**Both Models from Landlab**

Landlab Toolkit overview: <https://csdms.colorado.edu/wiki/Presenters-0407>

**VegCA**

Model website: <https://landlab.github.io>

Model forum / discussion board: <https://github.com/landlab/landlab/issues>

Files/model: <https://github.com/landlab/landlab/tree/master/landlab>

Model Description: This code is based on Cellular Automata Tree Grass Shrub Simulator (CATGraSS). It simulates spatial competition of multiple plant functional types through establishment and mortality. In the current code, tree, grass and shrubs are used.

Language: Python

Inputs

1. REQUIRED:
   1. RasterModelGrid: A grid.
2. OPTIONAL:
   1. ING: float, optional🡪 Parameter to define allelopathic effect of creosote on grass.
   2. method: str, optional🡪Method used.
   3. Edit\_VegCov: bool, optional
      * If Edit\_VegCov=True, an optional field 'vegetation\_\_boolean\_vegetated' will be output, (i.e.) if a cell is vegetated the corresponding cell of the field will be 1, otherwise it will be 0.
   4. Maximal establishment probability
      * Pemaxg: float, optional 🡪 Maximal establishment probability of grass.
      * Pemaxsh: float, optional 🡪 Maximal establishment probability of shrub.
      * Pemaxtr: float, optional🡪Maximal establishment probability of tree.
   5. Drought resistance threshold
      * ThetaGrass: float, optional🡪 Drought resistance threshold of grass.
      * ThetaShrub: float, optional🡪Drought resistance threshold of shrub.
      * Thetatree: float, optional🡪Drought resistance threshold of tree.
      * ThetaShrubSeedling: float, optional🡪Drought resistance threshold of shrub seedling.
      * ThetaTreeSeedling: float, optional🡪Drought resistance threshold of tree seedling.
   6. Background mortality probability
      * PmbGrass: float, optional 🡪 Background mortality probability of grass.
      * PmbShrub: float, optional🡪Background mortality probability of shrub.
      * PmbTree: float, optional🡪Background mortality probability of tree.
      * PmbShrubSeedling: float, optional🡪Background mortality probability of shrub seedling.
      * PmbTreeSeedling: float, optional🡪Background mortality probability of tree seedling.
   7. Maximum age
      * tpmaxShrub: float, optional🡪Maximum age of shrub (years).
      * tpmaxTree: float, optional🡪Maximum age of tree (years).
      * tpmaxShrubSeedling: float, optional🡪Maximum age of shrub seedling (years).
      * tpmaxTreeSeedling: float, optional🡪Maximum age of tree seedling (years).

Outputs : ASCII format

1. plant\_age 🡪 years
2. "plant\_\_live\_index"
3. "vegetation\_\_cumulative\_water\_stress"
4. "vegetation\_\_plant\_functional\_type" 🡪 grass, shrub, tree

Vegetation

Model Description: Landlab component that simulates net primary productivity, biomass and leaf area index at each cell based on inputs of root-zone average soil moisture.

Files/model: <https://github.com/landlab/landlab/tree/master/landlab>

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One plant functional type per cell

CATGraSS couples local vegetation dynamics, which simulate biomass production based on local soil moisture and potential evapotranspiration, and plant establishment and mortality based on competition for resources and space at each cell of a gridded model domain.

Inputs

1. REQUIRED:
   1. RasterModelGrid: A grid.
   2. method: str🡪Method name.
2. OPTIONAL:
   1. Initial value for vegetation
      * Blive\_init: float, optional🡪Initial value for vegetation\_\_live\_biomass.
      * Bdead\_init: float, optional🡪Initial value for vegetation\_\_dead\_biomass.
   2. Potential Evapotranspiration (PET) threshold
      * ETthreshold\_up: float, optional🡪 for growing season (mm/d).
      * ETthreshold\_down: float, optional 🡪 for dormant season (mm/d).
      * PETthreshold\_switch: int, optional🡪Flag to indiate the PET threshold. This controls whether the threshold is for growth (1) or dormancy (any other value).
   3. Specific leaf area
      * cb: float, optional🡪 green/live biomass (m2 leaf g-1 DM).
      * cd: float, optional🡪 dead biomass (m2 leaf g-1 DM).
   4. Storm stuff
      * Tr: float, optional🡪Storm duration (hours).
      * Tb: float, optional🡪Inter-storm duration (hours).
   5. Biomass Loss
      * ksg: float, optional🡪Senescence coefficient of green/live biomass (d-1).
      * kdd: float, optional🡪Decay coefficient of aboveground dead biomass (d-1).
   6. Constant for dead biomass loss adjustment (mm/d)🡪 Tdmax: float
   7. Conversion factor of CO2 to dry biomass (Kg DM/Kg CO2)🡪 w: float
   8. Water Use Efficiency - ratio of water used in plant water lost by the plant through transpiration (KgCO2Kg-1H2O).--> WUE
   9. Maximum leaf area index (m2/m2) 🡪 LAI\_max: float
   10. Maximum drought induced foliage loss rate (d-1)🡪 kws: float

Outputs : ASCII format

1. "surface\_\_evapotranspiration"🡪in mm actual sum of evaporation & plant transpiration"plant\_\_live\_index"
2. "surface\_\_potential\_evapotranspiration\_30day\_mean" in mm
3. "surface\_\_potential\_evapotranspiration\_rate"🡪 mm potential sum of evaporation and potential transpiration
4. "vegetation\_\_cover\_fraction"
5. "vegetation\_\_dead\_biomass"🡪 g m^-2 d^-1 weight of dead organic mass per unit area - measured in terms of dry matter
6. "vegetation\_\_dead\_leaf\_area\_index" 🡪 one-sided dead leaf area per unit ground surface area
7. "vegetation\_\_live\_biomass"🡪 g m^-2 d^-1, weight of green organic mass per unit area - measured in terms of dry matter
8. "vegetation\_\_live\_leaf\_area\_index"🡪 one-sided green leaf area per unit ground surface area
9. "vegetation\_\_plant\_functional\_type"🡪 grass=0, shrub=1, tree=2, bare=3, shrub\_seedling=4, tree\_seedling=5
10. "vegetation\_\_water\_stress"🡪 represents nonlinear effects of water deficit on plants