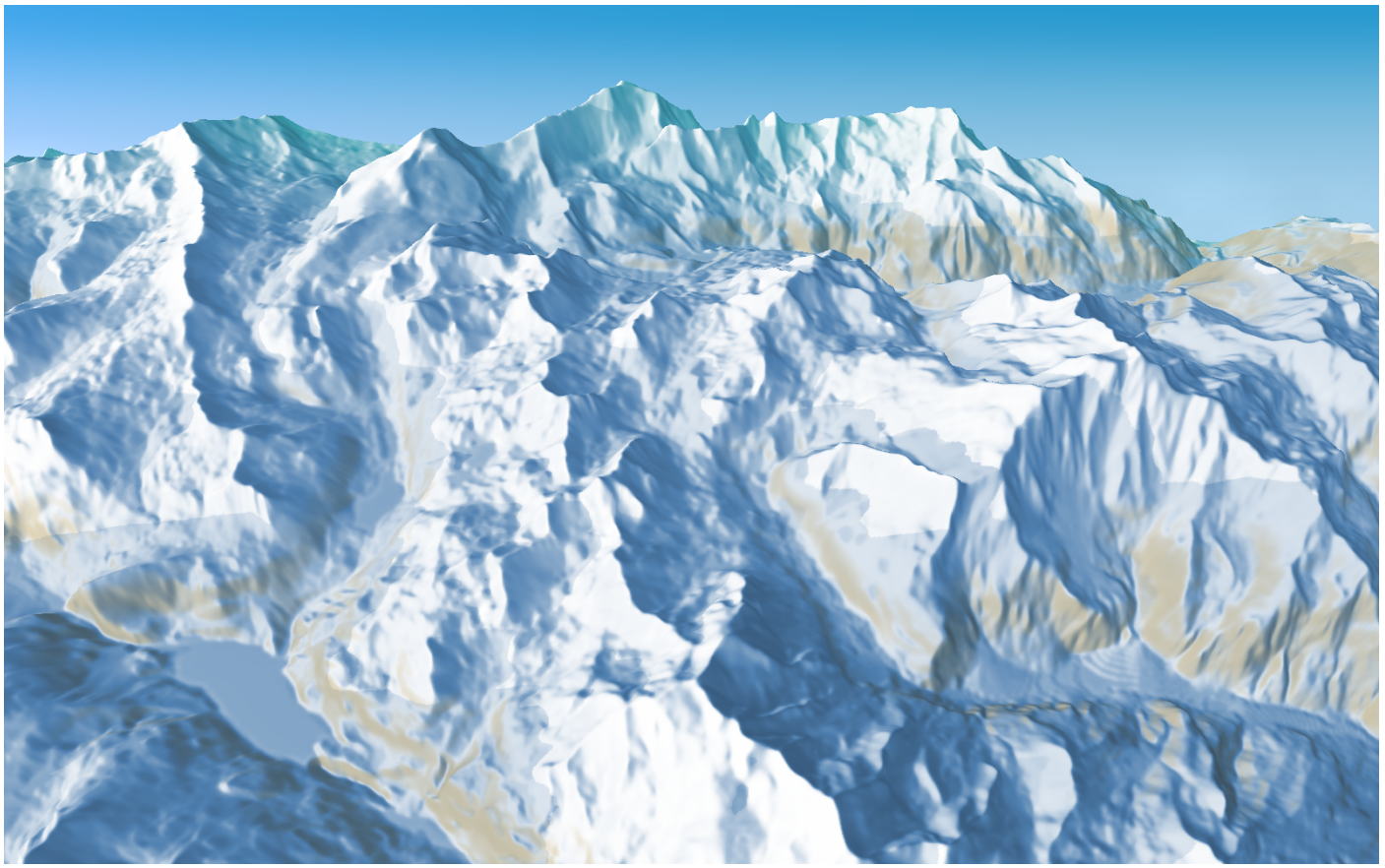
Rendering of stylized mountain panorama maps

The postdoc will take place in the Maverick team at Inria Grenoble and be supervised by Nolan Mestres, Joelle Thollot and Romain Vergne.



Context

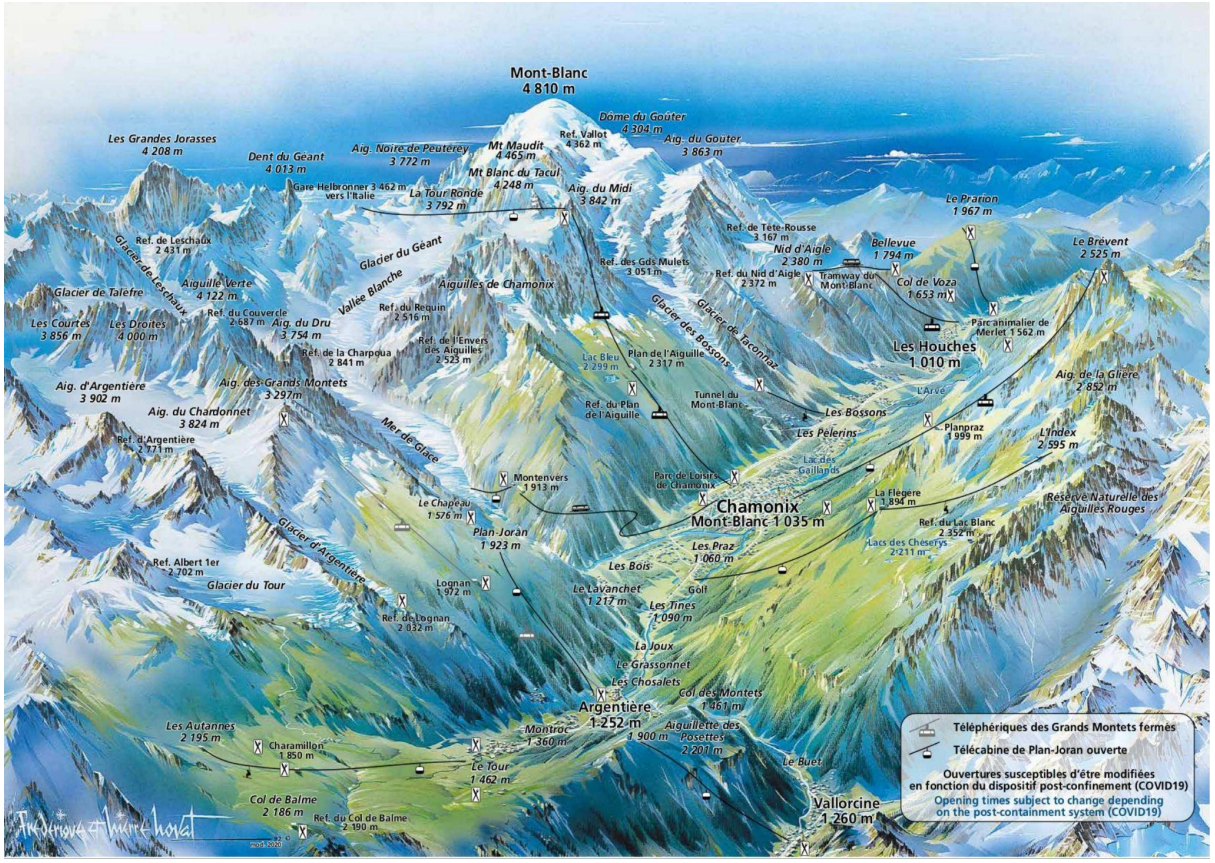
Panoramas are a specific type of map that transcends the boundary between cartography and art. They are excellent pictorial devices for visualizing landscapes, especially ski areas, for which the panorama has become a cartographic standard. However, very few artists or cartographers are able to draw visually pleasant and efficient panoramas. Indeed, a realistic view, or even a photograph, of a landscape does not provide the same legibility as a map. Therefore, drawing a panorama requires specific skills: the ability to understand and represent a landscape in 3D in a style that lies in between a painting and a 2D map.

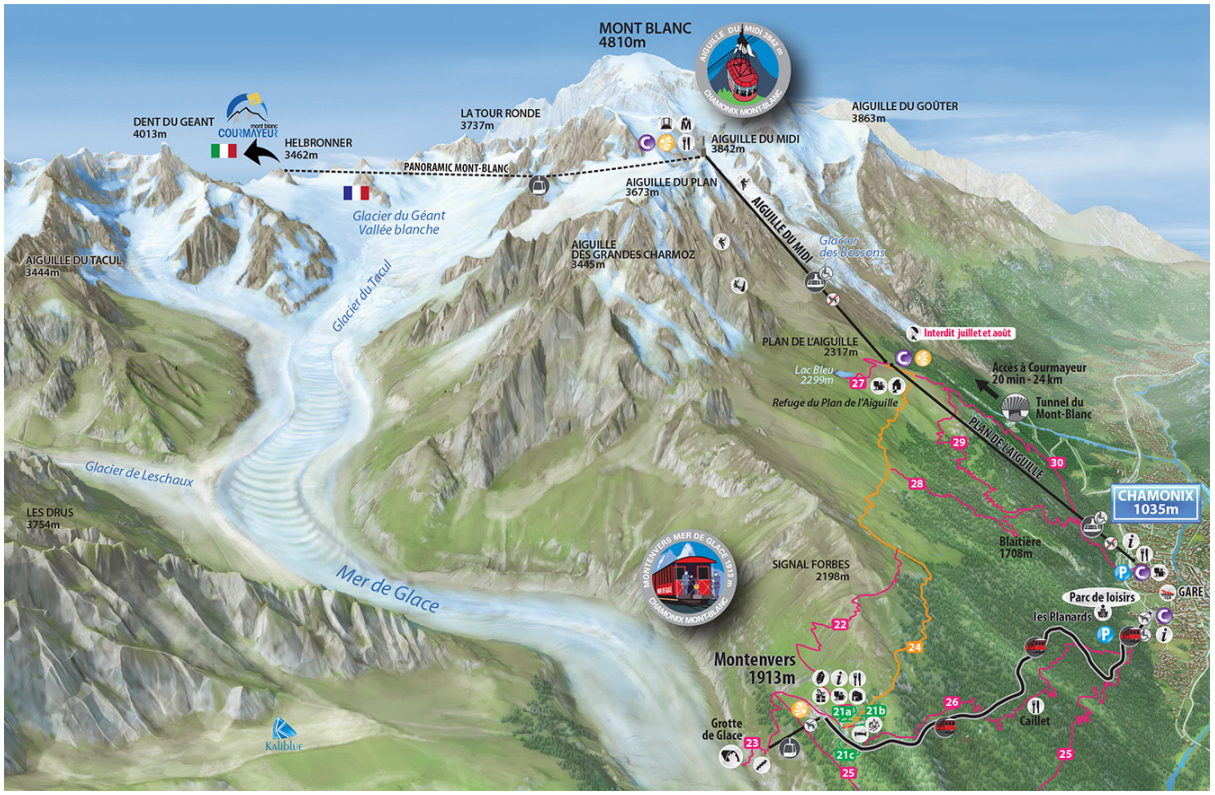
With the availability of full GIS (geographic information systems), we now have access to cartographic data that can be used to produce panoramas using a computer. The recent progress in computer graphics research allows the production of realistic renderings of 3D landscapes. However, the specific style of the best panoramists is still not fully reproduced by the scientific community.

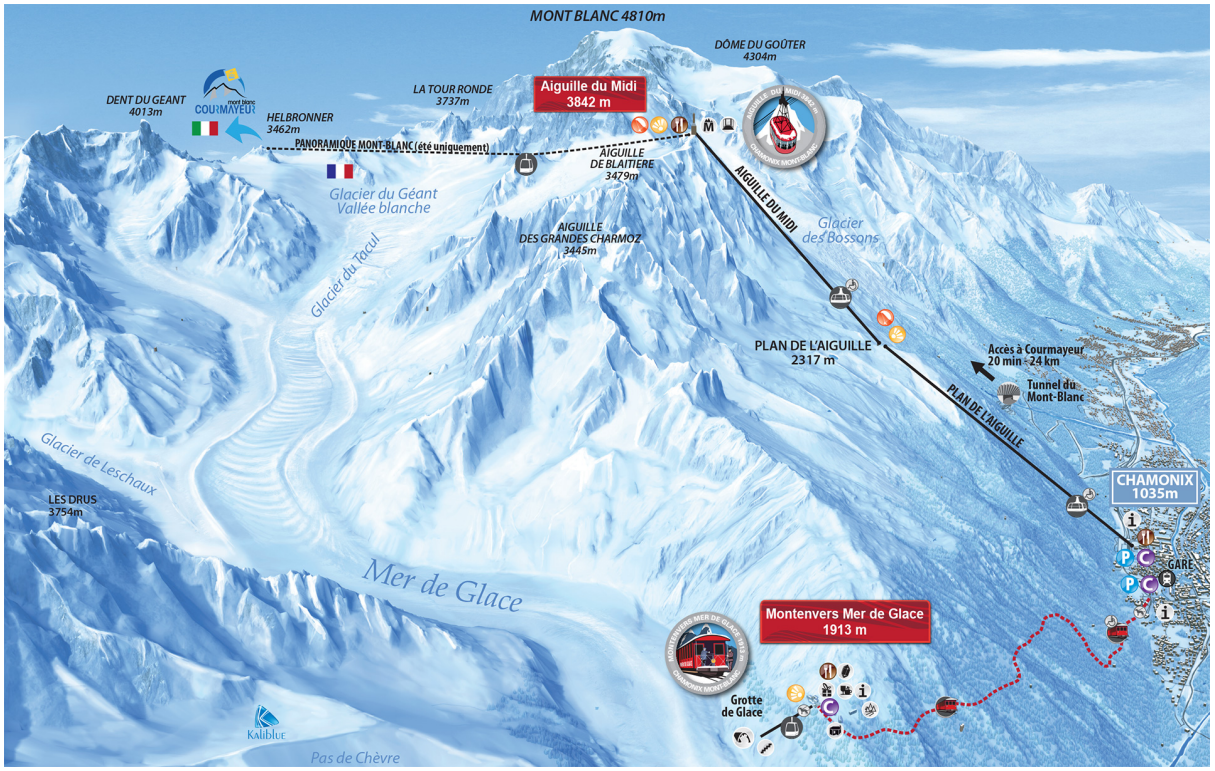
In this project, our goal is to design a process to produce panoramas starting from cartographic and topographic data as can be provided by IGN or OpenStreetMap. For that, we collaborate with Arthur Novat in order to understand and formalize the various steps of the drawing of a panorama. Arthur is the son of

Pierre Novat who founded [The Atelier Novat]() in the 60's that became the French standard for mountain panoramas.

Chamonix panorama examples





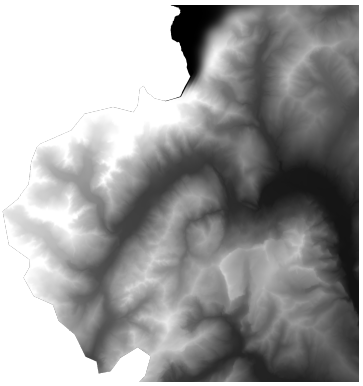


We show here several panoramas of the same place : Chamonix. The First panorama has been drawn manually by the atelier Novat in 2020. The two next panoramas have been generated by a computer based on GIS data by the Kaliblue company. The computer generated images are not fully automatized (they are partially manually reworked) and are less detailed and aesthetic than the manual drawing. However, they can be reused to produce winter vs. summer images or updated when a new ski track is created.

None of these panoramas are interactive whereas we may want to change the viewpoint according to the needs of the final user. When dealing with a 3D model, moving the viewpoint should be possible but the style itself (trees, houses, roads or even stroke brushes or hatches) will not naturally adapt, that's why there is still some work to do in order to invent an automatic approach for the creation of interactive and stylized panoramas.

Our current results

We have designed a method to compute the shading and shadows of the panorama starting from the height map of the terrain. We have also designed a simple deformation method to give a panoramic impression. This technique works in real time on the GPU.



Heightmap of Chamonix

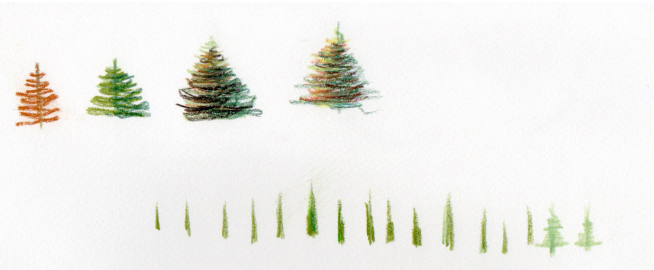
Rendering of the panorama

We can control the light direction, the colors and project any information as a texture on the terrain:

Projects

Several internships are currently working on various aspects of the panorama. The goal of the postdoc will be to continue these works so as to come up with a full solution. This will include:

1- Rendering raster graphics: Trees and rocks



The drawing of all the natural elements of the panorama is complex because it is not done in a realistic way. For example the trees do not follow the perspective rule: they keep more or less the same size on screen even if they are very far from the viewpoint. Actually they are drawn to indicate the nature of the terrain (e.g. this a forest) but also the direction of the slope (they are aligned with the slope). Both information are typically cartographic information more than photographic ones. Therefore we will have to devise specific techniques to render each natural element of the landscape.

These techniques will have to be controllable. For example we may want the rendering to vary depending on the season. And care will have to be taken to be able to move the viewpoint as continuously as possible.

For that, we propose to take inspiration from expressive rendering techniques : stroke-based and texture-based temporally coherent approaches will be the basis of this work.

2- Rendering vector graphics: Roads, rivers and names

Rivers

Rivers added on top of the terrain

A GIS provides a lot of vector layers containing cartographic data such as the road network, the buildings areas or all the toponyms of the geographical area. To be able to draw them in the final panorama we will have to design specific methods to generalize these data, rasterize them and deal with occluding parts of the terrain.

For that we will take inspiration from 2D cartography standards and vector graphics techniques.

3- Deformation of the terrain

We may want to deform the mountains themselves to show some places. Typically if we deal with ski tracks, we want them to be all visible on the panorama. For that we can either modify the camera parameters or modify the terrain itself. Ideally the deformation should be controllable by the user (for example the tourist office) so as to show what is important for the user.

In this project we propose to experiment a combination of global deformation (e.g. by designing original cameras) and local deformation (e.g. by warping the terrain heightmap).

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