VEMAP 2: ANNUAL ECOSYSTEM MODEL RESPONSES TO U.S. CLIMATE CHANGE, 1994-2100

Get Data

Summary:

The Vegetation-Ecosystem Modeling and Analysis Project (VEMAP) was a large, collaborative, multi-institutional, international effort whose goal was to evaluate the sensitivity of terrestrial ecosystem and vegetation processes to altered climate forcing and elevated atmospheric CO2. Phase 1 of the VEMAP project developed historical (1895-1993) data sets of observed climate, soils, and vegetation compatible with the requirements of ecosystem models and vegetation distribution models. See the VEMAP Phase 1 User's Guide for more information.

Phase 2 developed historical (1895-1993) gridded data sets of climate (temperature, precipitation, solar radiation, humidity, and wind speed) and projected (1994-2100) gridded annual and monthly climate data sets using output from two climate system models (CCCma (Canadian Centre for Climate Modeling and Analysis) and Hadley Centre models). See the VEMAP Phase 2 User's Guide for additional background information.

Two Phase 2 model experiments were run. First, a set of selected biogeochemical models and coupled biogeochemical-biogeographical models were run from 1895 to 1993 to compare model responses to the historical time series and current ecosystem biogeochemistry. Second, these same models were run on the projected 1994 to 2100 data to compare their ecological responses to transient scenarios of climate and atmospheric CO2 change. Model runs were performed for daily, monthly, and annual gridded data sets. The output of the annual model runs in VEMAP grid format are contained in this data set.

The models investigated included five biogeochemical cycling models, which simulate plant production and nutrient cycles but rely on a static land-cover type, and two dynamic global vegetation models (DGVMs), which combine biogeochemical cycling processes with dynamic biogeographical processes including succession and fire simulation.

Biogeochemical Cycling Models

- Biome-BGC (BioGeochemical Cycles)
- Century
- Century rxveg
- GTEC (Global Terrestrial Ecosystem Carbon Model)
- TEM (Terrestrial Ecosystem Model)

Dynamic Global Vegetation Models

- LPJ (Lund-Potsdam-Jena
- MC1 (MC 5 modified Century)

VEMAP 2 model intercomparison results have been published by Schimel et al.(2000), Bachelet et al. (2003) and Gordon and Famiglietti (2004).

Data Citation:

Cite this data set as follows:

Kittel, T.G.F., N.A. Rosenbloom, C. Kaufman, J.A. Royle, C. Daly, H.H. Fisher, W.P. Gibson, S. Aulenbach, D.N. Yates, R. McKeown, D.S. Schimel, and VEMAP 2 Participants. 2005. VEMAP 2: Annual Ecosystem Model Responses to U.S. Climate Change, 1994-2100. ORNL DAAC, Oak Ridge, Tennessee, USA. http://dx.doi.org/10.3334/ORNLDAAC/766.

References:

Gordon, W. S., and J. S. Famiglietti (2004), Response of the water balance to climate change in the United States over the 20th and 21st centuries: Results from the VEMAP Phase 2 model intercomparisons, Global Biogeochem. Cycles, 18, GB1030, doi:10.1029/2003GB002098.

Bachelet, D; Neilson, RP; Hickler, T; Drapek, RJ; Lenihan, JM; Sykes, MT; Smith, B; Sitch, S; and Thonicke, K. 2003. Simulating past and future

dynamics of natural ecosystems in the United States. Global Biogeochem. Cycles, 17 (2): 1045-1045.

Kittel, T. G. F., J. A. Royle, C. Daly, N. A. Rosenbloom, W. P. Gibson, H. H. Fisher, D. S. Schimel, L. M. Berliner, and VEMAP 2 Participants. 1997. A gridded historical (1895-1993) bioclimate dataset for the conterminous United States. Pages 219-222, in: Proceedings of the 10th Conference on Applied Climatology, 20-24 October 1997, Reno, NV. American Meteorological Society, Boston.

VEMAP Members. 1995. Vegetation/Ecosystem Modeling and Analysis Project (VEMAP): Comparing biogeography and biogeochemistry models in a continental-scale study of terrestrial ecosystem responses to climate change and CO2 doubling. Global Biogeochemical Cycles 9:407-437.

Schimel, D.S., Jerry Melillo, Hanqin Tian, A. David McGuire, David Kicklighter, Timothy Kittel, Nan Rosenbloom, Steven Running, Peter Thornton, Dennis Ojima, William Parton, Robin Kelly, Martin Sykes, Ron Neilson, and Brian Rizzo. 2000. Contribution of Increasing CO2 and Climate to Carbon Storage by Ecosystems in the United States. Science 17 March 2000; 287: 2004-200.

Data Format:

The model output data files are stored and distributed in netCDF format.

The network Common Data Form, or netCDF, refers to a comprehensive interface, library and file format designed to create, access and share scientific data. It was developed by the Unidata Program Center in Boulder, Colorado.

VEMAP Grid Characteristics

The grid used for the VEMAP coverage is a 0.5-deg. latitude x 0.5-deg. longitude grid covering the conterminous U.S. Grid edges are aligned with 1.0-deg. and 0.5-deg. latitude-longitude lines; grid centers are located at 0.25-deg. and 0.75-deg. latitude-longitude intersections. Latitude and longitude for each cell are included in the VEMAP data set.

The grid's minimum bounding rectangle (MBR) is defined by grid domain corners. The full 0.5deg. VEMAP grid contains 5520 cells, with 115 columns and 48 rows. Within the grid, 3261 cells are within the boundaries of the conterminous U.S. and predominantly covered by land. Background cells (ocean and inland water cells) are assigned the value of -9999. The VEMAP 'mask', found in the header of each netCDF file, enumerates land cells from 1 to 3261; background cells are indicated by 0.

VEMAP grid corners defining the minimum bounding rectangle (MBR).

Grid Position	Longitude*	Latitude
Lower Left Corner	-124.5deg.	25.0deg.
Upper Right Corner	-67.0deg.	49.0deg.

***Negative longitudes are degrees West.

Gridded Data Files

Layout of the VEMAP gridded array, with grid cell ID numbers.

Column 1 - to - 115

Row 1 1 2 3 4 ...115

116 117 118 119 ...230

231...

-to-

... Row 48 ... 5520

Available VEMAP 2 Results Variables: Annual

Model	BBGC	CENT	CENTrx	GTEC	LPJ	MC1	TEM
Time	annual	annual	annual	annual	annual	annual	annual
Variables	aetx	aetx	aetx	aetx	aetx	aetx	aetx

	ltfc nbpx neex nepx nmin nppx resh roff solc totc tslc vegc	agvc laix litt nbpx nepx nmin nppx petx resh roff solc totc tslc vegc	agvc laix litt nbpx nepx nmin nppx petx resh roff solc totc tslc vegc	gppx nppx roff totc tslc vegc	arbu bibu laiw nbpx nepx nppx roff solc totc tslc vegc vegt(vgat)	agvg(vgat) arbu bibu laiw ltfc nbpx nepx nmin nppx resh roff totc tslc vegc vveg(vgvt)	gppx ltfc nbpx nepx nmin nppx petx resh roff totc tslc tsln vegc vegn
Total	13	15	15	7	13	16	15

VEMAP 2 Results - Variable Naming Conventions and Description

Variable	Description	Units: annual [yr^{-1}] monthly [mo^{-1}] daily [day^{-1}]
aetx	total actual evapotranspiration	mm
agvc	Above ground live Carbon	gC
arbu	fraction of the gridcell that is burnt	-
bibu	biomass burnt	gC m-2
gppx	gross primary production	gC m-2
laiw	woody LAI	-
laix	leaf area index	-
litt	total fine litter	gC m-2
ltfc	total litterfall carbon	gC m-2
nbpx	change in total carbon	gC m-2
neex	total net ecosystem exchange	gC m-2
nepx	Net Ecosystem Production (NEP=NPP-RH)	gC m-2
nmin	total net nitrogen mineralization	g N m-2
nppx	total net primary production	g C m-2
petx	potential evapotranspiration	cm
resh	total heterotrophic respiration	gC m-2
roff	total runoff	mm H2O
solc	average soil organic matter carbon	gC m-2
totc	mean total carbon storage	g C m-2
tslc	average non-vegetation carbon	gC m-2
tsln	total soil nitrogen	gN m-2
vegc	mean total vegetation carbon	g C m-2
vegn	vegetation nitrogen	gN m-2

vegt/vgat/agvg	VEMAP aggregated vegetation classification	-
vveg(vgvt)	VEMAP vegetation classification	-

VEMAP 2 Results - File Naming Conventions and Description

	Variable name	Model	GCM model	GCM experiment	CO_2 experiment	Vegetation	Time step	Release	Grid	Compression
# characters	4	4	2	2	1	1	1	4	1	3
Range of possible values	model dependent	TEMx BBGC LPJx CENT GTEC MC1x	C1 H2	Su xx	C x	V	A M D	model dependent	i	- *.gz

example #1: aetxLPJxC1SuCVA4020i.nc.gz

variable = aetx (total actual evaporation)
model = LPJx (Lund/Pik/Jena)
GCM model = C1 (CGCM1)
GCM experiment = Su (sulphate aerosols)
CO_2 experiment = C (increasing CO2)
vegetation = V (VEMAP vveg2)
time step = A (annual)
release = 4020
grid representation = i (inflated)
compression = .gz (gzipped)

example #2: laiwMC1xH2SuxVA3010i.nc

variable = laiw (woody LAI)
model = MC1x (Oregon State Univ; USDA Forest Service-MAPSS Team)
GCM model = H2 (Hadley HADCM2)
GCM experiment = Su (sulphate aerosols)
CO_2 experiment = x (constant CO2)
vegetation = V (VEMAP vveg2)
time step = A (annual)
release = 3010
grid representation = i (inflated)
compression = - (uncompressed)

Document Information:

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