

Preparation on your laptop

Hisashi SATO (JAMSTEC)

1) Installation of G95

In this training course, we employ the G95, a free Fortran compiler. The installer of G95 ([g95-minGW.exe](#)) will ask you to locate the install folder on your PC. You can answer as you like (ex: C: ¥g95). For other questions, just reply “yes” or “ok”, basically.

On somewhere you like, create a new folder whose name is “[fortran](#)”. Within this folder, create a shortcut of command prompt. Right click on the shortcut→ Select “[property](#)”→ “[Shortcut](#)” tab→ “[Working folder](#)”. Delete all letters within this entry. By this modification, folder “[fortran](#)” becomes the working folder for command-prompt screen that was launched by this short cut.

2) Confirmation of the install

Create a new text file in the working folder. Rename the file to “[hello.f90](#)”. Using a text editor, write following code on the file, and save it.

<pre>! Sample program Program sample1 write(*,*) "Hello" End Program</pre>	Letters after “!” are regarded as comments
	Letters within double quotation are regarded as characters, not a variable

To compile this source code into an execution file, type “[g95 hello.f90](#)” in the command prompt. After a short time, you can find a new file whose name is “[a.exe](#)” in the working folder. Input “[a.exe](#)” in the command prompt, then it will write “[Hello](#)” on the screen.

Note1

“[a.exe](#)” is the default name for an executable file of G95. The default name depends on compiler. You can specify the name of execution file by adding a compile option as follows.

```
g95 hello.f90 -o hello.exe
```

In this example, name of execution file will be "hello.exe".

Note2

Here's are tips on the Windows command prompt and the Unix command line.

Up/down arrow keys	: Recall commands beginning with the most recent one
Tab key	: Suggests names for files and folders
exit	: Terminate command prompt

3) Compile and execution of the SEIB-DGVM

In the file package I distributed, you can find folder "seib-code", which contains code files (*.f90), a parameter file (parameter.txt), and forcing data (*.txt) of the SEIB-DGVM. Copy this folder into the above folder "fortran". In the command prompt screen, type "cd code" and "g95 start_point.f90", then all of the code files will be automatically compiled into an execution file "a.exe". Then, type "a.exe" to execute. After the while, you can find result files (output_*.txt) within the same folder.

Note (To change the place of simulation)

- (1) Specify the latitude and longitude of the simulation location by modifying variables "LAT" and "LON" on the [start_point.f90](#) (around line 60). Then compile again.
- (2) Modify the specification for the climate data file by changing parameter "Fn_climate" on the line 14 of "[parameter.txt](#)". Within the file package I distributed, you can find climate data files of several example locations. For simulating other locations, you can generate climate data with the web-service at http://seib-dgvm.com/data_server2.html

4) Visualization of the simulation result 1

SEIB-Viewer is a MS-Windows application, which visualizes simulation output from the SEIB-DGVM. SEIB-Viewer does not require install procedure, and it does not modify registry. Copy the folder "SEIB-Viewer" on any place on your PC, just double click [SEIB-Viewer.exe](#) in the folder to lunch the program. Then, open "output.txt" file in the execution folder. Further explanations of this software can be found in help file that can be accessed from the application.

Note (only for Windows-XP or Windows-98 family users)

To execute SEIB-Viewer, '.NET Framework 2.0' should be installed beforehand. This can be installed via Windows Update or via installer, which you can find on the following URL.

<http://msdn.microsoft.com/en-us/vstudio/aa496123> (English)

<http://msdn.microsoft.com/ja-jp/vstudio/aa496123> (Japanese)

You have to select proper version for your environment from three installers (32bit:x86, 64bit:x64, 64bit:IA64). If you are not sure which to select, I suggest install it via Windows Update.

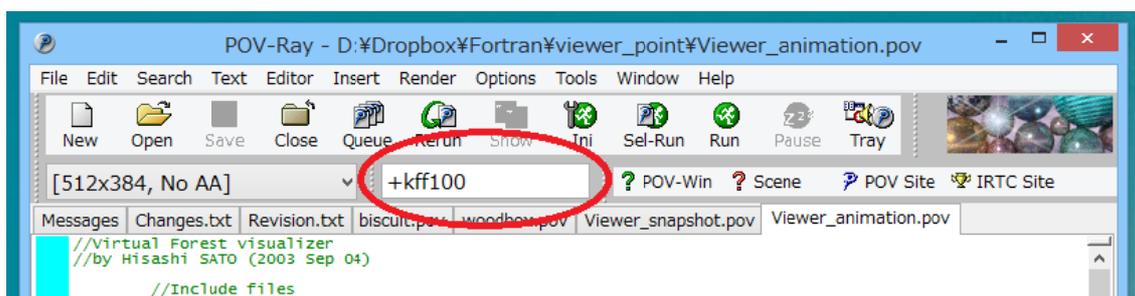
5) Visualization of the simulation result 2 [Optional]

SEIB-DGVM output the simulated 3D-forest-structure into the "output_forest.txt" for each simulation year. This image file can be visualized with the POV-Ray (<http://www.povray.org/>), which is a free rendering software.

- (1) Install the POV-Ray software. Its installer is separated into two files due to a license reason. First, execute the "[povwin-3.7-agpl3-setup.exe](#)", then execute "[povwin-3.7-editor.exe](#)".
- (2) You can find 3D-visualization-code "[Viewer_snapshot.pov](#)" within the distribution package. Double click the code file, then the POV-Ray will open the code in the editorial window.
- (3) In the editorial window, you can find the line "[#declare year = 100;](#)". By replacing the value in this line, you can specify the simulation year for visualize. In the pull down selector on the left-top, you can change the picture-size and quality of the rendering image.
- (4) Push the "Run" button (or Alt+g) lets the POV-Ray reads "[output_forest.txt](#)" within the same folder, then generates a 3D-image. This image is automatically saved as a bitmap file "[Viewer_snapshot.bmp](#)" on the same folder.
- (5) In the visualization code, lines start with double slash "///" are regarded as comment line in the POV-Ray. I prepared various settings of view angles for the simulated forest as comment lines.

Note (For generating sequential images)

Another POV-Ray code “Viewer_animation.pov” is for generating sequential images (1 year interval) of the changes of the simulated forest. If you generate sequential images for 100 years, for example, specify “#declare Flame = 100;” in the code. In the command line (red circle area in the following picture), which you can find on the upper middle of the screen, input “+kff100”. Just a single push of the “Run” button, POV-Ray will generate a sequential images of the virtual forest during 100 years. Do not forget to erase “+kff100” in the command line for visualizing single year, or the POV-Ray will generate 100 images each time for your single click of the run button.



Note that the sequential images can be converted into the animation file with some free software such as AviMaker (<http://www.vector.co.jp/soft/win95/art/se121264.html>).

Exercises with the SEIB-DGVM

1) Comparison between evergreen and deciduous forests, both of which are simulated at Tokyo region.

Compare patterns of seasonal changes between evergreen and deciduous forests, both of which are simulated in Tokyo. For this simulation, start_point.f90 and parameter.txt should be modified as follows.

Common setting 1: Line60 of start_point.f90

```
LAT = 35.7; LON = 139.77 !Tokyo
```

Common setting 2: Line14 @ parameter.txt

```
Fn_climate = 'Climate_Tokyo(1901~2005).txt',
```

Setting for simulation #1, which allows only **PFT8 (Temperate broad-leaved evergreen)** to establish, modify the parameter.txt (around lines 210) as follows:

```
Est_scenario = 1,  
Est_pft_OnOff = .false.,.false.,.false.,.false.,.false.,.false.,  
                .false.,.true.,.false.,  
                .false.,.false.,.false.,.false.,.false.,
```

Setting for simulation #2, which allows only **PFT9 (Temperate broad-leaved summer green)** to establish, modify the parameter.txt (around lines 210) as follows:

```
Est_scenario = 1,  
Est_pft_OnOff = .false.,.false.,.false.,.false.,.false.,.false.,  
                .false.,.false.,.true.,  
                .false.,.false.,.false.,.false.,.false.,
```

Definitions of an establishment parameter "Est_scenario" can be found at the bottom of the "parameter.txt".

Figure 1. Results in physiognomy from the simulation #1 (left) and #2 (right). 100 years from bare ground (Location: Tokyo, Climatic condition: years during 1901~2000, Atmospheric CO₂: 368ppm, One side of the forest stand: 30m).

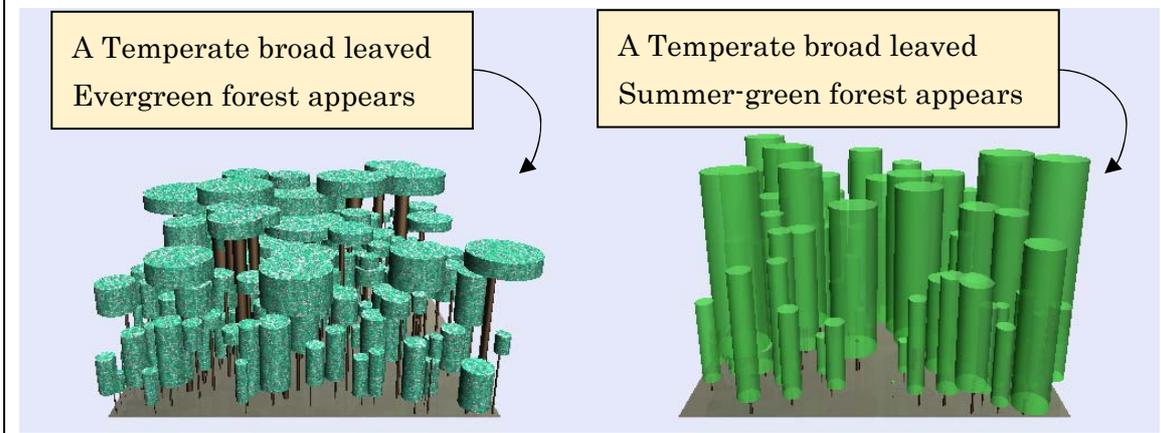


Figure 2. Results from the simulation #1 (left) and #2 (right). Seasonal changes in the LAI (Upper panels) and GPP (lower panels). Blue, brown, and red lines indicate PFT8, PFT9, and C3 grass PFT, respectively.

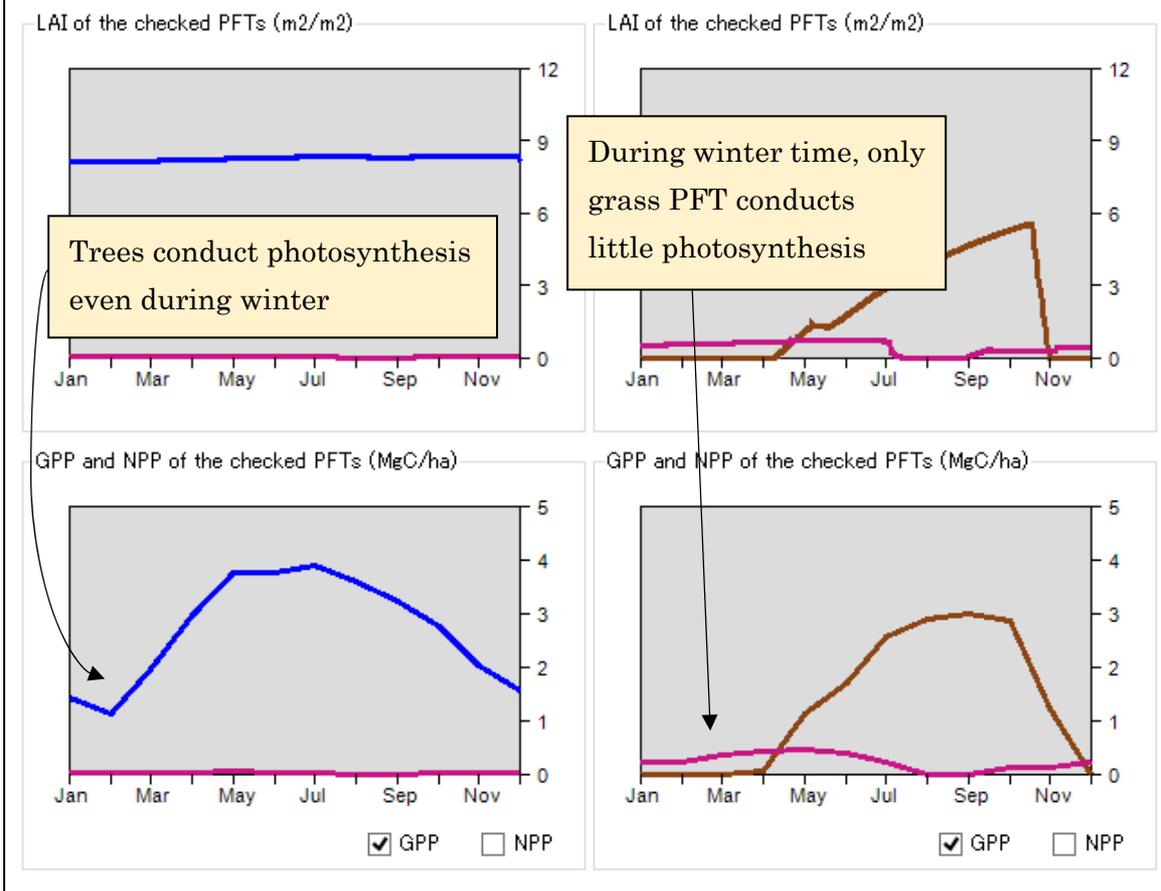
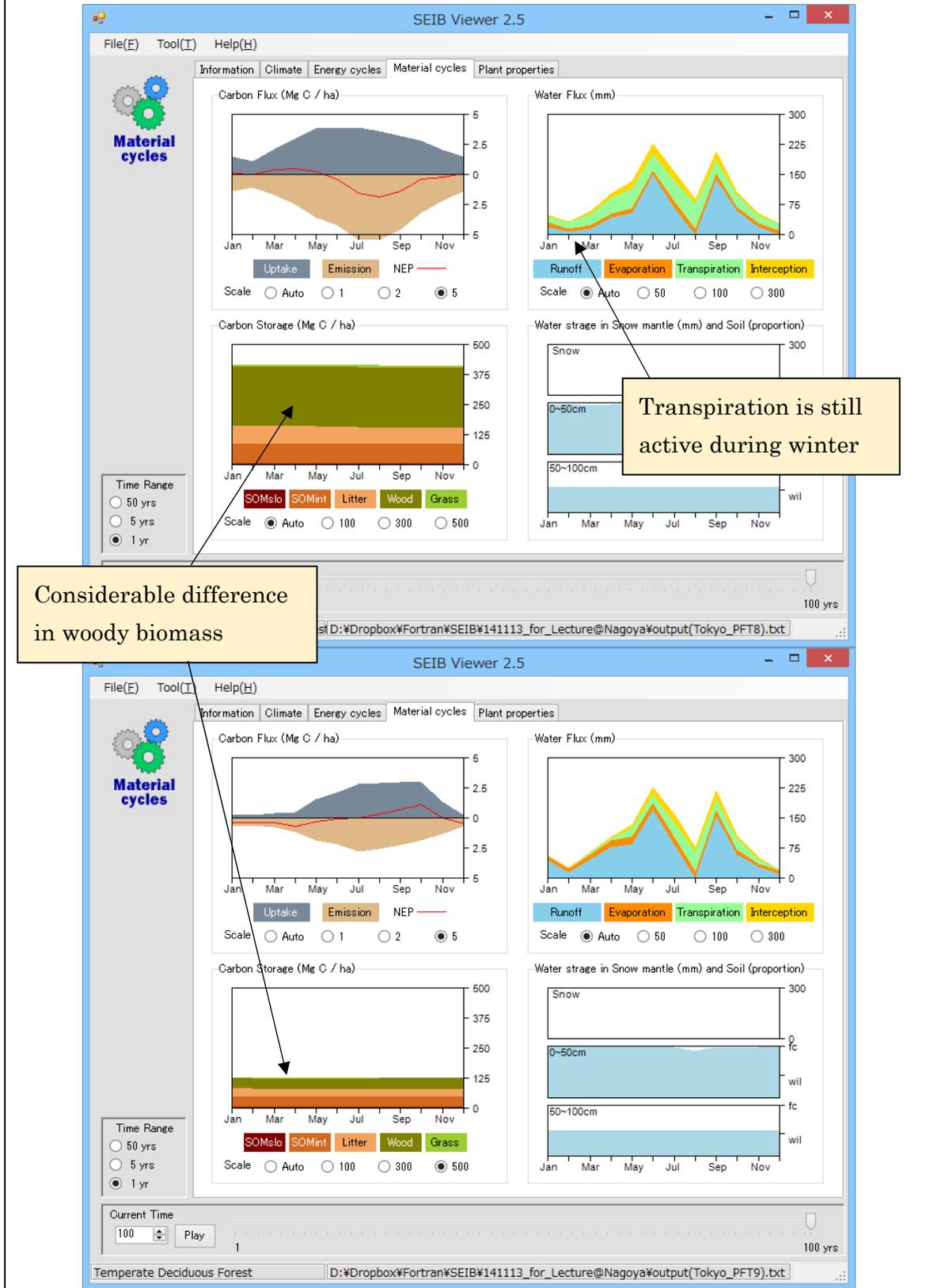


Figure 3. Results in material cycle from the simulation #1 (Upper) and #2 (lower). Visualized with the SEIB-Viewer.



2) Secondary succession in tropical rain forest (Simulation @ Pasoh, Peninsula-Malaysia).

Purpose: Observe secondary succession at Pasoh (Peninsula Malaysia), where Dipterocarp tropical-rain forest covers.

Setting 1: Line 63 of start_point.f90

```
LAT = 2.97; LON = 102.3 !Pasoh
```

Setting 2: Line14 of parameter.f90

```
Fn_climate = 'Climate_Pasoh(1901~2005).txt',
```

Setting 3: Line2 of parameter.f90

```
Simulation_year = 150
```

Setting 4: Line209 of parameter.f90

```
Est_scenario = 2,
```

In this simulation, secondary succession from the PFT3 (pioneer species, which lacks shade tolerance) dominant forest to the PFT1 (climax species, which have high shade tolerance) dominant forest occurs. However, occasional gap-formations provide bright environmental condition on the forest floor, and some fraction of PFT3 can be remained after 150 years of the simulation.

In simulations of tropical rain forest with the SEIB-DGVM, collapse of large trees can pull down surrounding healthy trees resulting in formation of large large gaps, which can be actually observed in nature. So, what will happen if this large gap formation mechanism is disabled by modifying the code as follows?

Comment out line 1071 of population_regu.f90 as follows

```
!death_list_gap(i)=.true.
```

3) CO₂ enrich experiment in a semi-arid vegetation (Simulation @ Angora, African continent).

Climatic condition of Angora is typical "Tropical savanna climate", which has distinct wet and dry seasons of relatively equal duration. The potential vegetation here is savanna, a

sparse forest of Tropical broad-leaved raingreen trees (PFT6) mixed with dence C4-grass (PFT16) layer. Confirm how the SEIB-DGVM reproduces vegetation here.

Setting 1: Line 63 of start_point.f90

LAT =-15.0; LON = 15.0 !People's Republic of Angola

Setting 2: Line14 of parameter.txt

Fn_climate = 'Climate_Angola(1901~2005).txt',

Setting 3: Line209 @ parameter.txt

Est_scenario = 2,

This is water limited vegetation. So, what happens under doubled atmospheric CO₂ condition, which should lower the stomata conductance resulting in higher water-use-efficiency of photosynthesis?

Modification for the higher atmospheric CO₂ concentration: Line29@main.f90

real,parameter::CO2atm_default = 700.0

In the CO₂ enriched experiment, biome shift from savanna to tropical seasonal forest occurs. This biome shift goes with notable increase of tree biomass. So, what happens on a non-water-limited vegetation under CO₂ enriched environment. Conduct CO₂ enriched experiment for the tropical rain forest in Pasoh.

Setting 1: Line 63 of start_point.f90

LAT = 2.97; LON = 102.3 !Pasoh

Setting 2: Line14 of parameter.f90

Fn_climate = 'Climate_Pasoh(1901~2005).txt',

Setting 3: Line209 of parameter.f90

Est_scenario = 2,

Setting 4: Line29 of main.f90

real,parameter::CO2atm_default = 700.0

References for the SEIB-DGVM

General description

Sato H, Itoh A, Kohyama T (2007)

SEIB-DGVM: A New Dynamic Global Vegetation Model using a Spatially Explicit Individual-Based Approach. *Ecological Modelling* 200(3-4), 279-307.

Modifications for tropical rain forest

Sato H (2009)

Simulation of the vegetation structure and function in a Malaysian tropical rain forest using the individual-based dynamic vegetation model SEIB-DGVM. *Forest Ecology and Management* 257(11), 2277-2286

Modifications for larch forest in Siberia

Sato H, Kobayashi H, Delbart N (2010)

Simulation study of the vegetation structure and function in eastern Siberian larch forests using the individual-based vegetation model SEIB-DGVM. *Forest Ecology and Management*, 259, 301-311

Modifications for African vegetation

Sato H, Ise T (2012)

Effect of plant dynamic processes on African vegetation responses to climate change: analysis using the spatially explicit individual-based dynamic global vegetation model (SEIB-DGVM). *Journal of Geophysical Research - Biogeosciences* 117

Applications to the Japanese ESM

Watanabe S, Hajima T, Sudo K, Nagashima T, Takemura T, Okajima H, Nozawa T, Kawase H, Abe M, Yokohata T, Ise T, Sato H, Kato E, Takata K, Emori S, Kawamiya M (2011)

MIROC-ESM: model description and basic results of CMIP5-20c3m experiments. *Geosci. Model Dev. Discuss.*, 4, 1063-1128

Acknowledgements

The SEIB-DGVM has been developed under the following budgets and projects.

2013.4-2016.3:

MEXT/JSPS KAKENHI Grant Number 25281003.



2012.10-2018.3: Program for Risk Information on Climate Change:Theme D
"Eco-climate system in Northeastern Eurasia and Southeast Asian tropics:
impacts of global climate change"



2012.2-2014.2: A research grants, Foundation for the Fusion Of Science and
Technology (FOST)



2010.1-2014.3: Nagoya University Global COE Program "From Earth Science
to Basic and Clinical Environmental Studies"



2007.4-2012.3: Innovative Program of Climate Change Projection for the 21st
Century, MEXT



2002.4-2007.3: Research Project for Sustainable Coexistence of Human,
Nature, and the Earth