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Indoor glaciology: "Melting Landscape" to increase people awareness on climate change impacts

Abstract: Senese A., Fugazza D., Chiatante G., Kaihoh K., Trasatti S., Maugeri M., Dioloaiuti G.A., *Indoor glaciology: "Melting Landscape" to increase people awareness on climate change impacts.* (IT ISSN 0391-9838, 2023). In recent times, it is becoming increasingly important to raise people's awareness and consciousness about climate change and its effects. Out of this need comes the importance to design innovative approaches able to make people aware of ephemeral natural resources. Freshwater is one of the most precious resources on our planet, and cryosphere mainly contributes to its availability for hydropower, cropping and civil uses. Within this context, the installation titled "Melting Landscape" by Kei Kaihoh exposed during the 17th International Architecture Exhibition of the Biennale di Venezia (Italy) in 2021 aimed to increase interest and consciousness of the Exhibition's visitors to climate change and its environmental impacts. The installation represented a modern version of Yukimuro, a traditional snow storage method, used to preserve food on the mountains of Japan. During this experiment of indoor glaciology and geoeducation, we monitored the thermal and radiative conditions driving indoor snowmelt comparing them to the actual outdoor conditions in the mountain environment. To achieve this purpose, in addition to meteorological data acquired near the "Melting Landscape" work, we analyzed data from other two sites: i) Venezia, the city where the International Architecture Exhibition was held, and ii) Cortina d'Ampezzo, from where the snow used for the "Melting Landscape" work was brought. By investigating the dynamics of snow melting in a controlled indoor setting, this study serves as a powerful tool for increasing public awareness and fostering a deeper understanding of the implications of climate change.

Key words: Indoor glaciology, Snow melting, Climate change impacts, Awareness, Environmental education.

Riassunto: Senese A., Fugazza D., Chiatante G., Kaihoh K., Trasatti S., Maugeri M., Dioloaiuti G.A., *Glaciologia indoor: "Melting Landscape" per sensibilizzare le persone sull'impatto dei cambiamenti climatici.* (IT ISSN 0391-9838, 2023). Negli ultimi decenni sta diventando sempre più importante sensibilizzare le persone sui cambiamenti climatici e sui loro effetti. Da questa esigenza nasce l'importanza di progettare approcci innovativi in grado di sensibilizzare le persone sulle risorse naturali effimere. L'acqua dolce è una delle risorse più preziose del nostro pianeta e la criosfera contribuisce principalmente alla sua disponibilità per l'energia idroelettrica, le coltivazioni e gli usi civili. In questo contesto, l'installazione intitolata "Melting Landscape" di Kei Kaihoh, esposta durante la XVII Mostra Internazionale di Architettura della Biennale di Venezia (Italia) nel 2021, mirava ad accrescere l'interesse e la consapevolezza dei visitatori della Mostra nei confronti del cambiamento climatico e del suo impatto ambientale. L'installazione rappresentava una versione moderna dello Yukimuro, un metodo tradizionale di stoccaggio della neve, utilizzato per conservare il cibo sulle montagne del Giappone. Durante questo esperimento di glaciologia e geoeducazione indoor, abbiamo monitorato le condizioni termiche e radiative che hanno determinato la fusione della neve all'interno dell'edificio, confrontandole con le reali condizioni esterne dell'ambiente montano. A tal fine, oltre ai dati meteorologici acquisiti in prossimità dell'opera "Melting Landscape", abbiamo analizzato i dati di altri due siti: i) Venezia, città in cui si è svolta la Mostra Internazionale di Architettura, e ii) Cortina d'Ampezzo, dove è stata presa la neve utilizzata per l'opera "Melting Landscape". Indagando le dinamiche della fusione della neve in un ambiente interno controllato, questo studio rappresenta un importante strumento per incrementare la consapevolezza del pubblico sugli effetti del cambiamento climatico e favorirne una più profonda comprensione.

Termini chiave: Glaciologia indoor, Fusione della neve, Impatti del cambiamento climatico, Sensibilizzazione, Educazione ambientale.

INTRODUCTION

In the face of intensifying climate change and its global consequences (IPCC, 2023), there is an increasing need for innovative and effective approaches to raise awareness and educate the public about the impacts of global warming (Lafuente-Lechuga *et al.*, 2023; Nieto-Sandoval, Ferré-Pavia, 2024). In the context of growing concerns about climate change and its impact on the cryosphere (IPCC, 2023), recognition of its role in maintaining freshwater resources becomes critical especially in those remote areas where the meltwater is the unique freshwater source (Immerzeel *et al.*, 2020; Senese *et al.*,

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2018a). Preserving the integrity of the cryosphere is not only essential for the ecosystems, but it is also related to ensuring a sustainable and secure water supply for human societies around the World (Mishra, Kumar, 2024). Recognizing the intricate connection between the cryosphere and freshwater availability is critical for a proper management of the environment and for the conservation of natural resources.

Recently, new strategies are increasingly being tested for sharing knowledge and making research results more understandable to the general public, with the aim of increasing people's awareness and consciousness about climate change and its effects (Frigerio *et al.*, 2021; Jurakulovna *et al.*, 2022; Kumar *et al.*, 2024; McKinley *et al.*, 2017). For example, augmented reality and immersive vision are among the most innovative approaches (Diolaiuti *et al.*, 2021, 2024). This paper contributes to this topic reporting a new and never published (as far as the authors know) approach called "Indoor Glaciology", a unique method that utilizes controlled environments for simulating and showing snow/ice melt processes. This method was developed in the framework of the project "Melting Landscape", an installation by Kei Kaihoh exposed during the 17th International Architecture Exhibition of the Biennale di Venezia (Italy) in 2021 (https://www.labiennale.org/en/architecture/2021/one-planet/kei-kaihoh-architects) with the main aim to sensibilize the Exhibition's visitors to the climate change theme.

Focusing on the complex interactions between snow/ice, temperature, and climate change, our research aims to shed light on the urgency of addressing environmental issues. Specifically, by showing the gradual reduction of the installation due to snowmelt and then leaving the room empty, this study serves as a powerful tool to increase public awareness and promote a deeper understanding of the implications of climate change.

La Biennale di Venezia has been for over 120 years one of the most prestigious cultural institutions in the World. Established in 1895, the Biennale has an attendance today of over 500,000 visitors per year at the Art Exhibition. The history of the La Biennale di Venezia dates back from 1895, when the first International Art Exhibition was organized. In the 1930s new festivals were born: Music, Cinema, and Theatre (the Venice Film Festival in 1932 was the first film festival in history). In 1980 the first International Architecture Exhibition took place. The 17th International Architecture Exhibition ran from 22 May to 21 November 2021, curated by architect and scholar Hashim Sarkis. The 17th International Exhibition included 112 Participants from 46 countries. From Japan it was selected the project by Kei Kaihoh named "Melting Landscape". The researchers from the University of Milan decided to support this artist and his project also considering the strong educational vocation of this architectural exhibition, representing an important opportunity to disseminate research results on the impacts of climate change and to raise awareness of environmental issues among many people.

In particular, the project "Melting Landscape" converted the pavilion into a snow storage (fig. 1) by creating a large pile of snow brought from the area of Col Gallina Huge at 2055 m a.s.l. (near Cortina d'Ampezzo, Italy, at about 170 km from Venice). It represented a modern version of Yukimuro (i.e. "snow room" in Japanese), a traditional snow storage method, used to preserve vegetables and other foods under low temperature by using natural cold source on the mountains of Japan (Kamiyama *et al.*, 2018, 2017). In this way, the choice to exhibit not just a snowbank but a real traditional Yukimuro led visitors to reflect both on the effects of climate change but also on ancient but still applicable sustainable techniques for conserving foods.

Snow storage or snow farming (i.e. the conservation of snow during the warm season of the year) is a well-known technique globally applied for a lot of different purposes. Already in ancient time, ice and snow were stored for cooling of food and houses (Morofsky, 2007; Skogsberg, 2005). Another example for a traditional application of snow storage is the collection of snow in deep underground wells e.g. in Afghanistan (Bhattacharyya *et al.*, 2004). The water derived by snowmelt can be used for irrigation or as drinking water during summer. Rising energy costs have increased interest in snow or ice as cooling source (Nordell, 2015). Another application of snow conservation is the protection from melt of glaciers used as ski resorts (Olefs, Fischer, 2008; Senese *et al.*, 2020).

In the framework of the experiment of Indoor Glaciology and geoeducation, we carried out in Venice in 2021, we monitored the thermal and radiative conditions driving indoor snowmelt compared to the actual outdoor conditions in the mountain environment. To achieve this purpose, in addition to meteorological data acquired near the "Melting Landscape" installation, we analyzed data from other two sites: i) Venezia, the city where the International Architecture Exhibition was held, and ii) Cortina d'Ampezzo, where the snow used for the "Melting Landscape" installation was brought. In this way, we compared the meteorological conditions i) occurred if the snow was not moved (i.e. Cortina d'Ampezzo), ii) occurred if the snow was not stored inside a building (Venezia), and iii) actually affecting the snowmelt (La Biennale).

DATA AND METHODS

The "Melting Landscape" installation has a shape of an elliptical shell with a base of 18.70 m^2 and a volume of 45.82 m^3 (fig. 1). In order to mitigate melt of the snow stored in the pavilion, it was covered by a heat-reflective insulating material consisting of 5 layers of the Over-all Over-foil 311 type. The material has the 2 external faces of protected pure aluminum, 2 sheets of inert air bubble in high-weight polyethylene and, interposed in the middle, a sheet of 3 mm thick polyethylene foam. The material is heat-sealed at the ends and in the middle of the roll for its entire length and has a nominal thickness of 9 mm. It has the following technical characteristics: i) certified thermal resistance in double cavity equal to 1.90 m^2K / W (U = 0.527 W / m^2K); ii) thermal resistance tested on site in double cavity equal to 2.30 m^2K / W (U = 0.435 W / m^2K); iii) noise reduction in the wall (interposed between two bricks) equal to 55 dB; iv) diffusion coefficient of the vapor of 30769, and v) emissivity of the external faces equal to 0.05.

Before the installation of the "Melting Landscape" structure, some computations were performed in order to predict the snowmelt rate and then the potential time persistence (i.e.: how many days the snow can survive before

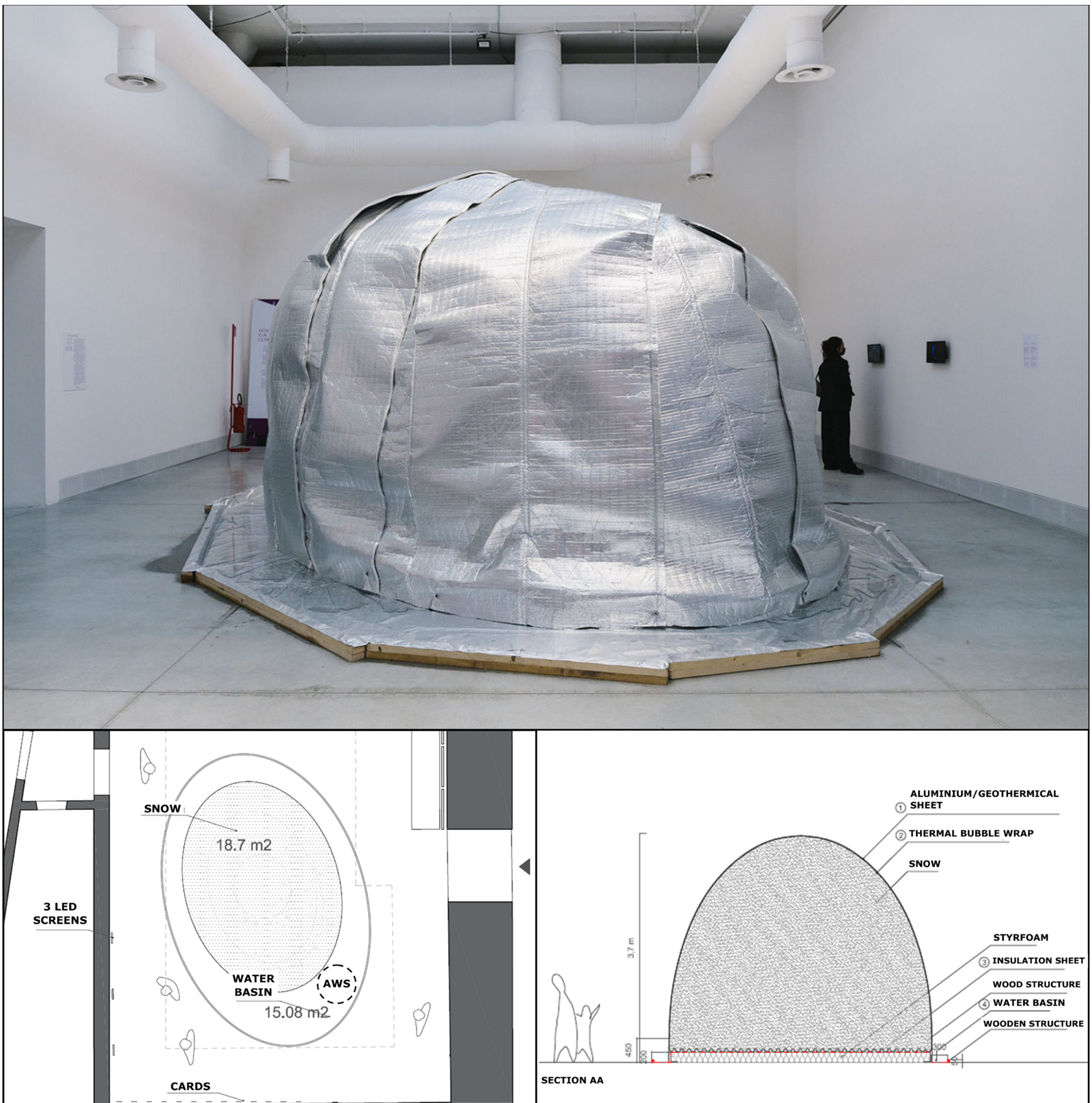

Figure 1 - "Melting Landscape" installation by Kei Kaihoh exposed during the Venice Biennale's 17^{th} International Architecture Exhibition in 2021. At the bottom the front and top view of the work. https://kaihoh.jp/news/project/melting-landscape/

melting completely) of the work. We applied a simple model (eq. 1) for quantifying snowmelt (M) from the temperature of air (T_a) inside the pavilion and from the temperature of its walls (T_{walls}) considering initially a not covered surface:

$$M = \frac{(q_{conv} + q_{rad}) \cdot \Delta t}{L_m} = \frac{A \cdot [h \cdot (T_a - T_s) + \varepsilon \cdot \sigma \cdot (T^4_{walls} - T^4_s)] \cdot \Delta t}{L_m} \quad (1)$$

Where:

- q_{conv} and q_{rad} are the convective and radiative heat transfer per unit time, respectively,
- Δt is the time of exposition,
- L_m is the latent heat of melting (3.34×10^5 J kg^{-1}),
- A is the external surface of the installation in m^2,
- h is a convective exchange coefficient,
- T_a, T_s, and T_{walls} are the temperatures of air (T_a) in the pavilion, of snow surface (T_s, assumed to be at the melting point, 0 °C) and of pavilion's walls (T_{walls}),
- ε is the emissivity of the snow and of pavilion's walls (i.e. 0.90),
- σ is the Stefan-Boltzmann constant (5.67×10^{-8} W m^{-2} K^{-4}).

In this model the thermal energy which is transferred to the snow's installation per unit time is assumed to depend on two terms: convective (q_{conv}) and radiative (q_{rad}) heat transfer. Convective heat transfer is modelled by means of Newton's law with the convective exchange coefficient (h) assumed to be 5 W m^{-2} K^{-1}. This value can be considered reasonable for air temperatures ranging from +10 to +30 °C. If the pavilion would be warmer, h would be higher and then q_{conv} would be underestimated. Radiative heat transfer is modelled assuming that both the installation and the pavilion's walls emit energy according to Stephan-Boltzmann's law and considering that the net energy transferred to the installation is given by the difference between the energy it absorbs and emits.

We estimated then the changes in the snowmelt rate obtained by covering the installation by mean of the heat-reflective insulating material. In this case we assumed that within this material heat is transferred only by means of thermal conduction, whereas from the external surface of the insulating material to the external environment heat is transferred by convective and radiative transfer, but with a much lower emissivity than for snow ($\varepsilon = 0.05$).

Figure 2 - The automatic weather station ($AWS_{Biennale}$) installed near the "Melting Landscape" work.

In order to validate our melt model and the input coefficients (i.e., convective exchange coefficient, the emissivity of the snow and pavilion's walls, and the emissivity of the external surface of the insulating material), we originally planned to measure snow melting rate of the installation but during the exposition was not possible to do it due several issues including logistic problems.

In order to investigate the conditions affecting the snow melt, an automatic weather station ($AWS_{Biennale}$) was installed near the Kaihoh's work (fig. 2). The instrumentation used, although similar to that used at high altitudes (e.g. (Fugazza *et al.*, 2023; Senese *et al.*, 2018b, 2012), was specifically developed for indoor use. $AWS_{Biennale}$ was equipped by an indoor weather station (gently provided by LSI Lastem) named "kit microclimate" measuring air temperature and relative humidity (instrument code DMA672.1) and air motions (instrument code ESV306) and by a CNR1 Kipp&Zonen net radiometer measuring short- (SW) and long-wave (LW) radiation (both incoming, IN, and outgoing, OUT). The latter sensor was placed vertically so as to be parallel to the surface of the work to properly measure radiative fluxes entering its surface. Data points were sampled every second and then averaged every minute, including the basic distribution parameters (minimum, mean and maximum values). From the incoming longwave radiation (LWin) the temperature of the room's wall can be derived as:

$$T_{walls} = \sqrt[4]{\frac{LW_{in}}{\varepsilon \cdot \sigma}} \tag{2}$$

assuming that the wall's emissivity (ε) is 0.90.

The instrumentation was provided free of charge by the Italian company LSI Lastem S.r.l., which has been cooperating with the staff of the University of Milan for several years in monitoring Alpine and Asian glaciers (e.g. Gambelli *et al.*, 2014; Bocchiola *et al.*, 2015; Minora *et al.*, 2015; Vuillermoz *et al.*, 2015; Senese *et al.*, 2020a). The $AWS_{Biennale}$ ran from May 18, 2021 (the day after the work was installed) to June 14, 2021 (when all the snow melted).

The Venezia and Cortina d'Ampezzo meteorological stations are managed by the Regional Department for Territory Security of Veneto Regional Agency for Environmental Protection (ARPA Veneto, 2021), which provides data validation and dissemination through a dedicated website. The available variables used in this study are: air temperature, relative humidity, incoming solar radiation and wind speed, all daily minimum, mean and maximum values. The Venice AWS is located at the Cavanis Institute at 18 m a.s.l. (Gauss Boaga coordinates: E 1760369 and N 5036126, western zone, EPSG:3003). The Cortina d'Ampezzo AWS is situated in the Gilardon fraction at 1271 m a.s.l. (Gauss Boaga coordinates: E 1739833 and N 5158457, western zone, EPSG:3003).

RESULTS

Snowmelt prediction

Applying the simple energy model, we quantified the snowmelt rate for studying the project feasibility. The convective (q_{conv}) and radiative (q_{rad}) energy fluxes were calculated assuming several different thermal conditions in the room (table 1). Since the snow surface was assumed to be at the melting point (i.e. 0 °C), we varied the values of the temperature of air in the pavilion's room (T_a) and of the room's walls (T_{walls}). In table 2 the water amounts derived from snowmelt are shown from the worst case (30 °C of both T_a and T_{walls}) to the best (but unrealistic) situation (10 °C of both T_a and T_{walls}). Applying the worst assumption, the whole snow amount was expected to melt within less than 10 days. These hypotheses did not take into account the presence of the insulating cover. By introducing this cover, we got a strong reduction of the snow melt rate which turned out to be about one order of magnitude lower. It is however important underlying that in this case the model probably underestimates the heat exchange because it is not easy keeping the insulation material tight to the installation and avoiding that air can pass through the different sheets of it (see fig. 1). Moreover, the material becomes wet and heat exchanges may also occur at the bottom of the installation where the insulation material is not present.

Table 1 - The convective (q_{conv}) and radiative (q_{rad}) energy fluxes depending on the temperature of air in the pavilion's room (T_a) and of the room's walls (T_{walls}) are shown.

T_{walls} and T_a (°C)	q_{conv} (W m^{-2})	q_{rad} (W m^{-2})
10	50	44
11	55	49
12	60	53
13	65	58
14	70	63
15	75	68
16	80	73
17	85	78
18	90	83
19	95	88
20	100	93
21	105	98
22	110	103
23	115	108
24	120	114
25	125	119
26	130	125
27	135	130
28	140	136
29	145	141
30	150	147

Table 2 - The snowmelt (in cm and in water equivalent) calculated assuming different combinations of temperature of air in the pavilion's room (T_a) and of the room's walls (T_{walls}).

T_a (°C)	T_{walls} (°C)	Energy driving melt (W m^{-2})	Approximate snowmelt (cm m^{-2} day^{-1})	Snow water equivalent (l m^{-2} day^{-1})	Number of days required to completely melt the snow
30	30	300	23	77.6	11
25	25	250	19	64.7	13
20	25	220	17	56.9	15
15	20	170	13	44.0	19
10	15	120	9	31.0	27
10	10	100	8	25.9	33

In any case we have evaluated that it was not possible storing the installation for the requested time without the insulation cover and we decided therefore to add it to the installation.

Meteorological conditions affecting snowmelt

Comparing meteorological variables measured in the Biennale pavilion, Venice and Cortina d'Ampezzo from 19 May to 14 June 2021, we found that the indoor conditions were the warmest (fig. 3) but not the wettest (fig. 4). In fact, the indoor daily air temperature ranged from +18.1 °C (on May 24) to +26.9 °C (on June 13) with a mean value of +22.3 °C. In Venice it was from +13.9 °C (on May 19) to +25.1 °C (on June 9) with a mean value of +19.9 °C and in Cortina d'Ampezzo was from +6.0 °C (on May 24) to +18.3 °C (on June 13) with a mean value of +11.0 °C. Even if Venice and La Biennale dataset resulted to have the highest correlation (0.97, compared to 0.90 between Venice-Cortina and 0.91 between Cortina-La Biennale), the hottest and the coldest days occurred on the same days at La Biennale and Cortina.

As regards relative humidity (fig. 4), Venice and Cortina d'Ampezzo showed similar pattern (even if with a low correlation value of 0.38 compared to 0.75 between Venice-La Biennale and 0.42 between Cortina-La Biennale): daily maximum of 88.0% (Venice) and 91.0% (Cortina d'Ampezzo) both recorded on June 6. In the pavilion, the maximum relative humidity was equal to 67.9% (on May 24), the minimum one was equal to 45.6% (on May 30) and the average was 58.3% (lower than the one recorded in Venice of 74.5% and in Cortina d'Ampezzo of 67.4%).

As expected, the highest differences regarded the incoming solar radiation (SWin, fig. 5) and the wind speed (fig. 6). Since the "Melting Landscape" work was located inside a building with only two skylights, only the diffuse solar radiative component was measured. On the contrary, at Venice and Cortina d'Ampezzo, all the solar radiative components were recorded: direct, diffuse and reflected ones. Therefore, SWin values acquired by $AWS_{Biennale}$ were very low (max of 2.13 W m^{-2} on May 20) if compared to the other ones (max of 343.9 W m^{-2} on May 20 at Venice and max of 372.1 W m^{-2} on May 31 at Cortina d'Ampezzo, fig. 5). As expected, the maximum value was recorded on the same day both at Venice and at La Biennale, since the sky conditions (i.e. cloudy or clear) were assumed constant over limited areas (Senese *et al.*, 2016). The building also affected wind conditions; in fact, the only air movement measured inside seemed due to the passage of visitors and staff (fig. 6): max of 0.06 m s^{-1} in the pavilion compared to max of 3.3 m s^{-1} in Venice (on May 24) and 3.2 m s^{-1} in Cortina d'Ampezzo (on May 19).

Trying to summarize the results we obtained, on the one hand, the building reduced relative humidity present outside, incoming solar radiation and wind speed, but on the

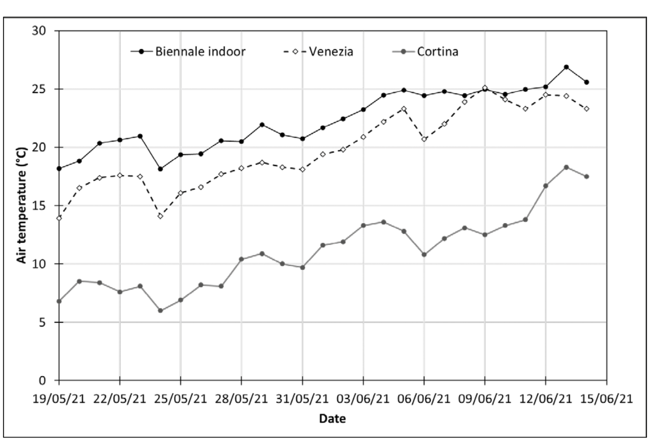

Figure 3 - Air temperature measured by $AWS_{Biennale}$, at Venice and at Cortina d'Ampezzo.

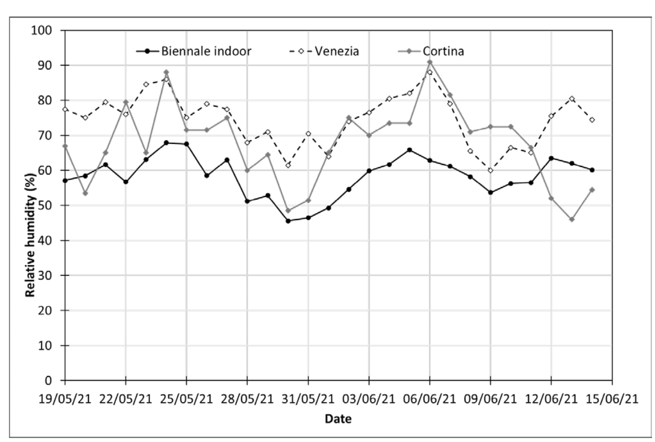

Figure 4 - Relative humidity measured by $AWS_{Biennale}$, at Venice and at Cortina d'Ampezzo.

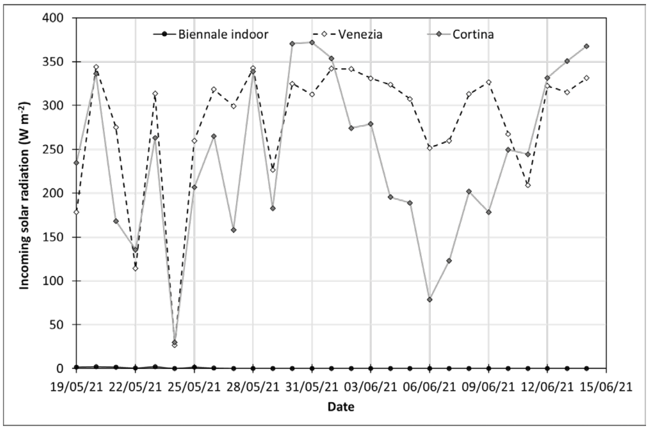

Figure 5 - Incoming solar radiation measured by $AWS_{Biennale}$, at Venice and at Cortina d'Ampezzo.

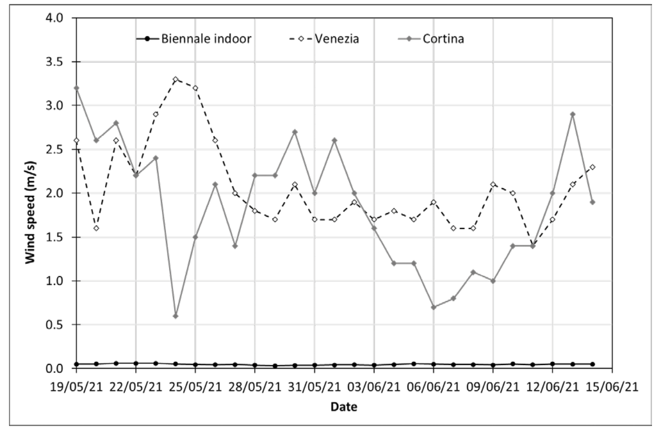

Figure 6 - Wind speed measured by $AWS_{Biennale}$, at Venice and at Cortina d'Ampezzo.

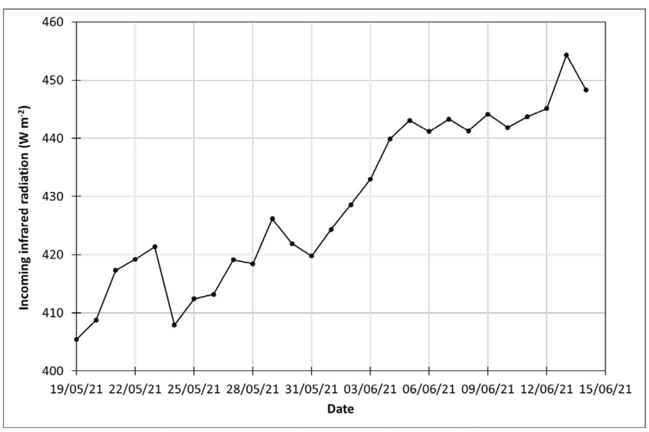

Figure 7 - Incoming infrared radiation (LWin) measured by $AWS_{Biennale}$.

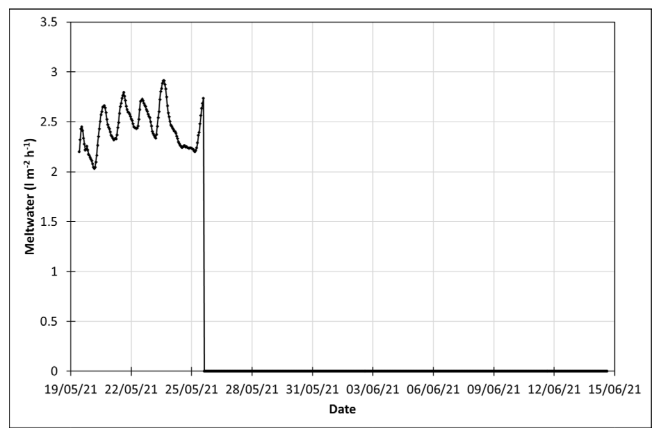

Figure 8 - Meltwater modelled by means of measured data by $AWS_{Biennale}$ considering a not covered snow surface.

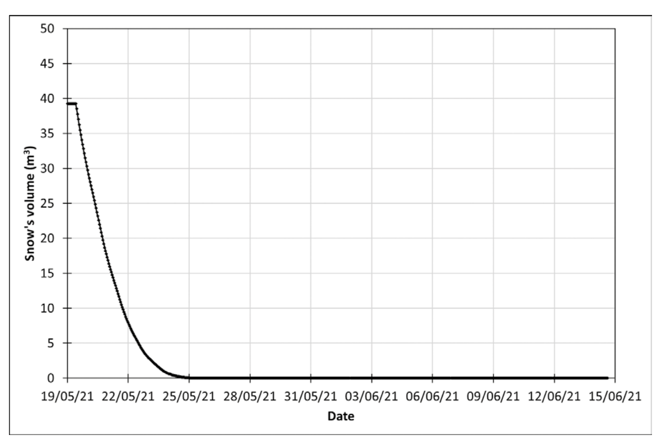

Figure 9 - Snow's volume modelled applying the melt model using measured data by $AWS_{Biennale}$ considering a not covered snow surface.

other hand, the closed room increased the air temperature. Therefore, while the near-zero direct solar flux may have accounted for the attenuation of snow melt, the warmer air greatly enhanced the melting processes. To better investigate the role of air temperature in driving snowmelt, we analyzed in more detail the infrared fluxes that reached the installation (fig. 7). In fact, the energy emitted by a body depends on the body's emission temperature following the Stefan-Boltzmann law (Hartmann, 2015). The daily mean values of LWin were from 405.4 to 454.3 W m^{-2} corresponding to a wall's temperature of +25.4 °C and +34.0 °C, respectively. The average value was 429.0 W m^{-2} (i.e. +29.6 °C). In addition, an increasing trend is evident, suggesting that melting processes have increasingly affected the snow.

Actual snowmelt quantification

We applied the same model used for predicting the snowmelt considering the actual thermal conditions measured by the $AWS_{Biennale}$: temperature of air (T_a) and room's walls (T_{walls} derived from LWin, Eq. 2). We assumed a not protected snow surface with the temperature at the melting point. We found that the hourly values of meltwater did not vary so much ranging from 2.0 to 2.9 liters per m^2 per hour (fig. 8). Considering an uninsulated snow surface, the snow should have completely melted on May 25 (7 days after installation, fig. 9). Therefore, our findings suggest that the Over-foil coverage mitigated the snowmelt extending the snow duration more than 4 times.

DISCUSSION AND CONCLUSION

Being able to directly observe the melting of snow and ice can help the public, i.e.: students, citizens, and politicians, to better understand how far-reaching climate change and its effects are.

The best way to see the ongoing reduction of snow and ice is to visit the mountains, where there are many glaciers that are shrinking and disintegrating due to global warming. However, mountains are remote areas and require skills to move around safely, and not everyone can or wants to visit them. This is why it is necessary and useful to fill the gap between what is happening in the mountains and citizens. The exhibition described in this paper is one of the many possibilities though which this becomes possible.

La Biennale, and in particular the installation by Kei Kaihoh, provided a valuable opportunity to make tens of thousands of visitors aware of an issue that many still ignore or underestimate. The people who visited the exhibition in 2021 were certainly attracted by the art and architecture and were not necessarily interested in environmental issues. In a different context, therefore, it was possible to meet them and provoke them with the theme of the impact of climate change on glaciers. This Japanese "Melting Landscape" is paradigmatic of actual suffering and melting landscapes of our mountains that we all need to know about. In addition, it should be considered that most of a person's scientific learning comes from informal learning experiences that occur outside of a formal science classroom (Hein, 2009). The 17th International Architecture Exhibition of the Venice Biennale (Italy) was an opportunity to communicate the effects of climate change on one of the most ephemeral elements of the landscape (i.e. snow) to a very wide audience (from every part of the world). To design the "Melting Landscape" work, scientists and artists collaborated to produce an artwork based on science. All over the world, more and more exhibitions or museums are being exploited to reach a wider audience and raise their awareness of environmental issues. For example, "Fires of Change" was a collaborative art exhibit designed to communicate about the shifting fire regimes of the United States Southwest through the lens of multimedia art (Colavito *et al.*, 2020). Katz-Kimchi, Atkinson (2014) presented an exploratory case study, examining how California's Monterey Bay Aquarium (MBA) sought to actively engage the public in climate change via an exhibit entitled "Hot Pink Flamingos: Stories of Hope in a Changing Sea". Hemstock, Capstick (2019) examined the content and responses to an art installation addressing climate change in the Pacific, collected at the Adapt and Survive exhibition held at the University of the South Pacific Oceania Centre Gallery in 2014. They found that while emphasizing both negative and positive emotional reactions to the artworks, people for the most part expressed confidence and hope that climate change can be effectively addressed, although there was uncertainty on whether or not Pacific islands had the resources to do so.

As regards the "Melting Landscape" work, to prolong the snow's stay in the pavilion and give as many visitors as possible a chance to view the artwork, the snow was covered by a heat-reflective insulating material that allowed to effectively mitigate the melting processes by quadrupling the duration of the snow. In fact, applying an energy model to measured thermal conditions, we calculated that the whole snow would melt within only 7 days. Analyzing the indoor meteorological conditions, if on the one hand the pavilion's room reduced the humidity present outside, the incoming solar radiation and the wind speed, on the other hand the closed room increased the air temperature. In addition, the walls' heat contributed to promote the melting processes. During the days in which the snow was still present, visitors could appreciate what was happening to the snow by means of a video (showed continuously) with the snow melting naturally in a mountain landscape. Once the snow's installation had all melted, it was decided to leave the pavilion of the Venice Biennale empty on purpose precisely to emphasize the sense of emptiness left by the disappearance of one of the most important elements of our landscape. Visitors were then surprised by an empty room, and to understand what they had missed on the walls were hung monitors showing videos of the artwork installation and in the form of a card set 53 sketches with related explanations about the installation. This feeling of emptiness was critical to understanding the fate that snow cover is experiencing especially in the Alps. In fact, a recent study found that the snow cover season above 3000 m a.s.l. is shortening by 17 days every decade (Fugazza *et al.*, 2021).

Finally, this experiment of "Indoor Glaciology" can be considered useful to start designing projects that combined glaciological science in the narrow sense with communication and dissemination sciences. To better assess the effectiveness of this kind of projects, it would be useful to receive feedback from visitors by means for example of an anonymous questionnaire on the level of interest and appreciation of the project.

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