Geographically Weighted Machine Learning and Downscaling for High-Resolution Spatiotemporal Estimations of Wind Speed

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Table S1. Variogram fitting and cross validation for estimation of the residuals of predicted wind speed for four typical seasonal days.

Date	Parameters for variogram (exponential models)			LOOCV ^b	LOOCV RMSE
	Nugget (m/s)	Range (km)	Partial sill (m/s)	K ²	(111/5)
04/01/2015	0.14	54	1.05	-0.24	0.72
07/01/2015	0.21	273	0.00	-0.06	0.55
10/01/2015	0.56	199	0.23	-0.25	0.72
12/20/2015	0.24	582	0.05	-0.03	0.54

Note: LOOCV^a: leave one site out cross validation.



a. daily wind speed (m/n) b. log daily wind speed (m/n). Figure S1. Histograms for wind speed (a) and its log transformations (b).



Figure S2. Boxplots of the observed values and ensemble predictions by GWR for wind speed. .







a. 1 April 2015 (spring)



b. 1 July 2015 (summer).

Figure S3. Plots of variogram fitting.



Figure S4. Plots of the original residual from ensemble predicted wind speed vs. estimated residuals using fitted variogram based universal kriging (UK) for four typical seasonal days.



Figure S5. Predictions by individual models (**a** for autoencoder-based deep network, **b** for XGBoost and **c** for random forest) and their ensemble predictions (**d**) by GWR for wind speed of 1 July 2015.



a. Intercept

b. Coefficient for the predictions of autoencoder-based network.



c. Coefficient for the predictions of XGBoost

d. Coefficient for the predictions of random forest.

Figure S6. Spatially varying intercept (a) and coefficients (b, c and d) for the predictions of thee individual learners for wind speed.



Figure S7. Spatially varying variance for the ensemble predictions by GWR for wind speed.



Figure S8. Plots of averages of matched finely resolved wind speed (**a**,**c**) and their residuals (b and d) vs. the coarsely resolved wind speed (reanalysis data) for 1 January 2015 (**a**,**b**) and 1 July 2015 (**c**,**d**).