

# Local Environmental Effects on Cultural Heritage

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nilu

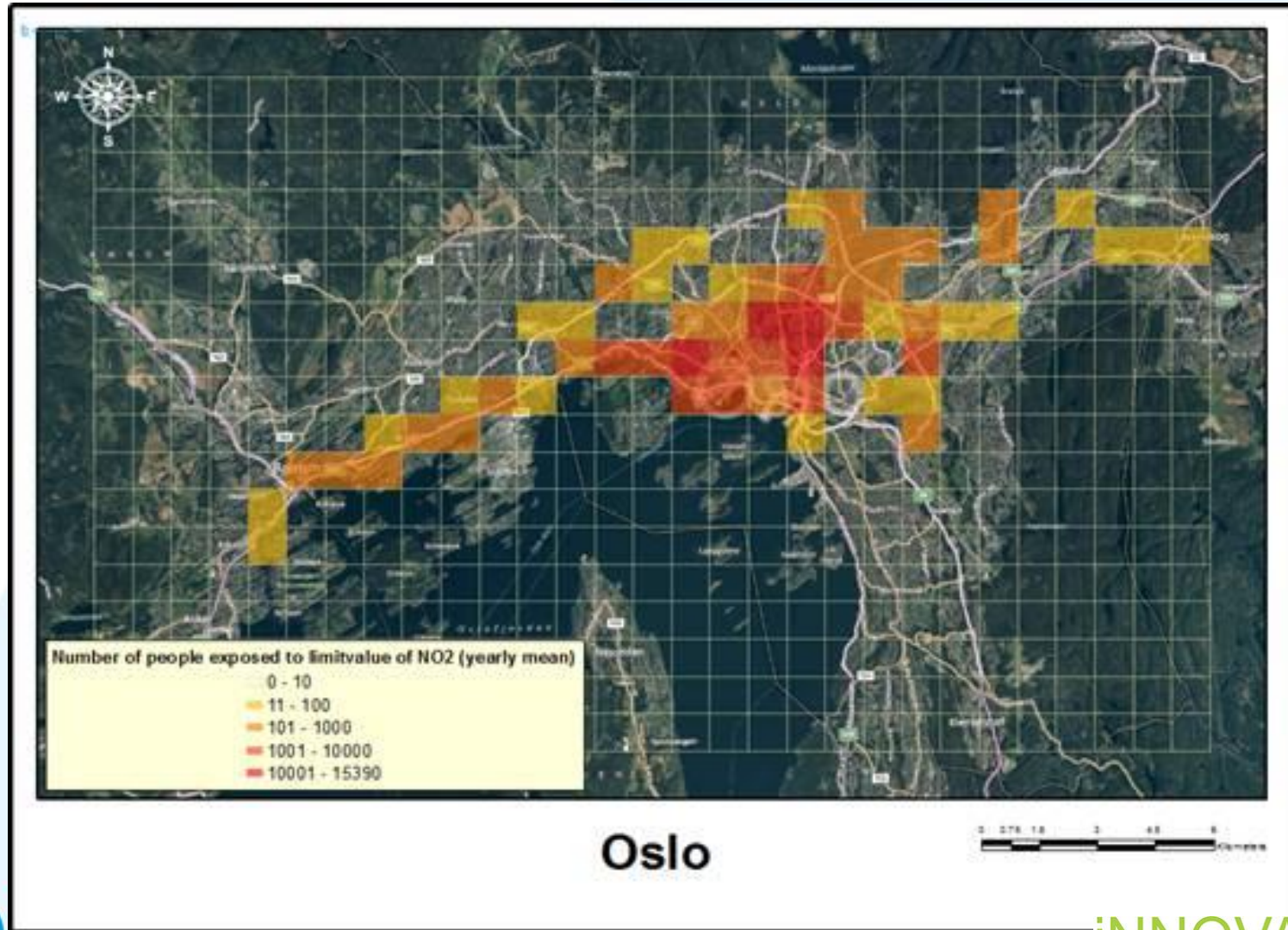
# Overview

- NILU Research
- City Pollution
- Is «**Green**» always environmentally friendly?
- A decade of research in protecting Cultural Heritage
  - EU Master project (2003-2006)
  - EU ProPaint project (2006 – 2010)
  - EU MEMORI project (2010 – 2013)

# NILU Core Research Areas

- Atmospheric composition
- Green house gases and climate forcing agents
- Ozone-layer depletion and UV radiation
- Long-range transport of air pollution
- Urban and industrial pollution
- Aerosol and particulate matter
- Chemicals and their environmental effects
- Health-effect studies
- Ecology and economics

# Urban Development and Planning





# Some Common Pollutants

$\text{NO}_2$ : 99% is man made, causes respiratory problems and degradation on many object types

$\text{SO}_2$ : driver for acidification, human health concerns and object degradation

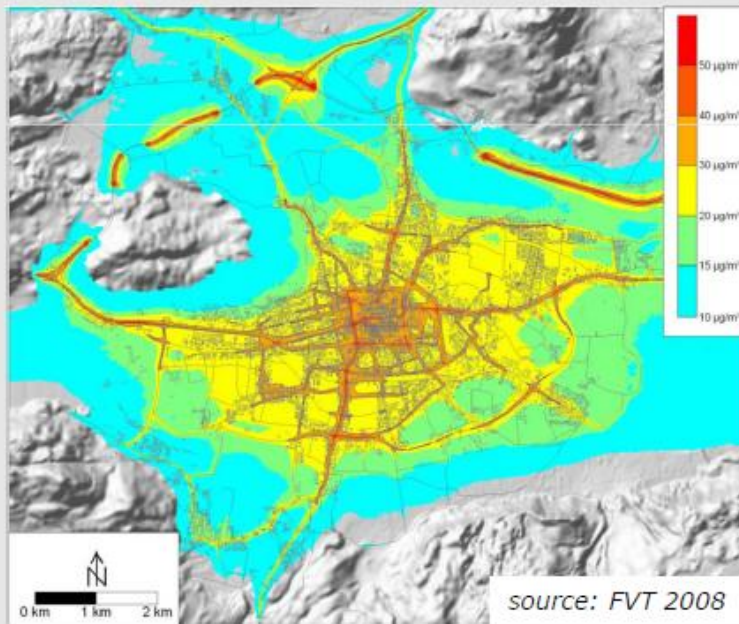
$\text{O}_3$ : concerns for human health and object degradation

PM (10 and 2.5): concerns for human health and object degradation

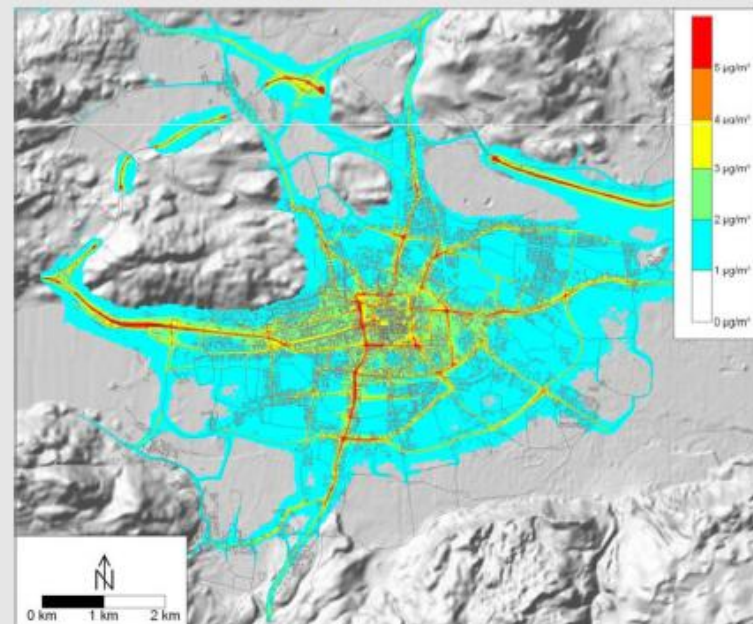
# Fuel Use Study

## Influence of Diesel vehicles

NO<sub>2</sub> annual mean BAU 2012



difference in NO<sub>2</sub> annual mean if from 2009 on only petrol cars are sold





# Is going «green» always environmentally friendly?



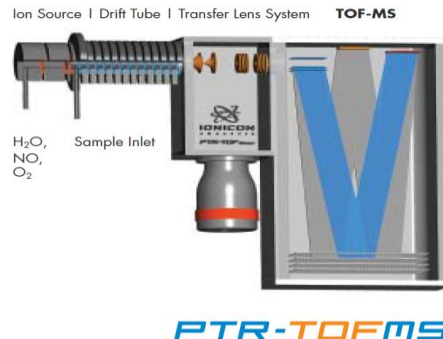
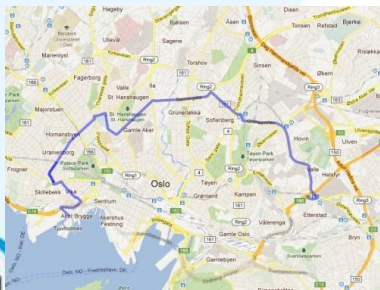
Between 2008 and Feb 2012 bio-ethanol fuelled buses were operated on line 21 in Oslo

BIEBUS Project

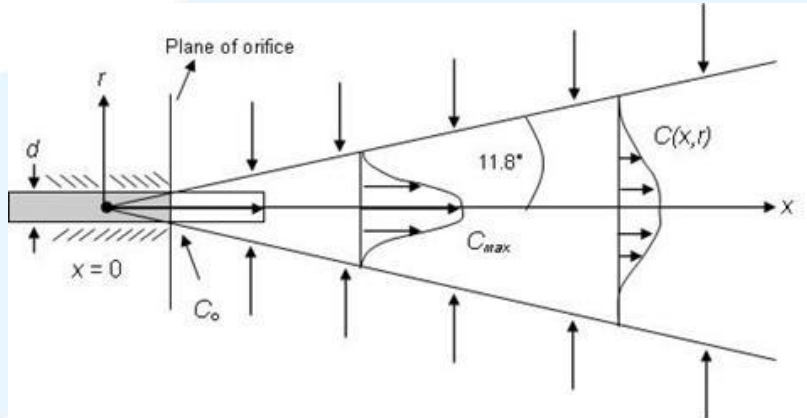
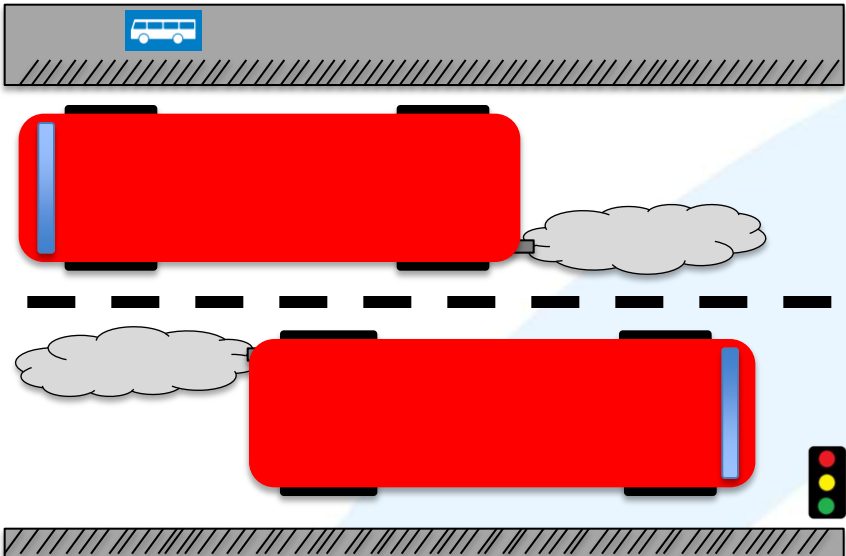
Measurement campaign in 2012

Emission measurements

- LI-6262 – CO<sub>2</sub>
- PTR-TOF – organic compounds (ethanol, aceticethanol, acetic acid, aldehydes, etc.)
- ECU Engine parameters
- GPS



# Example 2: BioBus project “Bio-ethanol in public transport: an integrated approach to evaluate the impact of climate change policies in urban areas”



Road Transport: 20% CO<sub>2</sub> emissions

**USE OF BIOFUELS**

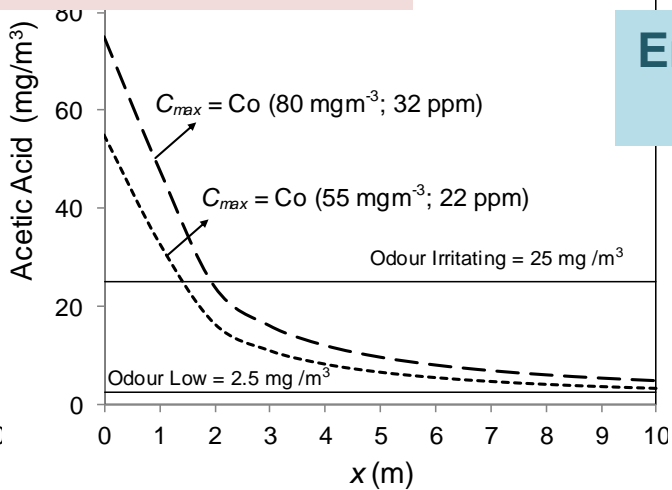
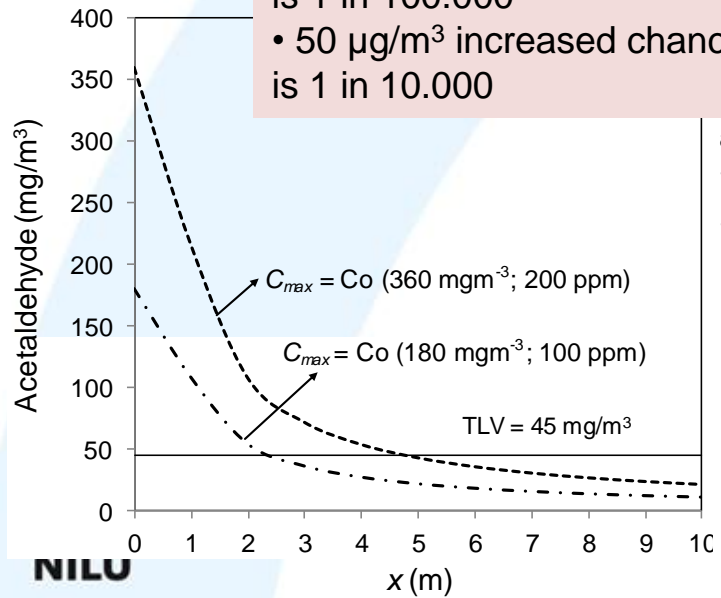


**Emissions Harmful Compounds**



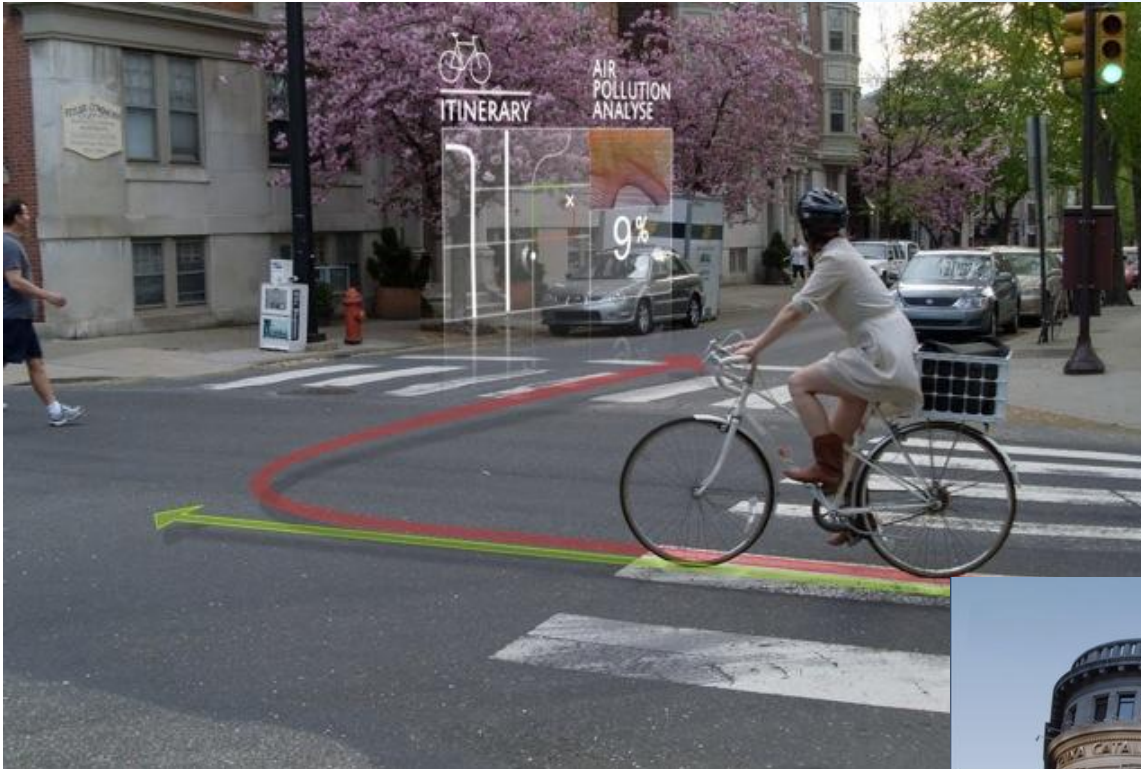
**Public Health**

- 5 µg/m<sup>3</sup> increased chance of developing cancer is 1 in 100.000
- 50 µg/m<sup>3</sup> increased chance of developing cancer is 1 in 10.000





# CITI-SENSE PROJECT



<http://www.citi-sense.eu>



centre de recerca  
en epidemiologia  
ambiental



# NILU: a decade of research in Cultural Heritage

Master (2004-2007)

Provided a new preventive conservation strategy for the protection of cultural property, based on an early warning system assessing the environmental impact on organic objects.

<http://www.nilu.no/master/>



# NILU's work in Cultural Heritage

## ProPaint (2007-2010)

To provide conservation staff and stakeholders with innovative protection treatments used as preventive conservation measure for paintings during exhibition, storage and transit.

<http://propaint.nilu.no/>



**PROPAIN**T

FP6 SSPI n° 044254





MEMORI

# NILU's work in Cultural Heritage

- MEMORI (2010-2013)
- <http://www.memori-project.eu/>

Provide the conservation market with innovative, non destructive, early warning technology combines with the latest in scientific knowledge for easy assessment of environmental impact on indoor cultural heritage.

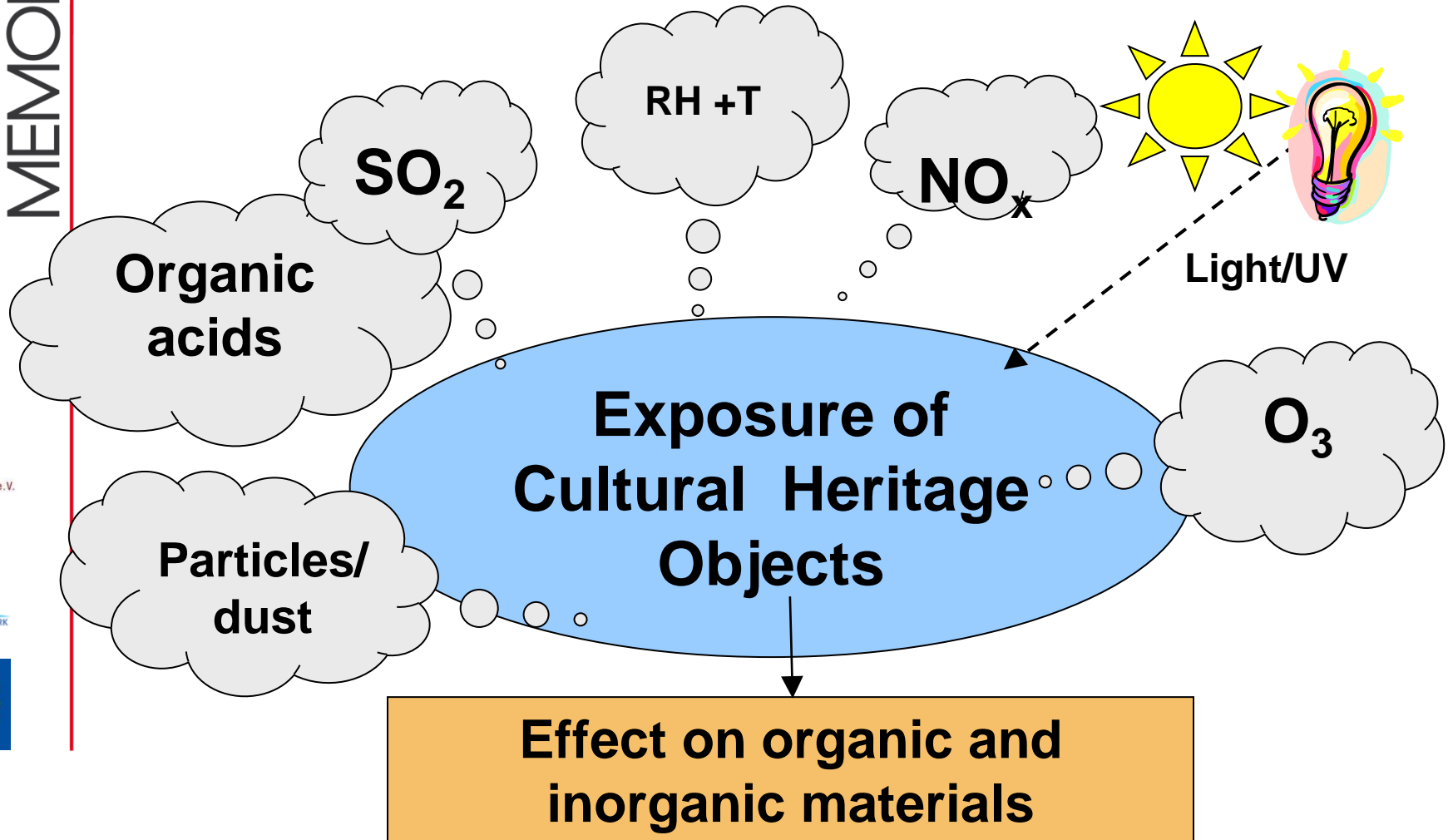




# Are You Aware?



MEMORI

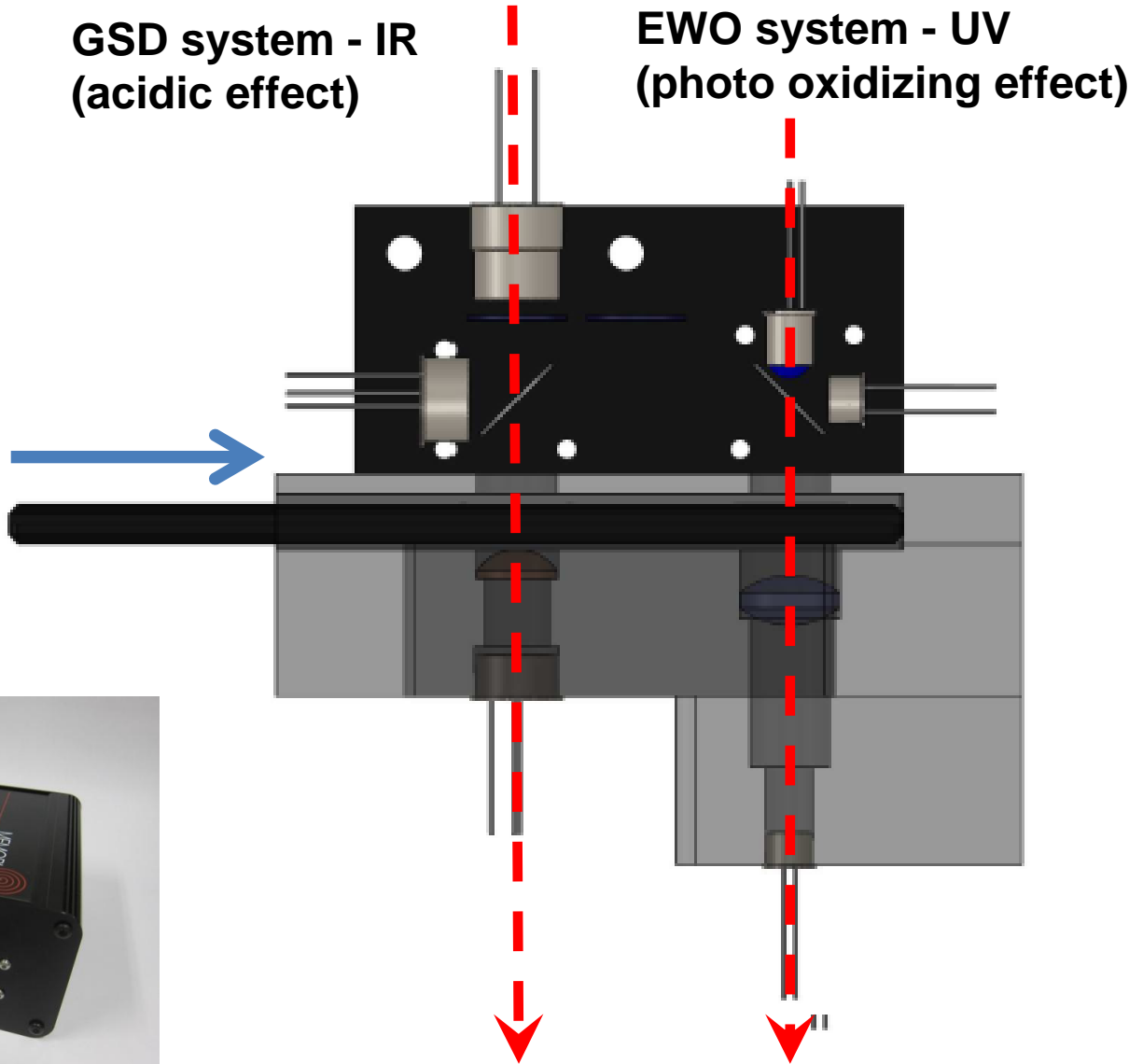


# The MEMORI technology



MEMORI

Dosimeter:



**Damage risk to selected CH materials**





MEMORI

# Research



Courtesy of EURONEWS





MEMORI

# Exposure



Courtesy of EURONEWS

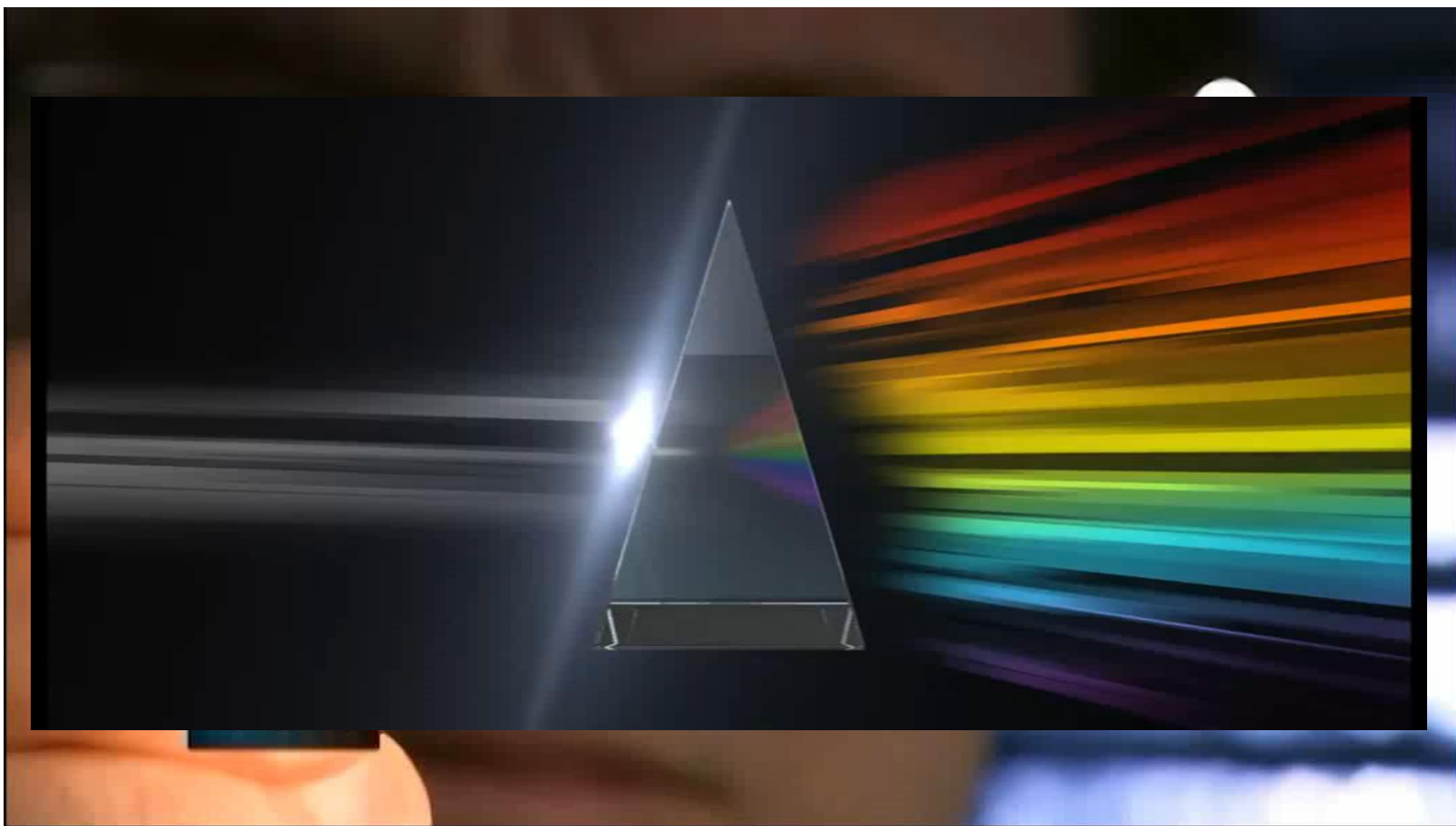






MEMORI

# Analysis



Courtesy of EURONEWS



# Assess Material Effect: Materials



MEMORI

LEAD	SILVER	COPPER ALLOYS	IRON
OTHER METALS	WOOD	PAPER	LEATHER
PARCHMENT	PIGMENTS	VARNISHES	TEXTILES
NATURAL HISTORY	GLASS	CERAMICS	STONE
BONE	IVORY	AMBER	



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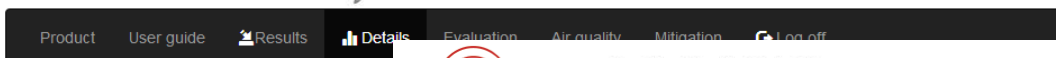
SEVENTH FRAMEWORK PROGRAMME





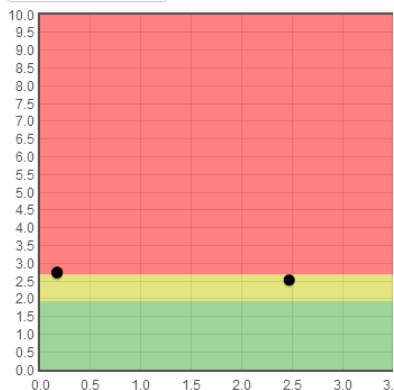
MEMORI

# Results

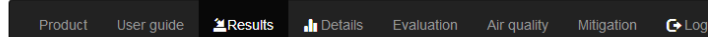


mount 3 mount 4

Lead X axis 10 Y axis



<input type="checkbox"/>	mount 4	2013-05-13T12:41:34
<input checked="" type="checkbox"/>	mount 4	2013-08-29T13:14:11
<input type="checkbox"/>	mount 3	2013-05-13T12:40:30
<input checked="" type="checkbox"/>	mount 3	2013-08-29T13:15:26



## 1. Upload data

Select...

## 2. Update location and material

A start measurement and an end measurement is needed to calculate the results

- = Missing values for calculations of result
- = Some risk for damage to sensitive objects
- = Very low risk
- = High risk for damage to sensitive objects

Sample	Location	Material	Measurement date	Result
0	monter 1	Lead	2013-05-02T13:09:53	
5	monter 2	Select material	2013-05-02T13:13:09	
6	monter 3	Silver	2013-05-02T13:08:43	
7	monter 4	Select material	2013-05-02T13:32:51	

- Lead
- Select material
- Lead
- Silver
- Copper alloys
- Iron
- Glass
- Ceramic
- Stone
- Bone
- Ivory
- Amber
- Pigment
- Varnish
- Wood
- Paper
- Leather
- Parchment
- Textile





MEMORI

# MEMORI

## Decision Support Model

- There are five main options for reducing the pollutant concentration within an enclosure, in order of their probability of these succeeding these are:
  - Avoid
  - Block
  - Dilute
  - Sorb
  - Filter
- For some of these it is important to understand whether the problem is caused by internally generated pollutants or externally generated pollutants. The MEMORI dosimeter responds to both of these, the EWO part typically measures externally generated pollutants and the GSD part internally generated pollutants.





# Mitigation Risk: Reduce Pollutant Concentration

- The practicality, cost and energy use of each mitigation method is considered:

**PRACTICALITY**

**COST**

**ENERGY USE**



MEMORI



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SEVENTH FRAMEWORK  
PROGRAMME





MEMORI

# Benefits of MEMORI

- Designed for use by both new and experienced conservators
- Easy to understand and detailed information
- Full inventory of air quality as it pertains to 19 material types
- Better management of artifact care
- Reduce restoration cost
- Ensure best quality environment for visiting pieces



# Case Studies

## (English Heritage and TATE Britain)

- A number of mitigation strategy case studies have been detailed on the [MEMORI website](#).
- These include:
  - Dilute and block – Kenwood House
  - Avoid, block and reduce relative humidity – Corbridge Museum
  - Avoid and filter – Apsley House Plate and China room
  - Filter – Fountains Abbey
  - Sorb – Apsley House basement gallery
  - Anoxia, avoid, block and sorb – framed sketch on paper displayed temporarily at TATE Britain.



MEMORI



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SEVENTH FRAMEWORK  
PROGRAMME





MEMORI

# Thank you for your attention!

## Contact details

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[www.memori-project.eu/](http://www.memori-project.eu/)

[www.innovationnilu.com](http://www.innovationnilu.com)

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