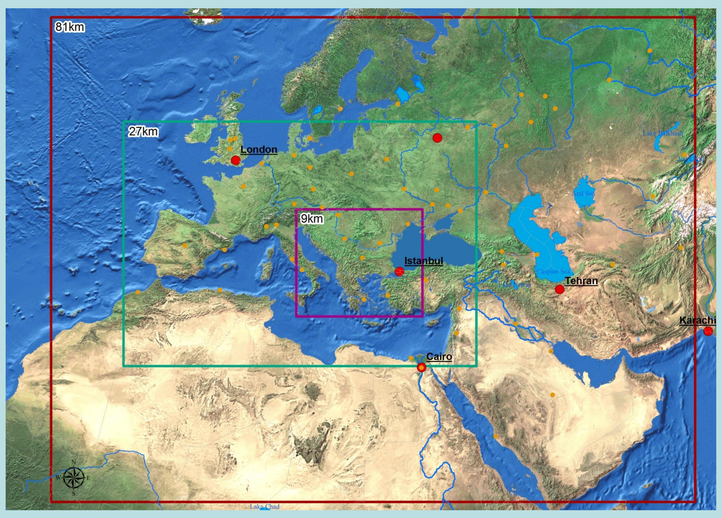

Fig.1

- To work with high spatial resolution , MM5 and CMAQ nesting capabilities were used as shown on (Fig.1).
- CMAQ simulations were performed on 27km and 09km domains and the 09km domains covers the Balkan peninsula.
- The used emission inventory is The TNO high resolution inventory (A. Visschedijk et all. ,2007)

RELATIVE CONTRIBUTION OF SNAP1 AND SNAP7 FOR SUMMER SEASON

Fig.2 Surface concentrations plots [mg/m³] and relative contributions of SNAP 1 and 7 sources for SO_2 at 06 and 16 UTC for “typical” summer day

Plots of this kind are rather spectacular and can give a good qualitative impression of the spatial complexity of the different SNAP categories contribution.
In order to demonstrate the pollution and SNAP code contribution behaviour in a more simple and easy to comprehend way, the respective fields can be averaged over some domain (in this case the territory of Bulgaria), which makes it possible to jointly follow and compare the diurnal behaviour of the overall pollution and the pollution from the respective SNAP categories (obtained by multiplying the relative contribution ϕ_m by the concentration from all the sources).

DIURNAL COURSE OF SURFACE CONCENTRATION FROM SNAP1, SNAP7 AND ALL SOURCES

The results from these averaged plots are:

- Significant contribution of both SNAP categories to NO_2, PM2.5
- For both winter and summer, SNAP 7 contribution for NO_2 is definitely bigger than SNAP 1 contribution
- The diurnal courses of the PM2.5 and PM-coarse overall concentrations, as well as the concentrations from Snap categories 1 and 7 for January and July are very similar

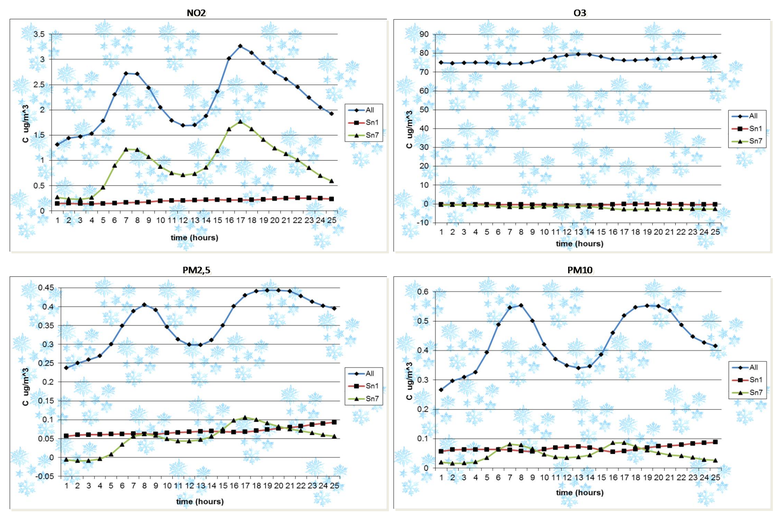

Fig.3 Plots of the diurnal course of surface concentrations [mg/m³] from all the sources and from the sources from SNAP 1 and 7 sources for NO_2, O_3, PM2.5 and PM-coarse for a “typical” winter day

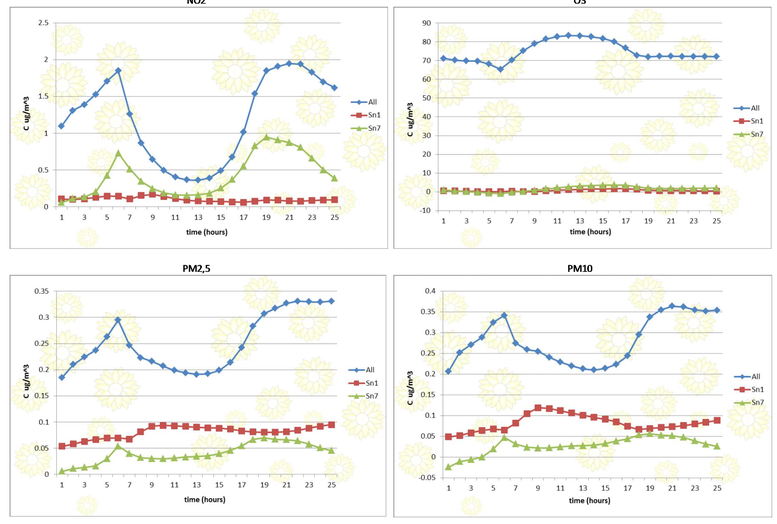

Fig.4 Plots of the diurnal course of surface concentrations [mg/m³] from all the sources and from the sources from SNAP 1 and 7 sources for NO_2, O_3, PM2.5 and PM-coarse for a “typical” summer day

The overall surface concentrations of NO_2, PM2.5 and PM-coarse have similar specifics for the overall concentration. The SNAP 7 contribution has peaks in the morning and early evening hours and a minimum around noon. This is due partially the specific diurnal course of the road transport (SNAP 7) emissions, but probably also due to meteorological conditions – a tendency for predominant unstable conditions during the day, which causes more intensive vertical mixing, thus transporting some of the surface pollution aloft. The last effect can be followed also in the diurnal course of the concentrations due to SNAP 1 emissions (elevated sources) – slight peaks around noon can be observed for NO_2, PM2.5 and PM-coarse in July.

The O_3 diurnal course manifests the expected maximum in daytime. Surprisingly the contribution of both SNAP categories to the overall O_3 concentration is small. This probably means that the O_3 in Bulgaria is mostly “imported”, while the Bulgarian sources cause O_3 formation somewhere else. This is not so revolutionary conclusion, having in mind that the O_3 is a secondary pollutant and can be formed away from the O_3 precursor sources.

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