Table S1. Parameterization schemes of the WRF model.

Physical process	Parameterization scheme
mp_physics	Predicted Particle Property scheme (Morrison and Milbrandt, 2015)
ra_lw_physics	RRTMG scheme (Iacono et al., 2008)
ra_sw_physics	Goddard shortwave scheme (Chou and Suarez, 1994)
bl_pbl_physics	YSU scheme (Hong and Pan, 1996)
sf_sfclay_physics	MM5 similarity theory and surface layer scheme (Janjić, 1996, 2001)
sf_surface_physics	Noah land surface model (Chen and Dudhia, 2001)
cu_physics	Grell 3D ensemble cumulus scheme (Grell, 1993; Grell and Dévényi, 2002)

Table S2. Optimal interpolation parameters L and q, and the number of stations used for reduced and oxidized nitrogen during 2011–2016.

Year	Species	L(km)	q	N(stations)
2011	Reduced	187.15	2.40	127
2011	Oxidized	100.21	0.13	127
2012	Reduced	49.34	1.00	203
2012	Oxidized	57.12	1.00	203
2013	Reduced	59.19	0.39	250
2013	Oxidized	76.81	0.36	250
2014	Reduced	77.13	0.45	291
2014	Oxidized	70.38	0.44	291
2015	Reduced	50.39	1.00	266
2015	Oxidized	83.42	0.27	266
2016	Reduced	67.91	0.33	272
2016	Oxidized	48.26	1.00	272

Table S3. Five-fold cross-validation results and coverage percentages for reduced and oxidized nitrogen under different Cressman influence radii.

Species	radius_km	R	RMSE	coverage_percent
Reduced nitrogen	45	0.48	0.13	54.86
	60	0.47	0.13	62.07
	75	0.44	0.14	68.71
	90	0.42	0.14	72.89
	105	0.42	0.14	77.85
	120	0.41	0.14	81.52
	135	0.40	0.14	85.90
Species	radius_km	R	RMSE	coverage_percent
Oxidized nitrogen	45	0.42	0.10	54.86
	60	0.42	0.10	62.07
	75	0.40	0.10	68.71
	90	0.39	0.10	72.89
	105	0.38	0.10	77.85
	120	0.37	0.10	81.52
	135	0.35	0.10	85.90

coverage_percent: the proportion of all jointly valid validation station–day samples that were actually corrected using observational residuals from at least one valid training station.

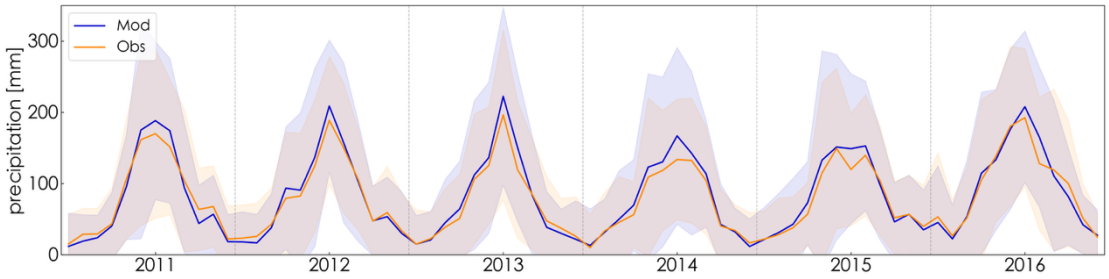

Figure S1. Monthly variation trends of precipitation over East Asia during 2011–2016 from observations (orange) and model simulations (blue). Solid lines denote the means, and the shading indicates the mean ±1 standard deviation.

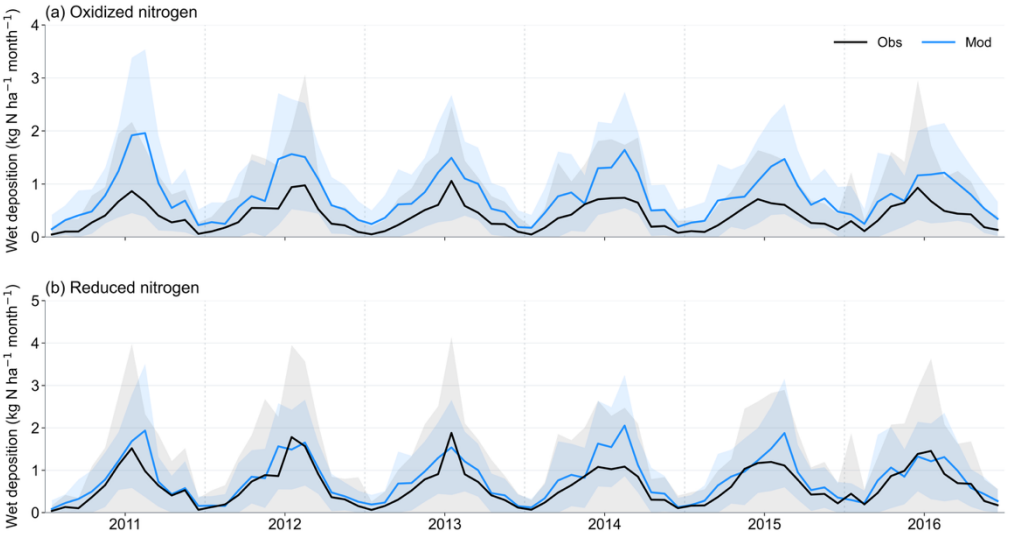

Figure S2. Monthly variation trends of wet deposition of oxidized nitrogen (a) and reduced nitrogen (b) over East Asia during 2011–2016 from observations (gray) and model simulations (blue). Solid lines denote the means, and the shading indicates the mean ±1 standard deviation.

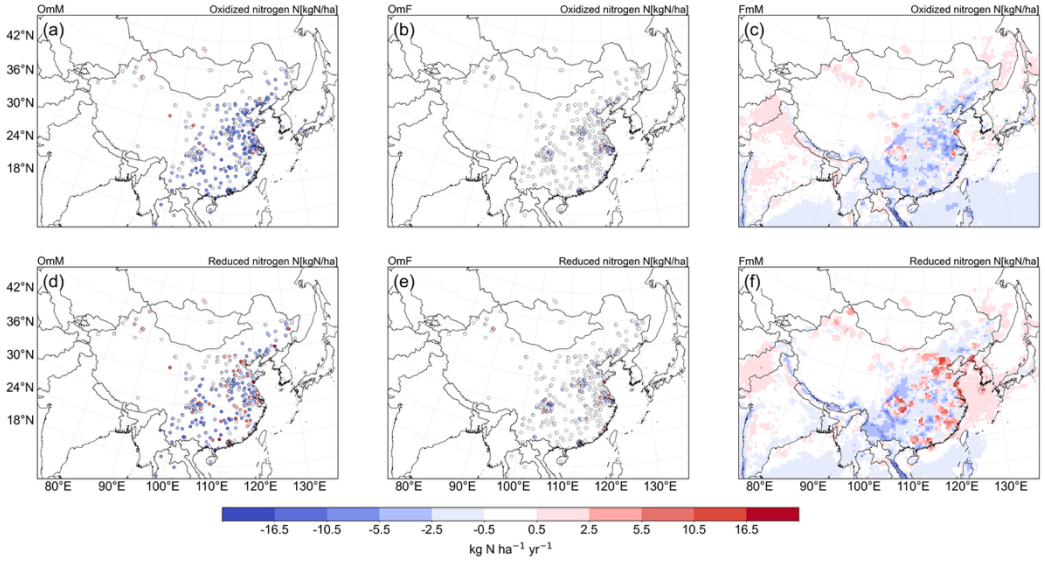

Figure S3. Spatial distributions of the six-year mean OmM (left column), OmF (middle column), and FmM (right column) for oxidized and reduced nitrogen wet deposition (kg N ha^{-1} yr^{-1}) over East Asia based on Cressman interpolation.

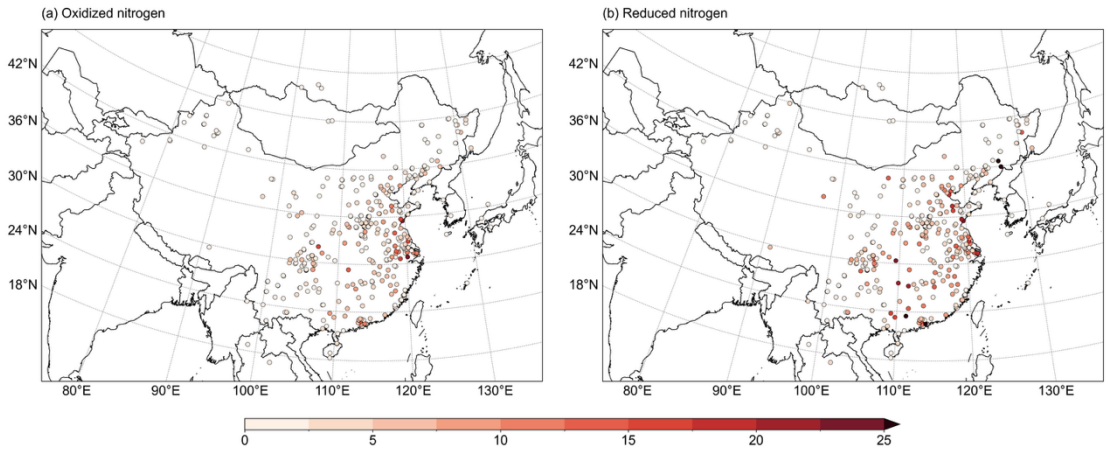

Figure S4. Spatial proximity differences of the annual mean wet deposition of oxidized and reduced nitrogen over East Asia.

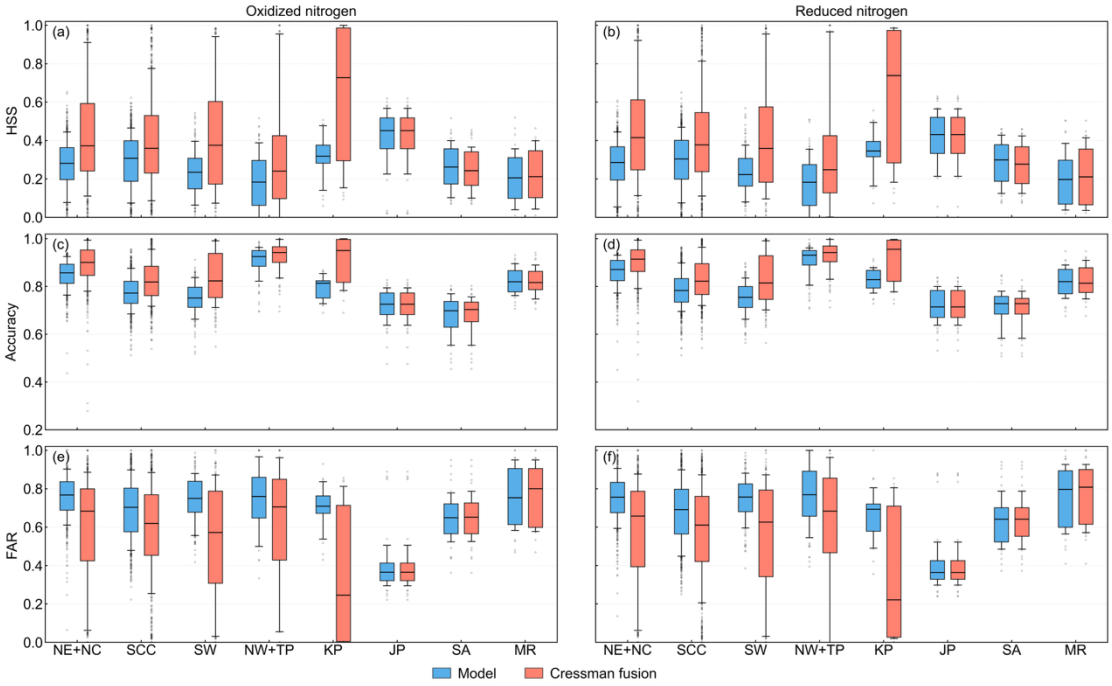

Figure S5. Regional evaluation of oxidized and reduced nitrogen wet-deposition occurrence before and after Cressman interpolation across eight East Asian regions. Panels (a–f) present the Heidke skill score (HSS), accuracy, and false alarm ratio (FAR) for the original model simulations and Cressman fusion results. Boxplots show the distributions of station–year evaluation metrics obtained from fivefold cross-validation.

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