Contribution of Petroula Louka to the TRAPOS WG-TPT meeting in Cambridge, 25.02.2000:

The study of the traffic produced turbulence by the ECN group is based on a recent field experimental campaign and on numerical modelling.

Field experiment

An experimental campaign in the framework of URBCAP took place during June 99 in a typical street canyon (H/W=1.4) in Nantes. The aim of the experiment was to assess the effects of wind speed and direction, vehicles and different heating of the street walls on the developing mean flow and turbulence within the street and consequently on the dispersion of vehicular exhausts. Measurements of mean wind speed and turbulence, air temperature, and CO concentration were taken at three different levels at both sides of the street as well as at a reference height above the roof. In some cases measurements of air temperature and CO concentration are also available across the canyon at middle height. Traffic was measured by vehicle counters within the street and in lateral streets. The mean velocity of the vehicles is also available close to the measuring section.

Due to the North-South orientation of the street, apart from pure mechanical effects (wind flow and traffic), there is also thermal influence on the mean flow and turbulence within the street through the different heating of the walls. As it is impossible to separate these effects it is anticipated that all three effects (wind flow, traffic and heating) will be apparent in the data. Therefore, the only possible way to study the sensitivity of the turbulence in the canyon specifically due to traffic is to chose measuring days with the least thermal effects and wind perpendicular to the street.

1-hour periods from two days with similar traffic intensity and low wind perpendicular to the street and with the least (25/6) and more pronounced (22/6) thermal effects were chosen. Results relating production of turbulent kinetic energy at the different heights in the street with traffic as well as traffic and CO concentration will be shown.

Numerical modelling.

Numerical modelling of the traffic produced turbulence in a 2-D street canyon has been performed in the past using the code CHENSI developed by the ECN group. The effect of the traffic on turbulence in the code is represented as an additional term in the turbulent kinetic energy (TKE) and dissipation equations. In the TKE equation $P_{car} = C_{car} V_{car}^2 Q_{car}$ where V_{car} is the mean velocity of the cars, Q_{car} is the number of vehicles per hour per lane and the coefficient C_{car} was fixed to C_{car}=0.0015 based on wind tunnel experiments (Kastner-Klein et al., 1999).

Comparison between normalised model concentrations and available data for a variety of situations with respect to two-way traffic and wind-flow characteristics shows great similarity. However, as pollutant concentration may be considered a secondary effect of traffic produced turbulence, it is of great importance to compare directly model results and TKE measurements at different positions across the street. Further aspects we would like to address concern the value of the coefficient, C_{car}, in the production of TKE as well as the production itself as they have been extracted only for a two-way traffic and after using only one experimental data set, and the modelling of the momentum produced by the vehicles in an one-way traffic case. Therefore we would like to know the available data bases on this subject and the possibility of future experiments in wind tunnels that could measure the velocity field across the street in an one-way and two-way traffic cases.