ACCESSING THE EFFECTS OF THREE SPATIAL AGGREGATION LEVELS OF HARVEST BLOCKS DESIGN ON INDIVIDUALS' PERCEPTIONS OF SCENIC BEAUTY

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ABSTRACT

Forest engineers and planners have used a variety of techniques to mitigate the visible effects of harvesting in visually sensitive areas. However, less empirical research and investigation have been conducted on spatial cues, for example, spatial aggregation level. I conducted a pilot study to investigate the perceptual effects of three different cutblock spatial aggregation levels (High, Medium, and Low). Thirty photo-realistic images were rendered of a forest landscape scene with three different aggregation levels. These scenes were rated by 74 individuals. There was no significant difference across three different spatial aggregation levels in terms of landscape scenic beauty ratings. Nevertheless, two major constructive findings are concluded. More differences are expected to be perceived by individuals on a given landscape with relatively larger scale clearcut and poorly designed cutlbocks. Colour contrast presented a significant influence on individuals' ratings across three different levels as well. Finally, some improvements for online survey design are suggested.

KEYWORDS

Human perception, scenic beauty, forested landscape, visual management

INTRODUCTION

Forest resources are important for humans. Forest resources can be divided into two major types. Hard economic resources (e.g. timber, botanical forest product, water, wildlife, livestock forage, and fish) are familiar to public. On the other hand, forest resources also include some "amenity" uses such as outdoor recreation and nature scenic beauty (Daniel, 1990). People today have higher levels of education and earn better wages than before. Given this development, people spend more leisure time in forests and on highways. Civil societies have become increasingly more concerned with the condition of the environment. They are not only sensitive to what our forest practices mean from a biological conservation view point, but are also concerned with how they look, and what this means from a socio-economic standpoint with respect to nonconsumptive opportunities and users of forests. There is a strong public sentiment that has roughly and consistently said: "if our forests look good, then the chances are that they are being managed well" (Jacques, 2001).

Visual quality of a landscape has often been described as an 'intangible' resource, primarily because it is difficult to quantify and measure in an objective, scientific manner (Hull *et al.*, 1984). Unlike some regular 'tangible' forest resources like timber, the quantity of which can be physically measured, the amount of visual quality present in a landscape depends not only on the physical characteristics of the landscape, but also on the subjective judgment of individual observers who review the landscape (Bergen *et al.*, 1995). British Columbia is economically reliant on the lumber and pulp and paper products industries. However, there is a growing tourism industry. Consequently, there is a challenge to meet the ever-present demand for fiber while maintaining visual quality and meeting the needs of the growing recreation and tourism sectors.

Visual resource management (VRM) systems were initially established in the United States in the 1960s and 1970s. VRM was, in part, a response to public backlash as a result of timber harvest practices common in this era (USDA Forest Service, 1974). VRM draws from principles across many domains, particularly from landscape architecture and environmental psychology. The core purpose of VRM is to connect principles of visual design to operational forest management and mitigate the potentially negative visual effects from harvesting (Chamberlain & Meitner, 2012).The BC VRM system in BC evolved to address provincial needs and circumstances. The system is still in use today (BC Ministry of Forests, 2001). VRM system has been revised and has evolved over the years. But even with these changes, it still can be argued that it has served its original purpose of mitigating impacts and subsequent public reactions (Sheppard, 2001).

Considerable empirical research has been conducted to provide designers with information about how humans relate to what they see in the landscape. Several methods have been used by researchers who aim to understand how people perceive the landscape in order to uncover the interaction between the human and environment (Daniel & Boster, 1976; Zube *et al*., 1982; Taylor *et al*., 1987). The most widely used approach is the psychophysical method, which enables researchers to quantitatively identify the role of certain landscape characteristics in an individuals' perception (Daniel & Boster, 1976; Ribe, 1989, 2005; Daniel, 1990, 2009). The application of VRM has been dramatically impacted by these methods, as they illustrate the essential connection between potential landscape change and perceived visual impact

(Chamberlain & Meitner, 2012).

Numerous similar studies have worked to identify specific elements of landscape modification and their relationship to individuals' preferences within forestry (Chamberlain & Meitner 2012). For instance, it is widely known that the amount of visible alteration of landscape is always the dominant factor in terms of scenic beauty preference or public acceptability (BC Ministry of Forests, 1996). In addition, clearcuts are a very common silviculture method in BC, as it provides sustained flow of wood products. However, clearcuts are known to cause negative aesthetic judgments by the public (BC Ministry of Forests, 1994, 1996; Lindhagen, 1996; Ribe *et al*., 2002; Palmer, 2008). Additionally, the rate of green-up can influence preferences as well. It usually takes about 10 years for a harvested landscape to nearly recover to original visual preferences (BC Ministry of Forests, 1994).

In light of Chamberlain & Meitner (2012), and personal communications with Dr. Michael J. Meitner, I decided to narrow my investigation scope to access how three different spatial aggregation levels of harvest blocks design influence individuals' perceptions of scenic beauty in a forested landscape. Little empirical evidence exists concerning the degree to which the spatial aggregation levels of harvesting blocks influence scenic beauty preference.

METHODS

According to Simon (1993), visual landscape design consists of a three-tier structure. The first tier includes the introduction of all basic elements from which all landscapes are composed (e.g. point, line, plane). The second tier is comprised of the variable elements which are unique to a landscape (e.g. shape, direction, number). The third tier is called organization, which covers the grouping of basic elements into different patterns (e.g. objectives, spatial cues, structure elements). It is the combination of these three components that describes the appearance of an existing landscape or produces a visual design. Spatial aggregation levels belong to the third tier under the spatial cues branch.

I focused on only one variable in the design: spatial aggregation level. Spatial aggregation level is a very important characteristic of the spatial cues in terms of visual landscape concepts and principles (BC ministry of Forests, 1994). Generally, spatial aggregation level refers to the relative positions or distances between elements in space. In other words, this concept can be interpreted as the nearness of visual elements. According to the BC Ministry of Forests (1994), when people see visual elements which are positioned together they usually subconsciously read them as a group instead of individuals. Individuals become less important when they are very similar in variable design elements and the group becomes the element at a large scale. However, if these visual elements are too dissimilar, this can also cause negative issues in terms of scenic beauty preference. Consequently, this principle can be very useful in particular cases of clearcut landscape design. If a number of small clearcuts are scattered about they might have a chaotic effect, but if they can be grouped together the result will be more harmonious, especially in the foreground and middle-ground. As I mentioned in the introduction, the percentage of alteration is the most important indicator (BC ministry of Forests, 1996). According to Shan and Bishop (2000), contrast weighted visual size plays a very important role in affecting individuals' preference as well, not just the size of the modification. As more dispersal alterations are located in the foreground and middle-ground, landscapes can be perceived to be much more disturbed compared to the harvesting patterns which mostly locate in background (Ribe, 2005, 2009). Moreover, middle-ground distances (500–5000 m) may be considered the most critical and sensitive in terms of individuals' scenic beauty ratings on forested landscapes (Litton, 1979; Hull & Buhyoff, 1983; McCool *et al.*, 1986).

Normally, the forest canopy is closed when trees are near to each other. However, sometimes silviculture systems produce more widely spaced trees. For example, in selective cut areas, space can become too wide to see the trees as a whole and continuous canopy. Consequently, this can cause problems, especially on skylines (BC Ministry of Forests, 1994). Additionally, spatial aggregation is usually related to some other characteristics of the other spatial cues and normally presented as a combination.

In a conclusion, my hypothesis is individuals' ratings in terms of forested landscape scenic beauty decrease from low to high aggregation levels of harvest blocks design (BC Ministry of Forests, 1994).

In order to access the hypothesis, 34 computer generated graphic images (10 images of different sites for each of three spatial aggregation levels, plus four preview images) were developed. These images were used in an online survey where participants were asked to provide a rating of each image based on their perceptions of the attractiveness of the images. These images were developed based on three different spatial aggregation levels (High, Medium and Low). I used Google Earth and Adobe Photoshop to simulate these relatively realistic images. In the survey, participants were informed that I was interested in knowing their opinions about the cutblock design impacts of forestry on scenic beauty. They were asked to “rate the each images on a 10 point scale of scenic beauty where 1 = low scenic beauty and 10 = high scenic beauty”. Participants were not informed of any information regarding the design purpose and components in terms of operational, ecological and aesthetic realism.

The total participants were 84 forestry undergraduate students at the University of British Columbia. 44 people took the order 1 survey and 40 people took the order 2 survey. The participants who took first order were primarily called by Dr. Meitner for a survey related to the green wall planting designs. All participates were older than 19 without any blindness or severe visual handicap. The second order survey was taken by volunteers who are international students transferred from Chinese University including Beijing Forestry University, Fujian Agriculture University and Nanjing Forestry University.

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My hypothesis is Individuals' ratings of forest landscape scenic beauty decrease from low to high aggregation levels of harvest blocks design (BC Ministry of Forests, 1994).

In order to create the images that were used in this study, I spent some time looking around the forest landscape in BC using Google Earth. As my study goal was to assess the degree to which spatial aggregation levels influence individuals' perceptions of scenic beauty in a forested landscape. I picked 10 suitable forest landscapes with the help of Dr. Michael Meitner. It was crucial to find good forest landscapes to maximize the differences across three different spatial aggregation levels. It is the sole fixed effect in the study. It was important to control as many other landscape and design characteristics/variables as possible. Otherwise, the variable I investigated may be confounded with other visual variables that were not controlled for.

I captured 10 different forested landscape images based on the following criteria: single landscape, same aspect ratio (2.5:1), similar colour gradation, and a cluster of visible cutblock located in the background (representing the low spatial aggregation level design). Table 1 provides further details about the variables that were controlled or altered.

Table 1 List of elements controlled and varied

Element of design	Constraints	Description
Aspect Ratio of images	Yes	Only one aspect ratio (2.5:1) was used for all images
Colour gradation	Yes	It is difficult to find 10 different sites which all have same colour gradation in Google Earth, but at least to minimize the differentiation
Site condition across different sites (include most elements of visual landscape design, random effect)	No	All landscape design elements within same site are same except spatial variable (which I am interested). However, most landscape design elements differ from each other across different sites (e.g. direction, shape)
Spatial aggregation level (fixed effect)	No	Three spatial aggregation levels were used: low (a cluster of cutblock are located on background), medium (less than 50% of cutblock are modified to foreground), high (more than 50% but less than 75% of cutblock modified to foreground).

The 10 original images indicated low spatial aggregation levels. The next step was to create two more images for each site which represent the medium and high spatial aggregation levels. I used Adobe Photoshop to manipulate and modify each image to accomplish this.

In order to adjust the cutblock spatial aggregation level into two different levels (Medium and High), I created new layers for each visible cutblock in the each of this 10 original image at first. This step was crucial as it allowed me to move each cutblock freely in the images. I then dragged each cutblock one by one according to guidelines I set, dispersing the clusters of cutblock into the foreground and middle-ground. For the medium spatial aggregation level, my primary goal was to manipulate some part of cutblock to the middle-ground. For the high spatial aggregation level, my primary goal was to move part of the cutblock to the foreground and middle-ground. Figures 1, 2, and 3 illustrate the change from low spatial aggregation to medium and high level respectively.

In additions four extra images were captured to serve as preview images for the survey. Two of them represented low spatial aggregation levels and the other two indicated high spatial aggregation levels.

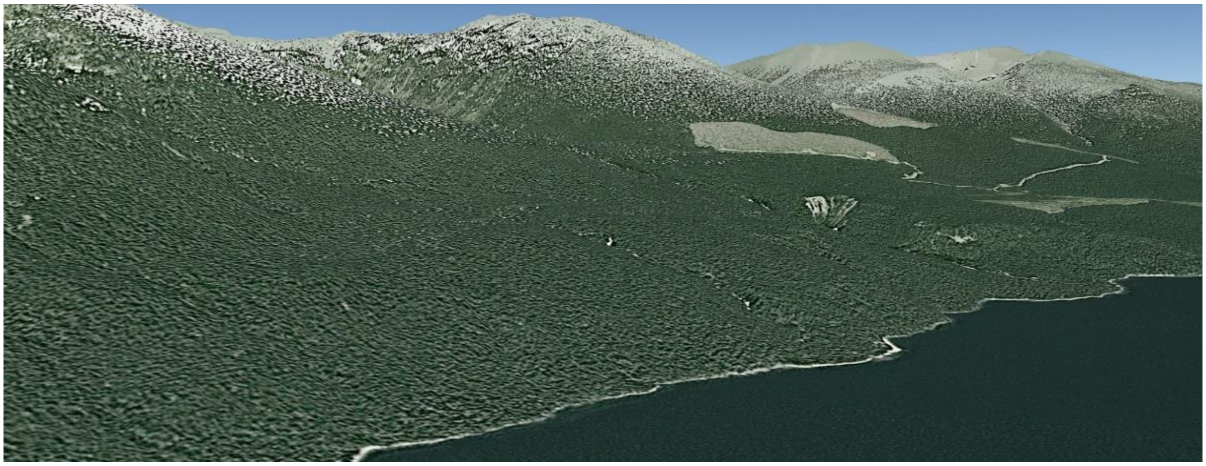

Figure 1 Low spatial aggregation (site 5)

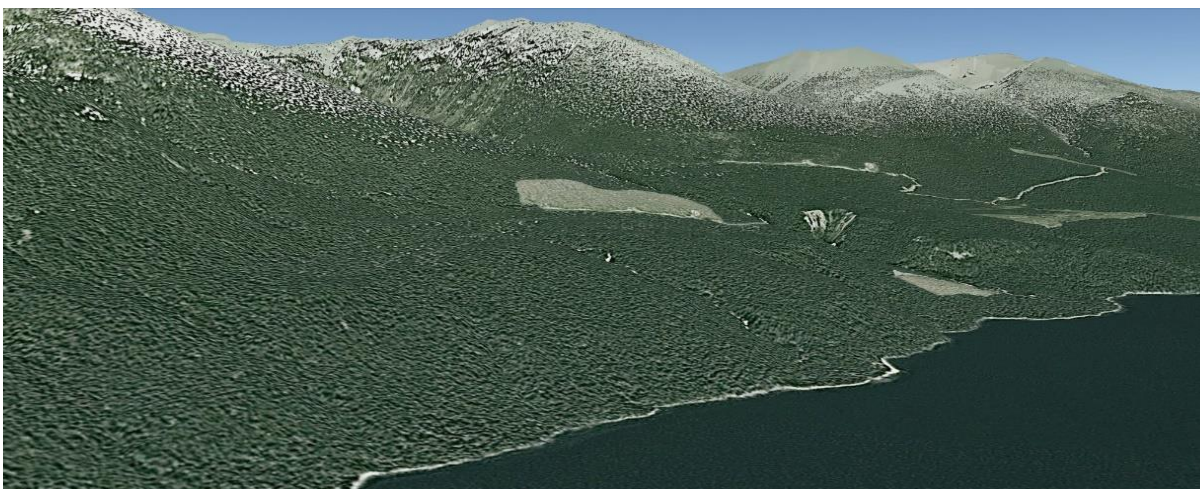

Figure 2 Medium spatial aggregation level (site 9)

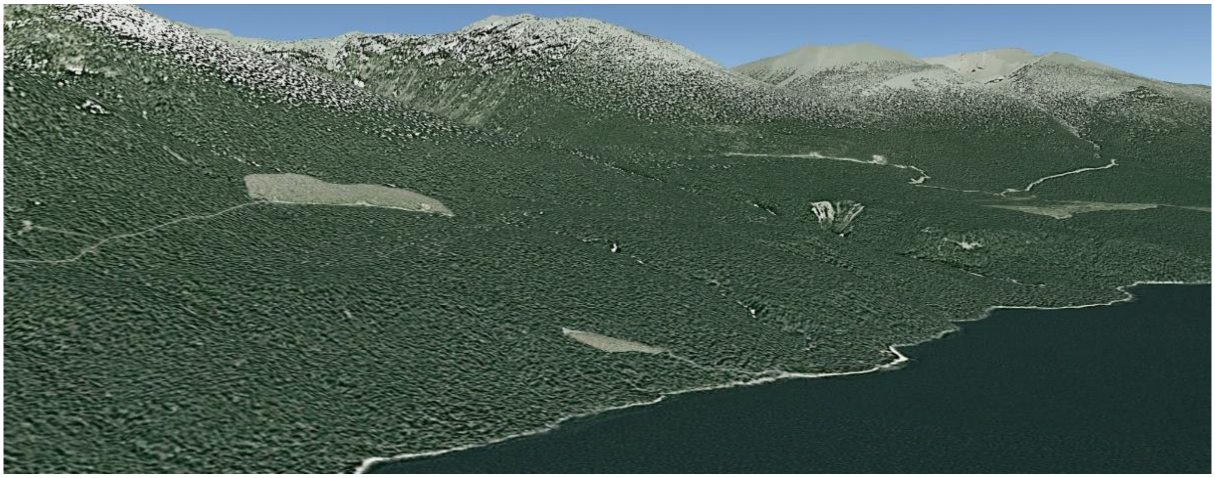

Figure 3 High spatial aggregation level (site 9)

The survey was designed using the on Google Form online platform to lead participations through a series of questions. The survey was conducted on a personal computer at the Ideal Lab in the Department of Forest Resource Management at UBC. All images were displayed at a resolution of approximately 2000×800. In addition, each of the images except for the four preview images was displayed full screen with space provided below for the rating scale. Before taking the survey, a client number was required in order to track the demographic information of participants.

All participants were asked to rate a series of images for scenic beauty. The full scale range was from 1 to 10, where 1 indicated low scenic beauty and 10 indicated high scenic beauty. I supposed to set the survey to automatically generate a completely randomized order with one constraint (adjacent two images cannot come from one same site) for all images. However, as I were not confident in programming, I used an excel spread sheet to automatically generate the two fixed orders which meet the constraint as well.

The survey included three parts. The first two parts were designed to help the participants prepare for the survey. Part 1 described what the survey was about and explained what the participants would be tasked with doing. Part 2 provided a brief preview for the survey. The four preview images were not part of the study but represented the type of images the participants would view in the study (Part 3). Unlike the images shown in Part 3, where only one image was shown on each page, the preview images were displayed two images per page. One indicated high spatial aggregation and the other indicates low spatial aggregation. Participants were asked to carefully look at each image and identify how they would rate each on a scale of 1 (least preferred) to 10 (most preferred). I also emphasized that it is quite important for participants to use the entire range of the scale (e.g. score the worst image of the set scores very low on the scale and the best image of the set very high on the scale). The purpose of this preview was to represent the full range of variability of the designs and allow participants to anchor the end points of the rating scale according to this range (Brown & Daniel, 1990). Participants were informed that it was not permissible to go back to previous images and modify the original rating in the survey.

Part 3 included the all actual study data collection. Participants need to rate each of the 30 images. Again, before the rating commenced, participants were reminded to use the entire range of scale to evaluate each image.

After all data were collected, I used Univariate Analysis of Variance for analyzing the results. The statistical analysis process was conducted with the help of the IBM software SPSS.

RESULTS

After the survey was conducted, I noticed that there were some problems within Site 3 images. I did not follow the design principle in which all modified cutblock should be moved to the foreground or the middle-ground. Consequently, I removed all the responses for Site 3 images. Additionally, two individuals from the Order 1 data set and eight individuals from the Order 2 data set were removed due to a poor range of ratings (less or equal to 3). As a result, the actual sample size was 74 individuals.

Table 2 ANOVA results of visual landscape design variables on preference rating (excluding site 3)

Source	DF	Type III SS	Mean Square	*F* value	Sig. *p*	Partial η^2
Site	8	1626.457	203.307	48.235	.000	0.164
Condition (Spatial aggregation)	2	12.115	6.058	1.437	.238	0.001
Site* Condition (Spatial aggregation)	16	63.633	3.977	.944	.518	0.008
Error	1971	8307.689	4.215			
Total	1998	81375.000				
Corrected Total	1997	10009.894				

*Statistically significant results at the $p = 0.05$ level.

An ANOVA was conducted using the IBM software SPSS (Table 2). The f value of spatial aggregation was 1.437, and the p value was 0.238 which is larger than $\alpha = 0.05$. Consequently, I could not reject H0. The three spatial aggregation levels did not cause a significant difference among individual’s ratings.

Four figures were exported from SPSS which are helpful for me to analyze and understand the results better (Figure 4-7).

Figure 1 shows the marginal mean ratings for all 9 sites. The line goes dramatically up and down along the average rating line of all images (about 6.0). It illustrates that there were a considerable differences across the 10 sites in terms of scenic beauty preference. In addition, according to table 2, the *f* value of spatial aggregation was 48.239, and the *p* value was smaller than 0.001 leading to reject H0. There were significant differences across the 10 sites in terms of individual's ratings.

Figure 5 illustrates the marginal mean ratings based on the three different spatial aggregation levels. Condition 1 represents the high spatial aggregation level, condition 2 represents the medium spatial aggregation level and condition 3 represents the low spatial aggregation level. A slightly increasing trend in mean ratings from the high spatial aggregation level to the low spatial aggregation occurred. However, the difference between the high level and the low level was only about 0.2. This was not large enough to be statistically significant.

Figure 6 illustrates the variance of the mean ratings across the three spatial aggregation levels for all nine sites. According to Figure 6, Sites 4, 5, 9 and 10 show relatively larger variance across three levels (increasing from High to Low). However, the average ratings for sites 1, 6 and 7 decreased from the high to low spatial aggregation level. Site 8 had no obvious difference across the three spatial aggregation levels. For site 2, the medium spatial aggregation level images had best scores.

Figure 7 shows the average ratings for each site. Site 1 was given the highest ratings. Site 10 was given lowest ratings.

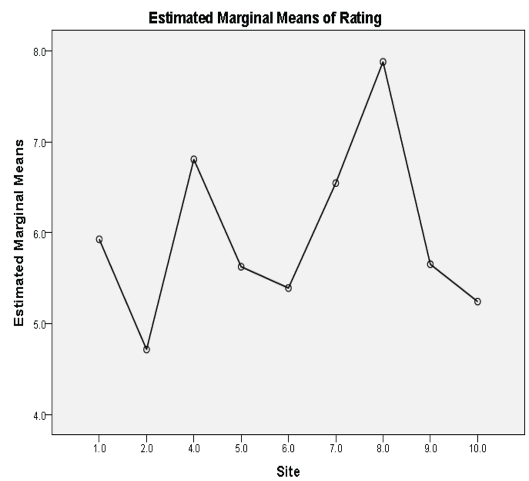

Figure 4 Marginal means of rating regarding different site

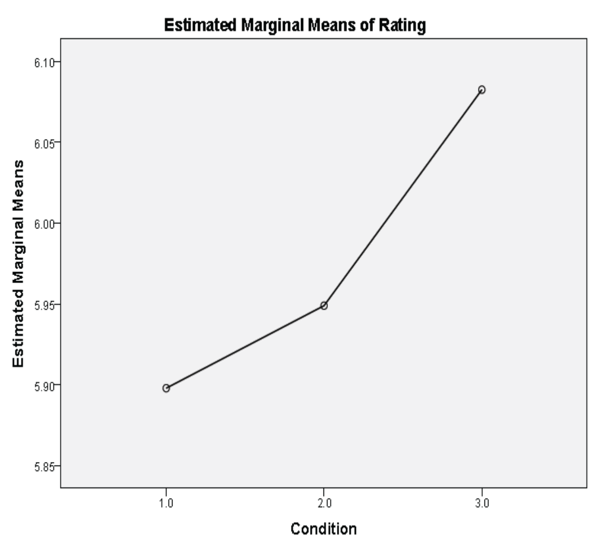

Figure 5 Marginal means of rating regarding condition

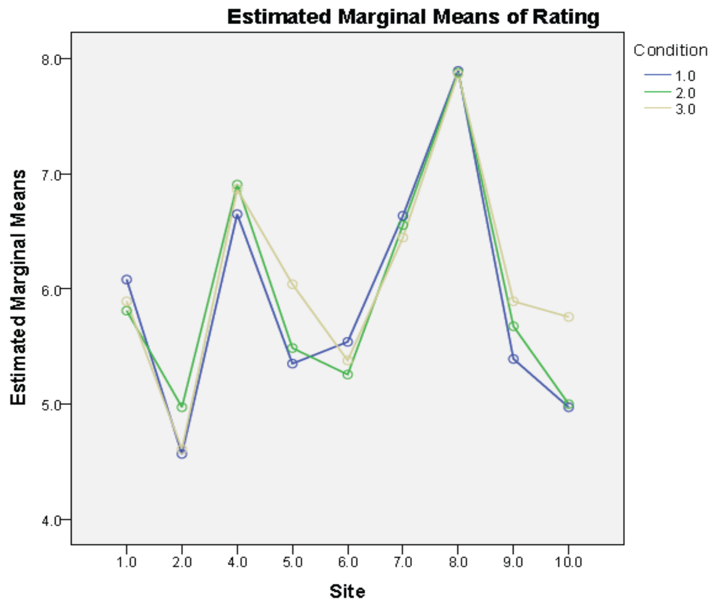

Figure 6 Marginal means of rating regarding sites

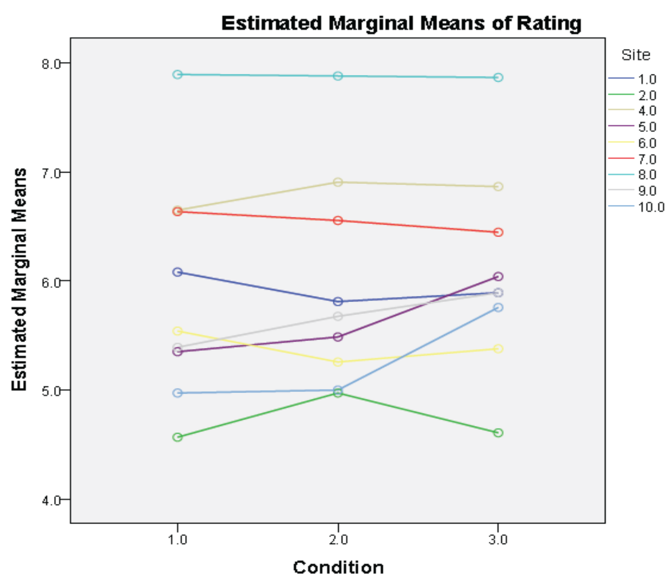

Figure 7 Marginal means of rating regarding interaction of sites& condition

DISCUSSION

Results derived from the survey did not support the hypothesis that individuals' perceptions of scenic beauty decrease with an increase in spatial aggregation. However, individuals' ratings were expected to decrease from low to high disturbance (BC ministry of Forests, 1994). It has been widely believed that this hypothesis holds in most circumstances. Thus, it is necessary to reflect on the experiment from a design principle perspective as well as from survey implementation perspective in order to gather insights regarding my results.

Images of Sites 2, 5, 9, 10 show a relatively larger variance (≥ 0.5 marks) across the three different levels (Figure 6). Mean ratings for Sites 5, 9, 10 decreased from the low to high disturbance level: however, the mean rating of the medium disturbance levels was highest within Site 2. These four sites can be distinguished from the other 5 sites based on the degree of variance of the mean ratings. Additionally, the mean ratings for Sites 2, 5, 9, 10 were much lower than the other 5 sites. The dominant harvest design in Sites 2, 5, 9, 10 was relatively large clearcuts.

In Sites 2, 5, 9, 10, the cutblock were generally better designed in terms of using a variety of techniques to mitigate the negative visible effects of harvesting in landscapes. These techniques (e.g. less blocky design) were used to keep cutblock as natural as possible when perceived by individuals. On the other hand, my results match the conclusion that the amount of visible alteration in forested landscape is the dominant factor in terms of scenic beauty preference in most circumstances (BC ministry of Forests, 1996).

The underlying question is why these two facts together contributed to the evidence that more differences were perceived by individuals within sites that had lower mean ratings? I got considerable feedback from survey participants. That showed an amazing consensus. The participants reported having a higher likelihood of perceiving more differences across the three different spatial aggregation levels within sites where the dominant harvesting design was relatively larger clearcuts. Those sites where techniques were used to mitigate the visible effects of harvesting were less easy for them to recognize. They showed less concern for the other sites where the dominant harvesting designs' were relatively small scale clearcuts and the cutblock were better designed.

Most participants also pointed out that colour contrast was important. Colour contrast is not similar to the colour gradation which refers to the whole image colour range I mentioned in the methods. It reflects to the contrast between the cutblock and forested landscape with no alteration visually perceived by individuals.

This point is supported by the SPSS outputs as well. According to Figure 4, the better scored sites (e.g. Sites 4 and 8) had much smaller colour contrasts between the cutblock and forested landscape. Although visual alteration percentage is the dominant indicator in visual landscape designs for scenic beauty preference (BC Ministry of Forests, 1996), all images which showed relatively larger variances also showed relatively larger colour contracts. Individuals are expected to perceive relatively more differences across three spatial aggregation levels given a site with larger colour contrasts. If individuals see another site which is exactly same, except for smaller colour contrast, then they are expected to have less difference in terms of scenic beauty ratings across three spatial aggregation levels.

This makes sense given the delineation of texture and Visual Absorption Capacity (VAC). If a modification of the same size is conducted on two forested landscapes, with one having an even and fine texture and the other having a much coarser texture, it is much more likely to be perceived as a serious degradation in the landscape with even and fine texture (BC Ministry of Forest, 1994). Many factors such as diversity, spacing of the trees, and distance variation relate to the perception of textures in the forest (BC Ministry of Forest, 1994).

In my study, sites with a lager colour contrast indicated lower VAC than sites with less colour contrast. If the size of modifications were the same, individuals showed less concern for degradation in sites with higher VAC and did not identify perception differences caused by spatial aggregation levels.

Among a series of similar forested landscapes, it is much more likely for individuals to perceive larger differences across three different spatial aggregation levels in forested landscapes with two characteristics. The first characteristic is if the dominant harvesting is a relatively clearcut. The second is if the colour contrast between cutblock and the forested landscape with no alteration is relatively large.

Another issue is the accuracy and consistency of guidelines determining manipulation of cutblock. The guidelines I listed and followed for creating the medium and high spatial aggregation levels in my experiment were not consistent and quantitative in terms of designate position and the percentage of cutblock moved. It is necessary to control the fixed effects as precisely as possible in order to get reliable results. In retrospect, Site 3 should have been removed.

I have identified revised guidelines for further studies based on my experiences,. For the medium spatial aggregation level, one third of the alteration should be moved to the middle-ground. For the high spatial aggregation level, one-third should be moved to the middle-ground and another one of third alteration should be moved to the foreground. However, in some sites (e.g. Site 4); it was infeasible to precisely control the modification percentage because the cutblock were not exactly separable.

A comprehensive suggestion for addressing the three is to create several forested landscape with rigid designs. Firstly, distinct foreground, middle-ground and background is required. Secondly, a relatively larger scale clearcut with poor design should be the dominant existing harvesting pattern. Thirdly, a relatively large colour contrast between the cutblock and the none-altered forest is preferred. Lastly, the size and number of cutblock should be controlled in order to meet the modification guidelines. In this case, I recommend using the Visual Studio Software to create those rigid images based on the criteria listed.

After analyzing experiment, I reflected on the survey process. Completely randomized order with only one constraint (adjacent two images are not allowed from the same site) is required for each survey participant. It is important to make sure that each participant has a different order in the survey so that order effect is mitigated.

The fundamental objectives of visual simulations are understanding, credibility, and lack of bias (Sheppard, 1989). Simulations should clearly convey information about a particular scene without being misleading or eliciting a certain responses from reviewer. For my experiment, this constraint was very important as participants could easily realize the design purpose if they could have seen a series of images from the same sites. However, two fixed random orders generated with an Excel spread sheet were used instead of completely randomized order due to limited time. Although it was an acceptable alternative, it is best to conduct a completely randomized order for each participant in future studies.

It is difficult to please everybody. Scenic beauty evaluation does not have absolute rules or standards which always represent better scenes. As Van den berg & Koole (2006) argued, scenic beauty preference is quite a subjective perception affected by different cultural backgrounds, age, education level and even gender. In my case, my participants were from a restricted pool (e.g. they are all university students with two major cultural backgrounds).

It is necessary to consider the demographic and psychophysical elements as well. Attempts to measure visual quality often take the form of psychophysical studies that relate human perception and judgment to environmental stimuli. Follow up questions related to the ratings and the user-preferred design characteristics is recommend for future study as well. The follow up portion would consist of open- and closed-ended questions. Demographic data should be collected along with the individuals' area of studies. Particular interest in these questions is whether or not the participants could identify differences across the three different aggregation levels and rank the images regarding scenic beauty, compared with how they actually rated the designs. To capture data, each of the three levels of aggregation levels I investigated could be listed and participants could be asked to rank how they thought to determine their design preference in terms of scenic beauty quality, as done by Chamberlain & Meitner (2012).

A more heterogeneous population sample is recommended for future studies to ensure better representation of the public. However, Stamps (1999) demonstrated in a meta-analysis of environmental aesthetic preference studies that the degree of correlation between different demographic groups (including students versus others, designers versus others pertaining to nature, gender, political affiliation, etc.) was high. However, there was a lower correlation between special interest groups versus others and age (when age groups are divided into children versus adults). Since forest planners often work with special interest groups, it is also important to conduct specific work to understand the preference of individuals in these special interest groups versus the general population.

CONCLUSION

The purpose of the experiment was to investigate how the spatial aggregation levels of harvesting cutblock design influence individuals' perceptions of scenic beauty in a forested landscape. My pilot study showed that there was no significant difference across the three different spatial aggregation levels in terms of individuals' ratings. Nevertheless, this trial still gave me useful insights for developing a more solid future study.

This study revealed three important indicators, what had an impact on how spatial aggregation levels influence individuals' perceptions of scenic beauty preference in a forested landscape. Firstly, variance of ratings across three spatial aggregation levels based on human perception was proportional to the amount of visual alteration of forested landscapes. Secondly, good design of harvest block led to less variance of ratings across the three spatial aggregation levels. Finally, the variance of ratings across the three aggregation levels was proportional to the colour contrast between harvested and no harvested landscape.

Based on my experience design and analyzing this experiment, I have two suggestions for improvement. First, a completely randomized order for each survey participant with one constraint is mandatory. Second, follow up questionnaires for demographic analysis are necessary.

The results of landscape perception experiments can be directly linked to forestry management, especially visual landscape design management. It provides a way for forest planners to better understand the effect that different spatial aggregation levels of harvesting cutblock design may have on individuals' ratings of scenic beauty. This study revealed that it is crucial to integrate related characteristics of the whole visual landscape design concept when implementing a visual management design. Additionally, it is impossible to isolate a single characteristic from the whole visual landscape design concept. These sorts of studies will help forest planners to provide a more solid and objective way to access visual landscape modification, reducing the amount of time to create a visual management plan.

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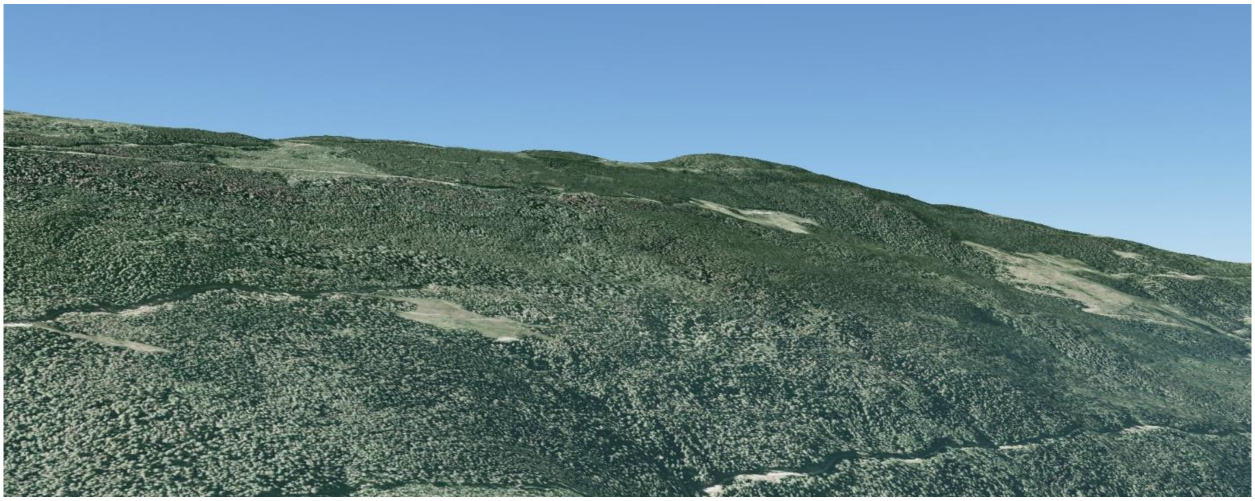
APPENDIX

Site1 High

Site1 Medium

Site1 Low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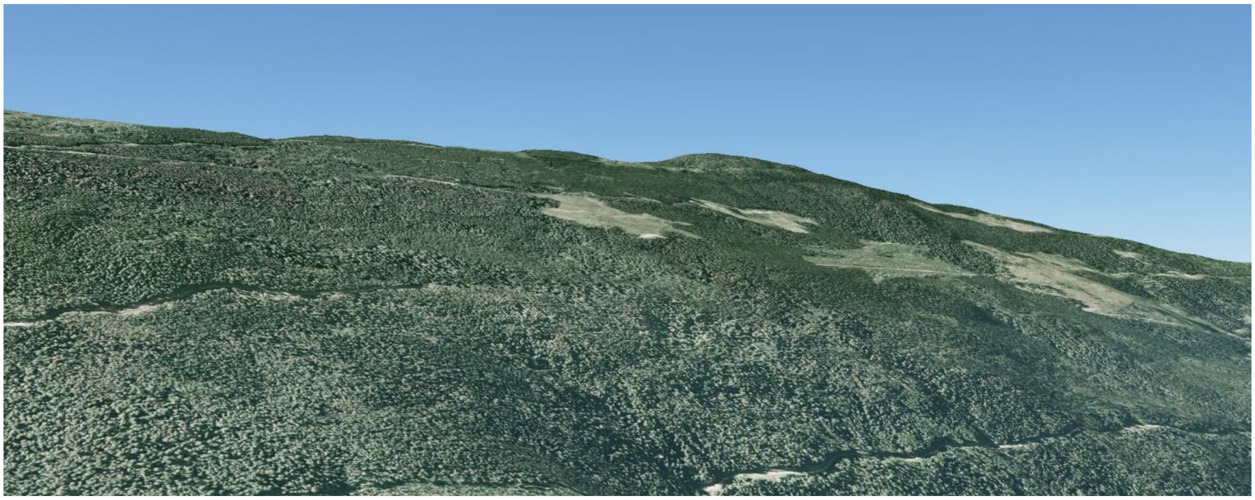
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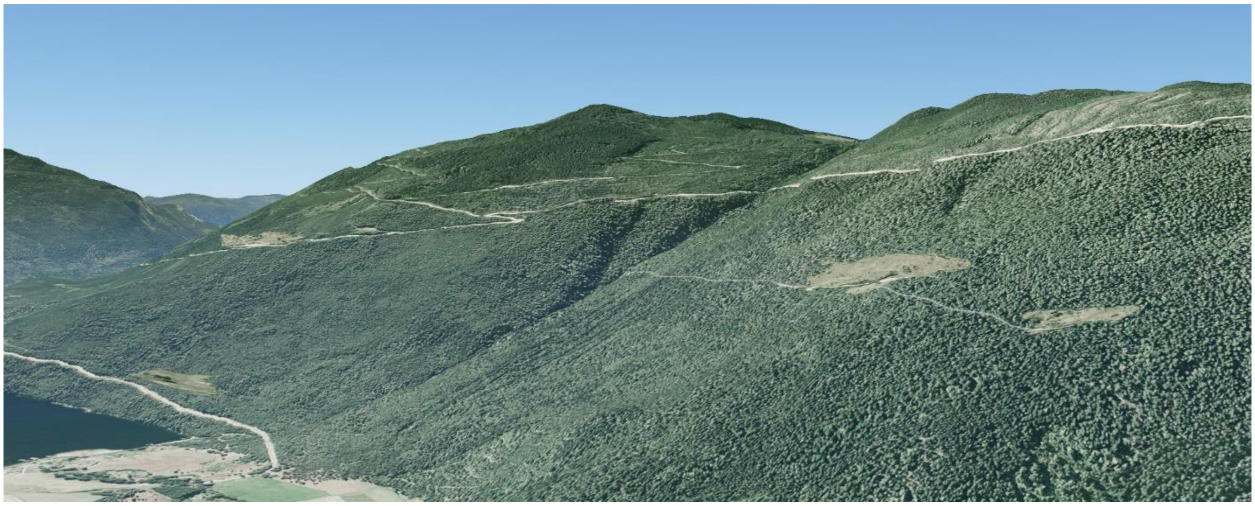

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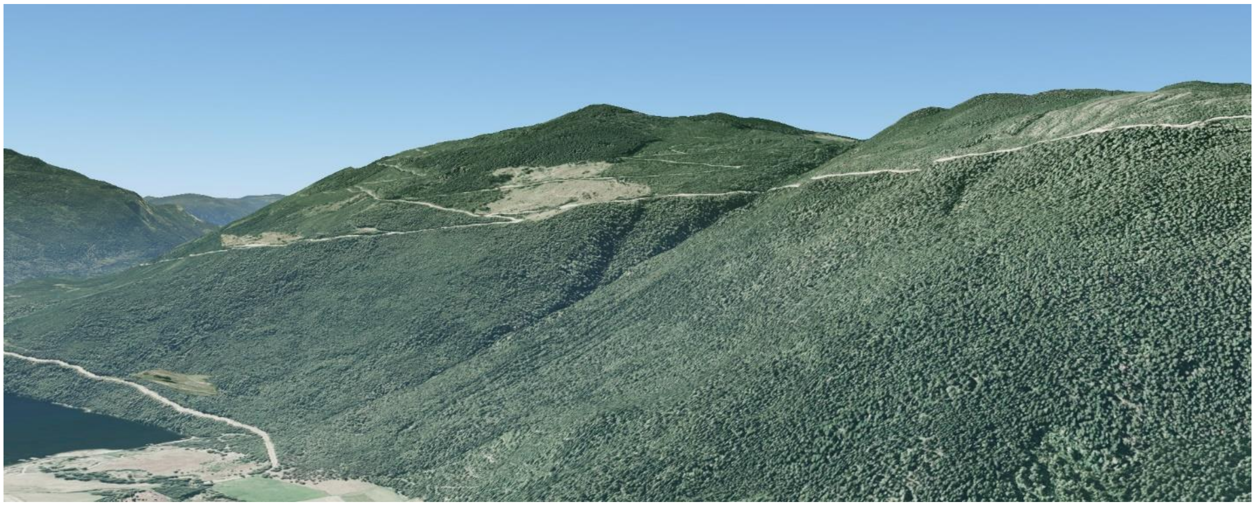

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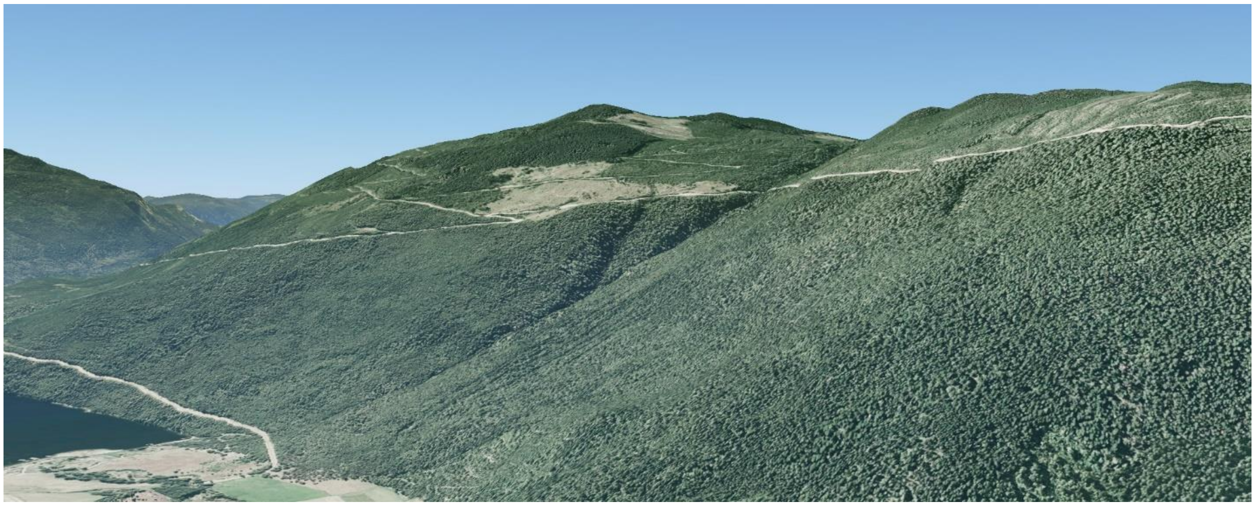

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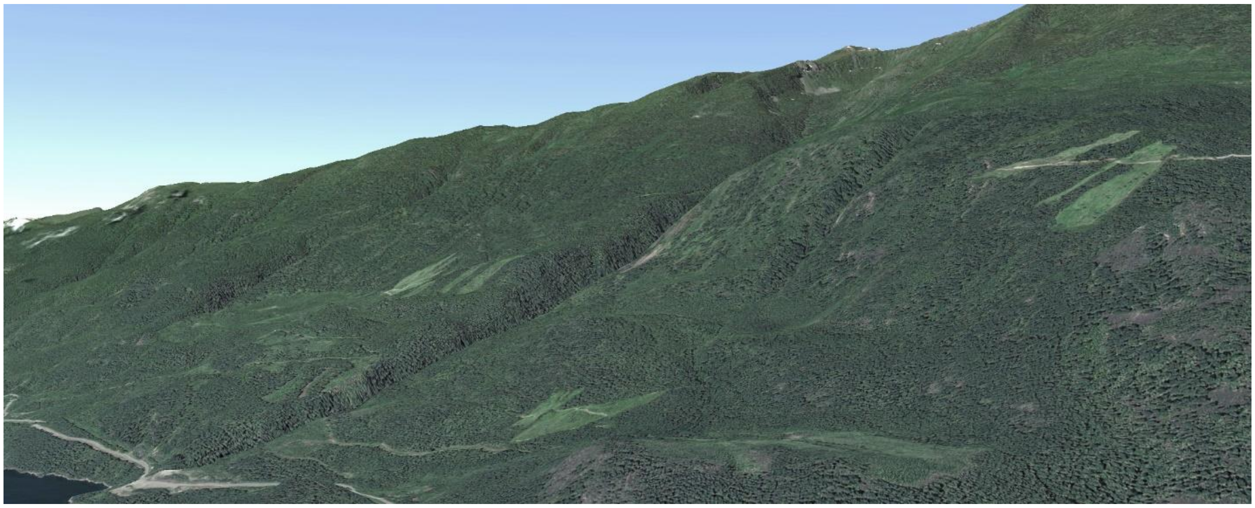

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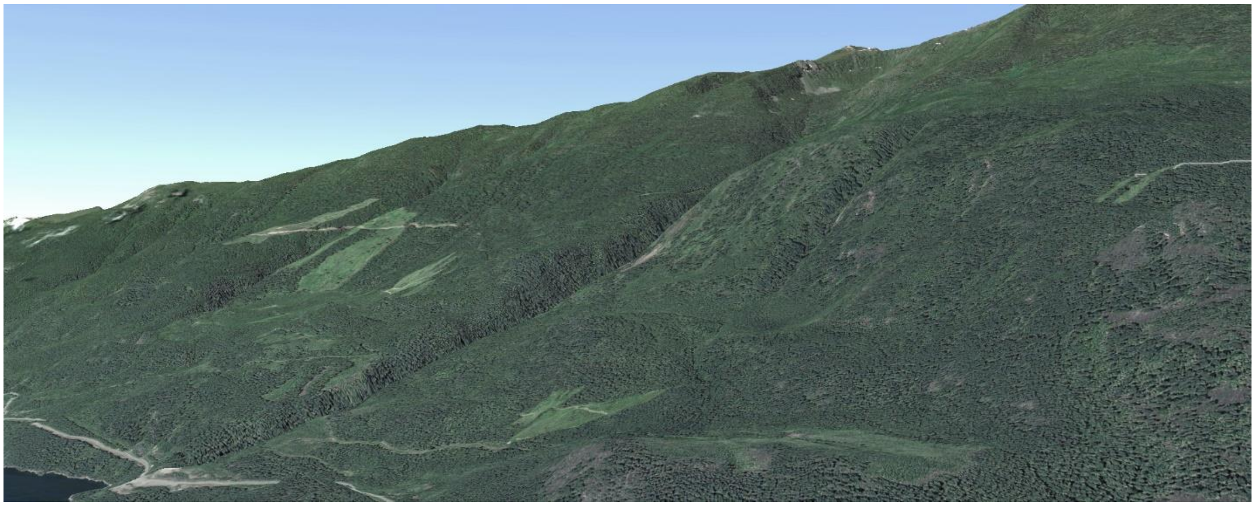

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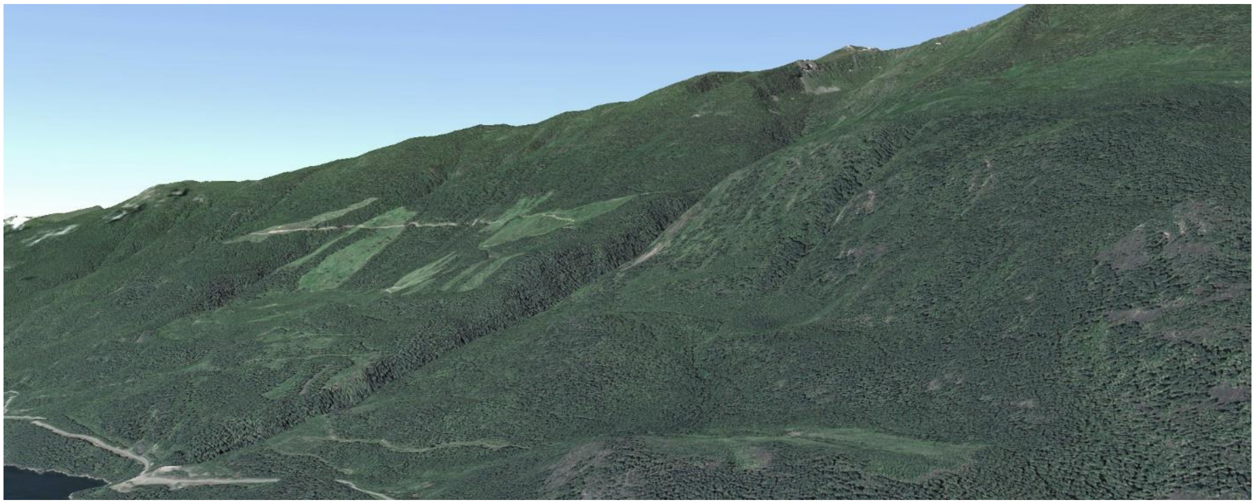

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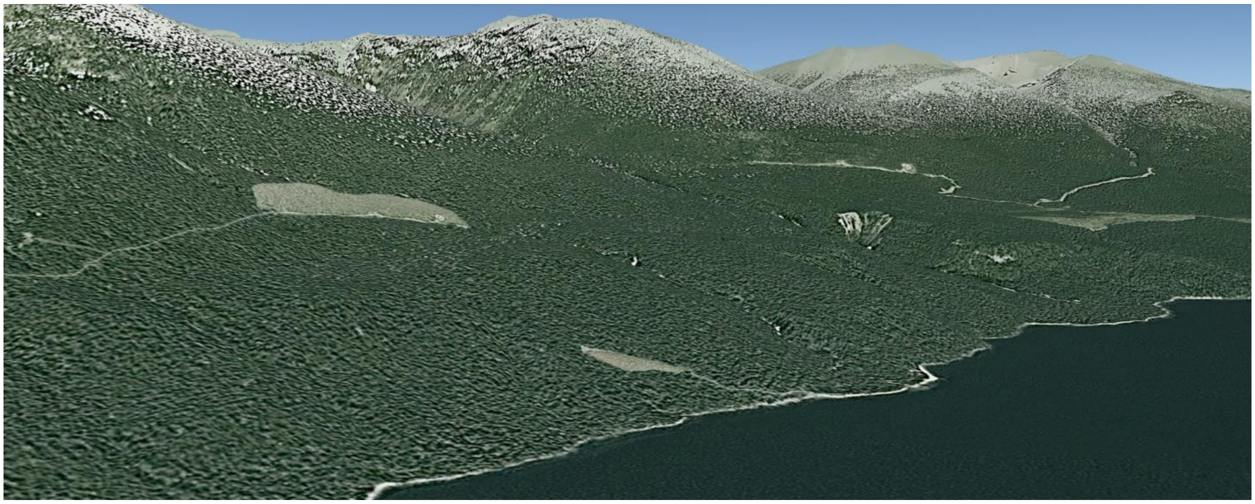
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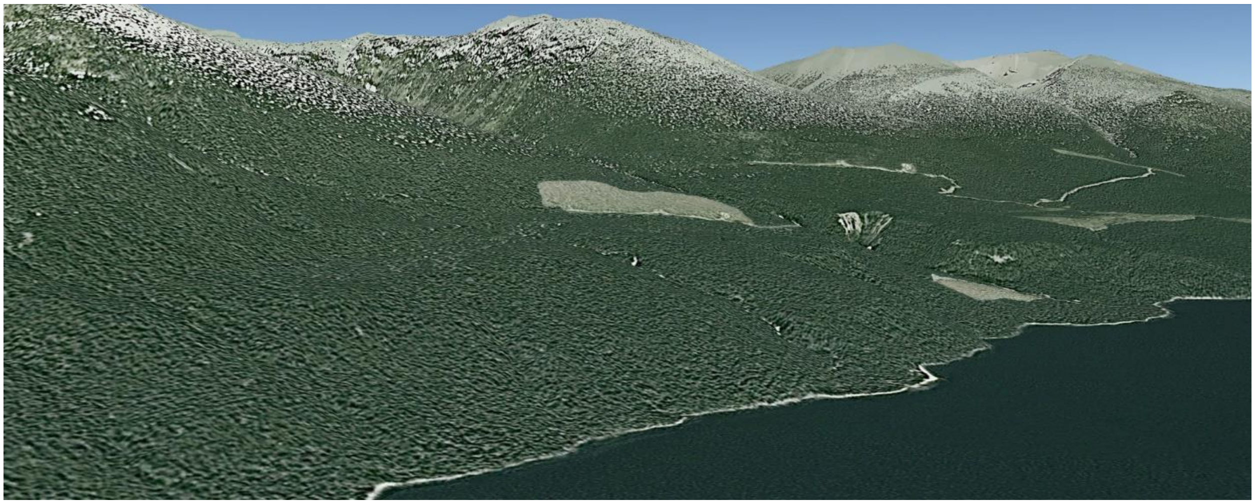
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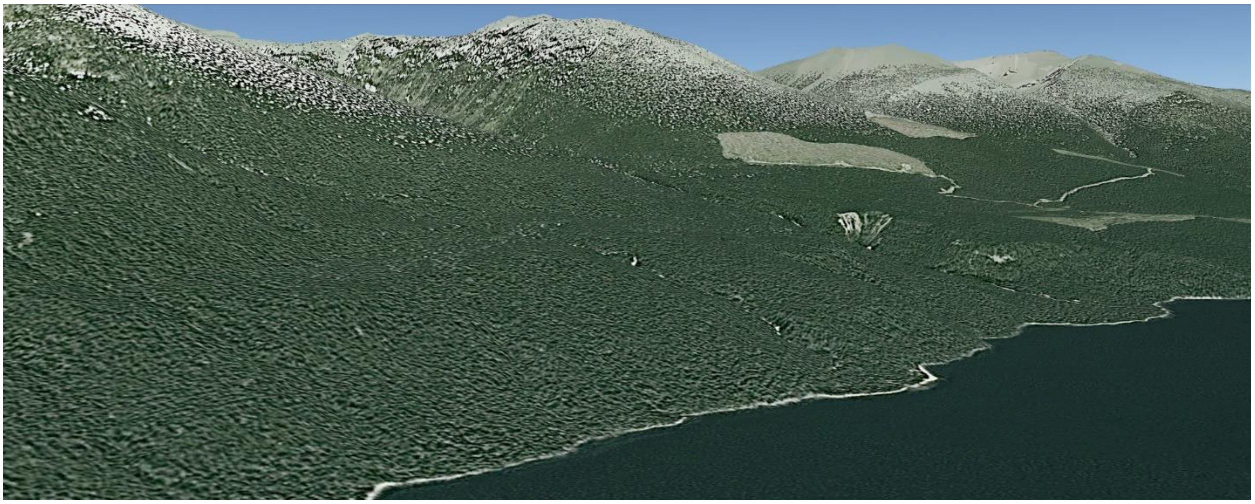
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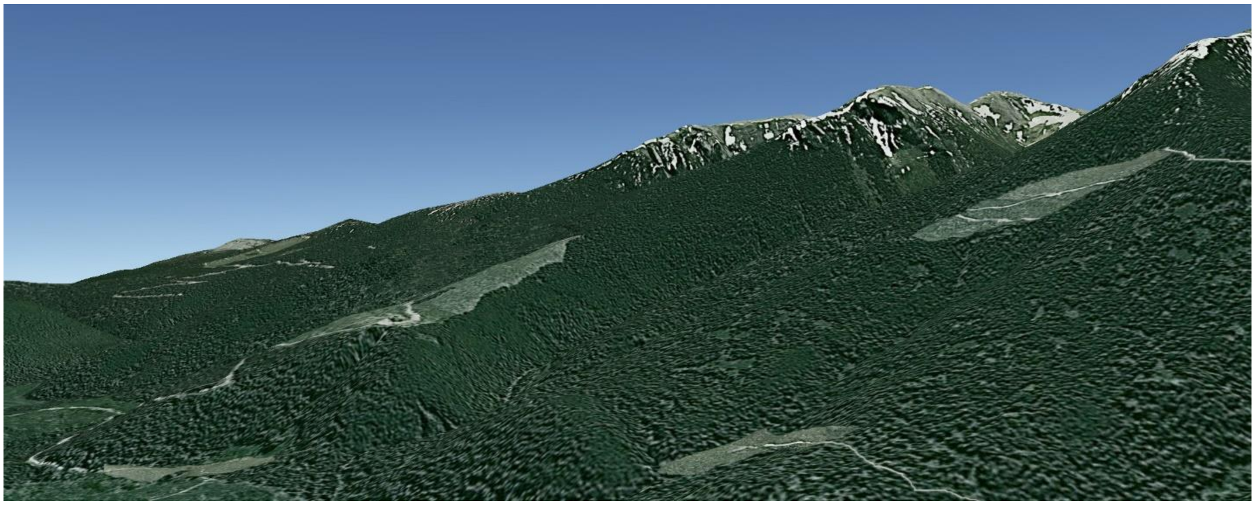

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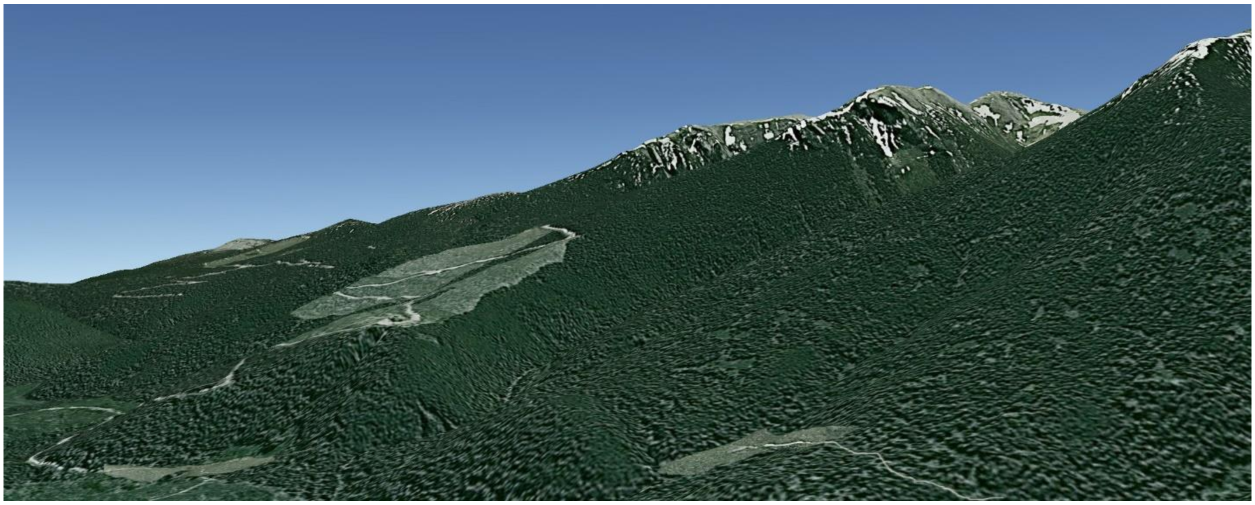

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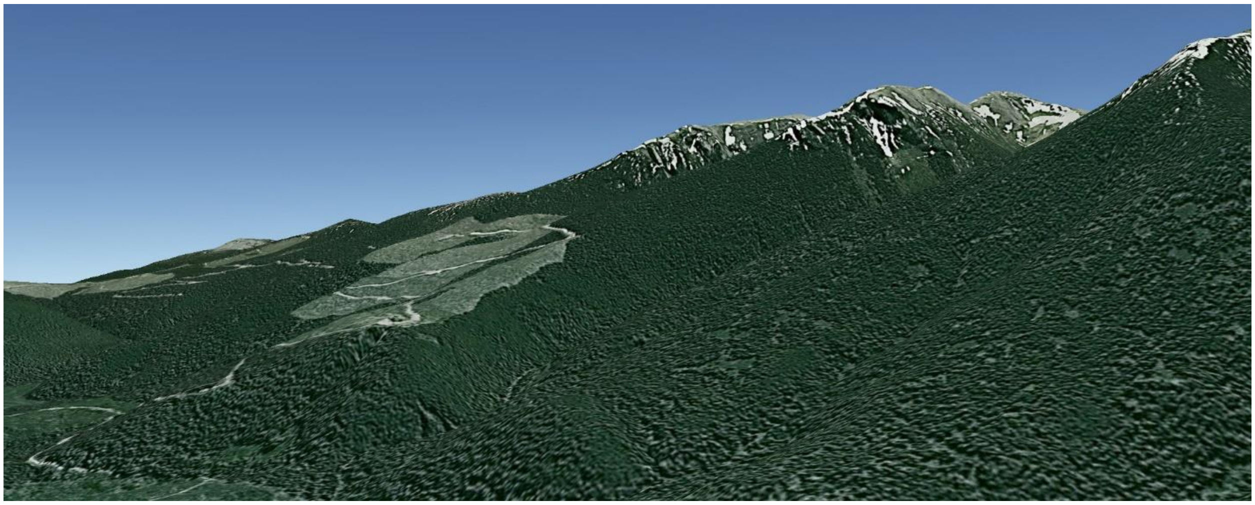

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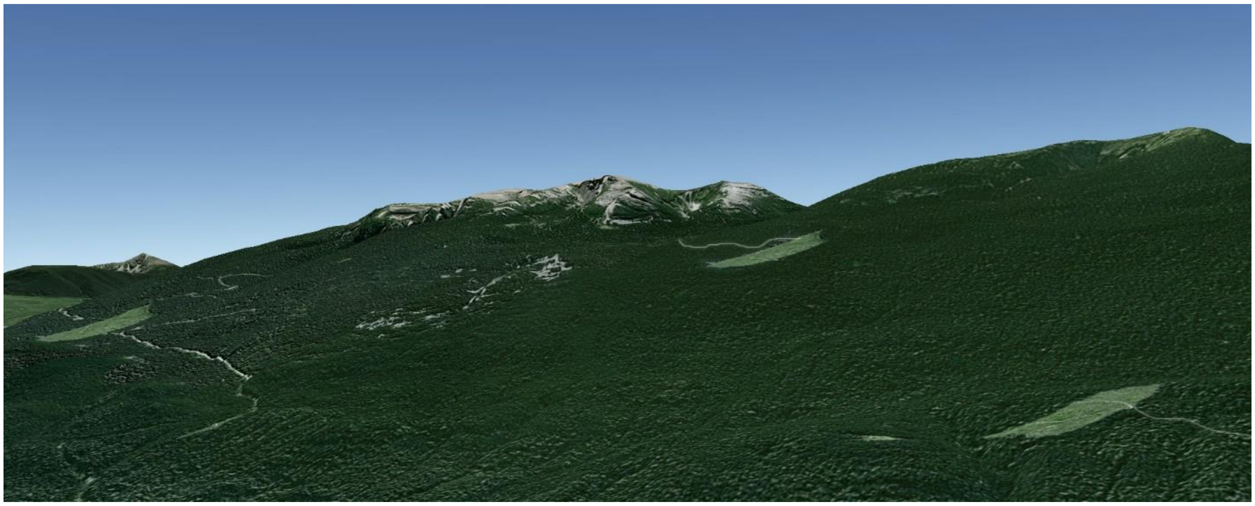

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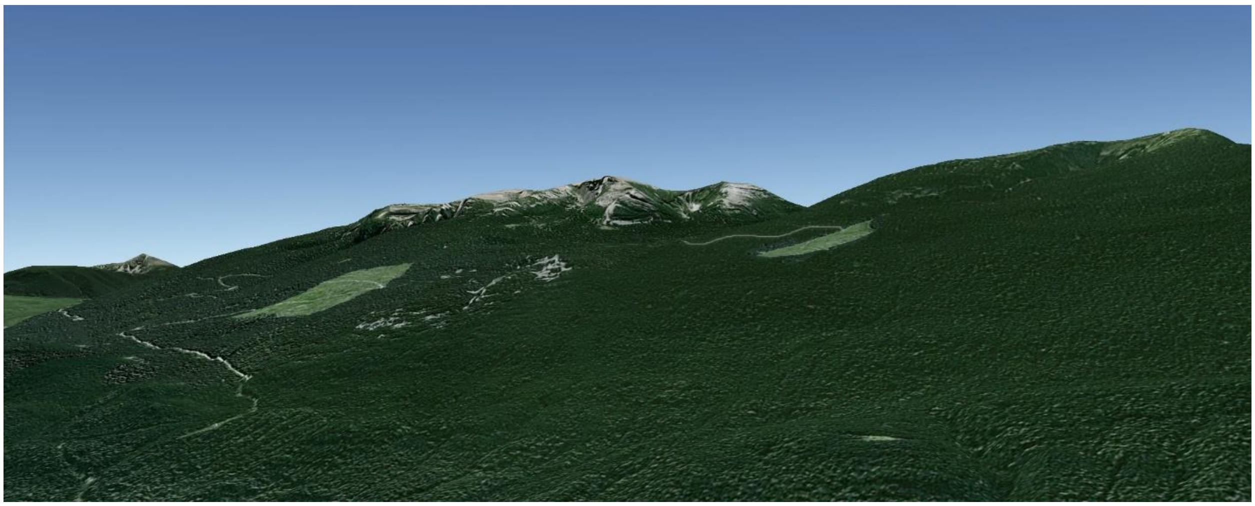

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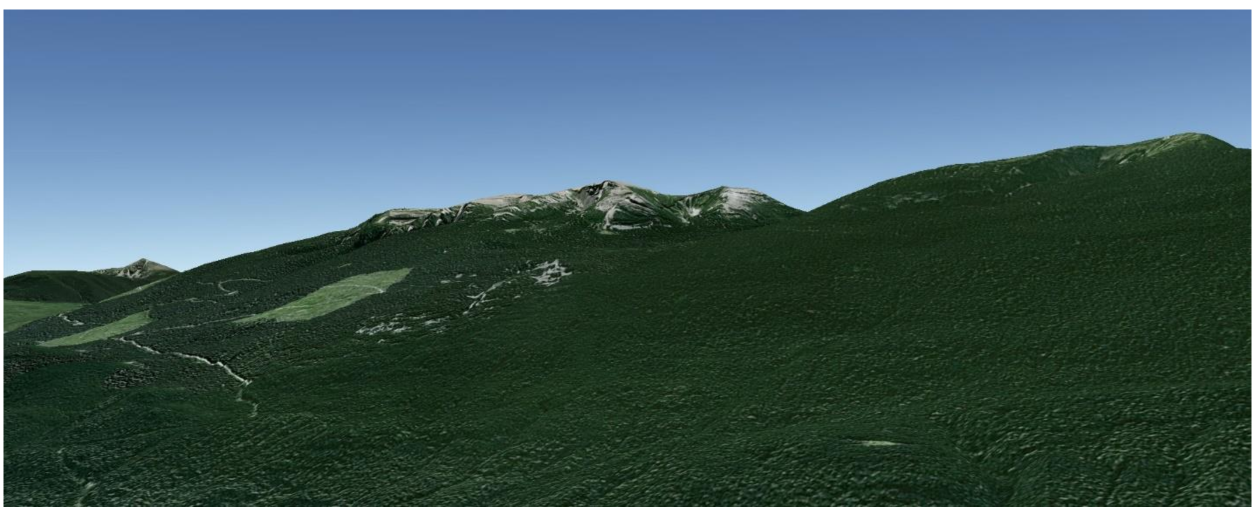

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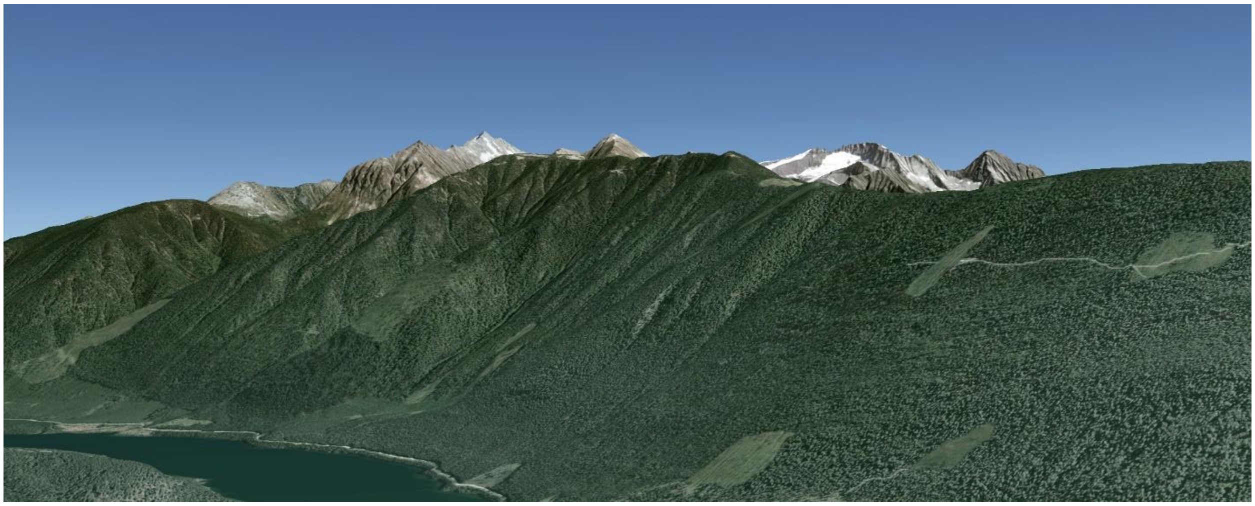

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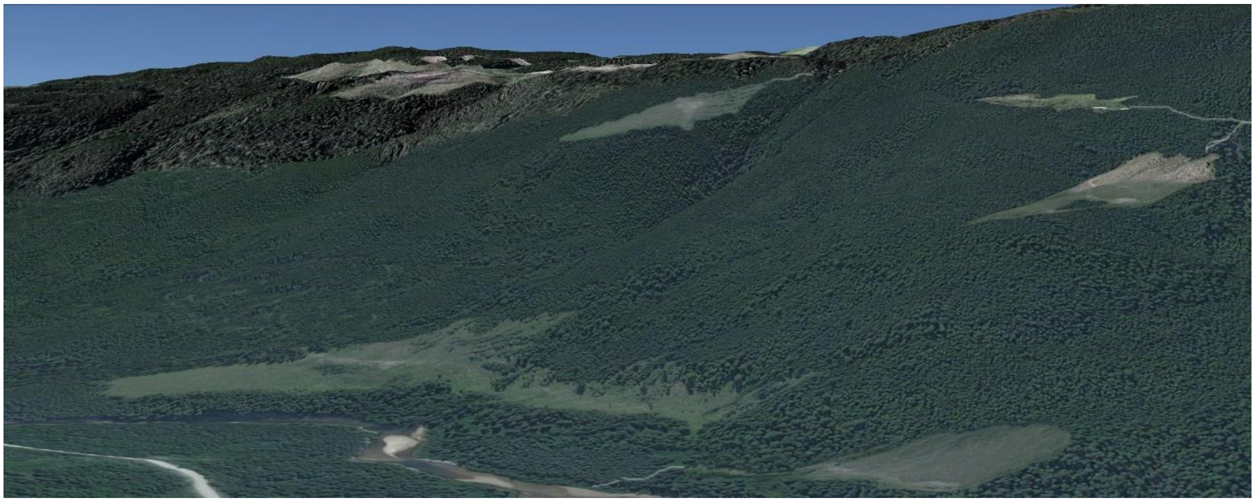

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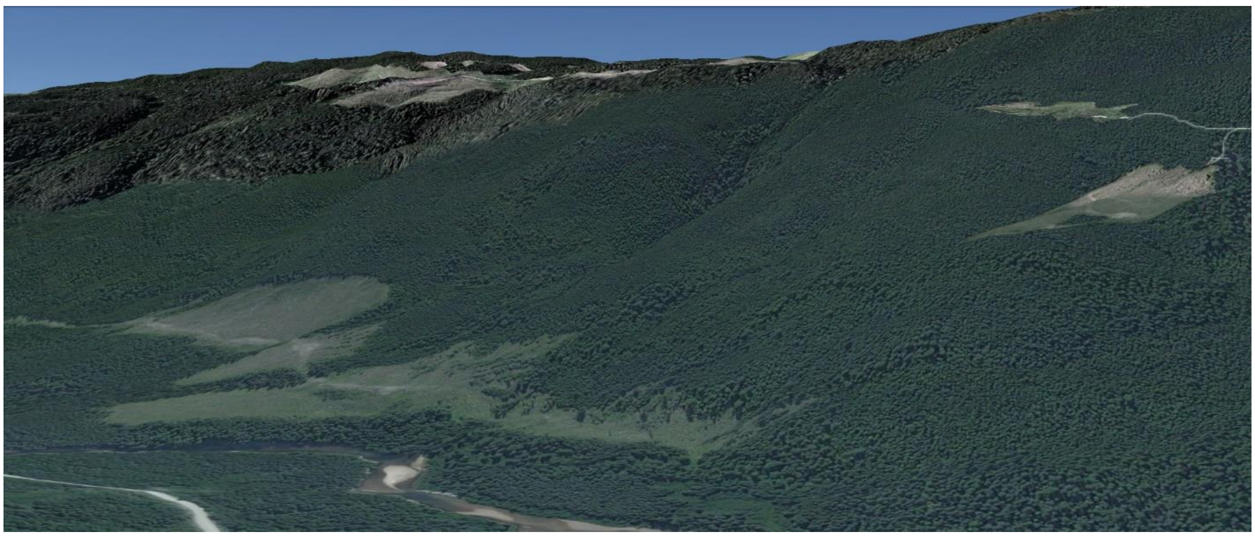

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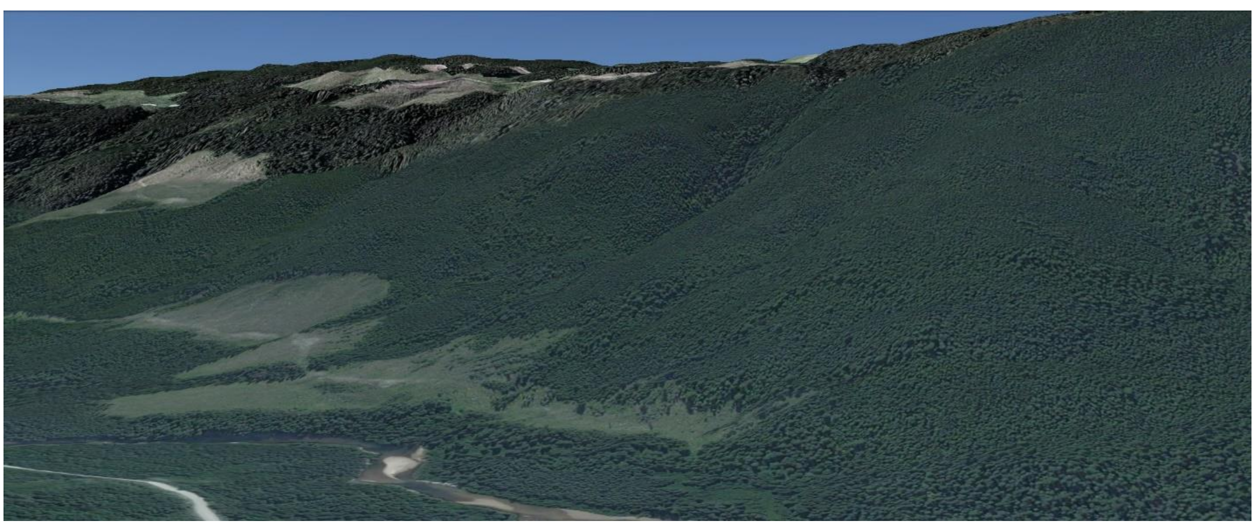

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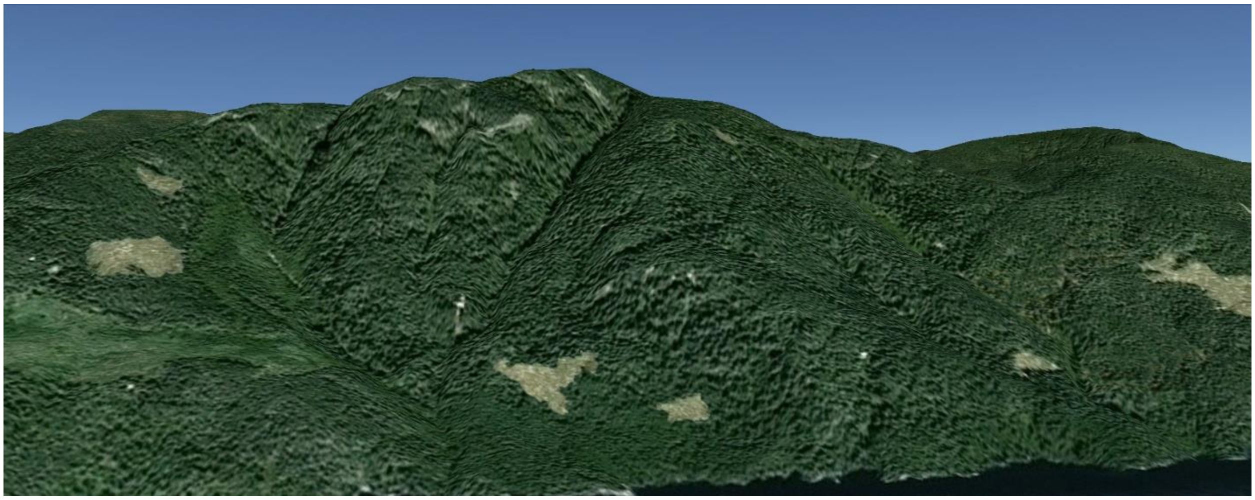
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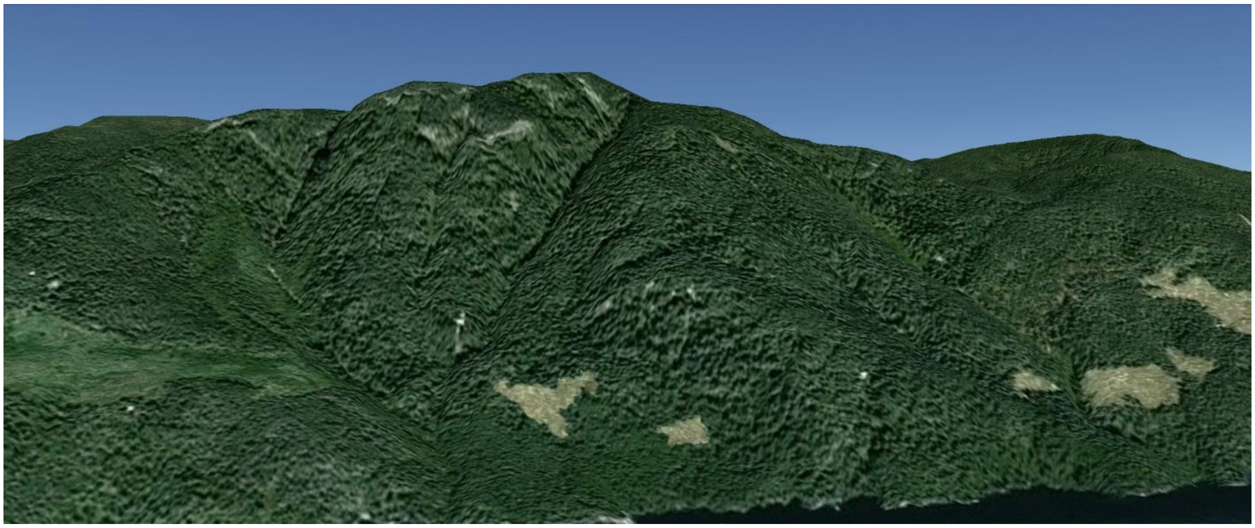
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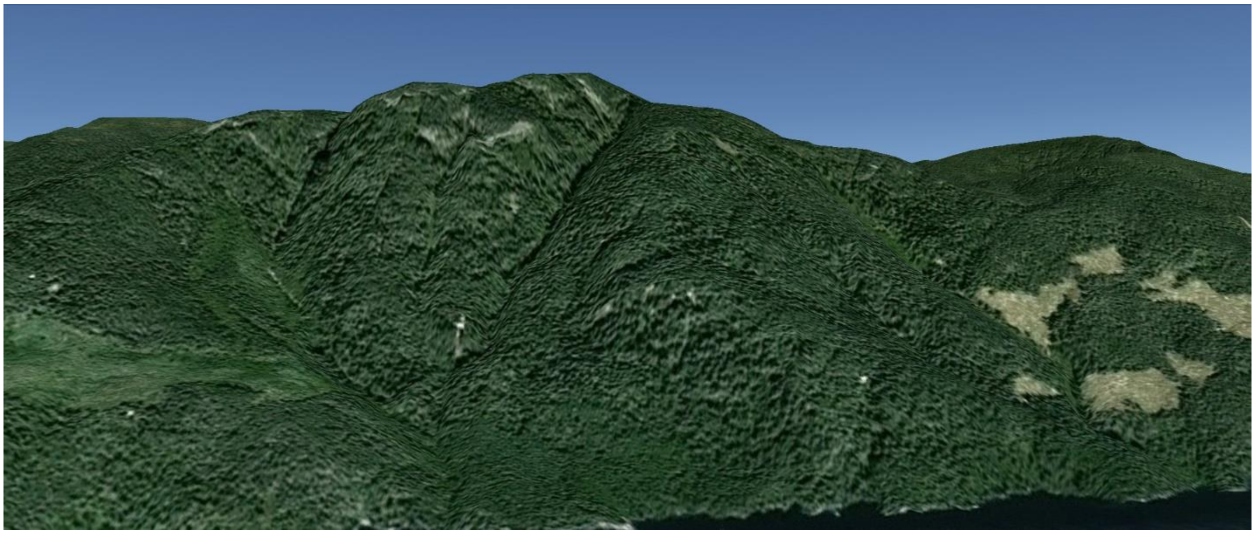
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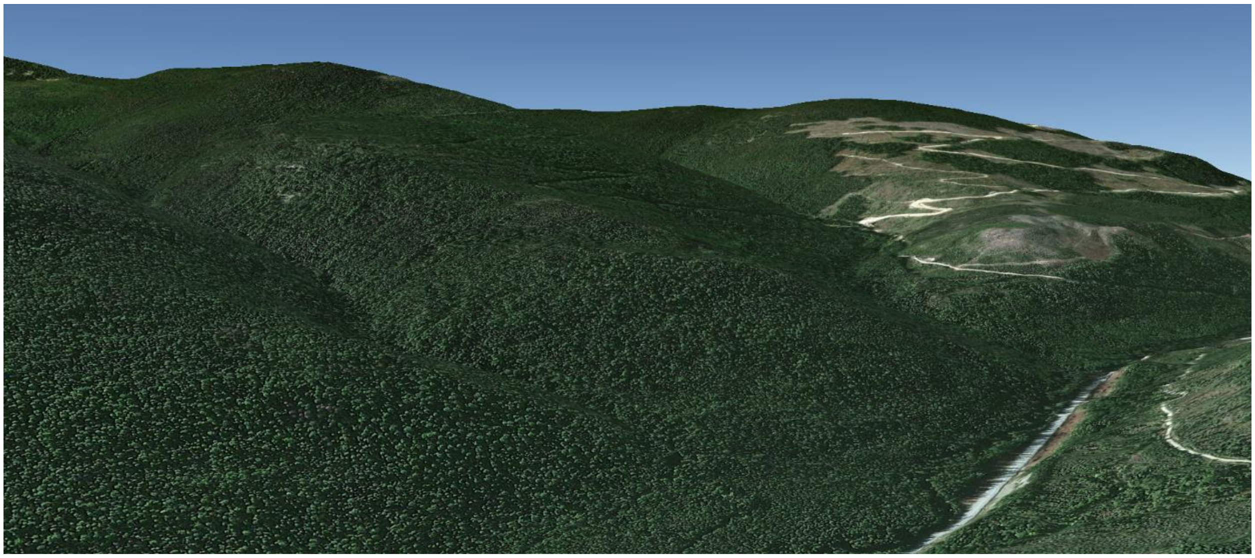

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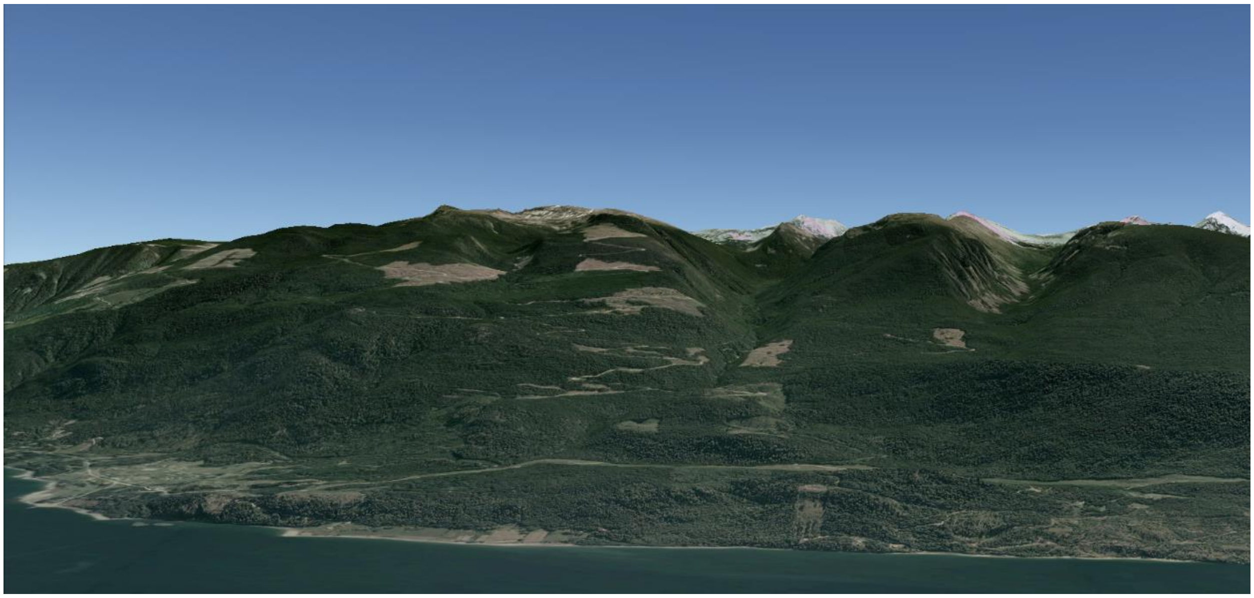

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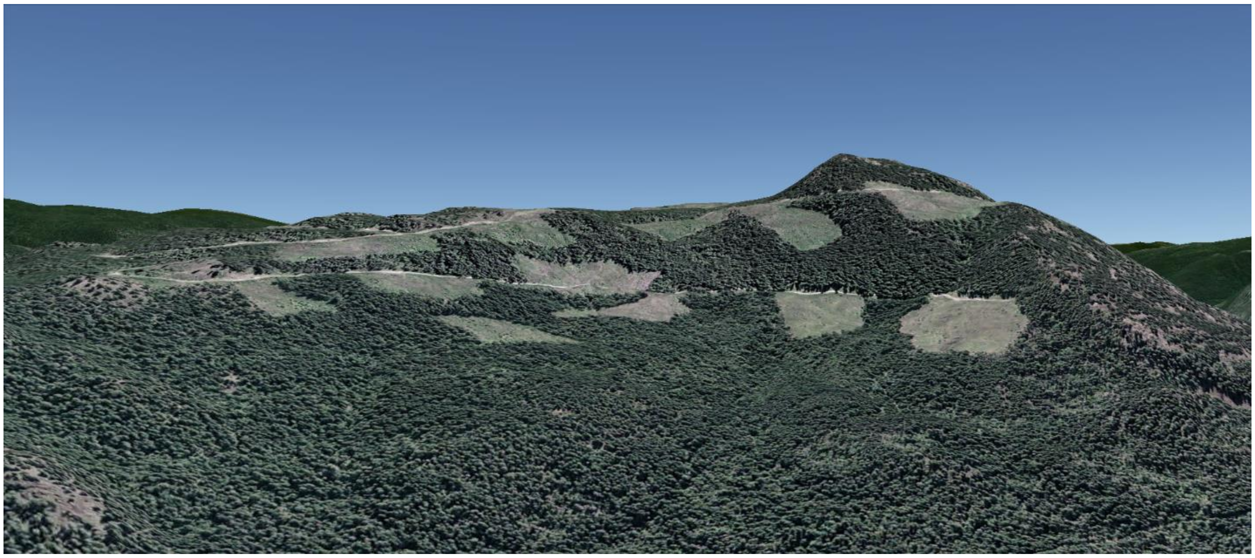

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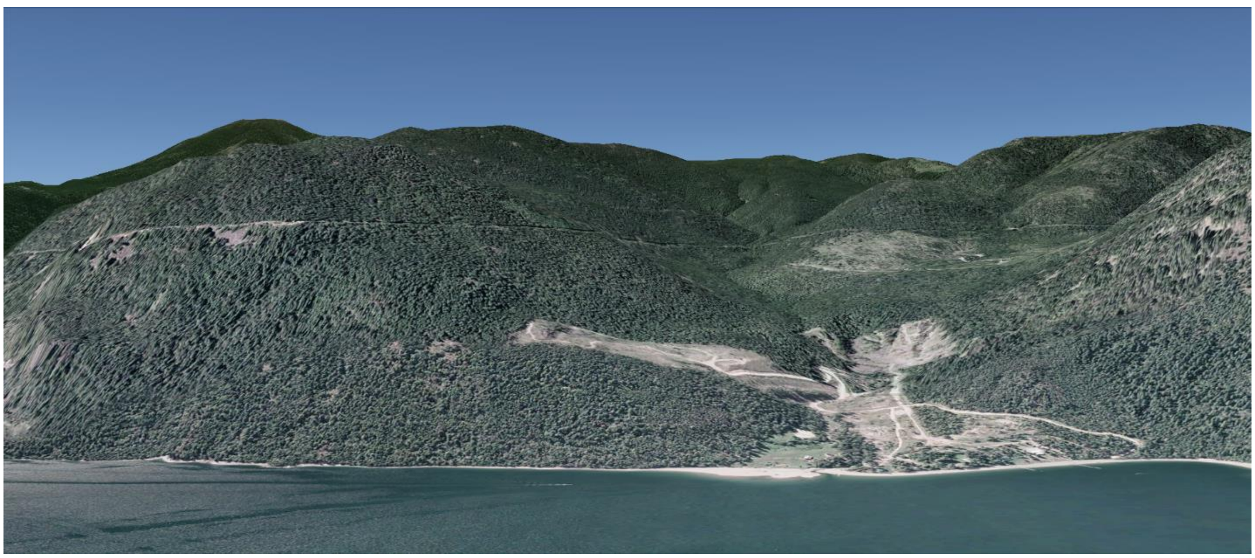

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