



# COMBINING DIFFERENT METHODOLOGIES FOR SOURCE APPORTIONMENT OF PARTICULATE MATTER IN CYPRUS



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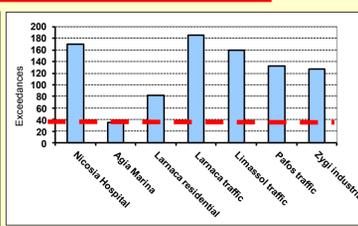
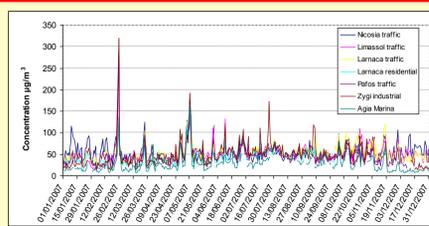
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## METHODOLOGIES

- **Air quality monitoring** data from different stations were examined along with meteorological data to classify exceedance situations and identify the conditions leading to air pollution episodes in Cyprus.
- The **combined analysis** of back trajectories, aerosol model results, aerosol maps and satellite images was used for the classification of exceedance situations in Cyprus.
- The **subtraction of the 30<sup>th</sup> percentile (Escudero et al., 2007)** method and of the sea salt ion ratios were the methods used to quantify long range dust and sea salt PM<sub>10</sub> contributions for the year 2008, according to the Guidance on the quantification of the contribution of natural sources under the EU Air Quality Directive 2008/50/EC.

## ANALYSIS BASED ON MEASURED CONCENTRATIONS FOR 2007



CYPRUS MONITORING NETWORK

SIMULTANEOUSLY OCCURRING PEAKS

2007 EXCEEDANCES

Station	Coordinates	Annual mean	Exceedances	Max
1. Nicosia Hospital	33° 21'16"E, 35°10' 18"N	52.92	170	316.1
4. Limassol Traffic	33°02' 09"E, 34°41' 11"N	52.36	159	605.3
5. Larnaca Traffic	33°37' 40"E, 34°54' 00"N	54.39	185	402.1
6. Larnaca Residential	33°36' 55"E, 34°54' 49"N	43.85	82	337.7
7. Pafos Traffic	32°25' 18"E, 34°46' 32"N	48.87	132	739.5
8. Agia Marina (EMEP)	33°03' 26"E, 35°02' 08"N	28.28	35	469.2
9. Zygi Industrial	33°20' 15"E, 34°43' 46"N	48.57	127	1142.6

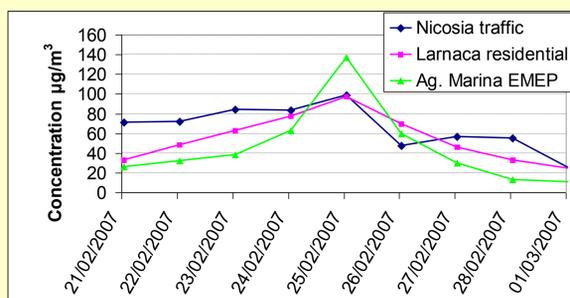
## CLASSIFICATION OF EXCEEDANCE SITUATIONS

**Exceedances** of PM<sub>10</sub> daily concentrations for 2007 were classified using:

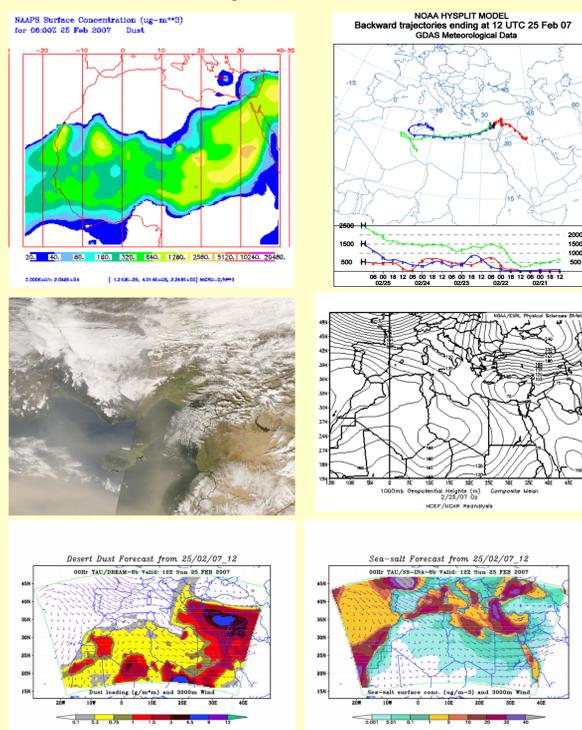
- **back-trajectory modelling:** 5-day back trajectories at different altitudes for each day with exceedance were calculated with the HYSPLIT4 model
  - study of **synoptic maps, NAAPs aerosol maps and MODIS satellite imagery**
- Dust load and sea salt surface concentrations with the **DREAM-8b** model of the Tel Aviv University were used.

### Saharan episode example:

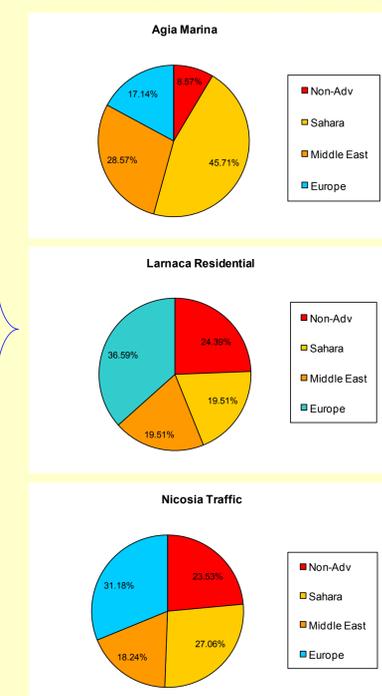
Observations indicated possible long-range transport due to peaks occurring **simultaneously** at different stations.



### Saharan Episode Identification



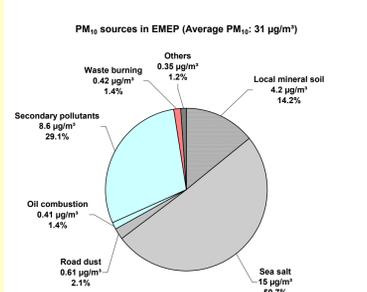
### Classification of exceedance situations at three stations



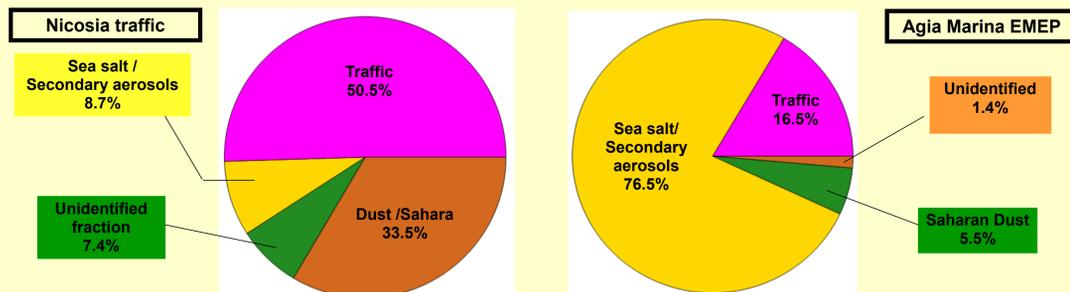
## CHEMICAL ANALYSIS AND RECEPTOR MODELLING

**Enrichment Factor (EF)** analysis for 2008 and **multivariate receptor modelling** showed:

- **sea salt** was the largest contributor to PM<sub>10</sub> considered as being of natural origin at the regional background station of Agia Marina EMEP
- **traffic pollution** was the largest contributor to PM<sub>10</sub> levels at Nicosia traffic
- **secondary pollutants** and **oil combustion** were more important sources at Nicosia residential station .

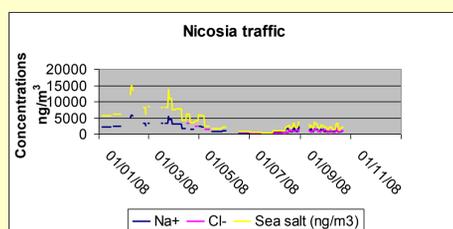
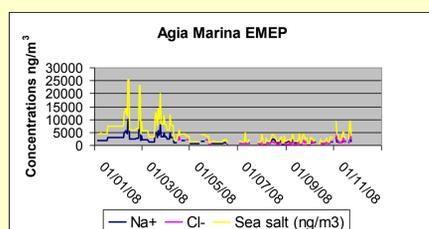


**Positive Matrix Factorisation (PMF)** was applied for a period between 2008 and 2010.



## SEA SALT QUANTIFICATION

- Chemical analysis 2008: **chloride** and **sodium ion** concentrations
- Assumption: sea salt is made up entirely by **NaCl** and that all Na and Cl are associated in sodium chloride



## TRAFFIC PM CONTRIBUTION AT HOTSPOTS IN CYPRIOT CITIES

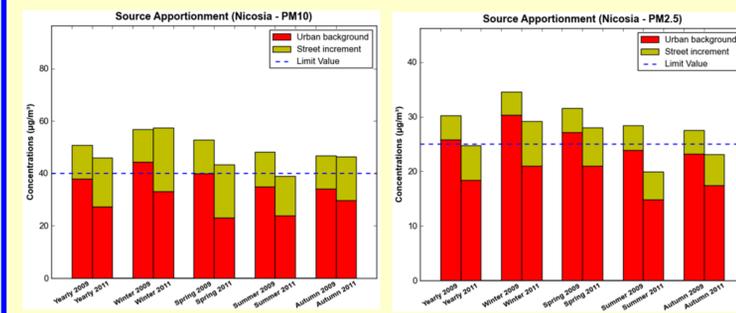
### Aim:

Estimation of the contribution of different sources in PM levels inside street canyons with emphasis on the impacts of:

- The natural variation in wind characteristics (wind direction and wind speed).
- Traffic induced road dust resuspension.

### Results

Street level annual average PM<sub>10</sub> and PM<sub>2.5</sub> concentrations in Makariou Ave. (Nicosia) and seasonal variation for 2009, 2011.



- The combination of direct vehicle emissions and road resuspension contributes significantly to the street level concentrations.
- Natural variation in wind conditions can have an important impact on street level concentrations.

## REFERENCES

Escudero, M., X. Querol, J. Pey, A. Alastuey, N. Pérez, F. Ferreira, S. Alonso, S. Rodríguez and E. Cuevas (2007b) A methodology for the quantification of the net African dust load in air quality monitoring networks, Atmospheric Environment 41, pp. 5516-5524.