Calibration Report
Brewers #157 and #033; Izaña, Spain; September 7-11, 2002

I. Overview and Instrument Status:

Brewer #157, a Mark III instrument was working well and been quite stable in past year. The instrument's constants were from 2001. Set at these values, the ozone readings were in good agreement with traveling standard instrument #017 (see graph of day 253). Standard Lamp (SL) ratios R6/R5 have been quite stable now at values of 339/580. The new computer was working better with the Brewer. The azimuth tracker has been a problem for the previous 6 weeks with low tension and stalling periodically from drive plate metal filings accumulating at the motor drive shaft contact point. Initially the problem was found to be due to improper movement of bearing offset stop nut, but on last day the metal filings appeared again and so a new drive plate was installed. The grating slope constants for micrometer #2 were corrected after collecting data using new G1 software routine and improved IOS analysis program. This improved sensitivity at low wavelengths (286.5-292 nm.) by up to 15%.

Brewer #033, a MKII instrument has been operated at sea level in Santa Cruz during the past two years and was re-located here for this calibration. It was still working well but its Standard Lamp ratios showed some temperature dependence, which contributed to the low ozone results (~2%). The early morning problem with HG test failures were found to be due to incorrect version of FR routine to match with the RE routine in use.

Traveling standard Brewer #017 was unstable initially during this visit and on the third day the sensitivity and DT results dropped off. The photomultiplier tube was removed and the tube socket contacts were cleaned and adjusted. Operation was much better for final two days and the calibration ETC constants had to be adjusted to correct results. Upon return to Canada the calibration was confirmed to be within 1% of reference triad. It was good that #157 has been so stable to act as initial reference and that calibrations are done each year.

II. Ozone Test Results:

This inter-comparison resulted in approximately ~300 near simultaneous Direct Sun measurements with the three instruments over 5 days. The sun scan results for #157 showed (reference graph on next page) that the cal step of 1027 was the proper setting. The dispersion test results at step 1027 produced an ozone absorption coefficient of 0.3402, a value very close to 0.3397 in use.

The sun scan results for #033 showed that the cal step of 920 could be one step higher but was not changed due to minimal effect. The dispersion test results in files (lf25202.033 and dcf25202.033) were very similar (<2 step difference) to file in use (dcf27900.033). The temperature coefficients for slits 1-5 were re-calculated from recent standard lamp (SL) test data (days 234-253/02) and put into use. The final results using new temperature coefficients and ETC constants are shown below which corrected ozone results. The new temperature coefficients are 0, -0.2755, -1.0579, -1.5213, -3.0124 and SL ratios are now 2040/3880.

Ozone final daily mean results all instruments:

day	#157 O_3	dev	SO_2	dev	# / tot	#033 O_3	dev	SO_2	dev	#017 O_3	dev.	SO_2	dev
25002	272.7	+1.6	-0.6	+0.5	47 / 63	270.8	+2.4	-0.7	+0.5	270.3	+1.8	0.0	+0.4
25102	277.3	+0.9	-0.7	+0.3	59 / 70	275.8	+2.2	-0.4	+0.3	276.2	+2.3	-0.6	+0.5
25202	285.5	+2.4	-0.6	+0.3	81 / 99	285.0	+2.3	-0.6	+0.5				
25302	273.7	+1.9	-0.7	+0.4	68 / 93	272.9	+1.7	-0.6	+0.4	272.9	+2.1	0.0	+0.4
25402	269.5	+1.9	-0.6	+0.2	50 / 56	269.8	+1.3	-0.7	+0.4	269.5	+2.6	0.2	+0.5

III. Summary of results and changes:

	Brewer #157	Brewer #033
SL ratios 2001	330 / 580	2065 / 3925
SL ratios 2002	339 / 580	2040 / 3880
Change in SL	9 / 0	-25 / -45
Cal step no chg.	1027	920
GS const. 2001	.9976 / 4.68	n/a
ICF file to use	icf25102.157	icf25302.033
DT constant	32 ns	42 ns

	Brewer #157	Brewer #033
ETCs 2001	1575 / 210	3370 / 3560
ETCs 2002	1575 / 210	3320 / 3470
Change in ETCs	0 / 0	-50 / -90
Absn. - no chg.	0.3397 / 1.15	0.3365 / 1.1362
GS const. 2002	.998 / -10	n/a
DCF file no chg.	dcf25601.157	dcf27900.033

IV. UV calibration results:

Some timed UA scans were completed and the agreement is good, reference graphs on page 4. Also note the comparison of #157 UV response files from days 23502, 25701 and now 25402 where the revised GS constants were used which improved sensitivity at low end. The overall sensitivity is down by about 5% from last year. Brewer #033 response file using same lamps was ~4% lower than last year. The INM portable 1000w UV calibration system and small 50w systems were used to check the UV calibration of each instrument. Scans of internal lamps were completed on each instrument and were very similar to last year results.

V. Servicing and Software changes:

The micrometer gears were cleaned and the pushrod bearings lubricated on each. The tracker upper tension on #033 was tightened a little. The film polarizer in filterwheel #1 (used for ZS measurements) was replaced since the existing one had deteriorated.

As mentioned earlier the drive plate on #157 tracker was replaced which is unusual. The aluminum metal on original plate appeared to be inferior and the offset nut should not have come loose.

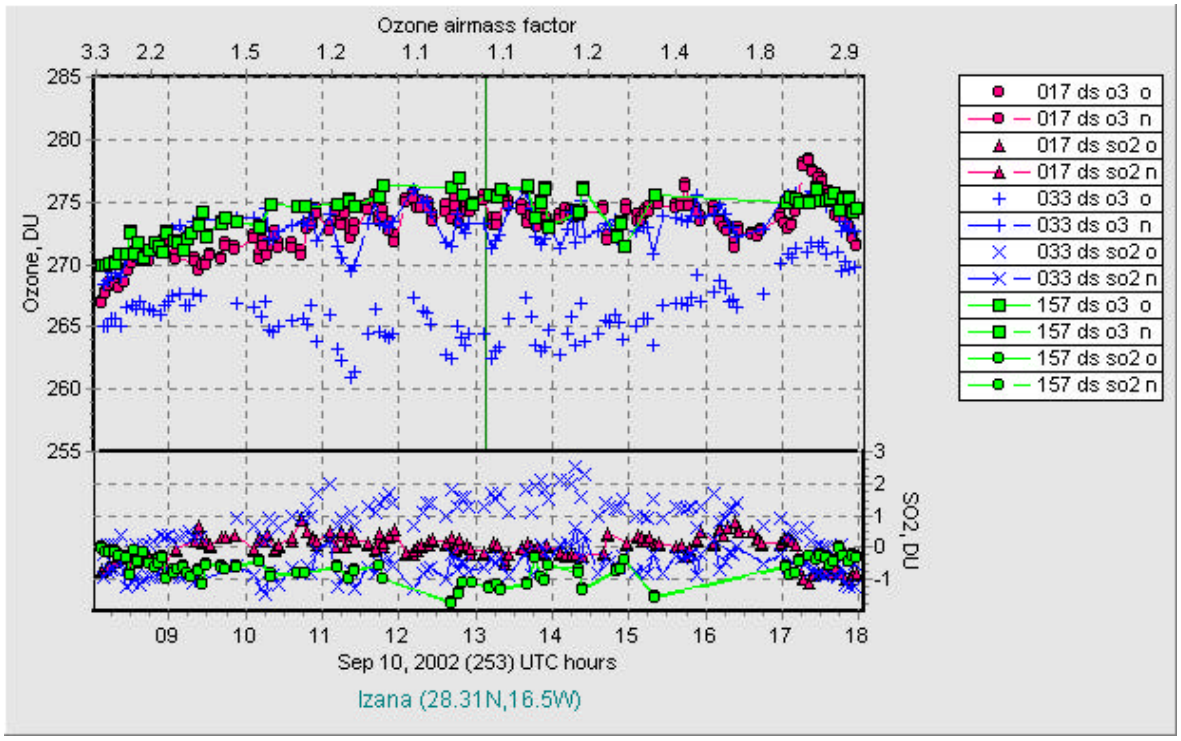
The main software control program V375c was installed which includes changes made last year as well as improved date change code. The IOS program (setdate.exe) was installed and set to run just before gwbasic program, in startup batch file. This records the computer's date into the instrument's operation state (op_st.###) file.

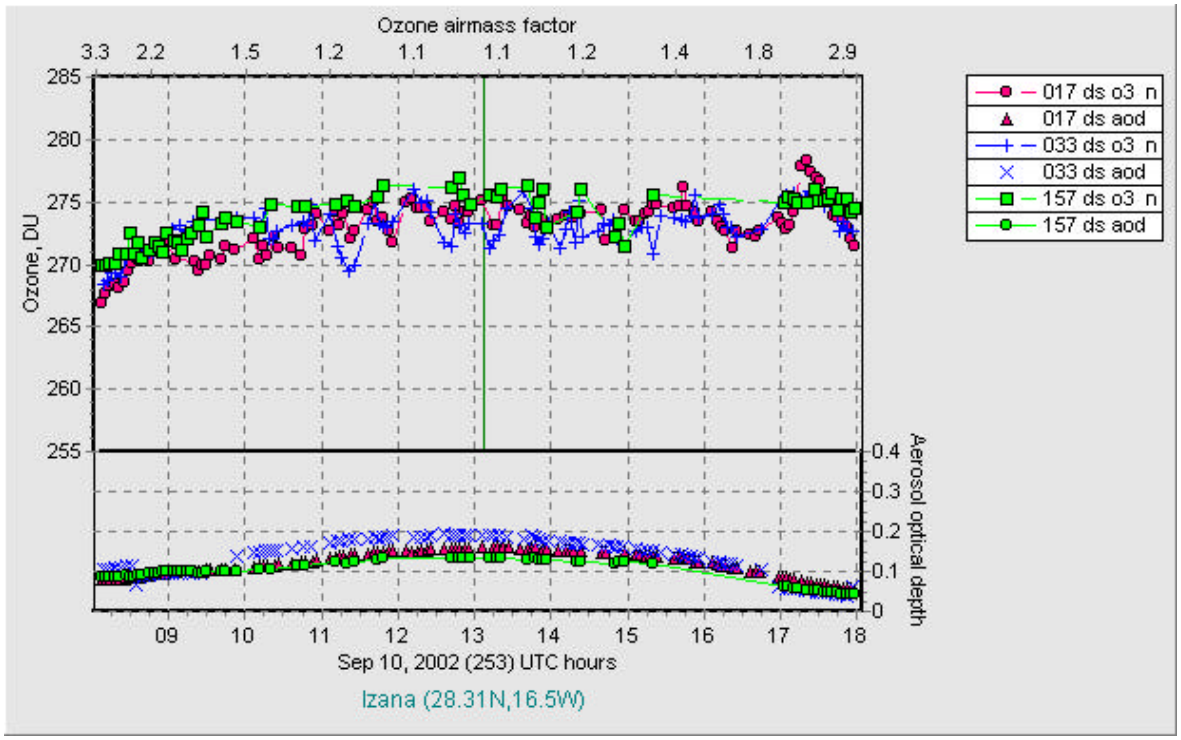
VI. Recommendations:

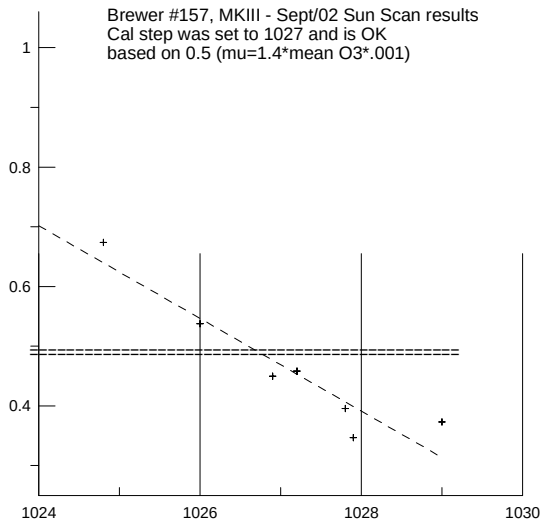
The past year of data from #033 should be corrected for SL ratio shift as a minimum and analysis be done to determine when the new temperature coefficients should be used with the revised ETC constants (corrected for SL ratios).

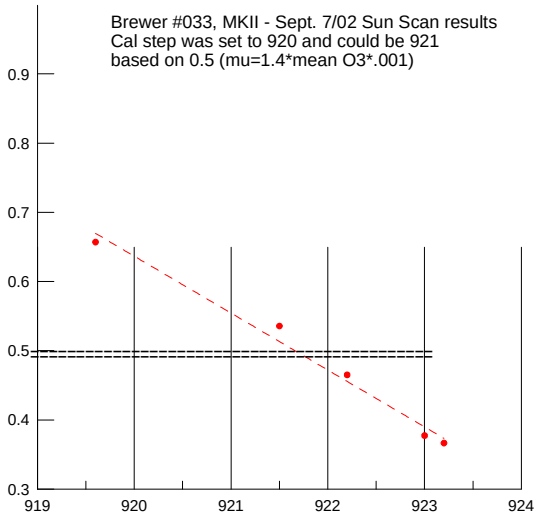
The tension for the new tracker drive wheel on #157 was set at 7 kg instead of 9 to reduce possibility of damage in future. A hand cleaner sample was left on site for use in cleaning drive wheel each month or so. Feedback to IOS on operation of this tracker would be appreciated.

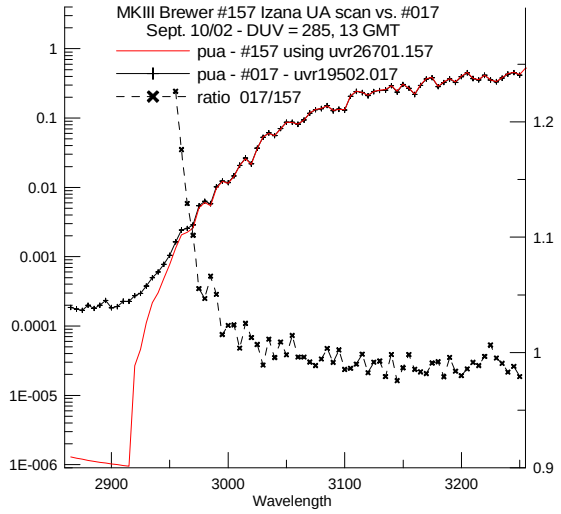
Below are original and final ozone/SO_2 results for day 253, note the blue crosses (+) for #033. Also on second plot is Aerosol Optical Depth results from same day using 2001 constants.

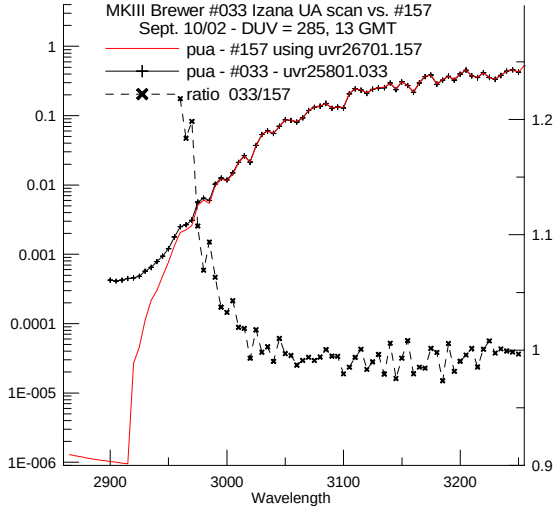


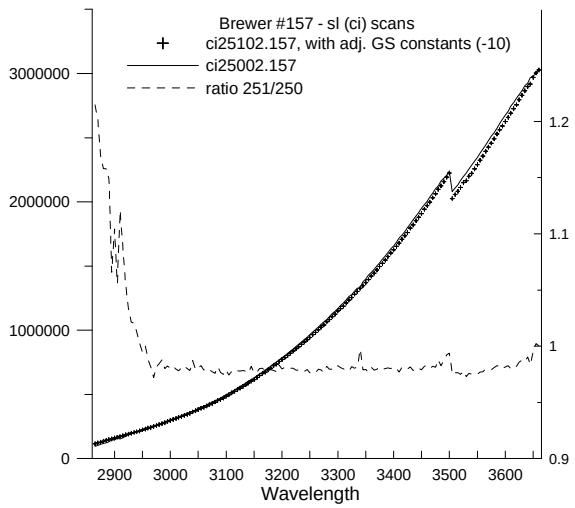


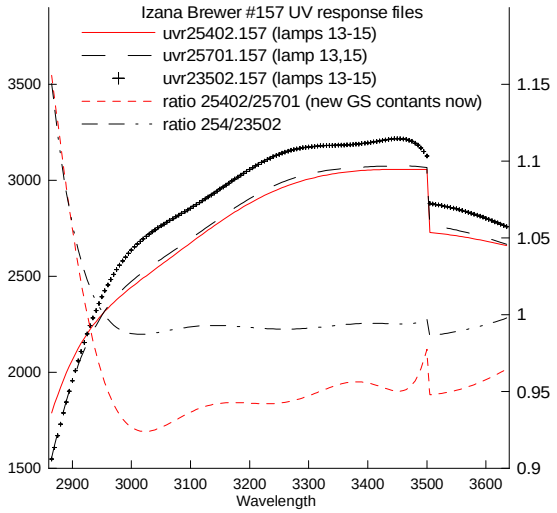

Brewer #157, MKIII - Sept/02 Sun Scan results
Cal step was set to 1027 and is OK
based on 0.5 (mu=1.4*mean O3*.001)
1
0.8
0.6
0.4
1024
1026
1028
1030


Brewer #033, MKII - Sept. 7/02 Sun Scan results
Cal step was set to 920 and could be 921
based on 0.5 (mu=1.4*mean O3*.001)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
919
920
921
922
923
924


MKIII Brewer #157 Izana UA scan vs. #017
Sept. 10/02 - DUV = 285, 13 GMT
pua - #157 using uvr26701.157
pua - #017 - uvr19502.017
ratio 017/157
1
0.1
0.01
0.001
0.0001
1E-005
1E-006
1.2
1.1
1
0.9
2900
3000
3100
3200
Wavelength


MKIII Brewer #033 Izana UA scan vs. #157
Sept. 10/02 - DUV = 285, 13 GMT
pua - #157 using uvr26701.157
pua - #033 - uvr25801.033
ratio 033/157
1
0.1
0.01
0.001
0.0001
1E-005
1E-006
1.2
1.1
1
0.9
2900
3000
3100
3200
Wavelength


Brewer #157 - sl (ci) scans
ci25102.157, with adj. GS constants (-10)
ci25002.157
ratio 251/250
3000000
2000000
1000000
0
1.2
1.1
1
0.9
2900
3000
3100
3200
3300
3400
3500
3600
Wavelength


Izana Brewer #157 UV response files
uvr25402.157 (lamps 13-15)
uvr25701.157 (lamp 13,15)
uvr23502.157 (lamps 13-15)
ratio 25402/25701 (new GS contants now)
ratio 254/23502
3500
3000
2500
2000
1500
1.15
1.1
1.05
1
0.95
0.9
2900
3000
3100
3200
3300
3400
3500
3600
Wavelength