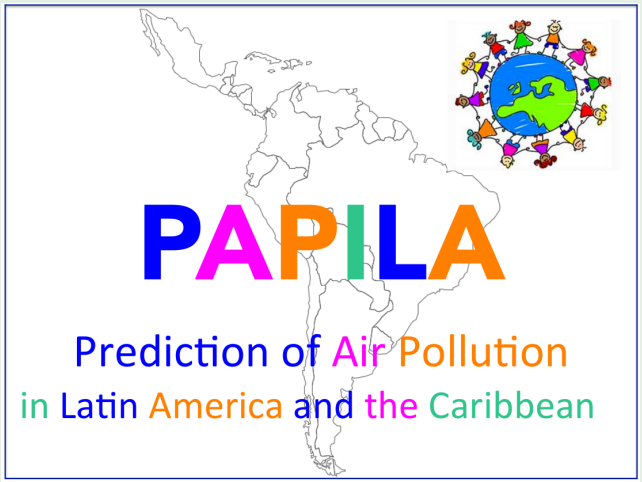
PAPILA WP5: Model evaluation

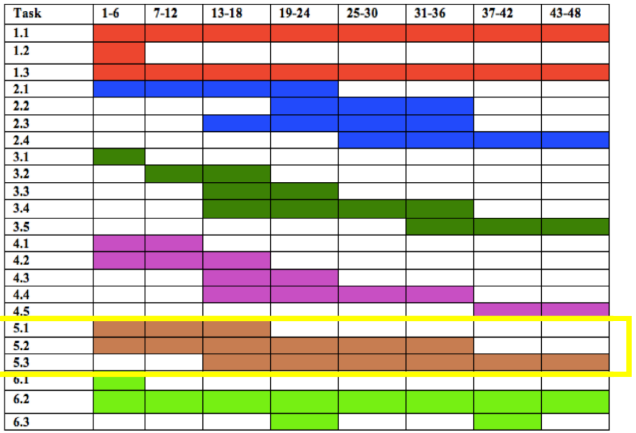
Regional modelling: MPG (WRF-Chem), CNRS (WRF-CHIMERE), FMI (SILAM)
Local downscaling: UCL (WRF-CHIMERE), UNAM (SILAM) and USP (SILAM)



Laurent MENUT
Laboratoire de Météorologie Dynamique, CNRS, Palaiseau, France

Main goals of WP5

1. To evaluate the concentration fields of chemical species derived from analysis and forecast simulations.
2. To compare the different models against each other, in order to provide an assessment of uncertainties, to identify the weaknesses of the model, and to improve their performance
3. To provide the necessary data and tools to statistically quantify the model accuracy.



Three tasks:

1. Task 5.1: M1 $\rightarrow$ M18
   Compilation of existing ground based observations.
2. Task 5.2: M1 $\rightarrow$ M36
   Development of a common database for observations.
3. Task 5.3: M13 $\rightarrow$ M48
   Validation of Air Quality Forecasts

Task 5.3: Validation of Air Quality Forecasts
5.3.1 Methodology. Lead: CNRS and CNEA

A few lines of the task description:

"... development of efficient evaluation methods for the AQ forecasts"

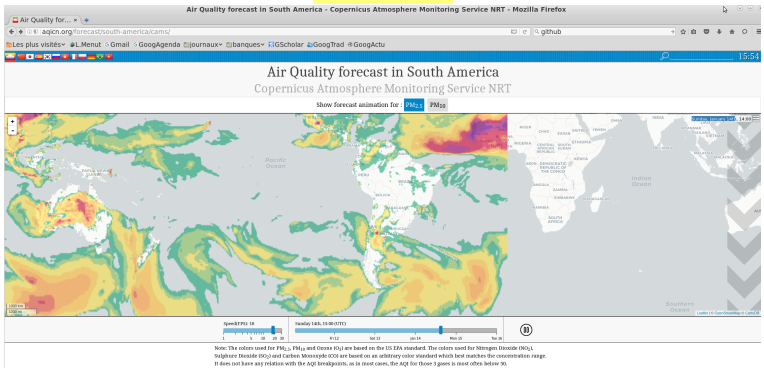
"... ability of the models to predict surface concentrations for the following 3 to 5 days"

"... additional scores such as the number of hours of exceedance, the occurrence of peaks"

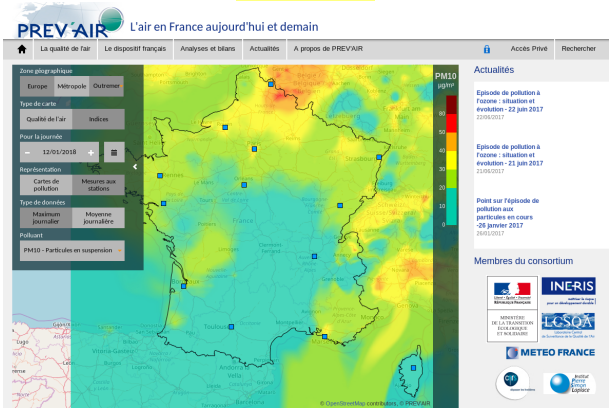
Several forecast systems already exist, from global to regional scale:

- The South-American forecast: *http://aqicn.org/forecast/south-america/fr/*
- The European forecast CAMS/Copernicus: *http://www.regional.atmosphere.copernicus.eu/*
- The French PREVAIR system: *http://www2.prevair.org/*
- ... among many others

AQICN



Prevair



Task 5.3: Validation of Air Quality Forecasts
5.3.2 Model Validation. Lead: CNRS and USP

A few lines of the task description:

"...specific situations (e.g., pollution episodes) will be identified"

"model evaluation will be performed for the spatial area covered by the reanalysis and for selected zooms on megacities"

"Standard scores (correlation, mean bias, RMSE) ... for the different models on an hourly and a daily basis" "Uncertainty analyses..."

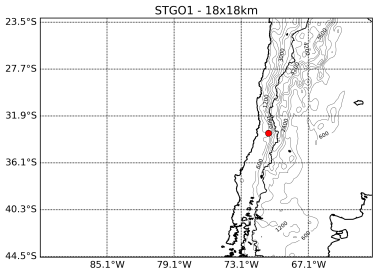
"(1) systematic data assimilation to constrain initial conditions, (2) bias corrections by statistical methods"

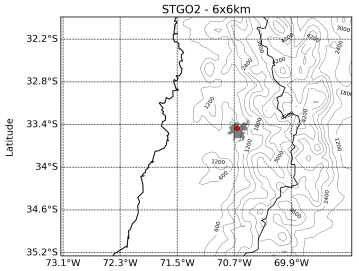
Main questions for discussion:

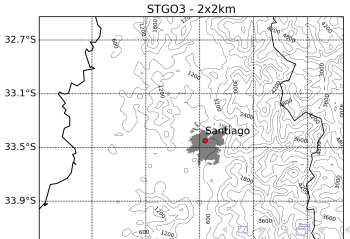
- What are the existing systems able to manage data assimilation in forecast?
- What are the assimilated variables? (ozone, nitrogen oxides, particulate matter, AOD?)
- What is the benefit of these assimilation systems on the forecast scores?
- What are the existing systems using bias corrections?

On going simulations over Santiago

Example of nested simulations with WRF-CHIMERE *(Mazzeo et al., 2018)*







Task 5.3: Validation of Air Quality Forecasts

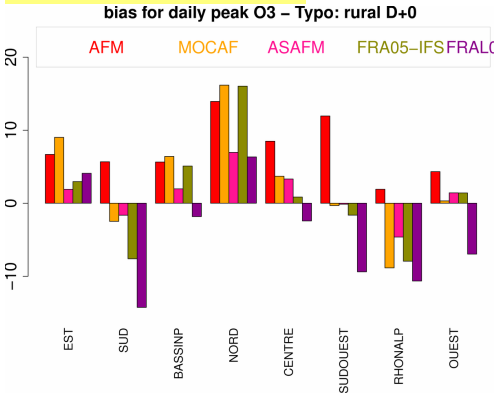
Examples of forecast scores calculations:
Examples of results by Frederik Meleux (INERIS) for the PREVAIR system.

The 'forecast' validation is close to the 'analysis' validation:

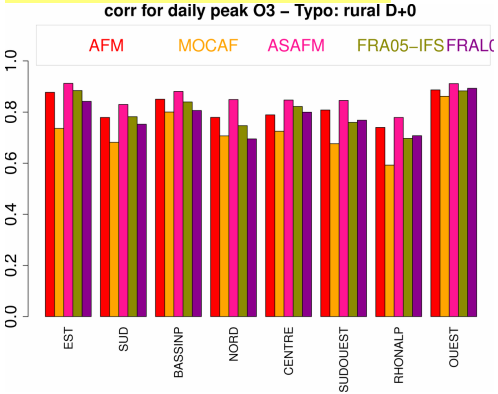
- Comparison to surface in-situ measurements with correlation, RMSE, bias
- Comparison to satellite with spatial correlation
- Calculation of number of exceedances for several pollutants (O_3, NO_2, PM_{10})

In addition: Possibility to add the quantification of the error growth with forecast lead.

Bias for O_3 forecast



Correlation for O_3 forecast



Task 5.3: Validation of Air Quality Forecasts

Examples of forecast scores calculations:
Examples of results by Frederik Meleux (INERIS) for the PREVAIR system.

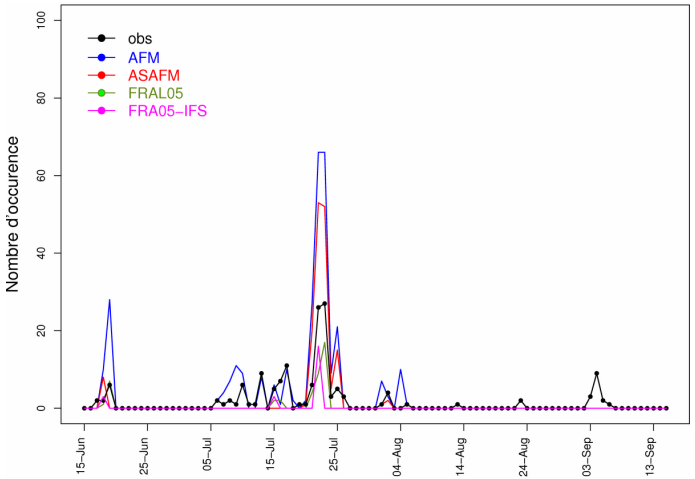
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Number of hours of exceedances of $O_3 > 180$ μg m^{-3}

Example for the year of 2013 and over France.
The colors are for several model versions of CHIMERE (with WRF or IFS, with statistical adaptation or not)



When dealing with "threshold" values, the model is more sensitive to the meteorological forcing, to the temporal and spatial resolution.

Task 5.3: Validation of Air Quality Forecasts

Examples of forecast scores calculations:
Examples of results by Frederik Meleux (INERIS) for the PREVAIR system.

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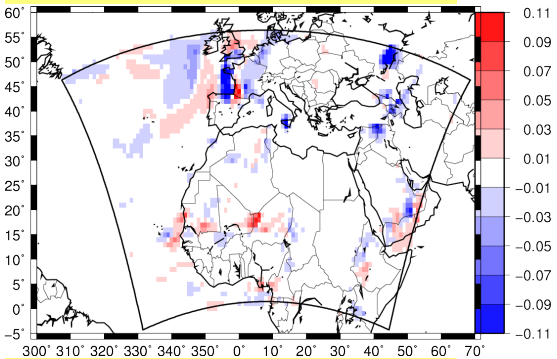
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In addition: Possibility to add the quantification of the error growth with forecast lead.

Example for mineral dust:
forecast propagation error

1. 10m wind speed $\rightarrow$ dust emissions
2. dust emissions $\rightarrow$ transport
3. transport $\rightarrow$ AOD maps

Forecast of AOD: (D+1) - (D+0)



Forecast of AOD: (D+3) - (D+0)

