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BAB II: Evaluation of the Accuracy of Emission Data for a Motorway

Starting position

As the reduction of air pollution is an political aim, model calculations are used to estimate the future load of the atmosphere by emissions. Based on this results environmental decisions are made. Therefore it is necessary to evaluate the precision of the emission data.

Objectives

The topics of BAB II (**B**undes**a**uto**b**ahn) initiated by Institut für Meteorologie und Klimaforschung and partly financed by the Umweltbundesamt (UBA) are:

- **measuring real world road traffic emissions,**
- **executing a corresponding traffic census,**
- **calculating emissions using an emission model and**
- **evaluating the model results by measurements.**

11 groups from universities, research centres and from industry participate in the program.

Method

The equation for the roademissions is:

$$Q_i = \int_0^h v(x_2,z)\cdot c_i(x_2,z)\,dz - \int_0^h v(x_1,z)\cdot c_i(x_1,z)\,dz$$

Q_i and c_i are the source intensity and the concentration of the component *I*, *h* is the height of the plume at the leeside distance x_2 from the road and *v* is the wind speed perpendicular to the motorway. The location x_1 is windward of the motorway. If the assumptions

- **no deposition and chemical transformation,**
- **negligible turbulent flow and**
- **homogenous and stationary conditions**

are made it is possible to solve the equation by measuring $v(x,z)$ and $c_i(x,z)$.

Realization

The field phase took place in May 2001. The site was an agriculturally used flat terrain along a motorway near Heidelberg. North and south of the motorway NO, NO_2, O_3, CO, CO_2 and VOC data where collected at different distances (Fig. 1). On each side at a 52 m high tower, profiles of NO, NO_2, O_3, CO, CO_2, VOCs and particulate matter were measured. Additional information about the vertical distribution of NO, NO_2, CO_2 and leeward particles were provided by using elevators at the towers.

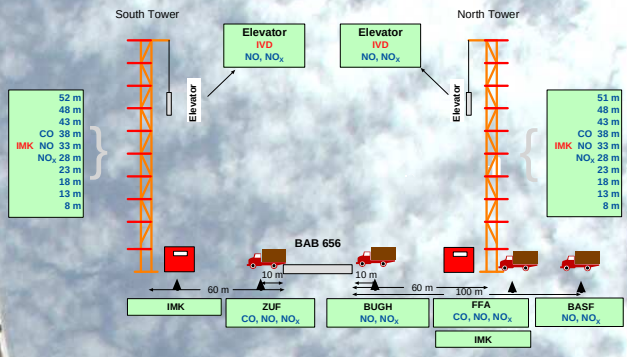

Fig. 1: Sketch of the measurement site perpendicular to the motorway A 656, shown for NO, NO_x and CO.

Results

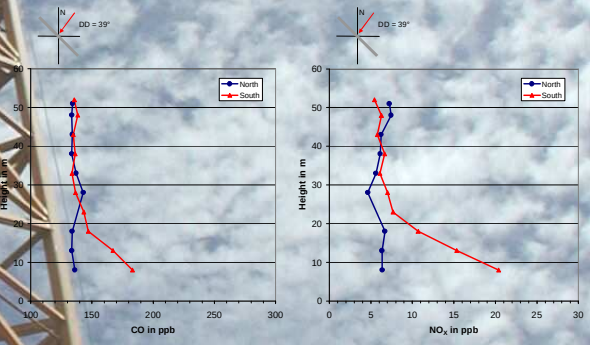

Fig. 2: Mean CO and NO_x profiles on May 11, 2001 between 11:00 and 18:00 CEST. The flow is from northeast (39°). Dots indicate windward side, triangles leeward measurements.

Figure 2 shows examples of mean vertical trace gas profiles at both side of the motorway. The wind direction was northeast, perpendicular to the highway (red arrow). In this case the plume originating from the traffic emissions of CO and NO_x is to be found south of the motorway. The plume is roughly 25 m to 30 m high. The difference between windward and lee values in the lowest level (8 m) is on average 50 ppb for CO and 15 ppb for NO_x. Using this measurements it is possible to calculate the source intensities for CO and NO_x and to compare them with the results of an emission calculation miodel usimng the data derived from the detailed traffic census done by IER, Universität Stuttgart.