Data assimilation experiments over Europe with the Chemical Transport Model FARM.

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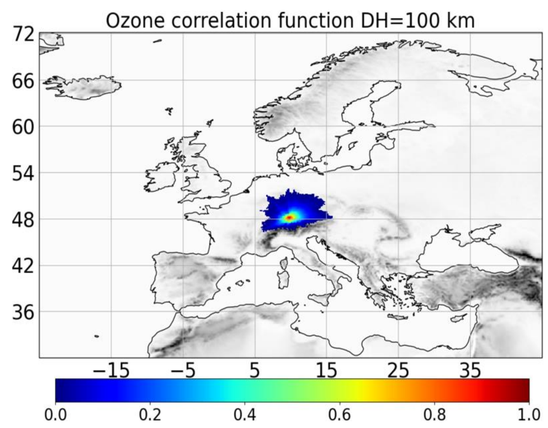
Introduction:

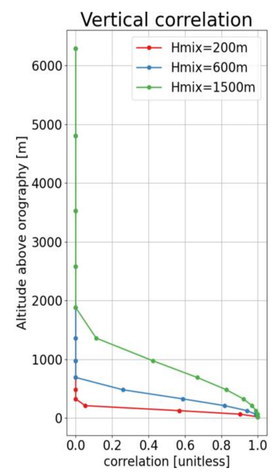
An Optimal Interpolation scheme has been implemented for the Chemical Transport Model FARM, core of the MINNI modelling system, operational within the regional Copernicus Atmospheric Monitoring Service. The scheme assimilates regulated pollutant concentration observations from ground stations.

Method :

Horizontal correlation are estimated by an exponential function using terrain-following distance.
Correlation length and error variances are computed for each pollutant using Hollingsworth-Lönnberg method using the median of the misfits. Error variances enter in the analysis expression only through their ratio $\varepsilon = \frac{\sigma_{obs}}{\sigma_{back}}$.
Vertical correlation is approximated to a Cressman function that fade out at Planetary boundary layer height.
Assimilation parameters are shown in the table and figure on the right.

Pollutant	Covariance ratios (ε)	Correlation Length (m)
NO_2	0.50	50
O_3	0.50	110
CO	0.85	30
SO_2	0.30	30
PM_{10}	0.40	90
$PM_{2.5}$	0.40	110

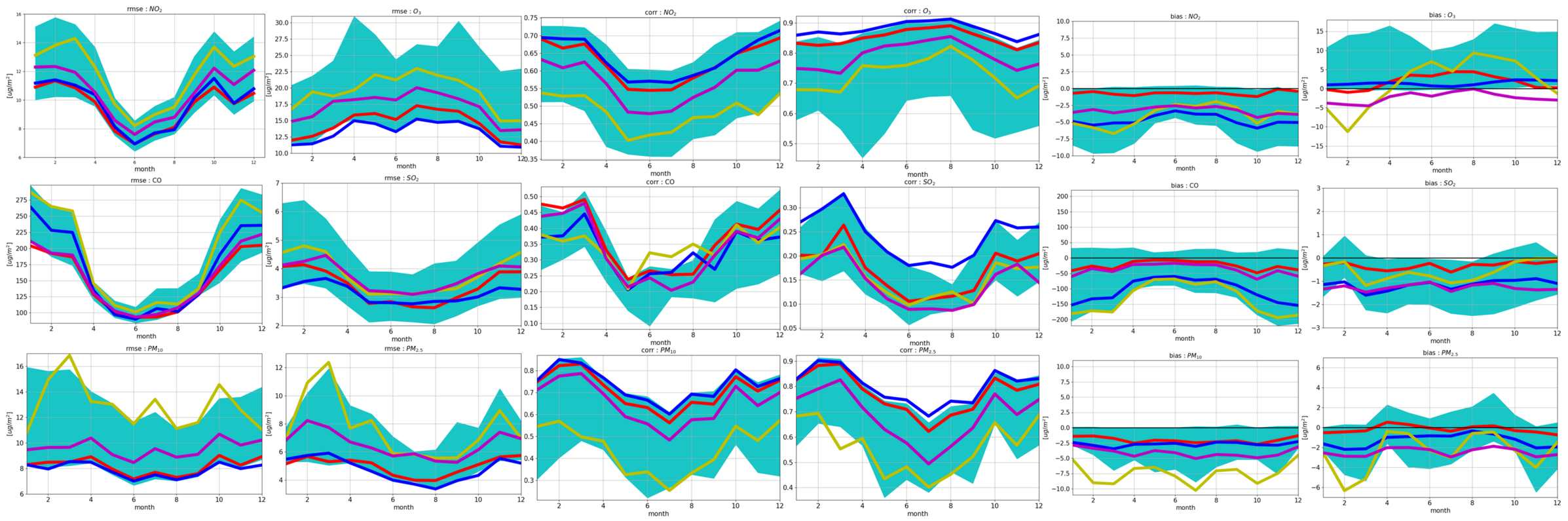




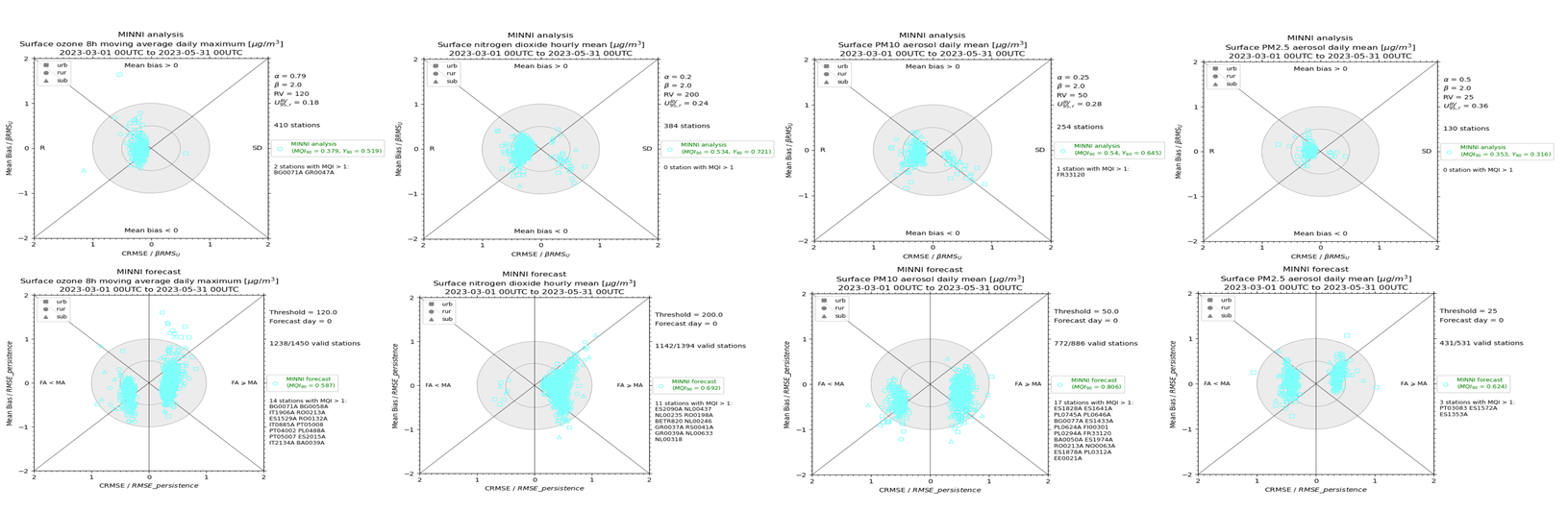
Two assimilations experiment (BF and SCT) are validated with independent observations and compared with CAMS Validated ReAnalysis ensemble (VRA) and a simulation (SIM) for year 2018 over the European domain. BF assimilates only measurements whose difference with respect to forecast state is less than a threshold, SCT apply also the Spatial Consistency Test (Lussana et al. 2010)

Results & Conclusion:

Results show that both assimilation experiments are consistent with the VRA ensemble for all pollutants. When the Spatial Consistency Test is used to selectively prevent the assimilation of "bad" information, results are greatly improved, comparing well with the ensemble median: The reason is that the SCT is able to assimilate a larger number of observations. Figure below show the RMSE, correlation and bias. SIM, BF, SCT and VRA results are shown as yellow, magenta, red and blue lines, respectively.



The operational products of the assimilation scheme are continuously evaluated in the framework of CAMS using also the FAIRMORE air quality indicators, that are the ones promoted by the European Commission. An example is the target plot on the right, where points should lay within the target and the MQI_{90} should be less than 1 with perfect value equal to 0.



References:

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