Analysis of GRACE Mascon Data for the Determination of Terrestrial Water and Ice Mass Changes

In this exercise, GRACE Mascon data (JPL RL06M v04) should be downloaded, analyzed, and interpreted. The goal is to create time series of terrestrial water storage anomalies (TWSA) and investigate trends for different regions (e.g., Finland, Greenland, and globally). For this purpose, you should use the shapefiles *country.shp* and *continents.shp* to aggregate TWSA time series for selected regions.

1. Download the GRACE Mascon data in NetCDF format from `https://grace.jpl.nasa.gov/data/get-data/jpl_global_mascons/`. Create a global map of TWSA for any chosen month.
2. Calculate the TWSA over Finland. Create a time series for the entire available period. Determine the trend with a linear regression.
   - How much water does Finland gain/lose per year (in gigatons)?
   - Are there any remarkable extreme years?
3. Mask the mascons over Greenland. Calculate the area-weighted TWSA time series. Determine the annual trend.
   - How much ice does Greenland lose per year (in gigatons)?
   - Do the results agree with literature values?
4. For each mascon, calculate the linear trend over the time series. Then visualize the resulting trends (in cm/year or Gt/year) in a global map.
   - Where are the strongest losses or increases found?
   - Which regions show stable or hardly changed water storage?
   - Are there large-scale patterns that could be related to known climate phenomena such as ENSO, glacier melt, or drought?

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