

# AIR POLLUTION NO<sub>2</sub> ASSESSMENT USING RS AND GIS IN HO CHI MINH CITY AND NEIGHBORHOOD PERIOD 2015-2019

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## ABSTRACT

*The sources of air pollution are mainly from industrial activities, transportation and human activities. This research aims to assess the level of NO<sub>2</sub> pollution in the air from data collected by OMI (Ozone Monitoring Instrument) on AURA satellite of A-Train group. Pollution levels of NO<sub>2</sub> will be calculated, assessed. The results of the study showed that NO<sub>2</sub> concentration varies significantly with the seasons, relatively high in the dry season reaching 80 (µg/m<sup>3</sup>) in Ho Chi Minh City, up to 70 (µg/m<sup>3</sup>) in Binh Duong, Dong Nai, Long An province, and decreasing in the rainy season. Therefore, it is necessary to have quick and timely measures to monitor air pollution to minimize the consequences caused by air pollution in urban areas.*

## 1. INTRODUCTION

At present, air pollution is not only in Ho Chi Minh City (HCMC) but also neighboring areas such as Long An, Binh Duong and Dong Nai which are increasing significantly in the dry season, especially on many main roads, there are often traffic jams everyday and city dwellers inhale a large amount of harmful emissions. In addition, the city's top priority; Ho Chi Minh City in solving air pollution include: reducing dust pollution in the building material manufacturing industry; SO<sub>2</sub> pollution from thermal power plants; as well as the amount of CO<sub>2</sub> and SO<sub>2</sub> generated from domestic activities by 2020 for urban and rural areas. Therefore, the control and reduction of air pollution in the urban area of Ho Chi Minh City must be based on a series of synchronous solutions, which must take into account climate and weather characteristics. Researches in Vietnam many research used to RS techniques to show air pollution for many years. In 2018, This paper presents the results of remote sensing application for mapping of air quality in mining area in Luong Son district, Hoa Binh province. Using Landsat 8 data with a resolution of 30m in three periods: 2013, 2015 and 2017 to calculate vegetation indices, air pollution index (API). The study also showed that the area with high forest cover would have better air quality than the area where mining activities were conducted (Tran Quang Bao et al, 2018). (Ngyen Hai Hoa, Nguyen Thi Huong, 2017) Using Landsat image to develop the distribution map of air pollution caused by mining activities in Hoanh Bo district, Quang Ninh province. Most of the dust concentration has increased from 2006 to 2010 because the mining industry has taken place extensively this period. The results also show that there is a relationship between vegetative cover and air quality, in which vegetation plays an important role in reducing air pollution and dust concentration from mining activities. In the world, there are related studies in the application of remote sensing techniques to evaluate NO<sub>2</sub> and SO<sub>2</sub> pollution, other air pollutants. In 2018, the study show impact of traffic-related air

pollution on morbidity and mortality in Copenhagen Municipality and the health gain of reduced exposure. The annual mean nitrogen oxide concentration is  $19.6 \mu\text{g}/\text{m}^3$  in Copenhagen; One-year gain in life expectancy by lowering nitrogen oxide exposure to rural level (Henrik Brønnum-Hansen et al, 2018).

## **2. STUDY AREA**

Ho Chi Minh City lives in the transitional zone between the Southeast and the Mekong River Delta. The general topography has a lower form from North to South and from East to West. Ho Chi Minh City is located in the subequatorial monsoon tropics, so it has a steadily high temperature throughout the year and has two distinct rainy and dry seasons affecting the air environment. The rainy season is from May to November, the dry season from December to April next year.

The HCMC region includes seven provinces and cities: Dong Nai, Binh Duong, Binh Phuoc, Tay Ninh, Long An, Tien Giang and HCMC. The task of adjusting construction planning has been approved by the Prime Minister, identifying this as a large urban area, the leading economic development engine of the country, also an international traffic hub, capable of adapting highly responsive, towards balanced and sustainable development, and at the same time a center of knowledge, modern services, and a unique cultural center. In particular, Ho Chi Minh City is a regional nuclear city, a multi-functional general economic center with synchronous and modern infrastructure on par with modern urban areas in the region. The development of industrial zones in the HCMC area is both an opportunity and a challenge in controlling and limiting air pollution.

## **3. METHOD AND DATA**

### **3.1 Method**

The research extracted air pollution information from data collected by OMI (Ozone Monitoring Instrument) on AURA satellite of the A -Train group, OMI data covers a period of more than 10 years for the analysis of pollution trends. It is important to correlate emissions with urban and industrial sources of emissions, to determine the location of emission sources from the VNREDSAT data. From the data set, ICST developed calculation techniques from the RT model (radiation propagation technique) to analyze remote sensing image data and extract  $\text{NO}_2$  and  $\text{SO}_2$  pollution data (Do The Hoang and ICST, 2018).

### **3.2. Data**

-Collect monthly OMI data set from 2015 to 2019 in Ho Chi Minh City and surrounding areas to analyze the laws of change and the impact of air pollutants.

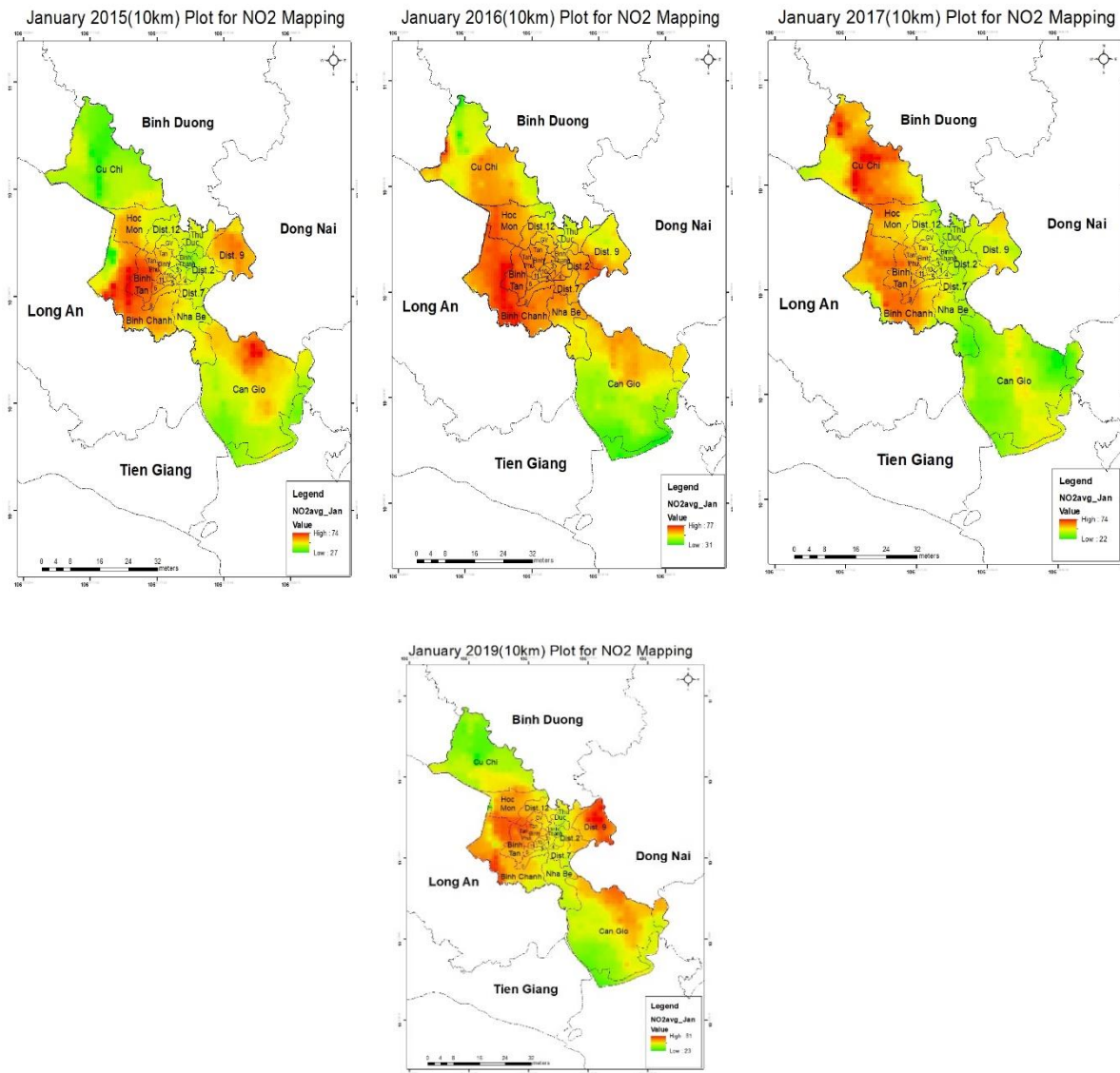
-Data  $\text{NO}_2$  and  $\text{SO}_2$  were extracted from the 2 km resolution image showing air pollutants for the HCMC area (90 km x 110 km).

-Interpolate extracted data for the study area, then display it on map and statistic data.

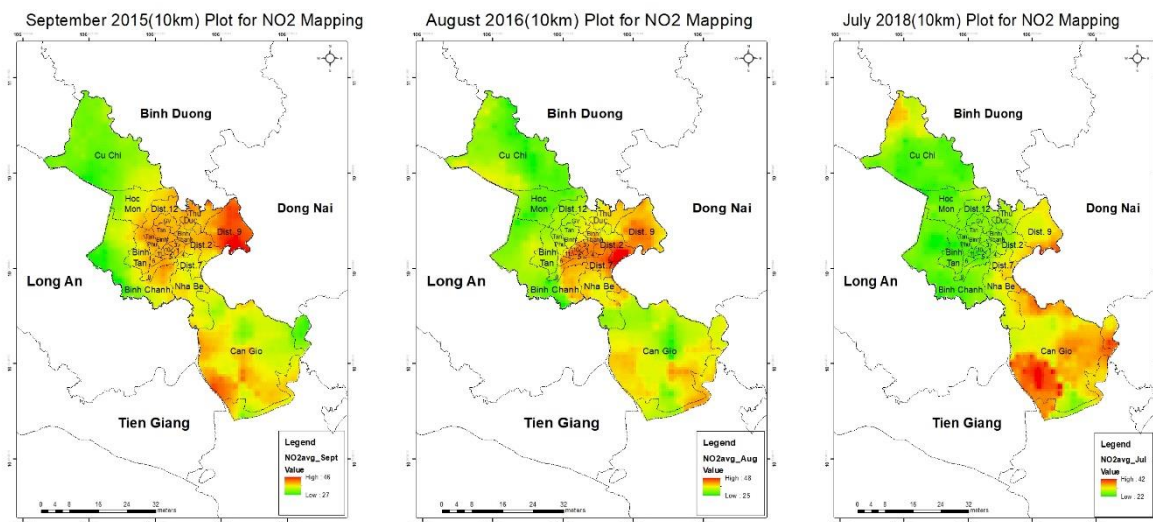
## **4. RESULT AND DISCUSSION**

The concentration of  $\text{NO}_2$  depends on time and according to the TCVN, in the area where the average  $\text{NO}_2$  concentration does not exceed  $100 \mu\text{g}/\text{m}^3$  according to the monitoring results, the air quality meets the allowable standards. Currently, the traditional method is to collect data from automatic air quality monitoring stations and show that  $\text{NO}_2$  concentrations are increasing faster than the previous annual average. Especially, the evolution of  $\text{NO}_2$  concentration in the air along the roads of the city. However, because the number of stations is not enough to

provide a city-wide pollution map, the solution to analyze OMI data to generate a map shows pollutants such as NO<sub>2</sub> collected on a monthly average for each month and surrounding areas are very helpful. Data's HCMC from 2015 to 2019 results show that the concentration of NO<sub>2</sub> clearly fluctuates with seasons which is relatively high in the dry months (Figure 1) and lower in the rainy season (Figure 2). Especially in 2018, the concentration exceeded 70 µg/m<sup>3</sup> in January, February, November, December with the value of 74.2 µg/m<sup>3</sup>, 79.1 µg/m<sup>3</sup>, 82.7 µg/m<sup>3</sup>, 74.3 µg/m<sup>3</sup>, respectively.

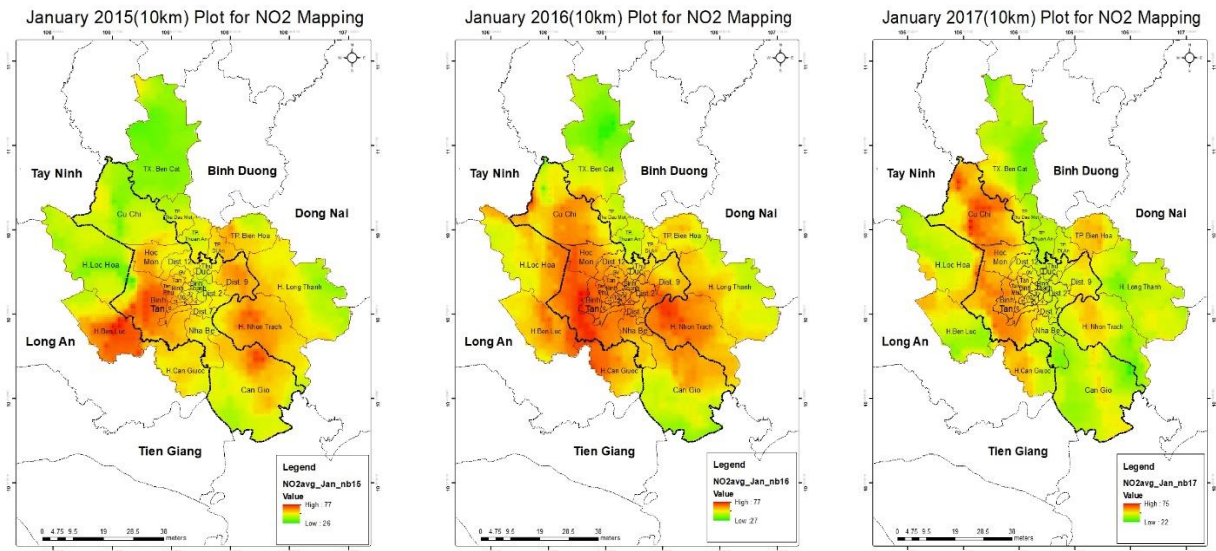


**Figure 1. Trend of NO<sub>2</sub> concentration in dry season.**



**Figure 2. Trend of NO<sub>2</sub> concentration in rainy season.**

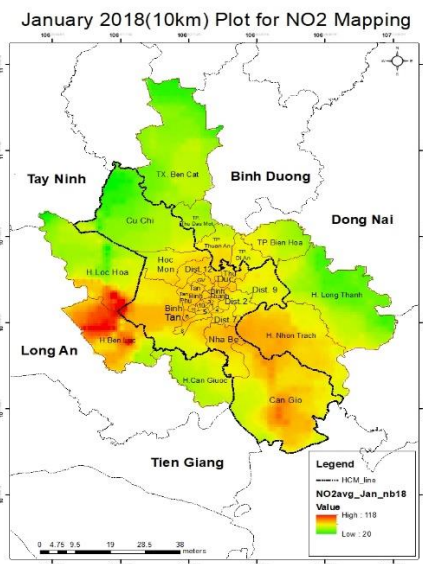
As for the neighboring areas, in Long An provinces (Loc Hoa, Ben Luc, Can Giuoc districts) located in the humid tropical climate zone, due to the contiguity between the Southeast and Southwest regions, should bring both the characteristics specific to the Mekong Delta and the distinct masculinity of the Eastern region; In the dry season from November to April, there is a northeast wind with a frequency of 60-70%. The rainy season from May to October has southwest wind with a frequency of 70%. Binh Duong (Dau Tieng District, Ben Cat Town, Thu Dau Mot City, Thuan An City, Di An City) has tropical monsoon characteristics, rainy season from May to November; dry season from about December to April next year; the least rainy month is January; the wind regime is relatively stable, not directly affected by storms and tropical depressions; In the dry season, the prevailing wind is mainly in the East and North-East direction; the rainy season prevails mainly in the west, west-southwest; The highest observed wind speed is 12m/s, usually in the west, west-southwest direction. Dong Nai (Bien Hoa City, Long Thanh District, Nhon Trach District) has a sub-equatorial monsoon tropical climate; influenced by the Northeast and Southwest monsoons; in addition, it is also influenced by the tropical Pacific air from April to October; There are two distinct seasons: rainy and sunny. The dry season lasts for 5 to 6 months (from December to March or April of the following year), and the dry season for 6 or 7 months (from April or May to November). The end of the rainy season ranges from early October to December; Rainfall distribution gradually decreases from the North to the South and from the middle to the East and West of Dong Nai. It can be seen that the concentration of NO<sub>2</sub> pollution in neighboring areas also peaks in the dry season months, specifically in January and February, ranging from 70 to 80 ( $\mu\text{g}/\text{m}^3$ ), especially in Dong Nai. reaching 81  $\mu\text{g}/\text{m}^3$  in 2019; Dong Nai currently has 35 industrial parks, including 31 industrial parks with active projects, but now the area of industrial parks has almost filled the area of the province based to many domestic and foreign investors. expanding production and Bien Hoa 1 industrial zone is considered a bomb of environmental pollution. Not only air pollution, but Dong Nai also faces with water pollution from Dong Nai river, dust pollution, noise pollution... HCMC reached 83  $\mu\text{g}/\text{m}^3$ , Long An and Binh Duong respectively 77  $\mu\text{g}/\text{m}^3$ , 74  $\mu\text{g}/\text{m}^3$  in 2019. Especially, in Long An province in 2018 this concentration exceeded the threshold of over 118  $\mu\text{g}/\text{m}^3$  due to the concentration of 16 industrial parks with the occupancy rate of more than 80% of the area of the industrial park.



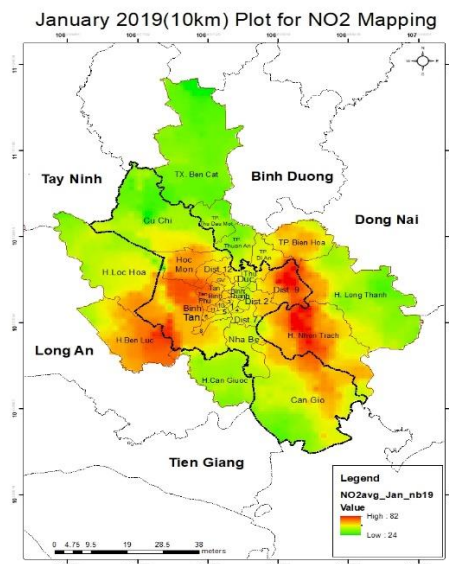
a)

b)

c)



d)



f)

**Figure 3. Trend of NO<sub>2</sub> concentration in January**

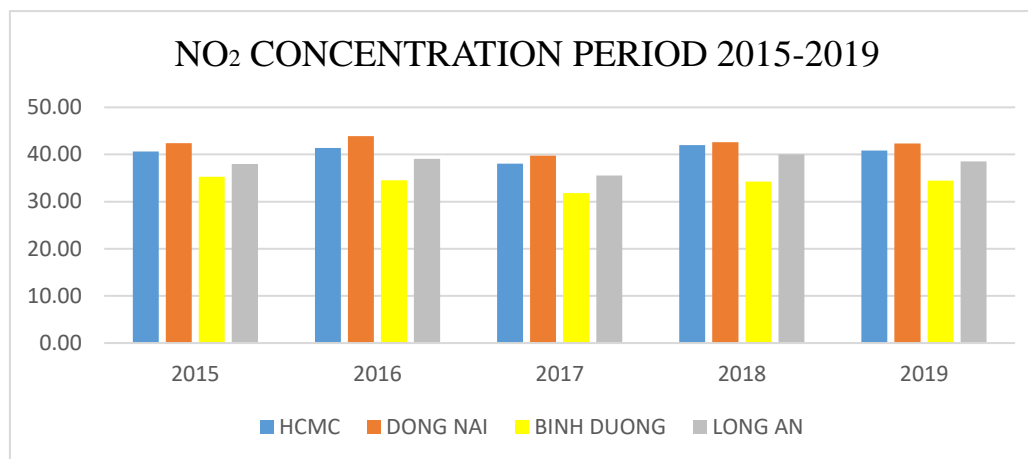
**a) 2015, b) 2016 and c) 2017, d) 2018 and f) 2019**

Pollutant NO<sub>2</sub> concentrations decreased in the rainy season, and in August average concentrations ranged between 28-37  $\mu\text{g} / \text{m}^3$  (table 1).

**Table 1. Average NO<sub>2</sub> concentration in August, period 2015-2019 ( $\mu\text{g}/\text{m}^3$ )**

	2015	2016	2017	2018	2019
Dong Nai	37.5	34	39.9	31.9	34.8

Binh Duong	30.4	29	29.9	28.6	29.1
Long An	31.7	30.9	34.4	29.6	27.9
HCMC	34.8	32.9	34.9	32.3	32



**Figure 4. Chart of NO<sub>2</sub> concentration in neighboring areas of HCMC period 2015-2019.**

## 5. CONCLUSION

This paper presents the results of extracting the pollution level of NO<sub>2</sub> from remote sensing images and develops a solution to map pollution trends over time. In addition, the data is analyzed and statistics to determine the location of emission sources in order to predict the exact change of pollutants to contribute very important to the development of an air quality management plan. The results show that the impact of air pollutants is usually concentrated in the dry season (from January to March) in Ho Chi Minh City and neighboring areas have higher pollution concentrations than other localities. Therefore, it is necessary to develop mainly clean industry with modern and advanced technology with high scientific content; great added value and above all does not pollute the environment.

## 6. REFERENCES

- Tran Quang Bao et al., 2018. *Application of GIS and RS for air quality assessing in mining area, Luong Son district, Hoa Binh province*. Journal of Sciences and forestry 6.
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