Problem Statement:

Comparing Transfer Learning Methods to Create Data-Driven Models for HVAC Cooling Tower Performance

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Introduction

Motivation:

Given cooling tower X with insufficient data, how can we utilize data from cooling tower Y? How much does the amount of data available for cooling tower X impact the model performance?

Steps:

- Collection of real data on Vanderbilt's ESB, Kissam and MRB cooling towers
- Preprocessing, understanding operation, identifying common features, filling missing data
- Creating base models on data from individual seasons + hyperparameter optimization
- Running intraseason and interseason transfers

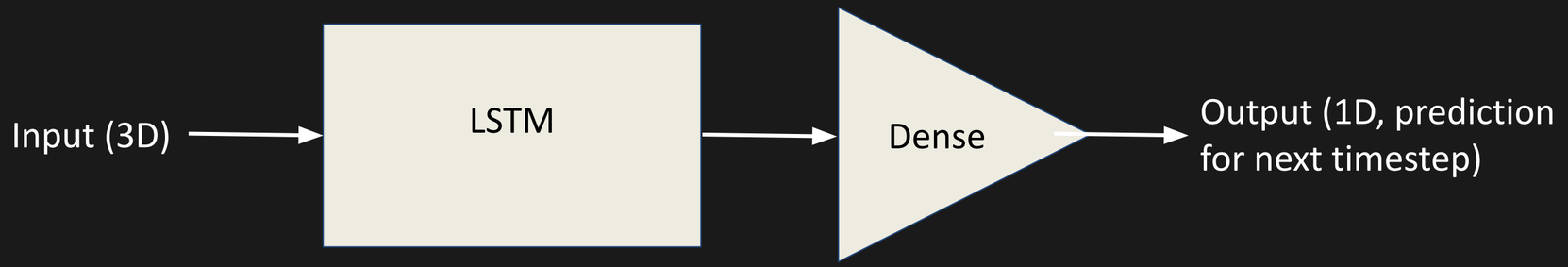
Approach:

- Train a base model on a cooling tower's data (source domain)
- Perform transfer learning using another cooling tower's (target domain) data with multiple transfer learning methods
- Repeat the process taking different amounts of target domain data

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Method 1 & 2: Weight initialization

Base model: LSTM + Dense

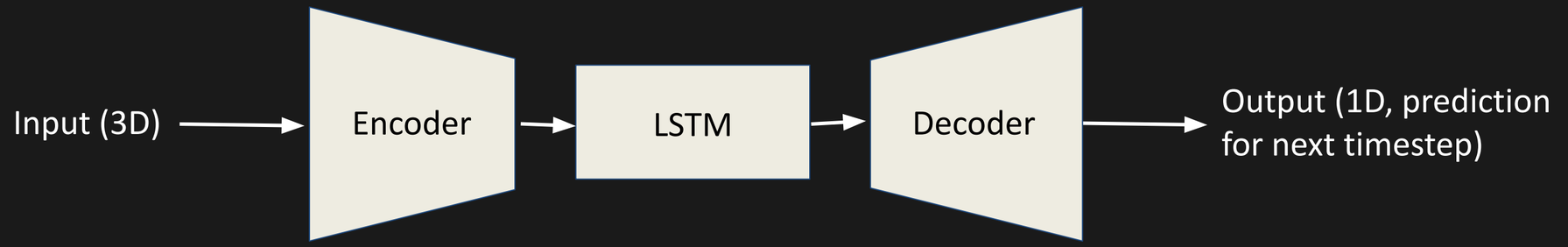


Method 1: Finetune entire model
Method 2: Finetune only the Dense layer

Showed the importance of capturing temporal behaviour of data in the model

Method 3: Feature Extraction

Base model: LSTM Autoencoder

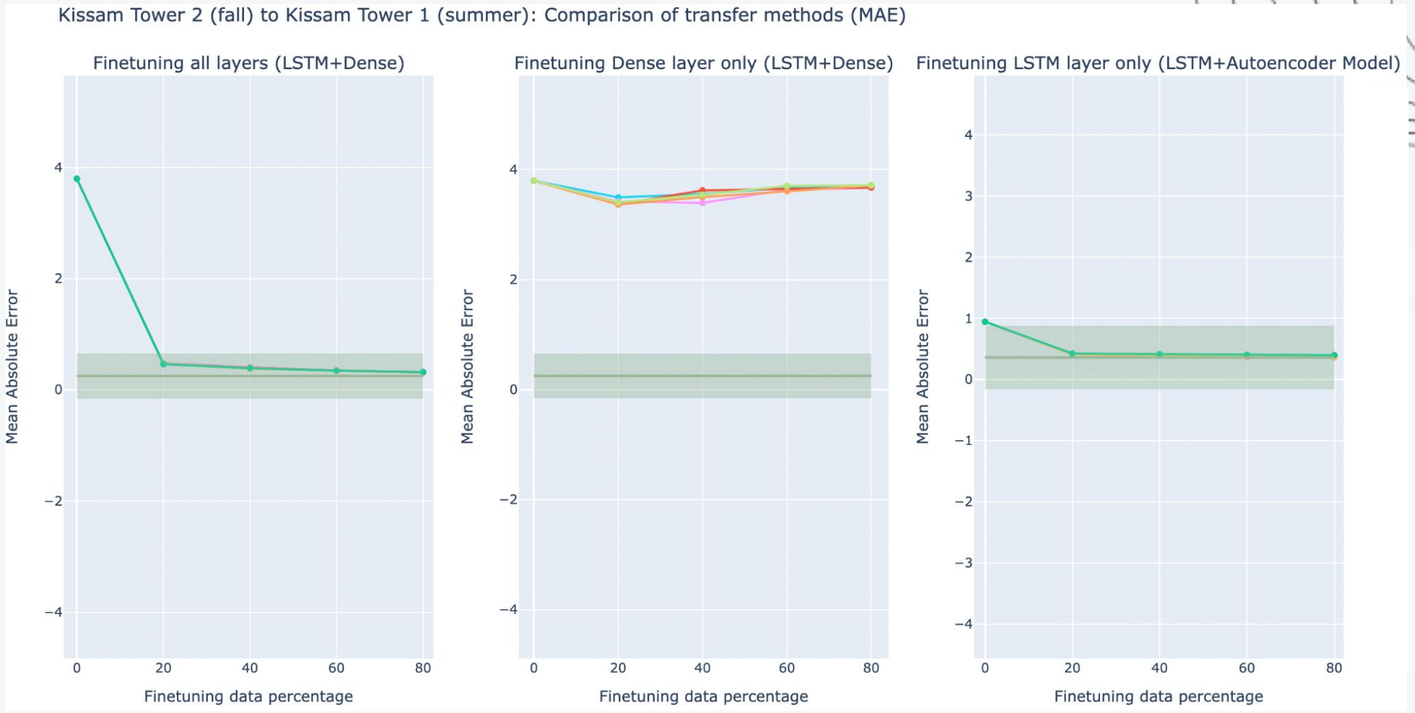


Method 3: Train the entire model on the source domain. Finetune only the LSTM layer.

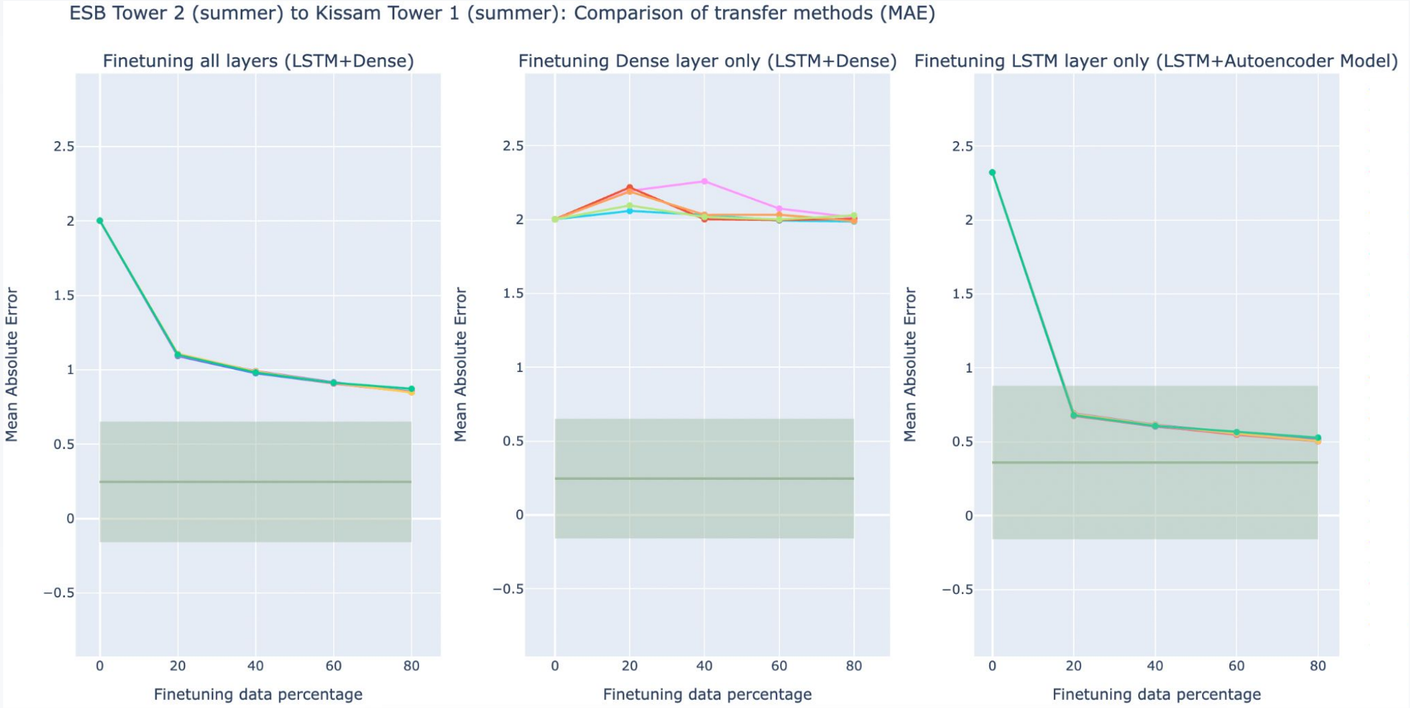
Base model's knowledge of relevant features is used and temporal behaviours of both source and target domains are used.

Results

Interseason example:



Intraseason example:



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Next steps:

- Implement more transfer learning methods
- Compile results

Reflections:

- Challenge: Finding transfer learning implementations that work for time series predictions
- Positives: Paper readings, hearing about related projects in weekly meetings
- Lessons learned: Keep implementations organized from the beginning

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