

Meteorological measurements in the Arctic

– extended package

Guide with lesson plans

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Meteorological measurements in the Arctic – extended package

Guide with lesson plans

The „Meteorological measurements in the Arctic – extended package” is designed for students 16-19 years old, so for those attending high schools and other upper secondary education. Within the scope of the subject Geography in this educational stage the package refers to the following content of the core curriculum:

Student:

- interprets meteorological phenomena from charts, figures, tables, schemes, and models;
- formulates cause-effect, functional and temporal relationships between selected elements of the natural and socio-economic environment, and verifies them using thematic maps;
- uses information and communication technologies to acquire, store, process, and present geographic information;
- explains the mechanism of air circulation in the subtropics and the higher latitudes, and describes the course of weather processes (movement of air masses, atmospheric fronts and accompanying phenomena);
- indicates the reasons for uneven distribution of air temperature and precipitation;
- explains, using examples, the genesis of winds (constant, periodic, and local) and indicates their importance for weather and economy (agriculture, communication);
- characterizes climatic zones and types of climate on Earth, and justifies their ranges;
- recognizes the climatic zone and climate type based on the annual air temperature and precipitation totals;
- prepares short-term weather forecasts based on synoptic maps and meteorological observations and measurements;
- explains, using examples, the causes and effects of global climate change on the planet;
- characterizes the climate of own country on the basis of numerical data and climatic maps and assesses the economic consequences of variation in length of growing season.

Title	Meteorological measurements in the Arctic – extended package
Author	Dr. Tomasz Wawrzyniak Department of Polar and Marine Research Institute of Geophysics Polish Academy of Sciences
Students' age	16-19 years
Educational stage	Upper secondary, high school
Subject	Geography
Overview of package content	
Meteorology is the interdisciplinary scientific study of the atmosphere and its phenomena. Knowledge on the weather (state of the atmosphere at a particular time) and the ability to predict future weather conditions (weather forecasting) is an important part of a person's life. It is not limited to helping with the selection of a daily wardrobe, but it is also of great importance in the economy of the country, particularly in agriculture and transport. There is a network of meteorological observatories around the world, where observations and atmospheric measurements are made. The data and statistics collected and the knowledge of the laws governing atmospheric processes are used to determine the most likely future weather conditions - weather forecasts. The proposed work package aims to familiarize students with meteorological measurements at meteorological site of Polish Polar Station Hornsund on Spitsbergen and to compare them to the current weather in the place of residence. Suggested meteorological databases are available online. The "Meteorological measurements in the Arctic" package is designed to educate students about the use of databases. It refers to the meteorological data that pupils use throughout school education - from simple observations in primary school to advanced statistical data analysis in the fourth educational stage. Meteorological data are also known to students in everyday life, so dealing with worksheets should not cause them much difficulties.	
Expected educational goals	
<u>The student knows:</u> • Definitions of: weather, climate; • what devices are used to measure particular meteorological parameters; • what is the weather forecast and where to find it?	

The student understands:

- what are the differences of weather conditions in different parts of the world;
- impact of weather / climate on life and human activities

The student is able to:

- identify, interpret, and summarize meteorological data presented on selected websites;
- calculate basic meteorological parameters (e.g. air temperature amplitude; daily, monthly, annual average);
- draw basic graphs (e.g. air temperature, precipitation);
- assess changes in meteorological parameters compared to the previous month / year.

Content of the package

1. "Meteorological measurements in the Arctic" – presentation - extended package;
2. ["Meteorological measurements in the Arctic" – short movie based on the presentation – extended package](#);
3. „Meteorological measurements in the Arctic” - worksheet;
4. „Climatic differences” – worksheet;
5. „Monthly Bulletins” – worksheet;
6. „Annual Bulletins” – worksheet;
7. „Cloudiness” – worksheet;
8. "Meteorological measurements in the Arctic" – Guide with lesson plans.

Additional materials

- <http://hornsund.igf.edu.pl/weather> - Meteorological Bulletins
- http://www.yr.no/place/Norway/Svalbard/Hornsund/hour_by_hour.html - weather forecast for Hornsund Station in the Arctic
- <http://meteo.us.edu.pl/arctowski> - present weather conditions at Arctowski Station in Antarctica - in case if there is no connection to automatic station check:
https://www.yr.no/place/Antarctica/Other/Henryk_Arctowski_Polish_Antarctic_Station/
- <https://www.windytv.com/> - present weather conditions and weather forecast

Lesson 1.

Topic: Meteorological measurements in the Arctic

Lesson plan for "Meteorological measurements in the Arctic – extended package"

In order to conduct the lesson, it will be necessary to provide:

- a multimedia projector, computer, loudspeakers;
- worksheets printed out for each student „Meteorological measurements in the Arctic” (no. 3) and „Climatic differences” (no. 4);
- geographical atlas;

Approximately 1 week before the lesson, the teacher gives the students (selected) additional work to do. The work consists of gathering information from various sources about the Polish Polar Stations (located both in the Arctic and Antarctica):

- **The Stanisław Siedlecki Polish Polar Station in Hornsund** on Spitsbergen is located in the Arctic, far behind the Arctic Circle. The station is managed by the Institute of Geophysics Polish Academy of Sciences in Warsaw. It is a year-round operating station, where continuous measurements have been conducted since 1978.
- **Henryk Arctowski Polish Antarctic Station** is located in the South Shetland Islands archipelago on the King George Island. It is managed by the Institute of Biochemistry and Biophysics of the Polish Academy of Sciences in Warsaw. An important information for students is that the station is located in the Antarctic, but outside of Antarctica (continent).
- **Antoni Bolesław Dobrowolski Polar Station** is an inactive Polish polar research station located in the Antarctica continent. The station belongs to Poland since 1959 (formerly belonged to the Soviet Union). It is planned to install maintenance-free measuring scientific instruments there.

Expected educational goals of the lesson:

Same as of the educational package "Meteorological measurements in the Arctic - extended package"

Suggested forms of work:

- offering: a lecture, a talk;
- displaying: a presentation, a movie;
- activating: a discussion, a brainstorm;
- practical: exercises based on worksheets.

Lesson procedure:

1. Start of the lesson, organizational activities, attendance list check.
2. Introduction to the topic. The teacher writes down the coordinates of the points on the blackboard. Students are asked to find points on the map in the geographical atlas. They then try to guess what objects are located in designated locations:
 - **77°00'N 15°33'E** (The Stanisław Siedlecki Polish Polar Station in Hornsund)
 - **62°10'S 58°28'W** (Henryk Arctowski Polish Antarctic Station)
 - **66°16'S 100°45'E** (Antoni Bolesław Dobrowolski Polar Station)

Selected students present information about each station. Then the teacher asks questions to see if the students are able to differentiate the research stations.

- At which Polish research stations annual observations have been conducted?
Answer: The Stanisław Siedlecki Polish Polar Station in Hornsund and Henryk Arctowski Polish Antarctic Station
 - Which stations are located in the Arctic and which in Antarctic?
Answer: Hornsund station is an Arctic station, the other two are Antarctic.
 - It is often a mistake to say that the station Arctowski is located in Antarctica. How should you determine the location of this station?
Answer: Arctowski Station is located in the Antarctic. It is located on the King George Island not on the continent of Antarctica.
3. Students watch the movie "Meteorological measurements in the Arctic - extended package" (no. 2). During the movie the teacher should check if the content presented is clear and legible to students, and should be aware of any difficulties and if necessary should provide additional explanations.
 4. After watching the movie, the teacher gives students a worksheet "Meteorological measurements in the Arctic" (no. 3). The students themselves fill in the tasks. During work, the teacher may display a presentation "Meteorological Measurements in the Arctic" (no. 1) so that students can return to the content they have not been able to remember.
 5. Before the end of the lesson, students work on the "Climate Difference" worksheet (no. 4). Their task is to read the current values of air temperature at polar stations: Arctic and Antarctic and in their place of residence. Based on the collected data and the previously acquired knowledge, students draw conclusions about the differences.

Lesson 2.

Topic: How to interpret meteorological data?

Lesson plan for "Meteorological measurements in the Arctic – extended package"

In the package „Meteorological measurements in the Arctic” students get the access to professional meteorological databases - bulletins prepared by employees of the Institute of Geophysics Polish Academy of Sciences from meteorological measurements and observations conducted at the Polish Polar Station Hornsund on Spitsbergen.

There are exercises included to this lesson. From previous lesson "Meteorological measurements in the Arctic" students have the theoretical background on the location of the Hornsund station. This lesson is supposed to be conducted in the school computer lab, where students have access to database, and will be able to download the necessary bulletins, and complete exercises on their own or with little teacher guidance. In case of lack of access to computers / the Internet, the lesson can be conducted on the basis of the bulletins previously selected by the teacher, which should be printed in advance and distributed among students.

In order to conduct the lesson, it will be necessary to provide:

- computer with internet access for each student (or group of students); or else worksheets printed out for each student „Meteorological bulletin”;
- worksheet "Monthly bulletins" (no. 5) printed for each student.

Expected educational goals of the lesson:

Same as of the educational package "Meteorological measurements in the Arctic - extended package"

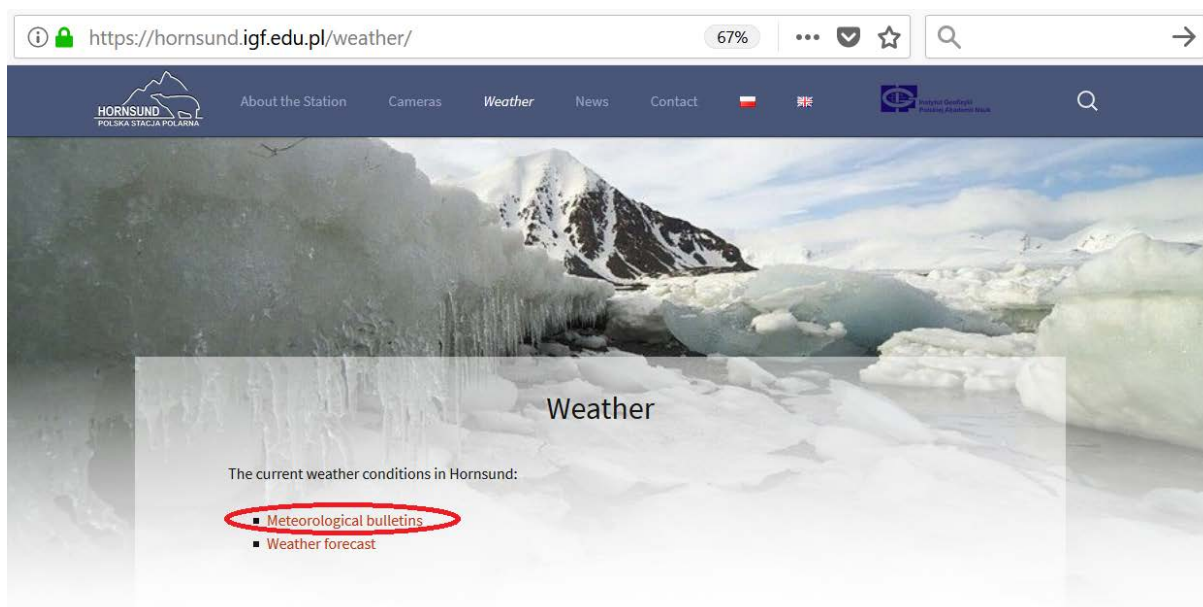
Suggested forms of work:

- practical: exercises based on worksheets.

Lesson procedure:

1. Start of the lesson, organizational activities, attendance list check.
2. Repetition of the most important information from previous lesson, e.g.:
 - Weather definition;
 - What is meteorology and synoptic meteorology?
 - What measurements are conducted using: thermometer, hygrometer, anemometer, barometer, heliograph?
 - Where the Polish Polar Station Hornsund is located?

3. Time to complete prepared tasks. The teacher distributes the worksheet „Monthly bulletins” (no. 5). Students go to the website: <https://hornsund.igf.edu.pl/weather/>



Then they open "Meteorological Bulletins" tab. The bulletins web page appears.

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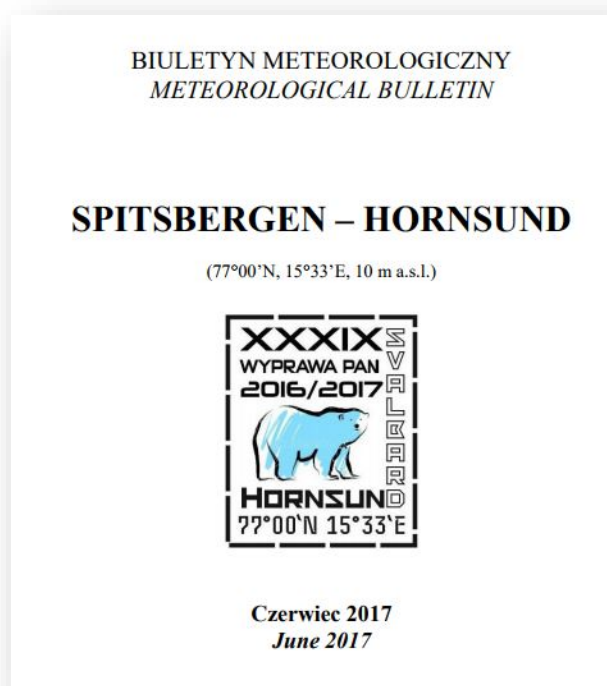
<u>Name</u>	<u>Last modified</u>	<u>Size</u>	<u>Description</u>
 Parent Directory		-	
 BIULETYN_32/	2016-08-31 15:06	-	
 BIULETYN_33/	2016-08-31 15:06	-	
 BIULETYN_34/	2016-08-31 14:50	-	
 BIULETYN_35/	2016-08-31 14:50	-	
 BIULETYN_36/	2016-08-31 14:50	-	
 BIULETYN_37/	2016-08-31 14:50	-	
 BIULETYN_38/	2016-08-31 14:50	-	
 BIULETYN_39/	2017-07-07 16:27	-	
 BIULETYN_40/	2017-08-18 15:32	-	

Choose one of the folders. Then you will see the individual bulletin files:

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<u>Name</u>	<u>Last modified</u>	<u>Size</u>	<u>Description</u>
 Parent Directory		-	
 report_2016_0.pdf	2017-01-31 14:30	2.2M	
 report_2016_07.pdf	2016-09-01 11:25	1.6M	
 report_2016_08.pdf	2016-09-14 00:13	1.9M	
 report_2016_09.pdf	2016-10-13 11:59	2.0M	
 report_2016_10.pdf	2016-11-15 15:54	1.9M	

Select one bulletin from the list, remembering that for example, report_2017_06_pdf denotes the Meteorological Bulletin of June 2017.



- The teacher assigns to students different bulletins to complete the tasks. Work can be done in groups (e.g. in pairs). Students perform tasks on the worksheet. During this time the teacher gives the necessary explanations.
- An assessment of students' work ends the lesson.

Lesson 3.

Topic: Analysis of annual meteorological bulletins

Lesson plan for “Meteorological measurements in the Arctic – extended package”

From previous lesson „How to interpret meteorological data?” students already know where to find meteorological bulletins published by the Institute of Geophysics Polish Academy of Sciences. Among bulletin files there are also those marked with a year and number 0 (example: report_2006_0.pdf). This entry indicates that this is the 2006 annual bulletin. This lesson will focus on analysing data from annual bulletins.

In order to conduct the lesson, it will be necessary to provide:

- computer with internet access for each student (or group of students); or else worksheets printed out for each student „Meteorological bulletin”;
- worksheet "Annual bulletins" (no. 6) printed for each student.

Expected educational goals of the lesson:

Same as of the educational package "Meteorological measurements in the Arctic - extended package"

Suggested forms of work:

- practical: exercises based on worksheets.

Lesson procedure:

1. Start of the lesson, organizational activities, attendance list check.
2. The teacher distributes the worksheets. Students download chosen annual bulletin from the web page <https://hornsund.igf.edu.pl/weather/>.
3. Students complete tasks included in worksheets. In the same time teacher gives the necessary guidance.
4. At the end of the lesson students give feedback, which tasks were most difficult for them and how did they manage to complete them.

Lesson 4.

Topic: Identifying clouds

Lesson plan for "Meteorological measurements in the Arctic – extended package"

Weather forecasting and dangerous atmospheric phenomena that threaten people, are topics that arouse curiosity among young people. Every day we get information about these phenomena from information services on the internet, television and radio. Not everyone knows that on the internet there are many services that show the current meteorological situation. The way of presenting data is increasingly accessible and visually appealing. At this lesson, students will follow some meteorological websites to describe clouds and related phenomena. These services can be used successfully to observe other meteorological parameters and processes in the atmosphere.

In order to conduct the lesson, it will be necessary to provide:

- computer with internet access for each student (or group of students);
- worksheet "Cloudiness" (no. 7) printed for each student.

Expected educational goals of the lesson:

Same as of the educational package "Meteorological measurements in the Arctic - extended package"

The lesson "Identifying clouds" aims to familiarize students with the most popular websites presenting meteorological data and their visualization. On this basis, students will be able to analyse the presented material, describe phenomena and draw conclusions.

Suggested forms of work:

- practical: exercises based on worksheets.

Lesson procedure:

1. Start of the lesson, organizational activities, attendance list check.
2. The teacher reminds students what the weather is and what are the meteorological parameters. Teacher explains what is the cloudiness and how clouds form. Identifying the types and species of clouds is complicated and difficult even for Geography students, but it is a very useful skill e.g. when practicing such sports as sailing, paragliding, etc. In 2017 World Meteorological Organization presented new online Cloud Atlas to make identifying clouds easier.
3. Students open the website <https://cloudatlas.wmo.int/> and learn how to recognize cloud types. Then they complete task no. 1 from the worksheet.

4. Students get acquainted with the website www.windy.com - a popular service used by television stations to visualize phenomena such as tornados, tropical cyclones. Cloudiness is one of the layers. Students complete tasks 2 and 3.
5. Changes of cloudiness above Europe can be observed from satellite images published in www.sat24.com. Students using this website complete tasks 4 and 5.
6. Using www.windy.com students complete task no. 6.
7. The Norwegian weather service www.yr.no is renowned for its very accurate and verifiable weather forecasts. Students using aforementioned website complete tasks 8 and 9.
8. On the www.blitzortung.org website one can check the storms and lightning strikes in real time across the planet. Students complete task 9, which is to describe the cumulonimbus cloud, and then describe the location of the most lightning strikes.
9. The lesson summary is to identify the types of clouds in a schematic image - students complete task 10.