Debris Flow Hazards in the Central Oregon Coast Range

Nicole Inman, Earth and Physical Science Dept., Western Oregon University, Email: ninman15@wou.edu

1 Abstract

Debris flows represent a potentially dangerous mass wasting process that is often difficult to predict. They are complicated events with many factors influencing their size and power, and every year they affect thousands of Oregonians.

The importance of creating accurate prediction models and educating the public as to their risk cannot be understated. This is especially imperative in western Oregon where climate and geology result in a higher rate of debris flow occurrence compared to other regions of the U.S.

Understanding the debris flow process, controlling factors and their triggers are essential for developing regional mitigation and emergency management plans. This paper provides a review of the literature and status of debris flow hazard research in the Central Oregon Coast Range.

2 Introduction

A debris flow is a form of mass wasting where a slurry of mixed materials, including everything from sand and silt to boulders and logs, become water logged and begin flowing downhill. Debris flows are capable of reaching rates as high as 50 miles an hour and can entrain objects they encounter in their path.

A debris flows power and travel distance is affected by many things but mainly what materials the flow is comprised of and whether or not the flow becomes channelized.

There are many different types of and names for mass wasting, which can be further confused by media's use of one main term (mudslide) to describe them all.

As Senate Bill 12 has a main focus was on rapidly moving "landslides" due to their cost and the public's safety risk we will focus on these.

3a Discussion

Debris flows are complex and as noted in the following column's Box A, there is a large number of things that come into play as to if a debris flow might occur. The largest contributing factors are topography (specifically hillslope) and precipitation.

As seen in Figure 1 the Central Oregon Coast Range receives a large quantity of rain each year. Precipitation that might trigger a landslide (see Box B) can span the spectrum of a short intense rainfall (several hours), a storm (lasting several days), or a long, wet period (an unusually rainy spring for example). Other important notes are how much rain has been received by that area prior to the triggering event and how saturated the soil is already. Or, conversely, if the soil cannot absorb the rain (frozen ground).

Combine this wet climate with the coast range's famous, beautiful scenic hills and you have quite a large increase in your probability for a landslide. A hill's topography, described in Figure 2, is a critical factor in a slopes stability.

A Factors

- Pore Water Pressure
- Rainfall Infiltration (Frozen Ground vs. Dry Sand)
- Timber Harvesting / Intense Clearcutting
- Road Construction
- Hillslope Angles
- Precipitation
- Topography
- Amount & Type of Vegetation (Root
- Fire Frequency (Fire Cycle & Stand Age)
- Basin Size
- Forest Gap / Hardwood Patch
- Underlying Strata
- Precipitation Threshold
- El Nino
- Hurricanes
- Volcanoes
- Antecedent Rainfall
- Composition of Soil/Rock

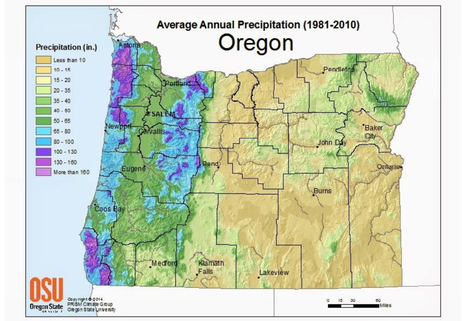

Figure 1. Map depicting the average annual precipitation in Oregon from 1981-2010.

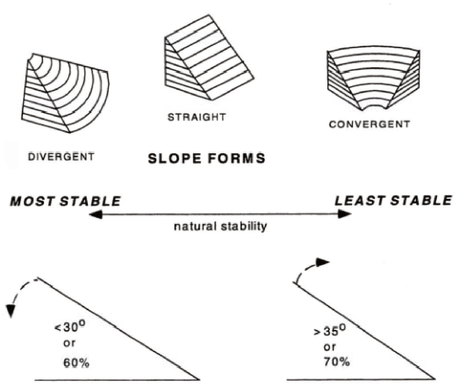

Figure 2. Diagram displaying the stability of different topographies and slope angles.

B Triggers

- Intense Rain After Heavy Snowfall
- Oversteepening of Slopes
- Higher Than Normal Precipitation in a Given Timeframe
- Earthquakes
- Loss of Root Cohesion
- Volcanic Eruptions
- Anything from Factors Box A that if Changed Creates a Larger Driving Force than the Slopes Strength of Resistance

3b Discussion (Cont.)

Some items can cause large scale landslides on a regional level. One such item was the 1996-97 winter season (seen in figure 3). Another can be after a large wild fire as these can denude the land of its vegetation and root strength. Figure 4 depicts the approximate number of debris flows each year for 60 years following the fire. This is referred to as the fire cycle and is one of many of the components that come in to play regarding a possible landslide or not.

The impact of these events cannot be understated. Every year Oregon's average cost due to landslides exceeds $10 million and effects thousands of residents. Figure 5 maps the location and cost of different debris flows around Oregon.

There is also a cost to our rivers and streams. The impact on these ecosystems has trickle down repercussions that hurts fish habitat and other resources. They are also one of the most damaging forms of erosion in forested watersheds.

Considering the consequences of these events it is imperative that Oregonians become better educated on how to spot a potential debris flow before it begins as well as how to react if one occurs and what to do in debris flow triggering weather.

The USGS has been publishing educational pamphlets for some time and in Figure 6 you can see an example of one of their graphics they use in their literature. One imperative fact that many citizens are not aware of is that like tsunamis, debris flows can have several "surges" or "pulses" of activity.

Just as an individual landslide may have several phases so to do landslide areas. This cycle is one way we derive an estimated recurrence interval. Landslide frequency has many components but at its most elemental the sequence is a hill building up regolith to the point where it starts to become unstable, it experiences a triggering event causing a debris flow, and then it starts the cycle of building up regolith again.

4 Conclusion

Landslides are complicated and difficult to predict. There are many parts to the equation as to what might increase the chance of one happening but they do have cycles and we can use this knowledge to help improve our predictions while better educating the public and working on ways to help mitigate debris flow costs and impact.

5 References

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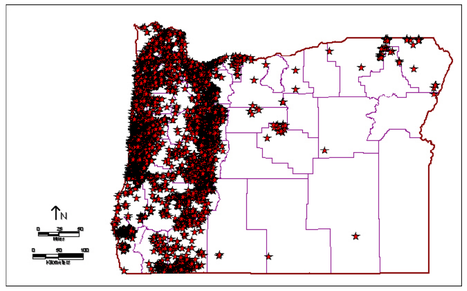

Figure 3. Distribution of the 9,582 debris flow database entries throughout Oregon in the 1996-97 winter season.

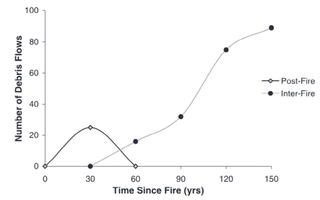

Figure 4. A graph charting the correlation between time after a fire and the number of landslides in the burned area.

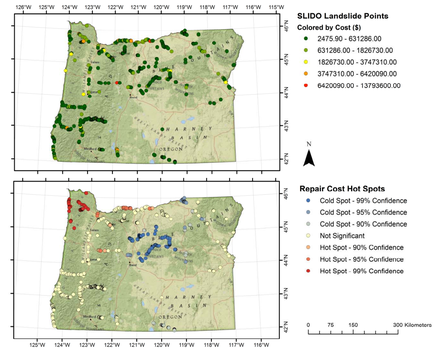

Figure 5. Landslides by cost and what areas require greater finances to repair post debris flow.

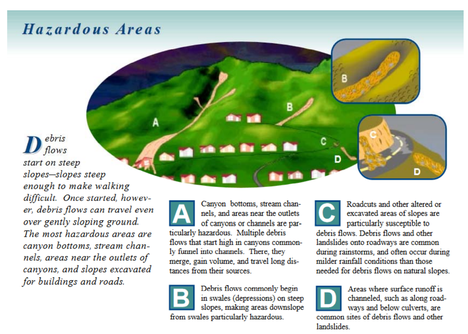

Figure 6. A USGS graphic to promote public education. Depicts a basic overview of debris flows.