Quantification of emission sources apportionment to the concentration of PM2.5 in Temuco, Chile, using receptor model.

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19th Annual CMAS Conference October 14-16, 2006, Chapel Hill, NC

ABSTRACT

In this study the composition of particulate matter was characterized in relation to its sources from concentrations of compounds it is formed. The registry samples were obtained in the monitoring station of University located in Temuco’s City, Chile. Fifty samples were collected, from August 18th to October 6th, during part of winter and spring time in 2008. Also, 11 samples were collected between January 27th and March 7th in 2009, during summer season in Chile. Usually, receptor models are used to identify and quantify the contributions of sources to particulate matter and organic volatile compounds, based on its chemical composition. The stages developed in this study are observed in figure 2.

RESULTS AND DISCUSSION

The first action was to measure particulate matter during different time periods to establish a variation on its characterization. IMPROVE sampler and Tetron filter of 45 mm were used to monitor samples. The elements were detected by spectrometry XRF in Crocker Nuclear of Davis UC Laboratory. The elemental species of the measurements were as following: Na, Al, Mg, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Ni, Cu, Zn, As, Pb, Se, Br, Rb, Sr, Zr, Pb, Sr, Zr, and Cs. Usually, receptor models are used to identify and quantify the contributions of sources to particulate matter and organic volatile compounds, based on its chemical composition. The stages developed in this study are observed in figure 2.

The chemical characterization of particulate matter samples brings information about the quantification of the emission sources of air pollution in Temuco City. In this case, the anthropogenic activities plus geography and meteorological conditions imply the main factors to consider. In this study, the meteorological simulation using WRF model3, represented an initial step to obtain air quality modelling for future studies in this city of Chile.

REFERENCES


Methodology

INTRODUCTION

Air pollution by particulate matter in the South of Chile is observed during winter season, especially during low temperature periods. Temuco, located in Region of Araucania is one of the cities where that situation takes place, with a lot of frequency of overcoming of the national standard limit. World of Health Organization considers Temuco is actually in the list of 20th cities with the most air quality problem in America.

Figure 1. Location of Temuco, Chile, in South Hemisphere

In that city, measurements of particulate matter (PM10) have been done since 1997, changing to continuous monitoring since 2000. The zone was declared as saturated by PM10 because of the high levels of that pollutant obtained during that period. By other side, an air decontamination plan for PM10 was elaborated by authorities and was approved recently in 2015. Many studies were developed since 2000, including air emission inventories in 2008. According to that, 90% of contribution to PM2.5 can be related to residential wood combustion. The second source was agricultural burning, which only 2% of contribution. Those results were questioned by some considerations and high uncertainty. The continuous monitoring showed a high contribution of those sources especially during winter, but the real input information was not available for other seasons.

Map Projection

Figure 5. Map Projection used in WRF model

Table 1. WRF model physics options

CONCLUSIONS

Figure 6. Winds used obtained using WRF model.

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Figure 4. Number of emission sources to PM2.5 in Temuco, Chile

August-October 2008
January-March 2009

Figure 7. Trend of species contribution to sources.

Source 1: Combustion of vegetal material or wood burning. Source 2: Suspended dust or salt material. Source 3: Combustion of vegetal material or wood burning. Source 4: Marine dust or salt material. Source 5: Suspended dust or salt material.

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Figure 3. Percent of species apportioned to sources.

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Results obtained using UNMIX model showed two sources during Spring - Winter (2008) period in Temuco, Chile. In other way, the data for Summer 2009 concluded the particulate matter is generated from 3 emission sources.