nsw_merge

August 1, 2023

[ ]:
```
import pandas as pd
import numpy as np

weather_path_cbr = "../data/nsw/au_canberra_act.csv"
weather_path_syd = "../data/nsw/au_sydney_act.csv"
solar_path = "../data/nsw/au_nsw_iso_satellite_pv_load_act.csv"
total_path_30 = '../data/nsw/au_nsw_total_load_act.csv'
total_path_5 = '../data/nsw/au_nsw_total_load_5_min.csv'
load_path = '../data/nsw/au_nsw_load_act.csv'

# load and store datasets
weather_cbr = pd.read_csv(weather_path_cbr, na_values='-99')
weather_syd = pd.read_csv(weather_path_syd, na_values='-99')
solar = pd.read_csv(solar_path, na_values='-99')
load = pd.read_csv(load_path, na_values='-99')
total_30 = pd.read_csv(total_path_30, na_values='-99')
total_5 = pd.read_csv(total_path_5, na_values='-99',␣
 ↪parse_dates=['SETTLEMENTDATE'])
```

Combine date and time to datetime for datasets where this is necessary - all but `total_5`.

[ ]:
```
def to_datetime_df(df):
    date = df['date'].astype('str')
    time = df['time'].astype('str').str.pad(4, fillchar='0')
    df['datetime'] = pd.to_datetime(date + time, format = '%Y%m%d%H%M')
    df_d = df.drop(['date', 'time'], axis = 1)
    return df_d

weather_cbr_d = to_datetime_df(weather_cbr)
weather_syd_d = to_datetime_df(weather_syd)
solar_d = to_datetime_df(solar)
load_d = to_datetime_df(load)
total_30_d = to_datetime_df(total_30)
total_5_d = total_5.rename({'SETTLEMENTDATE': 'datetime', 'TOTALDEMAND':␣
 ↪'load_act'}, axis=1).drop('RRP', axis=1)
```

Fix NAs and the latent 5-min step observations in the 30-min step total load data

[ ]:
```
print('NAs in 30-min file:', total_30_d['load_act'].isna().sum(), 'of',␣
 ↪total_30_d.shape[0])
#actually_30 = total_30_d['datetime'].shift(-1) - total_30_d['datetime'] == pd.
 ↪Timedelta('30m')
actually_30 = ~(total_30_d.diff()['datetime'] == pd.Timedelta('5m'))

total_30_actual = total_30_d[actually_30]
total_30_5 = total_30_d[~actually_30]

print('NAs in 30-min subset:', total_30_actual['load_act'].isna().sum(), 'of',␣
 ↪total_30_actual.shape[0],
    'range', total_30_actual['datetime'].
 ↪describe(datetime_is_numeric=True)[['min', 'max']].values)

total_30_actual_nas = total_30_actual.loc[total_30_actual['load_act'].isna(),␣
 ↪'datetime']
print('30-min NAs:', total_30_actual_nas.shape[0], 'in range',␣
 ↪total_30_actual_nas.describe(datetime_is_numeric=True)[['min', 'max']].
 ↪values)

print('NAs in 5-min subset:', total_30_5['load_act'].isna().sum(), 'of',␣
 ↪total_30_5.shape[0],
    'in range', total_30_5['datetime'].
 ↪describe(datetime_is_numeric=True)[['min', 'max']].values)

total_30_5_nas = total_30_5.loc[total_30_5['load_act'].isna(), 'datetime']
print('5-min NA range:', total_30_5_nas.shape[0], 'in range', total_30_5_nas.
 ↪describe(datetime_is_numeric=True)[['min', 'max']].values)
```

```
NAs in 30-min file: 24623 of 194784
NAs in 30-min subset: 24623 of 128545 range [Timestamp('2016-01-01 00:00:00')
Timestamp('2022-11-09 00:00:00')]
30-min NAs: 24623 in range [Timestamp('2021-10-01 00:30:00')
Timestamp('2022-11-08 23:30:00')]
NAs in 5-min subset: 0 of 66239 in range [Timestamp('2021-10-01 00:10:00')
Timestamp('2022-05-19 00:00:00')]
5-min NA range: 0 in range [NaT NaT]
```

Looks like we are stuck with the NAs in the range of 2022-05-19 to 2022-11-08.

Unless…… a script were to exist that could `retrieve.sh` the raw values from AEMO.

[ ]:
```
scripted_total = pd.read_csv('../data/nsw/demand_nsw_201601_202307.csv',␣
 ↪na_values='-99')
scripted_total['datetime'] = pd.to_datetime(scripted_total['SETTLEMENTDATE'])
scripted_total.drop(['REGION', 'RRP', 'PERIODTYPE', 'SETTLEMENTDATE'], axis=1,␣
 ↪inplace=True)
scripted_total.rename({'TOTALDEMAND': 'total_load'}, axis=1, inplace=True)
```

```
print('NAs in script-retrieved total load:', scripted_total['total_load'].
 ↪isna().sum())
scripted_total.describe(datetime_is_numeric=True)
```

```
NAs in script-retrieved total load: 0
```

[ ]:
```
          total_load                      datetime
count  293472.000000                        293472
mean     7680.646296  2021-05-12 23:09:33.650638592
min      3957.320000           2016-01-01 00:30:00
25%      6742.987500           2020-03-08 12:22:30
50%      7539.670000           2022-03-09 12:02:30
75%      8415.215000           2022-11-19 06:01:15
max     13985.870000           2023-08-01 00:00:00
std      1287.553396                           NaN
```

Fantastic. Now a single dataframe without missing values covers the full range of desired dates.

Weather data is hourly, so average up total, net, and pv load observations to hourly, then concatenate the older 30-min total load frame with the newer 5-min total load.

[ ]:
```
solar_hour = solar_d.set_index('datetime').resample(rule='H', closed='right',␣
 ↪label='right').mean()
load_hour = load_d.set_index('datetime').resample(rule='H', closed='right',␣
 ↪label='right').mean()
total_hour = scripted_total.set_index('datetime').resample('H', closed='right',␣
 ↪label='right').mean()
```

Now rename columns in preparation for join

[ ]:
```
load_hour.rename({'load_act': 'net_load'}, axis=1, inplace=True)
solar_hour.rename({'load_act': 'pv_est'}, axis=1, inplace=True)
weather_cbr_d.columns = [f'{x}_cbr' for x in weather_cbr_d.columns[:-1]] +␣
 ↪['datetime']
weather_syd_d.columns = [f'{x}_syd' for x in weather_syd_d.columns[:-1]] +␣
 ↪['datetime']

load_hour.columns, total_hour.columns, solar_hour.columns, weather_cbr_d.
 ↪columns, weather_syd_d.columns
```

[ ]:
```
(Index(['net_load'], dtype='object'),
 Index(['total_load'], dtype='object'),
 Index(['pv_est'], dtype='object'),
 Index(['tempc_cbr', 'cloud8_cbr', 'windk_cbr', 'wdir_cbr', 'humid_cbr',
        'rainmm_cbr', 'radkjm2_cbr', 'datetime'],
       dtype='object'),
 Index(['tempc_syd', 'cloud8_syd', 'windk_syd', 'wdir_syd', 'humid_syd',
        'rainmm_syd', 'radkjm2_syd', 'datetime'],
       dtype='object'))
```

[ ]:
```
load_total = load_hour.merge(total_hour, left_index=True, right_index=True,␣
↪copy=False, validate='1:1')
load_total_pv = load_total.merge(solar_hour, left_index=True, right_index=True,␣
↪copy=False, validate='1:1')
load_cbr = load_total_pv.reset_index().merge(weather_cbr_d, on='datetime',␣
↪copy=False, validate='1:1')
merged = load_cbr.merge(weather_syd_d, on='datetime', copy=False, validate='1:
↪1')
merged.head()
```

[ ]:

	datetime	net_load	total_load	pv_est	tempc_cbr	cloud8_cbr	\
0	2018-03-06 10:00:00	8499.5	8332.145	434.3715	19.0	2.0	
1	2018-03-06 11:00:00	8457.0	8294.325	468.8860	19.4	1.0	
2	2018-03-06 12:00:00	8396.0	8248.405	483.1315	19.1	4.0	
3	2018-03-06 13:00:00	8341.5	8193.080	491.4175	19.4	4.0	
4	2018-03-06 14:00:00	8321.5	8185.100	487.9780	18.9	7.0	

	windk_cbr	wdir_cbr	humid_cbr	rainmm_cbr	radkjm2_cbr	tempc_syd	\
0	15.0	110.0	52.0	0.0	2250.0	21.1	
1	14.0	140.0	49.0	0.0	2860.0	21.7	
2	15.0	150.0	52.0	0.0	2650.0	22.1	
3	14.0	140.0	55.0	0.0	2710.0	22.6	
4	17.0	120.0	57.0	0.0	1730.0	23.0	

	cloud8_syd	windk_syd	wdir_syd	humid_syd	rainmm_syd	radkjm2_syd
0	3.0	21.004327	190.0	71.0	0.0	1710.0
1	3.0	19.978409	180.0	71.0	0.0	2080.0
2	3.0	21.976250	180.0	65.0	0.0	2760.0
3	4.0	20.950332	180.0	67.0	0.0	2840.0
4	2.0	20.950332	180.0	65.0	0.0	2850.0

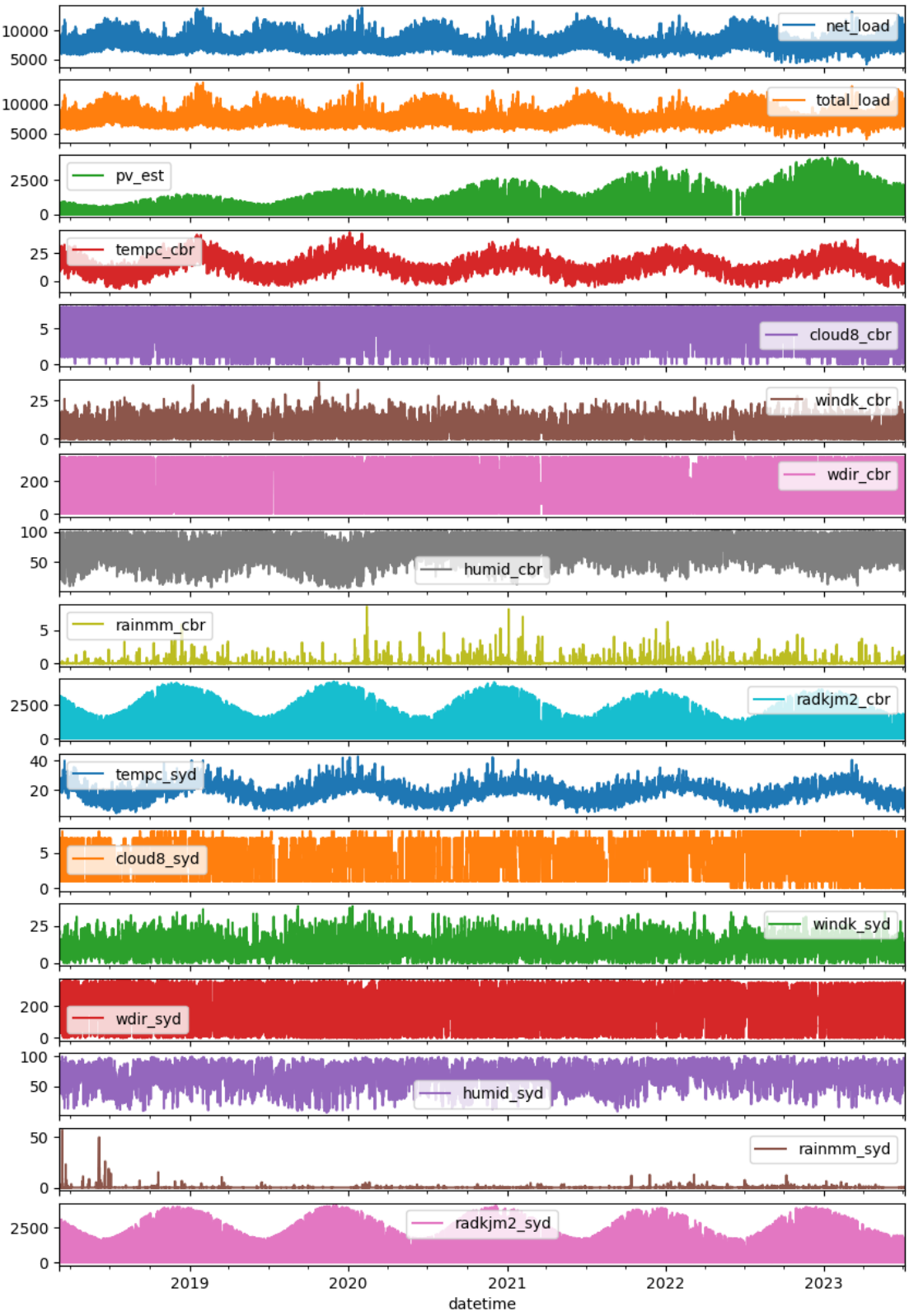
Ensure result is sorted by timestamp.

[ ]:
```
merged.sort_values(by='datetime', inplace=True)
```

Plot all columns against timestamp as a sanity check.

[ ]:
```
merged.plot(x='datetime', subplots=True, figsize=(10, 15))
```

[ ]:
```
array([<Axes: xlabel='datetime'>, <Axes: xlabel='datetime'>,
       <Axes: xlabel='datetime'>, <Axes: xlabel='datetime'>,
       <Axes: xlabel='datetime'>, <Axes: xlabel='datetime'>,
       <Axes: xlabel='datetime'>, <Axes: xlabel='datetime'>,
       <Axes: xlabel='datetime'>, <Axes: xlabel='datetime'>,
       <Axes: xlabel='datetime'>], dtype=object)
```


net_load
total_load
pv_est
tempc_cbr
cloud8_cbr
windk_cbr
wdir_cbr
humid_cbr
rainmm_cbr
radkjm2_cbr
tempc_syd
cloud8_syd
windk_syd
wdir_syd
humid_syd
rainmm_syd
radkjm2_syd
2019
2020
2021
2022
2023
datetime

[ ]:
```
merged.describe().round()
```

[ ]:
```
       net_load  total_load   pv_est  tempc_cbr  cloud8_cbr  windk_cbr  \
count   46752.0     46752.0  46204.0    46740.0     46740.0    46740.0
mean     7835.0      7742.0    454.0       13.0         6.0        7.0
std      1259.0      1254.0    696.0        7.0         2.0        5.0
min      4130.0      4023.0      0.0       -7.0         0.0        0.0
25%      6928.0      6836.0      0.0        8.0         4.0        4.0
50%      7700.0      7602.0     23.0       13.0         6.0        6.0
75%      8556.0      8455.0    719.0       18.0         8.0       10.0
max     13806.0     13654.0   4146.0       43.0         8.0       37.0

       wdir_cbr  humid_cbr  rainmm_cbr  radkjm2_cbr  tempc_syd  cloud8_syd  \
count   46740.0    46740.0     46717.0      46740.0    46660.0     31497.0
mean      169.0       71.0         0.0        598.0       18.0         5.0
std       124.0       22.0         0.0        894.0        5.0         2.0
min         0.0        5.0         0.0          0.0        5.0         0.0
25%        60.0       55.0         0.0          0.0       15.0         2.0
50%       140.0       75.0         0.0         30.0       19.0         5.0
75%       300.0       90.0         0.0        960.0       22.0         7.0
max       350.0      100.0         8.0       4200.0       42.0         8.0

       windk_syd  wdir_syd  humid_syd  rainmm_syd  radkjm2_syd
count    46663.0   46662.0    46663.0     46648.0      46740.0
mean        11.0     191.0       68.0         0.0        665.0
std          6.0     108.0       18.0         1.0        950.0
min          0.0       0.0        6.0         0.0          0.0
25%          7.0     100.0       56.0         0.0          0.0
50%         10.0     200.0       70.0         0.0         40.0
75%         14.0     290.0       82.0         0.0       1160.0
max         38.0     360.0      100.0        56.0       4070.0
```

[ ]:
```
merged.isna().mean()
```

[ ]:
```
datetime       0.000000
net_load       0.000000
total_load     0.000000
pv_est         0.011721
tempc_cbr      0.000257
cloud8_cbr     0.000257
windk_cbr      0.000257
wdir_cbr       0.000257
humid_cbr      0.000257
rainmm_cbr     0.000749
radkjm2_cbr    0.000257
tempc_syd      0.001968
cloud8_syd     0.326296
```

```
windk_syd      0.001904
wdir_syd       0.001925
humid_syd      0.001904
rainmm_syd     0.002225
radkjm2_syd    0.000257
dtype: float64
```

Write to file.

[ ]:
```
merged.to_csv('../data/nsw/merged.csv', index=False)
```

In case we want to compare against a 30-minute timestep with weather variables upsampled via interpolation..

[ ]:
```
solar_30 = solar_d.set_index('datetime')
load_30 = load_d.set_index('datetime')
total_30_real = scripted_total.set_index('datetime').resample('30min',␣
 ↪closed='right', label='right').mean()
```

[ ]:
```
load_30.rename({'load_act': 'net_load'}, axis=1, inplace=True)
solar_30.rename({'load_act': 'pv_est'}, axis=1, inplace=True)
weather_cbr_30 = weather_cbr_d.set_index('datetime').resample('30min').asfreq().
 ↪interpolate()
weather_syd_30 = weather_syd_d.set_index('datetime').resample('30min').asfreq().
 ↪interpolate()

load_hour.columns, total_hour.columns, solar_hour.columns, weather_cbr_30.
 ↪columns, weather_syd_30.columns
```

[ ]:
```
(Index(['net_load'], dtype='object'),
 Index(['total_load'], dtype='object'),
 Index(['pv_est'], dtype='object'),
 Index(['tempc_cbr', 'cloud8_cbr', 'windk_cbr', 'wdir_cbr', 'humid_cbr',
        'rainmm_cbr', 'radkjm2_cbr'],
       dtype='object'),
 Index(['tempc_syd', 'cloud8_syd', 'windk_syd', 'wdir_syd', 'humid_syd',
        'rainmm_syd', 'radkjm2_syd'],
       dtype='object'))
```

[ ]:
```
load_total_30 = load_30.merge(total_30_real, left_index=True, right_index=True,␣
 ↪copy=False, validate='1:1')
load_total_pv_30 = load_total_30.merge(solar_30, left_index=True,␣
 ↪right_index=True, copy=False, validate='1:1')
load_cbr_30 = load_total_pv_30.reset_index().merge(weather_cbr_30,␣
 ↪on='datetime', copy=False, validate='1:1')
merged_30 = load_cbr_30.merge(weather_syd_30, on='datetime', copy=False,␣
 ↪validate='1:1')
merged_30.head()
```

[ ]:

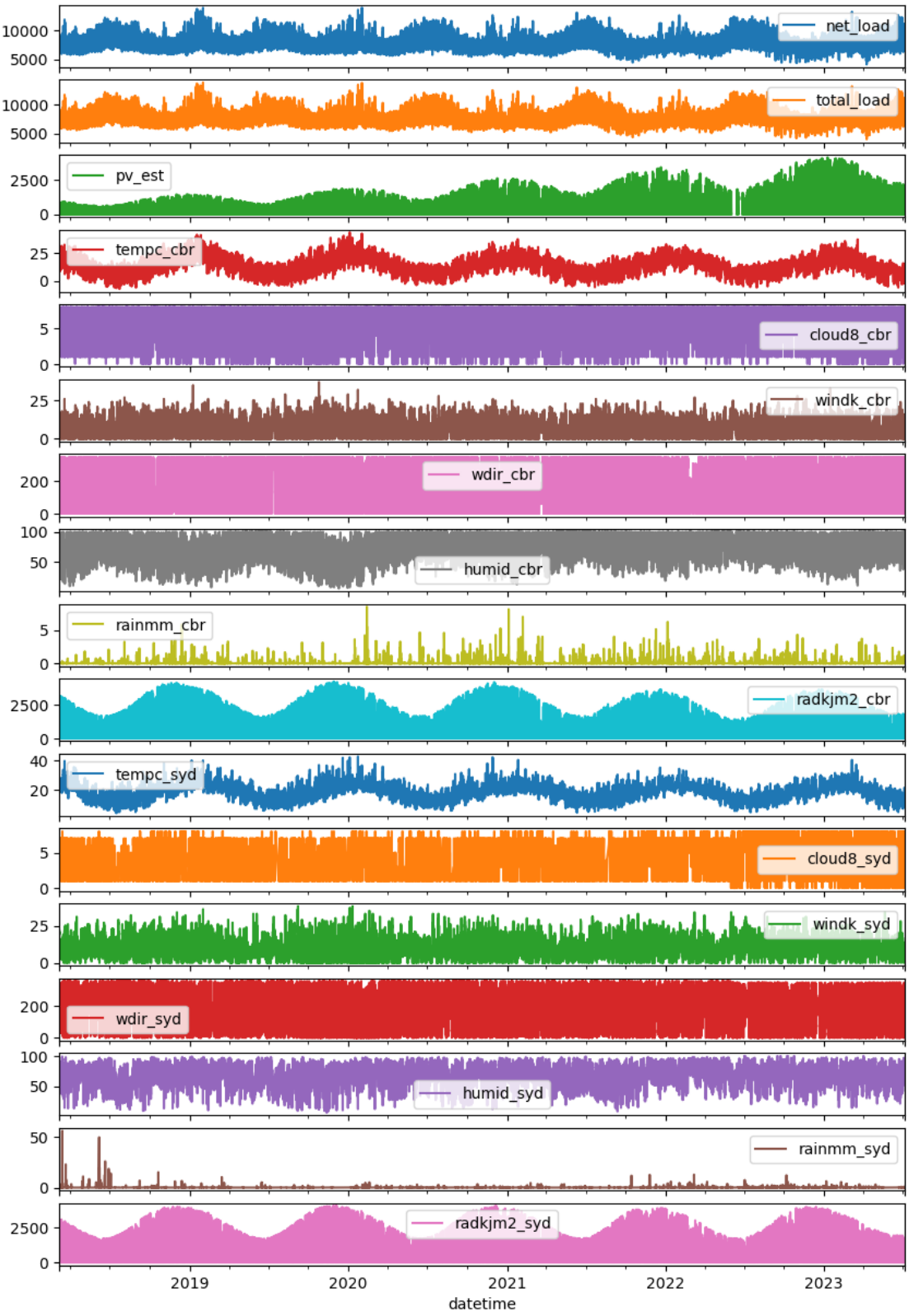
	datetime	net_load	total_load	pv_est	tempc_cbr	cloud8_cbr	\
0	2018-03-06 09:30:00	8503	8325.67	417.157	18.30	3.5	
1	2018-03-06 10:00:00	8496	8338.62	451.586	19.00	2.0	
2	2018-03-06 10:30:00	8467	8323.66	460.385	19.20	1.5	
3	2018-03-06 11:00:00	8447	8264.99	477.387	19.40	1.0	
4	2018-03-06 11:30:00	8404	8247.11	485.900	19.25	2.5	

	windk_cbr	wdir_cbr	humid_cbr	rainmm_cbr	radkjm2_cbr	tempc_syd	\
0	13.5	115.0	54.0	0.0	1720.0	21.35	
1	15.0	110.0	52.0	0.0	2250.0	21.10	
2	14.5	125.0	50.5	0.0	2555.0	21.40	
3	14.0	140.0	49.0	0.0	2860.0	21.70	
4	14.5	145.0	50.5	0.0	2755.0	21.90	

	cloud8_syd	windk_syd	wdir_syd	humid_syd	rainmm_syd	radkjm2_syd
0	3.5	20.005406	175.0	66.0	2.5	1390.0
1	3.0	21.004327	190.0	71.0	0.0	1710.0
2	3.0	20.491368	185.0	71.0	0.0	1895.0
3	3.0	19.978409	180.0	71.0	0.0	2080.0
4	3.0	20.977329	180.0	68.0	0.0	2420.0

[ ]:
```
merged_30.sort_values(by='datetime', inplace=True)
merged_30.plot(x='datetime', subplots=True, figsize=(10, 15))
```

[ ]:
```
array([<Axes: xlabel='datetime'>, <Axes: xlabel='datetime'>,
       <Axes: xlabel='datetime'>, <Axes: xlabel='datetime'>,
       <Axes: xlabel='datetime'>, <Axes: xlabel='datetime'>,
       <Axes: xlabel='datetime'>, <Axes: xlabel='datetime'>,
       <Axes: xlabel='datetime'>, <Axes: xlabel='datetime'>,
       <Axes: xlabel='datetime'>], dtype=object)
```


net_load
total_load
pv_est
tempc_cbr
cloud8_cbr
windk_cbr
wdir_cbr
humid_cbr
rainmm_cbr
radkjm2_cbr
tempc_syd
cloud8_syd
windk_syd
wdir_syd
humid_syd
rainmm_syd
radkjm2_syd
2019
2020
2021
2022
2023
datetime

Compute percent difference between hourly and half-hourly data with interpolated weather

[ ]:
```
((merged.describe() - merged_30.describe()) / merged.describe()).round(3)
```

[ ]:
```
       net_load  total_load  pv_est  tempc_cbr  cloud8_cbr  windk_cbr  \
count    -1.000      -1.000  -1.000     -1.000      -1.000     -1.000
mean      0.000       0.000   0.000     -0.000      -0.000     -0.000
std      -0.004      -0.004  -0.003      0.003       0.043      0.021
min       0.007       0.006     NaN     -0.000         NaN        NaN
25%       0.001       0.001     NaN      0.006       0.000      0.125
50%       0.000      -0.000   0.348      0.004       0.000      0.000
75%       0.000      -0.000  -0.003      0.000       0.000      0.000
max      -0.002      -0.003  -0.006      0.000       0.000      0.000

       wdir_cbr  humid_cbr  rainmm_cbr  radkjm2_cbr  tempc_syd  cloud8_syd  \
count    -1.000     -1.000      -1.001       -1.000     -1.004      -1.969
mean      0.000      0.000       0.000       -0.000     -0.000       0.118
std       0.053      0.006       0.034        0.011      0.002       0.024
min         NaN      0.000         NaN          NaN      0.000         NaN
25%      -0.250     -0.009         NaN          NaN      0.000       0.250
50%      -0.071      0.007         NaN       -0.833      0.000       0.200
75%       0.000      0.006         NaN       -0.010      0.000       0.107
max       0.000      0.000       0.000        0.000      0.000       0.000

       windk_syd  wdir_syd  humid_syd  rainmm_syd  radkjm2_syd
count     -1.004    -1.004     -1.004      -1.004       -1.000
mean      -0.000     0.000     -0.000      -0.012       -0.000
std        0.017     0.035      0.006      -0.007        0.008
min          NaN       NaN      0.000         NaN          NaN
25%        0.066    -0.100      0.000         NaN          NaN
50%        0.048     0.050      0.000         NaN       -0.750
75%       -0.002     0.017      0.000         NaN        0.000
max        0.000     0.000      0.000       0.000        0.000
```

[ ]:
```
merged_30.isna().mean()
```

[ ]:
```
datetime       0.00000
net_load       0.00000
total_load     0.00000
pv_est         0.01185
tempc_cbr      0.00000
cloud8_cbr     0.00000
windk_cbr      0.00000
wdir_cbr       0.00000
humid_cbr      0.00000
rainmm_cbr     0.00000
radkjm2_cbr    0.00000
tempc_syd      0.00000
```

```
cloud8_syd     0.00000
windk_syd      0.00000
wdir_syd       0.00000
humid_syd      0.00000
rainmm_syd     0.00000
radkjm2_syd    0.00000
dtype: float64
```

Most of the difference is probably the interpolation filling in ranges of missing values. Probably.

[ ]:
```
merged_30.to_csv('../data/nsw/merged_interpolated.csv', index=False)
```