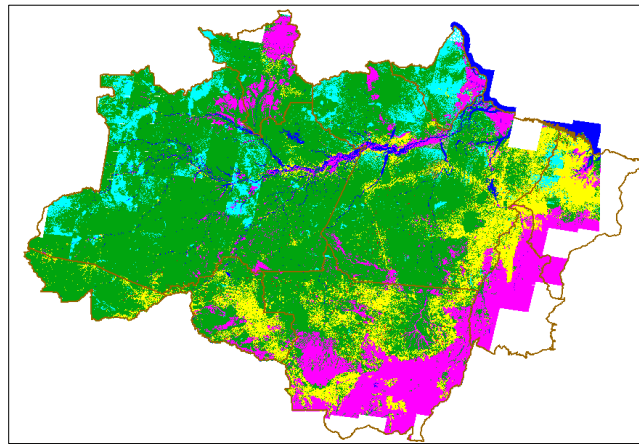


CST-317: Introduction to Earth System Science Modeling

Exercise IV: Deforestation



The objective of this exercise is to calibrate a model to study deforestation in the Brazilian Amazonia. The model tries to reproduce the spatial distribution of deforestation using up to four proximate factors: distance to roads, distance to ports, average deforestation of the neighbors, and percentage of protected areas. As three potential submodels use different factors, the idea is to change the parameters of each submodel related to the importance of such factors to find the best allocation of change. Two shapefiles with the same resolution and extent are available:

- 1) **amazonia.shp**: A shapefile with the following attributes: “defor2001” (deforestation until 2001), “distPorts” (distance to the nearest port), “distRoads” (distance to the nearest road), “protedArea” (percentage of the cell inside protected areas).
- 2) **prodes.shp**: A shapefile with PRODES data, with the attributes “prodes1997”, “prodes1998”, ..., and “prodes2011”, representing the yearly deforestation in each cell.

Execute the following steps:

- 1) Update the CellularSpace of Amazonia Model to use amazonia.shp above, instead of the file in base package. Update the attributes of the cells used by the model according to the names above.
- 2) The original Deforestation model supposes a constant demand for each year, but PRODES data changes yearly. Implement a script to compute such demands. Then, update the demand of Deforestation model to take into account the real deforestation from 2002 to 2011.
- 3) Compute the total deforestation in 2011 by summing up the deforestation data in 2001 with the yearly PRODES increments until 2011. You can use the function forEachCellPair to traverse two cellular spaces at the same time (see the documentation of Utils in base package). You will need this data at the end of the simulations to compute the goodness-of-fit of the results.

- 4) Calibrate the different potential strategies by changing the weights manually in order to increase the goodness-of-fit of the results. For example, you can manually change the values -0.450, +0.260, -0.140 and +5.313 from the expected potential given the source code below to try to achieve better results:

```
expected = - 0.450 * math.log(cell.distRoads)
           + 0.260 * 1 / cell.distPorts
           - 0.140 * cell.protectedArea
           + 5.313
```

Use `pixelByPixel()` function from package `calibration` to measure the goodness-of-fit between the real deforestation and the result of the simulations for 2011. Note that the model uses a continuous representation of deforestation and `pixelByPixel()` must have this information.

Deliver the source code that allows one to reproduce the results you have achieved and a small report with the spatial distribution of the real deforestation in 2011, the final allocation according to the three potential strategies, and a discussion of the different results using the three potential strategies.