

bgc_README.biome2

back

BGC-GESSys - Version 2.4 - 28 July 1994

This tar file contains the output files for the BGC round 3 VEMAP simulations for the contemporary climate @ 355 ppmv CO2, GFDL_R30 climate @ 710 ppmv CO2, OSU climate @ 710 ppmv CO2, and the UKMO climate@ 710 ppmv CO2 using the MAPSS and BIOME2 vegetation distributions.

The file naming convention is as follows:

MMM_BB_AAACCC.VVvr3

where - MMM = bgc model (bgc)

BB = vegetation distribution model -
 ma = MAPSS
 b2 = BIOME2

AAA = atmospheric CO2 (355 or 710 ppmv)

CCC = climate scenario -
 con = contemporary climate
 gf3 = GFDL_R30
 osu = OSU
 ukm = UKMO

VVV = output variable -
 et = evapotranspiration
 npp = net primary productivity
 nmin = nitrogen mineralization
 soilc = soil carbon
 vegC = vegetation carbon
 sum = summary tables

r3 = round 3

All summary tables have been included in a single file with the *.sumr3 extension.

BGC-GESSys - Version 2.4 - 15 July 1994

This dir contains the output files for the BGC round 3 VEMAP simulations for the contemporary climate at 355 and 710 ppmv CO2 using the original VEMAP VVEG layer (vveg.v1).

The file naming convention is as follows:

MMMAAACCC.VVvr3

where - MMM = model (BGC)

AAA = atmospheric CO2 (355 or 710 ppmv)

CCC = climate scenario -

con = contemporary climate

gf3 = GFDL_R30

osu = OSU

ukm = UKMO

VVV = output variable -

et = evapotranspiration

npp = net primary productivity

nmin = nitrogen mineralization

soilc = soil carbon

vegC = vegetation carbon

sum = summary tables

r3 = round 3

This third round of simulations contains the following "fixes":

1. The addition of a monthly soil water balance model to predict the maximum equilibrium LAI for each cell. The model uses a reduction in AET of 30% to simulate CO2 effects on LAI.
2. Photosynthesis was downregulated within BGC by reducing leaf N by 20%. The vegetation and soil C:N ratios were allowed to increase with a reduction in leaf N.
3. For potential vegetation in equilibrium with climate, we assumed that npp = autotrophic respiration = heterotrophic respiration. We added a module to BGC which, based on this assumption, adjusts the soil and vegetation C and N pools until heterotrophic and autotrophic respiration come into line with npp. We feel that this gets us at least a step closer to a better estimation of the C and N pools; however, give the Veg and Soil C,N variables the twice over - no matter what assumptions one makes, these are still difficult to predict with a single year simulation.

All summary tables have been included in a single file with the *.sumr3 extension.

BGC-GESSys - Version 2.4 - 15 July 1994

This dir contains the output files for the BGC round 3 VEMAP simulations for the GFDL_R30 climate at 355 and 710 ppmv CO2 using the original VEMAP VVEG layer (vveg.v1).

The file naming convention is as follows:

MMMAAACCC.VVvr3

where - MMM = model (BGC)

AAA = atmospheric CO2 (355 or 710 ppmv)

CCC = climate scenario -

con = contemporary climate

gf3 = GFDL_R30

osu = OSU

ukm = UKMO

VVV = output variable -

et = evapotranspiration

npp = net primary productivity

nmin = nitrogen mineralization

soilc = soil carbon

vegC = vegetation carbon

sum = summary tables

r3 = round 3

This third round of simulations contains the following "fixes":

1. The addition of a monthly soil water balance model to predict the maximum equilibrium LAI for each cell. The model uses a reduction in AET of 30% to simulate CO2 effects on LAI.
2. Photosynthesis was downregulated within BGC by reducing leaf N by 20%. The vegetation and soil C:N ratios were allowed to increase with a reduction in leaf N.
3. For potential vegetation in equilibrium with climate, we assumed that npp = autotrophic respiration = heterotrophic respiration. We added a module to BGC which, based on this assumption, adjusts the soil and vegetation C and N pools until heterotrophic and autotrophic respiration come into line with npp. We feel that this gets us at least a step closer to a better estimation of the C and N pools; however, give the Veg and Soil C,N variables the twice over - no matter what assumptions one makes, these are still difficult to predict with a single year simulation.

All summary tables have been included in a single file with the *.sumr3 extension.

BGC-GESSys - Version 2.4 - 15 July 1994

This dir contains the output files for the BGC round 3 VEMAP simulations for the OSU climate scenario at 355 and 710 ppmv CO2 using the original VEMAP VVEG layer (vveg.v1).

The file naming convention is as follows:

MMMAAACCC.VVvr3

where - MMM = model (BGC)

AAA = atmospheric CO2 (355 or 710 ppmv)

CCC = climate scenario -

con = contemporary climate

gf3 = GFDL_R30

osu = OSU

ukm = UKMO

VVV = output variable -

et = evapotranspiration

npp = net primary productivity

nmin = nitrogen mineralization

soilc = soil carbon

vegC = vegetation carbon

sum = summary tables

r3 = round 3

This third round of simulations contains the following "fixes":

1. The addition of a monthly soil water balance model to predict the maximum equilibrium LAI for each cell. The model uses a reduction in AET of 30% to simulate CO2 effects on LAI.
2. Photosynthesis was downregulated within BGC by reducing leaf N by 20%. The vegetation and soil C:N ratios were allowed to increase with a reduction in leaf N.
3. For potential vegetation in equilibrium with climate, we assumed that npp = autotrophic respiration = heterotrophic respiration. We added a module to BGC which, based on this assumption, adjusts the soil and vegetation C and N pools until heterotrophic and autotrophic respiration come into line with npp. We feel that this gets us at least a step closer to a better estimation of the C and N pools; however, give the Veg and Soil C,N variables the twice over - no matter what assumptions one makes, these are still difficult to predict with a single year simulation.

All summary tables have been included in a single file with the *.sumr3 extension.

BGC-GESSys - Version 2.4 - 15 July 1994

This dir contains the output files for the BGC round 3 VEMAP simulations for the UKMO climate at 355 and 710 ppmv CO2 using the original VEMAP VVEG layer (vveg.v1).

The file naming convention is as follows:

MMMAAACCC.VVvr3

where - MMM = model (BGC)

AAA = atmospheric CO2 (355 or 710 ppmv)

CCC = climate scenario -

con = contemporary climate

gf3 = GFDL_R30

osu = OSU

ukm = UKMO

VVV = output variable -

et = evapotranspiration

npp = net primary productivity

nmin = nitrogen mineralization

soilc = soil carbon

vegC = vegetation carbon

sum = summary tables

r3 = round 3

This third round of simulations contains the following "fixes":

1. The addition of a monthly soil water balance model to predict the maximum equilibrium LAI for each cell. The model uses a reduction in AET of 30% to simulate CO2 effects on LAI.
2. Photosynthesis was downregulated within BGC by reducing leaf N by 20%. The vegetation and soil C:N ratios were allowed to increase with a reduction in leaf N.
3. For potential vegetation in equilibrium with climate, we assumed that npp = autotrophic respiration = heterotrophic respiration. We added a module to BGC which, based on this assumption, adjusts the soil and vegetation C and N pools until heterotrophic and autotrophic respiration come into line with npp. We feel that this gets us at least a step closer to a better estimation of the C and N pools; however, give the Veg and Soil C,N variables the twice over - no matter what assumptions one makes, these are still difficult to predict with a single year simulation.

All summary tables have been included in a single file with the *.sumr3 extension.

bgc_README.bgc_doly

back

BGC-GESSys - Version 2.4 - 28 August 1994

This tar file contains the output files for the BGC round 3 VEMAP simulations for the contemporary climate @ 355 ppmv CO2, GFDL_R30 climate @ 710 ppmv CO2, OSU climate @ 710 ppmv CO2, and the UKMO climate@ 710 ppmv CO2 using the DOLY vegetation distributions.

The file naming convention is as follows:

MMM_BB_AAACCC.VVvr3

where - MMM = bgc model (bgc)

BB = vegetation distribution model, ma = MAPSS
b2 = BIOME2
do = DOLY

AAA = atmospheric CO2 (355 or 710 ppmv)

CCC = climate scenario - con = contemporary climate
gf3 = GFDL_R30
osu = OSU
ukm = UKMO

VVV = output variable - et = evapotranspiration
npp = net primary productivity
nmin = nitrogen mineralization
soilc = soil carbon
vegC = vegetation carbon
sum = summary tables

r3 = round 3

All summary tables have been included in a single file with the *.sumr3 extension.

bgc_README.mapss

back

BGC-GESSys - Version 2.4 - 28 July 1994

This tar file contains the output files for the BGC round 3 VEMAP simulations for the contemporary climate @ 355 ppmv CO2, GFDL_R30 climate @ 710 ppmv CO2, OSU climate @ 710 ppmv CO2, and the UKMO climate@ 710 ppmv CO2 using the MAPSS and BIOME2 vegetation distributions.

The file naming convention is as follows:

MMM_BB_AAACCC.VVvr3

where - MMM = bgc model (bgc)

BB = vegetation distribution model -
ma = MAPSS
b2 = BIOME2

AAA = atmospheric CO2 (355 or 710 ppmv)

CCC = climate scenario -
con = contemporary climate
gf3 = GFDL_R30
osu = OSU
ukm = UKMO

VVV = output variable -
et = evapotranspiration
npp = net primary productivity
nmin = nitrogen mineralization
soilc = soil carbon
vegC = vegetation carbon
sum = summary tables

r3 = round 3

All summary tables have been included in a single file with the *.sumr3 extension.

biome2_readme.new

back

biome2 outputs for climate change scenarios

gfdl r30 climate 1xco2 file= gf3_355.v4
gfdl r30 climate 2xco2 file= gf3_710.v4

ukmo climate 1xco2 file= ukm_355.v4
ukmo climate 2xco2 file= ukm_710.v4

osu climate 1xco2 file= osu_355.v4
osu climate 2xco2 file= osu_710.v4

century_README.biome2

back

century_README.mapss.v6_1

back

century_README.doly

back

README:

VEMAP CENTURY RESULTS

The units and scaling factors are described in the header of each output file.

The naming convention for the files is:

cent_{variable}.{co2 level}{gcm/weather}{_biome model}.{version #}

The 'biome model' is the model which produced the redistributed biome map.

Where:

cent = Century

output variable -

et = evapotranspiration
npp = net primary productivity
nmin = nitrogen mineralization
soilc = soil carbon
vegc = vegetation carbon

atmospheric CO2 (355 or 710 ppmv)

gcm/weather, climate scenario -

con = contemporary climate
gf3 = GFDL_R30
osu = OSU
ukm = UKMO

biome model / vegetation distribution model -

ma = MAPSS
b2 = BIOME2
do = DOLY

version # = v6._1

Each file has an associated summary table which adheres to the format outlined by the TEM group.

README:
VEMAP CENTURY RESULTS

The naming convention for the files is:

cent_{variable}.{co2 level}{gcm/weather}{years simulated}.{version #}

the 'years simulated' is the number of years we ran beyond our equilibrium / stand-age simulation.

Where:

cent = Century

output variable -

et = evapotranspiration
npp = net primary productivity
nmin = nitrogen mineralization
soilc = soil carbon
vegC = vegetation carbon

atmospheric CO2 (355 or 710 ppmv)

gcm/weather, climate scenario -

contemp = contemporary climate
gf3 = GFDL_R30
osu = OSU
ukm = UKMO

years simulated = number of years we ran beyond our equilibrium / stand-age simulation.

version # = v4 or v4_1

Each file has an associated summary table which adheres to the format outlined by the TEM group.

README.temxbiome2

README: TEM-VEMAP outputs using BIOME2 output, version 2

We are happy to provide you our new results (version 2) of TEM runs using the BIOME2 vegetation distribution. The new results contain 7 output variables (npp, vegc, solc, nmin, aet, strn, soln) from the TEM (version 4.0) runs under contemporary climate (version 1), and 3 revised GCM climates (OSU - version 1; UKMO,GFDL R30 - version 3), respectively.

Filename format: temxbiome2_vvvccc_ggg.dddvx

where:

vvv = output variables (missing data values after scaling)

aet = actual evapotranspiration (-99.0)
npp = net primary production (-99.0)
nmin = net nitrogen mineralization (-9.9)
solc = soil organic carbon storage (-99.0)
vegc = vegetation carbon storage (-99.0)
strn = vegetation structural nitrogen storage (-99.0)
soln = soil organic nitrogen storage (-99.0)

ccc = atmospheric CO2 (ppm) concentration

355 = 355 ppm
710 = 710 ppm

For GCMs: ggg = climate scenarios

gf3 = GFDL-R30 GCM scenario
osu = OSU GCM scenario
ukm = UKMO GCM scenario

ddd = data characteristics

ann = annual values
ave = average values for 12 months
sum = summary tables

vx = data version

Note:

1. Background values by variables (except nmin) are all set to fit the standard format Tim pooled in Table 1 in his June 14th memo, as agreed upon at the VEMAP meeting in Woods Hole (May 20-21). Background values include wetland and inland water. For nmin, we assigned a background value of -9.9 as described in Tim and Nan's June 22nd memo.

2. Although TEM did solve for all non-wetland grid cells for the contemporary climate scenario, the model did not solve ("bombed") all the non-wetland grid cells in the GCM scenarios:

Scenario	"Bombs"	Number of "Good" Values
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See README.qc for more information on "bombed" grid cells

More information about these "bomb-outs" (including location) is given in the summary tables. As agreed upon at the VEMAP meeting in Woods Hole, we assigned a value of -98 to these grid cells with the exception of nmin, which we assigned a value of -9.8 (see 1. above).

3. The unit of each variable is described in each svf file and matches those described in Table 1 of the June 14th memo from Nan Rosenbloom and Tim Kittel.

4. As the use of C/N ratios was discussed at the VEMAP meeting in Woods Hole as a possible diagnostic variable, we have included data on vegetation structural nitrogen (strn) and soil organic nitrogen (soln) with this release to allow such calculations (i.e. vegc/strn and solc/soln) and comparisons to the other models.

5. Each of the 7 output variables has a summary table associated with it (see all *.sumv2 files). The summary data are based on information from the original TEM data structure and not the svf files. As the svf format has truncated the values of many of the output variables, summaries based on the svf files might not exactly match the summary tables provided. In addition, the US totals at the bottom of the summary tables may not exactly match the sum of the vegetation types, again due to truncation of values in developing a "pretty" summary table.

In addition to summarizing the results for grid cells that were solved by TEM, we include summary information for the "bomb-outs" or "grid cells rejected for analysis" by vegetation type (column 1). By including the grid cell area (column 3) and the unit-area mean of each variable (by vegetation type - column 4), we can develop a regional estimate of each variable for the rejected grid cells (column 5). Adding the regional estimate for the rejected grid cells (column 5) to the appropriate regional estimate of "solved" grid cells, we can develop a regional estimate for vegetation types that includes both "solved" and "rejected" grid cells (column 6). The total at the bottom of column 6 would then be our final estimate for the conterminous United States.

Finally, we provide the longitude and latitude of each grid cell that "bombed".

If there are any questions, please contact us at MBL.

Yude	508 548-3705 x498	yudepan@lupine.mbl.edu
Kick	508 548-3705 x490	dkick@lupine.mbl.edu
Dave	303 872-3387	amcguire@lupine.mbl.edu

README_v2.tem

README: TEM-VEMAP outputs, version 2

We are happy to provide you our new results (version 2) of TEM runs using the VVEG vegetation distribution. The new results contain 7 output variables (npp, vegc, solc, nmin, aet, strn, soln) from the TEM (version 4.0) runs under contemporary climate, and 3 revised GCM climates (version 3), respectively.

Filename format: vvvccc_ggg.dddvx

where:

vvv = output variables (missing data values after scaling)
aet = actual evapotranspiration (-99.0)
npp = net primary production (-99.0)
nmin = net nitrogen mineralization (-9.9)
solc = soil organic carbon storage (-99.0)
vegc = vegetation carbon storage (-99.0)
strn = vegetation structural nitrogen storage (-99.0)
soln = soil organic nitrogen storage (-99.0)

ccc = atmospheric CO2 (ppm) concentration
355 = 355 ppm
710 = 710 ppm

ddd = data characteristics
ann = annual values
ave = average values for 12 months
sum = summary tables

vx = data version

For GCMs:

ggg = climate scenarios
gf3 = GFDL-R30 GCM scenario
osu = OSU GCM scenario
ukm = UKMO GCM scenario

The SVF format image files and summary files are as follows:

/Contemp :

aet355.annv2	soln355.avev2	solc710.avev2
aet355.sumv2	soln355.sumv2	solc710.sumv2
npp355.annv2	nmin355.annv2	strn710.avev2
npp355.sumv2	nmin355.sumv2	strn710.sumv2
vegc355.avev2	aet710.annv2	soln710.avev2
vegc355.sumv2	aet710.sumv2	soln710.sumv2
solc355.avev2	npp710.annv2	nmin710.annv2
solc355.sumv2	npp710.sumv2	nmin710.sumv2
strn355.avev2	vegc710.avev2	
strn355.sumv2	vegc710.sumv2	

/GFDLR30gcm :

aet355_gf3.annv2	soln355_gf3.avev2	solc710_gf3.avev2
aet355_gf3.sumv2	soln355_gf3.sumv2	solc710_gf3.sumv2
npp355_gf3.annv2	nmin355_gf3.annv2	strn710_gf3.avev2
npp355_gf3.sumv2	nmin355_gf3.sumv2	strn710_gf3.sumv2
veg355_gf3.avev2	aet710_gf3.annv2	soln710_gf3.avev2
veg355_gf3.sumv2	aet710_gf3.sumv2	soln710_gf3.sumv2
solc355_gf3.avev2	npp710_gf3.annv2	nmin710_gf3.annv2
solc355_gf3.sumv2	npp710_gf3.sumv2	nmin710_gf3.sumv2
strn355_gf3.avev2	veg355_gf3.avev2	
strn355_gf3.sumv2	veg355_gf3.sumv2	

/OSUgcm :

aet355_osu.annv2	soln355_osu.avev2	solc710_osu.avev2
aet355_osu.sumv2	soln355_osu.sumv2	solc710_osu.sumv2
npp355_osu.annv2	nmin355_osu.annv2	strn710_osu.avev2
npp355_osu.sumv2	nmin355_osu.sumv2	strn710_osu.sumv2
veg355_osu.avev2	aet710_osu.annv2	soln710_osu.avev2
veg355_osu.sumv2	aet710_osu.sumv2	soln710_osu.sumv2
solc355_osu.avev2	npp710_osu.annv2	nmin710_osu.annv2
solc355_osu.sumv2	npp710_osu.sumv2	nmin710_osu.sumv2
strn355_osu.avev2	veg355_osu.avev2	
strn355_osu.sumv2	veg355_osu.sumv2	

/UKMOgcm :

aet355_ukm.annv2	soln355_ukm.avev2	solc710_ukm.avev2
aet355_ukm.sumv2	soln355_ukm.sumv2	solc710_ukm.sumv2
npp355_ukm.annv2	nmin355_ukm.annv2	strn710_ukm.avev2
npp355_ukm.sumv2	nmin355_ukm.sumv2	strn710_ukm.sumv2
veg355_ukm.avev2	aet710_ukm.annv2	soln710_ukm.avev2
veg355_ukm.sumv2	aet710_ukm.sumv2	soln710_ukm.sumv2
solc355_ukm.avev2	npp710_ukm.annv2	nmin710_ukm.annv2
solc355_ukm.sumv2	npp710_ukm.sumv2	nmin710_ukm.sumv2
strn355_ukm.avev2	veg355_ukm.avev2	
strn355_ukm.sumv2	veg355_ukm.sumv2	

Note:

1. Background values by variables (except nmin) are all set to fit the standard format Tim pooled in Table 1 in his June 14th memo, as agreed upon at the VEMAP meeting in Woods Hole (May 20-21). Background values include wetland and inland water. For nmin, we assigned a background value of -9.9 to maintain a space and a 5-digit integer for each missing value in the svf file (which is comparable to the svf files of the GCM "change ratios" made available by UCAR/NCAR).

2. We fixed a very minor problem in TEM version 4.0 so that TEM solves for all the non-wetland grid cells (N=3168) of all the files in this release.

3. In version 1, we read the results of the water balance model (WBM) from input files into TEM to calculate TEM output variables. In these new runs (version 2), the WBM

variables were calculated concurrently with the TEM output variables. This process allowed us to estimate TEM output variables more accurately so that our results are slightly different from those obtained in version 1.

4. Our AET estimates do not depend upon CO2 concentration. As a convenience, we made two copies of our AET estimates for each climate scenario. We placed one copy with the TEM results at 355 ppmv and the other copy with the TEM results at 710 ppmv.

5. The unit of each variable is described in each svf file and matches those described in Table 1 of the June 14th memo from Nan Rosenbloom and Tim Kittel.

6. As the use of C/N ratios was discussed at the VEMAP meeting in Woods Hole as a possible diagnostic variable, we have included data on vegetation structural nitrogen (strn) and soil organic nitrogen (soln) with this release to allow such calculations (i.e. vegc/strn and solc/soln) and comparisons to the other models.

7. Each of the 7 output variables has a summary table associated with it (see all *.sumv2 files). The summary data are based on information from the original TEM data structure and not the svf files. As the svf format has truncated the values of many of the output variables, summaries based on the svf files might not exactly match the summary tables provided. In addition, the US totals at the bottom of the summary tables may not exactly match the sum of the vegetation types, again due to truncation of values in developing a "pretty" summary table.

If there are any questions, please contact us at MBL.

Yude	508 548-3705 x498	yudepan@lupine.mbl.edu
Kick	508 548-3705 x490	dkick@lupine.mbl.edu
Dave	303 872-3387	amcguire@lupine.mbl.edu

README.temxdoly

README: TEM-VEMAP outputs using DOLY output, version 2

Hi, VEMAPers:

We are happy to provide you our new results (version 2) of TEM runs using the DOLY vegetation distribution. The new results contain 7 output variables (npp, vegc, solc, nmin, aet, strn, soln) from the TEM (version 4.0) runs under contemporary climate (version 1), and 3 revised GCM climates (OSU - version 1; UKMO,GFDL R30 - version 3), respectively.

Filename format: temxdoly_vvvccc_ggg.dddvx

where:

vvv = output variables (missing data values after scaling)

aet = actual evapotranspiration (-99.0)
npp = net primary production (-99.0)
nmin = net nitrogen mineralization (-9.9)
solc = soil organic carbon storage (-99.0)
vegc = vegetation carbon storage (-99.0)
strn = vegetation structural nitrogen storage (-99.0)
soln = soil organic nitrogen storage (-99.0)

ccc = atmospheric CO2 (ppm) concentration

355 = 355 ppm
710 = 710 ppm

For GCMs: ggg = climate scenarios

gf3 = GFDL-R30 GCM scenario
osu = OSU GCM scenario
ukm = UKMO GCM scenario

ddd = data characteristics

ann = annual values
ave = average values for 12 months
sum = summary tables

vx = data version

The SVF format image files and summary files are as follows:

/Contemp:

temxdoly_aet355.annv2	temxdoly_strn355.avev2
temxdoly_aet355.sumv2	temxdoly_strn355.sumv2
temxdoly_npp355.annv2	temxdoly_soln355.avev2

temxdoly_npp355.sumv2
temxdoly_vegc355.avev2
temxdoly_vegc355.sumv2
temxdoly_solc355.avev2
temxdoly_solc355.sumv2

temxdoly_soln355.sumv2
temxdoly_nmin355.annv2
temxdoly_nmin355.sumv2

/GFDLR30gcm:

temxdoly_aet710_gf3.annv2
temxdoly_aet710_gf3.sumv2
temxdoly_npp710_gf3.annv2
temxdoly_npp710_gf3.sumv2
temxdoly_vegc710_gf3.avev2
temxdoly_vegc710_gf3.sumv2
temxdoly_solc710_gf3.avev2
temxdoly_solc710_gf3.sumv2

temxdoly_strn710_gf3.avev2
temxdoly_strn710_gf3.sumv2
temxdoly_soln710_gf3.avev2
temxdoly_soln710_gf3.sumv2
temxdoly_nmin710_gf3.annv2
temxdoly_nmin710_gf3.sumv2

/OSUgcm:

temxdoly_aet710_osu.annv2
temxdoly_aet710_osu.sumv2
temxdoly_npp710_osu.annv2
temxdoly_npp710_osu.sumv2
temxdoly_vegc710_osu.avev2
temxdoly_vegc710_osu.sumv2
temxdoly_solc710_osu.avev2
temxdoly_solc710_osu.sumv2

temxdoly_strn710_osu.avev2
temxdoly_strn710_osu.sumv2
temxdoly_soln710_osu.avev2
temxdoly_soln710_osu.sumv2
temxdoly_nmin710_osu.annv2
temxdoly_nmin710_osu.sumv2

/UKMOgcm:

temxdoly_aet710_ukm.annv2
temxdoly_aet710_ukm.sumv2
temxdoly_npp710_ukm.annv2
temxdoly_npp710_ukm.sumv2
temxdoly_vegc710_ukm.avev2
temxdoly_vegc710_ukm.sumv2
temxdoly_solc710_ukm.avev2
temxdoly_solc710_ukm.sumv2

temxdoly_strn710_ukm.avev2
temxdoly_strn710_ukm.sumv2
temxdoly_soln710_ukm.avev2
temxdoly_soln710_ukm.sumv2
temxdoly_nmin710_ukm.annv2
temxdoly_nmin710_ukm.sumv2

Note:

1. Background values by variables (except nmin) are all set to fit the standard format Tim pooled in Table 1 in his June 14th memo, as agreed upon at the VEMAP meeting in Woods Hole (May 20-21). Background values include wetland and inland water. For nmin, we assigned a background value of -9.9 as described in Tim and Nan's June 22nd memo.

2. Although TEM did solve for all non-wetland grid cells for the contemporary climate scenario, the model did not solve ("bombed") all the non-wetland grid cells in the GCM scenarios:

Scenario	"Bombs"	Number of "Good" Values
Contemporary Climate @ 355 ppmv	0	3168

UKMO Climate @ 710 ppmv	5	3163
OSU Climate @ 710 ppmv	14	3154
GFDL R30 Climate @ 710 ppmv	5	3163

More information about these "bomb-outs" (including location) is given in the summary tables. As agreed upon at the VEMAP meeting in Woods Hole, we assigned a value of -98 to these grid cells with the exception of nmin, which we assigned a value of -9.8 (see 1. above).

3. The unit of each variable is described in each svf file and matches those described in Table 1 of the June 14th memo from Nan Rosenbloom and Tim Kittel.

4. As the use of C/N ratios was discussed at the VEMAP meeting in Woods Hole as a possible diagnostic variable, we have included data on vegetation structural nitrogen (strn) and soil organic nitrogen (soln) with this release to allow such calculations (i.e. vegc/strn and solc/soln) and comparisons to the other models.

5. Each of the 7 output variables has a summary table associated with it (see all *.sumv2 files). The summary data are based on information from the original TEM data structure and not the svf files. As the svf format has truncated the values of many of the output variables, summaries based on the svf files might not exactly match the summary tables provided. In addition, the US totals at the bottom of the summary tables may not exactly match the sum of the vegetation types, again due to truncation of values in developing a "pretty" summary table.

In addition to summarizing the results for grid cells that were solved by TEM, we include summary information for the "bomb-outs" or "grid cells rejected for analysis" by vegetation type (column 1). By including the grid cell area (column 3) and the unit-area mean of each variable (by vegetation type - column 4), we can develop a regional estimate of each variable for the rejected grid cells (column 5). Adding the regional estimate for the rejected grid cells (column 5) to the appropriate regional estimate of "solved" grid cells, we can develop a regional estimate for vegetation types that includes both "solved" and "rejected" grid cells (column 6). The total at the bottom of column 6 would then be our final estimate for the conterminous United States.

Finally, we provide the longitude and latitude of each grid cell that "bombed".

If there are any questions, please contact us at MBL.

Yude	508 548-3705 x498	yudepan@lupine.mbl.edu
Kick	508 548-3705 x490	dkick@lupine.mbl.edu
Dave	303 872-3387	amcguire@lupine.mbl.edu

README.temxmapss

README: TEM-VEMAP outputs using MAPSS output, version 2

We are happy to provide you our new results (version 2) of TEM runs using the MAPSS vegetation distribution (w/prairie peninsula, current winds, and WUE for CO₂ = 710 ppmv). The new results contain 7 output variables (npp, vegc, solc, nmin, aet, strn, soln) from the TEM (version 4.0) runs under contemporary climate, and 3 revised GCM climates (version 3), respectively.

Filename format: temxmapss_vvvccc_ggg.dddvx

where:

vvv = output variables (missing data values after scaling)

aet = actual evapotranspiration (-99.0)
npp = net primary production (-99.0)
nmin = net nitrogen mineralization (-9.9)
solc = soil organic carbon storage (-99.0)
vegc = vegetation carbon storage (-99.0)
strn = vegetation structural nitrogen storage (-99.0)
soln = soil organic nitrogen storage (-99.0)

ccc = atmospheric CO₂ (ppm) concentration

355 = 355 ppm
710 = 710 ppm

For GCMs: ggg = climate scenarios

gf3 = GFDL-R30 GCM scenario
osu = OSU GCM scenario
ukm = UKMO GCM scenario

ddd = data characteristics

ann = annual values
ave = average values for 12 months
sum = summary tables

vx = data version

The SVF format image files and summary files are as follows:

/Contemp (or temdata_v2_mapss_contemp.tar):

temxmapss_aet355.annv2	temxmapss_strn355.avev2
temxmapss_aet355.sumv2	temxmapss_strn355.sumv2
temxmapss_npp355.annv2	temxmapss_soln355.avev2
temxmapss_npp355.sumv2	temxmapss_soln355.sumv2
temxmapss_vegc355.avev2	temxmapss_nmin355.annv2
temxmapss_vegc355.sumv2	temxmapss_nmin355.sumv2
temxmapss_solc355.avev2	
temxmapss_solc355.sumv2	

/GFDLR30gcm (or temdata_v2_mapss_gf3.tar):

temxmapss_aet710_gf3.annv2	temxmapss_strn710_gf3.avev2
temxmapss_aet710_gf3.sumv2	temxmapss_strn710_gf3.sumv2
temxmapss_npp710_gf3.annv2	temxmapss_soln710_gf3.avev2
temxmapss_npp710_gf3.sumv2	temxmapss_soln710_gf3.sumv2
temxmapss_vegc710_gf3.avev2	temxmapss_nmin710_gf3.annv2
temxmapss_vegc710_gf3.sumv2	temxmapss_nmin710_gf3.sumv2
temxmapss_solc710_gf3.avev2	
temxmapss_solc710_gf3.sumv2	

/OSUgcm (or temdata_v2_mapss_osu.tar):

temxmapss_aet710_osu.annv2	temxmapss_strn710_osu.avev2
temxmapss_aet710_osu.sumv2	temxmapss_strn710_osu.sumv2
temxmapss_npp710_osu.annv2	temxmapss_soln710_osu.avev2
temxmapss_npp710_osu.sumv2	temxmapss_soln710_osu.sumv2
temxmapss_vegc710_osu.avev2	temxmapss_nmin710_osu.annv2
temxmapss_vegc710_osu.sumv2	temxmapss_nmin710_osu.sumv2
temxmapss_solc710_osu.avev2	
temxmapss_solc710_osu.sumv2	

/UKMOgcm (or temdata_v2_mapss_ukm.tar):

temxmapss_aet710_ukm.annv2	temxmapss_strn710_ukm.avev2
temxmapss_aet710_ukm.sumv2	temxmapss_strn710_ukm.sumv2
temxmapss_npp710_ukm.annv2	temxmapss_soln710_ukm.avev2
temxmapss_npp710_ukm.sumv2	temxmapss_soln710_ukm.sumv2
temxmapss_vegc710_ukm.avev2	temxmapss_nmin710_ukm.annv2
temxmapss_vegc710_ukm.sumv2	temxmapss_nmin710_ukm.sumv2
temxmapss_solc710_ukm.avev2	
temxmapss_solc710_ukm.sumv2	

Note:

1. Background values by variables (except nmin) are all set to fit the standard format Tim pooled in Table 1 in his June 14th memo, as agreed upon at the VEMAP meeting in Woods Hole (May 20-21). Background values include wetland and inland water. For nmin, we assigned a background value of -9.9 as described in Tim and Nan's June 22nd memo.

2. Although TEM did solve for all non-wetland grid cells for the contemporary climate scenario, the model did not solve ("bombed") all the non-wetland grid cells in the GCM scenarios:

Scenario	"Bombs"	Number of "Good" Values
Contemporary Climate @ 355 ppmv	0	3168
UKMO Climate @ 710 ppmv	5	3163
OSU Climate @ 710 ppmv	14	3154
GFDL R30 Climate @ 710 ppmv	6	3162

More information about these "bomb-outs" (including location) is given in the summary tables. As agreed upon at the VEMAP meeting in Woods Hole, we assigned a value of -98 to

these grid cells with the exception of mmin, which we assigned a value of -9.8 (see 1. above).

3. The unit of each variable is described in each svf file and matches those described in Table 1 of the June 14th memo from Nan Rosenbloom and Tim Kittel.

4. As the use of C/N ratios was discussed at the VEMAP meeting in Woods Hole as a possible diagnostic variable, we have included data on vegetation structural nitrogen (strn) and soil organic nitrogen (soln) with this release to allow such calculations (i.e. vegc/strn and solc/soln) and comparisons to the other models.

5. Each of the 7 output variables has a summary table associated with it (see all *.sumv2 files). The summary data are based on information from the original TEM data structure and not the svf files. As the svf format has truncated the values of many of the output variables, summaries based on the svf files might not exactly match the summary tables provided. In addition, the US totals at the bottom of the summary tables may not exactly match the sum of the vegetation types, again due to truncation of values in developing a "pretty" summary table.

In addition to summarizing the results for grid cells that were solved by TEM, we include summary information for the "bomb-outs" or "grid cells rejected for analysis" by vegetation type (column 1). By including the grid cell area (column 3) and the unit-area mean of each variable (by vegetation type - column 4), we can develop a regional estimate of each variable for the rejected grid cells (column 5). Adding the regional estimate for the rejected grid cells (column 5) to the appropriate regional estimate of "solved" grid cells, we can develop a regional estimate for vegetation types that includes both "solved" and "rejected" grid cells (column 6). The total at the bottom of column 6 would then be our final estimate for the conterminous United States.

Finally, we provide the longitude and latitude of each grid cell that "bombed".

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Kick	508 548-3705 x490	dkick@lupine.mbl.edu
Dave	303 872-3387	amcguire@lupine.mbl.edu

Individual Model Descriptions (linked from above)

BIOME2

BIOME2 uses a coupled carbon and water flux simulation model to capture the broadscale environmental controls on the distribution of vegetation structural and functional types (Haxeltine et al. 1996, Haxeltine and Prentice 1996a, Haxeltine and Prentice 1996b). Model input consists of latitude, soil texture, and mean monthly climate data (temperature, precipitation, and sunshine hours).

A rule-based biogeography module based largely on the biome model of Prentice et al. (1992) is first used to select which plant types may potentially be present at a particular site. This rule-base captures the effects of minimum temperature tolerances and chilling requirements on determining the distributions of different plant types. Starting from the set of plant types that may potentially be present at a certain site the model then finds the combination of plant types which maximizes the whole ecosystem NPP. Gross primary production (GPP) is calculated as a linear function of absorbed photosynthetically active radiation based on an optimized version of the Farquhar photosynthesis equation (Haxeltine and Prentice 1996a). GPP is reduced by drought stress and low temperatures. Respiration costs are currently estimated simply as being 50% of the non-water-limited GPP. Through the effects of drought stress on NPP, the model correctly reproduces changes in FPC along moisture gradients. A simple two-layer hydrology model allows a realistic simulation of the competitive balance between grass and woody vegetation, including the effects of soil texture. The prescribed CO₂ concentration has a direct effect on GPP through the photosynthesis algorithm and greatly effects the competitive balance between C₃ and C₄ plants. The water balance calculation is based upon equilibrium evapotranspiration theory (Jarvis and McNaughton 1986) which suggests that the large-scale potential evapotranspiration rate is determined by the energy supply for evaporation. Stomatal conductance is not explicitly included in the water balance calculation and there is no direct effect of CO₂ on the water balance in the model.

Model output consists of net primary production (NPP) and leaf area (as foliar projective cover, FPC) for the combination of major plant types (e.g., evergreen and cold deciduous woody plants and C₃ and C₄ grasses) that maximizes whole ecosystem

NPP. A rule-base is then used to translate the model output into vegetation structural categories which can be directly compared with those of the VEMAP vegetation data set.

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BIOME2 Contacts:

Colin Prentice	colin@planteco.lu.se
Stephen Sitch	stephen@planteco.lu.se
Jed Kaplan	Jed_O.Kaplan@planteco.lu.se

DOLY

back to top

A global primary productivity and phytogeography model represents the biochemical processes of photosynthesis and the dependence of gas exchange on stomatal conductance, which in turn depends on temperature and soil moisture. Canopy conductance controls soil water loss by evapotranspiration. The assignment of nitrogen uptake to leaf layers is proportional to irradiance, and respiration and maximum assimilation rates depend on nitrogen uptake and temperature. Total nitrogen uptake is derived from soil carbon and nitrogen and depends on temperature. The long-term average annual carbon and hydrological budgets dictate canopy leaf area. Although observations constrain soil carbon and nitrogen, the distribution of vegetation types is not specified by an underlying map. Variables simulated by the model are compared favorably to experimental results. These comparisons extend from biochemical processes to the whole canopy, and the comparisons are favorable for both current and elevated CO₂ atmospheres. The model is used to simulate the global distributions of leaf area index and annual net primary productivity. These distributions are sufficiently realistic to demonstrate that the model is useful for analyzing vegetation responses to global environmental change. A statistical procedure is used to derive global distributions of ecosystem complexes from variables simulated by the primary productivity model. A multiple discriminant function analysis of variables including net primary productivity, leaf area index, evapotranspiration, and potential evapotranspiration accounts for both ecophysiological constraints as well as the effects of resource limitations to produce biogeographical ecosystem distributions.

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The MAPSS Model

[back to top](#)

MAPSS (Mapped Atmosphere-Plant-Soil System) is a global biogeography model which simulates the potential natural vegetation that can be supported at any upland site in the world under a long-term steady-state climate. MAPSS operates on the fundamental principle that ecosystems will tend to maximize the leaf area that can be supported at a site by available soil moisture or energy (Woodward 1987; Neilson et al. 1989; Neilson 1993a; Neilson 1995).

Conceptual Framework

The conceptual framework for this approach is that vegetation distributions are, in general, constrained by either the availability of water in relation to transpirational demands or the availability of energy for growth (Neilson and Wullstein 1983, Neilson et al. 1989, Stephenson 1990, Woodward 1987). In temperate latitudes, water is the primary constraint, while at high latitudes energy is the primary constraint (exceptions occur, of course, particularly in some areas that may be nutrient limited). The energy constraints on vegetation type and leaf area index (LAI) are currently modeled in MAPSS using a growing degree day algorithm as a surrogate for net radiation (e.g. Botkin et al. 1972; Shugart 1984).

The model calculates the leaf area index of both woody and grass life forms (trees or shrubs, but not both) in competition for both light and water, while maintaining a site water balance consistent with observed runoff (Neilson 1995). Water in the surface layer is apportioned to the two life forms in relation to their relative LAIs and stomatal conductances, i.e., canopy conductance, while woody vegetation alone has access to deeper soil water.

Biomes are not explicitly simulated in MAPSS; rather, the model simulates the distribution of vegetation lifeforms (tree, shrub, grass), the dominant leaf form (broadleaf, needleleaf), leaf phenology (evergreen, deciduous), thermal tolerances and vegetation density (LAI). These characteristics are then combined into a vegetation classification consistent with the biome level (Neilson 1995).

Model Workings

The principal features of the MAPSS model include algorithms for:

- 1) formation and melt of snow,
- 2) interception and evaporation of rainfall,
- 3) infiltration and percolation of rainfall and snowmelt through three soil layers,
- 4) runoff,

- 5) transpiration based on LAI and stomatal conductance,
- 6) biophysical 'rules' for leaf form and phenology,
- 7) iterative calculation of LAI, and
- 8) assembly rules for vegetation classification.

Infiltration, and saturated and unsaturated percolation, are represented by an analog of Darcy's Law specifically calibrated to a monthly time step. Water holding capacities at saturation, field potential, and wilting point are calculated from soil texture, as are soil water retention curves (Saxton et al., 1986). Transpiration is driven by potential evapotranspiration (PET) as calculated by an aerodynamic turbulent transfer model based upon Brutsaert's (1982) ABL model (Marks and Dozier, 1992; Marks 1990), with actual transpiration being constrained by soil water, leaf area and stomatal conductance. Stomatal conductance is modulated as a function of PET (a surrogate for vapor pressure deficit) and soil water content (Denmead and Shaw 1962). Canopy conductance (i.e., actual transpiration) is an exponential function of LAI, modulated by stomatal conductance.

Elevated CO₂ can affect vegetation responses to climate change through changes in carbon fixation and water-use-efficiency (WUE, carbon atoms fixed per water molecule transpired). The WUE effect is often noted as a reduction in stomatal conductance (Eamus 1991). Since MAPSS simulates carbon indirectly (through LAI), a WUE effect can be imparted directly as a change in stomatal conductance, which results in increased LAI (carbon stocks) and usually a small decrease in transpiration per unit land area.

MAPSS has been implemented at a 10 km resolution over the continental U.S. and at a 0.5o resolution globally (Neilson 1995, Neilson 1993a, Neilson and Marks 1994). The model has been partially validated within the U.S. and globally with respect to simulated vegetation distribution, LAI, and runoff (Neilson 1993a; Neilson 1995; Neilson and Marks 1994). MAPSS has also been implemented at the watershed scale (MAPSS-W, 200 m resolution) via a partial hybridization with a distributed catchment hydrology model (Daly 1994, Wigmosta 1994).

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BIOME-BGC

[back to top](#)

The BIOME-BGC (BioGeochemical Cycles) model is a multi-biome generalization of FOREST-BGC, a model originally developed to simulate a forest stand development through a life cycle [[Running and Coughlan, 1988](#); [Running and Gower, 1991](#)]. The model requires daily climate data and the definition of several key climate, vegetation, and site conditions to estimate fluxes of carbon, nitrogen, and water through ecosystems. Allometric relationships are used to initialize plant and soil carbon (C) and nitrogen (N) pools based on the leaf pools of these elements. [[Vitousek et al, 1988](#)]. Components of BIOME-BGC have previously undergone testing and validation, including the carbon dynamics [[McLeod and Running, 1988](#); [Korol et al, 1991](#); [Hunt et al, 1991](#); [Pierce, 1993](#); [Running, 1994](#)] and the hydrology [[Knight et al, 1985](#); [Nemani and Running, 1989](#); [White and Running, 1994](#)].

BIOME-BGC estimated NPP (3.8 PgC yr⁻¹) and total carbon storage (118 PgC) for the conterminous United States from derived Kuchler potential vegetation for contemporary climate and CO₂ concentrations. Of total carbon, soil and vegetation carbon were estimated at 70 and 48 PgC, respectively. In response to climate change, BIOME-BGC estimated NPP from 3527-4119 PgC yr⁻¹ and total carbon storage from 74-98 PgC for the three climate scenarios (OSU, GFDL, and UKMO). Estimates of total carbon storage to changes in climate were caused by decreased NPP as a result of decreased water availability, and increased plant and soil respiration response to increased temperatures. Soil C losses accounted for 72-85% of the total C loss across the three climate scenarios. Doubled atmospheric CO₂ caused continental-scale increased NPP by 11% (4.2 PgC yr⁻¹) and total carbon storage by 7% (126 PgC) in BIOME-BGC. The NPP and total carbon responses of BIOME-BGC to changes in both climate and CO₂ were essentially additive, with NPP ranging from 3.8-4.5 PgC yr⁻¹ and total carbon storage from 79-107 PgC.

The coupled-BIOME-BGC and Biogeography model experimental results ranged from 3.8-3.9 PgC yr⁻¹ for NPP and 120-122 PgC total carbon storage for contemporary climate. There were relative increases in NPP when BIOME-BGC is run with either the DOLY or MAPSS vegetation distributions for the UKMO climate. Estimates of NPP from coupled BIOME-BGC to the biogeography vegetation distributions and climate scenarios ranged from 3.8-5.0 PgC yr⁻¹ for changed climate and doubled CO₂ concentrations. Similarly, total carbon storage ranged from 73-120 PgC, with the MAPSS vegetation and UKMO climate scenario exhibiting the largest total carbon storage reduction (39%). This was an absolute loss of 47 PgC of which 33 Pg was from soil, and 14 Pg from vegetation. Increased water use efficiency produced by higher CO₂ concentrations was insufficient to overcome the negative effects of increased water stress on NPP resulting from warmer climates. The decrease in forested area from 44% to 38% under the MAPSS vegetation is responsible for the

structural response. The functional response indicates a large reduction in carbon density within the forests. The reduction is caused by a combination of lower NPP due to water stress and higher plant respiration and decomposition caused by elevated temperature. In BIOME-BGC, the Q10 for the decomposition relationship is 2.4 as compared for 2.0 in the other biogeochemistry models. Of the three biogeochemistry models (BIOME-BGC, CENTURY, and TEM), BIOME-BGC predicted the highest losses of total carbon as a result of changed climate and doubled atmospheric CO₂ concentrations.

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The CENTURY Model

[back to top](#)

Natural Resource Ecology Laboratory
Colorado State University

The CENTURY model is a general model of plant-soil nutrient cycling which has been used to simulate carbon and nutrient dynamics for different types of ecosystems including grasslands, agricultural lands, forests and savannas. CENTURY is composed of a soil organic matter/decomposition submodel, a water budget model, a grassland/crop submodel, a forest production submodel, and management and events scheduling functions. It computes the flow of carbon, nitrogen, phosphorus, and sulfur through the model's compartments. The minimum configuration of elements is C and N for all the model compartments. The organic matter structure for C, N, P and S are identical, the inorganic components are computed for the specific inorganic compound. The timestep is or monthly and the model requires the following driving variables as input:

- Monthly average maximum and minimum air temperature
- Monthly precipitation
- Soil texture
- Plant nitrogen, phosphorus, and sulfur content
- Lignin content of plant material
- Atmospheric and soil nitrogen inputs
- Initial soil carbon, nitrogen (phosphorus and sulfur optional)

These variables are available for most natural and agricultural ecosystems.

The soil organic matter submodel includes three soil organic matter pools (active, slow, and passive) with different potential decomposition rates, above and below ground litter pools and a surface microbial pool which is associated with decomposing surface litter. The simplified water budget model calculates monthly evaporation, transpiration, the water content of the soil layers, snow water content, and saturated flow of water between soil layers. As mentioned above, CENTURY contains two plant production submodels; a grassland/crop submodel and a forest production submodel. Both plant production models assume that the monthly maximum plant production is controlled by moisture and temperature, and that maximum plant production rates are decreased if there are insufficient nutrient supplies. The grassland/crop production model simulates plant production for different herbaceous crops and plant communities (e.g. warm or cool season grasslands, wheat, and corn). The forest model simulates the growth of deciduous or evergreen forests in juvenile and mature phases. To simulate a savanna or shrubland, CENTURY uses both of these submodels with some additional code to simulate nutrient competition and shading effects.

Disturbances such as fire, harvest, grazing and cultivation can be simulated via the management and events scheduling functions.

CENTURY was originally developed as a project of the U.S. National Science Foundation Ecosystem Studies Research Projects. Additional support for model enhancement has been provided by

Tallgrass Ecosystem Fire Project
Central Plains Experimental Range - LTER
NASA-EOS Project
Agricultural Research Service USDA

Link to the [CENTURY](#) webpage.

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CENTURY Contacts:

Dr. William Parton
Natural Resource Ecology Laboratory
Colorado State University
Fort Collins, CO 80523

FAX: (303) 491-1965
E-mail: century@nrel.colostate.edu

Terrestrial Ecosystem Model (TEM) top

The Terrestrial Ecosystem Model (TEM version 4) is a process-based ecosystem model (Raich et al., 1989; McGuire et al. 1992, 1993, 1996a, 1996b; Melillo et al., 1993, 1995) that describes carbon and nitrogen dynamics of plant and soils for non-wetland ecosystems of the globe. The TEM uses spatially referenced information on climate, elevation, soils, vegetation and water availability as well as soil- and vegetation-specific parameters to make monthly estimates of important carbon and nitrogen fluxes and pool sizes. Hydrological inputs for TEM are determined by a water balance model (Vorosmarty et al. 1989) that use the same climatic data and soil-specific parameters as used in TEM. The TEM operates on a monthly time step and at a 0.5 degrees latitude/longitude spatial resolution.

In TEM, annual primary production (NPP) is the difference between carbon captured from the atmosphere as gross primary production (GPP) and carbon respired to the atmosphere by the vegetation. Gross primary production is calculated as a function of light availability, air temperature, atmospheric CO₂ concentration, moisture availability and nitrogen supply. The nitrogen uptake in the model is controlled by the stoichiometric C:N ratio of biomass production. The carbon-nitrogen status of the vegetation cause the model to allocate more effort towards either carbon or nitrogen uptake. Plant respiration is a function of vegetation carbon(i.e. biomass) and air temperature. In TEM, decomposition is a function of the one soil organic carbon compartment, temperature and soil moisture. The carbon and nitrogen pool sizes of vegetation and soil are affected by dynamic carbon and nitrogen fluxes (NPP, litterfall C, decomposition, litterfall N, net N mineralization, N uptake, etc.). Elevated CO₂ may have either a direct or indirect effect on GPP. A direct consequence of elevated atmospheric CO₂ is to increase GPP via a Michaelis -Menton (hyperbolic) relationship. Elevated CO₂ may indirectly affect GPP by altering the carbon-nitrogen status of the vegetation to increase effort towards nitrogen uptake.

For simulating mature ecosystems at "equilibrium" as required by the VEMAP activity (VEMAP Members, 1995), TEM assumes equilibrium conditions are reached when: 1) annual fluxes of NPP, litterfall carbon, and decomposition are balanced; 2) the annual fluxes of net nitrogen mineralization, litterfall nitrogen, and nitrogen uptake by vegetation are balanced; and 3) nitrogen inputs are equal to nitrogen losses from the ecosystem.

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TEM Contacts:

Dave Kicklighter
Dave McGuire
Jerry Melillo
Yude Pan
Hanqin Tian

dkick@lupine.mbl.edu
ffadm@aurora.alaska.edu
jmelillo@lupine.mbl.edu
yudepan@lupine.mbl.edu
htian@lupine.mbl.edu