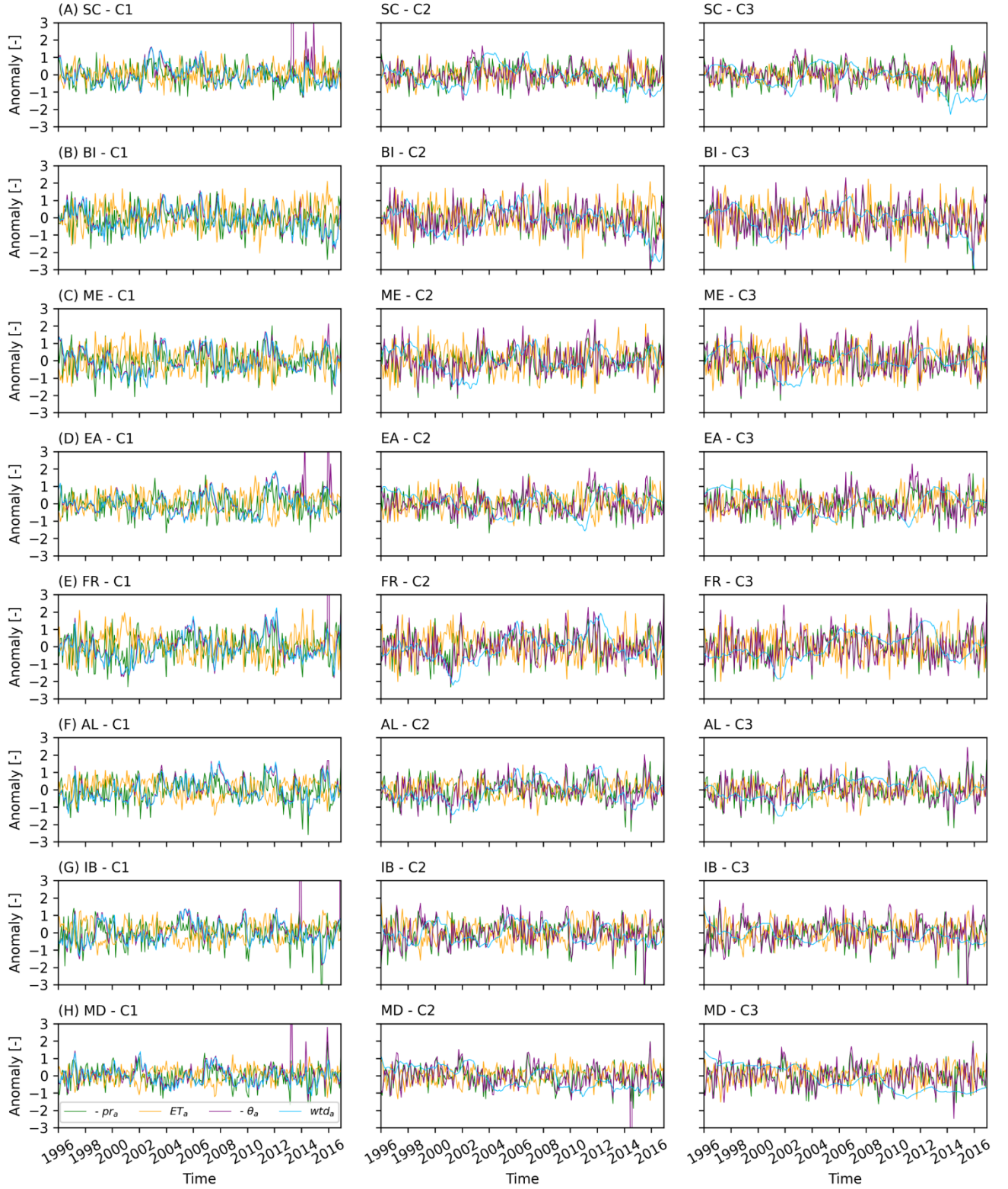
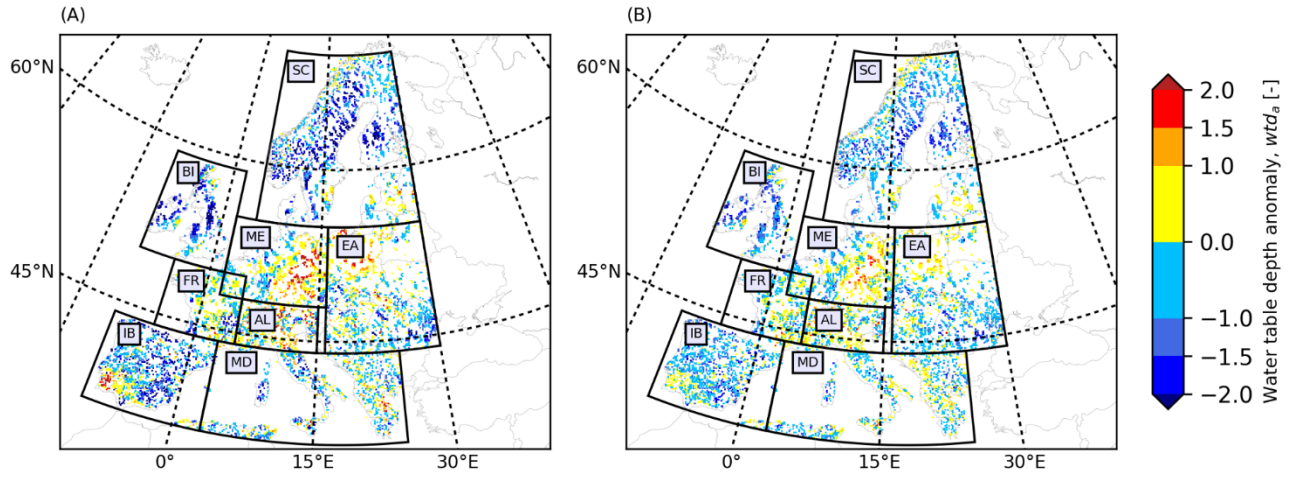


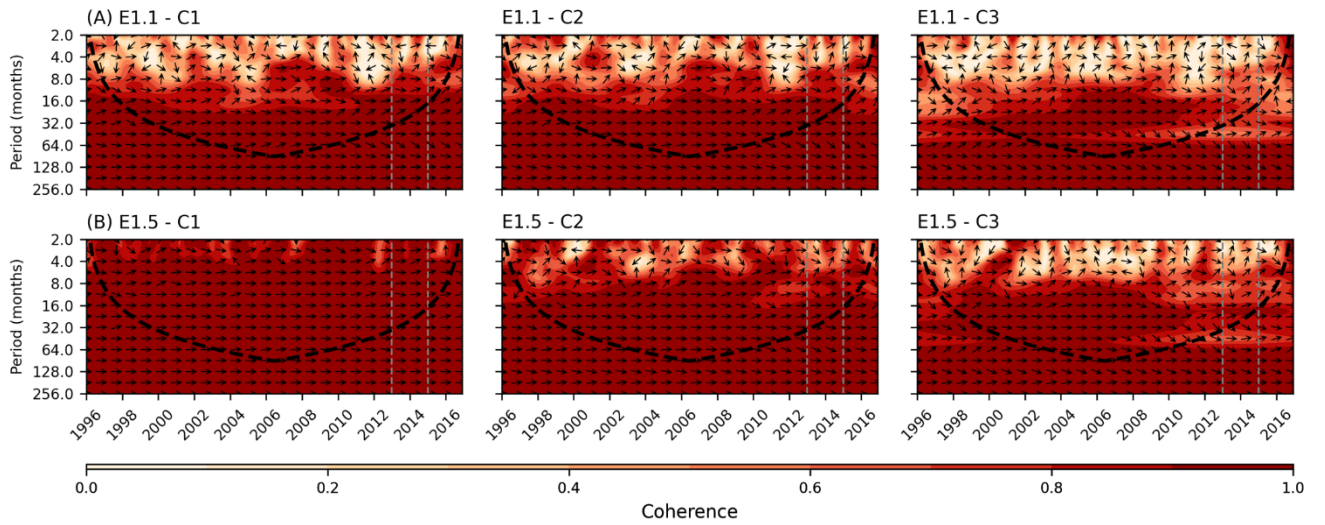
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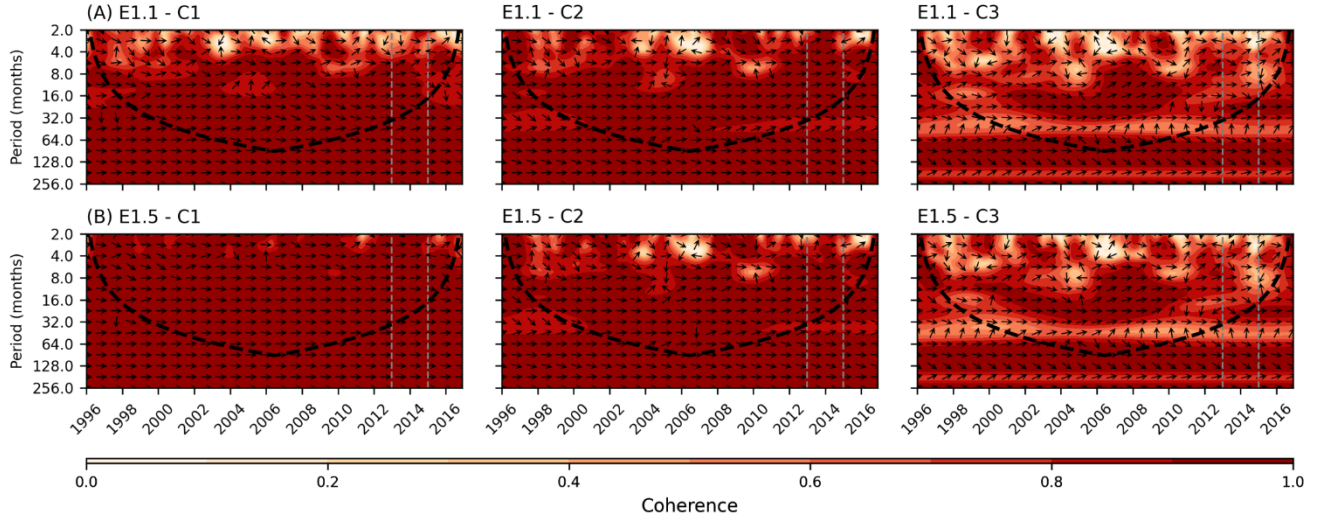
Supplementary Figure 1. Regionally averaged pr_a , ET_a , θ_a and wtd_a time series for the wtd categories C1 to C3 in different PRUDENCE regions.



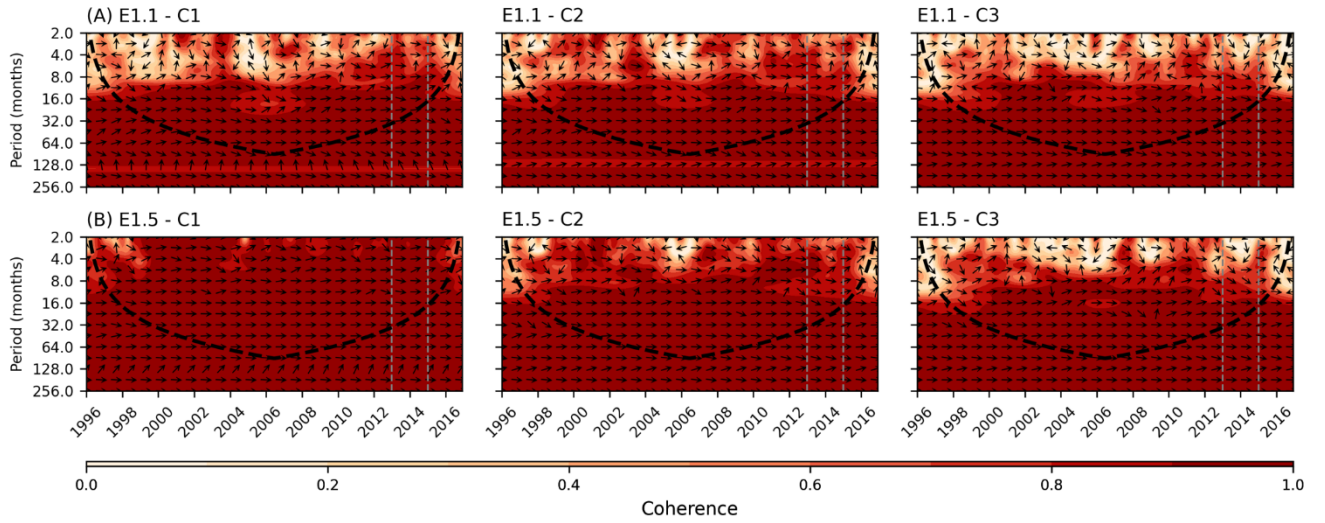
Supplementary Figure 2. European wtd_a maps for August 2015 (i.e., in the testing period), derived from (A) the TSMP-G2A data set and (B) results from the LSTM networks of E1.1 (pr_a).



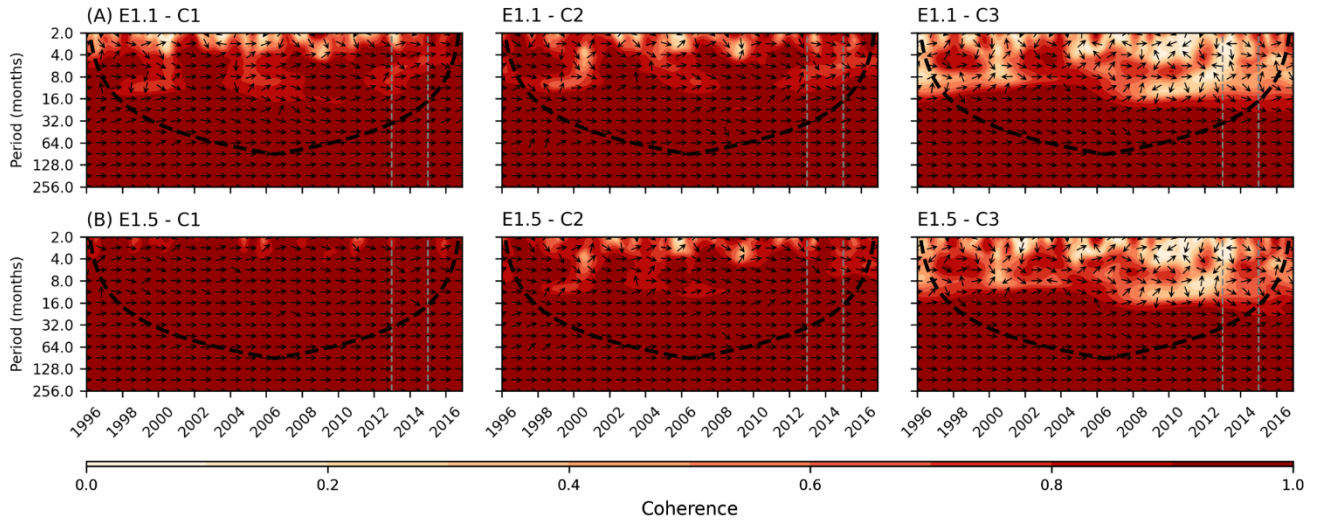
Supplementary Figure 3. Results of wavelet coherence analysis on the regionally averaged wtd_a time series for the wtd categories C1 to C3 in SC, which were derived from the TSMP-G2A data set and the results of the LSTM networks of: (A) E1.1: pr_a ; and (B) E1.5: pr_a and θ_a .



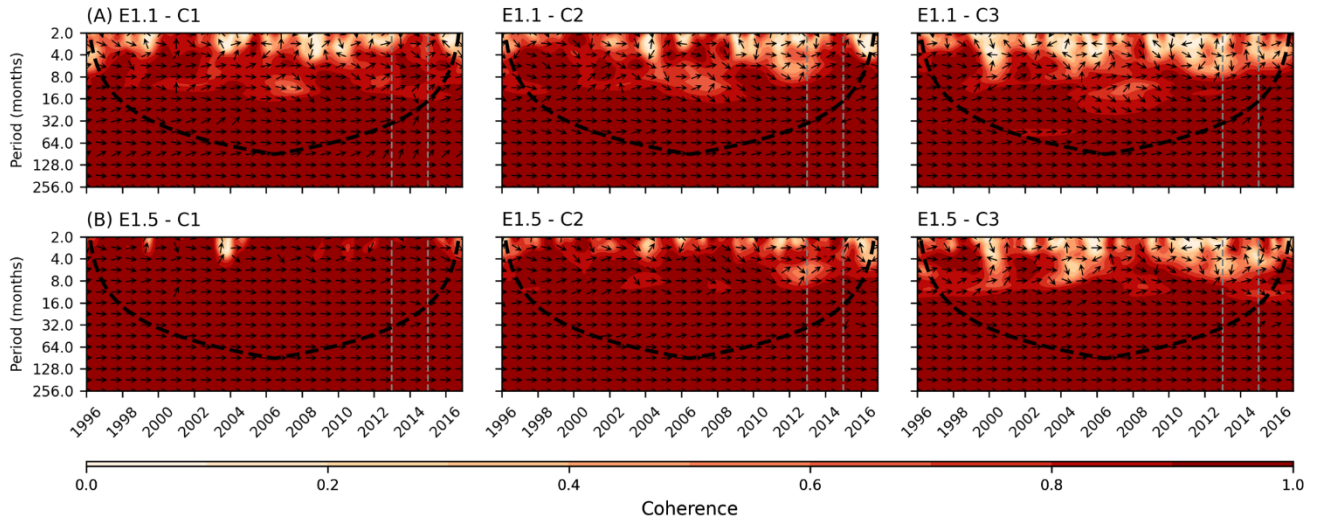
Supplementary Figure 4. Results of wavelet coherence analysis on the regionally averaged wtd_a time series for the wtd categories C1 to C3 in BI, which were derived from the TSMP-G2A data set and the results of the LSTM networks of: (A) E1.1: pr_a ; and (B) E1.5: pr_a and θ_a .



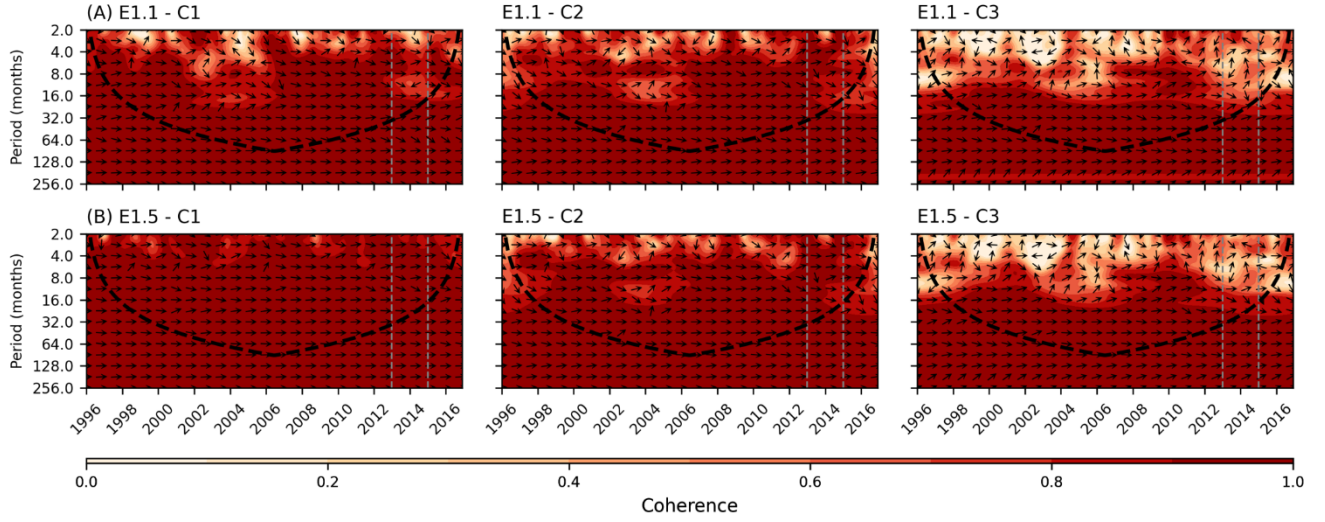
Supplementary Figure 5. Results of wavelet coherence analysis on the regionally averaged wtd_a time series for the wtd categories C1 to C3 in EA, which were derived from the TSMP-G2A data set and the results of the LSTM networks of: (A) E1.1: pr_a ; and (B) E1.5: pr_a and θ_a .



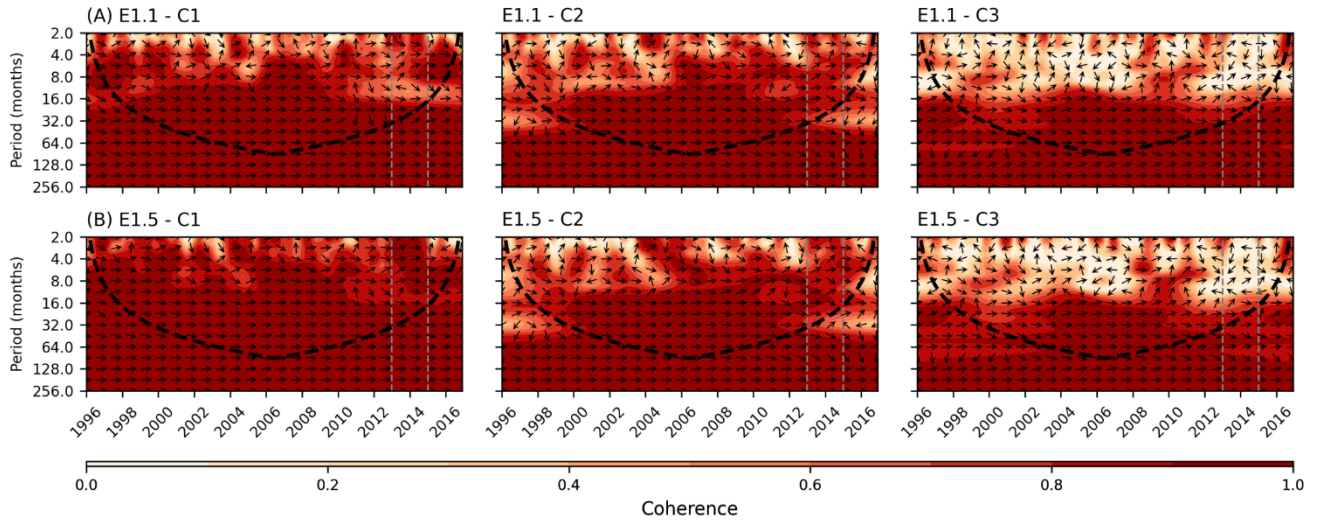
Supplementary Figure 6. Results of wavelet coherence analysis on the regionally averaged wtd_a time series for the wtd categories C1 to C3 in FR, which were derived from the TSMP-G2A data set and the results of the LSTM networks of: (A) E1.1: pr_a ; and (B) E1.5: pr_a and θ_a .



Supplementary Figure 7. Results of wavelet coherence analysis on the regionally averaged wtd_a time series for the wtd categories C1 to C3 in AL, which were derived from the TSMP-G2A data set and the results of the LSTM networks of: (A) E1.1: pr_a ; and (B) E1.5: pr_a and θ_a .



Supplementary Figure 8. Results of wavelet coherence analysis on the regionally averaged wtd_a time series for the wtd categories C1 to C3 in IB, which were derived from the TSMP-G2A data set and the results of the LSTM networks of: (A) E1.1: pr_a ; and (B) E1.5: pr_a and θ_a .



Supplementary Figure 9. Results of wavelet coherence analysis on the regionally averaged wtd_a time series for the wtd categories C1 to C3 in MD, which were derived from the TSMP-G2A data set and the results of the LSTM networks of: (A) E1.1: pr_a ; and (B) E1.5: pr_a and θ_a .

Supplementary Table 1. Medians of the test R^2 and RMSEs achieved in different experiments for C1 to C3 in each PRUDENCE region (set negative R^2 as zeros).

		Test R^2 [%]			Test RMSE [-]		
		C1	C2	C3	C1	C2	C3
SC	E1.1	13.30	0.00	0.00	0.57	0.6	0.87
	E1.2	0.00	0.00	0.00	0.84	1.12	1.37
	E1.3	74.52	0.00	0.00	0.29	0.76	1.005
	E1.4	13.39	0.00	0.00	0.58	0.64	0.885
	E1.5	79.25	0.00	0.00	0.28	0.58	0.78
	E1.6	76.77	0.00	0.00	0.29	0.76	0.965
	E1.7	78.55	0.00	0.00	0.27	0.6	0.79
	E2.1	79.14	0.00	0.00	0.27	0.59	0.8
	E2.2	75.58	15.19	0.00	0.29	0.53	0.735
	E2.3	79.45	12.07	0.00	0.28	0.55	0.74
BI	E1.1	49.98	12.6	0.00	0.51	0.69	1.00
	E1.2	0.00	0.0	0.00	0.77	1.46	1.56
	E1.3	87.93	18.9	0.00	0.24	0.63	0.98
	E1.4	47.91	0.0	0.00	0.53	0.77	1.06
	E1.5	88.41	32.1	0.00	0.24	0.60	0.94
	E1.6	86.98	20.5	0.00	0.26	0.66	0.98
	E1.7	86.95	21.0	0.00	0.25	0.65	1.03
	E2.1	88.70	28.8	0.00	0.23	0.64	0.94
	E2.2	82.32	8.9	0.00	0.28	0.68	1.09
	E2.3	86.94	29.2	0.00	0.25	0.60	0.64
ME	E1.1	62.39	49.29	0.00	0.48	0.41	0.41
	E1.2	0.00	0.00	0.00	0.91	0.89	0.89
	E1.3	90.21	38.57	0.00	0.25	0.45	0.45
	E1.4	57.16	36.14	0.00	0.51	0.46	0.45
	E1.5	90.94	58.15	0.00	0.22	0.38	0.38
	E1.6	87.91	42.18	0.00	0.27	0.48	0.52
	E1.7	89.27	54.26	0.00	0.25	0.39	0.41
	E2.1	90.62	58.79	0.00	0.23	0.39	0.39
	E2.2	87.23	62.96	12.03	0.27	0.34	0.38
	E2.3	87.06	57.91	5.22	0.28	0.37	0.42
EA	E1.1	41.53	11.18	0.00	0.47	0.45	0.47
	E1.2	0.00	0.00	0.00	0.64	0.78	0.74
	E1.3	89.97	12.74	0.00	0.18	0.45	0.50
	E1.4	45.51	0.00	0.00	0.46	0.48	0.49
	E1.5	91.25	20.64	0.00	0.17	0.42	0.46
	E1.6	88.44	12.92	0.00	0.20	0.46	0.55
	E1.7	89.71	13.79	0.00	0.18	0.43	0.50
	E2.1	90.70	26.44	0.00	0.18	0.42	0.50
	E2.2	86.86	31.88	0.00	0.21	0.37	0.50
	E2.3	91.52	41.70	9.33	0.18	0.38	0.35
FR	E1.1	74.96	44.82	20.52	0.40	0.34	0.37
	E1.2	20.34	0.00	0.00	0.70	0.59	0.71
	E1.3	94.41	42.06	0.00	0.19	0.37	0.43
	E1.4	73.72	36.35	0.00	0.39	0.37	0.41
	E1.5	95.03	57.44	13.97	0.17	0.32	0.36
	E1.6	92.77	41.97	0.00	0.21	0.38	0.47
	E1.7	93.50	51.47	8.91	0.19	0.33	0.38

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	E2.1	94.66	58.15	9.79	0.17	0.32	0.40
	E2.2	92.40	65.88	15.52	0.20	0.27	0.37
	E2.3	93.84	65.36	9.51	0.20	0.31	0.42
AL	E1.1	51.38	40.09	0.00	0.52	0.45	0.41
	E1.2	13.61	0.00	0.00	0.74	0.76	0.62
	E1.3	87.52	46.65	0.00	0.28	0.44	0.46
	E1.4	56.72	28.40	0.00	0.50	0.51	0.43
	E1.5	89.42	54.58	0.00	0.25	0.38	0.41
	E1.6	87.52	38.94	0.00	0.27	0.47	0.46
	E1.7	89.50	47.94	0.00	0.25	0.40	0.41
	E2.1	89.53	56.99	0.00	0.25	0.37	0.40
	E2.2	87.17	53.00	0.00	0.28	0.43	0.43
	E2.3	90.15	63.30	0.26	0.27	0.38	0.40
IB	E1.1	51.57	0.00	0.00	0.50	0.51	0.59
	E1.2	13.62	0.00	0.00	0.62	0.62	0.68
	E1.3	86.68	0.00	0.00	0.22	0.45	0.56
	E1.4	56.95	0.00	0.00	0.44	0.49	0.59
	E1.5	86.46	0.00	0.00	0.23	0.45	0.59
	E1.6	84.93	0.00	0.00	0.24	0.48	0.64
	E1.7	84.88	0.00	0.00	0.25	0.45	0.65
	E2.1	86.56	0.00	0.00	0.22	0.45	0.58
	E2.2	79.31	0.00	0.00	0.29	0.41	0.61
	E2.3	83.62	7.88	0.00	0.26	0.42	0.48
MD	E1.1	43.01	0.00	0.00	0.49	0.42	0.37
	E1.2	22.23	0.00	0.00	0.57	0.51	0.46
	E1.3	70.98	0.00	0.00	0.32	0.43	0.38
	E1.4	51.54	0.00	0.00	0.44	0.44	0.36
	E1.5	75.97	0.00	0.00	0.30	0.40	0.37
	E1.6	71.06	0.00	0.00	0.31	0.43	0.40
	E1.7	74.53	0.00	0.00	0.30	0.42	0.39
	E2.1	75.56	0.00	0.00	0.30	0.41	0.39
	E2.2	72.01	0.00	0.00	0.33	0.42	0.43
	E2.3	76.97	0.47	0.00	0.29	0.38	0.31