

## MODIS DATA TO ANALYZE UTILIZATION AND DISTRIBUTION FREQUENCY OF FUTURE PEATLAND FIRES

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### Abstract

Fires occur every dry season. The frequency of fires is increasing each year. Peat fires often occur in developed and developing countries. Peat fires also occurred in Indonesia, particularly Sumatra, Kalimantan and Papua. Peat fires can be monitored by utilizing remote sensing technology, using the hotspot data from Terra / Aqua MODIS. The more hotspots, the higher the potential peat fires. Knowing the frequency and distribution of hotspots is expected to reduce the impact of fire. The objective of this study was to determine the "Utilization of Modis Data to Analyze Frequency and Distribution Peatland Fires Future". This study is exploratory and descriptive. The method used in this research is quantitative. Collecting data using secondary data is data Hotspot. Hotspot image obtained from Terra / Aqua MODIS with the implementation of the algorithm for the fire. Hotspots are classified into three: confidence low, medium and high. Spatial analysis is done between data hotspot with the image of the spectral transformation. The results showed that the distribution of the most concentrated Hotspot District of Simpang Empat as many as 821 includes a satellite 419 satellite 402 aqua and terra. District of Cintapuri Darussalam was the District in the last 8 years was not found hotspots. Distribution and frequency of hotspots on the surface of the earth as an indication of a peat fire. Detection of peatland fires faster so that it can be done immediately known prevention.

**Keywords:** Distribution, Frequency, Hotspots, Peatland Fires

### 1. INTRODUCTION

Fire including natural disasters that are happening in countries that have specific climatic characteristics (de Diego J et al., 2019). Land and forest fires are a natural and necessary component in the ecological cycle. Fires can make a positive contribution to the ecosystem that is passed (Bentley, PD., 2017). The fire would be a disaster when a fire is not under control. Land and forest fires in some cases beneficial for biodiversity and ecology, but still expected to be a national emergency (Moreno, JM., 2014).

Peat fires become an international problem. Peat fires are one of the types of disasters that occur every dry season. The frequency of peatland fires is increasing each year. Peatlands in Indonesia is a potential burn is in Sumatra (Riau, North Sumatra, Jambi, and South Sumatra) and Kalimantan (West Kalimantan, Central Kalimantan, and South Kalimantan), Sulawesi and Papua (Wahyunto et al., 2004). Dry peat soil as a result of processing more flammable (Sudarsono., 1999).

Peat fires require comprehensive and integrated management given the nature of the typical fire spread and difficult to detect. Peat fires happened always repeated every year, especially during the dry season. Repair

forest areas damaged by uncontrolled fires require a long time, especially on peat (Supratomo., 2016; Siegert et al., 2004). The impact of fires affects air quality and human health in Indonesia and other countries (Sabani W et al., 2019). The impact of peat fires in feel in Province North Sumatra, West Sumatra, and cross-border countries such as Malaysia, Singapore, Thailand and the Philippines (CNN Indonesia Online, 2015; Sabani W et al., 2019).

Forest and peatland fires often occur in Indonesia, including South Kalimantan. Fires in South Kalimantan, including quite large for the existing condition of the region, mostly forests and land flammable peat (Harris, et al., 2017). Peat fires could be predicted through some hotspots. The more the number hotspot in an area, the potential for fires also higher. Almost every district in South Kalimantan found the distribution of hotspots. Banjar district is the highest number of hotspots in the district of South Kalimantan Province (BMKG., 2015-2018). Peatlands in Banjar district are thick peat and in (Wahyunto et al., 2004). When they burn peatland difficult to be quenched.

The human factor as one of the causes of peatland fires. Therefore, it is very difficult to predict the behavior of fire, such as where and when it will start (Paveglio, TB., 2018). Peat fires in Banjar Regency human causes for land clearing. Necessary to attempt to minimize the impact of peat fires. Remote sensing technology can provide information about the distribution of hotspots using MODIS (MODIS) on the Terra and Aqua satellites. MODIS has several advantages that can display daily data and has a temporal resolution of 2 times per day. The percentage accuracy for the detection of MODIS hotspot distribution is 64% (Zubaidah., 2014). Further analysis of peat by 66% (W Sabani et al., 2019). MODIS data provide the best data from other data (Vetrita et al., 2014). The frequency and distribution of peatland fires to note for the fire disaster mitigation. This study aims to "Analyzing the frequency and distribution of Peatland Fires Future".

## 2. METHODOLOGY

This study is exploratory and descriptive. The study is used to determine the distribution and identification of potential hotspots peat fires. The method used in this research is quantitative. Quantitative Data is data presented in the form of numbers. Collecting data using secondary data is data Hotspots. Hot spots obtained from the image of the Terra / Aqua MODIS with the implementation of the algorithm for the fire. Hotspots are classified into three: confidence low, medium and high. Spatial analysis was conducted between hotspot data to the image of the results of the spectral transformation.

The focus of research in South Kalimantan Banjar district. Banjar district is the highest district number of hotspots in the province of South Kalimantan (Sipongi.menlhk.go.id, 2015-2018; Satelit.bmkg.go.id, 2015-2018) (see Table 1 and Figure 1). Banjar district is also one of the peat fire-prone areas.

**Table 1. Distribution of Hotspots of Terra / Aqua MODIS in South Kalimantan Year 2015-2019**

KABUPATEN	SATELLITE AQUA									SATELLITE TERRA									JUMLAH TITIK PANAS
	JUMLAH TITIK PANAS	TAHUN								JUMLAH TITIK PANAS	TAHUN								
		2012	2013	2014	2015	2016	2017	2018	2019		2012	2013	2014	2015	2016	2017	2018	2019	
BALANGAN	355	43	49	74	125	30	12	22	0	153	7	9	24	83	16	0	14	0	508
BANJAR	1715	180	103	478	611	20	75	245	3	1099	139	43	278	430	8	26	174	1	2814
BANJAR BARU	156	5	17	37	67	2	7	21	0	81	5	8	7	31	0	4	26	0	237
BANJARMASIN	19	1	0	3	4	3	3	5	0	24	1	6	5	3	3	3	3	0	43
BARITO KUALA	872	114	29	253	440	1	5	30	0	428	49	17	130	211	4	4	13	0	1300
HULU SUNGAI SELATAN	1085	125	74	315	341	16	30	181	3	502	46	23	126	148	6	24	124	5	1587
HULU SUNGAI TENGAH	189	18	40	57	35	9	12	18	0	156	5	15	35	62	8	12	15	4	345
HULU SUNGAI UTARA	494	55	45	93	216	6	14	64	1	189	12	14	22	106	2	6	24	3	683
KOTA BARU	2219	265	186	457	1122	41	48	93	7	564	46	15	92	385	7	6	12	1	2783
TABALONG	465	74	58	91	181	20	15	25	1	258	28	10	27	147	18	8	17	3	723
TANAH BUMBU	1334	159	65	369	666	38	2	33	2	392	20	15	48	270	28	4	4	3	1726
TANAH LAUT	1332	128	108	316	588	23	52	117	0	408	29	23	91	194	8	15	45	3	1740
TAPIN	1251	146	87	337	505	11	16	82	67	1025	118	36	251	457	6	8	60	89	2276
JUMLAH	11486									5279									16765

Source: Sipongi.menlhk.go.id, 2015-2018; Satelit.bmkg.go.id, 2015-2018; Results Processing and Analysis, 2019.

The descriptive analysis in this study is required. Presentation of data in the tabular form then made the description and interpretation of the analyzes that are non-statistical (Safitri., 2007). Peat fires in the analysis used data hotspots that indicate a high temperature in an area. The spectrum of electromagnetic waves there is 7 to produce hotspots of MODIS data (Sabani W et al., 2019). Analysis of hotspots using MODIS band 7 that band 1, band 2, band 7, band 21, the band 22, the band 31 and band 32 (Giglio et al., 2016). The

data is processed using an algorithm to generate hotspot data (Giglio, 2015). The number of hotspots not only shows the number of fires but shows the scene of the fire (Sabani W et al, 2019). The number of hotspots is high in an area so the potential for fire is high in the area.

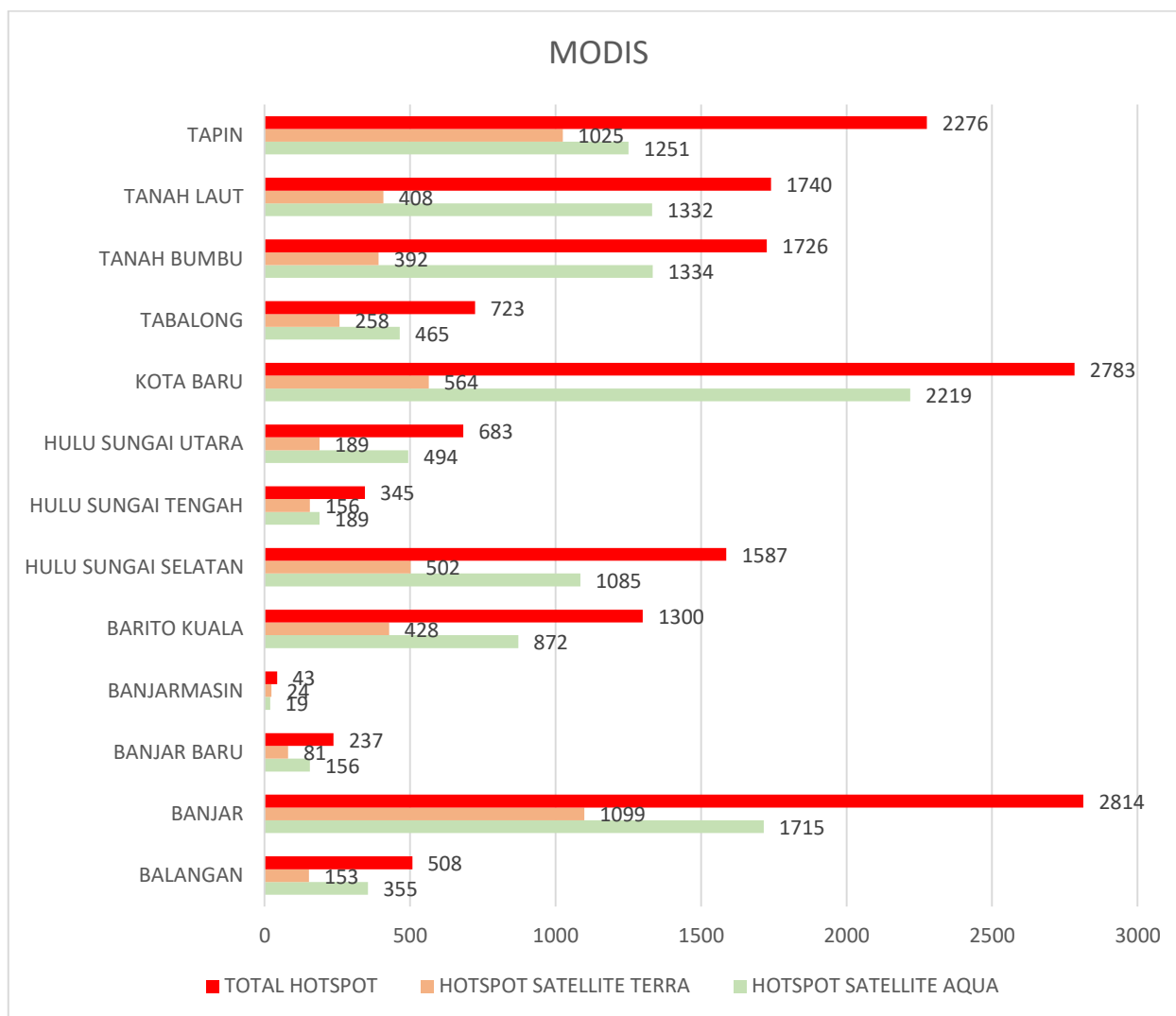


Figure 1. Distribution of Hotspots from Terra / Aqua MODIS in South Kalimantan Year 2012-2019

### 3. RESULTS AND DISCUSSION

#### 3.1. Frequency and Distribution Hotspots

The frequency and distribution of hotspot in the study area were obtained from the recording of data satellites Terra and Aqua MODIS. The recording was done 2 times per day morning and afternoon. The results of the recording showed the daily fluctuation of hotspot data in the study area. The analysis showed peat fires occurred in several locations. Some hotspots are in the same location continuously for several days because of a fire so that fire last long. The data taken was in 2012, 2015 and 2018. The result of recording the frequency and distribution of hotspots from Terra / Aqua MODIS are:

##### 3.1.1. Hotspots 2012

The hotspot is an indicator of the cause of the occurrence of peat fires. Peat fires detected by satellites as a hotspot which is then indicated as hotspots. Hotspots are the earth's surface that has a relatively higher temperature than the other surfaces (LAPAN., 2014 in Dyang Falila Pramesti, M.T dkk., 2017). Hotspots are highest in the Subdistrict of Simpang Empat with the number 133 hotspots (64 satellites Aqua and Terra satellites 69) (see Table 2). Distribution of most emerging hotspots in August, September, and October as the month is dry months. The dry season affects the number of hotspots in each area.

**Table 2. Distribution of Hotspots from Terra / Aqua MODIS in Banjar district year 2012**

KECAMATAN	SATELLITE AQUA				SATELLITE TERRA				JUMLAH TITIK PANAS
	JUMLAH TITIK PANAS	TINGKAT KEPERCAYAAN			JUMLAH TITIK PANAS	TINGKAT KEPERCAYAAN			
		RENDAH	SEDANG	TINGGI		RENDAH	SEDANG	TINGGI	
ALUH-ALUH	3	0	1	2	0	0	0	0	3
ARANIO	13	4	8	1	9	0	7	2	22
ASTAMBUL	5	1	3	1	8	0	4	4	13
BERUNTUNG BARU	1	0	0	1	0	0	0	0	1
GAMBUT	6	0	5	1	14	0	7	7	20
KARANG INTAN	9	0	8	1	3	0	2	1	12
KERTAK HANYAR	6	0	4	2	1	0	0	1	7
MARTA PURA	0	0	0	0	0	0	0	0	0
MARTA PURA BARAT	13	0	8	5	8	0	6	2	21
MARTA PURA TIMUR	1	0	1	0	1	0	1	0	2
MATARAMAN	4	0	2	2	2	0	1	1	6
PARAMASAN	8	0	4	4	5	0	3	2	13
PENGARON	14	3	7	4	6	0	5	1	20
SAMBUNG MAKMUR	0	0	0	0	0	0	0	0	0
SIMPANG EMPAT	64	5	36	23	69	5	39	25	133
SUNGAI PINANG	20	4	9	7	3	0	3	0	23
SUNGAI TABUK	12	2	5	5	4	0	2	2	16
TATAH MAKMUR	1	0	0	1	1	0	0	1	2
TELAGA BAUNTUNG	0	0	0	0	5	0	4	1	5
CINTA PURI DARUSSALAM	0	0	0	0	0	0	0	0	0
	180				139				319

Source: Sipongi.menlhk.go.id, 2012; Satelit.bmkg.go.id, 2012; Results Processing and Analysis, 2019.

### 3.1.2. Hotspots 2015

Hotspots can be interpreted as having a surface temperature relatively higher than in the surrounding area monitored by remote sensing satellites (Giglio et al., 2003). Conditions of low rainfall during the dry season and forest land cover flammable become an important factor in the formation of the fire. Factors formation of hotspots spread also into the potential of burning peat. The number of hotspots by Table 3 highest one is in Simpang Empat at number 330 hotspots (181 satellite aqua and terra satellite 149). The number of hotspots in 2015 occurred in August, September, and October.

**Table 3. Distribution of Hotspots from Terra / Aqua MODIS Banjar District 2015**

KECAMATAN	SATELLITE AQUA				SATELLITE TERRA				JUMLAH TITIK PANAS
	JUMLAH TITIK PANAS	TINGKAT KEPERCAYAAN			JUMLAH TITIK PANAS	TINGKAT KEPERCAYAAN			
		RENDAH	SEDANG	TINGGI		RENDAH	SEDANG	TINGGI	
ALUH-ALUH	23	3	9	11	6	0	6	0	29
ARANIO	52	8	25	19	26	1	19	6	78
ASTAMBUL	38	4	13	21	47	2	18	27	85
BERUNTUNG BARU	9	0	1	8	4	0	3	1	13
GAMBUT	57	6	21	30	52	4	28	20	109
KARANG INTAN	28	0	10	18	30	1	13	16	58
KERTAK HANYAR	1	0	1	0	7	0	1	6	8
MARTAPURA	0	0	0	0	1	0	1	0	1
MARTAPURA BARAT	36	2	16	18	15	2	6	7	51
MARTAPURA TIMUR	0	0	0	0	0	0	0	0	0
MATARAMAN	13	1	5	7	5	0	3	2	18
PARAMASAN	36	0	18	18	39	2	17	20	75
PENGARON	33	2	17	14	7	0	5	2	40
SAMBUNG MAKMUR	3	0	2	1	0	0	0	0	3
SIMPANG EMPAT	181	10	75	96	149	13	58	78	330
SUNGAI PINANG	67	6	17	44	17	1	10	6	84
SUNGAI TABUK	28	3	16	9	19	1	6	12	47
TATAH MAKMUR	5	0	1	4	5	0	1	4	10
TELAGA BAUNTUNG	1	0	0	1	1	0	0	1	2
CINTA PURI DARUSSALAM	0	0	0	0	0	0	0	0	0
	611				430				1041

Source: Sipongi.menlhk.go.id, 2015; Satelit.bmkg.go.id, 2015; Results Processing and Analysis, 2019.

### 3.1.3. Hotspots 2018

The highest number of hotspots is based on Table 4 in Martapura Barat Subdistrict with 99 hotspots (46 aqua satellites and 53 terra satellites). The greater the higher the number of hotspots that occurred peat fires in the area. (Rosa., 2014 in Autika., 2018) the emergence of hotspots occurs in mid-year highs during the peak of the dry season. The lower rainfall than the likelihood of hotspots higher.

**Table 4. Distribution Hotspots from Terra / Aqua MODIS Banjar District 2018**

KECAMATAN	SATELLITE AQUA				SATELLITE TERRA				JUMLAH TITIK PANAS
	JUMLAH TITIK PANAS	TINGKAT KEPERCAYAAN			JUMLAH TITIK PANAS	TINGKAT KEPERCAYAAN			
		RENDAH	SEDANG	TINGGI		RENDAH	SEDANG	TINGGI	
ALUH-ALUH	0	0	0	0	0	0	0	0	0
ARANIO	18	2	12	4	0	0	0	0	18
ASTAMBUL	13	0	3	10	18	0	7	11	31
BERUNTUNG BARU	5	1	3	1	3	0	1	2	8
GAMBUT	30	2	8	20	30	3	11	16	60
KARANG INTAN	8	2	4	2	4	0	2	2	12
KERTAK HANYAR	0	0	0	0	0	0	0	0	0
MARTAPURA	1	0	1	0	2	0	1	1	3
MARTAPURA BARAT	46	2	18	26	53	2	17	34	99
MARTAPURA TIMUR	2	0	1	1	1	0	0	1	3
MATARAMAN	3	0	2	1	3	1	2	0	6
PARAMASAN	37	0	16	21	4	1	2	1	41
PENGARON	14	1	7	6	5	0	3	2	19
SAMBUNG MAKJUR	1	0	0	1	0	0	0	0	1
SIMPANG EMPAT	24	0	11	13	32	0	16	16	56
SUNGAI PINANG	25	1	13	11	5	0	3	2	30
SUNGAI TABUK	16	1	8	7	14	1	7	6	30
TATAH MAKJUR	0	0	0	0	0	0	0	0	0
TELAGA BAUNTUNG	2	0	1	1	0	0	0	0	2
CINTAPURI DARUSSALAM	0	0	0	0	0	0	0	0	0
	245				174				419

Source: Sipongi.menlhk.go.id, 2018; Satelit.bmkg.go.id, 2018; Results Processing and Analysis, 2019.

### 3.2. Peatland Fires Concentration Banjar Year 2012-2019

Indonesia's peatland fires occur almost every year since 1997. The main cause of fire-related to human activity. Another factor that triggered the fire is influenced by climatic conditions El Nino during the dry season and biophysical conditions of degraded lands. Defined as a burning fire that is not restrained and spread freely (Dyang Faliia Pramesti, M.T dkk., 2017). Fire generally occurs on the land cover by type of peat (Agung Adiputra dkk., 2018). The number of hotspots in Banjar district years 2012-2019 fluctuated (see Table 5, Table 6 and Figure 2). These fluctuations are affected by natural and human factors.

**Table 5. Distribution of Aqua MODIS Hotspots In Banjar Regency Year 2012-2019**

KECAMATAN	JUMLAH TITIK PANAS	SATELLITE AQUA								
		TAHUN								
		12	13	14	15	16	17	18	19	
ALUH-ALUH	28	3	0	2	23	0	0	0	0	
ARANIO	130	13	8	31	52	2	6	18	0	
ASTAMBUL	95	5	1	37	38	0	1	13	0	
BERUNTUNG BARU	21	1	0	4	9	0	2	5	0	
GAMBUT	114	6	3	18	57	0	0	30	0	
KARANG INTAN	68	9	3	19	28	0	1	8	0	
KERTAK HANYAR	10	6	2	1	1	0	0	0	0	
MARTAPURA	5	0	1	1	0	2	0	1	0	
MARTAPURA BARAT	181	13	14	53	36	1	18	46	0	
MARTAPURA TIMUR	4	1	0	1	0	0	0	2	0	
MATARAMAN	34	4	2	12	13	0	0	3	0	
PARAMASAN	178	8	27	56	36	6	8	37	0	
PENGARON	101	14	5	24	33	3	5	14	3	
SAMBUNG MAKJUR	6	0	0	2	3	0	0	1	0	
SIMPANG EMPAT	419	64	15	115	181	3	17	24	0	
SUNGAI PINANG	207	20	17	62	67	3	13	25	0	
SUNGAI TABUK	98	12	2	36	28	0	4	16	0	
TATAH MAKJUR	7	1	0	1	5	0	0	0	0	
TELAGA BAUNTUNG	9	0	3	3	1	0	0	2	0	
CINTAPURI DARUSSALAM	0	0	0	0	0	0	0	0	0	
	1715	180	103	478	611	20	75	245	3	

Source: Sipongi.menlhk.go.id, 2012-2019; Satelit.bmkg.go.id, 2012-2019; Results Processing and Analysis, 2019.

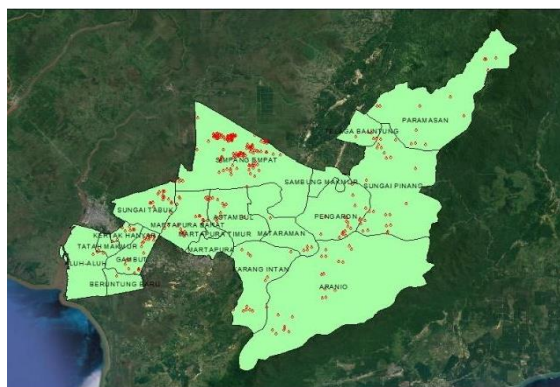
The highest number of hotspots in the Simpang Empat Subdistrict many as 821 (419 and 402 satellites satellite aqua terra). Subdistricts that are not found hotspot point is the Cintapuri Darussalam. The number of hotspots has decreased significantly from 2015 to 2016, 2015 the El Nino or dry seasons. In 2016 and 2017 the Banjar District experienced a la Nina or rainy season resulting in low fire rates. In 2018 the hotspots in Banjar Regency increased due to changes in weather conditions. The greater the number of hotspots, the potential for a fire is also getting bigger.

**Table 6. Distribution of Terra MODIS Hotspots In Banjar Regency Year 2012-2019**

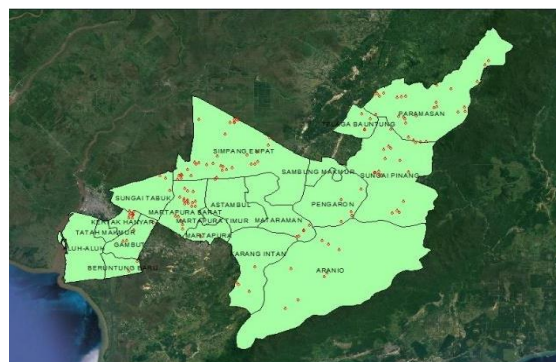
KECAMATAN	SATELLITE TERRA									
	JUMLAH TITIK PANAS	TAHUN								
		12	13	14	15	16	17	18	19	
ALUH-ALUH	6	0	0	0	6	0	0	0	0	
ARANIO	44	9	0	7	26	1	1	0	0	
ASTAMBUL	84	8	0	11	47	0	0	18	0	
BERUNTING BARU	15	0	2	4	4	0	2	3	0	
GAMBUT	119	14	1	22	52	0	0	30	0	
KARANG INTAN	63	3	1	16	30	0	9	4	0	
KERTAK HANYAR	17	1	5	4	7	0	0	0	0	
MARTAPURA	9	0	1	2	1	1	1	2	1	
MARTAPURA BARAT	130	8	6	44	15	0	4	53	0	
MARTAPURA TIMUR	3	1	0	0	0	0	1	1	0	
MATARAMAN	18	2	3	5	5	0	0	3	0	
PARAMASAN	60	5	0	10	39	2	0	4	0	
PENGARON	31	6	0	11	7	1	1	5	0	
SAMBUNG MAKMUR	0	0	0	0	0	0	0	0	0	
SIMPANG EMPAT	402	69	20	125	149	2	5	32	0	
SUNGAI PINANG	32	3	1	4	17	1	1	5	0	
SUNGAI TABUK	48	4	2	8	19	0	1	14	0	
TATAH MAKMUR	11	1	0	5	5	0	0	0	0	
TELAGA BAUNTING	7	5	1	0	1	0	0	0	0	
CINTAPURI DARUSSALAM	0	0	0	0	0	0	0	0	0	
	1099	139	43	278	430	8	26	174	1	

Source: Sipongi.menlhk.go.id, 2012-2019; Satelit.bmkg.go.id, 2012-2019; Results Processing and Analysis, 2019.

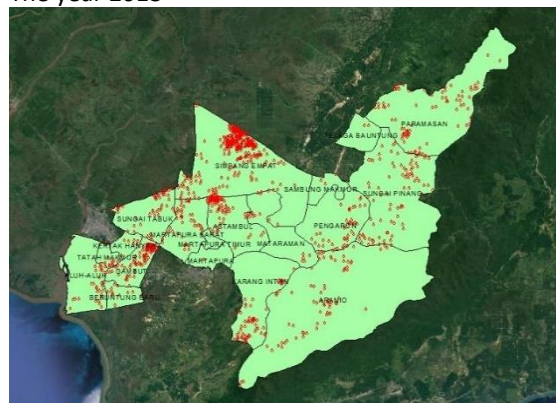
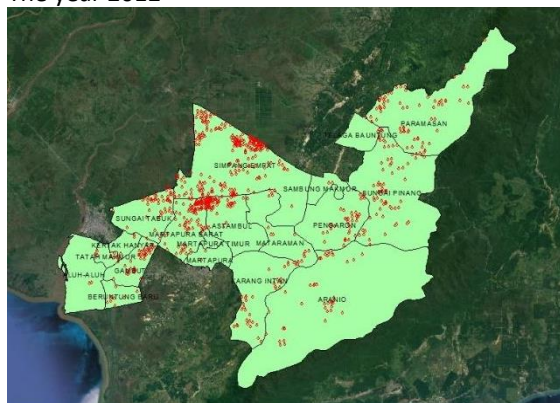
Peat fires happened always repeated every year, especially during the dry season. Repair forest areas damaged by fire requires a long time, especially if fires on peat (Rianawati et al., 2016). Peat fires require a comprehensive and integrated treatment because of the nature of a typical fire spread and difficult to detect.



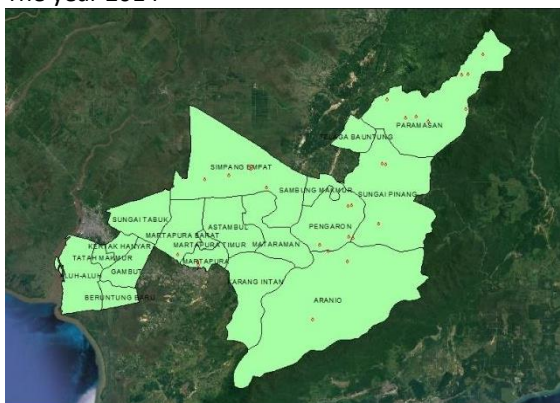
The year 2012



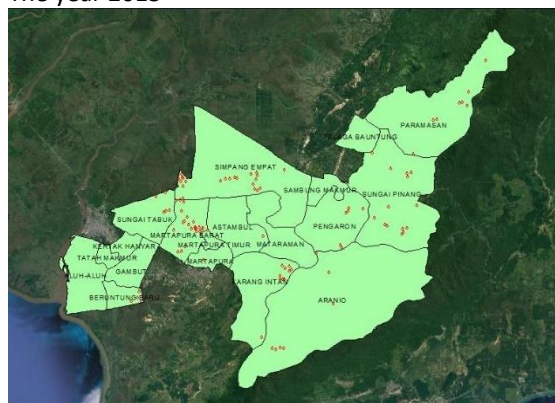
The year 2013



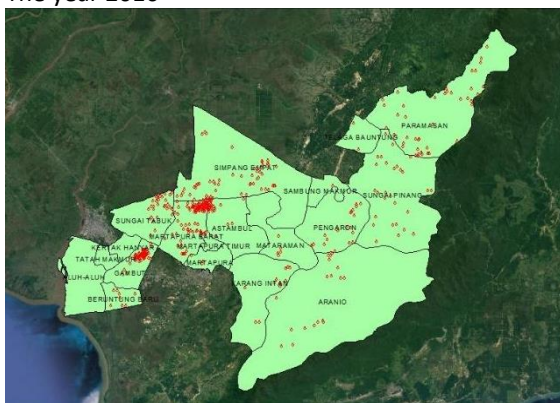
The year 2014



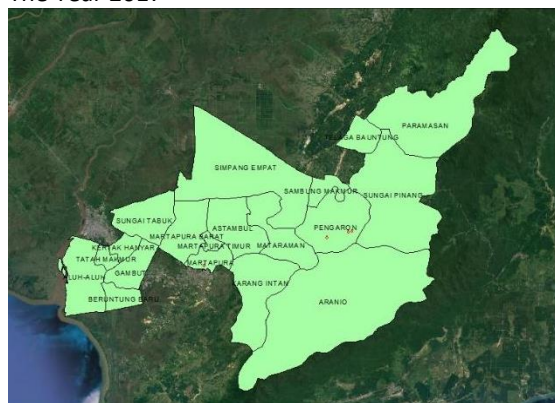
The year 2015



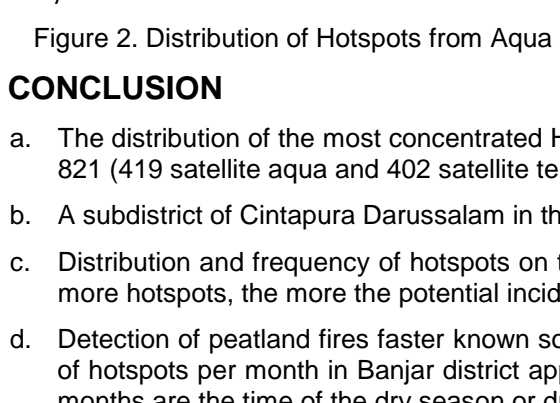
The year 2016



The Year 2017



The year 2018



The year 2019

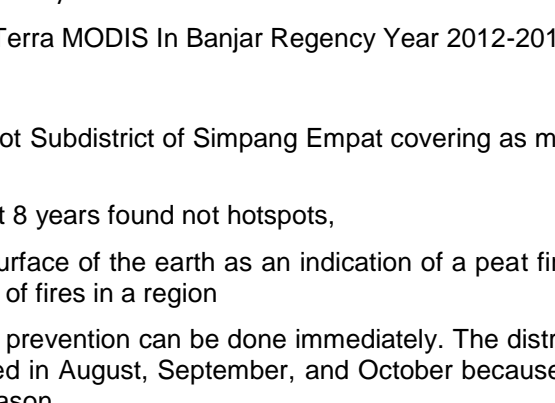


Figure 2. Distribution of Hotspots from Aqua and Terra MODIS In Banjar Regency Year 2012-2019

#### 4. CONCLUSION

- The distribution of the most concentrated Hotspot Subdistrict of Simbang Empat covering as many as 821 (419 satellite aqua and 402 satellite terra),
- A subdistrict of Cintapura Darussalam in the last 8 years found not hotspots,
- Distribution and frequency of hotspots on the surface of the earth as an indication of a peat fire. The more hotspots, the more the potential incidence of fires in a region
- Detection of peatland fires faster known so that prevention can be done immediately. The distribution of hotspots per month in Banjar district appeared in August, September, and October because these months are the time of the dry season or dry season.

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