GEOL 553 Lab 5: Fluvial Terrace Mapping: Eel and Van Duzen Rivers

Summary

In this lab, students learn about fluvial terraces as preserved along the Eel and Van Duzen Rivers in Humboldt County, California. Plate tectonic uplift, eustatic sea level, and millennial scale climate forcing factors have conspired to form and preserve these terrace landforms. Students will map the landforms using digital elevation data in the form of DEMs, shaded relief data, and slope data. The students will digitize their interpretations and make estimates of terrace elevations, relative to the active channel, from the digital data. The students will attempt to correlate terraces with each river system and between the two river systems. Finally, the students will create a map, prepare a figure plotting their terrace elevation results, and write a report.

Goals

Students will learn the following:

- To become familiar with fluvial terrace landforms
- To learn how to map these landforms in a GIS software application
- To learn how to correlate paired and unpaired terrace treads within a single river system, as well as between regional river systems.
- To hypothesize about the reasons why fluvial terraces may or may not correlate regionally.

Background

Fluvial processes are driven by gravity and mass fluxes, which include hydrologic and sedimentologic inputs and outputs. Potential energy is converted to kinetic energy via slope and moderated by base level. Steeper slopes lead to more energetic flow. The elevation of sea level or lake level is called base level. Changes in sea level or lake level can increase or decrease base level. Once rivers meet oceans or lakes, they no longer have elevation changes necessary to drive the energy transfer that causes rivers to flow. Steeper slopes generate higher flow velocities and more energetic flows. Lane (1955) is an excellent primer for these hydrologic-sedimentologic relations.

Part I. Mapping and Digitizing Marine Terraces

Use ArcMAP to digitize the fluvial terraces along the Eel and Van Duzen Rivers. Use 10 m resolution DEM derivatives (shaded relief and slope maps) to visualize the geomorphic expression of the fluvial terraces. Use the 10 m resolution DEM and derivative data to estimate the ground surface elevations that you use to interpret the fluvial terrace elevations for your mapped fluvial terraces. One may use the info tool to determine point elevations, or use the profile tool to generate cross section profiles (to see the variation in elevation across the landscape), or extract the elevations to a point data set. Choose the method that you are most likely to successfully determine elevations for this lab.

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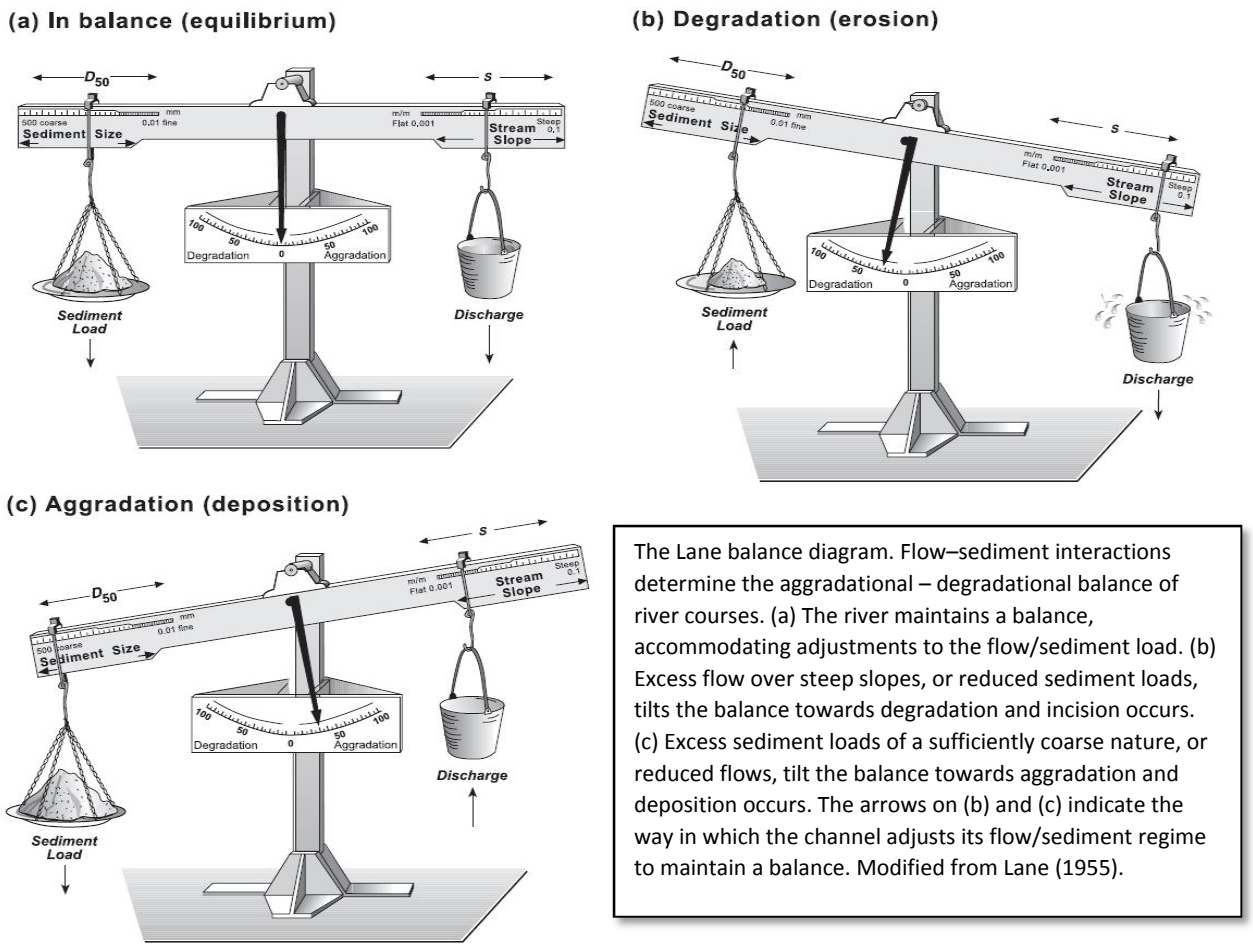

The Lane balance diagram. Flow–sediment interactions determine the aggradational – degradational balance of river courses. (a) The river maintains a balance, accommodating adjustments to the flow/sediment load. (b) Excess flow over steep slopes, or reduced sediment loads, tilts the balance towards degradation and incision occurs. (c) Excess sediment loads of a sufficiently coarse nature, or reduced flows, tilt the balance towards aggradation and deposition occurs. The arrows on (b) and (c) indicate the way in which the channel adjusts its flow/sediment regime to maintain a balance. Modified from Lane (1955).

Digitize polygons that surround the surfaces that you interpret to be preserved fluvial terraces. These polygons will be presented on the map for your report. You may (?) also want to present, on your map, how you estimated the elevations for the terraces.

After you have completed digitizing the terraces, open the table and add some fields called: abselevm and relelevm. These fields represent the absolute elevation of the terrace and the relative elevation of the terrace, or the elevation above the active floodplain or channel in the region normal/perpendicular to the terrace. The data type will be “long integer” and use the default settings. Use units of meters. Either use the DEM or the DRG to interpret these elevations. Enter the elevations into the records for each terrace.

Once you have digitized all the terraces and entered their absolute and relative elevations, attempt to correlate these terraces. Begin with each river system on its own. Add three new fields, using the “text” data type, make the field 10 characters long. These three fields will be named, eel_terr, vd_terr, and all_terr. Assign T-numbers for your interpreted terraces and enter these T-number (e.g. T-1 or T-2) in the records for each individual river system. Lastly, attempt to correlate the terraces from the Eel River to the Van Duzen River. When you are satisfied with these interpretations, enter the new T-numbers in the all_terr field. If a given

terrace exists in one system and not another, skip the T-number in the river system where that terrace does not exist.

After you digitize your fluvial terraces, and enter the data, prepare a map using the digitized linework and any combination of other background data that will help locate your linework. Prepare two maps, one with your terrace correlations for the two individual terrace correlation interpretations and the second map with your combined terrace correlation interpretations. Use colors or other symbology to distinguish the different terraces. Also, label the terraces with their T-numbers.

Part II. Questions and Report

Prepare a report with the map from part I as a figure. The report will include the standard sections (introduction, methods, results, discussion, and conclusion). The report will include answers to the following questions as part of the discussion and conclusions. Check out the references to help you think about how to answer the following questions. The report should include about 5 pages of text. Feel free to use references, like the ones provided below.

Questions:

- What were the issues that you encountered when correlating the terraces?
- Are the terraces paired or unpaired, or both? Can you explain why they are or are not paired?
- If not all the terraces correlate, why or why is this not the case?

References:

Blum, M.D. and Törnqvist, T.E., 2000. Fluvial responses to climate and sea-level change: a review and look forward in Sedimentology, v. 47, p. 2-48.

Stallman, J.D. and Kelsey, H.M., 2006. Transient geomorphic response to late Pleistocene base level change and climate forcing in the southern Cascadia thrust-and-fold belt, north coastal California in Hemphill-Haley, M.A., McPherson, R., Patton, J.R., Stallman, J., Leroy, T., Sutherland, D., and Williams, T., eds., 2006 Pacific Cell Friends of the Pleistocene Field Trip Guidebook, The Triangle of Doom: Signatures of Quaternary Crustal Deformation in the Mendocino Deformation Zone (MDZ) Arcata, CA.

GIS data sources:

DEM data (10 m) and USDA Imagery and USGS Topographic Imagery (MrSID) https://gdg.sc.egov.usda.gov/