Air Pollution Mitigation
How to evaluate the best strategies ?

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French National Institute for Industrial Environment and Risks

Integrated Environmental Health Impact Assessment

of Air Pollution and Climate Change in Mediterranean Areas

International Centre for Theoretical Physics, Trieste, Italy 23-27 April, 2018

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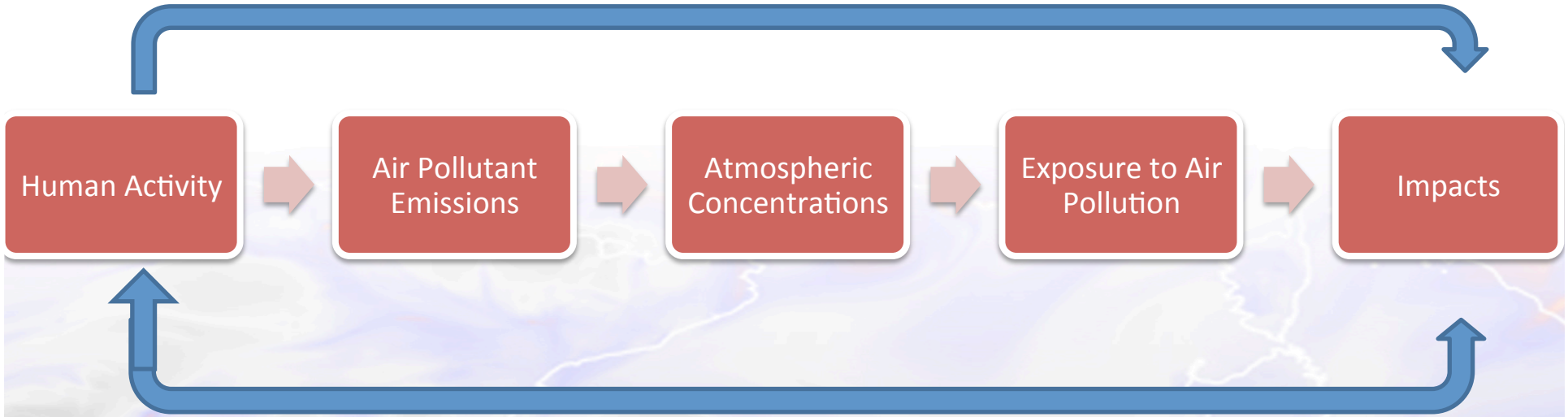
Integrated Assessment: optimisation problem

Successive testing different scenarios (« trial & error »)



Two-way « optimisation »: GAINS approach

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Overview

- Using Air Quality Models for Decision Support
  - Assessment
    - Long-term (climate)
    - Mid-term (2020-2030)
  - Forecast (days)
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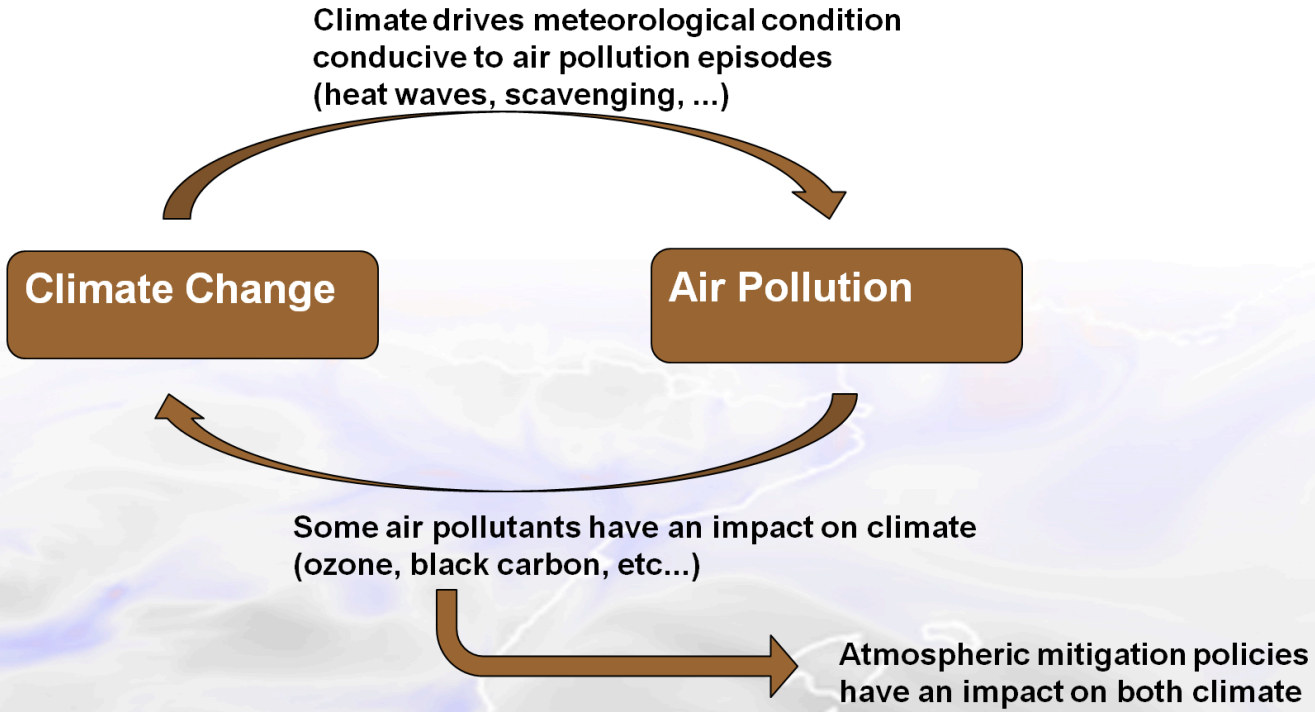
Air quality under climate change



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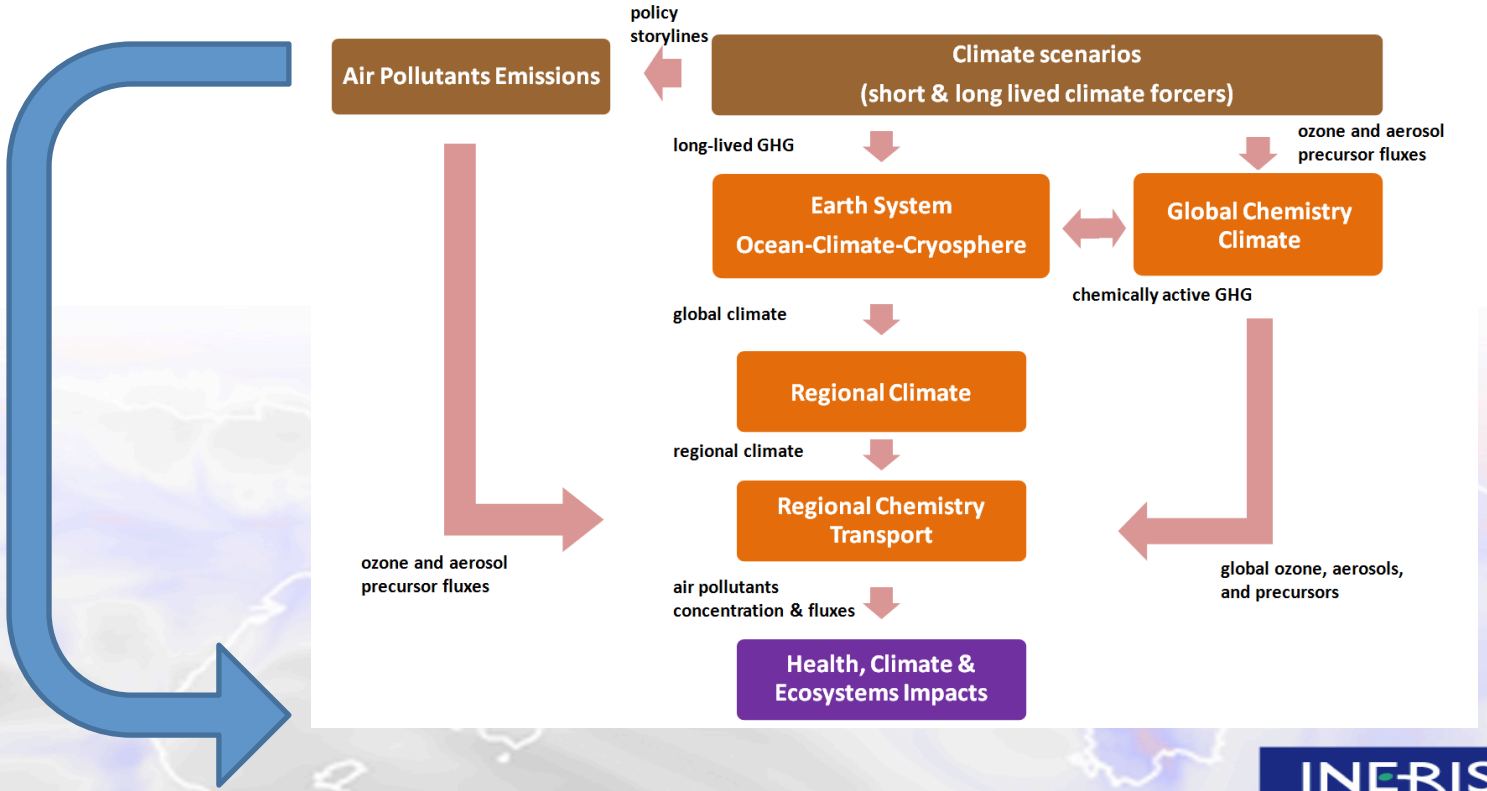
Air quality under climate change

Cost
Benefit
Analysis



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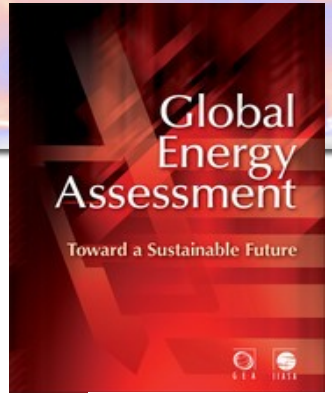
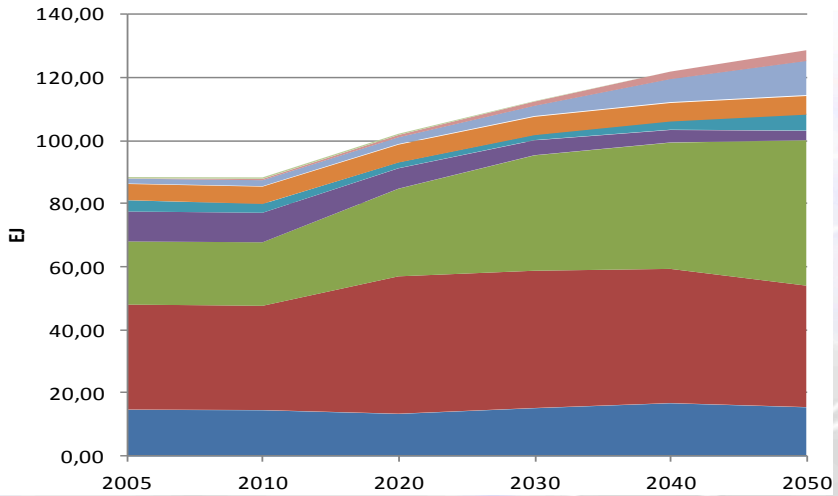
Emission projections

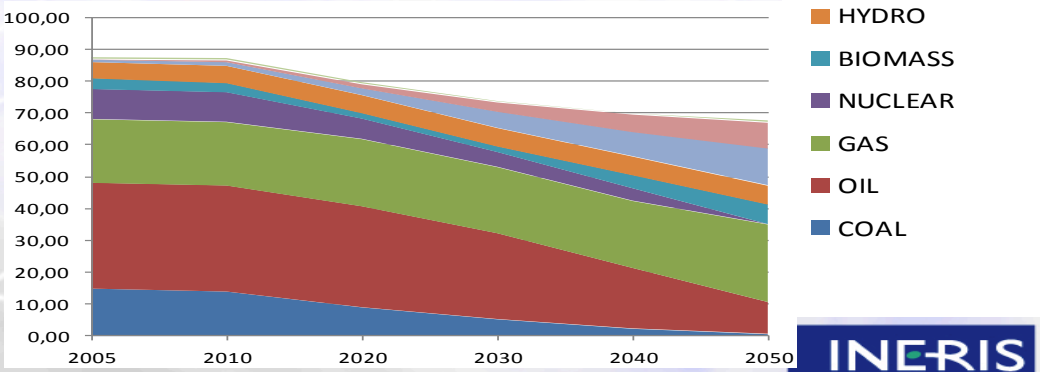


- The global energy assessment of the International Energy Agency (2012)
- Primary energy consumption in Europe:

Business as usual



Mitigation



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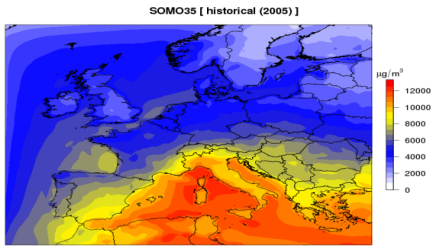
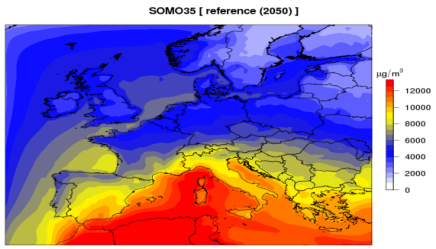
Future Air Quality: SOMO35 (sum of O3max > 35ppb)

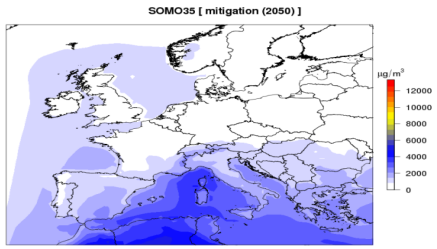
Historical



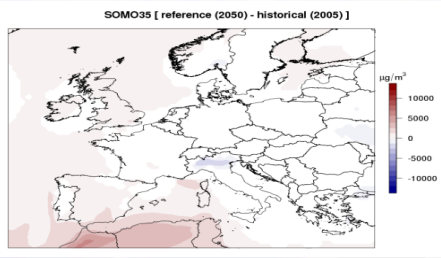
2050 Reference

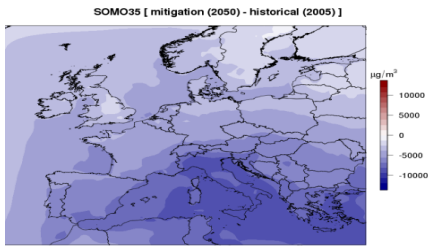


2050 Mitigation



Difference % historical





- Projections: status-quo for the Reference, large decrease for the Mitigation

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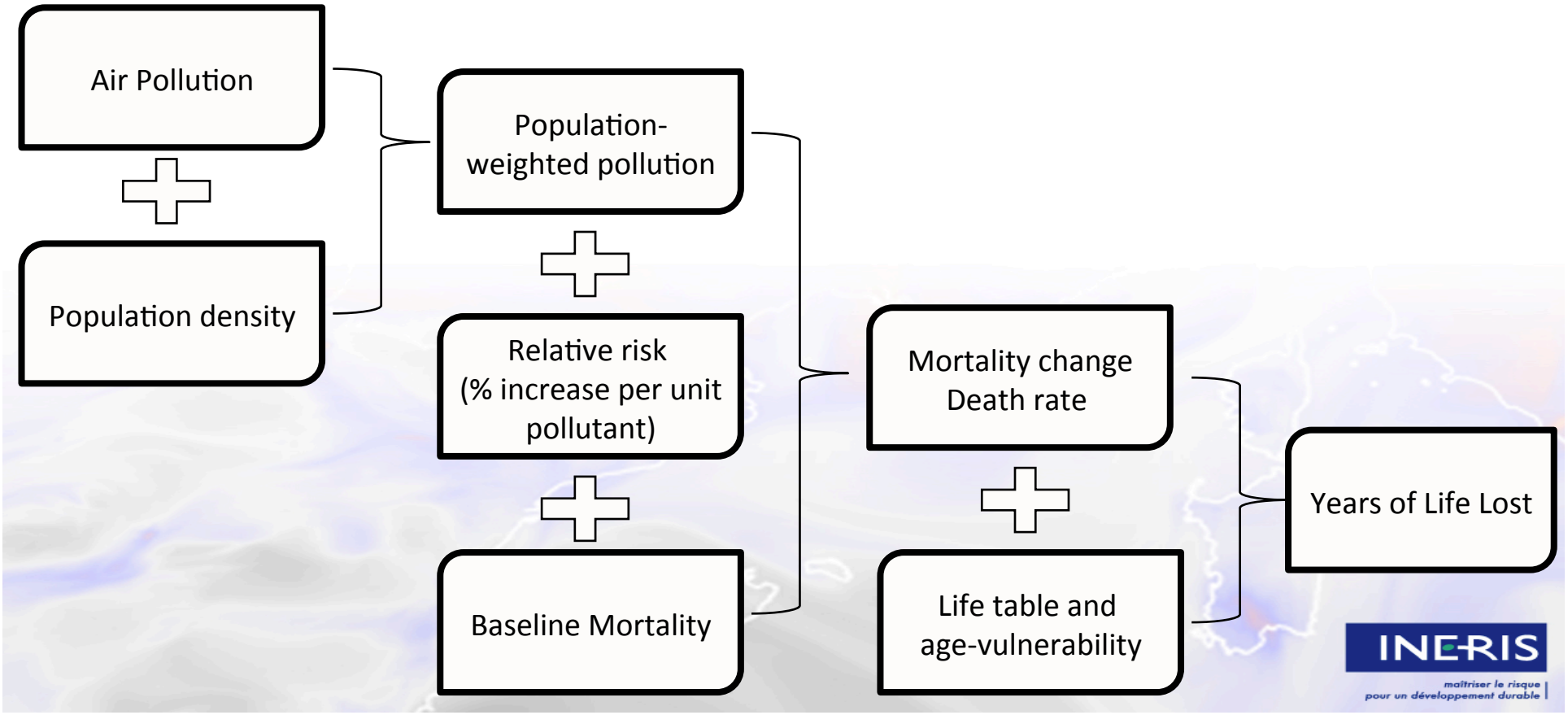
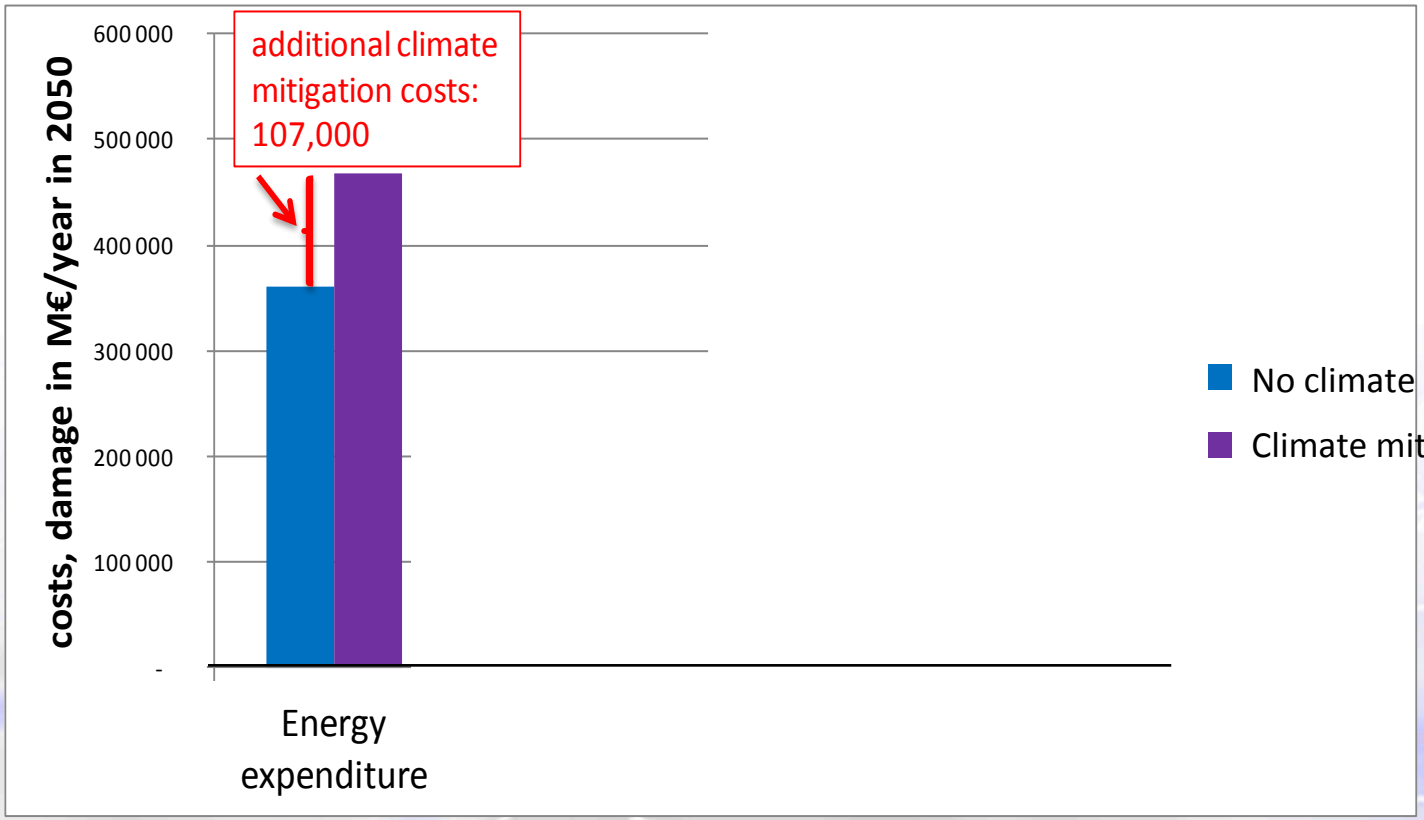
Health impact assessment



Analyse Coût-Bénéfice



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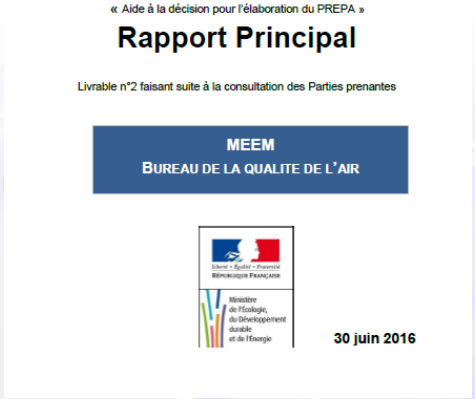
Assessing an emission reduction Plan

- French National Plan for the Reduction of Air Pollutant Emissions (May 2017)
- Under the auspices of French Ministry of Environment
- Consortium of
  - Energetic prospective
  - Air Pollutant emissions
  - Air Quality Modelling
  - Health impact assessment
- Indicators
  - Legal
  - Acceptability
  - Environment (AQ)
  - Economics (cost/benefits)


« Aide à la décision pour l'élaboration du PREPA »

Rapport Principal

Livrable n°2 faisant suite à la consultation des Parties prenantes

MEEM
BUREAU DE LA QUALITE DE L'AIR

30 juin 2016

List of mitigation measures

Mesures dans les transports	
Normes Euro 5 et V relatives aux véhicules légers et aux véhicules utilitaires	$TR1_{ME}$ (1)
Euro 6 norms for ligh & heavy duty vehicles	$TR2_{ME}$ (1)
Electric and hybrid vehicles	$TR3_{ME}$ (1)
Etape Euro 6c avec cycle Real Driving Conditions	$TR4_{MA}$ (2) (3)
Règlement n°168/2013 du 15 janvier 2013 relatif aux véhicules à 2 ou 3 roues	$TR5_{MA}$ (2) (3)
Renouvellement en véhicules propres d'une part des véhicules des flottes publiques	$TR6_{MA}$ (2) (3)
Restriction de circulation en cas de dépassement des seuils d'alerte de qualité de l'air en zones urbaines	$TR7_{MA}$ (2) (3)
Promotion du développement des transports en commun urbains électriques	$TR8_{MA}$ (2) (3)
Increasing taxes on fuels	$TR9_{MA}$ (2) (3)
Limitation de l'accès en centres villes aux véhicules les plus polluants (ZCR)	$TR10_{MA}$ (2) (3)
Limitation des émissions de l'abrasion des freins	$TR11_{MA}$ (2) (3)

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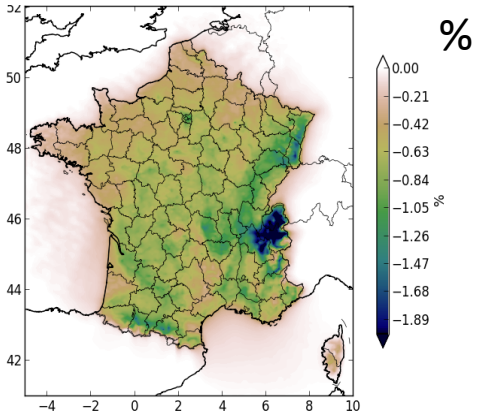
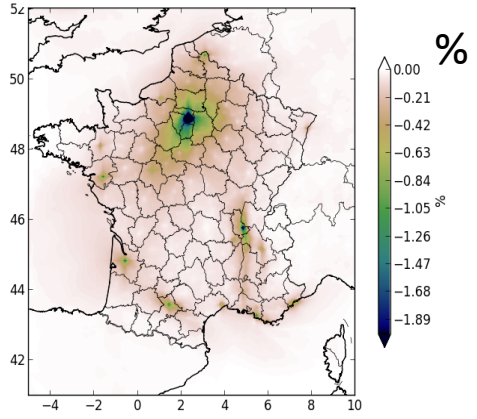
Quantification in an Air Quality Model

- Environmental:
  - Chimere Chemistry Transport Model + Data Fusion
    - Benefit of the measure for background and peak pollution
  - Health benefits assessed with AlphaRiskPoll
    - include economic valuation for cost benefit analysis

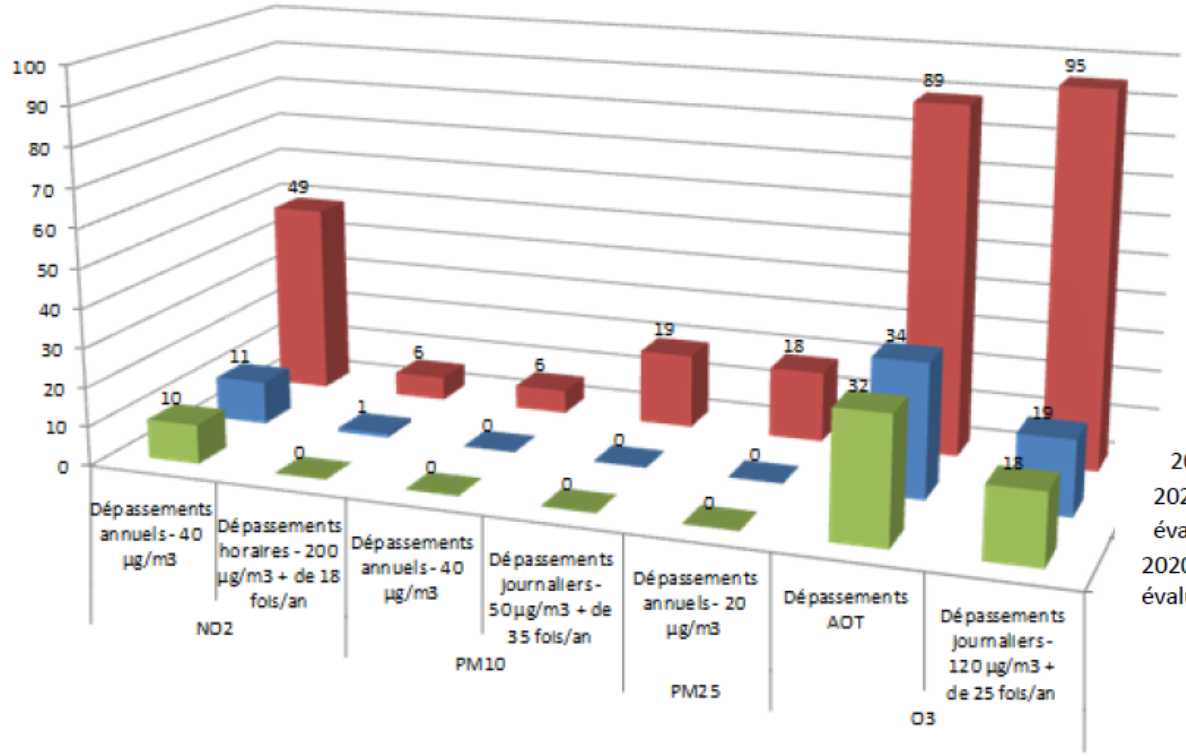
Benefit on [PM_{10}] of high perf wood stoves



Benefit on [NO_2] of reducing access to city centre



Impact on exceedances of regulatory thresholds



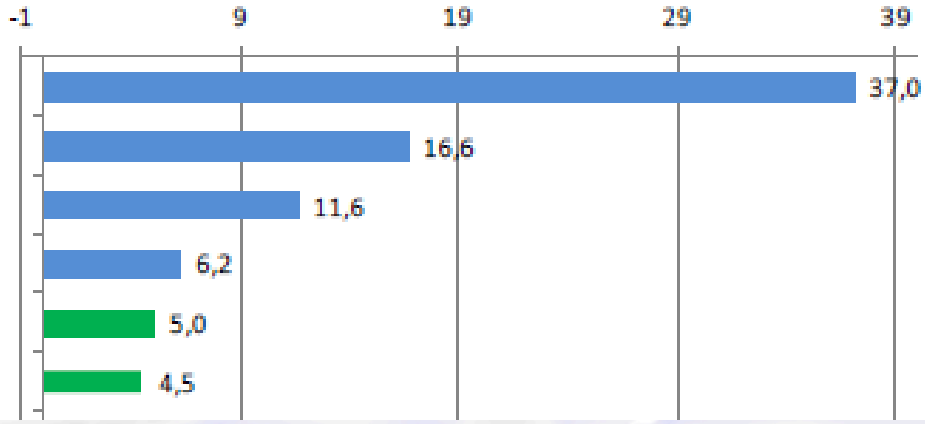
2010

2020 PREPA avec mesures existantes évaluées

2020 PREPA avec mesures existantes évaluées et MA haut

Overall impact on air quality

- AQ synthetic indicator



TR2ME - Euro 6 norms for ligh & heavy duty vehicles

TR1ME - Normes Euro 5 et V relatives aux véhicules légers et utilitaires

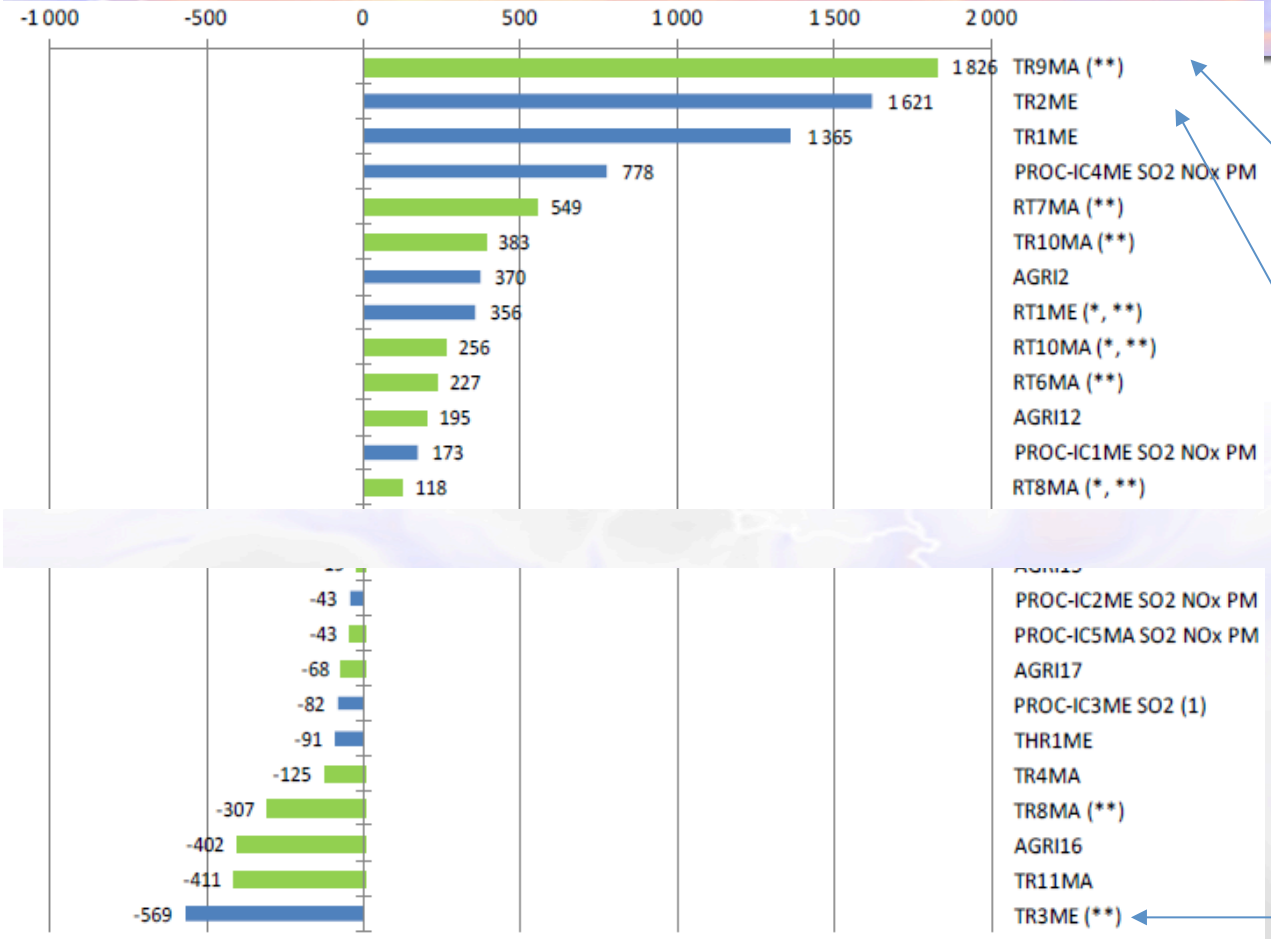
PROC-IC4ME - Arrêté du 26 août 2013 pour les IC de 20 à 50 MW...

THR1ME - Phase IIIB et IV des règlements EMNR de l'agri. et de l'ind.

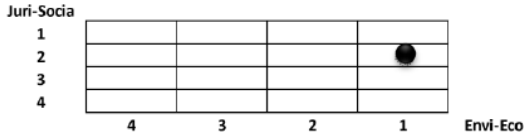
RT7MA - Nouvelles exigences flamme verte / hypothèses hautes

TR9MA - Increasing taxes on fuels

Net benefits (million €)



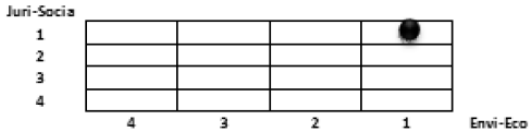
TR9MA - Augmentation des taxes sur les carburants



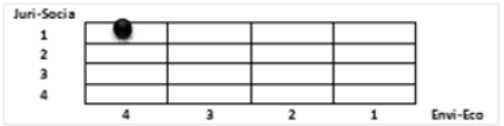
TR9MA: increasing taxes on fuels

TR2ME: Euro 6 Norms

TR2ME - Normes Euro 6 et VI



TR3ME - Pénétration des véhicules hybrides et électriques



TR3ME: Electric and hybrid vehicles

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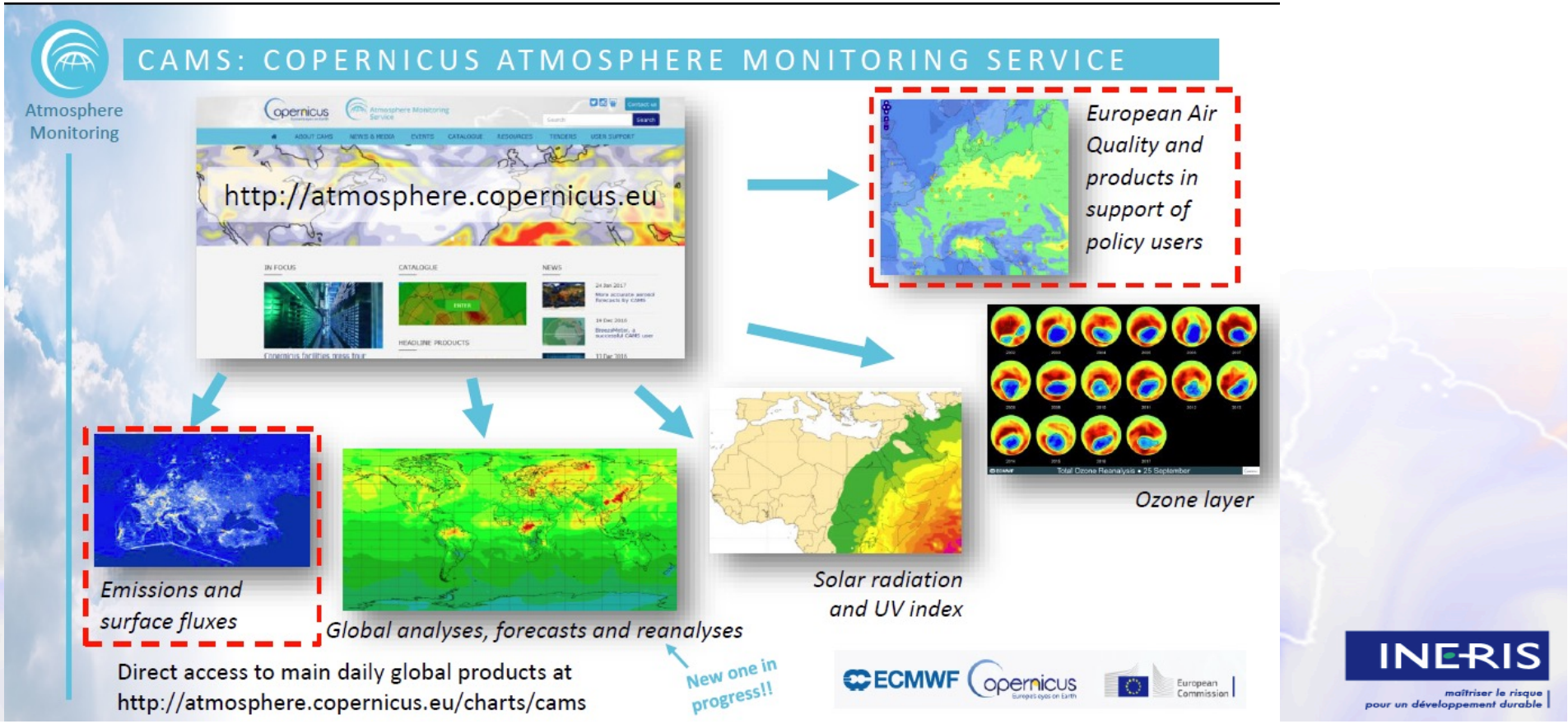
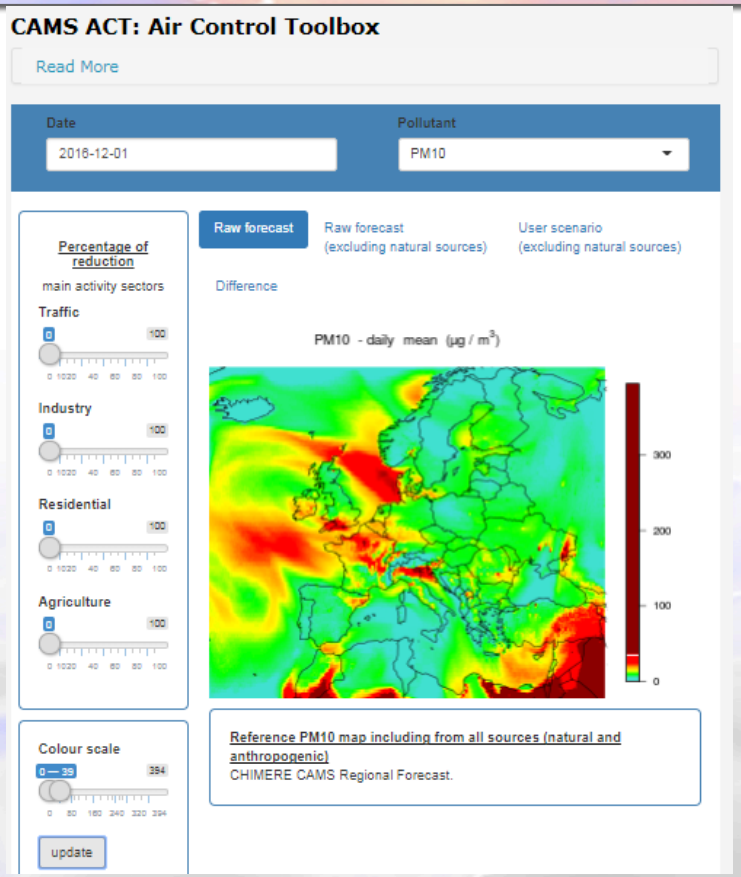
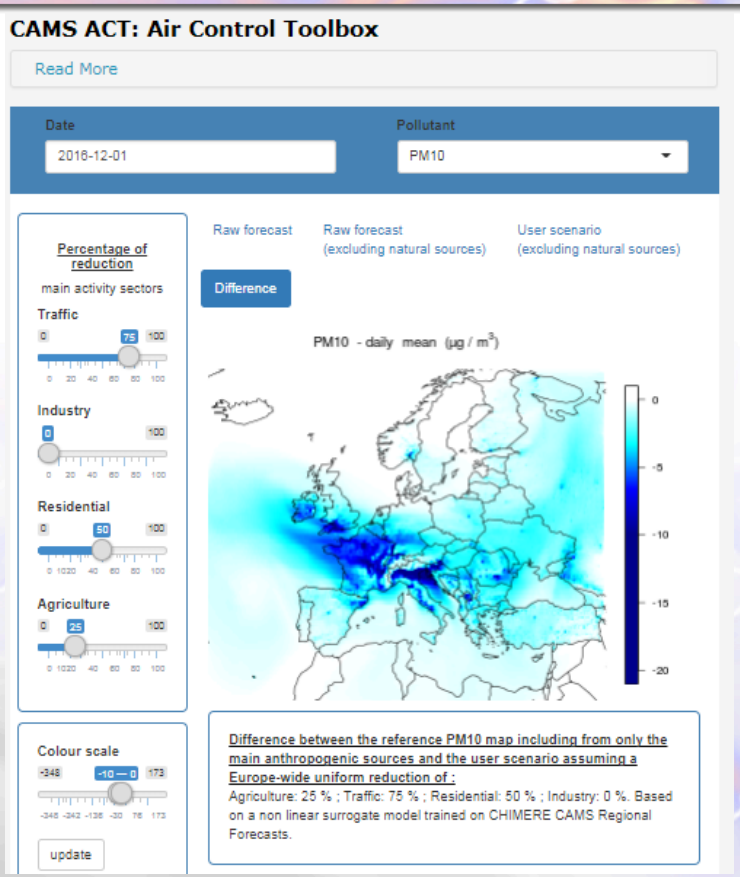
Forecasts: Copernicus Atmospheric Monitoring Service



Interactive scenario analysis: CAMS Air Control Toolbox





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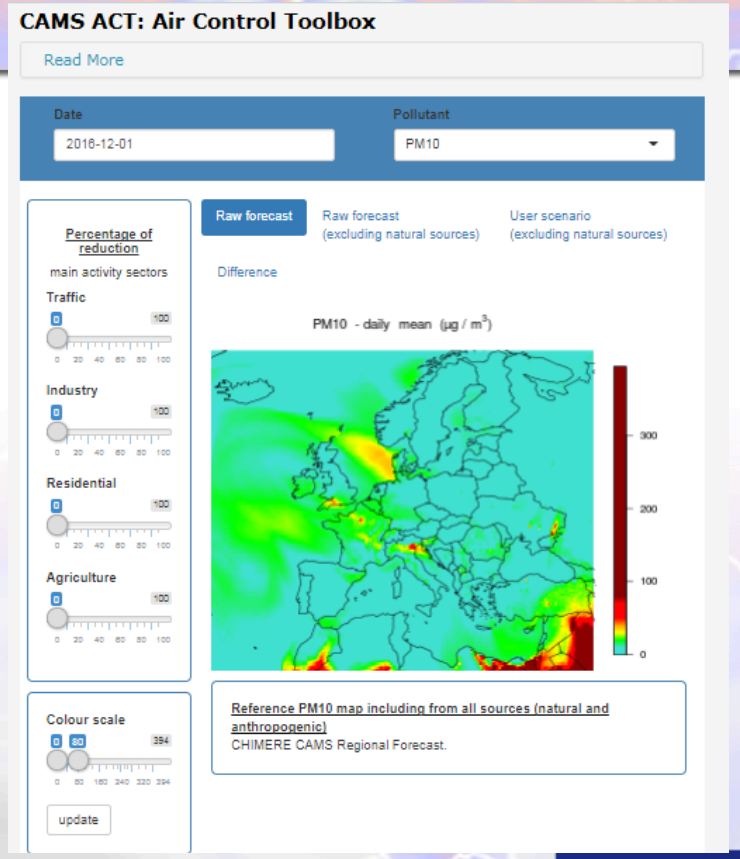
CAMS ACT: How it works

- Training scenarios
  - Chimere
  - 3 days forecast (D+0, D+1, D+2)
  - 0.25deg resolution

- Emission reduction of training scenarios
  - AGR 60%, AGR 100%
  - IND 60%, IND 100%
  - RH 90%
  - TRA 60%, TRA 100%
  - AGR 30% & IND 60%
  - TRA 100% & AGR100%
  - TRA 30% & IND 60%

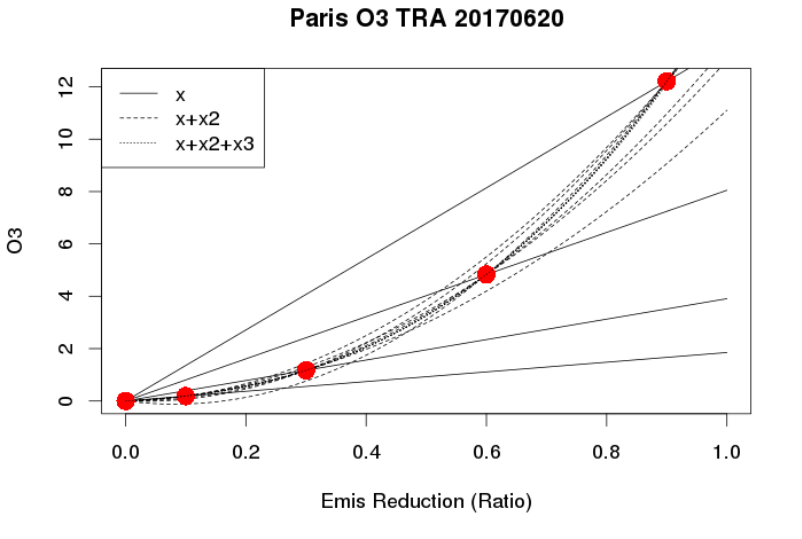
- Surrogate model
  - Non linear combination of the training senarios
  - Flexible web tool (immediate response)

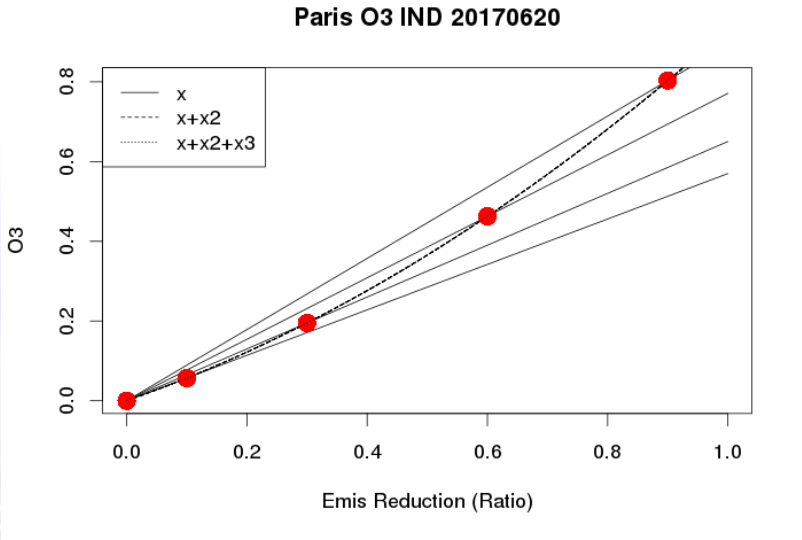


$$REF = AGR + AGR^2 + IND + IND^2 + RH + TRA + TRA^2 + AGR \times IND + TRA \times AGR + TRA \times IN$$

CAMS ACT: non-linearities

O3 daily max (Paris)





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Case Studies

- Contributions to air pollution episodes:
  - Activity sectors:
    - Traffic, industrial, residential, agriculture
  - Local / non-local sources

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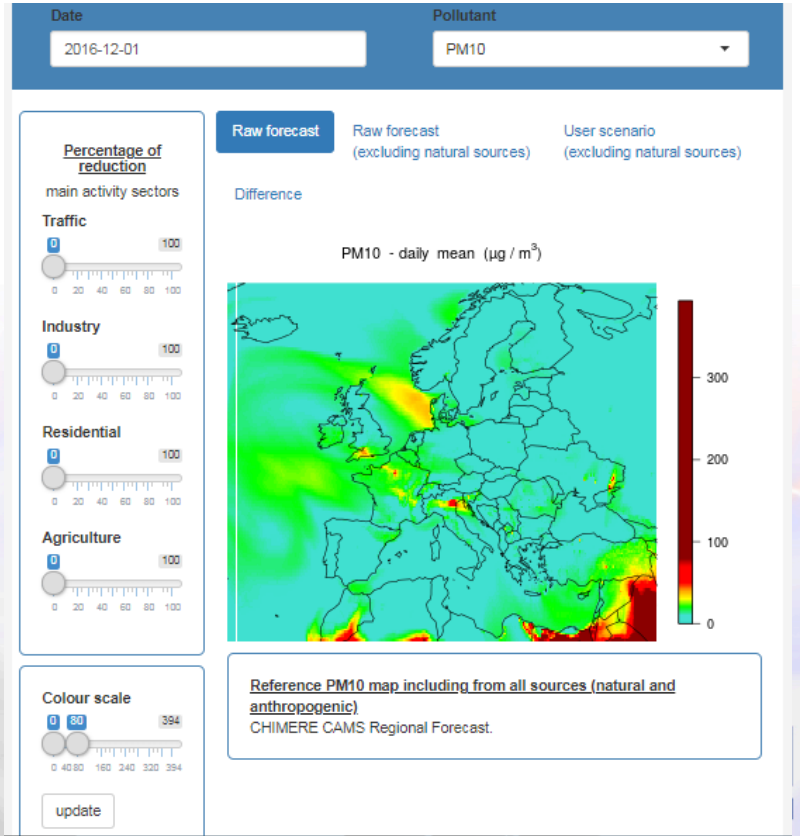
Tools

- Copernicus Atmospheric Monitoring Service:
  - Support to policy
    - http://policy.atmosphere.copernicus.eu/

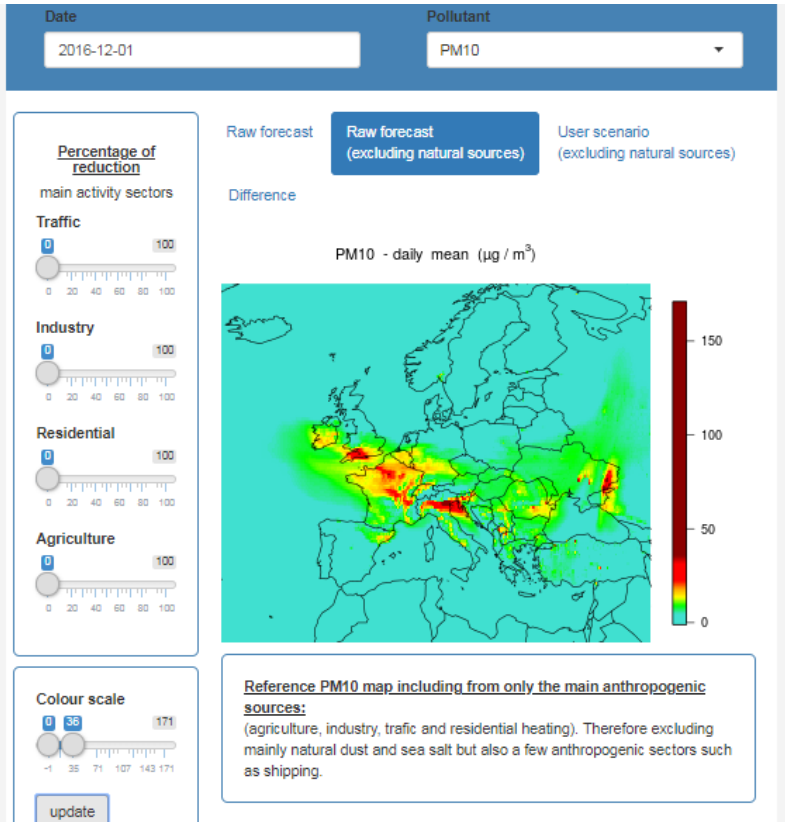
Contribution of Activity Sectors: CAMS Air Control Toolbox

- http://policy.atmosphere.copernicus.eu/CAMS_ACT.html



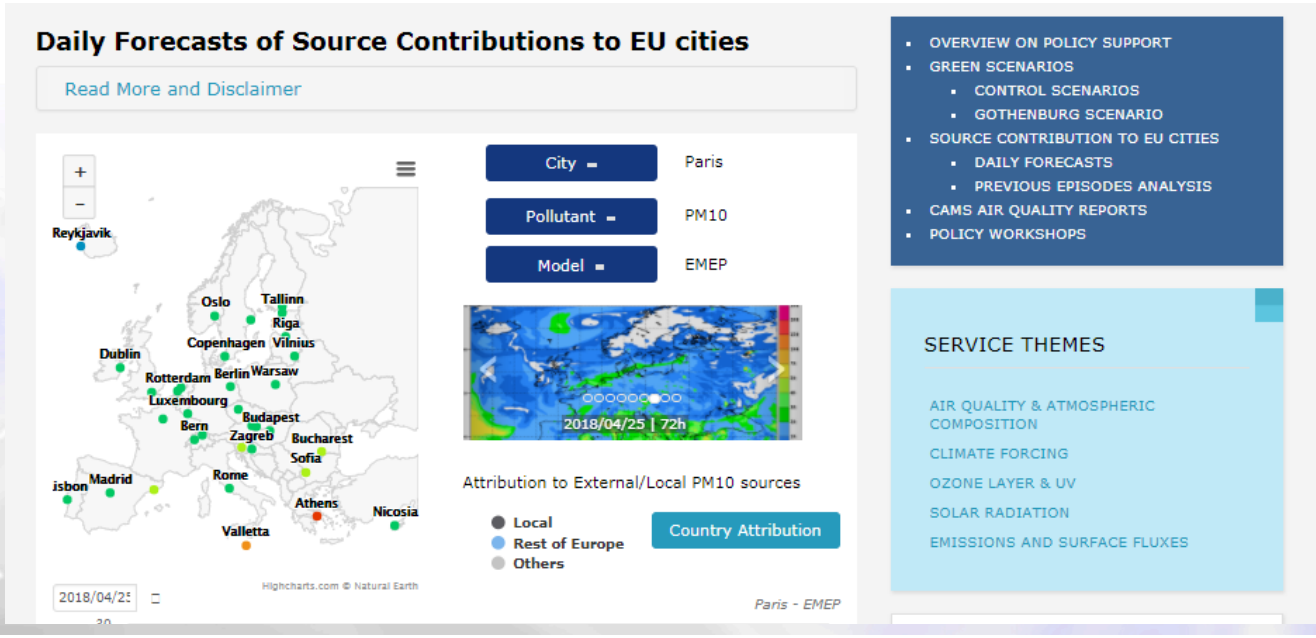
Contribution of Activity Sectors: CAMS Air Control Toolbox

- http://policy.atmosphere.copernicus.eu/CAMS_ACT.html
- Raw Forecast (exclude natural sources)
  - Adjust color bar => update
- Select
  - Date
  - Pollutant
  - Level of reduction of air pollutants (100%)
  - Update colorbar!



Contribution of local sources: CAMS City Allocation

- http://policy.atmosphere.copernicus.eu/DailySourceAllocation.html
- Select
  - City
  - Pollutant
  - Model=EMEP
  - Date



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Case Study

- Contribution of activity sectors
  - http://policy.atmosphere.copernicus.eu/CAMS_ACT.html
  - Raw Forecast (exclude natural sources)
  - Adjust color bar => update
  - Date
  - Pollutant
  - Level of reduction of air pollutants (100%)
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- Contribution of local/non-local sources
  - http://policy.atmosphere.copernicus.eu/DailySourceAllocation.html
  - City
  - Pollutant
  - Model=EMEP
  - Date

- Episodes:
  - Activity Sectors
    - 2016/12/01 PM10
    - 2015/03/18 PM10
    - 2017/06/21 O3
  - Local sources
    - 2016/12/01 versus 2016/12/06 PM10

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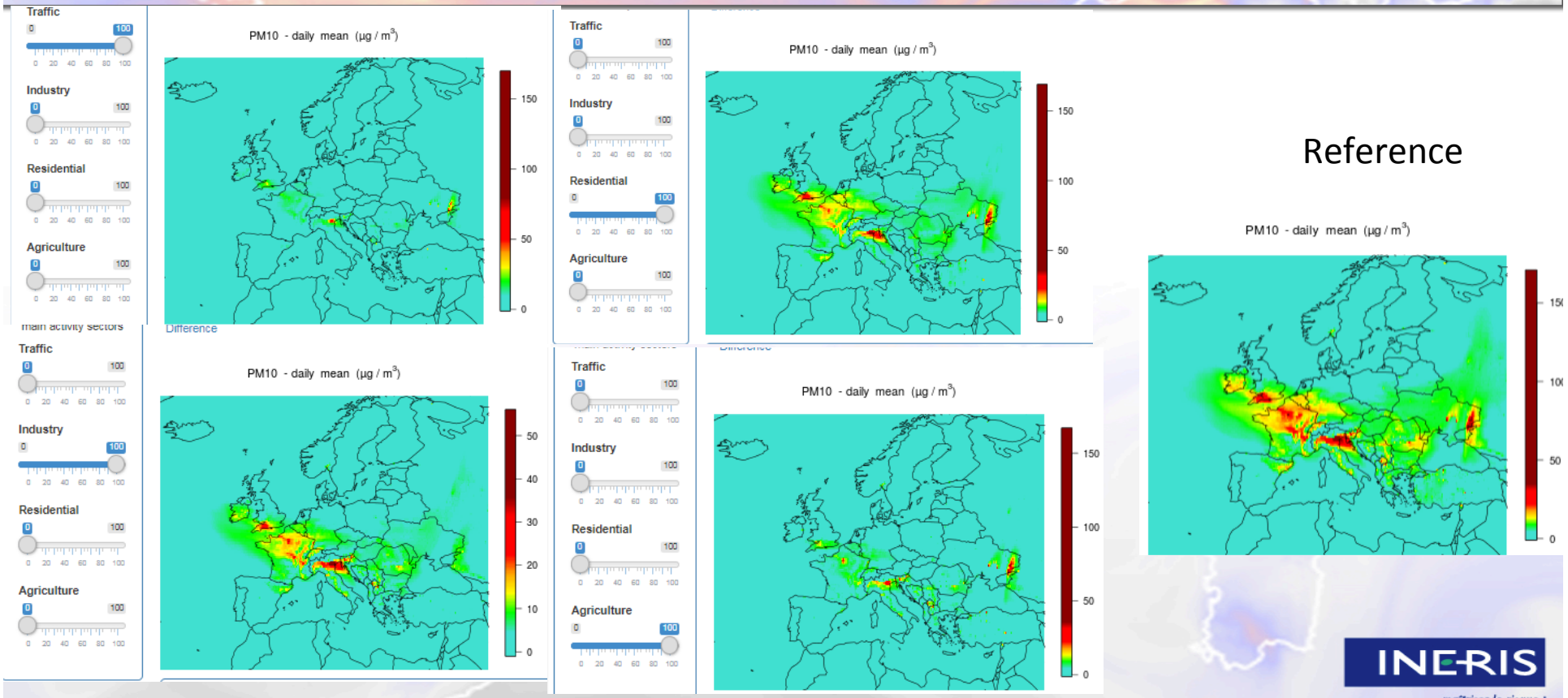
20161201: PM10



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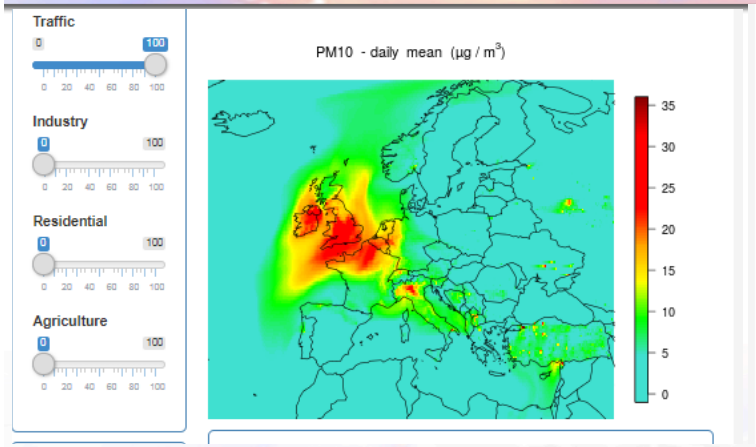
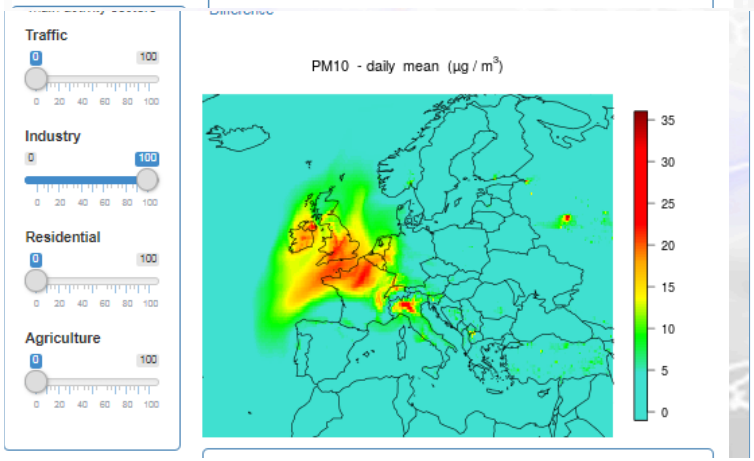
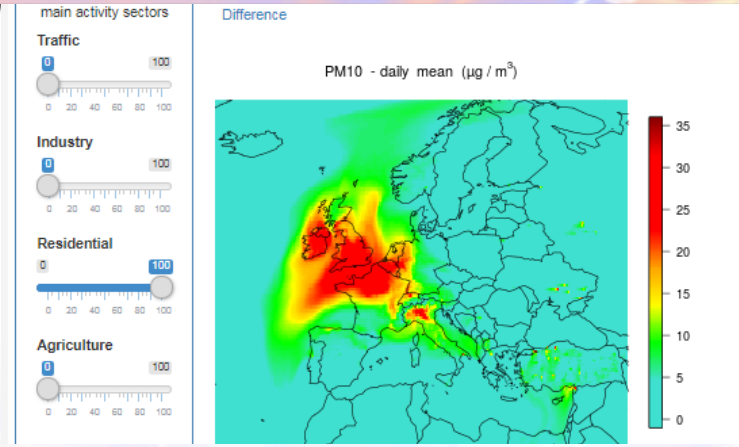
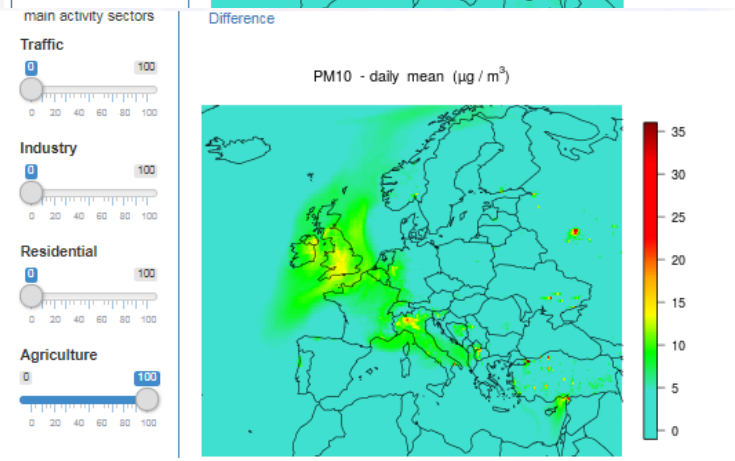
20150318: PM10

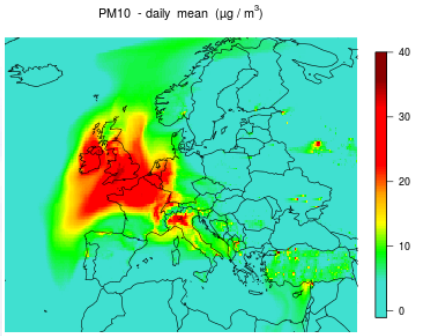








Reference



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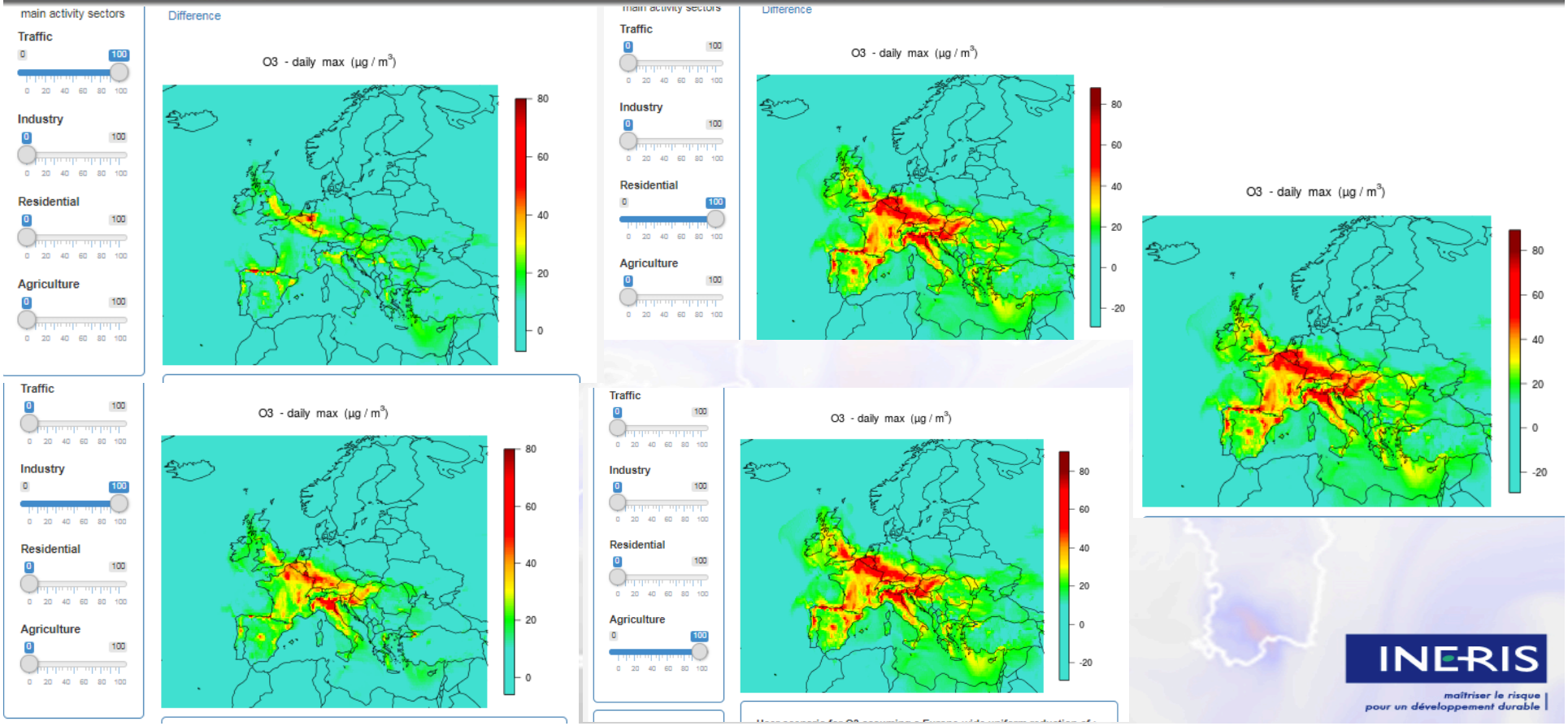
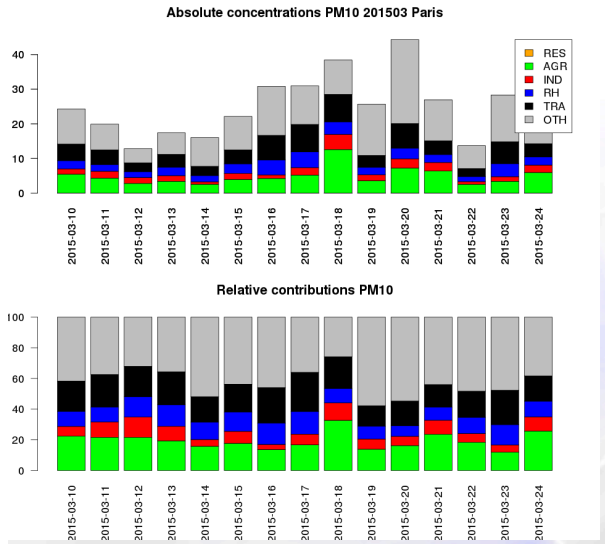
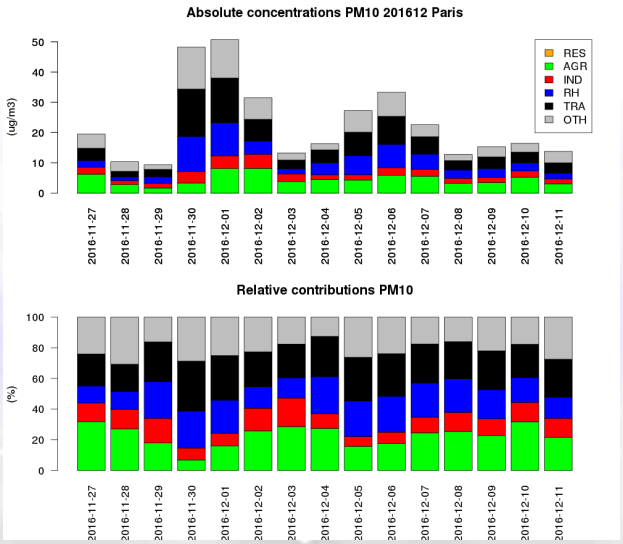
20170621: O3

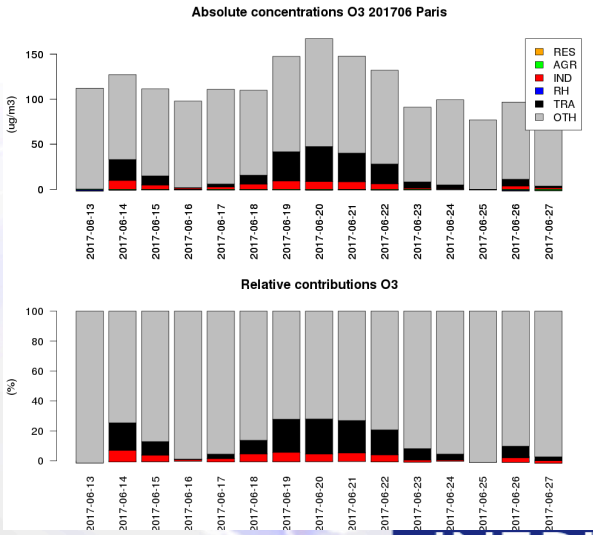

main activity sectors
Traffic
Industry
Residential
Agriculture
Difference
O3 - daily max (µg / m3)
80
60
40
20
0
-20

Source Apportionment

- 20150318 PM10 / 20161201 PM10 / 20170621 O3







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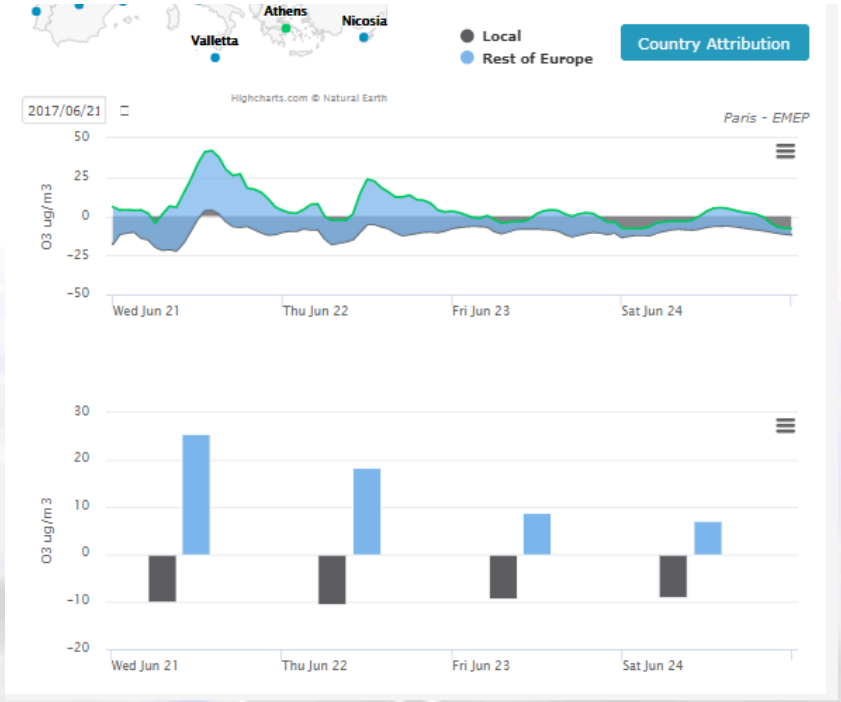
City Allocation: December 1st versus December 6th 2016 (PM10)

City Allocation: June 21 2018 (O3)



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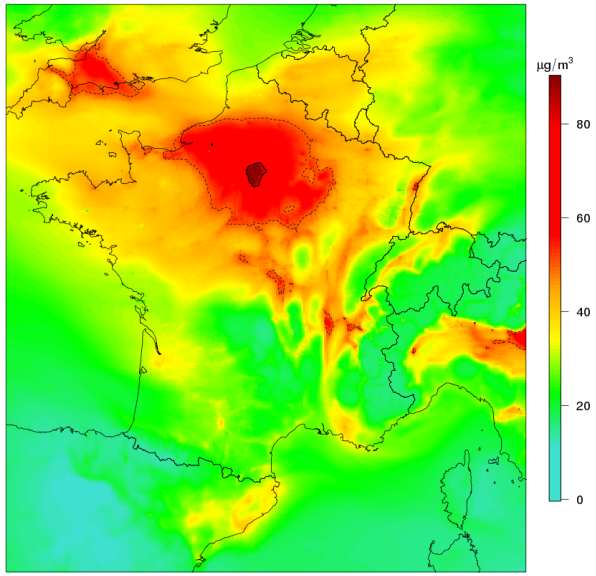
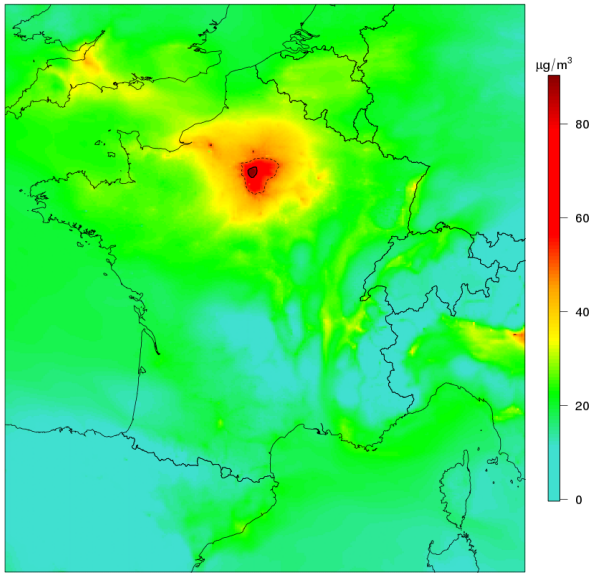
Benefits of long term action

20161201, PM_{10}



Under NEC2030 emissions



Applying nation-wide emission reductions as defined in the 2030 NEC objectives, the episode would have been much smaller

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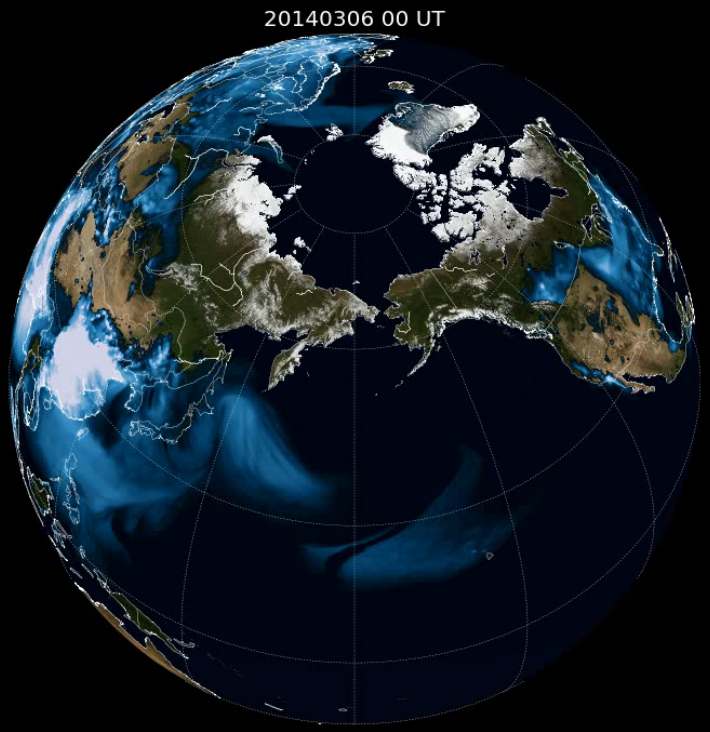

INERIS Youtube Channel
https://youtu.be/xuUsEOL0Lj8