Evaluation of Modelling Systems in High Resolution to Assess the Air Pollutant Impacts on Human Health

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Abstract- *Nowadays the modelling of systems in high resolution is being used for air quality and other forecasting applications, where a spatial area is related with different interrelated variables that could be displayed on a map. This area is usually represented by global domains (hundred to thousand of square km); when smaller regions need to be represented, a high resolution modelling system can be used, these systems goes from one square km to dozen of square km, health is one of these issues where this kind of resolution can be used. In Europe, Asia, North America, South America and other countries, health problems related with the air pollution and climate change is a concern for individuals and world organizations like the WHO; today studies show the relation between morbidity and mortality rates, air pollution and effects on human health; these modelling systems in high resolution help us to simulate scenarios and propose solutions to this problematic. So the objective of this work is to evaluate the system performance WRF – CMAQ and CALIOPE on high resolution (4 km x 4 km) to determine air pollutant impacts of PM_{10}, $PM_{2.5}$, Ozone, NO_2 and SO_2 on population, using BenMAP for assess impact on health. The methodology suggested is the time series analysis of two years of hospital admissions, morbidity and mortality rates and the air quality forecasting of the cities selected, previously modelled in WRF, CMAQ and CALIOPE; after that, the Response Functions (DRF/ERF) to determine the impacts on health and the BenMAP software will be used. It is expecting find the scenarios that could decrease the mortality and morbidity rates in diseases like lung cancer, chronic respiratory obstructive disease, asthma, and the acute respiratory diseases in adults and children under ten years old.*

Key words: Air quality, Modelling, Health impact

I. Introduction

Today Air quality (AQ) is an environmental issue that has become a concern for the effects on health, [1][2][3]. AQ studies show results on increased morbidity and mortality in Europe, USA, Asia, Latin America and Caribbean; respiratory diseases, cardiovascular diseases, nervous system and lung cancer are some examples, [4]; This is no longer just an issue of big cities such as Mexico City, New York, Hong Kong or Sweden, this is also a problem in small and medium cities, [5][6][7][8][9][10][11].

II. Modelling Systems

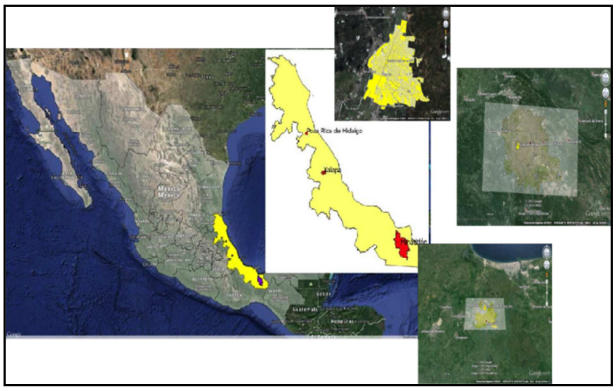

Fig. 1 Representation of two domains, a National domain and a high resolution domain at Veracruz cities, Mexico.

Reference [16] mentions that the air quality modelling (AQM) plays an important role in the policies and strategies for the air pollution control in many countries. There are different systems that allows estimated these values of AQ, some of these are: AERMOD, CALPUFF and CMAQ for example used by the US-EPA, CALINE 4 in UK, WRF- Chem in Mexico and CALIOPE Air Quality Forecast model (AQFM) in Spain. Tools coupled GIS are also options that provide support for this type of projects, [17][18][19].

III. Health Impact Assessment (HIA)

The health impact assessment is realized by a methodology that permit evaluate the human health impacts from different causes, nowadays the air pollution is one of these causes as can be seen in the Fig. 2. There are different ways to assess, the short-term studies and the long-term studies. In this project the short-term has been selected, by adapting the methodology proposed by the "Instituto Nacional de Ecología y Cambio Climático" INECC from Mexico, to assess the mortality and morbidity population rates related to PM_{10}, $PM_{2.5}$, Ozone and temporal series analysis, [20].

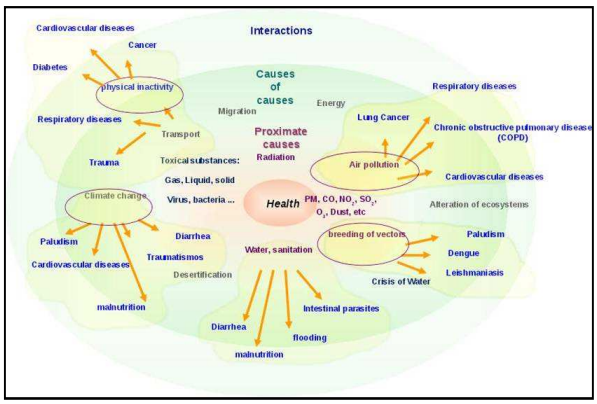

Fig. 2 Human health impacts from different variables and factors.

IV. Expected results

1. Estimate the exposure to air pollution in population and the effects on human health in the cities selected.
2. Find the rates of mortality and morbidity that could be decreased with this assessment.
3. Find some causes or etiologies that produce the number of deaths or morbidity.
4. Find a model or models with the best fit.
5. Determine the spatial scope of air pollutants.
6. Determine the benefits obtained in the simulation scenarios.

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