

Evaluation of microscale air quality modelling in idealized urban geometries with explicit building modelling

Anikó Rákai ¹

Jörg Franke ²

¹Budapest University of Technology and Economics
Department of Fluid Dynamics

²University of Siegen/Vietnamese-German University (VGU)

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Overview

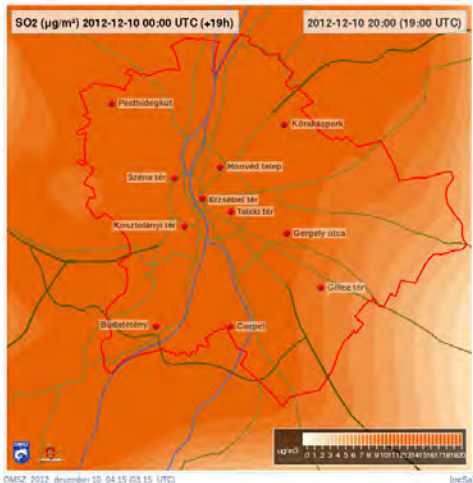
- 1 Motivation
- 2 Previous efforts
- 3 Present efforts
- 4 Preliminary results



Urban flow and air quality modelling

Navier-Stokes equations + transport equations

City and regional scale ($\sim 30 \times 30 \text{ km}$)

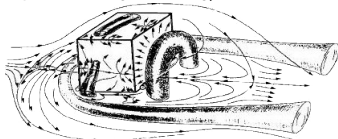


Forecast of the Hungarian Meteorological Service

Neighbourhood and street scale



explicit building modelling/obstacle resolving

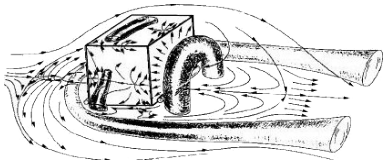


Martinuzzi and Tropea 1993

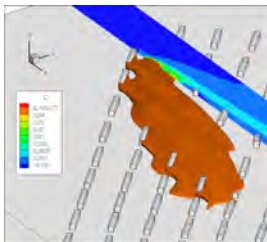


Validation to wind-tunnel datasets

Photos and measurements from the Environmental Wind Tunnel Laboratory of the University of Hamburg (<ftp://ftp-projects.zmaw.de/ewtl-data/>)



COST 732 Action: Quality Assurance and Improvement of Micro-Scale Meteorological Models



Approximately 10-20 research groups participating from Europe

Mock Urban Setting Test (MUST)

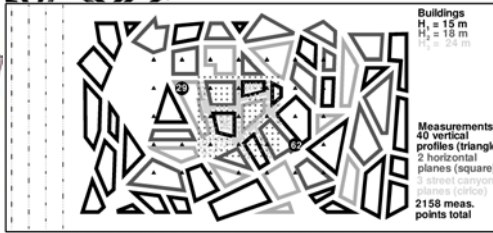
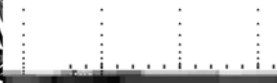
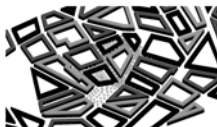


Joint Urban Test: Oklahoma city

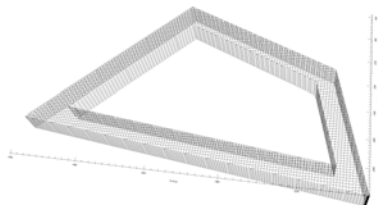
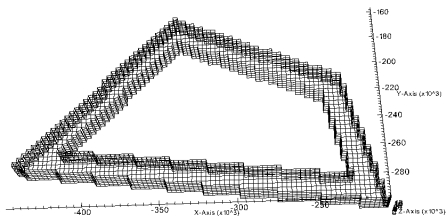
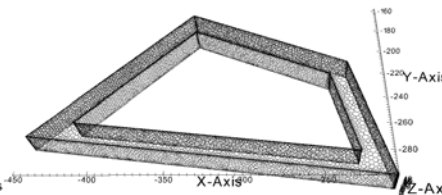
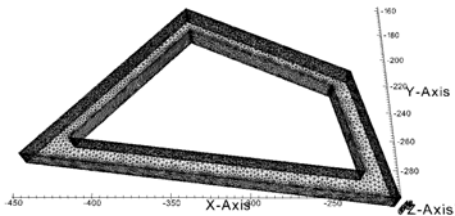


COST ES 1006 Action: Evaluation, improvement and guidance for the use of local-scale emergency prediction and response tools for airborne hazards in built environments

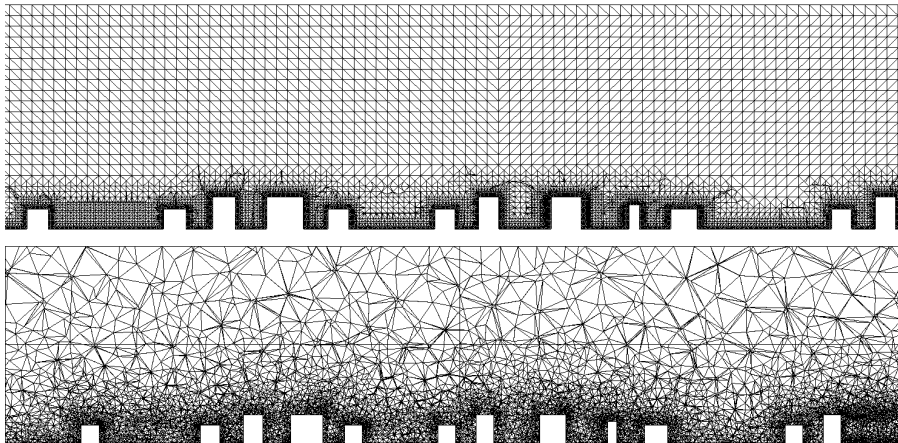
30 participants at the last meeting First investigations with Michel-Stadt



Explicit building modelling



Explicit building modelling



Errors and uncertainties

from the Best Practise Guideline of COST 732

Modelling

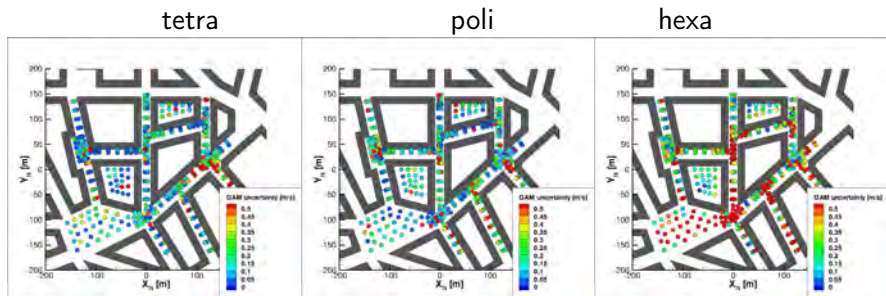
- Simplification of physical complexity
- Usage of previous data
- Physical boundary conditions
- Geometric boundary conditions

Numerical

- Computer programming
- Computer round-off
- Spatial and temporal discretization
- Iterative convergence



One way to estimate numerical uncertainty



Global Averaging Method based on Richardson extrapolation

Tyrone S. Phillips and Christopher J. Roy. Evaluation of Extrapolation-Based Discretization Error and Uncertainty Estimators. In 49th AIAA Aerospace Sciences Meeting including the New Horizon Forum and Aerospace Exhibition 4-7 January 2011, 2011.

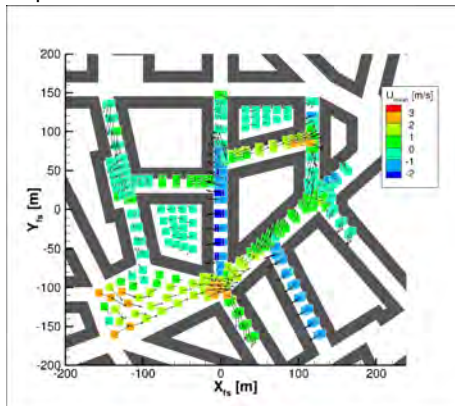
Recommendations by:

- ASME - American Society of Mechanical Engineers
- AIAA - American Institute of Aeronautics and Astronautics

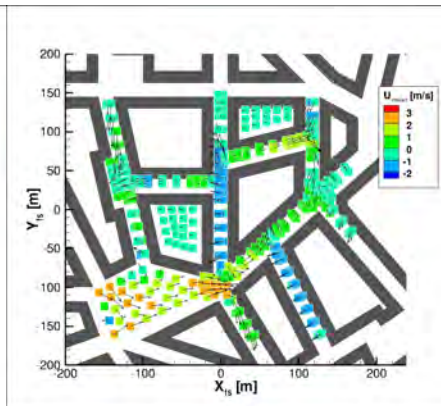


Flow field in the urban canopy

Experiment



result of the finest hexa mesh



Thank you for your attention!

