The ocean climate phenomenon: the challenges of earth physics lectures in Indonesia

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Abstract. This study aims was to describe ocean climate phenomena that occurring in Indonesia and earth physics lectures profile to answer crisis and challenge of ocean climate in Indonesia. This research was conducted in two university in Bima Town west Nusa Tenggara. The method used was descriptive analysis based on syllabus, test result and interview to 25 students of pre-service teacher about ocean climate through field study. The results shown that students have a low understanding of the impact of the ocean climate and it was found some issues related to the concept of ocean climate. Another fact of the syllabus used was the material about ocean climate in earth physics lectures was not deeply taught, dominated by theoretical studies and less focused on preparing students for ocean climate phenomena. As a recommendation, it is necessary to restructure the earth physics education of the ocean climate in order students be able to improve their participation to solve the problem of ocean climate crisis in the society.

1. Introduction
The Indonesian maritime continent (BMI) is a region vulnerable to the effects of climate change. Because the territory of Indonesia lies the tropics between the continent of Asia and Australia, and the ocean Pacific and Indian [1]. Such a layout the maritime continent is one of the world's climate control centers. As a result climate change events that occur in the BMI region will affect the global climate conditions. In the reverse function, changes that occur globally will also have an effect on BMI [2] [3].

In relation to its position, the territory of Indonesia is influenced by Hadley's north-south (meridional) circulation causing monsoons to reverse twice a year. This monsoon circulation led to a monsoon rains occurring during the Asian monsoon period (October - April) and the dry season in the Australian monsoon period (May - September) [4]. In addition to the monsoon BMI is also influenced by the circulation system of the east-west atmosphere (zonal) Walker causes two phenomena namely 1. El Niño-Southern Oscillation (ENSO), In general, experts divide warm ENSO (El Niño) and cold ENSO (La Niña) ENSO is the warming of sea surface temperatures in the central and eastern Pacific Ocean [5] [6]. 2. Indian Ocean Dipole Mode (IOD), defined as the difference between Sea Surface Temperature (SST) anomalies between the east coast of Africa and the west coast of Sumatra from the Indian Ocean [7].

The El Niño and IOD + events resulted in low rainfall and La Niña and IOD - causing high rainfall in some parts of Indonesia [8] causing hydrological disasters such as floods, landslides and droughts that impacted the livelihoods of Indonesians including the agricultural sector, industry, economy, fish
catch and others. Reduced crop yields in 2015 and first cycle harvest delays due to El Niño have resulted in poor households adopting negative coping strategies such as loans, asset sales and so on being less able to withstand future shocks. An estimated 3 million Indonesians live below the poverty line in drought-affected areas, 1.2 million of which rely on rainfall for food production and livelihoods. Meanwhile, the market price of rice was at a record high: in February 2016 about 9% higher than usual, and is expected to continue to increase gradually until now [9].

The livelihoods of the majority of Indonesian people as farmers and fishermen and living in coastal areas make Indonesian people affected by the phenomena of ocean climate each year. Events that occur each year are in desperate need of an understanding for long-term improvement for the community against disaster risk due to the ocean climate [10]. Climate problem solving is a key factor in understanding the occurrence of disasters caused by the ocean climate. The lack of community understanding and impacts of ocean climate are key to addressing the ocean climate crisis. This condition is strongly influenced by the role of tertiary physics lectures that are not optimal in building public knowledge.

Some developed countries problem solving explicitly into learning objectives and embodied in the earth physics curriculum, as well as in the curriculum that is currently being implemented in Indonesia namely Kurikulum Tingkat Satuan Pendidikan (KTSP). The underlying reason for this is that problem solving can develop students' cognitive in general, encourage creativity, develop creative thinking skills and can motivate students to learn [11] [12]. So the ability to solve the problem is the main goal in the Earth physics lecture. It is expected that prospective physics teacher students in Indonesia who will become agents of change can play a role in building public knowledge through solving ocean climate problems.

This research will describe the profile of Earth physics courses through teacher education institutions. An important question in this research is how to prepare physics teacher candidate students on ocean climate impact issues. The purpose of this research is to explain the phenomena of ocean climate and to criticize the education of earth physics in building a conscious and responsive attitude to the ocean climate. This analysis includes: (i) student misconceptions and (ii) student decisions after hearing of volcanic eruptions. To collect data is to conduct tests and in-depth interviews with some students.

2. Method
The field study was conducted on December 5th, 2017 at the Department of Physics in a university in Bima Town West Nusa Tenggara, with 25 respondents, subjects consisting of 7 male students and 18 female students. All students are 17-22 years old. The data obtained were presented descriptively. Some of the techniques used in data collection were: (1) syllabus analysis of Earth physics at two universities in NTB province (2) test conducted on students who have taken the tertiary physics lecture (3) questions aimed to explore the students understanding about the concept ocean climate.

3. Result and discussion
3.1. Analysis of syllabus of earth physics course
Based on the results of curriculum analysis of Earth physics course in table 1 above that neither the first university nor the second university does not include materials related to the climate. Though the material about the climate, especially about the ocean climate is needed by the people of Indonesia, especially people whose livelihood depends on the climate such as farmers and fishermen [8]. While the curriculum in the Earth physics courses in some developed countries such as America, Britain, Japan and China include materials related to climate and become the main learning subject of physics and earth science subjects [12] [13] [14].
Table 1. The syllabus of earth physics courses at two universities.

| University | Content syllabus |
|------------|------------------|
| University 1st | Topics and sub-topics: Earth shape, size and motion, rocks and minerals, tectonic plates, volcanism, earthquakes, hydrosphere, exploration methods, atmospheres, solar systems, Earth-moon systems, stars, galaxies, and astrophysics. Using approaches of lectures, presentations and discussions, media power point. |
| University 2nd | Topics and sub-topics: the concept of the equation of motion of two objects, Newton's law, gravity and form of Earth, the motion and position of celestial bodies the pseudo and annual motions of the Sun, moon phases, lunar eclipses and solar eclipses, motion and positions of celestial bodies. Using discovery learning and simulation approaches, mix and match methods, lectures and simulations. |

3.2. Analysis of a test of knowledge understanding of ocean climate

There are six basic questions to measure students’ initial knowledge about the ocean climate, including: (1) Does each island in the Indonesian maritime continent have the same climate (2) Mentions the factors that affect the climate change (3) What is ENSO and IOD (4) What is the influence of the monsoon on the Indonesian maritime continent (5) How to predict the weather and climate (6) Mention the disasters caused by the interaction of the ocean’s atmosphere. The results of tests conducted on 25 prospective teachers to measure basic concepts about ocean climate can be seen in figure 1.

![Student score distribution](image)

**Figure 1. Students score distribution.**

Based on the analysis of data that on the question number 1, problem there are 8% of students who did not answer the problem, 72% of students who the answer was false, 12% of students who the answer was enough good, and 8% of students who the answer was good. The number of students who answered falsely caused by the understanding of students about the climate is still lacking. This can be seen from the reasons described in maintaining the answer is still false. Most students do not have a thorough knowledge of the causes of ocean climate change [15].

In question number 2, as many as 84% of students who answer is false and 16% which the answer was enough good. The number of students who answered incorrectly caused by the students did not
correctly interpret the question so that the answers and reasons given false. This can be seen from the answers of students who tend to answer the impact of climate change was not the factors that affect the occurrence of climate change.

In question number 3, as many as 20% of students did not answer the question, 76% answered falsely and only 4% of the students had good answers. The existence of a number of students who did not answer the question number 3 and many who answered false was caused by students are not familiar with ENSO and IOD so that in explaining the notion of the term is still false. It was because the lecturer who has not taught the students about ENSO and IOD materials. While on the question number 4, 100% of students answered false. This is due to a lack of student understanding of the monsoon concepts so that the answers are given out of the context of questions.

Addition, in the question number 5 as many as 4% of students who do not answer questions, 84% who answered false and 12% of students who the answer was enough good. The number of people who answered incorrectly because most students attribute their answers to the hydrological cycle, actually it is supposed to predict weather and climate can be done using the data trends already available on the NOAA (National Oceanic and Atmospheric Administration) satellite web [16]. Unlike the problem number 6 where as many as 92% of students who answered the question quite well. This is caused by almost all students answer the problem by describing the phenomena that often occur in their life.

The lack of understanding of the students regarding the ocean climate was caused by the syllabus of the earth physics courses did not include material about the climate. It described that the Earth physics courses in teacher education institutions did not reflect international curriculum standards and were contradictory to Earth physics courses in some countries such as America, Britain, Japan and China that include materials on climate [17] [18]. It causes the ability of students in answering questions that are related to ocean climate was very low as shown in figure 2. Therefore, it is necessary to restructure the Earth physics curriculum by including material about the climate, especially the ocean climate because it is needed to solve the problems of ocean climate in the society [19].

![Figure 2. Average score of students.](image)

Based on figure 2, the general understanding of students about the oceanic climate is still very low. This is indicated by the problem of number 1 to number 5 the average score obtained by students below the score 2. While for question number 6 the average score of students is good, but does not represent the overall material of ocean climate. And actually this is a natural thing because the question number 6 about the phenomena that is popular in daily life.

4. Conclusion

Based on the discussion on the issues related to the earth physics Earth subject of ocean climate to physics teacher candidates in one university in NTB province can be summarized as follows: physics teacher candidate students have low understanding about ocean climate, students have low knowledge
to solving problems related to ocean climate, and studying ocean climate in Earth physics lecture still limited information.

The Earth physics courses in teacher education institutions do not reflect international curriculum standards, in stark contrast to the Earth physics curriculum in some developed countries. This is the cause of the mastery of the concept of ocean climate is relatively low. The student's expertise in knowing the impact of climate phenomena is relatively good but not yet associated with the ocean climate problem-solving process. My suggestion to solve this problem is the need to restructure the physical curriculum of earth's ocean materials to be in line with the needs of the people.

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This research will be useful for the readers

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