Tables

Table S1. Parameters of sensitively analysis with SNICAR model in snow cover surface across Xinjiang. 1. Incident radiation (a. Direct, b. Diffuse); 2. Solar zenith angle; 3. Surface spectral distribution (a. Mid-latitude winter, clear-sky, cloud amount < 5% b. Mid- latitude winter, cloudy, cloud amount ≥ 5%); 4. Snow grain effective radius (μm); 5. Snow depth (m); 6. Snow density (kg m^{-3}); 7a. Albedo of underlying ground (visible, 0.3-0.7 μm); 7b. Albedo of underlying ground (near-infrared, 0.7-5.0 μm); 8. MAC scaling factor (experimental) for BC; 9. BC concentration (ppb, Sulfate-coated); 10. Dust concentration (ppm, 5.0-10.0 μm diameter); 11. Volcanic ash concentration (ppm); 12. Experimental particle 1 concentration (ppb).

Code No.	1	2	3	4	5	6	7a	7b	8	9	10	11	12
XJ2015-1	a	85.09	a	150	0.06	50	0.15	0.3	1	8841.12	159.37	0	0
XJ2015-2	a	67.08	a	500	0.15	90	0.15	0.3	1	3936.41	122.98	0	0
XJ2015-3	b	89.00	b	150	0.21	160	0.15	0.3	1	7657.66	235.67	0	0
XJ2015-4	a	63.52	b	50	0.38	170	0.15	0.3	1	3536.58	107.29	0	0
XJ2015-5	b	86.00	a	250	0.05	140	0.15	0.3	1	6636.69	179.24	0	0
XJ2015-6	a	65.74	b	50	0.13	60	0.15	0.3	1	154.13	7.52	0	0
XJ2015-7	a	69.50	b	150	0.30	120	0.15	0.3	1	397.57	11.08	0	0
XJ2015-8	a	72.17	a	150	0.37	90	0.15	0.3	1	77.66	2.50	0	0
XJ2015-9	a	71.23	a	200	0.27	100	0.15	0.3	1	222.14	4.73	0	0
XJ2015-10	a	76.22	a	100	0.50	100	0.15	0.3	1	31.74	0.87	0	0
XJ2015-11	a	66.38	a	100	0.10	110	0.15	0.3	1	195.05	7.35	0	0
XJ2015-12	b	75.00	a	150	0.15	80	0.15	0.3	1	249.86	7.55	0	0
XJ2015-13	a	61.42	a	150	0.18	180	0.15	0.3	1	2050.00	11.69	0	0
XJ2015-14	a	70.71	a	50	0.60	150	0.15	0.3	1	215.03	2.51	0	0
XJ2015-15	a	88.30	a	150	0.05	130	0.15	0.3	1	127.87	2.77	0	0
XJ2015-16	a	73.05	a	150	0.34	100	0.15	0.3	1	214.47	2.19	0	0
XJ2015-17	a	63.77	a	400	0.10	200	0.15	0.3	1	2512.49	25.12	0	0
XJ2015-18	a	86.81	a	150	0.37	150	0.15	0.3	1	445.21	11.92	0	0

XJ2015-19	a	79.41	a	500	0.21	100	0.15	0.3	1	1200.38	18.98	0	0
XJ2015-20	a	61.48	a	400	0.19	150	0.15	0.3	1	823.07	51.88	0	0
HM2016-1	a	71.14	a	150	0.70	150	0.15	0.3	1	69.08	1.73	0	0
HM2016-2	a	72.96	a	150	0.78	150	0.15	0.3	1	92.55	2.31	0	0
HM2016-3	a	69.80	a	50	0.42	280	0.15	0.3	1	870.20	38.70	0	0
HM2016-4	a	69.80	a	50	0.45	300	0.15	0.3	1	86.01	4.11	0	0
HM2016-5	a	82.68	a	100	0.75	150	0.15	0.3	1	57.80	2.67	0	0
HM2016-6	a	69.58	a	100	0.96	150	0.15	0.3	1	97.81	1.96	0	0
HM2016-7	a	70.47	a	100	0.94	150	0.15	0.3	1	93.79	1.74	0	0
HM2016-8	a	71.69	b	150	0.92	150	0.15	0.3	1	126.81	2.00	0	0
HM2016-9	a	72.93	b	100	1.01	150	0.15	0.3	1	70.95	2.77	0	0
HM2016-10	a	74.41	b	150	0.94	150	0.15	0.3	1	52.06	1.31	0	0
HM2016-11	a	77.06	b	150	0.92	150	0.15	0.3	1	108.10	1.93	0	0
HM2016-12	a	81.31	b	100	0.92	150	0.15	0.3	1	159.45	1.20	0	0
HM2016-13	a	69.23	a	100	1.02	100	0.15	0.3	1	40.60	1.05	0	0
HM2016-14	a	69.78	a	100	1.00	130	0.15	0.3	1	56.82	1.80	0	0
HM2016-15	a	70.72	a	100	1.05	130	0.15	0.3	1	65.10	2.23	0	0
HM2016-16	a	72.33	a	100	1.10	140	0.15	0.3	1	36.83	1.54	0	0
HM2016-17	a	74.06	a	150	1.04	140	0.15	0.3	1	54.38	0.72	0	0
HM2016-18	a	76.40	a	100	1.02	140	0.15	0.3	1	41.19	1.25	0	0
HM2016-19	a	80.22	a	100	1.05	140	0.15	0.3	1	58.28	1.33	0	0
HM2016-20	a	69.93	b	150	0.91	150	0.15	0.3	1	38.88	1.31	0	0
HM2016-21	a	71.30	b	150	0.93	150	0.15	0.3	1	58.83	0.88	0	0
HM2016-22	a	72.83	b	150	0.86	150	0.15	0.3	1	74.33	1.38	0	0
HM2016-23	a	74.04	b	100	0.88	150	0.15	0.3	1	47.85	1.47	0	0
HM2016-24	a	75.76	b	100	0.85	150	0.15	0.3	1	50.37	0.78	0	0

HM2016-25	a	78.01	b	100	0.84	150	0.15	0.3	1	53.03	1.36	0	0
HM2016-26	a	80.39	a	100	0.80	150	0.15	0.3	1	73.07	1.31	0	0
HM2016-27	a	82.14	a	100	0.86	150	0.15	0.3	1	57.54	1.34	0	0
HM2016-28	a	84.11	a	150	0.83	150	0.15	0.3	1	45.40	1.04	0	0
HM2016-29	a	86.30	a	150	0.81	150	0.15	0.3	1	31.96	0.46	0	0
HM2016-30	a	88.00	a	150	0.80	150	0.15	0.3	1	48.80	0.88	0	0
HM2016-31	a	71.92	a	100	0.75	150	0.15	0.3	1	81.21	2.58	0	0
HM2016-32	a	73.68	a	100	0.74	200	0.15	0.3	1	42.77	1.16	0	0
HM2016-33	a	68.31	a	50	0.89	150	0.15	0.3	1	112.30	1.41	0	0
HM2016-34	a	68.74	a	50	0.92	140	0.15	0.3	1	154.48	1.52	0	0
HM2016-35	a	69.38	a	100	0.92	150	0.15	0.3	1	145.59	1.72	0	0
HM2016-36	a	70.46	a	150	0.95	140	0.15	0.3	1	111.51	1.22	0	0
HM2016-37	a	71.65	a	150	0.97	150	0.15	0.3	1	131.95	1.47	0	0
HM2016-38	a	73.06	a	150	0.98	140	0.15	0.3	1	103.07	1.71	0	0
HM2016-39	a	74.15	a	150	0.96	150	0.15	0.3	1	124.69	1.27	0	0
HM2016-40	a	76.31	a	100	0.94	140	0.15	0.3	1	96.89	1.84	0	0
HM2016-41	a	78.40	a	100	0.99	150	0.15	0.3	1	117.89	1.02	0	0
HM2016-42	a	81.15	a	100	1.01	150	0.15	0.3	1	103.98	1.42	0	0
HM2016-43	a	83.50	a	50	0.98	150	0.15	0.3	1	87.65	1.30	0	0
HM2016-44	a	85.71	a	50	0.96	140	0.15	0.3	1	69.33	1.06	0	0
HM2016-45	a	87.50	a	50	0.95	150	0.15	0.3	1	107.65	1.30	0	0
HM2016-46	a	67.83	a	100	1.01	150	0.15	0.3	1	146.32	1.42	0	0
HM2016-47	a	68.26	a	150	0.94	150	0.15	0.3	1	176.08	1.55	0	0
HM2016-48	a	69.03	a	150	0.96	150	0.15	0.3	1	138.98	1.74	0	0
HM2016-49	a	70.46	a	150	0.96	150	0.15	0.3	1	144.99	1.76	0	0
HM2016-50	a	71.54	a	150	0.95	160	0.15	0.3	1	188.94	1.92	0	0

HM2016-51	a	72.85	a	100	0.93	150	0.15	0.3	1	152.64	1.16	0	0
HM2016-52	a	74.70	a	100	0.96	140	0.15	0.3	1	109.27	1.42	0	0
HM2016-53	a	76.48	a	100	0.99	150	0.15	0.3	1	155.84	1.54	0	0
HM2016-54	a	78.41	a	100	0.97	160	0.15	0.3	1	156.45	2.00	0	0
HM2016-55	a	80.97	a	100	0.94	160	0.15	0.3	1	144.85	2.01	0	0
HM2016-56	a	83.73	a	50	0.95	160	0.15	0.3	1	164.35	1.48	0	0
HM2016-57	a	86.53	a	50	0.95	150	0.15	0.3	1	145.67	1.41	0	0
HM2016-58	a	87.12	a	100	1.00	140	0.15	0.3	1	144.22	1.27	0	0
HM2016-59	a	87.56	a	100	0.93	150	0.15	0.3	1	143.24	1.71	0	0
HM2016-60	b	88.20	a	150	0.96	150	0.15	0.3	1	153.40	1.73	0	0
XJ201611-1	a	68.08	b	100	0.02	60	0.15	0.3	1	3107.08	15.00	0	0
XJ201611-2	a	64.96	b	100	0.02	80	0.15	0.3	1	360.52	1.96	0	0
XJ201611-3	a	75.43	b	100	0.08	150	0.15	0.3	1	409.95	3.88	0	0
XJ201611-4	a	71.31	a	100	0.08	150	0.15	0.3	1	1342.53	6.44	0	0
XJ201611-5	a	79.70	b	150	0.10	200	0.15	0.3	1	1800.38	17.91	0	0
XJ201611-6	b	86.04	b	100	0.06	100	0.15	0.3	1	861.22	10.09	0	0
XJ201611-7	b	97.05	b	150	0.05	100	0.15	0.3	1	3687.08	25.55	0	0
XJ201701-1	a	74.37	a	150	0.15	100	0.15	0.3	1	8635.45	82.11	0	0
XJ201701-2	a	67.47	a	150	0.10	100	0.15	0.3	1	696.26	29.55	0	0
XJ201701-3	a	76.48	a	100	0.06	100	0.15	0.3	1	694.05	25.58	0	0
XJ201701-4	a	69.47	a	150	0.18	100	0.15	0.3	1	377.59	15.94	0	0
XJ201701-5	a	71.99	a	150	0.43	100	0.15	0.3	1	69.80	0.73	0	0
XJ201701-6	a	72.60	a	50	0.07	80	0.15	0.3	1	355.00	7.22	0	0
XJ201701-7	a	78.99	a	50	0.37	80	0.15	0.3	1	177.90	4.29	0	0
XJ201701-8	b	86.69	a	150	0.39	100	0.15	0.3	1	659.28	20.50	0	0
XJ201701-9	a	66.16	a	150	0.12	100	0.15	0.3	1	1560.60	20.60	0	0

XJ201701-10	a	75.30	a	150	0.55	130	0.15	0.3	1	762.20	7.77	0	0
XJ201701-11	a	69.57	a	150	0.53	120	0.15	0.3	1	314.51	30.80	0	0
XJ201703-1	a	49.73	b	50	0.24	250	0.15	0.3	1	1937.68	71.24	0	0
XJ201703-2	a	55.07	b	200	0.20	300	0.15	0.3	1	1533.35	43.49	0	0
XJ201703-3	a	45.20	b	200	0.20	250	0.15	0.3	1	3097.48	114.73	0	0
XJ201703-4	a	46.92	b	100	0.20	200	0.15	0.3	1	856.01	47.01	0	0
XJ201703-5	a	48.17	a	50	0.27	200	0.15	0.3	1	390.77	10.49	0	0
XJ201703-6	a	49.00	a	50	0.30	200	0.15	0.3	1	870.62	24.52	0	0
XJ201703-7	a	46.17	a	50	0.27	200	0.15	0.3	1	644.37	26.80	0	0
XJ201703-8	a	56.33	a	100	0.29	220	0.15	0.3	1	2839.73	66.22	0	0

Table S2. Snow grain effective radius and snow density calculated for albedo reduction of snow cover with SNICAR model in three scenarios.

Parameter	Low scenario	Medium scenario	High scenario
Snow grain effective radius (μm)	50	100	200
Snow density (kg m^{-3})	160	220	260

Table S3. Snow cover duration of snow melting for clean snow and snow with BC and/or MD for different shortwave radiation at SWE was 30 mm in 8 sampling sites.

Code No.	SW=130 Wm^{-2}				SW=165 Wm^{-2}				SW=200 Wm^{-2}			
	clean snow	BC	MD	BC+MD	clean snow	BC	MD	BC+MD	clean snow	BC	MD	BC+MD
XJ201703-1	8.98	4.40	7.08	4.28	5.64	2.64	4.34	2.57	3.74	1.69	2.82	1.65
XJ201703-2	9.34	4.92	7.87	4.83	5.85	2.95	4.84	2.89	3.86	1.88	3.15	1.85
XJ201703-3	8.67	3.70	6.58	3.62	5.45	2.23	4.03	2.18	3.60	1.43	2.51	1.40
XJ201703-4	8.77	5.28	7.46	5.14	5.51	3.18	4.61	3.10	3.64	2.04	3.01	1.98

XJ201703-5	5.59	4.53	5.41	4.50	3.71	2.91	3.58	2.89	2.61	1.97	2.47	1.95
XJ201703-6	5.61	4.63	5.46	4.60	3.73	2.98	3.61	2.96	2.61	2.03	2.52	2.01
XJ201703-7	5.62	4.09	5.24	4.04	3.73	2.59	3.43	2.56	2.62	1.74	2.38	1.72
XJ201703-8	5.53	4.20	5.13	4.13	3.68	2.68	3.36	2.63	2.58	1.80	2.33	1.77

Table S4. Snow cover duration of snow melting for clean snow and snow with BC and/or MD for different shortwave radiation at SWE was 65 mm in 8 sampling sites.

Code No.	SW=130 Wm^{-2}				SW=165 Wm^{-2}				SW=200 Wm^{-2}			
	clean snow	BC	MD	BC+MD	clean snow	BC	MD	BC+MD	clean snow	BC	MD	BC+MD
XJ201703-1	19.46	9.53	15.33	9.28	12.22	5.72	9.40	5.57	8.10	3.65	6.10	3.57
XJ201703-2	20.23	10.66	17.04	10.46	12.67	6.39	10.49	6.27	8.36	4.07	6.83	4.00
XJ201703-3	18.77	8.03	14.27	7.85	11.80	4.83	8.73	4.72	7.81	3.11	5.45	3.04
XJ201703-4	18.99	11.44	16.17	11.14	11.93	6.90	9.99	6.71	7.89	4.41	6.52	4.29
XJ201703-5	12.12	9.82	11.73	9.76	8.05	6.31	7.75	6.26	5.65	4.28	5.36	4.23
XJ201703-6	12.16	10.04	11.83	9.98	8.08	6.46	7.82	6.42	5.66	4.39	5.46	4.36
XJ201703-7	12.18	8.85	11.34	8.75	8.09	5.62	7.44	5.55	5.68	3.77	5.15	3.72
XJ201703-8	11.99	9.09	11.11	8.95	7.97	5.80	7.29	5.70	5.59	3.90	5.05	3.84

Figures

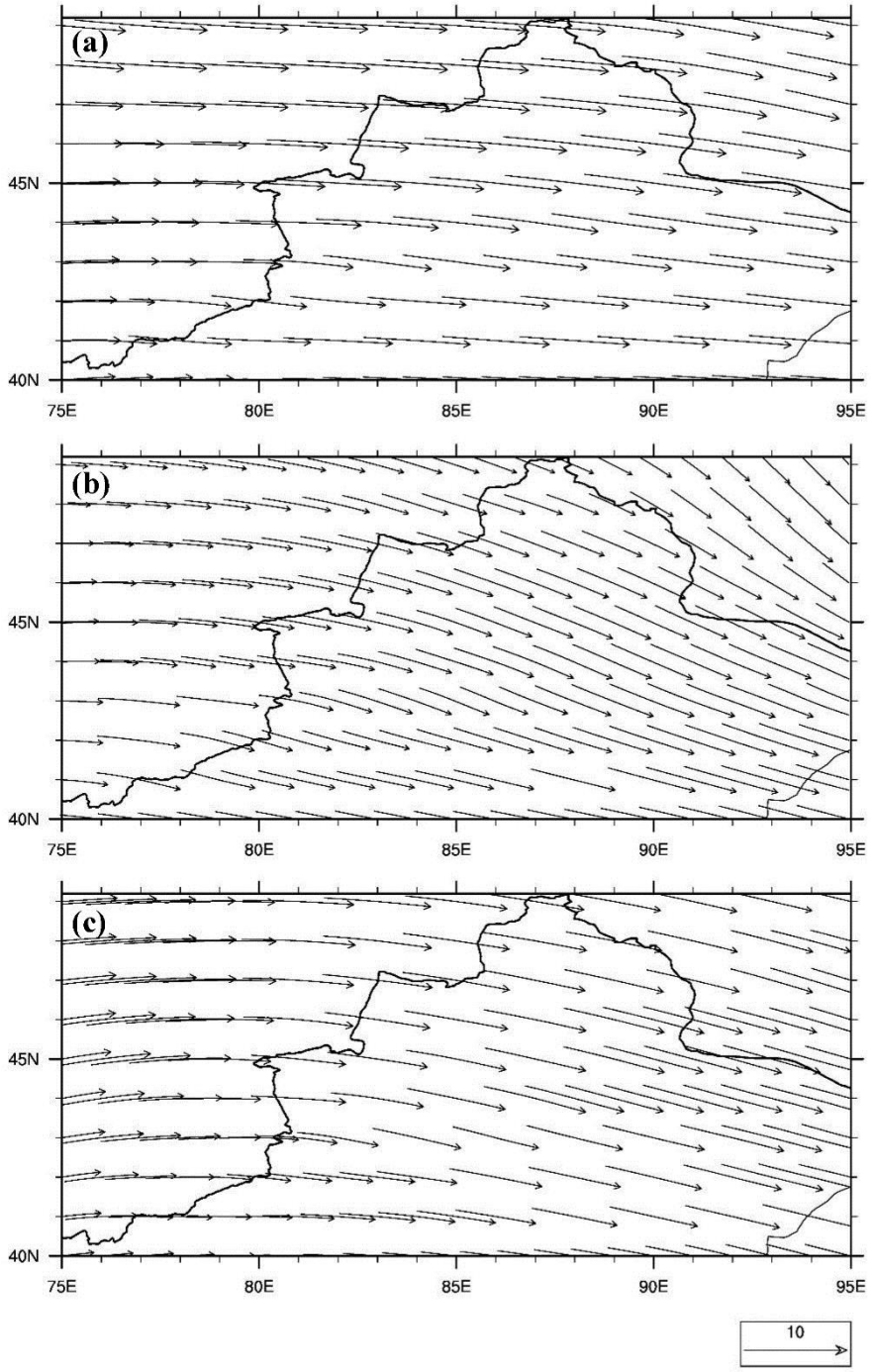

Fig. S1. Mean wind speed (m s^{-1}) at 500 hPa simulated by WRF-Chem model across the Northern Xinjiang: November in 2016 (a), January in 2017 (b), and March in 2017 (c).