

# Harnessing AI for Scientific Illustration: Exploring Tornado Dynamics Through Midjourney

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**Abstract**—Scientific illustration, with roots in ancient civilizations, has evolved from hand-drawn depictions to advanced digital visualizations. This research delves into the historical journey of scientific illustration, emphasizing its role in bridging art and science. With the advent of knowledge engineering, these illustrations have become more effective in simplifying complex scientific concepts. This study investigates using AI art generation platforms such as Midjourney to create captivating and informative scientific illustrations of complex meteorological phenomena. Focusing on tornado dynamics, Midjourney is prompted to visualize tornado supercells, interior anatomy, and multi-vortex systems with artistic flair. The generated images showcase Midjourney's ability to fuse empirical facts like weather data with aesthetic considerations such as composition, perspective, and lighting. Although limitations exist, the AI-generated image reveals Midjourney's promise in balancing scientific insight and creative expression. The tornado illustrations highlight the platform's ability to elucidate intricate meteorological concepts through imaginative, highly detailed scenes that educate and inspire.

**Keywords**—scientific illustration, generative AI, Midjourney, tornado dynamics, knowledge engineering

## I. INTRODUCTION

### A. Bridging Art and Science: A Historical Overview of Scientific Illustration

Scientific illustration has deep historical roots in ancient civilizations such as Egypt, Greece, and China [1-3]. These early depictions in papyrus scrolls, tomb walls, and ancient texts primarily showcased plants, animals, and human anatomy. As civilizations progressed, the Middle Ages saw an emphasis on herbals and books detailing plants and their medicinal uses. However, these illustrations were hand-copied, leading to potential inaccuracies.

The Renaissance era marked a significant turning point. The invention of the printing press allowed for more accurate reproduction of illustrations. With his detailed sketches of human anatomy and nature, Leonardo da Vinci epitomized the fusion of art and science, setting a benchmark for future illustrators [4-5]. This period also saw a surge in natural history documentation. Explorers and scientists collaborated on intricate illustrations of diverse flora, fauna, and geological formations. Notable contributors from the 18th and 19th centuries include John James Audubon, known for his bird illustrations [6], and Maria Sibylla Merian [7], a pioneer in botanical artistry.

The late 1700s brought about the invention of lithography, revolutionizing the printing process and making color illustrations more accessible. However, with the advent of photography in the twentieth century, many speculated on the decline of traditional illustration. However, the unique ability of illustrators to emphasize specific features and provide detailed, explanatory visuals ensured the discipline's

continued significance. Modern scientific illustration benefits from digital advancements, allowing intricate 3D models, animations, and interactive visuals [8-9].

Scientific illustration has been a crucial communication tool throughout its evolution, enabling the communication of complex scientific concepts engagingly. It offers perspectives cameras cannot obtain, from highlighting minute details to visualizing abstract theories. The significance of this art form is evident in the literature, with works like "The History of Scientific Illustration" [8] and "The Evolution and Influence of Art in Scientific Illustration" [9] offering deeper insights. Scientific illustration remains indispensable to bridge the gap between intricate scientific knowledge and public understanding.

### B. Bridging Complex Concepts: The Role of Knowledge Engineering in Scientific Illustration

Knowledge engineering plays a key role in enhancing the effectiveness of scientific illustrations [10-15]. These visual representations simplify complex scientific concepts, making them more tangible and relatable to students. Illustrations highlight vital features and relationships by breaking down intricate information into understandable components, aiding in better comprehension and retention. Engaging multiple senses, these visuals can make abstract ideas more applicable to real-world scenarios, emphasizing the practicality of scientific knowledge. Sequential illustrations, in particular, can depict processes step-by-step, ensuring students grasp the progression of events.

However, the use of scientific illustrations could be more challenging. Ambiguities can arise if illustrations need more clarity or precision, leading to potential misunderstandings [11-12]. To ensure relevance, these visuals must be precise, well-labeled, and periodically reviewed by experts. Oversimplification is another concern; while illustrations should be straightforward, they must not omit essential details [13]. Cultural biases in images can also hinder understanding among diverse student populations. To be inclusive, illustrations should be culturally sensitive, avoiding stereotypes. Accessibility is another concern; students with visual impairments or learning disabilities should have alternative formats, such as audio descriptions or tactile graphics [13-14].

The role of knowledge engineering in scientific illustrations is multifaceted [15]. It helps organize information for visual representation, standardize scientific terminology for consistency, and encourage collaboration between scientists and artists. By ensuring that illustrations are up-to-date and facilitating interdisciplinary connections, knowledge engineering ensures that scientific visuals remain a powerful tool in education, bridging the gap between intricate scientific concepts and student understanding [12-15].

### *C. Harnessing AI for Science: The Potential and Limitations of Midjourney in Scientific Illustration*

Art generated by AI, created using artificial intelligence technologies, has revolutionized the art world [16-17]. These algorithms create images or videos based on set parameters or alter existing visuals. With the advent of large language models (LLMs) like Google Brain's generative AI, art creation has reached new heights. LLMs predict the following sequence in words or images, leading to tools such as Text2Art, which can produce various art forms from simple text input [18].

One such platform that harnesses the power of AI is Midjourney [19]. This generative AI platform crafts images from text prompts, employing a two-step text encoding and image generation process. By understanding the textual description and representing it in a latent space, Midjourney uses advanced algorithms to produce visually coherent images. Although popular tools like DALL-E and Stable Diffusion exist, Midjourney stands out for its unique approach to AI art.

In the realm of scientific illustration, Midjourney offers immense potential. It can generate scientifically accurate visuals, create images of complex concepts, and even produce illustrations for scientific outreach. However, it has limitations. Ensuring scientific accuracy, precise compositions, and the closed-source nature of the platform can pose challenges. Moreover, while it offers various styles, it may only cater to some specific requirements of scientific illustration.

Despite these challenges, Midjourney finds applications in various scientific illustration scenarios. It can help in biological illustration, help visualize intricate scientific concepts, help with data visualization, and even create speculative drawings [19]. In addition, it is a collaborative tool that allows scientists and artists to explore visual possibilities together. While Midjourney has its constraints, its potential for scientific illustration is undeniable.

## II. ENHANCING ATMOSPHERIC SCIENCE LITERACY THROUGH SCIENTIFIC ILLUSTRATION

### *A. Introduction to Scientific Illustrations in Atmospheric Science*

Scientific illustrations are crucial in atmospheric science, particularly in elucidating complex phenomena such as hurricanes and tornadoes [2, 20-21]. These illustrations demystify the intricate structures and behaviors of such atmospheric events, breaking down their formation, intensity, and potential impact on populated areas. These illustrations render multifaceted data more comprehensible to a broader audience by visually representing data, such as graphs or charts. Furthermore, they can depict the implications of climate change on these phenomena, making scientific concepts more tangible and relevant to the general public.

### *B. Types of Scientific Illustrations in Atmospheric Science*

Atmospheric science research uses a wide range of illustrations [21]. The figures accompanying the scientific papers offer visual explanations of concepts and processes. The cover images in scientific journals capture the essence of the research. Natural history illustrations depict elements of the natural world relevant to weather patterns or climate change. Lastly, mappings, such as maps or satellite imagery,

represent spatial data that show the distribution of weather patterns or atmospheric conditions. These illustrations not only enhance understanding but also present information in an aesthetically pleasing manner.

While scientific illustrations, including infographics, are potent communication tools, there is a risk of misleading readers if not accurately presented. Illustrations should be accurate, precise, objective, and transparent to ensure clarity and prevent misinterpretation. They should be based on reliable data, unbiased, and transparent about their sources and methods. This ensures that students receive accurate information and fosters a solid foundation of scientific knowledge.

To strengthen students' scientific literacy [22-23], illustrations should encompass key atmospheric science topics, maintain visual clarity, foster the development of scientific process skills, and prioritize accuracy. Engaging and interactive elements, such as animations, can further enhance understanding and stimulate interest in the subject matter.

### *C. Analyzing Tornadoes: The Interplay of Scientific Illustrations and Data*

When examining tornadoes, scientific illustrations bridge the gap between numerical models and observational data. They offer a visual representation of the structure and behavior of a tornado, which helps researchers to discern patterns in the data. These illustrations can also depict the trajectory of a tornado, its potential impact, and the effects of climate change on its formation. Such visual aids are indispensable for comprehending complex processes and patterns in atmospheric science research.

To capture students and improve their scientific literacy and creativity, science illustrations must be visually appealing, simplify intricate concepts, and promote creativity. For example, using vibrant visual elements, explicit language, and interactive components can engage students when illustrating a tornado. Encouraging them to craft their illustrations can foster a personal connection to the subject, enhancing their understanding and creativity.

In conclusion, scientific illustrations play a pivotal role in atmospheric science education. When designed effectively, they can demystify complex concepts, engage students, and foster a deeper understanding of the intricate world of atmospheric phenomena.

## III. SCIENTIFIC ILLUSTRATIONS OF TORNADOES BY MIDJOURNEY

### *A. Tornado Supercell in Hyper-Realism: A Fusion of Physics and Visual Mastery*

Fig. 1a shows a scientific illustration of a tornado supercell generated by Midjourney with a prompt:

*Hologram of Tornado supercell in a physics laboratory, led lit, intricate detail, unreal engine 5, octane render, display lighting, 24K, --ar 2:3*

The scene is set in a physics laboratory, a place of scientific exploration and discovery. Within this setting, a hologram of a tornado supercell is prominently displayed. This meticulously detailed hologram captures the intricate nuances of a supercell, a powerful and awe-inspiring meteorological phenomenon. LED lighting illuminates the

hologram, highlighting its details and giving it a mesmerizing glow. This choice of lighting not only accentuates the visual appeal, but also adds a touch of realism to the hologram.

The mention of "unreal engine 5" and "octane render" indicates that cutting-edge technology and software are employed to create this visual masterpiece. These tools are known for their ability to produce hyper-realistic graphics, suggesting that viewers will be treated to a lifelike representation of the tornado supercell. The "24K" refers to an ultra-high resolution, ensuring every detail is crisp and clear. The aspect ratio "--ar 2:3" hints at the display's dimensions, suggesting a portrait orientation, which is apt for showcasing the towering nature of a supercell.

The setting and the tornado supercell are deeply rooted in science. The physics laboratory and the meteorological phenomena represent the pursuit of knowledge and understanding. However, artistic elements, such as LED lighting, intricate detailing, and advanced rendering techniques, transform this scientific representation into a work of art. It is a harmonious blend of science and art, where the raw power and complexity of nature are captured and presented in a visually stunning manner. This balance showcases how technology can be used as a bridge between science's empirical world and art's expressive realm.

Fig. 1b shows a scientific illustration of a tornado supercell generated by Midjourney with a prompt:

*A Holographic Projection Cutaway of Tornado in a physics laboratory, led lit, intricate detail, unreal engine 5, octane render, display lighting, 24K, --ar 2:3*

The scene is a holographic projection in a physics laboratory that shows a cutaway view of a tornado. This isn't a mere surface representation; it delves deep into the tornado's structure, revealing its inner workings with intricate detail. The LED and display lighting illuminates the hologram, emphasizing its detailed features and lending it a captivating glow.

The cutaway view of the tornado is a scientific exploration that reveals the inner dynamics of this meteorological wonder. However, the artistic flair is evident

in the intricate details, LED illumination, and advanced rendering techniques. It is a testament to how art can enhance scientific understanding, making complex phenomena more accessible and engaging.

Compared to the prompt of Fig. 1a, both descriptions involve a holographic representation of a tornado in a physics laboratory with similar technological and artistic elements. However, the "Tornado cutaway" focuses on an internal view, revealing the tornado's inner structure, whereas the "Tornado supercell" emphasizes the entire supercell, a larger meteorological entity. The cutaway offers a deeper dive into the tornado's anatomy, whereas the supercell provides a broader view of the phenomenon. Both balance science and art, but the cutaway offers a more intimate exploration of the tornado's core.

### B. The Inner Dynamics of a Tornado Supercell

Fig. 1c demonstrates an astonishing picture of the inner dynamics of a tornado supercell generated by Midjourney with a prompt:

*Hologram showcasing the inner phenomena of a Tornado supercell within a physics laboratory setting. The visualization captures the high-speed rotating wind field, creating a mesmerizing vortex that spirals upward. Intermittent flashes of lightning pierced through the supercell, illuminating its structure and adding a dynamic element to the scene. Ground-level visualization emphasizes the debris being lifted and swirled by the tornado's immense power, giving viewers a sense of its destructive force. LED lit to accentuate the contrasts and details, intricate depiction of the supercell's internal dynamics, Unreal Engine 5 for realistic animation and effects, octane render for photorealistic visuals, specialized display lighting to highlight the tornado's fury and the chaos it brings, 24K --ar 2:3*

Within the confines of a physics laboratory, a hologram comes to life, revealing the inner phenomena of a Tornado supercell. This is a static image and a dynamic visualization of the high-speed rotating wind field. The viewer is immediately drawn to the mesmerizing vortex that spirals upward, embodying nature's raw power and energy. Intermittent flashes of lightning, brilliant and sudden, pierce

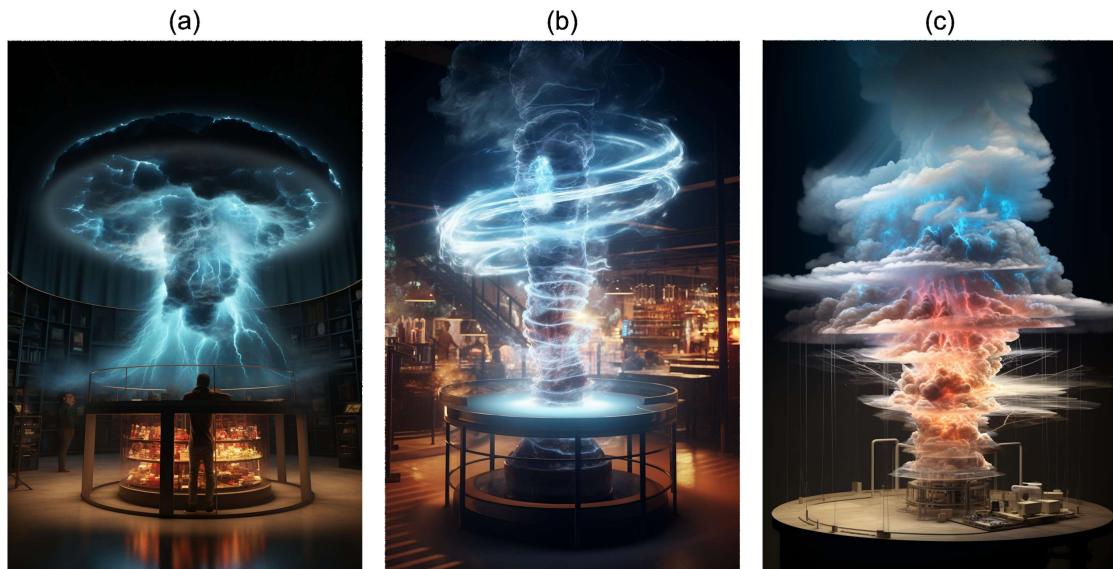


Fig. 1. AI-generated images of tornado supercell in a physics laboratory.

through the supercell. These flashes illuminate the supercell's structure and add a sense of unpredictability and drama to the scene. At the ground level, the visualization is open to showcasing the tornado's destructive force. The debris is seen being lifted, swirled, and tossed about, providing a tangible sense of the tornado's might.

The LED lighting and specialized display lighting accentuate the contrasts and intricate details of the supercell's internal dynamics. Unreal Engine 5 ensures realistic animation and effects, while octane rendering guarantees photorealistic visuals. The "24K" resolution and "--ar 2:3" aspect ratio further enhance the visual experience, ensuring clarity and depth.

In particular, the depiction is rooted in scientific understanding, capturing the complex dynamics of a tornado supercell. However, the artistic elements, from the LED lighting to the photorealistic visuals, elevate this scientific representation into a visual spectacle. It is a harmonious blend where the intricacies of science are made visually appealing and understandable through art.

Compared to the prompt of Fig. 1a, both descriptions involve a holographic representation of a tornado supercell in a physics laboratory. However, the initial prompt focuses more on the overall appearance and setting, while the "inner structure" prompt of Fig. 1c delves deeper into the internal phenomena and dynamics of the supercell.

The cutaway in Fig. 1b offers an internal view of a standard tornado, revealing its anatomy. In contrast, the "inner structure" prompt in Fig. 1c provides a more detailed and dynamic visualization of the internal phenomena of a supercell, emphasizing its rotating wind field, lightning, and ground-level effects.

### C. Detailed Tornado Structures with Aspect Ratio 2:1

#### 1) Global Picture of the Inner Dynamics of a Tornado

Fig. 2a demonstrates a detailed picture of the inner dynamics of the tornado generated by Midjourney with a

prompt:

*A Holographic Projection Cutaway delving deep into the inner dynamics of a Tornado set within a physics laboratory. This visualization immerses viewers into the heart of the tornado, where the ferocious, high-speed rotating wind field creates a mesmerizing vortex. Intermittent lightning flashes streak through the tornado's core, casting an electrifying ambiance and illuminating the swirling winds. Surrounding the base, viewers can witness debris lifted from the ground, swirling chaotically, emphasizing the tornado's raw power and the destruction in its path. LED lit to accentuate the contrasts and intricate details of the tornado's turbulent internal dynamics, Unreal Engine 5 for a realistic portrayal of the tornado's fury, octane render for photorealistic visuals, specialized display lighting to highlight the chaotic dance of wind, lightning, and debris, 24K, --ar 2:1*

The image depicts an immersive visualization of a tornado's inner workings in a high-tech physics laboratory. At the center lies the tornado's core, portrayed as a swirling vortex of chaotic winds rotating at tremendous speeds. Mesmerizing patterns of air currents twist and turn, creating a hypnotic funnel stretching high into the sky overhead. Intermittent flashes of lightning streak through the funnel's heart, casting an electrifying glow across the cyclone's interior and illuminating the complex flows of rotating air.

Surrounding the tornado's base, viewers can see debris sucked from the ground, caught in the tornado's powerful winds, and swirling chaotically around the vortex. The debris emphasizes the immense power of the tornado and gives a sense of destruction outside the walls of the funnel. Vivid contrasts between darkness and flashing light accentuate the tornado's raw, turbulent fury.

The scene is digitally rendered with photorealistic clarity using cutting-edge graphics engines and display technologies. This allows viewers to immerse themselves in the very heart of the tornado, witnessing its internal dynamics from an impossible vantage point. Advanced physics simulations and measurements overlay the visuals, transforming the tornado

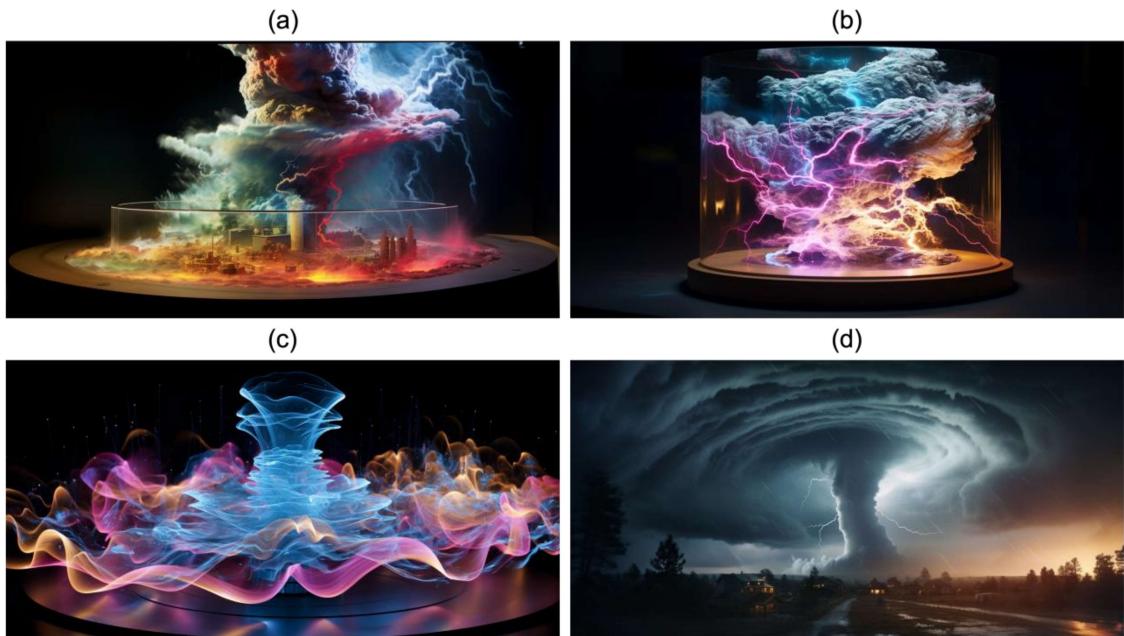


Fig. 2. AI-generated images of tornado inner dynamics and multiple vortex structure in a physics laboratory.

into a living laboratory specimen.

Overall, the image balances scientific insight with artistry. It educates viewers about tornado mechanics through an imaginative and visually striking portrayal. The lighting, physics data, and hypnotic vortex combine science and art to convey the tornado's intense destructive power in a thought-provoking way.

## 2) Close-up Picture of the Inner Dynamics of a Tornado

Fig. 2b demonstrates a close-up picture of the inner dynamics of a tornado generated by Midjourney with a prompt:

*Step into the heart of a tornado with a captivating holographic projection. Feel the power as the swirling winds create a mesmerizing vortex. Lightning flashes add an electrifying atmosphere, illuminating the intense dynamics. Chaotic debris lifts from the ground, showcasing the tornado's devastating impact. LED lighting emphasizes the intricate details, while Unreal Engine 5 and Octane Render provide stunning realism. Specialized display lighting highlights the dynamic interplay of wind, lightning, and debris. 24K, --ar 2:1*

Fig. 2b provides a zoomed-in view of the tornado's core, focused on the intricate structural details within the vortex. At the center, we see the tornado's powerful rotating winds swirling with greater clarity, the airflow patterns highlighted in sharp focus. The mesmerizing vortex stands out in higher resolution, emphasizing the complex turbulence churning within.

Flashes of lightning now spear directly through the core in electrifying detail, spiderwebs of light illuminating the tornado's heart. With the more intimate vantage point, the lightning takes on an even more vivid, threatening presence. Similarly, the swirling debris appears closer, allowing us to see the objects caught in the winds, splintered wood, twisted metal, and scattered debris.

Creating artistic technologies brings tiny structural details to life with enhanced realism and clarity. Cutting-edge graphics engines render turbulence and lightning with stunning photorealism and crispness. The advanced display lighting casts dramatic contrasts, accentuating the vortex's interplay between light, wind, and debris.

The prompt of Fig. 2b generates a more scientifically insightful portrayal of the tornado's core structure. The highlighted patterns of airflow and lightning, coupled with the debris detail, provide an intimate understanding of the dynamics within the vortex. Artistic enhancements balance science and art, conveying information and visceral impression. However, the zoomed-in scope offers greater structural detail than the wide-angle view of the entire tornado funnel.

## D. Multiple Vortex Tornado

Fig. 2c demonstrates a striking portrait of a multiple-vortex tornado generated by Midjourney with a prompt:

*A Dynamic Hologram of a Multiple Vortex Tornado in a physics laboratory, vividly illustrating the complex structure of intertwined mini-vortices within the primary tornado funnel. The high-speed rotating multi-vortex wind fields are intricately detailed, creating a mesmerizing dance of nature's fury. Intermittent flashes of lightning pierce through the tornado, illuminating the airborne debris lifted from the*

*ground, adding to the storm's terrifying beauty. LED-lit to accentuate the chaotic interplay of the vortices, the projection captures the raw power and intricacy of the tornado's anatomy. Rendered with Unreal Engine 5 for lifelike motion and Octane Render for crystal-clear visuals, the display is further enhanced with specialized lighting techniques to emphasize the lightning strikes and the swirling debris. The entire visualization, showcasing the awe-inspiring might of nature, is presented in high definition 24K --ar 2:1 --s 150*

Fig. 2c depicts a tornado's intricate internal structure, focusing on the interaction of smaller, intertwined vortices within the primary funnel. High-speed winds twist and coil at the center, merging the mini-vortices into a complex, collective vortex. The hypnotic flows glow with vivid luminosity, emphasizing the tornado's raw power and fluid dynamism.

The intermittent flashes of lightning pierced through the tornado, illuminating the airborne debris lifted from the ground, adding to the storm's terrifying beauty. The LED-lit projection captures the raw power and intricacy of the tornado's anatomy, and the display is further enhanced with specialized lighting techniques to emphasize the lightning strikes and the swirling debris.

The multi-vortex focus provides a greater understanding of tornado anatomy and airflow. The intricacy and interplay of the small vortices within the primary funnel add more complex fluid dynamics. The visualization balances artistry with physics knowledge, fusing science and creative technique to portray nature's awe-inspiring fury vividly.

Fig. 2d immerses viewers within a multi-vortex tornado, depicting its structure from macro to micro scales. The vast primary funnel houses numerous smaller, intricately twisting vortices swirling with hypnotic fury. Zooming into the micro-scale, the extreme detail of the high-speed rotating winds comes into focus, the flows' complexity accentuated through advanced rendering.

Lightning pierces the spaces between vortices, highlighting the overall anatomy while illuminating debris. The multi-scale perspective provides scientific insight into tornado dynamics at both macro and micro levels. Artistically, lifelike motion and crisp lighting enhance visual impact. The enhanced realism and multilevel views balance scientific analysis and aesthetic appreciation, fusing analytical knowledge with emotive experience. Overall, the hologram seamlessly blends meteorological science with artistic brilliance. Although the tornado's dynamics are scientifically accurate, lighting, rendering techniques, and immersive design transform this knowledge into a visual masterpiece, making complex phenomena understandable and captivating.

## IV. CONCLUSION

The intersection of art and science has always been a fertile ground for innovation and understanding. Scientific illustration, a discipline with ancient roots, has continually evolved, adapting to technological advancements and societal needs. The Renaissance era, marked by the likes of Leonardo da Vinci, set a precedent for the fusion of art and science. Today, with the integration of AI platforms such as Midjourney, this fusion has reached new heights. Although

limited, these platforms offer unprecedented potential to generate detailed and accurate scientific visuals.

In the realm of atmospheric science, such advancements are pivotal. Tornadoes can be challenging to represent accurately with their intricate structures and behaviors. As presented in this research, AI-generated illustrations provide a nuanced understanding of these phenomena. They demystify the complex processes and make them accessible to a broader audience.

Midjourney's platform can produce scientifically precise visuals and intricate concept illustrations, making it a valuable tool for scientific outreach. However, challenges exist in achieving absolute precision and creating complex visuals. Additionally, the platform's closed-source nature can limit its adaptability and transparency. Future research could focus on enhancing AI's ability to interpret and execute complex scientific instructions, thus improving the accuracy of generated illustrations. One possible avenue for exploration is the development of algorithms that can better comprehend the nuances of scientific language.

In conclusion, the future of scientific illustration is promising, with AI playing a central role. AI-powered illustration can construct imaginative worlds anchored in factual accuracy and insight by complementing science's pursuit of objectivity with art's subjective expressiveness. Moving forward, the thoughtful use of AI art may open new frontiers in conveying the beauty and intricacy of science through universally captivating storytelling. Platforms like Midjourney, when used judiciously, can revolutionize how we visualize and understand complex scientific phenomena. As we continue to harness the power of AI, it is crucial to remember the core purpose of scientific illustration: to bridge the gap between intricate scientific knowledge and public understanding. The fusion of art and science, facilitated by artificial intelligence, has immense potential for education, research, and public outreach.

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