Rapid prototyping of GPU-accelerated weather applications with NVIDIA Earth2Studio

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Accelerate weather modeling with NVIDIA Earth-2

Toolbox for GPU-accelerated weather and climate modeling:

Simulation

Accelerate numerical models on GPUs.

AI Training

Train physics-inspired models with PhysicsNeMo.

AI Inference

Build modular inference pipelines with Earth2Studio.

Visualization

Develop interactive apps with Omniverse.

Simplify AI weather inference with Earth2Studio

Open-source Python package with a focus on usability and interoperability.

Data sources

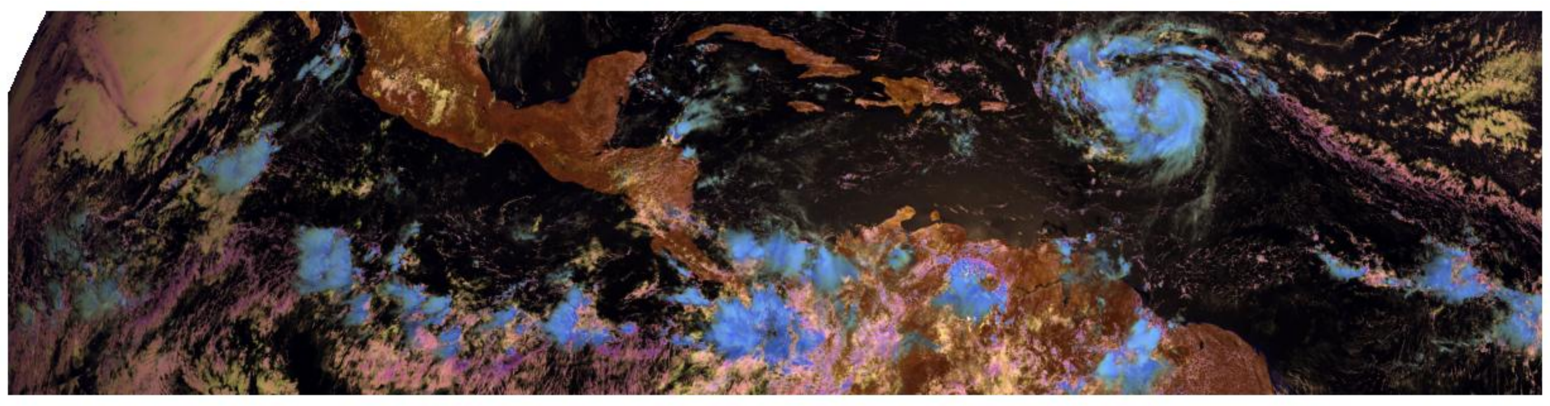
Adapters for many commonly used data sources: ERA5, IFS, GFS, HRRR, GOES, IMERG, CMIP6, etc.

Unified variable names, output format, and access pattern: time, variable, lead time (for forecast data sources)

Optimized retrieval routines (e.g., based on GRIB index) and async interfaces for several of the data sources.

Example:

```
goes = GOES(satellite="goes19")
variables = ["nir161", "nir224", "vis064"]
out = goes(datetime(2025, 8, 15, 16), variables)
```

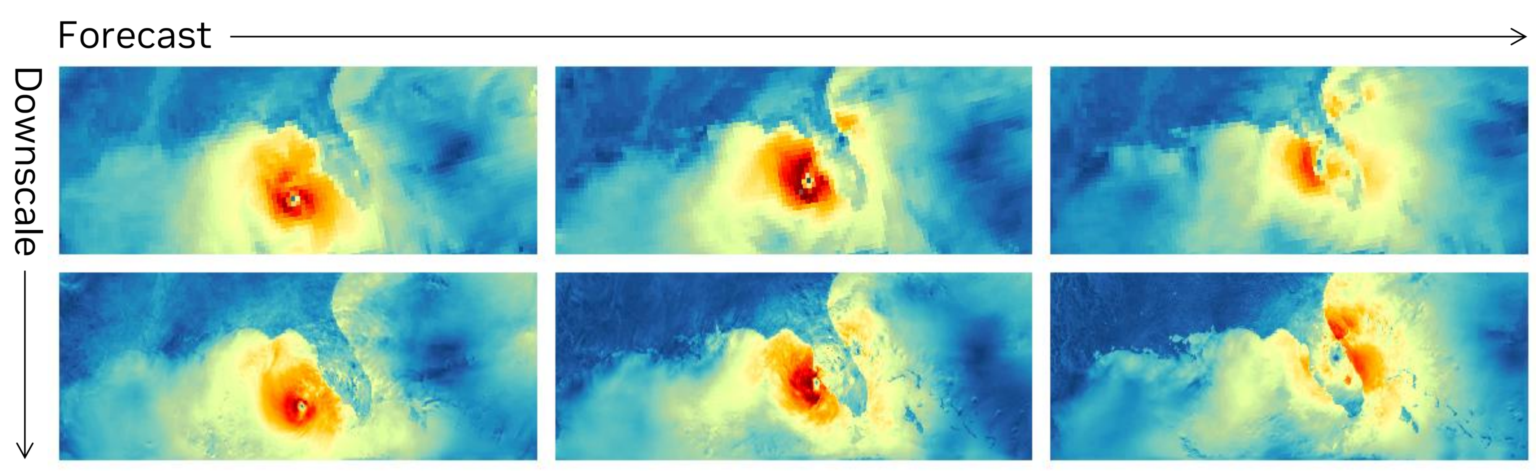


Cloud Phase RGB

Workflows and examples

Inference routines for deterministic and ensemble forecasts compatible with different data sources and models.

Example library for downscaling, seasonal statistics, distributed inference, temporal interpolation, cyclone tracking, etc.



10-meter wind speed

Model interface

Pretrained forecast models with aligned input/output interface: FCN3, Aurora, GraphCast, AIFS, Pangu, etc.

Additional models/interfaces for derived variables, time interpolation, cyclone tracking, downscaling, etc.

Generalized usage pattern based on tensor plus dimension coords (e.g., start time, lead time, variable, lat, lon).

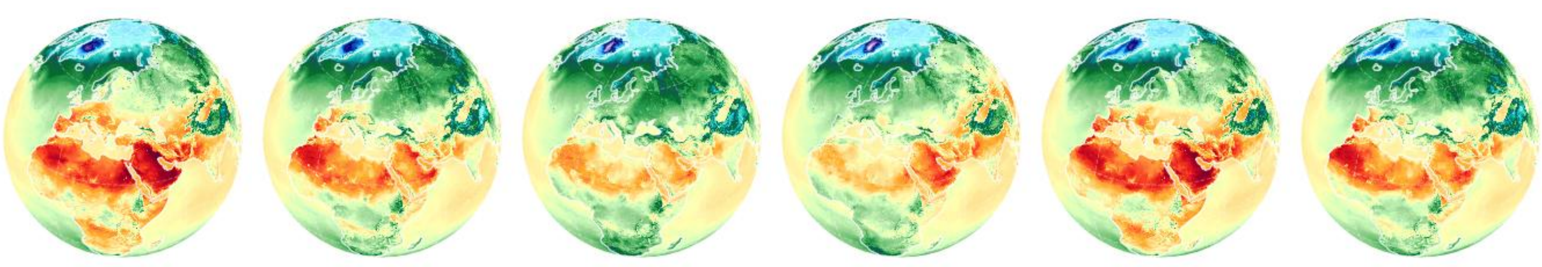
Example:

```
cls = AIFS if model_name == "aifs" else Aurora
model = cls.load_model(cls.load_default_package())
ifs = IFS()  # initial conditions
io = ZarrBackend()
run.deterministic(["2025-09-17"], 16, model, ifs, io)
```

Advanced recipes

Reference implementations for more complex workflows:

- Huge ensembles for large-scale probabilistic forecasting. Combines multiple checkpoints, distributed inference, and post-processing with cyclone trackers and other models.
- Subseasonal-to-seasonal forecasting beyond two weeks. Uses huge ensembles, distributed inference, and supports downstream processing including AIWQ scoring.



2-meter temperature

And more...

- Statistics: RMSE, CRPS, ACC, FSS, rank histograms, etc.
- Interchangeable IO backends: Zarr, NetCDF4, in-memory, etc.

Benefit from AI weather modeling

Complement numerical approaches with capabilities offered by AI systems:

Fast

Achieve large ensembles sizes and long rollouts.

Skillful

Competitive with numerical weather prediction.

Customizable

Finetune for custom data, regions, and use cases.

Versatile

Reduced state vector, obs-to-obs, chained models, etc.