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1. Introduction

In this chapter some major considerations of an environmental management by direct on-line monitoring of the air quality, illustrated by examples, as experienced by the authors, are discussed. First the standard (reference) methods for the main pollutants are indicated, further some non-standard methods.

Atmospheric pollution is a major problem facing all nations of the world. Rapid urban and industrial growth has resulted in vast quantities of potentially harmful waste products being released into the atmosphere. The atmosphere is the largest imaginable chemical reactor in which pollutants may be converted into more harmful or harmless substances. Societies have been reluctant to accept, or have simply failed to recognise the limitations of the cleaning properties of the atmosphere and self-adaptation of the ecosystem Planet, with no remnant damages or preventing a non-equilibrium status. The consequences has been that air pollution has affected the health and wellbeing of people, has caused widespread damage to vegetation, crops, wildlife, materials, buildings and climate, and has resulted in depletion of the scarce natural resources needed for long-term economic development. In the past, the earth was considered virtually infinite, and little thought was given to the polluting effects of our dumping wastes. The atmosphere felt to be so vast that it could absorb any amount. However, over the past decades, several factors have come together to bring this attitude into sharp question. Along with the realisation that we are on an all too finite spaceship - the earth - the increasing population and technological base for our way of life and the increased sensitivity of our instruments for measuring pollution have all played a role in bringing about an awareness regarding the environment and its quality.

Air pollution adversely affects soil, water, crops, vegetation, human-made materials, buildings, animals, wildlife, weather, climate, and transportation, as well as reduce economic values, personal comfort and well being. More and more, in the present time of the society of knowledge, the population and the policy makers are convinced and engaged for preserving the biodiversity that is fundamental to human welfare and economic development, and plays a critical role in meeting human needs by maintaining the ecological processes on which our survival depends. Broad-scale ecological systems provide benefits such as clean air and fresh water that are needed by everyone, whether in urban or rural settings.
As main sources for the pollution of air one recognises: the natural sources, and the man-made sources, in direct dependency to the energy consumption that is driven from the standard of comfort and industrial development, being influenced by the number of population, as well. It is not difficult to see that all of us are either directly or indirectly polluters and all of us share the disadvantages and cleanup costs of pollution generating activities, although often not in an equal and equitable manner.

In order to keep control over the quality of air the policy makers, in international co-operation mostly, decided to introduce specific regulations attesting the maximum admitted values as well the alert values. Thus, one controls both the emissions and the air quality, that represents a result of the transport in the air of the pollutants, in direct dependence to the topography and the weather conditions. Primary pollutants are those released directly from the source into the air in a harmful form. They are mostly result from combustion of classic C - containing non-renewable fuels, and not only even the combustion is perfect, according to thermodynamic concepts. Secondary pollutants, by contrast, are modified to a hazardous form after they enter the air or are formed by chemical reactions as components of the air mix and interactive. Fugitive emissions are those that do not go through a smokestack. By far the most massive example of this category is dust from soil erosion, strip mining, rock crushing, and building construction (and destruction). Fugitive industrial emissions are also an important source of air pollution.

2. Present state of art

2.1 Significance of the locations and sampling

When carrying out air quality measurements it is important to define the problem precisely (measuring plan) and to choose accordingly the site locations, measuring stations and methods. Applying the most expensive measuring instrument is of no use if, e.g., the pollutant to be investigated is influenced during its sampling to such a degree that it either cannot reach the measuring instrument at all or not in its original state. When measuring pollutant gases in the air a difference between mobile measurements and stationary measurements stations is necessary. Mobile stations (laboratories) are measuring at random and changing locations, according to a plan, to determine the spatial distribution of the air pollutants, whereas stationary measurements continuously record the temporal distribution in few fixed points of a certain area. Stationary measurements must be carried out at representative points of the investigated area. It is recommended to know the spatial distribution of the ambient air pollutants which might be determined only with mobile measurements at the corner points of a 1 x 1 km grid over the area to be investigated (Erste allg., 1986). Special guidelines have been drawn up so that the site locations for automatic measuring stations are chosen according to standardized criteria. Selection of the right sampling site can be of great importance for stationary as well as for mobile measurements. Guidelines have been drawn up so that in the measuring networks the site locations for automatic measuring stations are chosen according to standardized criteria. These guidelines are very important especially when planning on line in real time air quality measuring networks, i.e., when data are continuously transferred to a central station (RdSchr, 1983). Thus, selecting the site locations for ambient air quality measuring stations means to respect important guidelines in order to meet the general goal that the ambient air meaning that sample is representative of the area (Immissionsmessnetze in der
well the alert values. Thus, one controls both the emissions and the air quality, that represents mostly, decided to introduce specific regulations at testing the maximum admitted values as in international co-operation share the disadvantages and cleanup costs of pollution generating activities, although often it is not difficult to see that all of us are either directly or indirectly polluters and all of us comfort and industrial development, being influenced by the number of population, as well. As main sources for the pollution of air one recognizes:

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2. Present state of art

According to national standards and general international methods the main pollutants to be measured are: NO, (NO, NO\textsubscript{2}), CO, SO\textsubscript{2}, PM10, O\textsubscript{3}, TOC (Total organic carbon) respectively VOC (Volatile organic compounds).

Fig. 1 shows a scheme of a set-up of such a measuring station. The measuring gas suction hoods and different meteorological measuring instruments are installed on a 10 m high altitude. The management and working methods are respecting the international standards SR EN ISO/CEI 17025:2005 (General features and competences), according to the fundamentals and definitions imposed by SR EN ISO 9000:2006. In addition to the instruments for the specific measurement of pollutants there are numerous other instruments for the recording of meteorological parameters such as wind direction and wind
speed, temperatures, global radiation, duration of rain and bedewing, amount of rain etc., as well as an electronic controlled computer, to record, calculate and memorise the values. The computer also controls the valve timing and correctly stores the measured values according to the given valve position. Half-hourly mean values (or other mean values) are calculated and are stored in the memory or/and printed out. Further evaluation of the data is then carried out on a larger computing system. Some measuring stations work with direct data transmission to a central computing station. For reasons of safety the measured values are additionally recorded by multi-channel continuous-line recorders or multipoint recorders independently of the computer controlled measured value recording system. If the computer breaks down these recorder graphs can be evaluated if necessary.

![Set-up of the sampling system of an air quality station with air suction through tubes](image)

**Fig. 1.** Set-up of the sampling system of an air quality station with air suction through tubes and with calibration gas switching (www.mediu.ro).

In the example (Fig. 1.) also an optic open path device is included; this is an option not compulsory, for supplementary measuring possibilities, according non standardised methods. Monitors for NO₃ detection from ambient air, based on the chemiluminescence’s principle, according ISO 7996/1985; Monitor for the SO₂ ambient air concentration, working in UV by applying the fluorescence method, according ISO/FDIS 10498, instruments for CO detection applying ND spectroscopy in IR, according ISO 4224, Sampling analyser LVS3 for the PM10 specie, based on the filtration and mass determination of a specific suspension by
means of gravimetric principles, according EN 12341 are the basic standard main components. Mostly available are also an O₃ measuring devices applying as measurement principle the UV photometry, according reference method: EN 14625:2005, and CH₄, NMHC and THC instruments using the measurement principle of FID (flame ionization detection), reference method EN 12619:2002.

Calibration and adjusting are of major importance for the correctness of the measurements. Adjusting means setting or trimming a measuring instrument as accurately as possible, while calibrating signifies determining the deviation measured as compared to the accurate value or the value considered as such (DIN 1319, 1985). In air pollution measurements calibration conditions are set up with the help of calibration (ready made by special companies) gas mixtures. These are gas or gas mixtures having a composition predetermined with sufficient certainty by measuring basic parameters such as mass, volume, time, amount of substance (molar number) by applying independent analysis methods (Hartkamp et al., 1983). During calibration the calibration gas are entered into the measuring setup (measuring instrument), the values indicated are read and compared with the values of the calibration gases assumed correct, then the deviations are recorded. Frequently, calibrating a measuring instrument is accompanied by other measures such as maintenance, function control, trimming and others.

According (Hartkamp et al., 1983) the total of all calibration processes consists either of basic calibration, or routine calibration, and control calibration. The basic calibration provides the fundamental relationship between given calibration gas concentrations and recorded signals, and is called calibration function. In many instruments linear calibration functions are indicated. Routine and control calibrations ensure the validity of the calibration data of the basic calibration. This control verifies whether the data obtained by the basic calibration carried out last are still valid. The results of routine and control calibrations are yes-no-decisions. The principle of calibration gas production is based on the procedure of adding a known amount of the gas of interest to a known volume or volume flow of carrier gas (mostly N₂ or air) in certain amount. The most convenient way of calibrating is with commercially available calibration gases in pressure gas cylinders (produced with static methods).

Basically, the instruments are connected to a common sample line and the measurements are taking place in the same time and for the same spot for all species. Because of the instruments high precision and accuracy the station must be equipped with calibration gases with a minimum of ± 1% uncertainty. The numeric values provided be instruments are collected by an PC data acquisition system and stored continuously for interpretation. The station indoor environment must be controlled in order to maintain a constant temperature for instruments.

The data acquisition system of the station is automatic and the data are stored in an ASCI file type format. The operator is using the data mainly to perform graphics for each pollutant and to compare their concentration with law regulated concentrations.

2.2 Physical and Chemical Measuring Principles

For the physical measuring methods a specific physical property of the pollutant is made use of as quantity to be measured. The air sample does not change materially during its measurement. Specific physical properties of the substances to be investigated are applied to which other components of the sample do not contribute. In chemical measuring methods the quantity to be
measured is transformed into a condition with characteristic; measurable properties by a chemical reaction; during this chemical reaction the measured quantity changes. Measuring processes based on a physical principle can generally be automated better for continuous processes, chemical methods usually being suitable for discontinuous measurements. Chemo-physical measuring principles are also applied. An essential principle which is primarily applied in the continuous measurement of gaseous pollutants is the excitation of molecules by adding energy. Excitation can be caused by exposure to radiation in different wavelengths, by generating high temperatures, e.g., via combustion, or by chemical reactions. Either the energy used for excitation or the energy released in another form is exploited for measurement. There are still further methods of excitation, e.g., excitation by electric, magnetic or nuclear forces. Methods of this type can be used for laboratory analyses of air pollutant samples collected. They are used less frequently, however, for direct measuring.

Passive sampling methods provide reliable, cost-effective air quality analysis, which gives a good indication of average pollution concentrations over a period of weeks or months. Passive samplers are so-called because the device does not involve any pumping. Instead the flow of air is controlled by a physical process, such as diffusion. Active sampling methods use physical or chemical methods to collect polluted air, and analysis is carried out later in the laboratory. Typically, a known volume of air is pumped through a collector (such as a filter, or a chemical solution) for a known period of time. The collector is later removed for analysis.

2.3 Units
A number of different units are used in expressing the concentrations of various species in the atmosphere (Ionel, 2000).

For gas phase species, the most commonly used units are parts per million (ppm), parts per hundred million (pphm), parts per billion (ppb), and parts per trillion (ppt). These units express the number of molecules of pollutant found in a million (10⁶), a hundred million (10⁷), a billion (an American billion is 10⁹, an British billion is 10¹²) or a trillion (10¹⁵) molecules of air, respectively (Finlayson-Pitts & Pitts, 1986).

Alternatively because numbers of molecules (or moles) are proportional to their volumes according to the ideal gas law (pV = nRT, where p – pressure in Pa, V - volume in m³, n - mass in kg, R is the gas constant expressed in J/(kg K), T - temperature in K), one uses also the mass concentration. The conversion is carried out as follows:

\[
\rho = \frac{1 \text{mg/m}^3 = 1 \text{cm}^3/m^3 \cdot \rho = 1 \cdot \frac{\text{cm}^3}{\text{m}^3 \text{air} \cdot \text{cm}^3 \cdot \text{pollutant}}}{\text{mass concentration}}
\]

\[
\rho = \frac{\text{gas density}}{\text{kg/m}^3}
\]

\[
\rho = \frac{\text{molar mass}}{\text{kg/m}^3 \text{ or g/l or mg/cm}^3}
\]

\[
\rho = \frac{\text{molar mass}}{22.4} \text{kg/m}^3 \text{ or mg/cm}^3 \text{ (at 0°C, 1,013 mbar)}
\]

\[
\rho = \frac{\text{molar mass}}{24} \text{kg/m}^3 \text{ or mg/cm}^3 \text{ (at 20°C, 1,013 mbar)}
\]

3.1 Photometry

Photometry uses the absorption of infrared (IR), visible (VIS) or ultraviolet (UV) radiation by the gases as measuring effect. Wave length ranges are: IR (1,000 - 10,000 nm), VIS (400 - 800 nm), UV (approx. 200 - 400 nm). In the visible and UV electrons are excited by radiation, in the IR range predominantly molecule vibrations but also rotations are activated. During this, the gases absorb energy in certain wave length ranges (absorption bands). The loss of radiation intensity caused by this is consequently measured.

Fig. 2 shows the principle of a photometer that consists of a radiation source (lamp), having a focused beam of light falling through a cell on a radiation detector. The latter transforms the beam into an electric signal of proportional intensity. The loss of radiation intensity due to the absorption of the measuring gas is - when frame conditions are constant - a measure for its concentration.

The interrelationships of radiation absorption are described by the Lambert-Beer law:

\[ I = I_0 \cdot e^{-\varepsilon \cdot C \cdot l} \]  \hspace{1cm} (1)

\[ \frac{I}{I_0} = T = \frac{1}{E} \]  \hspace{1cm} (2)

\[ E = \ln \left( \frac{I_0}{I} \right) = \varepsilon \cdot C \cdot l \]  \hspace{1cm} (3)

where \( I_0 \) is the intensity of entering radiation (intensity of light for the reference), \( I \) the intensity of exiting radiation (intensity of light for the sample), \( T \) stands for the transmission, \( \varepsilon \) for the extinction coefficient (dependent on wave-length), \( C \) for the concentration of gas or pollutant, \( l \) for optical path-length of the cell measurement, \( E \) for extinction (non-dimensional) of the absorbing substance inverse logarithm of the transmission \( T \).

Most IR photometers function as so-called non-dispersive instruments (NDIR), i.e., radiation is emitted in the entire IR range. There is no spectral splitting of the IR radiation emitted by the radiation source. Selectivity is achieved by installing a radiation detector filled with the component to be measured. This type of detector is possible only in the IR range, as the lifespan of the molecules excited by IR radiation is so long that the excitation energy can be released via molecule collisions as thermal energy.
Extinction $E$ as a measure of the radiation absorption of a gas (or also of a liquid) is thus dependent on the properties of the gas (extinction coefficient epsilon), on the concentration $c$ and on the optical path-length $l$ which the beam of light must pass through. If ambient conditions are constant, $e$ for a gas is constant. If $l$ is also kept constant, then extinction $E$ is directly dependent on the concentration of the gas to be measured.

In practice it is not sufficient to form the logarithm of the ratio of intensity $I_0$ in and intensity $I_0$ out and to thus determine extinction $E$. Even without the presence of the component to be measured the instruments absorb radiation, e.g., via optical windows and the gases to be investigated. Thus, even without the presence of the component to be measured, radiation in is not equal to radiation $I_0$ out. This blank absorption must generally be determined experimentally.

NDIR instruments are primarily used for emission measurements; analyzers are mainly suitable for the determination of the gases CO, CO$_2$, NO, SO$_2$, H$_2$O, CH$_4$, C$_2$H$_4$, and many other hydrocarbons. For CO and CO$_2$, NDIR photometry is the most commonly used measuring technique, which is also unrivalled in its application for the measurement of these gases in the ambient air range.

As shown in the Fig. 3, the instruments for CO measurements uses the modulation effect that occurs with infrared absorption of sample gas itself when sample gas and zero gas are alternately sent to its cell at a certain flow rate using a solenoid valve which is actuated at a frequency of 1 Hz. Unless the gas concentration of the measured component is changed in the cell, the output from the detector essentially becomes zero, therefore, the zero drift dose not occur. Since the instrument also uses the AS-type detector, extremely high-accuracy results are obtained without any effect of the interference component.

The radiation source is an infrared radiation emitter. The radiation - modulated by a chopper - passes a chamber containing the probe and in parallels a chamber containing a reference gas. To reduce the influence of interfering gases optical filters are used. The content of the measurement cell receives periodically infrared radiation with different strength, which results in different temperature and pressure effects. The pressure effects are hence transferred to electrical signals by a sensor, and this signal correlates to the measured CO concentration. Some systems use the pressure waves for detection, while others use directly the IR receiving an optical detector to measure the CO concentration.
In practice it is not sufficient to form the logarithm of the ratio of intensity $I_{in}$, and on the optical path-length $l$ which the beam of light must pass through. If ambient dependent on the properties of the gas (extinction coefficient $\varepsilon$), on the concentration $c$. Extinction $E$ as a measure of the radiation absorption of a gas (or also of a liquid) is thus measured in the cell, the output from the detector essentially becomes zero, therefore, the zero drift dose alternately sent to its cell at a certain flow rate using a solenoid valve which is actuated at a certain time. Thus, even without the presence of the component to be measured, radiation measured the instruments absorb radiation, e.g., via optical windows and the gases to be measured. As shown in the Fig. 3, the instruments for CO measurements uses the modulation effect that occurs with infrared absorption of sample gas itself when sample gas and zero gas are alternately setting the chopper wheel to a position where all radiation (hot and cold emission lines) is passed through and to a position with a gas filter.

An UV absorption photometer for NO was developed as shown schematically in Fig. 4 (Hartmann & Braun, 1982), (FVLR, 1979). In a hollow cathode lamp filled with nitrogen and oxygen at reduced pressure, excited NO molecules are formed in an electrical discharge. The energy of the excited molecules is dissipated by emission of characteristic luminescence radiation. The source of radiation is selective; it produces an emission range which corresponds precisely to the absorption range of NO in the measuring cell. This is called resonance absorption. One peculiarity of the radiation excited by electrical discharge is that two groups of NO-specific lines are emitted, i.e.: (i) "cold" emission lines - this is the group absorbed by the NO to be determined in the measuring cell (measuring radiation), (ii) "hot" emission lines - that group of radiation showing lines in the neighboring range and meeting the detector not influenced by NO (reference radiation). The radiation is modulated by a chopper wheel and passed through the measuring cell via a condensing lens. It reaches the radiation detector, a photomultiplier, via an interference filter where interfering radiation is removed. If NO is present in the measuring cell, then the radiation is reduced by resonance absorption (extinction $E_0$) according to the Lambert-Beer law. For this measuring technique the blank value of extinction $E_0$ is compensated for by alternately setting the chopper wheel to a position where all radiation (hot and cold emission lines) is passed through and to a position with a gas filter.
Fig. 4. Diagram of a UV gas analyzer for the detection of NO with blind value compensation by wavelength comparison (FVLR, 1979).

The gas filter contains NO in high concentrations which completely absorbs the cold emission lines. The hot emission lines, however, which are in the immediate neighborhood range, pass through it as reference radiation. Just like the measuring radiation they are influenced by the in-line optics, by the cell windows but mainly by the wide-banded interfering components to produce the intensity reference value $I_0$ at the photomultiplier.

Fig. 5 presents an ozone instrument that performs a dry analysis of ozone, on continuous basis.

Fig. 5. O$_3$ monitoring device schematic (Horiba, User manual) 1 - Sample intake, 2 - Three way valve, 3 - Ozone generator (internal calibration), 4 - Measurement cell, 5 - Hg-Low pressure lamp, Mirror, 6 - Interference filter, 7 - Photo multiplier, 8 - Quartz - triple prisms, 9 - Amplifier, 10 - Display, 11 - Exit gas sample, 12 - Charcoal, 13 - Excess air exit.

The reference method for SO$_2$ measurements is the ultraviolet fluorescent method (UVF).
Fig. 15 shows the carbon monoxide CO recorded values, measured with 3 different instruments: two reference NDIR point measurement instruments and one DOAS-IR Siemens-Hawk instrument. The different methods used for CO measurements have given same result; the high concentration recorded values and background concentration values are similar for point and open path instruments. The CO-INOE measurements are in the same trend but the measured values are with \(~ 0.4 \text{ mg/m}^3\) lower than the other instruments. This could be caused by an error in span gas calibration. On top of the figure 2 are drafted the departures and arrivals of national/regional, international and charters corroborated with the carbon monoxide measured values. The dependency between aircraft traffic on the apron and the CO measured values is visible in figure 2, the higher values for CO have only been recorded during the departure or landing of the aircrafts. This result is important because it demonstrates that the selected placement of the mobile air laboratories near the airport facilities and apron is ideal for depicting the air quality and the measured values can be considered representatives for the airport facilities surroundings. The measured values for carbon monoxide are much lower than the 10 mg/m³ limit value, regulated by 2000/69/EC Directive. The measured values were normal because the airport location is far-off from the city or any main road and the only CO source is represented by the aircrafts. Fig. 16 shows the mean measured values of sulfur dioxide SO₂ measured by two instruments.
The SO$_2$ concentration in air is continuously measured and recorded (one value every second) and mediated every 3 minutes. Because the SO$_2$ - INOE instrument has given high variations (in short term intervals) two 4$^{th}$ degrees polynomial trend lines are added to the graph, one for the recorded values of each instrument. The correlation between the instruments is acceptable, just differences of about 5 µg/m$^3$N are recorded, differences that can be considered equivalent within the measurement uncertainty.

The recorded values for SO$_2$ are not higher then the 350 µg/m$^3$N limit value regulated by 1999/30/EC Directive but they are about 10 times higher then the background values (7 µg/m$^3$N). The 3 minutes mean value have been used for an easy observation of the influence of airplanes traffic on pollutants concentration, that is the main purpose of this study. The SO$_2$ concentrations below 150 µg/m$^3$ have only moderate (and reversible) irritant effect on human respiratory system, but in synergy with NO$_x$ and high air humidity can cause permanent pulmonary impairment (according to CCOHS - Canadian Centre for Occupational Health and Safety). The only possible source responsible for the SO$_2$ high values is the airplane fuel because there are no other possible emission sources of SO$_2$ in the airport vicinity (no main road traffic or industrial areas). The ground support vehicles are limited in number (5 busses and 2 passenger cars) and their contribution to airport emissions is insignificant (Ionel et al., 2010).
Fig. 17 shows the measured values for nitrogen dioxide NO\textsubscript{2}, with two identical instruments. The correlation between the instruments is good, polynomial trend lines have been added for better resolution. The recorded values are similar for both instruments and higher than the 200 \( \mu g/m^3 \) limit value regulated by 1999/30/EC Directive. Because the highest measured values are overlapping airplane traffic on apron it is clear that the only possibility to reduce NO\textsubscript{2} concentration is to manage more efficient airplane taxiing procedures.

Figure 18 shows the measured values for methane CH\textsubscript{4}, non-methane hydrocarbon NMHC (VOC) and total hydrocarbon THC, with one FID (flame ionization detection) instrument. The recorded values for methane are higher than the global background (1.7 ppm) with only 0.4 ppm. The values recorded for volatile organic compounds are up to 3 mg/m\textsuperscript{3} in periods with high airplane traffic. These values are representing a serious concern for the passenger health, knowing that some on these volatile compounds (like benzene) are causing cancer (www.epa.gov/). VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects. Key signs or symptoms associated with exposure to VOCs include conjunctival irritation, nose and throat discomfort, headache, allergic skin reaction, dyspnea, declines in serum cholinesterase levels, nausea, emesis, epistaxis, fatigue, dizziness. As with other pollutants, the extent and nature of the health effect will depend on many factors including level of exposure and length of time exposed. The measured values for VOCs are up to 3 mg/m\textsuperscript{3} (3000 \( \mu g/m^3 \)). These values emerge not only during airplanes departure or arrivals, but mostly when the airplanes are fueled.
Fig. 17. NO\textsubscript{2} measurements and polynomial (4 degree) trend lines.

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The most relevant values recorded with INOE DOAS instrument are presented in figures 19 to 22. Very high values have been recorded for acrolein and tert-butyl. Also significant values were recorded for benzen, toluen, benaldehyde, O-cresol, O-xylen, (2, 5) - dimethyl, and also for P-tolylaldehyde.

Fig. 18. CH\textsubscript{4}, NMHC (VOC) and THC measurements, 3 minutes mean value.

Fig. 19. DOAS measurements. Several species for the episode 25.06.2008, 3 minutes mean value.
Fig. 20. DOAS measurements of several species for the episode 25.06.2008, 3 minutes mean value.

Fig. 21. DOAS measurements of several species for the episode 26.06.2008, 3 minutes mean value.

It is well known that acrolein may be released to the environment in emissions and effluents from its manufacturing and use facilities, in emissions from combustion processes (including cigarette smoking and combustion of petro chemical fuels), from direct application to water and waste water as a slimicide and aquatic herbicide, as a photooxidation product of various hydrocarbon pollutants found in air (including propylene and 1,3-butadiene), and from land disposal of some organic waste materials. Acrolein is a reactive compound and is unstable in the environment (Popescu, 2009). In ambient air, the primary removal mechanism for acrolein is predicted to be reaction with photochemically generated hydroxyl radicals (half-life, 15–20 hours). Products of this reaction include carbon monoxide, formaldehyde, and glycolaldehyde. In the presence of nitrogen oxides, eroxynitrate and nitric acid are also formed. Small amounts of acrolein may also be removed from the atmosphere in precipitation. Insufficient data are available to predict the fate of acrolein in indoor air (Nicolae et al., 2007). But experimental data indicate that reaction of acrolein with ozone in specific conditions ($k = 2.8 \times 10^{-19} \text{ cm}^3/\text{molecules-s}^{-1}$ at 25 °C; half-life, 59 days) or nitrate radicals ($k = 5.9 \pm 2.8 \times 10^{-16} \text{ cm}^3/\text{molecules-s}^{-1}$ at 25 °C; half-life, 16 days) in the troposphere would be too slow to be environmentally significant (Nicolae & Cristescu, 2006), (Wang et al., 2009), (Ionel et al., 2010).

The second range of examples is comparisons between urban episodes from two EU cities, one in Romania (Timisoara - TM), one in Austria (Graz - GdB).

When considering carbon monoxide (CO) the maximum hourly mean value shows differences in the order of five to ten (Fig. 23). As Graz don Bosco is already the traffic hot spot of Graz the main reason of this difference can only be found in the difference of the technical standards of the vehicle fleet. The Austrian vehicle fleet consists of gasoline vehicles with three way catalytic converters and of diesel cars. Both groups have very small
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The second range of examples is comparisons between urban episodes from two EU cities, one in Romania (Timisoara - TM), one in Austria (Graz - GdB).

When considering carbon monoxide (CO) the maximum hourly mean value shows differences in the order of five to ten (Fig. 23). As Graz don Bosco is already the traffic hot spot of Graz the main reason of this difference can only be found in the difference of the technical standards of the vehicle fleet. The Austrian vehicle fleet consists of gasoline vehicles with three way catalytic converters and of diesel cars. Both groups have very small
CO concentrations. This is not the case for the vehicle fleet of Timisoara. Cars and domestic heating contribute strongly to the high CO level. Figure 24 depicts the NO, NO$_2$ and SO$_2$ concentrations; again the maximum hourly value is shown. NO and NO$_2$ are in most – but not all – cases in Timisoara higher than in Graz don Bosco. A clear picture is given only for SO$_2$ – which is a tracer for emissions from industry and private households. In Graz there is almost no SO$_2$ concentration measured, whereas Timisoara shows levels up to 50 µg/m$^3$, but well below the threshold of 200 µg/m$^3$.

**Fig. 23.** Comparative CO one hour mean values.

**Fig. 24.** Comparative NO, NO$_2$, SO$_2$ one hour mean values.
The comparison between AQ online monitoring data in two European cities (even no megacities) proofs that despite the fact that the same EU legislation and monitoring methods are applied, the results are quite different. Finally new results taken by the LIDAR system of the RADO (Romanian Atmospheric 3D research Observatory Project) consortium project in Romania are presented by Fig. 25. Thus the Range Corrected Signal from April 22-th, 2010, evening, is presented, indicating that the volcanic cloud is observed already starting from 3 km high, with an ascendant tendency, and that at 4.5 km approximately the clouds are formed. Combining LIDAR observations with in situ measurements and models is a strong complementary support for monitoring of different atmospheric parameters over various space-time scales, promoting the remote-sensing approaches in environmental applications. The Romanian Atmospheric research 3D Observatory (RADO) is an ambitious facility that aims to improve modelling of physical, chemical, and biological processes, to assess the effects of climate change, and to quantify and reduce uncertainties in evaluating the hydrological cycle and its influence on natural resources. Over the last five years, environmental research has focused increasingly on remote sensing of the atmosphere. The station is able to monitor a number of atmospheric parameters, including trace gases and aerosols, as well as meteorological ones. Microwave spectroscopy and mass spectrometry are the latest techniques to be implemented at this site.

Fig. 25. Range corrected signal from April 22-th, 2010, evening, presenting the Cloud and volcanic layer formation (http://inoe.inoe.ro/RADO).

6. Conclusion

Air pollution is a global environmental problem that represents a measure of the potential of the climate change rate influenced by local pollution sources, although its scale has a strong regional or local orientation. Improvements in technology supported by policy measures have lead to reduced pollution levels, but still, especially in new member states, more activity is needed. In developed countries advanced low pollution technique is applied in order to reduce the pollution levels However, in developing countries the relatively high economic growth rates increase the incomes but also the global (regional or local) pollution level, and hence contribute as long range transported pollution to air quality problems in regions far away. Reaching the stringent AQ levels remains to be the challenge for all...
countries and especially for urban areas. This calls for an intensive cooperation between all cities, in developed or developing countries, in terms of research collaboration, technology transfer, knowledge exchange and dissemination. There are many ways to measure air pollution, basic they are referring either to standard methods or to acceptable one, with both simple chemical and physical methods and with more sophisticated electronic techniques, in addition to modelling possibilities, according special tailored programs, according emission factors and pollutant inventory, for real or probable meteorological conditions (Ionel, & Popescu, 2009), (Varga et al., 2010). Automatic methods produce high-resolution measurements of hourly pollutant concentrations or better, at a single point. Pollutants analyzed include ozone, nitrogen oxides, sulphur dioxide, carbon monoxide and particulates. The samples are analyzed using a variety of methods including spectroscopy. The sample, once analyzed is downloaded in real-time, providing very accurate information. Remote optical, long path analyzers use spectroscopic techniques, make real-time measurements of the concentrations of a range of pollutants.

7. References


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Air pollution is about five decades or so old field and continues to be a global concern. Therefore, the governments around the world are involved in managing air quality in their countries for the welfare of their citizens. The management of air pollution involves understanding air pollution sources, monitoring of contaminants, modeling air quality, performing laboratory experiments, the use of satellite images for quantifying air quality levels, indoor air pollution, and elimination of contaminants through control. Research activities are being performed on every aspect of air pollution throughout the world, in order to respond to public concerns. The book is grouped in five different sections. Some topics are more detailed than others. The readers should be aware that multi-authored books have difficulty maintaining consistency. A reader will find, however, that each chapter is intellectually stimulating. Our goal was to provide current information and present a reasonable analysis of air quality data compiled by knowledgeable professionals in the field of air pollution.

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