



# Proposal for a QA/QC protocol for modelling applications

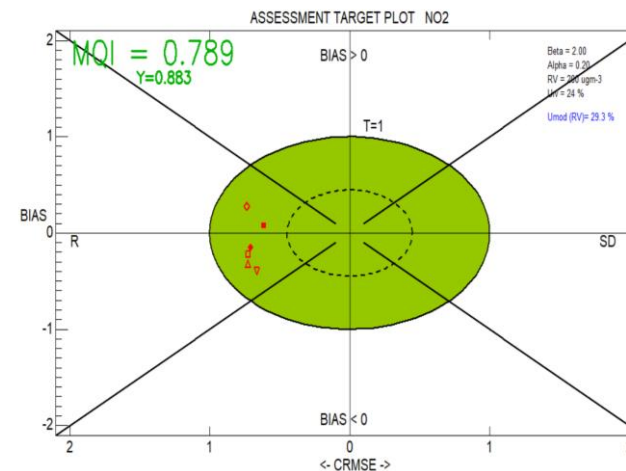
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*FAIRMODE Technical meeting – September 2020*

# Current situation

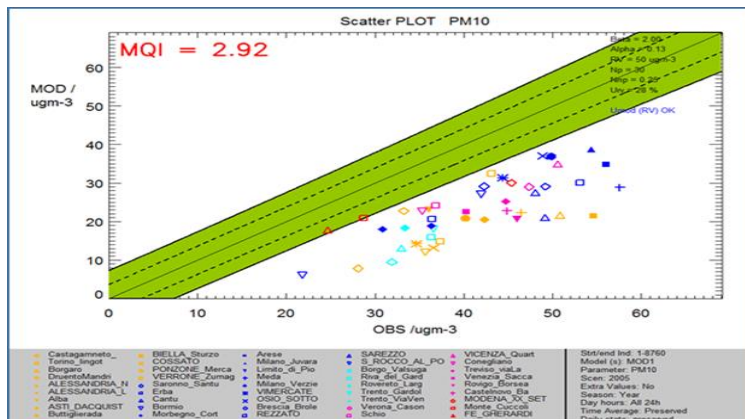
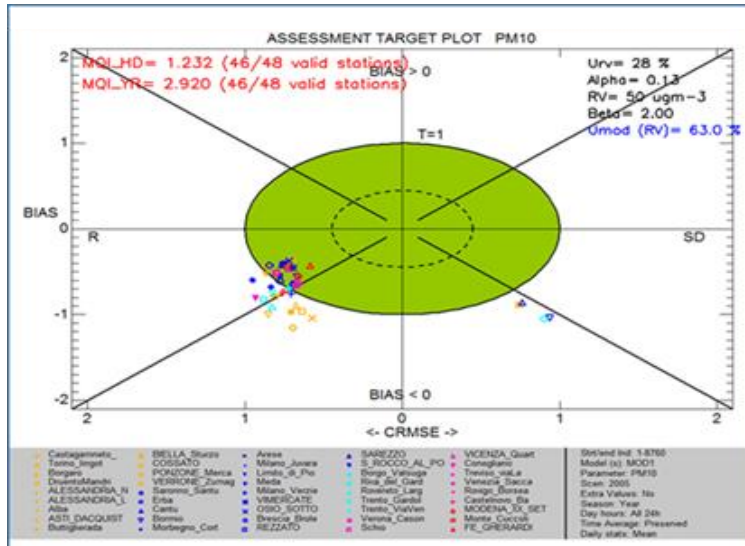
No prerequisites on the actual modeling APPLICATION to be used as long as it complies with the Modelling Quality Objectives (MQO)

FAIRMODE &  
CEN TC264 / WG43



Is this sufficient to ensure quality of modelling applications?

# Current limitations



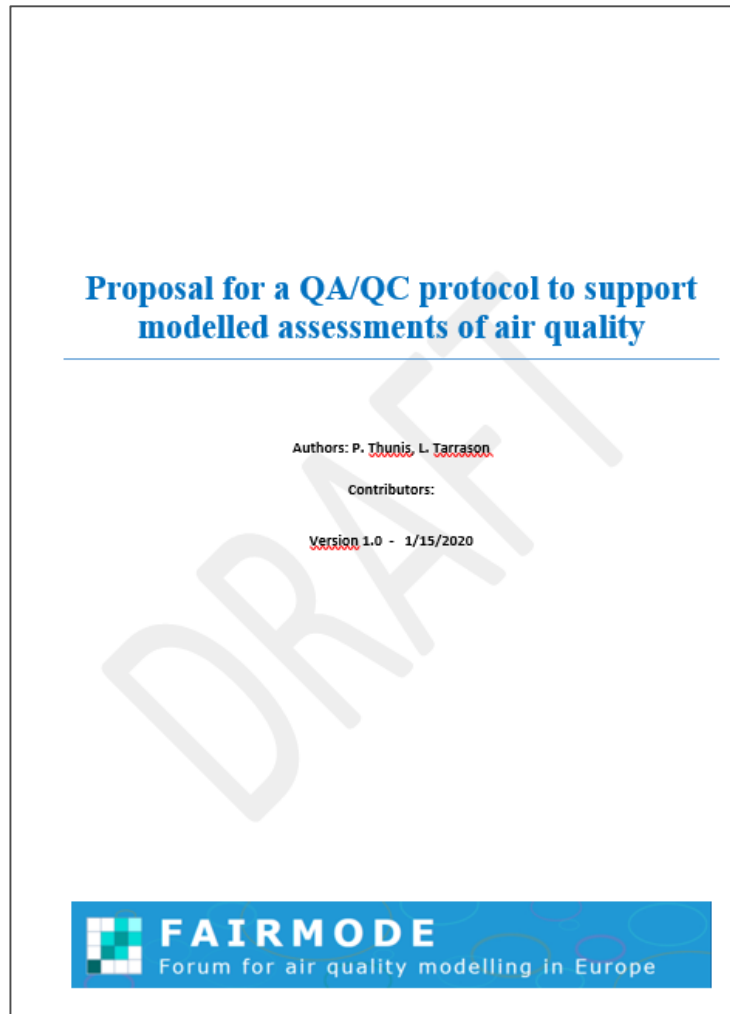
The main drawback of the MQOs is that they provide a single summary pass/fail information for a modelling application.

It provides limited information on the capability of the model to reproduce

- hot spot areas (spatial variability) or
- the timing of the pollution peaks (temporal variability).

This information is key in the context of the AAQD and is only partially addressed in the current MQO proposal.

# Draft proposal for an advanced QA/QC protocol



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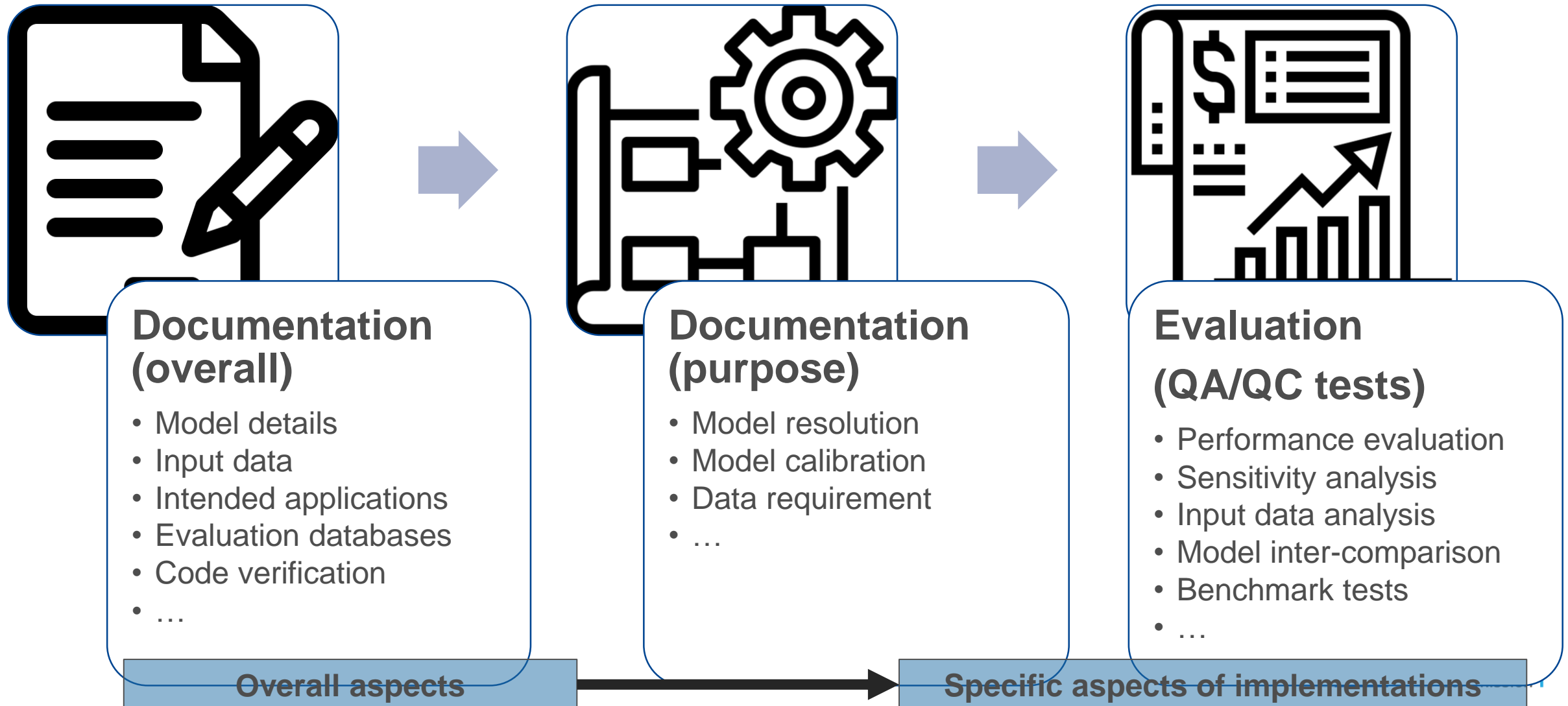
# Purpose and scope

The document proposes a QA/QC protocol to

- (1) ensure that sufficient information (metadata) is associated to the modelling results for their interpretation and
- (2) supplement the quality of the modelling results with different QA/QC tests to account for the variability of the air quality modelled situation.

*The proposed QA/QC protocol is intended to be mandatory*

# QA/QC protocol: ensuring quality through documentation and evaluation tests



# Scope (Assessment purposes)

- For which pollutants? NO<sub>2</sub>, PM and O<sub>3</sub>
- For which scales? All relevant to the AAQD
- Models? All types (Gaussian, Eulerian, Lagrangian, CDF...) relevant to the AAQD
- For which sampling points ? Sampling points from AQ network – classification according to IPR

# Proposed advanced QA/QC (main steps)

1. MQO - Passing the Modelling Quality objective
2. Spatial variability - How accurate is the representation of spatial variability?
  - Fulfilling the spatial Model Performance Criteria (MPC) as currently developed in CEN
  - Introducing a new Incremental assessment (rural vs. urban vs. street)
3. Temporal variability – Is the temporal variability well captured?
  - Fulfilling current percentile MPI for high concentrations
  - Introducing indicators for each station type to assess the seasonal, day/night and week/week-end behavior when appropriate
4. Input consistency - concerning meteorology, BC and emissions
5. Ex-post assessment
6. Multi-pollutant checks



# FAIRMODE QA/QC evaluation (indicators)

$$MQI(i) = \frac{|O_i - M_i|}{\beta U(O_i)}$$

	Model Performance Indicator (MPI)	Model Performance Criteria (MPC)
Correlation	$MPI = \frac{1 - R}{0.5\beta^2 \frac{RMS_{\sigma}^2}{\sigma_O \sigma_M}}$	MPC: $MPI \leq 1$
Standard deviation	$MPI = \frac{ \sigma_M - \sigma_O }{\beta RMS_{\bar{U}}}$	

	Model Performance Indicator (MPI) (to be implemented)	Model Performance Criteria (MPC)
Urban - rural	$MPI = \frac{INC_{urban-rural}^{model} - INC_{urban-rural}^{observed}}{\beta RMS_{\bar{U}}}$	MPC: $MPI \leq 1$
traffic - urban	$MPI = \frac{INC_{traffic-urban}^{model} - INC_{traffic-urban}^{observed}}{\beta RMS_{\bar{U}}}$	

MQO

Spatial indicators, normalised by measurement uncertainty

	Model Performance Indicator (MPI)	Model Performance Criteria (MPC)
Urban - rural	$MPI_{perc} = \frac{ M_{perc} - O_{perc} }{\beta U(O_{perc})}$	MPC: $MPI \leq 1$

	Model Performance Indicator (MPI) (to be implemented)	Model Perf. Criteria (MPC)
Urban	$MPI = \frac{SeasDiff_{urban}^{mod} - SeasDiff_{urban}^{obs}}{\beta RMS_{\bar{U}}}$	MPC: $MPI \leq 1$
Seasonal Traffic	$MPI = \frac{SeasDiff_{traffic}^{mod} - SeasDiff_{traffic}^{obs}}{\beta RMS_{\bar{U}}}$	
Rural	$MPI = \frac{SeasDiff_{rural}^{mod} - SeasDiff_{rural}^{obs}}{\beta RMS_{\bar{U}}}$	
Urban	$MPI = \frac{WeekDiff_{urban}^{mod} - WeekDiff_{urban}^{obs}}{\beta RMS_{\bar{U}}}$	
Week / weekend Traffic	$MPI = \frac{WeekDiff_{traffic}^{mod} - WeekDiff_{traffic}^{obs}}{\beta RMS_{\bar{U}}}$	
Rural	$MPI = \frac{WeekDiff_{rural}^{mod} - WeekDiff_{rural}^{obs}}{\beta RMS_{\bar{U}}}$	
Urban	$MPI = \frac{DayDiff_{urban}^{mod} - DayDiff_{urban}^{obs}}{\beta RMS_{\bar{U}}}$	
Day/night Traffic	$MPI = \frac{DayDiff_{traffic}^{mod} - DayDiff_{traffic}^{obs}}{\beta RMS_{\bar{U}}}$	
Rural	$MPI = \frac{DayDiff_{rural}^{mod} - DayDiff_{rural}^{obs}}{\beta RMS_{\bar{U}}}$	

temporal indicators, normalised by measurement uncertainty

# Indicators currently proposed in FAIRMODE/CEN

Mandatory	MQI	RMSE, BIAS	Main Model quality Objective
Informative	MPI	R	Temporal correlation MPC
			Spatial correlation MPC
		Std. Deviation	Temporal Std. deviation MPC
			Spatial Std. deviation MPC
		Bias	High Percentile MPC

# Indicators proposed in the advanced QA/QC FAIRMODE protocol

Informative	MPI	Bias & Increment	Urban	Seasonal MPC
				Week-end/week-days MPC
				Day/night MPC
			Rural	Seasonal MPC
				Week-end/week-days MPC
				Day/night MPC
			Traffic	Seasonal MPC
				Week-end/week-days MPC
				Day/night MPC
To be discussed and developed			Indicators to assess the input data (e.g. emissions)	
			Ex-Post Assessment/Multi-annual variability	
			Multi-pollutants checks	

# Comments received so far (BE, IT, NL, UK)

- Comments concerning classification of sampling points
  - Should the QA/QC hold irrespectively of representativeness/classification or not?  
Not just for 90% of all available stations as in the AAQDs?
  - Proposed protocol imposes stronger demands on assessing the spatial representativeness of stations
    - what stations to use ? How to select twin sites?
    - what to do with industrial sites?
  - Consider a additional analysis per meteorological situation

# Comments received so far (BE, IT, NL, UK)

- MQO sufficient – QA/QC as a complementary approach
- Metadata in composite mapping vs MDS
- Proposed QC/QA interesting to test with FAIRMODE Delta tools
- Comments concerning indicators – proposed use of dendrograms as QA/QC
- Comments concerning modelling applications
  - Should the proposed QA/QC apply for data fusion, intelligent interpolation applications?
  - How to consider Gaussian models? Or models only concerned with annual values?

Thank you