Identifying Landslides Using Google Earth

1. Introduction

1.1. Workshop Aims
1. Identify landslides from Google Earth images
2. Approximate date when the landslides took place
3. Find the latitude and longitude of the landslides
4. Calculate area of few landslides
5. Calculate slope of landslides

1.2. What are Landslides?
A landslide is the movement of a mass of rock, debris, or earth down a slope, under the influence of gravity.

1.3. Significance of Identifying Landslides
Landslides are a serious natural hazard and can result in major loss of life and property (Figure 1). In many regions, the damage caused by landslides can be severe. Field studies, to identify landslides are expensive and time consuming. However, with the advancement in technology and with the availability of high resolution remote sensing data, it has now become possible to identify landslides using satellite images and aerial photographs. Google Earth’s new features which include the ability to view old satellite images, has made landslide identification possible (Figure 2).

The global population has grown from 1 billion in 1800 to 7 billion in 2011 (Ezeh et al., 2012). It is expected to keep growing to reach 10.1 billion by the end of the 21st century (Ezeh et al., 2012). Increasing population has resulted in scarcity of space and people moving to hazardous areas, without knowing about the hazards. Landslide identification is one of the first steps in identifying potential hazard for the future. The landslides which are identified using satellite images, aerial photos and field studies, can be used for landslide susceptibility and risk mapping. These maps can then be used by planners and policy makers in restricting construction in hazardous areas, and ultimately reduce the impact of landslides.
2. Measuring landslides in Google Earth

In this practical, we will demonstrate how to measure the area of a landslide (and observe its change over time, and its profile) using Google Earth. We will use as an example a landslide from Hattian Bala, Kashmir. Later, in Section 3, you will be given three examples of regions where landslides have occurred that you can explore using Google Earth. The Hattian Bala landslide that we will use, was one of many thousand landslides (mainly rock falls and rock slides) triggered by the Kashmir earthquake which occurred on 8 October 2005. The landslide buried the village of Dandbeh. We will look at the Hattian Bala landslide and try to answer some basic questions. Finally we will prepare a report on few landslides (other than Hattian Bala).

While preparing the report, it would be good if you can include some snapshots of the landslides you have identified. Taking snapshots is very easy in Windows 7. Click on PrtScn on the keyboard and then click the right mouse button and select paste at the designated place. You can even use the ‘Snipping tool’ if you are comfortable with it.

We now illustrate, through a series of 14 steps, an exploration of how the landslide has changed with time.

2.1. Start Google Earth: Start Google Earth by going to Start > Departmental Applications > Social Science and Public Policy > Geography > Start Google Earth in DirectX mode
2.2. Search: Enter the name of location (Hattian Bala in this case) in the Search panel (top left) and click Search. The Google earth will automatically zoom to Hattian Bala, a small town near the Indo-Pak border.
2.3. **Pan or Move Around:** Now we will move around the landslide and see it more closely. You can navigate or move around the landslide in Google earth by holding the left mouse button and dragging it to the desired location.

2.4. **Zoom in:** There are a number of ways you can zoom into your image.

- **Zoom in and out using the mouse**
  - Using mouse wheel - To zoom out scroll the mouse wheel down (toward you).
  - Scroll the mouse wheel up (away from you to zoom in).
  - Right mouse button (or alternate mouse button) - Hold down the right mouse button and drag the mouse up to zoom out. To zoom in, hold down the right mouse button and drag the mouse down.
- **Zoom in and out using the navigation controls.** To view and use the navigation controls, move the cursor over the top right corner of the 3D viewer. The navigation controls automatically appear whenever you do this; they fade from sight when you move the cursor elsewhere. Zoom in by clicking on the zoom in button (+ sign) and zoom out by clicking on the zoom out button (- sign).

2.5. **Tilt the 3D View:** Hold the SHIFT key and drag the left mouse button towards you or hold the SHIFT key and press the Down key on the keyboard to tilt the viewer toward the horizon view. You will be able to see the 3D view as if you were looking towards the horizon. You can reset the view to the top-down orientation by pressing the “u” key on the keyboard.

2.6. **Look Around:** To look around from a single vantage point, as if you were turning your head, press CTRL and left mouse button and drag. You can reset the view to the north-up view by pressing the “n” key on the keyboard.

2.7. **Rotate the view:** Press CTRL and scroll UP to rotate clockwise, CTRL + scroll DOWN to rotate counterclockwise.

2.8. **Identify the coordinates (latitude and longitude):** Move your cursor to the location and you will see that the latitude and longitude are displayed in the bottom right corner.
2.9. **Elevation**: The elevation shows the approximate elevation of the place at which your cursor is.

2.10. **Eye Altitude**: It is the distance (from high up) from which you are viewing the ground.

2.11. **Viewing old (historical Imagery)**: To view the old images click on the “Show Historical imagery” icon.

Clicking on the historical imagery icon brings up a time slider. Drag the time slider to move between images of different dates and observe how the surface has changed (Figure 3). Make sure you note down the date of the acquisition of satellite imagery.
You might observe that images of different time periods look different. Other than the changes in surface topography, the time of the day and season of the image acquisition make two satellite images look different.

1. Images taken at different times of the year (different seasons) have different amount of vegetation. Between the equator and the poles, the vegetation greenness rises and falls as the seasons change and this has to be accounted for when interpreting satellite images.

2. Amount of solar energy reflected or emitted from the Earth's surface varies the time of day. An image taken in evening might appear darker as compared to images taken during noon. Moreover different times of the day will result in longer or shorter shadow.

2.12. How to identify landslide boundary in Google earth?

Landslides are identified from aerial photographs and satellite images with the help of many attributes, including colour, tone, mottling (surface roughness) and texture. These factors depend on the light reflected by the surface, and can be used to infer rock, soil and vegetation types, the latter being a proxy for wetness. Landslides are easily recognizable immediately after a landslide event. The landslide boundaries are usually distinct, making it relatively easy to identify and map the landslide.

Things to look for when mapping a landslide:

1. Fresh landslides do not have much vegetation. As time passes, vegetation starts to cover the landslides and humans might work the land thus destroying the boundary.

2. The landslides might be reactivated and move as time progresses.

A detailed look at Hattian Bala landslide reveals that the landslide boundaries are very clear in October 2005 images, particularly at the upper tip of the landslide. Very few terraces can be identified in the October 2005 images. However, a look at 2010 and 2011 images shows new vegetation, houses and new terraces coming up on the landslides.
No Vegetation

Landslide boundary is rugged and sharp

October, 2005

Vegetation

Landslide boundary has advanced and smoothed

May, 2010
2.13. **Calculate area:** Once you have identified the boundary of the landslide visually, you can calculate its area using Google Earth. You can create a closed surface, or polygon, by following the steps:

1. Click on “Add Polygon”. A new window opens up. Give a name to the landslide. You can simply call it LS1 or Landslide1. Do not click OK or Cancel now. Start clicking to create the boundary of the landslide. Once you are happy with the boundary, click OK.

2. You will see that LS1 or Landslide1 will be added to your Temporary places (on the left).
3. Right click LS1 or landslide1 and click on “Copy”
4. Open Firefox (web browser) and go to [http://earthpoint.us/shapes.aspx](http://earthpoint.us/shapes.aspx)
5. Right click in the blank space and click “Paste”. Make sure “Sq. Meters” or “Sq. Kilometres” is selected under area and “Meters” or “Kilometres” is selected under length.
6. Click on “Export to Excel”. A new window opens. Click OK when asked “Open with Microsoft Excel”.

---

*Identifying Landslides (This draft updated on 1 Dec 2014)*

**Page 9 of 15**
7. The excel document will give the area in sq. kilometres
8. Open Firefox (web browser) and go to http://earthpoint.us/shapes.aspx
9. Right click in the blank space and click “Paste”. Make sure “Sq. Kilometres” is selected under area and “Kilometres” is selected under length.
10. Click on “Export to Excel”. A new window opens. Click OK when asked “Open with Microsoft Excel”.
11. The excel document will give the area in sq. kilometres.

2.14. Elevation profile: If you are interested in viewing the change in elevation along a path, you can use the elevation profile functionality of Google Earth. We will take a simple profile here.

2. Click once on the top of the landslide and once at the bottom of the landslide. Click OK.
3. Right click on Profile1 under Places and click on “Show Elevation Profile”.
4. Average slope is listed on top of the elevation profile window.
3. Three examples of landslide impacted regions

In this practical we will be examining landslides using Google Earth. Three examples of regions where ‘many’ landslides have been triggered by a single earthquake (heavy-rain can also trigger landslides) are:

**A. Kashmir Earthquake Triggered Landslides, 8th October 2005**

Muzaffarabad, Kashmir
Latitude 34° 24’ 28” N and longitude 73° 28’ 08” E
Thousands of landslides resulted due to the earthquake
The government of Pakistan’s official death toll was 87,350 due to the earthquake

**B. Wenchuan Earthquake Triggered Landslides, 12th May 2008**

Wenchuan County, Ngawa Tibetan and Qiang Autonomous Prefecture, Sichuan, China
Latitude 31° 26’ 32” N and longitude 103° 32’ 8” E
More than 150,000 landslides, rockfalls, and debris flows occurred
About 20,000 deaths directly caused by landslides triggered by the earthquake.

**C. Haiti Earthquake Triggered Landslides, 12th January 2010**

Port-au-Prince, Republic of Haiti
Latitude 18° 21’ 6” N and longitude 72° 52’ 14” W
More than 1,000 landslides triggered due to the earthquake
Over 222,570 people died from the magnitude-7.0 Haiti event. No report of deaths from landslides.

![Figure 2: Location of three study regions where landslides have occurred.](image)
4. Report on Landslides Identification

Landslide Name:
Click here to enter text.

4.1. Location (Name of the city, county, country or any landmark): Click here to enter text.

4.2. Latitude and Longitude of the landslide (Make sure you include information about Northern/Southern and Eastern/Western Hemisphere): Click here to enter text.

4.3. Include few snapshots of your landslide
4.4. Include the before and after images, if possible

4.4.1. Before (Image of the surface before the landslide happened)

![Image of the surface before the landslide happened]

4.4.2. After (Image of the surface after the landslide happened)

![Image of the surface after the landslide happened]

4.5. Approximately between which dates did the landslide take place? Look at the before and after images of the landslides and estimate the approximate date of the landslide from the date the satellite image was acquired.

Click here to enter text.

4.6. Area of landslide

Calculate the area of landslide in both km$^2$ and m$^2$ (remember that 1 km$^2$ = 1,000,000 m$^2$). When you report your numbers, think about how many significant digits for reporting your value are appropriate.

Click here to enter text.

4.6.1. Using your area in m$^2$, what would be the sides of a rectangle that give this area (for example, if you find an area of 30,000 m$^2$, this would be equivalent to a rectangle of 100 m x 300 m)?  

Click here to enter text.
4.7. Elevation profile of your landslide (think about the boundary of the landslide relative to the profile you take).

4.8. Give the average slope of the landslide in degrees and percentage. Google Earth reports the slope in degrees. Report this to an appropriate number of significant digits, and convert to a percent. If you need help, see CalcuNATION (2014): Click here to enter text.

4.9. Provide a paragraph of how the landscape has changed over time, and any other observations you have made: Click here to enter text.

References Cited