How many measurement points would be needed for urban microscale model validation?

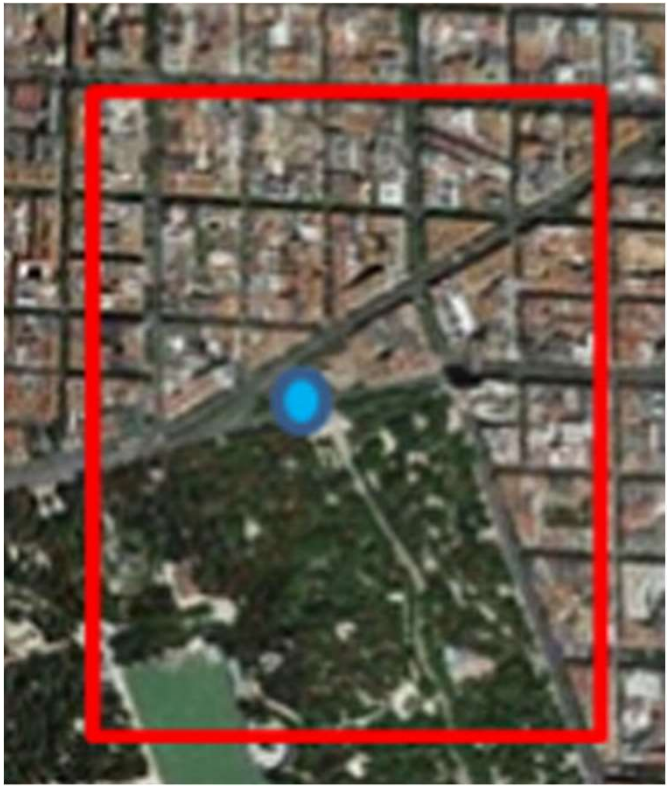
Fernando Martín and José Luis Santiago (CIEMAT)

WG4 Microscale Modelling - FAIRMODE

FAIRMODE TECHNICAL MEETING, DUBLIN, 7-9 October

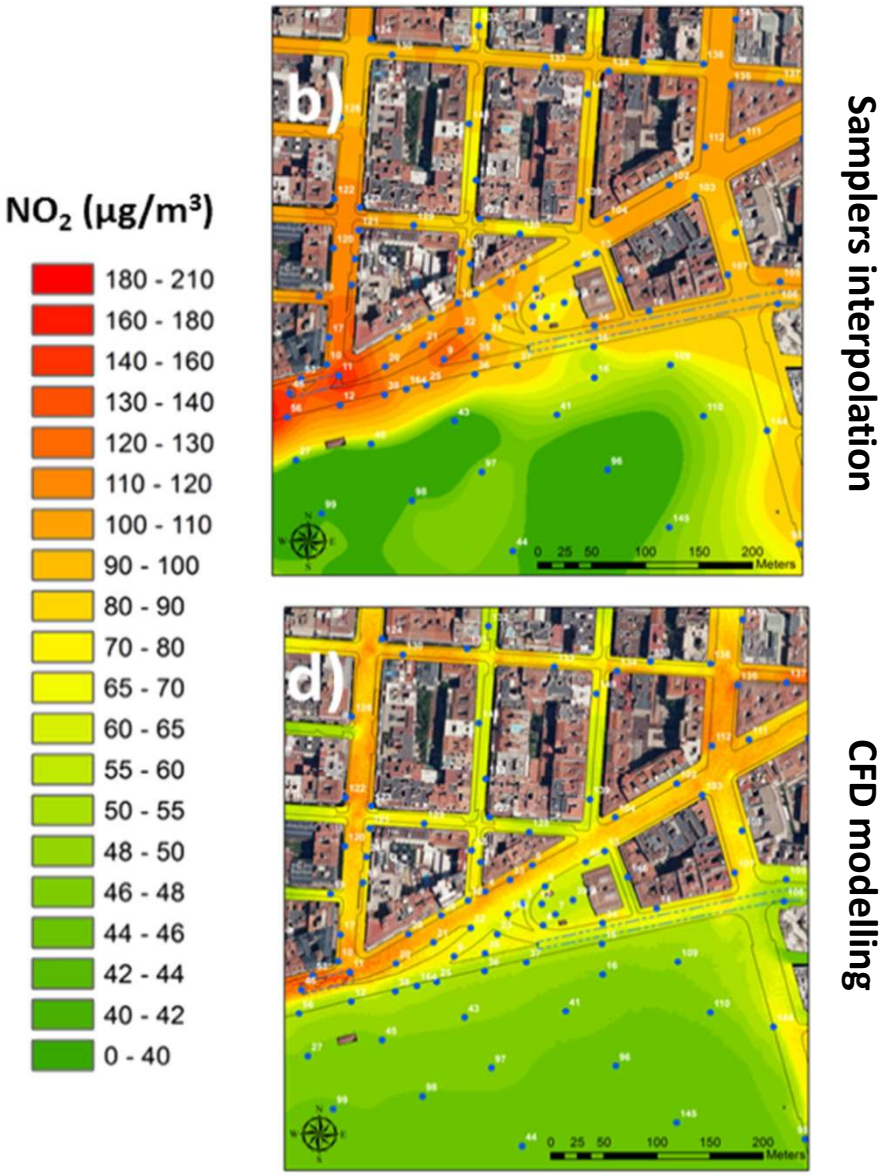
Rationale

- The limited measured concentration data could a very important issue for validating the urban microscale models.
- Urban microscale models are used for simulating urban hot-spots.
- Urban hot-spots generally small (less than 1 Km^2) ➔ very few or none AQ stations inside the hot-spot.



Rationale

- The spatial distribution of pollutants are generally very heterogeneous with sharp gradients inside the streets
  - ➔ not possible to represent with the AQ stations
  - ➔ need of other type of measurements with good spatial coverage:
    - **Passive samplers** ➔long-term averages of pollutant concentration, suitable for annual AQ indicators
    - **Sensors** ➔ measurement frequency less than one hour ➔ pollution time series.

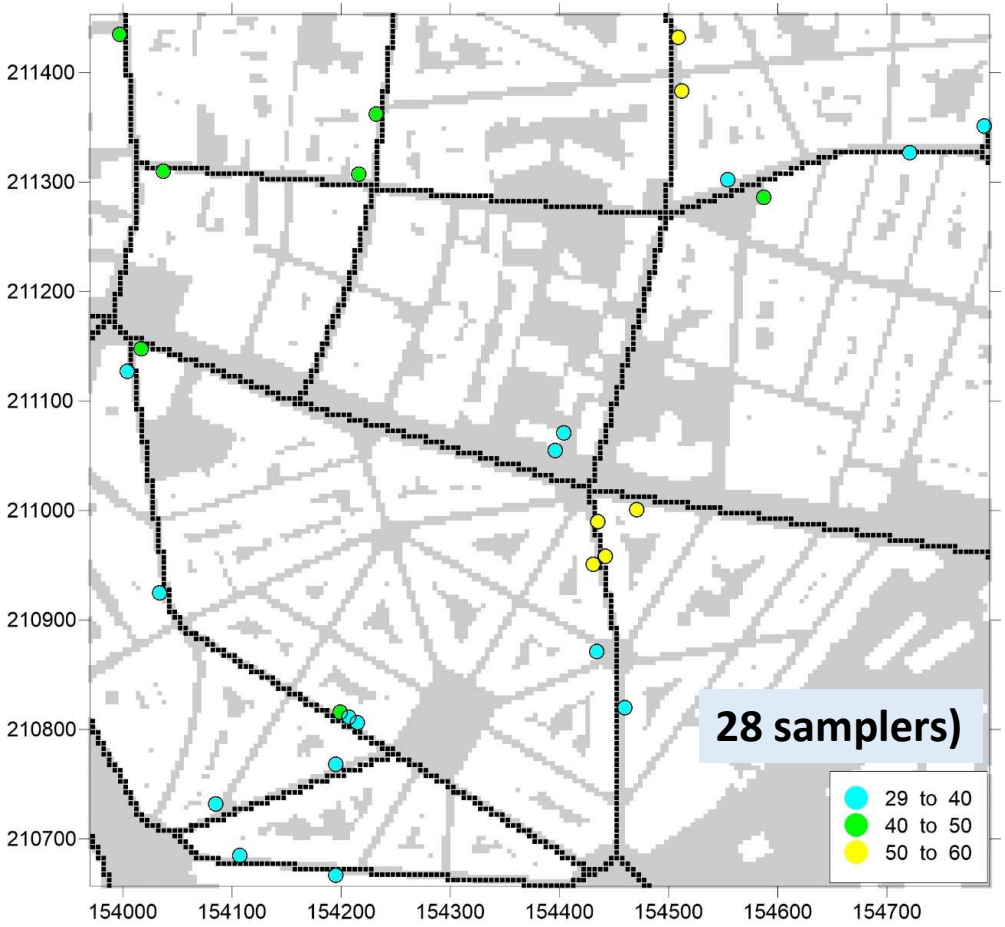


Key questions

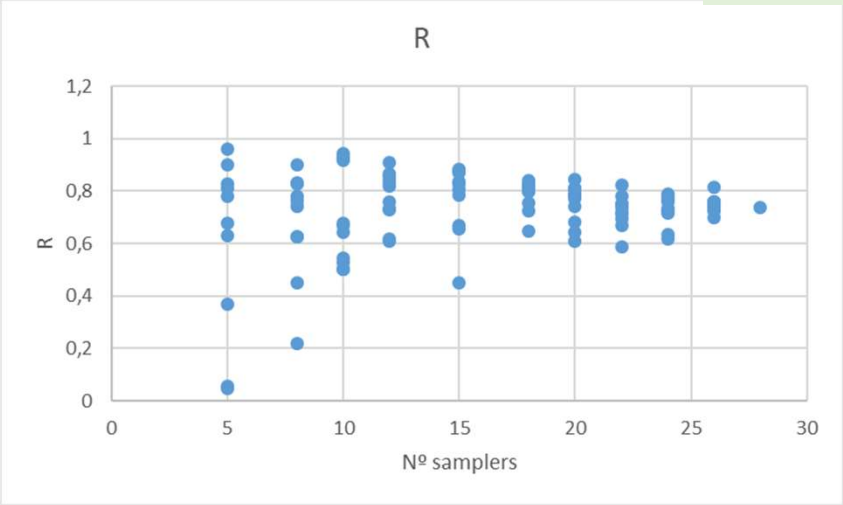
- How many measuring points should be needed for a correct model validation?
- How should the measuring points be distributed in the domain? Should this consider the spatial distribution of pollutant emissions, meteorology, and urban morphology?
- Which variables should be considered? Annual concentrations, hourly, daily?
- Which statistical indicators should be used? Correlation, Bias, Error, MQI-MQO, etc?

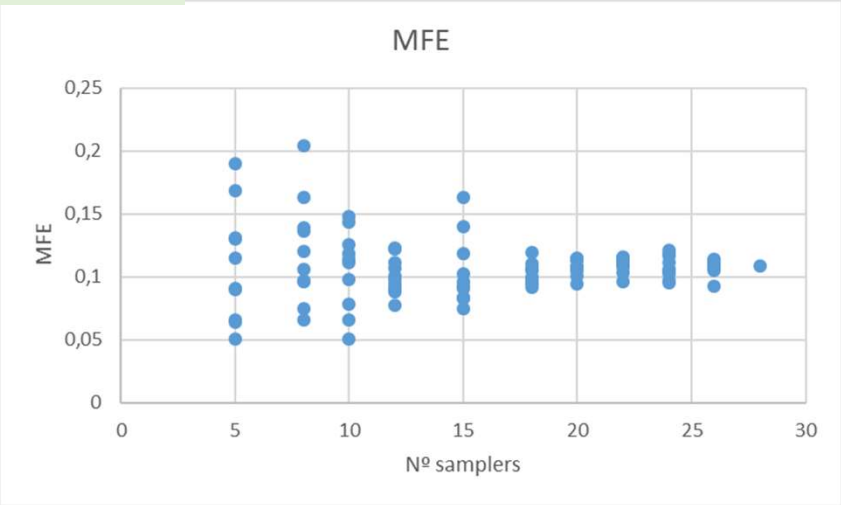
Minimum number of samplers for model evaluation (Antwerp case – WG4 exercise)

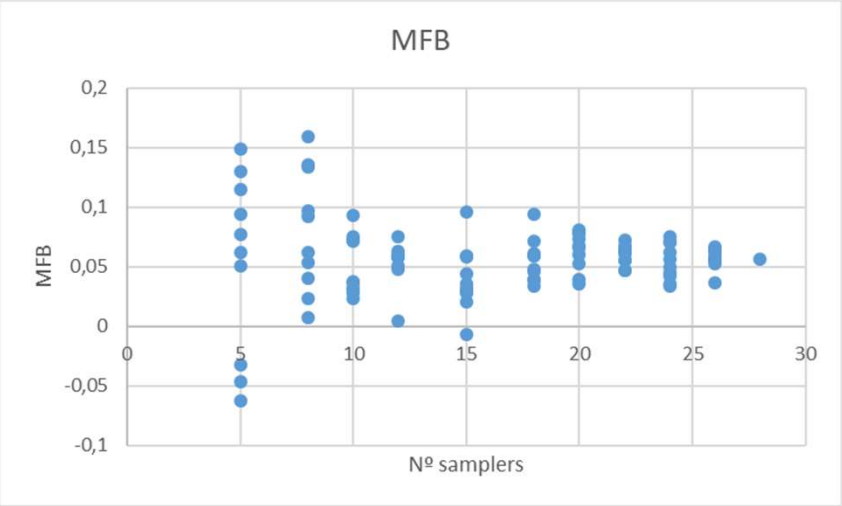
- Analysis on how the values of the statistics indicators (R, MFB, MFE, TARGET) changes depending on the number of samplers.
- 100 subsets with different number of samplers (from 5 to 26). 10 subsets for each number of samplers.
- Total number of samplers = 28
- 12 models (8 CFD, 1 Lagrangian, 3 Gaussian)
- Criterion: What is the minimum number of samplers are needed to get similar (with low variability) values of the statistical indicators when all samplers are used?
- Statistical indicators: R, MFB, MFE, Target

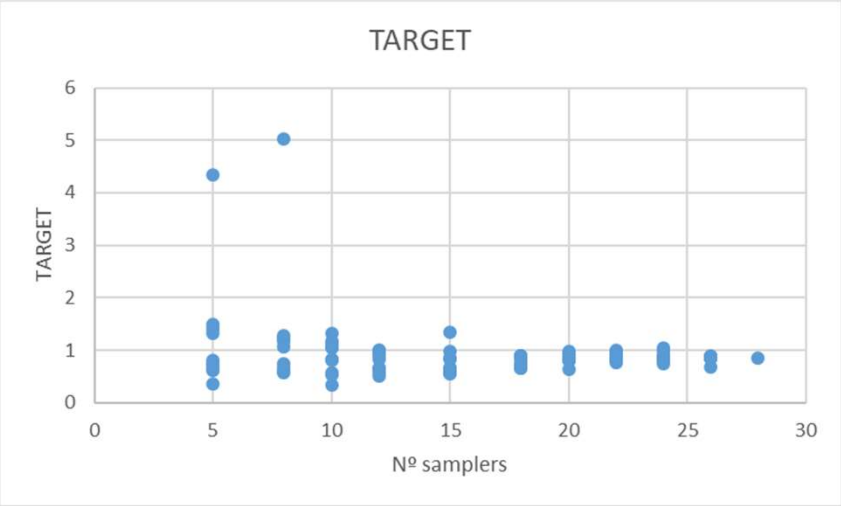


SZE-OPENFOAM - CFD









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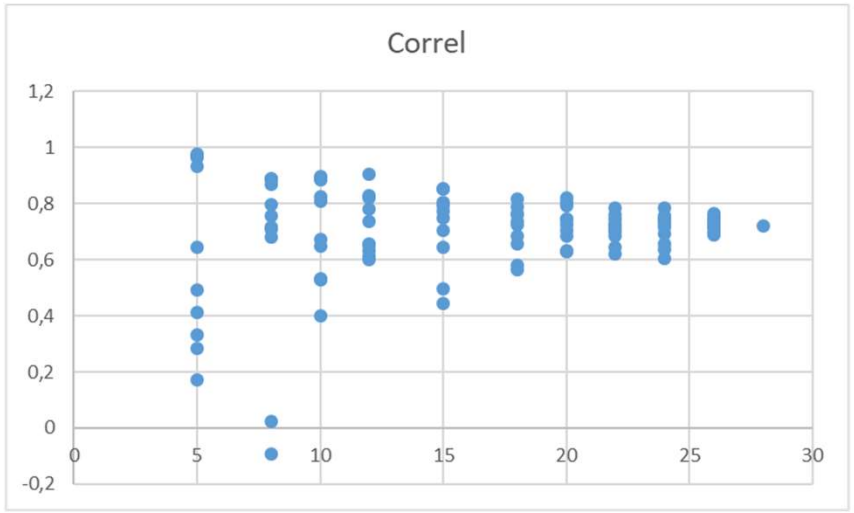
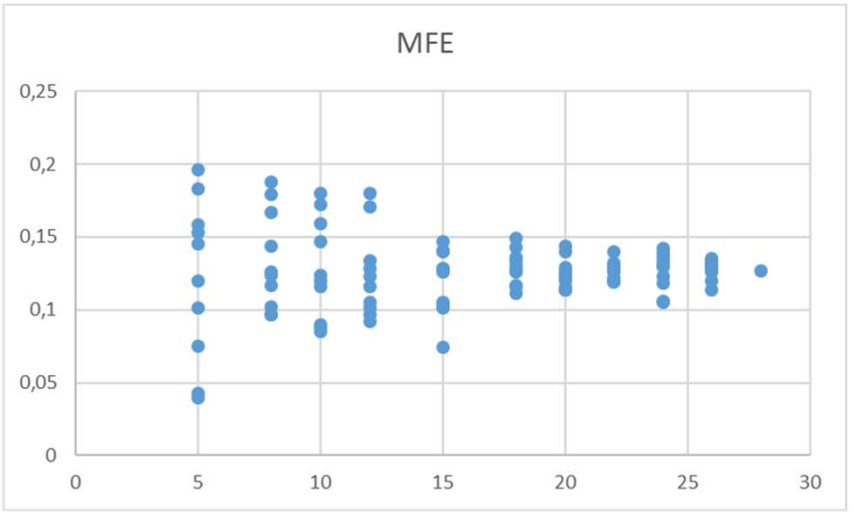
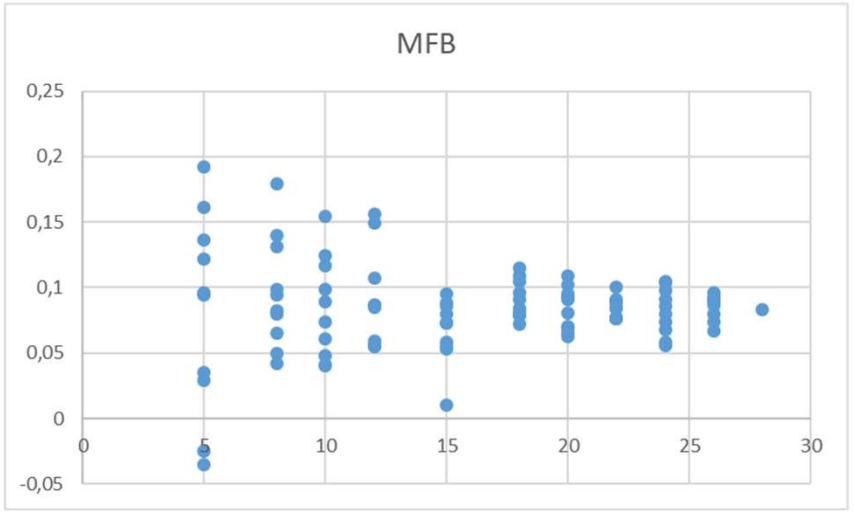
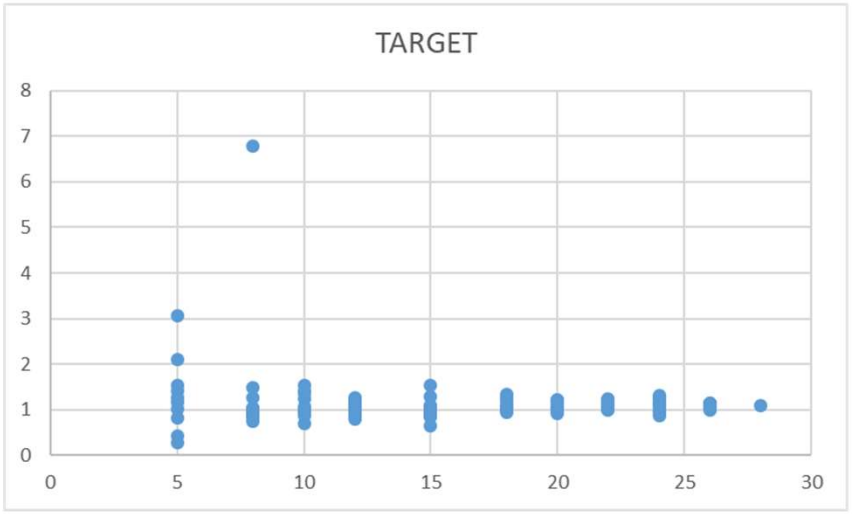
UPM-PALM4U - CFD









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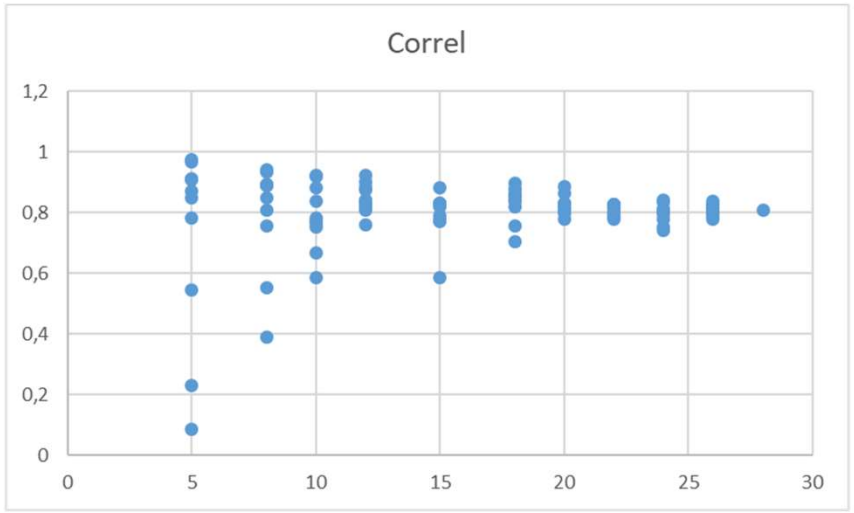
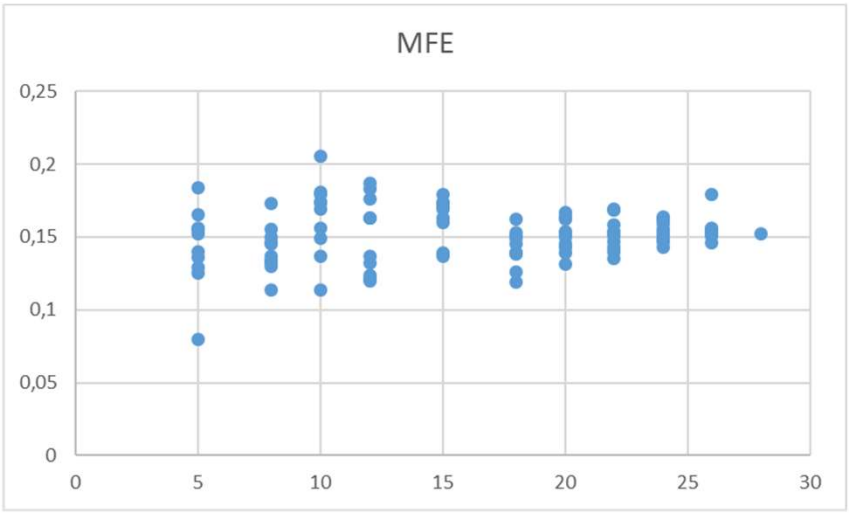
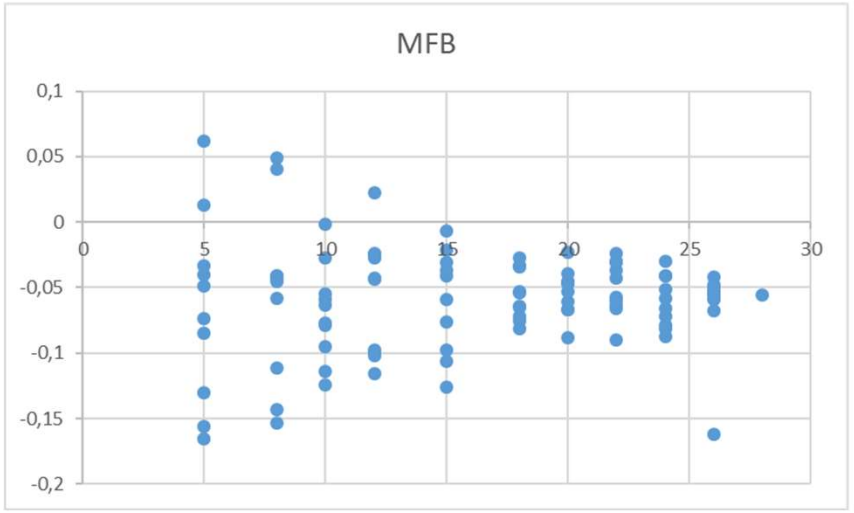
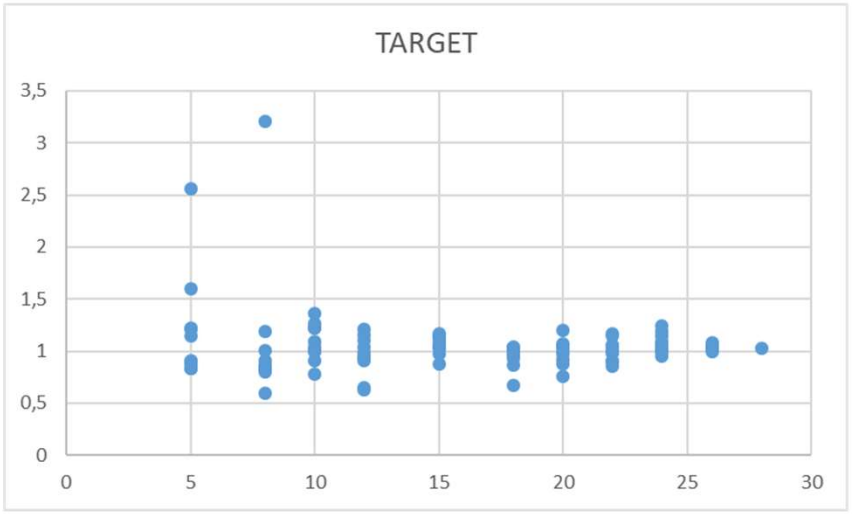
CERC-CIEMAT - STAR-CCM+ - CFD









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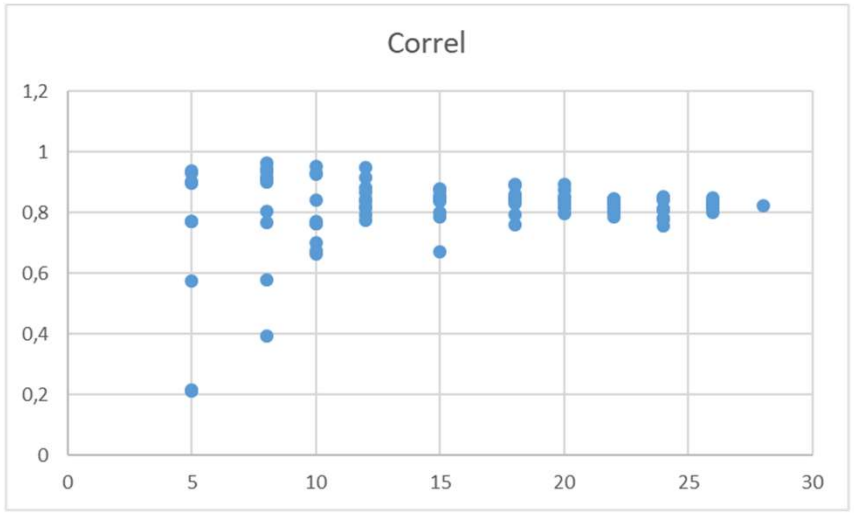
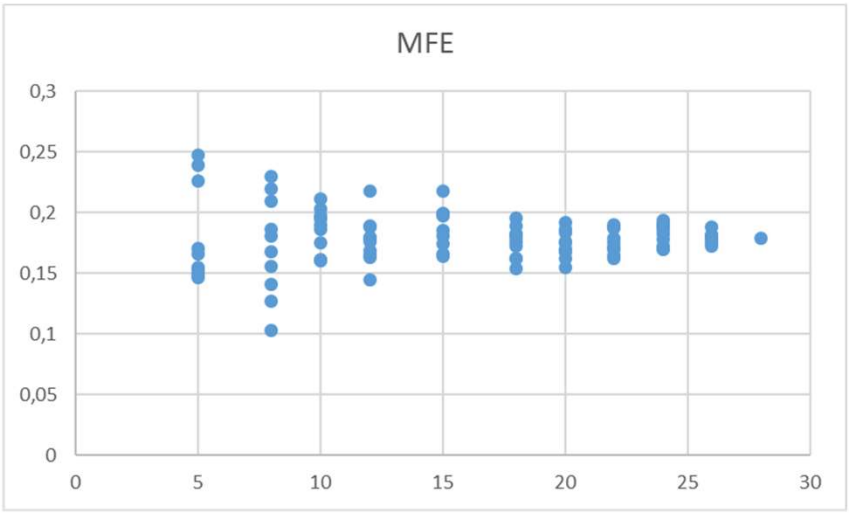
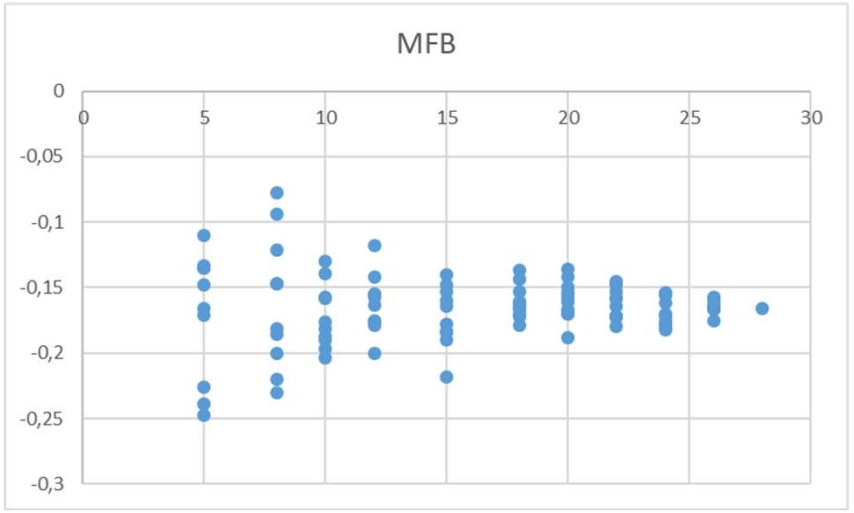
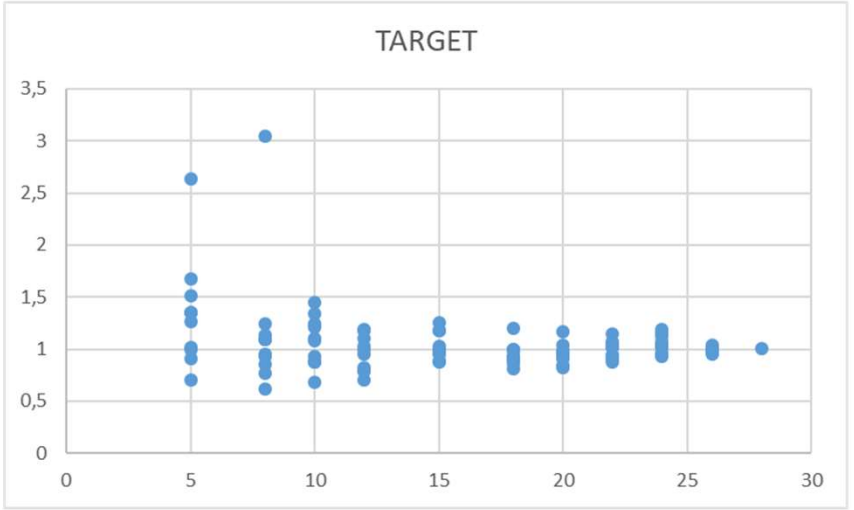
CIEMAT-SIMPLE - STAR-CCM+ - CFD









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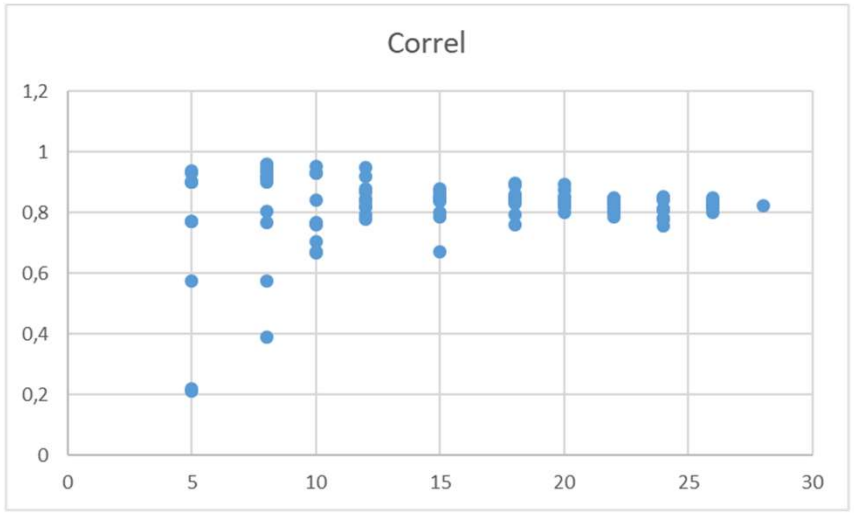
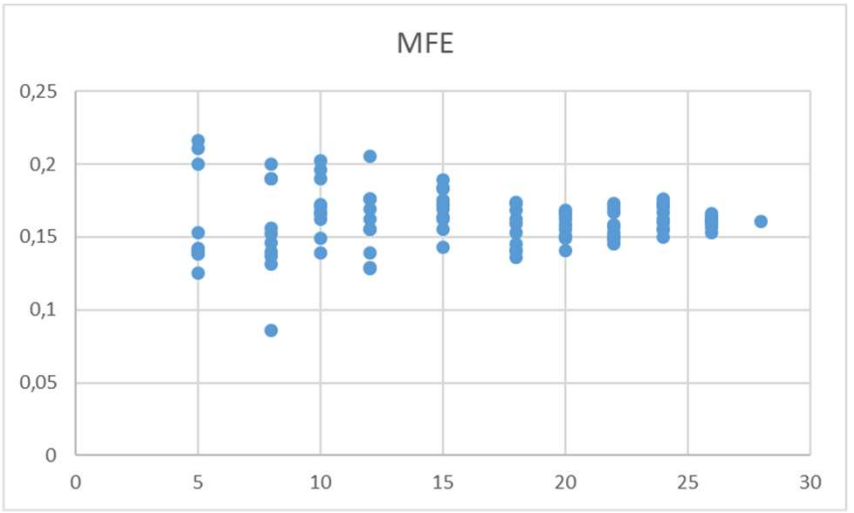
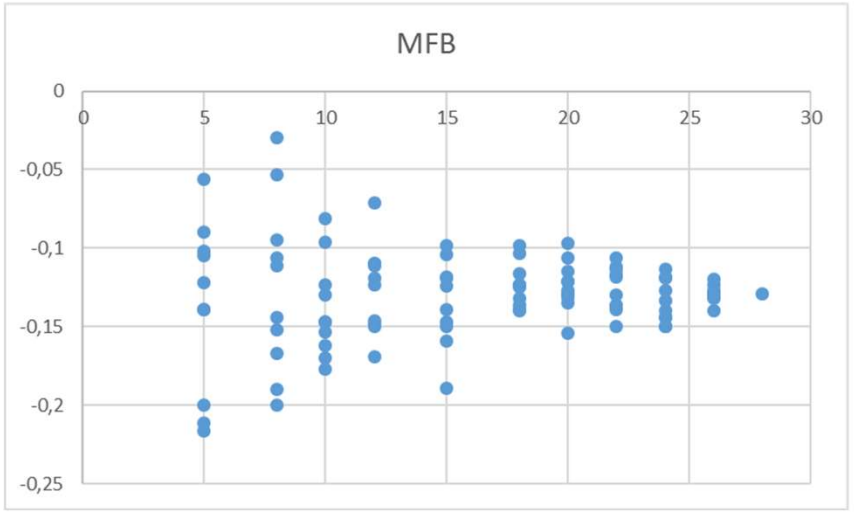
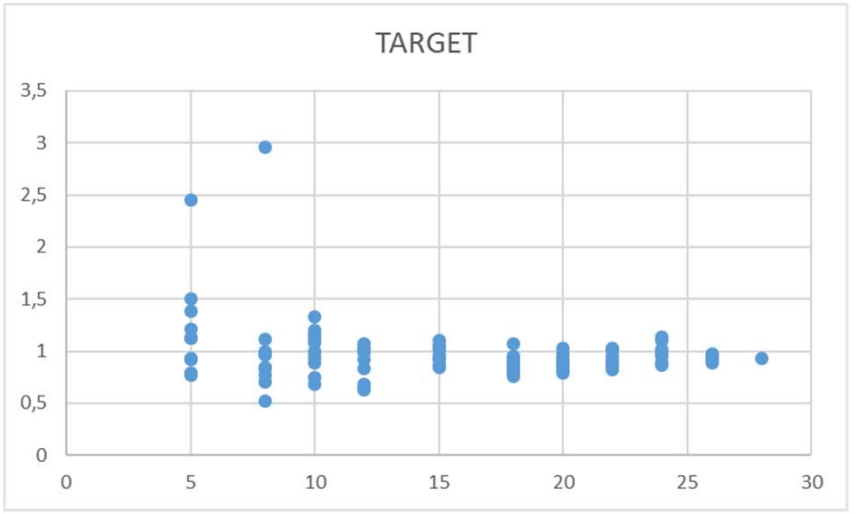
CIEMAT-WIND FACTOR - STAR-CCM+ - CFD

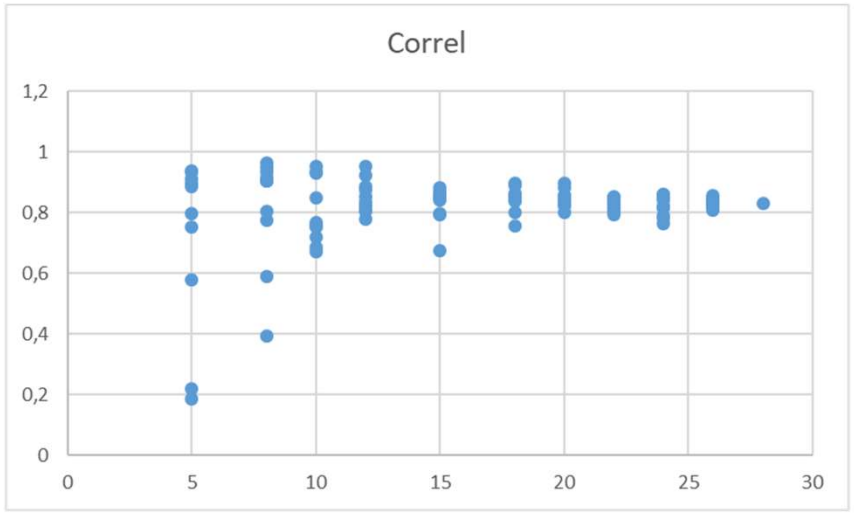


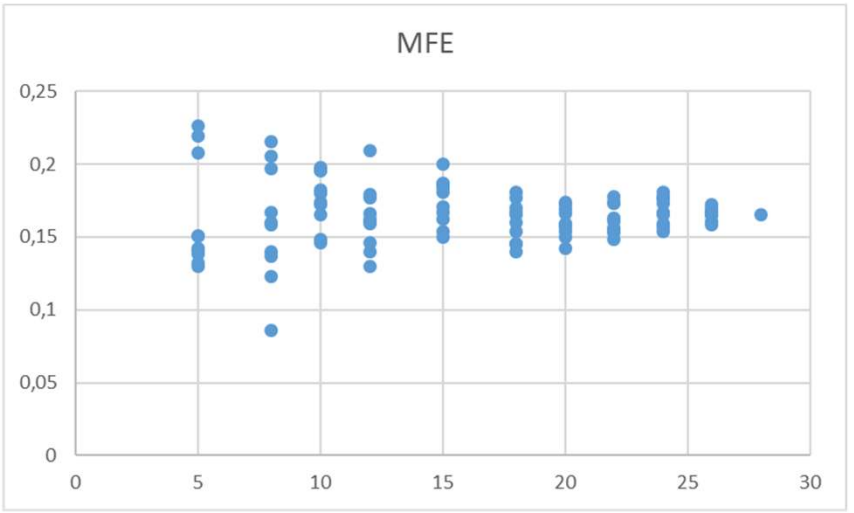


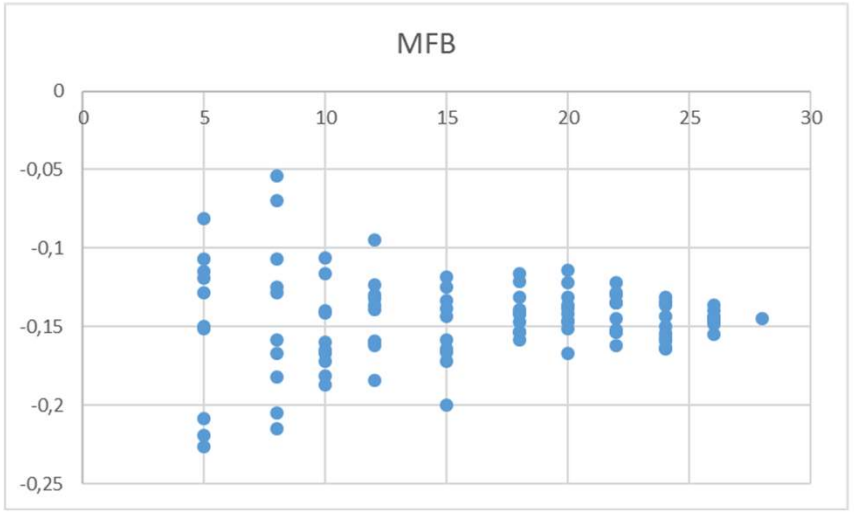


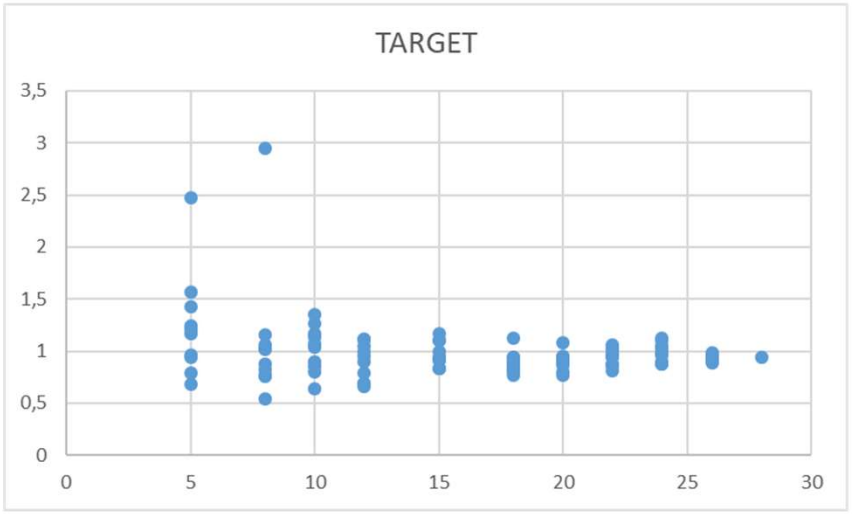


CIEMAT-DETAILED - STAR-CCM+ - CFD

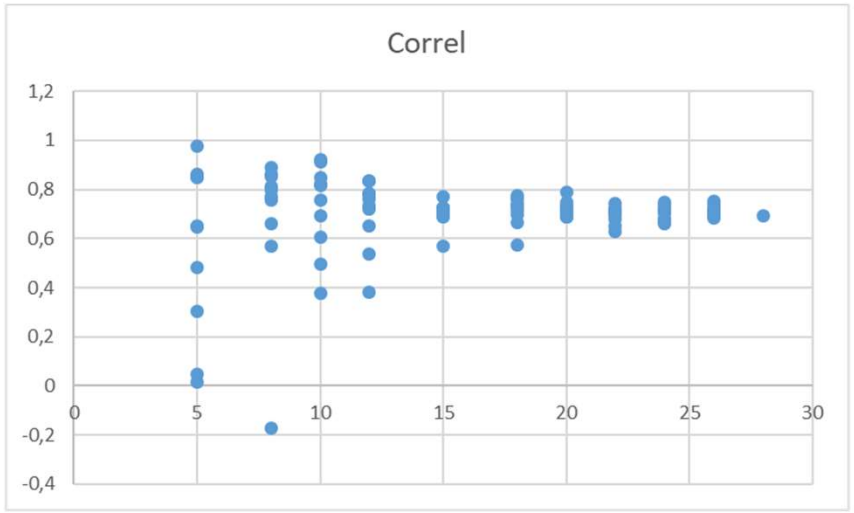


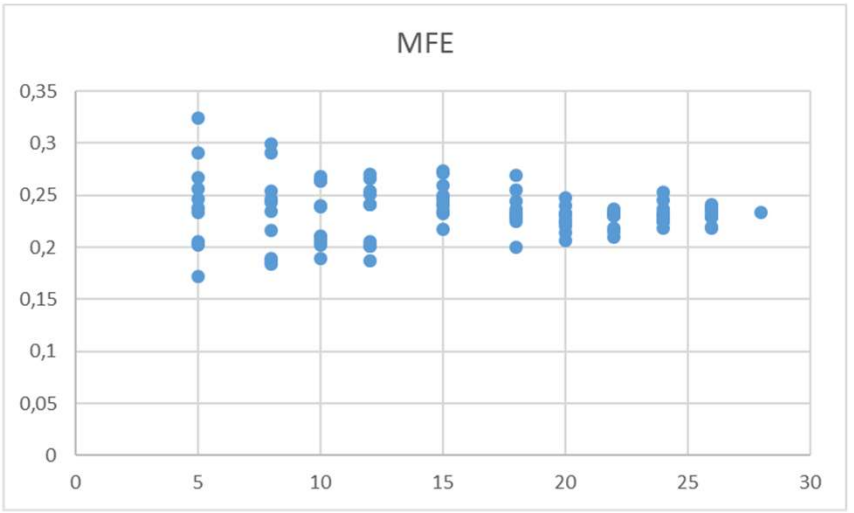


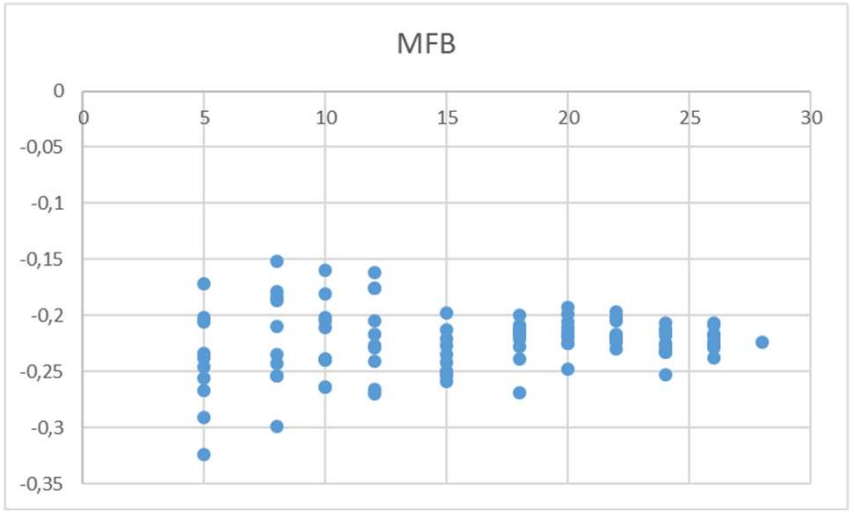


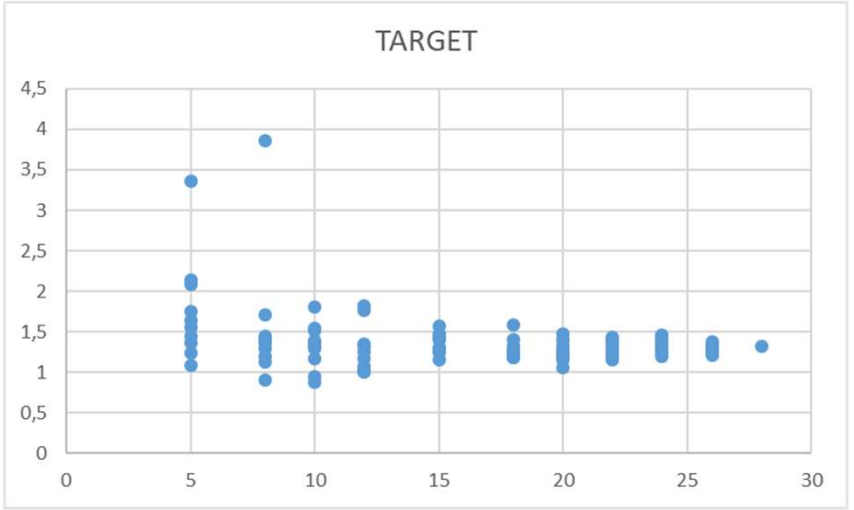


UOWM - ADREA - CFD

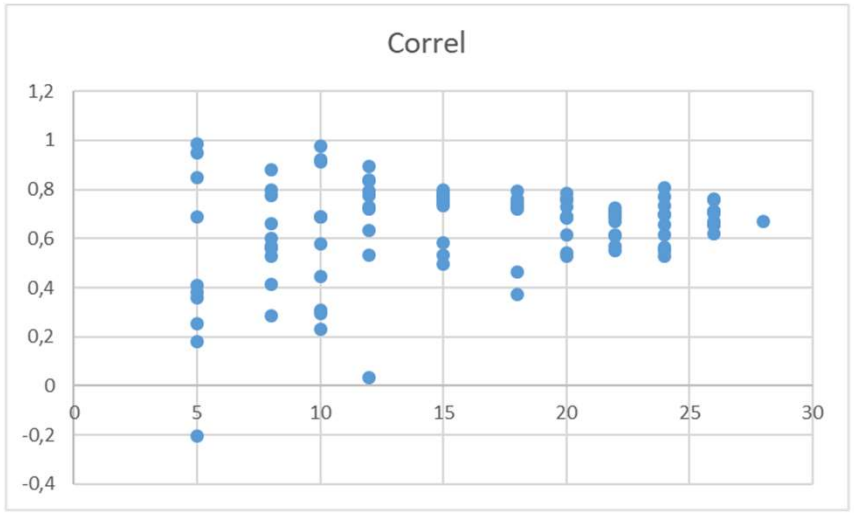


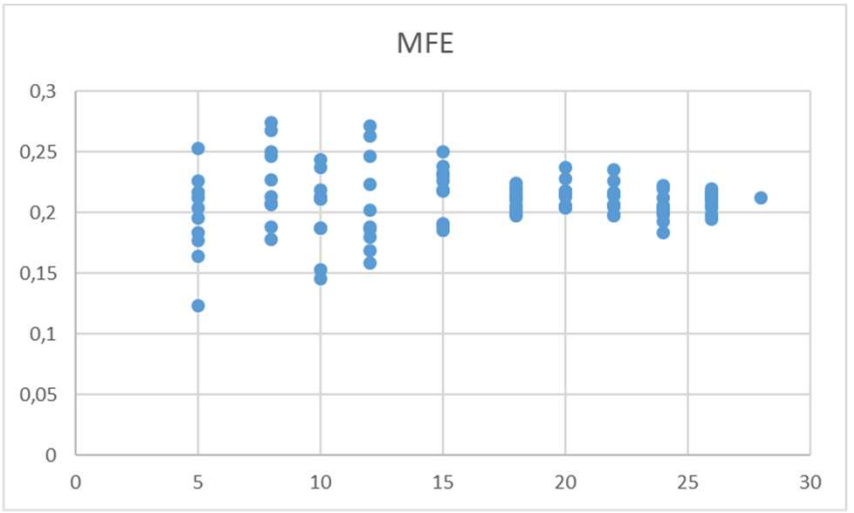


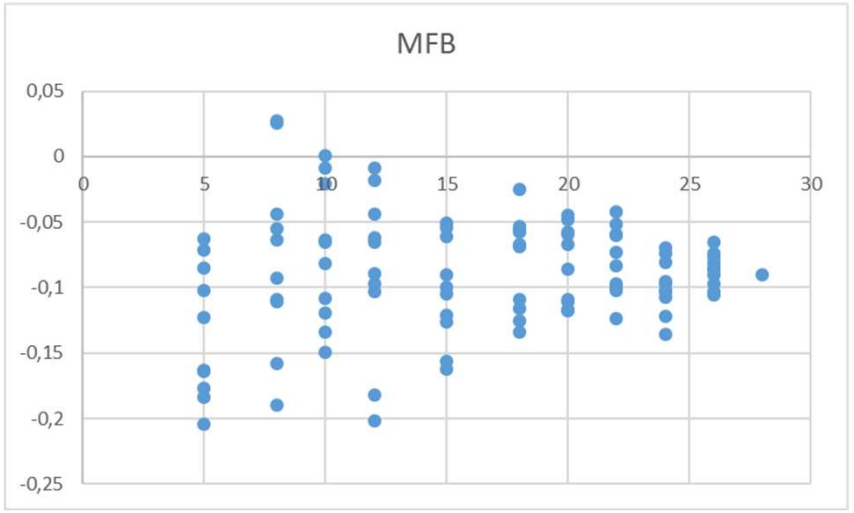


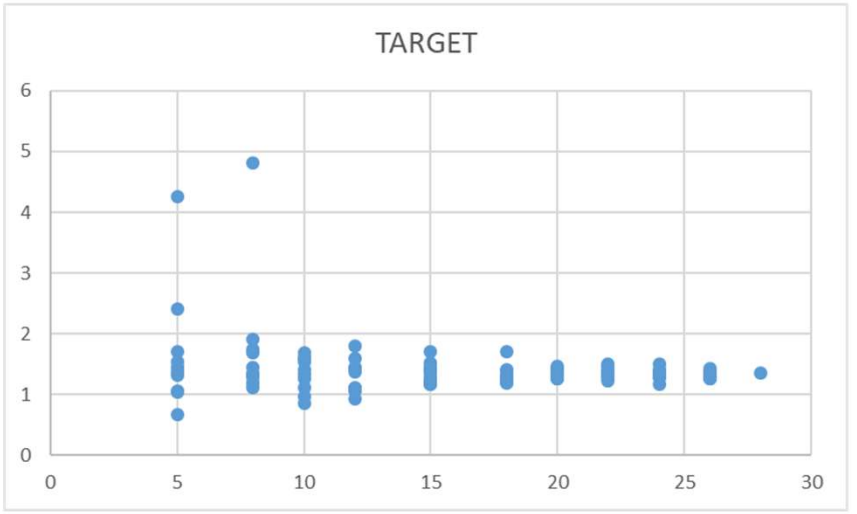


VITO – OPENFOAM - CFD









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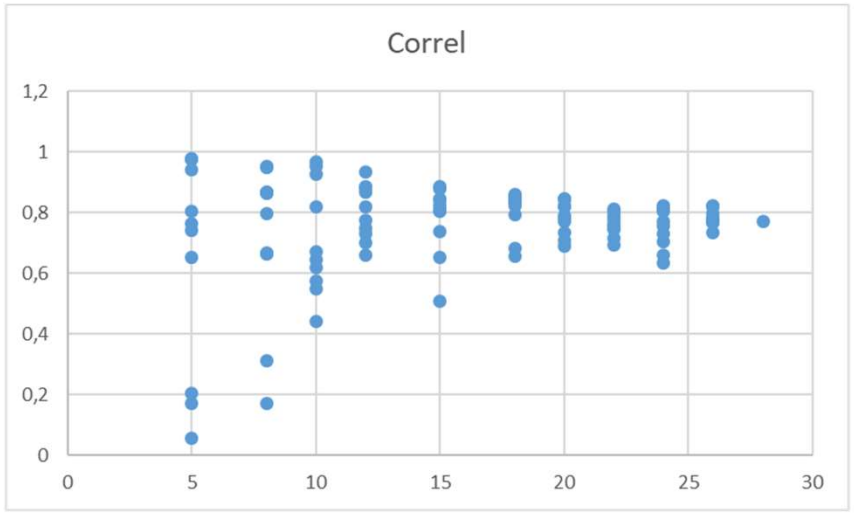
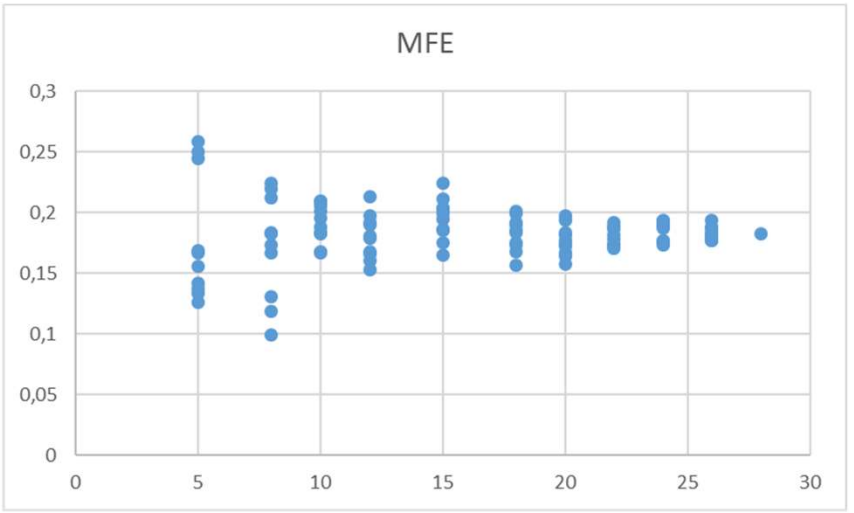
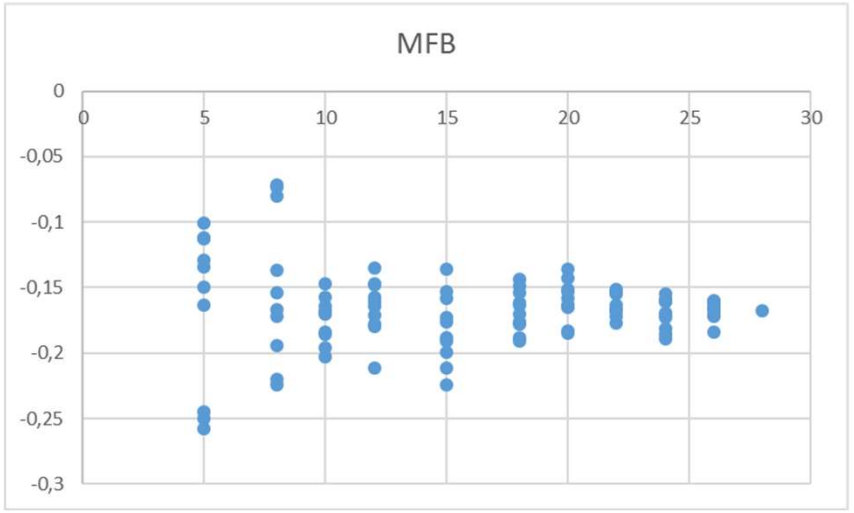
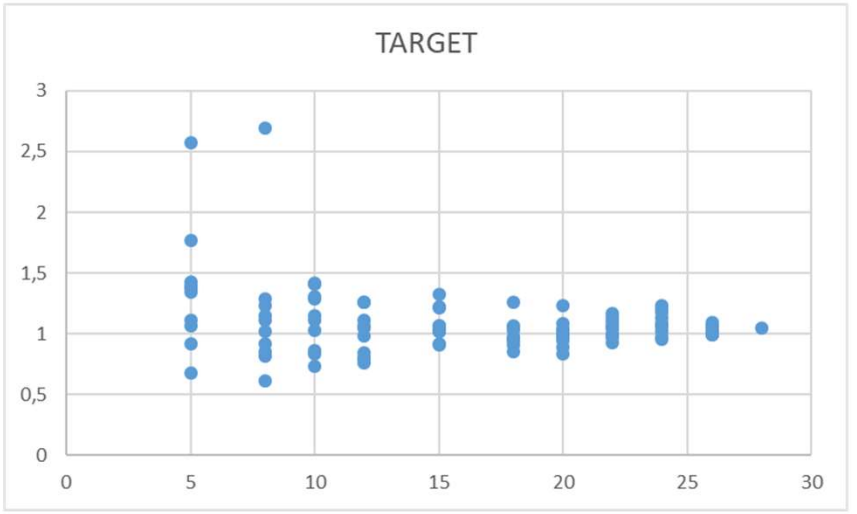
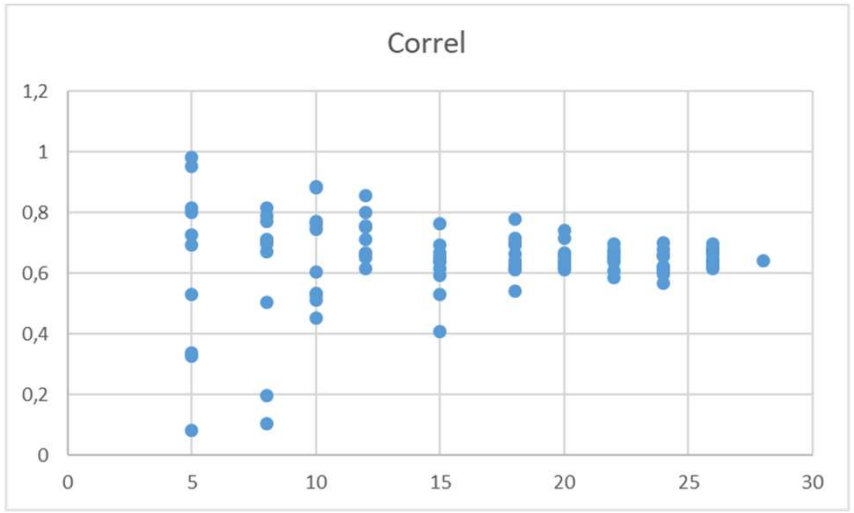


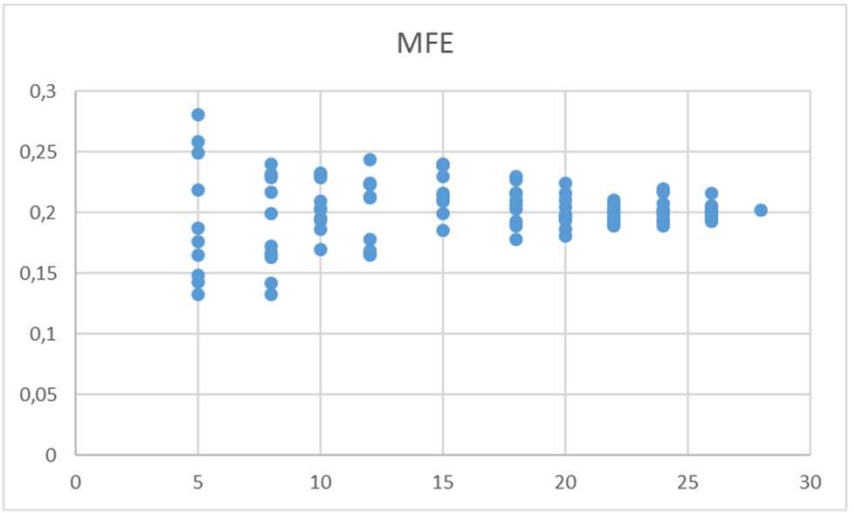


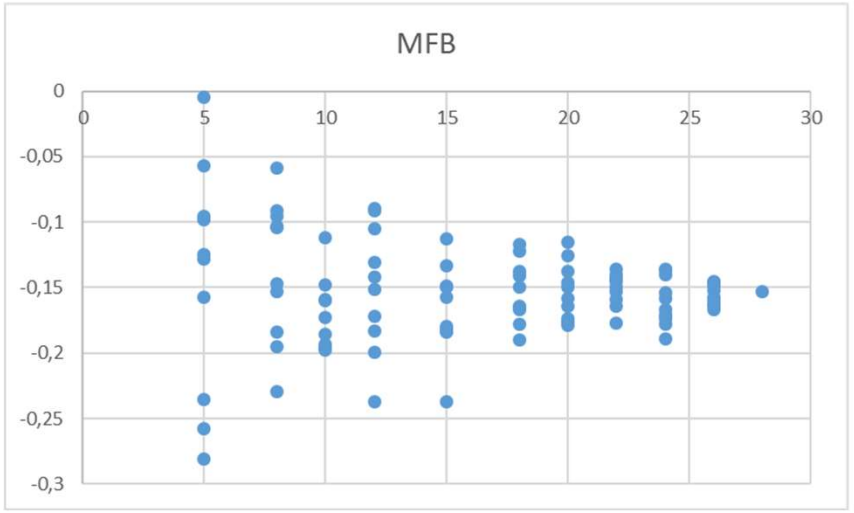


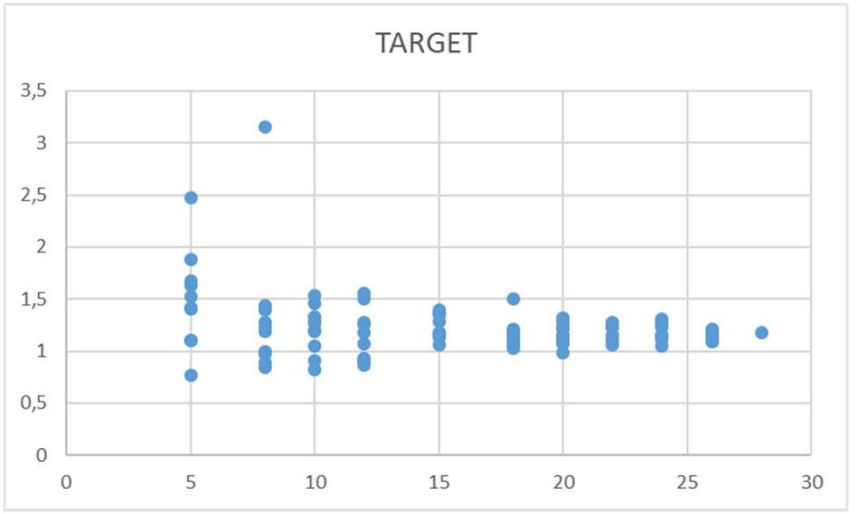


VITO – ATMOSTREET - GAUSSIAN

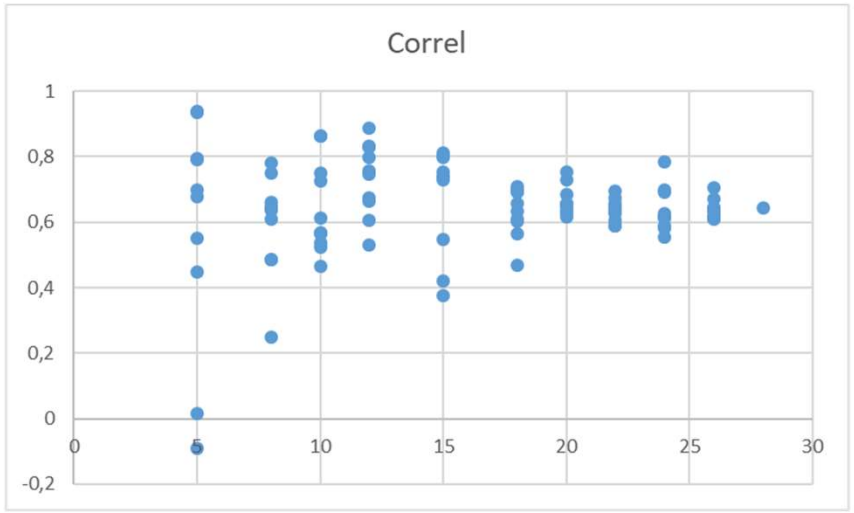


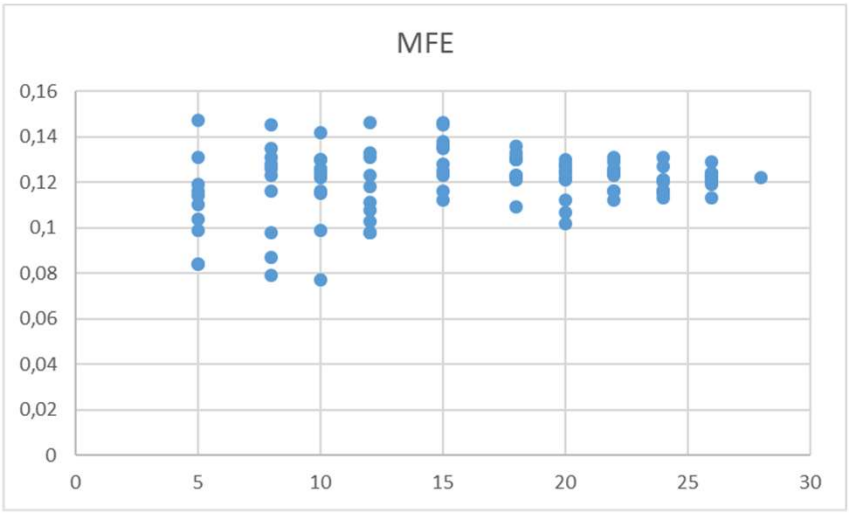


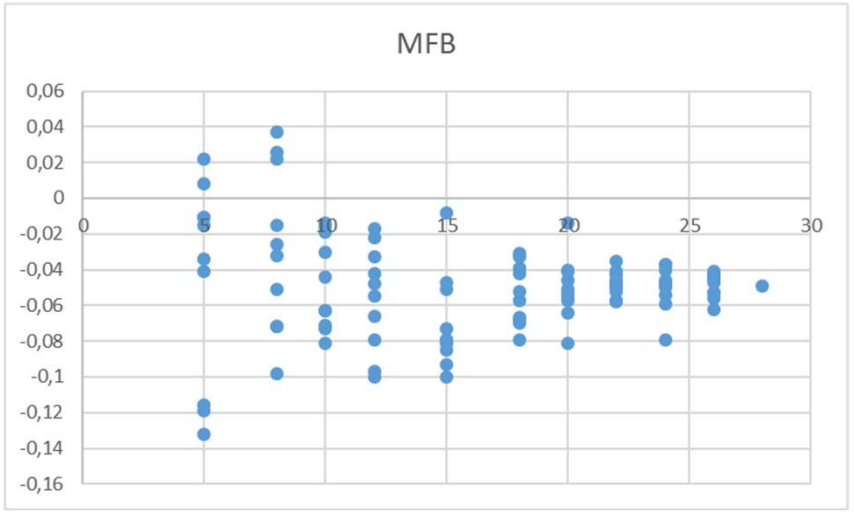


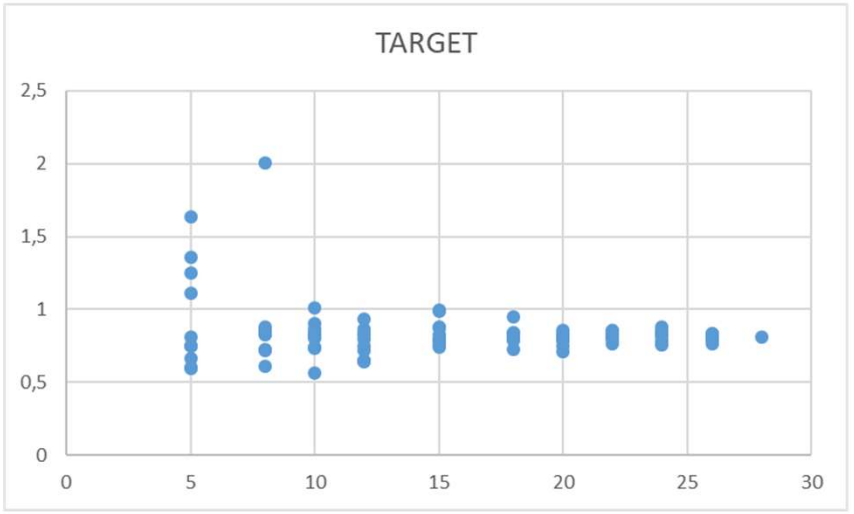


CERC – ADMS - GAUSSIAN

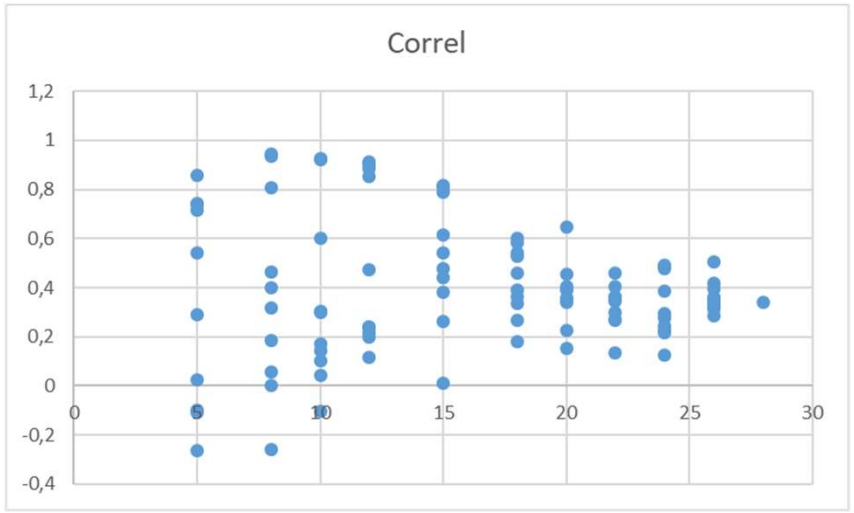


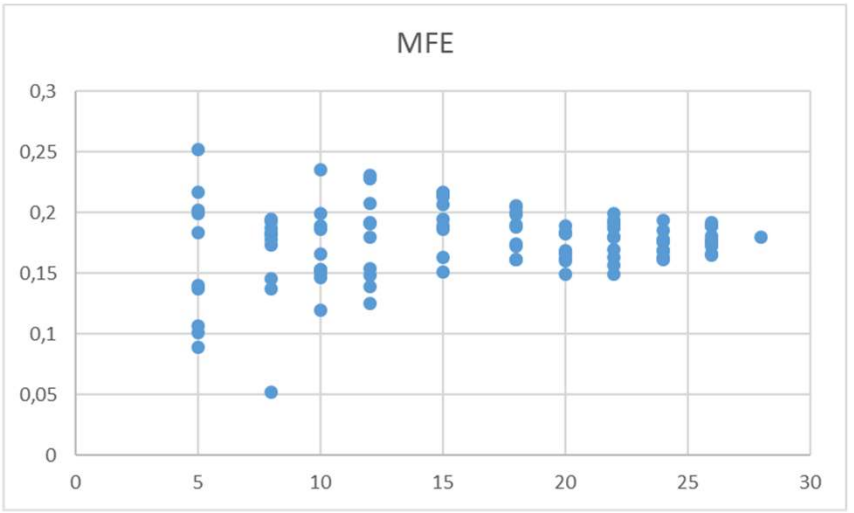


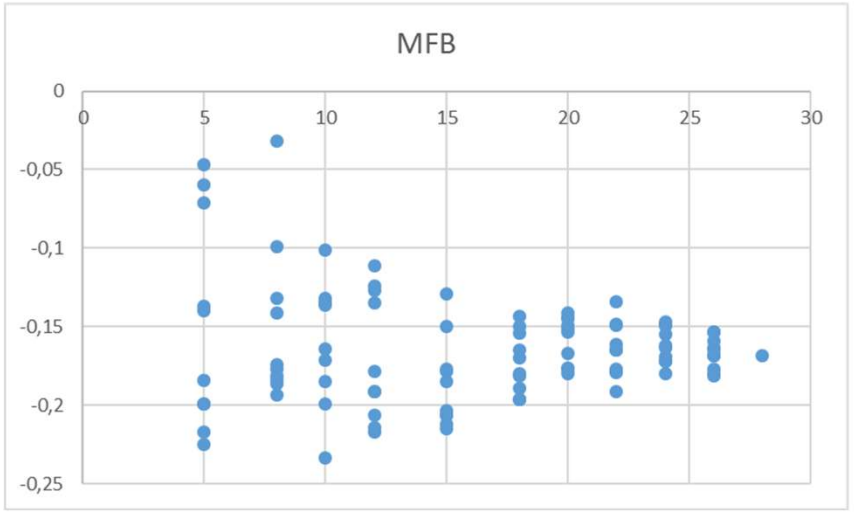


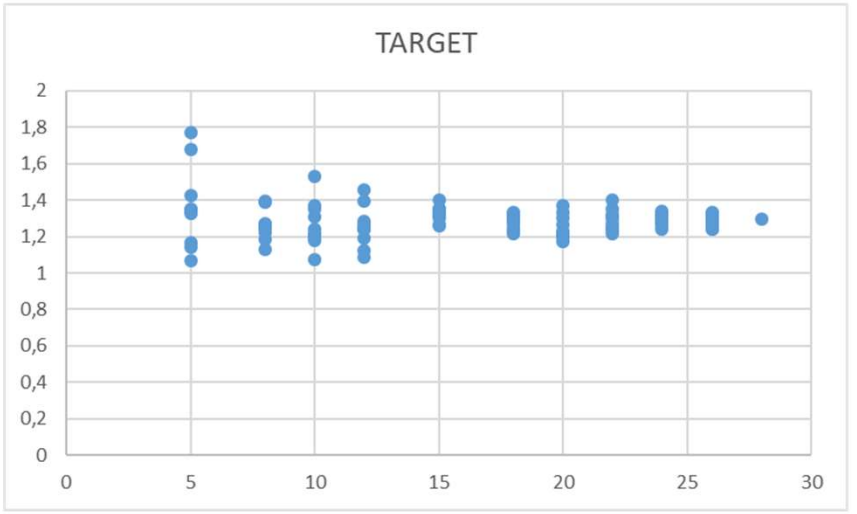


NILU – EPISODE - GAUSSIAN









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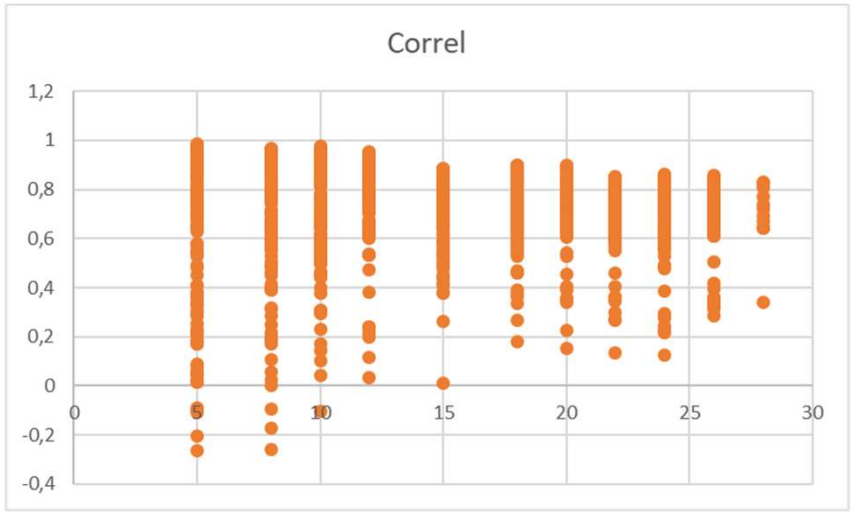
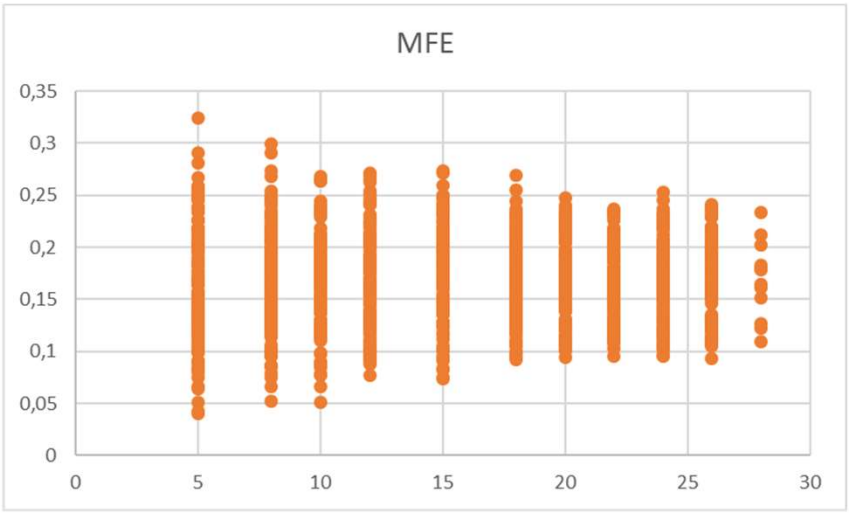
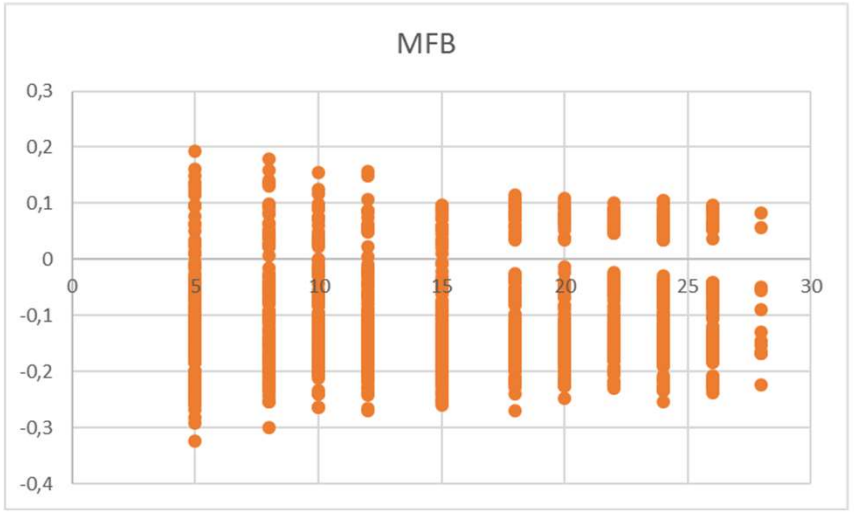
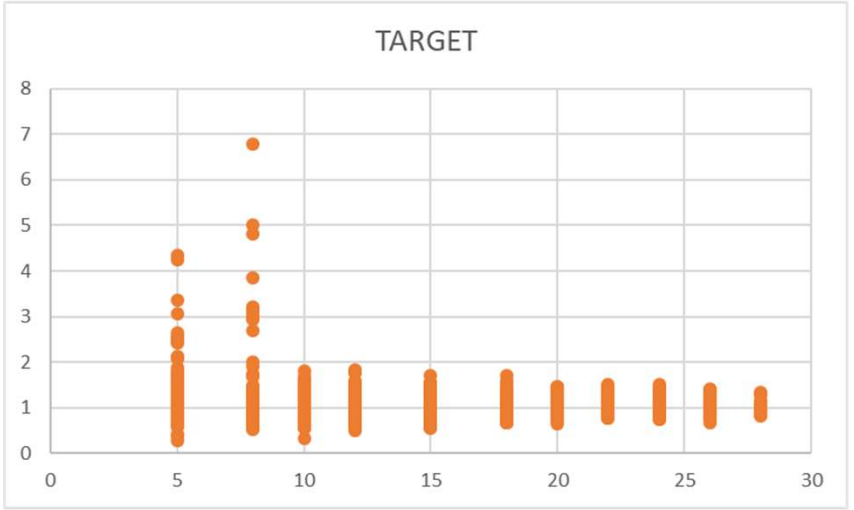
ALL MODELS









Minimum number of samplers for model evaluation (Antwerp case – WG4 exercise)

MODEL	R	MFB	MFE	TARGET
SZE - OPENFOAM	18	20	18	18
UPM – PALM4U	20	18	18	18
CERC - CIEMAT	20-22	18	20	20
CIEMAT - SIMPLE	18	22	18	22
CIEMAT - WINDFACTOR	18	18	18	15
CIEMAT - DETAILED	18	18	20	22
UOWM - ADREA	20	22	20	18
VITO - OPENFOAM	22	24	18	20
ENEA - PMSS	20	22	18	22
VITO - ATMOSTREET	20	22	20	20
CERC-ADMS	20	22	22	20
NILU -EPISODE	26	24	22	20
RANGE	18-26	18-24	18-22	15-22
MOST PROBABLE	20	22	18	20