

# Student response to the extreme cold weather phenomenon in East Java

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## Abstract

The phenomenon of extreme cold air is known as the peak of the dry season, which feels cold with scorching heat. Students of the Faculty of Mathematics and Natural Sciences (FMIPA) who focus on the world of science need to understand the processes and causes of the phenomenon that occurs with adaptive and complex responses. The study aims to examine the responses of FMIPA students to the phenomenon of extreme cold air in East Java as a form of awareness. Using a qualitative descriptive method involving 126 students, data was collected through a questionnaire on the Google Forms platform for physics majors at Surabaya State University. The results showed that FMIPA students understood the causes of extreme cold weather phenomena. FMIPA students' activities in July-August differed from those in the previous month, with students wearing jackets during the dry season. Thus, temperature is an important factor in daily life adaptation because adaptive awareness and scientific understanding of extreme cold temperatures can enhance ethnophysics in a tangible way. Therefore, students can relate to the local wisdom of the people of East Java in predicting temperature and weather changes.

## 1. Introduction

Indonesia, as a tropical country flanked by two oceans and two continents, has a complex and dynamic climate that causes variations in rainfall and differences in weather conditions between regions (Estiningtyas & Syakir, 2017; Malau et al., 2023). East Java Province, with an area of 47,803.49 km<sup>2</sup> and a population of around 40.88 million, has diverse topography and unique climatic conditions (Illahi et al., 2023). Geographically, East Java is bordered by the Java Sea to the north, where the characteristics of the water mass are influenced by regional circulation and seasonal oceanographic phenomena (Pratama et al., 2025). Oceanographic conditions in the southern Java Sea are influenced by the Asia-Australia monsoon winds (Nurlatifah et al., 2021). This situation indicates that the marine and atmospheric systems in southern Java are undergoing fundamental changes that could cause shifts in the climate patterns in the region. The interrelationship between geographical, oceanographic, and atmospheric conditions is an important basis for understanding the emergence of extreme temperature phenomena in East Java.

Future trend projections show alarming patterns. Data from the Meteorology, Climatology, and Geophysics Agency (BMKG) and studies by the National Research and Innovation Agency (BRIN) indicate that East Java faces various complex climate threats (PRIMA-BRIN, 2025). From July to August 2025, Indonesia will experience extreme cold temperatures, especially in East Java. The rainy season occurs from October to March, while the dry season lasts from April to September (Suhery et al., 2023). During the peak of the dry season from July to August, cold air currents from Australia caused temperatures on the island of Java to drop sharply (Sasmito et al., 2021). This phenomenon indicates strong regional atmospheric dynamics and provides an opportunity to examine the relationship between global climate factors and local microclimate conditions in East Java.

The winds that blow towards Indonesia are known as monsoon winds, which are seasonal winds that change direction every six months due to differences in heating between land and sea. Monsoon winds cause two seasons in Indonesia, the east monsoon and the west monsoon (Rifai et

al., 2020). Based on a study conducted by Haryanto et al (2019), the east monsoon occurs from June to September with the strongest winds coming from mainland Australia and bringing dry air. This results in a decrease in humidity and sea surface temperature in the Java Sea area. These conditions make the air near the surface feel cooler, especially at night and in the early morning (BMKG, 2023). The cooling effect that occurs at night in southern Java is called the bediding phenomenon. This phenomenon is a concrete example of the interaction between atmospheric dynamics and the local community's perception of extreme temperature changes.

The bediding phenomenon is known as the peak of the dry season, which is characterized by cold temperatures and intense heat (Kusrini et al., 2022). Bediding describes the extremely cold air at night during the dry season, often described as bone-chilling cold (Krissandi, 2023). Observations by the BMKG (2025) show a significant drop in air temperature in several areas of East Java, particularly around the cities of Probolinggo, Bromo, Batu, Pasuruan, and Malang. This phenomenon has not only physical impacts but also social and educational ones, as it elicits various responses and interpretations from the community. This is illustrated in Figure 1 below.

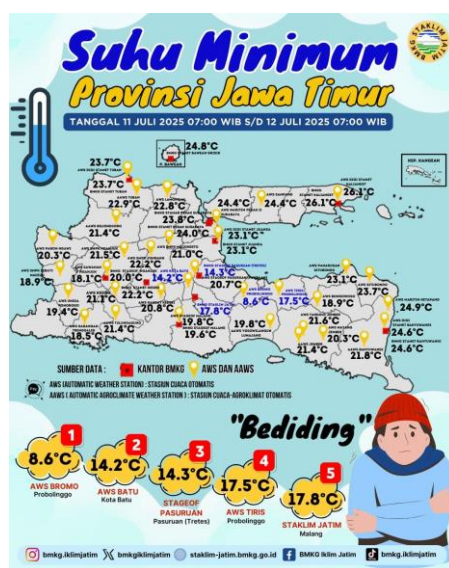


Figure 1. Infographic of Daily Minimum Temperatures in East Java over 24 Hours

Research studies related to temperature change generally focus on the impact of extreme temperatures. As in the Dieng highlands, research conducted by Ashari et al (2024) states that the Dieng Volcanic Complex (DVC) is often in the spotlight regarding frost because this phenomenon usually occurs at the peak of the dry season between late July and early August. Research by Wijaya et al (2024) also identified the impact of temperature changes on the Dieng plateau, which has temperatures ranging from 15-20°C during the day and 10°C at night, and can even reach 0°C in the morning during the dry season, which can cause frost or hoarfrost. Frost or hoarfrost is caused by very low air temperatures at night (Prasetyaningrum et al., 2025). Extreme temperatures during the dry season (July-August) are the main trigger (Firdaus, et al, 2023). However, these studies still focus on highland areas and have not discussed in depth how extreme temperature phenomena are also felt in lowland areas, especially in East Java.

Previous studies have focused more on the impact of extreme temperatures in highlands. To date, there have been no qualitative studies investigating the causes of extreme temperatures that result in frost or dew in the highlands and lowlands of East Java, even though both have similar topography and are influenced by the east monsoon. This extreme cold weather phenomenon occurs not only in the highlands of East Java but also in lowlands such as Surabaya, Sidoarjo, and Gresik. This phenomenon does not usually occur, so as students of the Faculty of Mathematics and Natural Sciences (FMIPA) who focus on science, it is necessary to understand the process and causes of this extreme cold weather phenomenon with adaptive and complex responses. There are still gaps in research regarding students' understanding of extreme cold weather phenomena and their relationship to climate literacy and awareness. Thus, this study aims to examine the response of FMIPA students to extreme cold weather phenomena in East Java as a form of awareness. This study

is expected to contribute to the development of local phenomenon-based learning that strengthens students' science literacy, ethnophysics, and environmental awareness.

## 2. Method

The research was conducted using a descriptive method with a qualitative approach. Descriptive research aims to describe an event systematically according to reality, consisting of one or more variables, and qualitative research is used to describe the responses of respondents (Sudarini et al., 2022). Data was collected through a questionnaire on the Google Forms platform containing 30 questions and readings related to the phenomenon of extreme cold air in East Java, followed by 5 essay questions. A total of 127 physics students from Surabaya University participated in this study. The flow of the qualitative descriptive research method is shown in Figure 2.



Figure 2. Research Method Flowchart

From Figure 2, after the next stage of data collection, the data will be sorted by removing respondents outside the physics department to make it easier to compile the data, thereby reducing the number of respondents by one. There are two types of data compilation, namely bar charts of questionnaire results and text or images of respondents' answers. The organised data will then be analysed in more depth in the form of percentages and descriptions of opinions to determine students' perceptions and responses to the extreme cold weather phenomenon that occurred, thereby reaching a conclusion.

## 3. Results and Discussion

This study examines the responses of physics students at Surabaya University to the cold weather phenomenon occurring in East Java. A total of 126 students responded to the questionnaire, which consisted of 30 Likert scale questions and 5 essay questions. Data analysis was conducted by creating a diagram of the average score for each questionnaire, as shown in Figure 3.

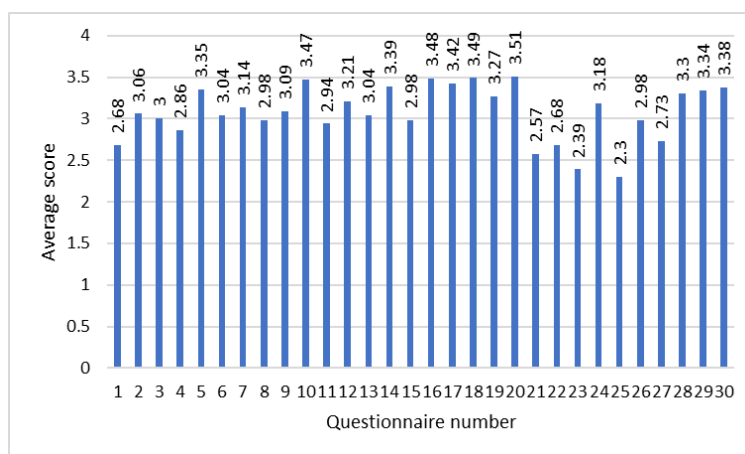


Figure 3. Average questionnaire diagram

Figure 3 shows the average questionnaire scores vertically and the questionnaire items horizontally. The average score category for disagree had 2 questionnaires with a score range of 1.75-2.49; the agree category had 18 questionnaires with a score range of 2.50-3.24; and the strongly agree category had 10 questionnaires with a score range of 3.25-4.00. In general, the lowest questionnaire score was number 25, a negative statement in the disagree category because extreme weather phenomena do not make students tire quickly, and the highest questionnaire score was number 18 in a positive statement supporting the government's efforts in climate change mitigation. Student responses to extreme cold weather phenomena can be described in the following 6 aspects:

### 3.1. Aspects of natural phenomena

In this aspect there are questionnaire numbers 1 to 5 with an overall average score of 2.99 with a strongly agree category contained in questionnaire statement 5, namely extreme cold weather is part of the symptoms of global climate change. This shows that students have knowledge of the symptoms of extreme weather phenomena due to global warming. Global warming is the impact of greenhouse gas emissions that are predicted to continue to increase by the World Meteorological Organization under the auspices of the IPCC climate assessment model (Dai, 2023). And questionnaire 1-4, students agreed in the statement *“awareness of temperature changes, the causes of phenomena such as monsoons, and news about phenomena”*. The agreement is in accordance with the research of Handoko et al (2023) because of the geographical location of Indonesia and Australia, this wind runs periodically which will affect the weather in various places. The monsoon is divided into two types, namely the Asian monsoon (west) and the Australian monsoon (southeast), but the Java region is influenced by the flow of the Australian monsoon (Apentido & Kritianto, 2024). Students' scientific understanding of this natural phenomenon forms the basis for reviewing ethnophysics aspects related to how communities interpret similar events.

### 3.2. Aspects of Ethnophysics

In the ethnophysics aspect contained in questionnaire number 6 to 10 has an overall average score of 3.14 with the category of agreeing in 4 numbers and strongly agreeing in 1 number, namely number 10. Number 10 discusses the implementation of physics learning that integrates local cultural knowledge in the explanation of natural phenomena. This shows that students have a positive response to the integration of local knowledge with physics learning. The application of strategies that are relevant and appropriate to students' experiences, such as integrating local and cultural contexts in physics learning is one way to increase learning motivation (Pardede et al., 2024; Sasmi et al., 2025). Local wisdom-based learning in physics can also significantly improve students' interest, motivation, conceptual understanding, and higher-order thinking skills (Deta, 2024). On the other hand, students understand that people generally have traditional knowledge about weather changes and traditional ways of predicting the weather. Students also expressed agreement related to folklore and local wisdom that explain natural phenomena such as wind and rain can be an important part of understanding the symptoms that exist around. Folklore can be used as an alternative in understanding concepts in learning because folklore has conceptual knowledge to support students' understanding (Karmadi & Suhartini, 2024). Students' understanding of the integration of local knowledge and science provides an overview of the extent of their scientific literacy in examining natural phenomena.

### 3.3. Aspects of science literacy

Questionnaire numbers 11 to 15 are included in the science literacy aspect with an overall average of 3.11 and there are two categories in this aspect, namely agree and strongly agree. The agree category is found in numbers 11-13 and 15 in the statement *“explanation of the causes of colder temperatures during the dry season, scientific explanations of phenomena, understanding the concept of air pressure, and finding scientific sources about related phenomena”* and questionnaire number 14 students strongly agree in the statement *“used to looking for scientific sources to understand phenomena”*. Based on the research of Jufri et al (2024), the cause of cold temperatures during the dry season is bedding which describes temperature fluctuations at the beginning of the dry season which becomes cold towards night until morning. Air pressure is related to the occurrence of extreme weather according to research by Widodo and Manaf (2021) showing extreme weather occurs due to air pressure reaching 1010.2 mb. In addition, the interaction between temperature and pressure is caused by the wind through meso-scale processes when the earth receives different heat, so that there are hot or cold parts in an area with high temperature can increase air and cause low pressure, while areas that have high pressure go to low pressure areas (Sioni et al., 2024). The importance of students' understanding in fostering environmental awareness to deal with climate change responsibly.

### 3.4. Aspects of environmental awareness

The aspect of environmental awareness that includes questionnaire numbers 16 to 20 obtained an average score of 3.43 and there is an agreed category, namely number 19, and 4 others or in numbers 16 - 18 and 20 show that respondents strongly agree with the statement. This indicates that students have a high level of awareness of the importance of protecting the environment, believe that human lifestyles affect climate balance, and support climate change mitigation efforts. In addition,

the sense of responsibility to preserve the environment is also very strong, although the interest in directly participating in environmental activities is still in the agree category. Overall, these results reflect the positive attitude and concern of students towards environmental issues and climate change. Concern for the environment can be fostered through more imaginative learning methods, and activities that motivate to take an active role in implementing environmentally friendly behavior (Tampubolon et al., 2024). This awareness plays a role in shaping students' perceptions and responses to the various impacts caused by extreme cold weather phenomena.

### 3.5. Aspects of the impact of the phenomenon

The phenomenon of extreme cold weather has an impact as seen from student responses with an average questionnaire score of 2.62 which has an overall agreed category for questionnaire numbers 21-25. The questionnaire in this aspect has several statements including “*cold air makes it uncomfortable to carry out activities, temperature changes affect learning concentration, cold weather reduces outdoor activities, and cold weather makes the body tired quickly*”. Extreme cold weather often makes students feel lazy to go to college because cold temperatures cause drowsiness. Air temperature and humidity conditions have an impact on the quality of learning, so when the temperature is too low, students tend to experience a decrease in focus (Kurnia et al., 2025). The impact felt by students due to extreme cold weather has prompted the need for more intensive climate education and communication in academic circles.

### 3.6. Aspects of Climate education and communication

The existence of the extreme cold weather phenomenon encourages students to talk about it in the academic and social environment as seen from the questionnaire response with an average score of 3.15 consisting of the categories of agree and strongly agree. Questionnaire numbers 26 and 27 students agreed in the statement “*discussion of the phenomenon with friends or lecturers and the response of surrounding people to extreme weather issues*”. The discussion about the phenomenon of extreme cold weather is very interesting because changes in air temperature are one of the most important aspects of research related to overall climate change. Air temperature is the main factor affecting climate conditions. This is logical, because temperature plays a role in determining human interactions in environmental and social economic aspects (Ananta et al., 2024). And the category of strongly agree is found in number 28-30 which states “*the importance of socializing knowledge about extreme weather, curiosity about phenomena, and this topic needs to be discussed in physics courses*”.

For the essay questionnaire in the form of news about the bediding phenomenon in East Java in 2025, students were asked to give their opinions or answers related to the phenomenon with 5 questions. The following questions and answers are presented in the image. Answer to essay question number 1 can be seen in Figure 4.

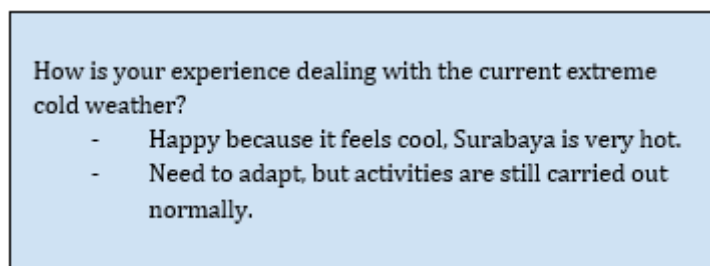


Figure 4. Answers to essay question number 1

Figure 4 shows two student answers to question number 1, which asked them to describe their personal experiences when the phenomenon occurred. When the phenomenon occurred, students needed to adapt because the area where they lived, especially Surabaya, had high temperatures or heat every day. The high temperatures in Surabaya are influenced by rapid development and urbanization. When experiencing weather changes such as cold air, students can still carry out outdoor activities with prior adaptation (Ervina, 2024). When the weather is hot, most students feel hot, especially when doing outdoor activities, but when the weather is cold, students feel cool doing activities anywhere. Answer to essay question number 2 can be seen in Figure 5.

In your opinion, does cold weather interfere with your daily activities?

- No, cold weather doesn't really interfere with my activities, as long as I wear warm clothes and keep myself fit and healthy.
- Yes, it interferes a little because I feel sleepy and lethargic, so I can't concentrate fully on my lectures.

**Figure 5. Answers to essay question number 2**

Figure 5 shows two different responses from respondents. These responses provide an overview of the overall response to the phenomenon of cold air and daily activities. The two responses shown are diverse. The first statement shows the ability to adapt and awareness in maintaining physical endurance in facing changes in environmental temperature. The second statement indicates that the cold air causes a slight disturbance, especially in the form of drowsiness and lethargy, which can affect concentration in receiving lecture material. This is because the learning environment affects learning concentration. The results of Tambunan et al (2020) study show that uncomfortable learning environments, such as rooms that are too hot or too cold, can reduce student's concentration and learning effectiveness. In line with the findings in Figure 6, which shows students responses regarding the impact of extreme cold weather on health, some respondents admitted to experiencing physical discomfort due to drastic temperature changes. Answer to essay question number 3 can be seen in Figure 6.

Have you ever experienced health problems due to cold weather (e.g., flu, cough, etc.)?

- No
- Yes, very often

**Figure 6. Answer to essay question number 3**

The impacts arising from extreme cold weather phenomena, such as health problems in Figure 6 received two responses from students: yes and no. A person can experience health problems when the weather changes because cold weather causes high humidity, which allows viruses to spread more quickly in humid air (Sarmin et al., 2020). In addition, cold weather weakens the immune system due to a lack of vitamin D and causes the body to need healthy activities such as exercise. When the weather is cold, people tend to drink less water, which causes dry throats. Answer to essay question number 4 can be seen in Figure 7.

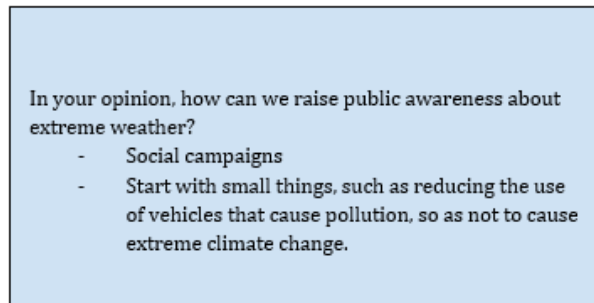
Have you ever discussed this phenomenon in class or with your lecturers? If so, what was their response?

- No
- Yes, I have discussed it in class and my lecturer explained that extreme temperature changes are related to global climate phenomena.

**Figure 7. Answers to essay question number 4**

Figure 7 shows two different responses. The first response is "no," indicating that some students have never discussed the phenomenon of extreme cold weather in an academic context. This shows that natural phenomena such as extreme temperature changes have not been fully integrated into

the classroom learning process. Thus, research on climate change skepticism within the university falls into the “low” category (Filho et al., 2019). The second response shows that some students have discussed the phenomenon of extreme cold weather in class with their lecturers, and that lecturers have explained that extreme temperature changes are related to global climate phenomena. Answer to essay question number 5 can be seen in Figure 8.



**Figure 8. Answer to essay question number 5**

Figure 8 shows the answers to the question of effective ways to raise public awareness of extreme cold weather phenomena through two answers, namely social campaigns and reducing vehicle use. Social campaigns can take the form of socialization of extreme weather mitigation to equip people with ways to anticipate before the phenomenon occurs and deal with extreme temperatures when it does occur. Campaigns are more effective when information is disseminated widely through social media. Small things such as reducing vehicle use, especially gas fuel, can produce greenhouse gas emissions. Gas emissions cause air pollution, global warming, and the greenhouse effect, which leads to extreme climate change (Kurnia & Sudarti, 2021). These efforts are concrete steps toward reducing the impact of climate change while fostering active community participation in environmental issues.

This research aims to increase student awareness of climate issues and encourage the development of relevant learning models by integrating scientific knowledge and local wisdom. In this way, the results of this research can strengthen the campus's efforts to promote understanding of climate concepts and critical attitudes towards the surrounding environment.

#### **4. Conclusion**

Based on the results of the analysis obtained in the study, it can be concluded that the average response of students to the phenomenon of extreme cold weather in East Java consists of six aspects, including natural phenomena, ethnophysics, science literacy, environmental awareness, the impact of the phenomenon, and climate education and communication. The questionnaire as a whole shows two categories, namely agree and strongly agree. Both categories are found in positive statements, especially in the aspect of environmental awareness. Meanwhile, there is a low trend in negative statements with the disagree category, which shows that students do not experience obstacles during cold weather. Further studies related to extreme cold weather are more focused on student adaptation strategies to temperature changes with conceptual application in the world of science.

#### **Author Contributions**

Ajeng Wahyu Setiani: Conceptualization, Methodology, Formal Analysis, and Writing -Original Draft. Fitria Rahmawati: Conceptualization, Formal Analysis, Resources, and Writing -Original Draft. Marisa Putri Utari: Formal Analysis, Resources, Visualization, and Data Curation. Heny Aryani: Formal Analysis, Resources, Visualization, and Data Curation. Wirawan Fadly: Validation, Supervision, dan Project Administration. Khalid Issa Khalifa Alemgadmi: Validation, Supervision, dan Project Administration. Utama Alan Deta: Validation, Supervision, dan Project Administration.

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