COST 732 WORKSHOP on “Quality Assurance of Micro-Scale Meteorological Models” に参加して

東京工芸大学　義江龍一郎

International WORKSHOP
on
“Quality Assurance of Micro-Scale Meteorological Models”

June 3 to 5, 2009

University of Hamburg, Bundesstraße 53 and 55, D-20146 Hamburg/Germany

COSTとは

COST is an intergovernmental framework for European Cooperation in Science and Technology, allowing the coordination of nationally-funded research on a European level. COST contributes to reducing the fragmentation in European research investments and opening the European Research Area to cooperation worldwide.

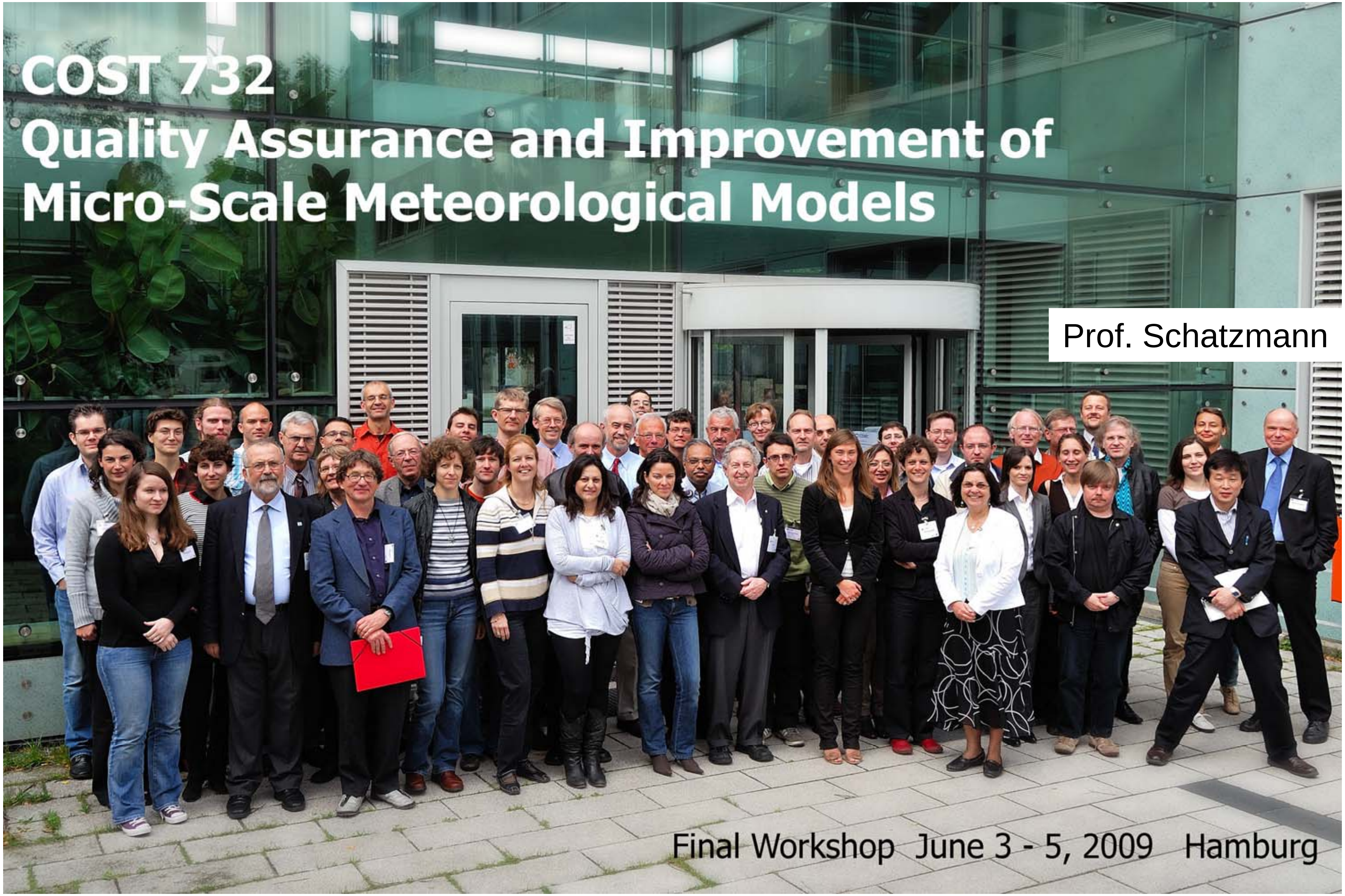
National fund

・ヨーロッパの３６カ国(EU27カ国＋9カ国）が加盟。

・加盟国の税金で運営されている。事務局はブリュッセルにある。

・研究費は出さないが、ヨーロッパの科学者たちの研究協力のための
プラットフォームを提供（会議費、出版費、旅費/宿泊費等）

・各プロジェクトはActionと呼ばれる。ひとつのActionの期間は4年で、
平均的には10万ユーロ/年のお金が支払われている。



※ ４年の期間が過ぎ、これが最後のワークショップ

COST732　ワークショップ　プログラム　初日

Wednesday, June 3, 2009

18:00 – 21:00　Get together: Cheese and Wine in Hamburg University's Wind Tunnel Facility

COST732　ワークショップ　プログラム　２日目朝
セッションA） Model Evaluation Activities World Wide

Thursday, June 4, 2009

08:45 – 09:00	Welcome, Motivation for the workshop	*Michael Schatzmann*
A)	**Model Evaluation Activities World Wide**	
09:00 – 09:30	Evaluation Activities for CFD codes in general	*William Oberkampf*
09:30 – 10:00	Evaluation Activities for URBAN Non-CFD codes	*Steve Hanna*
10:00 – 10:30	Evaluation Activities for URBAN CFD codes	*Ryuichiro Yoshie*
10:30 – 10:45	Evaluation Activities for URBAN LES codes	*Gopal Patnaik*
10:45 – 11:15	**Coffee/ Tea**	

Schatzmann教授の趣旨説明

Technical Meteorology

MOTIVATION

- Models are increasingly used
- Important decisions are based on modelled results
- Lack of confidence in modelled results
- A generally accepted quality assurance procedure is needed
- Consensus on validation data is needed

Schatzmann教授の趣旨説明

UHH

Technical Meteorology

Objective of COST action 732

- The main objective of the Action is to improve and assure the quality of micro-scale meteorological models that are applied for predicting flow and transport processes in urban or industrial environments.

Schatzmann教授の趣旨説明

UHH

Technical Meteorology

How will the objective be met ?

- Development of a coherent and structured evaluation procedure
- Provision of appropriate validation data
- Proof of serviceability of the procedure
- Consensus building within the scientific community

Schatzmann教授の趣旨説明

Technical Meteorology

Five COST 732 Documents:

- ESF/COST Exploratory Workshop Hamburg 2005 Quality assurance of microscale meteorological models
- Background and Justification Document to Support the Model Evaluation Guidance and Protocol
- Model Evaluation Guidance and Protocol Document
- Best Practice Guideline for the CFD simulation of Flows in the Urban Environment
- Model Evaluation Case Studies: Approach and Results

Verification and Validation in Computational Fluid Dynamics

Dr. William L. Oberkampf
Consultant, Albuquerque, New Mexico

Outline of the Presentation

- Quality assurance vis-à-vis verification and validation in CFD
- Elements of verification
- Elements of validation
- Characteristics of validation experiments
- Validation, calibration and predictive capability
- Closing Remarks

Verification and Validation in Computational Fluid Dynamics

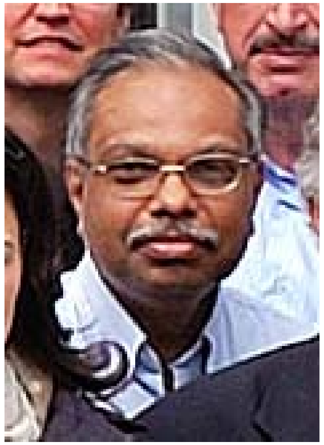
Closing Remarks

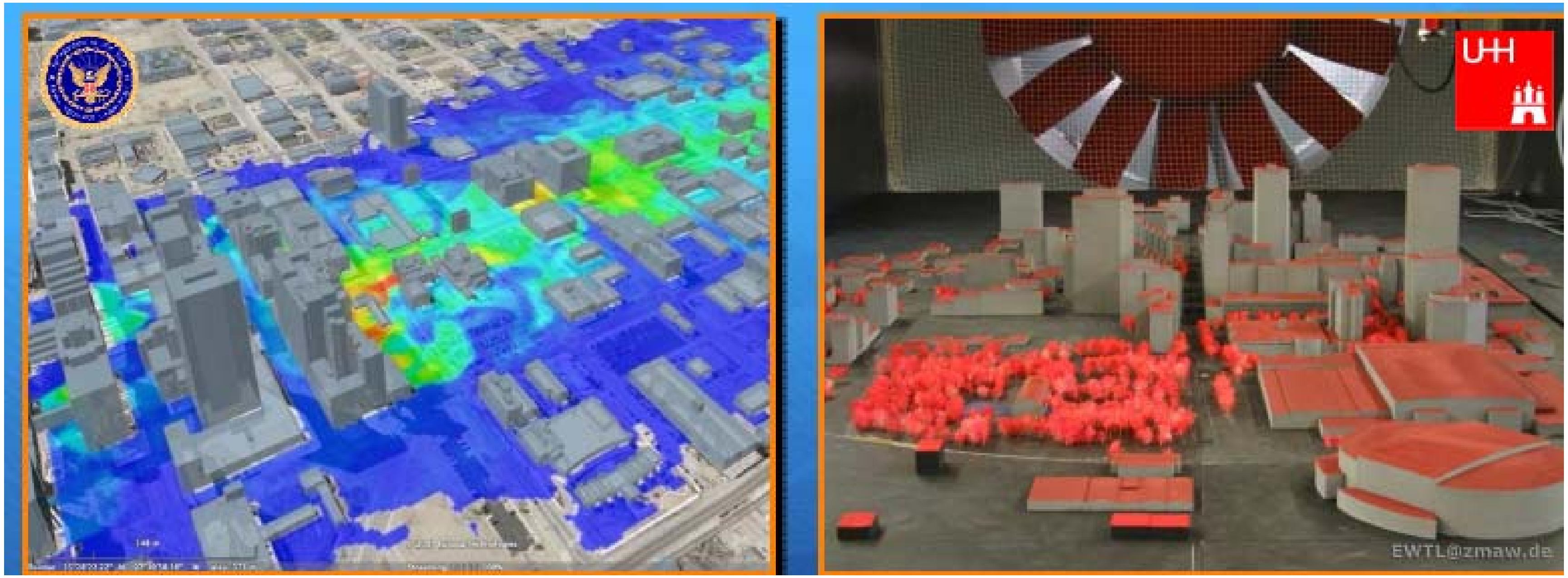
- If code verification and solution verification are not adequately addressed, the quality of our simulations is a mirage.
- In validation experiments the goal is a critical assessment of the predictive capability of the model.
- High quality validation experiments can only be achieved through:
  - Measurement of all of the important input data needed by the code
  - Close cooperation between experimentalists and computationalists.
- We must learn from history:

Science is built on reproducible results.

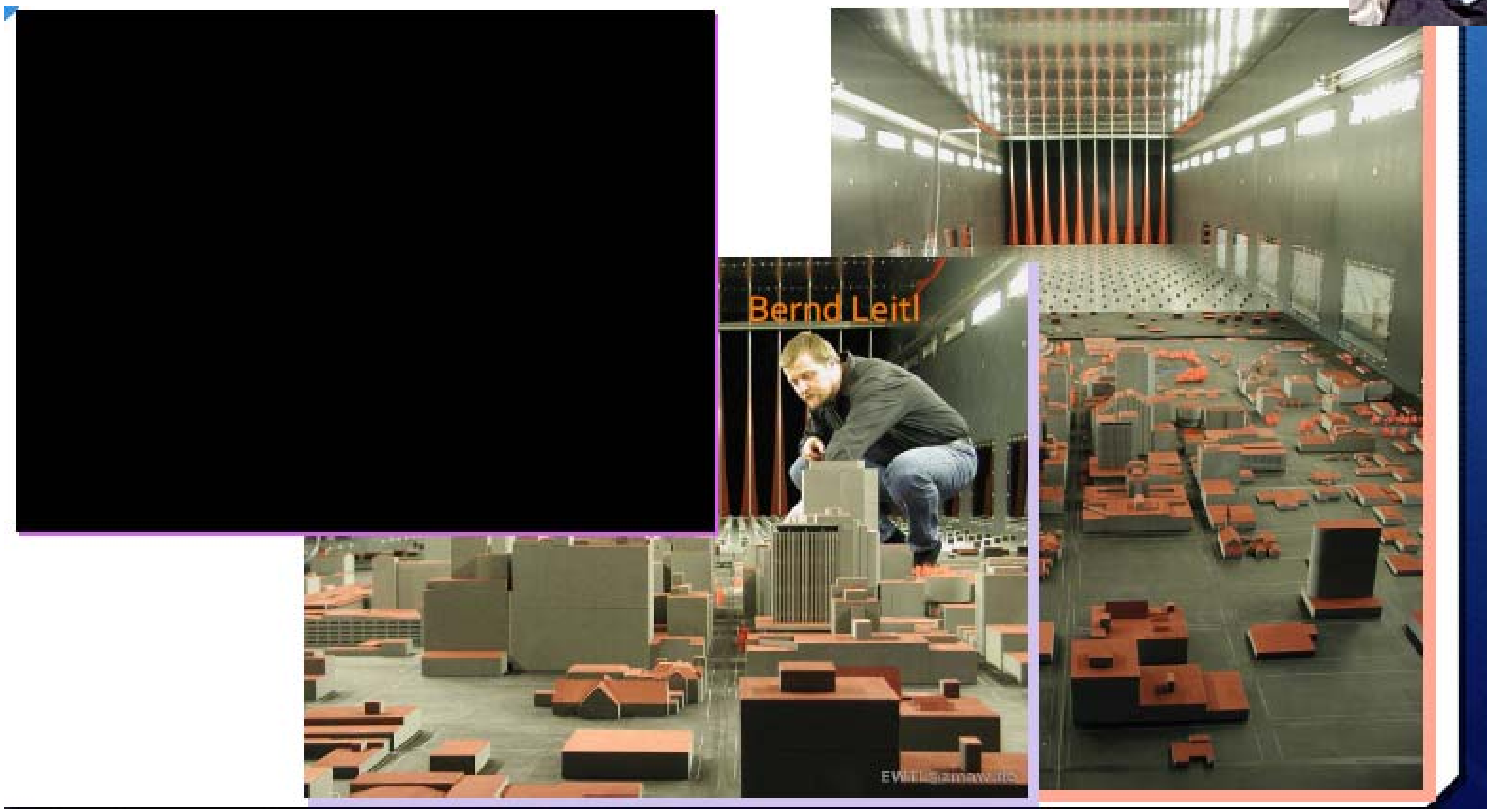
Model- and Application-Specific Validation Data for LES-Based Transport and Diffusion Models

Gopal Patnaik Naval Research Laboratory, Washington DC

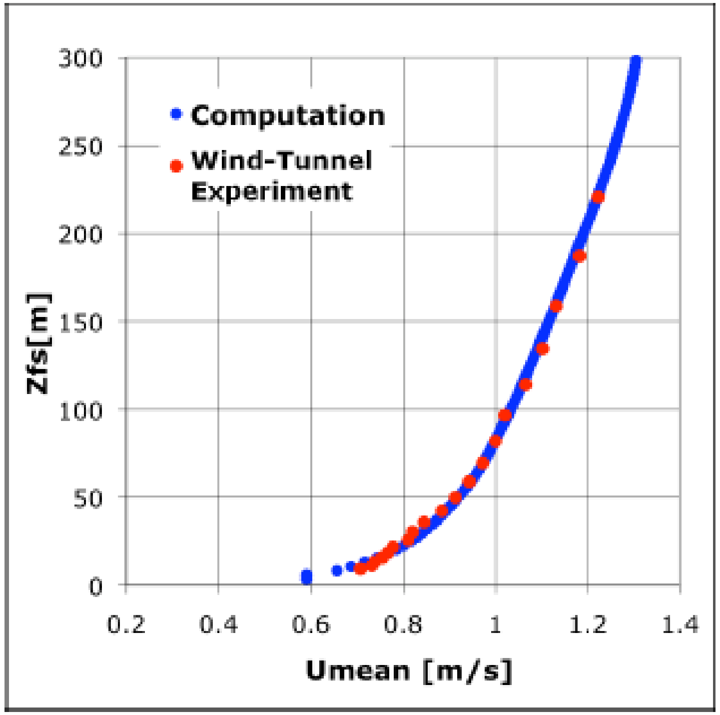




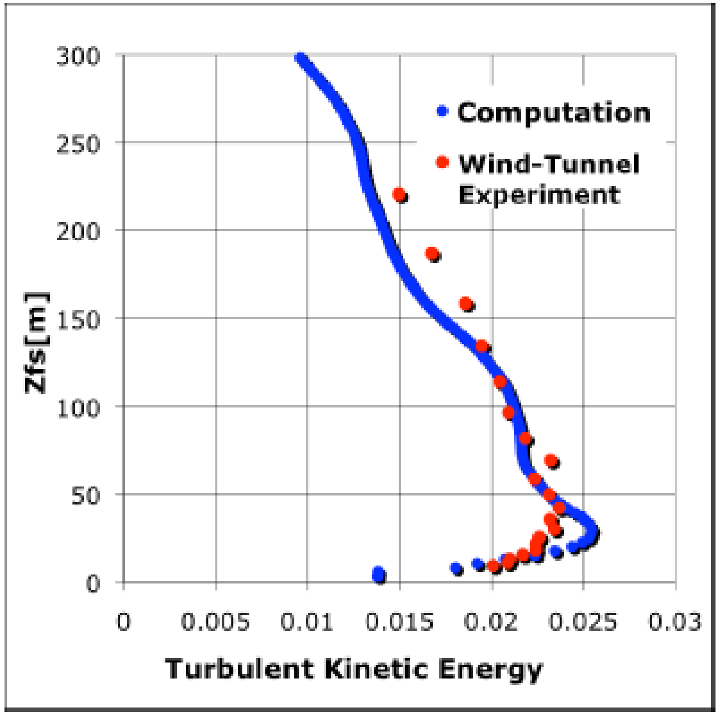
Model- and Application-Specific Validation Data for LES-Based Transport and Diffusion Models



Comparisons of Mean Flow & Turbulent Kinetic Energy Profiles at Inflow



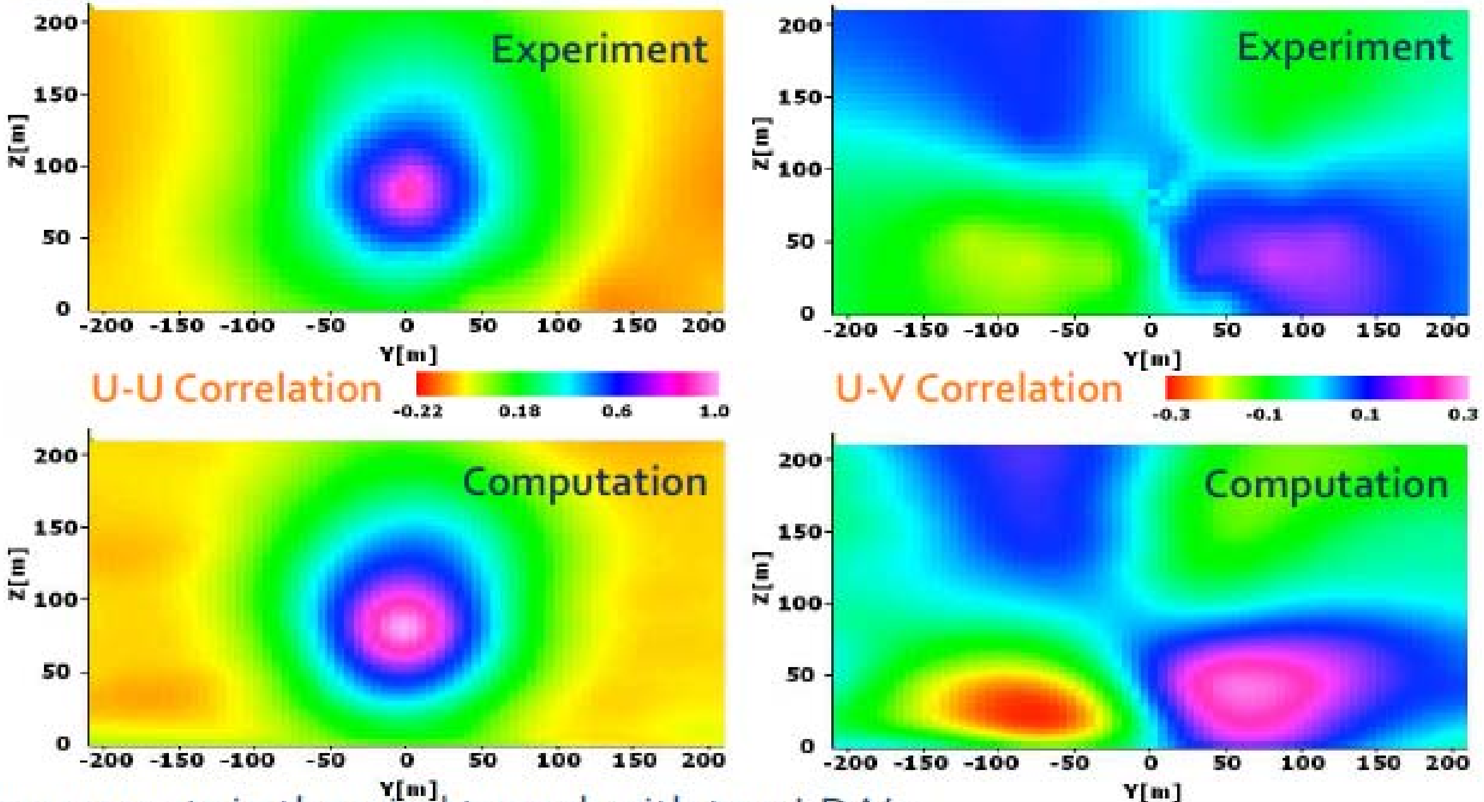
Mean Flow Profile



Turbulent Kinetic Energy Profile

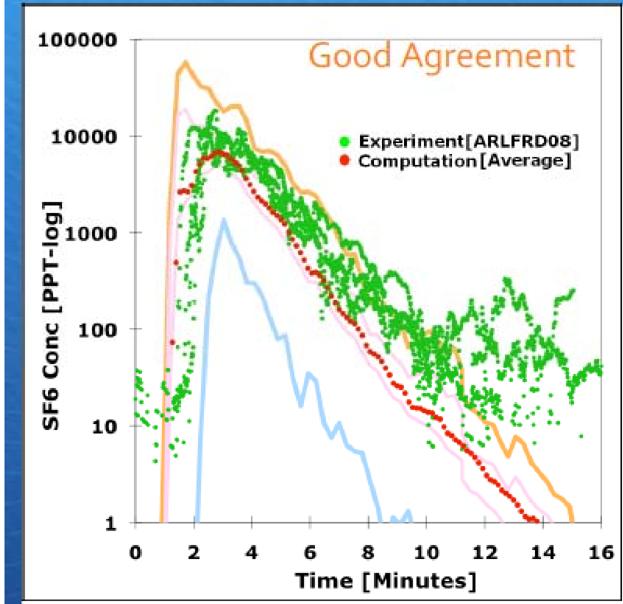
Various adjustments were made to the geometrical features to improve agreement with the wind tunnel turbulent kinetic energy (TKE).

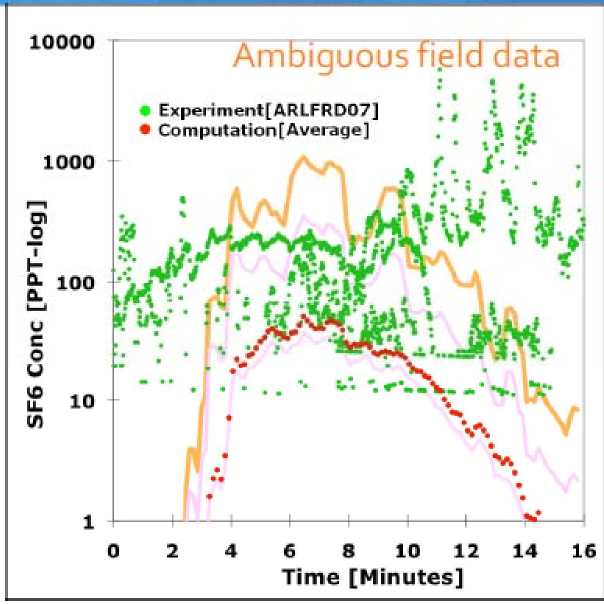
Correlation Measurement Comparisons

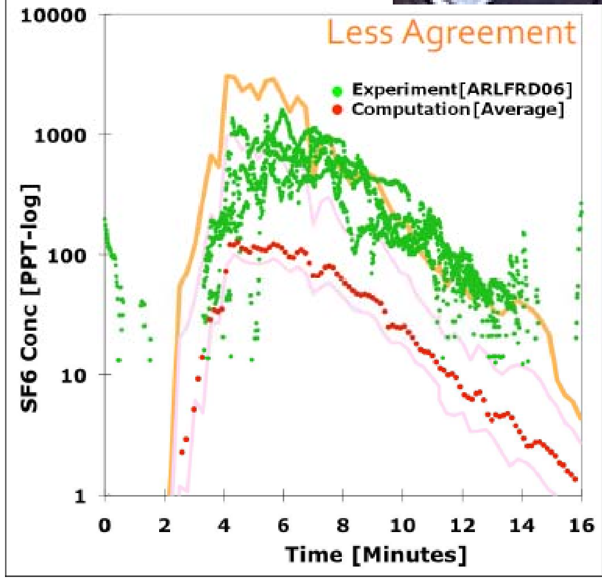


- Measurements in the wind tunnel with two LDA's
- Stream-wise velocity (U) was reference. U, V, W velocity are measured at test points.
- The geometry of the spires and roughness elements in the wind-tunnel inlet were modeled in the CFD simulations to generate the turbulent urban boundary layer.

JU2003 IOP8 Puff Release Field Test Comparisons

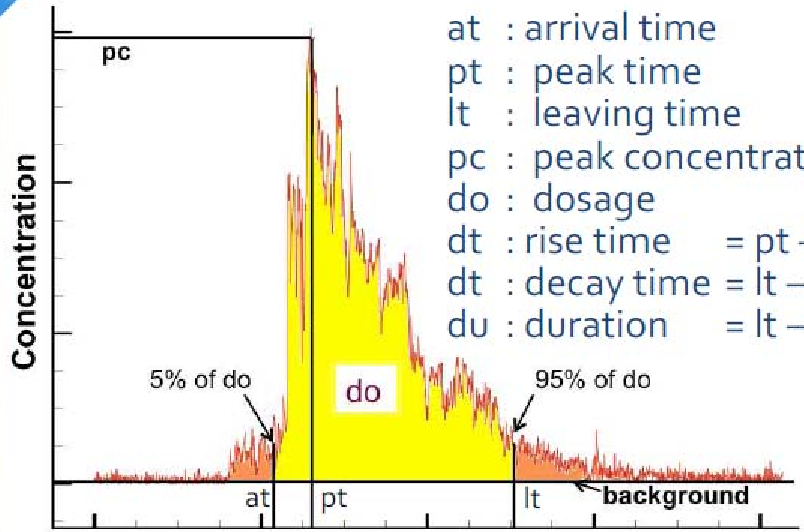






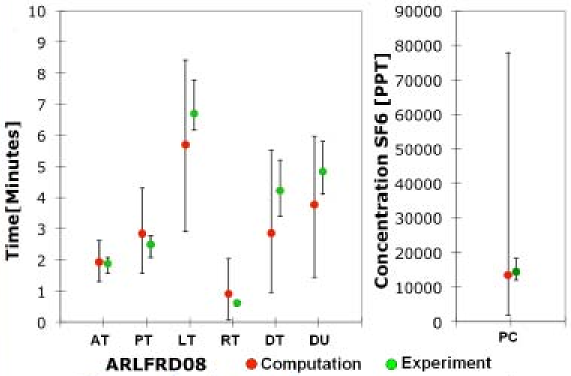
- The green dots show time shifted and stretched concentration normalized field data for all four puff releases. The red dots show the average of the sixty computational realizations and the pink lines show the standard deviation.
- The upper (orange) and lower (blue) lines show the maximum and minimum values respectively.
- Some experimental samplers show very large variability; cannot be used for visual comparison.

Puff Parameters for Quantitative Evaluation

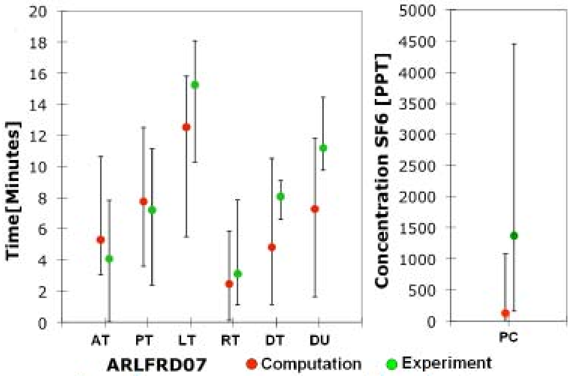


at : arrival time
pt : peak time
lt : leaving time
pc : peak concentration
do : dosage
dt : rise time = pt – at
dt : decay time = lt – pt
du : duration = lt – at

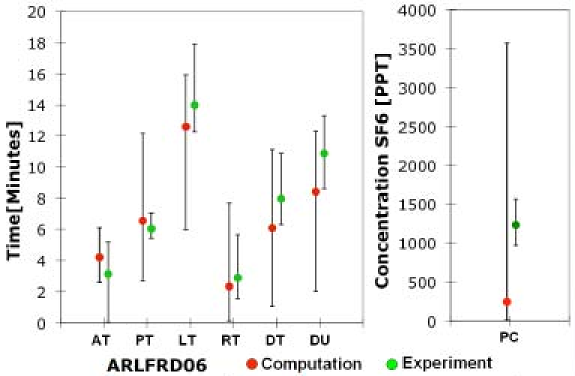
- Comparison of puff parameters
  - Average: red dots - computation, green dots - JU2003 IOP8
  - Cross bars: range between maximum and minimum values
- Puff parameters show better agreement then visual inspection would indicate.



Good visual agreement



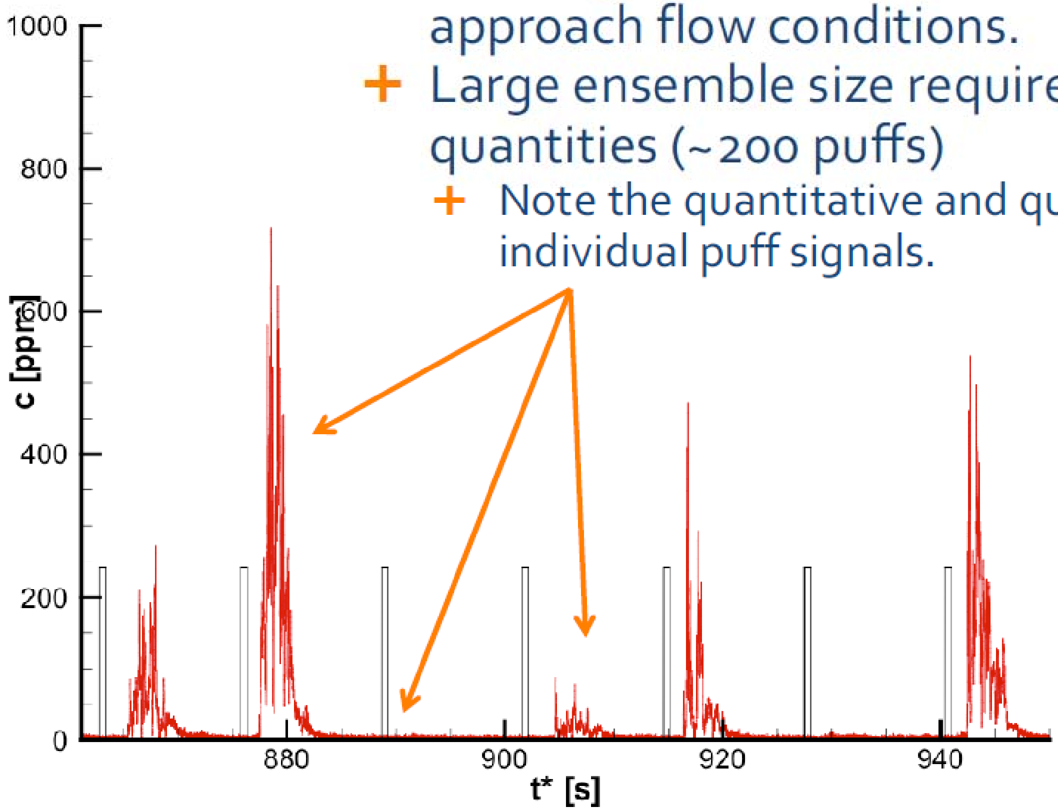
Ambiguous exptl. data

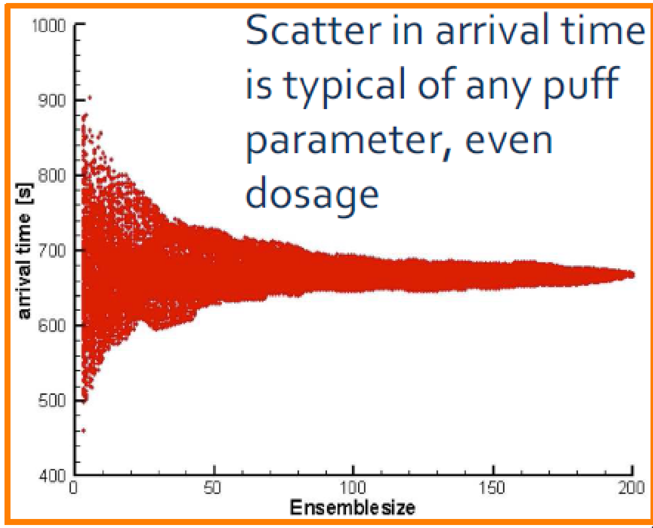


Poor visual agreement

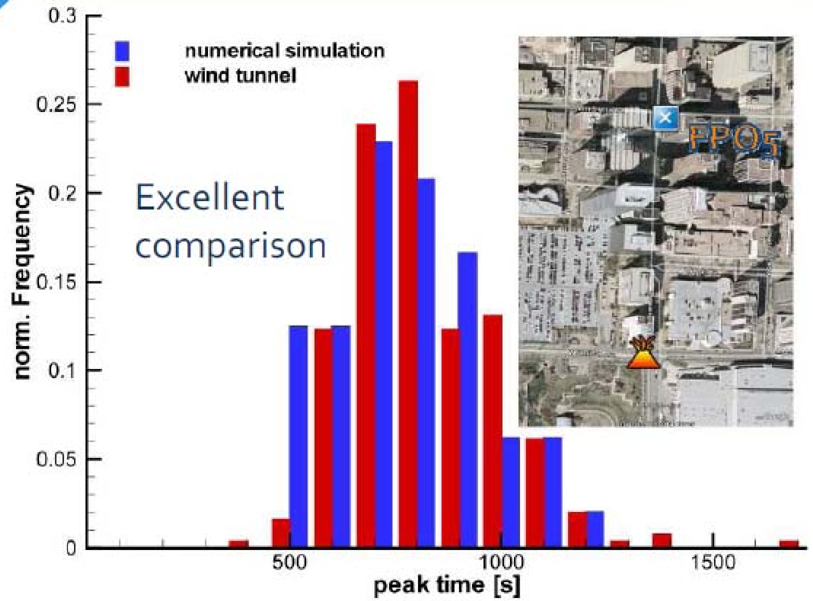
Typical Variability of Puff Time Series Signals from Wind Tunnel Measurements

- Typical segment taken from a puff time series signal, showing consecutive puffs under identical mean approach flow conditions.
- Large ensemble size required determine mean quantities (~200 puffs)
  - Note the quantitative and qualitative difference between individual puff signals.

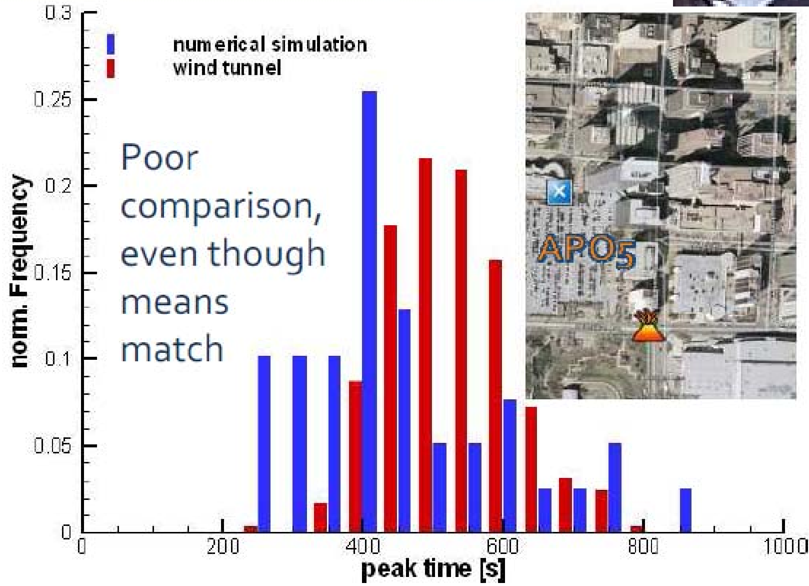




Comparison of Peak Time Probability Distributions – Numerical and Wind Tunnel



FPO5: Along Plume Centerline
Mean numerical peak time: 727 sec.
Mean wind tunnel peak time: 772 sec.
Difference: 5.8%
Mann-Whitney test: statistically *insignificant* difference in median



APO5: At Plume Edge
Mean numerical peak time: 376sec.
Mean wind tunnel peak time: 393 sec.
Difference: 4.3%
Mann-Whitney test: *extremely significant* difference in median