Interreg
Ελλάδα-Κύπρος
Ευρωπαϊκό Ταμείο Περιφερειακής Ανάπτυξης
ΕΥΡΩΠΑΪΚΗ ΕΝΩΣΗ
step2smart

ΔΕΣΜΟΙ
ΑΝΑΠΤΥΞΗΣ

Nicosia, 29 March 2019

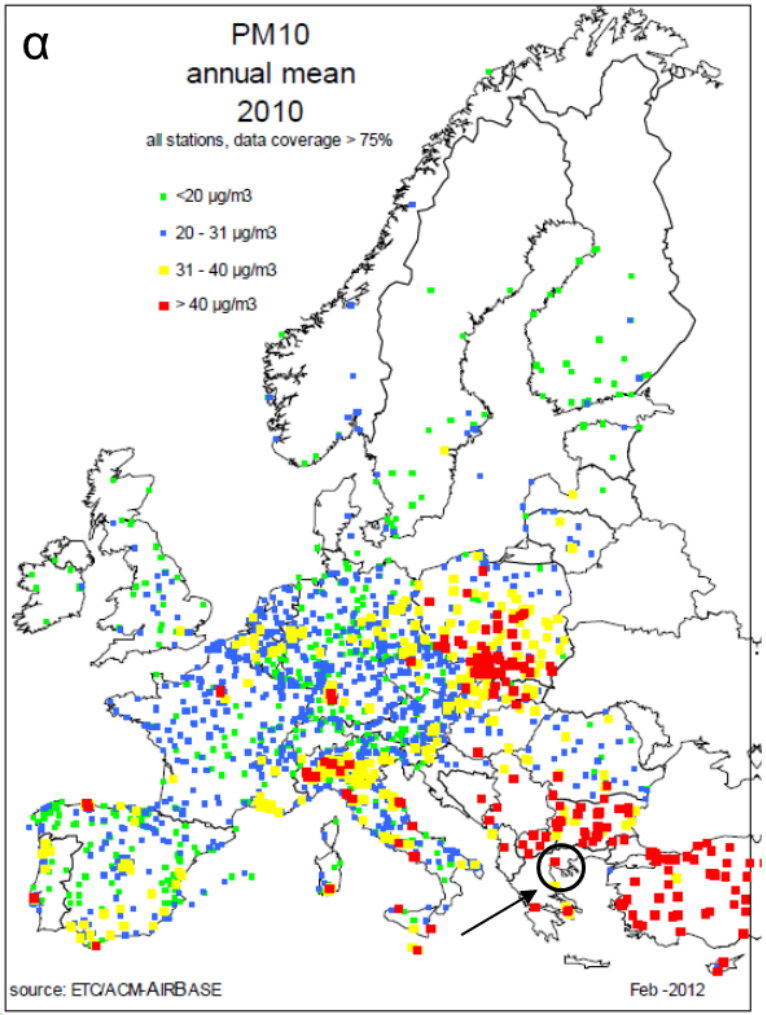
Step2Smart: Operational integration of traffic management and air quality assessment in the City of Nicosia

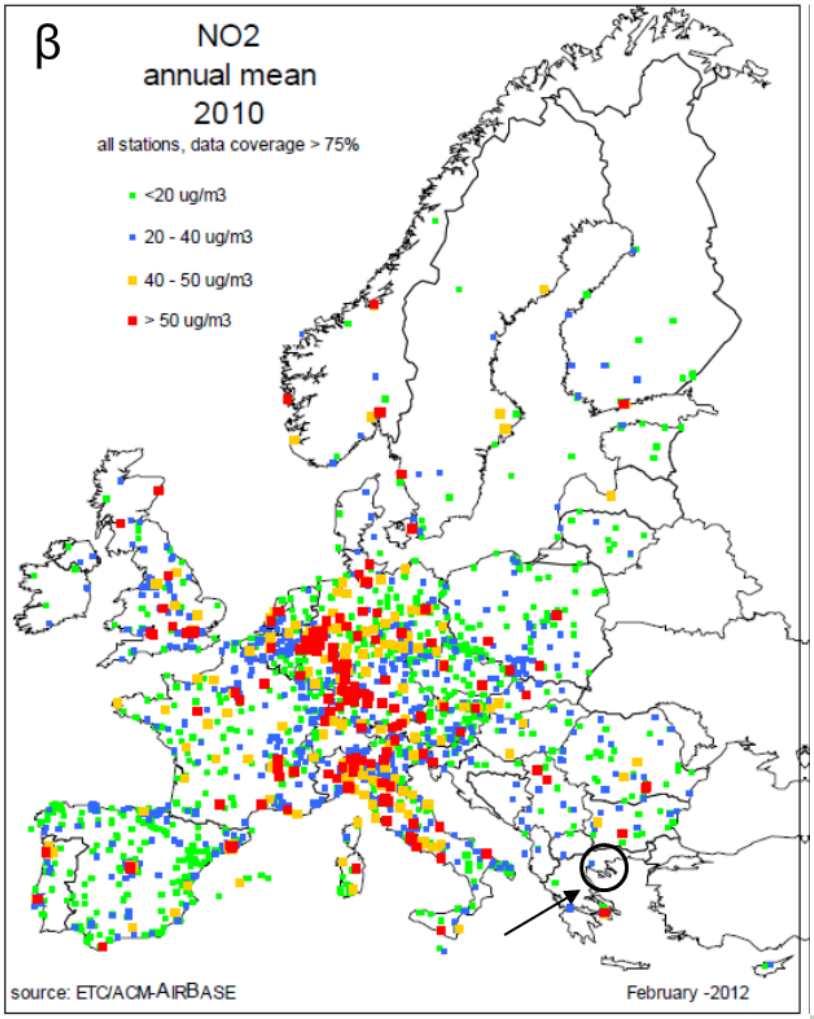
Aristotle University of Thessaloniki - Laboratory of Heat Transfer and Environmental Engineering

Dr. Fotios Barmpas

Step2Smart: Need for a state of the art AQMS

Air Quality in EU cities in 2010 *(Frank de Leeuw, 2012)*





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Problem definition

Road traffic emissions

+

Densely build environment – inefficient natural ventilation

→

Air pollution accumulation

+

Population exposure to AP = Adverse health impact – high external costs!

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Air Quality: basic functions of an AQMS

- ❑ AQ assessment in real time / near real time (Nowcasting)
- ❑ Provision of prognosis for the next 24hrs (Forecasting)
- ❑ AQ scenario analysis and assessment (Scenario Analysis)
- ❑ Operational verification and validation (Validation)
- ❑ Historical AQ data assimilation and analysis (Reanalysis)
- ❑ Numerical simulations for prognosis of prevailing meteo conditions
- ❑ Air pollutant (regulated, EC 2008/50) concentrations estimations

AQ assessment at street scale:

- ✓ Accurately estimate the exposure and the associated adverse impacts on the health of citizens
- ✓ Account for the external costs of the associated health endpoints (e.g Years of Life Lost, Loss of Productivity etc)

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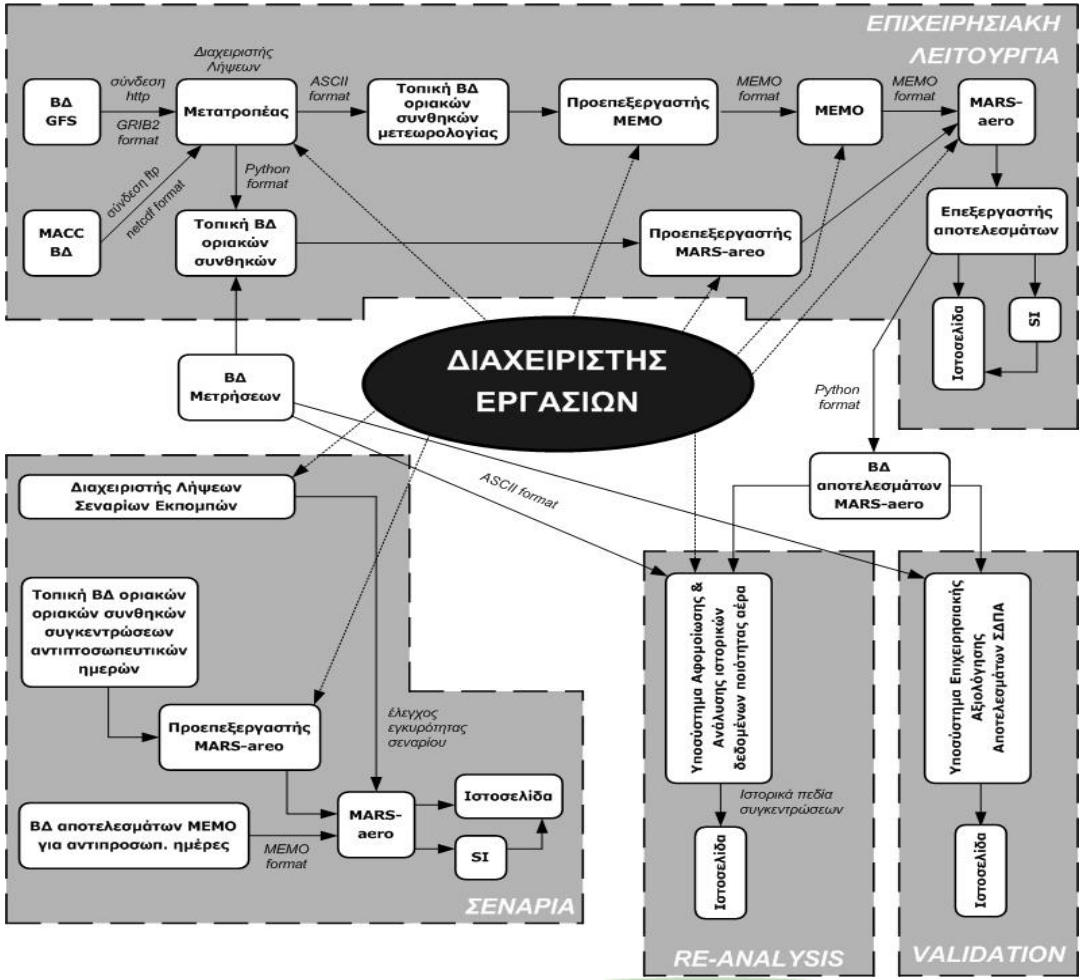
AQMS: System architecture and interfacing

- ✓ Implementation based on Python
- ✓ Need for workflow optimisation and sub - systems management
- ✓ Many sub - systems interlinked and working in parallel
- ✓ Mixture of information from in - situ measurements and models running operationally

Data assimilation needed!!!



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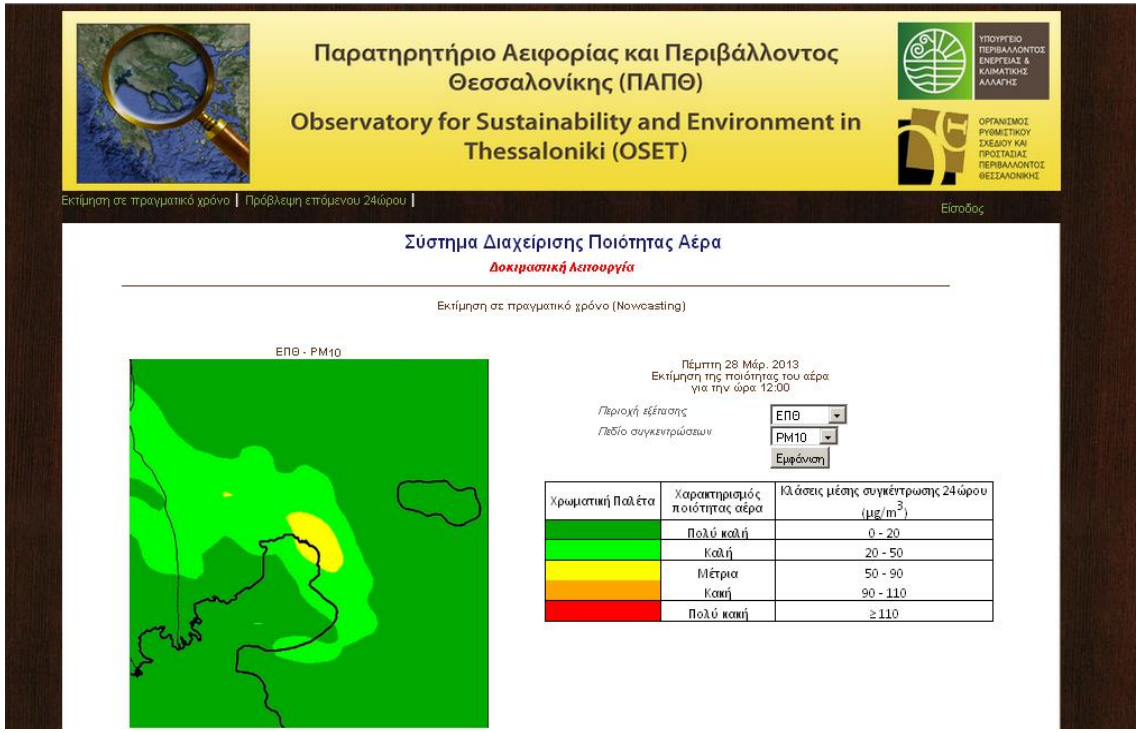
Operational AQMS in Thessaloniki: Aim – Main Features

Operational AQMS in Thessaloniki: Aim – Main Features

http://hydra.meng.auth.gr/aqms/

- System Functions:
  - ✓ Nowcasting (current hour)
  - ✓ Forecasting (next day)
  - ✓ Emission scenarios
- Updated nowcasts and forecasts available to the public through a dynamic, publicly accessible web interface
- **Data assimilation important!!!**



Development funded by the Organization of Planning and Environmental Protection of Thessaloniki (OR.TH.) in support of local authorities

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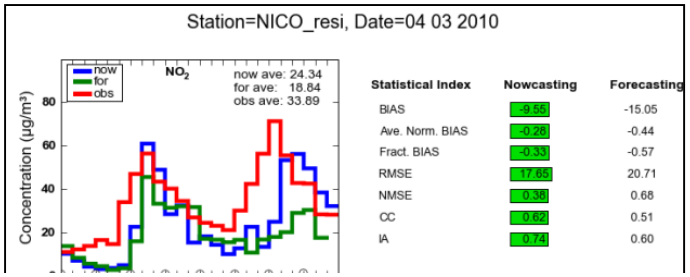
An EZM-based operational Air Quality Management System (http://www.airquality.gov.cy/)



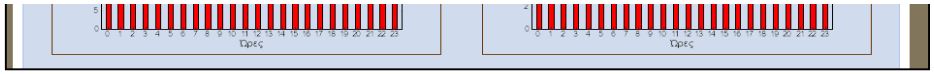
Ministry of Labour, Welfare and Social Insurance

Department of Labour Inspection

Air Quality and Strategic Planning Section

Contact person:

Dr. Chrysanthos Savvides, email: csavvides@dli.mlsi.gov.cy



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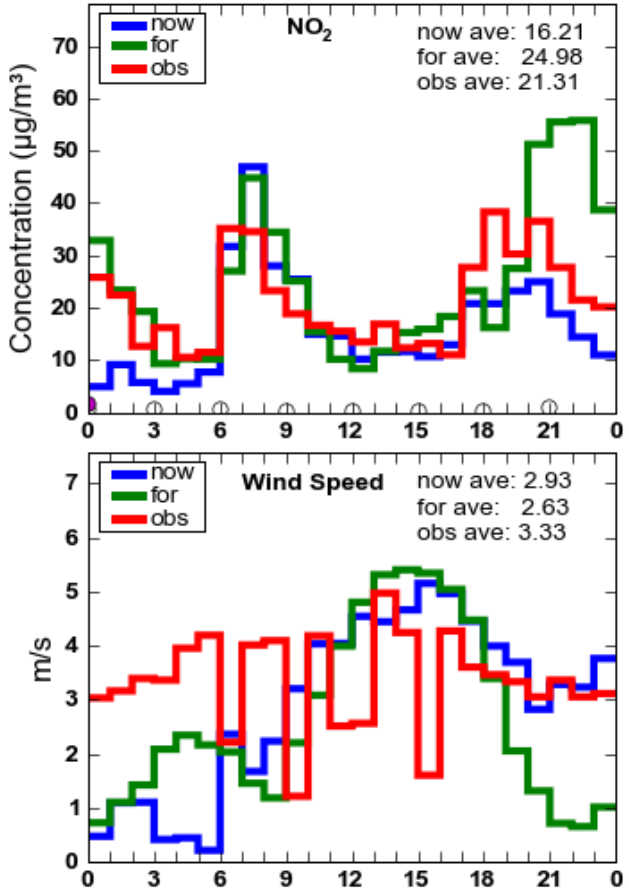
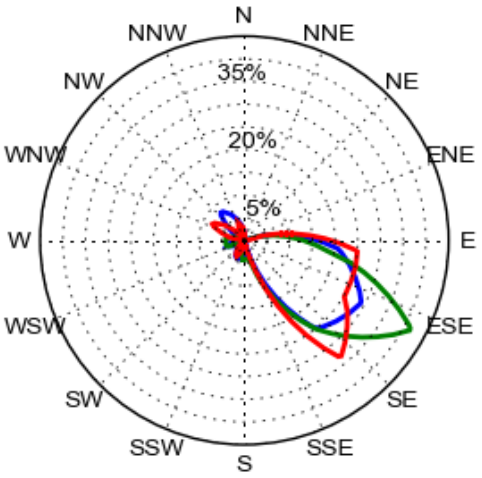
Comparison between AQMS info and in-situ observations



Statistical Index	Nowcasting	Forecasting
BIAS	-5.11	3.66
Ave. Norm. BIAS	-0.24	0.17
Fract. BIAS	-0.27	0.16
RMSE	8.87	12.35
NMSE	0.23	0.29
CC	0.70	0.59
IA	0.77	0.67



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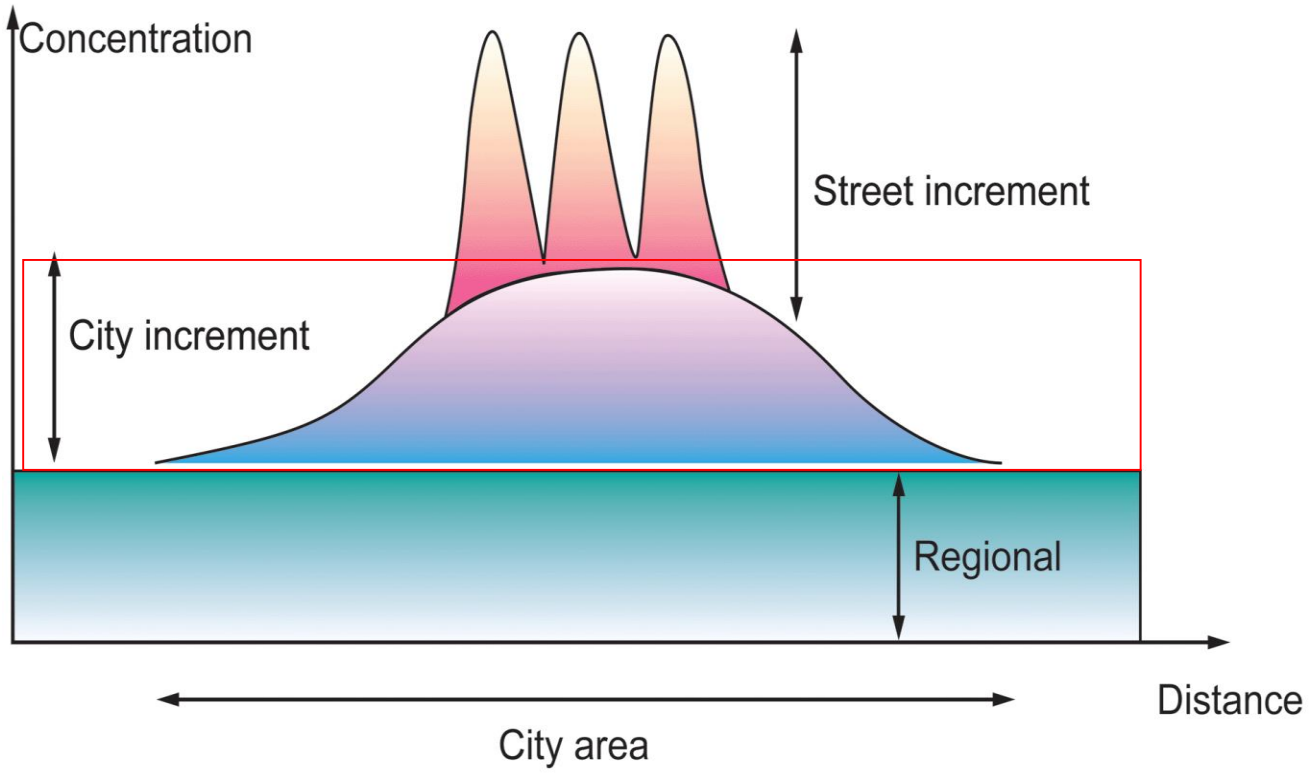
Linking traffic management and AQ assessment

But….



City scale

Goal = urban increment

3 steps

- ✓ Spatial sampling
- ✓ Multiple regression analysis
- ✓ Generalization

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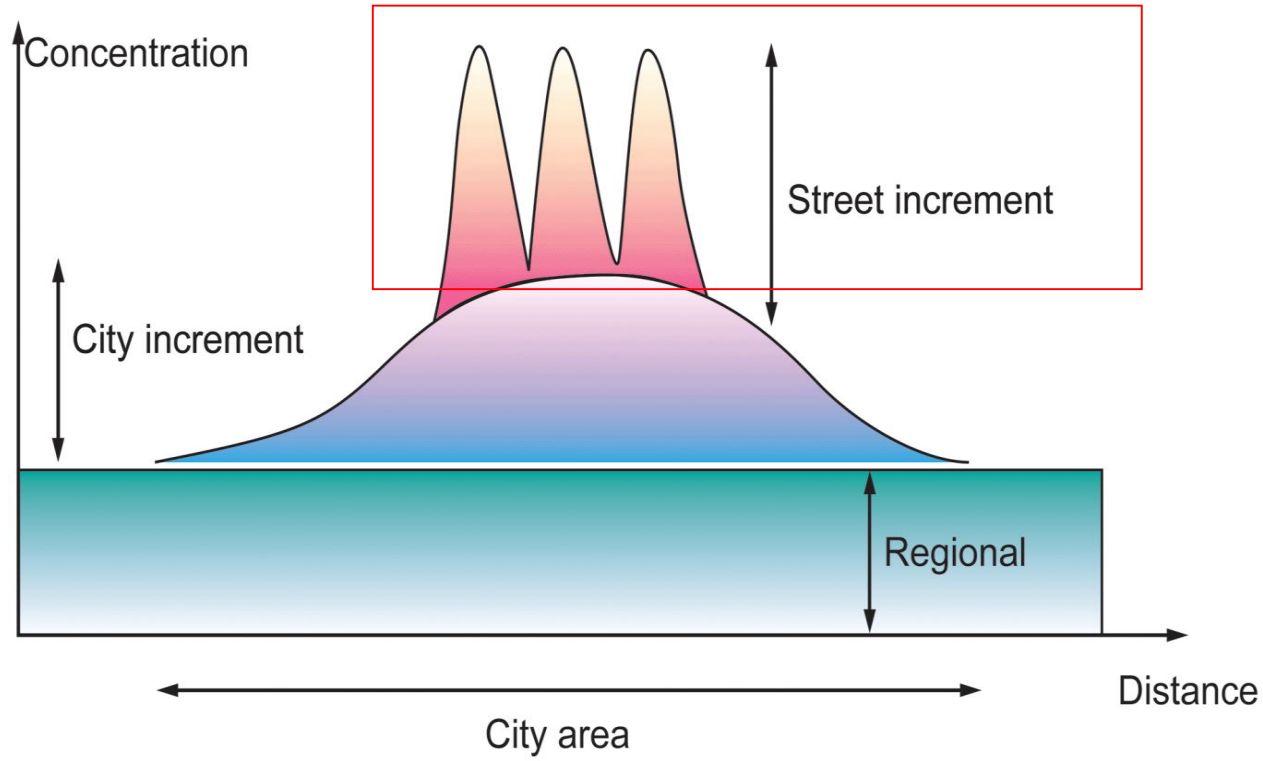
Linking traffic management and AQ assessment

But….



- **Street increment**
- **3 steps**
  - ✓ Selection of urban background pairs
  - ✓ Multiple regression analysis
  - ✓ Implementation of calculation

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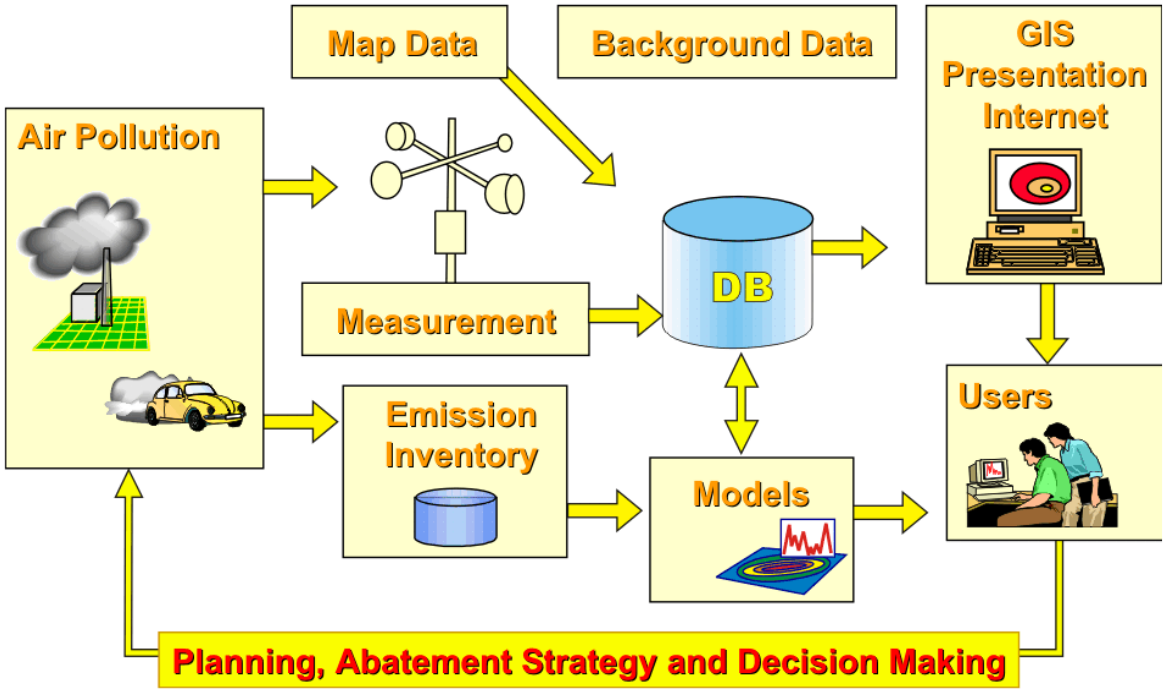
So…..

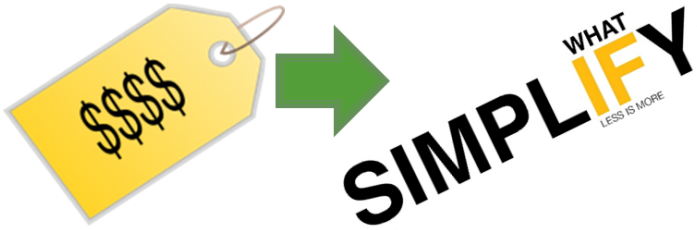
Linking traffic management and AQ assessment !

A modern system for Air Quality Management



Accuracy depends on:

- Traffic data (loops/models)
- Fleet composition
- Speed/driving patterns



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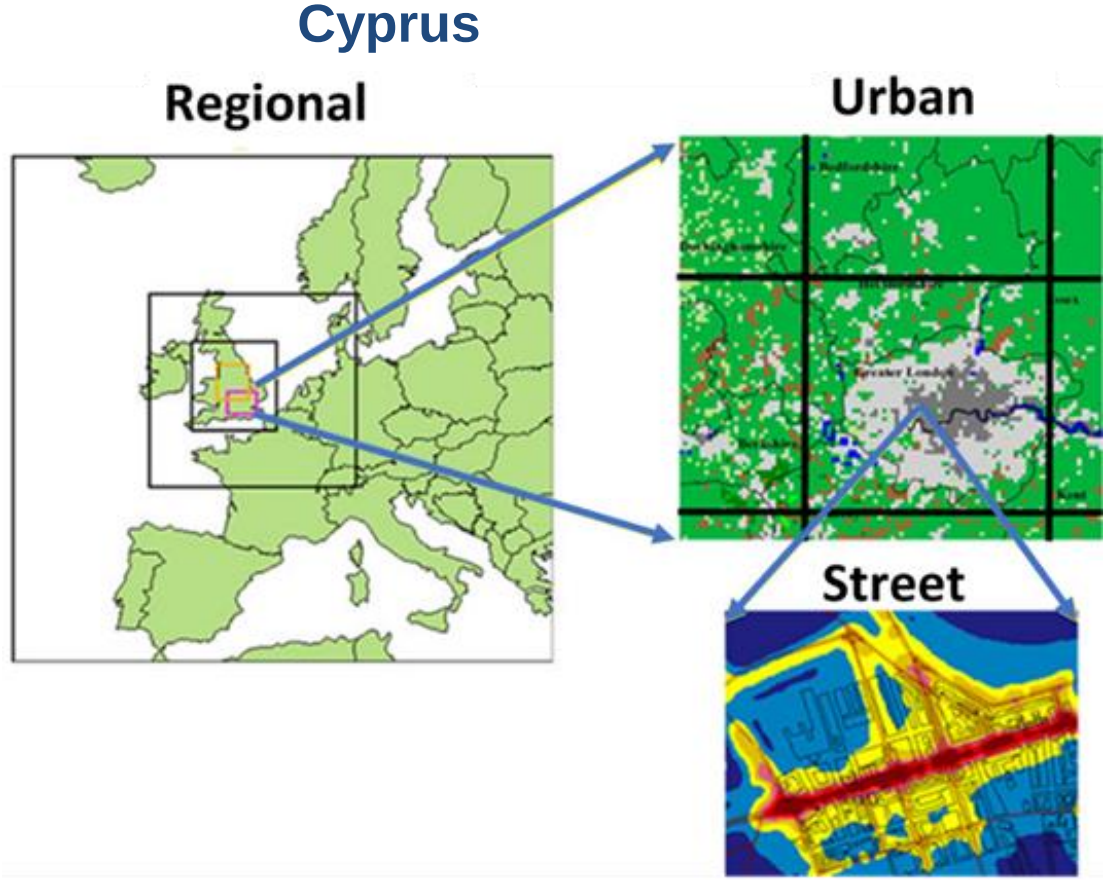
Linking traffic management and AQ assessment

What it does

- Evaluate AQ at real time
- City / street level exposure
- Identify hotspots
- Impact assessment of policy and technical measures



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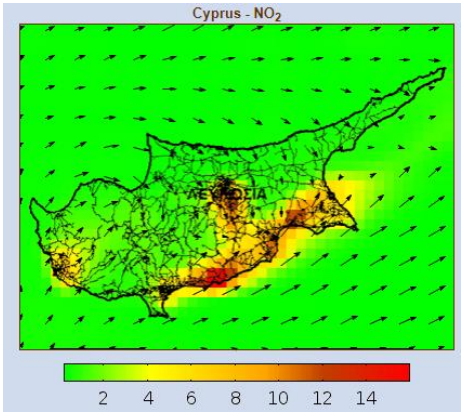
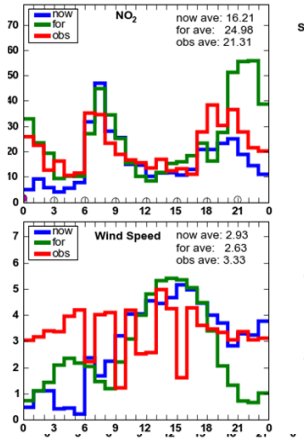
Linking traffic management and AQ assessment

Cyprus





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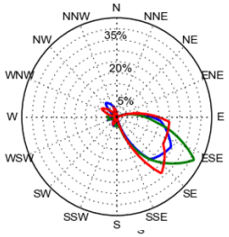

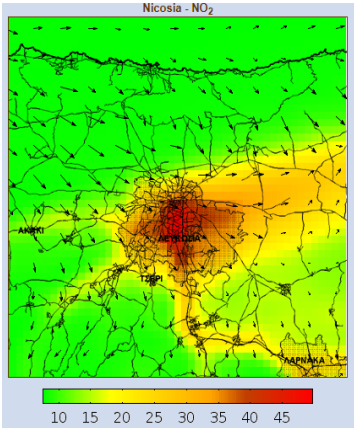

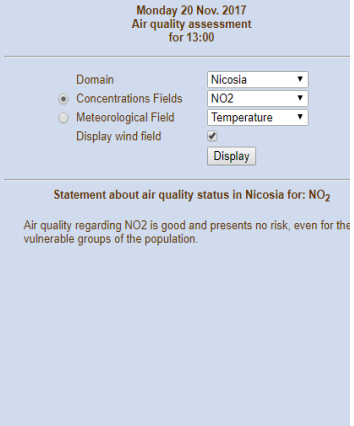

- 2-month pilot
- 2 urban locations
- AQMS Enhancement
- Comparison with monitoring network

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Linking traffic management and AQ assessment Cyprus

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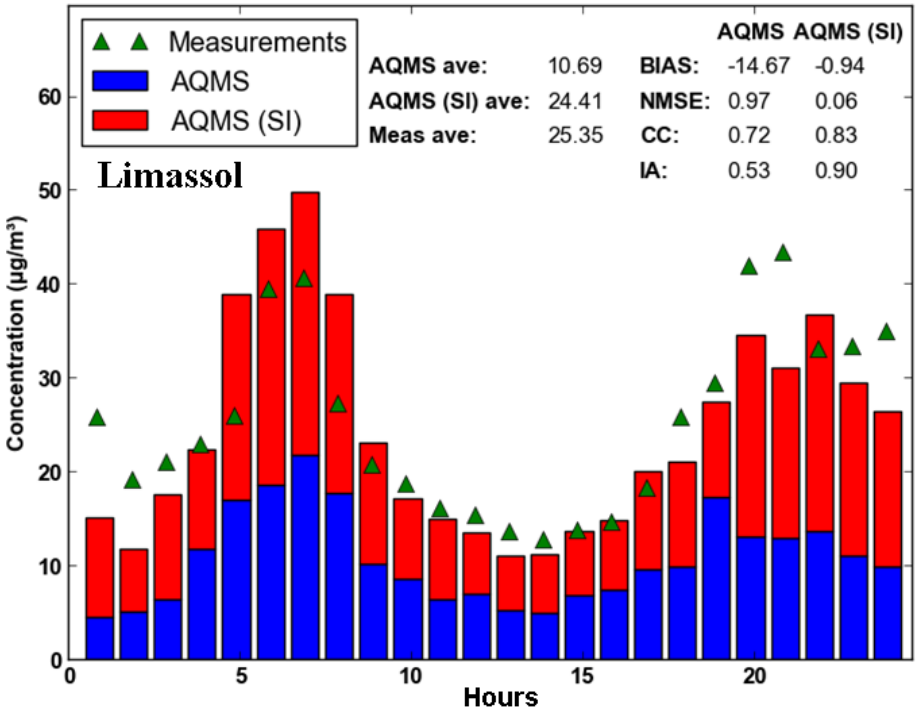

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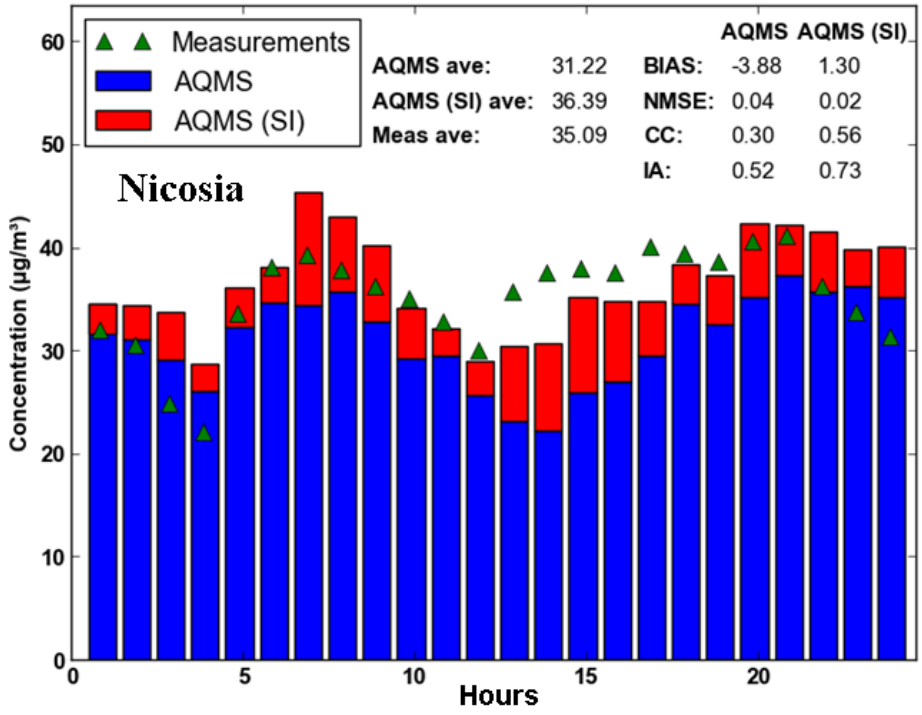

Clear improvement!

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Linking traffic management and AQ assessment Cyprus

Data Assimilation

Data Assimilation Module

1. Transfer of concentration data
2. Timebase checking, rejection of out-of-sequence data
3. Sanity checking: ranges (species-dependent), derivatives, spatial correlation
4. Classification (regional background, urban background, street-scale) and normalisation
5. Calculation of numerical tendencies (forcing terms)
6. Spatial “smearing” of tendencies
7. Incorporation of tendencies in the dynamical terms and step integration
8. Extraction of corrective terms, to be used in next assimilation/integration steps