Table A1: Generic DGVM process descriptions

	CLM4-CN	HYLAND (HYL)	LPJ	LPJ-GUESS	TRIFFID (TRI)
Shortest time step	0.5 h	1d	1d	1d	1/2h
Physiology					
Photosynthesis	Farquhar et al. (1980)/Collatz et al. (1991, 1992)	Farquhar et al. (1980)	Farquhar et al. (1980)/Collatz et al. (1992)	Farquhar et al. (1980)/Collatz et al. (1992), Haxeltine & Prentice (1996)	Collatz et al. (1991)/ Collatz et al (1992)
Stomatal conductance	Ball et al. (1987)	Jarvis (1976)/Stewart (1998)	Haxeltine & Prentice (1996)	Haxeltine & Prentice (1996)	Cox et al. (1998)
Canopy scaling	N_{leaf} distribution with sunlit and shaded leaves	Optimum N_{leaf} distribution	Optimum N_{leaf} distribution	Optimum N_{leaf} distribution	Optimum N_{leaf} distribution. Sellers et al. 1992
Sapwood respiration	Dependent on temperature, sapwood mass and C:N ratio	f(Assimilation) Gifford (1995)	Dependent on sapwood mass and C:N ratio (Lloyd & Taylor 1994)	Dependent on sapwood mass and C:N ratio (Lloyd & Taylor 1994)	Pipe model to diagnose sapwood volume, then Q_{10} relationship
Fine root respiration	Dependent on temperature, root mass and C:N ratio	f(Assimilation)	f(T,C_{root})	f(T,C_{root})	f(T,N_{root})
Evapotranspiration	Transpiration, interception loss, soil evaporation and snow sublimation are computed from energy balance	Penman-Monteith transpiration (Monteith & Unsworth 1990)	Total evapotranspiration (Monteith 1995)	Transpiration, interception loss and evaporation (Monteith 1995)	Penman-Monteith transpiration (Monteith 1981) + interception (Fixed fraction)
Water balance	1 canopy water pool, snow (frozen and liquid pools for 5 layers), soil water (frozen and liquid pools for 10 layers), 1 groundwater pool	1 soil layer Bucket model (dynamic water holding capacity)	2 soil layers Modified bucket model from Neilson (1993) Surface runoff+drainage Snowpack	2 soil layers Leaking bucket model. Surface runoff+drainage Snowpack Gerten (2004)	4 soil layer Darcy's law
Canopy temperature	Diagnosed from energy balance	Canopy energy balance (Friend 1995)	n/a	n/a	Diagnosed from Energy balance
Aerodynamics	Log-wind profile	n/a	n/a	n/a	Neutral transfer coefficients using z_0 proportional to height
Radiation	Two-stream approximation	Beer's Law (applied to PFTs)	Beer's Law (applied to vegetation fraction)	Beer's Law, light attenuation through multiple canopy layers	Beer's Law (applied to vegetation fractions)
Ecosystem structure				Mixed PFTs within patches with age/size classes distinguished for trees and shrubs, herbaceous understory	

Phenology					
Cold deciduous	GDD requirement and daylength	n/a	GDD requirement Temperature threshold	GDD requirement Temperature threshold	Temperature sum with threshold
Dry deciduous	Soil moisture threshold	n/a	Soil moisture threshold	Water deficit stress threshold	n/a
Grass	Temperature and soil moisture	n/a	Soil moisture and carbon balance threshold	Water deficit stress and carbon balance threshold	n/a
Litter fall	Every model timestep (0.5 hour)	Daily litter carbon balance	Annual litter carbon balance	Annual litter carbon balance	Monthly litter
Decomposition	Thornton and Rosenbloom (2005)	CENTURY (Parton et al. 1993), modified by Comins & McMurtrie (1993)	$f(T,\theta_{top},$tissue type)	$f(T,\theta_{top})$	$f(T,\theta,C_{soil})$ McGuire et al. (1992)
	CLM4-CN	HYLAND (HYL)	LPJ	LPJ-GUESS	TRIFFID (TRI)
C allocation	Allometric relationships	Allometric relationships	Annual allometric relationship for individuals	Annual allometric relationship for individuals	Partitioning into ‘spreading’ and ‘growth’ based on LAI leaf:root:wood partitioning from allometric relationships
N uptake	Based on soil N pool and plant requirement	n/a	n/a	n/a	n/a
N allocation	N uptake to meet fixed C:N and constrained by soil N	Fixed C:N	Implicit, dependent on demand	Implicit, dependent on demand	Fixed C:N
Interactive N-Cycle	Yes			n/a	
Pfts					
Trees Evergreen	Tropical broadleaf Temperate broadleaf Temperate needleleaf Boreal needleleaf	Broadleaf evergreen Needleleaf evergreen	Tropical evergreen Temperate broadleaf evergreen Temperate needleleaf evergreen Boreal needleleaf evergreen	Boreal evergreen shade tolerant needle-leaved Boreal evergreen shade intolerant needle-leaved Temperate evergreen shade tolerant broad-leaved Tropical evergreen shade tolerant broad-leaved Tropical evergreen shade intolerant broad-leaved	Broadleaf Needleleaf

Deciduous	Tropical broadleaf Temperate broadleaf Boreal broadleaf Boreal needleleaf		Tropical raingreen Temperate summergreen Boreal summergreen	Boreal summergreen shade intolerant needle-leaved Temperate summergreen shade tolerant broad-leaved Temperate summergreen shade intolerant broad-leaved Tropical raingreen shade intolerant broad-leaved	
Shrubs	Temperate evergreen Temperate deciduous Boreal deciduous	n/a	n/a	n/a	Shrubs
Grasses/forbs	C3 herbaceous C4 herbaceous	C3 herbaceous	C3 herbaceous C4 herbaceous	C3 herbaceous C4 herbaceous	C3 herbaceous C4 herbaceous
Vegetation dynamics					
Competition	Competition among PFTs for water and nitrogen	Competition between PFTs for light	Nonhomogeneous area-based competition for light (1-layer), H_2O (2 layers)	Individual-based competition for light (multiple-layers), H_2O (2 layers)	Lokta-Volterra in fractional cover
Establishment	Minimum 'seed' fraction	All PFTs establish uniformly as small individuals	Climatically favoured PFTs establish in proportion to area available, as small individuals	Climatically favoured PFTs establish stochastically as small individuals in proportion to past NPP and a fixed background rate.	Minimum 'seed' fraction for all PFTs
Mortality	Prescribed turnover and gap disturbance rate; fire	Dependent on carbon pools	Deterministic baseline self-thinning carbon balance Fire Extreme temperatures	PFT longevity, PFT growth efficiency, high temperature stress, fire, extreme temperatures and stochastic disturbance	Prescribed disturbance rate for each PFT

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	O-CN (OCN)	ORCHIDEE (ORC)	SDGVM (SHE)	VEGAS
Shortest time step	0.5h	0.5h	1d	1 d
Physiology				
Photosynthesis	Farquhar et al. (1980)/Collatz et al. (1992)/Friend & Kiang (2005)	Farquhar et al. (1980)/Collatz et al. (1992)	Farquhar et al. (1980)/Collatz et al. (1992)	Jarvis with modified Collatz (1992) colimiting function
Stomatal conductance	Friend & Kiang (2005)	Ball et al. (1987)	Leuning (1995)	Tie
Canopy scaling	Empirical Nleaf scaling with sunlit and shaded leaves;Nleaf simulated dynamically (Zaehle& Friend, 2010)	Optimum N_{leaf} distribution	Optimum N_{leaf} distribution	Exponential function of LAI (Sellers 1991)
Sapwood respiration	Dependent on sapwood mass and C:N ratio (Lloyd & Taylor 1994), capped by labile C availability (Zaehle& Friend 2010)	Dependent on temperature, sapwood mass and C:N ratio	Annual sapwood increment, C:N f(T)	Sapwood mass and temperature
Fine root respiration	$f(T,N_{root,})$	$f(T,C_{root})$	$f(T,C_{root})$	Fine root carbon and temperature
Evapotranspiration	Transpiration, interception loss, bare ground evaporation and snow sublimation are computed using Monteith-type formulations (Ducoudré et al., 1993)	Transpiration, interception loss, bare ground evaporation and snow sublimation are computed using Monteith-type formulations(Ducoudré et al., 1993)	Penman-Monteith transpiration (Monteith 1981) + interception + evaporation from soil surface	Transpiration, interception loss, bare soil evaporation. Bulk transfer formulae. Zeng et al. (2000)
Water balance	2 soil layers (deep bucket layer and upper layer of variable depth) Surface runoff+drainage Snowpack	2 soil layers (deep bucket layer and upper layer of variable depth) Surface runoff+drainage Snowpack	3 soil + 1 litter layer Modif. Bucket model Drainage Snowpack	2 soil layers with full evapotraspiration, surface and subsurface runoff
Canopy temperature	n.a.	n/a	n/a	n/a
Aerodynamics	Log-wind profile	Log-wind profile	Log-wind profile	
Radiation	Two stream approximation (Spitters et	Beer's Law (applied to vegetation fractions)	Beer's Law (applied to total vegetation)	Beer's Law

	al. 1986)			
Ecosystem structure	LPJ type	Fixed cover fractions		Dynamic fraction based on competition
Phenology	Botta et al. 2000; Zaehle& Friend 2010	Botta et al., 2000		Dynamically determined based on temperature limitation, cold stress
Cold deciduous	GDD requirement Temperature threshold	GDD requirement Temperature threshold	Temperature threshold	Temperature, cold stress
Dry deciduous	Soil moisture threshold	Soil moisture threshold	Soil moisture threshold	
Grass	Dependent on climate zone. Botta et al., 2000	Dependent on climate zone. Botta et al., 2000	Growth threshold	Compete with trees by height and growth strategy. C3 and C4
Litter fall			Monthly litter carbon balance	Two pools: metabolic and structural
Decomposition	Based on Parton et al.(1993)	Based on Parton et al.(1988)	Similar to CENTURY (Parton et al. 1993)	Decomposer pool
	O-CN	ORCHIDEE (ORC)	SDGVM (SHE)	VEGAS
C allocation	Daily allocation based on allometric relationships (Zaehle& Friend 2010)	Based on resource optimization (Friedlingstein et al., 1998)	Daily allocation by demand in order of priority LAI>roots > wood	Allocation priority by order leaf, root, wood but with smooth transition
N uptake	f(Croot, Nsoil, T, C:Nplant)	n/a	Based on soil C and N decomposition also dependent on soil T and moisture	n/a
N allocation	Prognostic leaf C:N, C:N of root and sapwood fixed fraction of leaf C:N	n/a	Variable N with light	n/a
Interactive N-Cycle	Yes			n/a
Pfts				5
Trees Evergreen	Tropical broadleaf evergreen Temperate broadleaf evergreen Temperate needleleaf evergreen	Tropical broadleaf evergreen Temperate broadleaf evergreen Temperate needleleaf evergreen	Broadleaf evergreen Needleleaf evergreen	Whether evergreen or deciduous is dynamically determined, not prescribed. Both broadleaf and needleleaf can be

	Boreal needleleaf evergreen	Boreal needleleaf evergreen		evergreen
Deciduous	Tropical broadleaf raingreen Temperate broadleaf summergreen Boreal broadleaf summergreen Boreal needleleaf summergreen	Tropical broadleaf raingreen Temperate broadleaf summergreen Boreal broadleaf summergreen Boreal needleleaf summergreen	Broadleaf deciduous Needleleaf deciduous	Dynamically determined
Shrubs	n/a	n/a	Shrubs	n/a
Grasses/forbs	C3 herbaceous C4 herbaceous	C3 herbaceous C4 herbaceous	C3 herbaceous C4 herbaceous	C3 herbaceous C4 herbaceous
Vegetation dynamics	Fixed cover fraction, hence no between PFT competition, but within PFT dynamics through establishment and mortality			Full competition based on biomass increment and vegetation height
Competition	Nonhomogeneous area-based competition for light (1-layer), H_2O (2 layers), soil N (1 layer)	Nonhomogeneous area-based competition for light (1-layer), H_2O (2 layers)	Nonhomogeneous area-based competition for light (1-layer), H_2O (3 layers)	Full competition based on biomass increment and vegetation height (light)
Establishment	Establishment according to LPJ criteria (but no dynamics across PFTs)	Climatically favoured PFTs establish in proportion to area available, as small individuals	Climatically favoured PFTs establish in proportion to area available, as small individuals	Seeds assumed always available. Compete according to growth
Mortality	Carbon balance, Self-thinning.	Deterministic baseline self-thinning carbon balance Fire Extreme temperatures	Carbon balance, Age Wind throw Fire Extreme temperatures	Carbon balance Cold and drought stress Fire
Land Use and Land Cover Description	Hurtt et al. 2005, updated annually			Hurtt et al. harmonized