COST732 ワークショップ プログラム ２日目昼
セッションB) Model Evaluation Activities in Europe: COST 732

10:45 – 11:15 Coffee/ Tea

B) Model Evaluation Activities in Europe: COST 732

11:15 – 11:35	COST 732 - Background and Justification Document	*Ana Margarida Costa* University of Aveiro, ポルトガル
11:35 – 11:55	COST 732 - Evaluation Guidance and Protocol Document	*Rex Britter* ケンブリッジ大学, 教授
11:55 – 12:15	COST 732 - Best Practice Guideline	*Bertrand Carissimo*
12:15 – 12:35	COST 732 - Metrics and Evaluation Tool	*Ruwim Berkowicz* デンマークの国立環境研

COST732 ワークショップ プログラム ２日目午後
セッションC) Application of the COST 732 Evaluation Strategy
MUST Case

C) Application of the COST 732 Evaluation Strategy

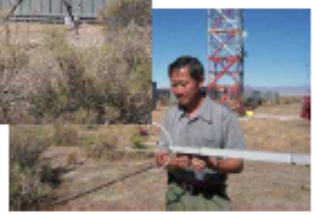
14:00 – 14:30	COST 732 - Data for Model Validation – MUST Case	*Bernd Leitl*
14:30 – 15:00	Non-CFD Codes Applied to MUST Data	*Kathrin Baumann-Stanzer*
15:00 - 15:30	Atmospheric RANS and Lagrangian Models	*Silvia Trini-Castelli*
15:30 – 16:00	CFD RANS Codes Applied to MUST Data	*Silvana Di Sabatino*

MUSTの実測と風洞実験

Bernd Leitl 教授

publication of data

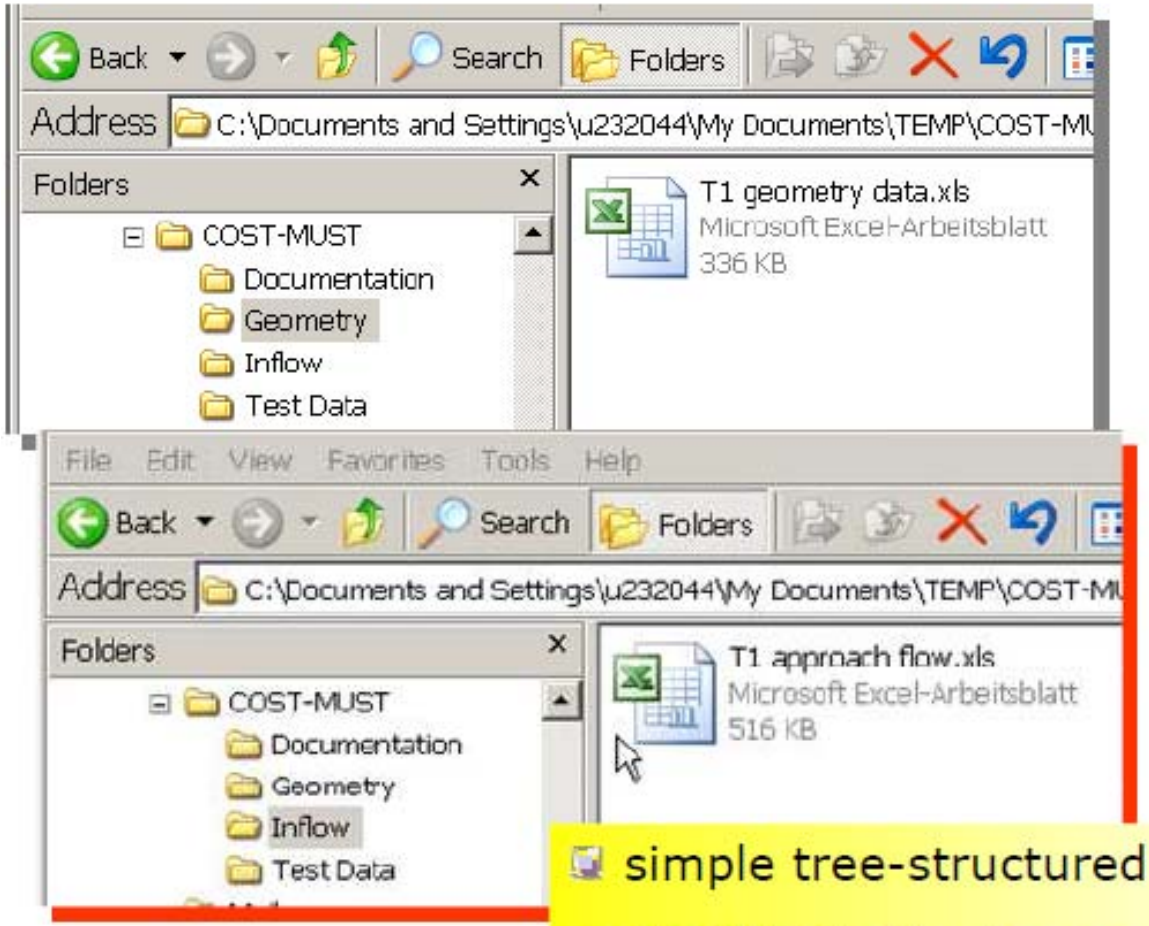
- MUST Mock Urban Setting Test (DPG West Desert Test Center, Fall 2001)
  - idealized suburban roughness array (120 containers 12.2m x 2.42m x 2.54m, 5H x 3H spacing)
  - flat open terrain / homogenous approach flow
  - well-instrumented and documented test site
  - systematic, application-specific test data available from field and laboratory experiments



publication of data

- MUST wind tunnel experiment @ EWTL
  - model scale 1:75, exactly scaled representation of the obstacle array
  - completely documented boundary conditions for neutrally stratified boundary layer flow similar to selected full scale conditions
  - systematic flow and dispersion measurements

publication of data



- simple tree-structured data archive
- MS EXCEL files format
- PDF files for documentation and references

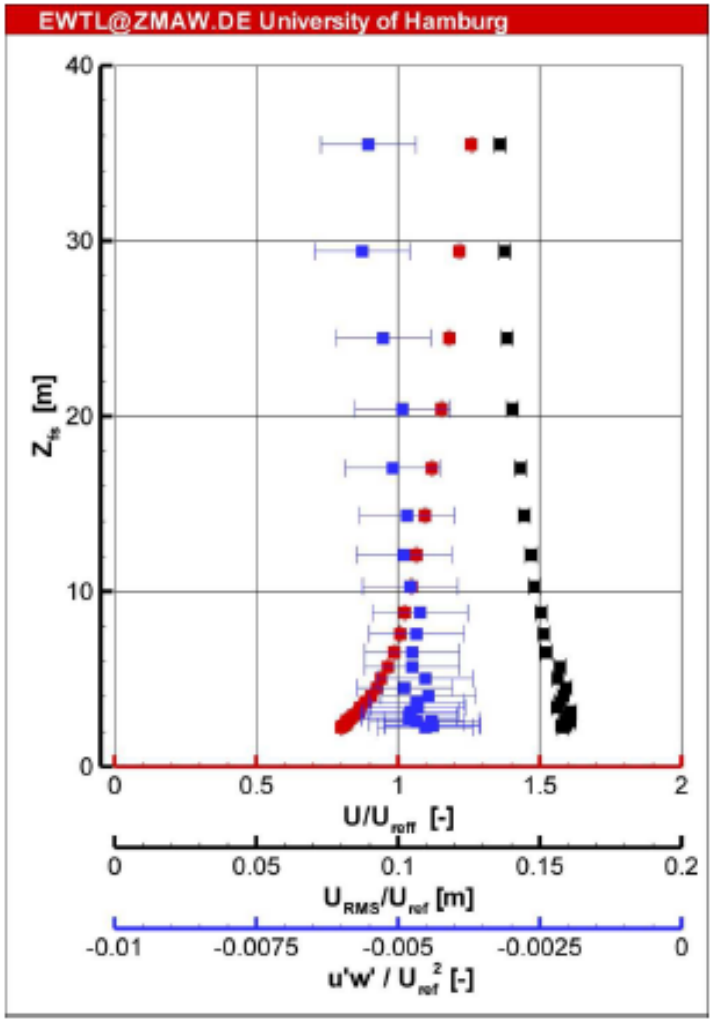
publication of data

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	Wind Tunnel Approach Flow Conditions Measured																	
2	see EWTL data report for description of the experimental setup																	
3																		
4	Part 1	approach flow wind profile characterization																
5		wind tunnel coordinate system, positive x-axis aligned with mean wind direction, full-scale dimensions																
6		wind profile fit																
7		best fit data for zref [m]		8.775														
8		roughness length z0 [m]		0.0166														
9		power law exponent 1/n [-]		0.16														
10		offset d0 [m]		0														
11																		
12																		
13	Part 2	measured mean wind profile																
14		wind tunnel coordinate system, positive x-axis aligned with mean wind direction, full-scale dimensions																
15																		
16		zref [m]	7.29															
17		variable	X	Y	Z	U/Uref	V/Uref	W/Uref	Urms/Uref	Vrms/Uref	Wrms/Uref	uV/Uref²	uW/Uref²	U skewness	V skewness	W skewness	U flatness	V flatness	W flatnes
18		unit	[m]	[m]	[m]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
19		confidence +/-	0.019	0.019	0.01	0.004	0.004	0.004	0.002	0.002	0.002	0.00084	0.00084						
20																			
21			-144.00	-2.25	2.25	0.79924	0.00131	0.00688	0.15835	0.16448	0.09289	0.00007	-0.00452	0.223	-0.104	0.188	3.456	3.034	3.
22			-144.00	-2.25	2.33	0.80502	0.00805	0.00703	0.15761	0.16616	0.09333	0.00022	-0.00439	0.199	-0.111	0.170	3.537	3.220	3.
23			-144.00	-2.25	2.40	0.81474	0.00667	0.00629	0.15918	0.15427	0.09229	0.00043	-0.00441	0.250	-0.119	0.162	3.633	3.255	3.
24			-144.00	-2.25	2.55	0.82300	0.00232	0.00578	0.16083	0.14496	0.09296	0.00013	-0.00457	0.188	-0.077	0.200	3.402	3.363	3.
25			-144.00	-2.25	2.63	0.81075	0.00304	0.00404	0.15667	0.14361	0.09206	-0.00002	-0.00441	0.165	-0.060	0.197	3.600	3.421	3.
26			-144.00	-2.25	2.78	0.83336	0.00069	0.00501	0.15961	0.13640	0.09198	0.00018	-0.00481	0.150	-0.047	0.185	3.255	3.275	3.
27			-144.00	-2.25	2.93	0.84351	0.00644	0.00372	0.15972	0.13214	0.09266	-0.00024	-0.00480	0.129	0.016	0.241	3.139	3.288	3.
28			-144.00	-2.25	3.15	0.86306	0.00193	0.00305	0.16089	0.13116	0.09094	-0.00085	-0.00477	0.113	-0.009	0.265	3.117	3.316	3.
29			-144.00	-2.25	3.38	0.86565	0.00470	0.00144	0.15621	0.13018	0.08971	-0.00064	-0.00465	0.110	0.053	0.241	3.181	3.170	3.
30			-144.00	-2.25	3.68	0.88648	0.00001	0.00128	0.15714	0.12805	0.08952	-0.00038	-0.00457	0.073	0.031	0.232	3.040	3.194	3.
31			-144.00	-2.25	4.05	0.90519	0.00000	0.00004	0.15840	0.12568	0.08971	-0.00048	-0.00446	0.023	0.076	0.194	2.997	3.135	3.
32			-144.00	-2.25	4.50	0.92606	-0.00280	0.00017	0.15922	0.12713	0.08965	-0.00063	-0.00458	0.002	0.022	0.200	3.002	3.109	3.
33			-144.00	-2.25	5.03	0.94022	-0.00303	0.00087	0.15637	0.12560	0.09083	-0.00088	-0.00452	0.009	0.019	0.136	2.957	3.084	3.
34			-144.00	-2.25	5.70	0.96473	-0.00435	-0.00049	0.15713	0.12585	0.09088	-0.00023	-0.00475	-0.009	0.033	0.135	2.943	3.129	3.
35			-144.00	-2.25	6.53	0.98679	-0.00513	-0.00170	0.15230	0.12530	0.09132	-0.00128	-0.00475	-0.026	0.011	0.122	2.978	3.023	3.
36			-144.00	-2.25	7.58	1.00802	-0.00485	-0.00033	0.15133	0.12405	0.09250	-0.00087	-0.00467	-0.051	0.072	0.135	3.040	2.998	3.
37			-144.00	-2.25	8.78	1.02413	-0.00457	-0.00116	0.15045	0.12388	0.09490	-0.00054	-0.00461	-0.087	0.080	0.088	3.006	3.078	3.
38			-144.00	-2.25	10.28	1.04866	-0.00580	-0.00251	0.14814	0.12445	0.09740	-0.00114	-0.00478	-0.036	0.101	0.062	3.042	2.950	3.
39			-144.00	-2.25	12.08	1.06565	-0.00416	-0.00206	0.14698	0.12368	0.09857	-0.00047	-0.00489	-0.090	0.096	0.062	3.091	2.954	3.
40			-144.00	-2.25	14.33	1.09486	-0.00121	-0.00612	0.14447	0.12066	0.10051	-0.00090	-0.00494	-0.097	0.079	0.064	3.250	2.993	3.
41			-144.00	-2.25	17.03	1.11860	-0.00381	-0.00778	0.14329	0.12146	0.10400	-0.00099	-0.00509	-0.064	0.072	0.044	3.270	2.938	3.
42			-144.00	-2.25	20.40	1.15384	-0.00174	-0.01364	0.14028	0.11931	0.10473	-0.00088	-0.00492	-0.163	0.028	0.095	3.279	3.005	3.
43			-144.00	-2.25	24.45	1.18163	0.00190	-0.01601	0.13862	0.11700	0.10736	-0.00057	-0.00526	-0.171	-0.007	0.136	3.156	3.066	3.
44			-144.00	-2.25	29.40	1.21702	0.00173	-0.02243	0.13758	0.11482	0.10841	-0.00080	-0.00563	-0.261	0.032	0.171	2.969	3.126	3.
45			-144.00	-2.25	35.48	1.25875	0.00226	-0.02723	0.13590	0.11145	0.10437	-0.00012	-0.00552	-0.378	0.065	0.287	3.061	3.139	3.
46			-144.00	-2.25	42.90	1.31132	0.00244	-0.03896	0.12857	0.10582	0.10288	-0.00043	-0.00492	-0.561	0.012	0.441	3.504	3.273	3.
47			-144.00	-2.25	51.90	1.36254	-0.00330	-0.04375	0.12080	0.09801	0.09629	-0.00036	-0.00443	-0.780	0.037	0.591	4.137	3.564	3.
48																		
49																		
50	Part 3	lateral homogeneity of the approach flow																
51		wind tunnel coordinate system, positive x-axis aligned with mean wind direction, full-scale dimensions																
52		Measured at 13 points for Y = -120m to Y = +112m !																
53						Maximum measured deviation for a given variable specified in percent of the reference wind speed												
54		variable	X	Y	Z	dU	dV	dW	dUrms	dVrms	dWrms	duV'	duW'	U skewness	V skewness	W skewness	U flatness	V flatness	W flatnes
55		unit	[m]	[m]	[m]	% of Uref	% of Uref	% of Uref	% of Uref	% of Uref	% of Uref	% of Uref²	% of Uref²	%	%	%	%	%	%
56																			
57			-144.00		3.75	2.78530	5.21669	1.46899	0.33214	0.91037	0.19958	0.16525	0.04424	11.350	13.000	8.600	12.850	13.100	20.

Yee & Biltoft 2004 | MUST field data | WT mean flow data | WT wind direction fluctuation | WT turbulence spectra | plots

publication of data

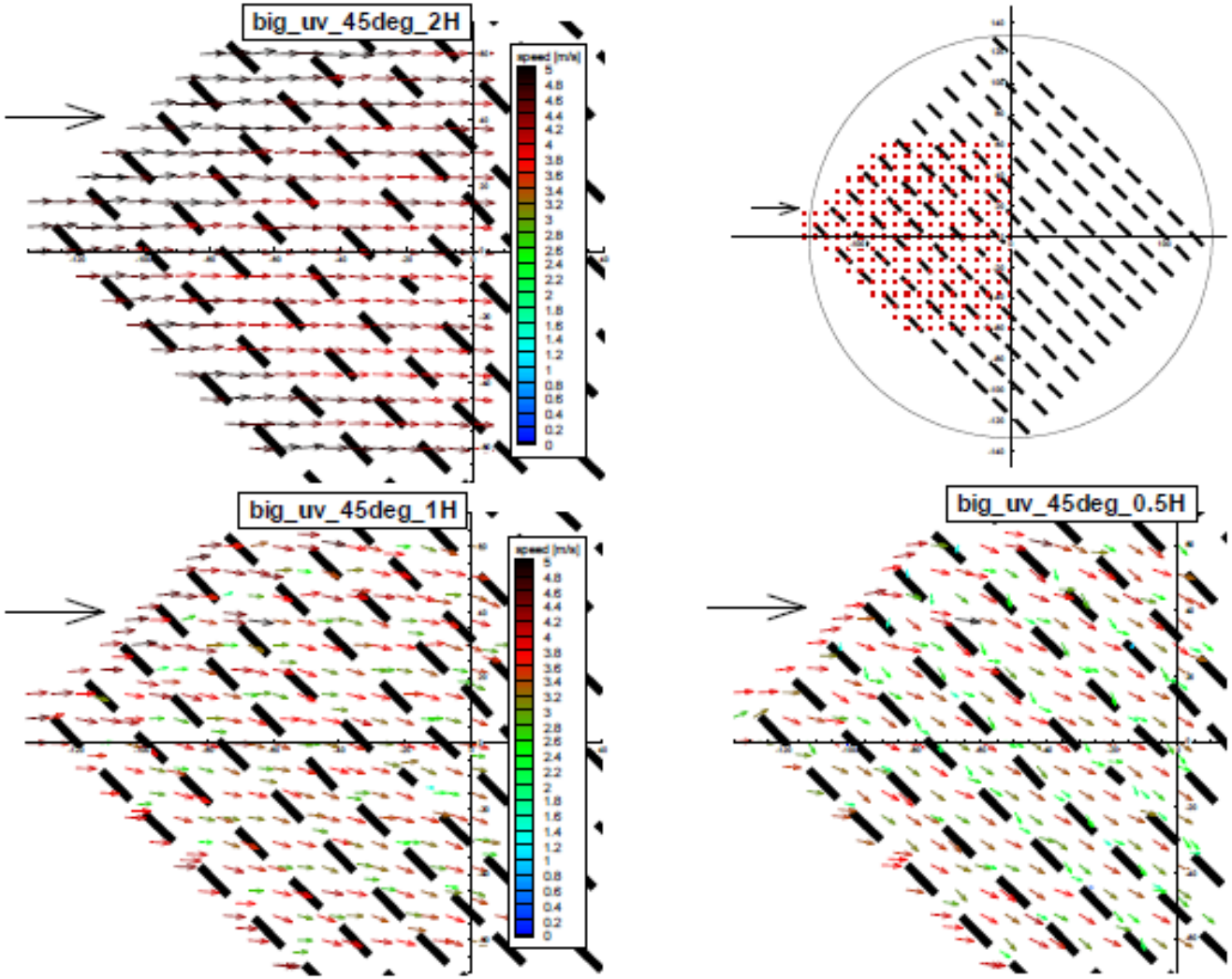
- example - approach flow / boundary conditions



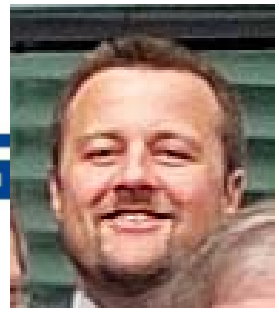
- sufficiently resolved vertical profiles
- statistically representative mean values
- specified confidence interval

publication of data

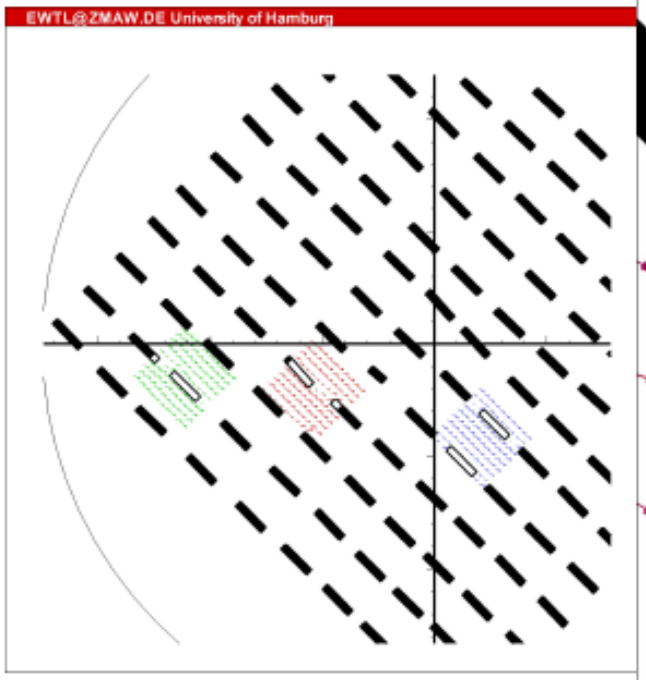
- example - flow data within a coarse measurement grid

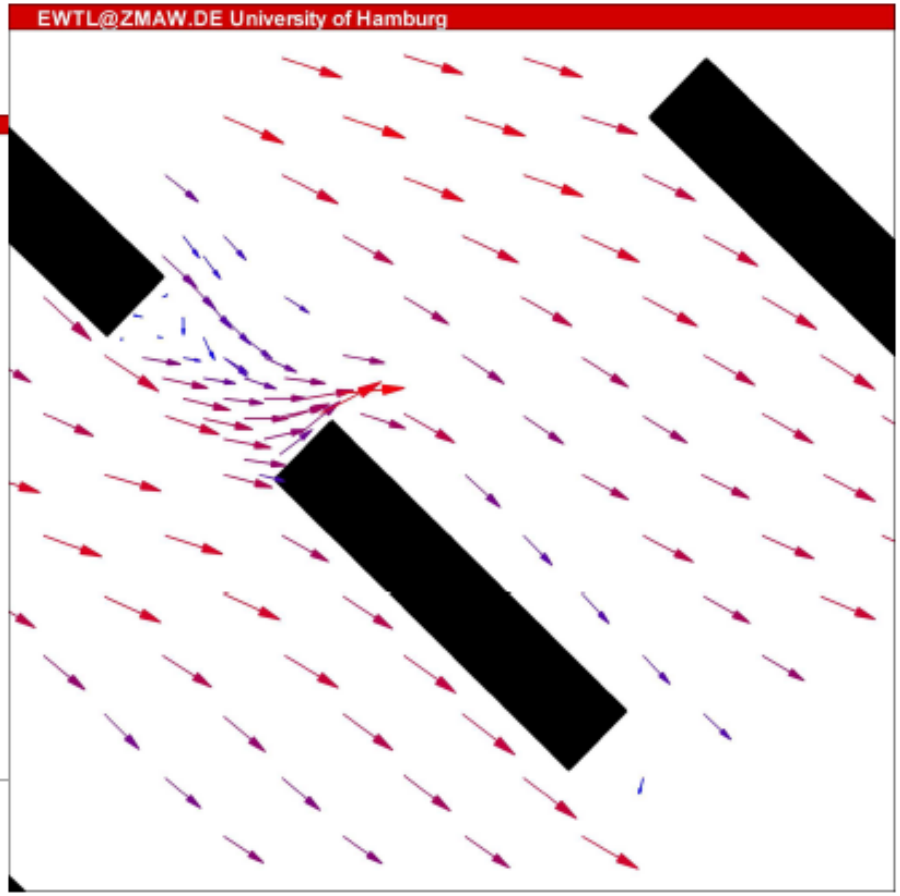


publication of data

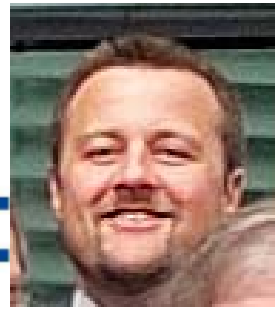


- example - locally resolved flow measurements

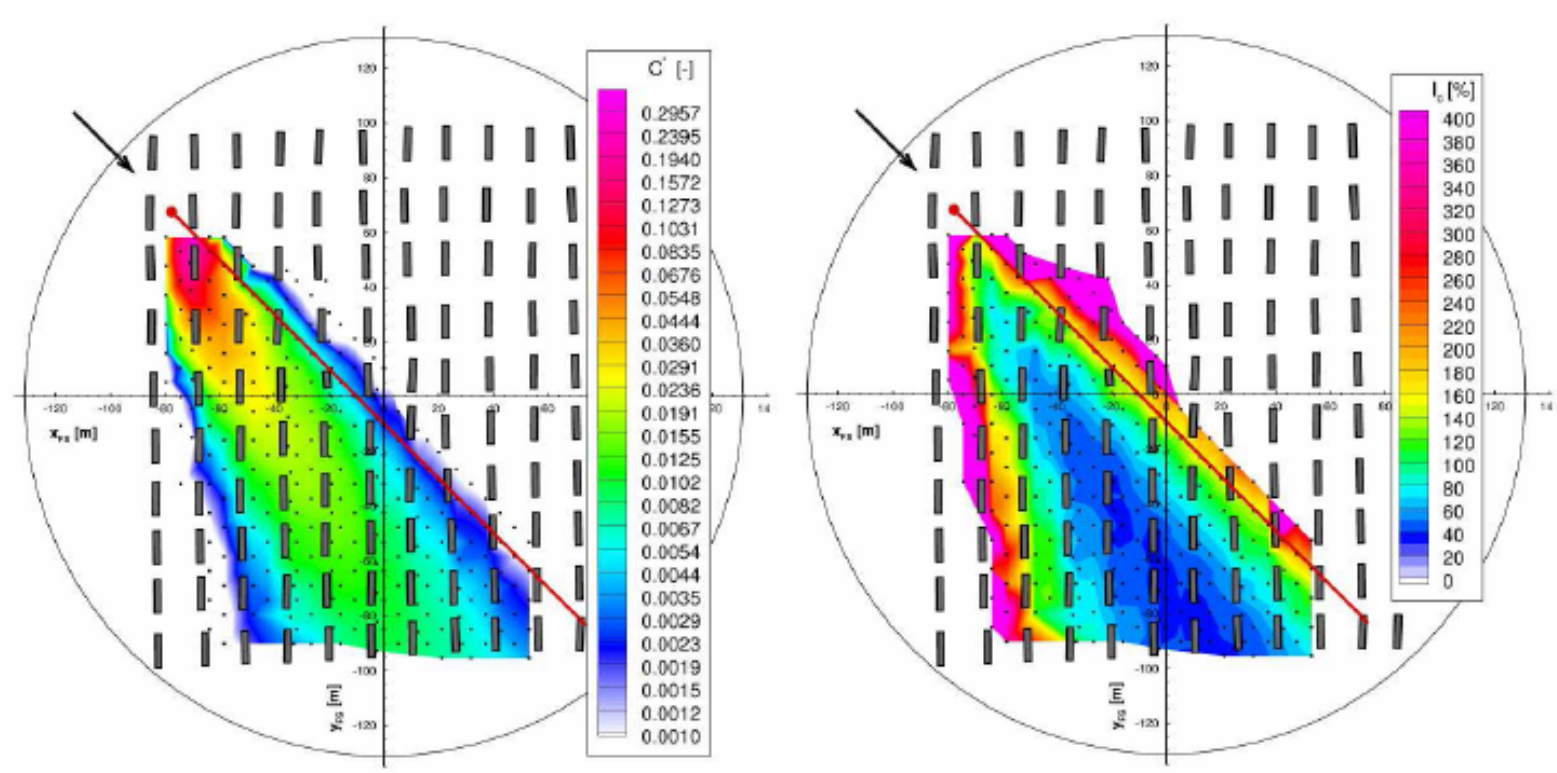




publication of data



- example - dispersion data within a coarse measurement grid



CFD RANS Codes Applied to MUST Data

***Silvana Di Sabatino*, Università del Salento**

The Must Exercise
codes involved

Models can be thought for general OR SPECIFIC applications, it is important to check their fitness for purpose when we use them for solving a problem or for a new application…

Computational Flui Dynamics (CFD) models

- MISKAM
- FLUENT
- ADREA
- STAR-CD
- FINFLO
- CFX
- MITRAS
- TSU/M2UE
- VADIS
- CODE_SATURNE

15 GROUPS INVOLVED

- ***0° case**: about 40 model flow results (32 public inside the Excel workbooks)*
- ***-45° case**: about 30 model flow results (28 public)*
- ***-45° case:** 22 model dispersion results (all public)*

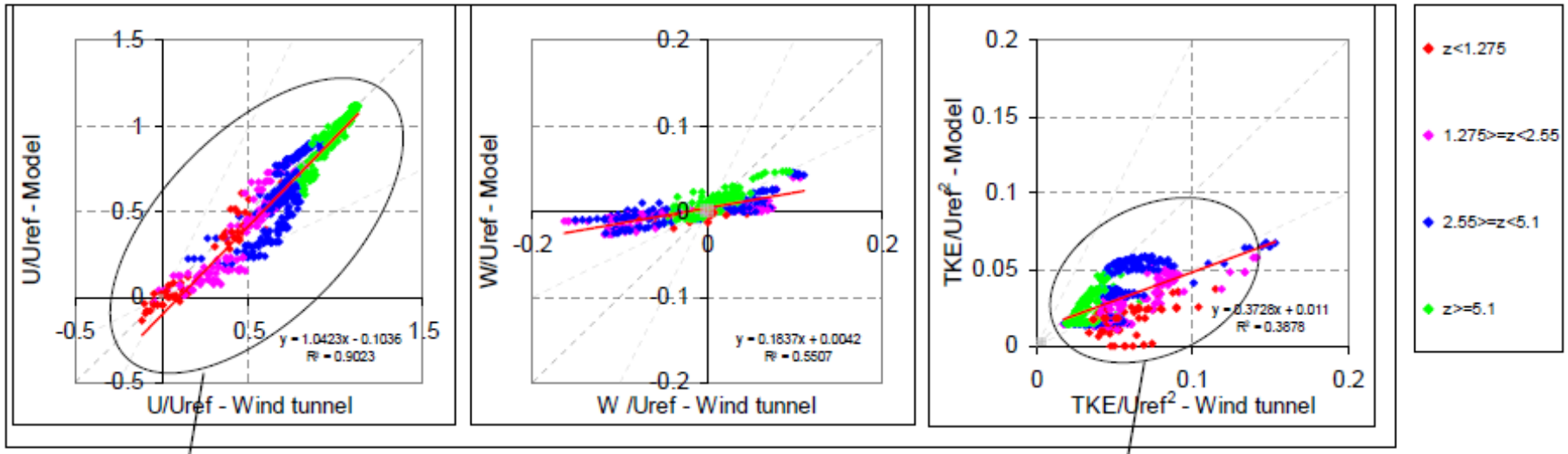
7 GROUPS INVOLVED

- *-45° case: about 10 model dispersion results*

Non-CFD models

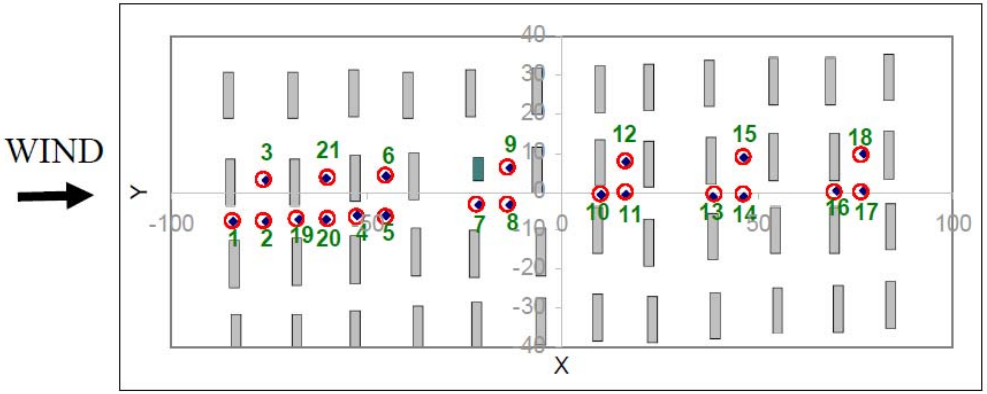
- LASAT
- ADMS-URBAN
- RAMS
- OML
- ESCAPE
- CALPUFF

1. Miskam A – standard k-ε



U well predicted

W and TKE underpredicted especially within the building layers

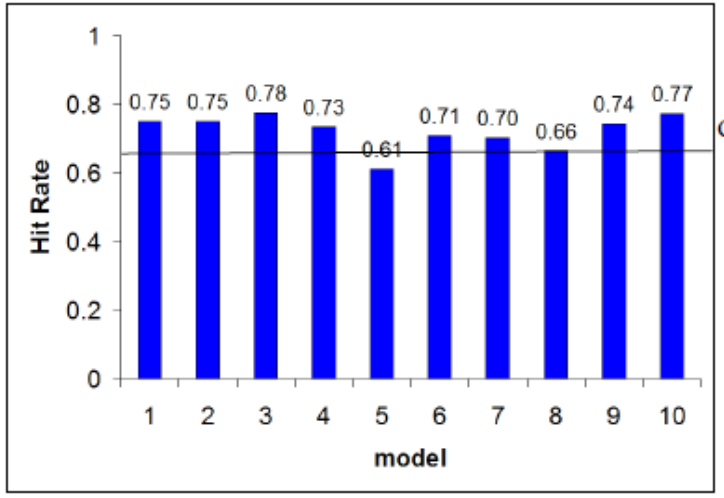


Results

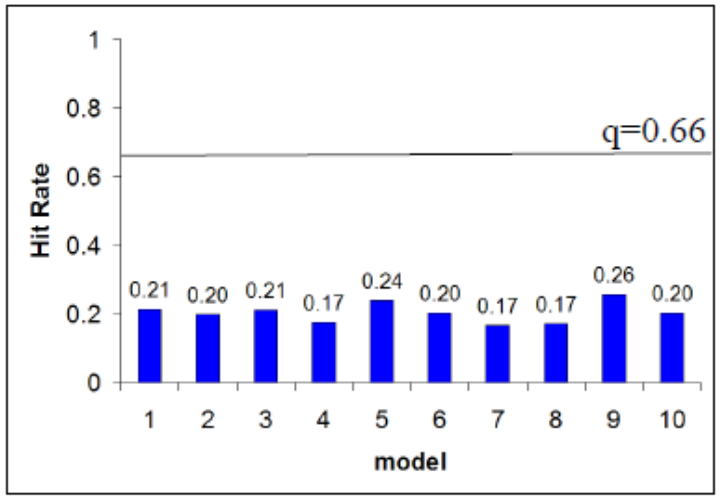
0° approach flow case - flow

q>0.66 (VDI)

Hit rate for mean velocity components



U/U_{ref}



W/U_{ref}

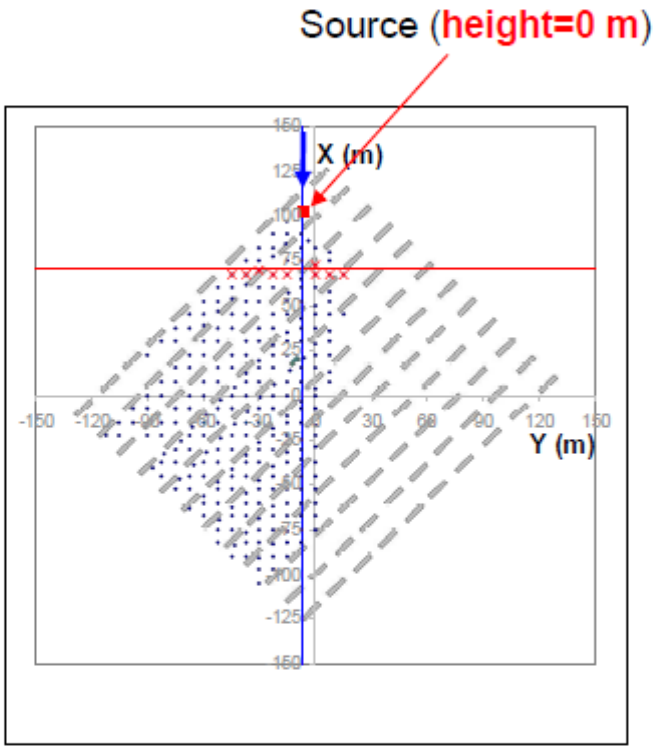
- U/U_{ref}: predicted very well by nearly all simulations with hit rates larger than 0.66. Mostly due to the good agreement between simulation and experiment above roof height
- W/U_{ref}: not well predicted by all simulations (mostly underpredicted). All runs failed to predict the strong downward flow, leading to these low hit rates (maximum at q=0.31)
- The quickly available metrics are therefore useful for identifying possible problems that can then be further analysed by a detailed inspection of the simulation results at the measurement positions.
- This does however not mean that a detailed analysis of the data is obsolete in the case of good metrics.

Distance from the source: 32m

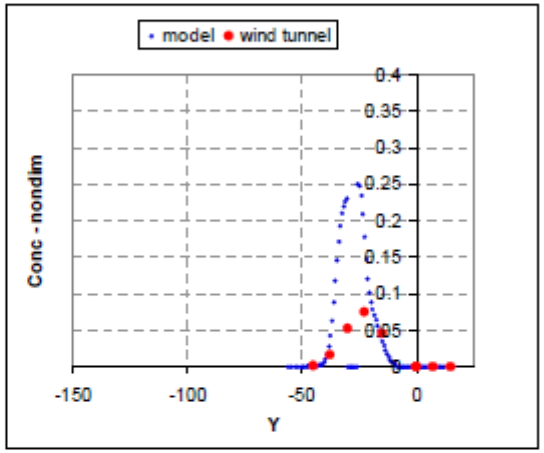
Profiles at z=0.5H

Results

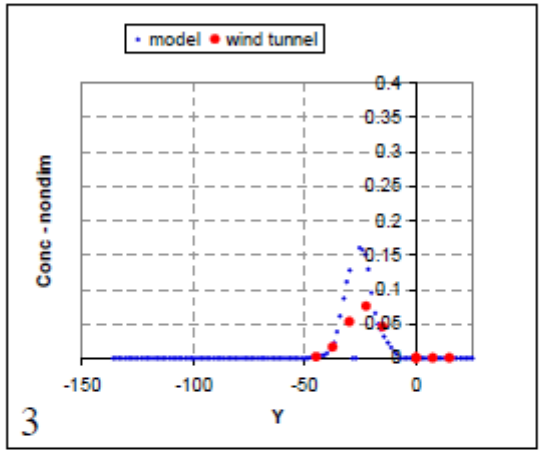
-45° approach flow case - dispersion



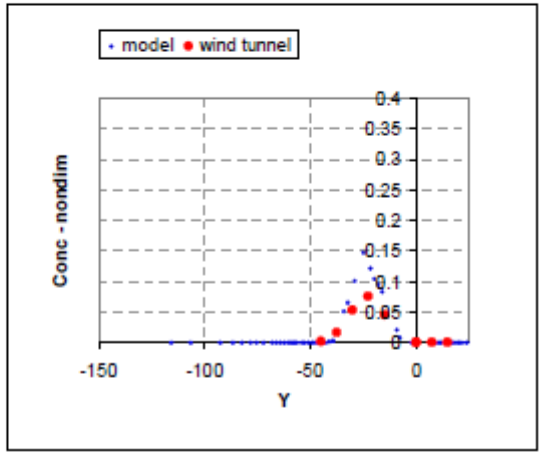
1. MISKAM A



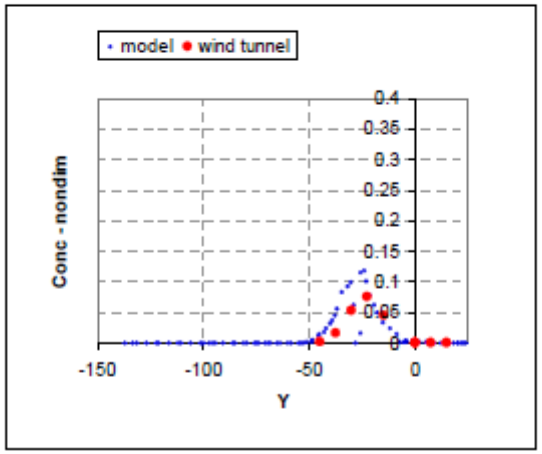
3. MISKAM C



5. FLUENT B



7. M2UE



- 2 different turbulence models (k-eps and modified k-eps)
- 2 different models (both k-eps)

In general, concentrations close to the source are overpredicted by most of the models.

Conclusions/1

- The **prediction of U** is quite satisfactory, while **W is underpredicted by all models** (especially negative values). Slight better results for the -45 case.
- **U is underpredicted at low heights in 'narrow streets'**
- Models have **difficulty in reproducing turbulent kinetic energy (TKE)**
- The **qualitative behavior of the pollutant plume seems reasonable**. Models predict the plume trajectory well –with minor exceptions. It is a common feature that models tend to **overpredict the centerline concentration** of the plume
- The exercise suggests that the **k-ε turbulence model seems to be quite satisfactory** to simulate flow and plume dispersion within complex geometries
- Statistical parameters and limits of acceptance should be decided for each specific case. It can be stated that the limits $q>0.66$, $FAC2 > 0.5$, $|FB| < 0.3$, $0.7 < MG < 1.3$, $NMSE < 4$ and $VG < 1.6$ could be used as quality acceptance criteria.

19:30 **Workshop Dinner** im Hamburger Segel-Club, An der Alster 47a