



Forecasting of Renewable Energy Generation in the Vietnamese Power System

October 2020

Figures	2
Acronyms.....	3
Introduction.....	4
1.1 Test results and description of further development of the tools .	4
1.1.1 Further development of the tool in 2020	4
1.1.2 Testing of VRE forecast tools	6
1.2 Comparison of procured forecast and in-house developed forecast	6
1.2.1 An overview of the current commercial forecasts in EVN NLDC	6
1.2.2 Comparison of commercial and in-house forecasts	7
1.3 Development of IT-solution for importing the forecasts into the SCADA system, guideline of IT integration of forecast tools for EVN NLDC	9
Annex: Evaluation for solar power forecasts Day Ahead and Intraday on 21-05-2020	12

Figures

Figure 1. Intraday Methodology	4
Figure 2. Renewable Energy forecasting tool – 2019 version.....	5
Figure 3. Data collection process – 2020 version	6
Figure 4. Comparison of forecasting errors for 18 power plants – Day Ahead Model.....	7
Figure 5. Compare the EVNNLDC Day Ahead Results and Solcast Day Ahead Results for the Europlast Long An Solar Power Plant	8
Figure 6. Comparison of forecasting errors for 18 power plants – Intraday Model.....	8
Figure 7. Compare the EVNNLDC Intraday Results and Solcast Intraday Results for the Europlast Long An Solar Power Plant	9

Acronyms

The below table lists acronyms used in this document.

DEA	Danish Energy Agency
ERAV	Electricity Regulatory Authority of Vietnam
EVN	Vietnam Electricity
GUI	General User Interface
NLDC	National Load Dispatch Center
RE	Renewable Energy
SCADA	Supervisory Control And Data Acquisition
SQL	Structured Query Language
TSO	Transmission System Operator

Introduction

The purpose of this report is to describe the forecasts tool developed in cooperation between EVN NLDC and Energinet, to test and compare it with externally procured forecasts and plan the implementation of forecasts in the system operation. All the activities will be described in subsequent articles, described below.

1.1 Test results and description of further development of the tools

1.1.1 Further development of the tool in 2020

Since 2019, the following feature have been included in the forecast tool in 2020:

- Complete Intraday renewable energy forecast tool;
During the last developments, the Intraday renewable energy forecast tool was designed to:
 - Collect latest offline historical forecast results for each forecast date. The offline results refer to the historical values, stored during the forecasting process. In order to serve the calculation of error values, it is necessary to compare the historical forecasted value with the actual value (at the same time);
 - Collect the actual streaming data of factories, compare with the forecasted numbers in the offline model and online errors;
 - From the online error, calculate the expected error for the next cycle (until the next 10 hours);
 - Update forecast results for the coming cycles from the latest offline forecast results and *expected errors for the next cycles*.

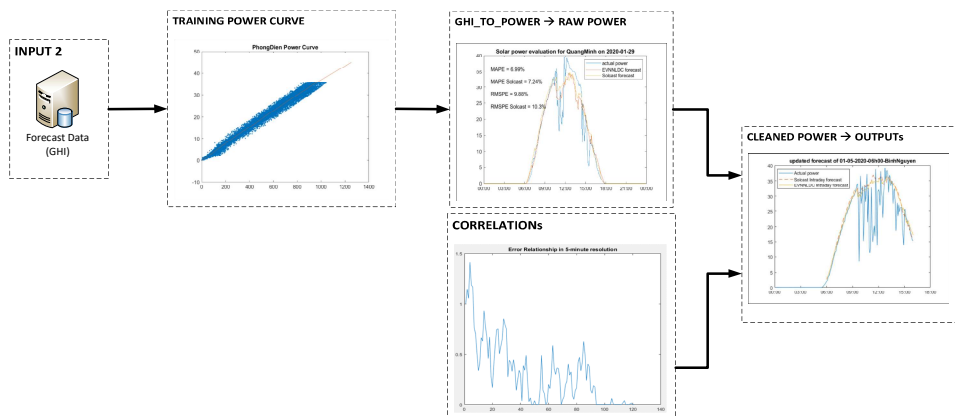


Figure 1. Intraday Methodology

- The 2020 version, in terms of structure and methodology, does not change compared to 2019. However, the main difference of 2020 comes from the fact that instead of offline forecasting, EVN NLDC has structured and revised program to match with online forecasting. As now, Intraday forecast has run completely online.

- Since the forecasting activity requires less SMO intervention, the development team has transformed and rewritten the prediction tool in a completely automatic way.

Therefore, the tool's GUI is different (no actual GUI in 2020 version) in to 2019, but still ensures all the function items are the same (but completely automatically):

- Collect historical operational data and forecast data from Oracle/SQL database systems;
This action will collect latest offline forecast results of meteorological parameters for the forecasted date and compare with actual streaming data of plants to identify the online errors.
- Build Power Curve (default value will cover all power plants);
- Forecast;
- Evaluate/Assess forecast errors;
- Send email with log-file (when error diagnosed) and results of errors estimation).

Figure 2. Renewable Energy forecasting tool – 2019 version

- The collection of historical operation data and forecast data from the Oracle/SQL database system has been done completely automatically.
 - In 2019, the data collection has been done manually, instead of automatically, taking data with the dbForge Studio for Oracle tool (for Oracle database) or SQL Server Management 2014 (for databases) SQL.
→ export .xlsx (excel) file and save it in a certain folder.
 - In 2020, the data collection has been conducted automatically according to the following model:

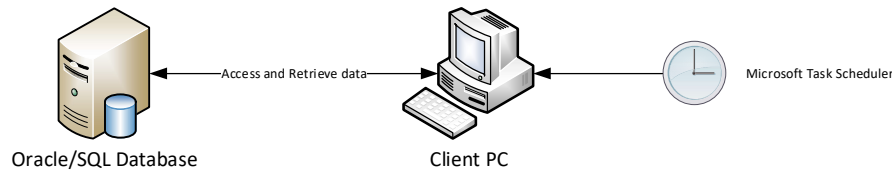


Figure 3. Data collection process – 2020 version

- Forecasting tool has built-in functions to access - collect - store data in .mat file (for forecast data, it also has a time-stamp to determine the time of receiving the forecast message to support evaluating forecast quality);
- Function to access - collect - store forecast data is also converted into .exe file. From this .exe file, the development team designed a batch file (.bat) so that the Microsoft Task Scheduler application can automatically call and run the program to prepare all the data needed for forecasting;
- On the other hand, due to the characteristics of Oracle system equipped at EVN NLDC, the collection of operation data for the past 3 months/renewable energy plant is slow (on average, it takes 20 minutes/power plant to replicate historical operation data of 05 minutes/sample for 03 consecutive months). Therefore, the development team designed a new specific function and embedded with Microsoft Task Scheduler to automate and minimize data retrieval time by retrieving only the data of the D-1 at 01:00 AM on the D-day and automatically filling in this D-1 data at the end of the data file, which has been collected from D-2 before.

1.1.2 Testing of VRE forecast tools

After reprogramming and adding the functions as stated in 1.1.1, with the support from Energinet experts, EVN NLDC team has implemented Unit Test, End - End Test and Regression Test to ensure the forecasting tool runs as stable and exact as designed. The result of this activity is the comparison between the forecasting tool built by the development team and other commercial tools (i.e. compared with the forecast results of the Solcast - Accuweather consortium) as mentioned in report 1.2.

1.2 Comparison of procured forecast and in-house developed forecast

1.2.1 An overview of the current commercial forecasts in EVN NLDC

- General information:
 - The joint venture between Solcast and AccuWeather, forecasting service provider, provide the forecasting capacity of renewable plants in Vietnam, for 114 solar power plants and 21 wind power plants in 12 months since June 2019.
- Technical information:
 - Information that EVN NLDC needs to provide to service provider (input):
 - Plant location (longitude and latitude);

- Technical information of the plant: MW designed capacity, inverter parameters (for solar power plants), turbine parameters (for wind power plants);
- Real generation capacity to calibrate the forecast results.
- Information that service provider needs to provide to EVN NLDC (output):
 - Forecasted generation capacity of renewable energy plants (MW);
 - Meteorological data at the location of renewable energy plants:
 - Solar power plant: Global horizontal irradiance, diffuse horizontal irradiance, direct normal irradiance, air temperature at 2m, solar zenith angle, solar azimuth angle, cloud opacity;
 - Wind power plant: Wind speed, wind direction, relative humidity and atmospheric pressure.
- Time frame & resolution:
 - Intraday: from 0-24h ahead
 - Solar: resolution 5 minutes, update every 15 minutes;
 - Wind: resolution 30 minutes, update every 6 hours.
 - Day-ahead: from 0-168h ahead
 - Solar: resolution 30 minutes, update every 24 hours;
 - Wind: resolution 30 minutes, update every 6 hours.

1.2.2 Comparison of commercial and in-house forecasts

Conducting an evaluation:

- The assessment was conducted for 05 days from 06/03/20 to 10/03/20 for 18 power plants with good SCADA data parameters. MAE and RMSE were used to compare forecasts between built-in tool (EVN NLDC) and vendor data (Solcast). The error results are as in the table below:

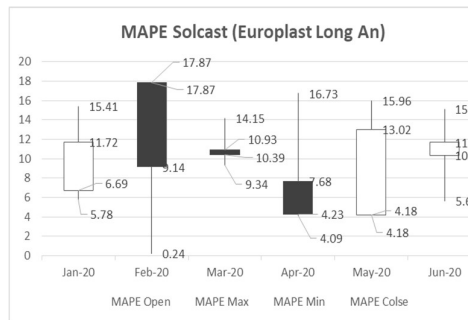
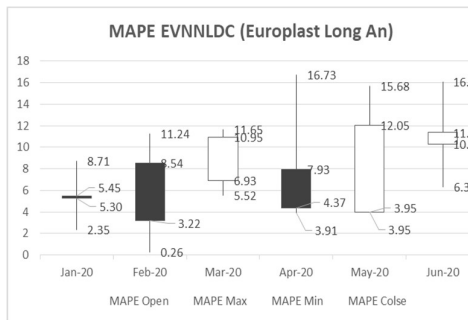
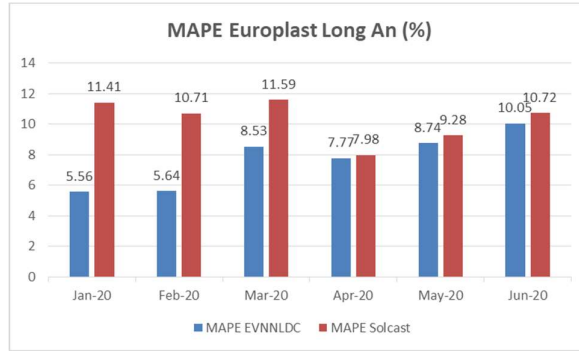
Solar Power Plant	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20
LigQuangTri	8.19	6.84	9.33	7.33	7.64	5.50
PhongDien	9.08	6.22	8.38	8.54	8.36	8.00
BinhNguyen	4.62	4.04	4.34	4.40	3.64	3.80
CatHiep	9.87	8.09	7.77	8.61	6.36	6.17
KrongPa	11.71	10.23	9.15	9.42	8.59	9.02
HoaiHoi	5.64	4.40	3.68	4.12	3.87	4.42
QuangMinh	8.70	8.19	5.06	7.34	8.62	10.77
AMIKhanhHoa	7.96	7.92	5.76	7.33	5.91	7.02
Culut	7.88	7.65	6.91	7.72	9.65	11.45
TrungNam	3.35	3.30	3.40	5.06	4.86	3.86
SonMy31	3.88	3.57	4.69	4.92	7.62	10.68
ThuanMinh2	4.67	4.37	6.89	6.26	7.36	6.60
TTCNamPhu2	2.74	2.83	4.15	5.25	5.19	6.30
DauTieng2	3.12	3.27	4.05	3.44	5.06	5.60
KCNChauDuc	6.50	5.38	6.11	7.01	10.42	11.20
EuroplastLongAn	5.56	5.64	8.53	7.77	8.74	10.05
TrungNamTraVinh	3.30	2.28	4.96	3.84	4.71	5.08

EVN NLDC Day-Ahead Results

Solar Power Plant	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20
LigQuangTri	9.96	6.64	9.70	9.18	8.33	5.63
PhongDien	7.91	5.99	7.31	8.46	7.35	6.12
BinhNguyen	5.57	5.09	5.63	4.75	3.04	3.01
CatHiep	11.23	9.70	9.66	9.19	5.95	5.38
KrongPa	11.72	10.09	6.96	9.76	8.68	10.64
HoaiHoi	5.62	4.53	3.74	4.46	4.83	5.53
QuangMinh	7.75	9.33	4.94	8.35	8.69	10.68
AMIKhanhHoa	8.50	8.68	6.55	7.87	8.03	9.58
Culut	9.10	7.58	6.93	9.24	12.91	14.57
TrungNam	6.26	4.68	3.58	5.41	5.12	4.76
SonMy31	6.26	5.47	6.07	5.49	8.42	11.47
ThuanMinh2	4.14	2.91	5.36	5.22	5.38	5.14
TTCNamPhu2	4.30	4.56	5.22	5.76	5.66	6.88
DauTieng2	5.55	5.23	4.72	2.81	3.89	4.53
KCNChauDuc	6.51	6.46	8.96	10.37	15.60	16.50
EuroplastLongAn	11.41	10.71	11.59	7.98	9.28	10.72
TrungNamTraVinh	2.55	2.07	4.84	3.57	3.81	5.84

Solcast Day Ahead Results

Figure 4. Comparison of forecasting errors for 18 power plants – Day Ahead Model



EVN NLDC Day Ahead Results for Europlast Long An Power Plant

Solcast Day Ahead Results for Europlast Long An Power Plant

Figure 5. Compare the EVN NLDC Day-Ahead Results and Solcast Day-Ahead Results for the Europlast Long An Solar Power Plant

Solar Power Plant	Week 18	Week 19	Week 20	Week 21	Week 22
UgQuangTri	6.27	3.81	4.83	8.07	7.40
PhongDien	6.27	3.81	4.83	8.07	7.40
Cathiep	10.70	2.55	5.09	10.61	7.55
KrongPa	6.27	3.81	4.83	8.07	7.40
HoaHoi	6.27	3.81	4.83	8.07	7.40
QuangMinh	6.27	3.81	4.83	8.07	7.40
CuJut	2.85	7.71	6.65	10.16	8.77
ThuanMinh2	6.27	3.81	4.83	8.07	7.40
TTCHamPhu2	6.27	3.81	4.83	8.07	7.40
DauTieng2	4.85	7.17	7.51	9.97	9.19
KCNChauDuc	6.27	3.81	4.83	8.07	7.40
EuroplastLongAn	3.93	7.70	7.27	10.27	8.52
TrungNamTraVinh	6.27	3.81	4.83	8.07	7.40

EVN NLDC Intraday Results

Solar Power Plant	Week 18	Week 19	Week 20	Week 21	Week 22
UgQuangTri	7.21	5.84	7.31	10.56	11.03
PhongDien	7.21	5.84	7.31	10.56	11.03
Cathiep	11.01	2.60	4.92	12.75	7.81
KrongPa	7.21	5.84	7.31	10.56	11.03
HoaHoi	7.21	5.84	7.31	10.56	11.03
QuangMinh	7.21	5.84	7.31	10.56	11.03
CuJut	6.09	10.87	9.87	13.33	11.72
ThuanMinh2	7.21	5.84	7.31	10.56	11.03
TTCHamPhu2	7.21	5.84	7.31	10.56	11.03
DauTieng2	2.53	5.58	5.07	8.36	7.70
KCNChauDuc	7.21	5.84	7.31	10.56	11.03
EuroplastLongAn	3.91	7.38	7.03	10.33	9.69
TrungNamTraVinh	7.21	5.84	7.31	10.56	11.03

Solcast Intraday Results

Figure 6. Comparison of forecasting errors for 18 power plants – Intraday Model

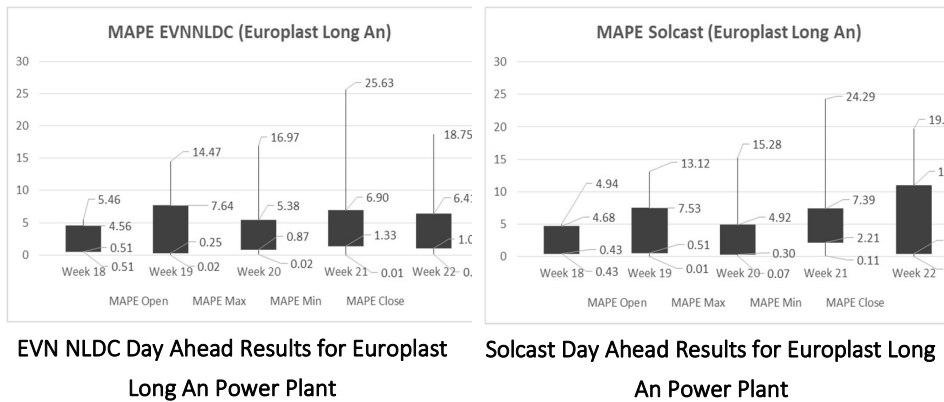
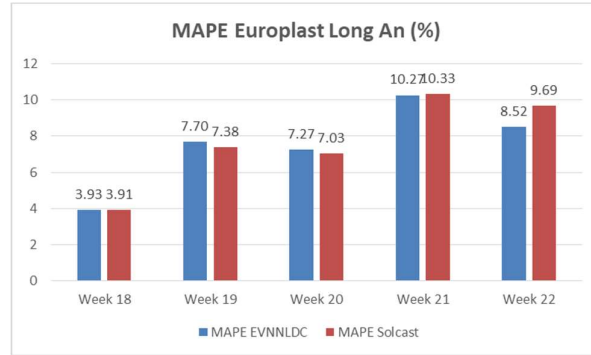


Figure 7. Compare the EVN NLDC Intraday Results and Solcast Intraday Results for the Europlast Long An Solar Power Plant

Detailed results for each power plant, each day are stored in the appendix (pdf files attached).

- Comments:
 - Some forecasts show that the quality of the tool's forecast improves compared to the supplier's forecast by 1-2%. However, there are also forecasting show worse results in compared to suppliers', e.g. for Cam Hoa, KrongPa. This may be due to the SCADA signal quality from these power plants are worse;
 - However, the overall assessment shows similar results between the forecast of the built-in tool and the forecast from provider. This is not particularly surprising, as the tool's meteorological data is used from the forecast provider's data source;
 - Therefore, it can be seen that the tool works well and gives improved results with consideration that the inputs are of good quality (mainly from SCADA signal). Nevertheless, it also shows the drawback of the tool, which performs poorly when SCADA data is bad, incomplete, or worst of all, there is no SCADA data.

1.3 Development of IT-solution for importing the forecasts into the SCADA system, guideline of IT integration of forecast tools for EVN NLDC

- Technical concern:

In terms of technical consideration, especially in IT field, the forecasting tool also has some issues:

- Due to security issues, except software/tools provided by SCADA/EMS system contractor for EVN NLDC, no direct access to SCADA/EMS system is allowed. Therefore, the integration of forecasting tools into SCADA system at EVN NLDC is not feasible.

However, technically, EVN NLDC has the database server system of Oracle and SQL data, which are synchronized from SCADA system, it is possible to provide data for the operation of project tools. Report (with sampling cycle of 05 minutes/sample; separately for parameters related to renewable energy sources is 01 minute/sample). The forecast results from the forecasting tool can be stored in EVN NLDC's database system, which can be displayed on websites or applications for real-time operation.

- Due to the characteristics of the Oracle system equipped at EVN NLDC, retrieving operation data of a large number of renewable energy plants is quite time-consuming (considering the retrieval of past operational data only: it takes an average of 20 minutes/renewable power plant for historical operating data 05 minutes/sample for 03 consecutive months of running in the past)

→ to accommodate the forecasts of large numbers of plants, there needs to consider the options allowing different servers to run different functions of renewable energy forecast tool or the options that allow the forecasting tools or functions to run in parallel to improve the forecasting speed.

- *Applying the tool in EVN NLDC:*

- Currently, EVN NLDC is using the following capacity forecast data to evaluate the available published capacity error of renewable energy plants in the week to report to RE GENCO and report to the EVN:
 - Declared capacity of the power plant itself;
 - Estimated capacity purchased by EVN NLDC: data from professional service provider;
 - Power calculation interpolated from solar radiation: EVN NLDC calculates the correlation function between generation capacity and solar radiation based on actual data collected from SCADA system of solar power plants with similar configuration with no limited capacity;
 - Actual generation capacity in cycles without transmission line limitation: is based on capacity in daily production reports sent to EVN NLDC by GENCOs.

With the support from Danish experts, other data will be added to the forecasting data package, to evaluate the error. This results from the product of generation forecasting of wind/solar power plants as mentioned above. In the coming time, EVN NLDC will test the forecasting tool in real-time context to

have the evaluation results to compare the data from purchased source versus collected from power plants to improve forecasting capacity of RE sources within EVN NLDC .

Evaluation for solar power forecasts (Day Ahead)

This function will evaluate the forecasting result.

- Created Time: 2nd March, 2020
- Input: start date, end date
- Output: calculate the RMSE, MAPE and MBE
- Calculations consider only day time (where forecasted GHI > 0).
- The curtailed parks are not taken in consideration.
- The function for "GHI Forecast Error" isn't activated.
- The forecasts don't take BIAS of lastweek forecasts in consideration.

The equation of MAPE, RMSPE, MBE:

- $MAPE = \text{nanmean}(\text{abs}(\text{actualpower} - \text{forecastedpower}) / \text{SP_instCap} * 100)$
- $RMSPE = \sqrt{\text{nanmean}((\text{actualpower} - \text{forecastedpower})^2) / \text{SP_instCap} * 100}$
- $MBE = \text{nanmean}(\text{actualpower} - \text{forecastedpower})$

The evaluation results:

MAPE of AMIKhanhHoa :
MAPE of AMIKhanhHoa for EVNNLDC : 5.858 %
MAPE of AMIKhanhHoa for Solcast provider : 8.6502 %
RMSPE of AMIKhanhHoa :
RMSPE of AMIKhanhHoa for EVNNLDC : 9.1108 %
RMSPE of AMIKhanhHoa for Solcast provider : 11.5204 %
MBE of AMIKhanhHoa :
MBE of AMIKhanhHoa for EVNNLDC : -2.6464
MBE of AMIKhanhHoa for Solcast provider : -4.0404

MAPE of BinhNguyen :
MAPE of BinhNguyen for EVNNLDC : 3.9806 %
MAPE of BinhNguyen for Solcast provider : 4.1812 %
RMSPE of BinhNguyen :
RMSPE of BinhNguyen for EVNNLDC : 7.5641 %
RMSPE of BinhNguyen for Solcast provider : 7.5691 %
MBE of BinhNguyen :
MBE of BinhNguyen for EVNNLDC : -0.91299
MBE of BinhNguyen for Solcast provider : -0.48207

MAPE of CamHoa :
MAPE of CamHoa for EVNNLDC : 24.2935 %
MAPE of CamHoa for Solcast provider : 5.6898 %
RMSPE of CamHoa :
RMSPE of CamHoa for EVNNLDC : 26.866 %
RMSPE of CamHoa for Solcast provider : 8.0866 %
MBE of CamHoa :
MBE of CamHoa for EVNNLDC : 10.5555
MBE of CamHoa for Solcast provider : -1.8542

MAPE of CatHiep :

MAPE of CatHiep for EVNNLDC : 7.2474 %
MAPE of CatHiep for Solcast provider : 6.6787 %
RMSPE of CatHiep :
RMSPE of CatHiep for EVNNLDC : 11.088 %
RMSPE of CatHiep for Solcast provider : 10.615 %
MBE of CatHiep :
MBE of CatHiep for EVNNLDC : -1.1296
MBE of CatHiep for Solcast provider : -0.54581

MAPE of CuJut :
MAPE of CuJut for EVNNLDC : 11.519 %
MAPE of CuJut for Solcast provider : 14.7698 %
RMSPE of CuJut :
RMSPE of CuJut for EVNNLDC : 17.2872 %
RMSPE of CuJut for Solcast provider : 20.8938 %
MBE of CuJut :
MBE of CuJut for EVNNLDC : -4.0135
MBE of CuJut for Solcast provider : -6.3743

MAPE of DauTieng2 :
MAPE of DauTieng2 for EVNNLDC : 4.9324 %
MAPE of DauTieng2 for Solcast provider : 3.5164 %
RMSPE of DauTieng2 :
RMSPE of DauTieng2 for EVNNLDC : 9.064 %
RMSPE of DauTieng2 for Solcast provider : 6.7098 %
MBE of DauTieng2 :
MBE of DauTieng2 for EVNNLDC : -8.3016
MBE of DauTieng2 for Solcast provider : -2.4903

MAPE of EuroplastLongAn :
MAPE of EuroplastLongAn for EVNNLDC : 7.6916 %
MAPE of EuroplastLongAn for Solcast provider : 8.1855 %
RMSPE of EuroplastLongAn :
RMSPE of EuroplastLongAn for EVNNLDC : 10.9901 %
RMSPE of EuroplastLongAn for Solcast provider : 11.5945 %
MBE of EuroplastLongAn :
MBE of EuroplastLongAn for EVNNLDC : -0.26317
MBE of EuroplastLongAn for Solcast provider : 0.083441

MAPE of HoaHoi :
MAPE of HoaHoi for EVNNLDC : 4.0518 %
MAPE of HoaHoi for Solcast provider : 4.7735 %
RMSPE of HoaHoi :
RMSPE of HoaHoi for EVNNLDC : 7.9867 %
RMSPE of HoaHoi for Solcast provider : 8.8558 %
MBE of HoaHoi :
MBE of HoaHoi for EVNNLDC : -7.5884
MBE of HoaHoi for Solcast provider : -9.5734

MAPE of KCNChauDuc :
MAPE of KCNChauDuc for EVNNLDC : 10.4681 %
MAPE of KCNChauDuc for Solcast provider : 15.5376 %
RMSPE of KCNChauDuc :
RMSPE of KCNChauDuc for EVNNLDC : 15.8928 %

RMSPE of KCNChauDuc for Solcast provider : 21.4635 %
MBE of KCNChauDuc :
MBE of KCNChauDuc for EVNNLDC : -4.2507
MBE of KCNChauDuc for Solcast provider : -8.7711

MAPE of KrongPa :
MAPE of KrongPa for EVNNLDC : 8.7416 %
MAPE of KrongPa for Solcast provider : 8.9922 %
RMSPE of KrongPa :
RMSPE of KrongPa for EVNNLDC : 13.2784 %
RMSPE of KrongPa for Solcast provider : 12.2813 %
MBE of KrongPa :
MBE of KrongPa for EVNNLDC : -2.6523
MBE of KrongPa for Solcast provider : 1.5547

MAPE of LIGQuangTri :
MAPE of LIGQuangTri for EVNNLDC : 5.8707 %
MAPE of LIGQuangTri for Solcast provider : 6.6072 %
RMSPE of LIGQuangTri :
RMSPE of LIGQuangTri for EVNNLDC : 8.8922 %
RMSPE of LIGQuangTri for Solcast provider : 9.2726 %
MBE of LIGQuangTri :
MBE of LIGQuangTri for EVNNLDC : -1.302
MBE of LIGQuangTri for Solcast provider : -1.2219

MAPE of PhongDien :
MAPE of PhongDien for EVNNLDC : 8.4769 %
MAPE of PhongDien for Solcast provider : 6.526 %
RMSPE of PhongDien :
RMSPE of PhongDien for EVNNLDC : 10.8263 %
RMSPE of PhongDien for Solcast provider : 8.5283 %
MBE of PhongDien :
MBE of PhongDien for EVNNLDC : -2.6513
MBE of PhongDien for Solcast provider : -1.1784

MAPE of QuangMinh :
MAPE of QuangMinh for EVNNLDC : 9.5853 %
MAPE of QuangMinh for Solcast provider : 9.2977 %
RMSPE of QuangMinh :
RMSPE of QuangMinh for EVNNLDC : 15.5782 %
RMSPE of QuangMinh for Solcast provider : 13.5741 %
MBE of QuangMinh :
MBE of QuangMinh for EVNNLDC : -2.7812
MBE of QuangMinh for Solcast provider : -0.49044

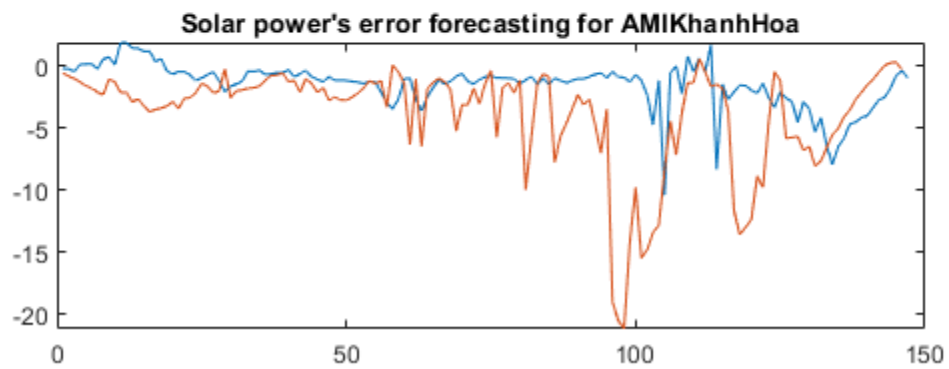
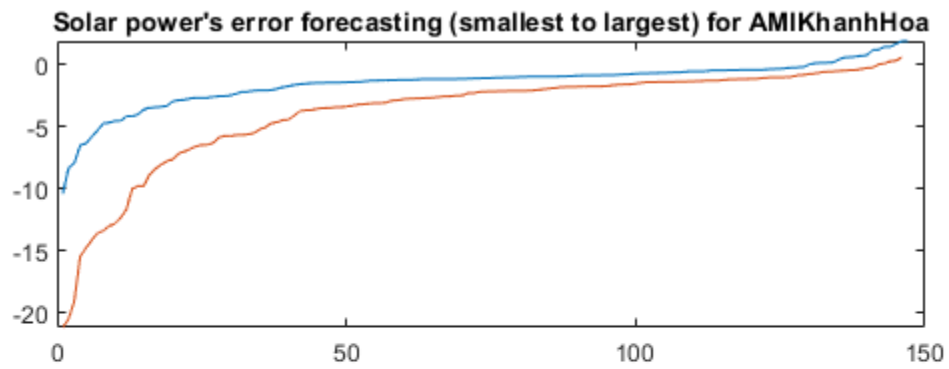
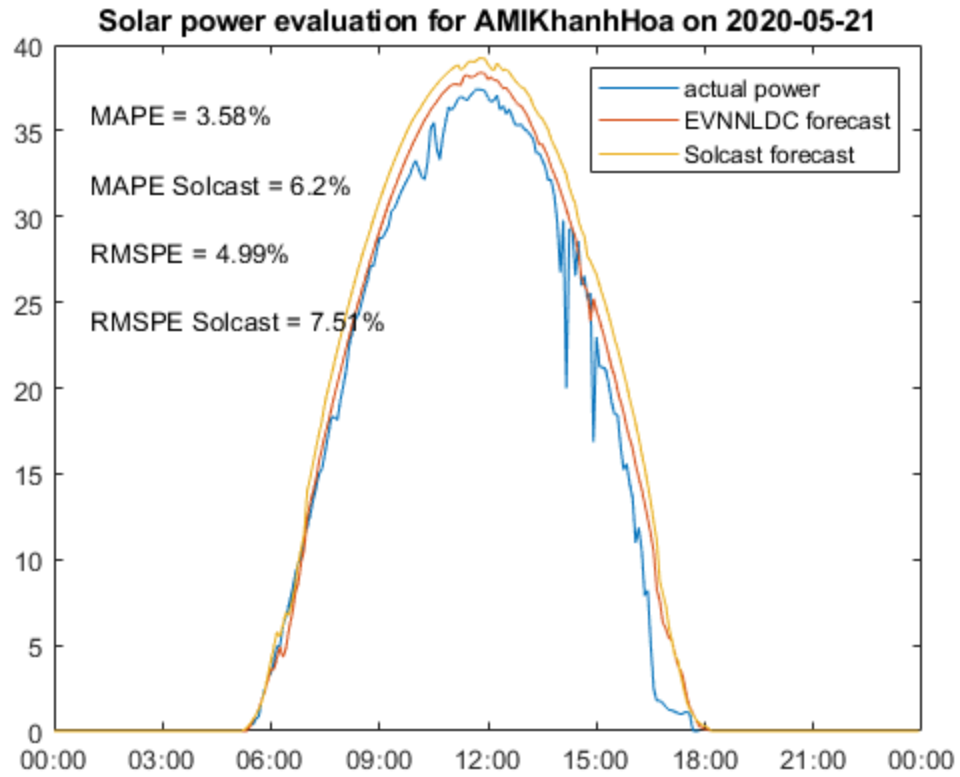
MAPE of SonMy31 :
MAPE of SonMy31 for EVNNLDC : 5.9032 %
MAPE of SonMy31 for Solcast provider : 5.9977 %
RMSPE of SonMy31 :
RMSPE of SonMy31 for EVNNLDC : 9.3394 %
RMSPE of SonMy31 for Solcast provider : 9.9584 %
MBE of SonMy31 :
MBE of SonMy31 for EVNNLDC : -1.0491
MBE of SonMy31 for Solcast provider : -1.064

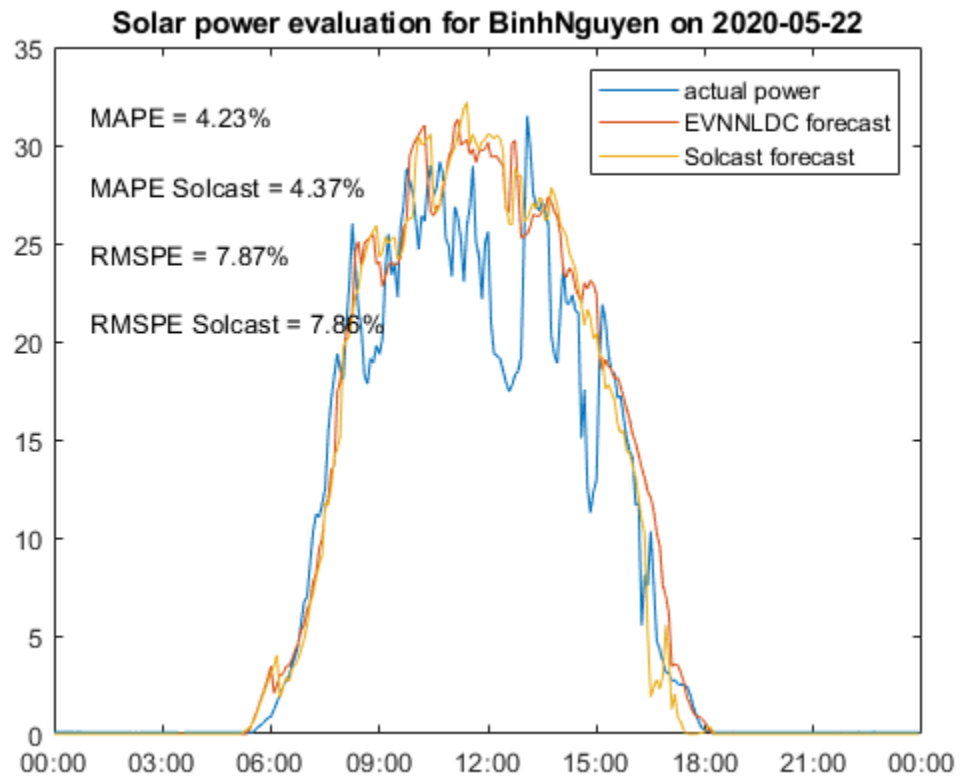
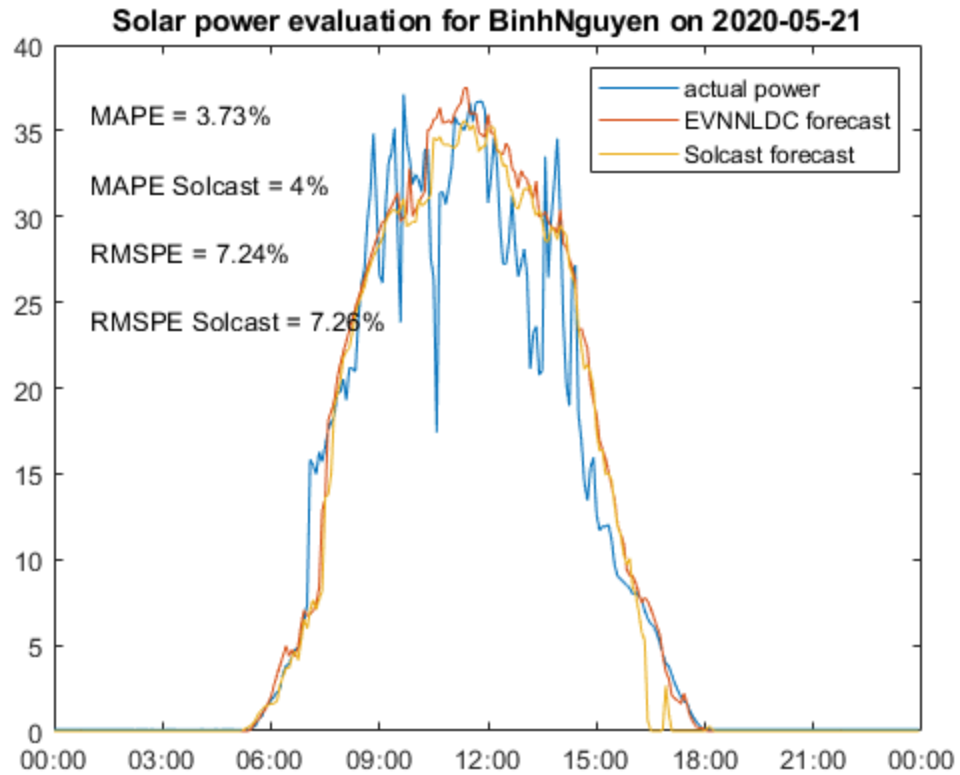
MAPE of ThuanMinh2 :
MAPE of ThuanMinh2 for EVNNLDC : 8.2015 %
MAPE of ThuanMinh2 for Solcast provider : 5.2696 %
RMSPE of ThuanMinh2 :
RMSPE of ThuanMinh2 for EVNNLDC : 14.6464 %
RMSPE of ThuanMinh2 for Solcast provider : 10.6606 %
MBE of ThuanMinh2 :
MBE of ThuanMinh2 for EVNNLDC : -3.3813
MBE of ThuanMinh2 for Solcast provider : -2.0355

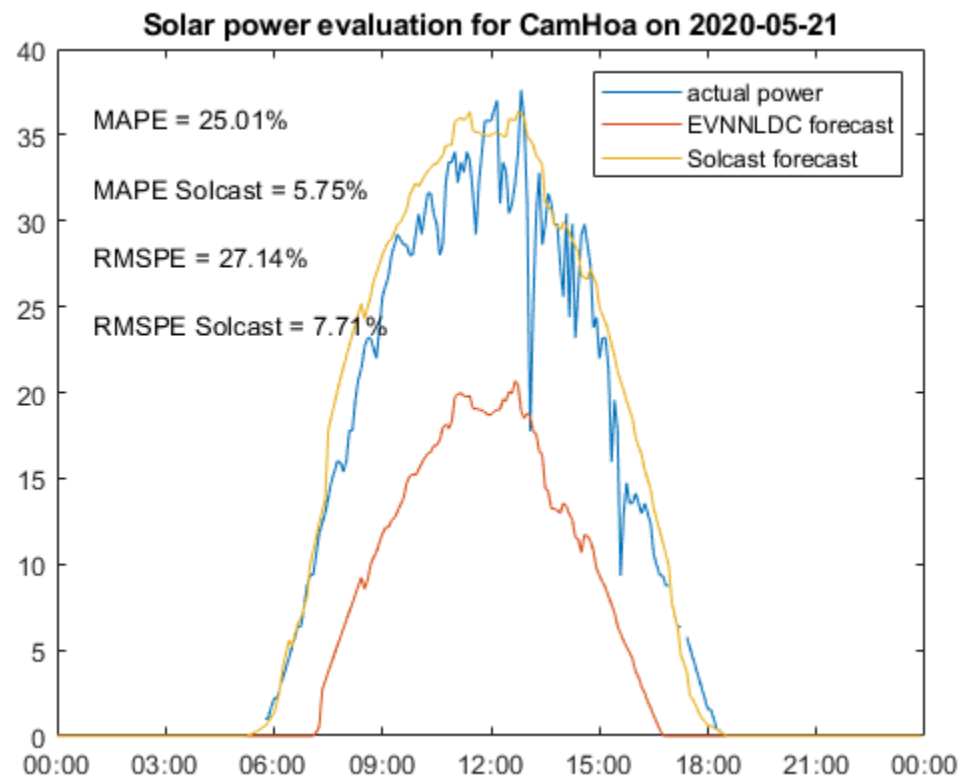
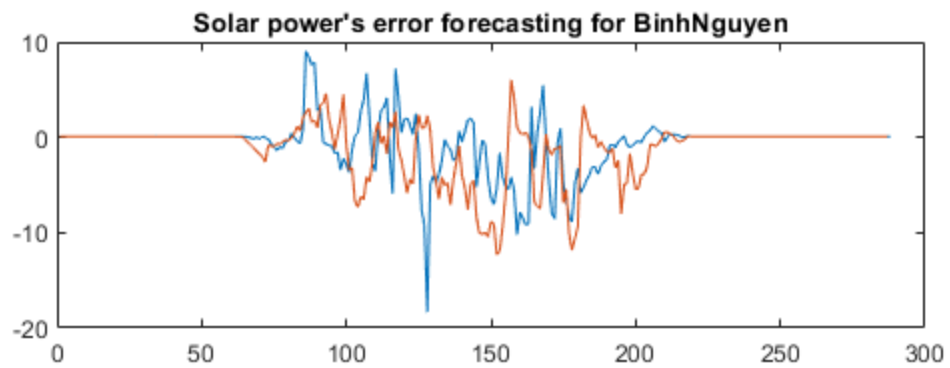
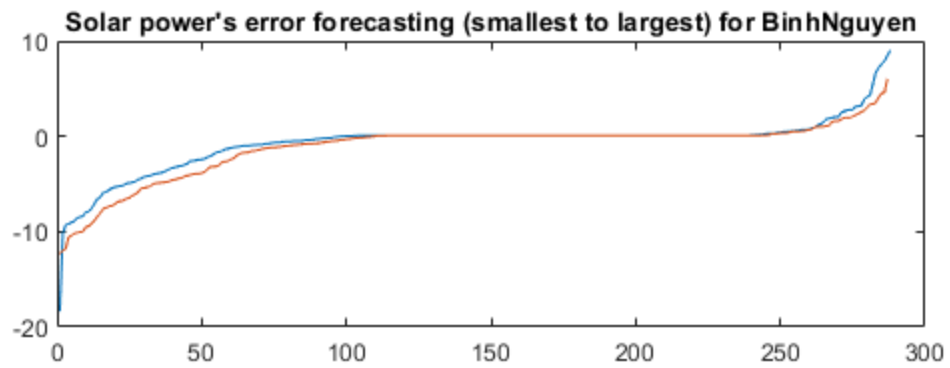
MAPE of TrungNam :
MAPE of TrungNam for EVNNLDC : 4.8502 %
MAPE of TrungNam for Solcast provider : 3.0072 %
RMSPE of TrungNam :
RMSPE of TrungNam for EVNNLDC : 9.9143 %
RMSPE of TrungNam for Solcast provider : 6.901 %
MBE of TrungNam :
MBE of TrungNam for EVNNLDC : -9.6247
MBE of TrungNam for Solcast provider : -1.1278

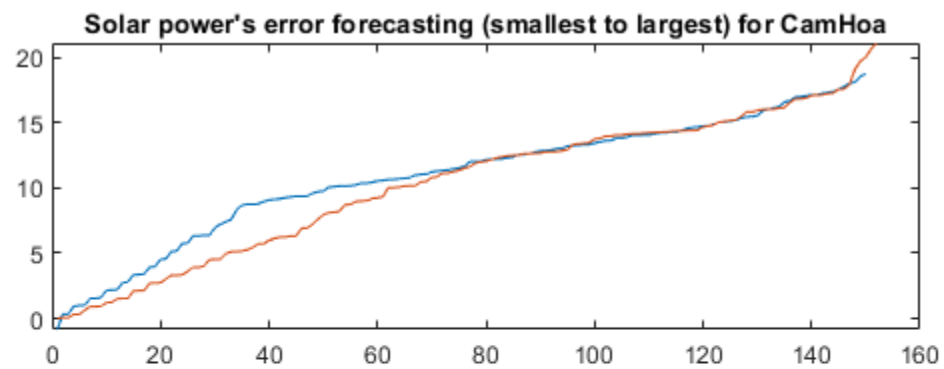
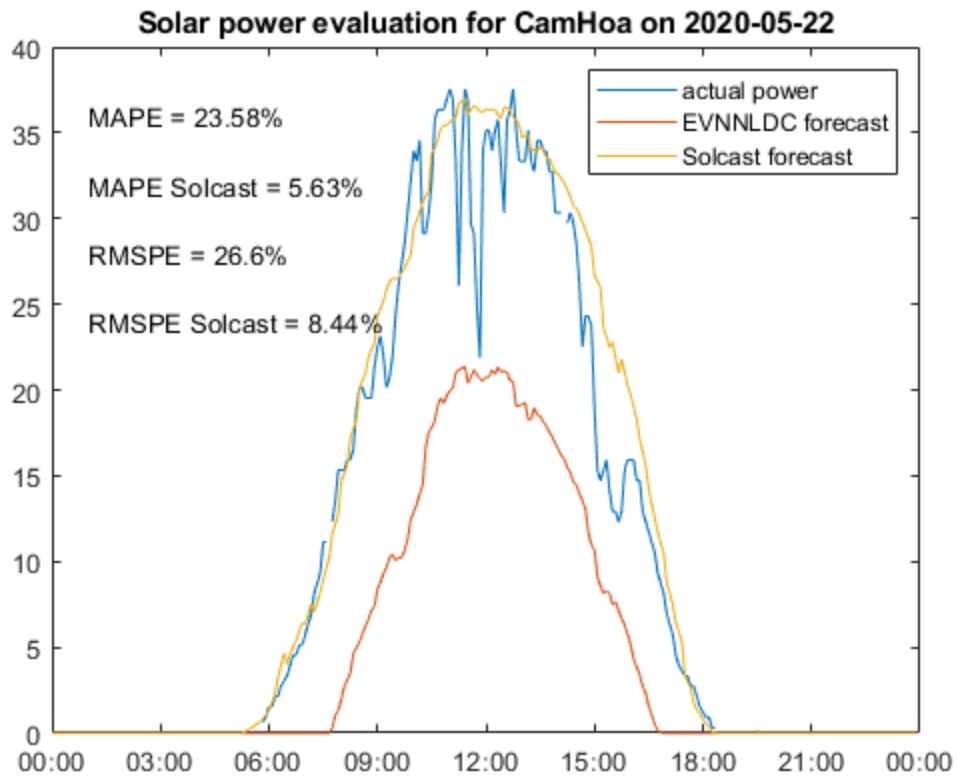
MAPE of TrungNamTraVinh :
MAPE of TrungNamTraVinh for EVNNLDC : 3.331 %
MAPE of TrungNamTraVinh for Solcast provider : 2.4112 %
RMSPE of TrungNamTraVinh :
RMSPE of TrungNamTraVinh for EVNNLDC : 6.3396 %
RMSPE of TrungNamTraVinh for Solcast provider : 4.8308 %
MBE of TrungNamTraVinh :
MBE of TrungNamTraVinh for EVNNLDC : -4.4206
MBE of TrungNamTraVinh for Solcast provider : 0.32991

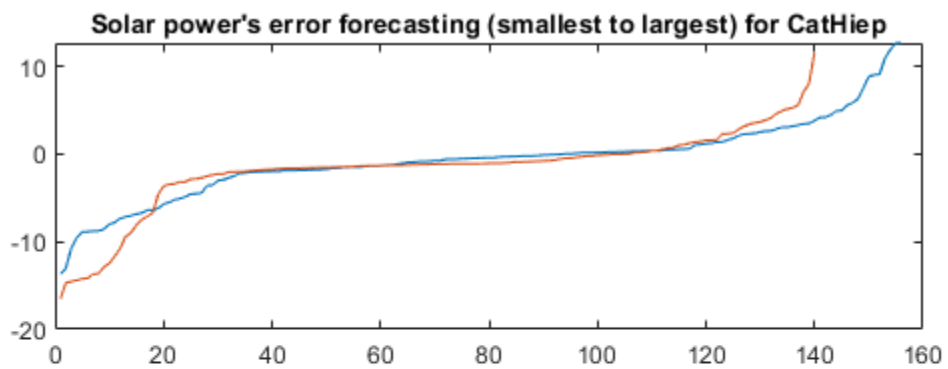
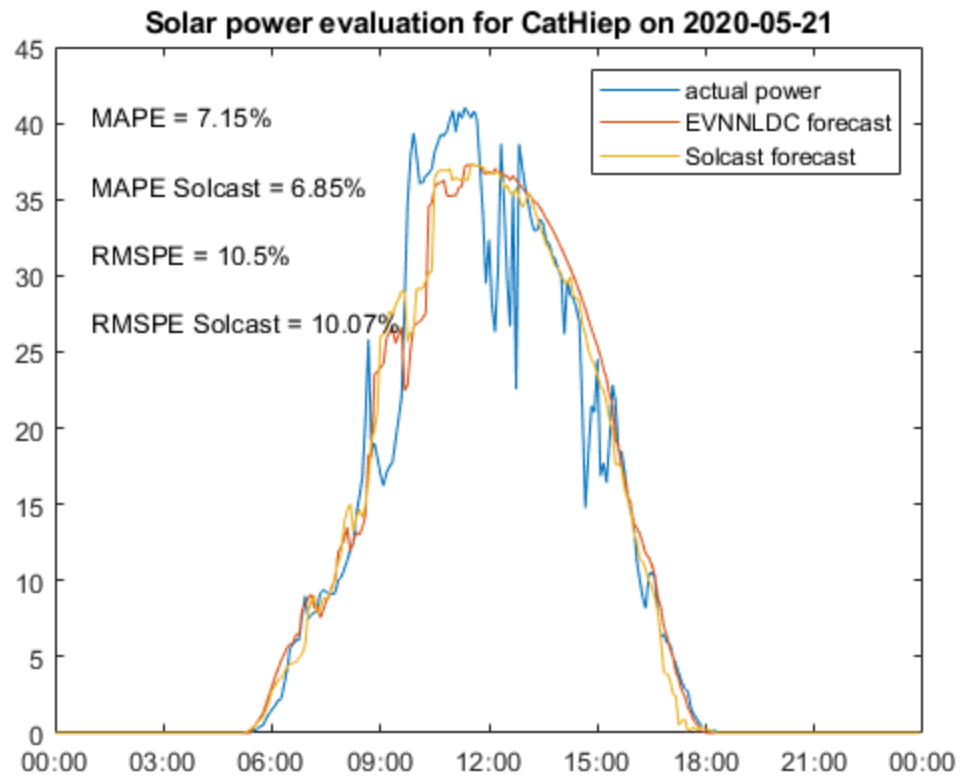
MAPE of TTCHamPhu2 :
MAPE of TTCHamPhu2 for EVNNLDC : 4.8745 %
MAPE of TTCHamPhu2 for Solcast provider : 5.1536 %
RMSPE of TTCHamPhu2 :
RMSPE of TTCHamPhu2 for EVNNLDC : 11.5949 %
RMSPE of TTCHamPhu2 for Solcast provider : 12.0332 %
MBE of TTCHamPhu2 :
MBE of TTCHamPhu2 for EVNNLDC : -1.741
MBE of TTCHamPhu2 for Solcast provider : -1.7921

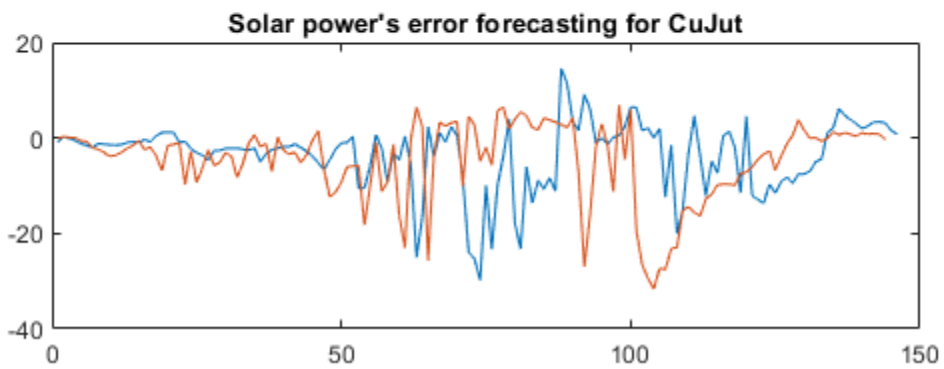
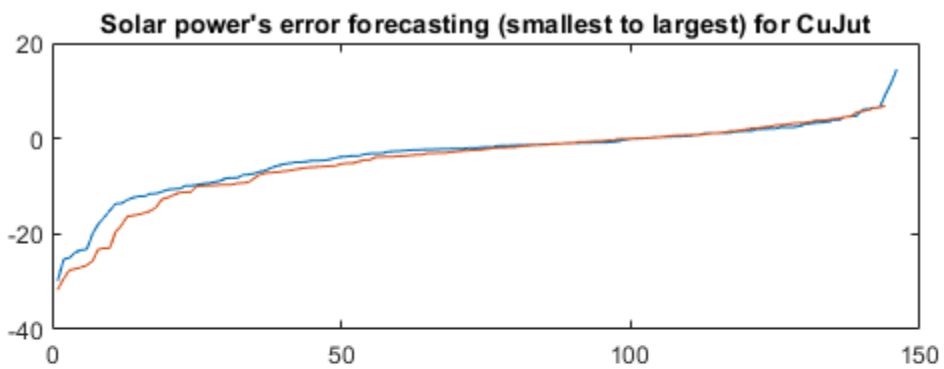
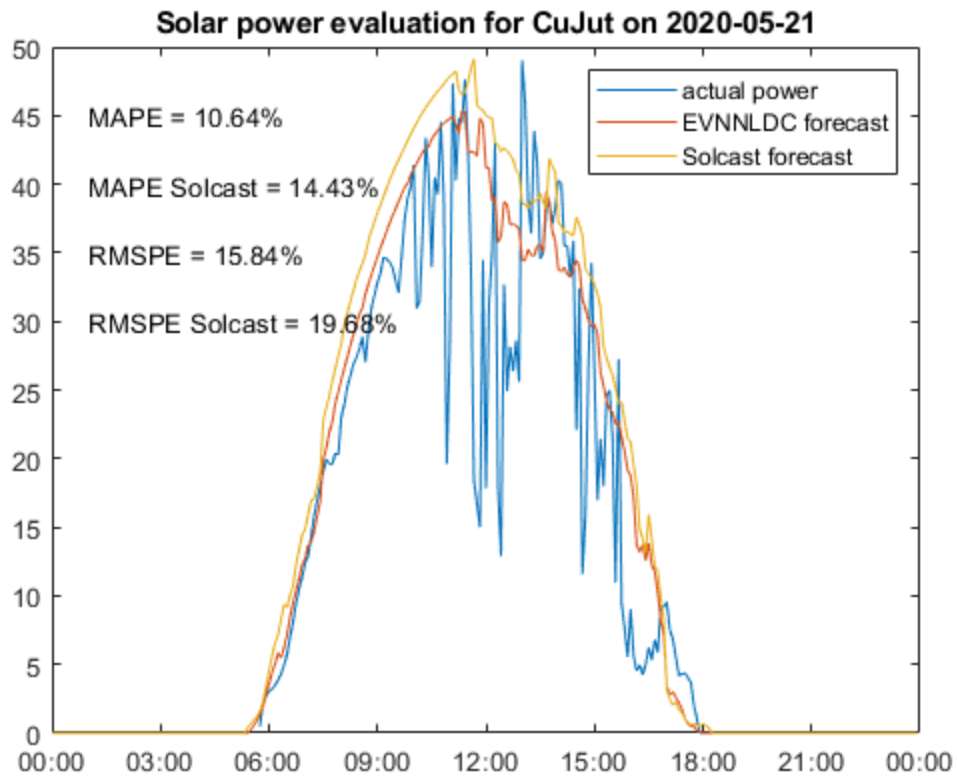


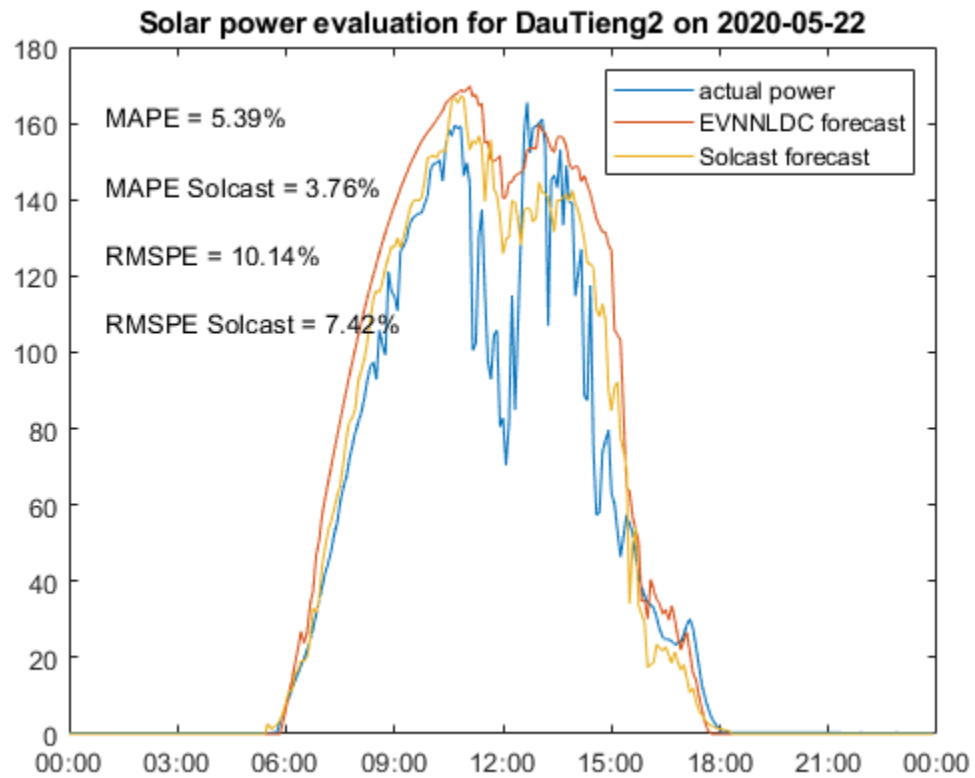
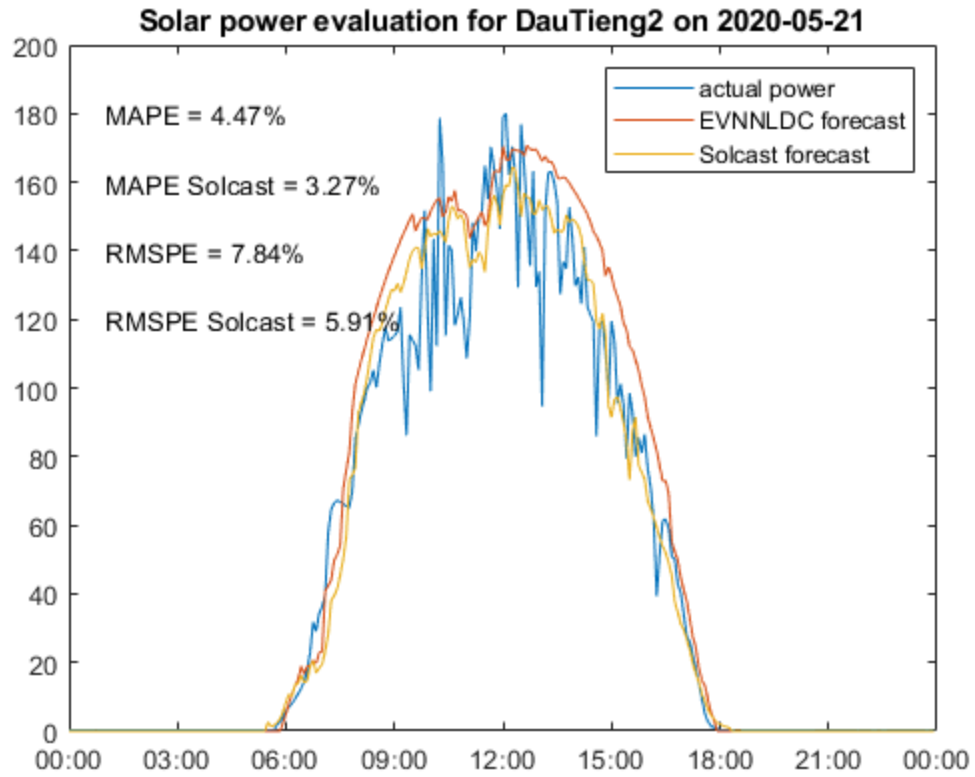


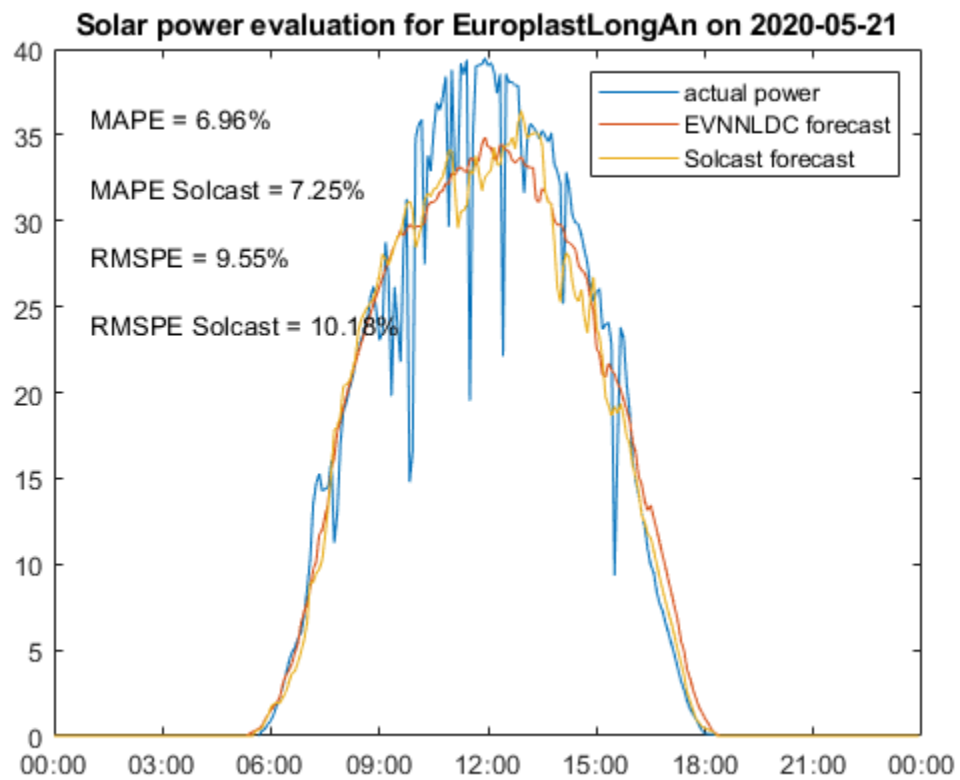
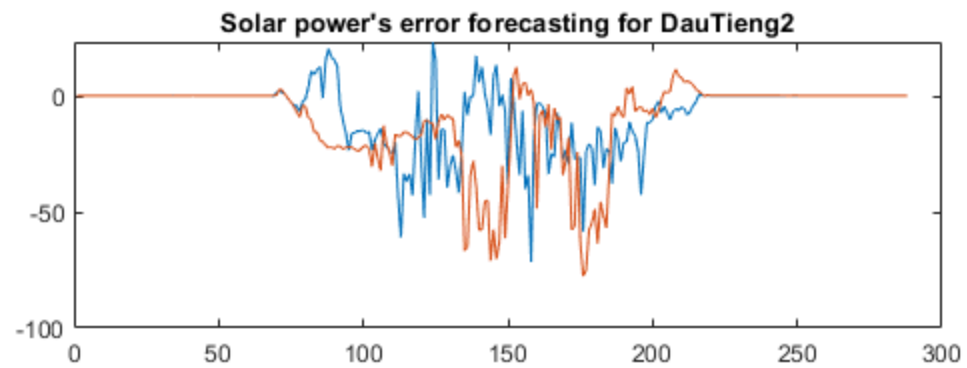
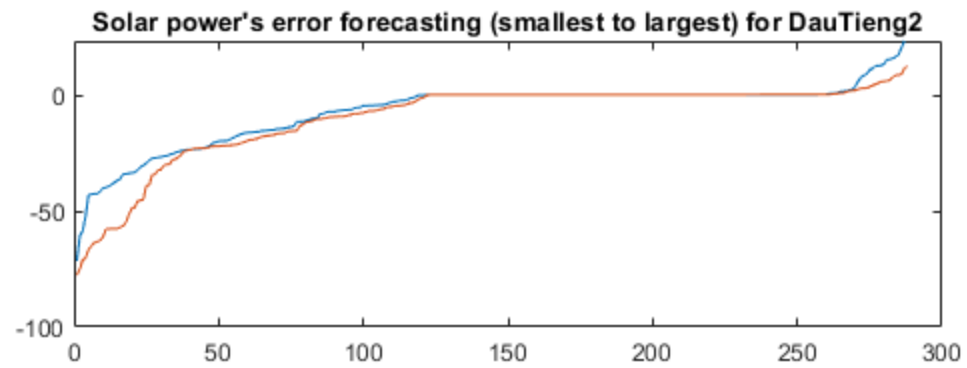


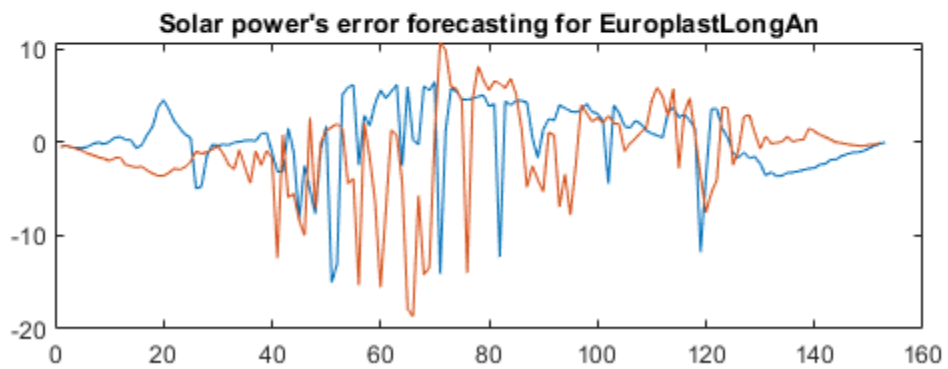
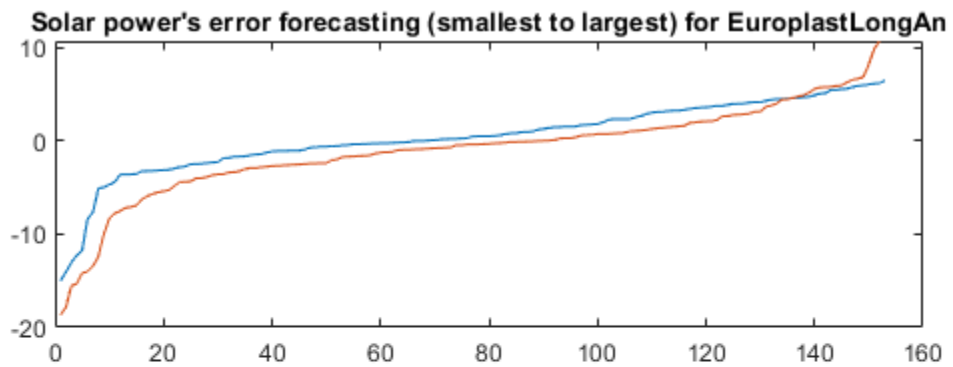
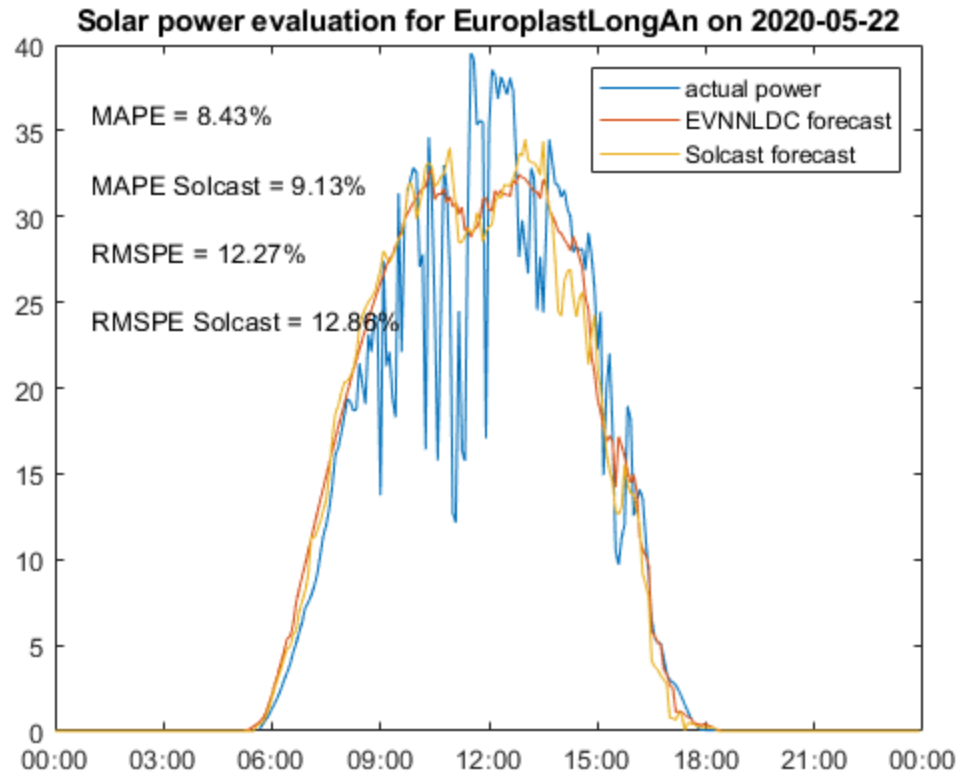


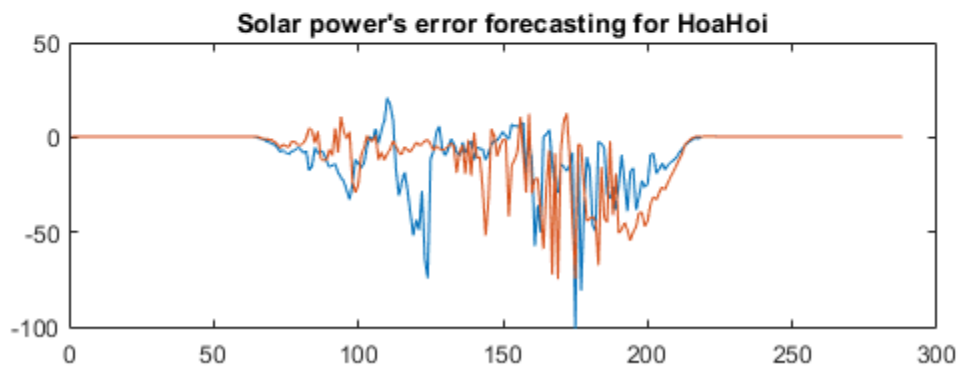
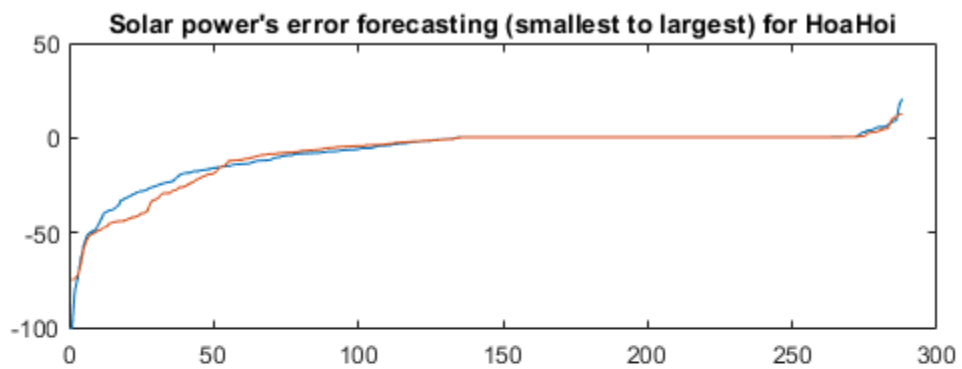
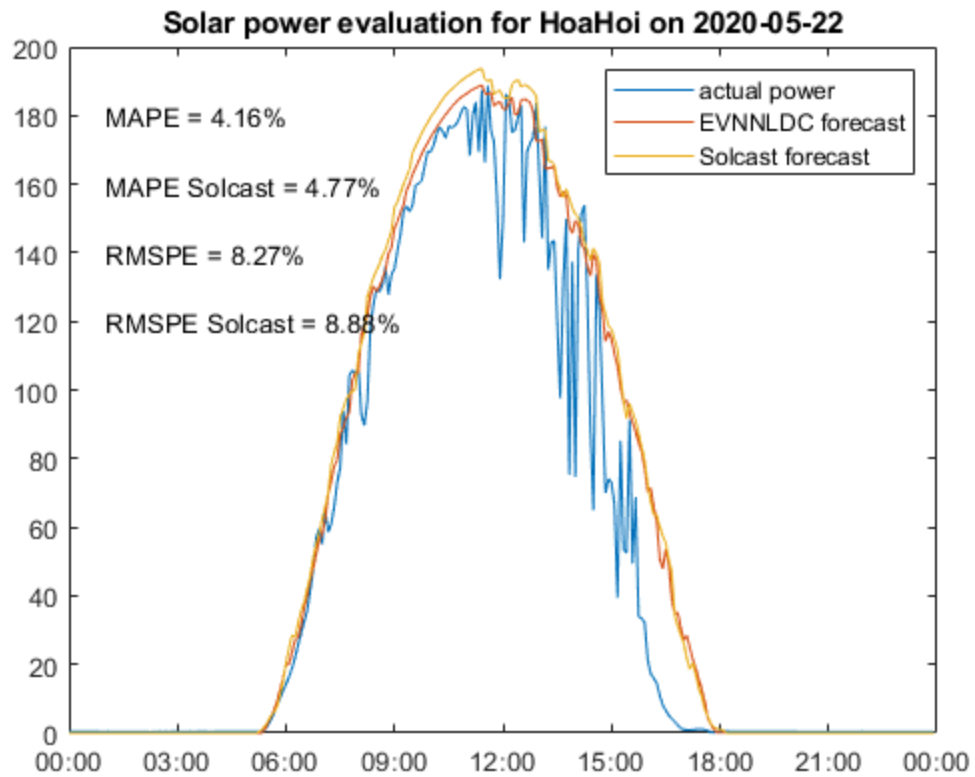


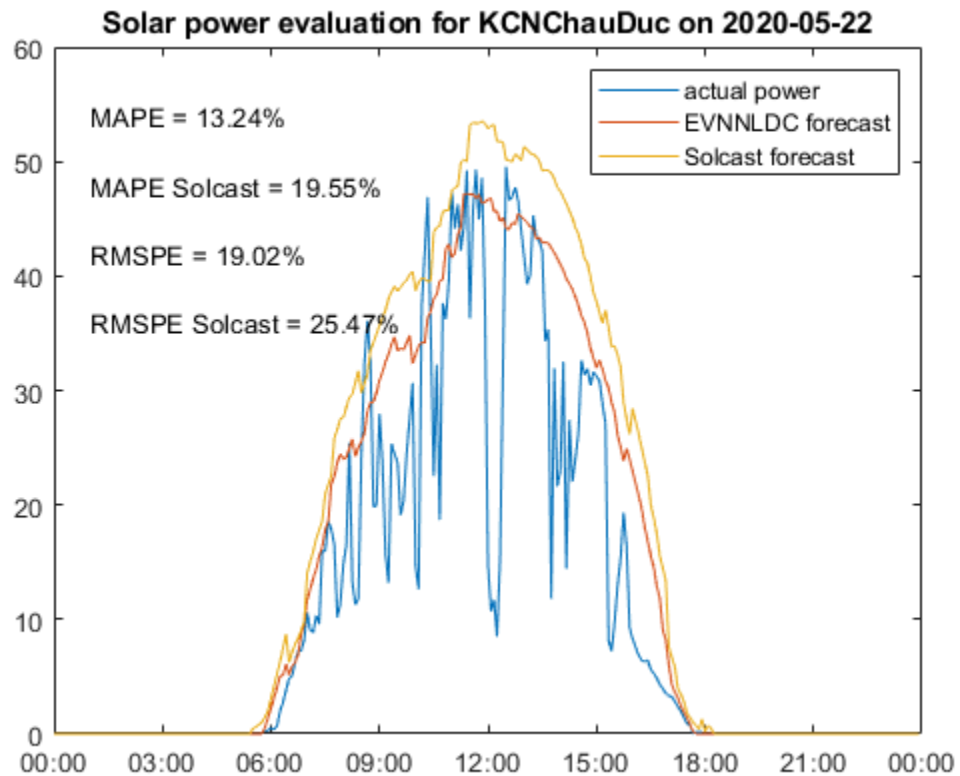
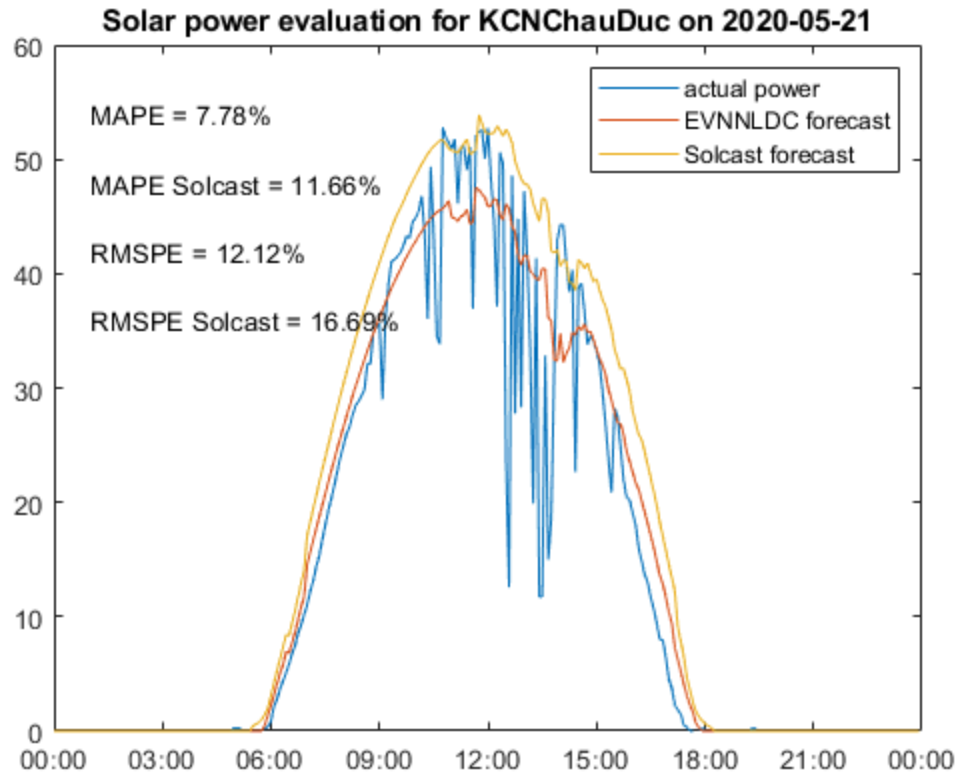


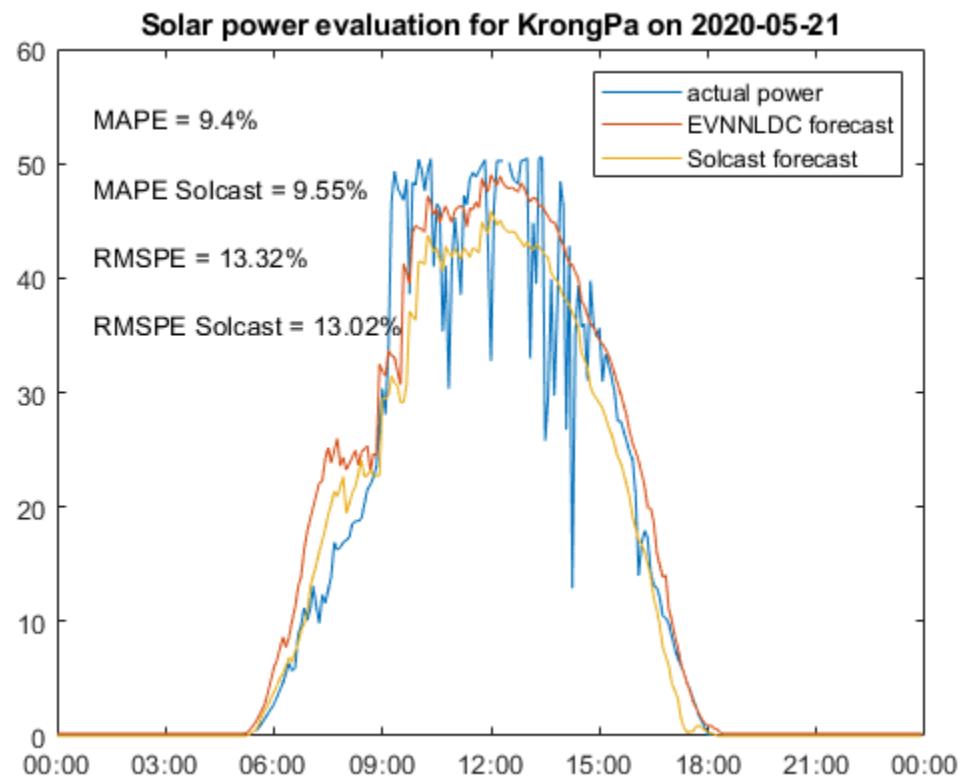
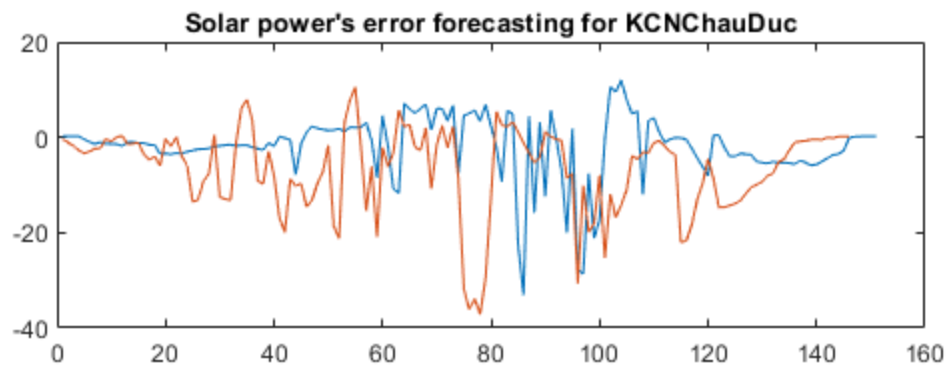
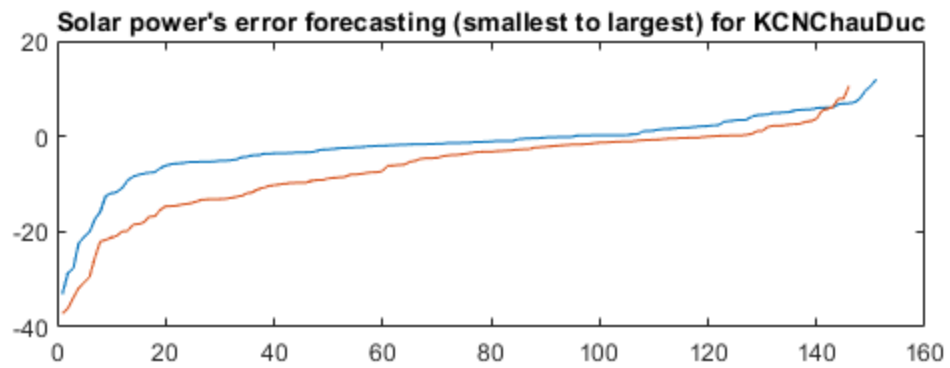


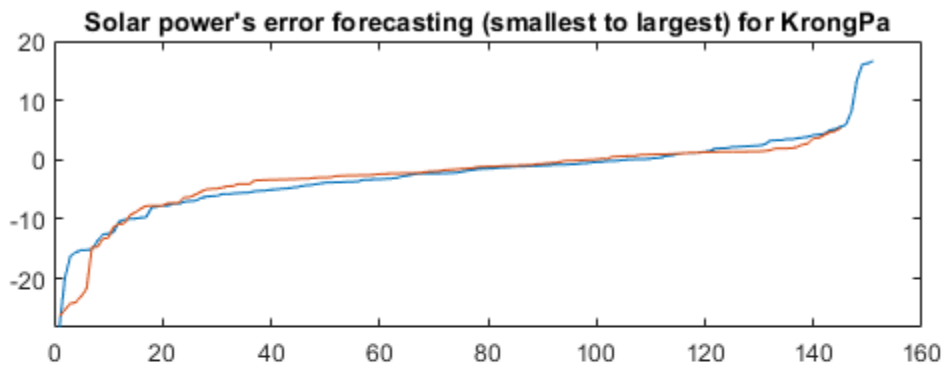
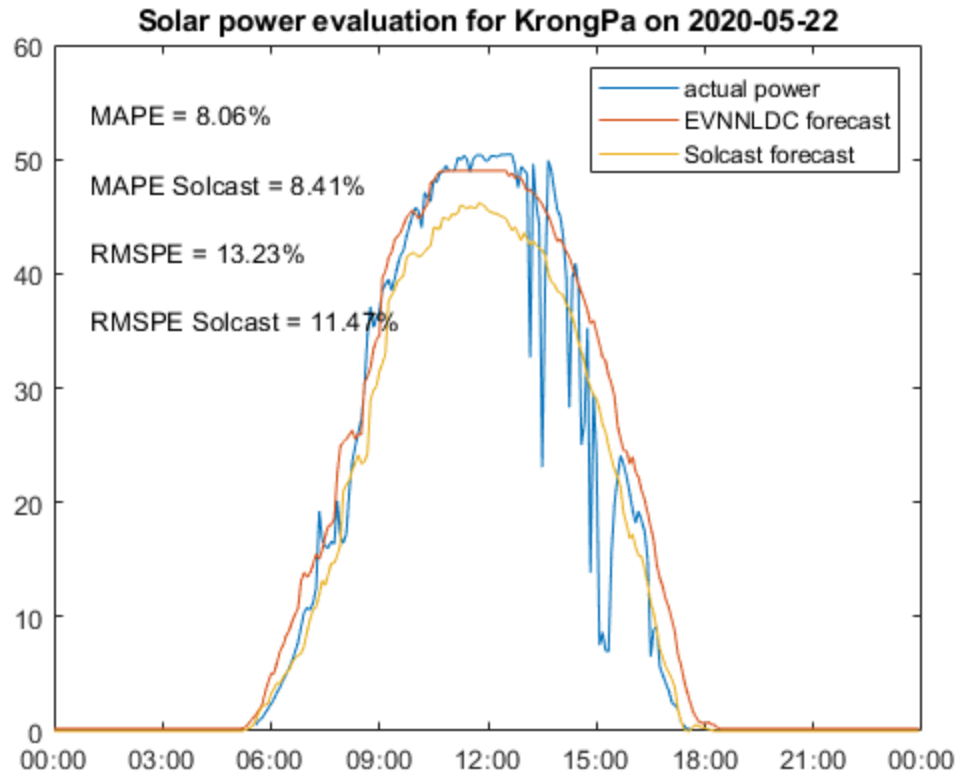


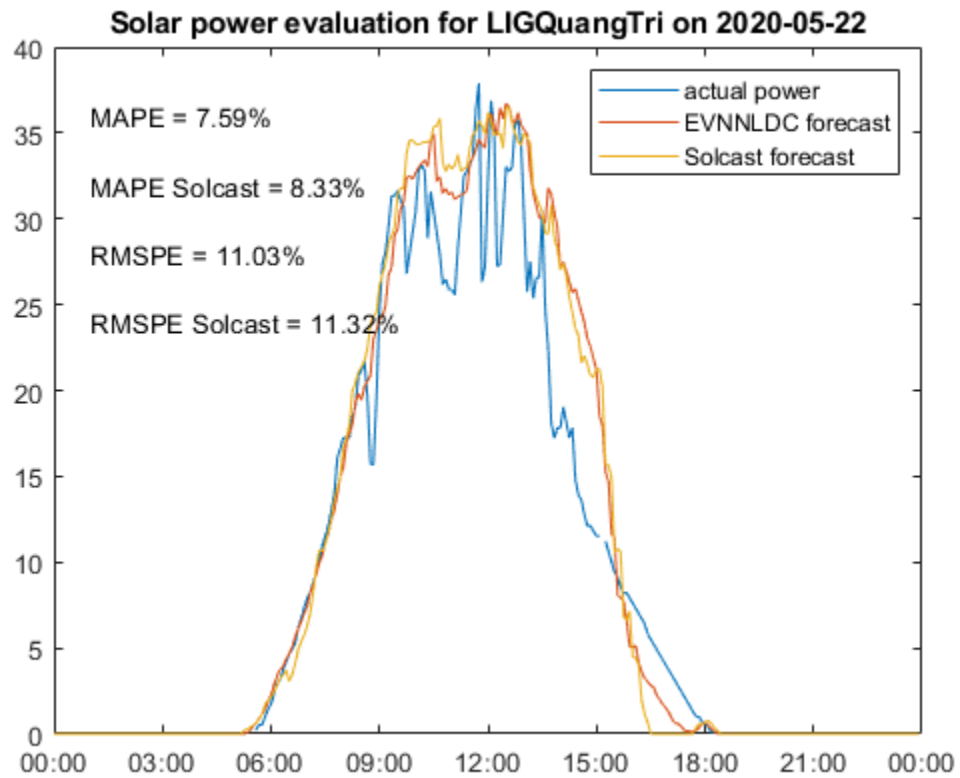
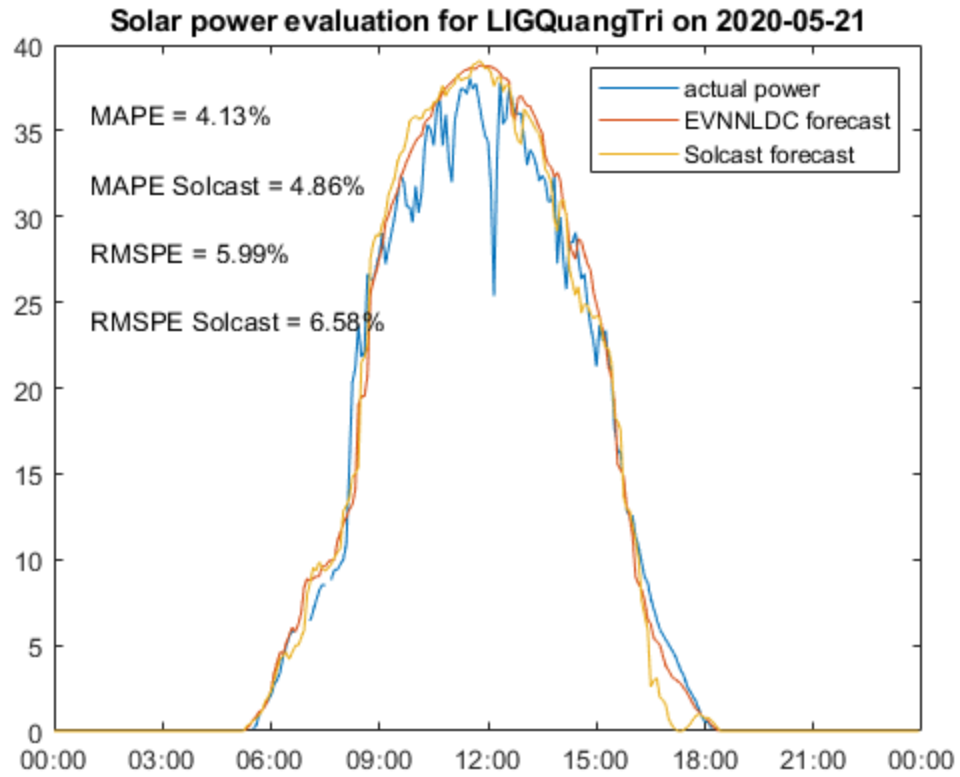


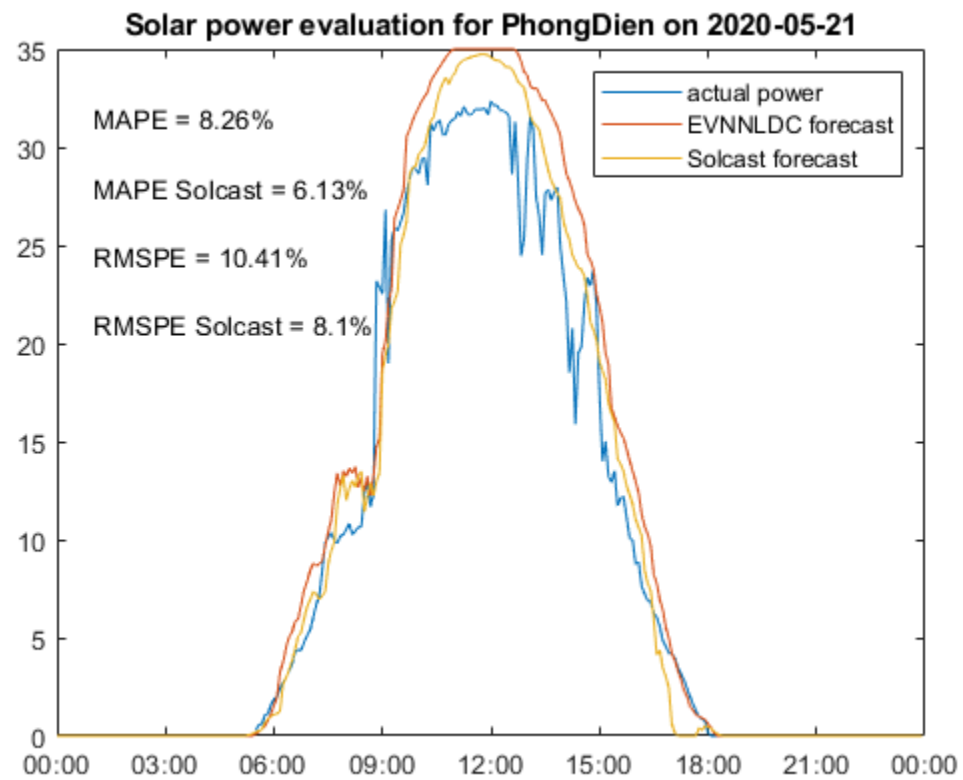
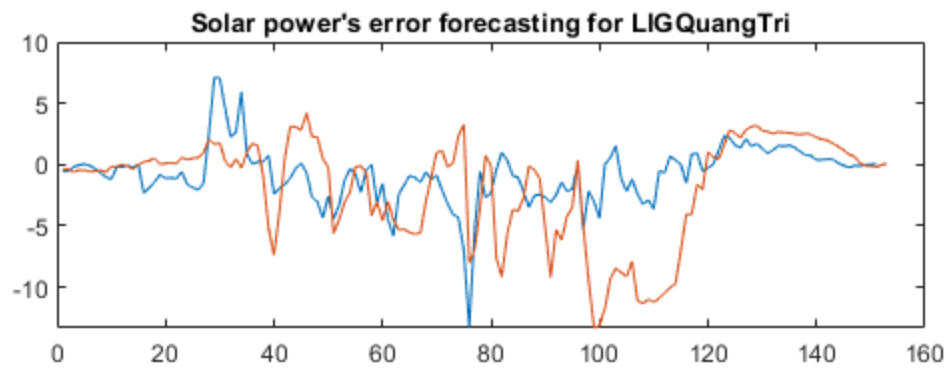
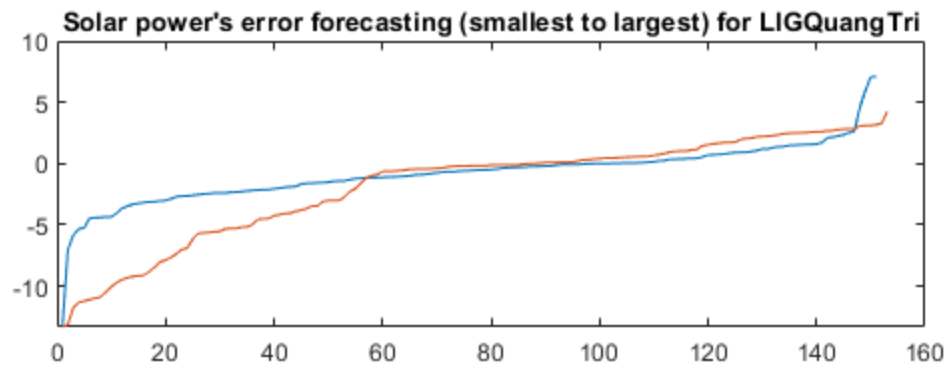


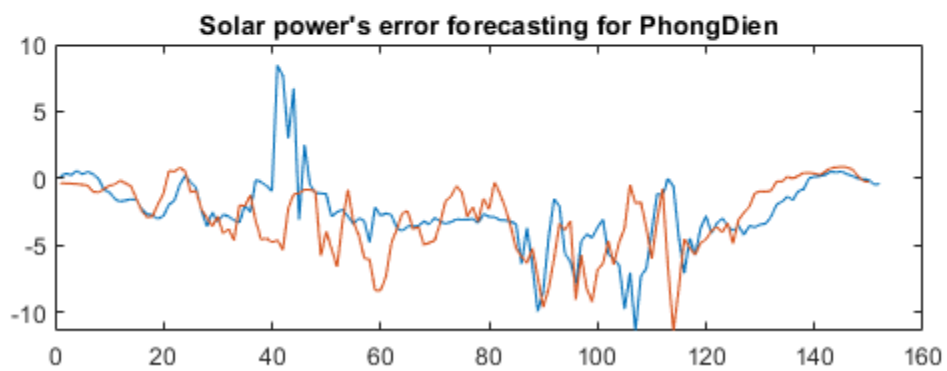
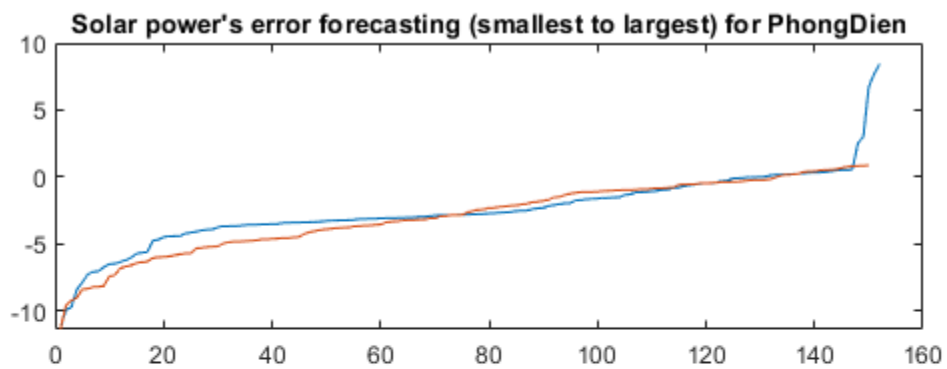
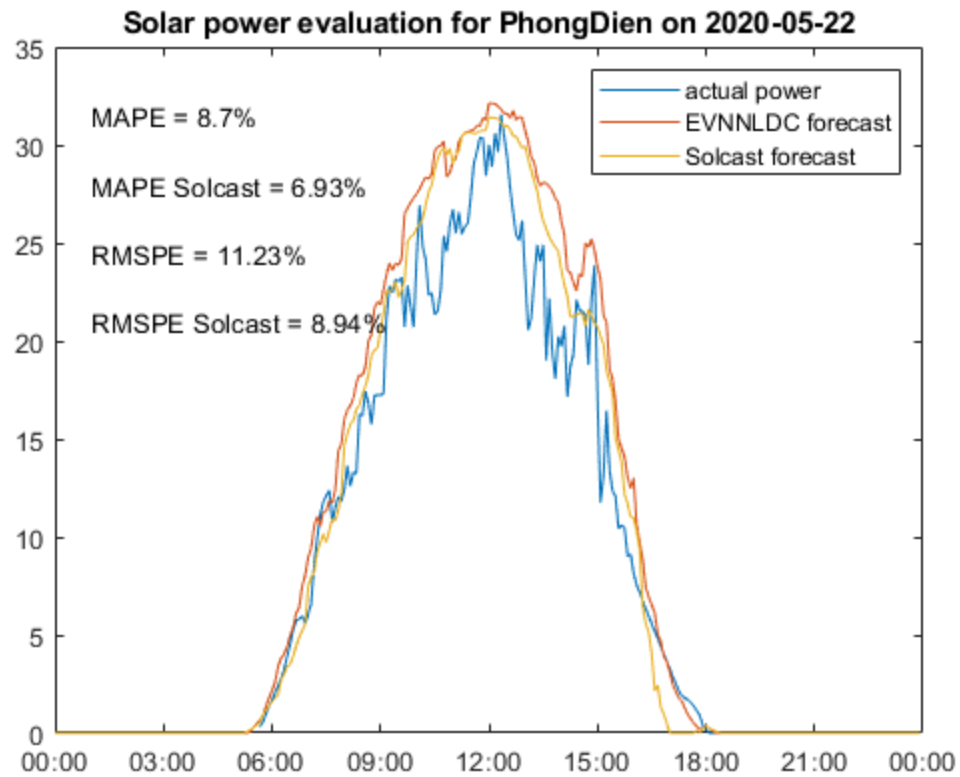


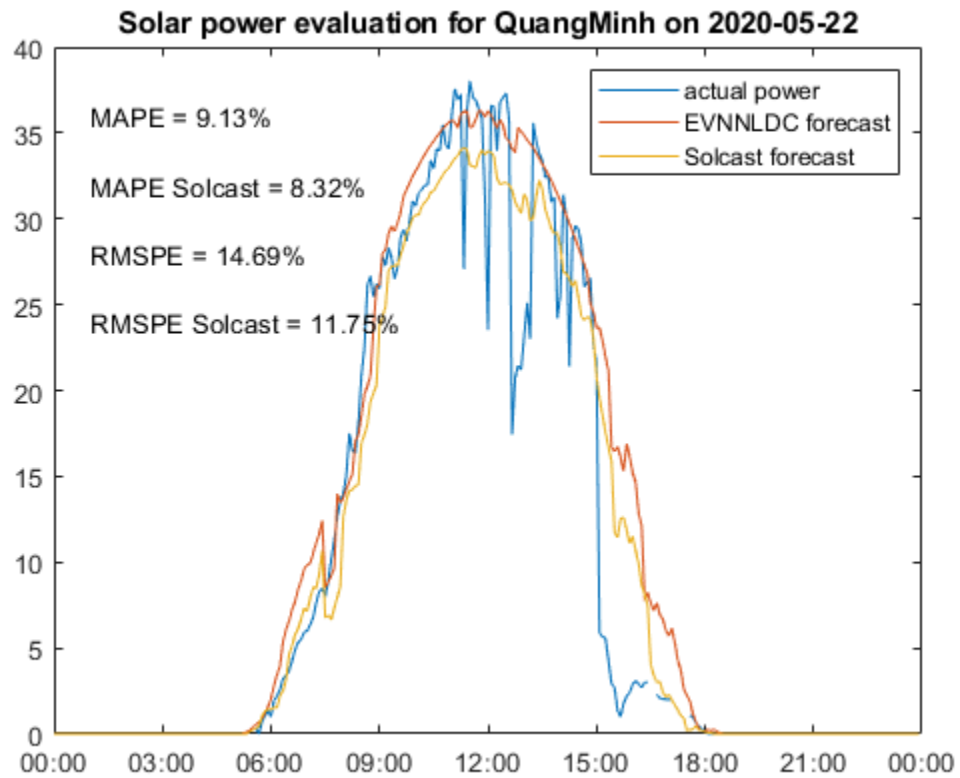
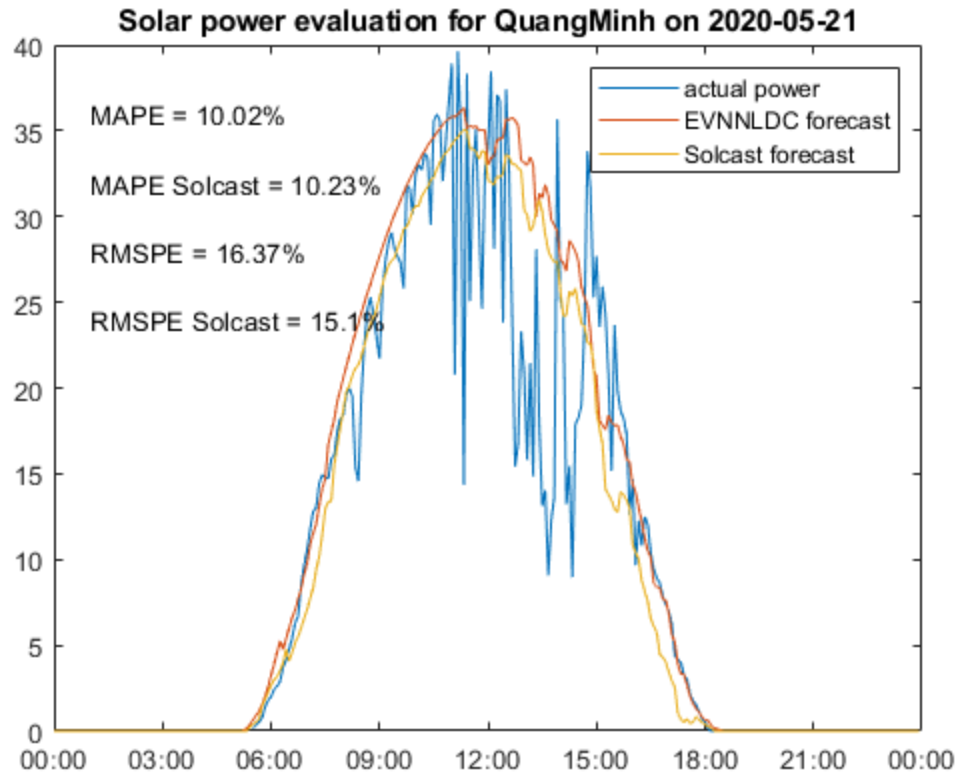


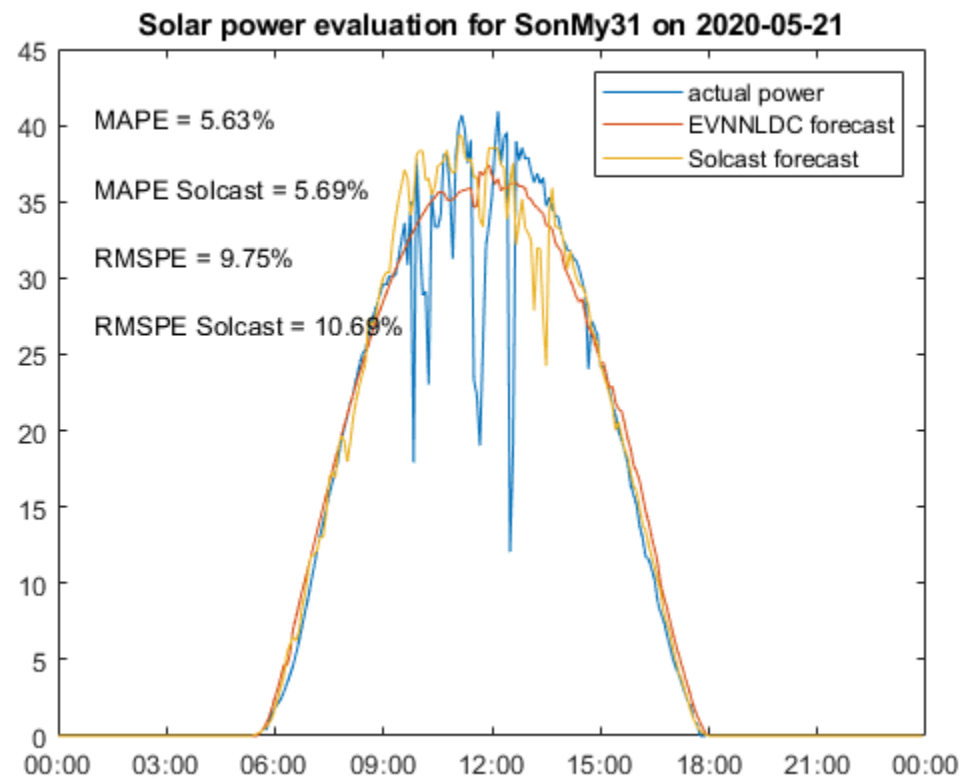
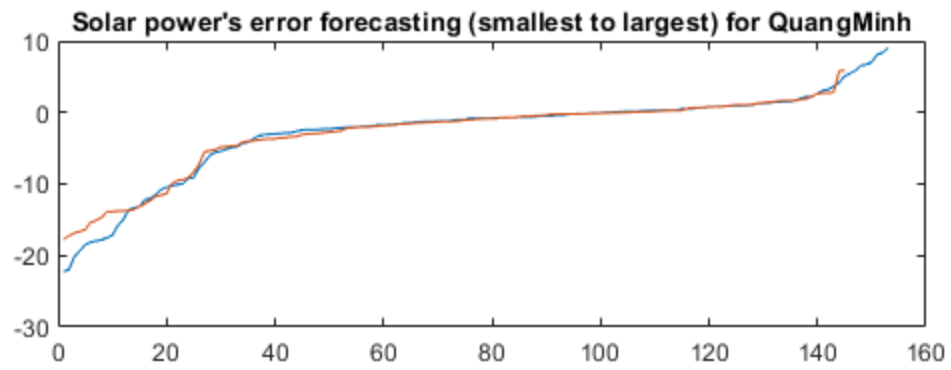


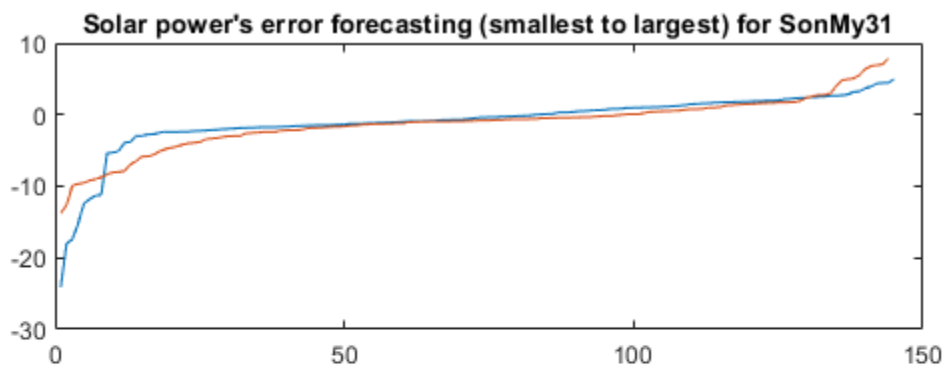
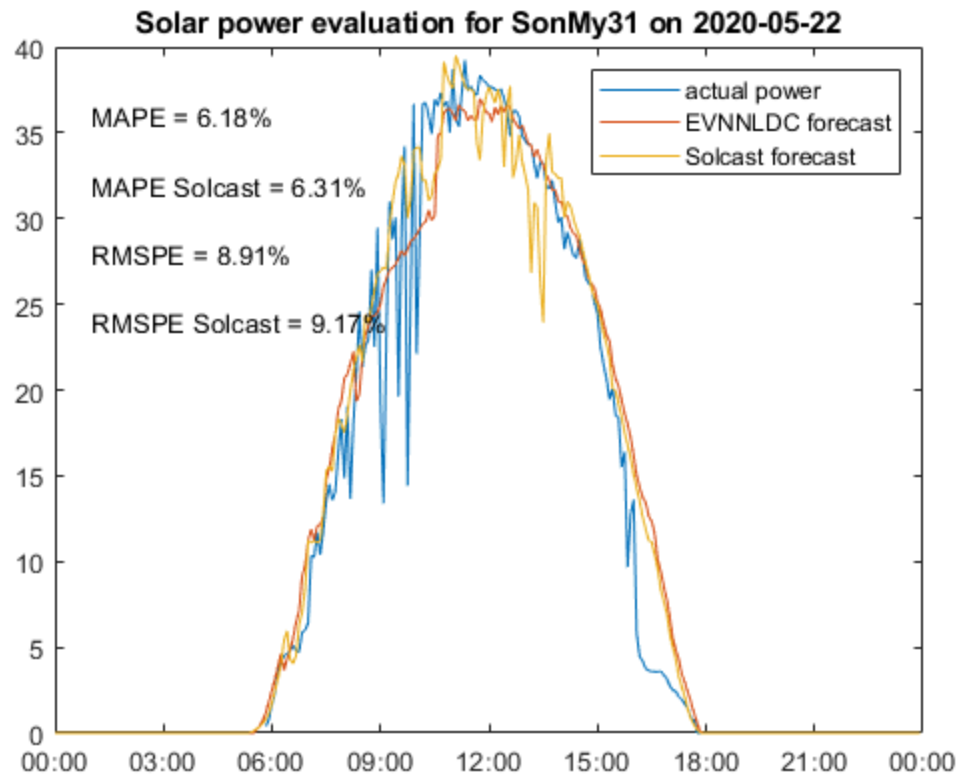


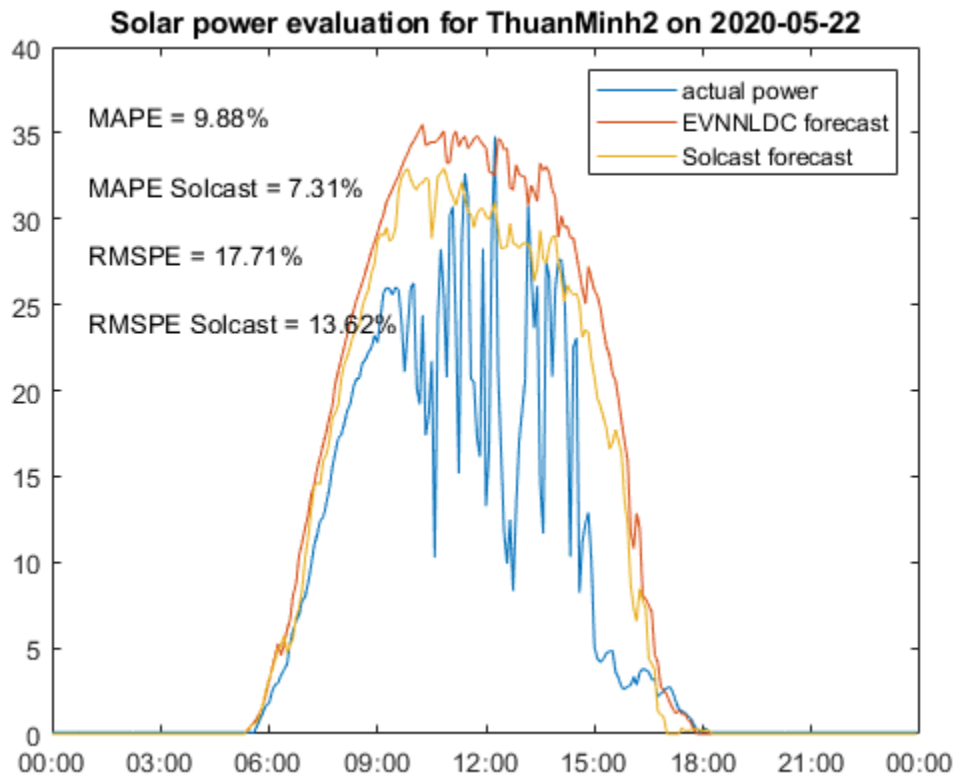
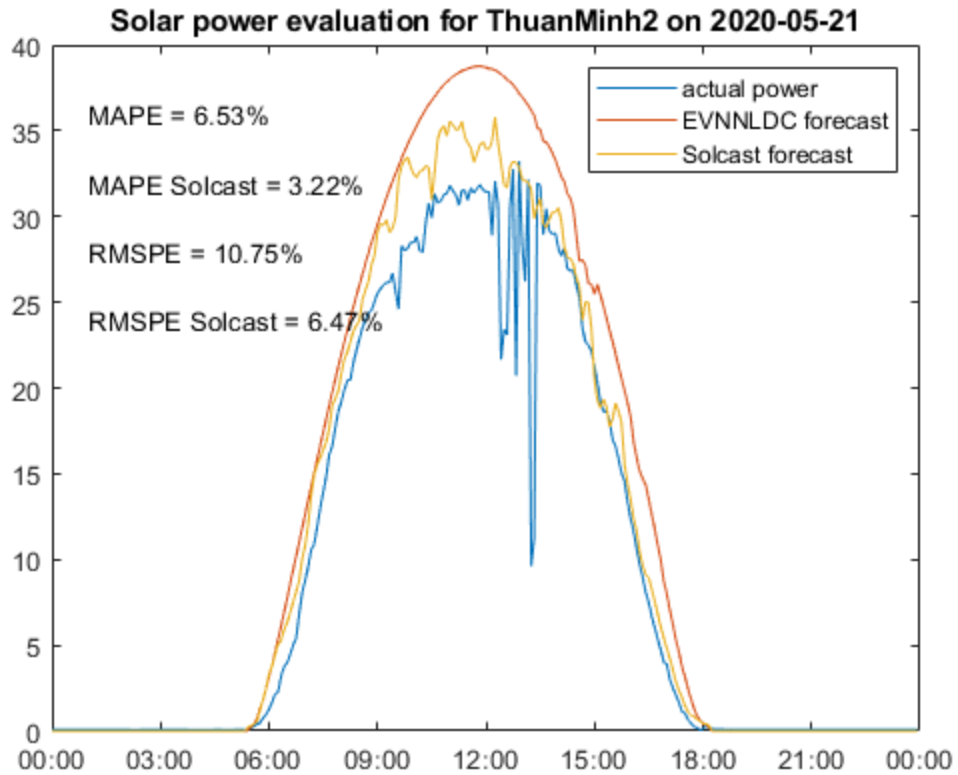


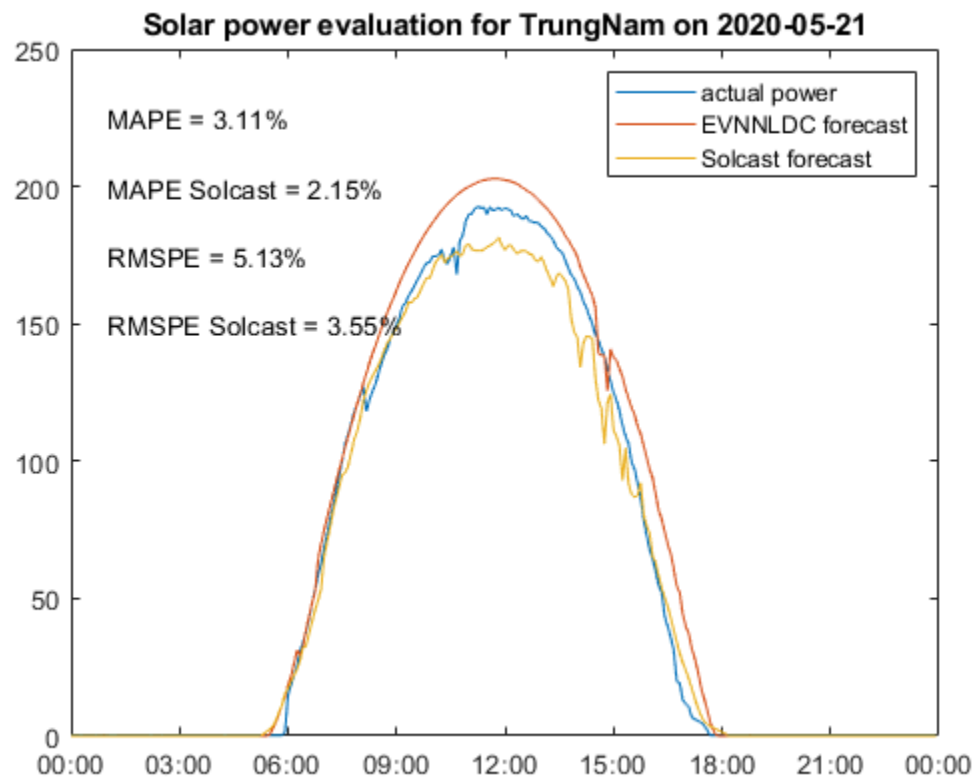
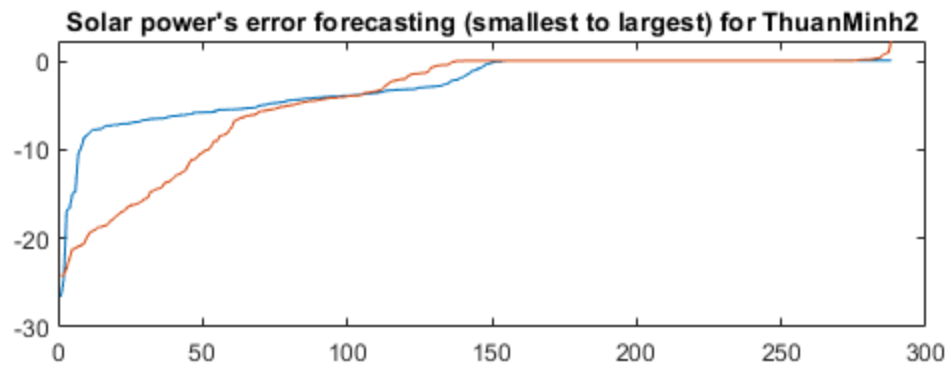


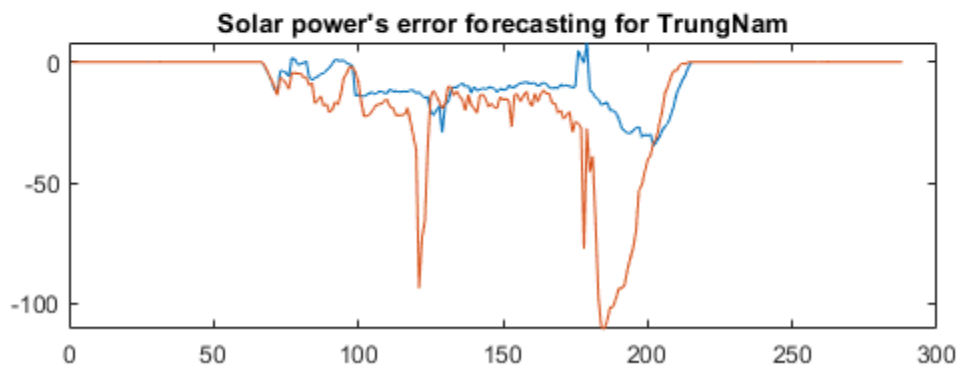
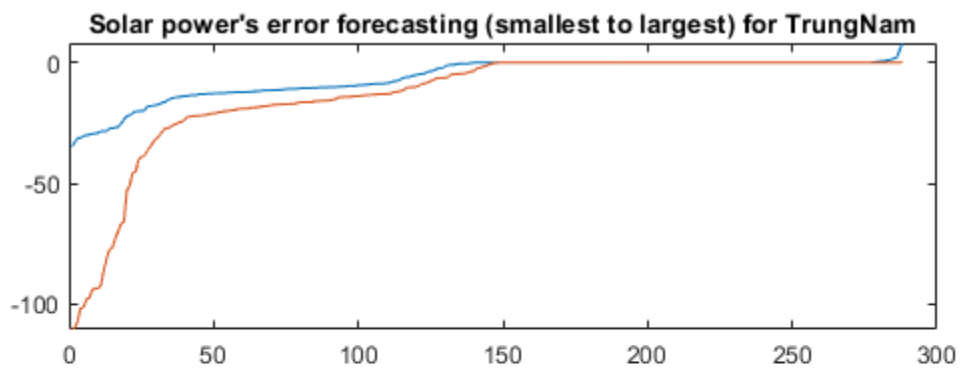
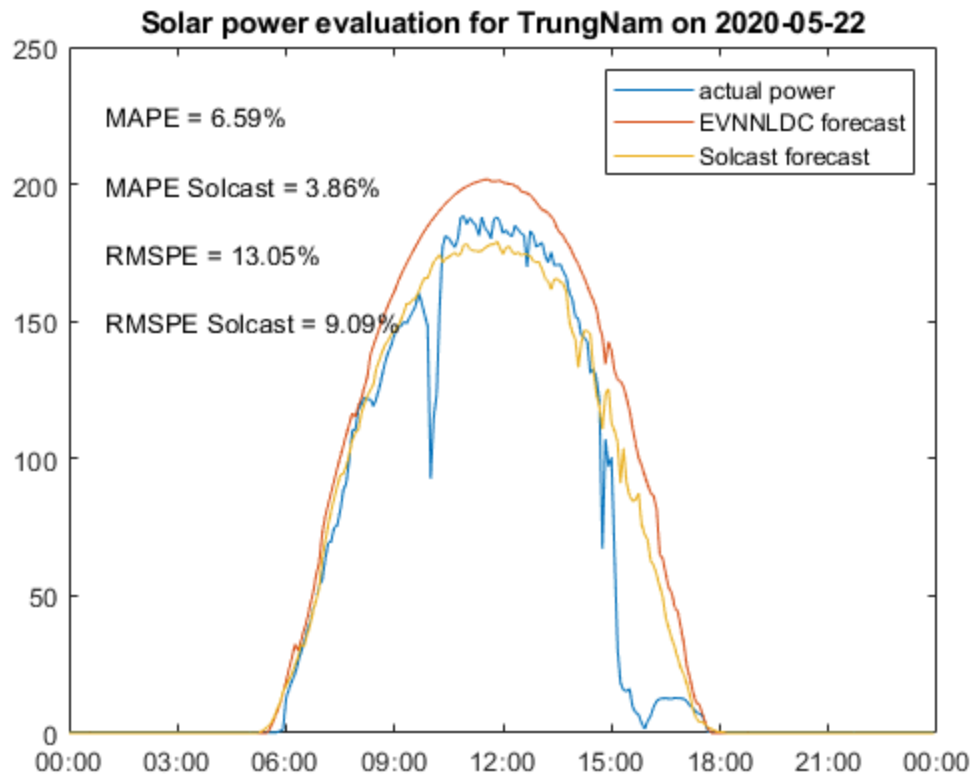


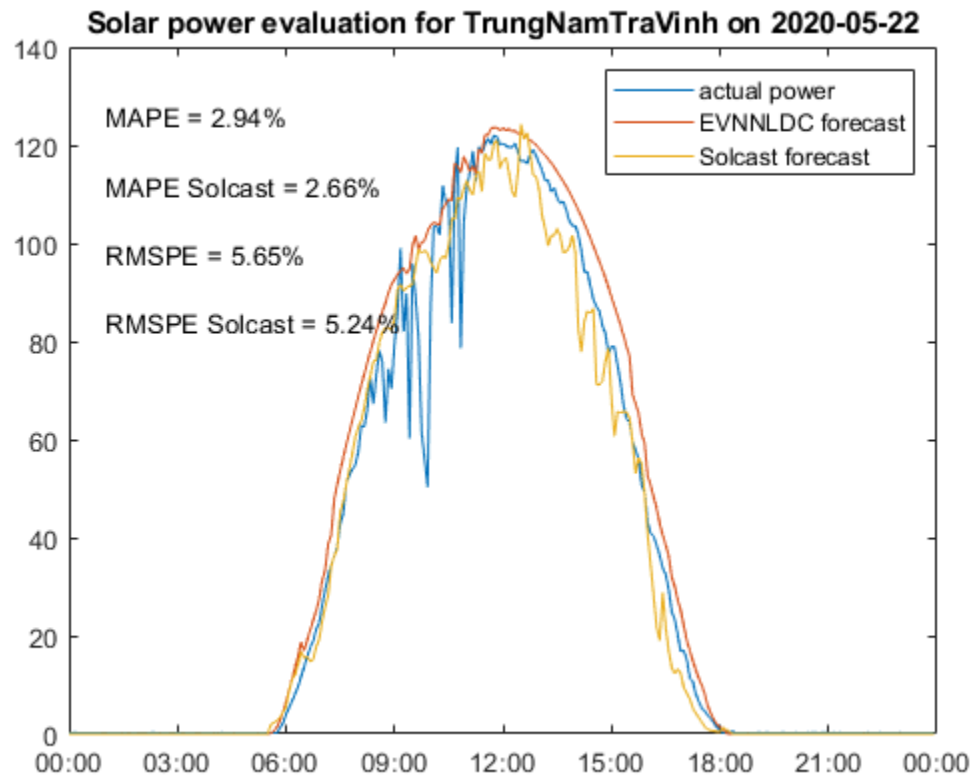
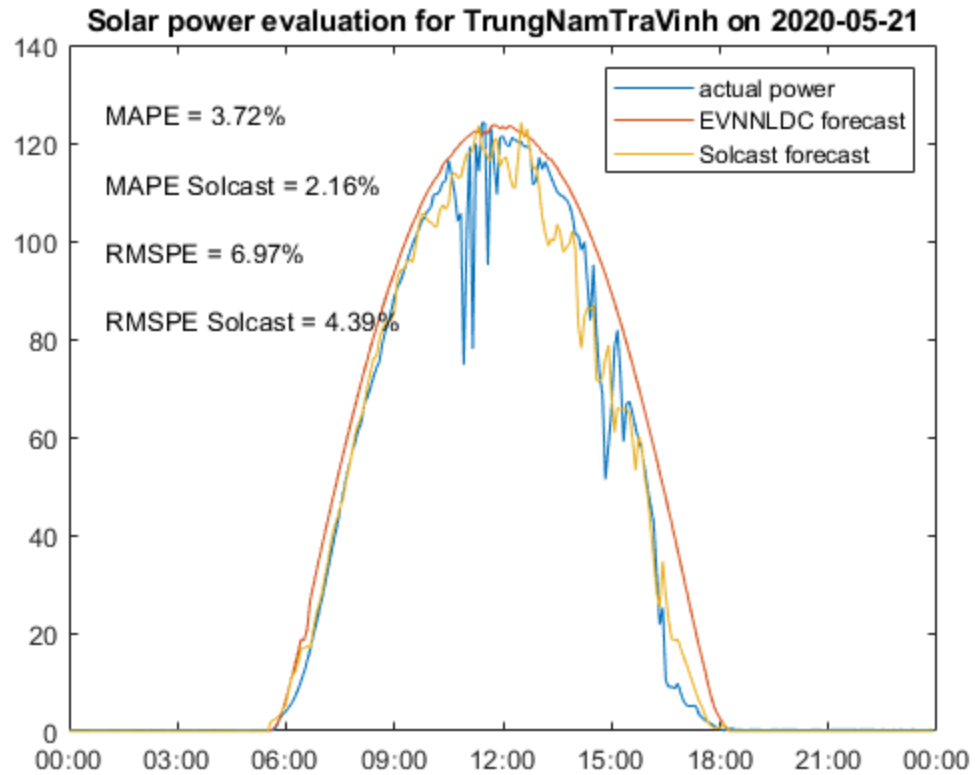




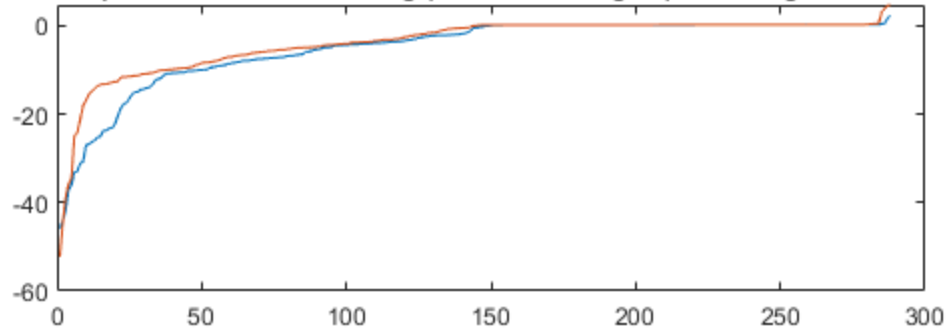




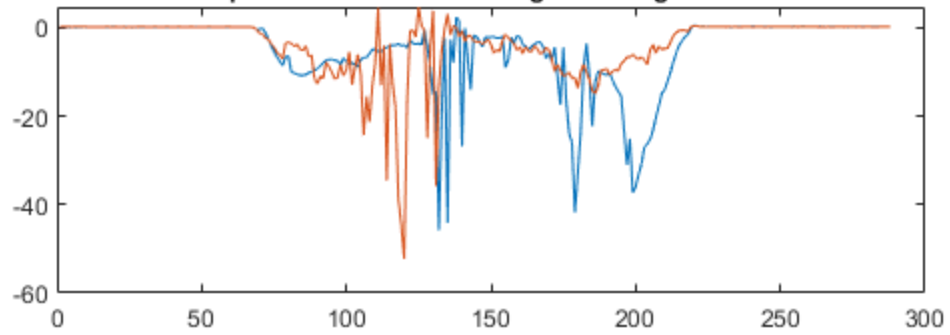




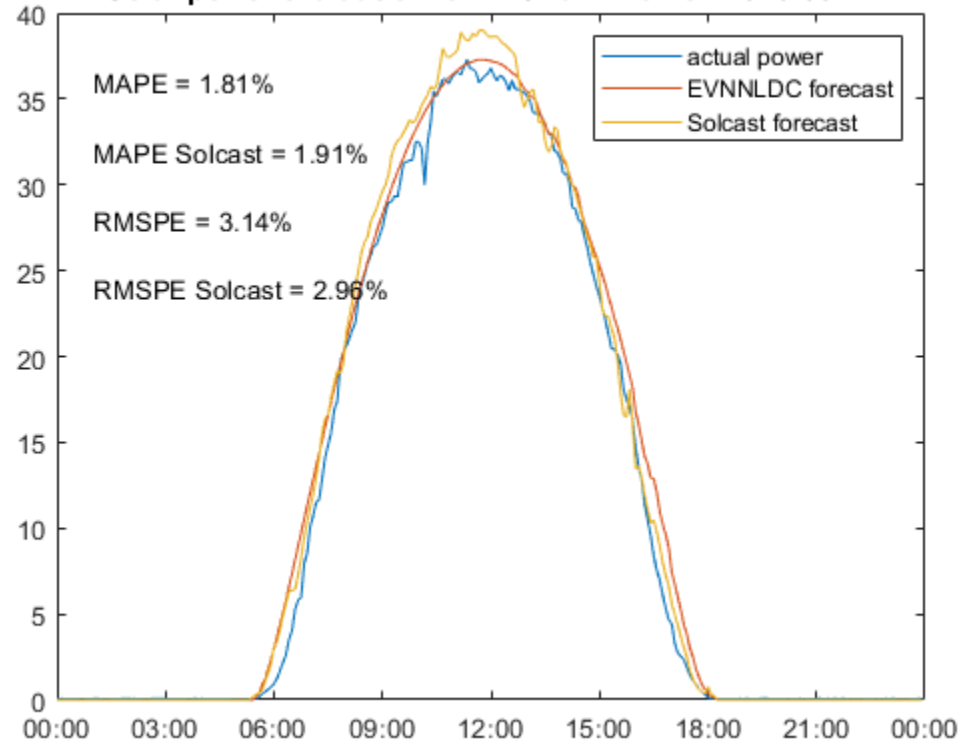
Solar power's error forecasting (smallest to largest) for TrungNamTraVinh

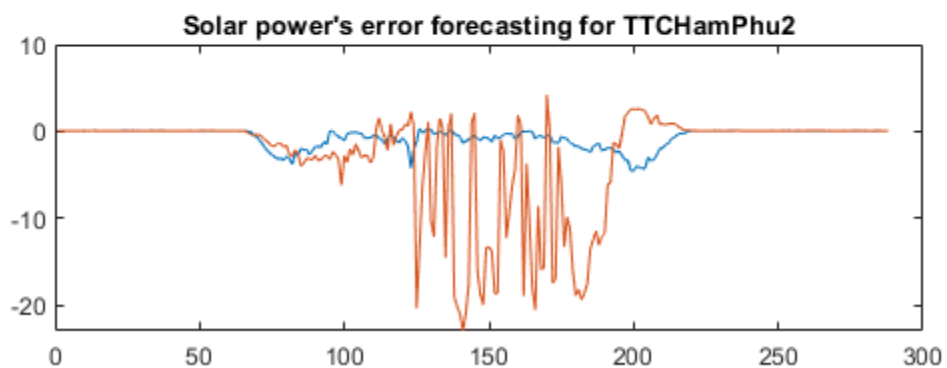
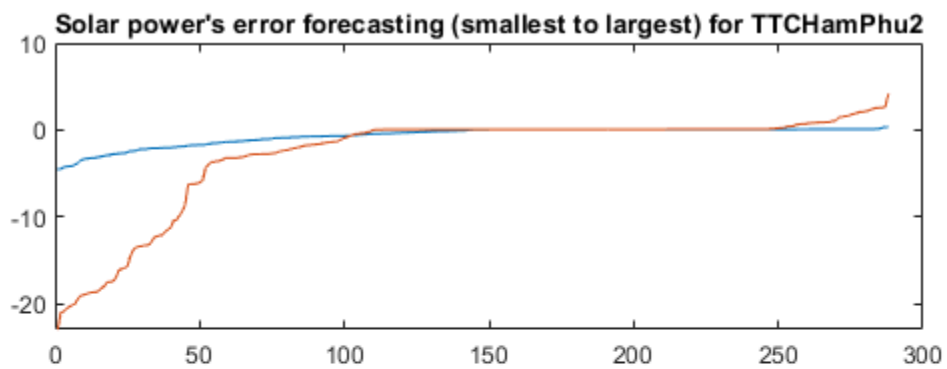
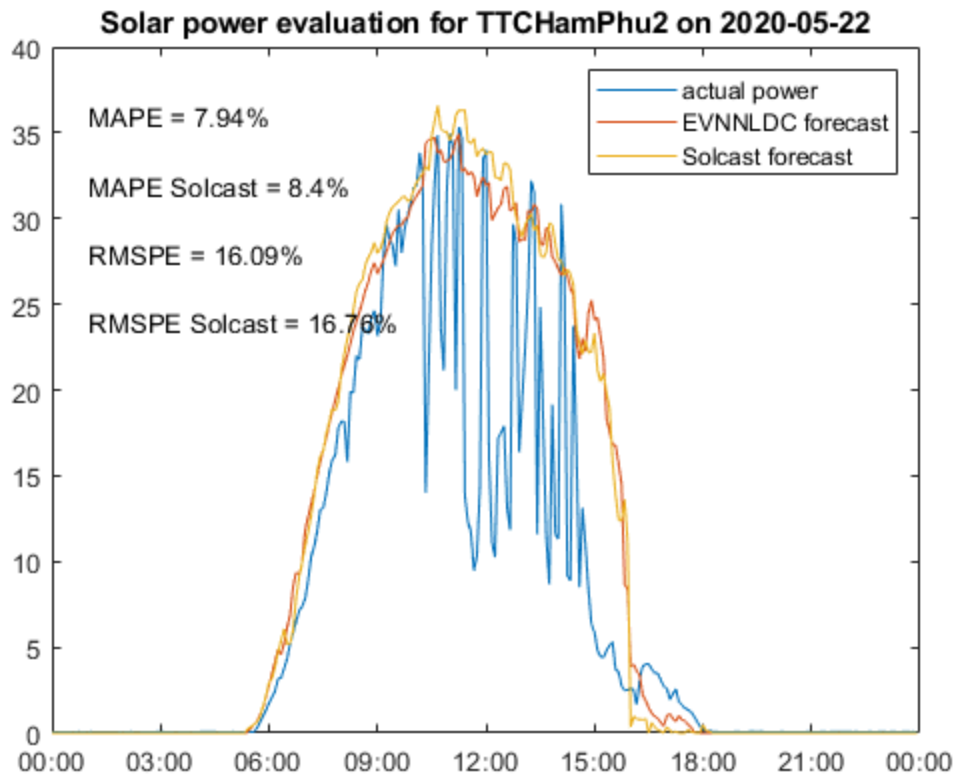


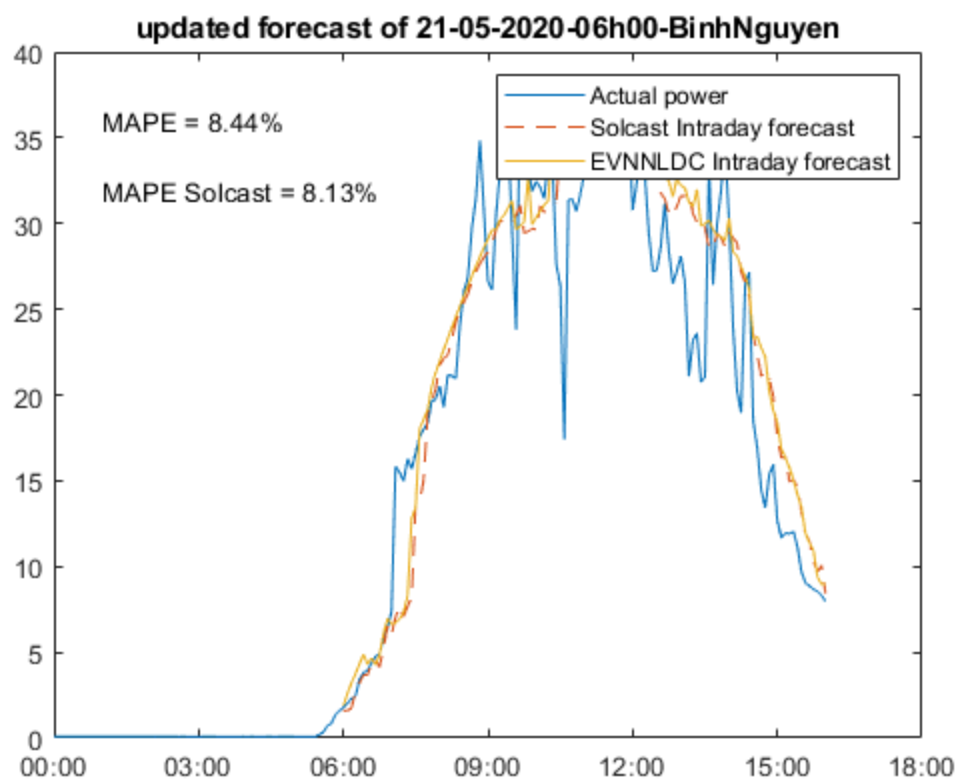
Solar power's error forecasting for TrungNamTraVinh

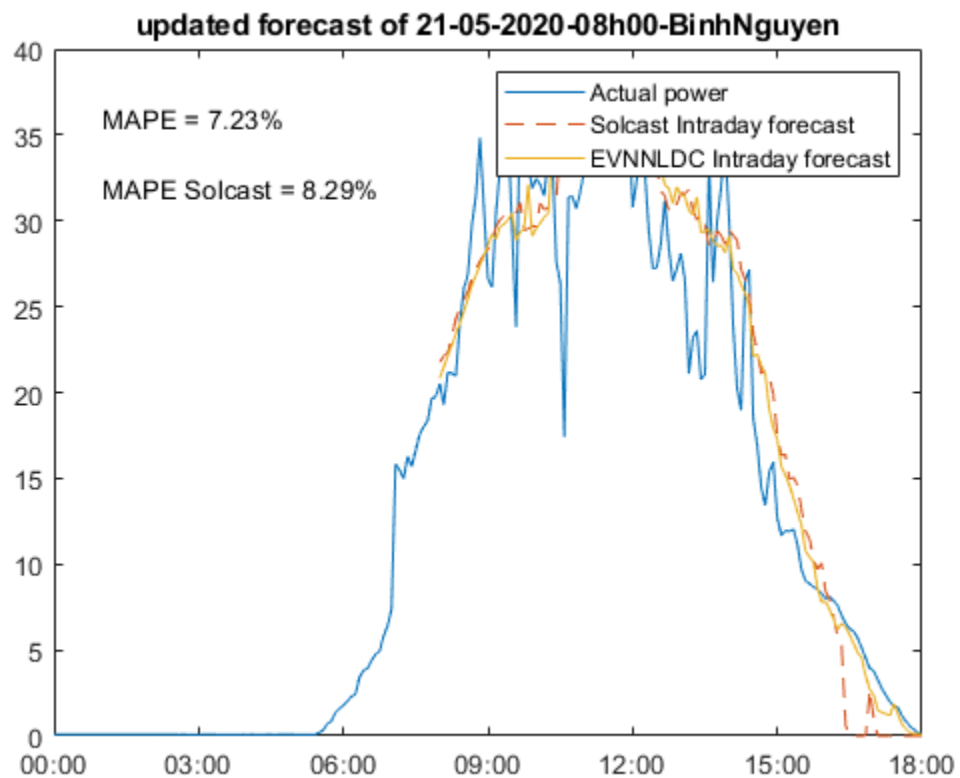
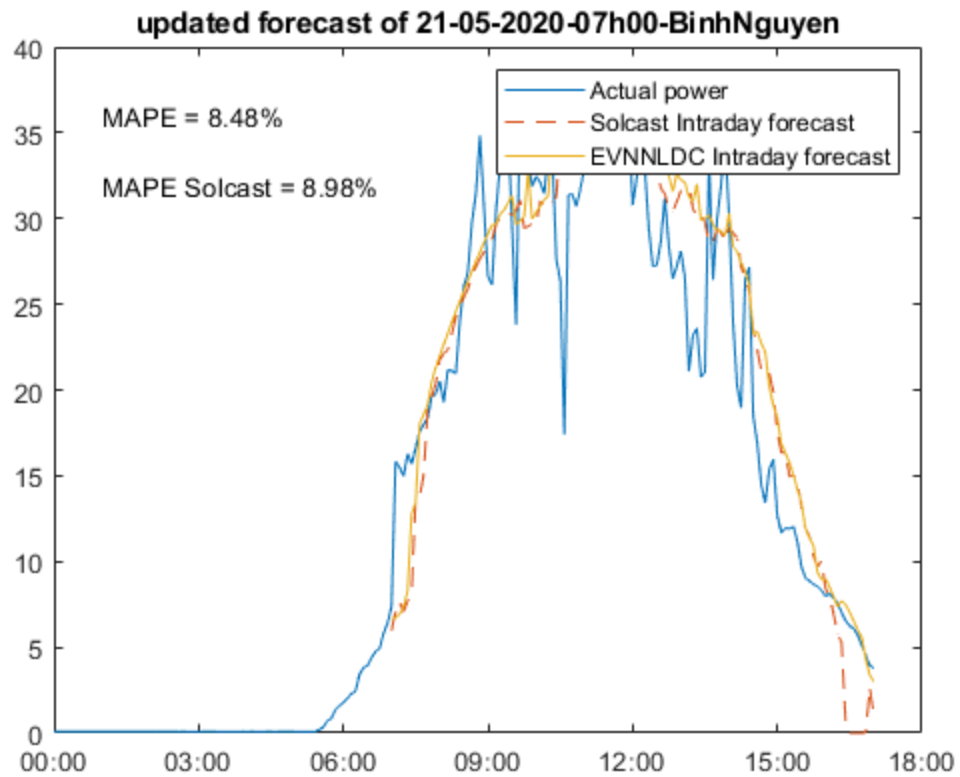


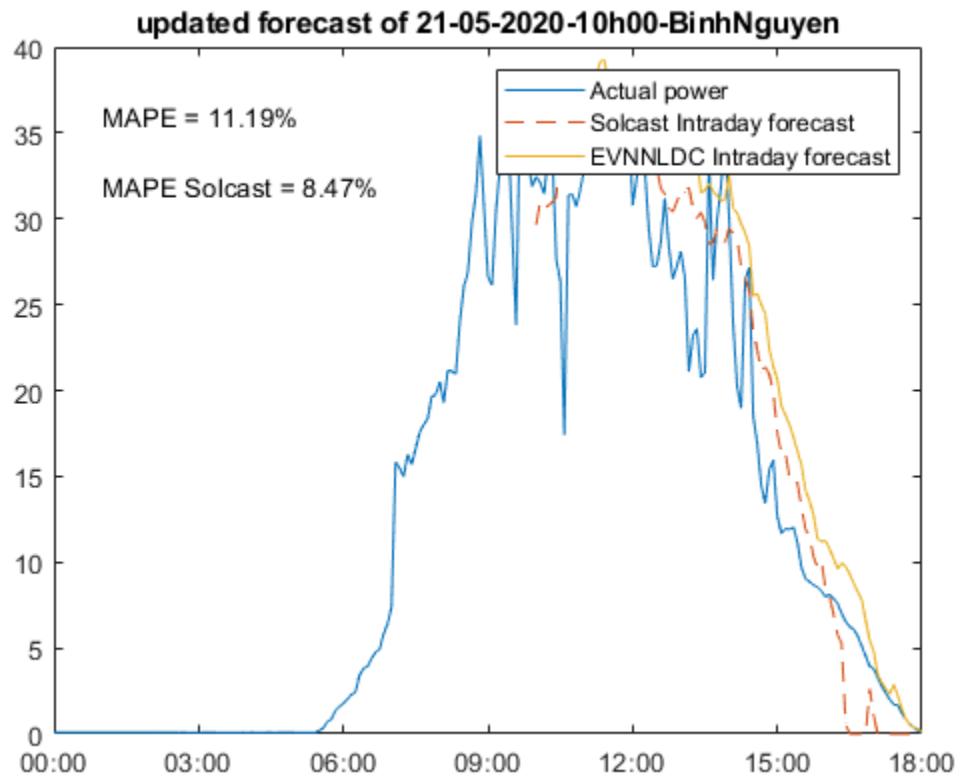
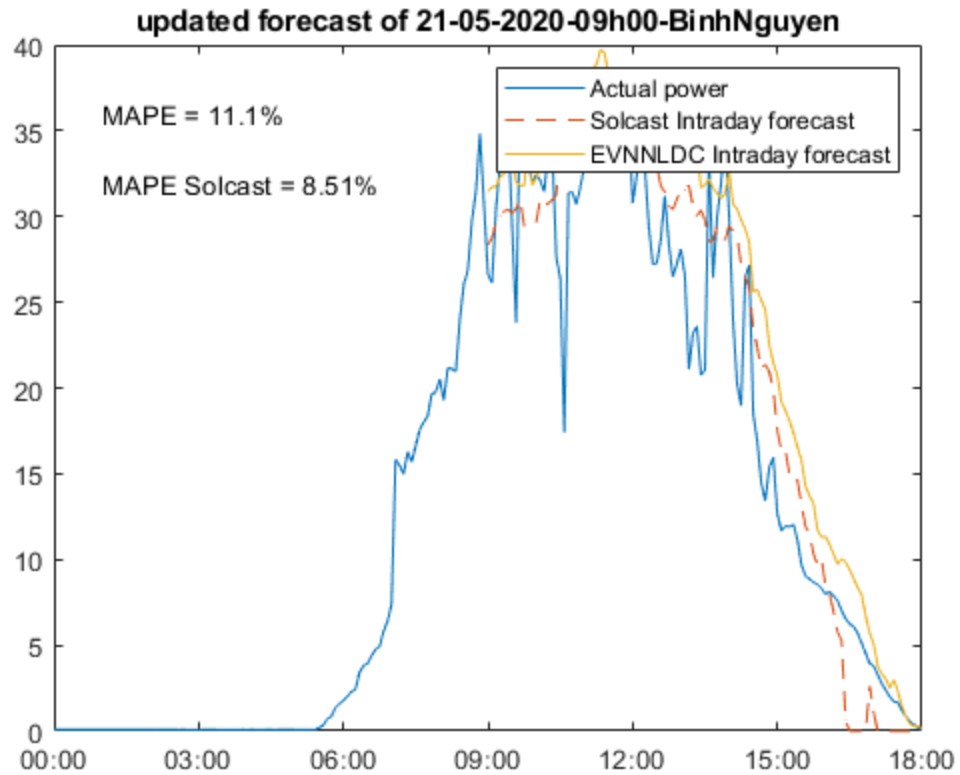
Solar power evaluation for TTCHamPhu2 on 2020-05-21

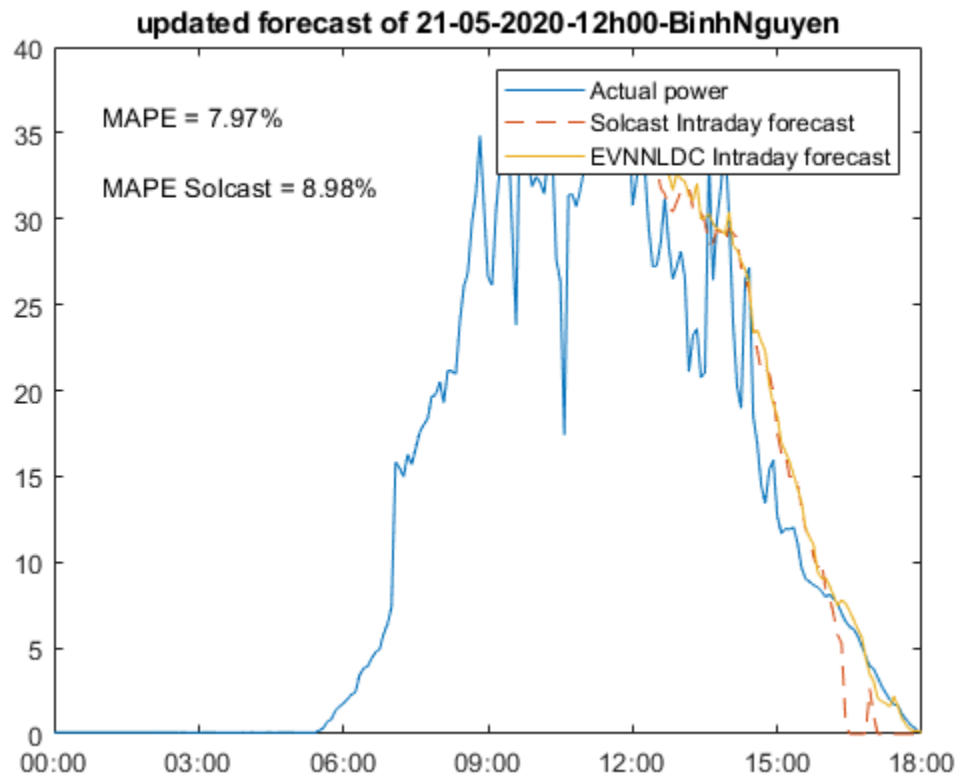
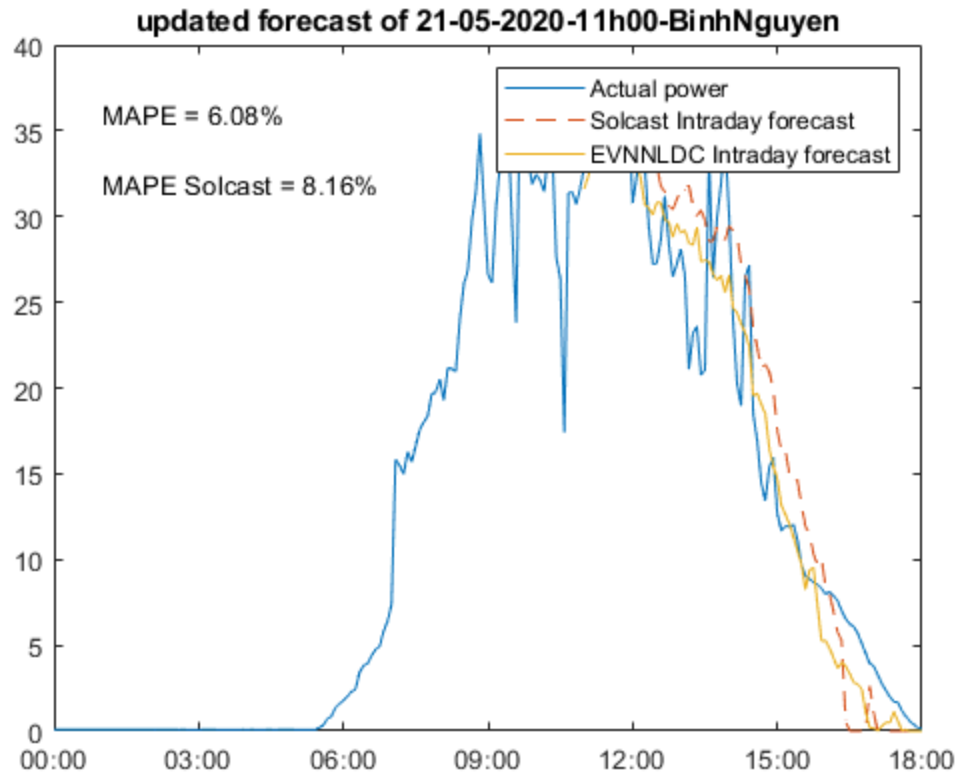


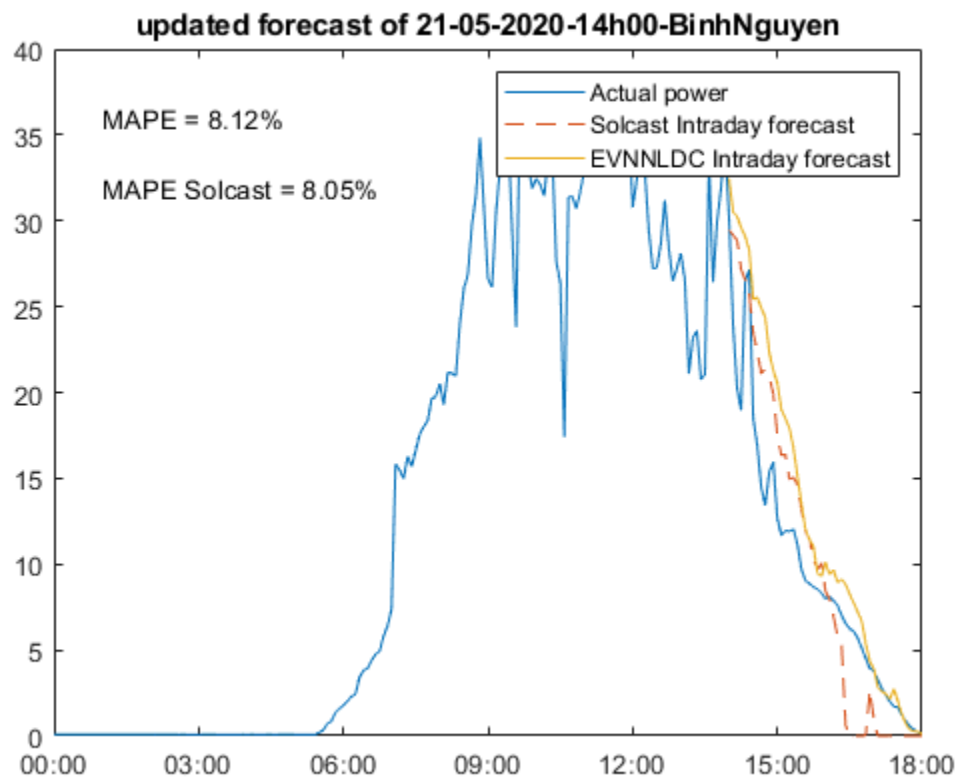
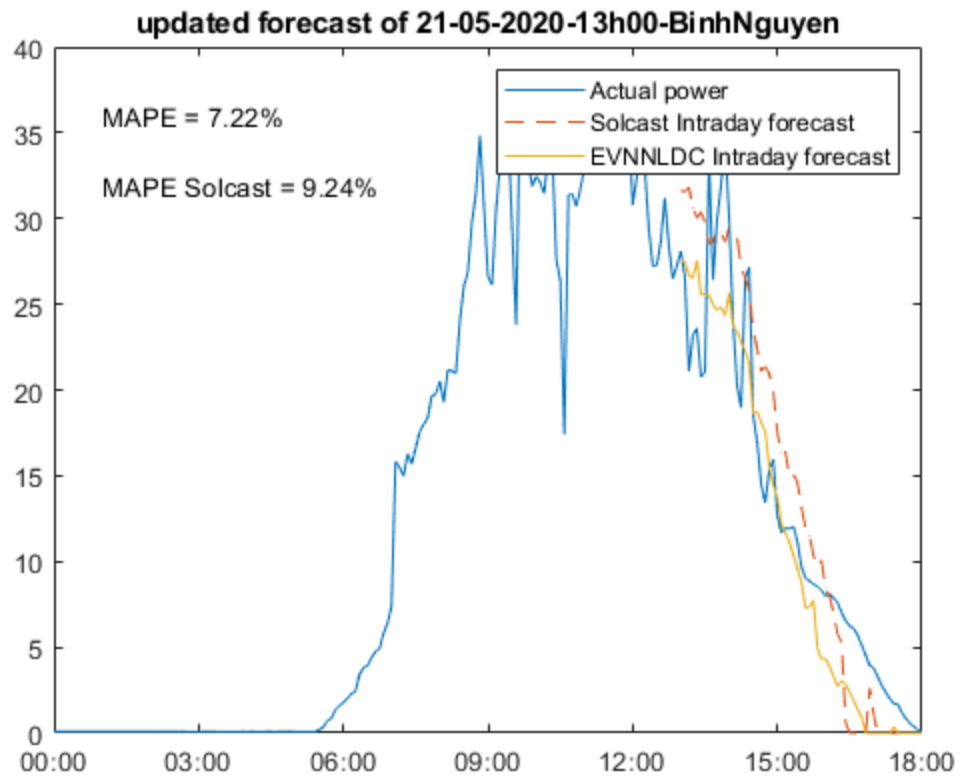


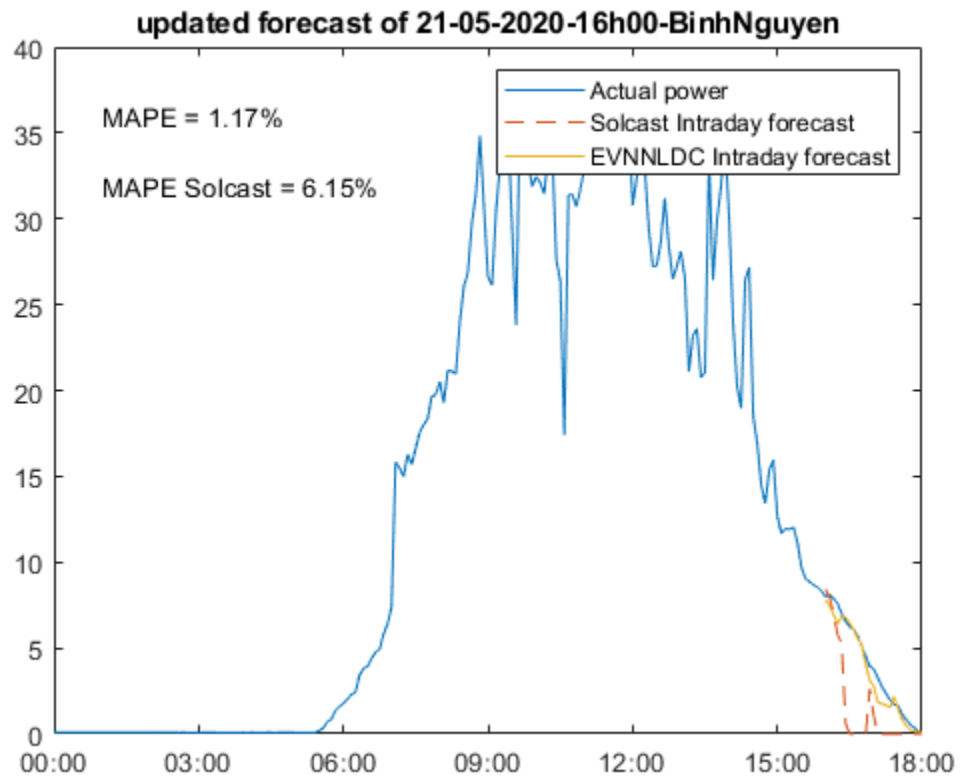
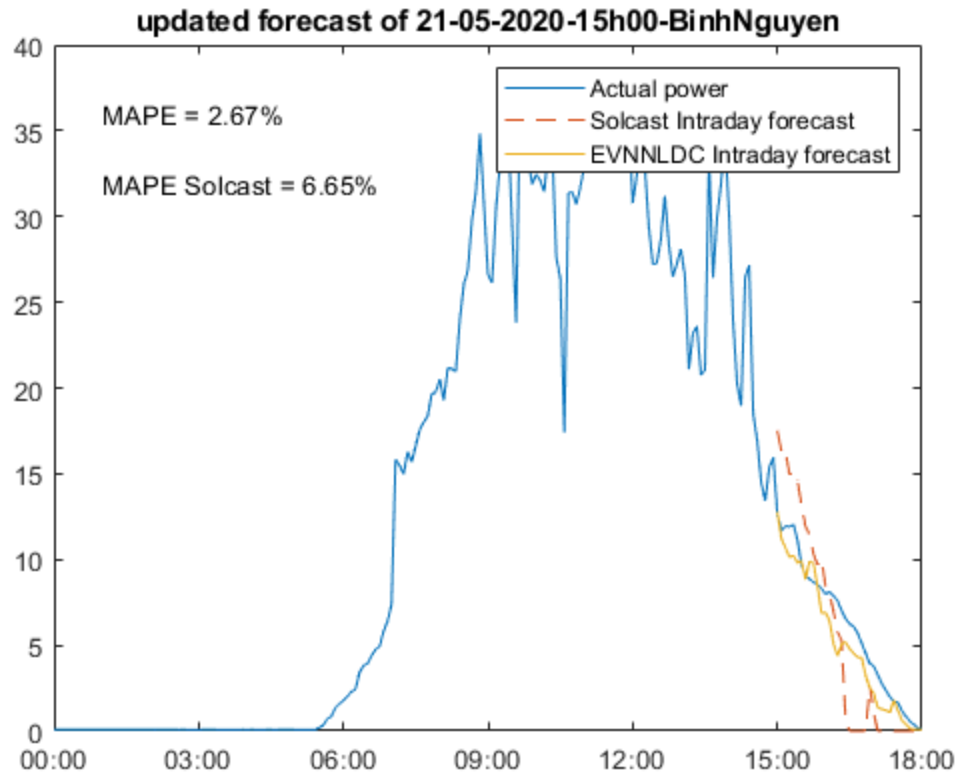


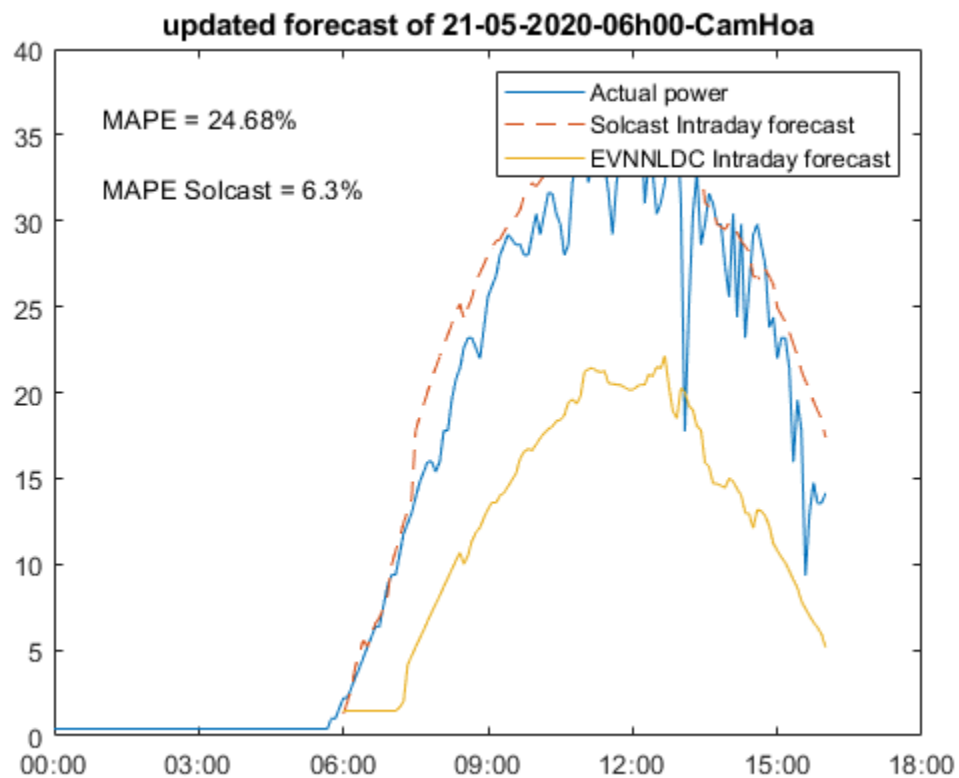
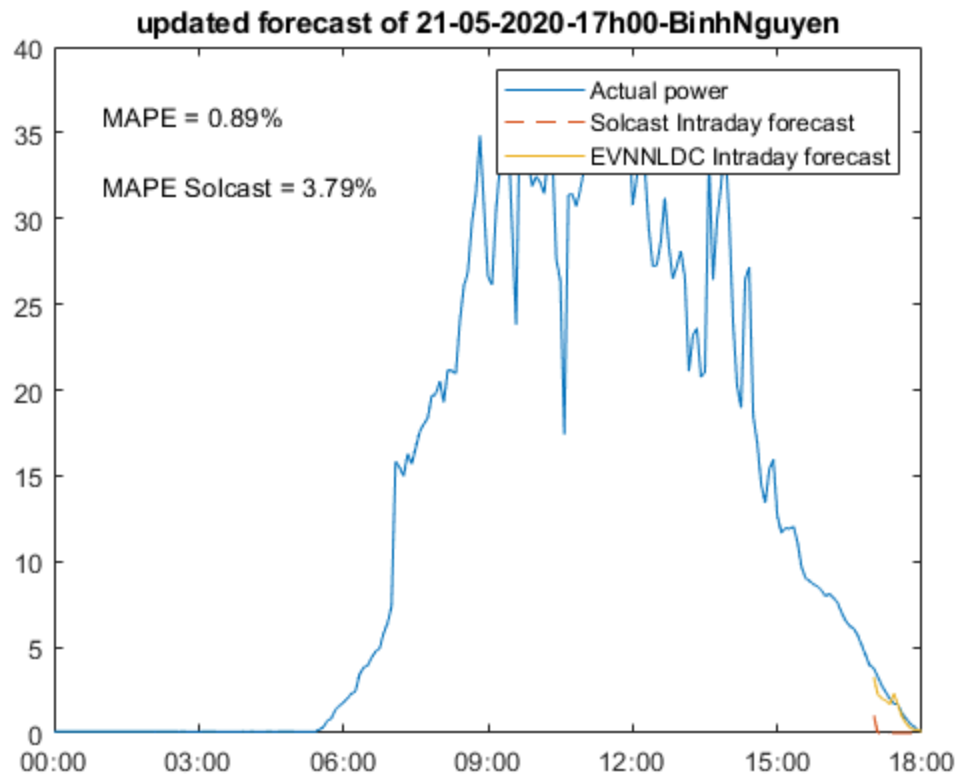


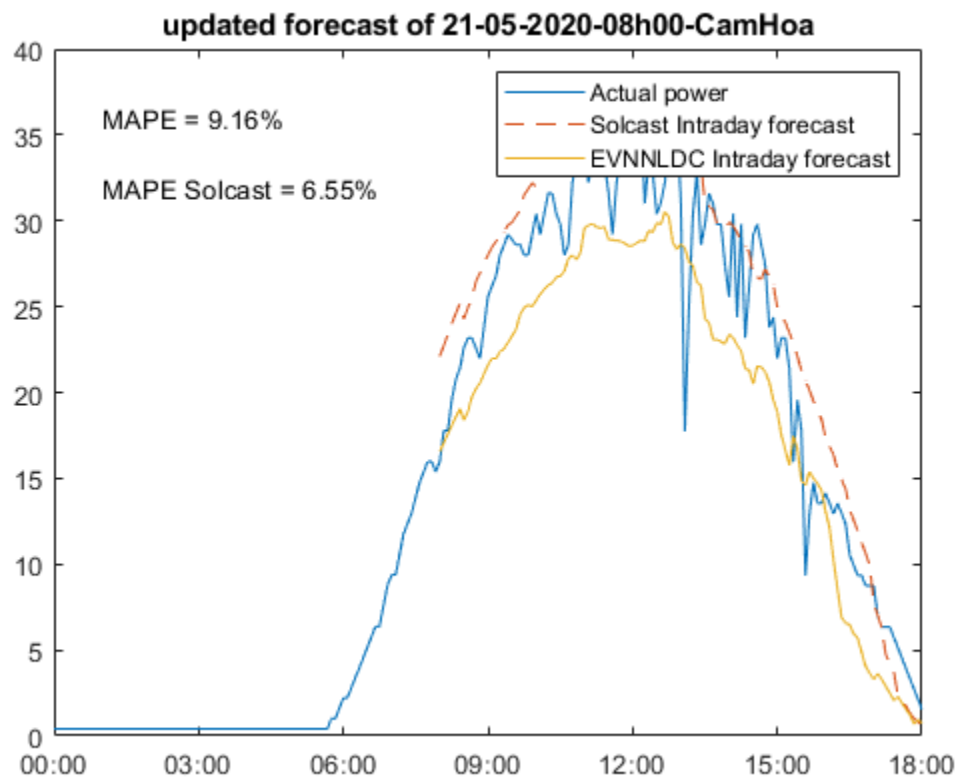
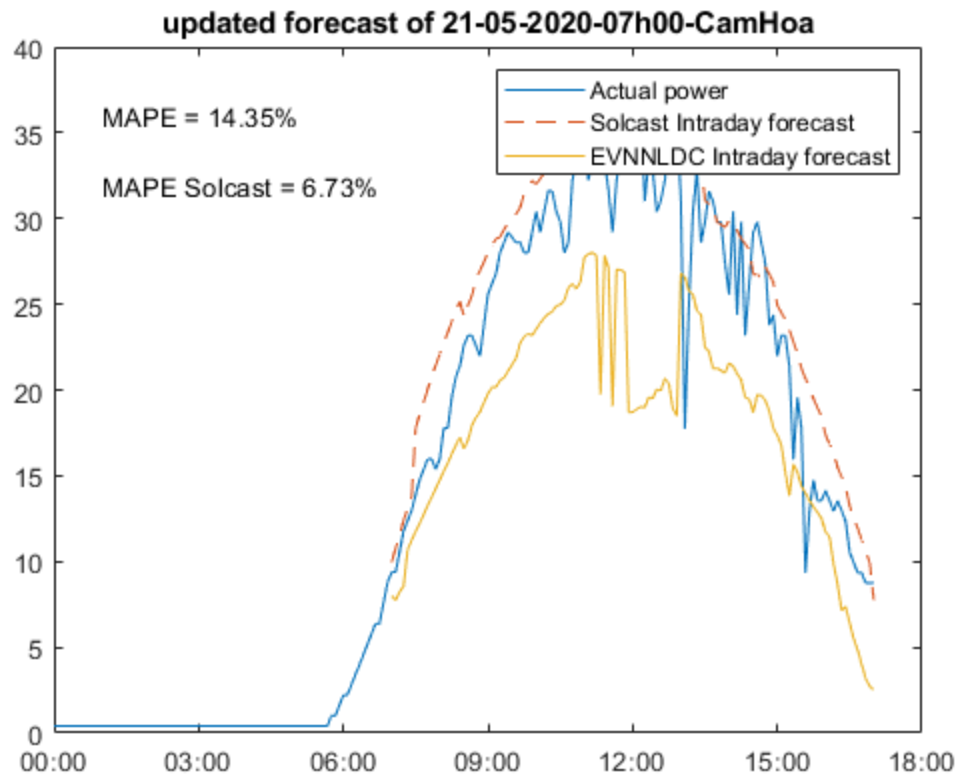


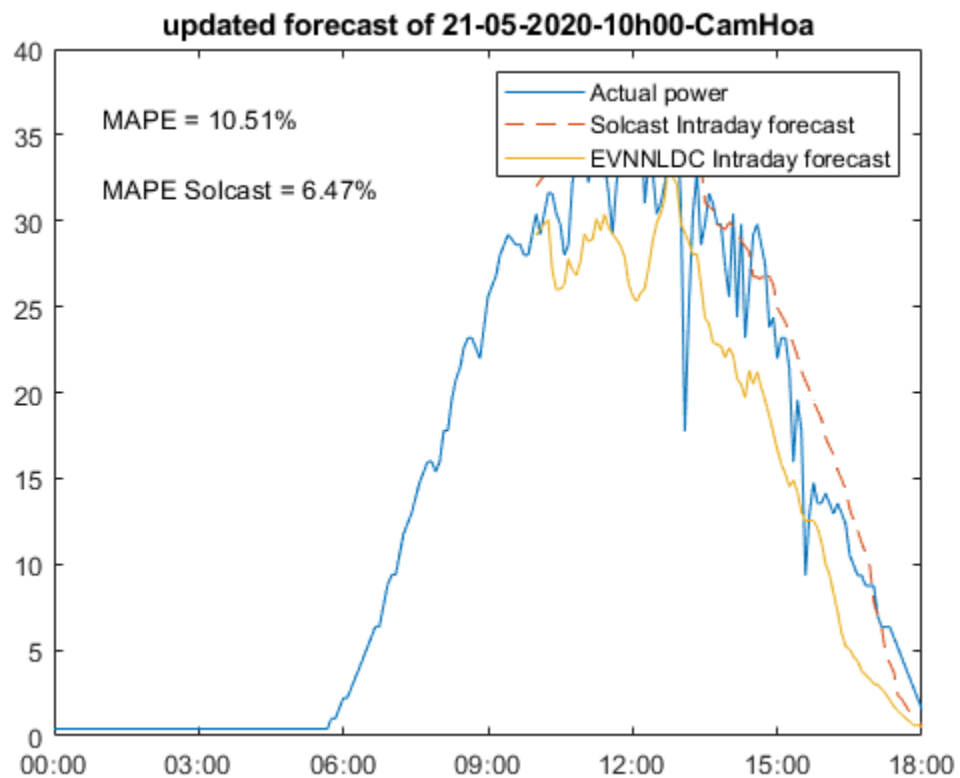
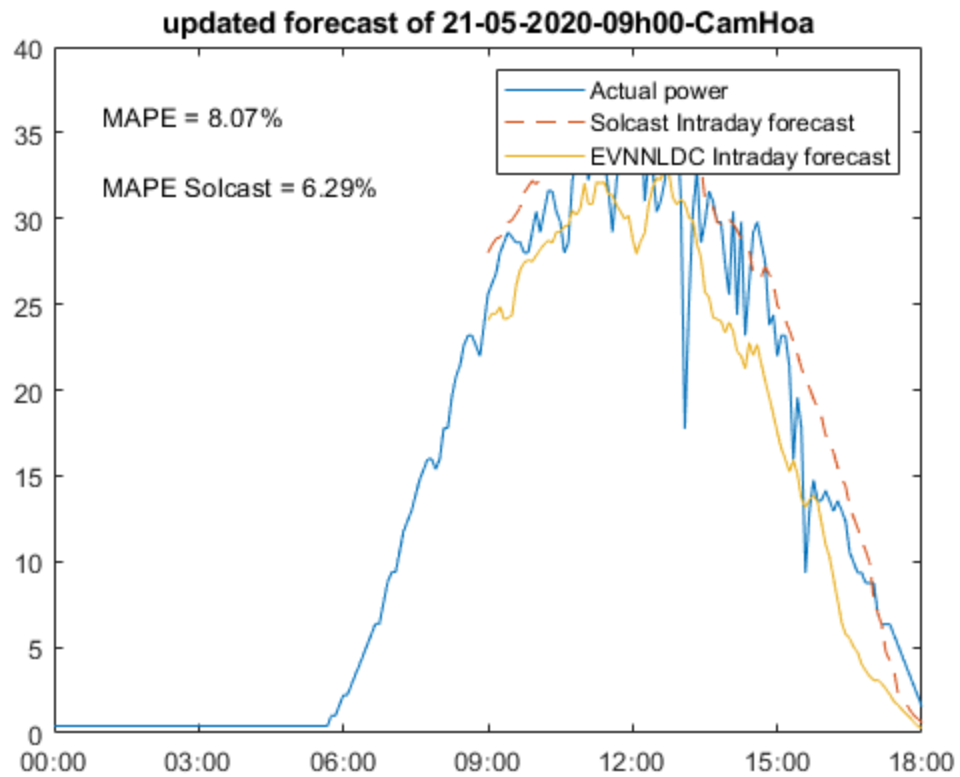


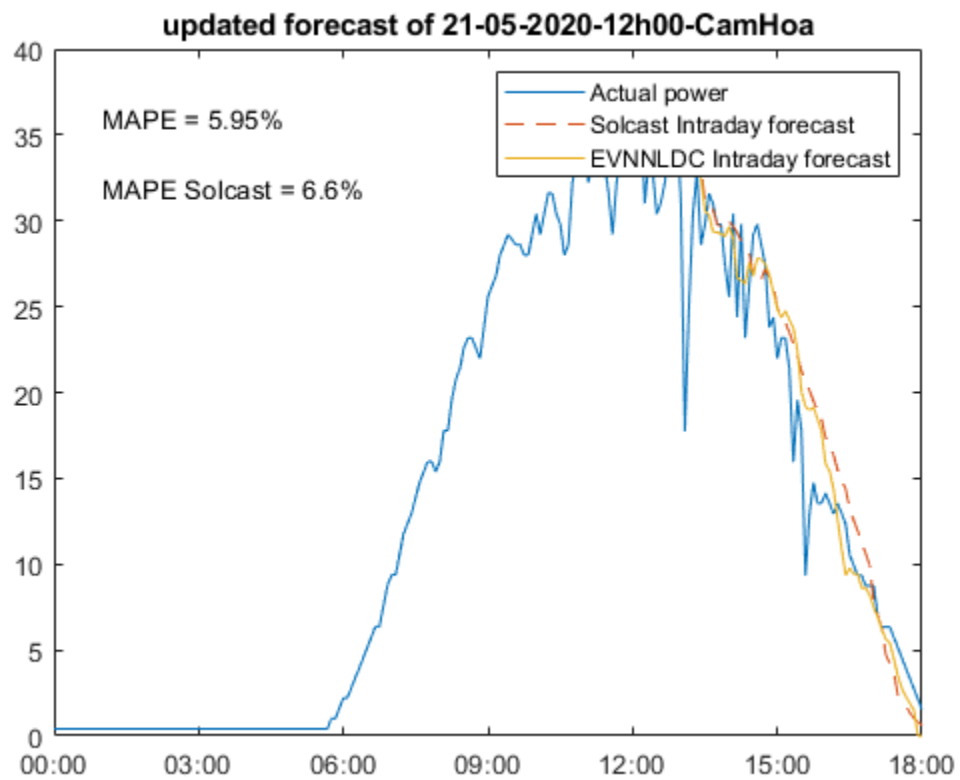
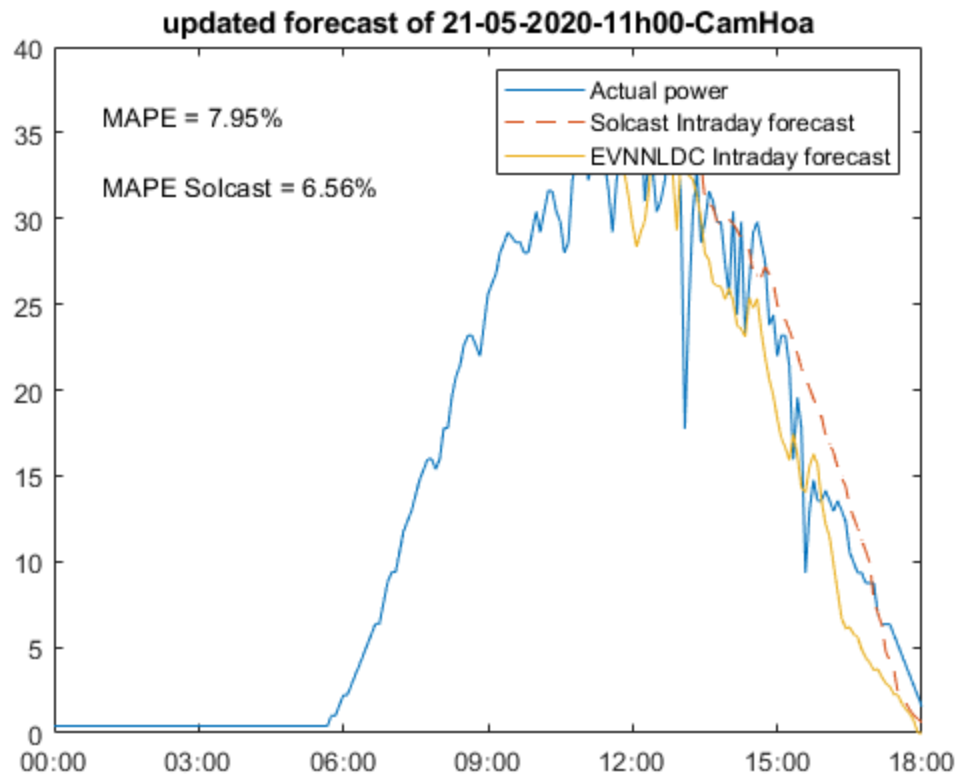


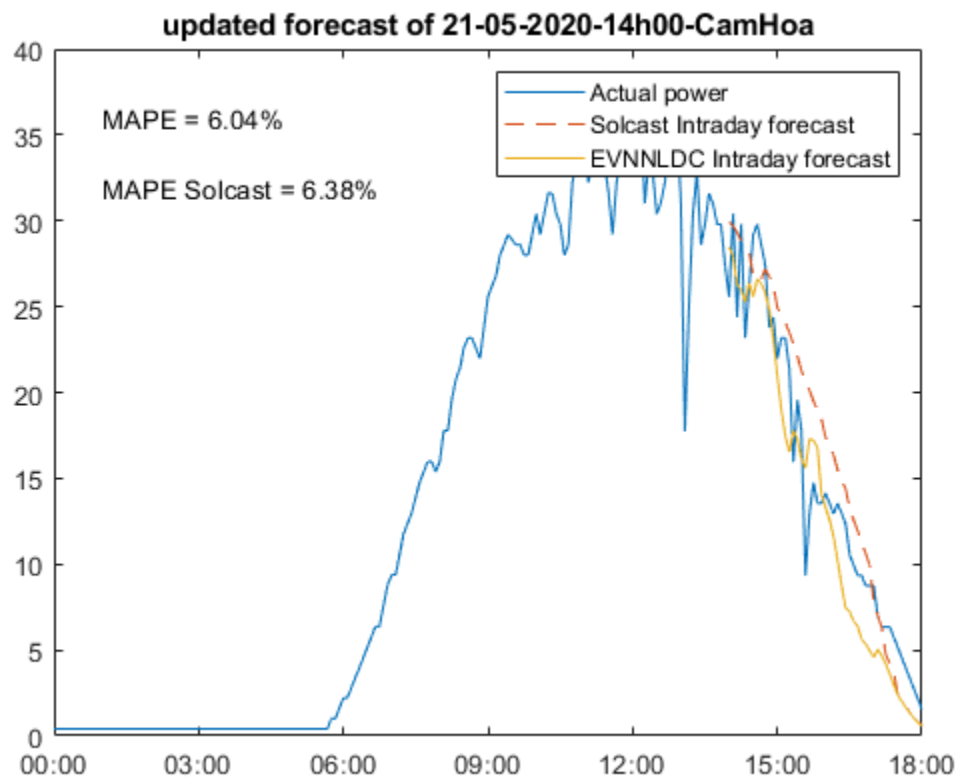
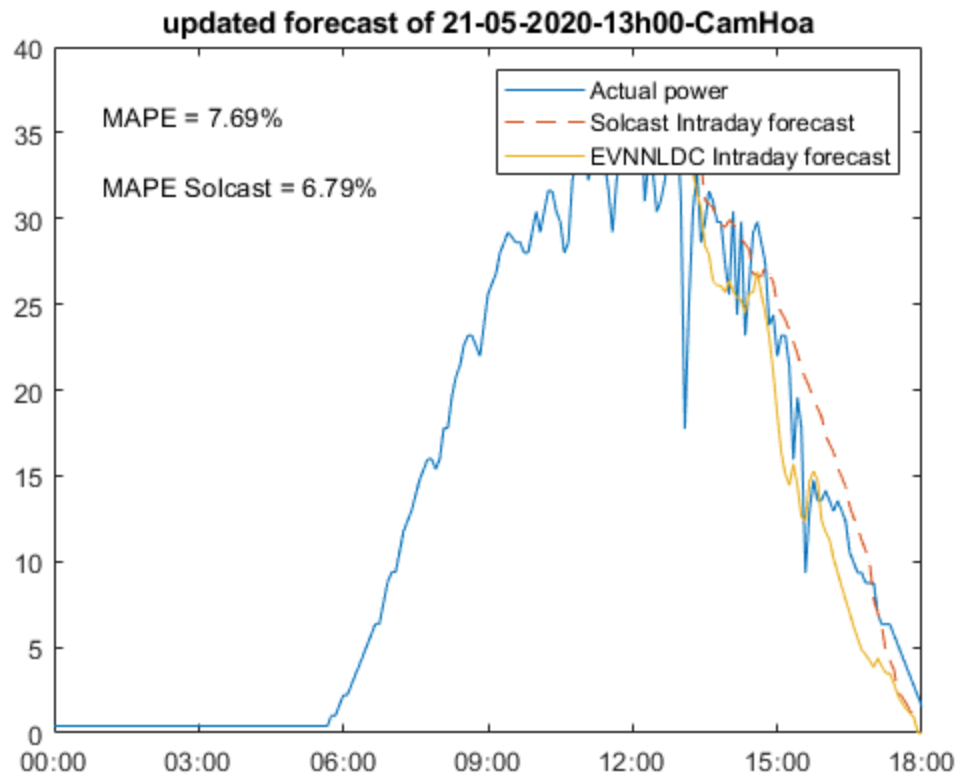


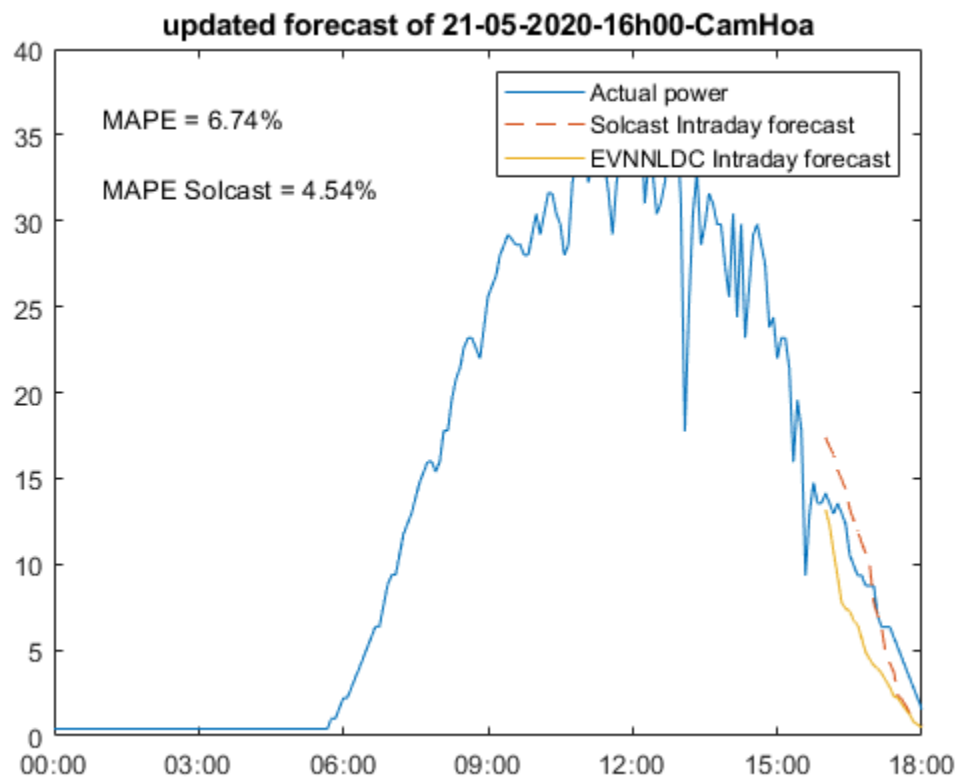
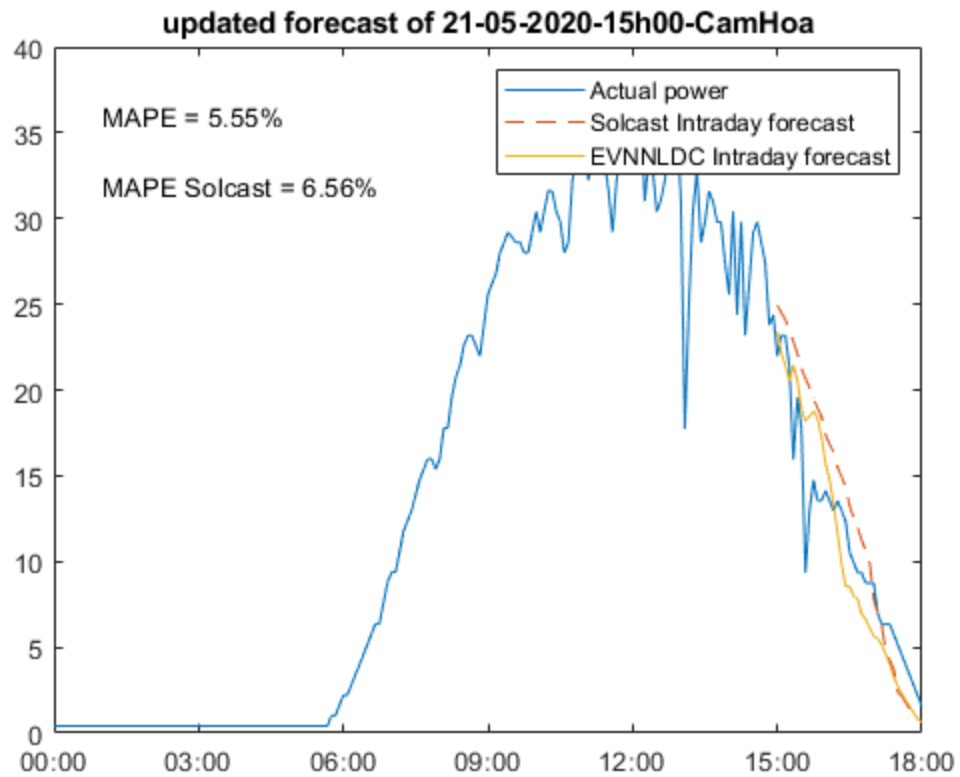


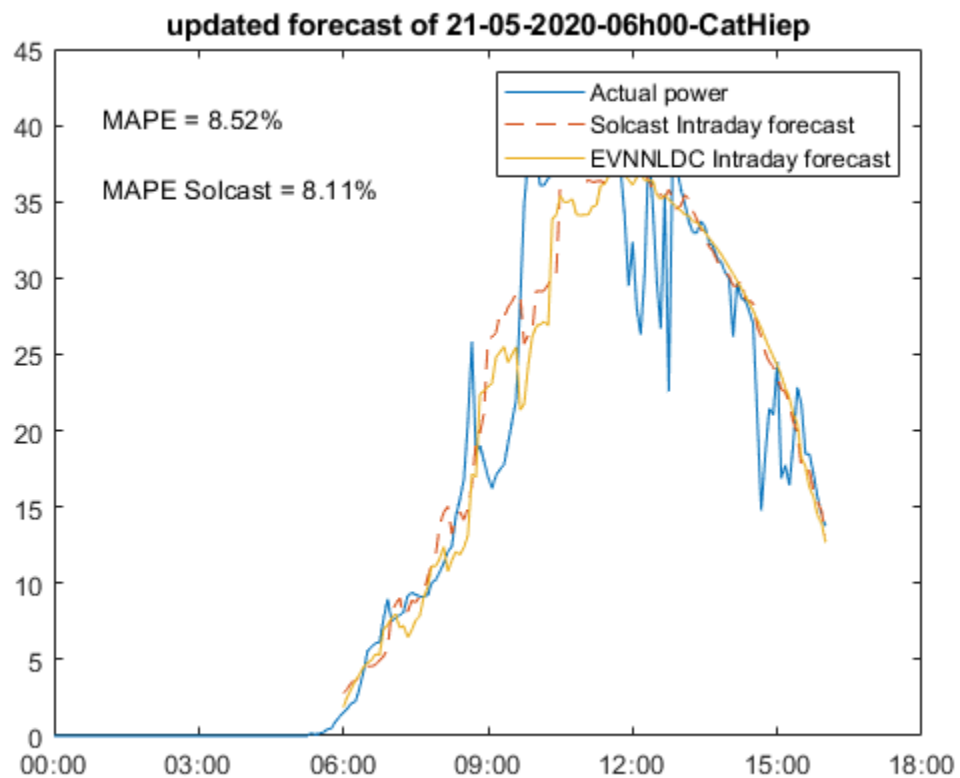
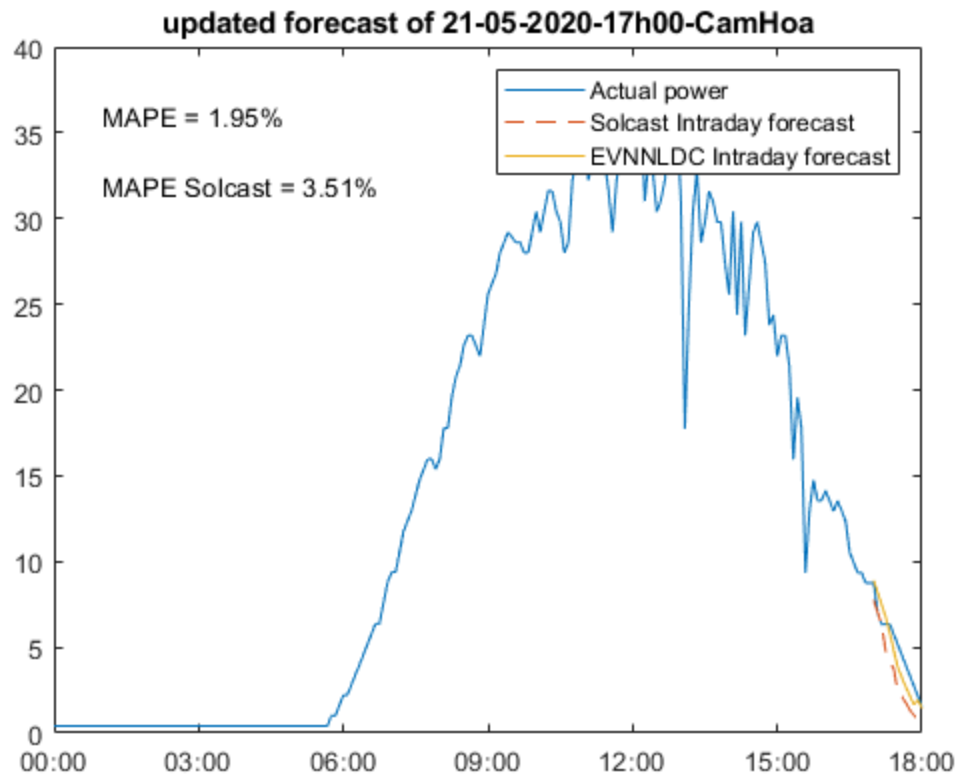


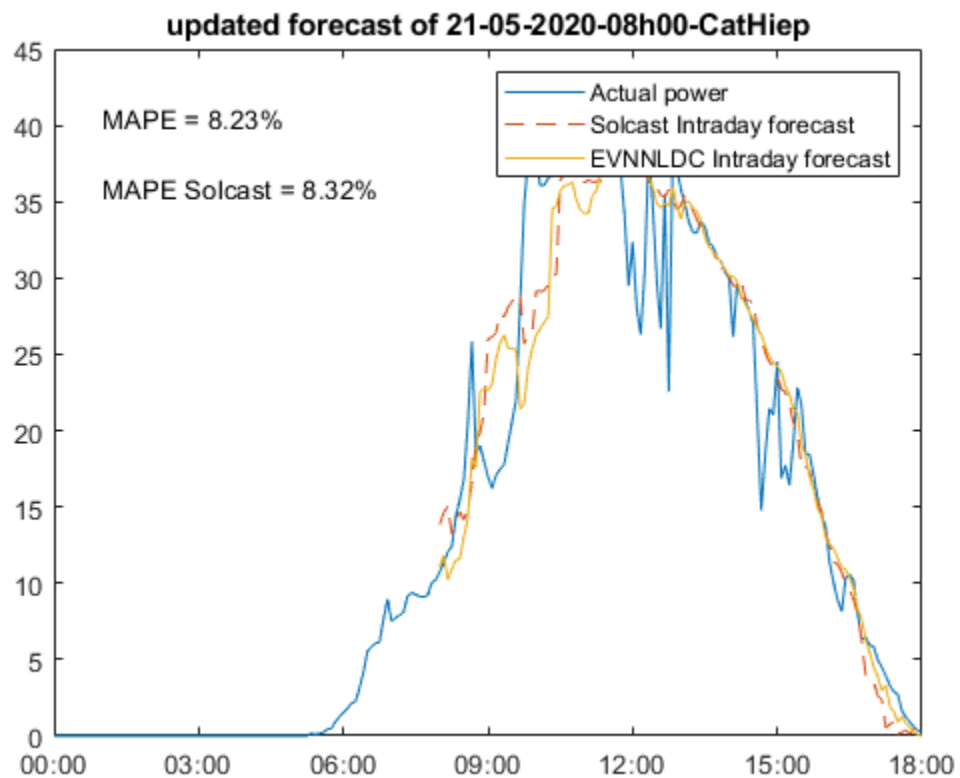
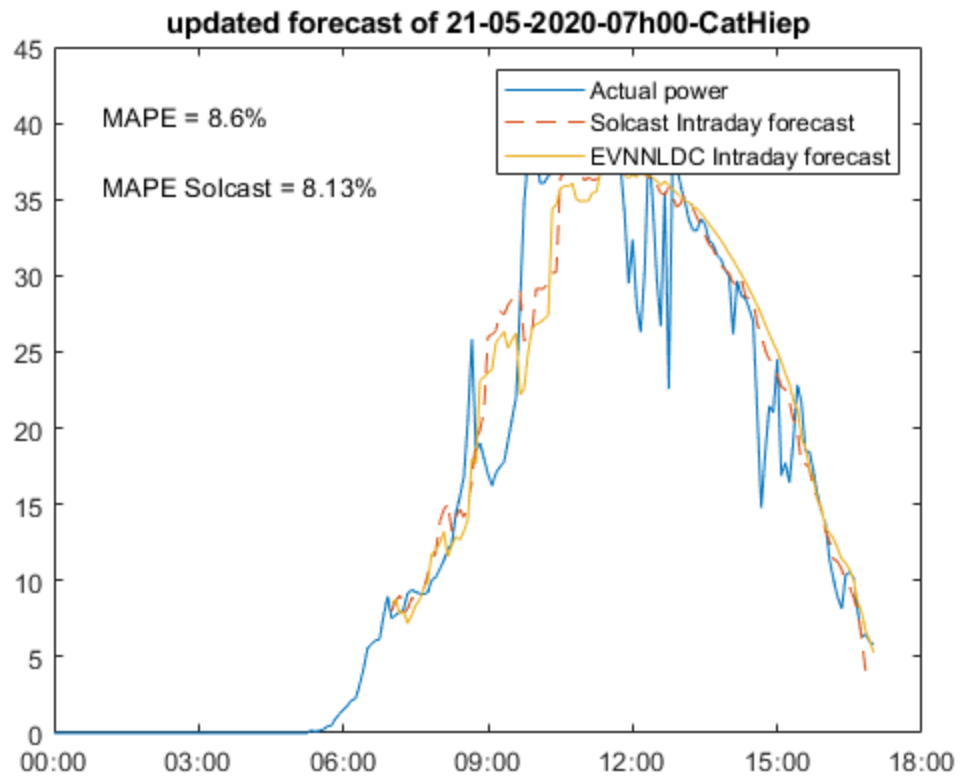


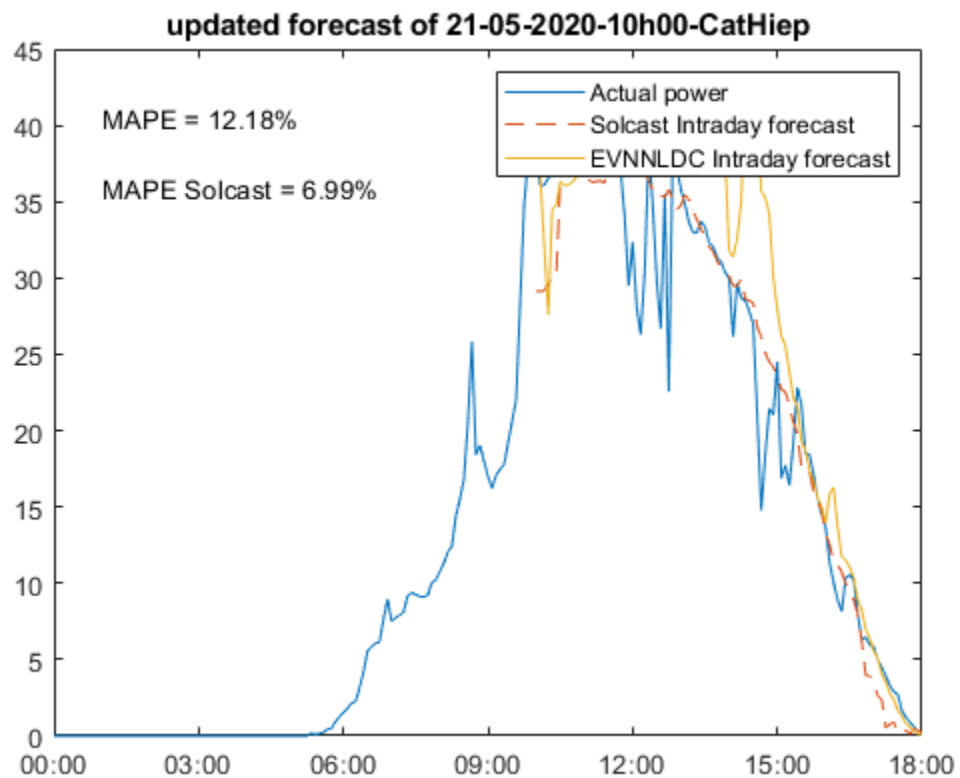
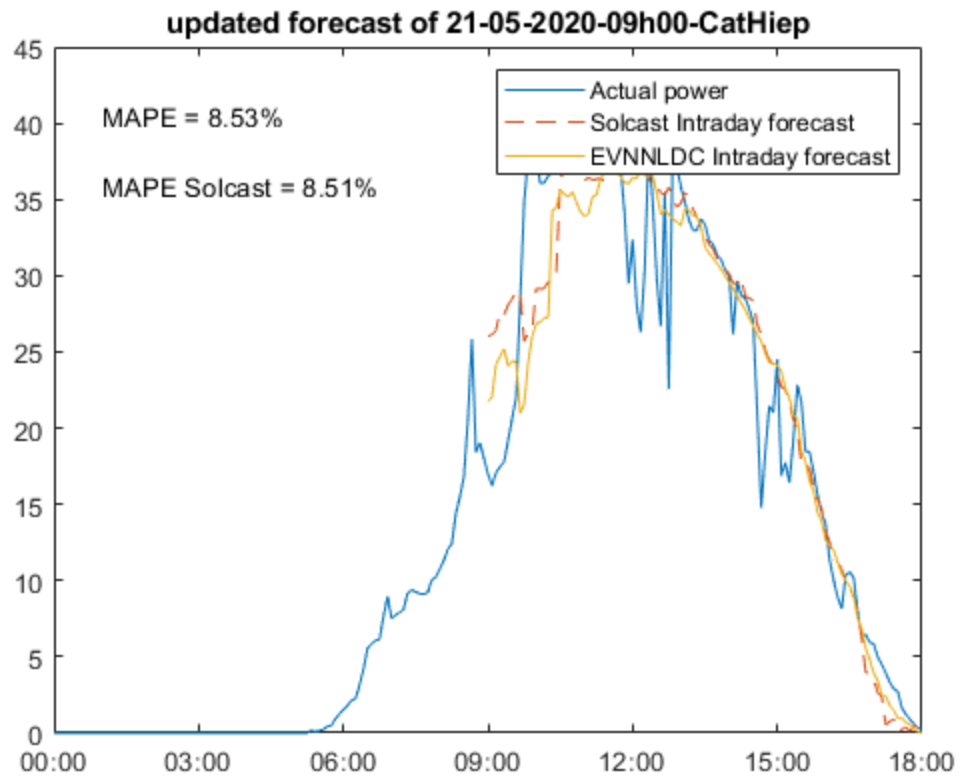


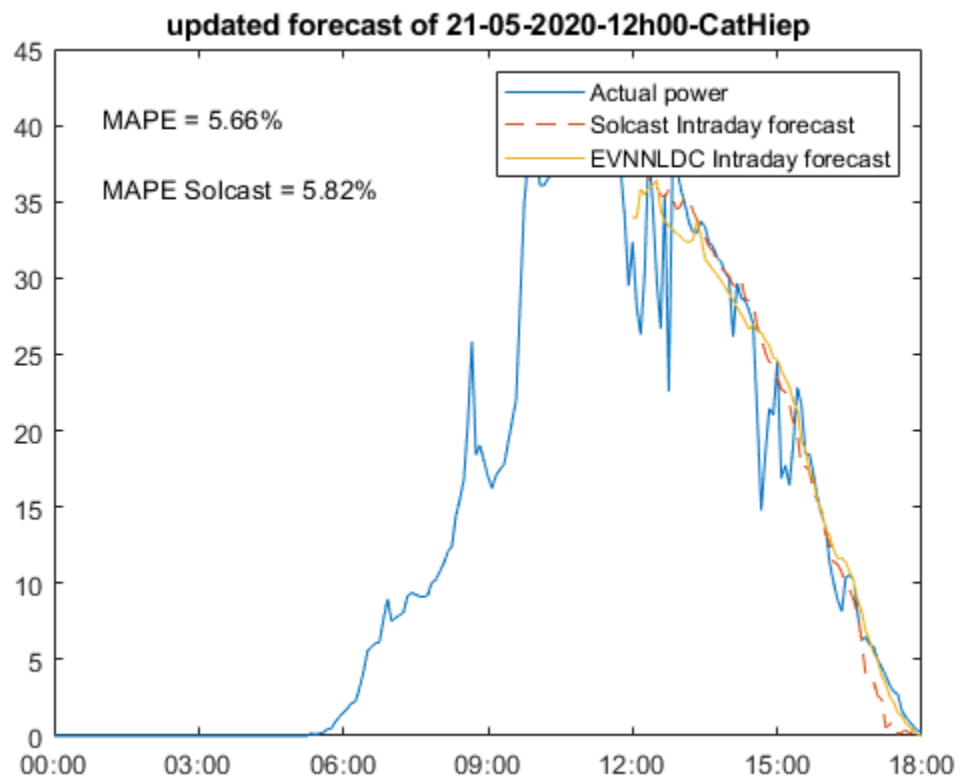
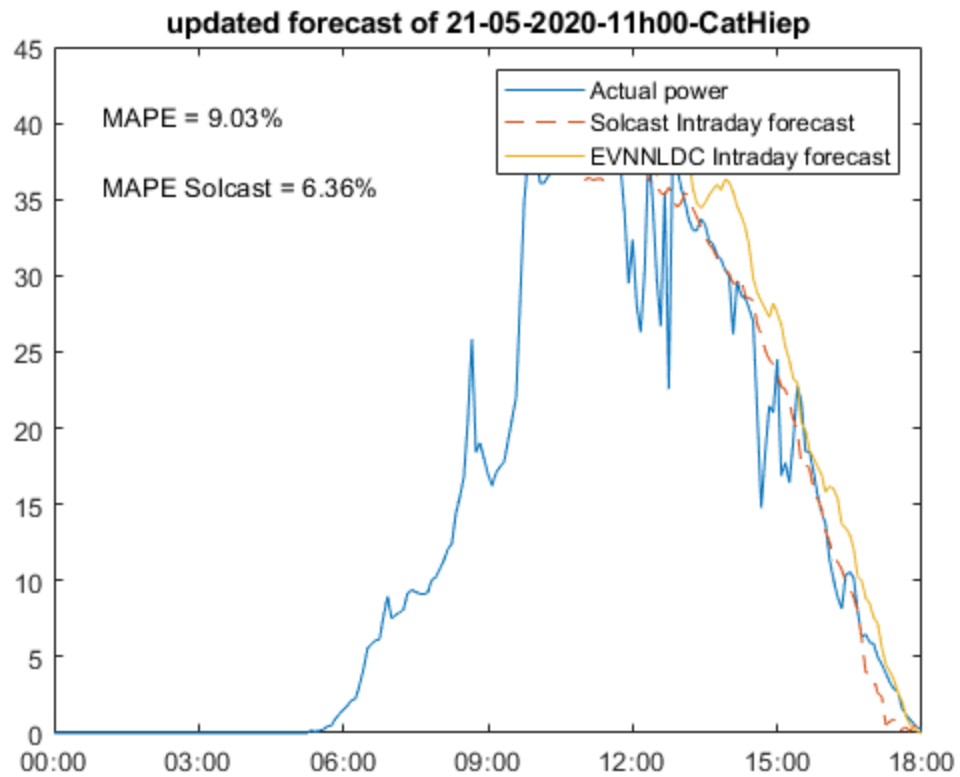


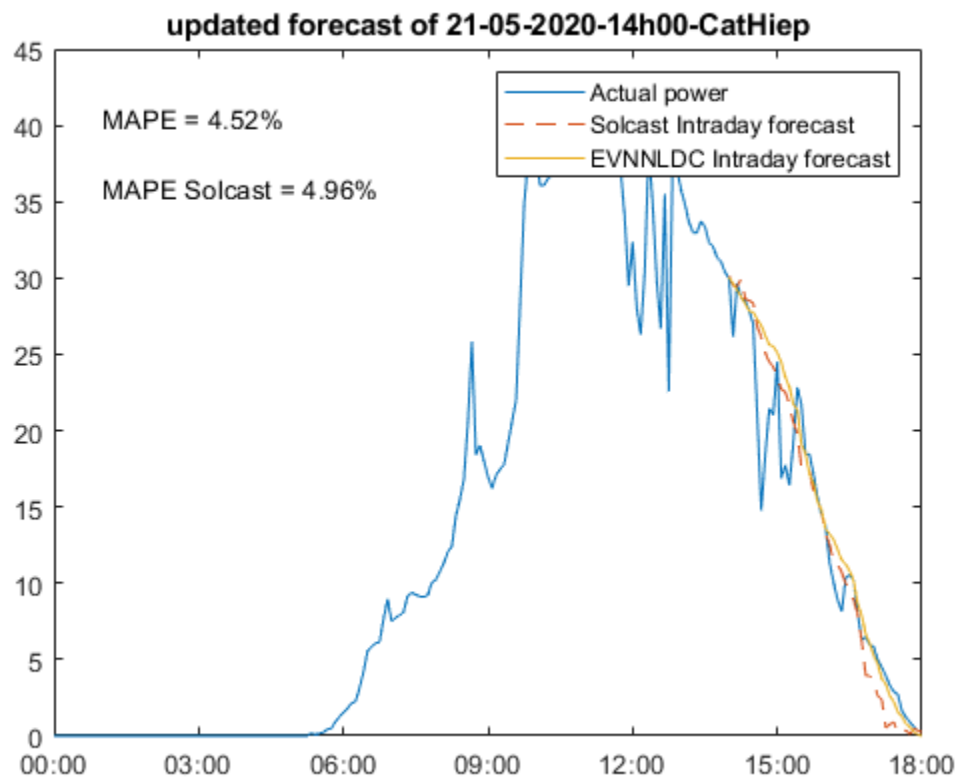
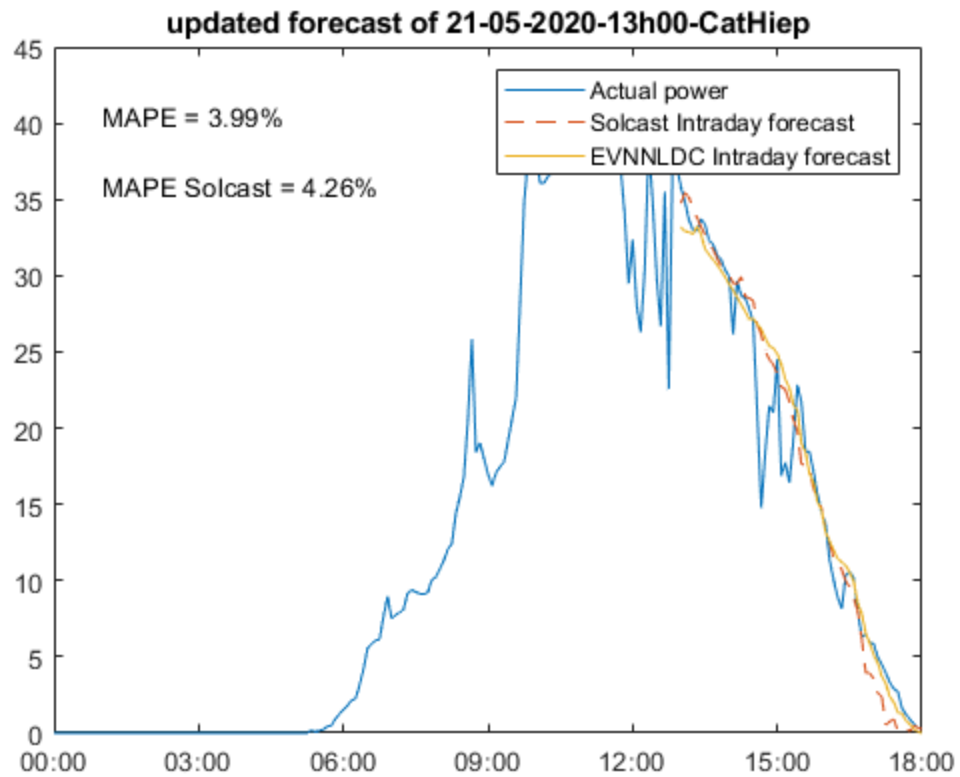


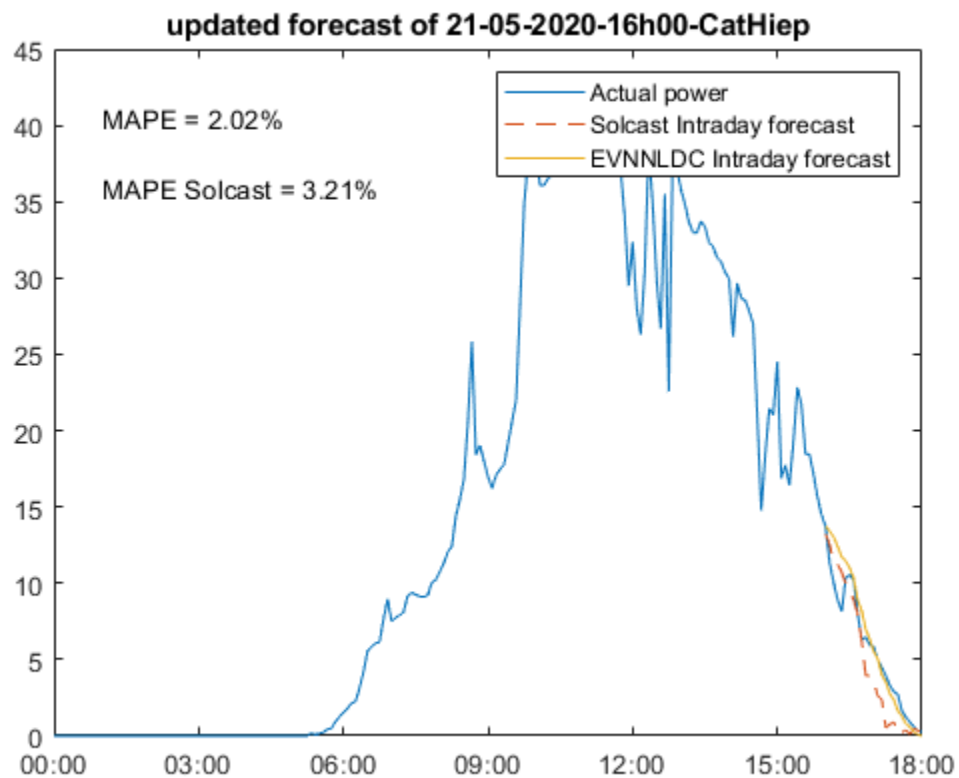
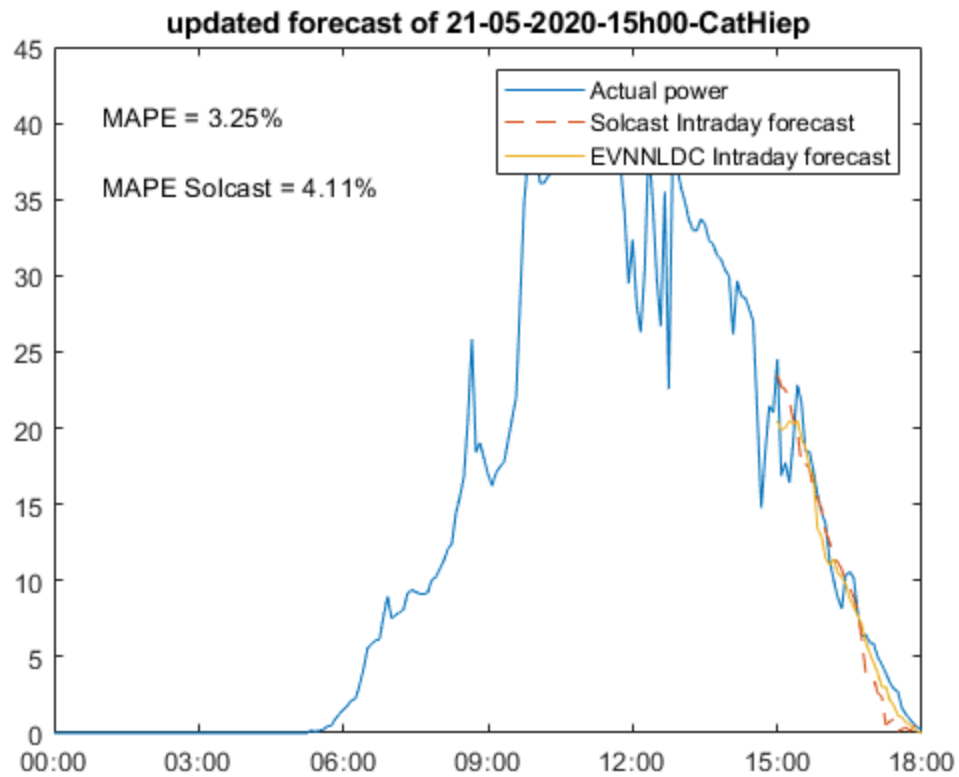


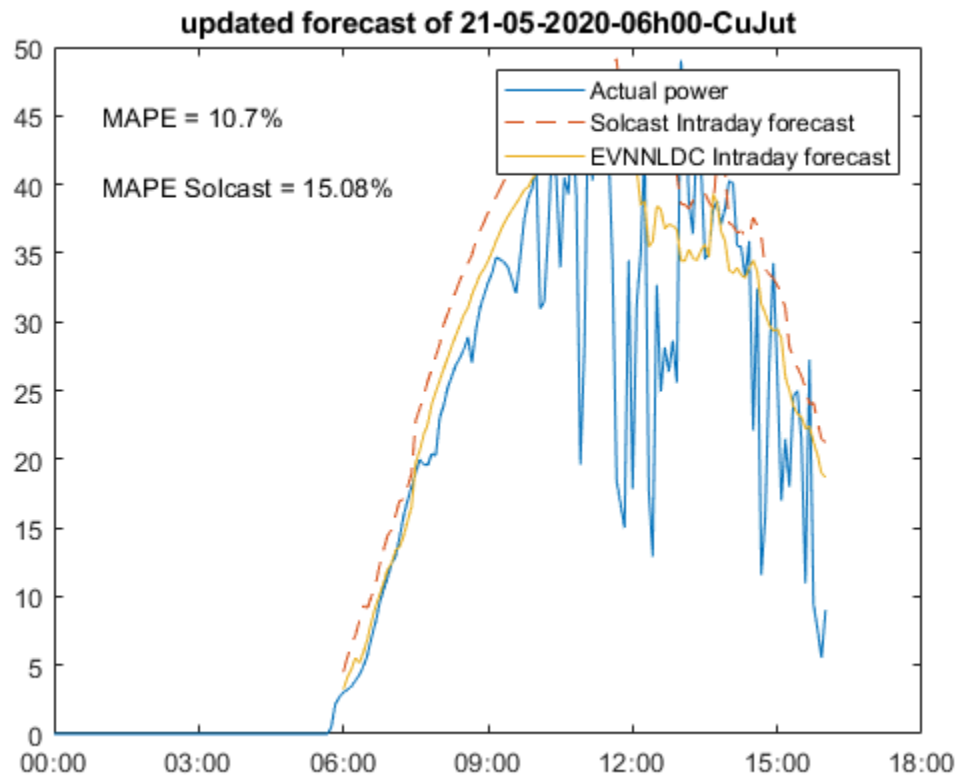
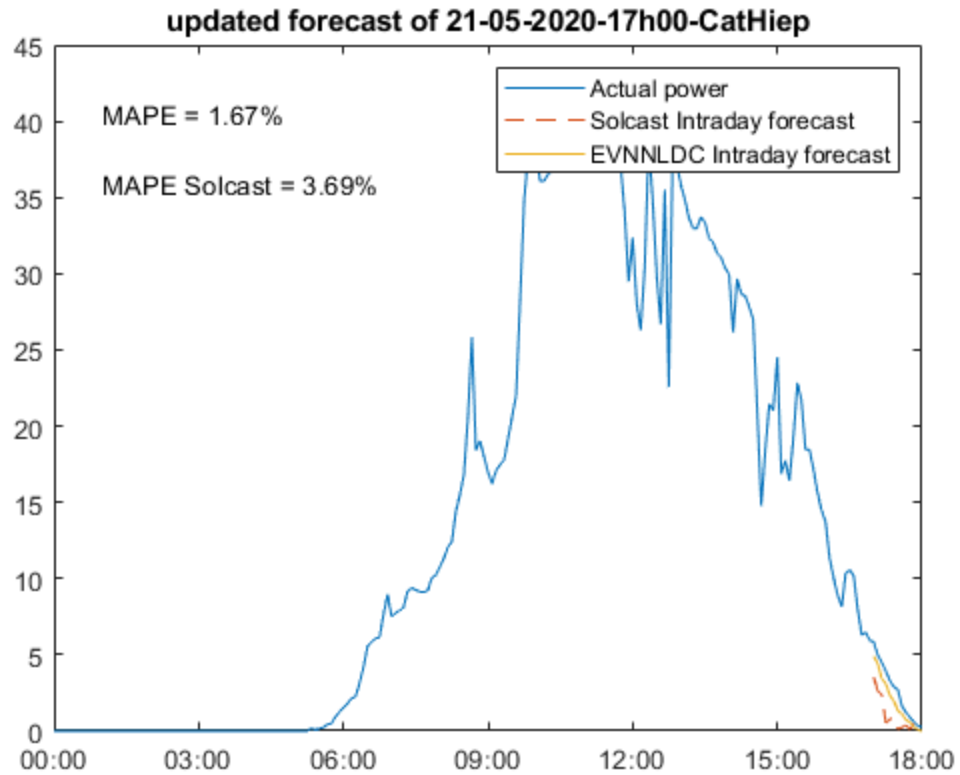


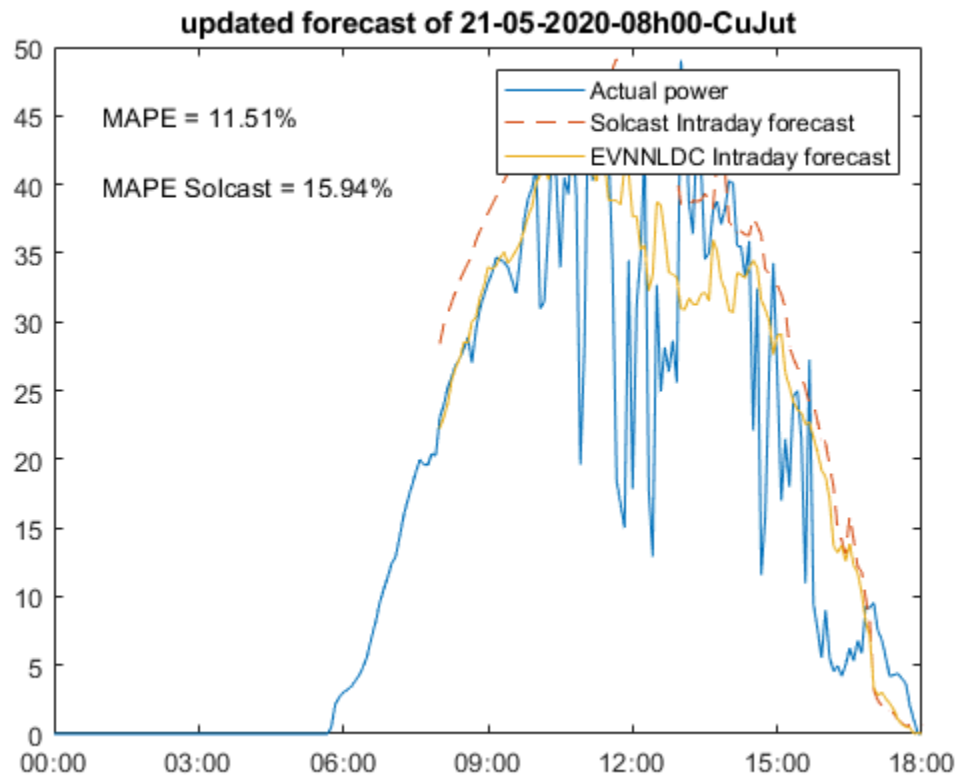
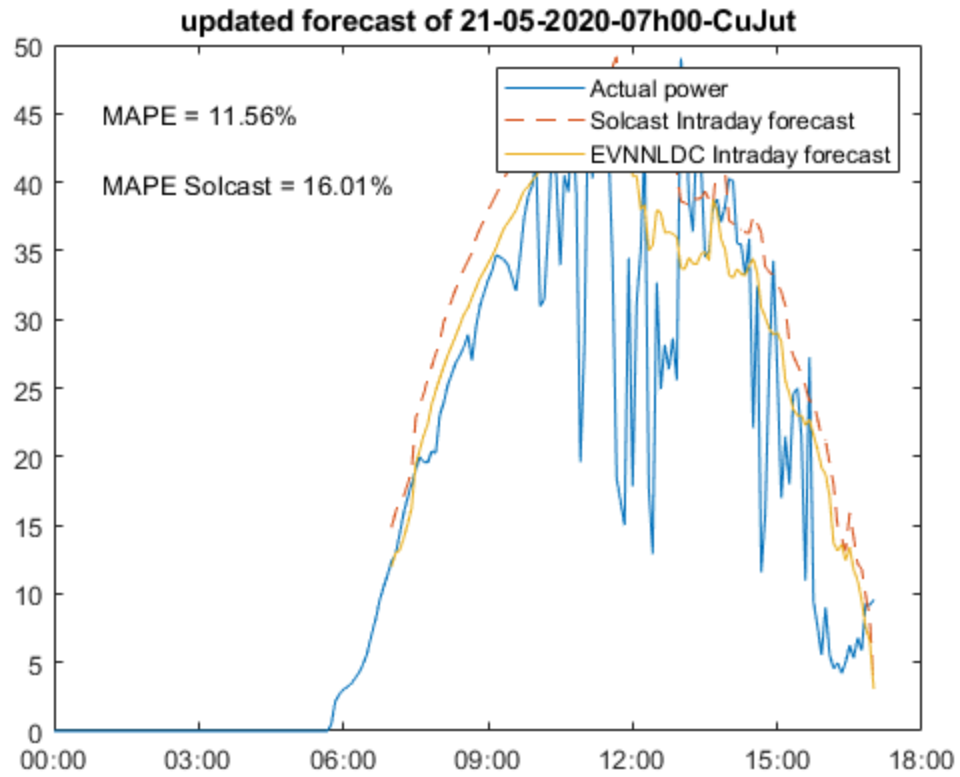


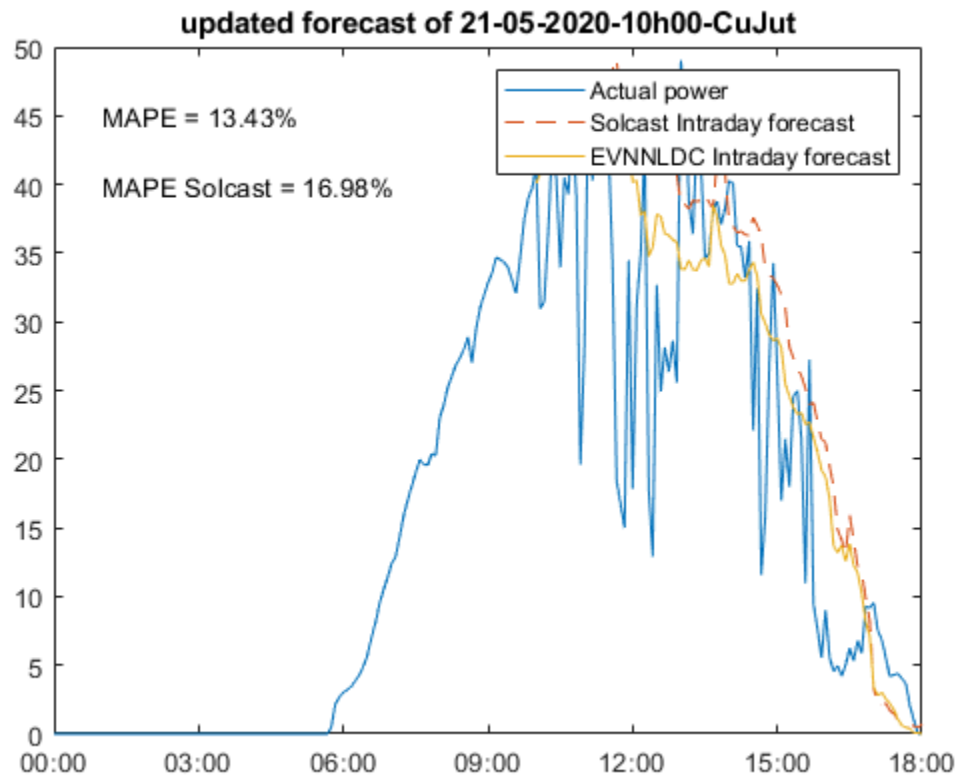
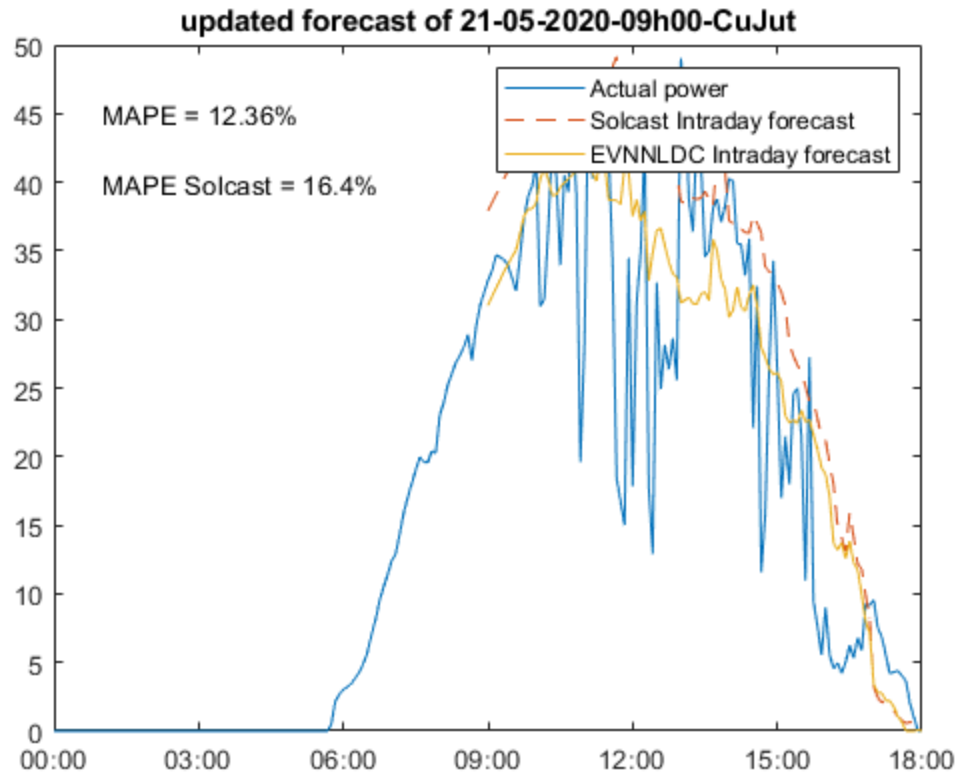


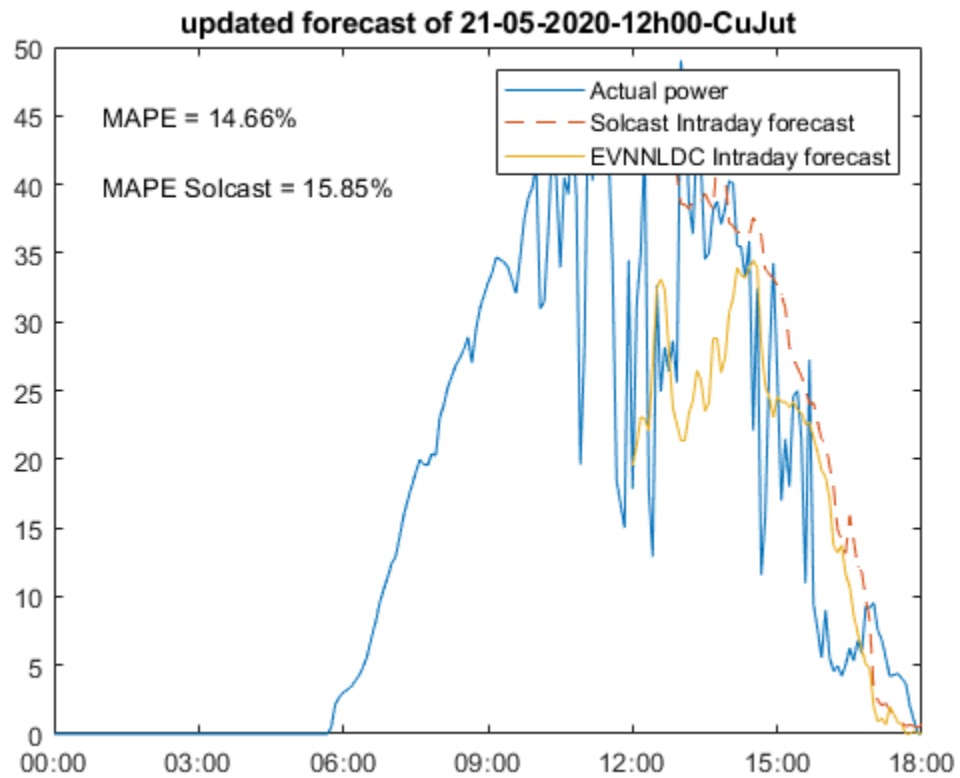
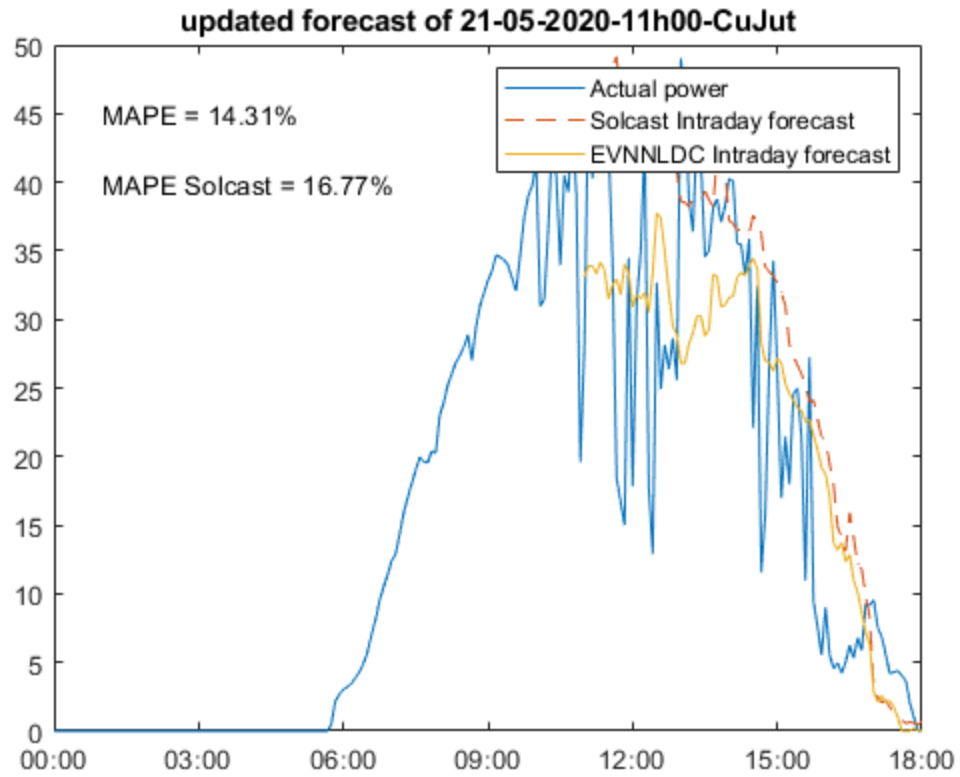


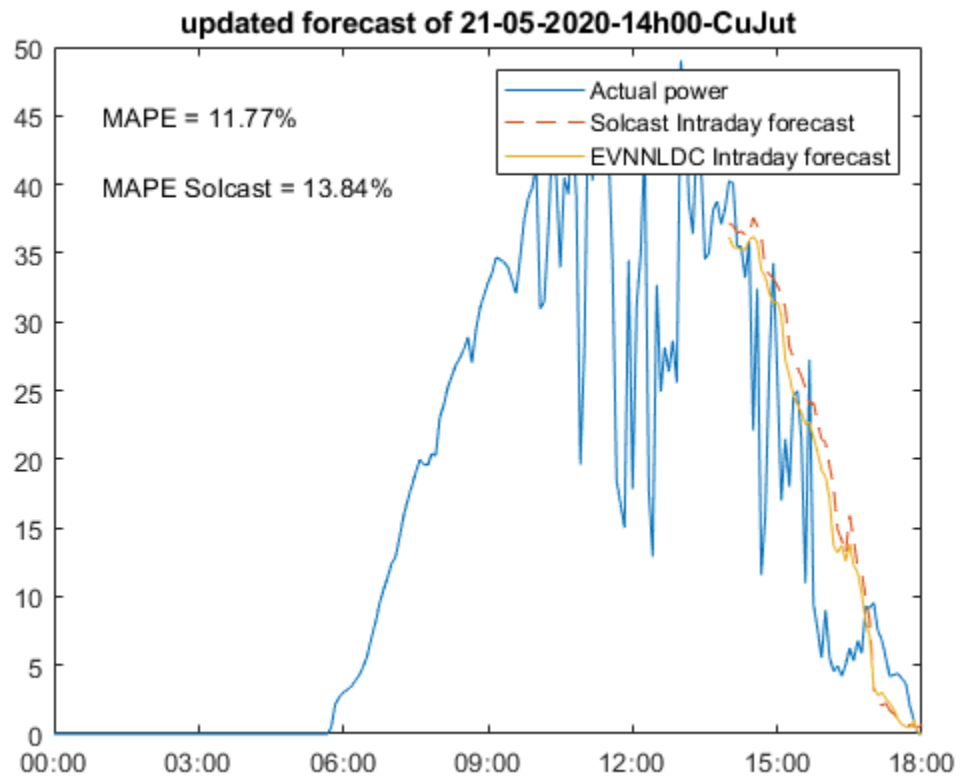
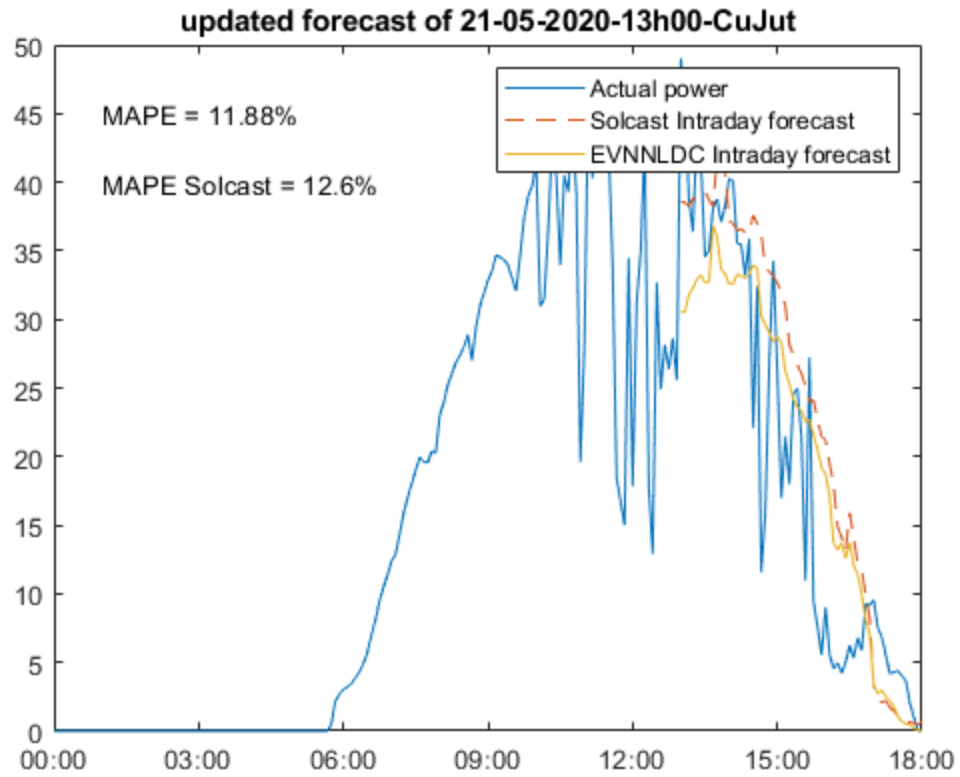


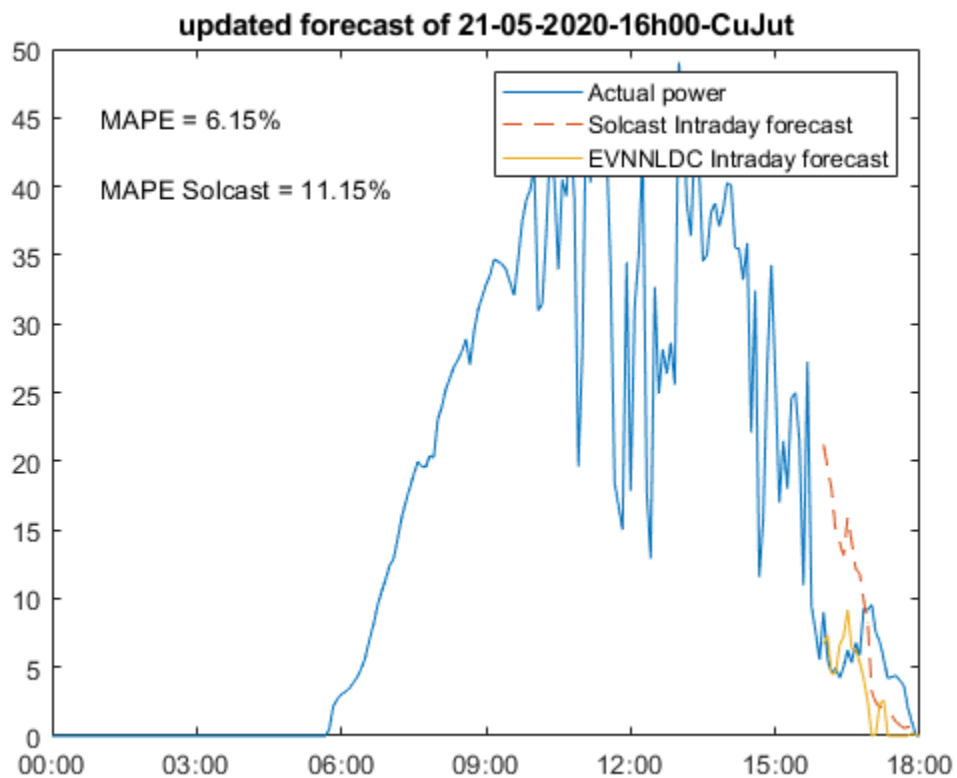
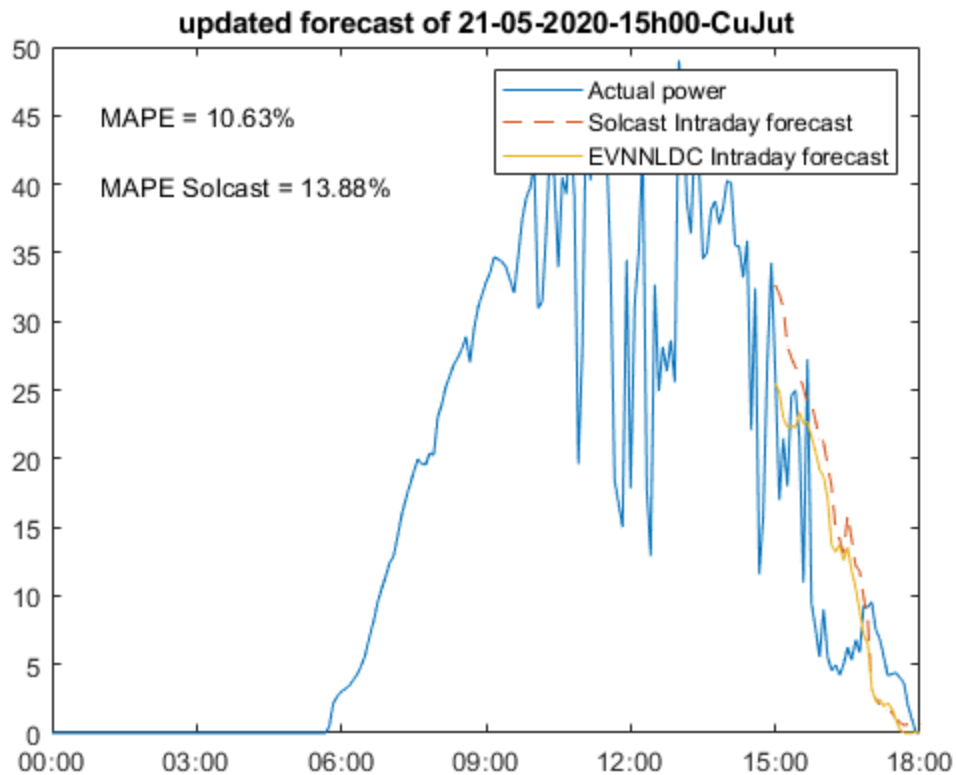


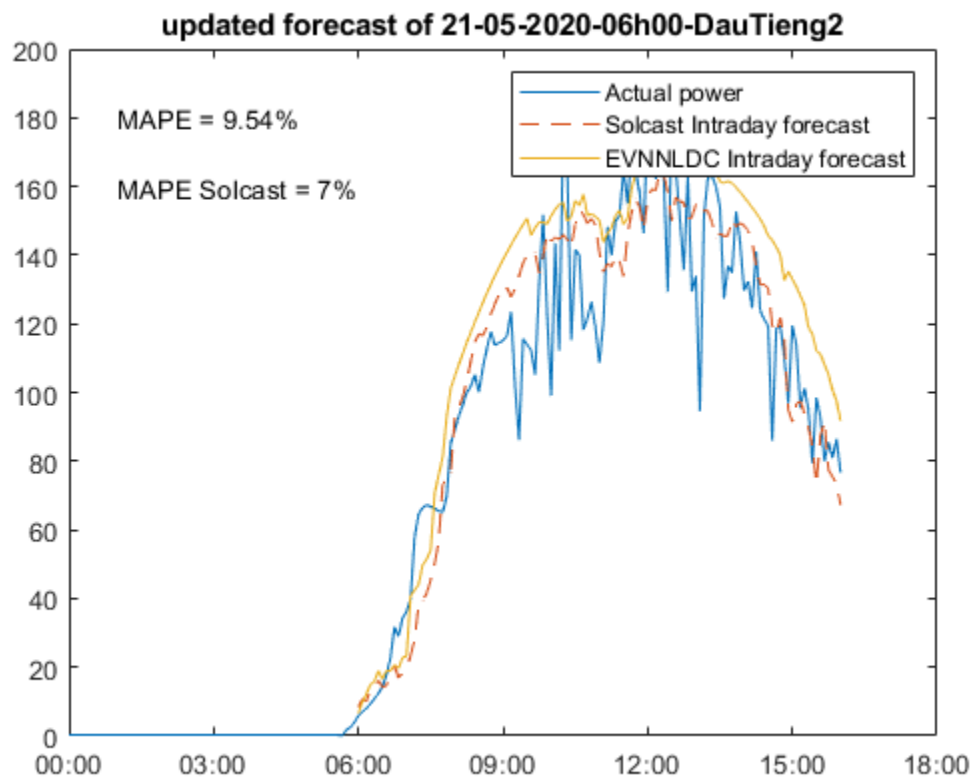
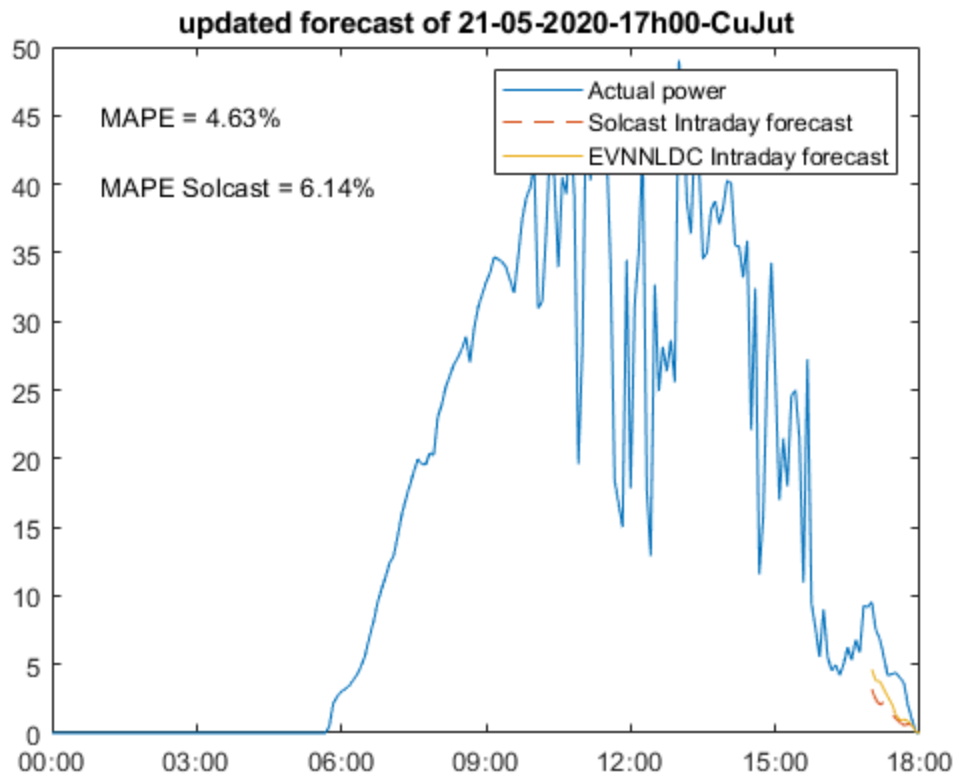


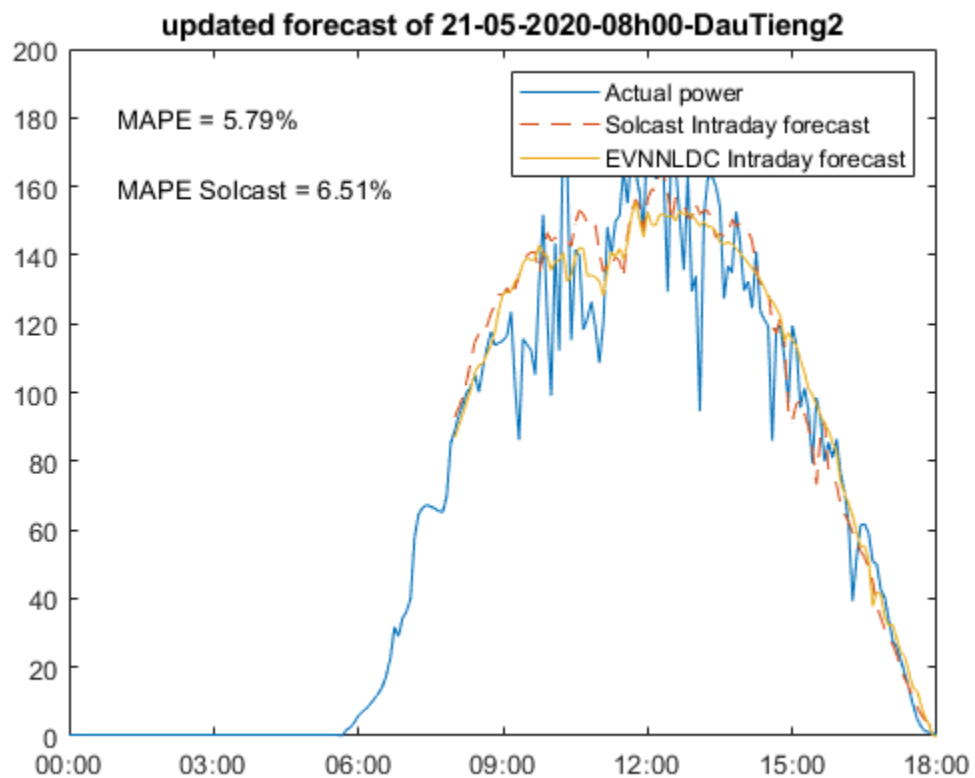
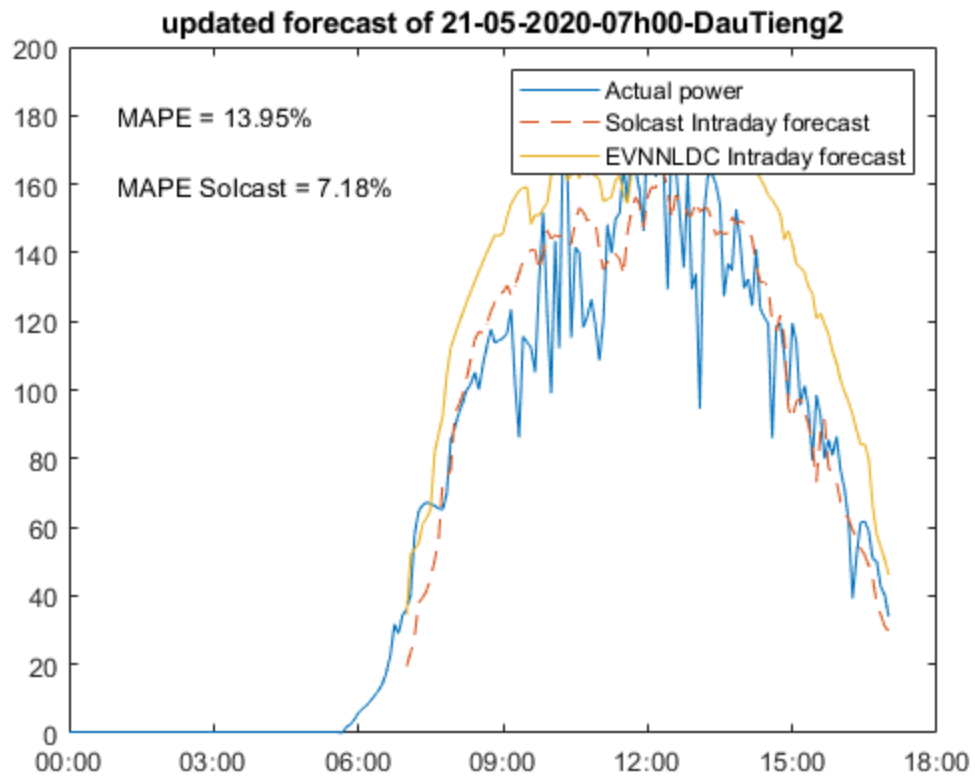


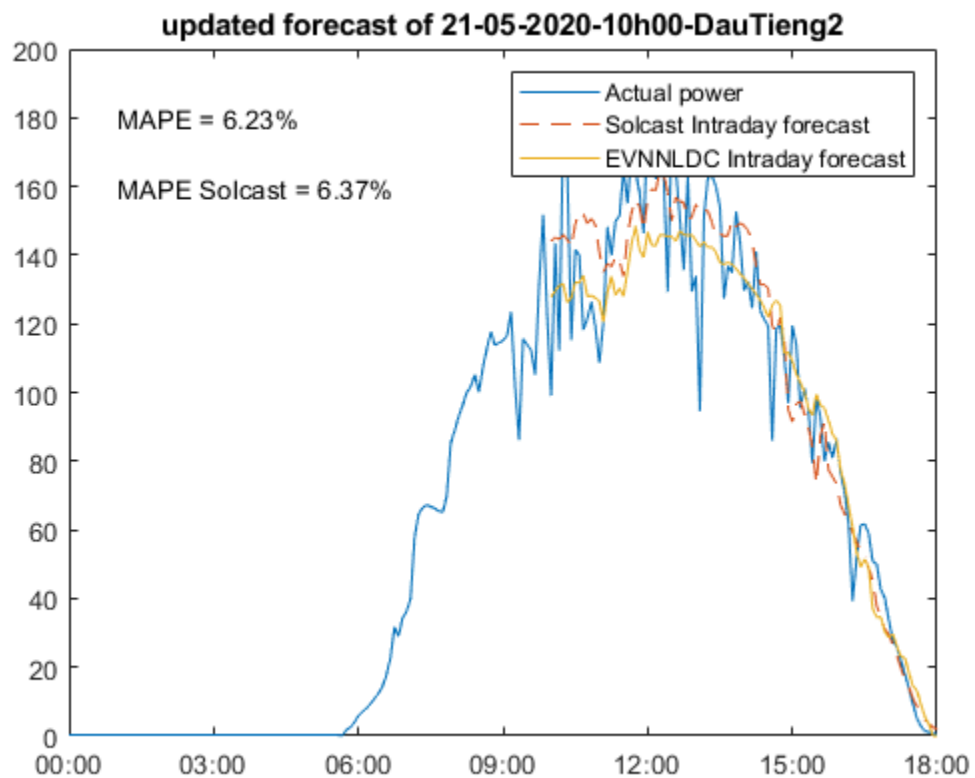
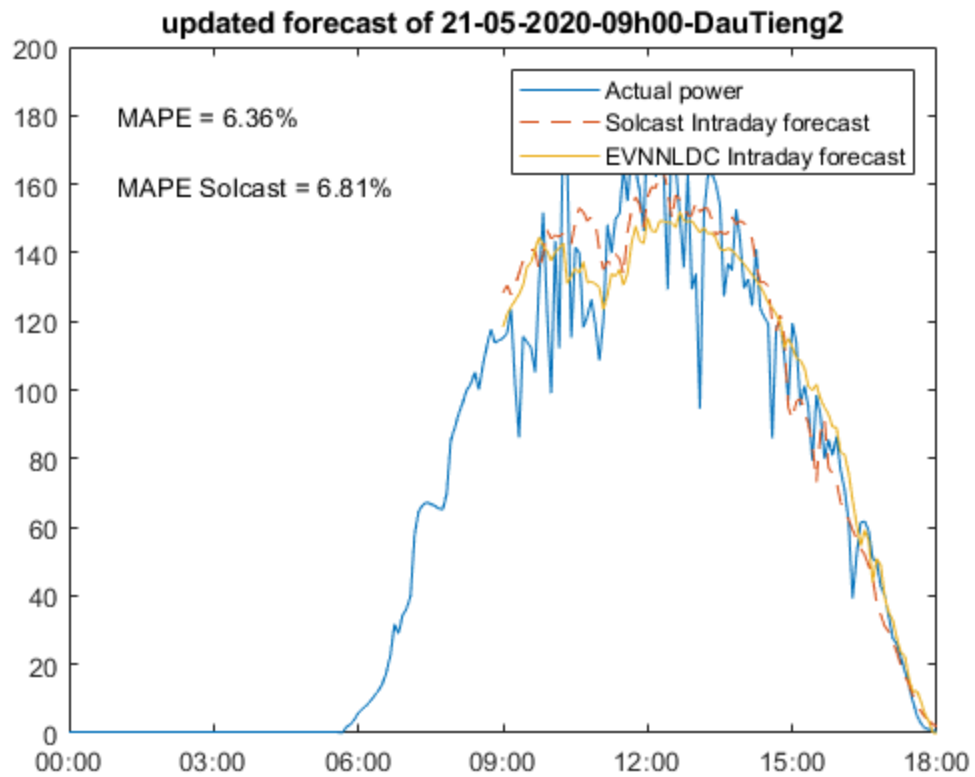


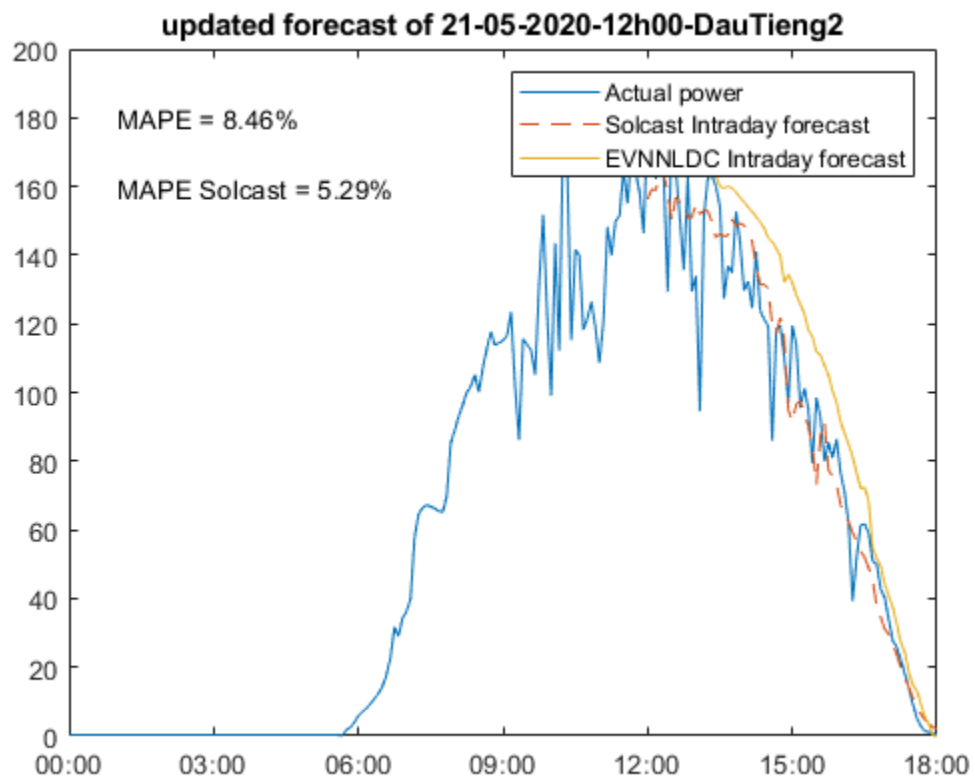
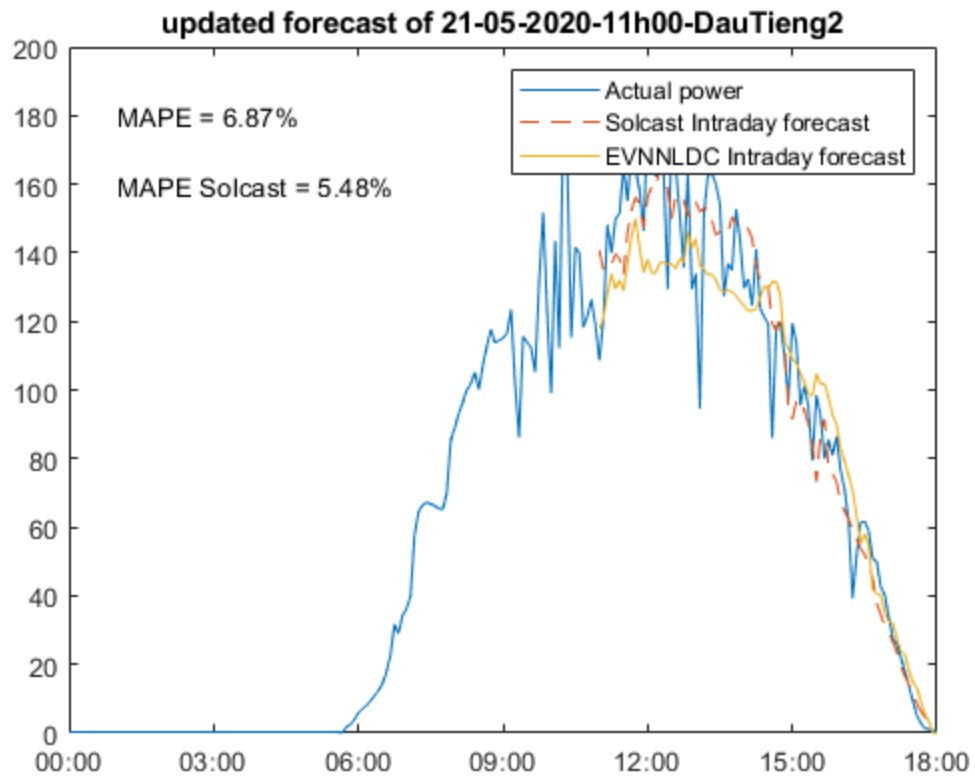


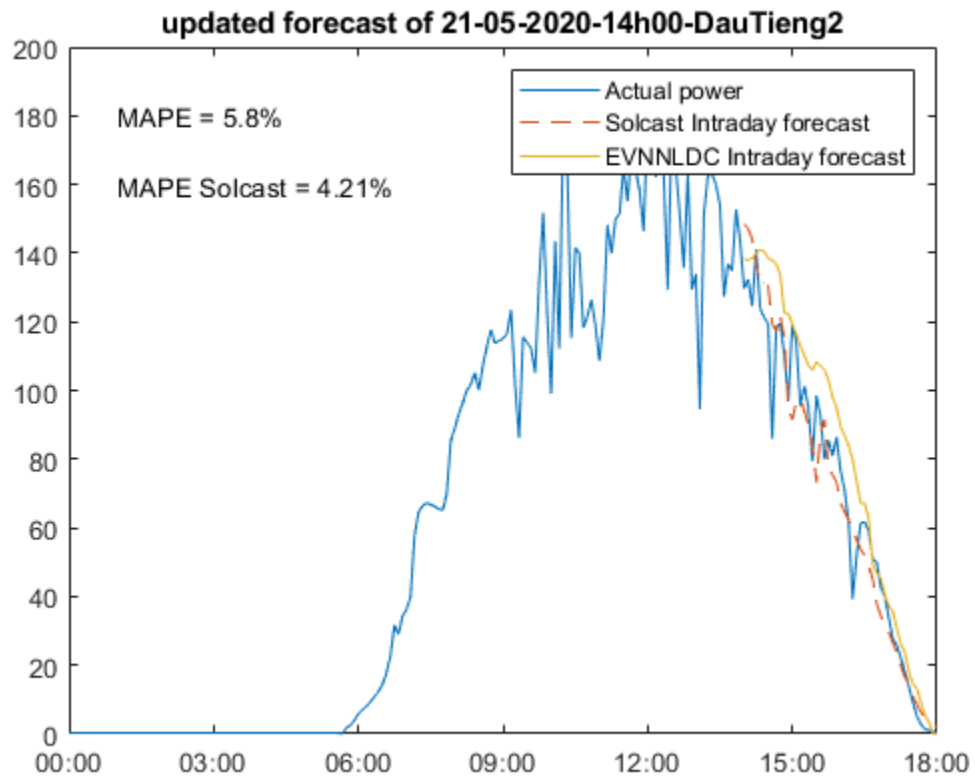
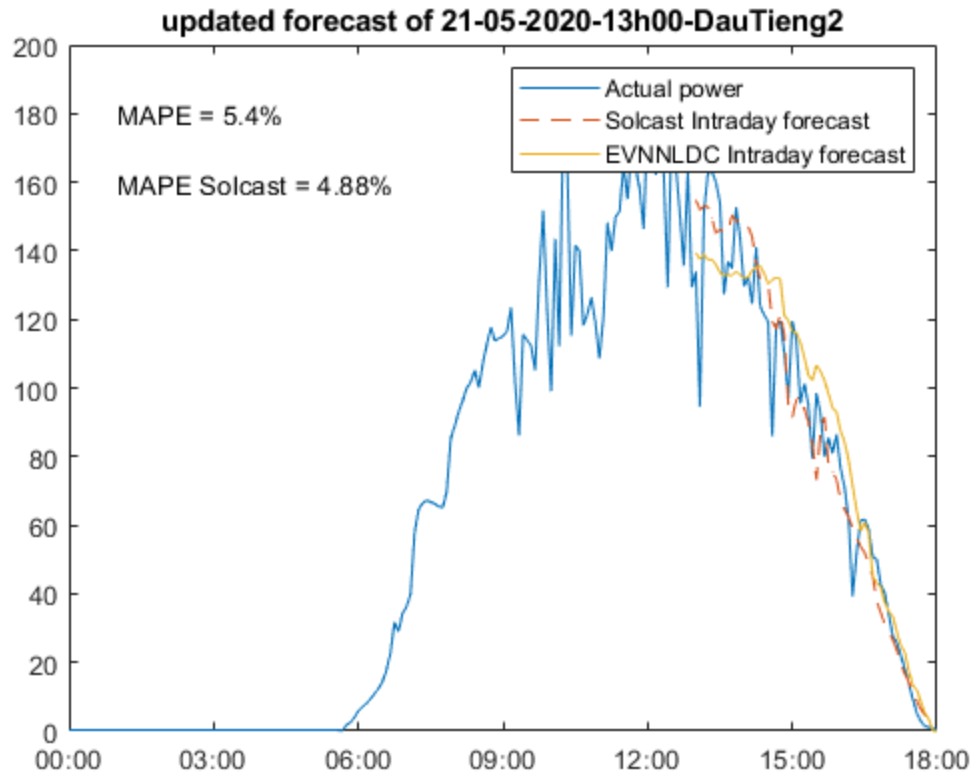


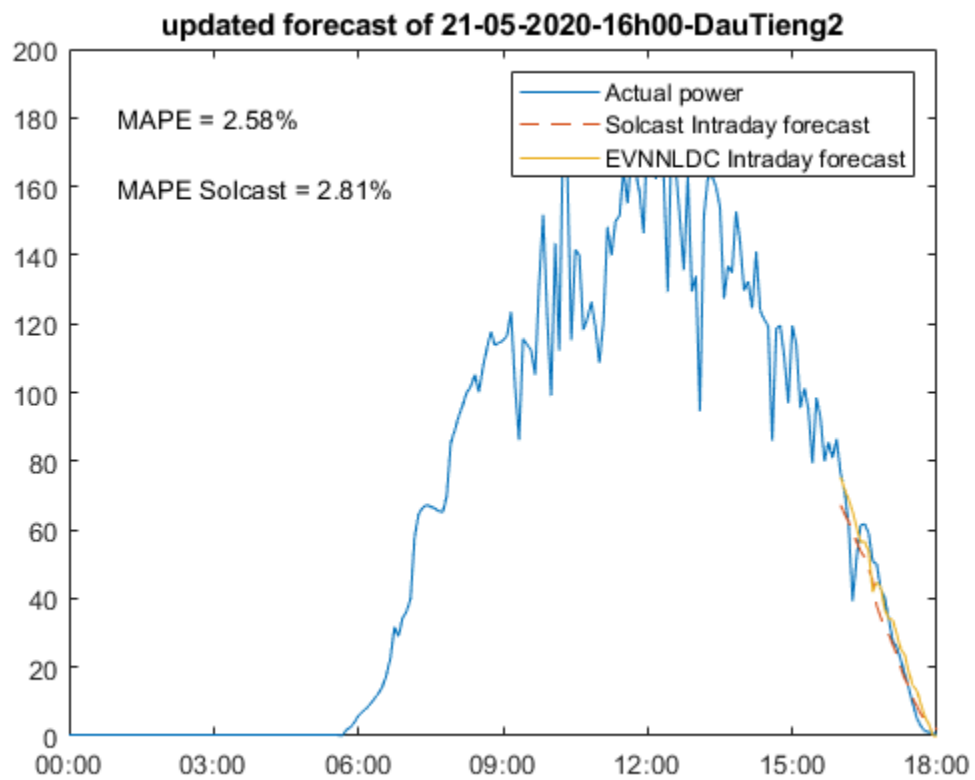
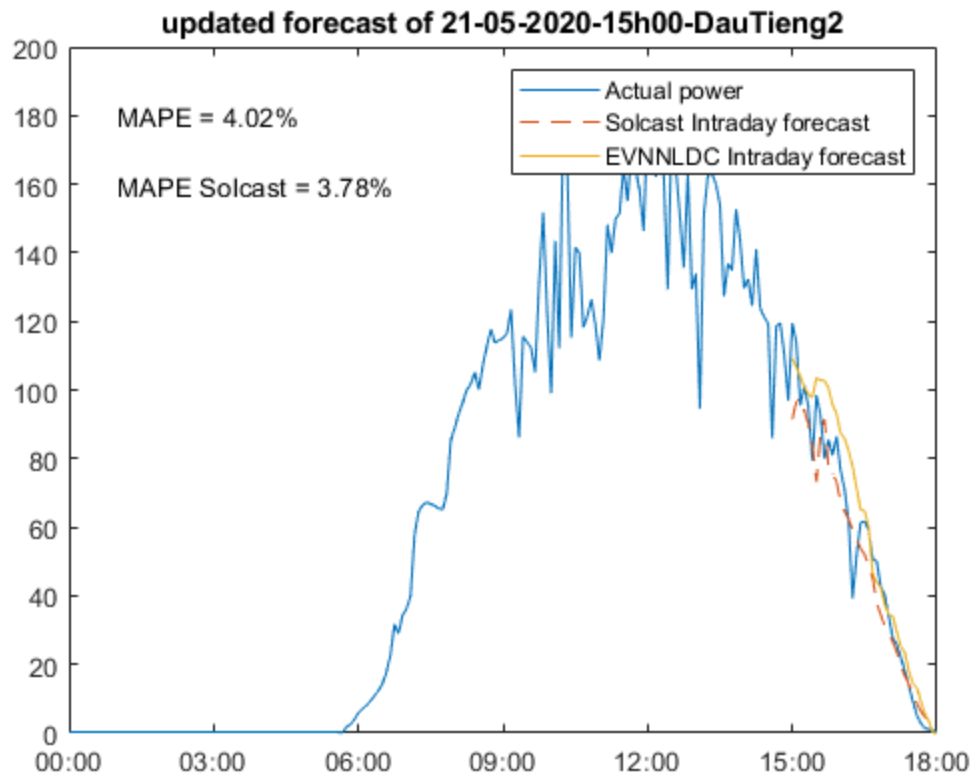


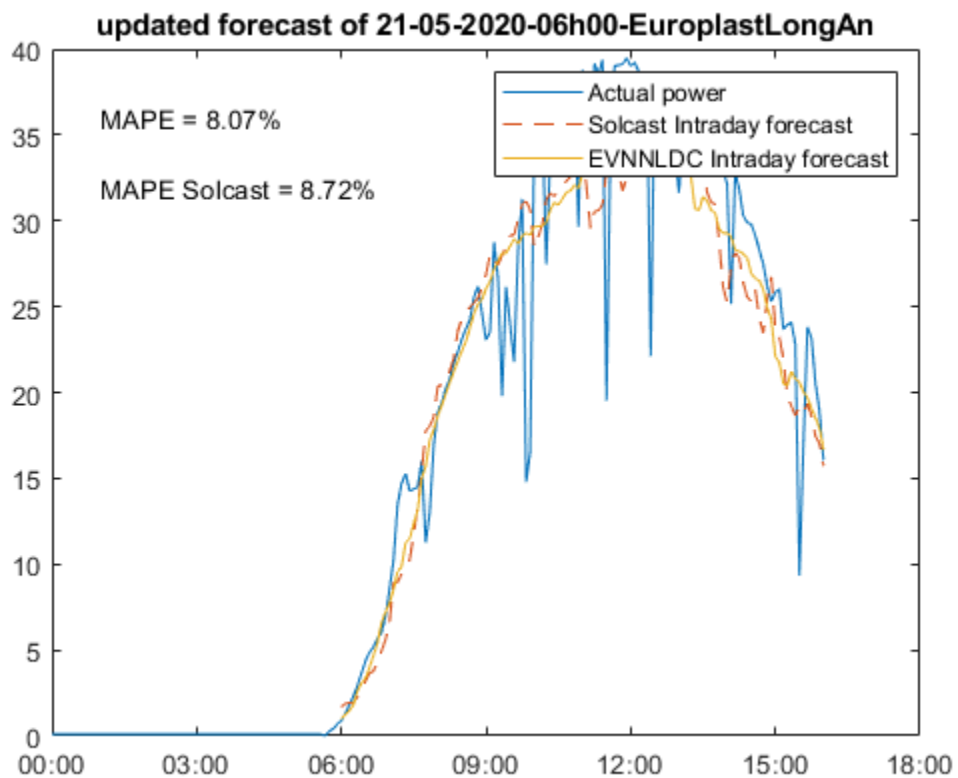
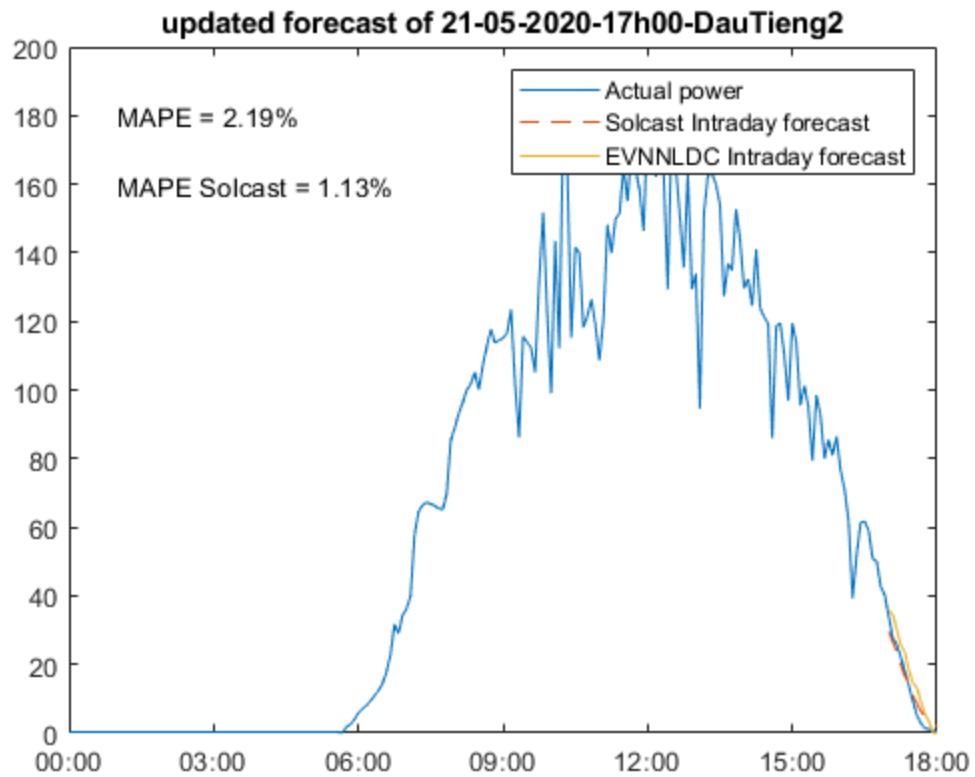


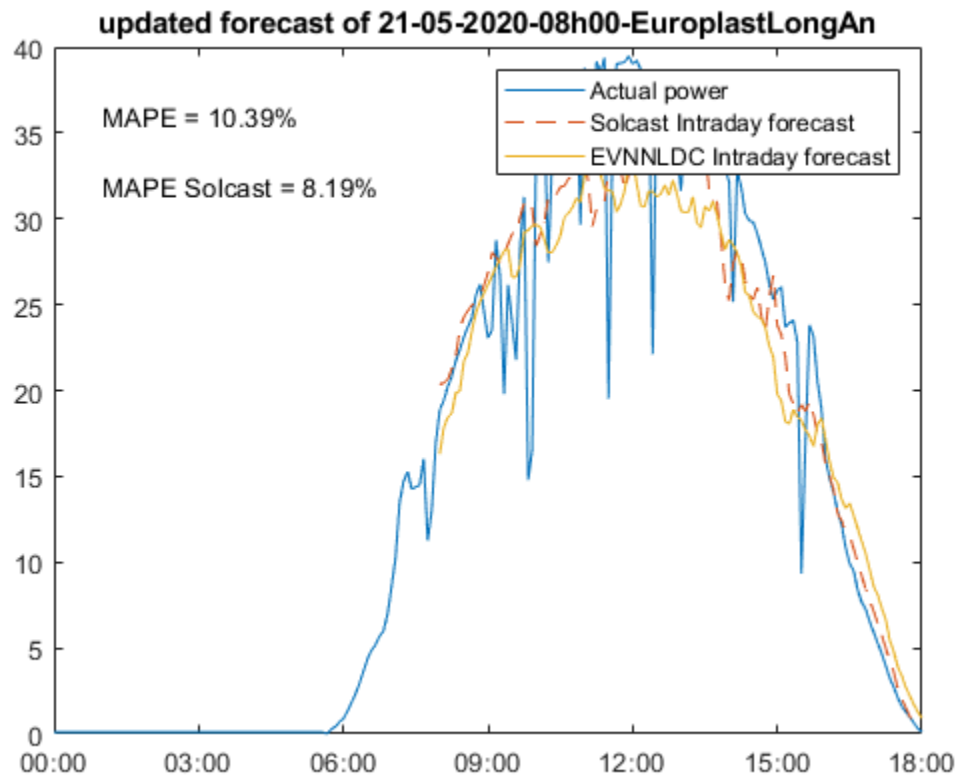
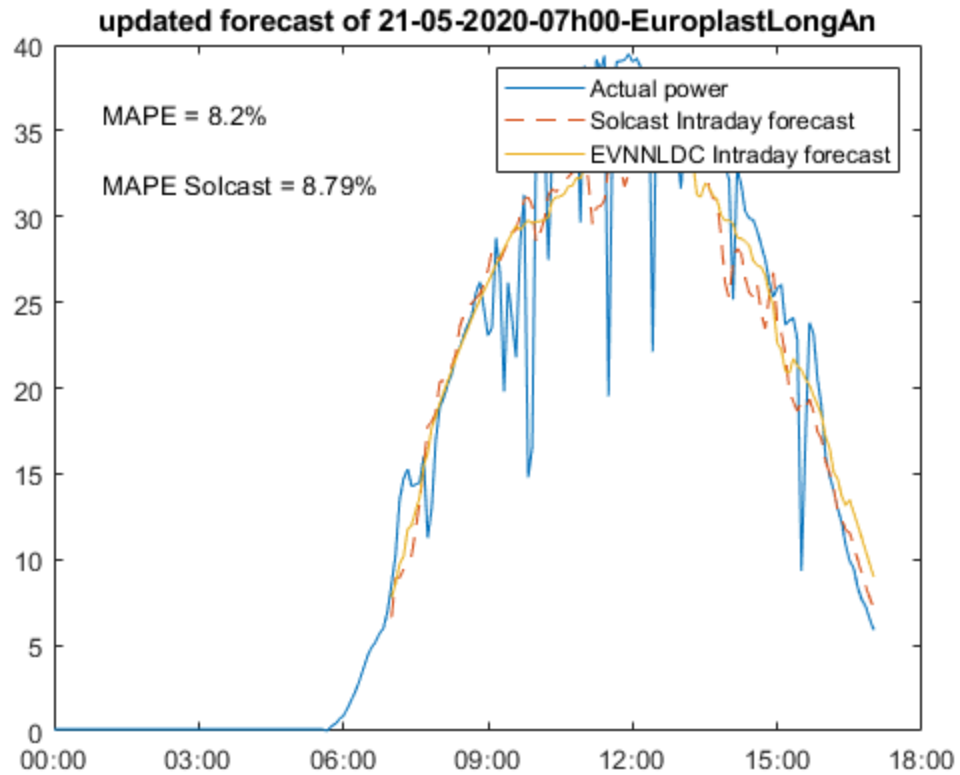


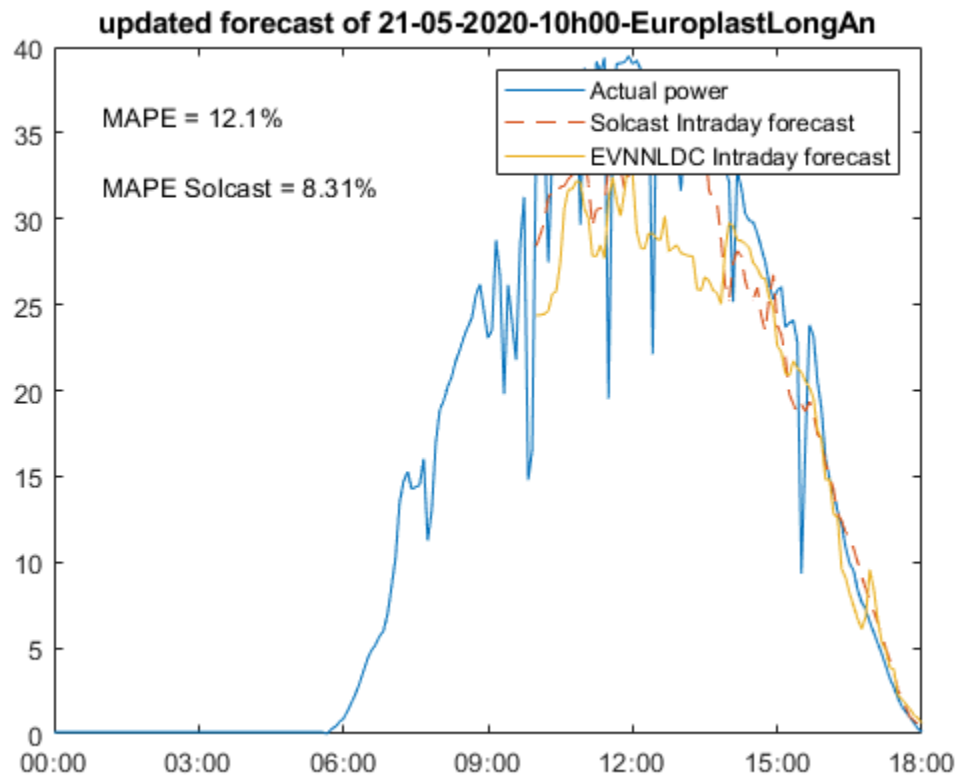
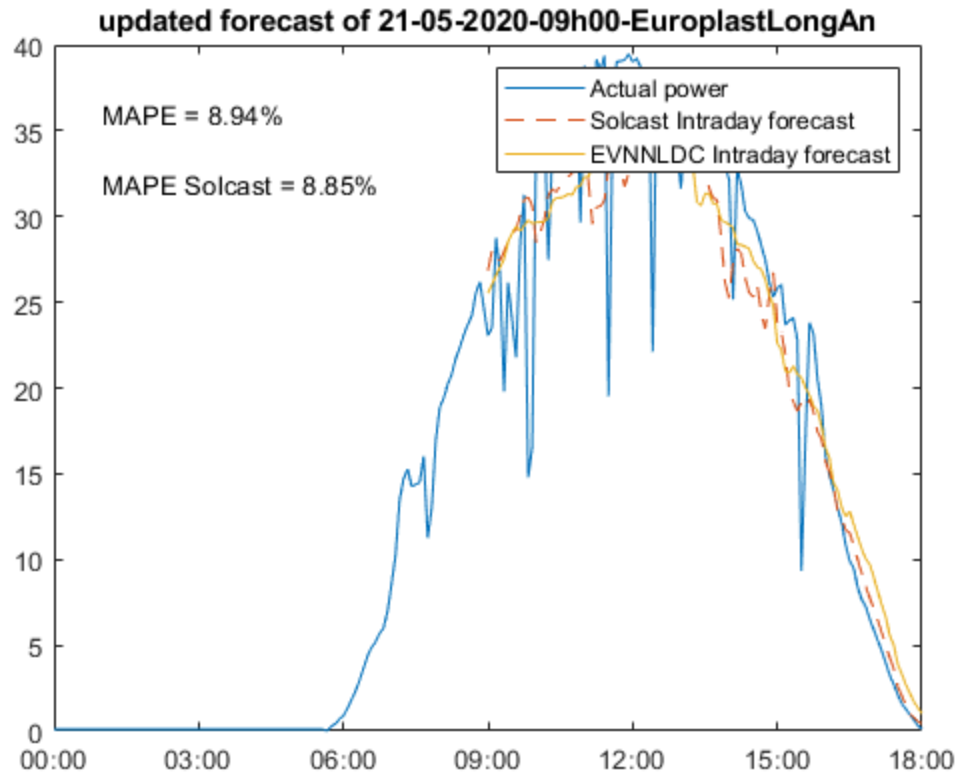


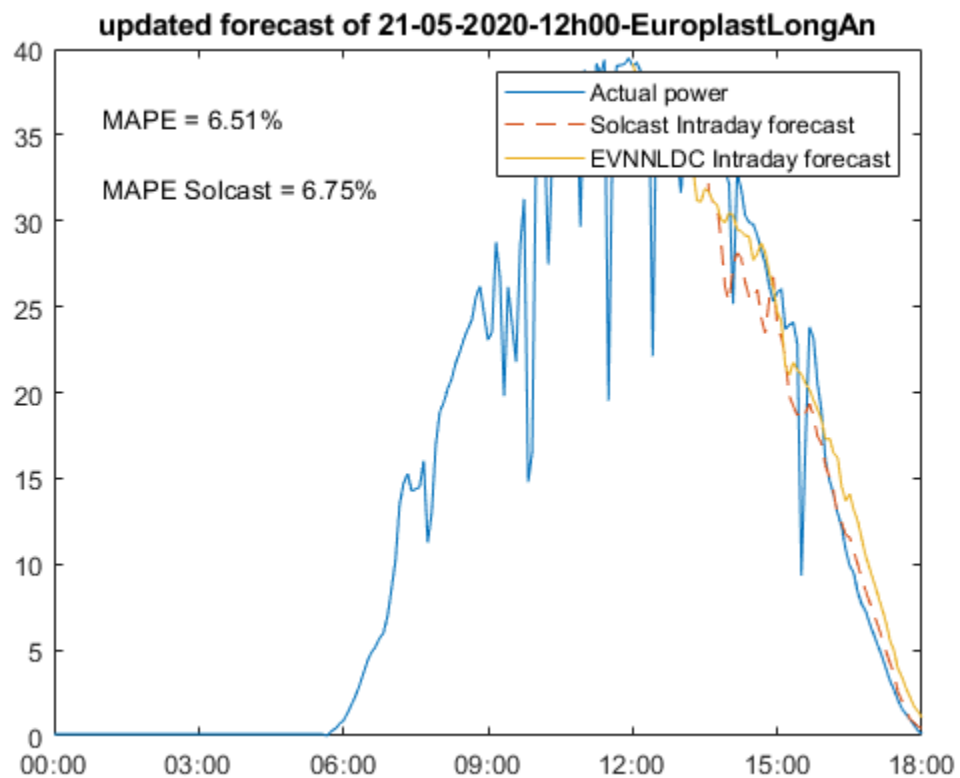
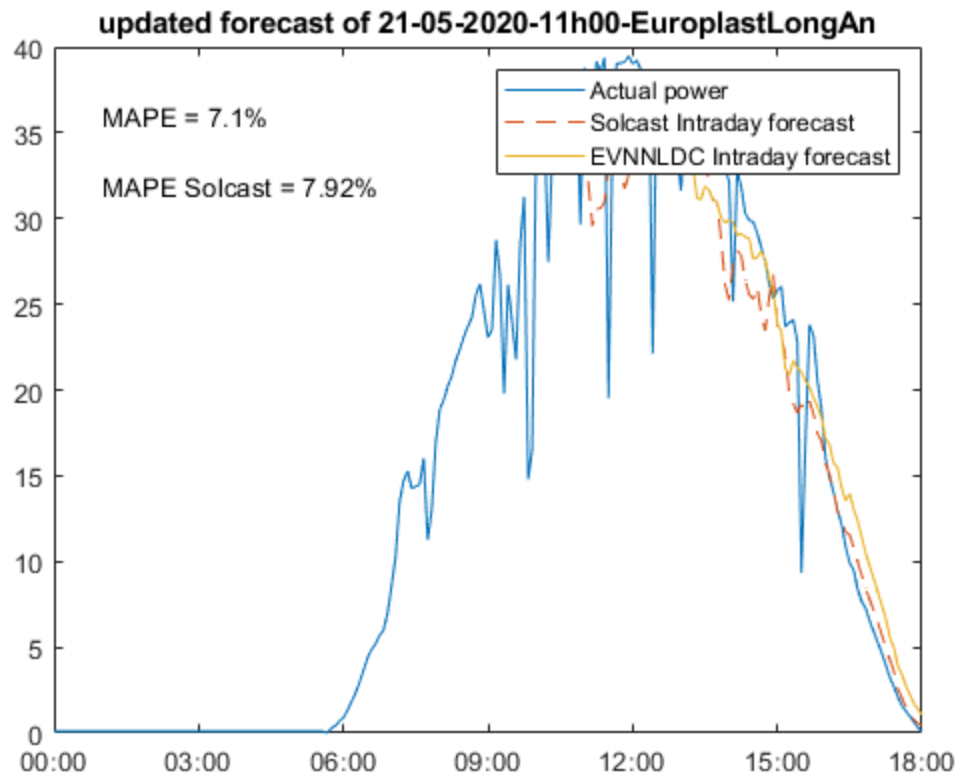


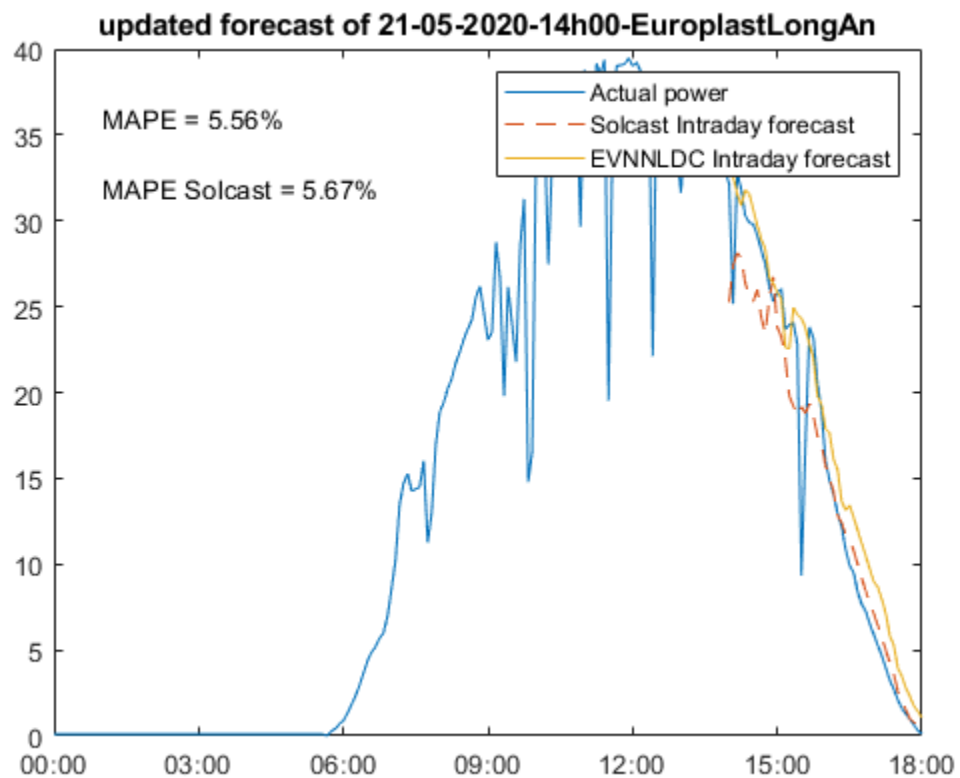
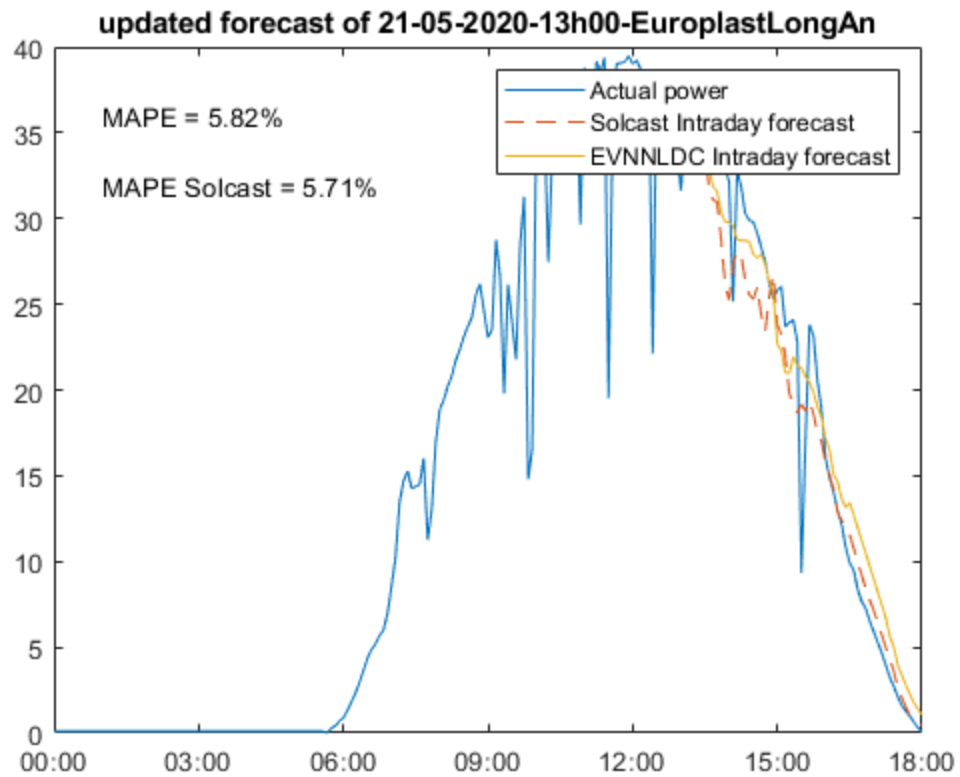


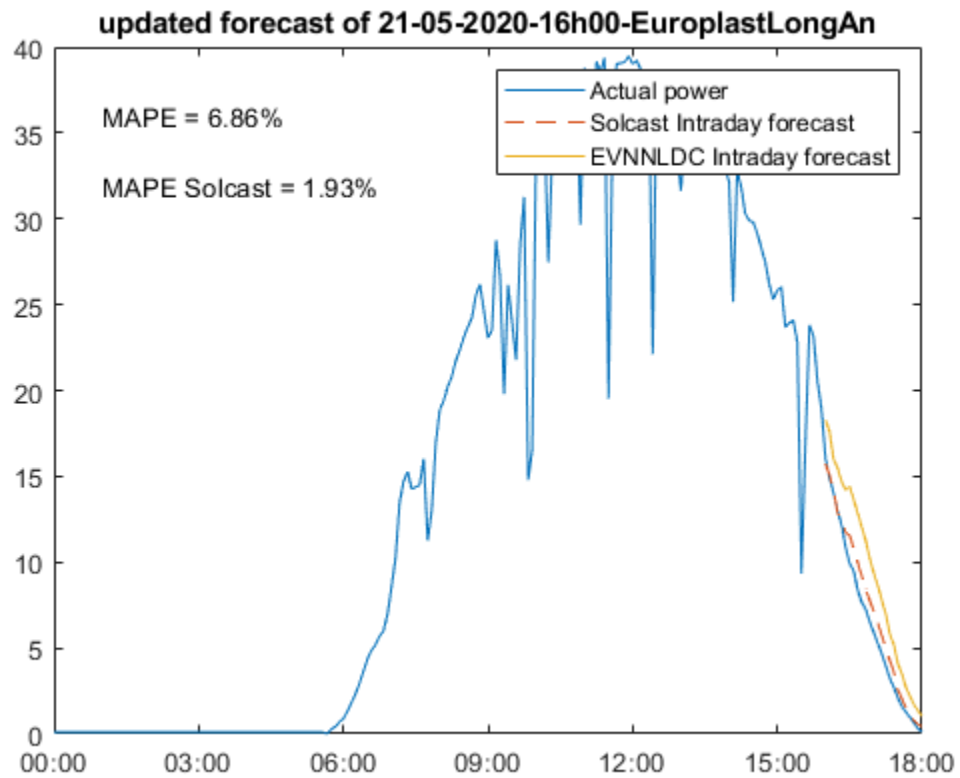
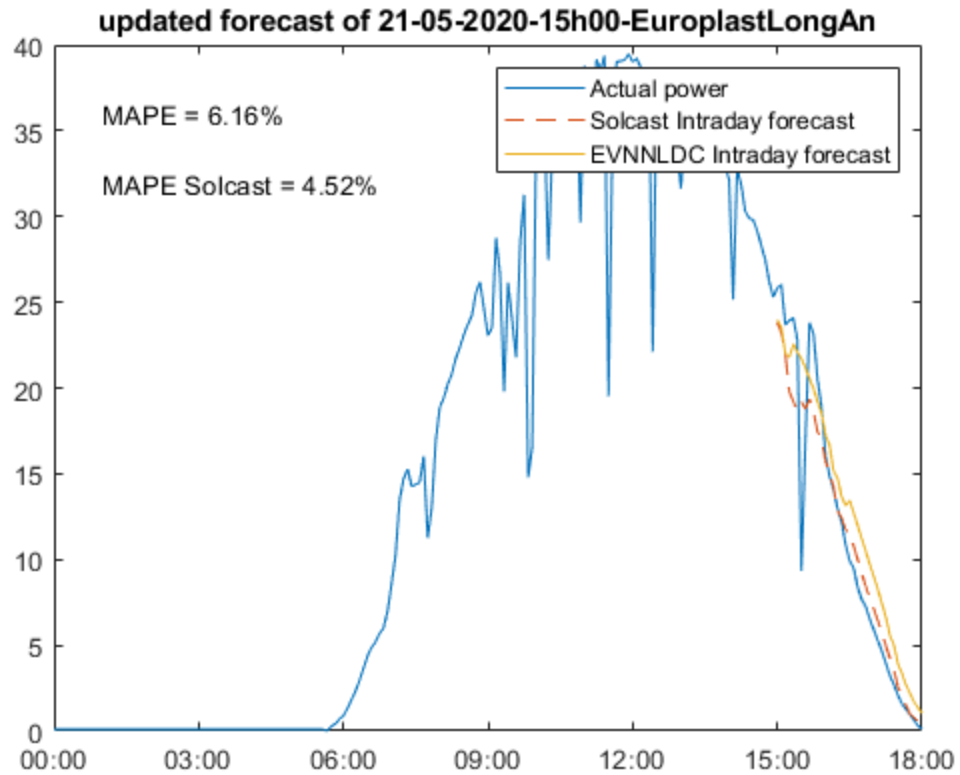


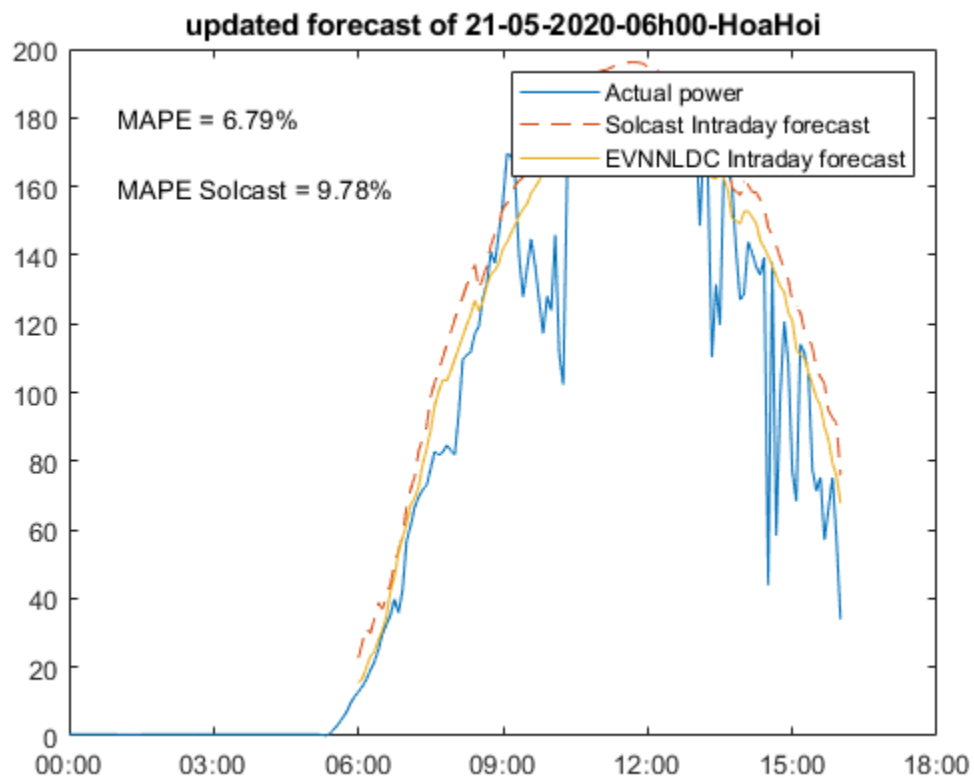
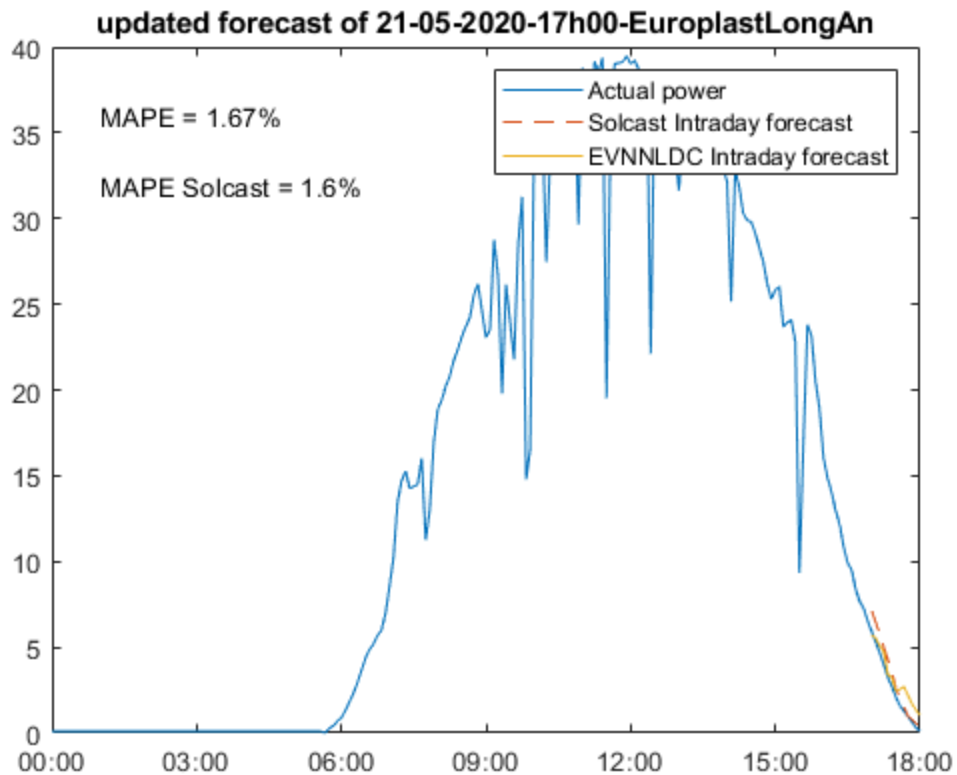


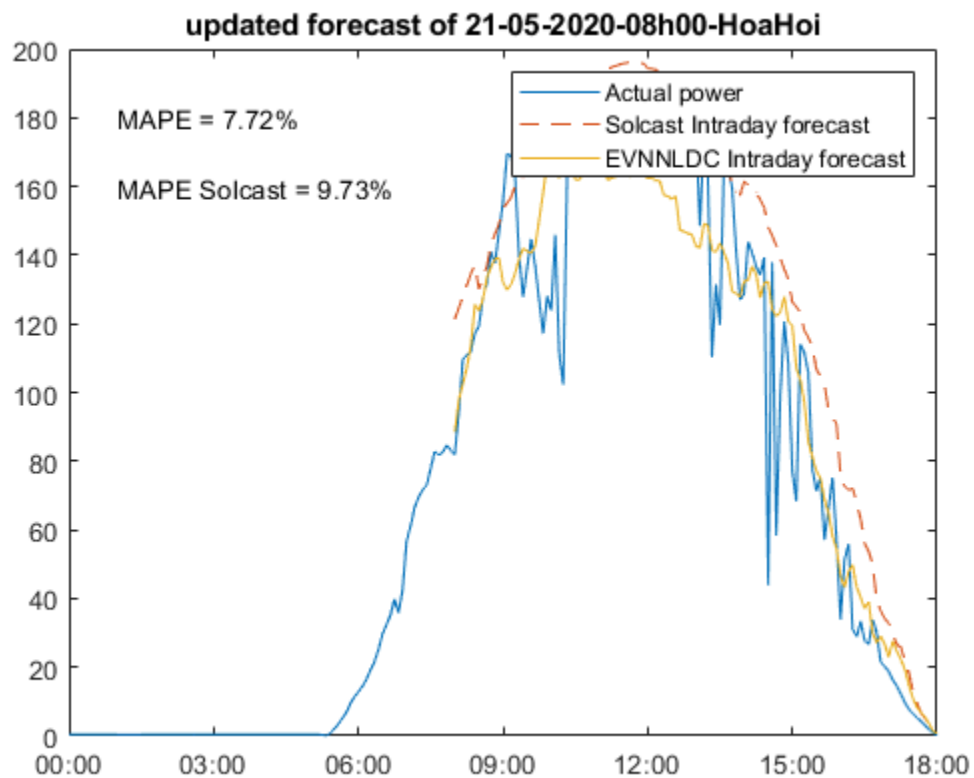
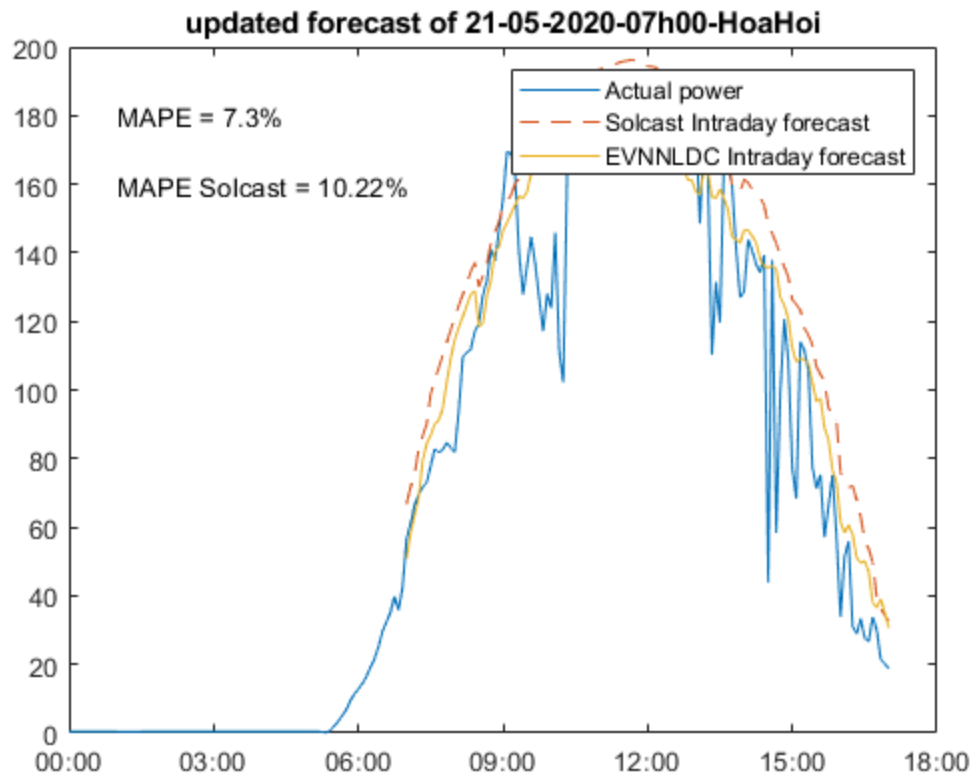


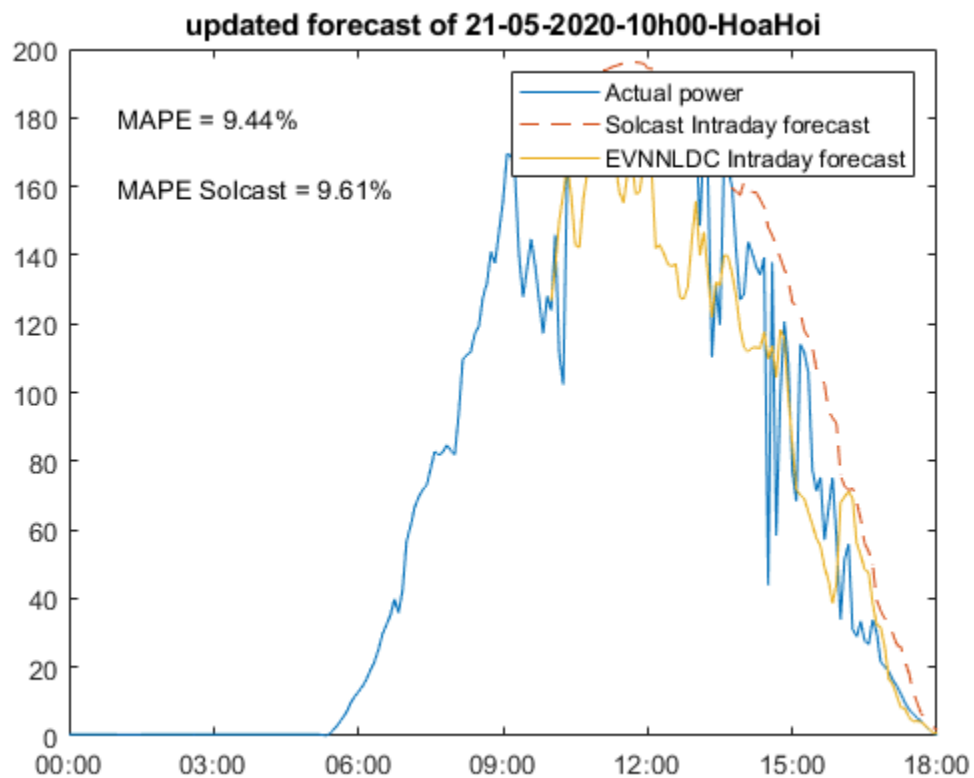
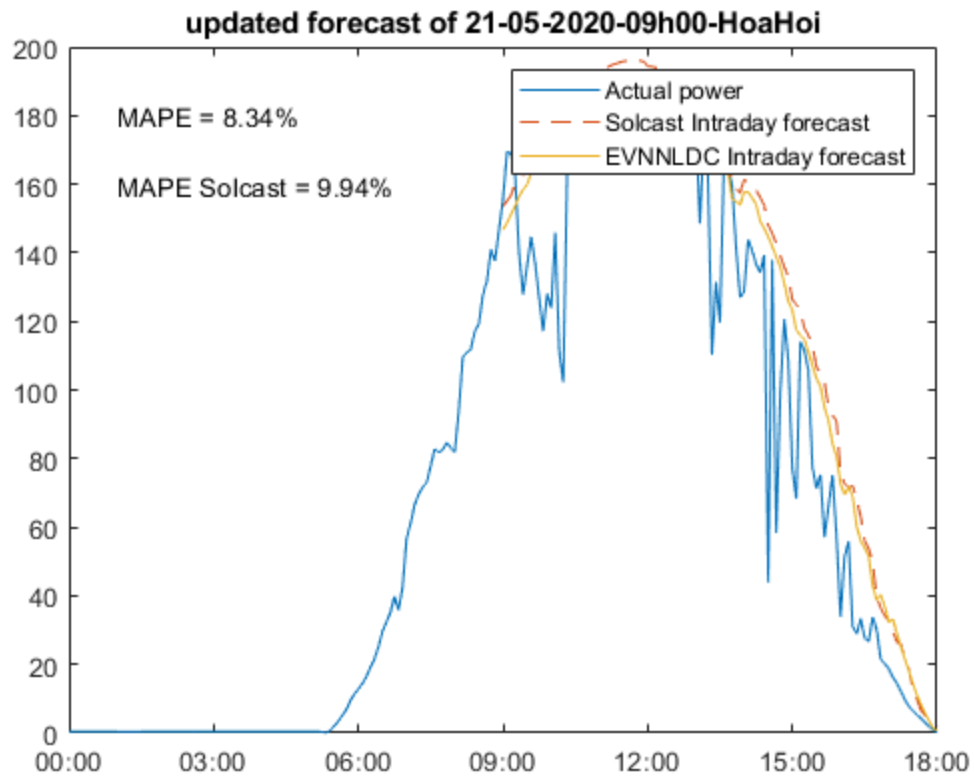


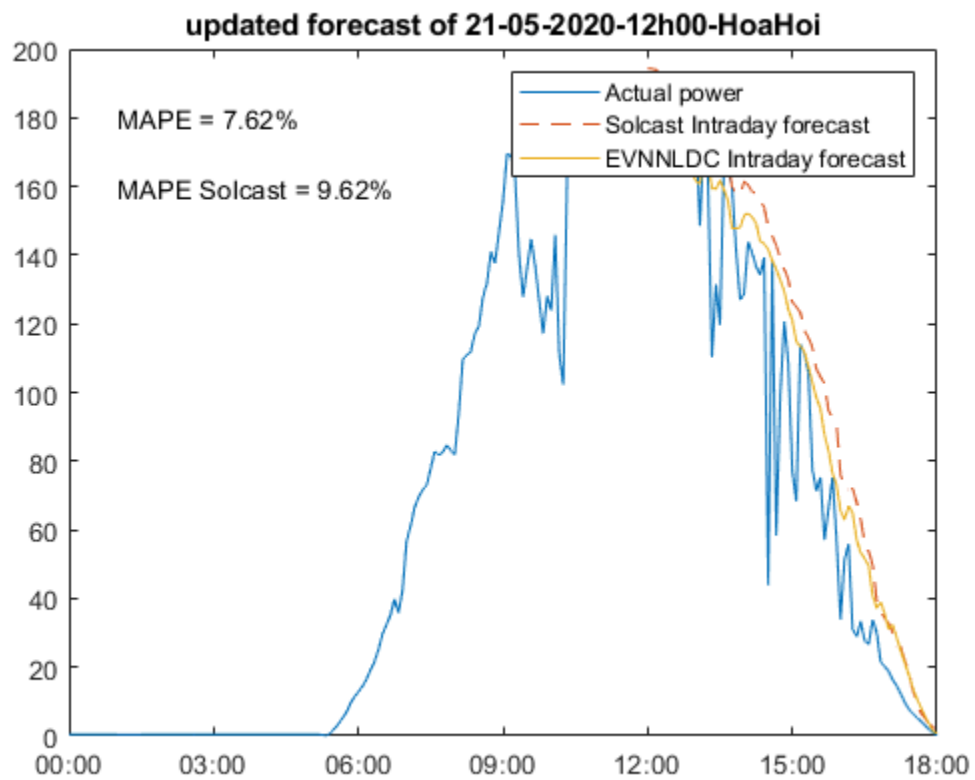
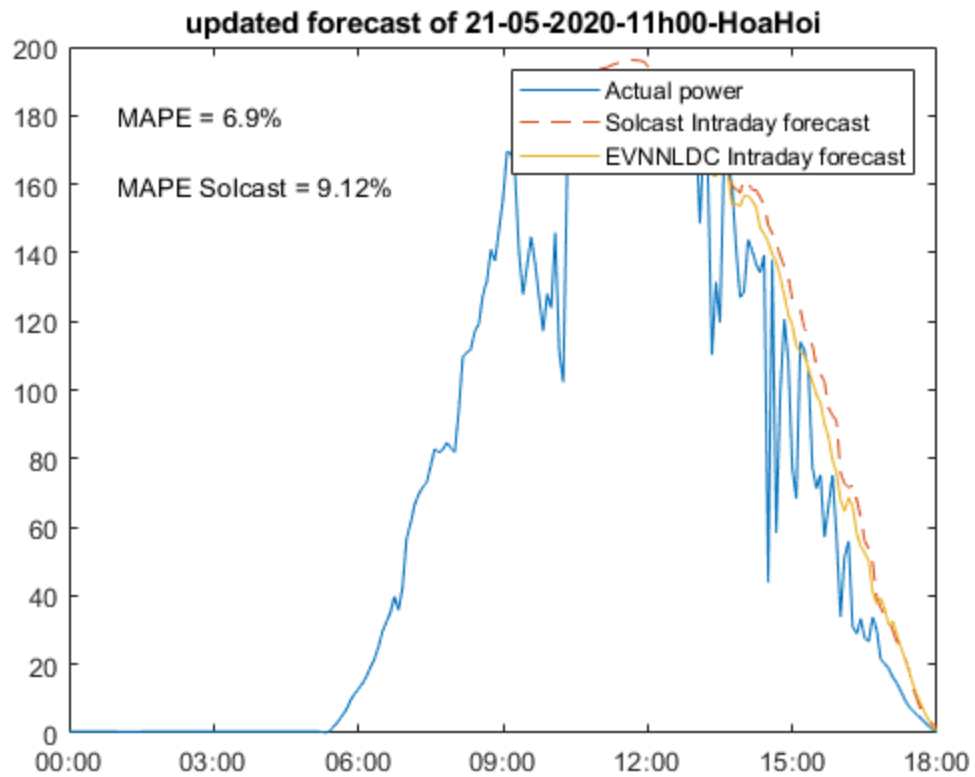


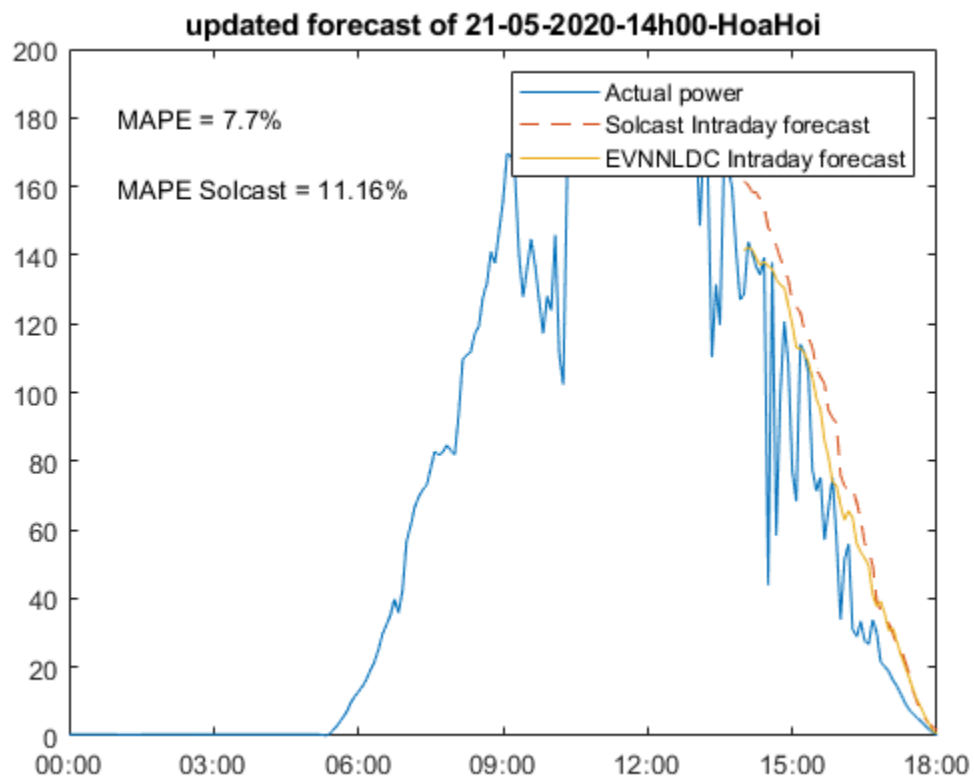
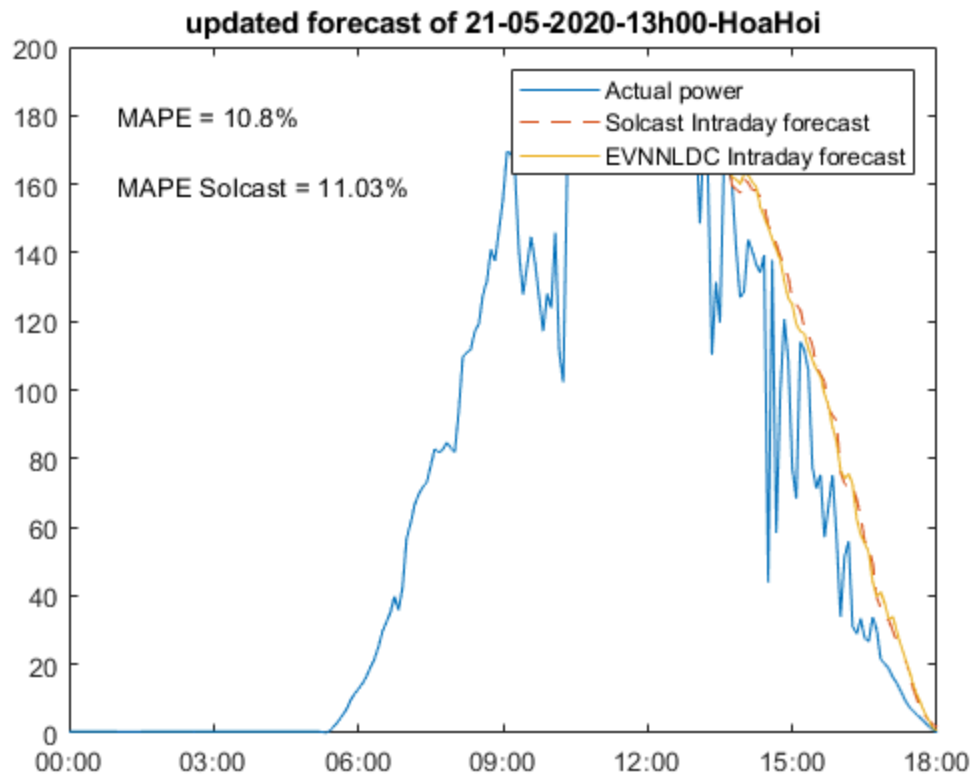


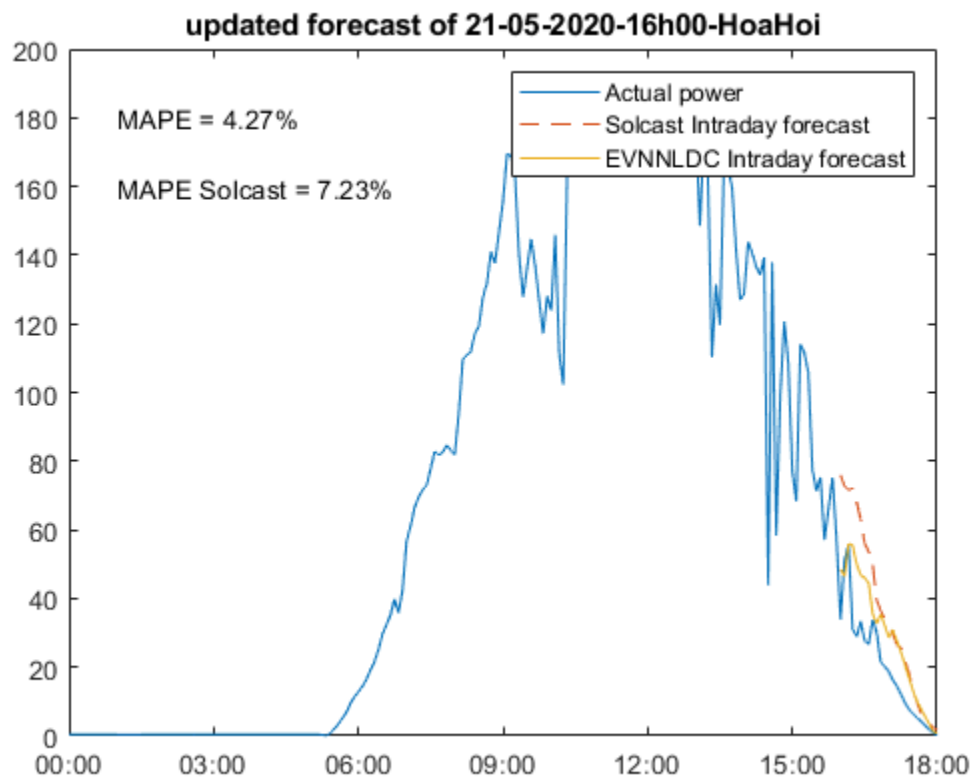
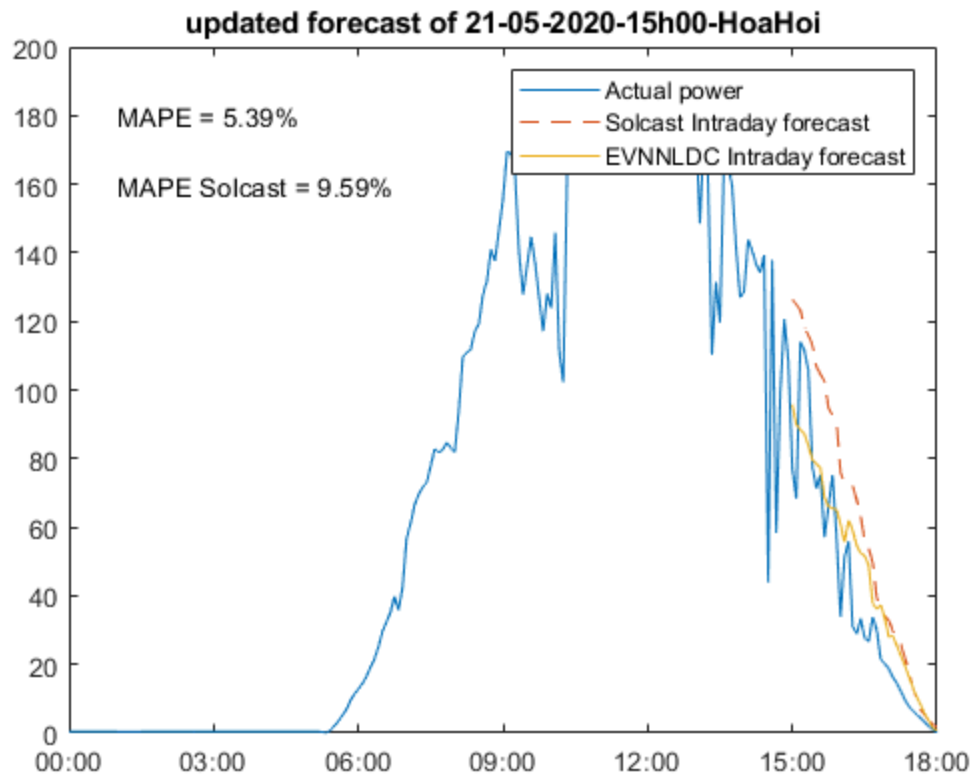


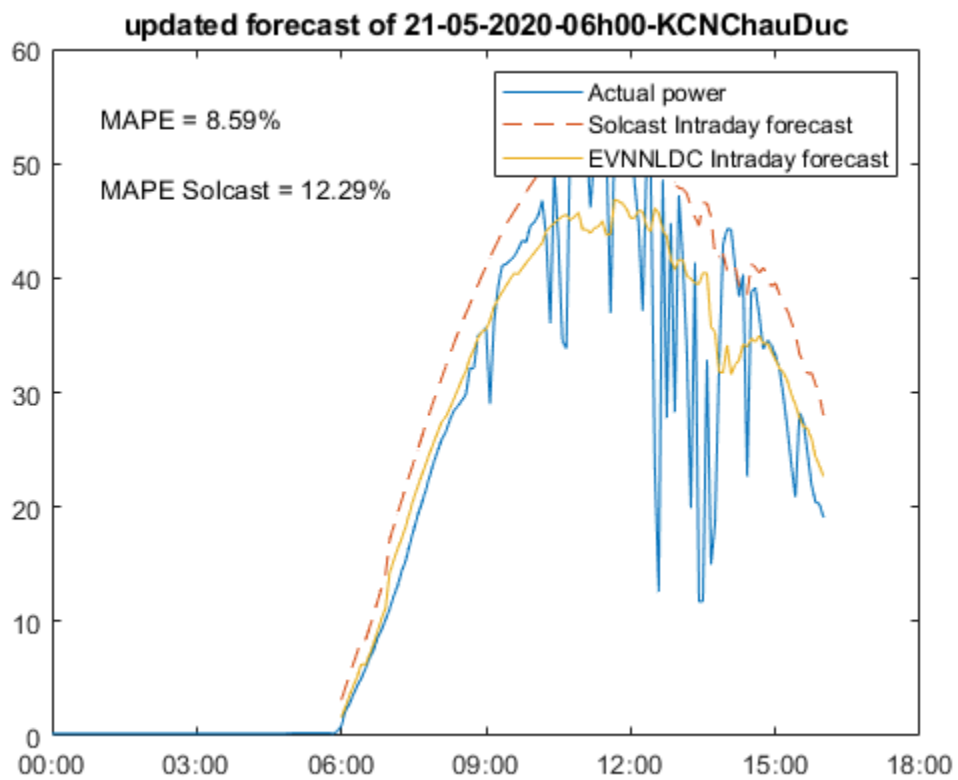
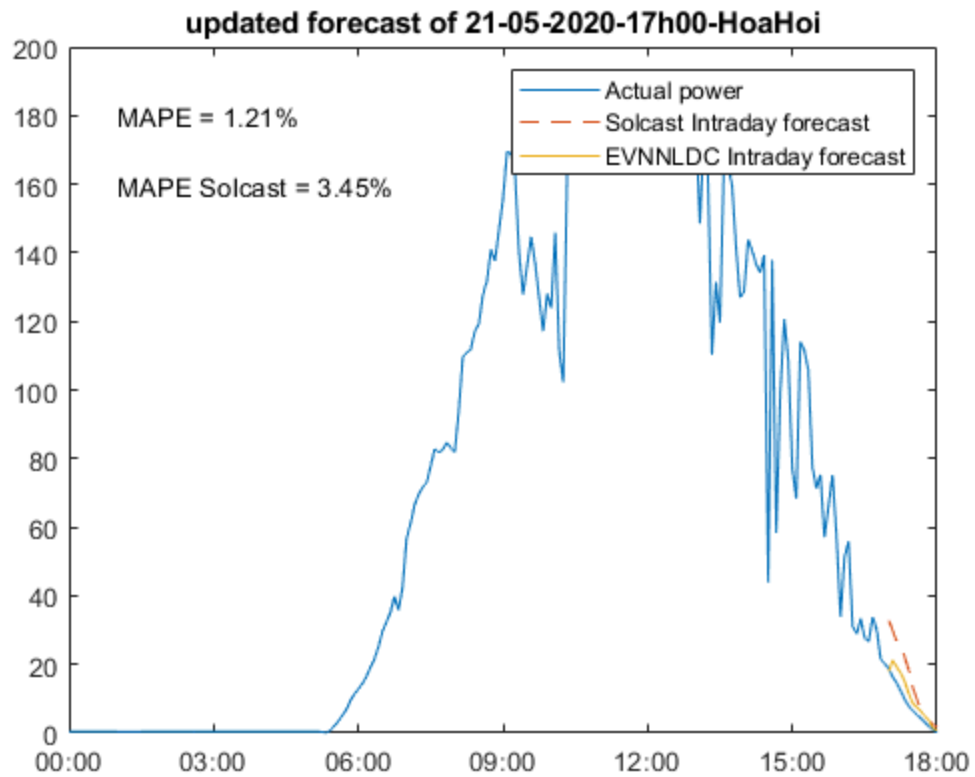


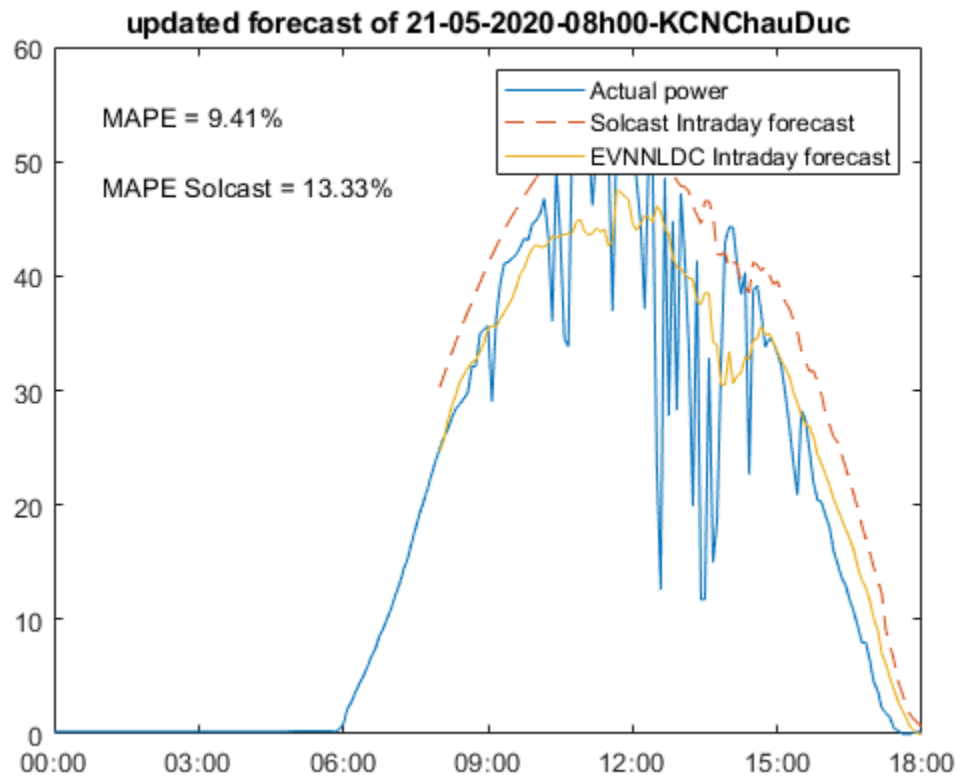
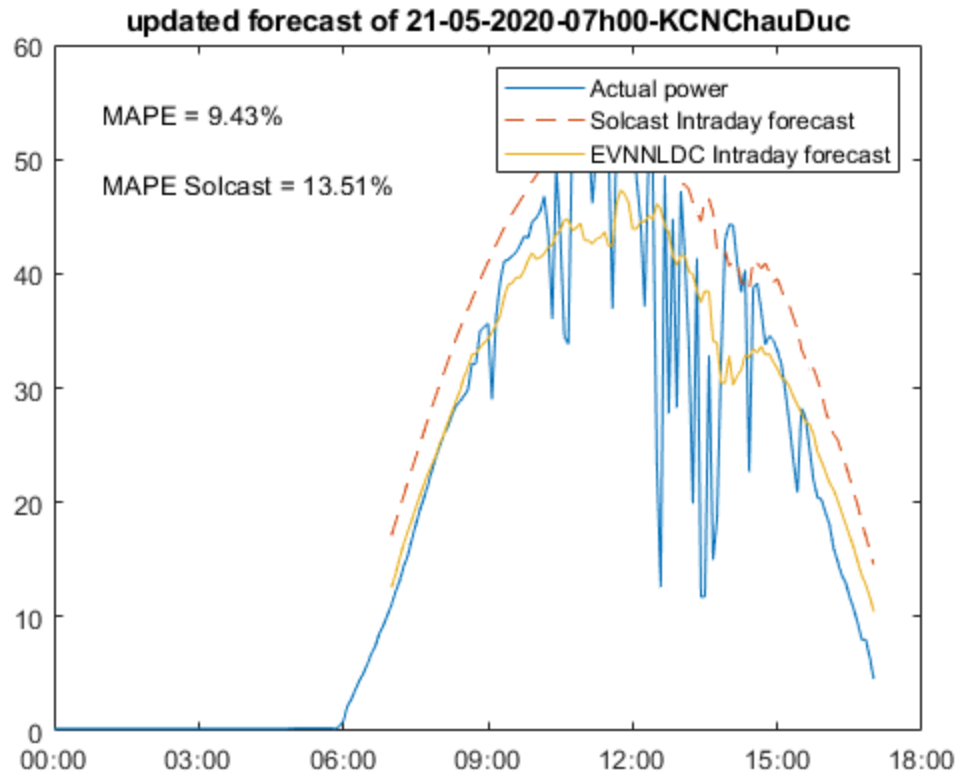


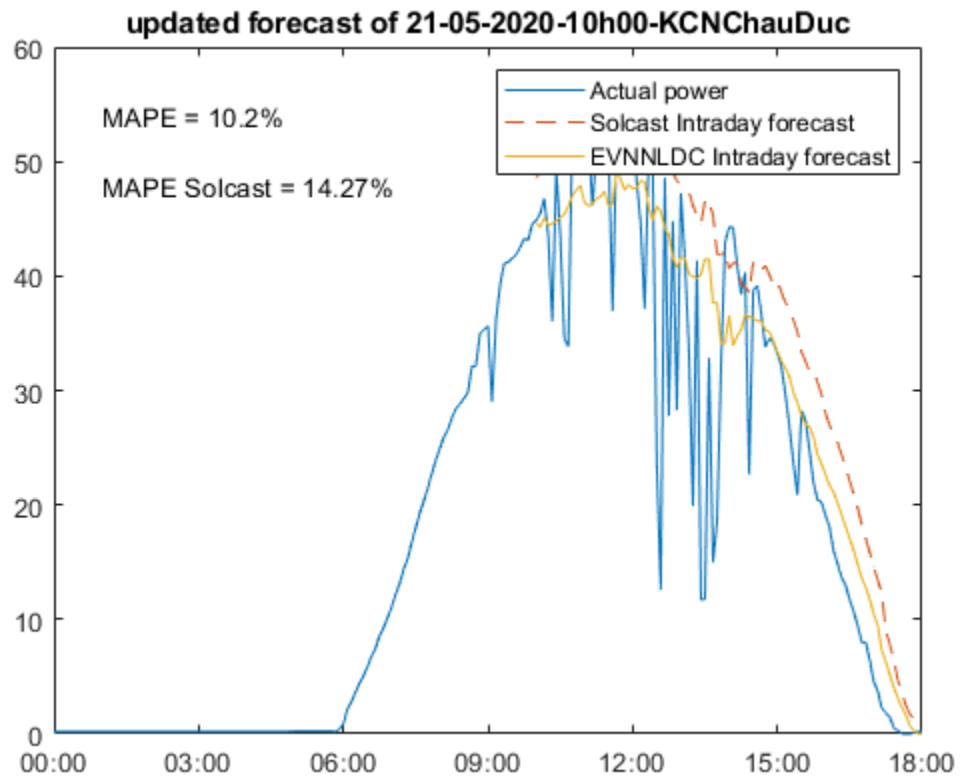
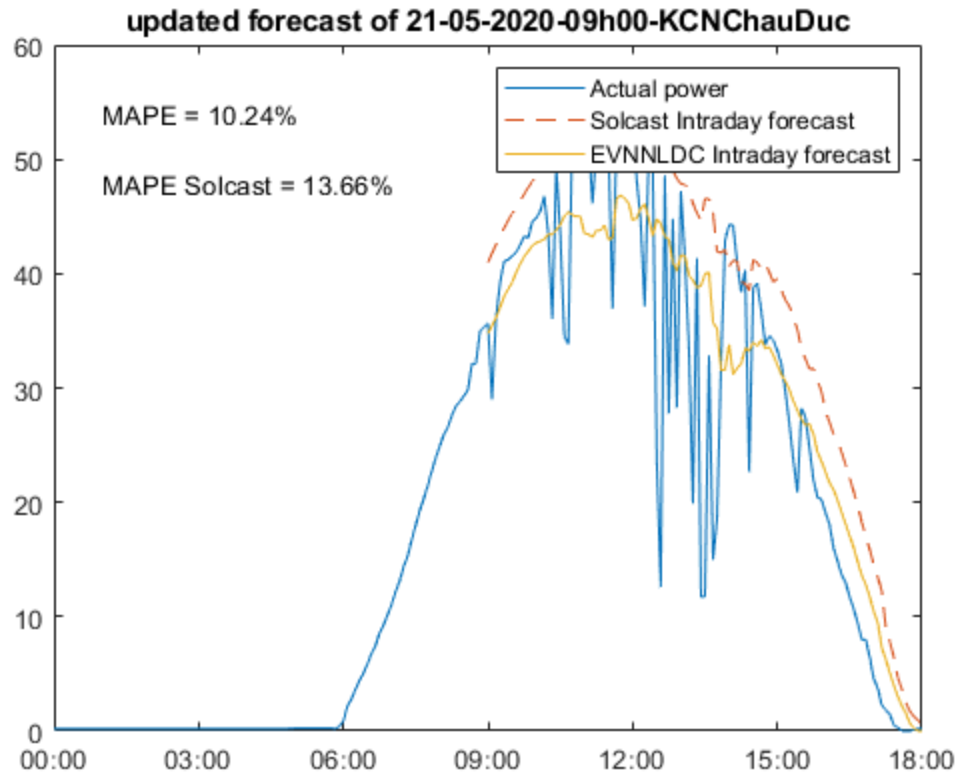


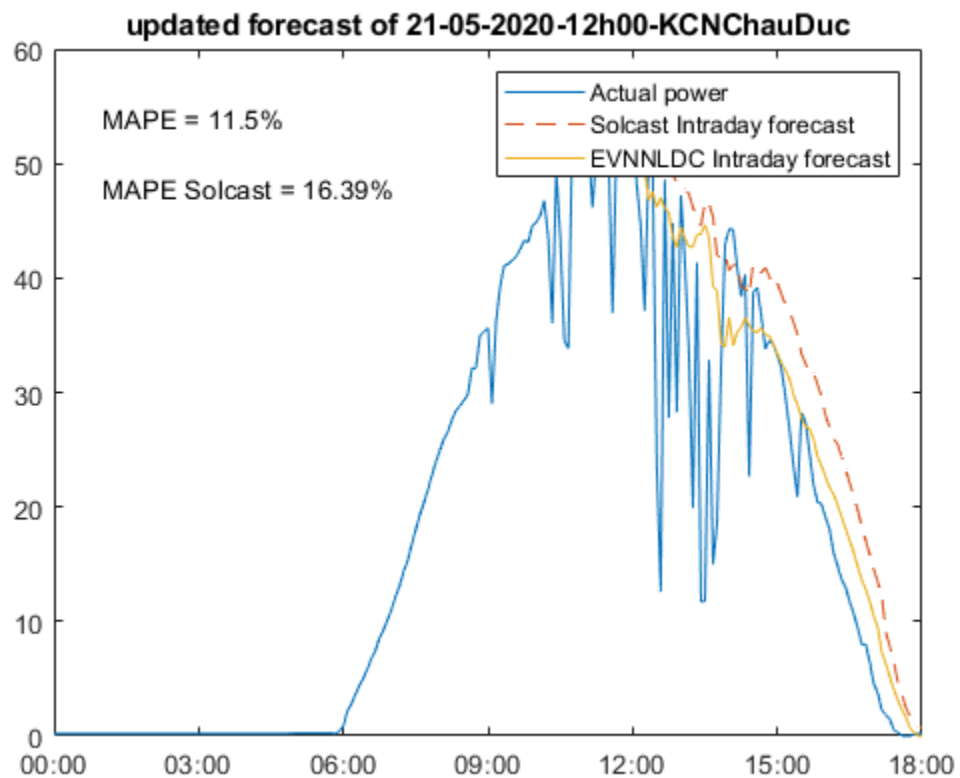
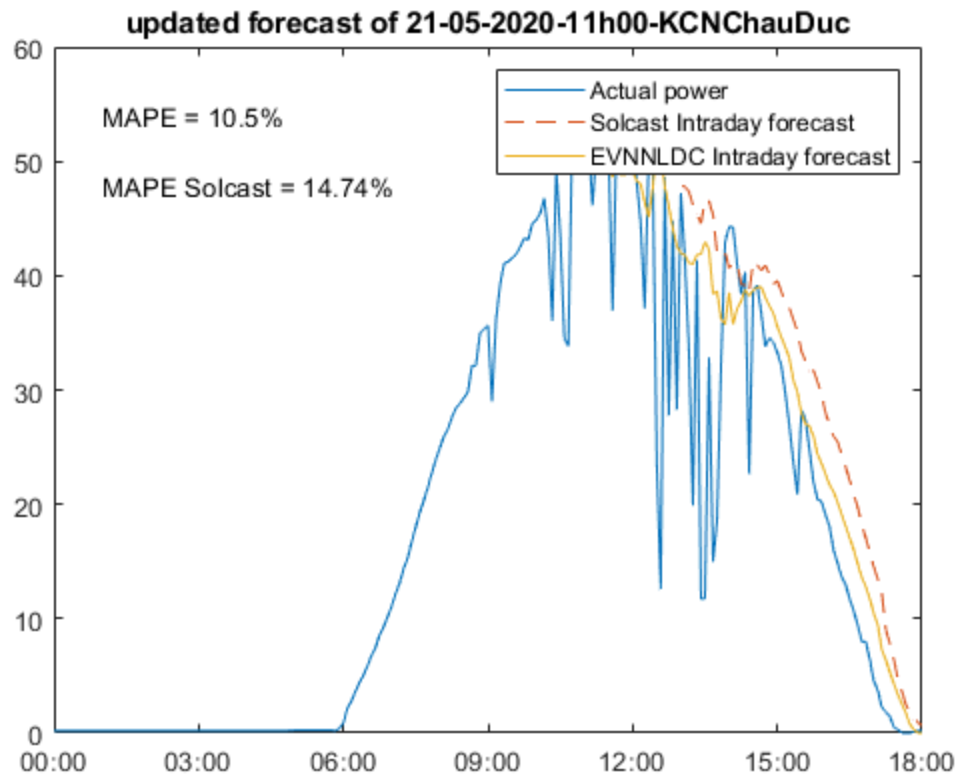


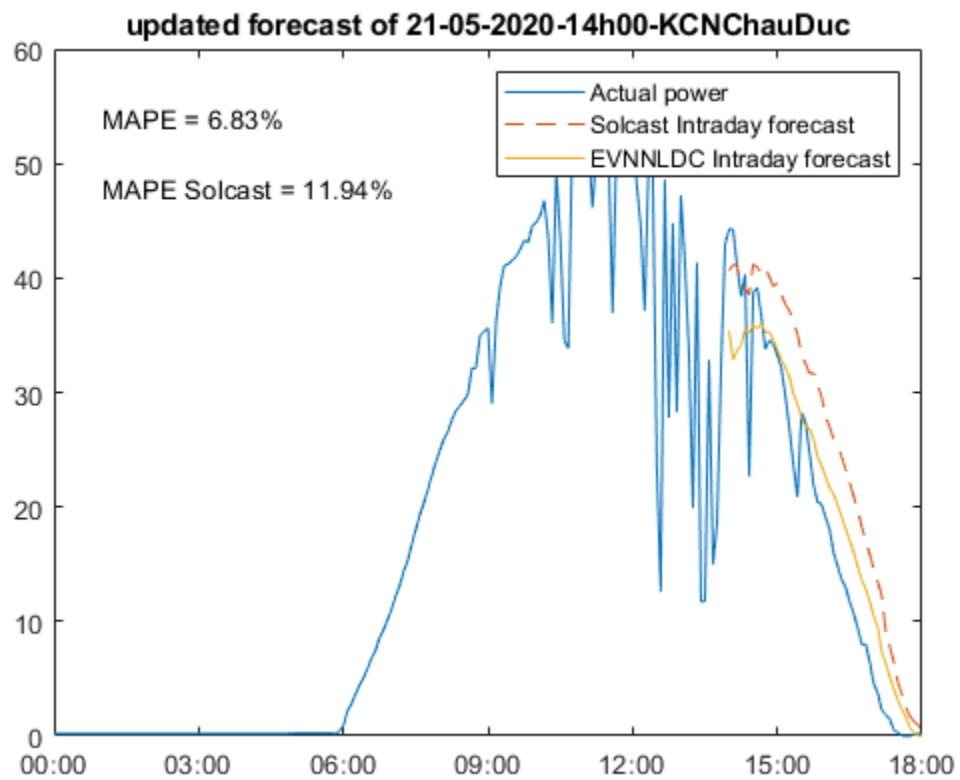
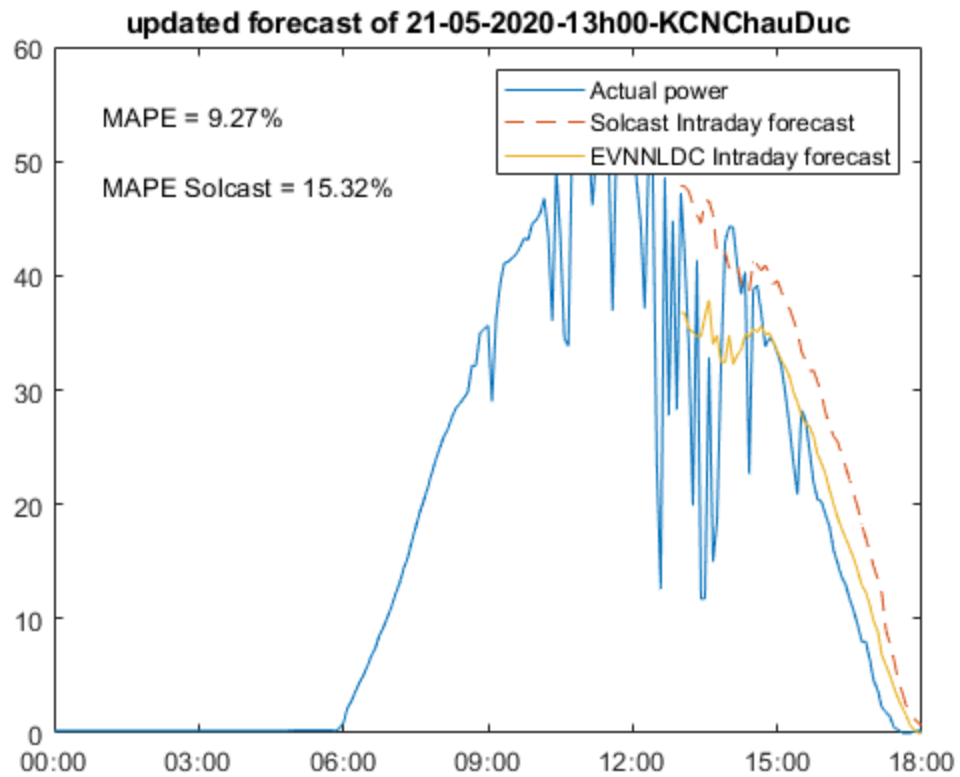


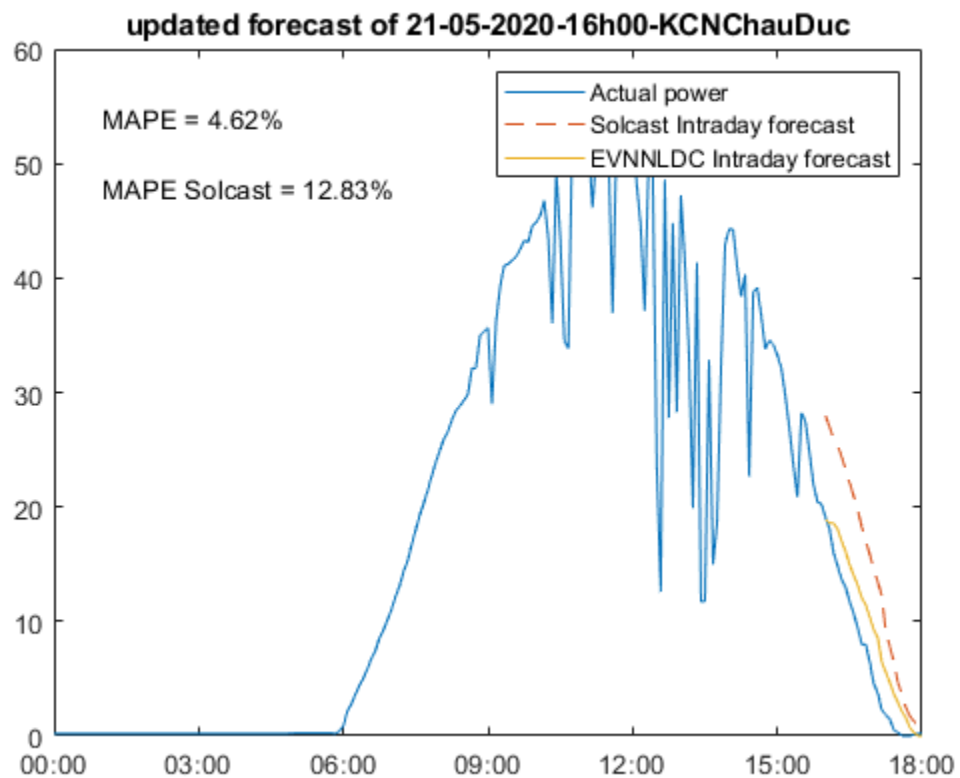
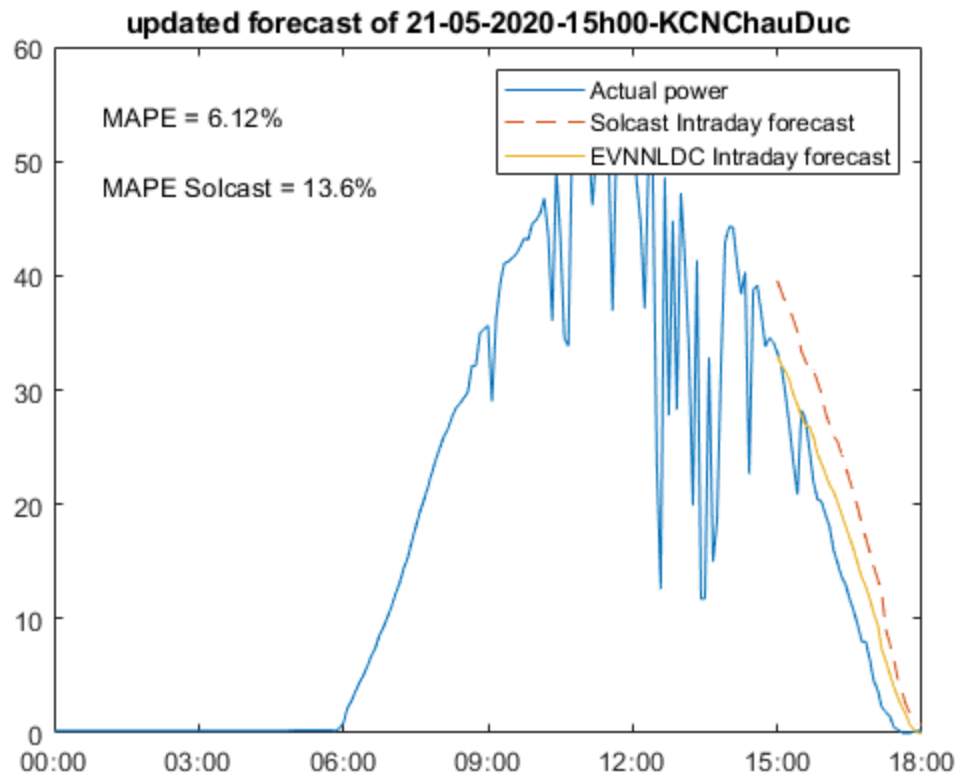


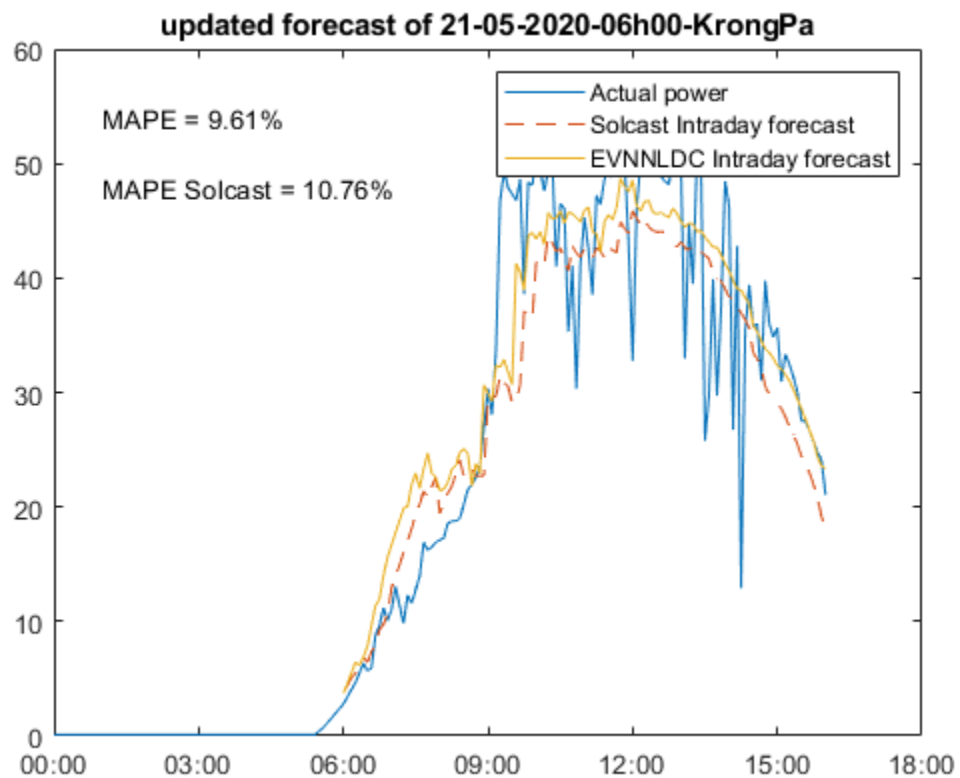
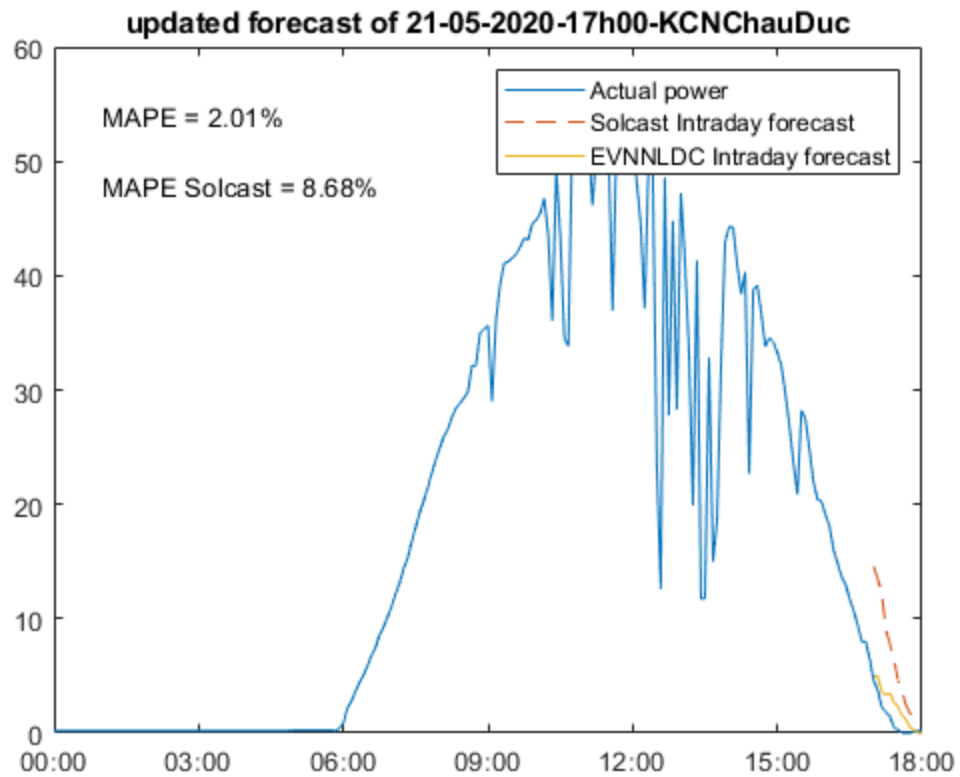


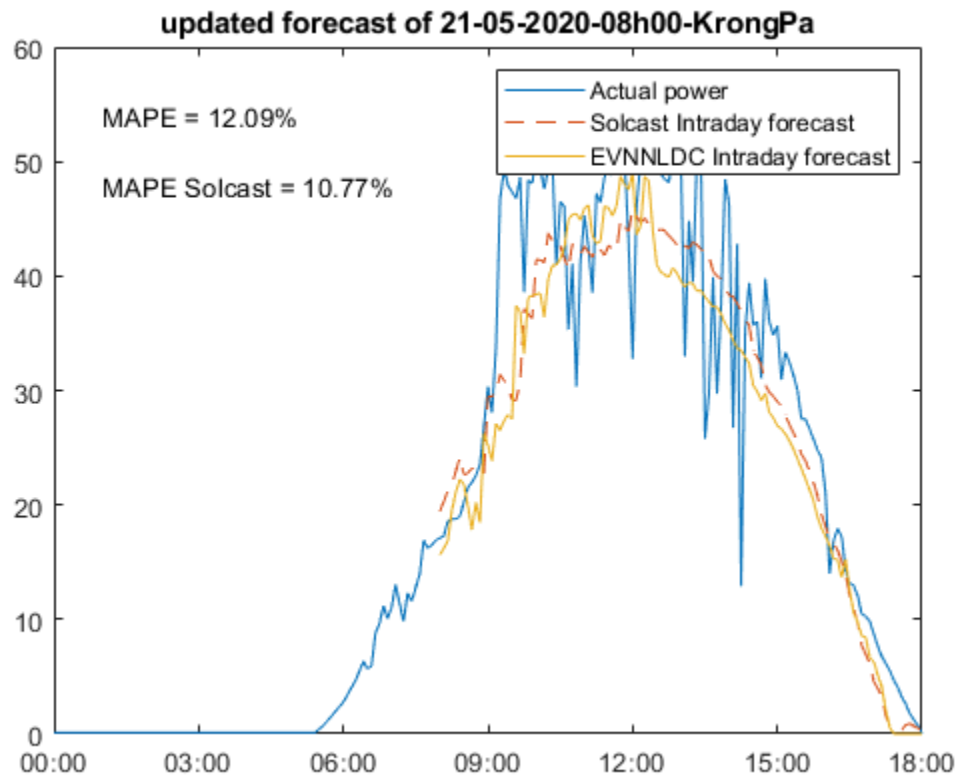
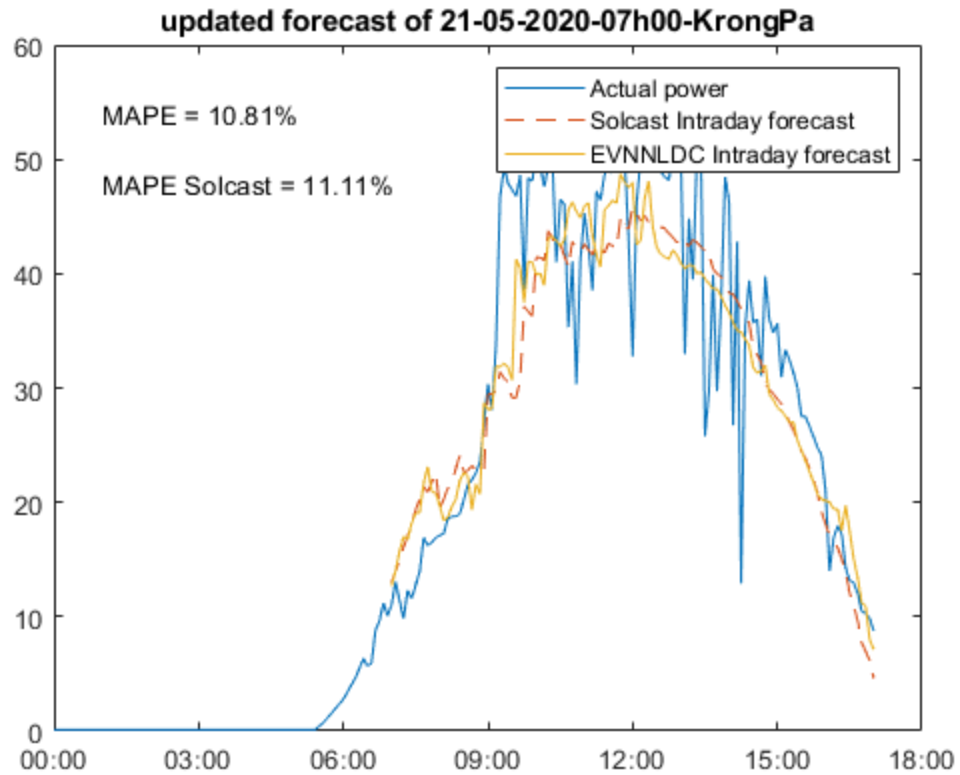


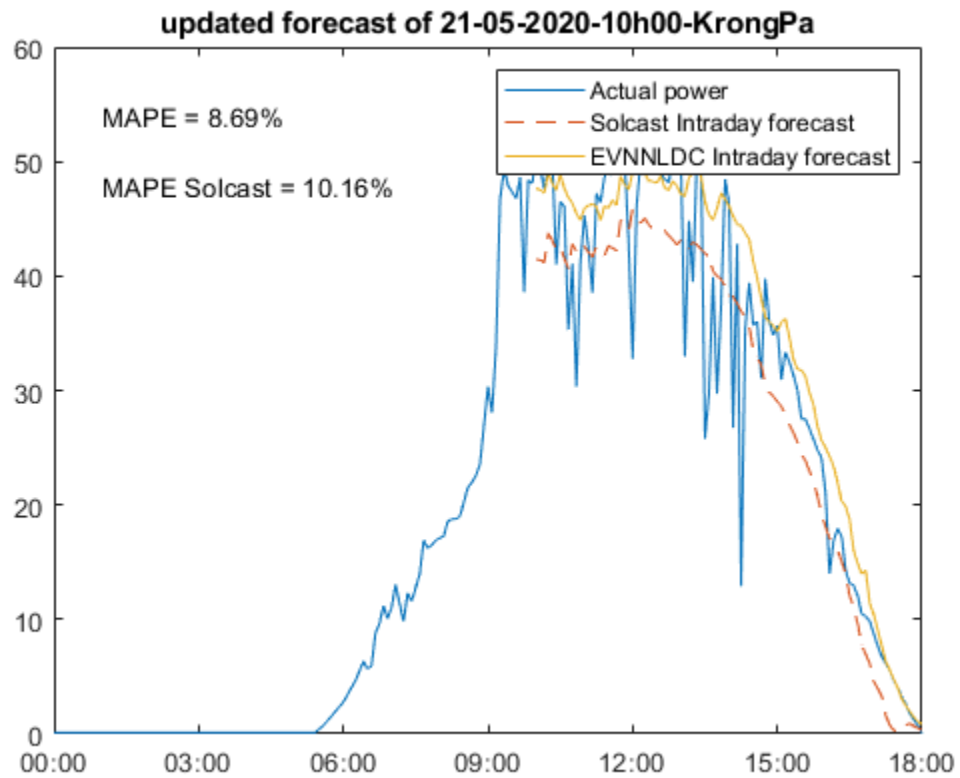
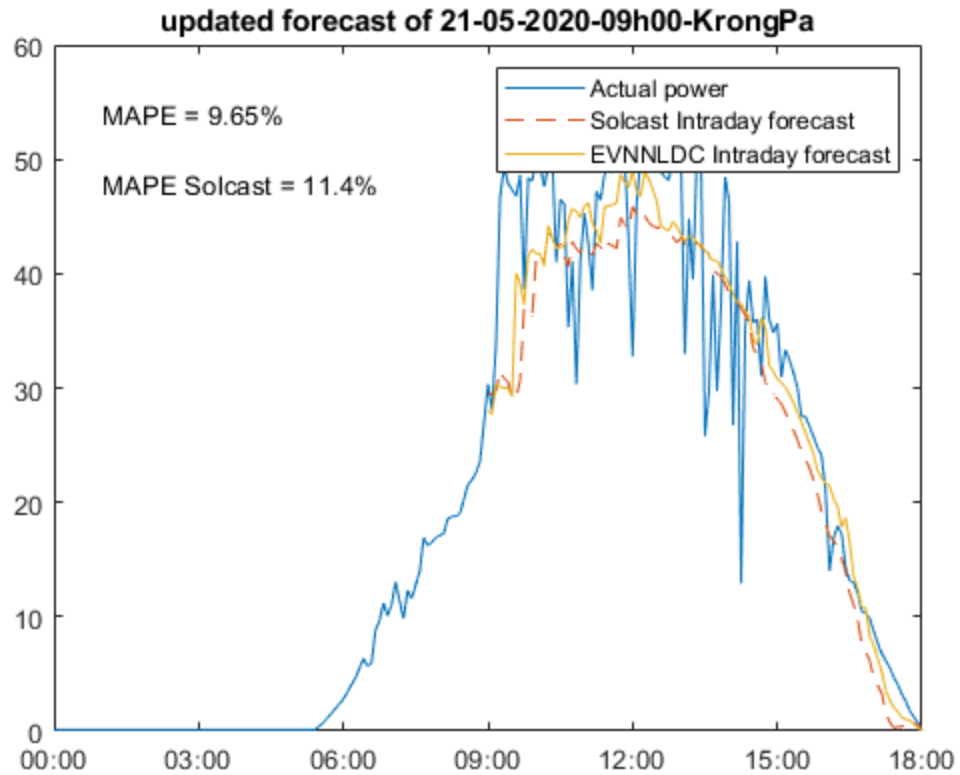


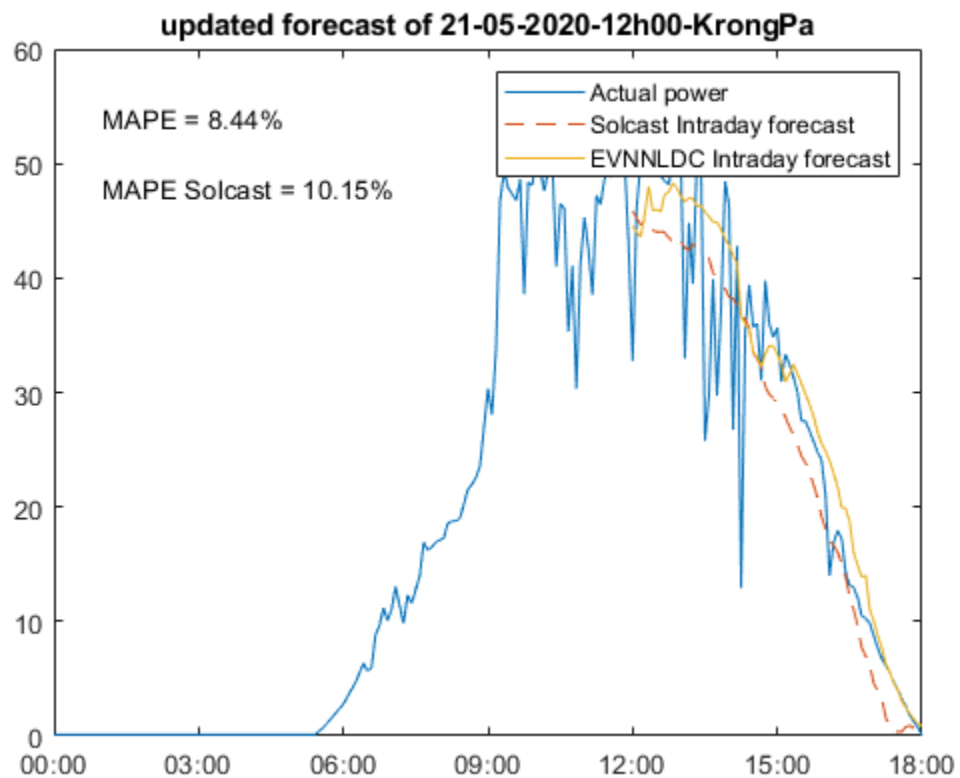
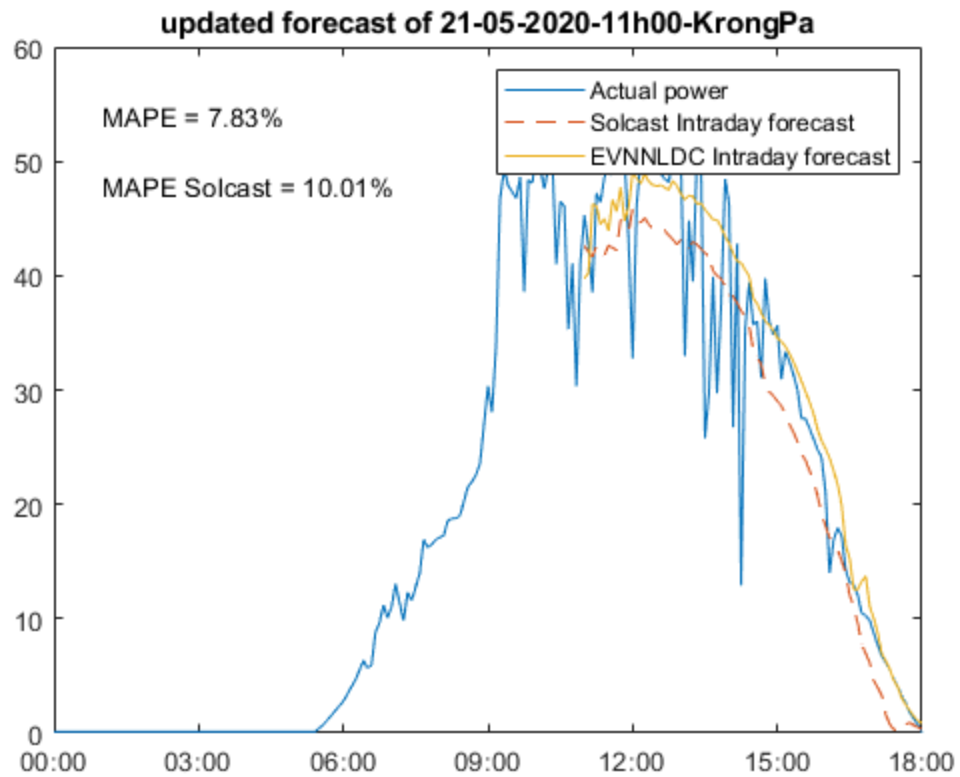


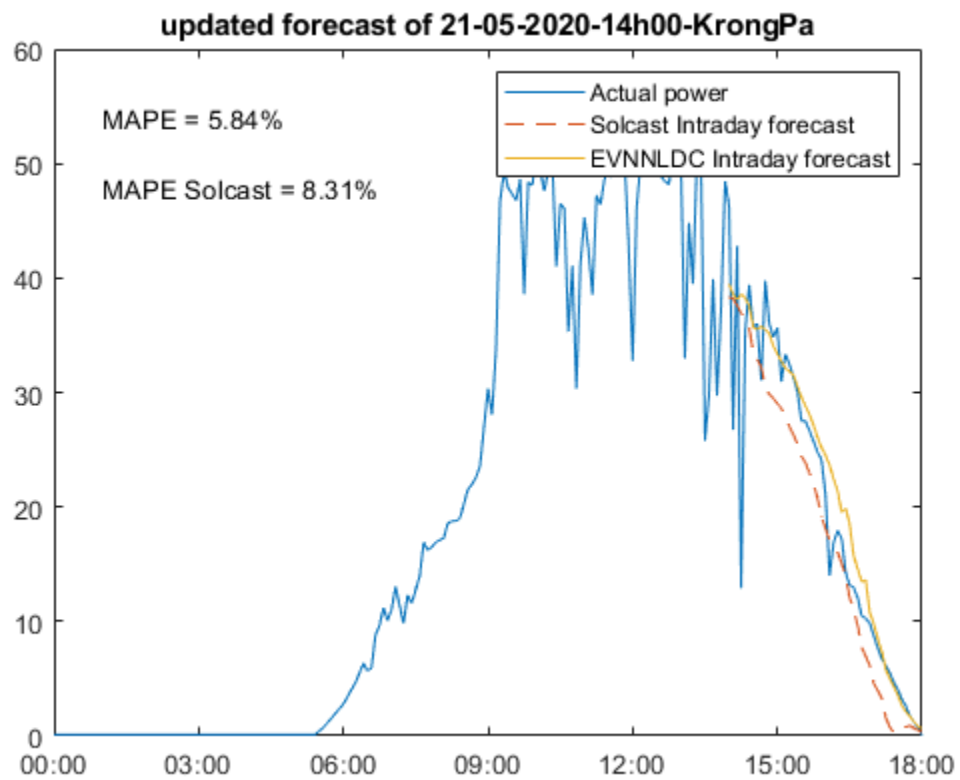
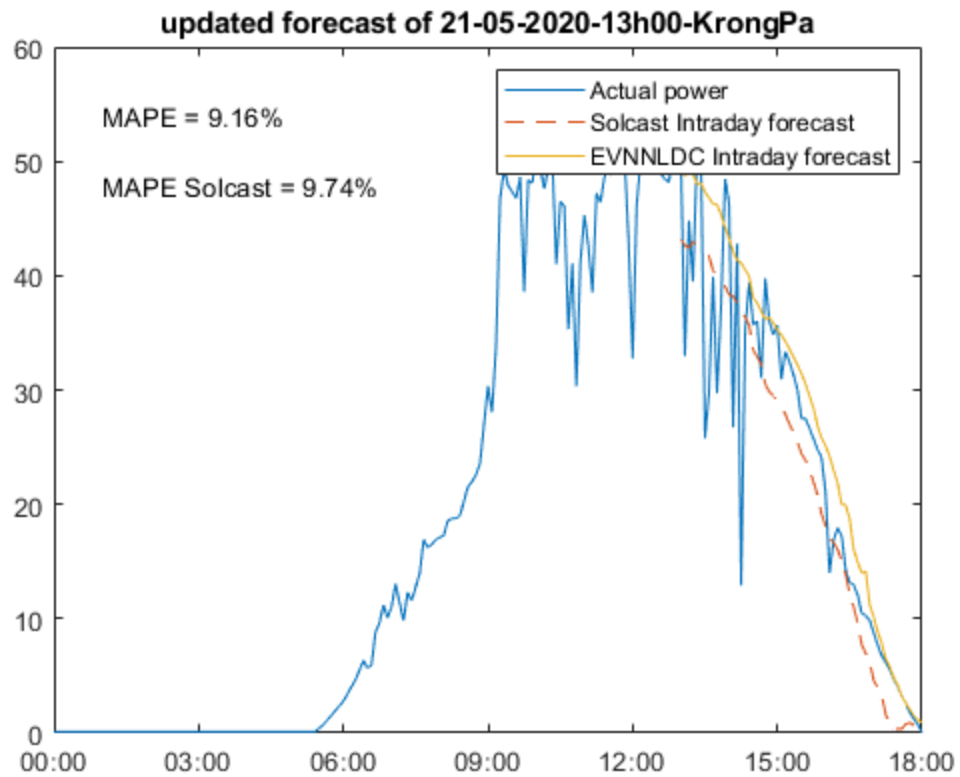


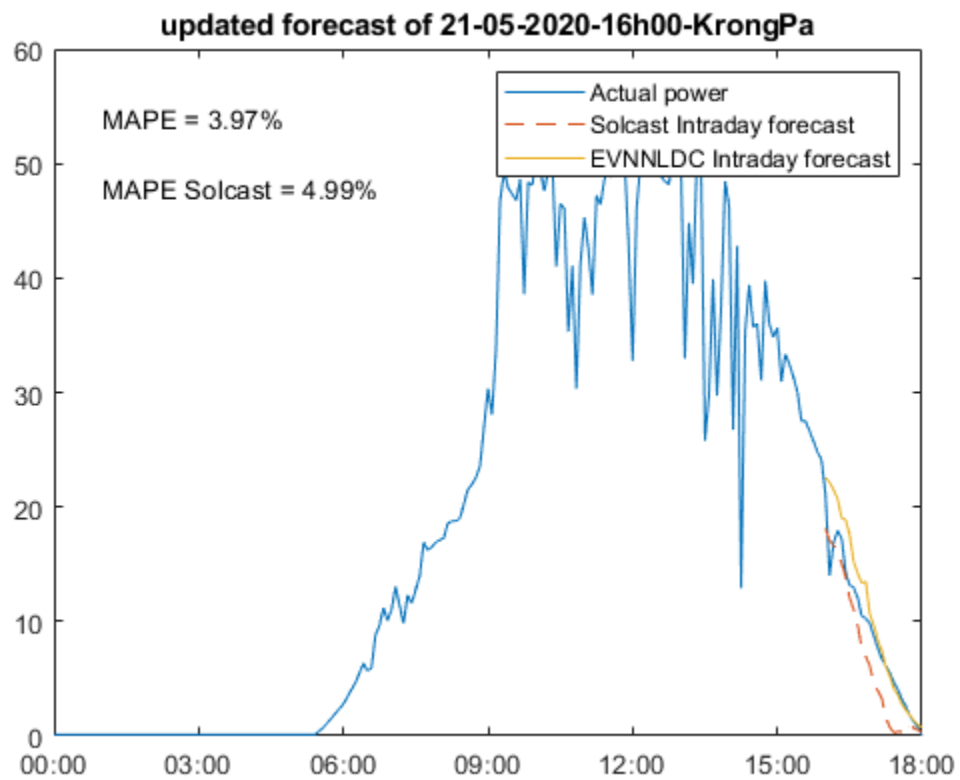
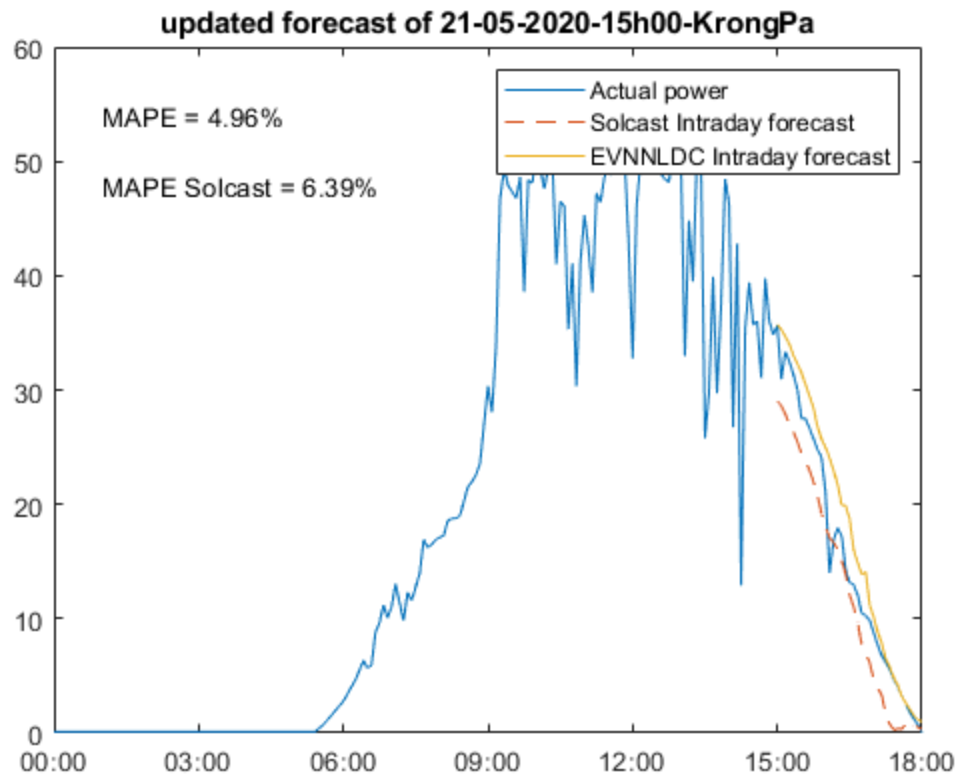


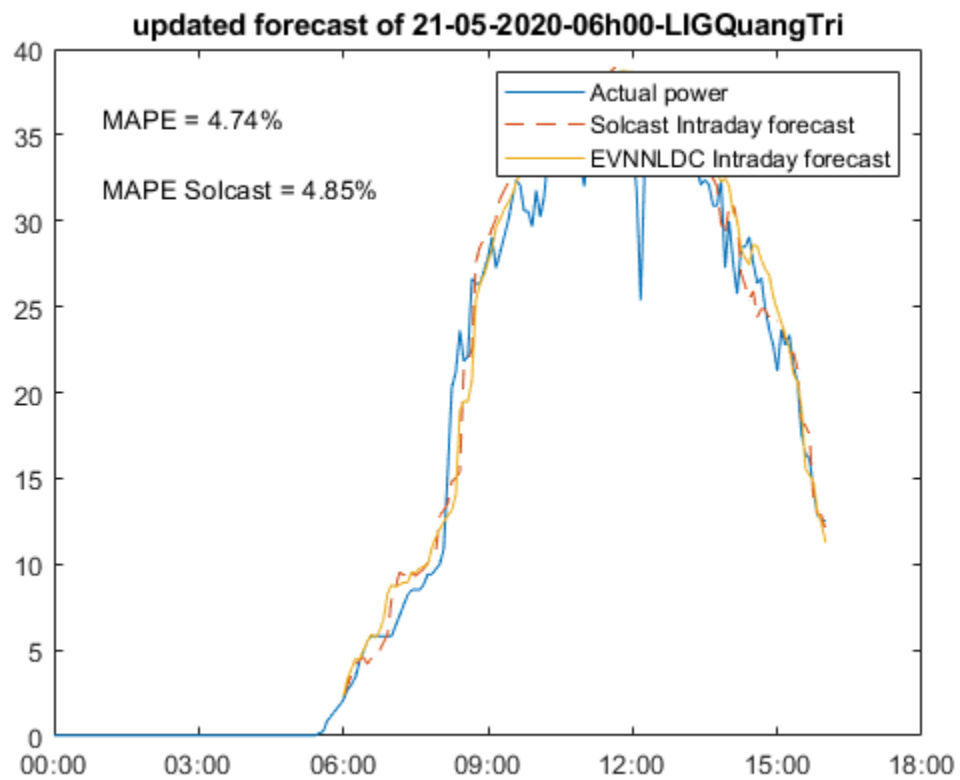
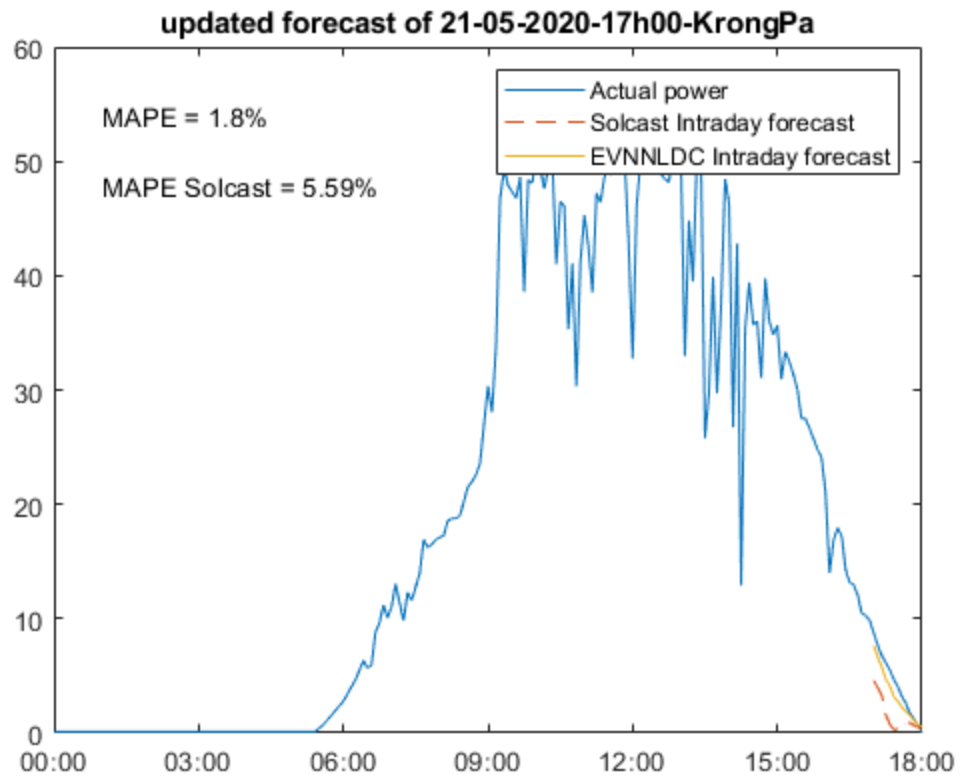


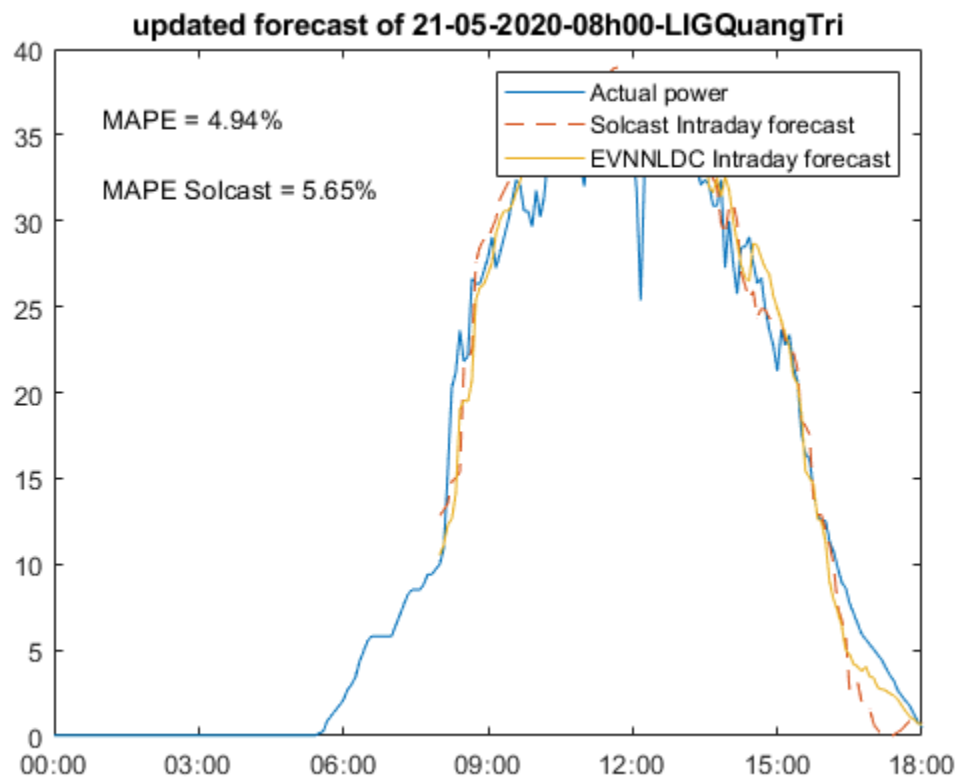
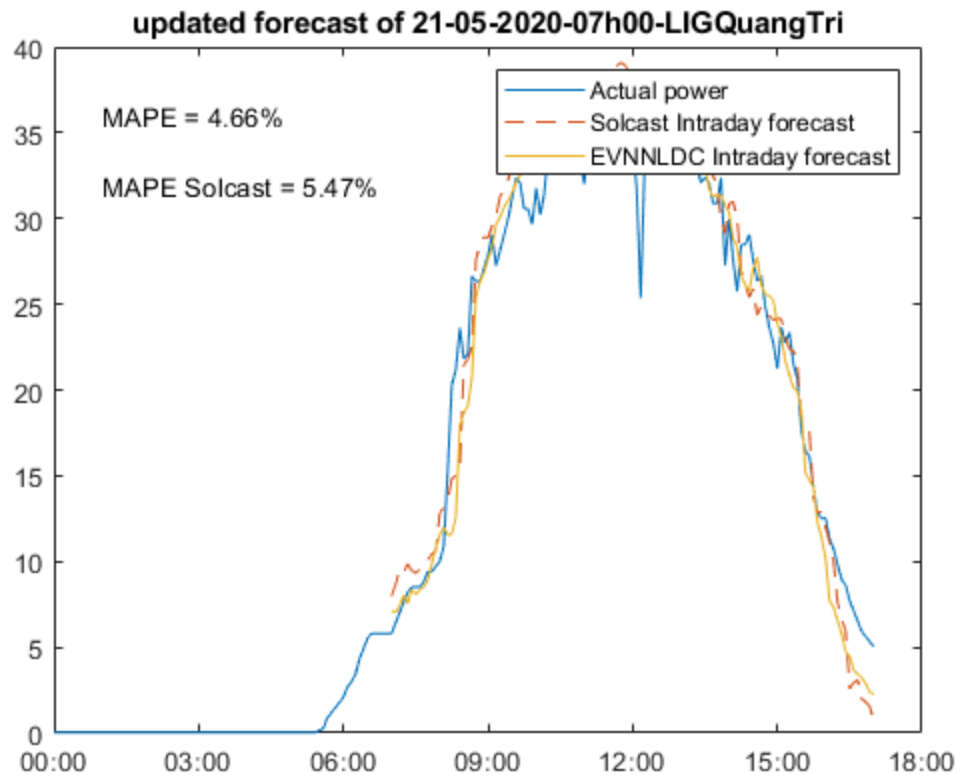


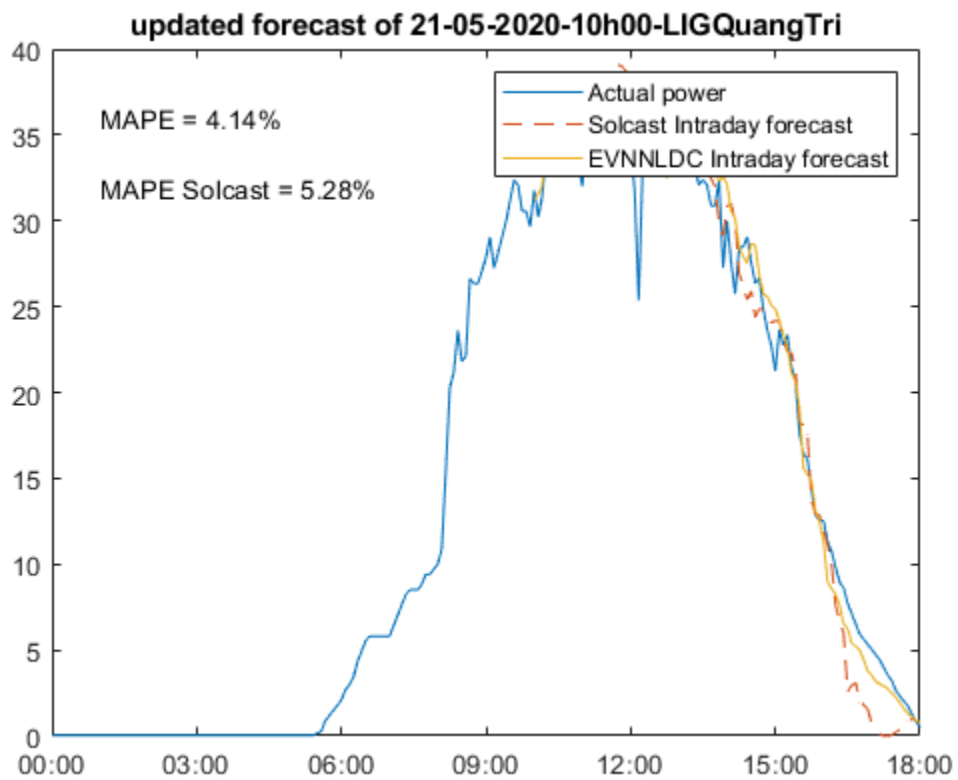
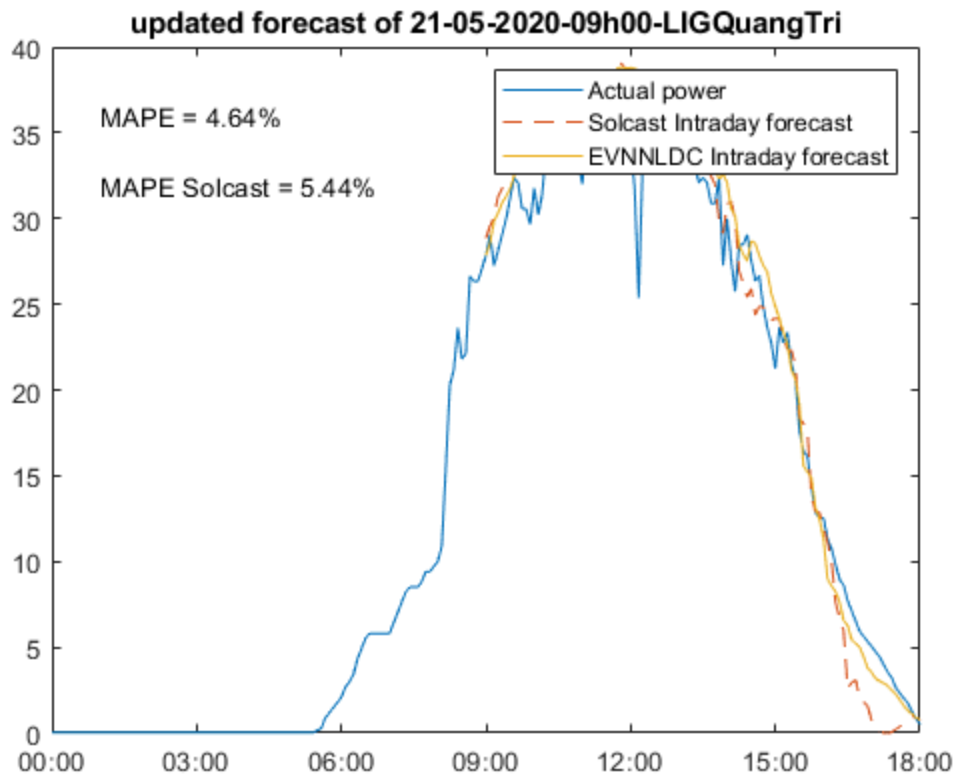


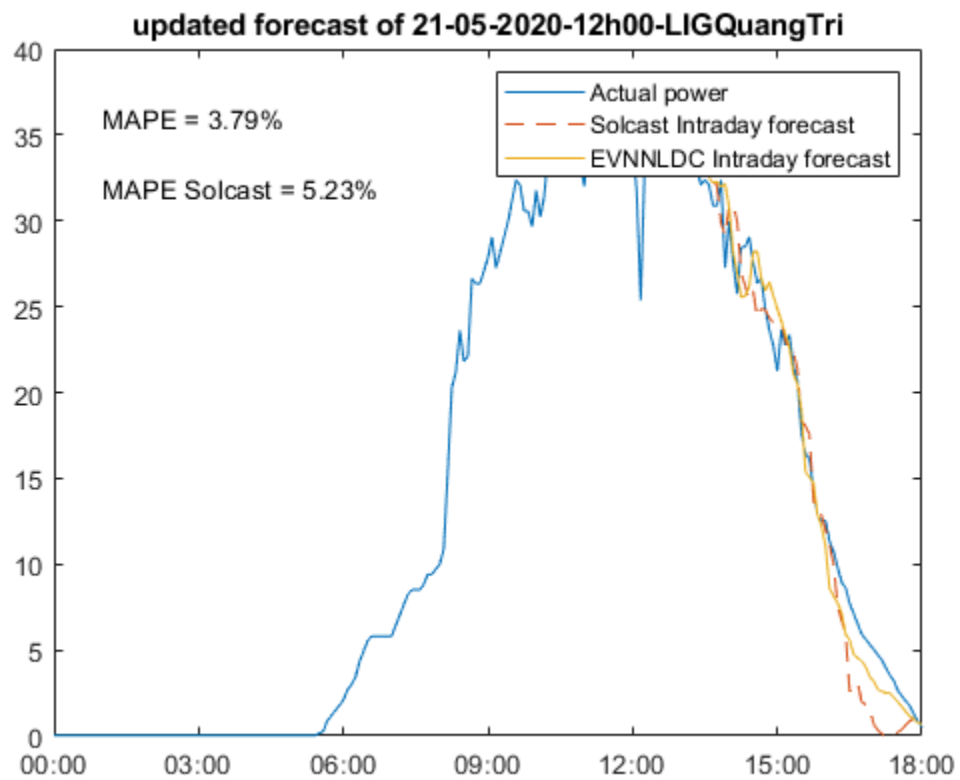
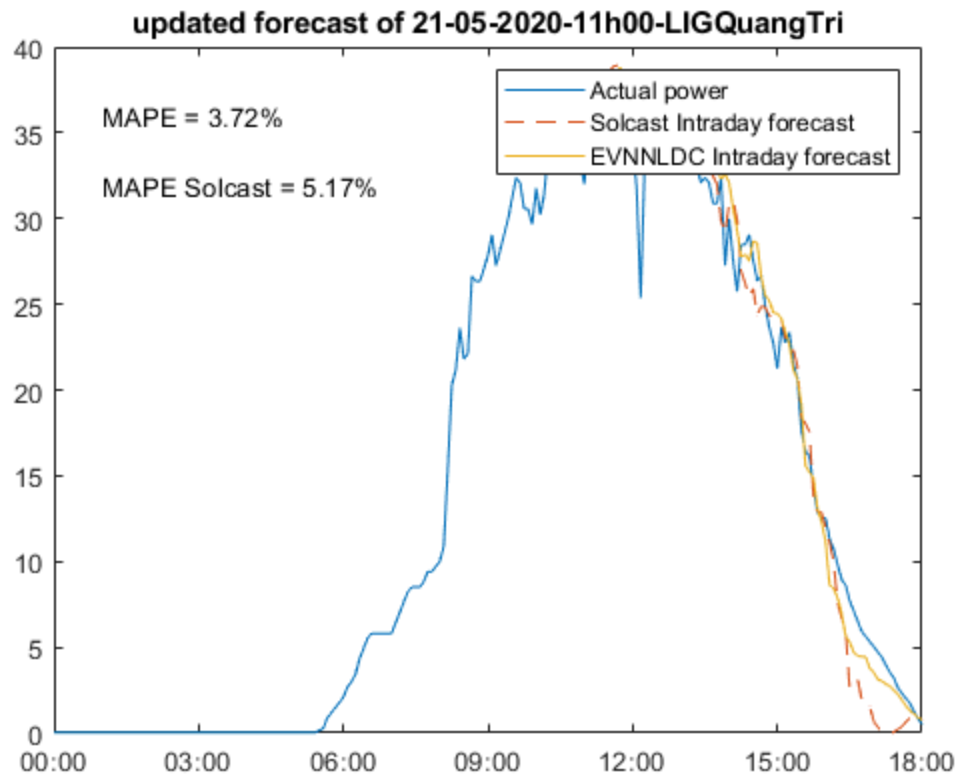


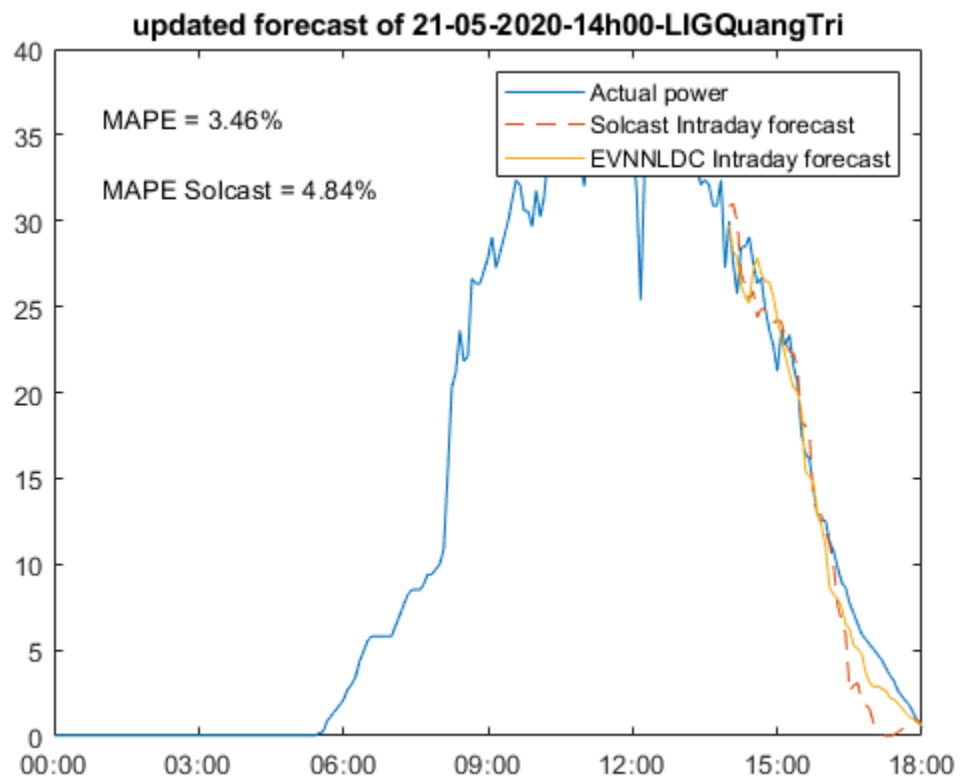
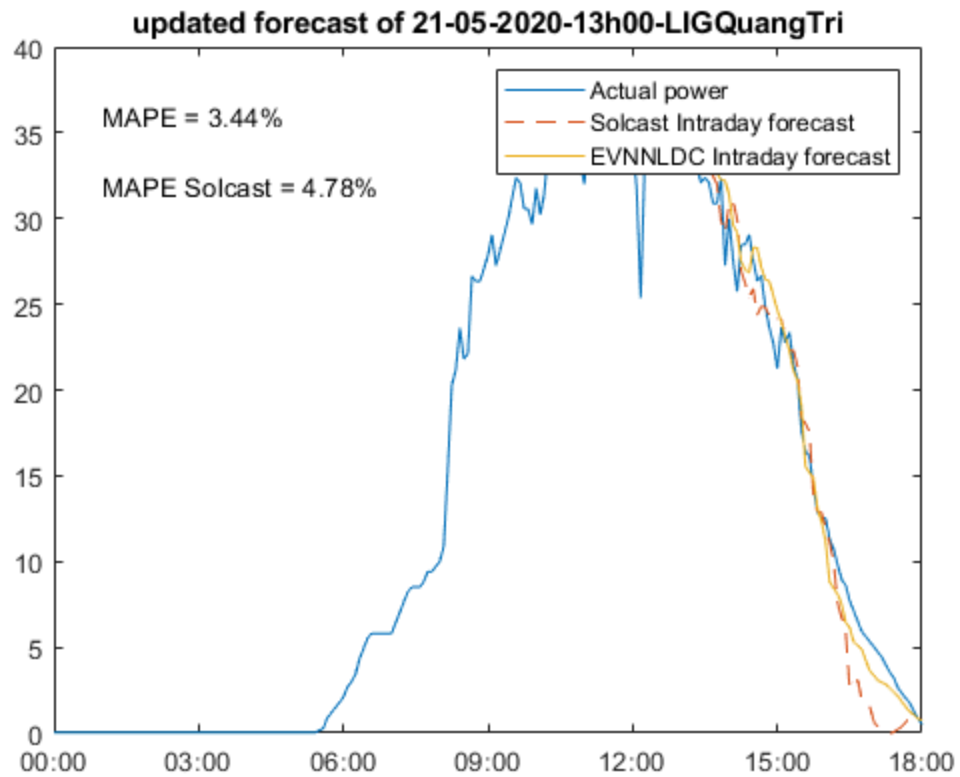


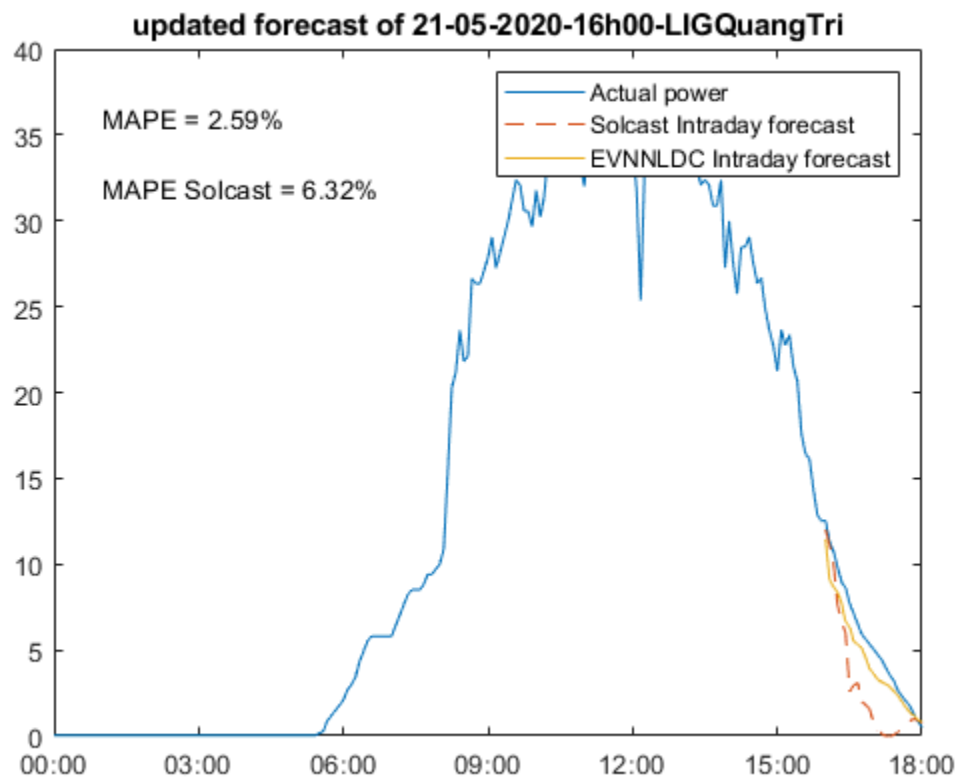
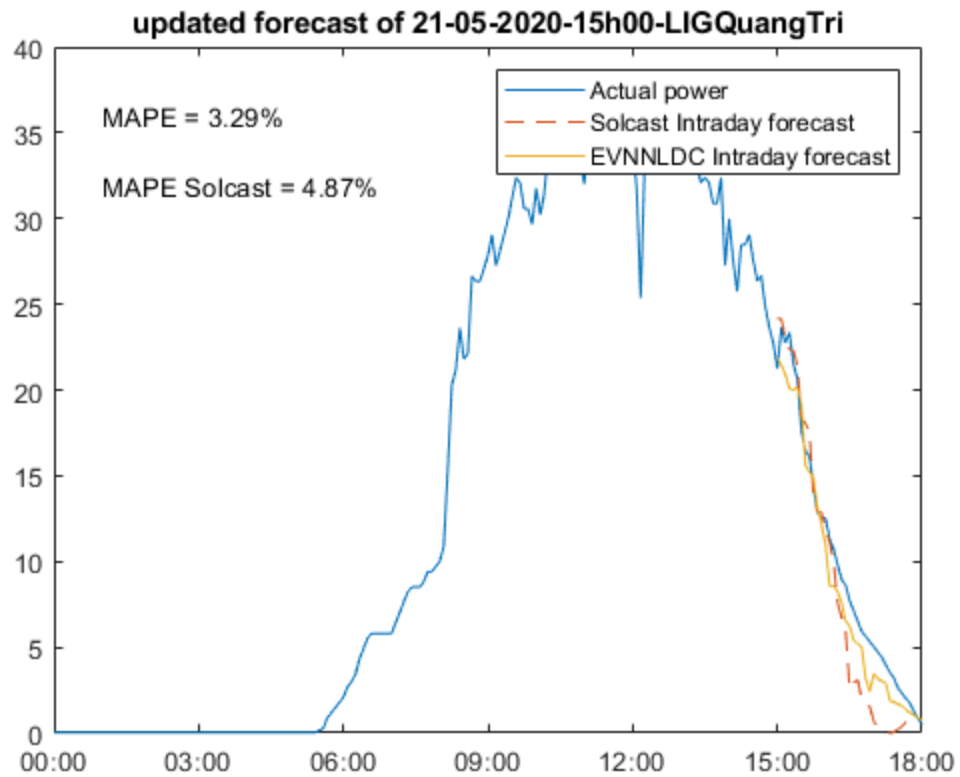


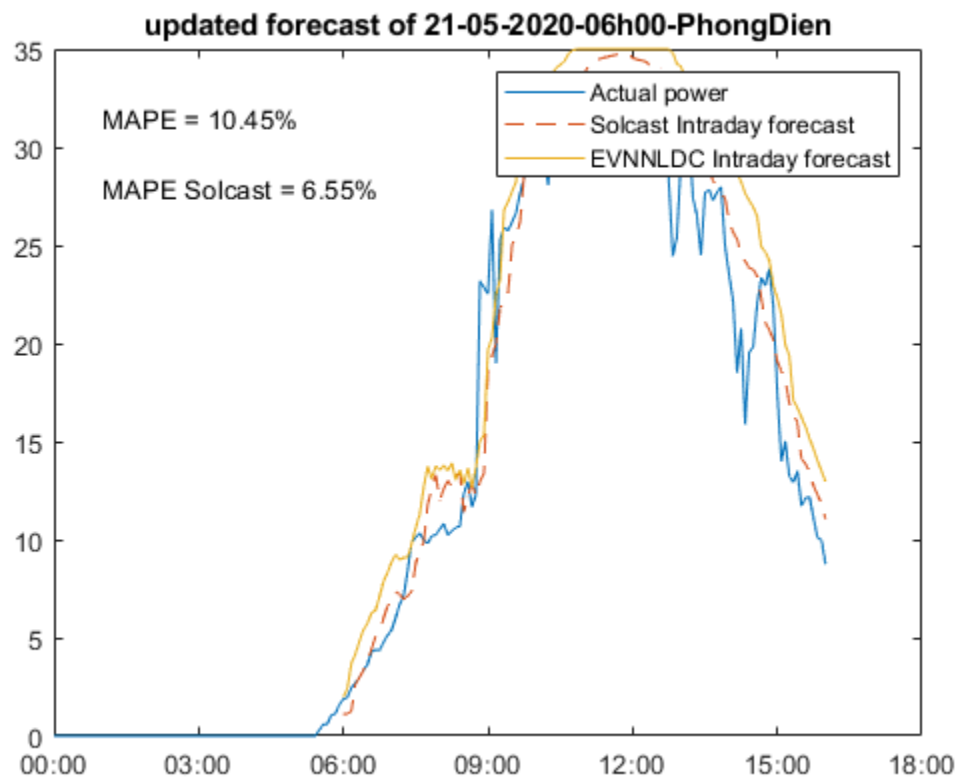
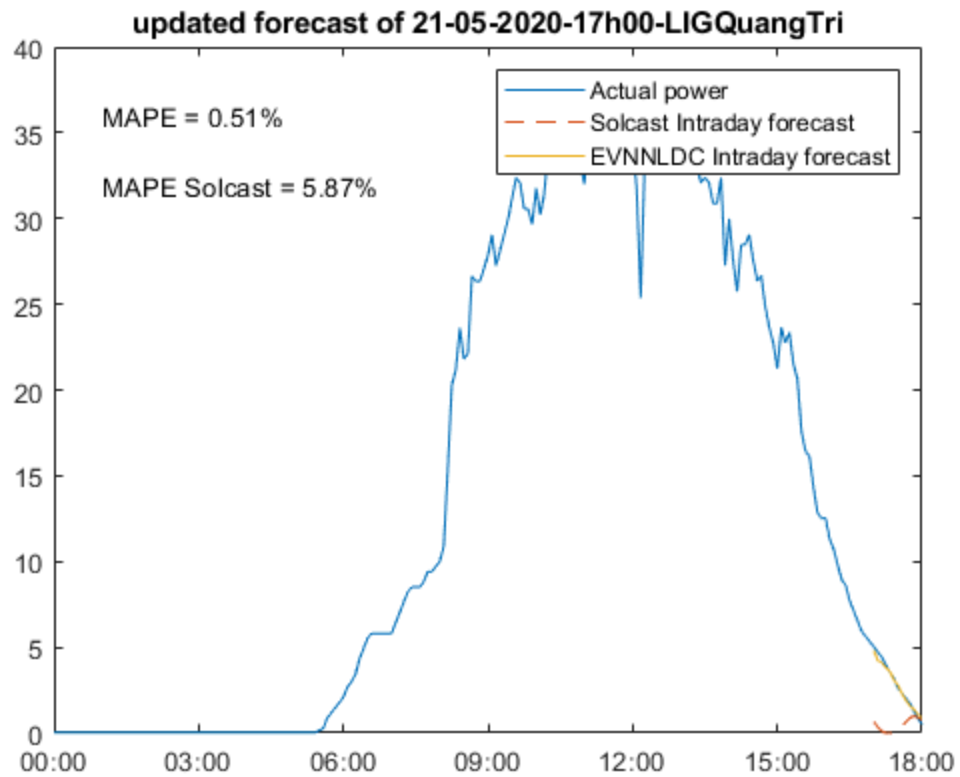


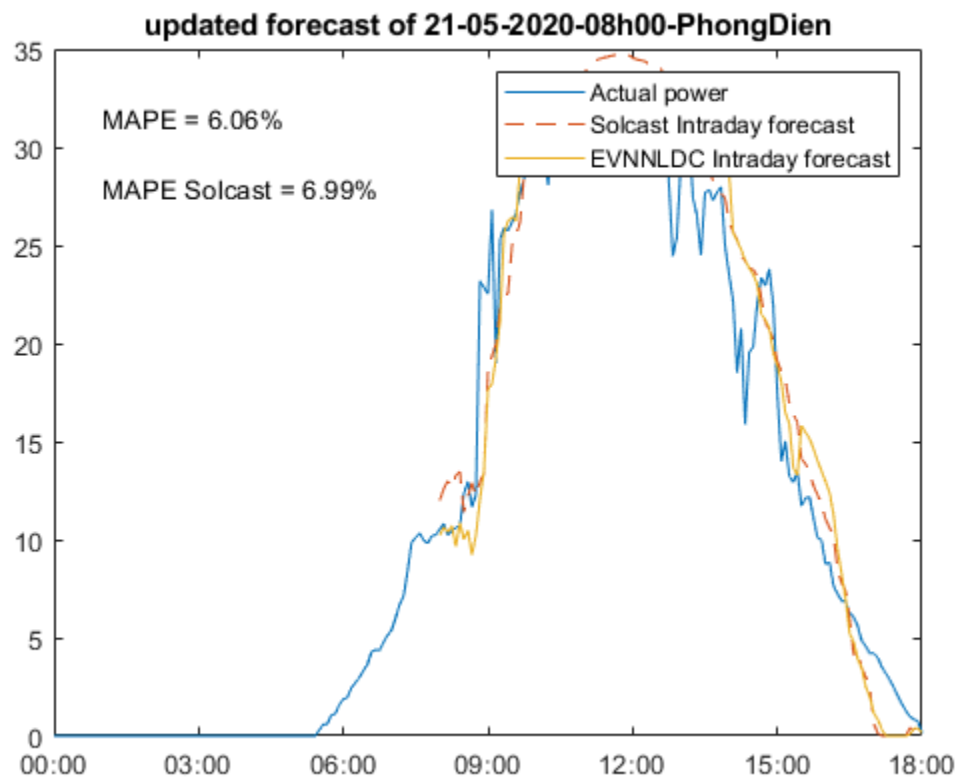
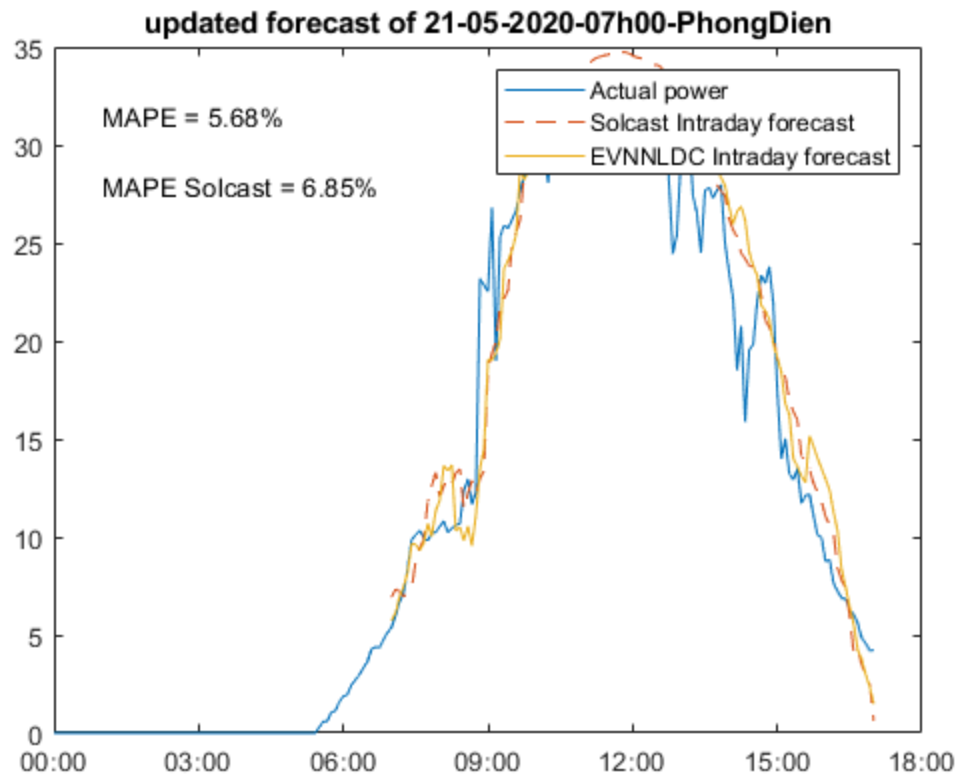


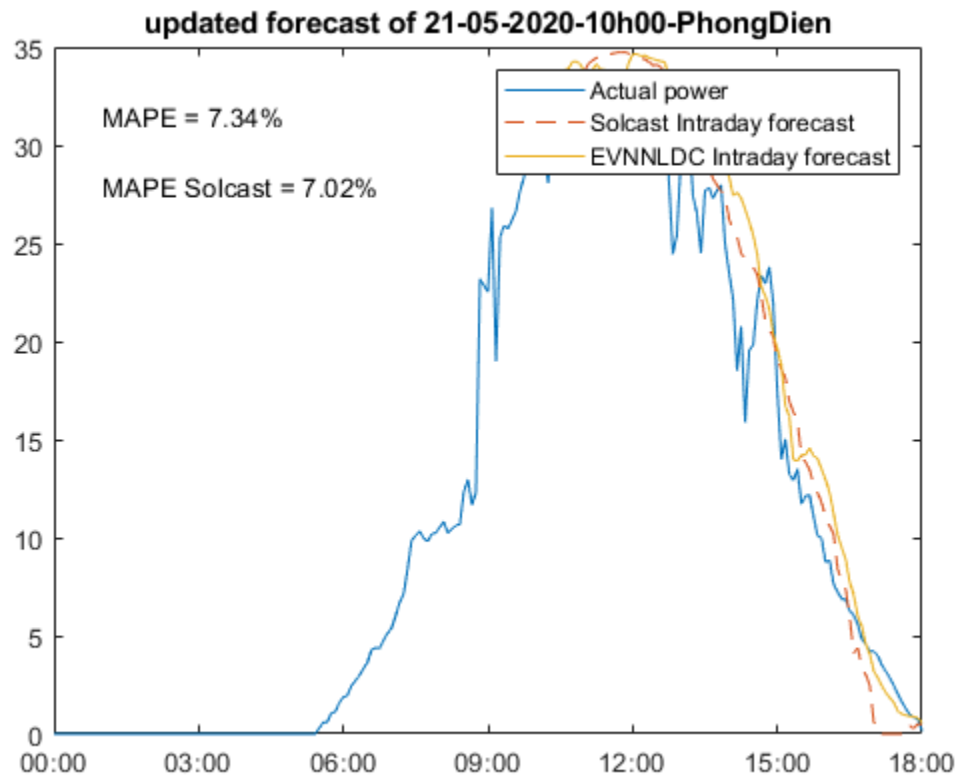
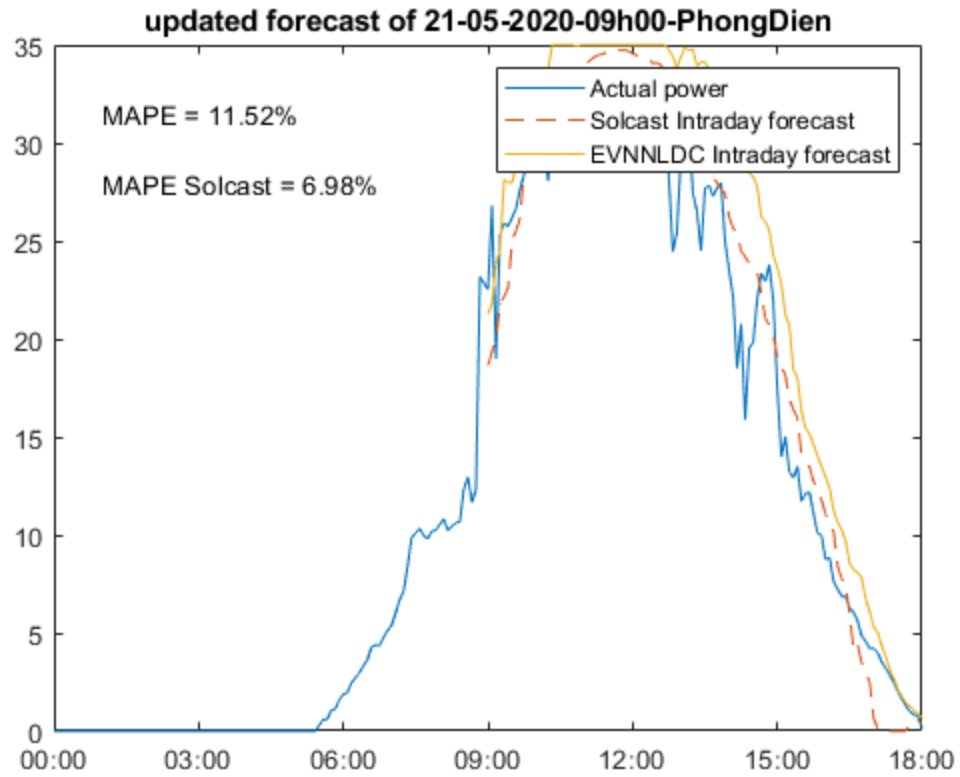


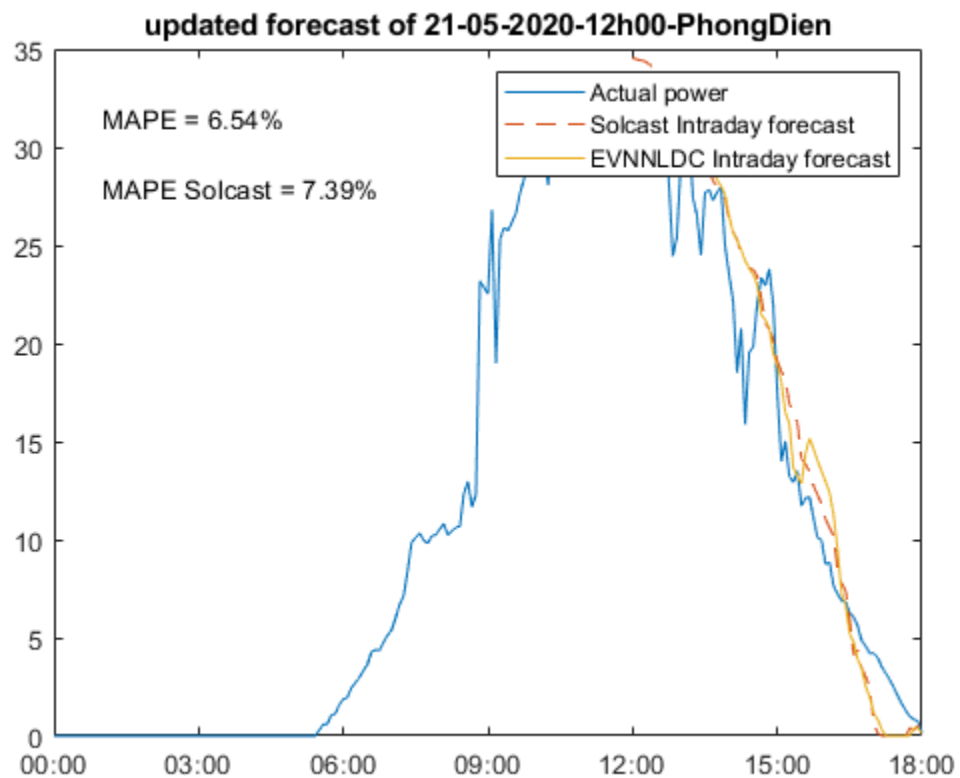
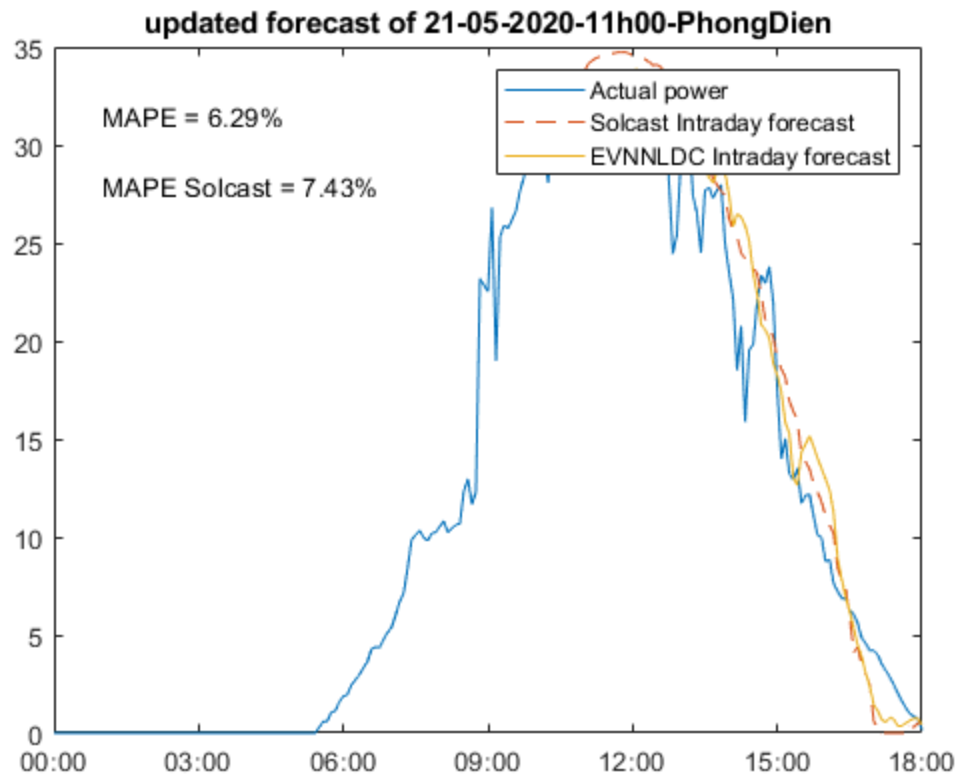


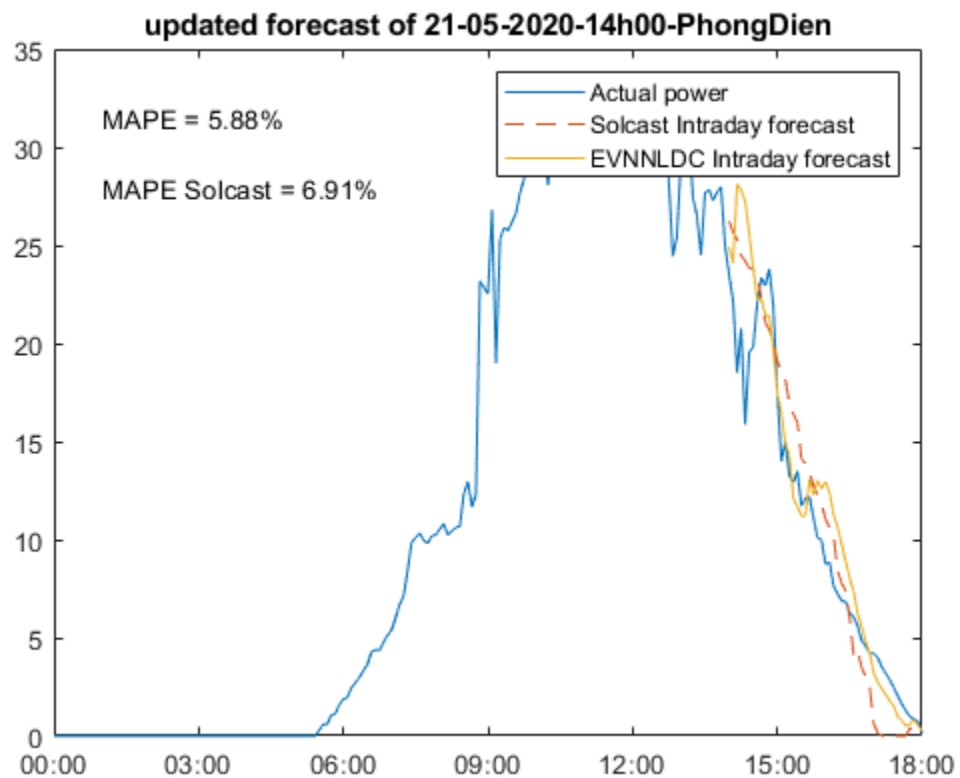
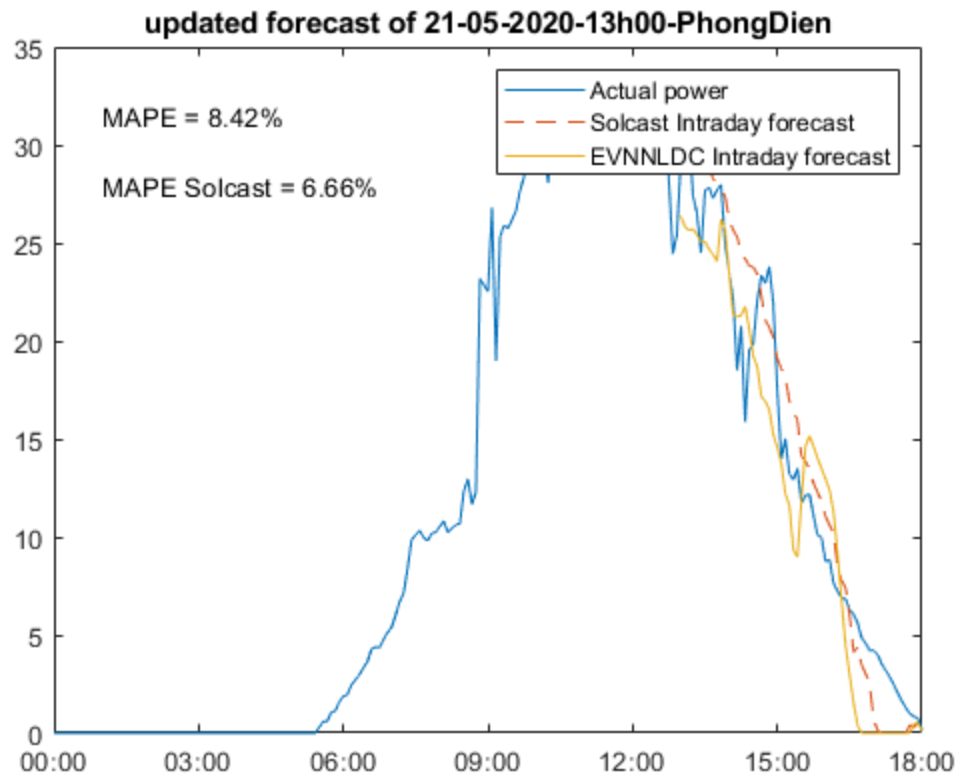


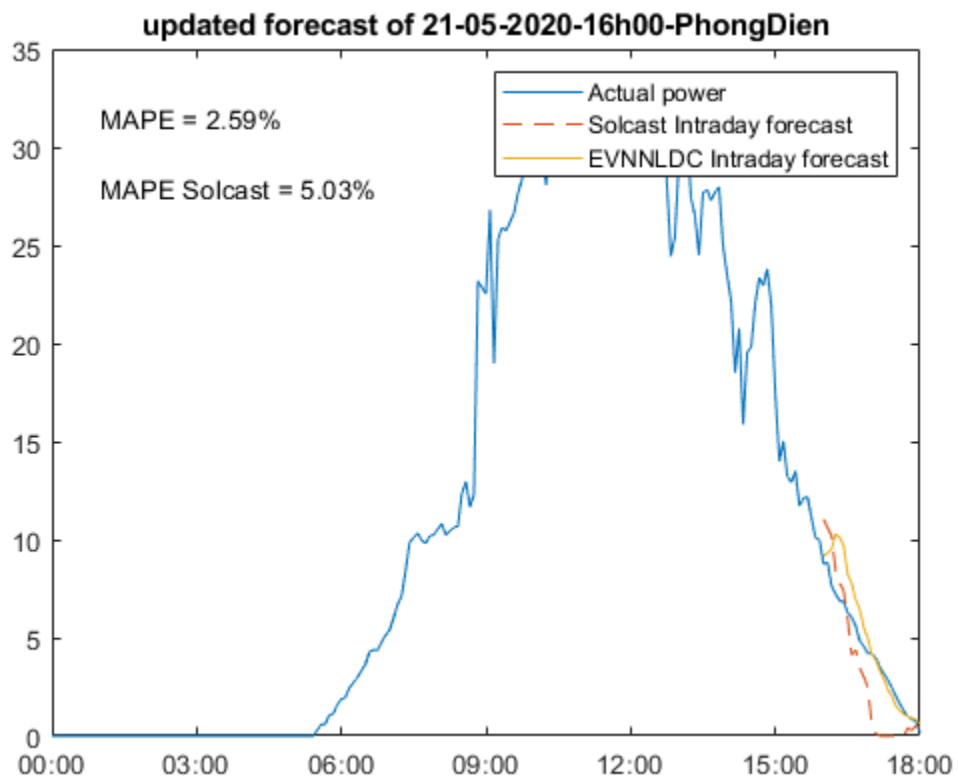
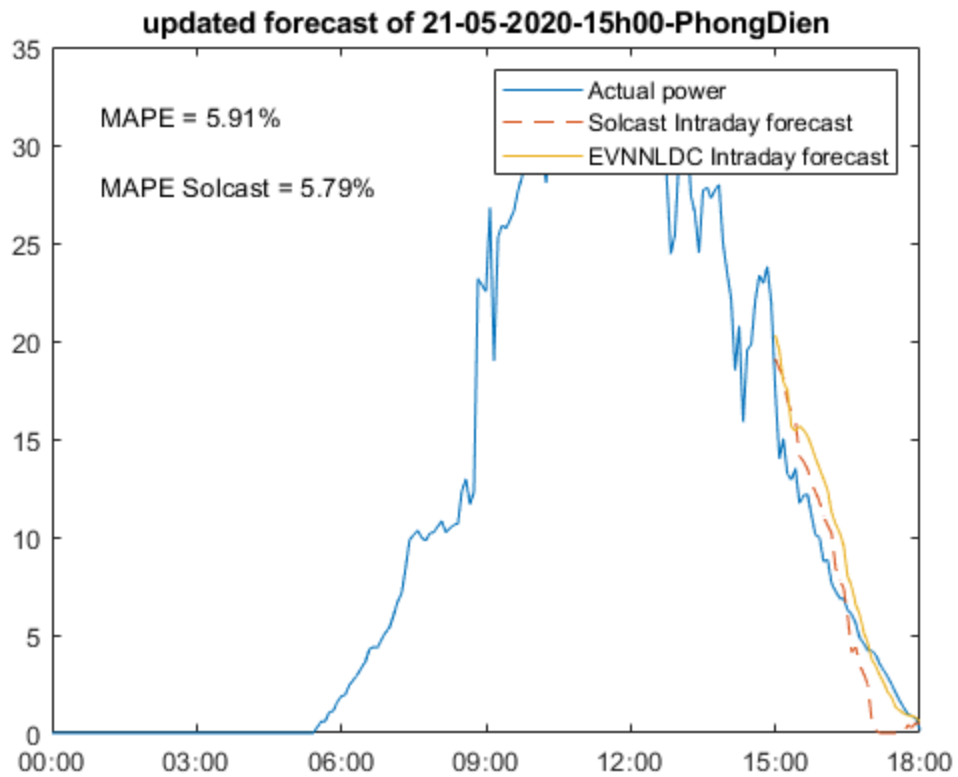


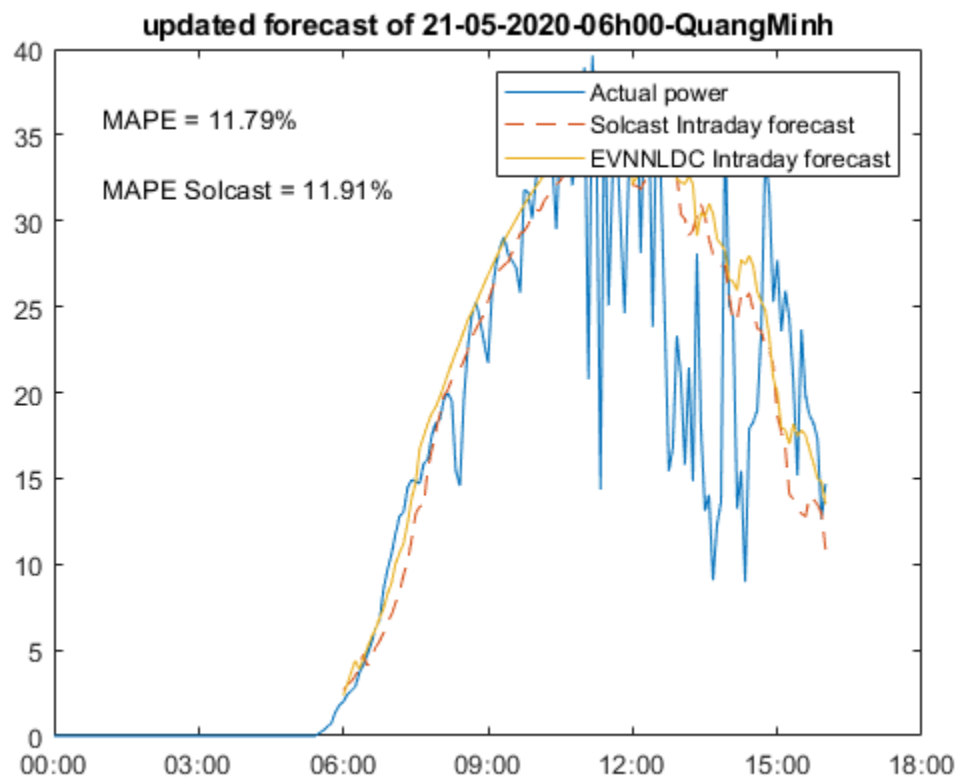
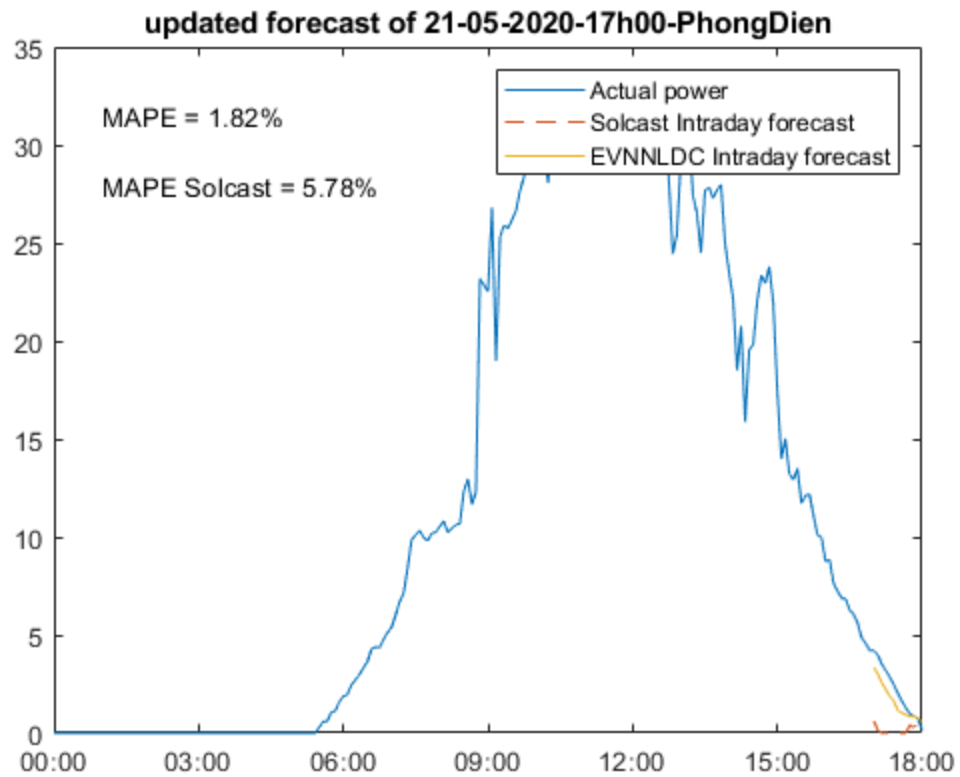


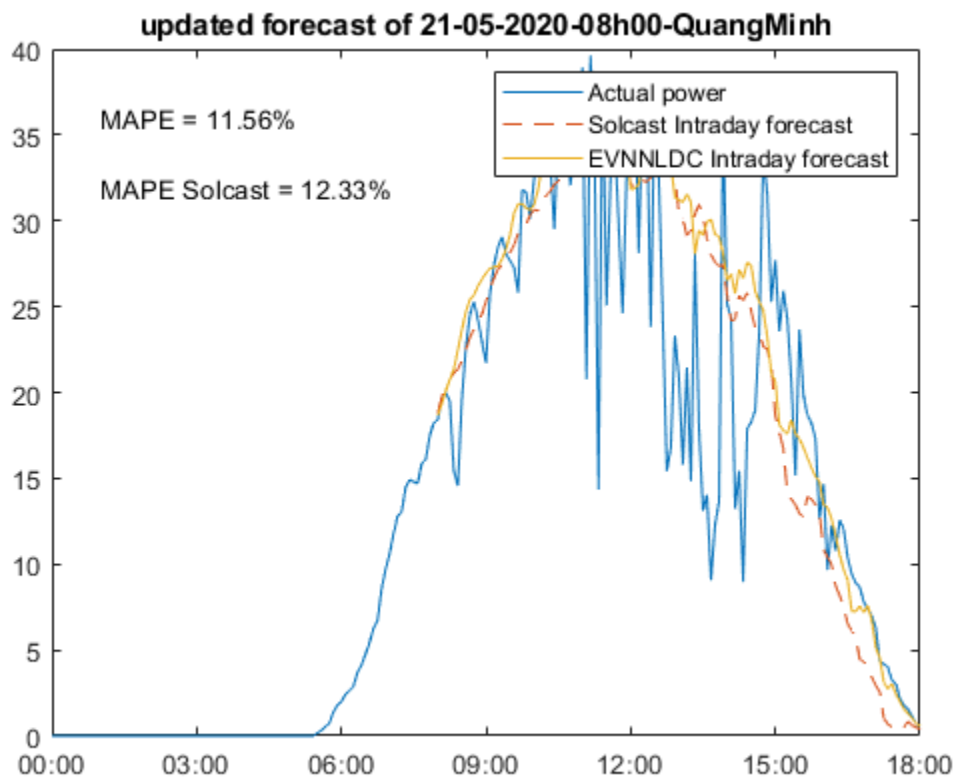
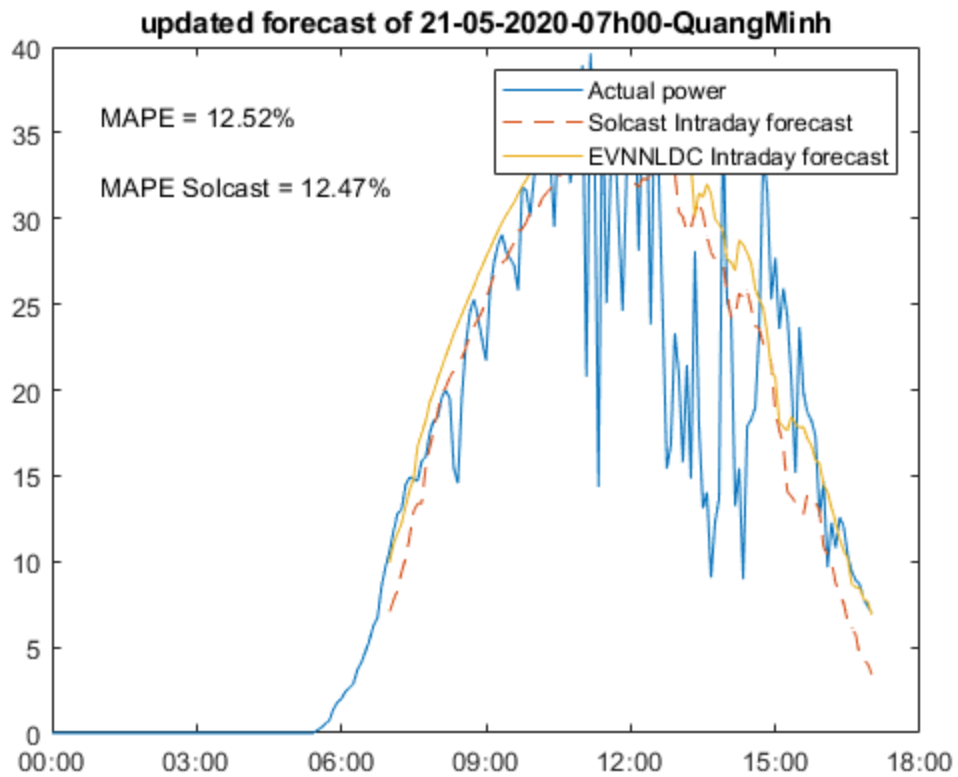


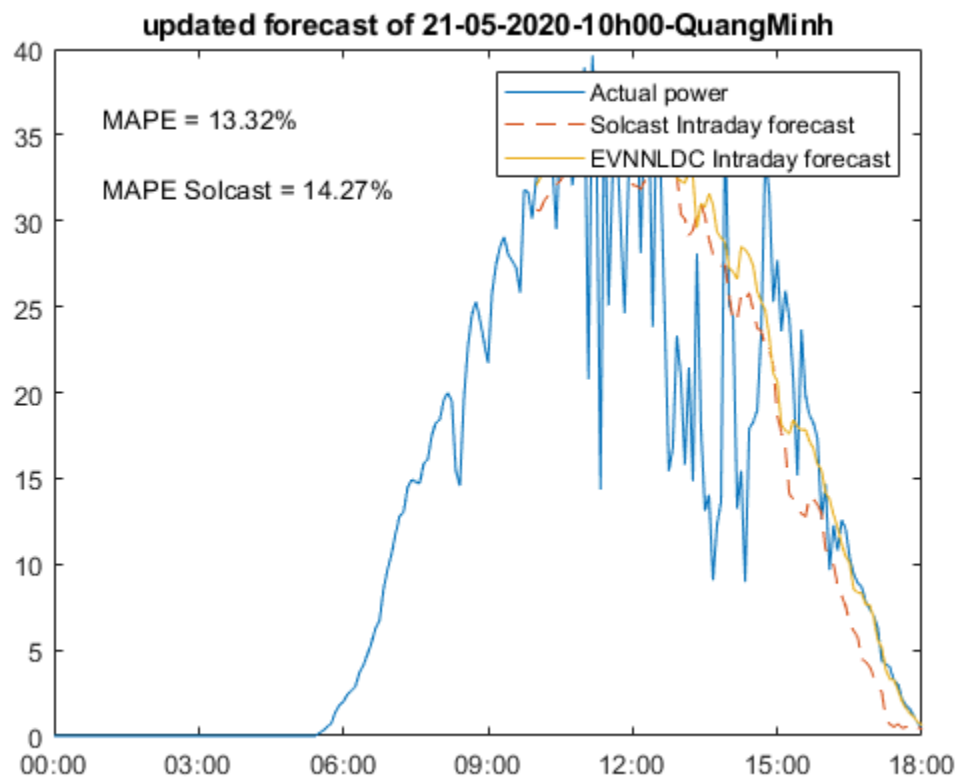
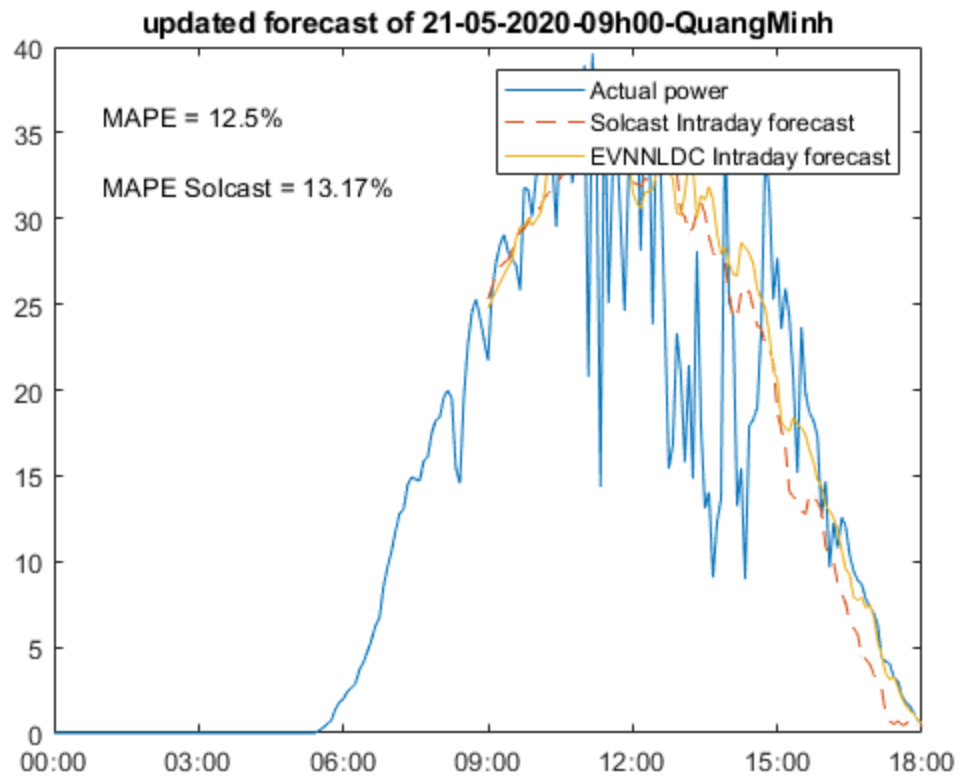


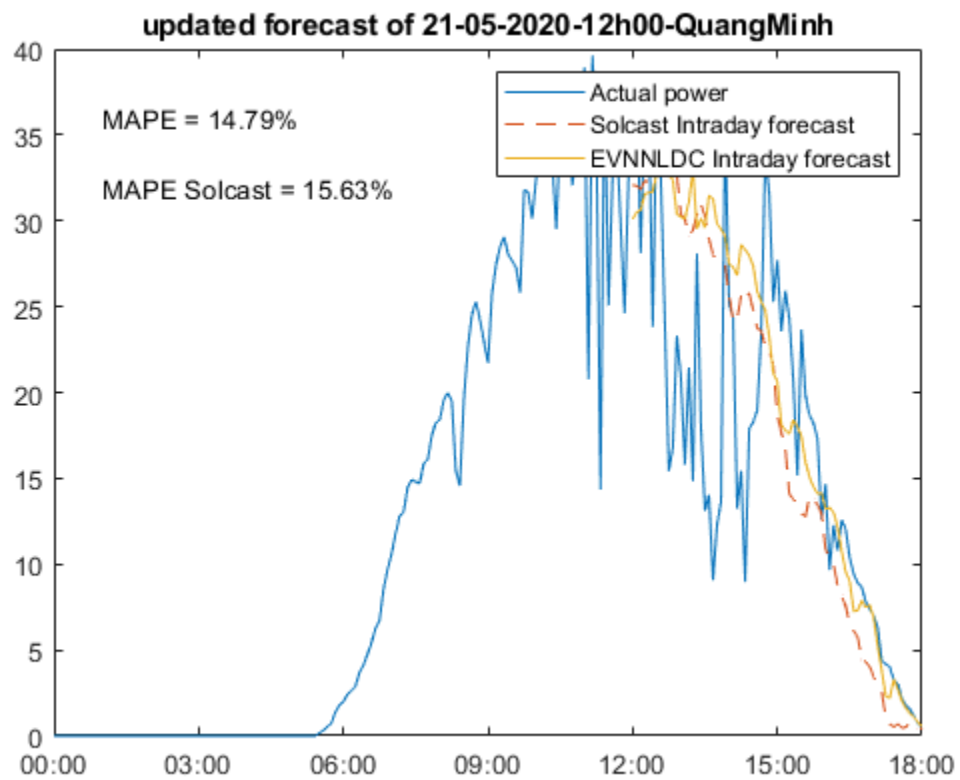
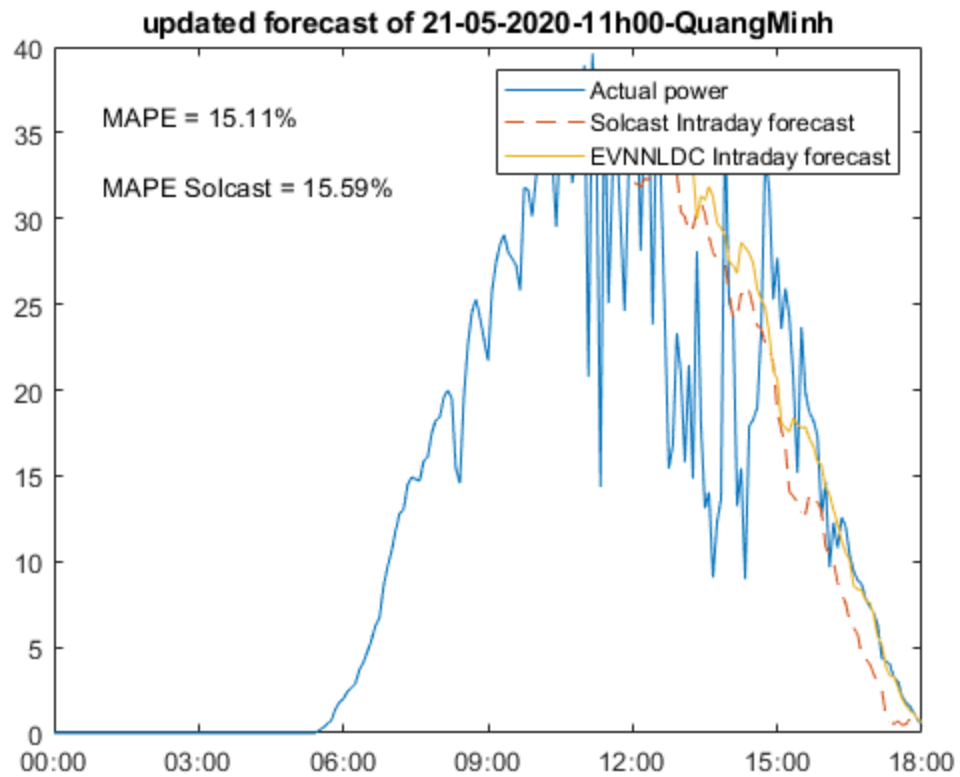


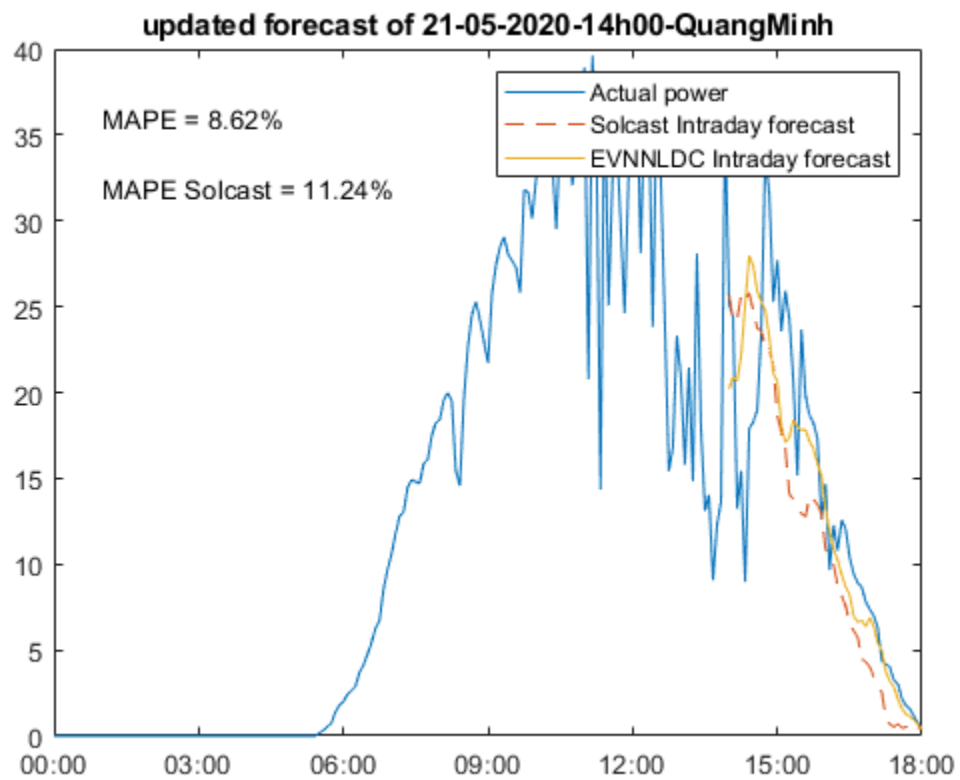
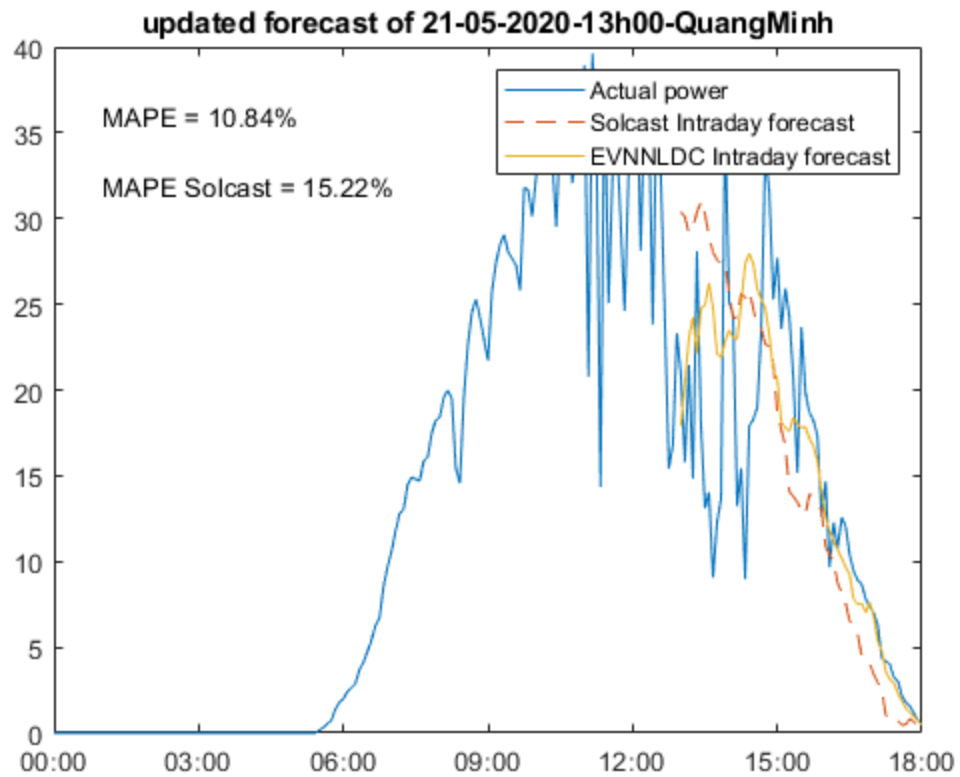


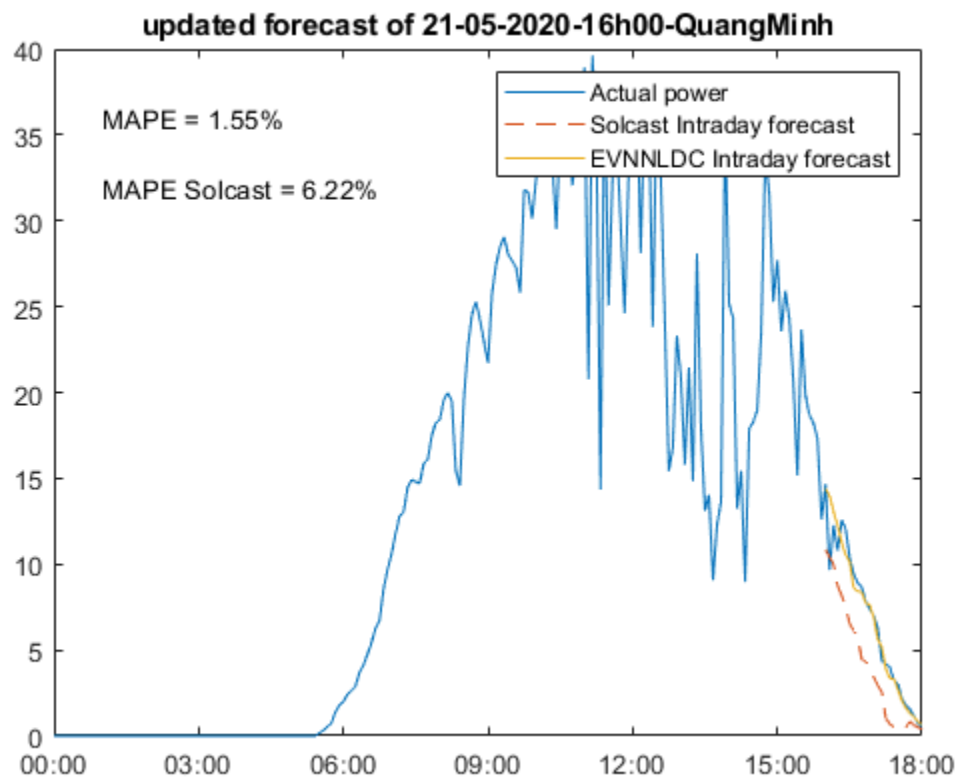
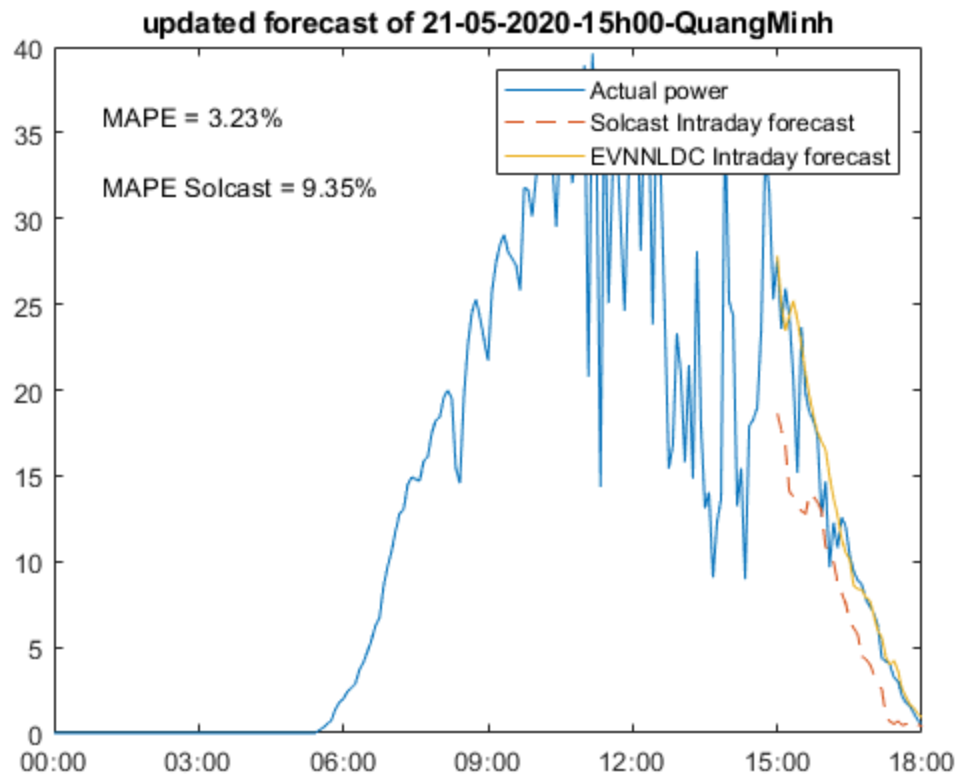


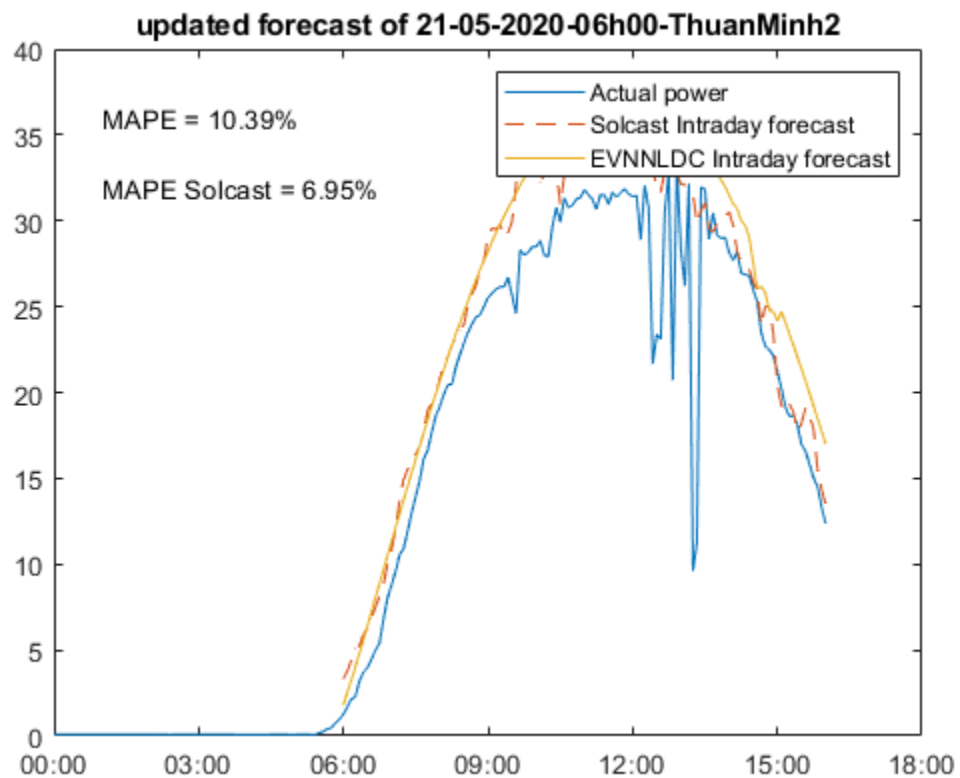
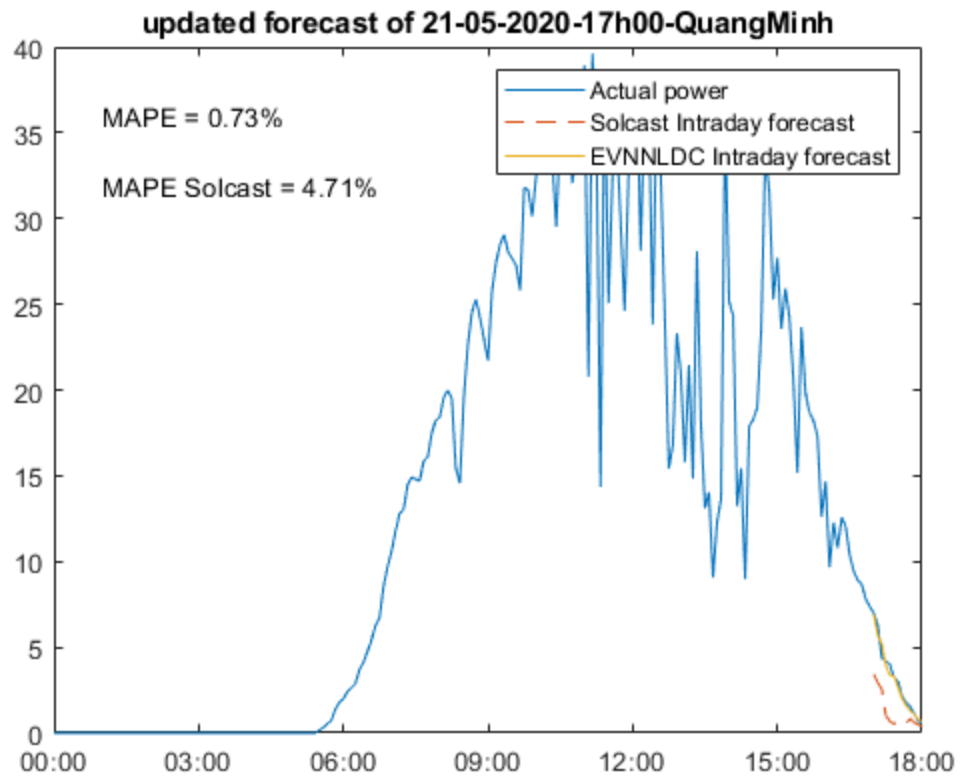


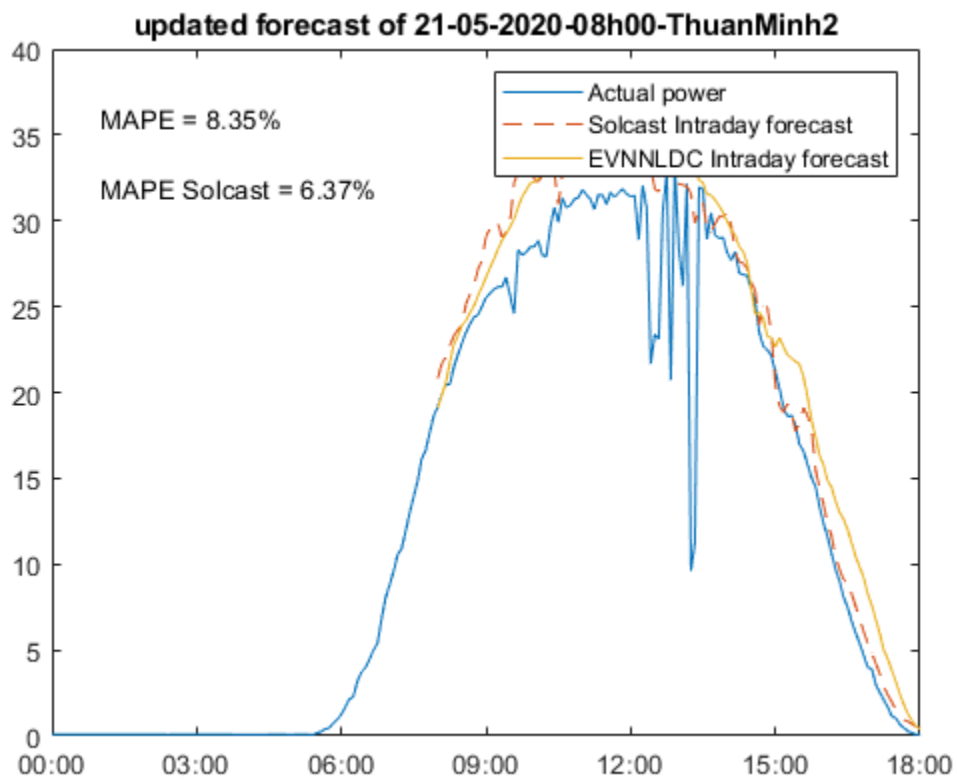
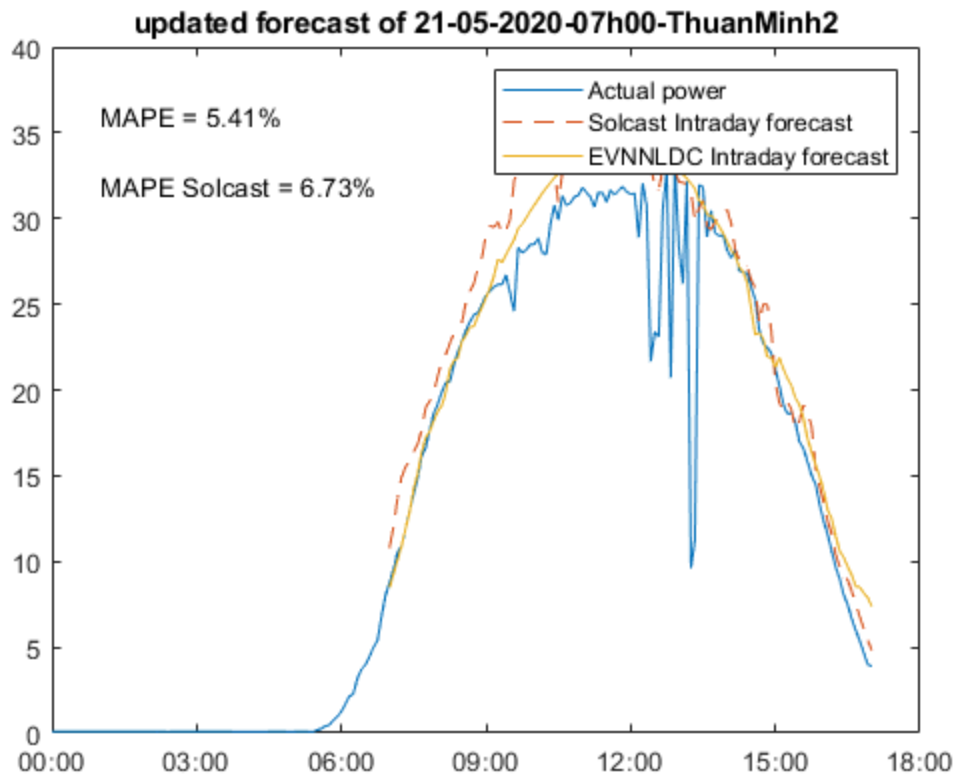


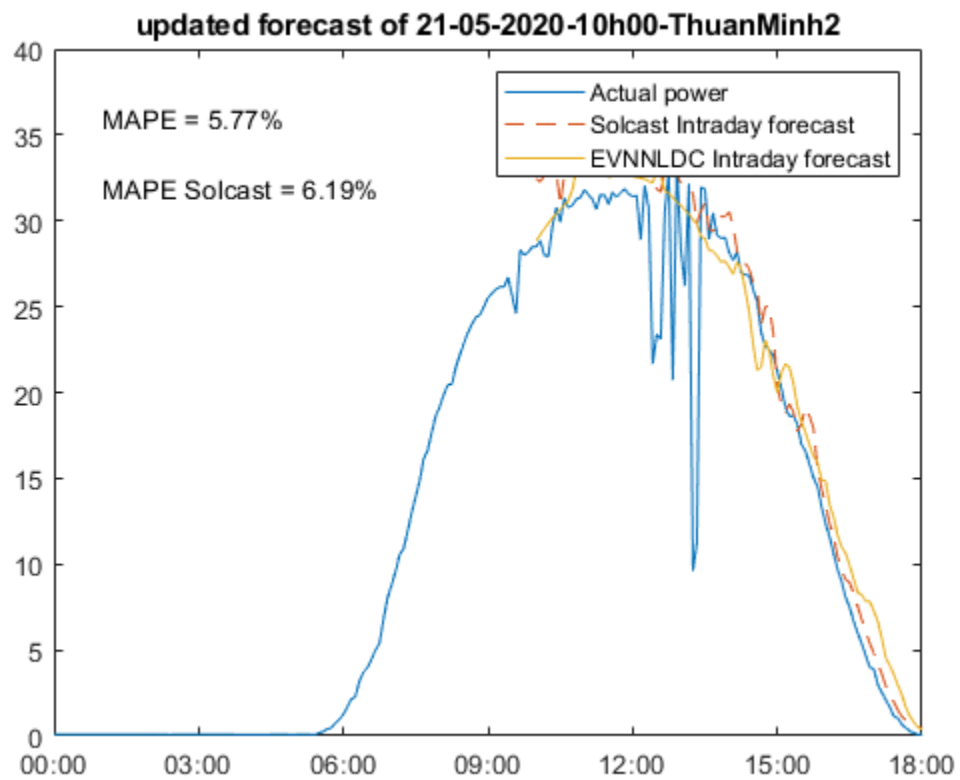
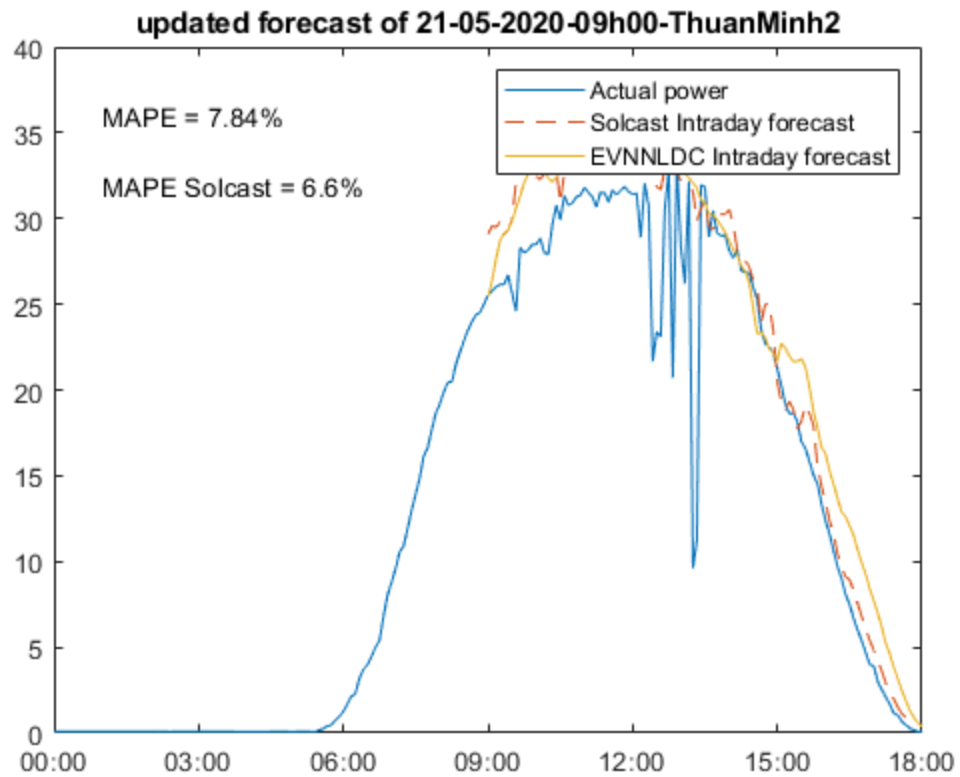


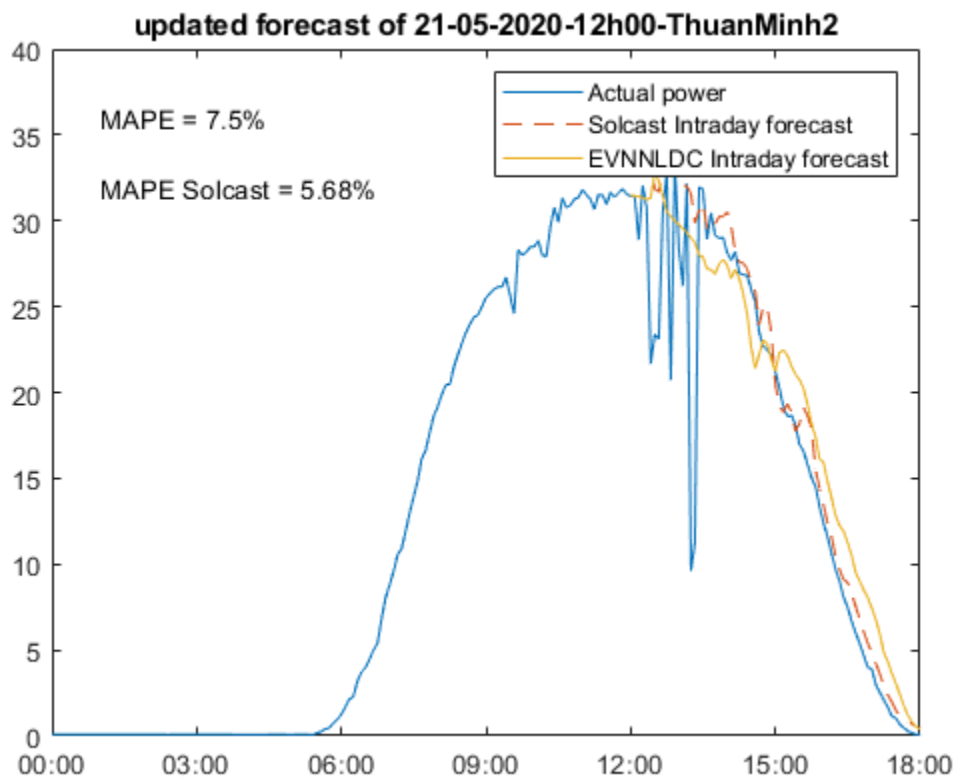
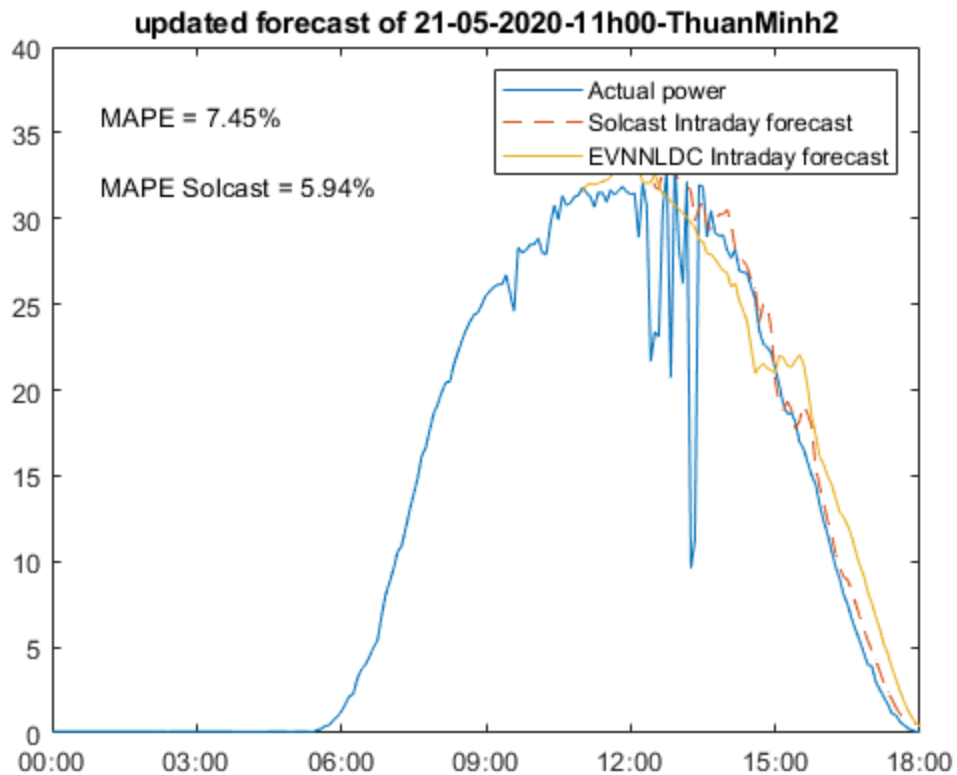


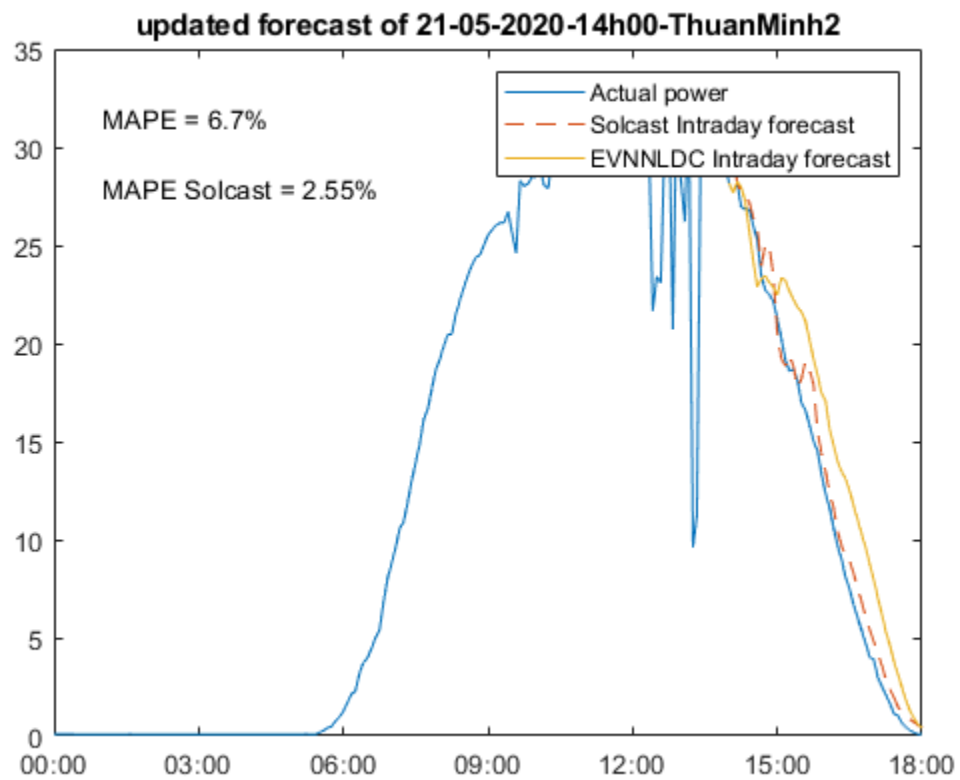
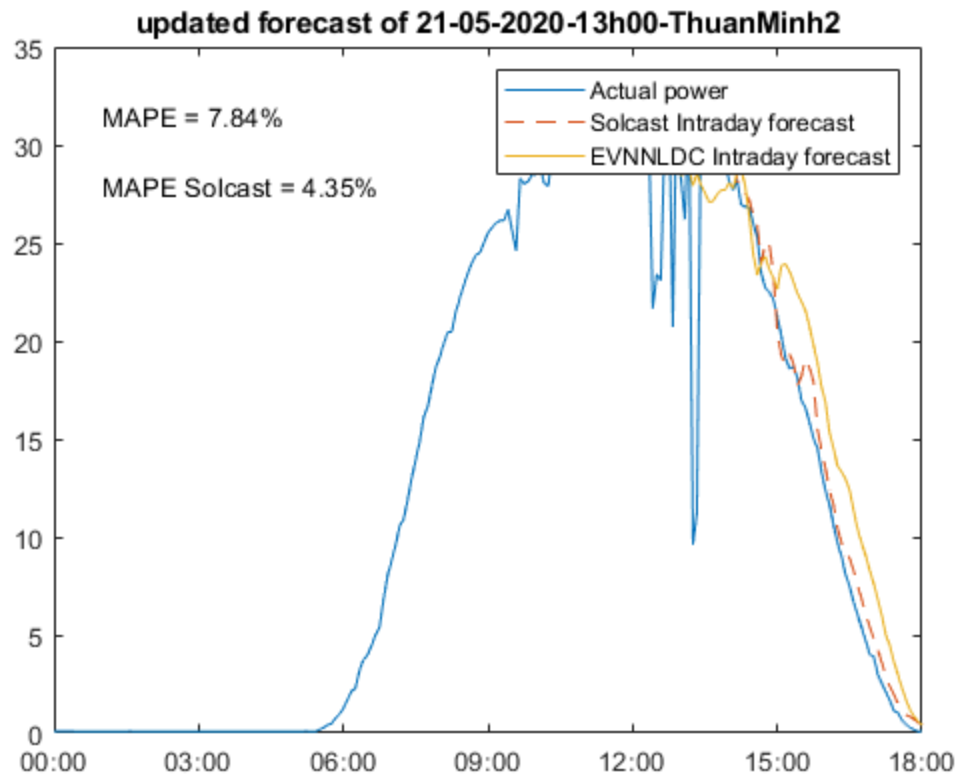


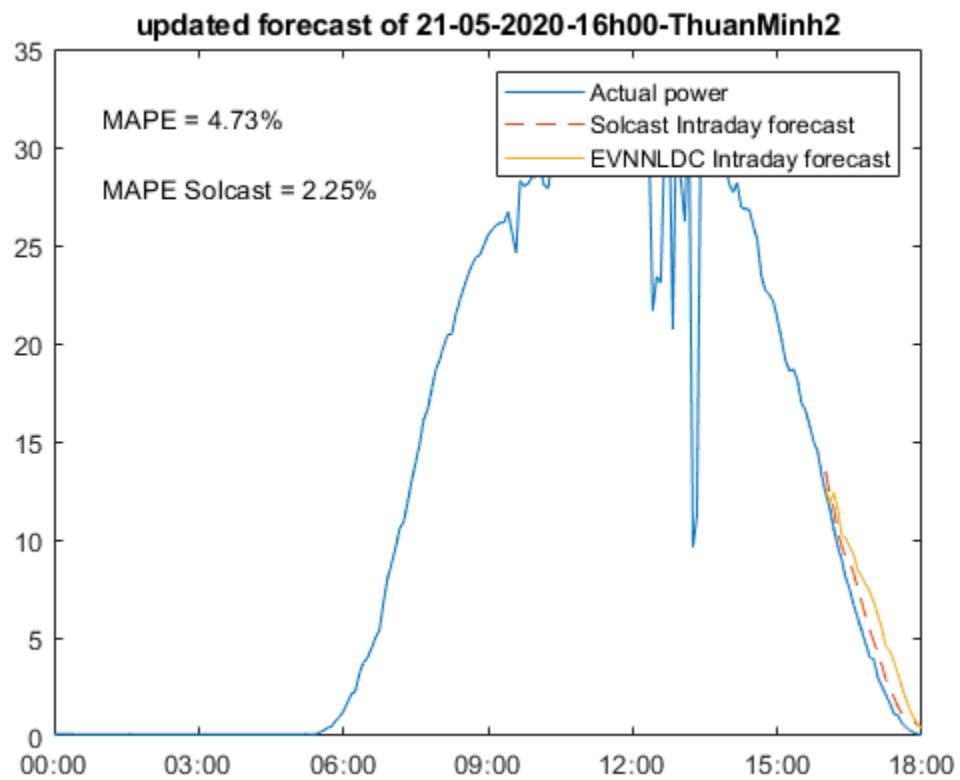
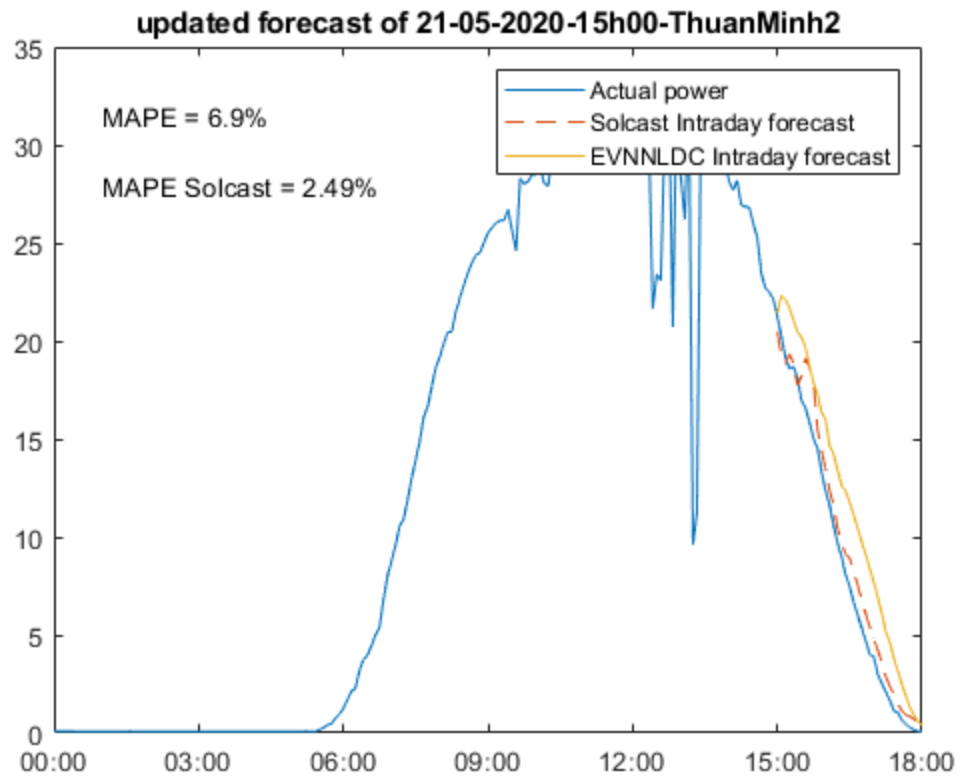


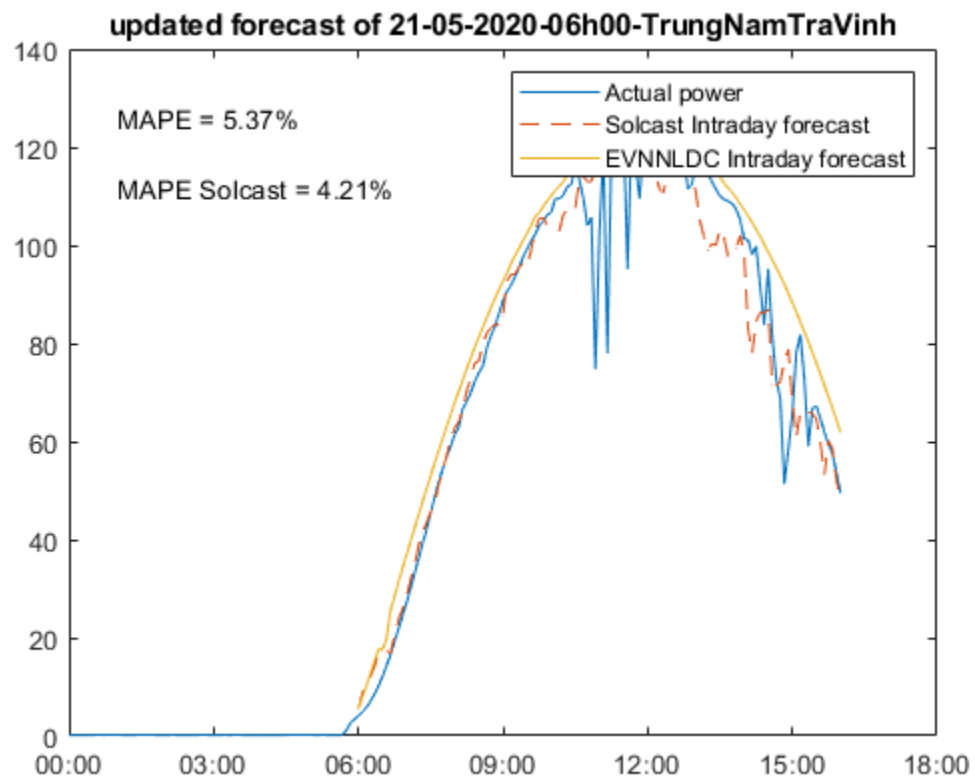
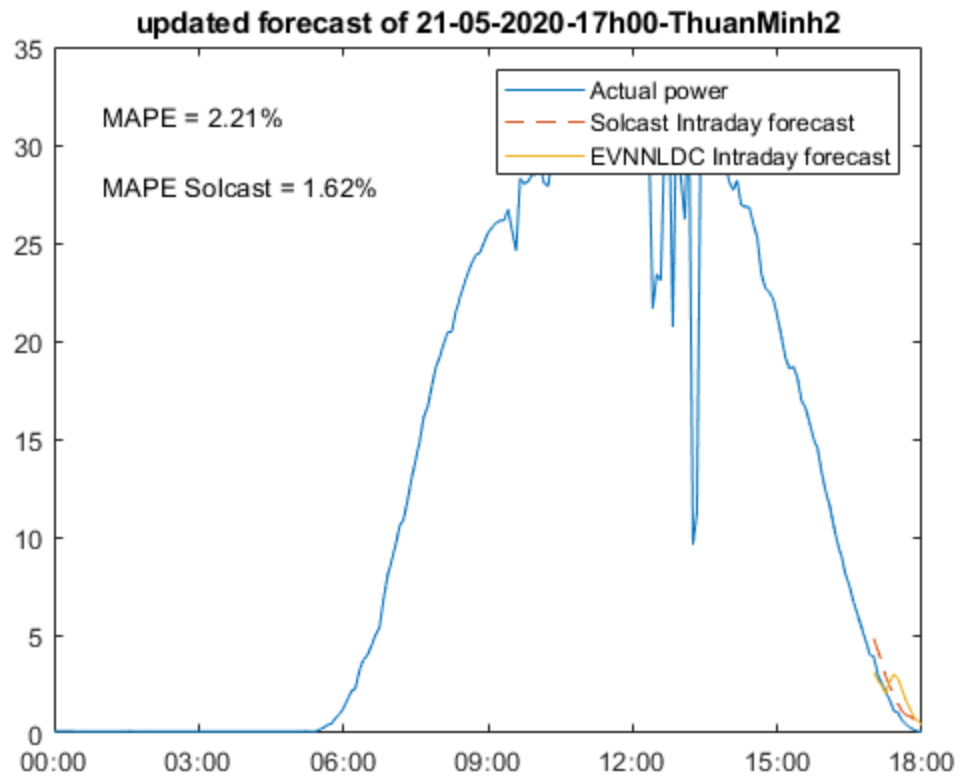


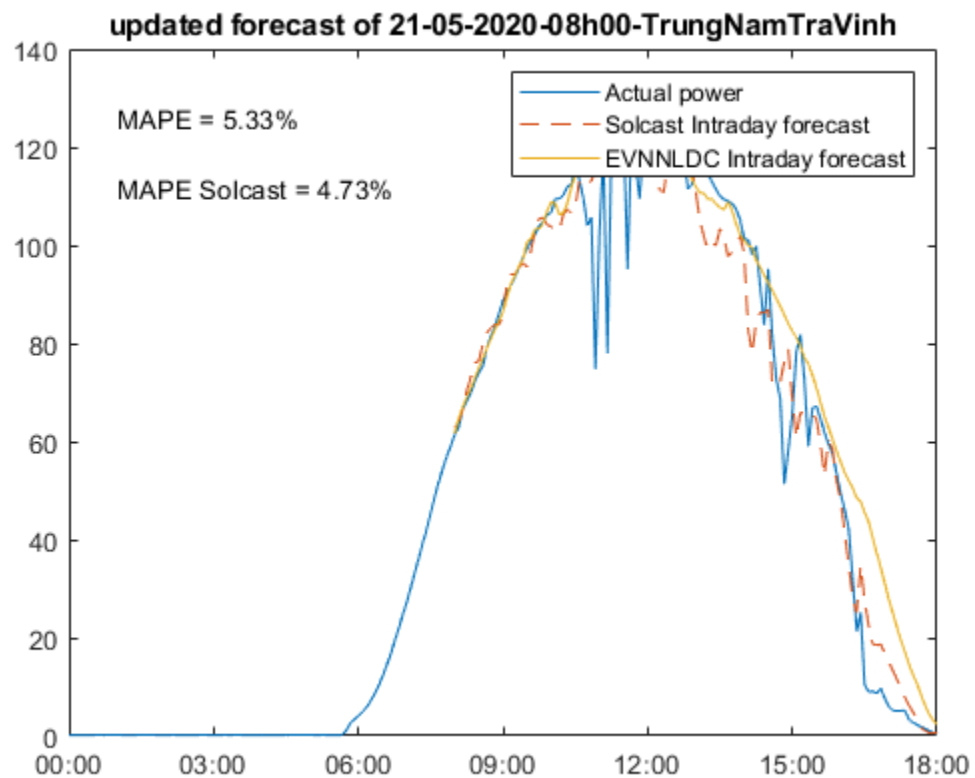
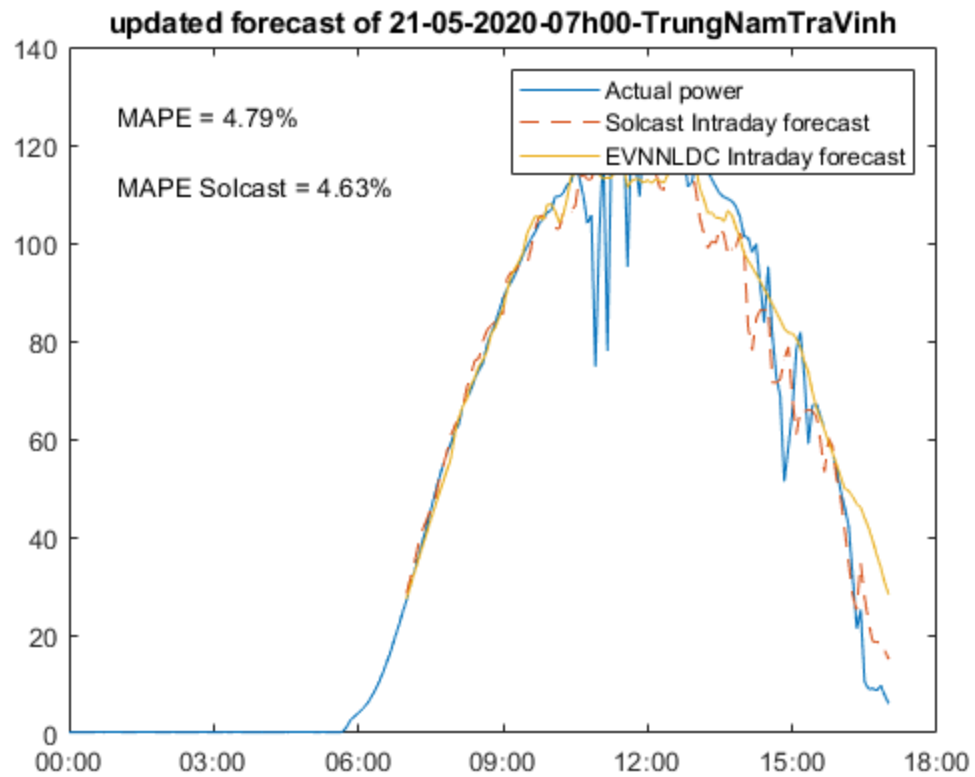


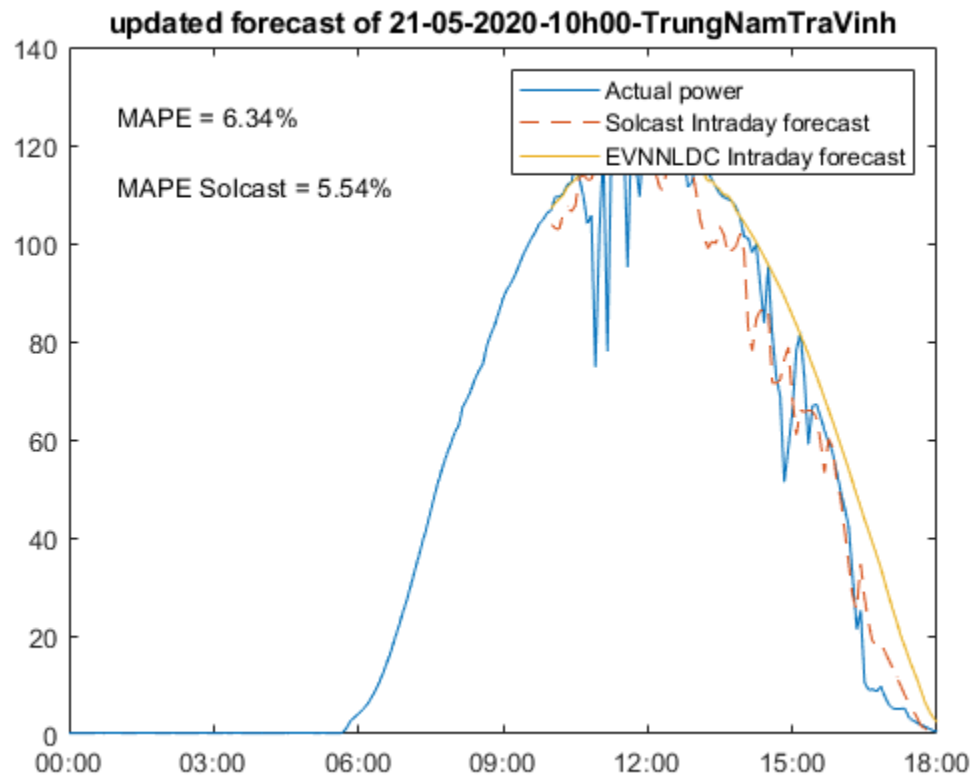
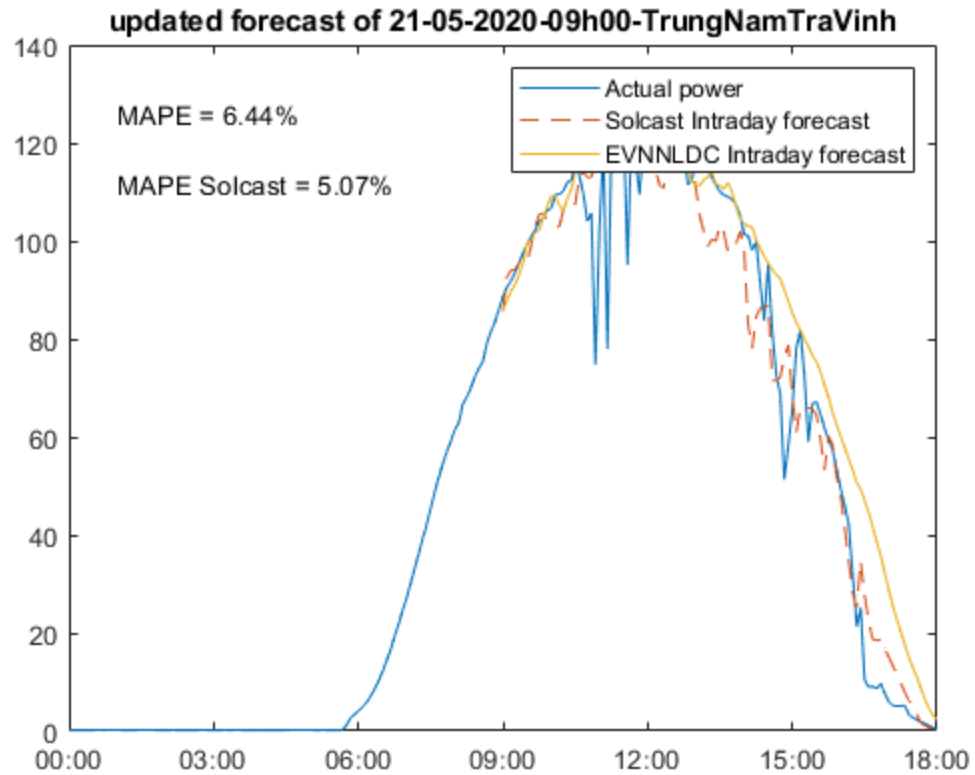


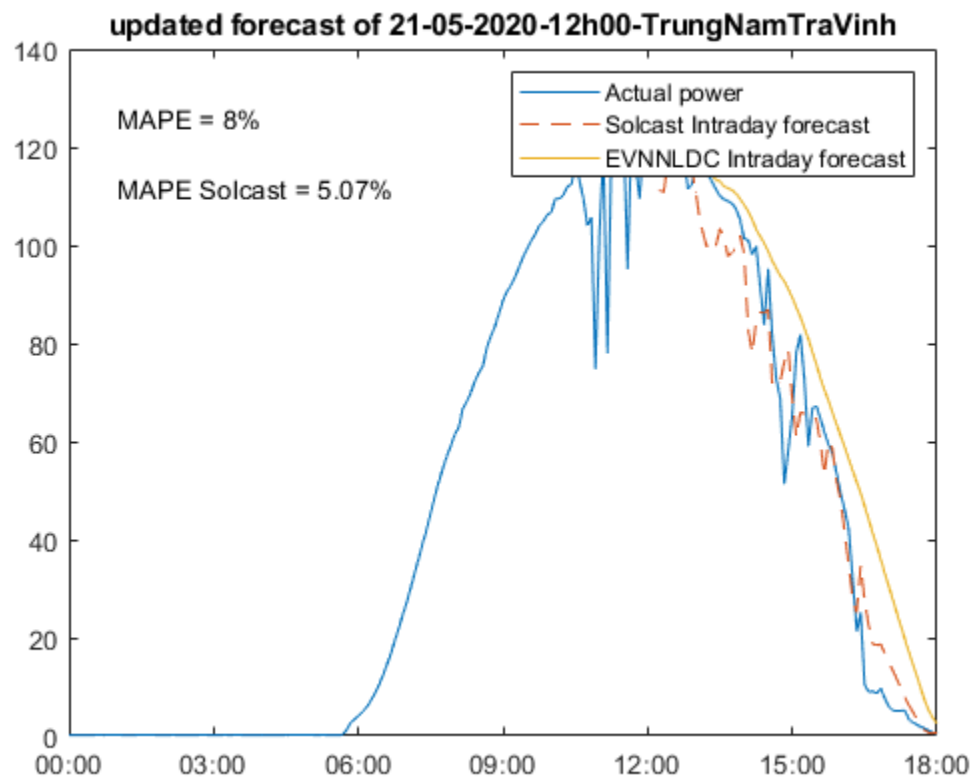
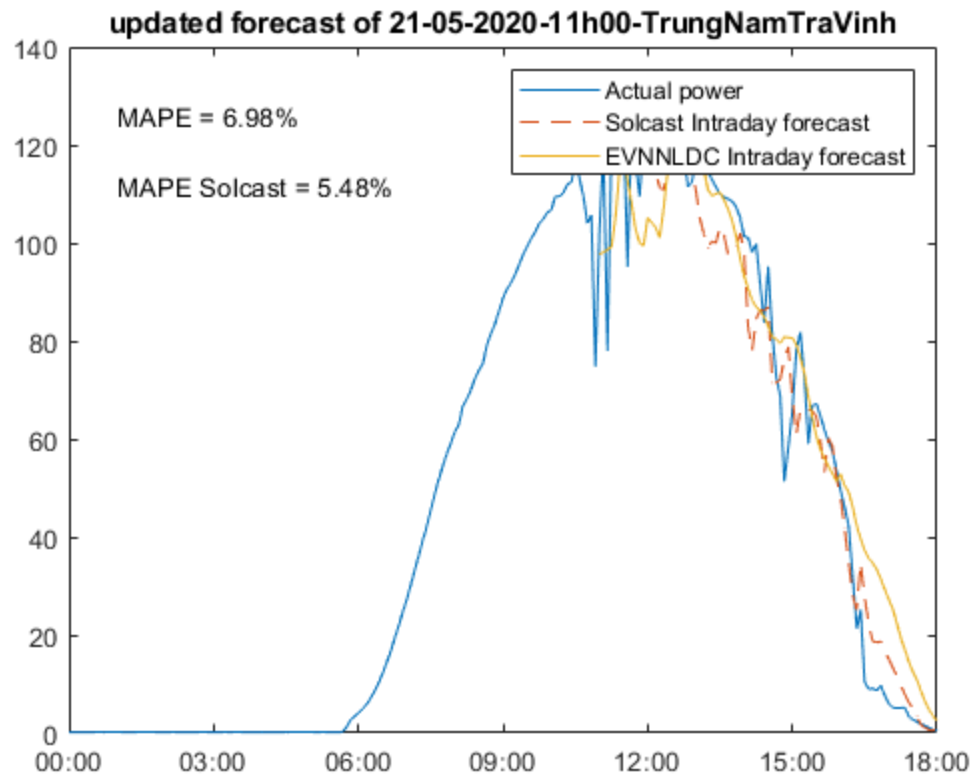


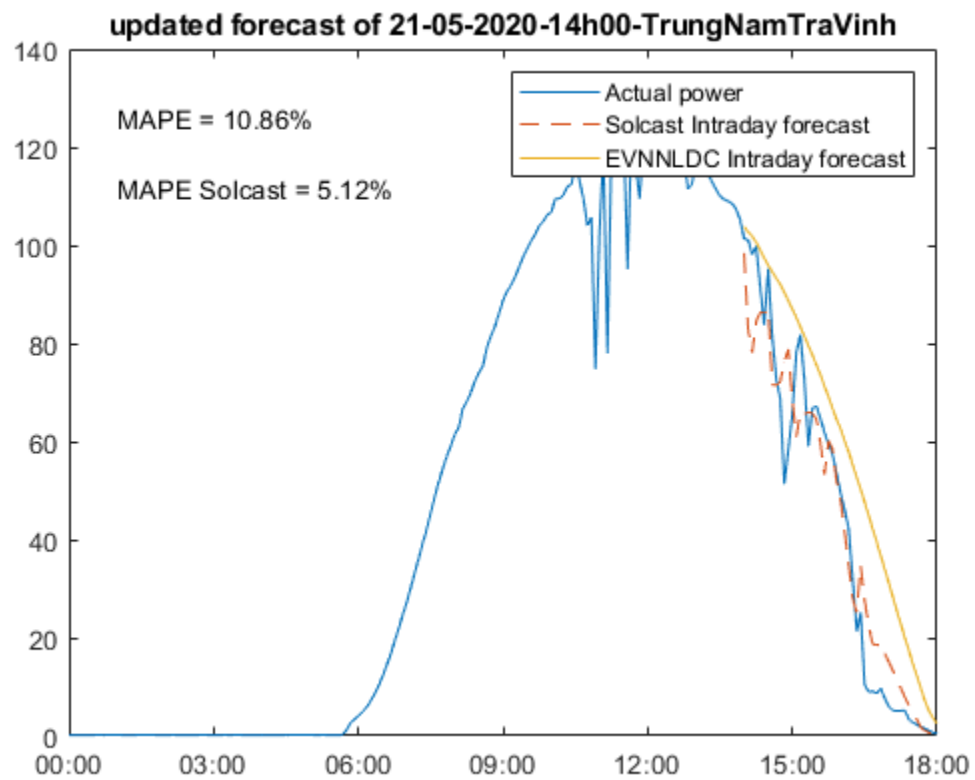
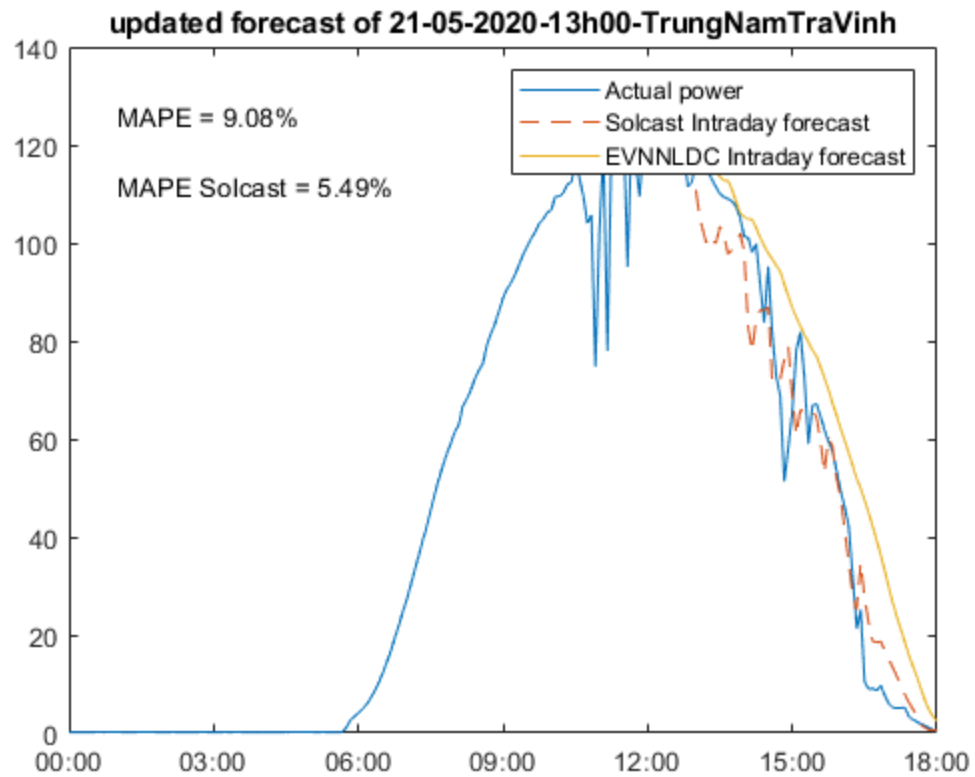


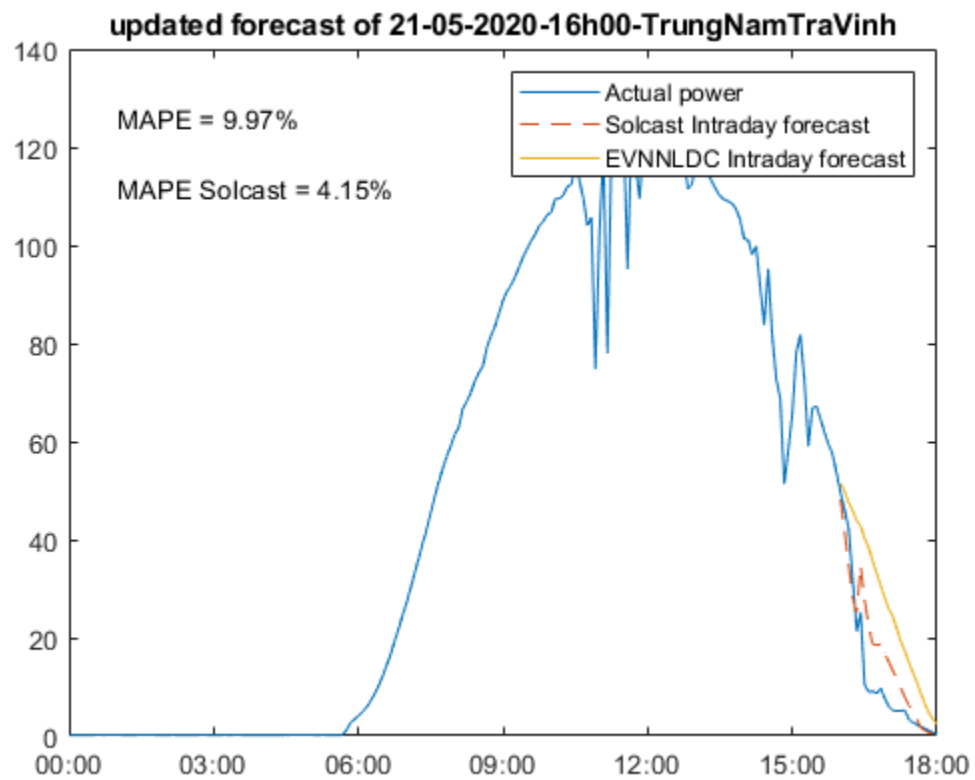
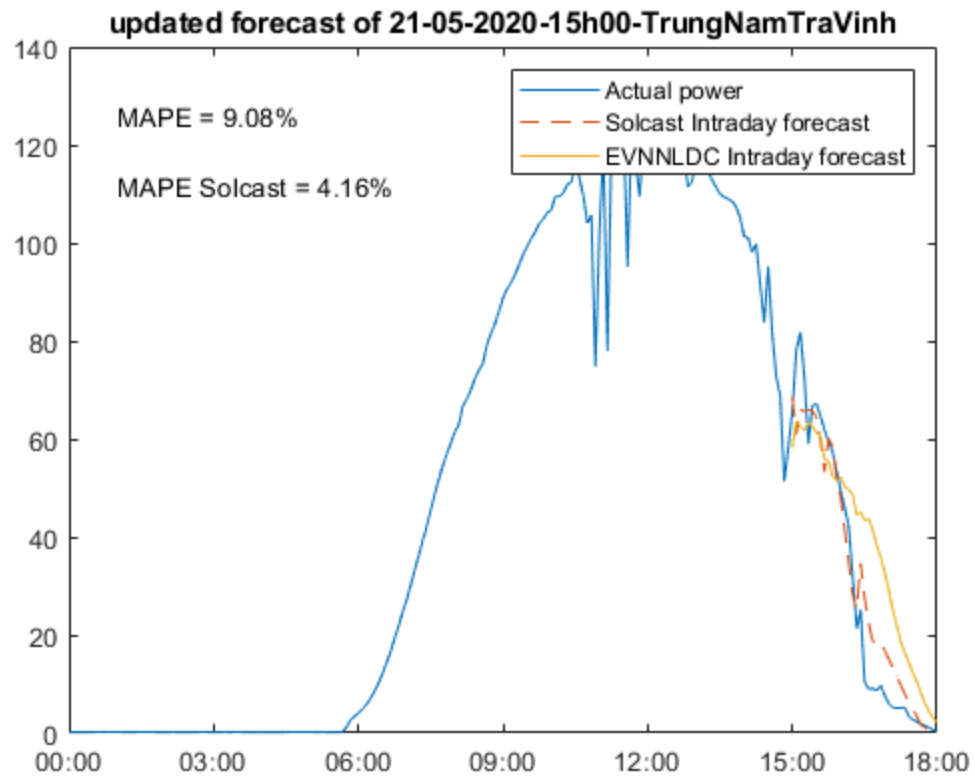


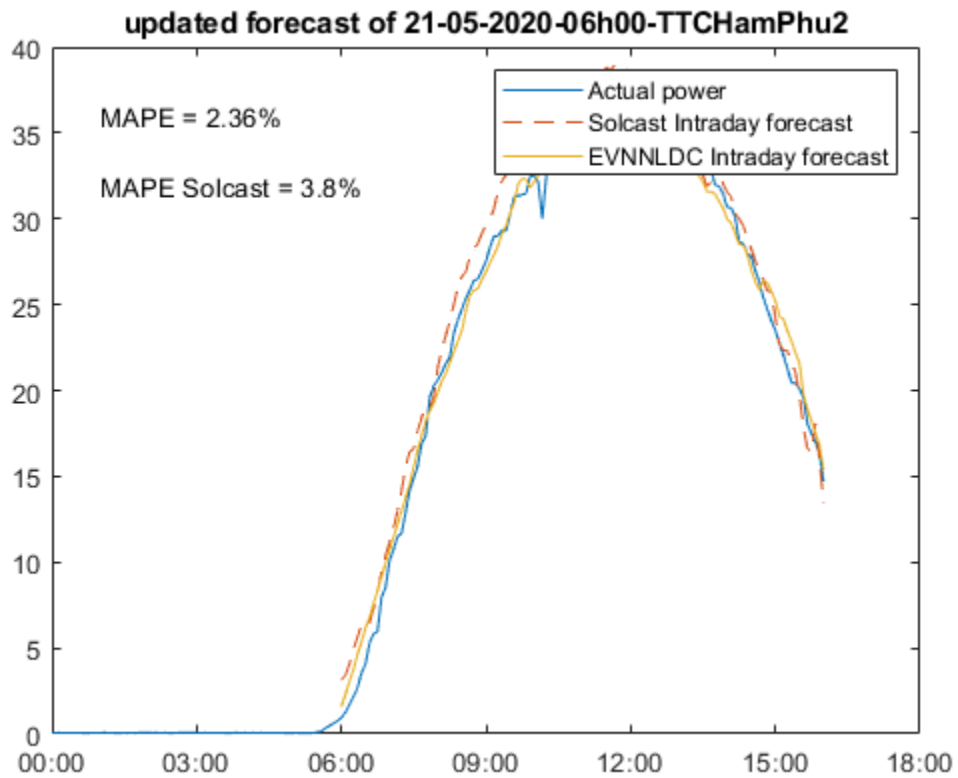
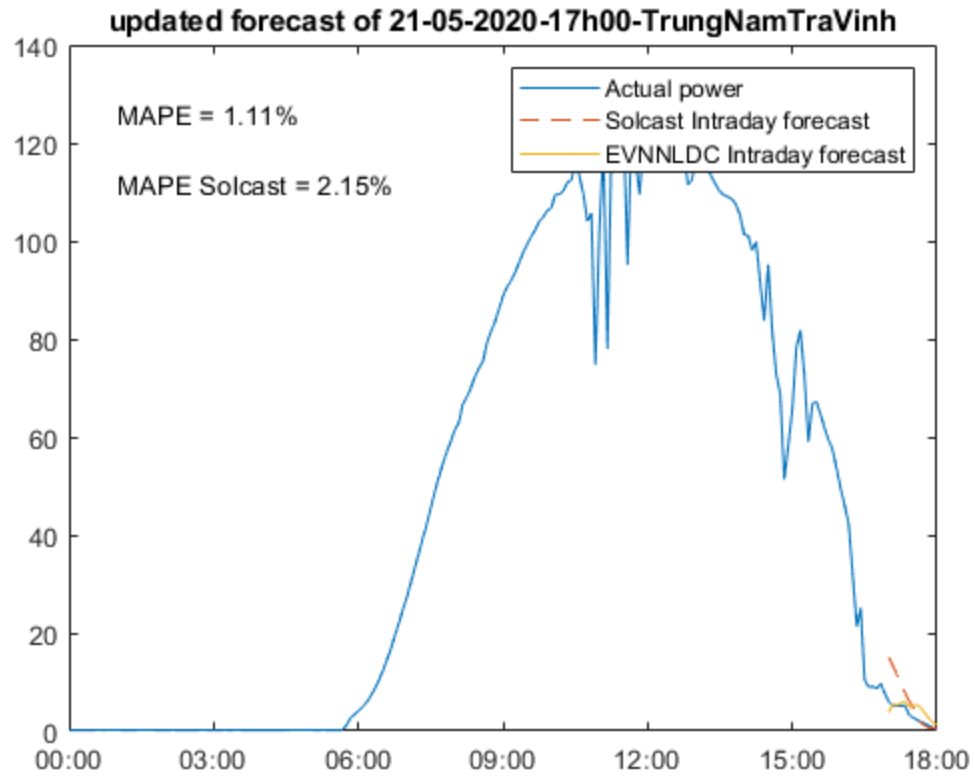


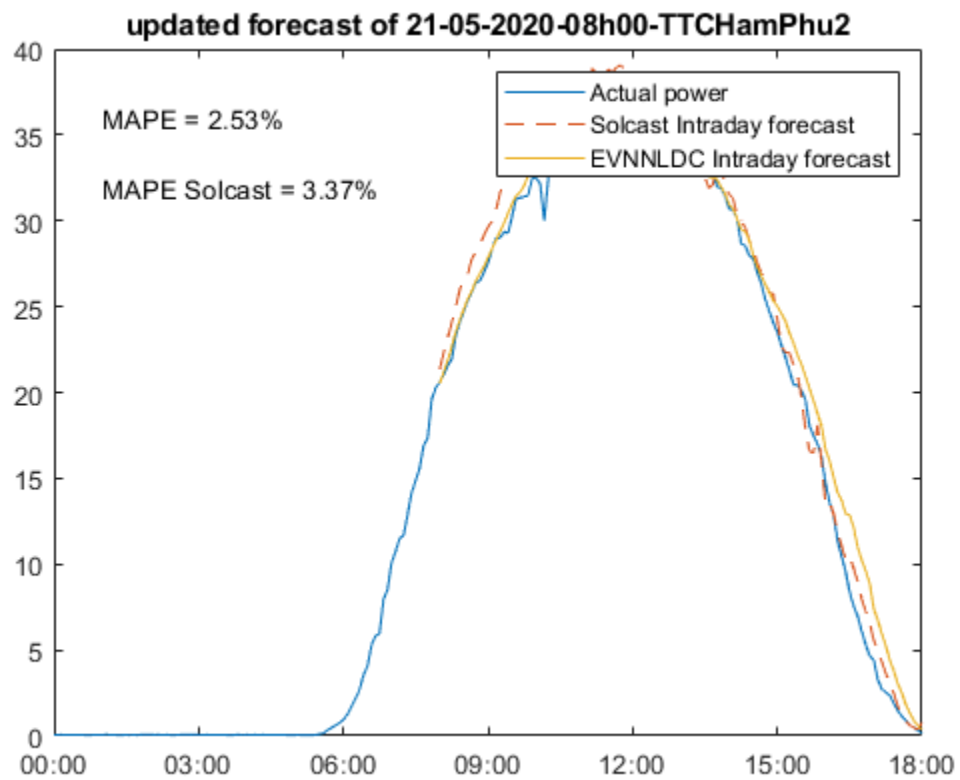
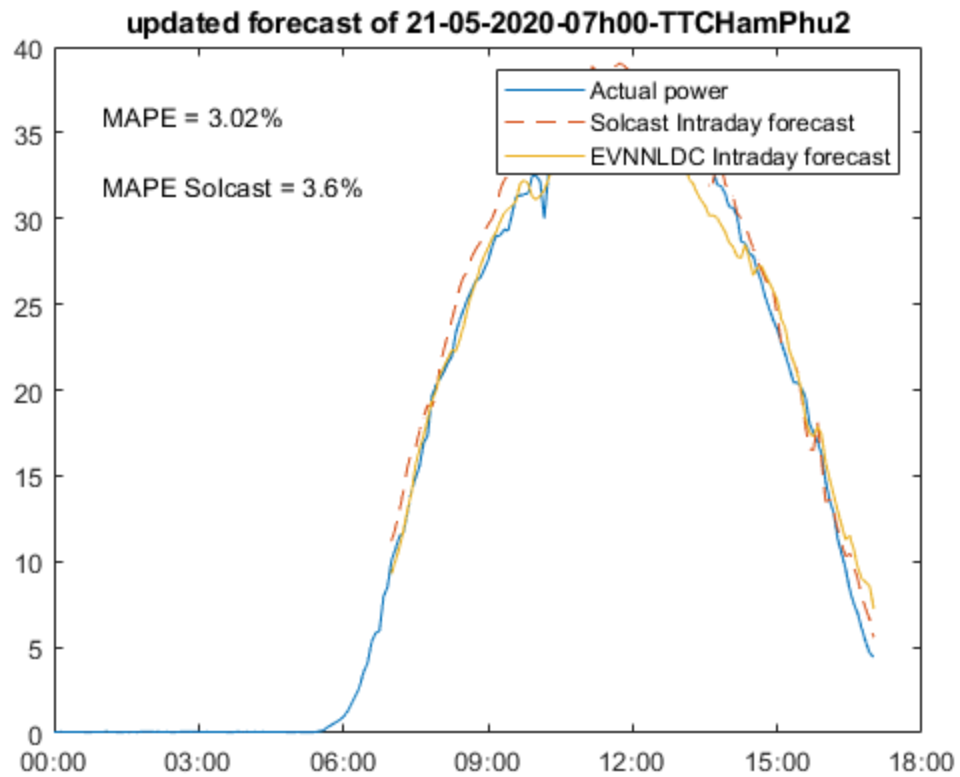


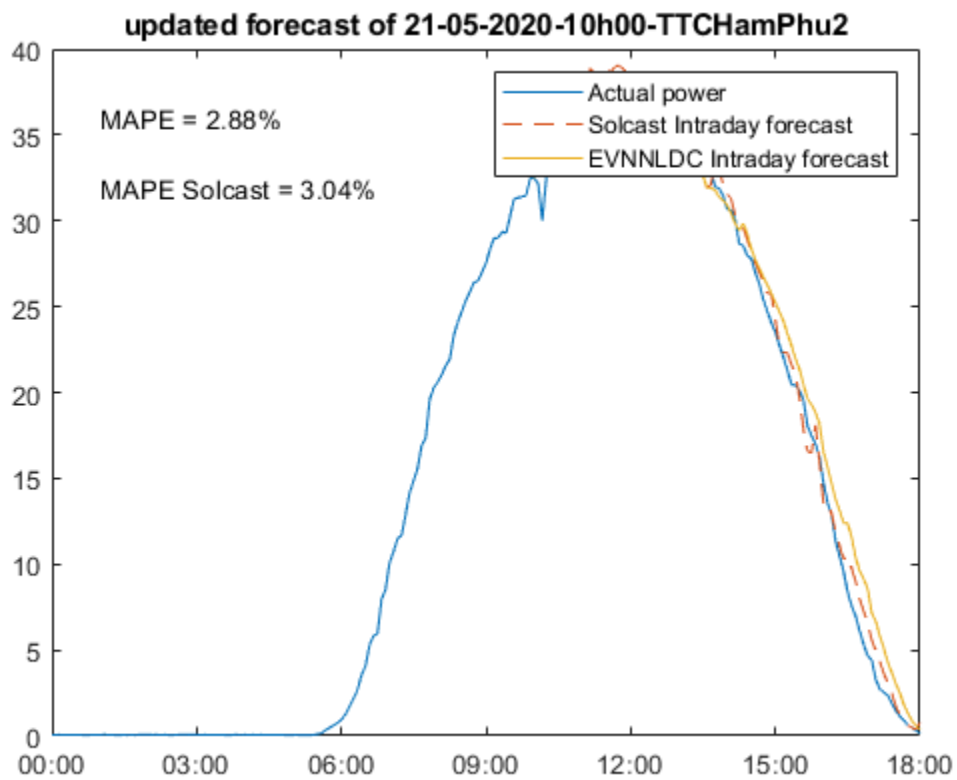
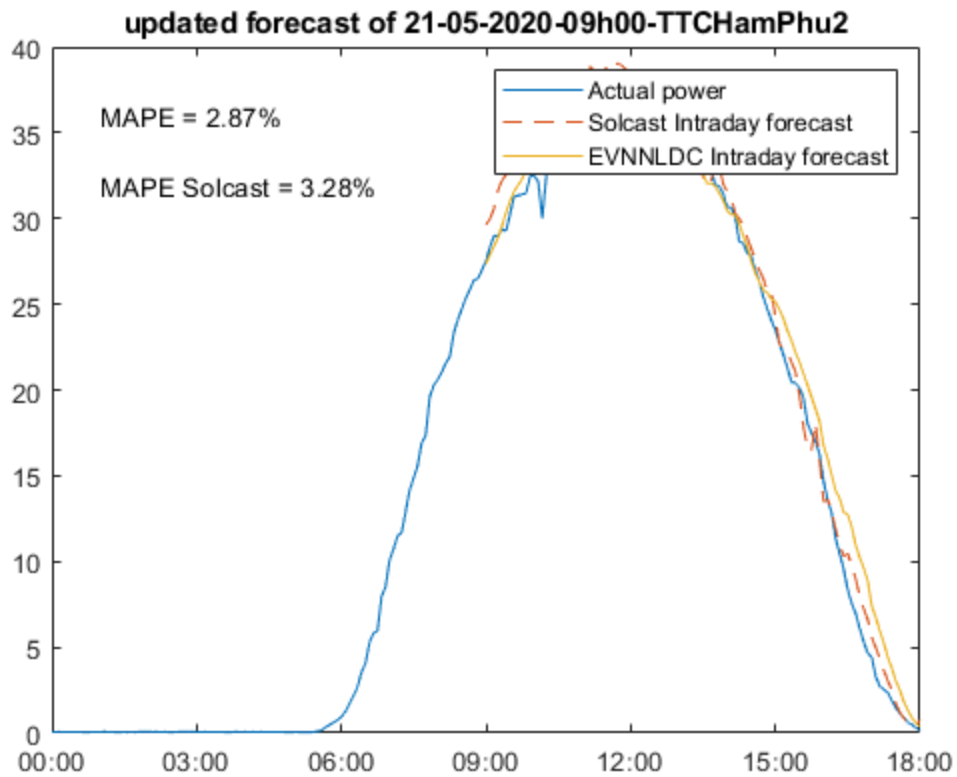


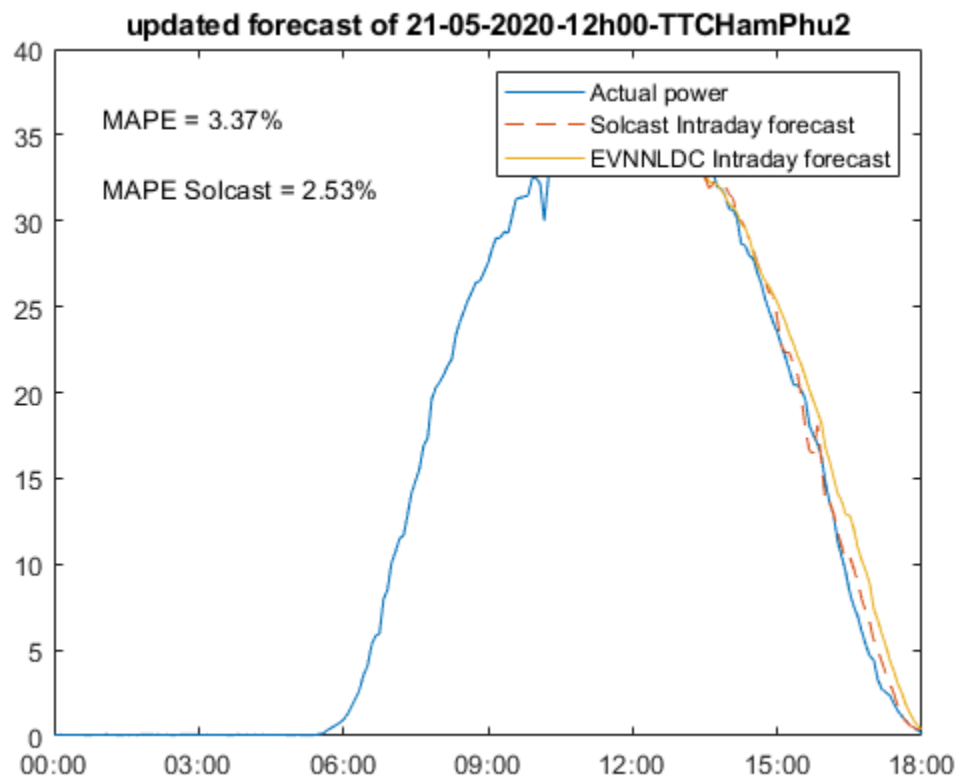
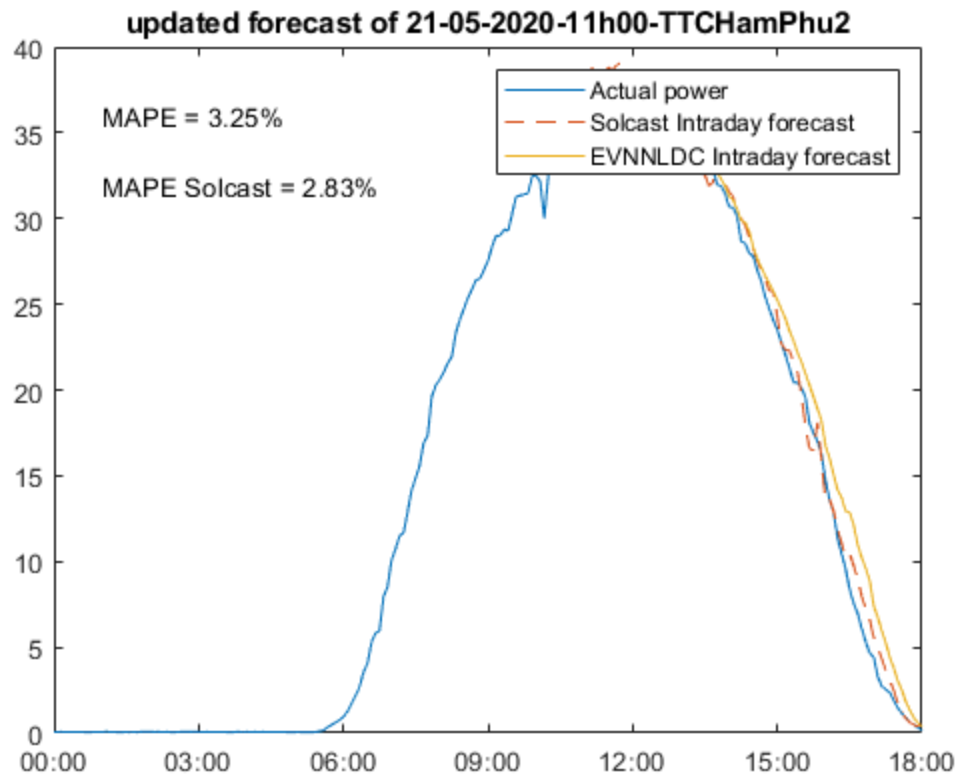


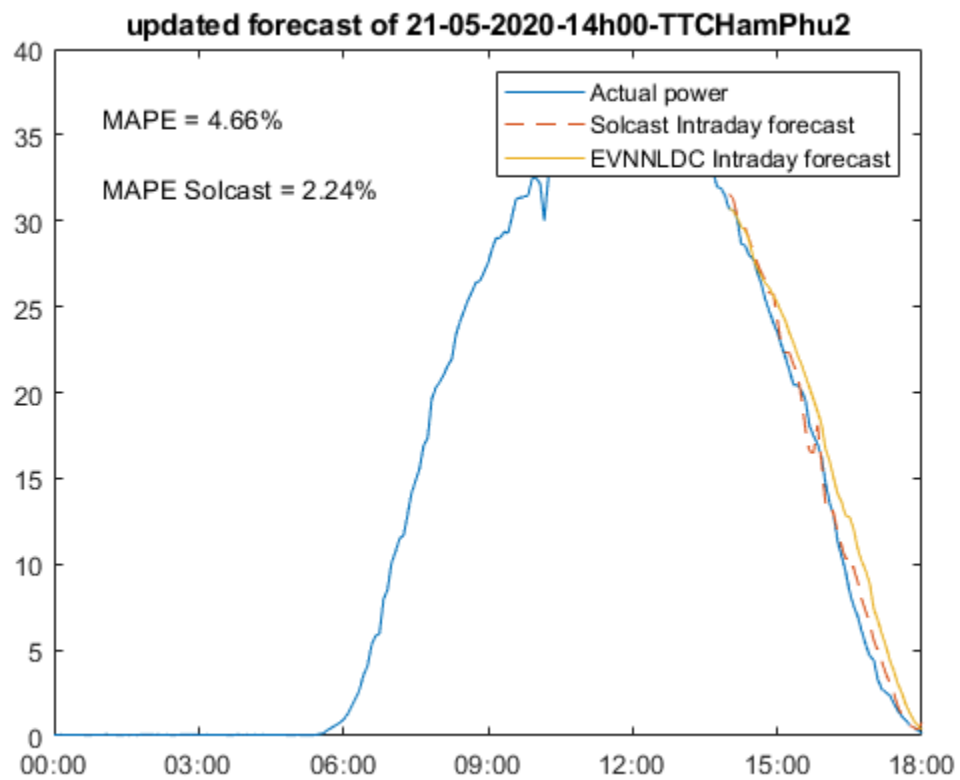
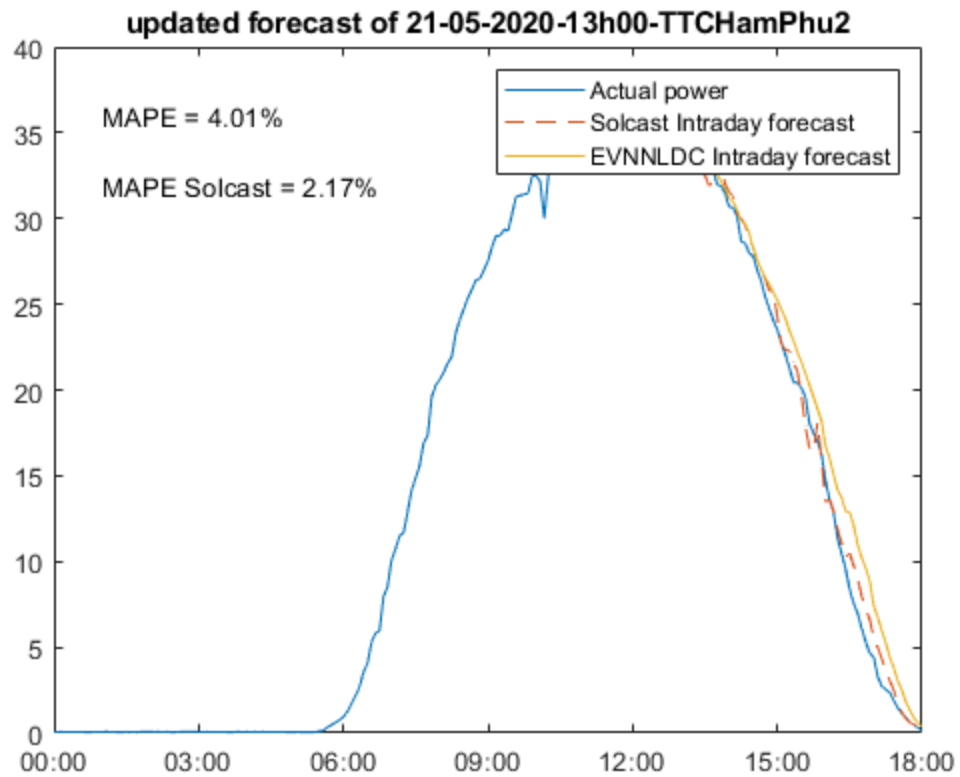


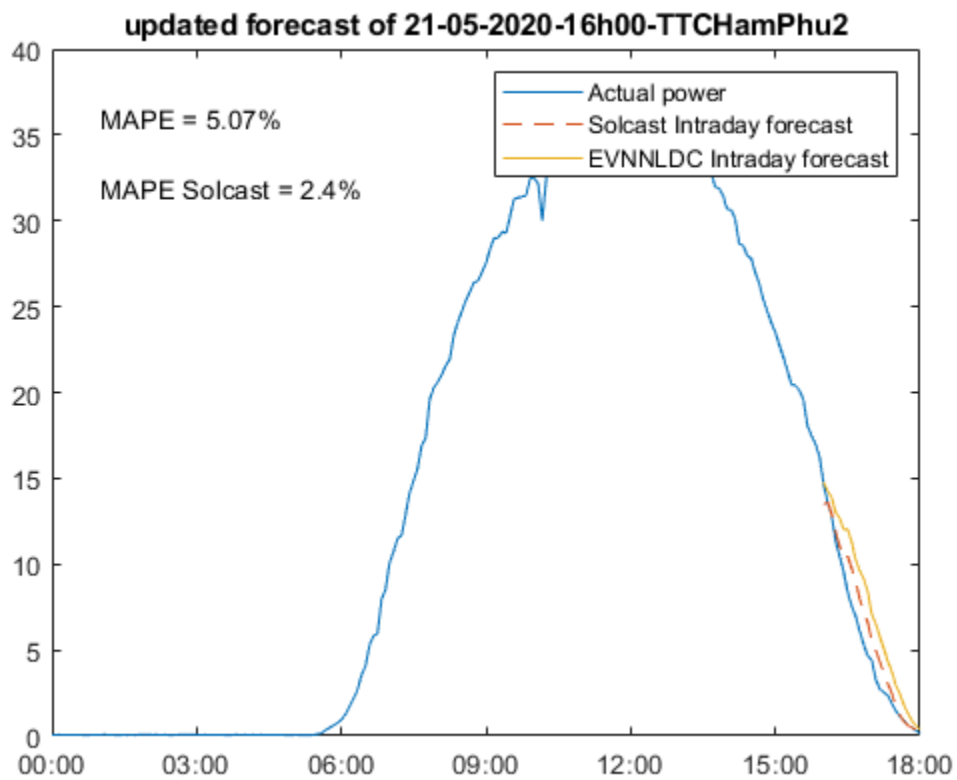
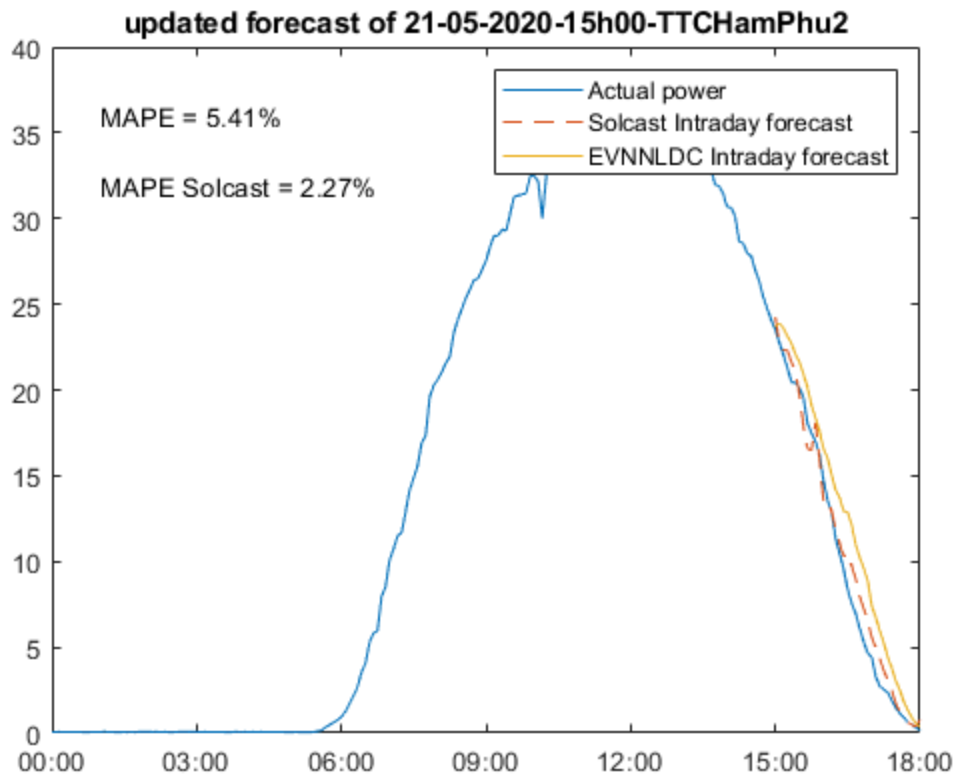


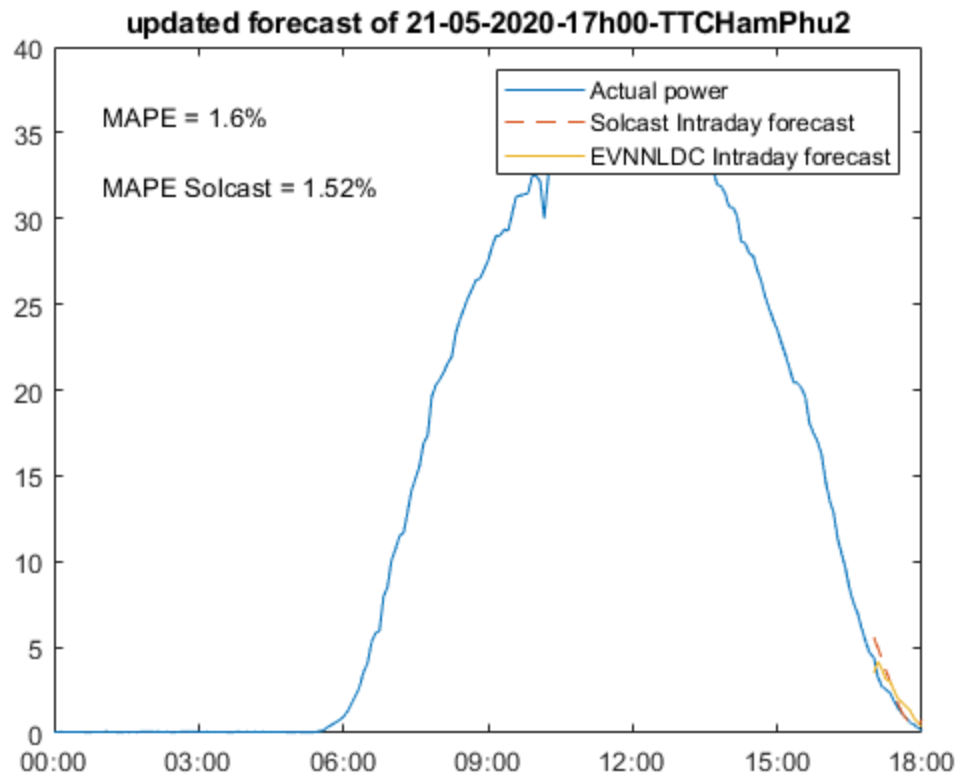












Published with MATLAB® R2018a

Published with MATLAB® R2018a