Ground-based validation

Irina Petropavlovskikh[1], K. Miyagawa[1], G. McConville[1], A. McClure[1], Eric Beach[2], L. Flynn[3] and N. Kramarova[4]

[1] NOAA/CU

[2] NOAA/STAR

[3] NOAA/NESDIS

[4] NASA/SSA

Objective for validation activities

- Provide NOAA Dobson and Brewer TO and ozone-sonde data in near real time
  - WinDobson automation system ftp://aftp.cmdl.noaa.gov/data/ozwv/Dobson/WinDobson/
  - Brewer online daily processing, plots of satellite/Brewer https://www.esrl.noaa.gov/gmd/grad/neubrew/ProductDisplays.jsp#o3timeseries
  - Skysonde software for ozone-sonde data processing ftp://aftp.cmdl.noaa.gov/data/ozwv/Ozonesonde/
- Produce calibrated and quality assured data
  - Dobson data reprocessing to homogenize record, paper is in reviews (Evans et al, ACPD, https://www.atmos-chem-phys-discuss.net/acp-2017-383/), submission of new version of NOAA data to WOUDC and NDACC is planned at the end of 2017, data are updated on NOAA aftp web site (see links above)
  - Ozone –sonde data reprocessing for homogenization – done, data available on NOAA aftp, paper is in preparation
  - Brewer/Dobson/sonde data comparisons, verification of 2014 Dobson calibration at MLO, assessment of seasonal biases
  - Dobson/Pandora - 3 years comparison – paper in reviews (J. Herman et al., AMTD, https://www.atmos-meas-tech-discuss.net/amt-2017-157/)
  - Dobson data correction for stratospheric temperature variability

TCO comparison between Dobson and OMPS overpass

NOAA NM (<50 km, 24 hour)

ftp://ftp.star.nesdis.noaa.gov/pub/smcd/spb/ozone/irina/NPP/NM/V8/reproc_jun_2017/

NOAA NP (<250 km)

ftp://ftp.star.nesdis.noaa.gov/pub/smcd/spb/ozone/irina/NPP/NP/V8/reproc_jun_2017/

NASA (<50 km)

ftp://toms.gsfc.nasa.gov/pub/omps_tc/overpass

NASA Profile (<250 km)

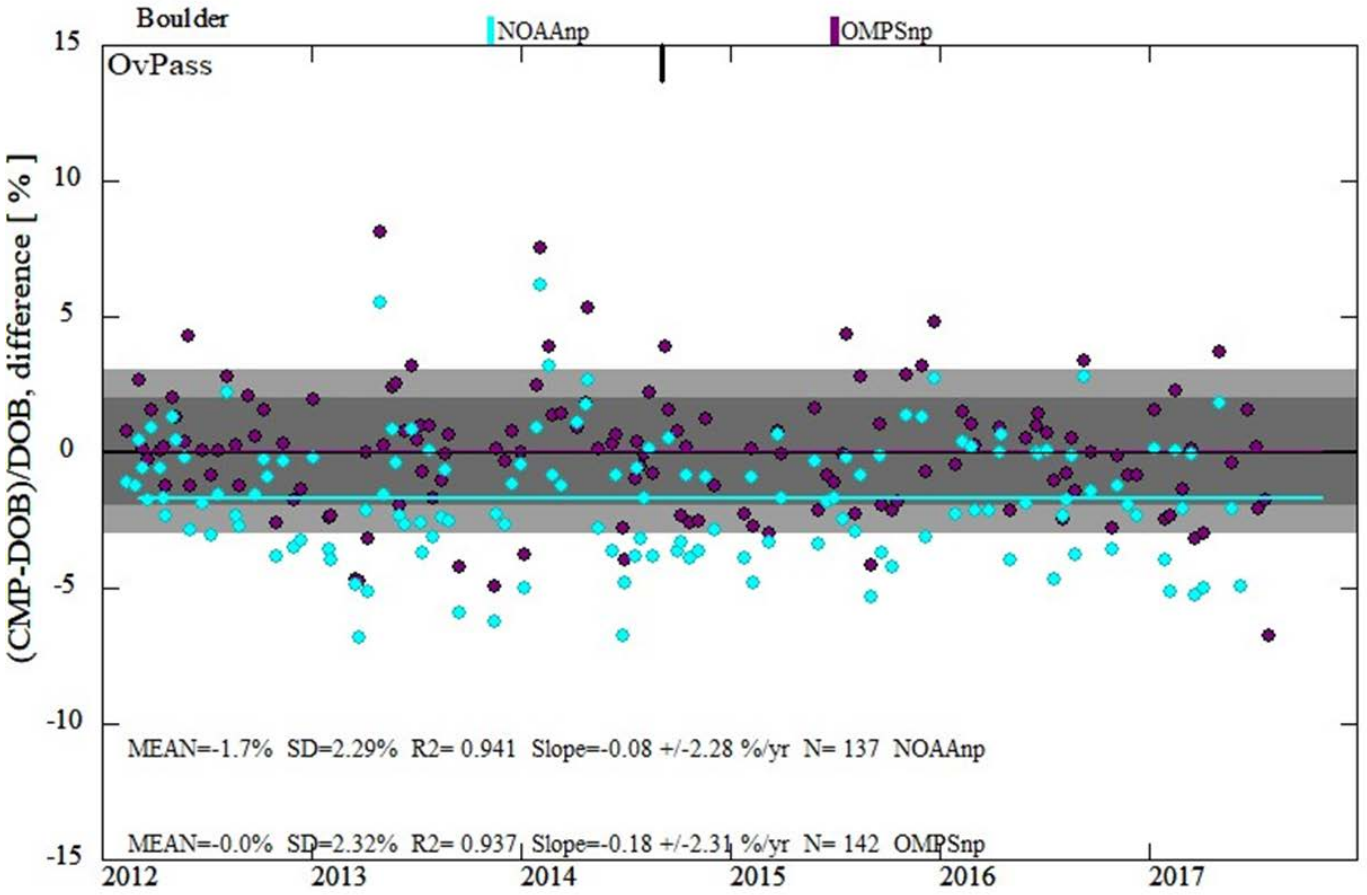
ftp://toms.gsfc.nasa.gov/pub/omps_np/overpass

Dobson

ftp://aftp.cmdl.noaa.gov/data/ozwv/Dobson/WinDobson/ + Windobson

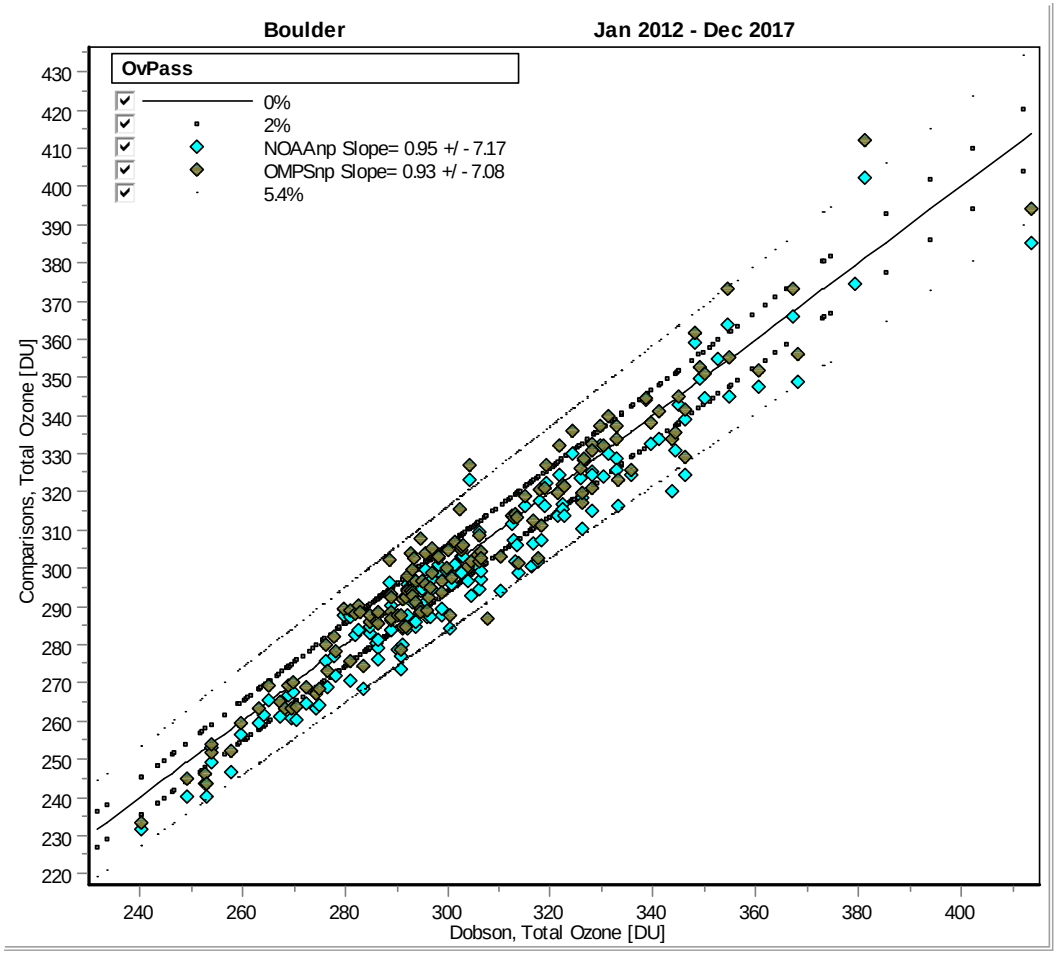
Total ozone data, Boulder, 2012-2017

NOAA (R2=0.94) and **NASA** (0.94)



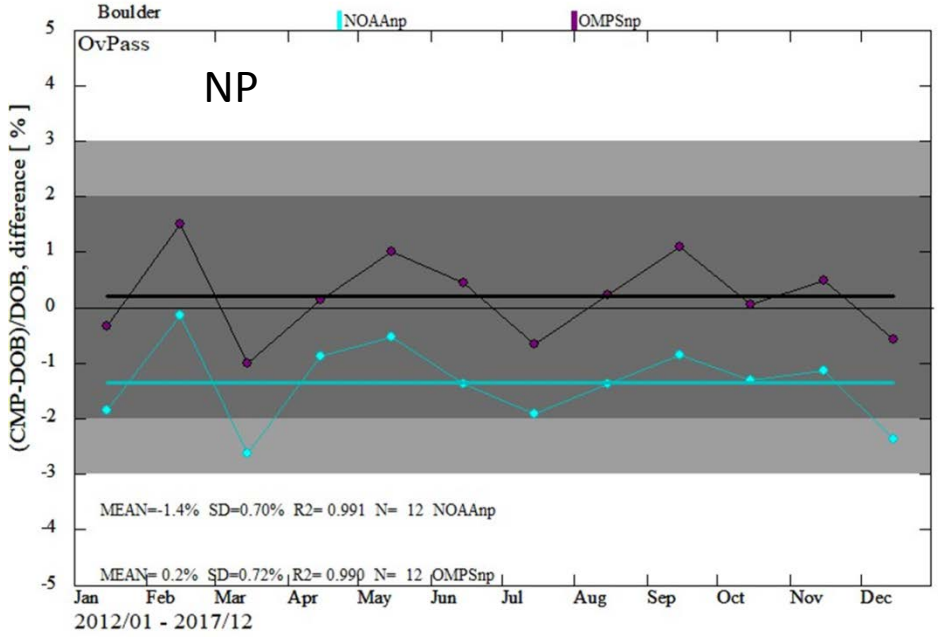
Total ozone data, Boulder, 2012-2017

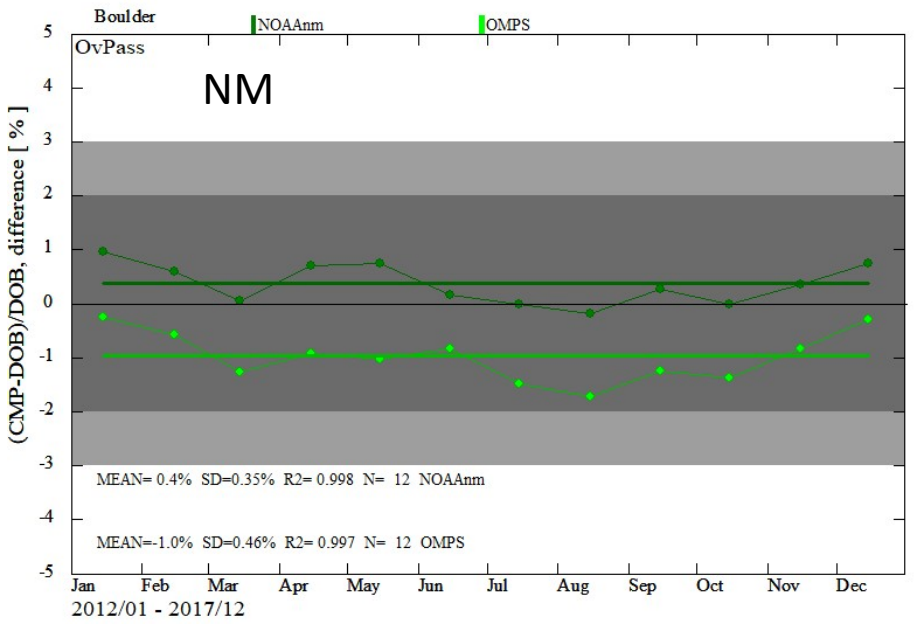
NOAA (slope=0.95) and **NASA** (0.93)



Total ozone data, Boulder, 2012-2017

NOAA and NASA vs. DB, seasonal av.

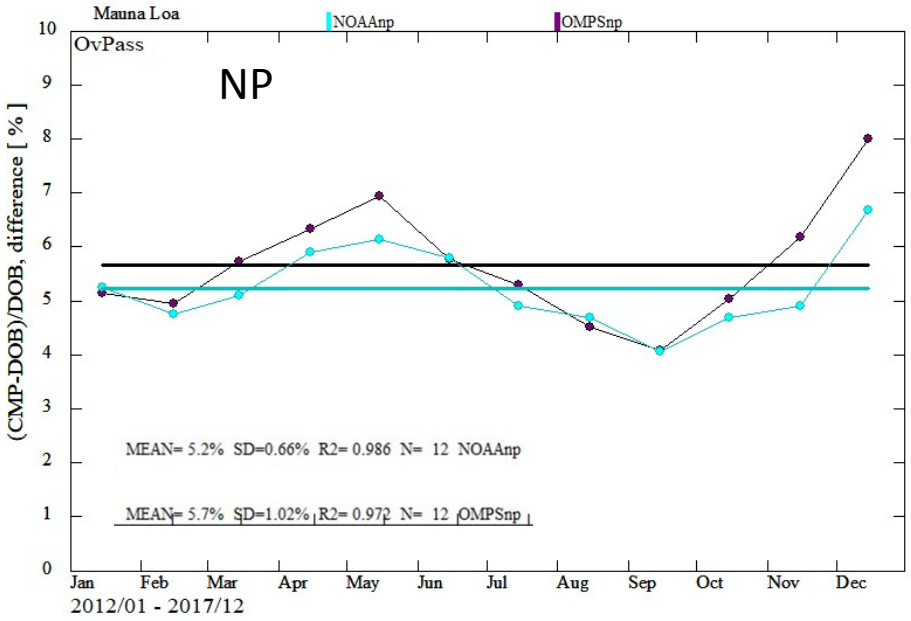


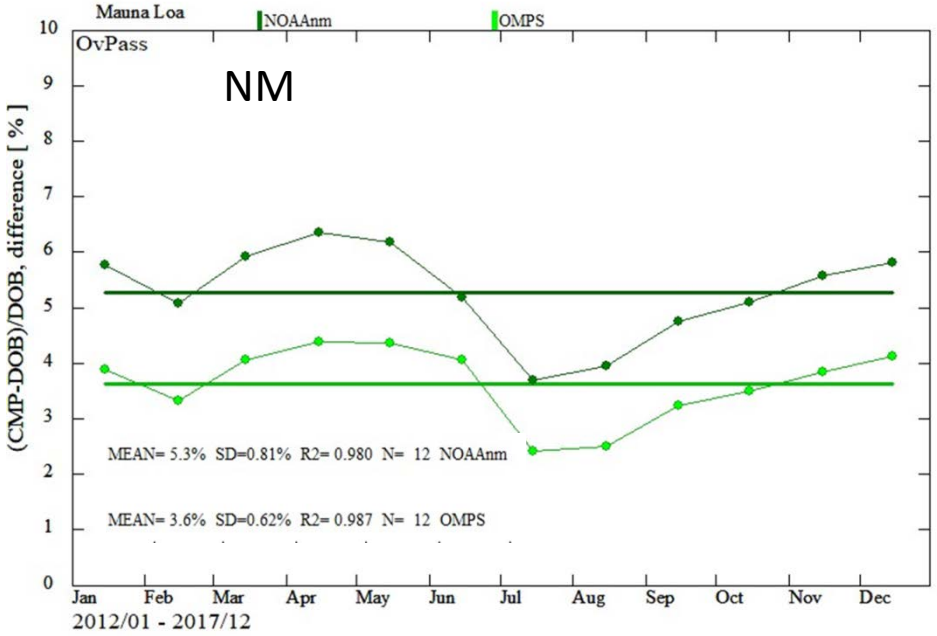


1) OMPS-NP: 2 % bias between NOAA and NASA version, NASA is higher, Dobson TO seasonal bias is corrected by daily GMI/MERRA2 effective temperatures, <250 km matching distance criteria might influence comparisons
2) OMPS-NM : still 2% bias, but it is reverse, NOAA is higher than NASA, smaller deviations

Total ozone data, MLO, 2012-2017

NOAA and NASA vs. DB, seasonal av.



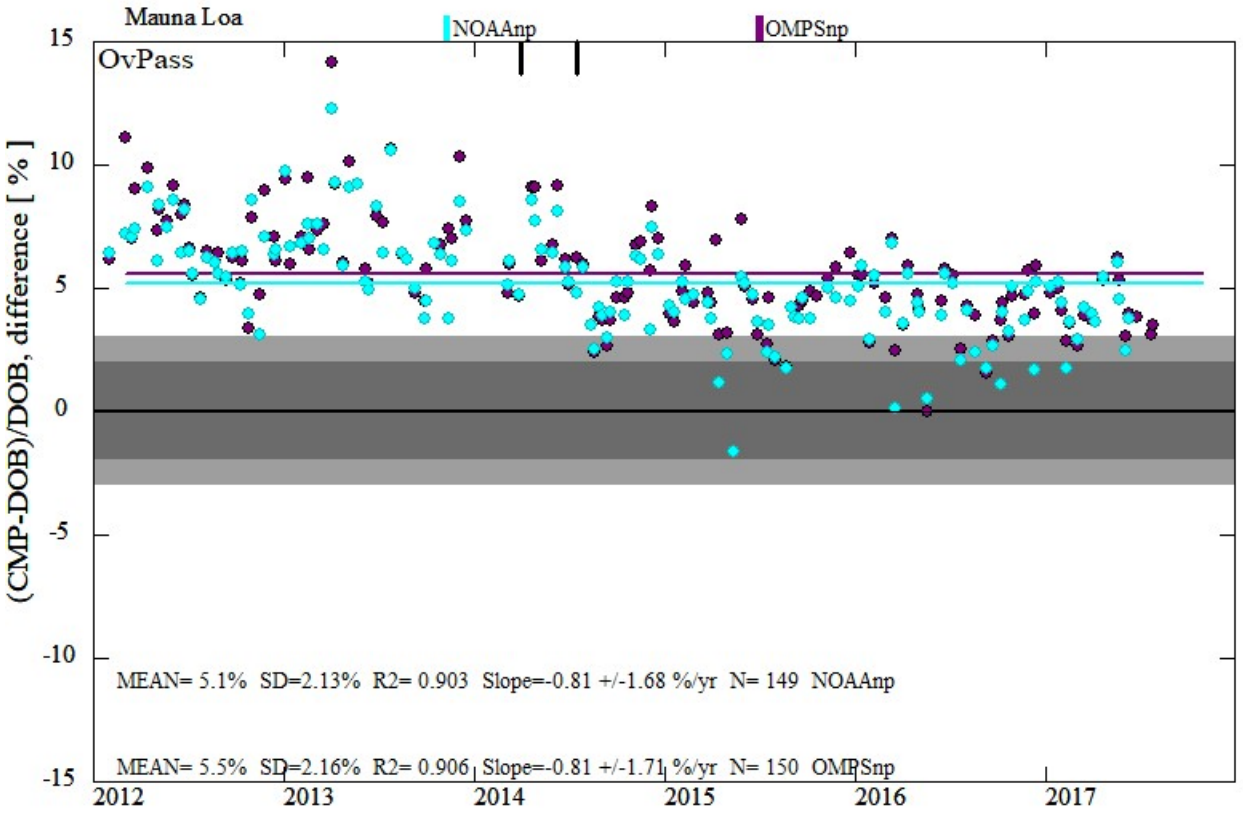


MEAN= 5.3%

MEAN= 3.6%

1) OMPS-NP: 2 % bias between NOAA and NASA version, NASA is higher, Dobson seasonal bias is corrected by daily GMI/MERRA2 effective temperatures, <250 matching distance criteria might influence comparisons
2) OMP-NM : still 2% bias, but it is reverse, NOAA is higher than NASA, smaller deviations

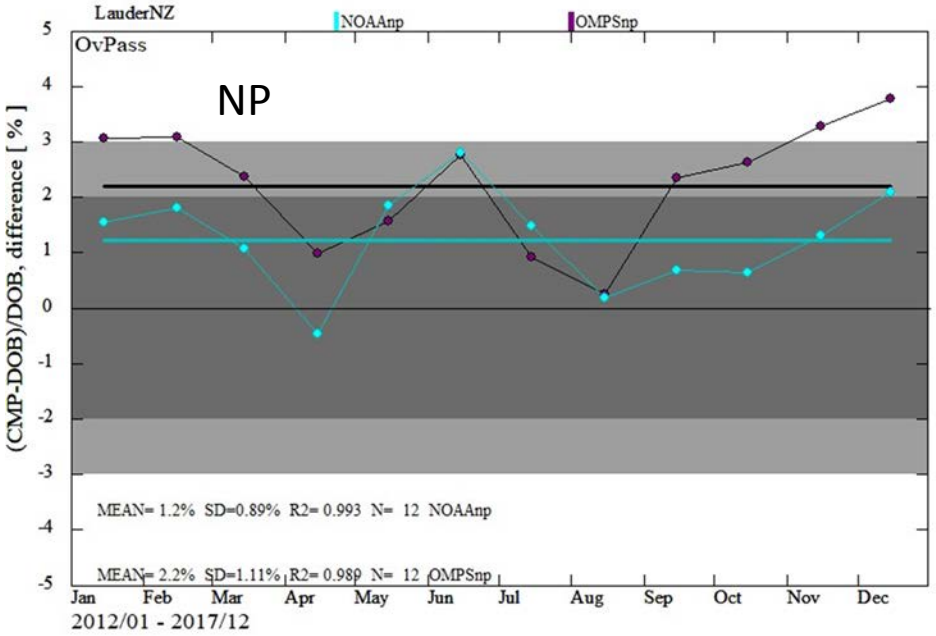
Total ozone data, MLO, 2012-2017
NOAA (R2=0.90) and NASA (0.91)

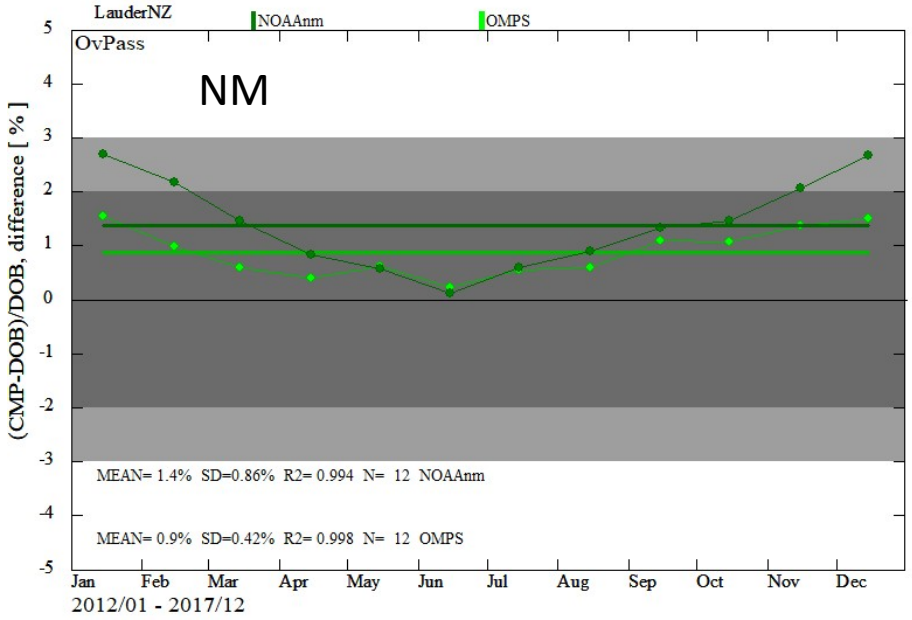


Apparent drift or step change in 2014, determined to be Dobson processing issue, ongoing work to correct for change in Q-table temperature sensitivity

Total ozone data, Lauder, 2012-2017

NOAA and NASA vs. DB, seasonal av.

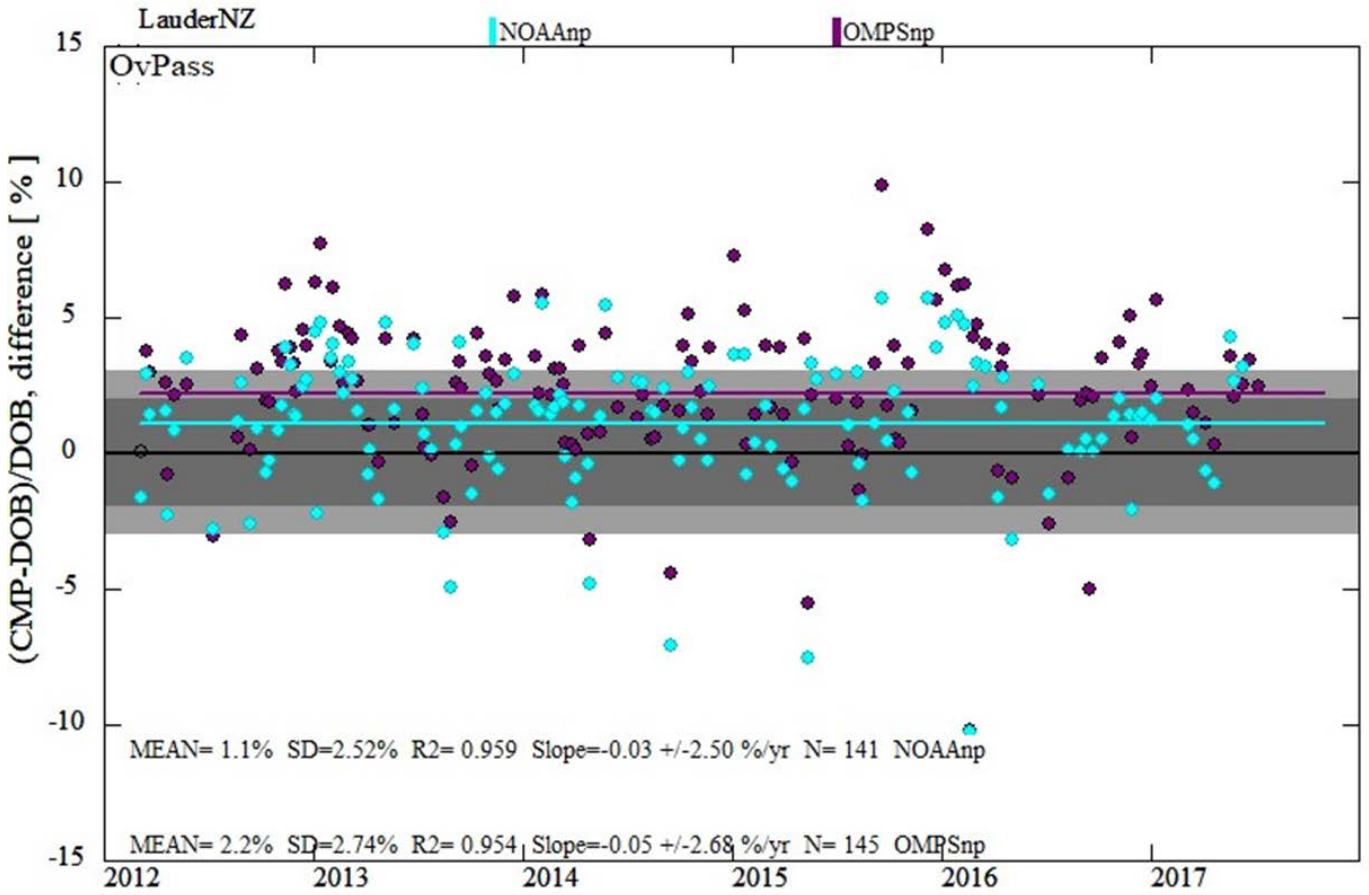




1) OMPS-NP: 1-2 % bias between NOAA and NASA, except in summer, NASA is still higher, bias varies across season
2) OMPS-NM : smaller bias, NOAA is higher than NASA (reversed from NP), smooth seasonal bias

Total ozone data, Lauder, 2012-2017

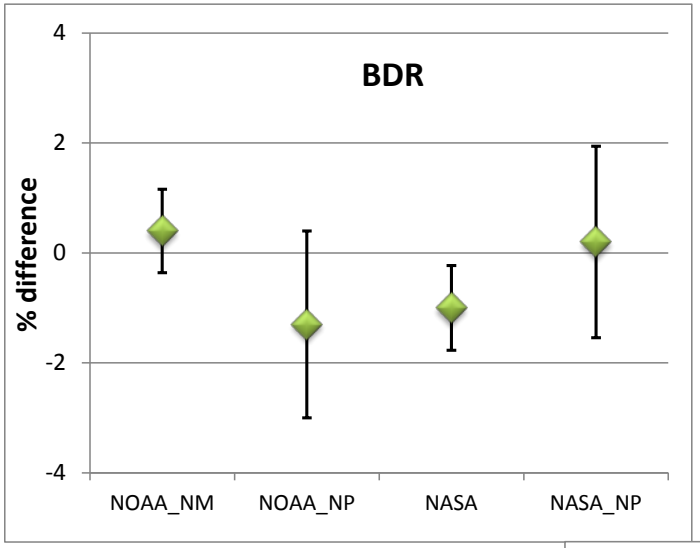
NOAA (R2=0.95) and NASA (0.95)

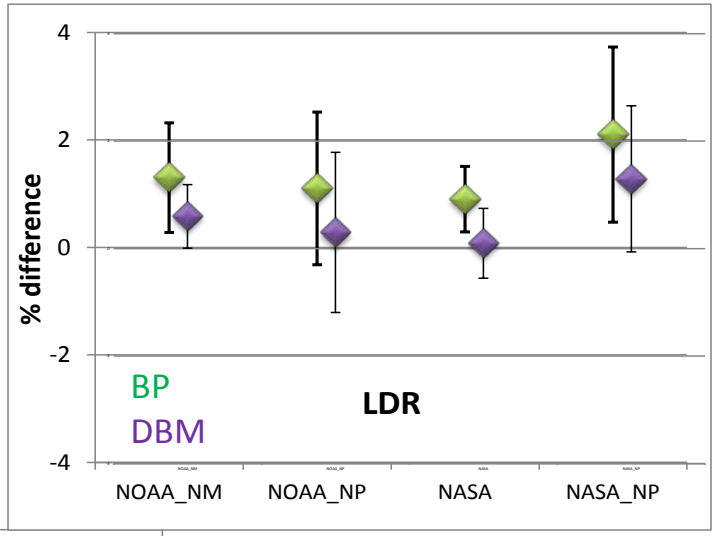


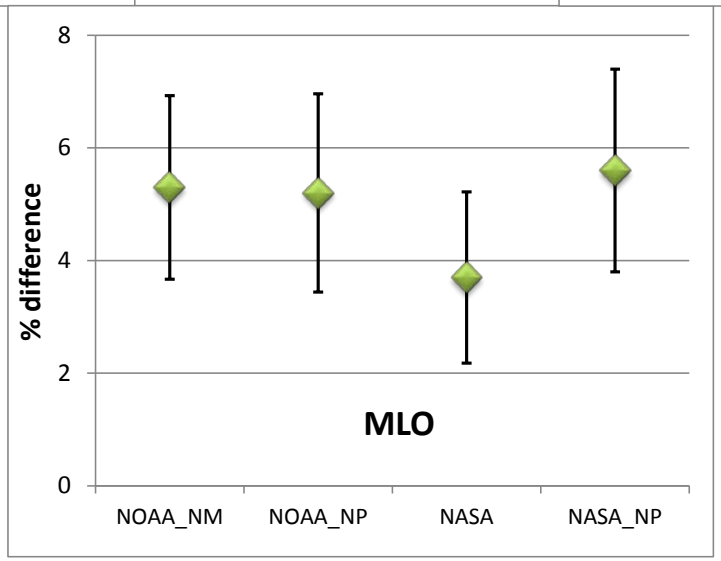
Noise in data comparisons are partially related to ozone spatial variability and the matching criteria to compare station observation with the OMPS overpass.

J1 option for 17x17 km resolution (along orbit) sampling will help to evaluate ozone variability.

Summary for Boulder, Lauder and MLO. NOAA and NASA OMPS vs Dobson







Monthly mean O3 pofile Time Series Comparison Umkehr , MLS V4.2, SBUV (NASA, aggregated), OMPS-NP (NASA V01, NOAA V8) MLO, BLD, LDR station

- Distance < 200 km, within +/-24 hours
- AK to MLS is applied
- A new WinDobson processing system was updated on January, 2012
- Reprocessed Total ozone is applied for Umkehr retrievals, AM and PM selected TO (old system used one daily value)
- No stray light correction is applied (provides improvement above 30 hPa, but distortion of profile below)
- Reprocessing of historical Umkehr data from primary R values (removal of old calibration parameters, homogenization)
- Operational Umkehr measurements are evaluated for cloud interference in the field of view

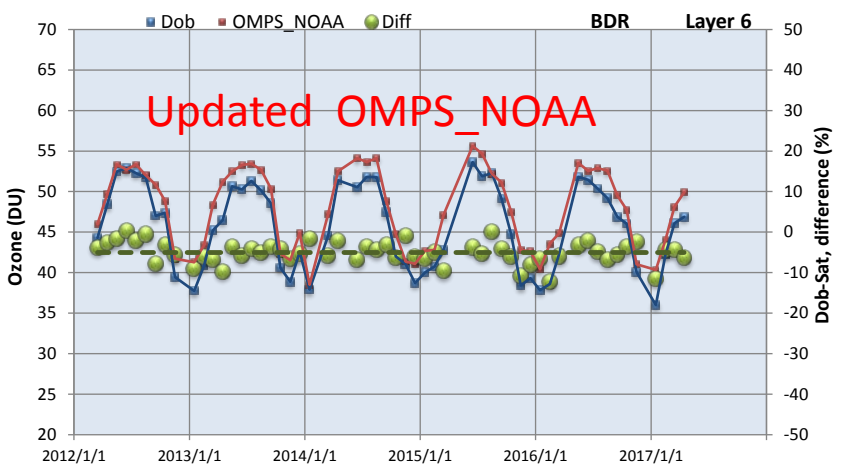
Ozone profile Datasets

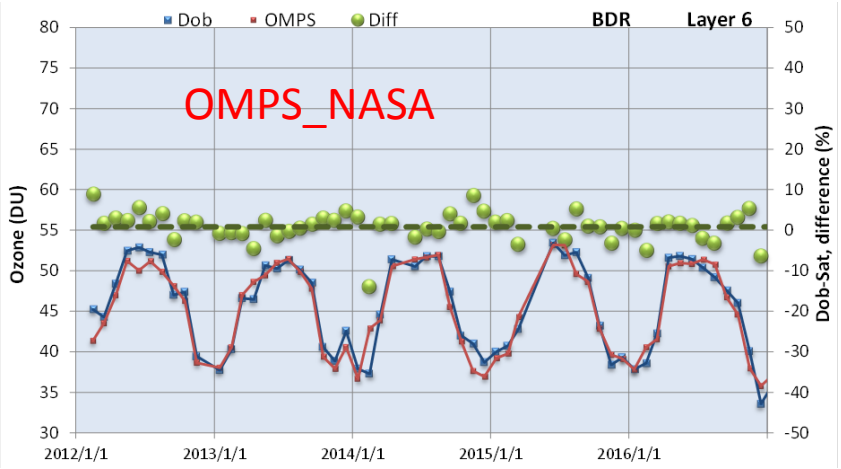
- MLS, V04
- http://avdc.gsfc.nasa.gov/pub/data/satellite/Aura/MLS/V04/L2GPOVP/O3/

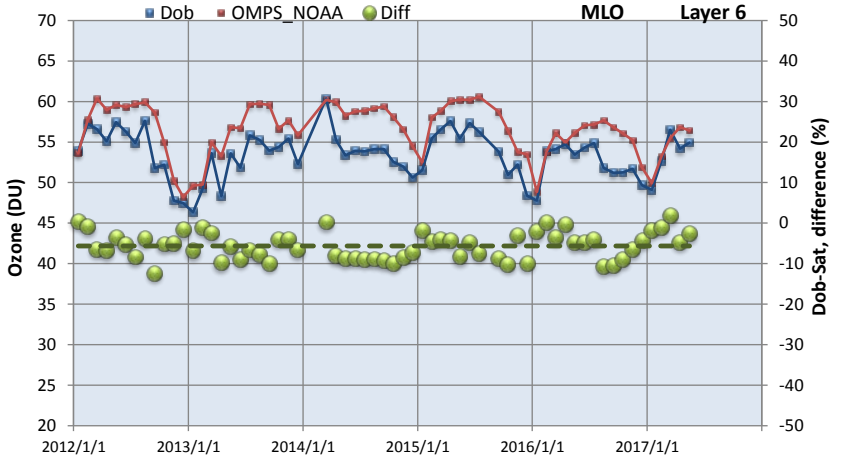
- OMPS –NP, V01 (NASA)
- http://avdc.gsfc.nasa.gov/pub/data/satellite/Suomi_NPP/L2OVP/NP_DAILYO3/du/

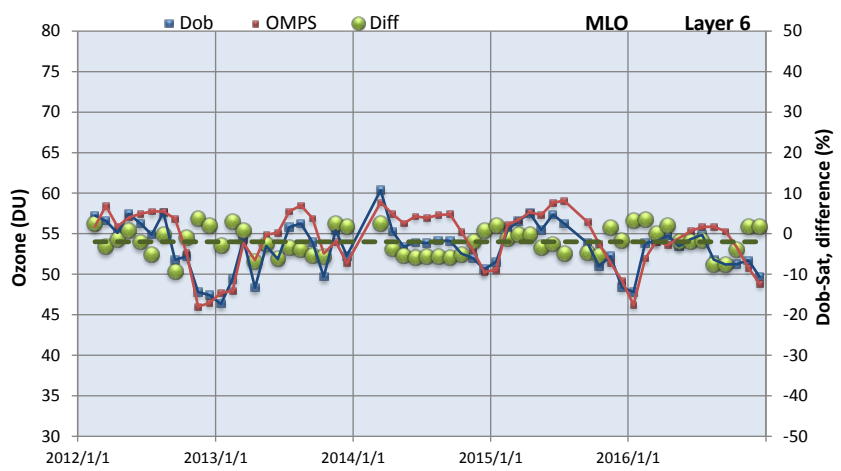
- SBUV (NASA) used 16 layers (aggregated)
- jwocky.gsfc.nasa.gov/pub/sbuv/aggregated

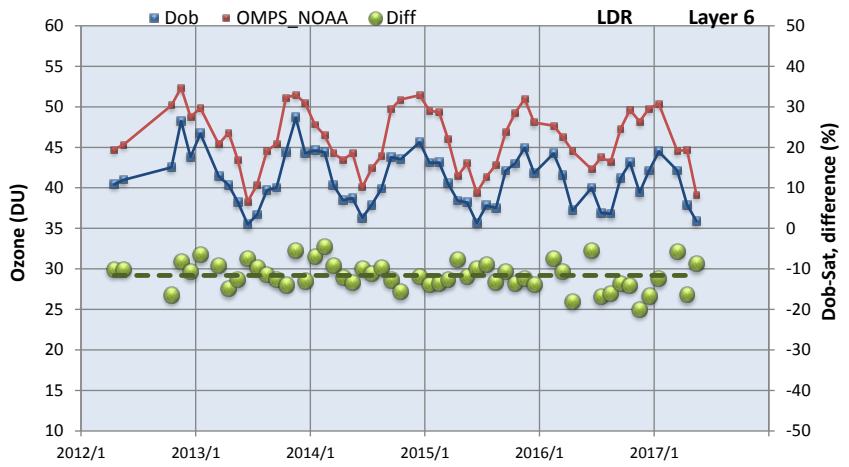
- OMPS-NP (NOAA), V8
- /pub/smcd/spb/ozone/irina/NPP/NP/V8/reproc_jun_2017

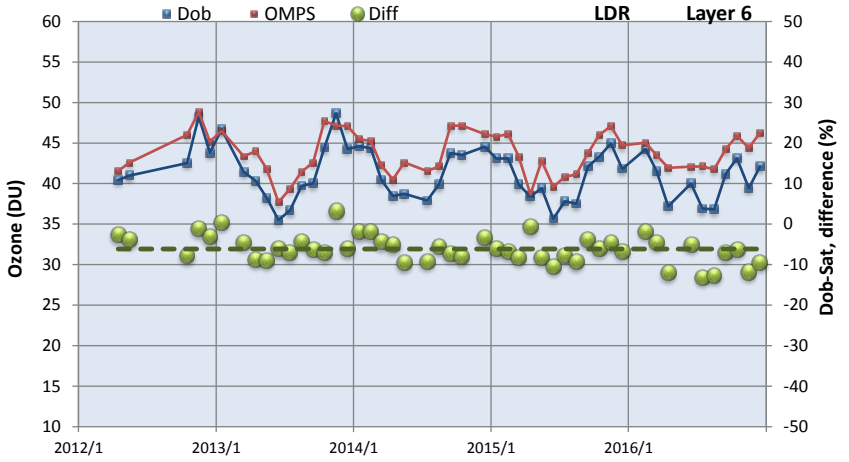

Dob
OMPS_NOAA
Diff
BDR
Layer 6
Updated OMPS_NOAA
Ozone (DU)
Dob-Sat, difference (%)
2012/1/1
2013/1/1
2014/1/1
2015/1/1
2016/1/1
2017/1/1

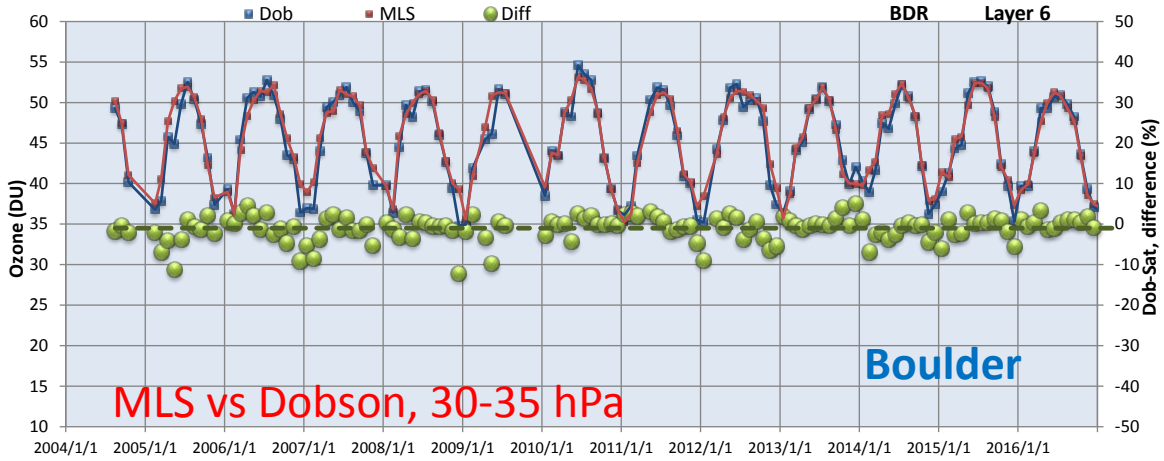

Dob
OMPS
Diff
BDR
Layer 6
OMPS_NASA
Ozone (DU)
Dob-Sat, difference (%)
2012/1/1
2013/1/1
2014/1/1
2015/1/1
2016/1/1

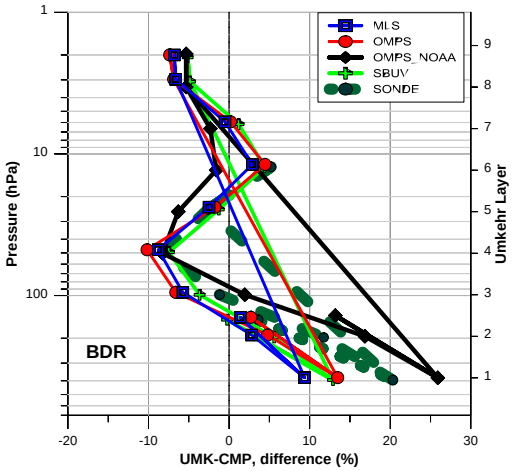

Dob
OMPS_NOAA
Diff
MLO
Layer 6
Ozone (DU)
Dob-Sat, difference (%)
2012/1/1
2013/1/1
2014/1/1
2015/1/1
2016/1/1
2017/1/1

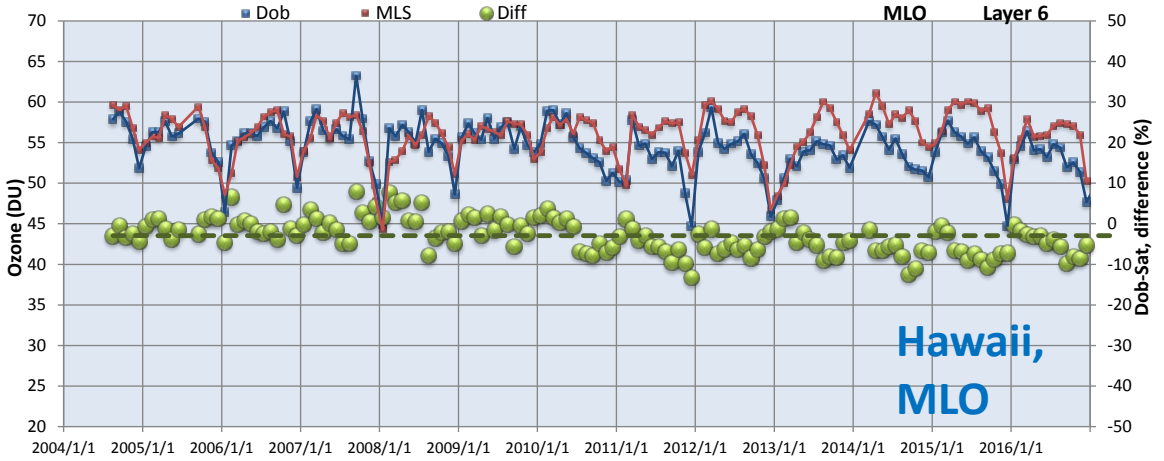

Dob
OMPS
Diff
MLO
Layer 6
Ozone (DU)
Dob-Sat, difference (%)
2012/1/1
2013/1/1
2014/1/1
2015/1/1
2016/1/1

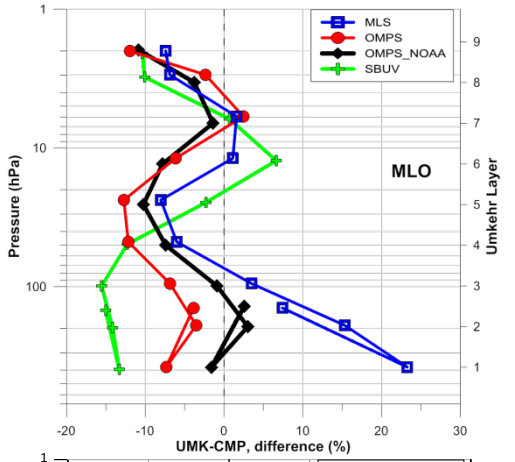

Dob
OMPS_NOAA
Diff
LDR
Layer 6
Ozone (DU)
Dob-Sat, difference (%)
2012/1
2013/1
2014/1
2015/1
2016/1
2017/1

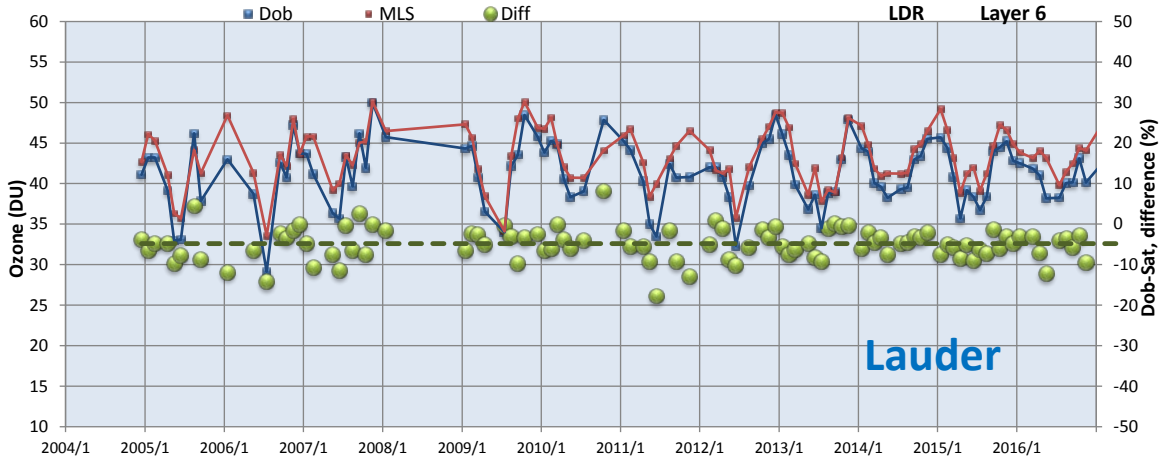

Dob
OMPS
Diff
LDR
Layer 6
Ozone (DU)
Dob-Sat, difference (%)
2012/1
2013/1
2014/1
2015/1
2016/1

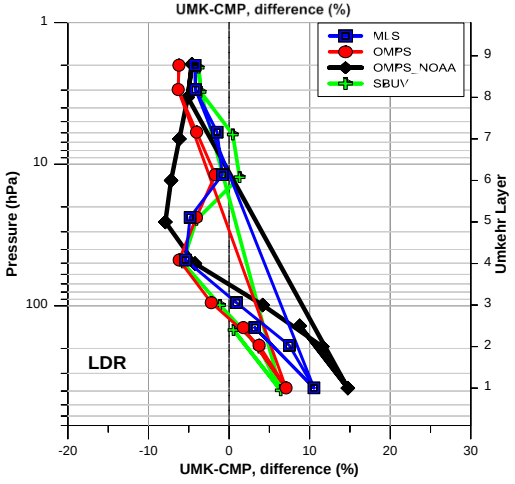

Dob
MLS
Diff
BDR
Layer 6
Ozone (DU)
Dob-Sat, difference (%)
Boulder
MLS vs Dobson, 30-35 hPa
2004/1/1
2005/1/1
2006/1/1
2007/1/1
2008/1/1
2009/1/1
2010/1/1
2011/1/1
2012/1/1
2013/1/1
2014/1/1
2015/1/1
2016/1/1


MLS
OMPS
OMPS_NOAA
SBUV
SONDE
BDR
Pressure (hPa)
Umkehr Layer
UMK-CMP, difference (%)


Dob
MLS
Diff
MLO
Layer 6
Ozone (DU)
Dob-Sat, difference (%)
Hawaii,
MLO
2004/1/1
2005/1/1
2006/1/1
2007/1/1
2008/1/1
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2011/1/1
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2014/1/1
2015/1/1
2016/1/1

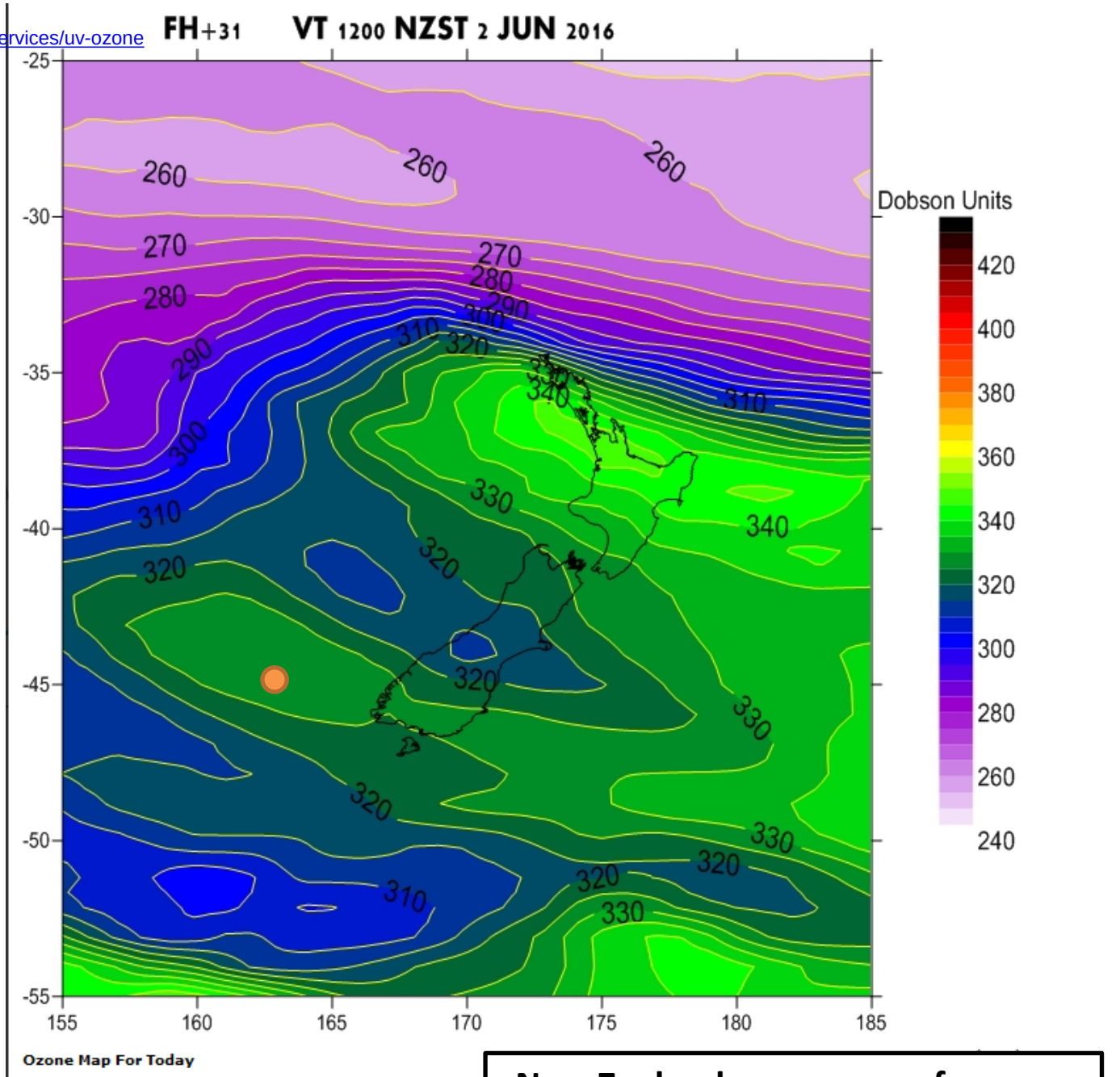

MLS
OMPS
OMPS_NOAA
SBUV
MLO
Pressure (hPa)
Umkehr Layer
UMK-CMP, difference (%)


Dob
MLS
Diff
LDR
Layer 6
Ozone (DU)
Dob-Sat, difference (%)
Lauder
2004/1
2005/1
2006/1
2007/1
2008/1
2009/1
2010/1
2011/1
2012/1
2013/1
2014/1
2015/1
2016/1


MLS
OMPS
OMPS_NOAA
SBUV
LDR
Pressure (hPa)
Umkehr Layer
UMK-CMP, difference (%)

https://www.niwa.co.nz/our-services/online-services/uv-ozone

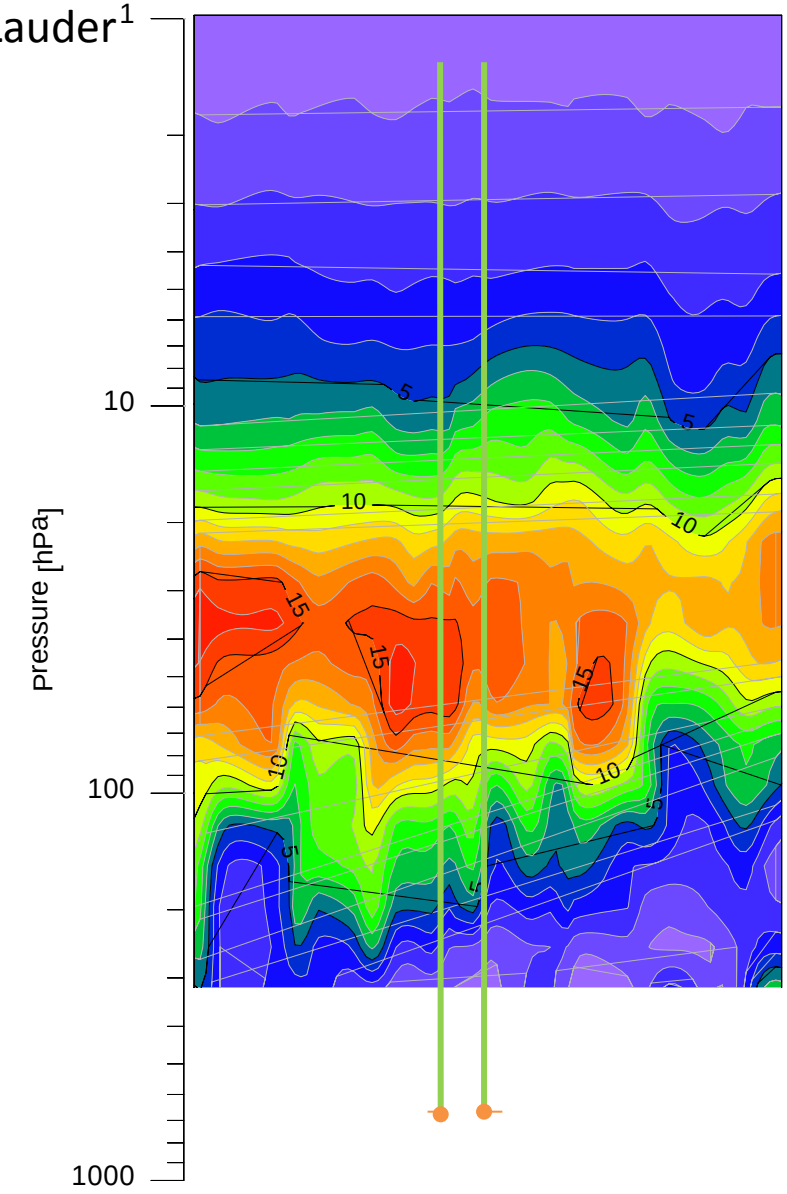
Lauder June 2, 2016

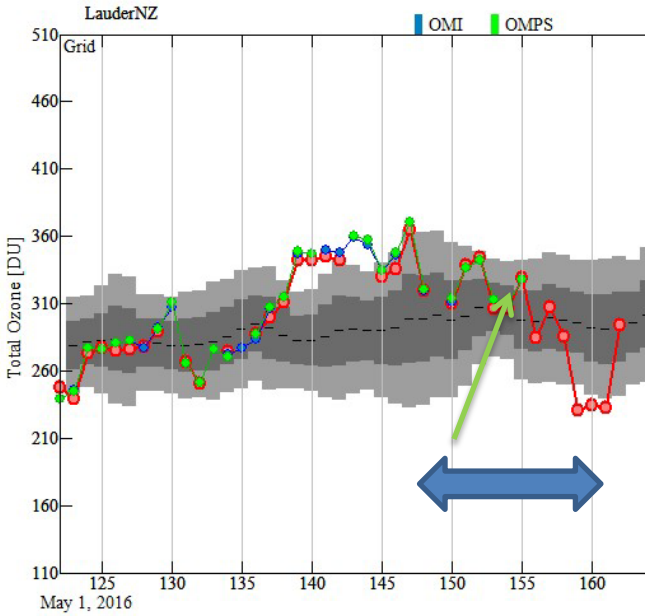


https://www.niwa.co.nz/our-services/online-services/uv-ozone

New Zealand ozone maps for noon (12:00NZST, 0:00GMT)

MLS over Lauder[1]

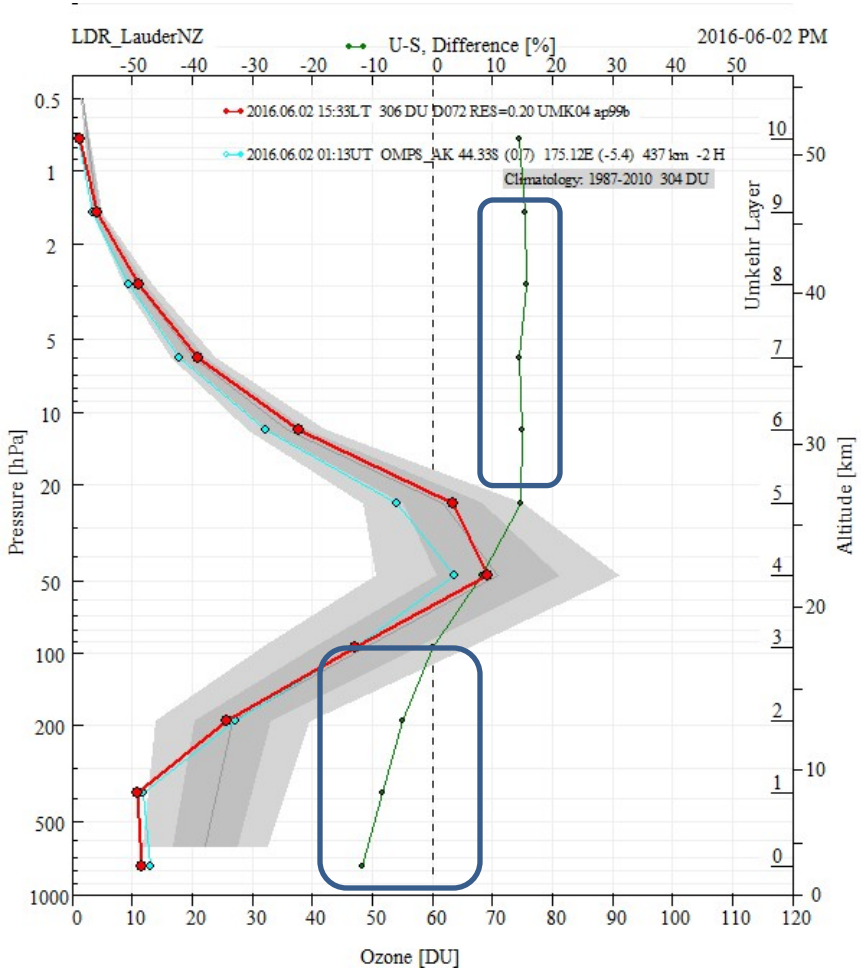




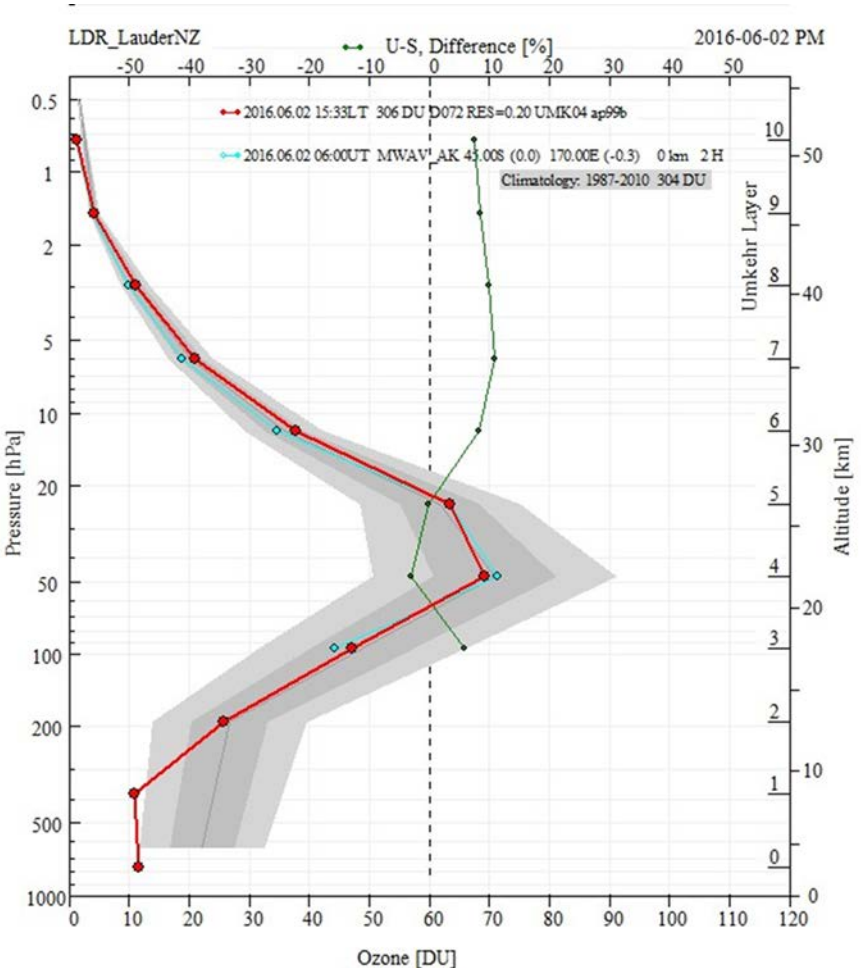
Umkehr AM PM

Case study: Lauder, June 2, 2016
Umkehr vs OMPS-LP V2 and NIWA Microwave

OMPS_LP V2, Dis= 437 km, dT = -2 hrs

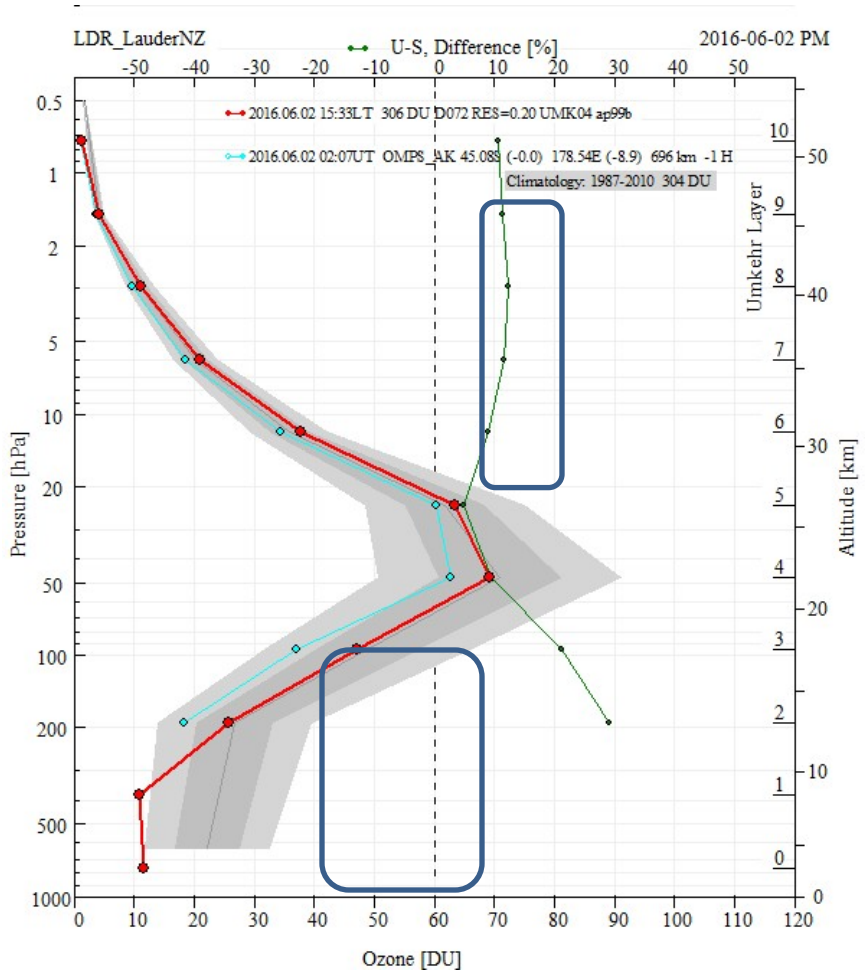


MW, Dis= 0 km, dT = 2 hrs

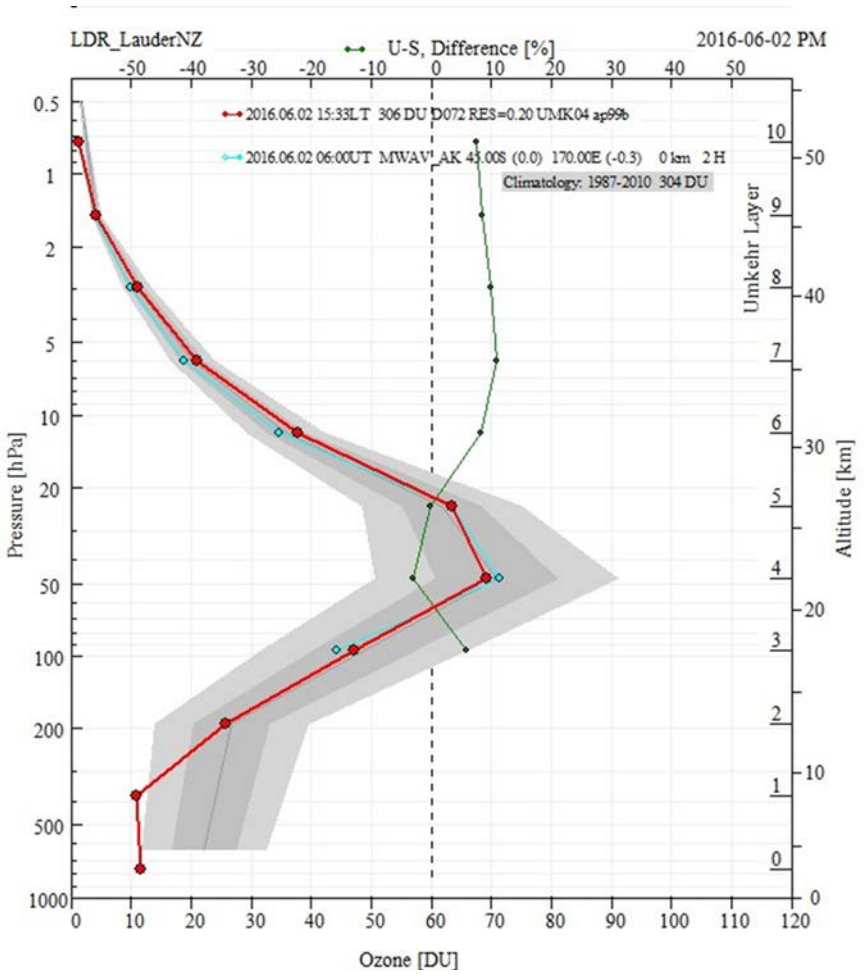


Case study: Lauder, June 2, 2016
Umkehr OMPS-LP V2.5 and NIWA Microwave

OMPS_LP V2.5, Dis= 696 km, dT = -1 hrs

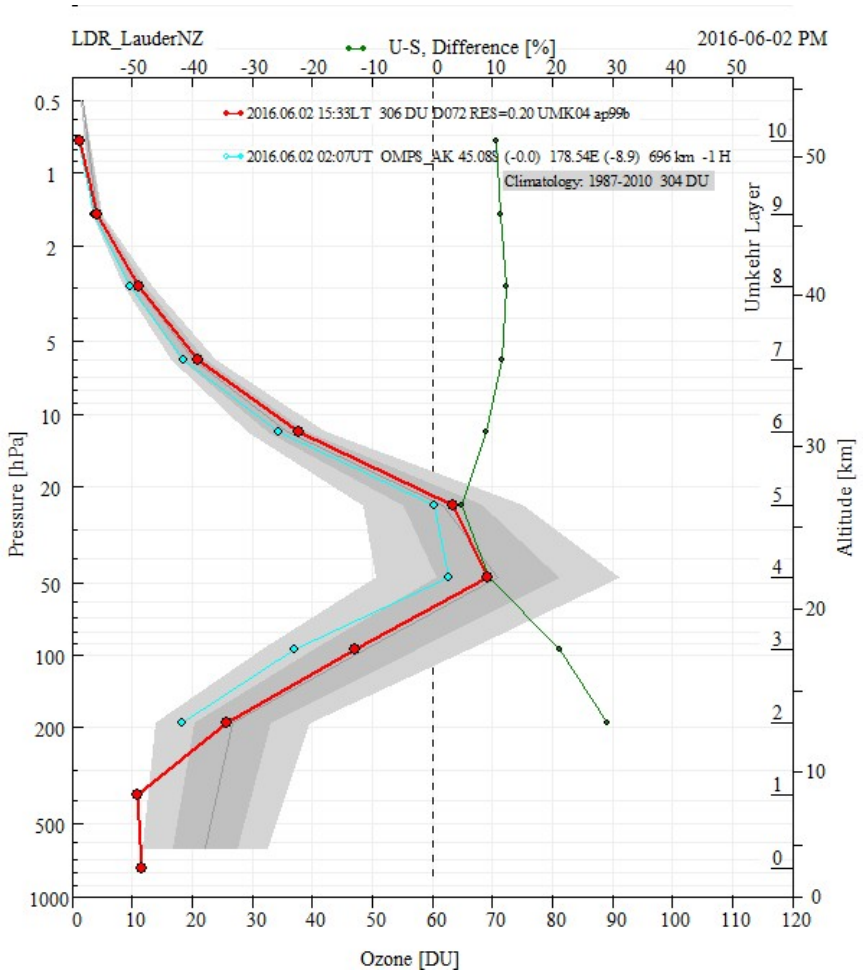


MW, Dis= 0 km, dT = 2 hrs

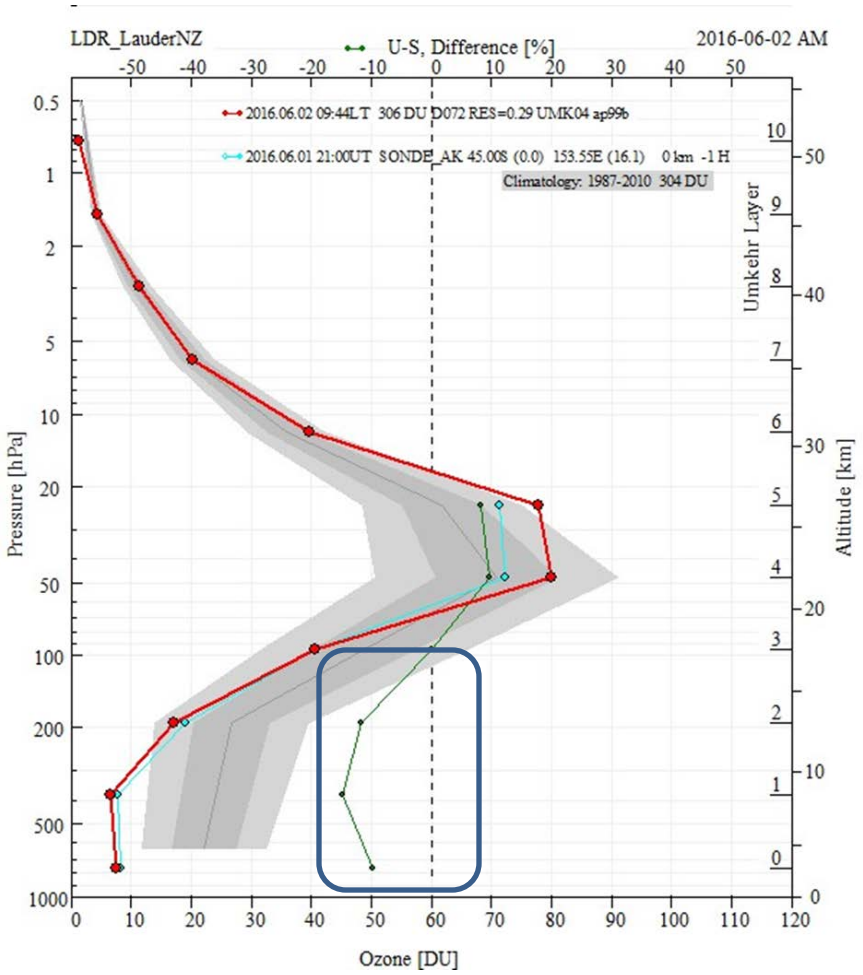


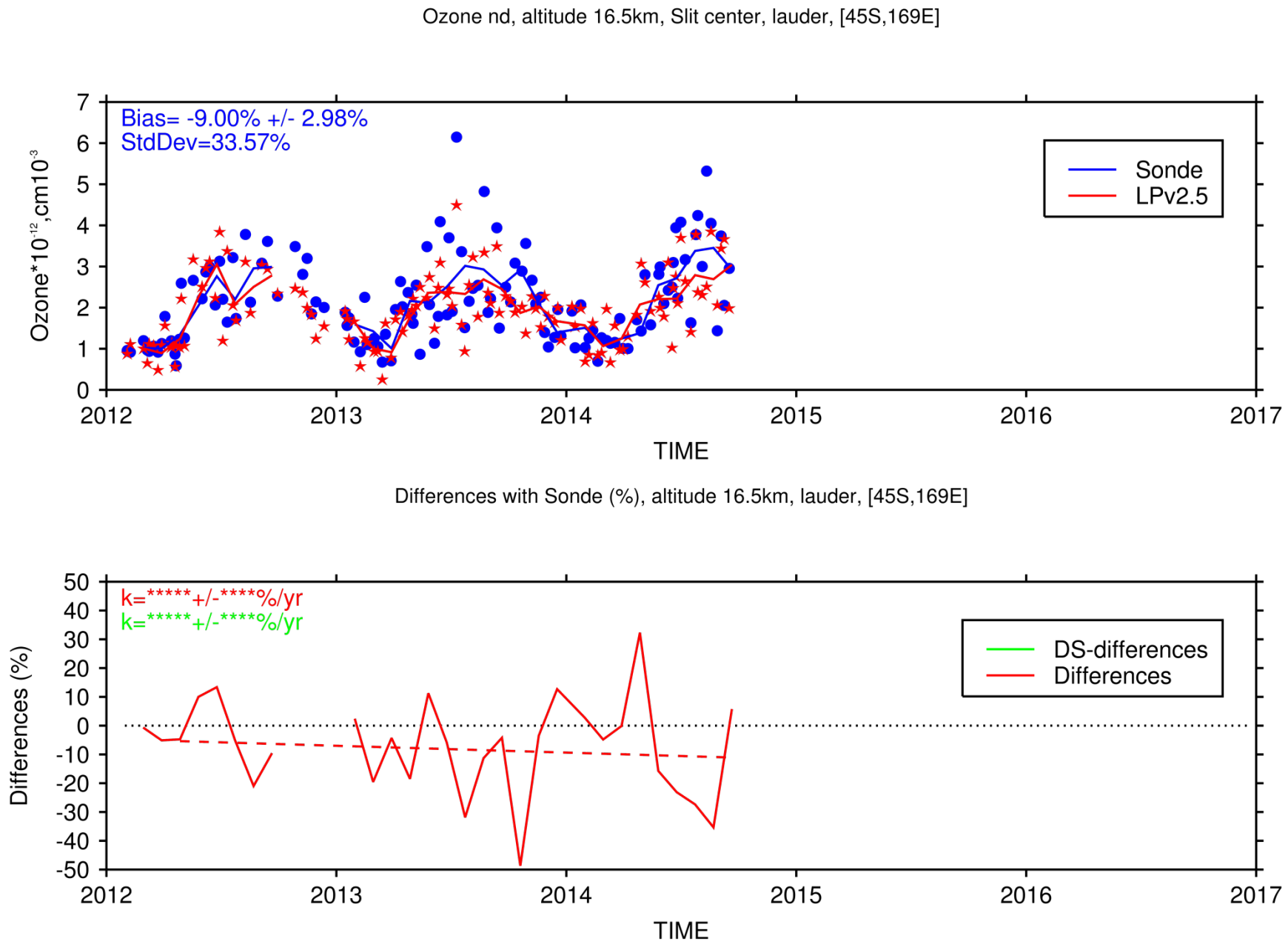
Case study: Lauder, June 2, 2016
Umkehr OMPS-LP V2.5 and NIWA Microwave

OMPS_LP V2.5, Dis= 696 km, dT = -1 hrs



Ozone sond, Dis= 0 km, dT = -1 hrs




Ozone nd, altitude 16.5km, Slit center, lauder, [45S,169E]
Bias= -9.00% +/- 2.98%
StdDev=33.57%
Ozone*10^-12,cm10^-3
Sonde
LPv2.5
TIME
Differences with Sonde (%), altitude 16.5km, lauder, [45S,169E]
k=*****+/-****%/yr
k=*****+/-****%/yr
Differences (%)
DS-differences
Differences
TIME

Conclusions

- TO and ozone profiles from OMPS NM and NP, V8 appear to be stable over 2012-2017 time period over Boulder, MLO, and Lauder
- TO from NOAA and NASA processing of the OMPS NM show bias over Boulder and MLO, but not over Lauder.
- TO from NM and NP also show bias, station dependent
- Umkehr stray light correction distorts the lower potion of the profile, although it reduces bias above 16 hPa – further work is needed
- MLO Dobson record before 2014 needs further adjustment to account for change in the instrument temperature sensitivity
- Spatial and temporal matching in troposphere is important when comparing profile to profile – looking forward to J-1 OMPS-NM with 17x17 km resolution data along the track to detect ozone field inhomogeneity