Agenzia nazionale per le nuove tecnologie,
l'energia e lo sviluppo economico sostenibile

ENEA nel Copernicus Atmosphere Monitoring Service (CAMS): Regional Air Quality production 2022, CAMEO e National Collaboration Programme

X Giornata della modellistica in ARIA(NET)

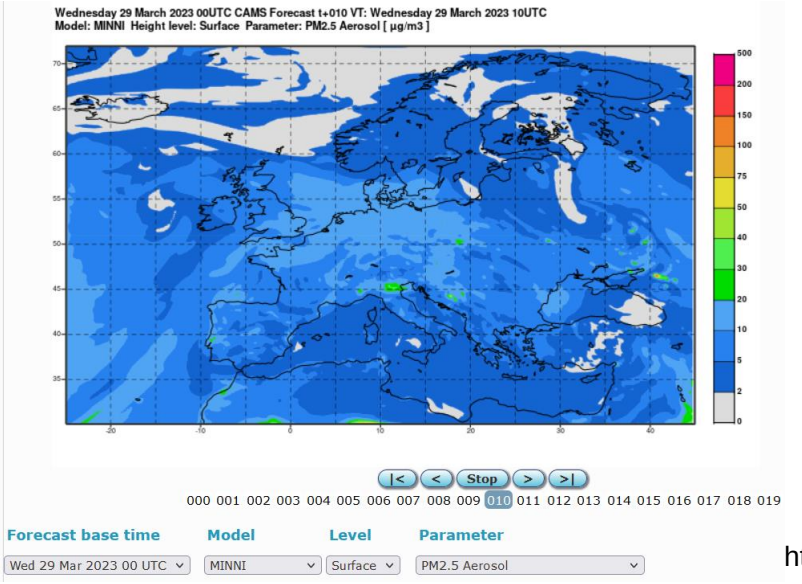
Milano, 29 marzo 2023

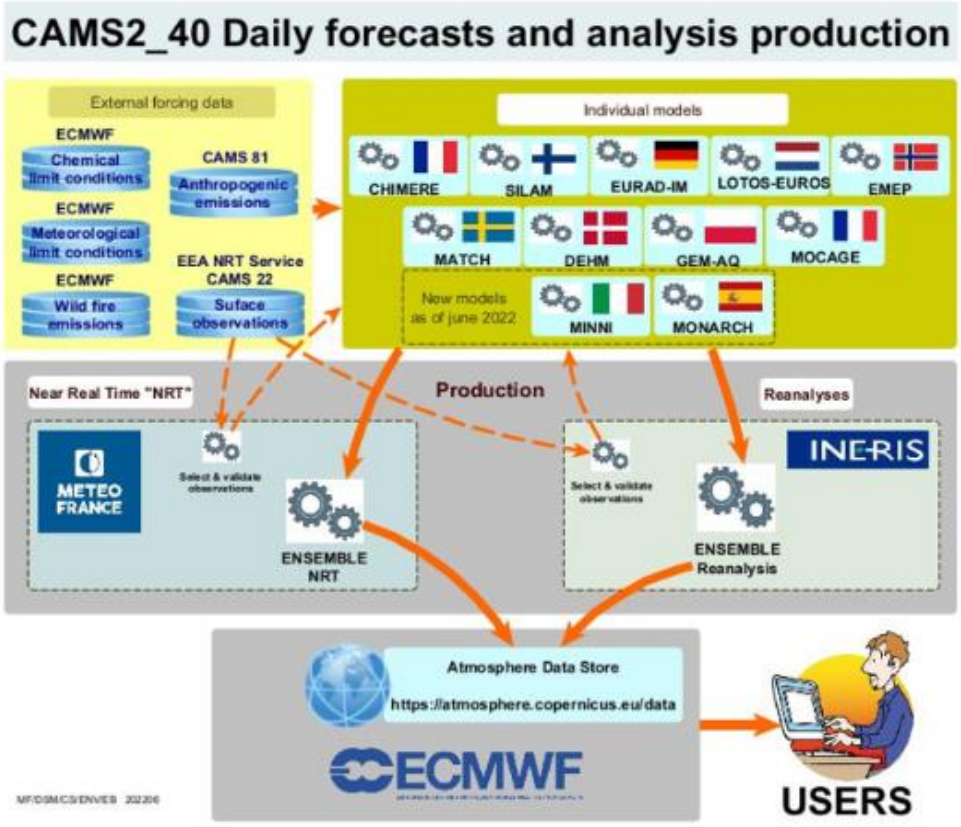
Antonio Piersanti, Mario Adani, Massimo D'Isidoro

CAMS2_40 - Regional Air Quality production

Data streams:

- Near real time: forecasts (+96h) and analyses (-24h) for key air pollutants
- Reanalyses: interim daily (with a delay of a few weeks), validated (annually, with a delay of up to two years)
- Spatial resolution 0.1° x 0.1°

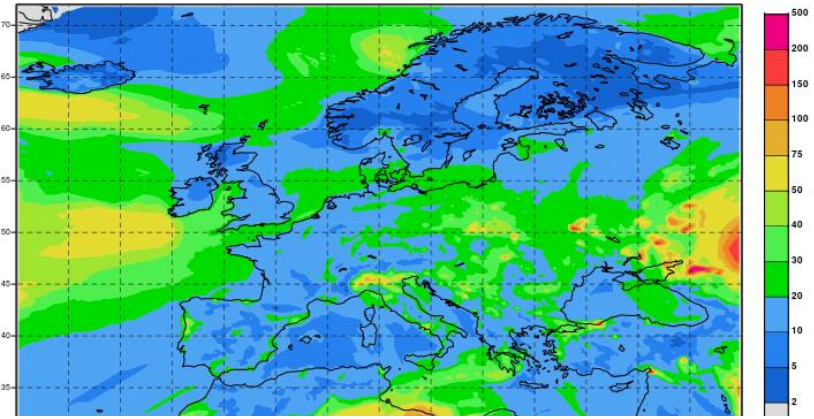




https://regional.atmosphere.copernicus.eu/

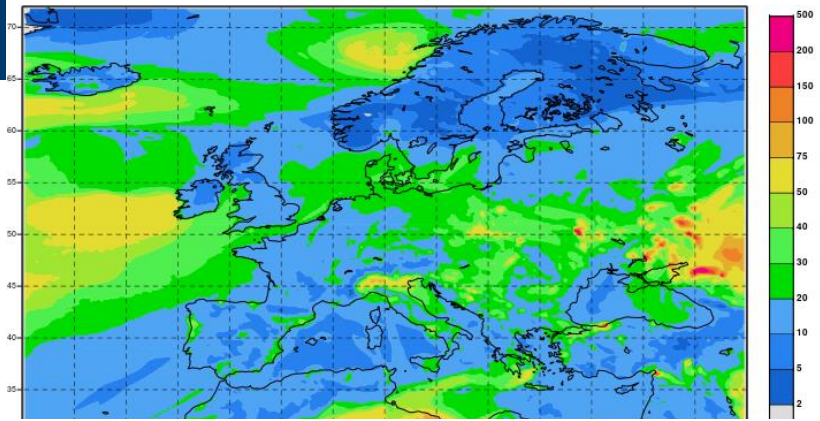
21 marzo 2023

Sunday 19 March 2023 00UTC CAMS Forecast D+2 VT: Tuesday 21 March 2023
Model: MINNI Height level: Surface Parameter: PM10 Aerosol Daily Maximum [µg/m3]



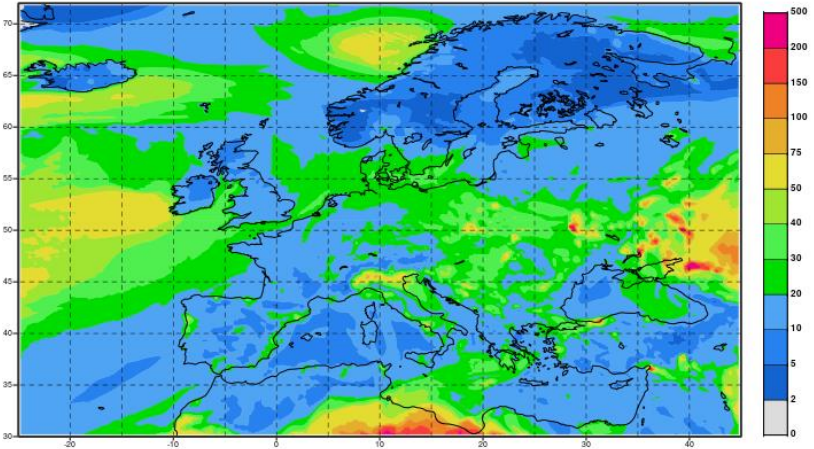
D2

Monday 20 March 2023 00UTC CAMS Forecast D+1 VT: Tuesday 21 March 2023
Model: MINNI Height level: Surface Parameter: PM10 Aerosol Daily Maximum [µg/m3]



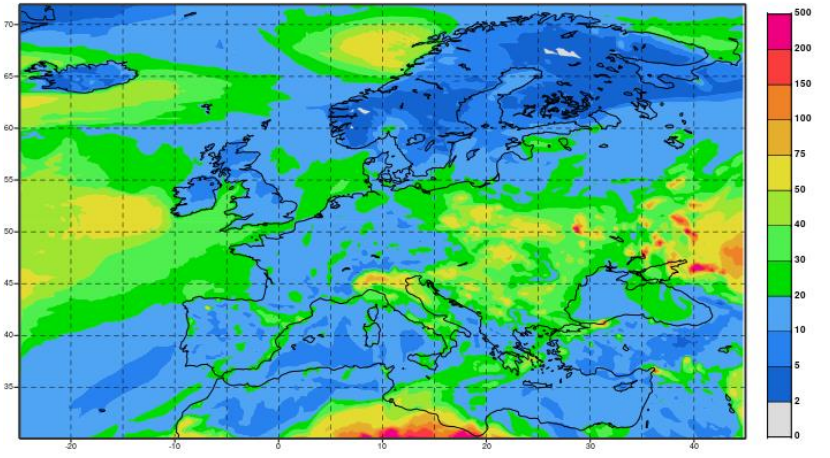
D1

Tuesday 21 March 2023 00UTC CAMS Forecast D+0 VT: Tuesday 21 March 2023
Model: MINNI Height level: Surface Parameter: PM10 Aerosol Daily Maximum [µg/m3]



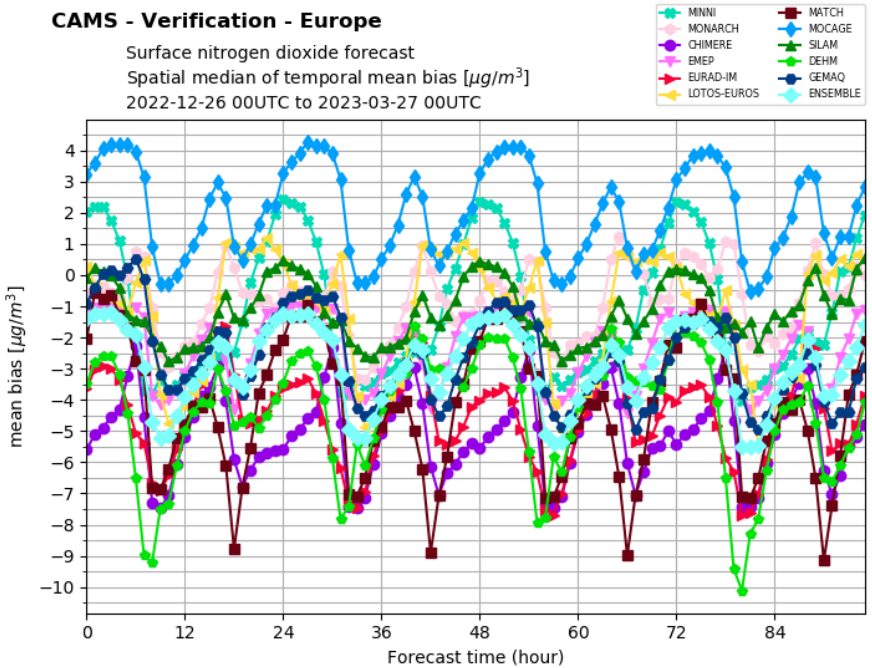
D0

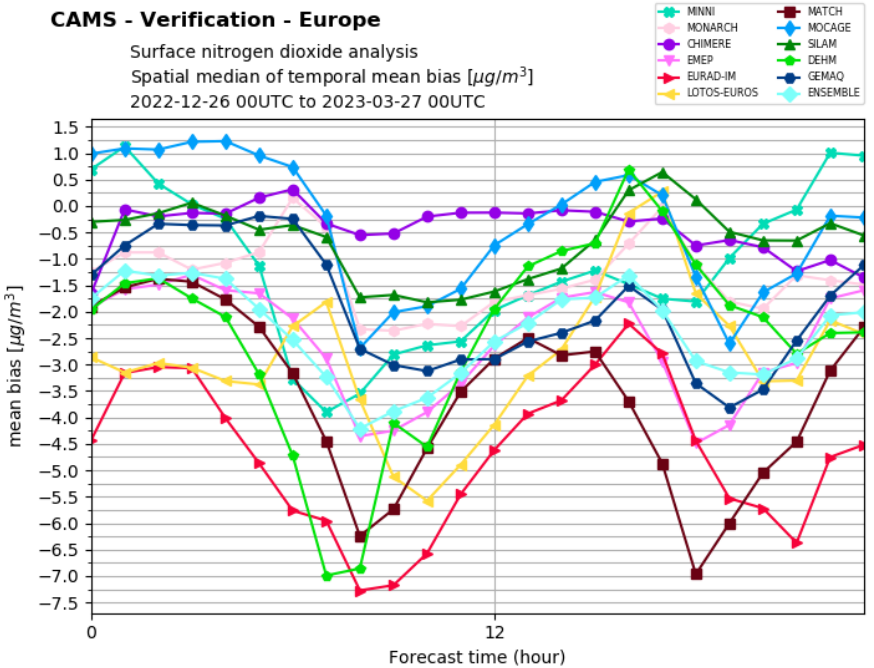
Wednesday 22 March 2023 00UTC CAMS Analysis t-24 VT: Tuesday 21 March 2023
Model: MINNI Height level: Surface Parameter: PM10 Aerosol Daily Maximum [µg/m3]



D-1
(analisi)

CAMS2_40 - Regional Air Quality production

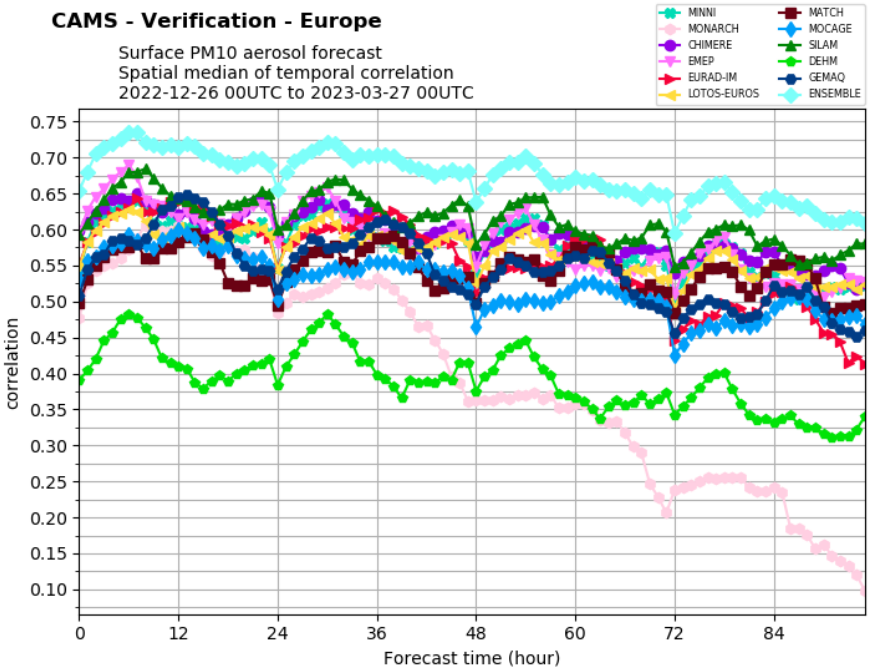


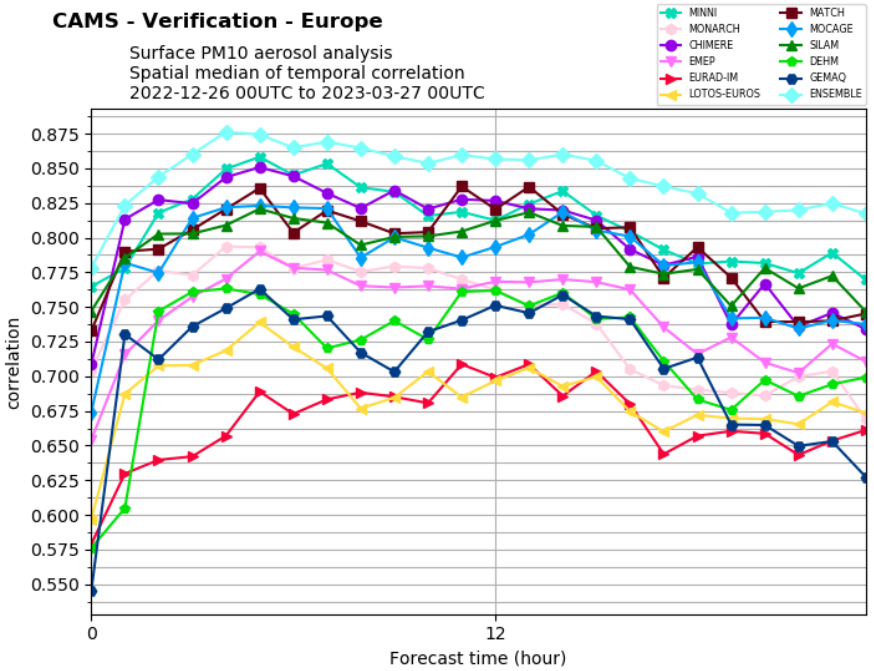


(EEA). Only measurements that are considered representative of background air pollution are kept. Such a filter is operated by selecting background stations that are classified from 1 to 7 according to the Joly and Peuch classification 2020 update[2]. In addition, observations

https://regional.atmosphere.copernicus.eu/evaluation.php?interactive=tsf

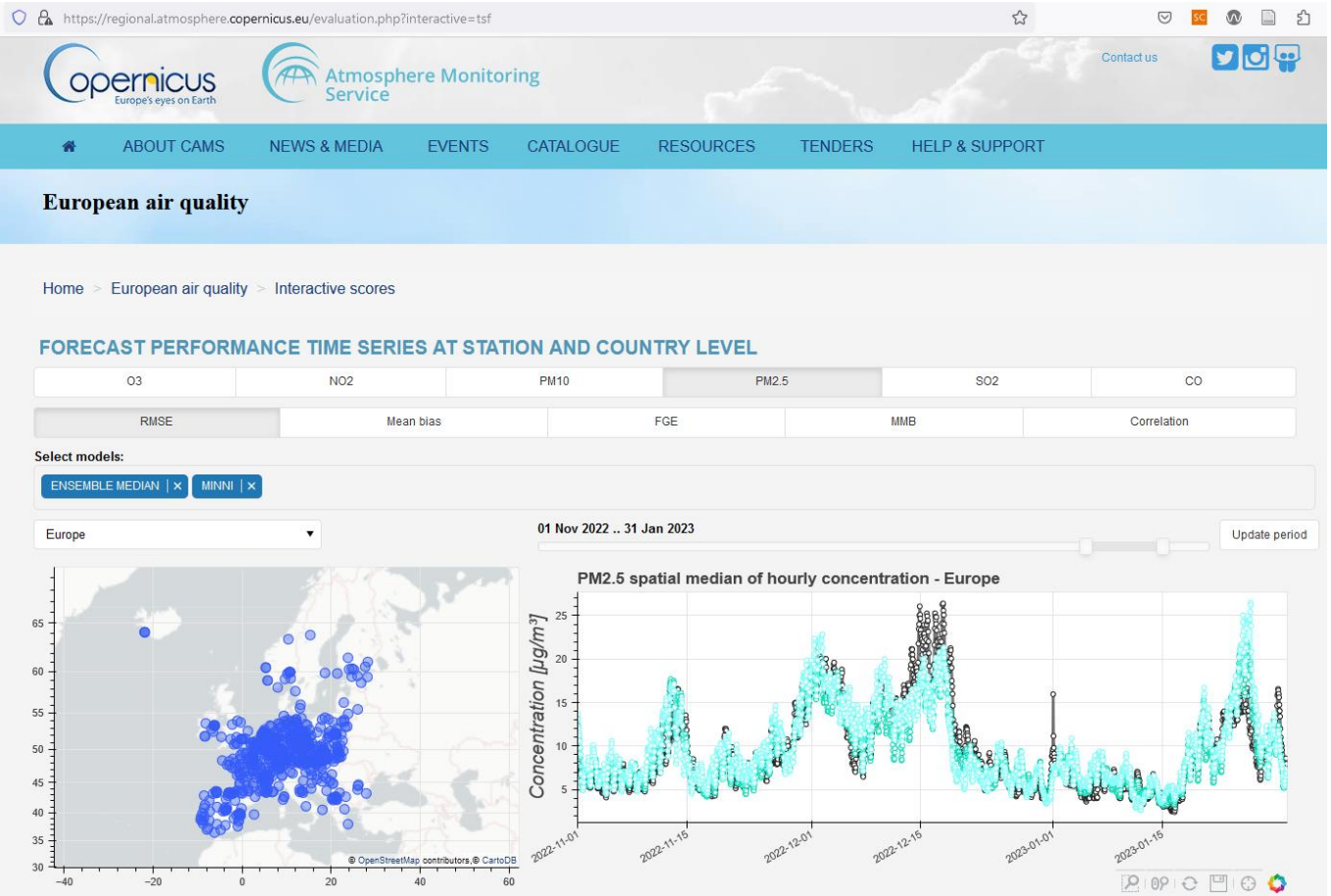
CAMS2_40 - Regional Air Quality production





https://regional.atmosphere.copernicus.eu/evaluation.php?interactive=tsf

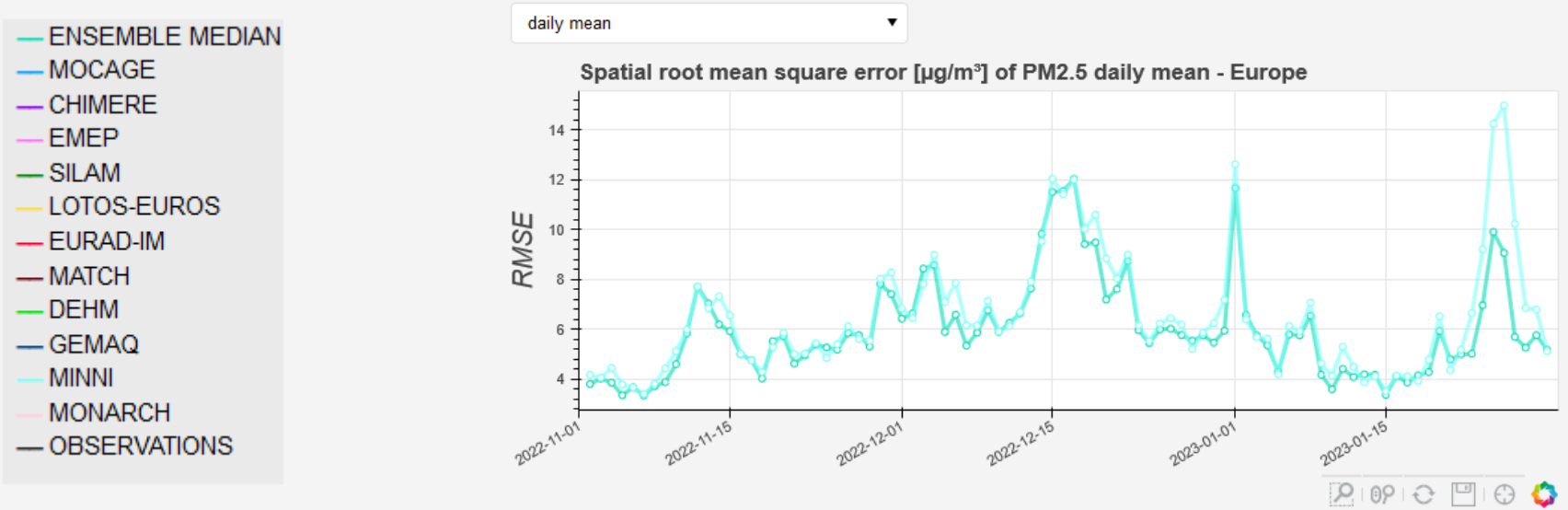
CAMS2_40 - Regional Air Quality production



- ENSEMBLE MEDIAN
- MOCAGE
- CHIMERE
- EMEP
- SILAM
- LOTOS-EUROS
- EURAD-IM
- MATCH
- DEHM
- GEMAQ
- MINNI
- MONARCH
- OBSERVATIONS

Atmosphere Monitoring Service

CAMS2_40 - Regional Air Quality production



https://regional.atmosphere.copernicus.eu/evaluation.php?interactive=tsf

CAMS2_40 - Regional Air Quality production

ENSEMBLE MEDIAN
MOCAGE
CHIMERE
EMEP
SILAM
LOTOS-EUROS
EURAD-IM
MATCH
DEHM
GEMAQ
MINNI
MONARCH
OBSERVATIONS

FORECAST PERFORMANCE TIME SERIES AT STATION AND COUNTRY LEVEL

O3 | NO2 | PM10 | PM2.5 | SO2

RMSE | Mean bias | FGE | MMB | Correl

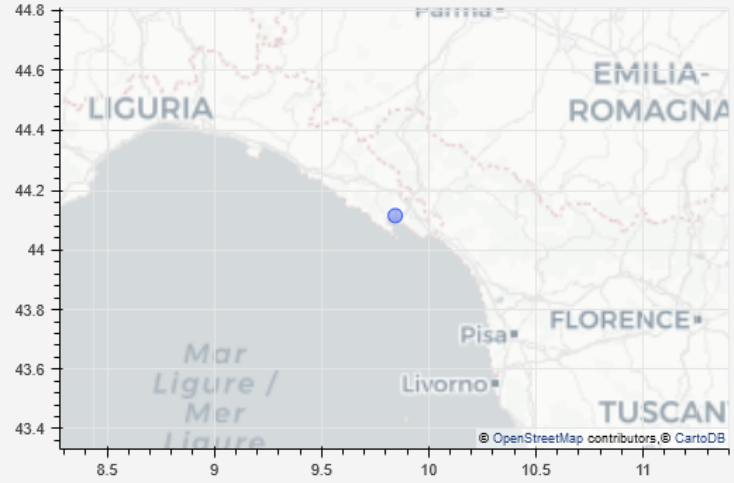
Select models:

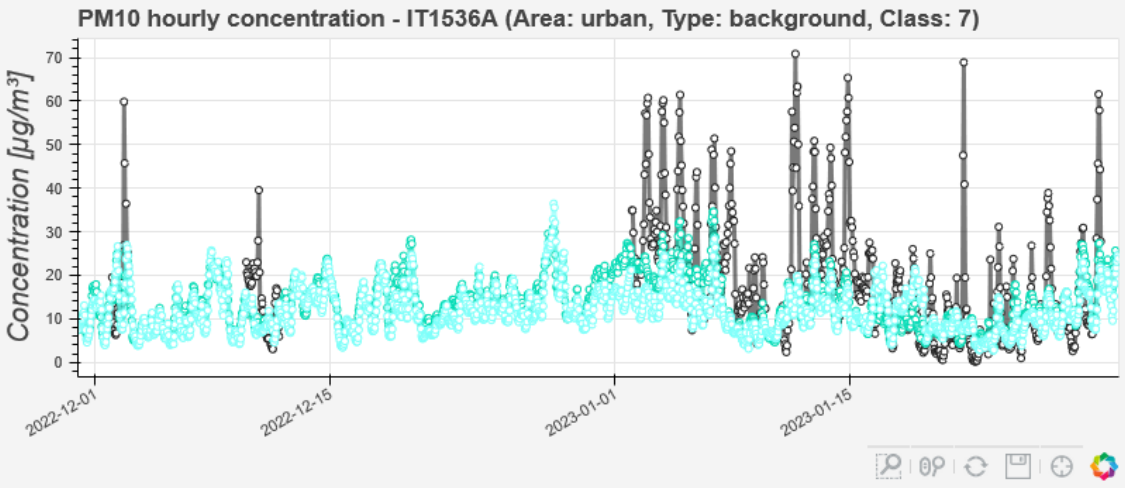
ENSEMBLE MEDIAN | MINNI

Select region

30 Nov 2022 .. 31 Jan 2023

Update period





https://regional.atmosphere.copernicus.eu/evaluation.php?interactive=tsf

Monitoring Service

CAMS2_40 - Regional Air Quality production

2.2.3 MINNI analysis: PM_{10}

Skill scores against data from representative sites

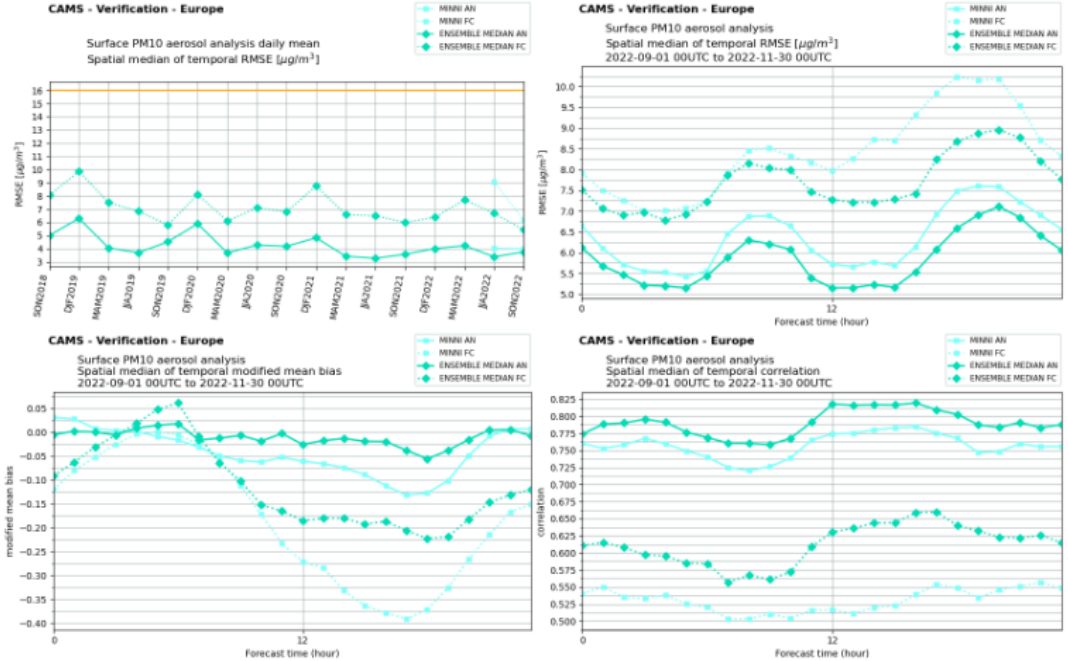


Figure 2.17: Skill scores of the PM_{10} analyses provided by the MINNI model, compared to the ENSEMBLE. Upper left: RMSE as a function of season (last 3 years); the orange line indicates the target performance. The other three panels show model performance as a function of analysis time (upper right: RMSE, lower left: MMB, lower right: temporal correlation). For each hour of the analysis, the median of all measurement stations is plotted. See the introduction to Section 2 for more information about the statistical parameters.

SON 2022

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

https://atmosphere.copernicus.eu/sites/default/files/custom-uploads/EQC-regional/SON-2022/CAMS283_2021SC1_D83.1.4.1-2022Q4_202302_MINNI_EQC_Report_v1.pdf

Copernicus Europe's eyes on Earth

Atmosphere Monitoring Service

CAMS2_40 - Regional Air Quality production

2.1.1 MINNI forecast: ozone

Skill scores against data from representative sites

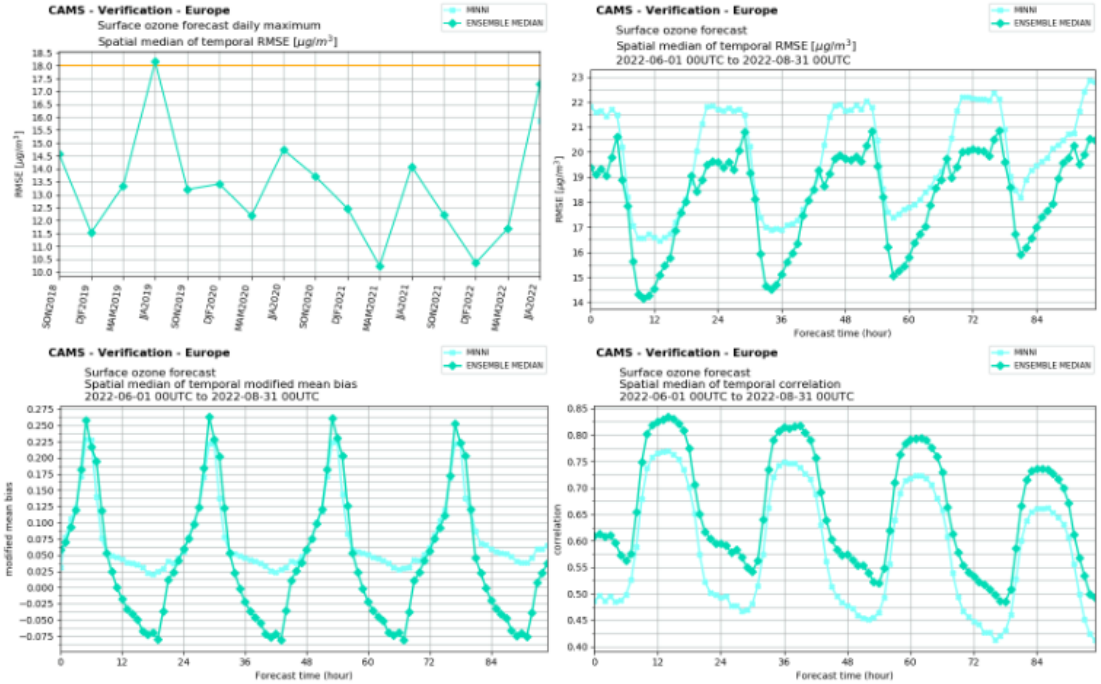


Figure 2.1: Skill scores of the ozone forecasts provided by the MINNI model, compared to the ENSEMBLE. Upper left: RMSE as a function of season (last 3 years); the orange line indicates the target performance. The other three panels show model performance as a function of forecast time (upper right: RMSE, lower left: MMB, lower right: temporal correlation). For each hour of the forecast, the median of all measurement stations is plotted. See the introduction to Section 2 for more information about the statistical parameters.

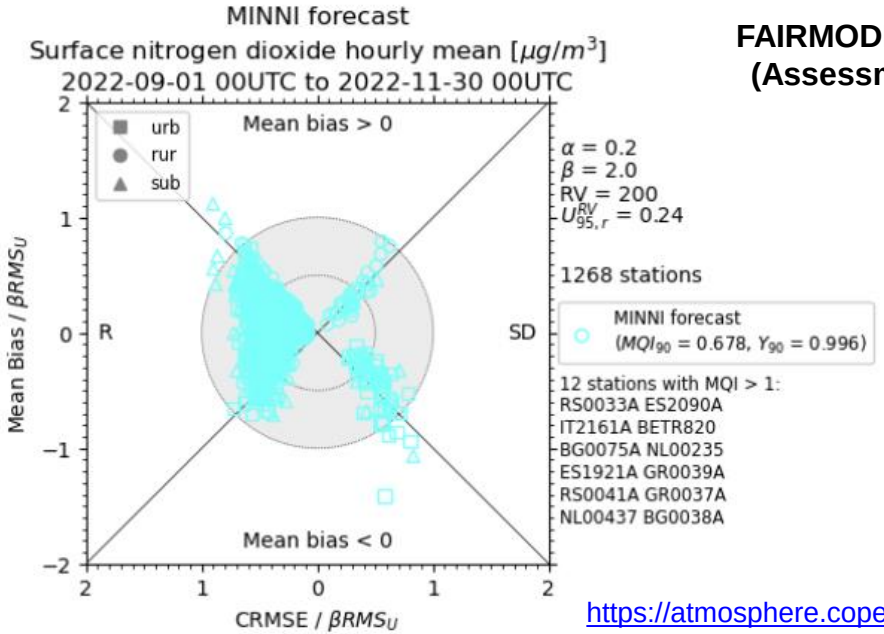
JJA 2022

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

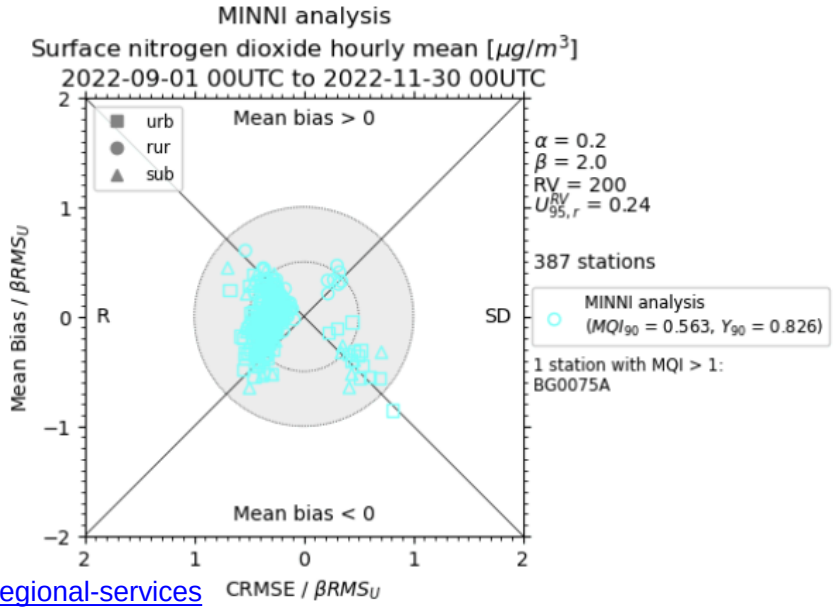
https://atmosphere.copernicus.eu/sites/default/files/custom-uploads/EQC-regional/JJA-2022/CAMS283_2021SC1_D83.1.4.1-2022Q3_202210_MINNI_EQC_Report_v1.pdf

Atmosphere Monitoring Service

CAMS2_40 - Regional Air Quality production



FAIRMODE MQI (Assessment)



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

https://atmosphere.copernicus.eu/sites/default/files/custom-uploads/EQC-regional/SON-2022/CAMS283_2021SC1_D83.1.4.1-2022Q4_202302_MINNI_EQC_Report_v1.pdf

ENEA

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Atmosphere Monitoring Service

CAMS2_72IT - National Collaboration Programme (NCP)

Durata: 18 mesi (novembre 2022 - aprile 2024)

Obiettivo: utilizzo dei prodotti CAMS (uso diretto, downscaling qualità dell'aria, emissioni, …)

Coordinamento: ISPRA

Partners: ENEA, ARPAE, ISAC-CNR, ARPA Lombardia, ARPAC, ARPAV, UNITOV

Budget totale: 150k€

Coinvolgimento ENEA (Massimo D'Isidoro et al.):

- **WP3**: Test del sistema FORAIR-IT con condizioni al contorno chimiche da CAMS-Regional (Ensemble o singoli), in coordinamento con i modelli CHIMBO (ISAC-CNR) e kAIROS (ARPAE-SNPA); successivi test di assimilazione dati superficiali.
- **WP4**: Armonizzazione inventario CAMS con inventario nazionale

H.EU CAMEO - CAMS EvOlution

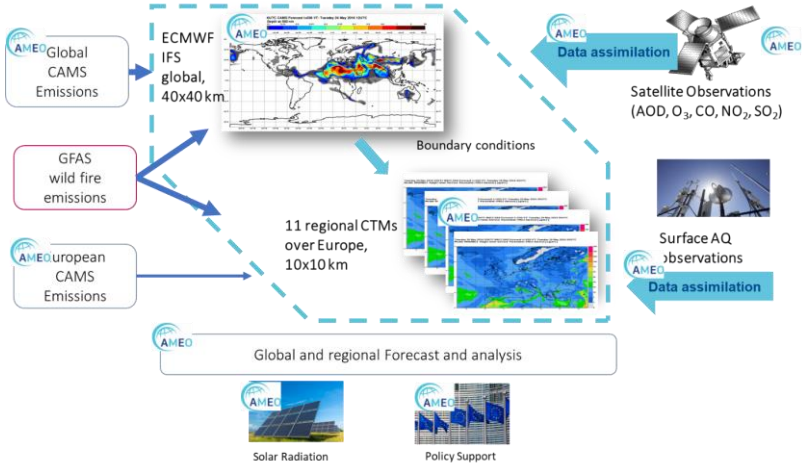
Durata: 36 mesi (gennaio 2023 - dicembre 2025)

Obiettivo: acquisizione dati satellitari Sentinel-4, -5 e 3MI, metodi di assimilazione di aerosol e gas, metodi per incertezza per gli utenti dei prodotti CAMS

Coordinamento: ECMWF

Partners: 23

Budget totale (ENEA): 110k€



Coinvolgimento ENEA (Mario Adani et al.)

- **WP3**: Enhancement of Satellite Data Assimilation in regional CAMS models →

innovare algoritmi di assimilazione già esistenti e produrre esperimenti numerici di assimilazione per gli inquinanti CO, O_3, SO_2 e CH_2O

https://impatti.sostenibilita.enea.it/projects/cameo

Ai fini della pianificazione della qualità dell'aria, quale lezione possiamo trarre da questo studio modellistico?

Nel periodo di simulazione (feb – mag 2020):

- la riduzione delle concentrazioni di NO_2 varia da 1 a 9 $\mu g/m^3$ (3% - 30%), con maggiori riduzioni in area urbana;
- le concentrazioni di O_3 si riducono in area rurale e incrementano fino al 13% nelle aree urbane;
- il PM mostra riduzioni comprese tra 3 e 4 $\mu g/m^3$ localizzate maggiormente nel bacino padano.

1. Gli effetti delle variazioni emissive sulle concentrazioni di inquinanti di natura secondaria (O_3) o con una importante componente secondaria (particolato) risultano particolarmente complessi.
2. Notevole attenzione deve essere prestata nella selezione di misure per contenere l'inquinamento atmosferico: interventi mirati in un unico settore non necessariamente portano alle riduzioni di concentrazione auspicate.

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Lessons learnt for air pollution mitigation policies from the COVID-19 pandemic: The Italian perspective

Massimo D'Isidoro [a 1], Ilaria D'Elia [a 1], Lina Vitali [a 1], Gino Briganti [a], Andrea Cappelletti [a], Antonio Piersanti [a], Sandro Finardi [b], Giuseppe Calori [b], Nicola Pepe [b], Alessandro Di Giosa [c], Andrea Bolignano [c], Gabriele Zanini [a]

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