Keely Ledbetter

#==SEAGRASS SURVIVAL AND REPRODUCTION===================================

Question 1: How does algae affect the survival and spread of seagrass, an aquatic plant whose depth range is limited by light levels, which is limited by water depth and clarity?

Question 2: How is the spread of seagrass affected by topography?

1. CONCEPTION
   1. Space – a 2D square grid. The edges will not wrap around
      1. Traits
         1. agents\_per\_cell; each grid cell can contain 1 or 0 agents
         2. elevation: the elevation of the grid cell
            1. + values indicate elevation above sea level
            2. 0 is elevation at sea level
            3. – values are elevations below sea level (depth)
         3. light\_depth: the depth that light penetrates
            1. range of values [grid elevation, 0]
            2. For cells with elevation >= 0, light\_depth = 0.
            3. For cells with elevation < 0, light\_depth is some negative number that cannot go below the elevation.
      2. States
         1. is\_inhabited: is there a plant in the cell?
      3. Interaction
         1. elevation feeds into light\_depth calculation
         2. If a cell’s elevation >= 0: light depth = 0
      4. Feedback
         1. I don’t think so?
   2. Agents
      1. Traits
         1. Loc\_x: x-coordinate of the cell the plant occupies
         2. Loc\_y: y-coordinate of the cell the plant occupies
         3. Max\_daughter: maximum number of daughter plants a plant can make. Default is 1
         4. Max\_agents: maximum number of agents; cannot be more than the number of grid cells.
      2. States
         1. is\_alive: is the plant alive or dead?
      3. Interaction
         1. Asexual reproduction: agents create daughter agents
         2. If a plant has 2 other plants in its neighborhood, then it can make more daughters (up to 2). This is based on more plants = more shelter = higher survival rate => translates into more daughters in this model
      4. Feedback
         1. I don’t think so?
   3. Model
      1. **Parameters**
         1. RSLR = rate of sea level rise. Constant for the entire model run.
         2. algae\_dens: density of algae in the water; value is constant for the entire model run. I haven’t decided if I want the user to have to change it in the code or if there will be a slider, or what.
         3. initial\_agentNum: number of initial plants in the model
         4. max\_timestep: maximum number of timesteps
         5. reg\_lightDepth: depth of light penetration in completely clear water.
      2. **Initialization**
         1. Space
            1. Develop the 2D square grid full of zeros for is\_inhabited (this changes when agents are assigned to grid cells, though)
            2. Assign elevation values based on data in a file. The data will be derived from a digital elevation model that I will get from somewhere.
            3. Calculate light\_depth: some math involving reg\_lightDepth and algae density. If light\_depth is smaller than elevation (more negative), then light\_depth = elevation.
         2. Agents
            1. Place initial number of agents into random uninhabited cells in the grid. (and set the grid cell’s is\_inhabited value to 1 for each)

Cells must be uninhabited (is\_inhabited = 0)

The cell’s light\_depth must equal the elevation value.

The cell’s elevation must be <= 0.

* + - * 1. All initial agents are is\_alive = True
    1. **Step Method** – repeat until Population\_live = 0 or timestep = max\_timestep:
       1. Space
          1. Decrease elevation values by the RSLR value for all cells.
          2. Recalculate light\_depth.
       2. Agents
          1. Check own grid cell

If own cell’s light\_depth > elevation (light doesn’t reach the bottom), then cell’s state is\_alive = False; if light\_depth = elevation, then cell’s state doesn’t change from True.

* + - * 1. Check own is\_alive state:

If is\_alive = False, then move on to another agent.

If is\_alive = True, then continue with this agent step method cycle.

* + - * 1. Set max\_daughter:

Check Moore neighborhood.

If there are at least 2 live neighbor in the neighborhood, then the plant can create a maximum of 2 daughter plants (max\_daughter = 2). Else: max\_daughter = 1.

* + - * 1. Create daughter(s):

Pick random cell in Moore neighborhood.

Is it empty and light\_depth = elevation?

If yes, put a plant there & change the cell’s is\_inhabited to 1.

If no, try another random cell in the neighborhood (up to 3 times per daughter).

If max\_daughter = 2, then repeat the previous step, then continue.

* 1. Analysis
     1. What to measure
        1. Population\_live: total number of living plants
        2. Timestep: number of turns passed
     2. How to measure
        1. Population\_live: Count the total number of alive plants
        2. Timestep: add 1 for each model step
     3. Justification for measurement
        1. Population\_live: If there are no living agents, the model should stop prior to the max timestep. It is also useful for determining the survival success (or failure) of the plants.
        2. Timestep: important to measure in order to stop the model.