Day 2

Practice Note

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Aim of this practice and your tasks (この実習と課題について)

The aim of this practice is to experience data analysis with Fortran 90/95 using varieties of global data. Students are obligated to write a report and have an oral presentation for the result of this analysis. Students can choose any theme that relates to global land-use-change and environmental problems. Any data, irrespective of it is included in the distribution library or not, can be used for the analysis. However, the land-use-change data must be included for the analysis.

配布ファイル群に含まれているデータセットを用いて、Fortran90/95 による基本的なデータ解析法を学ぶ。出席者は、この解析結果を基にレポートを作成し、口頭発表を行うこと。テーマは「土地利用と環境問題」に関するものであれば何でも OK。添付したもの以外のデータセットを使っても良いが、解析には土地利用変化のデータセットは必ず含めること。

Introduction for gnuplot, a free graphing utility (gnuplot の紹介)

Gnuplot is a free graphing utility for multi platforms. Gnuplot supports many types of plots in both 2D and 3D. It can draw using lines, points, boxes, contours, vector fields, surfaces, and various associated text. In this lecture, we employ the gnuplot for visualizing results of data analysis. However, student can either use the gnuplot or other visualizing applications, such as R and Excel.

●Install (For MS-Windows)：
(1) Uncompress the install package “gp440win32.zip” onto “C:¥”.
(2) Execute “C:¥gnuplot¥binary¥wgnuplot.exe”, then command line of the gnuplot will be appeared on the screen. Input “plot sin(x)” on the command line, and conform that the gnuplot draw the graph. If letters on the command screen is foggy, right click on the screen, then “Choose font”.
(3) Establish command path to the above folder so that the gnuplot can be used from any folder. Right click on the “My computer”-> “Properties”-> “Detailed setting” ->

“Environmental variables” -> “User variables” -> “Path” -> “Edit” -> “Variables” -> Add following characters “;C:¥gnuplot¥binary”.
(4) Conform the above path was established. Launch command prompt, then input “wgnuplot”.

●Basic usage
To test the following command, copy sample data file “dat_sample.txt” in the distribution library to the working directory.

(1) Scatter chart with line connects
- plot ‘dat_sample.txt’ with linespoints

(2) Scatter chart with columns 2 and 4
- plot ‘dat_sample.txt’ using 2:4 with linespoints

(3) 3D plot with values in columns 1, 2, and 4.
- splot ‘dat_sample.txt’ using 1:2:4 with linespoints

(4) Multiple plots on a same graph
- plot ‘dat_sample.txt’ using 1:2 with linespoints, ‘dat_sample.txt’ using 1:3 with linespoints

For more information about gnuplot, refer following websites
http://t16web.lanl.gov/Kawano/gnuplot/ (in Japanese)
http://t16web.lanl.gov/Kawano/gnuplot/index-e.html (in English)

A sample program for data analysis (解析用サンプルコード)

Following code (data_analyzer1.f90) computes fraction of each land-use type for each year, and write them on a file. For visualizing the resultant file, input the following command on the gnuplot.

- plot "result1.txt" using 1:2 with linespoints, "result1.txt" using 1:3 with linespoints, "result1.txt" using 1:4 with linespoints, "result1.txt" using 1:5 with linespoints

```
PROGRAM data_analyzer1
Implicit none

!_______ Set Fixed values _______
```

```
    integer,parameter::Row_max =   64
    integer,parameter::Col_max = 128

!_______ Define variables _______
    !Land Use Map (fraction, 0.00~1.00) (Left Upper corner= N90,W180)
    real frac_v(1:Row_max, 1:Col_max, 1701:2005) !Primary forest
    real frac_s(1:Row_max, 1:Col_max, 1701:2005) !Secondary forest
    real frac_p(1:Row_max, 1:Col_max, 1701:2005) !Pasture
    real frac_c(1:Row_max, 1:Col_max, 1701:2005) !Cropland

    !Variables for other usage
    integer year, row, col, count
    real value(4)

!_______ Read landuse data _______
write(*,*) 'Now reading landuse data'
    Open (10, file='dat_Land_Use.txt', status='OLD')
    Do year=1701, 2005
        do row=1,Row_max ; read(10,*) frac_v(row,:,year) ; enddo
        do row=1,Row_max ; read(10,*) frac_s(row,:,year) ; enddo
        do row=1,Row_max ; read(10,*) frac_c(row,:,year) ; enddo
        do row=1,Row_max ; read(10,*) frac_p(row,:,year) ; enddo
        write(*,'(a)',advance='no') '.'
    End do
    Close(10)

!_______ Output fraction of landuse types for each year _______
    Open (10, file='result1.txt')
    write(10,*) '#Year NaturalVeg 2ndForest CropLand Pasture'
    Do year=1701, 2005

        !Initialize variables
        value(:) = 0.0
        count = 0

        !Sumup land use type for all terrestrial surface
```

A way to set constant parameters

```
        do row=1,Row_max
        do col=1,Col_max
        if ( frac_p(row,col,year) <= 1.0 ) then !in case of land surface
            value(1) = value(1) + frac_v(row,col,year)
            value(2) = value(2) + frac_s(row,col,year)
            value(3) = value(3) + frac_c(row,col,year)
            value(4) = value(4) + frac_p(row,col,year)
            count = count + 1
        endif
        enddo
        enddo

        !Calculate fraction of each land use type
        value(:) = value(:) / real(count)

        !Write resultant variables
        write(10,*) year, value(1), value(2), value(3), value(4)
    End do
    Close(10)

END PROGRAM
```

Drill (演習問題)

Using data sets of land-use-change and potential-vegetation-map, compute fraction of cropland and pasture at the year of 2005 for grid cells whose potential vegetation is arid vegetation (Savanna, Grassland/Steppe, Shrubland). Conduct same computation for temperate forest (Broad leaf evergreen, Needle leaf evergreen, Deciduous).

Data sets in the distribution library (配布ライブラリ中のデータセットの説明)

Land use change

●File name:
dat_Land_Use.txt

●Coordinate:
T42 Gaussian coordinate system (128*64, Global)

●Data order (From innnermost):
128 Longitude, 64 Latitude, 4 Land use type (Natural vegetation, Secoundary forest, Crop land, Pature), 305 Year (1701~2005)

●Unit:
Fraction

●Undefined value (for water surface grids):
9.000

●Source of the original data:
RCP scenario for IPCC's Fifth Assessment Report (Not yet open to the public)

Potential Vegetation

●File name:
dat_Potential_Veg.txt

●Coordinate:
T42 Gaussian coordinate system (128*64, Global)

●Data order (From innnermost):
Longitude -> Latitude

●Unit: Potentail Vegetation Code
0 Water
1 Tropical Evergreen Forest/Woodland
2 Tropical Deciduous Forest/Woodland
3 Temperate Broadleaf Evergreen Forest/Woodland
4 Temperate Needleleaf Evergreen Forest/Woodland
5 Temperate Deciduous Forest/Woodland
6 Boreal Evergreen Forest/Woodland
7 Boreal Deciduous Forest/Woodland
8 Mixed Forest
9 Savanna
10 Grassland/Steppe
11 Dense Shrubland
12 Open Shrubland

13 Tundra
14 Desert
15 Polar desert/Rock/Ice

●Source of the original data:
ISLSCP2, http://islscp2.sesda.com/ISLSCP2_1/html_pages/islscp2_home.html

Global spatial data set for total (aboveground and belowground) biomass

●File name:
dat_Biomass.txt

●Coordinate:
T42 Gaussian coordinate system (128*64, Global)

●Data order (From innnermost):
Longitude -> Latitude

●Unit: Kg C/m2

●Source of the original data:
International Institute for Applied Systems Analysis,
http://www.iiasa.ac.at/Research/FOR/biomass.html

Soil Organic Carbon Density (0-1m depth)

●File name:
dat_SOC.txt

●Coordinate:
T42 Gaussian coordinate system (128*64, Global)

●Data order (From innnermost):
Longitude -> Latitude

●Unit: Category code
0 : Background
1 : 0-4 kgC/m2
2 : 4-8 kgC/m2
3 : 8-12 kgC/m2
4 : 12-16 kgC/m2
5 : 16-24 kgC/m2

6 : 24-36 kgC/m2
7 : 36-48 kgC/m2
8 : >48 kgC/m
9 : Glaciers
10 : Oceans & Inland waters

●Source of the original data:
Global Data Set of Derived Soil Properties, 0.5-Degree Grid (ISRIC-WISE), http://daac.ornl.gov/cgi-bin/dsviewer.pl?ds_id=546

World population change

●File name:
dat_Population.txt

●Data order (From innnermost):
7 Area (World, Africa, Asia, Europe, South Africa & Caribbean, North America, and Oceania) -> 301 Year (1750-2150)

●Unit:
million person

●Source of the original data:
Population of the world and its major areas *in* The World at Six Billion, UN, (1999), http://www.un.org/esa/population/publications/sixbillion/sixbilpart1.pdf

World major crops production

●File name:
dat_Crop_Production.txt

●Data order (From innnermost):
4 crop type (Weat, Barley, Rice, Maize) -> 48 Years (1961~2008)

●Unit:
million ton/year

●Source of the original data:
FAOSTAT, © FAO Statistics Division 2010 | 30 July 2010, http://faostat.fao.org/

World live animals

●File name:

dat_LiveAnimals.txt

●Data order (From inner most):
4 Animal Types(Cattle, Goat, Pig, Sheep) -> 48 Year (1961~2008)

●Unit:
million

●Source of the original data:
FAOSTAT, © FAO Statistics Division 2010 | 30 July 2010, http://faostat.fao.org/

CO_2 emission

●File name:
dat_CO2_a1b.txt

●Data order (From innnermost):
351 Years (1750-2100)

●Unit:
ppm

●Source of the original data:
1750~1957, Interporated on the assumption that CO_2 concentration was 284.6ppm at 1750
1958~2009, Observation data at Mauna Loa,
ftp://ftp.cmdl.noaa.gov/ccg/co2/trends/co2_mm_mlo.txt
2009~2100, Predictions from ISAM and BERN under IPCC's A1B scenario
http://www.ipcc-data.org/ancilliary/tar-isam.txt
http://www.ipcc-data.org/ancilliary/tar-bern.txt
http://en.wikipedia.org/wiki/Special_Report_on_Emissions_Scenarios

Other useful databases

●World population prospects: The 2008 Revision Population Database
(Birth rate, Death rate, etc...)
http://esa.un.org/UNPP/index.asp?panel=2