H13-119
THE DAPPLE WIND TUNNEL STUDIES – LESSONS FROM SENSITIVITY STUDIES
Alan Robins, Paul Hayden

The DAPPLE project concentrated on short range dispersion of traffic pollutants and hazardous emissions in urban areas, using a region of central London as the study area. The project included extensive wind tunnel simulations in the EnFlo meteorological wind tunnel. A major objective of this work was to conduct a range of sensitivity studies to investigate:

- the repeatability and variability in dispersion behavior,
- the influence of upstream flow characteristics (including stability) and wind direction,
- the influence of upstream model characteristics and model detail and, lastly,
- the effects of obstacles within the street network.

The important lessons from these studies will be discussed and interpreted in terms of the requirements and performance of urban dispersion models, whether used for air quality of emergency response applications. Finally, comparison of wind tunnel and field data in a sub-set of the full tracer dispersion data-base will be used to discuss the difficulties in using such information for model evaluation work.

H13-166
INFLUENCE OF TURBULENCE MODELS ON THE TRANSIENT FLOW IN STREET CANYONS
A. Pascau, N. García

It is well known that the weakest point of two-equation turbulence models (say, k-epsilon model) is the equation from which the turbulent scale is derived, either the epsilon equation or the omega equation. Menter suggested that this was due to the strategy followed to derive the scale-related equation that has traditionally been obtained in pure analogy to the k-equation. To overcome this problem Menter proposed a set of different models called shear stress transport models (SST) under the framework of so-called Scale Adaptive Simulation (SAS) [3]. In this paper a thorough study of the flow in a street canyon calculated with two turbulence models, namely, a standard k-epsilon model and a SST-SAS model is performed. The study is transient because as Chang and Meroney state, ‘it is evident that steady-state calculations are not reproducing the intermittent nature of the penetration of elevated flows down into the canyons’ [1].

The capacity of URANS models to tackle street canyon flows is in doubt [2]. The review paper by Li et al. [2] goes from RANS models to LES, overlooking URANS approaches. However, this work shows that URANS results are comparable to LES results with an appreciable reduction in the computational requirements. The study is mainly devoted to the comparison of the two turbulence models rather than trying to establish a comparison with available experimental data. In the cases dealt with the results show that SST-SAS is capable of reproducing the transient nature of the flow.

The code employed is an in-house code that solves the URANS equations in a collocated, structured arrangement using several turbulence models with various levels of sophistication. The solver is pressure-based of segregated type. Every care has been taken in ensuring that the collocated grid does not introduce additional errors due to the special interpolation required to calculate face convecting velocities.


H13-217
COMPARISON BETWEEN FLOW DYNAMICS INSIDE STREET CANYON WITH TWO GEOMETRIES OF ROOF SHAPE
Radka Kellnerova, Libor Kukacka, Zbynek Janour

Flow dynamics above two shapes of roof geometries in urban area are investigated in wind-tunnel experiment. Urban models consist from long series of street canyons with flat or pitched roofs. Different shape of roofs induces different turbulence above the canyon as well as dynamics of intermittent motions.

Character of intermittency is supposed to be linked to a ventilation in the street from combustion or vehicle traffic. Hence, two types of roofs produce dissimilar of ventilating process.

The first part of experiment uses one-point LDA measurement to get steady-state characteristics of turbulence. Moments of higher order like skewness and flatness of velocity point out a locality where extreme wind events take place. Namely spatial distribution of vertical skewness can show whether the intermittent penetrations rather help to ventilate the street or more likely cause a vortex breakdown followed by immediate accumulation of pollutants.

Momentum flux is analyzed with quadrant analysis what enables to reveal the regions with statistical dominance of “sweep” or “ejection” events.
Fourier analysis and wavelet analysis are applied at several altitudes inside boundary layer in order to determine typical wavelength of highly energetic patterns. Preliminary study using PIV is conducted in wind channel with the same models. Attention is focused on area near the obstacle edge where flow structure develops. Vorticity, vortex core and energetic modes using POD method are calculated. Both geometries generate boundary layer distinct from each other with specific flow structures and ventilating processes. Flat roofs support the ventilation inside the canyon to be more stable, downdrafts are properly localized to make convenient conditions for maintenance of large recirculating vortex in the street. Pitched roofs on the other side provide unfavourable dynamics that disturb the ventilation by hitting the true core of recirculating zone.