



Atmosphere Monitoring

# Regional evaluation & quality control (EQC) in CAMS

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PROGRAMME OF  
THE EUROPEAN UNION



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## Current QA/QC of the CAMS Regional ENSEMBLE

- CAMS regional ENSEMBLE (ENS) = Median of 11 CAMS regional models
- Air quality forecasts, analyses, and reanalyses
- Evaluation is done daily, quarterly and annually
  - surface measurements (EEA, up to Joly & Peuch classification 7)
  - satellite measurements (TROPOMI)
  - sonde measurements (provided by WOUDC, NOAA and NILU)
  - aircraft measurements (IAGOS)
- Ozone, PM<sub>2.5</sub>, PM<sub>10</sub>, NO<sub>2</sub>, SO<sub>2</sub>, and CO
- Evaluation results are published on the web (for ENS and the 11 models)
- Large number of plots and different statistical skill scores

https://cams2-83.aeroval.met.no/  
 → 'Overall Evaluation'  
 → 'Targets'

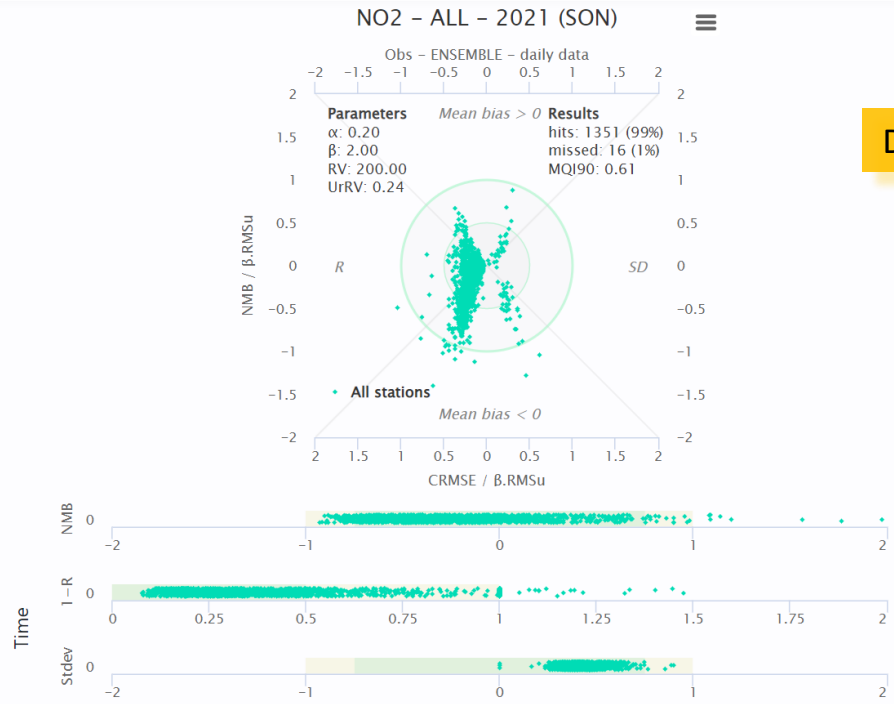
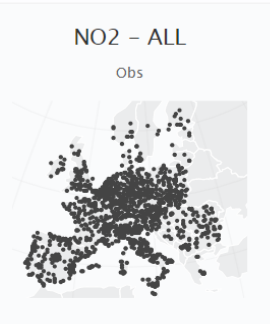
- Experiments
- forecast-last-seasons
- forecast-last-week
- forecast-last-day
- analysis-last-seasons
- analysis-last-week
- analysis-last-day

Heatmap Time Series Taylor Diagram Targets Hourly Scores

NO2 Obs ENSEMBLE ALL 2021 (SON)

The **target plots** have originally been designed within the **FAIRMODE** project for quickly identifying if a model satisfies predefined statistics criteria based on comparisons with observations. This includes a circular target (defined using observations uncertainties) as well as multiple bar targets investigating time and space statistics. More information can be found in the **FAIRMODE Guidance Document**.

**CAMS regional evaluation (forecast)**  
 Evaluation of the forecast for the 8 latest available complete seasons using EEA NRT obs.  
[+ Show More](#)  
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Done for O<sub>3</sub>, NO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub>



Based on version 3.3 of the *FAIRMODE Guidance Document on Modelling Quality Objectives and Benchmarking*





## Example from the quarterly reports (surface evaluation done by Meteo France):

Table 2: Summary of FAIRMODE metrics for the ENSEMBLE forecasts and analyses: 'MQO': is the Model Quality Objective fulfilled at at least 90% of all stations? (Y or N); 'MPI': are the Model Performance Indicators met? (number of MPIs met / number of total MPIs calculated). For more information about FAIRMODE metrics and more detailed results see Section 2.3.

	Forecast		Analysis	
	MQO	MPI	MQO	MPI
ozone	Y	6/6	Y	6/6
NO <sub>2</sub>	Y	5/6	Y	5/6
PM <sub>10</sub>	Y	6/6	Y	6/6
PM <sub>2.5</sub>	Y	6/6	Y	6/6

SON2022

(often regional models have difficulties meeting the *hperc norm* for NO<sub>2</sub>)

FAIRMODE plots are also used in the evaluation of the VRA and IRA

(→ F. Meleux's presentation tomorrow)

All EQC reports are publicly available at  
<https://atmosphere.copernicus.eu/regional-services/>



- Revisit the parameters to calculate RMSu (from Guidance Document v3.3)

**Table 7:** List of the parameters used to calculate the measurement uncertainty.

	$U_r(RV)$	$RV$	$\alpha$	$N_p$	$N_{np}$
<b>NO2</b>	0.24	200 $\mu\text{g}/\text{m}^3$	0.20	5.2	5.5
<b>O3</b>	0.18	120 $\mu\text{g}/\text{m}^3$	0.79	11	3
<b>PM10</b>	0.28	50 $\mu\text{g}/\text{m}^3$	0.25	20	1.5
<b>PM2.5</b>	0.36	25 $\mu\text{g}/\text{m}^3$	0.50	20	1.5

Source: JRC

$$RMS_U = \sqrt{\frac{\sum_{i=1}^N (U(O_i))^2}{N}} = U_r(RV) \sqrt{(1 - \alpha^2)(\bar{O}^2 + \sigma_o^2) + \alpha^2 RV^2}$$

- add CO and SO<sub>2</sub>?
- Near future: going to evaluate the «ENSEMBLE-MOS»



- FAIRMODE metrics are already in (operational) use in the CAMS evaluation of regional forecasts
- CAMS regional ENSEMBLE fulfills MQO
- CAMS individual models fulfill MQO most of the time
- Fulfilling the *hperc* MPI for NO<sub>2</sub> remains difficult
- Provide regular feedback to FAIRMODE and include updates from FAIRMODE guidance docs as they become available
- Attendance/discussions at relevant FAIRMODE meetings and the CAMS General Assemblies