Foundation models for weather and climate

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Modeling weather and climate is crucial

Thousands of Migrant Workers Died in Qatar’s Extreme Heat. The World Cup Forced a Reckoning

Droughts Take Widening Toll On World’s Largest Economies

Report on California Climate Impacts ‘Paints a Pretty Grim Picture’

Devastating floods in Pakistan

UNICEF is on the ground working with partners to help children and families.
Numerical methods

- Employ explicit equations based on the laws of physics, fluid motion, and chemistry

- Accurate and general-purpose

- Slow and computationally expensive

Image credits: https://celebrating200years.noaa.gov/breakthroughs/climate_model/
Data-driven approach

- Train a deep neural network from historical data to solve a certain task, e.g., weather forecast

- Competitive accuracies and fast prediction

- Data-hungry and not general-purpose
From task-specific to foundation models

Opportunities: Plenty of data

Data sources

Weather stations
Ships
Airplanes
Weather balloons
Simulated data
Satellite

ECMWF receives 800 million observations daily!
Challenges: Data heterogeneity

Data sources

- Temporal coverage
- Spatial coverage
- Variables
- Measurement methods
- Modeling assumptions
We develop and demonstrate ClimaX – the first foundation model for weather and climate. ClimaX can be pretrained on heterogeneous datasets.
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ClimaX

- We develop and demonstrate ClimaX – the first foundation model for weather and climate
- ClimaX can be fine-tuned for various climate and weather tasks under different settings
Future directions

- Scale up with respect to data size and model size
- Make ClimaX general to more downstream tasks
- Better architecture and/or pretraining objective
- GPT-3 style for weather and climate
Thank you for listening!


Code: https://github.com/microsoft/ClimaX

Website: https://microsoft.github.io/ClimaX/

More: https://aditya-grover.github.io/ml4climate/about