atmosphere

MDPI

Supplementary

Vertical Distribution of Aerosols during Deep-Convective Event in the Himalaya Using WRF-Chem Model at Convection Permitting Scale

Prashant Singh [1,2], Pradip Sarawade [1] and Bhupesh Adhikary [2,*]

[1] Department of Physics, University of Mumbai, Mumbai 400098, India; prashantsinghprs@gmail.com (P.S.); pradip.sarawade@physics.mu.ac.in (P.S.)
[2] International Centre for Integrated Mountain Development (ICIMOD), Khumaltar G.P.O. Box 3226, Lalitpur 44700, Nepal
* Correspondence: Bhupesh.Adhikary@icimod.org

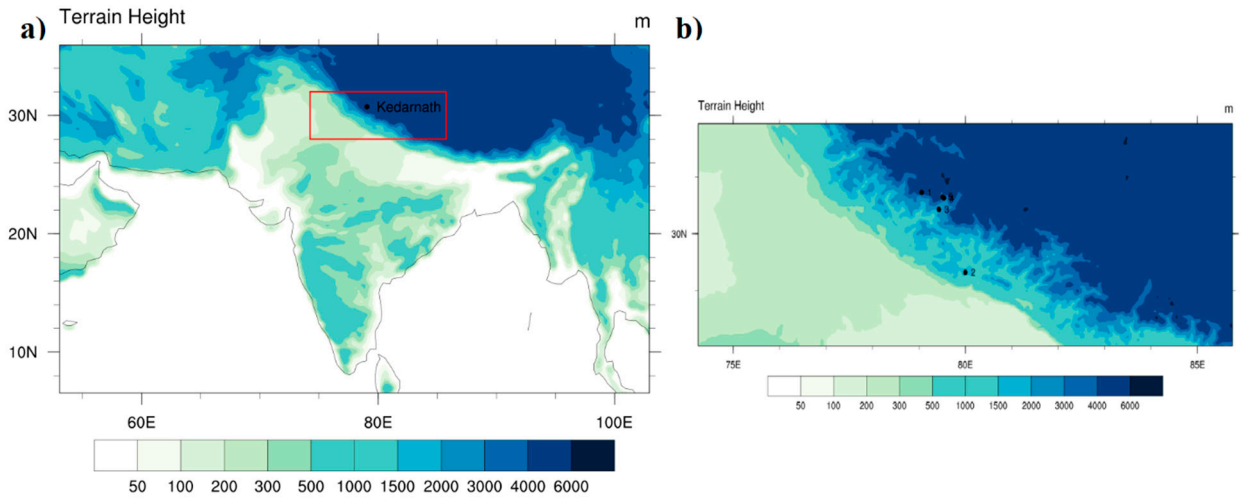

Figure S1. (**a**) Domain of simulation at 25 km resolution, domain of simulation at 4 km resolution (red box) and Kedarnath (black dot). (**b**) 4 km resolution pointing 1. Kedarnath, 2. Champawat, 3. Pipalkoti, 4. Pandukeshwar, and0 5. Lambgarh (4-5 are very close to each other).

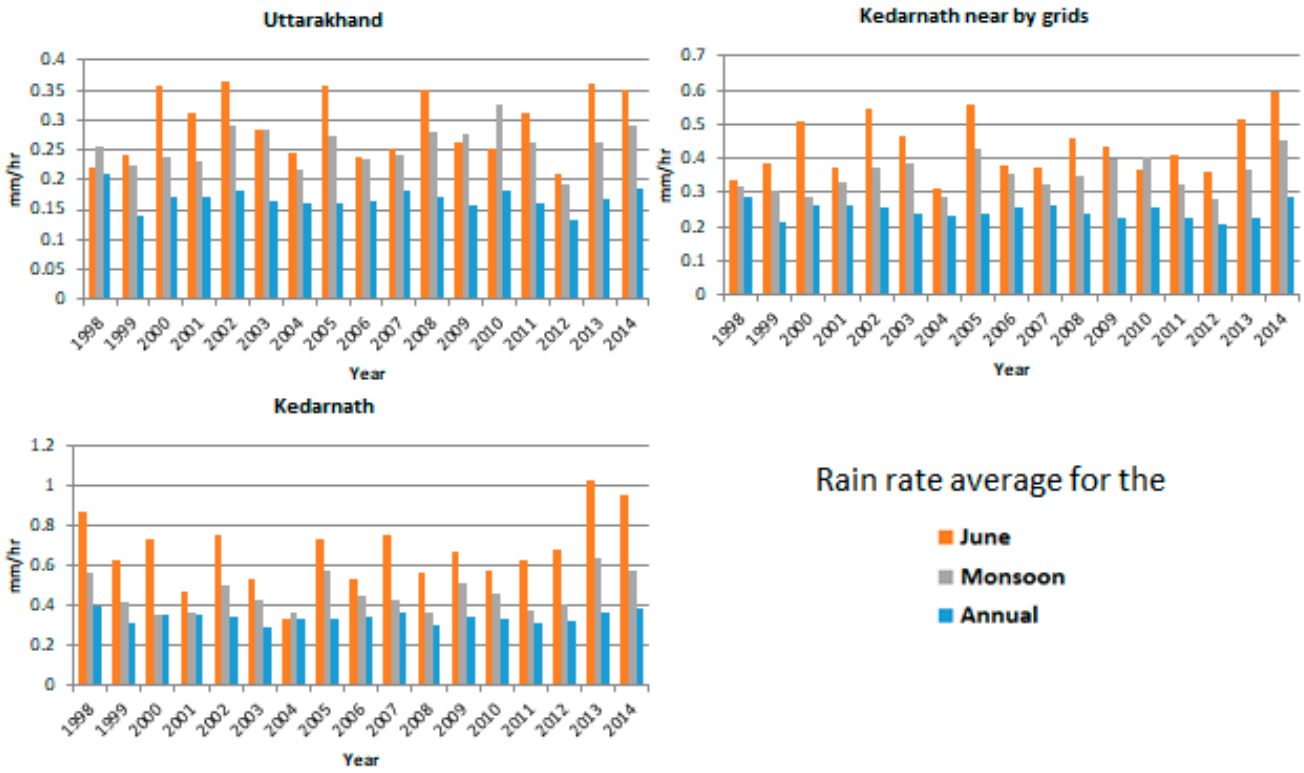

Figure S2. Rain rate over Uttarakhand, nearby Kedarnath and over Kedarnath average for annual, monsoon and June month.

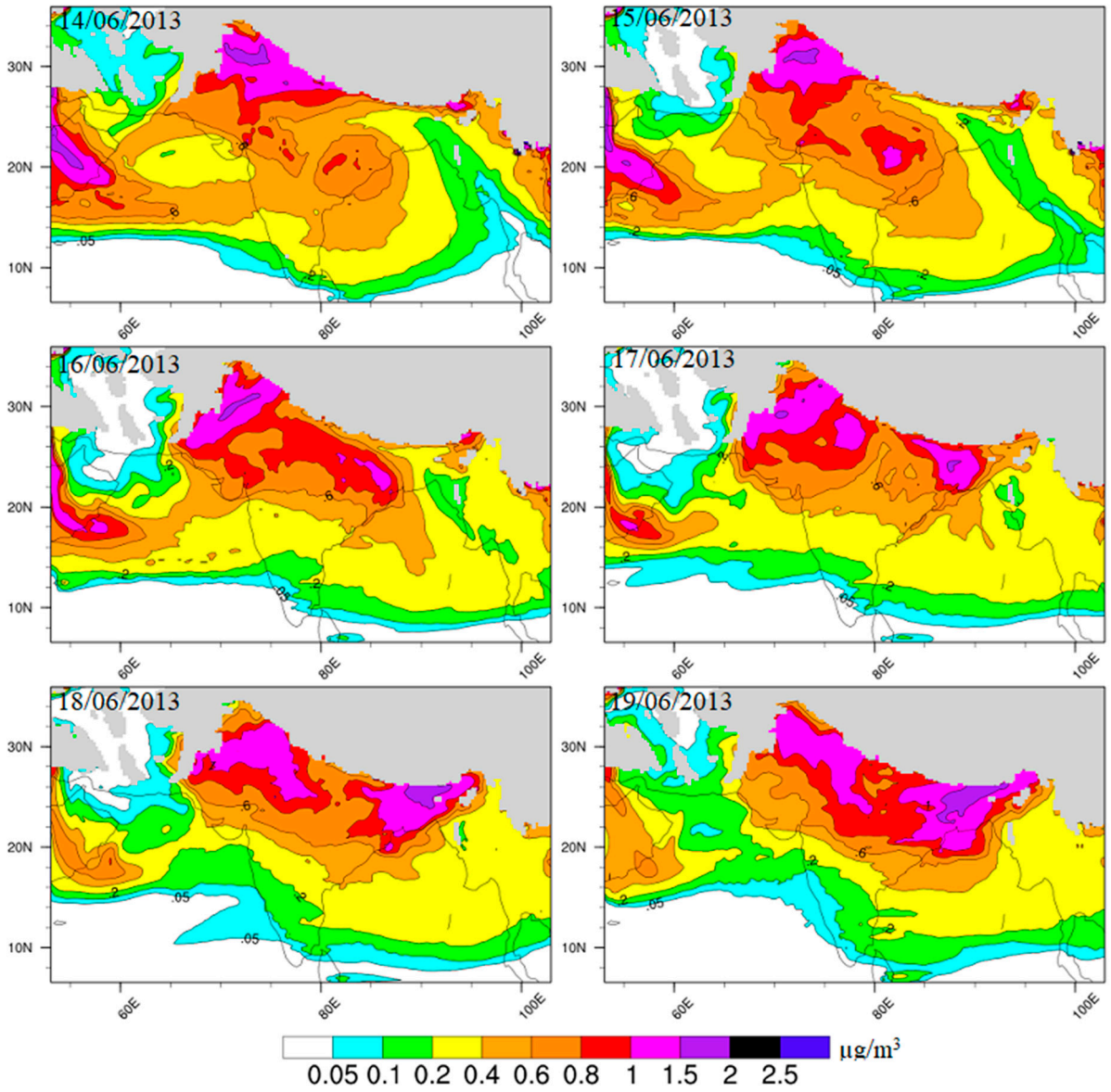

Figure S3. BC1 concentration at 850 hPa from 14 June 2013 to 19 June 2013.

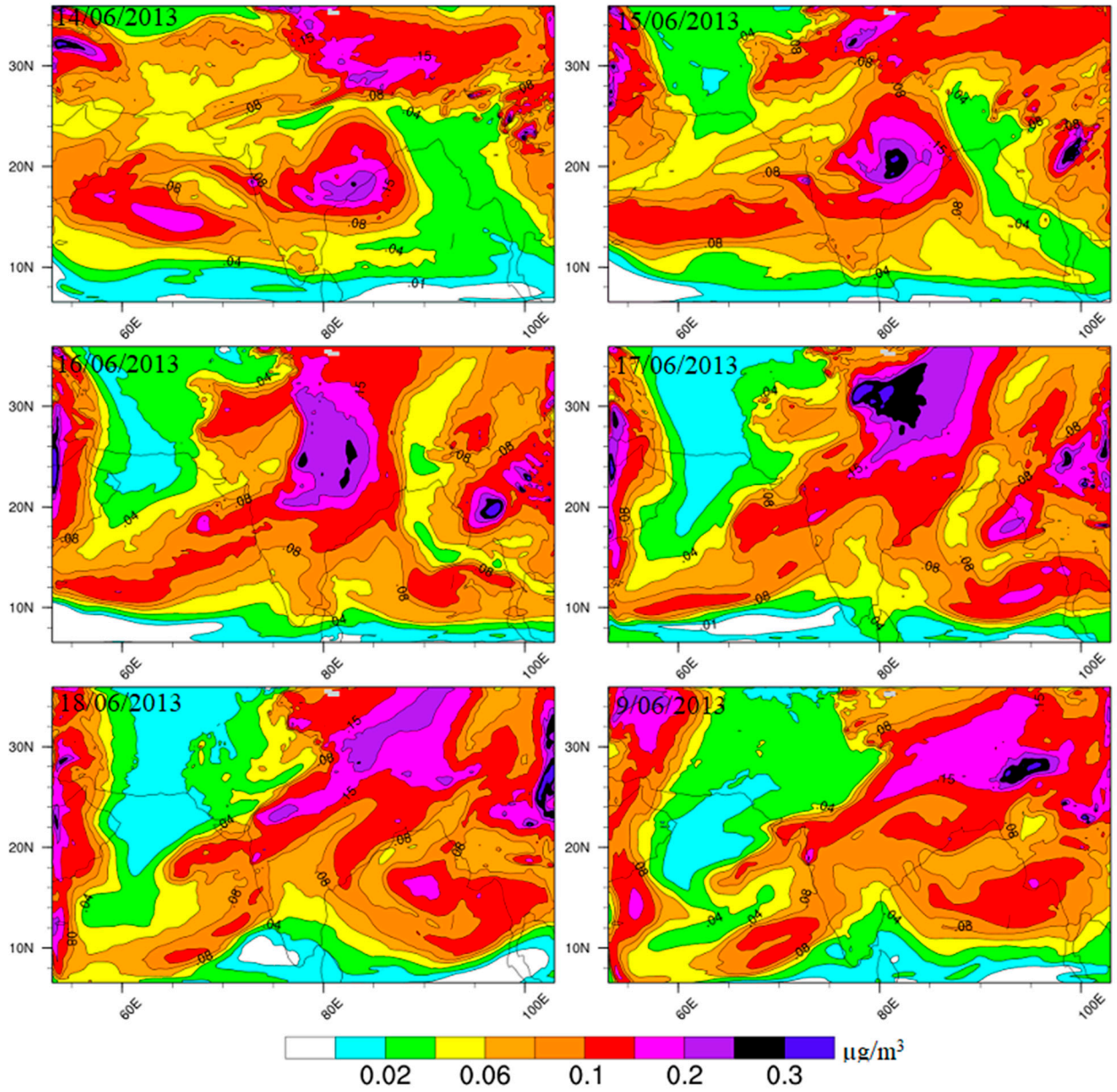

Figure S4. BC1 concentration at 500 hPa from 14 June 2013 to 19 June 2013.

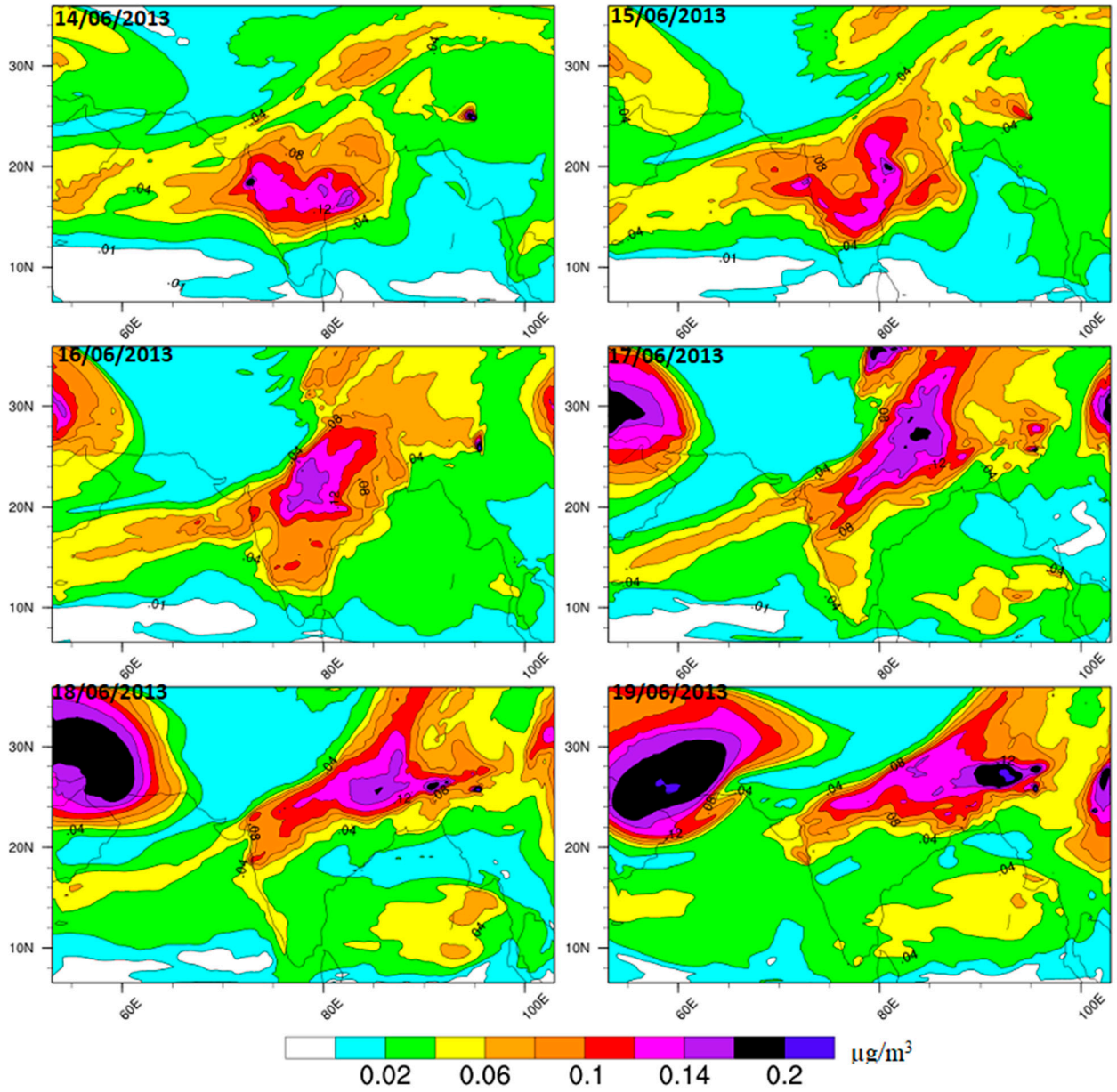

Figure S5. BC1 concentration at 300 hPa from 14 June 2013 to 19 June 2013.

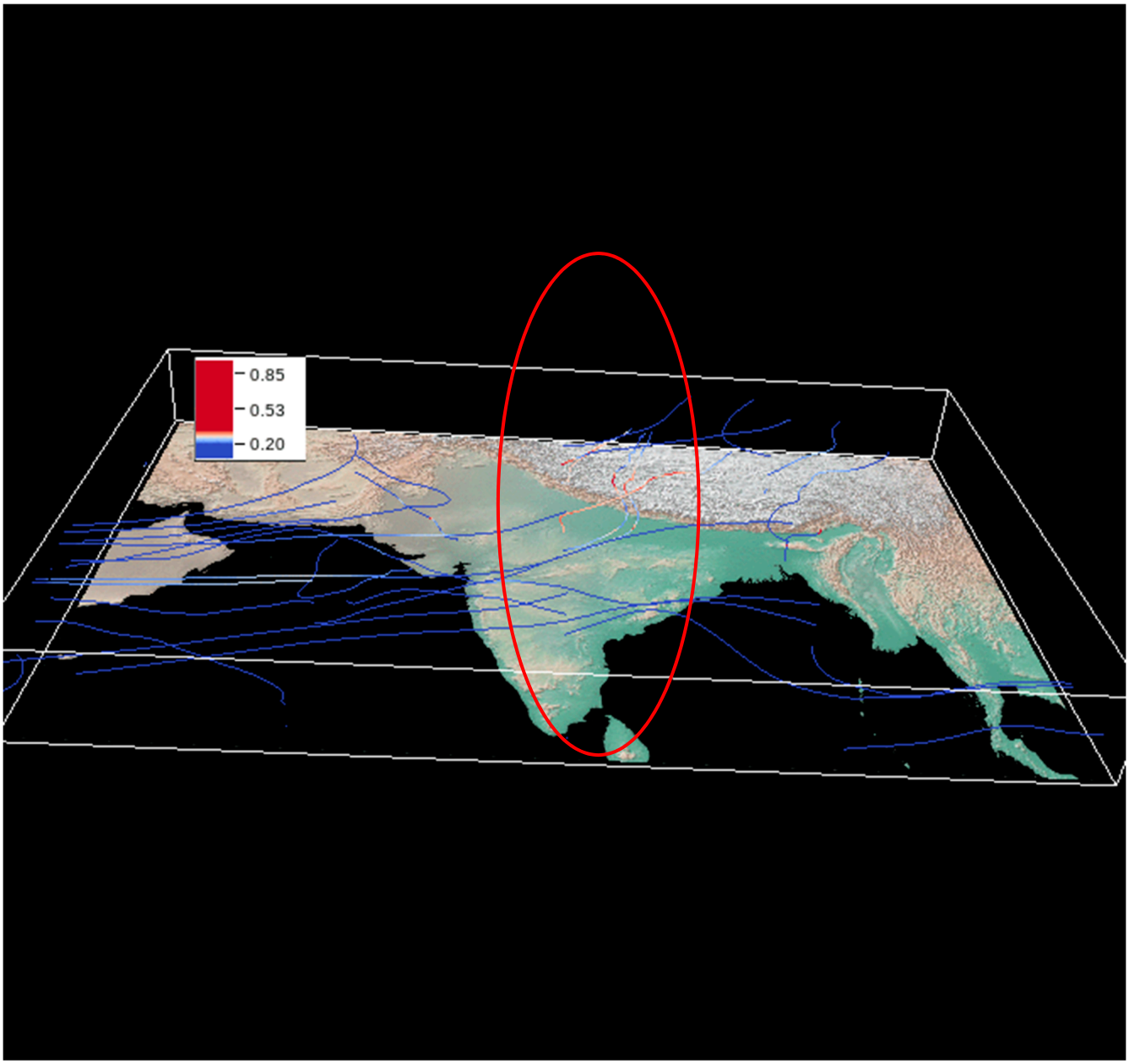

Figure S6. BC1 volume flow on 17 June 2013, 25 km resolution.

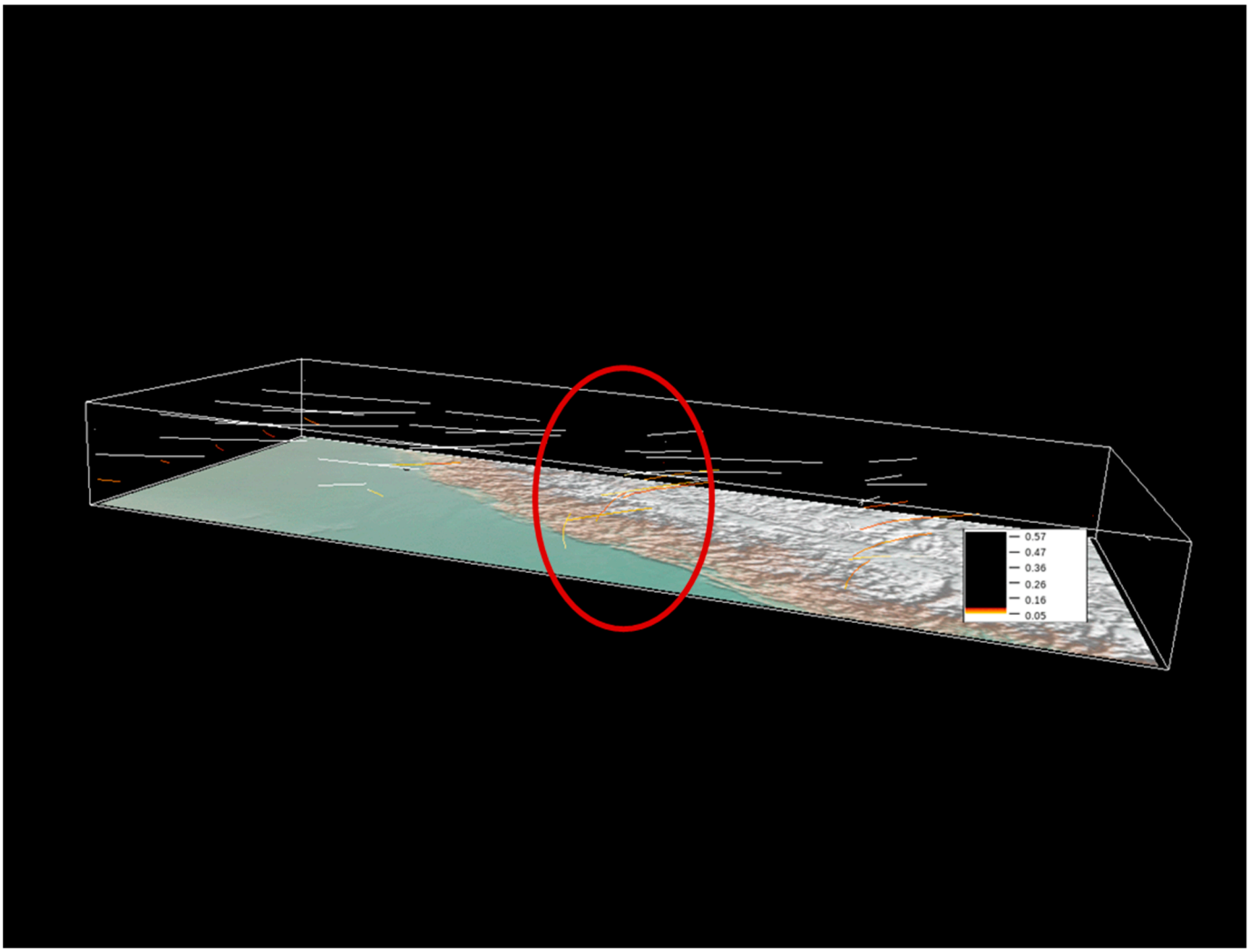

Figure S7. BC1 volume flow on 17 June 2013, 4 km resolution.

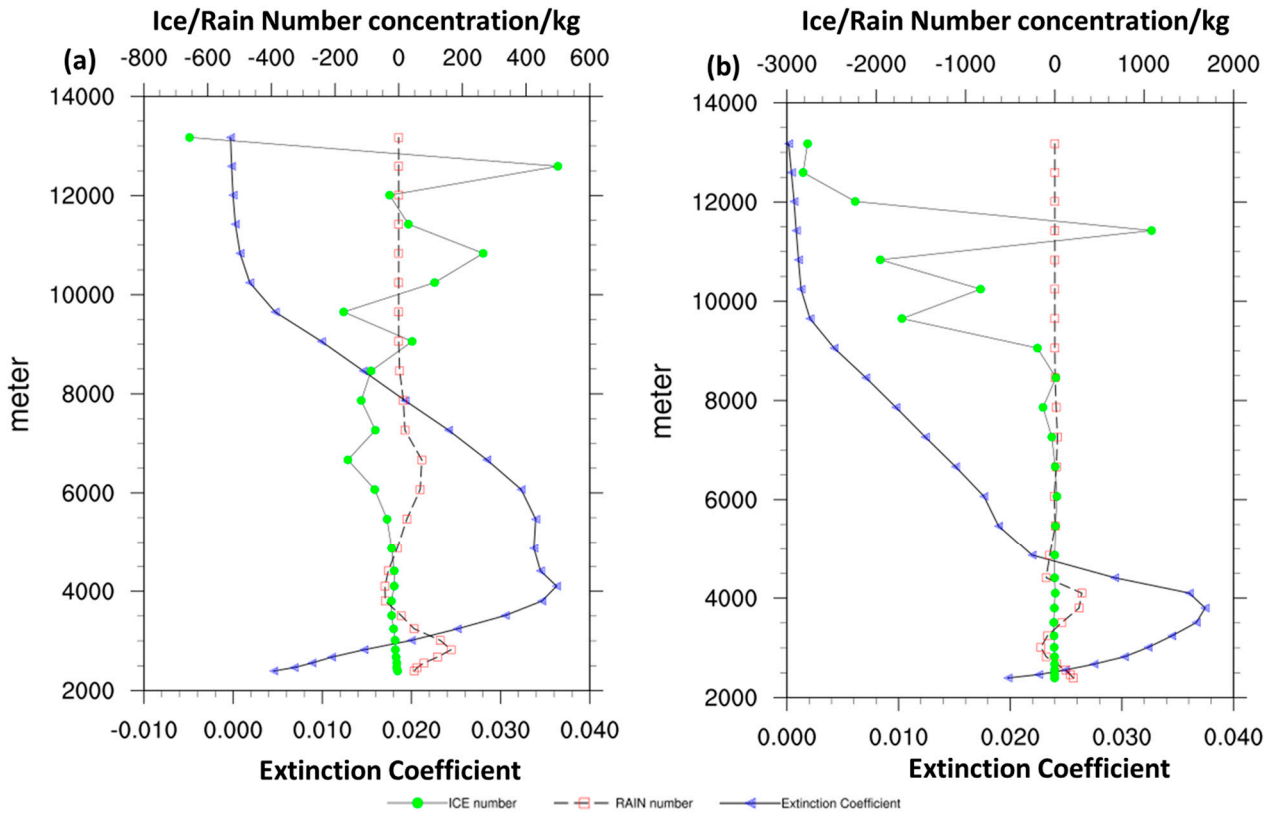

Figure S8. Difference of Extinction Coefficient, rain and ice concentration profile over Kedarnath during (**a**) 16 June and (**b**) 17 June from WC25, WRF25 simulations.

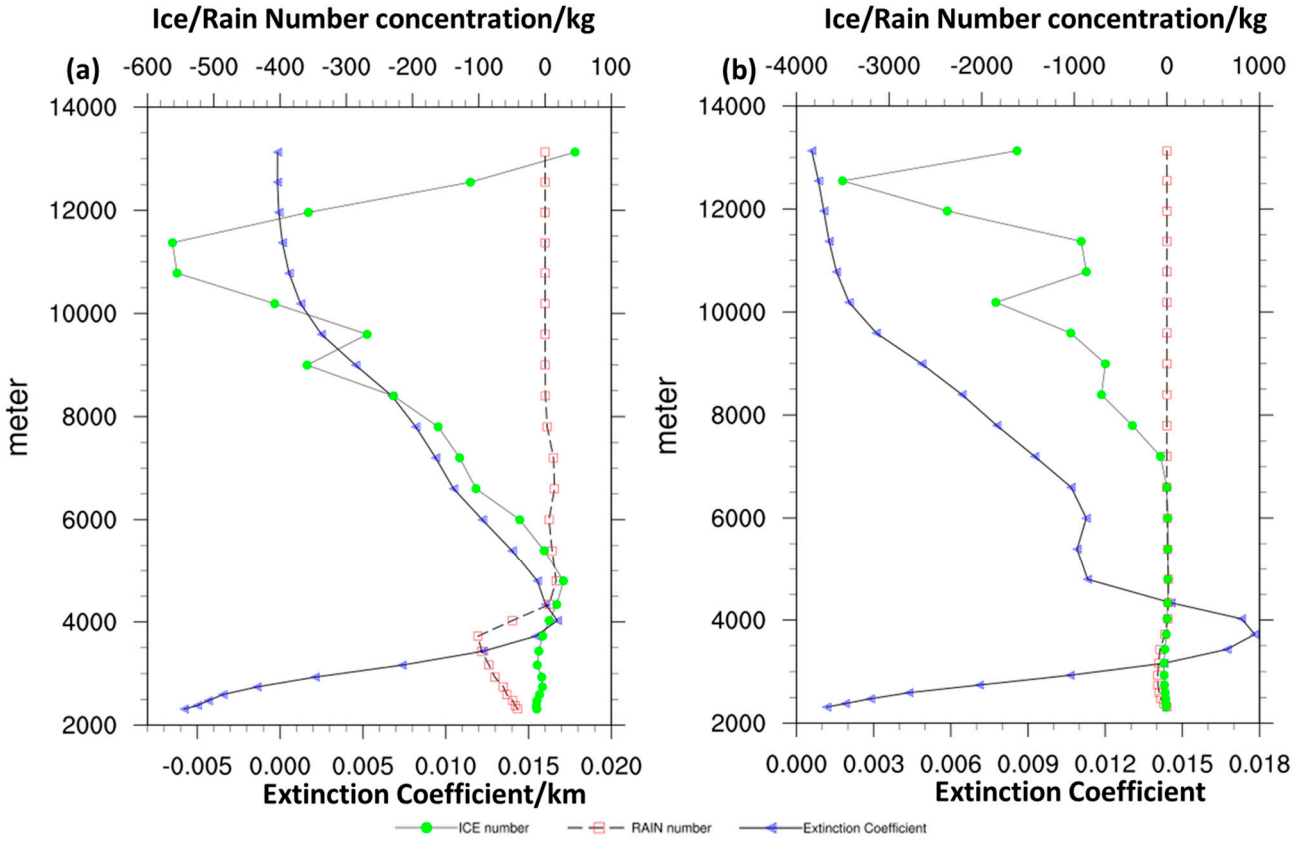

Figure S9. Difference of Extinction Coefficient, rain and ice concentration profiles over Kedarnath during (**a**) 16 June and (**b**) 17 June from WC4, WRF4 simulations (WC4-WRF4).

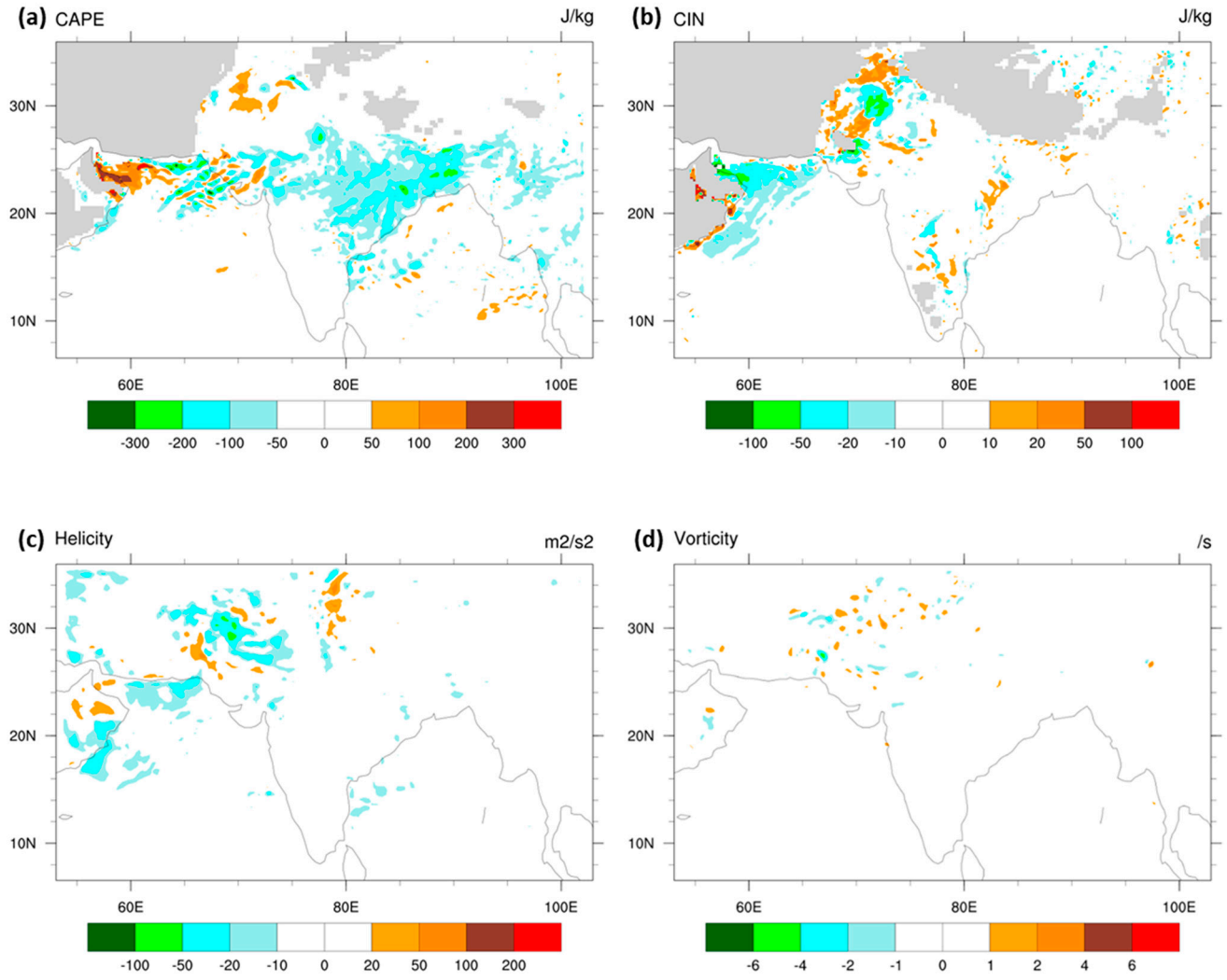

Figure S10. Effect of aerosols on (**a**) CAPE, (**b**) CIN, (**c**) helicity and (**d**) vorticity at 25 km resolution (WC25-WRF25) during 17 June.

Table S1. Average rain rate (mm/hr) over Uttarakhand, Kedarnath and nearby area for the period of 1998-2014 from TRMM.

Year	Uttarakhand			Kedarnath Nearby Area			Kedarnath		
	June	Monsoon	Annual	June	Monsoon	Annual	June	Monsoon	Annual
1998	0.22	0.26	0.21	0.34	0.32	0.28	0.87	0.57	0.39
1999	0.24	0.22	0.14	0.39	0.31	0.21	0.63	0.42	0.31
2000	0.36	0.24	0.17	0.51	0.29	0.26	0.73	0.36	0.35
2001	0.31	0.23	0.17	0.37	0.33	0.26	0.48	0.36	0.35
2002	0.36	0.29	0.18	0.55	0.38	0.26	0.76	0.50	0.35
2003	0.28	0.28	0.17	0.46	0.38	0.24	0.54	0.43	0.29
2004	0.24	0.22	0.16	0.31	0.29	0.23	0.34	0.37	0.34
2005	0.36	0.27	0.16	0.56	0.43	0.24	0.73	0.58	0.34
2006	0.24	0.23	0.16	0.38	0.36	0.26	0.54	0.45	0.35
2007	0.25	0.24	0.18	0.37	0.33	0.27	0.75	0.43	0.37
2008	0.35	0.28	0.17	0.46	0.35	0.24	0.57	0.36	0.30
2009	0.26	0.28	0.16	0.44	0.40	0.23	0.67	0.52	0.34
2010	0.25	0.33	0.18	0.37	0.40	0.26	0.58	0.46	0.34
2011	0.31	0.26	0.16	0.41	0.32	0.23	0.63	0.38	0.31
2012	0.21	0.19	0.13	0.36	0.28	0.21	0.68	0.41	0.33
2013	0.36	0.26	0.17	0.51	0.37	0.23	1.03	0.64	0.36
2014	0.35	0.29	0.19	0.59	0.45	0.28	0.96	0.57	0.39

Table S2. R^2 of precipitation from different simulation with observed precipitation from in situ and satellite observation.

Simulation	TRMM	WC25		WRF25		WC4		WRF4	
Stations	**Obs.**	**Obs.**	**Sat.**	**Obs.**	**Sat.**	**Obs.**	**Sat.**	**Obs.**	**Sat.**
Kedarnath	**NA**	**NA**	**0.36**	**NA**	**0.36**	**NA**	**0.40**	**NA**	**0.41**
Champawat	**0.52**	**0.40**	**0.95**	**0.63**	**0.70**	**0.60**	**0.74**	**0.60**	**0.74**
Nainital	**0.56**	**0.53**	**0.41**	**0.93**	**0.45**	**0.78**	**0.62**	**0.76**	**0.60**
Jolly grant	**0.60**	**0.31**	**0.32**	**0.02**	**0.01**	**0.28**	**0.06**	**0.21**	**0.04**
Dehradun	**0.32**	**0.28**	**0.27**	**0.14**	**0.02**	**0.41**	**0.06**	**0.36**	**0.03**
Lambagrh	**0.58**	**0.63**	**0.74**	**0.66**	**0.56**	**0.65**	**0.54**	**0.39**	**0.54**
Pandukeshwar	**0.49**	**0.23**	**0.74**	**0.41**	**0.56**	**0.36**	**0.56**	**0.36**	**0.56**
Pipalkoti	**0.40**	**0.23**	**0.57**	**0.67**	**0.45**	**0.42**	**0.44**	**0.40**	**0.43**

Table S3. Δconcentration for different aerosols and Δ in absolute percentage in model column and at 850 hPa, 500 hPa, 300 hPa for 16th and 17th June 2013 over Kedarnath at 4km resolution.

Aerosols	16 June 2013							
	Δ Column		Δ 850 hPa		Δ 500 hPa		Δ 300 hPa	
	ug/m^3	%	ug/m^3	%	ug/m^3	%	ug/m^3	%
BC	0.069	62.69	0.318	71.64	0.056	69.01	0.019	123.85
OC	0.267	49.22	1.321	58.75	0.173	51.07	0.059	119.12
DUST1	4.135	106	15.66	103.9	4.911	119	0.842	163.13
DUST2	9.283	107.1	35.49	104.3	10.94	123.1	1.831	168.1
DUST3	6.174	110.1	23.76	105.8	7.243	132.1	1.161	178.9
DUST4	1.829	124.1	7.276	112.3	2.063	169.8	0.307	204.4
DUST5	0.842	179.1	3.613	142.5	0.861	263.9	0.121	245.8
SEA SALT1	0.002	113.5	0.004	326.1	0.003	79.99	0.004	72.56
SEA SALT2	0.015	320.5	0.039	412.5	0.029	219.4	0.005	245.5
SEA SALT3	0.021	345.2	0.06	359.4	0.038	268.6	0.004	1001
SEA SALT4	0.0002	139.7	0.001	147.7	9E-05	188.6	5E-06	4185
sulf	−0.012	−1.28	−1.49	−30.99	0.321	64.39	0.161	69.71
	17 June 2013							
	Δ Column		Δ 850 hPa		Δ 500 hPa		Δ 300 hPa	
	ug/m^3	%	ug/m^3	%	ug/m^3	%	ug/m^3	%
BC	0.068	62.25	0.287	64.70	0.065	79.78	0.024	154.91
OC	0.242	44.57	1.082	48.12	0.203	59.73	0.072	146.51
DUST1	4.449	114	16.99	112.8	6.059	146.8	0.947	183.51
DUST2	9.998	115.4	38.55	113.3	13.52	152.2	2.078	190.90
DUST3	6.687	119.3	26.04	115.9	9.0213	164.6	1.339	206.4
DUST4	2.003	135.9	8.062	124.1	2.614	215.2	0.371	246.2
DUST5	0.923	196.9	3.857	152.1	1.119	343.1	0.155	315.1
SEA SALT1	0.002	97.29	0.004	353.4	0.002	51.76	0.003	58.84
SEA SALT2	0.011	234.4	0.042	436.6	0.01	79.35	0.004	198.68
SEA SALT3	0.012	204.2	0.053	315.7	0.01	76.25	0.002	595.5
SEA SALT4	2E-05	13.39	1E-04	9.75	1E-05	188.7	1E-06	1533
sulf	−0.026	−2.61	−1.157	−23.57	0.205	27.56	0.023	21.25