# A Stylistic Study of the Hand-Painted Winter Panorama Maps of Pierre Novat

Nolan Mestres

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Fig. 1. Grand Massif, Pierre Novat 1986, the most accomplished painting of his career according to his son, Arthur Novat.

I present a study of the hand-painted winter panoramas of Atelier Novat, a workshop founded by Pierre Novat (1928–2007) in the 1960s, whose style was perpetuated by his children Arthur and Frédérique. I offer a portrait of Pierre Novat and a brief historical overview of the workshop. The contribution of the paper is to describe the style of Novat through the analysis of its constituent elements: creation process, color palette, terrain deformation, light effects, and surface texture (trees, rocks, roads, and buildings). Creating an ideal yet personal representation of a mountain has a dual purpose: a practical one, to help the viewer understand the topography of the region, and an aesthetic one, to depict an imaginary mountain, now iconic of the French Alps, that encourages dreams. The paper concludes with a review of existing methods, in cartography and computer graphics, for the creation of digital panoramas.

Additional Key Words and Phrases: panorama maps, landscape visualization, hand-painting, ski maps, French Alps, Pierre Novat

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## 1 INTRODUCTION

In this paper, I am interested in characterizing the style of the French panoramist Pierre Novat (1928–2007). I will review the main aspects of his style, from the shades used in his paintings, to the depiction of lighting effects and surface texture, including the deformation of the terrain.

**Context.** Atelier Novat is a workshop founded in the 1960s by the French panoramist Pierre Novat. Through the subsequent years, the atelier (workshop) achieved national fame, delivering over 300 panoramas in total. Novat's panoramic maps accompanied the boom of alpine skiing in France in the latter half of the twentieth century, becoming emblematic of this period and helping to promote ski resorts. Figure 1 displays a 1986 panorama of Grand Massif (108 cm × 74 cm), representative of Novat's work. He has had a lasting impact on how the mountain landscapes are represented and perceived in the French collective imagination.

A fundamental problem among panorama makers is the transmission of their expertise from one generation to the next, as very few masters are capable of creating these pieces of work. A great loss of expertise occurred with the death of Pierre Novat in 2007, eight years after the death of the most famous panoramist, Heinrich C. Berann (1915–1999).

Novat's children, Arthur and Frédérique carried on the work of their father, but never trained apprentices. Frédérique Novat is now retired and Arthur Novat is about to cease his activity. That would mark the end of Atelier Novat. After them, who will know how to create panoramic maps in the style of Pierre Novat? In an attempt to save this knowledge, several multidisciplinary initiatives were launched, e.g., the MECOMO project (Balzarini, Dalmasso, and Murat 2015; Balzarini and Murat 2016), in which Arthur Novat was involved, but considerable work remains to be done.

**Methodology.** I am a researcher from the expressive (i.e., non-photorealistic) rendering branch of the computer graphics community. My long term goal is to provide artists with the means to convey information clearly through images, while maintaining a rich variety of available styles. The creation of panoramas is a prime case study in that regard.

It is in this context that I established a close collaboration with Arthur Novat. Through my careful observation of his painting, I have acquired a solid knowledge of the Novat style. To support this work, I also conducted several interviews with Arthur Novat in 2020 and 2021, and another with him and his sister, Frédérique Novat, in 2021. I also attended painting workshops taught by Arthur Novat. All my claims in this paper have been validated with Arthur Novat. Conversely, no claims made by the Novats that I could not verify myself in the panoramas were included.

**Previous works.** Though they achieve different styles in the end, panorama artists who have become prominent masters in the field all share a similar creative process. Several authors have previously examined the processes of panoramists, or have conducted interviews with them to document their methods.

Patterson (2000) provided an in-depth study of the work of Heinrich C. Berann, the most famous panoramist. Patterson (2000) and Kast and Fischer (2019) have interviewed Berann's former apprentice, Heinz Vielkind, about their methods. Tait (2010, 5) studied James Niehues's maps, which are "in use at over a quarter of all ski areas" in North America. Weyland (2004), Kelly (2021), and Preppernau (2022) have interviewed Niehues, while Bennett, Farrow, and Blevins (2019) described his technique in their book *The Man Behind the Maps*. A compilation of Pierre Novat's paintings and details about his creative process can be found in *Plans des Pistes* (Novat, Novat, and Belluard 2013). Finally, Dauer (2020) brings together the work of leading panoramists depicting the Alps.

In the next section, I will briefly introduce the concept of panoramas. In Section 3, I present the origins of Atelier Novat and its history, underlining elements that may have impacted the style of Pierre Novat. Then, I will describe his process for creating a panorama (Section 4). In Section 5, I examine what I think makes Novat's work so recognizable: the shades of blue he uses. Section 6 identifies and describes the main constituent elements of his style regarding terrain deformation and lighting phenomena. I address the role of surface texture elements (trees, rocks, roads, and buildings) in Section 7. Finally, I review the relevant research works that enable the creation of digital panoramas in the style of traditional artists in Section 8.

## 2 ON PANORAMAS

The word panorama (from Ancient Greek *pan* "all" and *horama* "view") was coined by Robert Barker (1739-1806) to describe a way to display 360° paintings. He applied for a British patent in 1787[1] and has since been credited with the invention of panoramas (Oettermann 1997; Patterson 2000). Barker's painting of Edinburgh (1788) was displayed in a rotunda, a circular building in which viewers were surrounded by the painting, fully immersing them in the scene (Figure 2). The word panorama was used to designate both the paintings and the buildings used to display them.

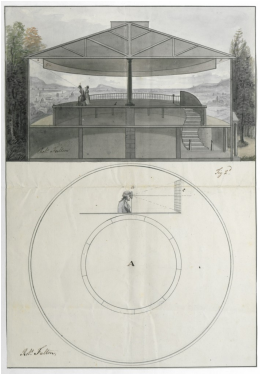

Fig. 2. A "Panorama" in Robert Fulton's French patent (1799).

Nowadays, the definition of panorama has evolved, and is neither limited to 360° paintings nor to the technical way of displaying such paintings. A panorama refers to a wide-angle view of a scene (e.g., a landscape or historical battle), regardless of the medium. Digital photographs as well as paintings can be called panoramas.

According to Tom Patterson, "panoramas are a unique variety of map that transcends the boundary between cartography and art … and are excellent pictorial devices for visualizing landscapes—especially ski areas, for which the panorama has become the de facto cartographic standard" (Patterson 2000, 39). As maps, they help the viewer understand the topography of the region, placing the ski areas in a wider geographic context. As paintings, they represent the personal interpretation of the artist, mixing reality with an imaginary representation of the landscape. The overall goal of these panoramas is to entice skiers to explore all the areas of a resort, luring them with ideal weather conditions, a deep snowpack, and downhill pistes (ski runs). They serve a practical purpose. These two modes imply that panoramists are themselves at the crossroads between the fine arts and the applied arts. Pierre Novat was no exception, and considered himself more of an artisan than an artist.

In France, similar to North America (Tait 2010), panoramas are the standard for mountain panoramas. They are widely used by mountain operators to promote their resorts and played an important role in the development of winter sport tourism.

## 3 ABOUT PIERRE NOVAT

Pierre Novat (see Figure 3 for a photograph) attended the École Nationale Supérieure des Beaux-Arts (National School of Fine Arts) in Lyon. There, he enrolled in the decorative arts track, not the painting one. After finishing his studies, he yielded to his love for

1. https://www.bl.uk/collection-items/specification-of-mr-barkers-patent-for-displaying-views-of-nature-at-large

the mountains and moved to Val d'Isère (in the French Alps) in 1956, at the age of 28. There he created an open workshop, simply named "L'Atelier" ("The Workshop"), in which he sold drawings, painted decorative items, some of which were made from enameled glass, and was open to the commissions of walk-in clients for bigger decorative works such as shop signs and murals. He built a whole network in Val d'Isère and quickly achieved local fame as Novat "the painter."

In the early 1960s, he moved back to Lyon for family reasons. Still, he received his first painting commission, to update the panorama of the Val d'Isère ski resort, which had originally been painted by Berann. As the resort was evolving quickly with the creation of ski tracks in Tignes (a neighboring village of Val d'Isère), the panorama by Berann had become outdated. Berann, being already quite famous at the time and busy with his commissions for the National Geographic Society, declined to make the necessary changes. Novat was therefore asked to paint the missing part. To obtain a pleasing result, he had to emulate the style of Berann and stitch his part to the existing panorama seamlessly (see Figure 4). But he did not yet envision that painting panoramas would become his main activity.

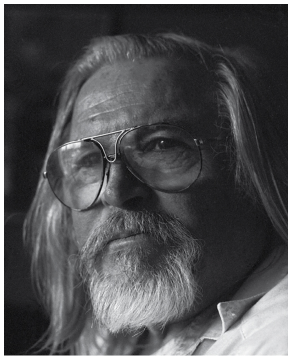

Fig. 3. Portrait of Pierre Novat circa 1995.

The head of the Courchevel resort (called Saint-Bon at the time) contacted him in 1964 to paint his first complete panorama. For the next decade, he painted about one panorama every three years. By 1975, it became a full time occupation, with a panorama painted every six months. He finally abandoned his professional identity of decorator—until then all panoramas were signed "Pierre Novat décorateur"—but he never fancied himself as an artist.

Novat painted more than 300 panoramas over the course of his career. His artworks were widely used as promotional materials such as piste maps, site plans, and brochures. Their aesthetic quality made them the preferred marketing tool for resorts, while also being better at depicting relief than 2D maps for skiers. The art of Pierre Novat accompanied the rise of modern alpine skiing in the 1970s and the 1980s and durably impacted the representation of the French Alps and Pyrénées in the collective imagination.

## 4 DESIGNING AND PAINTING A PANORAMA

Since the 1960s, Atelier Novat has produced most of the French mountain panoramas. This painstaking work was done by hand, first by Pierre Novat alone, then with, and finally by, his children Arthur and Frédérique.

**Commissioned artworks.** Panoramas are most of the time commissioned by corporate ski resorts, which introduces an economic dimension that influences the work of Pierre Novat. That is why the topographical reality sometimes gives way to a so-called economic

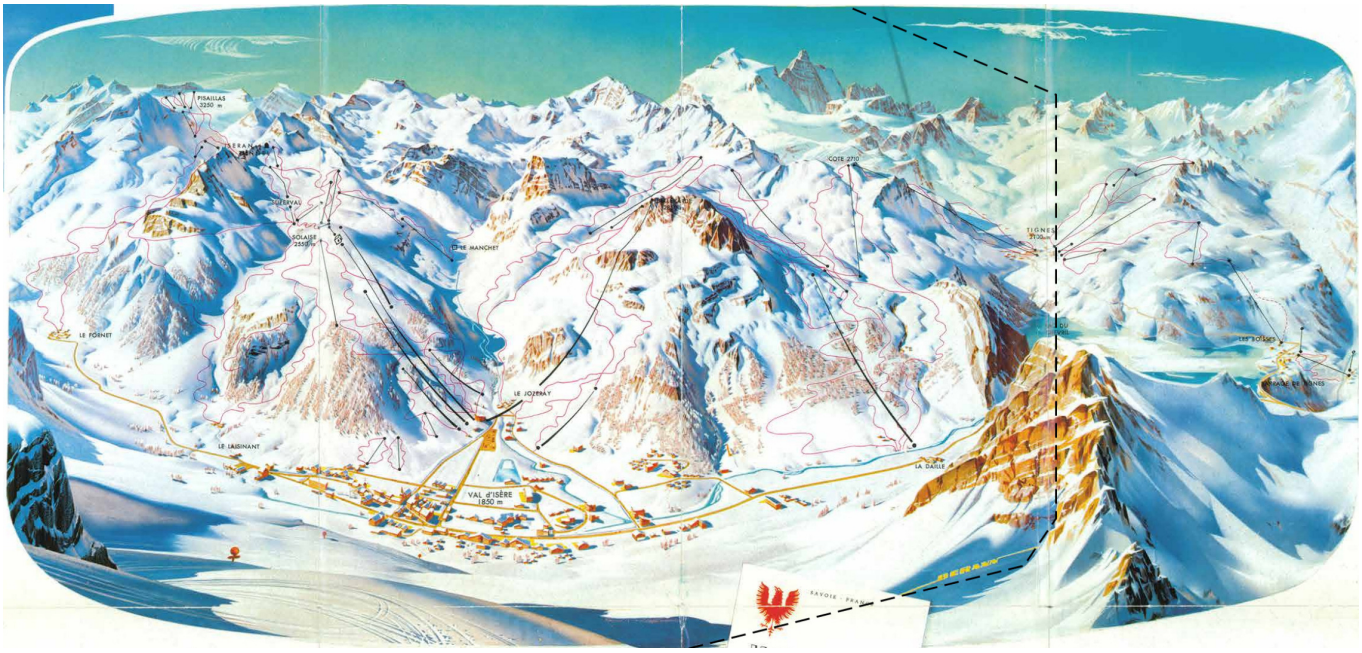


Fig. 4. Left of the dashed line is the original panorama map for Val d'Isère ski resort by Heinrich Berann. Right of the dashed line is the part added by Pierre Novat in 1962 to display Tignes and its surroundings. Novat also made some alterations to the left part directly on the original to support the creation of new tracks leading to Le Fornet. Novat's children still have the left panel but knowing exactly what is from Novat's hand proves difficult, if not impossible. This resort is now well-known as Espace Killy. See Figure 5 for the 1984 version of the panorama.

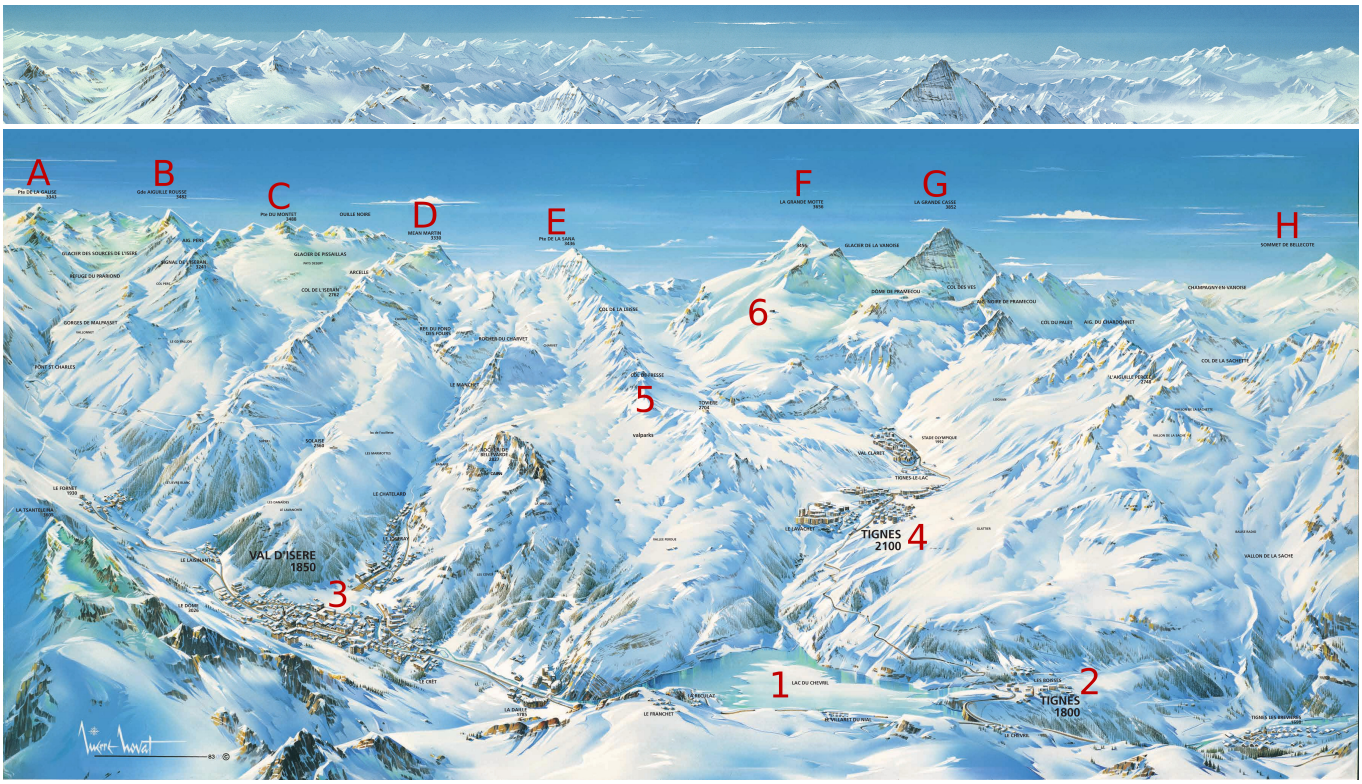


Fig. 5. Top: Background portion of Pierre Novat's 1983 panorama of Espace Killy. Bottom: 1984 version of the panorama, one of the most emblematic by Novat. Note how the focus has moved with respect to the 1962 version (Figure 4). Chevril Lake (1) is now at the center and Val d'Isère (3) on the left. The labeled landmarks (A–H, 1–6) are referred to later in the article and in Figure 10.

reality. Clients would sometimes ask Novat to hide the valley of a competing resort, to exaggerate the size of the ski areas, to represent on the same map two diametrically opposed valleys (e.g. Val d'Isère and Tignes, Figure 5), etc. They have highly specific requests not only because of their own mental representations of the mountain and their vision of what the panorama should depict, but also because of their artistic tastes and even for practical reasons (the safety of skiers, accessibility of the trails to snow groomers, location of the lifts, etc.). An example is the deletion of the background on the panorama of Espace Killy between the 1983 and 1984 versions (Figure 5). The goal was to focus attention on the resort itself, rather than depicting it as part of the broader alpine landscape. The whole panorama was also re-colorized after the client asked for warmer tones.

Remaining faithful to the topography while meeting the client's requirements leaves little room for the artist to express their creativity. Their degrees of freedom mainly reside in the colors chosen, and in areas of the panorama that are of lesser importance to the client. When moving away from the main focus of the panorama, the resort, we can feel these constraints loosening. For instance, see background and sides of Figures 1 and 5 (top) that are less precise, but vivid nonetheless.

Even though these economic and geographic constraints partly governed Novat's work, he did develop a unique style that is now

Fig. 6. Left: Close-up of a pencil sketch made for Espace Killy 1983 (Figure 9, c). Right: The same area of the resulting panorama converted to grayscale. The sketch already depicts the finest details of the terrain, shading, shadowing, and surface texture.

iconic of the French Alps in people's minds, and is still praised for the beauty of his landscapes as well as the precision and readability of the maps.

**Crafting the panorama.** Novat, Novat, and Belluard (2013) describe Pierre Novat's creation process. It starts with a careful observation of a topographic map on which a main viewpoint is chosen. Then, aerial photographs are taken by the painter or sent by the

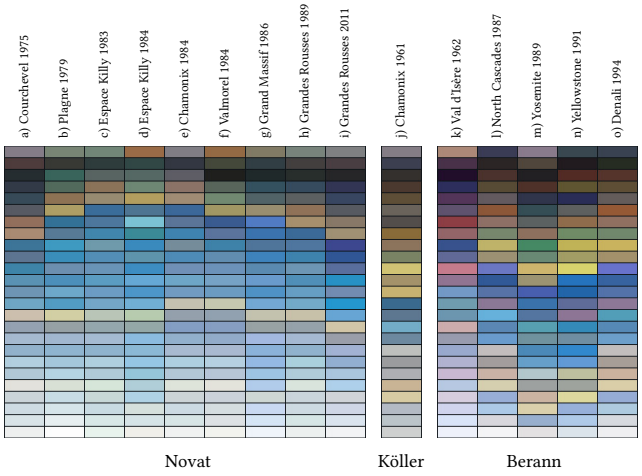


Fig. 7. Color palettes extracted from the panorama maps displayed in Figure 9. Note how an important part of Novat's palettes (a–i) is dedicated to snow and its blue shades, whereas Köller (j) and Berann (k–o) make use of more heterogeneous palettes. Note that Grandes Rousses 2011 (i) is a posthumous rework by Novat's son. Blues used in the rework are warmer (with a higher red component), hence the unusual purple tones.

ski resort. Nowadays, in addition to maps, Arthur also uses satellite imagery. These photographs are stitched together to create a panoramic view of the scene. Then, a grayscale sketch is drawn (see Figure 6) on tracing paper sheets, with all the lighting effects already present. Some parts of the sketch are then cut out so that they can be repositioned freely, but they are rarely redrawn. All parts are adjusted into a final view that already includes all terrain details and surface texture elements (trees, rocks, roads, and buildings, see Section 7).

At this stage, Novat would often say that the panorama was already finished and that adding colors to it was a mere formality. Before working on the final painting, the pencil drawing is shown to the client. After approval, masks are created to protect some areas from the airbrush spraying (Novat's favorite tool) and to preserve sharp contours for shadows. Finally, after having traced the main elements of the penciled panorama on the canvas with colored pencils, paint is applied directly onto the canvas. The entire process takes anywhere from a few weeks to four months to complete, depending on the depicted region, the constraints of the commission, and the available workforce.

Despite the similarities in their creative processes, and despite the many constraints imposed by the clients, panoramists still achieve different styles. In the next sections we will focus on the characteristic style of Novat.

## 5 ON THE SHADES OF BLUE

What usually strikes viewers at first sight in the winter panoramas of Atelier Novat is the dominance of blue. Regardless of the color palette, a blue ash gouache (Linel number 52, not produced anymore) is always used as a base and mixed across the panorama in numerous

Fig. 8. Color pencils are used to support shadows (left), bases of trees (middle), and rocks (right). Close-ups of Grandes Rousses, Arthur & Pierre Novat 2011.

shades. Grand Massif and Espace Killy (Figures 1 and 5, respectively) demonstrate this clearly.

In Figure 7, I extracted color palettes from several panoramas using a median-cut algorithm (Heckbert 1982). Each displays 25 colors, where each color is the average of an equal number of pixels in the panorama, therefore it contains the 25 most representative colors of a panorama. It clearly illustrates the dominance of blue in Novat's work, a key characteristic that makes his panoramas instantly recognizable from others. Other panoramists, though having their own styles, do not rely as much on one color in their works. I argue that the blue color has thus become an inherent part of Novat's visual identity: his signature.

Aside from being an artistic choice, the use of blue in winter panoramas is logical. Shadows cast onto snow are indeed blue under a clear sky, because of the scattering of ambient light. In Novat's paintings, shades of blue provide cues about the relief of the terrain, mimicking complex lighting phenomena such as shading, shadows, and inter-reflections (indirect light on a surface), drawing the viewer's attention to specific areas of the terrain.

Novat changed both the lightness and the hue of this blue to achieve his goal. These changes are implicitly guided by the laws of physics. He added more blue and lowered the contrast by lightening colors to depict atmospheric perspective in the background, conversely adding more red in the foreground. He modified his blues by adding a hint of yellow to depict color bleeding induced by trees, and to give a turquoise hue to glaciers. These color adjustments required a solid knowledge of the mountain and a careful observation of the landscape.

Another explanation for the variations in the shades of blue is the use by Novat of different media in a single painting. He mainly used watercolor pencils and gouache sprayed with an airbrush or directly applied with paintbrushes. According to Novat, Novat, and Belluard (2013), Pierre Novat painted entire regions, including details, rather than working on the whole panorama one layer at a time. For this reason, and because using an airbrush involves a drying time of about five minutes per coat, Novat kept switching between media and colors. As a result, the shade of blue used for a given feature is never exactly the same across the panorama.

Pencils were used to support the shapes of shadows and the slopes hinted by the trees and the edges of rocks, giving strength and contrast to the painting. To smooth the result, Novat used his airbrush to spray paint or water onto these harsh lines, blending them and the underlying blue together (Figure 8), again impacting its hue.


Fig. 9. Panoramas used to extract the color palettes in Figure 7. Panoramas displayed here are scaled and cropped to fill the available space while not distorting the image.

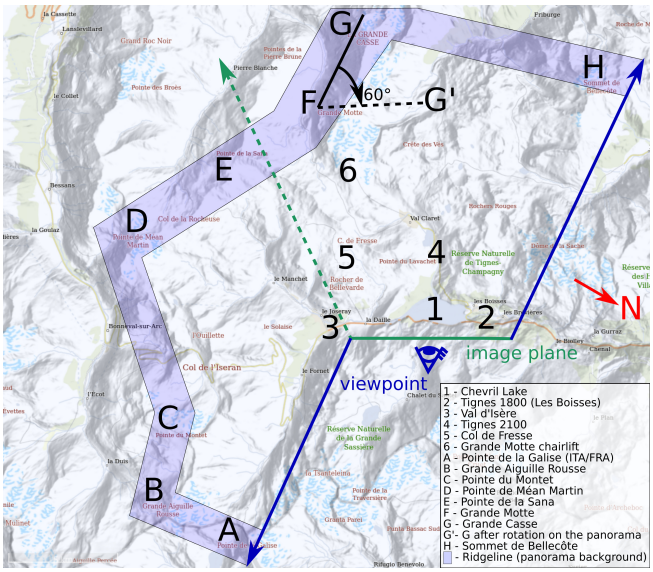


Fig. 10. 2D map of the area depicted in the Espace Killy panorama (Figure 5) with important landmarks captioned. The red arrow (N) indicates north. Note the wide angle of view used, allowing Novat to place the valley between Val d'Isère (3) and "Pointe de la Galise" (A) on the same map as Tignes (4). The angle of view chosen is wider on the left than on the right of the panorama, yet the deformation appears natural. The ridge F–G is rotated through around 60° about F, so that it faces the viewer. Still, Novat depicted the left sides of each peak, as if viewed from the Grande Motte lift (6).

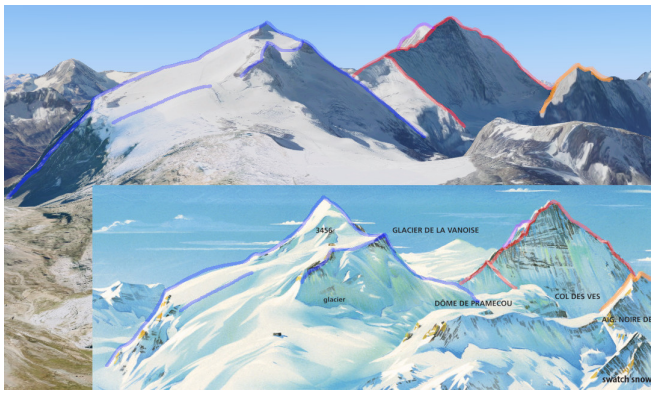


Fig. 11. Top: 3D view of Grande Motte (blue) and Grande Casse (red) as if viewed from Col de Fresse (5), a crucial part of the resort. Bottom: Close-up of Espace Killy, Pierre Novat, 1984 (Figure 5). These two peaks are rotated about their vertical axis to present a more familiar profile to skiers.

Client wishes are also a factor. For instance, clients asked for warmer colors in the 1984 panorama of Espace Killy (Figure 9, d) than those used for the 1983 version (Figure 9, c). In 1989 this change was reverted to the 1983 tones.

## 6 STYLIZED REALISM OR REALISTIC STYLIZATION

In the media, the style of Pierre Novat is often described as "hyperrealistic" (France 3 Alpes Sud 1992). This statement is ironic considering how much Novat bends reality in his panoramas. He locally deforms the topography and also exaggerates lighting phenomena. The goals are numerous: to hide or reveal details of the surface; to draw attention to a given area; and to discourage skiing in dangerous areas.

Regardless of these deformations and infringements, the result appears plausible even to locals and expert users. This feeling of "realness" comes from Novat's great attention to detail, his retention of important landscape features, and his thorough depiction of complex lighting phenomena.

### 6.1 Plausible deformation of the topography

Novat's panoramas make it easier for an uninitiated audience to understand the mountain terrain. It is represented from the skiers' point of view as they approach the slopes. More space is dedicated to areas that are of particular interest to them. Entire mountains are rotated or moved apart, to reveal in one painting all ski areas. Novat deforms the shape of the mountain while considering skier traffic, accessibility, number of pistes in the area, and their difficulty ratings.

Because features of the terrain are often represented from their most well-known viewpoints or from the viewpoint one has when skiing, both the visitors as well as locals still recognize the landscape. According to Arthur Novat, they sometimes do not notice these deformations. Pierre Novat interpolated seamlessly between several viewpoints, as if different cameras captured the landscape. He sometimes filled the gaps using his sole imagination, leading to what his son calls "panoramic cubism." The representation of the mountain conveyed by one panorama remains plausible, leading to Novat's style being mistakenly described as realistic.

Deformations are also necessary because the depicted region rarely fits within the field of view of an undistorted panorama. The angle of view can be huge and irregular. Figure 10 is a 2D map of the Espace Killy area (see Figure 5 for the panorama by Novat). In the panorama, the main viewpoint is above Chevril Lake (1). Note that the angle of view (blue arrows) is about 180° (from A to H, through 1). This allows Novat to place the valley between Val d'Isère (3) and "Pointe de la Galise" (A) on the same map as Tignes (4). Although the two valleys are almost aligned on the map, they are opposed on the panorama. The angle of view is also wider on the left part: a wider area is compressed into an equal portion of the panorama. This would have been impossible using a regular perspective view (green dashed arrow) instead.

Figure 11 displays the view one can enjoy from Col de Fresse (5) when looking at Grande Motte (F) and Grande Casse (G). Both Val d'Isère (3) and Tignes (4) have been equipped to reach this col (pass), turning it into a central junction for the resort. This view is then familiar to users of Espace Killy. It also strongly resembles what skiers experience when going up to the Grande Motte's summit using the Grande Motte chairlift (6). These reasons motivated Novat to locally change the viewpoint. To achieve this, he performed several different rotations. First, the whole ridge was rotated about F through around 60°, thus facing the main viewpoint of the panorama (1).

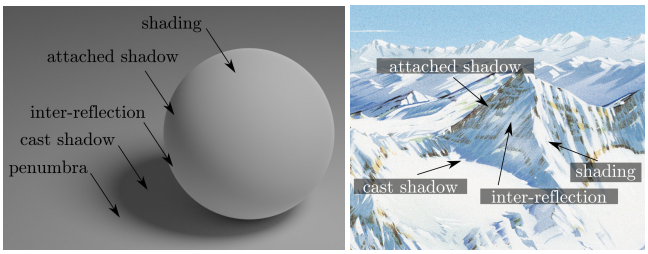


Fig. 12. Lighting terminology as defined by Mamassian, Knill, and Kersten (1998). Left: A rendering of a diffuse sphere. Right: The terminology applied to a close-up of Grandes Rousses, Arthur & Pierre Novat 2011. Note that penumbra does not occur with strong directional lights, e.g., the sun, hence its absence in Novat's panoramas.

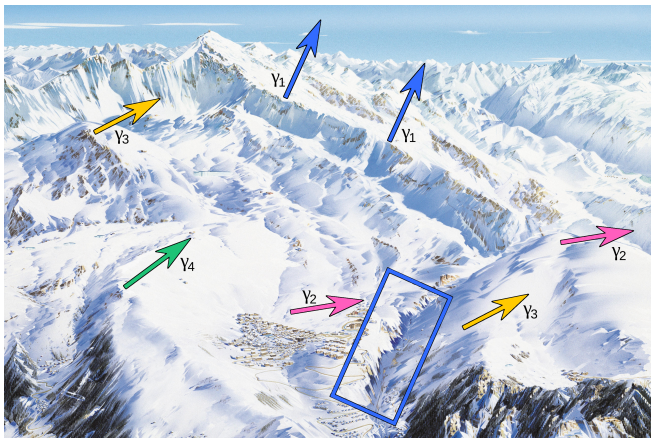


Fig. 13. The direction of light varies locally across the panorama. Arrows point towards the light source (i.e., the sun). Arrows with the same color (and label) point in the same direction. Note that small variations also occur at smaller scales. In a single feature, e.g., the foreground hill on the right, different lighting directions are used. Close-up of Grandes Rousses, Arthur & Pierre Novat 2011.

Then, each peak was individually rotated about its vertical axis to present its most recognizable profile.

Nevertheless, deforming the topography and rotating mountains are not characteristics of Novat's style alone: other panoramists have similar approaches, e.g., the Teton Range in Berann's Yellowstone panorama (Patterson 2000, 14), although Novat may make more extensive use of these techniques. Deforming the terrain allows the artist to depict terrain features that would otherwise be invisible, in such a way that viewers can more easily recognize the relief.

For instance, Berann exaggerated heights, projected the terrain onto a cylinder and used a quasi-orthographic view, leading to frontal majestic backgrounds typical of his style (Patterson 2000). On the other hand, Novat used a multi-perspective (graphical) projection, and varied the positions and heights of the viewpoints. Although the final look is different, the goal remains the same.

The complex nature of the mountain topography, especially in the Alps, makes these mandatory deformations difficult. I would argue that deforming the terrain is the main difficulty when creating a panorama. Novat excelled in this field for a variety of reasons, the influences of which are difficult to assess. His extensive knowledge of the regions represented, especially the French Alps, his ability to interpret topographic maps as 3D landscapes, and his skiing and skydiving experience, most certainly played a major role.

## 6.2 Light effects

When discussing lighting effects, and specifically shadows, I will use the terminology by Mamassian, Knill, and Kersten (1998) (Figure 12). Shading is a variation of the reflected light on a surface. For diffuse surfaces, the shading is governed by the Lambert's cosine law (i.e., the orientation of the surface with respect to the direction of light). An attached shadow is the part of the surface where the light is occluded by the object itself, whereas objects occluding the light source cause cast shadows to appear on remote surfaces. Inter-reflection is a phenomenon caused by light bouncing off surrounding surfaces. Penumbra is the region of the cast shadow where the light source is partly visible.

**Lighting design.** Panoramists often deviate from common cartographic conventions (Imhof 1982). For instance, they carefully choose orientations used in panoramas, and rarely align them with the north. Regarding lighting, they depict cast shadows in their paintings, rather than the simplified hillshading often used in 2D mapping.

A panorama displays ideal weather conditions, at either sunset or sunrise. However, a completely realistic depiction of the effects of the light direction and low sun angle at these times can impair the readability of the map. Therefore, panoramists must invent new ways of shading the terrain surface, casting shadows, and depicting complex lighting effects such as indirect illumination. To that end, Novat performs with his brushes the work of lighting designers with their lamps, or lighting artists using their 3D software.

A careful lighting design prevents shadows cast by the sun from masking important areas, and features parallel to the light direction from lacking contrast. These are also good reasons not to use aerial photographs in place of panorama maps, as they would suffer from these problems. Novat had numerous techniques to solve these issues.

**Lighting inconsistencies.** Novat changed the local direction of light in his panoramas. Figure 13 shows an example of how the light is aligned differently depending on the surface orientation of features. I estimated these local directions of light in several areas, depicted by arrows pointing towards the imaginary sun used to create lighting effects in that area. For instance, if the direction of light $\gamma_1$ were used to shade the valley in the rectangle, understanding the terrain would be difficult. Given their slopes, both sides of the valley would have about the same shading, diminishing contrast. Novat thus locally aligned the light with the illuminated face using light direction $\gamma_3$.

These variations in the light direction allow for a precise control over the shading. Illuminated slopes are brightened and shadowed ones darkened, thus increasing contrast. Although not based in physical reality, this particular way of lighting the scene does not impair our perception of shape, as the human visual system is rather insensitive to lighting inconsistencies (Ostrovsky, Cavanagh, and

Fig. 14. Novat used fine-scale cast shadows inside attached shadows of larger features. They improve the contrast of already shadowed areas, thus revealing masked terrain features. Close-ups of (left) Espace Killy, Pierre Novat, 1983 and (right) Courchevel, Pierre Novat, 1984.

Fig. 15. Novat ended the cast shadow just above the road to avoid masking it. The shape of the shadow therefore follows the road layout, highlighting it. Close-up of Mégève, Pierre Novat, 1986.

Sinha 2005). In fact, maximizing local contrast on the surface ensures a better shape depiction, and locally varying the direction of light has proven to be an efficient way to achieve this goal (Jenny 2001; Marston and Jenny 2015; Mestres et al. 2021). Manual relief shading for maps is also based on locally varying the light direction. It has inspired cartographic research that has produced numerous digital techniques since the foundational work of Brassel (1974). This research work on relief shading for digital terrain visualization is discussed in more details in Section 8.

Changing the direction of light not only helps with the shading. It also allows for the control of shadows, whose positions are important to recover spatial arrangement and to underline important features of the terrain.

**Cast shadows.** Figure 14 presents examples in which Novat used cast shadows to depict terrain details on shadowed slopes that would not be directly exposed to sunlight. In reality, cast shadows cannot be inside other shadows (attached or cast). Still, Novat allowed small features within the shadowed slopes of larger landforms to cast their own shadows. These multi-scale shadows were painted from the coarser to the finer scale. The increase in contrast caused by an additional layer of fine-scale shadows helps with the readability of even the smallest details and enhances the depiction of the relief.

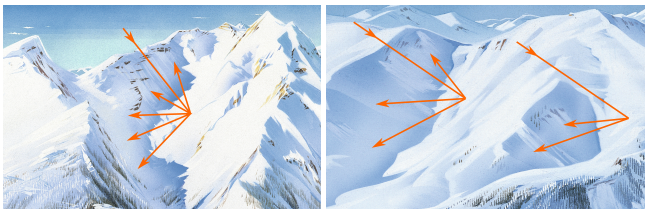

Fig. 16. Examples of indirect illumination from inter-reflections in Novat's work. Arrows represent light rays. Inter-reflections are caused by the light bouncing off slopes facing the light, thus brightening opposing slopes. Close-ups of (left) Puy Saint-Vincent, Pierre Novat, 1992, and (right) Val d'Allos, Pierre Novat, 1987.

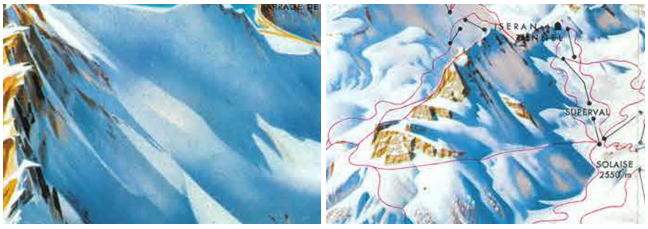


Fig. 17. Novat's treatment of inter-reflections (left) is more subtle than Berann's (right). The blue of the shadowed snow is lightened, creating a soft gradient whereas Berann used complementary shades, creating a stark contrast. Close-ups of Val d'Isère, Berann (with alterations by Novat) 1962.

Casting shadows on important parts of the terrain that should stay clearly legible would cause something that the visual perception community calls masking. Masking is a phenomenon in which another stimulus (the mask) makes it difficult for the human visual system to recover information (in our case, shape and spatial arrangement; Legge and Foley 1980).

Novat instinctively altered the shape of shadows to prevent masking. Strong shadows were stopped shortly after the bottom of slopes or before important elements of the panorama (see Figure 15 for an example). It allowed him to highlight abrupt changes in the slope that the user of the map should be aware of. Also, Novat's shadows are overall brighter than those in real life or than would be found in realistic renderings. It is again a way to prevent masking while still painting shadowed areas in a convincing way.

**Inter-reflections.** Novat's use of inter-reflections (i.e., indirect illumination) is a practical means of relighting dark areas in a way that feels natural for the viewer. For instance, in a valley, we expect inter-reflections to be painted on the slope opposing the one exposed to the sunlight. See in Figure 16 how the shadows are brightened by the faces that reflect direct lighting. Novat brightened mostly the center of shadows. He maintained a high contrast by keeping the bottom part dark. Novat developed his treatment of inter-reflections starting with his first panorama. We can see on his alteration of Val d'Isère by Berann (Figures 4 & 17) that although Novat integrated Tignes in the style of Berann, he also already had his own style.

Most of the complex lighting effects worth depicting in a panorama were captured in the photographs taken by Novat during his preliminary study of an area. Using these as a base for painting, Novat

retained a certain physical accuracy, making the scene even more plausible. But inter-reflections were also sometimes added solely because they were convenient for terrain depiction; again, another reason not to describe Novat's panoramas as "realistic." Intuition played an important role in his painting, and inter-reflections were often placed "where they feel right," says Arthur Novat.

**Atmospheric perspective.** Sunlight is scattered by particles in the atmosphere. Light that has a wavelength that is shorter than or similar to these particles is scattered more. This phenomenon is called Rayleigh scattering in optics[2], and atmospheric or aerial perspective in cartography and painting (Jenny and Patterson 2020). It is responsible for a decrease in contrast for distant objects and for giving them a bluish aspect, as blue light corresponds to the short wavelengths of the human visible spectrum.

To help us gauge the expanse of the Alps, Novat painted not only paint the resort, but also the scenery that surrounds it. However, he drew the attention of the viewer to the resort with a clever use of atmospheric perspective in the background. For instance, the Mont Blanc towers over the scene in the background of Figure 1. Aerial perspective makes it appear far away, reducing its importance without having to omit the emblematic summit. For areas inside the resort, the contrast is preserved, leaving it to stand out, within reach of the skier, distinct from the background that is veiled by a layer of haze. Thanks to this technique, the viewer focuses on important parts of the panorama.

## 7 SURFACE TEXTURE

I have presented the terrain deformation and use of lighting effects elements that are at the heart of Pierre Novat's style. However, these elements alone would lead to a very bland representation of the scene. Novat populated his panoramas with elements painted on top of the terrain surface: trees, rocks, roads, and buildings. They texture the mountain and serve an aesthetic as well as an informative purpose.

**Trees.** Some mountainous areas are covered with trees, so Novat decreased the tree coverage density to avoid losing terrain information in his paintings (Figure 18). His treatment of trees differed substantially from that of other artists. For example, James Niehues is known for painting each tree individually (Figure 19). Conversely, Novat used color pencils to depict trees. They were pencilled directly onto the snow, hatched to form bands of trees. A few trees are enough to represent a grove, add more of them and you have a forest. Their colors depend on their species: deep greens, almost black, for the spruces and firs; light browns and yellows for larches dusted with the first snow of the season. Larches are conifers, as are firs, but they lose their needles during fall, enabling light rays to pass through their branches. As a result, they are only lightly sketched over the snow in sunny areas (Figure 20, a).

Trees were depicted by more than just flat color pencil strokes onto the canvas. Their colors blend with the surroundings (Figure 20, b) and they catch light and shadows (Figure 20, c). Some are covered with snow (Figure 20, d). Those that stand alone or are at the edge of a forest cast shadows on the ground (Figure 20, e).

2. https://en.wikipedia.org/wiki/Rayleigh_scattering#Cause_of_the_blue_color_of_the_sky

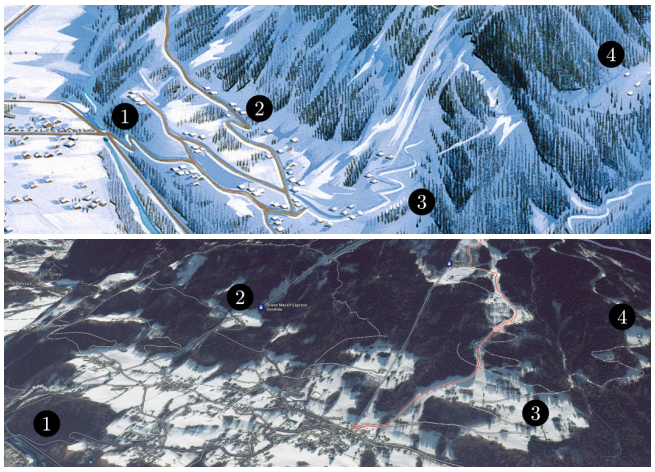


Fig. 18. Top: Close-up of Grand Massif, Pierre Novat, 1986. Bottom: Satellite view of the same area. Note how Novat diminished the tree coverage density in his painting; as a result, the terrain remains visible.

Fig. 19. James Niehues painting trees one by one. Figure adapted from the interview by Kelly (2021). See how Niehues's trees differ from Novat's in Figure 8, middle, and Figure 20.


Fig. 20. Novat's treatment of trees differed from one species to another. Larches (a) were lightly sketched over the snow. Novat smoothed trees in shadows with his airbrush by spraying them with paint or water, blending their color with the blue of the snow (b). Trees catch the light (c) and can be covered in snow (d). They cast shadows when alone or at the edge of a forest (e). Close-ups of Réallon, Pierre Novat, 1990.

Trees are exempted from perspective projection—they are depicted as if viewed from an orthographic camera. As a result, their height becomes strongly exaggerated in the background. They are always drawn vertically and distributed along the slope. The alignment of the trees thus become a visual cue giving precious implicit information about the relief of the terrain beneath them.

**Rocks.** Rocks are mainly visible when the slope is steep or when they protrude from the ground. In Novat's panoramas, they are depicted on important landmarks that must be recognized as faithful to reality. For example, note how the characteristic horizontal and

Fig. 21. Aiguille du Goûter. Left: Photograph (© Antonio Giani). Right: Close-up of *Chamonix*, Pierre Novat 1992. Note how the depiction is accurate on the painting, with cracks in the rocks clearly visible.

Fig. 22. Left: Photograph of rocks above Val d'Isère village at sunset from a webcam in the resort (© Val d'Isère Tourisme). Right: Close-up of Espace Killy, Pierre Novat 1984. The shades of brown and yellow are reproduced directly from the preliminary photographs taken by Novat.

Fig. 23. A road. Note how its path is highlighted using shadows and touches of white. Close-up of Mégève, Pierre Novat 1986.

Fig. 24. Top: The village of Aussois in 2011 (©Florian Pépellin CC-BY-SA 3.0). Bottom: Its 1993 painted version by Novat. The church and some houses are still recognizable today.

vertical cracks in the rocks are reproduced in Novat's depiction of Aiguille du Goûter seen in Figure 21.

They are also a practical way to implicitly inform skiers about the danger of the terrain. In difficult areas, rocks that are invisible because of snow are shown in the painting, to act as warnings. For easy ski trails, the terrain is often smoothed and rocks omitted so that beginners do not hesitate to ski there.

Regarding color, rocks were painted in very different shades from one panorama to the next. Although influenced by the complex geology of the Alps and the different types of rocks, the color depends also on the hour of the day chosen to represent the scene. As mentioned in Section 4, prior to the creation of a panorama, photographs were taken by flying over the area. These shots were taken in the morning or evening when the sun was very low. As a result, rocks exhibit vivid colors such as warm browns, yellows, and reds. See Figure 22 for an example on the Espace Killy panorama. The colors used for rocks in the painting are very similar to those seen in the modern photograph. Note how the snow is kept white, increasing contrast even more, as opposed to the photograph, in which it is yellow.

**Roads.** Roads on Novat's panoramas are not applied as a layer on top of the panorama after the painting is finished, as it is the case with the labels. While this might work well for a 2D map, for a panorama, roads need to be part of the painting itself.

In Novat's style, they are slightly lowered with respect to the surface of the terrain, as if snowbanks were framing them. To achieve this 3D look they were outlined with white paint on one side, particularly noticeable in shadowed areas, and with a dark blue stroke on the other (see Figure 23). Roads inform the viewer that different places in the panoramas are connected. They are enlarged to be clearly understood, but their shapes are also sometimes abstracted. Depicting only some of the roads has an impact on routes chosen by visitors. It helps to guide them towards spots considered of interest for the resort, while keeping them away from residential areas and competing villages.

**Buildings.** Like roads, chalets and buildings are 3D elements that have been integrated into the painting, not just layered above it. They cast shadows and are always represented with snow on their roofs.

Where roads are always exaggerated in size and sometimes abstracted, buildings are surprisingly accurate. Figure 24 compares Aussois on the 1993 panorama with a photograph taken in 2011. The village has undergone change, but some buildings can still be clearly identified. Indeed, characteristic buildings (e.g., city halls, churches) needed to be recognizable, as well as the ones visible from the road when driving, as they can be useful landmarks for visitors.

Often, Novat's commissions were updates to include newly constructed buildings and facilities in existing panoramas. Clients regularly requested that their homes appear on new and updated panoramas, which required painting with enough precision to depict a small chalet.

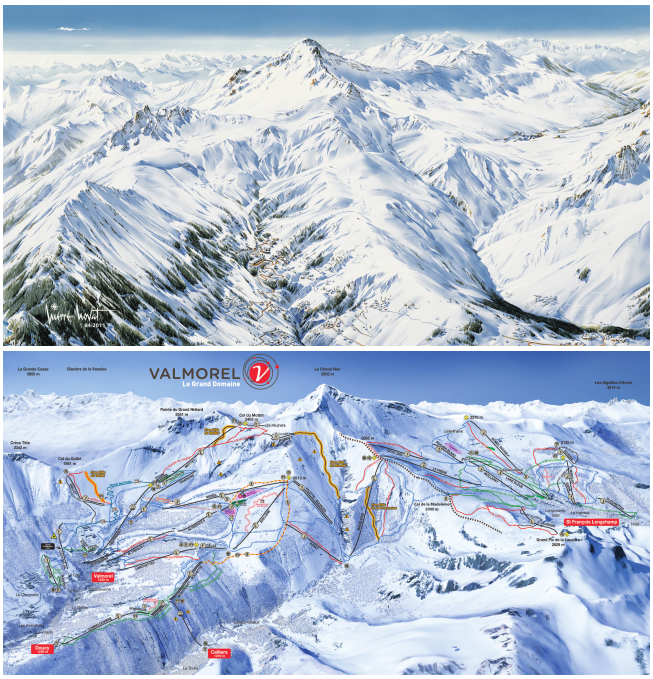


Fig. 25. Valmorel. Top: Novat's version (1984). Bottom: Kaliblue's panorama for season 2021–2022. ©Kaliblue.

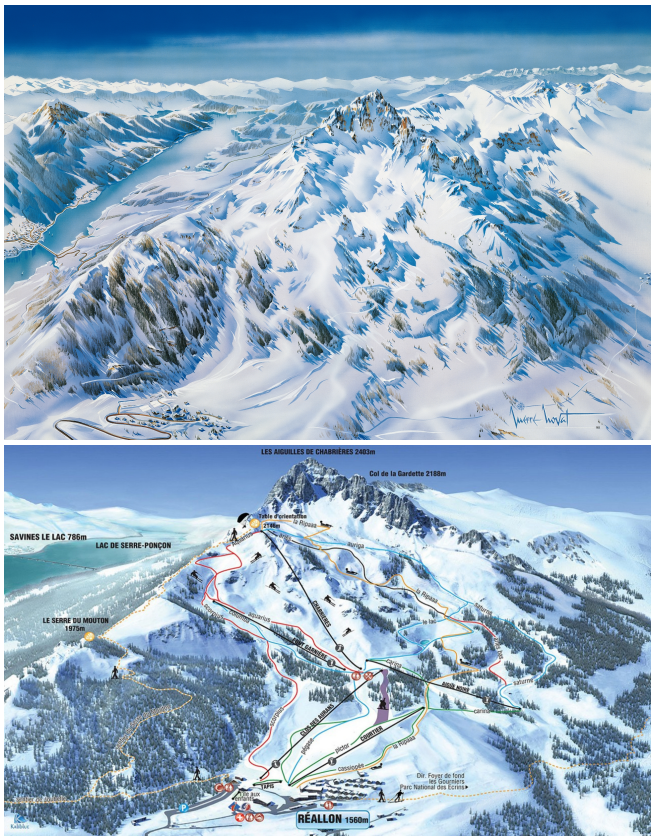


Fig. 26. Réallon. Top: Novat's version (1990). Bottom: Kaliblue's panorama for the 2011–2012 season. ©Kaliblue.

## 8 TOWARDS DIGITAL AND STYLIZED PANORAMAS

Producing a hand-painted panorama is a challenging task, involving a broad range of skills. Even for masters such as Berann or Novat, the production time for large paintings can take up to several months (Patterson 2000; Novat, Novat, and Belluard 2013). Panoramists, though experts at crafting beautiful aerial maps of the mountain, are now a dwindling profession due to these constraints.

Indeed, ski resorts rely more and more on Computer-Generated Imagery (CGI) to produce panoramas. Figures 25 and 26 display comparisons between Novat's hand-painted panoramas of Valmorel and Réallon and versions created by the company Kaliblue. Although fast, 3D rendering systems lack the editing tools to enable the creation of panoramas of similar artistic quality—they offer a limited range of styles. Artists are often required to manually or digitally repaint parts of the rendered images to achieve the desired result (as it seems to be the case in the panoramas by Kaliblue).

The cartographic and computer graphics research communities share common goals regarding terrain representation (Kennelly and Kimerling 2006). Both are tackling the challenge of enabling the creation of clear and stylized digital mountain panoramas. The main focus so far has been the style of Berann. Based on his artworks, rules that define his style are inferred, then translated into algorithms for image synthesis. Both the painterly rendering and the terrain deformations are currently being explored. Full rendering systems (Bratkova, Shirley, and Thompson 2009; Brown and Samavati 2017) mimic Berann's style regarding shading and surface texture. They also globally curve the terrain so that foreground landmarks do not mask background features. Jenny and Jenny (2013) used an early style transfer method, example-based texture synthesis, to apply Berann's style to 3D rendered terrains. This area of computer graphics has made significant progress since that time and continues to be a promising avenue of research—see the stylized panorama in Figures 11 & 12 of Futschik et al. (2021). Still, as these methods are automatic, they lack artistic control, a crucial feature for creating expressive renderings.

Automatic (Degener and Klein 2009) and computer-assisted (H. Jenny et al. 2011) methods have been proposed to deform the topography of the terrain locally, in the spirit of Berann. These deformations could be combined with the above-mentioned rendering techniques for convincing results, but to this date and to my knowledge, little work has been conducted in this regard.

More generally, digital artists can enhance the depiction of terrain shape using shading models that locally modify the intensity of the shading at the surface of objects (or terrain). Cartographic research often takes inspiration from hand-shaded relief while computer graphics research focuses on natural phenomena and human visual system properties. Nevertheless, the works of both communities sometimes overlap.

Accessibility Shading methods(Miller 1994; Pharr and Green 2004) adapt shading with respect to the surrounding geometry, darkening areas that are difficult to reach. Kennelly and Stewart (2006) use the sky model formulation to enhance terrain depiction. These were approximations assuming a uniform environment, though the same authors later 2014 address this issue by enabling the use of arbitrary sky models. Other methods control shading by combining images rendered using different light directions (Jenny 2001; Marston and Jenny 2015), or directly by varying the light direction before rendering (Brassel 1974; Rusinkiewicz, Burns, and DeCarlo 2006; Vergne et al. 2009; Veronesi and Hurni 2015; Mestres et al. 2021), similarly to what manual panoramists would do. The work of B. Jenny et al. (2021) is a notable exception that uses deep learning to produce shaded relief images from manual examples.

These approaches have much in common in terms of technique and purpose. In this regard, it seems beneficial to foster collaboration between the two communities of cartography and computer graphics, which hopefully will yield fruitful results for 3D terrain rendering and landscape visualization.

## 9 CONCLUSION

In this paper, I have described the characteristic style of the painter and panoramist Pierre Novat. We have seen how Novat's panoramas feature a deformed representation of the landscape that is viewer-centric. I presented his unique treatment of lighting phenomena, which was aimed at a clear depiction of the relief. I also showed how he used surface texture elements to convey crucial information. An examination of these three elements—terrain deformation, lighting effects, and surface texture—is a necessary first step for an in-depth understanding of the panoramas by Atelier Novat.Hopefully, this study will help to safeguard parts of Novat's knowledge and give contemporary artists insights about panoramic maps designed in the style of Novat.

As a marketing tool for resorts, Novat's panoramas played an important role in the expansion of alpine skiing in France. Still in use today, they respond to the clients' requests by reconciling commercial considerations with the topography of the area. When creating a panorama, compromises must be made, and Novat clearly excelled at the task.

Because many ski areas are rapidly evolving into "four season" mountain resorts, they have new demands, which the traditional techniques used by panoramists cannot meet. Computer assisted solutions for the creation of panoramic maps are therefore gaining more attention. Rendering systems are now used to generate mountain panoramas that are then digitally retouched by artists to fulfill the clients' desiderata. Automatic results of a quality equivalent to a hand-painted map are not within reach yet, and much work remains to be done to provide artists with tools to express their styles. This should prove to be an exciting avenue of future work in both the computer graphics and cartographic communities. The perpetuation of panoramists' know-how is at stake.

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