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DMAH ozone measurement net

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Abstract

The complexity of the study of tropospheric ozone lies in the fact that it is a secondary pollutant. It is not emitted by a source, instead its concentration in the air depends on other compounds (especially the nitrogen oxides emitted by motor vehicles and the volatile organic compounds emitted by the industry and the vegetation) and meteorological factors (especially solar radiation and temperature). The European legislation compells to make measurements of the tropospheric ozone due to its effects on people (fatigue, irritation of the mucous membranes, aggravation of asthma ...) and on environment (decrease of the production of cereals, synergy with plagues ...). The measuring net in Catalonia belongs to the Department of Environment and Housing (DMAH). It has a pyramidal structure and it allows a surveillance to notify in case of exceeding a certain threshold. From the registered data of last years it is shown that the number of incidences is related to meteorology. They are more frequent during afternoon and the behaviour of this pollutant is different according to the proximity of the point of measurement to the sources of its precursors.

1 Requirements

Ozone measurements are included in the Atmospheric Pollution Monitoring and Forecasting Network (XVPCA), a unit of the Surveillance and Air Control Service within the Environmental Quality Management of the Department of Environment and Housing of the Catalan government. The XVPCA was created as a tool to fight atmospheric pollution, since the Catalan Government has the competences for supervising and controlling the atmospheric pollution.

In particular, the measurement of the levels of concentration of tropospheric ozone becomes compulsory after the Royal Decree 1494/1995 on atmospheric pollution by ozone (transposition of the 92/72/CEE Guideline), in which the way of carrying out the measurements and what reference values were used to evaluate the air quality concerning this pollutant were established. However, from the end of 2003, the Royal Decree 1796/2003 about ozone in the ambient air, in which new criteria and reference values are established (transposition of the 2002/03/CE Guideline), became effective.

Specifically, definitions of values are given for the instantaneous and long-term protection of human health and also for the protection of vegetation, with the following very relevant thresholds:

- **Information threshold:** 180 μg m^{-3} in 1 hour[1], which represents the possibility of risk for the most sensitive population (people with any respiratory disease, such as asthma, as well as old people and children).

- **Alert threshold:** 240 μg m^{-3} during 1 running hour, which represents the possibility of risk for the population in general.

[1]The concentration of a pollutant in the air is determined by the quantity of pollutant in weight present in a certain volume of air, and it is usually expressed in mass units divided by volume units.

Figure 1. Air Quality Areas which Catalonia has been divided into.

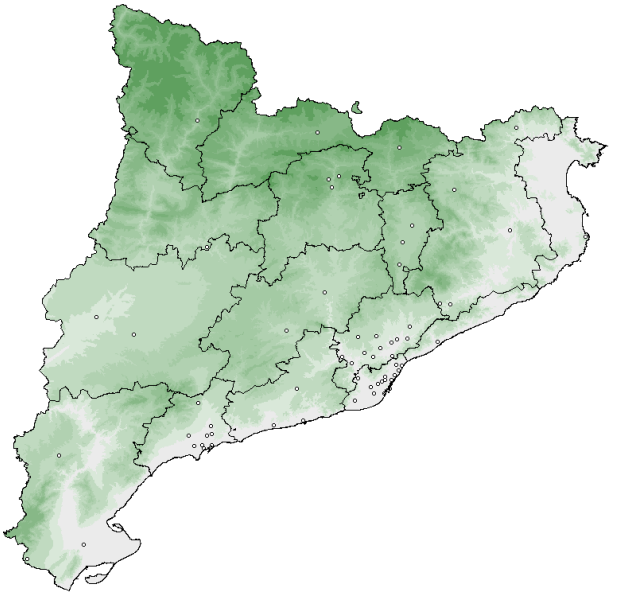

Figure 2. Measurement points of the XVPCA.

Figure 3. This particle attractor collects the sample, which will be taken to the laboratory in order to be analysed.

2 The Atmospheric Pollution Monitoring and Forecasting Network (XVPCA)

Nowadays, the XVCPA is composed of 69 stations with automatic measurement, out of which 50 measure ozone concentrations, and by 71 stations of manual measurement.

The XVPCA has a pyramidal structure, with a base formed by the **measurements** (either manual or automatic), which are assigned to groups in points of the domain, constituting the so-called **measurement points**. The measurement points can group one or more pollutant measurements, whether they are manual or not.

The automatic measurements capture a sample and automatically analyse it in the same measurement point. The manual measurements, instead, require the sample to be taken to a laboratory in order to be analysed.

In the case of ozone, since it consists of an automatic measurement, the measured levels in every point are transmitted to the respective Analysing Centres which make up the XVPCA. Each Analysing Centre is responsible for the conservation of the equipment, as well as for doing a first measurement validation. The second step is transmitting the data to the Receiver and Data Coordinator Centre (currently in the SVCA), where it is fully validated, and where it is stored and adequately treated in order to extract the necessary information, including the computations that allow the evaluation of the domain air quality.

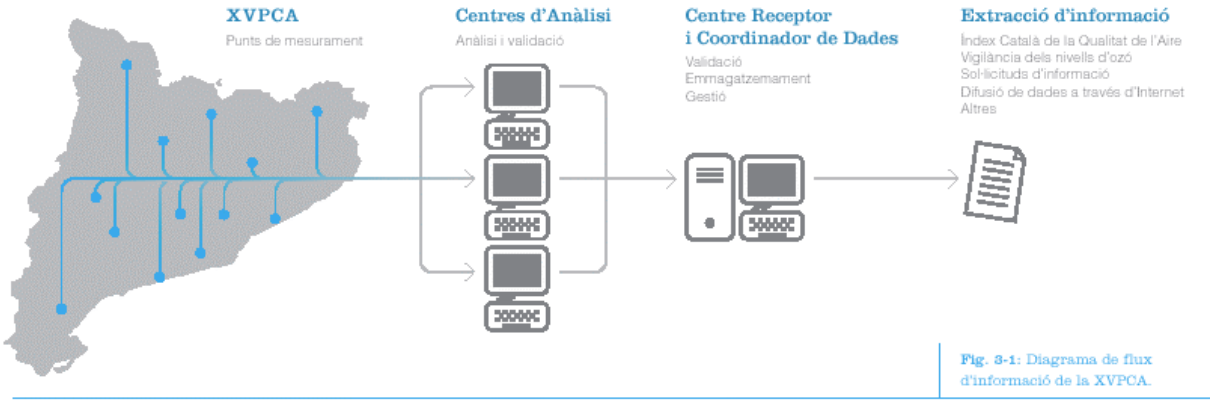

Figure 4. Flow diagram of the Surveillance and Atmospheric Pollution Forecast Net (XVCPA) Information.

Figure 5. In this cabin, several manual measurements are sampled and several automatic measurements are sampled and analysed as well.

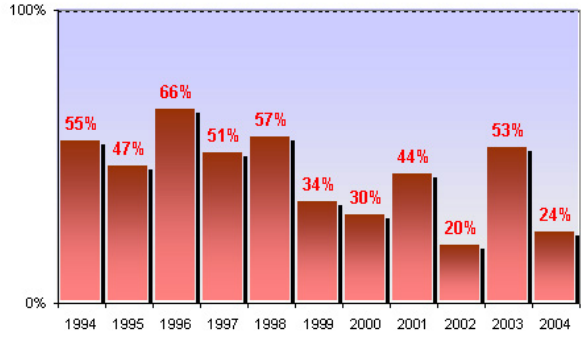

Figure 6. Interannual evolution of the measurement point percentage in which there has been at least one registered overcoming of the information threshold.

3 The tropospheric ozone level surveillance campaign

Due to the necessity of supervising the tropospheric ozone levels in order to inform the population in case of exceeding the information or alert thresholds, and since it does not usually occur between October and April, the Environmental Quality Management activates the Tropospheric Ozone Level Surveillance Campaign at the beginning of May, and terminates it at the end of September.

During this period, there is always a person in charge of the monitoring of the ozone levels daily between 9.00 am and 9.00 pm. They must ensure the proper functioning of the measurements and of the data transmission system. We have to take into account that the number of analysers is high and that they are in remote stations, and this increases the possibilities that at some point the measurements do not reach the Receiver and Data Coordinator Centre, i.e. due to electricity cut-offs, problems with the communications or problems with the analyser itself.

They also have to accomplish the routine tasks of forecasting and mantenance of the campaign web site[2]. In this site, we can find the occurrences of the surpassing of the information and alert thresholds, if any threshold has been exceeded in the last 24 hours, a list of surpassing events for the protection of human health at long term list, the forecast for the current day plus a link to the forecast for the current day done by the Universitat de Barcelona with a photochemical model connected to the output of a meteorological model. Finally, there is also the notice of the last incidence, as the latest information in the eventual case of an exceeded threshold, with recommendations and forecast of the episode evolution.

But, above all, its function is that of activating the information system in case of exceeding some of the thresholds. This consists of sending an email to a distribution list with

[2]http://mediambient.gencat.net/cat/el_medi/atmosfera/informacio_on_line/nivells_ozo.jsp

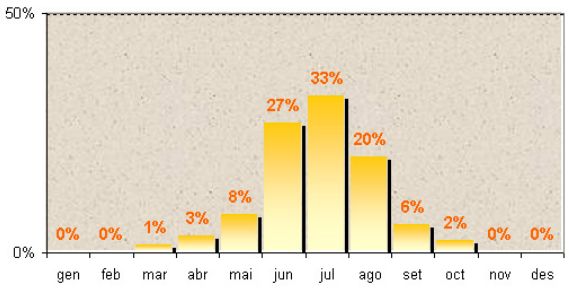

Figure 7. Percentage distribution of the information threshold passings during the year.

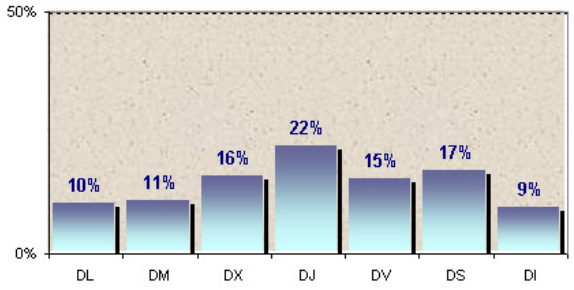

Figure 8. Percentage distribution of the information threshold passings during the week.

all the involved entities; Territorial Services, Area Councils, Municipalities, sanitary administration and other entities that should request it. A fax is also sent to the entities to whom the measurement point belongs and the web site is updated, especially with the last incidence notice, in order to make it available for the general public as fast as possible.

It is important that the information reaches the citizens as fast as possible and therefore these notices have to be quickly transmitted. That is why some municipalities think it convenient to have tools at their disposal to make this possible. In this sense, we recommend the use of electronic panels in the streets (as in Vic), stamps in the media, sending emails or sms (as in Reus), or elaborating a protocol so that there is always someone appropriately transmitting the information (as in Manresa). In this sense, this year the Department of Environment and Habitation has published material addressed to the municipalities describing how to perform these tasks.

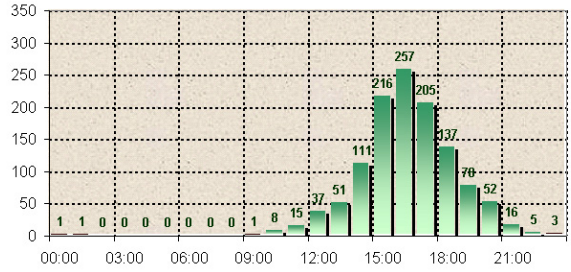

Figure 9. Time distribution of the number of registered passings during the 1994-2000 period.

4 Measurement results 1994-2004

From the validated data of this 11-year period, the following characteristics can be listed:

- The number of incidences varies from year to year and seems related to the temperatures of spring and summer, the hot years having higher ozone levels.

- The distribution of incidences is maximum during the summer months, and on the other hand, from November to February no incidence has been registered. This fact is clearly related to the larger solar radiation which reaches the Earth during the months close to the summer solstice, as well as the summer higher temperatures and anticyclonic situations.

- The evolution of the incidences during the days of the week shows a weak ascending trend and we can distinguish a maximum in the middle of the week, probably related to the generated emissions in the labour activity (transport, especially).

- Throughout the day, most of the incidences occur in the afternoon, since during the day the precursors accumulated in the atmosphere have been emitted, while the temperature and the solar radiations are still high and have already collaborated in creating an important ozone surplus. Surprisingly, though, they do not take place at the solar noon (in the diagram it corresponds to 14 h since it is in the official time). This is due to the fact that the precursors are transported by the wind to other different places than those in which they are generated themselves. During this transport, the different reactions that lead to an ozone surplus are unleashed.

- The measurements show different behaviours if they come from a rural, a suburban or an urban measurement point. This fact is clearly related to the proximity with the precursor-transmitting points. In the rural measurement points, the levels do not usually go below a certain value and their evolution throughout the day does not usually suffer large oscillations. On the other hand, in

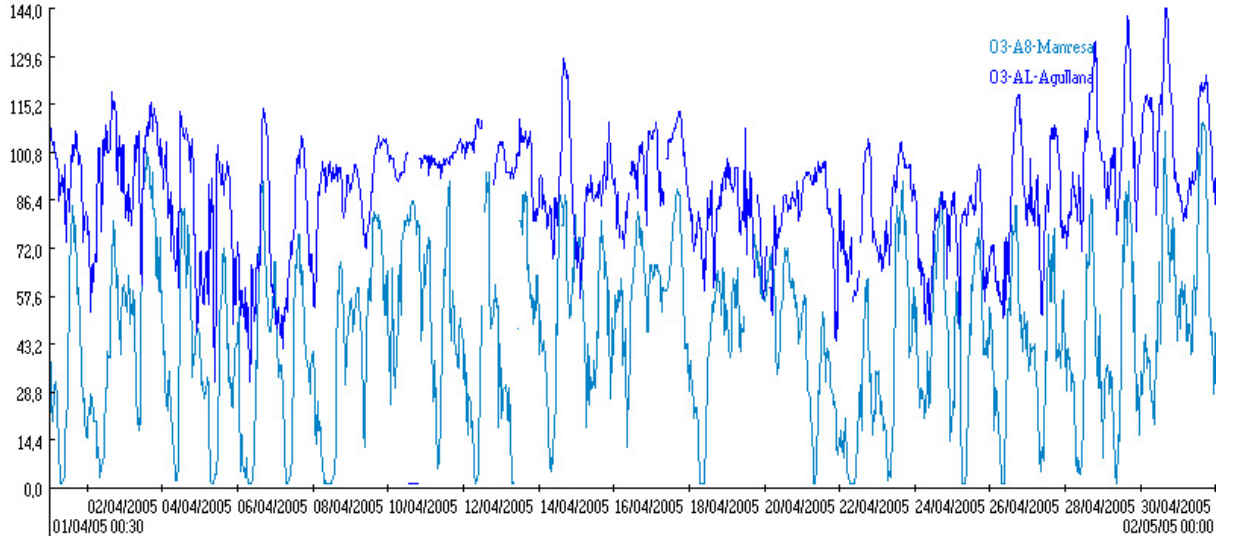

Figure 10. Given an example of differences between point of measurement in a rural enviroment (Agullana) and an urban traffic one (Manresa).

the urban measurement points, the minimum is registered during the night, coinciding with the lack of solar radiation, and it usually reaches very low levels or even 0 μg m^{-3}. Finally, the suburban points present an intermediate behaviour.