Accelerating climate models using an AI surrogate

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Introduction

- Global Climate Models (GCMs) are computationally expensive and lack the resolution required to model local convection and clouds.
- Model architecture resolves the world onto a grid of boxes, but predictions are sensitive to unresolved processes within a grid.
- Need a function $f(x)$ that represents the net impact of these processes on the global predicted variables x. These are currently predicted from rough empirical models that fail to capture key weather/climate structures.
- We aim to develop new AI/ML approaches to construct f, trained by observations and detailed process models.

AI Surrogate Architecture

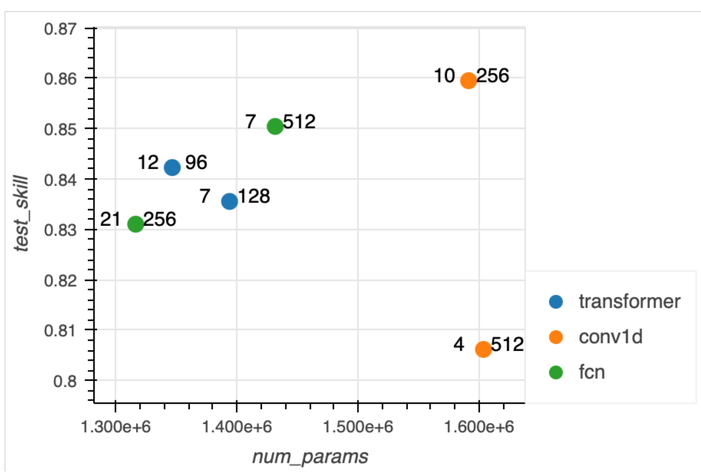

FIG1:Comparison of 3 different architectures

Benchmarking Surrogate

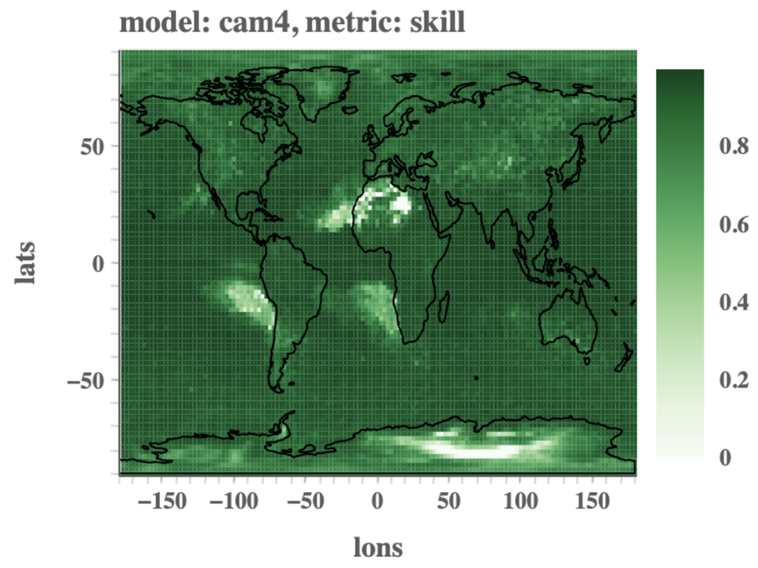

FIG2:Skill of CAM4 surrogate.

Hybrid Model Integration with *TorchClim*

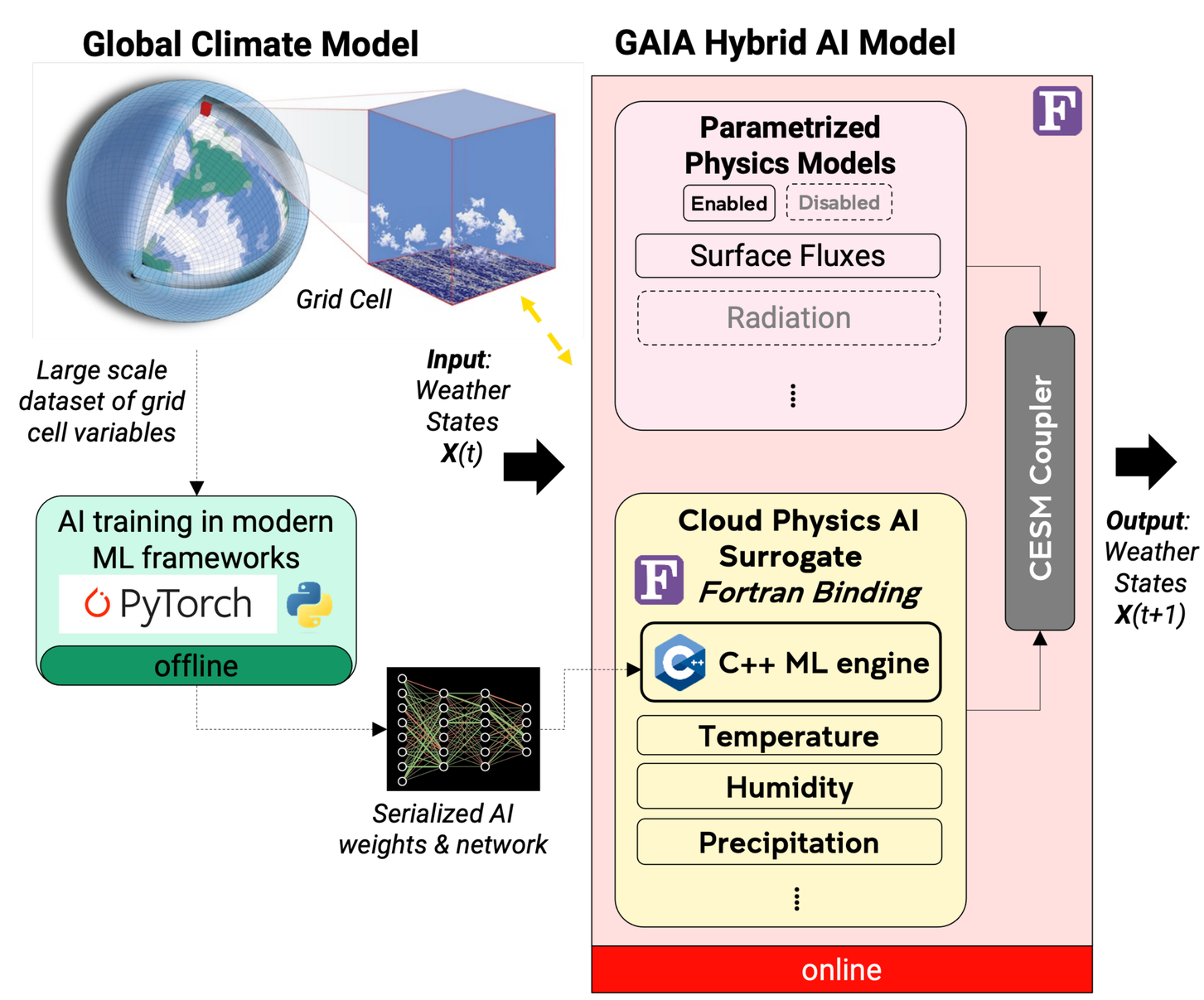

FIG3:Global AI Accelerator (GAIA).

Results

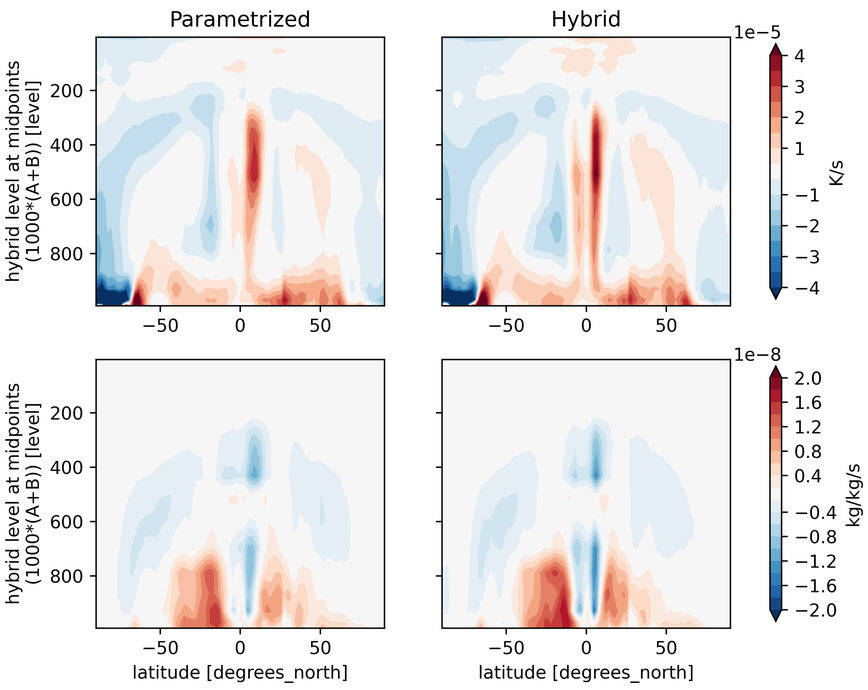

FIG4:Zonal mean moisture and temperature tendencies for the original parametrized CAM (left) and the hybrid model (right).

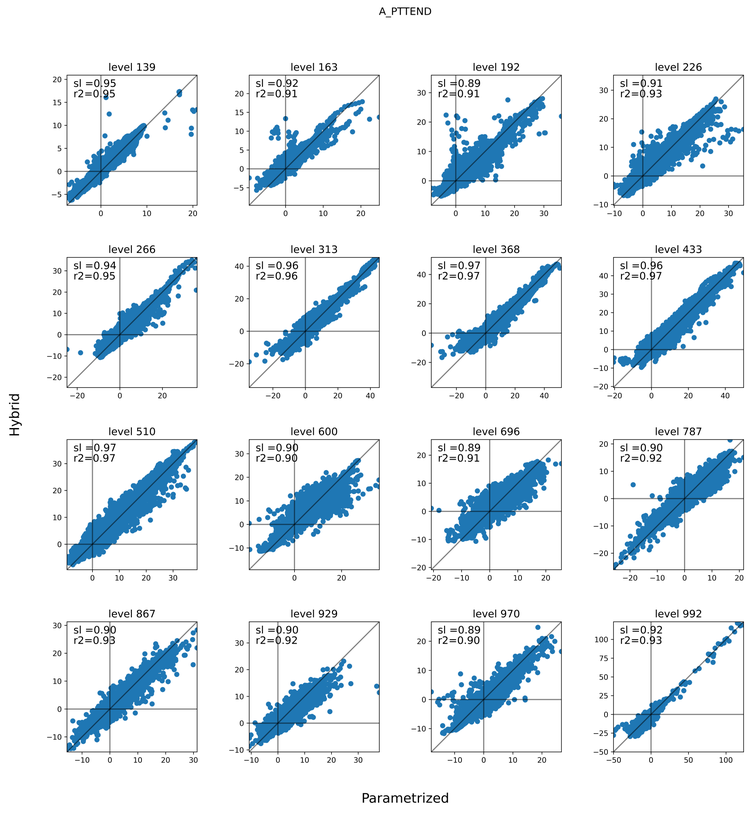

FIG5:Temperature tendencies (K/day) for various vertical levels at day 10 of the run.

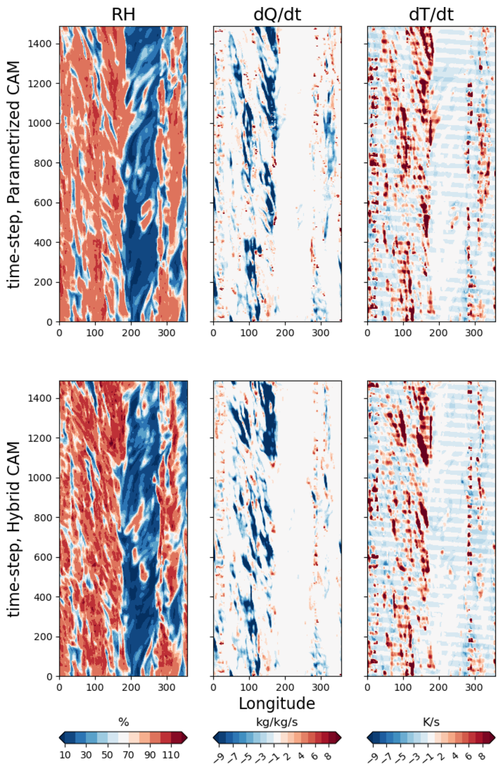

FIG6:Predicted values of RH, moisture and temperature tendencies.

Conclusions and Future Work

- A new framework *TorchClim*, that facilitates the introduction of ML/AI-based models into GCMs has been developed.
- Implemented a proof-of-concept into CAM physics, replacing parametrization of moist and radiative parametrization with a call to *TorchClim*.
- The flexibility and speed offered by *TorchClim* can be useful in replacing other parametrizations.

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