

Retrospective evaluation of MOCAGE forecasts at Météo-France

Towards higher resolution

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MOCAGE Chemistry-Transport Model

MOCAGE is the 3D global off-line CTM run at Météo-France since 2005 for air quality operational forecasts:

- Three nested domains: the globe at $2^\circ \times 2^\circ$, Europe at $0.5^\circ \times 0.5^\circ$, and France at $0.1^\circ \times 0.1^\circ$.
- 60 vertical levels, from surface to 0.1hPa, with about 7 levels in the planetary boundary layer.
- The chemical scheme combines RACM and REPROBUS (troposphere and stratosphere), i.e. 118 species and 350 reactions.
- 6 tracers for each type of aerosol (desert dust, sea salt, black-carbon, and anthropogenic particulate matter).
- Anthropogenic emissions from the European MACC project and biogenic emissions from GEIA.

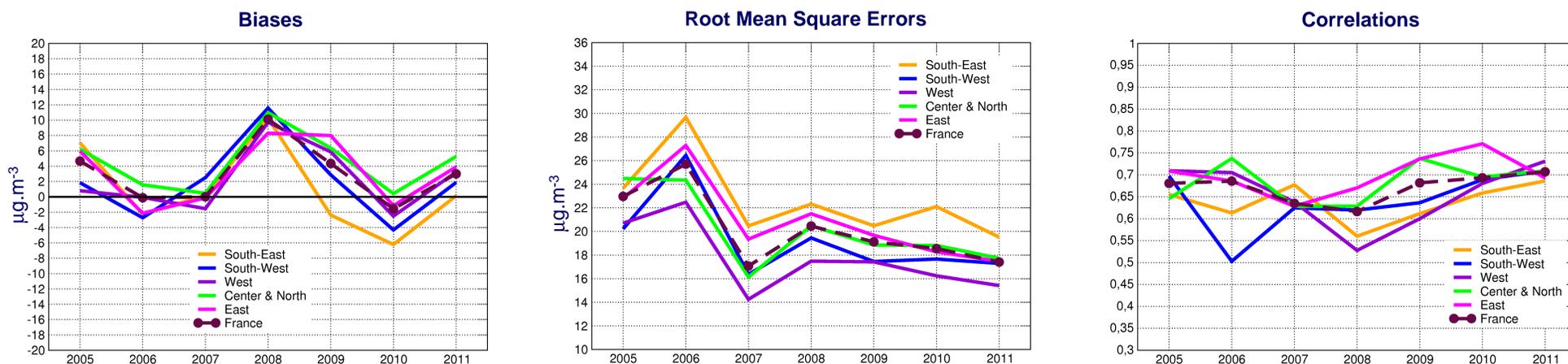


The model is initialized with the meteorological forecasts of the previous day, without assimilation, and is run for 4 days. In this study, only the first day of forecast is considered.

- Météo-France ARPEGE forecasts are used for the global and the European domain
- Météo-France ALADIN forecasts are used over France (except for the last summer for which ARPEGE forecasts have been used).

Performances of the operational forecasts since 2005

- The following comparison focuses on Ozone daily maxima of the first day of forecast, over the July-September period.
- The most exhaustive air quality observational data set available for France is called BDQA (Base de Données de Qualité de l'Air).
- We consider only the monitoring sites of the classes 1 to 8 of the objective classification set up by Joly & Peuch (2012), that are the most representative of the large-scale.
- France has been divided into 5 regions, in order to assess the spatial differences in the forecast performances.



→ Because of inter-annual variability, 6 years is too short to detect any trend in the performances of the forecasts. Summer 2005 and 2006 are characterized by strong RMSE, 2008 a strong positive bias, and 2007 and 2008 weaker correlations.

→ Interestingly, RMSEs evolve similarly in the different regions. The South-East (mainly the Rhone valley and the Mediterranean coast) has the largest RMSE, while the West region performs best.

→ Correlations are slightly higher for the East, and the Center & North regions (including Paris).

Towards higher resolution...

Since December 2008, Météo-France runs the non-hydrostatic AROME model for operational fine-resolution weather forecasts over France. One of the objectives of this high-resolution model (2.5 km) is a better representation of urban processes (e.g., the urban heat island), which are of strong interest for air quality applications.

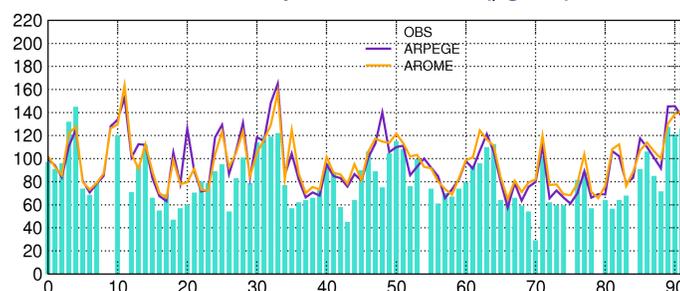
Before increasing the horizontal resolution, we first compare the results of ARPEGE and AROME fields at the 0.1° current resolution of MOCAGE operational runs.

Summer 2011

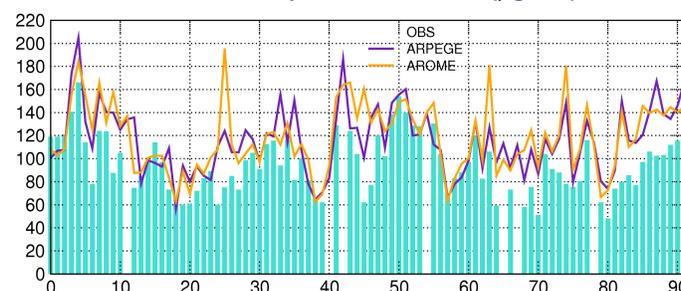
FRANCE – Daily Ozone Maxima ($\mu\text{g}\cdot\text{m}^{-3}$)

	ARPEGE	AROME
Bias	1,6	4,7
RMSE	18,3	18,8
Correlation	0,68	0,68

PARIS – Daily Ozone Maxima ($\mu\text{g}\cdot\text{m}^{-3}$)



LYON – Daily Ozone Maxima ($\mu\text{g}\cdot\text{m}^{-3}$)



→ At the scale of France, the performances are comparable in both versions. The bias and the errors are slightly stronger with AROME.

→ Differences are larger for some specific regions and meteorological situations. Over Paris, AROME fields give better results for two days. Over Lyon, AROME fields tend to generate non-observed ozone plumes, mainly due to a strong vertical velocity that concentrates primary pollutant in the lowest layers of the troposphere.

Changing the forcing fields over France does not perturb much MOCAGE forecasts. The next step will be to use the meteorological fields at their 2.5 km horizontal resolution, and to test new high-resolution (1kmx1km) emission estimates for France, that should be available soon.