01

FORECAST 2030 | AUGUST 2020

JOÃO INVERNO

Forecast 2030

The holidays of a surfer

02

Highlights

Holidays of a surfer

- Holidays schedulling

Wave forecast websites

- Intuiton of +10 years experience is good enough?

Exploring time series forecasting

- ARIMA model
- **FORECAST 2030** prototype

03

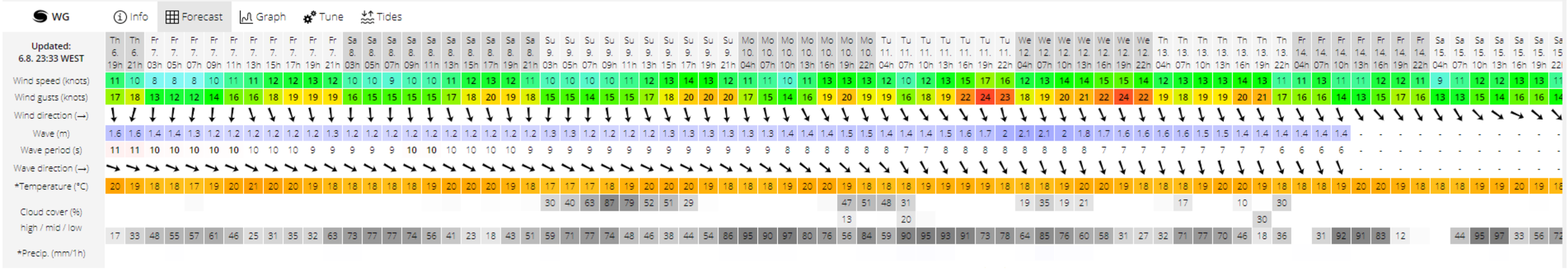
Wave forecast websites

www.windguru.cz/9472

8.5 days of forecast

Wave Height, Wave Period, Wave Direction, Wind, others

Archived data stored since 2008

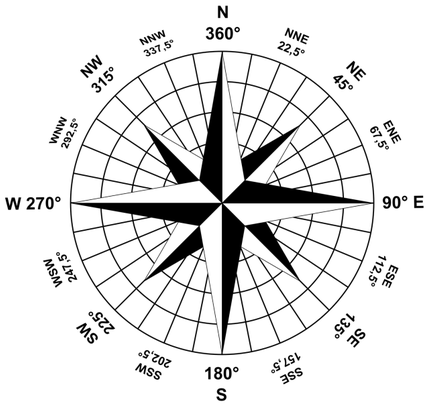


04

Forecast intuiton

Survey

Infering an extra week for 3 scenarios in a *fake* 2030



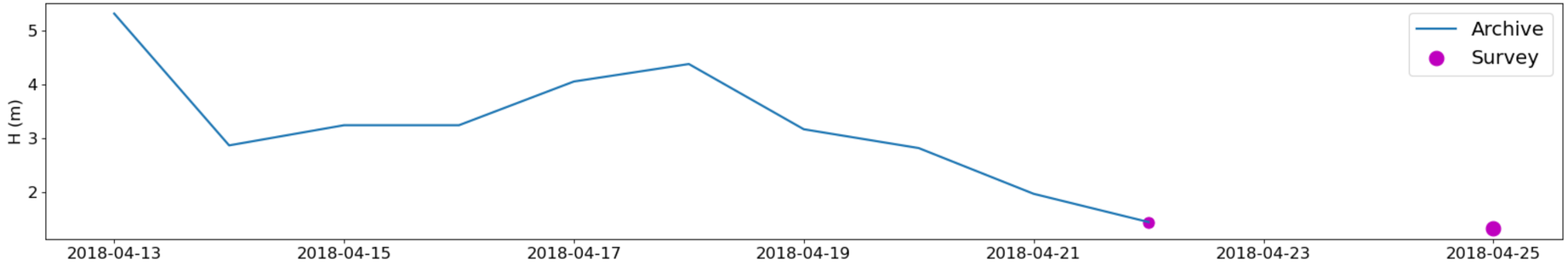
2030 April Forecast Ericeira			
date_time	Wave Height (m)	Wave Period (s)	Wave Direction (°)
13/04/2030	5.3	13	297
14/04/2030	2.9	12	306
15/04/2030	3.2	16	299
16/04/2030	3.2	13	304
17/04/2030	4.1	16	301
18/04/2030	4.4	16	296
19/04/2030	3.2	14	302
20/04/2030	2.8	13	306
21/04/2030	2.0	12	308
22/04/2030	1.4	11	301
23/04/2030	-	-	-
24/04/2030	-	-	-
25/04/2030	**H1 (m) ???**	**T1 (s) ???**	**D1 (°) ???**

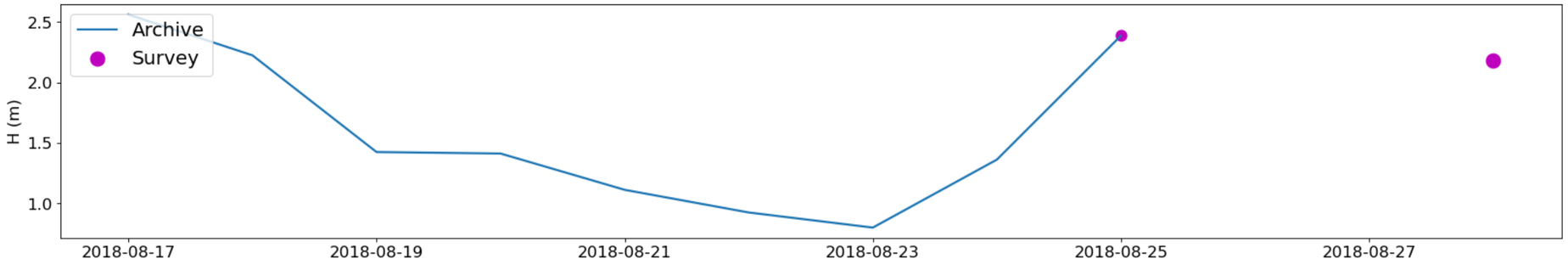
2030 August Forecast Ericeira			
date_time	Wave Height (m)	Wave Period (s)	Wave Direction (°)
17/08/2030	2.6	8	344
18/08/2030	2.2	10	329
19/08/2030	1.4	10	318
20/08/2030	1.4	11	302
21/08/2030	1.1	9	314
22/08/2030	0.9	8	320
23/08/2030	0.8	8	310
24/08/2030	1.4	9	316
25/08/2030	2.4	8	346
26/08/2030	-	-	-
27/08/2030	-	-	-
29/08/2030	**H2 (m) ???**	**T2 (s) ???**	**D2 (°) ???**

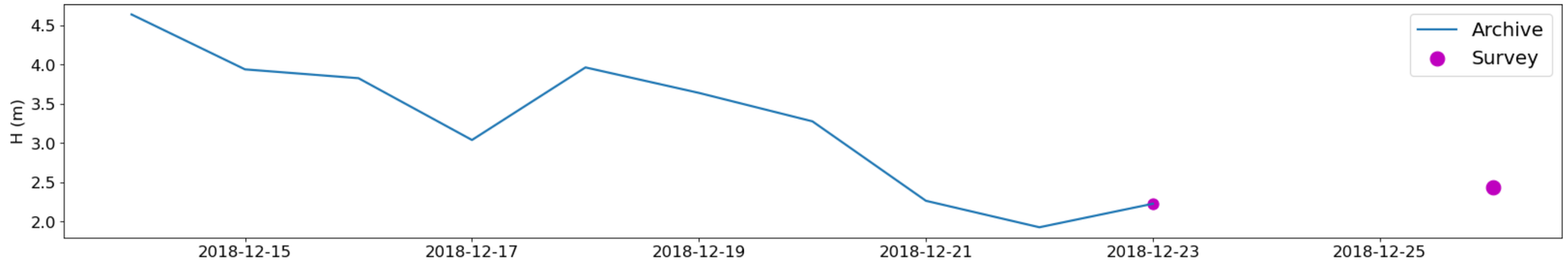
2030 December Forecast Ericeira			
date_time	Wave Height (m)	Wave Period (s)	Wave Direction (°)
14/12/2030	4.6	15	305
15/12/2030	3.9	17	305
16/12/2030	3.8	14	296
17/12/2030	3.0	13	299
18/12/2030	4.0	14	297
19/12/2030	3.6	13	294
20/12/2030	3.3	13	313
21/12/2030	2.3	13	323
22/12/2030	1.9	12	306
23/12/2030	2.2	14	288
24/12/2030	-	-	-
25/12/2030	-	-	-
26/12/2030	**H3 (m) ???**	**T3 (s) ???**	**D3 (°) ???**

05

Survey - Wave Height

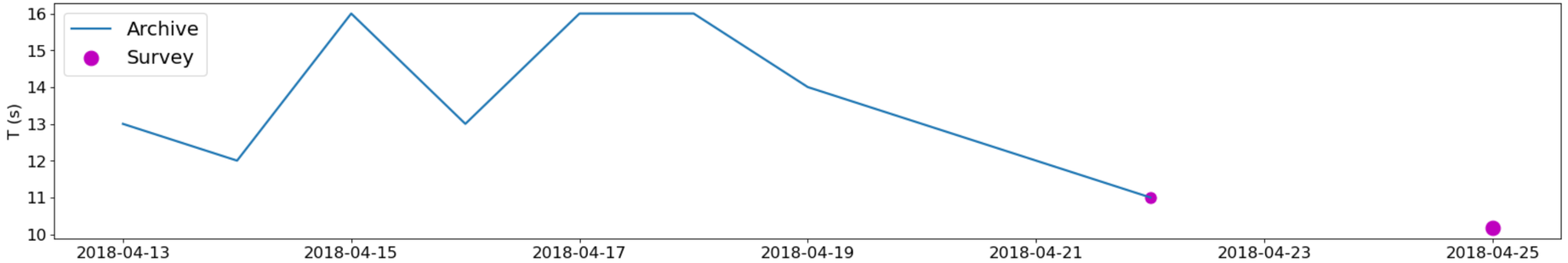


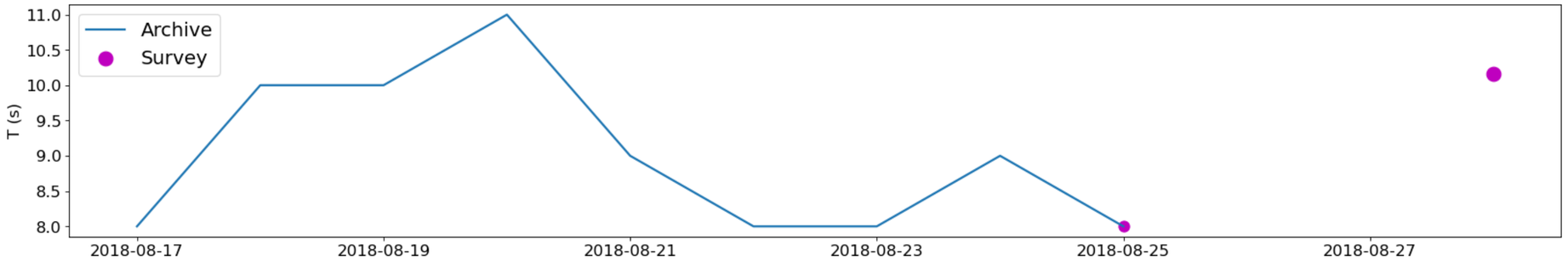


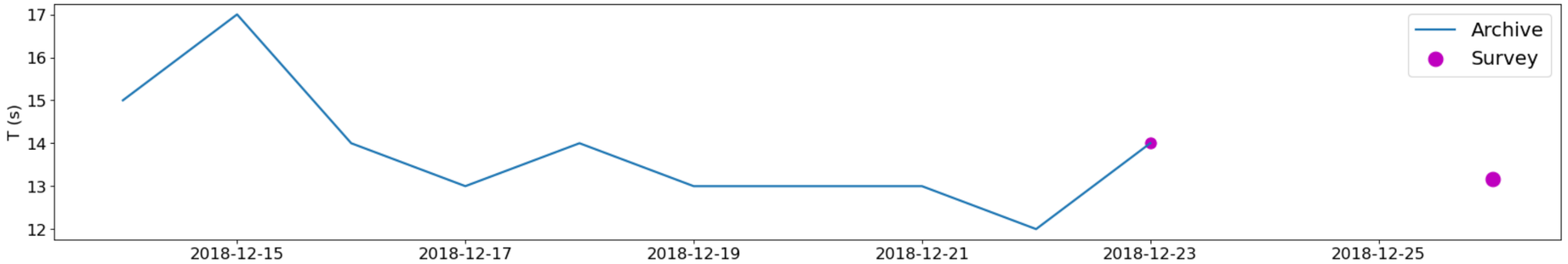


06

Survey - Wave Period

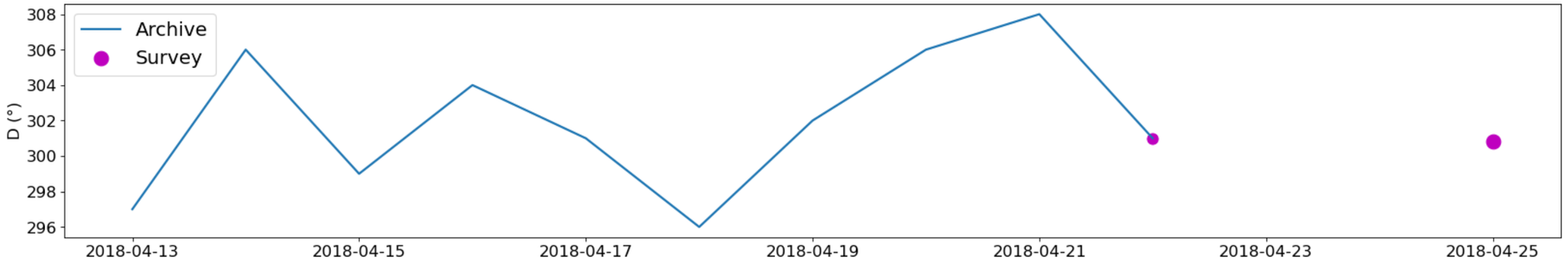


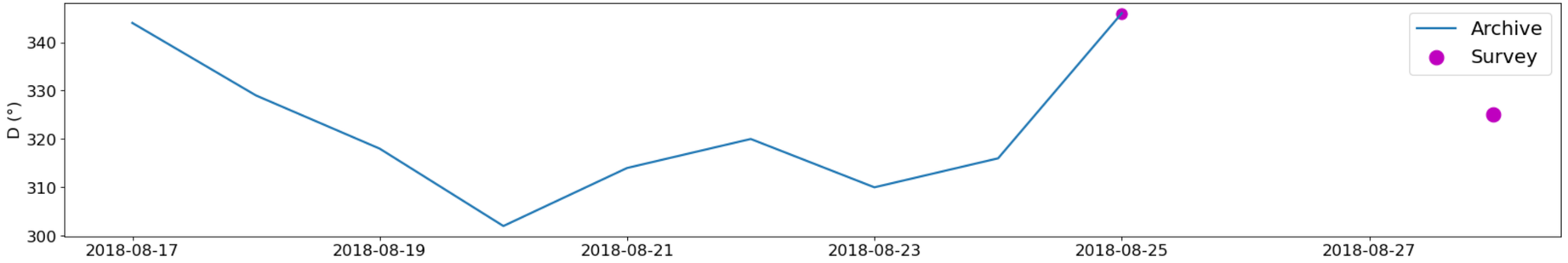


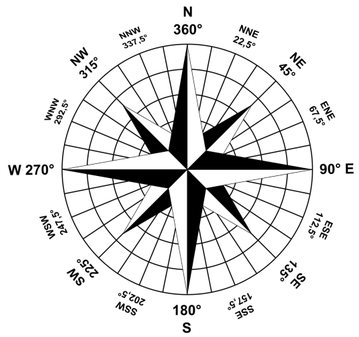


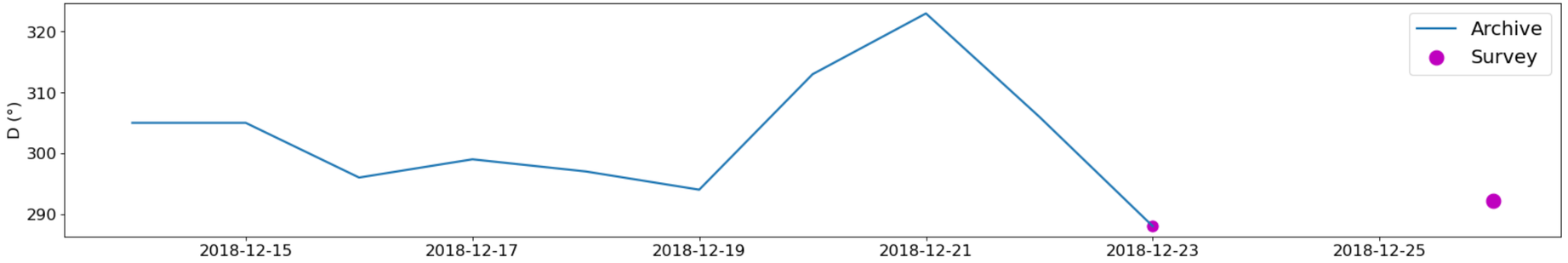
07

Survey - Wave Direction





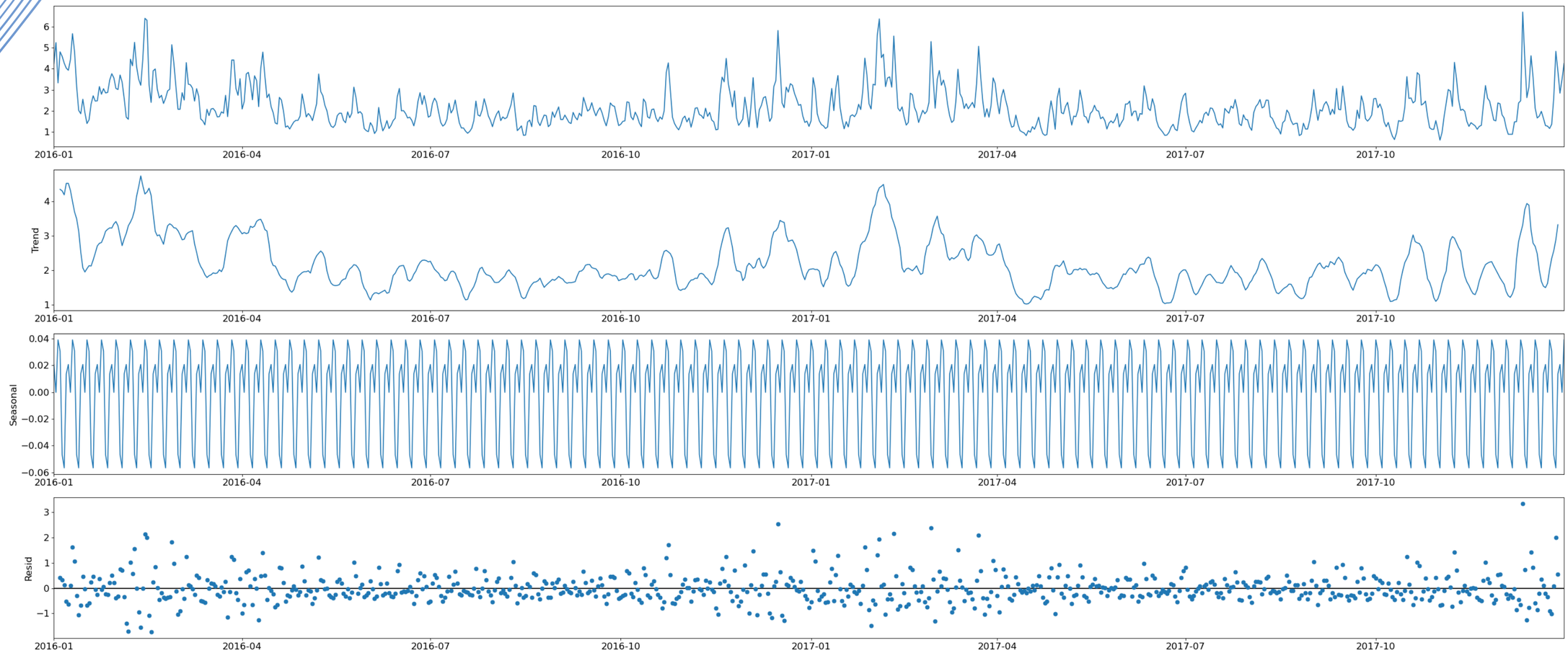




08

Time series forecasting

Components - Wave Height



09

Time series forecasting

ARIMA MODEL

ARIMA - Autoregressive Integrated Moving Average

Allows to forecast using a linear combination of past values

```
from statsmodels.tsa.arima_model import ARIMA
arima = ARIMA(series_wave_day, order = ((p,d,q))
arima = arima.fit()
```

How to fine tune the hyperparameters (p,d,q) for forecasting?

Time series forecasting

Evaluate ARIMA Model

1) Split the dataset into training and test sets

2) Walk the time steps in the test dataset

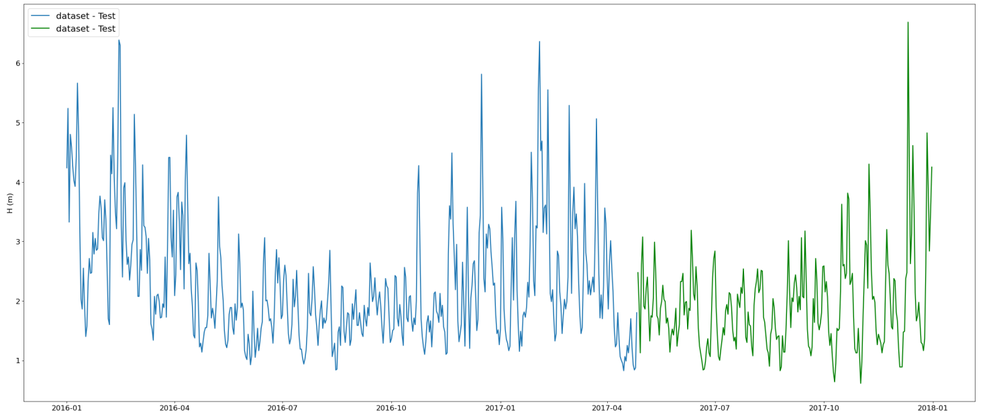
    1-Train an ARIMA model

    2-Make a one-step prediction

    3-Store prediction; get and store actual observation

3) Calculate error for predictions compared to expected values

4) Select (p,d,q) for min(MSE)



p_values = [1, 2, 4, 6, 8]
d_values = range(0, 3)
q_values = range(0, 3)

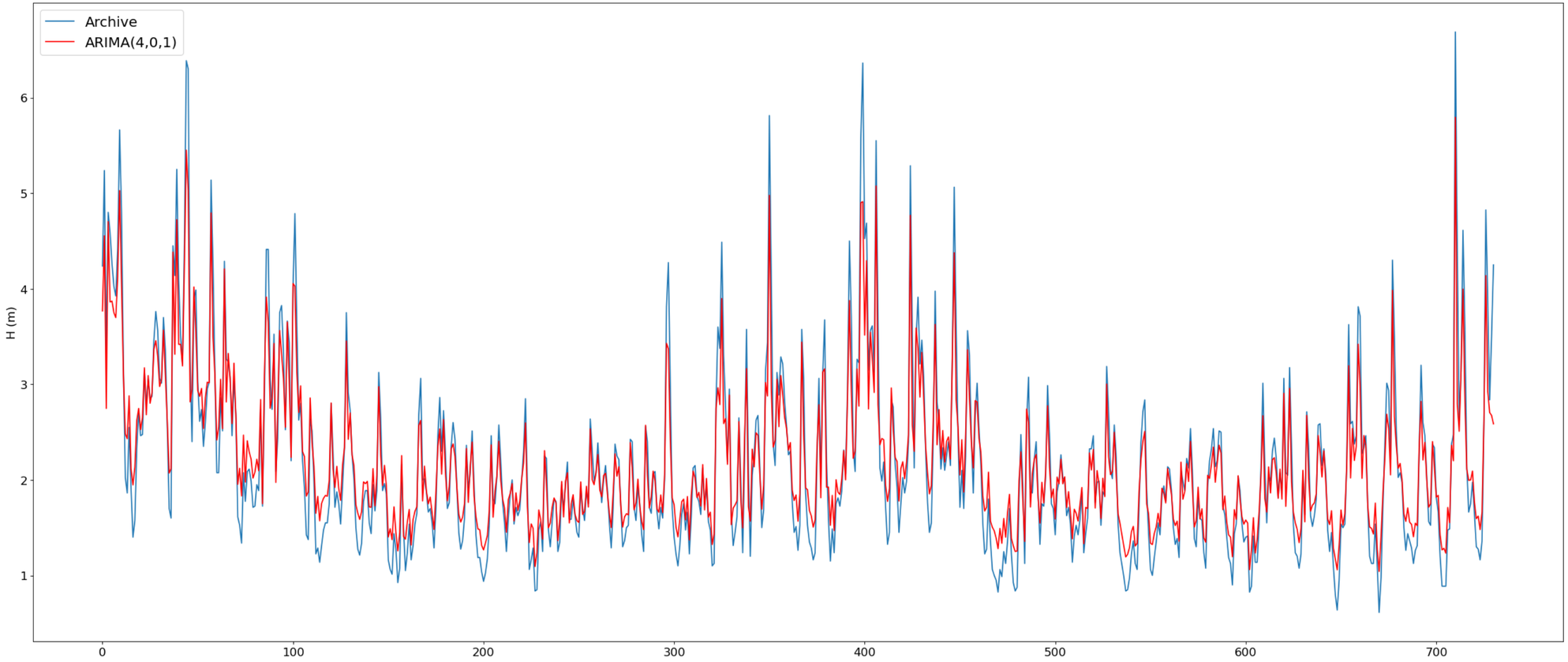
evaluate_models(series_wave_day.values, p_values, d_values, q_values)

$$\mathrm{MSE} = \frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2.$$

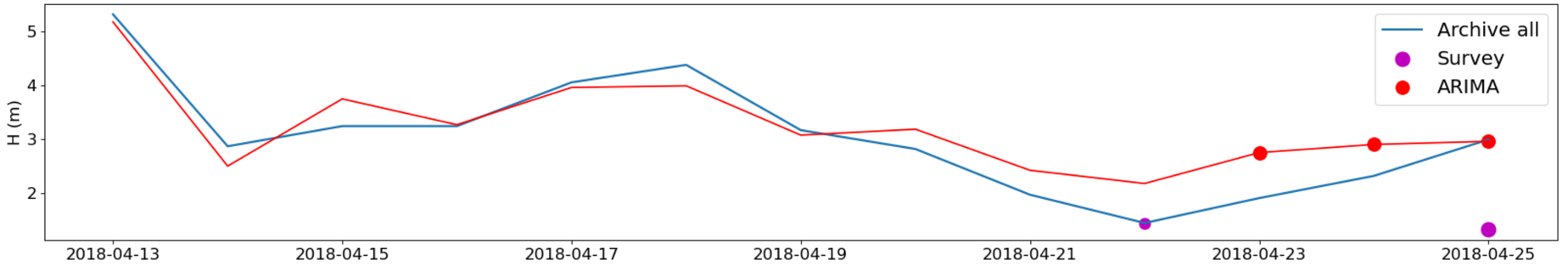
ARIMA MODEL - FIT

Wave Height

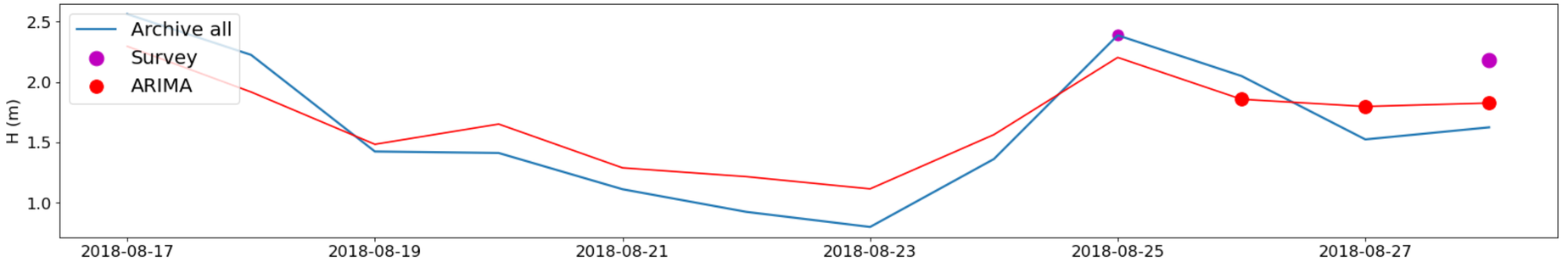
Best ARIMA(4, 0, 1) MSE=0.34



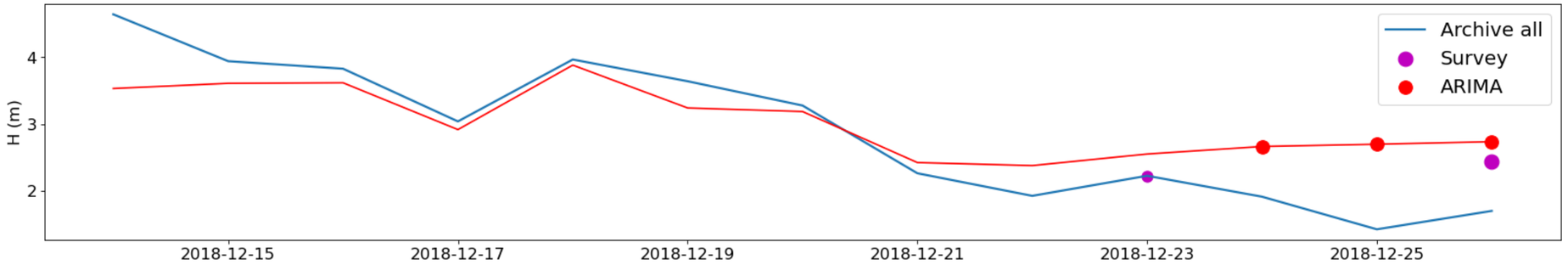
Survey vs ARIMA (H)



0 - 1

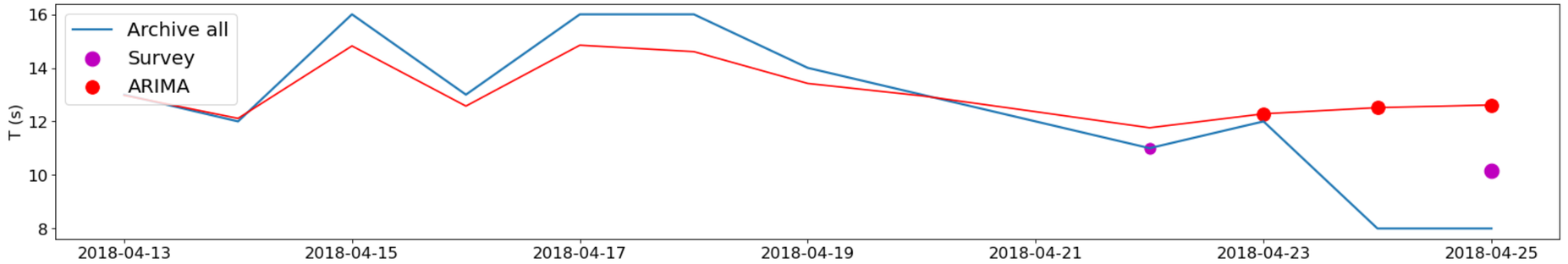


0 - 2

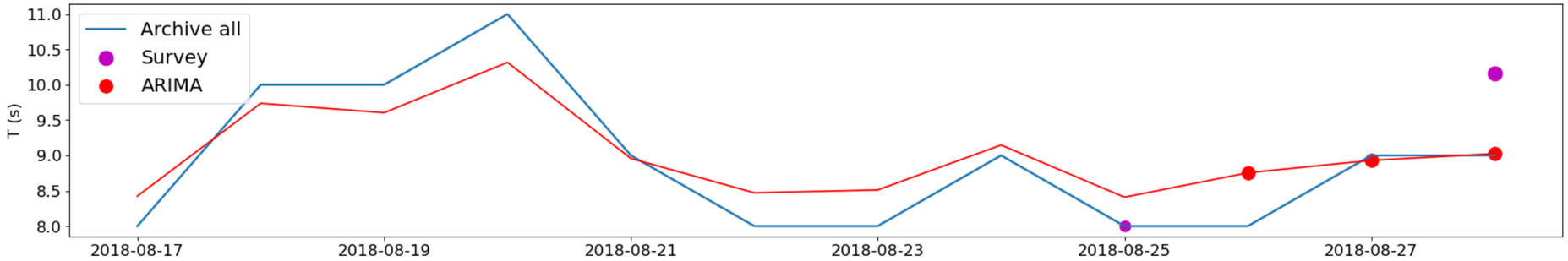


1- 2

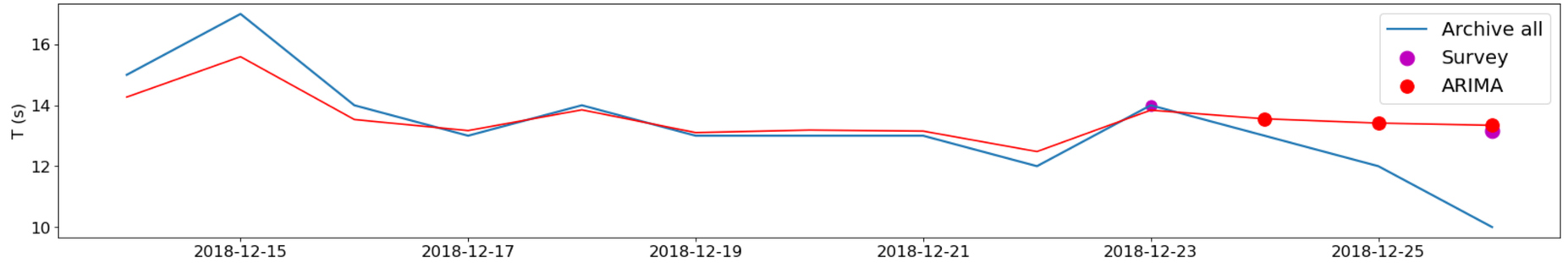
Survey vs ARIMA (T)



2 - 2

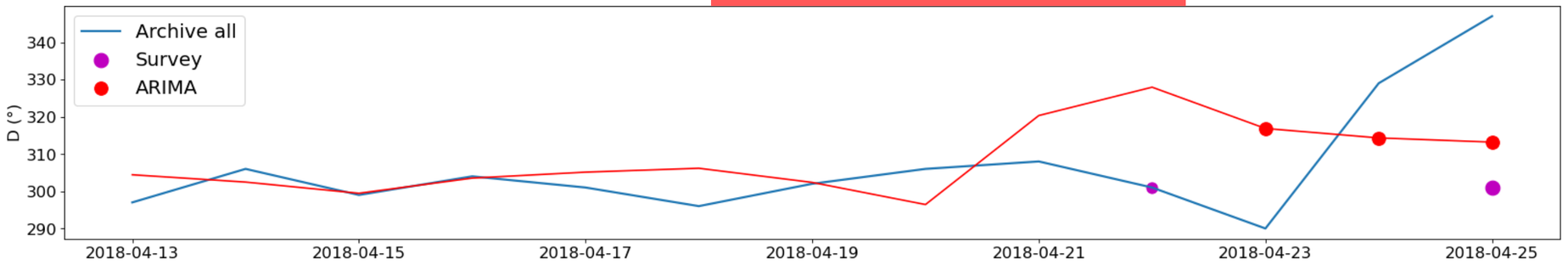


2 - 3

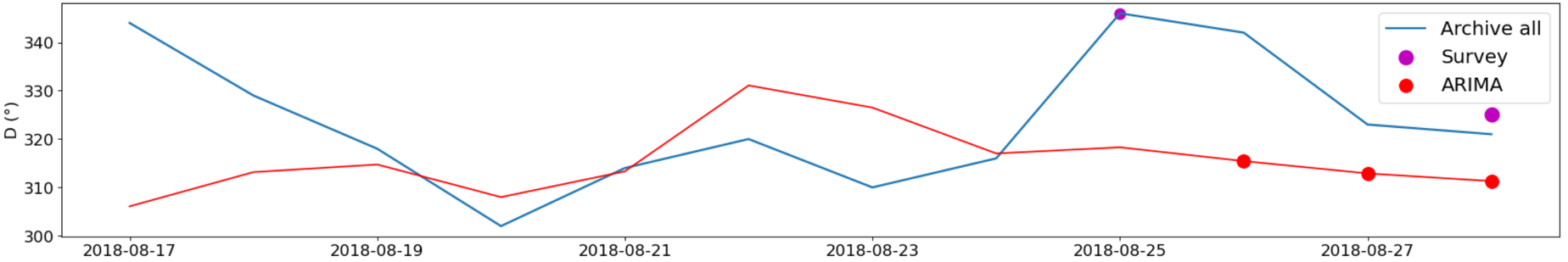


3- 3

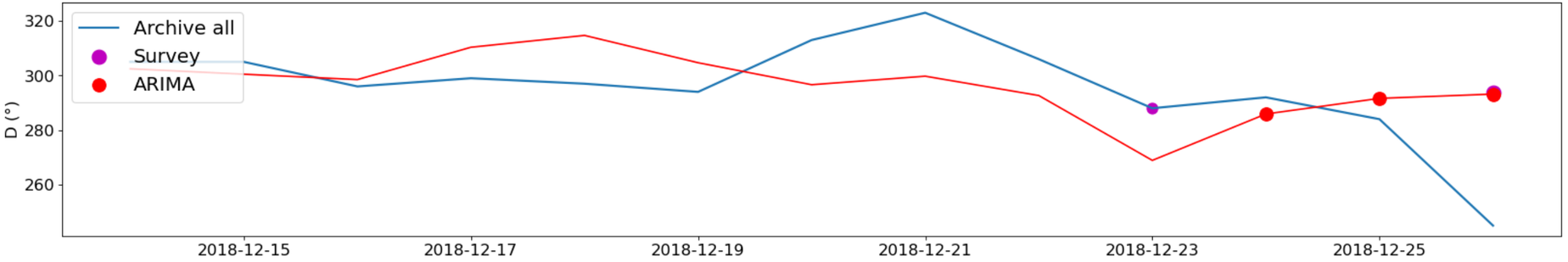
Survey vs ARIMA (D)



3 - 4



4 - 4



4 - 5

Conclusions

Holidays schedulling: Success.

ARIMA outperformed surfer's intuition.

FORECAST 2030 next steps:

- Explore further ARIMA Model and extensions.
- Explore diferent levels of Granularity.
- Present FORECAST 2030 to Windguru.

Ericeira circa 2009

Surfer friends, thank you for filling out the survey in such short notice!

IRON HACK
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