Articles

1. Andersson, T.R., Hosking, J.S., Pérez-Ortiz, M. et al. Seasonal Arctic sea ice forecasting with probabilistic deep learning. Nat Commun 12, 5124 (2021). https://doi.org/10.1038/s41467-021-25257-4
2. Price, I., Sanchez-Gonzalez, A., Alet, F. et al. Probabilistic weather forecasting with machine learning. Nature 637, 84–90 (2025). https://doi.org/10.1038/s41586-024-08252-9
3. Thomas Vandal, Evan Kodra, Sangram Ganguly, Andrew Michaelis, Ramakrishna Nemani, and Auroop R. Ganguly. 2017. DeepSD: Generating High Resolution Climate Change Projections through Single Image Super-Resolution. In Proceedings of the 23rd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining (KDD '17). Association for Computing Machinery, New York, NY, USA, 1663–1672. https://doi.org/10.1145/3097983.3098004
4. Evan Racah, Christopher Beckham, Tegan Maharaj, Samira Ebrahimi Kahou, Prabhat, and Christopher Pal. 2017. Extreme weather: a large-scale climate dataset for semi-supervised detection, localization, and understanding of extreme weather events. In Proceedings of the 31st International Conference on Neural Information Processing Systems (NIPS'17). Curran Associates Inc., Red Hook, NY, USA, 3405–3416.
5. Gordon, E. M., & Barnes, E. A. (2022). Incorporating uncertainty into a regression neural network enables identification of decadal state-dependent predictability in CESM2. Geophysical Research Letters, 49, e2022GL098635.

Title:
Authors:
Year:

1. What is the ML application? [Slide 3]

2. What type of problem is it (i.e. classification or regression)?

   What type of model is this (i.e. NN, CNN, LSTM etc.)?
   a. Bonus: Why do you think they chose this model type?

3. What are the inputs and outputs? What is their structure (i.e. maps, timeseries, data points)? What are the data sources?

4. What is the timescale (i.e. Δt between inputs and outputs)?

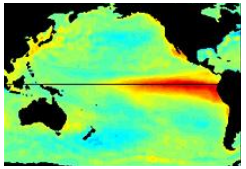
5. What type of challenges and solutions were faced or applied? [Slide 4]

ML Applications (Q1)

Sources of Predictability

Climate Modes

Causal analysis



Feature Detection

Extremes

Pattern Recognition

Forecasting

Short-term weather forecasting

Extreme Weather Events

Climate Forecasting

Satellite Data & Observations

Interpolation

Global Reconstruction

Variable Representation

Downscaling

Merging Satellite Data

Synthetic data

Sensor placement

Earth System Modeling

Emulators

Model Calibration and Validation

Equation Discovery

Uncertainty Quantification

Sources of uncertainty

Parameterizations

Bias Correction

Data Assimilation

Climate Model analysis and benchmarking

Challenges and Solutions (Q5)

Challenges	Solutions
Data Availability	Climate model output
Robustness on out-of-distribution samples	Transfer learning
Interpretability	eXplainable AI
Physical Inconsistency	Physics-informed ML
Uncertainty Quantification	Bayesian NNs, Problem Set-Up

Title:
Authors:
Type of problem:
ML application: