

Supplementary

Wildfires heat the middle troposphere over the Himalayas and Tibetan Plateau during the peak of fire season

Qiaomin Pei ¹, Chuanfeng Zhao ^{1,2 *}, Yikun Yang ¹, Annan Chen ¹, Zhiyuan Cong ³, Xin Wan ⁴,
Haotian Zhang ¹, Guangming Wu ⁵

1 Department of Atmospheric and Oceanic Sciences, School of Physics, Peking University, Beijing 100871, China.

2 Institute of Carbon Neutrality, Peking University, Beijing 100871, China.

3 School of ecology and environment, Tibet University, Lhasa 850000, China

4 State Key Laboratory of Tibetan Plateau Earth System, Resources and Environment (TPESRE), Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing 100101, China

5 National Institute of Natural Hazards, Ministry of Emergency Management of China, Beijing 100085, China

* Corresponding author: Chuanfeng Zhao email: cfzhao@pku.edu.cn

Table S1. Details of the study locations, including latitude, longitude, altitude and observation period.

AERONET Sites	Latitude	Longitude	Altitude (m)	Period
Nam Co, Tibetan Plateau	30.8°N	91.0°E	4725	2011-2024
QOMS, Himalayas	28.4°N	86.9°E	4294	2011-2024
Pokhara, Himalayas	28.2°N	84.0°E	800	2011-2024
MWR Sites				
QOMS, Himalayas	28.4°N	86.9°E	4294	2021-2022
Naqu, Tibetan Plateau	31.4°N	91.9°E	4471	2021-2022
SETS, Tibetan Plateau	29.8°N	94.4°E	3328	2021-2022
NADOR, Tibetan Plateau	33.4°N	79.7°N	4270	2021-2022

Table S2. Mean values of extinction, SSA, and asymmetry at wavelengths of 0.44 μm , 0.675 μm , 0.87 μm , and 1.02 μm for April at QOMS.

Date	Extinction [0.44 μm]	Extinction [0.675 μm]	Extinction [0.87 μm]	Extinction [1.02 μm]	SSA [0.44 μm]	SSA [0.675 μm]	SSA [0.87 μm]	SSA [1.02 μm]	Asymmetry [0.44 μm]	Asymmetry [0.675 μm]	Asymmetry [0.87 μm]	Asymmetry [1.02 μm]
2021/4/6	0.74	0.39	0.24	0.18	0.89	0.88	0.86	0.84	0.69	0.61	0.56	0.54
2021/4/6	0.74	0.38	0.24	0.18	0.88	0.88	0.86	0.84	0.68	0.61	0.56	0.54
2021/4/7	0.57	0.31	0.20	0.15	0.87	0.88	0.85	0.83	0.70	0.62	0.57	0.54
2021/4/7	0.54	0.29	0.18	0.13	0.85	0.85	0.83	0.81	0.69	0.61	0.56	0.53
2021/4/13	0.62	0.31	0.19	0.14	0.87	0.85	0.83	0.81	0.69	0.59	0.54	0.52
2021/4/13	0.57	0.28	0.18	0.13	0.87	0.87	0.86	0.84	0.69	0.59	0.55	0.53
Average	0.63	0.33	0.20	0.15	0.87	0.87	0.85	0.83	0.69	0.61	0.56	0.53
Standard Deviation	0.09	0.05	0.03	0.02	0.01	0.01	0.01	0.01	0.005	0.01	0.01	0.007

Table S3. Monthly means heating rates at Pokhara and QOMS for most months during the study period.

Pokhara						QOMS			
Year/Month	Heating Rate (K day ⁻¹)	Year/Month	Heating Rate (K day ⁻¹)	Year/Month	Heating Rate (K day ⁻¹)	Year/Month	Heating Rate (K day ⁻¹)	Year/Month	Heating Rate (K day ⁻¹)
2011/1	0.83	2014/3	0.51	2018/1	0.65	2011/1	0.15	2014/4	0.14
2011/2	0.40	2014/4	1.56	2018/2	0.93	2011/2	0.08	2014/5	0.20
2011/3	0.92	2014/5	0.66	2018/3	1.26	2011/3	0.21	2014/9	0.05
2011/4	1.83	2014/10	0.72	2018/4	1.90	2011/4	0.24	2015/2	0.19
2011/5	0.28	2014/12	0.58	2018/10	0.27	2011/5	0.18	2015/11	0.75
2011/10	0.85	2015/1	0.51	2018/11	0.40	2011/8	0.48	2016/4	0.60
2011/11	0.43	2015/2	1.45	2019/1	0.25	2011/11	0.05	2016/5	0.16
2012/1	0.80	2015/3	1.41	2019/2	0.14	2011/12	0.12	2016/8	0.07
2012/2	0.72	2015/5	1.57	2019/3	0.80	2012/2	0.16	2016/10	0.09
2012/3	1.48	2015/11	1.72	2019/4	1.41	2012/3	0.37	2017/5	0.41
2012/4	0.96	2016/1	0.91	2019/5	1.15	2012/4	0.45	2017/9	0.16
2012/5	1.59	2016/2	1.54	2019/6	0.20	2012/5	0.64	2017/10	0.13
2012/11	0.52	2016/3	2.73	2019/10	0.34	2012/9	0.38	2020/10	0.22
2012/12	0.33	2016/4	1.72	2020/1	0.45	2012/10	0.25	2021/2	0.62
2013/2	0.25	2016/11	0.69	2020/2	0.46	2012/11	0.09	2021/10	0.26
2013/3	0.62	2016/12	0.58	2020/3	0.44	2012/12	0.02	2021/11	0.52
2013/4	0.82	2017/1	0.72	2020/4	0.25	2013/4	0.05	2021/12	0.38
2013/10	0.47	2017/2	1.30	2020/10	0.45	2013/5	0.10	2022/1	0.35
2013/11	0.45	2017/3	1.07	2022/1	0.46	2013/11	0.04	2022/4	1.63
2014/1	0.58	2017/4	0.83	2022/2	0.66	2013/12	0.02	2023/1	0.84
2014/2	0.44	2017/5	0.51	2022/3	1.12	2014/3/	0.04	2023/2	1.29

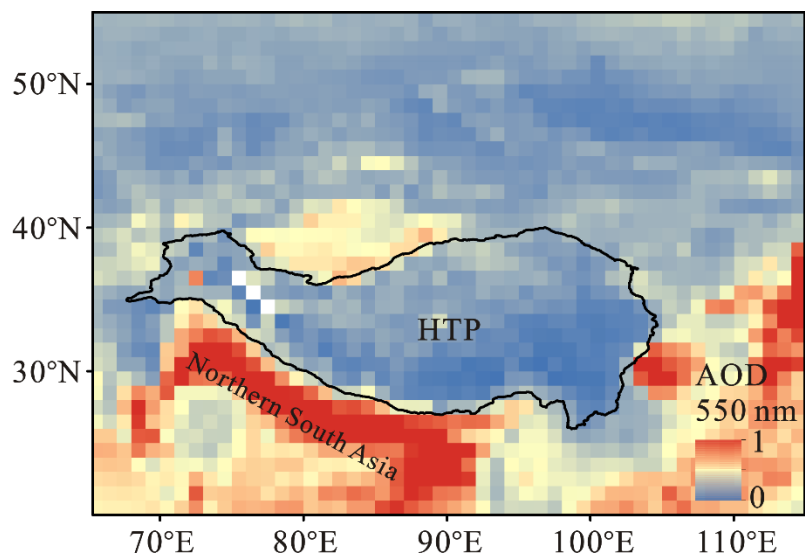


Figure S1. Annual average AOD at 550nm over the HTP region and its surrounding areas from 2011 to 2024.

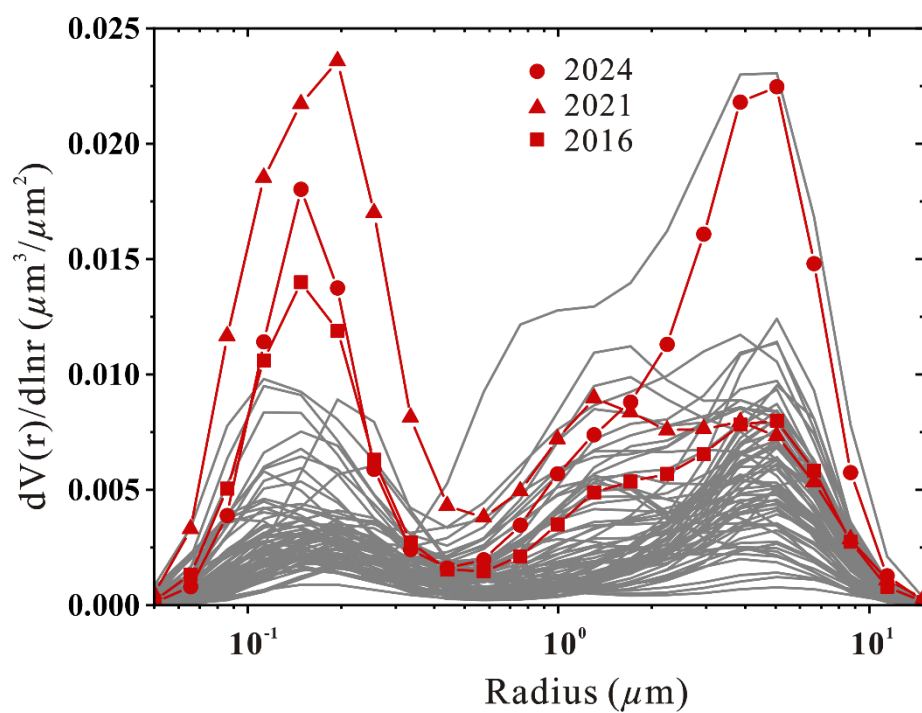


Figure S2. Averaged aerosol volume size distributions for April at QOMS from 2011 to 2024. The grey lines represent the other years.

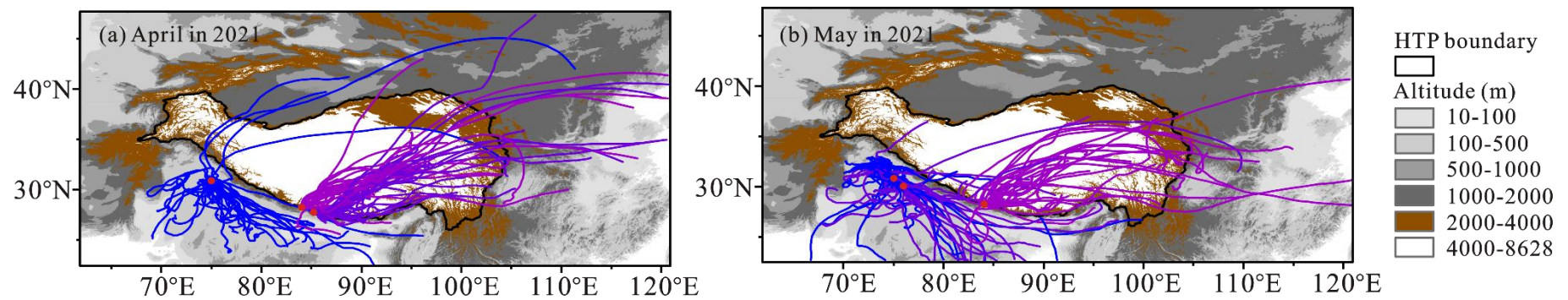


Figure S3. 72-hour forward trajectories starting from different sites located in the Himalayas and IGP above ground level 500 m in April (a) and May (b) 2021, simulated using HYSPLIT.

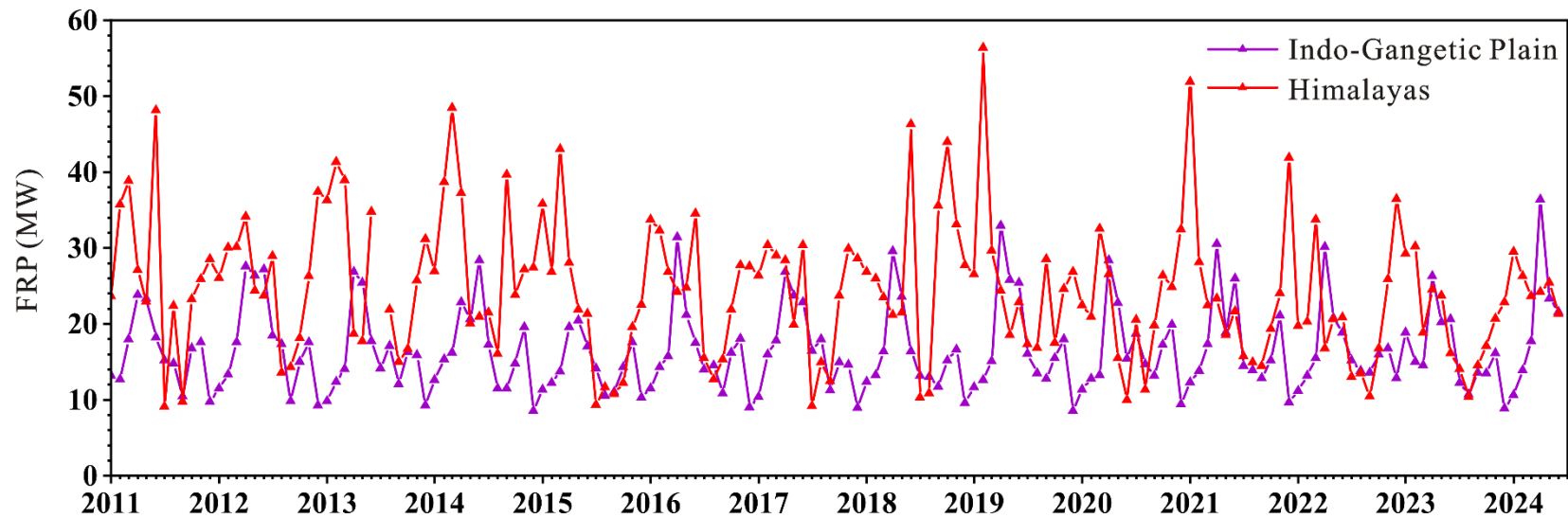


Figure S4. Temporal variations of monthly average FRP over the Himalayas and Indo-Gangetic Plain regions from 2011 to 2024

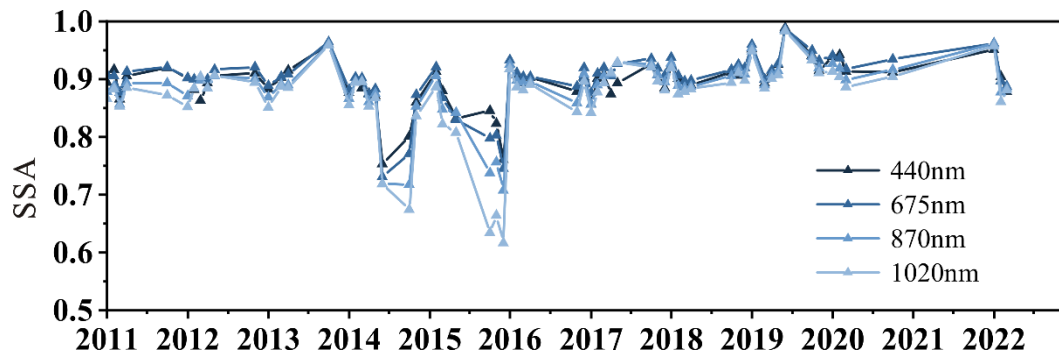


Figure S5. Monthly mean single scattering albedo (SSA) at Pokhara, Nepal, from AERONET data, covering the period from January 2011 to March 2022.