METHODS FOR INCORPORATING THE INFLUENCE OF URBAN METEOROLOGY IN AIR POLLUTION ASSESSMENTS COST 715

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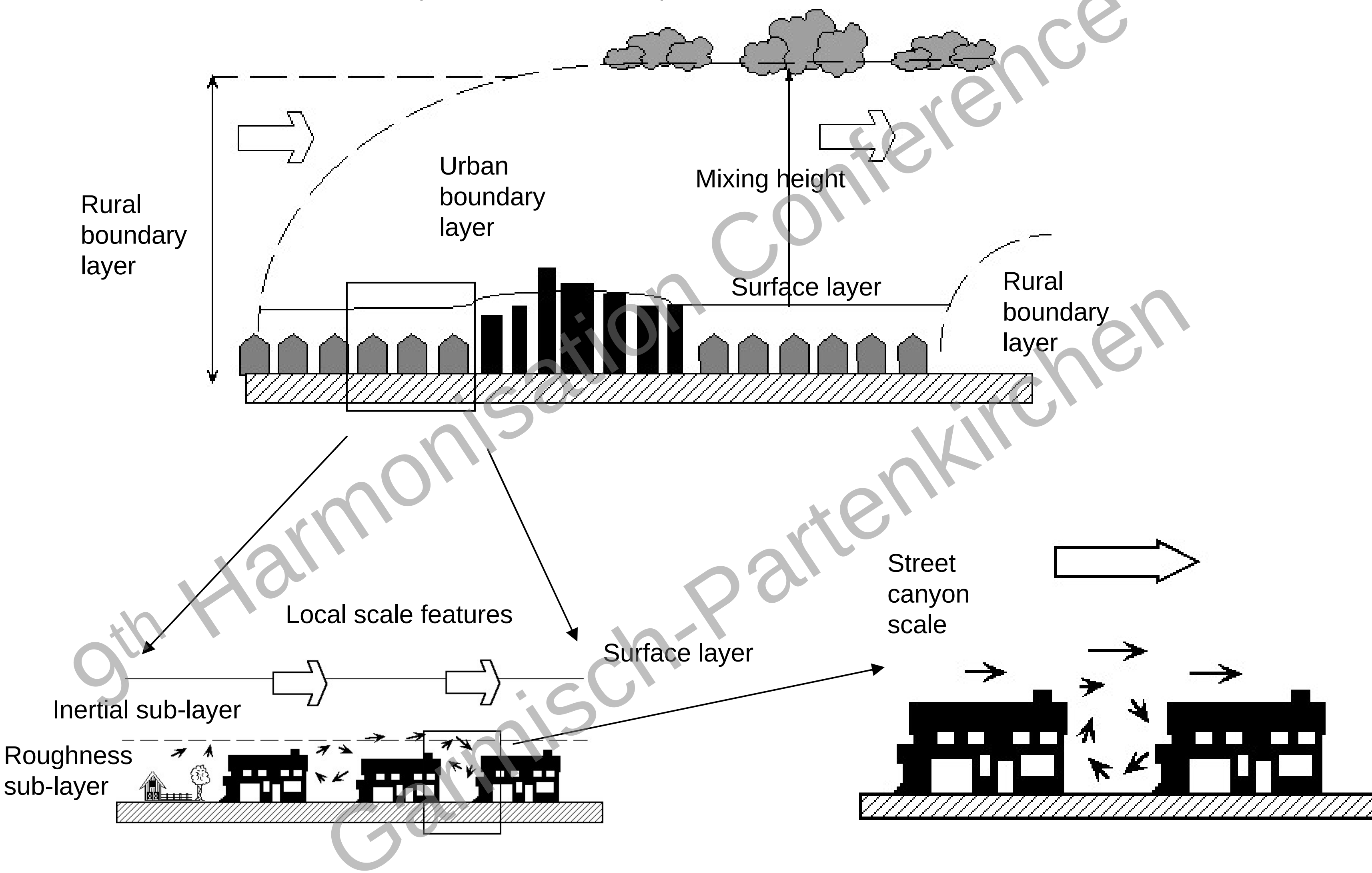
http://www.dmu.dk/atmosphericenvironment/cost715.htm
http://www.geo.umnw.ethz.ch/research/cost715/cost715
http://cost/fmi.fi/
http://www.mi.uni-hamburg.de/cost715/inventory.html

ENVIRONMENT AGENCY

Meso-scale Description of Urban Atmosphere



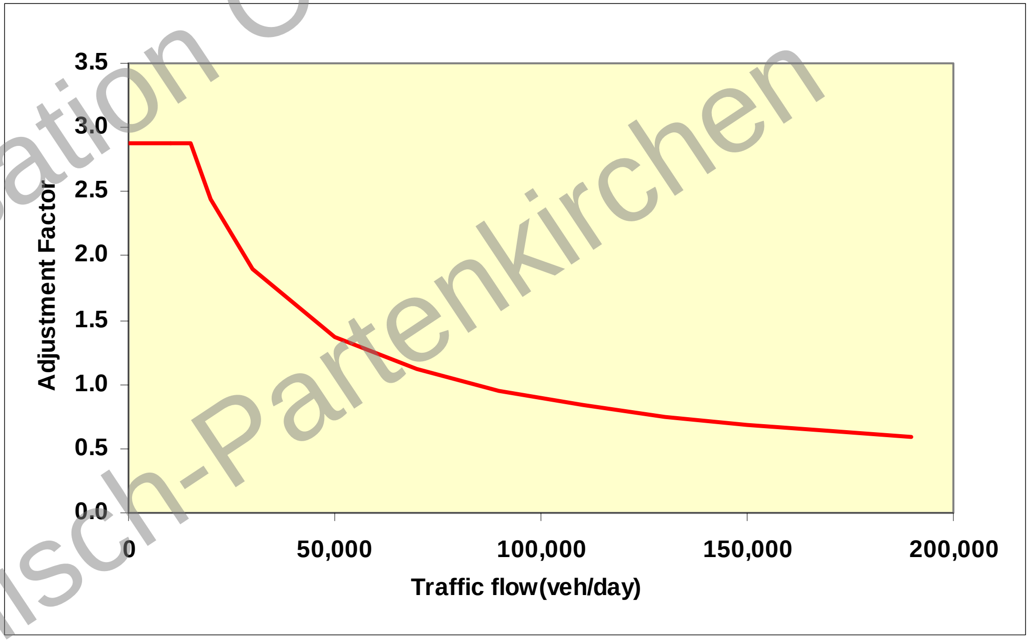
Schematic representation of processes within a developing urban boundary layer

Accuracy of urban air quality models - Some examples of urban meteorological modification

Model	Pollutants	Uncertainty
OML with urban corrections (z_0, urban sub-layer, L_{min}) for Zürich	Annual average SO_2 and NOx (P predicted) and (O observed) Urban effect ~ 30% increase	r = 0.8 Improved performance with urban modification
Urban modified particle model, Crosswind integrated concentrations	Urban tracer data, Copenhagen (C), and Indianapolis (I), elevated releases	r = 0.8 Some improved performance with urban modification
UDM-FMI, CAR-FMI with urban z_0, roughness sub-layer, L_{min}	NOx, NO2	r = 0.5 to 0.6 No non-urban comparison
UDM-FMI, CAR-FMI	NOx, NO2	r = 0.39 to 0.68
Helsinki study specific	Annual mean for each hour of the day, PM_{10}, at four monitoring stations, one year of data	r^2 = 0.36 to 0.9
CAR-FMI	Hourly NO_x, NO_2	r = 0.8
OSPM	Hourly NO_x, NO_2	r = 0.8

$$G(x,0)=\frac{1}{ku_*x(1+n)}$$

Typical source-receptor relation for a ground-level line source



Annual mean PM10 adjustment DMRB

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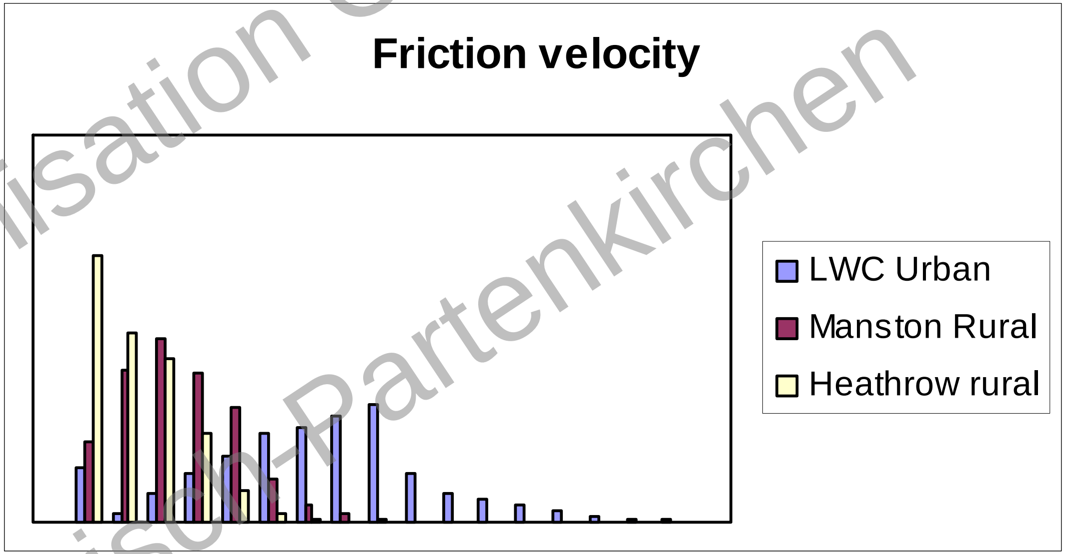
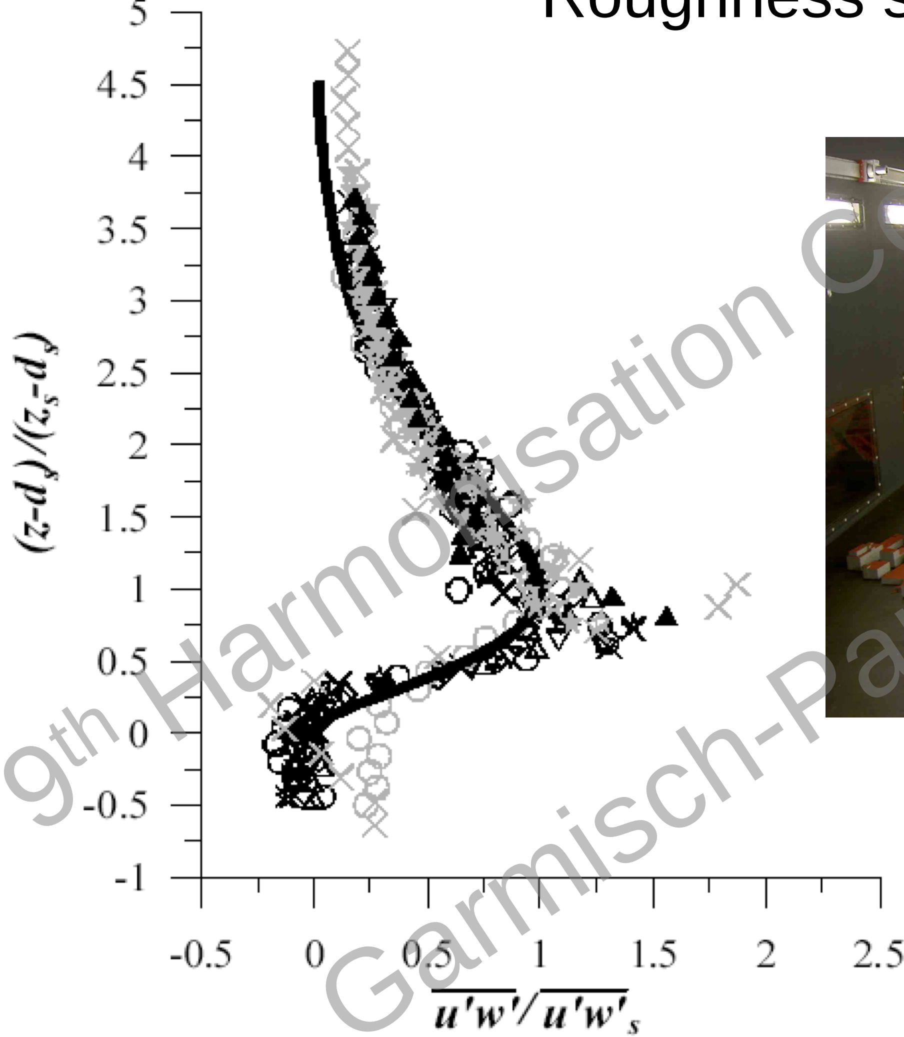
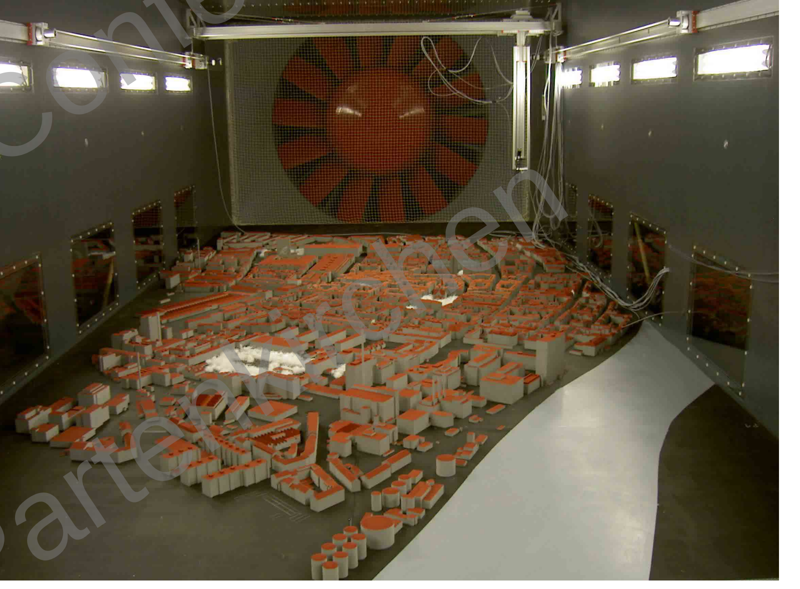
CONSIDER

roughness
albedo
thermal storage
Bowen ratio



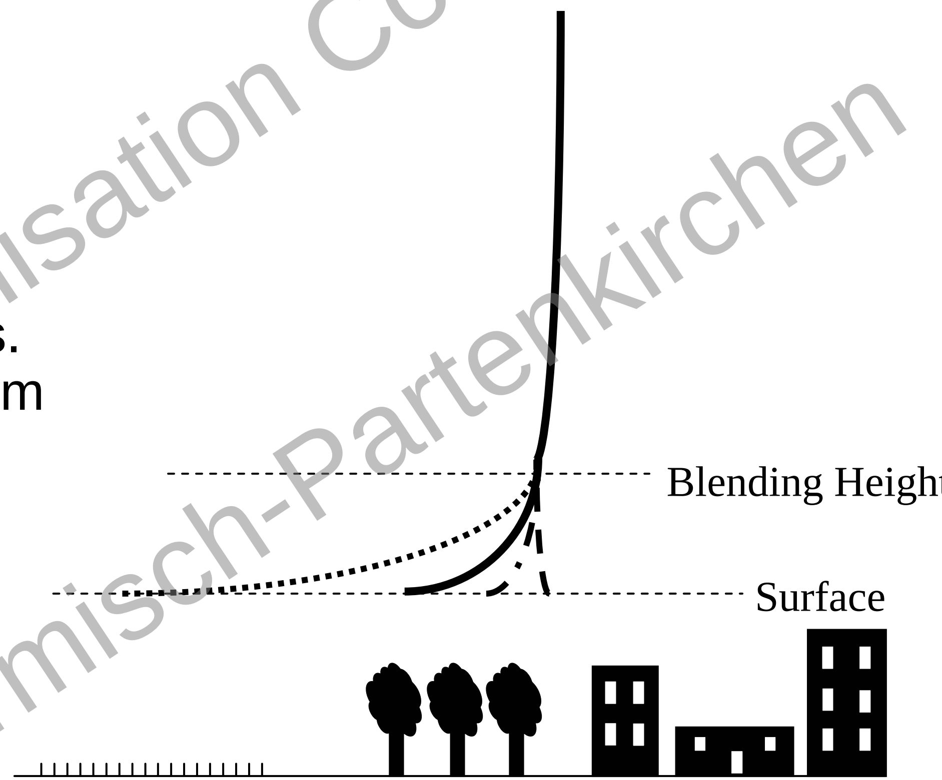
Roughness sublayer



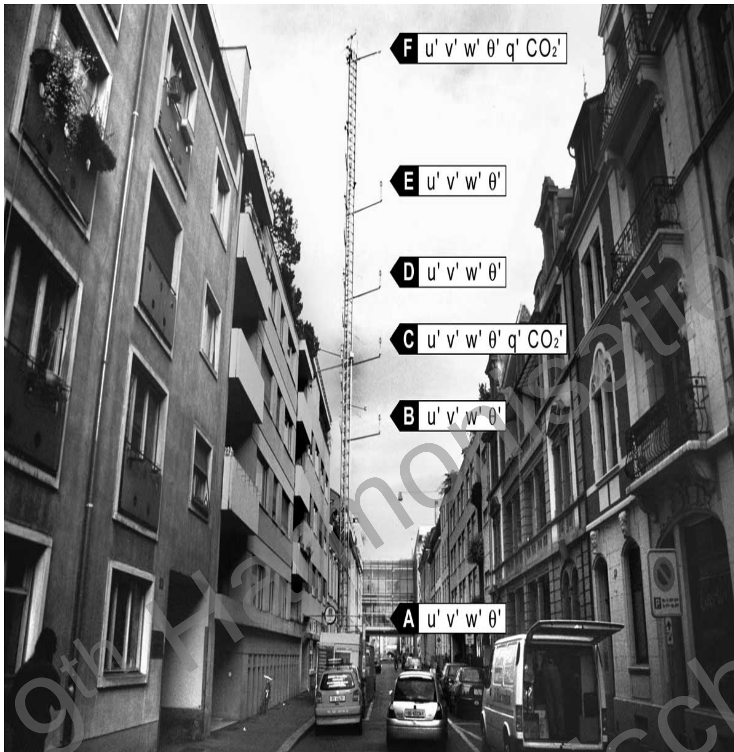


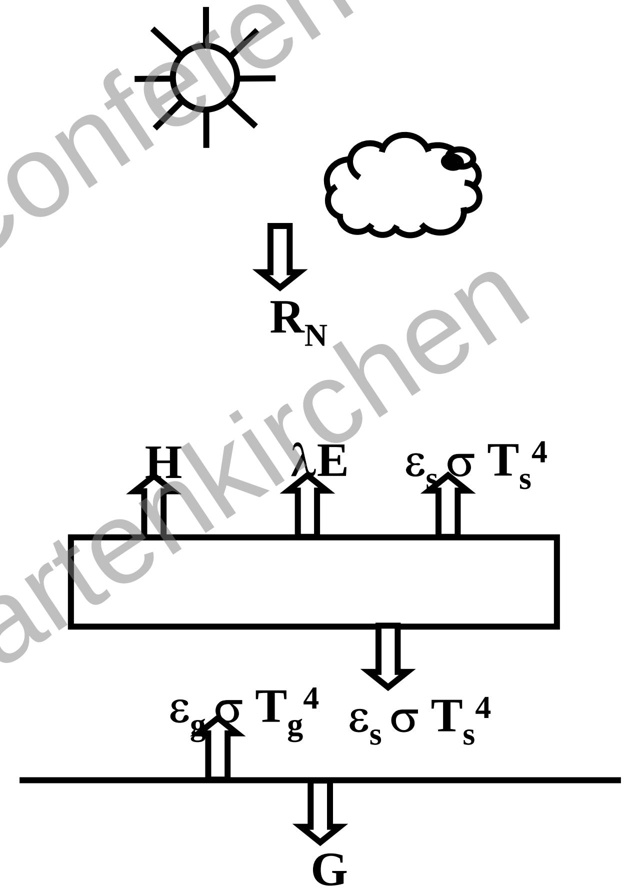
$$\int_{x_1}^{x_2} q(y)G(x, y)dx = C_{meas}(x_2)$$

For heterogeneous surfaces using 'blending height' techniques and tiles. Better posed problem

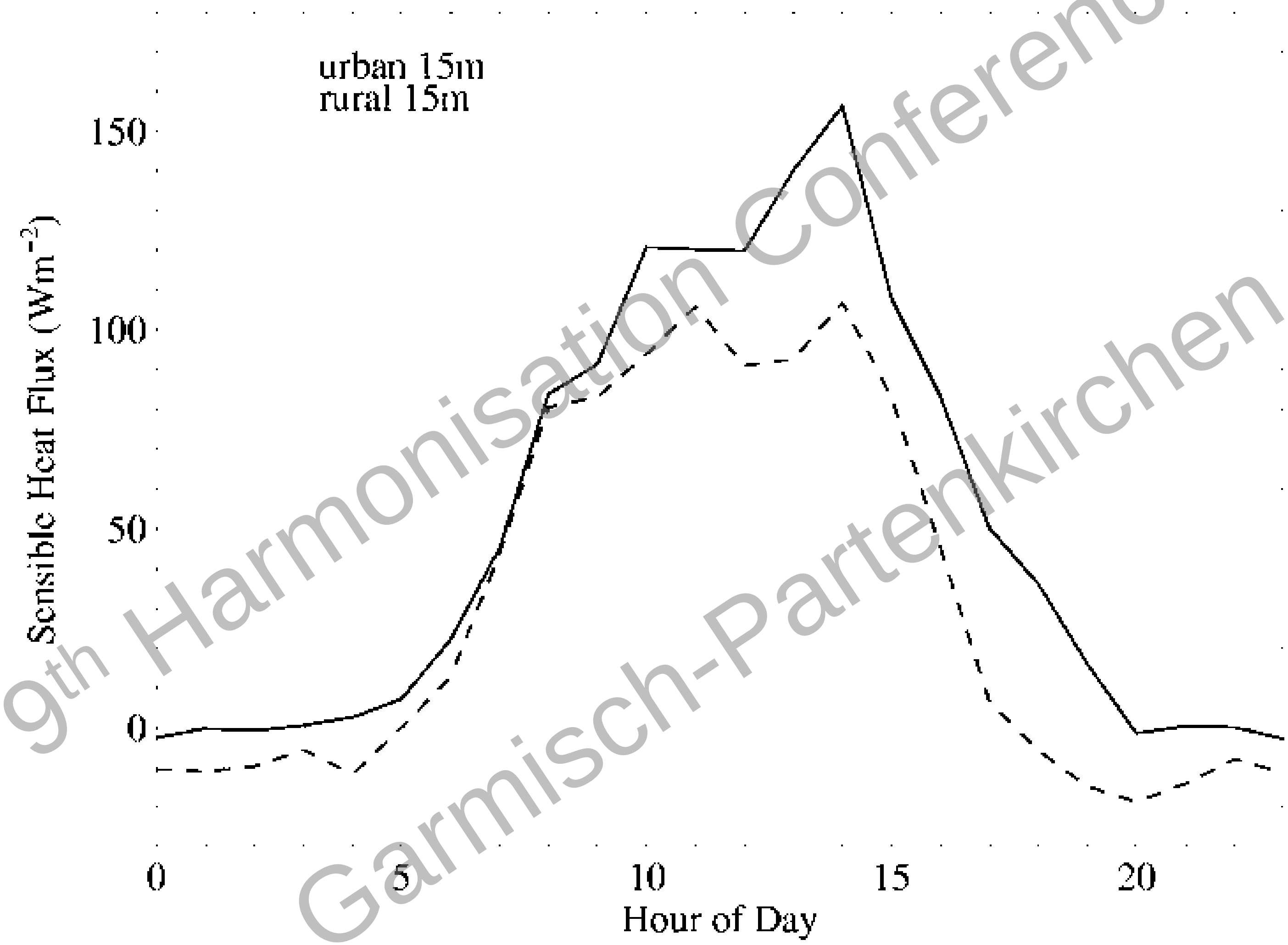


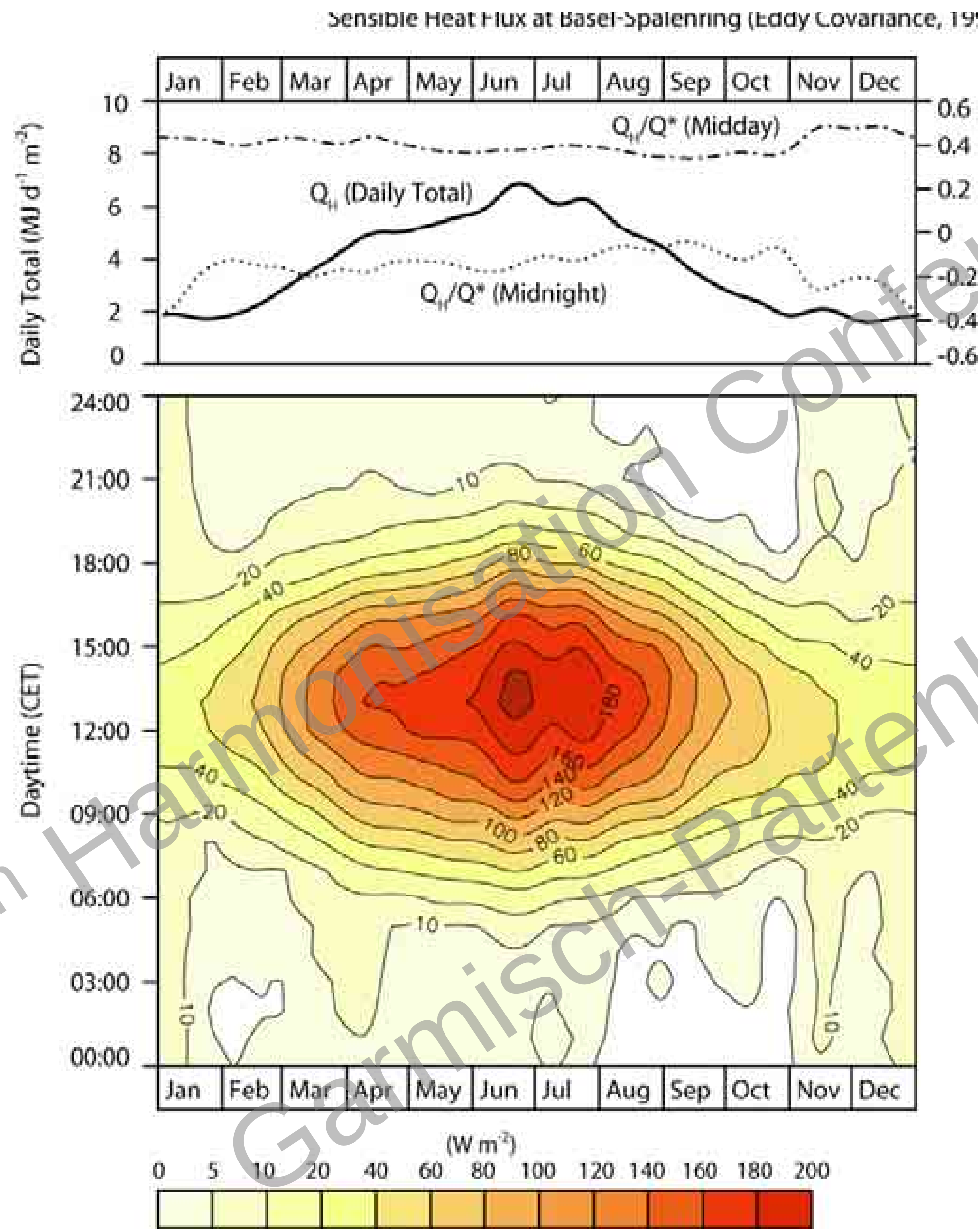
Near surface heat exchange





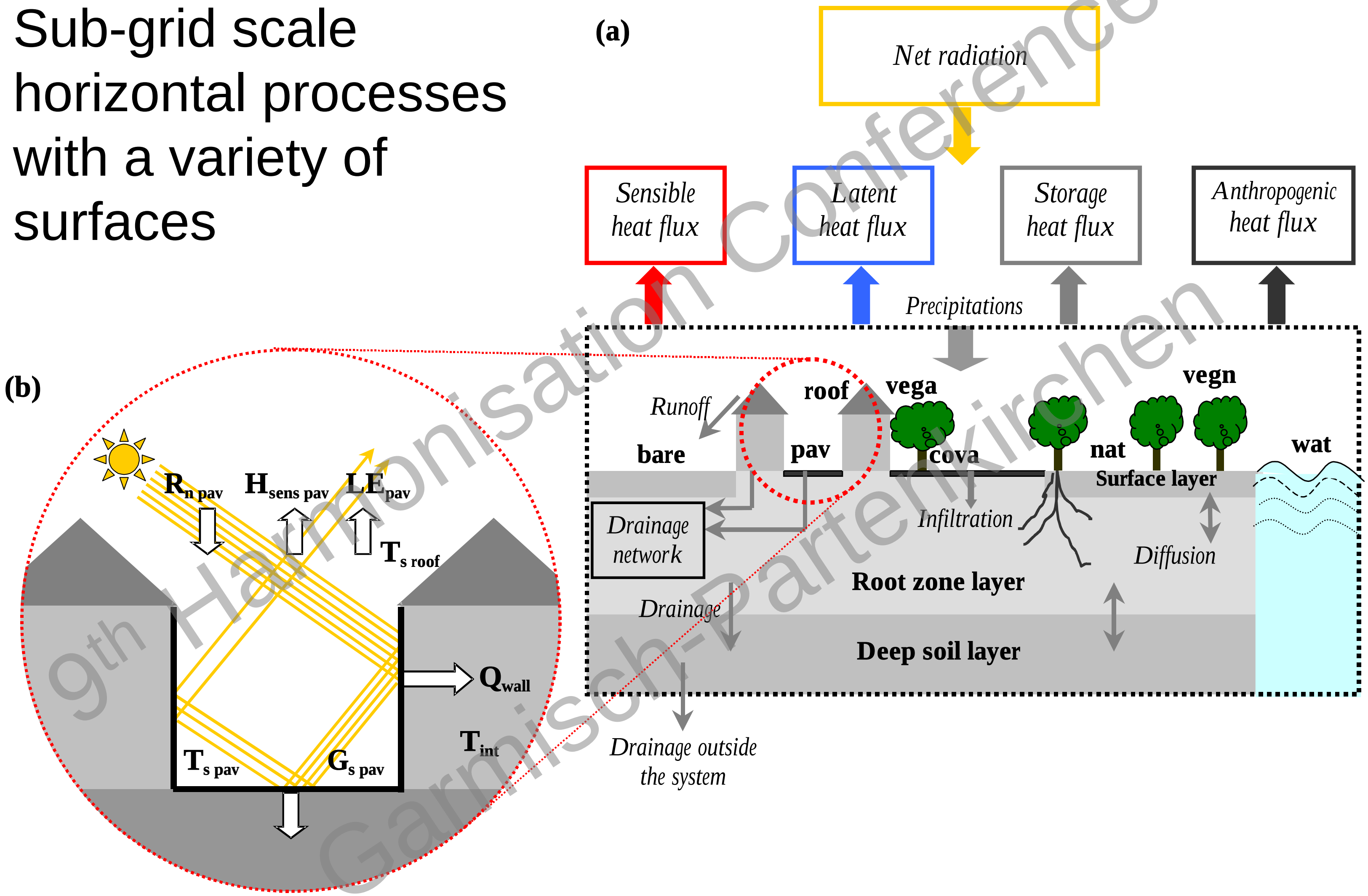
Urban nocturnal heat flux





Sensible heat flux always positive

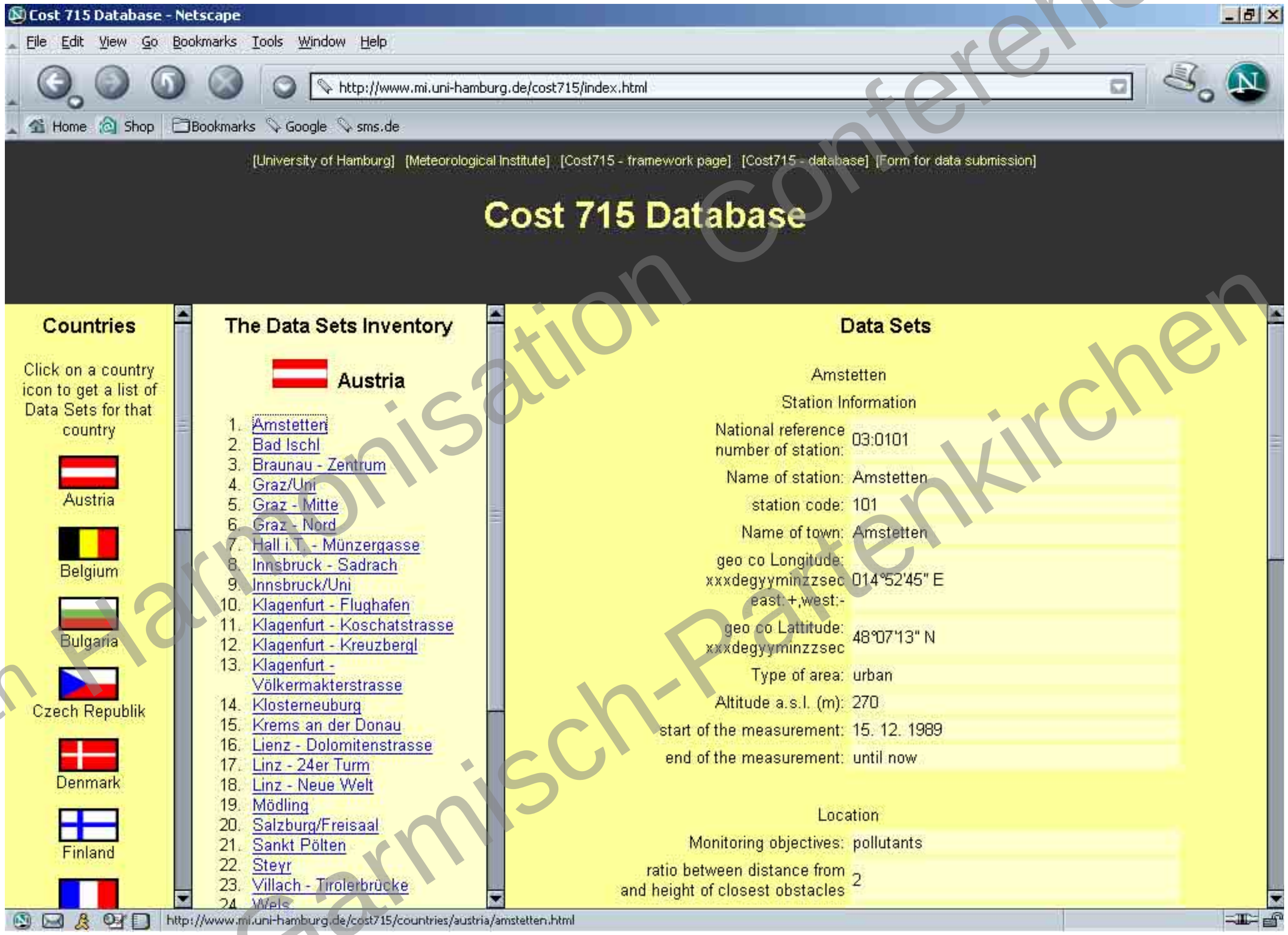
Sub-grid scale horizontal processes with a variety of surfaces



Methods for Urbanising the Meteorological Input

Meteorological Pre-processor	Transport Model	Where Tested
Minimum L, increased z_0	ADMS	
Roughness sub-layer scaling	Lagrangian stochastic particle model	Indianapolis, Lillestrom Wind tunnel BUBBLE
Roughness sub-layer scaling	OML	Zurich
LUMPS	Any dispersion model	Rural-urban temperature differences US cities
Oke parameterisation	BOXURB	Birmingham
Downscaling for complex terrain		
Wind field modelling		
Empirical correction/expert judgement	Any dispersion model	Refer to guidance used in Inventory of urban meteorological sites
AERMET based on Oke, z_0 Bowen ratio	AERMOD	
Wind tunnel modelling		Gottinger St, Hannover

Urban meteorological stations



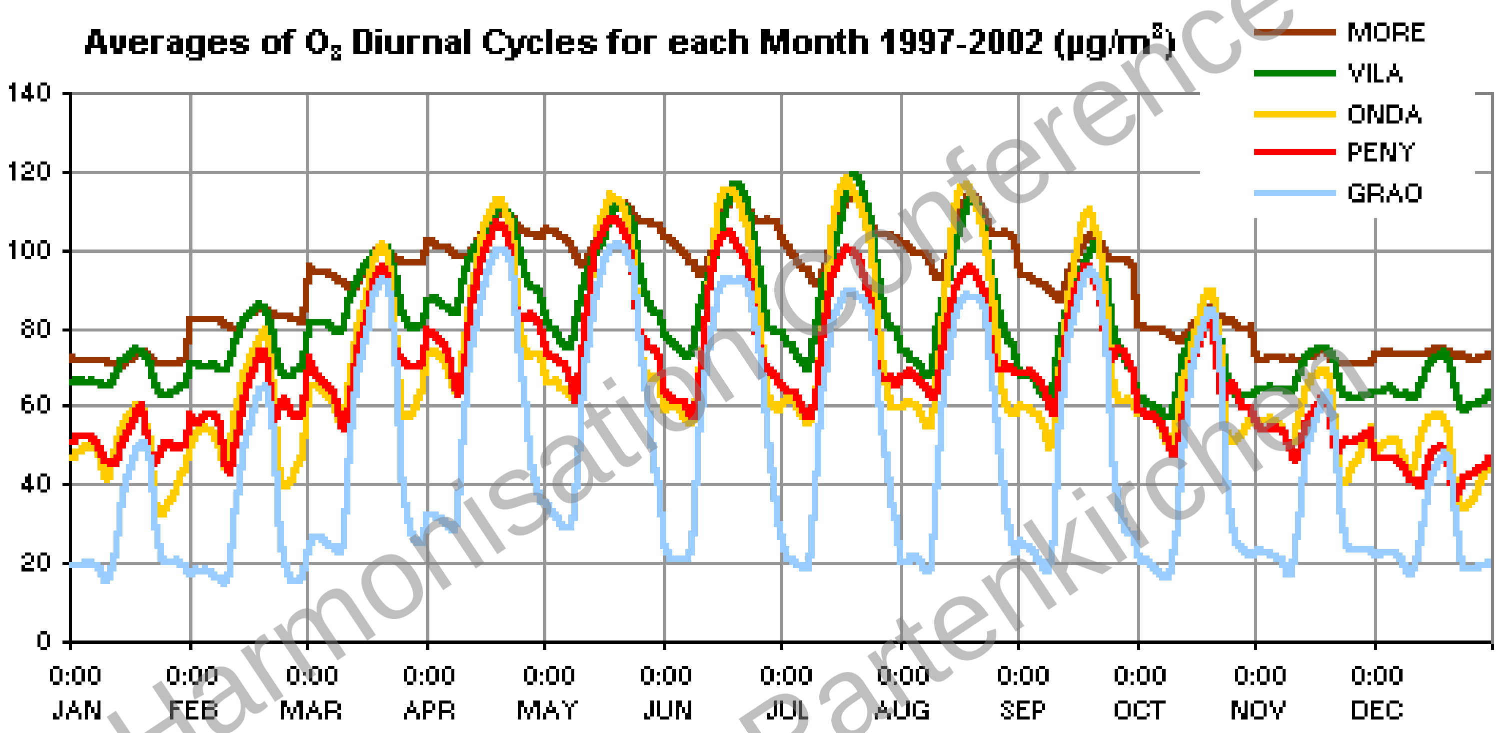
Methods for Urbanising the Meteorological Input in 3-D Transport Models

Meteorological Processor	Transport Model	Where applied
SM2-U (Soil Model Urbanised)	SUBMESO	European cities
Martelli et al scheme	FVM	Athens
TEB	MESO-NH	Marseilles
Objective Hysterisis Model	MM5	Athens
Urbanised and resolved	HIRLAM	Oslo, Helsinki
	Lokal Modell	Helsinki
	RAMS	Helsinki

Simplifying concepts or scaling methods

Concept	Transport model	Where tested
Mixing height/UBL height	MM5	Milan Marseilles
Mixing height	MM5(MRF scheme)	Oslo
Temperature inversion	MM5	Oslo Helsinki Milan
Blending height/aggregation methods	Slab model	Urban mixing height
Morphometric methods	Various	Urban wind speed profile

Predictive capacity of meso-scale models and the magnitude and sign of the effects of urban meteorology e.g. Basel or Athens

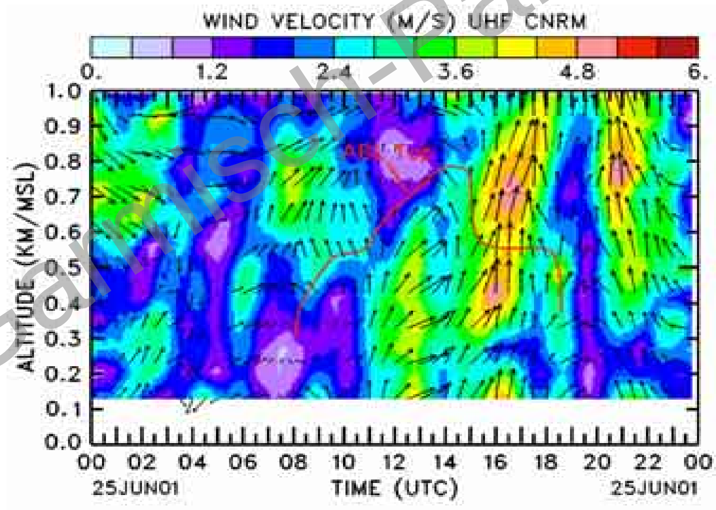


Average-day seasonal evolution of ozone for the 5 characteristic types in a typical Mediterranean Basin which depend on flow, sources and chemistry

In some situations only data around the urban area is available at say an airport. Correction factors can be suggested.

If data is available within the urban area suggestions on how it should be adjusted to provide wind profile information relevant to urban dispersion calculations. Reference height of wind speed.

After pre-processing a suitable set of representative winds, heat fluxes and stabilities will have been derived Some data sets available to check the analysis is reasonable. Standard pre-processors need adjustment for roughness length, minimum L in stable conditions, lag caused by heat storage, artificial heating, Bowen ratio and for an urban wind profile.



Answers concerning the validation of the meso-scale model are emerging.

Numerical models have a finite resolution. Methods for aggregating fluxes need to be agreed. Surface fluxes need to be parameterised. The lowest level in the model should be set at the blending height. Can extrapolation to within the roughness sub-layer be recommended?