

# RAINFALLS IN NAVARCLES: Visualisation and Forecasting

Liubov Shubina

# NAVARCLES (Catalonia, Spain)

Eastern end of the Pla de Bages  
11 km from the regional capital, Manresa



Llobregat River, where it  
meets the Calders River

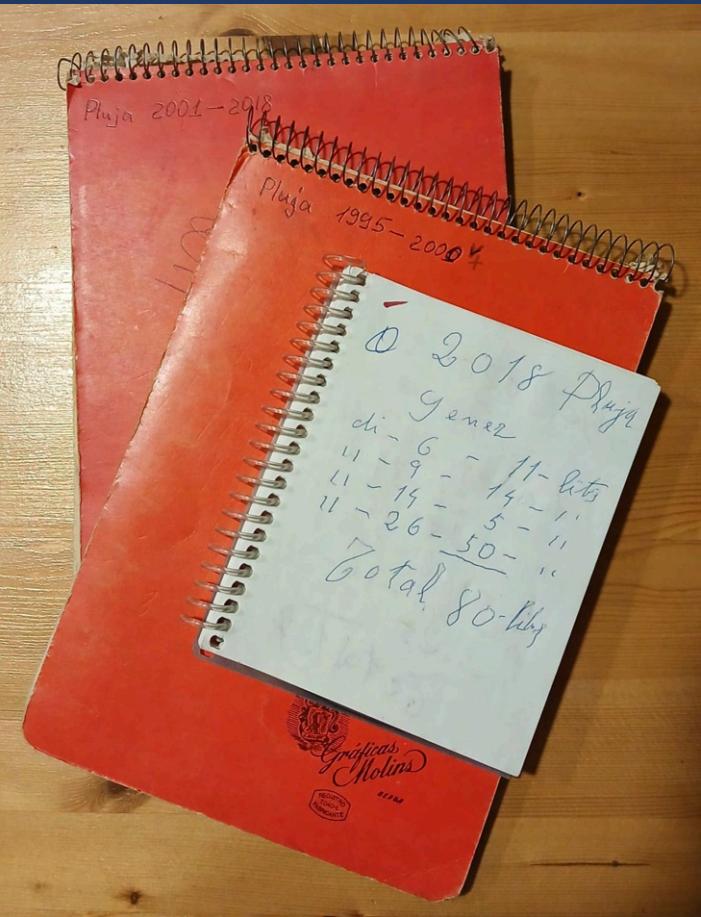


Montserrat Mountain



# DATA

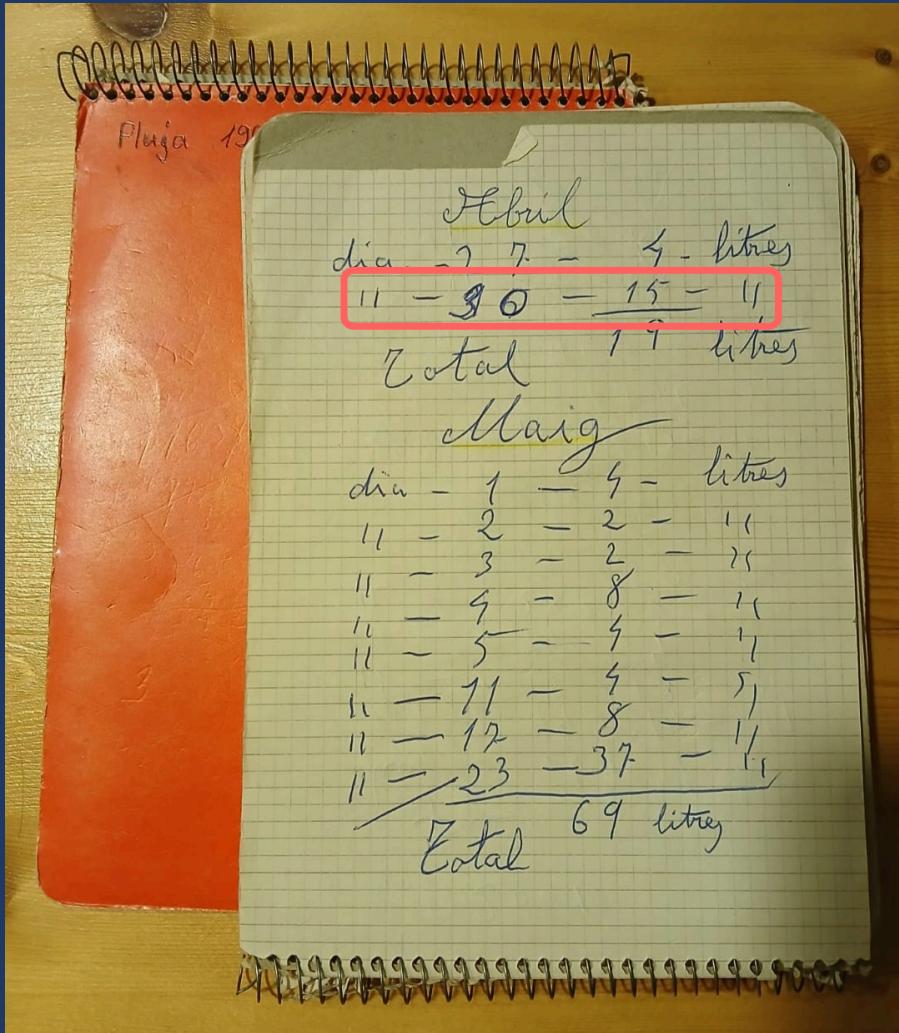
Manually collected daily precipitation data from 1995 to 2024



*Carmel Puig Vilaragut*

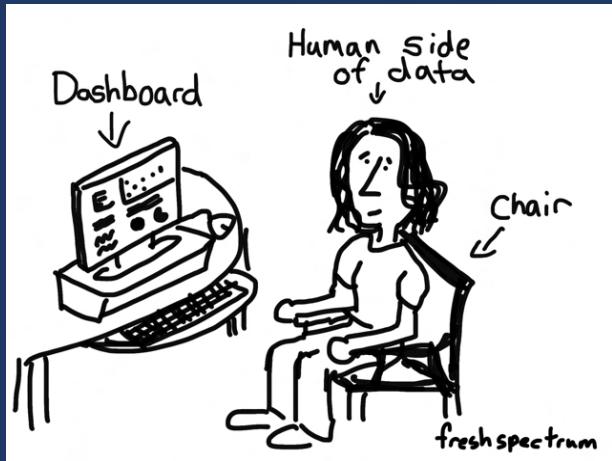
# DATA: RECOLLECTING

100% analog

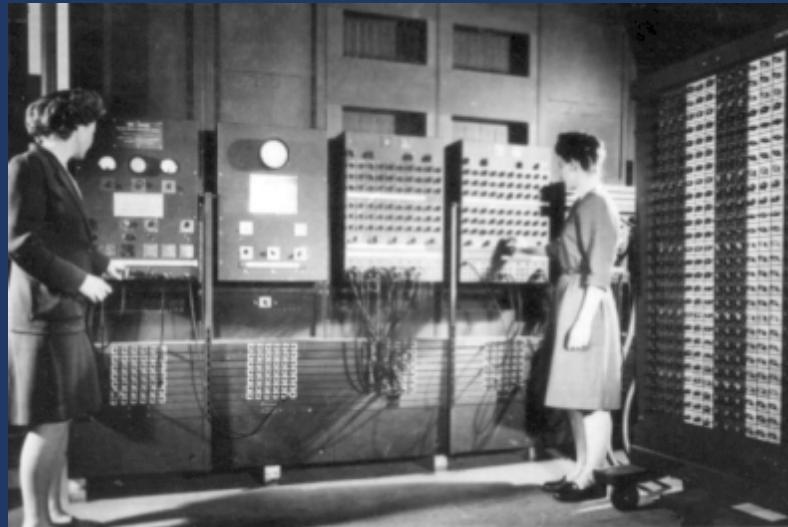


# GOAL

- Develop a user-friendly dashboard to visualize precipitation in Navarcles



- Build a machine learning (ML) model to predict monthly rainfall



[https://en.wikipedia.org/wiki/History\\_of\\_numerical\\_weather\\_prediction](https://en.wikipedia.org/wiki/History_of_numerical_weather_prediction)

# DATA: TRANSFORMATION AND PREPROCESSING



dia - 28 - 2-litres  
Total Feb 65-litres  
Maig  
dia - 10 - 29-litres  
11 - 12 - 6 - 11  
11 - 22 - 27 - 11  
11 - 27 - 6 - 1  
Total 68 litres  
Juny  
dia - 5 - 24-litres  
11 - 10 - 130 - 11  
Total 135 litres  
Juliol  
dia 25 - 7 - litres  
Total - 7 - litres



df	
	rainfall
full_date	
1995-01-01	0.0
1995-01-02	0.0
1995-01-03	0.0
1995-01-04	0.0
1995-01-05	0.0
...	...
2024-12-27	0.0
2024-12-28	0.0
2024-12-29	0.0
2024-12-30	0.0
2024-12-31	0.0

10958 rows × 1 columns

# DATA: MISSING VALUES

Coneix				
Dia	22	--	6	Altres
Dia	23	--	17	Altres
Dia	24	--	19	Altres
11	28	--	2	-- 11
11	29	--	12	-- 20
11	30	--	13	-- 11
Total	Coneix	69		
	Altres	765		
		745	5	Altres
Total				
No coneix				
dia	—	2	—	2 — litros
11	—	6	—	16 — 11
11	—	8	—	10 — 11
11	—	14	—	9 — 11
11	—	24	—	4 — 11
11	—	26	—	35 — 14



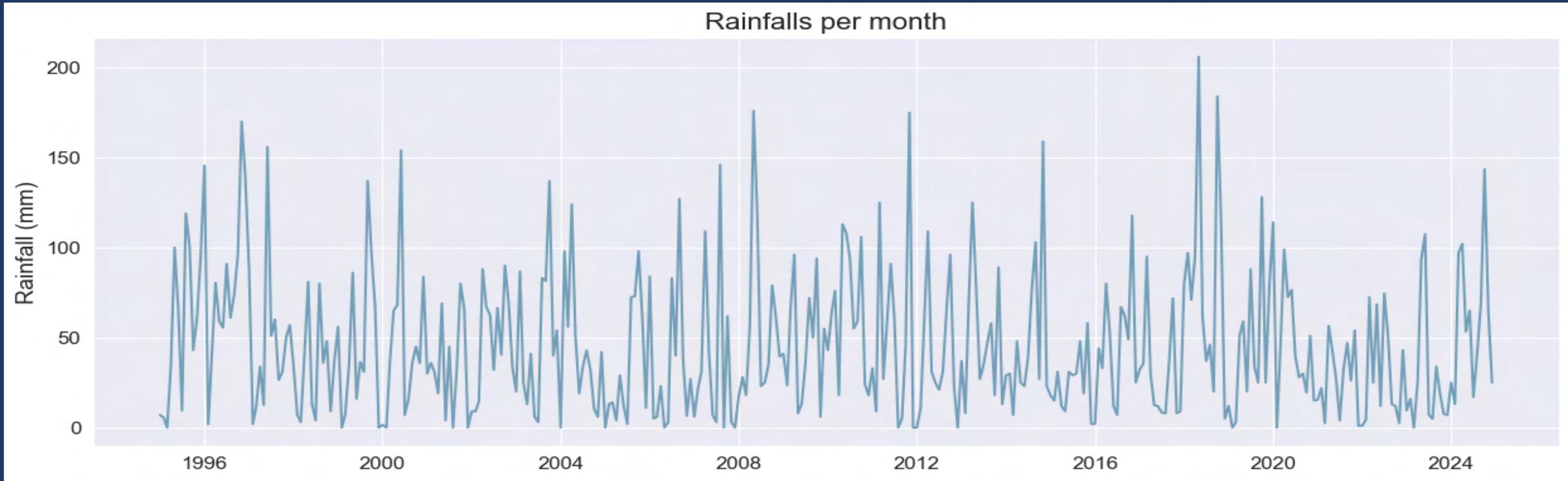
## CADTEP database for Manresa

<https://www.meteo.cat/web/climatologia/dades-i-productes-climàtics/series-climatiques-des-de-1950/>

## Navarcles City Hall's Data

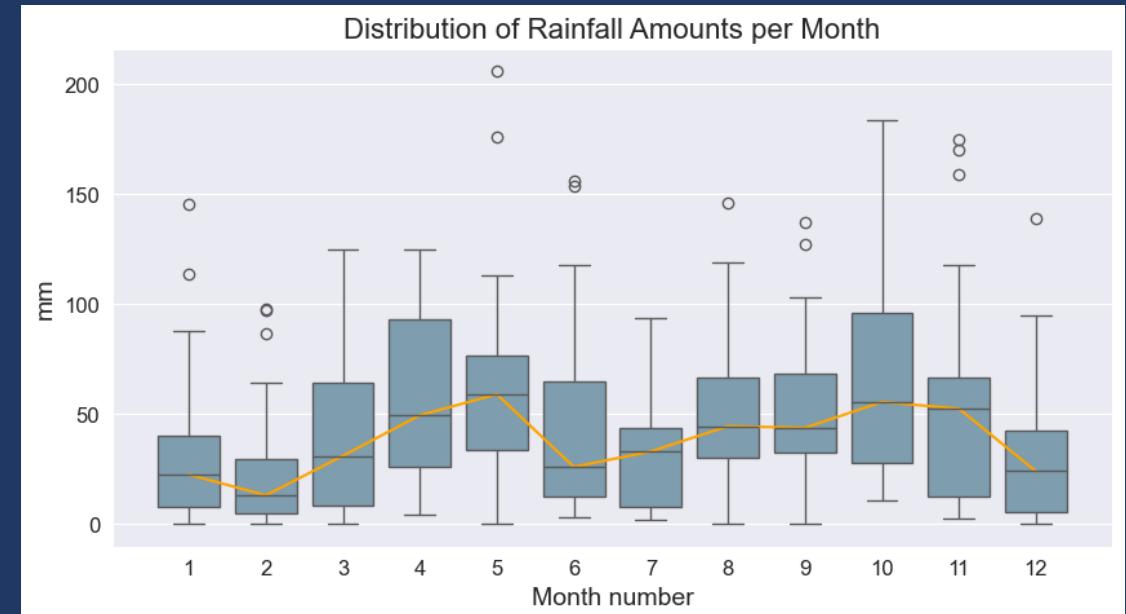
<https://www.navarcles.cat/el-municipio/informacio-meteorologica/resums-climatologics>

# Significant variation in monthly rainfall

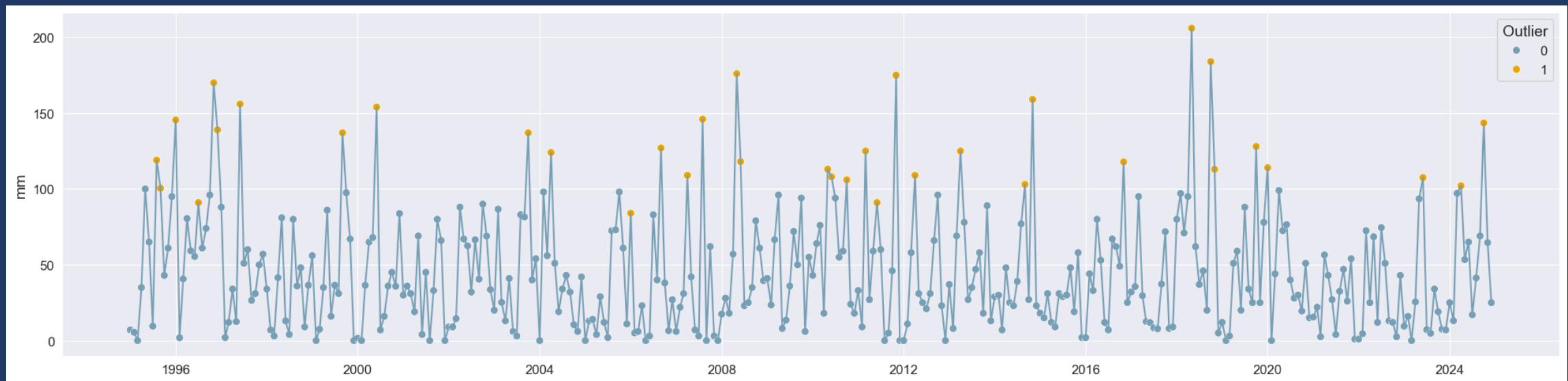


# HIGH VARIABILITY

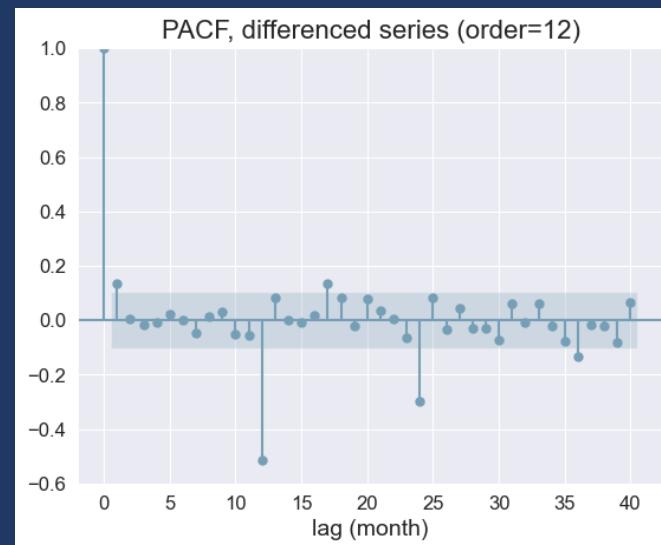
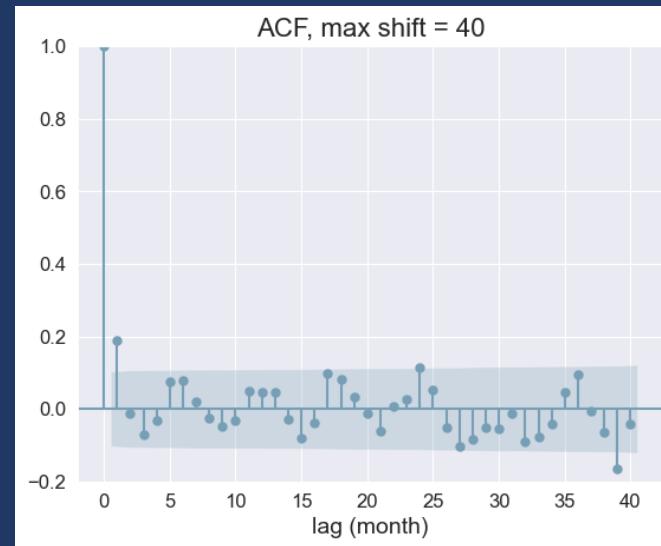
- large spread in monthly rainfall amounts
- some indication of annual seasonality: higher rainfalls in the spring and autumn



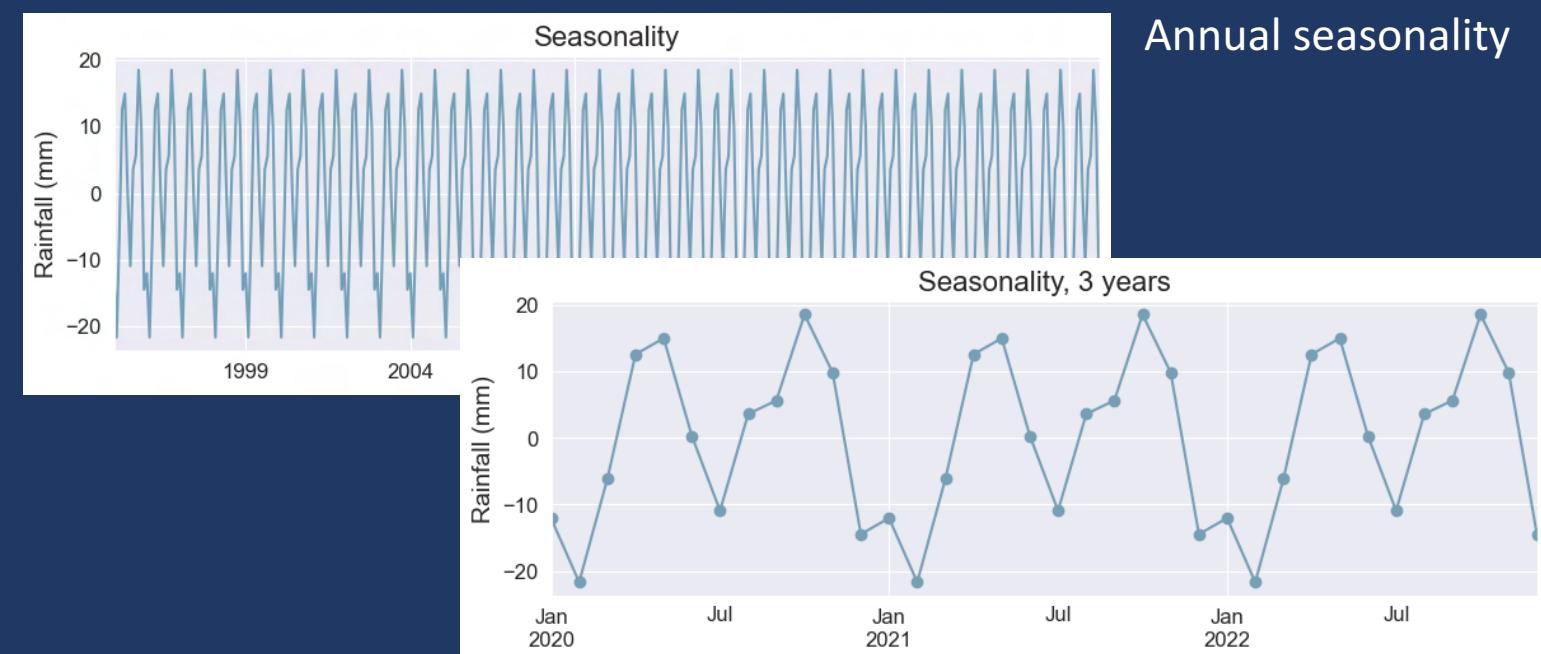
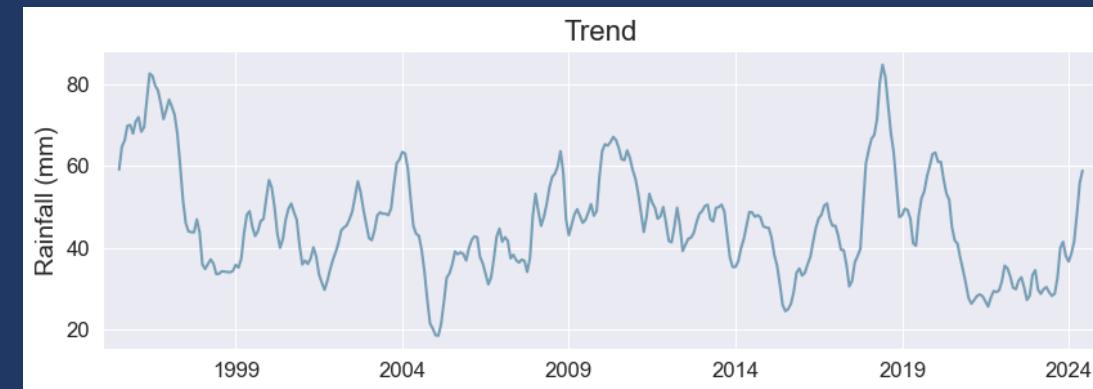
Outliers detected by the KNN



# Auto-Correlation



# Seasonal Decomposition



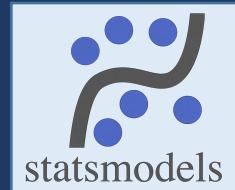
# MODELING

## Base Model

median rainfall for each month based on past data

## Specific

- SARIMA (Statsmodels):  
analytically selected parameters



- Auto-ARIMA (Pmdarima):  
automatically discovered optimal parameters

- Prophet (Facebook):  
useful for data with strong  
seasonal patterns



- SARIMAX (Statsmodels):  
SARIMA with external regressors

## Non-specific

- ElasticNet (Scikit-Learn):  
implementation of regularization

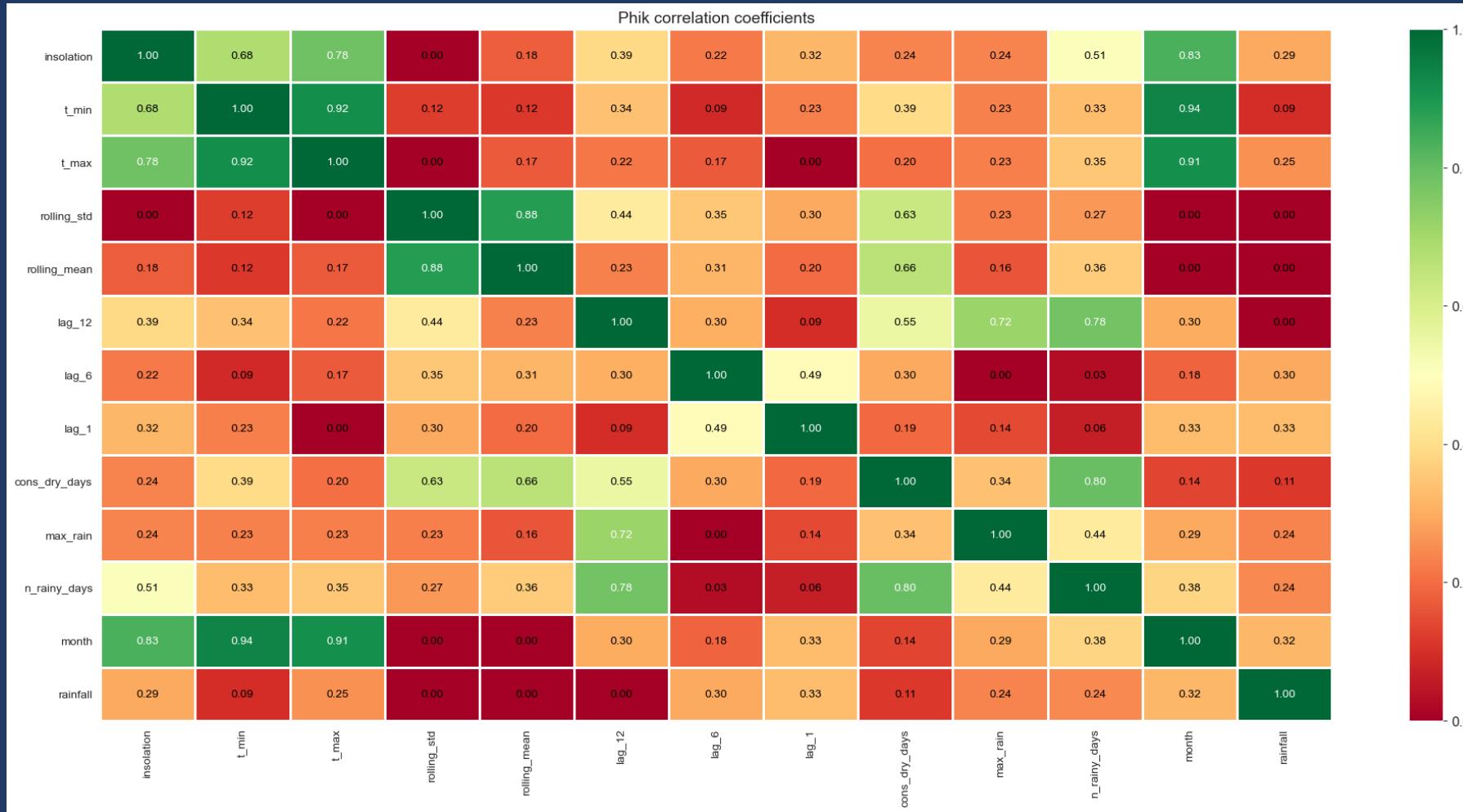


Tree-based, might capture potential non-linearities

- LightGBM (Microsoft)
- CatBoost (Yandex)



# EXOGENOUS FEATURES



- Month
- Number of rainy days
- Max rainfall
- Max N of consecutive dry days

Data from Manresa dataset:

- Medians of max/min temperature, insolation

Lag Rainfall:

- Previous month, 6 and 12 months ago (lag1, 6, 12)
- 12 months rolling mean
- 12 month rolling SD

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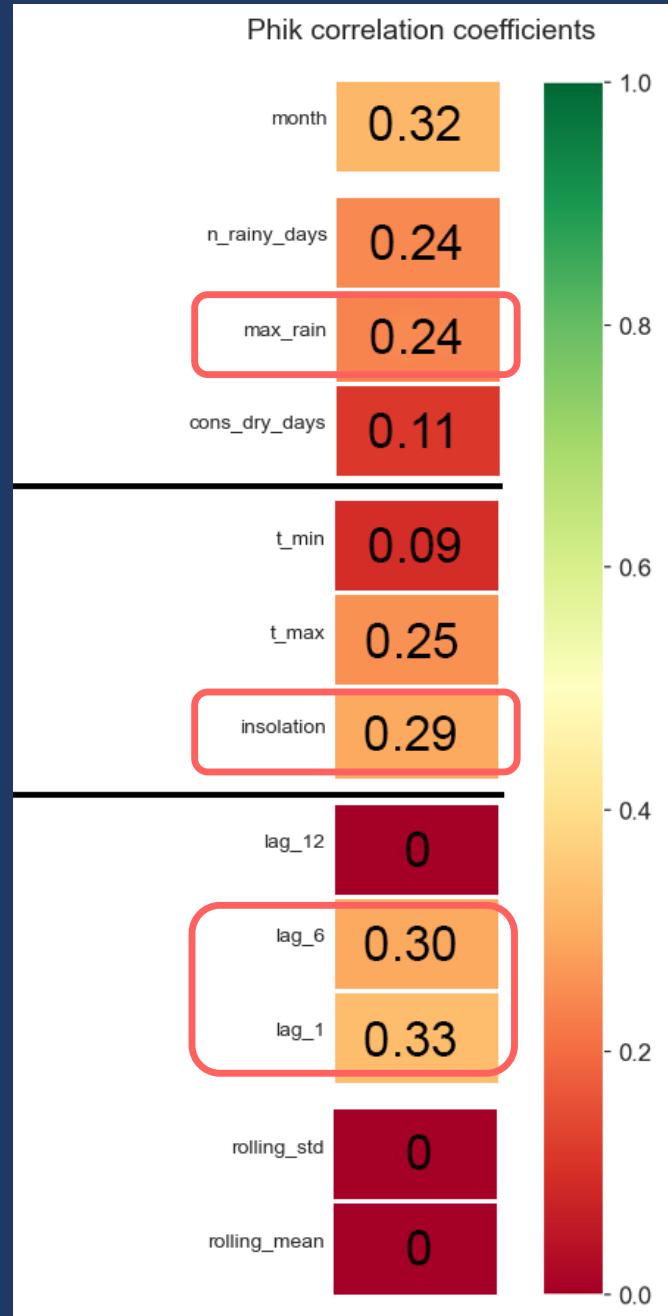
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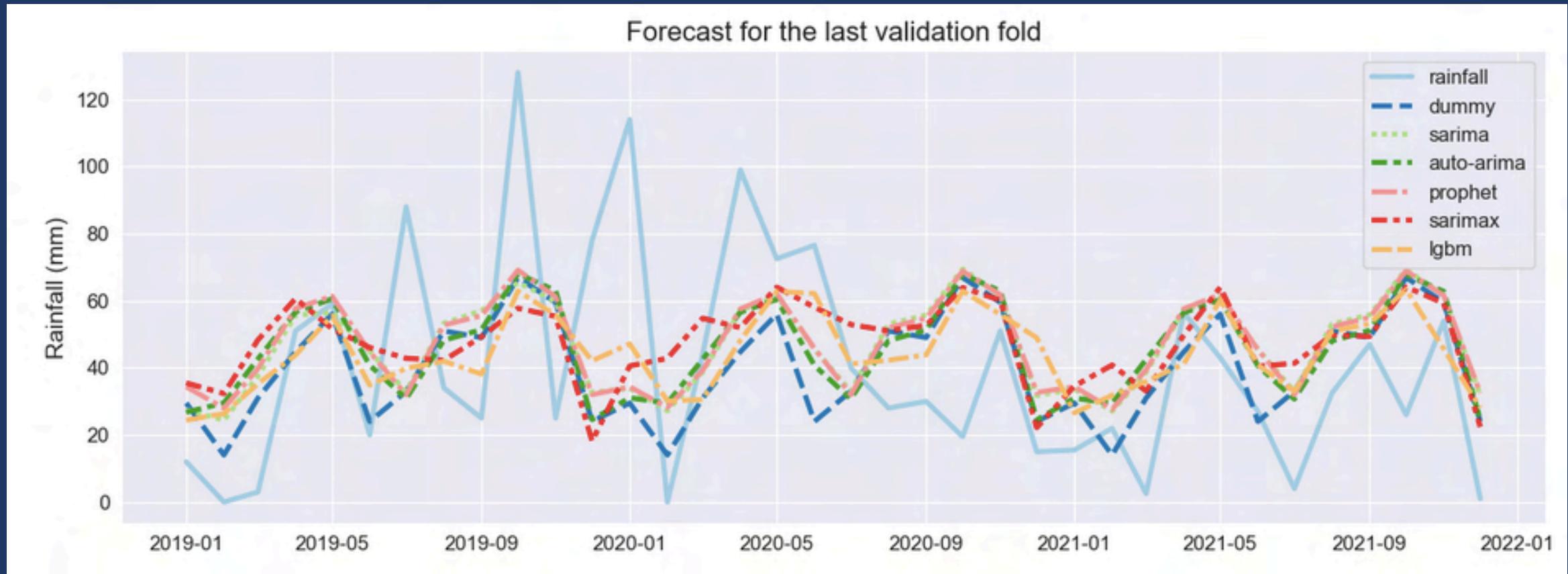
Lag Rainfall:

- Previous month, 6 and 12 months ago (lag1, 6, 12)
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*Rainfall does not show a significant correlation with any of the features.*

# MODEL COMPARISON



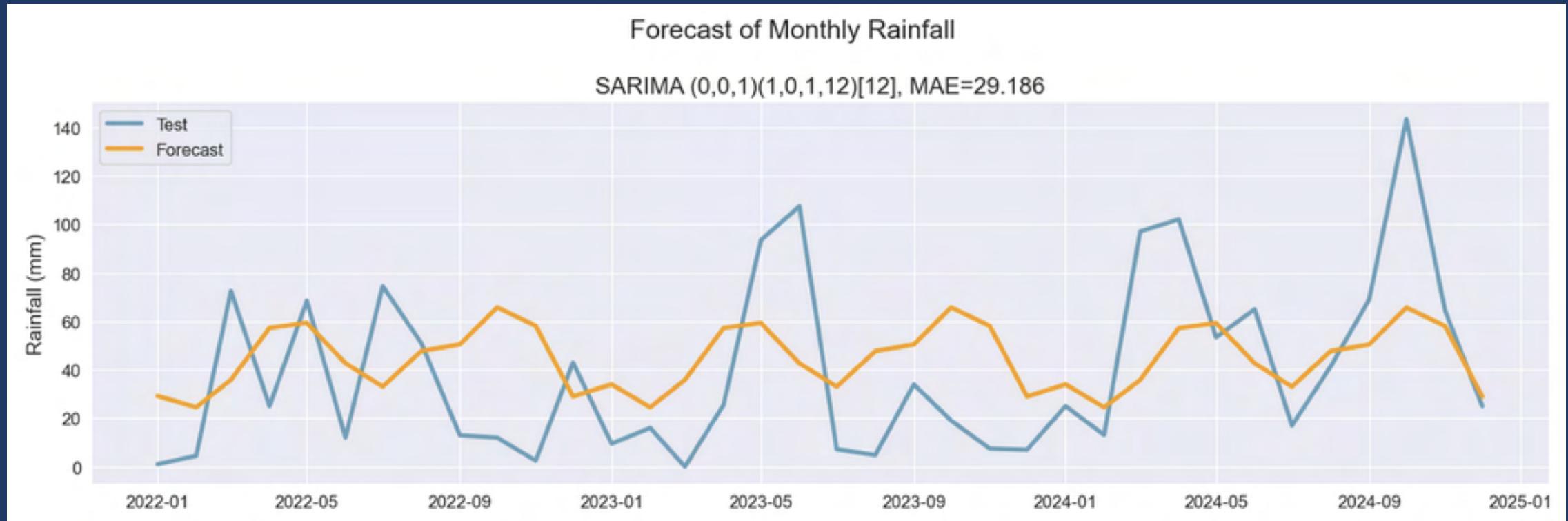
# MODEL COMPARISON

Average Rainfall: 45.89, SD = 39.56

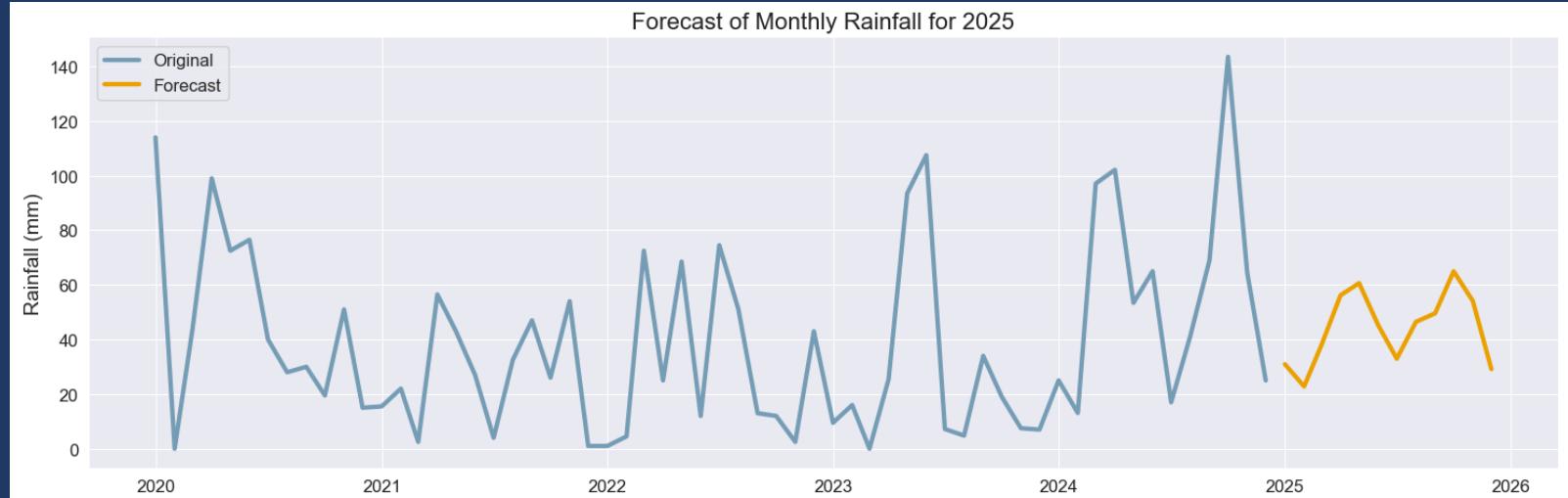
Model	Parameters	Cross-Validation MAE	STD
Median Model		30.68	4.16
SARIMA	(1,0,1)(1,1,1,12)	32.80	7.88
Auto-ARIMA	(0,0,1)(1,0,1)[12]	29.35	3.38
Prophet	yearly seasonality, multiplicative	29.72	3.44
SARIMAX	(0,0,1)(1,0,1)[12] X: maximum rain, lag6, insolation	30.63	3.34
LightGBM	num_leaves=72, n_estimators=130, max_depth=11, learning_rate=0.01	30.98	4.01

# TESTING

Test set – 10%, last 3 years



# FORECAST FOR 2025



Month	Total Rainfall, mm	Actual, mm
Jan	31	1.5
Feb	23	45
March	38	
Apr	56	
May	61	
June	45	
July	33	
Aug	46	
Sept	50	
Oct	65	
Nov	54	
Dec	29	

## CONCLUSION:

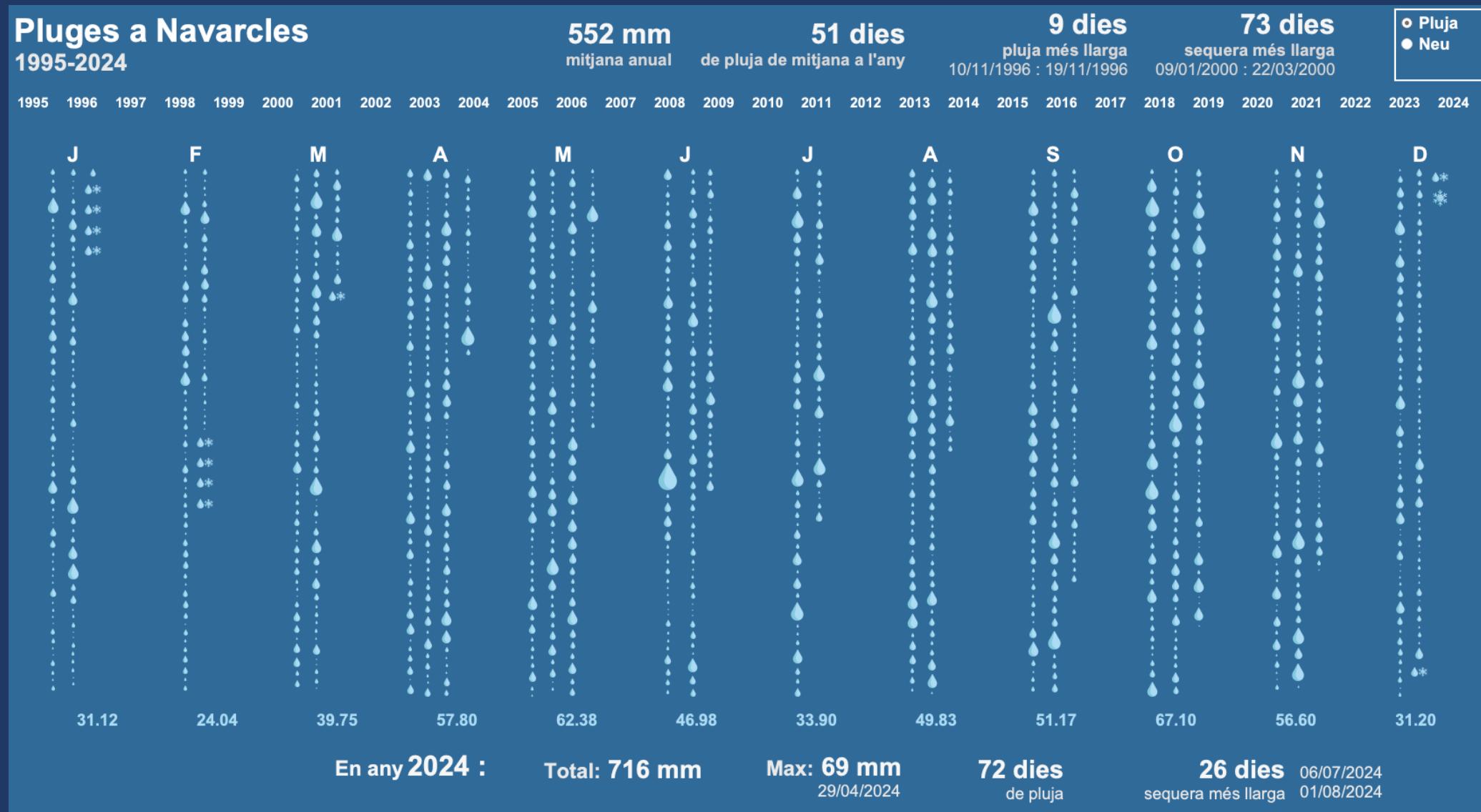
Due to the inherently unpredictable and random nature of weather patterns, accurately forecasting rainfall remains a challenging and complex task and needs good predictors



If we can't look into the future,

we can explore the past

# VISUALISATION: Dashboard in Tableau Public



[https://public.tableau.com/app/profile/liubov.shubina/viz/Rainfall\\_Navarcles/Dashboard\\_1995-2024](https://public.tableau.com/app/profile/liubov.shubina/viz/Rainfall_Navarcles/Dashboard_1995-2024)

**Thank you for your attention!**

