Notes & Reflections on PV_Hokk Coding

Notebook:	Var Notes		
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URL:	https://www.data.jma.go.jp/obd/stats/data/en/smp/index.html		

Notes & Reflections on PV_Hokk_Coding

First of all,, there is another evernote about the contests and the approaches "*Invitation for' PV in HOKKAIDO Contest " hosted by TEPCO and HEPCO, Best Models for Predicting Power Output of Solar Power Plants in Hokkaido " [T-contest-2]***"**

Comment on weather data accessibility from Judges on other contest on load forecasting (it seems need a vendor/provider to buy the data from)
https://cuusoo.com/projects/50136/challenges/result https://cuusoo.com/projects/50136
"*Although this team had limited access to the weather forecast data in Japan* and were not able to use a local weather vendor during the Actual Forecast*, they derived very high accuracy in both forecast of the Annual Forecast and the Actual Forecast. This suggests that if the weather data from a local weather vendor was used, this team may improve their performance in the prediction.*"
" *Despite using data that can be obtained free of charge, their method devised a means of achieving stable load forecasts even when weather forecasts are inaccurate.*"
But this below Japanese website from the load forecast report seems have data daily, month, year (in Japanese language**)**
http://www.data.jma.go.jp/obd/stats/etrn/index.php?prec_no=&block_no=&year=2018&month=12&day=&view=
http://nlftp.mlit.go.jp/ksj-e/index.html
Try the global or American websites (saved in data collection presentation)

In the Q&A section of the PV contest description: https://cuusoo.com/projects/50369
Q. Why predict the past?
A. Since the actual values of power output of solar power plants are not open to the public, **participants are to predict power output of solar power plants using meteorological actual data etc**. In this contest, we are seeking methods to accurately predict the power output from the given sources.

The following paper from japan and mentioned in data collection PPT file as a study of solar power variability:
☑Murata, A., Yamaguchi, H., & Otani, K. (2009). A method of estimating the output fluctuation of many photovoltaic power generation systems dispersed in a wide area. *Electrical Engineering in Japan*, *166*(4), 9-19. (Cited by 82)
The following papers are mentioning Hokkaido and have some results, in Mendeley:
☑***Junior, J. G. D. S. F., Oozeki, T., Ohtake, H., Shimose, K. I., Takashima, T., & Ogimoto, K. (2014). Forecasting regional photovoltaic power generation-a comparison of strategies to obtain one-day-ahead data. *Energy Procedia*, *57*, 1337-1345. (Cited by 9 one. To evaluate the strategies data of 6 PV systems, 149 kWh of installed capacity, in different locations in Hokkaido, Japan, were used to make 1 year of forecasts.)
☑Suzuki, T., Goto, Y., Terazono, T., Wakao, S., & Oozeki, T. (2013). Forecasting of solar irradiance with just-in-time modeling. *Electrical Engineering in Japan*, *182*(4), 19-28. (Cited by 7, It has Table 2 shows MAE accuracy for cities of Hokkaido)
☑Thevenard, D., & Pelland, S. (2013). Estimating the uncertainty in long-term photovoltaic yield predictions. *Solar energy*, *91*, 432-445. (Cited by 148, Iy has Ref [17] says 3.5% annual loss of PV power in Japan as a result of snow presencsnow not 3.5% losses)
☑Sugiura, T., Yamada, T., Nakamura, H., Umeya, M., Sakuta, K., & Kurokawa, K. (2003). Measurements, analyses and evaluation of residential PV systems by Japanese monitoring program. *Solar energy materials and solar cells*, *75*(3-4), 767-779. (Cited by 56, this Ref [17] in above paper which cited for 3.5%annual loss of PV power in Japan as a result of snow presence.)
☑Ohba, M., Kadokura, S., & Nohara, D. (2016). Impacts of synoptic circulation patterns on wind power ramp events in East Japan. *Renewable Energy*, *96*, 591-602.(Cited by 16, It's is well known that the AO significantly affect the climate in northern part (Hokkaido and Tohoku) of Japan. The Arctic Oscillation (AO) is the dominant mode ofvariability in atmospheric circulation in the Northern Hemisphere. It is wind study but can also affect the solar.)
Some papers that mentioned (Japan Meteorological Agency) in Mendeley:
☑Ohtake, H., Shimose, K. I., da Silva Fonseca Jr, J. G., Takashima, T., Oozeki, T., & Yamada, Y. (2013). Accuracy of the solar irradiance forecasts of the Japan Meteorological Agency mesoscale model for the Kanto region, Japan. *Solar Energy*, *98*, 138-152. (Cited by 30, it is testing JMA's accuracy for GHI forecast)
☑Liu, Y., Shimada, S., Yoshino, J., Kobayashi, T., Miwa, Y., & Furuta, K. (2016). Ensemble forecasting of solar irradiance by applying a mesoscale meteorological model. *Solar Energy*, *136*, 597-605. (Cited by 11The computational settings for the weather forecasting with WRF are summarized in Table 1....including JMA and other NWPs)
☑Santos, B., Monteiro, C., Soares, C., Catalão, J., Osório, G., Rojas, J., ... & Sanz, J. C. (2013). Report on the mathematical formulation of the different forecasting models and data analysis. *Deliverable D2*, *1*, 35-101. (Cited by 3, it includes a list of Global NWP models, such as GFS, ECMWF, JMA andKorea Meteorological Agency. It also citing Ref[104] of hydropower output forecast which uses historical precipitation data from JMA).
☑Ren, Y., Suganthan, P. N., & Srikanth, N. (2015). Ensemble methods for wind and solar power forecasting—A state-of-the-art review. *Renewable and Sustainable Energy Reviews*, *50*, 82-91.(Cited by 99, it review a paper on solar [19] using historical input data for 2 years from JMA.)

☑Chaouachi, A., Kamel, R. M., Ichikawa, R., Hayashi, H., & Nagasaka, K. (2009). Neural network ensemble-based solar power generation short-term forecasting. *World Academy of Science, Engineering and Technology*, *54*, 54-59.(Cited by 43, Ref [19] in the review paper above, data including cloud cover and sunshine duration collected from JMA.)

☑***Junior, J. G. D. S. F., Oozeki, T., Ohtake, H., Shimose, K. I., Takashima, T., & Ogimoto, K. (2014). Forecasting regional photovoltaic power generation-a comparison of strategies to obtain one-day-ahead data. *Energy Procedia*, *57*, 1337-1345.(Cited by 9, this paper also including Hokkaido. The weather forecast from GPV-MSM system of the JMA was used. GPV-MSM provides forecasts of several weather-related variables in every 3 hours UTC time, with forecast horizon ranges from15 to 33 hours.)

☑Forecasting wind gusts in winter storms using a calibrated convection-permitting ensemble, (COSMO-DE-EPS system contains various members from global models of four centers: ECMWF, DWD, National Centers for Environmental Prediction and JMA)

- Plot the PV power figs by plot or ggplot of the hourly variability with x-axis dates (not numerical values) **..Done** (*It seems the power from S1 is more consonant than S2, since S2 at July 2016 has several low output, why? more likely it is not weather since teh S1 and S2 should be depended in weather. The reason could be rooted to the operational conditions, so that the operational condition of PV systems in S1 and S2 could be included as an input feature for forecast the solar power.)*
- Check the weather data (solar radiation, cloud cover) for the month July for PV systems of S2, to see whether the weather is behind this low outcomes or the operational conditions, if operational it should be included for forecasts or excluding this period of time from training data.
- Draw boxplots hourly PV power before the trending and after the detrending (subtract or division of clear-sky model) or checking them by summary (min, max, mean, iqr, etc.)**..Done** (*It's not necessary that by detrending the variability becomes less, actually the variability could increase. But it is obvious that the seasonality is removed and the data become more stationary.)*

Std for PV S1 at 12:00

P_orig	P_det_div	P_det_sub
0.2995686	0.3084343	0.2833698

Std for PV S1 at 07:00

P_orig	P_det_div	P_det_sub
0.1738884	0.3379325	0.1539123

- Should the values of the trended data that are greater than 1 replaced by 1, **ypd[ypd>1]<- 1**, or there is no necessary, because that could leadd to confusion in the transforming back after the forecasting ?! (To solve this issue of values of detrend>1 I found using hours each 10 or 14 days better than 7 days in the filter: **df_h$S1=runmax(df_h$S1,14)**
- Include the albedo and check its effects on the solar power in the historical data,because Hokkaido is snowy region.
- To convince about the model complexity provide with and without results and improvement in forecasts skill. Such as using post processing approach to adjothe surface solar radiation from NWP(s) with its ground measurements and then using this approach to a adjust solar radiation at the locations of PV plants for further spatial refining.
- http://gpvjma.ccs.hpcc.jp/~gpvjma/ (Archive GPV-MSM from JMA)
- Weather Forecasts: https://www.meteoblue.com/en/weather/archive/yearcomparison/tokyo_japan_1850147
- Tables of Monthly (not hourly) Climate Statistics https://www.data.jma.go.jp/obd/stats/data/en/smp/index.html
- meteorological mesoscale model (MSM) https://www.jma.go.jp/jma/en/Activities/nwp.html
- Wunderground: https://www.wunderground.com/hourly/jp/sapporo?cm_ven=localwx_hour
- https://stackoverflow.com/questions/3200984/where-can-i-find-historical-raw-weather-data?rq=1 (**Stackoverflow question about where can raw weather data be found)

  Part 1. How to Use the Wunderground API · initialstate ... - GitHub

  https://github.com/topics/weather-underground

  https://github.com/Solcast/howto-pandas (Github How-To Solcast - Python, Pandas, MatPlotLib, and PvLib/ Japan)
  https://wiki.solargis.com/display/public/Solargis+API+User+Guide
- https://opendata.stackexchange.com/questions/5225/is-there-a-public-web-service-that-will-provide-hourly-forecasts-of-the-solar-ra
- https://opendata.stackexchange.com/questions/297/how-does-one-parse-weather-data (weather forecasts, data parse)
- https://stackoverflow.com/questions/6264196/parse-weather-forecast-data-from-the-ndfd-in-c-sharp (weather forecasts, data parse in C#)
- https://www.geeksforgeeks.org/python-find-current-weather-of-any-city-using-openweathermap-api/ (**Latest data parse of weather forecasts, it is useful for python scripts. BUT historical forecasts are not free. mhd3ella@yahoo.com, a...4)
- https://github.com/ZeevG/python-forecast.io (Github for weather data parsing. Darksky: mhd3ella@yahoo, Mh...3+, Secret Key: 4c1d8ffee5fc3ba8762c24c23f084a52)
- https://stackoverflow.com/questions/53186669/is-there-a-free-historic-weather-data-api-with-latitude-longitude-support (Stackoverflow code of Dark Sky)
- https://github.com/jacobtomlinson/datapoint-python (similar to Dark Sky UK weather data via the Met Office's open data API known as Datapoint).
- https://nomads.ncdc.noaa.gov/data/gfsanl/ (GFS model archive)

- https://pypi.org/project/weather-api/ (For python scripts for weather data parsing)
- https://opendata.stackexchange.com/questions/297/how-does-one-parse-weather-data (Answered by Jeanne Holm, she is an expert on open data, API, Data.gov and NASA/JP.)
- https://stackoverflow.com/questions/51313039/historical-weather-data-from-python-noaa-sdk-api-and-generator
- https://www.cpc.ncep.noaa.gov/products/wesley/wgrib2/compile_questions.html (compiling wgrib2 and info about Netcdf4)
- https://towardsdatascience.com/how-docker-can-help-you-become-a-more-effective-data-scientist-7fc048ef91d5 (since most function are based on Linux with weather data, see Docker to change the operation system virtually...."How Docker Can Help You Become A More Effective Data Scientist".
- Think of using just the weather data of last three months of 2018, Oct, Nov, Dec, in addition to the forecasting month Jan 2019.
- **NOTE (Post-processing Approach): I think the adjusting post-processing approach is good option. there is two stages for this approach. First, adjust the solar radiation by calibrating it with the solar radiation measurements to get adjusted POA solar. Second, use the adjusted solar radiation (POA) for solar power forecast at the location of the PV plants. Including both temperature and cloud cover data in both stages of this approach, it may be useful to incorporate information about surface albedo, aerosol optical depth (AOD), or snow fall in the Hokkaido location. I don't think the detrending of diurnal or annual variability might be necessary if the surface solar irradiance was provided as input to the forecast models!.**
- http://www.soda-pro.com/web-services/meteo-data/gfs-forecasts (Temperature, R.Humidity, Short-wave irradiance (GHI), wind, Snow, from GFS forecasts, as CSV. These forecasts are available for 1 month Only, so I used them for January 2019 at measurement and PV locations. **But it is not know which update are they, 00, 6:00,12:00, 18:00**?) because they should be at most at 18:00 updates not beyond in this contest.
- At the same website above, there is also MERRA forecasts http://www.soda-pro.com/web-services/meteo-data/merra;jsessionid=8AEFB9A88EC61CCCB6D0C19BEFCEA689
- I might look for easier grab website (similar to soda) online archive of GFS solar irradiance forecasts of but the updates should be clear and indicating which time the forecasts are generated each day, to be used in this contest.
- Package PVLIB_Python, especially topic of https://pvlib-python.readthedocs.io/en/latest/forecasts.html (Model data accessed with PVLIB-Python is returned as a pandas DataFrame with consistent column names: temp_air, wind_speed, total_clouds, low_clouds, mid_clouds, high_clouds, dni, dhi, **ghi**. and Tony Lorenzo Reps in GitHub.
- Also SolarData-master by Dazhi Yang has R code with grib commands for bring weather variable.
- http://iridl.ldeo.columbia.edu/SOURCES/.NOAA/.NCEP/.EMC/.CFSv2/.MONTHLY_REALTIME/.FLXF/.surface/.DSWRF/
- http://iridl.ldeo.columbia.edu/SOURCES/.ISCCP/
- http://www2.mmm.ucar.edu/wrf/users/download/free_data.html (WRF input data).

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From: 大竹秀明
Sent: Wednesday, February 13, 2019 12:17 AM
To: Mohamed Abuella

Subject: **RE: Inquiry about English version of Japan weather data**

Dear Mohamed Abuella

Thank you for your e-mail and your inquires on data access GPV-MSM.

JMA provided forecast data freely from the web site of Kyoto University.

However, the information on the data is explained in Japanese in the web site.

Would you have a contact the following address (glob-atmos@rish.kyoto-u.ac.jp)

After Dec 5, 2017, GHI forecasts from GPV-MSM and global model are provided from the database.

You can use the data base freely in the only research field.

http://database.rish.kyoto-u.ac.jp/arch/jmadata/gpv-original.html

Data base

http://database.rish.kyoto-u.ac.jp/arch/jmadata/data/gpv/original/

For a commercial use, you can receive the data from the The Japan Meteorological Business Support Center (JMBSC).

GPV datasets are not free for a commercial use.

http://www.jmbsc.or.jp/en/index-e.html

Best regards,

Hideaki

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From: Hiromasa Yoshimura
Sent: Sunday, February 17, 2019 7:18 PM
To: Mohamed Abuella

Subject: Re: Inquiry about English version of historical data of Japan weatherforecasts

Dear Mohamed Abuella,

Hello,

I search Web and find a homepage below.

http://apps.diasjp.net/gpv/

This is a Japanese homepage, but a download page below is English.

http://apps.diasjp.net/gpv/cgi-bin/GPVdate2b.sh

I hope it helps.

Sincerely,

Hiromasa Yoshimura

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