Climate II - Exercise 3: Glacial climate

(1) Thickness of the LGM ice sheet

Reconstructions indicate that sea level was lower by 108m during the Last Glacial Maximum and that the surface of the ice sheets was larger (45 million km^2 as against modern surface area of 15 million km^2).

Calculate the thickness of the LGM ice sheet (assume an equal thickness everywhere).

(use the following values: Earth's radius r_E = 6371 km; Earth surface area: A_E = 70% covered by water)

(2) Change of δ^{18}O in glacial oceans

The LGM ice sheets had an average isotopic composition of $\delta^{18}O = -30‰$. All water of these ice sheets has been evaporated from the ocean.

Calculate the LGM change of δ^{18}O in the ocean due to the build up of the ice sheets.

(use the following values: modern $\delta^{18}O_{ocean} = 0‰$)

(3) Change of LGM solar radiation, temperature and precipitation pattern

In the files PI.nc and LGM.nc (NetCDF format) you find mean monthly values of surface temperature, total precipitation and incoming solar radiation (top of atmosphere) for both the pre-industrial (PI) and LGM climate.

(i) Plot a Hovmöller diagram (x-axis: month of year; y-axis: latitudes) of the mean latitudinal incoming solar radiation for the PI and LGM climate. Compare both plots and discuss the results.

(ii) Plot maps of mean annual LGM-PI temperature and precipitation change. Compare the LGM changes of both variables with the change in incoming solar radiation. Discuss the different results.

(Plotting of NetCDF files can be done with the programme Panoply (https://www.giss.nasa.gov/tools/panoply/), Python Cartopy (https://scitools.org.uk/cartopy/) or any other programme of your choice.)