

## **MAPPING AND ZONING AREA LINOW LAKE FOR DEVELOPMENT ACTIVITIES STUDENTS STUDY FIELD OF PHYSICS**

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### **Abstract**

This study is an early stage of development research Linow lake area utilization - Tomohon as a natural laboratory for the Department of Physics, Manado State University. Linow Lake area is a geothermal area. Linow Lake is a hot water lake with a high sulfur content. Lake ecosystem is very rich with learning physics. In the area of Lake Linow there is a power plant with multiple wells so that the region can become the object of study students to conduct research and observation of physical phenomena that vary. The condition of geology, geophysics, geochemistry, hydrology, vegetation becomes the object of study of interest to students of Physical Science in understanding the manifestation Geothermal and geothermal potential, as well as the measurement of the spatial variation of the magnitudes of physical and chemical. Lake Linow which is rich in physical phenomena, as well as the existing power plant systems in the region, also became the object of study of interest to students Physics Education study program in understanding the physical properties of the surrounding natural for observation and measurement activities. Students Physics Education requires experience designing learning materials sourced from the surrounding environment that can be developed by utilizing the Linow lake region. Research activities include: (1) production of digital maps geothermal, (2) spatial zoning Shareable thermal energy, (3) the results of field inspections zoning. Basic data on the results of the research will be used for the design of field activities for students majoring in physics Unima, Utilization region Linow lake as a natural laboratory for students of the Department of Physics is possible because within the campus Unima of this region is only 10 km which can be reached by car in about 10-15 minute. Results are Linow lake area zoning map based on spatial variation of thermal energy.

**Keywords:** Linow Lake, a natural laboratory, geothermal, authentic learning

## Introduction

American Association of Physics Teachers in writing: Goals of the Introductory Physics Laboratory suggests that most students who study the basic physics do not have sufficient real experience of an everyday phenomenon to understand what was observed and construct theoretical physics. The process of observation of phenomena, analyze data, develop models of qualitative verbal and mathematical models to explain the results of observations enable students to connect concrete experiences with scientific theories.

Natural laboratory has an important role for students of physics to understand the physical phenomena of physics variables and variations in spatial and temporal changes through direct observation, measurement etc. Natural laboratory in the student confront the real natural phenomena (real phenomena). Observations and measurements in the field not only shows the relationship between the physical variables but also the influence of environmental conditions that can not be controlled as practical in the laboratory. Observation and measurement activities in the field can build the knowledge and skills to observe physical phenomena are strongly influenced by environmental conditions and changes. Natural laboratory which can provide a wealth of natural phenomena as learning material for students or students are not easily found.

Region LinowTomohon lake region as an area in which there is geothermal power plant Lahendong, serves a variety of physical phenomena that can be the object of study related to the concepts in the field of mechanics, thermodynamics, electricity. Variations of physical phenomena in the lake area: Linow very rich field for the development of various activities such as observation, measurement, experimentation, research, lab-based research etc. Linow lake area utilization for field activities for the students of Department of Physics, Manado State University (Unima) will provide reinforcement to the material obtained in the course of theory and practical work in the laboratory. Field activities serving the real phenomenon that is sometimes difficult to control as in the laboratory. Through fieldwork, students can study the causal relationship between factors that influence or control of physical phenomena. Mastery of students to the relationship between the phenomenon and the ability to describe the relationship with the concept of context will provide reinforcement and mastery of concepts of physics as a whole. For students Physical Science Concentration Geothermal, field activities to observe the phenomenon of geothermal given at the beginning of the semester will motivate and clarify the study orientation, providing experiences and impressions that could encourage the activity and productivity lectures. For students of Physical Education study program, field activities observing natural phenomena, identifies the relationship with the concept of context, would motivate him to further study the phenomenon as a source or learning materials. The fieldwork will be an experience to prepare materials and learning activities in natural surroundings. Some experts among others Higgins (2002), Slingsby (2006), Popov (2008), and Stohlmann et al. (2012), suggests that activities in the field of learning fun and motivate students, improve learning activity, improving scientific communication etc.

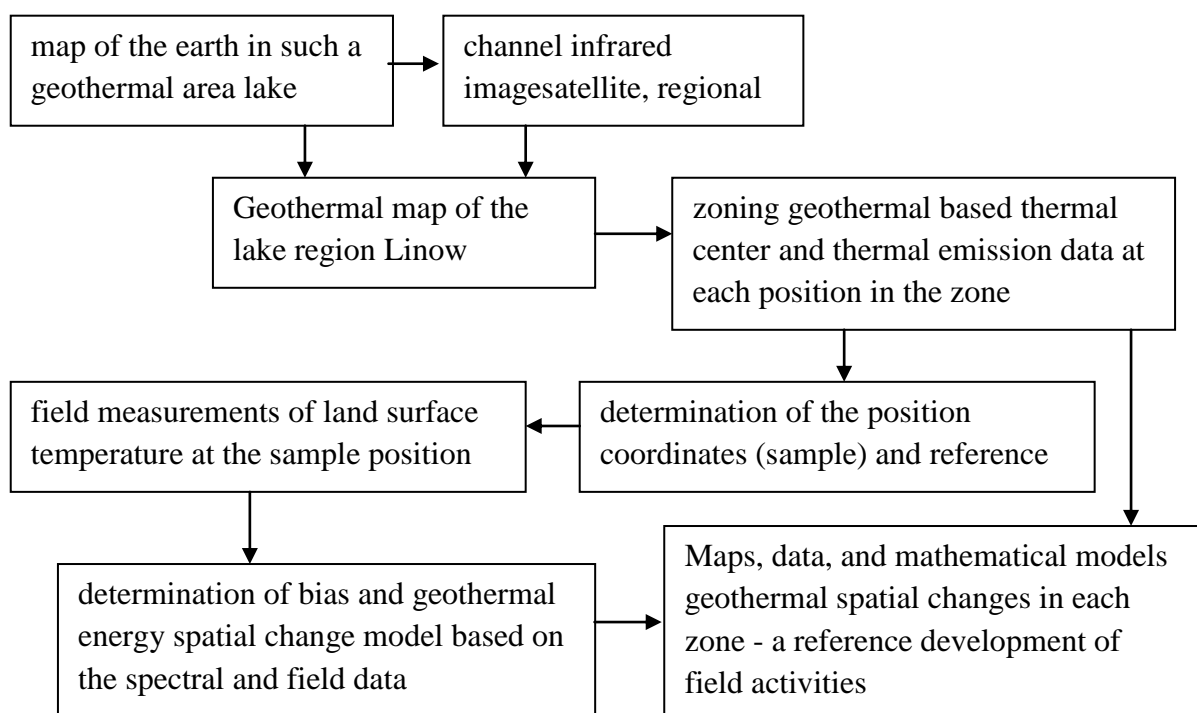
Field activities can be highly variable, due to the wide variety of phenomena, environmental conditions, as well as students' needs and strategy. Mapping and zoning of the lake Linow by Shareable spatial thermal energy recorded satellite imagery, will be the basis for determining the location of observation, measurement, thermal energy research related to the various components of the ecosystem. Shareable spatial mapping of thermal energy is made possible by the availability of Citra satellite recording channel infra-red. Shareable spatial geothermal indicated by the spectral pixel, can be used to determine the temperature of

the land surface, so it can be used as the basis for zoning and field measurements. Results zoning and geothermal basic data on some positions may be the basis for field activities

## Research Methods

### Design and Research Stage

This study is basically a research and development to produce data on Shareable geothermal Linow lake region. Data generated from the map for each zone and the point of observation (sample) validated by measurement data in the field, to determine the bias and the pattern of spectral values comparison with field data. Scope and stages of research are presented in Figure 1.



**Figure-1. Scope and stages of research**

### Indicators research targets

The first year results indicators

1. Generated zoning map the physical condition of the lake region Linow. The zoning map covers the whole catchment lake Linow.
2. The resulting data and research that can pursue advanced research and development activities in the field of research half of the zone. Material research include: the potential of geothermal, geophysical studies, geochemistry geology, hydrology and vegetation as a reference design of field activities Physical Science Concentration Geothermal. Outcomes research is also in the form of variable data and physical description of each zone (spatial variations, changes, factors affecting the physical condition) as a reference preparation of field activities for students Physics Education study program.

## Analysis and Presentation of Data

Value spectral pixel of the image of the visible channel is determined based on the legend (spectral values). The data of each pixel is expressed by pixel coordinates and spectral values. The field data obtained through direct measurements in the field of land surface temperature, using a thermometer, soil and water. The position measurements in the field according to the sample positions (coordinate) is determined from satellite imagery. The position measurements in the field is controlled using GPS. Shareable mathematical model of spatial and spectral values of field measurements obtained using a self-made software. Data presented in the form of data based on the coordinates and materiks matematiks function modeling results.

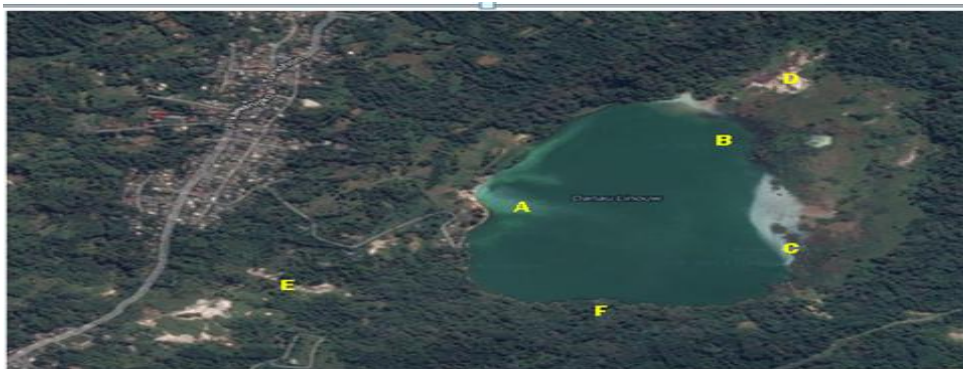
## Results and Discussion

### Map Area Geothermal Lake Linow and Results of Identification Manifestations of Geothermal.

Region covers an area of geothermal lake Linow , surrounding land consists of open land / shrub, forests, plantations, and settlement. Within this area there are various manifestations, among others:

- a. Hot tubs, in this case is Lake Linow. In Linowlake there are several large-scale hot springs and numerous small hot springs located on the edge of the lake. Supply of water in the lake apart from the hot springs, also through the river coming from the north.
- b. Land steamy, mostly found in the area around the lake to the residential area (Lahendong village, which lies east of the lake Linow. Ecological conditions around manifestations of soil steaming (steaming ground), varies. Some are in the form of land surface chalk, there are overgrown thicket and there wooded.
- c. Column mud, found in north lakeLinow.

Linow lake geothermal area maps presented in Figure 2. Linawlake is famous lake changes color, from noon until late pagim. this is related to the elevation of the sun associated with the reflection of radiation by the lake water containing sulfur and other chemicals that vary (spatial) is quite high. The identification and measurement in the field, shows the six characteristics of the geothermal manifestations and spatial changes that can be developed for field activities. The results of the identification of the location of field activities (observation measurement, research) at the lakeLinow presented in Table-1.



**Figure 2. Map of the Zoning lake Linow**

Observation and identification of geothermal manifestations in Linouw lake is steaming ground (soil steaming), output in the form of solfatara steam and steam vents, hot springs (hot springs) and mud pools (the mud pools). Geothermal manifestations in the area around the lake Linouw have a high temperature; mud pools 72.3 - 92.1 ° C; hot springs 100°C (boiling); steam output 94.5 - 100°C. The pH value for the second manifestation of hot springs and mud pools manifestation pH ranges 3 - 4. The color of the water to the hot springs was brown while mud pools manifestation gray, except for mudpool-1 brown. Size steaming ground 1567.46 m<sup>2</sup> at the first location and second location 16,753.42 m<sup>2</sup>. Most of the land in the form of clay mineral alteration even if there are deposits of sulfur formed steaming ground pretty well in the first location. High temperature (68.3°C) steaming ground area first location is located just near the emergence of geothermal manifestations and sulfur, while in the lower part has been overgrown by plants. The total value of the lost natural hot geothermal manifestations Linouw area around the lake is 9409 MW, making a geothermal system is a low-temperature region.

Some of the data of physics and chemistry measurement results at some position / location study are presented in Table 1. Data in Table 1. shows the results of the initial measurement of temperature and pH in some locations conducted over three days identification and zoning field activities. Basic data on field conditions as well as the observation of the diversity of environmental conditions around the manifestation demonstrates the superiority of a complete Linow lake to study the nature of geothermal manifestations, the spatial distribution (vertical and horizontal) and its influence on the environment (biota, vegetation, etc.) complete Linow lake to study the nature of geothermal manifestations, the spatial distribution (vertical and horizontal) and its influence on the environment (biota, vegetation, etc.)

**Table 1. Data from the measurement of physical variables temperature (surface and aerial manifestations: 2 m above the surface), as well as the pH.**

Type Manifestation Hot Earth	Coordinate (UTM)		Elevation (mdpl)	Temperature (°C)		Diameter (cm)	Noise / Quiet	pH	Location/ zone
	X	Y		Manifestation	water				
Hot spring	0703508	0140998	789	100	25.3	250	-	2	D
Mudpool-1	0703358	0140997	787	84.4	25.3	54	-	3-4	D
Mudpool-2	0703358	0140997	787	92.1	25.3	40	-	3-4	E
Mudpool-3	0703467	0141007	788	72.3	25.3	124	-	3	F
Solfatara-1	0702731	0140353	821	100	32.2	9	noise	-	D

Solfatara-2	07027 25	01403 44	815	100	32.2	42	nois e	-	E
Steam vent	07027 30	01403 56	821	100	32.2	64	nois e	-	E

### Geothermal Lake Linow Zoning Area Activity for the Practice Field.

The results of the identification of regional geothermal manifestations of geothermal lake Linow, producing six zones that can be used as the location of field research practicum and student of physics, geothermal concentration. Each zone has a special characteristic (Table 2.). For the common characteristics and special each zone can be developed variation of field activities (Table 2.), Field activities in each location, allowing for implementation of the surveillance activities common properties geothermal and interaction with the environment and measurement variable physics, chemistry and biology, analysis of interactions between geothermal manifestations with the environment, variations in spatial and temporal changes in energy, the relationship between the spatial variations in water temperature with water chemical properties and biota and poultry. Activity measurements can be directed into a thesis and thesis research materials that become feedback for the design of field activities. Table 2. The results of the identification of alternative manifestations and field activities.

**Table-2. The results of the identification of alternative manifestations and field activities**

No	zone	Manifestations and characteristics of the location
(1)	(2)	(3)
1	A. The western part of the lake	Manifestations hot, with a high enough temperature, varying between 50 ° C - 70 ° C, with an area of: a radius of about 20 m
2	B. The northern part of the lake	Water with a low temperature, 22 ° C - 28 ° C, fluctuating to situations Because irradiation truthfulness of the sun, there are biota and habitat men so poultry
3	C. The eastern part of the lake	Manifestations of hot water, small-scale, on the edge of a shallow lake, with temperatures varying between 30 ° C - 70 ° C, with an area of: a radius of about 1 m
4	D. Steaming ground in the north of the lake	Manifestations steaming ground with a radius of 5 m center manifestations, is a limestone land without land cover
5	E. The land south	Manifestations steaming ground with spatial

	of the lake	variation of high soil temperatures characterized by grasses and small trees
6	F. land south of the lake overgrown with trees	Land overgrown types of trees with a micro-climate that is influenced by the thermal manifestations of the lake and surrounding land

### Manifestation Geothermal Picture Zone A Until F



zone A



zone B



zone C



zone D



zone E



zone F

## Conclusion

The results have been obtained in this study can be concluded that:

1. Region covers an area of geothermal lake Linow Linow lake, surrounding land consists of open land / shrub, forests, plantations
2. geothermal manifestations in the area of the lake Linow of hot tubs, Land steamy and hot mud pool
3. The identification of regional geothermal manifestations of geothermal lake Linow, producing six zones that can be used as the location of field research practicum and student of physics, geothermal concentration.

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