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

European MINNI Simulation in the framework of CAMS Regional production

Validation using DELTA Tool Forecast Indicators

18-20/10/2022 – Oslo - FAIRMODE Technical Meeting

Lina Vitali, Mario Adani, Antonio Piersanti

ENEA, Laboratory of Atmospheric Pollution

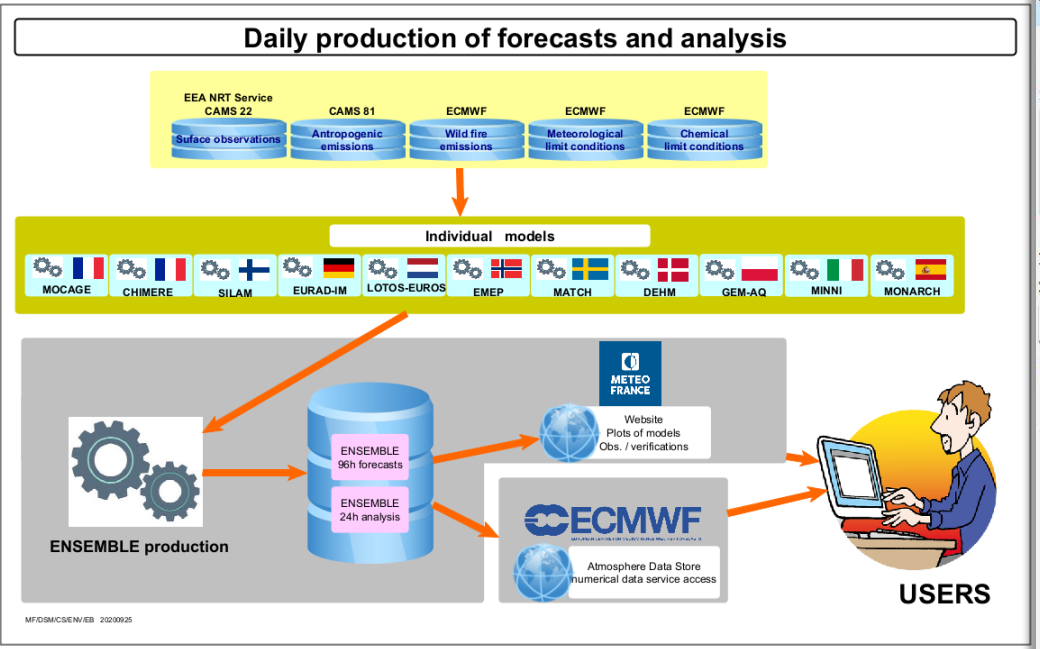
BACKGROUND

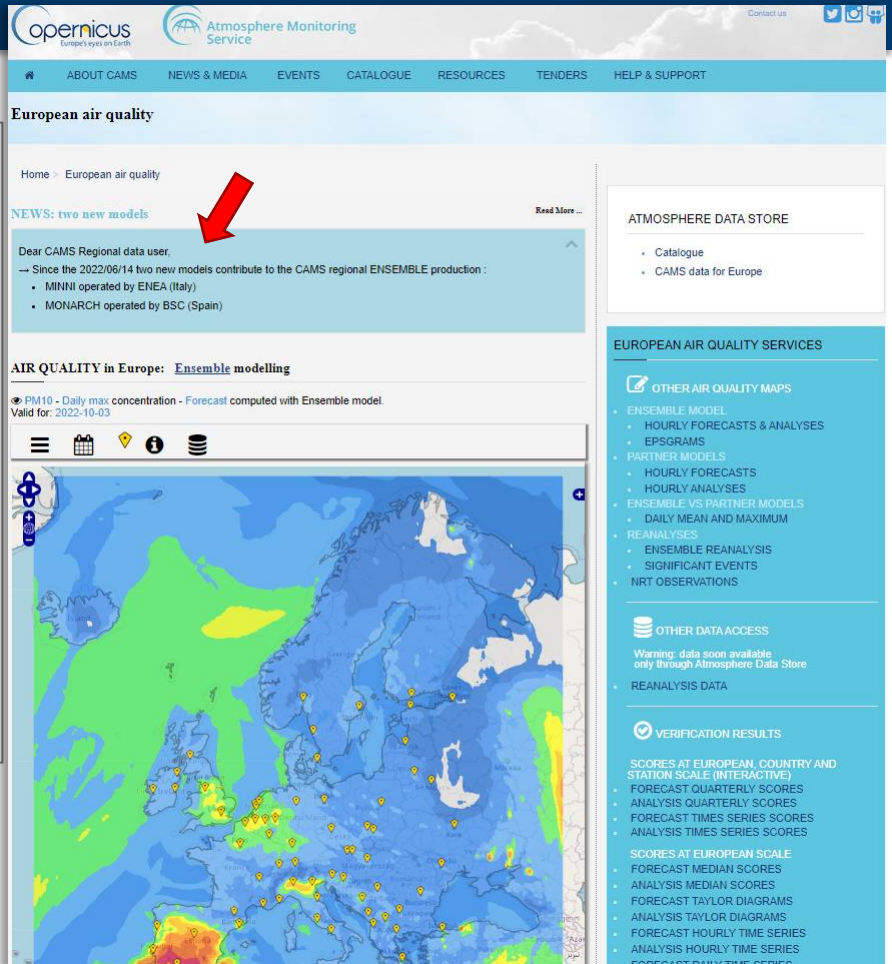
One of the questions for CT3 discussion on future activities

Can/should we plan an application of the methodology on European scale (e.g. on CAMS data)?

MINNI WITHIN CAMS2_40

https://regional.atmosphere.copernicus.eu/





ENEA team in CAMS2_40:

Mario Adani, Gino Briganti, Ilaria D'Elia, Massimo D'Isidoro, Guido Guarnieri, Mihaela Mircea, Antonio Piersanti

THE MINNI SIMULATION "V51" SETUP

MODELLING SYSTEM:	MINNI
GEOGRAPHICAL DOMAIN:	0.1 deg resolution, 25°W-45°E, 30°N-72°N
TIME PERIOD:	2018
METEOROLOGY:	IFS
BOUNDARY CONDITIONS:	C-IFS
EMISSION:	CAMS 5.1 Inventory
FIRE EMISSION:	hourly GFAS

The MINNI simulation "v51" was carried out within CAMS_50.II (2018-2021) when MINNI (operated by ENEA, Italy) and MONARCH (operated by BSC, Spain) was participating as "candidate" models

The MINNI simulation "v51" was carried out using CAMS input and setup but it is not an official CAMS product

THE DATA SET FOR THE VALIDATION

ALL AVAILABLE DATA MEASURED AT BACKGROUND MONITORING STATIONS WERE DOWNLOADED FROM EEA AND CONSIDERED FOR THE VALIDATION

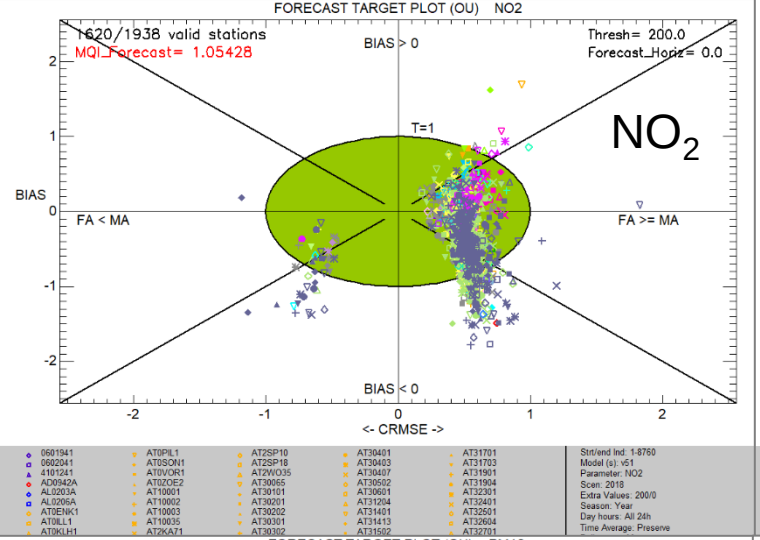
(E1a at https://discomap.eea.europa.eu/map/fme/AirQualityExport.htm)

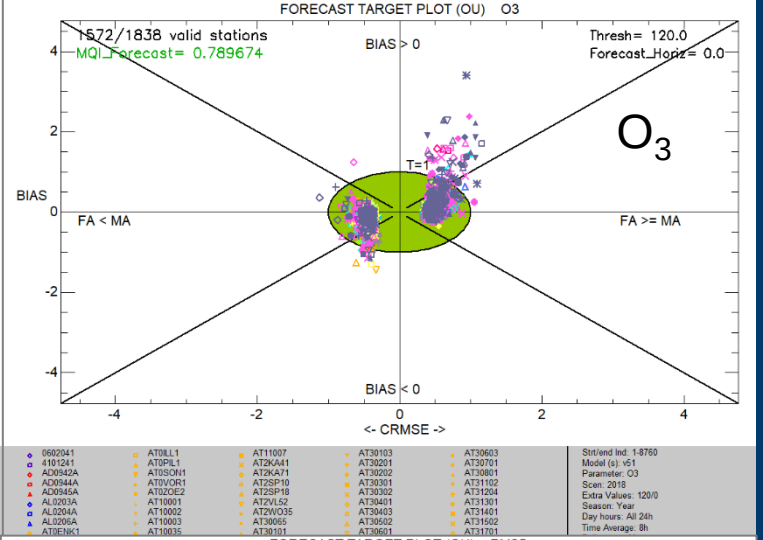
NO_2	1938 monitoring stations
O_3	1678 monitoring stations
PM10	1296 monitoring stations
PM2.5	619 monitoring stations

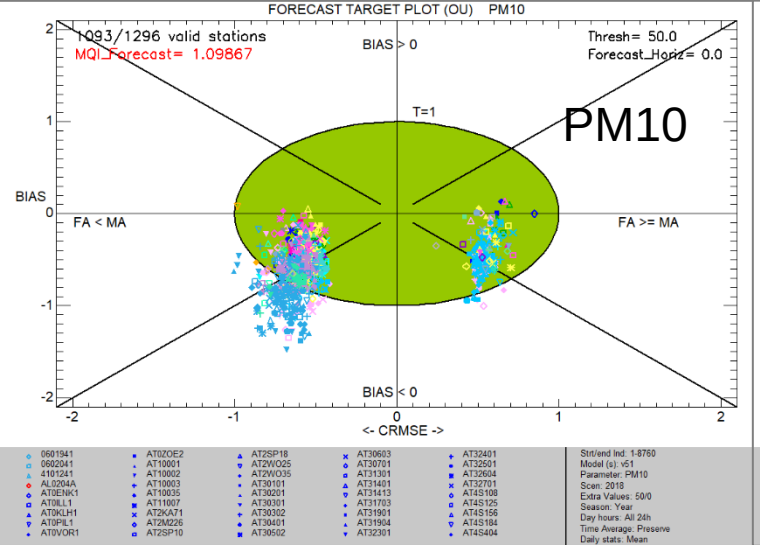
Statistics for a station are produced in DELTA only if data availability is at least 75% for the time period considered

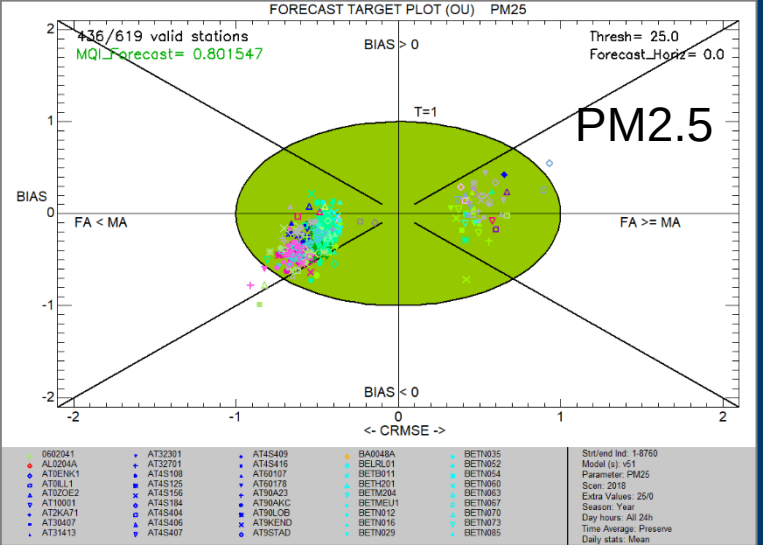
DELTA Tool Approach for Forecast Validation

1. Comparison with the Persistence Model to assess if the forecast application is “good enough”
2. Assessment of the model Capability in predicting Exceedances
3. Assessment of the model Capability in predicting Air Quality Indices





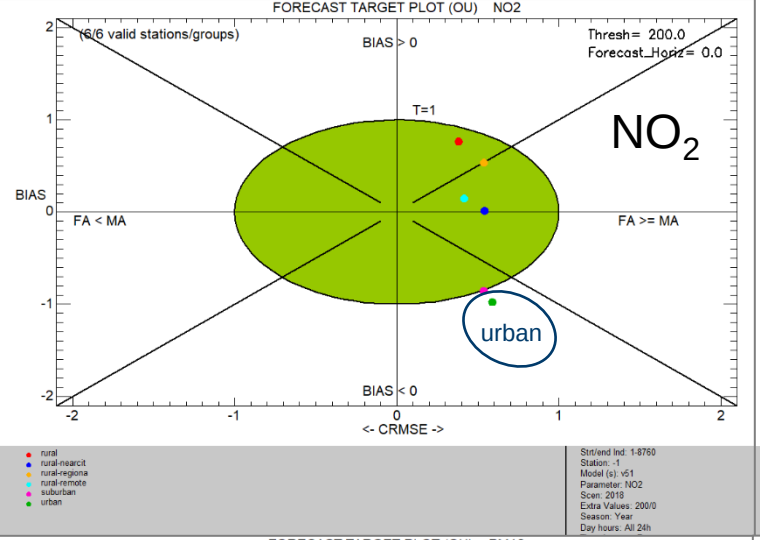


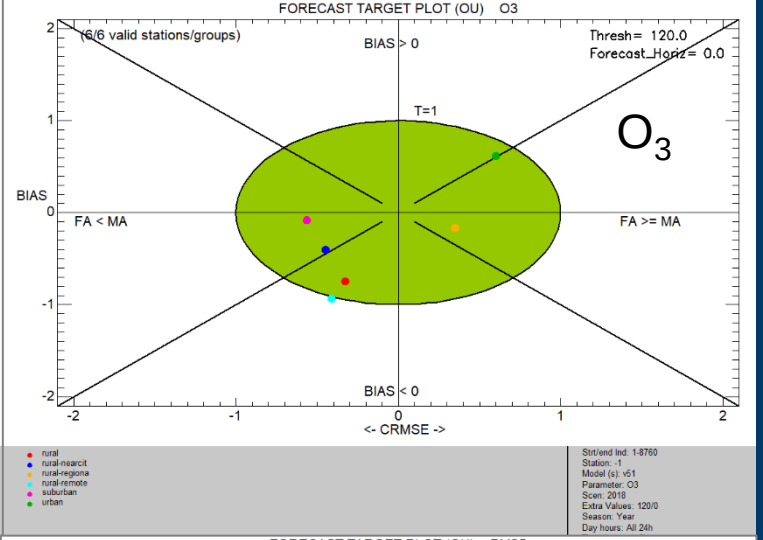


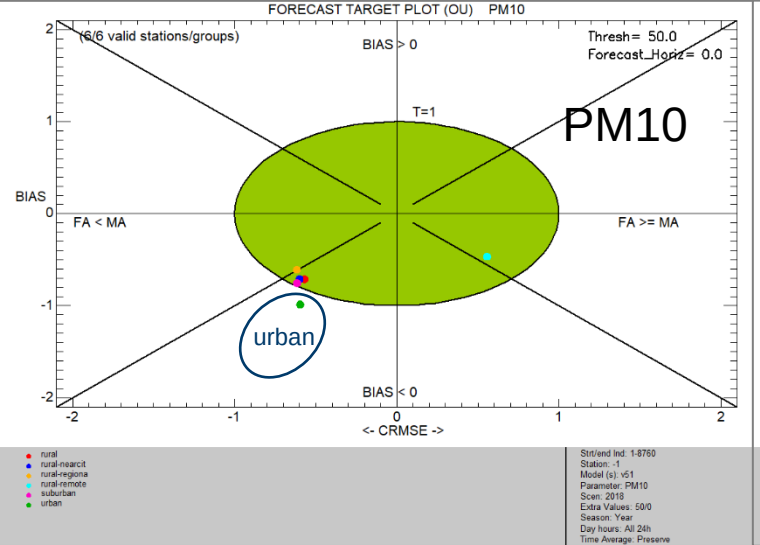
1. Comparison with the Persistence Model

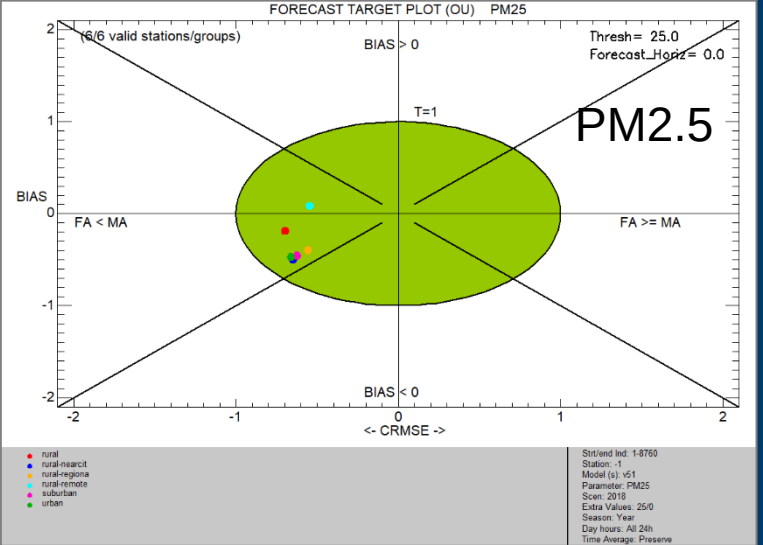
- ✓ MQO is fulfilled in simulating O_3 and PM2.5
- ✓ some room for improvement concerning NO_2 and PM10

THOUSANDS OF POINTS CAN MAKE TARGET PLOTS DIFFICULT TO INTERPRET IN PARTICULAR WHEN LOOKING FOR SOME EXPLANATION AND INSIGHT (E.G. REASON FOR MQI>1)







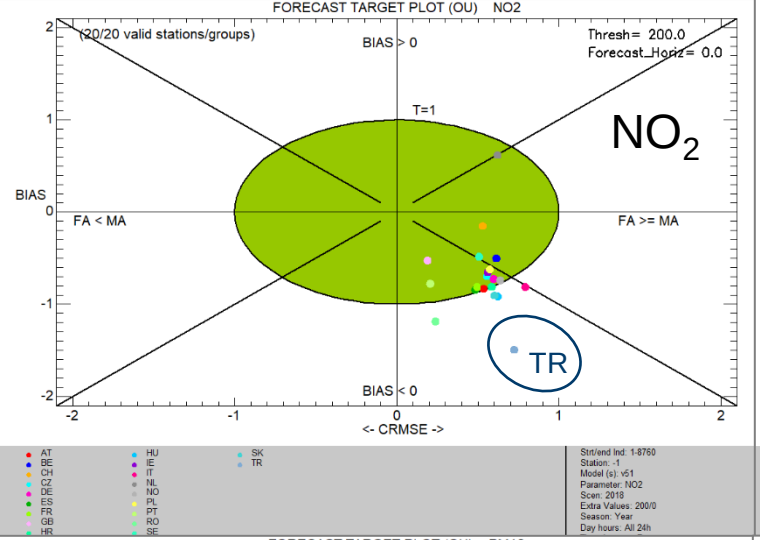


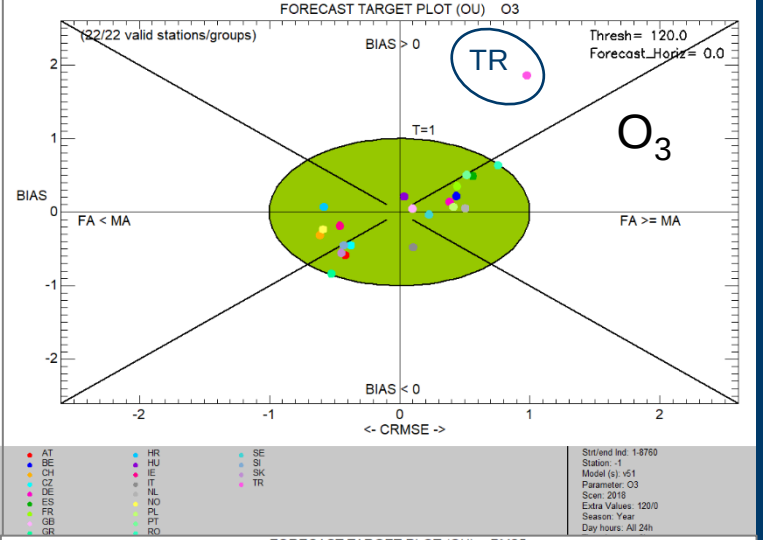
1. Comparison with the Persistence Model

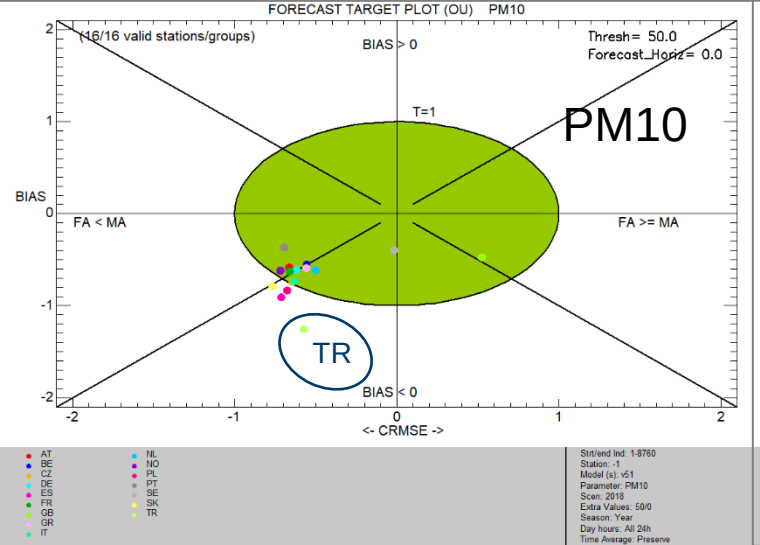
TARGET PLOT CAN BE PRODUCED CHOOSING **GROUP MODE** OPTION THAT IS GROUPING STATION BY AN ATTRIBUTE

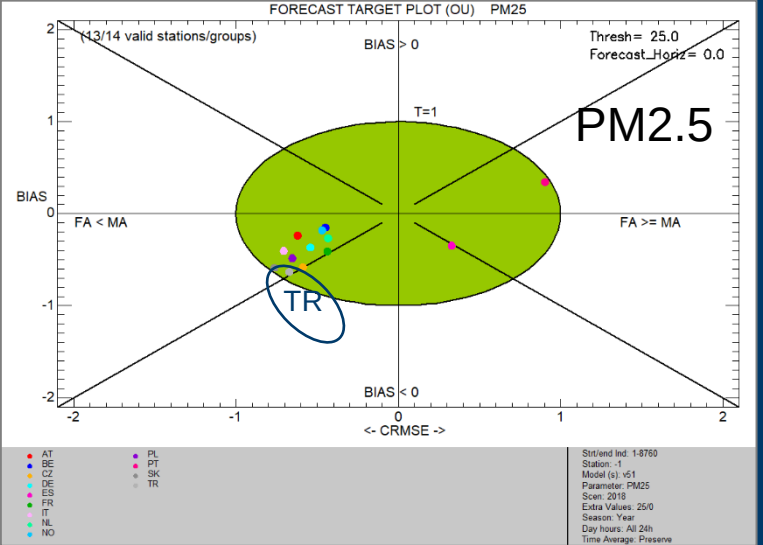
HERE STATIONS ARE GROUPED BY EMISSION ENVIRONMENT AND THE OPTION *«WORST INDIC IN 90% STAT»* IS SELECTED (I.E. THE POSITION OF THE POINT CORRESPONDS TO THE MQI OF THE GROUP)

- ✓ For both NO_2 and PM10 the main issues arise in urban environment (MQI is higher than 1 only for urban Group)









1. Comparison with the Persistence Model

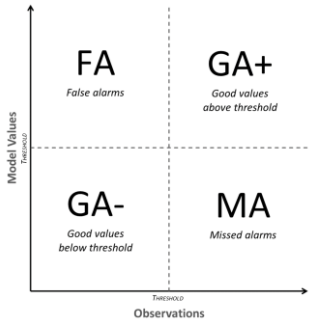
HERE STATIONS ARE GROUPED BY GEOGRAPHICAL AREA

- ✓ For both NO_2 and PM10 issues are spread in several geographical area (i.e. Nations)
- ✓ Turkey (TR) turns out to be the most critical context
- ✓ Performances in Turkey deteriorate not only for NO_2 and PM10 but for the other pollutants as well → **Are measured values reliable in Turkey?**

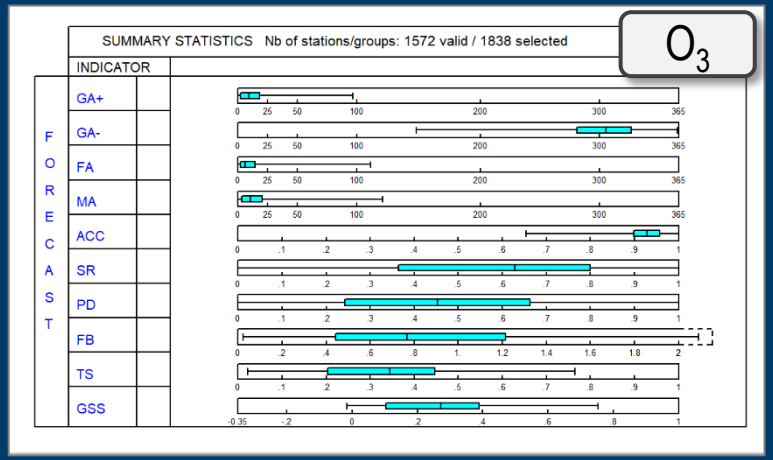
↓

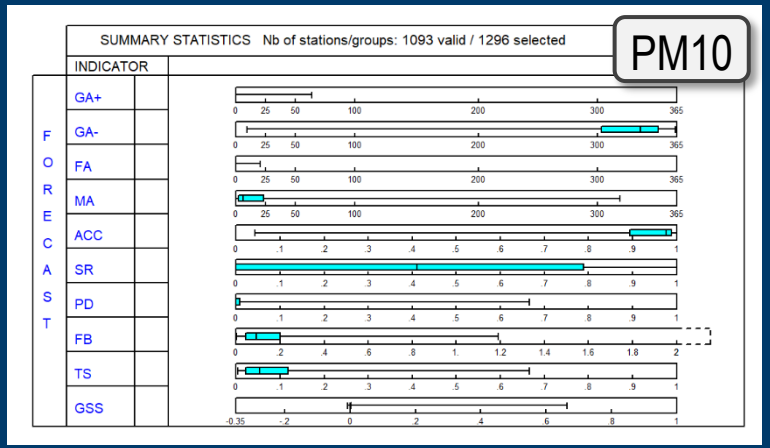
Evidence of several critical issues emerged from a preliminary investigation of the observed time series in Turkey in particular for PM10

2. Capability in predicting Exceedances



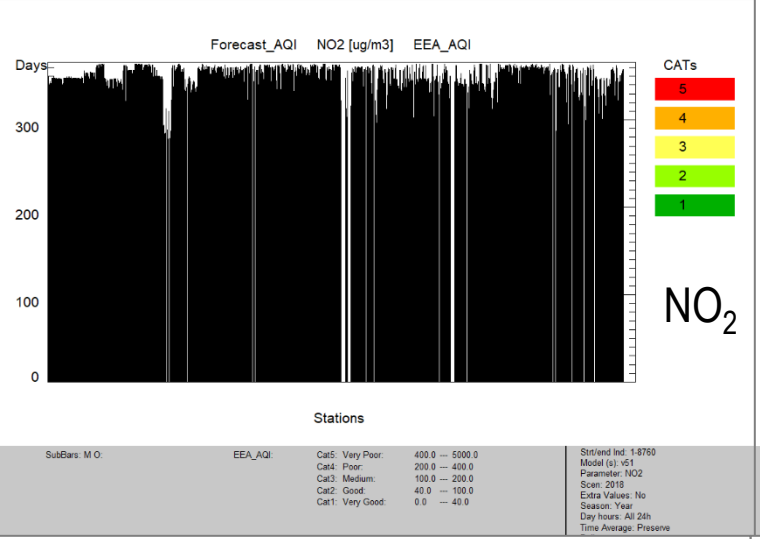
INDICATOR	ACRONYM
Accuracy = (GA_+ + GA_-) / Total	ACC
Success Ratio = GA_+ / (FA + GA_+)	SR
Probability of Detection = GA_+ /(MA + GA_+)	PD
FBias score = (GA_+ + FA) / (MA + GA_+)	FB
Threat Score = GA_+ / (MA + FA + GA_+)	TS
Gilbert Skill Score= (GA_+ - H) / (MA + FA + GA_+ - H) with H = (GA_+ + MA)(GA_+ + FA) / Total	GSS

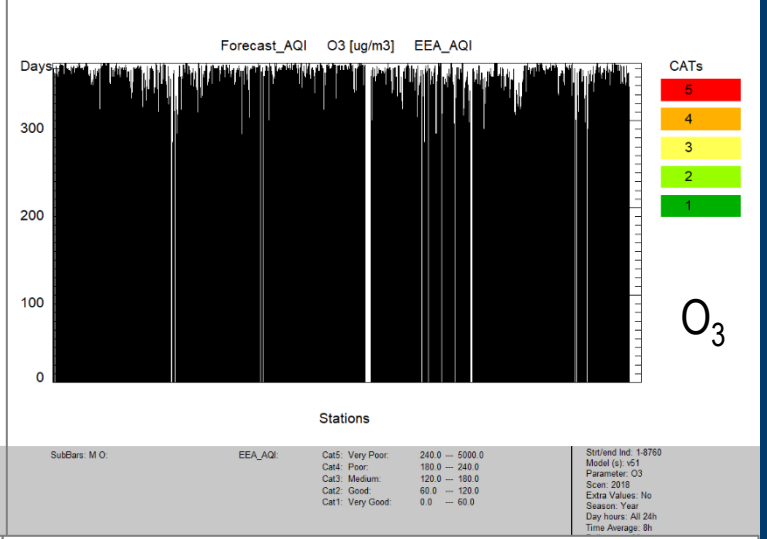


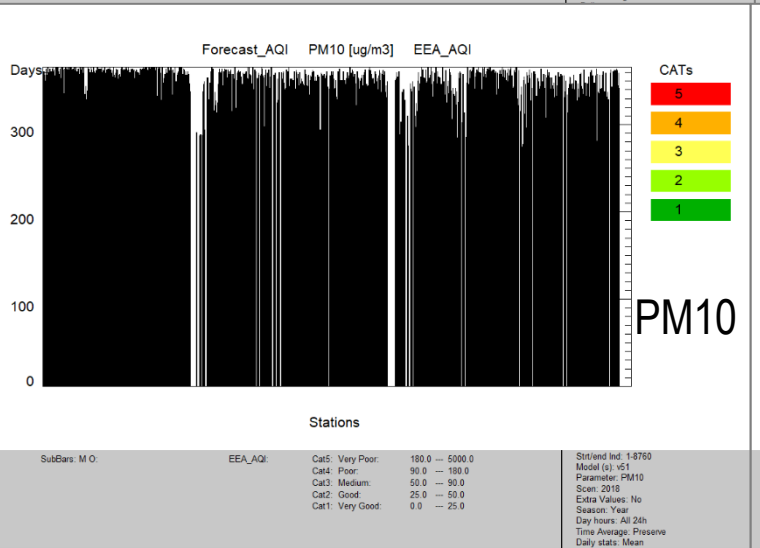


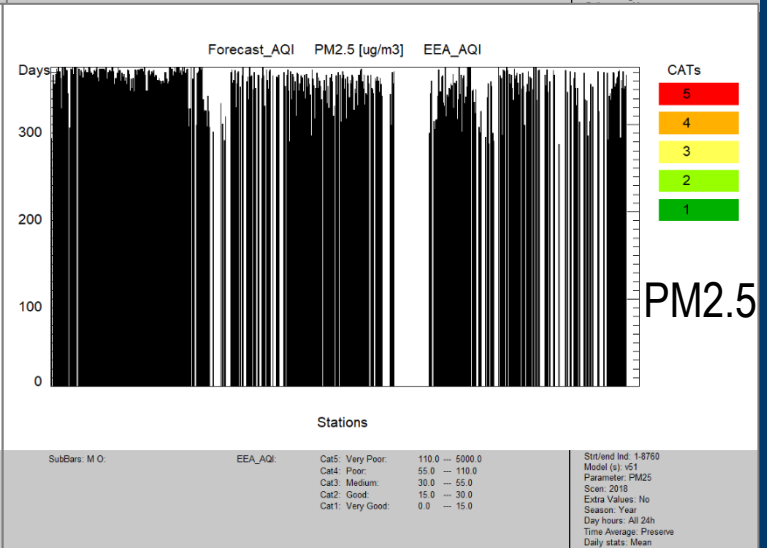
- ✓ A good performance level is reached for the Accuracy
- ✓ Performances in predicting O_3 exceedances are better than PM10 ones
- ✓ SR scores are generally better than POD ones, especially for PM10 (i.e. more Missed than False Alarms are predicted)

3. Capability in predicting Air Quality Indices

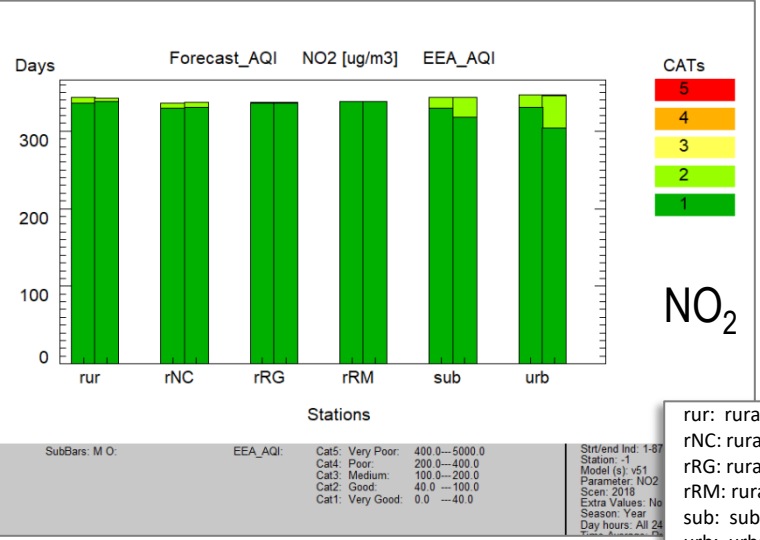


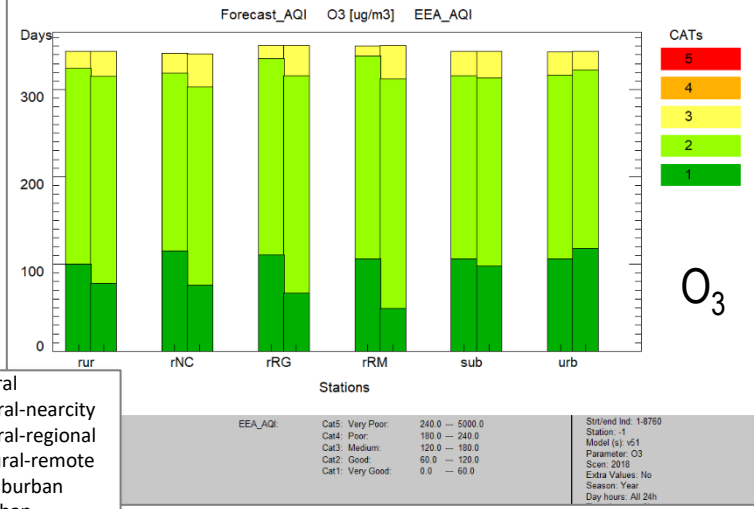




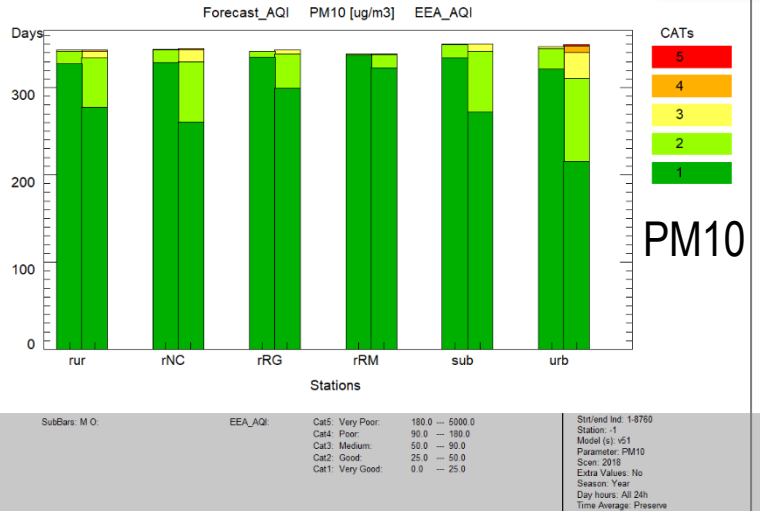


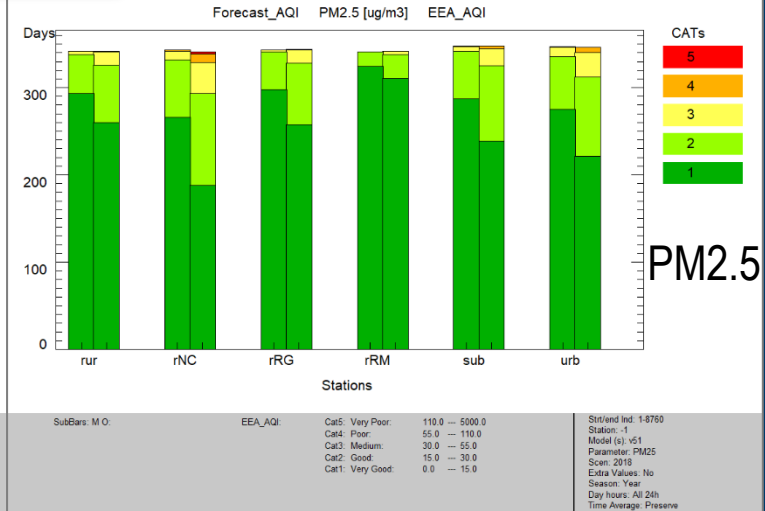
LARGE AMOUNT OF DATA MAKES THIS TYPE OF CHART IMPOSSIBLE TO READ





rur: rural
rNC: rural-nearcity
rRG: rural-regional
rRM: rural-remote
sub: suburban
urb: urban

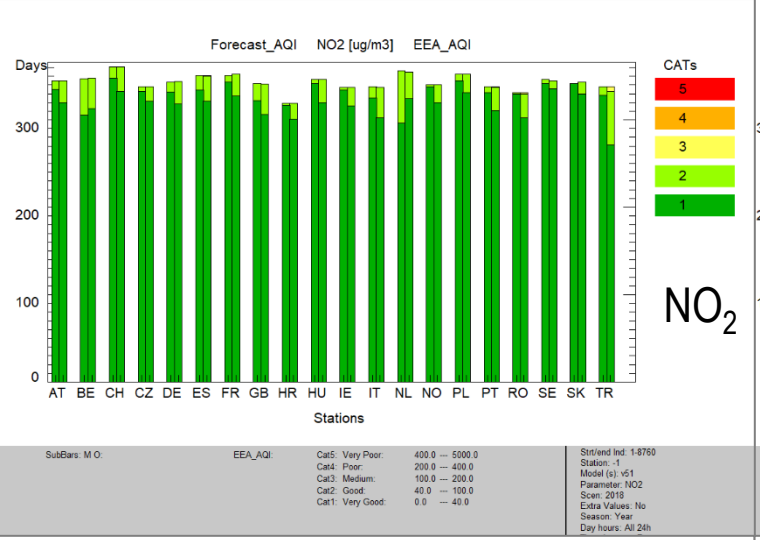


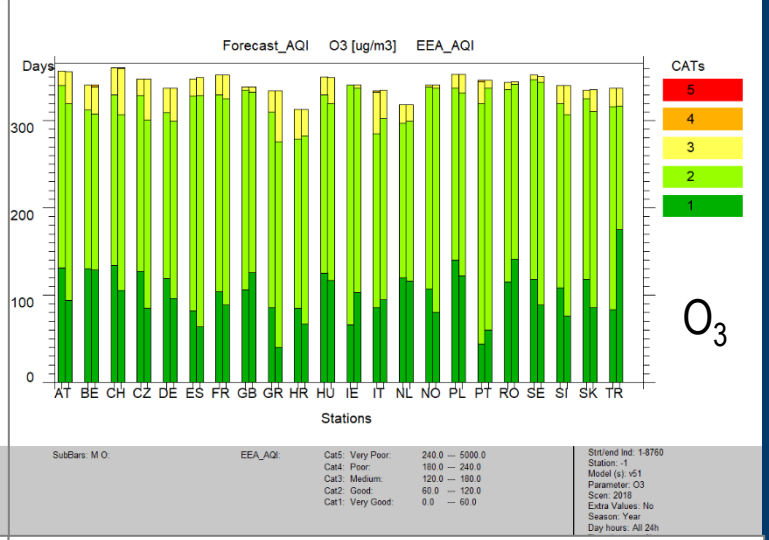


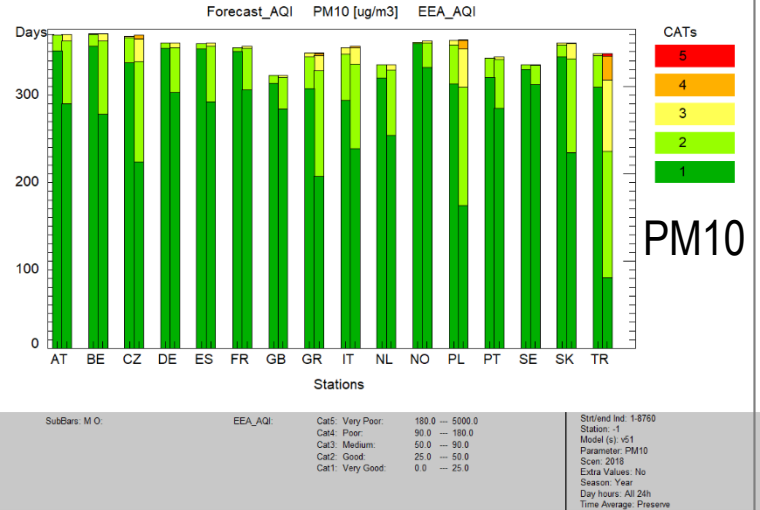
3. Capability in predicting Air Quality Indices

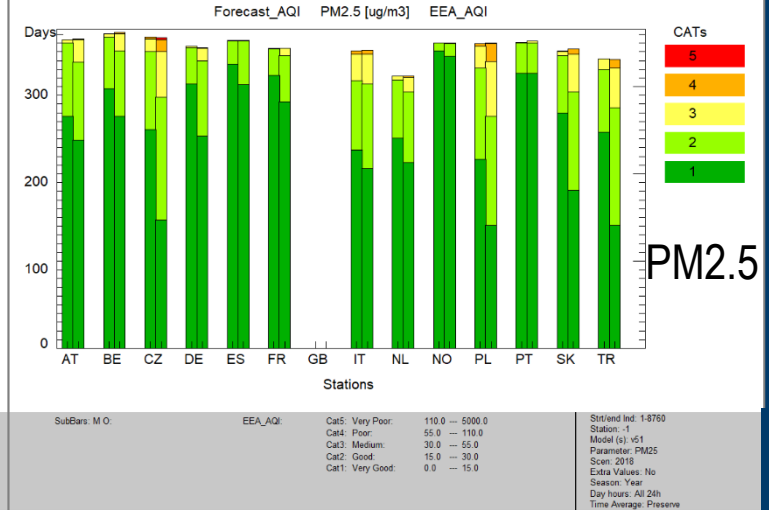
HERE **GROUP MODE** OPTION IS USED (GROUPING STATIONS BY EMISSION ENVIRONMENT)

- ✓ Model values populate lower level categories to a grater extent than the measured ones (in particular for PM)
- ✓ NO_2: both measurements and model predict concentrations values in Cat1 (Very Good AQ) or Cat2 (Good) for almost all the day of the year
- ✓ O_3: also concentration values in Cat3 (Medium) are predicted by both measurements and model
- ✓ PM: concentration values in Cat4 (Poor) and Cat5 (Very Poor) are predicted by measurements but not by the model









3. Capability in predicting Air Quality Indices

HERE **GROUP MODE** OPTION IS USED (GROUPING STATIONS BY GEOGRAPHICAL AREA)

- ✓ In the context of a general underestimation, some cases of overestimation are present: e.g. in Belgium (BE) and Netherlands (NL) for NO_2 and in Italy (IT), Turkey (TR) and Portugal (PT) for O_3
- ✓ The worst underestimation is observed for PM10 in Turkey (TR)

CONCLUSIONS

- A MINNI simulation on European scale was evaluated according to the new Forecast Indicators proposed by FAIRMODE
- The outcomes of the validation highlight
  - a good level of quality of this model application concerning O_3 and PM2.5
  - some room for improvement concerning NO_2 and PM10 in particular in urban areas
  - the need for further investigation concerning the quality of measurement data in Turkey
- This exercise points out the usefulness of the validation approach in highlighting shortcomings and strengths of a forecasting application
- Group Mode option turns out to be very useful in supporting the interpretation of the outcomes in particular when high numbers of validation points are taken into account

Thank you

lina.vitali@enea.it