

# Use of Direct Measures by i-Tree Eco (v6.0)

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*Overview of the derived variables and ecosystem services that are estimated by the i-Tree Eco model and how they use the direct measures collected in the field.*

## DERIVED VARIABLES

- **Leaf area** is estimated using:
  - Species – to identify shade coefficient
  - Total height – to estimate height of the crown
  - Crown base height – to estimate height of the crown
  - Crown width – to identify crown width dimension
  - Percent crown missing – to modify base leaf area for actual amount present
- **Leaf biomass** is based on leaf area estimates and uses the same direct measures (as described above).

## ECOSYSTEM SERVICES

- **Carbon storage** is estimated using:
  - Species – to identify biomass equation
  - Diameter at breast height (DBH) – to calculate tree biomass
  - Total height – to calculate tree biomass
  - Field land use – to assign biomass adjustment factor

Conditional: For evergreen and palm species, leaf biomass is added to tree biomass so that carbon storage calculations also indirectly use species, total height, crown base height, crown width, and percent crown missing for these species (as described above).
- **Gross carbon sequestration** is estimated using:
  - Species – to identify biomass equations
  - Diameter at breast height (DBH) – to calculate tree biomass
  - Total height – to calculate tree biomass
  - Field land use – to assign biomass adjustment factor
  - Crown health (condition/dieback) – to adjust growth rates
  - Crown light exposure (CLE) – to adjust growth rates
- **Net carbon sequestration** is estimated using:
  - Species – to identify biomass equations
  - Diameter at breast height (DBH) – to calculate tree biomass
  - Total height – to calculate tree biomass
  - Field land use – to assign biomass adjustment factor
  - Crown health (condition/dieback) – to adjust growth rates
  - Crown light exposure (CLE) – to adjust growth rates
- **Energy effects** are estimated using:
  - Species – to identify leaf class (i.e., deciduous or evergreen)
  - Total height – to identify energy height class
  - Percent crown missing – to adjust energy effect
  - Distance to building – to calculate carbon saved
  - Direction to building – to estimate shade effects

- Percent tree cover – to determine climate effects
- Percent building cover – to determine climate effects
- **Air pollution removal attributed to trees** is estimated using:
  - Percent tree cover

Indirect: Air pollution removal estimates use leaf area index (LAI) and percent evergreen which are derived by the Eco model. LAI is estimated using leaf area and thus air pollution removal is indirectly estimated from species, total height, crown base height, crown width, and percent crown missing (as described above). Percent evergreen is estimated based on the amount of leaf area that is contributed by evergreen species.
- **Air pollution removal attributed to maintained grass, unmaintained grass, and herbaceous ground cover** is estimated using:
  - Percent cover for maintained grass, unmaintained grass, and herbaceous ground cover combined

Indirect: Air pollution removal estimates use leaf area index (LAI) which is derived by the Eco model. LAI combined for maintained grass, unmaintained grass, and herbaceous is estimated using State-based annual LAI adjusted by percent cover and thus air pollution removal is indirectly estimated from percent cover.
- **Avoided runoff** is estimated using:
  - Percent tree cover

Indirect: Avoided runoff estimates use leaf area index (LAI) which is derived by the Eco model. LAI is estimated using leaf area and thus avoided runoff is indirectly estimated from species, total height, crown base height, crown width, and percent crown missing (as described above).
- **Transpiration** is estimated using:
  - *NO DIRECT MEASURES*

Indirect: Transpiration estimates use leaf area index (LAI) which is derived by the Eco model. LAI is estimated using leaf area and thus transpiration is indirectly estimated from species, total height, crown base height, crown width, and percent crown missing (as described above).
- **VOC emissions** are estimated using:
  - Species – to inform genus and base VOC emission rates

Indirect: VOC emission estimates use leaf biomass which is derived by the Eco model. Leaf biomass is estimated using leaf area and thus VOC emissions are indirectly estimated from species, total height, crown base height, crown width, and percent crown missing (as described above).
- **Compensatory value** is estimated using:
  - Species – to assign species specific factors and taxonomic class
  - Diameter at breast height (DBH) – to calculate trunk size
  - Field land use – to determine location factor
  - Crown health (condition/dieback) – to adjust value
- **UV effects** are estimated using:
  - Percent tree cover – to determine the amount of canopy cover
- **Wildlife suitability** is estimated using:
  - Diameter at breast height (DBH)

- Total height
- Crown health (condition/dieback)
- Field land use
- Percent tree cover
- Percent shrub cover
- Ground cover composition

Forest and plot structure is defined based on the above field data and used to determine local habitat characteristics. Wildlife modeling compares the available habitat to the desired habitat of a species.

	DERIVED VARIABLES		ECOSYSTEM SERVICES										
DIRECT MEASURES	Leaf Area	Leaf Biomass	Carbon Storage	Gross Carbon Sequestration	Net Carbon Sequestration	Energy Effects	Air Pollution Removal	Avoided Runoff	Transpiration	VOC Emissions	Compensatory Value	Wildlife Suitability	UV Effects
Species	D	D	D	D	D	D	I	I	I	D	D		
Diameter at breast height (DBH)			D	D	D						D	D	
Total height	D	D	D	D	D	D	I	I	I	I		D	
Crown base height	D	D	C				I	I	I	I			
Crown width	D	D	C				I	I	I	I			
Crown light exposure (CLE)				D	D								
Percent crown missing	D	D	C			D	I	I	I	I			
Crown health (condition/dieback)				D	D						D	D	
Field land use			D	D	D						D	D	
Distance to building						D							
Direction to building						D							
Percent tree cover						D	D	D				D	D
Percent shrub cover												D	
Percent building cover						D							
Ground cover composition												D	
Maintained Grass, Unmaintained Grass, and Herbaceous % cover							I						
	D	Directly used				I	Indirectly used			C	Conditionally used		