Generative AI-Enabled Disaster Scene Computing for Climate Risk-Informed Communication

- a case study of using ChatGPT for Tornado Disasters
ZhiQiang Chen, Ph.D.
Professor of Civil Engineering, Ph.D.
Division of Natural and Built Environments (NBE)
UMKC | chenzhiq@umkc.edu

Kailynn Barnt, Undergraduate Student, UMKC

Bandana Kar
Technology Policy Fellow @ U.S. DOE | Energy Resilience, Decarbonization, Science Policy, Geospatial Scientist and Educator, Science Communicator
Email: bandana.kar@ee.doe.gov

Disclaimer:
- A GPT4 based customized ChatGPT hub is created for this work. https://chat.openai.com/g/c-8RoKPe6Xr-disaster-risk-communication-through-generative-ai
- The Hub was used to conduct this study, including customization, prompting, code generation, and scene generation.
- Several publicly available documents and a review based on a published journal paper are used to augment the contents of the Hub. No copyright protected materials were used.
Risk Communication of Urban Flood through Augmented Reality

Risk Communication using AR/XR and Challenges – *presented during CPASW 2023*

- AR/XR provides an immersive human-'machine' interfacing where physical environment, simulated scenes and analytics are integrated.
- However, the generation is human (expert) based and takes time to prepare.

What if we use Generative AI (GenAI) to generate risk contents in the real-time, as *prompting in ChatGPT*?
Outline

- Generative AI Technologies
- Disaster Risk Communication Hub
- Evaluation of General Tornado Knowledge
- Evaluation of Tornado Scene Machine Understanding
- Evaluation of Tornado Scene Machine Generation
- Implication of misinformation or disinformation-bearing generation
- Conclusions
Generative AI: Foundational Learning Technologies

- Natural Language understanding and generation
  - Text generation, language translation, summarization, and answering (a few-shot / zero-shot learning); programming code generation
  - **Foundational Learning Models:** Transformer architecture; self-supervised pre-training; transfer learning; Human Reinforcement Learning; **prompting and in-context learning; RAG and fine-tuning**

- Natural Vision understanding and generation
  - Image/video understanding (e.g., zero-shot detection/segmentation); text to image (video) generation
  - **Foundational Learning Models:** Vision Transformers (ViTs); Generative Adversarial Networks; **Diffusion Models; Variational Diffusion Models; CLIP for language embedding**
Design the Hub

Disaster Risk Communication through Generative AI is tailored for first responders and the general public to inform risk arising from natural disasters that are further dependent on climate changes, hazards, exposures, post-disaster recovery, and socioeconomic measures from all dimensions.

https://chat.openai.com/g/g-8RoKPe6Xr-disaster-risk-communication-through-generative-ai
Design the Hub

- Promoted first that the GPT 4 is ‘aware of’
  - The Fifth National Climate Assessment
  - NOAA’s Enhanced Fujita Scale Report through uploading the ‘et-ttu.pdf’ document

- Not aware of
  - An image database from the 2013 Moore Tornado
We designed a set of five experiments to evaluate the LLM capacity:

1. Tornado case history
2. Tornado and climate change
3. Tornado scale and damage
4. Tornado response and recovery
5. Specific contextual-adding prompting

<table>
<thead>
<tr>
<th>General Tornado Knowledge</th>
<th>Questions (parallel or sequential)</th>
<th>Answers</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tornado case history</td>
<td>Are you aware of the Joplin Tornado, 2011? Give a general description about its scale, location, damage and loss, and recovery status?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Tornado and climate change</td>
<td>How climate change affect tornado hazards in the midwest (tornado valley), for example the general trend about its location, frequency, and intensity?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Tornado scale and damage</td>
<td>Give the fujita scale and the Enhanced Fujita scale, what is their relation?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Tornado response and recovery</td>
<td>What technologies are useful immediately before a tornado landing?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Specific contextual-adding prompting</td>
<td>Before uploading the review of the “Germini &amp; Brooks (2018)” paper, Comment that how tornado hazard changes (1) temporal changes in terms of annual frequencies, (2) spatial varying frequencies in different locations in the US, and (3) are these changes due to anthropogenic forcing?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Results

<table>
<thead>
<tr>
<th>General Tornado Knowledge</th>
<th>Questions (parallel or sequential)</th>
<th>Comment</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Tornado case history</strong></td>
<td>Are you aware of the Joplin Tornado, 2011? Give a general description about its scale, location, damage and loss, and recovery status?</td>
<td>Facts and description are correct.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Are you aware of the Moore Tornado, 2013? Give a general description about its scale, location, damage and loss, and recovery status?</td>
<td>Facts and description are correct.</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Are you aware of the tornado outbreak sequence of May 2019? Give a general description about its scale, location, damage and loss, and recovery status for the tornado outbreak in Lawrence, Kansas?</td>
<td>Facts and description are correct.</td>
<td>10</td>
</tr>
<tr>
<td><strong>1a. Specific contextual adding prompting</strong></td>
<td>Specific prompts with and without uploading a closed-source report? &lt;br&gt; (1) Can you summarize what technologies were used for the field reconnaissance? &lt;br&gt; (2) When the UAV was used to create 3D Photogrammetric products, what are the resolutions? &lt;br&gt; (3) What are the recommended damage assessment steps?</td>
<td>Uploaded a closed source report I couldn't read. Excellent document information retrieval and summary capabilities.</td>
<td>10</td>
</tr>
</tbody>
</table>

| 2. Tornado and Climate change | How climate change affect tornado hazards in the middle west (tornado valley), for example the general trend about its location, frequency, and intensity? | Consistent with my knowledge. | 10 |
| | What are the sources or are there the latest literatures that support your argument above? | All citations are checked and correct. | 10 |
| **2a. Specific contextual adding prompting** | Uploading the review of the “Gensini & Brooks (2018)” paper, (1) Comment that how tornado hazard changes Are the findings in this paper aligned with your previous answers? <br> (2) Combining your previous knowledge and this paper, are these changes due to anthropogenic forcing? | Amazing textual and comparisons capability given a newly uploaded document against its saved knowledge. | 10 |

| 3. Tornado scale and damage | Define the EF tornado scale. | Given the Fujita scale and the Enhanced Fujita scale, what is their relation? - Do you access the NOAA Enhanced Fujita Scale Report document? I recall there is a regression-based relation. - Uploaded above. Now answer the last question about the statistical relation. | Need to follow up prompting to have the answer. |
| | At an EF0 to EF1 tornado, what typical damage would be observed? | Correct description | 10 |
| | At an EF2-3 tornado, what typical damage would be observed? | Correct description | 10 |
| | At an EF4-5 tornado, what typical damage would be observed? | Correct description | 10 |

| 4. Tornado response and recovery | What technologies and other social/economic measures are useful for preparing before a tornado landing? | What technologies and other social/economic measures are useful for responding during a tornado strike? | Complete answer. |
| | | | 10 |
| | What communities should do after a tornado disaster for achieving rapid recovery and in the long term tornado resilience for future tornadoes? | Complete answer. | 10 |
| | Are you aware of any federal funding for a tornado recovery? | Complete answer. | 10 |

| 5. Advanced simulation questions | Can we do regional climate modeling or downscaling to forecast tornado hazards? | Consistent with my knowledge | 10 |
| | Are you aware of some recent large AI models for weather forecast? | Great summary yet knowledge up to 2023 | 10 |
| | Can we use these AI models to predict tornado hazards in the next year or next 50 years in a way similar to the regional/global temperature or sea rising prediction? | Reach the cap limit!! | 10 |
Remarks

1. Excellent general knowledge about tornados: Hazard, disaster response, technology and socioeconomical measures, climate change and attribution, and latest advance in simulation.

2. Excellent document comparison and summary when providing ‘new’ documents
   - A disaster recon report, when uploaded, it can quick summary and information retrieval [1].
   - For specific knowledge (e.g., statistical relation between the F-scale and the EF-scale), a few prompts with uploading a document are necessary.

3. Comprehensive knowledge about latest advances in large AI models for weather and climate simulation yet up to 2023.

4. The hub can keep context in one session, including what I asked to define a new of DoD levels.

Recognized Challenge and Solution

- When a large volume of non-open data (documents and multi-media) data need to be uploaded and analyzed, using the customized GPT Hub is practically difficult.

- Advanced fine-tuning and RAG techniques may be used using opensource Large Language Models (LLMs) and Large Multi-modality Models (LMMs).
Tornado Scene: Machine Understanding

- Disaster scene understanding using images (social networks, professional recon, and other crowdsourcing means) is a significant approach for disaster risk understanding and for rapid disaster severity/loss estimation/mapping.

- Our previous work using a deep learning technique proved that machine can understand multi-hazard disasters and infer damage levels [2, 3].
  - Can the GPT4-based ‘Hub’ realize this?

---

Dataset – Moore Tornado, 2013 Ground Recon Data

● 441 ground recon images; and all images were lost in the Internet [4]. Therefore, the ‘Hub’ would do ‘zero-shot’ learning.

● We prompted that for each input image, it should output
  ○ **Image to text:** General description in long text, including apparent tornado-indicator objects (buildings, vehicles, trees) **Image to text:** A short description as a caption.
  ○ **Detection and classification:** Count the number of buildings in the image
  ○ **Detection and classification:**
    ▪ Damage rating using newly defined DoD levels (3: complete; 2: substantial/major; 1 light/intact)
    ▪ We have visual ground truth!

---

<table>
<thead>
<tr>
<th>No</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>3</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>2</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>2</td>
</tr>
<tr>
<td>17</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>2</td>
</tr>
<tr>
<td>18</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>19</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>21</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>22</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>23</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>24</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>2</td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
<td>http://</td>
<td>Commercial</td>
<td>4</td>
</tr>
<tr>
<td>26</td>
<td></td>
<td></td>
<td>http://</td>
<td>Building</td>
<td>1</td>
</tr>
<tr>
<td>27</td>
<td></td>
<td></td>
<td>http://</td>
<td>Building</td>
<td>2</td>
</tr>
<tr>
<td>28</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>29</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>30</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>2</td>
</tr>
<tr>
<td>31</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>2</td>
</tr>
<tr>
<td>32</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>2</td>
</tr>
<tr>
<td>33</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>34</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>35</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>36</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>2</td>
</tr>
<tr>
<td>37</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>38</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>39</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>40</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>41</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>2</td>
</tr>
<tr>
<td>42</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>43</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>44</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>45</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>1</td>
</tr>
<tr>
<td>46</td>
<td></td>
<td></td>
<td>http://</td>
<td>Residence</td>
<td>2</td>
</tr>
</tbody>
</table>
Steps:
1. Recall the DoD levels
2. Prompt image by image – and request for output into a CSV file for each image including attributes:
   - Long description
   - Short description as a caption
   - # of buildings
   - DoD classification

You mentioned that you would use these levels to ask me to classify damage given an image. Please go ahead with the image, and I will classify the damage according to these levels.

Great. I will upload many disaster scene image; one by one. For each image, please provide: (1) a long description about the scene, describing major tornado scale damage indicator (DI) objects; (2) a short description as a caption; (3) number of buildings in the image; and (4) classification of damage using the DoD level above. Can you do this? also can you save them into a CSV file hence I can download (or you can go back same all of them into one CSF file given many images I will upload one by one)?

Certainly, I can provide the descriptions and classifications as you've requested. Once you've uploaded the images, I will analyze each one and compile the information into a CSV file for download. Please start by uploading the first image.
Sample Results

**Long Description:** The image depicts a residential neighborhood after a tornado event. In the foreground, there is an unharmed red pickup truck on the left. The focus of the image is a house that has sustained severe damage: the roof is largely missing, with only the trusses partially intact; walls have collapsed or are severely damaged, with debris scattered around; bricks and construction materials are strewn across the scene. Remarkably, there's spray paint on one of the remaining walls of the house that reads 'ALL OK', indicating a safety check or that no one was harmed in this specific residence.

**Short Description:** Severely damaged house with roof and walls collapsed post-tornado, next to an untouched red truck, marked with 'ALL OK'.

**Number of Buildings in the Image:** 1 (visible damaged house)

**Classification of Damage (DoD Level):** 2 (considerable to severe damage)

---

**Long Description:** The image shows a single-story residential brick house with a multi-pitched roof and a prominent chimney. The structure of the house appears intact with no evident structural damage. The surrounding lawn is well-kept but features a few small fallen branches, which could indicate minor wind damage. There is no discernible damage to the windows, doors, or the main structure of the house.

**Short Description:** Well-maintained brick house with minimal debris on the lawn, indicating minor wind damage.

**Number of Buildings in the Image:** 1

**Classification of Damage (DoD Level):** 1 (minor to moderate damage)
Remarks

- Excellent tornado understanding in general
  - Superb image-to-text capabilities
  - Read perfectly text in images
  - Superb detection and counting accuracy in identifying building structures.
  - Good accuracy in damage classification (90% overall accuracy with human interpretation)
- The overall performance meets the general tornado disaster scene understanding needs for the public.

- Supports only image-by-image input, and the output to CVS can be interrupted.
  - GPT APIs may overcome this and provides a batch mode – hence a collective tool for disaster scene understanding (description and damage classification), eventually GIS based damage mapping.
**Tornado Scene: Machine Generation**

- Image generation is the most difficult generative AI task to this end;
  - Spatial reasoning and embedding are extremely hard to encode in the image generation process.
  - SORA represents the most advanced GenAI capability.

- From this ‘golden-rush’ SORA generated video
  - Generative AI can generate built-environment scene in terms of all photorealistic criteria?
  - How about the tornado mechanics?
    - How about the spatial-temporal mechanics criteria?

Prompt: Historical footage of California during the gold rush.  
https://openai.com/sora?video=gold-rush
No one accesses SORA yet.

- The solution is to use DALL.E2 (DALL.E3 is ready; but not available in ChatGPT 4)
- The solution is to manually create **chronologically** sequenced disaster landing and striking scenes.
  - This is a 'mock-up' of the **underlying time-embedding** in the reverse diffusion process.

Courtesy of NVidia DL Diffusion Workshop
P1. Generate a photorealistic scene showing a tornado approaching a rural town.
P2. Continue the scene above and generate a scene that the tornado touches down the ground in the town.
P3. Continue the scene above and generate a closer scene that the tornado destroys the roof of a house.
P4. Continue the scene above and generate a closer scene that the tornado damages an adjacent structure with a different pattern.
P5. Continue the scene above and generate a closer scene that the tornado damages an adjacent structure with another different pattern.
P6. Continue the scene above and generate a closer scene that the tornado damages an adjacent structure with another different pattern.
P7. Continue the scene above and generate a closer scene that the tornado damages an adjacent structure with another different pattern. Show the path based on the last generation.
P8. Continue the scene above and generate a closer scene that the tornado damages an adjacent structure with another different pattern. Show the path based on the last generation.
Pg. Continue the scene above and generate a bird view scene that the tornado damages an adjacent structure with another different pattern. Show the path based on the last generation.
Continue the scene above and generate a closer scene again that the tornado damages an adjacent school building with another different damage pattern.
P11. Continue the scene above and generate a closer scene that the tornado damages an adjacent **residential building with a parking garage** with another different pattern.
P12. Continue the scene above, which shows an adjacent community, and generate a closer scene that the tornado damages the community with various patterns.
P13. Now generate that the tornado starts decaying and leaves the rural town.
P14. The final (test), generate an airborne remote sensing like view showing the all the damaged structures (buildings) in all the previous prompts, illustrating the tornado path through this town.
Questioning GPT

- Are the buildings with their individual damage patterns all included in the remote sensing image above?

- The remote sensing-like image aims to encapsulate the overall path of destruction through the town, highlighting the various damaged structures along the tornado's trajectory. Given the scale and perspective of an aerial view, the image provides a comprehensive overview rather than detailed depictions of individual damage patterns to specific buildings. The focus is on illustrating the tornado's path and the extent of the area affected.

- Can you summarize all the contexts I provided that are used as embeddings in the generations?

- Throughout the sequence of image generations, the contexts provided progressively depicted the approach, impact, and aftermath of a tornado striking a rural town. The narrative began with the tornado's approach toward the town, followed by scenes of it touching down and causing destruction to various structures, including houses, a school, and a community center, each with unique damage patterns. The story continued with the tornado damaging a residential building with a parking garage, followed by wider community damage showcasing various patterns. The narrative then transitioned to the tornado beginning to decay and leave the town, and concluded with an airborne, remote-sensing-like view of the aftermath, showcasing the tornado's path through the town. This progression effectively illustrates the evolving situation, from imminent threat through to the aftermath and the scale of the impact on the community.
To this end

- Our generations are curiosity-driven, in a form of scientific query, and bears no malign intension.

- What if my contexts / narratives as ‘embeddings’ are scientifically biased or even worse, contains intentional ‘agenda’?
I go back with a different though and check if you comply with some sort of 'standard' intrinsically (from your training).

**Disaster Risk Communication through Generative AI**

Certainly! While I can provide information and perform tasks based on a broad range of knowledge, my responses are guided by principles set during my training, which include:

- **Ethical Guidelines**: Ensuring the information provided respects privacy, copyright laws, and promotes safe and respectful interaction.
- **Accuracy**: Striving for factual accuracy based on the data available up to my last training update.
- **Neutrality**: Offering neutral and unbiased information to the best of my ability.
- **User Privacy**: Not storing personal user data or using it for future reference in conversations.
- **Adherence to Policies**: Following specific guidelines and policies, including content moderation standards, to prevent the dissemination of harmful or inappropriate content.

---

**Prompt: Generate a tornado scene showing a township with upper- and lower-income communities and damage is confined in the lower-income communities.**

- I took multiple 'malicious' prompts to generate this ...
Explaining the GenAI – context, context, context ...

Under the hood of DALLE.2 = Transformers + Diffusion + CLIP

Lacking spatial/temporal resolution
Lacking physical rigor
Ethically biased
Totally hallucinated (physically wrong)
Technical Remarks

- Impressive generation of general disaster striking scenes chronologically.
  - Spatial shapes and inter-relations of tornado, townships, buildings, and other objects are minimally satisfactory
- Spatial-temporal 'mechanics' as manifested in the generation significantly lacks scientific logic and fidelity.
  - Temporal progressing between different chronologic generation does not follow physics; and spatial 'memory' is not found
  - Tornado-structure interaction and impact mechanics are NOT in the knowledge of the generation or in the reverse diffusion process.

- Calling for PHYSICS-informed Generative Simulation
Legal/Ethical Concern and Opinion towards climate/disaster RISK Communication

- The possibility of generating misinformation and disinformation using GAI relevant to disaster risk communication does exist!
- The legal and ethical implications need to be examined from different user and stakeholder perspectives, if a GenAI enabled disaster risk communication tool is developed.
- We argue that human experts should be in the loop who oversee content generation, including correcting and tuning the AI models and making the final call on the objectiveness of generative content.
- This in turns calls for PHYSICS-informed Generative Simulation
Higher Resolution and Large-Scale AI Training with kilometer (km)-scale climate simulations and Low-latency interactivity.

- **Foundational Models**: Numerical models like ICON and IFS; machine learning models such as FourCastNet, GraphCast, and DLWP through NVIDIA Modulus
- **Data federation and visualization**: NVIDIA Omniverse™

Conclusions

- Generative AI provides powerful tool for possibly generating scientific contents regarding disaster risk communication.
  - In the case of tornado diesters, GPT4 based LLM provides impressive knowledge base regarding tornado hazards, climate change, and disaster response measures.
  - The GPT4 vision engine provides impressive zero-shot learning capability of understanding tornado scene images toward recognizing damage and damage classification.
  - The GPT4 image generation (DALL·E2) generally performs well to generate individual tornado scene image depending on objective prompting. Yet, it significantly lacks rigor/logic in spatial-reasoning reasoning when generating an event chronologically.

- User contexts via prompting serve as ‘embeddings’ in the diffusion based generation. Therefore, ethical and legal misconduct leading to disinformation or misinformation is concerning.
Thanks much!

Contact: chenzhiq@umkc.edu