



# SEEDS - Sentinel EO-based Emission and Deposition Service



Koninklijk Nederlands  
Meteorologisch Instituut  
*Ministerie van Infrastructuur en Waters*



# Added value of SEEDS emission products for daily forecasts

**Joaquim Arteta, Frebourg nicolas and Virginie Marécal**  
CNRM - Météo-France/CNRM

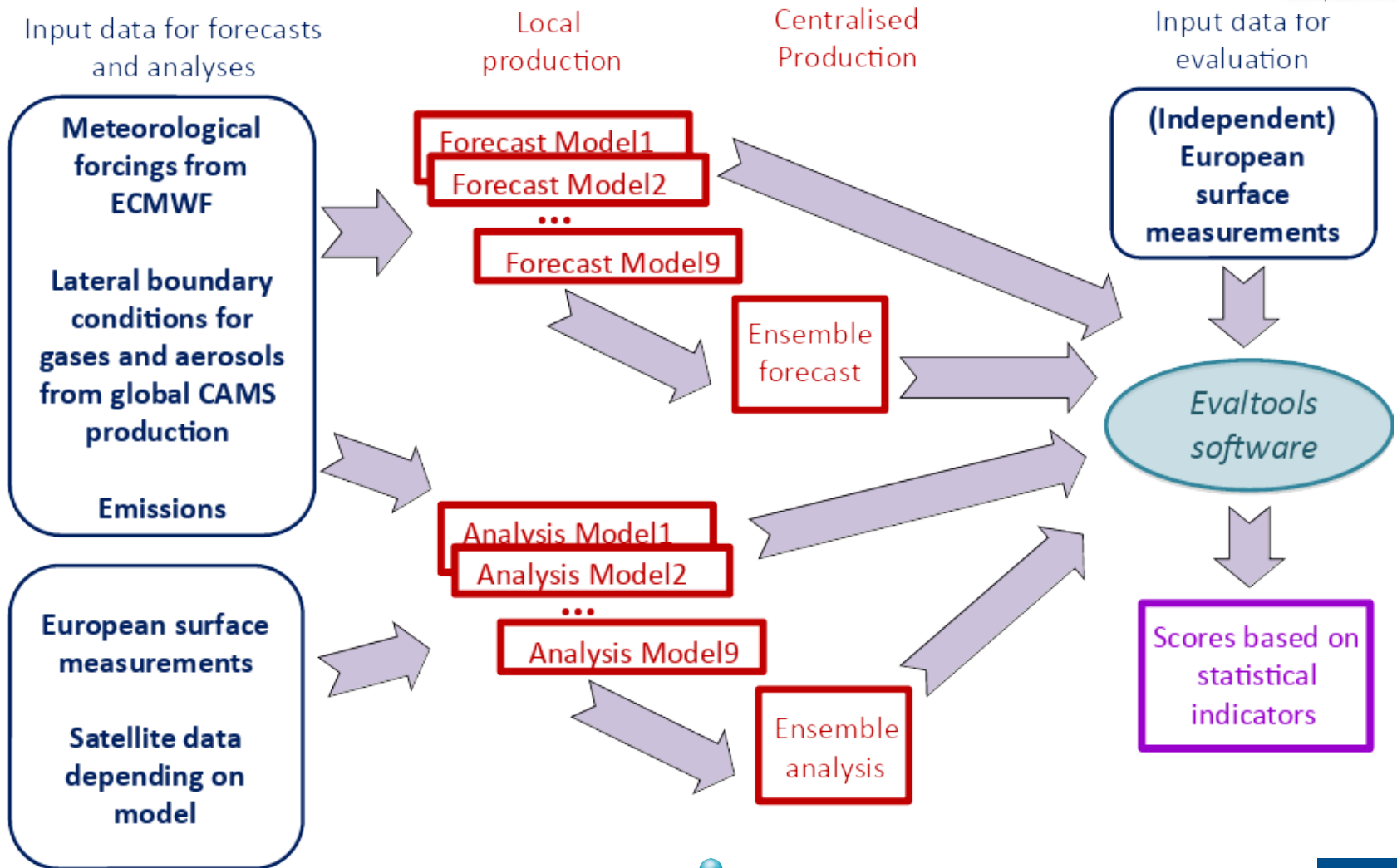
# General objective



- 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
- Test the SEEDS products as if they were delivered operationally



# General design of the CAMS regional production



# Configuration used to test products



## Current MOCAGE setup for CAMS2-40 (U7) (At project beginning)

- Forecasts/analyses from ECMWF + forecasts/analyses chemical BC
- MOCAGE forecast initialized from an assimilation cycle (satellite obs)
- MOCAGE cycle mo11 used
- Regional Emissions from CAMS-REG-APv5.1 (2018) + MEGAN for Isoprene
- Global domain : Arpege 1x1° + CAMS-GLOB-ANT/CAMS-GLOB-BIO/CAMS-GLOB-OCE (2020)

## Selected MOCAGE setup for SEEDS (U0)

- Forecasts/analyses from ECMWF + forecasts/analyses chemical BC
- MOCAGE forecast initialized from day before forecast
- MOCAGE cycle mo11 used (cycle mo07 in 2019)
- Regional Emissions from CAMS-REG-APv2.2 (2015) + MEGAN for Isoprene
- Global domain : Arpege 1x1° + MACCity (2016)/RCP60 (2016)/MEGAN-MACC (2010)
  - **MOCAGE o-suite in 2019** (except for source code)



# General overview of simulations for NO<sub>x</sub> emission products

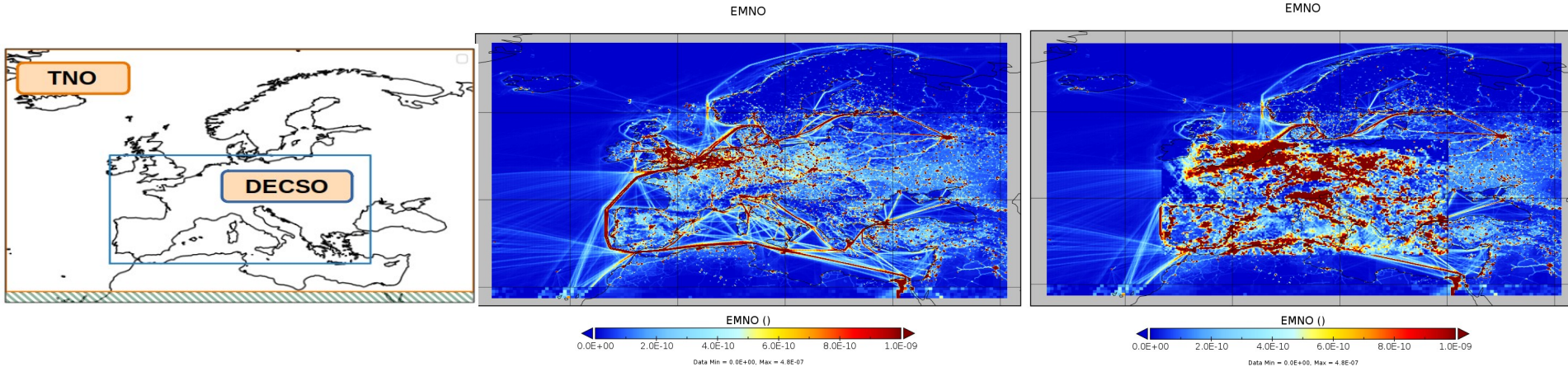
Product to test	MOCAGE simulation mode
Reference run	Hindcast (24h)
	Analysis (24h)
Biogenic NO <sub>x</sub> emissions	Analysis (24h)
	Hindcast (24h)
Anthropogenic NO <sub>x</sub> emissions	Analysis (24h)
	Hindcast (24h)
Anthropogenic + Biogenic NO <sub>x</sub> emissions	Analysis (24h)
	Hindcast (24h)

# NO<sub>x</sub> Emissions products

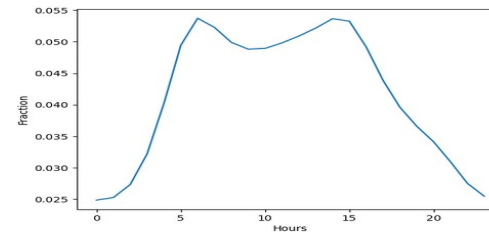
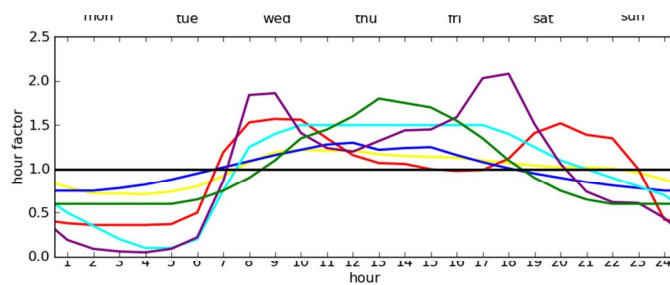
Some limiting factors : Size/resolution of DECSO, disruption at boundaries

TNO 0,1°

TNO 0,1°+ DECSO 0,2°



=> Issue with daily profiles



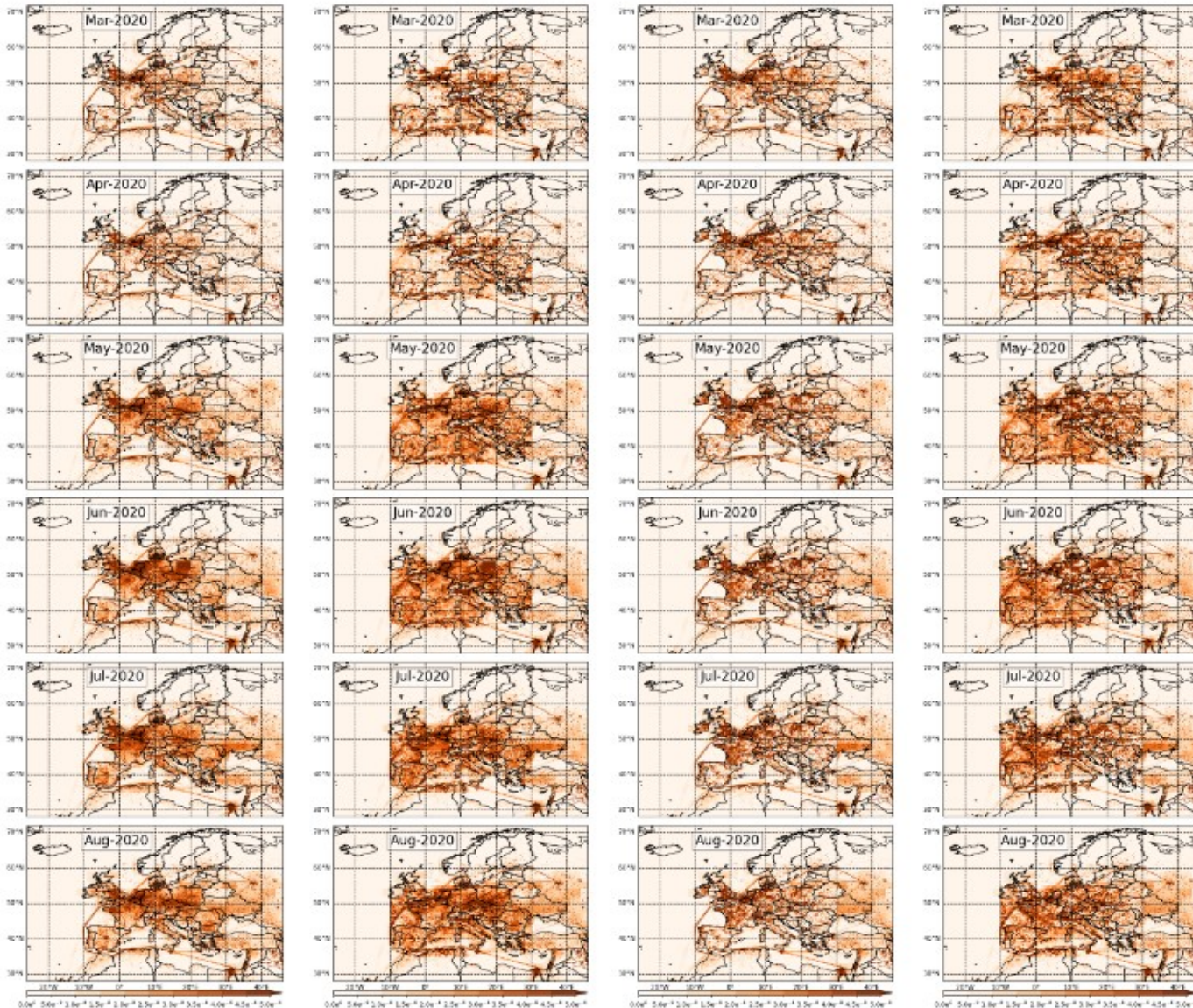
# NO<sub>x</sub> emissions comparisons

REF

NO<sub>x</sub> Anth

NO<sub>x</sub> Bio

NO<sub>x</sub> All



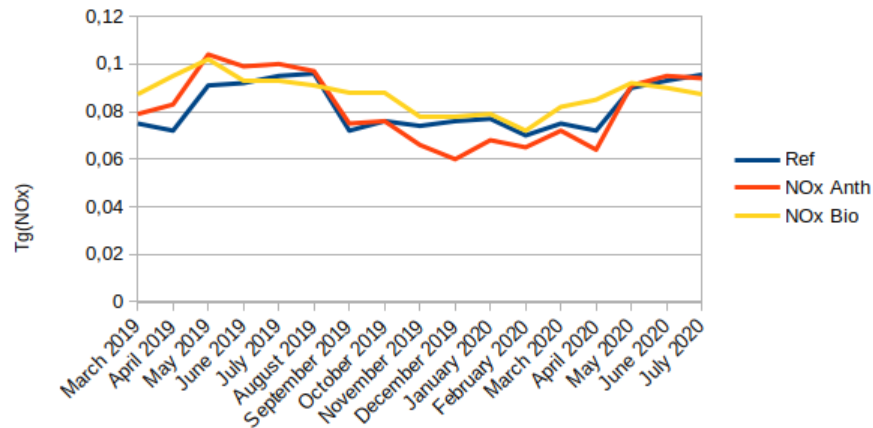


# NO<sub>x</sub> emissions comparisons

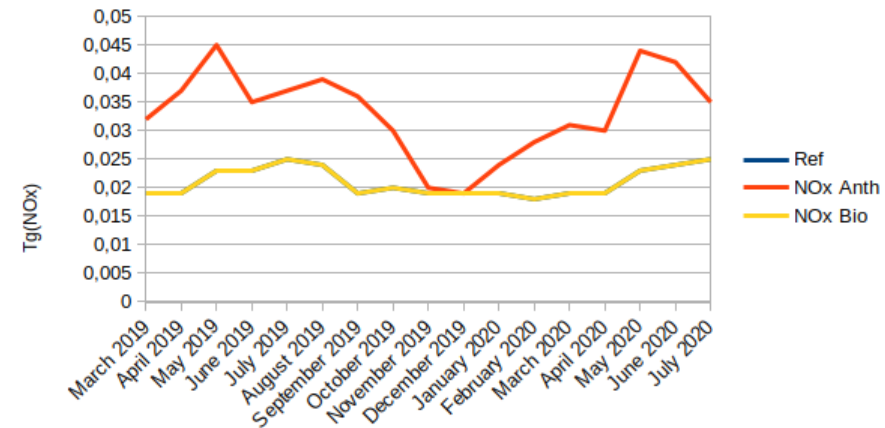
NO<sub>x</sub> emissions over DECSO domain



NO<sub>x</sub> emissions over Land



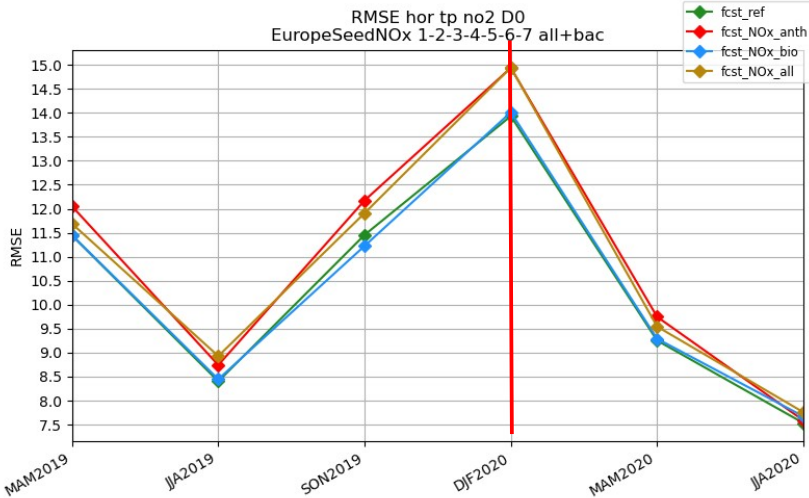
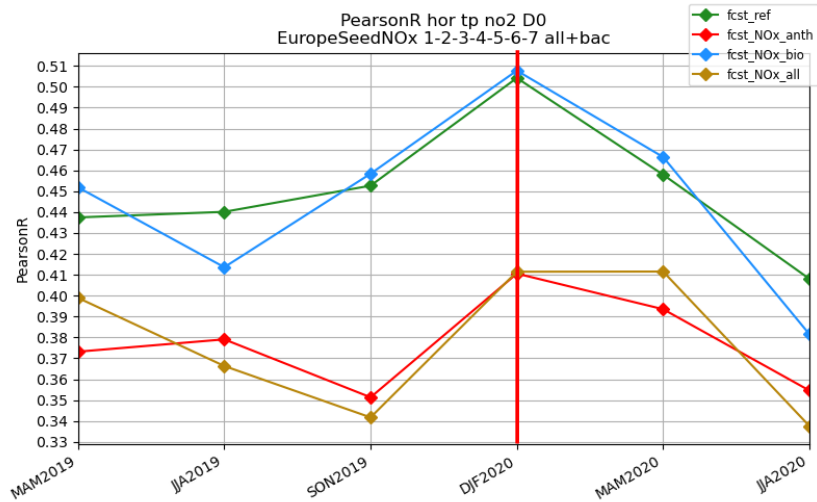
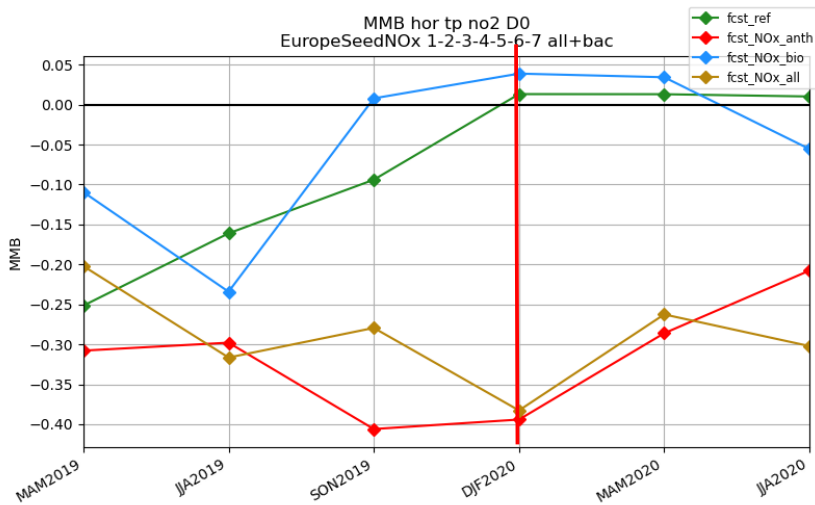
NO<sub>x</sub> emissions over Sea



No clear COVID lockdown effect?



# NO<sub>x</sub> emissions - Impact on NO<sub>2</sub>



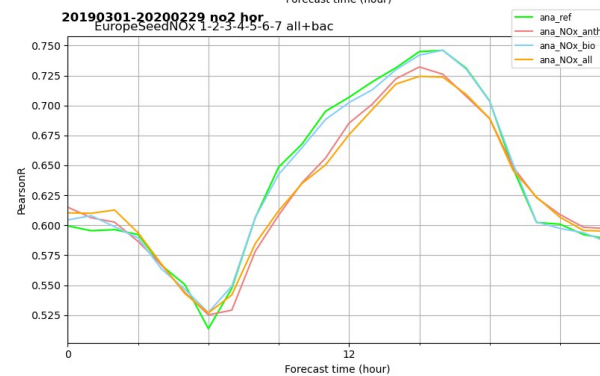
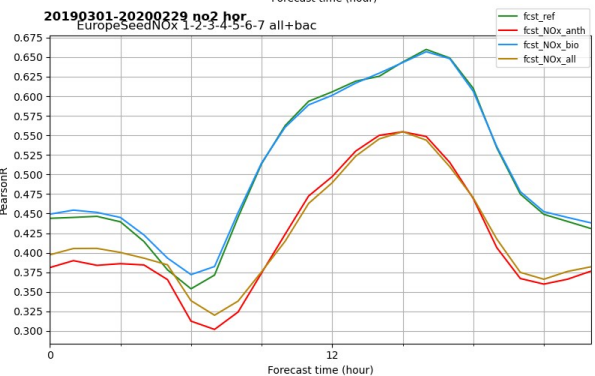
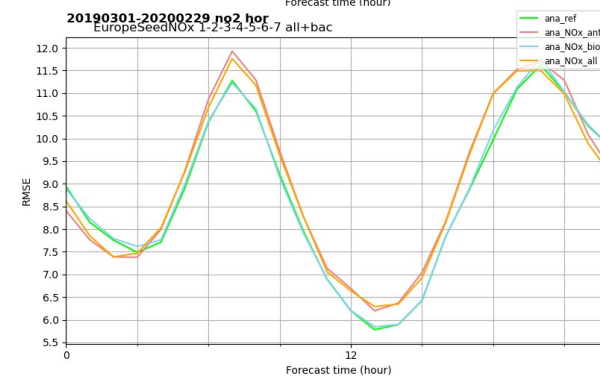
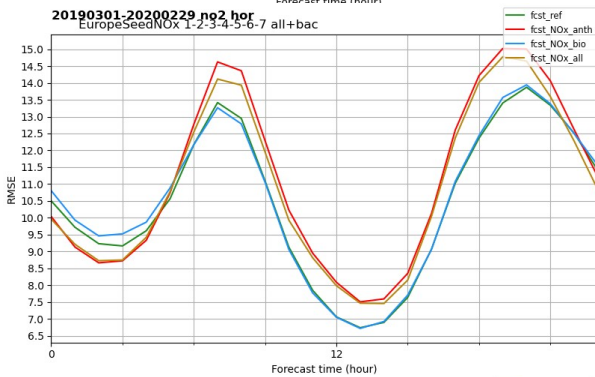
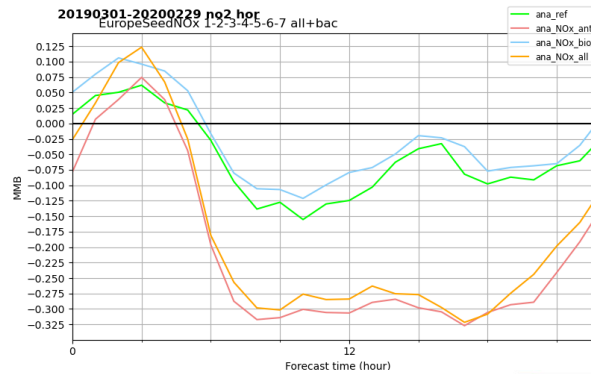
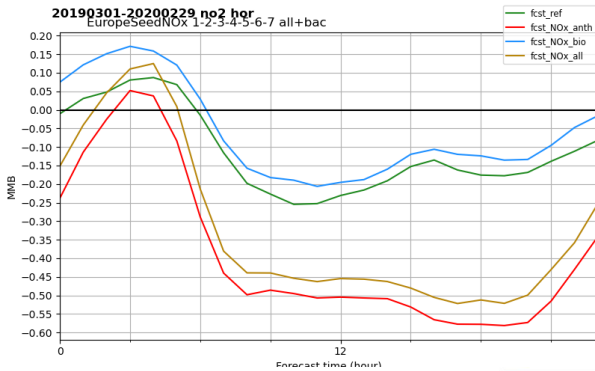
# NO<sub>x</sub> emissions - Impact on Pre-Covid NO<sub>2</sub>

Hindcast

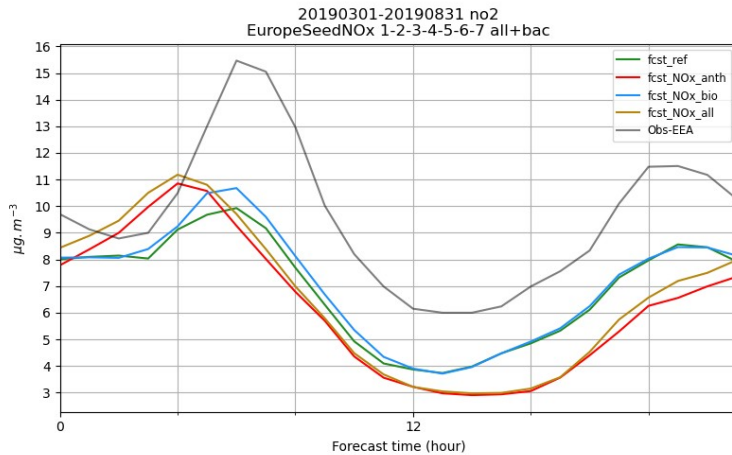
Analysis

Same behaviour in hindcast and analysis  
=> only focus on hindcast

NO<sub>x</sub> Anth seems performing less well

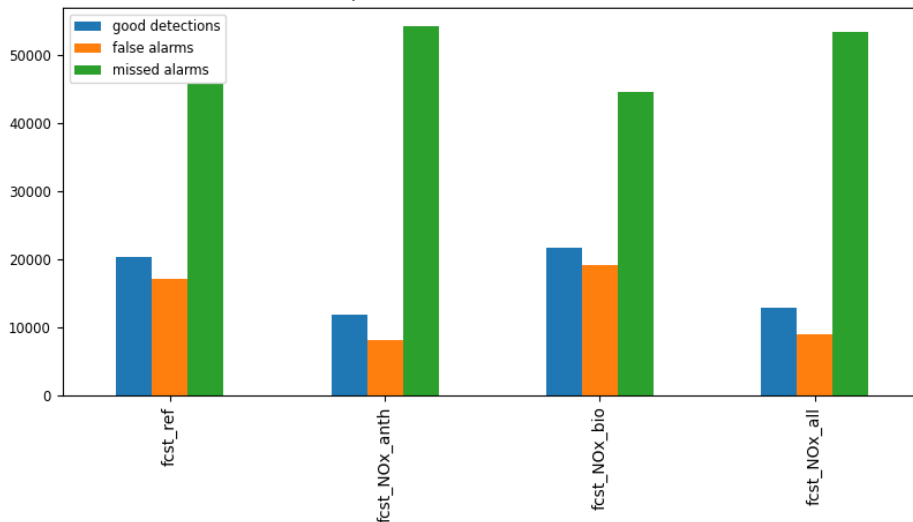


# NO<sub>x</sub> emissions - Impact on Pre-Covid NO<sub>2</sub>



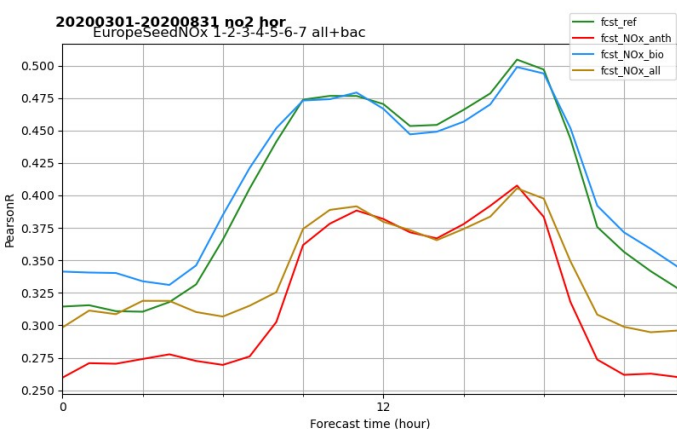
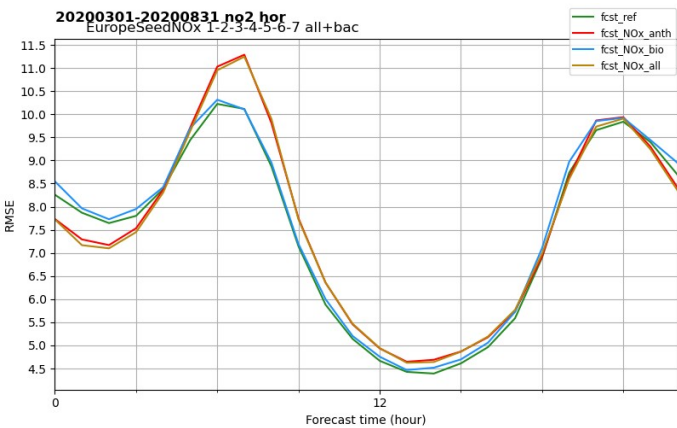
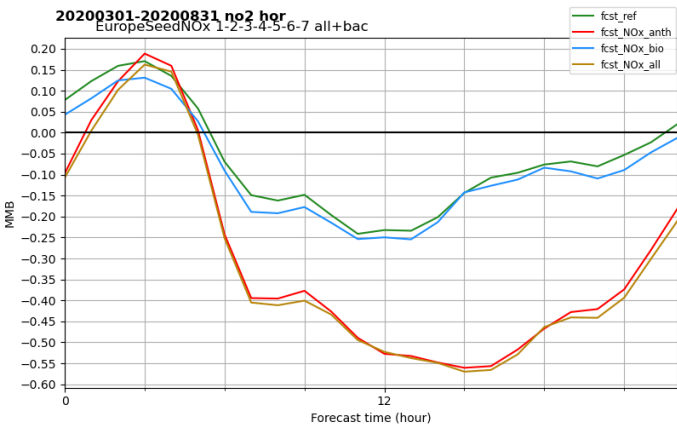
Shift in diurnal cycle => daily profile issue

20190301-20200229 D0 no2 max >40.0 $\mu\text{g}\cdot\text{m}^{-3}$   
EuropeSeedNOx 1-2-3-4-5-6-7 all+bac

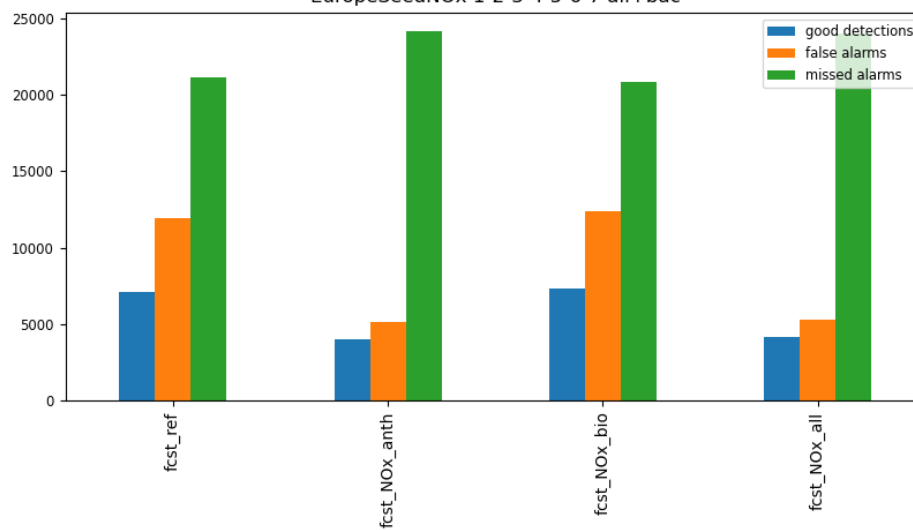


Slight better detections with NO<sub>x</sub> bio

# NO<sub>x</sub> emissions - Impact on Covid NO<sub>2</sub>



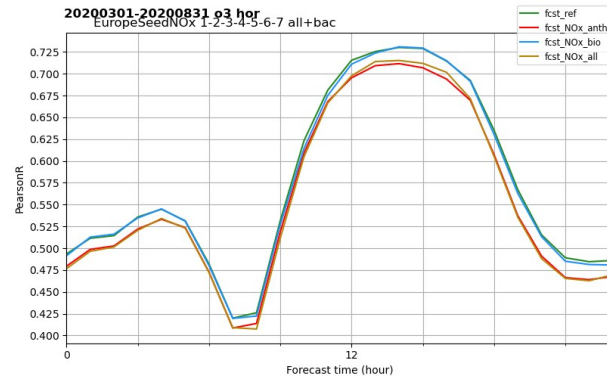
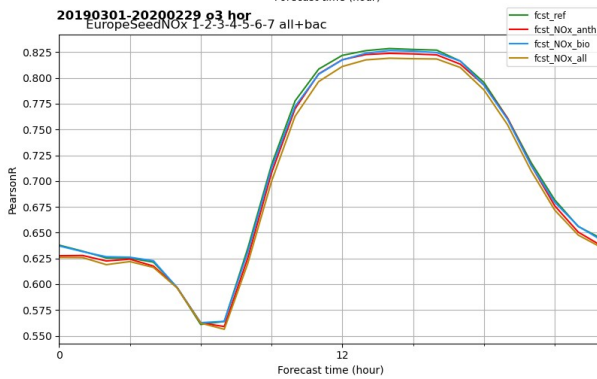
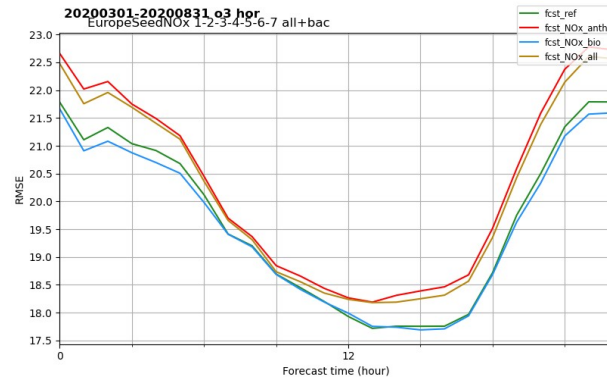
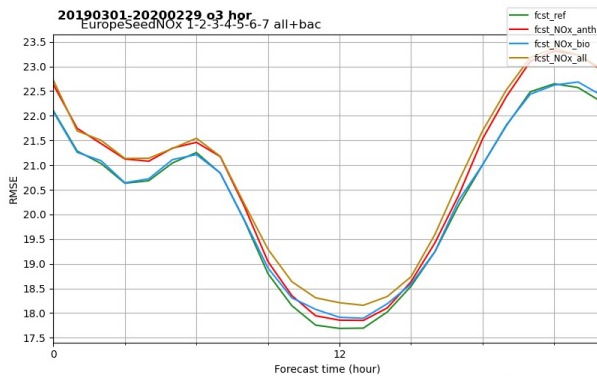
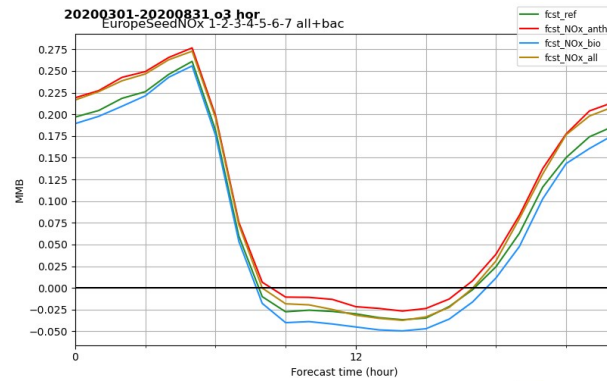
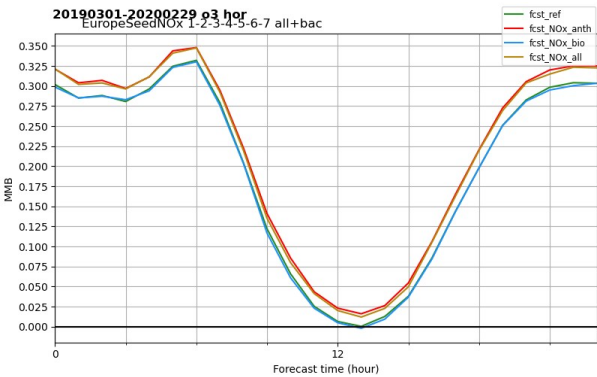
20200301-20200831 D0 no2 max >40.0µg.m<sup>-3</sup>  
EuropeSeedNOx 1-2-3-4-5-6-7 all+bac



# NO<sub>x</sub> emissions - Impact on O<sub>3</sub>

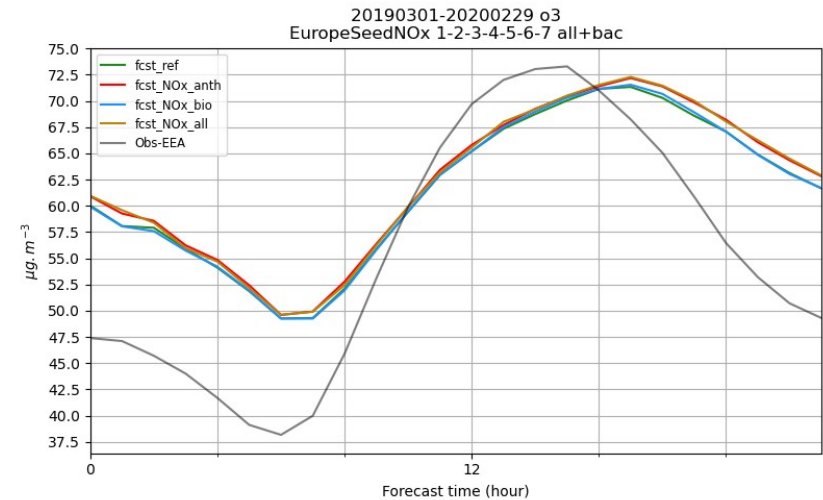
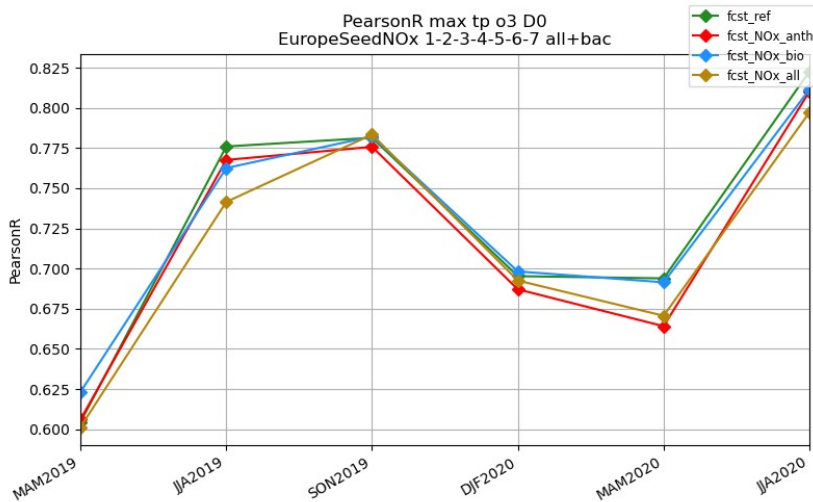
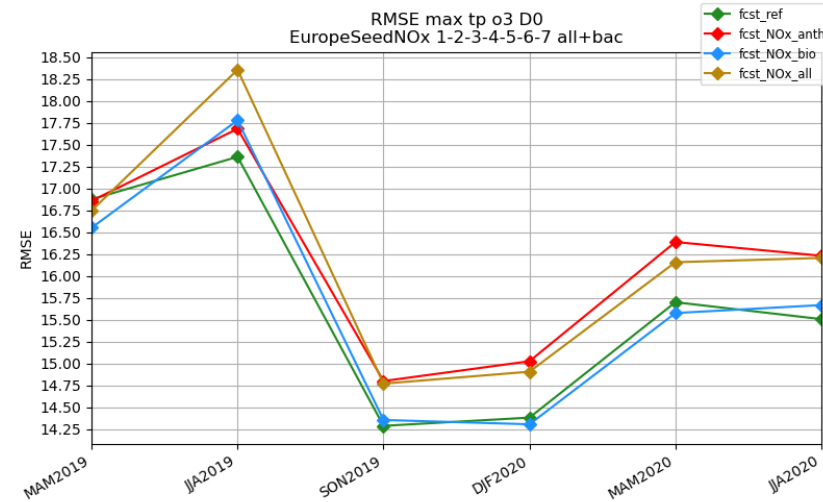
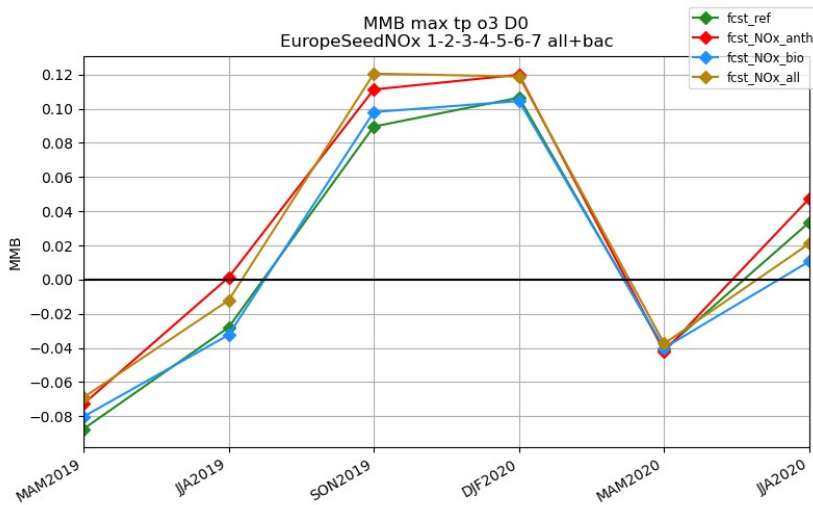
Pre-covid

Covid

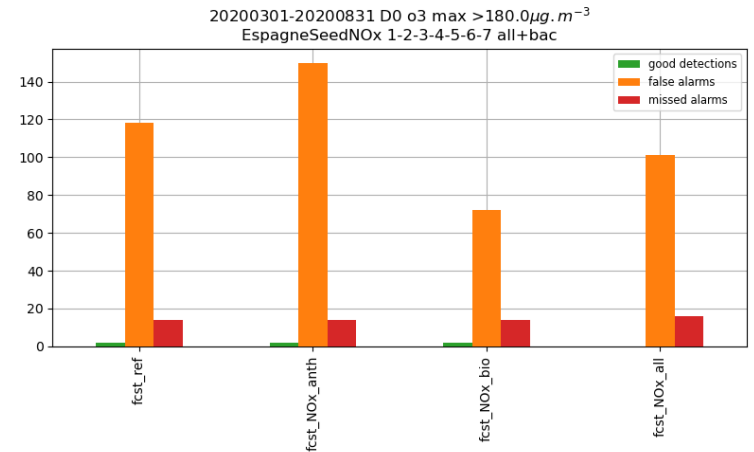
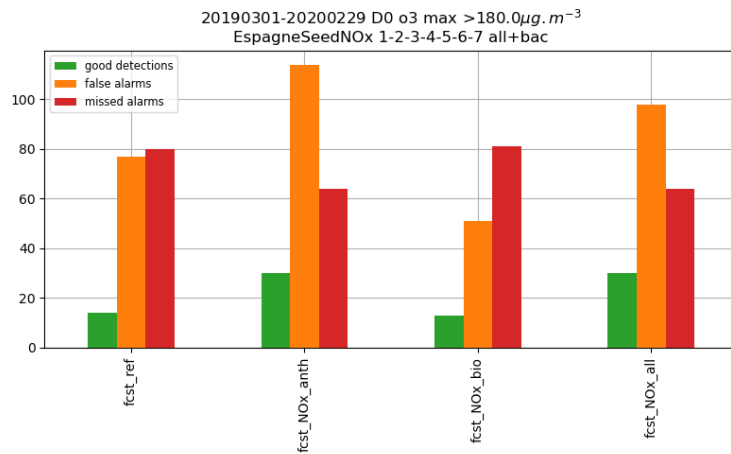
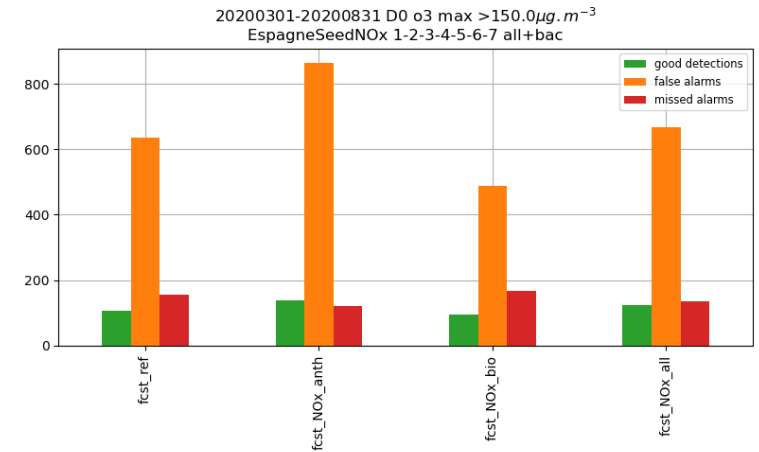
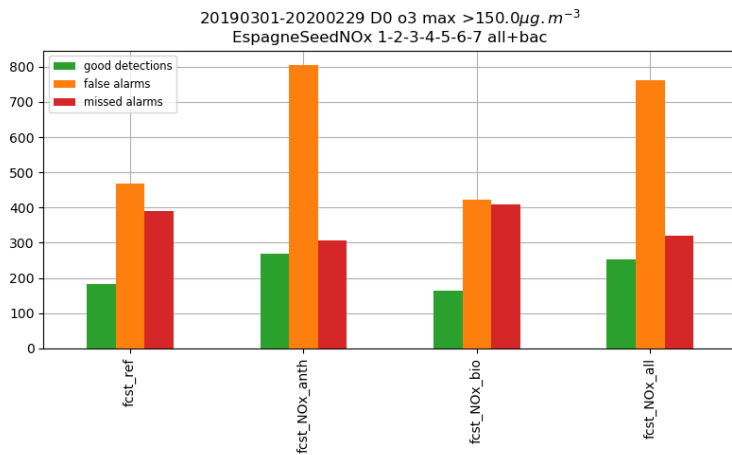


Limited impact on O<sub>3</sub> scores

# NO<sub>x</sub> emissions - Impact on O<sub>3</sub>



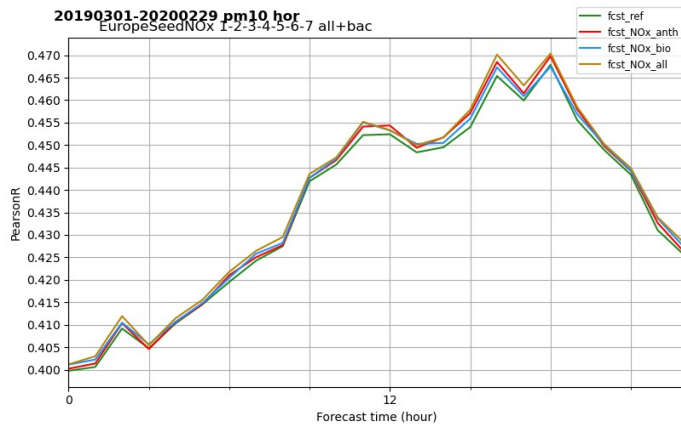
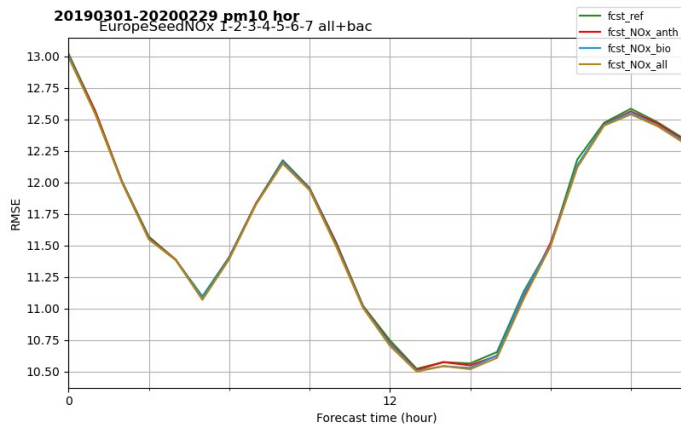
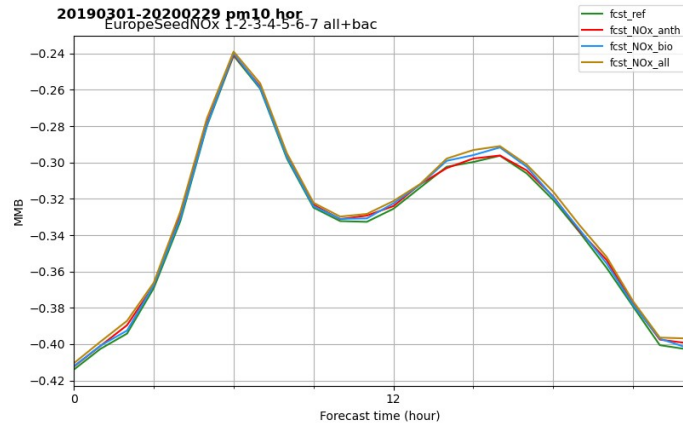
# NO<sub>x</sub> emissions - Impact on O<sub>3</sub>



Slightly better pic detection, but increasing false alarms



# NO<sub>x</sub> emissions - Impact on PM10

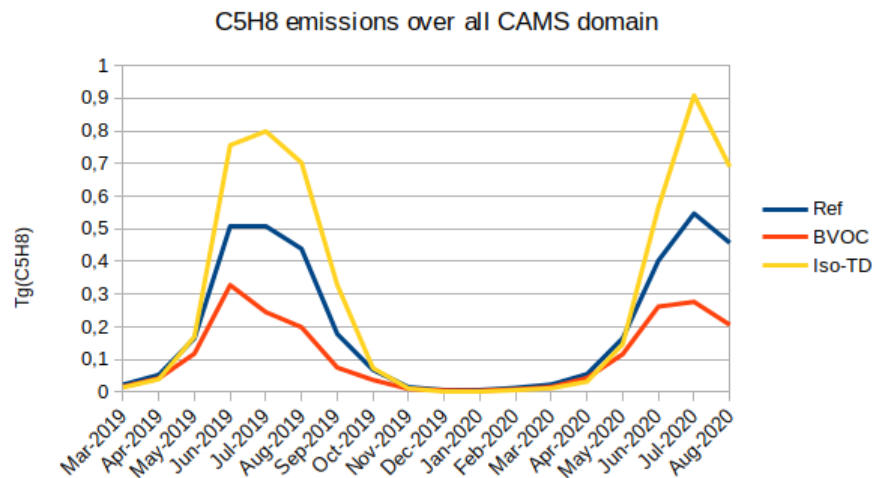


Negligible impact on PM scores

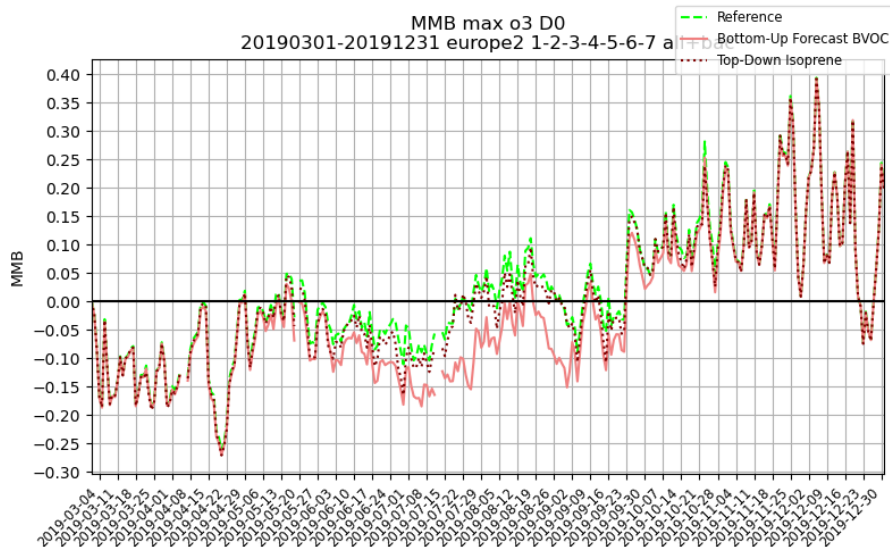
# BVOC emissions

Product to test	MOCAGE simulation mode
Reference run	Analysis (24h)
	Forecast (96h)
Biogenic Isoprene emissions for satellite retrieval	Analysis (24h)
	Hindcast (24h)
Biogenic VOCs emissions from SURFEX (Open-loop)	Analysis (24h)
	Forecast (96h)
Biogenic VOCs emissions from SURFEX (EKF)	Analysis (24h)
	Forecast (96h)

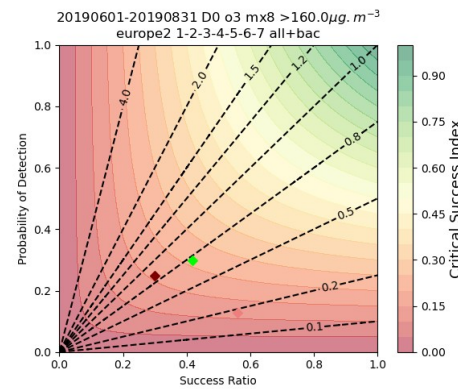
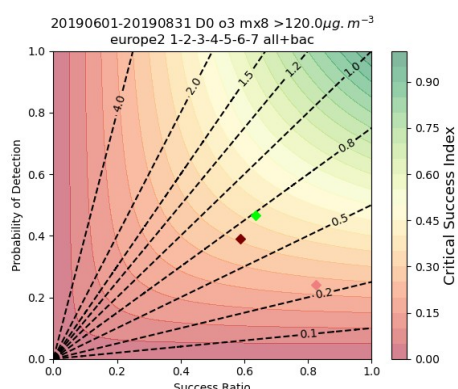
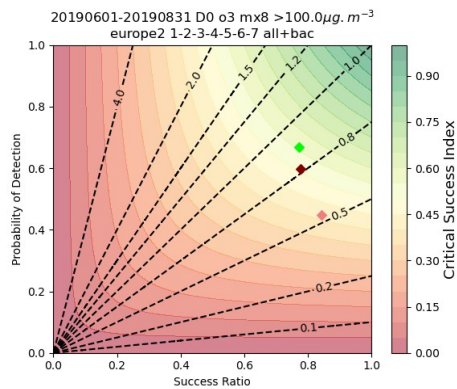
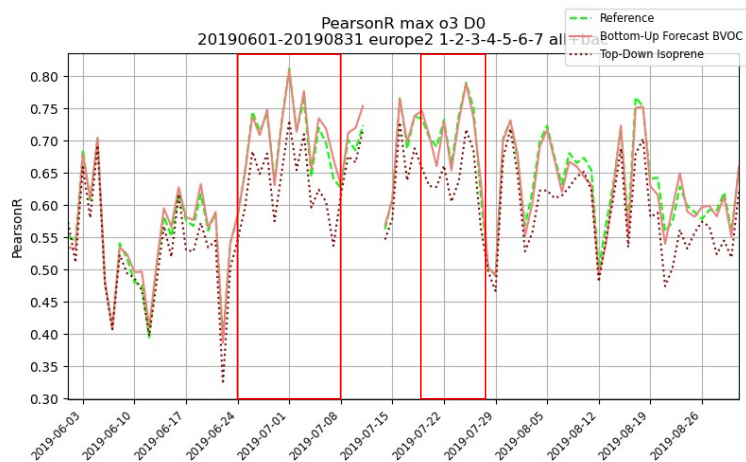
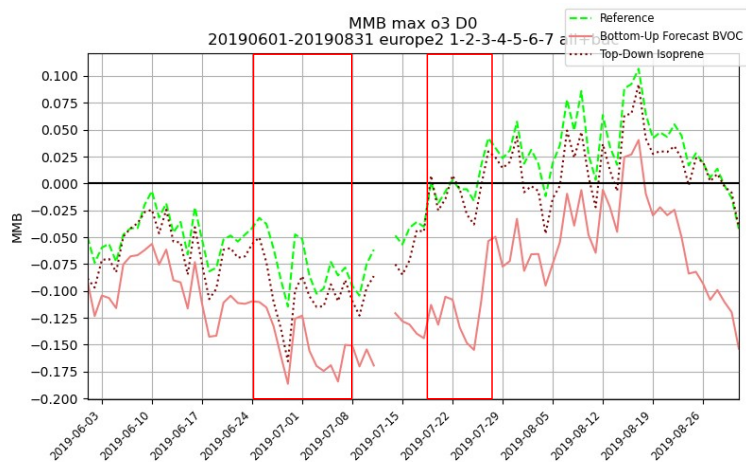
# BVOC emissions - Impact on O<sub>3</sub>



Summer 2019 and 2020 similar  
=> only focus on 2019

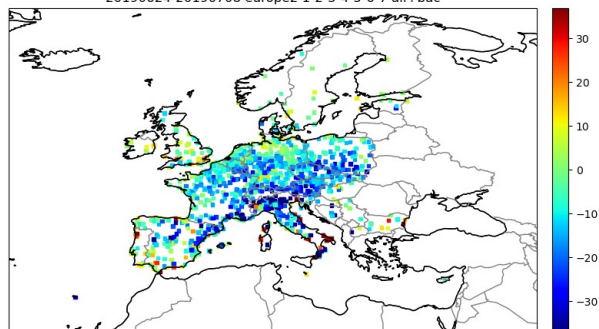


# BVOC emissions - Impact on O<sub>3</sub>



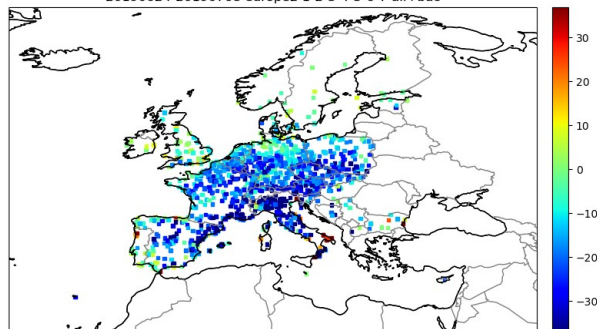
# BVOC emissions - Impact on O<sub>3</sub>

Bias max o3 Reference D0  
20190624-20190708 europe2 1-2-3-4-5-6-7 all+bac



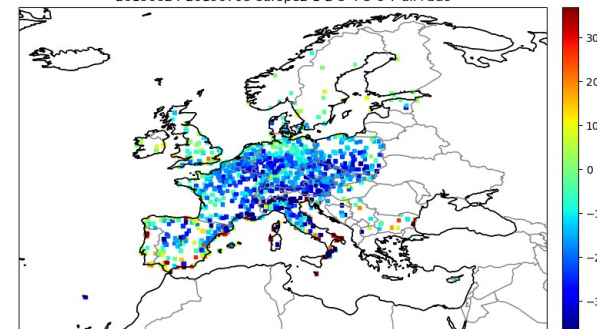
1234 processed stations over 1270  
min: -84.1, avg: -9.16, max: 74.1

Bias max o3 Bottom-Up Forecast BVOC D0  
20190624-20190708 europe2 1-2-3-4-5-6-7 all+bac



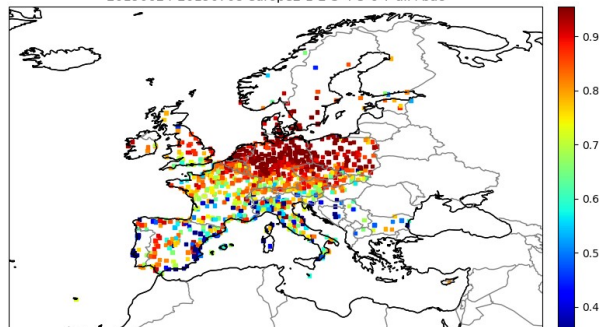
1234 processed stations over 1270  
min: -88.56, avg: -17.69, max: 62.65

Bias max o3 Top-Down Isoprene D0  
20190624-20190708 europe2 1-2-3-4-5-6-7 all+bac



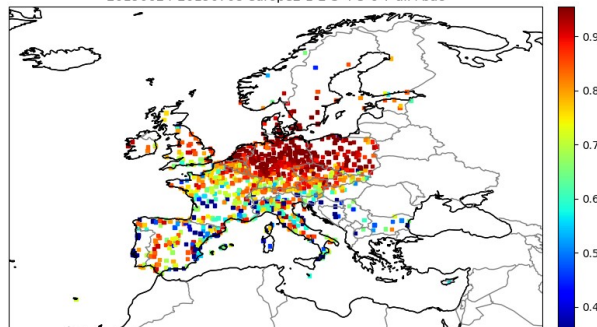
1234 processed stations over 1270  
min: -83.75, avg: -12.13, max: 86.72

PearsonR max o3 Reference D0  
20190624-20190708 europe2 1-2-3-4-5-6-7 all+bac



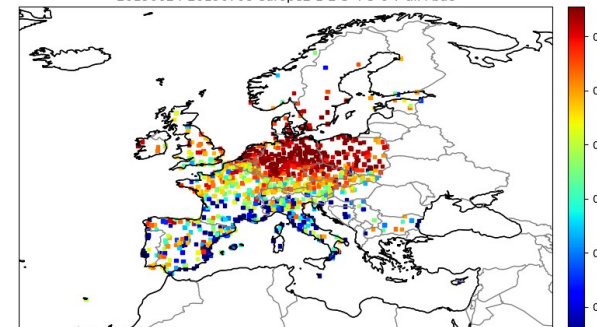
1234 processed stations over 1270  
min: -0.39, avg: 0.75, max: 0.99

PearsonR max o3 Bottom-Up Forecast BVOC D0  
20190624-20190708 europe2 1-2-3-4-5-6-7 all+bac



1234 processed stations over 1270  
min: -0.38, avg: 0.75, max: 0.99

PearsonR max o3 Top-Down Isoprene D0  
20190624-20190708 europe2 1-2-3-4-5-6-7 all+bac



1234 processed stations over 1270  
min: -0.49, avg: 0.7, max: 0.99

# Conclusions and perspectives

Analyses runs not usefull

For NO<sub>x</sub> products

- Pretty good NO<sub>2</sub> scores with biogenic NO<sub>x</sub>
- Issues with Anthopogenic NO<sub>x</sub>
  - related to size of domain/resolution/diurnal profile
- But slightly better threshold detection
  - For NO<sub>2</sub> with Biogenic NO<sub>x</sub>
  - For O<sub>3</sub> with Anthropogenic No<sub>x</sub>

For BVOC products

- Good performance for TD emissions
- Good overall performance for BVOC forecast but issues during summer

Test NO<sub>x</sub> retrieval on a larger domain with higher resolution  
Review BVOC emissions with updated emissions factors