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POLLUTANT DISPERSION IN A HEAVILY INDUSTRIALIZED REGION: COMPARISON OF DIFFERENT MODELS

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1. INTRODUCTION

The objective of this study is to analyse the meteorological fields and the dispersion patterns of different pollutants released by several types of industries on a heavily industrialized region located in the NE part of Spain. Petrochemical industries, several chemical plants are concentrated in an industrial park placed near the shoreline of the Mediterranean Sea and close to a relatively high mountain range, facts which increase the complexity of the wind fields in the region and therefore of the resultant pollutant dispersion patterns. Numerical modelling has been carried out with two different models: the 3-D Urban Airshed Model with variable grid (UAM-V) (Biswas et al., 2001), implemented to MM5 meteorological model (Grell et al. 1994); and an Australian model TAPM (Luhar and Hurley, 2003), which has its own photochemical module. The models have been run from 7th to 9th August 2003, during a summer ozone episode mainly characterized by a synoptic situation of high pressures which favour the development of mesoscale circulations forced by the topography. First results show how meteorological fields are certainly a critical component of the dispersion modeling systems because in this area local wind circulations are the main cause of the plume dispersion. In consequence, its evaluation is considered as a preliminary and an important point of this study. Afterwards a comparison between the dispersion patterns given by the two different photochemical is carried out and agreements and differences are analyzed.

2. METEOROLOGICAL MODEL EVALUATION

The meteorological simulations were performed using the nesting capabilities of the two models. Four nested domains were used at horizontal resolutions of 27, 9, 3 and 1 km. The dimensions of each domain are 31x31 for the two outer domains, and 46x40, 67x40 grid cells for the two inner domains, respectively. In the case of TAPM, all domains had the same number of cells (67x40). Table I shows the statistics of the

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comparison between measurement and the output of the two meteorological models for different surface stations.

Table 1. Statistics of the comparison between measured and simulated winds.

Stations	Bias (ms^{-1})		Accuracy (ms^{-1})		RMSE (ms^{-1})		Direction Accuracy (º)	
	MM5	TAPM	MM5	TAPM	MM5	TAPM	MM5	TAPM
Alcover	0.8	1.7	1.1	1.7	1.8	1.0	52	29
Botarell	-0.3	1.0	0.9	1.1	1.1	0.9	37	32
Constantí	1.1	1.9	1.3	1.9	1.3	1.0	51	35
Espluga de F.	-0.03	0.7	1.6	1.3	1.9	1.4	42	69
Reus	1.0	1.8	1.1	1.8	1.1	0.7	38	32
Torredembarra	0.02	0.1	0.9	0.8	1.2	1.0	43	37
Vila-Seca	0.5	1.0	1.5	1.0	0.8	0.6	50	43

The results above show that both models give good agreement with observations, especially for wind velocity. TAPM model tends to overestimate the wind velocity, while the Bias value for MM5 model depends of the station. For wind direction both models simulate correctly the sea breeze entrance, while during night time the wind velocity is low or calm and the models behaviour is worse.

3. DISPERSION SIMULATION

Since the intention of this study is to evaluate the contribution of the plume emitted by the main industries in the region, and to study its dispersion patterns, neither initial nor boundary conditions have been considered in the simulations.

Previous to the photochemical simulation, the models have been executed in a non-reactive mode using CO as a tracer in order to analyze the plume dispersion pattern. Results indicate that during daytime the plume is dispersed inland to the mountain range due to the sea breeze flow, while during nighttime, the plume is dispersed towards the sea due to the prevailing drainage winds.

The photochemical simulation shows for ozone a similar behaviour to that of CO, although previous day accumulated precursors originate some differences in the dispersion. As a consequence, ozone is generated in wider regions which are sometimes disconnected from the direct impact area of the plume.

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