

# Ground Based Air Quality Measurements During Forest Fires In Jambi and Correlation with Satellite Observed Data

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**Abstract.** Forest and land fires are natural disasters that often occur in Indonesia. According to the Ministry of Health (2015) forest and land fires that occurred in 2015, one of which was in Jambi province, caused quite severe air pollution in several Southeast Asian countries [1]. One of the main pollutants as an indicator of air quality is particulate matter (Particulate Matter). These particulates will float up to the atmosphere which is called an aerosol. Solid aerosols with a radius smaller than 10  $\mu\text{m}$  are called PM10 aerosols. One of the most important aerosol optical properties used for radiation transfer calculations is AOD (Aerosol Optical Depth) [2]. As a result of the forest fire incident in Jambi, the research could be carried out regarding the relationship between particulate concentration and satellite data during forest fires to determine the concentration of particulate (aerosol) loads. Relationship between PM<sub>2,5</sub> and PM10 concentrations. Fires in Jambi City occurred almost throughout 2018-2019 which were caused by several factors, both natural factors and human actions. Most of the soil types in Jambi are peat soil types so during the dry season the peat soil surface is very dry and easily flammable, fire on the surface can spread to the relatively moist inner layer. This causes the flames to mix with water vapor and produce a lot of smoke [5]. Therefore, the PM<sub>2.5</sub> and PM10 concentration values tend to be high during forest fires, especially during the dry season.

**Keyword:** Aerosol Optical Depth, Forest Fire, Jambi, Particulate Matter

## INTRODUCTION

Forest and land fires are natural disasters that often occur in Indonesia. According to the Ministry of Health (2015) forest and land fires that occurred in 2015 in several provinces, one of which was Jambi province, caused the worst disaster in 18 years, which caused quite severe air pollution in several Southeast Asian countries [1]. One of the main pollutants that serves as an indicator of air quality is particulate matter (particulate matter), which is a mixture of solid particles and liquid droplets in the air, including smoke, dust, and ash. These particulates will float up to the atmosphere which is called an aerosol. Solid aerosols with a radius smaller than 10  $\mu\text{m}$  are called PM10 aerosols. In the event of a forest fire, PM10 aerosol together with surface ozone creates a phenomenon called smog. One of the most important aerosol optical properties used for radiation transfer calculations is AOD (Aerosol Optical Depth) [2]. AOD is the value of an attenuation of solar radiation that enters the earth's surface as a result of the presence of aerosol particles

in the atmosphere. The attenuation process is by scattering and absorption [3]. Based on this, research was carried out related to the relationship of particulate concentration with satellite data during forest fires to determine the current load of particulate (aerosol) concentrations and measure pollution in the atmosphere which can be used as an exact measure of changes and/or modeling of air quality in the future and map the health risks from the distribution of particulate emissions due to forest fires.

## METHODOLOGY

The methodology used is in the form of secondary data collection related to:

1. Jambi City Meteorological Data obtained from the Ministry of Environment and Forestry
2. Jambi City Satellite Data (AOD) obtained from the results of the operation of the Google Earth Engine

From the secondary data that has been obtained, data processing is carried out in the form of screening and evaluation data then the development of linear regression between PM<sub>10</sub> on ground based data and AOD satellites.

## Data Collection

Geographically Jambi Province is located between 00°45' to 20°45' south latitude and between 1010°10' to 1040°55' east longitude. Then in the north Jambi Province is bordered by Riau Province and the Riau Islands, then in the east, it is bordered by the South China Sea, in the south it is bordered by South Sumatra Province while in the west it is bordered by West Sumatra and Bengkulu Provinces. The total area of Jambi Province is 53,435 km<sup>2</sup> with a total land area of 50,160.05 km<sup>2</sup> and a water area of 3,274.95 km<sup>2</sup> [6].

The Jambi City area is at an altitude of 10-60 meters above sea level. The topography of Jambi City is mostly flat (0-2%) with an area of 11,326 Ha, undulating (2-15%) with an area of 8,081 Ha and slightly steep (15-40%) with an area of 41 Ha. Jambi City's land use consists of settlements, industry, gardens, rice fields, lakes and vacant land [6].

The Jambi Province Administrative Map can be seen in the following figure.

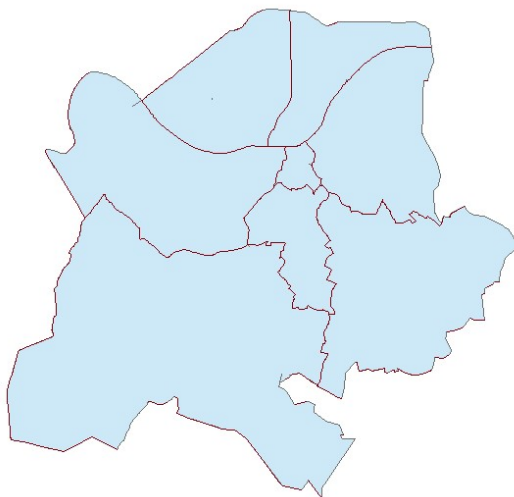
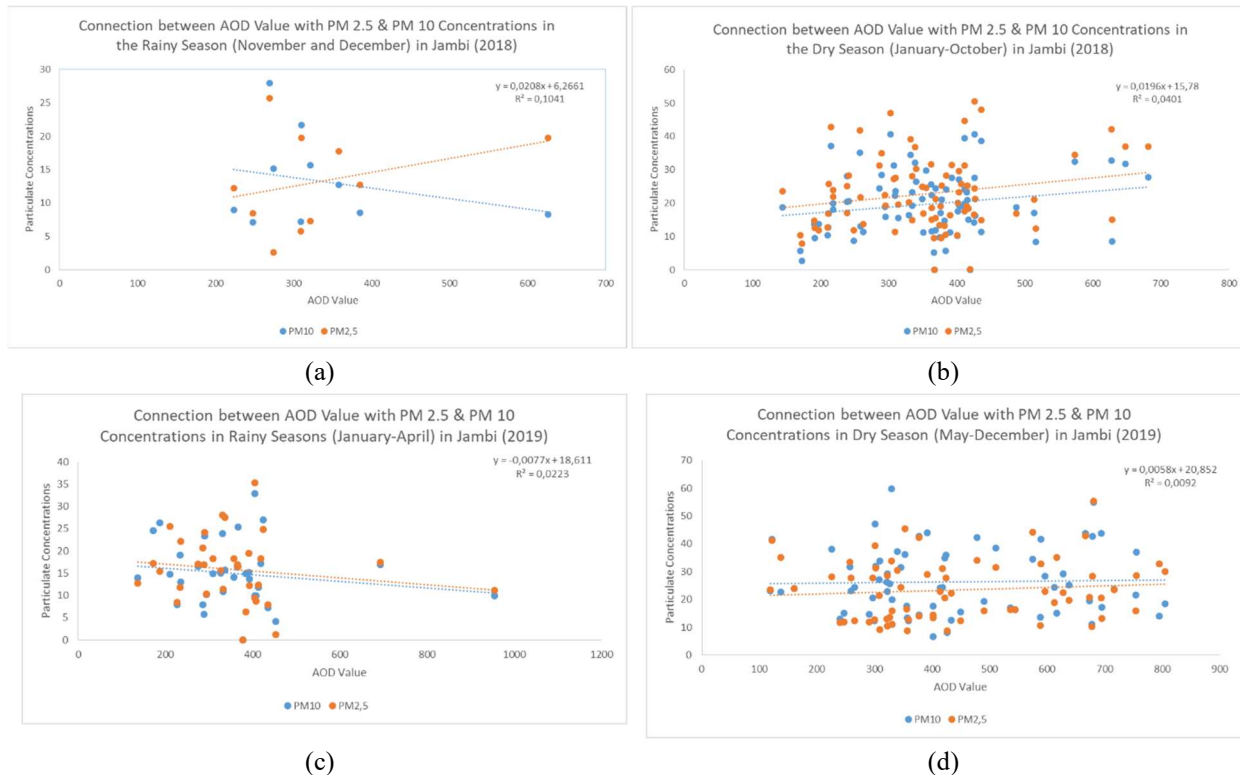


FIGURE 1. Province Administrative Map of Jambi

## RESULT AND DISCUSSION

The relationship between AOD values and PM<sub>2.5</sub> and PM<sub>10</sub> concentrations during the rainy and dry seasons are presented in Figure 1 as follows.



**FIGURE 2.** Graph of the Scattered Relationship of AOD Values with PM<sub>2.5</sub> and PM<sub>10</sub> Concentrations. (a) 2018 Rainy Season. (b) 2018 Dry Season. (c) 2019 Rainy Season. (d) 2019 Dry Season.

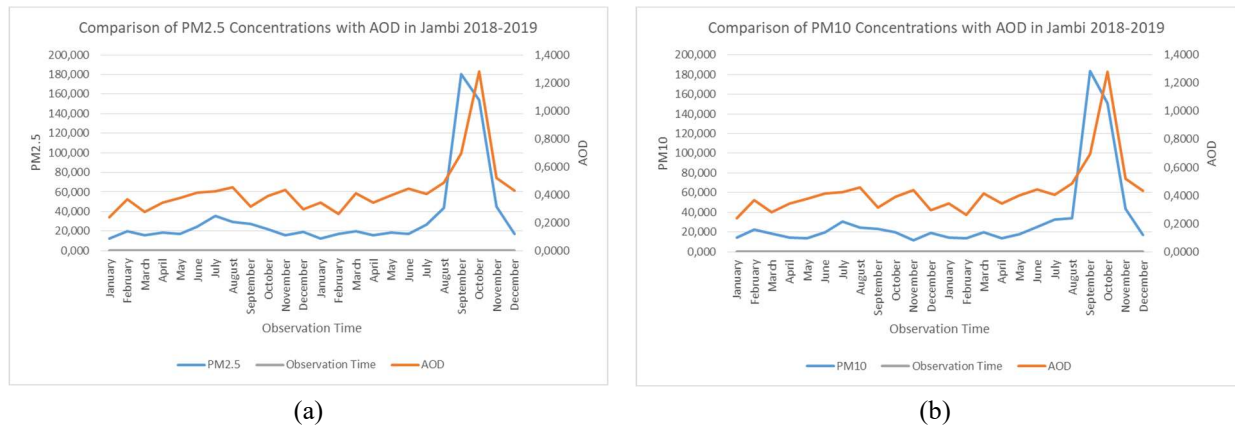
Based on the results of data processing, a graph of the relationship between AOD values and PM<sub>2.5</sub> and PM<sub>10</sub> concentrations in the rainy and dry seasons in Jambi City is obtained. The graph presented is a scatter graph to represent the values of two different numerical variables. PM<sub>2.5</sub> and PM<sub>10</sub> concentrations increase during the dry season because during the dry season, pollutant substances in the atmosphere do not undergo a process of removal or reduction from the presence of air washing by rainwater. Conversely, concentrations of PM<sub>2.5</sub> and PM<sub>10</sub> will tend to be lower than during the dry season due to air washing by rainwater which results in reduced or disappearing pollutant substances in the atmosphere [4].

Fires in Jambi City occurred almost throughout 2018-2019 which were caused by several factors, both natural factors and human actions. Most of the soil types in Jambi are peat soil types so during the dry season the peat soil surface is very dry and easily flammable, fire on the surface can spread to the relatively moist inner layer. This causes the flames to mix with water vapor and produce a lot of smoke [5]. Therefore, the PM<sub>2.5</sub> and PM<sub>10</sub> concentration values tend to be high during forest fires, especially during the dry season.

Based on the results of data processing presented in the scatter chart above, it was found that the relationship between PM<sub>2.5</sub> and PM<sub>10</sub> concentrations with AOD was not significantly correlated. This can be caused by several factors, one

of which is missing a lot of AOD value data or the retrieval scheme does not work properly under certain conditions so that the available AOD values do not represent the relationship with  $PM_{2.5}$  and  $PM_{10}$  concentrations. The retrieval scheme does not work properly, one of which is the presence of cloud cover which causes some data to be lost because it is not induced in the AOD retrieval scheme, another possibility is that the air is too heavily polluted.

Then, a comparison between  $PM_{2.5}$  and  $PM_{10}$  concentrations with AOD values is shown in **Figure 3**.



**FIGURE 3.** Graph of Monthly Comparison of Particulate Concentrations with AOD in 2018-2019. (a)  $PM_{2.5}$  concentration. (b)  $PM_{10}$  concentration.

Based on the graph above, on a monthly average  $PM_{2.5}$  and  $PM_{10}$  concentrations tend to increase from August to October because at that time forest fires occurred in Jambi which paralyzed the economic sector and caused environmental damage. Smoke from forest fires is one of the biggest factors in the increasing concentrations of  $PM_{2.5}$  and  $PM_{10}$ .

## CONCLUSION

Based on the results of this study it can be concluded that:

1.  $PM_{2.5}$  and  $PM_{10}$  concentrations are higher during the dry season because pollutant substances in the atmosphere do not undergo a process of removal or reduction from the presence of air washing by rainwater.
2. Forest fires that occur especially during the dry season cause the flames to mix with moisture and produce a lot of smoke so that the  $PM_{2.5}$  and  $PM_{10}$  concentrations will increase.
3. The relationship between  $PM_{2.5}$  and  $PM_{10}$  concentrations with AOD was not significantly correlated because a lot of data on AOD values were missing or the sampling scheme was not working properly.

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