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Supplement of

Source sector and region contributions to BC and $PM_{2.5}$ in Central Asia

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Table S1. Statistical summary of comparison of observed and modeled surface meteorological parameters at the a) LST and b) Bishkek sites.

(a) Site : LST	T(K)		RH%		WS(m/s)		WDir	
	Obs	MDL	Obs	MDL	Obs	MDL	Obs	MDL
Mean	280.3	27.2	59.2	61.7	3.0	4.5	182.1	220.8
Standard Error	0.4	0.4	0.8	0.8	0.0	0.1	1.3	2.9
Median	280.9	279.4	58.3	60.0	3.0	4.0	183.3	235.0
Standard Deviation	7.9	8.2	15.4	16.3	0.7	1.7	26.3	57.2
Sample Variance	61.7	67.2	236.1	265.1	0.5	3.0	691.4	3276.1
Range	30.7	34.5	71.2	73.6	4.4	11.1	149.3	293.7
Minimum	266.1	260.6	26.8	20.1	0.7	1.6	109.3	31.4
Maximum	296.8	295.1	97.9	93.7	5.2	12.7	258.6	325.1
Count	382.0	382.0	382.0	382.0	382.0	382.0	382.0	382.0
Confidence Level (95.0%)	0.8	0.8	1.5	1.6	0.1	0.2	2.6	5.8
RMSE	2.4		13.2		2.5		131.3	
Mean Bias Error	-1.2		2.4		1.5		86.2	
Mean Normalized Bias Error	0.0		0.1		0.7		0.5	
Pearson's R	1.0		0.7		-0.1		0.1	
R-squared	0.9		0.4		0.0		0.0	

(b) Site: Bishkek	T(K)		RH (%)		WS(m/s)		WDir	
	Obs	MDL	Obs	MDL	Obs	MDL	Obs	MDL
Mean	288.0	287.9	51.8	46.4	0.7	4.1	216.0	180.3
Standard Error	0.5	0.4	1.0	0.7	0.0	0.1	2.1	2.8
Median	288.9	289.1	50.2	43.1	0.7	3.9	221.5	201.3
Standard Deviation	10.1	9.2	21.1	15.4	0.3	1.2	46.8	62.5
Sample Variance	102.5	85.6	443.8	236.6	0.1	1.4	2189.1	3912.0
Range	40.0	37.3	80.8	71.7	2.3	7.4	298.3	239.0
Minimum	266.3	267.2	16.5	20.7	0.4	1.6	61.7	55.8
Maximum	306.3	304.4	97.3	92.4	2.8	9.0	360.0	294.8
Count	486.0	486.0	484.0	484.0	483.0	483.0	484.0	484.0
Confidence Level (95.0%)	0.9	0.8	1.9	1.4	0.0	0.1	4.2	5.6
RMSE	3.1		13.5		3.5		86.2	
Mean Bias Error	-0.2		-5.4		3.3		-35.7	
Mean Normalized Bias Error	0.0		0.0		5.1		0.1	
Pearson's R	1.0		0.8		0.1		0.0	
R-squared	0.9		0.7		0.0		0.0	

Table S2. Statistical summary of comparison of observed and modeled surface AOD and PM at a) LST and b) Bishkek sites.

(a) Site : LST	AOD				$PM_{2.5}(\mu g/m^3)$			$PM_{10}(\mu g/m^3)$		OC(µg /m3)		BC(µg /m3)	
	Obs-SP	MDL	Obs-LE	MDL[1]	Filter	TEOM-NonVOL	MDL	Filter	MDL	Filter	MDL	Filter	MDL
Mean	0.19	0.25	0.28	0.28	7.21	6.98	11.31	15.82	29.59	1.48	0.23	0.29	0.11
Standard Error	0.01	0.01	0.02	0.01	0.35	0.34	0.55	1.06	2.04	0.09	0.01	0.02	0.00
Median	0.15	0.24	0.16	0.24	5.80	5.99	10.01	12.04	20.76	1.16	0.19	0.20	0.10
Standard Deviation	0.14	0.12	0.26	0.17	4.31	4.09	6.74	14.31	27.45	1.17	0.16	0.26	0.04
Sample Variance	0.02	0.01	0.07	0.03	18.57	16.72	45.46	204.86	753.33	1.36	0.03	0.07	0.00
Range	0.85	1.00	1.29	1.17	25.77	22.26	57.15	130.39	200.86	9.71	1.26	1.50	0.42
Minimum	0.04	0.08	0.03	0.07	1.00	0.93	3.53	1.69	6.83	0.04	0.07	0.00	0.04
Maximum	0.89	1.08	1.33	1.25	26.77	23.19	60.69	132.08	207.69	9.75	1.33	1.50	0.46
Count	286	286	171	171	148	148	148	181	181	179	179	179	179
Confidence Level (95.0%)	0.02	0.01	0.04	0.03	0.70	0.66	1.10	2.10	4.03	0.17	0.02	0.04	0.01
RMSE	0.16		0.28		7.86	7.84		28.93		1.72		0.32	
Mean Bias Error	0.06		0.00		4.10	4.32		13.77		-1.26		-0.19	
Mean Normalized Bias Error	0.83		0.93		1.04	1.03		1.68		-0.73		-0.14	
Pearson's R	0.34		0.23		0.32	0.35		0.39		0.02		0.22	
R-squared	0.12		0.05		0.10	0.12		0.15		0.00		0.05	

[1-] These model results are for the comparison with the LE observations.

(b) Site: Bishkek	AOD		$PM_{2.5}$(μg/m^3)		PM_{10}(μg/m^3)		OC (μg/m^3)		BC(μg/m^3)	
	Obs(SP)	MDL	Filter	MDL	Obs	MDL	Obs	MDL	Obs	MDL
Mean	0.21	0.25	8.65	11.87	17.66	29.79	1.49	0.21	0.27	0.10
Standard Error	0.01	0.01	0.38	0.61	0.94	2.02	0.07	0.01	0.02	0.00
Median	0.17	0.24	7.95	9.65	14.01	21.83	1.46	0.18	0.23	0.10
Standard Deviation	0.15	0.12	5.23	8.26	12.80	27.51	0.93	0.13	0.20	0.04
Sample Variance	0.02	0.01	27.39	68.18	163.72	756.74	0.87	0.02	0.04	0.00
Range	0.87	0.89	29.91	59.45	77.00	191.20	5.26	1.19	1.30	0.40
Minimum	0.03	0.08	0.53	2.32	0.87	5.74	-0.03	0.07	0.01	0.04
Maximum	0.90	0.98	30.44	61.77	77.87	196.94	5.23	1.26	1.31	0.43
Count	341	341	186	186	186	186	186	186	170	170
Confidence Level (95.0%)	0.02	0.01	0.76	1.19	1.85	3.98	0.13	0.02	0.03	0.01
RMSE	0.18		9.76		30.77		1.57		0.26	
Mean Bias Error	0.04		3.22		12.13		-1.28		-0.17	
Mean Normalized Bias Error	0.79		1.33		2.34		-0.72		-0.18	
Pearson's R	0.19		0.12		0.39		0.22		0.17	
R-squared	0.04		0.01		0.15		0.05		0.03	

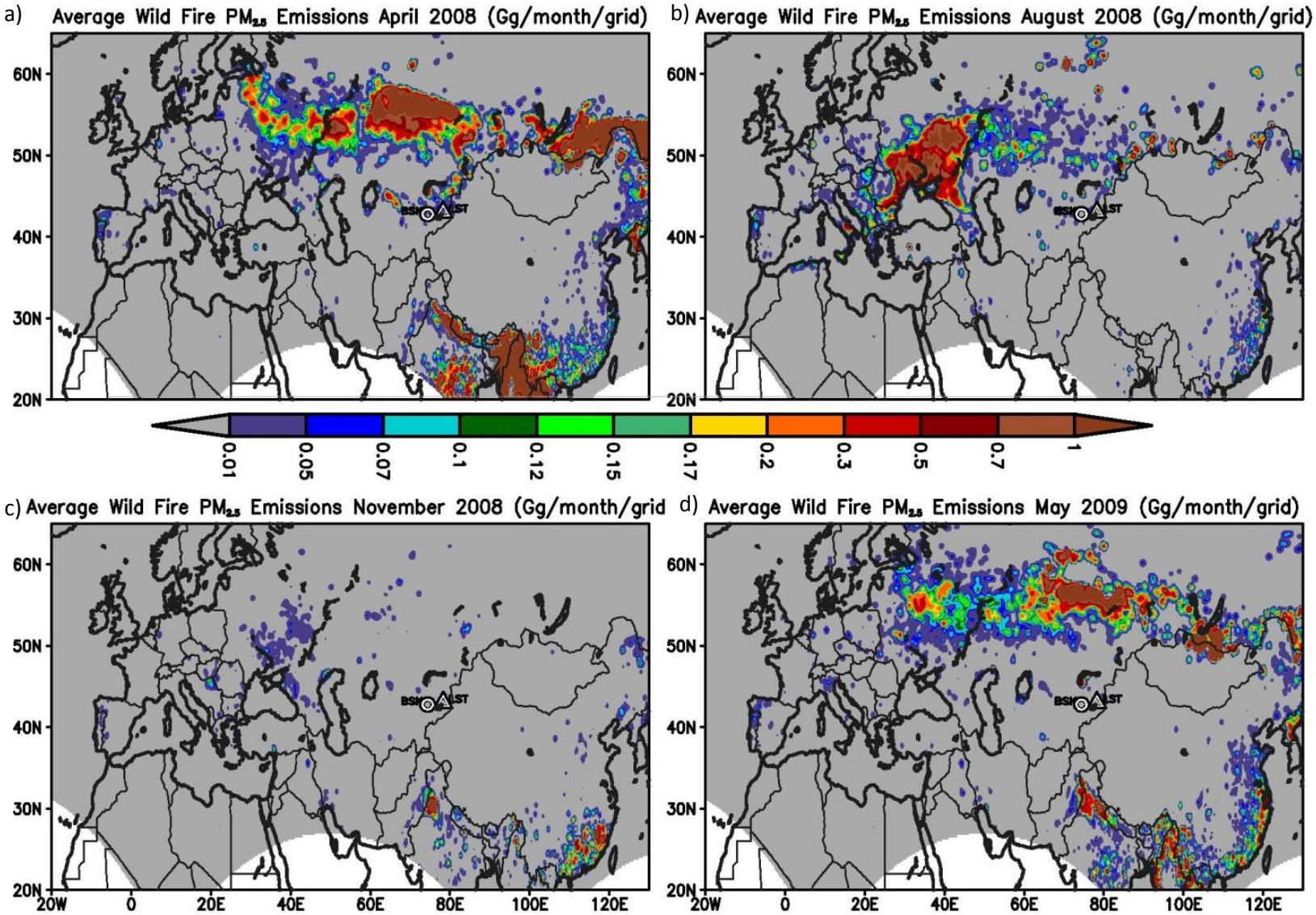

Fig. S1. Seasonal variability in spatial distribution of biomass burning $PM_{2.5}$ emissions in Gg/month/grid (a) April 2008, (b) August 2008, (c) November 2008, and (d) May 2009.

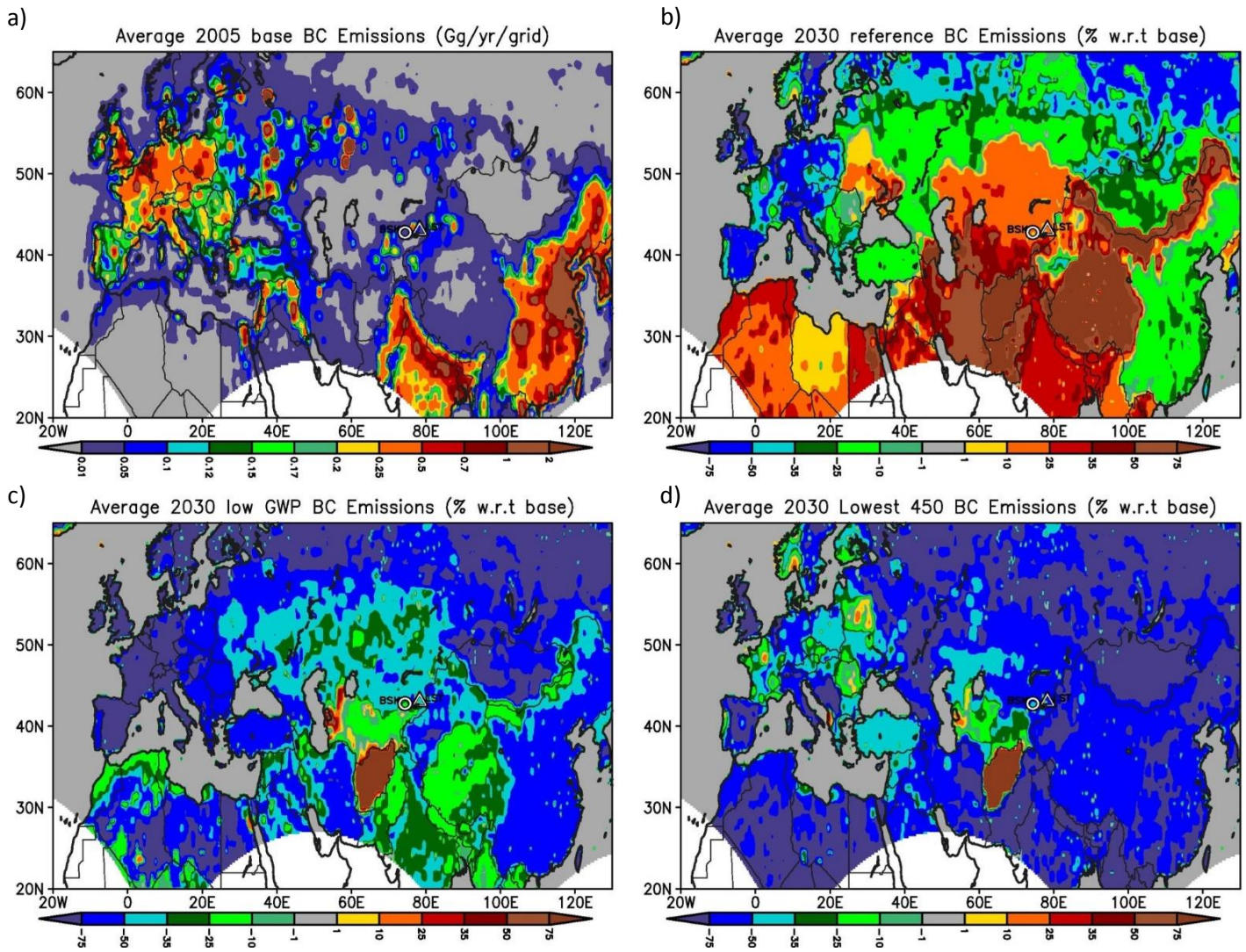

Fig. S2. Spatial distribution of a) base year 2005 BC emissions (Gg/yr/grid) along with percent change (w.r.t to base year 2005) in (b) Reference 2030 BC emissions c) 2030 BC emissions with BC measures (low) and d) 2030 BC emissions with BC (lowest) and greenhouse gas measures aimed at keeping CO_2 levels below 450ppm. The triangle and circle markers denote locations of the LST and Bishkek sites. Refer to Sec. 2.3 for more details on emission scenarios.

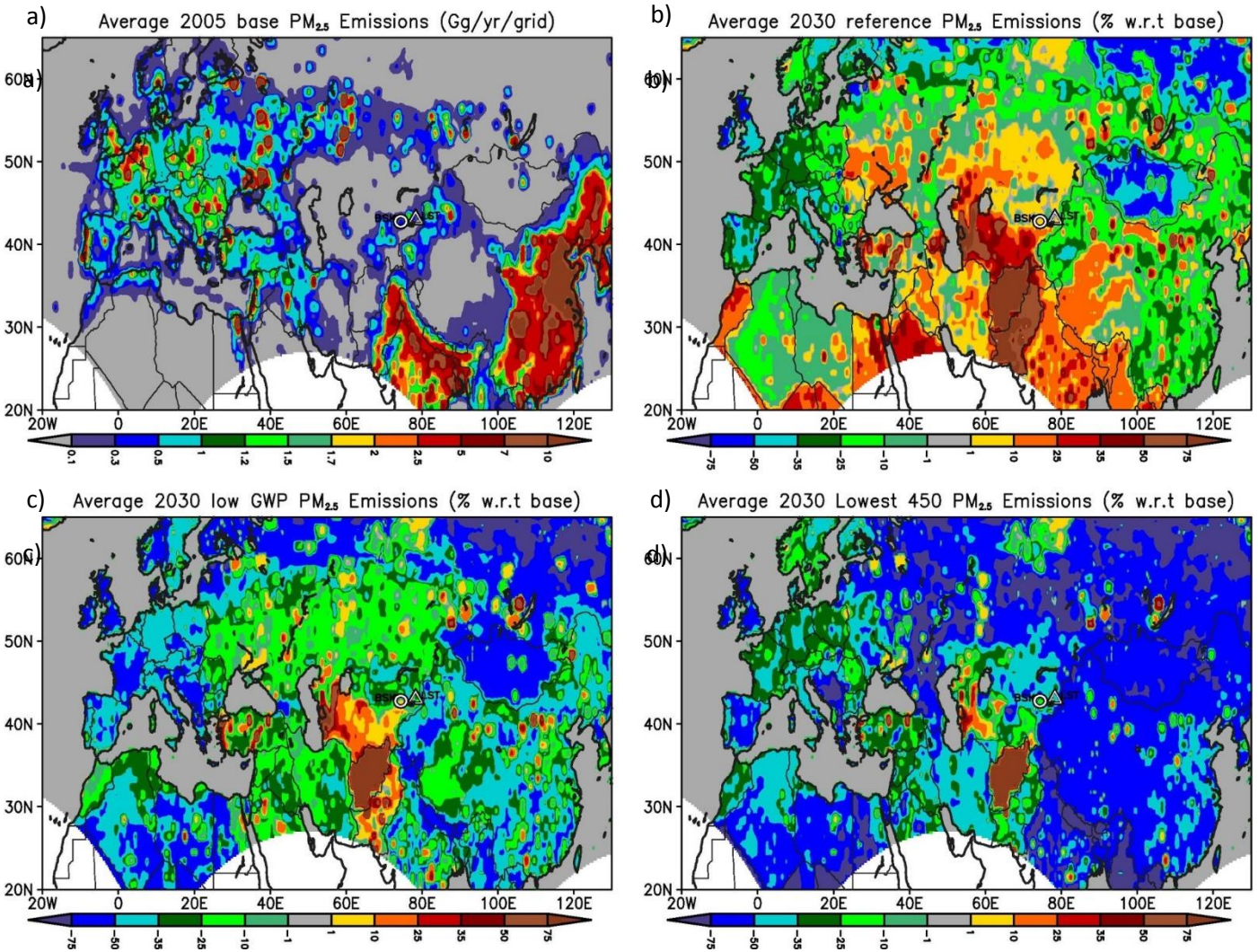

Fig. S3. Spatial distribution of a) base year 2005 $PM_{2.5}$ emissions (Gg/yr/grid) along with percent change (w.r.t to base year 2005) in (b) Reference 2030 $PM_{2.5}$ emissions c) 2030 $PM_{2.5}$ emissions with BC measures and d) 2030 $PM_{2.5}$ emissions with BC and greenhouse gas measures aimed at keeping CO_2 levels below 450ppm. The triangle and circle markers denote locations of the LST and Bishkek sites. Refer to Sec. 2.3 for more details on emission scenarios.

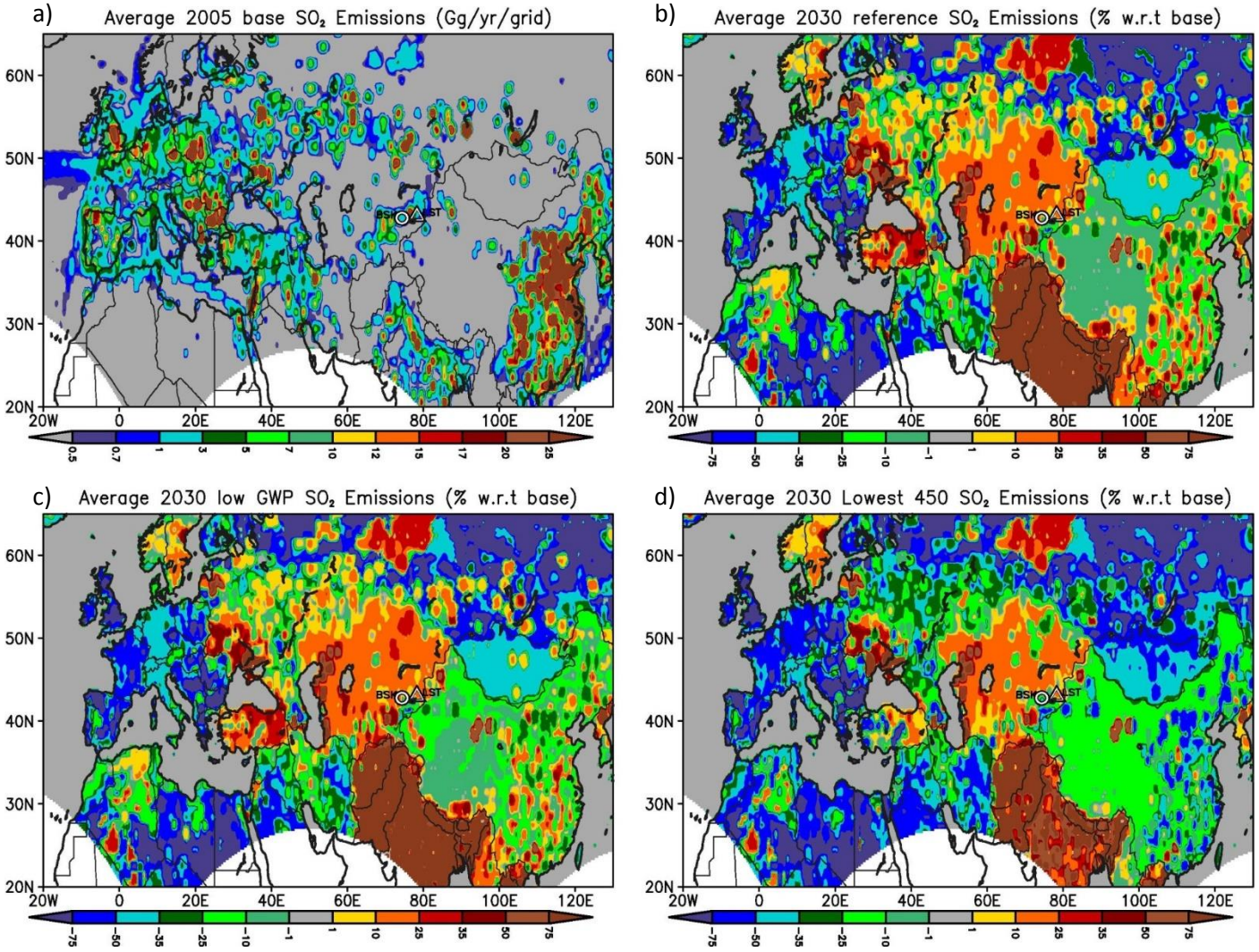

Fig. S4. Spatial distribution of a) base year 2005 SO_2 emissions (Gg/yr/grid) along with percent change (w.r.t to base year 2005) in (b) Reference 2030 SO_2 emissions c) 2030 SO_2 emissions with BC measures and d) 2030 SO_2 emissions with BC and greenhouse gas measures aimed at keeping CO_2 levels below 450ppm. The triangle and circle markers denote locations of the LST and Bishkek sites. Refer to Sec. 2.3 for more details on emission scenarios.

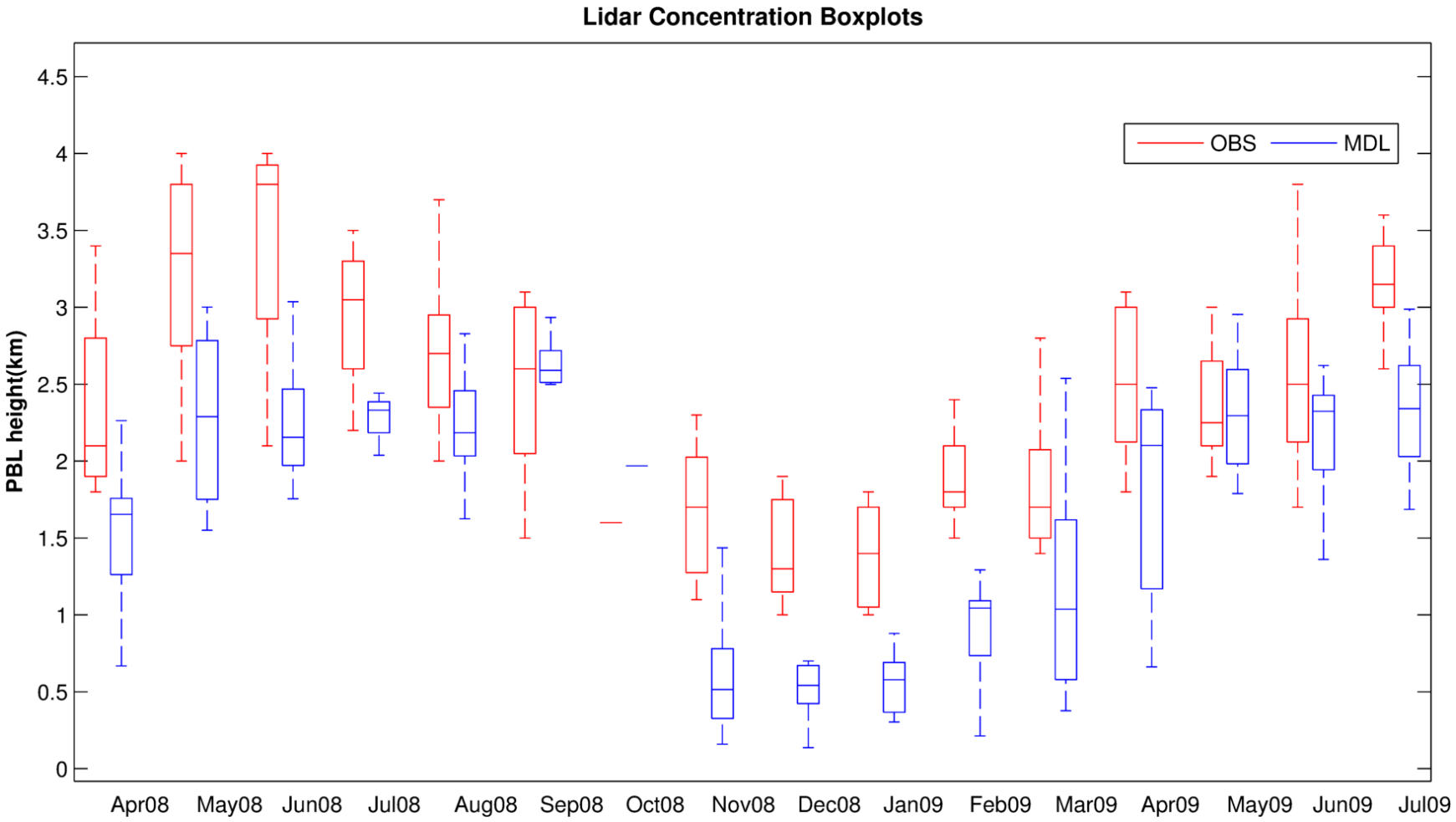

Fig. S5. Comparison of observed and predicted PBL heights (m) at the LST site. Observed PBL heights were determined from the Lidar profiles.

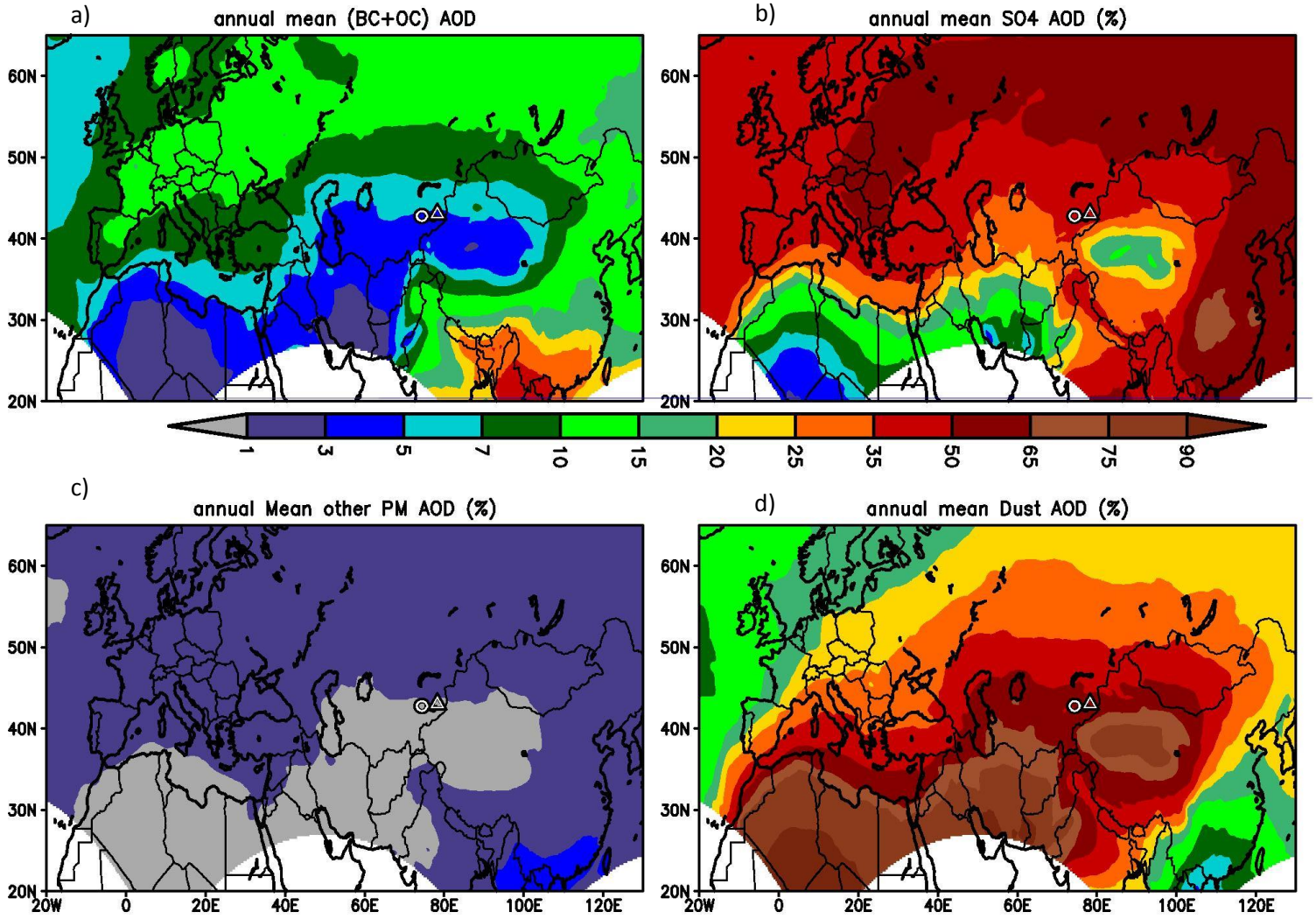

Fig. S6. Spatial distribution of predicted species contributions (%) to AOD averaged over the simulation period a) Carbonaceous aerosols (BC+OC), b) SO4, c) Other PM, and d) Dust.

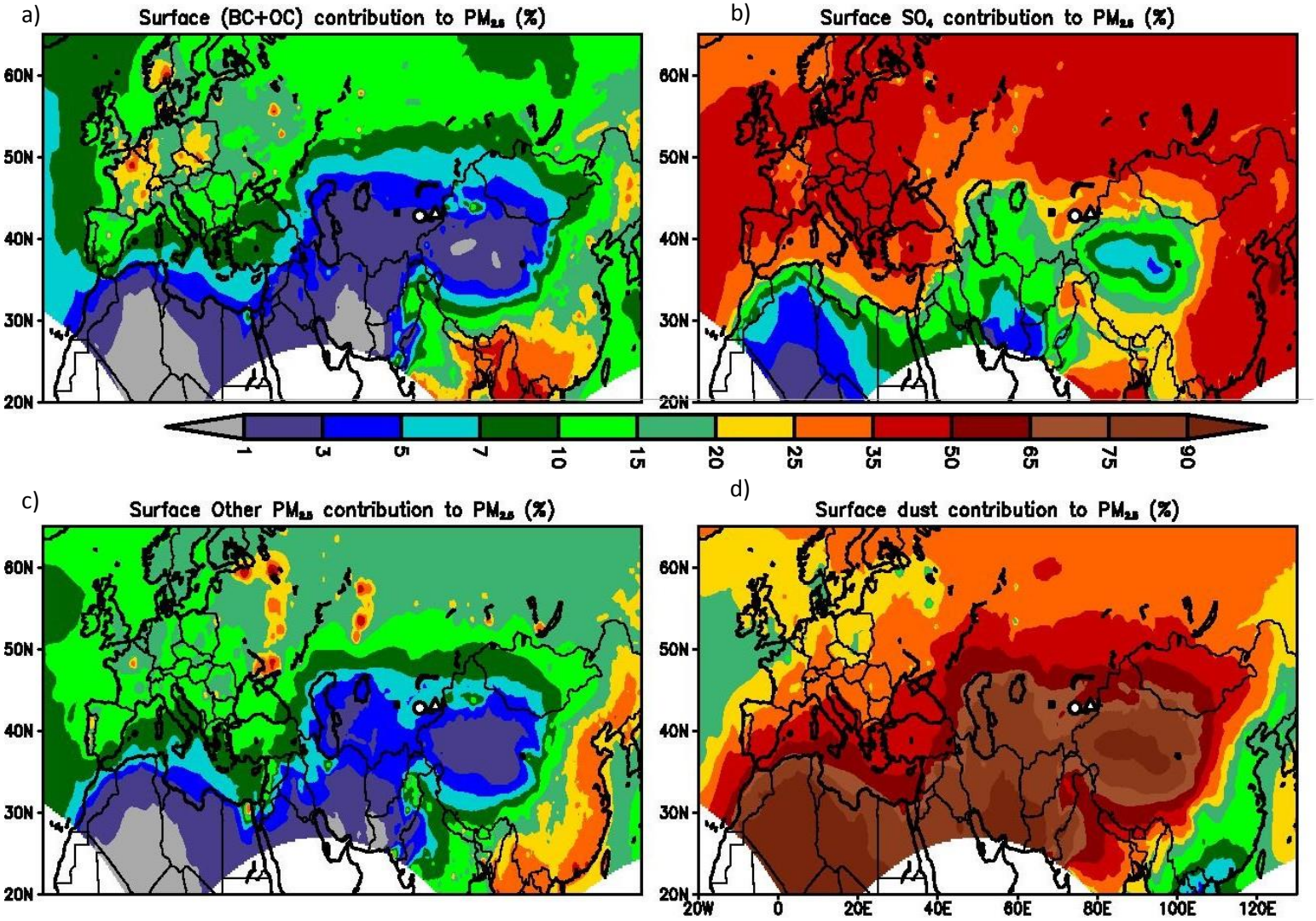

Fig. S7. Spatial distribution of predicted species contributions (%) to $PM_{2.5}$ averaged over the simulation period a) Carbonaceous aerosols (BC+OC), b) SO4, c) Other $PM_{2.5}$, and d) Dust.

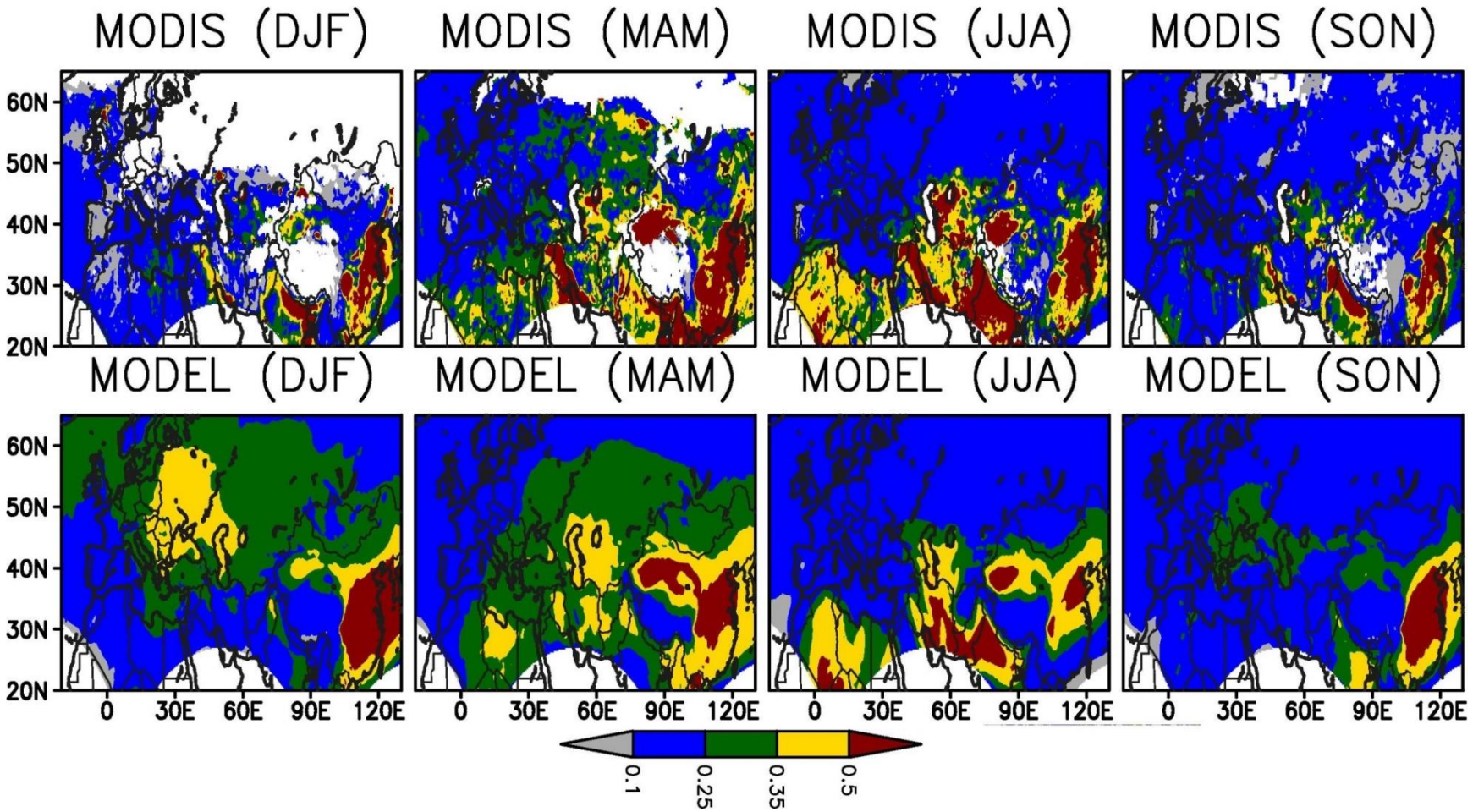

Fig. S8. Seasonal variability in spatial distribution of MODIS and simulated AOD averaged over the simulation period.

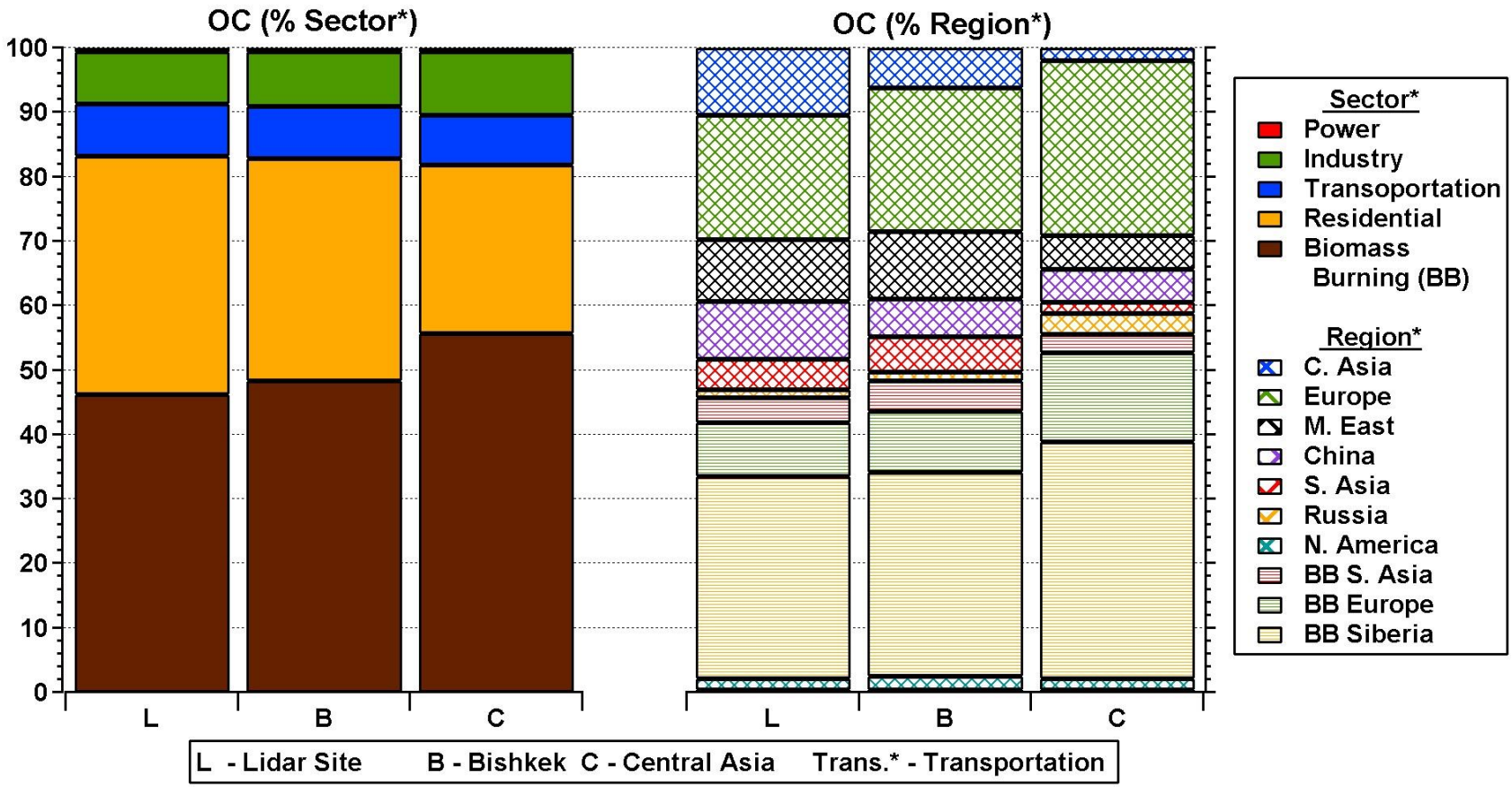

Fig S9. Summary of period mean contributions by source regions and sectors for OC in % for the grid cells containing the Bishkek and LST observation sites, and spatially averaged over the Central Asia region. See Fig. 1 for anthropogenic and fire source regions.