AN AIR QUALITY MANAGEMENT SYSTEM FOR CYPRUS: DEVELOPMENT AND EVALUATION

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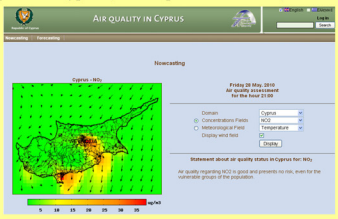
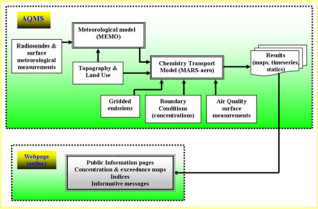
Introduction

Operational air quality modelling has been increasingly recognised as an indispensable component of any integrated air quality assessment strategy, especially in view of the provisions of the new **European Union Directive (2008/50/EC)** which encourages the use of computational methods along with direct monitoring and remote sensing-based assessment methodologies. In view of this emerging need for better incorporation of modelling methods in air quality management, integrated informational systems known as **Air Quality Management Systems (AQMS)** have been developed aiming to provide technical users and policy makers with a consistent and robust environment for their regular workflows. In this framework, a newly-developed AQMS has been installed and used operationally in the **Department of Labour Inspection (DLI)** of the Republic of Cyprus (Moussiopoulos et al., 2010).



The core of the new **AQMS** consists of a model system which performs nested grid meteorological and photochemical model simulations in two parallel operational modes, providing users with updated air quality nowcasting and forecasting for the entire island of Cyprus. Air quality assessment and decision making is supported by the **AQMS** by enabling authorised users to interactively configure custom emission scenarios and computationally assess air quality trends over user-defined domains of interest.

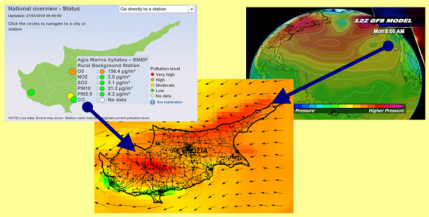


Following an operational validation of the system performance and by continuously evaluating user feedback, a range of improvements on the model core as well as structural modifications on the system's user interface have recently taken place.

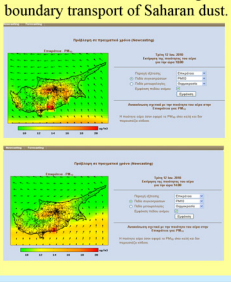
Development

In an effort to optimize the model core performance, a revised methodology has been incorporated in the boundary condition module which enables the combined use of concentration values obtained from the results of larger scale models and air quality measurements conducted by the **DLI**.

Moreover, one of the most important adjustments in the boundary

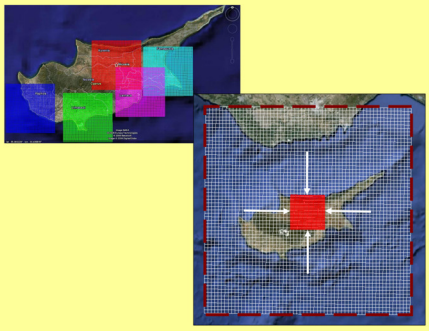


condition module is the integration of a dust increment in PM calculations. This increment, which originates from specifically developed larger scale models, aims to improve the system's prognostic skill in the cases of high PM levels associated with trans-boundary transport of Saharan dust.



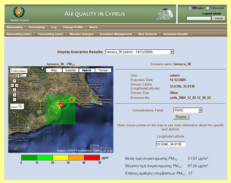
The figures presented on the left demonstrate the gradual dust transport over the Cyprus domain during a typical Saharan dust episode. As evidenced from these maps, the system performs reasonably well in reproducing the qualitative aspects of the spatial distribution of PM during dust episodes.

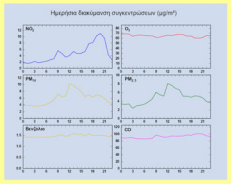
A final set of enhancements focused on the improvement of the nesting capabilities of the meteorological and transport models. The upgraded nesting methodology which has recently been developed and incorporated in the system's core provides the capability for multiple nested domains as well as increased flexibility in the coupling of the nested domains by enabling the optional assimilation of initial and lateral concentrations obtained from the respective model calculations in the coarse domain.



Besides, the system provides to the DLI staff the capability to perform AQ scenario runs based on emission scenarios that have been produced using the emissions calculation software.

Scenario results are displayed in the form of maps and statistical indices.

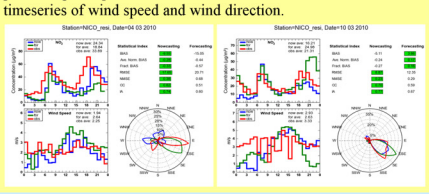




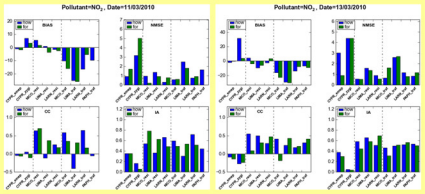
Evaluation

At the end of each day, a wide range of statistical indicators are calculated according to the guidelines set by COST728 (2008), for the station locations and pollutants of interest, and numerous charts are produced for visually assessing the accuracy of the simulations in both nowcasting and forecasting mode.

In order to have a better overview of the system's performance, validation charts for meteorological parameters are also produced presenting comparisons between the calculated and the observed timeseries of wind speed and wind direction.

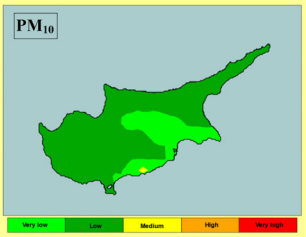


Besides, in order to better evaluate the system's performance, suitable statistical indicators are calculated and presented to the user at the end of each day. Indicators are calculated from simulated and measurement data series on the sites where DLI's air quality measurements take place.

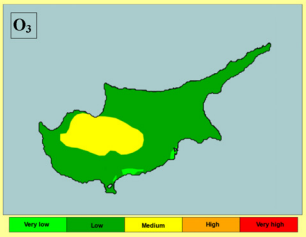


Public awareness through television bulletins

The system provides information about the daily air quality forecast of the next 24 hours in the form of appropriate maps. These maps are produced in a specific format compatible with television requirements.



The public will be informed about the expected health impacts of the forecasted air quality situation by air quality bulletins broadcasted on the Cyprian television on a daily basis.



Conclusions

As part of the continuous evaluation and improvement of the ability of the Cyprus **AQMS** to computationally assess the air quality status for the entire island as well as in five major cities, a range of improvements and modifications on its model core structure have recently taken place. Part of those are:

- The operational evaluation of the system using a variety of statistical indices and validation charts presenting comparisons between the calculated and the observed timeseries of pollutant concentrations and meteorological variables.
- A highly configurable nesting module.
- The integration of observed concentrations and results of larger scale models in the initial and boundary conditions of the model calculations, also including a dynamically estimated dust increment.

Acknowledgements

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Reference

Moussiopoulos N., Douros I., Tsegas G., Kleanthous S. and Chourdakis E. (2010): An air quality management system for Cyprus, Global NEST Journal Volume 12 No. 1, Pages 92-98.

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