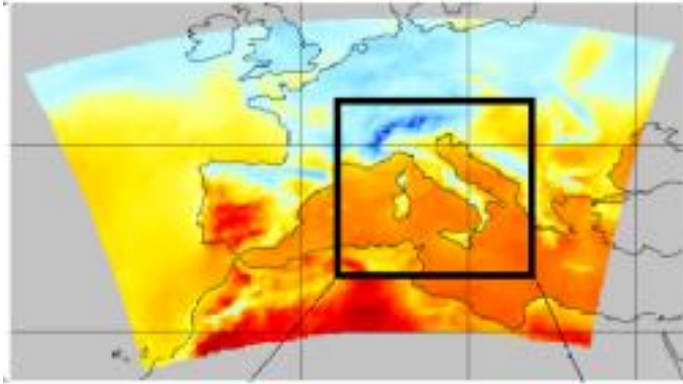


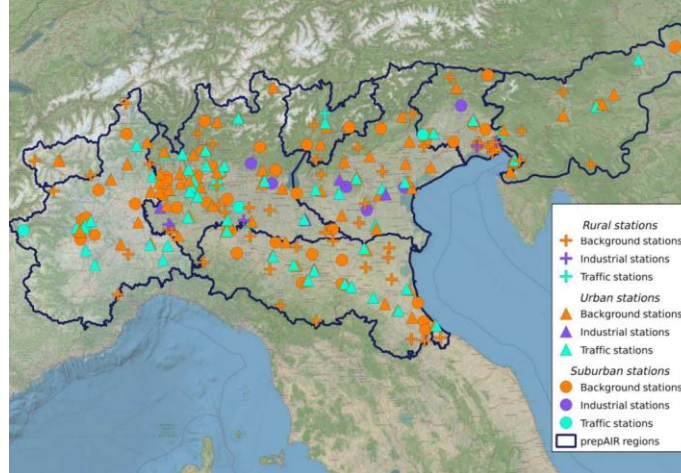
Result and feedback on the DELTA tool for forecast on the Po valley

Giulia Giovannini, Michele Stortini, Roberta Amorati, Lidia Bressan
ARPAE-Italy Fairmode technical meeting , Oslo 18-20 October 2022

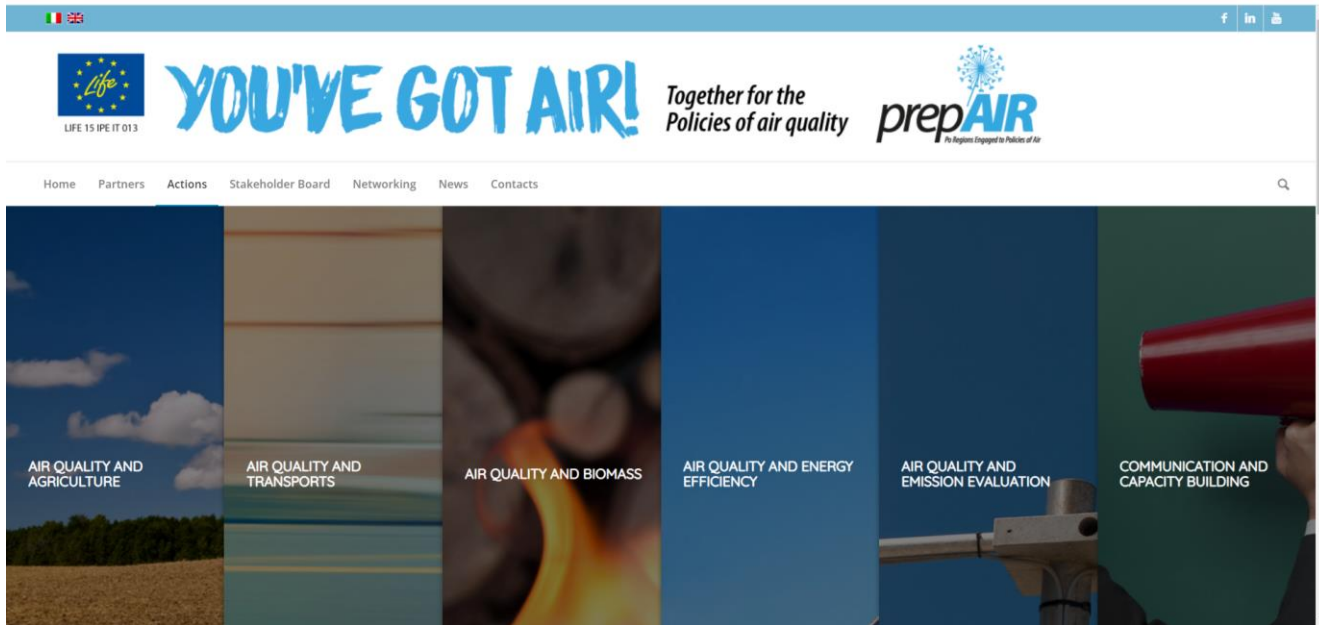
Air Quality Modelling System



- PREPSLO: 5*5km inner domain nested to kAIROS (italian SNPA model system) including Northern Italy and Slovenia.
- CTM: CHIMERE2017
- METEO: COSMO_5MED
- BC: kAIROS
- Emission: PREPAIR project

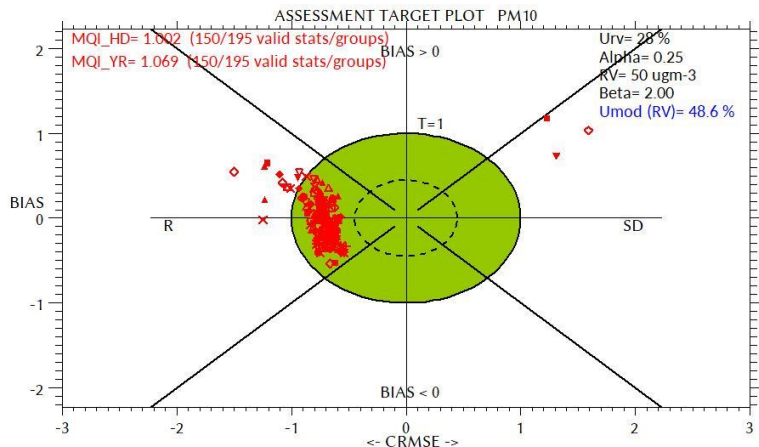


The monitoring station available in PREPAIR project.

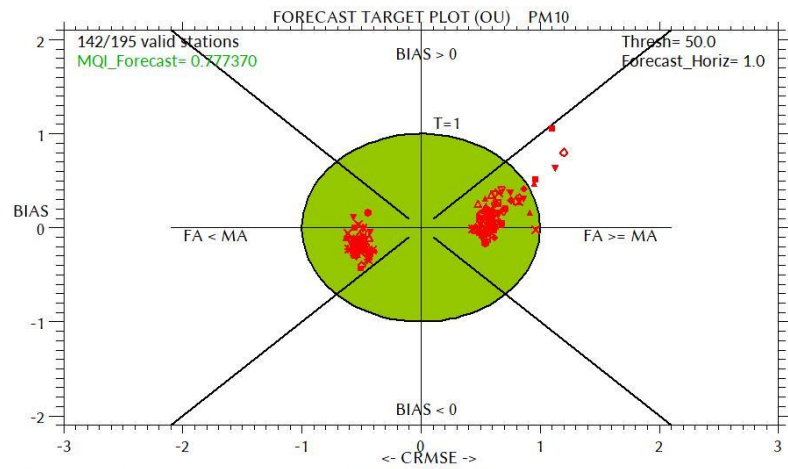


PREPAIR (Po Regions Engaged to Policies of AIR) aims at implementing the measures foreseen in the regional plans and in the Po Valley agreement at a larger scale so to strengthen the sustainability and durability of results: the geographical coverage of the IP is the Po Valley with the regions and cities that mainly influence air quality in the basin. The IP actions are also extended to Slovenia in order to assess and reduce pollutants transportation also across the Adriatic sea

PM10 - All regions - Background,d+24h



● MARECCHIA	● SANROCCO	● PARCOPRESISTEN	● GRA	Str/End Ind: 1-8760
● VERUCCHIO	● REMESINA	● FRANCHINIANGE	● TAVAZZANO	Model (s): PREPSLOd1
● SANLEO	● PARCOFERRARI	● SAVIGNANDIRI	● VESACCARISOLA	Parameter: PM10
● OTTADELLA	● GAVELLO	● GIARDINMARGH	● ROVERETOLGP	Scen: 2021
● BADIA	● PARCOEDILCARA	● SANPIETROCAP	● BRU	Extra Values: No
● SARAGAT	● LUGAGNANO	● VIACHARNI	● CAL	Season Year
● CASTELLARANO	● BESENZONE	● CASTELLUCCIO	● CAS	Day/hours: All 24h
● SLAZZARO	● PARCOMONTECUC	● GHERARDI	● EDI	Time Average: Preserve
● FEBBIO	● CORTEBRUGNATE	● CENTO	● FIU	Daily stats: Mean
		● VILLAFULVIA	● CADBLE	
		● DELTACERVIA	● PARCOBERTOZZ	
		● BOLOGNINO	● PORGIVAL	
		● SCHIO	● LIMITO	
		● BERGAMOVIAMEU		



● MARECCHIA	● FEBBIO	● CORTEBRUGNATE	● GHERARDI	● CAI	Str/End Ind: 1-8760
● VERUCCHIO	● SANROCCO	● PARCOPRESISTEN	● CENTO	● CAS	Model (s): PREPSLOd1
● SANLEO	● REMESINA	● FRANCHINIANGE	● VILLAFULVIA	● EDI	Parameter: PM10
● OTTADELLA	● PARCOFERRARI	● SAVIGNANO	● OSTELLATO	● FIU	Scen: 2021
● BADIA	● GAVELLO	● SAVIGNANDIRI	● CADBLE	● GRA	Extra Values: 50/1
● SARAGAT	● PARCOEDILCARA	● GIARDINMARGH	● BALIRANA	● TAVAZZANO	Season Year
● CASTELLARANO	● LUGAGNANO	● SANPIETROCAP	● DELTACERVIA	● VESACCARISOLA	Day/hours: All 24h
● SLAZZARO	● BESENZONE	● VIACHARNI	● PARCOBERTOZZ	● ROVERETOLGP	Time Average: Preserve
	● PARCOMONTECUC	● CASTELLUCCIO	● BRU	● RHO	Daily stats: Mean

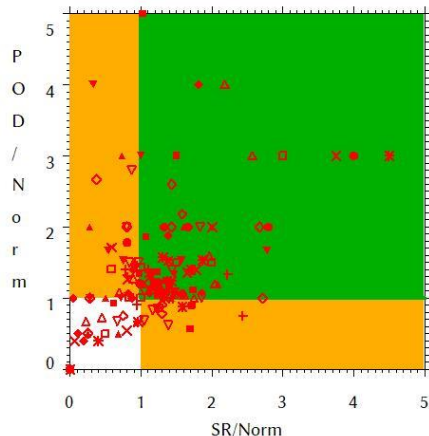
In the *summary report* all indicators satisfy the performance criteria.

In the *assessment target plot* MQI_HD and MQI_YR is > 1

target plot MQI_Forecast is < 1

PM10 - All regions - Background,d+24h

Forecast Threshold Performance Normalized PM10

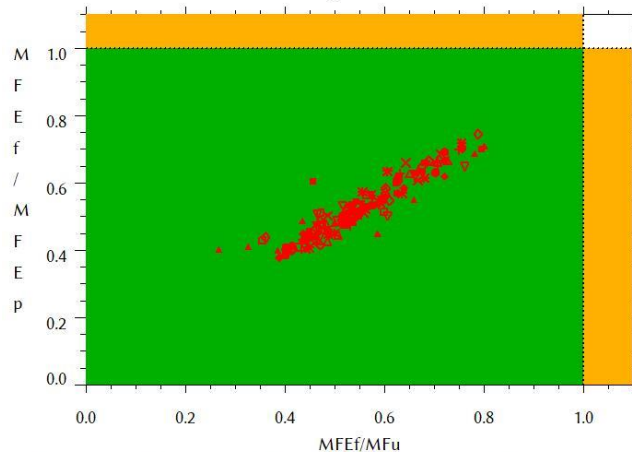


Forecast_Horiz= 1
 Thresh= 50.0
 MPI_(POD/PODp)= 0.666667
 MPI_(SR/SRp)= 0.404575
 141/195 valid stations
 55 % valid Stats better than Persistence

◊ MARECCHIA	◊ FEBBIO	◊ CORTEBRUGNATE	◊ GHERARDI	◊ CAI	Strt/End Ind: 1-8760
◊ VERUCCHIO	◊ SANROCCO	◊ PARCORESISTEN	◊ CENTO	◊ CAS	Model (s): PREPSLOd1
◊ SANLEMENITE	◊ REMESINA	◊ FRANCHINIANGE	◊ VILLAFULVIA	◊ EDI	Parameter: PM10
◊ SANLEO	◊ PARCOFERRARI	◊ SAVIGNANO	◊ OSTELLATO	◊ FIU	Scen: 2021
◊ CITTADELLA	◊ GAVELLO	◊ SAVIGNANODIRI	◊ CAORLE	◊ GRA	Extra Values: 50/1
◊ BADIA	◊ PARCOEDILCARA	◊ GIARDINIMARGH	◊ BALLARANA	◊ TAVAZZANO	Season: Year
◊ SARAGAT	◊ LUGAGNANO	◊ SANPIETROCAPU	◊ DELTACERVIA	◊ VESACCAFISOLA	Day hours: All 24h
◊ CASTELLARANO	◊ BESENZONE	◊ VIACHIARINI	◊ PARCOBERTOZZI	◊ ROVERETOLGP	Time Average: Preserve
◊ SLAZZARO	◊ PARCOMONTECU	◊ CASTELLUCCIO	◊ BRU	◊ RHO	Daily stats: Mean

Forecast better than persistence in 55% valid station

Forecast_MPI Plot PM10

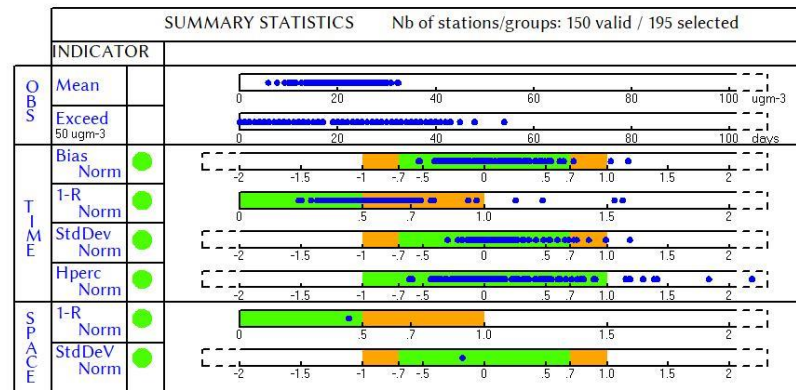
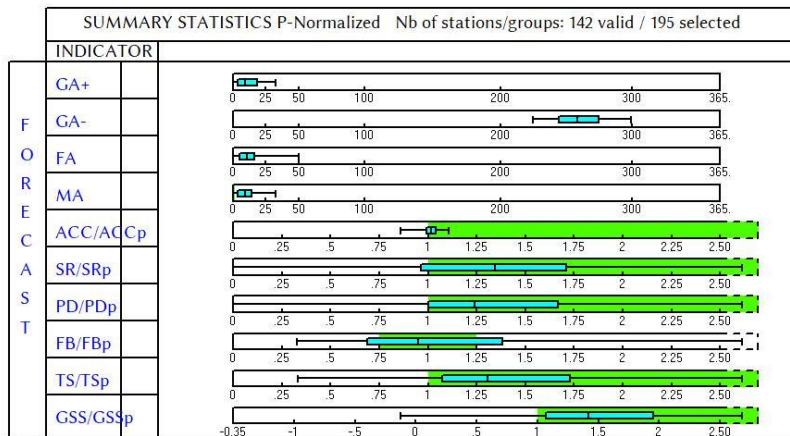


Forecast_Horiz= 1
 Valid Stats= 142/195
 OK= 100%

◊ MARECCHIA	◊ SANROCCO	◊ PARCORESISTEN	◊ DELTACERVIA	◊ ROVERETOLGP	Strt/End Ind: 1-8760
◊ VERUCCHIO	◊ REMESINA	◊ FRANCHINIANGE	◊ PARCOBERTOZZI	◊ SCHIO	Model (s): PREPSLOd1
◊ SANLEO	◊ PARCOFERRARI	◊ SANPIETROCAPU	◊ CAI	◊ noname2	Parameter: PM10
◊ OTTIADELLA	◊ GAVELLO	◊ VIACHIARINI	◊ CAS	◊ LIMITO	Scen: 2021
◊ BADIA	◊ PARCOEDILCARA	◊ CASTELLUCCIO	◊ EDI	◊ BERGAMOVIAMEU	Extra Values: 1
◊ SARAGAT	◊ LUGAGNANO	◊ GHERARDI	◊ FIU	◊ SAREZZO	Season: Year
◊ CASTELLARANO	◊ BESENZONE	◊ CENTO	◊ GRA	◊ ODOLU	Day hours: All 24h
◊ SLAZZARO	◊ PARCOMONTECU	◊ VILLAFULVIA	◊ TAVAZZANO	◊ RIVAGAR	Time Average: Preserve
◊ FEBBIO	◊ CORTEBRUGNATE	◊ CAORLE	◊ VESACCAFISOLA	◊ noname4	Daily stats: Mean

All stations are in green area: the comparison of MFE from forecast to MFE from persistence model and MFE from forecast to mean fractional uncertainty is good

PM10 - All regions - Background,d+24h

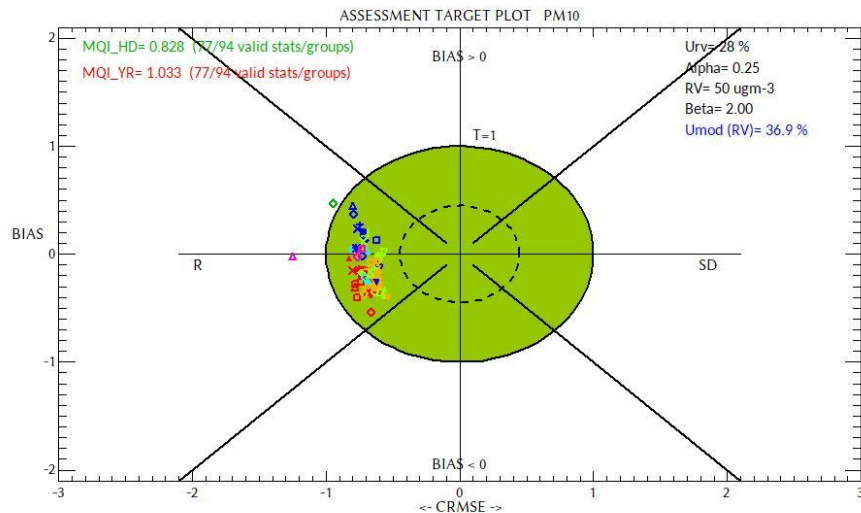


- Performance Criteria satisfied
- Performance Criteria satisfied; Error dominated by corresponding Indicator
- TIME: >90% of stations fulfill the Performance Criteria
- SPACE: Dot fulfills the Performance Criteria
- TIME: <90% of stations fulfill the Performance Criteria
- SPACE: Dot does not fulfill the Performance Criteria

This summary plot is good enough?

Summary statistics ok

PM10 - All regions - Plane Background,d+24h



<ul style="list-style-type: none"> ◇ MARECCHIA ◇ VERUCCHIO ◇ CITTADELLA ◇ SARAGAT ◇ SLAZZARO ◇ SANPOCCO ◇ REMESINA ◇ PARCOFERRARI ◇ GAVELLO 	<ul style="list-style-type: none"> ◇ PARCOEDILCARA ◇ BESENZONE ◇ PARCOMONTEON ◇ PARCORESISTEN ◇ FRANCHINIANGE ◇ GIARDINIMARGH ◇ SANPIETROCAPP ◇ VIACHIARINI ◇ GHERARDI 	<ul style="list-style-type: none"> ◇ CENTO ◇ VILLAFULVIA ◇ CAORLE ◇ DELTACERVIA ◇ PARCOBERTOZZI ◇ BRU ◇ CAS ◇ EDI 	<ul style="list-style-type: none"> ◇ FIU ◇ GRA ◇ TAVAZZANO ◇ VESACCAFISOLA ◇ noname2 ◇ LIMITO ◇ RIVAGAR ◇ OREMA ◇ PAVIAVIAFOLPE 	<ul style="list-style-type: none"> ◇ VEPARCOBISSUO ◇ MAGENTA ◇ VIQUARTIEREIT ◇ ADRIA ◇ ROBORSEA ◇ SANDONADIPIAV ◇ TURBIGO ◇ PONTISULMINCI ◇ BORGOFRANCO 	<p>Str/End Ind: 1-8760 Model (s): PREPSLOd1 Parameter: PM10 Scen: 2021 Extra Values: No Season: Year Day hours: All 24h Time Average: Preserve Daily stats: Mean</p>
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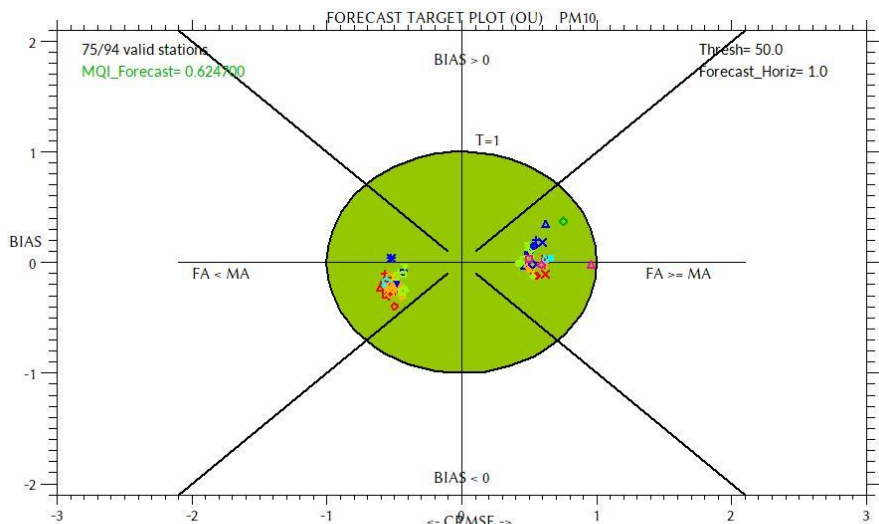
SUMMARY STATISTICS		Nb of stations/groups: 77 valid / 94 selected	
INDICATOR			
O B S	Mean		
	Exceed 50 ug-m-3		
T I M E	Bias		
	1-R		
	StdDev		
	Hperc		
S P A C E	1-R		
	StdDeV		

	Performance Criteria satisfied
	Performance Criteria satisfied; Error dominated by corresponding Indicator
	TIME: >90% of stations fulfills the Performance Criteria
	SPACE: Dot fulfills the Performance Criteria
	TIME: <90% of stations fulfills the Performance Criteria
	SPACE: Dot does not fulfill the Performance Criteria

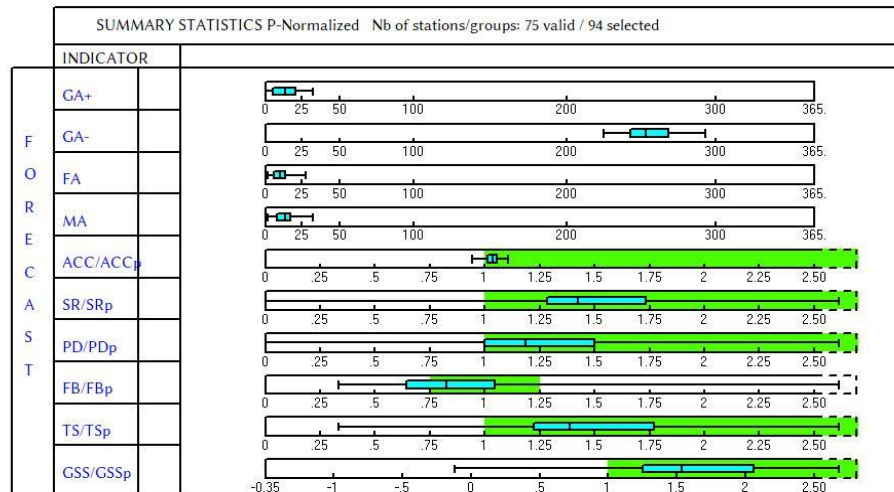
In the *summary report* all indicators satisfy the performance criteria.

In the assessment *target plot* MQI_HD satisfies the performance criteria while the MQI_YR is > 1

PM10 - All regions - Plane Background d+24h



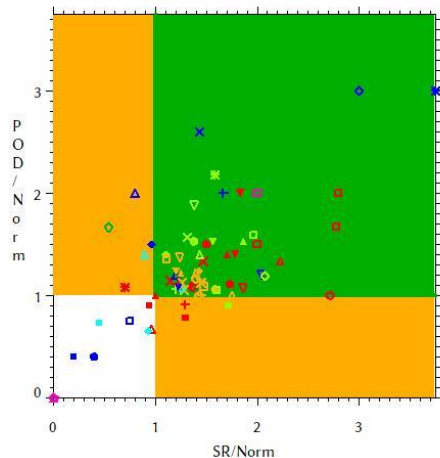
<ul style="list-style-type: none"> ● MARECCHIA ● VERUCCHIO ● SANLEMENTE ● OTTADELLA ● SARAGAT ● SLAZZARO ● SANROCCO ● REMESINA ● PARCOFERRARI 	<ul style="list-style-type: none"> ● GAVELLO ● PARCOEDILCARA ● BESENZONE ● PARCOMONTECUC ● PARCOPRESISTEN ● FRANCHINIANGE ● SAVIGNANO ● GIARDINIMARGH ● SANPIETROCAPA 	<ul style="list-style-type: none"> ● VIACHIARINI ● GHERARDI ● CENTO ● VILLAFULVIA ● OSTELLATO ● CAORLE ● BALLIRANA ● DELTACERVIA ● PARCOBERTOZZI 	<ul style="list-style-type: none"> ● BRU ● CAI ● CAS ● EDI ● FIU ● GRA ● TAVAZZANO ● VESACCAFISOLA ● noname2 	<ul style="list-style-type: none"> ● LIMITO ● GAMBARA ● RIVAGAR ● CREMA ● noname5 ● PAVIAVIAFOLPE ● VEPARCOBISSUO ● MAGENTA ● BASSANODELGRA 	<p>Str/End Ind: 1-9760 Model(s): PREPSLOd1 Parameter: PM10 Scan: 2021 Extra Values: 50/1 Season: Year Day/hours: All 24h Time Average: Preserve Daily stats: Mean</p>
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All medians are in green area!!

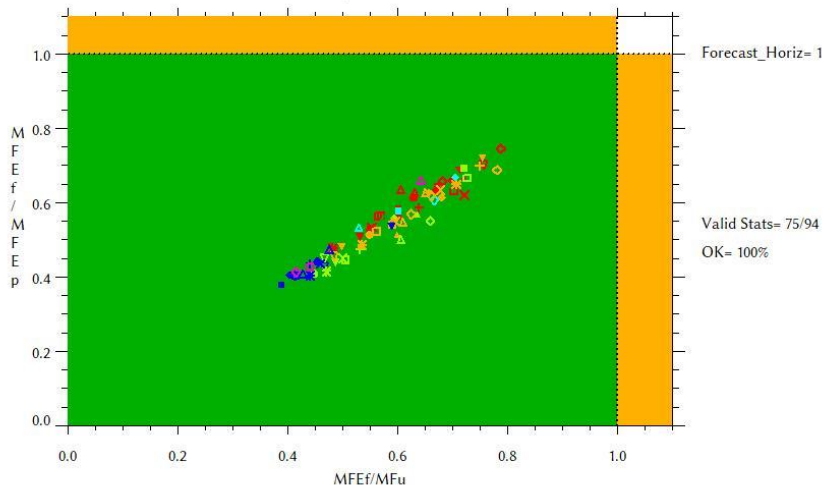
PM10 - All regions - Plane Background, d+24h

Forecast Threshold Performance Normalized PM10



Forecast_Horiz= 1
 Thresh= 50.0
 MPI_(POD/PODp)= 0.738636
 MPI_(SR/SRp)= 0.775000
 75/94 valid stations
 70 % valid Stats better than Persistence

Forecast_MPI Plot PM10



Forecast_Horiz= 1
 Valid Stats= 75/94
 OK= 100%

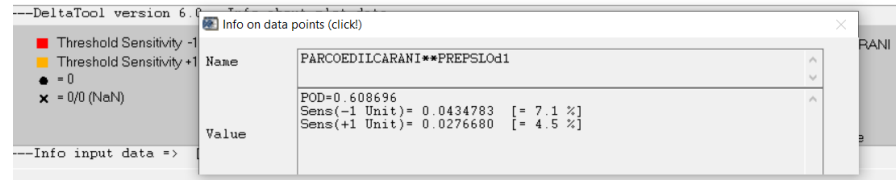
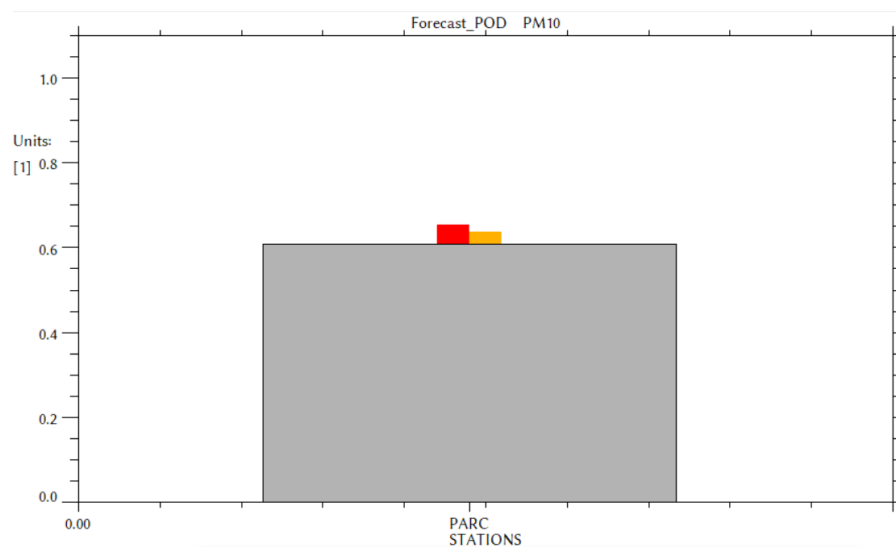
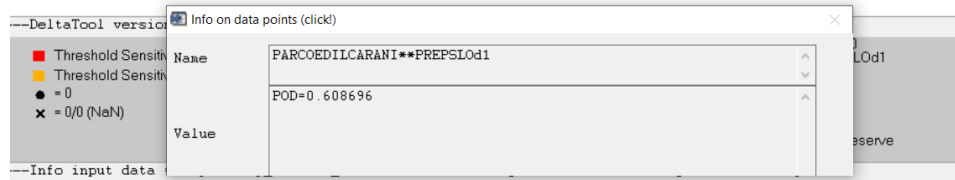
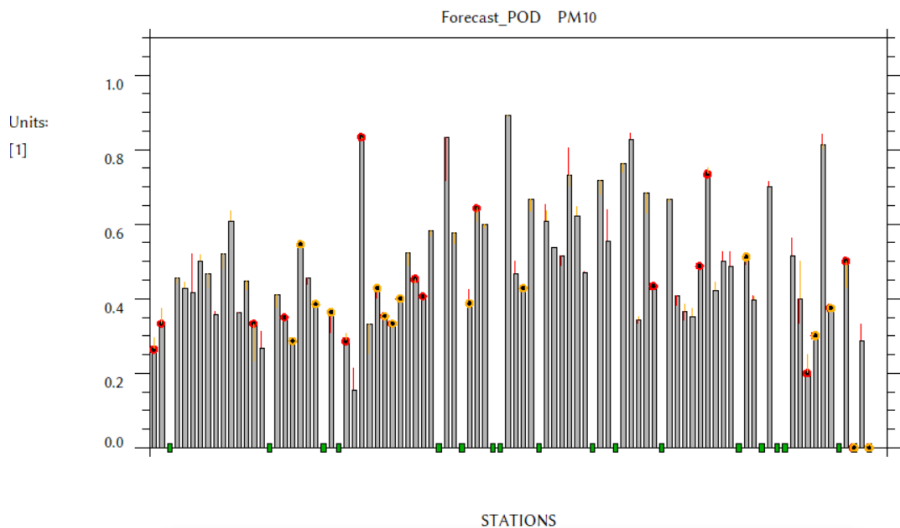
◊ MARECCHIA	● GAVELLO	▲ VIACHIARINI	◊ BRU	▲ LIMITO	Str/end Ind: 1-8760
◊ VERUCCHIO	● PARCOEDILCARA	▲ GHERARDI	◊ CAL	▲ GAMBARA	Model (s): PREPSLOd1
◊ SANLEONTE	● BESENZONE	▲ CENTO	◊ CAS	▲ RIVAGAR	Parameter: PM10
◊ CITTADELLA	● PARCOMONTECUC	▲ VILLAFULVIA	◊ EDI	▲ CREMA	Scen: 2021
◊ SARAGAT	● PARCOMONTECUC	▲ OSTELLATO	◊ FIU	▲ noname5	Extra Values: 50/1
◊ SLAZZARO	● FRANCHINIANGE	▲ CAORLE	◊ GRA	▲ PAVIAVIAFOLPE	Season: Year
◊ SANROCCO	● SAVIGNANO	▲ BALLIRANA	◊ TAVAZZANO	▲ VEPARCOBISSUC	Day hours: All 24h
◊ REMESINA	● GIARDINIMARGH	▲ DELTACERVIA	◊ VESACCAFISOLA	▲ MAGENTA	Time Average: Preserve
◊ PARCOFERRARI	● SANPIETROCAP	▲ PARCOBERTOZZI	◊ noname2	▲ BASSANO DELGRA	Daily stats: Mean

◊ MARECCHIA	● PARCOEDILCARA	▲ VILLAFULVIA	◊ TAVAZZANO	▲ VIQUARTIEREIT	Str/end Ind: 1-8760
◊ VERUCCHIO	● BESENZONE	▲ CAORLE	◊ VESACCAFISOLA	▲ ADRIA	Model (s): PREPSLOd1
◊ SANLEONTE	● PARCOMONTECUC	▲ DELTACERVIA	◊ noname2	▲ ROBORSEA	Parameter: PM10
◊ CITTADELLA	● PARCOMONTECUC	▲ PARCOBERTOZZI	◊ LIMITO	▲ SANDONADIPIAV	Scen: 2021
◊ SARAGAT	● FRANCHINIANGE	▲ CAI	◊ RIVAGAR	▲ TURBIGO	Extra Values: 1
◊ SLAZZARO	● SANPIETROCAP	▲ EDI	◊ CREMA	▲ PONTISULMINCI	Season: Year
◊ SANROCCO	● VIACHIARINI	▲ FIU	◊ PAVIAVIAFOLPE	▲ BORGOFRANCO	Day hours: All 24h
◊ REMESINA	● GHERARDI	▲ GRA	◊ VEPARCOBISSUC	▲ PDMANDRIA	Time Average: Preserve
◊ PARCOFERRARI	● CENTO	▲ noname2	◊ MAGENTA	▲ CASIRATEDADDA	Daily stats: Mean

Forecast better than persistence in 75% valid station

Also in this case the comparison of MFE from forecast to MFE from persistence model and MFE from forecast to mean fractional uncertainty is good.

PM10 - All regions - Plane Background, d+24h



Not very easy to understand in case of large number of stations.

Comment and open questions:

- A +24h forecast better than persistence model is very hard to achieve. Performance in plane stations is better than all bg stations: horizontal resolution (5km) is too coarse?
- How we can take into account the uncertainty of the measure also in threshold? The POD&FAR diagrams even in the case of a number of stations not very high are not “friendly”.
- Which Forecast MPI_plot or forecast threshold normalized plot?
- In the forecast summary plot how many indicators should be in the green area in order to have a “good enough” forecast?