THESIS

CORRELATION ANALYSIS BETWEEN LIGHTNING ACTIVITY AND RADAR DATA,CASE STUDY IN PALEMBANG, INDONESIA

Prepared to Meet the Requirements for Obtaining a Bachelor's Degree Engineering in the Department of Electrical Engineering, Faculty of Engineering
Sriwijaya University

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VALIDITY SHEET

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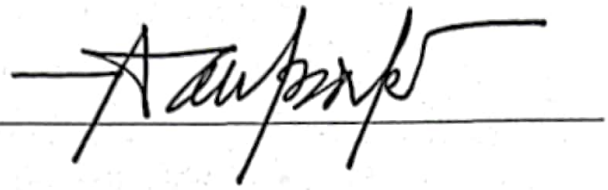
Signature : 

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ABSTRAK

ANALISIS KORELASI ANTARA AKTIVITAS PETIR DAN DATA RADAR, STUDI KASUS DI PALEMBANG, INDONESIA.

(Bintang Furqon Lintang,03041281924038, 2023, xiv + 77 p. + attachments)

Penelitian ini bertujuan untuk mengamati hubungan antara aktivitas petir yang terekam di stasiun BMKG dan citra radar kota Palembang. Penelitian ini digunakan untuk mendapatkan kesesuaian aktivitas petir berdasarkan data radar. Data aktivitas petir dan data radar diperoleh dari BMKG dengan total 970 aktivitas yang terjadi pada tanggal 24 Februari. Data aktivitas petir diklasifikasikan berdasarkan jenisnya dan citra radar diklasifikasikan berdasarkan tinggi desibel (DBZ). Tipe petir yang dapat berupa tipe *cloud to ground* (CG) dan *intra cloud* (IC) dengan masing-masing terdapat 668 *cloud to ground negatif*, 172 *cloud to ground positif* dan 130 *intra cloud* dengan nilai DBZ tertinggi pada tanggal 24 Februari adalah 60 DBZ. Hasil penelitian menunjukkan bahwa hubungan antara aktivitas petir dengan data radar adalah r = 0.3 dan masing-masing petir memiliki korelasi r = 0.30 pada *negative cloud to ground*, r = 0.29 pada *negative cloutd to ground* dan r = 0.32 pada *intra cloud*. Data tersebut menunjukkan bahwa hasil korelasi aktivitas petir dan data radar memiliki nilai yang positif.

Kata kunci : Radar;Aktivitas Petir ; DBZ; BMKG; *Negative Cloud to Ground*

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ABSTRACT

CORRELATION ANALYSIS BETWEEN LIGHTNING ACTIVITY AND RADAR DATA, CASE STUDY IN PALEMBANG, INDONESIA

(Bintang Furqon Lintang,03041281924038, 2023, xiv + 77 p. + attachments)

This study aims to observe the relationship between lightning activity recorded at the BMKG station and radar images of Palembang. This research is used to determine lightning activity suitability based on radar data. Lightning activity data and radar data were obtained from BMKG, with 970 activities on 24 February. Lightning activity data is classified based on type, and radar imagery is classified based on high decibel (DBZ). The types of lightning can be cloud-to-ground (CG) and intra-cloud (IC) types, with each having 668 negative cloud-to-ground, 172 positive cloud-to-ground, and 130 intra-cloud, with the highest DBZ value on 24 February being 60 dbz. The results show that the relationship between lightning activity and radar data is r = 0. 3, and each lightning correlates r = 0.30 on the negative cloud to ground, r = 0.29 on the negative cloud to ground, and r = 0.32 on intra-cloud. These data indicate that the results of the correlation between lightning activity and radar data have a positive value.

Key words : Radar; Lightning activity; DBZ; BMKGl; Negative Cloud to Ground

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LIST OF TERMS

Altitude	:	The height of an object or location above sea level.
atmosphere	:	The layer of gas that surrounds planets, including Earth, consisting of nitrogen, oxygen, water vapor, and other gases.
Radar Image	:	Visual representation of the data obtained through the radar system.
Cloud To Ground	:	The lightning bolt that occurred from the thundercloud headed towards the ground
Correlation	:	statistical relationship between lightning activity and radar data
Cumulonibus	:	(Abbreviated as Cb) is a cloud towering verticals (D2 family) that are very tall, dense, and deep engaged thunder storm And other cold weather
Dipole	:	Use the idea of an electric dipole moment to measure a "polarity" of chemical bonds in amolecule
Electric field	:	The region of space around an electrically charged particle or an object in which the charge body experiences force
Electromagnetic	:	A type of magnet in which a magnetic field is generated by an electric current
electrons	:	Subatomic particles are negatively charged and are often written as e-
electrostatic	:	The branch of physics that deals with the force exerted by a static (unchanging/moving) electric field on other charged objects
Flash	:	Lightning strike/flash

intensity	:	the strength of the radar wave reflection displayed in the radar image.
intracloud	:	Lightning strikes that occur within clouds
Latitudes	:	An imaginary line used to determine the north-south position of a point on Earth.
leader	:	The heat generated by the plasma filaments is generated when many streamers join together in a small airspace
Lightning Activity	:	The occurrence and distribution of electric lightning that occurs within an area.
Lightning Location System	:	The system is designed to be able to determine the location or estimate of a lightning strike more accurately
Longitude	:	An imaginary line used to determine the east-west position of a point on Earth.
Low Frequency	:	Frequency with a wavelength of 30 MHz - 300 MHz
Magnetic Fields	:	The region around a magnetic material or a moving electric charge within which the force of magnetism acts
meteorology	:	The science that studies the earth and its symptoms, which are related to the earth's components in the form of gas or commonly called air
Narrow Bipolar Events	:	The phenomenon occurs in thunderclouds with a positive peak that has a short duration and a different polarity.
originlab	:	Software used for the analysis and visualization of scientific data, including in the fields of meteorology and weather.
Orthogonal Vertical Loops	:	Two vertical and orthogonal loops with planes-oriented NS (north-south) and EW (east-west)

		were used, each to measure the magnetic field to obtain the direction.
Picoscope	:	The perfect PC Oscilloscope for measuring and testing virtually all of the electronic components and circuits in any modern vehicle
Leader plots	:	One of the stages in the formation of lightning that occurs when the developing lightning channel reaches the ground or object which is the starting point of lightning.
Reflectivity	:	states the amount of reflectivity energy returning from an object depends on the size, shape and composition of the object.
Seqdownload	:	Software used to download and manage weather data from various sources.
thunderstorm	:	a sudden discharge of electricity accompanied by lightning and thunder originating from Cumulunimbus (Cb) clouds.
Tri Polar Charge	:	Type of charge on the cloud
Very High Frequency	:	Frequency with a wavelength of 30 MHz - 300 MHz
Very Low Frequency	:	Frequency with a wavelength of 3 - 30 kHz
weather	:	The atmospheric conditions at a location at one time involving temperature, humidity, wind, precipitation, and other conditions.

NOMENCLATUR

BMKG	:	Meteorology, Climatology and Geophysics Agency
CAPPI	:	Constant Altitude Plan Position Indicator
CG – Flash	:	Cloud to Ground - Flash
CG+	:	Cloud to Ground positive
CG-	:	Cloud to Ground negative
DBZ	:	Decibels
IC - Flash	:	IntraCloud - Flash
kHz	:	Kilo Hertz
LF	:	Low Frequency
MHz	:	Mega Hertz
NBE	:	Narrow Bipolar Events
PC	:	Personal Computers
r	:	Correlation coefficient
RADAR	:	Radio Detection and Ranging
rs	:	ReturnStroke

CHAPTER 1
INTRODUCTION

1.1 Background

Lightning is a natural phenomenon that occurs during the rainy season, but sometimes lightning can occur during the dry season. Lightning is usually indicated by a flash of light followed by a thunderous sound.

Lightning can be divided into two types based on where it occurs. Cloud to Ground Flash (CG-flash) and Intra-Cloud flash. Cloud-to-Ground flash (CGflash) is a lightning flash between the center of charge on the triple structure in the cloud to the ground. Towards the ground is a negative CG flash. Cloud Flash is divided into 2, namely Cloud Cloud (InterCloud) flash and Intra-Cloud (IC) flash[1]. Lightning usually occurs when cumulonimbus clouds are thick enough to produce lightning.

To detect and measure the electromagnetic fields generated by lightning flashes, Remote sensing (sensors) can be used. The sensor that detects a lightning flash's radiation component is an electric field antenna system that operates from a few hertz to megahertz. Several types of sensors include (a) vertical whip antenna; (b) field mills; and (c) flat plate antenna, which has been developed into a parallel plate antenna[2]. Measurements, in order to observe the behavior of the changing electric field generated by the lightning flash, are recorded using the parallel-plate-antenna method connected to the buffer circuit (slow-field and fast-field systems); in certain cases, a slow-field system is used as a method for estimating the distance from which the lightning flash occurred to within 30 km of the recording station[3].

One of the instruments used to detect rain is radar. Radar is a modern measuring tool that can be used to detect the intensity of rainfall to be used as a warning when dangerous bad weather occurs. The radar data used is BMKG radar images available throughout Indonesia[4].

The relationship between lightning and radar imagery data can be used as an aid to weather forecasts to detect impending bad weather. In this study, an analysis of the correlation between lightning activity and radar image data was carried out around the city of Palembang.

1.2 Formulation of the problem

Lightning activity has a strong relationship with rainfall because lightning is an indication of bad weather, which is often accompanied by heavy rain. Lightning strikes are often associated with rainy events. Sometimes rain events are preceded by lightning events and vice versa, but the appearance of rain is not always accompanied by the appearance of lightning. For this reason, it is necessary to do research, then identify the correlation between the intensity of lightning strikes and radar reflectivity.

Based on research conducted by Norbayah Yusopet et al [5]. In research conducted in Melaka in 2020, a total of 33 thunderstorms were obtained in the first storm, and the type of lightning that occurred the most was a positive narrow bipolar event (+NBE), which was around 21 lightning, with radar data obtained of 37 DBZ but at the second storm, 980 lightning data caught and intra-cloud is the most dominant type of lightning for the second storm with radar data obtained of 50 DBZ. From these data, it can be analyzed that the relationship between lightning and rainfall is related.

Many studies related to the correlation of radar data and lightning activity have been carried out, but many of these observations were made outside Indonesia.

So that until now, there has not been found any analysis of the correlation between radar data and lightning activity in Indonesia, especially in the city of Palembang.

1.3 Research purposes

In this final project research, the author has a goal which includes the following :

1. To determine the correlation between radar image data and lightning activity in Palembang.
2. To analyze the type of lightning with the strongest correlation from radar data in Palembang.

1.4 The scope of research

To simplify the research problems of this final project, there are several limitations of the problem which are as follows :

1. Lightning activity data comes from The Badan Meteorologi and Geophysics (BMKG).
2. Radar image data will be obtained from BMKG and is a Cappi-type radar.
3. The process of identifying and analyzing lightning data used lightning activity data and radar images around Palembang.

1.5 Hypothesis

This research found a correlation between lightning activity and radar data in Palembang City, Indonesia. The level of lightning activity that occurs in the region has a significant influence on the weather radar data.

1.6 Writing system

The systematics of writing related to the work on this thesis consists of five chapters sequentially with the aim that this writing can be more directed and systematic, while the chapters used are as follows :

CHAPTER I INTRODUCTION

This chapter discusses the research background, problem formulation, research objectives, research scope, and systematics writing.

CHAPTER II LITERATURE REVIEW

Chapter this is the general theoretical basis of lightning, weather radar and discussions related to lightning flashes.

CHAPTER III RESEARCH METHODOLOGY

Chapter This contains the place, time, equipment and materials used, series of experiments, data collection techniques and data processing used about the research process to be carried out.

CHAPTER IV RESULTS AND DISCUSSION

This chapter describes the results of the data that have been identified and analyzed as well as discussion.

CHAPTER V CONCLUSIONS AND RECOMMENDATIONS

This chapter is a conclusion from the results of the research that has been presented in CHAPTER IV and suggestions put forward related to the research that has been done.

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ATTACHMENT

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