International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

Vol. 37 No. 1 February 2023, pp. 720-731

Analysis Of The Monsoon Contribution In Forming Rainfall Characteristics In Kalimantan As An Effort In Formulating Flood Disaster Mitigation Policies To Support National Security

Firman Setia Budi, Dr. Daryono, M.Si, Kolonel Caj. Kusuma, M.Si, Achmad Fahruddin Rais

Faculty of National Security Republic of Indonesia Defense University

Indonesian Agency for Meteorology, Climatology, and Geophysics

Faculty of National Security Republic of Indonesia Defense University

National Research and Innovation Agency

firmansetiabudi1210@gmail.com

Abstract – Rainfall plays an important role in human life activities. Floods, landslides, and droughts are the impacts caused by excessive rainfall or no rainfall at all. The characteristics of rainfall are an important factor as a climatological consideration in adjusting and preparing for disasters caused by rainfall. The atmosphere in Indonesia, located in the tropical region, is highly variable and is interference by various atmospheric waves, ranging from daily to decadal periods. National defense and national security are closely related to disaster management because disasters can threaten the sovereignty, integrity, and stability of a country. National security and defense in Indonesia encompass various aspects such as military, political, economic, socio-cultural, and intelligence. Disasters can affect all of these aspects and can threaten national security and defense as a whole. This study aims to determine the characteristics of rainfall in Kalimantan and the phenomena that cause the characteristics of rainfall in Kalimantan, which can be used as one of the considerations in formulating appropriate flood disaster mitigation policies to minimize losses and casualties. The method used in this research is to use descriptive analysis method and literature review (literature review) which the author collects from various sources related to this paper. This method aims to provide a comprehensive and analytical explanation based on data from the literature. The data used in this study are BMKG daily rainfall data for Nunukan, Tarakan, Tanjung Selor, Tanjung Redep, Balikpapan, Samarinda, Kotabaru, Banjarmasin, Banjarbaru, Muara Teweh, Buntok, Palangkaraya, Sampit, Pangkalanbun, Ketapang, Pontianak, Siantan, Nangapinoh, Sintang, Paloh, and Putusibau with the data period 2003-2012 and ECMWF ERA INTERIM 925 HPa with resolution 0.1250 and data period 2003-2012. The methodology used in this research is Make a daily rainfall periodogram with the FFT technique, Make a graph of daily rainfall that is averaged every month, Create a map of wind direction and speed grouped by month, Analyze the periodogram to find the largest period of the rainfall spectrum, Analyze the peak of rainfall on the daily rainfall chart, and Analyze the monsoon winds that affect the peak of rainfall. The results show that Kalimantan's rainfall, with annual periodicity, has 1-2 average daily rainfall peaks spread across Nunukan, Tanjung Selor, Muarateweh, Tanjung Redep, Paloh, Nangpinoh, Putusibau, Sintang, Samarinda Ketapang, Balikpapan, Pangkalanbun, Sampit, Buntok, Palangkaraya, Banjarmasin, Banjarbaru, and Kotabaru. Generally, rainfall with one peak has a higher spectrum density than rainfall with two peaks. Kalimantan's semi-annual periodicity rainfall generally has 2 peaks spread across Tarakan, Siantan, and Pontianak. Then, the Asian monsoon wind greatly affects rainfall in Tanjung Selor, Tanjung Redep, Paloh, Nangapinoh, Putusibau, Sintang, Pangkalanbun, Sampit, Buntok, Banjarbaru, and Banjarmasin. The Asian monsoon transitional wind has an effect on Tarakan, Samarinda, Pontianak, Siantan, and Ketapang. Then, the Australian monsoon wind influences rainfall in Nunukan, Balikpapan, and Kotabaru. By knowing the rain pattern in Kalimantan, it is hoped that it can be used as a basis for consideration in setting policies in mitigating floods. There needs to be more in-depth research on locations that are a national priority, such as East Kalimantan because the area will be a candidate for the National Capital

Keywords – Rainfall, Floods, Monsoon, Disaster Mitigation, National Security and FFT technique

I. Introduction

Rainfall has an important role in human life activities. Floods, landslides, and drought are the impacts that occur when rainfall is too large or does not fall at all. Rainfall characteristics are an important factor as climatological considerations in adjusting and preparing for disasters caused by rainfall.

Daily rain is a periodic occurrence of rain somewhere in one day. At the equator, the sun illuminates land and sea for the same duration during the day. However, due to differences in the ability to absorb and store heat between land and sea, during the day the temperature of the land is hotter than the temperature of the ocean, while at night it is the opposite, namely the ocean is hotter than the land. This factor acts as a regulator of diurnal wind circulation, which results from the instability of the air atmosphere over land and the ocean (Ramage, 1952). Due to differences in the absorption of heat from the ocean and land, monsoon winds arise (Prawirowardoyo, 1996). The purpose of this article is To find out the characteristics of rainfall in Kalimantan and what phenomena cause the characteristics of rainfall in Kalimantan so that it can be used as a consideration in formulating appropriate flood disaster mitigation policies to minimize losses and casualties.

II. Literature Review

2.1. Terminology of Rainfall and Its Classification

Water from both land and sea is first heated and undergoes evaporation and evapotranspiration. Where water vapor will rise to the top due to its smaller density plus a higher temperature than around. This water vapor will experience condensation into water droplets that form cloud droplets. Cloud drops that have condensed undergo a collision-merging process and three phases. After that the cloud drops will turn into bulk drops and fall as precipitation (Prawirowardoyo, 1996).

In its partnership, Dassault has a variety of partnership experiences such as partnerships in the industry aiming to develop One form of sediment that is often encountered is rain. Precipitation itself has the meaning as a form of water either in the form of liquid or solid (ice) from the condensation of water vapor that falls from clouds or precipitated from the air on the surface including rain, drizzle, snow and hail (WMO, 2006). While rainfall is the thickness of rainwater that collects in a flat place, does not evaporate, does not seep and does not flow (BMG, 2007).

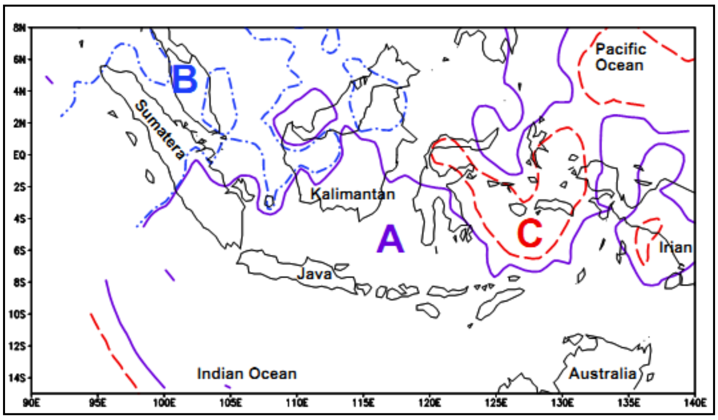


Figure 2.1. The regional distribution of rainfall types is based on the annual pattern (Aldrian, 2003).

In Indonesia, rainfall is divided into three categories based on the annual average pattern (Aldrian, 2003 and 2008), namely:

1. The Australian monsoonal or monsoon rain pattern where the region has a clear difference between the rainy season period and the dry season period and is grouped into Seasonal Zones (ZOM). The monsoonal rainfall type is unimodal with one peak rainy season during the DJF and JJA periods experiencing a dry season. This occurs due to the Australian monsoon and the Asian monsoon which blow alternately. The distribution of the monsoonal area extends from southern Sumatra to the islands in southwest Papua and most of its distribution is south of the equator.

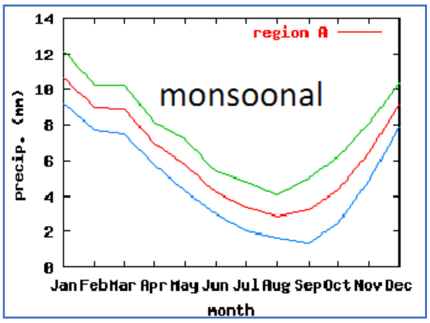


Figure 2.2. Monsoonal rainfall type temporal graph

2. The northeastern or equatorial monsoon pattern has the characteristics of having a bimodial monthly rainfall distribution with two maximum rainfall peaks and unclear differences between the peaks of the dry season and the rainy season. The peak of maximum rain occurs around March and October or when the equinoxes occur. The distribution of the equatorial pattern is around the equator.

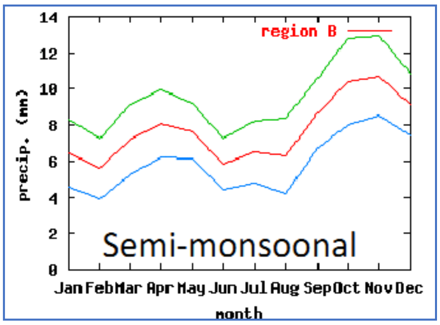


Figure 2.3. Equatorial rainfall type temporal graph

3. The local or anti-monsoon rain pattern has a temporal distribution of rainfall in contrast to the monsoon pattern. The local pattern is characterized by the shape of the unimodial rain pattern, but the shape is opposite to the monsoon rain type. The local pattern is related to the distribution of ocean currents which bring warm temperatures from the Pacific Ocean during the JJA period and distribute cold temperatures during the DJF period. Its distribution is mostly around the Maluku islands

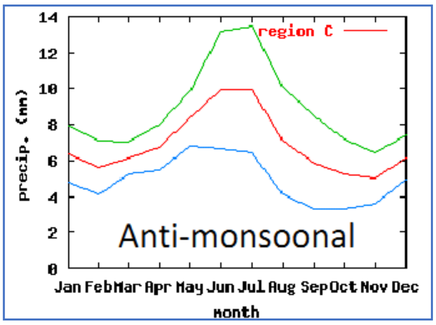


Figure 2.4. Local rainfall type temporal graph

2.2. Climate Variability in Indonesia

Indonesia's atmosphere, which is in the tropics, is very varied and is interference with various atmospheric waves. Starting from waves with daily periods to tens of years as shown in the following table:

Tabel 2.1. Variasi klimatik atmosfer tropis **(Yamanaka D dalam Wirjohamidjojo dan Swarinoto, 2010)**

Category	Variation	Time Scale	Information
Seasonal and inter-annual	Oscillation 10-12 annual (TTO)	10 – 12 years	The TTO (ten to twelve oscillations) oscillations are often associated with the sunspot cycle.
	ENSO (El Niño Southern Oscillation)	4 years	Dominant tropospheric oscillations in relation to global climate, and seen as an independent ocean-atmosphere pair.
	QBO (Quasi Binary oscillation)	2 years	The predominant mode of oscillation is in the lower equatorial stratosphere. Also a component of southern tropospheric oscillations and monsoon cycles, but their origin is unknown with certainty.
	AO (Annual Oscillation) and SAO (Semi-Annual Oscillation)	1 - 0.5 years	Dominant in the equatorial region. AO tropopause and mesopause are affected/elicited by flow interactions (monsoon).
	ISO (Interseasonal oscillation)	30 – 60 Daily	Kelvin wave with zonal wave number = 1. Considered as results from CSIK (Convective Stability of Secondary Kind).
Movement disturbance east	Super cloud	10–20 days	Kelvin waves with a zonal wavelength of 2000-4000 km. Seen as a regime of deep turmoil of the ISO whose movement is eastward.
	Kelvin waves	20 days	Near the tropopause, centered on the Western Pacific.
	Kelvin waves	10 – 20 days	In the lower stratosphere with wave numbers k between 1 and 2.
	Kelvin waves	5 days	Near the stratopause at great speed eastward.
	MRG (Mixed Rossby gravity waves)	4 – 5 days	In the lower stratosphere with wave numbers 4 – 5.
Movement disturbance West	Cloud Clusters	4 days	In the troposphere.
	Wave two daily	2 days	Near the tropopause; in the form of inertial gravitational or cyclontropic waves. Generated from the CISK mechanism.
	ups and down	1 day	Planetary scale.
	Land-sea wind	1 day	meso scale.
Shorter variation	semi-daily tides	0.5 days	Planetary scale.
	Cloud Cb	1 hour	Sea-land breezes up to a distance of 10 km, driven by unstable atmospheric conditions. Generated from the CISK mechanism.

2.3. Monsun and Its Influence on The Climate In Indonesia.

The maritime continent of Indonesia is not a source of monsoons but is located within the influence area of the monsoons, namely the South Asian monsoon, the Asian monsoon, and the Australian monsoon. The three of them interact with each other to form the Indonesian monsoonal system. For example, during winter in Asia, most of Indonesia has a westerly monsoon (west monsoon), and a small part of the west has a northeast monsoon (northeast monsoon). During the summer of Asia, most of Indonesia experiences an east-southeast monsoon (east monsoon) and a small part in the west occurs a southwest monsoon (southwest monsoon). The west monsoon is generally accompanied by a lot of rain, so the west monsoon is identified with the rainy season and vice versa, the east monsoon is accompanied by little rain, so it is identified with the dry season (Wirjohamidjojo and Swarinoto, Windshear lines (shear lines) often occur in the Asian hot and cold monsoon seasons, especially during the transitional periods of April and November. In the wind shear area, there are small eddies that can cause upheaval, turbulent clouds, and lots of rain (Wirjohamidjojo and Swarinoto, 2010).

2.4. Spectral Analysis and Its Usage of Rain Data

Spectral analysis is a method for converting data signals from the time domain to the frequency domain, so that we can see periodic patterns and then determine the dominating frequency of rainfall (Aldrian, 2003). The period obtained from the frequency is associated with climate variability in table 2.1. Spectral analysis with Fast Fourier Transform (FFT) is needed to determine the periodicity of weather phenomena from the periodogram. Chatfield (1995) explained that a periodogram is a graph showing the value of the power spectral density (PSD) against frequency or period (Reed, 1961). The maximum peak of the spectrum in the periodogram is expressed as the main period of all data

Periodogram with Fast Fourier Transform expressed by the following formula:

$$x_t = \frac{a_0}{2} + \sum \left[a_p \cos\left(\frac{2\pi \mathrm{pt}}{\mathrm{T}}\right) + b_\mathrm{p} \sin\left(\frac{2\pi \mathrm{pt}}{\mathrm{T}}\right) \right] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. \quad (1)$$

Where :

$$a_0 = \bar{x}$$

$$a_p = \frac{2[\sum x_\mathrm{t} \cos\left(\frac{2\pi \mathrm{pt}}{\mathrm{T}}\right)]}{T}$$

$$b_p = \frac{2[\sum x_t\, sin\left(\frac{2\pi pt}{T}\right)]}{T}$$

Then, the Fourier series above (1) is converted from the time function into frequency (ω) using the following equation (2):

$$x(\omega) = \int_{-\infty}^{\infty} x(t) e^{-i\omega t}\, dt \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Markthe spectral density of the periodogram is obtained from the formula:

$$PSD(\omega) = \frac{T}{2}(a_p^2 + b_p^2) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (3)$$

Spectral density (PSD) is a function of the positive frequency variable associated with a stationary stochastic process, or time deterministic function, which has the dimension of force per Hz. This is often referred to as the signal spectrum. Spectral density captures the frequency of stochastic processes and helps identify periodicity. Fast fourier transform calculations in this paper are carried out using the MATLAB 2012 program

2.5. The National Defense and National Security

As stated in the Law of the Republic of Indonesia No. 3 of 2002 Chapter I Article 1 concerning National Defence, National Defense is all efforts to defend state sovereignty, territorial integrity of the Unitary State of the Republic of Indonesia, and all the safety of the entire nation from threats and disturbances to the integrity of the nation and state. Threats that will be faced, can be in the form of military threats such as military attacks from other countries, as well as non-military threats such as pandemic threats, natural disasters and others. The Indonesian defense system is a universal defense system, the implementation of which is based on awareness of the matters and obligations of all citizens in achieving national goals as stated in the 1945 Constitution. The area of the State of Indonesia reaches 1,919 million km2 and of which around 17,504 islands demand the existence of a system. maximum and comprehensive national defense from all components, namely land, sea and air.

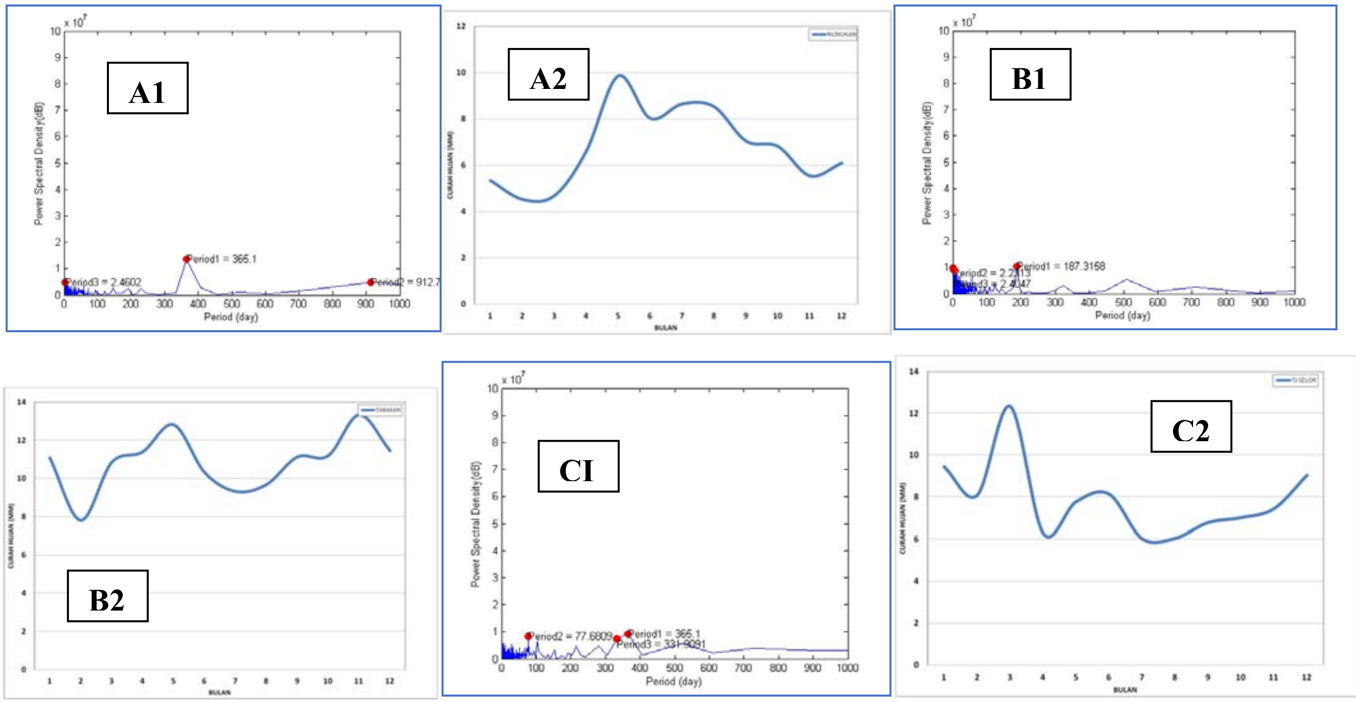
National defense and national security are closely related to disaster management because disasters can threaten the sovereignty, integrity, and stability of a country. National security and defense in Indonesia encompass various aspects such as military, political, economic, socio-cultural, and intelligence. Disasters can affect all of these aspects and can threaten national security and defense as a whole. In the context of disaster management, national security and defense can take several steps, including: Prevention: Preventing disasters by strengthening infrastructure, conducting research and development to find ways to reduce disaster risk, and providing education to the public on how to reduce disaster risk. Mitigation: Handling disasters that occur through evacuation, rescue, and rehabilitation efforts. National security and defense can assist by providing emergency aid and interagency coordination. Recovery: Restoring conditions after a disaster occurs through rehabilitation and infrastructure reconstruction efforts and restoring the psychological state of disaster victims. In addition, national security and defense can also assist in emergency situations that occur during disasters, such as ensuring the supply of water and food, maintaining public order, and providing medical assistance.

III. RESEARCH METHODS

The method used in this research is to use descriptive analysis method and literature review (literature review) which the author collects from various sources related to this paper. This method aims to provide a comprehensive and analytical explanation based on data from the literature. The data used in this study are BMKG daily rainfall data for Nunukan, Tarakan, Tanjung Selor, Tanjung Redep, Balikpapan, Samarinda, Kotabaru, Banjarmasin, Banjarbaru, Muara Teweh, Buntok, Palangkaraya, Sampit, Pangkalanbun, Ketapang, Pontianak, Siantan, Nangapinoh, Sintang, Paloh, and Putusibau with the data period 2003-2012 and ECMWF ERA INTERIM 925 HPa with resolution 0.1250 and data period 2003-2012. The methodology used in this research ara Make a daily rainfall periodogram with the FFT technique, Make a graph of daily rainfall that is averaged every month, Create a map of wind direction and speed grouped by month, Analyze the periodogram to find the largest period of the rainfall spectrum, Analyze the peak of rainfall on the daily rainfall chart, and Analyze the monsoon winds that affect the peak of rainfall.

IV. DISCUSSION

4.1. North Kalimantan



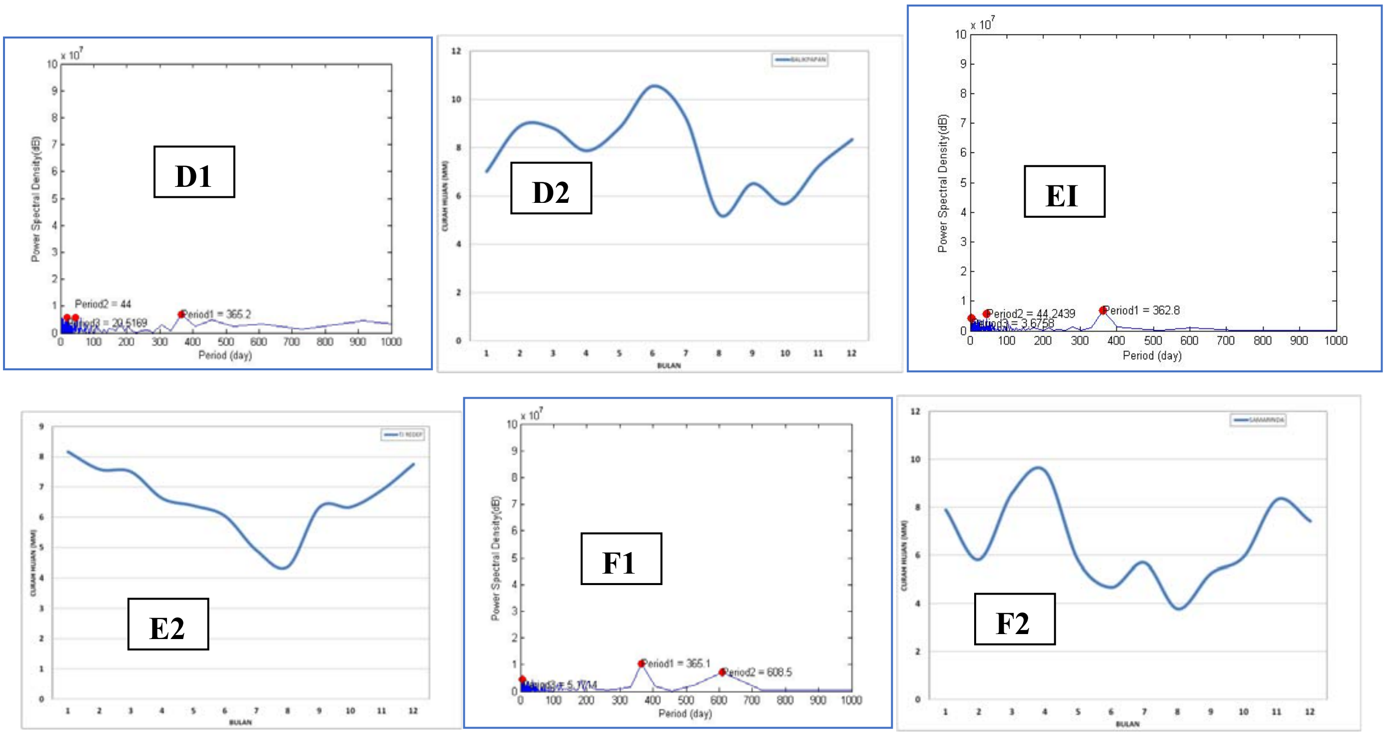
Graph 4.1. Nunukan daily rainfall periodogram (A1), Nunukan average daily rainfall (A2), Tarakan daily rainfall periodogram (B1), Tarakan daily average rainfall (B2), Tanjung Selor daily rainfall periodogram (C1) and Tanjung Selor average daily rainfall (C2).

The dominant rainfall spectrum A1 in Nunukan has a period of 365.1 days which indicates a strong influence from the annual oscillation. The annual oscillation causes the peak of A2 rainfall in May and forms a type of rainfall with a local pattern. The peak of rainfall occurs due to the interaction of the Australian monsoon winds that blow around Nunukan. The southeast wind that blows forms a shear line, causing upheaval that has the potential to cause rain.

In Tarakan, the 187.3158 day period dominates the value of the B1 daily rainfall spectrum, so that the semi-annual oscillation appears to affect daily rainfall. The semi-annual oscillation gives rise to two maximum peaks of B2 rainfall in May and November. As a result of the two peaks of rainfall in one year, the Tarakan rainfall type is equatorial. As in Nunukan, the peak of rainfall in May occurs due to the shearline of the Australian monsoon transition activity. In November, a shearline also forms around Tarakan due to the interaction of the Asian monsoon transition.

Tanjung Selor, which is located southwest of Tarakan, has a main period of rainfall on the C1 chart of 366.1 days and is annual in nature, but the spectral density value is not much greater than the other spectra. This annual oscillation triggers the peak of maximum rainfall to occur in March and January. Graph C2 tends to be bimodal but has adjacent peaks. In January, the interaction effect of the blowing Asian monsoon winds is evident. Meanwhile, in March, the transitional winds of the Asian monsoon blow and cause a shearline to form which causes upheaval.

4.2. East Kalimantan



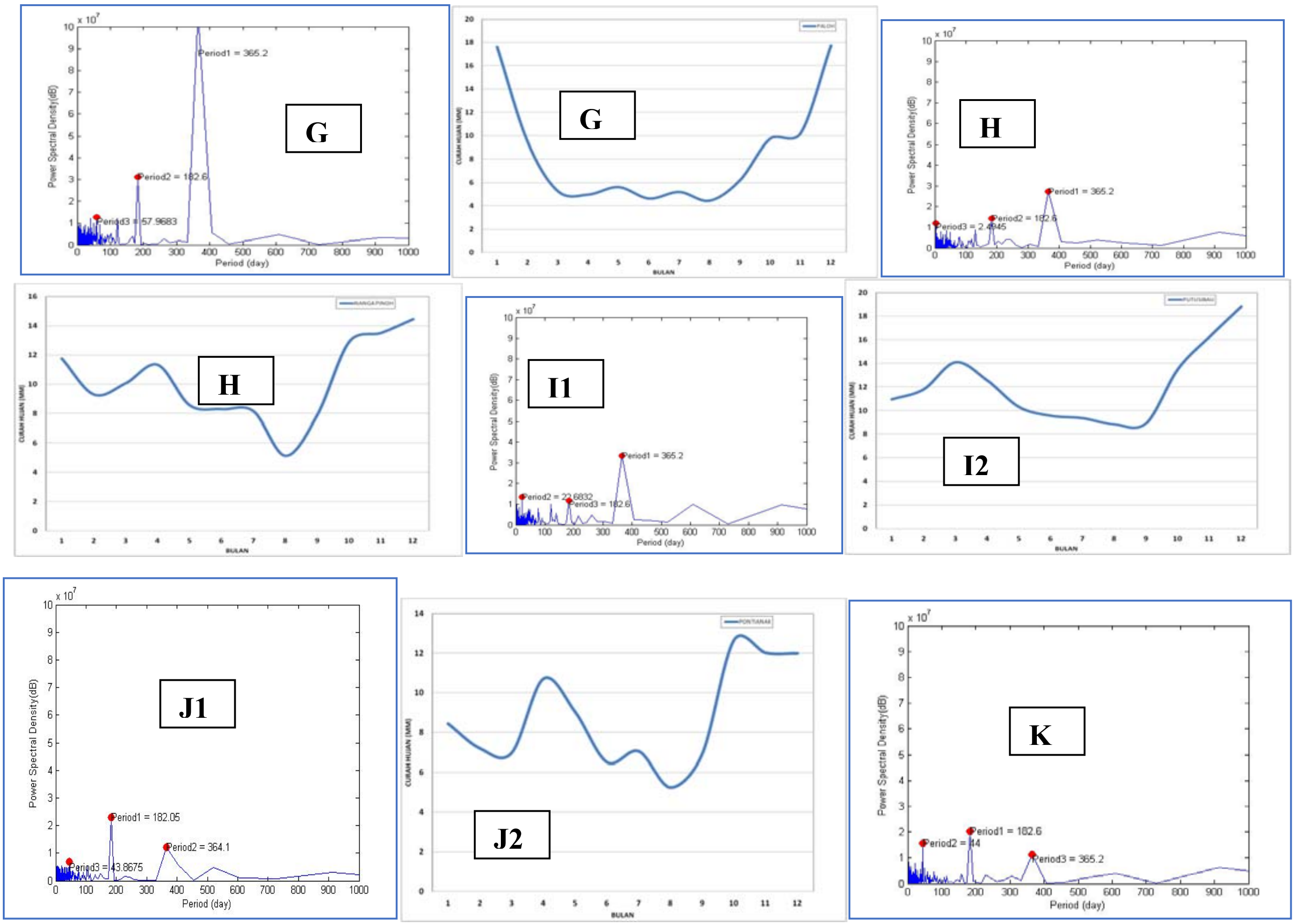
Graph 4.2. Periodogram of Balikpapan's daily rainfall (D1) and Balikpapan's average daily rainfall (D2). Periodogram of daily rainfall of Tanjung Redep (E1), average daily rainfall of Tanjung Redep (E2), Periodogram of daily rainfall of Samarinda (F1) and average daily rainfall of Samarinda (F2).

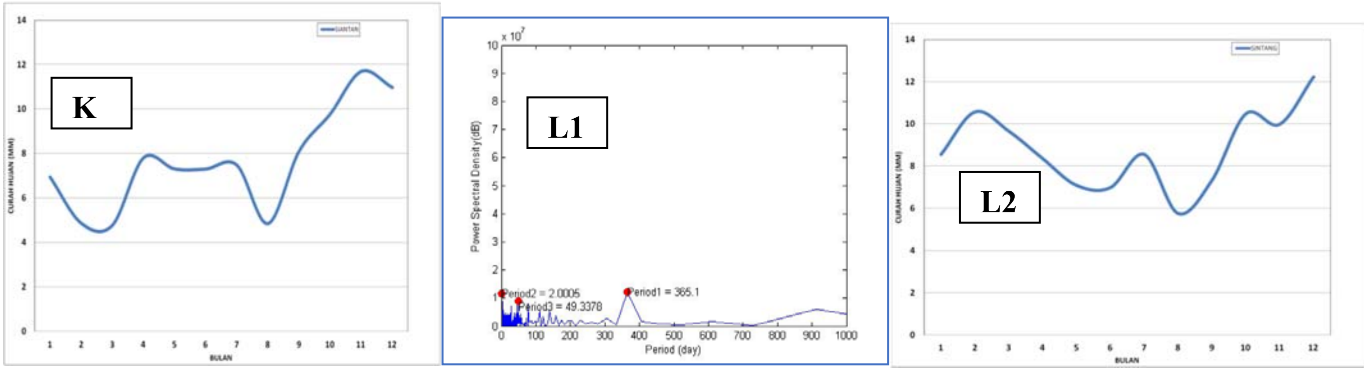
The rainfall in Balikpapan D1 has a dominant spectrum with a period of 365.2 days and indicates a large role for annual oscillations. The peak of rainfall, which is caused by an annual oscillation, occurs in June. The unimodal D2 chart in the middle of the year makes Balikpapan's rainfall have a local type. The peak of rainfall occurs due to the interaction of the Australian monsoon winds that blow from the southwest around Balikpapan.

The annual oscillation appears to dominate the Tanjung Redep E1 rainfall spectrum which has a period of 365.3 days, although the density of the spectrum is not too much greater than the spectrum in other periods. The peak of rainfall occurs in January. The E2 unimodal graph with a "v" shaped pattern makes the Tanjung Redep rainfall pattern classified into the monsoonal rainfall type. In January, when the peak of rainfall is formed, the interaction of the Asian monsoon winds has a major influence on rainfall.

In Samarinda, the largest F1 daily rainfall spectrum is 365.1 days, thus indicating that the annual oscillation has the strongest influence on daily rainfall. Same with Tanjung Redep, the annual oscillation is not too big compared to the spectrum in other periods. The type of rainfall depicted in the F2 rainfall chart is bimodal. In March, the Australian monsoon transition blows and the Asian monsoon transition in November. The two monsoon wind transitions form a shearline that can cause upheaval.

4.3. West Kalimantan





Graph 4.3. Periodogram of daily rainfall of Paloh (G1), average daily rainfall of Paloh (G2), Periodogram of daily rainfall of Nangapinoh (H1) and average daily rainfall of Nangapinoh (H2). Putusibau daily rainfall periodogram (I1), Putusibau average daily rainfall (I2), Pontianak daily rainfall periodogram (J1), Pontianak average daily rainfall periodogram (J2), Siantan daily rainfall periodogram (K1) and rainfall Siantan average daily rainfall (K2), Sintang daily rainfall periodogram (L1) and rainfall Sintang average daily rainfall (L2).

The daily rainfall spectrum is dominated by a period of 365.2 days in Paloh G1. This period indicates a strong role of annual oscillations. In fact, the value of the density of the spectrum is much greater than the spectrum in other periods. The G2 rainfall chart forms a unimodal pattern so that it is categorized as a monsoonal type and has a peak rainfall in December. In December, the cold Asian monsoon winds blow strongly over Paloh and interact to form clouds with the potential for rain.

Nangapinoh has a dominant H1 rainfall spectrum with a period of 365.2 days which indicates the influence of annual oscillations. The peak of H2 rainfall occurs in December which is unimodal so that it is categorized as a monsoonal type. The interaction of the cold Asian monsoon winds in December which blows over Nangapinoh, produces clouds with the potential for rain.

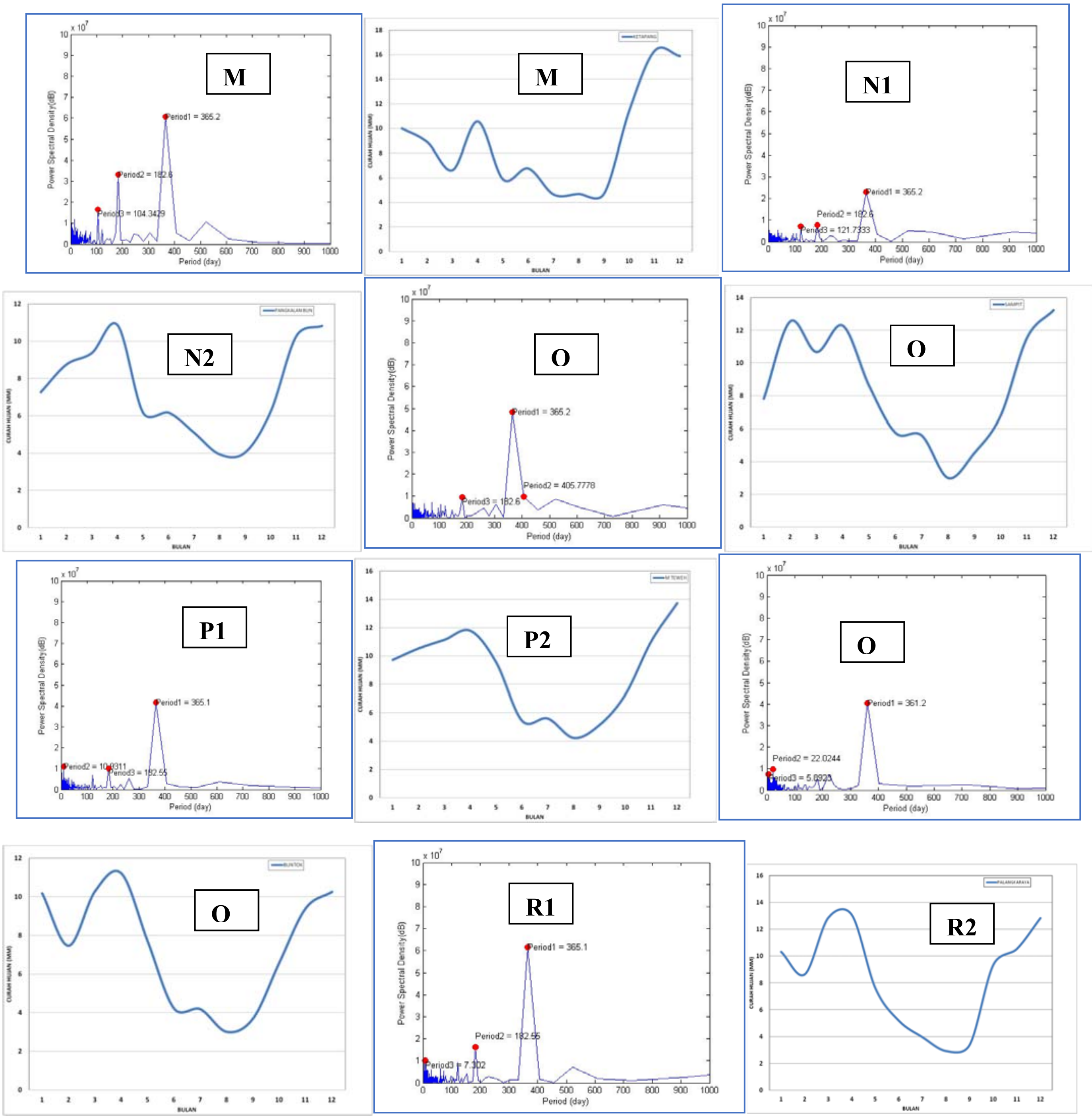
Annual oscillations appear to dominate the daily rainfall spectrum of Putusibau I1 which has a dominant spectrum period of 365.2 days. Putusibau I2 rainfall forms a bimodal pattern with a peak in March and December. Like Nangapinoh, the Asian monsoon and the Australian monsoon transition also affect rainfall in Putusibau, which blows in December and March.

Pontianak, which is located on the equator, has a rainfall spectrum with a dominant period of 182.05 days. The J1 dominant spectrum period indicates that the semi-annual oscillation has a significant impact on rainfall. The bimodal pattern shown in graph J2 indicates an equatorial type with peak rainfall in April and November. The peak of rainfall in April and November occurs due to the interaction of the Asian monsoon transitional winds and the Australian monsoon transitional winds which generate shearlines.

Siantan's rainfall has a K1 spectrum with a dominant period of 182.6 days. The periodicity value illustrates that the semi-annual oscillation has the greatest effect on rainfall in Siantan. The Siantan K2 rainfall pattern has an equatorial type because the graph is bimodal with rainfall peaks in April and November. However, the peak of rainfall in April is not too large because the density value of the dominant Siantan rainfall spectrum is not much greater than the spectrum in other periods. Like the peak rainfall in Pontianak, the peak rainfall in Siantan is triggered by a shearline.

Sintang has an L1 rainfall spectrum with a dominant period of 365.1 days. This value illustrates that there is an effect of annual oscillations. The unimodal type can be seen from the L2 rainfall pattern with the highest rainfall peak in December. Even so, the density spectrum of the annual period is not much different from the spectrum of other periods. In December, the interaction of the cold Asian monsoon winds causes the peak of rainfall in Sintang

4.4. Central Kalimantan



Graph 4.4. Periodogram of the daily rainfall of Ketapang (M1) and the average daily rainfall of Ketapang (M2). Pangkalanbun daily rainfall periodogram (N1), Pangkalanbun average daily rainfall (N2), Sampit daily rainfall periodogram (O1), Sampit average daily rainfall (O2), Muara Teweh daily rainfall periodogram (P1) and Muara Teweh average daily rainfall (P2). Buntok daily rainfall periodogram (Q1), Buntok average daily rainfall (Q2), Palangkaraya daily rainfall periodogram (R1) and Palangkaraya average daily rainfall (R2).

The dominant spectrum period of Ketapang M1 daily rainfall is 365.2 days. The period value shows the influence of the annual oscillation. The peak of rainfall occurs in April and November on the M2 chart. The maximum value of rainfall in April is influenced by the Australian monsoon winds. As for November, it is caused by the interaction of the Asian monsoon transitional winds that blow to form a shearline.

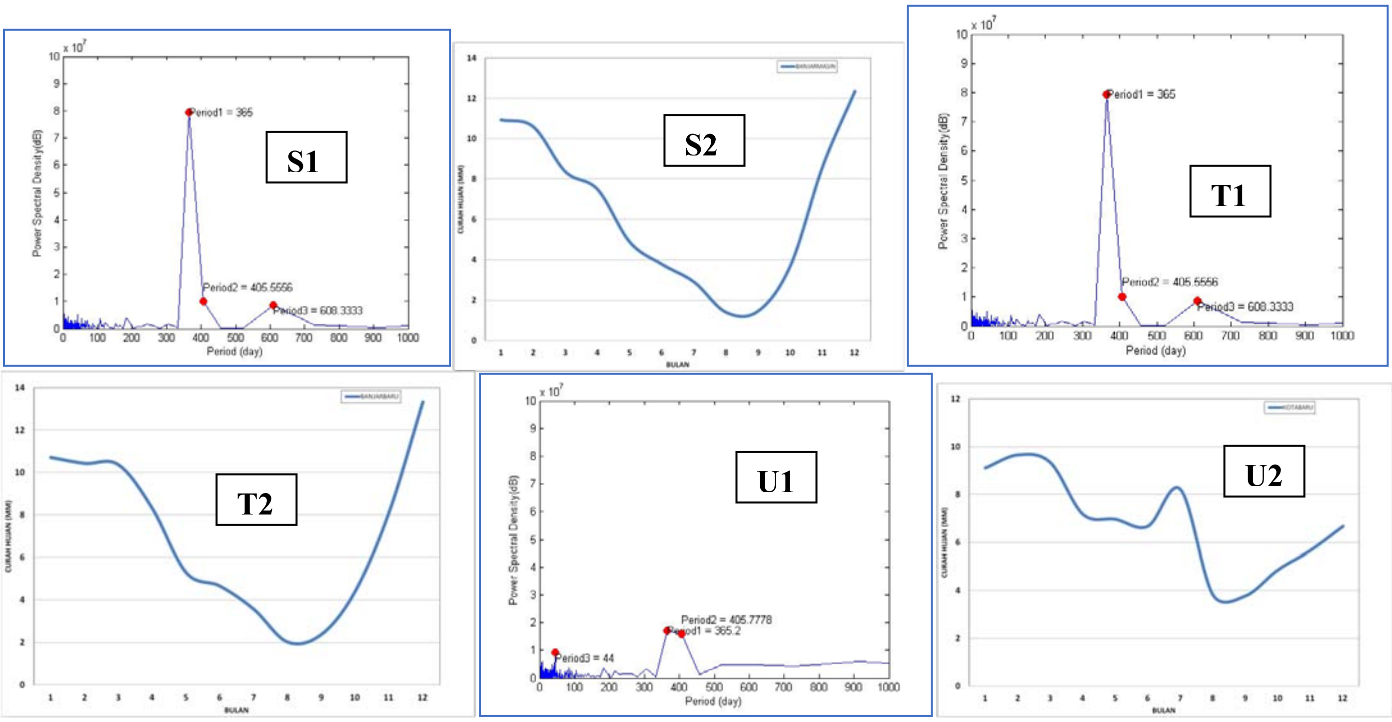
The Pangkalanbun N1 daily rainfall spectrum has a dominant period of 365.2 days which indicates the influence of annual oscillations. Graphical pattern N2 illustrates that rainfall in Pangkalanbun has two rainfall peaks or is bimodal. The peak of rainfall in December is related to the interaction of Asian monsoon winds and the peak in April is influenced by the interaction of the Australian monsoon transition winds which form a shearline.

Sampit O1 daily rainfall has a spectrum with a dominant period of 365.1 days, where this value indicates a strong influence of annual oscillations. Graph O2 illustrates the unimodal pattern which is characteristic of the monsoonal type. The peak of rainfall in December is influenced by the interaction of Asian monsoon winds around Sampit.

The period of the daily rainfall spectrum for Muara Teweh P1 has the greatest value at 365.1 which indicates that the annual oscillation has such a large effect on the daily rainfall of Muara Teweh. The shape of the P2 rainfall chart is bimodal with the peak of rainfall occurring in December and April, where the Asian monsoon and the Australian transitional monsoon blow across Muara Teweh.

The daily rainfall spectrum for Buntok Q1 and Palangkaraya R1 has the greatest periodicity at 361.2 and 365.1 which indicates that the effect of the annual oscillation is so great on daily rainfall in these two regions. The shape of the rainfall chart for Q2 and R2 has a bimodal pattern with peak rainfall occurring in March and December. In March, the wind that blows in Buntok and Palangkaraya is the Australian monsoon transition wind. Whereas in December, the cold Asian monsoon blows.

4.5. SOUTH KALIMANTAN



Graph 4.5. Banjarmasin daily rainfall periodogram (S1) and Banjarmasin average daily rainfall (S2). Banjarbaru daily rainfall periodogram (T1), Banjarbaru average daily rainfall (T2), Kotabaru daily rainfall periodogram (U1) and Kotabaru average daily rainfall (U2).

The daily rainfall spectrum for Banjarmasin S1 and Banjarbaru T1 has a dominant periodicity with values of 365.2 and 365 days. This value indicates the greatest influence from the annual oscillation. The unimodal pattern is depicted in the S2 and T2 daily rainfall charts with the peak of rainfall occurring in December. The cool Asian monsoons blowing, play an important role in the formation of the rainfall peak in December. Kotabaru U1 daily rainfall has a spectrum with the highest period value of 365.2

days. This value illustrates the strength of annual oscillations in influencing daily rainfall. The peak of rainfall on the U2 chart occurs in March and July. The flow that influences in March is the Australian monsoon transition wind while in July the influence of the Australian monsoon winds is evident on daily rainfall

V. CONCLUSION & SUGGESTION

Kalimantan's rainfall has an annual period, has 1-2 average daily rainfall peaks spread over Nunukan, Tanjung Selor, Muarateweh, Tanjung Redep, Paloh, Nangpinoh, Putusibau, Sintang, Samarinda Ketapang, Balikpapan Pangkalanbun, Sampit, Buntok, Palangkaraya , Banjarmasin, Banjarbaru and Kotabaru. Generally, rainfall with 1 peak has a greater spectral density than rainfall with 2 peaks. Kalimantan's rainfall, which has a semi-annual period, generally has 2 peaks spread across Tarakan, Siantan and Pontianak. The Asian monsoon winds greatly affect rainfall in Tanjung Selor, Tanjung Redep, Paloh, Nangapinoh, Putusibau, Sintang, Pangkalanbun, Sampit, Buntok, Banjarbaru and Banjarmasin. The transitional winds of the Asian monsoon have an influence on Tarakan, Samarinda, Pontianak, Siantan and Ketapang. Then the Australian monsoon winds affect rainfall in Nunukan, Balikpapan and Kotabaru.

By knowing the rain pattern in Kalimantan, it is hoped that it can be used as a basis for consideration in setting policies in mitigating floods. There needs to be more in-depth research on locations that are a national priority, such as East Kalimantan because the area will be a candidate for the National Capital.

REFERENCES

[1] Ramage, C S. 1952. Monsoon Meteorology. Academic Press. New York-London.

[2] Prawirowardoyo, Susilo. 1996. Meteorology. ITB Publisher. Bandung.

[3] WMO. 2006. WMO No 8 : Guide to Meteorological Instruments and Methods of Observation. Secretary of WMO. Geneva.

[4] BMG. 2007. Rainy Season Forecast 2007/2008. BMG. Jakarta

[5] Aldrian, Edwin. 2003. Simulation of Indonesian Rainfall with a hierarchy of climate models. Dissertation of the Max Planck Institute for Meteorology – University of Hamburg, Germany.

[6] Aldrian. Edwin. 2008. Marine Meteorology. BMKG Research and Development Center. Jakarta

[7] Wirdjohamidjojo, Soerjadi and Yunus S Swarinoto. Indonesian Regional Climate. BMKG Research and Development Center. Jakarta

[8] Chatfield, C. 1995. The Analysis Of Time Series An Introduction. Chapman & Hall. New York. ISBN: 0412716402. USA

[9] Reed, RJ. 1961. Evidence of a down propagating annual wind reversal in the equatorial stratosphere. Journal Of Geophysics. 66:813-818.