*Table 1. Information for 65 models applicable for forest ecosystem modeling**			
Software	**Description**	**Source**	**Data**
1. ACORn	ACORn (A Comprehensive Ozark Regeneration simulator) is a computer program that can help forest managers predict the number and species of trees that will regenerate following harvest in upland oak stands in the Ozark Highlands of Missouri and adjacent states.	http://www.nrs.fs.fed.us/tools/software/	
2. ASPEN	ASPEN is an empirical simulation model that projects the growth and yield of aspen (Populus tremuloides and P. tremula) stands from establishment to breakup. The model incorporates the system of equations developed from growth and yield data from throughout the range of P. tremuloides and P. tremula; the model should thus be applicable throughout the circumboreal region. The model runs on an annual time step and predicts total yields in number of trees, basal area, and biomass, as well as merchantable yields in cubic feet and cords for user-specified utilization standards, and in Scribner board feet. Outputs are in the form of stand tables and stocking guides. The model supports silvicultural operations such as thinning, as well as management for multiple products.	http://www.nrs.fs.fed.us/tools/software/	
3. The Community Land Model's Dynamic Global Vegetation Model (CLM-	CLM-DGVM consists of CLM3.0 as described by Oleson et al. (2004) plus a set of routines that allow vegetation cover and structure to be simulated instead of prescribed from data. Annual (or slow) processes include the update of vegetation biogeography and structure. The plant-atmosphere exchange of carbon (in the form of CO2) occurs at a subhourly time step. Plant phenology is calculated daily (Figure 1). Vegetation is represented by the	http://nldr.library.ucar.edu/repository/assets/technotes/TECH-NOTE-000-000-000-599.pdf	CLM-DGVM Output BURN: fraction of naturally vegetated landunit burned (variable A(s): part I section 2.9). CFLUXFIRE: carbon flux to the atmosphere due to fire (g C m-2 of naturally vegetated landunit area) (variable Φfire: part I section 2.9). NPP: net primary production (g C m-2 of plant functional type area; note different area unit) (variable NPP: part I section 2.1)

DGVM)	carbon stored in leaves, roots, stems (sapwood), and heartwood. Given these carbon pools, the model can derive every pft's leaf area index, canopy height, and fractional cover relative to the portion of the grid cell allocated to natural vegetation. (In standard CLM simulations, these variables come from input datasets.) The leaf area index participates in the calculation of photosynthesis. Generally, photosynthesis minus autotrophic respiration (defined as net primary production) minus mortality determines a pft's success at the grid cell level. Carbon from live plants eventually ends up in above and below ground litter and turns to soil carbon, which decomposes at various rates to close the terrestrial carbon cycle. At this time, CLM-DGVM has been tested only with a prescribed atmospheric CO_2 concentration. CLM-DGVM is not supported for fully coupled carbon simulations where atmospheric CO_2 is predicted. In CLM-DGVM the maximum number of pfts in a grid cell's naturally vegetated landunit has changed from 4 (standard CLM) to 10 to allow all pfts to coexist when climate permits. CLM-DGVM keeps track of all 10 pfts, even when a pft's area is zero, in order to allow for the annual introduction and removal of pfts. This differs from the standard CLM, where pfts are maintained only when their area is greater than zero. Filters may be used at run time to eliminate redundant calculations for pfts with zero area.		Rh: heterotrophic respiration (g C m-2 of naturally vegetated landunit area) (variable Rh: part I section 2.12). PFT: plant functional type (pft: concept first mentioned in part I section 1.1). FPCGRID: pft fractional cover relative to the naturally vegetated landunit area (FPC: first defined in part I section 2.1). LCIND: grams of leaf carbon per individual (Cleaf: part I section 2.1). RCIND: grams of root carbon per individual (Croot: part I section 2.1). SCIND: grams of sapwood carbon per individual (Csapwood: part I section 2.1). HCIND: grams of heartwood carbon per individual (Cheartwood: part I section 2.1). NIND: number of individuals per m2 naturally vegetated landunit area (P: part I section 2.1). List of Subroutines DGVMrespiration: Sub-hourly. Calculates autotrophic respiration for each existing pft. The corresponding equations were adapted from the equations in subroutine npp in LPJ version 1. Lpj: Annual. Calls the so-called slow processes in the order listed here. The model returns from subroutine lpj with updates to the following pft variables: maximum leaf area index, canopy height, and fraction of the naturally vegetated landunit occupied by the pft. These variables are used in the model's sub-hourly biogeophysical calculations. Reproduction: Annual. Adapted from subroutine reproduction in LPJ version 1. Calculates

			the cost of reproduction for existing pfts and updates above ground litter and annual net primary production. Turnover: Annual. Adapted from the subroutine by the same name in LPJ version 1. Given pft-specific longevity values for various types of plant tissue (Table 2), calculates the amount of living carbon that enters the above and below ground litter pools and the amount of sapwood that turns to heartwood. Kill: Annual. Adapted from the subroutine by the same name in LPJ version 1. When a pft ends the year with negative net primary production, the pft is removed and its carbon converted to litter. Allocation: Annual. Adapted from the subroutine by the same name in LPJ version 1. Determines the fractions of the year's biomass increment that become leaf, sapwood, and root carbon. Light: Annual. Adapted from the subroutine by the same name in LPJ version 1. Deals with aboveground competition, otherwise described as mortality due to shading. Mortality: Annual. Adapted from the subroutine by the same name in LPJ version 1. A fraction of trees is removed and converted to litter every year due to background mortality and mortality due to heat stress. Fire: Annual. Adapted from subroutine fire in LPJ version 1. A fraction of trees and above ground litter is removed and converted to atmospheric CO2. Establishment: Last of the annual processes. Adapted from subroutines bioclim and establishment

			in LPJ version 1. This subroutine provides a seed amount of vegetation for new pfts in the presence of suitable climate conditions. Phenology: Daily. Called from subroutine EcosystemDynDGVM to determine daily leaf area index as a fraction of the annual maximum value. Adapted from subroutine pheno in IBIS version 2 (Kucharik et al. 2000). Unlike LPJ's equivalent algorithm, the IBIS algorithm requires no prior knowledge of the meteorological conditions of the upcoming year. Since CLM doesn't have access to such information when coupled to a GCM, the algorithm found in IBIS was used. FireSeason: Sub-hourly. Called from subroutine EcosystemDynDGVM to determine the length of the year's fire season. Adapted from subroutine fire in LPJ version 1. LitterSOM: Sub-hourly. Called from subroutine EcosystemDynDGVM to convert litter to soil organic matter. Adapted from the corresponding subroutine in LPJ version 1. EcosystemDynDGVM: Calls Phenology to determine daily leaf area index, which takes part in the photosynthesis calculation (Oleson et al. 2004). EcosystemDynDGVM also sets stem area index, height of the bottom of the canopy for trees, and top and bottom canopy heights for grasses, all needed in the model's biogeophysical calculations.
4. ECOST	ECOST is a Visual Studio .net program that estimates stump-to-mill costs of cable logging, conventional ground-based skidding, cut-to-length, feller-buncher applications, forwarding, and small	http://www.nrs.fs.fed.us/tools/software/	

	farm tractors for logging Eastern hardwoods.		
5. ED (Ecosystem Demography model version 2)	The land surface in ED2 is subdivided into a series of grid cells that experience meteorological forcing from either of natural disturbance processes such as wind-throw and fire, and anthropogenic disturbances such as forest harvesting, land clearing, and land-abandonment. Like its predecessor ED, ED2 captures subgrid scale biotic heterogeneity arising from disturbance events using a system of size- and age-structured partial differential equations (PDEs) that closely approximate the ensemble meanbehavior of a corresponding individual-based stochastic gap model [Moorcroft et al., 2001]. These PDEs are solved usingthe method of characteristics, subdividing each grid cell into a series of dynamic horizontal tiles, representing locations within the grid cell that have experienced a similar disturbance history, and with an explicit dynamic vertical canopy structure within each tile.	http://www.oeb.harvard.edu/faculty/moorcroft/publications/publications/Medvigy_etal_2009.pdf	**Input Data**: There are four types of input data: Grid Cell Area; Land Sea Mask; Mechanism Input; and ISLSCP I Initiative data. These extrapolate into 8 subdirectories (grid_cell_area, mask, mechanism, precip, soils, soil_temp; sois, and temp) each described as follows: **Grid Cell Area**. The grid_cell_area subdirectory contains a single file, GRIDAREA.GRD, which is a one degree global ASCII map of grid cell area provided in km2, and provided by Moorcroft et al. 2001. **Mask**. The mask subdirectory contains a single file, land_sea.msk, which is a land/sea mask where a value of 1 represents land and a value of 0 represents water. This file is in ascii text format at a spatial resolution of 1 degree latitude by 1 degree longitude arranged in 360 columns and 180 rows. **Mechanism Input**. The files in the mechanism subdirecory (lat**long**.in) provide pre-computed, monthly-integrated photosynthesis and transpiration per leaf area for 121 light levels within the canopy. There are two sets of files, one for each physiology (C3 and C4) with one file per grid cell. Each file contains 5 columns for each light level for each month and includes: fraction of full light; photosynthesis with stomates open (g C/m2/month); photosynthesis with stomates closed (g C/m2/month); transpiration with stomates open (g Water/m2/month); and transpiration with stomates closed (g Water/m2/month). **ISLSCP I Initiative Data**. For the ED South American data set, the model was run using data from the International Satellite Land Surface

			Climatology Project (ISLSCP) Initiative I. These data input files provide modelers with many of the fields required to prescribe boundary conditions and initialize and force a wide range of land-biosphere-atmosphere models. All of these data have been preprocssed to the same spatial resolution (1 degree by 1 degree), using the same land/sea mask and processing steps to ensure spatial and temporal continuity. These data cover the period 1987 through 1988 at a 1-month time resolution for most of the seasonally varying quantities and at 6-hourly resolution for the near-surface meteorological and radiative forcings. The data for 1987 and 1988 were averaged into a single average year.
6.FIDO	FIDO gives you access to the National FIA (Forest Inventory and Analysis) databases. You now have the ability to generate tables and maps of forest statistics through a web browser without having to understand the underlying data structures.	http://www.nrs.fs.fed.us/tools/software/	
7.The Forest Stewardship Planning Guide	The Planning Guide is one of a group of computer programs intended to support good forest stewardship. The full set of tools is known collectively as NED, a computer-based, decision-support system being developed by the US Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. NED will provide site-specific expert recommendations to improve management for multiple values on forests in the Northeastern United States.	http://www.nrs.fs.fed.us/tools/software/	
8.ForGate	ForGATE is a downloadable spreadsheet tool designed to communicate information relevant to the evaluation of projected net greenhouse gas (GHG) exchange in the context of Maine's forests, the forest sector of northeastern North America, and alternative national or regional carbon (C)	http://www.nrs.fs.fed.us/tools/software/	

	accounting guidelines. A full version of Microsoft Excel® (2007 or later) is required to run ForGATE. Documentation and instructions are integrated into the tool itself.		
9.GIS-FIA Model	The GIS-FIA Model was developed by Michigan Technological University in cooperation with the North Central Forest Inventory and Analysis (FIA) research unit. The GIS-FIA Model is a geographic information system program that summarizes FIA data. The model runs from a project file in ArcView under the Windows98/NT operating system.	http://www.nrs.fs.fed.us/tools/software/	
10.GMLSM: (Gypsy Moth Life System Model)	The gypsy moth life system model (GMLSM) is a very complete model of the population dynamics of this insect pest as it is known to exist in North America. It simulates these dynamics within a single forest stand over a user defined time interval (no. of years). It models the growth, feeding, and mortality of the gypsy moth in a single forest stand by following a number of cohorts on a degree-day basis.	http://www.nrs.fs.fed.us/tools/software/	The Stand-Damage Model simulates tree diameter and height growth, foliage production, and mortality. Each year the model calculates diameter growth of trees as a function of relative stocking (a measure of tree crowding), shading, heat, and defoliation. Users describe a forest stand by entering tree counts by species and diameter class. Parameters for over sixty tree species are provided. **Gypsy Moth Software** Two models describe the North American Gypsy Moth population dynamics. The Life System Model is the most complex. The simple model is the system of three coupled differential equations (Ordinary Differential Equations Model). **Gypsy Moth Life System Model (GMLSM)** The GMLSM simulates the gypsy moth population dynamics within a single forest stand over a defined time interval (years). It models the growth, feeding, and mortality of gypsy moth by following a number of cohorts on a degree-day basis. It also models the population dynamics of natural enemies, including predators, parasites, and pathogens affecting and affected by gypsy moth. Because foliage is growing at the same time that gypsy moth is feeding, foliage

			growth dynamics is represented on a tree species-specific basis. Default conditions are provided and the user can set up simulated management actions (including viral, bacterial, or chemical pesticides, mating disruption, sterile egg release, and/or stand manipulations). Model parameters can be adjusted to account for local conditions. The Stand-Damage **Model is included in the GMLSM.** **Ordinary Differential Equations Model** This model consists of three coupled ordinary differential equations: One represents gypsy moth, one represents forest stand foliage, and the third represents natural enemies. While it lacks the details of the GMLSM, it provids insights into the stability and asymptotic behavior of this three trophic-level system. It has been extended to a system of partial differential equations and used to examine dispersal questions on a local level.
11.GMPHEN (Gypsy Moth Phenology Model)	The GMPHEN model predicts the growth of gypsy moth from egg eclosion to adult emergence from the pupal stage. In this DOS program, users are provided with a menu structured access system, permitting one to supply weather data for a particular site in one of 5 formats. The program will predict instar distribution over time.	http://www.nrs.fs.fed.us/tools/software/	

12.HARVEST v6.1 HARVEST v6.0	HARVEST is a timber harvest allocation model that was constructed to allow the input of specific rules to allocate forest stands for even-age harvest (clearcuts and shelterwood) and group selection, using parameters commonly found in National Forest Plan standards and guidelines. The model produces landscape patterns that have spatial attributes resulting from the initial landscape conditions and potential timber management activities. Modeling this process allows experimentation to link variation in management strategies with the resulting pattern of forest openings and the distribution of forest age classes. The updated HARVEST Version 6.1 was released in Summer 2005. HARVEST Lite is the educational version of the software.	http://www.nrs.fs.fed.us/tools/software/	New Features in Version 6.1: HARVEST parameter menu • The user can specify any combination of two treatment effects when a harvest is implemented, 1) the age to which the treated cells are set, including reducing the current cell age by a constant and 2) whether the forest type will be converted upon cutting (e.g., planting, different type of the residual stand, deterministic succession) • Display the Age, Forest Type and the Management Area maps at any time • The user can require harvest units to completely fill stand boundaries, even when a target cutblock size is specified • The user can specify a maximum age, above which stands cannot be cut • Save the Forest Type Map, since it now can change • The menus of version 6.1 have been re-designed • The user can conduct analyses of the spatial pattern of the landscape both before and after simulated harvest using the spatial pattern analysis software, APACK • Version 6.1 adds calculation of the fragmentation index GISfrag (Ripple et al. 1991) • Execution speed has been increased

13.HYBRID	The model, Hybrid v3.0, treats the daily cycling of carbon, nitrogen, and water within the biosphere and between the biosphere and the atmosphere. It combines a mass-balance approach with the capacity to predict the relative dominance of different species or generalised plant types (such as evergreen needleleaved trees, cold deciduous broadleaved trees, and C3 grasses). The growth of individual trees is simulated on an annual timestep, and the growth of a grass layer is simulated on a daily timestep. The exchange of carbon, nitrogen, and water with the atmosphere and the soil is simulated on a daily timestep (except the flux of tree litter to the soil, which occurs annually). Individual trees and the grass layer compete with each other for light, water, and nitrogen within a 'plot'. Larger and taller plants shade smaller ones; they also take up a greater proportion of the available water and nitrogen. The above-ground space in each plot is divided into 1 m deep layers for the purposes of calculating irradiance interception; horizontal variation in the plot environment is not treated. The soil is represented as a single layer, with a daily hydrological budget. Decomposition of soil organic matter is calculated using an empirical sub-model. The initial size of each tree seedling is stochastic. To predict the mean behaviour of the model for a particular boundary condition it is necessary to simulate a number of plots. Hybrid v3.0 has been written with three major requirements in mind: (i) the carbon, water, and nutrient cycles must be fully coupled in the soil-plant-atmosphere system; (ii) the internal constraints on the model's behaviour, and the driving forces for the model, must be the same as	http://www.sysecol2.ethz.ch/Refs/EntClim/F/Fr035.pdf	Input data Autumn daylength for leaf fall Daylength Rubisco oxygenation turnover number Photorespiration comp. CO 2 conc. Constant for electron transport Intercept in Rubisco calculation Top leaf limit on N uptake Latitude Relative foliage to root C:N Atmospheric CO 2 concentration M- M const, of Rubisco for O 2 Fine root/foliage C ratio M - M const, of Rubisco for CO 2 Rubisco/chlorophyll N ratio Height/dbh coefficient Growth respiration coefficient PAR extinction coefficient Rubisco carboxylation turnover no. Maximum e- transport rate Fine root turnover rate Limit on top leaf N content Tree form factor Mean wood plus bark density Maximum temperature for stomatal conductance 40°C Foliage turnover rate Relative C:N of foliage and sapwood plus bark Specific leaf area Fine root respiration rate Degree-day requirement for bud burst Constant in photosynthesis equation Maximum stomatal conductance/Rubisco N ratio Temperature threshold for phenology Stomatal conductance

	those which operate in nature (e.g., climate, nitrogen deposition, and the atmospheric concentrations of CO 2 and 02); and (iii) the model must be constructed so that it is capable of predicting transient as well as equilibrium responses to climate change. These conditions have largely been met by constructing the model around a set of fundamental hypotheses regarding the general constraints under which plants and soils behave, independently of any particular location or time. The model is thus potentially capable of making reliable predictions of ecosystem behaviour and structure under future, new, amaospheric conditions. The model is tested for a site in eastern North America. A quasi-equilibrium is reached after approximately 250 years with 10 plots. It is found that more plots are not necessary in order to obtain a reliable estimate of mean behaviour. Predictions of productivity, leaf area index, foliage nitrogen, soil carbon, and biomass carbon are all within the range expected for this location.		Soil decomposition rate of all soil pools Wood respiration coefficient Apparent sky temperature SW extinction coefficient Fraction of sapwood alive Foliage/sapwood area ratio Bark thickness/dbh ratio N uptake coefficient Thermal resistance to heat loss N deposition rate Lignin content of litter Night foliage respiration coefficient Atmospheric vapour pressure deficit Water outflow fraction Leaf characteristic dimension Minimum stem increment Foliage dark respiration coefficient Boundary layer resistance to CO 2 Wood plus bark turnover rate Maximum soil water potential Soil water filled pore space Height effect on stomatal conductance PAR reflection coefficient Ratio of soil water saturation to field capacities Plot area Soil texture (clay and sand contents); effect on decomposition Soil water holding capacity Accuracy of pipe model solution Below ground wood plus bark fraction Day temperature calculation factor SW reflection coefficient Molecular effect on diffusion Soil water drying curve parameter Leaf internal

			Canopy interception of precip. Plant C:N for N uptake calculation Snowmelt coefficient Exponent of height/dbh relationship N:C ratios of soil pools Fraction of live sapwood available for storage Foliage N retranslocation fraction Soil carbon leach rate Cuticular conductance http://www.sysecol2.ethz.ch/Refs/EntClim/F/Fr035.pdf
14.IBIS (Integrated Biosphereulator)	IBIS simulates a wide variety of ecosystem processes, including •energy, water, and carbon dioxide exchange between plants, the atmosphere, and the soil •physiological processes of plants and soil organisms, including photosynthesis and respiration •seasonal changes of vegetation, including spring budburst, fall senescence, and winter dormancy •plant growth and plant competition •nutrient cycling and soil processes	http://www.sage.wisc.edu/download/IBIS/ibis.html	IBIS input files 1961-1990 means These input files contain climate data based on the Climate Research Unit of the University of East Anglia http://www.cru.uea.ac.uk Dataset CRU CL 1.0 climate dataset modified by SAGE researchers at UW-Madison for compatibility with IBIS.
15.i-Tree	The i-Tree suite of software tools was developed to help users—regardless of community size or technical capacity—identify, understand and manage urban tree populations. Better awareness of the benefits and services provided by the urban forest resource leads to increased attention to	http://www.nrs.fs.fed.us/tools/software/ https://www.itreetools.org/index.php	**i-Tree Analysis Tools** The three core i-Tree analysis tools are i-Tree Eco, Streets, and Design. All three quantify tree benefits. The main difference is in scale: • i-Tree Eco can be used anywhere at any

	stewardship, appreciation of operations, and investment in maintenance.		scale • i-Tree Streets focuses on street trees • i-Tree Design is used to quantify ecological benefits at a site scale. i-Tree Eco Based on a complete inventory or random plots, i-Tree Eco can analyze structure, function, and value of benefits of trees at any scale. Pollution and weather data, as well as dollar value for ecological services provided, are pre-programmed into i-Tree Eco for geographical locations in the US, Canada, and most of Australia. The types of structural analysis provided includes: • Number of trees by land use (chart) • Number of trees per unit area by land use (chart) • Species composition by DBH class • Most important tree species • Species richness, Shannon/Wiener Diversity Index • Origin of trees by land use • Condition of trees by species • Condition of trees by land use • Condition of trees by DBH and land use • Leaf area of trees by land use (chart) • Leaf area of trees per unit area by land use (chart) • Leaf area and biomass of tree by DBH class and land use • Leaf area and biomass of shrubs by land use • Leaf area and biomass of trees and shrubs by land use • Ground cover composition by land use • Accuracy of land use predictions The types of ecosystem services values provided

			include: • Environmental services of trees by species • Environmental services of trees by land use • Environmental services of trees per unit area • Carbon storage of trees by land use (chart) • Carbon storage of trees per unit area by land use (chart) • Annual carbon sequestration of trees per unit area by land use (chart) • Energy effects of trees • Avoided runoff of trees by species • Avoided runoff of trees by land use • Oxygen production of trees by land use (chart) • Oxygen production of trees per unit area by land use (chart) • Monthly pollutant removal by trees and shrubs • Monthly pollutant removal by trees and shrubs (chart) • Hourly pollutant removal by trees and shrubs (chart) • Bioemissions of trees by species • Bioemissions of trees by land use i-Tree Streets i-Tree Streets analyzes structure, management needs, costs, and benefits of a municipality’s street trees based on a sample or complete inventory. It is a valuable tool to set priorities for maintaining street trees, planning tree replacements, and advocating for the value of street trees. Cost benefit analysis includes: • Energy benefits • Stormwater benefits • Air quality benefits

			• Carbon dioxide benefits • Carbon storage benefits • Aesthetic benefits • Management costs • Net annual Benefits Structural summary and analysis includes: • Population summary • Species distribution • Relative age distribution • Importance values • Condition • Relative performance index • Stocking level • Maintenance • Land use • Site type • Conflicts • Canopy cover i-Tree Design i-Tree Design is a very easy to use web tool that estimates benefits of individual or multiple, existing or proposed, trees at the site level on Google Maps imagery. It can be used, for example, to advocate for the value of existing or proposed trees, and as a design tool to compare benefits by potential new tree species, size and location alternatives. Benefits quantified by i-Tree design include tree benefits related to greenhouse gas mitigation, air quality improvements, and stormwater interception. Tree benefits can be estimated "for (a) the current year, (b) a user-specified forecast year sometime in the future, (c) the projected total benefits across that future timespan, and (d) the total benefits provided to date (based on estimated tree age)." (i-Tree website at **http://www.itreetools.org/design.php**,

			accessed 8/12/2014) Other i-Tree analysis tools include i-Tree Hydro, Vue, and Canopy. i-Tree Hydro (beta) i-Tree Hydro (beta) analyzes the effects of tree cover and impervious cover on stream flow and water quality. i-Tree Vue i-Tree Vue uses the National Land Cover Database (NLCD) imagery to assess land cover, tree canopy, and ecological services provided by the urban forest. It can also model the effects of changing the current urban forest on benefits provided by the urban forest. i-Tree Canopy i-Tree Canopy is a fast and easy way to determine land cover types and percent tree cover world-wide based on google maps imagery. It also estimates values for air pollution reduction and capturing atmospheric carbon. The land cover data from i-Tree Canopy can also be used to estimate land cover inputs for i-Tree Hydro. **i-Tree Utility Tools** i-Tree Species i-Tree Species is a tool used to select tree species based on desired environmental services, geographical location, and tree height constraints. i-Tree Storm According to the i-Tree website, "i-Tree Storm establishes a standard method to assess widespread damage immediately after a severe storm in a simple, credible, and efficient manner. This assessment method is adaptable to various community types and sizes, and it provides information on the time and funds needed to mitigate

			storm damage.
16.[LANDIS Landscape Disturbance and Succession model]	LANDIS is designed to model forest succession, disturbance (including fire, wind, harvesting, insects, global change), and seed dispersal across large (>1 million ha) landscapes. LANDIS represents landscapes as a grid of cells and tracks age cohorts of each species (presence/absence or biomass) rather than individual trees. LANDIS simulates distinct ecological processes, allowing complex interactions to play out as emergent properties of the simulation. LANDIS is designed with these considerations: It simulates forest landscape change over large spatial (103 - 107 ha) and temporal (101 -103 years) scale with flexible resolutions (10-500 m pixel size), balancing ecological complexity with current and foreseeable computational capability. It simulates the main natural and anthropogenic disturbances and their interactions with adequate mechanistic realism for these broad scales. It simulates species-level forest succession in combination with disturbances and management. It assumes that detailed, individual tree information and within-stand processes can be simplified, allowing large-scale questions about spatial pattern, species distribution, and disturbances to be adequately addressed.	http://www.nrs.fs.fed.us/tools/software/ http://www.landis-ii.org/	**LANDIS 4.0** is a fully modular software product with improved fire simulation and new capabilities for simulating fuel accumulation and decomposition and disturbance by biological agents such as insects and disease. Dr. He led the development of this version at the University of Missouri in collaboration with the Northern Research Station in Rhinelander, Wisconsin. **LANDIS-II** is a completely re-engineered version developed at the Forest Landscape Ecology Laboratory, University of Wisconsin-Madison, in collaboration with the Northern Research Station in Rhinelander, Wisconsin. LANDIS-II was designed to advance forest landscape simulation modeling in many respects. Most significantly, LANDIS-II • allows for the incorporation of ecosystem processes and states (e.g., live biomass accumulation) at broad spatial scales • has flexible time steps for every process, • and uses an advanced architecture that will significantly increase collaborative potential.

	It uses a component-based, object-oriented design that provides users with the flexibility of parameterizing and simulating only the processes of interest. It uses classified satellite imagery as input, and output is compatible with most GIS software. It requires moderate parameter input since for most landscapes in these scale ranges available input data may be coarse and parameters may be poorly estimated. LANDIS does not predict specific disturbance or management events. Rather, it is a scenario model that compares long-term effects of various disturbance and management scenarios on the simulated landscape		
17.LPJmL - Lund-Potsdam-Jena managed Land	The model LPJmL is designed to simulate vegetation composition and distribution as well as stocks and land-atmosphere exchange flows of carbon and water, for both natural and agricultural ecosystems. Using a combination of plant physiological relations, generalized empirically established functions and plant trait parameters, it simulates processes such as photosynthesis, plant growth, maintenance and regeneration losses, fire disturbance, soil moisture, runoff, evapotranspiration, irrigation and vegetation structure. LPJmL is currently the only DGVM that has dynamic land use fully incorporated at the global scale and also simulates the production of woody and herbaceous short-rotation bioenergy plantations. It differs from other models in the wider field by computing both carbon and water	https://www.pik-potsdam.de/research/projects/activities/biosphere-water-modelling/lpjml	

	flows explicitly: most other macro-hydrological models lack the important vegetation structural and physiological responses that influence the water cycle, while most other vegetation models lack the advanced consistent water balance of LPJmL, or are not global in scale. The monthly and daily input data are spatially explicit time series (typically ~60,000 global 0.5x0.5° grid cells) of climate, human land use, soil properties, and river flow directions. Grid cells may contain mosaics of one or several types of natural or agricultural vegetation. Outputs are generated as daily, monthly or annual spatially explicit time series for individual plants, carbon and water pools and fluxes, individual land-use types or the entire mosaic present in each grid cell.		
18.MC1 Dynamic Vegetation Model	MC1 is a model that simulates vegetation types, ecosystem fluxes of carbon, nitrogen, and water, as well as wildfire occurrence and impacts. MC1 is routinely implemented on spatial data grids of varying resolution (i.e., grid cell sizes ranging from 900 m2 to 2500 km2). The model reads climate data at a monthly time step and calls interacting modules that simulate: - Biogeography - Biogeochemistry - fire disturbance	http://consbio.org/products/tools/mc1-dynamic-vegetation-model	The **biogeography module** simulates the potential life-form mixture of evergreen needleleaf, evergreen broadleaf, and deciduous broadleaf trees, as well as C3 and C4 grasses. The tree lifeform mixture is determined at each annual time-step as a function of annual minimum temperature and growing season precipitation. The C3/C4 grass mixture is determined by reference to their relative potential productivity during the three warmest consecutive months. The tree and grass lifeform mixtures together with growing degree-day sums and biomass simulated by the biogeochemistry module are used to determine which possible potential vegetation types (~20) occurs at each grid cell each year. The **biogeochemistry module** is a modified version of the CENTURY model, which simulates plant productivity, organic matter decomposition, and water and nutrient cycling once the vegetation type has been determined by the biogeography module.

			Plant growth is determined by empirical functions of temperature, moisture, and nutrient availability which decrement set values of maximum potential productivity. Plant growth is generally assumed not to be limited by nutrient availability. The direct effect of an increase in atmospheric carbon dioxide (CO_2) is simulated using a beta factor that increases maximum potential productivity and reduces the moisture constraint on productivity. Grasses compete with woody plants for soil moisture and nutrients in the upper soil layers where both are rooted, while the deeper-rooted woody plants have sole access to resources in deeper layers. The growth of grasses may be limited by reduced light levels in the shade cast by woody plants. The values of model parameters that control woody plant and grass growth are adjusted with shifts in the lifeform mixture determined annually by the biogeography module. Plant parts simulated include leaves, fine branches, coarse branches and boles, fine and coarse roots. Litter pools include surface litter and standing dead, belowground litter and 3 soil carbon organic matter pools with increasing degrees of resistance to decomposition based on their chemical composition. The **fire module** simulates the occurrence, behavior, and effects of fire. It simulates the behavior of a fire event in terms of the potential rate of fire spread, fireline intensity, and the transition from surface to crown fire. Several measurements of the fuel bed are required for simulating fire behavior, and they are estimated by the fire module using information provided by the other two MC1 modules. The current lifeform mixture is used by the fire module to select factors that allocate live and dead biomass into different classes of live and dead fuels. The

			moisture content of the two live fuel classes (grasses and leaves/twigs of woody plants) are estimated from moisture at different depths in the soil provided by the biogeochemical module. Dead fuel moisture content is estimated from climatic inputs to MC1 using different functions for each of four dead fuel size-classes. Fire events are triggered in the model when the moisture content of coarse woody fuels, and the flammability of fine fuels all meet set thresholds. Sources of ignition (e.g., lightning or anthropogenic) are assumed to be always available. Area burned is not simulated explicitly as fire spread within a given cell. Instead, the fraction of a cell burned by a fire event is estimated as a function of set minimum and maximum fire return intervals for the dynamically-simulated vegetation type and the number of years since a simulated fire event. Simulated fire effects include consumption and mortality of dead and live vegetation carbon, which is removed from (or transferred to) the appropriate carbon pools in the biogeochemistry module. Live carbon mortality and consumption are simulated as a function of fireline intensity and the tree canopy structure, and dead biomass consumption is simulated using functions of fuel moisture that are fuel-class specific.
19.Metavist	Version 1.5 of Metavist 2005 computer program for creating metadata compliant with the Federal Geographic Data Committee (FGDC) 1998 metadata standard or the National Biological Information Infrastructure (NBII) 1999 Biological Data Profile for the FGDC standard. The software runs under the Microsoft Windows 2000 and XP operating systems, and requires the presence of	http://www.nrs.fs.fed.us/tools/software/	Data Format Conventions To facilitate data entry, Metavist's user interface attempts to present data elements in commonly used formats. However, the metadata documents it creates conform to required standard formats. As specified in FGDC (1998), these formatting conventions are used in the output files: Δ Calendar Dates (Years, Months, and Days)

	Microsoft's .Net Framework version 1.1. The metadata are output in XML format. Notes: Checksum for the zip file is 597a3ee9b3da253bdc7396e608f3fcf5 Review "MetavistReadMe.html" (installed in the Metavist program directory) for information on the bug fixes and added feature in this version. Software and User's Guide:**http://nrs.fs.fed.us/pubs/2737**		• Common Era (C.E.) to December 31, 9999 C.E.—Values are formatted as YYYY for years, YYYYMM for a month of a year, and YYYYMMDD for a day of a year. • Before Common Era (B.C.E.) to 9999 B.C.E.—Values are formatted as for Common Era dates but are preceded by "bc" (e.g., bcYYYY for years). • Before Common Era before 9999 B.C.E.—Values consist of as many numeric characters as needed to represent the number of the year B.C.E., preceded by lower case letters "cc" (e.g., ccYYYYYY). Months and days are not relevant for this timeframe. • Common Era after 9999 A.D.—Values consist of as many numeric characters as needed to represent number of the year C.E., preceded by the lower case letters "cd" (e.g., cdYYYYYY). Months and days are not relevant for this timeframe. Δ Time of Day (Hours, Minutes, and Seconds) • Because some geospatial data and related applications are sensitive to time of day information, three conventions are sanctioned. When authoring a metadata document you may choose which convention will be used, but you must use that convention throughout the document. The conventions are: — Local Time. Values follow the 24-hour timekeeping system for local time of day in the hours, inutes, seconds, and decimal fractions of a second (to the precision desired) without separators convention (general form of HHMMSSSS). — Local Time with Time Differential Factor. Values follow the 24-hour timekeeping system for local time of day in hours, minutes, seconds, and decimal fractions of a second (to the precision desired) without separators convention. This value is followed, without separators, by the time differential

			factor. The time differential factor expresses the difference in hours and minutes between local time and Universal Time (Greenwich Mean Time). It is represented by a four-digit number preceded by a plus sign (+) or minus sign (-), indicating that hours and minutes local time is ahead of or behind Universal Time, respectively. The general form is HHMMSSSSshhmm, where HHMMSSSS is the local time using 24-hour timekeeping, 's' is the plus or minus sign for the time differential factor, and hhmm is the time differential factor. (This option allows authors to record local time and time zone information. For example, Eastern Standard Time has a time differential factor of -0500, Central Standard Time has a time differential factor of -0600, Eastern Daylight Time has a time differential factor of -0400, and Central Daylight Time has a time differential factor of -0500.) — Universal Time (Greenwich Mean Time). Values follow the 24-hour5 timekeeping system for Universal Time of day in hours, minutes, seconds, and decimal fractions of a second (expressed to the precision desired) without separators convention, with the upper case letter "Z" directly following the low-order (or extreme right hand) time element of the 24-hour clock time expression. The general form is HHMMSSSSZ, where HHMMSSSS is Universal Time using 24-hour timekeeping, and Z is the letter "Z". Δ Latitude and Longitude • Values for latitude and longitude are expressed as decimal fractions of degrees. Whole degrees of latitude are represented by a two-digit decimal number ranging from 0 through 90. Whole degrees of longitude are represented by a three-digit decimal

			number ranging from 0 through 180. When a decimal fraction of a degree is specified, it is separated from the whole number of degrees by a decimal point. Decimal fractions of a degree may be expressed to the precision desired. — Latitudes north of the Equator are specified by a plus sign (+), or by the absence of a minus sign (-), preceding the two digits designating degrees. Latitudes south of the Equator are designated by a minus sign (-) preceding the two digits designating degrees. A point on the Equator is assigned to the Northern Hemisphere. — Longitudes east of the prime meridian are specified by a plus sign (+), or by the absence of a minus sign (-), preceding the three digits designating degrees of longitude. Longitudes west of the meridian are designated by minus sign (-) preceding the three digits designating degrees. A point on the prime meridian is assigned to the Eastern Hemisphere. A point on the 180th meridian is assigned to the Western Hemisphere. One exception to this last convention is permitted. For the special condition of describing a band of latitude around the Earth, the East Bounding Coordinate data element shall be assigned the value +180 (180) degrees. — Any spatial address with latitude of +90 (90) or -90 degrees will specify the position at the North or South Pole, respectively. The component for longitude may have any legal value. ∆ Network Addresses and File Names • Values for file names, network addresses for computer systems, and related services use the Internet's Uniform Resource Locator (URL) convention when possible. The link referenced in the

			http://www.ling.upenn.edu/advice/urlprimer.html
20.NED	**NED** is a collection of software products being developed by the USDA Forest Service. The NED software is intended to aid resource managers to develop goals, assess current and future conditions, and produce sustainable management plans for forest properties. **NED-3** NED 3 has many similarities with NED-2 but also has many improvements. It runs simulations much faster and works with all of the latest variants of FVS, which can be updated by the user as new ones are released. The report generation interface has been revised substantially to make it easier to use and to keep using a standard set of reports. NED-3 now incorporates SILVAH, a sister program created by the Northern Research Station that can provide expert-based prescriptions for timber management of a stand. There are now four different wildlife habitat evaluation models built into NED-3 for a wider area of applicability, according to the user's request. NED-3 also links with ForGATE, an external program that provides a life-cycle analysis of carbon from the forest and forest products. There are additional features of NED-3 still being developed. **NED-2** The final version of NED-2 (version 2.60.02) was released on June 27, 2012. Designed for stand-alone Windows-based personal computers, NED-2 integrates a variety of forest management tools into a single environment. These tools include databases, growth and yield models, wildlife	http://www.nrs.fs.fed.us/tools/software/	**Minimum dbh for height** estimates - If you do not record merchantable height, NED can estimate merchantable height for sawtimber and pulpwood in hardwoods and softwoods. If the dbh is less than the minimum dbh you specify, sawtimber and/or pulpwood height is set to zero. **Minimum top diameter for board-foot** volume estimates-You can specify a minimum top diameter for calculating board-foot volume. NED will calculate volume for logs only if the diameter of the top portion of the log is greater than or equal to the threshold. **Minimum lengths** - When NED is estimating sawlog and/or pulpwood height, it will return zero for any value that is less than the minimum log lengths you specify. **Include dead trees in timber values (stems-per, ba, vols)** - You can choose whether you want NED to include dead trees in its calculations. If this box is checked, all computations for timber values will include dead trees. When configuring vegetation tables and reports, you will again be given the option to include dead trees in those calculations as well as the ability to calculate values for dead trees only. **Boardfoot volume equation** - There are several options for boardfoot volume equation Scrivani—Wiant: uses Scrivani for logs greater than or equal to 16-feet, and Wiant for logs less than 16-feet. Scrivani only: taken from Scrivani, John A. 1989. An Algorithm for Generating "Exact" Girard Form Class Volume Table Values. Northern Journal of Applied Forestry (6) p140-142. Wiant only: taken from Wiant, H.V. Jr., and F. Castenada. 1977.

	models, geographic information systems (GIS), visualization tools, and others. The software is distributed with an online help system and a printed user's manual. This user's manual provides guidance for use of the software and a basic introduction to the principles and calculations used in NED-2. A reference guide with more detailed explanations of the models, equations, and rules that underlie the software is available separately. MIWILD As of October 5, 2007, a new product, MIWILD, is available for download. MIWILD is software that uses a database of expert knowledge to analyze extent of wildlife habitat. Originally designed for use in planning activities on state land in Michigan, MIWILD was developed as a set of information and assessment tools for individuals interested in the wildlife of Michigan and their associated habitats.		Mesavage and Girard's Volume Tables Formulated. Resource Inventory Notes, USDI, BLM 4: 1-4, Denver, CO. Wiant, 1986 NJAF 3(1986) Forest Service Eastern Region: from FSH 2409.12A - Timber Volume Estimator Handbook; Chapter 50 - Application page 12. Wengert: see http://www.woodweb.com/knowledge_base/Measuring_Logs_and_Lumber.html User table: this gives the user a chance to enter their own volumes. When this option is chosen the "Table" button is enabled which allows the user to build the board-foot table. Instructions for filling out that table are covered in another document. **Boardfoot volume rule** - You can specify which rule you want NED to use in estimating board-foot volume. NED provides the three most commonly used equations, or log rules: International 1/4 Inch, Doyle, and Scribner. **Regeneration rule** Silvah McWilliams Green Mountain National Forest **Q-factor size class interval** - In calculating the q-factor for a stand, NED can use 1- or 2-inch diameter size-class intervals. Which one you choose depends on how you tallied your data. **Overstory/Understory dbh-threshold**- NED-2 uses diameter at breast height (dbh) to distinguish between overstory and understory stems, with a default threshold value of one inch. This means that any woody stem with a dbh greater than or equal to one inch would be inventoried as overstory, and would be included in any subsequent analysis of the

			overstory. This setting may affect the default dbh when you enter a new overstory observation. If this threshold is greater than your default dbh value, NED will apply the overstory/understory dbh threshold as the initial dbh value for the new observation. This threshold does not affect calculations on stand metrics such as basal area, relative density, biomass, etc. However, during treatment plan simulation, stems less than the current dbh threshold would be considered understory. Once these stems grow to a dbh that is greater than or equal to the current threshold, they would be considered overstory. **Big tree dbh threshold -** The big tree threshold is a specific diameter at breast height (DBH) that indicates whether a tree is considered large or "big". NED uses the big tree threshold to report on big trees in your forests.
21.OUTCOMES	**OUTCOMES** (OUTdoor COMfort Expert System), is a Windows® program that shows the shade pattern of a tree and calculates a human comfort index for any time and geographic location considering the full range of weather variables, the density of a tree crown that shades a person, and other features of the surrounding neighborhood. The program was written to provide an easy-to-use interface and ample on-screen help. Another program, OUTCOMES Batch, calculates the comfort index for any length of weather records.	http://www.nrs.fs.fed.us/tools/software/	1. The program considers only one person and the direct beam solar radiation reduction by one tree. 2. The person is modeled as a vertical cylinder within a sphere of influence that includes blocking of sun by a tree or solid object, diffuse and thermal radiation from the sky which is proportional to a numerical sky view that is input by the user, reflected radiation from the ground that varies with the reflection index (albedo) of the ground, and thermal radiation from objects that are assumed in this version to be at air temperature. 3. If solar radiation is not provided as input, the program calculates solar radiation with the assumption that the sky is clear of clouds. 4. Calculated solar radiation can be adjusted for pollution effects by choosing "air pollution" from a menu that includes the categories "very clean,"

			"fairly polluted," or "very polluted." 5. OUTCOMES has limited ability to extrapolate weather data from an airport site to neighborhoods in the vicinity. Modifications to airport temperature and humidity may be predicted for sites in a small woodland ("garden" in the "Site" menu), a dense residential area with large trees ("Residential") and a "Downtown" site. The equations for this extrapolation were derived for summer conditions in Atlanta, GA and may not apply to other cities, climates, or times of the year. (See also item 2 in "How to use below.) Modifications to wind speed are given based on the "Cover density," the estimated percentage of the area in the upwind direction out to about 300 m (1000 ft) that is covered by trees and buildings. Wind reductions by very close buildings, walls, or trees would likely be greater than the reductions calculated from Cover density.
22. Quick-Silver (only available within the Forest Service)	Fast and flexible program for economic analysis of long-term, on-the-ground resource management projects for forest managers. (Windows version) Non- FS users may contact Doug Smith or Susan Winter to request a copy of the current version.	http://www.nrs.fs.fed.us/tools/software/	
RPA Data Wiz	The RPA Data Wiz software allows users to create summary tables, graphs, and maps of RPA data with only basic computer skills and resources. With the Data Wiz volumes for growing stock, live cull, dead salvable, net growth, mortality, acreage, biomass and tree count can be estimated for a given area.	http://www.nrs.fs.fed.us/tools/software/	FIA tools are specialized computer programs created specifically to analyze FIA data. Tools allow the user to create custom maps and tables and to determine facts such as these: 1. How much forest land is there in the United States? 2. What is the distribution of American beech

			in New England? 3. What is the area of timberland, by county, in Minnesota? 4. What is the volume of red oak saw timber in New Hampshire? The FIA database contains extensive data on forest area attributes, such as forest type, stand size, stand age, and forest disturbance. Data are also collected on individual trees, which are tracked over time. Some tree attributes include species identification, diameter at breast height, tree length, and tree damage. More in-depth measurements related to forest health are collected on a sub sample of the plots. These include Tree Crown Condition, Lichen Communities, Ozone Injury, Down Woody Materials, Soil Condition, and Vegetation Diversity and Structure.
23.RPGrow$	A red pine growth and analysis spreadsheet for the Lake States.	http://www.nrs.fs.fed.us/tools/software/	SPREADSHEET DESIGN A1.........G1 Growth and yield assumptions Thinning strategy I1.........P1 Financial and annual incremental cost calculations Q1.........AB1 Initial growth assumptions A21.........H21 Alternative assumptions I11.........P21 One-time incremental cost assumptions R79.........AB79 2nd growth calculations A41.........H41 Growth and yield summary I41.........P41 One-time incremental cost assumptions R156.........AB156 3nd growth calculations A141.........H141 Yearly growth summary

			I61.........P61 Revenue R233.........AB233 4th growth calculations I82.........O82 Financial summary I101.........K101 Timber account
24.SEIB-DGVM	The SEIB-DGVM is a dynamic vegetation model, which aims to simulate transient impacts of climatic change on terrestrial ecosystem, and land-atmosphere interactions.	http://seib-dgvm.com/	It contains mechanical-based or empirical-based algorithms for : 1. Land physical processes (hydrogy, radiation, air, etc.) 2. Plant physiological processes (photosynthesis, respiration, growth, etc.) 3. Plant dynamic processes (establishment, mortality, disturbance)
25.Species parameterisation of the Sheffield Dynamic Global Vegetation Model (SDGVM)	The parameterisation of vegetation models requires assessment of a large amount of data and necessarily involves the reduction of complex ecological and physiological parameters to averages. In an ideal world, variation in each parameter would be assessed in the natural environment to give an estimate of variability for each average value.	http://www.biogeo.org/ASJ/SDGVM.html	In an attempt to increase the accuracy of vegetation model simulations for particular regions (for example, the United Kingdom, Europe or Siberia), it is necessary to find representative values to describe the vegetation parameters used in the models. The parameterisation of vegetation models requires assessment of a large amount of data and necessarily involves the reduction of complex ecological and physiological parameters to averages. In an ideal world, variation in each parameter would be assessed in the natural environment to give an estimate of variability for each average value. It is necessary to attempt to determine average values from a variety of sources, both published (eg. research papers, textbooks, forestry and crop manuals, web-based databases) and unpublished (eg. unpublished datasets and the vast reserve of knowledge held by individual foresters/ecologists/physiologists).
26.SILVAH	SILVAH is a computer tool for making silvicultural decisions in hardwood stands of the Allegheny Plateau and Allegheny Mountain region. It is an "expert system" in that it recommends appropriate	http://www.nrs.fs.fed.us/tools/software/	Tree Data Species Codes; Diameter; Quality; Merchantable Height or A Tree Count; Grade, Defect, Crown, and Wildlife Codes;

	treatments based upon user objectives and overstory, understory, and site data provided by the user. SILVAH also contains a forest stand growth simulator, provides the ability to test alternative cuts, enables development of a forest-wide inventory database, and facilitates other forest management planning functions.		
27.SOLVE	A computer program that helps sawmill managers improve efficiency and solve problems commonly found in hardwood sawmills. SOLVE provides information on key operational factors including log size distribution, lumber grade yields, lumber recovery factor and overrun, and break-even log costs. (Microsoft Windows? Edition)	http://www.nrs.fs.fed.us/tools/software/	
28.Spec2Harv	Spectrum to Harvest - Spec2Harv was developed to automate the conversion of harvest schedules generated by the Spectrum model into script files that can be used by the HARVEST simulation model to simulate the implementation of the Spectrum schedules in a spatially explicit way.	http://www.nrs.fs.fed.us/tools/software/	Spectrum produces output files that include the acres to be treated with various timber harvest methods by Analysis Unit over the time period of the planning horizon. If the Analysis Units are designed to coincide with Management Areas (MA) and forest types (FT), the output can be converted into the parameters that HARVEST requires for spatial simulation. This conversion is not trivial because Spectrum produces treatment prescriptions for each Analysis Unit over all time periods in a single record, while HARVEST sequentially implements all treatments for all Analysis Units (MA and FT combinations) within each time period. Spec2Harv was designed to automate the conversion process. Algorithms were developed to interpret the Spectrum output and to automatically create a HARVEST script file. Script files eliminate the need to manually specify the harvest parameters for each Analysis Unit, saving time and reducing the risk of typographical errors.

29.Stand-Damage Model	The Stand-Damage Model simulates the growth of individual trees within forest stands. The user can change much about the forest and its environment: the location of the forest, its weather and soil, and the trees at the beginning of the simulation. One can try different logging practices and introduce global warming temperature changes. You can grow your own forest stand and graph the results.	http://www.nrs.fs.fed.us/tools/software/	Trees, Defoliation, Management, Weather
30.TPO Reporting Tool	Two similar RPA / TPO applications are offered here. The National RPA application generates tables based on RPA report years: 1996 (aka 1997), 2001 (aka 2002), 2006 (aka 2007) only. There are 12 tables that may be generated for the United States, Regions (Northeast, North Central, Southern, Rocky Mountains or Pacfic Coast) for State(s) and/or Counties.	http://www.nrs.fs.fed.us/tools/software/	The SRS TPO application generates tables based on report years (1996, 1997,2001,2002,2003,2005,2007) or data years (1995,1996,1997,1999,2001,2002,2003,2005,2007). The output tables have been recently re-written, changing the format so that the html output can be read as an xls file. 1) Right click on link 2) Save target as change the file name extension to .xls leave the file type as HTML document.
31.TRIFFID	TRIFFID (Top-down Representation of Interactive Foliage and Flora Including Dynamics)" is a dynamic global vegetation model, which updates the plant distribution and soil carbon based on climate-sensitive CO2 fuxes at the land-atmosphere interface.	http://climate.uvic.ca/model/common/HCTN_24.pdf	The surface CO2 fuxes associated with photosynthesis and plant respiration are calculated in the MOSES 2 tiled land-surface scheme (Essery et al (In preparation)), on each atmospheric model timestep (normally 30 minutes), for each of 5 plant functional types. The area covered by a plant type is updated (normally every 10 days) based on the net carbon available to it and on the competition with other plant types, which is modelled using a Lotka-Volterra approach. Soil carbon is increased by litterfall, which can arise from local processes such as leaf-drop as well as large-scale disturbances which reduce the vegetated area. Soil carbon is returned to the atmosphere by microbial respiration which occurs at a rate dependent on soil moisture and temperature. TRIFFID has been designed to

			allow economical diagnosis of initial states using a Newton-Raphson descent towards the equilibrium state consistent with a given climate.
32.TWIGS-Central States and Lake States	TWIGS is a DOS program used to simulate growth and yield for forests in the North Central region. It also includes management and economic analysis components. Two variants are available: Central States (Indiana, Illinois, and Missouri) and Lake States (Michigan, Minnesota, and Wisconsin). SeeGen. Tech. Rep. NC-125 (Miner et al. 1988. A guide to the TWIGS program for the North Central United States. Gen. Tech. Rep. NC-125, St. Paul, MN: USDA Forest Service, North Central Forest Experiment Station, 105p.) for details on running the program.	http://www.nrs.fs.fed.us/tools/software/	
33.U.S. Forest Carbon Calculation Tool (CCT)	The Carbon Calculation Tool 2007, *CCT.exe*, is a computer application that reads publicly available forest inventory data collected by the USDA Forest Service's Forest Inventory and Analysis Program (FIA) and generates state-level annualized estimates of carbon stocks on forestland based on FORCARB2 estimators. Estimates can be recalculated as new inventory data become available. The input set of FIA data files available on the Internet (as well as some older inventory files used to fill in gaps) are summarized by the application, converted to carbon stocks, and saved as part of a state or substate level "survey summary" file. This is used to produce state-level and national tables with annualized carbon stocks and flux (or net stock change) beginning with the year 1990.	http://www.nrs.fs.fed.us/tools/software/ Software, User's Guide, and Example Data Sets:**http://nrs.fs.fed.us/pubs/2394**	Th e input set of FIA data files available on the Internet (as well as some older inventory fi les used to fi ll in gaps) are summarized by the application, converted to carbon stocks, and saved as part of a state or substate level "survey summary" file. This is used to produce state-level and national tables with annualized carbon stocks and flux (or net stock change) beginning with the year 1990.
34.The Urban Forest Effects	The UFORE computer model was developed to help managers and researchers quantify urban forest structure and its functions. UFORE is designed to	http://www.nrs.fs.fed.us/tools/software/	The model also calculated various forest functions and values related to tree effects on:

(UFORE) Model	use standardized field data from randomly located plots, and local hourly air pollution and meteorological data to quantify urban forest structure and numerous urban forest effects for cities across the world. The model calculates numerous attributes about the urban forest, including: • Species composition • Diameter distribution • Tree health Species diversity • Exotic vs. native species distribution		Air pollution Greenhouse gases and global warming Building energy use This model is currently available through i-Tree. The program, which was originally written in SAS, is currently being converted, in cooperation with the Davey Resource Group, to a Windows® based code. New analytic modules are and will be developed in the future, including GIS-based mapping and analysis capabilities. **Field Data Collection Manuals (UFORE manual available at i-Tree)** Presents information of how to establish plots and measure variables that can be used to quantify urban forest structure, functions, and values. Manual for urban FIA (2mb- pdf) plots is complete. **Tree/shrub species codes -** (used for both manuals) are available in two formats. Tree/shrub species code list as pdf Tree/shrub species codes list as .XLS **Funding Sources:**USDA Forest Service's State and Private Forestry, Cooperative Forestry's Urban and Community Forestry Program; Forest Health Monitoring; and Northern Research Station; the National Urban and Community Forestry Advisory Council; and the Texas Forest Service
35.EnVision -- Environmental Visualization System	EnVision is designed to be a full featured rendering system for stand- and landscape-scale images. Applicable projects range from a few to several thousand acres. The system is built upon many of the original concepts used to develop the Vantage Point visualization system. However, EnVision does not attempt to model changes to the landscape	http://vterrain.org/Plants/Forestry/	Basic components of an EnVision project include a digital terrain model to define the ground surface, color and texture maps to define ground surface characteristics, and groups of objects or "actors". Scene definitions include background imagery used to add clouds and distant landscape features, model components (e.g. terrain model(s) and polygon

	over time.		overlays), viewpoint and camera characteristics, and foreground imagery used to provide high detail in the image foreground. EnVision models individual light sources including a simulated sun position and atmospheric effects such as fog and haze. EnVision renders images using a geometrically correct camera model making it possible to match real photographs taken from known viewpoints to simulated scenes.
36.SVS - Stand Visualization System	The Stand Visualization System or SVS generates graphic images depicting stand conditions represented by a list of individual stand components, e.g., trees, shrubs, and down material (example SVS image 67k). The images produced by SVS, while abstract, provide a readily understood representation of stand conditions. Images produced using SVS help communicate silvicultural treatments and forest management alternatives to a variety of audiences. SVS provides the following capabilities: • Display stand information represented by a list of individual plant and log components in a realistic, although abstract, fashion • Display stand information in a manner that communicates the overall structural diversity present within the stand • Differentiate between stand components using different plant forms, colors, or other types of marking • Provide overhead, profile and perspective views of a stand • Allow the user to vary the parameters controlling all views • Allow users to define plant forms and	http://vterrain.org/Plants/Forestry/	

	colors based on species, plant type, and plant position within the canopy • Provide tabular and graphical summaries of stand information before and after a silvicultural treatment • Display information describing individual stand components as they are selected by the user • Allow the user to design of silvicultural treatments by "marking" stand components and specifying a treatment		
37.TreeView	As trees are three-dimensional objects the program TreeView was created for three-dimensional representation. From the available data three-dimensional bodies are created for every single tree. These are moved to a ground according to the tree coordinates and displayed on the screen using the central projection. By the usage of different optimizations it is possible for the user to move in real-time through such a virtual forest and thereby viewing it from an arbitrary position. Because of the interaction possibilities in the virtual stand this kind of representation is versatile: From simply representing a stand to the training of wood reaping measures.	http://vterrain.org/Plants/Forestry/	
38.L-Vis	As an addition to this stand visualization another program named L-Vis was developed with which one can even represent whole forest landscapes. Data from forest enterprises as they arise in inventories such as the forest distribution or structure can be changed into representations of the forest areas again with help of Silva and L-Vis. Thus it is possible to judge changes in the	http://vterrain.org/Plants/Forestry/	

	appearance of these forest landscapes in advance without actual taking actions and also to show developments of forests.		
39.The Virtual Forest	Advanced 3-D Visualization Techniques for Forest Management and Research	http://proceedings.esri.com/library/userconf/proc98/PROCEED/TO350/PAP337/P337.HTM	
40.VECODE (Vegetation Continuous Description model)	Simulation of vegetation dynamics and carbon cycle within climate system model CLIMBER-2 Fractional description of vegetation cover, regressional model for NPP and parameters of the carbon cycle, explicit equations for vegetation dynamics. The model is designed for simulations on a global spatial scale and on a time scale from decades to millennia. However, for model intercomparison purposes, it can be used on a fine (local) spatial resolution. Seasonal dynamics of carbon fluxes/pools are not accounted for in the present version of the model.	http://gaim.sr.unh.edu/Structure/Intercomparison/EMDI/models/vecode.html	PROCESSES AND PROCESS COMPONENTS SIMULATED (E.G. CARBON: GPP, NPP, NEP): **Carbon:** NPP, allocation of NPP between leaves and structural biomass, SOC dynamics, NEP **Water:** Soil water budget, energy balance are not accounted for in VECODE; their dynamics are calculated in climate module of CLIMBER-2 a) Soils (simple bucket, saturated/unsaturated flow, controls on water movement through the profile, etc.): b) Energy balance: (e.g. latent, sensible heat, aet, pet): c) Snow: e) 'Order' of water balance: (e.g. incoming water is first evaporated from plant/soil surface, then infiltration, transpiration, runoff) **Nitrogen:** No
41.Stand visualization system (SVS)	The Stand Visualization System or SVS generates graphic images depicting stand conditions represented by a list of individual stand components, e.g., trees, shrubs, and down material. The images produced by SVS, while abstract, provide a readily understood representation of stand conditions. Images produced using SVS help communicate silvicultural treatments and forest management alternatives to a variety of audiences.	http://forsys.cfr.washington.edu/svs.html	SVS requires two primary types of data: a list of stand components and plant form definitions. The stand component list describes the species, size and location of each component in a stand. Plant form definitions describe the appearance of each species and, optionally, the appearance of individuals exhibiting different growth forms within a species. The following parameters describe each stand component:

<table>
<tr>
<td></td>
<td>SVS provides the following specific capabilities:
Display stand information represented by a list of individual plant and log components in a realistic, although abstract, fashion
Display stand information in a manner that communicates the overall structural diversity present within the stand
Differentiate between stand components using different plant forms, colors, or other types of marking
Provide overhead, profile and perspective views of a stand
Allow the user to vary the parameters controlling all views
Allow users to define plant forms and colors based on species, plant type, and plant position within the canopy
Provide tabular and graphical summaries of stand information before and after a silvicultural treatment
Display information describing individual stand components as they are selected by the user
Allow the user to design of silvicultural treatments by "marking" stand components and specifying a treatment</td>
<td></td>
<td><table>
<tr><td>Species code</td><td>End diameter</td><td>Crown radius 4</td></tr>
<tr><td>Plant class</td><td>Crown radius 1</td><td>Crown ratio 4</td></tr>
<tr><td>Crown class</td><td>Crown ratio 1</td><td>Expansion factor</td></tr>
<tr><td>Plant status</td><td>Crown radius 2</td><td>Marking status</td></tr>
<tr><td>Diameter</td><td>Crown ratio 2</td><td>X</td></tr>
<tr><td>Height</td><td>Crown radius 3</td><td>Y</td></tr>
<tr><td>Felling angle</td><td>Crown ratio 3</td><td>Elevation</td></tr>
</table></td>
</tr>
<tr>
<td>42.UTOOLS and UVIEW</td>
<td>UTOOLS is geographic analysis software developed for watershed-level planning. The system provides a flexible framework for spatial analyses and can be used to address a variety of problems. The difference between UTOOLS and other spatial analysis software packages is that in UTOOLS all spatial data for a given project is integrated into a single Paradox databases, where basic data operations can be quickly and easily performed. For instance, complex overlay</td>
<td>http://forsys.cfr.washington.edu/utools.html</td>
<td>The Paradox "spatial databases" are built with several UTOOLS programs as follows:
Project data are assembled and downloaded to a PC. This involves the following operations:
Exporting map layers from the local GIS
Exporting attribute data from Oracle or elsewhere
Obtaining raw USGS digital</td>
</tr>
</table>

	operations that involve combinations of map layers and attributes can be done (and re-done) with simple Paradox queries. Generating new layers from combinations of existing ones is also easy.		elevation data (available on all forests). • The GIS map layers are gridded and converted to a Paradox "spatial database" with the program UCELL5. Spatial databases contain a record for each pixel or grid cell on the ground, and a field for each map layer. The pixel cell size can be varied according to the needs of the user. • Attribute data that describe GIS polygons (e.g. canopy closure, species, stand structure etc) are imported to Paradox and added to the spatial database using a Paradox relational query. • Elevation data are added to the spatial database by processing the USGS digital elevation data with the programs IMPRTDEM and ADDELEV. • A "terrain model", which is required by UVIEW for 3D viewing is also built by running the program EXTELEV. • "Derived" map layers are added to the spatial database, like slope, aspect, stream buffers using UCELL5. • Landsat data are added with the ADDERDAS utility
43.SmartForest		http://www.imlab.uiuc.edu/SF/SF_II.html	
44.BALANCE	The model BALANCE simulates growth of single trees under variable environmental conditions (CO_2, climate, soil, competition), including stress (O_3) and parasite influence. It is meant to assess the strategies for resource acquisition of different tree	http://www.wwk.forst.tu-muenchen.de/research/methods/modelling/balance	

	species, which is assumed to be a critical point in forecasts of stand development under changed conditions (e.g. temperature increase, changed thinning regime) at least if long time frames are to be judged.		
45.BWINpro	BWINPro is a random growth model, which is based on the long-term time series of forest growth and yield test plot data NW-FVA. In Lower Saxony BWINPro has for some years part of the forest management planning process.	http://www.nw-fva.de/index.php?id=194&no_cache=1&sword_list[]=bwinpro#c682	
46.CABALA CArbon BALAnce	CABALA (CArbon BALAnce) is a model designed to support management of plantations and forests. Using inputs like rainfall, temperature, salinity, water table depth and data on the species of tree, CABALA can estimate variables like biomass production, carbon sequestration, nitrogen content and canopy height of trees in plantations and forests. CABALA can be used to model relatively homogeneous forests and plantations with a wide range of planting designs, including row, widely spaced and block plantings.	http://www.csiro.au/services/CABALA	Applications: estimating plantation performance siting plantations managing forests estimating carbon credits managing drought risks
47.CO2FIX	CO2FIX is a modelling frame in which a user builds his own (forest) data in order to simulate the long term carbon balance of a forest ecosystem. It provides annual output in terms of carbon stocks and fluxes.	http://www.efi.int/projects/casfor/	
48.CONIFERS	Conifers is an individual-plant growth and yield simulator with two variants. The SWO variant is for young mixed-conifer stands in southern Oregon and northern California and the SMC variant variant is for northwestern Oregon and western Washington. Conifers provides forecasts for young plantations of single species or mixed-species growing with or without competition from shrubs (data requirements/overview).	http://www.fs.fed.us/psw/topics/forest_mgmt/conifers/	

49.DFSIM Douglas-fir Simulator	DFSIM (Douglas-fir Simulator) is a managed stand growth and yield simulator for coastal Douglas-fir (Pseudotsuga menziesii (Mirb.) Franco var. menziesii). It was developed in the 1980s from remeasured plot data contributed by many organizations in the Pacific Northwest. It is designed to project the development of stand with at least 80 percent basal area in Douglas-fir and produces yield tables for managed stands with include the effects of initial spacing, precommercial thinning, commercial thinning and fertilization. The DFSIM model also contains an economics option that allows users to estimate present net worth of the simulated regime.	http://www.fs.fed.us/pnw/software/DFSIM14/DFSIM.htm	
50.FIRE-BGC FIRE BioGeoChemical process model	FIRE-BGC is a mechanistic vegetation dynamics model developed to investigate the role of fire and climate on long-term landscape dynamics in northern Rocky Mountain coniferous forests.	http://eco.wiz.uni-kassel.de/model_db/mdb/fire_bgc.html	FIRE-BGC is a highly complex, individual tree model created by merging the gap-phase, process-based model FIRESUM with the mechanistic ecosystem biogeochemical model FIRE-BGC. It has mixed spatial and temporal resolution in the simulation architecture. Ecological processes that act at a landscape level, such as fire and seed dispersal, are simulated annually from stand and topographic information contained in spatial data layers. Stand-level processes such as tree establishment, growth, and mortality; organic matter accumulation and decomposition; and undergrowth plant dynamics are simulated both daily and annually on a simulation plot that represents the stand. Daily climate is strongly linked to FIRE-BGC algorithms. FIRE-BGC also explicitly simulates fire behaviour and effects on landscape characteristics and processes.
51.FORECAST	FORECAST is an ecosystem-based, stand-level, forest growth simulator. The model was designed to accommodate a wide variety of harvesting and silvicultural systems in order to compare and	http://www.forestry.ubc.ca/ecomodels/moddev/forecast/forecast.htm	As a management model, FORECAST can simulate a wide variety of activities such as fertilizer application, brushing, partial harvesting, and mixedwood management. Disturbances such as fire

	contrast their effect upon forest productivity, stand dynamics, and various biophysical indicators of non-timber values. The model uses a hybrid approach whereby local growth and yield data are combined with other data to derive estimates of the rates of key ecosystem processes related to the productivity and resource requirements of selected species. FORECAST uses relatively simple measures of decomposition, nutrient cycling, light competition, and other ecosystem properties to simulate forest growth and ecosystem dynamics under changing management conditions. Growth occurs in annual time steps. Depending upon the species, plant populations within the model can be initiated from seed and/or vegetatively, and stand development can occur with or without competition from non-target tree species and understory populations.		and insect defoliation can also be represented. Timber volume projections generated by FORECAST are ultimately constrained by the potential yields of single species stands as specified in the calibration data for a range of site qualities. Growth and yield in complex stands is based on a simulated partitioning of limited resources (light and nutrients) among species and age cohorts. The biological properties of individual species, as defined by the input data, determine their relative competitiveness for limited resources. To date, the FORECAST model has been calibrated and used in variety of forest ecosystems, both in Canada and elsewhere. In B.C. it has been used in conjunction with various landscape level models for projecting the spatial and temporal dynamics of a wide range of stand attributes in forests subjected to alternative management strategies. The output of such analyses is being used to support the development of sustainable forest management plans.
52.Forest-BGC Model (OTTER)	Six parameters were investigated and predicted in Running's BGC-forest model: the decomposition ratio of detritic material; the amount of water that was evaporated, respired, and transpired; the net photosythesis that occurred, and the soil moisture content.	http://daac.ornl.gov/OTTER/guides/Runnings_Forest_BGC_Model.html	The Oregon Transect Ecosystem Research (OTTER) Project was a cooperative effort between NASA and several universities to discern the ecology of western coniferous forests using remote sensing technology supported by gound observations. OTTER is an interdisciplinary project that tested a model that estimated the major fluxes of carbon, nitrogen, and water through a temperate coniferous forest ecosystem. Six Oregon sites across an elevational and climatic gradient were intensively studied. The transect began at the Pacific coast at the site called Cascade Head, passed through the outskirts of Corvallis,

			through a dense Douglas fir forest at Scio, through a mountain hemlock/subalpine fir community at Santiam Pass, through a Ponderosa pine community near Metolius, and ended at a site east of Sisters called Juniper. In all, the transect stretched some 300 kilometers west to east. Goals of the project were to simulate and predict ecosystem processes such as photosynthesis, transpiration, above-ground production, nitrogen transformation, respiration, decomposition, and hydrologic processes; combine field, lab, and remote sensing techniques to estimate key vegetaion and environmental parameters; construct a "geo-referenced" database for extrapolation and testing of principles, techniques, and prediction; and verify the predictions through direct measurements of process rates or controls on processes. Six parameters were investigated and predicted in the BGC-forest model: the decomposition ratio of detritic material; the amount of water that was evaporated, respired, and transpired; the net photosythesis that occurred; and the soil moisture content.
53.FORET Forests of Eastern Tennessee	The forest stand growth simulator FORET was developed by adapting the northeastern forest growth model JABOWA for modeling the diverse forests of the southern United States.	http://eco.wiz.uni-kassel.de/model_db/mdb/foret.html	
ForGro 54.Forest Growth Model	ForGro is a process-oriented, deterministic model. The model is a physiologically based carbon-balance model of forest growth. It describes the flow of water, carbon and nutrients in the forest ecosystem. The model can be described as an integrated and closed-system Forest-Soil-Atmosphere model. Processes that are included	http://eco.wiz.uni-kassel.de/model_db/mdb/forgro.html	ForGro includes hydrological submodels for calculating snow-fall, canopy water dynamics, forest-floor water dynamics and soil water dynamics. Compartments: - Hydrology: Solution of water content from nutrient balance model. Transpiration from Penman-Monteith. - Nutrient uptake: Driven by demand and limited by radial

	consist of: photosynthesis and respiration, phenology, hydrology (detailed and partly empirical), nutrient cycling (mechanistic), forest growth (detailed and partly empirical), and forest structure development.		diffusion from the bulk soil to the root. - Soil chemistry: ForGro uses NuCSAM as submodel. - Forest growth: Photosynthesis is driven by light interception. Gross carbon assimilation is summed per leaf layer. Fixed allocation scheme. - Effect relations: Nutrient shortage, and stomatal uptake of SO2 and O3 in foliage reduce photosynthesis. Al effects root growth and nutrient uptake. Direct uptake of NH3.
55.FORSKA	The FORSKA model was originally developed to simulate forest dynamics in Scandinavia (Prentice & Leemans 1990; Prentice et al. 1993). It simulates growth, regeneration and mortality of individual trees on small forest patches. FORSKA shares the common gap model structure with many other models (Shugart 1984), but it includes more mechanistic formulations of tree growth and some environmental constraints of forest growth than most earlier gap models.	https://www.pik-potsdam.de/acl_users/credentials_cookie_auth/require_login?came_from=https%3A//www.pik-potsdam.de/institute/archive/1994-2000/chief/forska.htm	
56.FPS Forest Projection and Planning System	Forest Biometrics supports the Forest Projection and Planning System (FPS) software for forest inventory, growth projection, silvicultural planning and long-term harvest scheduling.	http://forestbiometrics.com/software_functionality.html	
57.FVS Forest Vegetation Simulator	The Forest Vegetation Simulator (FVS) is an individual-tree, distance-independent growth and yield model (Dixon 2002). It has been calibrated for specific geographic areas (variants) of the United States (Figure 1). FVS can simulate a wide range of silvicultural treatments for most major forest tree species, forest types, and stand conditions.	http://www.fs.fed.us/fmsc/fvs/	**FVS Models and Components** The FVS software system is comprised of the regional FVS variants, model extensions, a graphical user interface (called Suppose), and a suite of post-processing programs that allow stand visualization and customize output reports to meet user requests. **FVS Geographic Variants**

			An FVS variant is a growth and mortality model calibrated to a specific geographic area of the United States. There are 20 different FVS variants. Users select an appropriate FVS variant for their area. FVS variants are calibrated for each of the major tree species within a geographic region. Extensions to the base variants are also available to assess the effects of insect, disease, and fire. You can find information regarding the codes, relationships, and logic specific to the individual variants in theVariant Overview documents. We developed an FVS Variant Map to suggest the FVS variant for any point in the United States, and is distributed in the form of a shapefile. **Model Extensions** Extensions to FVS are models that function interactively with the base FVS geographic variant to simulate the effects of various forest ecological disturbances on forest growth and mortality. **Insect and Disease Extensions** The insect and disease extensions incorporate the effects of insects and forest pathogens on forest stands. Fully functioning physiologic sub-models include: • Western root disease model • Douglas-fir Beetle Model • Douglas-fir Tussock Moth Model • Dwarf Mistletoe Model • Lodgepole Mountain Pine Beetle Model • Western Spruce Budworm Damage Model

			• White Pine Blilster Rust Model • Westwide Pine Beetle Model **Fire and Fuels Extension (FFE)** The FFE links the FVS variant with models of fire behavior, fire effects, fuel loading, and snag dynamics. Model outputs include predictions of potential fire behavior and effects and estimates of snag levels and fuel loading over time. **Carbon Submodel** The FVS carbon reports are part of the Fire and Fuels Extension to FVS and estimate the amount of carbon stored in various forest stand components, such as standing live and dead trees and surface fuels, over time. **Climate-FVS** The Climate Extension to the Forest Vegetation Simulator (Climate-FVS) provides forest managers a tool for considering the effects of climate change on forested ecosystems. **ECON** The Economic Extension (ECON) computes economic measures during FVS simulations to aid evaluation of silvicultural alternatives.
58.JABOWA	JABOWA is a simulation model of northern hardwood forest groth, in which changes in the state of the forest are a function of the present state and random components.	http://ecobas.org/www-server/rem/mdb/jabowa.html	Tree species are defined by a few general characteristics: - maximum age, - maximum diameter, - maximum hight,

			relations between: - height and diameter, - total leaf weight and diameter, - rate of photosynthesis and available light, - relative growth and a measure of climate, range of soilmoisture conditions within which the species can grow, number of samplings which can enter the stand under shaded, open or very open conditions. The abiotic environment and cut of trees are also considered. Direct competition among individuals is restricted to competition for light. The simulation refers to 10 x 10 m plots. For each plot year of simulation three major subroutines are called: subroutine GROW, which deterministically provides the annual growth increment for each tree; subroutine BIRTH, which stochastically adds new samplings; and subroutine KILL, which stochastically decides which trees die.
59.SORTIE	SORTIE is a mechanistic, spatially explicit, stochastic model of forests in the northeastern United States that describes local competition among nine species of trees in terms of empirically derived responses of individuals. The nine species modeled are all dominant or subdominant species found in mid- and late-successional stands: American beech (Fagus grandifolia; Be), eastern hemlock (Tsuga canadensis; Hm), sugar maple (Acer saccharum; SM), red maple (Acer rubrum; RM), yellow birch (Betula alleghaniensis; YB), white pine (Pinus strobus; WP), red oak (Quercus rubra; RO), black cherry (Prunus serotina; BC), and white ash (Fraxinus americana; WA). (For more detailed species descriptions, see Pacala et al. 1993. Data for the model were collected in northwestern	http://www.wiz.uni-kassel.de/model_db/mdb/sortie.html	

	Connecticut at elevations between 350 and 550 m.		
60.STIM Stand and Tree Integrated Model	The Stand and Tree Integrated Model (STIM) is an empirical model that integrates a stand-level sub-model with an individual-tree, distance-independent sub-model. This integration allows the two sub-models to interact and reconcile with one another. it was designed to produce potential growth and yield tabels for even-aged stands of coastal western hemlock and trembling aspen. The hemlock model has been calibrated for both natural and thinned stands based on data from coastal British Columbia, Washington and Oregon. The aspen model has been calibrated for both natural and thinned stands based on data from across Canada.	http://www.for.gov.bc.ca/hre/gymodels/STIM/	
61.TADAM	TADAM-df, TADAM-p, and TADAM-s, are growth models for British Columbia Coastal Douglas-fir , Interior lodgepole pine, and Interior white spruce plantations, respectively. They are based on a stand-level dynamical system approximation to output from TASS.	http://forestgrowth.unbc.ca/tadam/	
62.TASS Tree and Stand Simulator	The Tree and Stand Simulator (TASS) is a three dimensional growth simulator that generates growth and yield information for even-aged stands of pure coniferous species of commercial importance in coastal and interior forests of British Columbia.	http://www.for.gov.bc.ca/hre/gymodels/TASS/index.htm	
63.TRAGIC	TRAGIC++ is an interactive forest stand simulation program. In TRAGIC++, the development of a forest is simulated as the collective dynamics of individually growing trees, each of which competes with the others for light, space and nutrients. Interaction is possible by removing or planting single or groups of trees and by changing the environmental conditions (light an nutrients). The TRAGIC++ program is based on a relatively simple process-based tree growth model that can be	http://www.bayceer.uni-bayreuth.de/mod/html/webapps/tragic++/index_englisch.html	

	parameterised to represent trees of different species.		
64.TRIPLEX	TRIPLEX is a generic hybrid model of forest growth and carbon and nitrogen dynamics, developed based on three well-establisher process model, i.e. 3-PG (Landsberg and Waring, 1997), TREEDYN3.0 (Bossel, 1996) and CENTURY4.0 (Parton et al., 1993).	http://flash.lakeheadu.ca/~chpeng/	The model is intended to be comprehensive without becoming complex, and minimizes the number of input parameters required, while capturing key processes and important interactions between the carbon and nitrogen cycles of forest ecosystems. It is designed as a hybrid of both empirical and mechanistic components that can be used for 1) making forest management decisions (e.g., growth and yield prediction), 2) quantifying forest carbon budgets, and 3) assessing the effects of climate change in both the short and long term. In addition, TRIPLEX simulates average stand characteristics rather than those of individual trees. It is designed to develop as a generic model that can be parameterized for even- or uneven-age coniferous and broad-leaved species at any geographical location and for different soil and climate conditions. Modelling processes of TRIPLEX are described in details by Peng et al. (2002).
65.ZELIG	ZELIG (Urban, 1990) is an individual tree simulator that simulates the establishment, annual diameter growth, and mortality of each tree on an array of model plots.	http://ecobas.org/www-server/rem/mdb/zelig.html	Model states are recorded in a tally of all trees on a plot, with each tree labeled by species, size (diameter), height to base of live crowns, and vigor (based on recent growth history). The competitive environment of the plot is defined by the height, leaf area, and woody biomass of each individual tree determined by allometric relationships with diameter. Plot size is defined by the primary zone of influence of a single canopy-dominant tree. The plot is considered homogeneous horizontally, but vertical heterogeneity (canopy height and height to base of crown) is simulated in some detail. Adjacent cells interact through light interception at low sun angles. Establishment and annual diameter growth is first computed under optimal (nonlimiting) conditions,

			and then reduced based on the constraints of available light, soil moisture, soil fertility, and temperature. Climate effects are summed across simulated months. Seedling establishment, mortality, and regeneration are computed stochastically, while the growth stage is largely deterministic. Simulations can start or stop at any point within the life cycle of a forest.

***Информацията е обобщена от: M. Lyubenova, A. Chikalanov, S. Boteva, S. Peteva**