



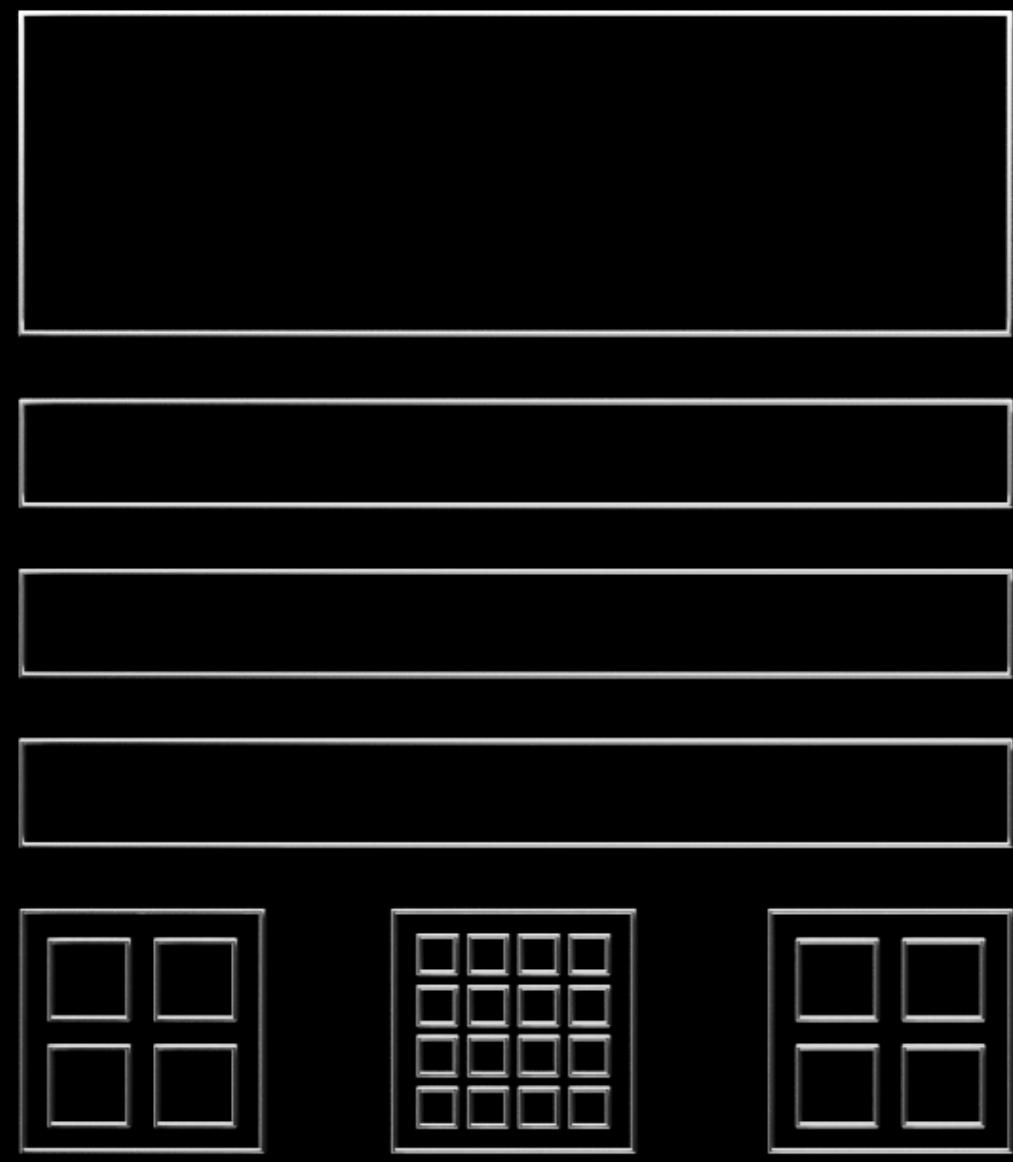
Earth-2 Overview

Jay Chen | Solution Architect, Nov 2024.

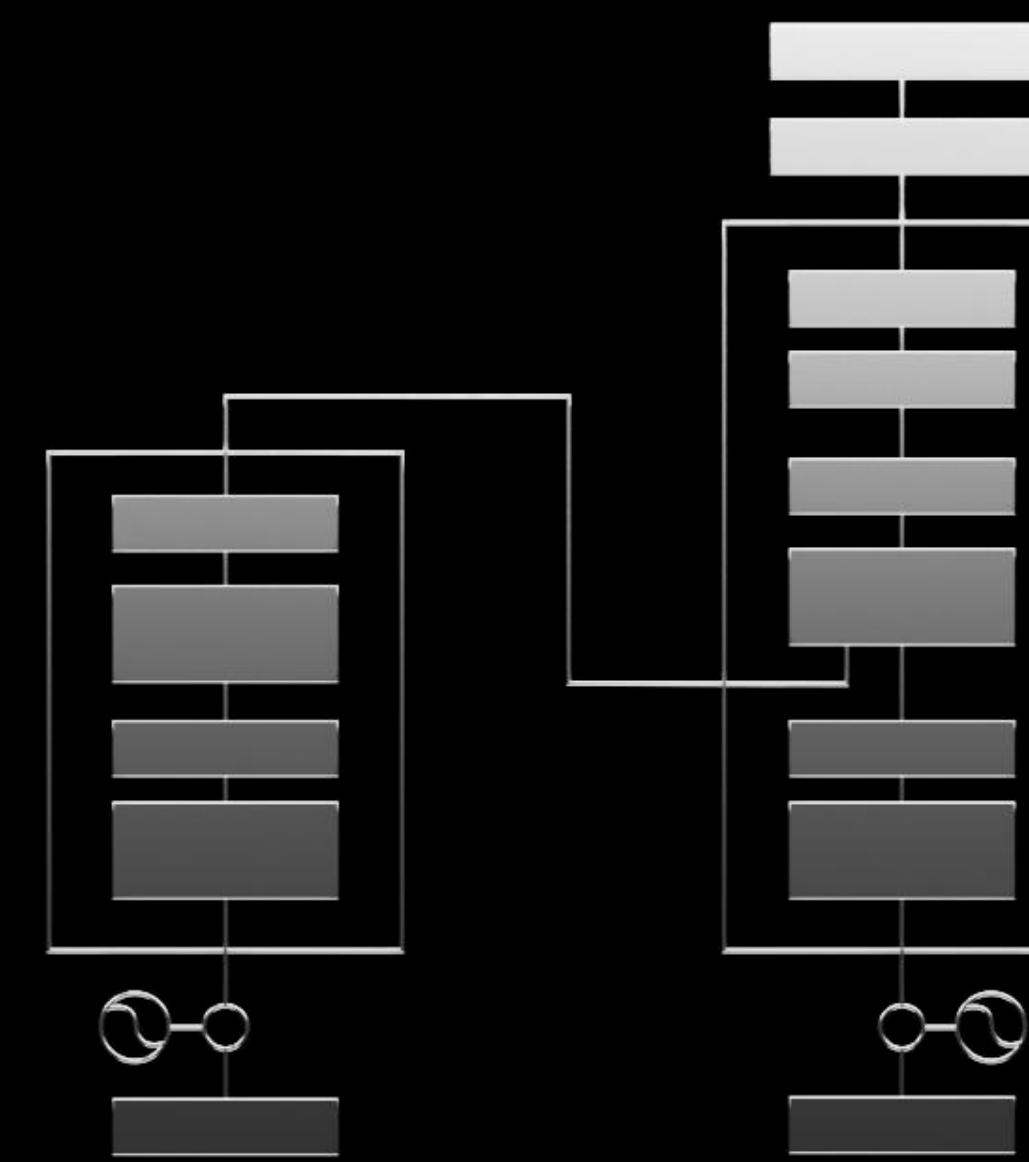
Earth-2 Platform

3 Pillars - HPC & AI & VISUALIZATION

CWA Earth-2 Applications



HPC



AI

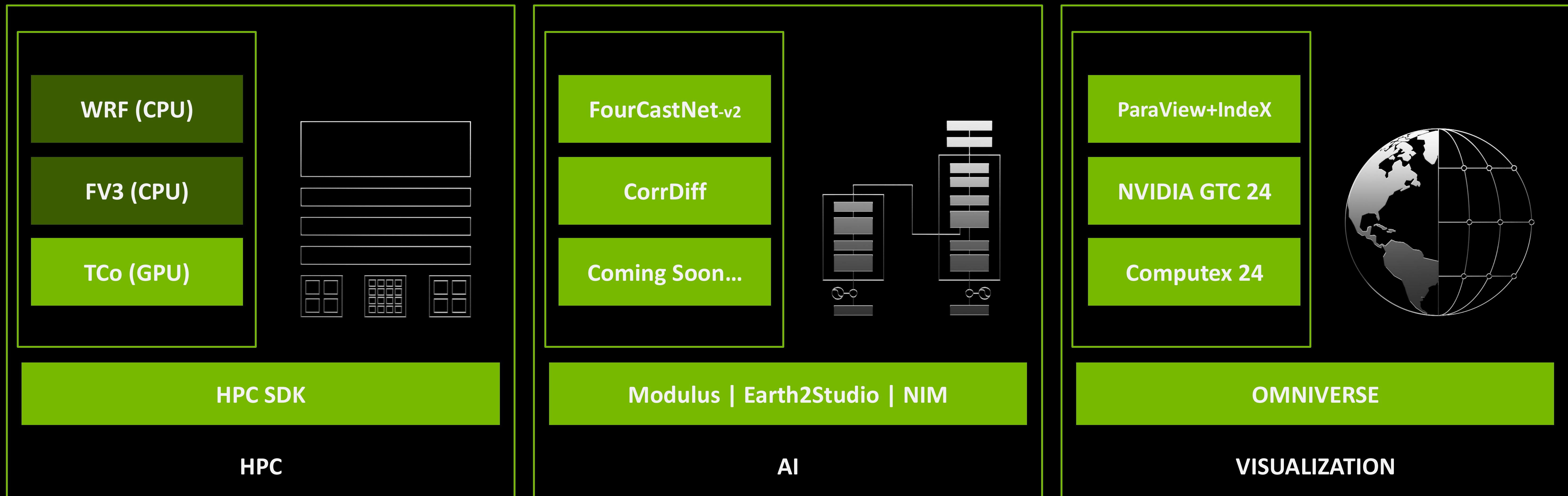


VISUALIZATION

Earth-2 Platform

CPU | GPU | DPU

Earth-2 @ CWA

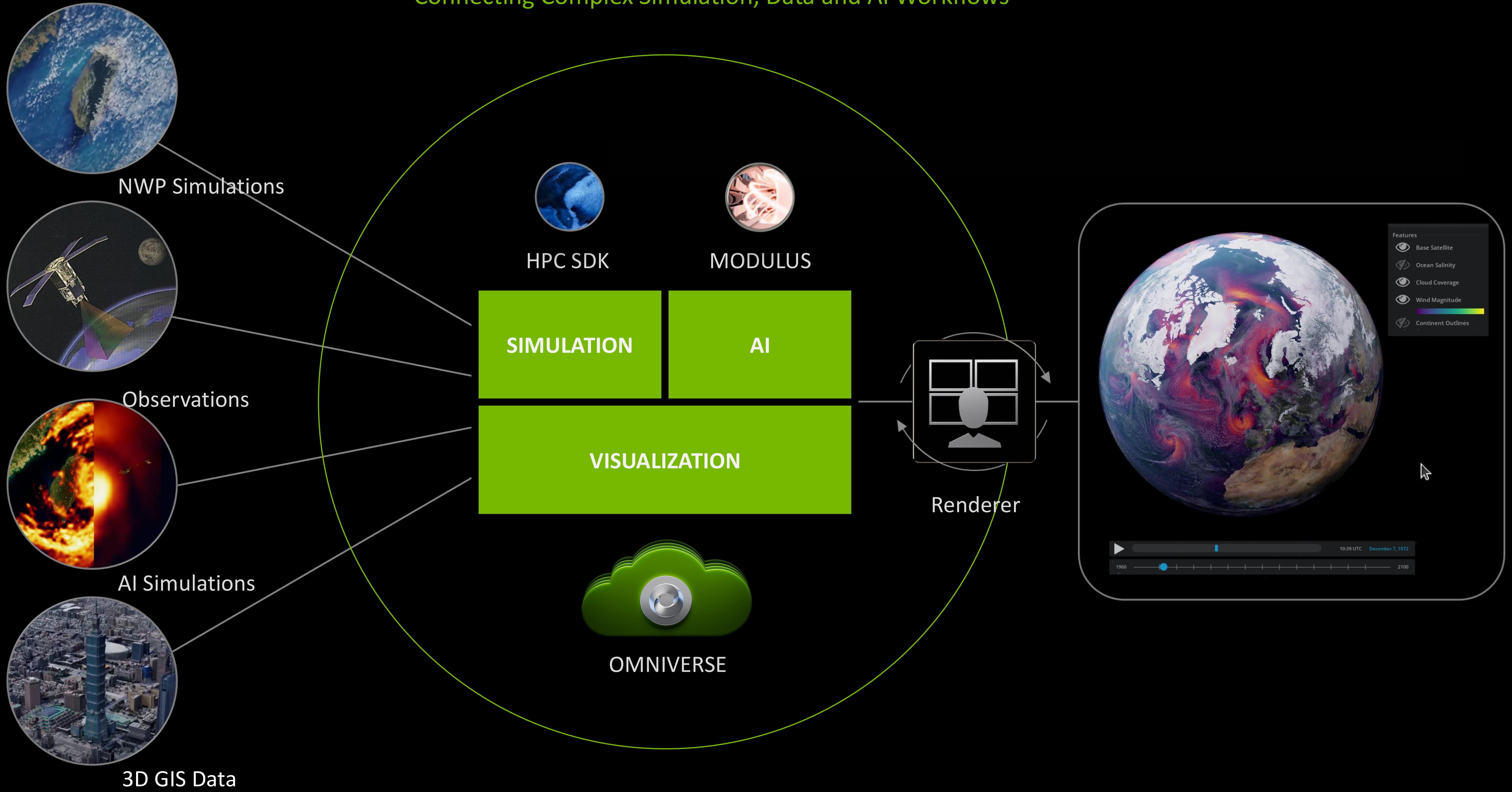


Earth-2 Platform

CPU | GPU | DPU

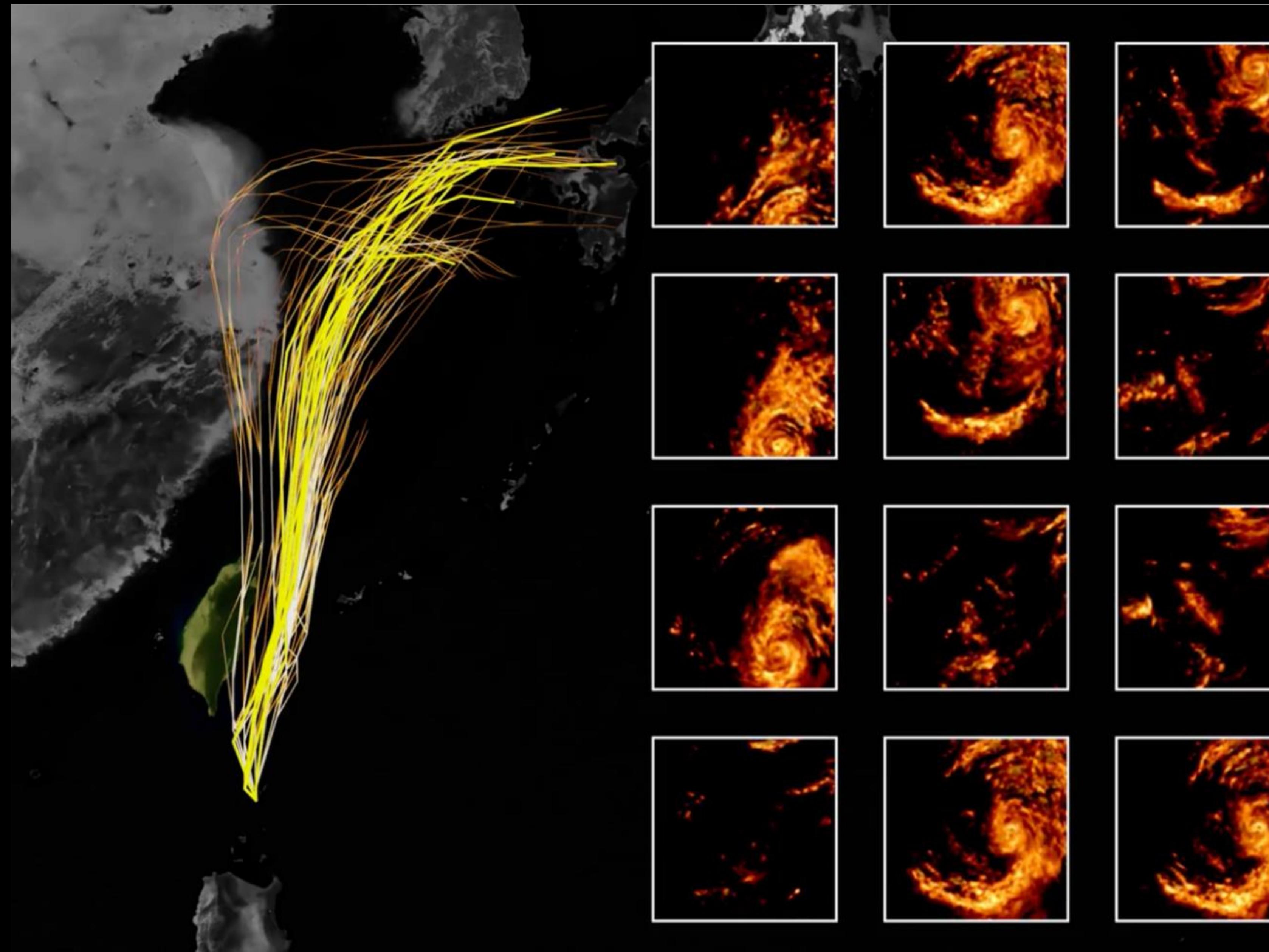
Earth-2 Platform

Connecting Complex Simulation, Data and AI Workflows



Earth-2 Digital Twin

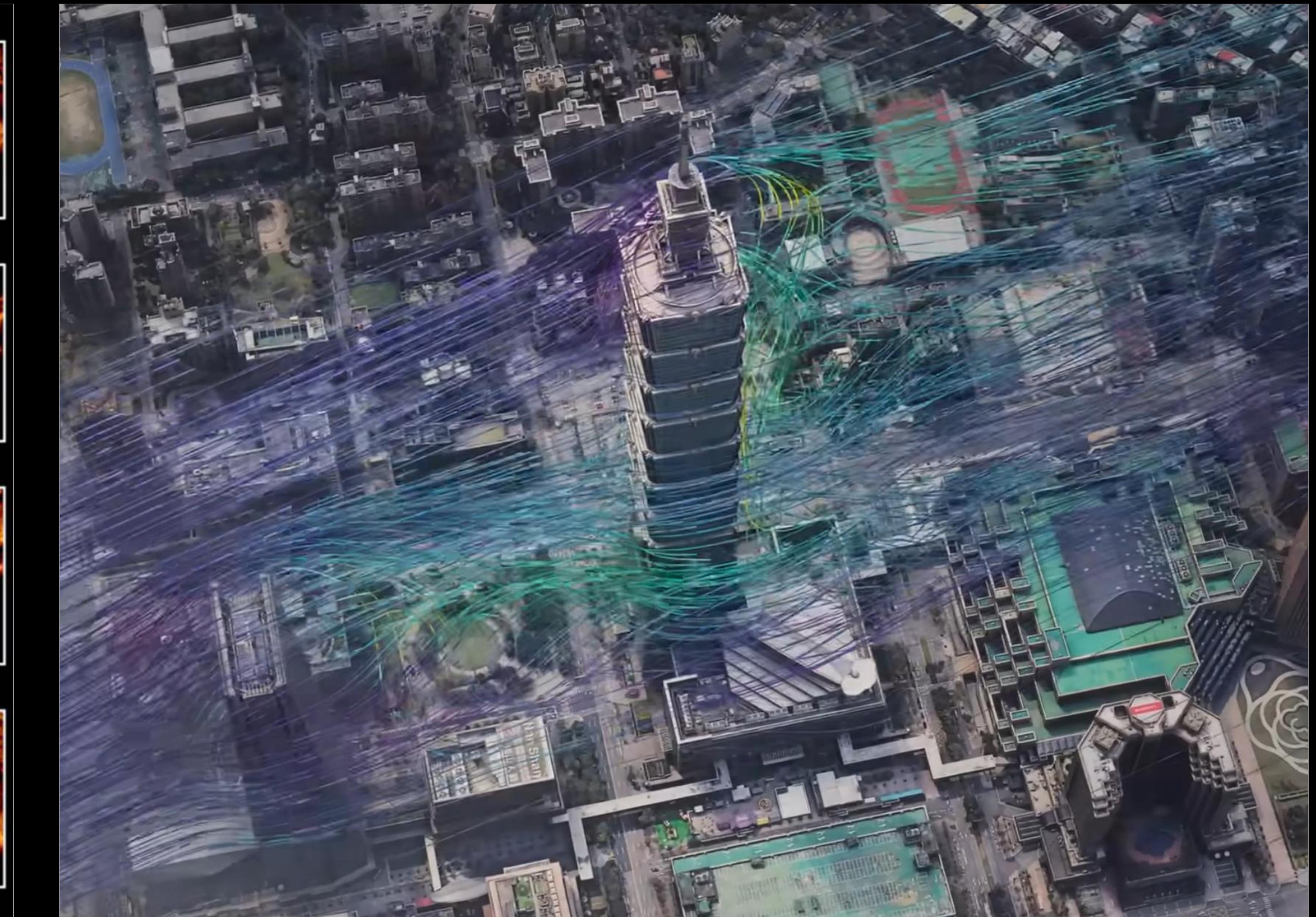
Based on Omniverse



GTC 2024-March

FourCastNet and CorrDiff Ensemble of Typhoon Track Predictions

VISUALIZATION



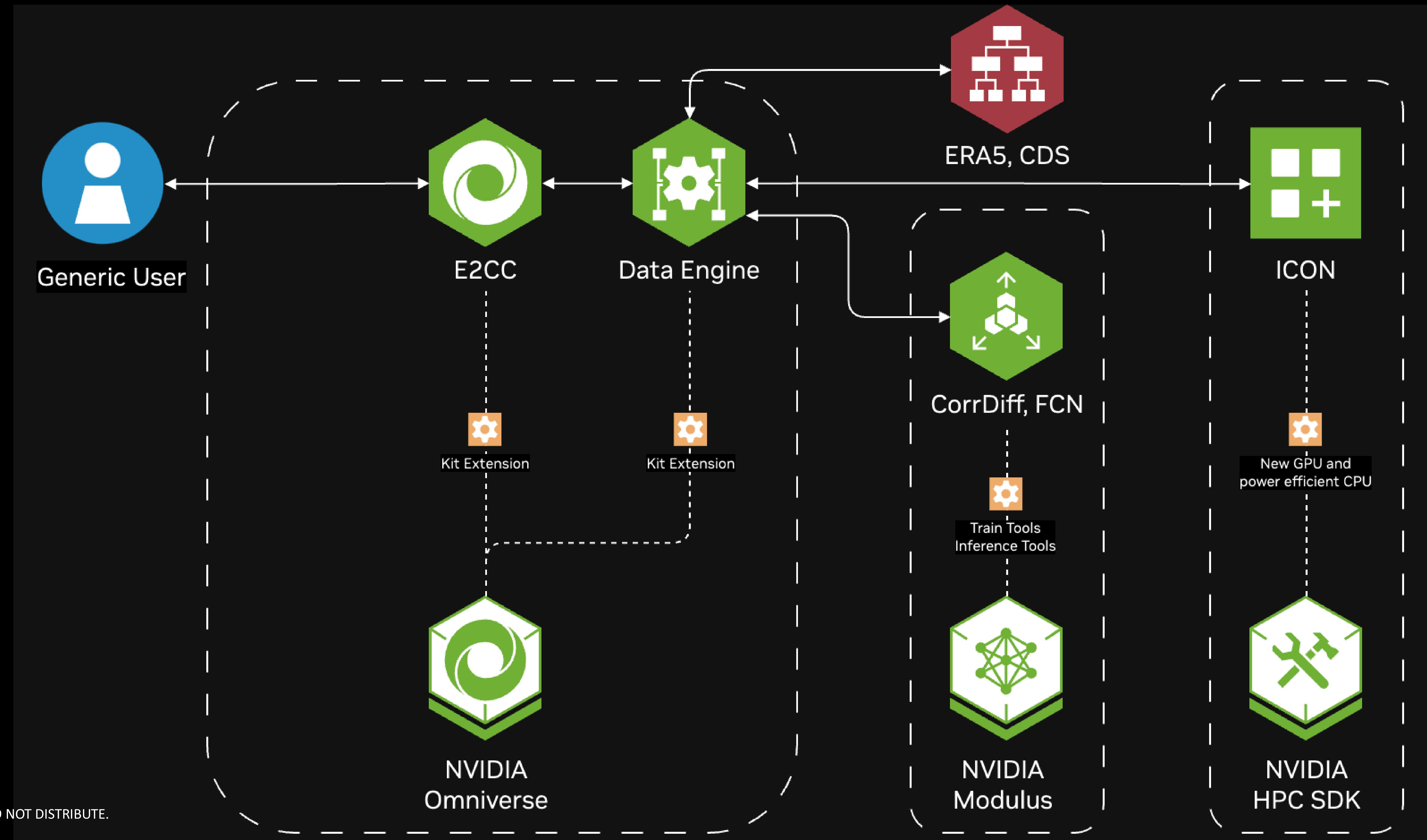
Computex 2024-June

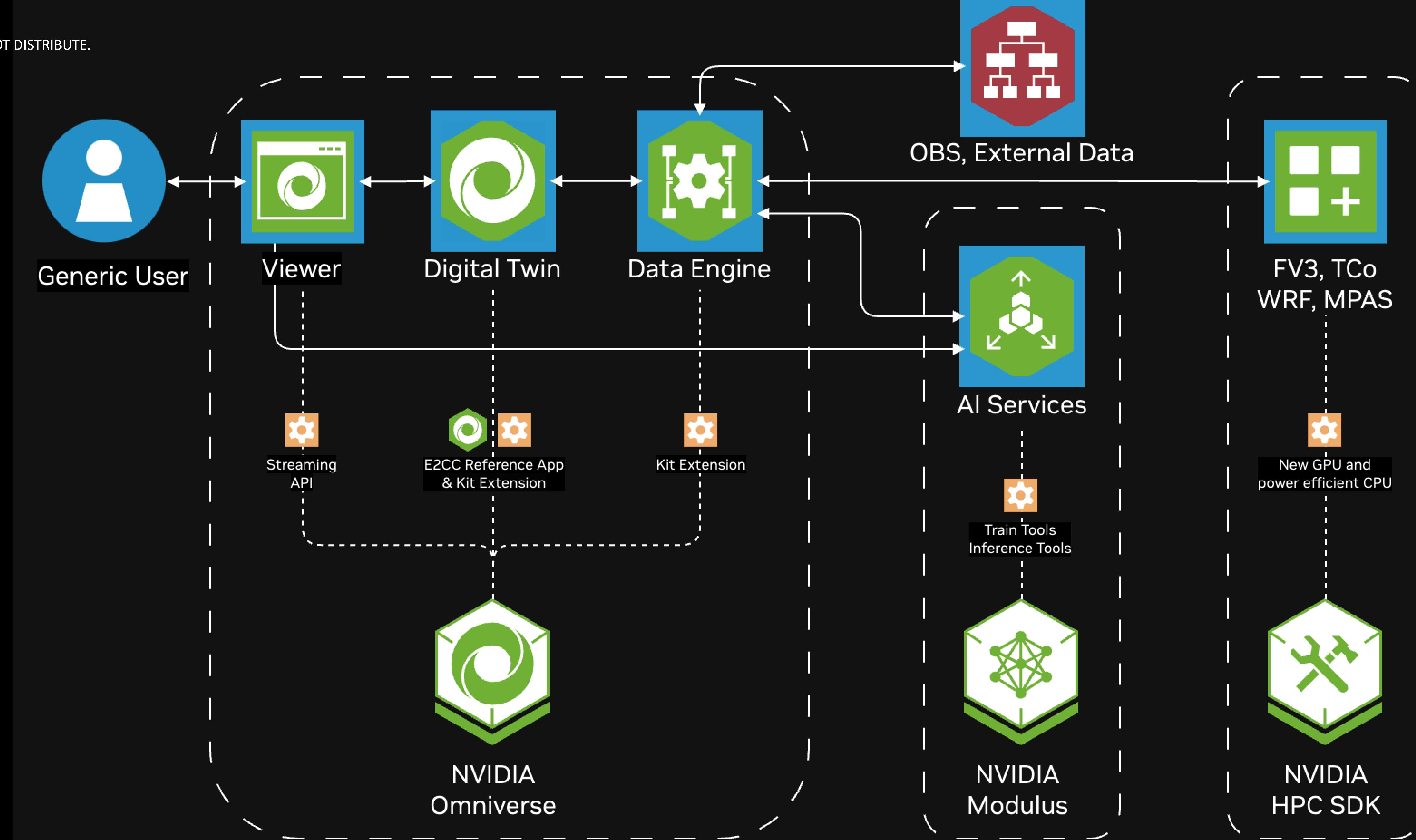
Earth-2 Goes Down to Street Level with City-Scale Simulation

VISUALIZATION

Earth-2 Service Architecture

Architecture demonstrated at GTC 2024



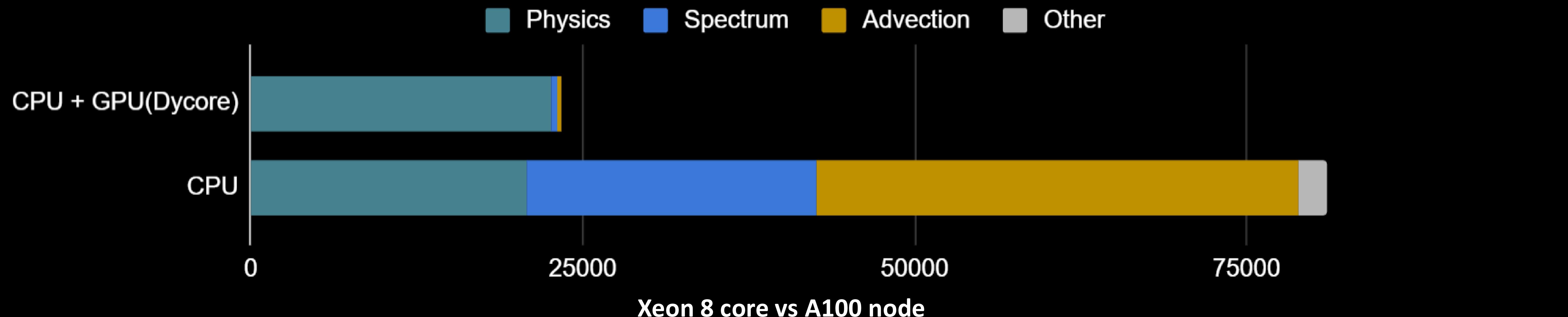


	DIGITAL TWIN	AI	HPC
Use Cases	Streaming digital twin to developers/ users Rendering videos by OVX render farm	DLWPs (CorrDiff, StormCast ... etc.) LLMs (TAIDE, NeMo ... etc.)	NWP (FV3, TCo, WRF, MPAS ...) Data Processing, Mesh Generation, Verification ...etc.
Personas	Front-end Engineer, Omniverse Engineer, Data Engineer	Data Scientist	Domain Scientist, Engineers
Comments	Recommendation: Virtual Machines with vGPU (vWS) - Workstation with RTX6000Ada - Server with L40S	CorrDiff A100 Ref Sizing - Inference: few seconds on 1 * A100 - Training: 7 Days on 128 * A100s	Status of Co-projects - [GPU - A100] TCo Dycore > 108X (node by node) - [CPU - Grace] WRF >12X (node by node)

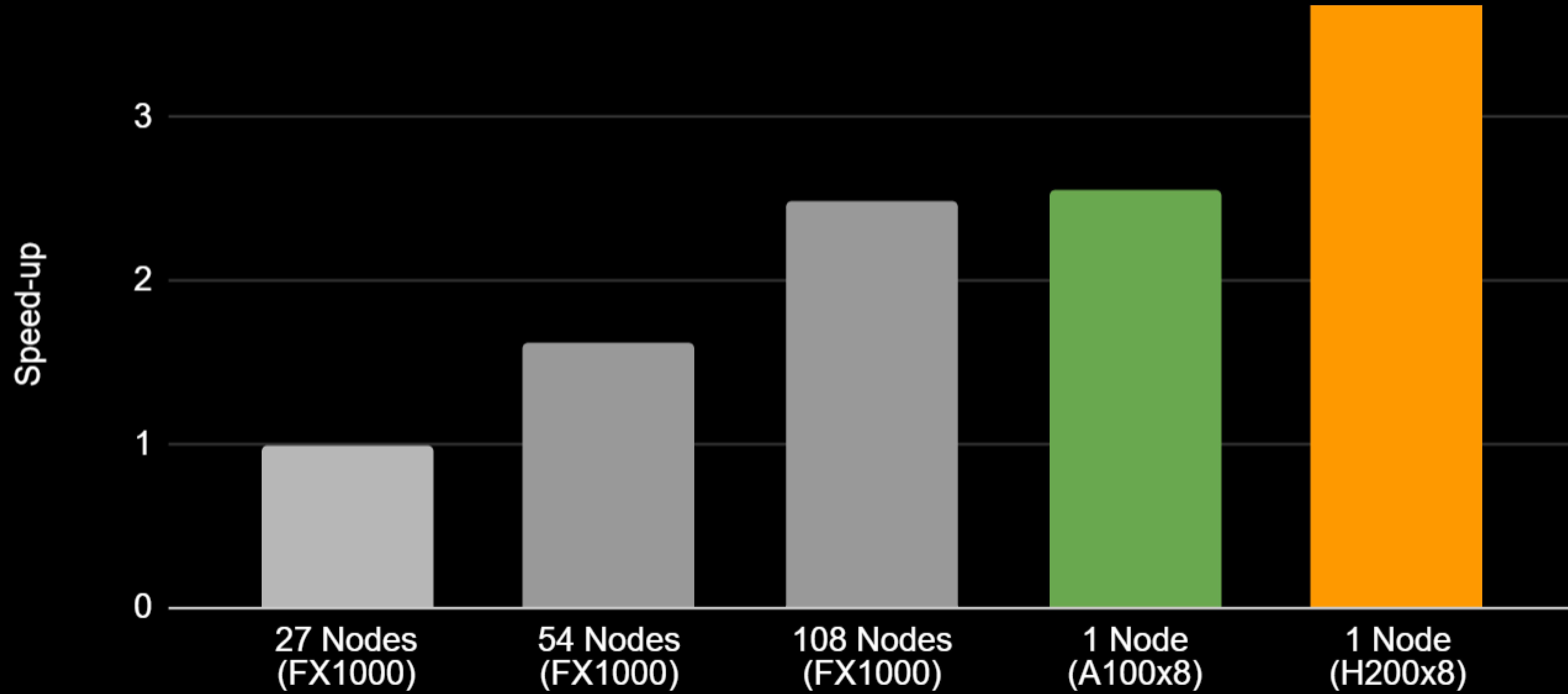
Current Status of TCo

- **Dynamic Core (Dycore):**
 - The Dycore, which includes **advection** and **spectrum** operations, has been successfully **optimized** by porting its subroutines to **GPU**.
- **Physics Parameterization:**
 - Targeted optimizations for this component could bring similar performance improvements as seen with the dynamic core.

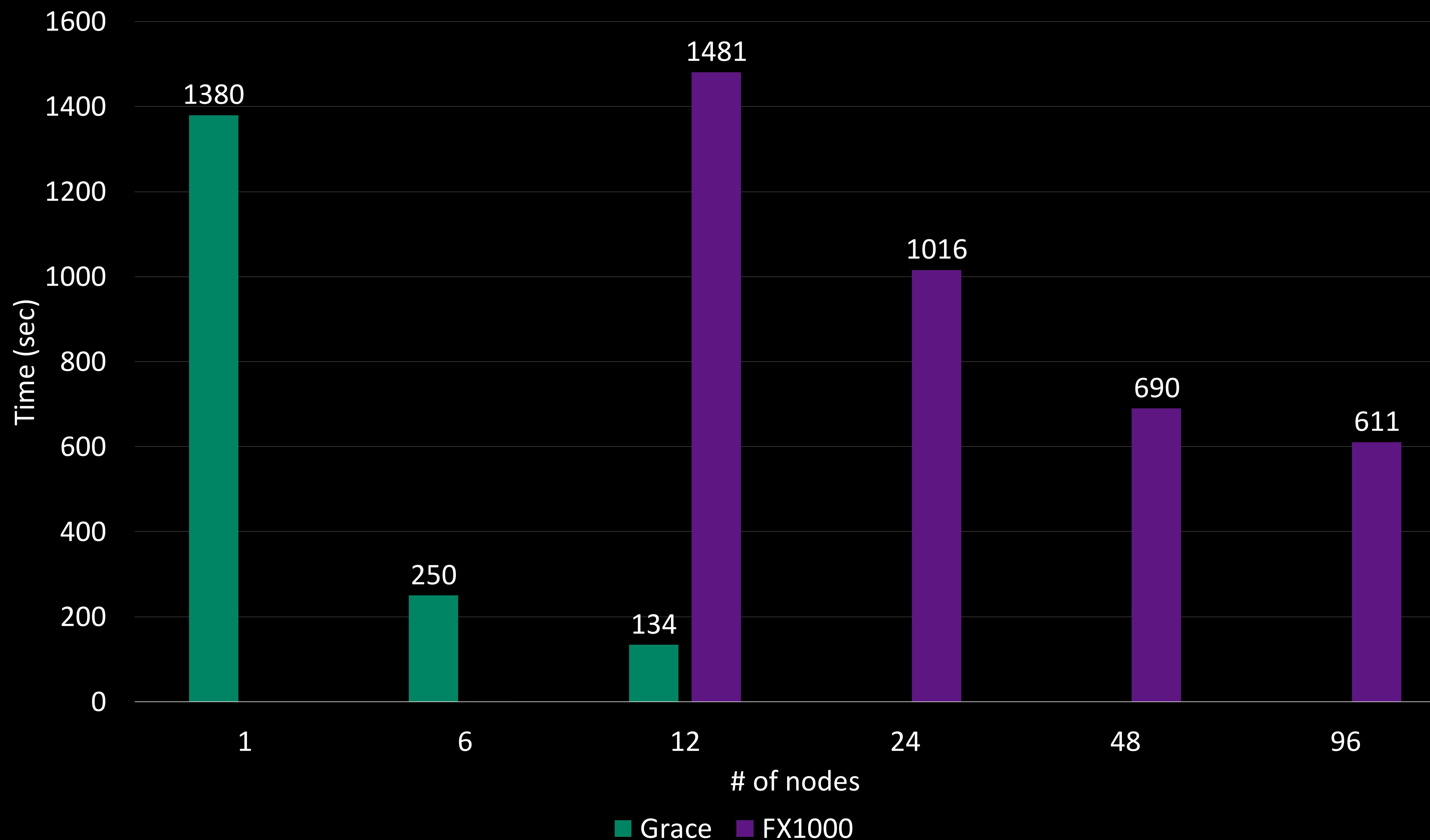
TCo383 Benchmark



CPU vs GPU for TCo639 Dycore



WRF with Grace vs FX1000



Summary

WRF (CPU)

6X+

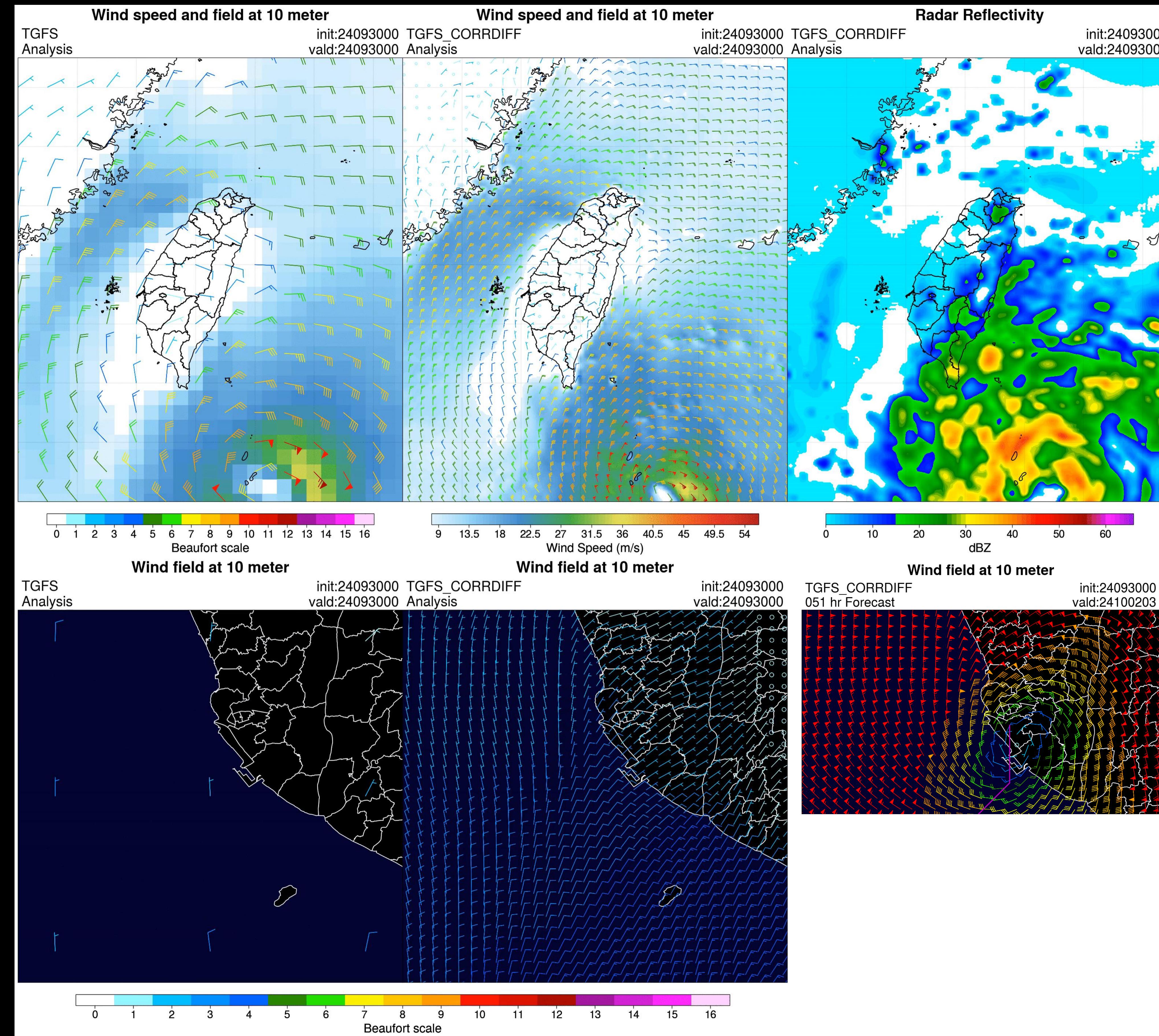
Socket-by-Socket
Grace vs A64FX

TCo (GPU)

108X+

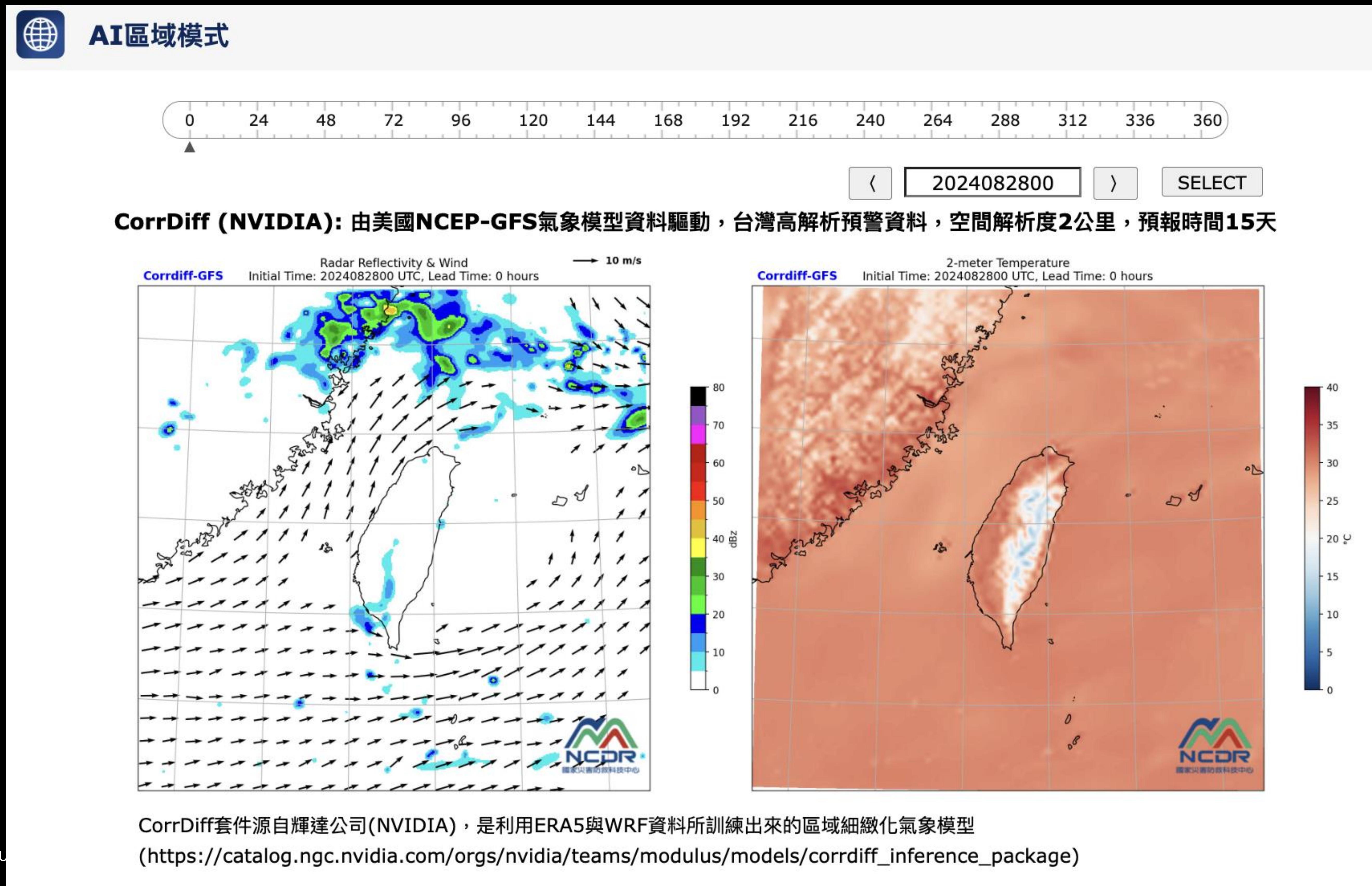
Dycore, Node-by-Node
A100 vs A64FX

CorrDiff as a Potential Downscale Tools



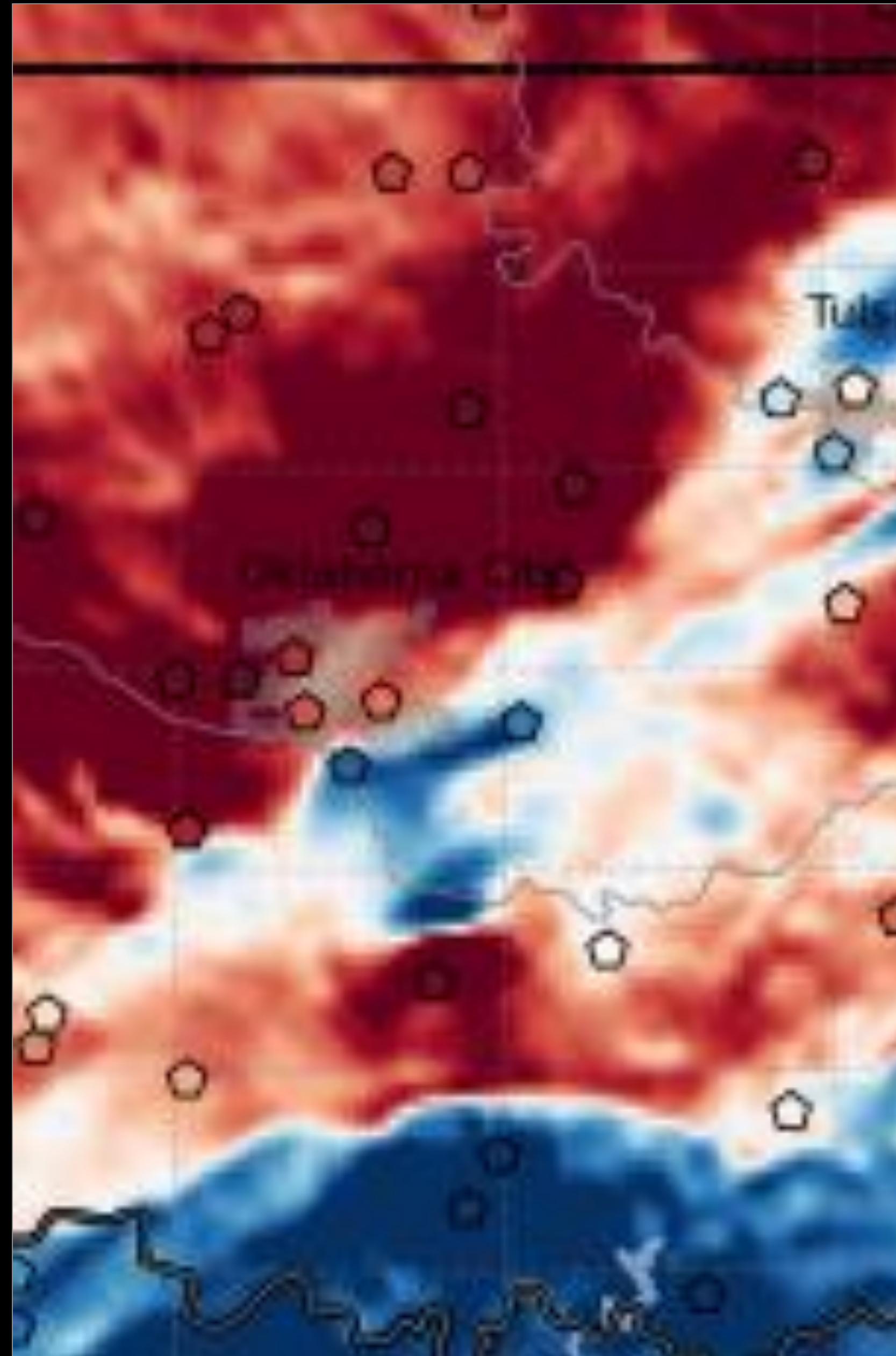
Aug 2024 - NCDR deploys CorrDiff on TWCC

Key Developers 江宙君, 朱容練, 于宜強 (NCDR) supported by Jay Chen (NVIDIA)
https://watch.ncdr.nat.gov.tw/watch_page_corrdiff



The Latest Progress from NVIDIA Earth-2 Research Team

New techs will soon on Modulus and Earth2Studio.



Stochastic Data Assimilation (SDA)

19 Jun 2024

<https://arxiv.org/abs/2406.16947>

Oxford, NVIDIA



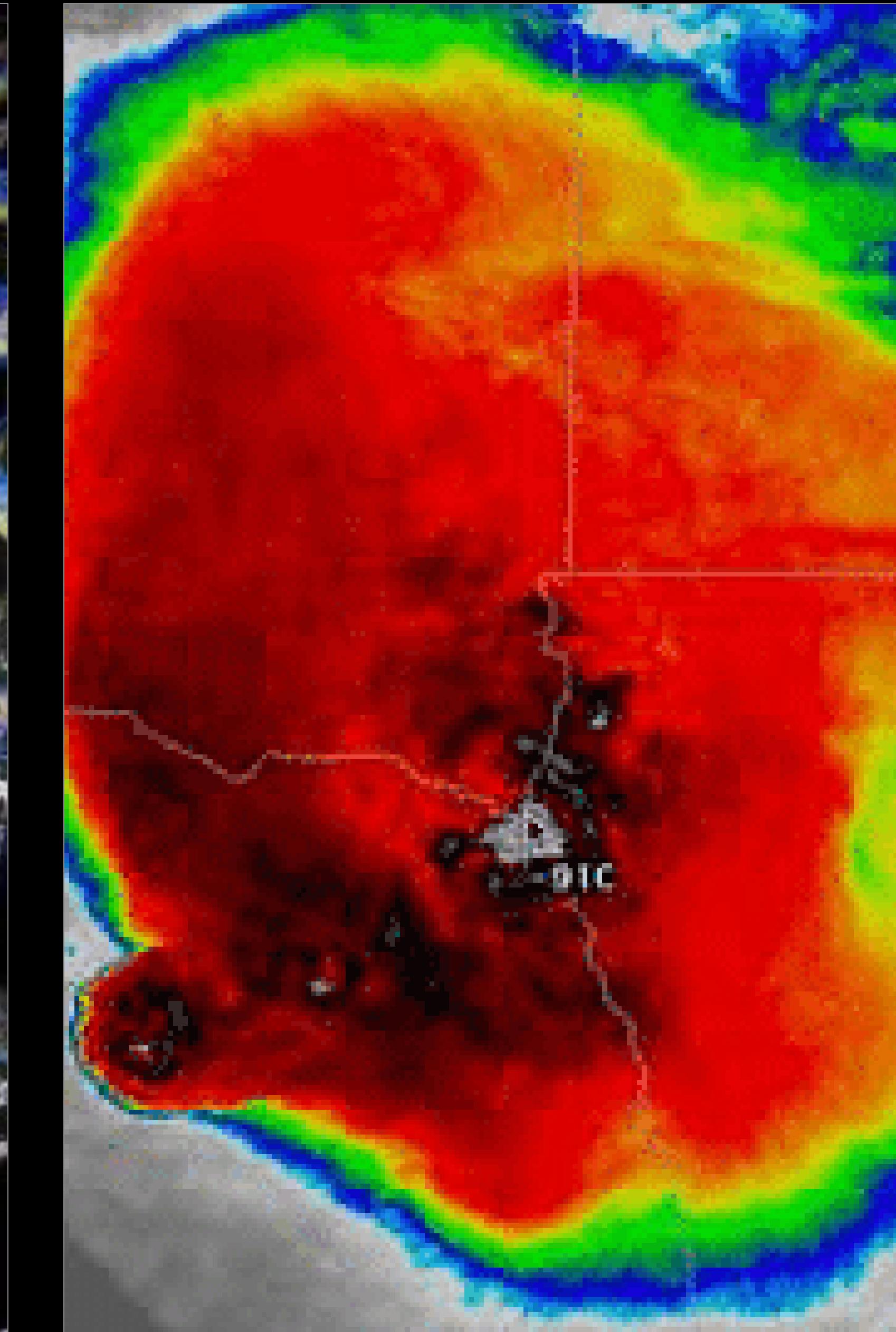
Huge Ensembles (HENS)

6 Aug 2024

<https://arxiv.org/pdf/2408.03100>

<https://arxiv.org/abs/2408.01581>

LBNL, Berkeley, NVIDIA

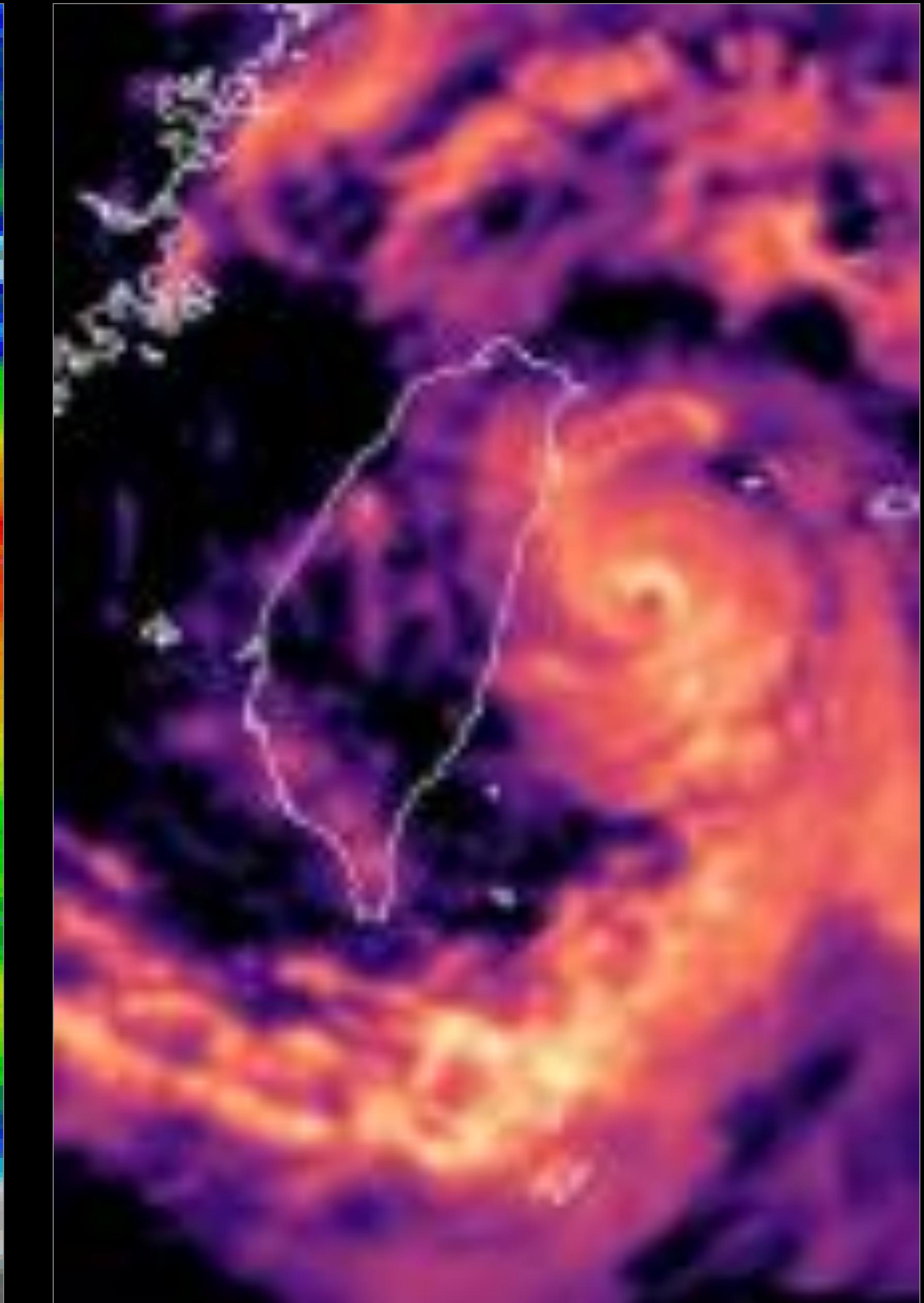


StormCast

19 Aug 2024

<https://arxiv.org/html/2408.10958v1>

NVIDIA, LBNL, Washington



Stochastic Flow Matching (SFM)

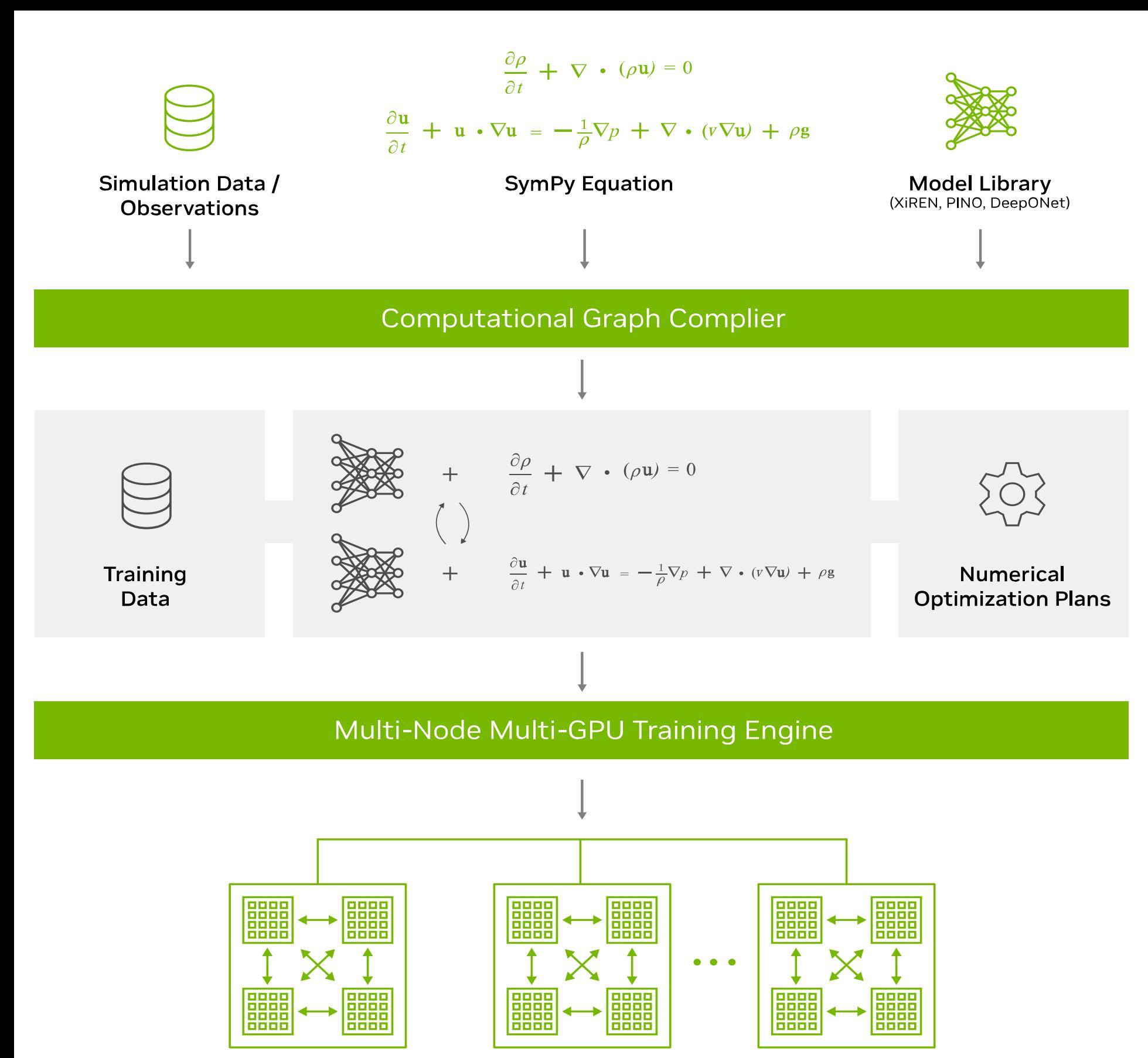
28 Sept 2024

<https://openreview.net/pdf?id=HZxJfzs3w6>

UCI, NVIDIA

NVIDIA Earth-2 AI Tools

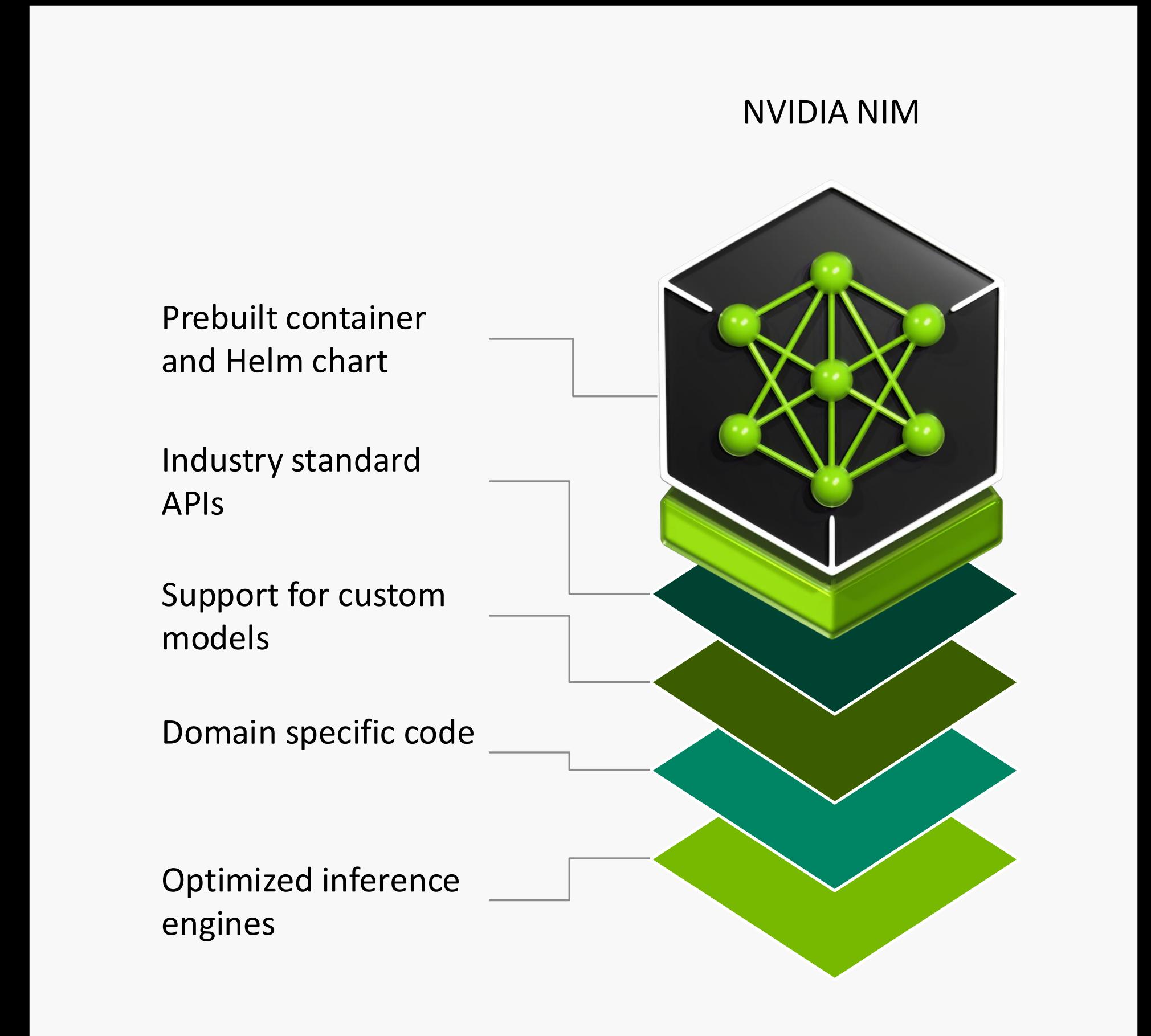
Modulus & Earth2Studio & NIMs



Modulus - Training
<https://github.com/NVIDIA/modulus>



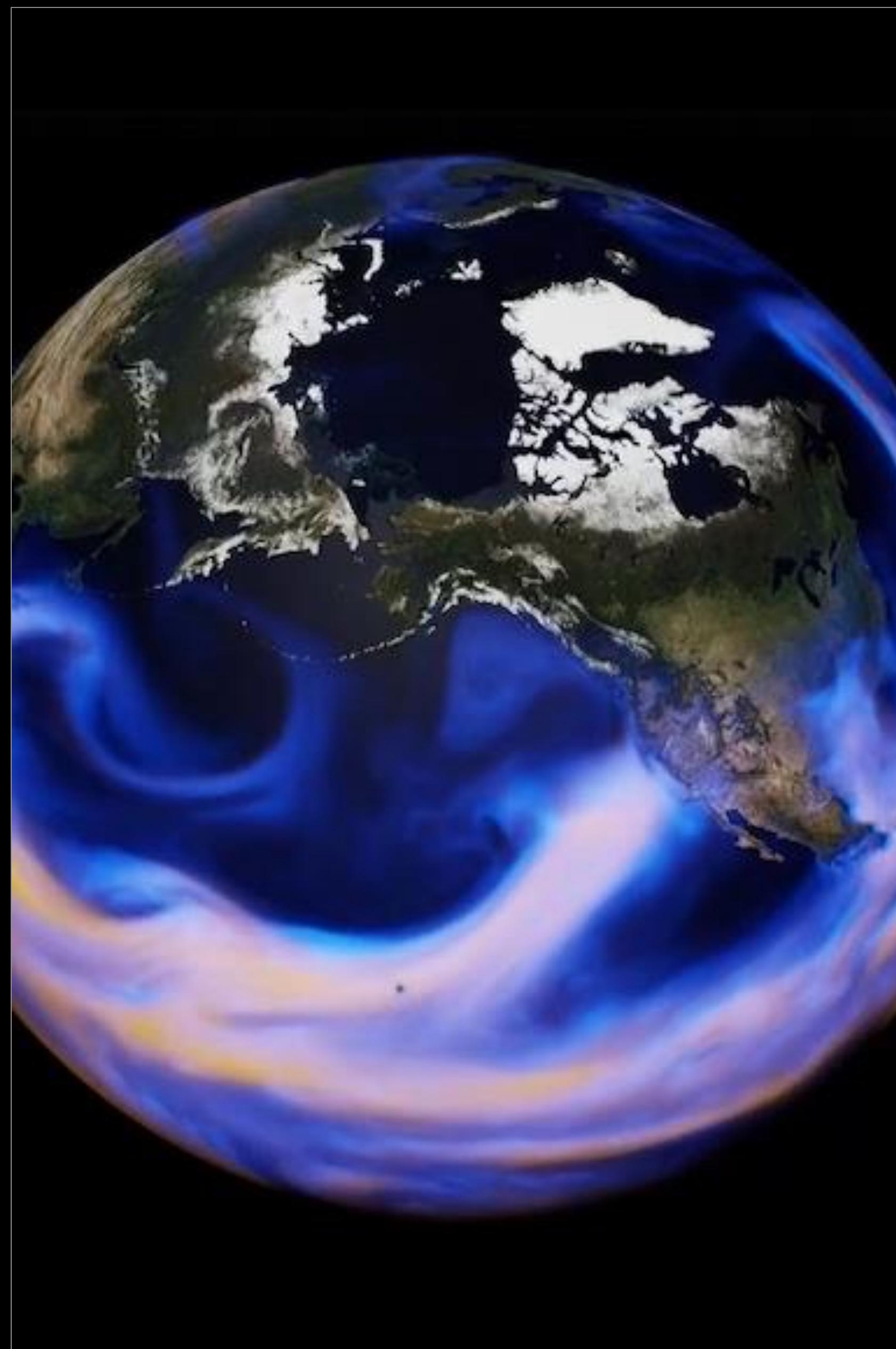
Earth2Studio - Exploration
<https://github.com/NVIDIA/earth2studio>



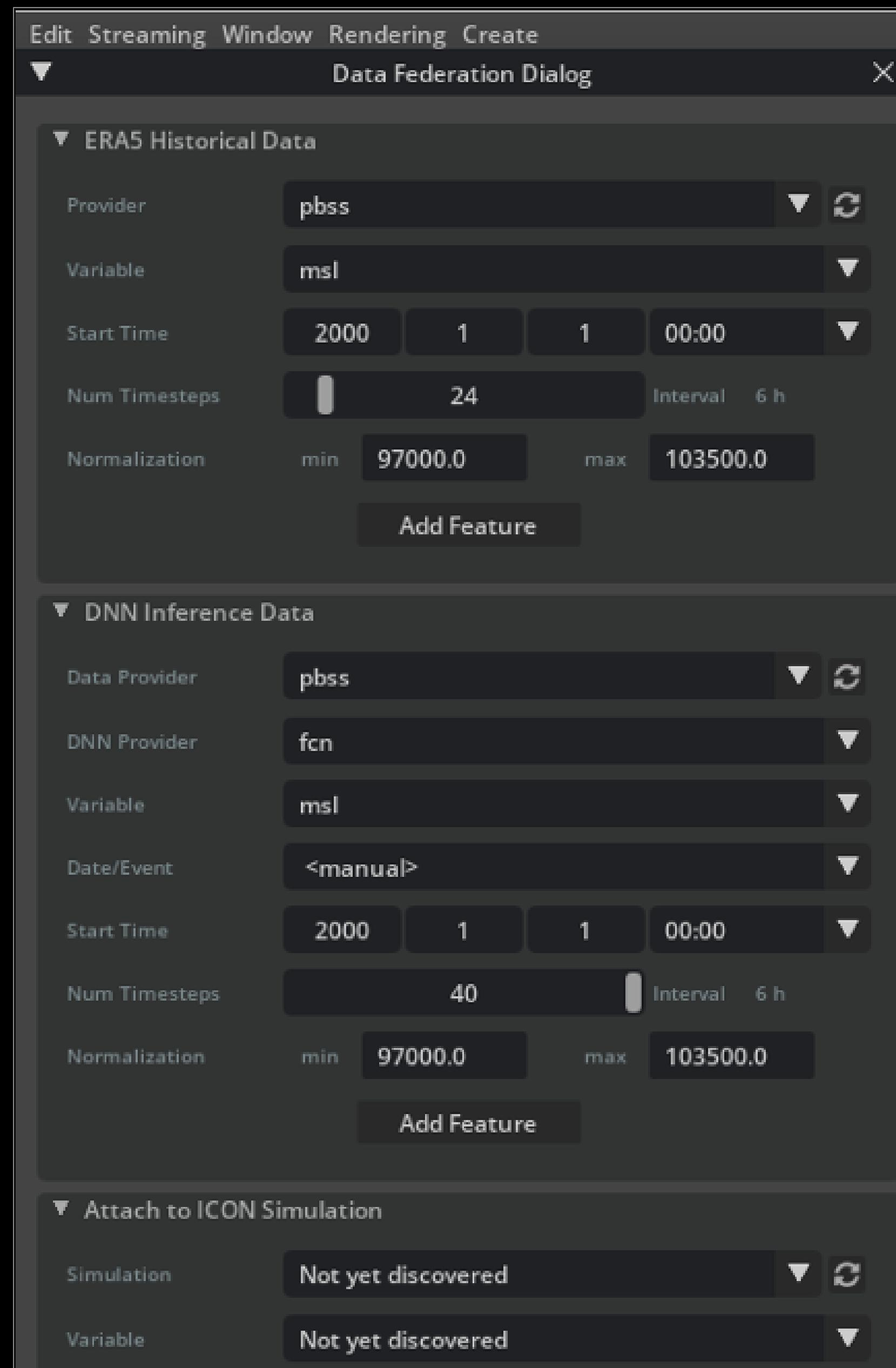
NIMs – Services
<https://build.nvidia.com/nvidia/ai-weather-forecasting>

CWA Earth-2 Visualization

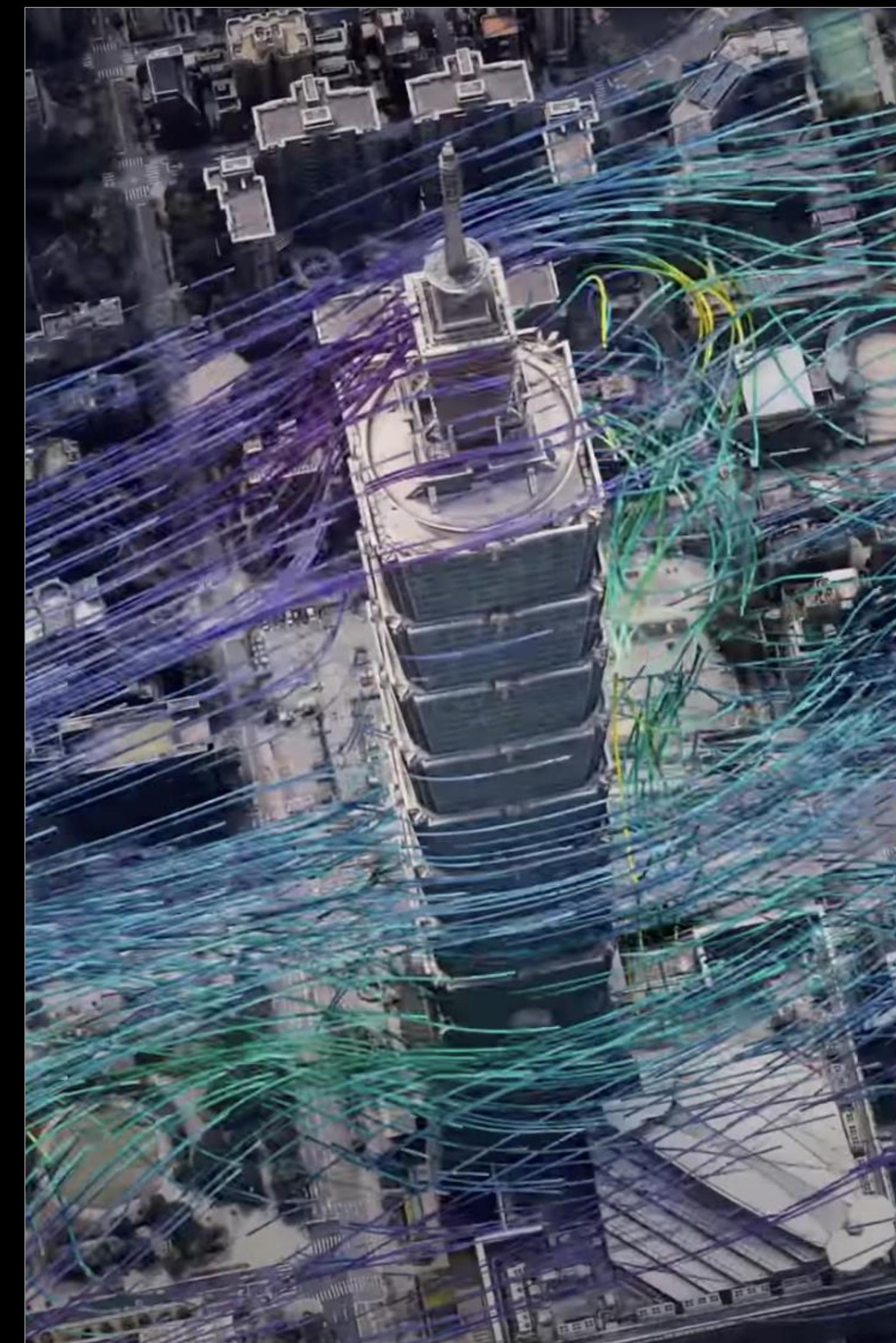
Recommended Stages



Visualizing Processed Image
Stage 1



Visualizing Multi-data Sources
Stage 2



Visualizing 3D and GIS Data
Stage 3

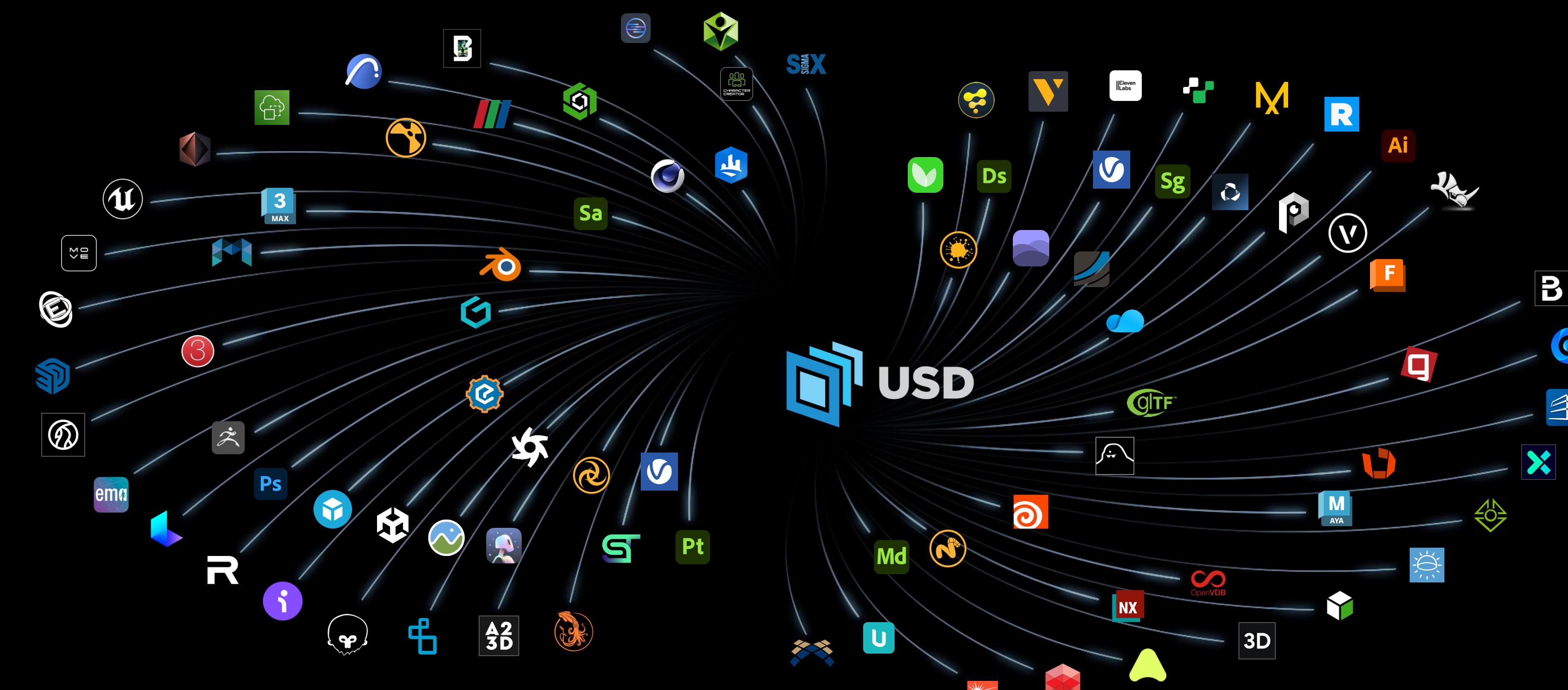


Connecting to Open Data
& DLWP APIs
Stage 4

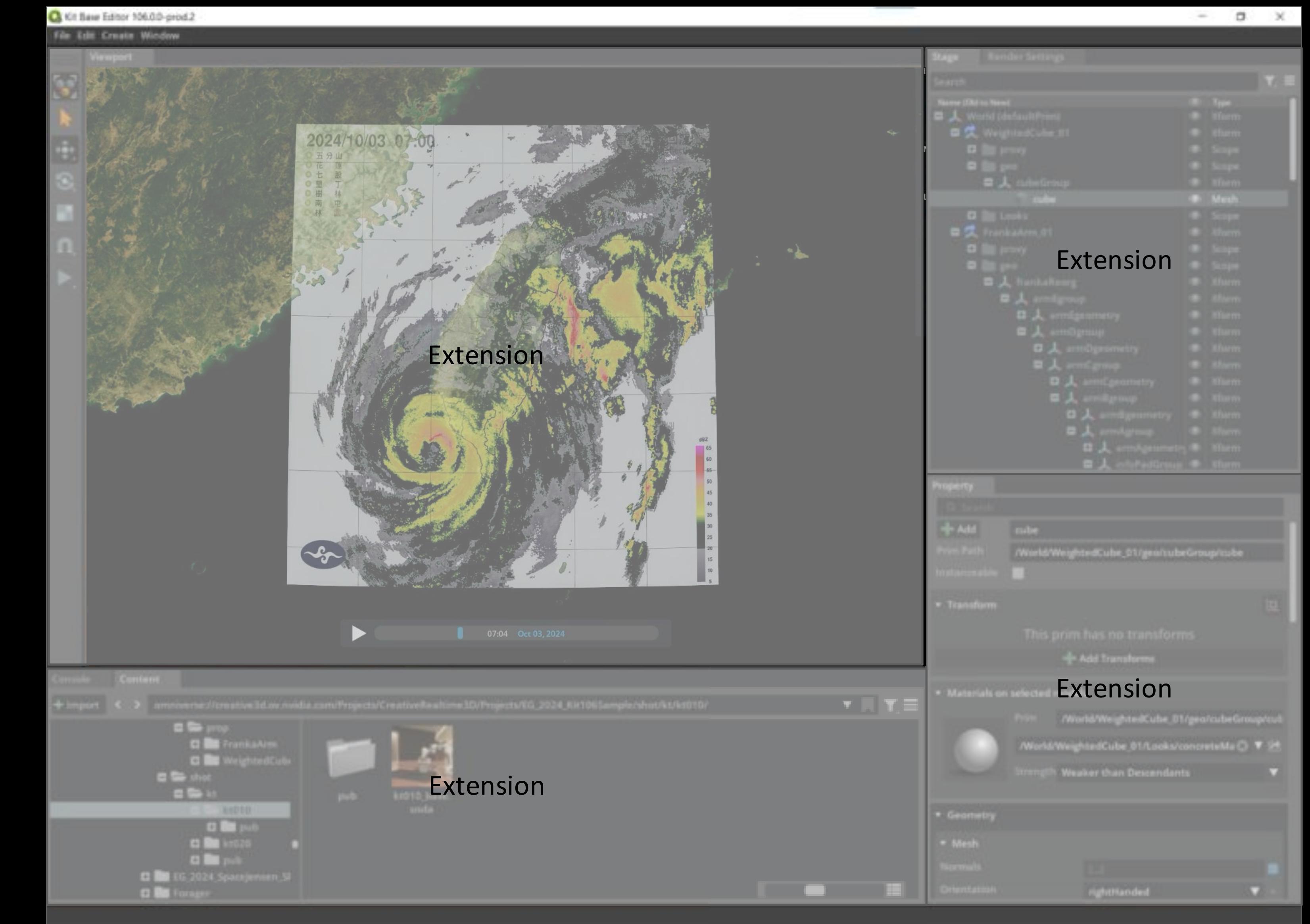
Static Digital Twin

Dynamic Digital Twin

Why NVIDIA Omniverse



OpenUSD Ecosystem Momentum



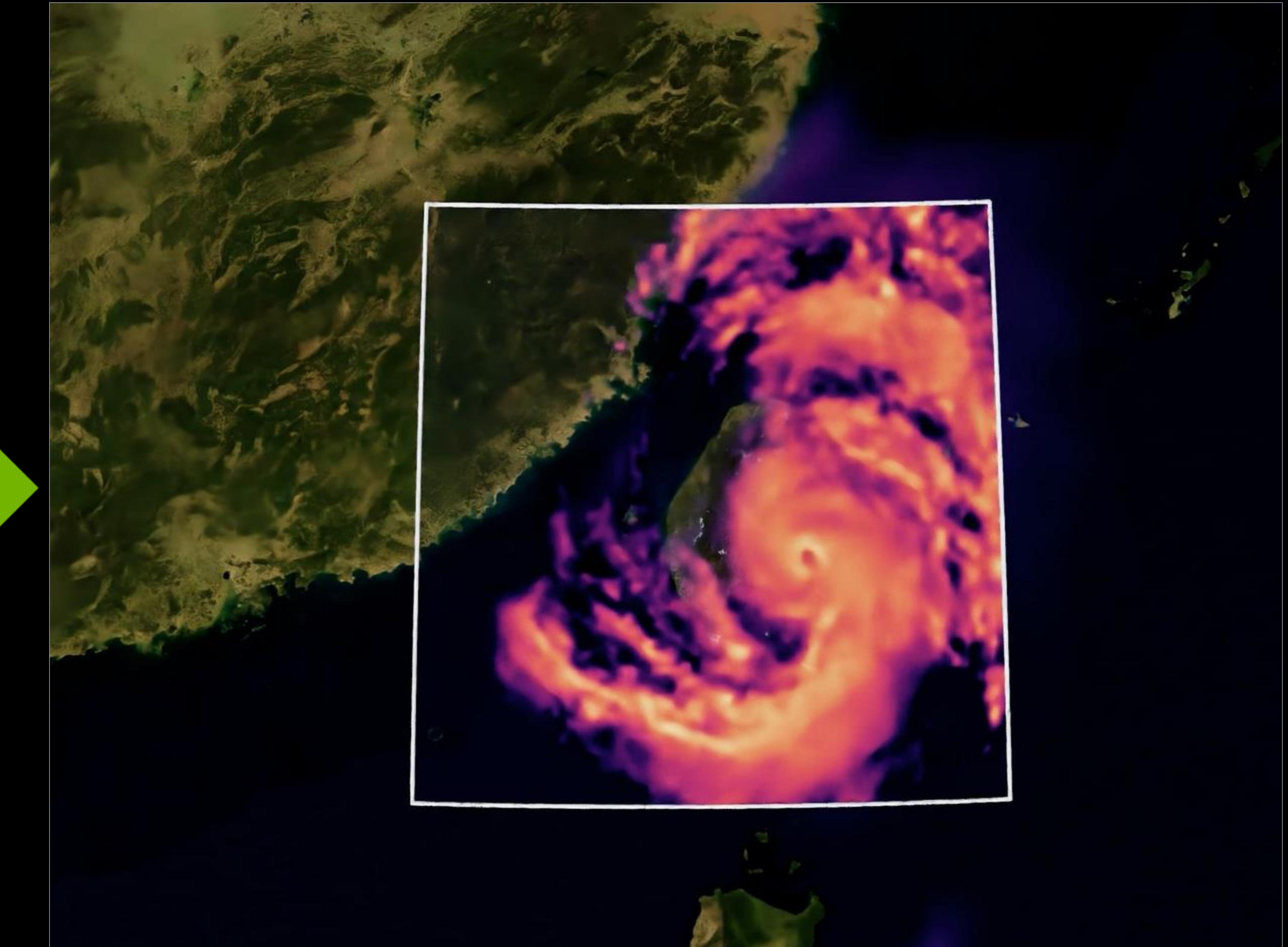
Scalability & Extensibility

Stage 1: Visualizing Processed Image

How CorrDiff was visualized by E2CC in GTC 24

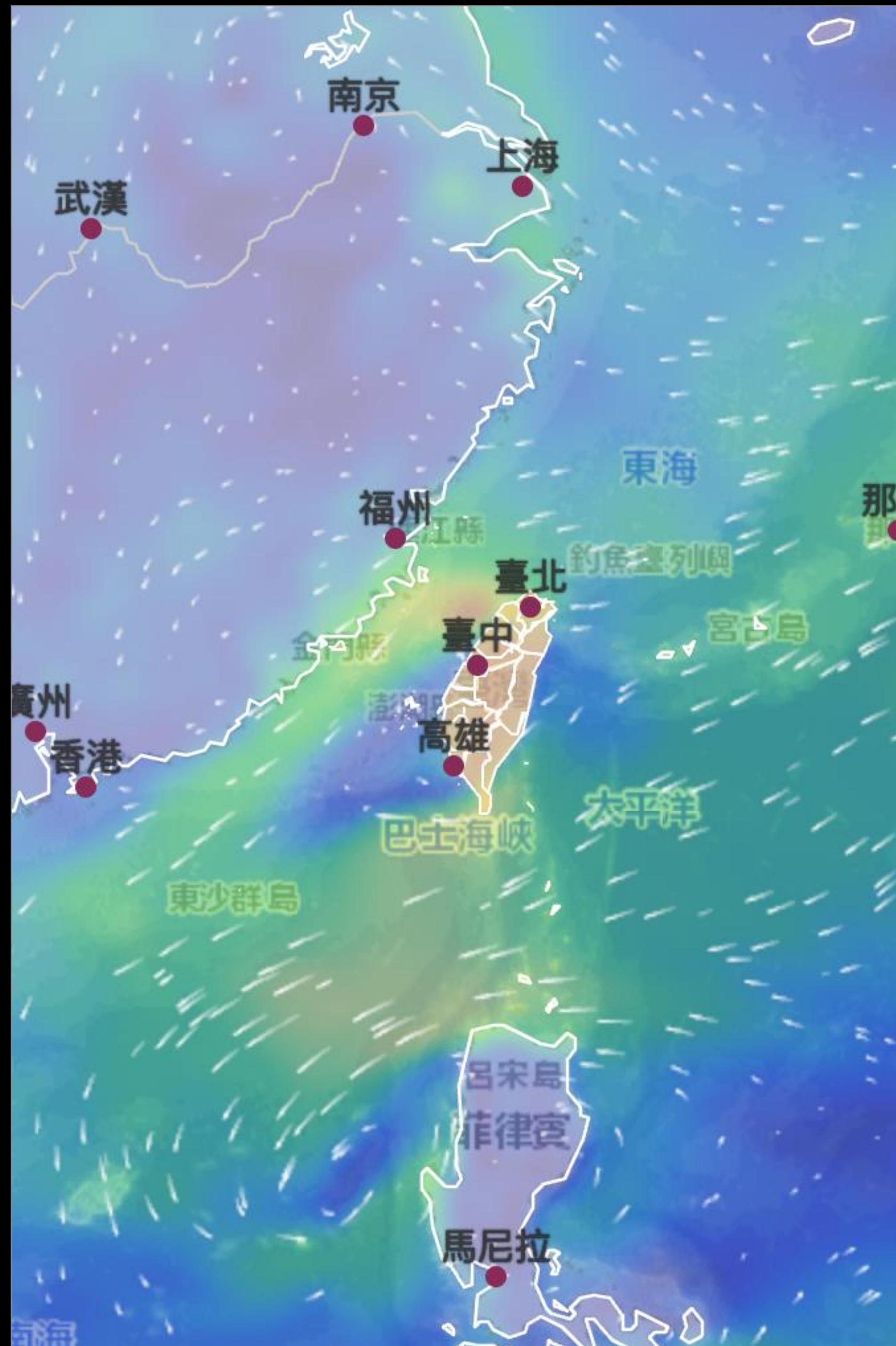


Earth-2 Command Center (E2CC)

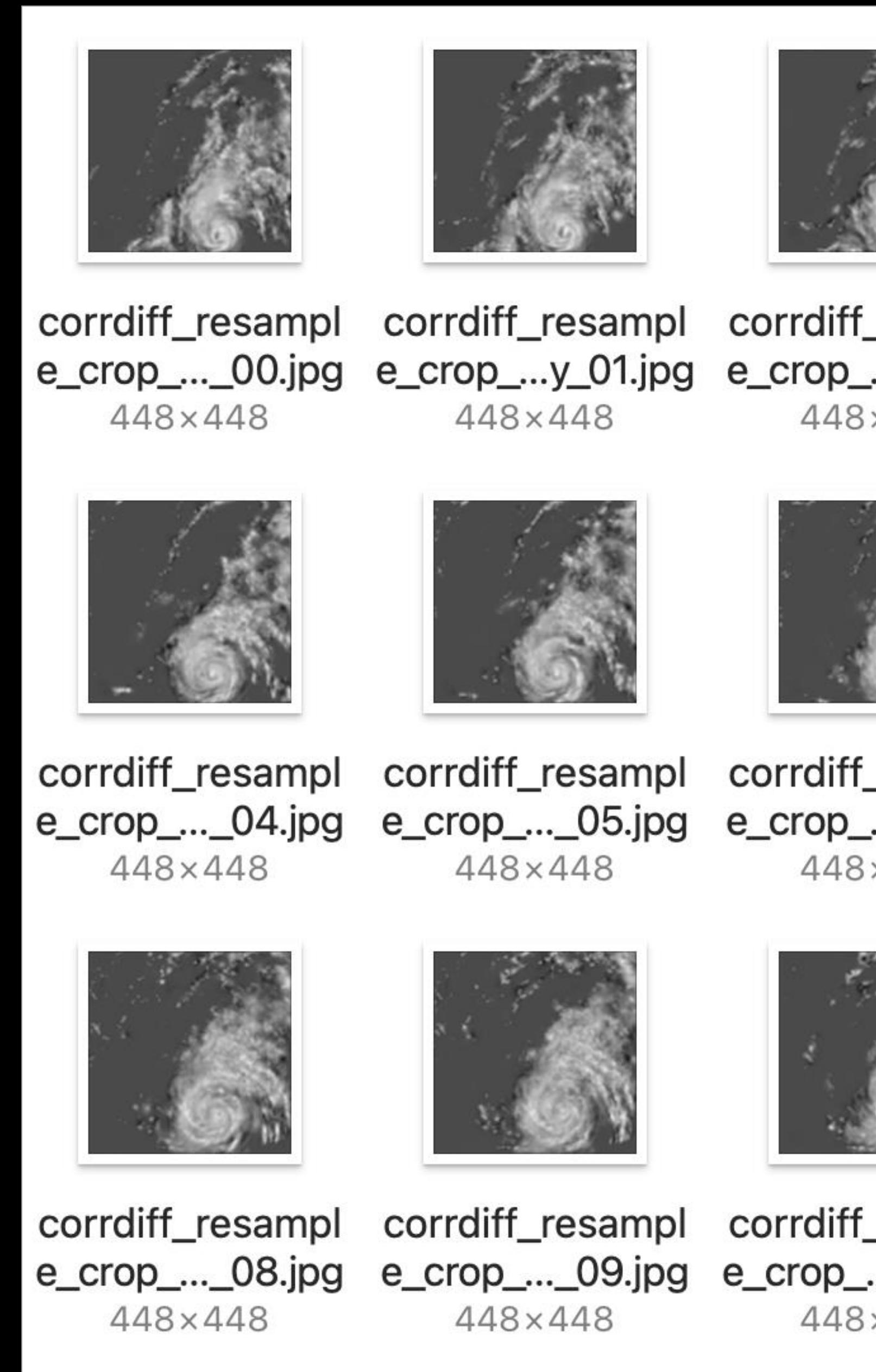


Stage 1: Visualizing Processed Image

How does it work?



Collect global NWP data
Step 1



Downscaled by CorrDiff
Save in JPG format
Step 2

```
def add_corr_diff_callback(ext):
    base_url = carb.settings.get_settings().get_as_string("path_pattern")
    path_pattern = base_url + '/corrdiff_test_001/corrdiff'

    # Create Timestamped Sequence
    seq = TimestampedSequence()
    idx = ext.get_next_idx()

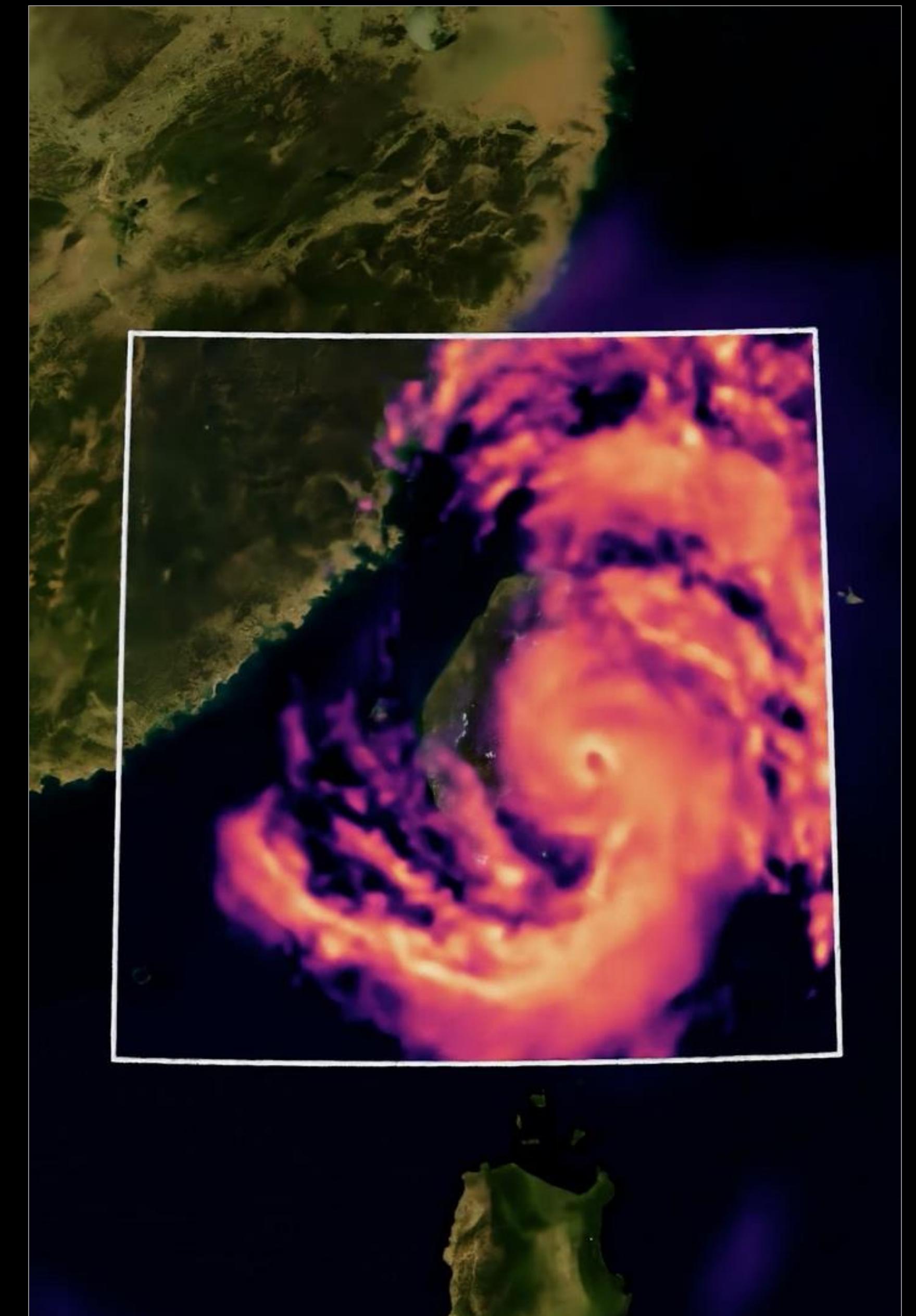
    # create a unique url for this sequence
    import uuid
    seq.target_url = f'dynamic://test_sequence_{uuid.uuid1()}/'

    import datetime
    start_time = datetime.datetime(year=1990, month=1, day=1)
    # NOTE: That's how the timestamps were stored
    raw = [277824, 277825, 277826, 277827, 277828, 277829, 277830]
    timestamps = [start_time+datetime.timedelta(hours=v) for v in raw]
    frame_skip = 1
    start_frame = 0
    end_frame = 38
    to_insert = []
    for i in range(start_frame, end_frame+1, frame_skip):
        cur_utc = timestamps[i]
        to_insert.append([cur_utc, path_pattern.format(frame=i)])
    seq.insert_multiple(to_insert)

    # create feature
    features_api = get_state().get_features_api()
    img = features_api.create_image_feature()
    img.sources = [seq.target_url]
    img.alpha_sources = img.sources

    from omni.earth_2.command_center.app.core.utils import *
    lon_min, lon_max = (116.3906250000000, 125.182250976562)
    lat_min, lat_max = (19.613136291503906, 27.8267860412597)
    affine_mapping = latlong_rect_to_affine_mapping(
        lon_min, lon_max, lat_min, lat_max,
        is_in_radians=False)
    img.affine = list(affine_mapping.flatten())[0:6]
```

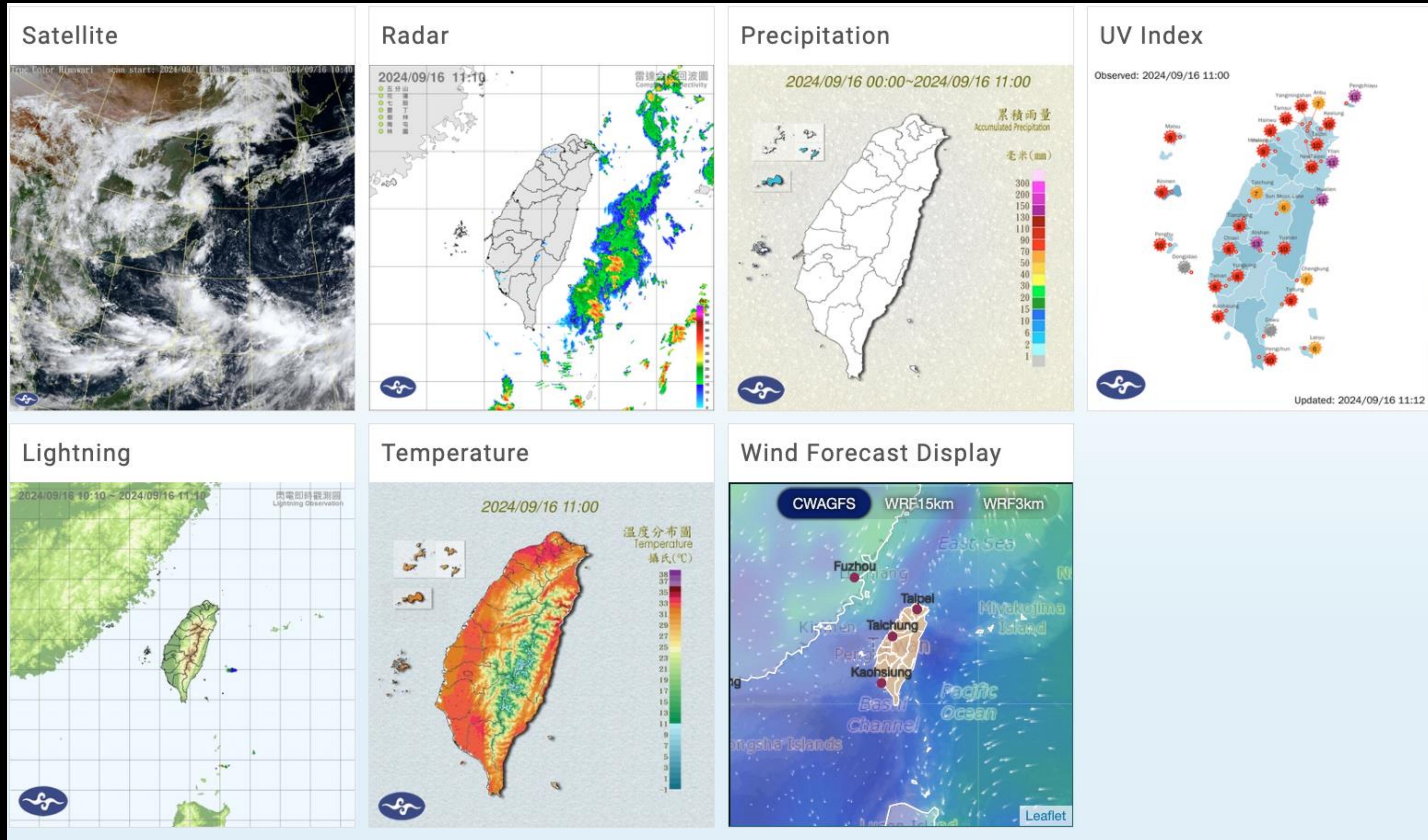
Load into E2CC
by a few lines of code
Step 3

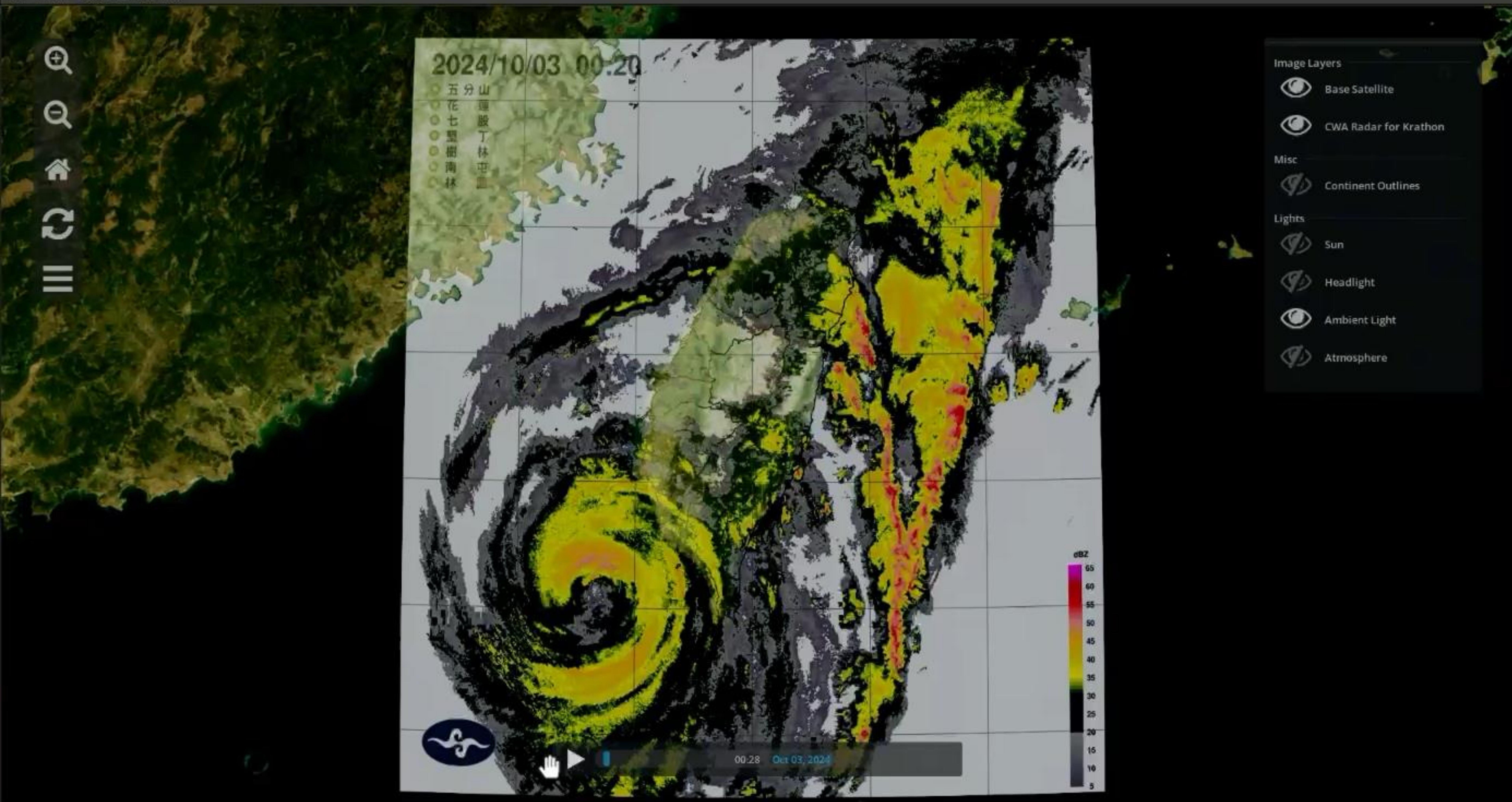


Show JPG data on E-2
Step 4

Stage 1: Visualizing Processed Image

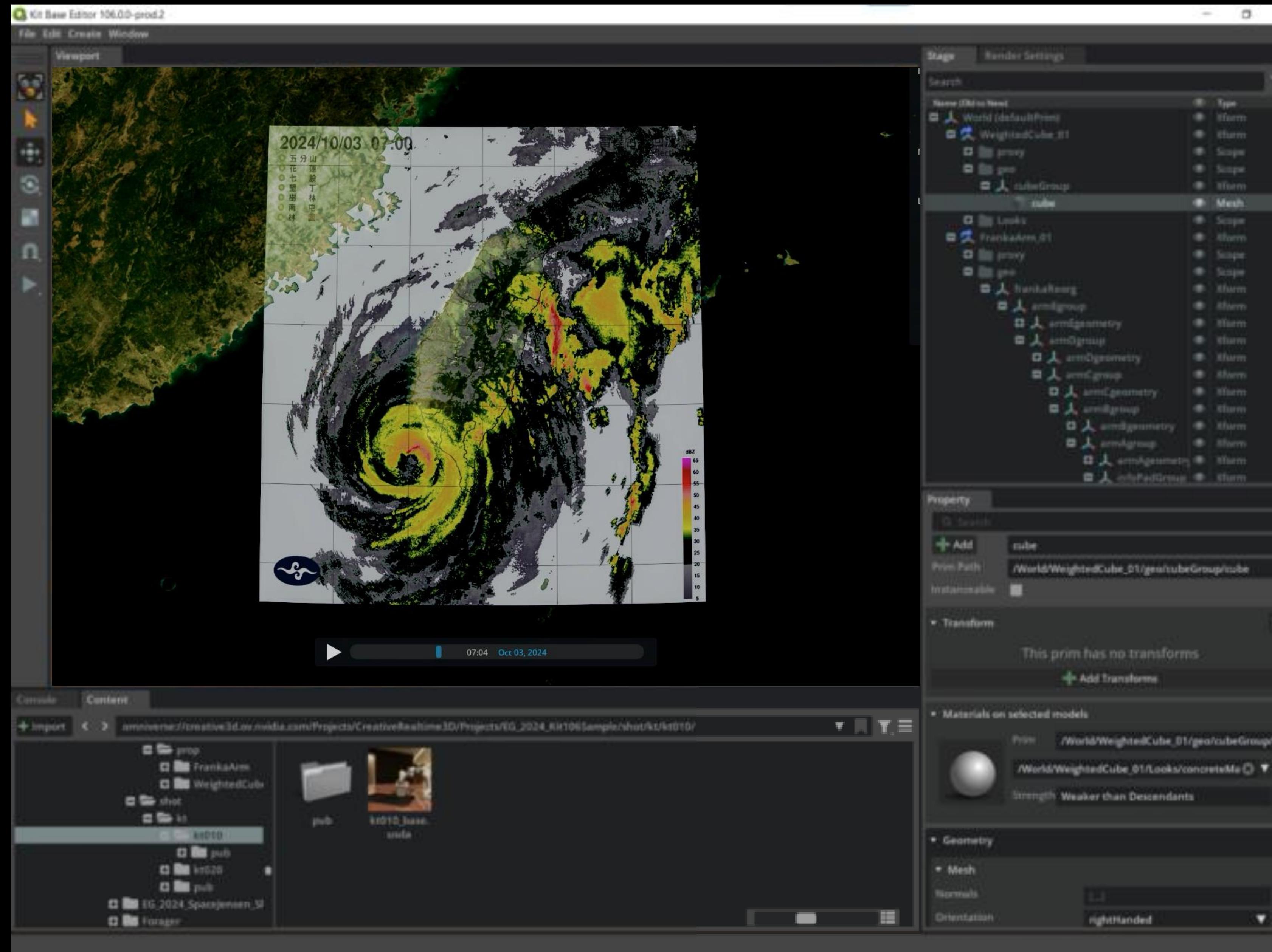
How to customize with CWA own dataset on E2CC?



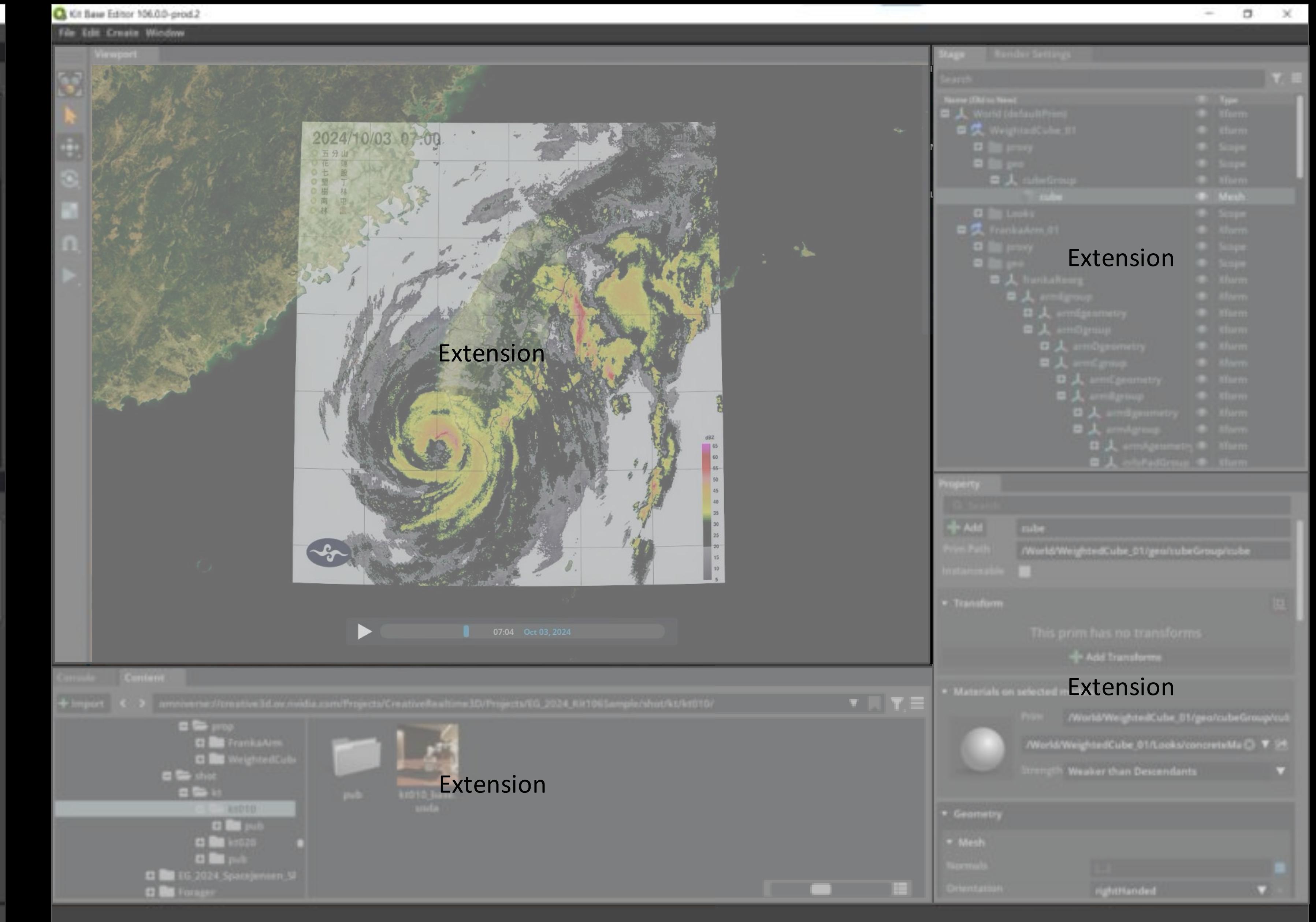


Omniverse Kit-Based Applications

Modular, Extensible Development



Omniverse Kit Base Editor
Launch-ready Sample Environment



Omniverse Kit Extensions
Applications Composed of Modular Extensions

A Concept DEMO: E2CC through OVAs



live broadcast at 1F lobby

Screenshot of the Central Weather Administration website (交通部中央氣象署) showing a weather forecast for Kaohsiung City (嘉義市) on October 8th. The forecast details are as follows:

时段	日期	时段	气温 (°C)	湿度 (%)
今晚明晨	10/08	18:00~06:00	24° - 28°	20%
明日白天		06:00~18:00	24° - 31°	20%
明日晚上		18:00~06:00	23° - 27°	20%

The website also features a map of Taiwan with various weather icons indicating different conditions across the island. A promotional banner for "Mountain Climbing Habit Survey" (登山習慣大調查) is visible on the right.

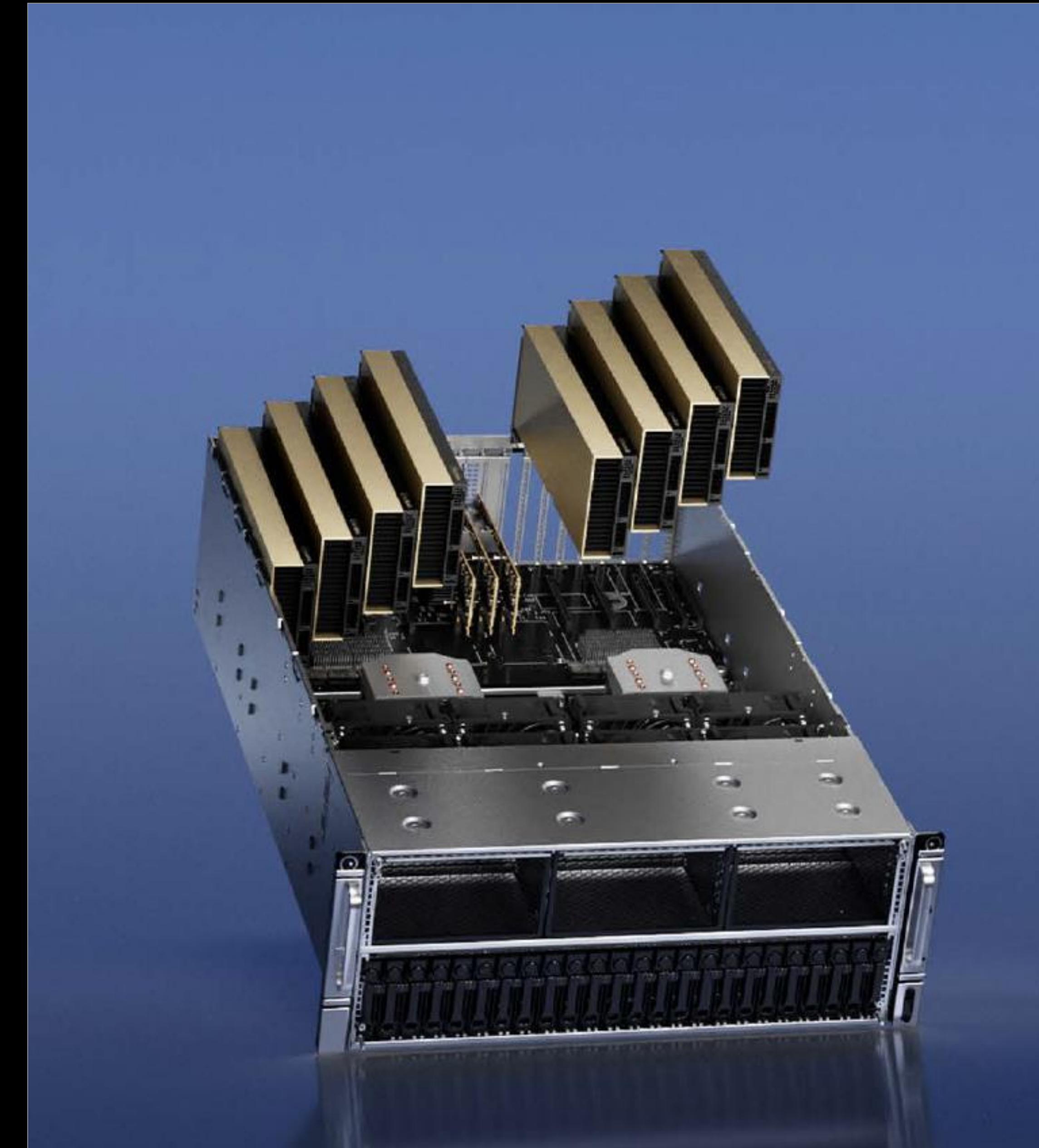
embeded in website

Omniverse Runs on NVIDIA RTX

NVIDIA-Certified Systems Optimized for Omniverse Workloads



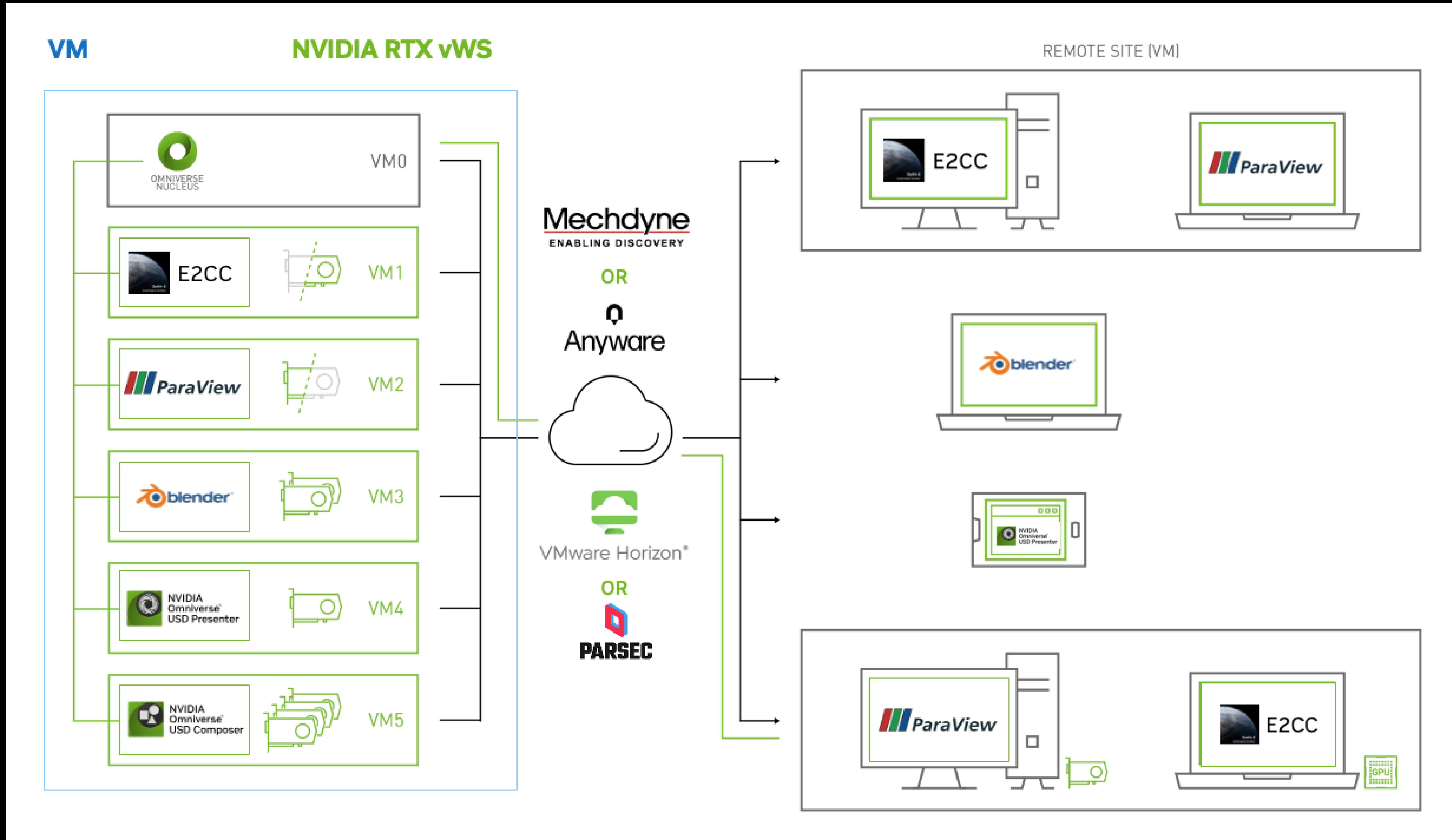
RTX 工作站
Desktop: RTX 6000 Ada



NVIDIA認證伺服器 (NCS)
L40S

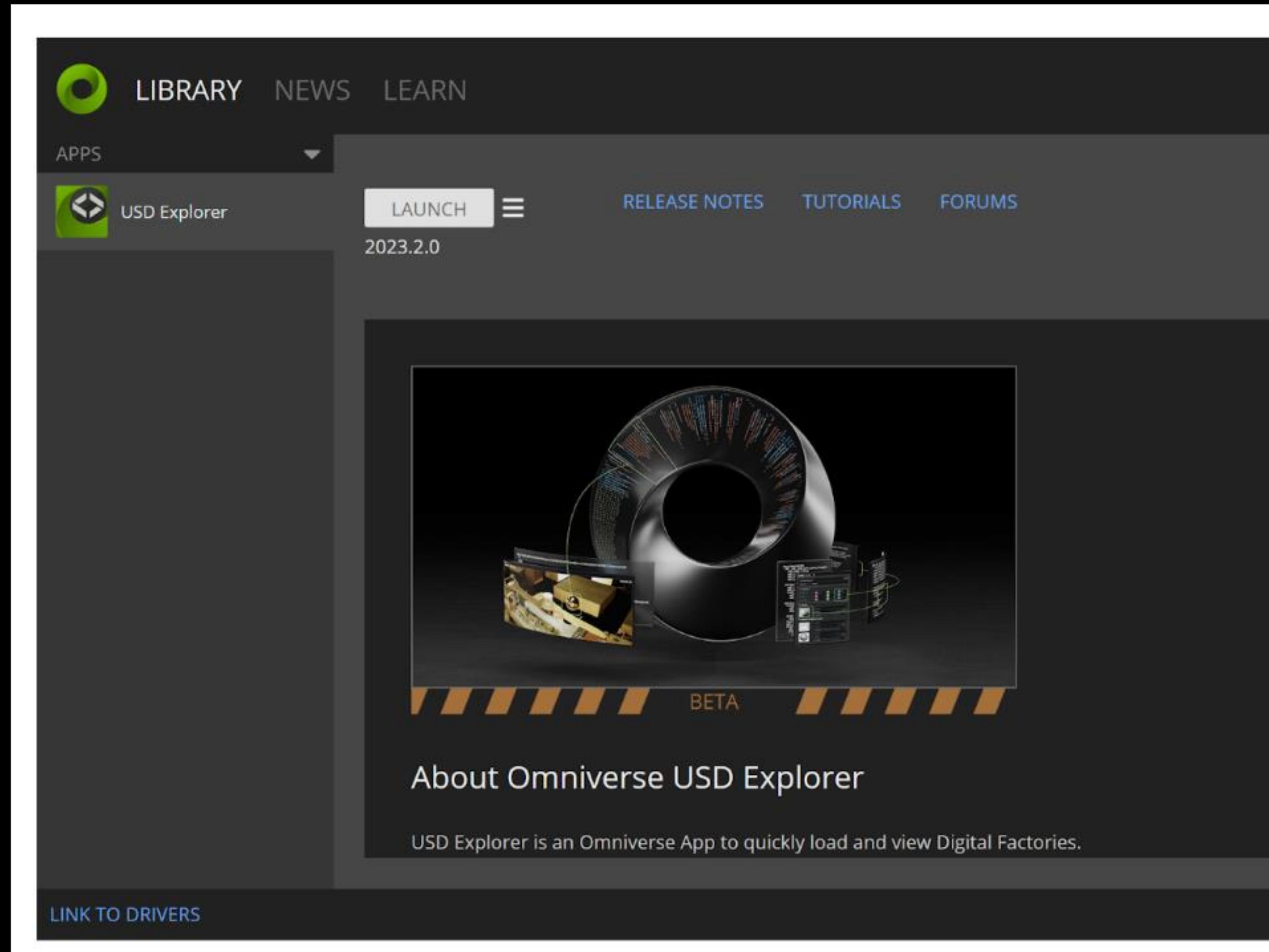
Reference Architecture

Virtualized Topology



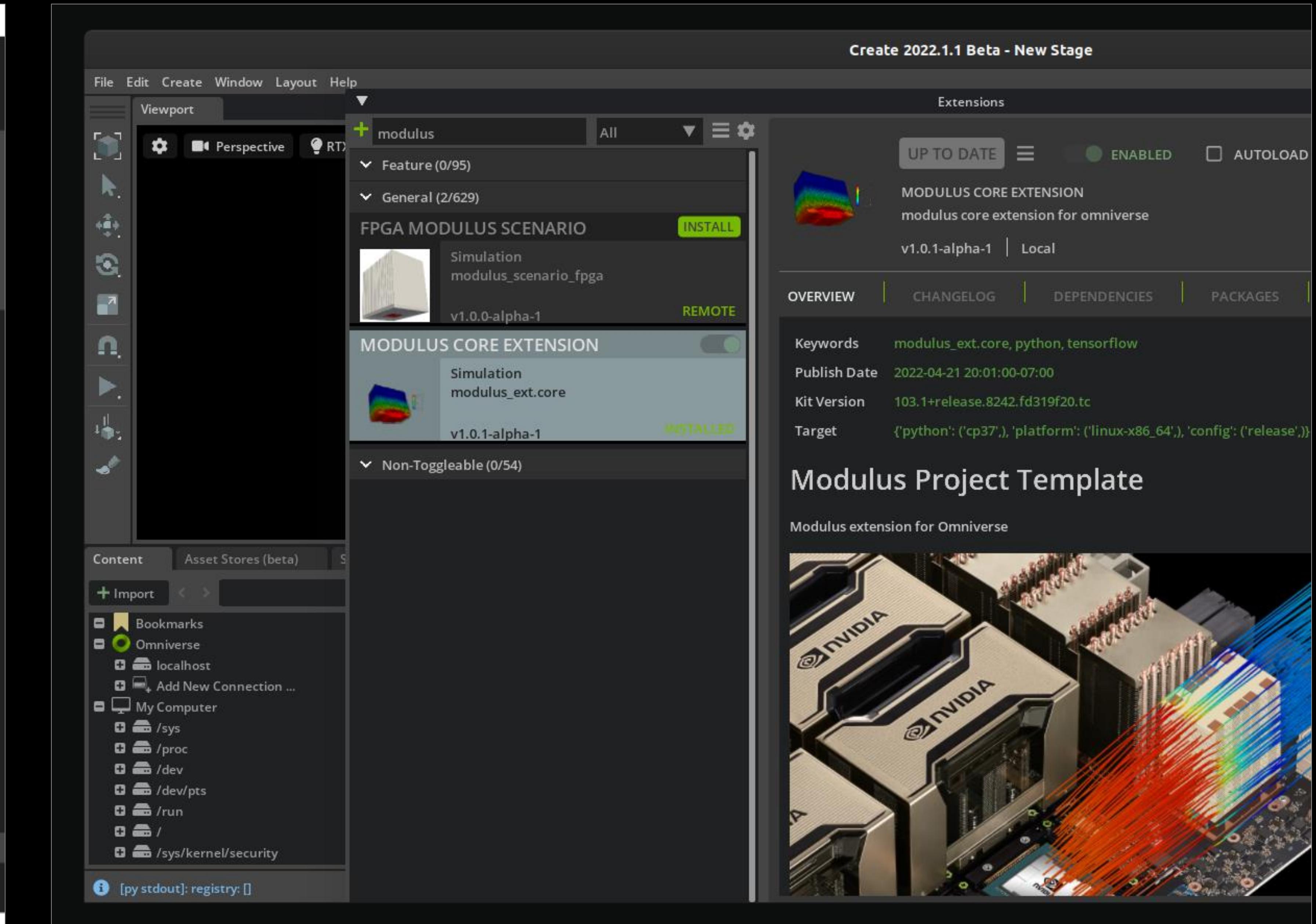
Omniverse Basics

Get started with the recommended courses



Developing an Omniverse Kit-Based Application (2 HR)

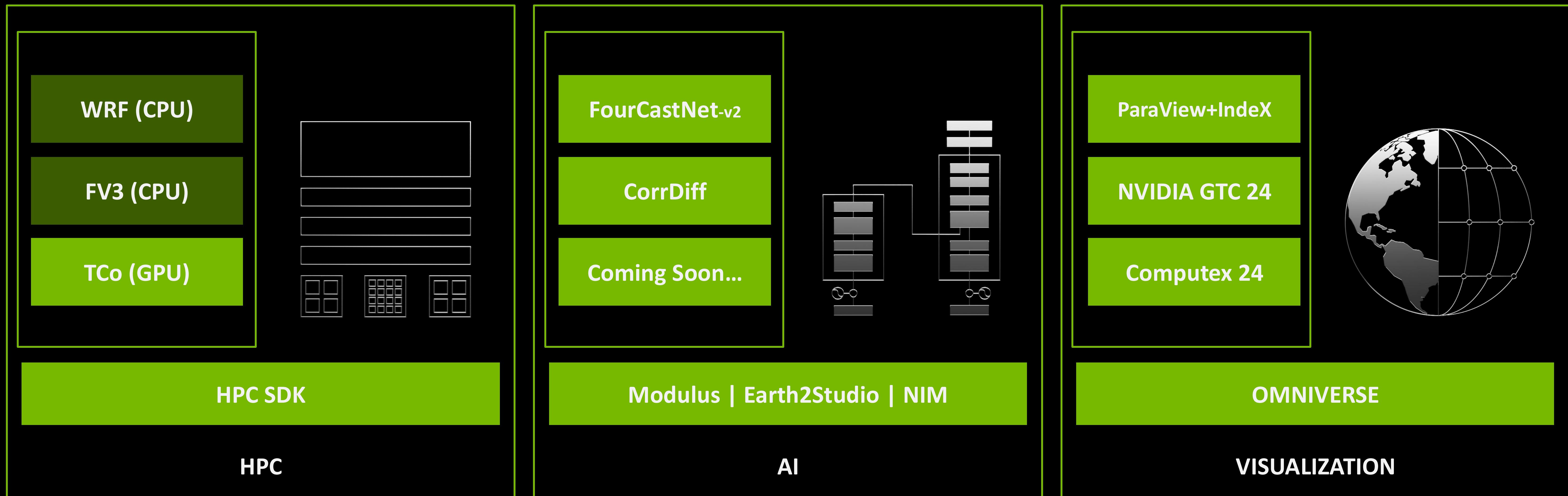
[Course Detail | NVIDIA](#)



Develop, Customize, and Publish in Omniverse With Extensions (8 HR)

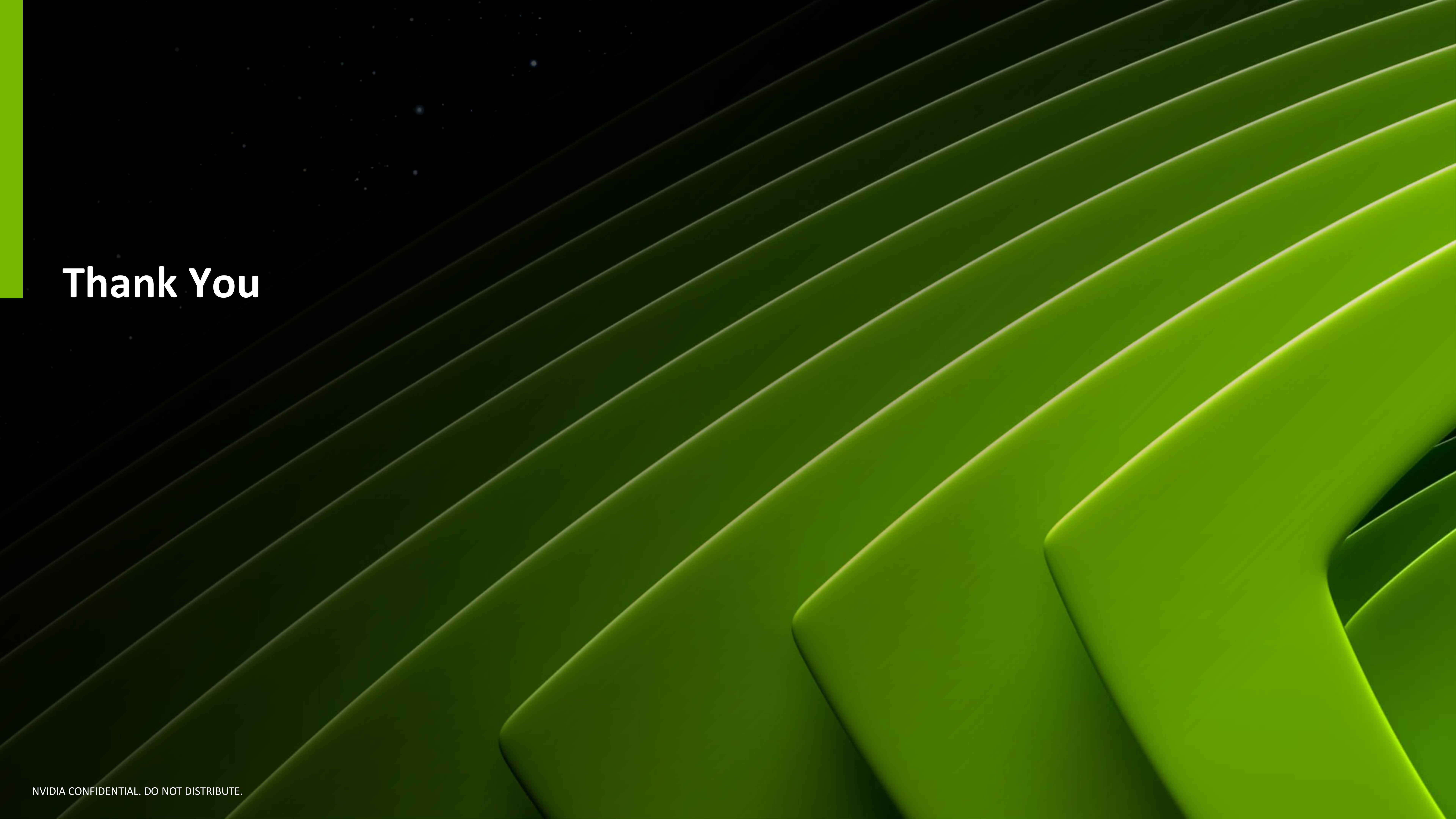
[Course Detail | NVIDIA](#)

Earth-2 @ CWA



Earth-2 Platform

CPU | GPU | DPU



Thank You