

The FAIRMODE CT4 Intercomparison Exercise

The UOWM Experience

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Topics

- ❑ Atmospheric stability effect on the present exercise
- ❑ NO₂ hourly concentration extremes and statistics vs Beta Hypothesis (Bartzis et al ,2020)
- ❑ NO₂ European Directives vs monitoring and modeling

PRESENT INTERCOMPARISON EXERCISE VS ATMOSPHERIC STABILITY

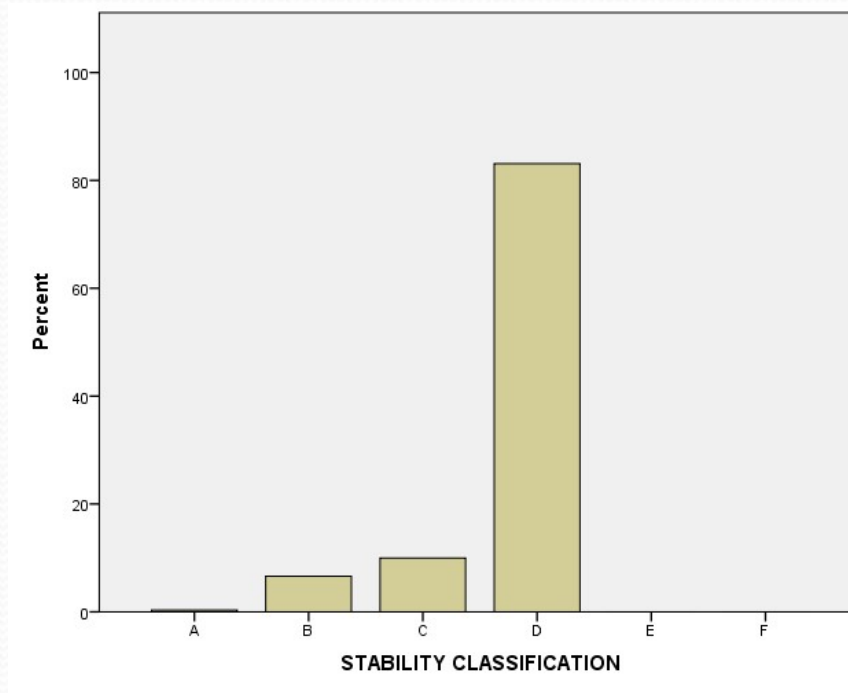
The weather parameters association: Spearman Correlation

Spearman Correlation Coefficients			
NO ₂ concentration	1/V	Wind Direction	Atmospheric Stability
Station: 42R801	.448*	.215*	.091*
Station: 42R802	.383*	.194*	.003

*Correlation is significant at the 0.01 level

PRESENT INTERCOMPARISON EXERCISE VS ATMOSPHERIC STABILITY

ATMOSPHERIC STABILITY CLASSIFICATION FOR YEAR 2016



PRESENT INTERCOMPARISON EXERCISE VS ATMOSPHERIC STABILITY

Conclusion

- **The dependency on the ambient atmospheric stability in the present results, seems to be rather minor. The effect is even lower in the streetside compared to a background site.**
- **NOTE**
- **In UDINEE experiment there was no significant differences on concentrations between day and night experiments,**
- **Reference : *Steven Hannal, Joseph Chang², Thomas Mazzola³* AN ANALYTICAL URBAN PUFF DISPERSION MODEL COMPARED WITH TRACER OBSERVATIONS IN JU2003 Proceedings **18th International Conference on Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes 9-12 October 2017, Bologna, Italy****

Beta Hypothesis [Bartzis et al,2020] for NO2 Hourly Concentrations

At a specific sensor location the yearly mean(m) and hourly sigma(σ) are known

The Beta hypothesis for No2 Houly concentrations

Extreme value : $C_{max} \approx m[1 + 23.51(\frac{\sigma}{m})^2]$

pdf : beta function

References

[Bartzis et al (2020) *Environmental Research*, 181,108864

<https://doi.org/10.1016/j.envres.2019.108864>]

Bartzis et al (2015), *Journal of Hazardous Materials*, 300, 182–188.

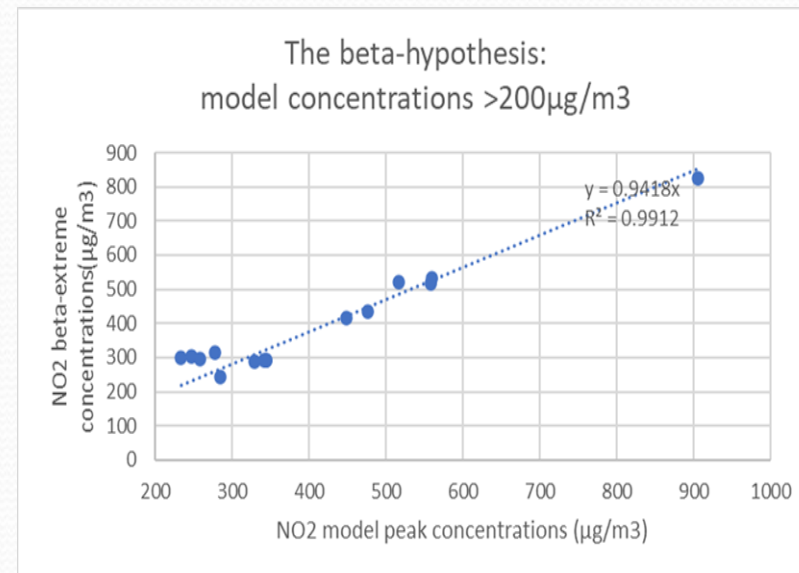
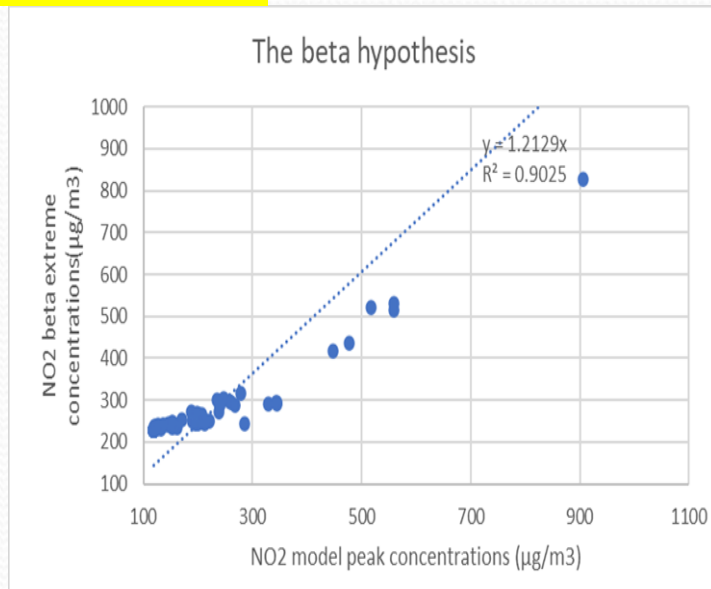
<https://doi.org/10.1016/j.jhazmat.2015.06.057>

The present exercise

ADREA CFD RANS Model vs Beta Hypothesis for NO₂ Hourly Concentrations, The extreme values

Reference : Bartzis et al (2022) : Proceedings,13th International Conference on Air Quality Science and Application, 27 June – 1 July 2022, Thessaloniki, Greece

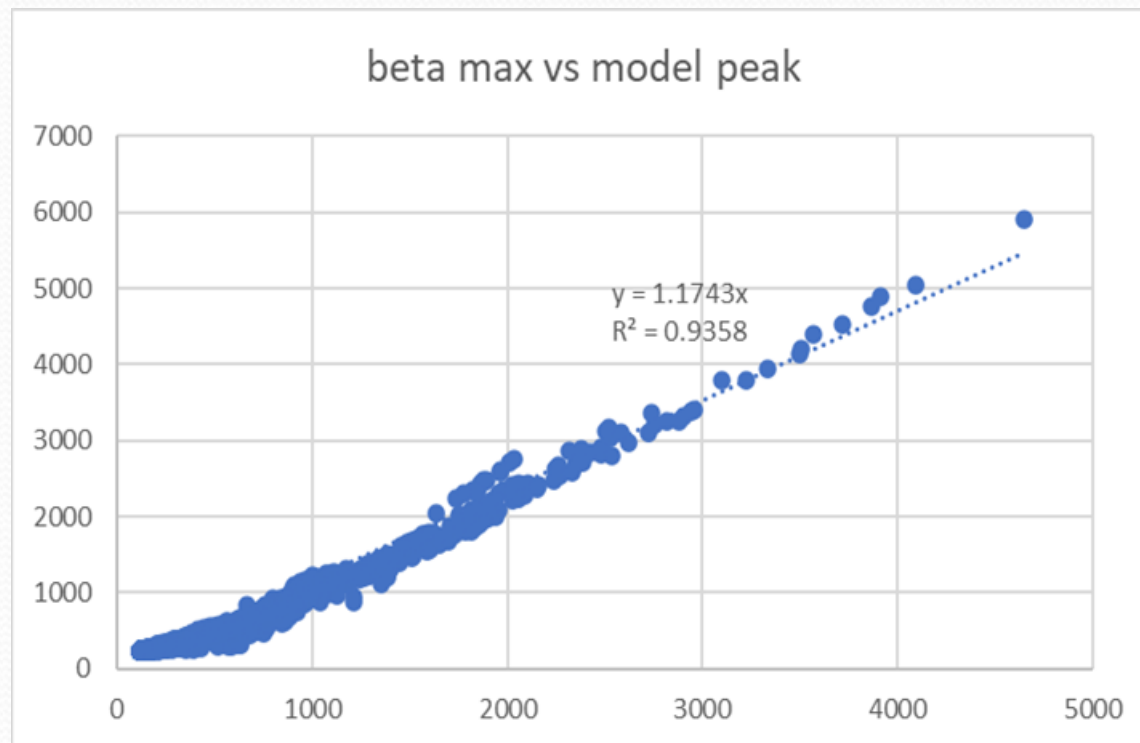
111 sensors



The present exercise

ADREA CFD RANS Model vs Beta Hypothesis for NO₂ Hourly Concentrations, The extreme values

17387 sensors



The present exercise

ADREA CFD RANS Model vs Beta Hypothesis for NO₂ Hourly Concentrations

Conclusion

The beta hypothesis introduced by Bartzis et al(2020) can be used to extrapolate NO₂ hourly concentration statistics based on the estimation of the yearly mean and hourly sigma only.



The NO₂ hourly concentration statistics i.e. (peaks, 18hr peaks, percentiles) is to a large degree predictable via Beta Hypothesis (Bartzis et al, 2020) if mean and sigma are known

The EU Directives and Monitoring

- ❑ **Fact** : The EU Directive requires reliable monitoring values for the NO₂ concentration yearly mean and 18hr extreme
- ❑ **Note**: Theoretically, almost nobody provides such values for the simple reason that several hourly values are missing most probably due to equipment failure and/or maintenance
- ❑ **Remark** :Under these circumstance the parameters with sufficient accuracy seem to be : **the yearly mean and the hourly sigma**
- ❑ **Proposal**: For NO₂, examine the rearrangement of the EU limits by building around yearly mean and hourly sigma only

Antwerp two stations Monitoring and Modeling (model : ADREA CFD RANS)

42R801

42R801					
year	miss hours	mean(m)	sigma(σ)	peak	σ/μ
2015-obs	491	38.22	20.83	215	0.545003
2016-obs	442	38.81	20.34	173	0.524092
2017-obs	423	36.34	19.82	167	0.545405
year	miss hours	mean(m)	sigma(σ)	peak	σ/m
2016-obs	442	38.81	20.34	173	0.524092
2016-mod	0	36.05	17.93	199	0.497365

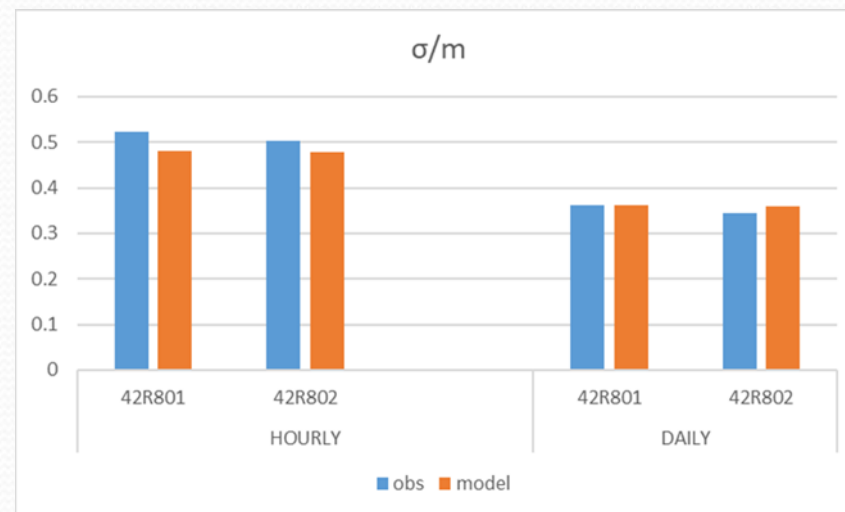
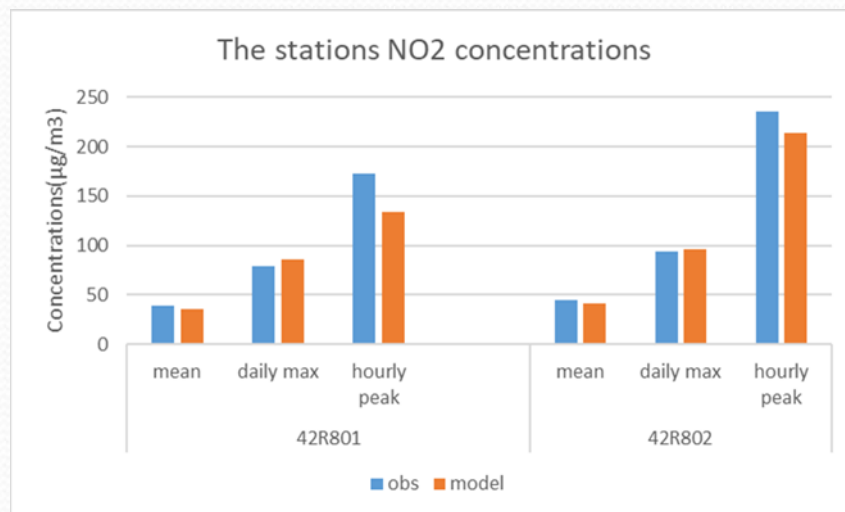
42R802

42R802					
year	miss hours	mean(m)	sigma(σ)	peak	σ/μ
2015-obs	520	45.23	22.94074	237	0.507202
2016-obs	335	45.25	22.80618	235	0.504004
2017-obs	336	42.68	21.45852	187	0.502777
	miss hours	mean(m)	sigma(σ)	peak	σ/m
2016-obs	335	45.25	22.80618	235	0.504004
2016-mod	0	40.76	21.016	344	0.515604

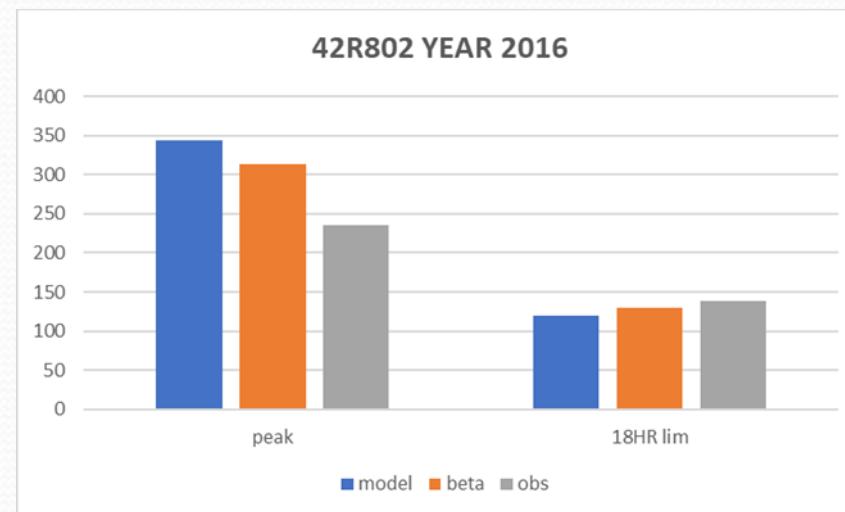
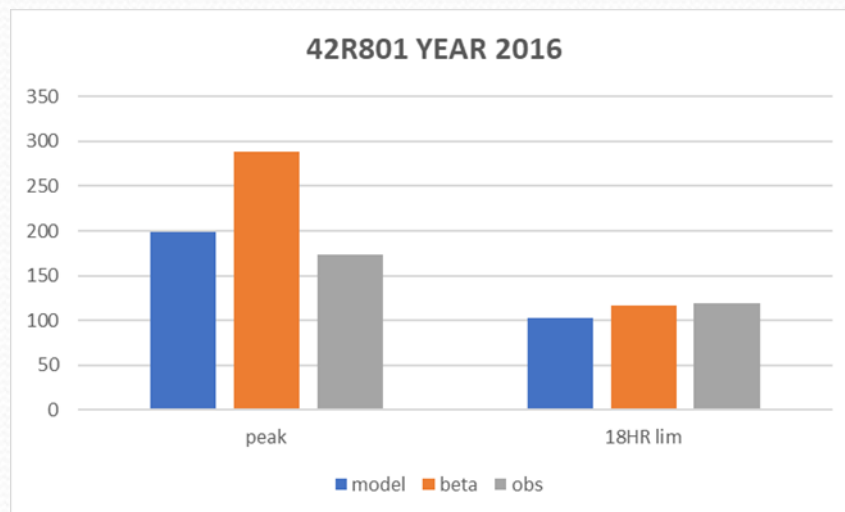
The Antwerp problem: The two stations concentrations (model vs observation)

Mean and Max

Sigma/mean



The Antwerp problem: The two stations concentrations extremes



The EU Directives vs Monitoring and Modeling

Additional Remarks

- ❑ There is evidence that the **hourly concentration sigma** given the fact that σ/m experiences a rather small degree of spatial variability, is a parameter that could be predicted with sufficient accuracy.



- ❑ **NO₂ hourly concentration sigma** needs to be seriously examined as a prime parameter in setting limits in the future EU Directives.

The NO₂ EU Directives vs Monitoring and Modeling

Two Challenging Questions

1. Can NO₂ EU Directive be limited to yearly mean only ?
2. If yes under what conditions/circumstances ?

The answersnext time ...

ARISTOTELES

Ευχαριστώ
Thank you

FAIRMODE Technical Meeting , 18-20 October
2022, Oslo

NO2 Concentrations from UOWM Experience.

Positions	years	Mean	Sigma/mean
EEA stations observations (1673 stations , 23 countries)	2012	0.52 - 90.32	0.33-1.86
Antwerp exercise two atations observations (42R801,42R802)	2015-2017	36.34 -45.25	0.50-0.55
Antwerp exercise :17387 'sensors' model(ADREA CFD RANS-scaled)	2016	33.09-204.53	0.48-1.10

The Antwerp Exercise

The sigma/mean ratio histogram

Model : ADREA CFD RANS -scaled

