

The Earth Magnetic Field

WORKSHEET to lesson "The Earth Magnetic Field"

Exercise 1.

A ship navigator reads on a map published in 1990 the following information on magnetic declination: $2^{\circ}10'$ W ($10'$ E). Additionally he knows that the deviation of his ship's compass is -4.5° . By which value must the navigator correct the compass indication to obtain today's geographic North direction?

Space for calculations:

Answer:

Exercise 2.

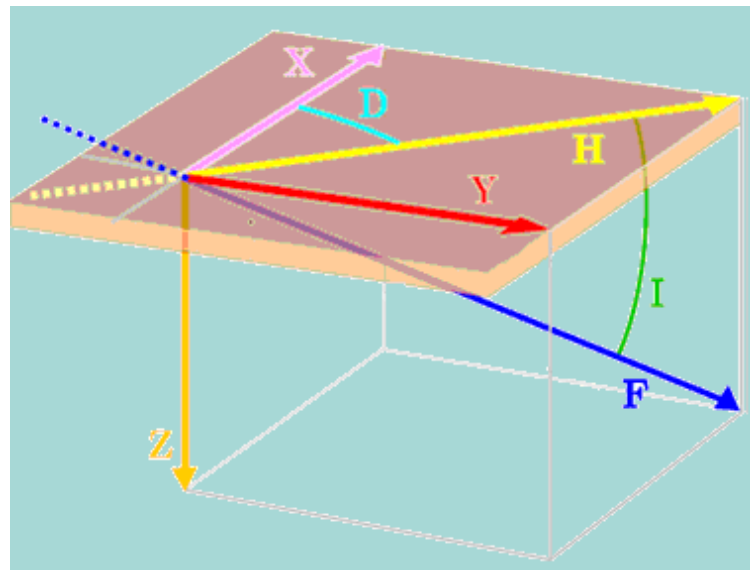
The following values of geomagnetic field components are known.

$$X = 18635 \text{ nT},$$

$$Y = 1983 \text{ nT},$$

$$Z = 46555 \text{ nT}$$

Determine declination D and inclination I .



Space for calculations:

Answer:

Exercise 3.

Answer the following questions basing on information you have got during the lecture.

a) What does a compass indicate?

Answer:
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b) What is the difference between the geomagnetic and the geographic poles?

Answer:
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c) What is the magnetosphere?

Answer:
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d) What is a CME?

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e) How are polar lights created?

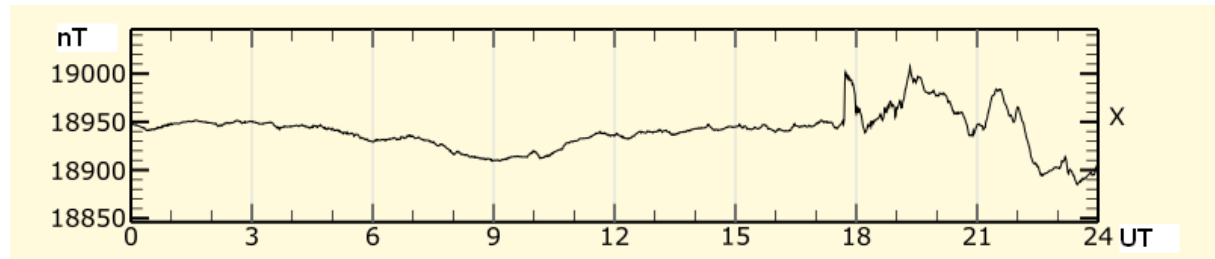
Answer:
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.....

Compare your answers with the ones of your classmates.
Try to explain possible differences among your answers.

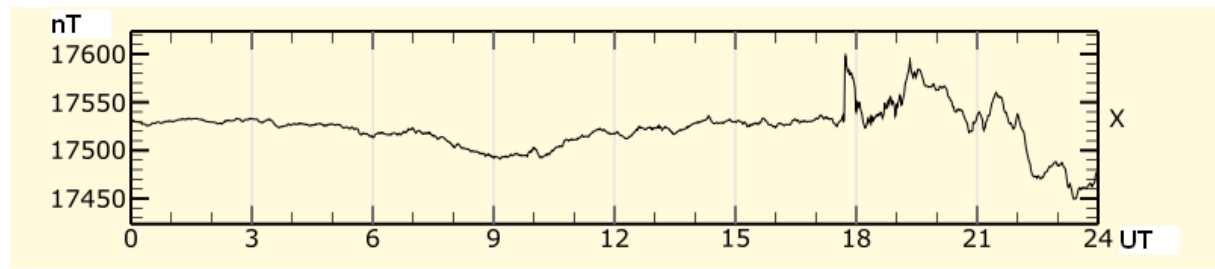
Exercise 4.

You can find magnetograms of three magnetic observatories below. Determine the variation amplitude (this is, the difference between the maximum and the minimum value) for this day. Then find the positions of the observatories by means of their coordinates on the map below and insert the determined differences. Can you draw a conclusion about dependency of the variation amplitude on latitude?

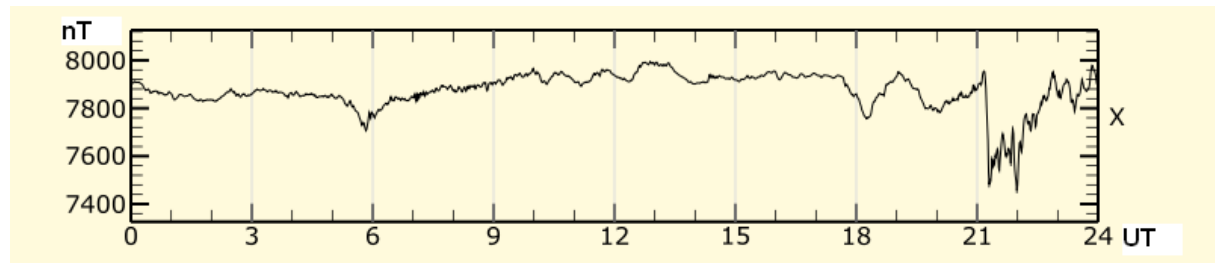
1 Magnetogram for Belsk, 3 August 2010, Geographic coordinates: latitude= $51^{\circ}50.2'$ N, longitude= $20^{\circ}47.5'$ E



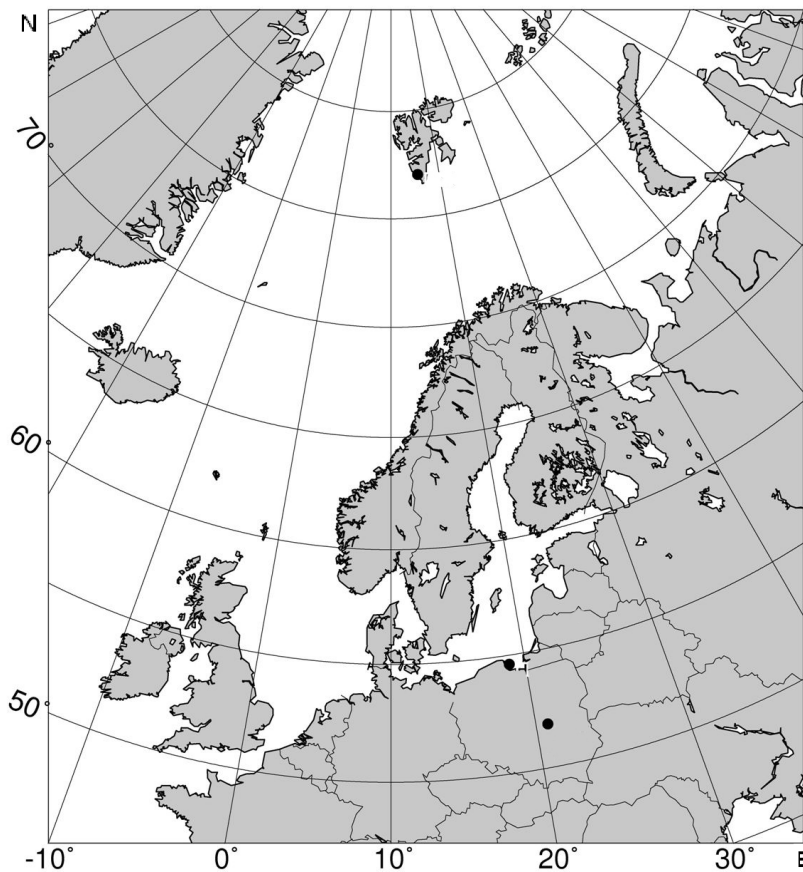
2 Magnetogram for Hel, 3 August 2010, Geographic coordinates: latitude= $54^{\circ}36.5'$ N, longitude= $18^{\circ}49.0'$ E



3 Magnetogram for Hornsund, 3 August 2010, Geographic coordinates: latitude= $77^{\circ}0.0'$ N, longitude= $15^{\circ}33.0'$ E



Space for calculations:



Answer:

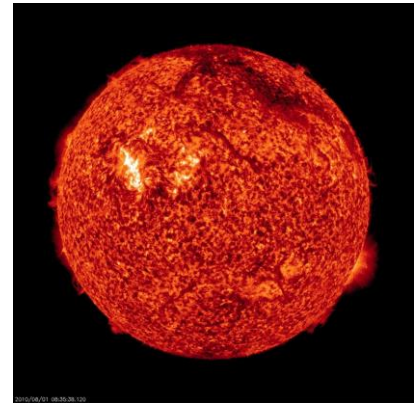
Exercise 5.

You can find below a photo of the Sun taken by the NASA during a coronal mass ejection. The photo has been taken on August 1, 2010 at 08:35:35 o'clock UT (Universal Time).

In the magnetograms of Belsk and Hel in the previous exercise you can see a sudden, vertical rise of the magnetic field strength by more than 50 nT. This is the start of a geomagnetic storm caused by the CME on the photo.

Determine the start time of the storm from one of the magnetograms as precise as possible. Then use the date and time information, and the information that the distance between Sun and Earth is 150,000,000 km, to determine the velocity of the released plasma moving towards the Earth. Give your result in km/sec.

Space for calculations:



Answer:

Exercise 6.

You can find below a table with the positions of the geomagnetic North pole over a number of years. Mark these positions in the grid below. Determine the mean velocity of the pole's motion per year using the scale and a ruler. Then use this mean velocity to make a suggestion where the geomagnetic North pole will be located in 2020 and in 2030. Give reasons for your choice.

Space for calculations

Answer

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Year	The Magnetic North Pole	
	Latitude	Longitude
1995	79.0N	105.3W
2000	81.0N	109.6W
2005	83.2N	118.2W
2010	85.0N	132.8W
2015	86.3N	160.0W
2020	?	?
2030	?	?

