RMLands Landcover Type Descriptions FAQ

**What is RMLands?**

RMLands is a grid-based, spatially-explicit, stochastic landscape simulation model designed to simulate disturbance and succession processes affecting the structure and dynamics of Rocky Mountain landscapes, but it is easily extended to any forested landscape.

RMLands simulates two key processes: succession and disturbance. These processes are fully specified by the user (i.e., via model parameterization) and are implemented sequentially within 10-year time steps for a user-specified period of time.

Succession occurs at the beginning of each time step in the simulation and represents the gradual growth and/or development of vegetative communities over time. Succession is implemented using a stochastic state-based transition approach in which vegetation cover types transition probabilistically between discrete states (conditions).

Transition pathways and rates of transition between states are defined uniquely for each cover type and are conditional on several attributes of a disturbance-succession patch. These patches, as defined for succession, for example, represent spatially contiguous cells having the same cell attributes (e.g., identical cover type, condition class, disturbance history and age).

Most cover types progress through a series of stand conditions (states) over time as a result of successional processes (albeit at different rates due to the stochastic nature of succession). In some cases, these transitions are affected by the occurrence of certain disturbances (e.g., low-mortality fire) or are regulated by management (e.g., silviculture). Other cover types (e.g., meadows, barren, water) are treated as having a single, static condition and are not affected over time by the interplay of disturbance and succession.

**Why is it called “landcover” type and not “vegetation” type?**

Principally because not all the landcover types ARE vegetation types. For example, barren, urban, and water are all non-vegetated landcover types. We refer to landcover even when the type is the same as a species (e.g. Lodgepole Pine) because it is more consistent to always use this general term, rather than use one sometimes and the other sometimes.

**What is a patch?**

Patches are defined differently in different contexts. As noted above, we define patches for the purpose of implementing succession and disturbance transitions as spatially contiguous cells having the same cell attributes. However, for the purpose of quantifying landscape structure, we usually define patches on the basis of cover type and stand condition; specifically, spatially contiguous cells of the same cover type and stand condition.

**What is a cell?**

RMLands is grid-based, which means that the landscape and all its spatial attributes are represented as grids (or rasters). A cell is equivalent to one pixel in the raster. All the cells have dimensions of 30m x 30m.

**Why are the fire types called “high mortality” and “low mortality”?**

The words *intensity*, *severity*, and *mortality* are often used when discussing disturbance. The following are definitions as they apply to RMLands:

* Intensity: the magnitude in physical force of the event per unit area and time. Note, RMLands does not include any measures of disturbance intensity.
* Severity: the magnitude of impact on an organism, community, or ecosystem. Note, RMLands equates severity with "mortality" (below).
* Mortality: death of dominant plants on a site. Note, this is what RMLands uses.

While the LandFire BpS models refer to high, mixed, and low severity regimes, in RMLands we will only model high and low mortality effects of disturbance events. After a fire is simulated on the landscape, each disturbance patch (i.e., spatially contiguous cells with the same attributes) is probabilistically assigned to either high or low mortality. We consider high mortality patches of burned land to be those where ≥70%) of the dominant plant individuals are killed. In our model, all high mortality patches are reset successionally to early development, while low mortality patches may transition to an open condition of the same age or remain in the same condition. Note, in RMLands we consider ALL disturbance events to be comprised of a mixture of high and low mortality patches. Thus, ALL disturbance events are technically "mixed" severity disturbances, and the area within the perimeter of a disturbance event would typically be comprised of a mixture of high severity, low severity and undisturbed patches.

**How are succession transitions implemented?**

RMLands simulates succession using a simple state-based transition approach in which discrete vegetation states (i.e., stand conditions) are defined for each cover type. Succession involves the probabilistic transition from one condition (state) to another over time and it occurs at the beginning of each time step in response to the gradual growth and development of vegetation over time. Transition probabilities are typically based on the age of the stand (i.e., the time since the last stand-replacing event) or the length of time in the current condition (i.e., condition-age), but they can be based on any number of parameters such as the abiotic setting or disturbance history. Each cover type has a separate transition model that uniquely defines its successional stages.

In contrast to disturbance, which is mostly implemented at the cell level, succession is entirely patch based. Specifically, each cell belongs to a temporary patch defined as contiguous (touching based on the 8-neighbor rule) cells sharing the same values for each of the attributes used to define succession probabilities. For example, if in a particular cover type transition model, age, time since low-mortality fire and aspect are all used to define transition probabilities, then contiguous cells with the same values for these three attributes will be treated as a patch and undergo succession together. Note, successional patches are not static; they change over time in response to disturbance events, which can act both to break up single patches into several new patches and to coalesce several patches into a single patch by changing the disturbance history at the cell level. This patch-based approach for succession is necessary to avoid the salt-and-pepper effect of cell-based succession given that succession is implemented as a stochastic process.

**How are disturbance transitions implemented?**

Following mortality determination, each mortality vegetation patch is evaluated for potential immediate transition to a new stand condition (state). Transition pathways and rates of transition between states are defined uniquely for each cover type and are conditional on several attributes at the patch level. Note, these disturbance-induced transitions are differentiated from the successional transitions that occur at the beginning of each time step in response to gradual growth and development of vegetation over time.

**How is disturbance initiated?**

Disturbance events are initiated at the cell level. Each cell has a probability of initiation in each time step that is a function of its susceptibility to disturbance and, optionally, its proximity to other disturbance events or landscape features (e.g., roads) and the user-specified total number of disturbance events per timestep (which is a model calibration parameter).

**What is susceptibility?**

Susceptibility to wildfire, for example, is a function of cover type, stand condition, time since last fire, elevation, aspect, slope, and road proximity - factors that influence fuel mass and moisture and risk of human-caused ignition. Susceptibility influences the cells probability of initiating a disturbance and the probability of a disturbance spreading to it from a neighboring cell.