

Balloon-borne measurements of temperature, water vapor, ozone and aerosol backscatter at the southern slopes of the Himalayas during StratoClim 2016-2017

Simone Brunamonti¹, Teresa Jorge¹, Peter Oelsner², Sreeharsha Hanumanthu^{3,4}, Bhupendra B. Singh³, K. Ravi Kumar^{3,9}, Sunil Sonbawne³, Susanne Meier², Deepak Singh⁵, Frank G. Wienhold¹, Bei Ping Luo¹, Maxi Böttcher¹, Yann Poltera¹, Hannu Jauhiainen⁸, Rijan Kayastha⁶, Ruud Dirksen², Manish Naja⁵, Markus Rex⁷, Suvarna Fadnavis³ and Thomas Peter¹

¹Institute for Atmospheric and Climate Science (IAC), Swiss Federal Institute of Technology (ETH), Zürich, Switzerland

²Deutscher Wetterdienst (DWD) / GCOS Reference Upper Air Network (GRUAN) Lead Center, Lindenberg, Germany

³Indian Institute of Tropical Meteorology (IITM), Pune, India

⁴Forschungszentrum Jülich (FZJ), Jülich, Germany

⁵Aryabhata Research Institute of Observational Sciences (ARIES), Nainital, India

⁶Kathmandu University (KU), Dhulikhel, Nepal

⁷Alfred Wegener Institute (AWI) for Polar and Marine Research, Potsdam, Germany

⁸Vaisala Oyj, Vantaa, Finland

⁹Now at King Abdullah University of Science and Technology (KAUST), Thuwal, Saudi Arabia

Correspondence to: Simone Brunamonti (simone.brunamonti@env.ethz.ch)

Supplementary material

Sound- ing ID	Date	Time of lau- nch	Radiosonde	Payload	Status / notes	Burst height
NT001	Aug 02, 2016	18:59 UT	iMet-1-RSB	ECC / CFH / CO- BALD	-	34.4 km
NT002	Aug 03, 2016	15:20 UT	iMet-1-RSB	ECC / CFH / CO- BALD	-	29.0 km
NT003	Aug 05, 2016	17:23 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	Early burst	18.6 km
NT004	Aug 06, 2016	17:57 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	-	34.0 km

NT005	Aug 08, 2016	16:30 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	-	30.2 km
NT006	Aug 11, 2016	05:04 UT	RS41-SGP / RS92-SGP	ECC / CFH	CFH electronics failure	32.8 km
NT007	Aug 11, 2016	18:57 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	ECC failure, CFH contaminated	32.5 km
NT008	Aug 12, 2016	04:57 UT	RS41-SGP / RS92-SGP	ECC / CFH	-	32.0 km
NT009	Aug 12, 2016	16:20 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	Early burst	19.8 km
NT010	Aug 15, 2016	04:53 UT	RS41-SGP / RS92-SGP	ECC / CFH	CFH contaminated	29.2 km
NT011	Aug 15, 2016	16:53 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	CFH contaminated	26.7 km
NT012	Aug 16, 2016	03:43 UT	RS41-SGP / RS92-SGP	ECC / CFH	-	31.0 km
NT013	Aug 16, 2016	18:27 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	Launch failure (early burst)	2.7 km
NT014	Aug 17, 2016	10:10 UT	RS41-SGP / RS92-SGP	ECC / CFH	-	33.0 km
NT015	Aug 17, 2016	15:30 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	-	32.7 km
NT016	Aug 18, 2016	06:28 UT	RS41-SGP / RS92-SGP	ECC / CFH	-	29.6 km
NT017	Aug 18, 2016	16:04 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	-	33.9 km
NT018	Aug 19, 2016	17:28 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	-	33.0 km

NT019	Aug 20, 2016	03:23 UT	RS41-SGP / RS92-SGP	ECC / CFH	-	33.4 km
NT020	Aug 20, 2016	07:19 UT	RS41-SGP / RS92-SGP	CFH	-	31.2 km
NT021	Aug 21, 2016	03:35 UT	RS41-SGP / RS92-SGP	ECC / CFH	-	32.3 km
NT022	Aug 21, 2016	07:12 UT	RS41-SGP / RS92-SGP	None	Early burst	18.6 km
NT023	Aug 21, 2016	15:51 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	-	33.0 km
NT024	Aug 22, 2016	04:21 UT	RS41-SGP / RS92-SGP	ECC	ECC battery failure	33.6 km
NT025	Aug 23, 2016	16:33 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	-	32.1 km
NT026	Aug 24, 2016	06:03 UT	RS41-SGP / RS92-SGP	ECC / CFH	-	29.6 km
NT027	Aug 26, 2016	18:18 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	-	33.0 km
NT028	Aug 28, 2016	16:11 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	-	33.9 km
NT029	Aug 30, 2016	15:44 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	CFH contaminated	31.3 km
NT030	Aug 31, 2016	05:58 UT	RS41-SGP / RS92-SGP	ECC / CFH	CFH contaminated	33.0 km
NT031	Nov 08, 2016	18:50 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	COBALD battery failure	32.7 km
NT032	Nov 10, 2016	06:56 UT	RS41-SGP / RS92-SGP	ECC / CFH	-	31.5 km

NT033	Nov 10, 2016	14:44 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	-	32.4 km
NT034	Nov 11, 2016	15:37 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	-	32.1 km
NT035	Nov 12, 2016	07:27 UT	RS41-SGP / RS92-SGP	ECC / CFH	CFH contaminated	30.1 km
DK001	Jul 30, 2017	18:27 UT	RS41-SGP / RS92-SGP	ECC / COBALD	-	34.8 km
DK002	Jul 31, 2017	18:40 UT	RS41-SGP / RS92-SGP	ECC / COBALD	-	25.5 km
DK003	Aug 2, 2017	18:48 UT	RS41-SGP / RS92-SGP	ECC	Early burst	18.0 km
DK004	Aug 3, 2017	19:36 UT	RS41-SGP / RS92-SGP	ECC / CFH / CO- BALD	-	32.8 km
DK005	Aug 4, 2017	18:18 UT	RS41-SGP / RS92-SGP	ECC / CFH	CFH contamin-ated, early burst	22.7 km
DK006	Aug 5, 2017	18:09 UT	RS41-SGP / RS92-SGP	ECC / CFH	ECC failure	35.0 km
DK007	Aug 6, 2017	04:22 UT	RS41-SGP / RS92-SGP	-	-	33.5 km
DK008	Aug 6, 2017	07:40 UT	RS41-SGP / RS92-SGP	-	-	34.8 km
DK009	Aug 6, 2017	18:44 UT	RS41-SGP / RS92-SGP	ECC / CFH	ECC failure CFH contaminated	27.8 km
DK010	Aug 7, 2017	16:45 UT	RS41-SGP / RS92-SGP	ECC / CFH	-	34.4 km
DK011	Aug 8, 2017	04:55 UT	RS41-SGP / RS92-SGP	-	-	26.9 km

DK012	Aug 8, 2017	06:49 UT	RS41-SGP / RS92-SGP	-	-	33.8 km
DK013	Aug 8, 2017	10:20 UT	RS41-SGP / RS92-SGP	ECC / CFH	-	32.4 km
DK014	Aug 9, 2017	03:51 UT	RS41-SGP / RS92-SGP	-	-	36.9 km
DK015	Aug 9, 2017	07:18 UT	RS41-SGP / RS92-SGP	-	-	35.3 km
DK016	Aug 9, 2017	16:49 UT	RS41-SGP / RS92-SGP	ECC / CFH	Early burst	19.0 km
DK017	Aug 10, 2017	03:13 UT	RS41-SGP / RS92-SGP	-	-	33.6 km
DK018	Aug 10, 2017	05:16 UT	RS41-SGP / RS92-SGP	-	-	35.9 km
DK019	Aug 10, 2017	07:33 UT	RS41-SGP / RS92-SGP	-	-	36.5 km
DK020	Aug 10, 2017	16:29 UT	RS41-SGP / RS92-SGP	ECC / CFH	Early burst	18.0 km
DK021	Aug 11, 2017	02:51 UT	RS41-SGP / RS92-SGP	-	-	35.6 km
DK022	Aug 11, 2017	05:30 UT	RS41-SGP / RS92-SGP	-	-	32.5 km
DK023	Aug 11, 2017	07:37 UT	RS41-SGP / RS92-SGP	-	-	33.2 km
DK024	Aug 11, 2017	11:51 UT	RS41-SGP / RS92-SGP	ECC / CFH	-	33.5 km

DK025	Aug 12, 2017	05:44 UT	RS41-SGP / RS92-SGP	-	Telemetry issues, sounding terminated manually	Unknown
DK026	Aug 12, 2017	08:18 UT	RS41-SGP / RS92-SGP	-	-	26.8 km
DK027	Aug 12, 2017	11:36 UT	RS41-SGP / RS92-SGP	CFH	CFH contaminated	31.8 km
DK028	Aug 12, 2017	16:53 UT	RS41-SGP	CFH	Early burst, CFH contaminated	22.3 km

Table S1. List of all balloon soundings performed, including sounding identifier (ID), date and time of launch, radiosondes and payload used, status / notes (instrumental malfunctionings), and burst altitude. The sounding ID is composed of the station abbreviation (NT for Nainital, India; DK for Dhulikhel, Nepal) and sounding chronological number. Exact coordinates (latitude, longitude) of the sounding stations were, in NT: 29.3554°N, 79.4619°E; in DK: 27.6193°N, 85.5386°E.

Figure S4. All measurements of the NT16_{AUG} campaign (dots), shown as a scatter plot of BSR at 940 nm (BSR_{940}) as a function of color index (CI), color-coded with ice saturation (S_{ice}). Dashed lines show the $BSR_{940} = 2.5$ and $CI = 7$ isolines, which are the optical thresholds used for cloud-filtering (discussed in Section 6.2).