European Commission

FAIRMODE
Forum for air quality modelling in Europe

CT3 session
Forecast indicators

Fairmode Techincal Meeting

Oslo - Norway, October 18-20, 2022

agenda

10:30 – 10:40	A. Piersanti	Introduction and recap on the Fairmode MQI for forecast
10:40 – 11:00	C. Gama, A. Monteiro	Results of the new DELTA Tool for forecast on Portugal
11:00 – 11:20	L. Vitali	Validation using DELTA Tool Forecast Indicators of the European MINNI Simulation in the framework of CAMS Regional production
11:20 – 11:45	D. Burke S. Vranckx	Forecast validation and use of the FAIRMODE guidance in Interreg Transfair Belgium-France and Life Emerald Ireland
11:45 – 12:00	G. Giovannini, M. Stortini	Results of and feedback on the DELTA Tool for Forecast on the Po Valley
12:00 – 12.10	A. Lochno, A. Bartocha	Analysis of AQI in Pristina and Drenas in Kosovo
12:10 – 12:40		Discussion on future activities based on 4 questions: • Are the side outcomes (MPI diagram, POD & SR diagram on stations, summary report, Air Quality Index diagram) adequate to support the model evaluation, especially for experts? • Does the current methodology look sufficiently complete? What (if any) important features are missing? • Should the Air Quality index diagram be improved (with Multi-category Contingency Tables)? • Can/should we plan an application of the methodology on European scale (e.g. on CAMS data)?

Italian National Agency for New Technologies,
Energy and Sustainable Economic Development

European Commission

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CT3

INTRODUCTION AND RECAP ON THE FAIRMODE MQI FOR FORECAST

Fairmode Techincal Meeting

Oslo - Norway, October 18-20, 2022

Antonio Piersanti, Lina Vitali, Stijn Janssen

FAIRMODE crosscutting task CT3 - Quality indicators for model forecast

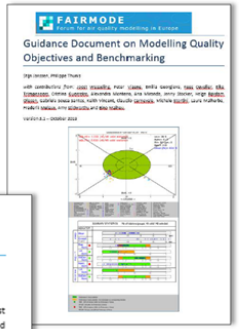
ROADMAP

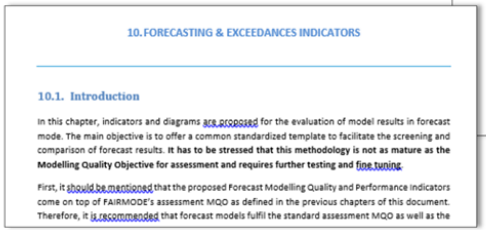
CT3 Roadmap presented at FAIRMODE SG Berlin, February 2020

CT3 - Quality control indicators for AQ forecasts

Guidance

- Test the proposed indicators (national and CAMS data).
- Elaborate a guidance document on the use of forecast indicators





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FAIRMODE crosscutting task CT3 - Quality indicators for model forecast

ACTIVITIES

2020-2022

- the proposed indicators were **tested by CT3 community**
  among the others Pawel Durka (IEP), Lina Vitali (ENEA), Alexandra Monteiro, Carla Gama, Miguel Rosa (UniAveiro), Giulia Giovannini, Michele Stortini, Roberta Amorati, Giorgio Verratti (ARPAE), Annalisa Tanzarella (Arpa Puglia), Eivind Grøtting Wærsted (MetNorway), Agniezska Bartocha (ATMOTERM), and ***for CAMS Regional****: Augustin Colette, Frédérik Meleux (INERIS), Adrien Royer (MétéoFrance) and Micheal Gauss (Met Norway)*

2021

- feedback of the users was collected and discussed during hackathons and FAIRMODE Technical Meetings
- consensus was reached on the final current formulation

2022

- a new version of the DELTA Tool (7.0) was developed including the new indicators (available for the download at https://aqm.jrc.ec.europa.eu/index.aspx) → thanks to Kees Cuvelier
- **FAIRMODE Guidance Document on Modelling Quality Objectives and Benchmarking** was produced including the new formulation (https://publications.jrc.ec.europa.eu/repository/handle/JRC129254) → thanks to Philippe Thunis

Developed Methodology

MAIN FEATURES

Within the proposed formulation, Forecast Evaluation addresses three main topics

1. An overall assessment in order to evaluate if the forecast application is “good enough” based on the Comparison with the Persistence Model
2. An assessment of the model Capability in predicting Exceedances
3. An assessment of the model Capability in predicting Air Quality Indices

Comparison with the Persistence Model: Target Plot and MPI Plot

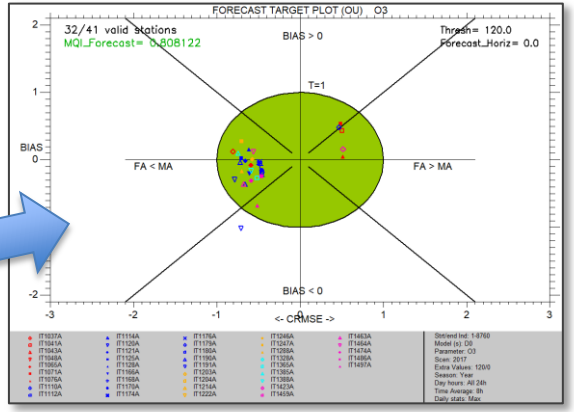
Comparison with the Persistence Model

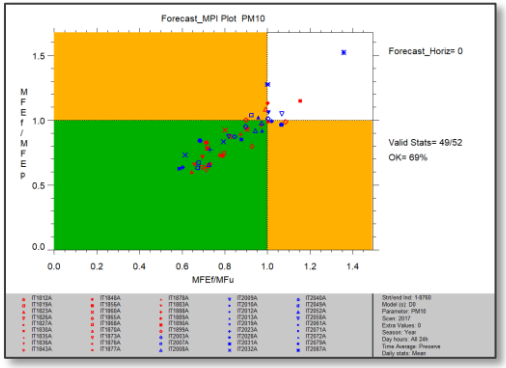
MAIN OUTCOME:
FORECAST TARGET PLOT

Formulation

$$MQI_f = \sqrt{\frac{\frac{1}{N}\sum_{i=1}^{N}(M_i - O_i)^2}{\frac{1}{N}\sum_{i=1}^{N}(P_i - O_i)^2}}$$

$$P_i = O_{i-1-FH} \pm U(O_{i-1-FH})$$





Comparison with the Persistence Model

SIDE OUTCOME:
FORECAST MPI PLOT

Formulation

$$MFE_f = \frac{2}{N}\sum_{i=1}^{N}\frac{|M_i - O_i|}{(M_i + O_i)}$$

$$MFE_p = \frac{2}{N}\sum_{i=1}^{N}\frac{|P_i - O_i|}{(P_i + O_i)}$$

$$MF_U = \frac{1}{N}\sum_{i=1}^{N}\frac{2U(O_i)}{O_i}$$

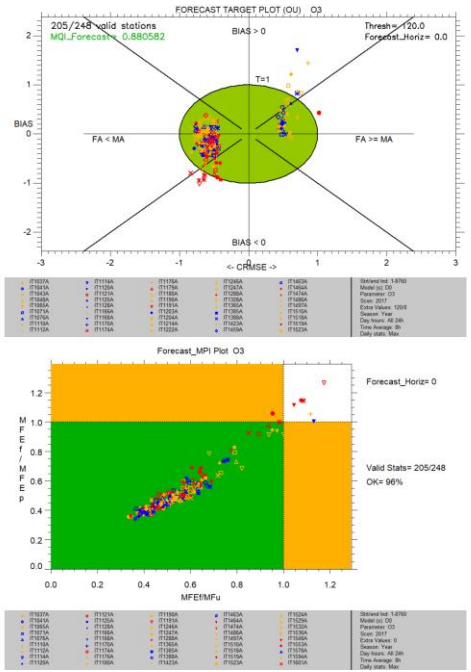
$$MPI_1 = MFEf\ /MFE_p\ (Yaxis)$$

$$MPI_2 = MFEf\ /MFU\ (X\ axis)$$

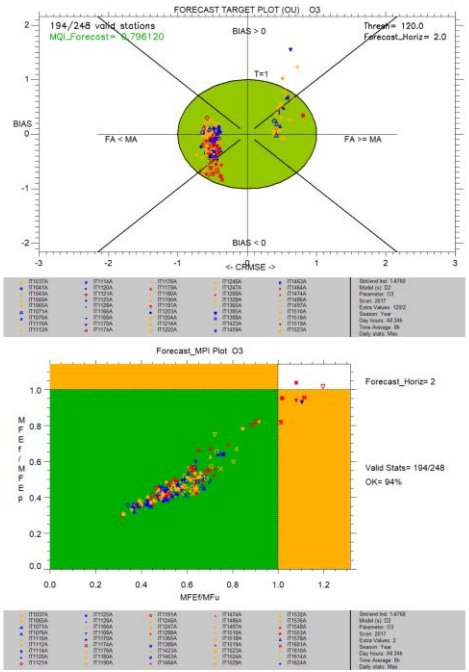
Comparison with the Persistence Model

The Forecast MPI Plot can be used to support the interpretation of results

D0



D2

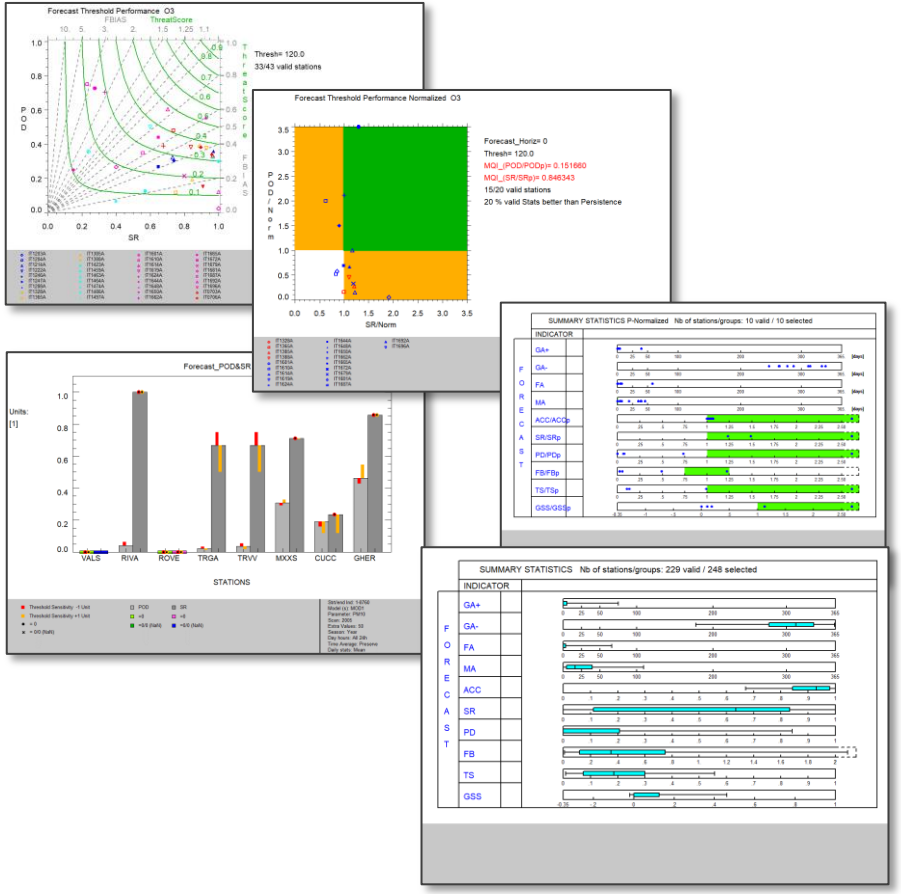


- ✓ according to Forecast Target Plot outcomes, modelling performances get better from D0 (today forecast) to D2 (the day after tomorrow)
- ✓ according to Forecast MPI plot outcomes, modelling performances get better from D0 to D2 along Y axis (i.e. when normalized to persistence model skills), but they slightly deteriorate along X axis (i.e. when considered regardless of persistence aspects)

both forecast and persistence model peformances degradate along the forecast horizon but persistence model does it worse

Capability in predicting exceedances

- It turned out that Persistence Model is very difficult to beat in predicting exceedances
- Model performances skills in predicting Exceedances are presented both with and without the comparison with Persistence Model ones
- The comparison with the Persistence Model can be included by the user in order to better understand the results but it is not mandatory
- Forecast Summary Report: a different graphical layout is applied depending on the number of stations taken into account in the analysis:
  if number of stations < 15 → “dots style”
  if number of stations ≥15 → “boxplots style”



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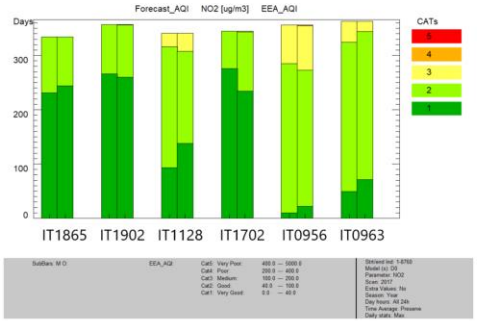
Capability in predicting Air Quality Indices

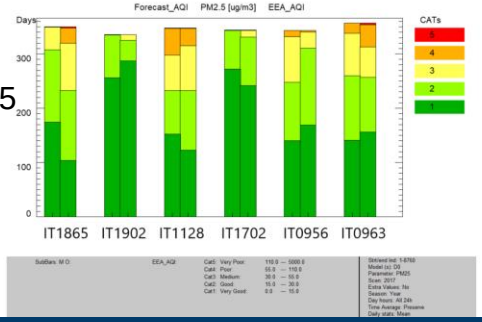
A simple multiple thresholds assessment is included in the developed approach, based on Air Quality Indices, i.e a classification of concentrations levels into air quality categories commonly used for air quality forecasting purposes.

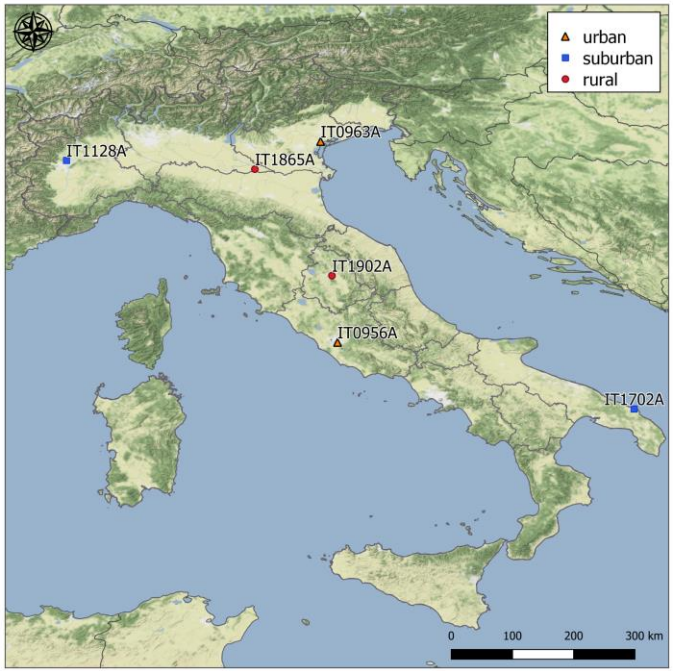
The AQI is used for public information, also an obligation under the Ambient Air Quality Directive

NO_2



PM2.5





During the CT3 discussion it was highlighted that AQI forecast bar plots give information about the total number of occurrences in each AQI class but there is no information about the timing of the forecasted AQI levels → There is room for future improvement (e.g. other additional outputs based on Multi-category Contingency Table)

NEWS AND IDEAS

- the submission of a full paper is foreseen

- CAMS has included the (assessment) Target and Report Plots in the routine evaluation, available online in the Aeroval tool:

https://cams2-83.aeroval.met.no/overall.php?project=cams2-83&exp_name=last-seasons-analysis&station=AT4S184&tab=target#

Questions for discussion

- **Did we deliver what we planned? YES = x, NO = y**
- **Is there scope for keeping the CT3 active in the next 3 years? YES = j, NO = k**
- **If YES, what would be the priorities?**
  - **Are the side outcomes (MPI diagram, POD & SR diagram on stations, summary report, Air Quality Index diagram) adequate to support the model evaluation, especially for experts?**
  - **Does the current methodology look sufficiently complete? What (if any) important features are missing?**
  - **Should the Air Quality index diagram be improved (with Multi-category Contingency Tables)?**
  - **Can/should we plan an application of the methodology on European scale (e.g. on CAMS data)?**
- **Is there need to merge/share activities with other groups?**