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The *Little Ice Age* between science and art

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Abstract
The *Little Ice Age* was a period of global cooling placed between the 14th and 19th centuries, associated with the advance of glaciers in major mountain ranges and the freezing of lakes, rivers and seas, especially in the Northern Hemisphere. This period, preceded by the Medieval Climatic Optimum and followed by the 21st-century global warming, was mainly influenced by a combination of natural events: decreased solar activity, increased volcanic activity, and a decreased in thermohaline circulation. The analysis reported here is based on scientific studies, while the historical reconstruction is based on documentary evidences, in particular on paintings of winter landscapes made by Flemish, Dutch, and Italian artists, particularly active in the 17th century.

Keywords: *Maunder Minimum; Historical Climatology, Winter landscapes, Frost fairs, Glacier Advance*

Introduction

The paper offers a reconstruction of the causes and effects related to the *Little Ice Age*, which apparently affected the entire planet Earth from the 14th to the 19th century, but with a particularly severe cold spell from 1645 to 1715, a period known as the *Maunder Minimum*. The reconstruction based on scientific studies is followed by a historical reconstruction, based on documentary studies, which serves as a prologue to the commentated presentation of paintings by Flemish, Dutch, and Italian artists who, from 16th to 18th century, were impressed witnesses of climatic events that changed people's lives.

Scientific framework

After the relatively warm climatic period known as the *Medieval Climatic Optimum* (now more properly called *Medieval Climatic Anomaly* to indicate that the mild climate was not widespread across the Earth), that occurred between the 9th and 10th centuries, both the 13th and 14th centuries were characterized by a very unstable climate, with a series of extratropical storms and recurrent floods. Among others, the two so-called First and Second St. Marcellus floods are famous because they both occurred on January 16 (the feast day of St. Marcellus) of the years 1219 and 1362 (Sheppard, 1912; Meier, 2010). The first hit West Friesland and Groningen causing the death of about 36,000 people, while the second struck the British Isles, the Netherland, northern Germany and Denmark and caused approximately 25,000 deaths. Around the 14th century also frost reappeared throughout the Northern Hemisphere, followed everywhere, within a few centuries, by a new, vigorous advance of glaciers (e.g., Holzhauser, 2010; Harning et al., 2016). This new cold climatic phase lasted approximately until the mid-19th century, was persistent, and was characterized by many extremely cold winters (e.g., Chu, 1972; Cowie, 2007). It was rightly called the *Little Ice Age* by specialists in historical climatology, a discipline at the interface between the natural and historical sciences (Matthes, 1939; Mann, 2002). And there is no better definition, since, in Europe and much of the world, the extent of snow and ice on land and sea during those nearly five centuries recorded maximum values never reached since the end of the Würmian glaciation (about 10-12,000 years ago). The develop-

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ment of the *Little Ice Age* was probably caused by the simultaneous occurrence (on a multi-centennial time scale) of at least three events, one astronomical like the decrease in solar activity (Crowley, 2000) and two terrestrials such as the variation of the thermohaline circulation (Broecker and Wallace, 2000) and the increase in volcanic activity (Robock, 1979; Miller et al., 2012). Although some climatologists trace the beginning of this climatic phase back to the harsh winters and marked episodes of frost that occurred after 1200 or to the harsh winter of 1407-1408, both the cold and glacialism did not have, until the middle of the 16th century, either a lasting character in time or an extension as vast as that which occurred during the actual *Little Ice Age* (Oerlemans, 2005). In light of historical (such as grape harvest dates), botanical, and geomorphological knowledge, and studies on the evolutionary dynamics of Alpine glaciers, the French historian Le Roy Ladurie (1967) proposed the mid-16th century as the starting date. In effect, the so-called *Maunder Minimum*, a period of reduced solar activity that is one of the three causes of cooling, began rather abruptly in 1645 and ceased in 1715 (e.g., Beckman and Mahoney, 1988; Usoskin, 2008). However, even if the areas affected by the cooling phase extended from Europe to North America, New Zealand, and Patagonia, the IPCC (2001) considered this cooling to be due to largely independent regional climate changes and not to a globally synchronized cooling. Conversely, Kreutz (1997), comparing results of studies run in West Antarctica and Greenland ice cores, suggested a synchronous global cooling. Furthermore, using radiocarbon dating of dead plants with intact roots collected under the Baffin Island and Iceland ice sheets, Miller *et al.* (2012) estimated that cold summers and glacier growth began between 1275 and 1300, followed by substantial intensification between 1430 and 1455. Further demonstrating the synchronous global cooling, through stable isotope studies of ice cores from the Mount Erebus Saddle, Rhodes et al. (2012) established that, during the *Little Ice Age*, the Ross Sea region of Antarctica experienced temperatures about 1.5°C cooler than the last 150 years. By studying both glaciers and tree rings, Winckler (2000), Fagan (2001), and Lorrey et al. (2013) established that the *Little Ice Age* also occurred in New Zealand, from approximately 1300 to 1850. Not even South America and the Indo-Pacific Warm Pool escaped from the *Little Ice Age*. Indeed, tree-ring data from Patagonia indicated a cold pulse from 1520 to 1670 (Villalba, 1994), while studying the $\delta^{18}O$ of foraminafera, Field and Lape (2010) estimated that the Pool was warm and saline from 1000 to 1400, and had cooled from 1400 to about 1700. Finally, during the *Little Ice Age* temperatures worldwide were between 0.5 and 1.5°C lower than today (Fagan, 2001; Lorrey et al., 2013) and although the causes of the climate variations responsible of this decrease are not yet known unequivocally, data provided by ice cores from northern Greenland (the Greenland Ice Core Project) have suggested a substantial solar influence (Fisher et al., 1998).

Historical climatology

One of the first symptoms of the climate change was the terrible winter of 1407-1408, which has gone down in history as the great cold wave that besieged much of the European continent. That winter, Iceland remained isolated being surrounded by a frozen sea (Malte-Brun, 1855), the Thames in London remained frozen for 14 consecutive weeks, from December 1407 to March 1408 (Davis, 1814), and a 60-centimeter layer of snow remained on the ground for 45 consecutive days in and around Florence, drying out olive trees, vines, and other fruit trees (Borchi and Macii, 2011). Reports of bay and river frosts are of great importance because they allow us to estimate winter temperatures when thermometers were not yet available (they only became fairly common in the 18th century). For example, in 1407-1408, the Po Valley froze over a vast area, and from the loss of agricultural production, including vines, and the deaths of many people from exposure (Baronio, posthumus by Spondano, 1680), we can estimate that the temperature dropped well below -15 °C several times; in fact, the epigean portion of *Vitis vinifera* L. (the only grapevine present in Europe at that time) dies at temperature below -20°C (Pàstena, 1990). Other winters were also terrible in the 15th century. However, according to Camuffo et al. (2017), the event related to the winter 1407-1408 are not adequately supported by contemporary documents or scientific literature. During the winter of 1431-1432, the Po River froze for over two months, and the Venetian lagoon froze so much that carts could travel by sea from Mestre to Venice (Camuffo et al., 2017). The Venetian lagoon and the Po river froze with, in both cases, the possibility to support people and horse-drawn carts in the winters 1442-1443, 1475-1476, 1489-90; during these winters, olive trees and vines died across much central and northern Italy (Camuffo et al., 2017). We then come to the 16th century when, after a series of very harsh winters, the coldest of the century arrived in 1564-1565, but many other severe winters occurred by the end of the century (Camuffo et al., 2017). It was so

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cold that snowy landscapes inspired many painters, including Pieter Brueghel the Elder. In the late 16th and early 17th centuries, Italy experienced some relief, but cold continued to break records in northern Europe, especially in the second half of the century. The Baltic Sea remained frozen for much of the winter of 1651–1652 and the same thing happened in 1658 when Charles X of Sweden crossed the Little Belt over the ice from Holstein to Denmark with his whole army, infantry and cavalry, followed by the baggage train and artillery (Tillock, 1820; Camuffo et al., 2017). Extreme cold was recorded across all Europe, with significant snow and ice in Rome from December 24, 1657, to late February 1658. The Seine river was frozen for three weeks in 1666–1667 (Camuffo et al., 2017). In the annals of cold, the winter of 1683-1684 holds a prominent place. In Italy, the Venetian lagoon and all the wells of northern Italy froze (Fiandrini, 1796). During this winter, the Thames in London froze so deeply (28 centimetres) that sporting activities and even a fair (the *Frost Fair*) were held there, featuring horse races, dances, and stalls of all kinds (Manley, 1975; Camuffo et al., 2017; Lockwood et al., 2017; Shaull-Thompson, 2019). Previously, in other winters (695, 1608, 1634-1635), something similar had already been organized, but on a much smaller scale: some merchants selling furs, a barber, a shoemaker, some stalls, ale sellers, and skaters (Lockwood et al., 2017) (Figure 1). The fair of 1683-1684 was something majestic and paved the way for four more fairs coinciding with the deep frosts of the Thames: 1715-1716, 1739-1740, 1789-1790, 1813-1814 (Lockwood et al., 2017). After 1814 it was no longer possible to organize *Frost Fairs* on the Thames. In the winters of 1683-1684 and 1694-1695, Lake Constance froze completely and so thickly that it could support the weight of carts (Meichle, 1963; Dobras, 1992). The 17th century is remembered for its widespread cold: over the course of the century, Alpine glaciers reached an enormous extension that many villages in Haute-Savoie and Tyrol were destroyed by the advance of the glaciers, and the inhabitants had to relocate (Riccardi, 2012). Contemporary chronicles confirm that the summers of the last decade of the 17th century and the first years of the 18th century were characterized by a rather unstable and cool, if not downright cold, climate (about 0.6°C less than the summers of the thirty-year period 1961-1990) (Lamb, 2013). During this part of the century, snowfalls were quite frequent on the Apennines (central Italy) down to medium-low altitudes. For example, the monks of Vallombrosa Abbey, in the province of Florence at 980 meters above sea level, recorded two summer snowfalls that lightly whitened the roofs and grounds of the abbey complex: on August 16, 1692, and on August 22, 1695 (Ricordanze del'Abbazia di Vallombrosa). Another indicator of the severity of the 17th century is the famines. Three severe famines in France (1693-1694), Norway (1695-1696), and Sweden (1696-1697) caused each country's population to decline by approximately 10%, while in Estonia and Finland the 1696-1697 losses were estimated to be at one-fifth and one-third of the population, respectively (Ewan and Nugent, 2008). Viticulture disappeared in many regions of northern Europe, and there was a resurgence of storms, causing severe flooding and numerous casualties (Lamb, 1995). However, since there is always a silver lining, we can say even in the 17th century something good happen. For example, the Italian violin maker Antonio Stradivari created his world-famous violins, violas, and cellos at the height of the *Little Ice Age*, and it is possible that the cold climate in which the spruce and maple trees he used grew made the wood more compact than in warmer periods, contributing to the improved sound of his instruments (Burcklem and Grissino-Meyer, 2003; Tai et al., 2016). By the early 18th century, the winter of 1708-1709 was considered the worst in Europe in the previous two centuries and is remembered as *Le Grand Hiver* (Luterbacher et al., 2004). In early 1709, and particularly on the night of January 5-6, the drop in temperature was so sudden that within hours the following were frozen: *i*) the ports and the sea off Marseille, Genoa, and Venice; *ii*) the mouth of the Tagus River in Lisbon; *iii*) the rivers Seine, Rhone, Po, and Ofanto (southern Italy); *iv*) the entire Lake Garda and the Venetian lagoon, making crossings with heavy wagons possible in both cases. Temperatures of -17°C were recorded in Venice, -25°C in the suburbs of Paris, and -35°C in the Berlin countryside (Pain, 2009; Le Roy Ladurie, E., 2010; Camuffo et al., 2017). The cold wave was so intense that most of the fruit trees and all growing crops died in France and northern Italy, resulting one of the worst famines of the millennium; it is estimated that in France alone there were around 600,000 deaths from starvation (Lachiver, 1991; Monahan, 1993, Le Roy Ladurie, 2010). Throughout the 18th century cold weather gripped Europe. As mentioned, the Thames in London froze three times in that century: 1715-1716, 1739-1740, and 1789-1790. Drangajökull, Iceland's northernmost glacier, reached its maximum extent between 1665 and 1765 (Harning et al., 2016). There were also record snowfalls, such as that of 1744 in Pa-

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lermo, with almost half a meter of snow on the ground (Mungitore, 1872). In the winter of 1788-1789, temperature dropped to -21°C in London and Paris and to -15.5 in Padua (Camuffo et al., 2017). In December 1788, it snowed for three days in Rome; in Naples, with 40 centimetres of snow accumulated at the port (Le Courier de L'Escaut, 1789). It was probably due to the rigour of the first half of the 18th century, but also to the acumen of the abbot Giuseppe Calandrelli, that a modern meteorological observatory was established in Rome at the Collegio Romano (Roman College) in 1782. Since then, temperatures have been measured continuously, first in degrees Réaumur (°Re) and later in degrees Celsius (°C), so much so that the Collegio Romano, now under the jurisdiction of the Agriculture and Environment Centre of the Council for Agricultural Research and Economics (Centro Agricoltura e Ambiente del Consiglio per la Ricerca in Agricoltura e l'Economia Agraria, CREA), holds one of the oldest historical series in the world and is part of the Network of Italian Historical Meteorological Observatories (Rete degli Osservatori Storici Meteorologici Italiani, ROSMI). The first 50 years of the 19th century were also cold. As evidence of this, the winter of 1811-1812 will be remembered as *le General Hivèr* (the Winter General) from a letter by General Michel Ney wrote to explain the disaster of Napoleon's Russia campaign (Le Petit Journal, 1916). In 1813-1814 the Thames froze, although the frost was not like the previous ones and, moreover, it has not happened since then (Lockwood et al., 2017). In the winter of 1829-1830, Bologna was covered by over two meters of snow (Comandini, 1940-1942); in Modena, in 1844, 89 centimetres of snow fell (Lombroso and Quattrocchi, 2008). To resume, the cold climate phase known as *Little Ice Age* lasted for centuries and was characterized by the concurrence of the following events: - a general decrease in average temperatures, in all seasons, in most temperate and high-latitude regions;
- an increase in interannual meteorological variability;
- a general expansion of Arctic glaciers, as well as the growth and vigorous advance of continental ice sheets;
- an increase in precipitation in mid-latitudes and subtropical zones, resulting in greater frequency of floods;
- a general lowering of the polar and altitudinal limits of forests and crops.

Although during the *Little Ice Age* glaciers experienced periods of stasis or retreat, and temperatures showed short-term increasing trends (Kupperman, 1982), as also documented by thermometric series starting from the second half of the 18th century, it is certain that these phases represent fluctuations or oscillations secondary to the onset, in space and time, of a cold climate. No deglaciation phase that occurred during that period can be compared, in terms of magnitude and duration, to the current one, which can be traced back to the end of the *Little Ice Age*, in the second half of the 19th century.

The testimonies of Flemish, Dutch, and Italian painters

Historical climatology has numerous historical sources and naturalistic evidence for the *Little Ice Age*. Regarding the former, in reconstructing the main events of this climatic phase, a primary role must be recognized both by ancient chronicles and by iconography, namely by images that can serve as a valuable documentary source. We have therefore focused this study on the indirect contribution to historical climatology by considering paintings by Flemish, Dutch, and Italian artists who, between the 16th and early 18th centuries, vividly portrayed the central phase and, for some regions of Europe, even the worst (*pessimum*) phase of the *Little Ice Age*, corresponding to the *Maunder Minimum*. The depiction of the winter season occupies a prominent place in Flemish and Dutch painting of the 16th and 17th centuries and benefits from a tradition dating back to the 15th century. The harsh winters, capable of causing extensive ice formations on inland and coastal waters, must have provided landscape painters with a source of inspiration. Thus, in depicting winter scenes, painters combined their realistic intent, clearly inspired by the climatic upheavals of their time and the cycle of the seasons in general, with allegorical and symbolic connotations. The painted images realistically reproduce frozen places, particularly water bodies and canals whose frozen surfaces served as a backdrop for urban and commercial activities, alternating moments of play and entertainment. At the same time, they carry allegorical and symbolic allusions and implications. Thus, for example, sliding on ice alludes to the falls and unexpected events that can occur in life; playing with skates alludes to the precariousness of human existence. Some masterpieces reproduced and briefly commented on below document in an exemplary manner the terrible climatic conditions that characterized the *Little Ice Age* in Europe (Fig. 1). This image is the frontispiece to *The great frost: cold doings in London, except it be at the lotteries* … (1608), an account of what is believed to be the first recorded and explicitly named "Frost Fair" held on the Thames when it froze during

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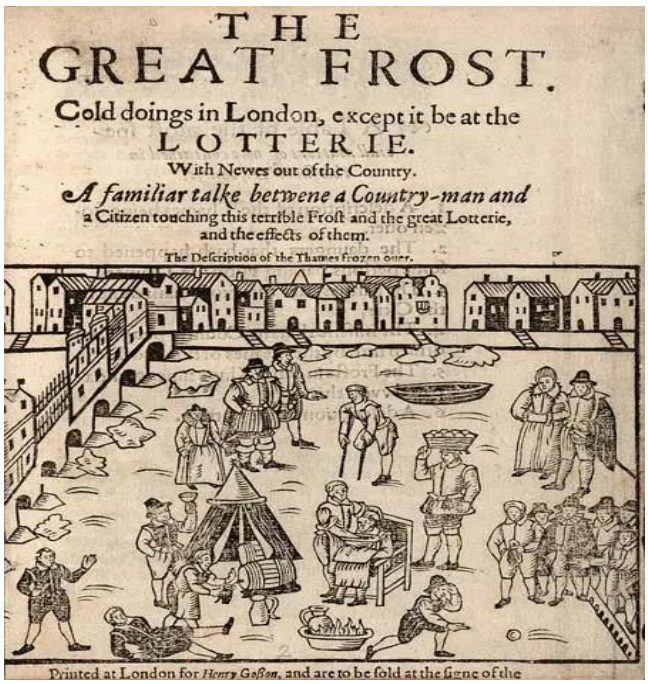

Figure 1. *Flyer documenting the first Frost Fair of 1608.*

some winters between the 17th and 19th centuries, a period now well known as the *Little Ice Age*. It is attributed to Thomas Dekke (1572-1632), a colourful writer who described the social life and customs of the London commoners of his time like, perhaps, no other Elizabethan author. This book would have profoundly affected one of the most influential British writers of the 20th century, Virginia Woolf, so much so that she imagined, through her satirical novel *Orlando: A Biography* (1928), the atmosphere of the Frost Fair of 1608 in this way: *"But while the country people suffered the extremity of want, and the trade of the country was at a standstill, London enjoyed a carnival of the utmost brilliancy. The Court was at Greenwich, and the new King [James I Stuart] seized the opportunity that his coronation gave him to curry favour with the citizens. He directed that the river [Thames], which was frozen to a depth of twenty feet and more for six or seven miles on either side, should be swept, decorated and given all the semblance of a park or pleasure ground, with arbours, alleys, drinking booths, etc., at his expense."*.

Winter landscape, by Joos *(Joost) de Momper the Younger (Antwerp, 1564 – 1635) and Jan Brueghel the Elder (Brussels, 1568 – Antwerp, 1625). It is a winter scene (oil on canvas, 167x232 cm, belonging to a private collection) depicting a completely frozen lake, probably the Lake of Love (near Bruges), from the second decade of the 17th century. The two painters collaborated intensively, producing over eighty paintings in nearly thirty years. This was a typical collaboration of the Flemish Baroque, an artistic movement that blended the meticulous realism of the Northern European tradition with the monumentality, dynamism, and colour typical of the Italian Baroque: de Momper created vast, evocative landscapes, while Brueghel added figures and architectural details. Their winter scenes often depict tranquil villages, frozen rivers, or travellers on paths. They are characterized by a refined, high-quality, and sometimes "avant-garde" approach to the tradition of winter landscape painting inaugurated by Pieter Bruegel the Elder (Behringer, 2013), father of Jan Brueghel the Elder.*

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***Winter landscape in the Fôret de Soignes**, with the flight into Egypt: a painting, oil on oak panel (48.5x66.8 cm, belonging to a private collection) by Denijs van Alsloot (Mechelen, around 1570 – Brussels, 1626), probably executed around 1616. Van Alsloot was a Flemish painter of lively landscapes and festive scenes (civil processions, local festivals, ceremonial events); a court artist renowned for his detailed drawings, characterized by topographical accuracy and imaginative flourishes on Brussels life, winter views and the Forêt of Soignes, a vast remnant of an ancient forest extending over 4,400 hectares across the three Belgian regions of Brussels-Capital, Flanders, and Wallonia. This painting is probably a free pictorial composition of the various abbeys nestled among the ponds of this wooded area south and east of Brussels.*

***Skaters on the Frozen Canal,** by Anton Ghiboons (The Hague, 1580–1639), a Dutch painter specialized in the kind of "winter landscapes". The painting, oil on oak panel (46x109 cm, belonging to a private collection), probably dates to the period between the second and third decades of the 17th century. Ghiboons was active in The Hague between 1613 and 1639 and was influenced by the painter Adam van Breen, who was active in the city and was likely his teacher. He was a rare painter, whose style shows affinities with that of the great masters of winter landscapes, such as Hendrick Avercamp and David Vinckboons.*

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Winter landscape with villagers on a path: *an oil on panel painting (48.5x52 cm, belonging to a private collection) by the Flemish painter Gijsbrecht Leytens (Antwerp, 1586 – 1643/56), long known as the "Master of winter landscapes". It probably dates back to the third decade of the 17th century. Leytens is recognized as the author of similar winter landscapes painted in Antwerp in the first half of the 17th century. They are inspired by Joost de Momper's model, maintaining the Mannerist incisiveness of the contours: a technique characterized by a clean, precise, and sometimes "heavy" line, aimed at emphasizing volumes, torsions, and anatomy in an almost sculptural manner, distancing itself from Raphael's soft use of light and shadow in the foreground, then developing a certain tonalism in the background. Archival documents indicate that Gijsbrecht Leytens was still alive in 1642, but it is certain that he had died by 1657. In addition to winter landscapes, he is credited with painting marine paintings and at least one non-winter landscape.*

January. Ice Skaters, *by the Flemish artist Jan Wildens (Antwerp, 1586 – 1653). It is an oil on canvas painting (120x193 cm), housed in Genoa, Italy, at the Strada Nuova Museums. This Flemish-style winter landscape depicts a lively winter scene with skaters on a frozen river, a snowy landscape with houses and a church, and children playing. The work, probably from 1614, is part of a cycle of twelve paintings dedicated to the months of the year, created between 1613 and 1616, presumably during Wildens's stay in Genoa. The painting was likely commissioned by a Genoese patron, and this would have influenced the Wildens's original style through the integration of realist elements such as children with sleds, people throwing snowballs, and women carrying bread (scenes of everyday life).*

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***A winter scene: probable view of Dordrecht**, [during the winter of] 1643. The author is the Dutch landscape painter Aert van der Neer (Amsterdam, c. 1603 – 1677), best known for his winter and nocturnal landscapes. This oil on canvas painting (88x117 cm) is characterized by a chilly atmosphere and soft, diffused lighting on a frozen canal: a true landscape masterpiece of the Dutch Golden Age. The use of light to convey the sensation of frost is masterful. This artwork, held in London at the Wallace Collection, depicts Dutch daily life in a sober, monochrome style, with frozen rivers, skaters, and architectural structures that highlight the detail of the distant cityscape of Dordrecht. Van der Neer's skilful use of light to convey the sensation of frost and atmospheric changes is highly original.*

***Winter landscape with skaters,** an oil on panel painting (65x94.5 cm, belonging to a private collection) signed by Isaack (Isaac) van Ostade (Haarlem, 1621 – 1649) and dated 1641. Van Ostade was an important Dutch Golden Age painter, specialized in winter landscapes and rustic scenes in the 1640s. The painting depicts a lively Dutch winter scene with peasants gathered near a rural inn, a horse-drawn sleigh on a frozen river, and skaters in the distance. It is a key example of van Ostade's Little Ice Age style: the tones are warm, the lighting is soft, and the figures are detailed and dynamic. The contrasts between light and shadow are strong and often diagonal.*

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***A winter landscape with woodmen before a cottage**, an oil on canvas (58x87 cm, belonging to a private collection) dating back to the decade 1661-1670 and partially signed by Willem Schellinks (Amsterdam, 1623 or 1627 – 1678), Dutch painter, engraver, and poet. Schellinks's first known artistic production dates back to 1642 and consists of charcoal drawings of Amsterdam houses. Through his numerous travels in Italy, France and England, he became acquainted with 17th-century European painting and Italianate landscapes. Schellinks's subjects included Italian and Dutch landscapes, with rivers, ports, inns, or ancient ruins, with resting horsemen, groups of hunters, and winter scenes like this painting.*

***Landscape with skaters in front of the Zaltbommel** Tower, an oil on canvas dating back to the 1640s (67x97 cm, belonging to a private collection) by Salomon van Ruysdael (Naarden, c. 1602 – Haarlem, 1670), Dutch landscape painter of the Golden Age. He was renowned for his landscapes and river scenes influenced by one of the greatest Dutch landscape painters, Jan van Goyen (1596 – 1656), but also for about twenty winter landscapes like this one.*

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***Winter Landscape**, an oil on canvas painting (60.3×54.1 cm) by Jan van de Cappelle (Amsterdam, 1626 – 1679), the most important Dutch marine painter of the 17th century. The main subject of this scene is a frozen canal. It was painted around 1652 and is housed in the Rijksmuseum Twenthe in Enschede. The colours in this painting are based on cool tones, conveying the impression of winter chill through an almost monochromatic palette. Fewer than two dozen winter scenes by this artist have survived, all painted between 1652 and 1658.*

***Winter landscape with figures skating on the Oude Schans canal near the Montelbaanstoren, Amsterdam**, an oil on canvas painting (72.6×107.7 cm) by Thomas Heeremans (Haarlem, 1641–1694), a Dutch painter and art dealer known for his winter landscapes, cityscapes, harbour views, beach views, and river and village scenes, and Abraham Storck (Amsterdam, 1644 – 1708), remembered primarily for the topographical precision and chromatic finesse of his Dutch seascapes and riverscapes. This work depicts a frozen canal in the heart of Amsterdam, the Oude Schans. Painted in 1678, at the height of the Little Ice Age, it looks north toward the docks. To the left of this composition stands the Montelbaanstoren, a tower that was originally part of the city walls and was used by sentries. It features various ships' masts and a bridge that could be raised in the centre to allow ships to enter and leave the city. The figures drawn are attributed to the mannerist Storck. This canvas is housed in Amsterdam, at the Kunsthandel P. de Boer, a gallery specialised in Dutch and Flemish old master paintings.*

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***Dutch whalers in the Arctic**, an oil on canvas painting (67.3x94.2 cm) belonging to a private collection, probably dating to 1660–1670. The author was a Dutch artist specialized in paintings with maritime subjects and Italian landscapes, Lieve Pietersz Verschuier (Rotterdam, 1627 – 1686), best known for his detailed oil on canvas "The Great Fire of London in 1666". The canvas shown here depicts whaling in the Arctic Ocean, a genre that enjoyed a certain popularity in the last decades of the 17th century, with paintings depicting climates significantly colder than today. Pictorial representations, as well as accounts from the 17th century, show whaling ships surrounded by extensive and compact ice formations, even in midsummer, between Svalbard and Greenland. Paintings like this testify that the Svalbard fjords remained frozen even in summer and that whalers operated at the limits of survival in an Arctic much colder than today. In addition to their value for historical climatology, these maritime paintings are also of great interest from the perspective of the history of naval technology, being the subject of studies aimed at deepening our understanding of 17th-century shipbuilding.*

***The frozen lagoon at Fondamenta Nuove in 1708**, a painting by an anonymous painter from Veneto, probably made in 1709. This oil on canvas (95x129 cm) depicts how, despite the severe human impact of the exceptional cold spell that characterised the winter of 1708-1709, the lively and playful side of Venetian people managed to find resources for entertainment by skating on the completely frozen lagoon. Interesting, the ice was thick enough to allow the population to walk and transport heavy goods between Venice and Murano. The painting is preserved in Venice, at the Querini Stampalia Foundation, which owns it.*

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Conclusions

The *Little Ice Age* caused temperatures to drop across much, if not all, of the Earth from the 14th to the 19th century, which was even more marked during the *Maunder Minimum* (1645-1715). This cooling was uneven across the globe, varying from 0.5 to 1.5 °C below current temperatures. During this period, humanity had to reorganize much of its daily life, adapting to the new climatic conditions. In some cases, the transport of goods was facilitated by the presence of ice on lakes, canals, and lagoons; entertainment options also changed, especially during the winter, as did dietary changes that, however, in some areas, were unable to prevent thousands of deaths due to famine. Painters of the period, fascinated by winter landscapes, depicted scenes of everyday life, involving both manual labour and moments of leisure. For this reason, they painted glimpses of winter landscapes that, with great realism, reproduced the harshness of the cold spells that repeatedly struck European countries. The paintings reported and commented on are true historical climate documents that provide irrefutable evidence of the frequent freezing winters that struck Europe at the height of the *Little Ice Age*, with scenes of frozen canals, lakes and lagoons, persistent snow and ice, and dark skies unimaginable today. These paintings, beyond artistic expressions, also offer a glimpse of the artistic inspiration driven by the harsh climate, although the scenes of children and adults engaged in recreational and playful activities such as ice skating nonetheless represent the joy of life and resilience that characterized humanity at the time.

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