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Understanding Ozone formation in Spain

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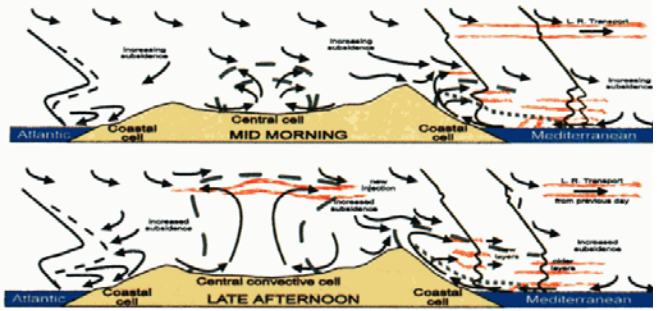
15/10/2021

2n Congrés Qualitat de l'aire

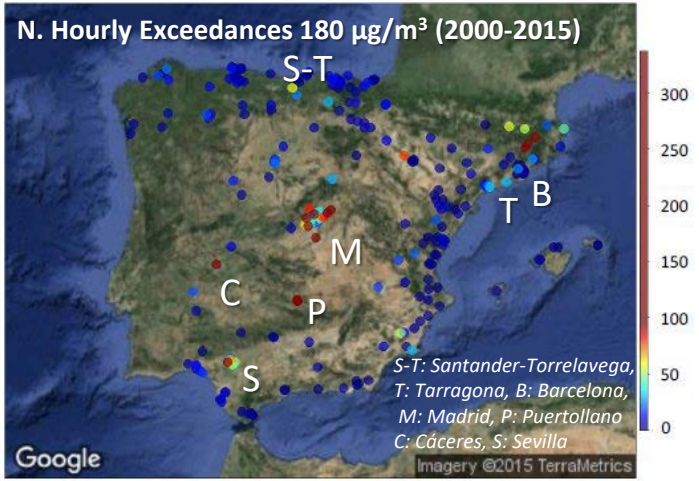
Motivation

O_3 dynamic



Sources: Millán et al., 1997, 2000, 2014; Gangoiti et al, 2001, 2002, 2006; Toll and Baldasano, 2000

O_3 Trends and exceedances



Source: Querol et al. (2016).

Open questions:

- What are the sources responsible for the high O_3 concentration in Spain?
- Can administrations implement control strategies that are effective to reduce high O_3 concentration?

CALIOPE air quality modelling system

www.bsc.es/caliope

METEO

- **WRF-ARWv3.5** (RRTM/WSM3/YSU/NoahLSM)
- Ver. Res.: 37σ/50hPa (top)
- Hor. Res: 12km (EU) - 4km (IP) - 1km (CAT,MAD,etc)
- IC/BC (EU12/IP4): GFS (NCEP) / nesting EU12

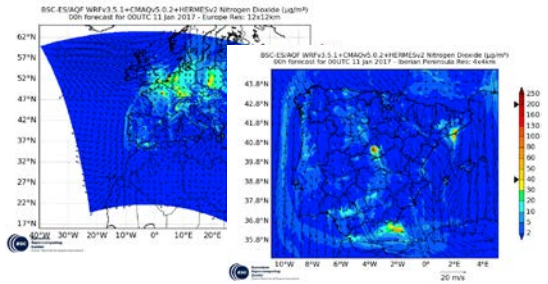
EMIS

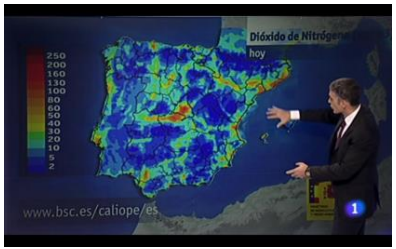
- **HERMESv2.0 and v3.0**
- EU12: HERMES-DIS (EMEP, TNO-MACC)
- IP4: HERMES-BOUP (Spain) + HERMES-DIS(Europe)
- Biogenic emission MEGANv2.0.4

CHEM

- **CMAQv5.0.2** (ISAM, CB05TUCL, AERO6)
- Ver. Res: 37σ / 50hPa (top)
- Hor. Res: 12km (EU) - 4km (IP) - 1km (CAT,MAD,etc)
- BC (EU12/IP4): MOZART4-GEOS-5 & CAMS
- MCIPv4.0

Air quality products





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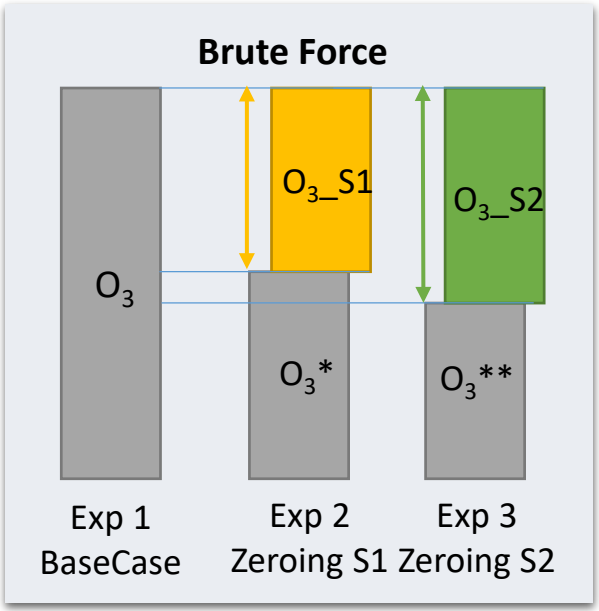
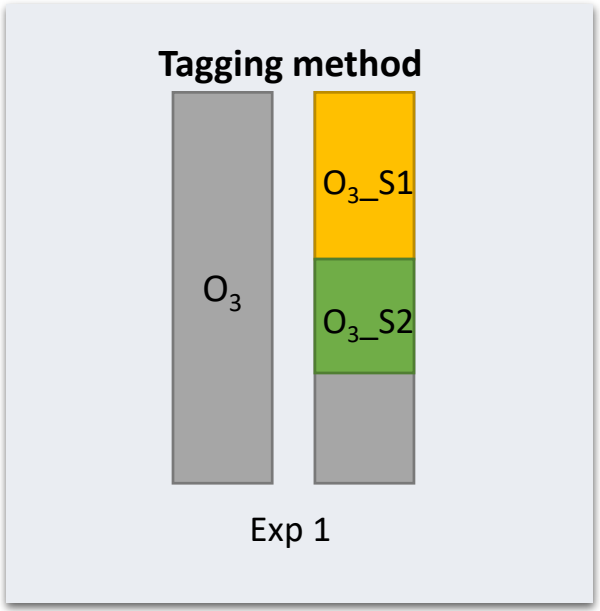
Source apportionment



+ Straightforward for any model
- Mass inconsistency
- Not real atmospheric conditions
- High computational resources



+ Time saving (one simulation)
+ Mass consistency
+ Real atmospheric conditions
+ Appropriate secondary pollutant (O_3)
- Model coding required

Emissions are critical

CALIOPE system (CMAQ-ISAM)

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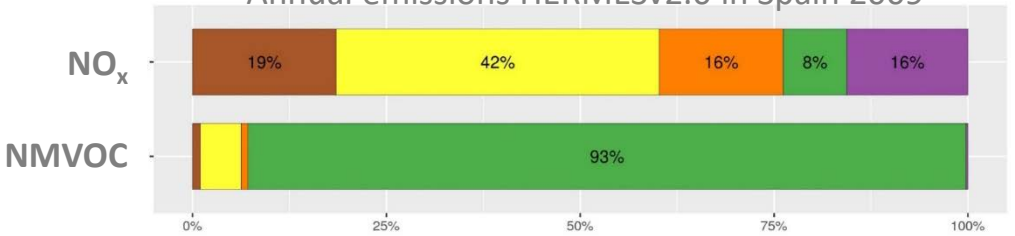
Experiment: sector emissions + imported O_3

Experiment set-up

Which sources?

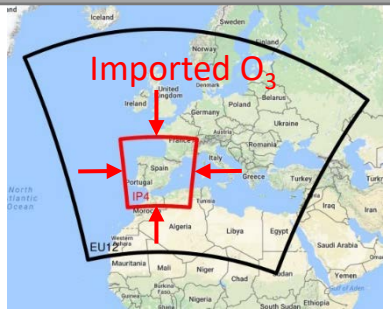
Annual emissions HERMESv2.0 in Spain 2009



Sectors that account 92% of the total NO_x

- Others
- Power Plants
- Industry
- On-road transport
- Non-road transport

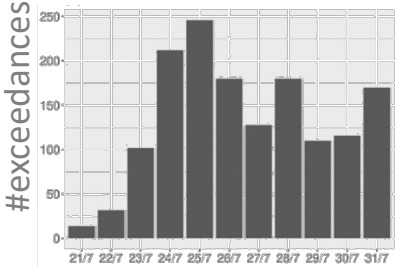
Imported O_3 from where?

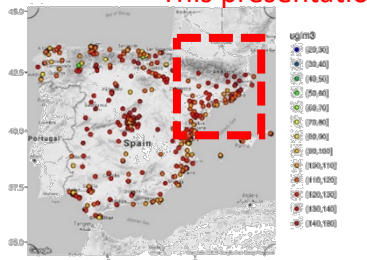


The episode

21-31 July 2012

This presentation





Pay et al. (2019 ACP)

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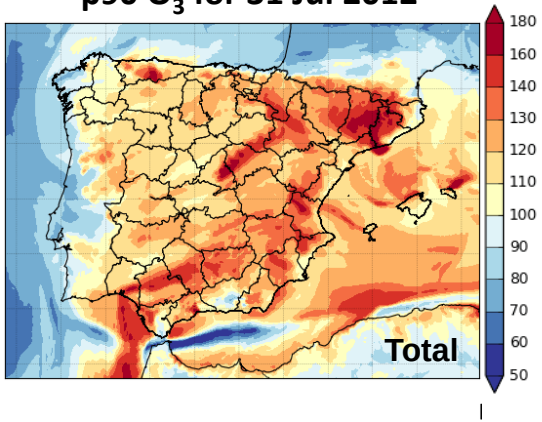
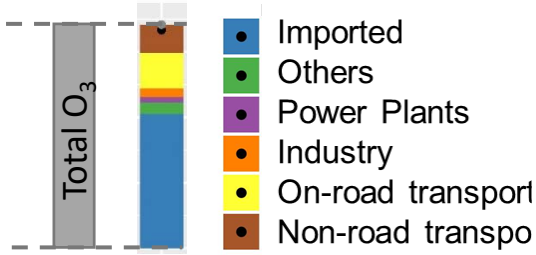
Results

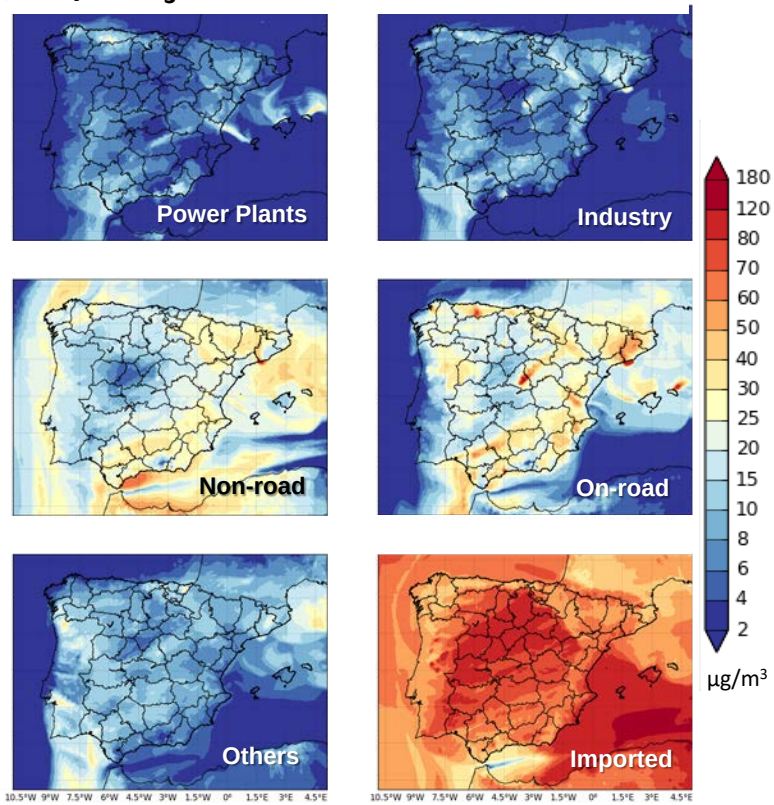
p90 O_3 for 31 Jul 2012



Tagging method



p90 O_3 contributions for 31 Jul 2012



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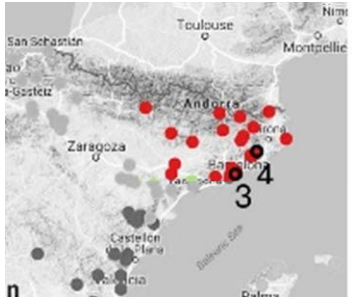
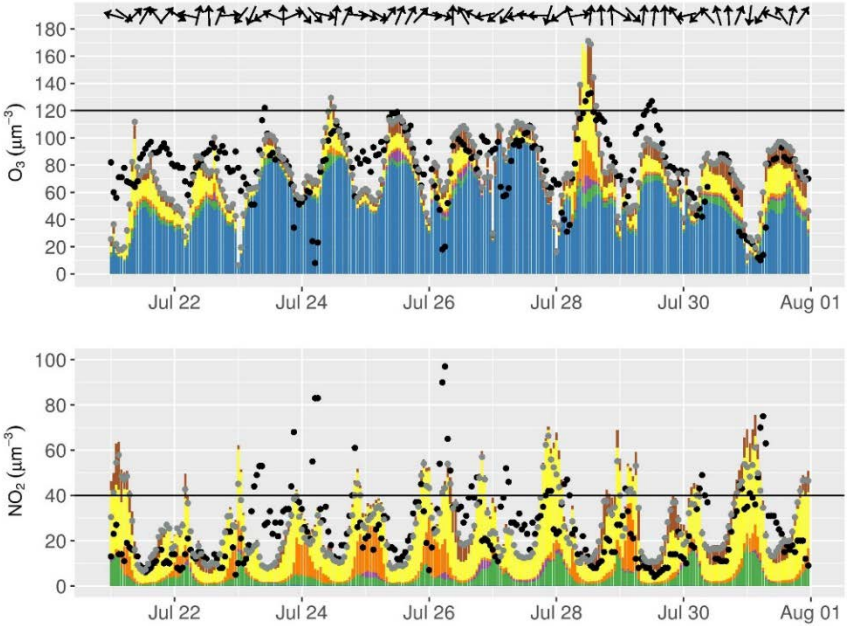
Results



- Imported
- Others
- Power Plants
- Industry
- On-road transport
- Non-road transport

- obs
- cmaq

Receptor: **urban station (3)**



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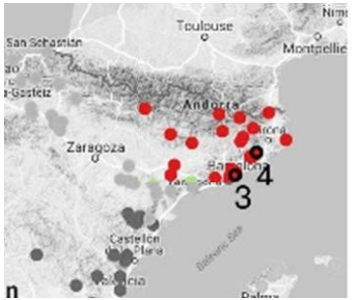
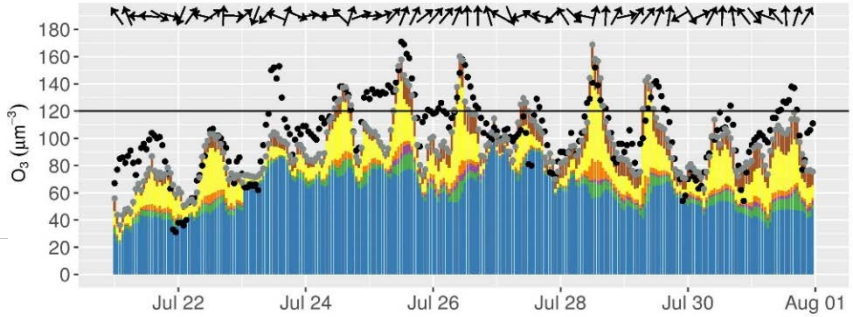
Results

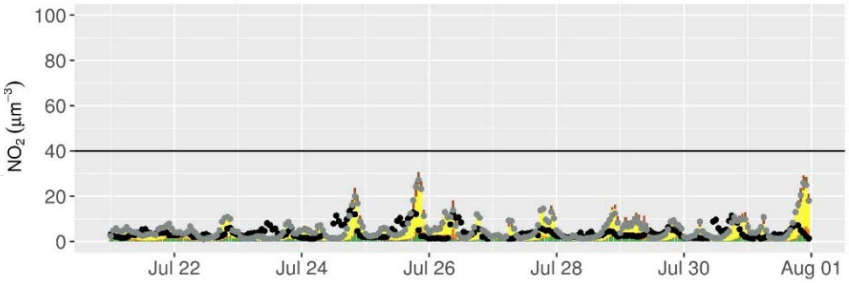


- Imported
- Others
- Power Plants
- Industry
- On-road transport
- Non-road transport

- obs
- cmaq

Receptor: **rural station (4)**





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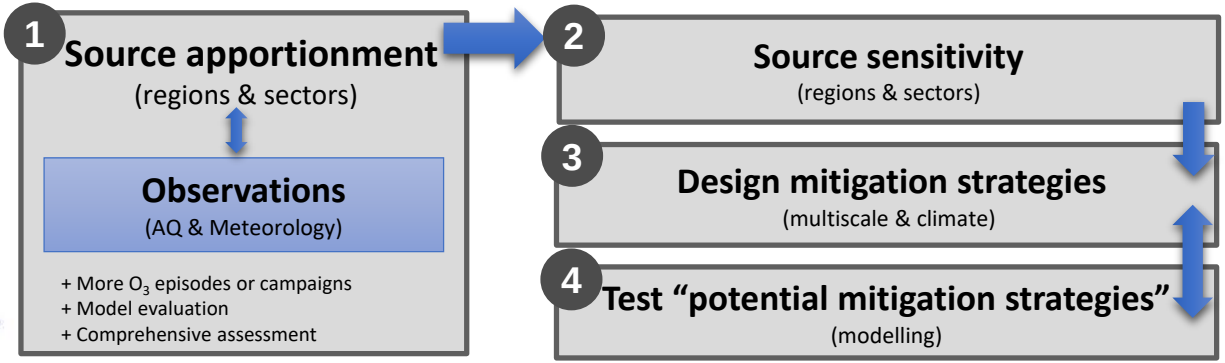
Conclusions

- **Valuable methodology** to characterize source contributions
- **Regional/local source** contributions dominate O_3 during peaks (i.e., traffic and shipping)
- **Imported O_3** to the IP is a main contributor to ground-level O_3 concentration overall in summer in Spain (background levels).
- **Modelled mitigation strategies** have been designed mostly for targeting primary pollutants and the traffic sector.



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Thank you

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