



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>

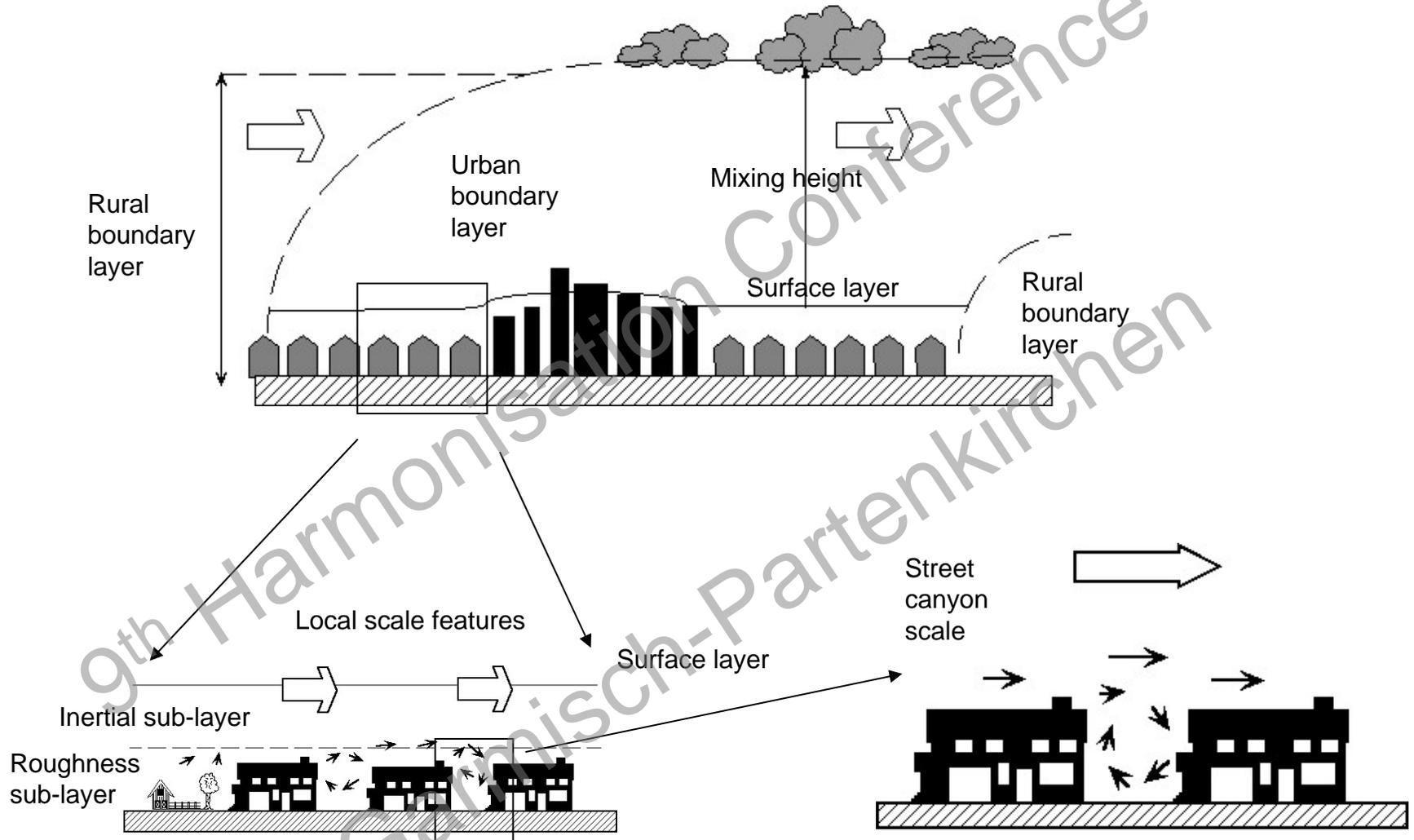
<http://www.geo.umnw.ethz.ch/research/cost715/cost715>

<http://cost/fmi.fi/>

<http://www.mi.uni-hamburg.de/cost715/inventory.html>



Meso-scale Description of Urban Atmosphere



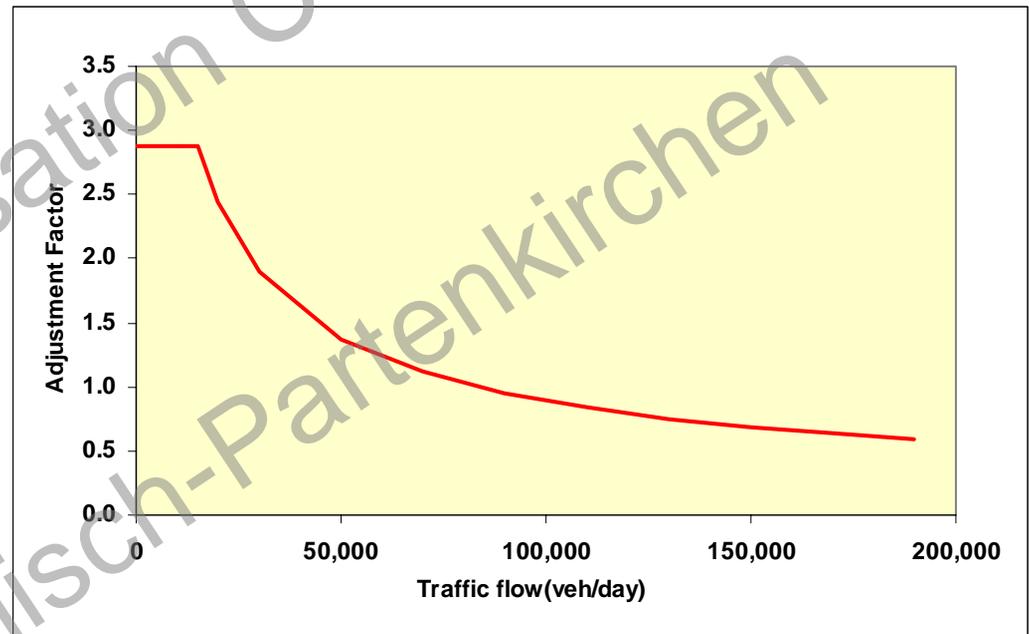
Schematic representation of processes within a developing urban boundary layer

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 NO_x (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} | NO_x , NO_2 | $r = 0.5$ to 0.6 No non-urban comparison |
| UDM-FMI, CAR-FMI | NO_x , NO_2 | $r = 0.39$ 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 | $r = 0.8$ |

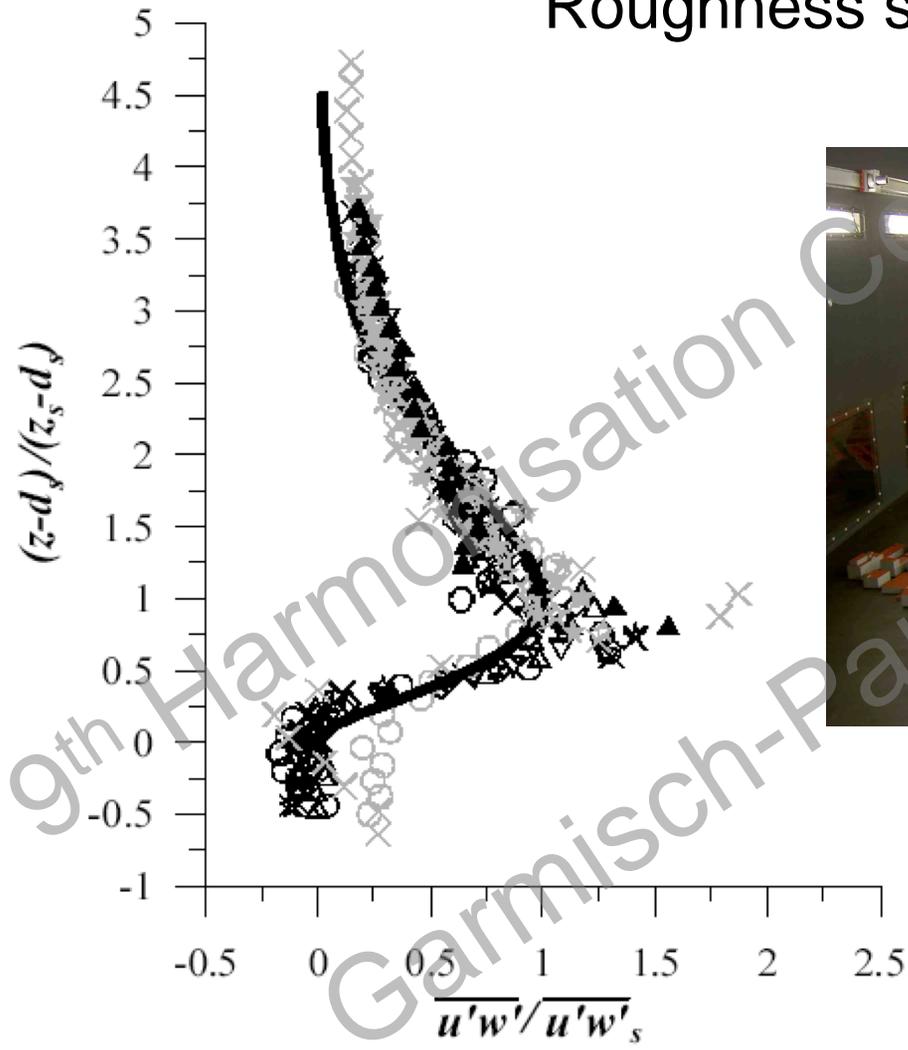
$$G(x,0) = \frac{1}{ku_* x (1+n)}$$

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



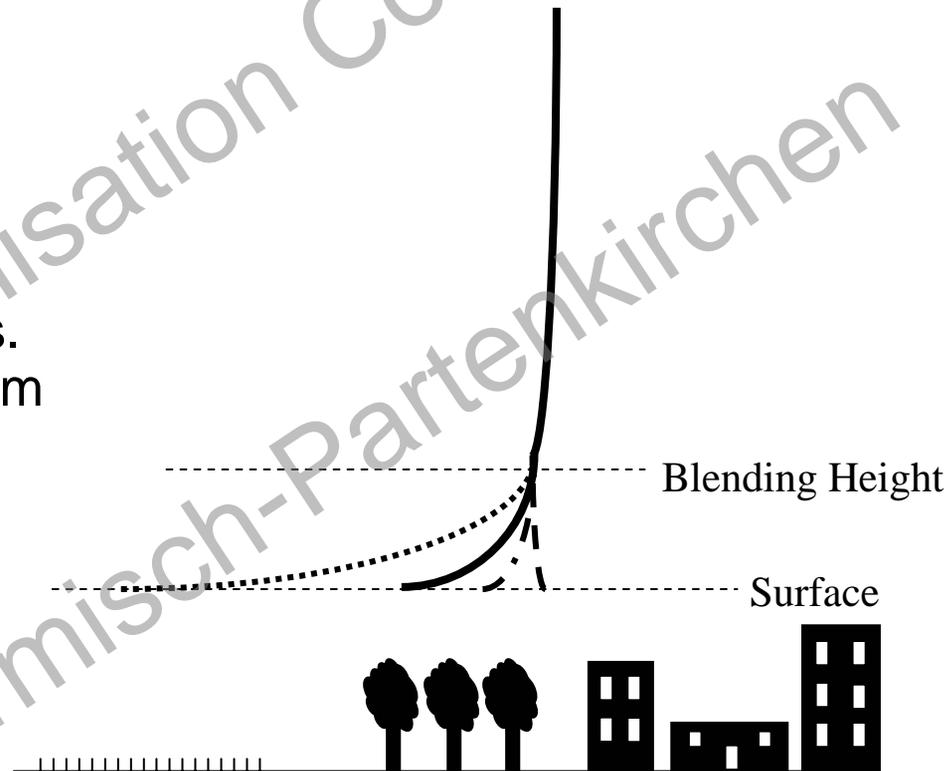
Annual mean PM10 adjustment DMRB

Roughness sublayer

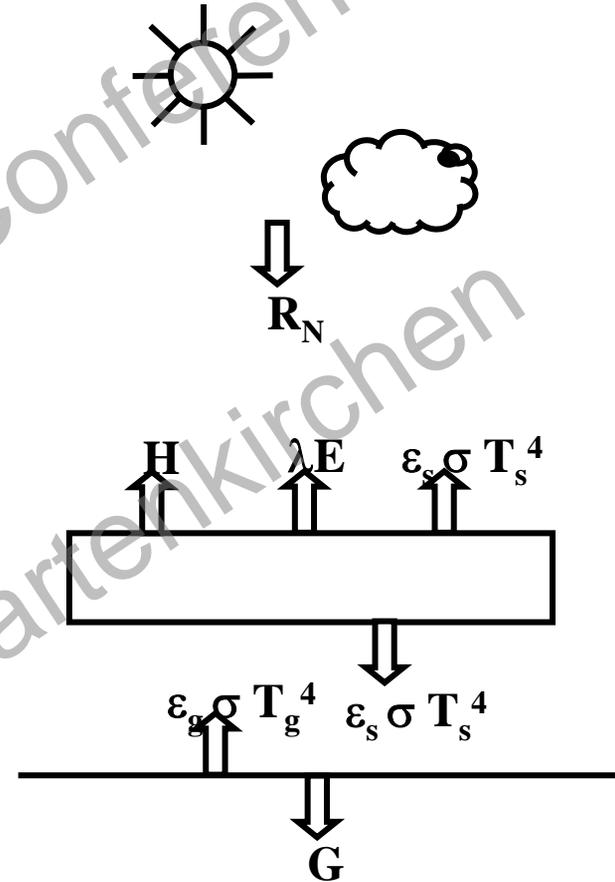
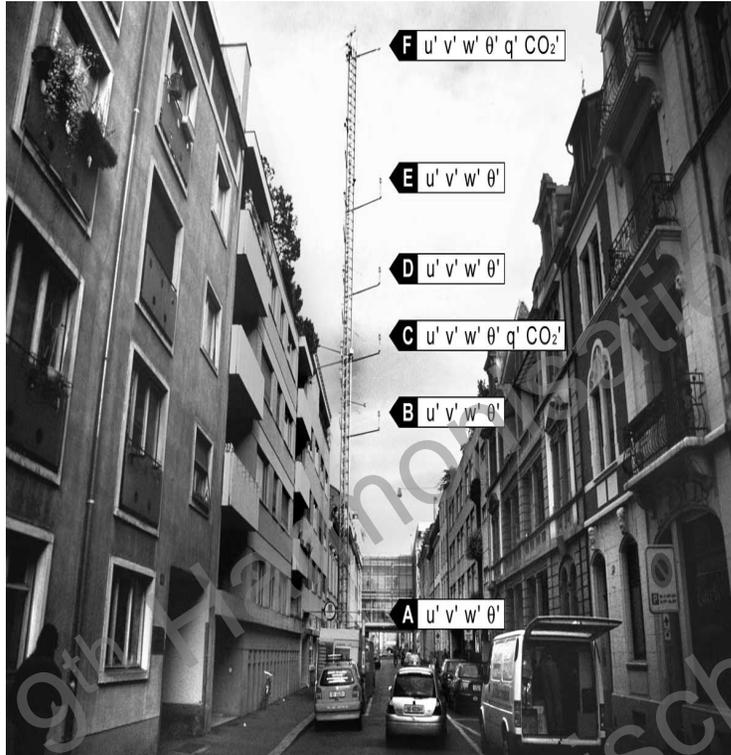


$$\int_{x_1}^{x_2} q(y)G(x, y)dx = C_{\text{meas}}(x_2)$$

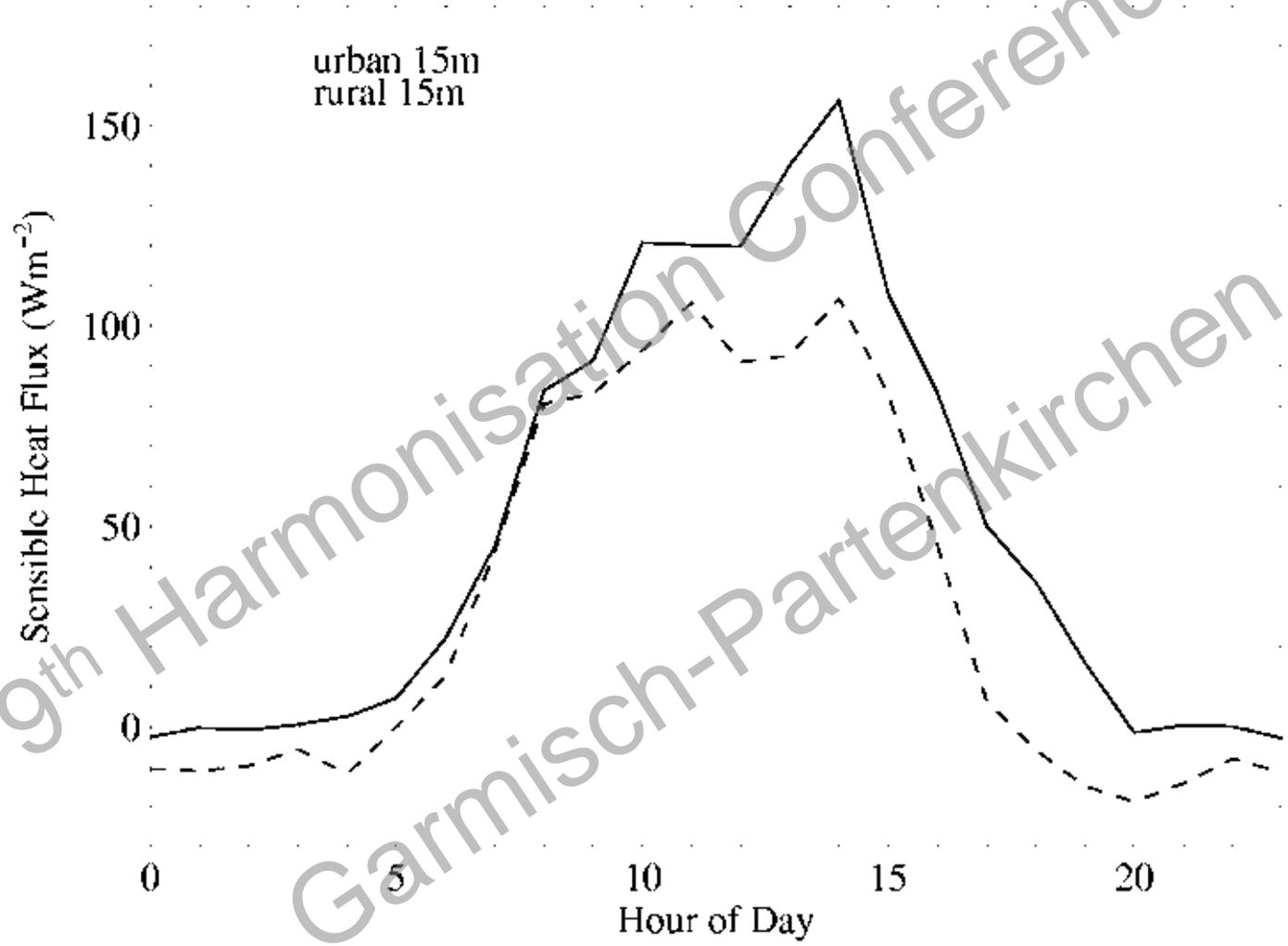
For heterogeneous surfaces using 'blending height' techniques and tiles. Better posed problem



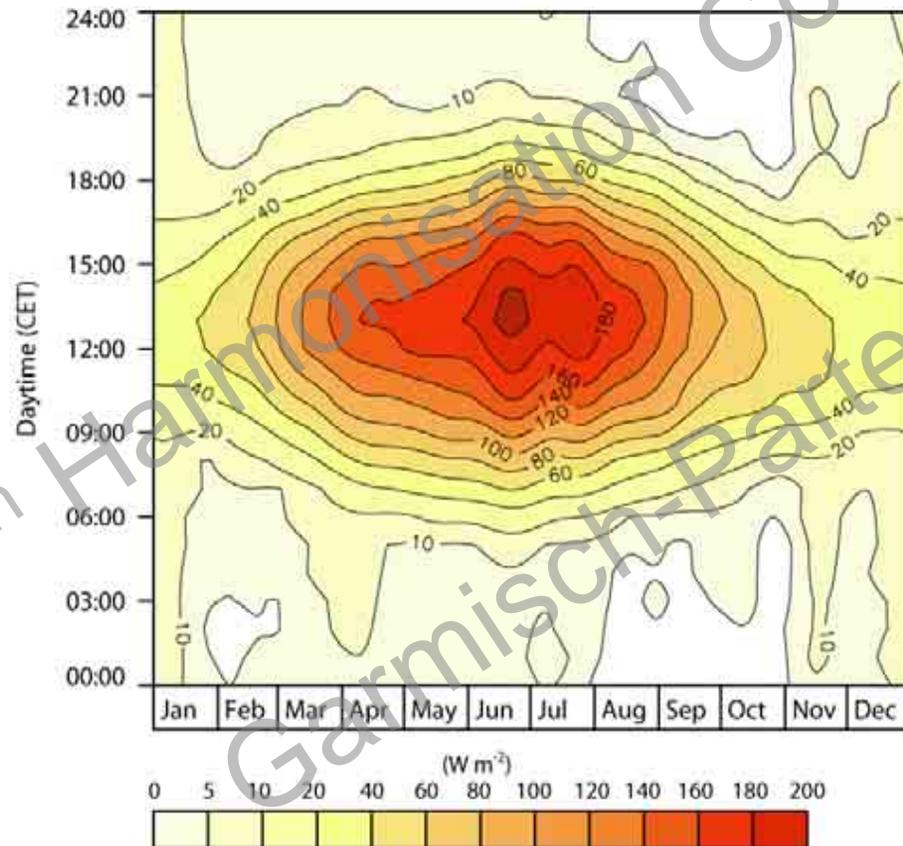
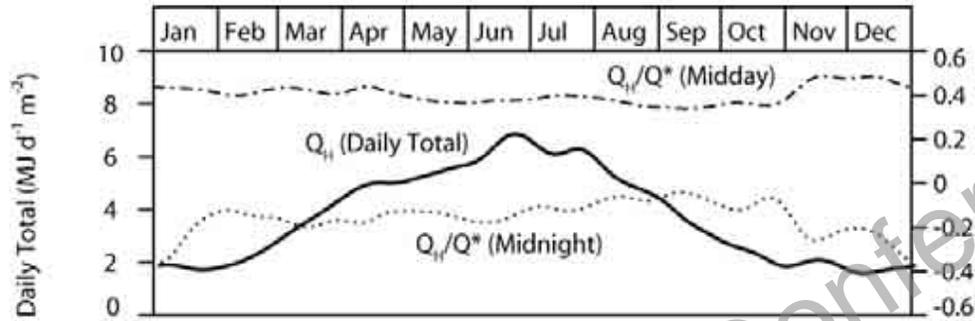
Near surface heat exchange



Urban nocturnal heat flux

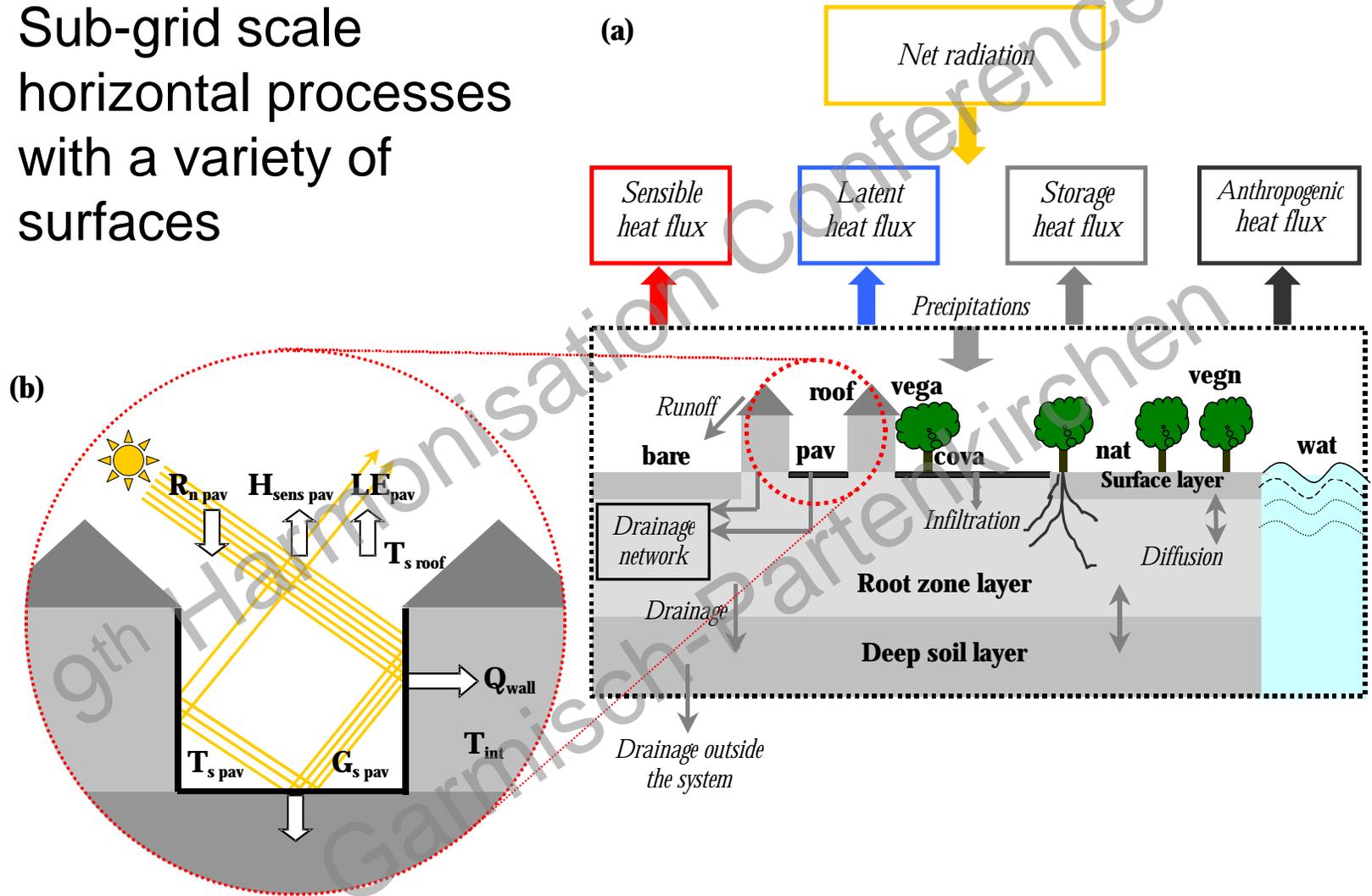


Sensible Heat Flux at Basei- β paiering (Eddy Covariance, 1994-2002)



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

The screenshot shows a Netscape browser window displaying the Cost 715 Database website. The browser's address bar shows the URL <http://www.mi.uni-hamburg.de/cost715/index.html>. The website header includes navigation links: [University of Hamburg] [Meteorological Institute] [Cost715 - framework page] [Cost715 - database] [Form for data submission].

Cost 715 Database

The main content area is divided into three sections:

- Countries:** A list of countries with their respective flags. The text says: "Click on a country icon to get a list of Data Sets for that country". The countries listed are Austria, Belgium, Bulgaria, Czech Republik, Denmark, Finland, and France.
- The Data Sets Inventory:** A list of data sets for the selected country, Austria. The list includes:
 1. [Amstetten](#)
 2. [Bad Ischl](#)
 3. [Braunau - Zentrum](#)
 4. [Graz/Uni](#)
 5. [Graz - Mitte](#)
 6. [Graz - Nord](#)
 7. [Hall i. T. - Münzergasse](#)
 8. [Innsbruck - Sadrach](#)
 9. [Innsbruck/Uni](#)
 10. [Klagenfurt - Flughafen](#)
 11. [Klagenfurt - Koschatstrasse](#)
 12. [Klagenfurt - Kreuzbergl](#)
 13. [Klagenfurt - Völkermakterstrasse](#)
 14. [Klosterneuburg](#)
 15. [Krems an der Donau](#)
 16. [Lienz - Dolomitenstrasse](#)
 17. [Linz - 24er Turm](#)
 18. [Linz - Neue Welt](#)
 19. [Mödling](#)
 20. [Salzburg/Freisaal](#)
 21. [Sankt Pölten](#)
 22. [Steyr](#)
 23. [Villach - Tirolerbrücke](#)
 24. [Wals](#)
- Data Sets:** Detailed information for the selected station, Amstetten.

Amstetten
Station Information

| | |
|--|--------------|
| National reference number of station: | 03:0101 |
| Name of station: | Amstetten |
| station code: | 101 |
| Name of town: | Amstetten |
| geo co Longitude: xxxdegyyminzsec east + west: | 014°52'45" E |
| geo co Latitude: xxxdegyyminzsec east + west: | 48°07'13" N |
| Type of area: | urban |
| Altitude a.s.l. (m): | 270 |
| start of the measurement: | 15. 12. 1989 |
| end of the measurement: | until now |

Location

Monitoring objectives: pollutants

ratio between distance from and height of closest obstacles: 2

The browser's status bar at the bottom shows the URL: <http://www.mi.uni-hamburg.de/cost715/countries/austria/amstetten.html>.

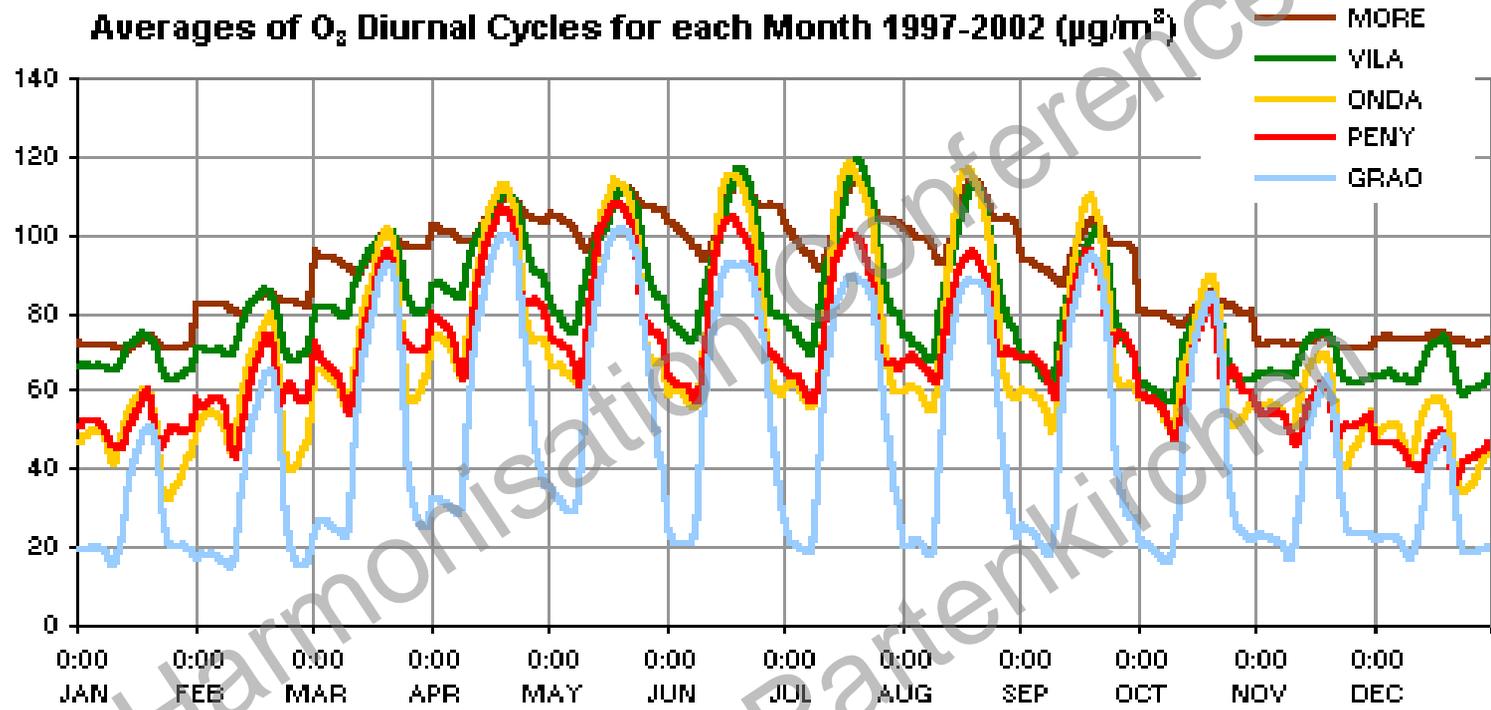
Methods for Urbanising the Meteorological Input in 3-D Transport Models

| 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 Hysteresis 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

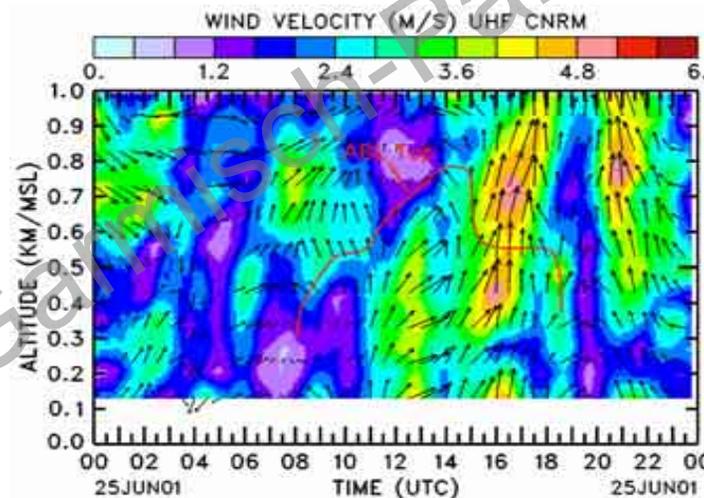


Average-day seasonal evolution of ozone for the 5 characteristic types in a typical Mediterranean Basin which depend on flow, sources and chemistry

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?

