APPENDIX

1 Validation

To ensure the dependable operation of our approach, validation of the simulation scheme is performed on an hourly level using actual generation data collected in 2016 and 2017 from 11 wind parks in Germany. The data was provided by the Fraunhofer Institute for Solar Energy Systems ISE in Freiburg, Germany; however, it originated from the European Energy Exchange (EEX) [1]. The modeled generation data is simulated, with corresponding turbine specifications [2] at the center of each wind park, as individual turbines within a park could not be located. The method described in Section 2 is used in the simulation of individual parks. Afterwards, generation values are scaled by turbine capacity in order to compare the capacity factors independently of the overall capacity of each park.

Figure 1 shows an exemplary period for both "Amrumbank West" and "Sandbank", two wind parks within the dataset, between December 20th 2016 and February 14th, 2017. There is good agreement in terms of both the range and correlation between the measured and modeled data in general. However, slight variation occurs at individual time steps. For instance, actual generation in Amrumbank West is reproducible by the model, as is shown in the figure. In comparison, less agreement is observed for the Sandbank park in the presented time-frame. It is noticeable that data is not valid when the areas of flat generation are focused, as well as the step function looking like data. These erroneous values in the actual measurements may include maintenance, system downtime or other parameters related to the operation of the wind park that cannot be captured by the weather data alone. As operation-related decisions are not included within the data, it is not possible to completely recreate the behavior of each park. Moreover, the time periods in which the weather data is unable to reflect local dynamics due to its low resolution should also be taken into account in the validation process.

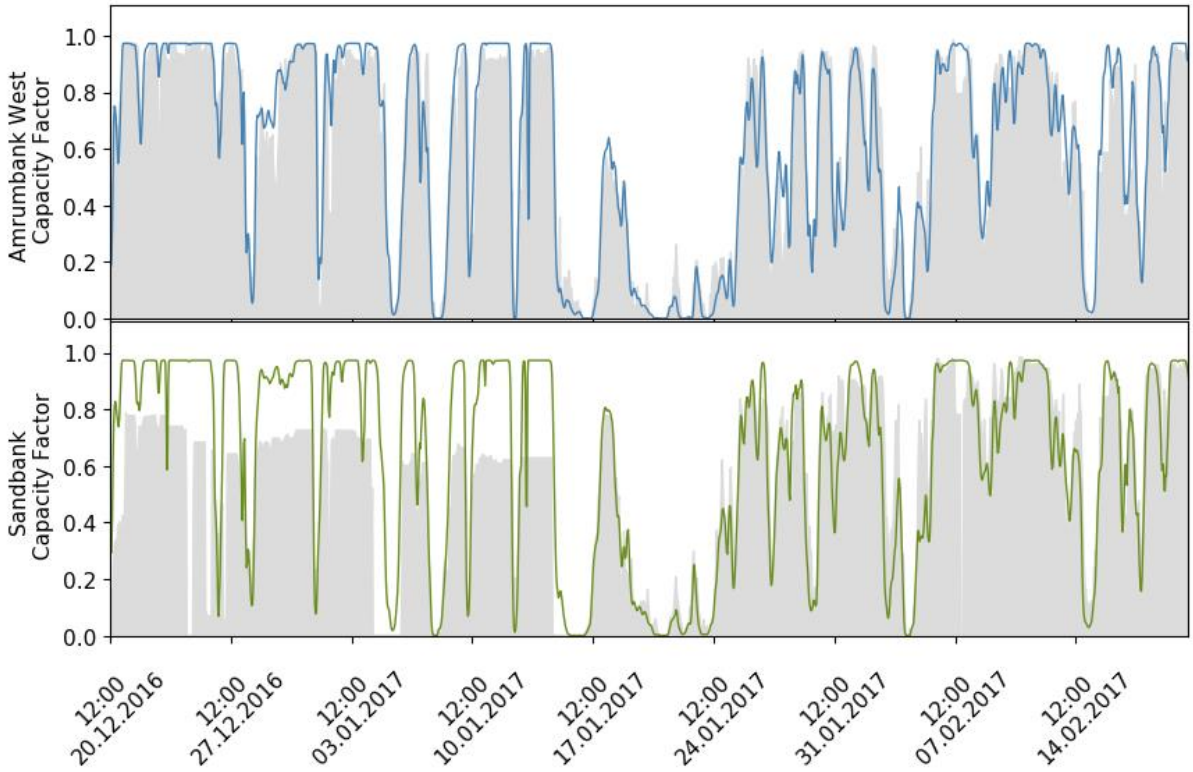

Figure 1. Comparison of modeled and actual generation data for exemplary wind parks.

Figure 2 shows the comparison of the data for all the wind parks in terms of capacity factors, as well as a histogram of errors at each time step. When actual and modeled capacity factors are compared with each other, as is shown in Figure 2 (a), a large collection of data points, especially at low and high capacity factors, can be observed. Points at the top are caused by the erroneous points with flat generation previously mentioned. A loss factor of 3% at the peak power can also be noticed, as the modeled capacity factor never reaches the value of 100% due to the selected low generation suppression factors. Despite the strong correlation between the measured and modeled generation values, this plot is not enough to make final conclusions.

Figure 2 (b) shows the same data as a histogram of percent error calculated for each park and each time step individually. The distribution has a distinct and sharp center around 0, whereas the tails are dispersed. Although the lower bound of error percentage can only reach -100%, when the measured data is finite and modeled is 0, there is not an upper limit. Compared to the measured data, the model has a small tendency to over-predict, although this is largely an artifact of comparisons against the erroneous data. Nevertheless, a good way of filtering erroneous data without intimate knowledge of the data-gathering procedures of the individual parks could not be found for this analysis. Due to the reasonable hourly agreement involving the erroneous measurement time periods, a strong correlation between the measured and modeled data and

sharp zero-centered percent error distribution, the simulation is assumed to be valid for the simulation of offshore wind energy.

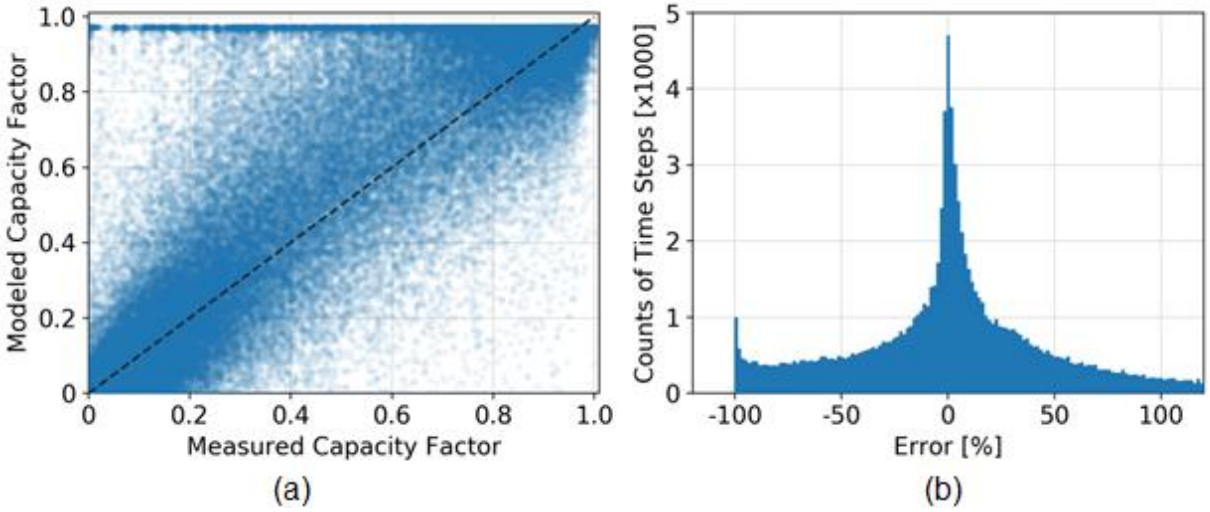

Figure 2. Correlation of actual and modeled data and percent error distribution.

2 Ocean Eligibility Results at National Scale

Table 1. Available areas on a national scale as a result of ocean eligibility.

	Total Area (km^2)	Available Area (km^2)	Percent Availability (%)
Albania	12,176	7,293	59.89
Belgium	3,500	767	21.92
Bulgaria	34,788	8,660	24.89
Croatia	55,492	24,216	43.64
Denmark	104,932	45,830	43.68
Estonia	36,468	15,397	42.22
Finland	81,592	38,935	47.72
France	345,124	92,468	26.79
Germany	56,760	13,512	23.81
Greece	482,868	59,645	12.35
Ireland	427,044	192,550	45.09
Italy	536,612	104,732	19.52
Latvia	28,352	17,874	63.04
Lithuania	6,836	3,855	56.39
Montenegro	6,404	4,087	63.82
Netherlands	64,320	26,652	41.44
Norway	854,580	438,436	51.3
Poland	29,908	16,696	55.83
Portugal	315,492	22,779	7.22
Romania	29,592	21,326	72.07
Slovenia	208	0	0
Spain	561,808	48,740	8.68
Sweden	155,544	77,765	50
Turkey	262,160	27,169	10.36
United Kingdom	732,780	338,877	46.25

3 Capacity values at National Level with Economic Constraints

Table 2. Capacity at a national scale with economic constraints (optimal turbine design scenario).

	Total Turbines	Total Capacity[GW]	Capacity [GW]		
			< 6 €$_{ct}$/kWh	< 8 €$_{ct}$/kWh	< 10 €$_{ct}$/kWh
Europe	**589,826**	**8557.14**	**3303.74**	**6621.97**	**7845.96**
Albania	2,606	33.47	0	0	0.03
Belgium	551	4.72	4.72	4.72	4.72
Bulgaria	3,285	40.83	0	11.85	39.34
Croatia	9,045	109.12	0	0	12.92
Denmark	21,332	263.69	172.35	252.31	263.69
Estonia	6,511	86.1	81.81	86.1	86.1
Finland	15,478	194.05	46.92	193.5	194
France	34,595	490.89	177.11	397.19	486.55
Germany	6,646	82.19	40.98	79.68	82.19
Greece	22,036	322.39	9.5	176.4	285.15
Ireland	70,626	1138.89	648.74	947.79	1135.21
Italy	39,439	502.25	0	70.2	258.41
Latvia	7,247	97.01	85.16	97.01	97.01
Lithuania	1,253	18.16	14.09	18.16	18.16
Montenegro	1,428	17.98	0	0	0
Netherlands	14,445	149.68	77.07	147.21	149.68
Norway	120,813	1959.18	641.03	1756.42	1957.7
Poland	6,363	90.71	79.68	90.71	90.71
Portugal	8,412	113.24	2.83	99.04	111.82
Romania	8,236	96.33	0	45.34	87.43
Slovenia	0	0	0	0	0
Spain	18,241	249.04	25.71	75.42	140.05
Sweden	29,435	394.13	166.65	384.33	394.1
Turkey	9,932	129.08	0.46	16.35	36.24
United Kingdom	131,871	1974.01	1028.93	1672.24	1914.75

4 Average Turbine Capacity values at National Level with Economic Constraints

Table 3. Average turbine capacity at a national scale with economic constraints (optimal turbine design scenario).

	Average Capacity [MW]	Average Turbine Capacity [MW]		
		< 10 €$_{ct}$/kWh	< 8 €$_{ct}$/kWh	< 6 €$_{ct}$/kWh
Europe	**14.51**	**14.72**	**14.98**	**14.80**
Albania	12.85	13.00	-	-
Belgium	8.57	8.57	8.57	8.57
Bulgaria	12.43	12.43	11.69	-
Crotia	12.06	10.96	-	-
Denmark	12.36	12.36	12.41	11.49
Estonia	13.22	13.22	13.22	13.26
Finland	12.54	12.54	12.56	12.92
France	14.19	14.20	14.58	14.77
Germany	12.37	12.37	12.40	10.74
Greece	14.63	14.85	15.62	16.60
Ireland	16.13	16.13	16.46	16.52
Italy	12.73	13.39	13.64	-
Latvia	13.39	13.39	13.39	13.03
Lithuania	14.49	14.49	14.49	13.98
Montenegro	12.59	-	-	-
Netherlands	10.36	10.36	10.35	9.03
Norway	16.22	16.22	16.50	16.59
Poland	14.26	14.26	14.26	13.99
Portugal	13.46	13.49	13.57	12.54
Romania	11.70	11.58	10.51	-
Spain	13.65	14.22	15.03	16.55
Sweden	13.39	13.39	13.46	13.89
Turkey	13.00	13.42	14.13	16.60
United Kingdom	14.97	15.03	15.37	15.12

5 Share of Foundation Types National Level with Economic Constraints

Table 4. Share of foudation type at a national scale with economic constraints (optimal turbine design scenario).

	Number of Turbines	Percentage [%]			
		Jacket	Monopile	Semisubmersible	Spar
Europe	589,826	0.06	13.82	85.51	0.60
Albania	2,606	0.00	0.58	96.39	3.03
Belgium	551	0.54	99.46	0.00	0.00
Bulgaria	3,285	0.00	11.54	88.46	0.00
Crotia	9,045	0.00	19.47	80.36	0.17
Denmark	21,332	0.52	56.68	42.80	0.00
Estonia	6,511	0.00	46.66	53.34	0.00
Finland	15,478	1.31	40.01	58.50	0.19
France	34,595	0.03	10.49	88.85	0.63
Germany	6,646	0.00	64.20	35.80	0.00
Greece	22,036	0.00	0.93	98.10	0.96
Ireland	70,626	0.00	1.35	98.65	0.00
Italy	39,439	0.00	9.41	88.31	2.28
Latvia	7,247	0.00	47.62	52.38	0.00
Lithuania	1,253	0.00	36.39	63.61	0.00
Montenegro	1,428	0.00	0.00	91.11	8.89
Netherlands	14,445	0.00	71.34	28.66	0.00
Norway	120,813	0.00	0.21	99.78	0.00
Poland	6,363	0.00	35.47	64.53	0.00
Portugal	8,412	0.00	0.83	94.66	4.51
Romania	8,236	0.00	27.19	72.81	0.00
Spain	18,241	0.00	1.43	97.50	1.07
Sweden	29,435	0.01	25.29	71.00	3.70
Turkey	9,932	0.00	0.71	96.13	3.15
United Kingdom	131,871	0.03	13.58	86.38	0.00