Use Case

Solar Power Plant
Inverter Anomaly Detection

Solar Power Plant - Inverter Anomaly Detection

Objective

- Prediction of the power generation for next couple of days? - this allows for better grid management
- Identify the need for panel cleaning/maintenance?
- Identify faulty or sub-optimally performing equipment?

Data Aggregated – Power Generation Dataset (Plant 1&2)

- Datetime
- Plant ID
- Inverter ID
- DC power Generated
- AC power Generated
- Daily Yield
- Total Yield

Data Aggregated – Weather Sensor dataset(Plant 1&2)

- Datetime
- Plant ID
- Panel ID
- Ambient Temperature
- Module Temperature
- Irradiation

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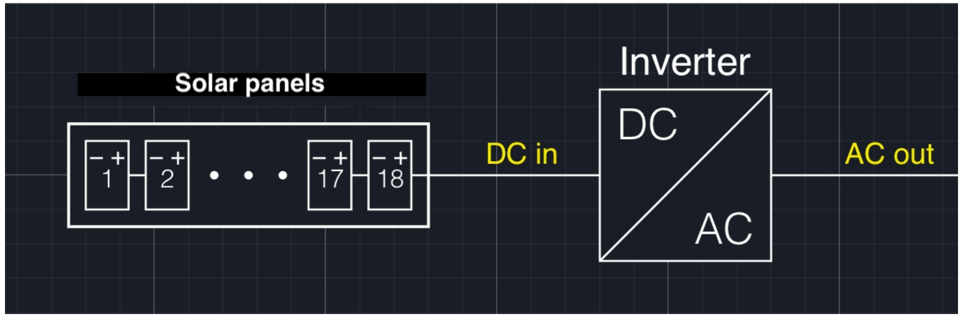
Typically the factors that determine the performance of a solar power plant are:

- Temperature
- Dirtiness
- Inverters Efficiency
- Inverters or panels seniority



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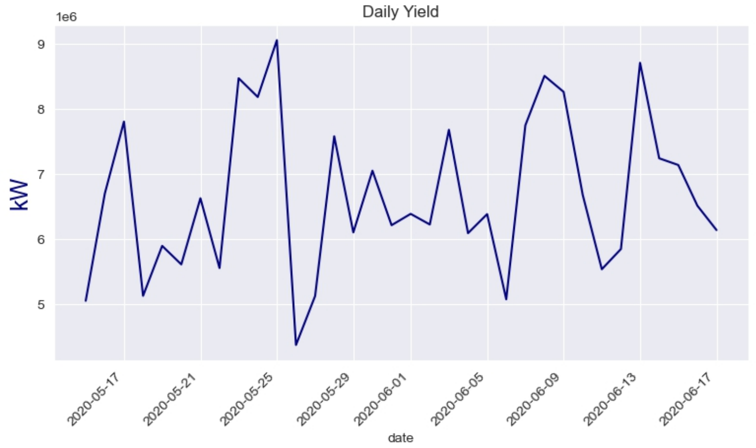
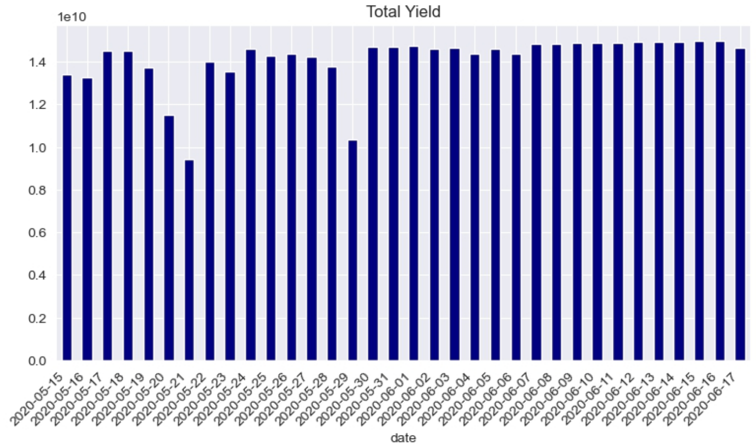
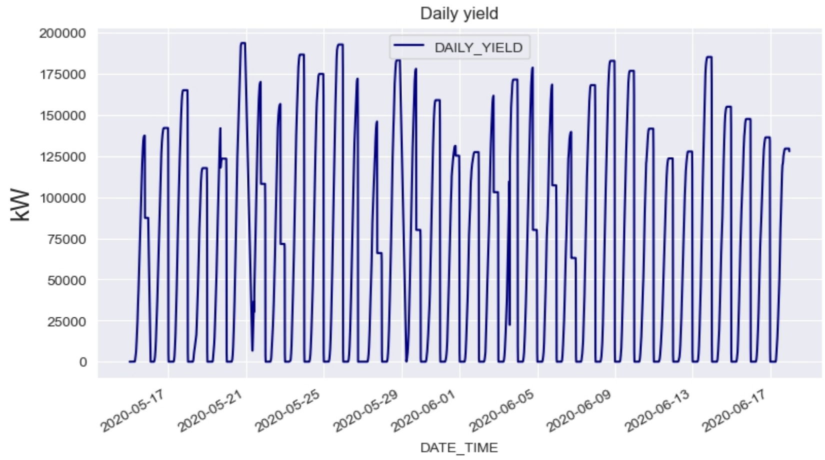
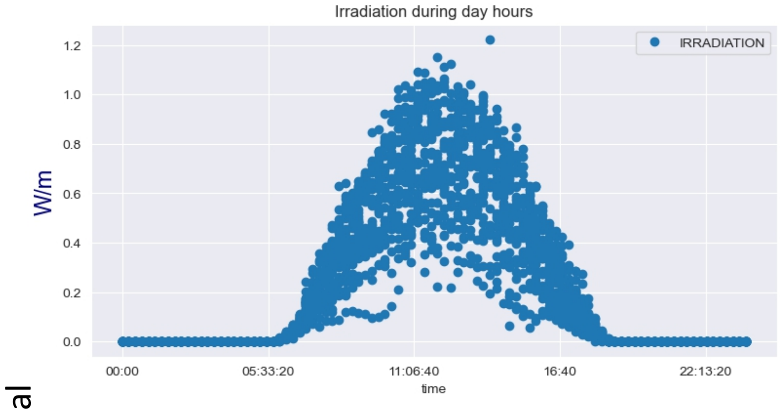
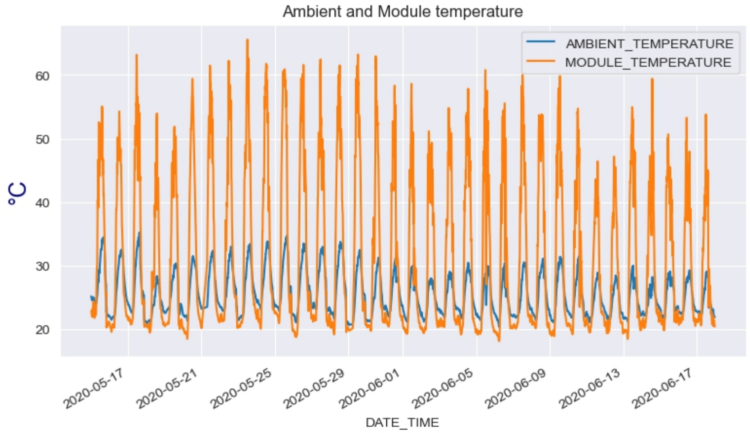
Exploratory Data Analysis:

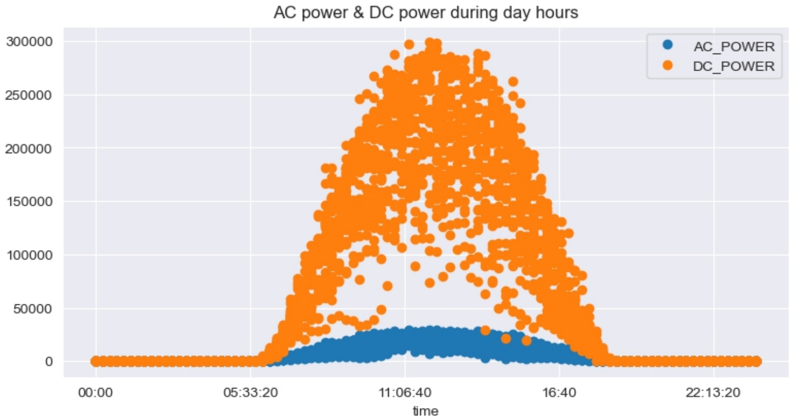












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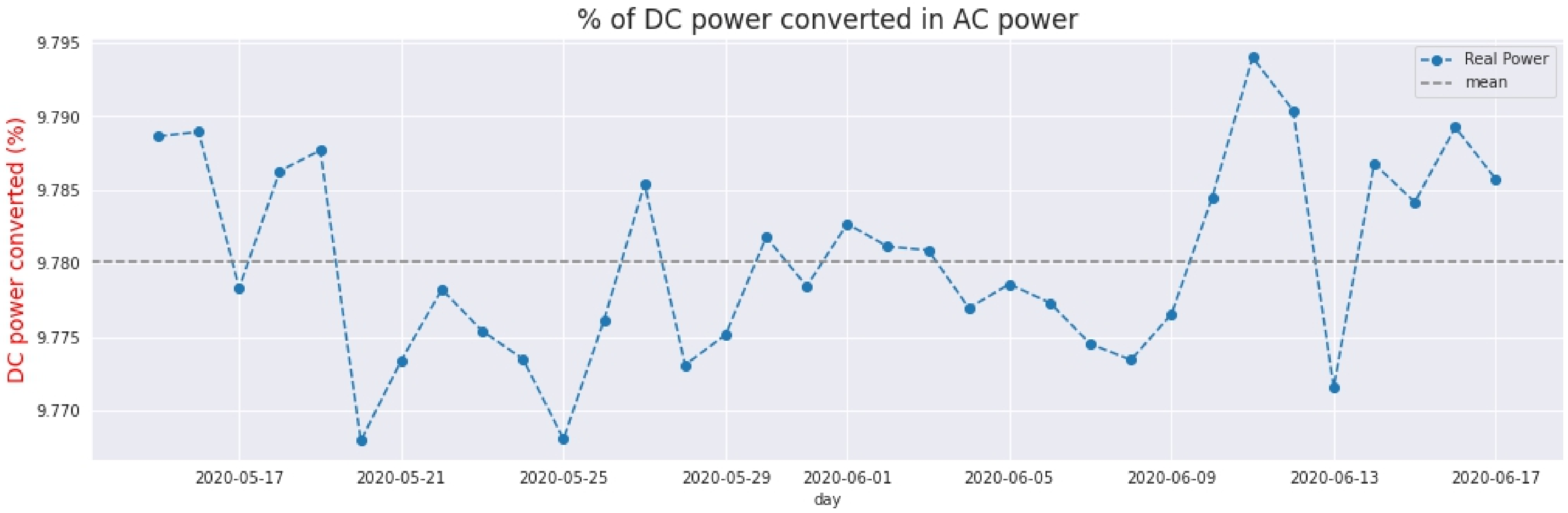
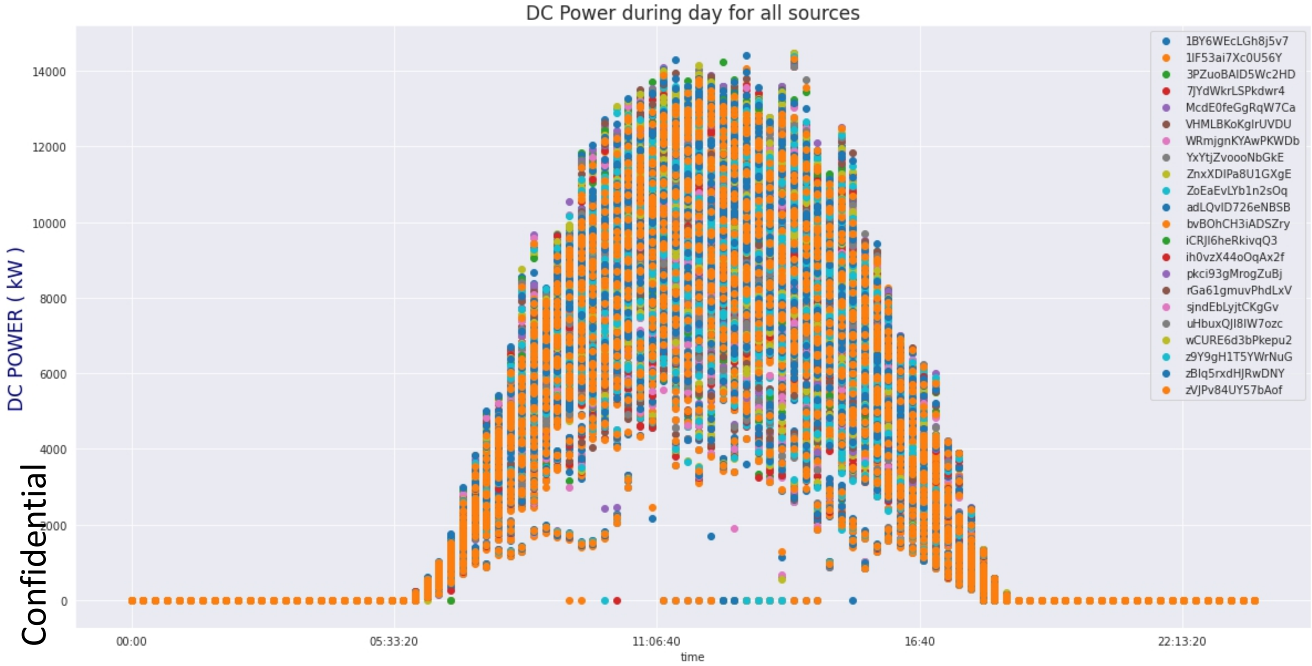
Identify faulty Inverter:

- Loss = AC Power/DC Power * 100
- 22 Inverters are Present
- Distribution of the DC power generated





- The Distribution for all the inverter tends to behave normally over the period of time during the day hours
- Most of Inverters start to generate the power by morning 6AM and ends by Evening 6 PM during the day
- The productivity of the Inverters for converting the DC to AC should be considered in this time frame

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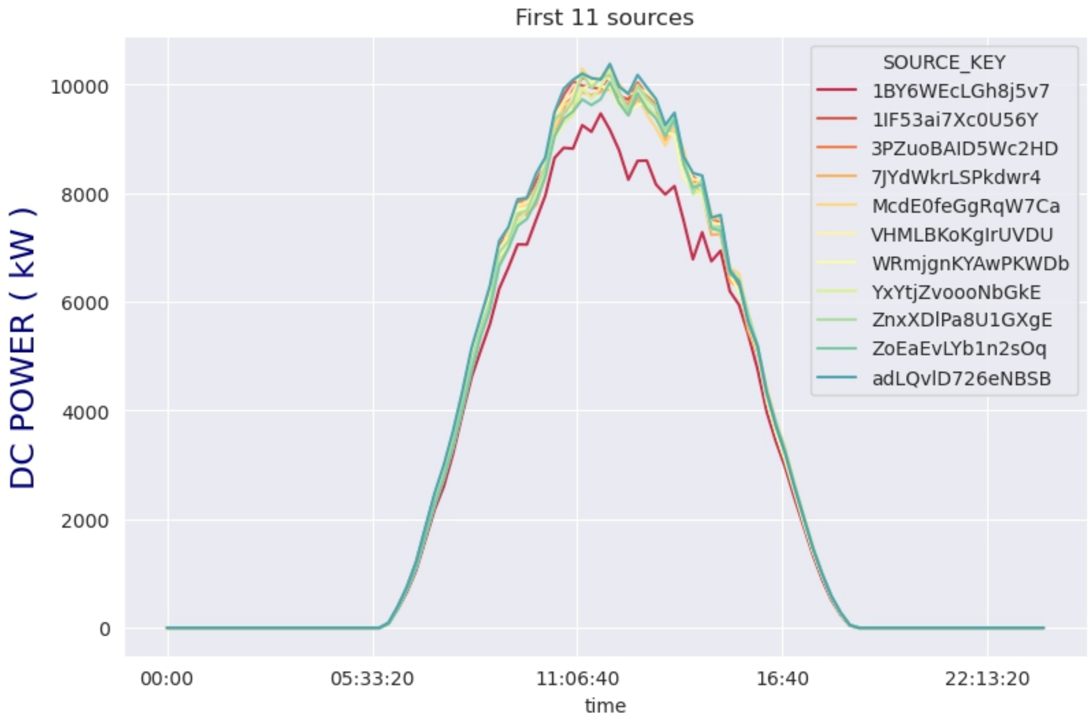
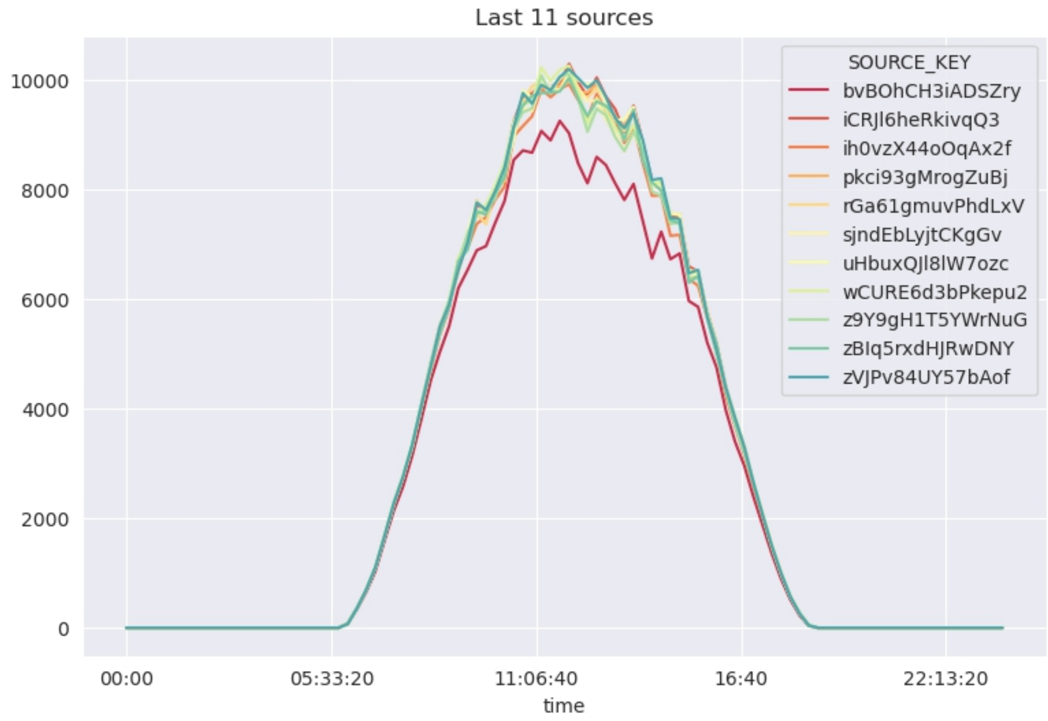
Identify faulty Inverter:

- The average of DC power from the source Inverter over the period of time indicates that Inverter with ID ~1BY6.. & ~bvBOh.. are anomalous
- The maintenance requirement for the inverter is identified and should be scheduled appropriately





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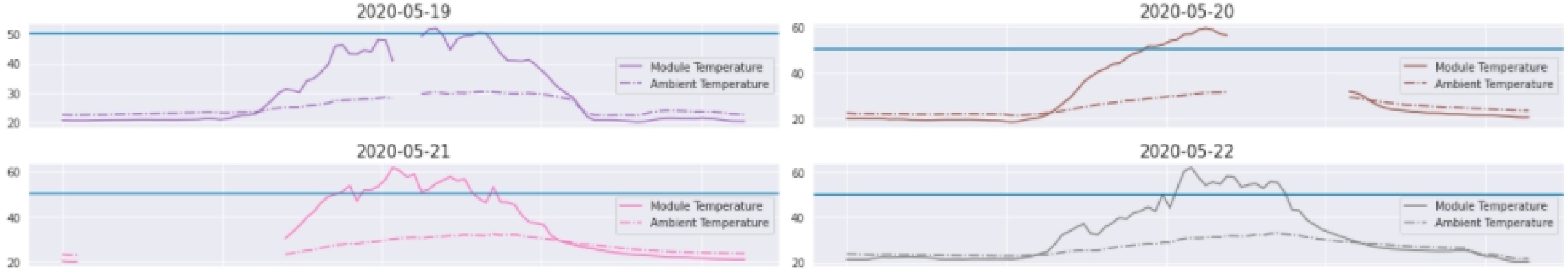
Identify the need for panel cleaning/maintenance

- Daily behavior of the plant:
- It is evident that from 19th to 21st May the plant is behaving abnormally due to no Power Generation
- Module Temperature seems to be heavily dependent on the Ambient Temperature
- Module overload happens when Temp > 50 deg. It was observed for the Inverter to be non-performing because of this reason

DC power Generated

Module Temperature



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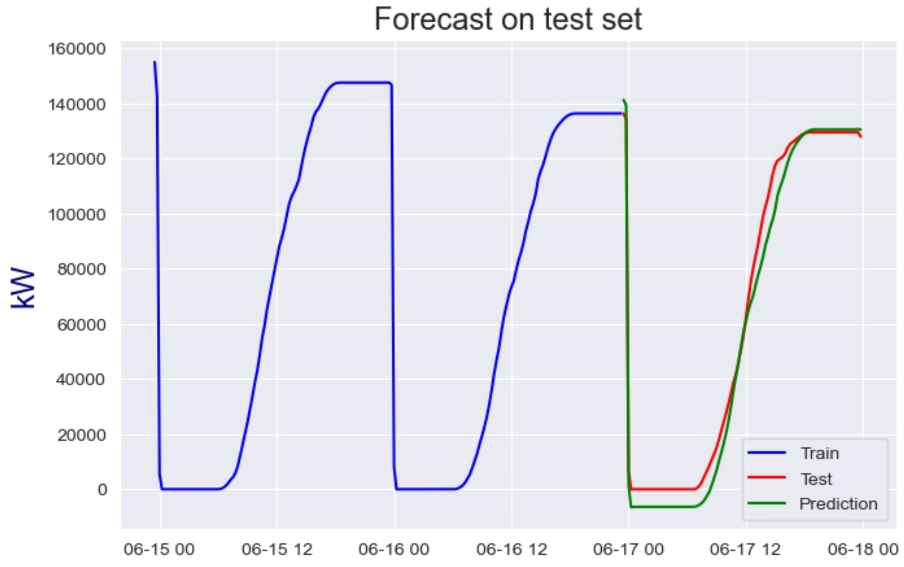
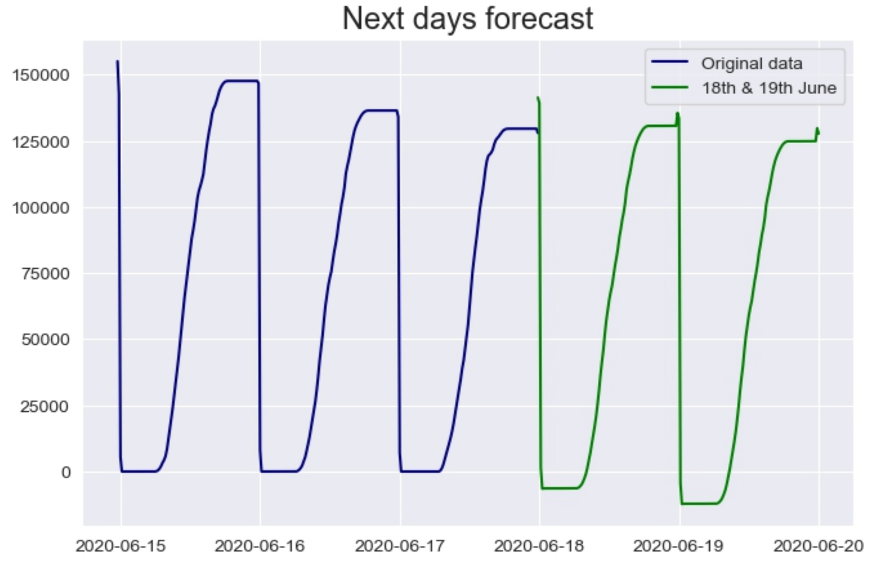
Forecasting the DC power Generation and Yield:





SARIMAX Results

Dep. Variable:	y	No. Observations:	192
Model:	SARIMAX(4, 1, 0)x(0, 1, [1], 96)	Log Likelihood	-757.647
Date:	Tue, 15 Sep 2020	AIC	1527.294
Time:	16:36:13	BIC	1542.617
Sample:	0	HQIC	1533.486
	- 192		
Covariance Type:	opg		

	coef	std err	z	P>|z|	[0.025	0.975]
ar.L1	-0.2318	0.025	-9.315	0.000	-0.281	-0.183
ar.L2	0.0985	0.058	1.699	0.089	-0.015	0.212
ar.L3	0.0988	0.041	2.434	0.015	0.019	0.178
ar.L4	0.0265	0.068	0.389	0.697	-0.107	0.160
ma.S.L96	-0.1111	0.053	-2.100	0.036	-0.215	-0.007
sigma2	5.751e+05	6.5e+04	8.852	0.000	4.48e+05	7.02e+05

Ljung-Box (Q):	92.31	Jarque-Bera (JB):	27.18
Prob(Q):	0.00	Prob(JB):	0.00
Heteroskedasticity (H):	5.49	Skew:	0.21
Prob(H) (two-sided):	0.00	Kurtosis:	5.59