TDE Model Intercomparison Project Data Archive

*This web site provides and documents data from a project whose purpose is to compare the output of various ecosystem models when they are run with the [data](#) from the [Throughfall Displacement Experiment](#) (TDE) at Walker Branch Watershed, Oak Ridge, Tennessee. The project is **not** designed to determine which models are "best" for diagnosis (i.e., explaining the current functioning of the system) or prognosis (i.e., predicting the response of the system to future conditions), but, rather, to clarify similarities and differences among the models and their components, so that all models can be improved. The intercomparison is described in Hanson, P.J., et al., 2002. Throughfall Displacement Experiment (TDE) Ecosystem Model Intercomparison (manuscript in preparation).*

Project Coordinator:

Paul J. Hanson
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Participating Models:

- BGC++ (contact: E. Raymond Hunt Jr., Hydrology and Remote Sensing Laboratory, Agricultural Research Service, U.S. Department of Agriculture)

- BIOME BGC (contact: John S. Kimball and Peter E. Thornton, School of Forestry, University of Montana)

- CANOAK (contact: Kell B. Wilson, Atmospheric Turbulence and Diffusion Division, National Oceanic and Atmospheric Administration, U.S. Department of Commerce)

- EALCO (contact: Shusen Wang, Geomatics Canada - Canada Centre for Remote Sensing, Natural Resources Canada)

- ecosys (contact: Robert F. Grant, Department of Renewable Resources, University of Alberta, Canada)

- INTRASTAND (contact: Paul J. Hanson, Environmental Sciences Division, Oak Ridge National Laboratory)

- LaRS (contact: Jeffrey S. Amthor, Environmental Sciences Division, Oak Ridge National Laboratory)

- LINKAGES V2.1(contact: Stanley D. Wullschleger, Environmental Sciences Division, Oak Ridge National Laboratory)

- LoTEC (contact: Anthony W. King, Environmental Sciences Division, Oak Ridge National Laboratory)

- MAESTRA (contact: Yiqi Luo and Dafeng Hui, Department of Botany and Microbiology, University of Oklahoma)

- NuCM (contact: Dale W. Johnson, Department of Environmental and Resource Sciences, University of Nevada, Reno)

- PnET II (contact: Ge Sun, Department of Forestry, North Carolina State University; and Steven G. McNulty, Southern Global Change Program, U.S. Forest Service, U.S. Department of Agriculture)

- SPA (contact: Anne E. Hartley, Department of Evolution, Ecology & Organismal Biology, The Ohio State University; and Mathew Williams, Institute of Ecology and Resource Management, University of Edinburgh, United Kingdom)

Model intercomparisons:

- data documentation file
- annual model predictions
- daily evapotranspiration (ET) model predictions
- daily net ecosystem carbon exchange (NEE) model predictions
- daily soil respiration (SResp) model predictions
- hourly net ecosystem carbon exchange (NEE) model predictions
- hourly transpiration (T) model predictions

Relevant publications

Prepared for the
U.S. DEPARTMENT OF ENERGY
Office of Science
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by
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Carbon Dioxide Information Analysis Center
Environmental Sciences Division
OAK RIDGE NATIONAL LABORATORY
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THROUGHFALL DISPLACEMENT EXPERIMENT (TDE)
ECOSYSTEM MODEL INTERCOMPARISON
DATA ARCHIVE
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This archive provides and documents data from a project whose purpose is to compare the output o

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QUALITY-ASSURANCE CHECKS AND DATA-PROCESSING ACTIVITIES PERFORMED BY CDIAC

For all files, data format was checked.

Reported "Mean model" values were verified from the individual model values.

Approximate mean annual values of model output estimates of evapotranspiration and soil respirat
1993-2000 mean annual value calculated from the mean annual values provided by the individual in

The following equivalences were checked:

     Annual sum of daily NEE (in DailyNEE.csv) = annual NEP (in Annual.csv)
     ET = E + T (in Annual.csv)
     Reco = Rauto + Rheter (in Annual.csv)
     NEP = GPP - Reco (in Annual.csv)

All discrepancies (greater than could be explained by rounding error) were resolved by consulati

LIST OF FILES

This report documents the following 6 files:

Annual.csv   Annual model predictions
DailyET.csv   Daily evapotranspiration (ET) model predictions (except see note for model MAES
DailyNEE.csv   Daily net ecosystem carbon exchange (NEE) model predictions
DailySResp.csv   Daily soil respiration model predictions
NEEhour.csv   Hourly net ecosystem carbon exchange (NEE) model predictions
Thour.csv   Hourly transpiration (T) model predictions

DESCRIPTION and FORMAT OF THE DATA FILES

The 6 models described herein are all ascii comma-delimited (also known as comma-separated-varia

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Contents and format of the file Annual.csv

Column   Variable   Units   Definition and comments

1   Model   -----   Name of model used to produce the predicted value (BGC++, BIOME-BG
                                 CANOAK, EALCO, ecosys, INTRASTAND, LaRS, LINKAGES, LoTEC, MAESTRA,
                                 NuCM, Pnet, SPA, or Mean Model), or source of measured data
                                 (Obseddy = eddy covariance data, Obswatershed = watershed-based
                                 estimates from precipitation and streamflow data, Biometric = mass
                                 allometric observations)

2   Year   -----   Year (1993 through 2000)

```
3        ET        mm y-1      Evapotranspiration

4        T         mm y-1      Transpiration

5        E         mm y-1      Evaporation

6        Drain     mm y-1      Drainage of water through the soil below the rooted profile

7        NEP       gC m-2 y-1  Net ecosystem production

8        GPP       gC m-2 y-1  Gross primary production

9        NPP       gC m-2 y-1  Net primary production

10       Reco      gC m-2 y-1  Total ecosystem respiration

11       Rheter    gC m-2 y-1  Heterotrophic respiration

12       Rauto     gC m-2 y-1  Autotrophic respiration

13       Rleaf     gC m-2 y-1  Leaf respiration

14       Rstem     gC m-2 y-1  Stem respiration

15       Rgrowth   gC m-2 y-1  Growth respiration

16       Rsoil     gC m-2 y-1  Soil respiration, including root and heterotrophic respiration

17       Gleaf     gC m-2 y-1  Leaf growth

18       Gwood     gC m-2 y-1  Wood production

19       Groot     gC m-2 y-1  Root growth
```

Header line and first two data records:

```
Model,Year,ET,T,E,Drain,NEP,GPP,NPP,Reco,Rheter,Rauto,Rleaf,Rstem,Rgrowth,Rsoil,Gleaf,Gwood,Groo
BGC++,1993,644,342,302,495,311,1591,893,1280,534,698,97,130,347,658,186,347,360
BGC++,1994,843,493,351,831,823,2027,1178,1204,323,849,95,130,447,500,230,531,417
```

Last two data records:

```
Biometric,1999,,,,,327,,840,,,,,,,,223,248,182
Biometric,2000,,,,,160,,703,,,,,,,,246,215,167
```


```
**********
Contents and format of the file DailyET.csv

Column   Variable        Units       Definition and comments

1        Year            -----       Year (1993 through 2000)

2        DOY             -----       Day of the year (1 through 365 or 366)

3        RDOY            -----       Running day of the year, i.e., days since 1 January 1993 (1

4        PPFD            mol m-2 d-1 Measured daily photosynthetic photon flux density (per unit

5        VPD             kPa         Measured mean vapor pressure deficit

6        BGC++           mm d-1      BGC++ model estimate of daily evapotranspiration

7        BIOME-BGC       mm d-1      BIOME-BGC model estimate of daily evapotranspiration

8        CANOAK          mm d-1      CANOAK model estimate of daily evapotranspiration

9        EALCO           mm d-1      EALCO model estimate of daily evapotranspiration
```

10	ecosys	mm d-1	ecosys model estimate of daily evapotranspiration
11	INTRASTAND	mm d-1	INTRASTAND model estimate of daily evapotranspiration
12	LaRS	mm d-1	LaRS model estimate of daily evapotranspiration
13	LINKAGES	mm d-1	LINKAGES model estimate of daily evapotranspiration
14	LoTEC	mm d-1	LoTEC model estimate of daily evapotranspiration
15	MAESTRA	mm d-1	NOTE: the value presented for MAESTRA is actually the model
16	SPA	mm d-1	SPA model estimate of daily evapotranspiration
17	Model Mean ET	mm d-1	Mean of estimates, from all reporting models, of daily evapo
18	Eddy ET	mm d-1	Measured daily evapotranspiration from tower-based eddy cova

Header line and first two data records:

```
Year,DOY,RDOY,PPFD,VPD,BGC++,BIOME-BGC,CANOAK,EALCO,ecosys,INTRASTAND,LaRS,LINKAGES,LoTEC,MAESTR
1993,1,1,8.04,0.65,0.500,1.000,,-0.094,,0.873,0.320,0.547,0.000,0.003,0.630,0.420,
1993,2,2,8.04,0.65,0.074,0.424,,0.030,0.412,0.071,0.160,0.561,0.000,0.003,0.320,0.205,
```

Last two data records:

```
2000,365,2921,8.87,0.24,0.007,0.001,0.238,0.016,0.152,0.071,0.000,0.114,0.000,0.001,0.000,0.054,
2000,366,2922,14.26,0.28,,,,0.238,0.028,0.134,,0.000,,0.000,0.002,0.000,0.057,
```

****
Contents and format of the file DailyNEE.csv

Column	Variable	Units	Definition and comments
1	Year	-----	Year (1993 through 2000)
2	DOY	-----	Day of the year (1 through 365 or 366)
3	RDOY	-----	Running day of the year, i.e., days since 1 January 1993 (1
4	PPFD	mol m-2 d-1	Measured daily photosynthetic photon flux density
5	BGC++	gC m-2 d-1	BGC++ model estimate of daily net ecosystem carbon exchange
6	BIOME-BGC	gC m-2 d-1	BIOME-BGC model estimate of daily net ecosystem carbon exch
7	CANOAK	gC m-2 d-1	CANOAK model estimate of daily net ecosystem carbon exchang
8	EALCO	gC m-2 d-1	EALCO model estimate of daily net ecosystem carbon exchange
9	ecosys	gC m-2 d-1	ecosys model estimate of daily net ecosystem carbon exchang
10	INTRASTAND	gC m-2 d-1	INTRASTAND model estimate of daily net ecosystem carbon exc
11	LaRS	gC m-2 d-1	LaRS model estimate of daily net ecosystem carbon exchange
12	LoTEC	gC m-2 d-1	LoTEC model estimate of daily net ecosystem carbon exchange
13	MAESTRA	gC m-2 d-1	MAESTRA model estimate of daily net ecosystem carbon exchan
14	Model Mean NEE	gC m-2 d-1	Mean of estimates, from all reporting models, of daily net

Header line and first two data records:

```
Year,DOY,RDOY,PPFD,BGC++,BIOME-BGC,CANOAK,EALCO,ecosys,INTRASTAND,LaRS,LoTEC,MAESTRA,Mean Model
1993,1,1,8.0430696,-1.39,-1.26,,-0.75,,-1.03,-1.91,-1.16,0.03,-1.07
1993,2,2,8.0430768,-1.39,-1.17,,-0.80,-1.18,-1.04,-1.89,-1.13,0.03,-1.07
```

Last two data records:

```
2000,365,2921,8.8668,-0.45,-0.48,-1.15,-0.50,-0.51,-0.79,-1.37,-0.69,0.03,-0.66
2000,366,2922,14.256,,,,-0.50,-0.44,,-1.33,-0.69,0.04,-0.59
```

```
**********
Contents and format of the file DailySResp.csv
```

Column	Variable	Units	Definition and comments
1	Year	-----	Year (1993 through 2000)
2	DOY	-----	Day of the year (1 through 365 or 366)
3	RDOY	-----	Running day of the year, i.e., days since 1 January 1993
4	BGC++	gC m-2 d-1	BGC++ model estimate of daily soil respiration
5	BIOME-BGC	gC m-2 d-1	BIOME-BGC model estimate of daily soil respiration
6	CANOAK	gC m-2 d-1	CANOAK model estimate of daily soil respiration
7	EALCO	gC m-2 d-1	EALCO model estimate of daily soil respiration
8	ecosys	gC m-2 d-1	ecosys model estimate of daily soil respiration
9	INTRASTAND	gC m-2 d-1	INTRASTAND model estimate of daily soil respiration
10	LaRS	gC m-2 d-1	LaRS model estimate of daily soil respiration
11	LoTEC	gC m-2 d-1	LoTEC model estimate of daily soil respiration
12	Model Mean SResp	gC m-2 d-1	Mean of estimates, from all reporting models, of daily so
13	Eddy SResp	gC m-2 d-1	Estimated daily soil respiration from a 1.5 meter eddy co located under the forest canopy (data are available for 1

Header line and first two data records:

```
Year,DOY,RDOY,BGC++,BIOME-BGC,CANOAK,EALCO,ecosys,INTRASTAND,LaRS,LoTEC,Model Mean SResp,Eddy SR
1993,1,1,1.232,1.245,,0.435,,0.912,1.530,1.020,1.062,
1993,2,2,1.229,1.152,,0.479,1.171,0.902,1.500,0.985,1.060,
```

Last two data records:

```
2000,365,2921,0.385,0.474,1.014,0.272,0.503,0.695,1.170,0.643,0.645,0.823
2000,366,2922,,,,0.276,0.435,,1.130,0.635,0.619,
```

```
**********
Contents and format of the file NEEhour.csv
```

Column	Variable	Units	Definition and comments
1	Year	-----	Year (1993 through 2000)
2	DOY	-----	Day of the year (1 through 365 or 366)
3	HOD	-----	Hour of the day (1 through 24)
4	PPFD	umol m-2 h-1	Measured hourly photosynthetic photon flux density
5	CANOAK	gC m-2 h-1	CANOAK model estimate of hourly net ecosystem carbon exchange
6	EALCO	gC m-2 h-1	EALCO model estimate of hourly net ecosystem carbon exchange
7	ecosys	gC m-2 h-1	ecosys model estimate of hourly net ecosystem carbon exchange
8	INTRASTAND	gC m-2 h-1	INTRASTAND model estimate of hourly net ecosystem carbon excha

9	LaRS	gC m-2 h-1	LaRS model estimate of hourly net ecosystem carbon exchange
10	LoTEC	gC m-2 h-1	LoTEC model estimate of hourly net ecosystem carbon exchange
11	MAESTRA	gC m-2 h-1	MAESTRA model estimate of hourly net ecosystem carbon exchange
12	Eddy NEE	gC m-2 h-1	Measured hourly net ecosystem carbon exchange from tower-based

Header line and first two data records:

```
Year,DOY,HOD,PPFD,CANOAK,EALCO,ecosys,INTRASTAND,LaRS,LoTEC,MAESTRA,Eddy NEE
1998,238,1,0,-0.184032,-0.231552,-0.396,-0.226957,-0.301536,-0.240984,-0.086759456,-0.055728
1998,238,2,0,-0.183168,-0.227232,-0.381,-0.217353,-0.295056,-0.230985,-0.079769403,-0.07344
```

Last two data records:

```
1999,219,23,0,-0.250992,-0.31752,-0.5075,-0.284366,-0.335232,-0.345701,-0.105069002,-0.071928
1999,219,24,0,-0.249264,-0.309744,-0.4928,-0.272442,-0.327456,-0.330579,-0.093936352,-0.06156
```

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Contents and format of the file Thour.csv

Column	Variable	Units	Definition and comments
1	Year	-----	Year (1993 through 2000)
2	DOY	-----	Day of the year (1 through 365 or 366)
3	HOD	-----	Hour of the day (1 through 24)
4	VPD	kPa	Mean vapor pressure deficit
5	PPFD	umol m-2 h-1	Measured hourly photosynthetic photon flux density
6	CANOAK	mm h-1	CANOAK model estimate of hourly transpiration
7	EALCO	mm h-1	EALCO model estimate of hourly transpiration
8	ecosys	mm h-1	ecosys model estimate of hourly transpiration
9	INTRASTAND	mm h-1	INTRASTAND model estimate of hourly transpiration
10	LaRS	mm h-1	LaRS model estimate of hourly transpiration
11	LoTEC	mm h-1	LoTEC model estimate of hourly transpiration
12	MAESTRA	mm h-1	MAESTRA model estimate of hourly transpiration
13	SPA	mm h-1	SPA model estimate of hourly transpiration
14	Sapflow	mm h-1	Estimated stand transpiration derived from individual tree w measurements (heat dissipation) scaled to the stand level

Header line and first two data records:

```
Year,DOY,HOD,VPD,PPFD,CANOAK,EALCO,ecosys,INTRASTAND,LaRS,LoTEC,MAESTRA,SPA,Sapflow
1998,238,1,0.174,0,0.00044226,0.00014742,-0.0004,0.00108,0.00324,0.011156,0,0.002,0.002510565
1998,238,2,0.014,0,0.010909091,-0.027420147,-0.0038,0,-0.001296,0.000836,0,-0.001,0.002120777
```

Last two data records:

```
1999,219,23,1.128,0,0.039066339,0.008402948,0.0136,0.01123,0.034344,0.07995,0,0.015,0.009238887
1999,219,24,0.733,0,0.032432432,0.012825553,0.0095,0.00813,0.026568,0.05197,0,0.015,0.00856049
```

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RMC 08/2002

```
Model
,Year,ET,T,E,Drain,NEP,GPP,NPP,Reco,Rheter,Rauto,Rleaf,Rstem,Rgrowth,Rsoil,Gleaf,Gwo
od,Groot
BGC++,1993,644,342,302,495,311,1591,893,1280,534,698,97,130,347,658,186,347,360
BGC++,1994,843,493,351,831,823,2027,1178,1204,323,849,95,130,447,500,230,531,417
BGC++,1995,666,371,295,477,351,1437,726,1086,319,711,98,135,293,504,200,226,301
BGC++,1996,1090,731,359,519,951,2198,1310,1247,321,888,95,128,488,498,222,642,447
BGC++,1997,964,563,402,496,743,1936,1110,1192,330,826,90,130,421,514,208,501,401
BGC++,1998,628,309,318,592,203,1291,580,1088,314,711,104,146,241,534,173,136,271
BGC++,1999,773,468,305,398,416,1564,797,1148,325,767,95,136,307,555,158,334,306
BGC++,2000,800,453,348,366,427,1548,794,1121,324,754,99,136,311,533,170,299,325
BIOME-BGC,1993,566,435,130,576,155,1341,640,1186,484,798,394,36,192,659,240,123,258
BIOME-BGC,1994,556,410,146,1118,114,1443,759,1329,645,797,362,40,226,814,241,124,259
BIOME-BGC,1995,518,391,126,626,86,1317,586,1231,500,824,418,36,186,683,238,121,256
BIOME-BGC,1996,607,418,189,1000,142,1399,750,1256,608,758,341,38,220,768,234,121,252
BIOME-BGC,1997,682,493,189,800,225,1583,812,1358,587,891,417,41,240,780,267,136,286
BIOME-BGC,1998,546,401,145,670,70,1333,570,1263,500,854,443,37,183,691,247,125,266
BIOME-BGC,1999,572,432,140,588,133,1320,681,1187,548,739,344,36,200,708,223,108,239
BIOME-BGC,2000,640,487,153,537,171,1456,753,1285,582,813,380,38,221,757,243,121,261
CANOAK,1993,,,,,,,,,,,,,,,,,
CANOAK,1994,,,,,,,,,,,,,,,,,
CANOAK,1995,804,673,131,,525,1564,895,1039,370,669,95,205,,739,,,
CANOAK,1996,733,614,119,,440,1472,812,1032,372,660,92,196,,744,,,
CANOAK,1997,733,611,122,,447,1481,817,1034,370,664,93,197,,748,,,
CANOAK,1998,794,678,116,,538,1584,909,1046,371,675,95,208,,744,,,
CANOAK,1999,823,682,141,,598,1649,976,1051,378,673,95,201,,754,,,
CANOAK,2000,808,675,133,,591,1639,968,1048,377,671,96,198,,754,,,
EALCO,1993,516,,,624,153,1532,566,1379,413,966,365,193,,821,,36,
EALCO,1994,529,,,1145,353,1829,808,1476,455,1021,380,205,,890,,281,
EALCO,1995,523,,,623,41,1546,508,1505,467,1038,400,200,,905,,122,
EALCO,1996,572,,,1052,282,1672,689,1390,407,983,342,205,,844,,297,
EALCO,1997,577,,,897,354,1835,772,1481,418,1063,389,214,,878,,322,
EALCO,1998,543,,,675,7,1499,430,1492,423,1069,379,214,,898,,12,
EALCO,1999,653,,,505,298,1875,776,1577,478,1099,388,224,,965,,226,
EALCO,2000,639,,,575,336,1922,834,1586,498,1088,411,212,,962,,326,
ecosys,1993,686,524,162,400,371,2321,1067,1950,696,1254,611,281,,1058,214,326,491
ecosys,1994,668,508,161,1007,453,2404,1116,1951,664,1287,660,340,,951,271,366,364
ecosys,1995,665,493,172,475,420,2338,1048,1918,628,1290,668,289,,962,234,331,396
ecosys,1996,696,523,173,931,418,2306,1056,1888,638,1250,661,319,,908,268,327,270
ecosys,1997,730,557,173,737,518,2473,1123,1955,605,1350,724,337,,895,271,363,294
ecosys,1998,656,481,175,567,346,2319,966,1973,619,1353,723,293,,957,240,314,277
ecosys,1999,727,537,189,488,545,2380,1125,1835,580,1255,650,310,,874,247,348,282
ecosys,2000,726,545,181,448,534,2393,1155,1859,621,1238,603,298,,958,230,352,338
INTRASTAND,1993,609,432,177,512,354,1742,747,1388,393,995,301,152,149,786,,,
INTRASTAND,1994,627,440,187,1030,271,1827,732,1556,461,1095,286,159,189,922,,,
INTRASTAND,1995,586,377,209,557,201,1683,626,1482,425,1058,290,174,169,849,,,
INTRASTAND,1996,657,412,245,876,132,1693,587,1561,455,1106,281,163,207,910,,,
INTRASTAND,1997,645,411,234,766,239,1779,698,1540,459,1082,281,165,178,915,,,
INTRASTAND,1998,582,355,227,598,8,1610,479,1602,471,1131,293,205,161,944,,,
INTRASTAND,1999,595,386,209,579,162,1750,627,1588,465,1123,282,189,188,928,,,
INTRASTAND,2000,636,438,198,545,285,1902,754,1617,469,1149,315,190,174,939,,,
LaRS,1993,666,390,276,607,243,1639,858,1396,615,781,292,166,,797,214,166,210
LaRS,1994,657,356,301,895,345,1789,971,1444,626,818,278,175,,837,214,249,317
LaRS,1995,668,366,302,558,107,1604,760,1497,653,844,319,182,,851,214,187,217
LaRS,1996,710,403,307,769,302,1760,938,1458,636,822,296,179,,830,214,238,290
LaRS,1997,760,417,343,862,326,1827,974,1501,648,853,300,180,,867,214,242,283
LaRS,1998,706,399,307,622,108,1650,786,1542,678,864,336,197,,863,214,206,189
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