

Evaluation of Relief Shading Methods Applied to Landforms

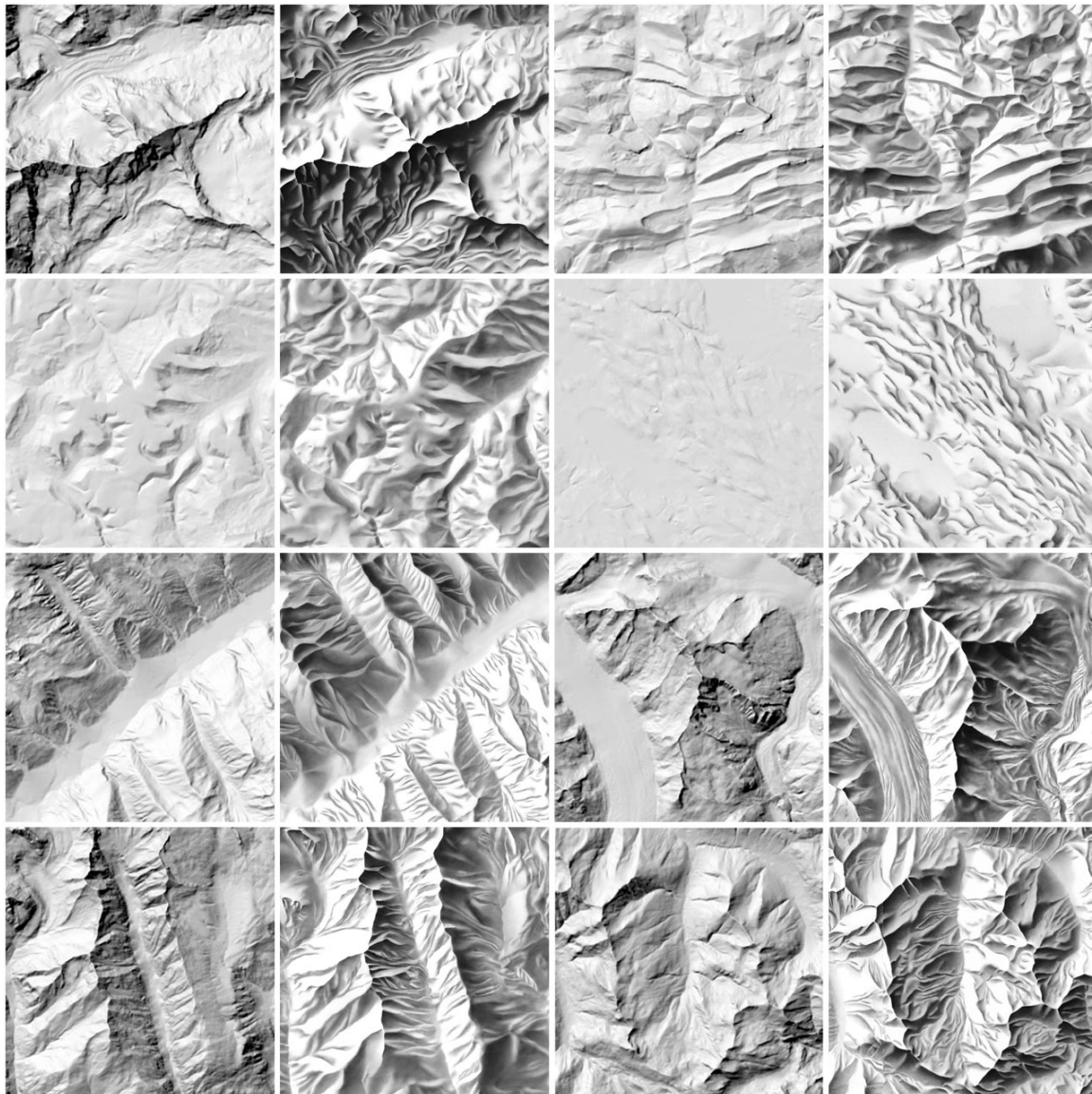
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This survey is conducted within the scope of the doctoral project "Auto-Adaptive Algorithm for Small-Scale Terrain Representation" by Marianna Farmakis-Serebryakova at the Institute of Cartography and Geoinformation, ETH Zurich. The survey is aimed at the evaluation of automated relief shading methods applied to a selection of landforms.

Originally a manual technique, relief shading creates the three-dimensional effect and allows users to perceive the terrain intuitively. With the advent of digital elevation models analytical (i.e. automated) relief shading came into a wider use, since it is faster, requires less effort, and delivers reproducible results. In contrast to manual relief shading though, it often lacks clarity when representing heterogeneous landscapes with diverse landforms.

Below, you can see examples of standard analytical relief shadings followed by swisstopo manual relief shadings for the same area. In the next pages, you will see how selected landforms look like using oblique aerial images from Google Earth together with the swisstopo manual relief shadings and you will be asked to assess automated methods used to generate shaded reliefs. The analysis of results should reveal which of the methods are more efficient when it comes to depicting specific landforms or their elements.

For questions or comments concerning the survey, please contact mserebry@ethz.ch.

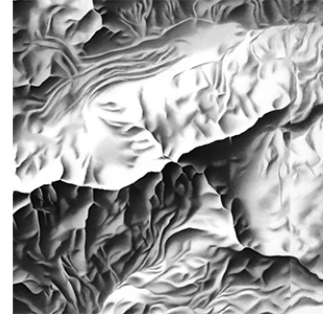
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Evaluation of Relief Shading Methods Applied to Landforms

Block mountains

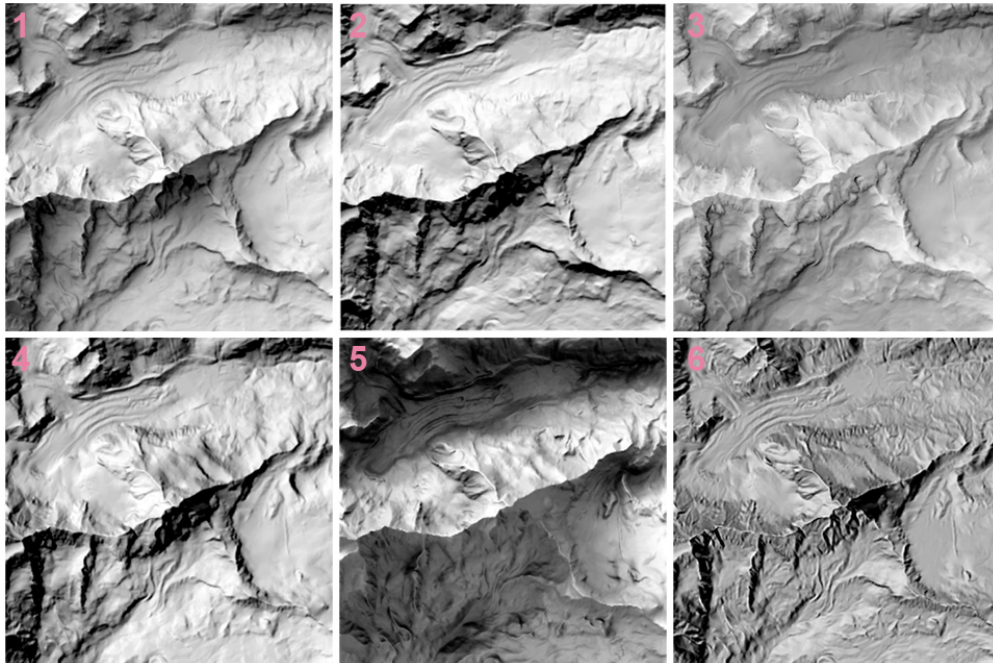
The main characteristics of block mountains are sharp ridges and a high contrast between their slopes. They comprise most of the high altitude regions.

On the left you can see an oblique aerial photo of the Matterhorn and on the right its manual relief shading.



1. The images below show different methods used to generate shaded reliefs automatically. Please choose the most/least suitable methods regarding a visual impression of block mountains on them. For each category, more than one method can be chosen.*

	Most suitable	Rather suitable	Not sure	Rather not suitable	Least suitable
Method 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Method 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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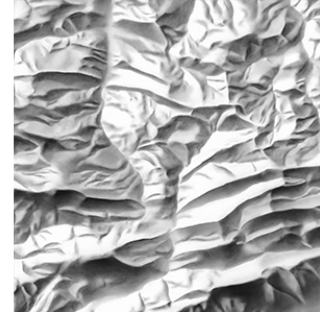
2. Feel free to explain your choice:

Evaluation of Relief Shading Methods Applied to Landforms

Folded mountains

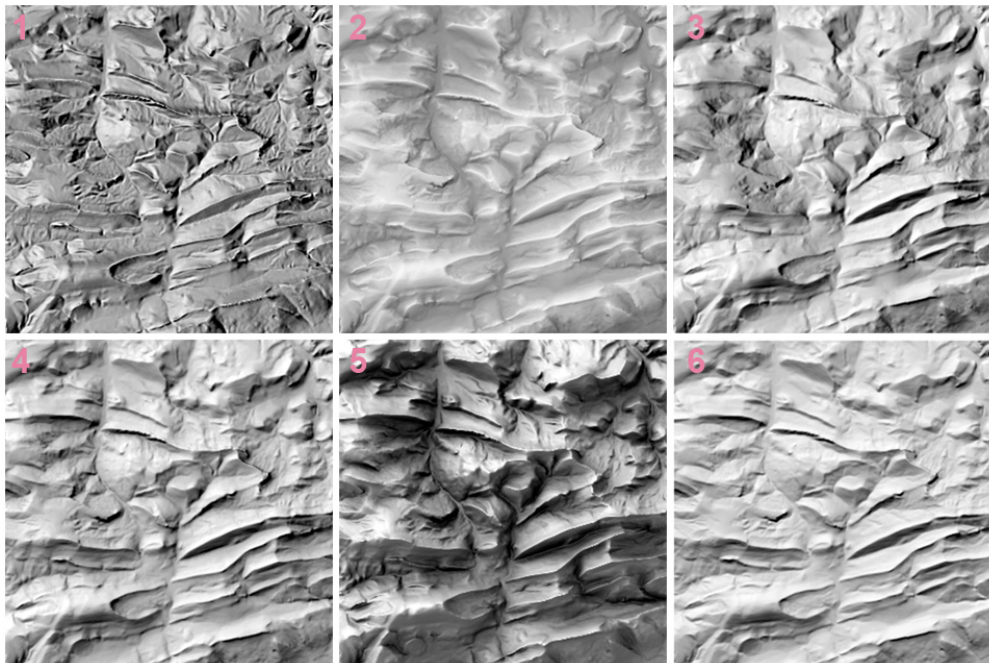
Folds form when originally flat surfaces are bent or curved as a result of permanent deformation for multiple reasons, such as stress, pressure, or temperature changes. Folds in rocks vary in size and may occur in great numbers or as isolated folds. Compared to block mountains, their edges are less sharp and their slopes are less contrasted in tone to each other due to lower elevations.

At the following images you can see an oblique aerial view of a part of the Jura folded mountains in the canton of Basel-Country on the left and a manually shaded relief on the right.



3. The images below show different methods used to generate shaded reliefs automatically. Please choose the most/least suitable methods regarding a visual impression of folded mountains on them. For each category, more than one method can be chosen.*

	Most suitable	Rather suitable	Not sure	Rather not suitable	Least suitable
Method 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Method 6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



4. Feel free to explain your choice:

Evaluation of Relief Shading Methods Applied to Landforms

Mountains formed by erosion processes

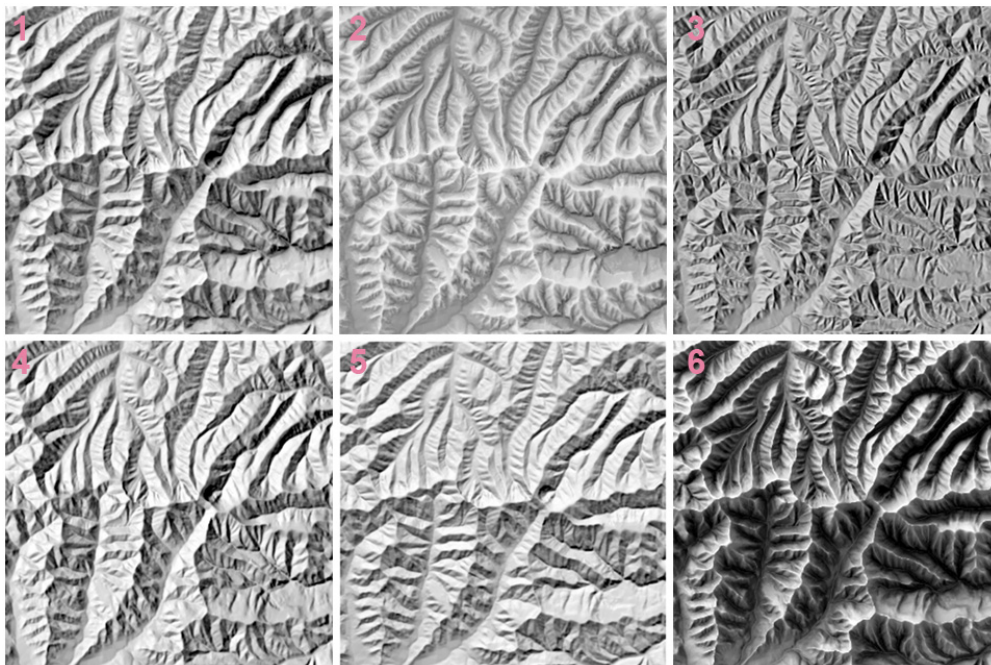
Under the influence of surface processes like water flow, wind, ice, or gravity that remove rock or dissolved material and transport it to another location, uplifted areas are gradually worn down. Such regions are usually significantly lower and can be considered as hilly. Thus, their main distinction from block or folded mountains is that ridges are generally more rounded and transitions between the slope tones are not that sharp anymore.

A typical example is the hilly region surrounding the Napf mountain on the border between the Swiss cantons of Bern and Lucerne.



5. The images below show different methods used to generate shaded reliefs automatically. Please choose the most/least suitable methods regarding a visual impression of mountains formed by erosion processes. For each category, more than one method can be chosen.*

	Most suitable	Rather suitable	Not sure	Rather not suitable	Least suitable
Method 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Method 3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Method 4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Method 5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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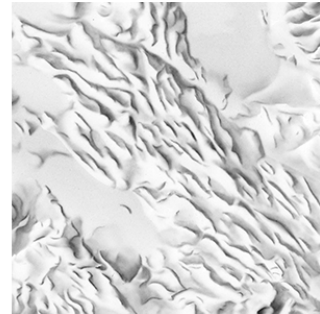


6. Feel free to explain your choice:

Evaluation of Relief Shading Methods Applied to Landforms

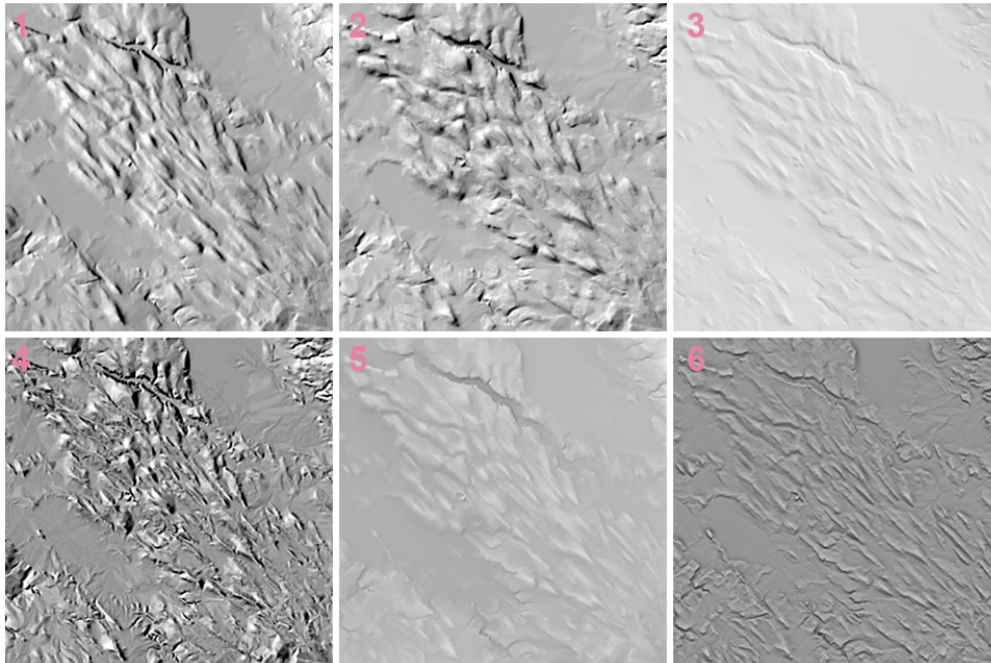
Drumlins

Drumlins are elongated hills formed by glacial processes. To provide better readability, slopes of drumlins have to be depicted with more contrast to each other, despite their rounded top, as the manual relief shading of Zurich highlands region illustrates below.



7. The images below show different methods used to generate shaded reliefs automatically. Please choose the most/least suitable methods regarding a visual impression of drumlins. For each category, more than one method can be chosen.

	Most suitable	Rather suitable	Not sure	Rather not suitable	Least suitable
Method 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Method 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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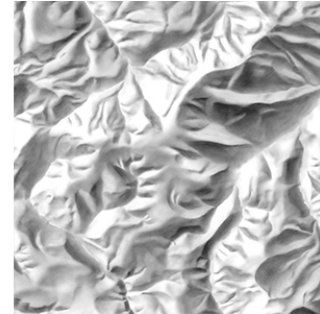
8. Feel free to explain your choice:

Evaluation of Relief Shading Methods Applied to Landforms

Plateaus

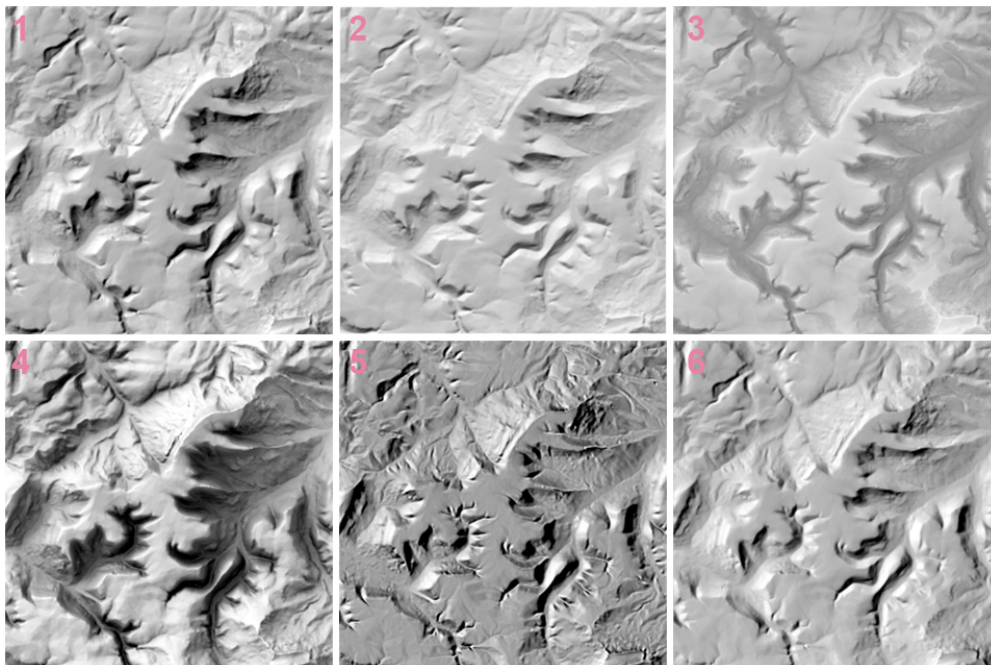
An important characteristic of a plateau or a tableland is that its flat and steep parts are represented with strong contrast to each other. Moreover, its slopes are not rounded off as for hills but are abruptly incised, which makes them well recognizable.

Below, you can see an example of a plateau in Table Jura in the Swiss canton of Basel-Country and its manual relief shading.



9. The images below show different methods used to generate shaded reliefs automatically. Please choose the most/least suitable methods regarding a visual impression of plateaus on them. For each category, more than one method can be chosen.*

	Most suitable	Rather suitable	Not sure	Rather not suitable	Least suitable
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Method 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Method 5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Method 6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



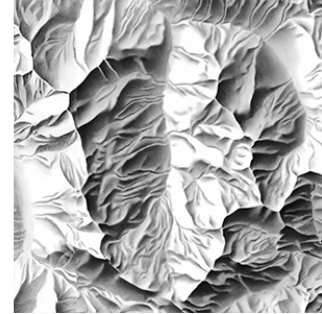
10. Feel free to explain your choice:

Evaluation of Relief Shading Methods Applied to Landforms

V-shaped valleys

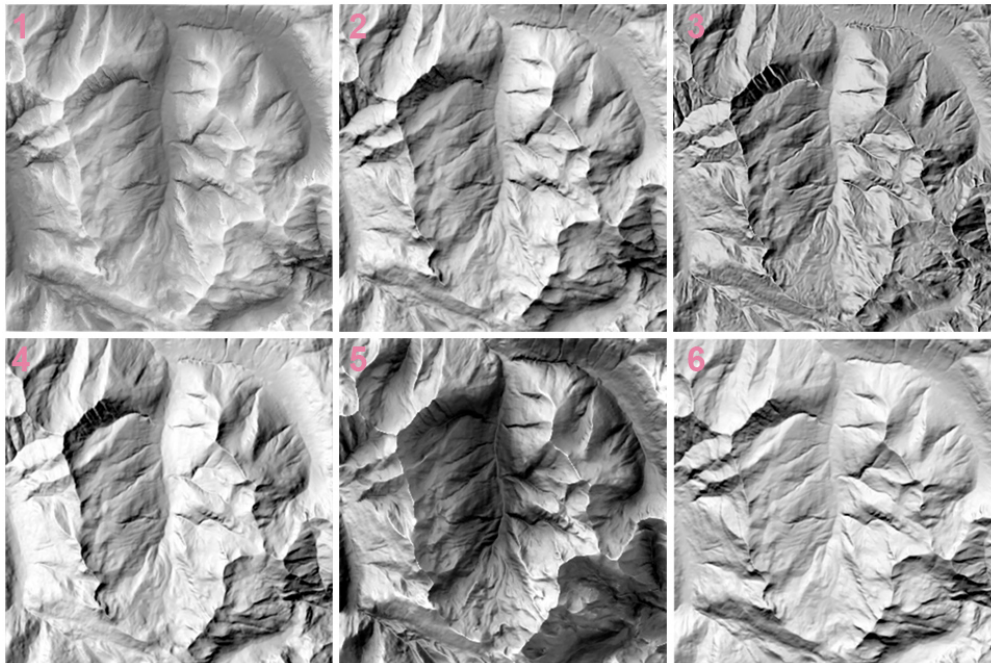
The next two landforms are valleys. The terms V-shaped and U-shaped relate to their form. They are the main two types of valleys that are representative in relief shading.

V-shaped valleys are usually carved by rivers and have V-shape in cross-section. The example below is Bregalga valley in the canton of Grisons.



11. The images below show different methods used to generate shaded reliefs automatically. Please choose the most/least suitable methods regarding a visual impression of V-shaped valleys on them. For each category, more than one method can be chosen. *

	Most suitable	Rather suitable	Not sure	Rather not suitable	Least suitable
Method 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Method 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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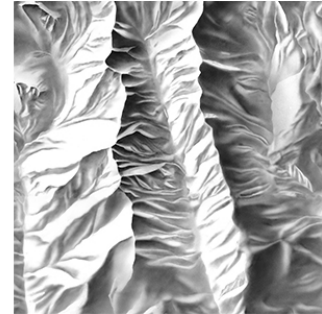
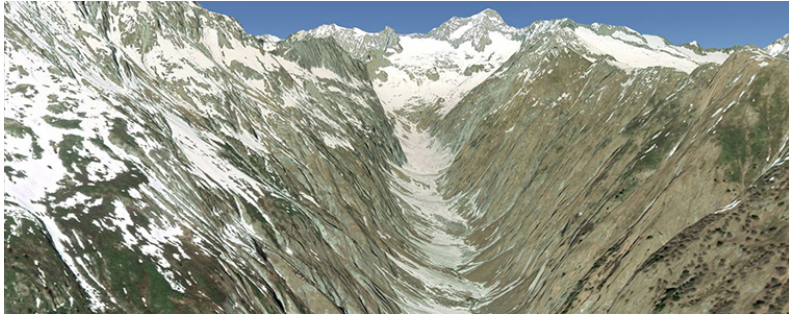


12. Feel free to explain your choice:

U-shaped valleys

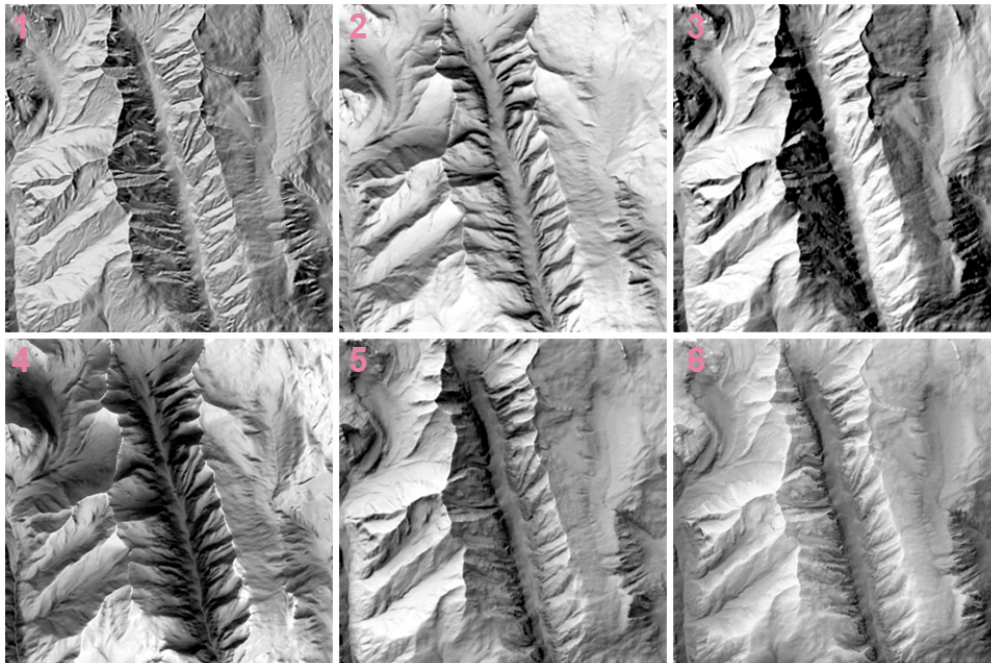
In regions that remained glaciated for long time, flowing ice erodes V-shaped valleys into steep-sided U-shaped valleys that have wide, flat, or rounded floors. This type of valleys is very common in the Alps and in Scandinavia. As it can be seen from relief shading, the slopes of U-shaped valleys are depicted with more contrasting tones due to their steepness and they are separated by a grey tone at the bottom.

A part of the Gredetschtal in the canton of Valais and its manual relief shading are below.



13. The images below show different methods used to generate shaded reliefs automatically. Please choose the most/least suitable methods regarding a visual impression of U-shaped valleys on them. For each category, more than one method can be chosen.*

	Most suitable	Rather suitable	Not sure	Rather not suitable	Least suitable
Method 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Method 5	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Method 6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



14. Feel free to explain your choice:

Evaluation of Relief Shading Methods Applied to Landforms

Alluvial fans

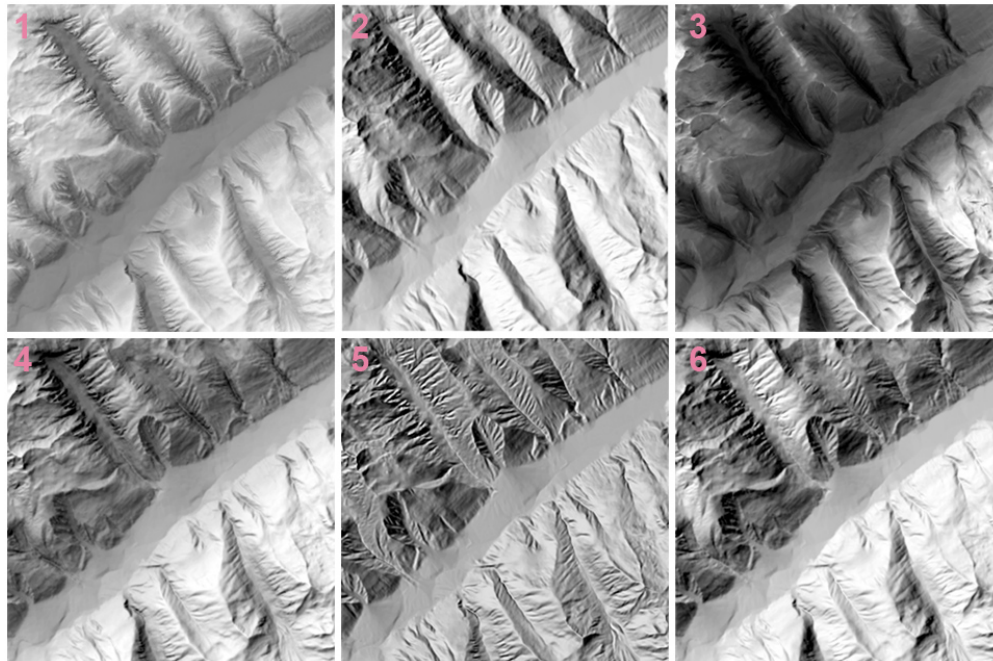
Adjacent to flat and hilly areas are alluvial fans (marked with arrows), which are deposits of water-transported material. Since their main characteristic is a slope, its appearance can be improved by changing the light direction to make it look more convex.

On the left, you can see an example of alluvial fans in the Goms region, the upper most part of the canton Valais, and its manual relief shading on the right.



15. The images below show different methods used to generate shaded reliefs automatically. Please choose the most/least suitable methods regarding a visual impression of alluvial fans on them. For each category, more than one method can be chosen.

	Most suitable	Rather suitable	Not sure	Rather not suitable	Least suitable
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Method 2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Method 6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



16. Feel free to explain your choice:

Evaluation of Relief Shading Methods Applied to Landforms

Glaciers

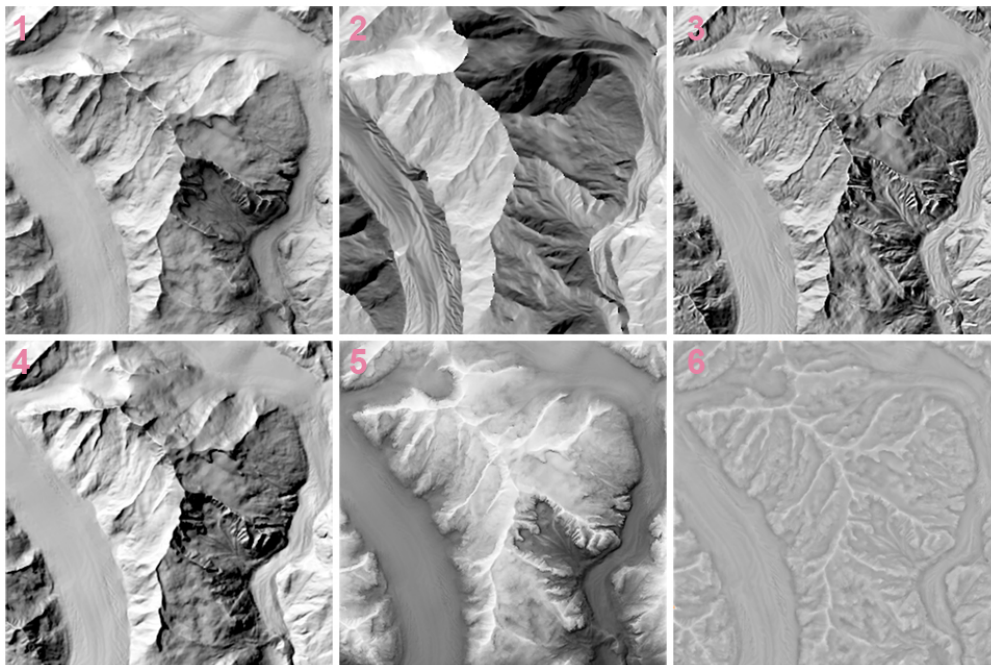
Regions of permanent snow should be well distinguished from those without snow. Opposed to landforms that are usually accentuated by removing unnecessary details, glaciers need small detail to be shown on their surface to distinguish them from flat snow-free areas, usually depicted using even flat tone throughout its surface. Ice and snow texture at glacial tongues, produced by ice fractures and crevasses, bring out the characteristic look to glacial areas.

Below you can see an oblique aerial image of the Aletsch glacier and a manual relief shading of the same area.



17. The images below show different methods used to generate shaded reliefs automatically. Please choose the most/least suitable methods regarding a visual impression of glaciers on them. For each category, more than one method can be chosen.*

	Most suitable	Rather suitable	Not sure	Rather not suitable	Least suitable
Method 1	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Method 6	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



18. Feel free to explain your choice:

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Demographic questions

Please answer the last three questions. All the information is stored anonymously and will not be used beyond the scope of the survey.

19. What is your gender?*

-- Please Select -- ▼

20. What is your age?*

-- Please Select -- ▼

21. What is the highest degree or level of education you have completed?*

-- Please Select -- ▼

22. How experienced are you with maps?*

-- Please Select -- ▼

23. How familiar are you with relief shading?

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Done