Instructor Guide for Using MATLAB for Earth Surface Modeling Inquiry

Purpose: We will be using MATLAB programming to quantify and model a natural hillslope surface. By experimenting with given codes to accomplish basic tasks that will allow us to construct and analyze a modeled surface and learning what the codes do, we will come up with some of the relevant questions that are asked in landscape evolution modeling. In so doing this, we will be forced to asses and compare modeled and numerical results with observations and theoretical predications of the landform.

General Framework Guidelines: The important steps are numbered and the codes are what the students need to search for and discover and then explain what they do. Following are supplementary questions to have students think more deeply about what the program did with the data and what more the student can do with data.

1. Load x, y, z data, imported from a terrestrial laser scanner, into MATLAB

```
load data.txt
```

2. Rename the data in the file

```
x=data(1:end,1);
y=data(1:end,2);
z=data(1:end,3);
```

3. Gridding the points to prepare them for a mesh

```
xlin = linspace(1.3411,3.3208,300); values based on the actual data
ylin = linspace(0.5206,1.7910,300); values based on the actual data
[X,Y]=meshgrid(xlin,ylin);
Z=griddata(x,y,z,X,Y,'linear');
```

4. Modeling the surface

```
mesh(X,Y,Z);
surf(X,Y,Z);
```

5. Reorienting the surface to align with original directions (values are examples)

```
ang=atand(1.384);
rotate(h,[0 0 1],-ang);
rotate(h,[1 0 0],-h);
az=144.5;
el=50;
view(az,el);
```

6. Visualizing micro-topography

```
shading interp
axis equal
```

Supplement questions:

A. What is lost from the actual surface in the model just by the gridding process?

There should be a class discussion about what the code is saying is being done to the values. Have students hand draw a cartoon of the process.

B. How would you model surface change if you had data from two different years of the same surface?

Students could be given another year's data and for homework, perform the same essential steps, but find the difference of the two surfaces, creating a third data set and a difference-surface that they model the same way.

C. How can you visualize topographic change between the surfaces?

Students work with the surf function to add the difference layer to the first year's surface and observe where material has been lost and gained relative to the first year's surface.

D. What other questions could you query about the data?

Students could find where the min and max, average, values of erosion and deposition were in each year; calculate the combined gains and losses and relate it to the local slope of the surface, compare an erosion rate with the erosion rate measured using hillslope diffusion. Students can be asked to find the average elevation in each cell in the first year, collect the values above and below the average in separate files, and then overlay the highs and lows on the first year surface in order to spatially analyze where erosion and deposition occurred.