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Rainfall Characteristics and Correlation of Rainfall Anomaly with Outgoing Longwave Radiation in Seven Province of the Indonesian Food Production Center

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Abstract

The study of rainfall characteristics will help in understanding climate conditions. the information on climate conditions in the planting season will help in managing the farming system such as determining the type of plant that is suitable for development in an area. To obtain an overview of conditions on the surface, it is necessary to study the spatial and temporal characteristics of diurnal and monthly rainfall variations from surface observations. The characteristics of diurnal rainfall can be characterized by patterns of intensity, and peak time of rainfall and the characteristics of monthly rainfall can be characterized by wet months, dry months, climate types and rainfall patterns. Based on the analysis correlation of rainfall anomaly with Outgoing Longwave Radiation (OLR) expected to give a more comprehensive picture of factors influence climate characteristics in seven provinces of food production centers.

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Based on the analysis of rainfall characteristics, the average annual rainfall in the western region is relatively wetter (> 2500 mm year^{-1}) shifting to the middle region The dominant rainfall pattern at the study site is the Monsunal pattern. Some stations in West Java have local and equatorial rainfall patterns including Bogor, Cianjur, Plered. The characteristics of diurnal rainfall during rainy peaks in Lampung occur between 17:00 - 18:00, in West Java the peak of rain occurs between 15:00 - 17:00 in the Central Java I and III sapron in sapron I and II occurring during the day between 13:00 - 15:00. When the peak rains on. Kalimantan has two rain peaks namely afternoon; 14.00 - 15.00 and night; 22:00 - 01:00 In East Nusa Tenggara the peak of rain is 12.00 - 14.00 and in Southeast Sulawesi the peak of rain is between 13.00 - 15.00. Rainfall anomaly in Bogor and Plered two stations in West Java is negatively correlated with OLR index, meaning that the characteristics of rainfall in Bogor and Plered are influenced by local components. Negative correlations between rainfall anomalies and OLR were also found in East Kalimantan, namely Kebun Tabara and Muara Wahau stations. Areas with rainfall diversity that are not only influenced by global components need to be explored further to find out what local components affect the characteristics of rainfall in the region.

Keywords: Rainfall Characteristics; Outgoing Longwave Radiation; rainfall intensity; peak time; rainfall patterns.

1. Introduction

The agricultural sector is a mainstay sector for the Indonesian economy and plays an important role in national development. The important role of the agricultural sector is reflected through its contribution to the formation of the National GDP, employment, and export of agricultural products. On the other hand, the agricultural sector, especially the food subsector, is most vulnerable to climate conditions [1]. This is because food crops are generally seasonal plants that are relatively sensitive to stress, especially excess and lack of water. Technically, the limitations of vulnerability are closely related to land use systems and soil physical properties, cropping patterns, technology for managing land, water, and plants, and plant varieties [2]. So that the information on climate conditions in the planting season will help in managing the farming system such as determining the type of plant that is suitable for development in an area, when planting and harvesting time is right, when and how much water is given, what cropping patterns are used, when spraying pests / disease must be done etc. Information on climate conditions, especially rainfall in Indonesia still has a high value of uncertainty because the territory of Indonesia has a high diversity of rainfall both temporally and spatially. Temporally rainfall diversity can be distinguished based on diurnal, daily, inter-season, yearly and inter-year scales. The dominant component of the diversity of inter-season rainfall in the tropics is Madden-Julian Oscillation (MJO) [3]. Reference [4] explained that the MJO phase significantly impacts on rainfall in Indonesia. The diversity of annual rainfall is caused by the circulation of Asian-Australian monsoon [5] and cold surge [6]. El Nino-Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) contribute to the diversity of inter-annual rainfall in Indonesia. Indonesian rainfall has a strong correlation with variations in ENSO [7,8] and IOD [9]. Spatially rainfall diversity is influenced by: (1) The distribution of complex oceans and land influences local circulation of land winds and sea breeze (2) Asia-Australia monsoon circulation which mainly affects air circulation on Sumatra, Java, Bali and Nusa Tenggara Island, (3) zonal circulation in the Pacific equator (Walker Cycle) which mainly affects air circulation around Papua, Maluku, Sulawesi and Kalimantan, (4) zonal circulation in the equatorial Indian Ocean which also affects air circulation in western Indonesia [5, 10, 11, 12]. Some of the dominant global components affecting the diversity of rainfall in Indonesia include the Sea Surface Temperature anomaly (SST anomaly), Southern Oscillation Index (IOS), sea level elevation, Madden Julian Oscillation (MJO), cold surge and cross flow Indonesia (Arlindo) [3, 4, 5, 6, 7, 8, 9]. Reference [10] explained that besides global influence, the diversity of rainfall in Indonesia is also influenced by local conditions, namely the distribution of the ocean and land complex. The diversity of rainfall in the sea and land is strongly influenced by ocean and land wind circulation, but on land differently regionally, there are indications of local topographic influences determining the diversity of diurnal cycle rainfall. Therefore besides the global component, information on local components that influence the diversity of daily rainfall in an area and the distribution of affected areas will be very much needed in the management of farming systems. The difference in solar radiation warming between sea and land or highlands and lowlands causes changes in air circulation between land and sea and air circulation in the highlands which affects the diurnal cycle of rainfall [10, 11, 13, 14, 15, 15, 17]. The diurnal cycle of rainfall has been the main topic of research in recent years in many countries [18, 19, 20, 21, 22]. The study of the characteristics of the diurnal cycle of rainfall will help in understanding the processes or physical mechanisms of rainfall formation [23, 24]. Studies of the diurnal cycle of Indonesian rainfall have been carried out in several regions using data from automatic weather stations, satellites, GPS, radar, climate models and weather [10, 11, 13, 15, 16, 17, 23, 25]. Reference [10] conducted studies in tropical regions including Indonesia using data from Brighnest temperature (Tb) of multiple satellites and Met. Office Unified Model to see the characteristics of the diurnal cycle on land and sea. The model results show that the active convection process in the sea occurs in the morning while on land occurs in the afternoon. But on land varies regionally, there are indications of the influence of topography: land-sea winds and mountain winds. Reference [23] Studying diurnal variations in precipitation in the mountains of Sumatra using precipitable water data, temperature profile data, humidity from radiosonde, and meteorological data from observations on the surface. Based on the analysis results precipitation increases during the day and is maximum at midday until it reaches a height of 3 km. The diurnal cycle of water vapor affected by the intensity of solar radiation shows that diurnal variations in water vapor are caused by horizontal displacement of local circulation. Reference [25] conducted a study of diurnal rainfall variations in Indonesia, especially in South Sumatra, West Kalimantan, and Central Java using a very high resolution atmospheric general circulation model (GCM-TL959) and compared the results of models with Tropical Rainfall Measure Mission (1998-2003). Based on the model successfully explained the spatial and temporal characteristics of the diurnal rainfall cycle in Central Java The peak of rain on land generally occurs at 16.00-17.00 and at sea it occurs at 04.00 - 06.00. In the mountains of the island of Sumatra, the southern part of the rain peak is around 14.00-15.00 with an average velocity of rainfall of 8 ms^{-1}. Reference [15] examined the spatial and temporal characteristics of rainfall variations in the highlands (mountains) and lowlands (coast) of West Sumatra and their relation to wind variations and convection activities using critical data from 34 stations. Reference [15] defines the locality index based on critical data and divides the pattern of rainfall distribution into four types: coastal, inland, active and inactive. Based on correlation and composite analysis between 850 mb zonal wind and locality index, there were significant differences between coastal and inland types with increasing zonal wind speed. The study of seasonal and diurnal cycle of rainfall in Indonesia is mostly carried out on the islands of Sumatra, Java and Kalimantan. Because of the limitations of hourly rainfall observation data on the surface, information from the satellite or model approach is used. To obtain a description of the conditions on the surface, it is necessary to study the spatial and temporal characteristics of seasonal and diurnal rainfall variations from surface observations. This study aims to (1) conduct a comparative study of rain intensity, and the peak time of the rain diurnal cycle, based on hourly data from 56 automatic weather stations for the period 2000 - 2011 in Indonesia, (2) Study the characteristics of monthly rainfall which includes: wet months, dry months, climate types (Oldeman and Schmidt-Ferguson) and rainfall patterns, based on daily data from 56 automatic weather stations for the period 2000 - 2011 in Indonesia, (3) analyzing correlation of rainfall anomaly with Outgoing Longwave Radiation on 56 automatic weather station.

2. Material and Method

2.1. Data collecting

Analysis of rainfall characteristics and correlation of rainfall anomaly with Outgoing Longwave Radiation was carried out in 56 automatic weather stations in seven provinces: West Java, Central Java, Yogyakarta, Lampung, East Kalimantan, East Nusa Tenggara and Southeast Sulawesi. Data include hourly and daily rainfall data (2000 – 2011) from 56 automatic weather stations (Enerco 407 type) belong to the Agricultural Research and Development Agency.

2.2. Data analysis

Analysis of rainfall characteristics and correlation of rainfall anomaly with Outgoing Longwave Radiation is done by stages, including: 1). Updating rainfall data, 2). Processing of monthly rainfall data (10 years), 3). Processing of diurnal rainfall data, 4). Classification of diurnal rainfall data based on Subround: January-April, May-August, September-December, 5). Correlation analysis and significance between rainfall anomalies with Outgoing Longwave Radiation. Rainfall data and Outgoing Longwave Radiation are collected and arranged by year and locations are then stored in excel format. Processing carried out after collecting data is normalization of data by presenting in the form of daily tables that will be calculated monthly for each rain station, as well as giving a number 0 on days where there is no rain, and giving a sign (*) for data that is not measurable or no data does not change the results of monthly rainfall. In the table there are months, dates, years of rainfall recorded at the rain station. Data processing in the form of daily rainfall data is displayed in the form of an Excel table of the many rainfall stations in each province in Indonesia. The data is processed in advance in the form of time series, compiling the rainfall data into two columns, namely the first column is the date with the format of month / day / year and the second column is daily rainfall. The sum of monthly rainfall data will produce the annual amount of rainfall in a given period, the average rainfall each month in a given period, maximum rainfall and minimum rainfall for a certain period. The rainfall data is compiled from January in the longest year to December in the latest year. The table view in Excel besides showing monthly rainfall data but also there is information on the geographical location of rain stations in the form of provinces, districts or cities and coordinates.

2.3. Method

Characteristics of diurnal rainfall can be characterized by patterns of intensity and peak time of rainfall according to Reference [22] Rainfall Intensity is the amount of diurnal rainfall in one month divided by the number of days in one month in mm / hour / day. Peak time of rainfall is the time when the amount of diurnal rainfall is maximum with classification: Morning: 04: 00-09: 00, Afternoon: 10:00 - 15:00, Afternoon: 16:00 - 21:00, Night: 10:00 p.m.: 00: 00: 00. The anomaly value of rainfall at an observation point in a particular month is the difference between the value of observations in a particular month with the average value of the same month from observations for 12 years during the period 2000-2011. The stages of processing correlation and significance are carried out after Rainfall Anomaly processing at each Rain station. Correlation coefficients are used to find out the relationship between two variables, and if there is a relationship, how is the relationship going. The closeness of the relationship between one variable with another variable is usually marked by "r" [26]. The two variables used in this study are rainfall anomalies and Outgoing Longwave Radiation. Besides correlation analysis (r = positive / negative), the value of p will also be seen. The p value is the smallest probability value of a test so that the observed statistical value of the test is still significant. This P value or often also called P-value and has been popular among researchers as an approach in providing conclusions "reject or" accept "from the proposed hypothesis. The p-value approach in decision making is quite reasonable because almost all computer programs in the calculation of hypothesis testing provide p-values. In this study the p value of 0.05 was used with the information that the value of $p <0.05$ means there is a relationship / accepted and the value of $p> 0.05$ means there is no relationship / rejected. Processing the correlation and the p value using Minitab 16 software. Furthermore, based on the correlation results that have been obtained, the determination of stations with global and local climate characteristics is based on the following conditions: a. Areas that are influenced by global indicators are selected stations with correlations: positive, b. Areas that are influenced by local indicators are selected stations with correlations: negative

3. Results and Discussion

3.1. Analysis of Monthly and Diurnal Rainfall Characteristics

Analysis of monthly rainfall characteristics was carried out at 56 climate stations of the IAARD which were spread across seven provinces, namely Central Java, Yogyakarta, West Java, Lampung, East Kalimantan, East Nusa Tenggara, and Southeast Sulawesi. The rainfall characteristics analyzed included the amount of annual average rainfall, type of rain according to Oldeman and pattern rain (moonsunal, ekuatorial, local). The average rainfall in Indonesia for each year is not the same. But it is still quite a lot, which is an average of 1500 - 2500 mm $year^{-1}$. Figure 1 presents a distribution map of the average annual rainfall in the 56 Weather Stations Automatic. Lampung Province the average rainfall ranges from 1500 - 2000 mm $year^{-1}$. West Java Province, two stations in Bogor and Pacet (Cianjur) have annual average rainfall > 2500 mm $year^{-1}$, while the middle and low plains areas have lower rainfall rates of 1500 - 2500 mm $year^{-1}$, even at the Station Sukamandi is less than 1500 mm $year^{-1}$. Central Java Province annual rainfall ranges from 1500 - 2500 mm $year^{-1}$ but for highlands such as Ngablak (1394 msl) and Kertek (847 msl) the total rainfall is greater than 2500 mm $year^{-1}$. Based on the results of rainfall analysis in Central Java and DI Yogyakarta, two stations in the east have an average rainfall of less than 1500 mm $year^{-1}$, namely Pati and Wonosari stations. The central region is East Kalimantan Province, the annual average rainfall ranges from 1500 - 2500 mm $year^{-1}$. Shifting to the eastern region, namely Southeast Sulawesi and East Nusa Tenggara, most stations show rainfall of less than 1500 mm year^{-1}.

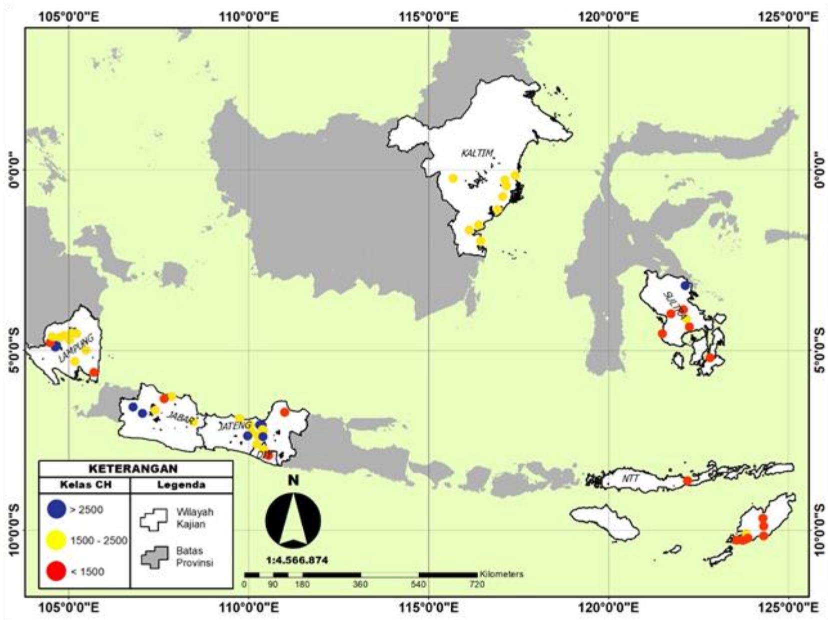


Figure 1: Annual Average Amount of Rainfall Distribution Map 56 Weather Stations Automatic Indonesian Agricultural Research and Development Agency (2000-2011)

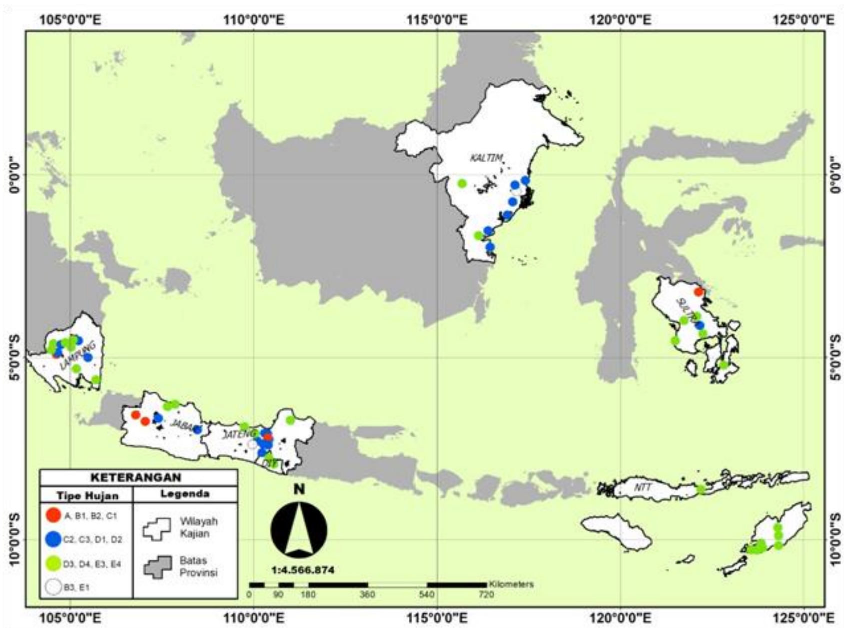


Figure 2: Oldeman Climate Type Distribution Map 56 Weather Stations Automatic Indonesian Agricultural Research and Development Agency (2000-2011)

Figure 2 presents the distribution of rain types in the study area of 56 climate stations. Areas with types A, B2, B2 and C1 are found in West Java and Central Java so they are suitable for continuous rice, planting rice twice a year with short-lived varieties and short dry seasons for crops or rice can be once and crops twice a year. Generally the type of climate according to Oldeman in the study area is C2, C3, D1 and D2 so it is recommended to plant rice once and crops twice a year. The types of climate in East Nusa Tenggara are D3, D4, E3 and E4 so that only one rice or one crop per year may depend on the availability of irrigation.

Indonesia is generally divided into 3 main climate patterns by looking at year-long rainfall patterns, namely monsoonal patterns, equatorial patterns and local patterns. The Monsunal pattern is characterized by a form of unimodal rain pattern (one peak of the rainy season which is around December). For six months the rainfall is relatively high (usually called the rainy season) and the next six months are low (usually called the dry season). In general the dry season lasts from April to September and the rainy season is from October to March. The equatorial pattern is characterized by a bimodal pattern of rain, namely two peaks of rain which usually occur around March and October when the sun is near the equator. The local pattern is characterized by a form of unimodal rain pattern (one rain peak) but its shape is contrary to the rain pattern on the moonson type. Reference [5] state that Indonesia's territory along the equator has an equatorial rainfall pattern, while monsoonal rainfall patterns are found in Java, Bali, NTB, NTT, and parts of Sumatra. One area has a local rainfall pattern is Ambon (Maluku). Figure 3 presents rainfall patterns in the study area. Based on the analysis results of Lampung, Central Java, West Java, East Nusa Tenggara and Southeast Sulawesi provinces, most of them have monsoonal rainfall patterns while equatorial rainfall patterns are found in East Kalimantan and the one location in Southeast Sulawesi that is closest to the equator is Asera station.

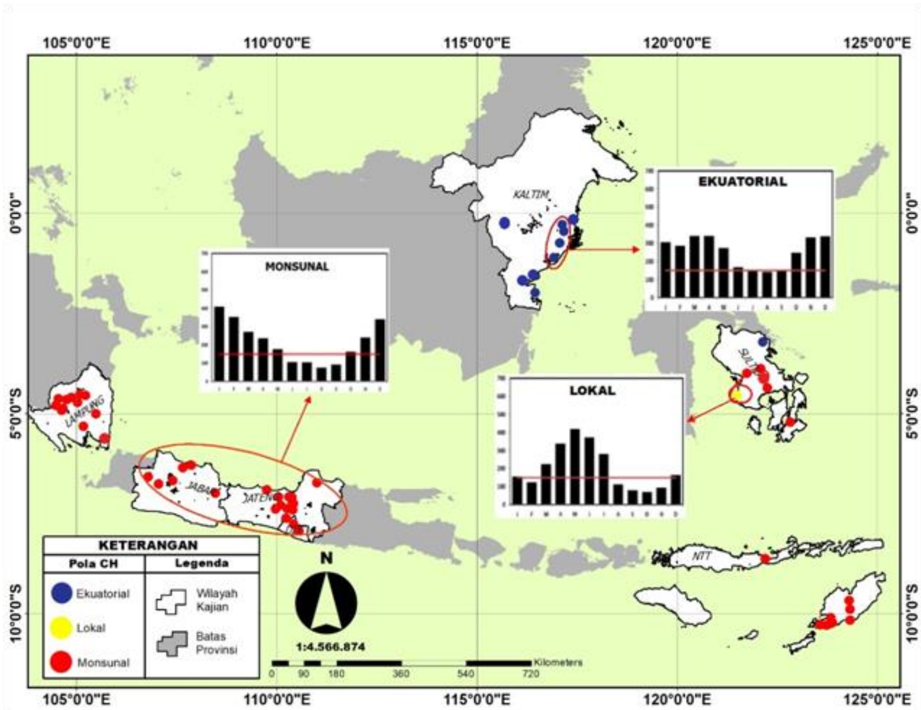
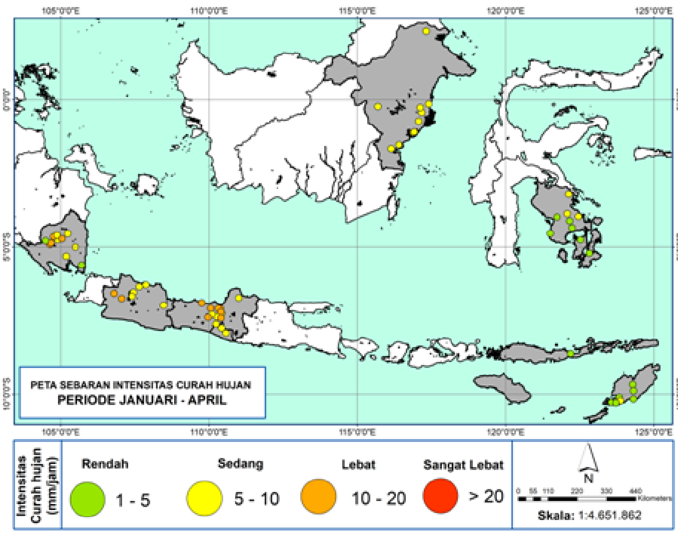


Figure 3: Rainfall Pattern Distribution Map 56 Weather Stations Automatic Indonesian Agricultural Research and Development Agency (2000-2011)

Figure 4 presents a map of the distribution of intensity of diurnal rainfall in 56 climate stations on a) sub-round I (January-April), b) sub-round II (May - August), and c) sub-round III (September - December). The spatial daily rainfall intensity between regions is not the same. The eastern region, East Nusa Tenggara Province, the average daily rainfall intensity ranged between 1-4 mm hour^{-1} and Southeast Sulawesi ranged from 2-3 mm hour^{-1}. The central region, namely Central Java Province, the average daily rainfall intensity is relatively higher ranging between 4-8 mm hour^{-1} and West Java ranging from 2-9 mm hour^{-1}. The Western Region, namely Lampung Province, the intensity of average daily rainfall ranges from 2-7 mm hour^{-1}. The province of East Kalimantan which is located close to the equator the average daily rainfall intensity ranges from 3-6 mm hour^{-1}. The intensity of daily rainfall on a temporal average also varies. Sapron I and III periods in East Nusa Tenggara Province the average daily rainfall ranges between 1-6 mm hour^{-1} while sapron II is only 0 - 2 mm hour^{-1}. In the Province of Central Java in the period of Sapron I and III ranged between 2-14 mm hour^{-1} while in Sapron II it only ranged between 1-3 mm hour^{-1}. The daily rainfall intensity in West Java Province in Sapron I and III ranged from 1 - 14 mm hour^{-1} and in Sapron II ranged between 1-5 mm hour^{-1}.



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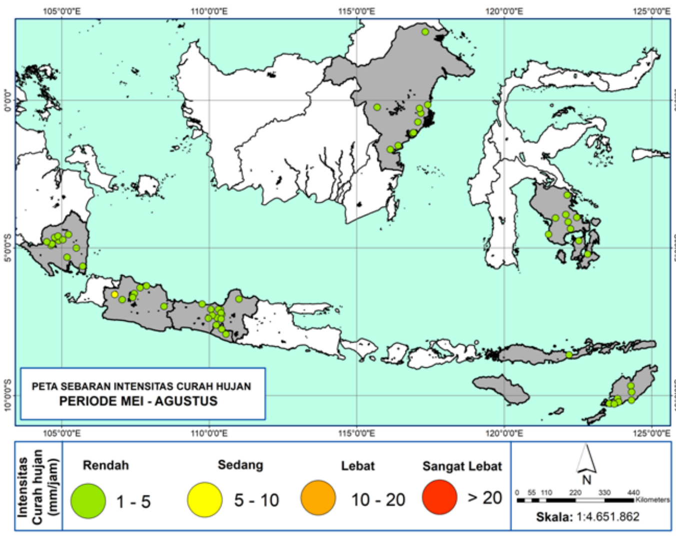

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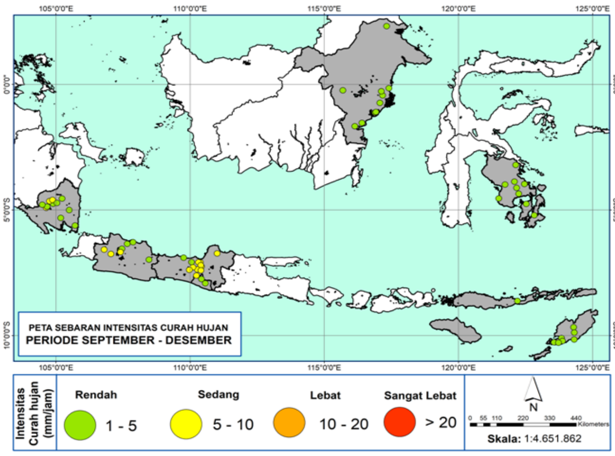
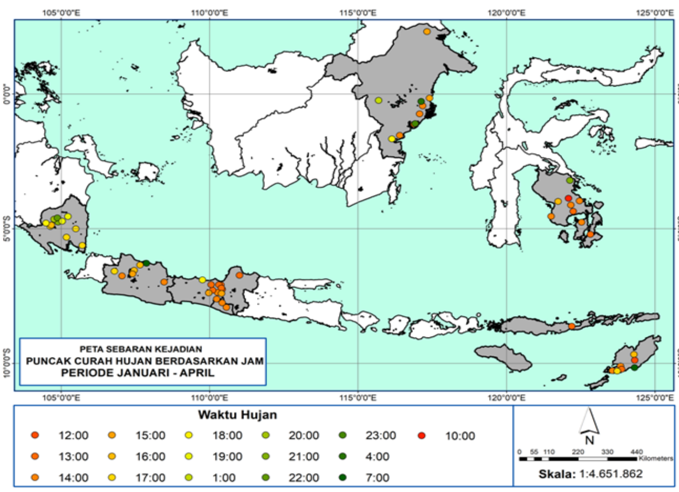


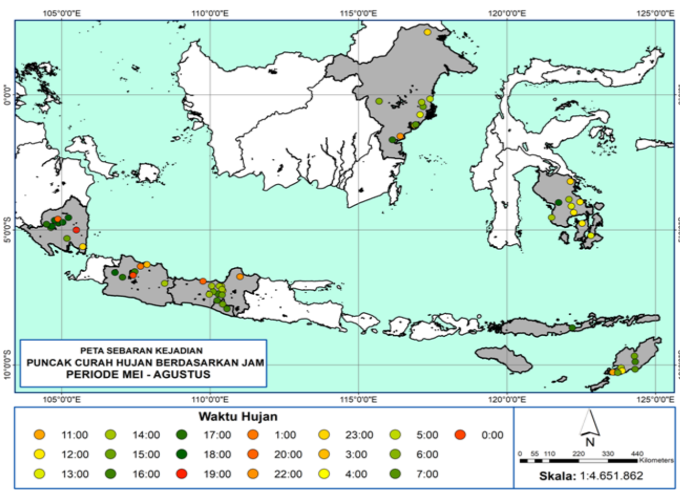
c.

Figure 4: Map of rainfall intensity distribution in 56 climate stations at a: sub-round I (January-April), b: sub-round II (May - August) and c: sub-round III (September - December)

Figure 5 presents the distribution of maps of average daily rainfall peaks at 56 climate stations on a) sub-round I (January-April), b) sub-round II (May - August), and c) sub-round III (September - December).



a.



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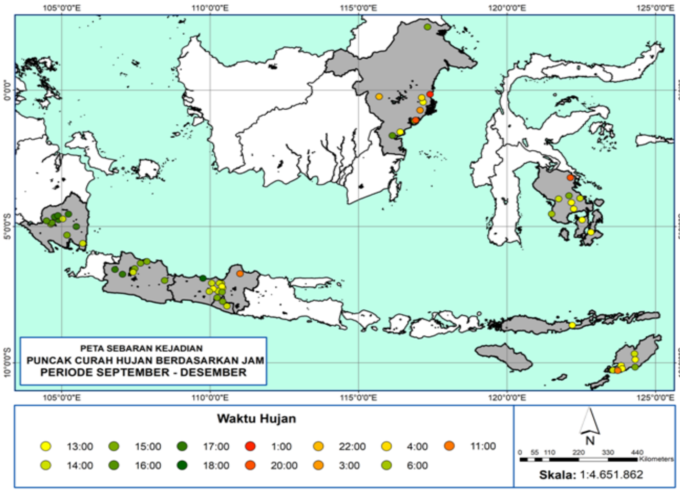
c. 

Figure 5: Map of rainfall peak time distribution in 56 climate stations at a: sub-round I (January-April), b: sub-round II (May - August) and c: sub-round III (September - December)

Spatially there is a shift in peak rainfall time from east to west, where the eastern region when peak rainfall occurs earlier (daytime) and further west when peak rainfall occurs in the afternoon and evening. The average peak daily rainfall in the easternmost region of East Nusa Tenggara and Southeast Sulawesi occurs between 11:00 - 14:00 (3 hours). Shifting to the western region, namely the Province of Central Java and DI Yogyakarta, the peak daily rainfall on average occurs between 13:00 - 16:00 (3 hours) and the more west, West Java Province occurs between 14:00 - 18:00 (4 hours) . In the westernmost region, namely Lampung Province, the peak of daily rainfall occurs on average between 15:00 - 19:00 (4 hours). For areas close to the equator such as East Kalimantan Province, the average daily rainfall peak occurs twice, between 14:00 and 17:00, and 23:00 to 04:00. The temporal peak of rain also shifts. In sapron 1 and 3 the peak rain time in East Nusa Tenggara and Southeast Sulawesi occurs between 13:00 - 14:00 and sapron 2 occurs faster, 11:00 - 14:00. In the provinces of Central Java and Yogyakarta, the average daily rainfall peaks in sapron 1 and 3 occur between 13:00 - 15:00 and sapron 2 is slower at 14:00 - 16:00. West Java Province when the rain peaks in Sapron 1 and 3 occur between 14.00 - 16.00 while in Sapron 2 it occurs between 14.00 - 18.00. Lampung Province during the peak of rain on Sapron 1 occurred between 17:00 - 19:00, in Sapron 2 it happened between 15:00 - 19:00 while in Sapron 3 it happened between 15:00 - 17:00. Padas apron 1 and 2 in East Kalimantan Province, when the peak of the rain is relatively the same, it occurs twice, from 14:00 to 17:00, and 23:00 to 04:00 while the sapron 2 time peak is the opposite. For example, in Separi, the peak of rain in sapron 1 and 3 is 04:00 and in Sapron 2 is 14:00. The different conditions of peak rain time indicate the level of diversity of high rainfall characteristics both spatially and temporally. To understand what factors cause this diversity, further studies are needed regarding the thermodynamic processes that occur in planetary boundaries.

3.2. Correlation and Significance of Rainfall Anomalies with Outgoing Longwave Radiation (OLR)

In addition to global influences, the diversity of rainfall in Indonesia is also influenced by local conditions, namely the distribution of oceans and land complexes. Yang and Slingo 2001, show the diversity of rainfall in the sea and land is greatly influenced by sea and land wind circulation. But on land differ regionally, there are indications of local topographic influence determining the diversity of diurnal cycle rainfall. One local component that affects the diversity of daily rainfall in an area is the convection process. Outgoing Longwave Radiation (OLR) is a measure of the amount of energy emitted into space by the surface of the earth, oceans and atmosphere. OLR values are often used as a proxy for convection in the tropics and subtropics because cloud peak temperature is an indicator of cloud height. An increase or decrease in convection activity can be shown from negative or positive OLR values. Sofiati 2013, conducted a correlation analysis of rainfall with Outgoing Longwave Radiation in several areas with monsoonal, equatorial and local rainfall patterns. For areas with monsoonal and local rainfall patterns, the OLR pattern is inversely proportional to the rainfall pattern, whereas for areas with equatorial rainfall patterns, the OLR pattern does not show irregular patterns. To see the local components that affect rainfall diversity based on the convection process, the relationship between rainfall anomalies and OLR global indicators is analyzed in 56 automatic weather stations. Areas with negative correlations indicate that the diversity of rainfall is influenced by the local component because the convection process largely determines the characteristics of rainfall in the region. The results of the correlation analysis showed that from 56 stations analyzed there were 15 locations that were negatively correlated (table 1).

Table 1: Correlation and significance of rainfall anomalies with outgoing longwave radiation .

No.	Provinsi	Nama Stasiun	Koofisien Korelasi (r)	Nilai P
1	Jawa Barat	Plered	-0.063	0.590
2	Jawa Barat	Bogor (Balitbio)	-0.098	0.286
3	Jawa Tengah	Parakan (BPP)	-0.010	0.913
4	Kalimantan Timur	PN XIII Kb Tabara (PT)	-0.020	0.840
5	Kalimantan Timur	Muara Wahau (BPP)	-0.051	0.648
6	Lampung	Sungkai Selatan (BPP)	-0.067	0.548
7	Lampung	Sungkai Utara (BPP)	-0.134	0.169
8	Lampung	Menggala (BPP)	-0.177	0.089
9	Lampung	Srimenanti (BPP)	-0.196	0.040
10	Lampung	Palas (BPP)	-0.228	0.042
11	Lampung	Natar (LPTP)	-0.246	0.008
12	NTT	Naibonat (BPTP)	-0.002	0.982
13	NTT	Soba (Kades)	-0.125	0.231
14	NTT	Tesbatan (BPP)	-0.202	0.054
15	Sulawesi Tenggara	Toari (BPP)	-0.018	0.863

Rainfall anomaly in Bogor and Plered two stations in West Java is negatively correlated with OLR index, meaning that the characteristics of rainfall in Bogor and Plered are influenced by local components. Based on an analysis of monthly rainfall characteristics, the Bogor and Plered regions have monsoonal rainfall patterns but the diversity of daily rainfall is very high so there are years when Bogor and Plered have local rainfall patterns. Negative correlations between rainfall anomalies and OLR were also found in East Kalimantan, namely Kebun Tabara and Muara Wahau stations. Both of these stations have equatorial rainfall patterns but there are years with monsoonal rainfall patterns. Areas with rainfall diversity that are not only influenced by global components in 15 research locations, for example in Bogor, Plered, Tabara and Muara Wahau, need to be explored further to find out what local components affect the characteristics of rainfall in the region.

4. Conclusions

Based on the analysis of rainfall characteristics, the average annual rainfall in the western region is relatively wetter (> 2500 mm year^{-1}) shifting to the middle region, namely East Kalimantan rainfall ranges from 1500 - 2500 mm year^{-1} and further east is relatively more dry which is <1500 mm year^{-1} (East Nusa Tenggara and Southeast Sulawesi). Areas with types A, B2, B2 and C1 are found in West Java and Central Java so they are suitable for continuous rice, planting rice twice a year with short-lived varieties and short dry seasons for crops or rice can be once and crops twice a year. Generally the type of climate according to Oldeman in the study area is C2, C3, D1 and D2 so it is recommended to plant rice once and crops twice a year. The types of climate in East Nusa Tenggara are D3, D4, E3 and E4 so that only one rice or one crop per year may depend on the availability of irrigation. The dominant rainfall pattern at the study site is the Monsunal pattern (Lampung, Central Java, Southeast Sulawesi and East Nusa Tenggara), except East Kalimantan which has an equatorial rainfall pattern. The characteristics of diurnal rainfall during rainy peaks in Lampung occur between 17:00 - 18:00, in West Java the peak of rain occurs between 15:00 - 17:00 in the Central Java I and III sapron in sapron I and II occurring during the day between 13:00 - 15:00. When the peak rains on. Kalimantan has two rain peaks namely afternoon; 14.00 - 15.00 and night; 22:00 - 01:00 In East Nusa Tenggara the peak of rain is 12.00 - 14.00 and in Southeast Sulawesi the peak of rain is between 13.00 - 15.00. Areas with rainfall diversity that are not only influenced by global components in 15 research locations, for example in Bogor, Plered, Tabara and Muara Wahau, need to be explored further to find out what local components affect the characteristics of rainfall in the region.

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