

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

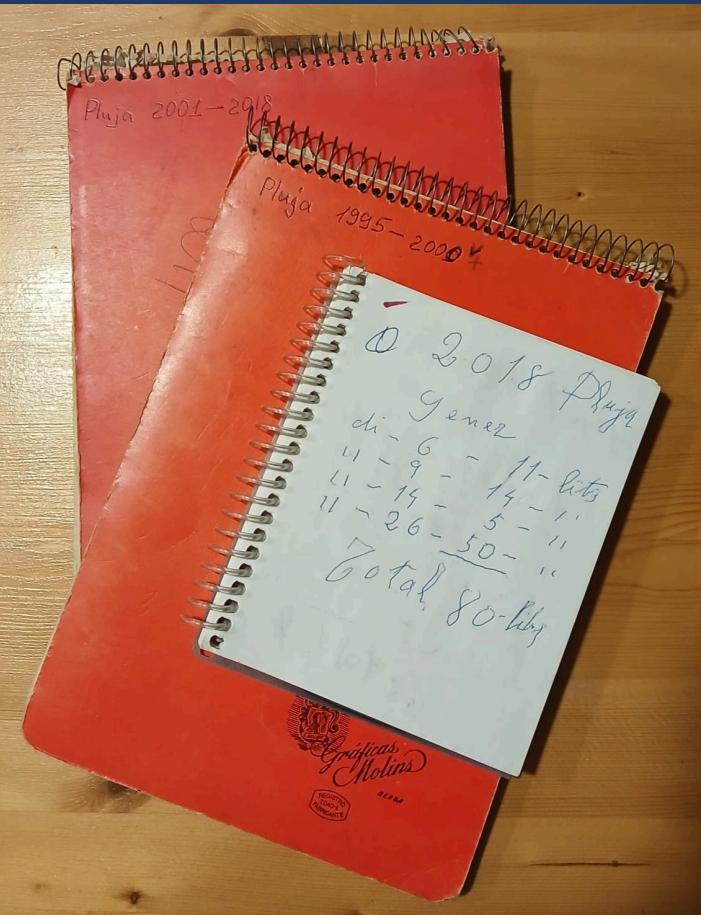


Montserrat Mountain



DATA

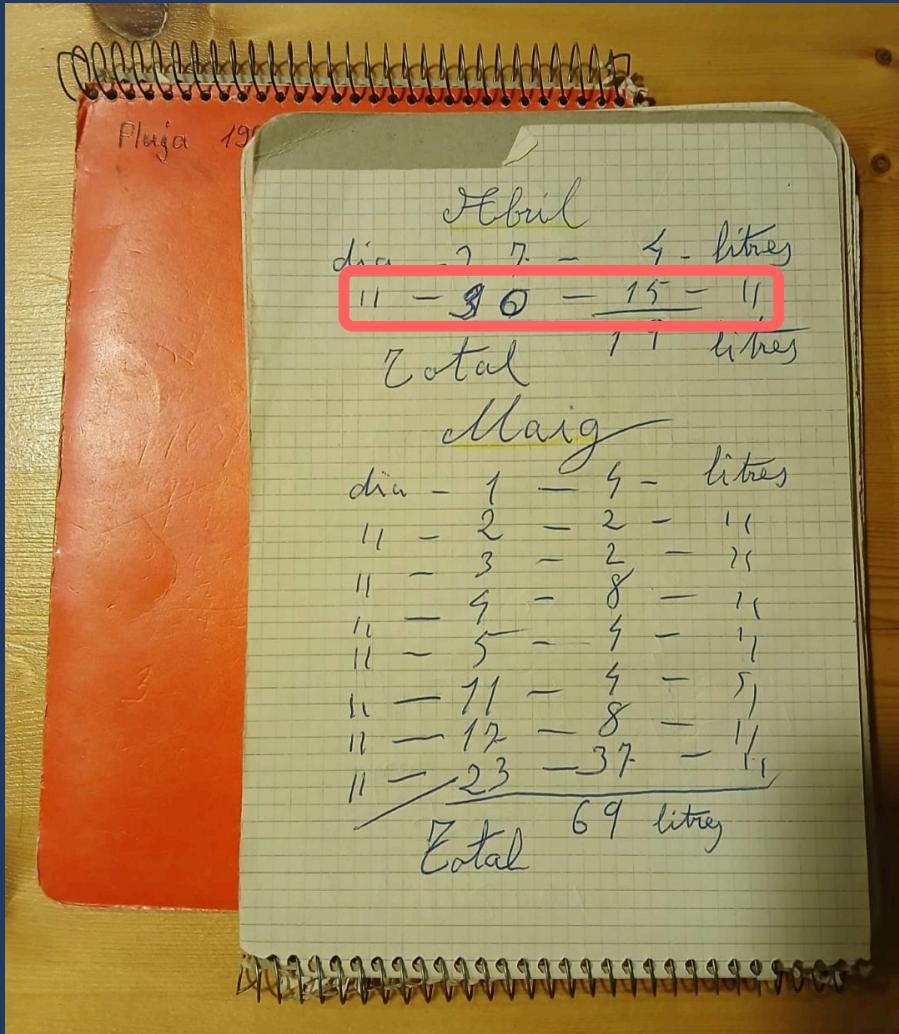
Manually collected daily precipitation data from 1995 to 2024



Carmel Puig Vilaragut

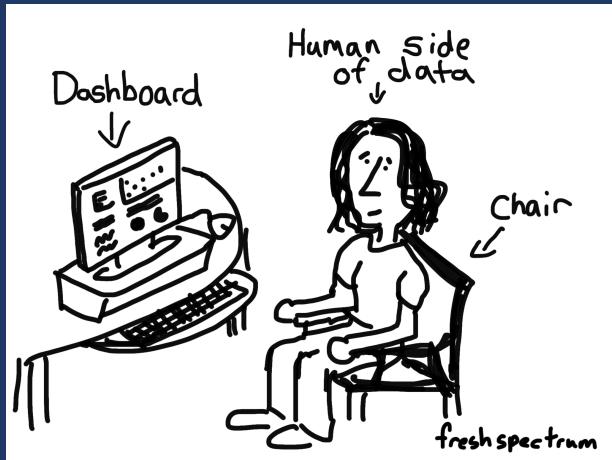
DATA: RECOLLECTING

100% analog

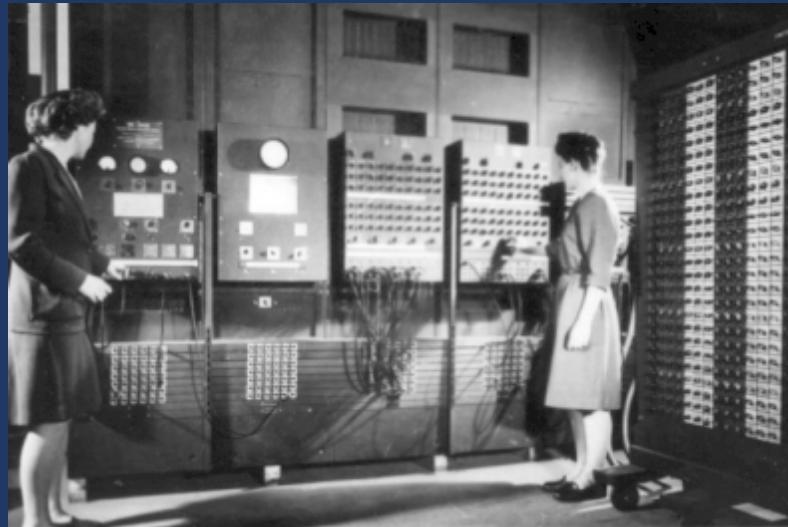


GOAL

- 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

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

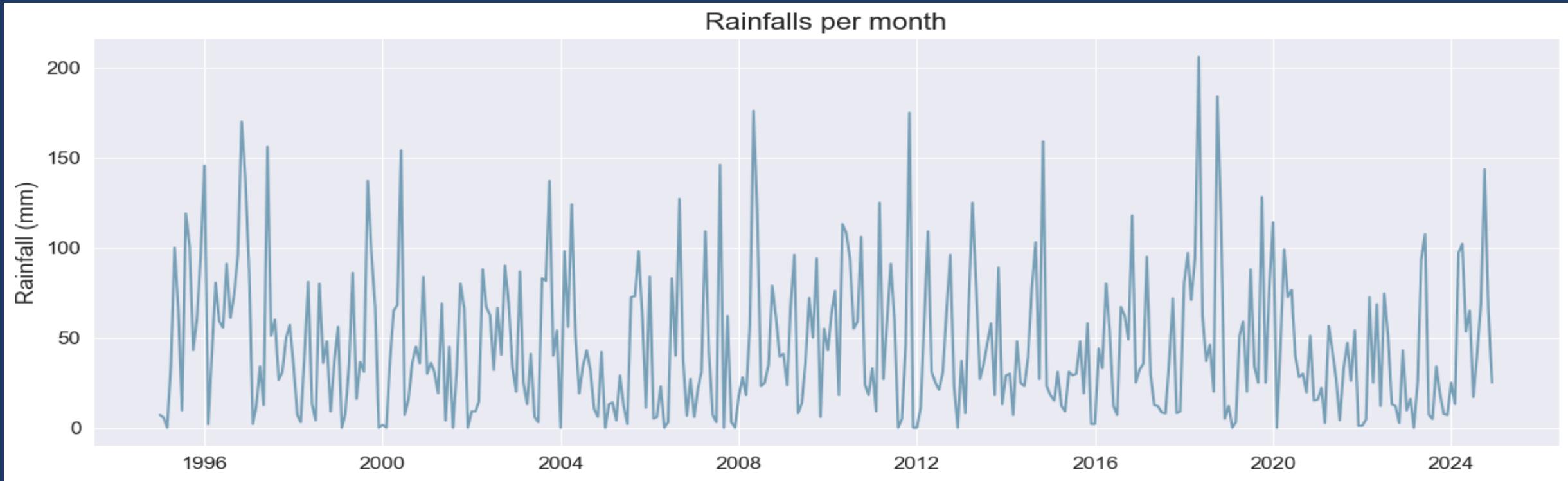
Missing values <- CADTEP database for Manresa

Gener			
Dia	22	--	6 litros
Dia	23	--	17 litros
Dia	24	--	19 litros
	28	--	2 - 1
	29	--	12 - 10
	30	--	13 - 11
Total	Gener	69	
		76.5	
		745.5	litros
Enero			
Dia	1	--	2 - litros
	6	--	16 - 11
	8	--	10 - 11
	14	--	9 - 11
	29	--	4 - 11
	26	--	35 - 14

df_manresa				
	rainfall	t_max	t_min	insolation
full_date				
1950-01-01	0.6	11.1	4.3	-99.9
1950-01-02	0.0	10.5	0.8	-99.9
1950-01-03	0.0	12.7	0.8	-99.9
1950-01-04	0.0	11.8	3.8	-99.9
1950-01-05	0.0	13.9	0.8	-99.9
...
2023-12-27	0.0	15.1	-3.2	7.2
2023-12-28	0.0	5.8	-4.1	0.2
2023-12-29	0.0	11.0	-0.4	0.8
2023-12-30	0.0	15.5	-0.3	7.3
2023-12-31	0.0	13.6	-0.1	3.0

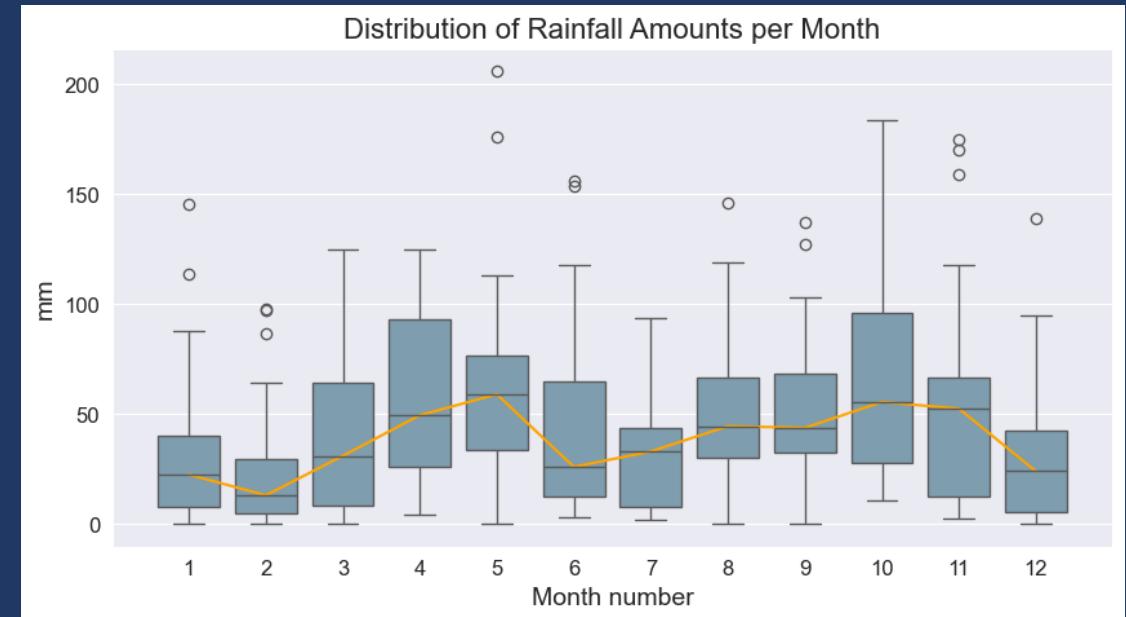
27028 rows × 4 columns

Significant variation in monthly rainfall

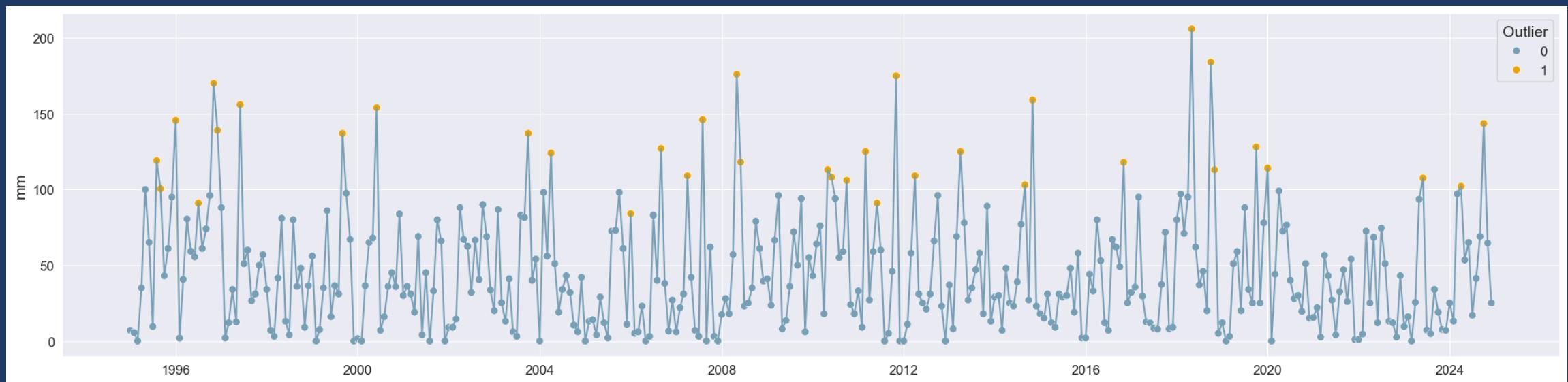


HIGH VARIABILITY

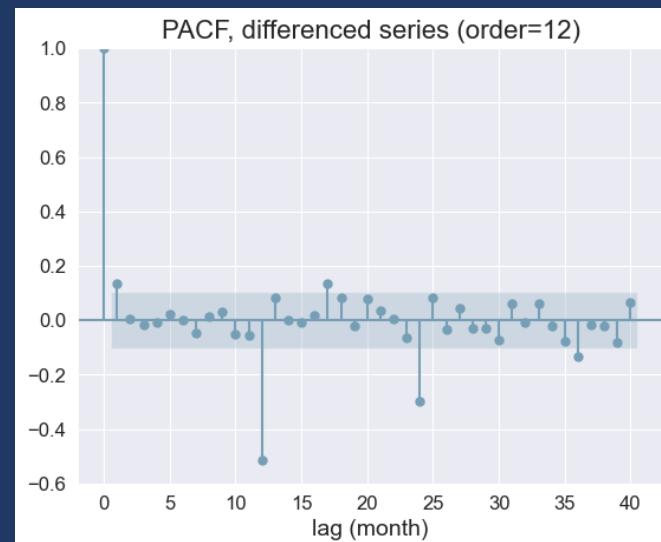
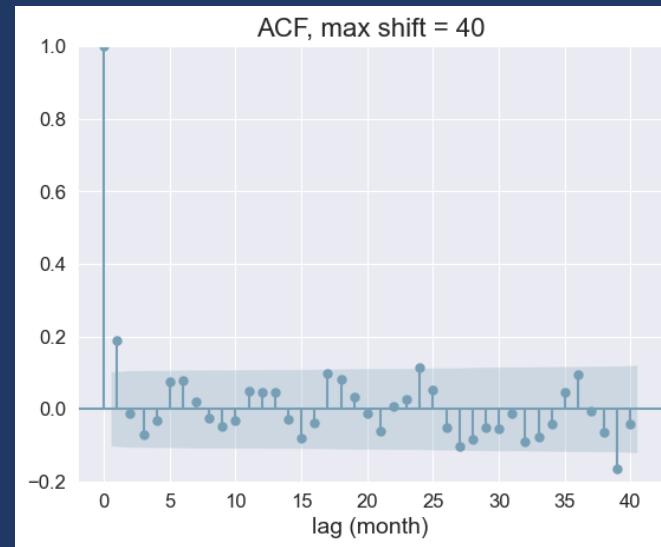
- large spread in monthly rainfall amounts
- some indication of annual seasonality: higher rainfalls in the spring and autumn



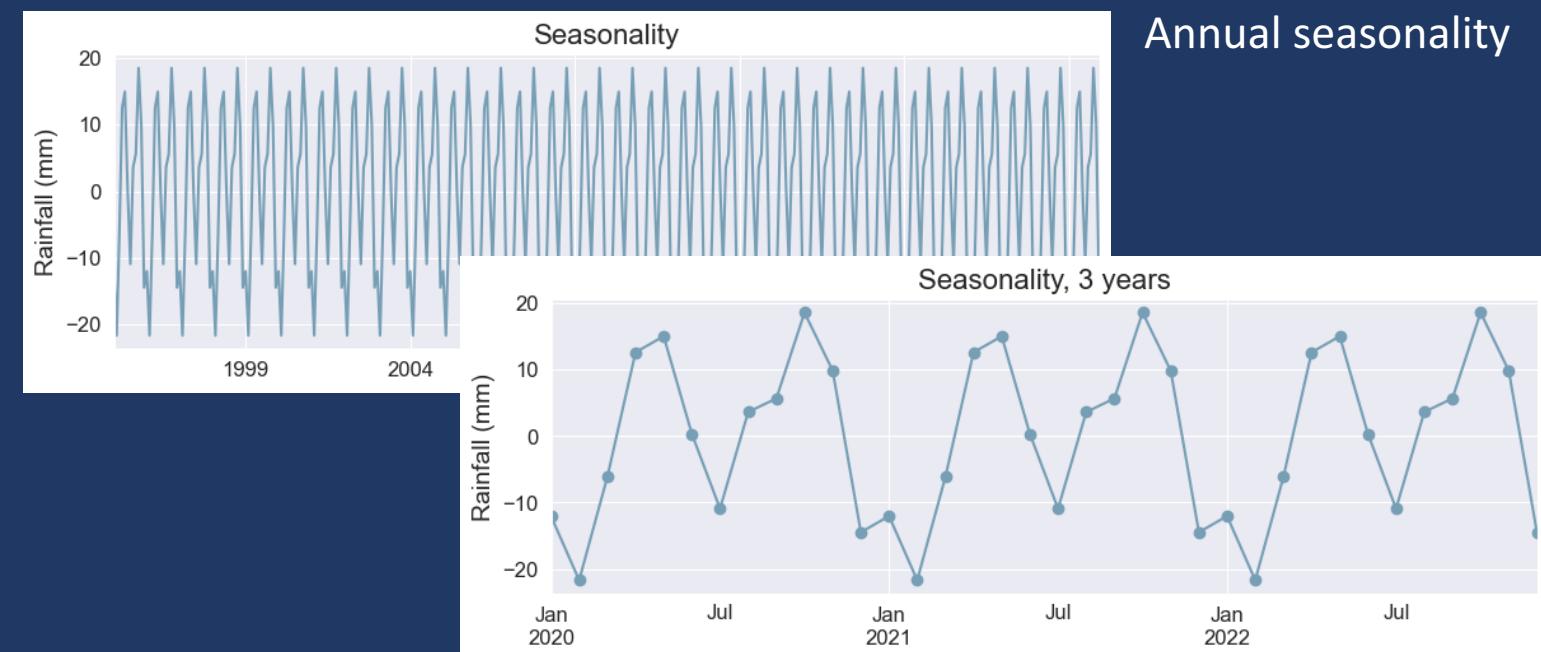
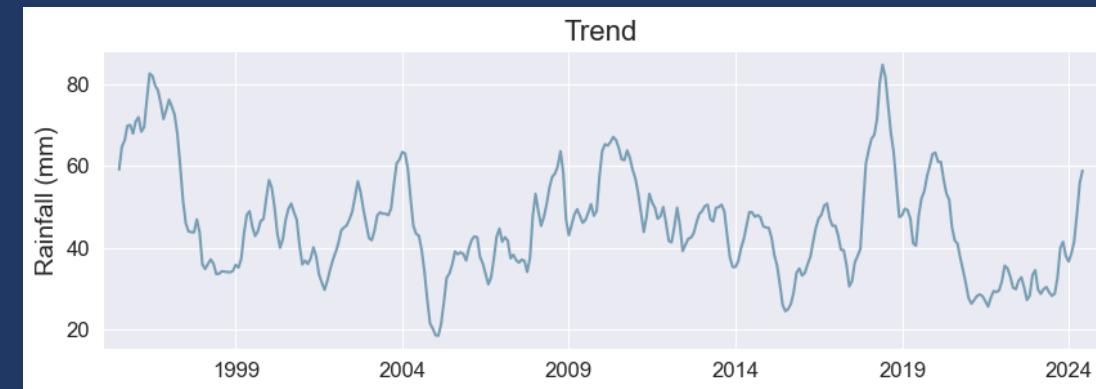
Outliers detected by the KNN



Auto-Correlation



Seasonal Decomposition



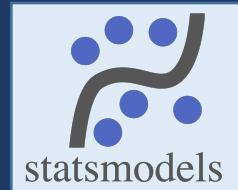
MODELING

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

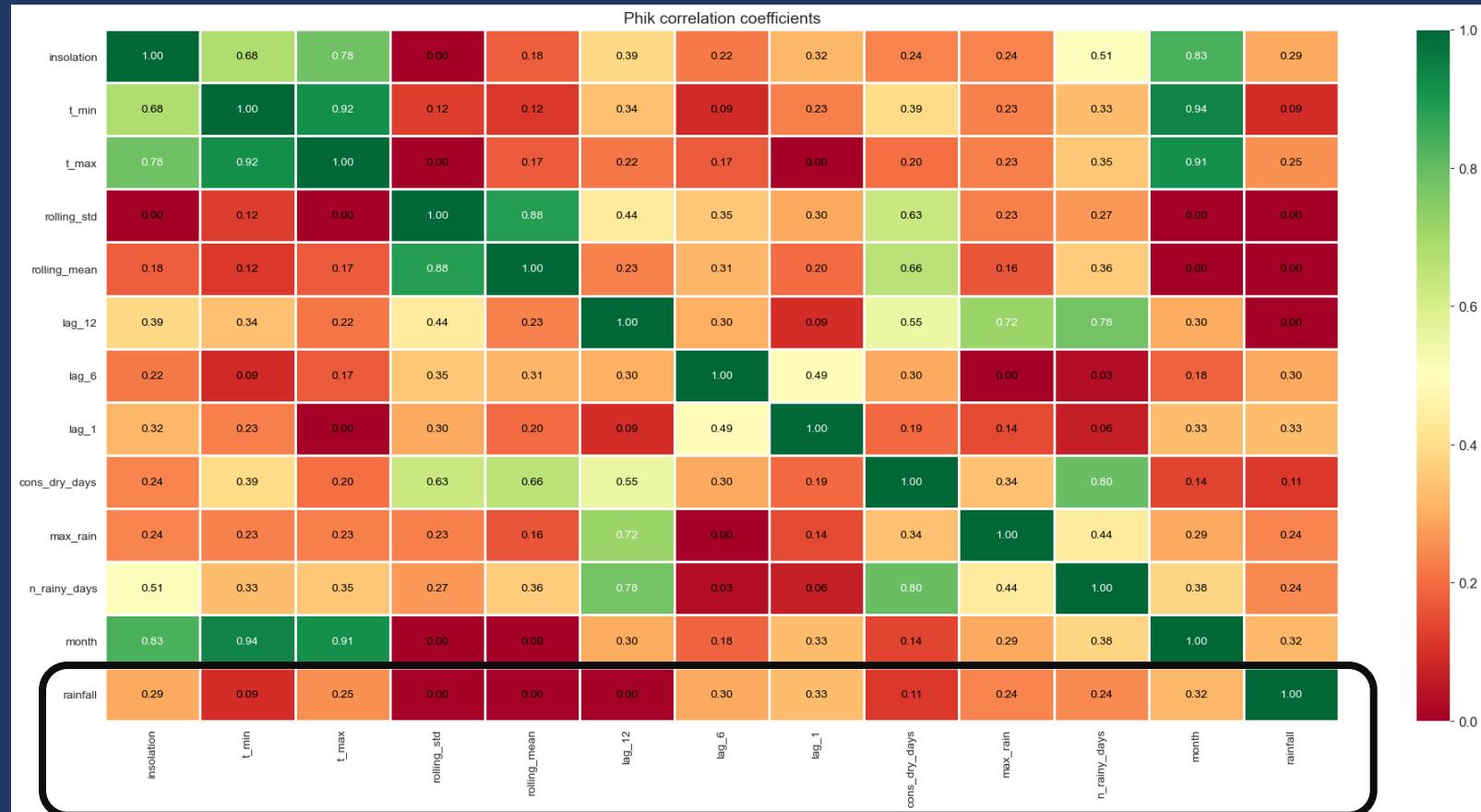


Tree-based, might capture potential non-linearities

- LightGBM (Microsoft)
- CatBoost (Yandex)



EXOGENOUS FEATURES



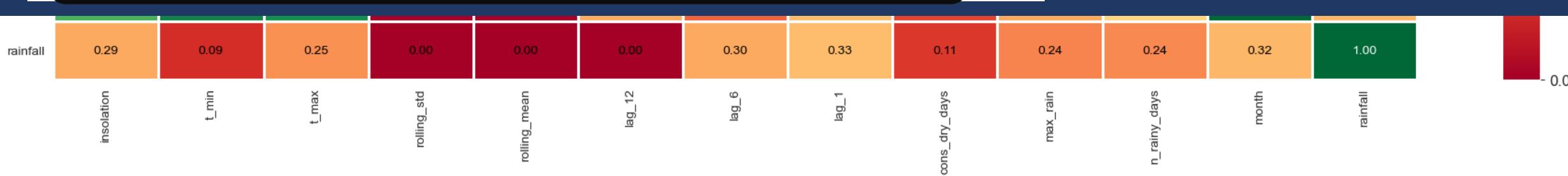
- Month
- Number of rainy days
- Max rainfall
- Max N of consecutive dry days

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

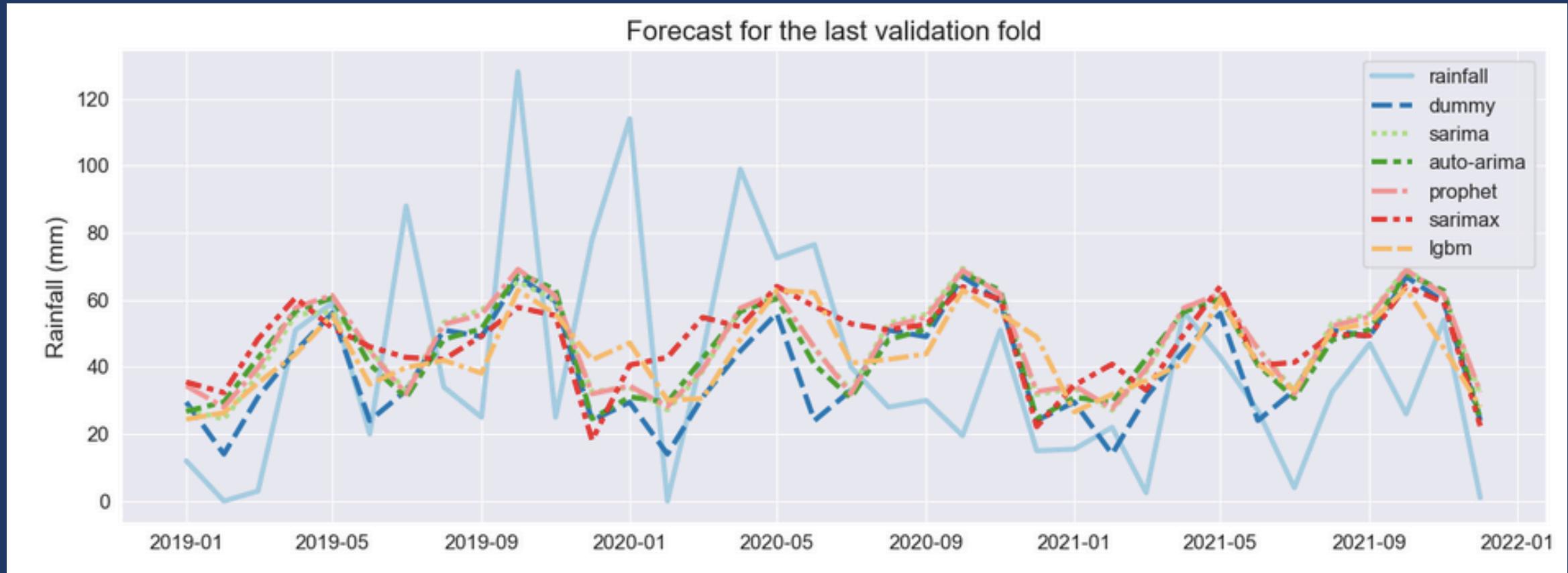


MODEL COMPARISON

Average Rainfall: 45.89, SD = 39.56

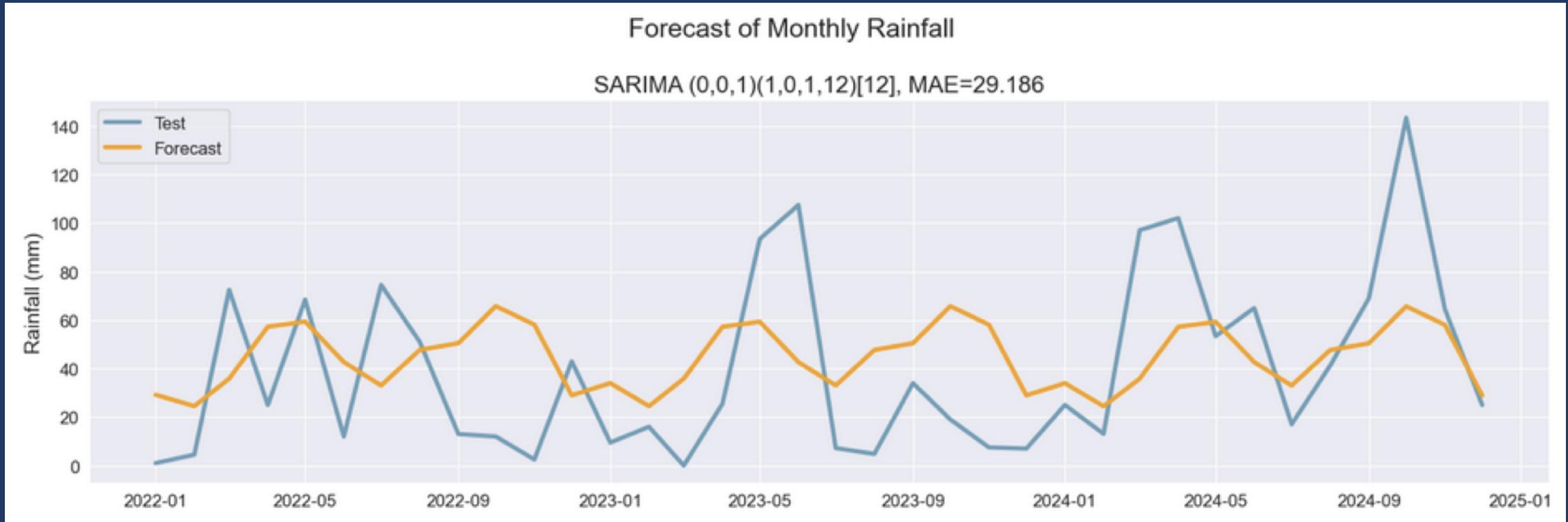
Model	Parameters	Cross-Validation MAE	STD
Median Model		30.68	4.16
SARIMA	(1,0,1)(1,1,1,12)	32.80	7.88
Auto-ARIMA	(0,0,1)(1,0,1)[12]	29.35	3.38
Prophet	yearly seasonality, multiplicative	29.72	3.44
SARIMAX	(0,0,1)(1,0,1)[12] X: maximum rain, lag6, insolation	30.63	3.34
LightGBM	num_leaves=72, n_estimators=130,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

MODEL COMPARISON

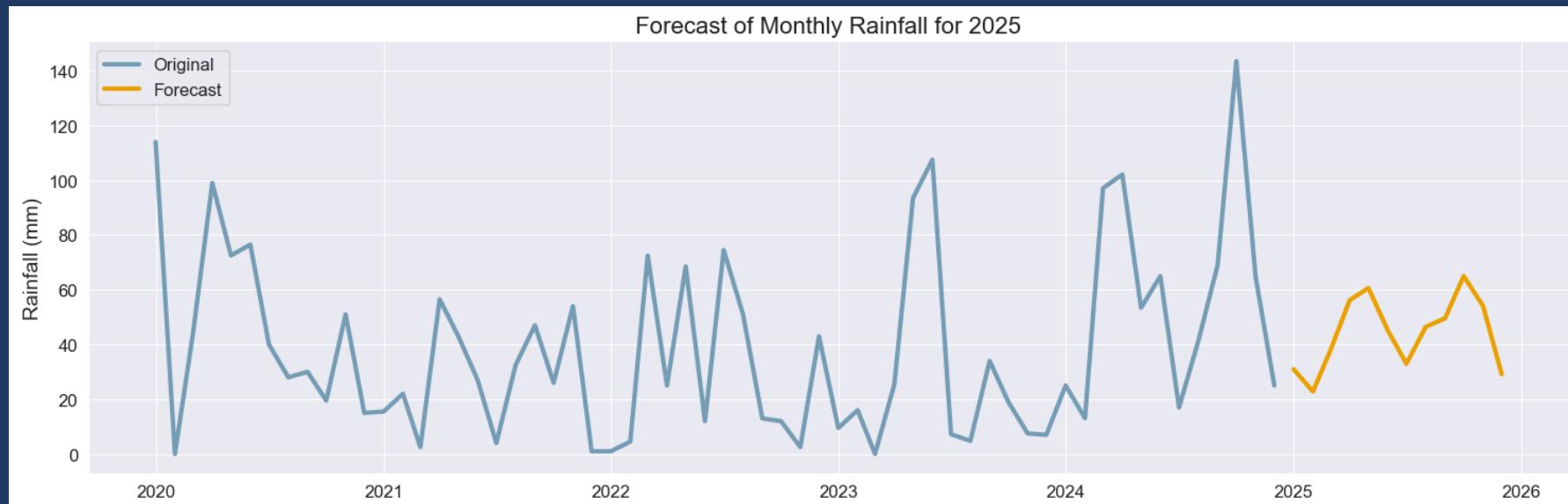


TESTING

Test set – 10%, last 3 years



FORECAST FOR 2025



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

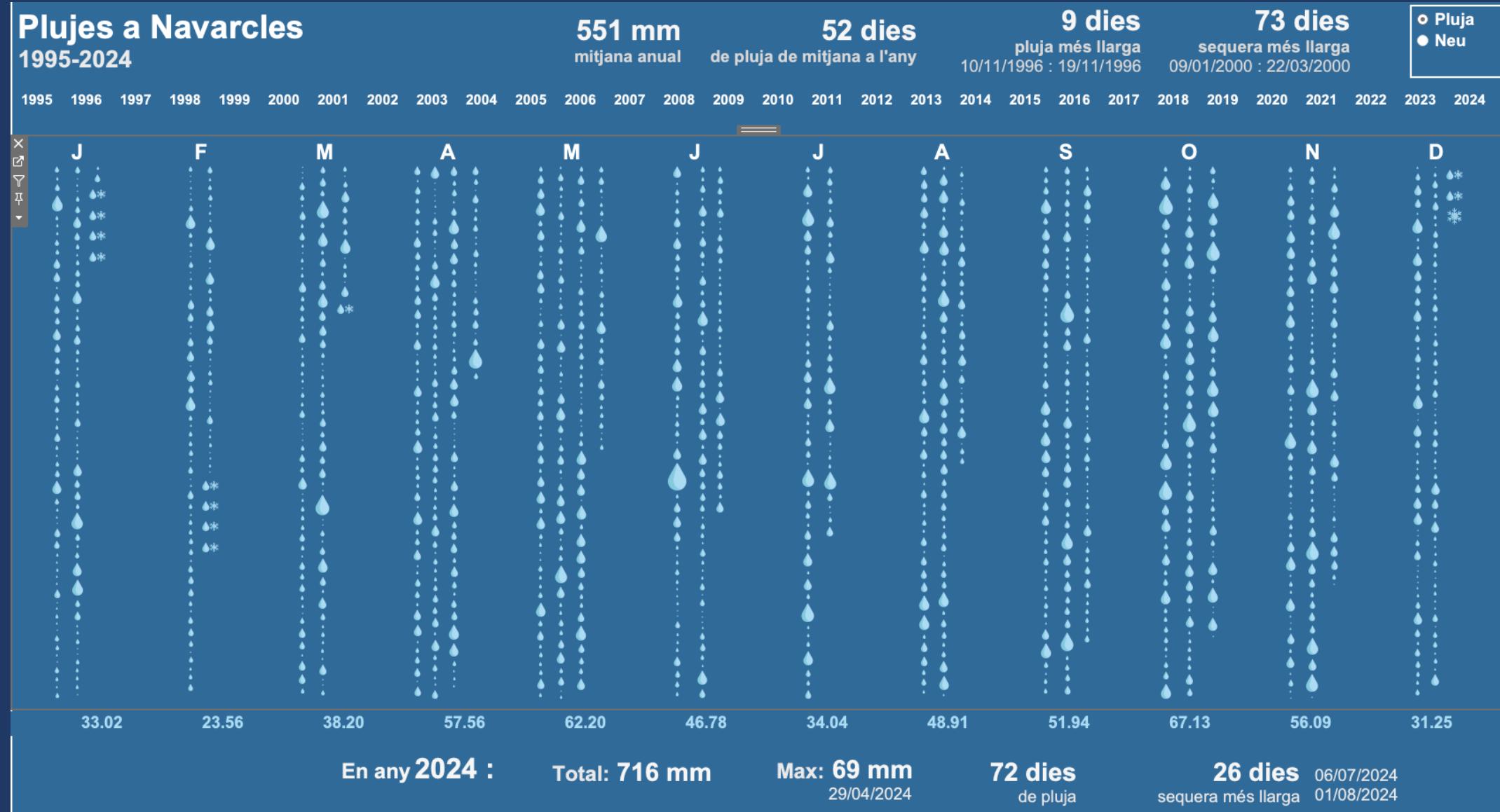
CONCLUSION:

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



If we can't look into the future,
we can explore the past

VISUALISATION: Dashboard in Tableau Public



Thank you for your attention!

