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Evaluation of the performance of the air quality models AERMOD and CALPUFF for the region Anchieta-ES

Introduction

The city of Anchieta is in a period of an industrial expansion, promoted by its strategic location in the logistics sector. The economic benefits arising from these developments are evident; however the development of these large industrial centers, without proper planning, exposes the population to high levels of air pollution. From this problematic, the desired goal in this work is to evaluate the current air quality in the region, and to identify the contribution of industrial and mobile sources for the concentration levels of air pollutants in the area. This study also aimed to compare the results obtained by the use of AERMOD and CALPUFF models, both recommended by the United States Environmental Protection Agency (EPA) for regulatory purposes.

Materials and Methods

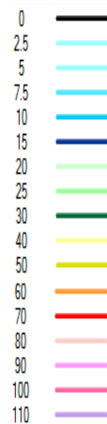
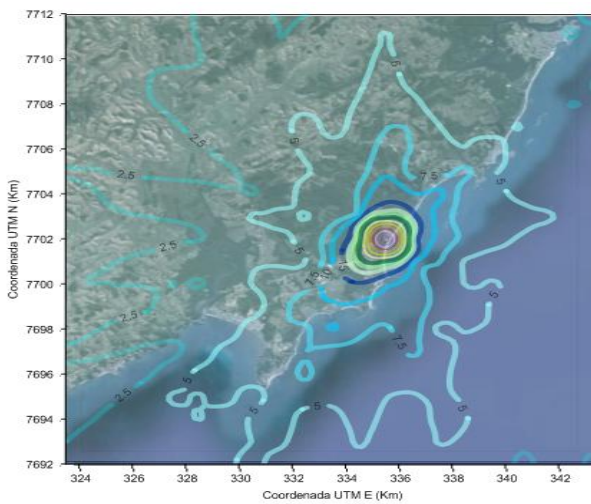
In the present study we used the regulatory models suggested by EPA (2004), AERMOD and CALPUFF for analysis of air quality in the area of Anchieta. The data used were the Samarco SA's inventory of sources, provided by IEMA, beyond the traffic lanes, whose values present in the Environmental Impact Study of Samarco were considered in the inventory of sources used in the modeling, with the variation of hourly concentration for the mobile sources. Meteorological data for the year 2010 were also ceded by IEMA to stations Ubu and Mae-Ba, next to the venture. The surface data were

taken from the USGS website, for free. To Upperair data needed for modeling in CALPUFF model was necessary formatting reanalysis data available to users over the Internet.

For the models were used a computational mesh of 20km by 20km, with spacing of 1Km between the points, and the concentration data of PTS were obtained from Mae-Ba, Ubu, Meaipe and Anchieta stations while for concentration data of PM10 were from Mae-Ba and Ubu stations.

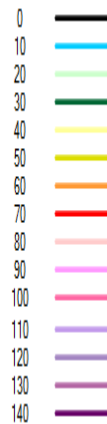
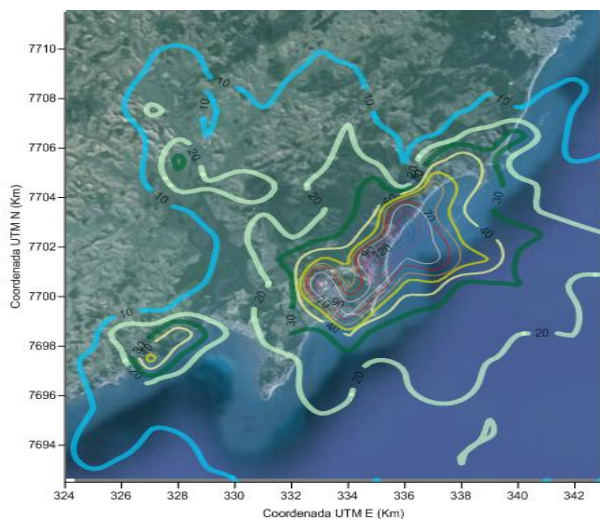
Results and Discussion

At the study were made a comparison of the dispersion and concentrations of PM10 for models AERMOD (a) and CALPUFF (b) for 24h averages:



(a)

Estation	Distance (Km)	Maximum Concentration 24 hours ($\mu\text{g}/\text{m}^3$)
Mae-Ba	1,65	30 - 60
Ubu	2,78	9,8
Meaipe	6,91	7,4
Anchieta	7,05	4,5

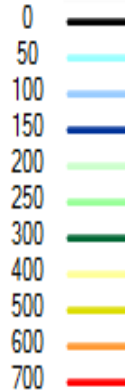
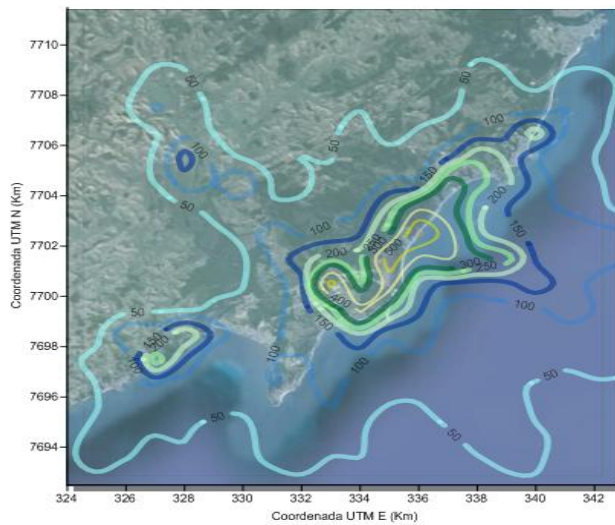


(b)

Estation	Distance (Km)	Maximum Concentration 24 hours ($\mu\text{g}/\text{m}^3$)
Mae-Ba	1,65	70 - 100
Ubu	2,78	60 - 70
Meaipe	6,91	40
Anchieta	7,05	18

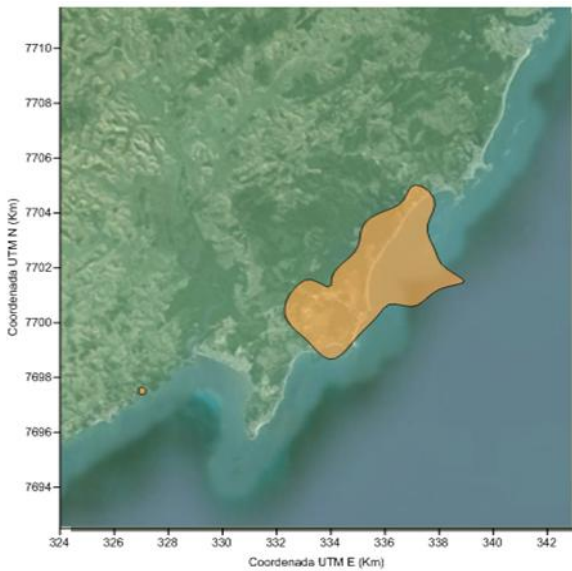
As observed at the concentrations average, the media calculated by AERMOD is very smaller than the obtained with CALPUFF, but the dispersion are similar in both of models.

The (a) dispersion and concentrations of PTS for the model CALPUFF for 24 hours average and (b) the OMS concentration analysis for PM10, 24 hours average.



(a)

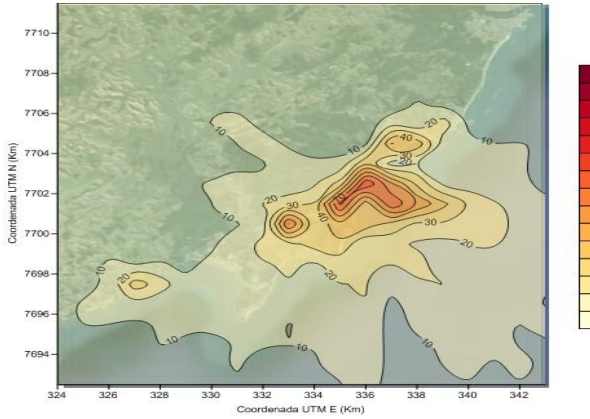
Estation	Distance (Km)	Maximum Concentration 24 hours ($\mu\text{g}/\text{m}^3$)
Mae-Ba	1,65	400 -500
Ubu	2,78	300
Meaipe	6,91	220
Anchieta	7,05	65



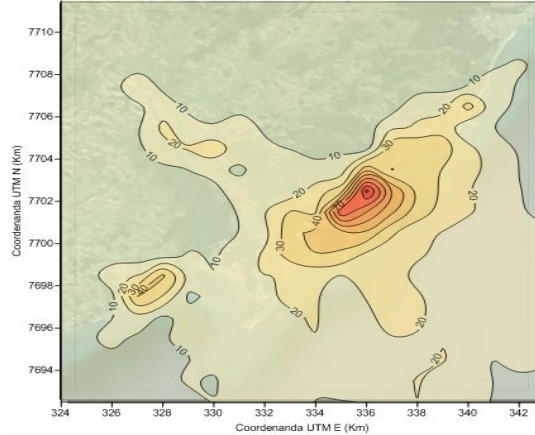
(b)

Even with the results below the local legislation, the near cities have the concentrations above the limits permitted by the World Health Organization.

Comparative of the dispersion and concentration of the PM10 for 24 hours average at the (a) summer and (b) winter at CALPUFF.

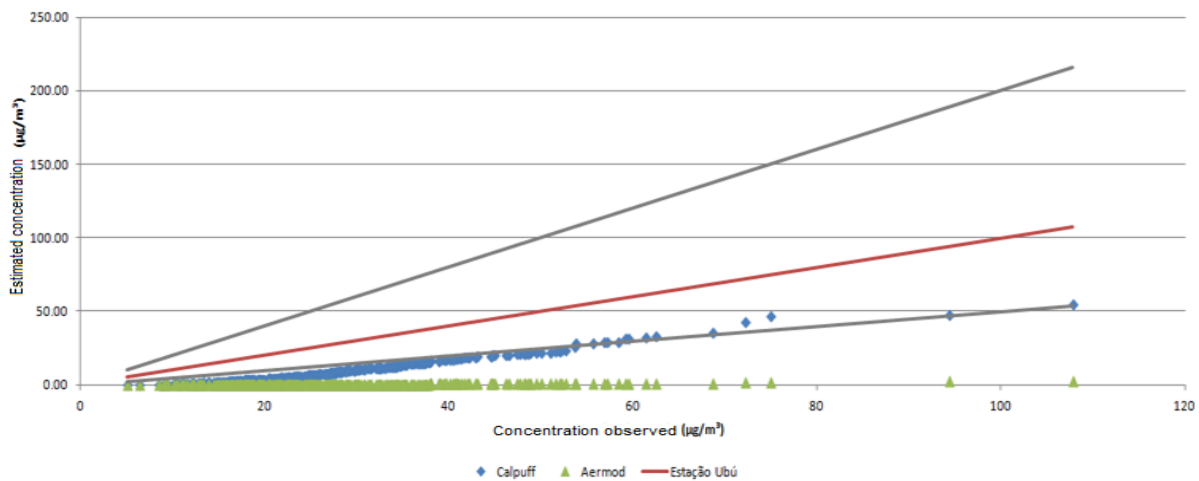


(a)



(b)

Statistical analysis of the results of PM10 for 24 hours average comparing AERMOD and CALPUF.



As noted in the graph of statistical data, compared with the values measured in the station located in Ubu, the results presented by the model CALPUFF are closer, besides being inserted between the lines of average error in some spots.

Conclusions

The results in both models show that air quality limits set by CONAMA Resolution 03/90 were not exceeded, although the modeling with CALPUFF, the results show that although the standard was not achieved, the mean concentrations reached close to the

limit, and disturbing the expansion and implementation of industries in the region. The highest concentrations were observed where the enterprise is. The models showed a consideration of the relief in the calculations, which could be observed in the concentration results in grid points near the high altitudes. In the analysis of sources available to perform the work, were considered the industrial and mobile sources, the latter being represented by the routes of traffic in the region. Despite the vehicle fleet in the region still have low numbers of cars in relation to the Grande Vitoria, there is a significant influence of these sources on air quality in the region. The communities of Mae-Ba and Ubu, closest to the project are those with the highest concentration values calculated and measured. It is important to remember that despite the modeling does not show values above the CONAMA 03/90, considering the limits of the IQA, some areas have air quality considered "Good" or "Fair". Regarding the accuracy of the calculated data, it can be observed in the chapter on statistical analyzes that CALPUFF showed better results, with concentration values in the same order of magnitude of the concentrations observed in stations. However, is also necessary consider analyzing the performance of models, the absence of meteorological data in the altitude of the AERMOD modeling, which can significantly influence the results. Note also that both models underestimate the results. One reason that may explain the underestimation of the results is that the inventory does not consider other important sources of particulate matter that are scattered in the study area. And according to recent studies of characterization of particulate matter in Anchieta and industrial processes, there is a strong contribution from construction activities, forest fires and vehicular movement on unpaved roads as well as marine aerosols. Moreover, the inventory does not bring the dimensions of sources and extensive strategy was the use of an inventory of other steel company, in the same state, to extract this data, based on some benchmarks. However it should be noted that some of these sources may have been underestimated, since the production process of these mills have their specificities. Considering this information, it was concluded that, due to limitations of current data for atmospheric modeling in the region, the models AERMOD and CALPUFF not satisfactorily accounted for the observed data at stations air quality.

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