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Regional dynamical and statistical downscaling temperature, humidity and wind speed for the Beijing region under stratospheric aerosol injection geoengineering

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Supplementary Information

Table S1. Monthly driving data fields from ESMs.

	Variable	Variable long name	Units
Pressure level	hus	Specific Humidity (%)	%
	ta	Air Temperature (K)	K
	ua	Eastward Wind (m/s)	m/s
	va	Northward Wind (m/s)	m/s
	zg	Geopotential Height (m)	m
Near surface	huss	Near-Surface Specific Humidity (%)	%
	tas	Near-Surface Air Temperature (K)	K
	uas	Eastward Near-Surface Wind (m/s)	m/s
	vas	Northward Near-Surface Wind (m/s)	m/s
Surface	ps	Surface Air Pressure (Pa)	Pa
	psl	Sea Level Pressure (Pa)	Pa
Soil level	mrlsl	Water Content of Soil Layer (kg m-2)	kg m-2
	tsl	Temperature of Soil (K)	K
Skin_temp	ts	Surface Temperature (K)	K

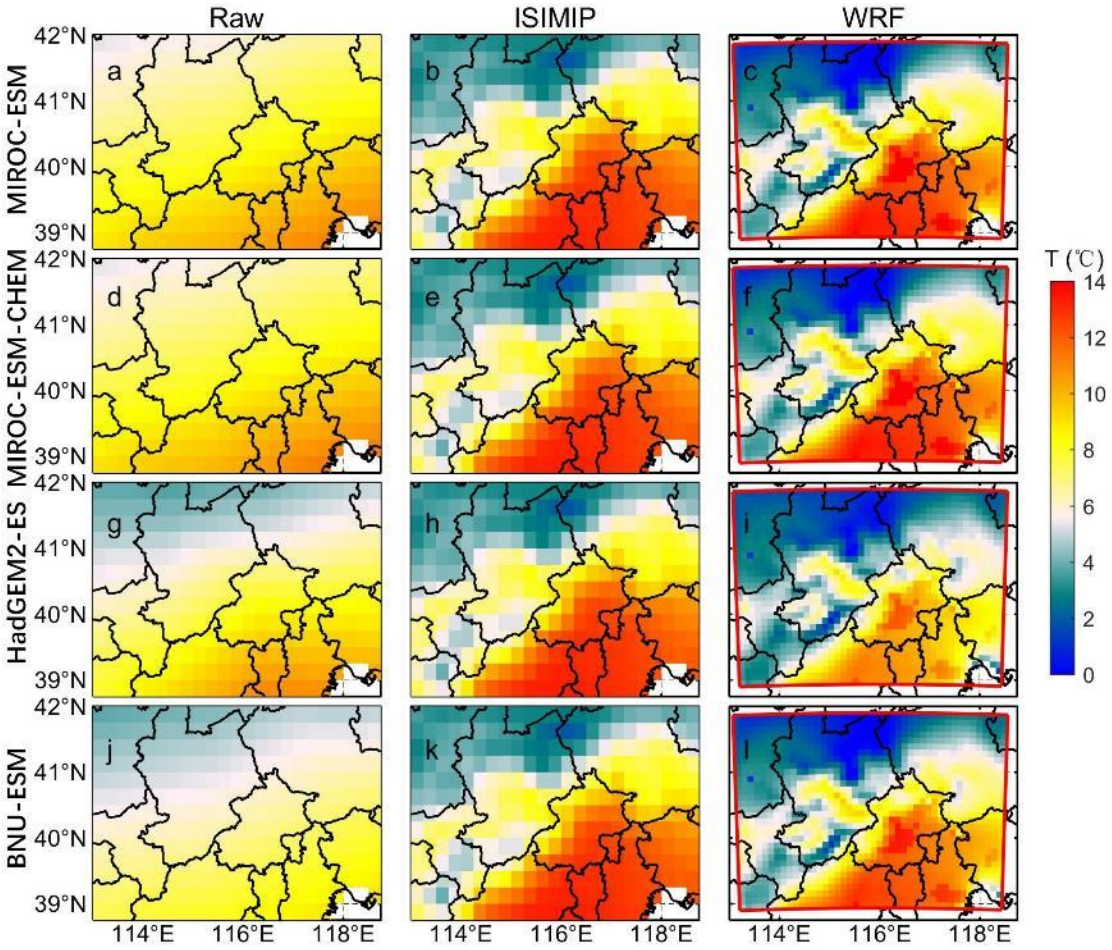

Figure S1: The mean 2m temperature of raw ESMs, ISIMIP bias correction and WRF downscaling by top to bottom rows: MIROC-ESM (a-c), MIROC-ESM-CHEM (d-f), HadGEM2-ES (g-i) and BNU-ESM (j-l) during 1980-1989. Raw ESMs results are interpolated into the same resolution as ERA5 using bilinear interpolation.

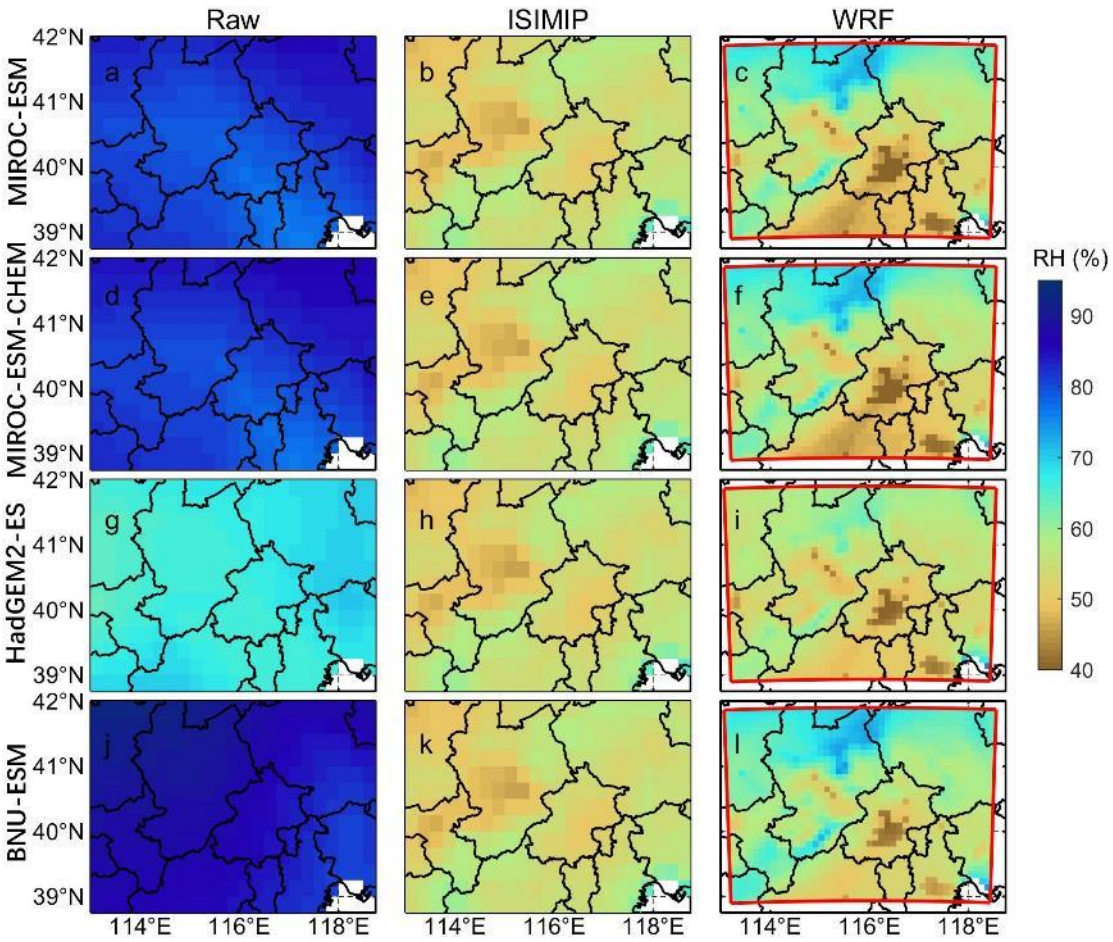

Figure S2: The mean relative humidity (%) of raw ESMs, ISIMIP bias correction and WRF downscaling by top to bottom rows: MIROC-ESM (a-c), MIROC-ESM-CHEM (d-f), HadGEM2-ES (g-i) and BNU-ESM (j-l) during 1980-1989. Raw ESMs results are interpolated into the same resolution as ERA5 using bilinear interpolation.

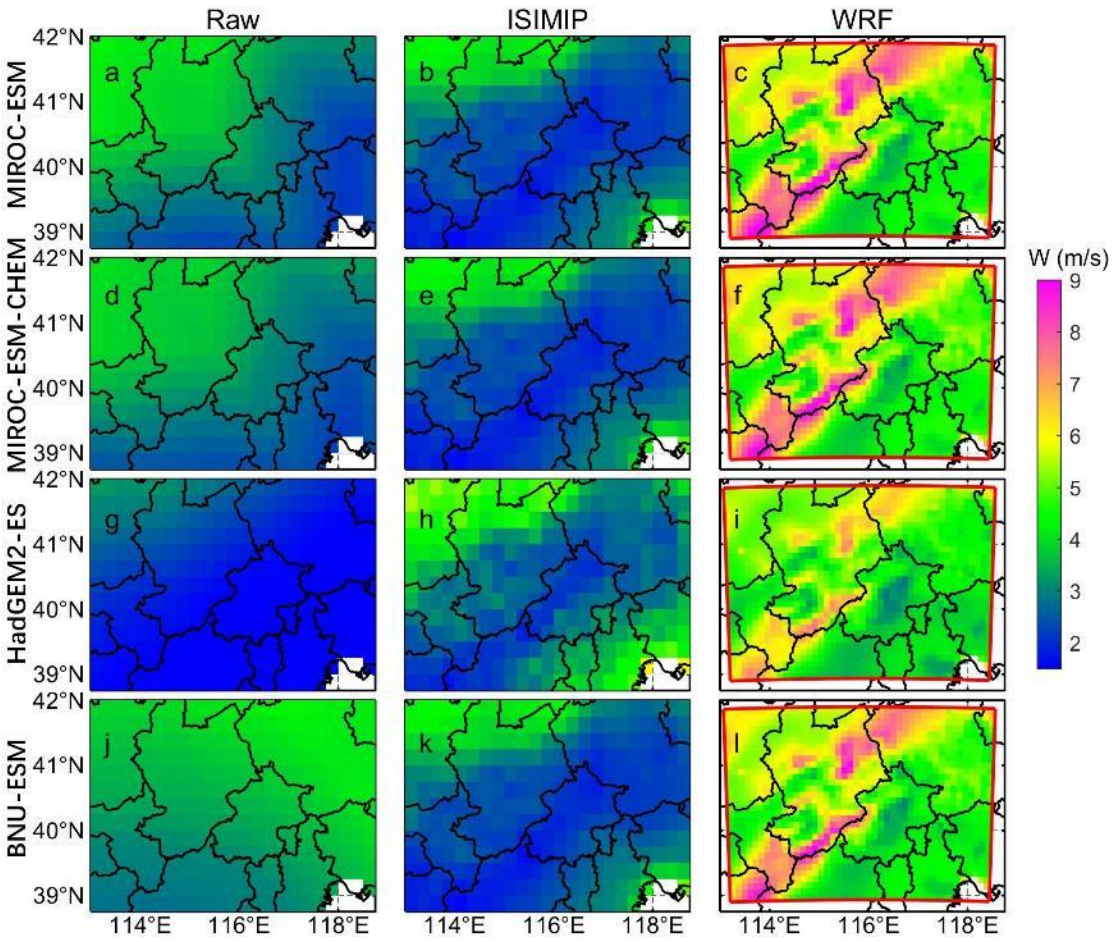

Figure S3: The mean wind speed (m/s) of raw ESMs, ISIMIP bias correction and WRF downscaling by top to bottom rows: MIROC-ESM (a-c), MIROC-ESM-CHEM (d-f), HadGEM2-ES (g-i) and BNU-ESM (j-l) during 1980-1989. Raw ESMs results are interpolated into the same resolution as ERA5 using bilinear interpolation.

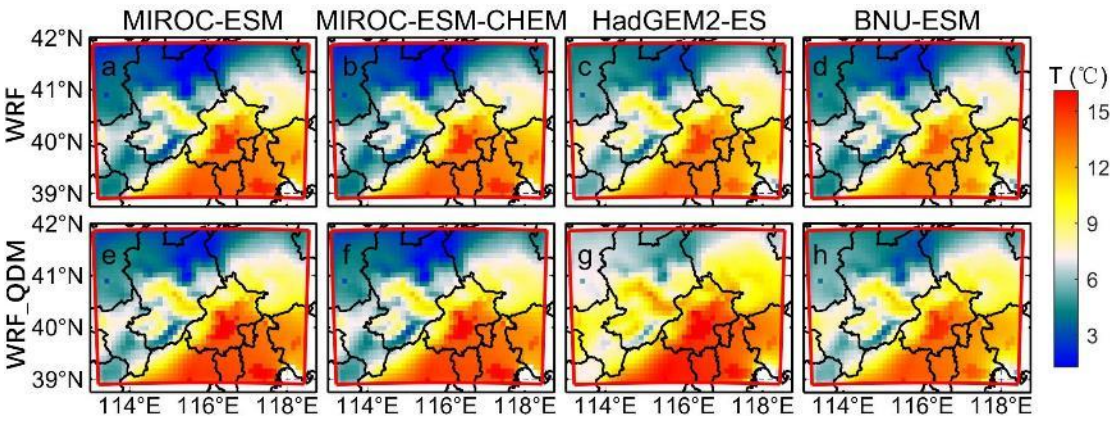

Figure S4: The mean 2m temperature from WRF raw results (a-d) and WRF after QDM bias correction results (e-h) during 2008-2017. Columns from left to right are MIROC-ESM (a, e), MIROC-ESM-CHEM (b, f), HadGEM2-ES (c, g) and BNU-ESM (d, h).

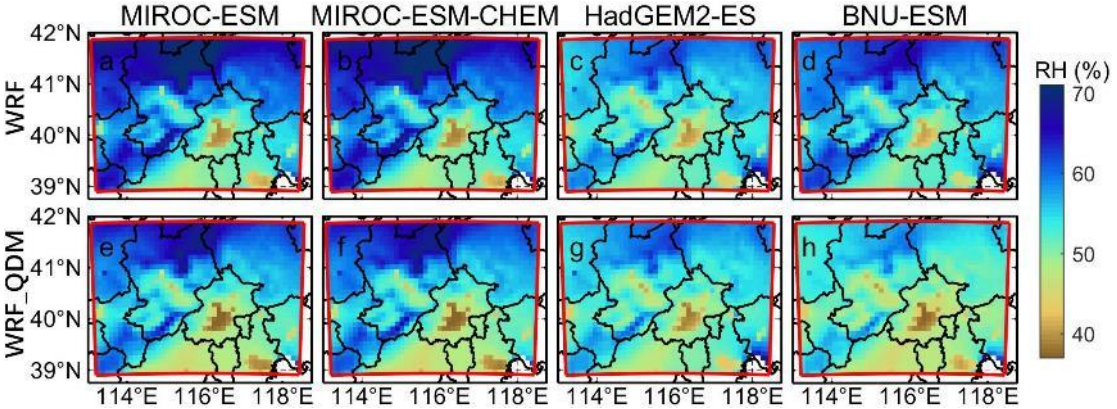

Figure S5: Same as figure S4 but for relative humidity (%).

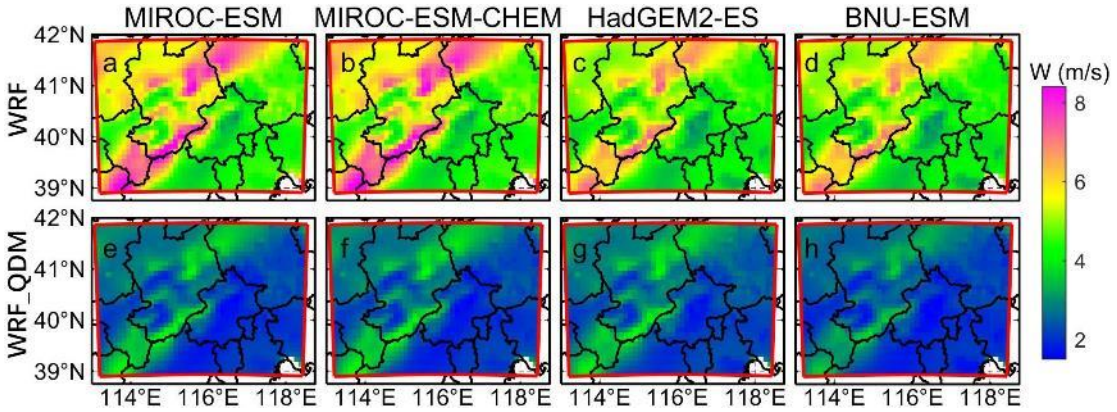

Figure S6: Same as figure S4 but for wind speed (m/s).

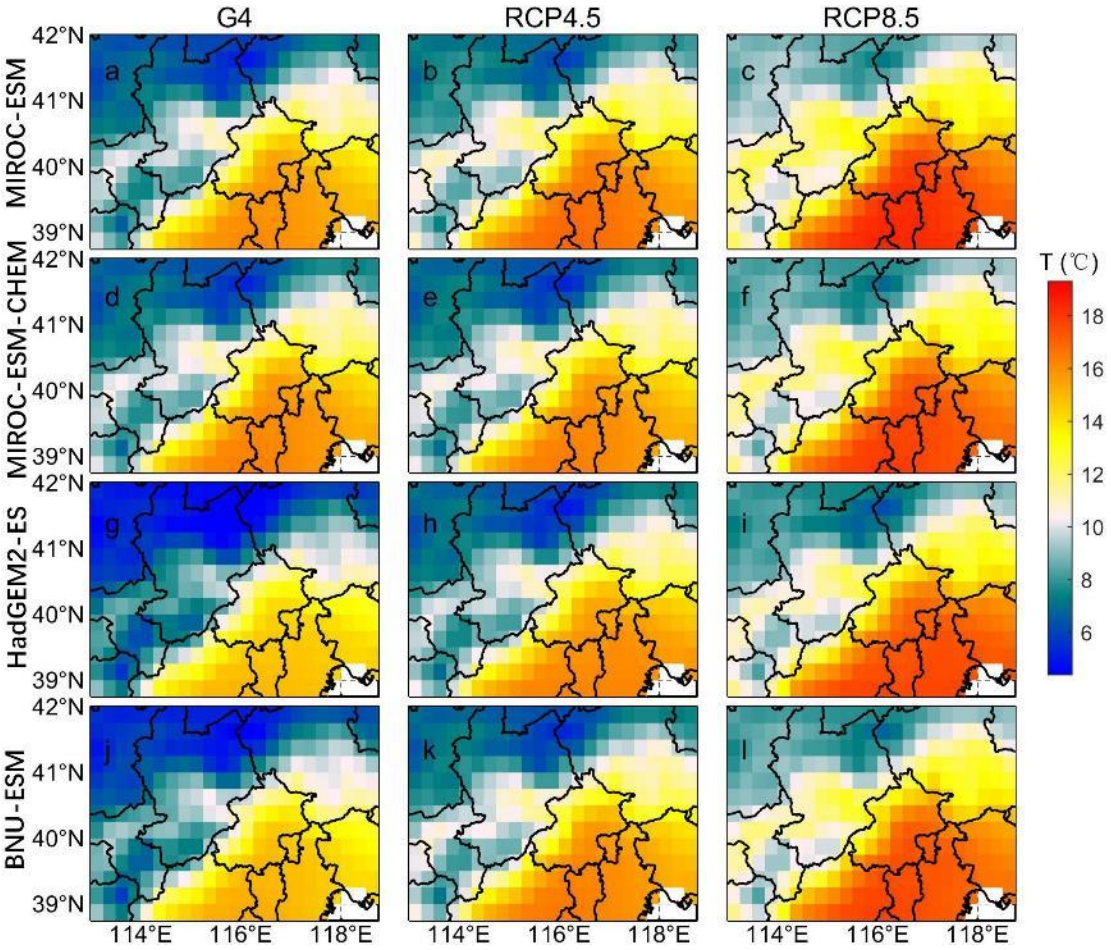

Figure S7: The mean 2m temperature of G4 (a, d, g, j), RCP4.5 (b, e, h, k) and RCP8.5 (c, f, i, l) from ISIMIP by top to bottom rows: MIROC-ESM (a-c), MIROC-ESM-CHEM (d-f), HadGEM2-ES (g-i) and BNU-ESM (j-l) during 2060-2069.

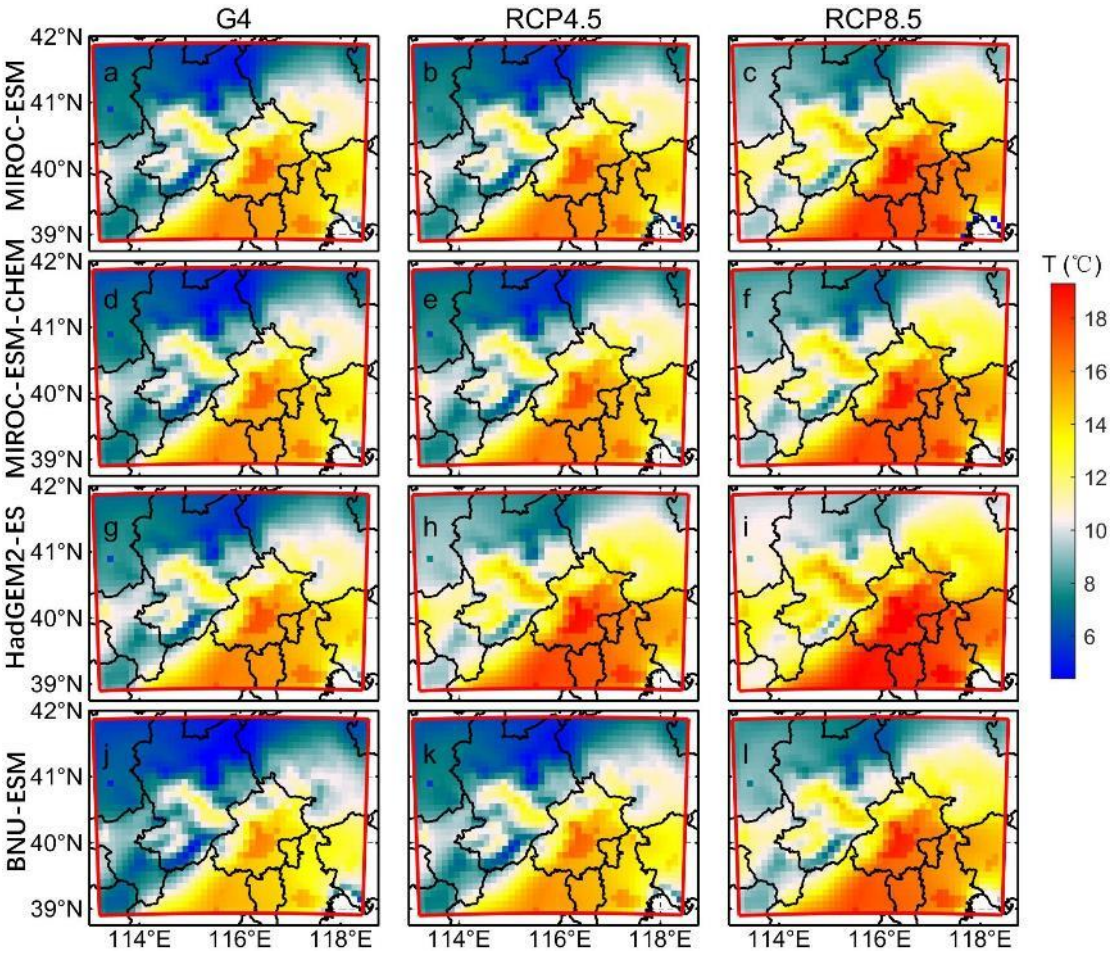

Figure S8: The mean 2m temperature of G4 (a, d, g, j), RCP4.5 (b, e, h, k) and RCP8.5 (c, f, i, l) from WRF_QDM by top to bottom rows: MIROC-ESM (a-c), MIROC-ESM-CHEM (d-f), HadGEM2-ES (g-i) and BNU-ESM (j-l) during 2060-2069.

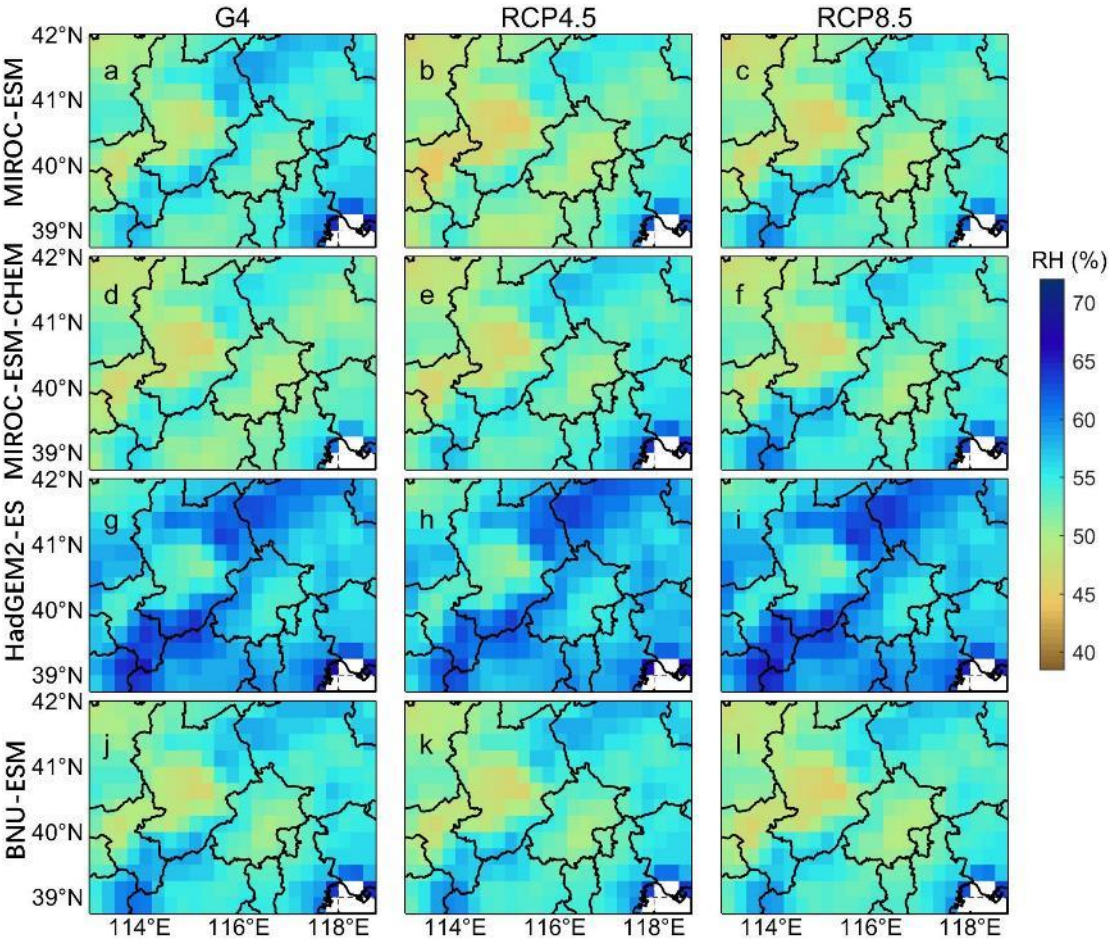

Figure S9: The relative humidity (%) of G4 (a, d, g, j), RCP4.5 (b, e, h, k) and RCP8.5 (c, f, i, l) from ISIMIP by top to bottom rows: MIROC-ESM (a-c), MIROC-ESM-CHEM (d-f), HadGEM2-ES (g-i) and BNU-ESM (j-l) during 2060-2069.

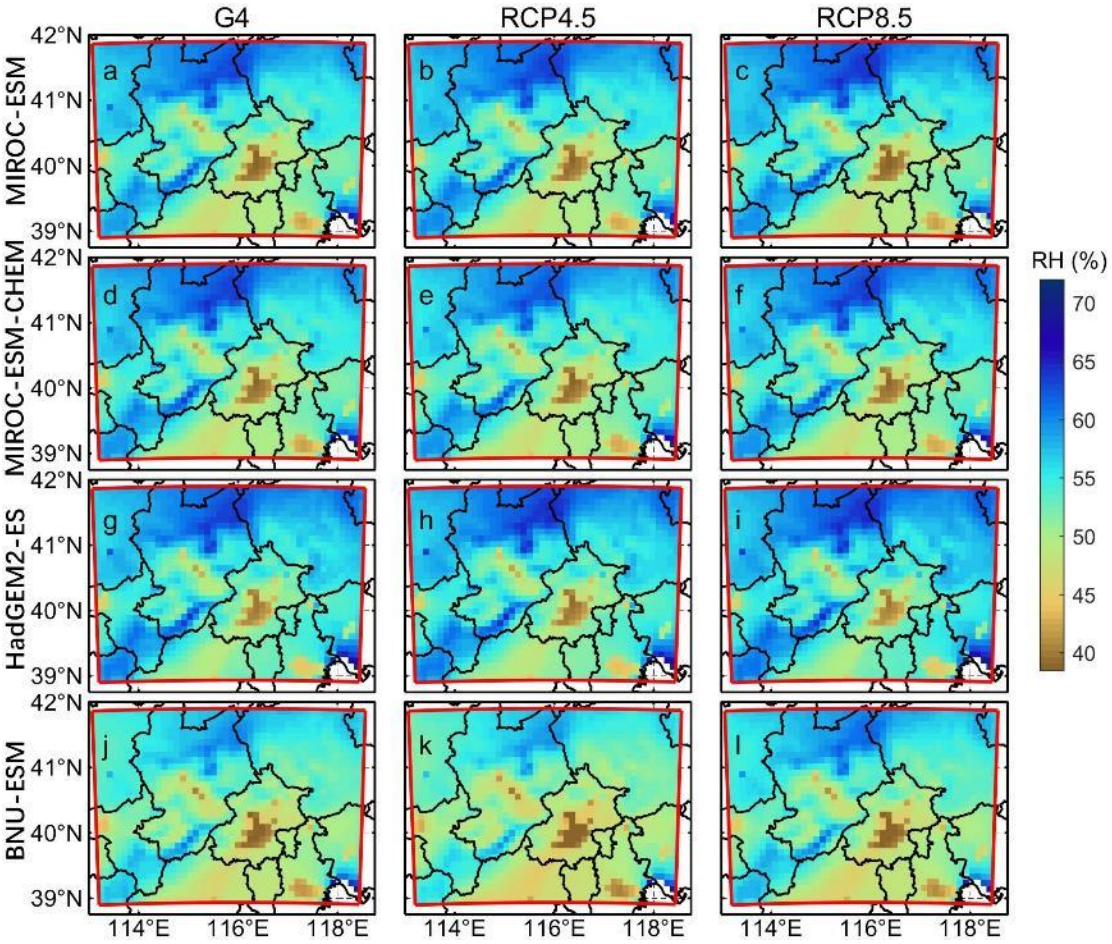

Figure S10: The relative humidity (%) of G4 (a, d, g, j), RCP4.5 (b, e, h, k) and RCP8.5 (c, f, i, l) from WRF_QDM by top to bottom rows: MIROC-ESM (a-c), MIROC-ESM-CHEM (d-f), HadGEM2-ES (g-i) and BNU-ESM (j-l) during 2060-2069.

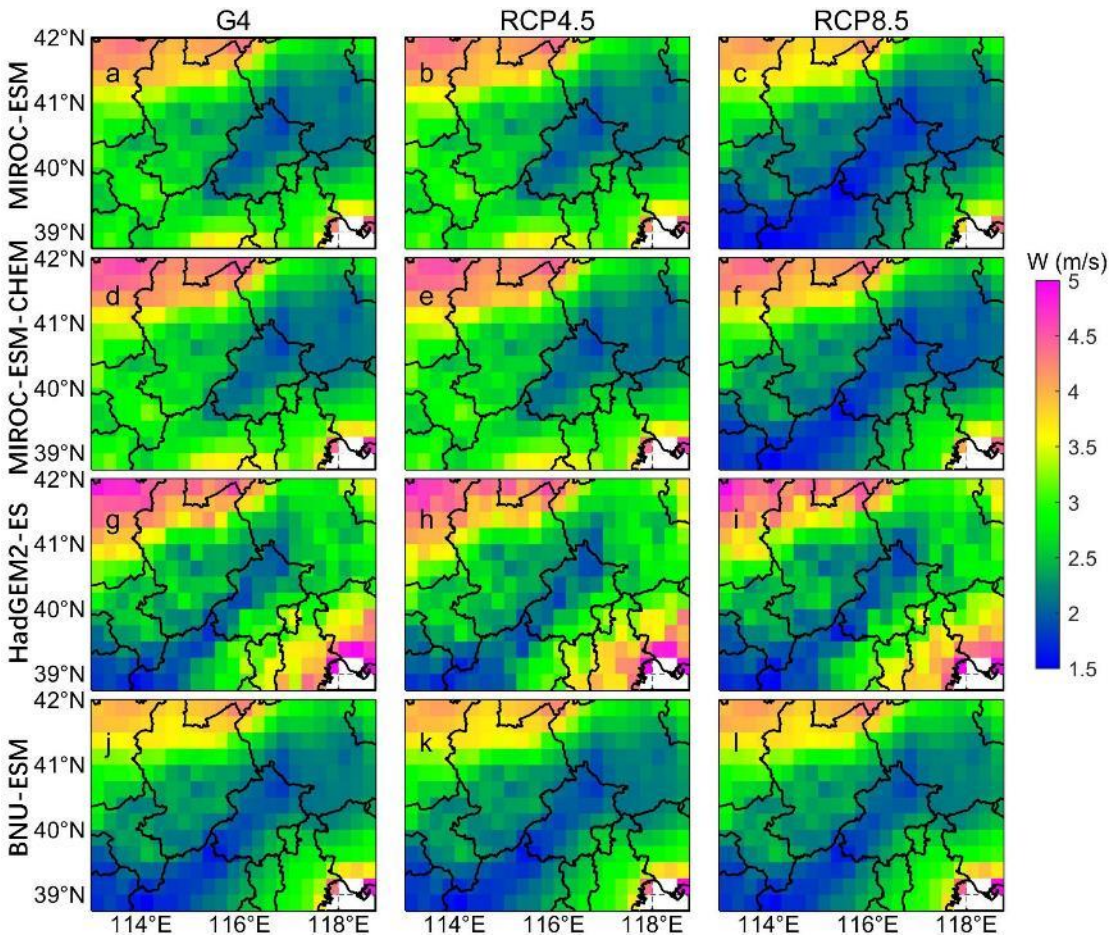

Figure S11: The mean wind speed (m/s) G4 (a, d, g, j), RCP4.5 (b, e, h, k) and RCP8.5 (c, f, i, l) from ISIMIP by top to bottom rows: MIROC-ESM (a-c), MIROC-ESM-CHEM (d-f), HadGEM2-ES (g-i) and BNU-ESM (j-l) during 2060-2069.

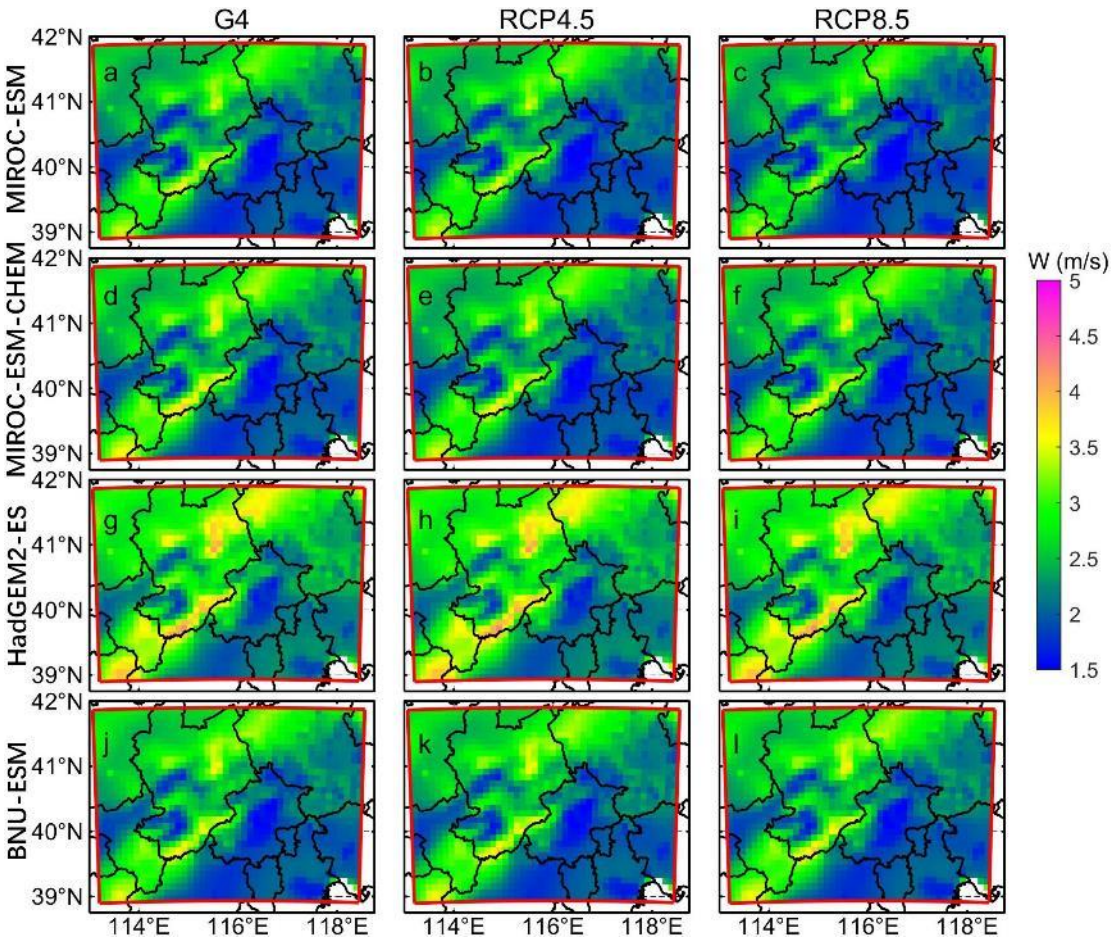

Figure S12: The mean wind speed (m/s) of G4 (a, d, g, j), RCP4.5 (b, e, h, k) and RCP8.5 (c, f, i, l) from WRF_QDM by top to bottom rows: MIROC-ESM (a-c), MIROC-ESM-CHEM (d-f), HadGEM2-ES (g-i) and BNU-ESM (j-l) during 2060-2069.

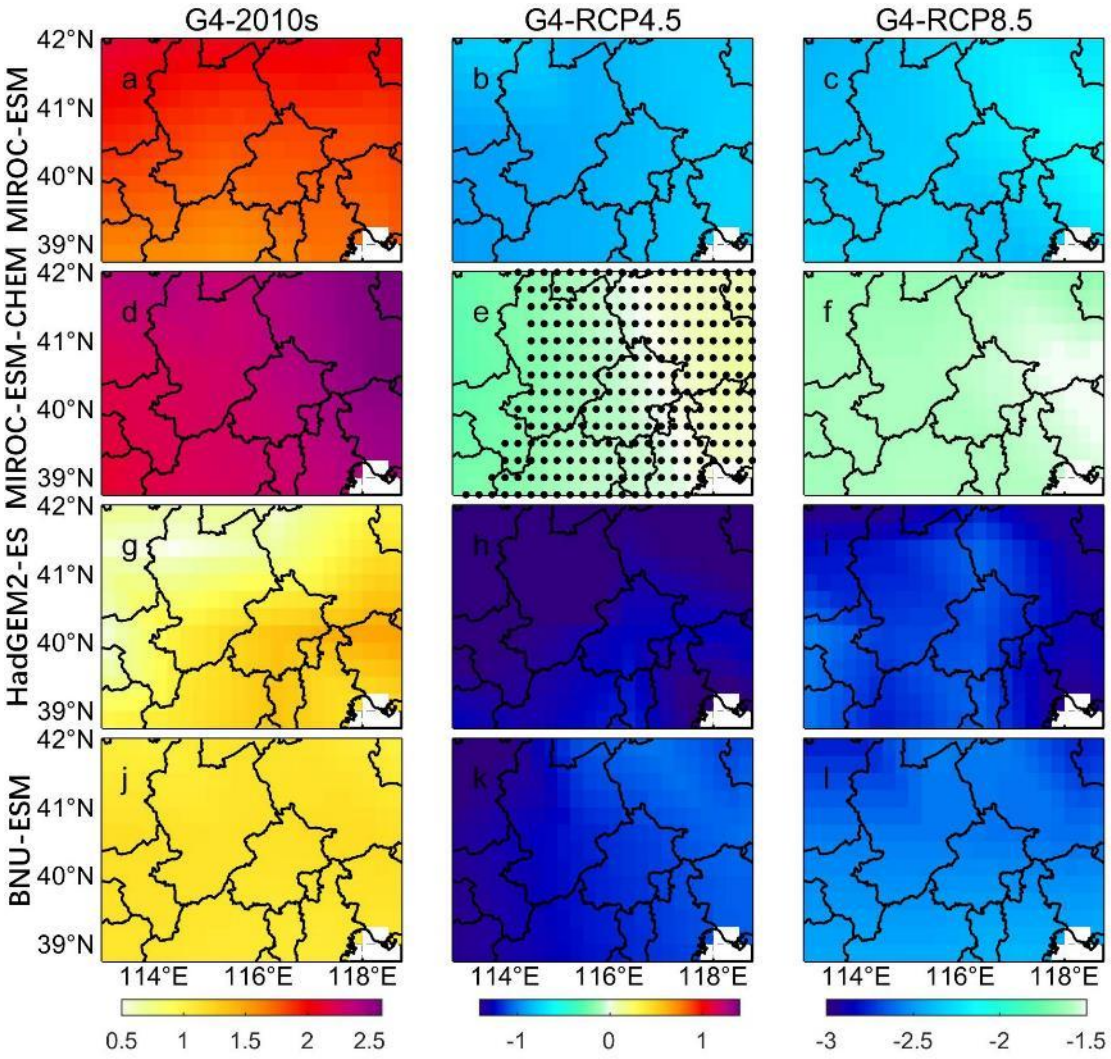

Figure S13: Spatial pattern of 2m temperature difference (°C) under different scenarios over 2060-2069: G4-2010s (left column), G4-RCP4.5 (second column) and G4-RCP8.5 (right column) based on ISIMIP method. 2010s means the results simulated during 2008-2017. From top to bottom are MIROC-ESM (a-c), MIROC-ESM-CHEM (d-f), HadGEM2-ES (g-i) and BNU-ESM (j-l), respectively. Stippling indicates grid points where differences or changes are not significant at the 5% level according to the Wilcoxon signed rank test.

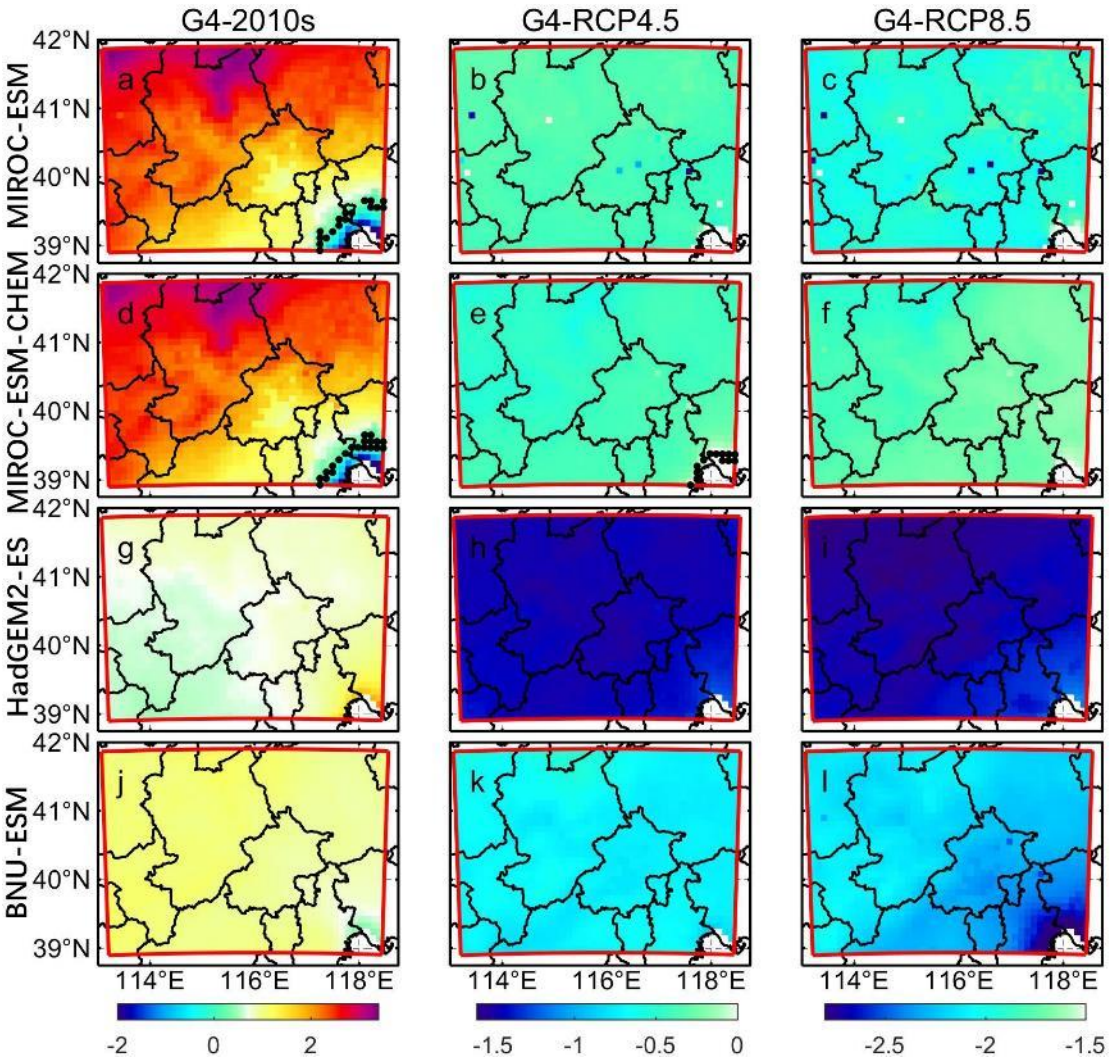

Figure S14: Spatial pattern of 2m temperature difference (℃) under different scenarios over 2060-2069: G4-2010s (left column), G4-RCP4.5 (second column) and G4-RCP8.5 (right column) based on WRF_QDM results. 2010s means the results simulated during 2008-2017. From top to bottom are MIROC-ESM (a-c), MIROC-ESM-CHEM (d-f), HadGEM2-ES (g-i) and BNU-ESM (j-l), respectively. Stippling indicates grid points where differences or changes are not significant at the 5% level according to the Wilcoxon signed rank test.

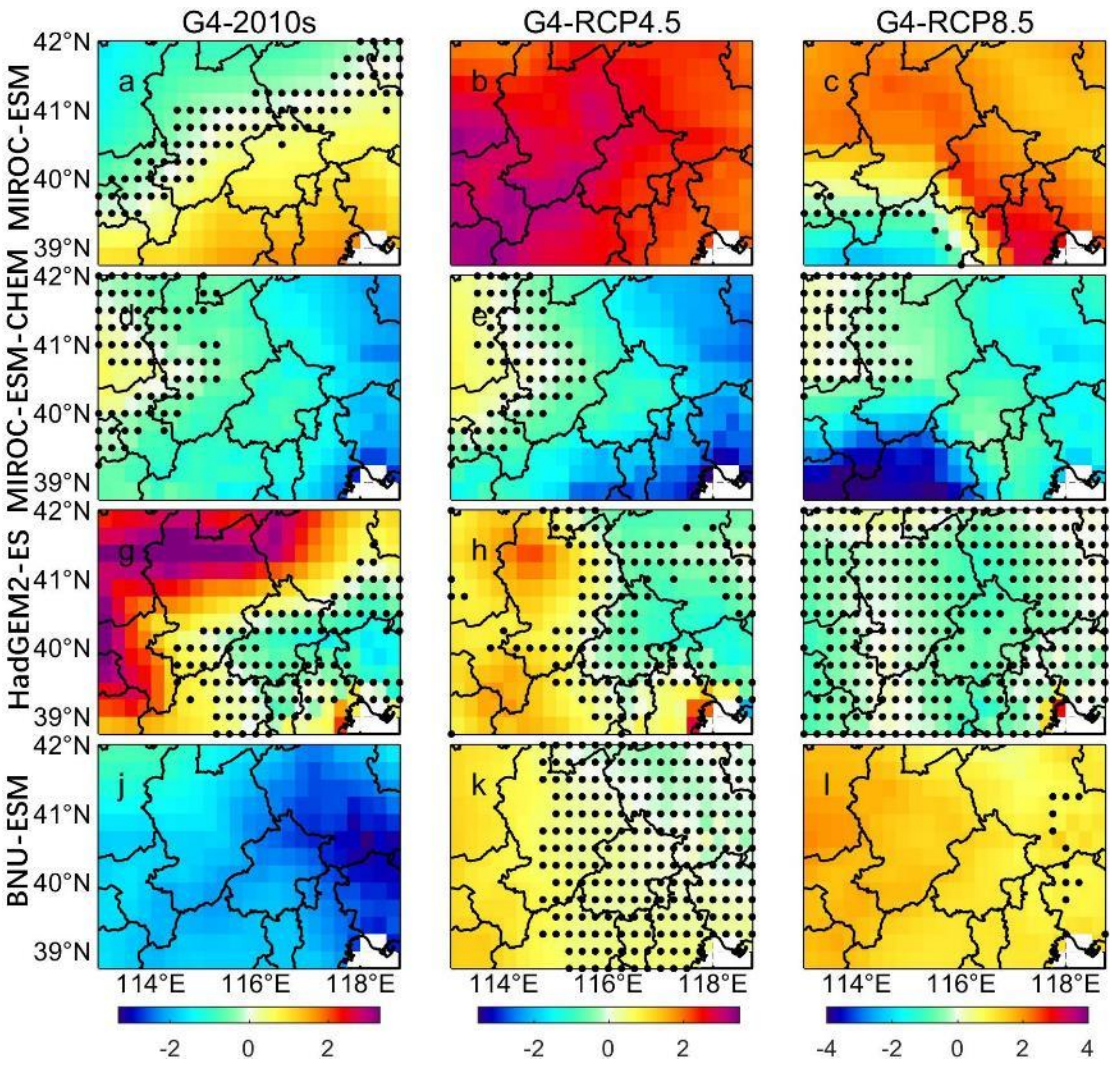

Figure S15: Spatial pattern of relative humidity (%) difference under different scenarios over 2060-2069: G4-2010s (left column), G4-RCP4.5 (second column) and G4-RCP8.5 (right column) based on ISIMIP method. 2010s means the results simulated during 2008-2017. From top to bottom are MIROC-ESM (a-c), MIROC-ESM-CHEM (d-f), HadGEM2-ES (g-i) and BNU-ESM (j-l), respectively. Stippling indicates grid points where differences or changes are not significant at the 5% level according to the Wilcoxon signed rank test.

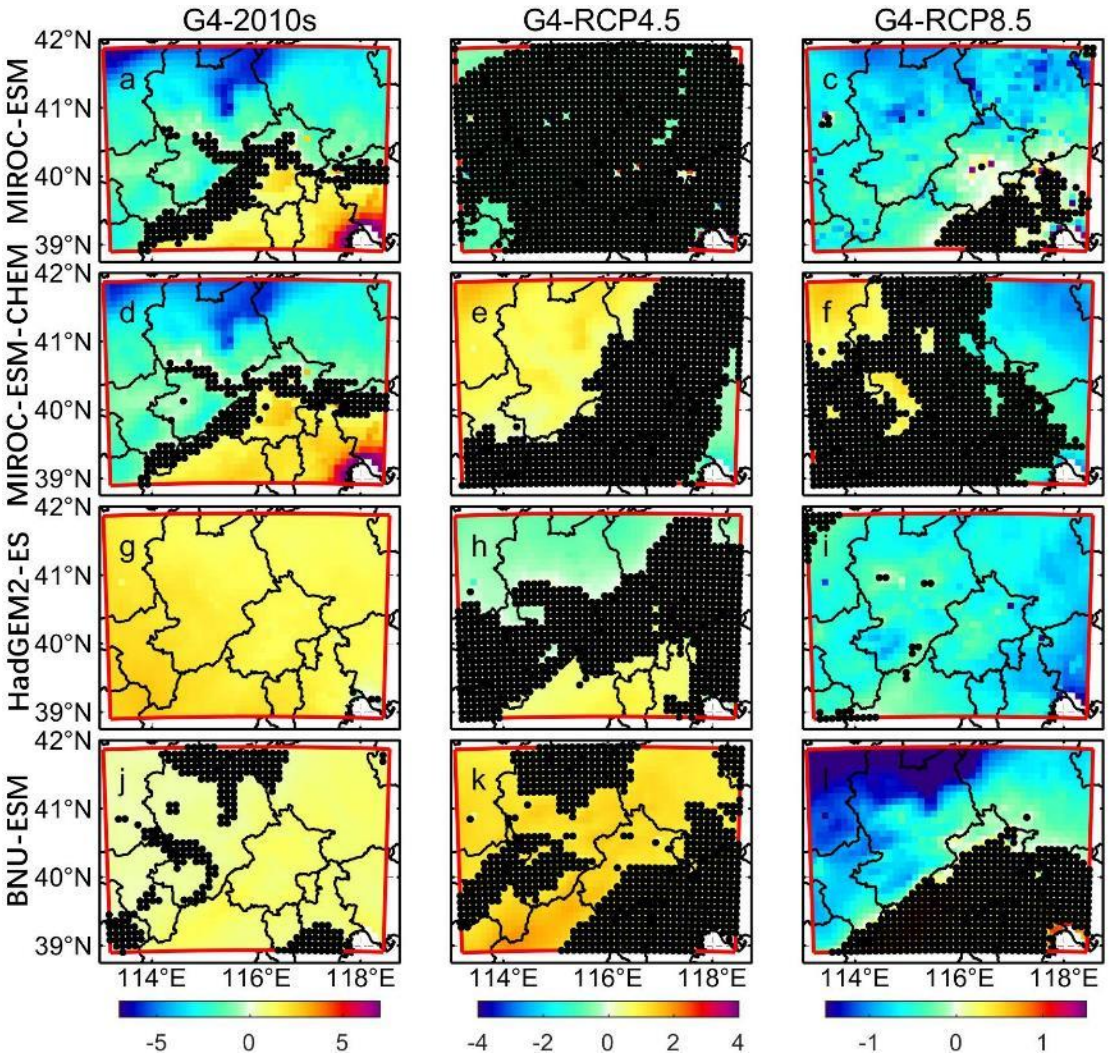

Figure S16: Spatial pattern of relative humidity difference (%) under different scenarios over 2060-2069: G4-2010s (left column), G4-RCP4.5 (second column) and G4-RCP8.5 (right column) based on WRF_QDM results. 2010s means the results simulated during 2008-2017. From top to bottom are MIROC-ESM (a-c), MIROC-ESM-CHEM (d-f), HadGEM2-ES (g-i) and BNU-ESM (j-l), respectively. Stippling indicates grid points where differences or changes are not significant at the 5% level according to the Wilcoxon signed rank test.

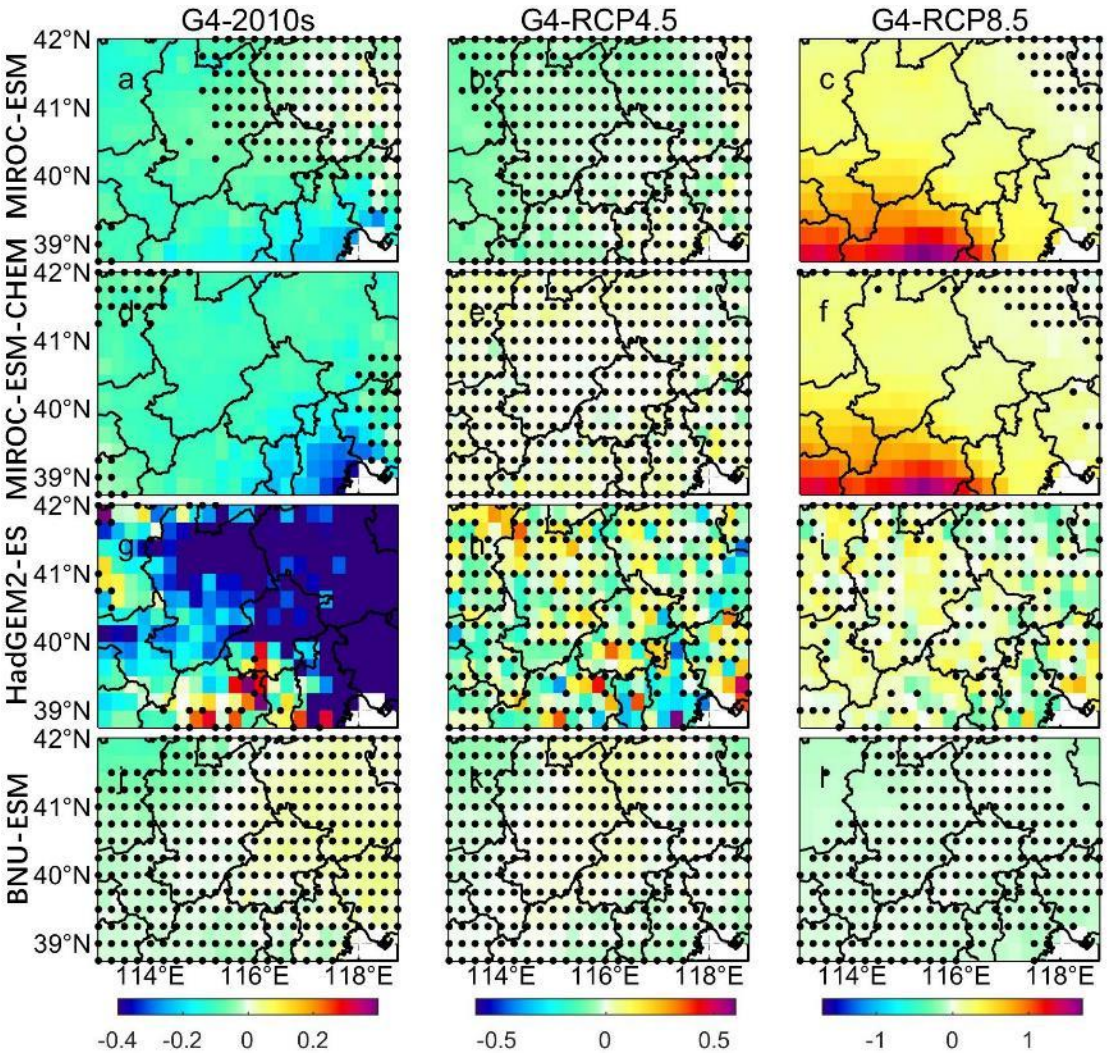

Figure S17: Spatial pattern of wind speed (m/s) difference under different scenarios over 2060-2069: G4-2010s (left column), G4-RCP4.5 (second column) and G4-RCP8.5 (right column) based on ISIMIP method. 2010s means the results simulated during 2008-2017. From top to bottom are MIROC-ESM (a-c), MIROC-ESM-CHEM (d-f), HadGEM2-ES (g-i) and BNU-ESM (j-l), respectively. Stippling indicates grid points where differences or changes are not significant at the 5% level according to the Wilcoxon signed rank test.

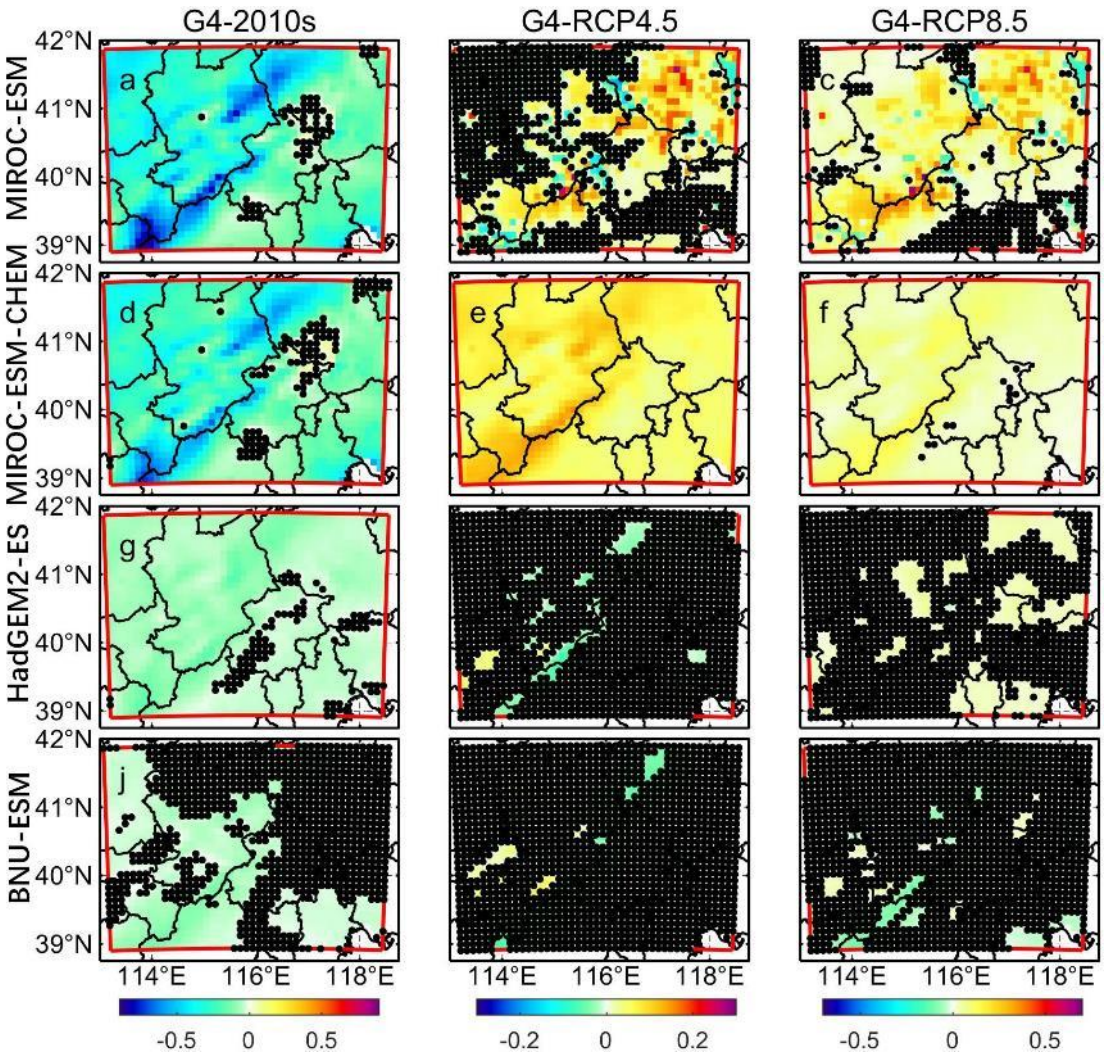

Figure S18: Spatial pattern of wind speed (m/s) difference under different scenarios over 2060-2069: G4-2010s (left column), G4-RCP4.5 (second column) and G4-RCP8.5 (right column) based on WRF_QDM results. 2010s means the results simulated during 2008-2017. From top to bottom are MIROC-ESM (a-c), MIROC-ESM-CHEM (d-f), HadGEM2-ES (g-i) and BNU-ESM (j-l), respectively. Stippling indicates grid points where differences or changes are not significant at the 5% level according to the Wilcoxon signed rank test.