Geomagnetism 2015
Exercise 1/6
Return to reko.hynonen@fmi.fi by: Sun 13.9.2015 10:00
Exercise session: Mon 14.9.2015 14-16, Physicum room D115

1. Write a Matlab (or equivalent) function for computing the new coordinates when the location of the pole is changed: given a location (latitude *lat1* and longitude *lon1*) and the location of the new north pole (*lat0,lon0*) with respect to the old north pole, the function returns the coordinates (*lat2,lon2*) with respect to the new north pole. The new zero meridian (*lon2*=0) is defined as the meridian running from the old north pole to the new north pole to the old south pole. Implement the inverse transformation as well.

2. Write a function that similarly implements the change of the frame of reference for the spherical vectors (B_θ,B_φ).

3. On 30 October 2003 at 20:03:30 UT, the IMAGE magnetometer network (http://space.fmi.fi/image/beta/) measured the values given in the Table (the main field has been subtracted from the values, so that they can be estimated to be of ionospheric origin).

Latitude [°] (geogr.)	Longitude [°] (geogr.)	B_x [nT] (pos. north)	B_y [nT] (pos. east)	B_z [nT] (pos. down)
58.26	26.46	-1105.4	375.6	-891.5
60.50	24.65	-2515.9	682.1	-1469.8
62.07	9.12	-2531.7	388.8	-412.0
62.30	26.65	-3051.1	855.0	-1364.8
64.52	27.23	-4388.5	1334.7	-616.1
64.94	10.98	-3462.3	292.5	1159.2
66.90	24.08	-3183.9	935.9	1024.3
67.37	26.63	-2961.4	1112.2	1098.5
68.02	23.53	-2734.9	771.0	1592.9
68.13	13.55	-1907.6	-413.6	1659.4
68.56	27.29	-2463.8	1565.0	1193.1
69.02	20.79	-2021.0	308.6	1744.2
69.30	16.03	-2014.5	-358.4	2547.9
69.46	23.70	-1923.3	777.5	1981.9

69.66	18.94	-1971.5	-194.8	1846.1
69.76	27.01	-1955.0	1437.5	1470.3
70.54	22.22	-1642.6	384.7	2040.1

The data are also given in the file

IMAGE_data.txt.

Use your functions to convert the locations of the magnetometers (latitude and longitude) and the horizontal magnetic field components (B_x, B_y) from the geographic to the geomagnetic frame of reference. You can use *lat0*=79.7°, *lon0*=-71.7° for the geographic location of the geomagnetic north pole. Then do the inverse transformation. Did you get the original values back?

4. Write a function for estimating the geomagnetic time at a given location and UT. What was the geomagnetic time at the locations of the magnetometers when the measurements given above were made?