Journal of Advances in Physics Education
(JAPE)
E-ISSN: 3109-0702
DOI: https://doi.org/10.23960/jape.v2i1.1612

Analysis Comparative Neo-MABIMS and KHGT Criteria in Determination of the Beginning of Rabiul Awal 1447 H (Case Study: Bandar Lampung)

Nistiyani Anggraini [1*], Djamaluddin Perawironegoro [2]
[1*] Ahmad Dahlan University, Indonesia, Ahmad Dahlan University, Indonesia
Email: [1*] 2507041001@webmail.uad.ac.id, [2]djamaluddin@mpai.uad.ac.id

Accepted :	Reviewed :	Accepted :	Published :
30- January-2026	03-February-2026	21-April-2026	29-May-2026

Keywords:
Hilal, Neo-MABIMS, Global Hijri Calendar, Stellarium , Islamic Astronomy

Abstract
This study aims to analyze differences in determining the beginning of the month of Rabiulawal 1447 H using Neo-MABIMS criteria and the Single Global Hijri Calendar (KHGT). It applies a descriptive-comparative approach by integrating astronomical data from BMKG and Stellarium simulations conducted at the coordinates of Bandar Lampung. The parameters examined include the conjunction time (ijtima'), crescent altitude, elongation, and the equatorial coordinates of the Moon and the Sun. The results show that the conjunction occurred on August 23, 2025, at 13:06:22 WIB. However, the crescent altitude and elongation observed in Indonesia on that date do not satisfy the Neo-MABIMS criteria, and only meet the required threshold on August 24, 2025. In contrast, the KHGT criteria allow the beginning of the month globally on August 23, 2025, due to meeting visibility conditions in other regions. These findings indicate that differences arise mainly from variations in criteria thresholds and approaches (regional versus global), rather than discrepancies in astronomical data, contributing to a more objective and scientific understanding of Hijri calendar determination.

CORRESPONDENT: 2507041001@webmail.uad.ac.id

INTRODUCTION

Determining the beginning of the Hijri month is a fundamental issue in Islamic religious practice because it is directly related to the certainty of the timing of worship and religious celebrations. In Indonesia, differences in determining the beginning of the month still occur frequently and recur from year to year due to the diverse criteria used by religious authorities and Islamic community organizations (Hidayat et al., 2025) . This phenomenon is particularly evident in the determination of the month of Shawwal (Eid al-Fitr), which in recent years has shown differences in determination, such as in 2011, 2023, and 2025. In 2025, for example, the beginning of Shawwal was set on March 31 based on the Neo-MABIMS criteria and March 30 based on the Single Global Hijri

Calendar (KHGT) (Ilham Majid, 2024). These recurring differences are caused by the use of diverse methods and criteria, particularly between *hisab* (astronomical calculations) and *rukyat* (crescent moon observation), as well as differences in the threshold for crescent moon visibility. (Yunus et al., 2025). These recurring differences demonstrate the urgent need for a more consistent and data-driven approach to determining the Hijri calendar. (Hidayat et al., 2025).

These differences are not limited to Ramadan or Shawwal, but reflect broader issues within the Hijri calendar system that potentially affect other months, including Rabi al-Awwal. These differences often lead to variations in the timing of religious observances and indicate the lack of a uniform standard. Scientifically, determining the beginning of a Hijri month is closely related to astronomical phenomena (Loucif et al., 2024). The term ijtima' (astronomical conjunction) refers to the moment when the Moon and Sun have the same celestial longitude. Following this event, the visibility of the crescent (the first observable crescent moon after sunset) becomes the primary basis for determining the beginning of the month. In this context, imkanur rukyah refers to the astronomically minimum conditions that allow the crescent to be observed, which are generally determined based on parameters such as altitude and elongation (Taher and Abdulla 2024).

Based on this concept, various approaches have developed in determining the beginning of the Hijri month. In Indonesia, one approach used is the *wujudul hilal method* adopted by Muhammadiyah, which determines the beginning of the month based on the presence of the Moon above the horizon after conjunction without requiring its visibility. This approach emphasizes logical consistency and the use of precise astronomical calculations Gita Syamsiyah, et.al. (2025). On the other hand, MABIMS member countries (Brunei, Indonesia, Malaysia, and Singapore) apply the Neo-MABIMS criteria based on the threshold of hilal visibility, requiring the fulfillment of certain astronomical parameters such as the Moon's altitude and elongation before the beginning of the month is determined. (Fitriyani, Isfihani, 2024). In a broader development, efforts to unify the Hijri calendar globally gave birth to the concept of a Single Global Hijri Calendar (SGHC), which determines the beginning of the month based on the presence of the crescent moon anywhere on Earth. SGHC emerged as a response to the fragmentation of the Hijri calendar due to differences in regional boundaries and criteria for determining the beginning of the month (Hidayat et al., 2025). However, fundamental differences between the visibility-based (Neo-MABIMS) and presence-based (SGHC) approaches still result in different decisions, even though both use the same astronomical data (Syarif et al., 2025). In addition, studies show that local factors and observation conditions also influence the success of rukyat, so empirical data-based analysis is very important in understanding these differences (Iqbal et al., 2025).

A review of previous research shows that most studies regarding the determination of the Hijri calendar still focus on conceptual, juridical, or methodological aspects related to hisab and rukyat. (Marwadi, 2018). Although several studies have discussed the crescent visibility model, studies directly comparing the Neo-MABIMS and KHGT criteria using the same astronomical dataset are still relatively limited, especially in terms of quantitative evaluation of the performance of both criteria under identical astronomical conditions (Karim, and Mahsun 2024) . This indicates a research gap in data-based comparative studies.

In this context, this study occupies a position as a development in the study of contemporary Islamic astronomy based on data, by integrating observational data and simulation results to directly compare two main criteria. This study is not just a replication, but rather the development of an approach through the use of official astronomical data combined with digital simulations to produce a more objective and measurable analysis. This study aims to analyze the astronomical parameters of the Moon and the Sun including conjunction time, right ascension/declination, elongation, and angular diameter based on BMKG data and Stellarium simulations; apply the Neo-MABIMS and KHGT criteria on the same dataset to identify differences in determining the beginning of Rabiulawal 1447 AH; and explain scientifically and from the perspective of Islamic jurisprudence the reasons for the differences in the results produced by the two criteria.

To achieve these objectives, this research focuses on the geographic coordinates of Bandar Lampung as a case study. The analysis was conducted using official data from the Meteorology, Climatology, and Geophysics Agency (BMKG) combined with simulations using Stellarium software. This approach allows for quantitative and comparative analysis of each research objective based on the same dataset.

The expected contributions of this research encompass three main aspects. First, it provides a data-based scientific explanation for the differences in the determination of the Hijri calendar. Second, it strengthens the integration between astronomy and Islamic jurisprudence through an interdisciplinary approach by linking quantitative astronomical data such as conjunction times, elongation, and the altitude of the crescent moon with Islamic jurisprudence analysis related to the criteria for determining the beginning of the month, so that the differences in results can be explained scientifically and normatively. Third, it supports the development of astronomy learning, particularly in physics education, by increasing scientific literacy in understanding lunar phenomena and calendar systems.

METHOD

This study uses a descriptive-comparative approach based on secondary astronomical data to analyze the differences in determining the beginning of the month of Rabiulawal 1447 H using the Neo-MABIMS criteria and the Single Global Hijri Calendar (KHGT). This approach is used to integrate precise astronomical data with the criteria for determining the beginning of the month to produce an objective and data-based analysis (Makhmudah, 2024) . The research procedure is carried out in stages and systematically. The first stage is the collection of secondary astronomical data from the Meteorology, Climatology, and Geophysics Agency in the form of ephemeris data and crescent visibility maps. The data collected include the ijtimak (conjunction) time, crescent altitude, elongation, and distribution maps of crescent altitude and elongation globally and regionally on August 23 and 24, 2025. This data is used as the basis for macro analysis to describe the conditions of crescent visibility in Indonesia and globally (Sudarto, 2024).

The second stage is an astronomical simulation using Stellarium software at Bandar Lampung coordinates as a local (topocentric) case study. The simulation was conducted under two main conditions used in the analysis of the results, namely: (1) at ijtima on August 23, 2025 at 13.06.22 WIB to verify the suitability of the conjunction time, and (2) at sunset on August 23 and 24, 2025 to analyze the geometric position of the crescent moon. The simulation was conducted with the same parameter settings, including the observation location, time, and coordinate system. Because Stellarium is deterministic, the simulation results will remain the same as long as the input parameters do not change. Therefore, the simulation repetition is not aimed at testing the consistency of the results, but rather to ensure the accuracy of the parameter settings (*input verification*) and the suitability of the simulation results with the reference data. The simulation output in the form of equatorial coordinates (Right Ascension and Declination), altitude, elongation, and angular diameter is documented in the form of screenshots and tables.

The third stage is validation of the simulation data. Validation is carried out by comparing the main astronomical parameters between the simulation results and reference data, as well as through geometric precision tests using the apparent angular diameter parameters of the Sun and Moon. Differences within astronomical tolerance limits indicate that the simulation data has a sufficient level of accuracy for use in analysis. This validation approach is in line with research that emphasizes the importance of verifying hisab and rukyat data using measurable astronomical analysis (Faizah 2024). The fourth stage is determining the research variables. The main variables include the altitude of the crescent moon, elongation, and equatorial coordinates (Right Ascension and Declination). The altitude of the crescent moon is defined as the angle of the Moon's elevation relative to the horizon at sunset, while elongation is the angular distance between the Moon and the Sun. All angular parameters are expressed in degrees (°), while the angular diameter is expressed in *arcseconds*.

The fifth stage is descriptive and comparative data analysis. Descriptive analysis is conducted by presenting data in the form of tables and visualizations, such as distribution maps of the height and elongation of the crescent moon, to describe the spatial visibility conditions. Comparative analysis is conducted by comparing the height and elongation parameter values against the Neo-MABIMS and KHGT criteria thresholds. The analysis is conducted chronologically, starting from: (1) verification of the ijtimak time as the beginning of the synodic cycle of the Moon, (2) analysis of the crescent conditions at sunset on August 23, 2025, and (3) analysis of the crescent conditions on August 24, 2025 as a comparison. This comparison process is also supported by a study that uses rukyat data as a comparison against the results of hisab in determining the beginning of the Hijri month. (Reskiani, 2022).

The Neo-MABIMS criteria use a minimum altitude limit of ≥ 3° and elongation of ≥ 6.4° in a particular region, which is based on a regional crescent visibility approach based on geometric parameters and empirical observations (Soderi & Mustaqim, 2024 ; Sopwan and Al-Hamidy Novi, 2020) Meanwhile, KHGT uses a global approach in determining the beginning of the Hijri month which is based on the principle of international unification of the Hijri calendar. In one of the formulations discussed in an international conference, the criteria used are a minimum crescent height of ≥ 5° and a minimum elongation of ≥ 8° at sunset (Aspar, Sumartini, 2016 ; Alfalaah, 2025) in borderline conditions, values that are exactly on the threshold are still considered to meet the criteria with special notes in the interpretation of the results.

The analysis focused on altitude and elongation parameters, as they are the primary indicators in the Neo-MABIMS and KHGT criteria and are directly related to the geometric visibility of the crescent moon. Other parameters were not considered primary indicators because they fall outside the operational thresholds of both criteria. The final stage was the interpretation of the results by linking the obtained astronomical parameters to the differences in the approaches of the two criteria: the regional approach in Neo-MABIMS and the global approach in KHGT.

RESULTS AND DISCUSSION

The research data is presented systematically in two main sections: local (topocentric) astronomical simulations using Stellarium software at the researcher's observation location, and macro-astronomical data analysis sourced from the Meteorology, Climatology, and Geophysics Agency (BMKG). These two approaches are interrelated, with local simulations verifying the geometric accuracy of astronomical events, while BMKG data provides a broader spatial context for interpreting the visibility of the crescent moon. Therefore, the presentation of the results is not only descriptive but also analytical, explaining the implications of astronomical parameters for determining the beginning of the month of Rabiulawal 1447 AH.

1. Simulation Astronomy Local (Topocentric) Using Stellarium in Bandar Lampung

A local (topocentric) astronomical simulation using Stellarium software was conducted as an initial step to determine the conjunction time (ijtima') while verifying its conformity with BMKG data and the geometric characteristics of the Moon and Sun at that moment. This step not only serves as a chronological basis before analyzing the crescent conditions at sunset, but also has an analytical role in explaining the initial geometric conditions that affect the visibility of the crescent. The proximity of the moon and sun at the time of ijtima' directly impacts the small angular separation (elongation), which is a major factor in determining the likelihood of the crescent's visibility.

a. Conjunction Time (Ijtima')

Conjunction geocentric (ijtima ') Incident This happen when longitude the Moon's ecliptic is the same with longitude the Sun's ecliptic , with observer assumed is at the center of the Earth. Incident This mark the end One cycle synodic month and the beginning cycle next.

DATA HILAL DAN MATAHARI PADA SAAT MATAHARI TERBENAM
SABTU, 23 AGUSTUS 2025 M
PENENTU AWAL BULAN RABIULAWAL 1447 H

KONJUNGSI: SABTU, 23 AGUSTUS 2025 M, PUKUL 13.6.22 WIB

NO	NAMA LOKASI	POSISI LOKASI		WAKTU TERBENAM		AZIMUTH		TINGGI BULAN	POSISI BULAN RELATIF TERHADAP MATAHARI (ELONGASI)	FI BULAN
		BUJUR	LINTANG	MATAHARI	BULAN	MATAHARI	BULAN			
		° '	° '	j	j	° '	° '	° '	° '	%
	LAMPUNG									
1	Bandar Lampung	105 15.59 BT	5 25.76 LS	18.00.38 WIB	18.08.17 WIB	281 14.34	281 55.89	1 19.83	2 49.19 Bulan di sebelah Utara - Atas Matahari	0.03
2	Krui	103 56.01 BT	5 11.20 LS	18.06.08 WIB	18.13.58 WIB	281 14.20	281 54.06	1 22.31	2 51.46 Bulan di sebelah Utara - Atas Matahari	0.03
3	Liwa	104 4.96 BT	5 2.18 LS	18.05.39 WIB	18.13.29 WIB	281 14.19	281 53.68	1 22.20	2 51.26 Bulan di sebelah Utara - Atas Matahari	0.03
4	Blambangan Umpu	104 28.85 BT	4 32.03 LS	18.04.28 WIB	18.12.16 WIB	281 14.15	281 52.38	1 22.02	2 50.77 Bulan di sebelah Utara - Atas Matahari	0.03
5	Kotaagung	104 37.38 BT	5 29.55 LS	18.03.08 WIB	18.10.51 WIB	281 14.32	281 55.61	1 20.85	2 50.22 Bulan di sebelah Utara - Atas Matahari	0.03
6	Kotabumi	104 52.78 BT	4 49.14 LS	18.02.39 WIB	18.10.23 WIB	281 14.20	281 53.60	1 21.08	2 50.02 Bulan di sebelah Utara - Atas Matahari	0.03
7	Pringsewu	104 58.31 BT	5 20.88 LS	18.01.51 WIB	18.09.32 WIB	281 14.30	281 55.40	1 20.40	2 49.69 Bulan di sebelah Utara - Atas Matahari	0.03
8	Gedong Tataan	105 5.23 BT	5 24.03 LS	18.01.21 WIB	18.09.01 WIB	281 14.32	281 55.66	1 20.15	2 49.49 Bulan di sebelah Utara - Atas Matahari	0.03
9	Panaragan	105 5.45 BT	4 30.14 LS	18.02.03 WIB	18.09.46 WIB	281 14.18	281 52.76	1 21.02	2 49.78 Bulan di sebelah Utara - Atas Matahari	0.03
10	Gunungsugih	105 12.69 BT	4 58.82 LS	18.01.11 WIB	18.08.52 WIB	281 14.24	281 54.38	1 20.36	2 49.42 Bulan di sebelah Utara - Atas Matahari	0.03
11	Menggala	105 13.21 BT	4 29.68 LS	18.01.32 WIB	18.09.15 WIB	281 14.19	281 52.84	1 20.81	2 49.57 Bulan di sebelah Utara - Atas Matahari	0.03
12	Metro	105 18.40 BT	5 6.88 LS	18.00.42 WIB	18.08.21 WIB	281 14.27	281 54.89	1 20.07	2 49.22 Bulan di sebelah Utara - Atas Matahari	0.03
13	Wiraga Mulya	105 25.67 BT	3 52.39 LS	18.01.12 WIB	18.08.55 WIB	281 14.20	281 51.10	1 21.05	2 49.43 Bulan di sebelah Utara - Atas Matahari	0.03
14	Sukadana	105 33.05 BT	5 3.99 LS	17.59.46 WIB	18.07.23 WIB	281 14.27	281 54.93	1 19.71	2 48.84 Bulan di sebelah Utara - Atas Matahari	0.03
15	Kalianda	105 35.22 BT	5 43.01 LS	17.59.06 WIB	18.06.41 WIB	281 14.44	281 57.10	1 18.99	2 48.56 Bulan di sebelah Utara - Atas Matahari	0.03

Figure 1. Current Crescent Moon Data Sun Sunset on Saturday, August 23, 2025

Based on Figure 1, the initial conjunction of the month of Rabiulawal 1447 H occurred on Saturday, August 23, 2025, at 06:06:22 UT or 13:06:22 WIB. At that time, the ecliptic longitude of the Sun and Moon were exactly the same, namely 150.38°. The synodic period of the Moon from the previous conjunction (the beginning of Safar 1447 H) until this conjunction was 29 days, 10 hours, and 55 minutes. On the same date, sunset times in Indonesia varied, ranging from 5:37:37 PM WIT in Merauke to 6:49:25 PM WIB in Sabang. Meanwhile, on August 24, 2025, sunset times ranged from 5:37:34 PM WIT in Merauke to 6:49:00 PM WIB in Sabang (BMKG, 2025) . This indicates that the ijtima' occurred within a relatively close timeframe to the crescent moon observation time.

The temporal proximity between ijtima' and sunset directly impacts the geometric conditions of the crescent moon, particularly the angular separation between the Moon and the Sun. Under these conditions, the Moon's elongation is still very small so that the resulting illumination fraction is also low, while the position of the crescent moon is close to the horizon. The combination of small elongation and low altitude causes the contrast of the crescent moon against the background of twilight to be weak, so that geometrically it does not meet the requirements for visibility (Rajab et al., 2023). In a broader context, the study of Islamic astronomical literature confirms that the visibility of the crescent moon is not only determined by elongation, but also by the height of the crescent moon and its contrast against the twilight sky as the main geometric parameters in observation (Syarif et al., 2025).

Furthermore, the conjunction data from BMKG was verified through local astronomical simulations (topocentric) using Stellarium software at the Bandar Lampung location.

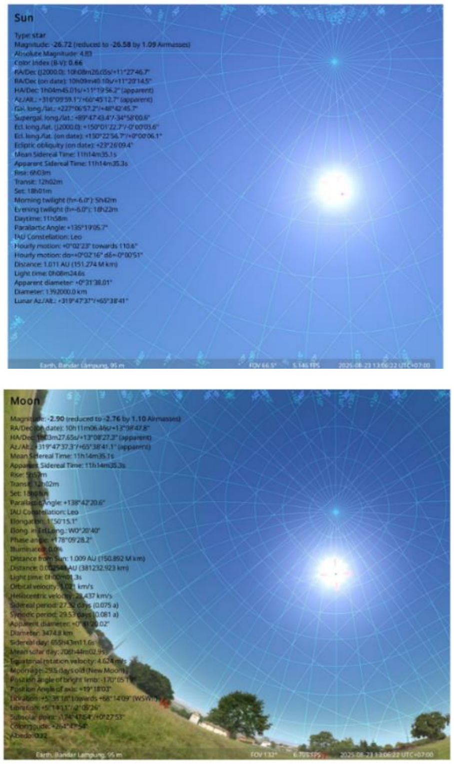

Figure 2. Display Position Sun at Conjunction August 23 , 2025, at 1:06:22 PM WIB. Results of the Stellarium Simulation in Bandar Lampung.

The simulation results in Figure 2 show that on August 23, 2025, at 1:06:22 PM WIB, the equatorial positions of the Sun and Moon are in very close proximity. Based on *the Right Ascension* and *Declination* (RA/Dec on date) parameters, the Sun is at coordinates RA 10h 09m 49.10s and Dec +11°20′14.5″, while the Moon is at RA 10h 11m 06.47s and Dec +13°08′47.8″. This close equatorial position confirms that the Moon and the Sun

Are at nearly the same ecliptic longitude, thus astronomically confirming the occurrence of the conjunction event as reported by the BMKG. This closeness of coordinates not only confirms the occurrence of the conjunction but also indicates that the angular separation between the sun and the moon was still very small at that time. This condition strengthens the analysis that the crescent does not yet have sufficient geometric parameters to be observed at sunset (Rajab et al., 2023).

b. Characteristics Geometric During Conjunction (Simulation Validity Test)

In addition to verifying time conjunction, simulation Stellarium used For test validity geometric data output via visible diameter parameter The Sun and the Moon at the time ijtima'. Although this parameter No determinant direct visibility month sickle , its suitability with results manual calculations are used as indicator level precision simulation. Comparison between results manual calculations and output Stellarium at the moment conjunction , namely August 23, 2025, at 13.06.22 WIB, is presented in Table 1.

Table 1. Comparison of the Apparent Angular Diameters of the Sun and the Moon

Object	Calculation Results	*Apparent diameter* (Stelarium)	Difference
Sun	31'37.8″	31 minutes 38.01 seconds	0.21″
Month	31'19.8″	31'20.02″	0.22 inches

The analysis shows that the difference in apparent angular diameter is below 0.5 arcseconds for both the Sun and the Moon. This very small difference indicates a high level of precision between the manual calculations and the simulation results. However, this small difference still represents numerical uncertainty in the simulation and calculation processes. In the context of crescent visibility, this uncertainty is important because the parameters used are often near the threshold criteria. Therefore, although the difference in values is astronomically very small, its impact still needs to be considered in the interpretation of crescent visibility, especially in marginal conditions. The agreement between the results of the Stellarium simulation and the manual calculations also shows no significant systematic differences, so both data sources can be considered geometrically consistent (Andy Muhammad Ruknanto, Fatmawati, 2023) . Thus, the obtained astronomical parameters are not only valid for verification but can also be used as a basis for further analysis regarding the development of crescent visibility based on BMKG macro astronomy data to examine how these parameters develop spatially and temporally in determining the beginning of the month of Rabiulawal 1447 AH.

2. Macro Astronomy Data Analysis (BMKG)

The determination of the beginning of the month of Rabiulawal 1447 H is based on the analysis of the position of the crescent moon at sunset at two observation times, namely Saturday, August 23, 2025, and Sunday, August 24, 2025. The crescent moon position data is analyzed using the main parameters in the form of altitude and elongation of the Moon to the Sun, which are visualized in the form of a height map and a crescent moon elongation map for observers between 60 ^{0} N to 60 ^{0} S and for observers in Indonesia.

a. Crescent conditions on Saturday, August 23, 2025

For see global distribution , map height crescent moon shown in Figure 2 .

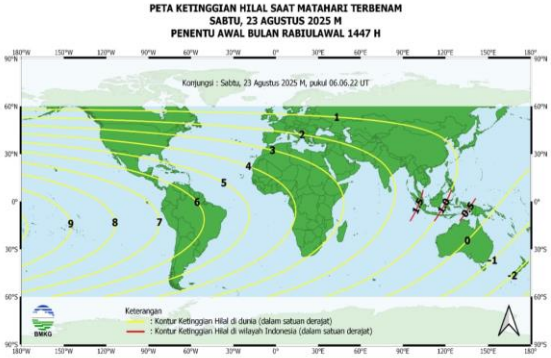

Figure 2. Map of the Crescent Height for observers between 60 ^{0} N to 60 ^{0} S on Saturday, August 23, 2025 AD

Figure 2 shows that on August 23, 2025, some regions such as Africa will have height crescent moon about 5°, which has been fulfil criteria KHGT visibility . This caused by position relative to the Moon The sun that produces corner elevation more big moment Sun immersed in the area . For the Indonesian region, distribution height crescent moon shown in Figure 3

Figure 3. Map of the Crescent Height for observers in Indonesia on Saturday, August 23, 2025 AD

Based on Figure 3, the analysis of the crescent height map shows that on August 23, 2025, the height of the crescent in Indonesia at sunset ranged from 0.3° in Merauke to 1.72° in Sabang. This value is still below the minimum height limit of ≥ 3° set in the Neo-MABIMS criteria, so geometrically the crescent does not meet the visibility requirements in Indonesia (Soderi & Mustaqim, 2024) This condition is caused by the relatively short time interval between ijtima' and sunset, so that the Moon has not experienced a significant increase in the angle of elevation to the horizon.

b. Crescent conditions on August 24, 2025

The global distribution of crescent heights on August 24, 2025 is shown in Figure 4.

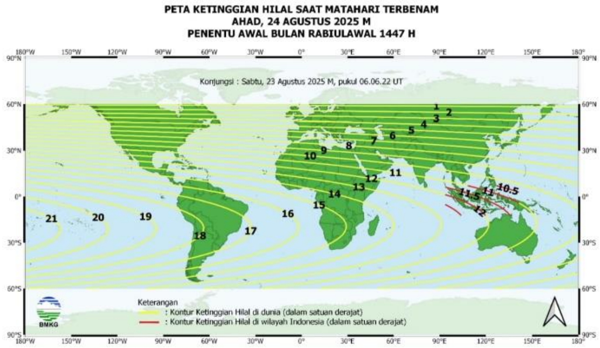

Figure 4. Map of the Crescent Height for observers between 60 ⁰ N to 60 ⁰ S on Sunday, August 24, 2025 AD

Figure 4 shows a significant increase in the height of the crescent over almost all regions of the Earth. This is caused by the Moon's rapid orbital movement relative to the Sun after the ijtima'. For the Indonesian region, these conditions are shown in Figure 5.

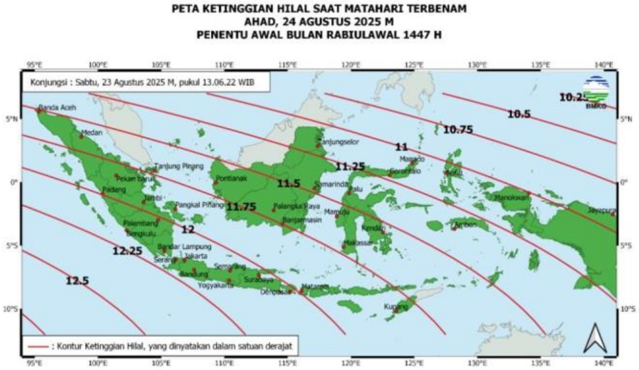

Figure 5. Crescent Height Map for observers in Indonesia on Sunday, August 24, 2025 AD

Based on Figure 5, there is an increase in the height of the crescent moon that can be measured quantitatively, from a range of 0.3°–1.72° (Figure 3) to 10.81°–12.21° (Figure

5), which indicates an increase of more than 9° in a period of approximately 24 hours. In this time interval after ijtima', the position of the Moon experiences a significant geometric change, so that the height of the crescent moon at sunset increases drastically. This condition causes almost all regions of Indonesia to meet the visibility criteria according to Neo-MABIMS. The implications of this condition indicate that the implementation of rukyat hilal astronomically will only be possible on August 24, 2025. Meanwhile, in the hisab approach, geometric parameters such as height, elongation, and the relative positions of the moon and the sun on that date can be used as a basis for determining the beginning of the month according to the criteria used.

c. Crescent Moon Elongation Analysis

The global distribution of geocentric elongation on August 23, 2025 is shown in Figure 6.

Figure 6. Elongation map for observers between 60 ⁰ N to 60 ⁰ S on Saturday, August 23, 2025 AD

Figure 6 shows that some regions such as India have achieved elongation ≥8°, so that according to the KHGT criteria globally they have met the geometric requirements for the beginning of the month (Alfalaah, 2025). This shows that the visibility of the crescent is influenced by the spatial distribution of the Moon's position relative to the Sun. For the Indonesian region, the elongation distribution is shown in Figure 7.

Figure 7. Elongation Map for Observers in Indonesia on Saturday, August 23, 2025 AD

Based on Figure 7, the elongation in Indonesia at sunset ranges from 1.96° in Merauke to 3.16° in Sabang , thus not meeting the Neo-MABIMS minimum limit (≥6.4°). This condition is consistent with the results of the crescent height analysis, which also does not meet the visibility criteria. The global distribution of elongation is shown in Figure 8.

Figure 8. Elongation map for observers between 60 ⁰ N to 60 ⁰ S on Saturday, August 24, 2025 AD

Based on Figure 8, the elongation distribution on August 24, 2025, shows that nearly all areas on Earth's surface have reached relatively high elongation values. This condition indicates that globally, the crescent moon has reached a sufficiently large angular separation from the Sun, thus geometrically being in a condition favorable for visibility. For the Indonesian region, these conditions are shown in more detail in Figure 9.

Figure 9. Elongation Map for Observers in Indonesia on Sunday, August 24, 2025 AD

Based on Figure 9, elongation in Indonesia increased from a range of 1.96°–3.16° on August 23, 2025 (Figure 7) to 13.14°–14.69° on August 24, 2025. This increase indicates a rate of angular change of approximately 10° per day, which is in line with the average angular velocity of the Moon relative to the Sun of 12–13° per day. This indicates that changes in the visibility of the crescent moon are non-linear, where in a short time there can be a spike in the parameters that determine visibility.

The increase in elongation occurs simultaneously with the increase in the height of the crescent, so that both parameters together strengthen the conditions for the visibility of the crescent on August 24, 2025. Based on the analysis of height and elongation, there is a difference in determining the beginning of the month of Rabiulawal 1447 H between the Neo-MABIMS and KHGT criteria.

According to Neo-MABIMS, with the requirement of a crescent altitude of ≥3° and an elongation of ≥6.4°, the crescent conditions in Indonesia will only meet the criteria on August 24, 2025. Therefore, according to the calculation, the night of 1 Rabiulawal is set on August 24, 2025 and the beginning of the month falls on August 25, 2025. In contrast, KHGT uses a global approach with the requirement of an altitude of ≥5° and an elongation of ≥8°. On August 23, 2025, several regions outside Indonesia have met these criteria, so the beginning of the month is set earlier, namely August 24, 2025.

DISCUSSION

The analysis of determining the beginning of the month of Rabiulawal 1447 AH begins with verifying the conjunction time (ijtima') as the starting point of the Moon's synodic cycle. Conjunction is a condition when the ecliptic longitude of the Moon and the Sun are equal, which is the astronomical basis for determining the beginning of the Hijri month. The proximity of the ijtima' time to sunset directly impacts the small initial angular separation between the Moon and the Sun, so that visibility parameters such as elongation and altitude remain at low values. In modern crescent visibility studies, the visibility of the crescent is not determined by a single parameter, but by a combination of several geometric parameters. This is emphasized by Taher, and Abdulla (2024) which states that the visibility of the crescent moon depends on the interaction of parameters such as altitude and elongation. This view is supported by Munir, (2024) which shows that a multi-parameter approach provides more accurate results in predicting crescent visibility. In addition, a review of Islamic astronomy literature also confirms that the contrast factor against the twilight sky is an important component in the success of crescent observation (Syarif et al., 2025).

The validity of the simulation data was verified by comparing the apparent angular diameters of the Sun and Moon between the manual calculations and the Stellarium output. The very small difference indicates a high level of precision, so the simulation data can be used as a basis for further geometric analysis. This is in line with the findings of (Al Ayyubi, et.al 2025) This is in line with the research of Al Ayyubi, et.al

(2025) which shows that astronomical software such as Stellarium can be used to produce calculation data that is consistent with other computational methods, so it can be utilized in astronomical analysis. However, numerical uncertainty still needs to be considered, especially when the parameters are around the visibility threshold, because small differences can affect the interpretation of the visibility of the crescent moon in marginal conditions.

The crescent sighting conditions on August 23, 2025, indicate that Indonesia's geometric parameters do not yet meet the Neo-MABIMS visibility criteria. Low altitude and elongation values not only indicate the crescent's proximity to the horizon but also reflect a small fraction of illumination, resulting in very weak contrast against the twilight sky. This condition makes the crescent difficult to observe geometrically and observationally. This finding aligns with research by Arkanudin and Sudibyo (2015). which emphasizes that the height of the crescent moon significantly influences the probability of visibility, particularly in tropical regions. However, the results of this study also indicate that elongation plays an equally important role in determining the extent of the crescent moon's illumination. This finding is supported by Imas Musfiroh (2018). which shows that the relationship between elongation and visibility is non-linear. Furthermore, observational factors such as sky brightness and atmospheric conditions also influence the success of rukyat, as explained by Alhan, et.al, (2025).

A significant change occurred on August 24, 2025, where within approximately 24 hours after the ijtima', there was a drastic increase in altitude and elongation. This increase reflects the angular velocity of the Moon relative to the Sun, which ranges from 12–13° per day, resulting in a significant change in visibility parameters within a short period of time. This condition caused the crescent that previously did not meet the visibility criteria to meet the visibility criteria. This finding indicates that the visibility of the crescent is dynamic and non-linear. This is consistent with the results of research by Imas Musfiroh (2018) which shows that small changes in time can result in significant differences in visibility conditions .

A comparison between BMKG data and simulation results shows high consistency in describing the geometric parameters of the crescent moon. This strengthens the reliability of the data used in the analysis, as shown in the research of Sugiharto et.al (2025) where the integration between macro astronomy data and local simulations not only serves as verification but also provides a more comprehensive understanding of the dynamics of the positions of the Moon and the Sun in the context of crescent moon visibility.

On the other hand, the Single Global Hijri Calendar (SGH) approach yields different results. On August 23, 2025, several regions outside Indonesia had already met the global visibility threshold, thus establishing the beginning of the month earlier than the Neo-MABIMS approach. This difference stems not from different astronomical data, but from a different conceptual framework in defining crescent visibility. A study by Muhamad Syazwan Faid et al. (2024) shows that variations in threshold criteria can produce systematic differences in the Hijri calendar, even when using the same astronomical dataset.

More broadly, the differences between Neo-MABIMS and KHGT reflect the difference in regional and global approaches. Neo-MABIMS emphasizes location-based visibility, while KHGT uses a global approach that allows one region to serve as a reference for the entire world. This demonstrates that determining the beginning of the month is not solely an astronomical issue but also relates to methodological construction and Islamic jurisprudence. Suleman et.al (2025) emphasizes that the criteria for crescent visibility are inseparable from the context of ijtihad and Islamic scholarly tradition.

Overall, the results of this study indicate that the differences in determining the beginning of the month of Rabiulawal 1447 AH are a consequence of the rapidly changing geometric dynamics of the Moon after the ijtima' and differences in the thresholds of the visibility criteria used. The integration of BMKG data and simulations shows that both approaches, Neo-MABIMS and KHGT, have a valid scientific basis within their respective frameworks. These findings strengthen the view that differences in the Hijri calendar are not caused by data inaccuracies, but rather by differences in the interpretation of the same parameters. (Marwadi, 2018).

However, this study has limitations that require attention. The analysis is still based on geometric models and simulations, so it does not fully represent actual observational conditions, which are influenced by atmospheric factors, weather, and observer capabilities. Furthermore, numerical uncertainties in the simulations and modeling of BMKG data can also influence the results under threshold conditions. Therefore, interpretation of the results of this study should be placed in the context of a geometric feasibility analysis, rather than as an empirical confirmation of visibility.

CONCLUSION

This study shows that the difference in determining the start of Rabiulawal 1447 AH between the Neo-MABIMS criteria and the Single Global Hijri Calendar (SGHC) is due to differences in conceptual approaches and visibility thresholds used. These differences reflect the consequences of regional and global approaches to determining the start of the Hijri month, not due to differences or discrepancies in astronomical data. These findings confirm that the determination of the beginning of the Hijri month is the result of an interaction between the rapidly changing geometric dynamics of the Moon after the ijtima' and the interpretative framework of the criteria used. In the Indonesian context, this study contributes to strengthening a more rational and data-driven understanding of the frequent differences in the beginning of the month, and emphasizes the importance of integrating astronomical analysis and Islamic jurisprudence in Hijri calendar decision-making. This research is still limited to one observation location and is based on simulation data and secondary data, so the results need to be interpreted carefully and do not directly represent the conditions of crescent observation in all regions. Further research is recommended to involve more observation locations and integrate actual rukyat data to increase the validity of the analysis. Developing interdisciplinary studies between astronomy and Islamic jurisprudence is also crucial to support efforts to unify the Hijri calendar, particularly in Indonesia.

REFERENCE

Al Ayyubi, I. I., Nurhikmah, N., Prayetno, E., Noerzanah, F., & Musaldin, L. (2025). Determination of Prayer Times Through Islamic Astronomy Applications: Repositioning Traditional Authority in the Digital Era. *Borneo International Journal of Islamic Studies*, *7*(1), 1-18. https://doi.org/10.21093/bijis.v7i1.10062.

Alfalaah, S. (2025). Single Global Hijri Calendar in the Muhammadiyah Perspective : Integration of Hisab , Rukyat, and Dates Unification. *Al-Hisab: Journal of Islamic Astronomy* 2(3), 181-191. https://doi.org/10.33096/jah.v2i3.26668

Alhan, D.K., Ruslandi, Ismail. (2025). Analisis Tingkat Kecerahan Langit Malam Terhadap Visibilitas Hilal Menggunakan Sky Quality Meter di Observatorium Malikussaleh IAIN Lhokseumawe. *ASTROISLAMICA Journal of Islamic Astronomy*. 4(1), 25–39. https://doi.org/10.47766/astroislamica.v4i1.3374

Andy muhammad ruknanto, fatmawati, f. a. (2023). komparasi software stellarium dan accurate times dalam penentuan waktu salat duhur. *HISABUNA: Jurnal Ilmu Falak*, *4*(1), 1–13. https://doi.org/10.24252/hisabuna.v4i1.36131.

Arkanudin, M., & Sudibyo, M. A. (2015). Kriteria Visibilitas Hilal Rukyatul Hilal Indonesia (Rhi) (Konsep, Kriteria, dan Implementasi). *Al-Marshad: Jurnal Astronomi Islam dan Ilmu-Ilmu Berkaitan*. 1(1). 34-43. https://doi.org/10.30596/jam.v1i1.737.

Aspar, sumartini, m. b. (2016). Kalender Hijriah Global Tunggal dan Tantangan Penerapannya di Indonesia. *Jurnal Pendidikan Agama Islam*. Vol. 5 No 1 Tahun 2026, 131-137.

BMKG. (2025). informasi prakiraan hilal saat matahari terbenam tanggal 23 dan 24 agustus 2025 m (penentu awal bulan rabiulawal 1447 h).

Faizah, N. F., & Ahmad Syifaul Anam. (2024). Scientific Analysis of Evaluating the Methodology of Confirming Hilal Observing Reports in Determining the Beginning of the Hijri Month. *AL - AFAQ : Jurnal Ilmu Falak Dan Astronomi*, *6*(1), 1–13. https://doi.org/10.20414/afaq.v6i1.9876.

Fitriyani, F., Isfihani, I., & Octasari, A. . (2024). Implikasi Kriteria Imkanur Rukyat Mabims Baru Terhadap Penyatuan Awal Bulan Kamariah Di Indonesia. *Jurnal Mediasas: Media Ilmu Syari'ah Dan Ahwal Al-Syakhsiyyah*, *7*(2), 462–482. https://doi.org/10.58824/mediasas.v7i2.197

Gita Syamsiyah, N., Adelia Fahmasari, C., & Fu'ad Abdul Baqi, A. (2025). KHGT Muhammadiyah: Bukti Nyata Islam Sejalan dengan Ilmu Pengetahuan Modern. *Jurnal Studi Pendidikan Agama Islam*, *1*(1), 120–134. https://doi.org/10.32806/jspai.v1i1.1462.

Hidayat, D., Pujastuti, O., Putri, R. C., Nuragnia, S. A., & Ekodwiansyah, V. A. (2025). Pendekatan Hisab Penentuan Awal Bulan Hijriyah: Studi

Metode Muhammadiyah Dan Konsepsi Hisab Hakiki Wujudul Hilal. *Jurnal Pendidikan Tambusai*, *9*(2), 28820–28827. https://doi.org/10.31004/jptam.v9i2.31548.

Imas musfiroh, Hendri. (2018). Analisis Regresi Non Linier (Polinomial) dalam Pembentukan Kriteria Visibilitas Hilal di Indonesia. *Al-Marshad: Jurnal Astronomi Islam dan Ilmu-Ilmu Berkaitan*, 4 (1). 46–66. https://doi.org/10.30596/jam.v4i1.1935.

Iqbal, M. M., Habib, M. a., & Ramdhani, F. Z. (2025). Evaluating the feasibility of yanbu ′ ul qur ′ an observatory in menawan kudus for lunar crescent observation. *Al-hilal: journal of islamic astronomy*, 7(1), 117–132. https://doi.org/10.21580/al-hilal.2025.7.1.27090.

Karim, Moh. F.R, and Mahsun. (2024). Kriteria Baru Mabims 3-6,4: Upaya Penyatuan Kalender Hijriah di Indonesia Dalam Perspektif Maqāṣid Al-Syarī'ah, *Astroislamica: Journal of Islamic Astronomy* 3(1). https://doi.org/10.47766/astroislamica.v3i1.2735.

Loucif, S., Rajab, M. Al, Zitar, R. A., & Rezk, M. (2024). toward a globally lunar calendar : a machine learning - driven approach for crescent moon visibility prediction. Journal of Big Data. (2024) 11:114. 1-23. https://doi.org/10.1186/s40537-024-00979-6

Makhmudah, s. (2024). Peran Data Astronomi Dalam Akurasi Kalender Hijriah Nasional. *Jurnal Astronomi Islam*, 1(2).

Marwadi. (2018). pembaruan kriteria visibilitas hilal dan peluangnya terhadap penyatuan hijriyah di indonesia. *Al-Manahij: Jurnal Kajian Hukum Islam*. 7(1).

Muhamad Syazwan Faid, Mohd Saiful anwar mohd nawawi, mohd hafiz mohd saadon, raihana abdul wahab, nazhatulshima ahmad, muhamad syauqi nahwandi, ikramullah ahmed, i. m. (2024). assessment and review of modern lunar crescent visibility criterion. april. https://doi.org/10.1016/j.icarus.2024.115970.

Munir, B. (2024). Faktor Atmosfer dalam Visibilitas Hilal Badan Meteorologi Klimatologi dan Geofisika (BMKG). *Lunggi Journal*, *2*(4), 684-713. Retrieved from https://journal.iaisambas.ac.id/index.php/lunggi/article/view/3384.

Rajab, M. Al, Loucif, S., & Risheh, Risheh Y. al. (2023). Predicting New Crescent Moon Visibility Applying Machine Learning Algorithms. *Scientific reports*, 1–15. https://doi.org/10.1038/s41598-023-32807-x.

Reskiani, A., & Subhan, R. (2022). Analisis Visibilitas Hilal Sebagai Acuan Penentuan Awal Bulan Kamariyah (Studi Data Penampakan Hilal di Makassar). *El- Falaky: Jurnal Ilmu Falak*, 6(1), 96–111. https://doi.org/10.24252/ifk.v6i1.26772.

Soderi, R., Darlius & Mustaqim, R. A. (2024). Rekontruksi Kriteria Visibilitas Hilal Serta Dampak Implementasi Kriteria Imkanurukyah MABIMS Baru Dalam Kemaslahatan. *Astroislamica: Journal of Islamic Astronomy*. 3(2), 233–

255. https://doi.org/10.47766/astroislamica.v3i2.3642.

Sopwan, N., & Al-Hamidy, A. D. (2020). Implikasi Kriteria Visibilitas Hilal Rekomendasi Jakarta 2017 Terhadap Penanggalan Hijriah di Indonesia. *Azimuth: Journal of Islamic Astronomy*, *1*(1), 52–73. https://doi.org/10.15642/azimuth.v1i1.786.

Sudarto, S. (2024). Pengaruh Kondisi Atmosfer Terhadap Visibilitas Hilal Kajian Ilmiah dan Implikasinya. *Jurnal Astronomi Islam*, 2(1).

Sugiharto, T. I., Hariyadi, M. A., Chamidy, T., Santoso, I. B., Crysdian, C., Zarkoni, A., … Syahreni, S. (2025). Analytic Predictive of Crescent Sighting Using Astronomical Data-Based Multinomial Logistic Regression in Indonesia. *G-Tech: Jurnal Teknologi Terapan*, *9*(4), 2240–2247. https://doi.org/10.70609/g-tech.v9i4.8246.

Suleman, F., Khusurur, M., Alwi, B., Muhajir. (2025). Dynamics of MABIMS Criteria in Preliminary Determination of Kamariyah: Maqasid Syariah Analysis of Accuracy and Istbat Session Decisions. *Pena Justisia: Media Komunikasi Dan Kajian Hukum*. 24 (1). https://doi.org/10.31941/pj.v24i2.6209.

Syarif, M.R., Sakirman, S., & Syarif, M. F. (2025). A Semantic Literature Review on Crescent Visibility : Trends, Models, and Implications for the Islamic Calendar. *Al-Hilal: Journal of Islamic Astronomy*, 7(1), 67–88. https://doi.org/10.21580/al-hilal.2025.7.1.26099.

Taher, M. Y., & Abdulla, F. M. (2024). Evaluating the Development of the Crescent Visibility Criteria. *Iraqi Journal of Science*, *65*(1), 555-566. https://doi.org/10.24996/ijs.2024.65.1.43

Yunus, M., Madrasah, S., Bayang, A., Imam, U. I. N., & Padang, B. (2025). Analisis Penentuan Awal Bulan Hijriyah Dengan Metode Pendekatan Hisab dan Rukyat. *Jurnal Al-Mizan: Jurnal Hukum Islam dan Ekonomi Syariah*, 6468, 17–32.