An Application of the EU Directive (April, 1999) on Relation to Modelling Accuracy

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1 Introduction

Council Directive 1999/30/EC, April, 22, 1999[1] on relation to limit values for sulphur dioxide, nitrogen dioxide and oxides of nitrogen, particulate matter and lead on ambient air is the first EU directive with explicit reference to “modelling tools” and also with more detailed focus on the interpretation of monitoring data and the representativeness of these data. Focusing on ozone, the standards outseid of the European Union have been moving toward a continuos reduction of the limits in combination with different averages. EU April, 1999 Directive stands for pollutants different than ozone however in this contribution we have used the criteria for modelling established in April, 1999 directive for other pollutants and applied over ozone concentrations. Outside Europe, ozone limit concentrations are somehow more exigent than those operating in EU. So that Switzerland has 120 $\mu g/m^3$ for one hour mean; USA has currently the primary (health related) and secondary (vegetation related) national ambient air quality standards are both set to 0.12 ppm as 1-hour mean. An area attain when the number of days per year on which the level is exceeded is less than or equal to one averaged over 3 years. American EPA after extensive reviews and scientific findings concluded that the current standard is not sufficient to protect the public and vegetation from adverse effects. President Clinto approved the EPA proposal to replace the current primary and secondary standard by an 8-hour standard set at 0.08 ppm. An area would not attain when the 4^{th} highest daily maximum 8-hour concentration, averaged over 3 years is above 0.08 ppm. In EPA-454/R-99-009[2], July, 1999 document. This document and other undeline the importance of the interpretation of the forecast and the goals of the user. In EPA document special importance is given to analyze the forecast in terms of contingency tables showing the degree of accuracy of the ozone forecast based on the success on forecasting exceedances. The fact of that observation data is only referred to information for a very local effects – particulary over urban domains – and the modelling data is in many cases referred to grid cells with larger spatial domains and means is analysed. The comparison between both approaches should be done with care and always keeping in mind both concepts. See Ozone position paper[4].

2 Methodology and experiences

The EU Directive, April, 1999 mentions that the accuracy of the modelling tools should be 50-60% for hourly averages and the concept of accuracy is under discussion. We have adopted an approach which is explained in Figure 1.

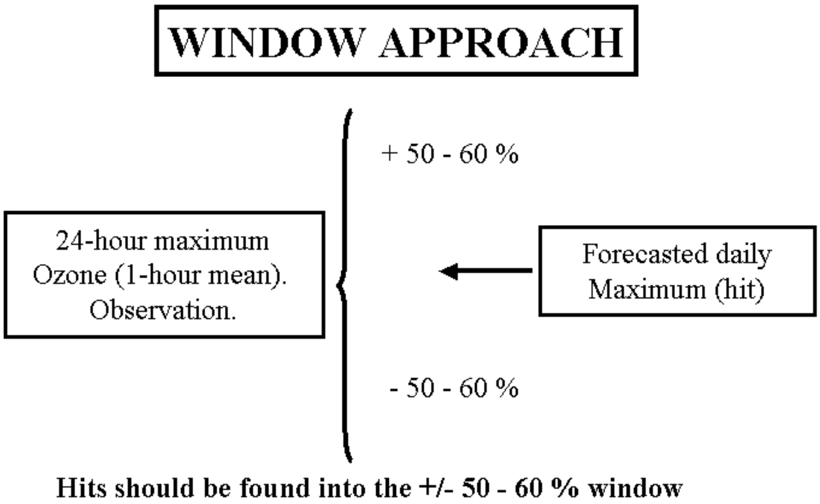

Figure 1 Scheme of the so challed 'window approach'.

Figure 2 show a flow diagram which has been built to account for hits and to evaluate the success of the ozone forecasts. The OPANA modelling system[3] (OPerational Atmospheric Numerical pollution model for urban and regional Areas) has been applied over Madrid Community (Spain) during 2000 summer and also over Bilbao (Spain) city during the EQUAL project[4] (EU, DGXIII programme). In the case of Bilbao we have analysed 4 days and 5 stations and 4 weeks corresponding to the 4 seasons during 2000 year and several pollutants: SO_2, NO, NO_2, O_3 and CO with a number of cases between 64 and 80. The results are shown in Table 1 and Table 2 for Bilbao. In case of Madrid, we have analysed data from August, September and October, 2000 for ozone concentrations. Results are shown in table 3.

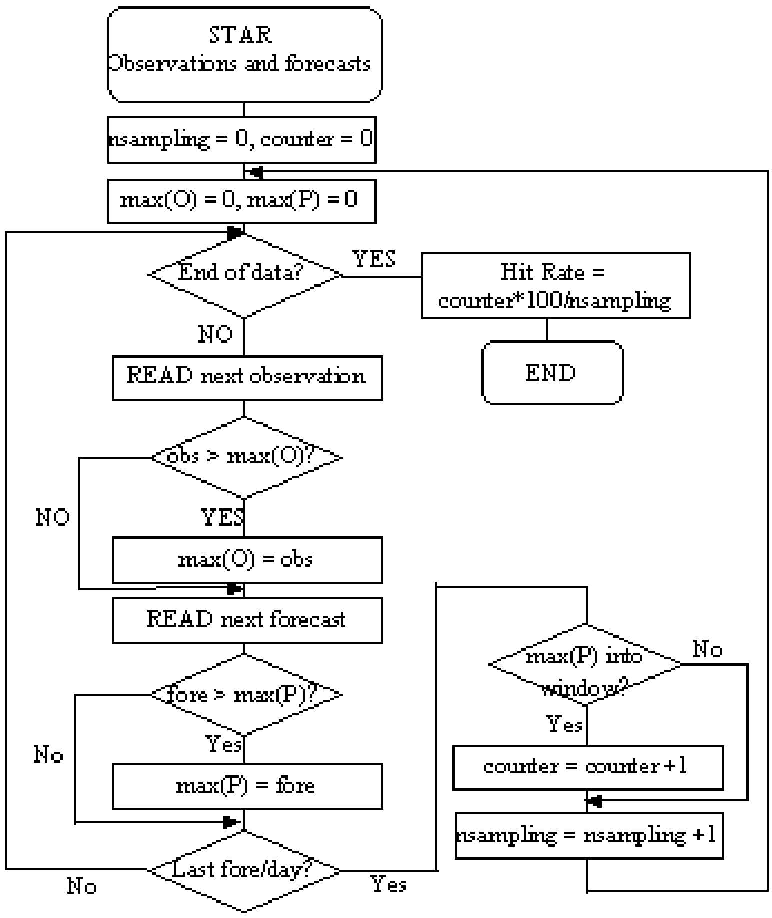

Figure 2 Flow chart for the 'window-approach' method.

Table 1 Percentages of hit rates for a defined 'size of window' for the different pollutants. 2000, Bilbao.

	10 %	*15 %*	*20 %*	*25 %*	*30 %*	*35 %*	*40 %*	*45 %*	*50 %*
SO_2	16,2 %	27,5 %	31,2 %	36,2 %	38,7 %	45 %	51,2 %	58,7 %	61,2 %
NO	14,1 %	21,9 %	23,4 %	28,1 %	34,4 %	46,9 %	48,4 %	53,1 %	59,4 %
NO_2	23,7 %	36,2 %	41,2 %	47,5 %	58,8 %	65 %	66,2 %	68,7 %	75 %
O_3	18,4 %	26,3 %	31,6 %	42,1 %	50 %	57,9 %	61,8 %	67,1 %	75 %
CO	15,3 %	23,6 %	33,3 %	41,7 %	45,8 %	52,8 %	61,1 %	68,0 %	72,2 %

Table 2 Hit rates for ozone during the summer scenario (2000, Bilbao).

	5%	*10 %*	*15 %*	*20 %*	*25 %*	*30 %*	*35 %*	*40 %*	*45 %*	*50%*
O3	25 %	25 %	35 %	50 %	65 %	75 %	90 %	90 %	90 %	100 %

Table 3 Ozone hit rates for August, September and October, 2000 over the Madrid Community by using the OPANA modelling system. Header shows the month and window size; second line after header shows the number of hit rates int such a "window".

Aug, 2000	*5%*	*10 %*	*15 %*	*20 %*	*25 %*	*30 %*	*35 %*	*40 %*	*45 %*	*50%*
O3	15 %	25 %	35 %	50 %	65 %	75 %	90 %	90 %	90 %	100 %
Sep., 2000	*5%*	*10 %*	*15 %*	*20 %*	*25 %*	*30 %*	*35 %*	*40 %*	*45 %*	*50%*
O3	18 %	23 %	37 %	50 %	60 %	85 %	85 %	85 %	85 %	90 %
Oct, 2000	*5%*	*10 %*	*15 %*	*20 %*	*25 %*	*30 %*	*35 %*	*40 %*	*45 %*	*50%*
O3	13 %	22 %	27 %	27 %	43 %	46 %	53 %	55 %	60 %	70 %

OPANA modelling system includes emission inventory, initial forecasted meteorological sounding profiles, air quality monitoring data, landuse data and digital elevation model datasets. All these input datasets have an associated an uncertainty. Possible the largest uncertainty is associated with the emission database. In the case of Bilbao a large amount of data related to industrial emissions has been modelled and in the case of Madrid a similar lack of data is found.

3 Results

The results of applying the OPANA modelling system show that the window approach offers a good estimation of the performance of the modelling system in test. In our case, when OPANA modelling system is used over Bilbao the results are poor for NO and for O3 are better. This can be interpreted as that traffic emission database can be improved significantly in order to improve the results. This consequence related to emission inventories is also found for Madrid Community although in this case results are good in spite of that emission inventory should also be updated. This technique should be combined with classical approaches such a linear regression comparisons, FB, t-student , F-Fisher, etc. It is also important to underline that the associated uncertainties to the initial dataset should be carefully quantified and the emission database should be progressively incorporated to the meteorological module since traffic emissions and biogenic emissions are very much related so that on-line modelling of meteorology and emissions should be performed.

Acknowledgements

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