Spatiotemporal Probabilistic Scenarios

S. Gomez[1]

[1] School of Mathematics, University of Edinburgh

2026-02-04

Table of contents I

Overview

Progress check

New

- Spatial modelling
- Model estimates
- PC fitting

Next Steps

- OOS validation
- Add case study to overleaf
- Address other comments

Spatial modelling for probabilistic scenarios

Model shapes

New models are modifications of the Normalised Error with Normal distribution (NEN)

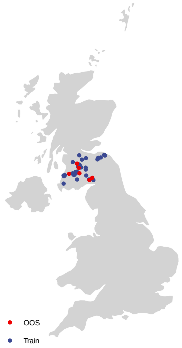
- Model list
  - ST-PR-NEN
  - Power Ramp (PR-NEN)
  - AR1 (PR-AR1-NEN)
  - Matern-AR1 (ST-NEN)
- Pending
  - ST-RS-PR-NEN

Data

- For US data:
  - Length: 18 months
  - Resolution: hourly
  - Locations: 1 region aggregated
- UK data:
  - Length: 1 to 3 months
  - Resolution: hourly
  - Locations 10 Scottish wind farms

Trying to keep fit time < 60min

10 Scottish wind farms



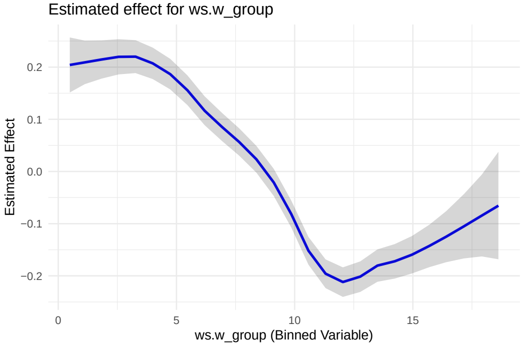
ST-PR-NEN model

Parameters summary

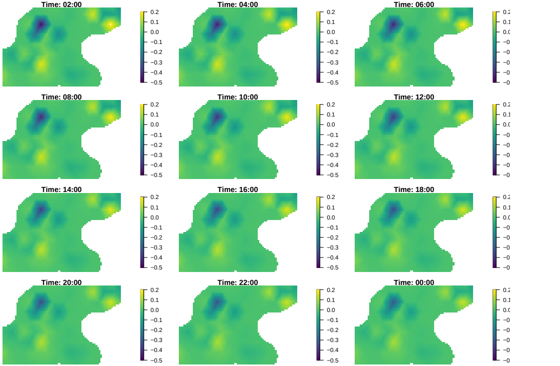
X	intercept	Gaussian...tau.	Wind...tau.	Range	Spatial...sigma.	AR..rho	PR.effect
mean	-0.04	185.47	1350.78	6.15	0.47	0.98	-0.08
sd	0.01	4.39	551.67	2.65	0.20	0.00	0.02
0.025quant	-0.07	177.07	485.89	2.13	0.22	0.98	-0.12
0.5quant	-0.04	185.39	1275.85	5.74	0.43	0.98	-0.08
0.975quant	-0.02	194.34	2598.63	12.32	0.99	0.99	-0.03
mode	-0.04	185.15	1119.36	4.91	0.35	0.98	-0.08

Effects

Effects

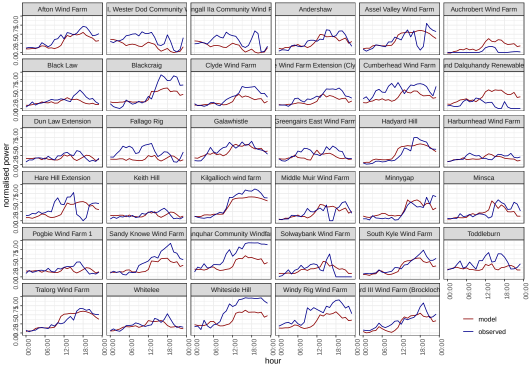


Spatial effect

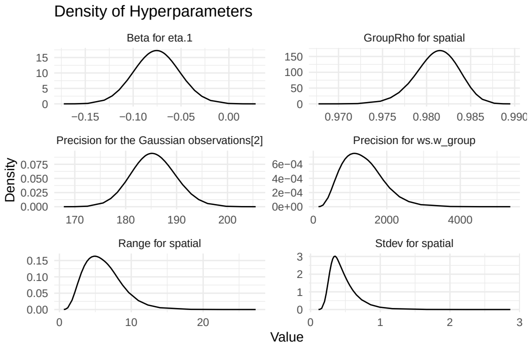


Posterior distributions

Day-ahead forecast



Hyperparameters



PR-NEN model

Parameters summary

Effects

Hyperparameters

PR-AR1-NEN model

Parameters summary

Effects
Hyperparameters

ST-NEN model

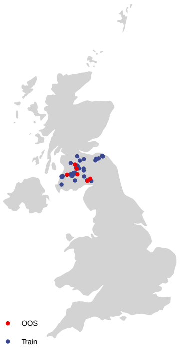
Parameters summary

Effects
Hyperparameters

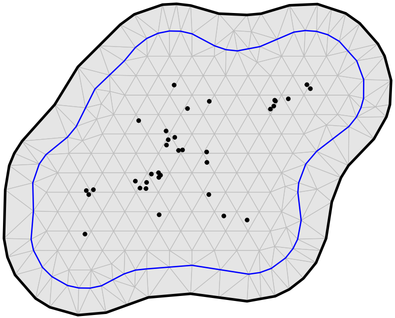
Appendix

Map and mesh

Map of wind farm samples



Mesh



Power Curve fitting

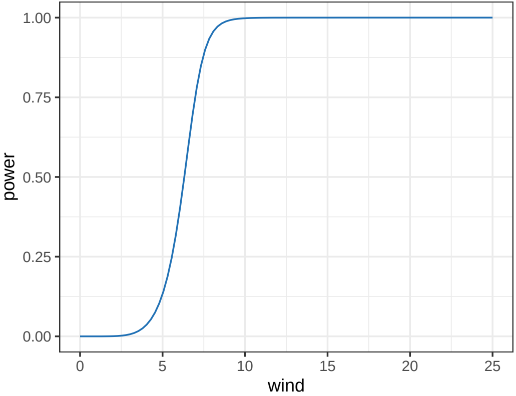
Classic parametric shape

The five-parameter formula (Lydia et.al, 2013):

$$P(u) = D + \frac{A - D}{(1 + (u/C)^B)^G}$$

where: A and D are the upper and lower asymptotes, C controls the inflection point, B is related to the slope at inflection point, and G controls the asymmetry.

5 parameters power curve



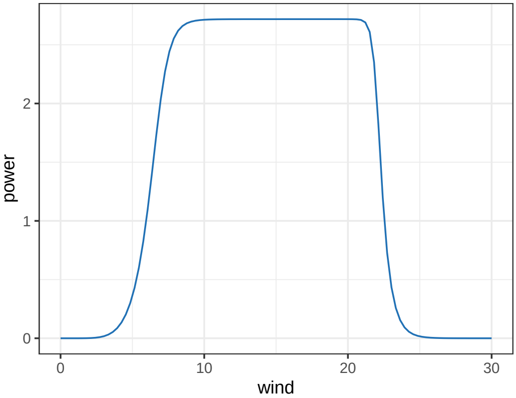
Parametric shape for cut-off

Adding extra parameters we can model de decay after cut-off:

$$P(u) = D + \frac{A - D}{(1 + (u/C_1)_1^B)^G (1 + (u/C_2)_2^B)^G}$$

where: A and D are the upper and lower asymptotes, C_1 is the first inflection point, C_2 is related to the cut-off, B_1 is related to the slope at inflection point, B_2 to the slope during cut-off, and G controls the asymmetry.

7 parameters power curve



Parametric fit for Scottish wind farms

- We can fit the parametric shape using optim
- As long as there is a reasonable amount of points showing the cut-off optim can converge

Estimates from data

par	estimate
A	1.00
B1	-11.99
C1	8.00
D	0.00
G	1.00
C2	22.00
B2	35.98