

Lab 5: Landlab: Longterm Landscape Evolution (50 pts)

Due: Friday, December 6, midnight

In this lab you'll be working with Jupyter Notebooks to run a Python-based landscape evolution model (Landlab). This can readily be set up at no cost on a personal computer (Mac or PC) and is also set up on computers in both H450 and H461. Operation is user friendly and while you get a look under the hood at a landscape evolution model, no coding is involved. The Jupyter Notebooks I do not expect to cause difficulty, and are very cool tools for all science applications.

For this project you will complete the landscape evolution exercise in Landlab (<https://landlab.github.io/#/>). You will work through the exercise in the Jupyter Notebook "stream_power_channels_class_notebook". The assignment is straightforward and clearly laid out. No coding or knowledge of Python is needed.

Deliverable: short answers (a paragraph or two) to each of the questions at the end of the lab (within the stream_power_channels_class_notebook). Include saved or screen-shot captured figures that document the results that support your interpretation.

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To get to the exercise and run the landscape evolution model on a computer already set up for landlab:

1. Open an Anaconda Prompt (scroll to Anaconda in the start menu on Windows)
2. Change directory to the location where landlab_teaching_tools are stored with "cd" command:
(base) C:\Users\kwhipple>cd C:\user_data\kxw\landlab\landlab_teaching_tools-master\geomorphology_exercises (*this example is where the files are stored on my computer*).
3. Enter the command "jupyter notebook": **(base) C:\Users\kwhipple>jupyter notebook**
4. If a browser window for the modules does not open, cut and paste the URL listed in the Anaconda Prompt window into a browser.
5. In the browser navigate to "channels_streampower_notebooks" and click on "stream_power_channels_class_notebook".
6. Scroll down, reading the background material and follow the step-by-step instructions. General guidance and tutorials on using Jupyter Notebooks can be found here: https://github.com/landlab/landlab_teaching_tools.
7. Take your time working through Code Blocks 1-12. Look each one over and understand what that block of code is doing. To execute each code block, place the cursor in that block and press *Shift-Enter*. Also make note of the model parameters that you can (and will) change to explore controls on landscape evolution (these are typically in bright green, such as uplift rate in Code Block 6:
a. $uplift_rate = np.ones(mgl.number_of_nodes)*0.0001$
8. Work through and answer the 8 questions listed after Code Block 13. As noted, once you have completed the runs for Question 1 and have produced an initial steady-state landscape, for the remainder of the lab use the version of the model in Code Blocks 14-21 (These appear BELOW the lab questions). This is the same model, but outputs slightly different figures that should be most helpful to you and are set so you can retain the

initial steady state landscape and simulate how it responds to various perturbations. To run efficiently you can place the cursor in the top-most Block not changed for a new run (Code Block 14 if you change the fluvial erosivity K_{sp2} , Code Block 15 if you change runtime or timestep dt , Code Block 16 if you change only uplift rate, Code Block 17 if you change no parameters and just want to run for a longer time) and in the main toolbar select Cell -> Run All Below – this will re-run all remaining code blocks and update figures without the need to hit *Shift-Enter* in each Code Block. (NOTE: if you select Cell -> Run All, this will also re-run blocks 1-13 and will reset that initial landscape, likely producing a landscape not in steady state.

Make sure to keep dt to 500 years or less to mitigate the effects of numerical diffusion.

To Setup on Your Computer: Local Install of Python and Landlab

Instructions for setting up Python (Anaconda distribution) and Landlab are here:

<https://landlab.github.io/#/> but the process is straight forward.

1. Download and Install Anaconda (Python v 3.7) <https://www.anaconda.com/download/>
2. Open the Anaconda Prompt (Windows) or Terminal (Mac) as above (*Another option: open Spyder Python editor in Anaconda and on the toolbar select Tools -> Open to open a command window*)
 - a. IF you have trouble with the install, you may need to re-run this step as Administrator: Right click on Anaconda Prompt, select “more”, then select “Run as Administrator”
3. Enter at the prompt: **> conda install python=3.7 landlab -c landlab -c conda-forge**
4. Update python: **>conda update --all**
5. This will take a few minutes, but should take care of everything. Follow any prompts that come up – it will add and subtract various python elements, this is OK and necessary.
6. Download the Landlab learning modules Jupyter Notebooks from the class website, choose a location and expand the zip folder.
7. Once done you should be ready to go – see step 1 above for using Landlab once Python and Landlab are installed.