Ambient air pollution assessment

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Air quality research and monitoring had gained attention primarily due to negative impacts of airborne pollutants on human health, yet recently ecosystem health has been taken into consideration as well. Various air sampling methods applied at mostly automated monitoring stations belong to the standard tools of air quality monitoring. Such measurements are usually located within larger urban areas and industrial zones, while rural areas remain widely neglected as prevailingly clean and safe from any harmful pollution (Kotlík et al., 2005), with only a limited number of the pollution background measurement spots. However, certain areas in the rural landscape may experience air pollution levels comparable to cities, mainly because of unfavourable terrain features of settlements and communications. This applies in particular to deeper valleys where local conditions allow for frequent inversions and inhibited mixing of emissions into the ambient air. Although the Bystřice River valley represents a nominaly rural area, its bottom contains significant air pollution sources: households using coal, wood and natural gas for local heating, a railway using diesel-fueled engines, road traffic, stone quarries and also larger industrial plants: the foundry of Foundeik s. r. o. and household appliances factory of Mora Moravia s. r. o., both located in Hlubočky-Mariánské Údolí, as well as a plastic products company Granitol a. s. in Moravský Beroun.

Temperature stratification characteristics

Temperature inversions in the Bystřice River valley have been recently studied by Vysoudil (see this volume, pages 47-50). An overall longer-term statistics of temperature inversions in the valley cannot be derived from direct measurements due to lack of meteorological stations in the natural park area. Nevertheless, differences in temperatures recorded at stations in Olomouc (49°34′ N, 17°15′ E, 225 m a. s. l.) and Červená (49°47′ N, 17°33′ E, 749 m a. s. l.) can be analysed to obtain a rather general description of the (pseudo)vertical temperature profile characteristics for the natural park area. Coufal (1973) defined three basic types of temperature stratification in the atmospheric boundary layer: (1) *very stabile* with vertical temperature gradient of up to 0.3°C/100 m; (2) *neutral* with vertical temperature gradient between 0.4° to 0.8°C/100 m; (3) *labile* with vertical temperature gradient of at least 0.9°C/100 m. Daily temperature records (at 07, 14, 21 CET) from Olomouc and Červená were analysed for the period 1981-2000 with the following results: the maximal occurrence of very stabile boundary layer stratification occurred in January (34.7% of all time possible) and December (30.5%), while in the summer months (June-August) its occurrence decreased to 15.1-16.5% and in fact reduced to short night episodes. The labile stratification reached maximum in occurrence during the spring months of April (34.8%) and May (32.5%), while in the winter months (December-February) it occurred in only 14.3-14.7% of all time possible. A further analysis of temperature stratification occurrence during individual meteorological situations (Typizace povětrnostních situací pro ČR, 1946-2005) showed that the very stabile stratification occurred most frequently with south-western anticyclonic situation (58.8% of all time possible), followed by the situation of an anticyclone above Central Europe (47.5%) and by the south anticyclonic situation (46.8%), while it occurred only at limited frequency with the norh-eastern cyclonic situation (8.9%), eastern cyclonic situation (9.1%) and north-western cyclonic situation (9.6%). On the contrary, the labile temperature stratification occurred most frequently during the eastern cyclonic situation (48.3%) and north-eastern anticyclonic situation (44.7%) but only rarely during the south anticyclonic and south-western anticyclonic situations (both 5.7%).

Emission inventory analysis

Pollution prevention is considered to be the most powerful tool of air quality management. As part of the legal-administrative process of controlling the amount of pollutants released into the atmosphere, regular emission inventories have been carried out in the Czech Republic (and former Czechoslovakia) since the 1980s. Air pollution sources are classified into four distinct categories: REZZO 1 – large pollution sources (mainly industrial plants); REZZO 2 – medium pollution sources (smaller industrial and public service sources), REZZO 3 – small pollution sources (local heating); REZZO 4 – mobile pollution sources (mainly traffic). The REZZO 1 inventory has been collected annually since 1982 and represents the most accurate dataset of the four categories (REZZO 2-4 have been updated less frequently and carried out as estimates based on proxy data, such as fuel distribution statistics and public censuses). Combined with detailed meteorological and terrain data, emission inventories can be used in modelling spatial dispersion of pollutants (the current standard model used in the Czech Republic is SYMOS ’97). A less detailed, yet sufficiently informative tool on spatial distribution of the sources of air pollution is producing grid maps of emission densities.

In order to assess the longer-term development of industrial emissions in the district of Olomouc, grid maps (resolution 2 km × 2 km) of average annual emission densities from industrial air pollution sources (REZZO 1) were produced for particulate matter (PM), sulphur dioxide (SO_2) and nitrogen oxides (NO_x) for the decades of 1981-1990 and 1991-2000. Figure 1 shows the difference in the emission amounts for particulate matter. Five major spatial clusters of pollution sources can be identified, representing areas of Olomouc, Šternberk, Uničov, Litovel, and Hlubočky. The last one, even though not being an urban area, shows significant industrial activity. Despite a pronounced decrease in the emission amounts, the area of the natural park remained influenced by industrial air pollution towards the end of the 1990s, both by the industrial production in the southern part of the natural park area and by the sources located in the city of Olomouc.

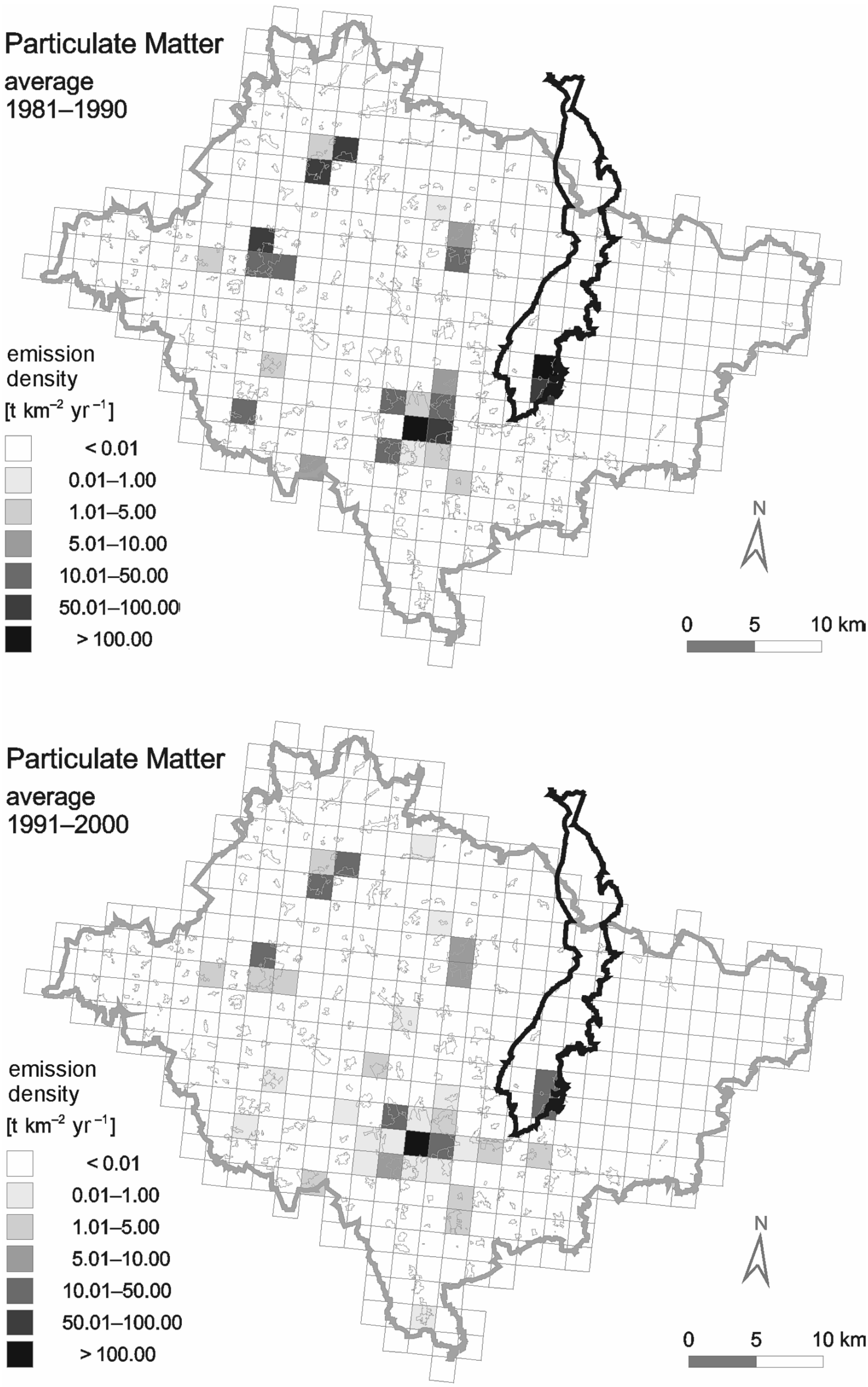

Figure 1 Average annual emission densities of particulate matter from industrial sources in the district of Olomouc.

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