WP5: SEEDS to CAMS operations

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KO SEEDS, 19/01/2021
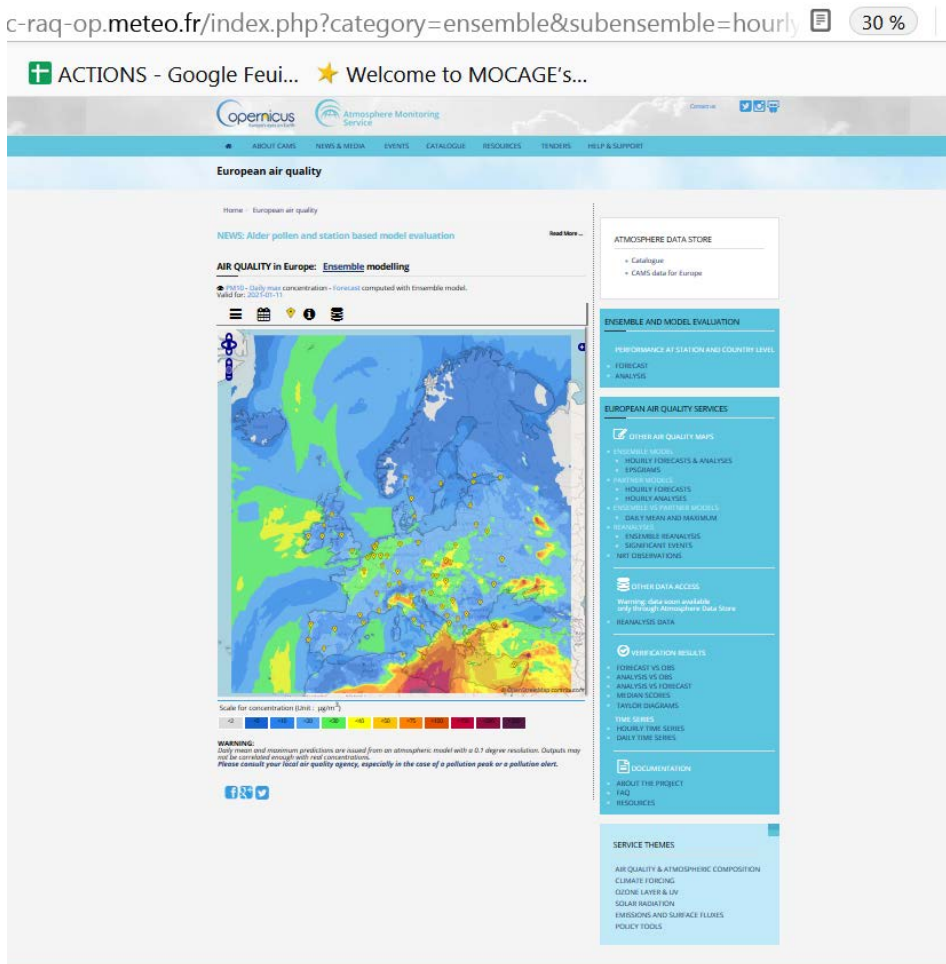
WP5: general objective

Assessment of the impact of the SEEDS products (WP1, WP2, WP3 and WP4) on the Copernicus Atmosphere Monitoring Service (CAMS) operational regional analyses and forecasts
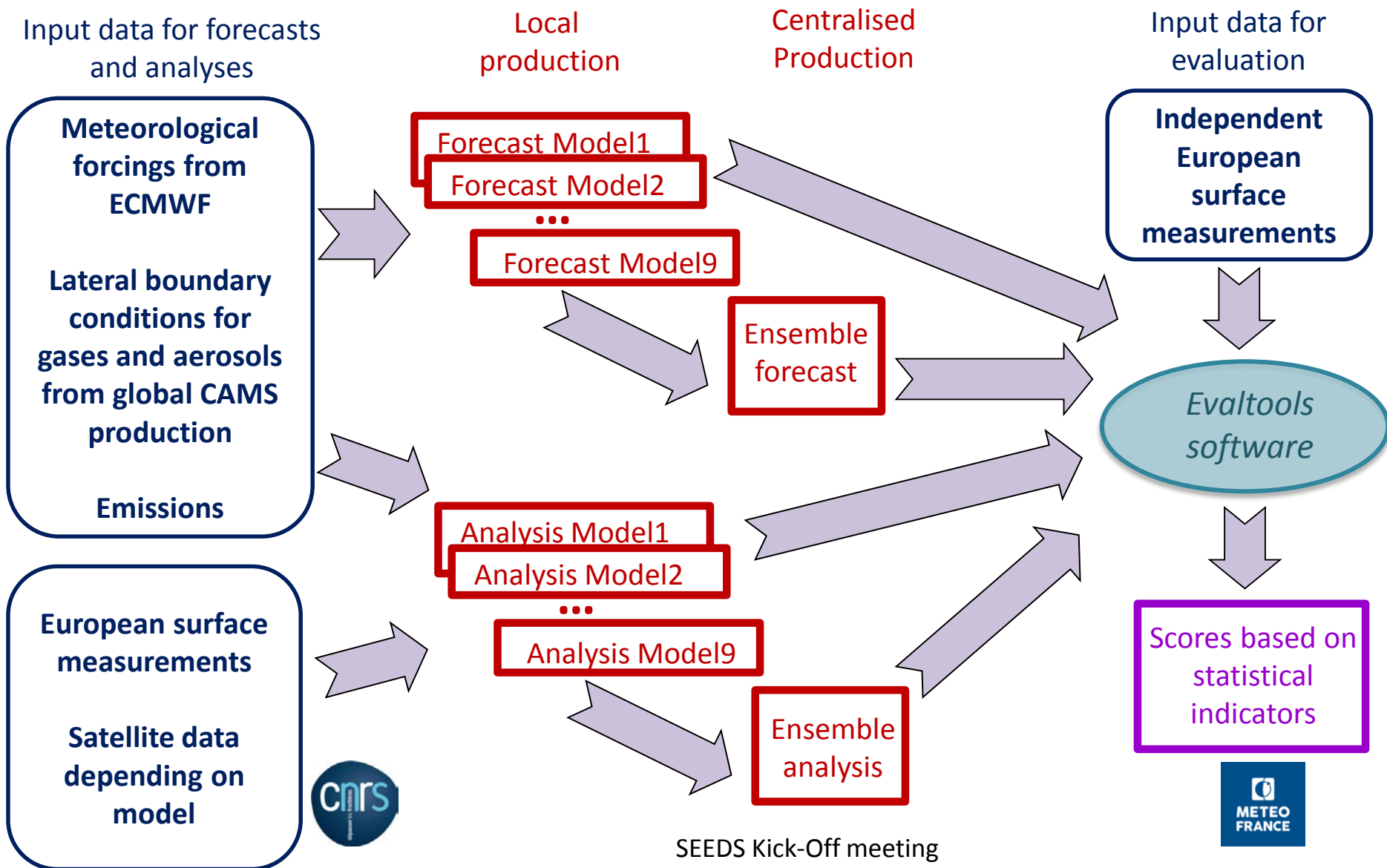
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About CAMS regional (=Europe) air quality forecasts and analyses

CAMS provides daily to the users:

- 96h forecasts and hourly analyses (24h) and annual reanalyses of the main air quality pollutants

- Based on an Ensemble of 9 atmospheric chemistry European models using similar setup for the emission inventory for anthropogenic emissions (TNO), NRT fire emissions, gas/aerosol boundary conditions and meteorological parameters

- Hourly outputs of concentrations at surface and in the lower atmospheric layers

- Available over a wide European domain with a resolution of 0.1° latitude x 0.1° longitude
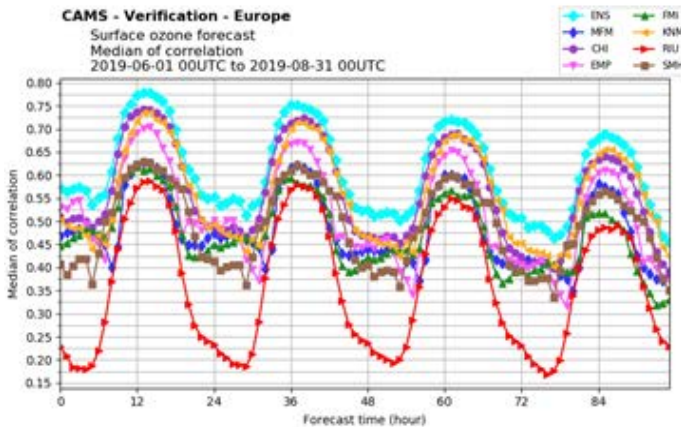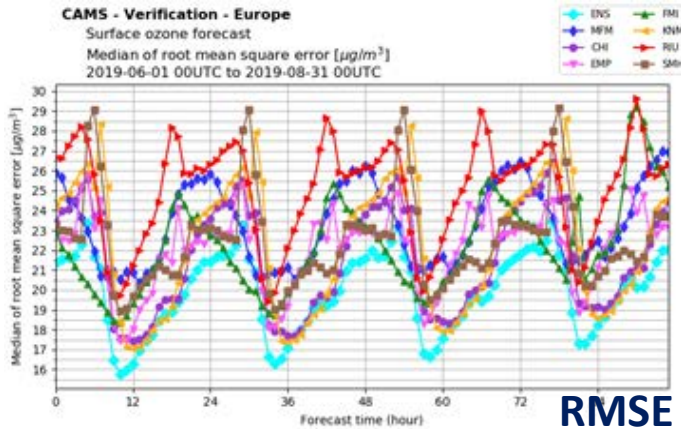
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General design of the CAMS regional production

Input data for forecasts and analyses

Local production

Centralised Production

Input data for evaluation

Meteorological forcings from ECMWF

Lateral boundary conditions for gases and aerosols from global CAMS production

Emissions

European surface measurements

Satellite data depending on model

Forecast Model1
Forecast Model2
...
Forecast Model9

Ensemble forecast

Analysis Model1
Analysis Model2
...
Analysis Model9

Ensemble analysis

Independent European surface measurements

Evaltools software

Scores based on statistical indicators
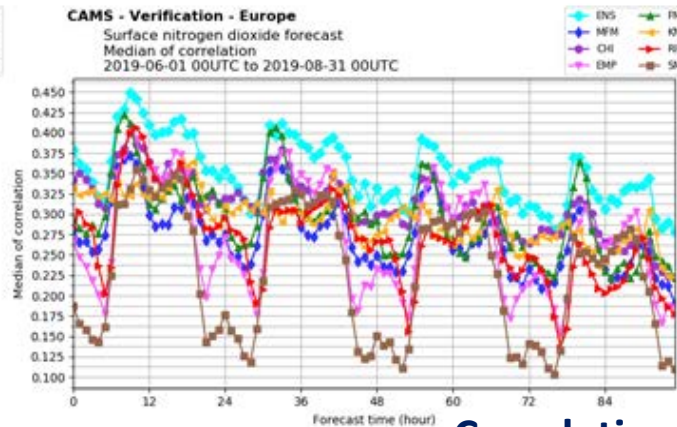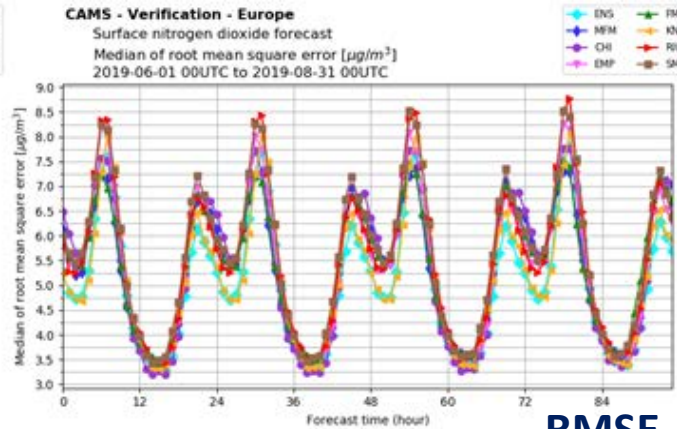
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Weaknesses of the current system: 96h forecasts

ozone

NO₂

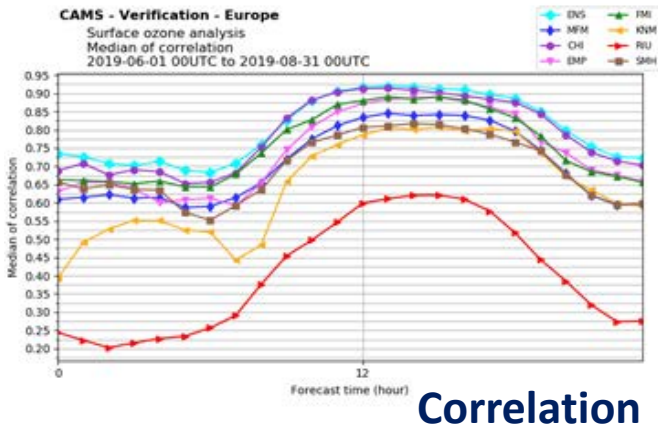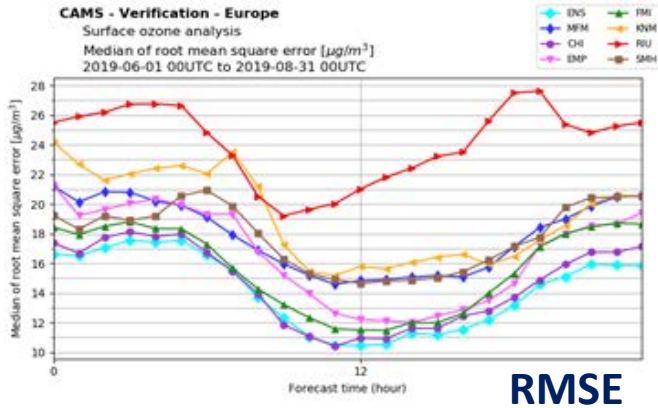Systematic errors: strong diurnal cycle on the scores that are due to uncertainties of:

- Anthropogenic emissions
- Biogenic emissions
- Dry deposition

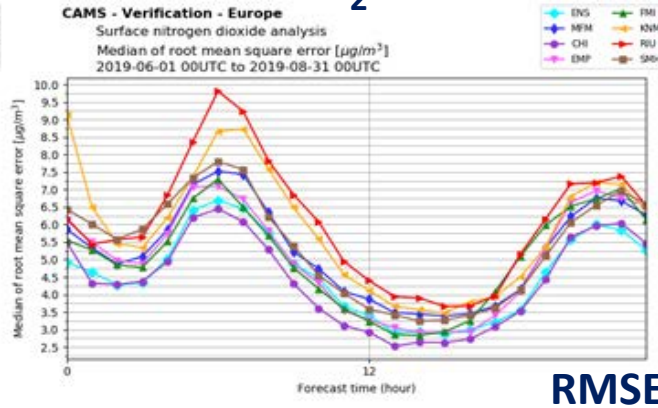**Improvements foreseen from SEEDS products**

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Weaknesses of the current system: hourly analyses

ozone

NO₂

RMSE

RMSE

Correlation

Correlation
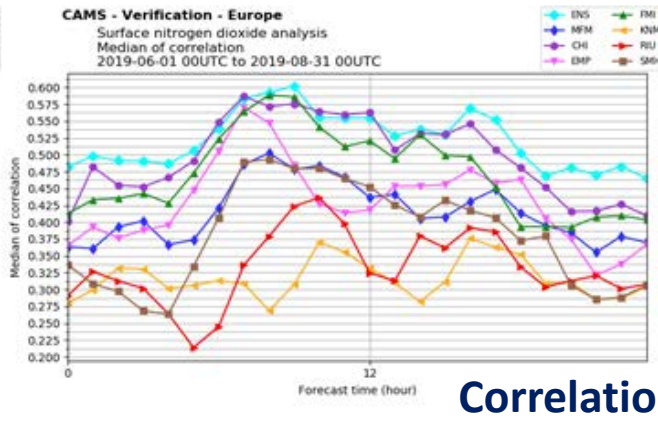
Strong diurnal cycle on the model scores even after data assimilation

Improvements foresseen from SEEDS products

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WP5: specific goals

- Assessment of the impact of the SEEDS products on CAMS regional analyses and forecasts
    - top-down emissions
    - bottom-up emissions
    - dry deposition products.

- Assessment in a similar way of the 4DEnVAR analyses (WP4) on CAMS regional forecasts

→ Establishment of the added value of each SEEDS product in the production of CAMS analysis and forecasts

→ Identification of the most effective pathways for the introduction of SEEDS products in the CAMS operational chain
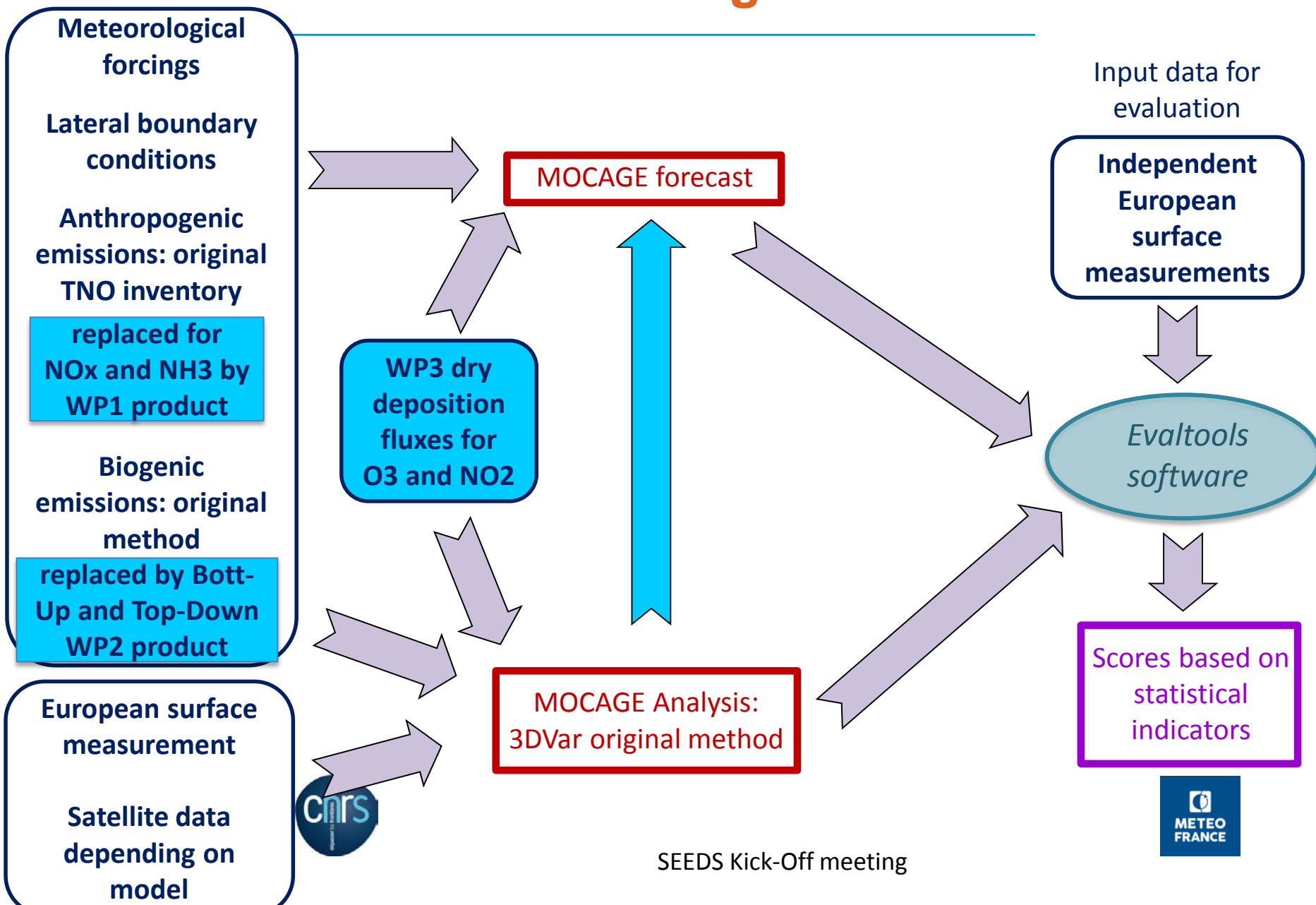
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WP5: methods (1)

To test the added value of the SEEDS emission, deposition and 4D-EnVar analyses:

- Use of the CAMS50 production framework:
  - Input data for model and data assimilation system, except those provided in SEEDS
  - Evaltools free software developed by CNRM-Meteofrance for the evaluation of the forecast and analysis performances

- Focus on the 4 main air quality pollutants, ozone, NO_2, PM10 and PM2.5 that are also chemically related to the species of the new emission products (NOx, HCHO, NH_3, satellite-derived and bottom-up BVOC) and affected directly or indirectly by dry deposition of ozone and nitrogen compounds.

- Use **MOCAGE** model that is the model developed by CNRM-Meteofrance together with CERFACS for its data assimilation system
  - MOCAGE is one of the models of the CAMS regional operational ensemble produced by Meteo-France in CAMS50
  - MOCAGE performances are representative of the mean performances of the 9 models of the ensemble

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General design of the WP5 method

Input data for forecast/analysis

Meteorological forcings

Lateral boundary conditions

Anthropogenic emissions: original TNO inventory

replaced for NOx and NH3 by WP1 product

Biogenic emissions: original method

replaced by Bott-Up and Top-Down WP2 product

European surface measurement

Satellite data depending on model

MOCAGE forecast

WP3 dry deposition fluxes for O3 and NO2

MOCAGE Analysis: 3DVar original method

Input data for evaluation

Independent European surface measurements

Evaltools software

Scores based on statistical indicators

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WP5 workplan

- Task 5.1: MOCAGE reference experiments with the latest CAMS50 configuration
- Task 5.2: Simulations, evaluation and analysis of the impact of SEEDS dry deposition products **(from D3.5)** → **D5.1 at M24**
- Task 5.3: Simulations, evaluation and analysis of the impact of SEEDS emission products **(from D1.1, D1.3, D2.2, D2.3 and D2.6)** → **D5.2 at M29**
- Task 5.4: Simulations, evaluation and analysis of the combined impact of SEEDS dry deposition **(from D3.5)** and emission **(from D1.1, D1.3, D2.2, D2.3 and D2.6)** products
- Task 5.5: Overall synthesis of SEEDS operational capability
  - Full synthesis of the impact of new SEEDS emissions/dry deposition products and of the 4DEnVar **(from WP4)** on MOCAGE scores and foreseen application to the other 8 CAMS regional models. → **D5.3 at M36**
  - Guidance on the future use of these products in the full operational context of CAMS. → **D5.4 at M36**

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WP5 plan for M1 to M6

Technical discussions for preparing future implementation in MOCAGE of SEEDS products with KNMI, BIRA, NILU

Choice of the year of reference: 2020 as planned or other to be more representative?

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