



NORTH ATLANTIC TREATY ORGANIZATION



The multi-year Project G5970->Cube4EnvSec: Big Earth Datacube Analytics for Transnational Security and Environmental Protection

Monitoring Mediterranean Sea: SST and Sea Level with Machine Learning Applications

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Training and Workshop

18 October 2024

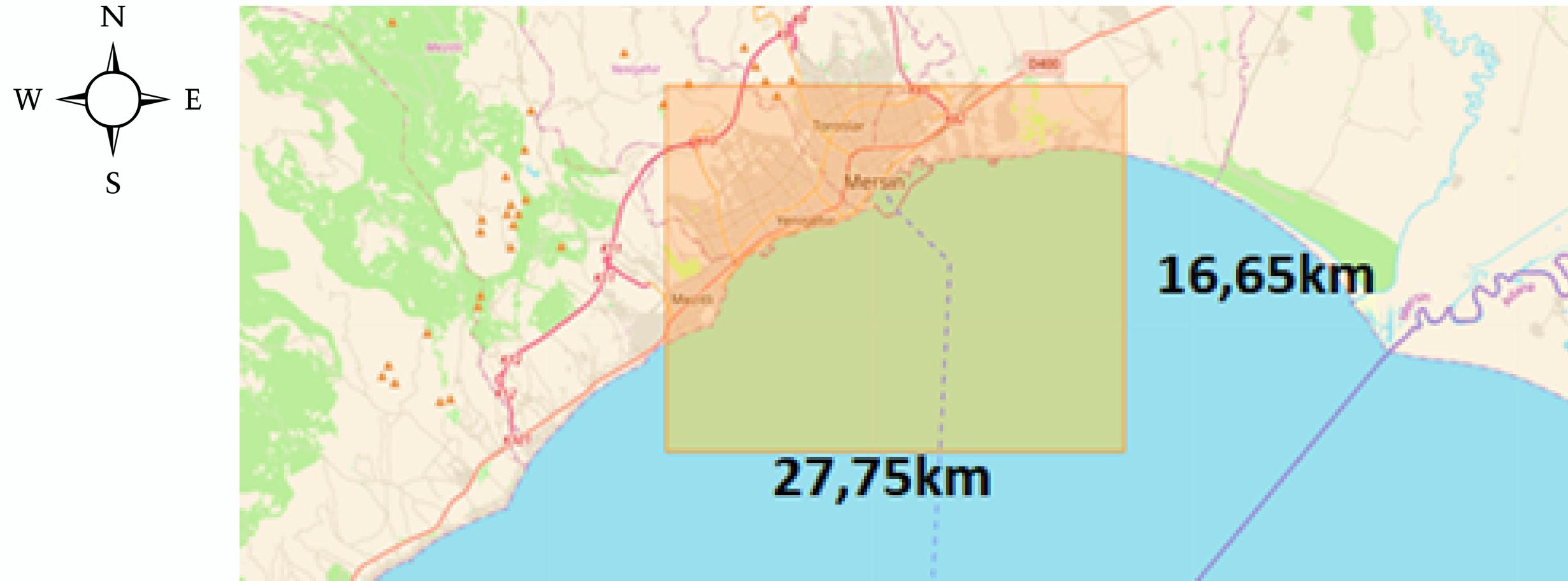
SST heat affects of the water density



The warmer the water, the more space it takes up, and the lower its density.

- 1) Sea Level Rise**
- 2) Impact on Marine Life**
- 3) Stratification (Lower density stays at surface, lesser exchange with deep water)**
- 4) Ocean Circulation**

Study Area



- **SST in the region of Mersin is one of the highest levels of daily SST in the Mediterranean Sea**
- **Mersin Port is the biggest port in Türkiye at the Mediterranean sea**



NATO
OTAN

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İSTANBUL
TOPKAPI
ÜNİVERSİTESİ



SÜLEYMAN DEMİREL ÜNİVERSİTESİ
S. Demirel
1992



İSTANBUL TEKNİK ÜNİVERSİTESİ
1773



İSTANBUL AYDIN
UNIVERSİTESİ

Project Methodology

1. Data Collection

Coordinates-Dates-Files Conversion

2. Data Cleaning & Pre-Process

3. Exploratory Data Analysis (EDA)

Feature Engineering

4. Model Building

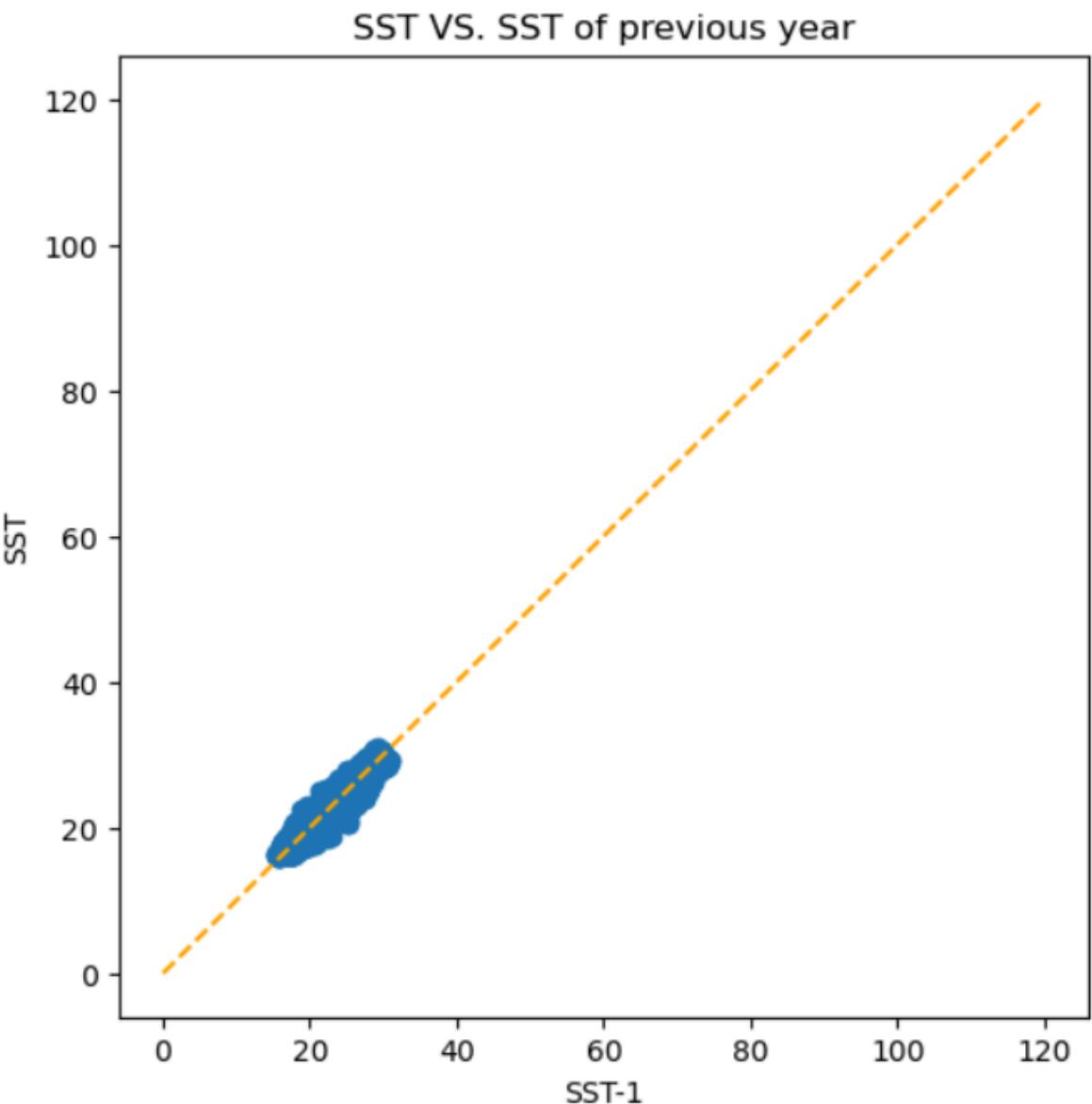
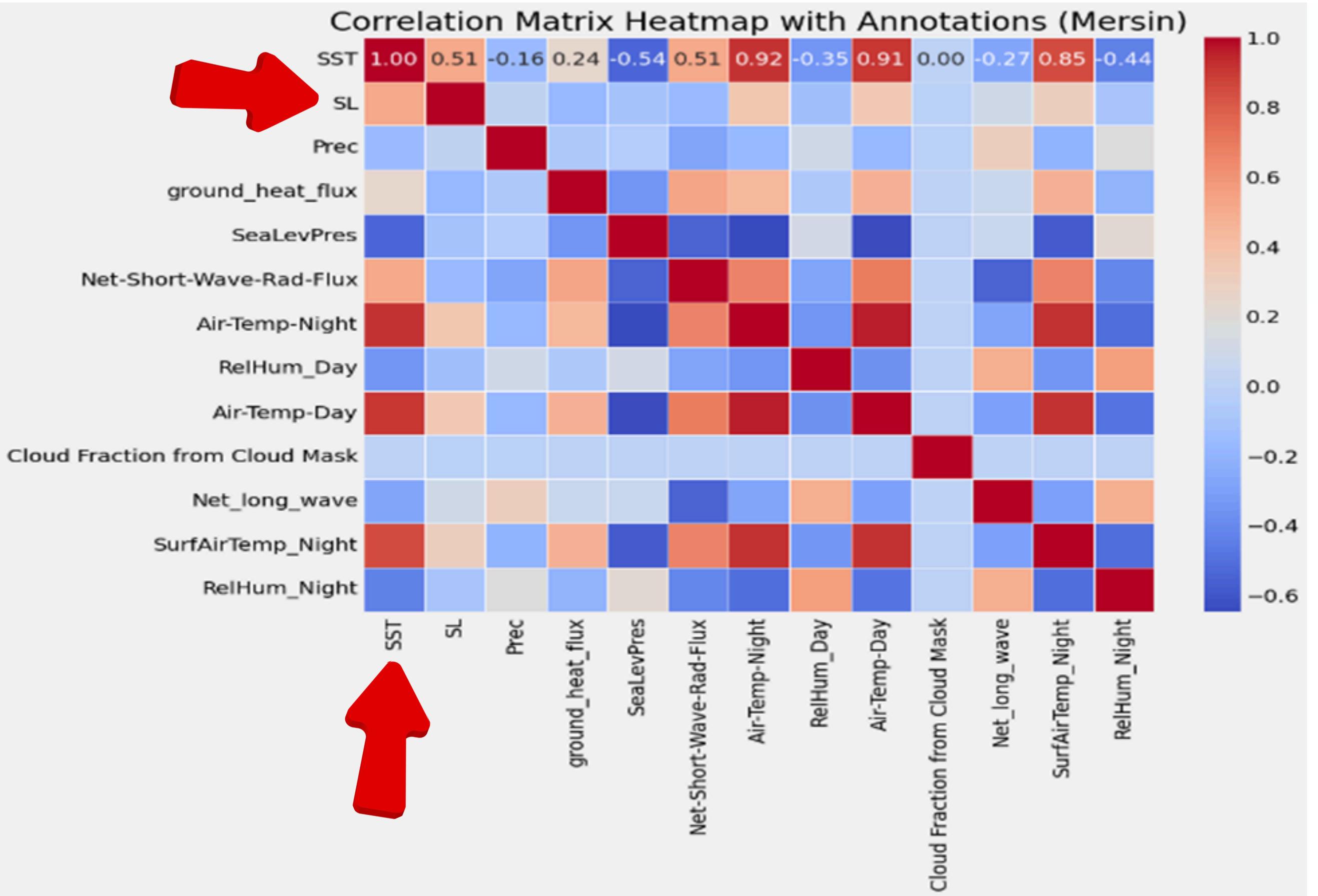
5. Communication Results



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• Correlation Matrix Heatmap



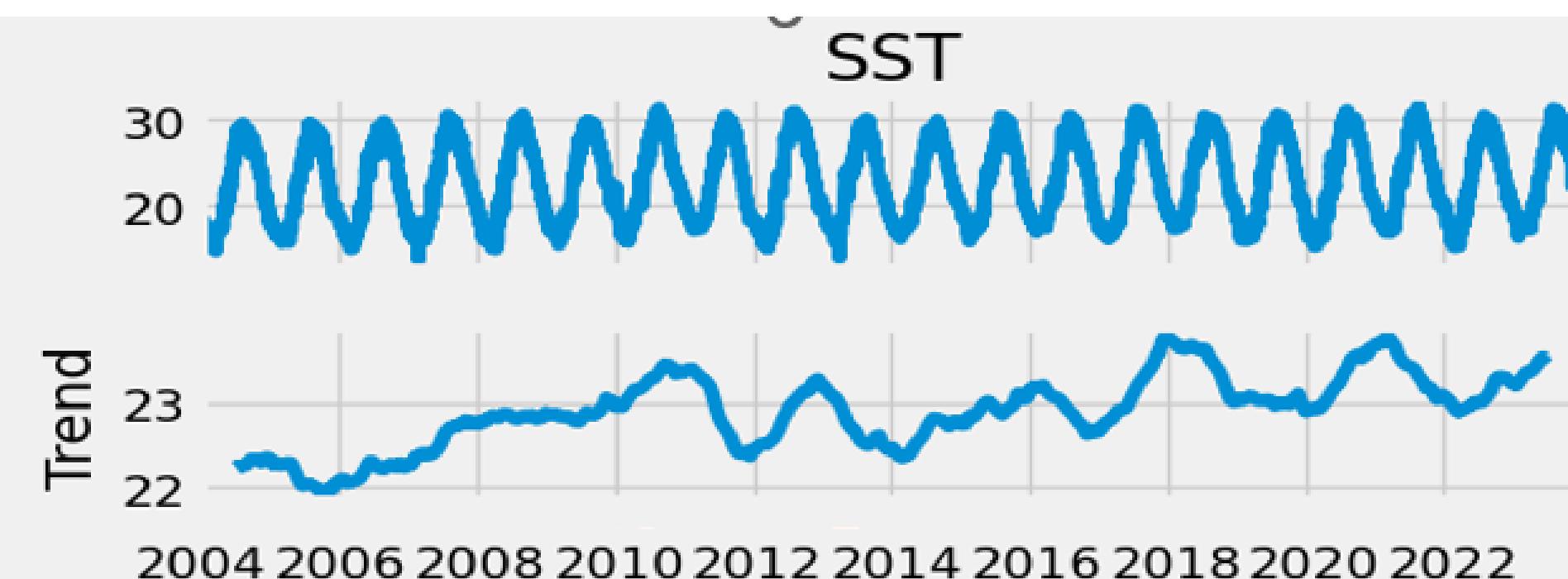


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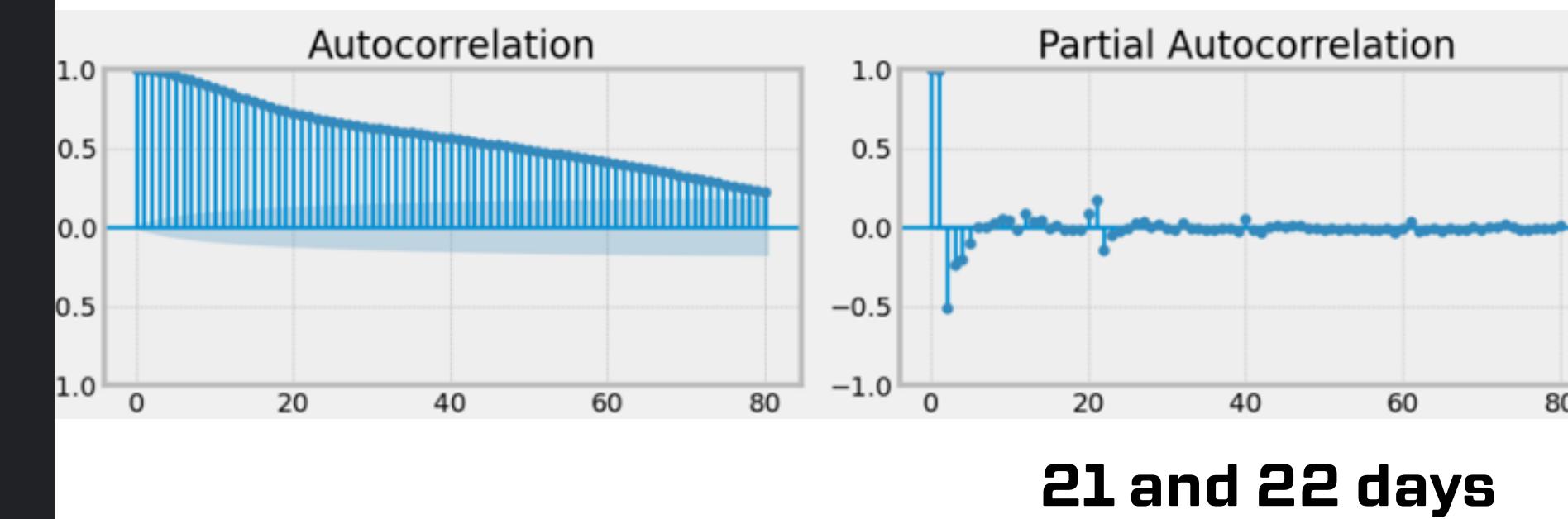
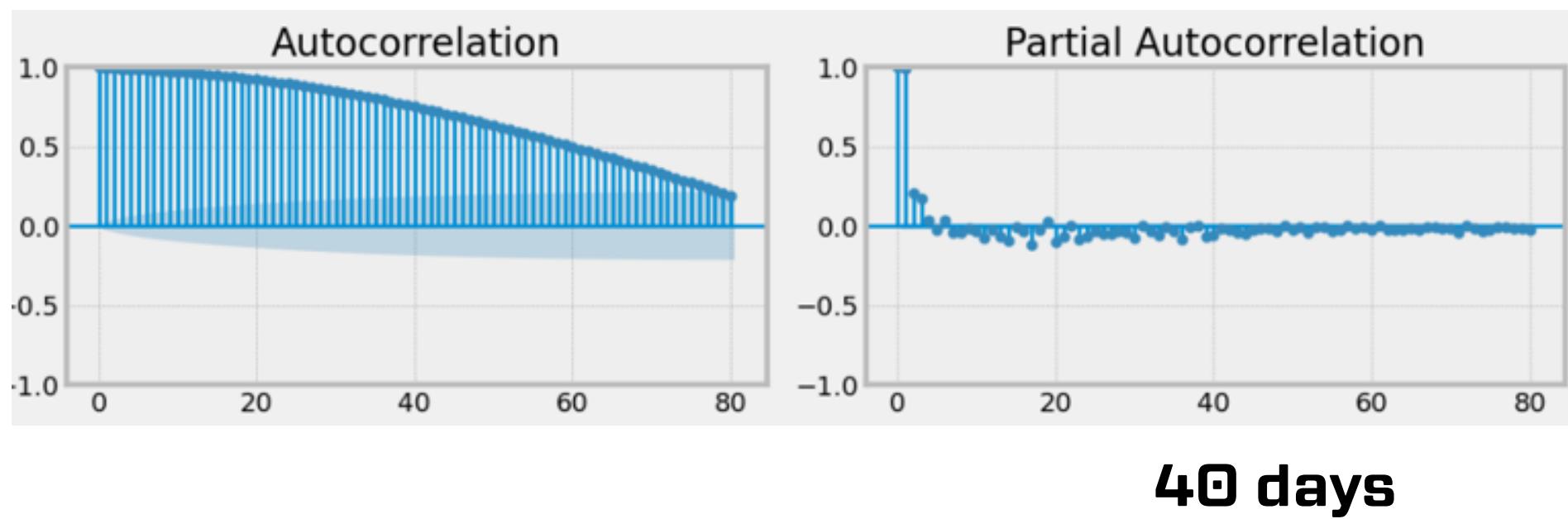
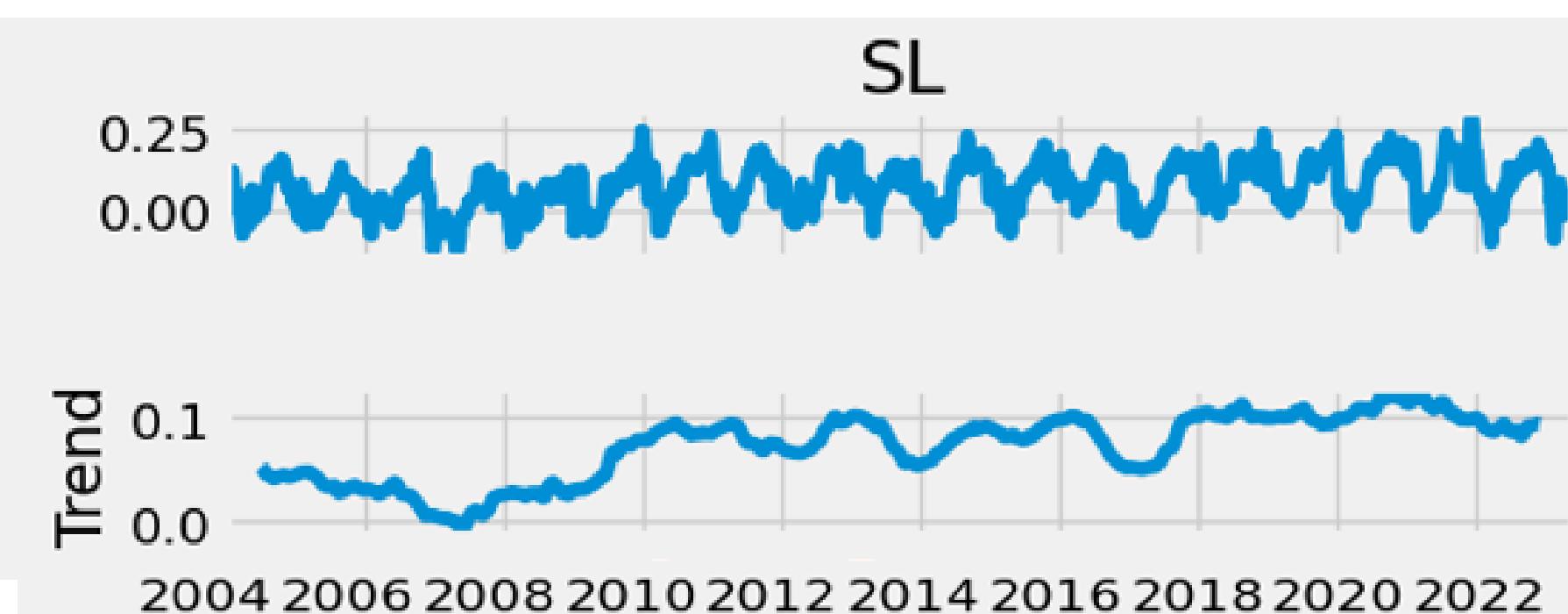


General Analysis - Trends

Sea Surface Temperature



Sea Level



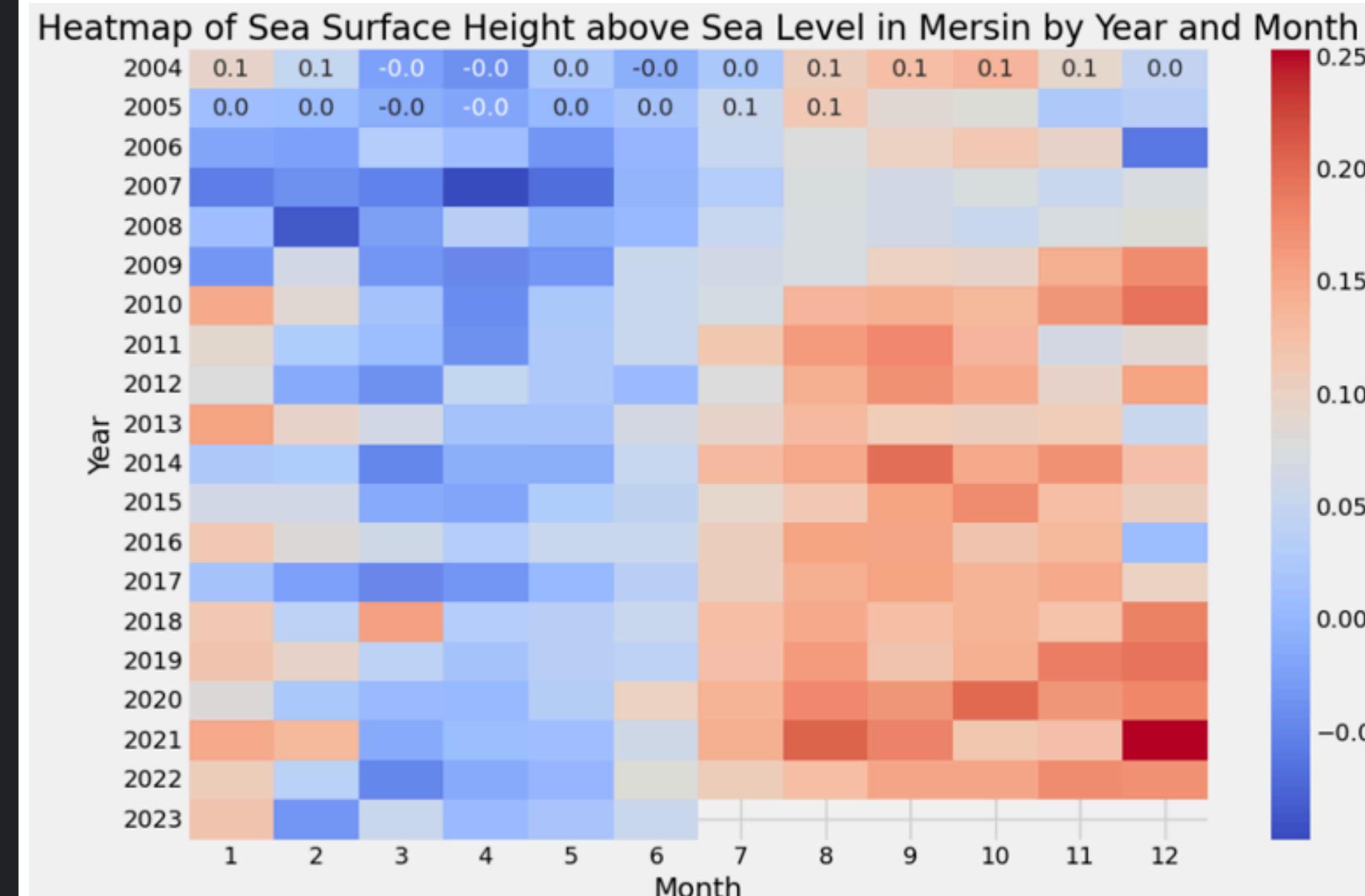
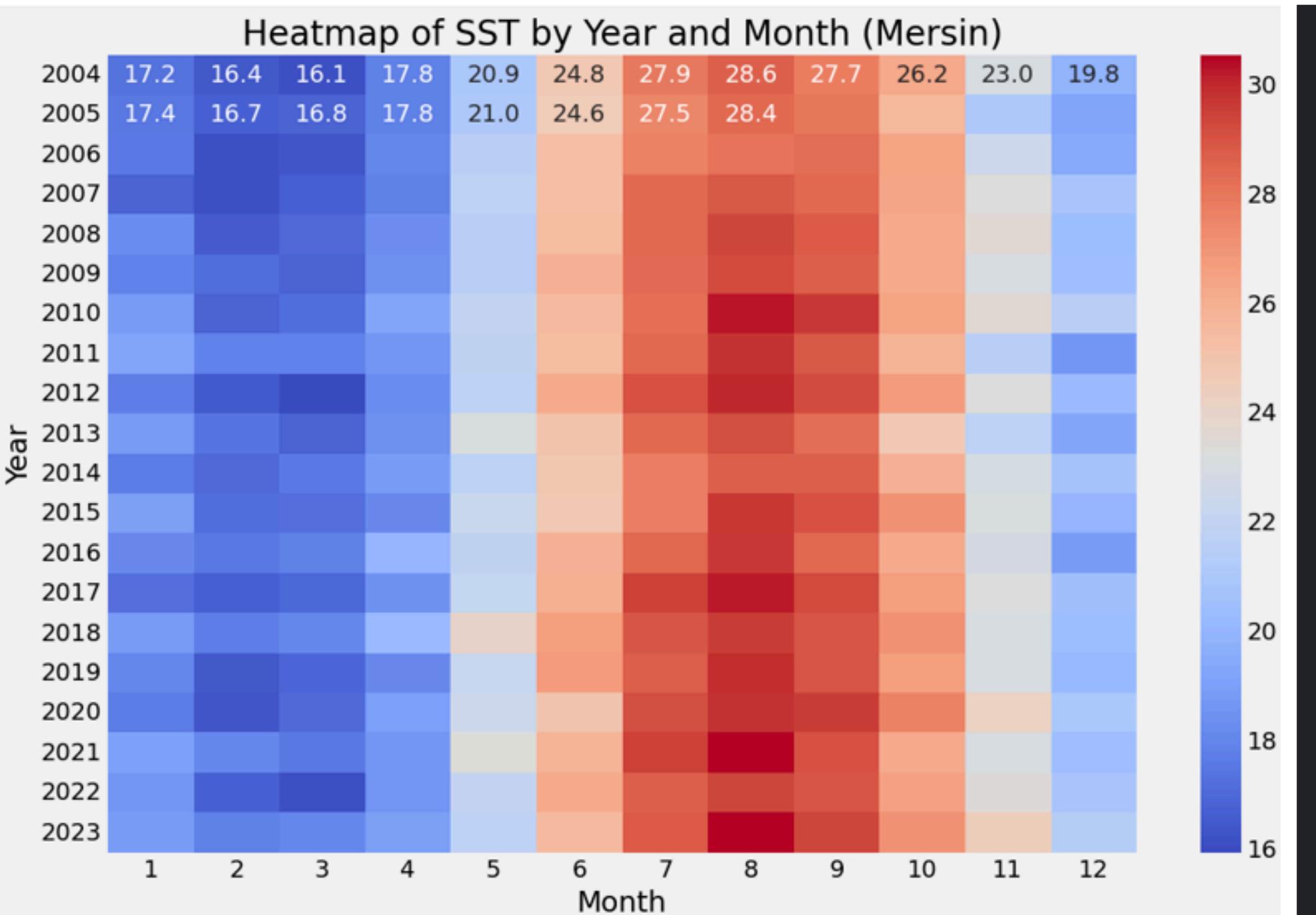


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Specific Analysis

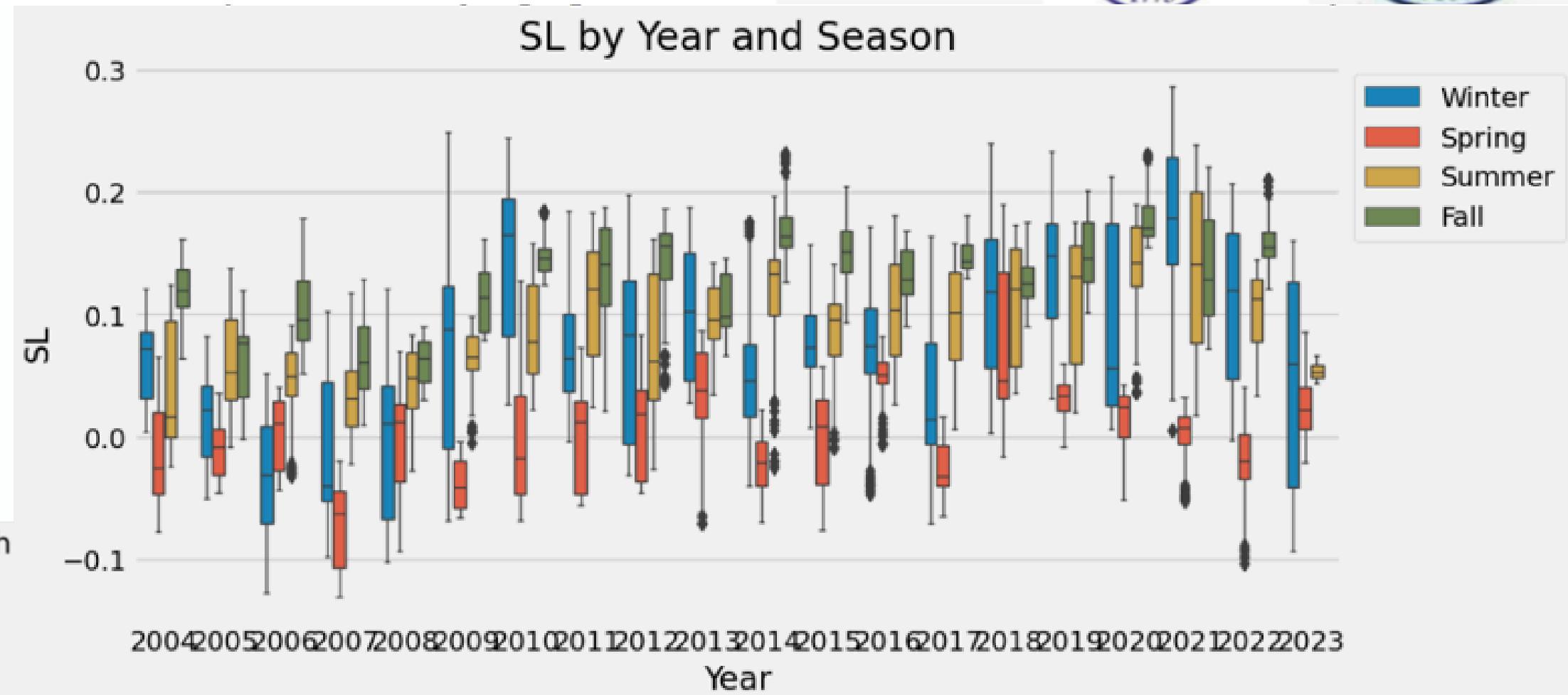
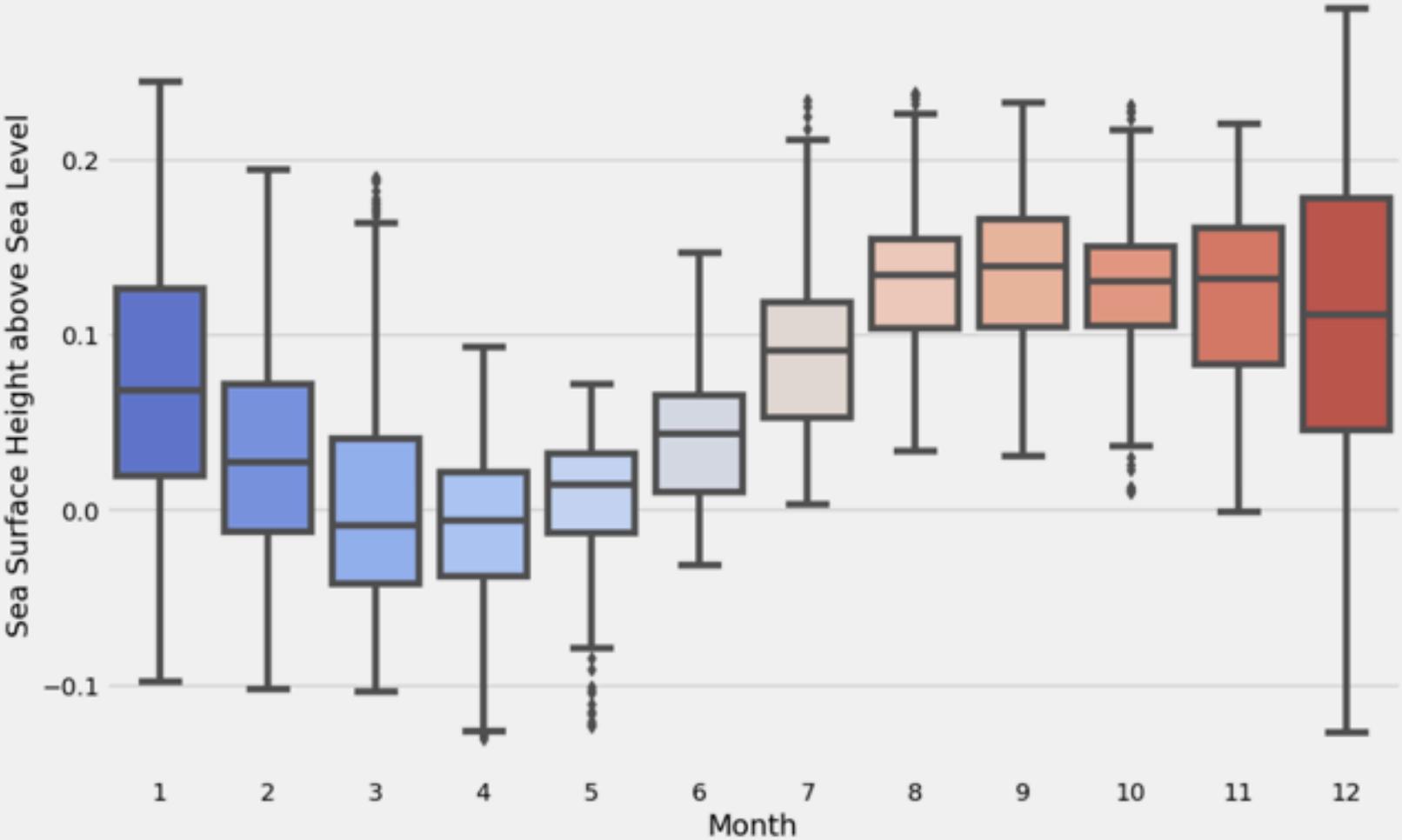
Sea Surface Temperature



September 2009...

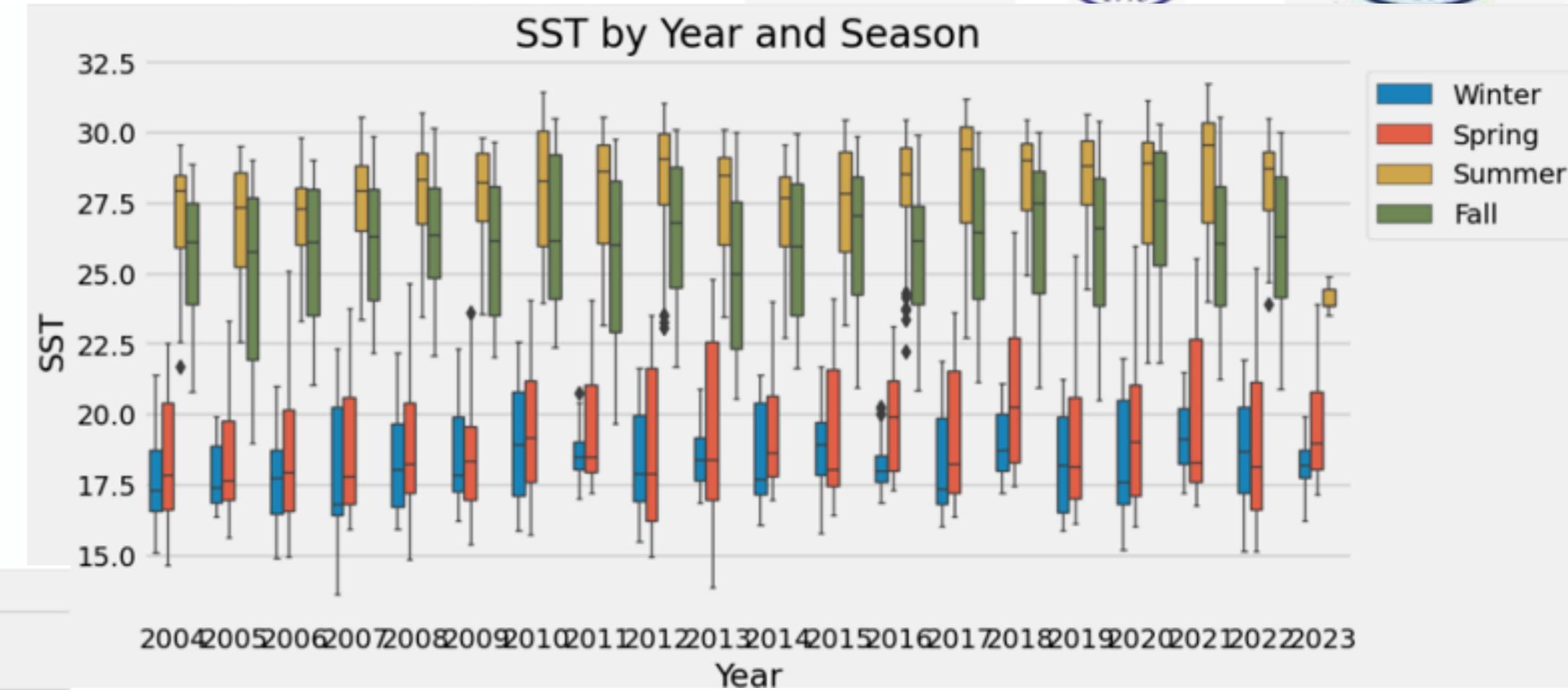
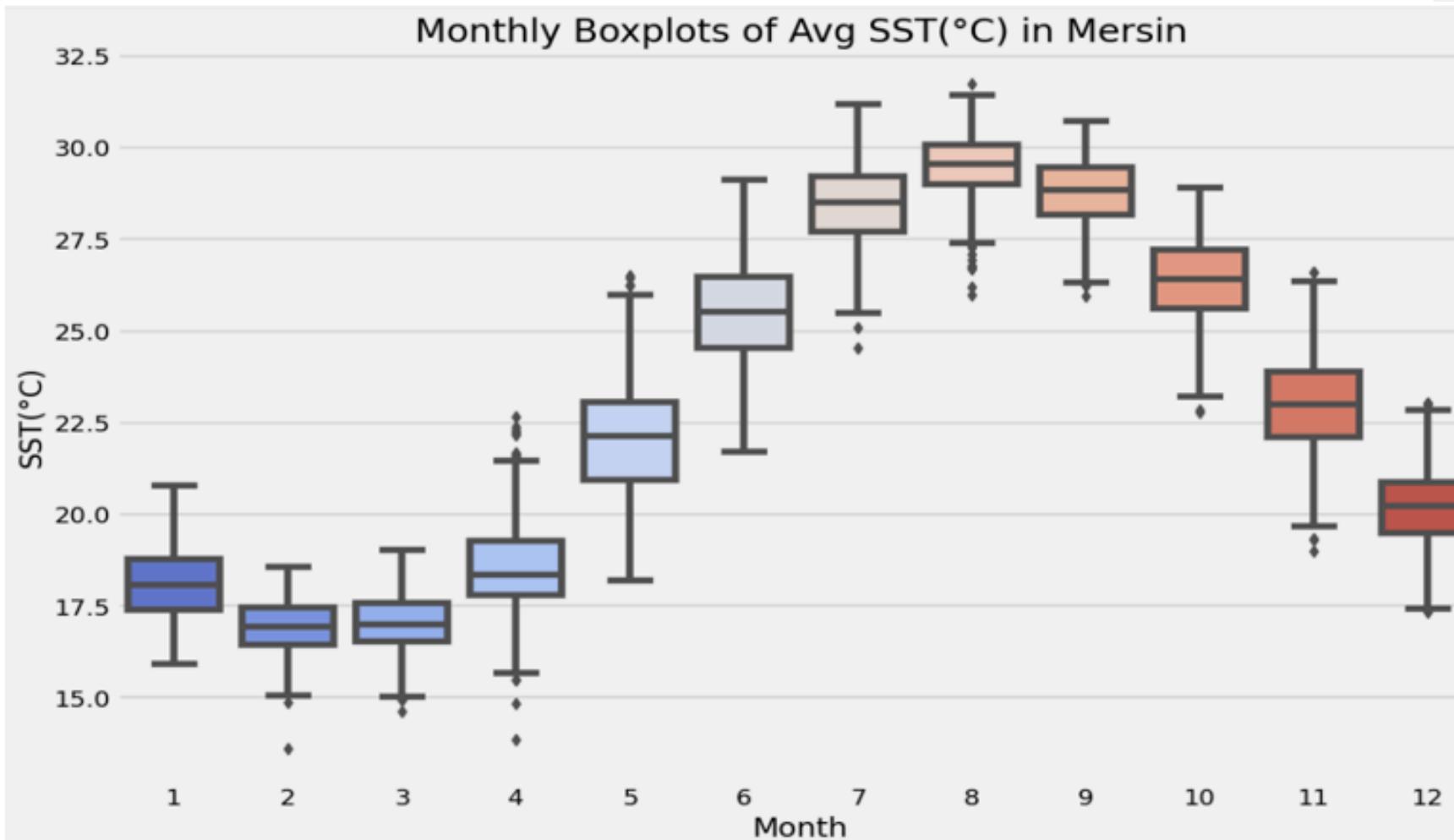
Sea Level [meter] for Mersin

Monthly Boxplots of Sea Surface Height above Sea Level in Mersin by Month



- Fall has the highest Sea Level
- Spring has the least Sea Level

SST for Mersin



- **Importance of understanding unusual events and linkage between other natural and Atmos activities in the region**



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Models Used

Machine Learning Models

Short-Term

A] Auto-Regressive
 $P=8$

B] LSTM
Window=8

Long-Term

A] Prophet
Additive Model

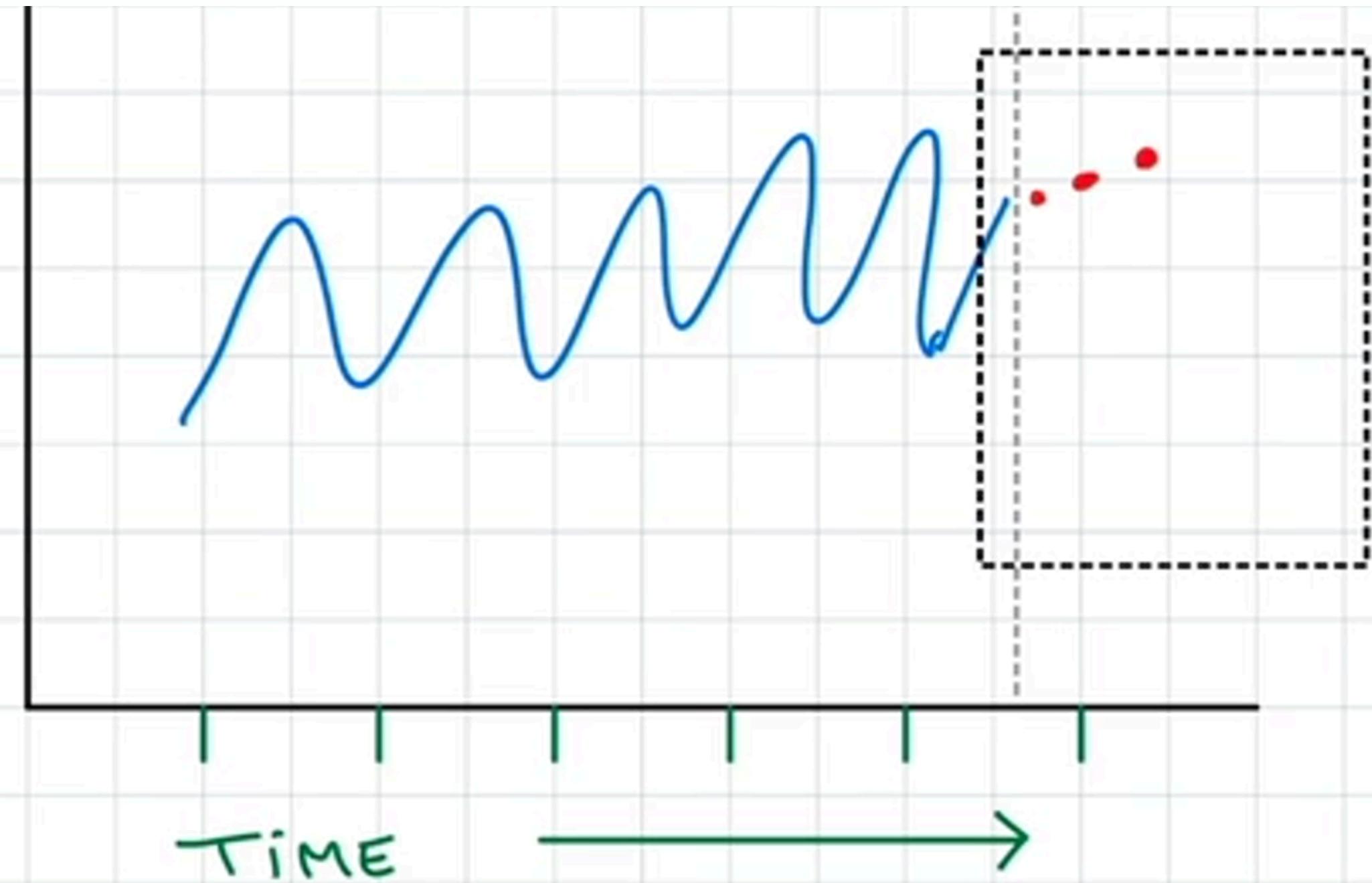
B] LSTM
Window=365

HYPERPARAMETER GRID



Auto-Regressive

ARMA MODEL (P, Q) VALUES



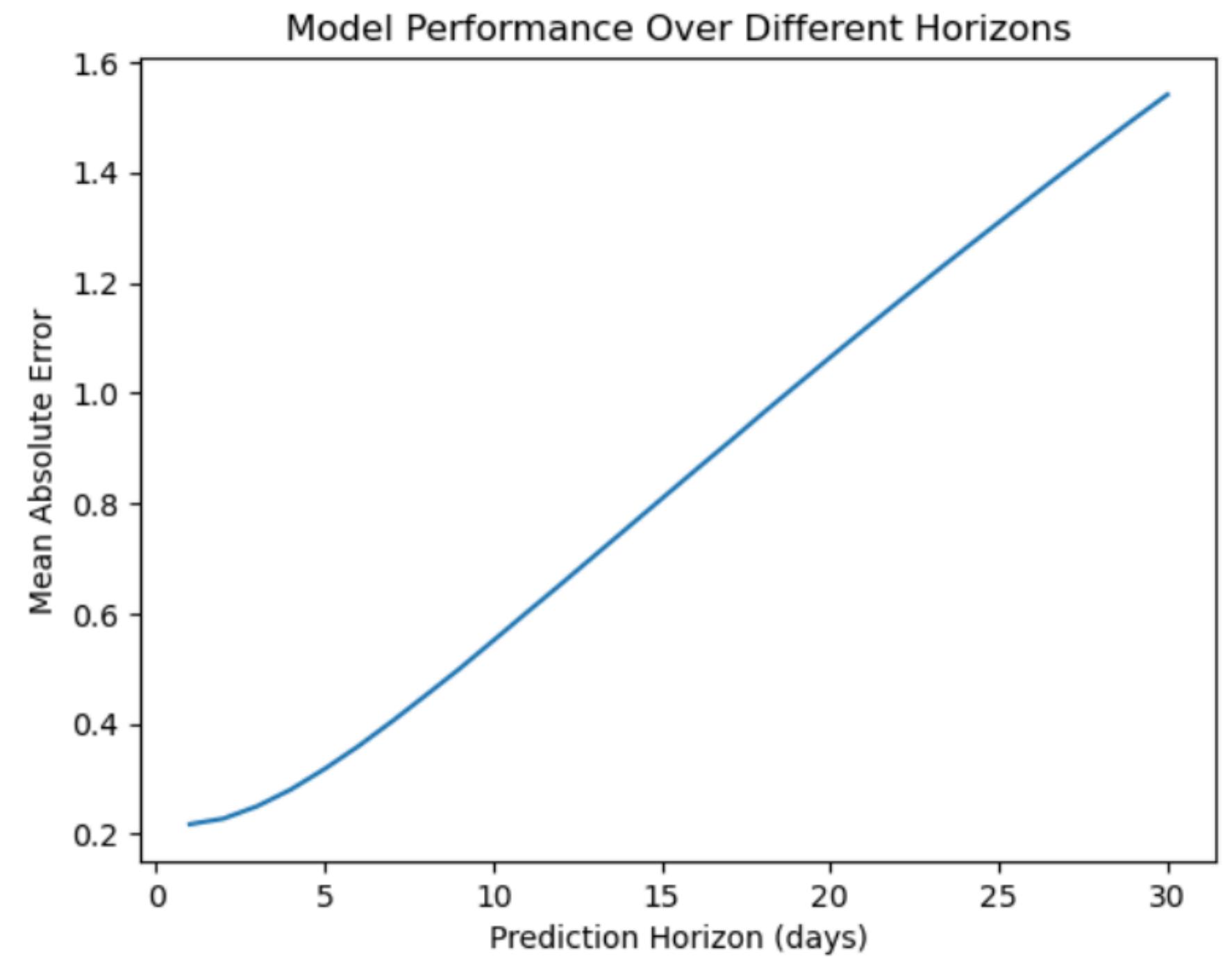


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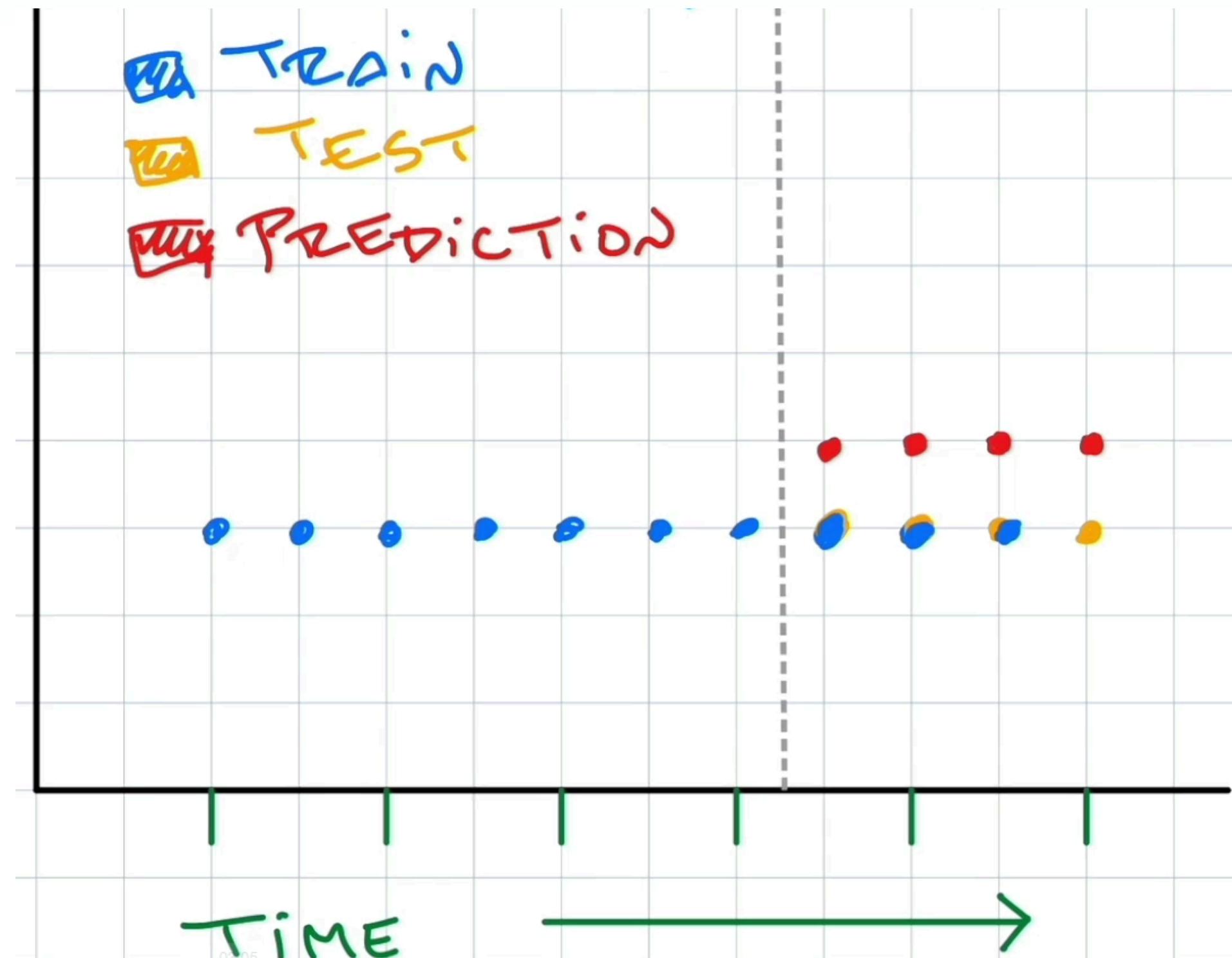


Walk-Forward Validation

The Problem:



The Solution:

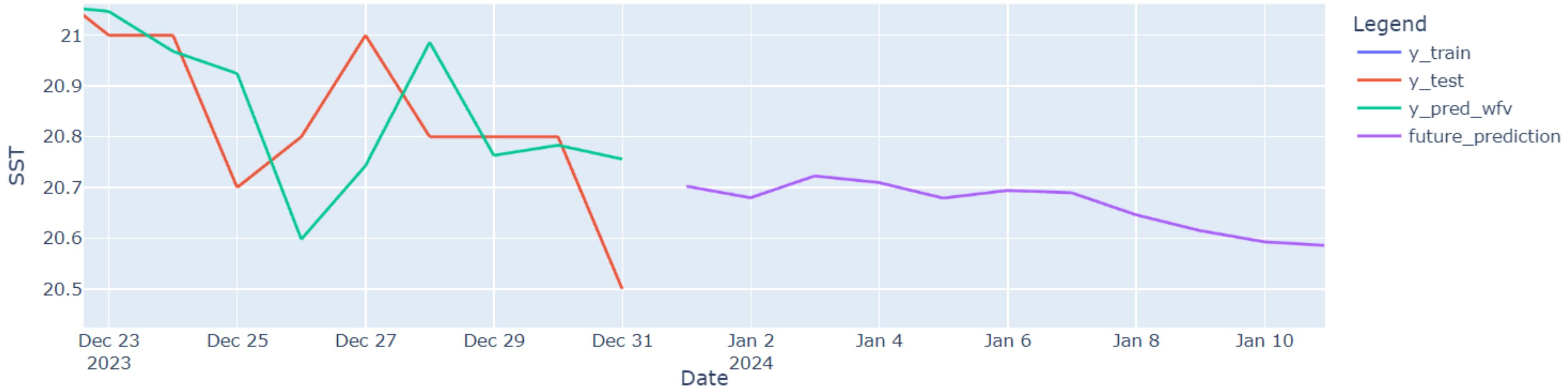




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Auto-Regressive WVF Methodology



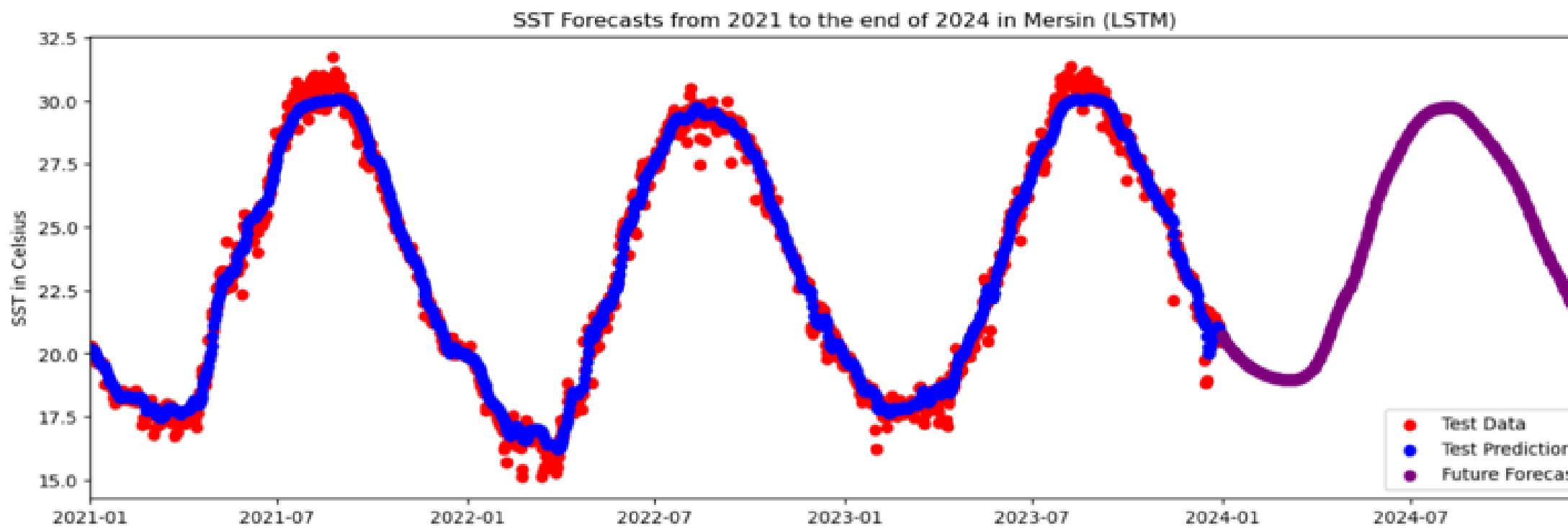
- Continuous data collection is necessary



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LSTM Window = 365

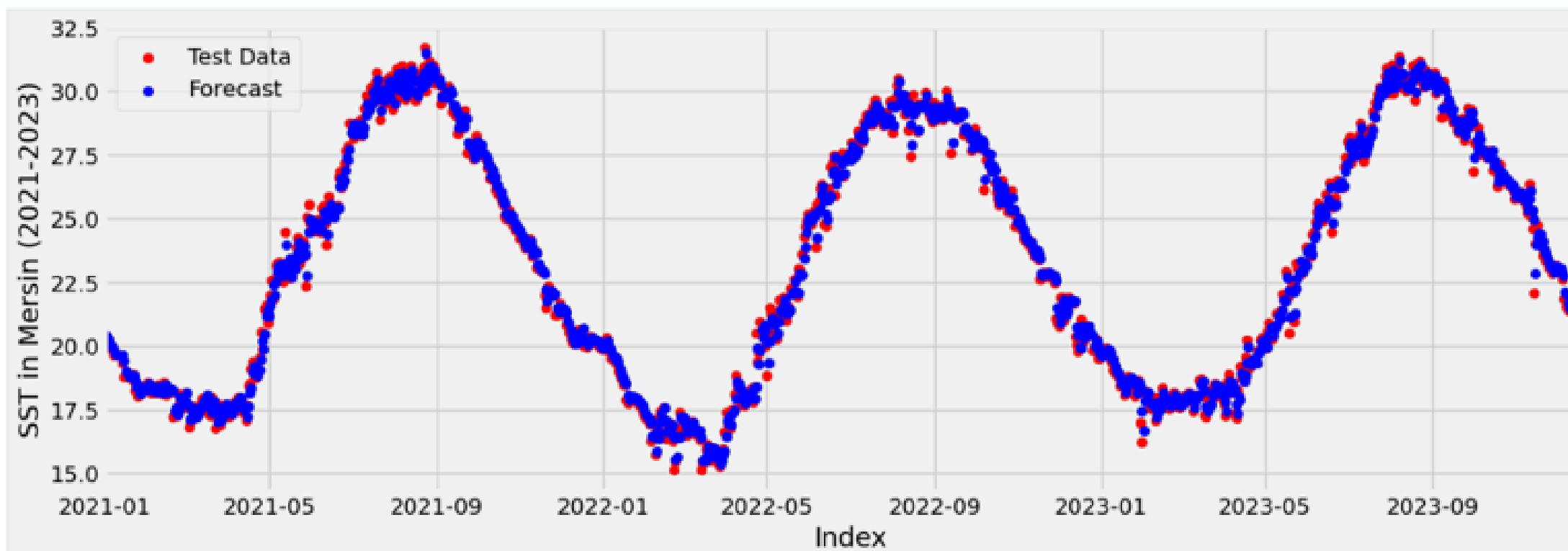


SST Results

98.57%

Increase in the winter of 2024

Auto-Regressive P=8



98.9%

Walk-Forward Validation

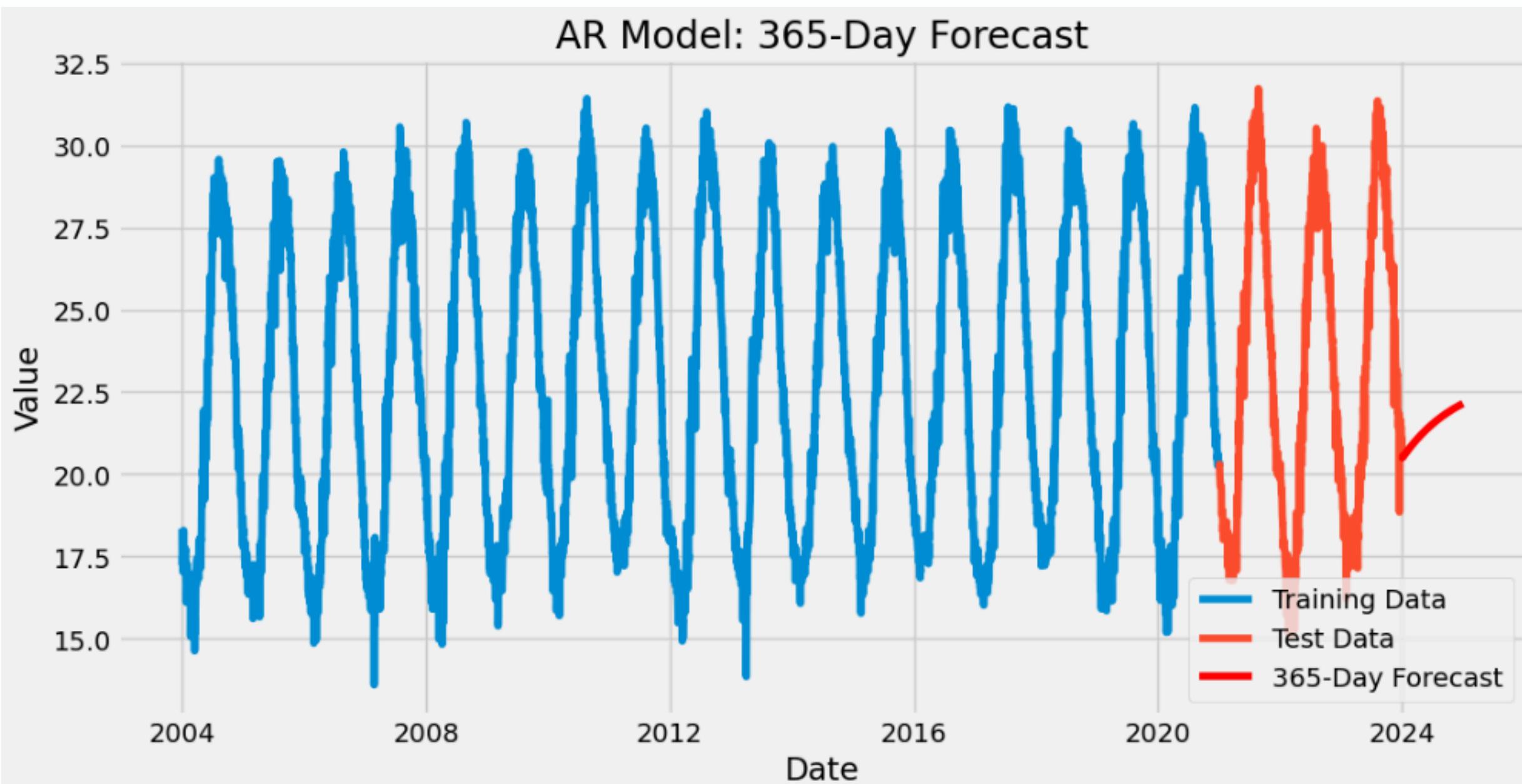


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SST in Future



forecasts:

2024-01-01: 20.5

2024-12-30: 22.2

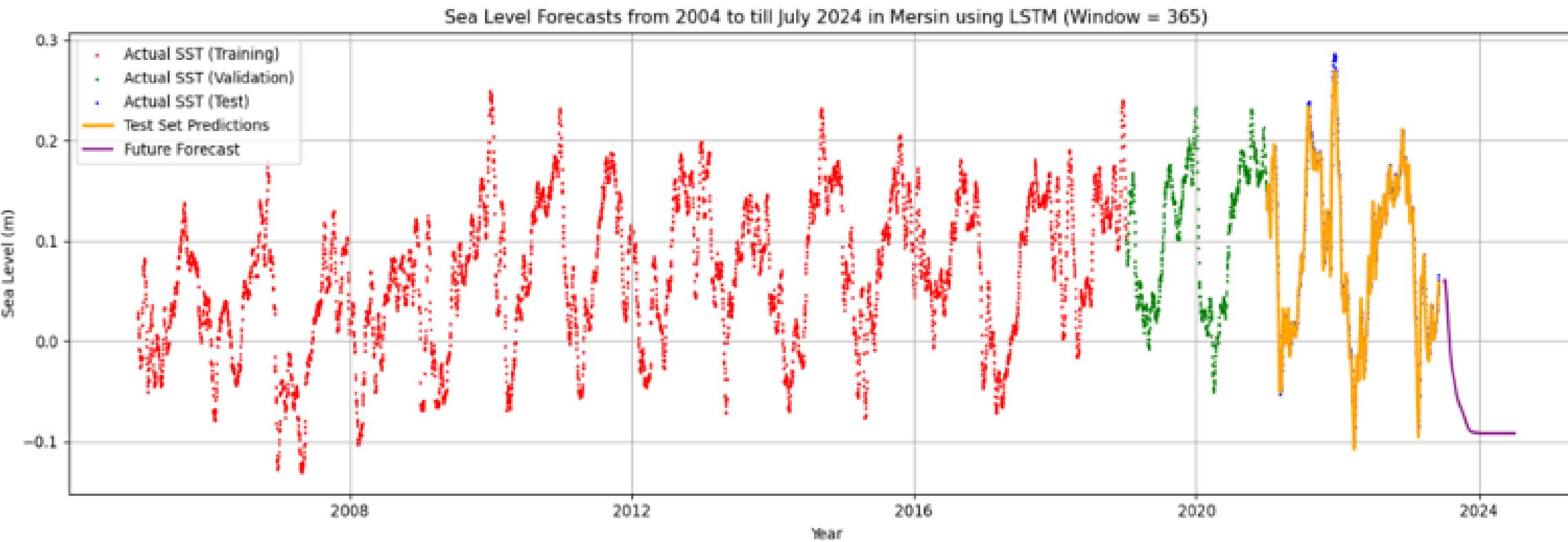
Almost 2 degree celsius of increases between the beginning of 2024 and the beginning of 2025



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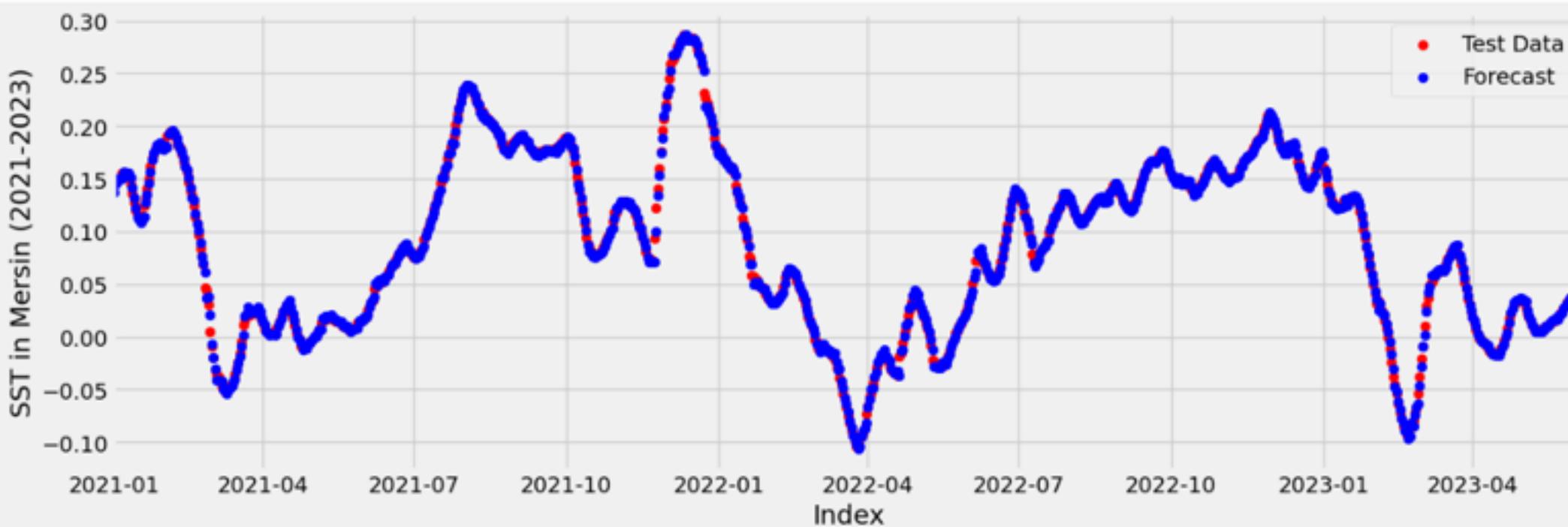
LSTM Window = 365



Sea Level Results

99.21%

Auto-Regressive P=8



99.81%
Walk-Forward Validation

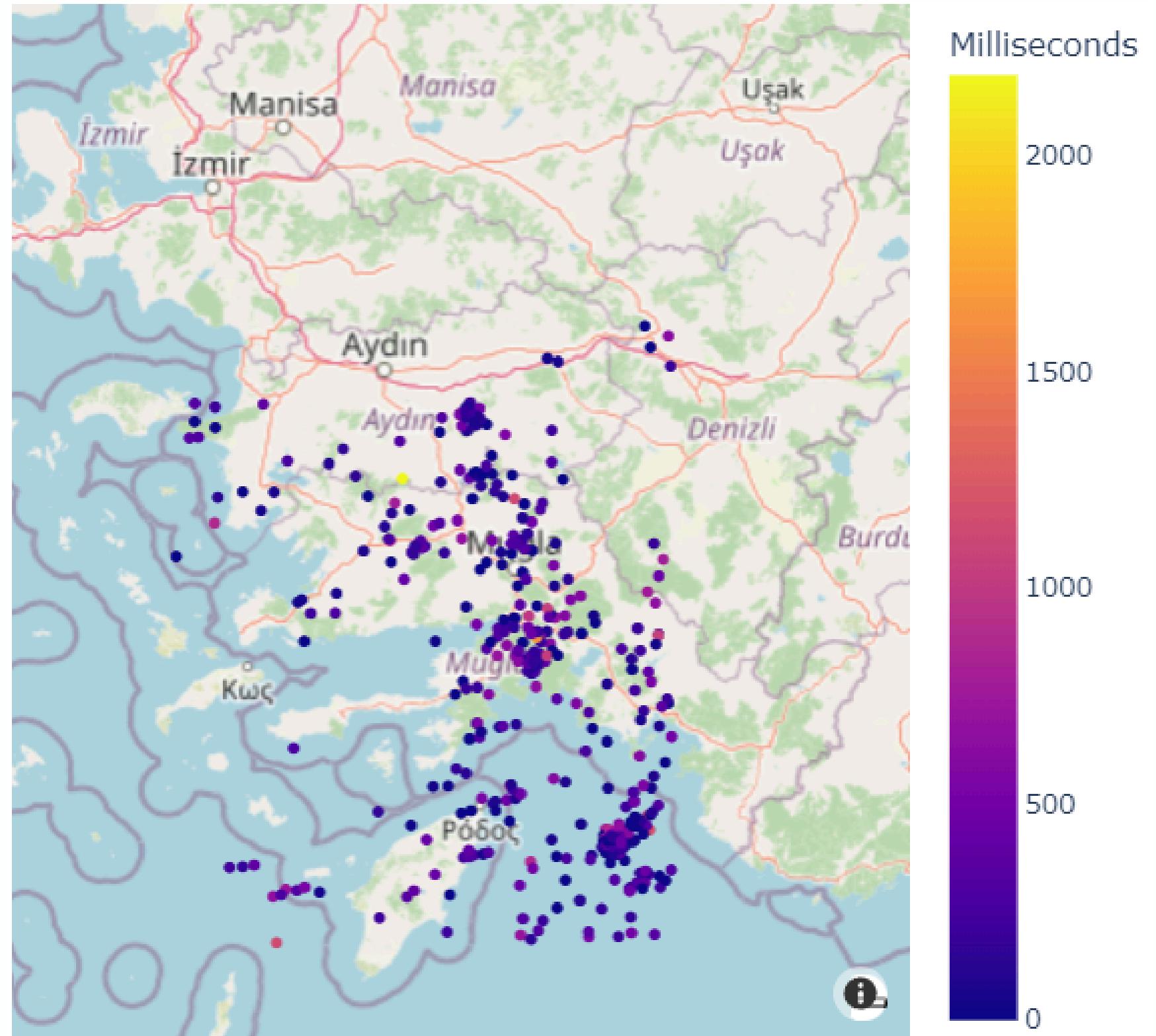
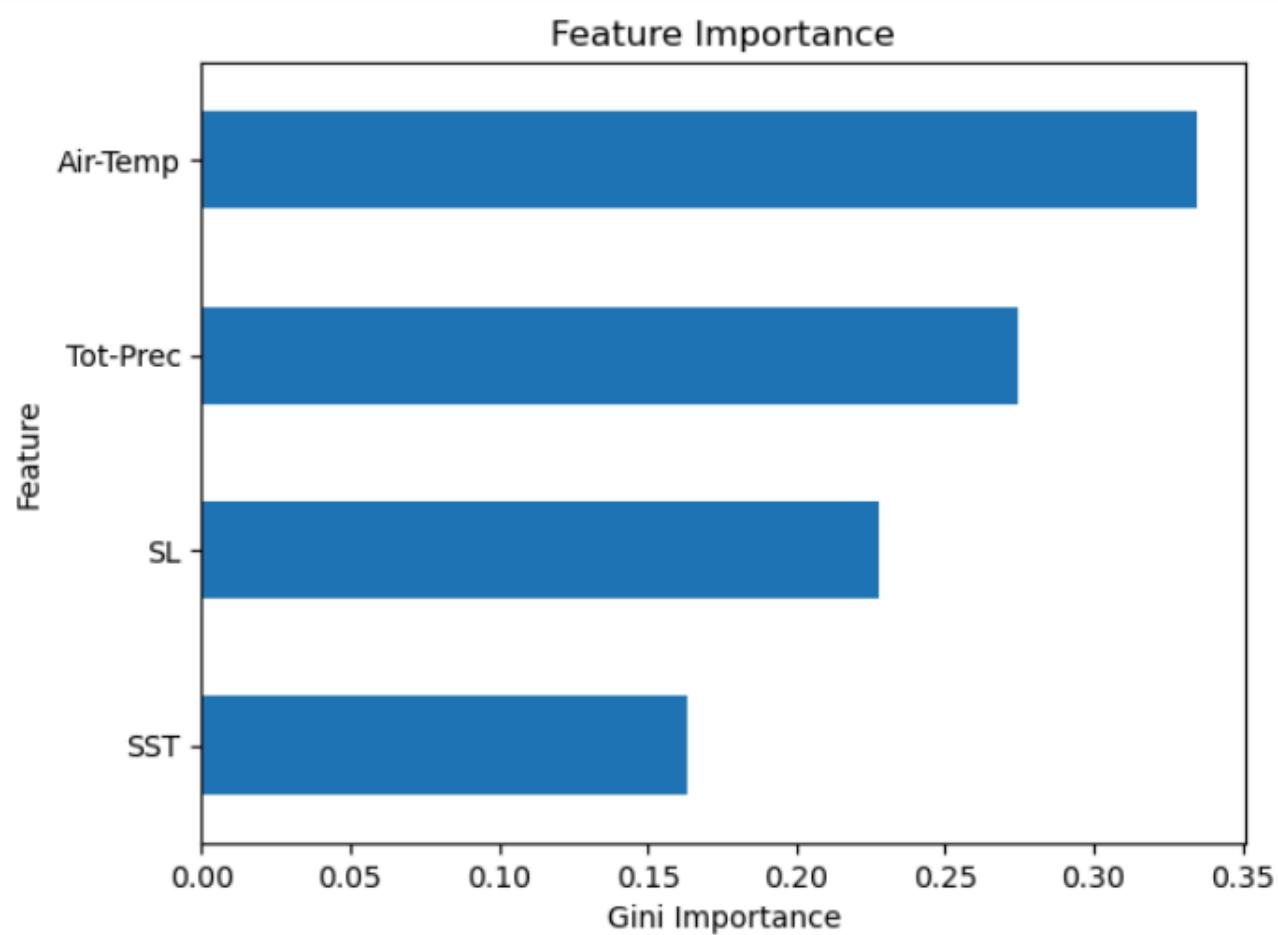


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Further Work - Flashing -ML Classification

	SL	SST	Air-Temp	Tot-Prec	Event
SL	1.000	0.618	0.276	-0.073	0.004
SST	0.618	1.000	0.869	-0.188	-0.081
Air-Temp	0.276	0.869	1.000	-0.202	-0.117
Tot-Prec	-0.073	-0.188	-0.202	1.000	0.209
Event	0.004	-0.081	-0.117	0.209	1.000





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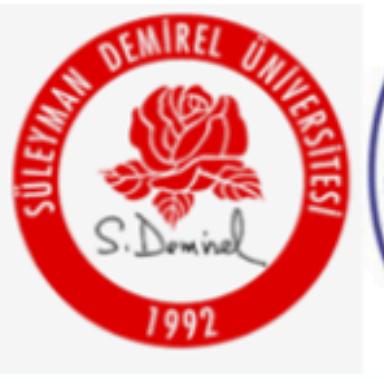


United Nations Strategic Development Goals





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Acknowledgement

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Thanks for listening!

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