File Revision Date:
September 20, 2019
This file to be modified as re-analysis or new analysis results are available

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NDACC METAFILE FOR JPL STRATOSPHERIC OZONE LIDAR AT Table Mountain, Calif. (TMF)

- Applies to instrument and data history from 01-Jan-1989 to 19-Sep-2019
- PLEASE READ IMPORTANT 2019 UPDATE AT THE BOTTOM OF THIS FILE
- The above period covers analyzed and (re-)analyzed data sets available at this time
- Applies to TMF stratospheric ozone data, temperature and aerosol data processed with
  LidAna version v5.15 or later, and GLASS v1.0 or later
- Does NOT apply to TMF data processed with older program versions, namely v5.00 or SO3ANL
- Does NOT apply to TMF tropopsheric ozone data (see other meta data file for that)
- Applies to all Ames files cataloged on NDACC database with the following names:
  tma3YYMM.mdl (AEROSOL353)   (YYMM is for year and month)
  tma4YYMM.mdl (AEROSOL355)
  tmo3YYMM.mdl (OZONE)
  tmteYYMM.mdl (TEMPERATURE)
  tma3YYMM.tll (AEROSOL353)
  tma4YYMM.ttl (AEROSOL355)
  tmo3YYMM.tll (OZONE)
  tmteYYMM.tll (TEMPERATURE)
- Refer to "Reported Events" section for detailed report of unexpected problems
- This file to be modified as re-analysis or new analysis results are available
- ******************************** ATTENTION !! ********************************
  As of today, the archived year 1988 is an old and unstable version.
  Do not use for trends. Use with extreme caution for all other purposes.
- **

- ***** See metafile "TMF_tropo3_ldr_jpl_2019.txt" for tropospheric ozone system and data *****

Data Set Description:
PI: T. Leblanc (before 2013: I. Stuart McDermid)
Instrument: Lidar
Site(s): Table Mountain Observatory, CA, USA
Measurement Quantities: Ozone
Temperature
(Aerosol)

Contact Information:
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Reference Articles:

lease refer to the file named "jpl_publications_2000.txt" for publications list prior to 2000.
Note: A 2019-updated list of publications will be posted here soon

Instrument Description:

- DIAL stratospheric ozone lidar, 4 Rayleigh channels (2 pairs at 308/353 nm), and later 2 additional Raman channels (1 pair at 308-332/353-385(355-387) nm)
- Ozone profiles between 15-50 km
- Temperature profiles between 25-90 km
- Backscatter ratio profiles at 353 or 355 nm between 12-50 km
- Please refer to the publications list for more details

Description of Algorithms:

I - LidAna 5.xx and LidAna 6.xx (1989 - 2018)

Temperature/ozone/aerosol analysis program LidAna v5.xx, by Thierry Leblanc (TL) first released in June 1999. LidAna v5.00 (in IDL) replaced the old FORTRAN analysis program SO3ANL v4.62 by Eric Sirko. This v5.00 no longer used. LidAna data processor is manual processingl, using 20+ keywords tailored for a specific type of science application. The results are quality-checked visually, manually, during analysis.

- Data set from beginning to July 1999 analyzed with versions 5.2x.
- Data set from November 1999 to December 2004 analyzed with versions 5.40 or later.
- Data set from January 2005 to 2018 analyzed with versions 6.2x or later.

An analysis overview is described below. Please refer to T. Leblanc for details.

a) For ozone, temperature and aerosol retrievals, raw signals are corrected for saturation, background noise, solid angle, Rayleigh extinction, and NO2 absorption if applicable.
b) For temperature and aerosol retrievals the signals are additionally corrected for ozone absorption.
c) Ozone Number Density calculation uses standard DIAL method: Calculating the derivative of the ratio of the slopes of the logarithm of the absorbed and non-absorbed corrected signals. Natural vertical grid is geometric altitude.
Signal is smoothed to reduce statistical noise by applying a derivative filter.
Raman channel is used below 30 km to avoid contamination by aerosols (systematically used since early 2001).
d) Aerosol primary information is the backscatter ratio profile: Ratio of the Rayleigh (353 or 355 nm) to the Raman (385 nm) corrected signals. An a priori density coming from radio-sounding or NCEP is used if Raman channel is not available.

e) Temperature calculation uses ideal gas law and hydrostatic equilibrium.
Signal is normalized to a priori density coming from either radio-sounding or, if radio-sounding not available, from NCEP analysis.
Temperature is tied-on at the top (near 85 km) using the a priori MSISE-90 daily mean climatology.
Raman channel (385 nm) systematically used below ~30 km to avoid contamination by aerosols.

f) All results are output in NetCDF (native format), and then compiled into monthly data files in ASCII Ames format following NDACC requirements

g) In Ames files, the measured quantities are provided together with the following derived products: Ozone mixing ratio, ozone column from top of profile, potential temperature, and backscatter coefficient. These products are usually obtained using either the density-pressure profiles measured by lidar, or a priori density-pressure profiles coming from NCEP or radio-sounding. Refer to "Ames description" section for more details.

Expected Precision/Accuracy of Instrument:

a) Ozone overall precision is calculated statistically during analysis and provided at 1-sigma in Ames files. The errors taken into account are the statistical error associated to photon counting, and systematic errors due to various corrections. The overall precision runs from 1-2% in ozone peak (near 24 km), to 15% at the bottom (near 16 km), and >40% at the top of the profiles (near 50 km).

b) Temperature overall error is calculated as for ozone, with additional systematic errors related to the use of a priori density normalization and tie-on temperature.

c) Unexpected - but identified - errors are issues in this metafile in the "Reported Events" section.

Ames description:

This section gives a few details on the Ames files content:
- All units are MKSA except pressure (in hPa), and mixing ratio (in ppmv).
- "Hour-Mean" and "Minute-Mean" is the averaged time of measurements
- "Hour-Stop" and "Minute-Stop" is the time at which the measurements stopped
- "Day of year (UT xxx.xx)" is the time at which the measurements started
- "pres/dens code" is the source of the "a priori" dens. and press. information
- "channel code" indicates which channels have been used and combined:

*** On and before July 1, 1999 (TMF-1, TMF-2): code based on 3 ranges
If Low Rayleigh channel (or pair of channels) used alone, then code=2**1 = 2
If High Rayleigh channel (or pair of channels) used alone, then code=2**2 = 4
If Low Rayleigh and High Rayleigh combined, then code=2**1 + 2**2 = 6
etc...

*** From Nov 19, 1999 to Mar 30, 2004 (TMF-3, TMF-4):
Code redefined based on 4 ranges
If Raman channel (or pair of channels) used alone, then code=2**0 = 1
If Low Rayleigh channel (or pair of channels) used alone, then code=2**1 = 2
If Med Rayleigh channel (or pair of channels) used alone, then code=2**2 = 4
If High Rayleigh channel (or pair of channels) used alone, then code=2**3 = 8
If Low Rayleigh and High Rayleigh combined, then code=2**1 + 2**3 =10
etc...

*** ATTENTION: This change in channel code definition reflects migration from
*** 6-channel (3 ranges) analysis in LidAna v5.2x to 12-channel (4 ranges)
*** analysis in LidAna v5.4x. The analysis version upgrade was implemented as
*** both TMF and MLO systems were upgraded in May and June 2001.

*** From Mar 30, 2004 to present (TMF-8):

Code redefined based on 4 ranges including Medium and Low Raman
If Raman Low channel (or pair of channels) used alone, then code=2**0 = 1
If Rayleigh Low channel (or pair of channels) used alone, then code=2**1 = 2
If Raman Medium channel (or pair of channels) used alone, then code=2**2 = 4
If Rayleigh Medium channel (or pair of channels) used alone,then code=2**3 = 8
If Rayleigh High channel (or pair of channels) used alone, then code=2**4 =16
If Rayleigh Medium and Rayleigh High combined, then code=2**3 + 2**4 =24
If Raman Medium and Rayleigh High combined, then code=2**2 + 2**4 =20
etc...
Note: 24 permutations/combinations between 2 to 5 ranges are possible
*** ATTENTION: The change in channel code definition reflects migration from
*** 4 ranges analysis in LidAna v5.2x 5.3x, 5.4x, 5.5x, and 5.6x to 5 ranges
*** analysis in LidAna v6.0x. The analysis version upgrade was implemented as
*** TMF 8 chan system was upgraded in April 2004.

II - GLASS 1.xx (2018 - Present)

Temperature/ozone/aerosol analysis program GLASS v1.xx, by Thierry Leblanc (TL) first released in early 2017. This program overrides all previous analysis programs (LidAna, SO3ANL, see section I above)
New GLASS data processor does not require manual processing. Analysis is automated, using 100+ keywords tailored for a specific type of science application.
The resutls are quality-checked visually, manually, after analysis is completed.
This new automation capbility allows for the re-analysis of a large number of measurements without user intervention.
- Data set from XXXXXX to present analyzed with versions 1.00, to be released in 2019.

An analysis overview is described below. Please refer to T. Leblanc for details.

a) For ozone, temperature and aerosol retrievals, raw signals are corrected for saturation, background noise, solid angle, Rayleigh extinction, NO_2 and SO_2 absorption if applicable.
b) For temperature and aerosol retrievals the signals are additionally corrected for ozone absorption.
c) Ozone Number Density calculation uses standard DIAL method: Calculating the derivative of the ratio of the slopes of the logarithm of the absorbed and non-absorbed corrected signals. Natural vertical grid is geometric altitude. Signal is smoothed to reduce statistical noise by applying a derivative filter. Raman channel is used below 30 km to avoid contamination by aerosols (systematically used since early 2001).

d) Aerosol primary information is the backscatter ratio profile: Ratio of the Rayleigh (353 or 355 nm) to the Raman (385 or 387 nm) corrected signals. An a priori density coming from radio-sounding or NCEP is used if Raman channel is not available.

e) Temperature calculation uses ideal gas law and hydrostatic equilibrium. Signal is normalized to a priori density coming from either radio-sounding or, if radio-sounding not available, from NCEP analysis. Temperature is tied-on at the top (near 85 km) using the a priori MSISE-90 daily mean climatology. Raman channel (385 nm) systematically used below ~30 km to avoid contamination by aerosols.

f) All results output in HDF-5 (native format), and HDF-4 (GEOMS template) following NDACC requirements

g) In the HDF files, the measured quantities are provided together with the Ozone mixing ratio. This product is obtained using either the density-pressure profiles measured by lidar, or a priori density-pressure profiles coming from NCEP or radio-sounding. Refer to "HDF description" section for more details.

<u>Expected Precision/Accuracy of Instrument:</u>

a) Ozone overall precision is calculated statistically during analysis and provided at 1-sigma in output files files. The uncertianty components taken into account include photon counting noise (random), and systematic terms due to various corrections. The overall precision runs from 1-2% in ozone peak (near 24 km), to 15% at the bottom (near 16 km), and >40% at the top of the profiles (near 50 km). The largest systematic uncertainty of 4% comes from the ozone absorption cross-sections uncertainty, and their temperature dependence

b) Temperature overall uncertainty comproses same uncertianty cmponents as in the ozone retrieval, with additional systematic components related to the use of a priori density, tie-on temperature uncertainty, and the acceleration of gravity.

c) Unexpected - but identified - errors are issues in this metafile in the "Reported Events" section.

<u>HDF File description:</u>

This section provides details on the HDF files content:

- All units are MKSA except pressure (in hPa), and mixing ratio (in ppmv).

***** Due to the novelty of the GLASS program and its HDF outputs, *****
***** this section is still under construction. It will be updated *****
***** as further documentation is available *****

<u>Instrument History:</u>

- Oct 1985	-	Start of program
- Jan 1988	-	Start of routine measurements (internally referred as TMF-1)
- Sep 1994	-	MCS replacement End system referred as TMF-1. Start system referred as TMF-2.
- Jul 1999	-	2 laser failures: O3 AND TEMPERATURE MEASUREMENTS INTERRUPTED End of system internally referred as TMF-2
- Nov 1999	-	Laser replacement (new YAG): TEMPERATURE MEASUREMENTS RESUMED Start system internally referred as TMF-3
- Jun 2001	-	New system setup (YAG + Excimers): O3 MEASUREMENTS RESUMED

End system referred as TMF-3. Start system referred as TMF-4.

- Jun 2001 - New system setup (YAG + Excimers): O3 MEASUREMENTS RESUMED
  End system referred as TMF-3. Start system referred as TMF-4.
- Jul 2012 - Excimer laser failure, causing unrecoverable 7-month-long data gap
- Feb 2013 - Excimer laser reconfiguration, allowing measurements at low STNR
- Aug 2016 - New excimer laser, improving STNR, yet not as good as to 2-laser ops
- Oct 2018 - New Licel Transient recorder increasing resolution from 300-m to 15-m
  Also, new data acquisiton program allowing remote automated operations

<u>Reported events 1989-2006:</u>

Below is a chronological list of notes describing unexpected events affecting the results quality. The notes are referenced in the comment section of the Ames files.

- 89-A Aerosol status in 1989: No aerosols detected

- 89-B Anomalous BSR>1 between 20 and 30 km in January and February 1989.
  BSR slightly tilted as if diffuse aerosol layer was present.
  Temperature profile significantly colder than NCEP and radio-soundings.
  Ozone profile slightly underestimated.

- 89-C Unstable system in April and May 1989.
  Several experimental problems causing system and data to be unstable
  Consequently, low channel inconsistent with high channel. A few nights archived on NDSC, with possible inconsistencies with other months.

- 89-D July 1989: STOIC intercomparison campaign

- 90-A BSR tilted throughout 1990: Anomalous BSR slope alternat. >0 and <0.
  BSR oscillating between right-tilted slopes (BSR<<1 in upper part and BSR>>1 in lower part) and left-tilted slopes.
  Before April 12, 1990: Observed on a few profiles for alts <20 km.
  Rayleigh temperature slightly overestimated when present. High channel only used for some NDSC temperature archive. Rayleigh ozone weakly affected, except for occasional events.
  Between April 12 and July 6, 1990: Observed on almost all profiles for alts <20 km. Rayleigh temperature significantly overestimated. High channel only used for most of NDSC temperature archive. Rayleigh ozone weakly affected, except for occasional events.
  On and after July 6, 1990: Observed on almost all profiles <30-38 km.
  Rayleigh temperature and ozone significantly overestimated. High channel only used for most of NDSC temperature archive.
  This problem (seemingly) fixed after Feb 16, 1991, after new mirrors installed, except for BSR<<1 below 20 km (see note 91-D).

- 90-B Aerosol status in 1990: No aerosols detected

- 91-A Aerosol status in 1991: Major eruption of Pinatubo on June 22, 1991
  *** For all data before July 12, 1991: No aerosols. ***
  *** First sign of aerosols on July 12, 1991: Thin layer observable on BSR below 20 km from July 12 to August 28, 1997. Slightly observable on Rayleigh ozone and temperature as cloud-type features.
  *** Main (opaque) layer arrived on August 29, 1991 ***: Thickening during summer and fall 1991, BSR>>2. Both Rayleigh ozone and temperature significantly affected. NDSC archived ozone and temperature profiles systematically cut-off above detected layer (generally 25-33 km). Lower part of ozone (down to 17 km) and temperature (down to 19 km) profiles available upon request to T. Leblanc.

- 91-B High channels saturation and SIN effects in 1991.
  Significant saturation and SIN observable on high channels signals.
  Pile-up correction, and SIN subtraction not sufficient to completely remove their polluting effect. Lower part of high range ozone and high range temperature affected by pile-up effect. Upper part of high range and low range ozone affected. These problems mainly fixed on September 1994 after MCS changed (see metafile note 94-D).

- 91-C BSR anomalously tilted in Jan 1991: BSR slope alternat. >0 and <0.
  BSR oscillating between right-tilted slopes (BSR<<1 in upper part and BSR>>1 in lower part) and left-tilted slopes. Rayleigh temperature profiles significantly affected, especially low channel. High channel only mostly used for NDSC archive. Ozone weakly affected except for occasional events. This problem (seemingly) fixed after Feb 16, 1991, except for BSR<<1 below 20 km (see note 91-D).

- 91-D Low channel anomaly: Unexpected BSR<<1 below ~20 km.
  Before August 29, 1991: Systematically observed on almost all profiles
  On and after August 29, 1991: Occasionally identified below 18-19 km, but mostly undetectable because of opaque aerosols. Effect on temperature and ozone not quantifiable.

- 92-A Aerosol status in 1992: Opaque layer detectable throughout 1992
  Thick layer extending from 30 km to below 20 km, BSR always peaks over 1.8. Both Rayleigh ozone and temperature significantly affected. NDSC archived ozone and temperature profiles systematically cut-off above detected layer (generally 30-35 km). Lower part of ozone (down to 17 km) and temperature (down to 19 km) profiles available upon request to T. Leblanc.

- 92-B High channels saturation and SIN effects throughout 1992.
  Significant saturation and SIN observable on high channels signals throughout 1992. Pile-up correction, and SIN subtraction not sufficient to completely remove their polluting effect. Lower part of high range ozone and high range temperature affected by pile-up effect. Upper part of high range and low range ozone affected. These problems mainly fixed on September 1994 after MCS changed (see metafile note 94-D)

- 92-C Low channel anomaly: Unexpected BSR<<1 below ~20 km.
Occasionally identified below 18-19 km. Mostly undetectable because of opaque aerosols, or because problem was not present. Effect on temperature and ozone not quantifiable.

- 93-A Aerosol status in 1993: Moderately thick layer detectable through 93
Bulk of the layer peaking near 20 km, BSR always between 1.2 and 1.6, slightly thinner in summer. Thin but widespread layer also observable above main layer (i.e., 26-32 km). Both Rayleigh ozone and temperature significantly affected. NDSC archived ozone and temperature profiles systematically cut-off above detected layer (generally 27-32 km). Lower part of ozone (down to 15 km) and temperature (down to 19 km) profiles available upon request to T. Leblanc.

- 93-B High channels saturation and SIN effects throughout 1993.
Significant saturation and SIN observable on high channels signals throughout 1993. Pile-up correction, and SIN subtraction not sufficient to completely remove their polluting effect. Lower part of high range ozone and high range temperature significantly affected by pile-up effect. Upper part of high range and low range ozone significantly affected. These problems mainly fixed on September 1994 after MCS changed (see metafile note 94-D)

- 93-C Systematic low and high channels inconsistency in ozone through 1993
Origin of problem thought to be a combination of inaccurate saturation correction of the high channel(s), and inaccurate SIN extraction of the low channel(s). Consequently low Rayleigh ozone content appears systematically few percent lower than high Rayleigh ozone content.

- 93-D Low channel anomaly: Unexpected BSR<<1 below ~20 km.
Identified below 18-19 km in second half of 1993. Not detectable earlier either because of opaque aerosols, or because problem was not present.
Effect on temperature and ozone not quantifiable.

- 93-E Channel 3 anomaly: Unexpected parasitic noise near 20 km on Chan. 3 for experiment December 30, 1993. Consequently low Rayleigh ozone profile is garbage. Used only high range for NDSC archive. This problem fixed on April 5, 1994 (see metafile note 94-C).

- 94-A Aerosol status in 1994: Moderately thick layer detectable through 94
Bulk of the layer peaking near 22 km, BSR peaking at 1.10 and more, variable but observable throughout 1994. Both Rayleigh ozone and temperature significantly affected. NDSC archived ozone and temperature profiles systematically cut-off above detected layer (generally 27-32 km). Lower part of ozone (down to 15 km) and temperature (down to 19 km) profiles available upon request to T. Leblanc.

- 94-B Low channel anomaly: Unexpected BSR<<1 below ~20 km throughout 1994.
Identified mostly below 18-19 km. Effect on temperature and ozone not quantifiable due to the presence of aerosol layer at 20 km.

- 94-C Channel 3 anomaly: Unexpected parasitic noise near 20 km on Chan. 3 for all experiments between December 30, 1993 and April 5, 1994.
Consequently low Rayleigh ozone profile is garbage. Used only high range for NDSC archive.

- 94-D ****** Sep 1994: Major system modification: ALL MCS CHANGED ********
Vertical sampling is doubled (from 4 microsec to 2 microsec). Saturation effects (pile-up and SIN) greatly reduced, especially channels 1, 2 and 3. This change considered as largest system change between 1988 and 1999
***************************** END TMF-1 *******************************
**************************** START TMF-2 *******************************

- 95-A Aerosol status in 1995: Mostly detectable.
Bulk of the layer peaking near 21 km, frequent BSR at 1.10.
From January to April: Mostly observable. Rayleigh ozone slightly affected. Rayleigh temperature significantly affected (up to 10K too cold at 20 km).
From April to November: Partly observable. Rayleigh ozone almost unaffected. Rayleigh temperature slightly affected.
From November to December: Ultra-thin Mie scattering layer near 21-22 km
Effects on both ozone and temperature often unpredictable from one night to another.

- 95-B Low channel anomaly: Unexpected BSR<<1 below ~20 km throughout 1995.
Easily detectable in 1996 and after, but difficult to identify in 1995 due to the counter-effect of a superimposed aerosol layer near 20 km.
Effect on temperature and ozone not quantifiable.

- 96-A Aerosol status in 1996: Sporadic layers detectable.
One clear event observable on BSR profile on March 16.
Except for March 16, Rayleigh ozone almost unaffected. Rayleigh temperature slightly affected.

- 96-B Low channel anomaly: Unexpected BSR<<1 below ~20 km throughout 1996.
Consequently, Low Rayleigh ozone slightly overestimated and low Rayleigh temperature significantly overestimated.

- 96-C April 1996: PMTs replaced. Numerous tests to adjust SIN.
Channels 1 and 3 contain significant SIN during several days.
Consequently, ozone at top of profiles slightly underestimated, especially low-chan.

- 96-C2 July 1996: Full night campaign (mesospheric tides)

- 96-D December 1996: Channel 1 abnormally saturated.
Consequently High-channel Rayleigh ozone over-estimated below 35-40 km.
Low channel used between 35 and 40 km instead of high-channel.

- 97-A Aerosol status in 1997: Almost undetectable.
Sometimes two layers slightly observable on BSR profile.
Rayleigh ozone almost unaffected. Rayleigh temperature slightly affected.

- 97-B Low channel anomaly: Unexpected BSR<<1 below ~20 km throughout 1997.
This problem occasionally enhanced in April 97. Consequently, Low Rayleigh ozone slightly overestimated and low Rayleigh temperature significantly overestimated.

- 97-B2 January 1997: Full night campaign (mesospheric tides)

- 97-C 14-Aug-1997: Backscatter ratio abnormally tilted (from <1 top to >1 bottom). Smoke from forest fire also reported. Source of problem can be either Mie scattering or initial misalignment. Consequently Rayleigh temperature underestimated.

- 98-A Aerosol status in 1998: Diffuse mini-layer at and below 30 km.
Mostly observable between January and April, almost undetectable in summer, observable in November-December. Sometimes two layers observable on BSR profile. Rayleigh ozone almost unaffected. Rayleigh temperature slightly to significantly affected (5-10 K too cold).

- 98-B Low channel anomaly: Unexpected BSR<<1 below ~20 km throughout 1998.
Consequently, Low Rayleigh ozone slightly overestimated and low Rayleigh temperature significantly overestimated.

- 98-C January 1998: Low signal level (reduced laser power).
Consequently, Ozone and temperature profiles do not go as high as expected.

- 98-C2 February 1998: Full night campaign (mesospheric tides)

- 98-D Spring 1998: Backscatter profile sometimes abnormally tilted.
Consequently, low Rayleigh ozone slightly underestimated and low Rayleigh temperature severely underestimated. Low part often cut near 30 km to avoid any significant biases.

- 98-E August 1998: Lower stratospheric ozone unusually high.
No explanation.

- 99-A Aerosol status as of January 2000: Below detection level. However, frequent suspect low temperatures between 22 and 35 km. No way to link that to aerosols.

- 99-B LASER FAILURE, Jan 13, 1999:
Excimer laser failure causing major performance reduction. System reconfigured for Jan 23's measurements but ozone results quality is significantly affected.

- 99-C Low channel anomaly: Unexpected BSR<<1 below ~20 km throughout 1999.

Consequently, Low Rayleigh ozone slightly overestimated and low Rayleigh temperature significantly overestimated.

- 99-C2 January-February 1999: Full night campaigns (mesospheric tides)

- 99-D SECOND LASER FAILURE ON JULY 2, 1999: Second excimer laser failure.
Only one more operational laser. No more measurements until new laser arrival
*************************** END TMF-2 *******************************

*** ATTENTION: Channel code definition in Ames files modified as new system ***
*** configuration was set up. Changes reflect migration from 6-channel analysis
*** in LidAna v5.2x to 12-channel analysis in LidAna v5.4x. Refer to section
*** named "Ames description" for a re-definition of channel code **************

- 99-E ************** NEW YAG SYSTEM SETUP 19 NOV 1999 *******************
New (YAG) laser. New wavelength: 355 nm instead of 353 nm.
Temperature/Aerosols measurements only.
No ozone measurements until 2001 except on November 19, 1999.
*************************** START TMF-3 *******************************

- 00-A Aerosol status as of January 2000: Near or below detection level.
However, frequent suspect low temperatures between 20 and 35 km. No way to link these anomalies to aerosols. NDSC archived temperature profiles usually cut-off near 30 km to avoid any possible contamination.

- 00-B Ozone measurement status as of January 2000: No O3 available in 2000

- 00-C Low channel anomaly: Unexpected BSR<<1 below ~20 km throughout 2000.

- 00-C2 January-February 2000: Full night campaigns (mesospheric tides)

- 01-A Aerosol status as of January 2001: Near or below detection level.

- 01-B Ozone measurements status as of January 2001: No O3 between Jan 1 and early June 2001.

- 01-C Low channel anomaly: Unexpected BSR<<1 below ~20 km continuing in 2001.

- 01-C2 February 2001: Full night campaign (mesospheric tides) 2 nights only

- 01-D Unexpected misalignment and timing changes: System disturbed in March
Consequently, low Rayleigh temperature significantly underestimated.

- 01-E Unexpected BSR tilt: System disturbed in early April
BSR slope tilted from <1 at top to >1 at bottom

Consequently, low Rayleigh temperature slightly underestimated.

- 01-F ************* NEW OZONE SYSTEM SETUP EARLY JUNE 2001 ***************
First half of June: Early test experiments. Second half of June fully operational. Ozone, temperature and aerosols 355 results OKAY.
**************************** END TMF-3 *****************************
*************************** START TMF-4 *******************************

- 01-G Unexpected 355 channels anomaly from in July, August, and Sept 2001
BSR slope strongly tilted from <1 top to >1 bottom. Origin of problem thought to be misalignment. Problem partially fixed by applying correction using BSR slope, but final results remain arguable.
Problem fixed on September 15, 2001.

- 01-H Low and high range T profiles do not match well in mid-strato.
High range appears to be 2-3 K warmer than low range throughout Dec 2001
Origin of problem unknown at this date.

- 01-I Suspect high values of ozone concentration detected on high channel.
Positive anomaly >3% above 40 km.
Origin of problem (if problem) is unknown at this date.

- 02-A Aerosol status as of January 2002: Near detection level.
Rayleigh ozone assumed to be unaffected.
Rayleigh temperature assumed to be slightly to significantly affected.

- 02-B Excimer Laser down first half of January 2002.
First 2002 stratopsheric ozone measurements on January 12.

- 02-C YAG laser power reduced during second half of May 2002.
BSR, ozone and Temperature results noisier than usual.

- 02-D October 2002: One Excimer power supply failure.
Ozone measurements on low power from Sep 18 to Oct 17 2002.
Nominal power resumes on Oct 18, 2002.

- 02-E October 2002: YAG laser power reduced.
Origin of malfunction unknown. Osc and Amp sides uneven.
Temperature measurements affected (noisy) from Oct 9 to Nov 5, 2002.

- 02-F November 2002: YAG laser service maintenance
Power back up starting November 11, 2002

- 02-G December 2002: One Excimer laser failure

Ozone profile quality significantly affected starting December 3, 2002

- 03-A January 2003: One Excimer laser not yet fixed
  Ozone profile quality significantly affected

- 03-B February 2003: Faulting Excimer laser fixed. Back running on 2 lasers
  Ozone profile quality back to optimal starting February 19, 2003 (UT).

- 03-C July-August 2003: Few measurements due to various circumstances.
  (bad weather, operator availability, and some laser problems)

- 04-A Aerosol status as of January 2004: Near detection level.
  Rayleigh ozone assumed to be unaffected.
  Rayleigh temperature assumed to be slightly affected.

- 04-B MARCH 30, 2004 ***** MAJOR CHANGE: NEW 8-CHANNEL RECEIVER SETUP ****
  Preliminary tests between March 31 - April 7, 2004.
  **** ATTENTION **** **** ATTENTION **** **** ATTENTION ****
  As of today: All TMF stratospheric ozone, temperature, and aerosol profiles starting April 7, 2004 are preliminary. First reliable archived profiles (still temporary) starts on April 7.
  Validation is undergoing.
  Permanent version to be archived later.
  NDSC flag bit #1 currently set to 1 ("preliminary data").
  CONTACT THIERRY LEBLANC FOR ANY CONCERNS REGARDING THE NEW DATASET
  Details:
  355-side config. starting 4/7: 355H + 355M + 387MR + 387LR
  308-side config. between 3/31 and 6/11: 308H + 308M + 332MR + 308L
  308-side config. starting 6/12: 308H + 308M + 332MR + 332LR
  Note: Temporary DIAL pair 308L/387L between 3/31 and 6/11.
  Permanent DIAL pairs, starting 6/12, are as follows:
  Range code 2^0: 332L/387L (ref. to as "Low Raman" or "Near Raman")
  Range code 2^1: 332M/387M (ref. to as "Mid Raman" or "Mid Raman")
  Range code 2^2: 308M/355M (ref. to as "Mid Rayleigh" or "Mid Rayleigh")
  Range code 2^3: 308H/355H (ref. to as "High Rayleigh" or "Far Rayleigh")
  Channel combination code in Ames is updated, see "Ames description, channel code" section above for more details.
  **** ATTENTION **** **** ATTENTION **** **** ATTENTION ****
  Because of various instrumental, atmospheric, and configuration setups, all results starting April 7 are temporary: Overall coverage is improved but overall quality has degraded. Main problems encountered are:
  1. Systematic T and O3 underestimation by the mid-range Raman as compared to mid-range Rayleigh and low-range Raman. Issue not yet resolved.
  2. Numerous Excimer laser failures or malfunction, leading to weak signal-to-noise ratios, and noisy ozone profiles.

3. Several Chopper failures or malfunction, leading to 308/355 cross-talk interferences. All failures fixed, but expecting further malfunctions.
Again: CONTACT TL FOR ANY CONCERNS REGARDING THE NEW DATASET
**** End of metafile note 04-B **** **** **** **** **** **** **** ****

- 04-C October 2004: Excimer laser problems and poor weather
No ozone measurements from Oct 9 to Nov 5. Temperature measurements OK.

- 04-D Nov-Dec 2004: Low laser power for both Excimers and YAG resulting in very poor ozone and temperature measurements throughout November and December 2004.
Good quality measurements resume on January 15, 2005.

- 05-A Aerosol status as of January 2005: Near detection level
Rayleigh ozone assumed to be unaffected.
Rayleigh temperature assumed to be slightly affected.

- 05-B Jan-Feb 2005: YAG power back to nominal for Jan 15 UT.
Temperature results back to nominal ABOVE 20-25 km ONLY.
Cold T bias below 20 km on Raman channels NOT YET RESOLVED.

- 05-C Jan-Feb 2005: Multiple Excimers failures in connection with cooling system malfunction.
Mixed good and poor quality measurements throughout Jan and Feb.

- 05-D March-April 2005: Chopper failure and reconfiguration
No measurements from March 27 to April 15.

- 05-E April-May 2005: Multiple laser and receiver failures.
No measurements from April 20 to May 12.
Temperature measurements resumed on May 13.
As of today, ozone measurements not resumed yet, resulting in only 1 stratospheric ozone profile for the entire period March 27 to today.

- 05-F May-June 2005: 355 and 387 PMT strongly affected by electronic noise
Problem source thought to be electrical cables providing power to chopper motor. Resulting PMT noise caused very unstable background noise extraction, resulting in very poor quality results on both temperature and ozone.

- 05-G Jul-Aug 2005: Multiple problems on 308 side and 355 side
308 side: No high-range ozone in mid-July. Mid-range only.
355 side: Additional filtering on temperature profiles to account for low YAG laser power.

- 05-H Sep 2005: System stable for the first time in months except 387M
Still no temperature retrieval below 23-30 km due to unavailable Raman

- 05-I Nov-Dec 2005: measurements plagued by persisting high clouds
  Numerous datasets affected by clouds, especially in December

- 06-A Aerosol status as of January 2006: Near detection level
  Rayleigh ozone assumed to be unaffected.
  Rayleigh temperature assumed to be slightly affected.

- 06-B Jan 2006: 387M Channel still invalid below 22 km
  Still no temperature retrieval below 23-30 km

<u>Reported events 2006-Present:</u>

Below is a chronological list of notes describing major events affecting the results. These notes are retrospective, and are not included in any other data or meta data files.

July 2012 - Excimer laser failure, no funds available for replacement
Main impact is an irreversible 7-month-long data gap (7/2012 to 2/2013)

February 2013: Redesign of remaining excimer laser configuration
Measurements resumed, but running on 1 laser only and with low power.
Main impact is reduced data quality (noisier).

August 2016: Installation of a new Excimer laser
Excimer laser replacement. Still running on one excimer laser only. No funds available to get second laser. Main impact is low STNR, noisy measurements.

April 2019: New Licel recorders
Installation of new Licel Transient recorders, in replacement of the old MCS cards.
Also, new data acquisition software, with full automation capability. Main impact is an increase of sampling resolution from 300 m to 15 m, which allowed a refinement of altitude registration, and an increase in measurement frequency.

************ CURRENT END OF LOG OF EVENTS, PENDING UPDATES *************