General description of a MixFor-SVAT model

The Mixfor-SVAT model is an one-dimensional process-based SVAT model for parameterisation of the energy, H_2O and CO_2 exchange between multi-specific and vertically structured forest stand and the atmosphere. It allows integrating the horizontal homogeneity of the forest stand with three-dimensional features of forest canopy, such as multi-specific structure, and different heights, leaf area index (LAI), crown shapes and foliage distributions of the different tree species. The Mixfor-SVAT model assumes that all trees of the different species are evenly distributed over the homogeneous ground surface area (at least 1 ha) and there are not any differences between trees of the same species. Horizontal advection of energy, water and CO_2 through the boundaries of the modelled forest plot is not taken into account, too.

Mixfor-SVAT consists of several closely coupled sub-models describing:

- solar radiation transport within a vertically structured forest canopy;
- turbulent exchange of momentum, sensible heat, H_2O, CO_2 within and above a forest canopy;
- transpiration of different tree species, and of different sub-layers of forest overstorey and understorey;
- water uptake by roots and water transport through the roots, trunk and branches to the leaves of different tree species and understorey plants;
- interception, storage and evaporation of intercepted rain water and dew by different sub-layers of forest overstorey and understorey;
- evaporation of bare soil;
- photosynthesis and respiration of living and dead biomass of the trees and plants, partitioning of CO_2 fluxes among different tree species and overstorey and understorey sub-layers;
- heterotrophic respiration of soil;
- thermal heat and water exchanges in soil.

Coupling of the different sub-models is based on aggregated solution and closing the energy and water balance equations for individual tree species, different canopy layers, and the entire forest stand. Iteration procedures allow determining for each time step (15-60 minutes) the energy, water vapour and CO_2 fluxes for both entire forest ecosystem and each canopy sub-layer. Additionally Mixfor-SVAT allows describing:

- vertical profiles of air and canopy temperatures, specific humidity, CO_2 concentration within and above a forest stand;

- vertical profiles of the temperature and moisture in soil;
- fractions of wet and dry leaf surface for each canopy sub-layer and tree species;
- leaf water potentials for each tree species and sub-layer in forest overstorey and understorey;
- water uptake rates and storages for each tree species in a forest stand.

Required meteorological information for model calculations includes measured or predicted air temperature, air specific humidity, wind speed, global radiation, precipitation rate and CO_2 concentration at some reference height above a forest stand within the atmospheric surface layer.

All forest vegetation in the model is divided into two main layers (overstorey and understorey) and many sub-layers within these main layers. Tropical rain forests are usually characterised by a very complex and layered structure which renders it very difficult to distinguish the forest overstorey and understorey. In our study the vegetation height was used as criteria for forest understorey. For tropical forest with mean height of about 30 meters all vegetation types with a mean height less than 2 meters was referred as an understorey, and all tree types that mean height is more than 2 meters – as an overstorey.

The main concept used in the Mixfor-SVAT model is an aggregated description of the physical and biological processes on different spatial scales of a forest ecosystem: individual leaf, canopy sub-layer, individual tree (plant) and entire ecosystem (Fig. 1-4). For description of the different scale processes in multi-species forest ecosystems the model uses both species specific and species averaged input parameters. Thus, for description of the processes occurring inside an individual leaf or tree (e.g. transpiration, water uptake, interception, water storage, photosynthesis, respiration) the model uses individual species specific input parameters. On the other hand, for parameterisation of exchange processes between different tree species within each sub-layer, as well as for description of the processes on ecosystem scale (e.g. turbulent exchange, radiation transport) the model uses species averaged parameters of vegetation cover (e.g. morphological and physical properties of the canopy). These effective parameters are calculated for each individual canopy sub-layer from individual properties of tree species taking into account the vertical distributions of living and dead biomass of the trees. Total leaf (LAD) and plant (PAD) area density are calculated for each canopy sub-layer by integration of LAD and PAD of individual tree species.

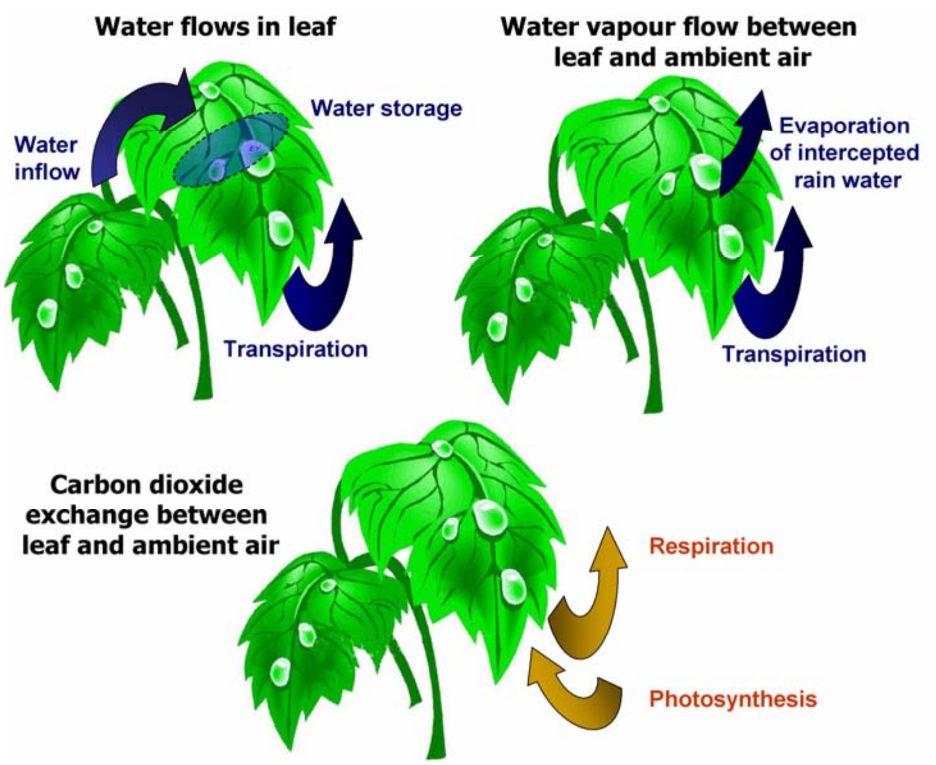


Fig. 1: H_2O and CO_2 exchange on leaf level: exchange in the leaf and between leaf and ambient air.

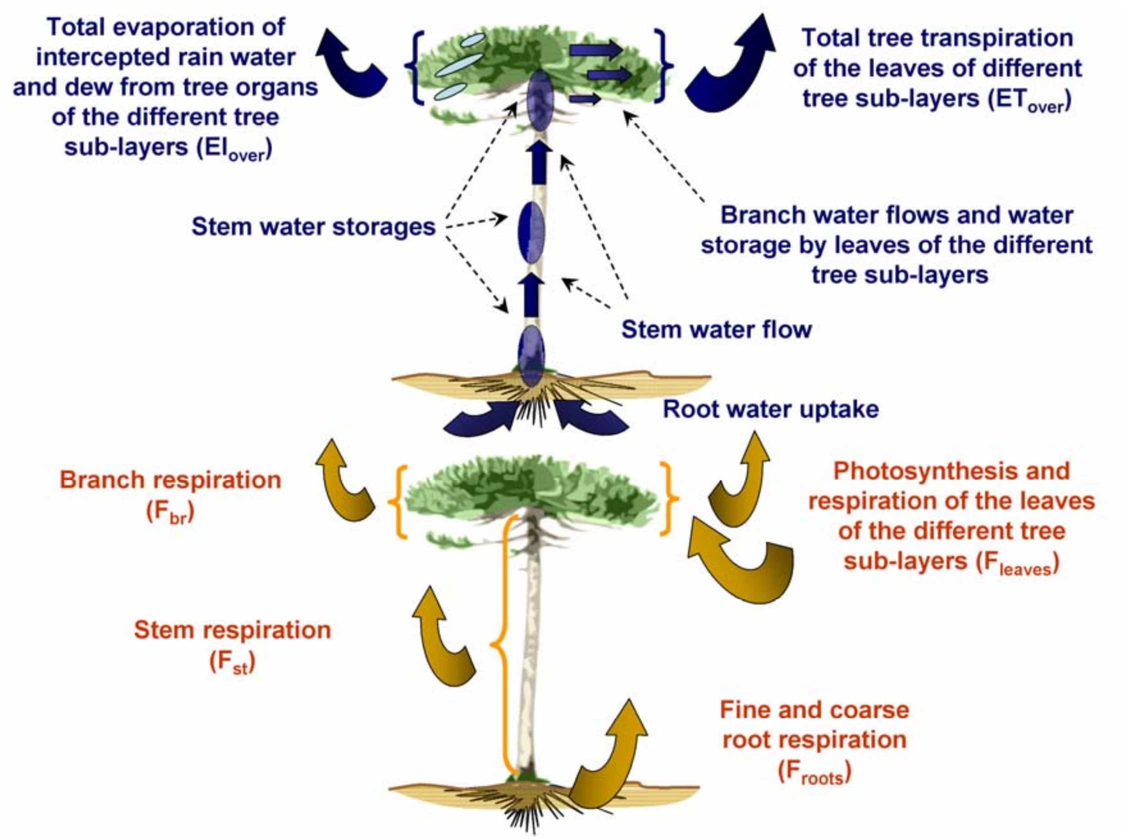


Fig. 2: H_2O and CO_2 exchange on tree level: water flows in tree, as well as H_2O and CO_2 exchanges between tree/plant organs and ambient air.

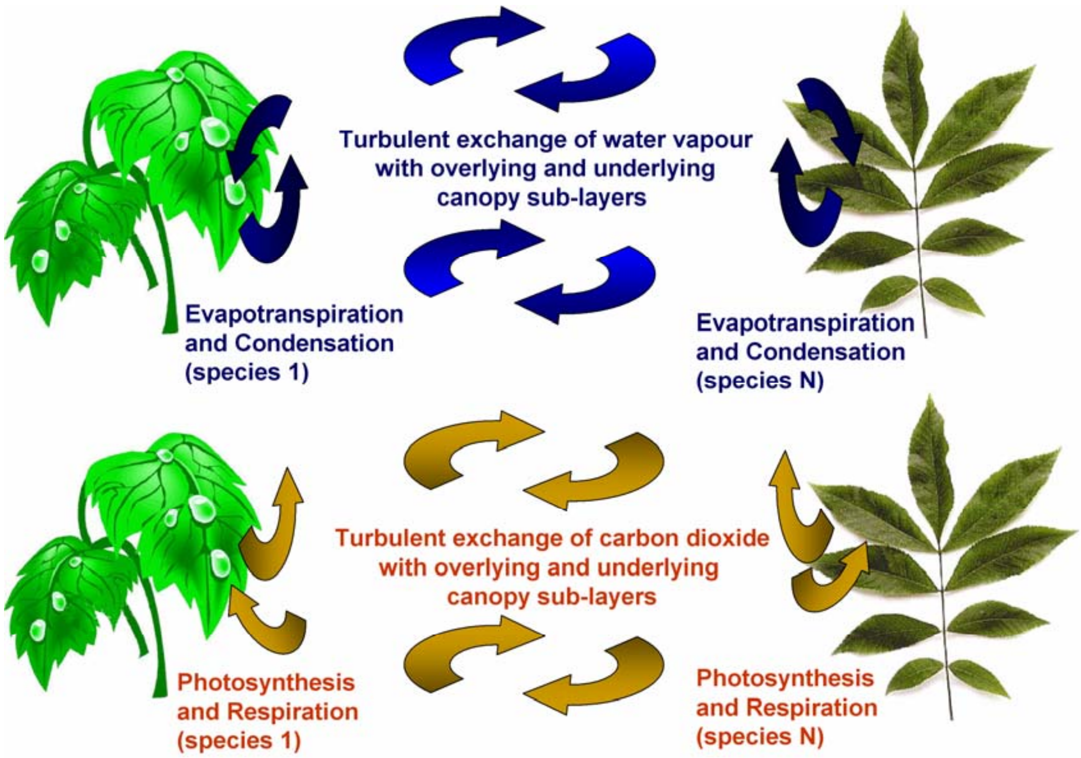


Fig. 3: H_2O and CO_2 exchange within an individual canopy sub-layer, as well as the exchange with overlying and underlying canopy sub-layers in multi-species forest stand.

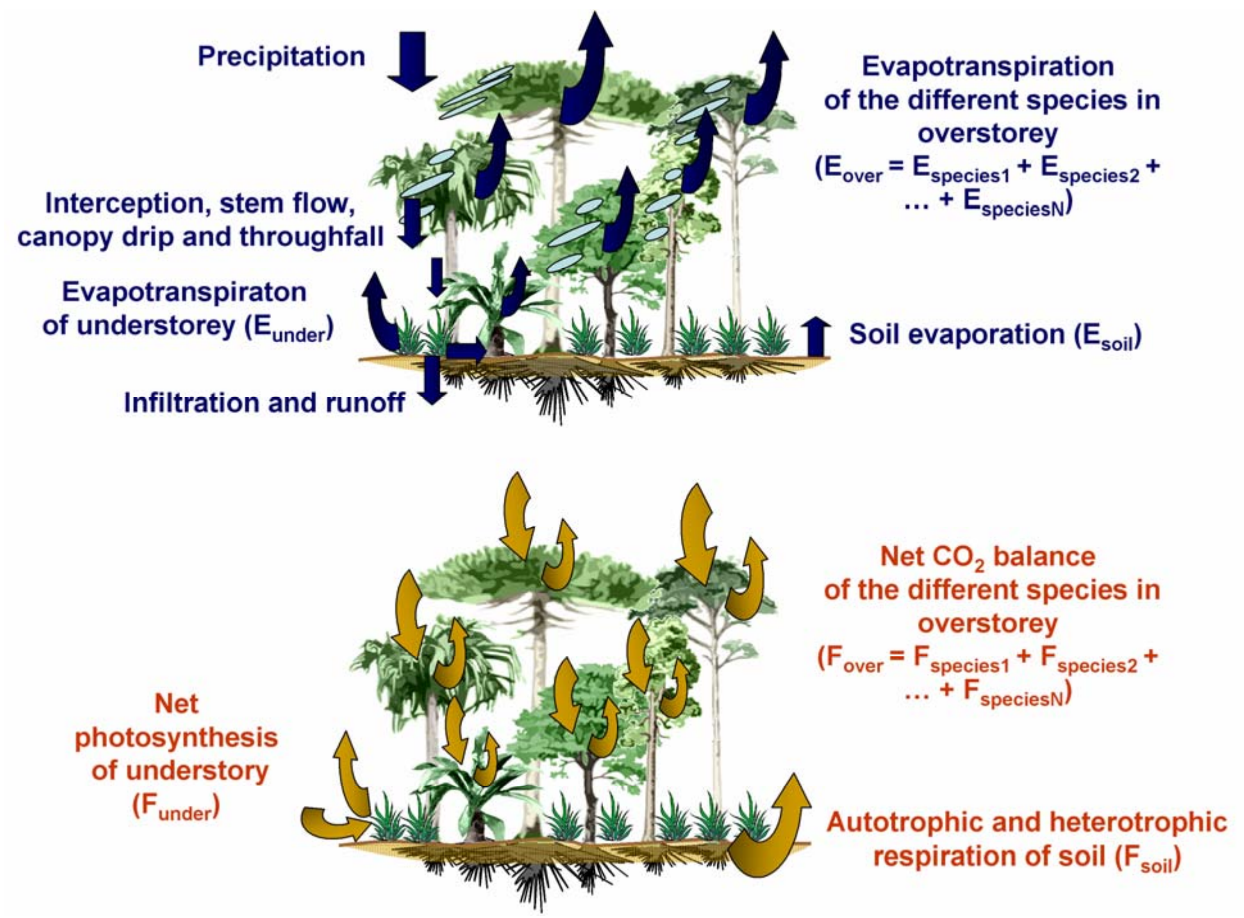


Fig. 4: H_2O and CO_2 fluxes between multi-species forest ecosystem and the atmosphere.

Program structure

The MixFor-SVAT model is written in Fortran90 and it consists of one main program and 34 sub-programs which are grouped in 12 following files: *Model.f90, Vodbal.f90, Vodpl.f90, Vodgr.f90, Photo.f90, Rad.f90, Rainfall.f90, Resist.f90, Temper.f90, Mull.f90, Soil.f90, Gfenpssu.f90.*

Model.f90 – the governing program of the MixFor-SVAT model which is responsible for the input of meteorological data, storage of the modelling results, and interaction of the different sub-programs within the model;

Vodbal.f90 - calculation of latent heat fluxes for canopy overstorey and understorey;

Vodpl.f90 – calculation of the water fluxes in canopy overstorey;

Vodgr.f90 - calculation of the water fluxes in canopy understorey;

Photo.f90 – calculation of total CO_2 fluxes and flux partitioning between different canopy layers and tree/plant species;

Rad.f90 – calculation of reflected and transmitted solar radiation within a forest stand, as well as calculation of net radiation of canopy overstorey and understorey;

Rainfall.f90 – calculation of precipitation interception by canopy overstorey and understorey;

Resist.f90 – calculation of vertical profiles of wind speed and turbulent coefficients, as well as calculation of aerodynamic resistances;

Temper.f90 – calculation of sensible heat fluxes for canopy overstorey and understorey;

Mull.f90 – solution of nonlinear equations of the energy balance of canopy overstorey and understorey by means of Mueller's iteration method;

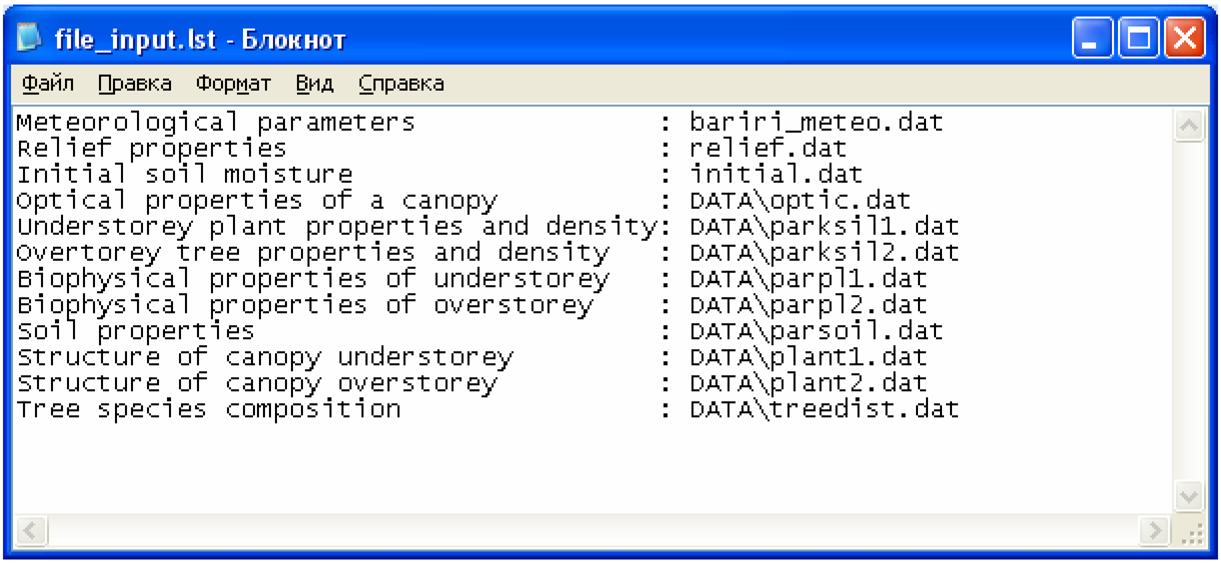
Soil.f90 – calculation of the soil moisture and water fluxes between different soil layers, as well as soil temperature profile and soil heat flux;

Gfenpssu.f90 – file including several sub-programs that are necessary to provide an input of biophysical parameters of the different vegetation types and soil properties, a calculation of psychrometric constant and saturation water vapour for specific temperature, as well as a calculation of G-function and initial vertical distribution of soil moisture.

Input parameters

The names of the files with input data describing meteorological input data, relief properties as well as biophysical properties of vegetation and soil are listed in file "**File_input.lst**":

Example of “**File_input.lst**” file is given below:



file_input.lst - Блокнот

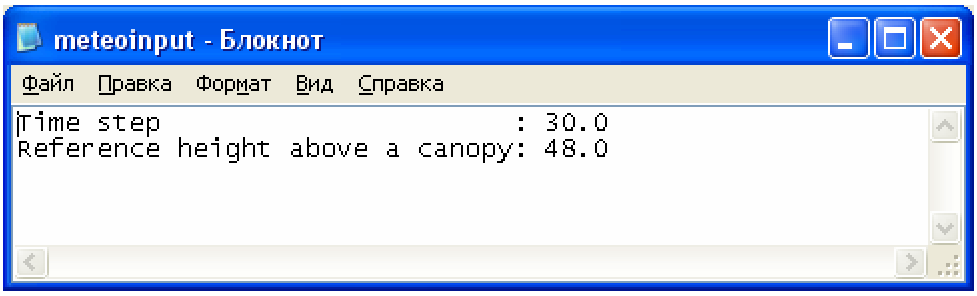
Файл Правка Формат Вид Справка

```
Meteorological parameters                   : bariri_meteo.dat
Relief properties                           : relief.dat
Initial soil moisture                       : initial.dat
Optical properties of a canopy              : DATA\optic.dat
Understorey plant properties and density: DATA\parksil1.dat
Overtorey tree properties and density       : DATA\parksil2.dat
Biophysical properties of understorey       : DATA\parpl1.dat
Biophysical properties of overstorey        : DATA\parpl2.dat
Soil properties                             : DATA\parsoil.dat
Structure of canopy understorey             : DATA\plant1.dat
Structure of canopy overstorey              : DATA\plant2.dat
Tree species composition                    : DATA\treedist.dat
```

Additionally, to quantify geographical coordinates, time step and the height of the upper boundary of model simulations the MixFor-SVAT model uses 2 additional configuration files (**meteoinput.cfg** and **geogr_coord.cfg**).

Meteoinput.cfg includes information about a time step for used meteorological data and corresponding reference height above a plant canopy at which these data were obtained**.**

Example of “m**eteoinput.cfg**” file is given below:



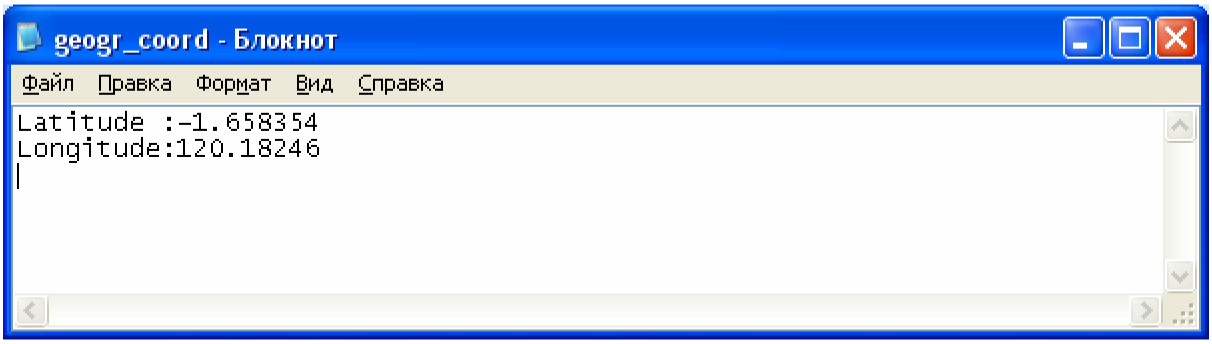
meteoinput - Блокнот

Файл Правка Формат Вид Справка

```
Time step                   : 30.0
Reference height above a canopy: 48.0
```

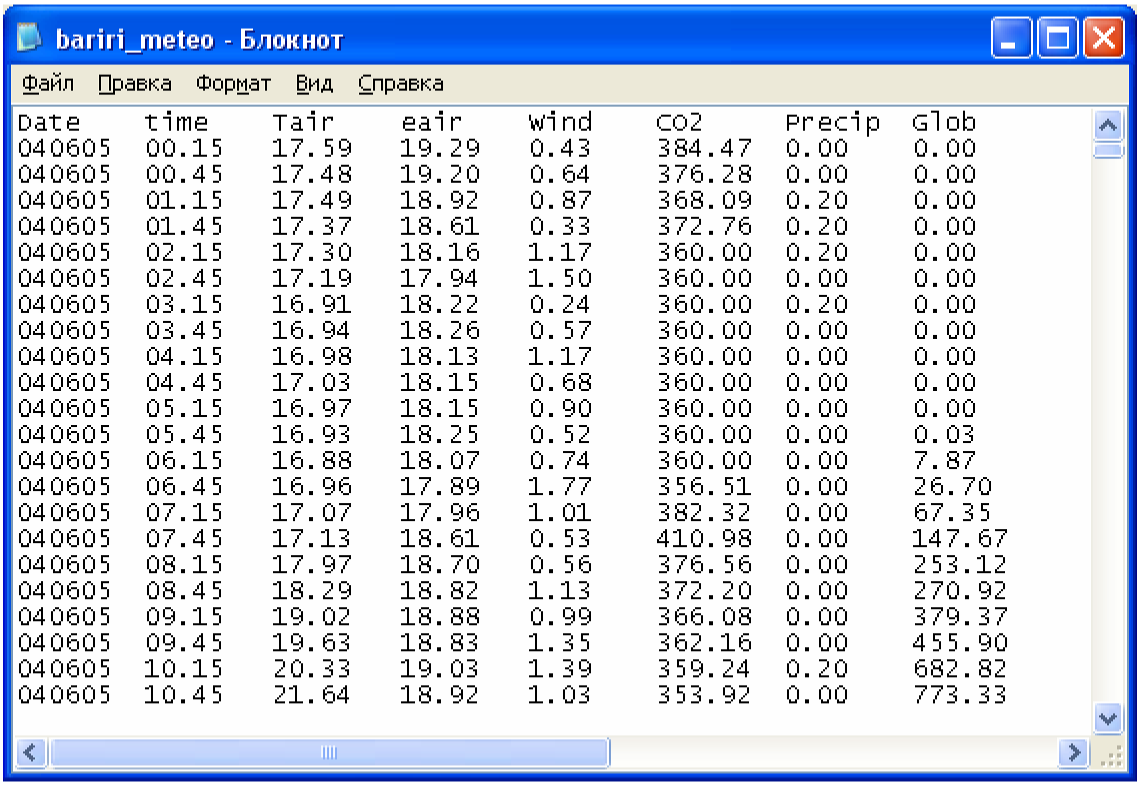
Geogr_coord.cfg includes information about latitude and longitude of study area**.**

Example of “**Geogr_coord.cfg**” file is given below:




```
Latitude :-1.658354
Longitude:120.18246
```

Example of input file with meteorological data “**bariri_meteo.dat**” is given in figure below:



Date	time	Tair	eair	Wind	CO2	Precip	Glob
040605	00.15	17.59	19.29	0.43	384.47	0.00	0.00
040605	00.45	17.48	19.20	0.64	376.28	0.00	0.00
040605	01.15	17.49	18.92	0.87	368.09	0.20	0.00
040605	01.45	17.37	18.61	0.33	372.76	0.20	0.00
040605	02.15	17.30	18.16	1.17	360.00	0.20	0.00
040605	02.45	17.19	17.94	1.50	360.00	0.00	0.00
040605	03.15	16.91	18.22	0.24	360.00	0.20	0.00
040605	03.45	16.94	18.26	0.57	360.00	0.00	0.00
040605	04.15	16.98	18.13	1.17	360.00	0.00	0.00
040605	04.45	17.03	18.15	0.68	360.00	0.00	0.00
040605	05.15	16.97	18.15	0.90	360.00	0.00	0.00
040605	05.45	16.93	18.25	0.52	360.00	0.00	0.03
040605	06.15	16.88	18.07	0.74	360.00	0.00	7.87
040605	06.45	16.96	17.89	1.77	356.51	0.00	26.70
040605	07.15	17.07	17.96	1.01	382.32	0.00	67.35
040605	07.45	17.13	18.61	0.53	410.98	0.00	147.67
040605	08.15	17.97	18.70	0.56	376.56	0.00	253.12
040605	08.45	18.29	18.82	1.13	372.20	0.00	270.92
040605	09.15	19.02	18.88	0.99	366.08	0.00	379.37
040605	09.45	19.63	18.83	1.35	362.16	0.00	455.90
040605	10.15	20.33	19.03	1.39	359.24	0.20	682.82
040605	10.45	21.64	18.92	1.03	353.92	0.00	773.33

Where:

Date – the date in format “YYMMDD”;

Time – the time in format “hh,mm”;

Tair – air temperature at the reference height in °C;

Eair – water vapour pressure in mbar;

Wind – wind speed in m s^{-1};

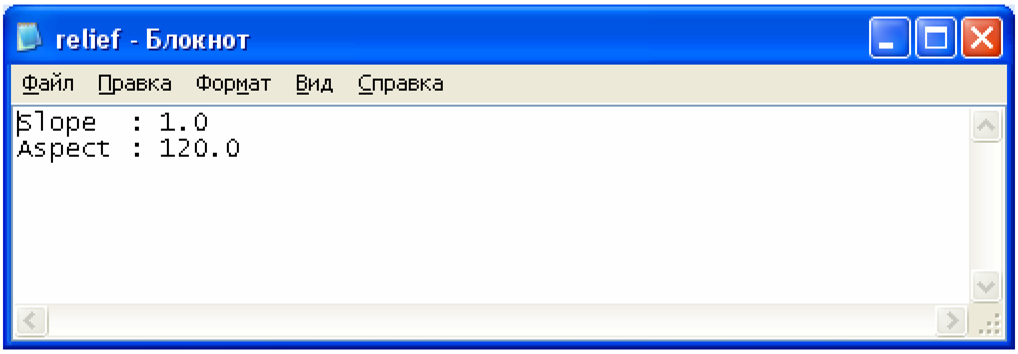
CO2 – CO_2 concentration in ppm;

Precip – precipitation rate in mm;

Glob – global solar radiation in W m^{-2}.

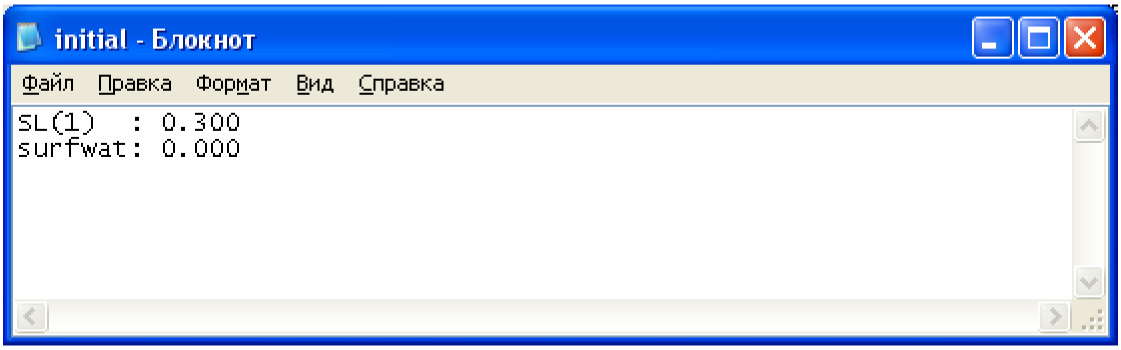
Information about relief features of study area (slop (in degrees) and aspect (in degrees)) is given in file: **relief.dat**. If the slop of study area has the northern direction the aspect is assumed to be equal to 0.0°.

Example of "**relief.dat**" file is given below:



Information about initial volumetric soil moisture of the upper soil layer "**SL(1)**" and the thickness of stored rain water on soil surface "**surfwat**" in meters (default value: **surfwat = 0.0000**) is given in file: **initial.dat .**

Example of "**initial.dat**" file is given below:



File "**Treedist.dat**" includes information about partitioning the Plant Area Index (PAI) among different tree species in overstorey. For each plant/tree species the file indicates the ratio between species PAI and total ecosystem PAI. The current version of MixFor-SVAT assumes that the number of tree species in forest stand doesn't exceed 6 main plant/tree species.

Example "**Treedist.dat**" file is given below:

```
1 0.0
2 0.0
3 0.38
4 0.27
5 0.23
6 0.12
```

File “**Optic.dat**” includes information about optical properties of the different plant species of canopy overstorey and understorey, as well as optical properties of soil surface. In the present model version a number of possible tree/plant species is limited by “6”. The values of optical properties for the different species are written consecutively after colon one after another. A sequence of the species range is identical with sequence range used in file “**Treedist.dat**”.

Example of “**Optic.dat**” file is given below:

```
CROP    :  0.060   0.06    0.06    0.06    0.06    0.06
CTOP    :  0.010   0.001   0.06    0.06    0.06    0.05
CROB    :  0.40    0.34    0.44    0.44    0.44    0.44
CTOB    :  0.04    0.01    0.44    0.44    0.44    0.44
GROP    :  0.06
GTOP    :  0.05
GROB    :  0.40
GTOB    :  0.40
ROTRP   :  0.05
ROTRB   :  0.34
RSP     :  0.06
RSB     :  0.36
```

Where:

CROP – leaf PAR reflection coefficient for the tree leaves (for each of 6 selected tree species);

CTOP – leaf PAR transmission coefficient for the tree leaves (for each of 6 selected tree species);

CROB – leaf NIR reflection coefficient for the tree leaves (for each of 6 selected tree species);

CTOB – leaf NIR transmission coefficient for the tree leaves (for each of 6 selected tree species);

GROP – leaf PAR reflection coefficient for the plants of canopy understorey;

GTOP – leaf PAR transmission coefficient for the plants of canopy understorey;

GROB – leaf NIR reflection coefficient of canopy understorey plants;

GTOB – leaf NIR transmission coefficient of canopy understorey plants;

ROTRP – mean stem PAR reflection coefficient for all plant/tree species;

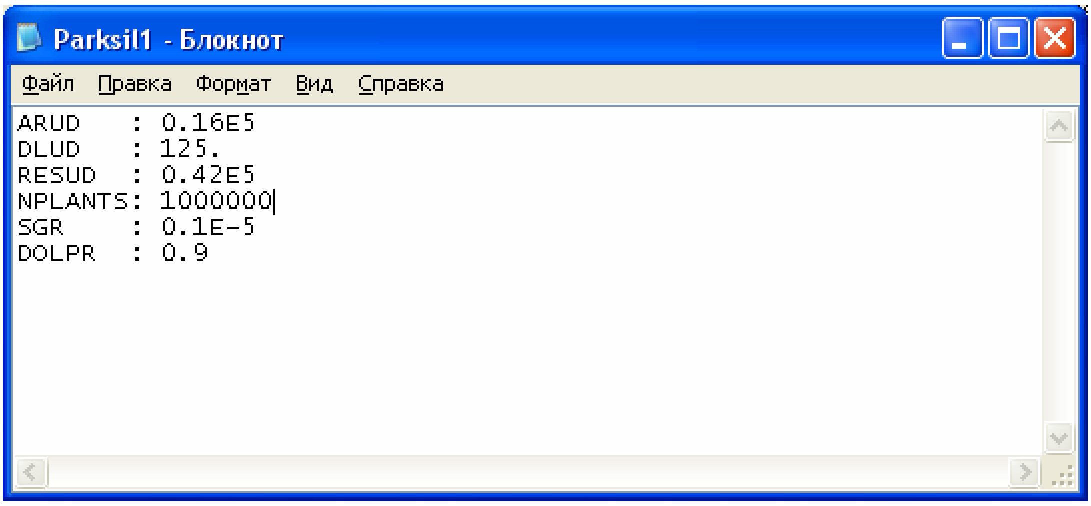
ROTRB – mean stem NIR reflection coefficient for all plant/tree species;

RSP – PAR reflection coefficient of soil surface;

RSB – NIR reflection coefficient of soil surface.

File “**Parksil1.dat**” includes information about hydraulic properties of stems and roots of understorey plants as well as plant density and mean plant diameter in understorey layer.

Example of the file is given below:




```
ARUD    : 0.16E5
DLUD    : 125.
RESUD   : 0.42E5
NPLANTS: 1000000
SGR     : 0.1E-5
DOLPR   : 0.9
```

Where:

ARUDg – specific resistance of roots (fine, coarse) per unit root length, s/m;

DLUDg – root density, m m^{-3};

RESUDg – specific resistance imposed by plant vascular system per unit stem length, s/m;

NPLANTS – number of the plants per hectare in understorey;

SGR – mean cross-section area of understorey plants, m^2 m^{-2};

DOLPRg – mean fraction of the vascular system in understorey plants.

File “**Parksil2.dat**” includes information about hydraulic properties of stems and roots of overstorey trees/plants as well as the tree/plant density and mean tree/plant diameter.

Example of the file is given below:

parksil2 - Блокнот

Файл Правка Формат Вид Справка

```
ARUD    : 0.12E5
DLUD    : 800.
RESUD   : 0.62E5     0.62E5     0.20E5     0.22E5     0.24E5     0.23E5
NTREES  : 600
SC      : 0.0299
DOLPR   : 0.70
```

Where:

ARUD - specific resistance of roots (fine, coarse) to water transport, s/m;

DLUD - root density, m m^{-3};

RESUD - specific resistance imposed by vascular system of the different tree/plant species, s/m;

NTREES - number of the trees/plant (all species) per hectare;

SC - mean stem cross-section area for different tree species, m^2 m^{-2};

DOLPR – mean fraction of the vascular system of the different trees/plant species.

File "**Parpl1.dat**" includes information about maximal leaf stomatal conductance, specific parameters describing the influence of different limiting environmental factors on leaf stomatal conductance, parameters of photosynthesis and respiration for plants growing in understorey. Example of the file is given below:

Parpl1 - Блокнот

Файл Правка Формат Вид Справка

```
GGMAX    : 120.0
RGPARM   : 0.012
Jmax25g  : 53.6
Vcmax25g: 32.1
RESOPT   : 0.40
APSST    : -80.
APSCLO   : -240.
TMIN     : 0.0
TOPT     : 23.0
TMAX     : 42.0
HHUM     : 0.012
```

Where:

GGMAX – mean maximal leaf stomatal conductance for understorey plants, mmol $m^{-2}s^{-1}$;

RGPARM – empirical parameter describing the slop of light response curve of leaf stomatal conductance;

Jmax25g – maximal electron transport rate of the understorey leaves under saturating light and temperature 25°C, μmol electrons m^{-2} s^{-1} ;

Vcmax25g - carboxylation capacity of canopy Rubisco of understorey leaves under saturating light and temperature 25°C, μmol CO_2 m^{-2} s^{-1};

RESOPT - leaf mitochondrial respiration in the light, excluding CO_2 loss in photorespiration under optimal temperature (t=25°C), μmol CO_2 m^{-2} s^{-1};

APSST - leaf water potential when stomata start to close, m;

APSCLO - leaf water potential when stomata are completely closed, m;

TMIN, TOPT, TMAX - minimal, optimal, maximal temperatures for stomatal functioning;

HHUM - empirical constant describing dependence of stomatal conductance on water vapour deficit.

File "**Parpl2.dat**" includes information about maximal leaf stomatal conductance, specific parameters describing the influence of different limiting factors on leaf stomatal conductance, parameters of photosynthesis and respiration for the different tree/plants species growing in overstorey. The values of some parameters are specified individually for each species and they are given in the file after colon consecutively one after another according to the range used in "**Treedist.dat**" file.

Example of the file is given below:

```
Parpl2 - Блокнот
Файл  Правка  Формат  Вид  Справка
GCMAX     : 120.0    113.4    260.0    240.0    280.0    220.0
RCPARM    : 0.009    0.010    0.011    0.010    0.010    0.009
Jmax25c   : 91.4     91.4     68.6     62.1     75.7     53.6
Vcmax25c  : 54.8     54.8     41.2     37.3     45.5     32.1
RESOPT    : 0.50     0.50     0.50     0.40     0.60     0.40
RESST     : 0.40     0.40     0.45     0.40     0.50     0.35
RESROOT   : 0.40     0.40     0.60     0.40     0.50     0.35
APSST     : -100.   -120.    -120.    -120.    -120.    -120.
APSCLO    : -340.   -320.    -320.    -310.    -320.    -300.
TMIN      : 0.00
TOPT      : 24.0    24.0     25.0     26.0     25.0     26.0
TMAX      : 44.0
HHUM      : 0.012
```

Where:

GGMAX –maximal leaf stomatal conductance for each tree/plant species in overstorey, mmol $m^{-2}s^{-1}$;

RCPARM – empirical parameter describing the slop of light response curve for the leaves of different tree species;

Jmax25g – maximal electron transport rate of the leaves of the different tree/plant species under saturating light and temperature 25°C, μmol electrons m^{-2} s^{-1};

Vcmax25g – carboxylation capacity of canopy Rubisco of the leaves of the different tree/plant species under saturating light and temperature 25°C, µmol CO_2 m^{-2} s^{-1};

RESOPT – leaf mitochondrial respiration in the light of overstorey tree/plant species, excluding CO_2 loss in photorespiration under optimal temperature (*t*=25°C), µmol CO_2 m^{-2} s^{-1};

RESST – stem respiration rate of different tree/plant species under optimal temperature 25°C, µmol CO_2 m^{-2} s^{-1};

RESROOT – root (both fine and coarse) respiration rate of different tree/plant species under optimal temperature 25°C, µmol CO_2 m^{-2} s^{-1};

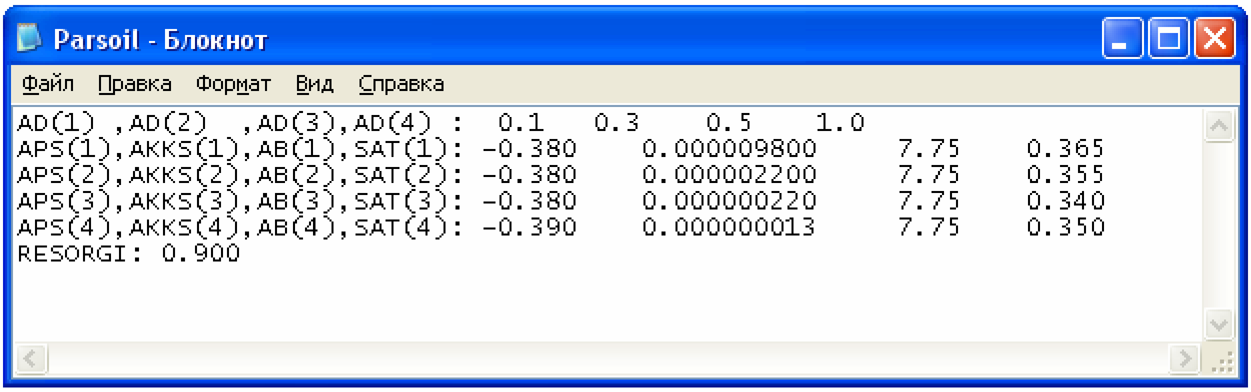
APSST – species depended leaf water potential when stomata start to close, m;

APSCLO – species depended leaf water potential when stomata are completely closed, m;

TMIN, TOPT, TMAX – minimal, optimal, maximal temperatures for stomatal functioning of the different tree/plant species;

HHUM – empirical constant describing dependence of leaf stomatal conductance on water vapour deficit.

File "**Parsoil.dat**" includes information about thickness of the main 4 soil layers, about their physical properties and about heterotrophic respiration rate of the soil under optimal temperature. Example of the file is given below:




```
AD(1) ,AD(2)  ,AD(3),AD(4) :  0.1   0.3    0.5    1.0
APS(1),AKKS(1),AB(1),SAT(1): -0.380    0.000009800     7.75     0.365
APS(2),AKKS(2),AB(2),SAT(2): -0.380    0.000002200     7.75     0.355
APS(3),AKKS(3),AB(3),SAT(3): -0.380    0.000000220     7.75     0.340
APS(4),AKKS(4),AB(4),SAT(4): -0.390    0.000000013     7.75     0.350
RESORGI: 0.900
```

Where:

AD(1-4) – thickness of the main soil layers, m;

APS(1-4) – water potential of soil layers at saturation, m;

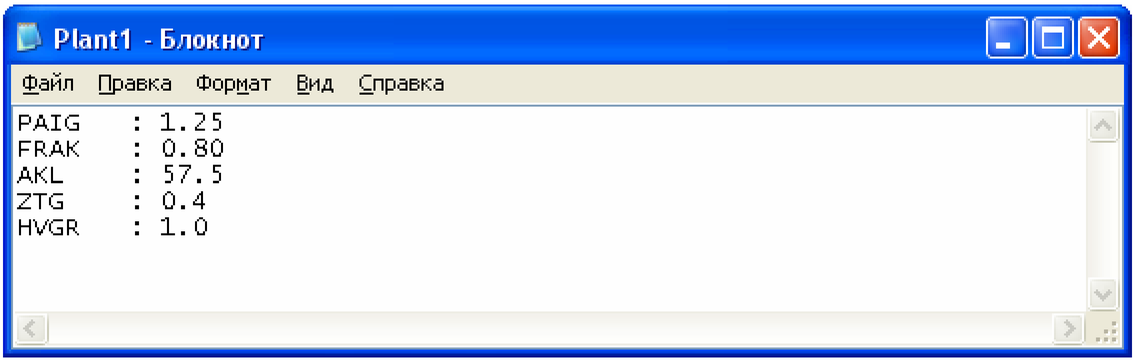
AKKS(1-4) – hydraulic conductivity of soil layers at saturation, m/s;

AB(1-4) – empirical constant describing dependence of soil water potential and hydraulic conductivity on soil moisture (Clapp and Hornberger, 1978) ;

SAT(1-4) – the volumetric soil moisture of soil layers at saturation, m^3 m^{-3};

RESORGI – soil heterotrophic respiration rate under optimal temperature 25°C, μmol CO_2 m^{-2} s^{-1}.

File "**Plant1.dat**" includes information about structural parameters of canopy understorey. Example of the file is given below:




```
PAIG    : 1.25
FRAK    : 0.80
AKL     : 57.5
ZTG     : 0.4
HVGR    : 1.0
```

Where:

PAIG – total plant area index of the understorey plants, m^2 m^{-2};

FRAK – fraction of PAI that consists of live photosynthesising leaves;

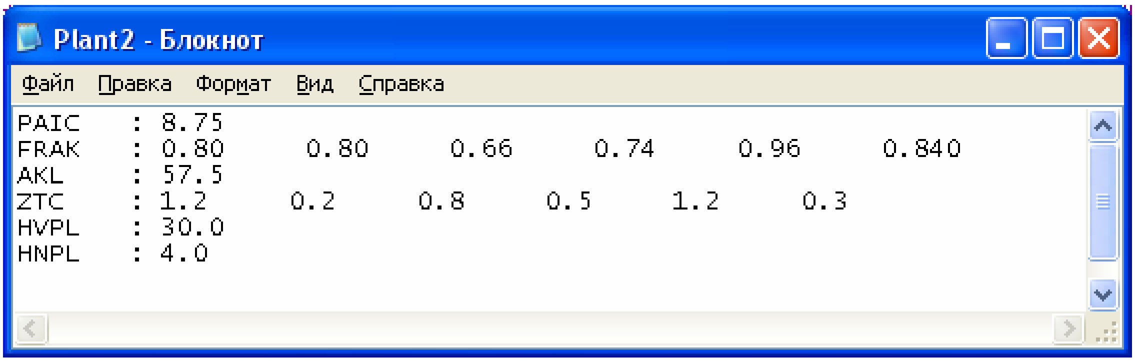
AKL – mean leaf inclination angle above the horizontal plane;

ZTG – maximal depth of the roots for the understorey plants, m;

HVGR – mean height of the plants in understorey, m.

File "**Plant2.dat**" includes information about structural parameters of the tree/plant species in overstorey. The values of some parameters are specified individually for each species and they are given in the file after colon consecutively one after another according to the range used in "**Treedist.dat**" file.

Example of the file is given below:




```
PAIC    : 8.75
FRAK    : 0.80     0.80     0.66     0.74     0.96     0.840
AKL     : 57.5
ZTC     : 1.2     0.2     0.8     0.5     1.2     0.3
HVPL    : 30.0
HNPL    : 4.0
```

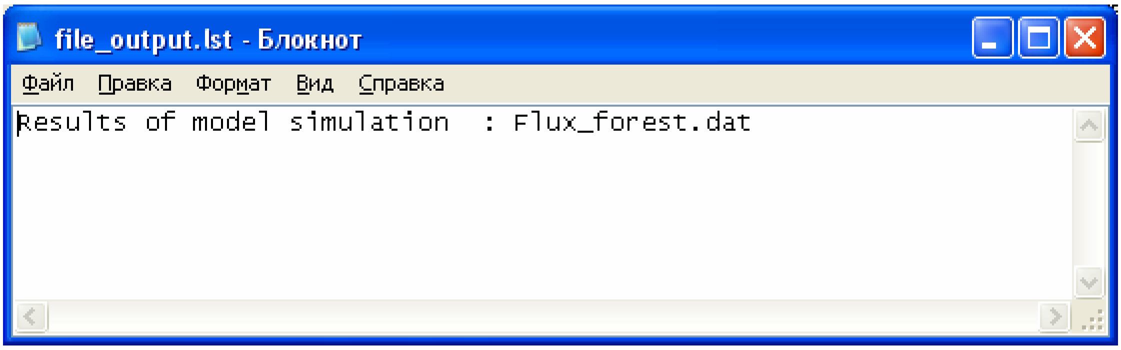
Where:

PAIC – total plant area index of the overstorey trees/plants, m^2 m^{-2};

FRAK– fraction of PAI that consists of live photosynthesising leaves for each individual species;
AKL – mean leaf inclination angle above the horizontal plane;
ZTC – maximal depth of the roots for each individual species in overstorey, m;
HVPL – mean height of the plants in overstorey, m.
HNPL – mean height of the crown bottom in overstorey, m.

Output parameters

The name of the main output file is given in file “**File_output.lst**”:
Example of “**File_output.lst**” file is given below:



Additionally, the MixFor-SVAT model generates several additional output files which stored:
CO2fluxes.dat – the main components of the total ecosystem CO_2 flux (e.g. photosynthesis and respiration of overstorey and understorey, soil respiration);
profCO2.dat – vertical CO_2 profile within and above a forest stand;
proftu.dat – vertical air temperature profile within and above a forest stand;
soiltem.dat – temperatures of the different soil layers;
soilws.dat – wetness of the different soil layers.

The main output file given in file “**File_output.lst**” (in our case **Flux_forest.dat**) includes information about modelled total energy, water and CO_2 fluxes, predicted aerodynamic and bulk boundary layer resistances, mean stomatal conductance of overstorey plant/trees, evapotranspiration, transpiration and water fluxes in overstorey and understorey plants/trees, mean leaf water potential of overstorey as well as mean temperatures of overstorey and understorey.

Example of “**Flux_forest.dat**” file is given below. Because of a large width of data table the example of the output file consists of multiple parts showing the different parts (columns) of the table.

Flux_forest - Блокнот

Файл Правка Формат Вид Справка

DAY	TIME	TV	EV	UV	CO2v	AP	R	LE
040605	0.15	17.59	19.29	0.43	384.47	0.00	-22.50	-0.01
040605	0.45	17.48	19.20	0.64	376.28	0.00	-23.18	-0.02
040605	1.15	17.49	18.92	0.87	368.09	0.20	-21.61	-6.43
040605	1.45	17.37	18.61	0.33	372.76	0.20	-22.37	-3.98
040605	2.15	17.30	18.16	1.17	360.00	0.20	-24.17	-6.72
040605	2.45	17.19	17.94	1.50	360.00	0.00	-27.32	-0.47
040605	3.15	16.91	18.22	0.24	360.00	0.20	-25.06	-2.78
040605	3.45	16.94	18.26	0.57	360.00	0.00	-24.51	-9.60
040605	4.15	16.98	18.13	1.17	360.00	0.00	-25.47	-10.40
040605	4.45	17.03	18.15	0.68	360.00	0.00	-25.87	-6.40
040605	5.15	16.97	18.15	0.90	360.00	0.00	-25.42	-8.38
040605	5.45	16.93	18.25	0.52	360.00	0.00	-28.26	-7.57
040605	6.15	16.88	18.07	0.74	360.00	0.00	-24.11	-9.09
040605	6.45	16.96	17.89	1.77	356.51	0.00	-12.54	0.36
040605	7.15	17.07	17.96	1.01	382.32	0.00	25.01	12.57
040605	7.45	17.13	18.61	0.53	410.98	0.00	91.66	58.31
040605	8.15	17.97	18.70	0.56	376.56	0.00	167.51	118.83
040605	8.45	18.29	18.82	1.13	372.20	0.00	185.33	160.17
040605	9.15	19.02	18.88	0.99	366.08	0.00	269.21	213.22
040605	9.45	19.63	18.83	1.35	362.16	0.00	331.57	275.90
040605	10.15	20.33	19.03	1.39	359.24	0.20	522.05	392.90
040605	10.45	21.64	18.92	1.03	353.92	0.00	579.80	422.93

Flux_forest - Блокнот

Файл Правка Формат Вид Справка

LE	H	PS	PHOT	CCAN	APSIR	PSI(2)	ara_over
-0.01	-13.49	-9.01	3.17	0.00	-1.527	-1.737	255.256
-0.02	-19.32	-3.85	3.18	0.00	-1.527	-1.737	171.500
-6.43	-23.12	7.94	3.31	0.00	-1.527	-1.736	126.161
-3.98	-8.54	-9.86	3.23	0.00	-1.526	-1.736	332.606
-6.72	-26.36	8.91	3.38	0.00	-1.525	-1.732	93.812
-0.47	-28.13	1.26	3.47	0.00	-1.525	-1.734	73.173
-2.78	-5.08	-17.20	3.23	0.00	-1.524	-1.733	457.333
-9.60	-13.82	-1.10	3.21	0.00	-1.524	-1.732	192.561
-10.40	-23.85	8.77	3.32	0.00	-1.511	-1.708	93.812
-6.40	-14.46	-5.03	3.14	0.00	-1.512	-1.714	161.412
-8.38	-18.36	1.31	3.18	0.00	-1.508	-1.708	121.956
-7.57	-11.77	-8.92	3.21	0.00	-1.509	-1.711	211.077
-9.09	-16.52	1.48	2.69	0.64	-1.504	-1.704	148.324
0.36	-28.74	15.84	1.17	2.77	-1.480	-1.657	62.011
12.57	-8.86	21.30	-1.85	5.29	-1.479	-1.664	108.673
58.31	8.02	25.33	-5.77	8.07	-1.479	-1.670	15.230
118.83	17.61	31.08	-8.76	10.72	-1.480	-1.672	12.181
160.17	14.98	10.19	-9.08	11.10	-1.478	-1.669	15.403
213.22	24.00	32.00	-11.49	12.89	-1.477	-1.670	11.858
275.90	29.49	26.18	-12.88	14.10	-1.476	-1.669	11.292
392.90	82.22	46.94	-15.98	16.48	-1.476	-1.670	8.376
422.93	95.41	61.47	-18.59	18.79	-1.478	-1.675	7.046

Flux_forest - Блокнот

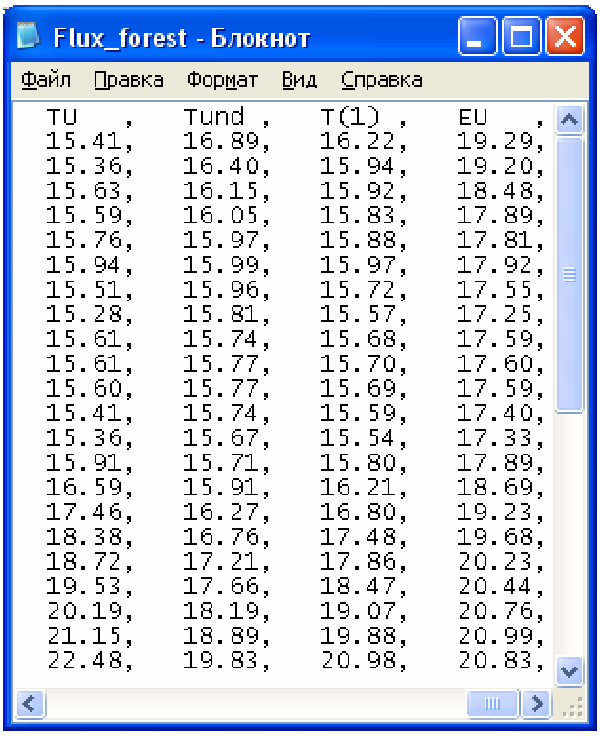
Файл Правка Формат Вид Справка

ara_over ,	arb_over,	PSIover ,	Wc ,	Sapfl ,	Sapfl_br ,	Trans ,
255.256,	50.927,	-25.400,	0.000,	0.0004,	0.0000,	0.0000,
171.500,	36.065,	-25.388,	0.000,	0.0003,	0.0000,	0.0000,
126.161,	27.771,	-25.373,	0.059,	0.0003,	0.0001,	0.0000,
332.606,	64.321,	-25.359,	0.171,	0.0002,	0.0001,	0.0000,
93.812,	21.676,	-25.348,	0.279,	0.0002,	0.0000,	0.0000,
73.173,	17.670,	-25.337,	0.522,	0.0001,	0.0000,	0.0000,
457.333,	85.505,	-25.329,	0.629,	0.0001,	0.0000,	0.0000,
192.561,	39.849,	-25.322,	0.914,	0.0001,	0.0000,	0.0000,
93.812,	21.676,	-25.315,	0.848,	0.0001,	0.0000,	0.0000,
161.412,	34.239,	-25.309,	0.908,	0.0001,	0.0000,	0.0000,
121.956,	26.988,	-25.302,	0.881,	0.0001,	0.0000,	0.0000,
211.077,	43.147,	-25.297,	0.929,	0.0001,	0.0000,	0.0000,
148.324,	31.855,	-25.292,	0.901,	0.0001,	0.0000,	0.0000,
62.011,	15.449,	-25.289,	0.769,	0.0002,	0.0000,	0.0000,
108.673,	24.499,	-25.319,	0.731,	0.0001,	0.0001,	0.0002,
15.230,	42.439,	-25.797,	0.697,	0.0002,	0.0008,	0.0027,
12.181,	40.463,	-27.072,	0.650,	0.0005,	0.0032,	0.0081,
15.403,	22.311,	-27.934,	0.576,	0.0014,	0.0057,	0.0090,
11.858,	24.913,	-30.727,	0.488,	0.0028,	0.0100,	0.0208,
11.292,	19.262,	-34.846,	0.382,	0.0053,	0.0185,	0.0340,
8.376,	18.806,	-43.748,	0.315,	0.0098,	0.0354,	0.0681,
7.046,	24.101,	-61.551,	0.235,	0.0187,	0.0676,	0.1306,

Flux_forest - Блокнот

Файл Правка Формат Вид Справка

Trans ,	Trans_low,	Evap_ov ,	Evap_und ,	AWCl ,	AWCc ,	Tover,	TU ,
0.0000,	0.0000,	0.0000,	0.0000,	0.995,	0.995,	15.13,	15.41,
0.0000,	0.0000,	0.0000,	0.0000,	0.995,	0.995,	15.07,	15.36,
0.0000,	0.0000,	-0.0045,	0.0000,	0.995,	0.995,	15.36,	15.63,
0.0000,	0.0000,	-0.0028,	0.0000,	0.995,	0.995,	15.37,	15.59,
0.0000,	0.0000,	-0.0048,	0.0001,	0.995,	0.995,	15.53,	15.76,
0.0000,	0.0000,	-0.0005,	0.0001,	0.995,	0.995,	15.74,	15.94,
0.0000,	0.0000,	-0.0019,	0.0000,	0.995,	0.995,	15.33,	15.51,
0.0000,	0.0000,	-0.0069,	0.0003,	0.995,	0.995,	15.05,	15.28,
0.0000,	0.0000,	-0.0075,	0.0004,	0.995,	0.995,	15.39,	15.61,
0.0000,	0.0000,	-0.0044,	0.0001,	0.995,	0.995,	15.41,	15.61,
0.0000,	0.0000,	-0.0061,	0.0003,	0.995,	0.995,	15.39,	15.60,
0.0000,	0.0000,	-0.0053,	0.0002,	0.995,	0.995,	15.20,	15.41,
0.0000,	0.0000,	-0.0065,	0.0003,	0.995,	0.995,	15.15,	15.36,
0.0000,	0.0000,	0.0001,	0.0000,	0.995,	0.995,	15.73,	15.91,
0.0002,	0.0000,	0.0089,	-0.0005,	0.995,	0.995,	16.51,	16.59,
0.0027,	0.0000,	0.0414,	-0.0002,	0.993,	0.995,	17.60,	17.46,
0.0081,	0.0000,	0.0850,	-0.0002,	0.989,	0.994,	18.67,	18.38,
0.0090,	0.0000,	0.1136,	-0.0006,	0.986,	0.992,	18.86,	18.72,
0.0208,	0.0000,	0.1533,	-0.0002,	0.977,	0.990,	19.79,	19.53,
0.0340,	0.0000,	0.1988,	0.0002,	0.963,	0.985,	20.43,	20.19,
0.0681,	0.0001,	0.2871,	0.0010,	0.935,	0.976,	21.80,	21.15,
0.1306,	0.0003,	0.3258,	0.0023,	0.880,	0.959,	23.45,	22.48,



TV ,	Tund ,	T(1) ,	EV ,
15.41,	16.89,	16.22,	19.29,
15.36,	16.40,	15.94,	19.20,
15.63,	16.15,	15.92,	18.48,
15.59,	16.05,	15.83,	17.89,
15.76,	15.97,	15.88,	17.81,
15.94,	15.99,	15.97,	17.92,
15.51,	15.96,	15.72,	17.55,
15.28,	15.81,	15.57,	17.25,
15.61,	15.74,	15.68,	17.59,
15.61,	15.77,	15.70,	17.60,
15.60,	15.77,	15.69,	17.59,
15.41,	15.74,	15.59,	17.40,
15.36,	15.67,	15.54,	17.33,
15.91,	15.71,	15.80,	17.89,
16.59,	15.91,	16.21,	18.69,
17.46,	16.27,	16.80,	19.23,
18.38,	16.76,	17.48,	19.68,
18.72,	17.21,	17.86,	20.23,
19.53,	17.66,	18.47,	20.44,
20.19,	18.19,	19.07,	20.76,
21.15,	18.89,	19.88,	20.99,
22.48,	19.83,	20.98,	20.83,

Where:

DAY – the date in format “YYMMDD”;

TIME – the time in format “hh,mm”;

TV – input air temperature at a reference height above a plant/forest canopy, °C;

EV – input water vapour pressure at a reference height above a plant/forest canopy, mbar;

UV – input wind speed at a reference height above a plant/forest canopy, m s-1;

CO2v – input CO_2 concentration at a reference height above a plant/forest canopy, ppm;

AP – input precipitation rate, mm per used time step;

R – total ecosystem net radiation, W m^{-2};

LE – total ecosystem latent heat flux, W m^{-2};

H – total ecosystem sensible heat flux, W m^{-2};

PS – physical storage of the energy by canopy biomass, W m^{-2};

PHOT – total ecosystem CO_2 flux, μmol CO_2 m^{-2} s^{-1};

CCAN – mean bulk stomatal conductance of overstorey plants/trees, mm s^{-1};

APSIR – mean soil water potential in root zone of overstorey plants/trees, m;

PSI(2) – water potential of the second soil sub-layer (0.10-0.20 m), m;

ara_over – aerodynamic resistance for momentum between canopy air space and reference height, s m^{-1};

arb_over – bulk boundary layer resistance for momentum between overstorey phyto-mass (leaves) and surrounding air, s m^{-1};

PSIover – mean leaf water potential of overstorey plants/trees, m;

Wc – the ration between the water (rain or dew) intercepted by phyto-elements (leaves) of overstorey plants/trees and maximal interception capacity;

Sapfl – water uptake by roots of overstorey plants/trees, mm per time period (in our case 30 min);

Sapfl_br – total branch water flow in overstorey plants/trees, mm per time period (in our case 30 min);

Trans – transpiration of overstorey, mm per time period (in our case 30 min);

Trans_low – transpiration of understorey, mm per time period (in our case 30 min);

Evap_ov – evapotranspiration of overstorey, mm per time period (in our case 30 min);

Evap_und – evapotranspiration of understorey, mm per time period (in our case 30 min);

AWCl – mean wetness of overstorey leaves;

AWCc – mean wetness of xylem of overstorey plants/trees;

Tover – mean modelled temperature of overstorey, °C;

TU – modelled effective temperature of the air in overstorey crown space, °C;

Tund – mean modelled temperature of understorey, °C;

T(1) – modelled air temperatures at 1 meter above a ground surface, °C;

EU – modelled effective water vapour pressure in overstorey crown space, mbar;

File "**CO2fluxes.dat**" includes information about modelled total CO_2 ecosystem flux, net photosynthesis and respiration rates of overstorey and understorey, as well as soil respiration. Example of the output file is given below. Because of a large width of data table the example of the output file consists of two parts showing the left and right parts of the table.

CO2fluxes - Блокнот

Файл Правка Формат Вид Справка

day	time	FTotal	FOver	FUndSoil	Pover	Rover	FUnder
040605	0.15	3.144	2.535	0.610	1.046	1.489	0.388
040605	0.45	3.177	2.572	0.605	1.054	1.518	0.381
040605	1.15	3.364	2.705	0.659	1.127	1.578	0.381
040605	1.45	3.194	2.597	0.598	1.070	1.526	0.375
040605	2.15	3.348	2.749	0.598	1.142	1.608	0.380
040605	2.45	3.471	2.768	0.703	1.152	1.616	0.381
040605	3.15	3.180	2.581	0.600	1.042	1.538	0.375
040605	3.45	3.210	2.611	0.599	1.052	1.558	0.373
040605	4.15	3.311	2.720	0.591	1.120	1.600	0.375
040605	4.45	3.123	2.664	0.459	1.088	1.576	0.374
040605	5.15	3.191	2.689	0.501	1.102	1.587	0.375
040605	5.45	3.204	2.608	0.596	1.050	1.558	0.372
040605	6.15	2.594	2.138	0.456	0.567	1.571	0.371
040605	6.45	1.217	0.444	0.773	-1.207	1.652	0.377
040605	7.15	-1.777	-2.311	0.534	-3.959	1.648	0.377
040605	7.45	-5.751	-6.208	0.457	-7.851	1.643	0.379
040605	8.15	-8.754	-9.239	0.486	-11.067	1.828	0.403
040605	8.45	-9.074	-9.667	0.593	-11.517	1.850	0.395
040605	9.15	-11.483	-12.004	0.521	-13.965	1.961	0.366
040605	9.45	-12.882	-13.514	0.632	-15.549	2.036	0.360
040605	10.15	-15.976	-16.583	0.606	-18.766	2.184	0.320
040605	10.45	-18.555	-18.976	0.421	-21.382	2.406	0.249

CO2fluxes - Блокнот

Файл Правка Формат Вид Справка

FUnder	Pund	Rund	Rsoil	CO2ac	Rlover	Rlund
0.388	0.208	0.180	0.221	0.000	1.046	0.208
0.381	0.201	0.180	0.224	-7.427	1.054	0.201
0.381	0.199	0.182	0.278	-6.845	1.127	0.199
0.375	0.197	0.178	0.223	6.754	1.070	0.197
0.380	0.196	0.184	0.218	-12.751	1.142	0.196
0.381	0.197	0.185	0.321	-0.586	1.152	0.197
0.375	0.195	0.180	0.225	6.132	1.042	0.195
0.373	0.192	0.181	0.226	-4.318	1.052	0.192
0.375	0.192	0.182	0.216	-1.136	1.120	0.192
0.374	0.193	0.181	0.085	2.256	1.088	0.193
0.375	0.193	0.182	0.127	-0.904	1.102	0.193
0.372	0.191	0.180	0.224	0.302	1.050	0.191
0.371	0.191	0.181	0.085	-1.715	1.069	0.191
0.377	0.193	0.184	0.396	-5.034	1.175	0.193
0.377	0.198	0.179	0.157	19.365	1.313	0.198
0.379	0.205	0.174	0.079	21.953	1.470	0.205
0.403	0.215	0.188	0.083	-24.937	1.669	0.215
0.395	0.201	0.194	0.199	-3.978	1.681	0.223
0.366	0.166	0.200	0.155	-4.331	1.893	0.233
0.360	0.153	0.207	0.272	-3.894	2.030	0.244
0.320	0.104	0.216	0.286	-2.584	2.359	0.260
0.249	0.020	0.229	0.172	-4.692	2.880	0.282

Where:

day – the date in format “YYMMDD”;

time – the time in format “hh,mm”;

FTotal – total ecosystem CO_2 flux, μmol CO_2 m^{-2} s^{-1};

FOver – CO_2 flux between overstorey and the atmosphere, μmol CO_2 m^{-2} s^{-1};

FUndSoil – CO_2 flux between understorey&soil and the atmosphere, μmol CO_2 m^{-2} s^{-1};

Pover – net photosynthesis of overstorey leaves, μmol CO_2 m^{-2} s^{-1};

Rover – respiration of overstorey vegetation, μmol CO_2 m^{-2} s^{-1};

FUnder – CO_2 flux between understorey vegetation and the atmosphere, μmol CO_2 m^{-2} s^{-1};

Pund – net photosynthesis of understorey leaves, μmol CO_2 m^{-2} s^{-1};

Rund – respiration of understorey vegetation, μmol CO_2 m^{-2} s^{-1};

Rsoil – soil (authotrophic and heterotrophic) respiration, μmol CO_2 m^{-2} s^{-1};

CO2ac – CO_2 storage in air space within and above a plant/forest canopy, μmol CO_2 m^{-2} s^{-1};

Rlover – mitochondrial respiration of overstorey leaves, μmol CO_2 m^{-2} s^{-1};

Rlund – mitochondrial respiration of understorey leaves, μmol CO_2 m^{-2} s^{-1};

File "**profCO2.dat**" includes information about modelled CO_2 concentration profile within and above a plant/forest canopy. Corresponding altitude above a ground surface is given in brackets in column titles.

Example of the output file is given below. Because of a large width of data table the example of the output file consists of two parts showing the left and right parts of the table.

profCO2 - Блокнот

Файл Правка Формат Вид Справка

day	time	co2(1)	co2(3)	co2(5)	co2(9)	co2(12)	co2(15)	co2(18)
040605	0.15	408.23	404.41	384.47	384.47	384.47	384.47	384.47
040605	0.45	398.20	394.44	401.67	398.24	396.56	395.36	394.43
040605	1.15	386.06	383.87	391.71	388.34	386.69	385.50	384.58
040605	1.45	397.64	393.96	382.36	379.96	378.16	376.86	375.86
040605	2.15	377.96	375.74	391.32	388.05	386.45	385.29	384.39
040605	2.45	376.21	374.11	373.61	371.53	370.18	368.86	367.49
040605	3.15	387.50	383.81	372.66	370.59	369.25	367.97	366.66
040605	3.45	382.10	378.42	381.49	378.18	376.56	375.37	374.45
040605	4.15	377.74	375.55	375.75	372.45	370.84	369.67	368.77
040605	4.45	384.44	380.70	373.71	371.66	370.32	369.00	367.61
040605	5.15	379.94	377.62	377.77	374.32	372.59	371.30	370.24
040605	5.45	382.41	378.75	376.12	374.16	372.30	370.86	369.70
040605	6.15	378.88	376.59	376.55	373.26	371.64	370.46	369.53
040605	6.45	370.56	368.57	374.97	371.66	370.04	368.85	367.91
040605	7.15	397.60	395.39	367.19	365.17	363.87	362.65	361.42
040605	7.45	431.41	427.35	393.98	392.17	390.90	389.54	387.93
040605	8.15	397.85	393.59	423.51	420.40	418.79	417.50	416.29
040605	8.45	386.69	384.51	390.00	386.81	385.13	383.75	382.36
040605	9.15	380.79	378.73	383.16	381.51	380.31	378.93	377.15
040605	9.45	374.70	372.78	377.18	375.87	374.81	373.44	371.48
040605	10.15	371.02	369.30	371.44	369.81	368.65	367.33	365.64
040605	10.45	364.79	363.53	367.98	366.19	364.95	363.62	361.93

co2(18)	co2(21)	co2(24)	co2(28)	co2(32)	co2(36)	co2(40)	co2(44)	co2v
384.47	384.47	384.47	384.47	384.47	384.47	384.47	384.47	384.47
394.43	393.65	392.94	390.72	388.33	386.83	385.82	385.07	376.28
384.58	383.82	382.83	380.49	378.87	377.86	377.19	376.69	368.09
375.86	374.63	373.12	371.32	370.08	369.31	368.79	368.40	372.76
384.39	383.63	382.93	381.06	377.88	375.88	374.56	373.56	360.00
367.49	366.00	364.46	362.62	361.51	360.92	360.53	360.24	360.00
366.66	365.28	363.86	362.17	361.21	360.74	360.42	360.19	360.00
374.45	373.66	372.91	371.57	367.04	364.30	362.47	361.10	360.00
368.77	368.01	367.30	364.76	362.94	361.79	361.03	360.46	360.00
367.61	366.10	364.51	362.61	361.48	360.90	360.52	360.23	360.00
370.24	369.28	367.62	364.33	362.41	361.47	360.85	360.38	360.00
369.70	367.89	365.85	363.32	361.85	361.13	360.65	360.29	360.00
369.53	368.74	367.99	365.33	363.23	361.97	361.13	360.50	360.00
367.91	367.09	365.48	363.19	361.90	361.16	360.67	360.30	356.51
361.42	360.13	358.76	357.22	356.85	356.72	356.63	356.56	382.32
387.93	385.96	383.55	380.92	381.36	381.74	381.98	382.17	410.98
416.29	414.74	411.78	406.96	409.37	410.00	410.41	410.73	376.56
382.36	380.36	376.08	371.28	374.90	375.54	375.98	376.30	372.20
377.15	374.69	371.18	368.68	370.74	371.31	371.69	371.97	366.08
371.48	368.49	363.95	361.51	364.45	365.08	365.51	365.83	362.16
365.64	363.20	359.54	357.96	360.51	361.15	361.58	361.90	359.24
361.93	359.42	355.54	354.79	357.78	358.35	358.73	359.01	353.92

Where:

day – the date in format “YYMMDD”;

time – the time in format “hh,mm”;

CO2(1) - CO2(44) – modelled CO_2 concentration at corresponding height above a ground surface given in brackets, °C;

CO2v – input CO_2 concentration at a reference height above a plant/forest canopy, °C.

File “**proftu.dat**” includes information about modelled air temperature profile within and above a plant/forest canopy. Corresponding altitude above a ground surface is given in column titles in brackets.

Example of the output file is given below. Because of a large width of data table the example of the output file consists of two parts showing the left and right parts of the table.

proftu - Блокнот

Файл Правка Формат Вид Справка

day	time	ttgs	tu(1)	tu(3)	tu(5)	tu(9)	tu(12)	tu(15)	tu(18)
040605	0.15	16.866	15.491	15.477	15.465	15.446	15.435	15.427	15.420
040605	0.45	16.385	15.401	15.394	15.388	15.379	15.374	15.370	15.366
040605	1.15	16.140	15.851	15.814	15.785	15.737	15.709	15.687	15.670
040605	1.45	16.053	15.610	15.604	15.600	15.592	15.587	15.583	15.581
040605	2.15	15.964	15.859	15.847	15.837	15.822	15.813	15.806	15.800
040605	2.45	15.990	15.963	15.960	15.958	15.954	15.952	15.951	15.949
040605	3.15	15.964	15.524	15.516	15.509	15.498	15.492	15.487	15.483
040605	3.45	15.802	15.306	15.302	15.299	15.294	15.291	15.288	15.286
040605	4.15	15.739	15.679	15.673	15.667	15.659	15.654	15.649	15.646
040605	4.45	15.774	15.608	15.607	15.606	15.604	15.603	15.603	15.602
040605	5.15	15.764	15.670	15.658	15.649	15.634	15.625	15.618	15.612
040605	5.45	15.742	15.410	15.407	15.405	15.401	15.399	15.397	15.395
040605	6.15	15.666	15.384	15.382	15.381	15.379	15.377	15.376	15.375
040605	6.45	15.703	15.877	15.894	15.907	15.928	15.941	15.951	15.959
040605	7.15	15.911	16.352	16.406	16.447	16.516	16.557	16.589	16.613
040605	7.45	16.290	17.487	17.497	17.505	17.518	17.526	17.532	17.537
040605	8.15	16.777	18.339	18.352	18.362	18.378	18.388	18.395	18.401
040605	8.45	17.226	18.136	18.240	18.321	18.457	18.536	18.599	18.647
040605	9.15	17.677	18.806	18.943	19.050	19.228	19.333	19.415	19.478
040605	9.45	18.213	19.463	19.595	19.699	19.871	19.972	20.052	20.113
040605	10.15	18.925	20.353	20.502	20.619	20.813	20.927	21.017	21.086
040605	10.45	19.865	21.454	21.643	21.791	22.037	22.182	22.296	22.383

proftu - Блокнот

Файл Правка Формат Вид Справка

tu(15)	tu(18)	tu(21)	tu(24)	tu(28)	tu(32)	tu(36)	tu(40)	tu(44)	tv
15.427	15.420	15.415	15.412	15.846	16.611	16.992	17.246	17.437	17.590
15.370	15.366	15.364	15.362	15.785	16.529	16.899	17.146	17.331	17.480
15.687	15.670	15.657	15.649	16.013	16.661	16.984	17.199	17.361	17.490
15.583	15.581	15.579	15.577	15.935	16.565	16.878	17.087	17.244	17.370
15.806	15.800	15.796	15.794	16.094	16.623	16.887	17.062	17.194	17.300
15.951	15.949	15.948	15.948	16.196	16.632	16.849	16.994	17.103	17.190
15.487	15.483	15.481	15.479	15.764	16.267	16.517	16.684	16.810	16.910
15.288	15.286	15.285	15.284	15.615	16.197	16.486	16.679	16.824	16.940
15.649	15.646	15.644	15.643	15.909	16.379	16.613	16.769	16.886	16.980
15.603	15.602	15.602	15.602	15.887	16.389	16.638	16.805	16.930	17.030
15.618	15.612	15.608	15.605	15.877	16.357	16.596	16.755	16.874	16.970
15.397	15.395	15.394	15.394	15.701	16.240	16.509	16.688	16.822	16.930
15.376	15.375	15.375	15.374	15.676	16.204	16.467	16.643	16.774	16.880
15.951	15.959	15.964	15.968	16.168	16.516	16.689	16.804	16.891	16.960
16.589	16.613	16.631	16.643	16.735	16.882	16.955	17.004	17.041	17.070
17.532	17.537	17.541	17.543	17.461	17.316	17.244	17.195	17.159	17.130
18.395	18.401	18.406	18.409	18.322	18.168	18.091	18.039	18.001	17.970
18.599	18.647	18.682	18.707	18.635	18.483	18.408	18.358	18.320	18.290
19.415	19.478	19.525	19.557	19.465	19.269	19.172	19.108	19.059	19.020
20.052	20.113	20.158	20.189	20.092	19.889	19.788	19.721	19.671	19.630
21.017	21.086	21.137	21.172	21.020	20.717	20.566	20.466	20.390	20.330
22.296	22.383	22.447	22.491	22.342	22.034	21.881	21.778	21.702	21.640

Where:

day – the date in format “YYMMDD”;

time – the time in format “hh,mm”;

ttgs – the ground surface temperature, °C;

tu(1) - tu(44) – modelled air temperatures at corresponding height above a ground surface given in brackets, °C;

tv – input air temperature at a reference height above a plant/forest canopy, °C.

File “**soiltem.dat**” includes information about modelled temperatures of 10 upper soil sub-layers. The thickness of each soil sub-layer is 10 cm.

Example of the output file is given below. Because of a large width of data table the example of the output file consists of two parts showing the left and right parts of the table.

soiltem - Блокнот

Файл Правка Формат Вид Справка

day	time	Ts(0)	Ts(1)	Ts(2)	Ts(3)	Ts(4)	Ts(5)	Ts(6)
040605	0.15	16.866	16.457	15.598	14.884	14.305	13.855	13.487
040605	0.45	16.385	16.408	15.604	14.892	14.298	13.862	13.494
040605	1.15	16.140	16.357	15.608	14.898	14.294	13.868	13.501
040605	1.45	16.053	16.308	15.609	14.904	14.291	13.873	13.507
040605	2.15	15.964	16.261	15.607	14.909	14.289	13.877	13.513
040605	2.45	15.990	16.217	15.603	14.913	14.288	13.881	13.519
040605	3.15	15.964	16.177	15.598	14.916	14.288	13.885	13.524
040605	3.45	15.802	16.137	15.591	14.919	14.288	13.889	13.530
040605	4.15	15.739	16.098	15.582	14.921	14.289	13.892	13.535
040605	4.45	15.774	16.062	15.573	14.922	14.290	13.896	13.540
040605	5.15	15.764	16.027	15.563	14.923	14.291	13.899	13.545
040605	5.45	15.742	15.995	15.552	14.923	14.292	13.902	13.550
040605	6.15	15.666	15.963	15.540	14.922	14.294	13.906	13.555
040605	6.45	15.703	15.933	15.528	14.921	14.295	13.909	13.559
040605	7.15	15.911	15.906	15.516	14.919	14.296	13.912	13.564
040605	7.45	16.290	15.885	15.503	14.917	14.298	13.915	13.568
040605	8.15	16.777	15.872	15.491	14.915	14.299	13.918	13.572
040605	8.45	17.226	15.867	15.480	14.912	14.300	13.921	13.577
040605	9.15	17.677	15.869	15.470	14.909	14.302	13.924	13.581
040605	9.45	18.213	15.878	15.461	14.906	14.303	13.927	13.585
040605	10.15	18.925	15.896	15.453	14.903	14.304	13.930	13.589
040605	10.45	19.865	15.925	15.448	14.900	14.305	13.933	13.593

soiltem - Блокнот

Файл Правка Формат Вид Справка

Ts(5)	Ts(6)	Ts(7)	Ts(8)	Ts(9)	Ts(10)
13.855	13.487	13.192	12.956	12.766	12.614
13.862	13.494	13.198	12.960	12.769	12.617
13.868	13.501	13.203	12.965	12.772	12.620
13.873	13.507	13.209	12.969	12.775	12.623
13.877	13.513	13.214	12.973	12.778	12.626
13.881	13.519	13.219	12.977	12.781	12.629
13.885	13.524	13.225	12.982	12.784	12.632
13.889	13.530	13.230	12.986	12.788	12.634
13.892	13.535	13.235	12.990	12.791	12.637
13.896	13.540	13.240	12.995	12.795	12.640
13.899	13.545	13.245	12.999	12.798	12.643
13.902	13.550	13.250	13.003	12.802	12.646
13.906	13.555	13.255	13.007	12.805	12.649
13.909	13.559	13.260	13.011	12.808	12.652
13.912	13.564	13.264	13.015	12.812	12.654
13.915	13.568	13.269	13.019	12.815	12.657
13.918	13.572	13.273	13.023	12.819	12.660
13.921	13.577	13.278	13.027	12.822	12.663
13.924	13.581	13.282	13.031	12.826	12.666
13.927	13.585	13.286	13.035	12.829	12.669
13.930	13.589	13.291	13.040	12.832	12.672
13.933	13.593	13.295	13.044	12.836	12.675

Where:

day – the date in format “YYMMDD”;

time – the time in format “hh,mm”;

Ts(1-10) – modelled temperatures of corresponding soil sub-layer, , °C.

File “**soilws.dat**” includes modelled wetness of 10 upper soil sub-layers. The thickness of each soil sub-layer is 10 cm.

Example of the output file is given below. Because of a large width of data table the example of the output file consists of two parts showing the left and right parts of the table.

soilws - Блокнот

Файл Правка Формат Вид Справка

day	time	AW(1)	AW(2)	AW(3)	AW(4)	AW(5)	AW(6)	AW(7)
040605	0.15	0.822	0.828	0.835	0.842	0.850	0.859	0.868
040605	0.45	0.822	0.828	0.835	0.842	0.850	0.859	0.868
040605	1.15	0.822	0.828	0.835	0.842	0.850	0.859	0.868
040605	1.45	0.822	0.828	0.835	0.842	0.850	0.859	0.868
040605	2.15	0.822	0.828	0.835	0.842	0.850	0.859	0.868
040605	2.45	0.822	0.828	0.835	0.842	0.850	0.859	0.868
040605	3.15	0.822	0.828	0.835	0.842	0.850	0.859	0.868
040605	3.45	0.822	0.828	0.835	0.842	0.850	0.859	0.868
040605	4.15	0.824	0.830	0.836	0.843	0.850	0.859	0.868
040605	4.45	0.823	0.830	0.836	0.843	0.850	0.859	0.868
040605	5.15	0.824	0.830	0.836	0.843	0.851	0.859	0.868
040605	5.45	0.824	0.830	0.836	0.843	0.851	0.859	0.868
040605	6.15	0.824	0.830	0.837	0.843	0.851	0.859	0.868
040605	6.45	0.827	0.832	0.838	0.844	0.851	0.859	0.868
040605	7.15	0.827	0.832	0.838	0.845	0.851	0.859	0.868
040605	7.45	0.826	0.832	0.839	0.845	0.852	0.860	0.869
040605	8.15	0.826	0.832	0.839	0.845	0.852	0.860	0.869
040605	8.45	0.826	0.832	0.839	0.845	0.852	0.860	0.869
040605	9.15	0.826	0.832	0.839	0.845	0.852	0.860	0.869
040605	9.45	0.826	0.832	0.839	0.846	0.853	0.860	0.869
040605	10.15	0.826	0.832	0.839	0.846	0.853	0.861	0.869
040605	10.45	0.826	0.832	0.839	0.846	0.853	0.861	0.869

soilws - Блокнот

Файл Правка Формат Вид Справка

AW(6)	AW(7)	AW(8)	AW(9)	AW(10)
0.859	0.868	0.878	0.890	0.903
0.859	0.868	0.878	0.890	0.903
0.859	0.868	0.878	0.890	0.903
0.859	0.868	0.878	0.890	0.903
0.859	0.868	0.878	0.890	0.903
0.859	0.868	0.878	0.890	0.903
0.859	0.868	0.878	0.890	0.903
0.859	0.868	0.878	0.890	0.903
0.859	0.868	0.878	0.890	0.903
0.859	0.868	0.878	0.890	0.903
0.859	0.868	0.878	0.890	0.903
0.859	0.868	0.879	0.890	0.903
0.859	0.868	0.879	0.890	0.903
0.859	0.868	0.879	0.890	0.903
0.859	0.868	0.879	0.890	0.903
0.860	0.869	0.879	0.890	0.903
0.860	0.869	0.879	0.890	0.903
0.860	0.869	0.879	0.890	0.903
0.860	0.869	0.879	0.890	0.903
0.860	0.869	0.879	0.890	0.903
0.861	0.869	0.879	0.890	0.903
0.861	0.869	0.879	0.890	0.903

Where:

day – the date in format “YYMMDD”,

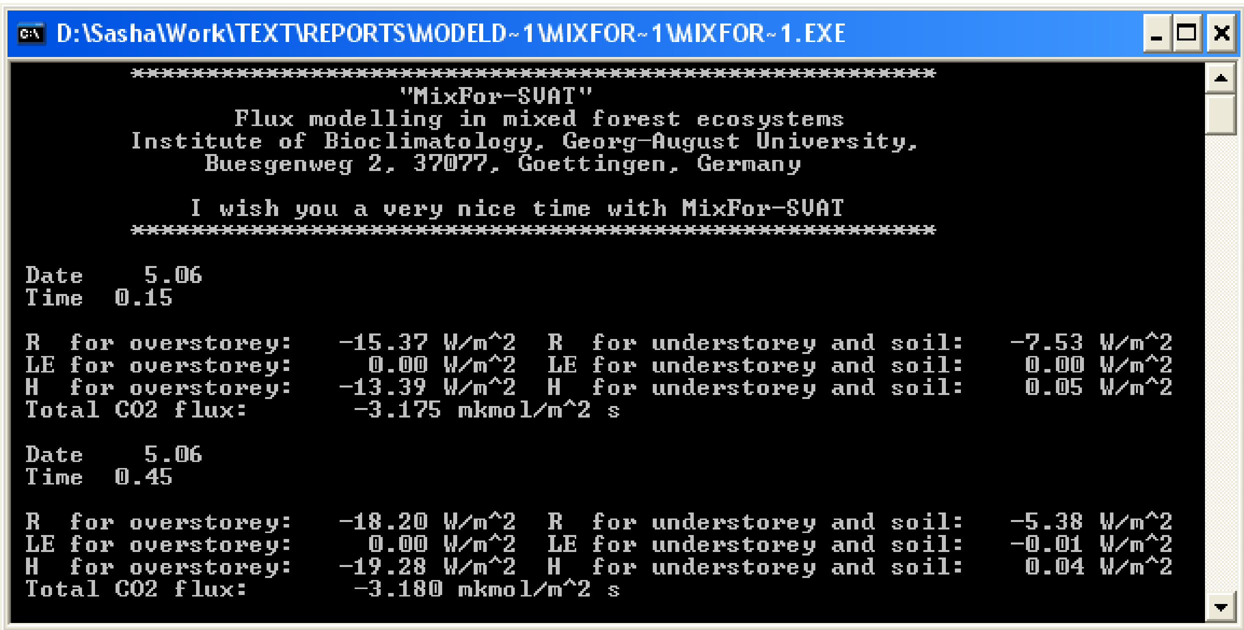
time – the time in format “hh,mm”

AW(1-10) – modelled wetness of corresponding soil sub-layer. If the value of AW is equal to “1” its means that this soil sub-layer reached saturated soil moisture conditions.

Model start and running

The main executing file of the MixFor-SVAT model is **Mixfor-SVAT.exe.** It can be called either in standard DOS-Window or by Windows File Manager.

An example of the standard view of the running MixFor-SVAT model under Windows is given in figure below:



Attention: Errors in input data (format errors or use of not realistic values) as well as gaps in input data can results in interruption of the model calculation…..

I wish you a very good time with the MixFor-SVAT model….