

# Master Thesis

## Normalized Electricity Consumption

### Appendix

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# 1 Data Cleaning

## 1.1 Outlier Detection and Removal

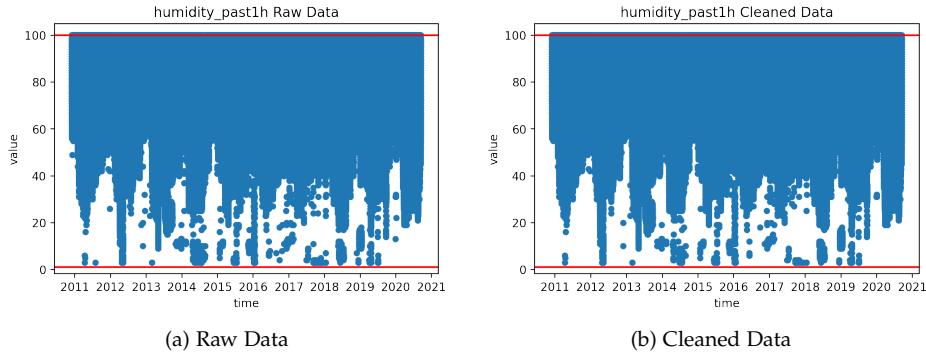


Figure 1: Humidity measurements before/after cleaning (Red lines show upper/lower bound for value)

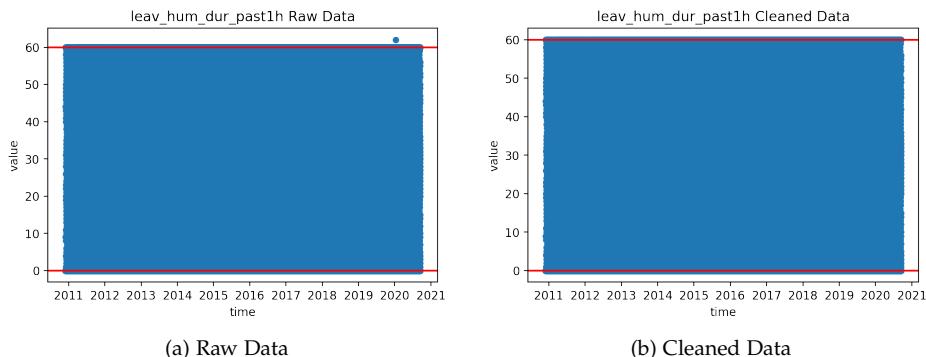


Figure 2: Leaf humidity measurements before/after cleaning (Red lines show upper/lower bound for value)

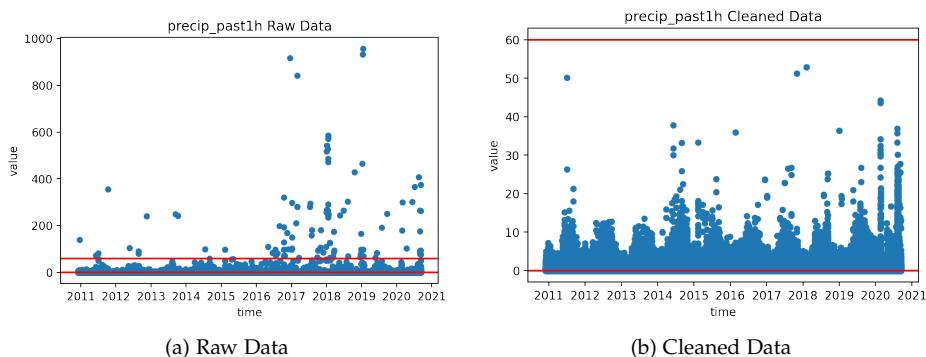


Figure 3: Precipitation measurements before/after cleaning (Red lines show upper/lower bound for value)

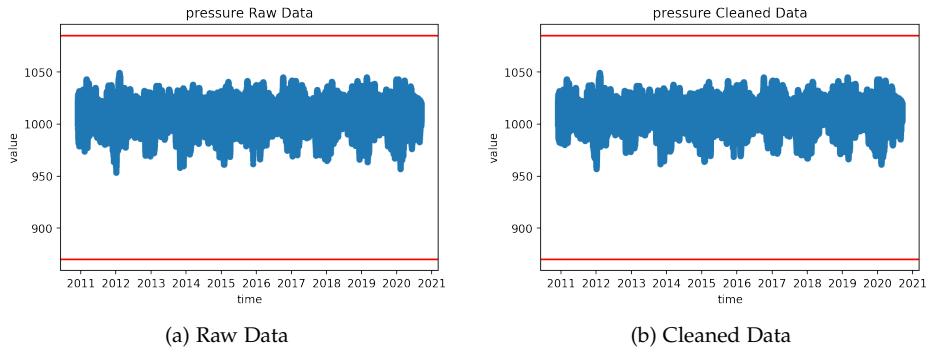


Figure 4: Pressure measurements before/after cleaning (Red lines show upper/lower bound for value)

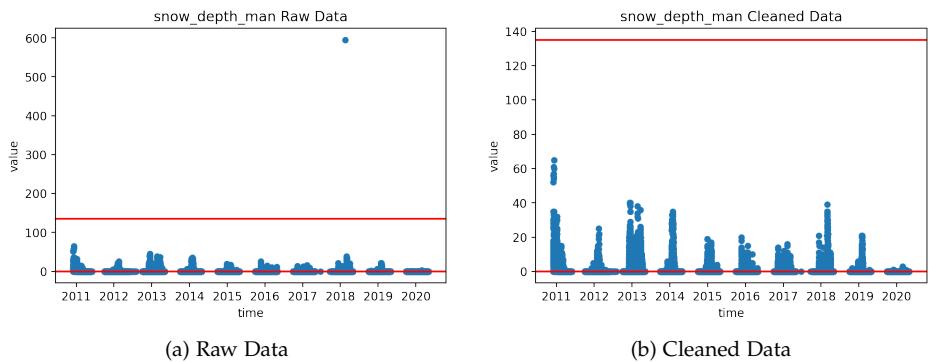


Figure 5: Snow depth measurements before/after cleaning (Red lines show upper/lower bound for value)

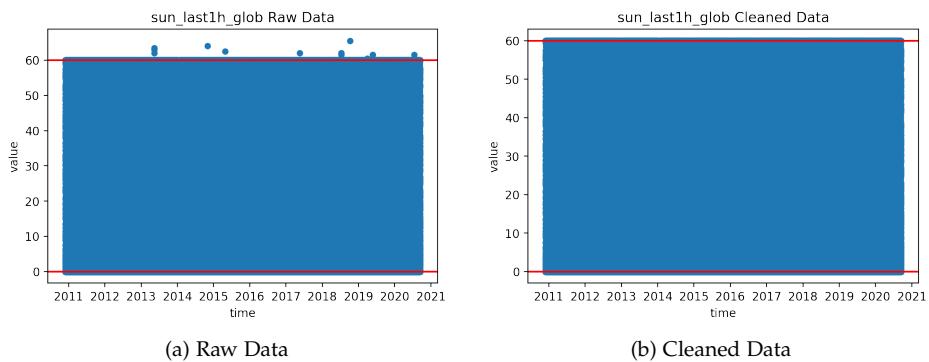


Figure 6: Sunshine duration measurements before/after cleaning (Red lines show upper/lower bound for value)

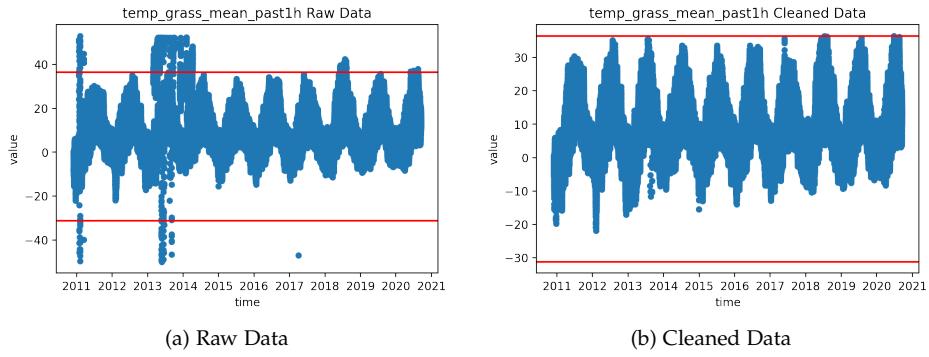


Figure 7: Grass temperature measurements before/after cleaning (Red lines show upper/lower bound for value)

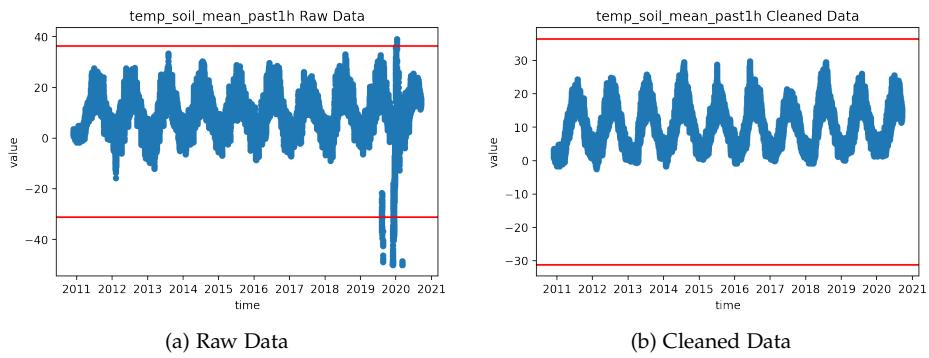


Figure 8: Soil temperature measurements before/after cleaning (Red lines show upper/lower bound for value)

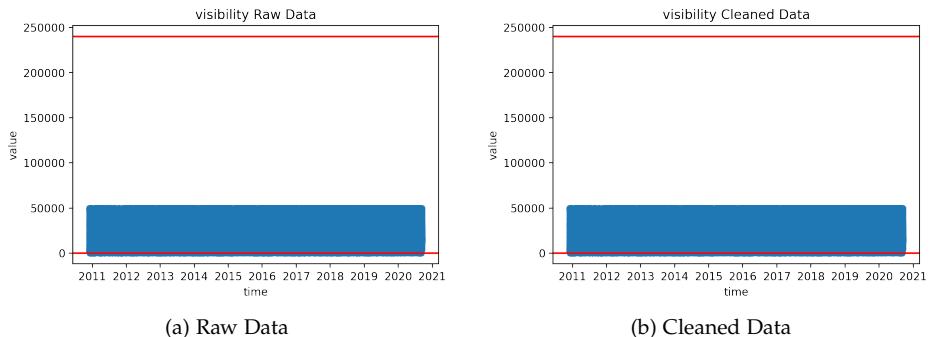


Figure 9: Visibility measurements before/after cleaning (Red lines show upper/lower bound for value)

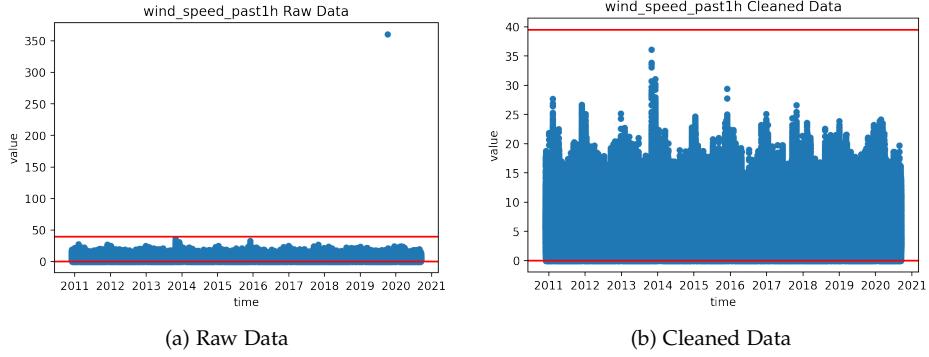


Figure 10: Wind speed measurements before/after cleaning (Red lines show upper/lower bound for value)

## 2 Multivariate Models

### 2.1 Principal Component Regression Using Multiple Weather Parameters

Table 1: The ratio of explained variance and corresponding basis vector (in row format) of each principal component, with the weather parameter associated with each dimension. Based on PCA applied to data from DK1. Basis vectors are continued in Table 2. PC stands for Principal Component.

PC	Ratio of Explained Variance	Solar Radiation	Air Temperature	Precipitation	Humidity	Sunshine Duration
1	0.704691	0.0117955	0.00055665	-2.19936e-06	-0.000770896	0.700552
2	0.195212	0.000347826	0.000609781	6.27139e-06	8.2015e-06	0.00636203
3	0.100088	-0.00941378	-0.00052608	2.86809e-06	0.000170167	-0.713414
4	8.42111e-06	0.986226	0.087808	0.000563344	0.0106818	-0.0149681
5	4.3548e-07	0.134978	-0.550321	-0.00068408	-0.0608569	-0.000715138
6	1.99291e-07	-0.0938202	0.197129	0.0037718	0.0717665	0.00132846
7	5.02347e-08	0.00435711	-0.107668	-0.000648111	0.974989	0.000673949
8	4.37601e-09	-0.00525784	-0.35779	-0.000881875	-0.137017	5.354e-05
9	3.46199e-09	-0.00454898	-0.04021	0.0200563	0.145956	0.000225571
10	3.70119e-10	-0.00640403	-0.713677	-0.00511639	-0.0185412	1.32724e-05
11	7.26607e-12	-5.26819e-05	-0.00440073	0.999778	-0.00283009	2.50763e-06

Table 2: Table 1 continued.

PC	Wind Speed	Grass Temperature	Soil Temperature	Leaf Humidity	Pressure	Visibility
1	-7.8242e-05	0.000602906	0.000545089	-0.290208	0.000218148	0.651817
2	-2.47873e-05	0.000570922	0.00058347	0.916052	-0.000416679	0.401007
3	2.51533e-05	-0.000589128	-0.000419986	-0.276816	-0.00025235	0.64368
4	0.00101022	0.093063	0.0939442	0.000332427	-0.0426397	-0.00182453
5	0.034689	-0.530089	-0.525937	0.000779392	-0.341198	0.000119482
6	0.0133616	0.192712	0.176157	-0.000703865	-0.937456	-0.000137035
7	-0.168615	-0.0773173	0.0411682	-8.54755e-05	0.0410002	0.000406936
8	-0.183391	-0.412064	0.805798	2.12854e-05	-0.0211073	-0.000117082
9	0.96673	-0.104243	0.17441	-2.26864e-05	0.0283774	9.39234e-05
10	0.0400966	0.69753	0.0457821	9.39583e-06	0.00169392	1.41117e-05
11	-0.0194864	0.00410506	-0.00360443	-2.12255e-06	0.00277461	-2.95271e-06

Table 3: The ratio of explained variance and corresponding basis vector (in row format) of each principal component, with the weather parameter associated with each dimension. Based on PCA applied to data from DK1. Basis vectors are continued in Table 4. PC stands for Principal Component.

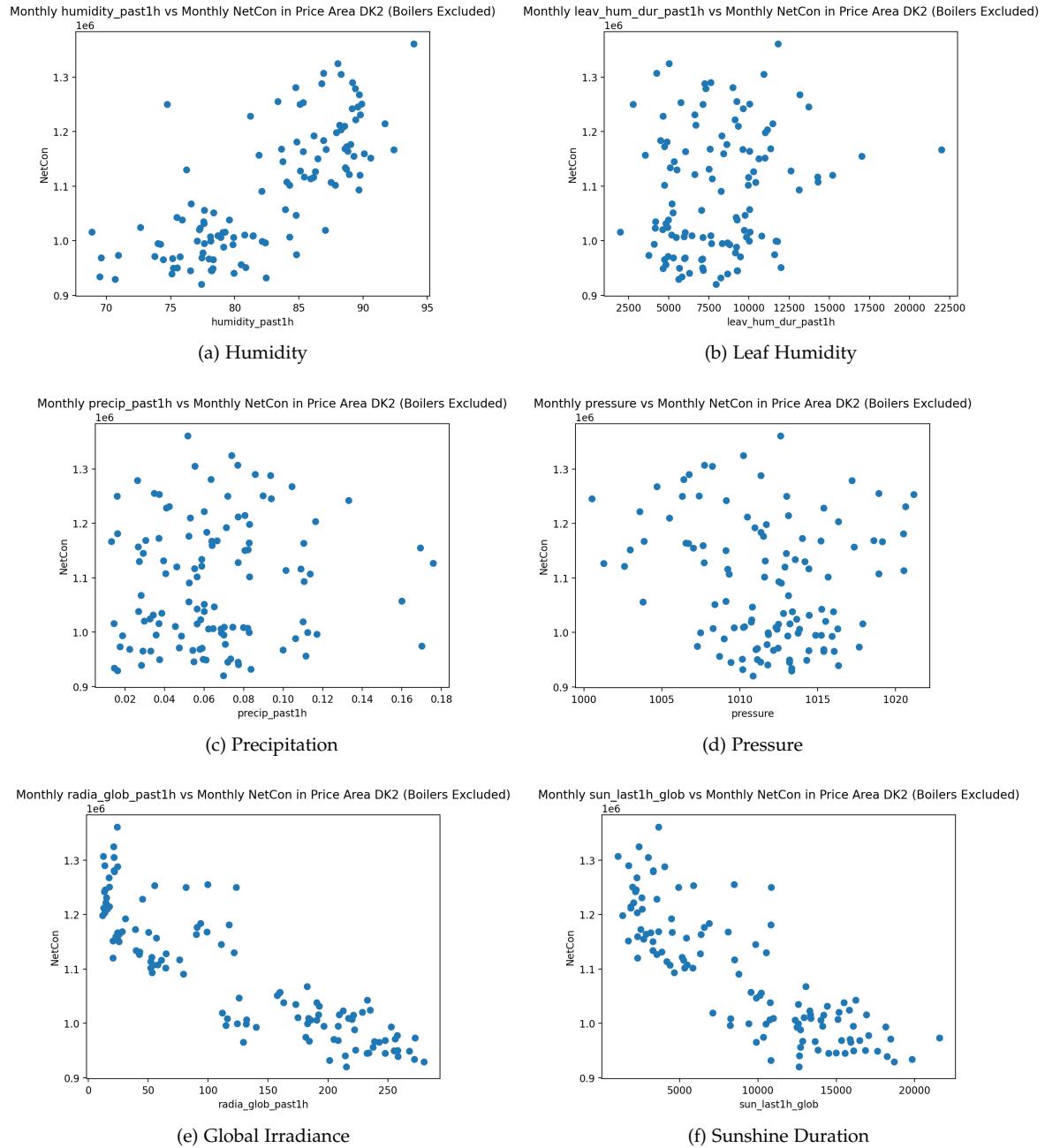
PC	Ratio of Explained Variance	Solar Radiation	Air Temperature	Precipitation	Humidity	Sunshine Duration
1	0.780636	-0.0111022	-0.000574759	1.34834e-06	0.000749351	-0.691735
2	0.121046	0.00731115	0.000828989	7.03645e-07	-9.00459e-05	0.560924
3	0.0983113	0.00516423	-0.000460877	-5.1494e-06	-0.000215106	0.454604
4	5.94089e-06	0.989945	0.0698936	0.000542289	0.0167428	-0.0141066
5	3.8827e-07	-0.120692	0.58481	0.00113075	0.0684323	0.000587111
6	1.99098e-07	-0.0715729	0.087287	0.00335315	0.070237	0.00124201
7	4.92935e-08	0.00387106	0.0743814	-0.00134614	-0.9899	-0.000777322
8	4.5375e-09	0.00423258	0.107939	0.0133372	0.0981987	5.49293e-05
9	2.59737e-09	-0.00547567	-0.263701	0.00989012	0.00519237	0.000196785
10	3.66754e-10	-0.00727841	-0.747477	0.00898132	-0.0228757	2.01974e-05
11	6.20645e-12	-9.20654e-05	0.00699132	0.999814	-0.00281063	1.79398e-06

Table 4: Table 3 continued.

PC	Wind Speed	Grass Temperature	Soil Temperature	Leaf Humidity	Pressure	Visibility
1	7.77559e-05	-0.00062333	-0.00055515	0.223011	-0.000133971	-0.686763
2	-8.9172e-05	0.000843174	0.000759959	0.764843	0.000103726	-0.31674
3	-3.76717e-05	-0.000369635	-0.000526478	-0.604384	0.000430384	-0.654238
4	-0.00314205	0.0764953	0.0775623	-0.000180608	-0.0525585	-0.00201589
5	-0.0241892	0.563437	0.545392	-0.00127749	0.152463	-0.000454592
6	0.0268232	0.0913423	0.063775	-0.000407603	-0.98447	-0.000162097
7	0.092823	0.051161	0.0122952	0.000111534	-0.0562439	-0.000420672
8	0.90728	0.219455	-0.324908	1.88414e-05	0.0403479	5.7515e-05
9	0.407758	-0.440489	0.754982	-4.80197e-05	-0.00342975	-6.25602e-05
10	-0.0198356	0.650773	0.129313	1.6205e-05	0.000870931	5.5978e-06
11	-0.0158941	-0.00533222	-0.00515193	-8.13799e-07	0.00256992	-8.34383e-07

## 2.2 Motivation for Linear Models

### 2.2.1 Monthly Data



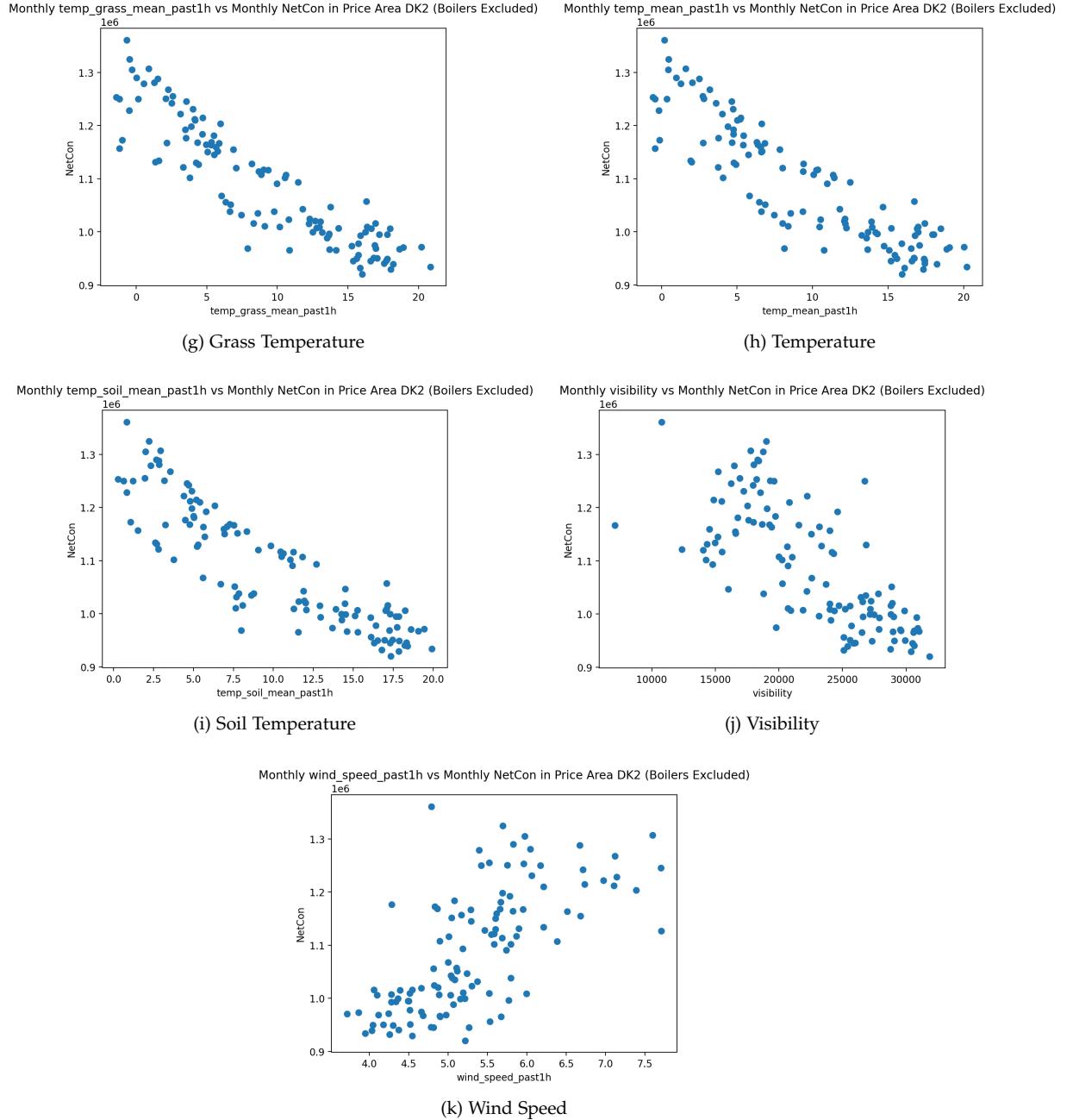
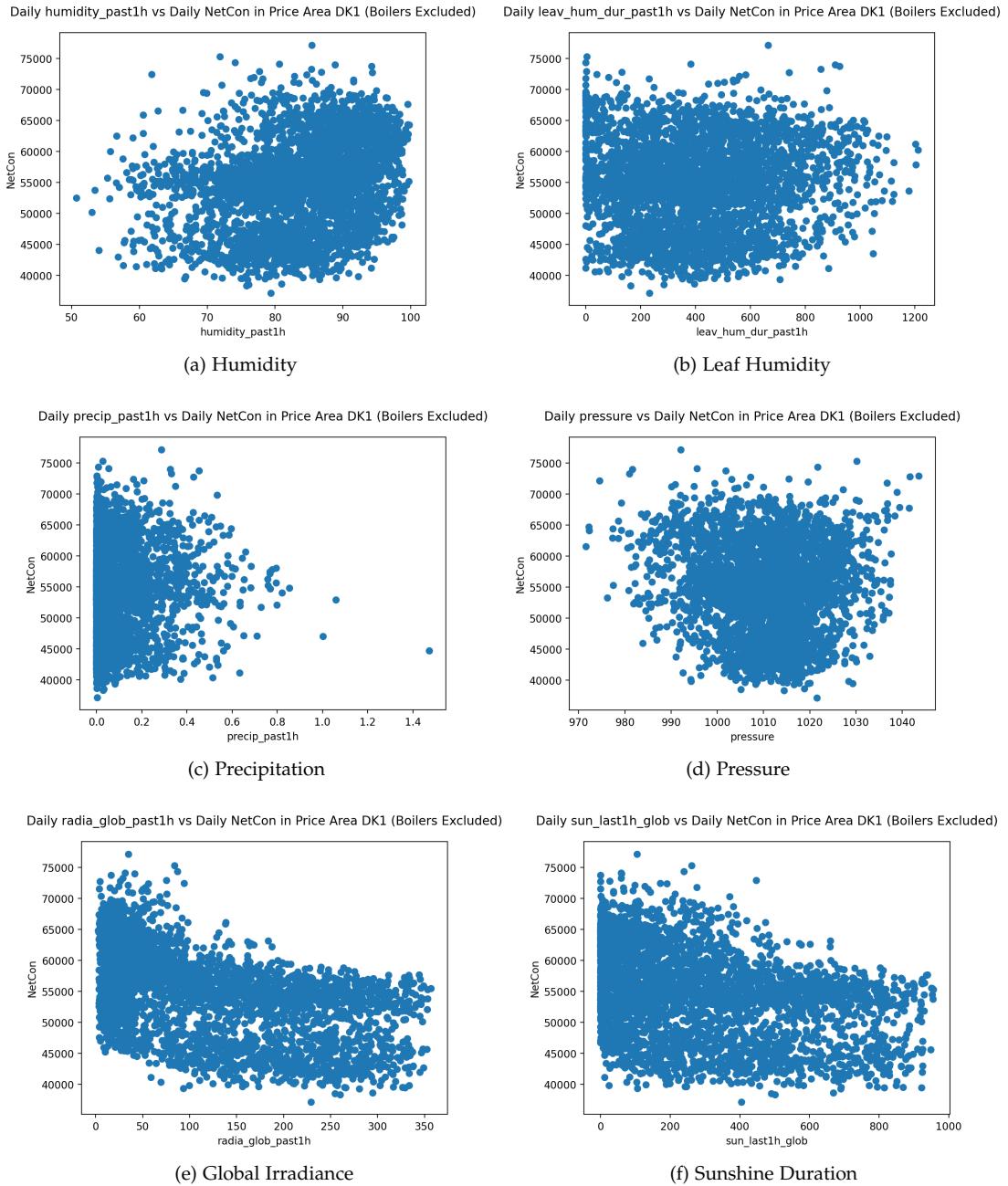


Figure 10: Plotting each weather parameter, downsampled to a monthly time resolution, versus the total monthly electricity consumption of the price area DK2.

## 2.2.2 Daily Data



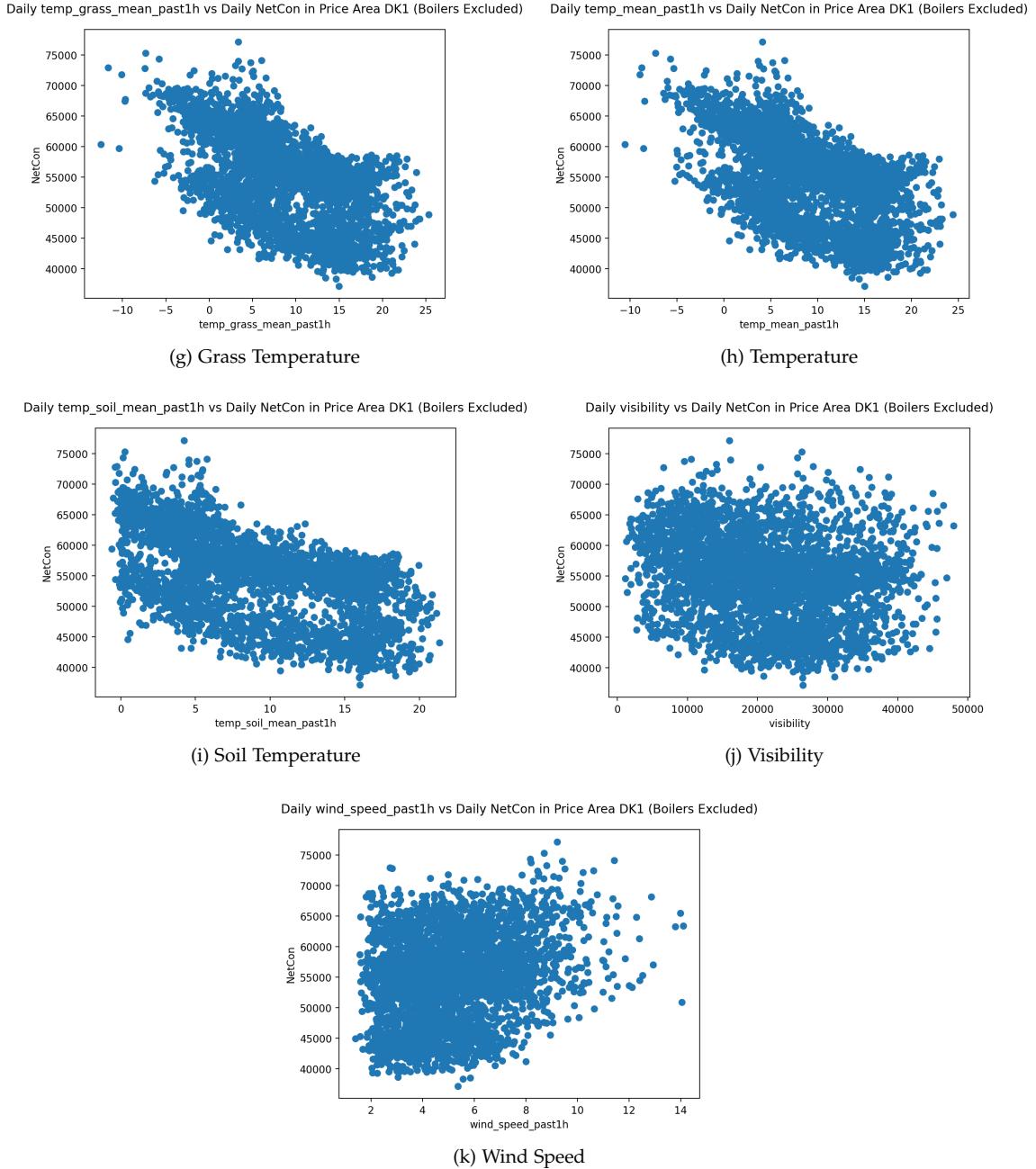
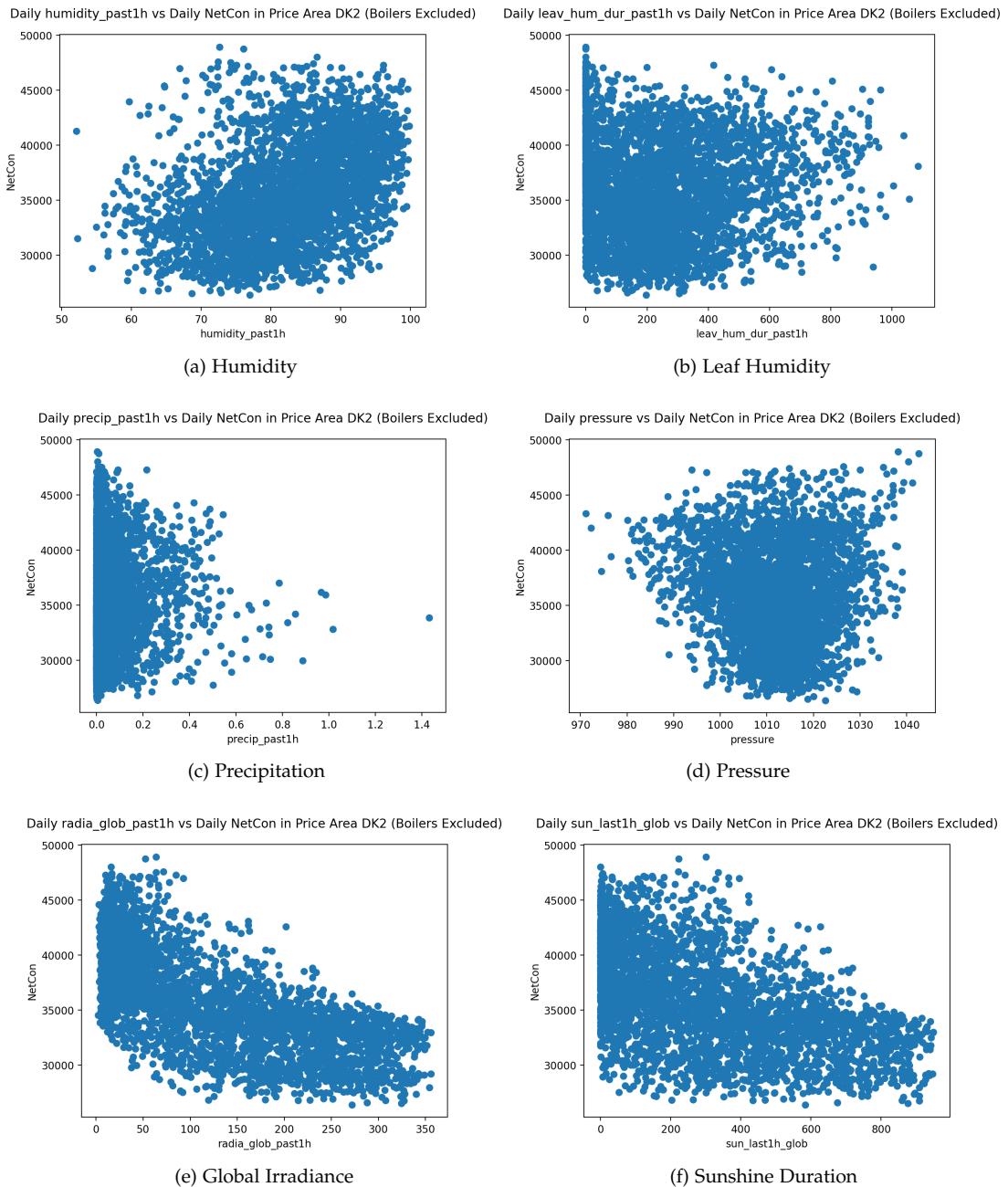


Figure 10: Plotting each weather parameter, downsampled to a Daily time resolution, versus the total Daily electricity consumption of the price area DK1.



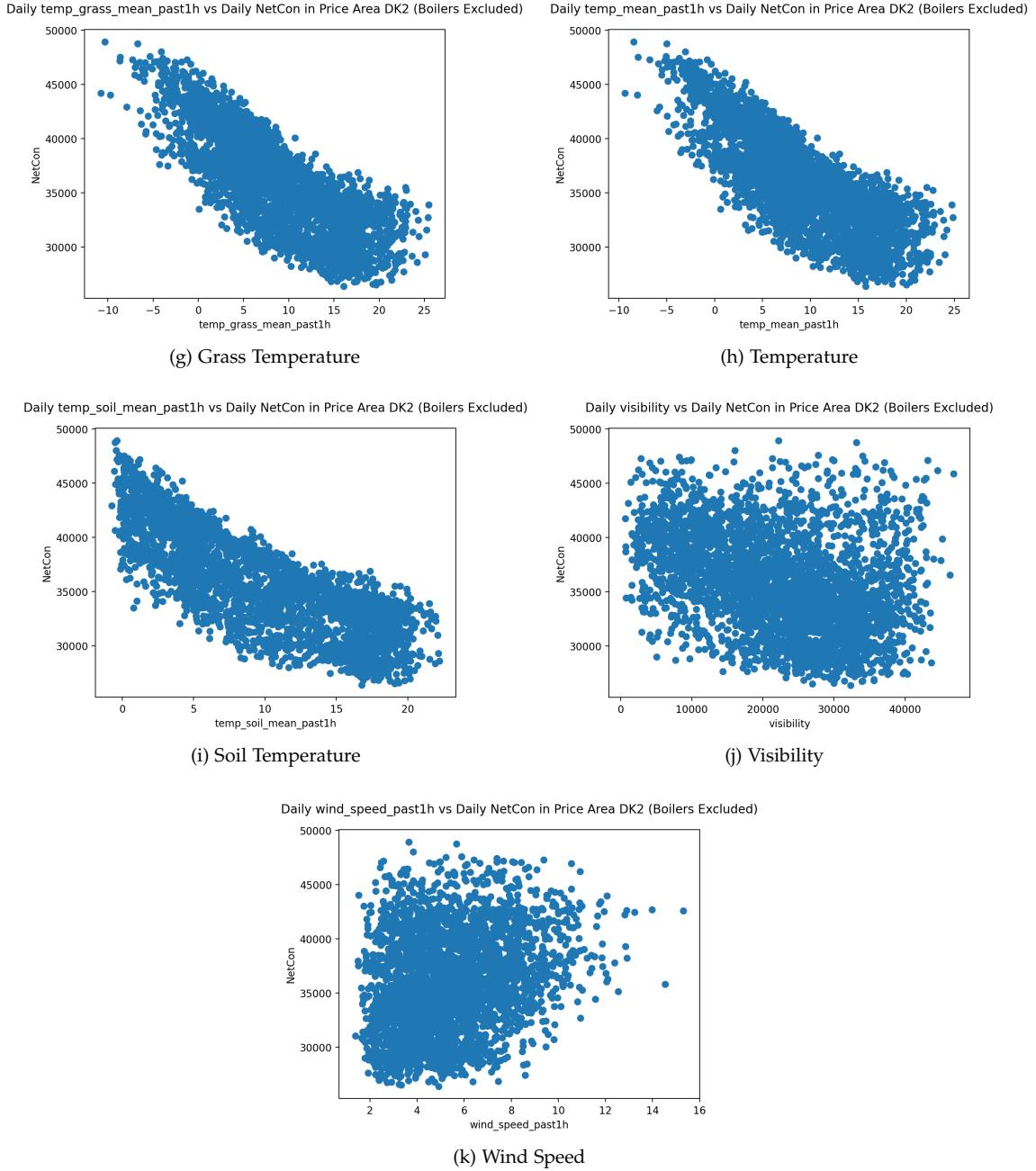
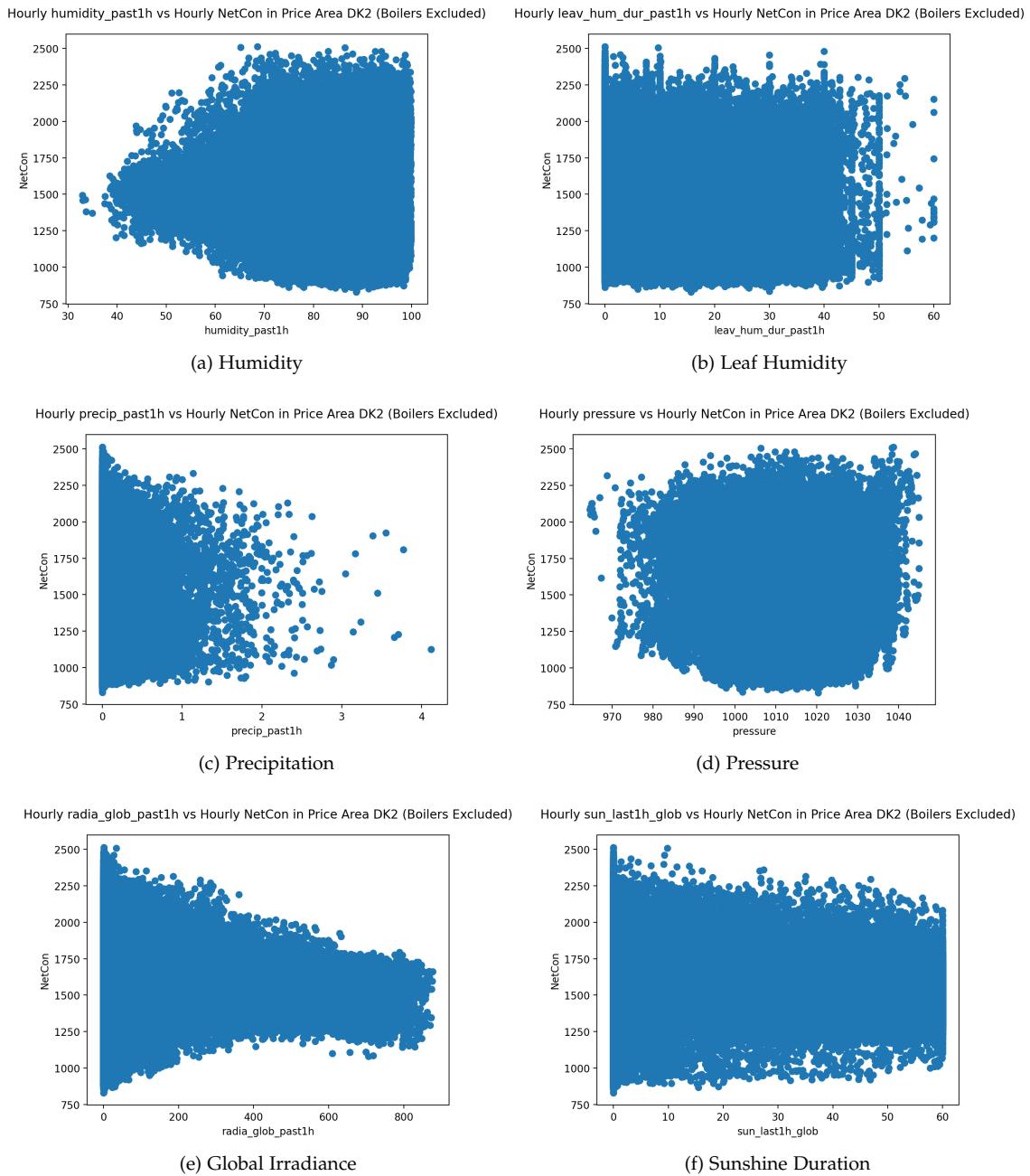


Figure 10: Plotting each weather parameter, downsampled to a Daily time resolution, versus the total Daily electricity consumption of the price area DK2.

### 2.2.3 Hourly Data



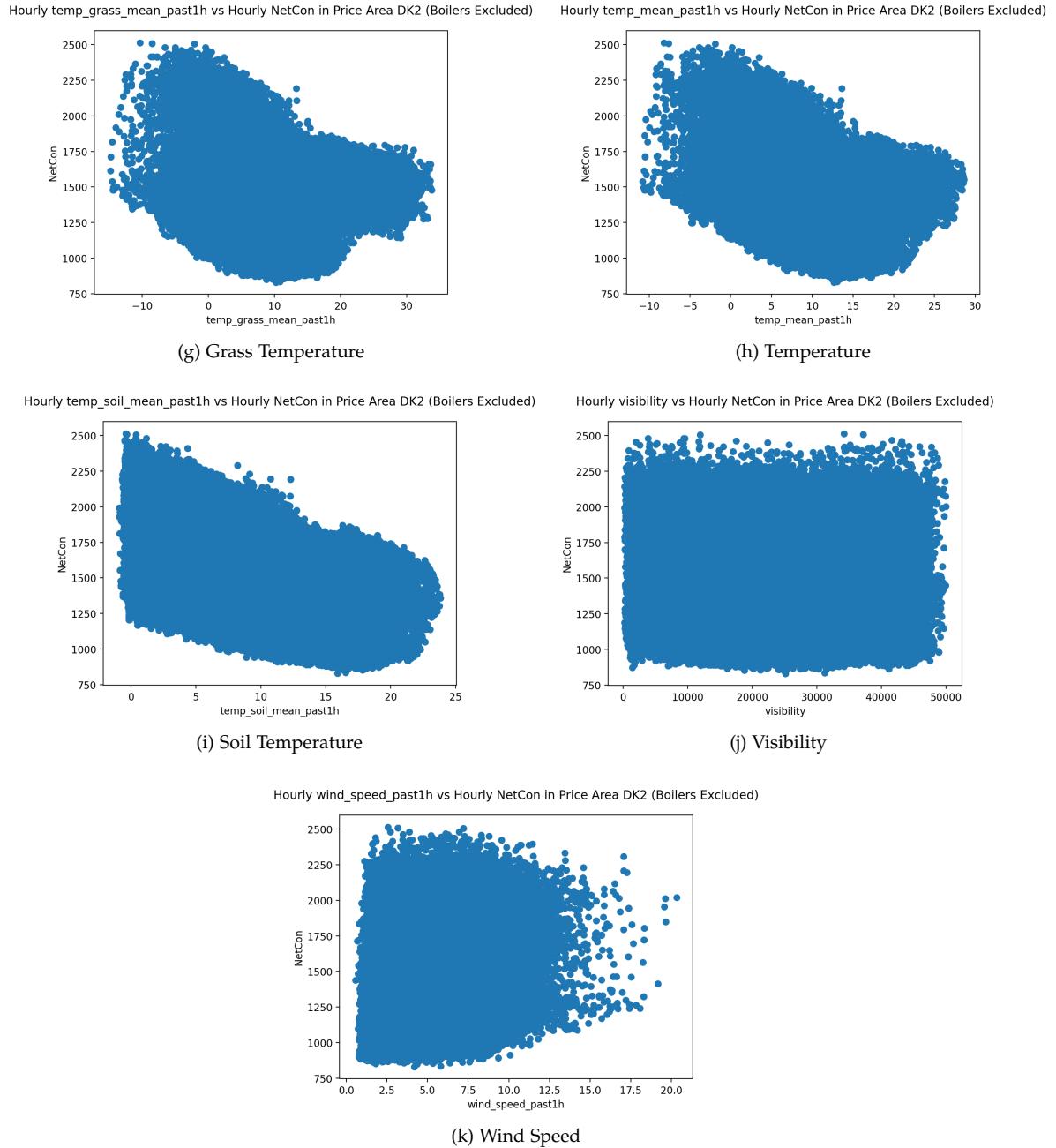
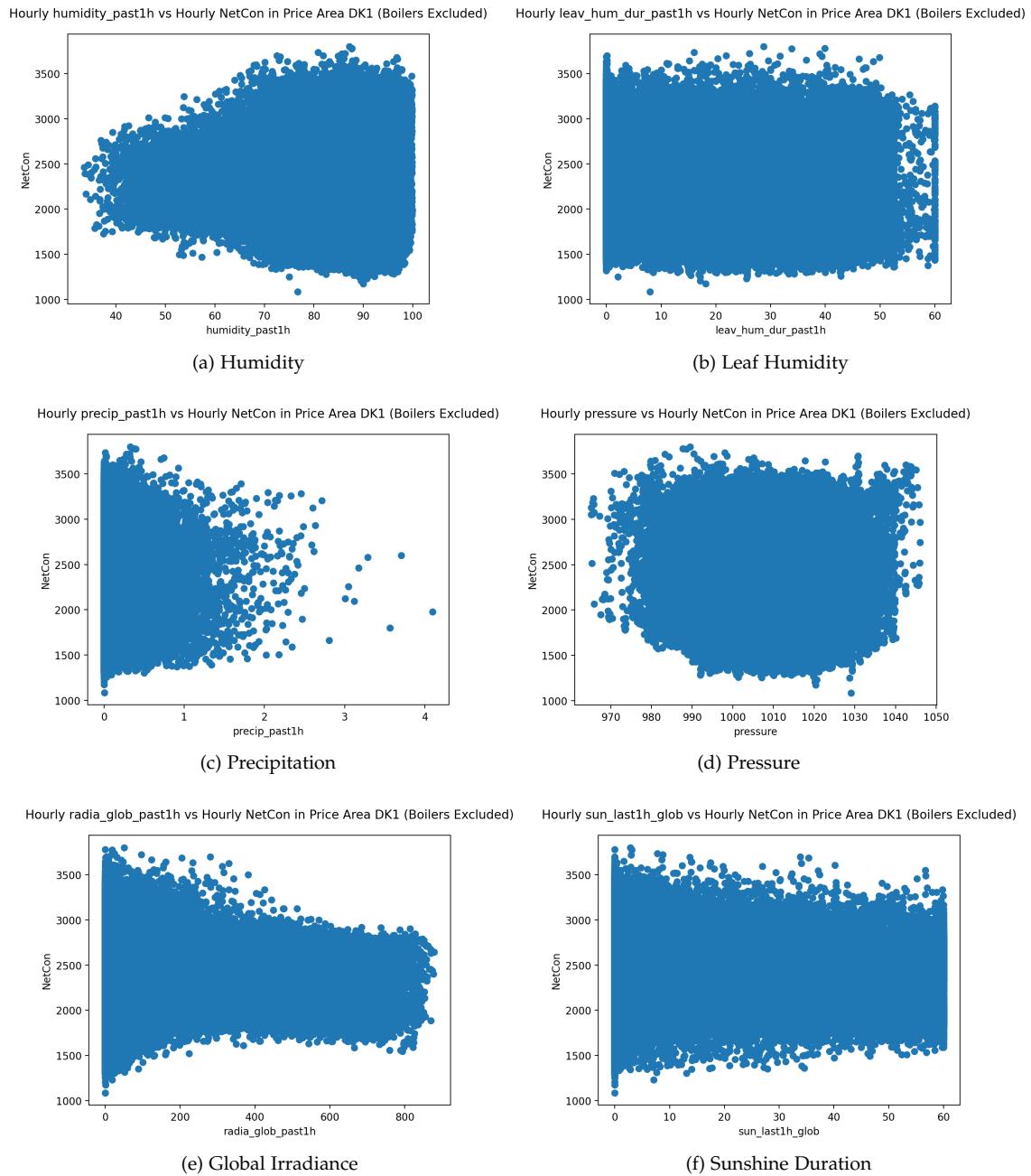


Figure 10: Plotting each weather parameter at an hourly time resolution versus the total Hourly electricity consumption of the price area DK2.



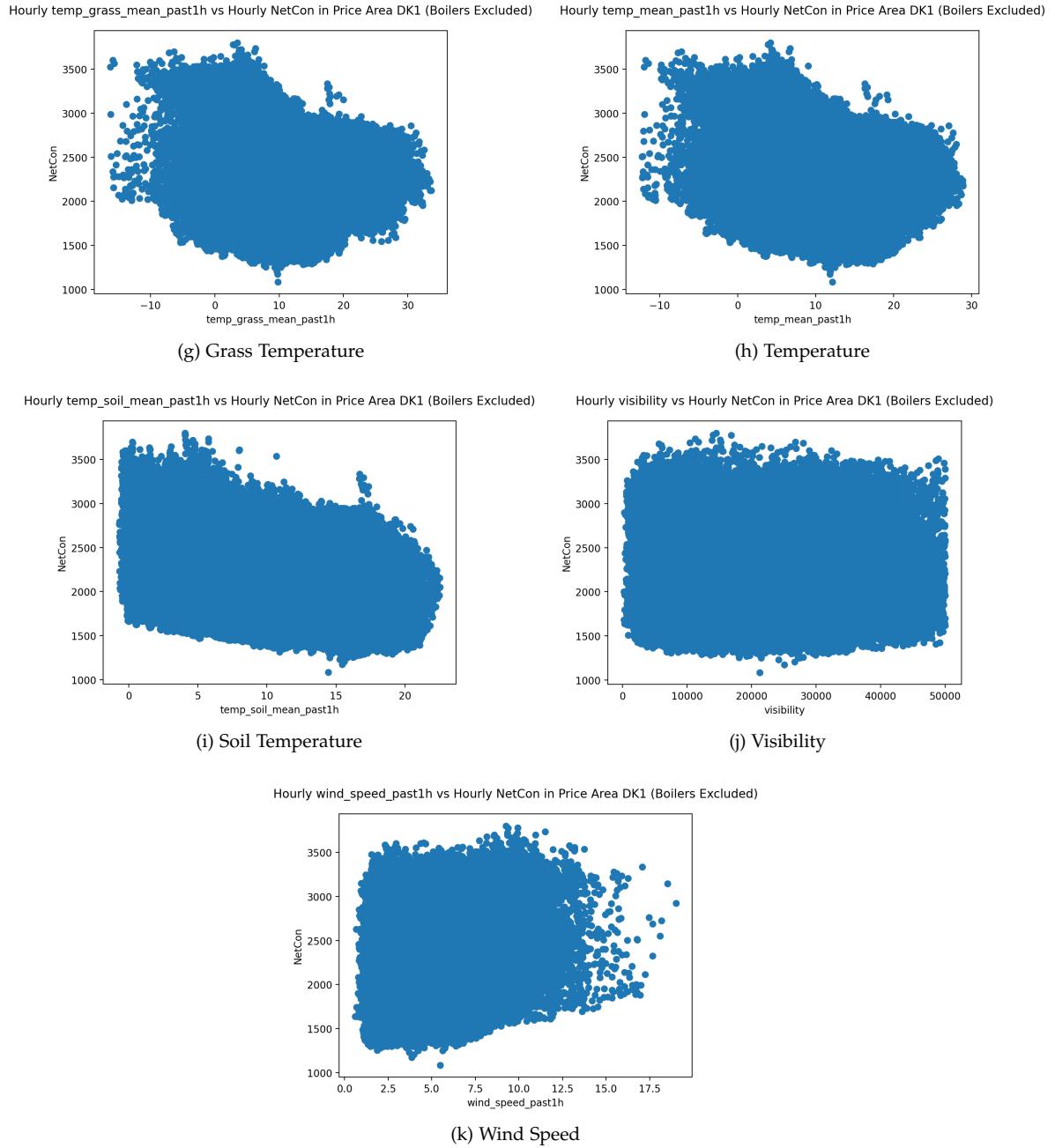


Figure 10: Plotting each weather parameter at an hourly time resolution versus the total Hourly electricity consumption of the price area DK1.