Modelling the Urban Environment - A 'surface CFD code'

Background

1. *Development of Strategy* for UWERN Urban Meteorology Programme
(www.met.rdg.ac.uk/Research/urb_met/strategy)
Informed by Jan. 2002 Reading Workshop and subsequent group discussions.

Mixing and transport within urban areas a key element
(major driver - urban air quality)

City Scale ⇒ Neighbourhood Scale ⇒ Street Scale
(i) (ii) (iii)

(i) **CS**: (<50km). The 'conventional view' - z_o, d and u^*, L and H parameters to represent effect of urban area on mixing and transport within the boundary layer

Qu: What is large-scale effect of urban areas on b.l?
Are urban areas too heteorogeneous for z_o, etc?

(iii) **SS**: (<200m). Individual buildings affect flow/dispersion directly; extreme unsteadiness and variability; quantification of the larger-scale context necessary for development of general understanding.

Qu: how do geometry and synoptic meteorology fix street circulation & mixing, and ventilation aloft?
What fraction of street sources is mixed from/to aloft?
Is there a canonical geometry?

(ii) **NS**: (200m - 10km and up to z<100m). Variations in building density and type are resolved - bridge between CS and SS; 'averaged approaches' may suffice. Maybe the proposed microscale model would cover this region? Eventually, UM might go down to 1km?

Qu: what defines smallest length scale?
What 'averaged descriptors' of the surface should be used?
How can results from SS studies be used to improve modelling in NS?

2. *Proposed microscale model*

From original project specification (approved by UWERN):

'A new microscale atmospheric modelling system for scales from building scales (10m) to tens of kilometers will be developed for use by the UWERN research community.'

One conclusion from1st Microscale modelling workshop (27th March 2003) was:

'An "urban scale" model and "steep terrain" model **were not compatible**. If both objectives are to be attained, then separate models would need to be constructed. The feasibility of this will be discussed at the next workshop.'

Surface CFD code

(NB: 'urban', rather than 'surface', is too specific).

Urban Scale Modelling Group Meeting, Wed. 1st October

Led to presentation at UWERN Management Meeting on 22nd Oct.
www.env.leeds.ac.uk/~alan/microscale/build_7.pdf

proposing development of an 'urban CFD code'.

1. *Methodology*

(i) Partnership between commercial CFD vendor, UWERN and the Met. Community.

(Reasons: infrastructure, long-term support, sophisticated meshing and numerics for complex geometry).

(ii) Establish base-line CFD code (vendor) - *via* initial test case computations with all three possibilities?

(iii) Develop appropriate user-defined code linking CFD code to microscale (or, eventually UM) for b.c. dynamic provision.

(iv) Establish turbulence model to use (LES?).

(v) Determine validation procedures.

(vi) ....

2. *Progress*

(i) UWERN 'agreement in principle' to fund PDRA.

(ii) SEB & IPC (and JT) have talked to the three major code vendors (90 minutes each at Reading).

(iii) All have written 'letters of intent'.