To: Users of GSFC Scanning Raman Lidar IHOP2002 data
Date: August 03, 2004
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Revision History:

First Release (31May03)
Revision 1 (10June03) : Water vapor data from 14June have been added
Revision 2 (05Dec03) : Water Vapor data from 1 June, 7 June, 11 June, 15 June have been added
Revision 3 (02July04) : A reprocessing of datasets starting on the UT days: May 22, May 25, May 29, May 31, June 01, June 03 (listed as June 02_04), June 12, June 14, June 15, June 18, June 19.
Revision 4 (02August04) : A complete re-processing of all the vertical IHOP data including datasets starting on the UT days: May 22, May 25, May 28, May 29, May 30, May 31, June 01, June 03 (listed as June 02_04), June 6, June 7, June 9, June 10, June 11, June 12, June 14, June 15, June 17, June 18, June 19.

This is a re-processing of all of the vertical Scanning Raman Lidar water vapor data from the IHOP2002 field campaign. A global mean calibration constant was determined using all the vertical datasets from IHOP. This values changed 0.3% between the Revision 3 release and this release. The data released on 02July04 have been re-processed here for completeness although the difference in the calibration of those datasets between Revision 3 and Revision 4 is only 0.3%.

We are releasing images of both water vapor and aerosol scattering ratio data although only water vapor data are included. The aerosol scattering ratio data require more careful analysis that we have not yet performed but that will be focused on after the water vapor processing is complete.

All data provided here are vertical only. Therefore, not all measurements acquired during IHOP are included. The new processing includes corrections for the lidar system overlap function and the temperature dependence of water vapor and nitrogen Raman scattering as described in Whiteman et. al., 1992, Whiteman 2003 a,b. The overlap correction was determined based on an ensemble of comparisons with total-precipitable-water-corrected radiosondes launched at the Homestead site. The overlap correction influenced the data in the lowest 750 meters and increases from 0% to approximately 6% at 300 meters. In addition, the calibration has been done with respect to updated processing of the total precipitable water from SuomiNet GPS (updated from what was available in near realtime during IHOP). The inclusion of these corrections now permits most of the datasets to be released with a minimum altitude of 300 meters. The maximum altitude for all datasets is now 12 km.

Except for three dates (June 14, 17, 18), the water vapor data have been processed using a single, height independent calibration constant determined from the updated processing of the SuomiNet GPS data mentioned above. The standard deviation of the calibration constant for the data released here was approximately 6%. The analysis of the calibration constant yielded the following information: the standard deviation of the calibration constant was ~6.5% when using only daytime measurements and ~4.5% when using only nighttime measurements. The smaller standard deviation of the calibration constant for nighttime measurements is thought to be due to increased horizontal homogeneity at night and thus the better agreement between the profile of water vapor measured over the lidar site and the volume average measured by the GPS. The daytime and nighttime calibration constants differed by ~1% indicating no significant diurnal bias in the SRL water vapor measurements. The data from June 14, 17 and 18 were processed using a calibration with respect to the GPS on those specific days due to the fact that the atmosphere appeared homogeneous on those days (thus minimizing differences between the GPS and lidar measurement) and the SRL daily calibration constant differed by more than 10% from the mean SRL calibration constant. The reason for these large changes in SRL calibration constant is thought to be mis-alignments of the lidar system on these days or incorrect settings on the instrument. The data released here are in general drier than the preliminary releases of 10 June 03 and 05 Dec03 by approximately 3% in the boundary layer.

As in any lidar system, measurements are more difficult in the near field. For the first time, during IHOP the SRL used a small telescope designed to improve the low level retrievals of the vertical measurements. However, this new telescope was installed in the field and we discovered that the optics for the Raman channels from this small telescope had a defective mirror. Therefore, the small telescope data have not been used in the re-processing. However, the use of the overlap correction permits most of the datasets to be released to 300-400m above the surface. Some datasets (May 22-500m, May 25-500m, June 17-750m) were truncated at higher altitudes as noted.

Moving window averages in the vertical and temporal domains have been applied. The temporal moving window for the water vapor data was 3 minutes while the spatial moving windows were as follows: 0-1km: 90 meters, 1-2km: 150 m, 2-3km: 210m, 3-4km: 270m, >4km: 330m. The resulting water vapor data resolutions, determined by the half-power point in a Fourier spectral analysis, are approximately 2 minutes temporal for the water vapor and 1 minute temporal for the aerosol. The data are provided at 1-minute intervals. In the vertical, the approximate resolutions are:

water vapor vertical resolution

0-1 km : 60m
1-2 km : 100m
2-3 km : 150m
3-4 km : 180m
>4 km : 210m

The aerosol scattering ratio images are not smoothed in the temporal domain so they possess the original 1-minute resolution. The vertical resolutions, again according to the half power point in the Fourier specttrum, are approximately:

aerosol scattering ratio vertical resolution

0-3 km : 30m
3-5 km : 60m
5-7 km : 100m
7-9 km : 150m
9-11 km : 180m
>11 km : 210m

These data were taken between May 22 and June 20, 2002 at the Homestead location in western Oklahoma. The specific dates and times (UTC) included in this release are given below. Early in the mission an offset of 1 hour was found in the data acquisition computer that was corrected. Times given should now be correct. Datasets often spanned multiple days. Unless otherwise indicated, the date noted is the UT date on which data acquisition began.

Date Start Time	Aerosol Image Name	Status
5/22/02	AImage_22May02_Processed_7_1_2004_16_11_36.gif	Preliminary
5/25/02	AImage_25May02_Processed_7_1_2004_16_11_36.gif	Preliminary
5/28/02	AImage_28May02_Processed_7_1_2004_16_11_36.gif	Preliminary
5/29/02	AImage_29May02_Processed_7_1_2004_16_11_36.gif	Preliminary
5/30/02	AImage_30May02_Processed_7_1_2004_16_11_36.gif	Preliminary
5/31/02	AImage_31May02_Processed_7_1_2004_16_11_36.gif	Preliminary
6/01/02	AImage_01Jun02_Processed_7_1_2004_16_11_36.gif	Preliminary
6/03/02	AImage_02_04Jun02_Processed_7_1_2004_16_11_36.gif	Preliminary
6/06/02	AImage_06June02_Processed_7_1_2004_16_11_36.gif	Preliminary
6/07/02	AImage_07June02_Processed_7_1_2004_16_11_36.gif	Preliminary
6/09/02	AImage_09June02_Processed_7_1_2004_16_11_36.gif	Preliminary
6/10/02	AImage_10June02_Processed_7_1_2004_16_11_36.gif	Preliminary
6/11/02	AImage_11June02_Processed_7_1_2004_16_11_36.gif	Preliminary
6/12/02	AImage_12June02_Processed_7_1_2004_16_11_36.gif	Preliminary
6/14/02	AImage_14June02_Processed_7_1_2004_16_11_36.gif	Preliminary
6/15/02	AImage_15June02_Processed_7_1_2004_16_11_36.gif	Preliminary
6/17/02	AImage_17June02_Processed_7_1_2004_16_11_36.gif	Preliminary
6/18/02	AImage_18June02_Processed_7_1_2004_16_11_36.gif	Preliminary
6/19/02	AImage_19June02_Processed_7_1_2004_16_11_36.gif	Preliminary

Date Start Time	Water Vapor Image Name	Status

5/22/02	WImage_22May02_Processed_8_2_2004_15_51_11.gif	Reprocessed
5/25/02	WImage_25May02_Processed_8_2_2004_15_51_11.gif	Reprocessed
5/28/02	WImage_28May02_Processed_8_2_2004_15_51_11.gif	Reprocessed
5/29/02	WImage_29May02_Processed_8_2_2004_15_51_11.gif	Reprocessed
5/30/02	WImage_30May02_Processed_8_2_2004_15_51_11.gif	Reprocessed
5/31/02	WImage_31May02_Processed_8_2_2004_15_51_11.gif	Reprocessed
6/01/02	WImage_01Jun02_Processed_8_2_2004_15_51_11.gif	Reprocessed
6/03/02	WImage_02_04Jun02_Processed_8_2_2004_15_51_11.gif	Reprocessed
6/06/02	WImage_06June02_Processed_8_2_2004_15_51_11.gif	Reprocessed
6/07/02	WImage_07June02_Processed_8_2_2004_15_51_11.gif	Reprocessed
6/09/02	WImage_09June02_Processed_8_2_2004_15_51_11.gif	Reprocessed
6/10/02	WImage_10June02_Processed_8_2_2004_15_51_11.gif	Reprocessed
6/11/02	WImage_11June02_Processed_8_2_2004_15_51_11.gif	Reprocessed
6/12/02	WImage_12June02_Processed_8_2_2004_15_51_11.gif	Reprocessed
6/14/02	WImage_14June02_Processed_8_2_2004_15_51_11.gif	Reprocessed
6/15/02	WImage_15June02_Processed_8_2_2004_15_51_11.gif	Reprocessed
6/17/02	WImage_17June02_Processed _8_3_2004_9_26_26.gif	Reprocessed
6/18/02	WImage_18June02_Processed_8_2_2004_15_51_11.gif	Reprocessed
6/19/02	WImage_19June02_Processed_8_2_2004_15_51_11.gif	Reprocessed

The reprocessed water vapor datafile names are:

Recal_WVMR_ASCII_22May02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_25May02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_28May02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_29May02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_30May02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_31May02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_01Jun02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_02_04Jun02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_06June02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_07June02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_09June02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_10June02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_11June02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_12June02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_14June02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_15June02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_17June02_Processed_8_3_2004_9_26_26.txt
Recal_WVMR_ASCII_18June02_Processed_8_2_2004_15_51_11.txt
Recal_WVMR_ASCII_19June02_Processed_8_2_2004_15_51_11.txt

Notes on datasets:

5/22/02: stippling at various times due to attenuation of laser by lower level clouds, compare aerosol image to see cloud locations
5/25/02: Noise at 2330 due to cardboard falling and obstructing telescope
5/28/02: stippling at various times due to attenuation of laser by lower level clouds, compare aerosol image to see cloud locations
5/29/02:
5/30/02: misalignment and triggering errors between 1845 and 1930 UT.
5/31/02: misalignment at 1830
6/01/02 :
6/2-4/02: data actually degan on June 3. Angle data acquired at 30-31 UT causing dropout in vertical data displayed here.
6/07/02 :
6/9/02 : vertical banding is apparent in the data between 11-14 UT due to an as yet unidentified external noise source. misalignment at 20 UT.
6/10/02: misalignment at 20 UT, data dropout at 22 UT
6/11/02 :
6/12/02: data dropout at 1830.
6/14/02 : Data dropouts at ~1030 and 1200 are due to clouds. No aerosol image provided.
6/15/02 : the feature in the water vapor at ~2136 at 2.2km may be a processing glitch.
6/19/02:

In the images, some profiles show stippling above clouds. This stippling is caused by attenuation of the laser beam due to clouds. These data should be avoided for the purposes of analysis. Time gaps occasionally exist in the data for various reasons. These gaps are shown with profiles of all zeros such that the times provided are at the same 1 minute intervals. The determination of the time gap was done before the application of the temporal smoothing window so the profile on either side of a time gap will be influenced by this gap and be incorrect. These profiles can most easily be identified by visual inspection of the gif images supplied and should be avoided.

All the files have the same format. If you have used our data before, then the format is the same except that data do not have fixed fields as indicated in the example below. The columns of data are separated by tabs, instead. Each file is an ASCII file in the following format:

```
  13 = number of files
   1       1.5000    0.0000 = file number, time, angle
   2   123 = number of header, data lines
 This is a dummy line to keep the formatting the same as before
         Range (km)    Height(km)    w (g/kg)       err (g/kg)     res (km)
   1     0.18000E-01 0.18000E-01 0.11229E+02 0.49583E-01 0.75000E-01
   2     0.25000E-01 0.25000E-01 0.11175E+02 0.54908E-01 0.75000E-01
   3     0.32000E-01 0.32000E-01 0.11220E+02 0.64867E-01 0.75000E-01
   .           .              .                  .                 .               .
   .           .              .                  .                 .               .
   .           .              .                  .                 .               .
```

line 1 = gives number of profiles (13) in file

then for each profile the following is listed on the following lines:

line 2 = profile number, time in UTC (1.5000), scan angle (not relevant for you) (0 deg = zenith direction), file name (not relevant for you)
line 3 = number of header lines (1) and data lines (123) to follow. The rest of the information as well is not relevant for you.
Lines 4 = information not relevant for you.
lines 5 = column identifiers

then for each data line, the following is listed:

1. The first column is the bin number (not relevant for you)
2. Range (km) = distance from lidar
3. Altitude (km) = height above ground level (AGL). Ground level at lidar site about XXX meters MSL.

For these data, range is the same as altitude.

4. w (water vapor mixing ratio g/kg) = derived from lidar data
5. Random error in w (g/kg) = random error in lidar mixing ratio (precision) using Poisson statistics
6. Resolution (km) = range resolution of lidar data (not used). Data are recorded every 7.5 meters but provided here at 30 meter range intervals.

This format (4 header lines and the specified number of data lines) is repeated for each profile in file (13 in this example).

Any questions can be directed to David Whiteman 301-614-6703 (david.n.whiteman@nasa.gov).

For more information on the Scanning Raman Lidar, data products and algorithms, see our web site:

http://ramanlidar.gsfc.nasa.gov .

References

Whiteman, D. N., S. H. Melfi, R. A. Ferrare, "Raman Lidar System for Measurement of Water Vapor and Aerosols in the Earth's Atmosphere", Appl. Opt. Vol. 31 No. 16 3068 - 3082 (1992).

Whiteman, D. N., “Examination of the traditional Raman Lidar technique I: Evaluating the temperature dependent lidar equations”,Appl. Opt. (2003).

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