A JOINT SPACE-TIME ENCODER FOR GEOGRAPHIC TIME-SERIES DATA

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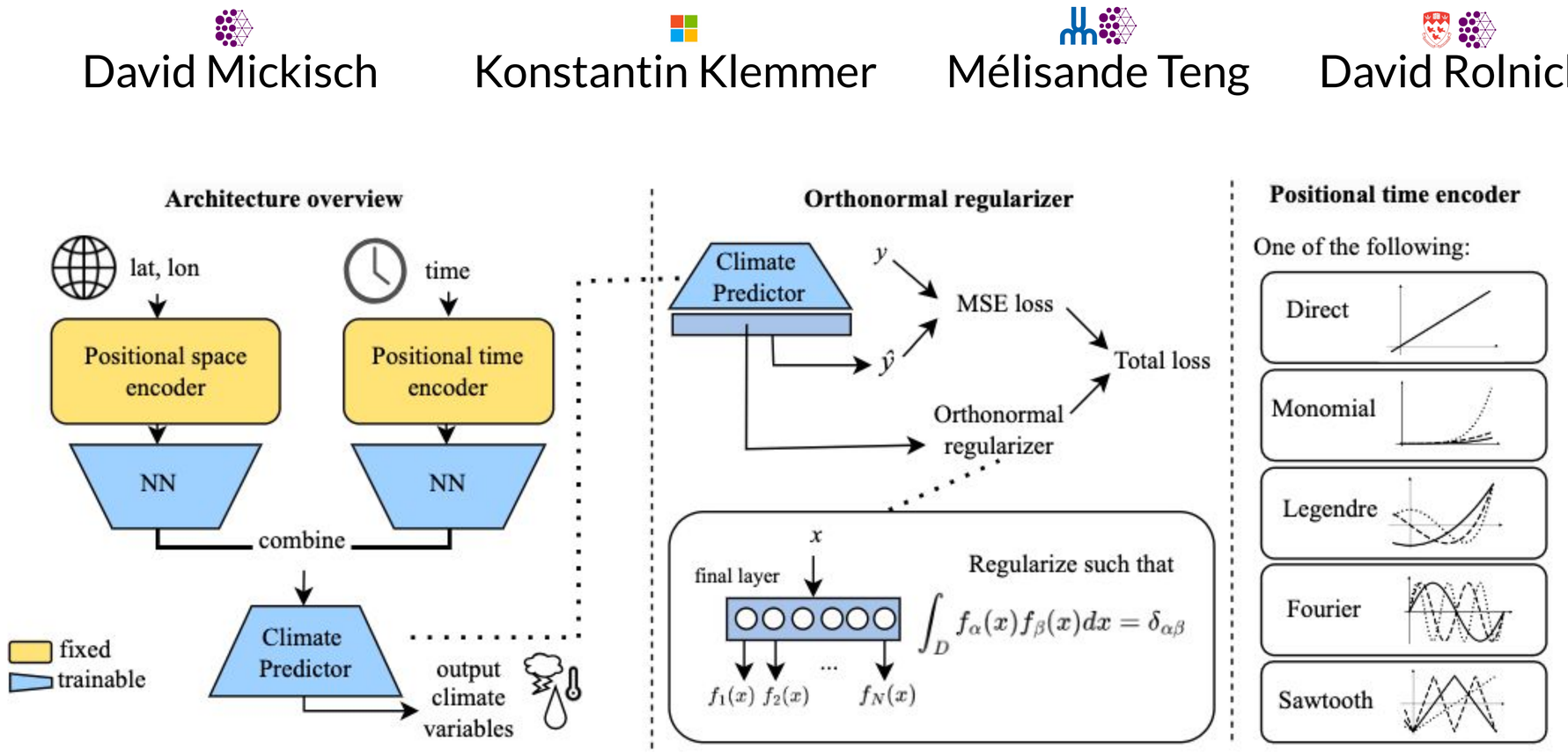


Overview of the Space-Time Encoder Architecture with Orthonormal Regularization

Motivation

- A common problem in domains such as atmospheric science, ecology, and agriculture is to build dense maps from observations that are sparse in space and time.

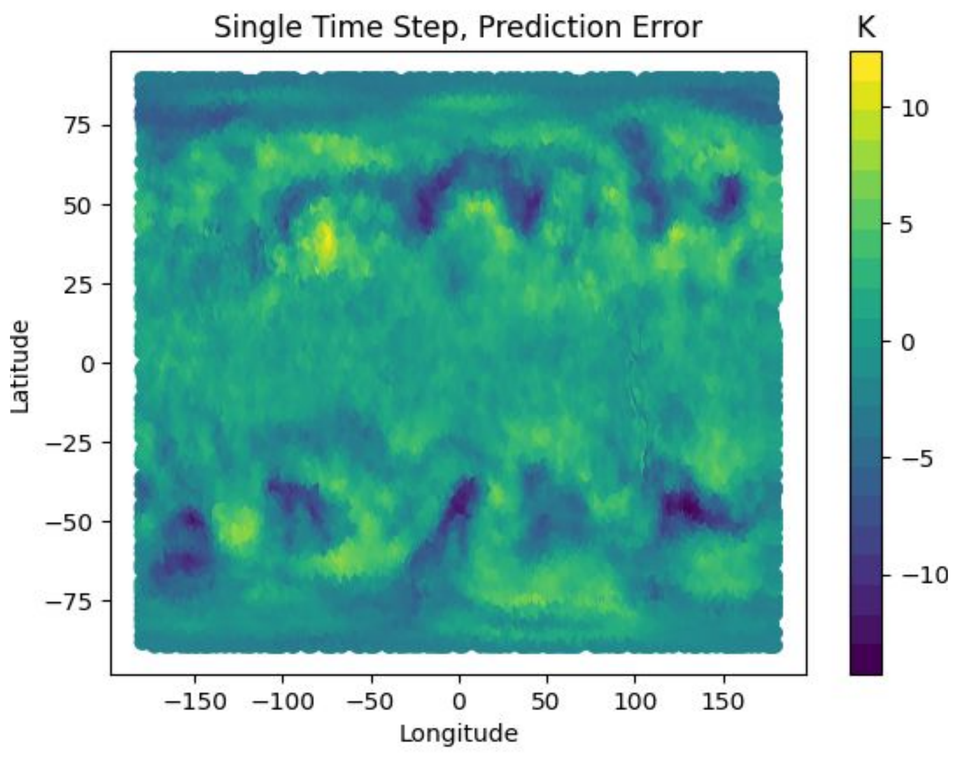
Method

- We introduce the **Space-Time Encoder**, a neural network architecture aimed at learning complex spatio-temporal patterns at scale.
- The proposed space-time encoder first maps the spatial and temporal coordinates to two separate embedding vectors which are later combined for the final prediction.
- We further introduce a method for regularizing the last layer neurons to represent orthonormal functions.

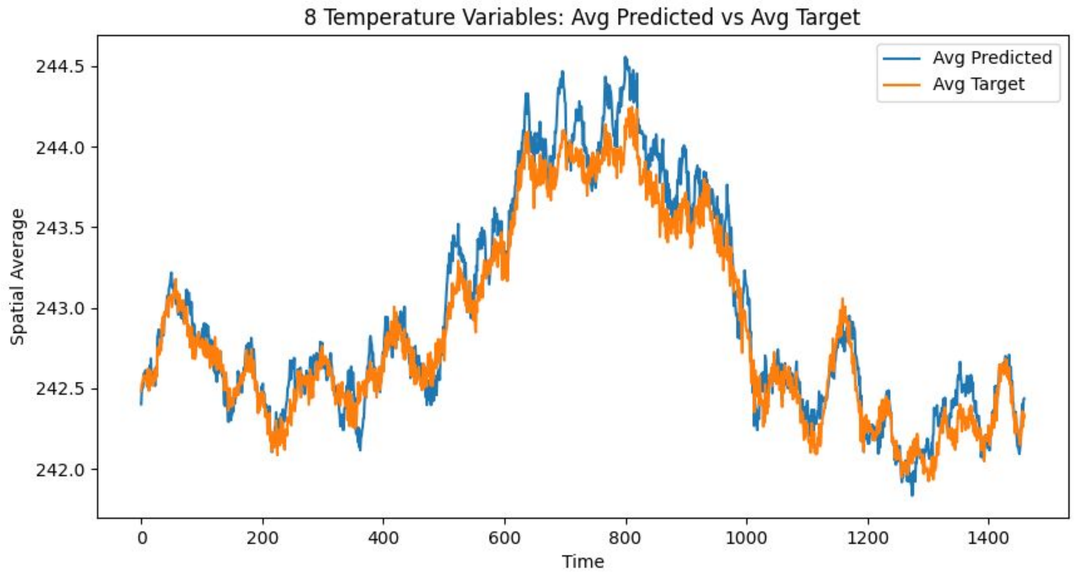
Experiments

- on AI2 Climate Emulation Data (ACE), the best performance is achieved by the model with **Fourier time embedding** and **orthonormal regularization**.

Time Embedding Type	*Without* Regularization	*With* Regularization
Drop Time Coordinate	*5.691*	5.737
Direct	3.147	*3.144*
Monomial	3.222	*3.190*
Legendre	2.971	*2.953*
Fourier	2.731	***2.704***
Sawtooth	3.456	*3.44*



Prediction Error for a Randomly Sampled Time Step



Spatial Averages of Targets and Predictions with Fourier Embeddings and Regularization for 12 months of data

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