Drainage Basins Field Lab:
San Gabriel Mountain Foothills

Dr. Jeff Marshall
GSC 323 – Geomorphology
Geological Sciences Department
Cal Poly Pomona University

Digital Elevation Model (DEM) of the central San Gabriel Mountains, Los Angeles County, California.
(Modified from NASA Shuttle Radar Topography Mission (SRTM) Image PIA 03332)

Introduction

One of the first tasks in a geomorphic investigation is to identify meaningful units of analysis within the landscape. On a first order, this involves dividing the landscape into areas of similar geomorphic and lithologic characteristics. This is often expressed by obvious variations in the local topographic relief and in the patterns of drainage networks developed on the landscape.

During our field trip to the San Gabriel Mountain foothills, we will identify three basic landscape units: 1) low relief alluvial fan surface, 2) moderate relief foothills, and 3) high relief mountain front.
Drainage Basin Analysis

Each of the three basic landscape units in our field area can be further subdivided into a system of drainage basins (also known as watersheds or catchments). Geomorphologists view drainage basins as a fundamental unit of landscape analysis. A drainage basin is defined as an area of land that contributes surface runoff to a common trunk stream. Every point on the Earth’s land surface belongs to a drainage basin. The edges of a particular basin are referred to as drainage divides. These boundaries consist of a line that follows the highest elevation points along the basin’s edge. A drainage divide separates one basin from another adjacent basin.

Drainage basins can be viewed as integrated landscape systems that are formed and modified by a suite of interrelated geomorphic processes, including tectonic uplift, rock weathering, runoff, erosion, stream flow, sediment transport, and deposition. The drainage basin system can be subdivided into two principal sub-systems which are affected by different sets of processes: 1) the hill slopes and 2) the stream channel network.

Analysis of drainage basin morphology can provide important data for understanding the processes operating in the landscape. This type of analysis focuses on a particular set of measurable basin characteristics referred to as morphometric parameters. These characteristics serve as indicators of equilibrium or disequilibrium in the landscape. Key morphometric parameters include: drainage basin area, width, and length; topographic relief and slope; the longitudinal profile; basin asymmetry; hypsometric integral; stream-length gradient index; and valley floor width to valley height ratio.

In this lab, you will identify the basic landscape units in the San Gabriel Mountain foothill region, delineate a set of drainage basins, and analyze some of the geomorphic characteristics of these basins. From this information, you will be asked to draw some basic conclusions about the processes affecting this landscape system, and its relative state of equilibrium.
Assignment

Turn in a professional field report following the format described in the *Lab Report Guidelines* that I provided at the beginning of the quarter.

1) Primary Landscape Units:

a) On Topographic Map #1, mark the boundaries between the three primary landscape units we identified in the field. Lightly shade each area with the indicated color: 1) alluvial fan surface (yellow), 2) moderate relief foothills (red), 3) high relief mountain front (green). The limits of your mapping area are defined by the edges of the map, San Antonio Creek, and the National Forest boundary.

b) Trace (in blue) all stream channels shown on the map (the solid lines)

c) Mark (in red) the regional drainage divide between the San Gabriel River and Santa Ana River drainage basins.

2) Drainage Basins and Longitudinal Profiles:

a) On Topographic Maps #2 and #3, outline the drainage divides (in red), and channel network (in blue) of the following local drainage basins:

*Map #2:*

1) Burbank Canyon
2) "Cobalito" Canyon
   (small unnamed basin we visited - between Burbank and Cobal Canyons)
3) Cobal Canyon
4) Palmer-Williams Canyons
5) Chicken Canyon
6) Evy Canyon

*Map #3:*

7) Spruce Canyon
8) Cat Canyon
9) Dry Lake Canyon

b) Make a *longitudinal profile* graph for the trunk stream of each of these 9 basins

c) Calculate the *drainage area* for each basin.
3) **Morphometric Indices:**

In the following three steps (a-c), you will calculate *morphometric indices* for our drainage basins. See detailed instructions for these calculations in Chapter 4 of:


a) Calculate the *Drainage Basin Asymmetry Factor (AF)* for each the nine drainage basins.

b) Calculate the *Hypsometric Integral (Hi)* for each basin.

c) Calculate the *Stream Length-Gradient Index (SL)* for the upper, middle, and lower reaches of each trunk stream. To define these reaches, divide each stream into thirds.

4) **Results & Discussion:**

a) Present your results neatly in a set of maps, figures, and tables.

b) Provide a general discussion of the drainage basin morphologies in this area. How do the basins differ between landscape units (maps #2 and #3)?

c) Examine the longitudinal profiles and discuss any irregularities. What might be the cause of any departures from a "graded profile"?

d) How do the long profiles compare between Maps #2 and #3? What similarities or differences are there between long profiles within each major landscape unit? Explain.

e) Do any of the basins show significant asymmetry (AF)? If so, what does this indicate?

f) Are there variations in hypsometric integral among the basins? What do your computed Hi values indicate about this area?

g) How do SL values compare among basins? Are there similarities or differences between each major landscape unit? Explain the significance.

h) Discuss any other significant observations

4) **Conclusions**

Based on your observations, describe the overall set of geomorphic processes that have influenced the development of this landscape. Explain any significant variations in the geomorphology between the three primary landscape units.