



Supplement of

Methodology to obtain highly resolved SO₂ vertical profiles for representation of volcanic emissions in climate models

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Table S1: CALIOP-swaths used in this study. From I:\second-paper-code\CALIOP_swaths_zoom_parameters_all_clouds.csv and create_FLEXPART_RELEASES_from_CALIOP_zoom_then_automatic_all_clouds.py.

CALIOP filename	Start time	End time	Lower height [km]	Upper height [km]
CAL_LID_L1-Standard-V4-10.2009-06-14T02-23-41ZD.hdf	2009-06-14 02:55	2009-06-14T02:55:29	9	13
CAL_LID_L1-Standard-V4-10.2009-06-14T14-48-13ZN.hdf	2009-06-14 14:51	2009-06-14 14:52	10	12
CAL_LID_L1-Standard-V4-10.2009-06-15T13-00-16ZD.hdf	2009-06-15 13:51	2009-06-15 13:52	10	13
CAL_LID_L1-Standard-V4-10.2009-06-15T13-52-36ZN.hdf	2009-06-15 13:52	2009-06-15 13:54	11.3	13
CAL_LID_L1-Standard-V4-10.2009-06-15T15-31-31ZN.hdf	2009-06-15 15:33	2009-06-15 15:34	9.57	18

CAL_LID_L1- Standard-V4- 10.2009-06- 15T22-53- 32ZD.hdf	2009-06-15 23:26	2009-06-15 23:28	12	14
CAL_LID_L1- Standard-V4- 10.2009-06- 16T02-11- 23ZD.hdf	2009-06-16 02:42	2009-06-16 02:43	12.8	14.5
CAL_LID_L1- Standard-V4- 10.2009-06- 16T12-04- 39ZD.hdf	2009-06-16 12:55	2009-06-16 12:56	10	13
CAL_LID_L1- Standard-V4- 10.2009-06- 16T14-35- 54ZN.hdf	2009-06-16 14:39	2009-06-16 14:39	12.8	17.5
CAL_LID_L1- Standard-V4- 10.2009-06- 16T16-14- 45ZN.hdf	2009-06-16 16:15	2009-06-16 16:16	12.5	13.5
CAL_LID_L1- Standard-V4- 10.2009-06-	2009-06-17 00:05	2009-06-17 00:12	10	15

16T23-36-51ZD.hdf				
CAL_LID_L1-Standard-V4-10.2009-06-17T01-15-41ZD.hdf	2009-06-17 01:45	2009-06-17 01:46	13	18
CAL_LID_L1-Standard-V4-10.2009-06-17T02-54-36ZD.hdf	2009-06-17 03:25	2009-06-17 03:26	10.5	24
CAL_LID_L1-Standard-V4-10.2009-06-17T11-09-02ZD.hdf	2009-06-17 11:59	2009-06-17 12:01	10	16
CAL_LID_L1-Standard-V4-10.2009-06-17T12-47-52ZD.hdf	2009-06-17 13:38	2009-06-17 13:40	10	13
CAL_LID_L1-Standard-V4-10.2009-06-17T13-40-12ZN.hdf	2009-06-17 13:41	2009-06-17 13:44	9	18

CAL_LID_L1- Standard-V4- 10.2009-06- 17T15-19- 08ZN.hdf	2009-06-17 15:21	2009-06-17 15:22	13	20
CAL_LID_L1- Standard-V4- 10.2009-06- 17T16-57- 58ZN.hdf	2009-06-17 16:57	2009-06-17 17:01	10.5	24
CAL_LID_L1- Standard-V4- 10.2009-06- 17T21-02- 18ZD.hdf	2009-06-17 21:32	2009-06-17 21:39	10	13
CAL_LID_L1- Standard-V4- 10.2009-06- 17T22-41- 14ZD.hdf	2009-06-17 23:11	2009-06-17 23:18	11	16
CAL_LID_L1- Standard-V4- 10.2009-06- 18T00-20- 04ZD.hdf	2009-06-18 00:49	2009-06-18 00:50	12.5	18
CAL_LID_L1- Standard-V4- 10.2009-06- 04:07	2009-06-18 04:07	2009-06-18 04:12	10	14

18T03-37-49ZD.hdf				
CAL_LID_L1-Standard-V4-10.2009-06-18T10-13-20ZD.hdf	2009-06-18 11:03	2009-06-18 11:05	10	15
CAL_LID_L1-Standard-V4-10.2009-06-18T11-52-15ZD.hdf	2009-06-18 12:40	2009-06-18 12:42	10	16
CAL_LID_L1-Standard-V4-10.2009-06-18T12-44-35ZN.hdf	2009-06-18 12:44	2009-06-18 12:49	9	19
CAL_LID_L1-Standard-V4-10.2009-06-18T16-02-21ZN.hdf	2009-06-18 16:02	2009-06-18 16:06	10	22
CAL_LID_L1-Standard-V4-10.2009-06-18T16-48-56ZD.hdf	2009-06-18 17:39	2009-06-18 17:41	10	15

CAL_LID_L1- Standard-V4- 10.2009-06- 18T21-45- 32ZD.hdf	2009-06-18 22:15	2009-06-18 22:24	9	16
CAL_LID_L1- Standard-V4- 10.2009-06- 18T23-24- 27ZD.hdf	2009-06-18 23:52	2009-06-19 00:05	10	19
CAL_LID_L1- Standard-V4- 10.2009-06- 19T02-42- 12ZD.hdf	2009-06-19 03:12	2009-06-19 03:16	10	22
CAL_LID_L1- Standard-V4- 10.2009-06- 19T10-56- 38ZD.hdf	2009-06-19 11:45	2009-06-19 11:48	8	16
CAL_LID_L1- Standard-V4- 10.2009-06- 19T11-48- 59ZN.hdf	2009-06-19 11:48	2009-06-19 11:53	9	20
CAL_LID_L1- Standard-V4- 10.2009-06-	2009-06-19 13:24	2009-06-19 13:27	9	15

19T12-35-29ZD.hdf				
CAL_LID_L1-Standard-V4-10.2009-06-19T15-06-44ZN.hdf	2009-06-19 15:05	2009-06-19 15:10	12	20
CAL_LID_L1-Standard-V4-10.2009-06-19T16-45-34ZN.hdf	2009-06-19 16:45	2009-06-19 16:50	10	23
CAL_LID_L1-Standard-V4-10.2009-06-19T17-32-09ZD.hdf	2009-06-19 18:18	2009-06-19 18:24	11	13
CAL_LID_L1-Standard-V4-10.2009-06-19T20-49-55ZD.hdf	2009-06-19 21:18	2009-06-19 21:27	9	16
CAL_LID_L1-Standard-V4-10.2009-06-19T22-28-45ZD.hdf	2009-06-19 22:57	2009-06-19 23:06	10	20

CAL_LID_L1- Standard-V4- 10.2009-06- 20T03-25- 26ZD.hdf	2009-06-20 03:54	2009-06-20 03:55	20.4	23.8
CAL_LID_L1- Standard-V4- 10.2009-06- 20T03-25- 26ZD.hdf	2009-06-20 04:00	2009-06-20 04:02	10.75	13.5
CAL_LID_L1- Standard-V4- 10.2009-06- 20T10-00- 56ZD.hdf	2009-06-20 10:47	2009-06-20 10:53	9	15
CAL_LID_L1- Standard-V4- 10.2009-06- 20T10-53- 17ZN.hdf	2009-06-20 10:53	2009-06-20 10:59	10	19
CAL_LID_L1- Standard-V4- 10.2009-06- 20T11-39- 52ZD.hdf	2009-06-20 12:27	2009-06-20 12:32	10	15
CAL_LID_L1- Standard-V4- 10.2009-06-	2009-06-20 12:32	2009-06-20 12:35	12	19

20T12-32-12ZN.hdf				
CAL_LID_L1-Standard-V4-10.2009-06-20T13-18-42ZD.hdf	2009-06-20 14:07	2009-06-20 14:11	9	14.5
CAL_LID_L1-Standard-V4-10.2009-06-20T18-15-23ZD.hdf	2009-06-20 18:51	2009-06-20 19:07	9	14
CAL_LID_L1-Standard-V4-10.2009-06-20T19-54-18ZD.hdf	2009-06-20 20:25	2009-06-20 20:33	9	16
CAL_LID_L1-Standard-V4-10.2009-06-20T21-33-08ZD.hdf	2009-06-20 22:00	2009-06-20 22:12	10	19
CAL_LID_L1-Standard-V4-10.2009-06-20T23-12-03ZD.hdf	2009-06-20 23:47	2009-06-20 23:49	10	15

CAL_LID_L1- Standard-V4- 10.2009-06- 21T02-29- 49ZD.hdf	2009-06-21 03:01	2009-06-21 03:08	10	15
CAL_LID_L1- Standard-V4- 10.2009-06- 21T09-05- 19ZD.hdf	2009-06-21 09:51	2009-06-21 09:57	10	16
CAL_LID_L1- Standard-V4- 10.2009-06- 21T09-57- 40ZN.hdf	2009-06-21 09:57	2009-06-21 10:02	10	16
CAL_LID_L1- Standard-V4- 10.2009-06- 21T10-44- 15ZD.hdf	2009-06-21 11:32	2009-06-21 11:36	10	17
CAL_LID_L1- Standard-V4- 10.2009-06- 21T11-36- 35ZN.hdf	2009-06-21 11:37	2009-06-21 11:41	12	20
CAL_LID_L1- Standard-V4- 10.2009-06- 21T11-36- 35ZN.hdf	2009-06-21 13:08	2009-06-21 13:11	10	16

21T12-23-05ZD.hdf				
CAL_LID_L1-Standard-V4-10.2009-06-21T13-15-25ZN.hdf	2009-06-21 13:15	2009-06-21 13:19	9	19
CAL_LID_L1-Standard-V4-10.2009-06-21T14-54-20ZN.hdf	2009-06-21 14:54	2009-06-21 15:00	9	21
CAL_LID_L1-Standard-V4-10.2009-06-21T15-40-50ZD.hdf	2009-06-21 16:28	2009-06-21 16:33	9	15
CAL_LID_L1-Standard-V4-10.2009-06-21T16-33-10ZN.hdf	2009-06-21 16:33	2009-06-21 16:34	12	15
CAL_LID_L1-Standard-V4-10.2009-06-21T18-58-36ZD.hdf	2009-06-21 19:33	2009-06-21 19:39	10	15

CAL_LID_L1- Standard-V4- 10.2009-06- 21T20-37- 31ZD.hdf	2009-06-21 21:07	2009-06-21 21:16	9	19
CAL_LID_L1- Standard-V4- 10.2009-06- 21T22-16- 21ZD.hdf	2009-06-21 22:43	2009-06-21 23:08	9	20
CAL_LID_L1- Standard-V4- 10.2009-06- 21T23-55- 16ZD.hdf	2009-06-22 00:26	2009-06-22 00:35	9	15
CAL_LID_L1- Standard-V4- 10.2009-06- 22T01-34- 12ZD.hdf	2009-06-22 02:02	2009-06-22 02:13	10	15
CAL_LID_L1- Standard-V4- 10.2009-06- 22T08-09- 43ZD.hdf	2009-06-22 08:55	2009-06-22 09:01	9	16
CAL_LID_L1- Standard-V4- 10.2009-06- 10:34	2009-06-22 10:34	2009-06-22 10:40	7	17

22T09-48-33ZD.hdf				
CAL_LID_L1-Standard-V4-10.2009-06-22T10-40-53ZN.hdf	2009-06-22 10:40	2009-06-22 10:46	10	19
CAL_LID_L1-Standard-V4-10.2009-06-22T11-27-28ZD.hdf	2009-06-22 12:15	2009-06-22 12:19	9	16
CAL_LID_L1-Standard-V4-10.2009-06-22T13-06-18ZD.hdf	2009-06-22 13:53	2009-06-22 13:58	10	16
CAL_LID_L1-Standard-V4-10.2009-06-22T15-37-34ZN.hdf	2009-06-22 15:37	2009-06-22 15:40	9	15
CAL_LID_L1-Standard-V4-10.2009-06-22T17-16-29ZN.hdf	2009-06-22 17:20	2009-06-22 17:21	21	24

CAL_LID_L1- Standard-V4- 10.2009-06- 22T18-02- 59ZD.hdf	2009-06-22 18:37	2009-06-22 18:47	9	15
CAL_LID_L1- Standard-V4- 10.2009-06- 22T19-41- 49ZD.hdf	2009-06-22 20:17	2009-06-22 20:24	10.5	16
CAL_LID_L1- Standard-V4- 10.2009-06- 22T21-20- 44ZD.hdf	2009-06-22 21:57	2009-06-22 22:02	10.7	15.5
CAL_LID_L1- Standard-V4- 10.2009-06- 22T22-59- 39ZD.hdf	2009-06-22 23:32	2009-06-22 23:40	10.5	15

Example COMMAND-file (COMMAND_forward_CAL_LID_L1-Standard-V4-10.2009-06-17T01-15-41ZD):

```

*****
*
5 *      Input file for the Lagrangian particle dispersion model FLEXPART      *
*          Please select your options                                       *
*
*****
&COMMAND
10 LDIRECT=          1, ! Simulation direction in time      ; 1 (forward) or -1 (backward)
   IBDATE=          20090617, ! Start date of the simulation ; YYYYMMDD: YYYY=year, MM=month, DD=day
   IBTIME=          010000, ! Start time of the simulation  ; HHMISS: HH=hours, MI=min, SS=sec; UTC

```

```

IEDATE=          20090623, ! End date of the simulation      ; same format as IBDATE
IETIME=          010000, ! End time of the simulation      ; same format as IBTIME
LOUTSTEP=        1800, ! Interval of model output; average concentrations calculated every LOUTSTEP (s)
LOUTAVER=        1800, ! Interval of output averaging (s)
5  LOUTSAMPLE=    900, ! Interval of output sampling (s), higher stat. accuracy with shorter intervals
ITSPLIT=         99999999, ! Interval of particle splitting (s)
LSYNCTIME=       900, ! All processes are synchronized to this time interval (s)
CTL=             -5.0000000, ! CTL>1, ABL time step = (Lagrangian timescale (TL))/CTL, uses LSYNCTIME if CTL<0
IFINE=           4, ! Reduction for time step in vertical transport, used only if CTL>1
10  IOUT=          9, ! Output type: [1]mass 2]pptv 3]1&2 4]plume 5]1&4, +8 for NetCDF output
IPOUT=           0, ! Particle position output: 0]no 1]every output 2]only at end
LSUBGRID=        0, ! Increase of ABL heights due to sub-grid scale orographic variations;[0]off 1]on
LCONVECTION=     0, ! Switch for convection parameterization;0]off [1]on
LAGESPECTRA=     0, ! Switch for calculation of age spectra (needs AGECLASSES);[0]off 1]on
15  IPIN=          0, ! Warm start from particle dump (needs previous partposit_end file); [0]no 1]yes
IOUTPUTFOREACHRELEASE= 1, ! Separate output fields for each location in the RELEASE file; [0]no 1]yes
IFLUX=           0, ! Output of mass fluxes through output grid box boundaries
MDOMAINFILL=     0, ! Switch for domain-filling, if limited-area particles generated at boundary
IND_SOURCE=      1, ! Unit to be used at the source      ; [1]mass 2]mass mixing ratio
20  IND_RECEPTOR= 1, ! Unit to be used at the receptor; [1]mass 2]mass mixing ratio 3]wet depo. 4]dry depo.
MQUASILAG=       0, ! Quasi-Lagrangian mode to track individual numbered particles
NESTED_OUTPUT=   0, ! Output also for a nested domain
LINIT_COND=      0, ! Output sensitivity to initial conditions (bkw mode only) [0]off 1]conc 2]mmr
SURF_ONLY=       0, ! Output only for the lowest model layer, used w/ LINIT_COND=1 or 2
25  CBLFLAG=       0, ! Skewed, not Gaussian turbulence in the convective ABL, need large CTL and IFINE
OHFIELDS_PATH=   ".././flexin/", ! Default path for OH file
/

```

Sets of CALIOP swaths transported into AIRS swaths:

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30  AIRS.2009.06.18.222.nc:   ['CAL_LID_L1-Standard-V4-10.2009-06-14T02-23-41ZD',   'CAL_LID_L1-Standard-V4-
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