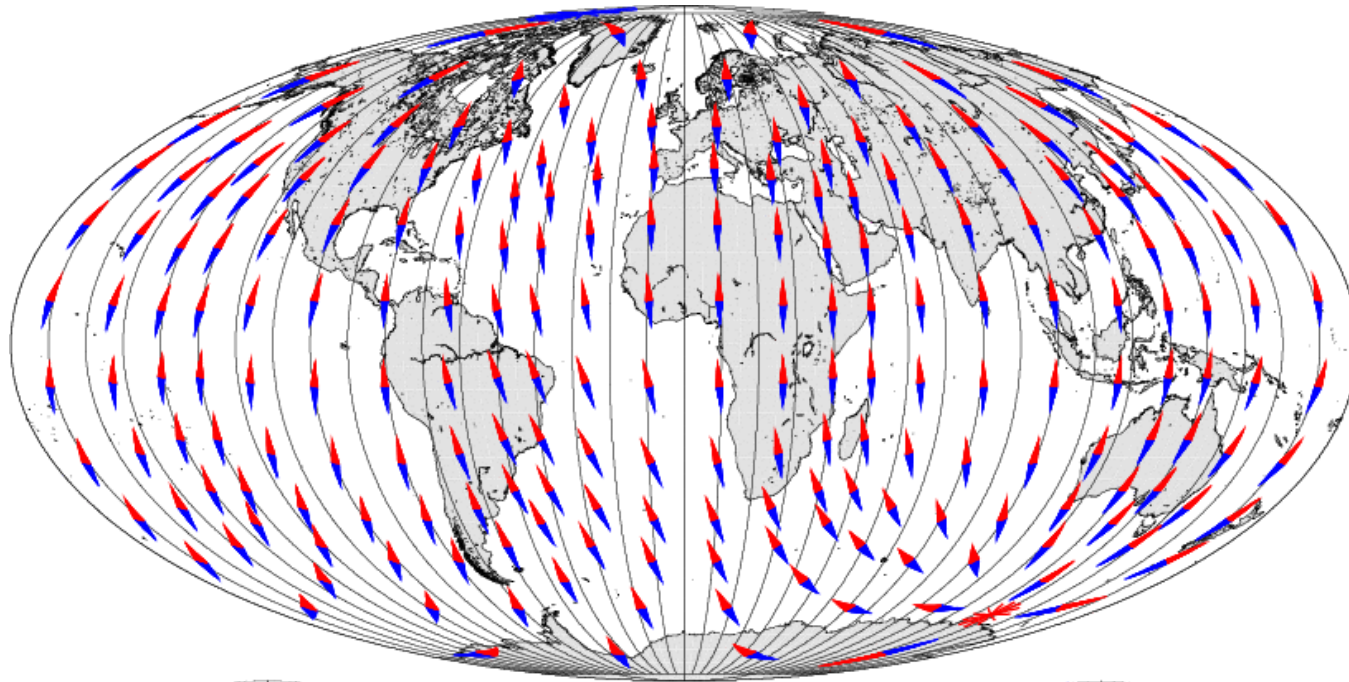


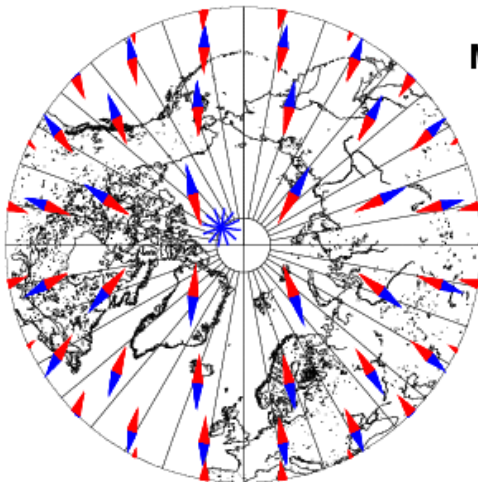
# Chapter 7

## The compass

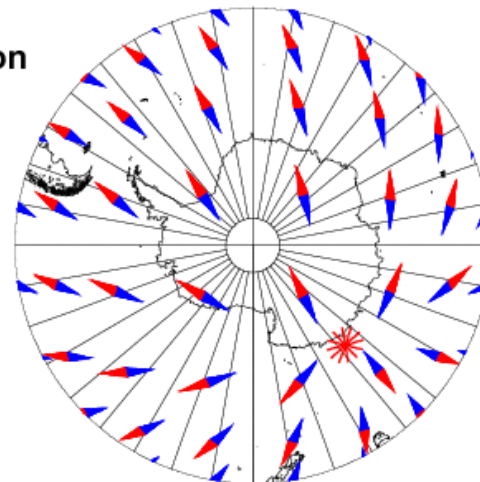
# Previously



On the Earth's surface, a small, freely turning magnetic needle aligns itself roughly with the north-south direction.



**Magnetic Field Direction  
2010**

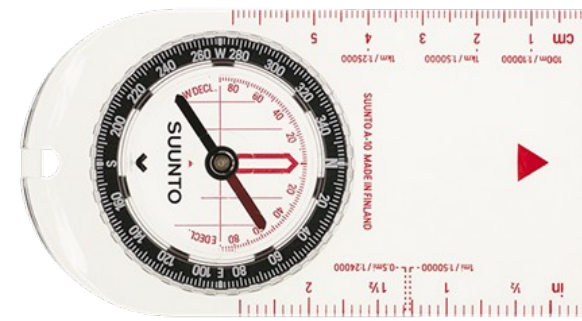


<http://geomag.org>, 2008

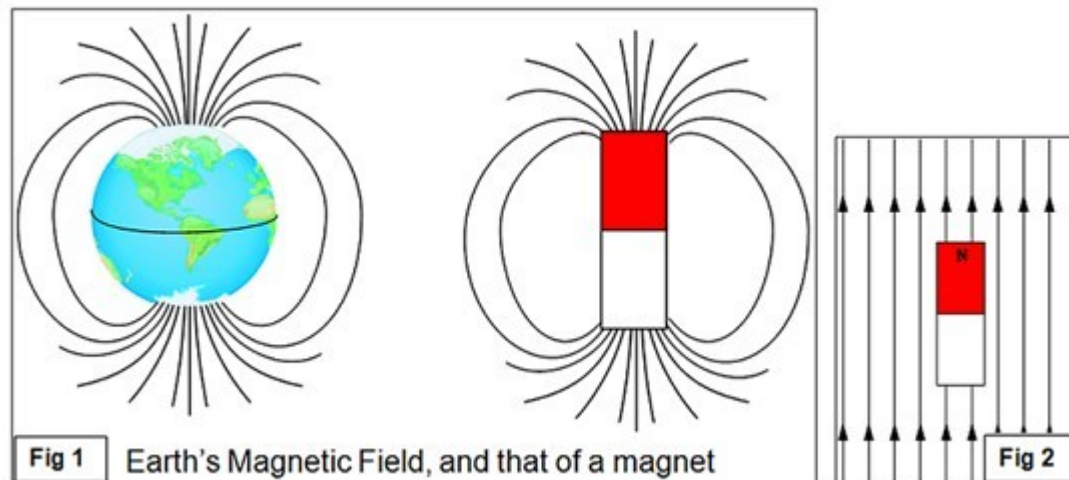
# Content

- The compass
- Where does the compass point?

# The compass

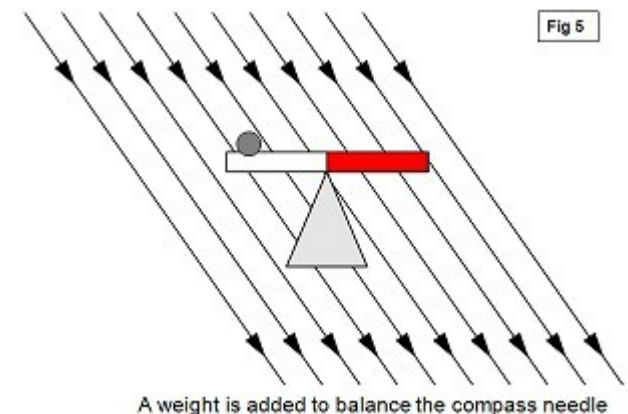
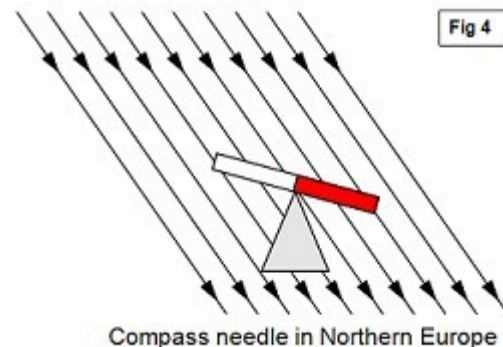
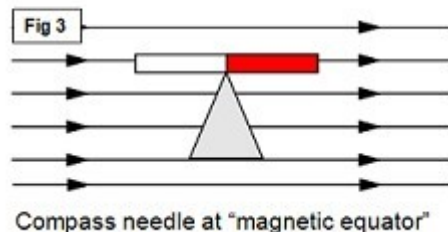


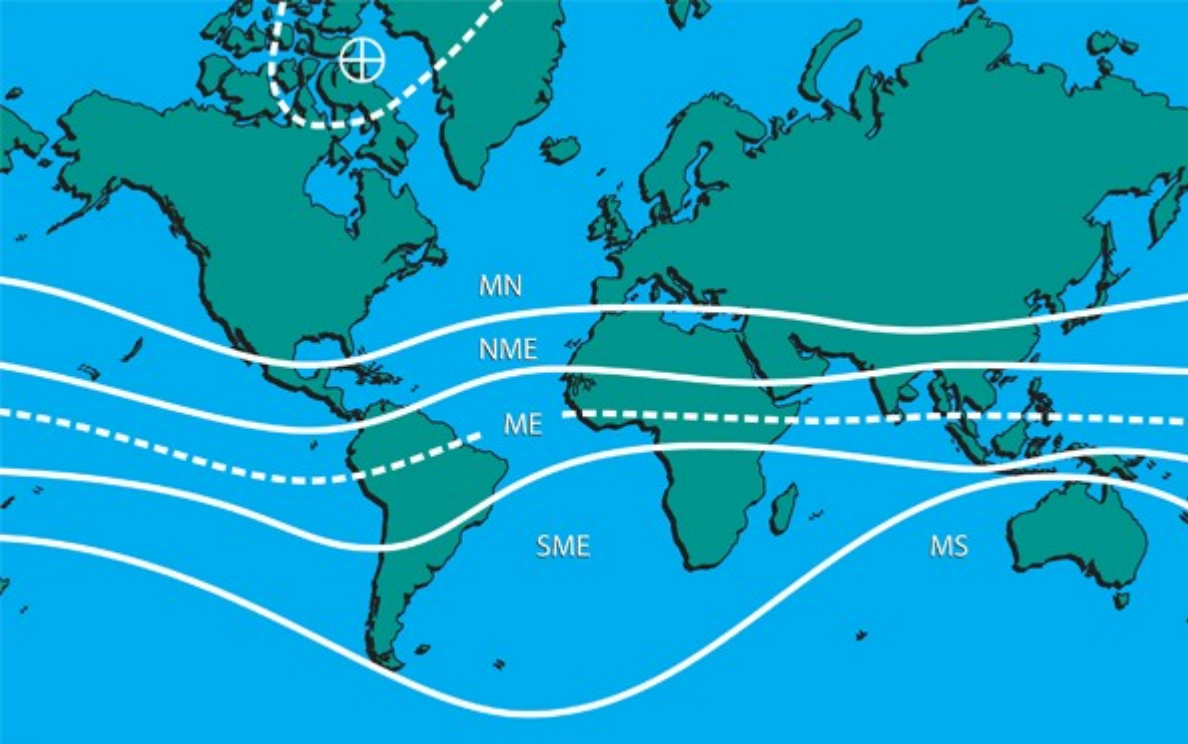
- A compass is an instrument used for navigation and orientation that shows approximately the direction relative to the geographic north.
- The magnetic compass is the most familiar compass type. It functions as a pointer to magnetic north, the local magnetic meridian, because the magnetized needle at its heart aligns itself with the horizontal component of the Earth's magnetic field. The magnetic field exerts a torque on the needle, pulling one end or pole of the needle approximately toward the Earth's north magnetic pole, and pulling the other toward the south magnetic pole. The needle is mounted on a low-friction pivot point so it can turn easily. When the compass is held level, the needle turns until, after a few seconds to allow oscillations to die out, it settles into its equilibrium orientation.



# Balancing the compass needle against inclination

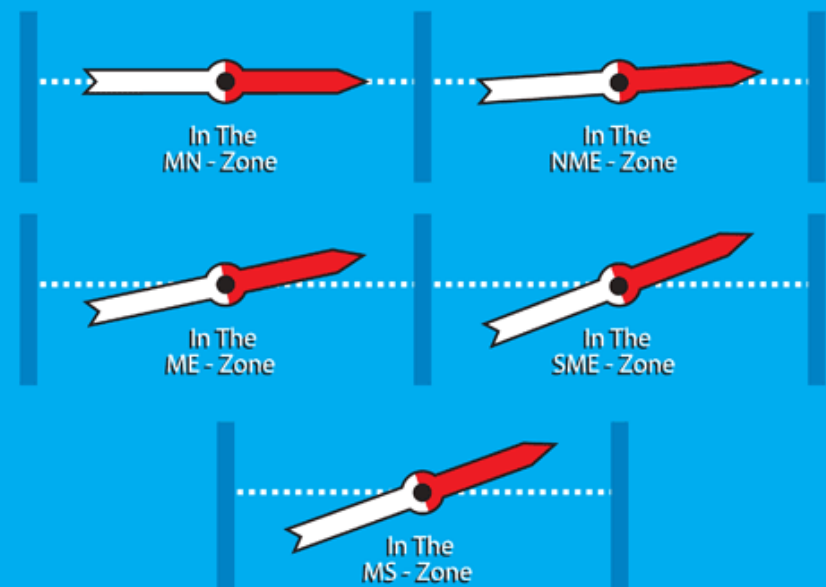
- To work accurately the compass needle must be able to turn freely inside its liquid filled capsule, else it may drag against the compass housing and give an incorrect reading. This is why a compass should be held horizontally when in use.
- At the magnetic equator the needle is perfectly level. Between the magnetic equator and the poles, however, one end of the needle tends to dip down (by the local inclination angle), causing drag, with the potential for inaccurate readings.
- To overcome this situation, manufacturers balance their compasses to allow for inclination.
- Adding an appropriate weight to one side of the compass balances it for a particular area, or zone of the Earth's magnetic field. Not all parts of the world are balanced in the same way.





The balance zones used by the manufacturer Silva.

Effect on an MN-zone-balance compass needle in other magnetic zones.

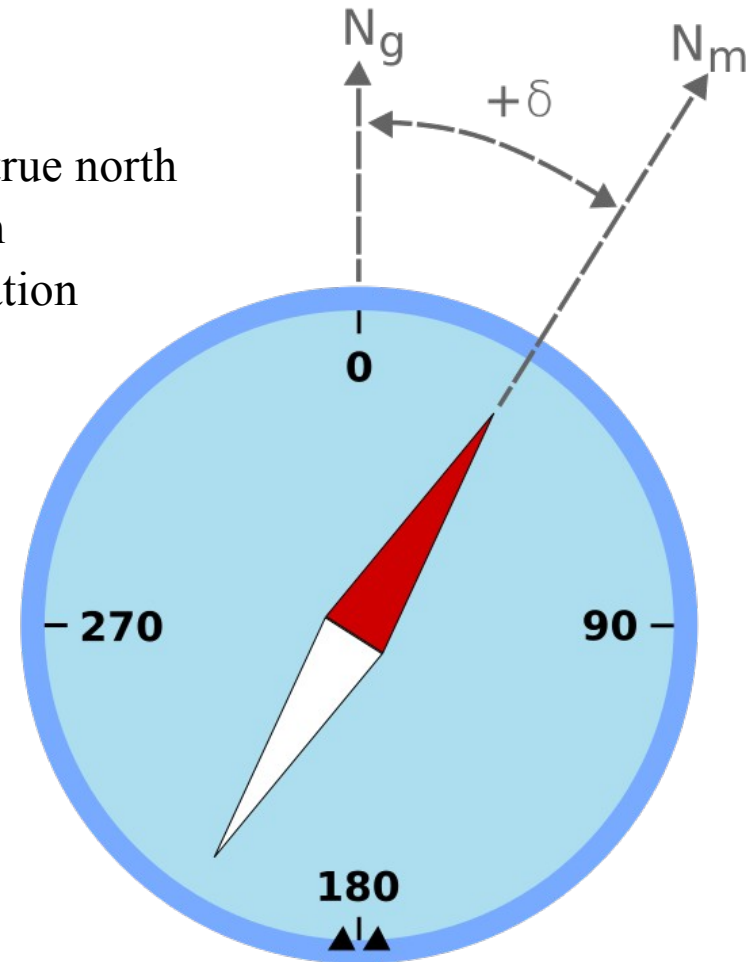
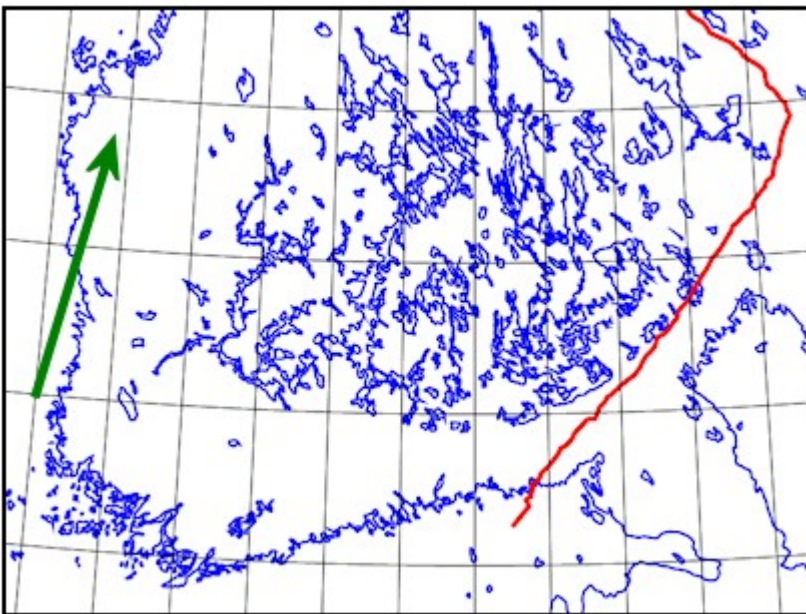




# Correcting the compass reading for declination

$N_g$  geographic or true north  
 $N_m$  magnetic north  
 $\delta$  magnetic declination

Grid north equals true north, for this map.  
Magnetic north is shown by the arrow.



Example of magnetic declination showing a compass needle with a positive (or easterly) variation from geographic north.



In an area where there is a magnetic disturbance, the compass direction may differ several degrees from the given declination.

## Teknisiä tietoja Tekniska data Technical data

Koordinaattisto Koordinatsystem Coordinate reference system: EUREF-FIN (WGS84)  
 Ellipsoid Ellipsoid Ellipsoid: GRS 80  
 Karttaprojektio Kartprojektion Map projection: ETRS-TM35FIN (UTM35)  
 Keskimeridiaani Medelmeridian Central meridian: 27°E / 500 000 m  
 Korkeusjärjestelmä Höjdsystem Vertical reference system: N60

• Magneettisia häiriöitä Magnetiska störningar Magnetic disturbance

Nak35: -2°12' -2°25' -2°39'

2	4	2	4	2	4	2	4
Q5324B	Q5324D	Q5324F	Q5324H				
1	3	1	3	1	3	1	3
2	4	2	4	2	4	2	4
Q5324A	Q5324C	Q5324E	Q5324G				
1	3	1	3	1	3	1	3

Nak35: -2°11' -2°25' -2°38'

KP35 Karttopohjoinen Kartnorr Grid North 27°E

KP35 Kaistapohjoinen Zonnorr Zone North 27°E

NeP Neulapohjoinen Kompassnorr Magnetic North

★ Napapohjoinen Polnorr True North

Nak35	Neulaluvun korjaus Näitelskorrektion Magnetic Correction	+10°45'	+179°	+191 mils
Nak35	Napaluvun korjaus Pöitelskorrektion True North Correction	-2°25'	-40°	-43 mils
Kok35	Kokonaiskorjaus Totalkorrektion Total Correction	+8°20'	+138°	+148 mils
Kok35	Vuotuinen muutos Årlig förändring Annual variation	+0°10'	+2.8°	+3.0 mils

Ennen kartasta otetun suunnan käyttämistä kulkusuuntana maastossa on sen kompassisuunnasta vähennettävä yllä laskettu kokonaiskorjaus (Kok).

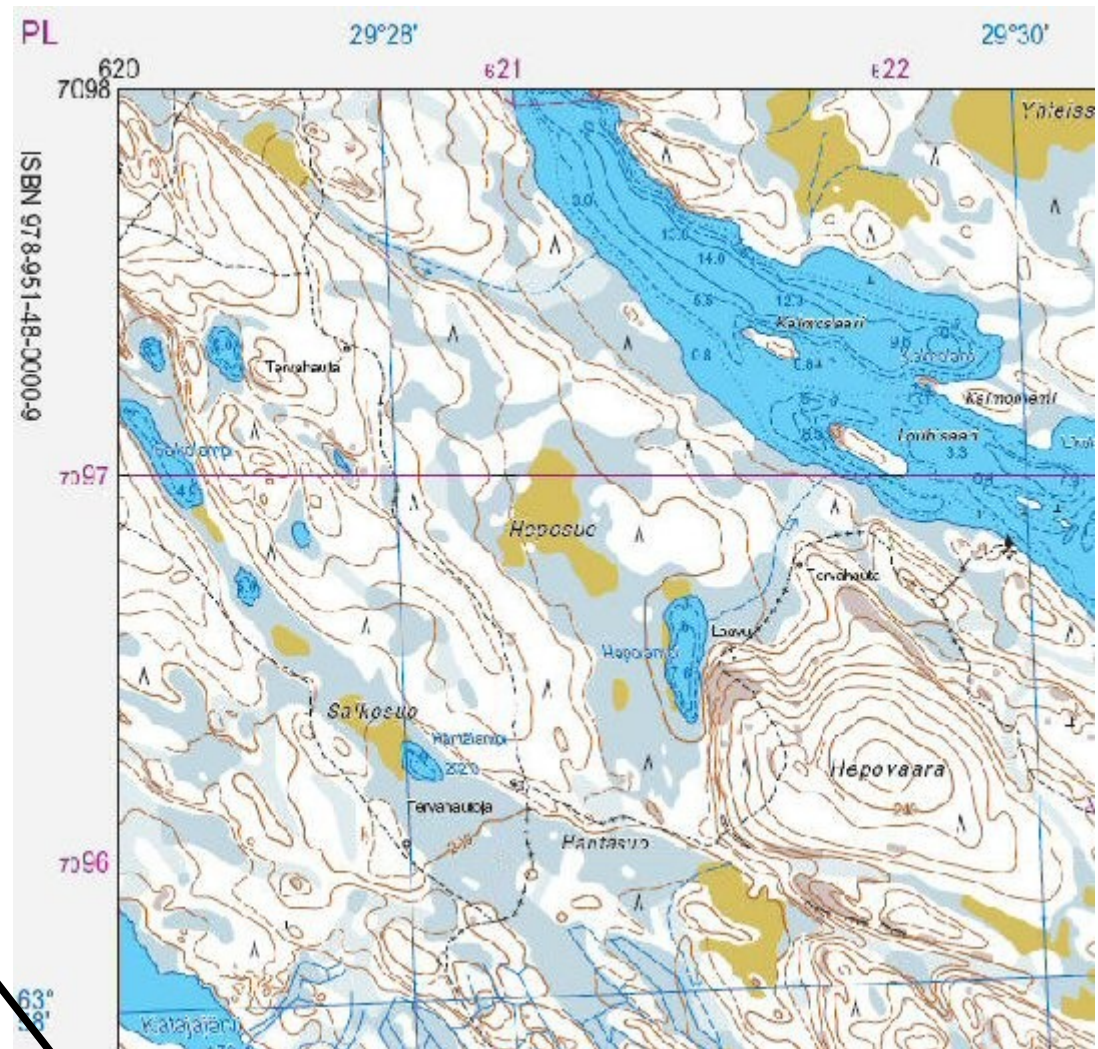
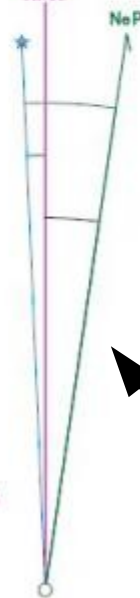
Innan den på kartan mätta riktningen används i terrängens skall ovan angivna totalkorrektion (Kok) subtraheras från kompasskursen.

Before the measured grid azimuth is used in the terrain the above-indicated total correction (Kok) must be subtracted from the bearing.

Kartalla on kuvattu UTM-kaistan 35 mukaisten mustien koordinaattiristien lisäksi punaisella värillä UTM-kaistan 35 mukainen koordinaattiruudukko.

Förutom svart koordinatnät i UTM-zonen 35 har på kartan avbildats koordinatrutorna i UTM-zonen 35 i rött.

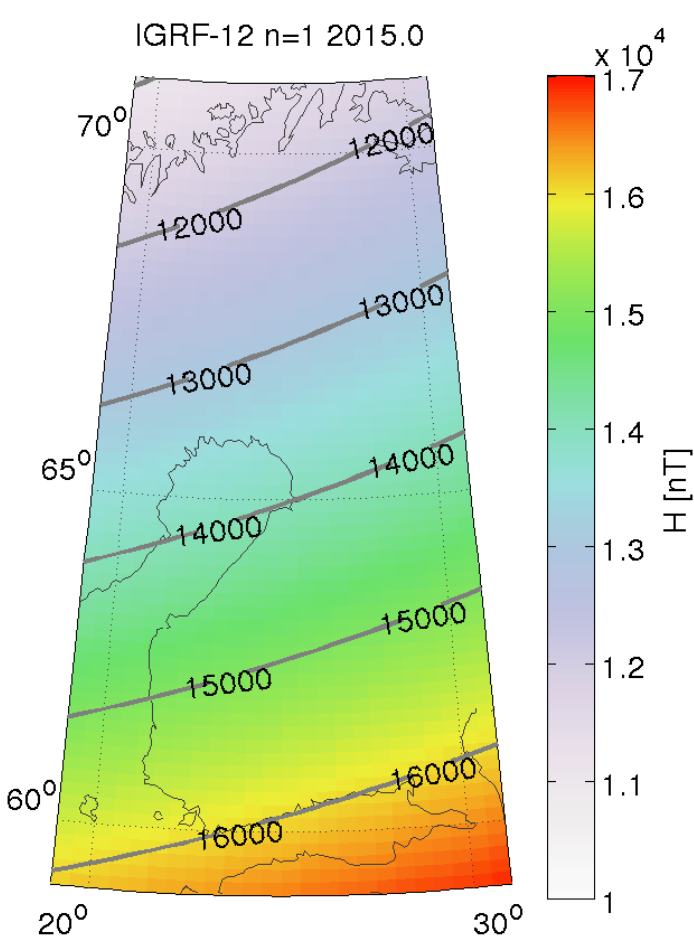
On the map the grid intersections in UTM zone 35 are shown in black and the grids in UTM zone 35 in red.



The information are based on the local magnetic field models of Finland described in chapter 6.

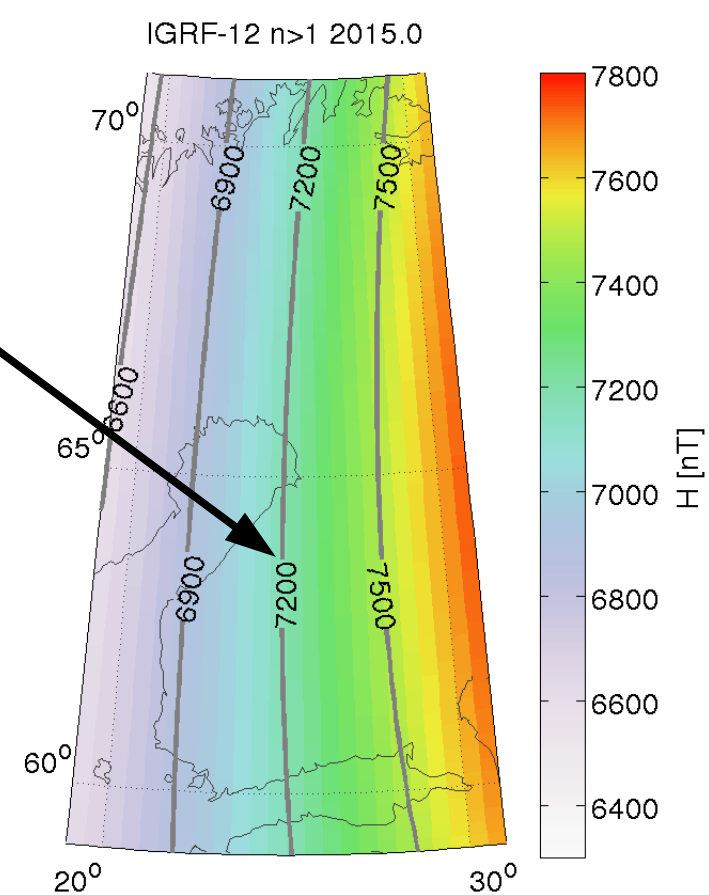
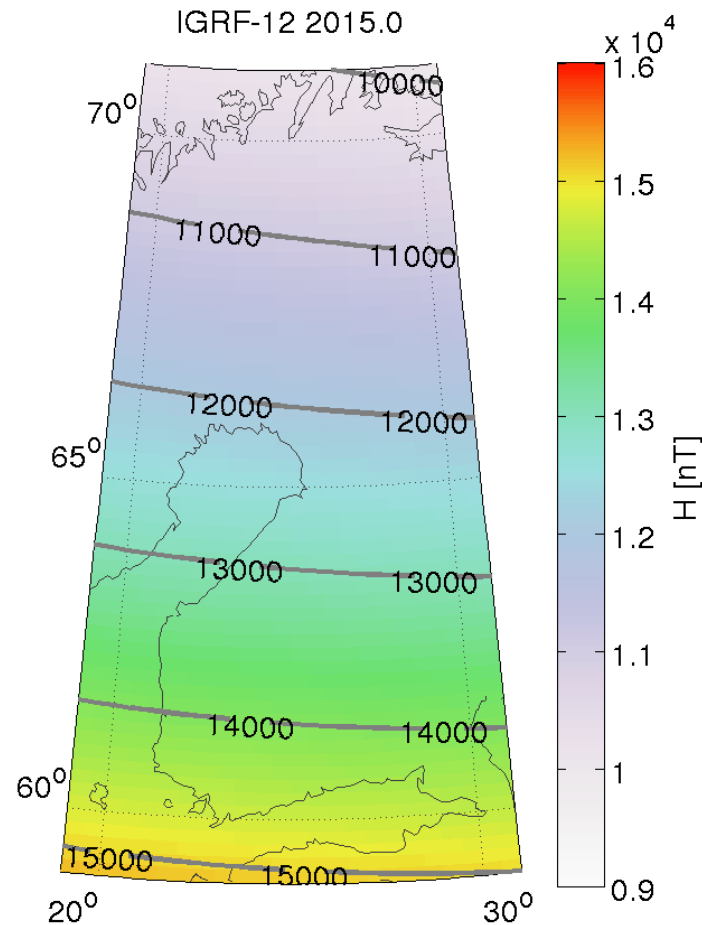
Where does the compass point?

- A compass needle points to the direction of the magnetic north, which is the same as the direction of the horizontal component of the magnetic field,  $H$ .
- In general, a compass needle is estimated to point towards the north geomagnetic (dipole) pole or magnetic pole.
- The north geomagnetic pole and magnetic pole lie roughly northwest of Finland.
- Nonetheless, in Finland declination is eastern (positive) and a compass needle generally does not point northwest.



$H_{anomalous}$  almost 50% of  $H_{dipole}$

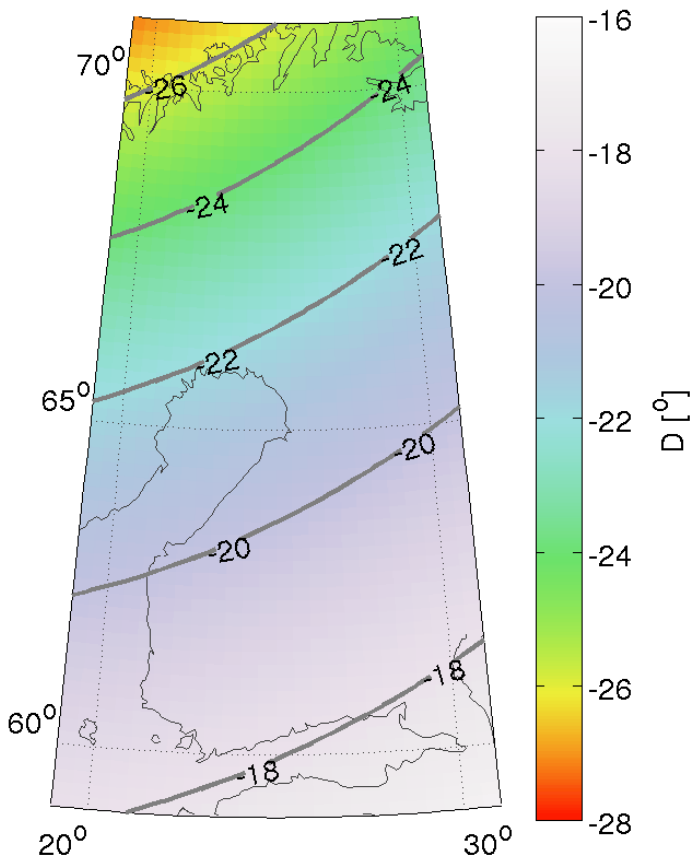
$$H = H_{dipole} + H_{anomalous}$$



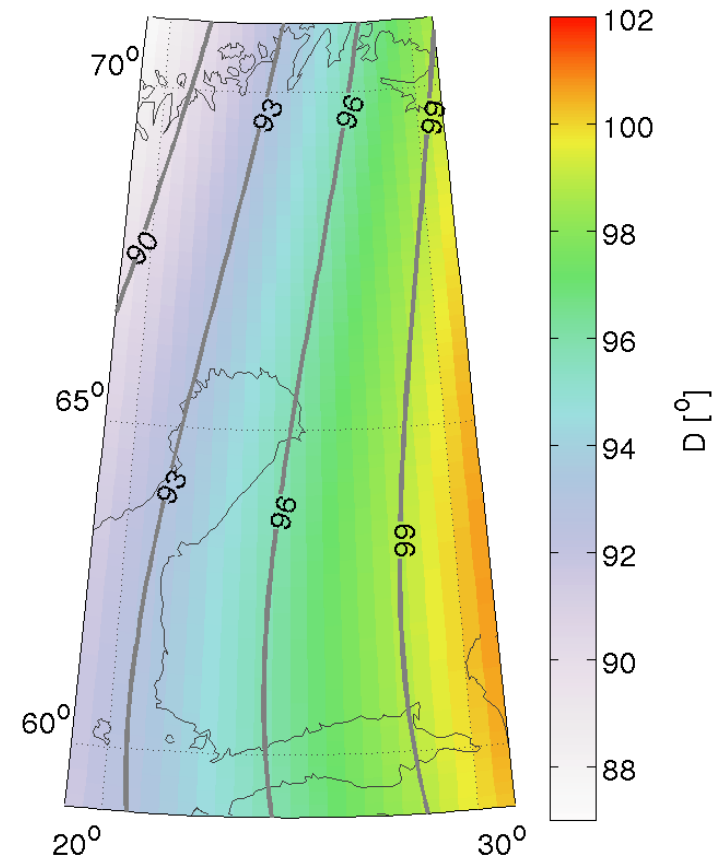
If  $H_{dipole} = 0$

(In these plot,  $H_{anomalous}$  only consists of the non-dipolar terms if IGRF. In reality,  $H_{anomalous}$  also includes the crustal field.)

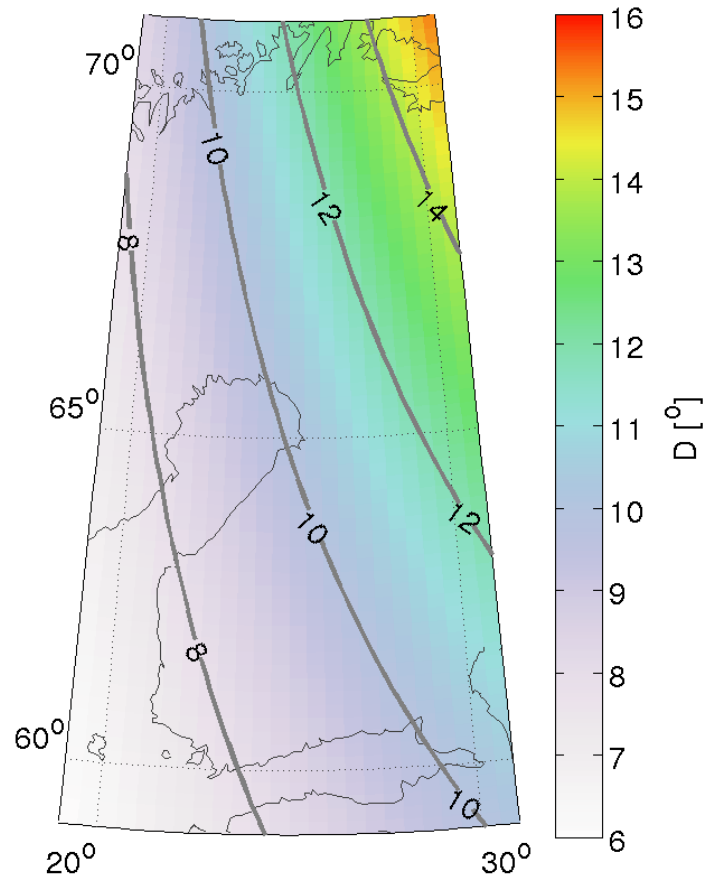
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IGRF-12 n&gt;1 2015.0

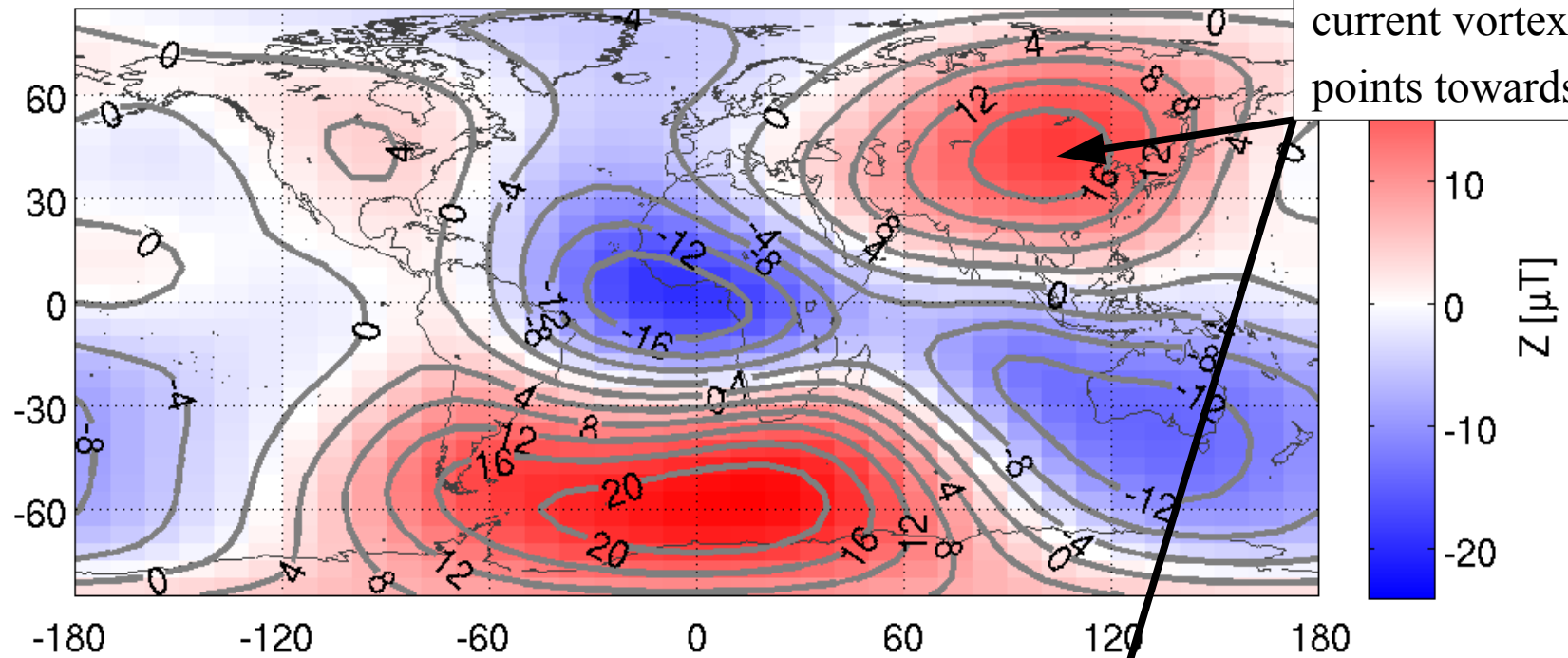


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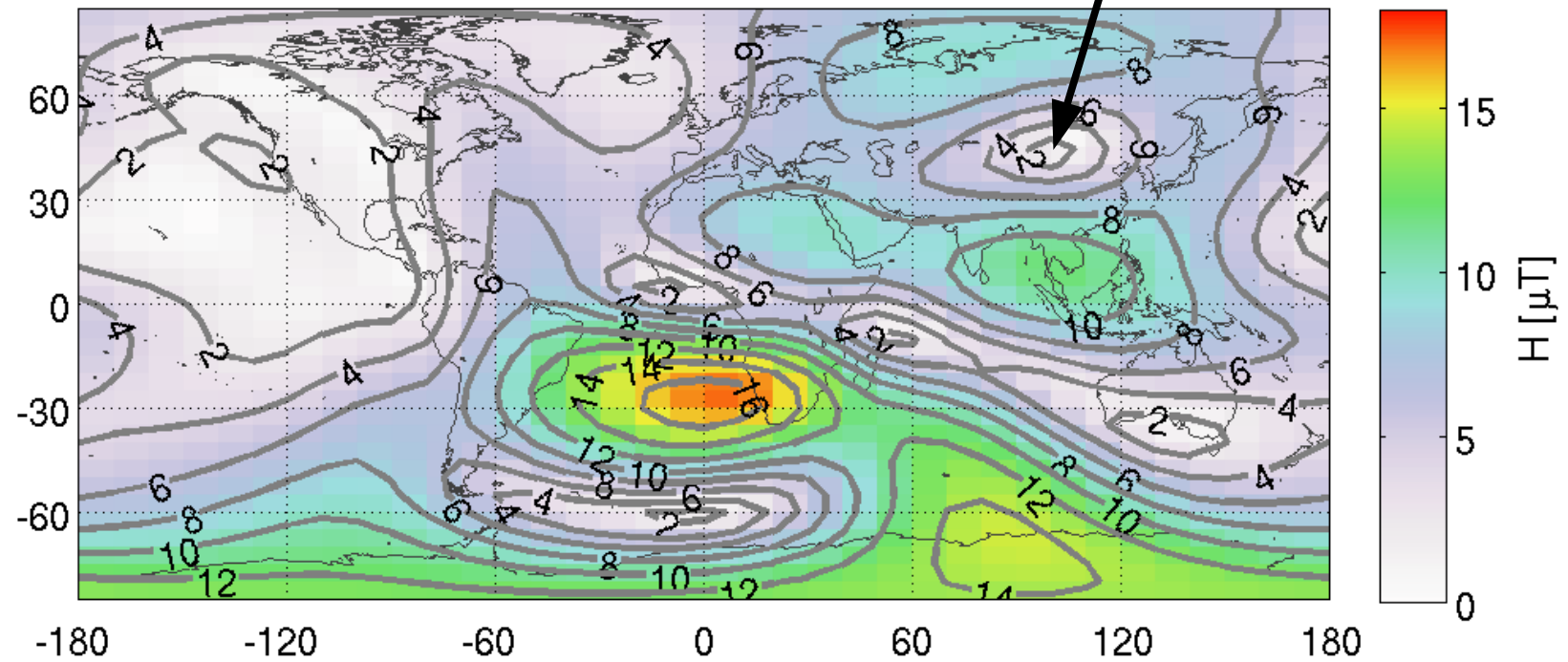




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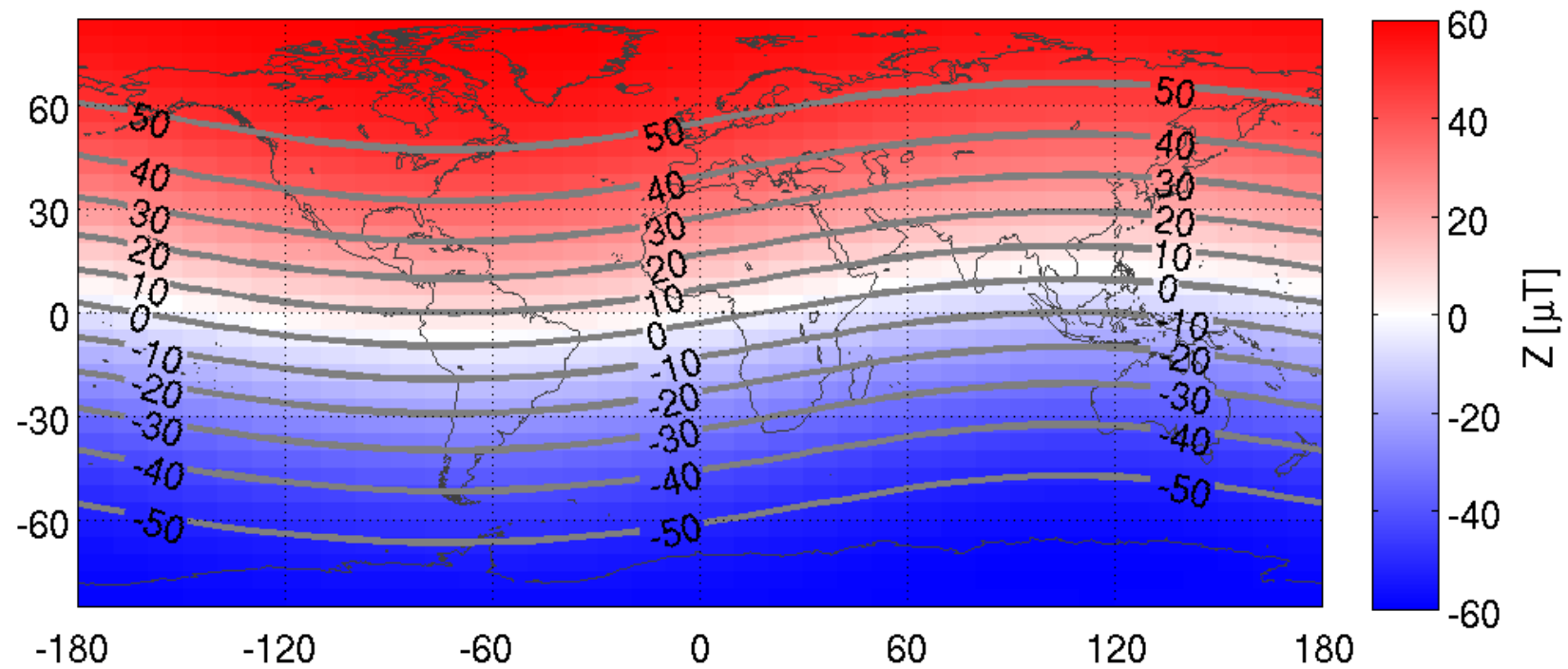


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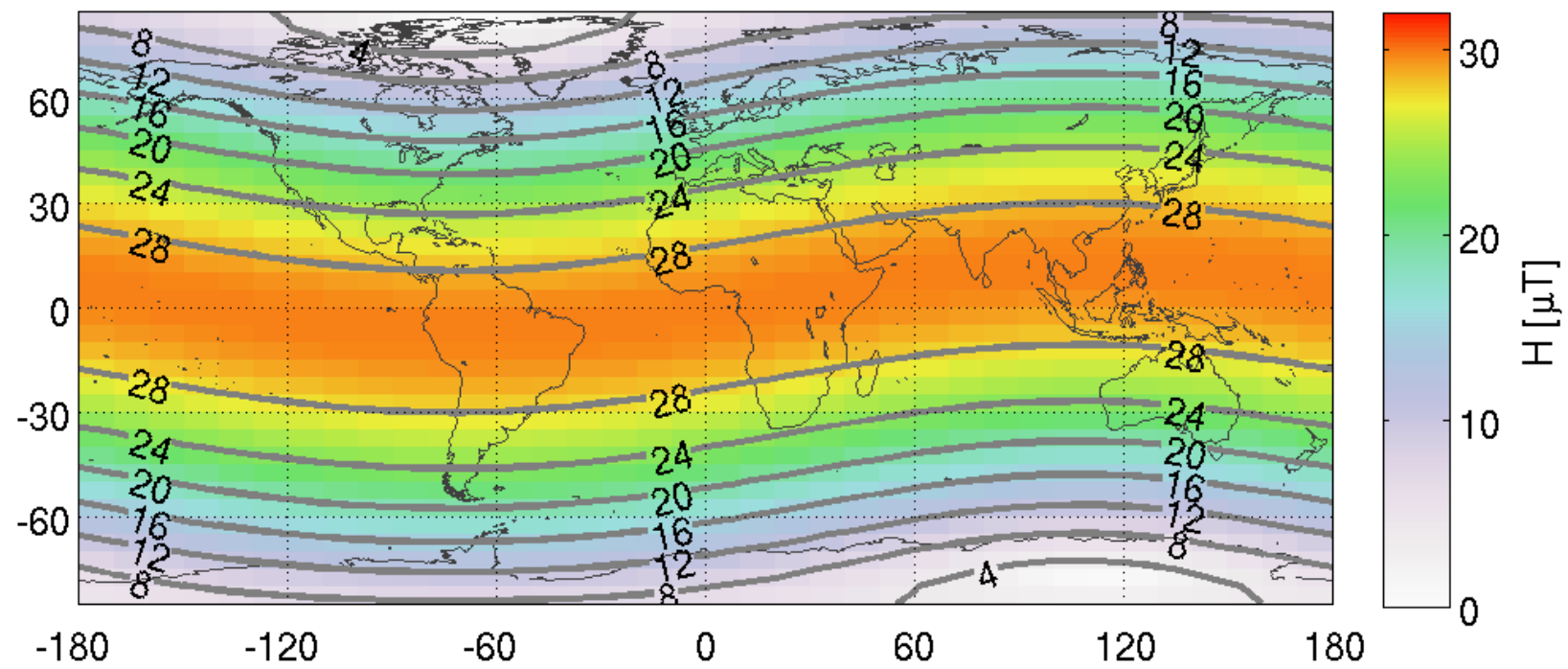




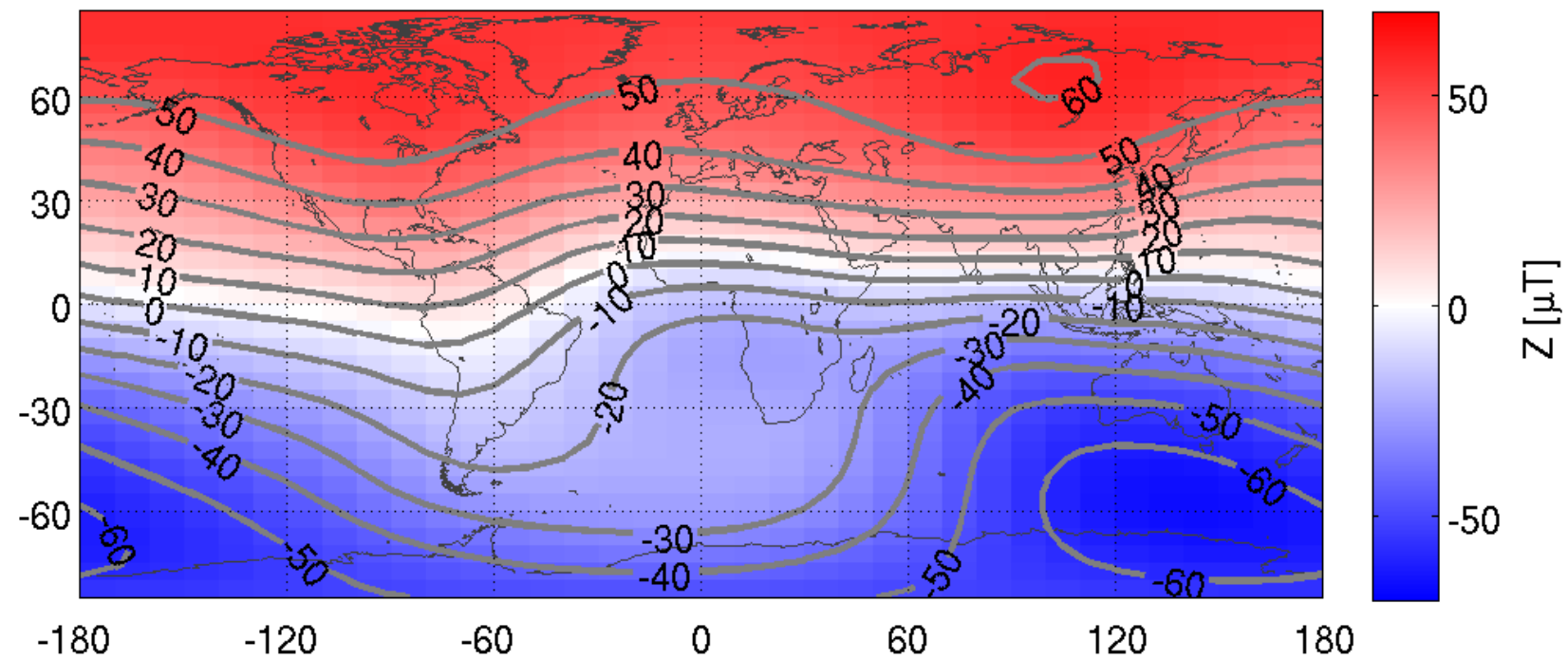
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