Ozone modelling: state of the art and key issues for sensitivity analysis

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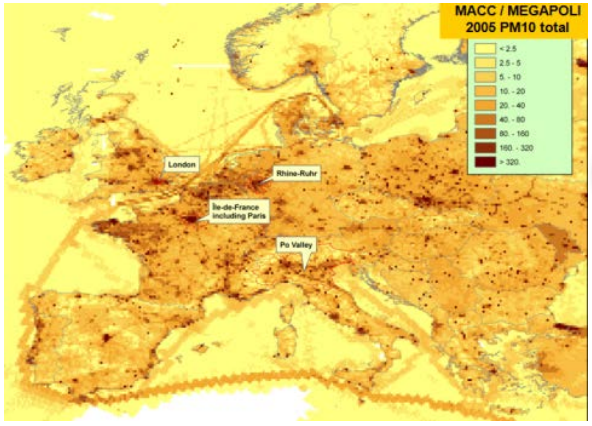
Ozone modelling : what for ?

1. Forecasting concentrations and episodes in a short term perspective
   - Information of the general public and sensitive population
   - The model must predict exceedances of the information/alert thresholds

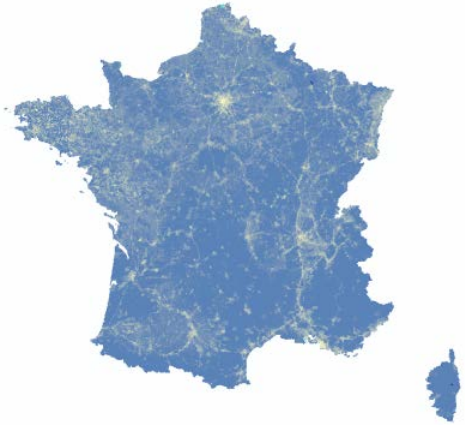
2. Simulating the impact of emission reduction strategies
   - Information for decision makers regarding the efficiency of control strategies
   - The model must simulate future ozone levels, changes in chemical regimes, actual influence of biogenic VOCs…

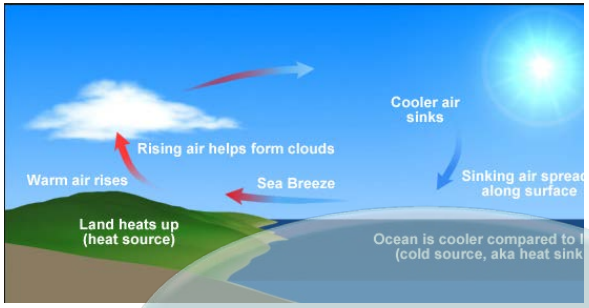
3. Understanding the chemical and dynamical processes
   - Sensitivity analysis on chemical schemes parameters, emissions
   - Understanding the episodes

Ozone modelling challenges



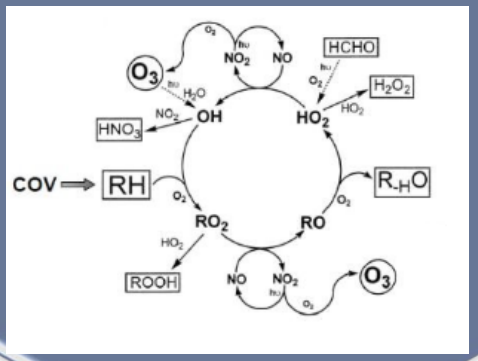
Emissions



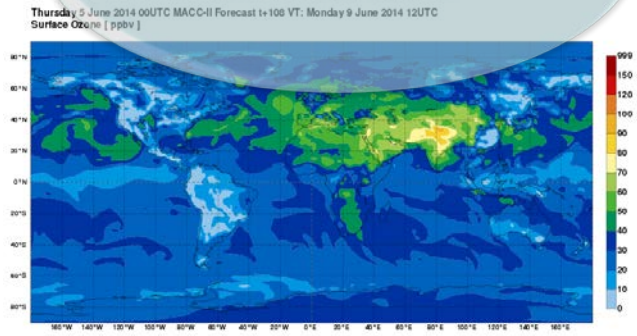


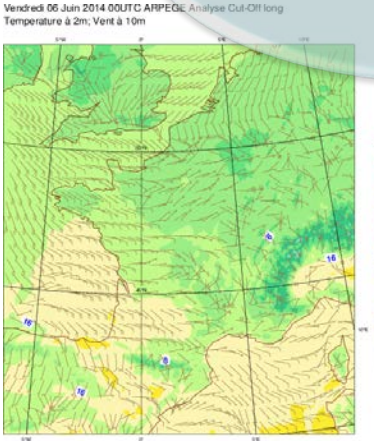
Meteorology

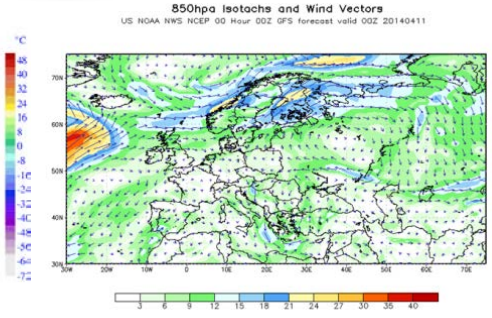
CTM

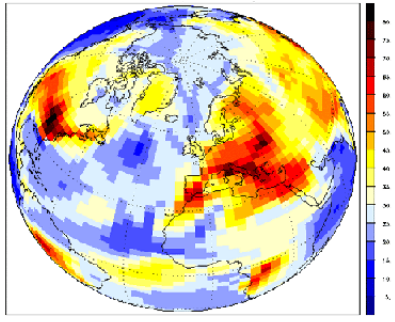


Boundary conditions









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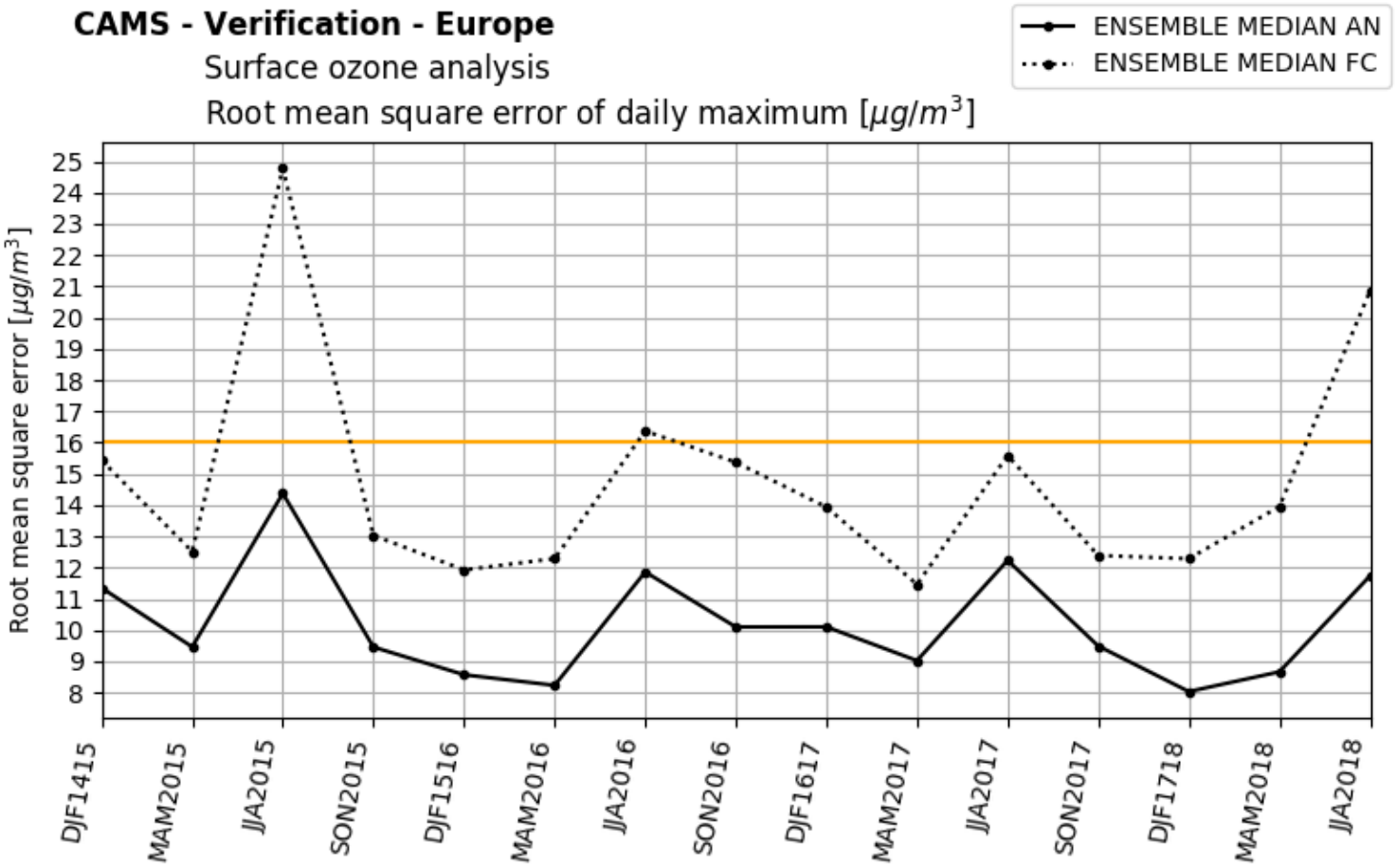
Forecasting systems evaluation (i)

- The Copernicus Atmosphere services (CAMS) from the European Commission provide every day air quality forecasts issued from 7 regional Chemistry Transport models



- Good convergence of the models year by year
- Still some difficulties in the summer periods (peaks)
- Assimilation of observations in analyses

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Forecasting systems evaluation (ii)

RMSE accross Europe

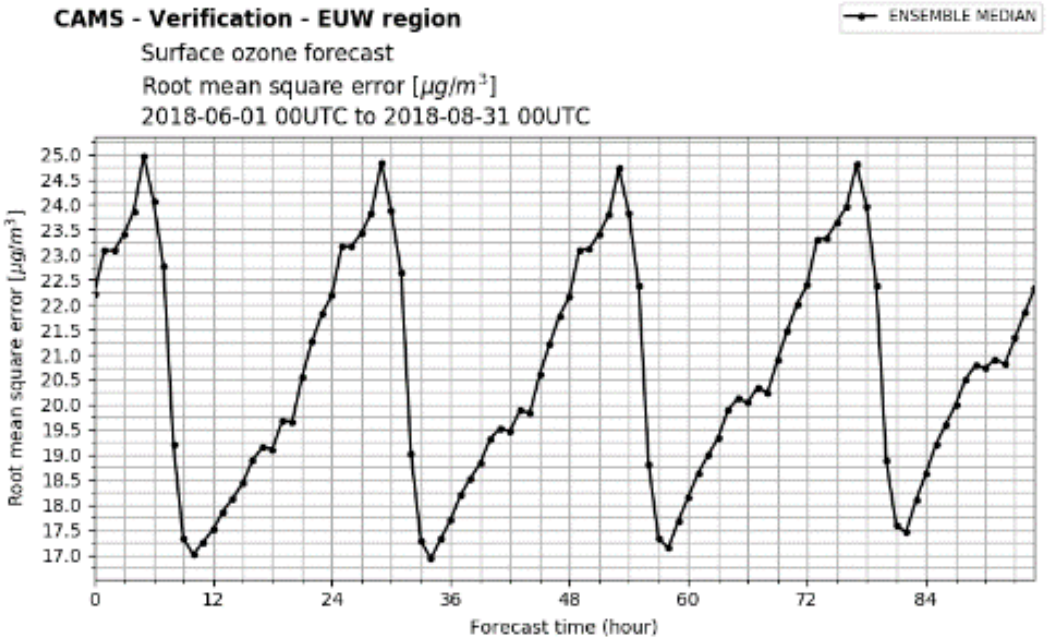
- Daily cycle
- Minimum at noon
- Scale differs from a region to another

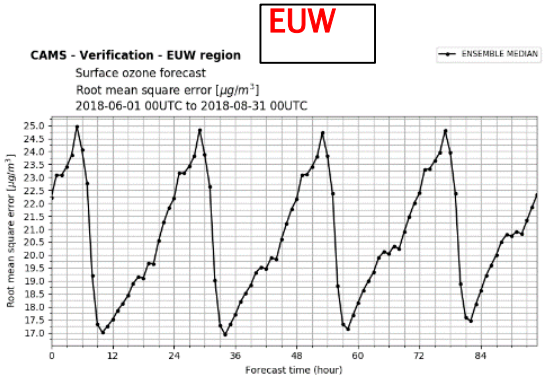
South

- High RMSE in the morning
- Improve by noon and remain good during the night

North/Central/East/West

- Gradual decrease of performance in the afternoon





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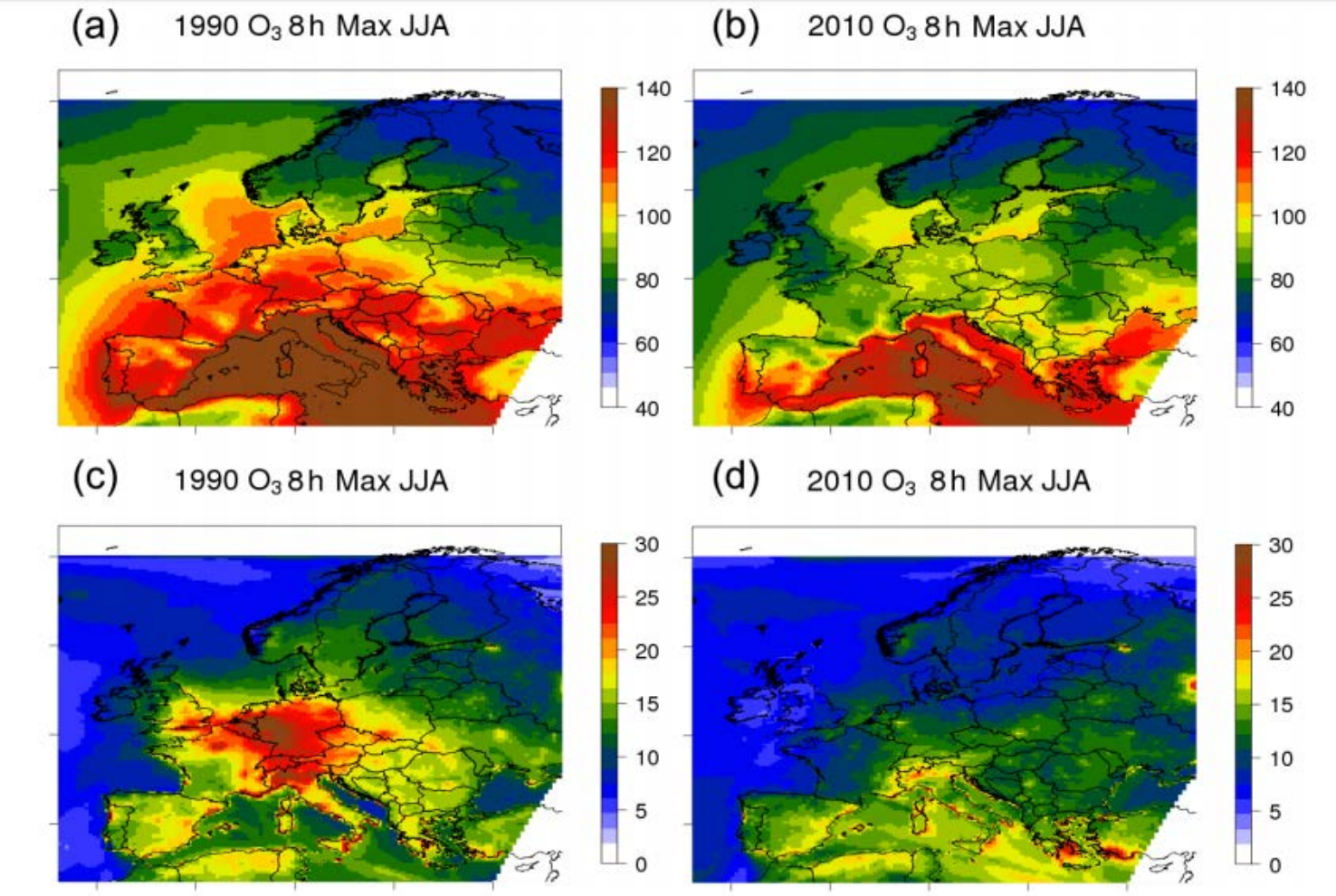
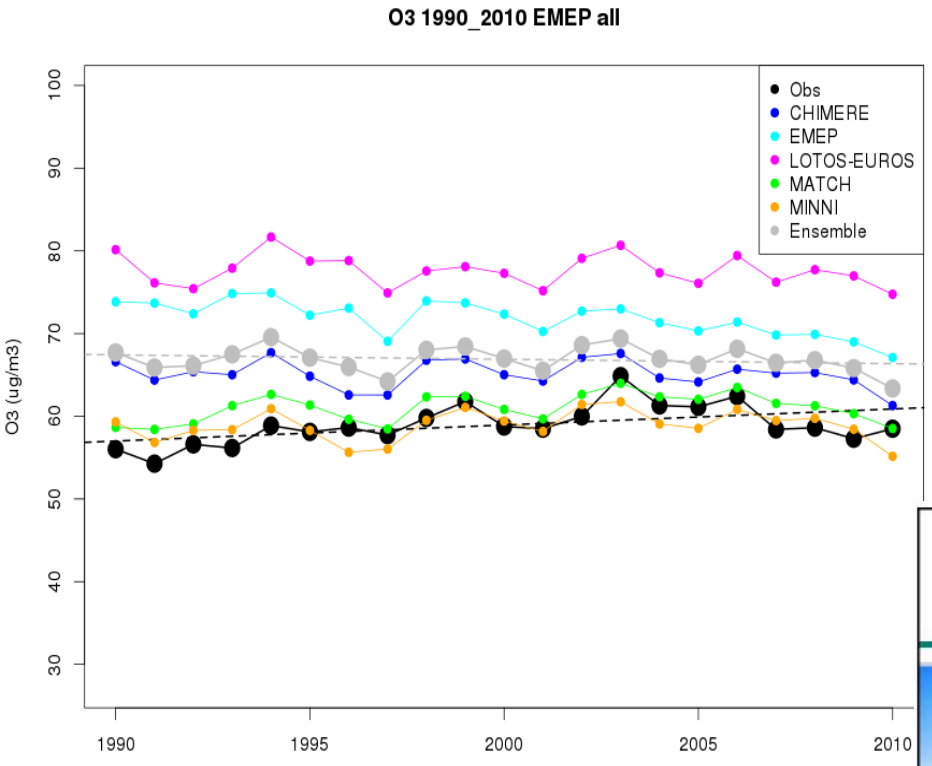
Fitness for policy purposes (i)

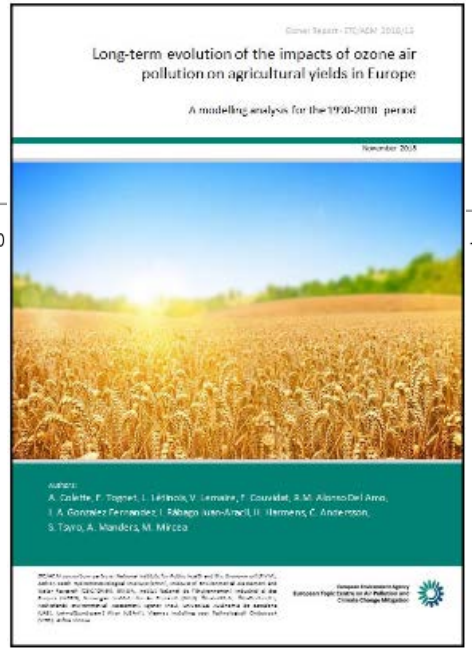
- The models must reproduce correctly the impact of changes emissions : spatial variability, chemical regimes, influence of long range transport
- Overall agreement between the different tools competing in Europe but peak/summer situations remain challenging
- See Eurodelta Experiment (8 models) Colette et al, 2017

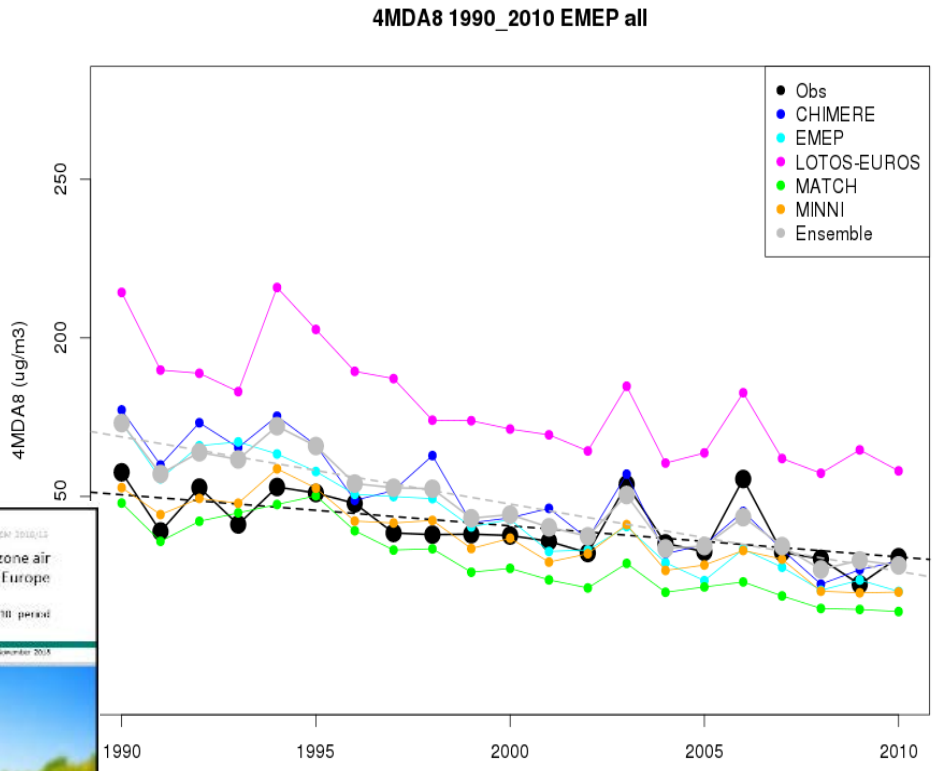


Fitness for policy purposes (ii)



Annual average





Average of summer daily maximum

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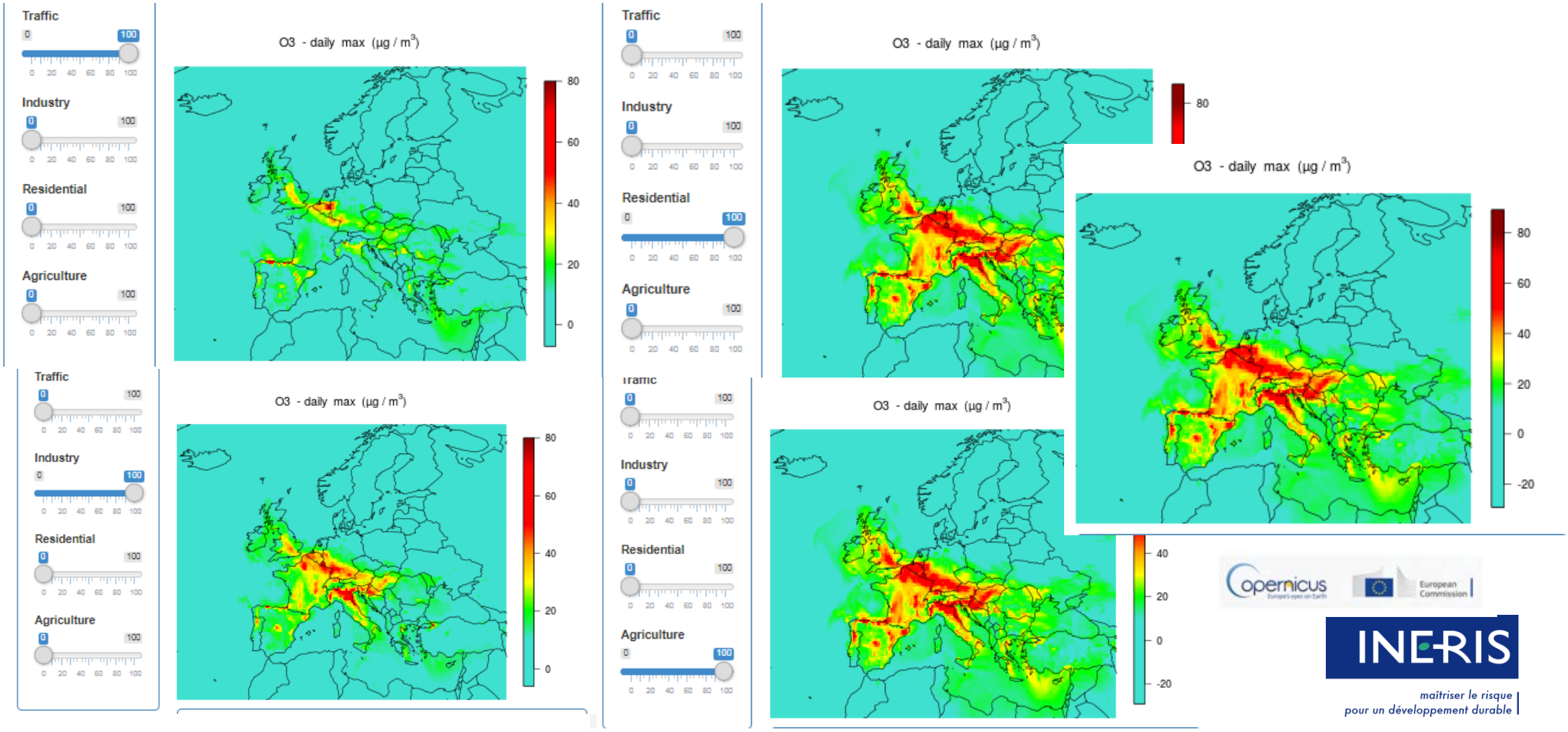
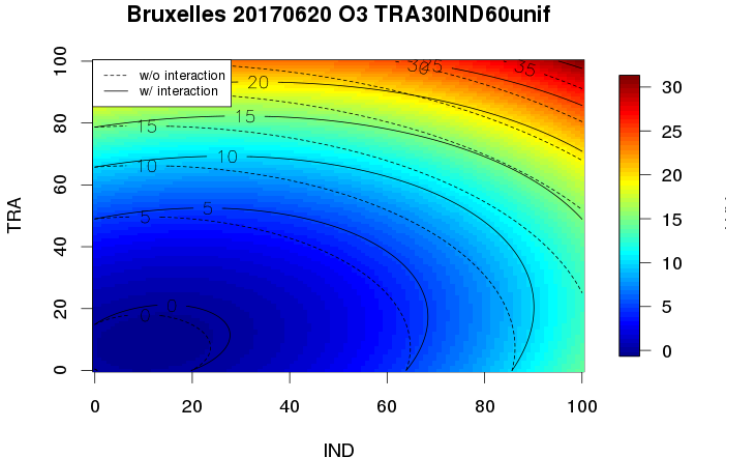
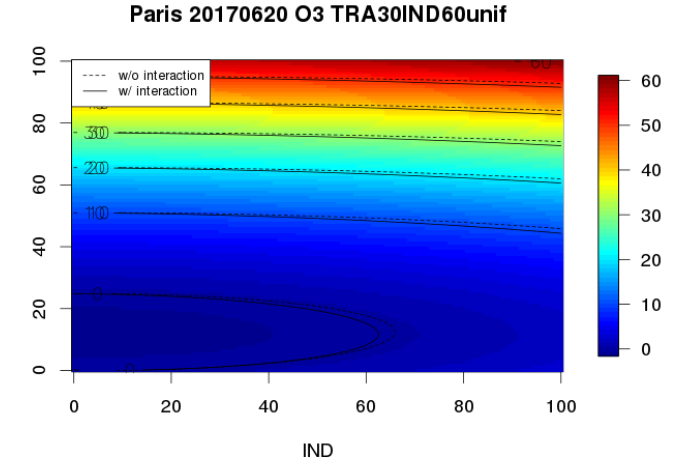
Fitness for policy purposes (iii)

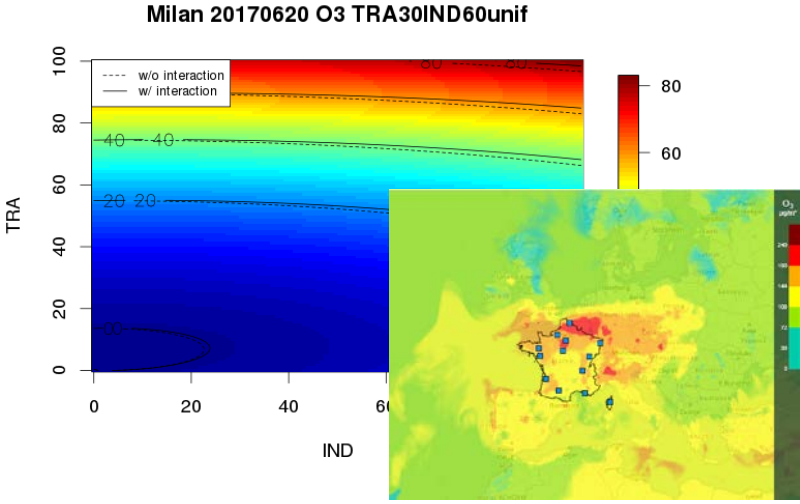
- A new generation of tools can help in understanding ozone issues, especially in episode situation: the Copernicus CAMS-ACT tool http://policy.atmosphere.copernicus.eu/CAMS_ACT.html

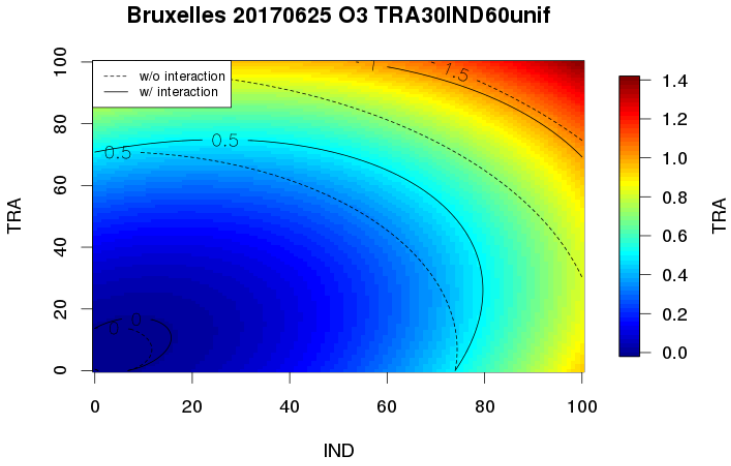


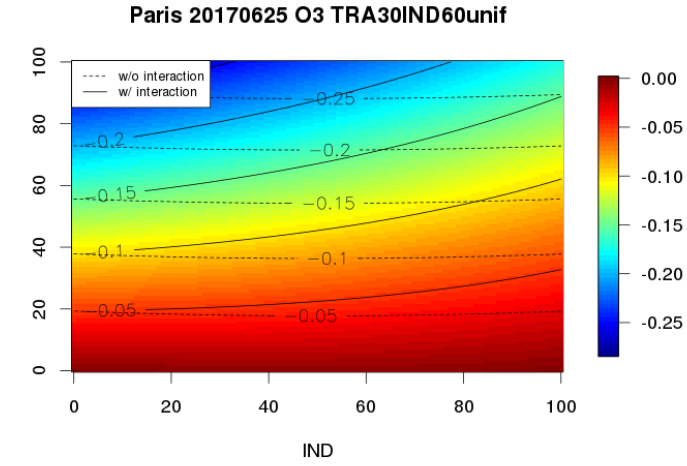
Understanding the chemical regimes in the cities

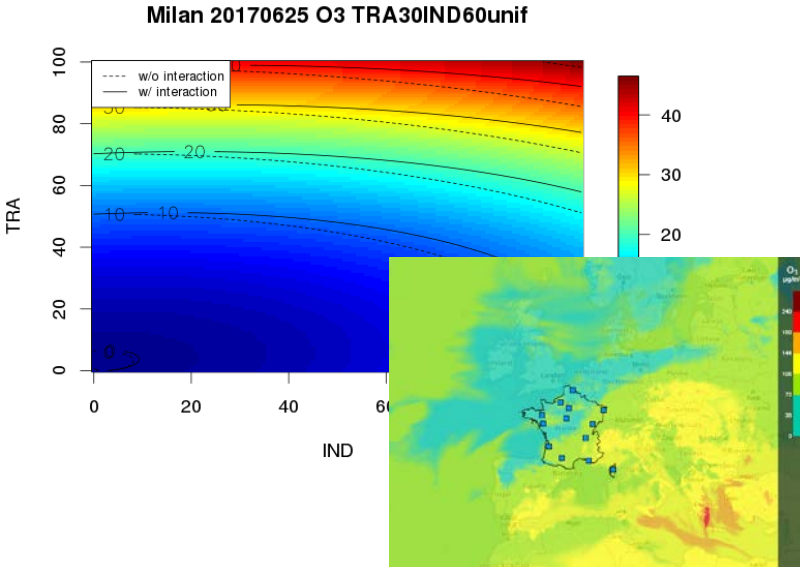












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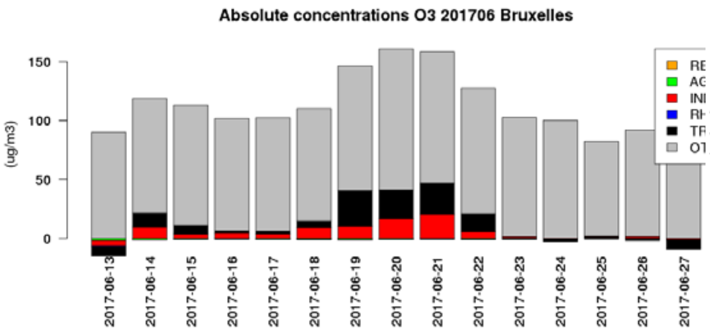
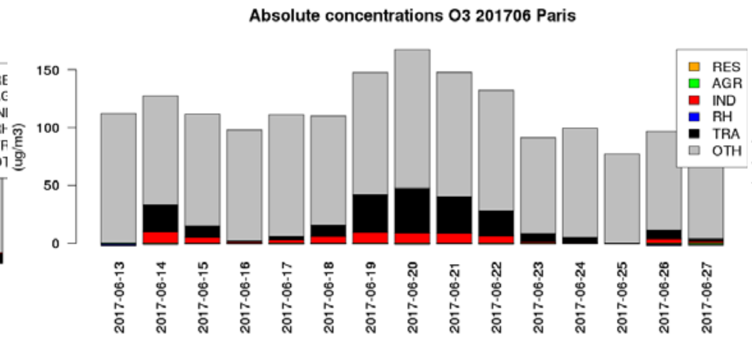
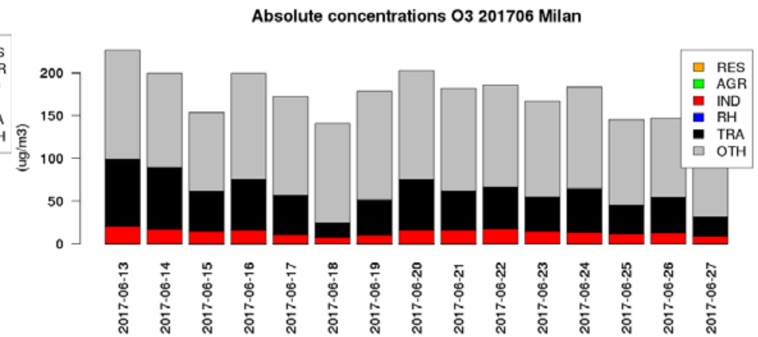
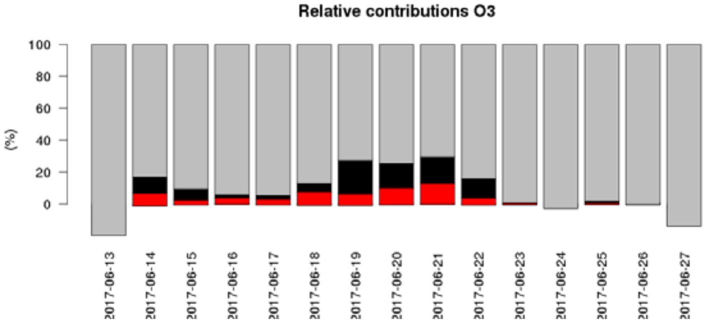
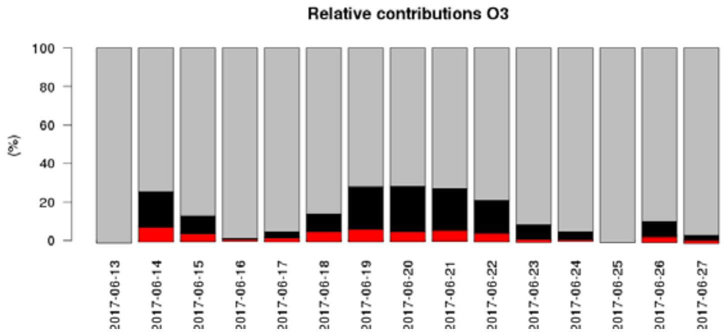
Understanding the drinving factors in episodes

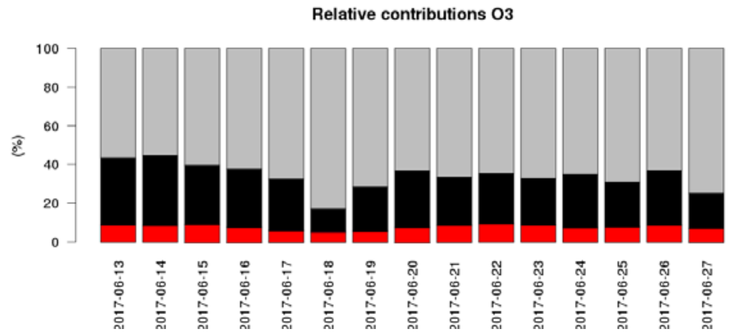












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Conclusions

- Numerical models are considered for a quite long time as mature enough to support policy decision
- But simulating episodes and the impact of multi-driving factors remain a bit challenging
- Investigating models responses to local and regional emission changes in urban areas is still necessary to be sure that models catch correctly :
  - the chemical regimes
  - The influence of long range transport
- Modelling pilot studies for the European teams ?
  - Simulate the year 2018 with 2003 emissions
  - Simulate the year 2003 with 2018 emissions
  - Sensitivity to emission reduction scenarios
  - Investigate the role of natural VOCs and vegetation
  - …
  - Define appropriate metrics (Ox) and for effects as well (PODy)?

Many thanks for your attention

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