Action 4: Construction of emission inventories

Work on this action is progressing in two directions, related to the estimation of (i) natural emissions (beneficiary responsible TUC) and (ii) anthropogenic emissions (beneficiary responsible AXON Envirogroup Ltd.) for the three studied areas (AMA, TMA, VGA).

Natural emissions:

➢ Collection of the necessary data to create a spatially, temporally and chemically resolved emission inventory from natural sources for the three areas of interest (AMA, TMA and GVA) has been completed. Specifically, input data include:
  - Land cover map (European Environmental Agency, EEA)
  - Meteorological parameter values (Temperature, Relative Humidity, Air velocity, Photosynthetically active radiation)
  - Soil texture map (European Soil Database, ESDB v2.0 2004).
➢ Collection of the annular gaseous pollutants (NOx, SOx, NMVOCs, CO, and NH3) emissions (tn/yr) from the UNECE/EMEP database has been completed.
➢ Calculation of secondary PM based on aerosol formation potential factors for the different gaseous precursors (NOx, SOx, NMVOCs and NH3).
➢ Estimation of windblown dust emissions based on the land cover, soil texture, wind friction velocity and threshold friction velocity.
➢ Estimation of emissions of sea salt particles for two distinct cases:
  - Open-ocean emissions are computed as a function of air velocity, particle radius and density, and relative humidity

(without taking into account the direct spume mechanism, which is excluded due to high uncertainty).

- Sea-shore emissions are computed as a function of air velocity, particle diameter and density, relative humidity and the solute weight fraction in natural sea salt solutions.

➢ Calculation of emissions of BVOCs using methodologies presented in the EMEP/CORINAIR Guidebook (2007), with modified environmental correction factors for light and temperature dependence of emissions. Emission potentials and foliar biomass densities are adapted from the EMEP/CORINAIR Guidebook (SNAP codes 11) in accordance with predominant species of Greek flora (Ministry of Rural Development and Food, FILOTIS database for the natural environment of Greece). Different foliar biomass densities and emission potentials are used for the growing (summer) and dormant (winter) season.

➢ The effect of forest fires to the emission from natural sources are incorporated in the calculations.

➢ Quantification of African dust load during dust outbreaks according to the method proposed by Escudero et al. (Atmospheric Environment, Vol. 41, pp. 5516-5524, 2007), included also in the "Guidance to member states on PM10 monitoring and inter-comparisons with the reference method" (EC Working Group on Particulate Matter, 2002).

Initial results have been presented in:
o Scientific journals:

Air Quality, Atmosphere and Health
Journal of Environmental Monitoring

Water, Air & Soil Pollution
o International conference:

European Aerosol Conference 2011, Manchester, U.K., 4-9 September 2011

Regarding anthropogenic emissions, the tasks undertaken are:

Identification of the special characteristics of each study area: Athens, Thessaloniki and Volos. Previous studies for the areas of interest were investigated in order to clarify local air quality problems. Studies for the areas of Athens and Thessaloniki are already under consideration.

Collection of available data concerning: a) traffic loads, b) mean traffic speeds, c) traffic composition and d) fleet characteristics data (composition and population) in the study areas (on going task).

Processing and analysis of fleet data (statistical) and of available traffic data in order to a) complement with traffic characteristics data the parts of the study area with missing information and b) specify the diurnal variation of traffic loads and speeds. In case of lacking data, other data available as length of existing road network and classification of roads will be applied (on going task).

Study and processing of traffic and fleet characteristics data in terms of engine technology categories for each vehicle type. Data for the areas of Athens and Thessaloniki have already been processed without particular problems (on going task).

Preliminary discussions for the preparation of the most suitable grid that will be used for the allocation of total road traffic emissions for all three areas of study.

Development of the methodology that will be applied for the spatial and temporal disaggregation of traffic data. Quality control and consistency control of existing traffic data and fleet data.

Calculation of road traffic emissions (model application). The calculations of yearly road traffic emissions for the Greater Athens area have already been completed. Emissions calculations have been carried out for the period 1990-2010. For Thessaloniki and Volos, the corresponding inventories are also in progress.

The methodology will be based on known scientific experience. Similar methodologies have already been applied in the past by Prof. I Ziomas and Dr. A. Progiou (on going task).

Continuous control of data gathered with regard to the data source, completeness, methodology of processing, if applied (on going task).

Continuation of the work on the compilation of emission inventories for anthropogenic and natural sources and presentation of the initial results from TUC and AXON Enviro-group Ltd. in the framework of the 2nd Plenary Meeting of March 28th, 2011.
Meeting organized by the Project Manager with AXON Envirogroup Ltd to discuss on the progress achieved. Prof. I. Ziomas (National Technical University of Athens), who will be subcontracted by AXON

Envirogroup Ltd. to participate in the emissions inventory compilation (related to industrial sources), has also participated at the meeting between NCSR "D" and AXON Envirogroup Ltd.

The air pollution inventory for the Industrial Sector includes emissions deriving from Fuel Combustion and emissions related to the actual (Industrial) Production Processes themselves. The estimated emissions reflect the overall contribution of the Industry to the deterioration of air quality in the Greek territory. The NTUA team has in its possession a detailed database of all the high emissive industrial plants in Greece, including energy power plants. Production quantities, consumption of fuels and also of raw material data are included in the database, whereas information on the exact location of each plant is also recorded, based on the information provided by the plants in the framework of their reporting obligations under the E.U. Emissions Trading Scheme. Aggregated statistical data (including confidential data in some cases) provided by national and international sources such as the Hellenic Statistical Authority (Prodcom), the Ministry of Development (national energy balance), EUROSTAT etc are also introduced in the database, whereas information provided by the plants on the basis of personal communication with the NTUA team is also included. The collected data permit the estimation of emissions from the following main air pollutants: CO, NOx, SOx, PM2.5, PM10, NMVOC, NH3. The emission factors used are provided by the EMEP/EEA air pollutant emission inventory guidebook that has been released by the EEA in 2009.

The Industrial Inventory is divided in the following subcategories:

o Combustion in energy and transformation industries

o Mineral Production

o Chemical Production

o Metal Production

o Other Production (mainly from Pulp & Paper and Food industries)

o Solvents

In addition to emission inventories compilation, the temporal evolution of PM concentrations and anthropogenic and natural emissions is being studied. The reduction in emissions needed in order to meet the current air quality standard (AQS) for PM10 is being estimated, based on the rollback equation (Seinfeld J.H. and Pandis S.N., Atmospheric Chemistry and Physics: From Air Pollution to Climate Change, J. Wiley, New York, 1998). Results for several PM monitoring stations in the areas of interest have been already produced. Initial results from natural and anthropogenic emission inventories and the estimation of necessary reductions of emissions have been presented in the 1st Progress Report.

The publications related with the first results of action 4 are:

<u>In scientific journals</u>

1. Aleksandropoulou V., Torseth K., Lazaridis M., "Atmospheric emission inventory for natural and anthropogenic sources and spatial emission mapping for the Greater Athens Area", Water, Air & Soil Pollution, Vol. 219, pp. 507–526, 2011.

2. Aleksandropoulou V., Eleftheriadis K., Diapouli E., Torseth K., Lazaridis M., "Assessing PM_{10} source reduction in urban agglomerations for air quality compliance", Journal of Environmental Monitoring, accepted for publication.

<u>In international conference</u>

1. Aleksandropoulou V., Lazaridis M., Eleftheriadis K., "Assessing PM_{10} source reduction in urban agglomerations for air quality compliance", European Aerosol Conference, Manchester, U.K., 4 - 9 September 2011.

The Initial results of the emission inventories compilation have been presented by AXON Envirogroup Ltd., during the 1st informative meeting for stakeholders, held on the 14th of December 2011.

The first phase of this action "Collection and control of input data" has been completed. Processing and analysis of data is in progress.

During the reporting period, calculations for anthropogenic and natural emission inventories, temporally and spatially disaggregated, for the period 2000-2010, have been completed.
Work on this Action is proceeding according to plan without any problems.

A list of the completed deliverables and milestones is presented below.
Deliverables:
D10: Emission inventories for the three urban areas (AMA, TMA, GVA), for anthropogenic and natural sources, for the past decade (2000-2010)
D11: Spatial and temporal disaggregation of emissions for the past decade (2000-2010)

Milestones:

M18: Completion of data collection

M24: Completion of data processing and analysis and of models application (compilation of emission inventories) for the past decade (2000-2010)

M27: Completion of spatial and temporal disaggregation of emissions for the past decade (2000-2010)

The below deliverables are in progress:

D12. Emission inventories for the three urban areas (AMA, TMA, GVA), for anthropogenic and natural sources, for 2010-2013 and projections for the future

D13. Spatial and temporal disaggregation of emissions, for 2010-2013 and projections for the future

Completion of data processing and analysis and of models application (compilation of emission inventories) for 2010-2013 and projections for the future

Completion of spatial and temporal disaggregation of emissions for 2010-2013 and projections for the future