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FIFE Data Analysis:
Testing BIOME-BGC Predictions for Grasslands

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Hunt, E. R., Jr. (in preparation). Effects of climatic data resolution on ecosystem processes: Testing the simulation Model, BIOME-BGC, with flux data from the FIFE experiment. Agricultural and Forest Meteorology.

Rollins, M. G. (in preparation). Comparing simulated and measured H_2O and CO_2 fluxes spatially over the 15-km by 15-km FIFE site. MS Thesis, University of Montana, Missoula.

Rollins, M. G. and E. R. Hunt, Jr. (in preparation). Comparing H_2O and CO_2 fluxes measured with eddy-flux aircraft with predictions from an ecosystem process model for the 15-km by 15-km FIFE site.

Running, S.W. and E.R. Hunt, Jr., 1993. Generalization of a forest ecosystem process model for other biomes, BIOME-BGC, and an application for global-scale models. Pages 141-158 in: J.R. Ehleringer and C. Field (eds). Scaling Physiological Processes: Leaf and Landscape Levels. Academic Press, Orlando.

Presentations:

Hunt, E.R., Jr., 1993. Generalization of a conifer ecosystem model to other ecosystems, BIOME-BGC: Application to local and global carbon budgets. Invited seminar to the Environmental Sciences Division, Oak Ridge National Laboratory.

Hunt, E.R., Jr., 1993. Generalization of a forest ecosystem model to other ecosystems, BIOME-BGC, and prediction of ecosystem response to global climate change. Invited seminar to the Department of Forest Science, Oregon State University.

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Introduction

The First International Satellite Land Surface Climatology Project (ISLSCP) Field Experiment (FIFE) was conducted in a 15 km by 15 km research area located 8 km south of Manhattan, Kansas. The site consists primarily of native tallgrass prairie mixed with gallery oak forests and croplands. The area receives a mean of 835 mm in annual precipitation, with monthly means from -2.7 °C in January to 26.6 °C in July. Native tallgrass prairie covers most of the area with big bluestem (*Andropogon gerardii*), little bluestem (*Andropogon scoparious*), and indian grass (*Sorghastrum nutans*) as the dominant species. The area is characterized by three relatively deep drainages (60 m relief) and a central upland region. Areas within the Konza Prairie Long Term Ecological Research site (occupying the northwestern corner of the site) are under controlled treatment regimes that include grazed and ungrazed and burned and unburned in several annual cycles. Gallery-oak forests (*Quercus* spp.) are found in valley bottoms and some of the steeper north-facing slopes. Uplands are used primarily for grazing, and some cereal crops are grown in the valley bottoms. Soils in the area are predominantly silty loams or silty clay loams.

The objectives of FIFE are to better understand the role of biology in controlling the interactions between the land and the atmosphere, and to determine the value of remotely sensed data for estimating climatological parameters. The goals of FIFE are twofold: the upscale integration of models, and algorithm development for satellite remote sensing (Sellers et al. 1992). The specific objectives of the field campaigns carried out during the summers of 1987 and 1989 were the simultaneous acquisition of satellite, atmospheric, and surface data; and the understanding of the processes controlling surface energy and mass exchange (Sellers et al. 1992). Collected data were used to study the dynamics of various ecosystem processes (photosynthesis, evaporation and transpiration, autotrophic and heterotrophic respiration, etc.).

Modelling terrestrial ecosystems at scales larger than that of a homogeneous plot led to the development of a simple, generalized models of biogeochemical cycles that can be accurately applied to different biomes through the use of remotely sensed data (Running and Hunt 1993). I have developed such a model called BIOME-BGC (for <u>B</u>io<u>G</u>eochemical <u>C</u>ycles) from a coniferous forest ecosystem model, FOREST-BGC (Running and Coughlan 1988, Running and Gower 1991), where a biome is considered a combination of a life form (grass, coniferous tree, shrubland, deciduous broadleaved tree) in a specified climate. A predominately C_4-photosynthetic grassland is probably the most different from a coniferous forest possible, hence the FIFE site was an excellent study area for testing BIOME-BGC. Thus, I tested the model for site 16 with the soil moisture, evapotranspiration and net ecosystem exchange (NEE) of CO_2 data from

Sashi Verma's site (Kim et al. 1992, Stewart and Verma 1992).

The transition from essentially one-dimensional calculations to three-dimensional, landscape scale simulations requires the introduction of such factors as meteorology, climatology, and geomorphology. By using remotely sensed geographic information data for important model inputs, process-based ecosystem simulations at a variety of scales are possible. The second objective of this study is concerned with determining the accuracy of the estimated fluxes from BIOME-BGC, when extrapolated spatially over the entire 15-km by 15-km FIFE site. To accomplish this objective, a topographically distributed map of soil depth at the FIFE site was developed according to the method of Zheng et al. (in press). These spatially-distributed fluxes were then tested with data from aircraft by eddy-flux correlation obtained during the FIFE experiment.

Methods

Ecosystem Model

BIOME-BGC (Figure 1) is a process-based ecosystem simulation model which calculates the cycling of carbon, nitrogen, and water (Hunt and Running 1992, Running and Hunt 1993). Like its predecessor, FOREST-BGC, leaf area index (LAI) is the most important ecosystem variable driving the fluxes of carbon, water and nitrogen. Also inherited from FOREST-BGC, this model has a duel time step, daily for photosynthesis, respiration, and hydrologic processes, and yearly for allocation and nitrogen cycle processes. Daily meteorological required for the model are: maximum/minimum daily air temperature (°C), daily solar radiation ($KJ/m^2/day$), average daytime relative humidity (rh, %), daily precipitation (mm H_2O), average daily soil temperature (°C) at a depth of 0.1 m, average daily wind speed ($m\ s^{-1}$) measured at 2.25 m height, and incident photosynthetically active radiation (PAR, $\mu mol\ m^{-2}\ s^{-1}$) at noon (Hunt, in preparation). The model calculates interception of precipitation and its evaporation, evaporation from bare soil, transpiration, photosynthesis, growth and maintenance respiration, and heterotrophic respiration. The model has a mixed time resolution with hydrologic and carbon biogeochemical cycles calculated daily, and allocation and nitrogen cycles calculated yearly. For the purposes of testing BIOME-BGC with data from the FIFE experiment, only the daily part of the model is used and hence described summarized below.

A summary of the hydrologic cycle is described here. Precipitation is routed to a soil reservoir and held according to soil water holding capacity, a function of soil depth and texture. Interception is based on leaf area index (LAI) and evaporated if sufficient radiation is available. Stomatal conductance of the canopy to water vapor is calculated from average daytime air temperature, vapor pressure deficit, incident PAR, and available soil water. Available soil water are a functions of soil texture and depth, and soil water potential. Aerodynamic conductance is fixed at 0.01 m s^{-1} because high resolution wind data did not improve simulations (Hunt, in preparation). The interfacial conductance to water vapor from the bare soil to the atmosphere is calculated based on the number of days since rain (John Stewart, personal communication). Both bare soil evaporation and transpiration were estimated using the Penman-Monteith equation taking into account the incident solar radiation absorbed by the soil and canopy, respectively.

Photosynthetic rate (A) for plants with the C_3-photosynthetic pathway is determined using the biochemical model of Farqhuar, von Caemmerer and Berry (Hunt and Running 1992). For plants with the C_4-pathway, a maximum photosynthetic rate (A_{max}, μmol m^{-2} s^{-1}) was obtained from other FIFE investigators (Knapp et al. 1993, Polley et al. 1992). The maximum rate for C_3 and C_4 plants was then modified for temperature and available soil water. The final rates of photosynthesis were then averaged, weighted by the relative proportions of C_3 and C_4 leaf area. The canopy average photosynthetic rate was then estimated from the weighted average photosynthetic rate, total leaf area index, the extinction of PAR through the canopy, incident PAR, and the quantum-use efficiencies of C_3 and C_4 photosynthesis using an equation from Edward Rastetter (Hunt and Running 1992).

Autotrophic respiration is the sum of daily maintenance and growth respiration. Maintenance respiration is estimated from the mass of leaves, stems (gallery oak forests), coarse roots and fine roots and a Q_{10} of 2.0. We assumed a ratio of 1:1:1 for the masses of leaves, coarse roots and fine roots, respectively (David Schimel, personal communication). Growth respiration is taken as 33% of total daily photosynthesis. Heterotrophic respiration from decomposition of litter is calculated from the lignin:nitrogen ratio of the litter (Taylor et al. 1988). Heterotrophic respiration from decomposition of soil organic matter is estimated similar to the model, Century (Parton et al. 1988). Net primary production is estimated from total photosynthesis net autotrophic respiration, whereas net ecosystem exchange is calculated by net primary production net heterotrophic respiration.

Model Inputs

Data collection at FIFE was divided into monitoring activities and intensive field campaigns (IFCs). Monitoring data included satellite imagery, meteorological observations, atmospheric conditions, and surface biophysical and hydrologic measurements (Strebel 1992). Four IFCs were conducted during the summer of 1987. They were designed with the goal of providing complete data coverage for a variety of conditions; and were dedicated to collecting the detailed coincident data necessary for exact comparison of satellite observations with surface and atmospheric processes (Strebel et al. 1992). The timing of these campaigns was originally designed to capture the range of variation in vegetation development through the year (Sellers et al. 1992).

Six site description variables were identified that could be acquired using standard remote sensing and GIS techniques. These variables are: elevation, slope, aspect, soil depth, land cover type, and leaf area index. To execute the model for each grid cell we will create 530 by 530 (30m resolution) binary files for the six variables and use them as input. An image of forest cover and an image of croplands were combined to create the cover type coverage (Figure 2). This image will determine which physiological pathway the model will follow. The oak forests were defined for model parameterization as deciduous broadleaf forest, the croplands as C_3 grasslands, and the tallgrass prairie as C_4 grasslands.

Data were available through the FIFE Information System on a series of five CD-ROMs (Strebel et al. 1992). A digital elevation model (DEM), and images of slope and aspect were available on volume 5 from Frank Davis (Strebel 1992). All maps were coregistered to a 30 meter by 30 meter ground spatial resolution, using the UTM projection. Slope and aspect were derived by taking local derivatives of elevation in the x and y direction. Furthermore values of slope were scaled as sin(slope), with zero equaling no slope and the maximum value a vertical slope. Aspect was scaled with byte values less than 128 corresponding to azimuths from 180 to 360, and values more than 128 corresponding to azimuths from 0 to 180 (Jeff Dozier, personal communication).

Soil depth (Figure 3) was estimated using maximum and mean values of soil depth in conjunction with a topographic index (Bevin and Kirby 1979, Famiglietti et al. 1992) defined as: $\ln(\alpha/\tan\beta)$, where α is the area that drains through a given cell on the DEM and β is the slope of the cell. It had been shown that a linear relation exists between soil depth and this ratio (Zheng et al. in press). By analyzing the frequency distributions of $\ln(\alpha/\tan\beta)$ and the soils data available for the site a topographically distributed image of soil depth was constructed (Figure 6). This was preferable to existing soil-depth maps because then variability of soil depth is related to topography (Schimel et al. 1991, Famiglietti et al. 1992).

Leaf area index (LAI) is the only variable that was altered through the year, so images of LAI were created for three FIFE "golden days" during the summer of 1987 (June 6, July 11, August 15). These days are optimum because satellite observations and surface-flux data are complete. LAI was determined using Landsat-TM imagery (Figure 4) for the three golden days. The most commonly used ratio is the normalized differential vegetation index (NDVI):

$$NDVI = (NIR - RED)/(NIR + RED) \quad (1)$$

where NIR is reflectance from the ground surface in wavelengths between 0.76 and 0.90 μm, and RED is the reflectance between 0.63 and 0.69 μm for Landsat-TM images. LAI was determined from NDVI using the SAIL model (K. F. Huemmrich, personal communication), which assumes an exponential relationship between NDVI and LAI:

$$LAI = -\ln\left(\left(NDVI_x - NDVI\right) / NDVI_d\right) / k \quad (2)$$

where $NDVI_x$ is the NDVI value for an infinitely thick canopy, measured to be 0.877 for a tall-grass prairie; and $NDVI_d$ is the difference between $NDVI_x$ and the NDVI of the background, equal to 0.454, and k, the extinction coefficient, is 0.834 (K. F. Huemmrich, personal communication).

Finally BIOME-BGC was run for each 30-m grid cell using the eight data layers: elevation, aspect, slope, cover type, soil depth, and LAI from yearday 146 (May 26, 1987) to yearday 289 (Oct. 16, 1987). The output layers for daily evapotranspiration, net primary productivity, and net ecosystem exchange were for the first three "golden days." The output layers were then aggregated and compared to the aircraft eddy-flux data published by R.L. Desjardins et al. (1992). A linear regression were then used to test the degree of similarity between simulated and measured flux data for the FIFE site. For brevity, only the data from the June and August "golden days" will be shown for comparison.

Results and Discussion

A large amount of effort was dedicated to testing the model using tower eddy-flux correlation data from station 16 (Sashi Verma and collaborators). The model predictions fit the data very well for evapotranspiration, soil moisture and net ecosystem exchange (data not shown). This shows that when quality site data are provided for model site inputs, the predicted fluxes agree with the measured data (Hunt, in preparation).

We display the simulated evapotranspiration (Figure 5) and net ecosystem exchange (Figure 6) for 530 by 530 pixels for the entire FIFE site for 2 dates. Figure 7 shows the differences between these two dates (August simulations - June simulations). We picked these dates because the vegetation shows the greatest differences in LAI. In June values of ET are highest in the deciduous forests and lowest in the croplands. Values are higher across the image on August 15 because: a large storm on August 13 that recharged the soil; very high net radiation; and very high vapor pressure deficit. The largest differences in NEE were found in areas of deciduous forest and occupying the steepest slopes and croplands which went from 0 LAI in June to maximum LAI in August. Surprisingly, NEE remains approximately constant between the two dates, although both photosynthesis and respiration decreased in August compared to June, due to a lower LAI.

Of the two dates, presented in this study, only August 15, 1987, has corresponding aircraft eddy-flux correlation data from Desjardins et al. (1992) for comparison to the predictions. We are currently comparing flux measurements for July 11, 1987 and for the FIFE-89 Campaign. The predicted and measured fluxes have different units and different temporal scales; hence the null hypothesis is that the predictions and measured values are not correlated. We found a significant relationship between measured and predicted NEE, thereby rejecting the null hypothesis.

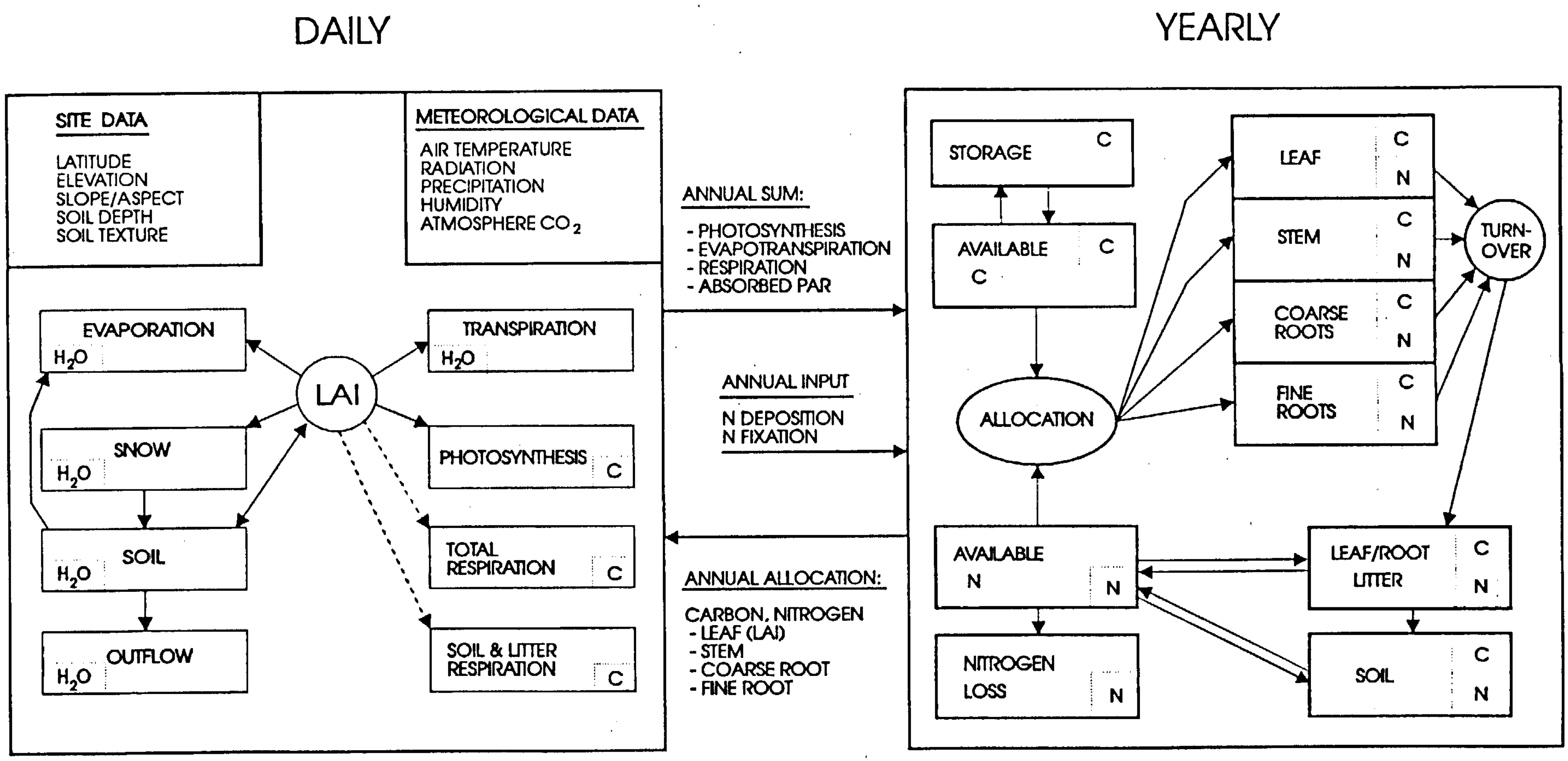
The R^2 is not what we would consider high, only 0.27, indicating we have not explained most of the variance of NEE at the FIFE site for this date. However, previous validations comparing NPP along the Oregon transect (Running 1994) occurred over a very large change in precipitation, hence a higher R^2 is expected. We have used data from Towne and Owensby (1984) and found that BIOME-BGC had an R^2 of 0.32 with measured and predicted NPP. may not be indicative of the ability of this model to predict NEE for a given single day using the same climatic data. We are continuing to analyze these data.

In general, we have succeeded in our goal of testing BIOME-BGC using data from the FIFE experiment. The results of this testing are incorporated into a BIOME-BGC version for predicting the carbon fluxes for the entire terrestrial biosphere. In the future, we expect the simulation results for FIFE may be useful to extend data analysis by suggesting possible footprints for the aircraft fluxes, and thereby increasing knowledge of the finer scale heterogeneity measured by eddy-flux aircraft.

Figure 1. Flow chart for BIOME-BGC

BIOME-BGC has two time steps, a daily step for the hydrologic, photosynthetic and respiratory processes, and a yearly step for the allocation and nitrogen-cycle processes. For a given land cover type, the model need various site and meteorological data such as latitude, elevation, slope, aspect, soil depth, soil texture, minimum and maximum air temperatures, solar radiation, relative humidity, and atmospheric CO_2 concentration. These data, except for soil depth, were well measured at the FIFE site. The key variable for simulation and prediction of ecosystem processes is leaf area index (LAI). LAI controls directly evaporation from intercepted radiation and soil, transpiration, the amount of snowmelt, and net photosynthesis (solid lines). In contrast, LAI controls indirectly through soil temperature the amount of root maintenance respiration and heterotrophic respiration (dotted lines). The boxes show the state variables of carbon, nitrogen and water; the calculated fluxes move these substances from one box to another keeping mass in balance.

BIOME - BGC



ECOSYSTEM PROCESS MODEL BASED ON

DATA DERIVED BY REMOTE SENSING

Figure 2. Land Cover Type for the FIFE Site

The three cover types: tallgrass prairie, croplands and deciduous forest (gallery oak woodlands) are important inputs to BIOME-BGC, because land cover type determines the photosynthetic pathway (C_3 or C_4) and other parameters used by the model (maximum photosynthetic rate, maximum stomatal conductance, vapor pressure deficit at stomatal closure, etc.). This image was compiled from georeferenced datasets (530 pixels by 530 pixels) by Frank Davis et al. (1992) and obtained from the FIFE CD-ROMs (Strebel et al. 1992).

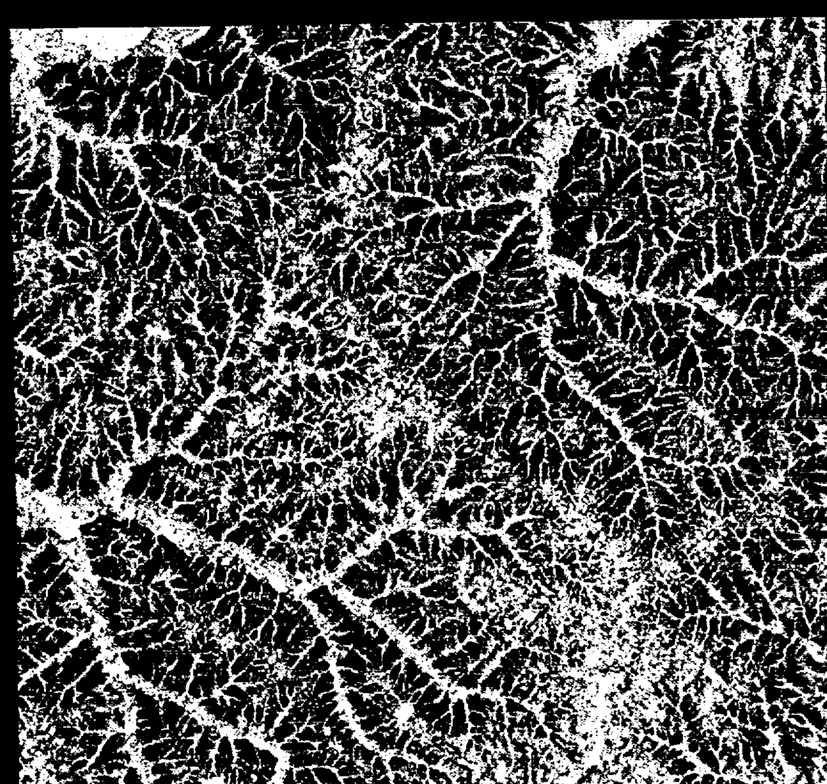
Figure 3. Soil Depth for the FIFE Site

Soil depth was estimated from a correlation between measured soil depth and the Topmodel Index, $\ln(\alpha/\tan\beta)$, where α is the area that drains through a given grid cell and β is the slope of the grid cell. The Topographic Index was calculated from the Digital Elevation Model provided on the FIFE CD-ROMS using programs by Drs. Rama Nemani and Larry Band. Measured soil depths at various locations are from Schimel et al. (1991), then extrapolated throughout the FIFE site from the Topmodel index. Values of soil depth range from 0 cm (black) to 250 cm (bright white), with high values in the flat upland regions and lowlands, and low values seen on the steeper slopes.

Cover Types for the FIFE Site

Croplands

Simulated Soil Depth for the FIFE Site



Rollins/Hunt/NTSG

Figure 4. Leaf Area Index for the FIFE Site: (A) June 12, 1987 and (B) August 15, 1987.

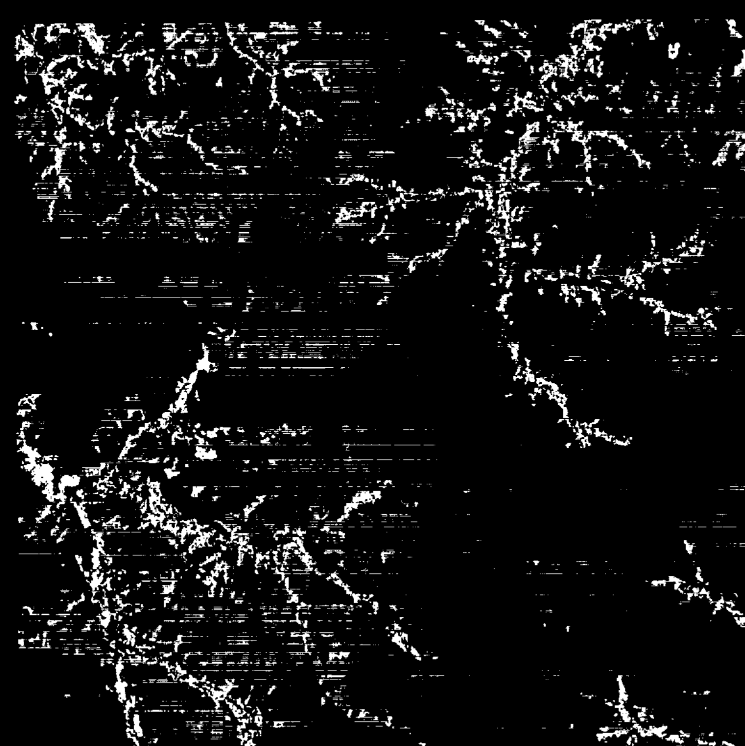
LAI was determined using the SAIL model, which was parameterized for the FIFE site by Fred Hummerich. Radiometrically corrected Thematic Mapper data from the FIFE CD-ROM set was used to determine LAI for various dates during 1987, only two dates are shown here. The LAI ranges are:

Black:	0
Blue:	0.1 to 1.0
Green:	1.1 to 2.0
Yellow:	2.1 to 3.0
Red:	3.1 to 5.0

The higher values of LAI (red) correspond to areas of gallery oak forest, and for crops in August. A shift in LAI for areas of tallgrass prairie may be seen, with generally lower values in August compared to June.

LAI for the FIFE Site; June 12, 1987

LAI for the FIFE Site; August 15, 1987



Rollins/Hunt/NTSG

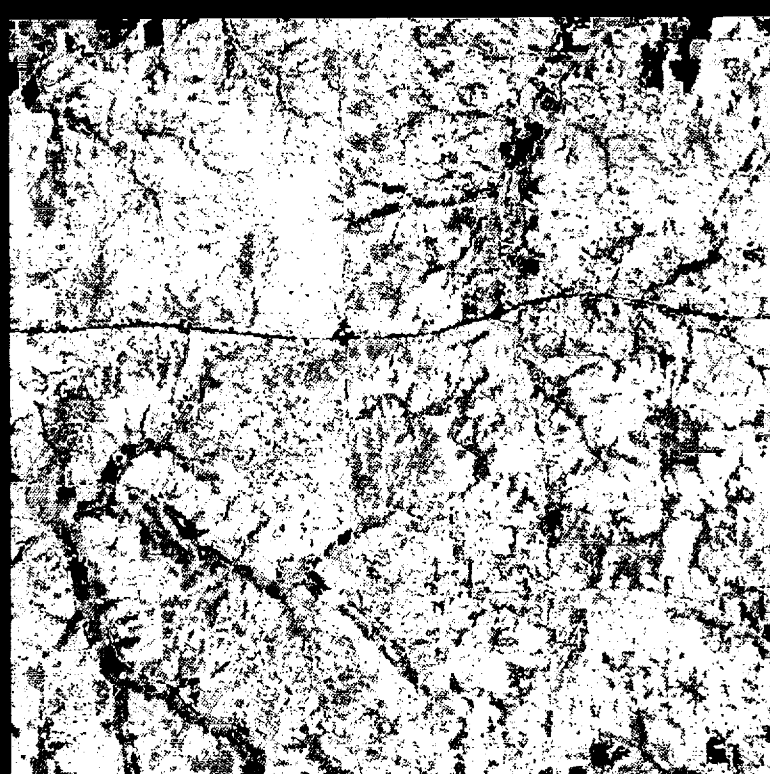
Figure 5. Simulated evapotranspiration for the FIFE site: (A) June 12, 1987 and (B) August 15, 1987.

Daily evapotranspiration (ET, mm/day) is the sum of transpiration from the vegetation and evaporation from the soil for these two dates. The ET ranges are:

Black:	0
Blue:	0.1 to 3.0 mm/day
Green:	3.1 to 4.0 mm/day
Yellow-green:	4.1 to 5.0 mm/day
Yellow:	5.1 to 6.0 mm/day
Orange:	6.1 to 7.0 mm/day
Red:	7.1 to 8.0 mm/day

Simulated Evapotranspiration for the FIFE Site; June 12, 1987

Simulated Evapotranspiration for the FIFE Site; August 15, 1987



Rollins/Hunt/Ntsg

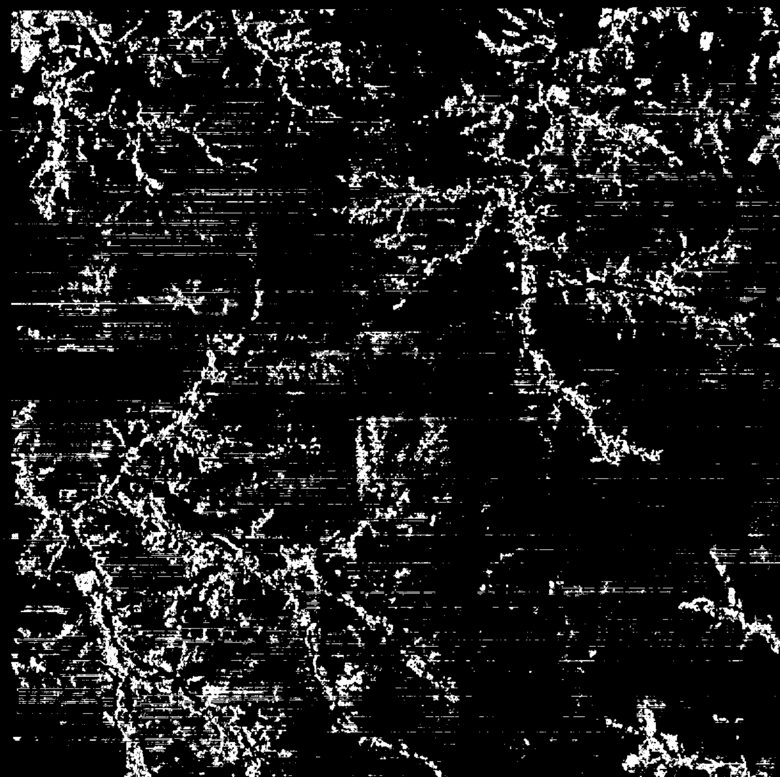
Figure 6. Simulated net ecosystem exchange for the FIFE site: (A) June 12, 1987 and (B) August 15, 1987.

Daily net ecosystem exchange (NEE, g C/m^2/day) is daily photosynthesis net autotrophic and heterotrophic respiration. The NEE ranges are:

Black:	< -50 g C/m^2/day
Gray:	-50 to 0 g C/m^2/day
Blue:	0.1 to 10 g C/m^2/day
Green:	11 to 30 g C/m^2/day
Yellow-green:	31 to 50 g C/m^2/day
Yellow:	51 to 70 g C/m^2/day
Red	> 71 g C/m^2/day

Negative NEE indicates that autotrophic and heterotrophic respiration are greater than daily photosynthesis.

Simulated Net Ecosystem Exchange for the FIFE Site; June 12, 1987



Simulated Net Ecosystem Exchange for the FIFE Site; August 15, 1987

Rollins/Hunt/NTSG

Figure 7. Differences between August 13 and June 12 of: (A) Evapotranspiration and (B) Net Ecosystem Exchange.

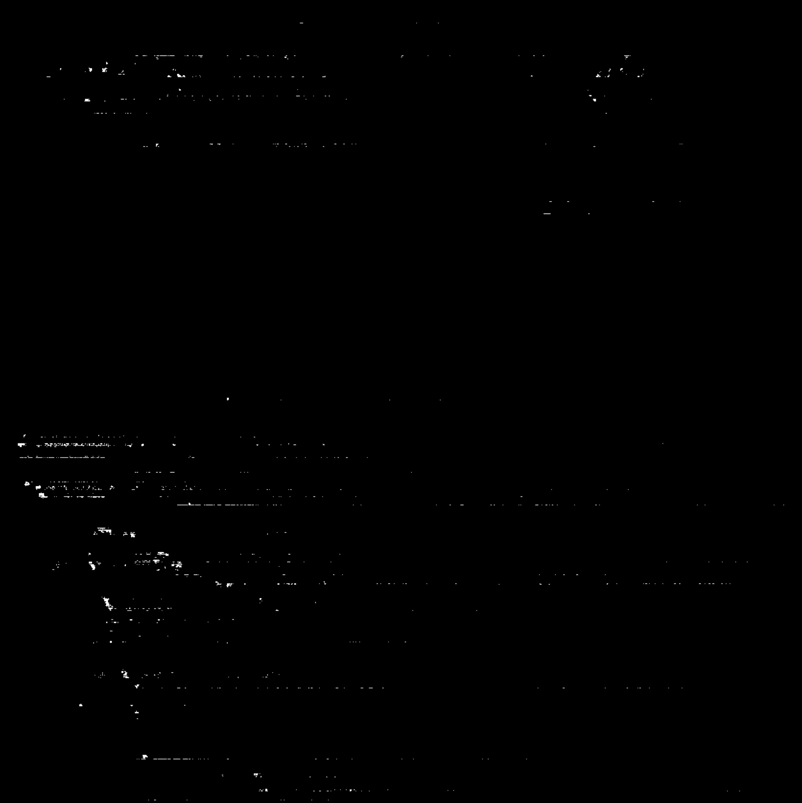
The ranges of difference in ET (August 13 value - June 12 value) are:

Black:	0 to 1.0 mm/day
Blue:	1.1 to 2.0 mm/day
Green:	2.1 to 3.0 mm/day
Yellow:	3.1 to 4.0 mm/day
Orange:	4.1 to 5.0 mm/day
Red:	5.1 to 7.5 mm/day

and the ranges of difference in NEE (August 13 value - June 12 value) are:

Gray:	0 g C/m^2/day
Blue:	0.1 to 10 g C/m^2/day
Green:	11 to 30 g C/m^2/day
Yellow:	31 to 50 g C/m^2/day
Orange:	51 to 70 g C/m^2/day
Red:	71 to 92 g C/m^2/day

Difference Between Aug 15 ET and June 12 ET



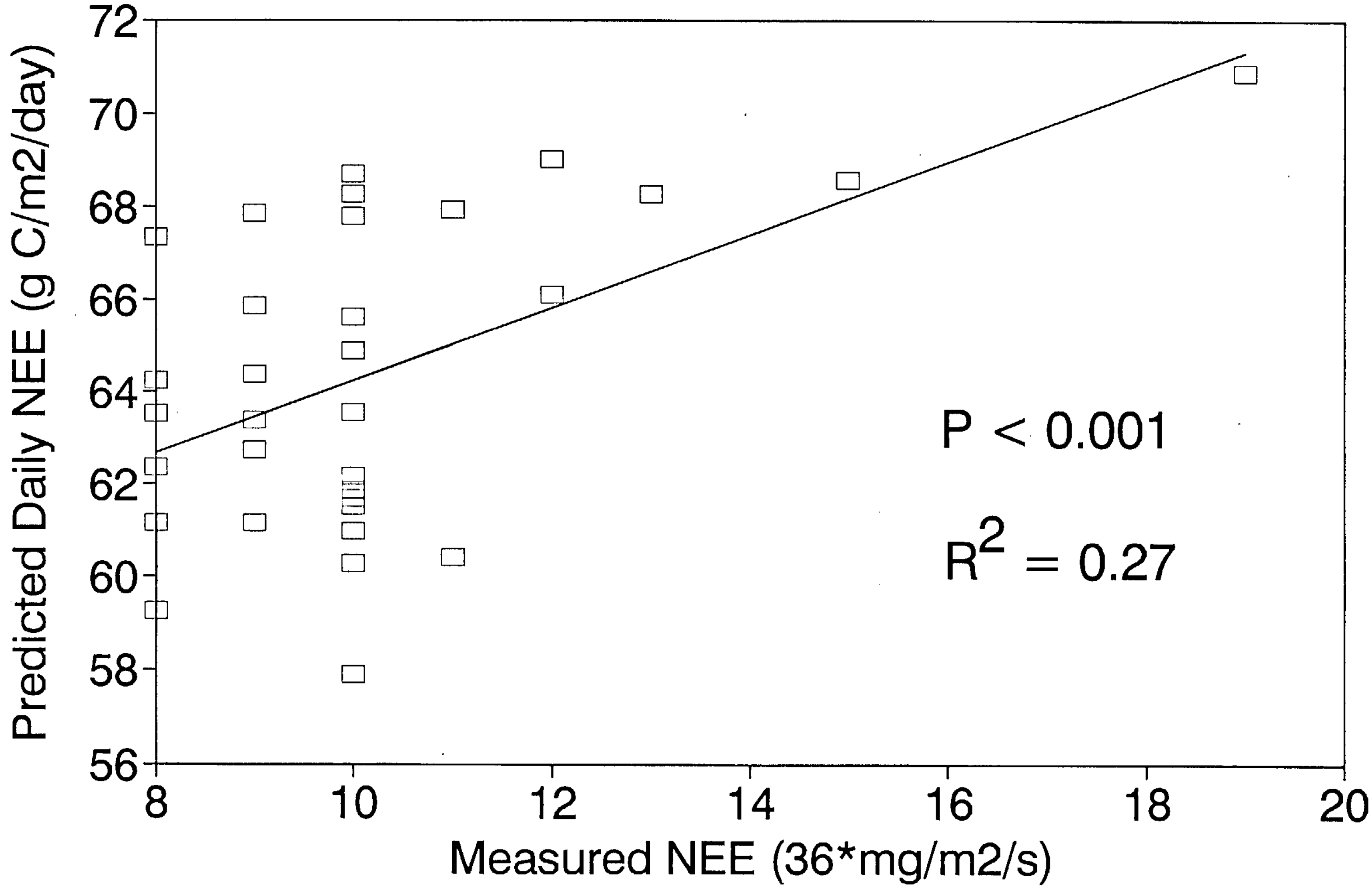
Difference Between Aug 15 NEE and June 12 NEE

Rollins/Hunt/NTSG

Figure 8. Correlation between predicted net ecosystem exchange and aircraft eddy-flux correlation data

BIOME-BGC predictions of daily net ecosystem exchange (NEE) g C m^{-2} day^{-1} and NEE measured using aircraft eddy-flux correlation by Desjardins et al. (1992). The foot print of the eddy flux aircraft was 66 by 132 pixels, resulting in 32 grid cells for the FIFE site, so the simulated fluxes were averaged within the foot print.

Predicted Net Ecosystem Exchange Versus Aircraft Flux Data (Desjardens et al.)



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FIFE data analysis: Testing BIOME-BGC predictions for grasslands | FIFE

ABQ: NC
ABA: Author (revised)

CIN: SAF
KIN: JXP
AIN:

data for important model inputs, process-based ecosystem simulations at a variety of scales are possible. The second objective of this study is concerned with determining the accuracy of the estimated fluxes from BIOME-BGC, when extrapolated spatially over the entire 15-km by 15-km FIFE site. To accomplish this objective, a topographically distributed map of soil depth at the FIFE site was developed. These spatially-distributed fluxes were then tested with data from aircraft by eddy-flux correlation obtained during the FIFE experiment.

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4B• A =-•PC LINE 11 COL 2

DOC NUMBER: 34004 INDEXING: SUBJECT/TERMS SCREEN CIN: SAF

TITLE: FIFE data analysis: Testing BIOME-BGC predictions for grasslands KIN: JXP

AIN:

MAJOR TERMS: SWITCH

1: GRASSLANDS
2: REMOTE SENSING
3: FORESTS
4: FARMLANDS
5: SATELLITE OBSERVATION
6: SURFACE ENERGY
7: ENERGY TRANSFER
8: ECOSYSTEMS
9: ENVIRONMENT MODELS
10: TERRAIN ANALYSIS
11: LAND USE
12:
13:
14:
15:

MINOR TERMS:

1: RESPIRATION
2: BIOGEOCHEMISTRY
3: THREE DIMENSIONAL MODELS
4: TOPOGRAPHY
5: METEOROLOGY
6: GEOMORPHOLOGY
7: CLIMATOLOGY
8: PHOTOSYNTHESIS
9: EVAPORATION
10: TRANSPIRATION
11:
12:
13:
14:
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PF2=RESET; PF3=SIGNON; PF4=RELEASE; PF5=SELECTION; PF6=SUBQ
PF10=ALPHA; PF11=HIERARCHY; PF12=STORE; PF13=CENTRAL SCREEN; PF20=TITLE/WNF

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DOC #: 34004 ABSTRACT SCREEN PAGE: 1 ** WORDS NOT FOUND *

FIFE data analysis: Testing BIOME-BGC predictions for grasslands

FIFE

ABQ: NC
ABA: Author (revised)

CIN: SAF
KIN: JXP
AIN:

The First International Satellite Land Surface Climatology Project (ISLSCP) Field Experiment (FIFE) was conducted in a 15 km by 15 km research area located 8 km south of Manhattan, Kansas. The site consists primarily of native tallgrass prairie mixed with gallery oak forests and croplands. The objectives of FIFE are to better understand the role of biology in controlling the interactions between the land and the atmosphere, and to determine the value of remotely sensed data for estimating climatological parameters. The goals of FIFE are twofold: the upscale integration of models, and algorithm development for satellite remote sensing. The specific objectives of the field campaigns carried out in 1987 and 1989 were the simultaneous acquisition of satellite, atmospheric, and surface data; and the understanding of the processes controlling surface energy and mass exchange. Collected data were used to study the dynamics of various ecosystem processes (photosynthesis, evaporation and transpiration, autotrophic and heterotrophic respiration, etc.).

FIFE
MANHATTAN
TALLGRASS
FIFE
FIFE/UPSCALE
AUTOTROPHIC/HETEROTROPHIC

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DOC #: 34004 ABSTRACT SCREEN PAGE: 2 ** WORDS NOT FOUND *

FIFE data analysis: Testing BIOME-BGC predictions for grasslands FIFE

ABQ: NC
ABA: Author (revised)

CIN: SAF
KIN: JXP
AIN:

Modelling terrestrial ecosystems at scales larger than that of a homogeneous plot led to the development of simple, generalized models of biogeochemical cycles that can be accurately applied to different biomes through the use of remotely sensed data. A model was developed called BIOME-BGC(for BioGeochemical Cycles) from a coniferous forest ecosystem model, FOREST-BGC, where a biome is considered a combination of a life forms in a specified climate. A predominately C4-photosynthetic grassland is probably the most different from a coniferous forest possible, hence the FIFE site was an excellent study area for testing BIOME-BGC. The transition from an essentially one-dimensional calculation to three-dimensional, landscape scale simulations requires the introduction of such factors as meteorology, climatology, and geomorphology. By using remotely sensed geographic information

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