Acquisizione e visualizzazione di dati CAMS

Modalità di download di dati CAMS

Ing. Loris Colombo, ARPA LOMBARDIA

24 Ottobre 2025, Università degli Studi di Roma “Tor Vergata”, Roma

Atmosphere Monitoring

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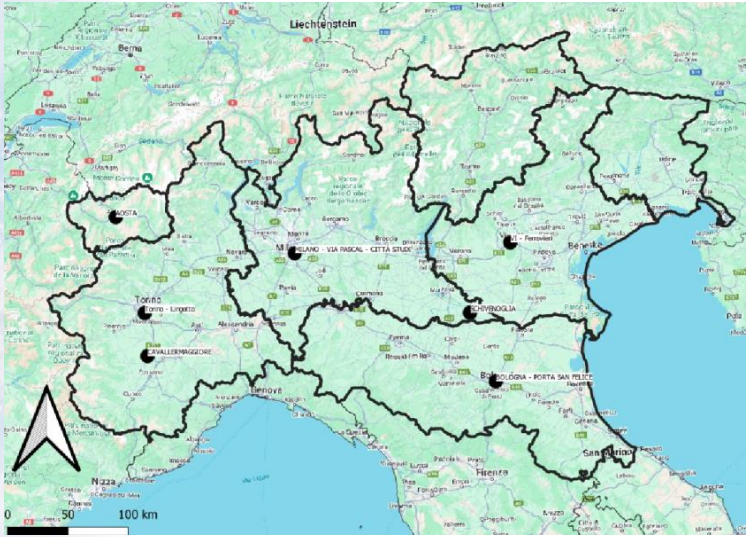
WP2 OBIETTIVO

Uso diretto dei dati CAMS per la speciazione del Particolato in alcune stazioni «SuperSito» nel Bacino Padano

Stazioni SuperSito



Stazioni PM10

Da Prepair Project: Action D6

NCP NATIONAL COLLABORATION PROGRAMME ITALIAN INITIATIVE

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WP2 OBIETTIVO

Uso diretto dei dati CAMS per la speciazione del Particolato in alcune stazioni «SuperSito» nel Bacino Padano

Stazioni SuperSito

EU_COD	Special Station PREPAIR Project	Type/network	Lat, lon		Availability	Instruments/species measured
IT1865A	SCHIVENOGLIA	RB	11.07	44.99	From 2018	
IT1692A	MILANO- VIA PASCAL	UB	9.23	45.47	From 2018	
IT2168A	TORINO LINGOTTO	UB	7.64	45.02	From 2018	
	BOLOGNA	UB	11.32	44.49	From 2018	
IT1905A	VICENZA- FERROVIERI	UB	11.52	45.53	From 2018	
IT2294A	CAVALLERMAGGIORE	SB	7.68	44.70	From 2021	
IT0983A	AOSTA (PIAZZA PLOUVES)	UB, PREPAIR Project	7.32	45.73	From 2024	

X-ray Fluorescence (XRF): (element with Z> 11), Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, Br, Rb and Pb

Ion cromatography: Na^+, NH_4^+, K^+, Mg^{2+}, Ca^{2+}, Cl^-, NO_2^-, Br^-, NO_3^-, PO_4^{3-}, SO_4^{2-}, Levoglucosan

Thermo-optical method **(TOT/TOR):** Carbon compounds (OC, EC)

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PRINCIPALI DATASET UTILIZZATI

COME POSSIAMO CONFRONTARE I DATI MISURATI CON I DATI PRODOTTI DAI MODELLI A SCALA EUROPEA?

1. Confronto misurato-modello PM_{10}, NO_3^-, SO_4^{2-}, NH_4^+, POM, EC, SEA SALT, DUST

Dataset: https://policy.atmosphere.copernicus.eu/yearly/chemical-speciation/?year=2024&from=2024-01-01&to=2024-12-31
Anno: 2019-2020-2021-2022-2023-2024
Stazioni: Milano
Modello: EMEP, LOTOS-EUROS

2. Confronto misurato-modello data-fused PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-reanalyses?tab=download
Anno : 2019-2020-2021-2022-2023-2024
Stazioni : tutte le stazioni
Modello: EMEP, LOTOS-EUROS, ENS

3. Confronto misurato-modello previsionale PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-forecasts?tab=download
Anno : 2021-2022-2023-2024
Stazioni : tutte le stazioni
Modello: EMEP, LOTOS-EUROS, ENS

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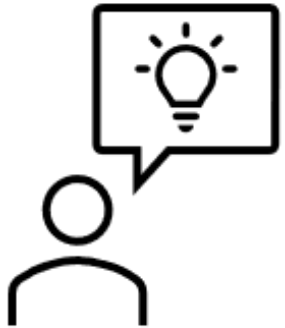
- register for events
- enrol on online courses
- access training resources
- create and track service requests

To check if you are eligible for more features you can read about access to forecast data and access to our computing facilities.

Register new user



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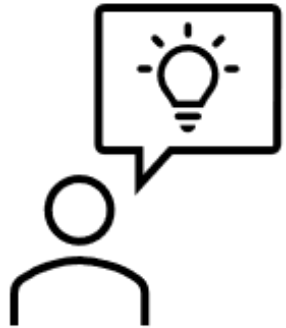

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INTERFACCIA PER LE PREVISIONI (1)

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3. Confronto misurato-modello previsionale PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

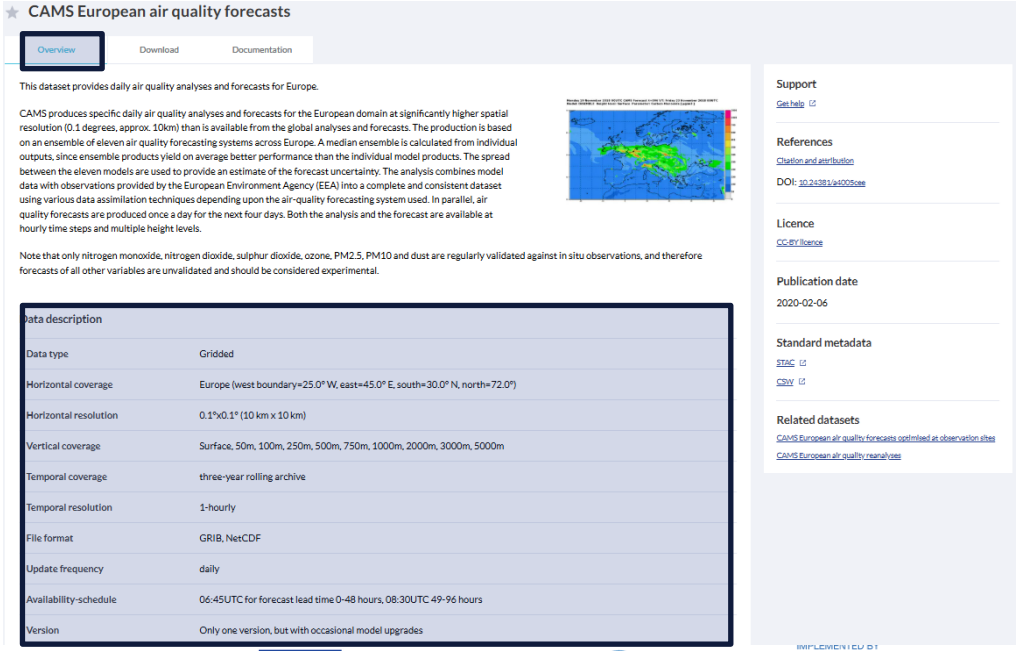
Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-forecasts?tab=download

Anno : 2021-2022-2023-2024

Stazioni : tutte le stazioni

Modello: EMEP, LOTOS-EUROS, ENS

Contiene:
La descrizione dei dati
Le variabili principali
Formato file output e u.d.m.



CAMS European air quality forecasts

Overview | Download | Documentation

This dataset provides daily air quality analyses and forecasts for Europe.

CAMS produces specific daily air quality analyses and forecasts for the European domain at significantly higher spatial resolution (0.1 degrees, approx. 10km) than is available from the global analyses and forecasts. The production is based on an ensemble of eleven air quality forecasting systems across Europe. A median ensemble is calculated from individual outputs, since ensemble products yield on average better performance than the individual model products. The spread between the eleven models are used to provide an estimate of the forecast uncertainty. The analysis combines model data with observations provided by the European Environment Agency (EEA) into a complete and consistent dataset using various data assimilation techniques depending upon the air-quality forecasting system used. In parallel, air quality forecasts are produced once a day for the next four days. Both the analysis and the forecast are available at hourly time steps and multiple height levels.

Note that only nitrogen monoxide, nitrogen dioxide, sulphur dioxide, ozone, PM2.5, PM10 and dust are regularly validated against in situ observations, and therefore forecasts of all other variables are unvalidated and should be considered experimental.

Data description

Data type	Gridded
Horizontal coverage	Europe (west boundary=25.0° W, east=45.0° E, south=30.0° N, north=72.0°)
Horizontal resolution	0.1°x0.1° (10 km x 10 km)
Vertical coverage	Surface, 50m, 100m, 250m, 500m, 750m, 1000m, 2000m, 3000m, 5000m
Temporal coverage	three-year rolling archive
Temporal resolution	1-hourly
File format	GRIB, NetCDF
Update frequency	daily
Availability-schedule	06:45UTC for forecast lead time 0-48 hours, 08:30UTC 49-96 hours
Version	Only one version, but with occasional model upgrades

Support
Get help

References
Citation and attribution
DOI: 10.24381/a4005cee

Licence
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Publication date
2020-02-06

Standard metadata
STAC
CSW

Related datasets
CAMS European air quality forecasts optimised at observation sites
CAMS European air quality reanalyses

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INTERFACCIA PER LE PREVISIONI (2)

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3. Confronto misurato-modello previsionale PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

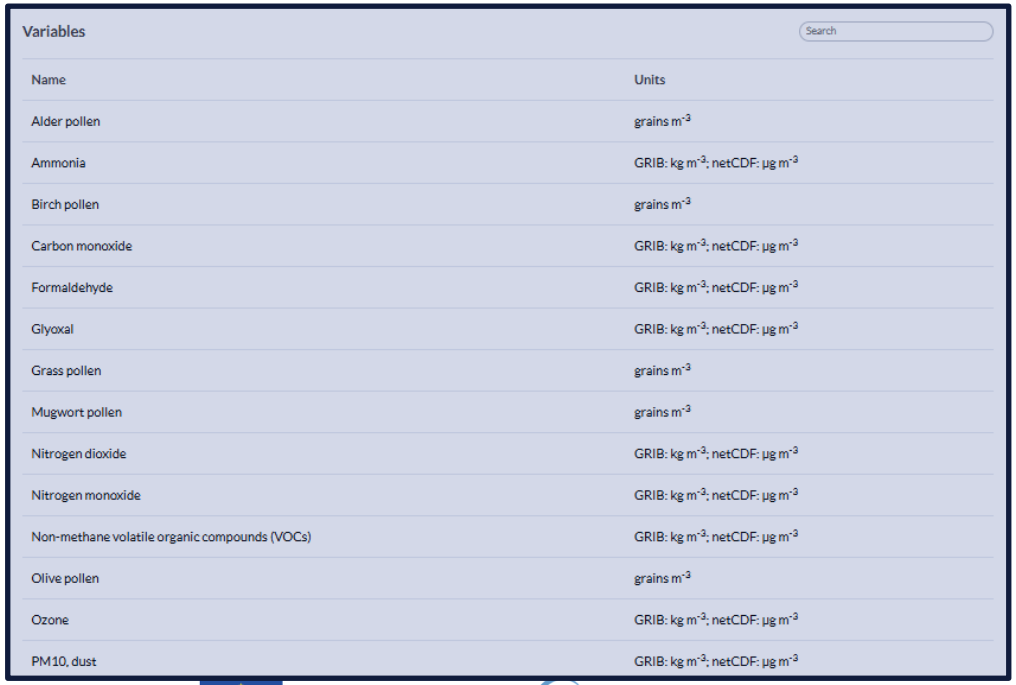
Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-forecasts?tab=download

Anno : 2021-2022-2023-2024

Stazioni : tutte le stazioni

Modello: EMEP, LOTOS-EUROS, ENS

Contiene:
La descrizione dei dati
Le variabili principali
Formato file output e u.d.m.



Variables

Search

Name	Units
Alder pollen	grains m^{-3}
Ammonia	GRIB: kg m^{-3}; netCDF: µg m^{-3}
Birch pollen	grains m^{-3}
Carbon monoxide	GRIB: kg m^{-3}; netCDF: µg m^{-3}
Formaldehyde	GRIB: kg m^{-3}; netCDF: µg m^{-3}
Glyoxal	GRIB: kg m^{-3}; netCDF: µg m^{-3}
Grass pollen	grains m^{-3}
Mugwort pollen	grains m^{-3}
Nitrogen dioxide	GRIB: kg m^{-3}; netCDF: µg m^{-3}
Nitrogen monoxide	GRIB: kg m^{-3}; netCDF: µg m^{-3}
Non-methane volatile organic compounds (VOCs)	GRIB: kg m^{-3}; netCDF: µg m^{-3}
Olive pollen	grains m^{-3}
Ozone	GRIB: kg m^{-3}; netCDF: µg m^{-3}
PM10, dust	GRIB: kg m^{-3}; netCDF: µg m^{-3}

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3. Confronto misurato-modello previsionale PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

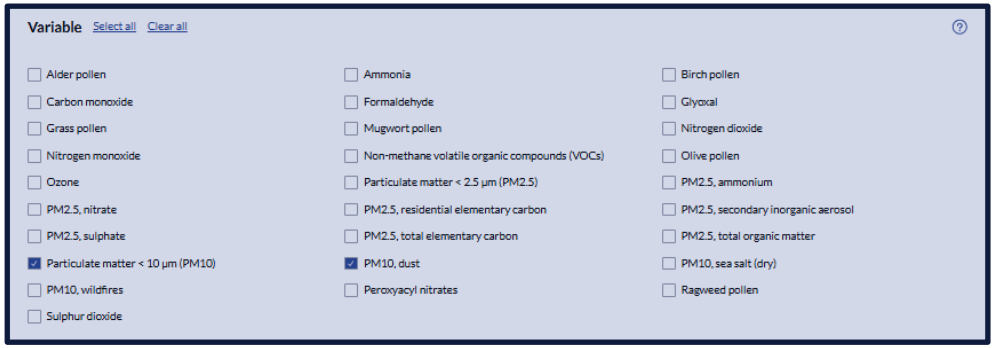
Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-forecasts?tab=download

Anno : 2021-2022-2023-2024

Stazioni : tutte le stazioni

Modello: EMEP, LOTOS-EUROS, ENS

Contiene:
Scelta delle variabili
I modelli disponibili
Quota z di estrazione
Data di estrazione
Tipo di estrazione (forecast o analisi)
Numero di ore di previsione
Area di estrazione



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INTERFACCIA PER LE PREVISIONI (4)

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3. Confronto misurato-modello previsionale PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

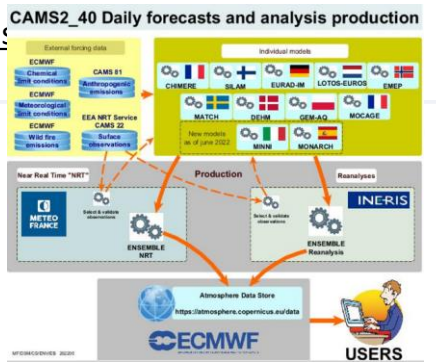
Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-forecas

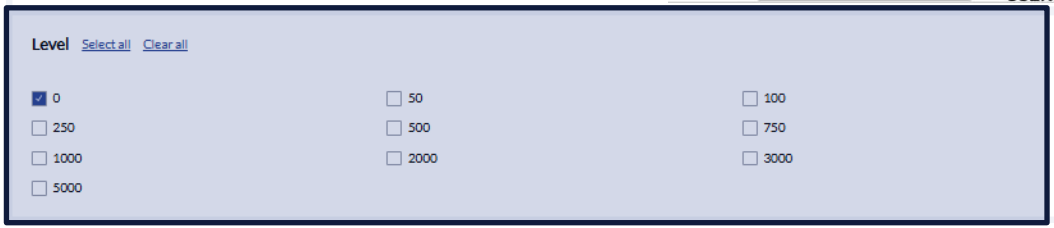
Anno : 2021-2022-2023-2024

Stazioni : tutte le stazioni

Modello: EMEP, LOTOS-EUROS, ENS

Contiene:
Le variabili
I modelli disponibili
Quota z di estrazione
Data di estrazione
Tipo di estrazione (forecast o analisi)
Numero di ore di previsione
Area di estrazione





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INTERFACCIA PER LE PREVISIONI (5)

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3. Confronto misurato-modello previsionale PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

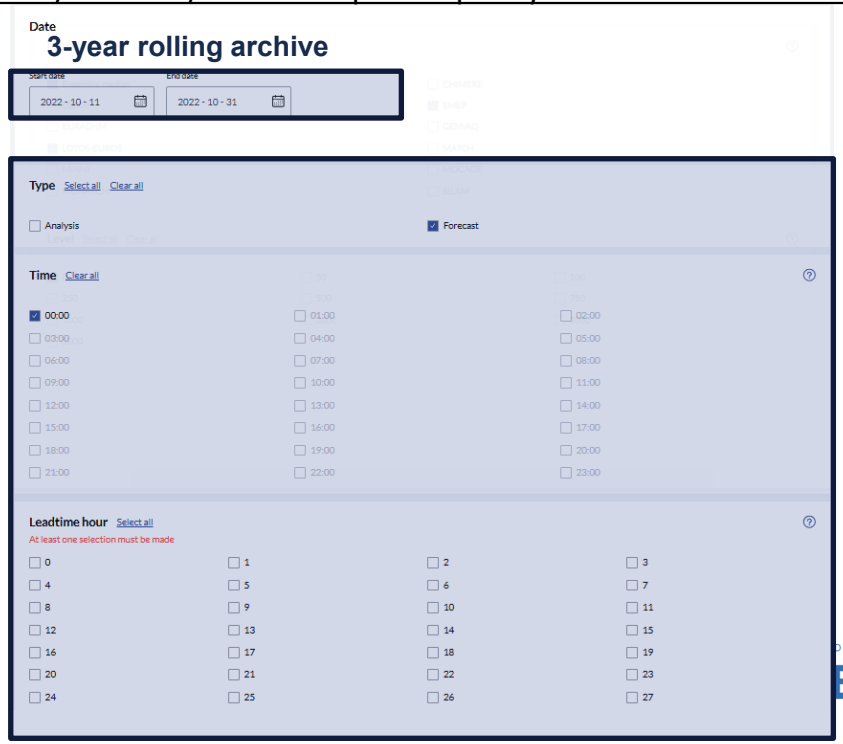
Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-forecasts?tab=download

Anno : 2021-2022-2023-2024

Stazioni : tutte le stazioni

Modello: EMEP, LOTOS-EUROS, ENS

Contiene:
Le variabili
I modelli disponibili
Quota z di estrazione
Data di estrazione
Tipo di estrazione (forecast o analisi)
Numero di ore di previsione
Area di estrazione



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INTERFACCIA PER LE PREVISIONI (6)

3. Confronto misurato-modello previsionale PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

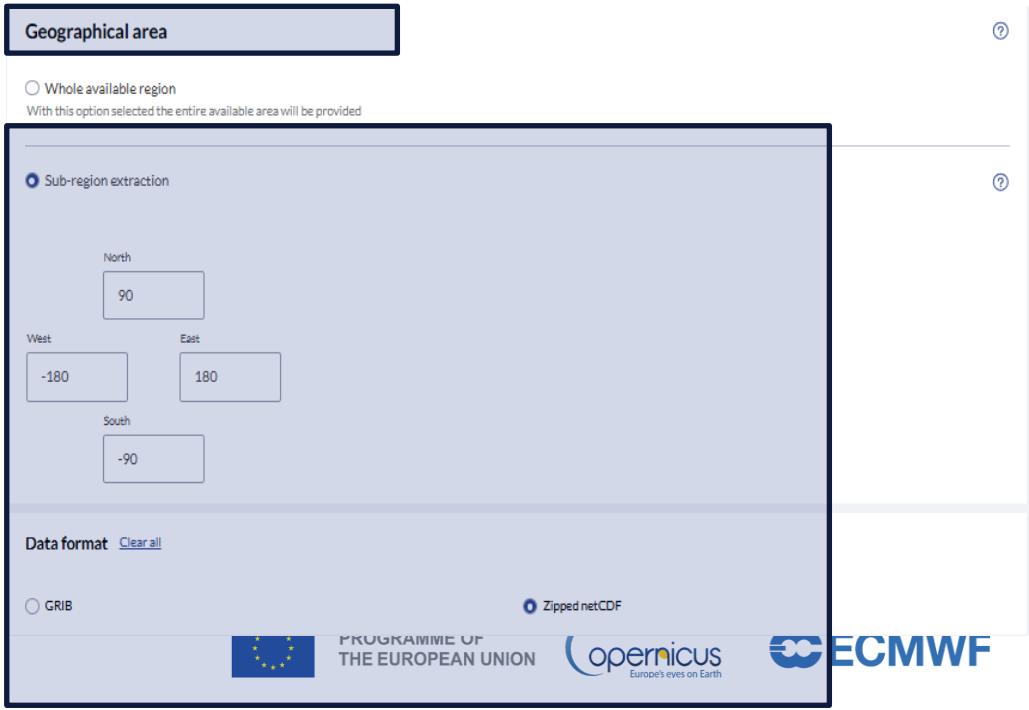
Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-forecasts?tab=download

Anno : 2021-2022-2023-2024

Stazioni : tutte le stazioni

Modello: EMEP, LOTOS-EUROS, ENS

Contiene:
Le variabili
I modelli disponibili
Quota z di estrazione
Data di estrazione
Tipo di estrazione (forecast o analisi)
Numero di ore di previsione
Area di estrazione



INTERFACCIA PER LE PREVISIONI (7)

Atmosphere Monitoring

3. Confronto misurato-modello previsionale PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

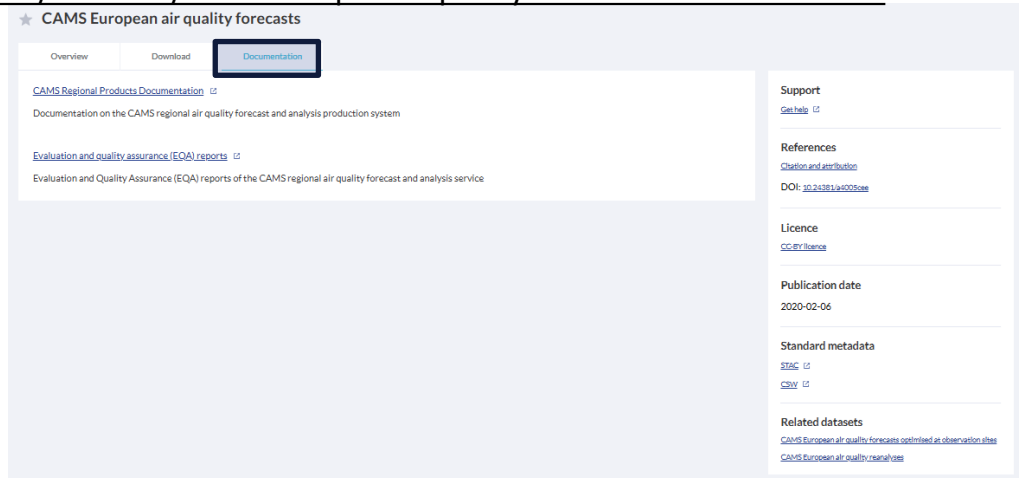
Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-forecasts?tab=download

Anno : 2021-2022-2023-2024

Stazioni : tutte le stazioni

Modello: EMEP, LOTOS-EUROS, ENS

Contiene:
Riferimenti per analisi e previsioni



CAMS Regional: European air quality analysis and forecast data documentation - Copernicus Knowledge Base - ECMWF Confluence Wiki

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PRINCIPALI DATASET UTILIZZATI

COME POSSIAMO CONFRONTARE I DATI MISURATI CON I DATI PRODOTTI DAI MODELLI A SCALA EUROPEA?

?

1. Confronto misurato-modello PM_{10}, NO_3^-, SO_4^{2-}, NH_4^+, POM, EC, SEA SALT, DUST

Dataset: https://policy.atmosphere.copernicus.eu/yearly/chemical-speciation/?year=2024&from=2024-01-01&to=2024-12-31

Anno: 2019-2020-2021-2022-2023-2024

Stazioni: Milano

Modello: EMEP, LOTOS-EUROS

2. Confronto misurato-modello data-fused PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-reanalyses?tab=download

Anno : 2019-2020-2021-2022-2023-2024

Stazioni : tutte le stazioni

Modello: EMEP, LOTOS-EUROS, ENS

3. Confronto misurato-modello previsionale PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-forecasts?tab=download

Anno : 2021-2022-2023-2024

Stazioni : tutte le stazioni

Modello: EMEP, LOTOS-EUROS, ENS

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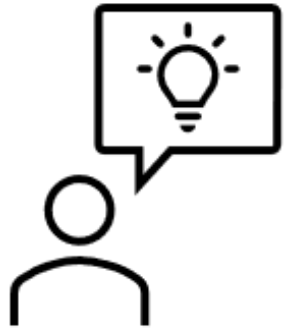

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INTERFACCIA PER LE ANALISI (1)

Atmosphere Monitoring

2. Confronto misurato-modello data-fused PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

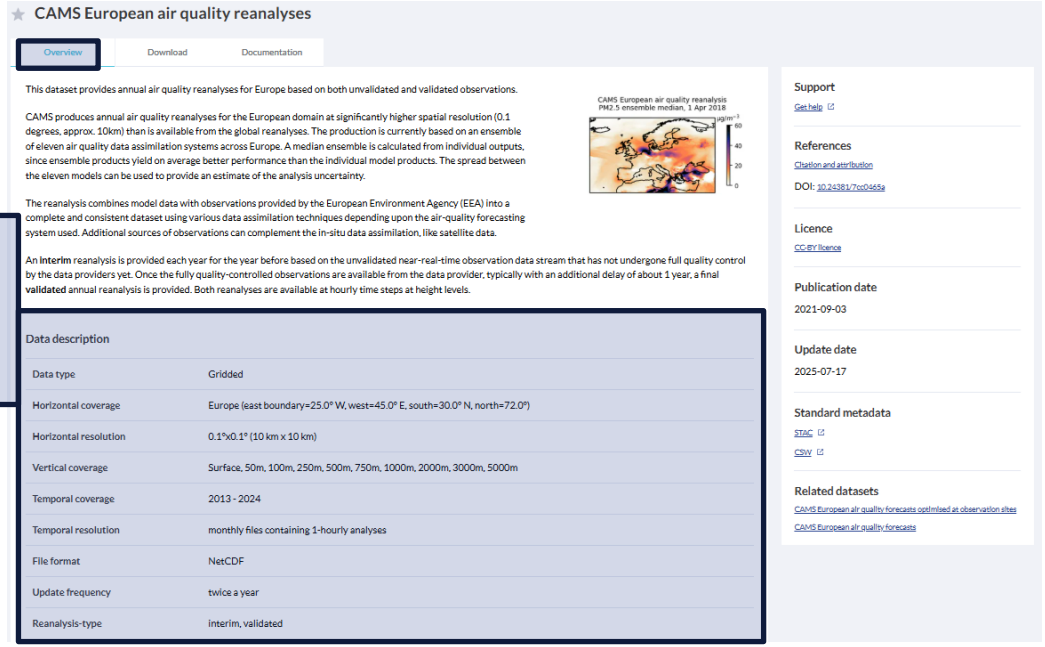
Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-reanalyses?tab=download

Anno : 2019-2020-2021-2022-2023-2024

Stazioni : tutte le stazioni

Modello: EMEP, LOTOS-EUROS, ENS

Contiene:
La descrizione dei dati
Le variabili principali
Formato file ouTput e u.d.m.



CAMS European air quality reanalyses

Overview | Download | Documentation

This dataset provides annual air quality reanalyses for Europe based on both unvalidated and validated observations.

CAMS produces annual air quality reanalyses for the European domain at significantly higher spatial resolution (0.1 degrees, approx. 10km) than is available from the global reanalyses. The production is currently based on an ensemble of eleven air quality data assimilation systems across Europe. A median ensemble is calculated from individual outputs, since ensemble products yield on average better performance than the individual model products. The spread between the eleven models can be used to provide an estimate of the analysis uncertainty.

CAMS European air quality reanalysis PM2.5 ensemble median, 1 Apr 2018

The reanalysis combines model data with observations provided by the European Environment Agency (EEA) into a complete and consistent dataset using various data assimilation techniques depending upon the air-quality forecasting system used. Additional sources of observations can complement the in-situ data assimilation, like satellite data.

An **interim** reanalysis is provided each year for the year before based on the unvalidated near-real-time observation data stream that has not undergone full quality control by the data providers yet. Once the fully quality-controlled observations are available from the data provider, typically with an additional delay of about 1 year, a final **validated** annual reanalysis is provided. Both reanalyses are available at hourly time steps at height levels.

Data description

Data type	Gridded
Horizontal coverage	Europe (east boundary=25.0° W, west=45.0° E, south=30.0° N, north=72.0°)
Horizontal resolution	0.1°x0.1° (10 km x 10 km)
Vertical coverage	Surface, 50m, 100m, 250m, 500m, 750m, 1000m, 2000m, 3000m, 5000m
Temporal coverage	2013 - 2024
Temporal resolution	monthly files containing 1-hourly analyses
File format	NetCDF
Update frequency	twice a year
Reanalysis-type	interim, validated

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References
Citation and attribution
DOI: 10.24381/7cc0465a

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Publication date
2021-09-03

Update date
2025-07-17

Standard metadata
STAC
CSW

Related datasets
CAMS European air quality forecasts optimised at observation sites
CAMS European air quality forecasts

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INTERFACCIA PER LE ANALISI (2)

2. Confronto misurato-modello data-fused PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-reanalyses?tab=download

Anno : 2019-2020-2021-2022-2023-2024

Stazioni : tutte le stazioni

Modello: EMEP, LOTOS-EUROS, ENS

Contiene:
La descrizione dei dati
Le variabili principali
Formato file output e u.d.m.

MAIN VARIABLES	
Name	Units
Ammonia	µg m^{-3}
Carbon monoxide	µg m^{-3}
Nitrogen dioxide	µg m^{-3}
Nitrogen monoxide	µg m^{-3}
Non-methane volatile organic compounds (VOCs)	µg m^{-3}
Ozone	µg m^{-3}
PM10 dust fraction	µg m^{-3}
PM10, wildfires only	µg m^{-3}
PM2.5 secondary inorganic aerosol fraction	µg m^{-3}
Particulate matter d < 10 µm (PM10)	µg m^{-3}
Particulate matter d < 2.5 µm (PM2.5)	µg m^{-3}
Peroxyacyl nitrates	µg m^{-3}
Residential elementary carbon	µg m^{-3}
Sulphur dioxide	µg m^{-3}
Total elementary carbon	µg m^{-3}

INTERFACCIA PER LE ANALISI (3)

Atmosphere Monitoring

2. Confronto misurato-modello data-fused PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-reanalyses?tab=download

Anno : 2019-2020-2021-2022-2023-2024

Stazioni : tutte le stazioni

Modello: EMEP, LOTOS-EUROS, ENS

Contiene:
Scelta delle variabili
I modelli disponibili
Quota z di estrazione
Data di estrazione (solo come annualità e mese non più di 4 mesi alla volta)
Tipo di estrazione (validated o interim)

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INTERFACCIA PER LE ANALISI (4)

Atmosphere Monitoring

2. Confronto misurato-modello data-fused PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

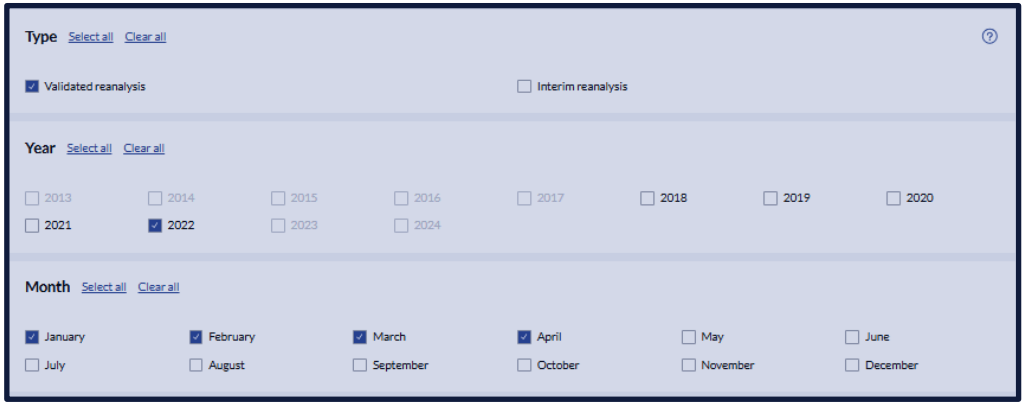
Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-reanalyses?tab=download

Anno : 2019-2020-2021-2022-2023-2024

Stazioni : tutte le stazioni

Modello: ~~EMEP, LOTOS-EUROS, ENS~~

Contiene:
Scelta delle variabili
I modelli disponibili
Quota z di estrazione
Tipo di estrazione (validated o interim)
Data di estrazione (solo come annualità e mese non più di 4 mesi alla volta)



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INTERFACCIA PER LE ANALISI (5)

2. Confronto misurato-modello data-fused PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

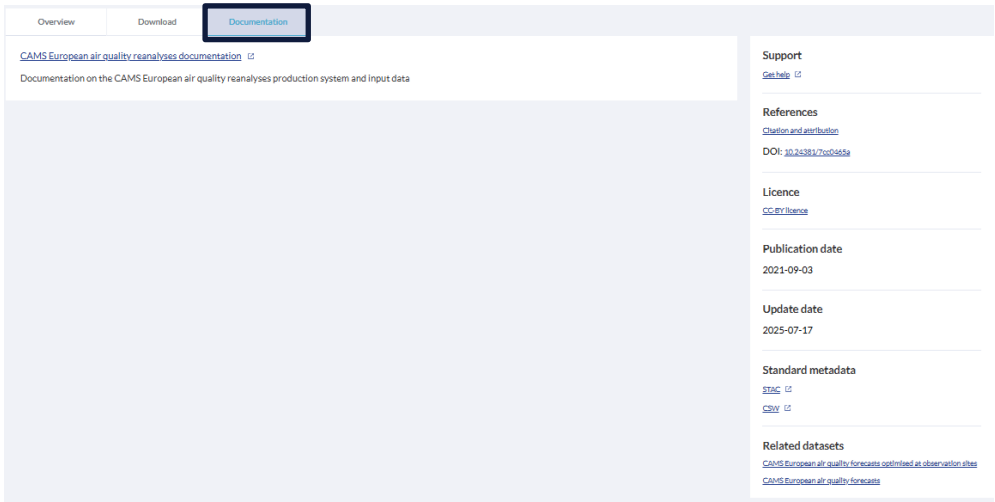
Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-reanalyses?tab=download

Anno : 2019-2020-2021-2022-2023-2024

Stazioni : tutte le stazioni

Modello: EMEP, LOTOS-EUROS, ENS

Contiene:
Riferimenti per analisi e previsioni



CAMS Regional: European air quality reanalyses data documentation - Copernicus Knowledge Base - ECMWF Confluence Wiki

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PRINCIPALI DATASET UTILIZZATI

COME POSSIAMO CONFRONTARE I DATI MISURATI CON I DATI PRODOTTI DAI MODELLI A SCALA EUROPEA?

?

1. Confronto misurato-modello PM_{10}, NO_3^-, SO_4^{2-}, NH_4^+, POM, EC, SEA SALT, DUST

Dataset: https://policy.atmosphere.copernicus.eu/yearly/chemical-speciation/?year=2024&from=2024-01-01&to=2024-12-31

Anno: 2019-2020-2021-2022-2023-2024

Stazioni: Milano

Modello: EMEP, LOTOS-EUROS

2. Confronto misurato-modello data-fused PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-reanalyses?tab=download

Anno : 2019-2020-2021-2022-2023-2024

Stazioni : tutte le stazioni

Modello: EMEP, LOTOS-EUROS, ENS

3. Confronto misurato-modello previsionale PM_{10}, SIA (NO_3^- + SO_4^{2-} + NH_4^+) e DUST

Dataset: https://ads.atmosphere.copernicus.eu/datasets/cams-europe-air-quality-forecasts?tab=download

Anno : 2021-2022-2023-2024

Stazioni : tutte le stazioni

Modello: EMEP, LOTOS-EUROS, ENS

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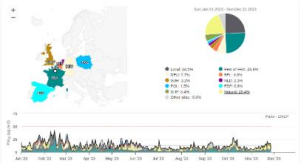
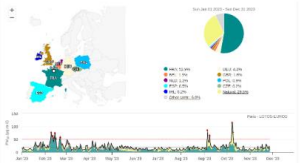


Country impact

Annual and seasonal summary of **potential impact** of source regions to $PM_{10/2.5}$ using EMEP results.

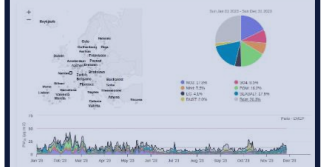
yearly analysis



Country contribution

Annual and seasonal summary of **contribution** of source regions to $PM_{10/2.5}$ using LOTOS/EUROS results.

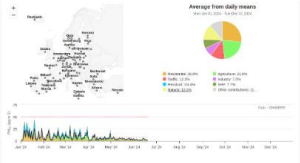
yearly analysis



Chemical speciation

Annual and seasonal summary of the PM_{10} **chemical speciation** for EMEP and LOTOS/EUROS results.

yearly analysis

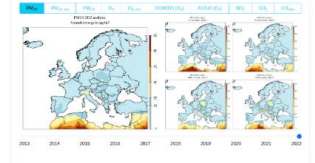


Sector apportionment

Annual and seasonal summary of the **sector apportionment** of the $PM_{10/2.5}$, O_3 and NO_2 at targeted cities with the CHIMERE model.

Model evaluation

Annual statistics of **comparisons** between model forecasts and EEA observations for EMEP and LOTOS/EUROS for $PM_{10/2.5}$.



Air quality indicators

European maps of annual/seasonal averages, exceedances and exposure

european maps

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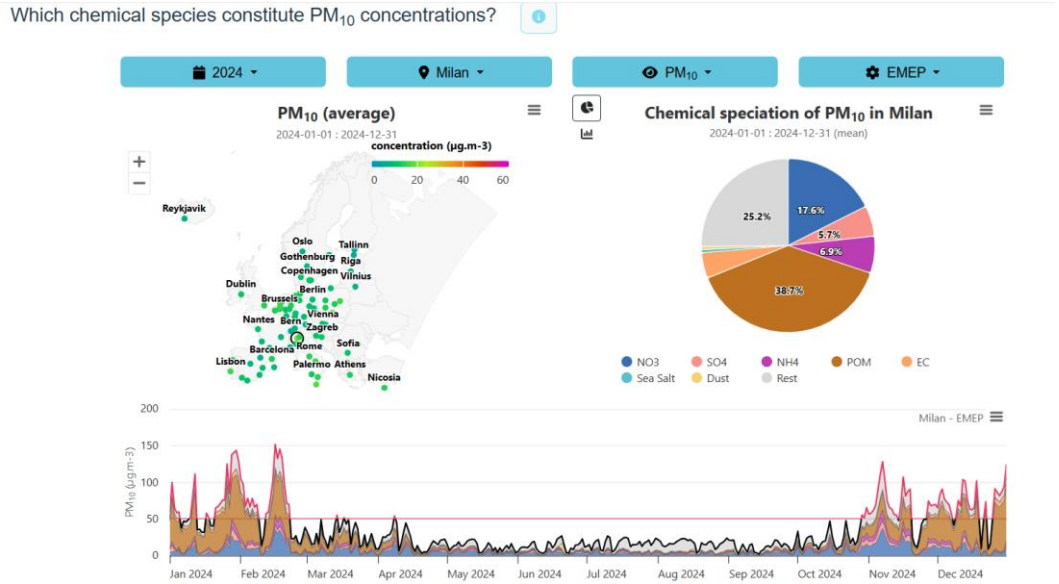
Stazioni: Milano

Modello: EMEP, LOTOS-EUROS

Contiene:
Tutta la speciazione del PM ma solo per alcune città
Output disponibili come file json



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JSON DOWNLOAD – UN ESEMPIO

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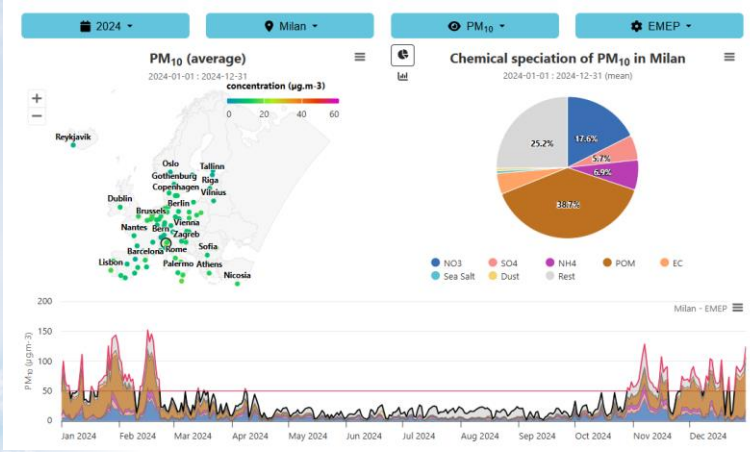

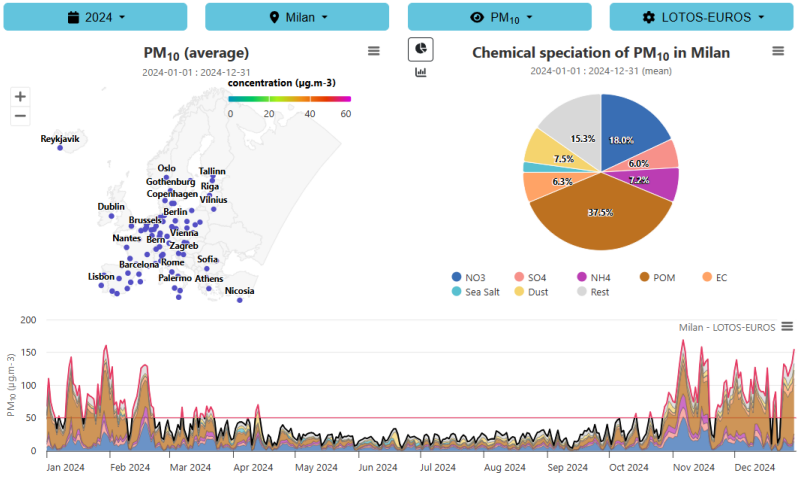

PER LO SCARICO DEI DATI:
Occorre uno script esterno
Conversione da json a csv
Aggregazione da orario a giornaliero
Presenza di valori negativi

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API DOWNLOAD – UN ESEMPIO

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API request

Please go to the documentation page for information as to how to use the CDS API.

Hide API request code

```
import cdsapi

dataset = "cams-europe-air-quality-reanalyses"
request = {
    "variable": ["particulate_matter_10um"],
    "model": ["ensemble"],
    "level": ["0"],
    "type": ["validated_reanalysis"],
    "year": ["2022"],
    "month": ["01", "02", "03"]
}

client = cdsapi.Client()
client.retrieve(dataset, request).download()
```

Copy

PER LO SCARICO DEI DATI:
- SHOW API REQUEST
-SUBMIT FORM

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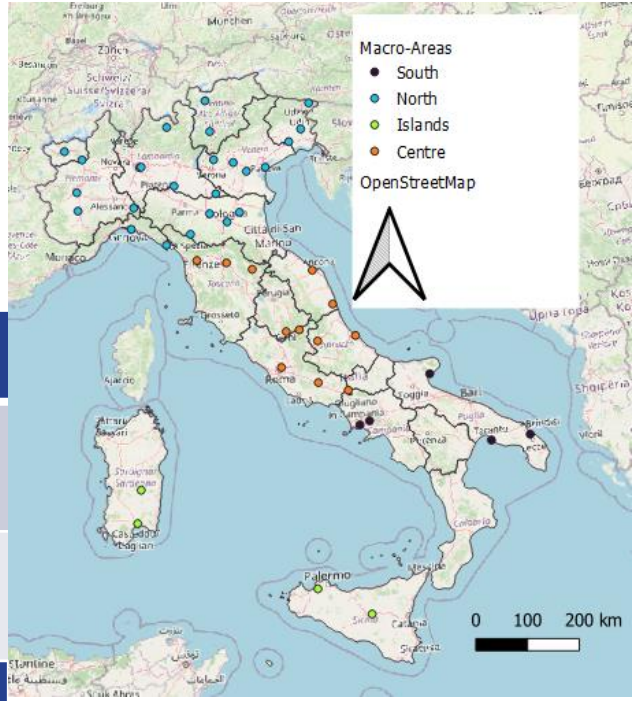
POSTPROCESSAMENTO

- Confronto prodotto CAMS con i modelli selezionati sia previsionale +24, sia assimilazione (IRA-VRA)
- Confronto con le misure di composizione del PM10 per 7 stazioni di caratterizzazione del PM10 + stazioni nazionali PM10
- Utilizzo degli indicatori tipici della modellistica (Mean bias, NMB (Normalized mean bias), RMSE (Root mean square error), Correlation, MQI)

MODEL OUTPUT	Meteorology	Emissions	Assimilation	Reference
EMEP-CAMS	D-1 12:00 UTC IFS, 3hrly	CAMS_REG.v7 for the year 2023	Intermittent 3d-var	EMEP
LOTOS-EUROS	D-1 12:00 UTC IFS, 3hrly	CAMS-REG v7 for the year 2023	Ensemble Kalman filter technique	LOTOS-EUROS
ENSEMBLE (CHIMERE, DEHM, EMEP, EURAD-IM, GEM-AQ, LOTOS-EUROS, MATCH, MOCAGE,SILAM)	**Median model: for each grid-cell, the value corresponds to the median of the different model values**			



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ALCUNI RISULTATI

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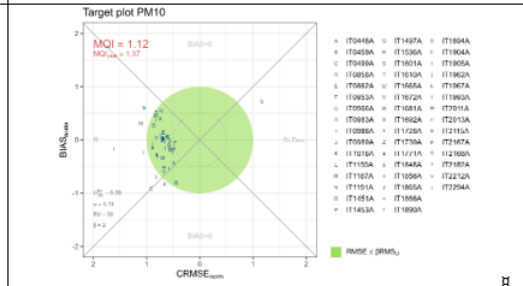
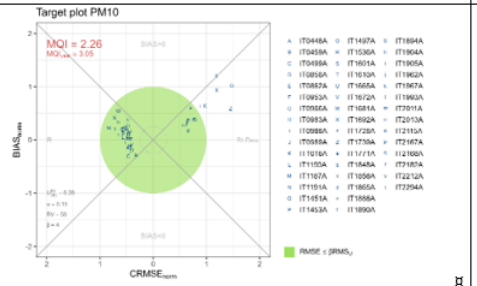
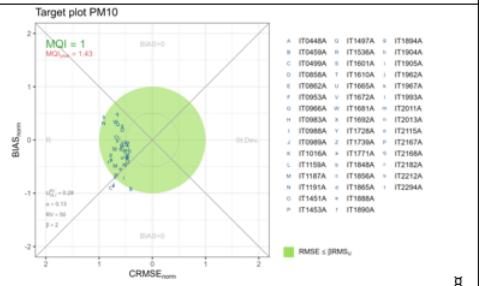
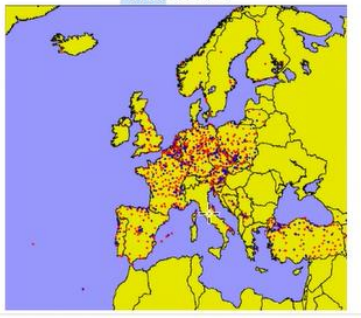
2023	EMEP	LOTOS	ENSEMBLE
Target diagrams			

	NORMALIZED-BIAS-2023		
	EMEP	LOTOS	ENSEMBLE
2023 FORECAST			

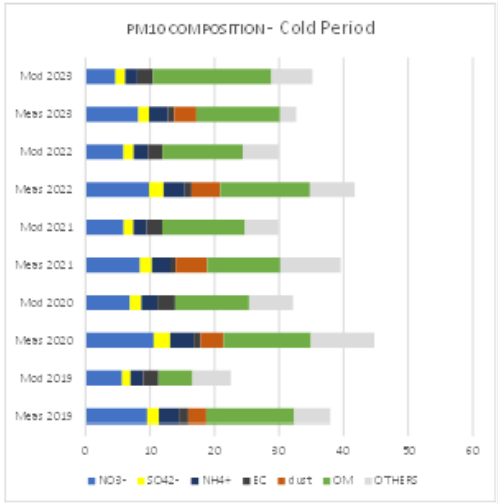


Stazioni assimilate

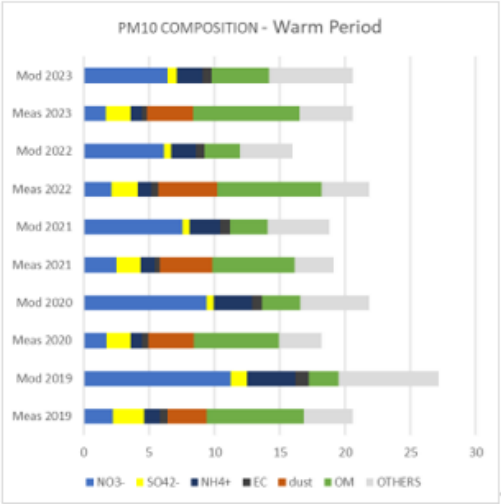
PM10 sovrastimato

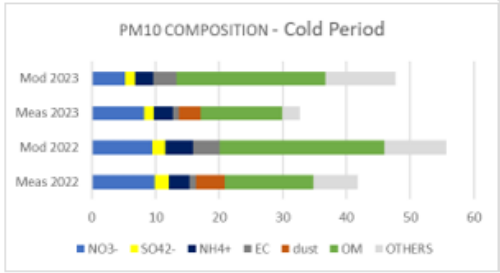
ALCUNI RISULTATI

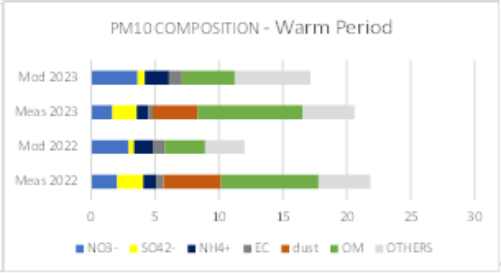
15.10 – 14.04



15.04 – 14.10







OM e DUST: EMEP sottostima (N.B. la misura non è diretta)

DUST: LOTOS sovrastima (N.B. la misura non è diretta)

Periodo freddo: EMEP sottostima, LOTOS sovrastima

Periodo caldo: EMEP/LOTOS sovrastima

NCP Atmosphere Monitoring Service

NATIONAL COLLABORATION PROGRAMME
ITALIAN INITIATIVE

Grazie per l’attenzione

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