How to convert NetCDF to CSV

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Introduction

This article explains how to extract data from a 3 dimension NetCDF file using different options and save the output as a CSV (comma separated variables) file.

You are expected to have installed python 2.7 or later, and the CDS API on a Linux machine before you continue.

First option : Python Script

The first option is to use a python script (below). The script allows you to covert data from NetCDF in two different ways, as explained in the workflow below:

- Retrieve data with the CDS API and store as a netCDF4 file in the working directory.
- Extract the variable from the NetCDF file and get the dimensions (i.e. time, latitudes and longitudes)
- Extract each time as a 2D pandas DataFrame and write it to the CSV file
- Write the data as a table with 4 columns: time, latitude, longitude, value

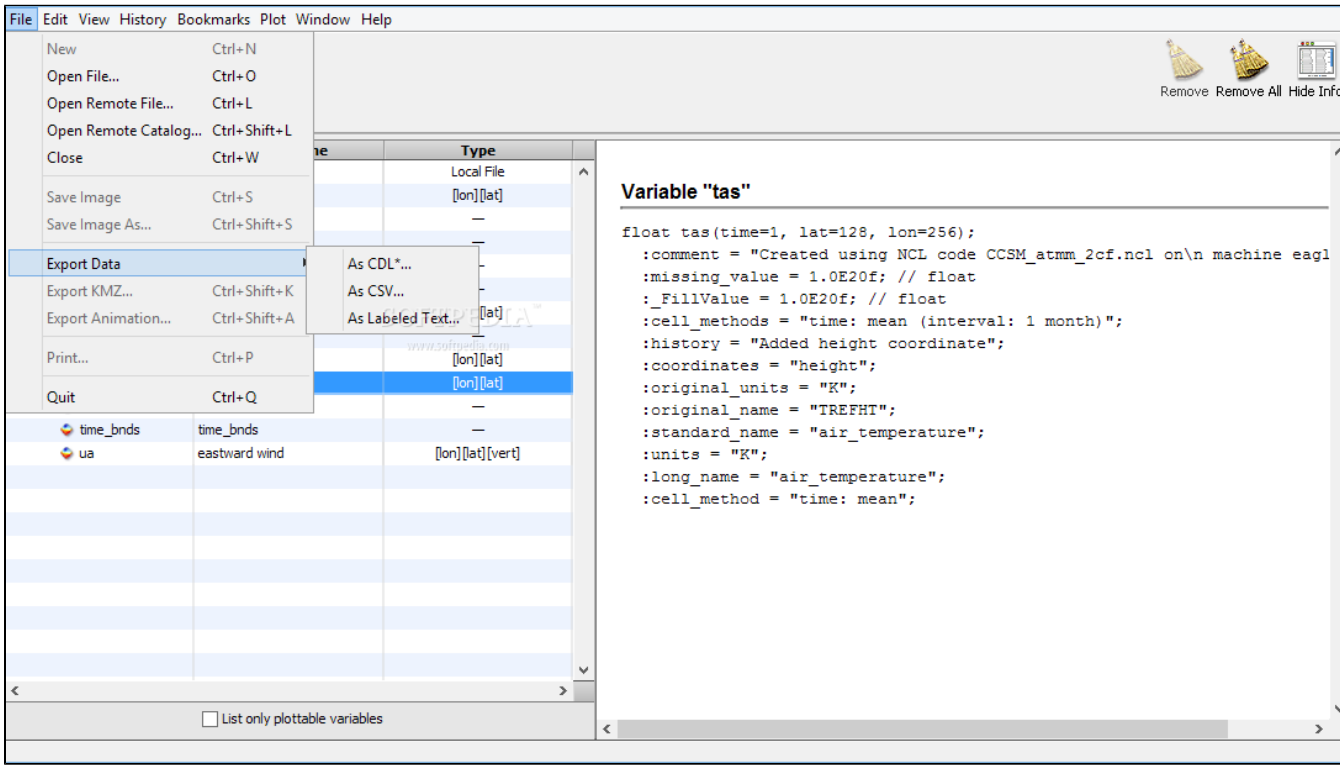
Python source code example for ERA5 single level data

```
#!/usr/bin/python3

import cdsapi
import netCDF4
from netCDF4 import num2date
import numpy as np
import os
import pandas as pd

# Retrieve data and store as netCDF4 file
c = cdsapi.Client()
file_location = './t2m.nc'
c.retrieve(
    'reanalysis-era5-single-levels',
    {
        'product_type':'reanalysis',
        'variable':'2m_temperature',  # 't2m'
        'year':'2019',
        'month':'06',
        'day':[
            '24','25'
        ],
        'time':[
            '00:00','06:00','12:00',
            '18:00'
        ],
        'format':'netcdf'
    },
    file_location)

# Open netCDF4 file
f = netCDF4.Dataset(file_location)

# Extract variable
t2m = f.variables['t2m']

# Get dimensions assuming 3D: time, latitude, longitude
time_dim, lat_dim, lon_dim = t2m.get_dims()
time_var = f.variables[time_dim.name]
times = num2date(time_var[:], time_var.units)
latitudes = f.variables[lat_dim.name][:]
longitudes = f.variables[lon_dim.name][:]

output_dir = './'

# ============================== METHOD 1 ============================
# Extract each time as a 2D pandas DataFrame and write it to CSV
# ====================================================================
os.makedirs(output_dir, exist_ok=True)
for i, t in enumerate(times):
    filename = os.path.join(output_dir, f'{t.isoformat()}.csv')
    print(f'Writing time {t} to {filename}')
    df = pd.DataFrame(t2m[i, :, :], index=latitudes, columns=longitudes)
    df.to_csv(filename)
print('Done')

# ============================== METHOD 2 ============================
# Write data as a table with 4 columns: time, latitude, longitude, value
# ====================================================================
filename = os.path.join(output_dir, 'table.csv')
print(f'Writing data in tabular form to {filename} (this may take some time)...')
times_grid, latitudes_grid, longitudes_grid = [
    x.flatten() for x in np.meshgrid(times, latitudes, longitudes, indexing='ij')]
df = pd.DataFrame({
    'time': [t.isoformat() for t in times_grid],
    'latitude': latitudes_grid,
    'longitude': longitudes_grid,
    't2m': t2m[:].flatten()})
df.to_csv(filename, index=False)
print('Done')
```

Please note that the netCDF file could contain an additional dimension when there is a mix of ERA5 and ERA5T data. For more details please have a look at the following link: ERA5 CDS requests which return a mixture of ERA5 and ERA5T data

Second option : Panoply

A second option is to convert the data using the NASA 'Panoply' software. User can find the option under File Export data As CSV. The data are saved in the file maintaining the structure of the lot/lan matrix, but different times are divided by an empty row.



Third option : Windows users

A third option to convert the data from NetCDF to CSV, for Windows users, is download and install **netcdf4excel.** The plug-in opens directly NetCDF files in Microsoft Excel maintaining conventions for the NetCDF variables. Please see the link for more details: http://netcdf4excel.github.io/.

Other solutions

For Unix users, there are others options provided by some common NetCDF software packages. Please the links for more details:

- ncdump http://manpages.ubuntu.com/manpages/xenial/man1/ncdump-hdf.1.html
- cdo https://code.mpimet.mpg.de/projects/cdo/wiki/Tutorial
- ncks https://www.unidata.ucar.edu/support/help/MailArchives/netcdf/msg08405.html

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