O3Dobson

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1. Introduction

O3Dobson is the software for reduction of total ozone observations with the Dobson spectrophotometer.
This system is the upgrade of the software named "Dobson", which was created at the Solar and Ozone Observatory of the Czech Hydrometeorological Institute at the end of the last century - http://www.chmi.cz/meteo/ozon/dobsonweb/software.htm.
O3Dobson is a modification of O3EDobson - the software for the semiautomatic Dobson spectrophotometer data recorder, which use the same data and files of constants structure.

The program is designed to keep correct calibration level of the Dobson spectrophotometer. In case of the changes of ETC constants or wavelengths settings (for example due to the change of measuring place with the different altitude), the software can reset proper values based on standard and mercury lamp tests results.
As part of O3Dobson package there is a software for calculation of coefficients of zenith polynomials "O3Dpoly" and software for recalculation of data files "O3Drec".

2. Hardware requirements

- IBM PC compatible, screen resolution 1024x768 (recommended)
- MS Windows 95/NT/98 ...XP
- laser printer - optional

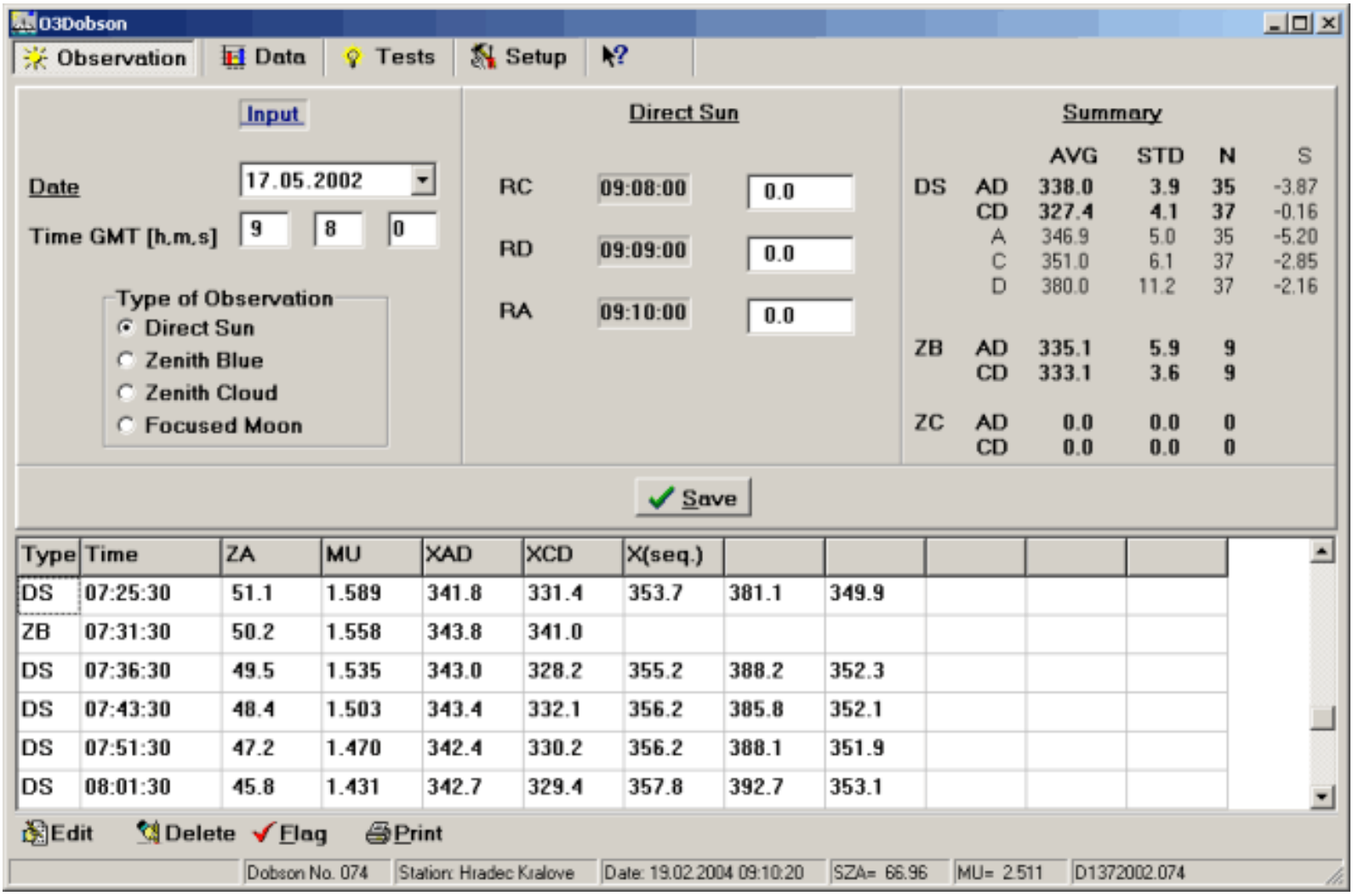
3. O3Dobson directory and file structure

If the installation launcher is not running, double-click on setup.exe in the root directory of your O3Dobson CD to start the installation.
All files of constant must be set manually using editor (Notepad) before total ozone calculations. After installation the constants are set as example from Dobson #074.
After installation there must be these files in one directory:
O3Dobson.exe - main program
O3Dobson.ini, O3DPoly.nnn, O3DECor.nnn, O3DRNT.nnn, O3DQTab.nnn... - files of constants (initialization file , files of constants)
Ddata … Data directory
Djjjyyyy.nnn … ozone data file (jjj – julian day, yyyy – year, nnn – instrument number) - header, data format
Lampxxx.slf … standard lamp files

4. Using O3Dobson

Observation

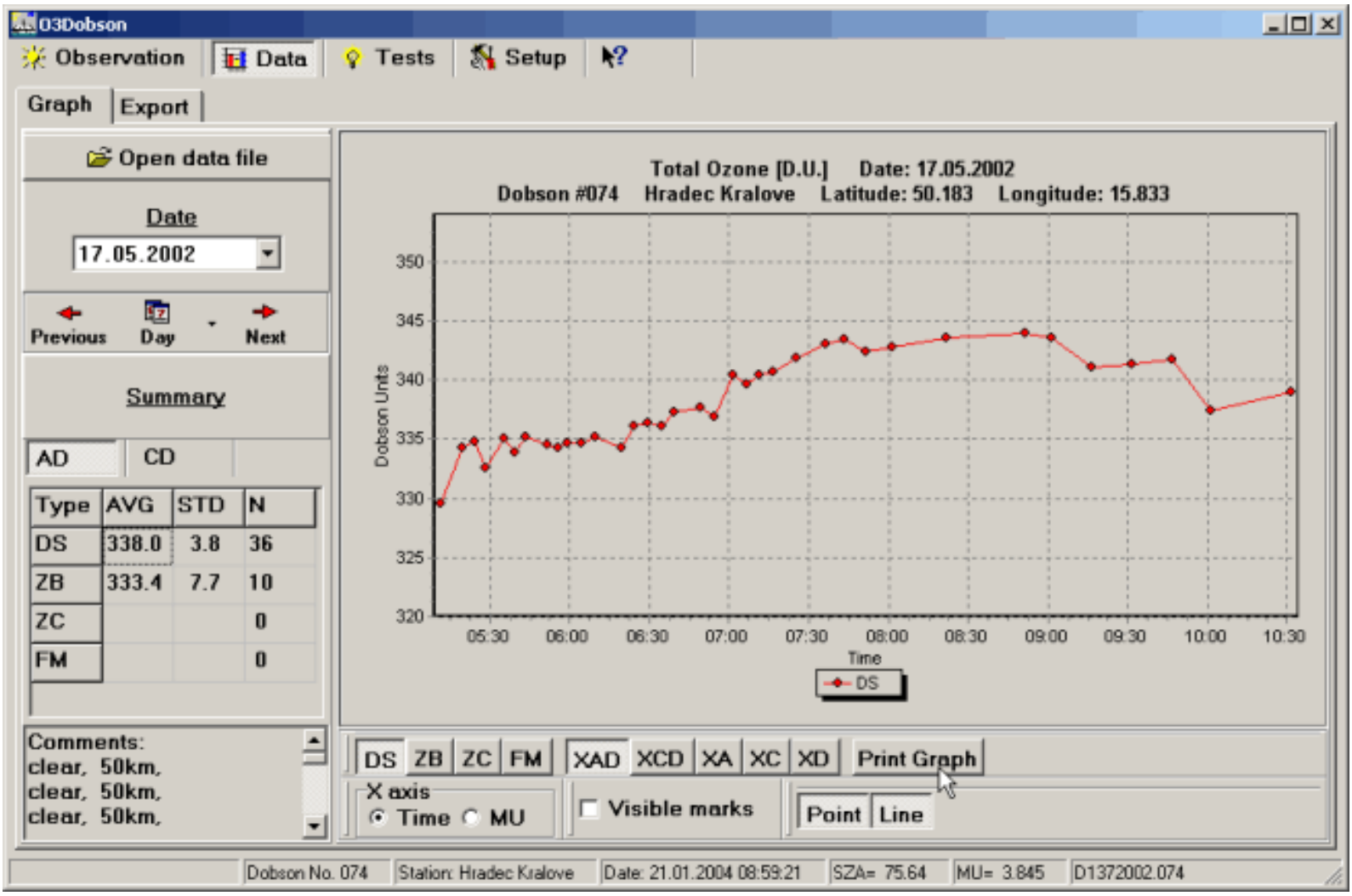
- Input of raw observation data, editing and printing records.
- Calculation of total ozone for all selected wavelength pairs.
- Display daily results of total ozone
- Save data to daily files - Djjjyyyy.nnn



In the grid there are final results of each observation of the day - type of observation, time of XAD, Solar zenith angle, air mass, total ozone XAD, XCD, and XC, XD, XA - for CDA sequence. Daily summary is calculated and AVG, STD, N, and ETC correction (when N > 4 and MU range > 1) are displayed.

Data

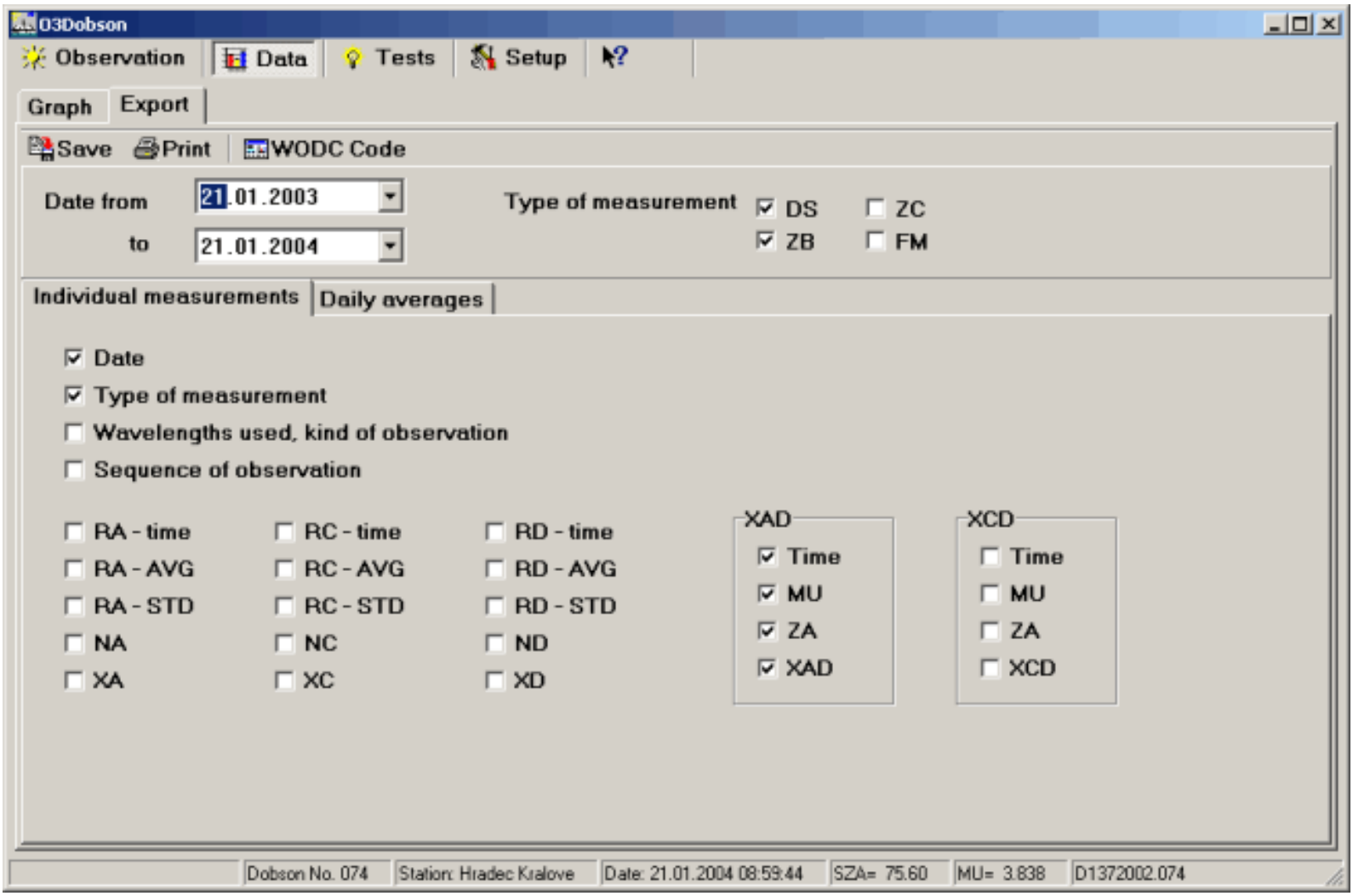
Here you can display, print or save to file any individual values or daily averages of the total ozone measurements for one day, month, year or selected period of time.



Buttons below "Date" - "Previous", "Day", "Next" - allow fast navigation in data files and plot daily records or daily averages.

In the Export section there is a "WODC code wizard" for easy coding to the new WOUDC extended comma separated values (extCSV) data format.

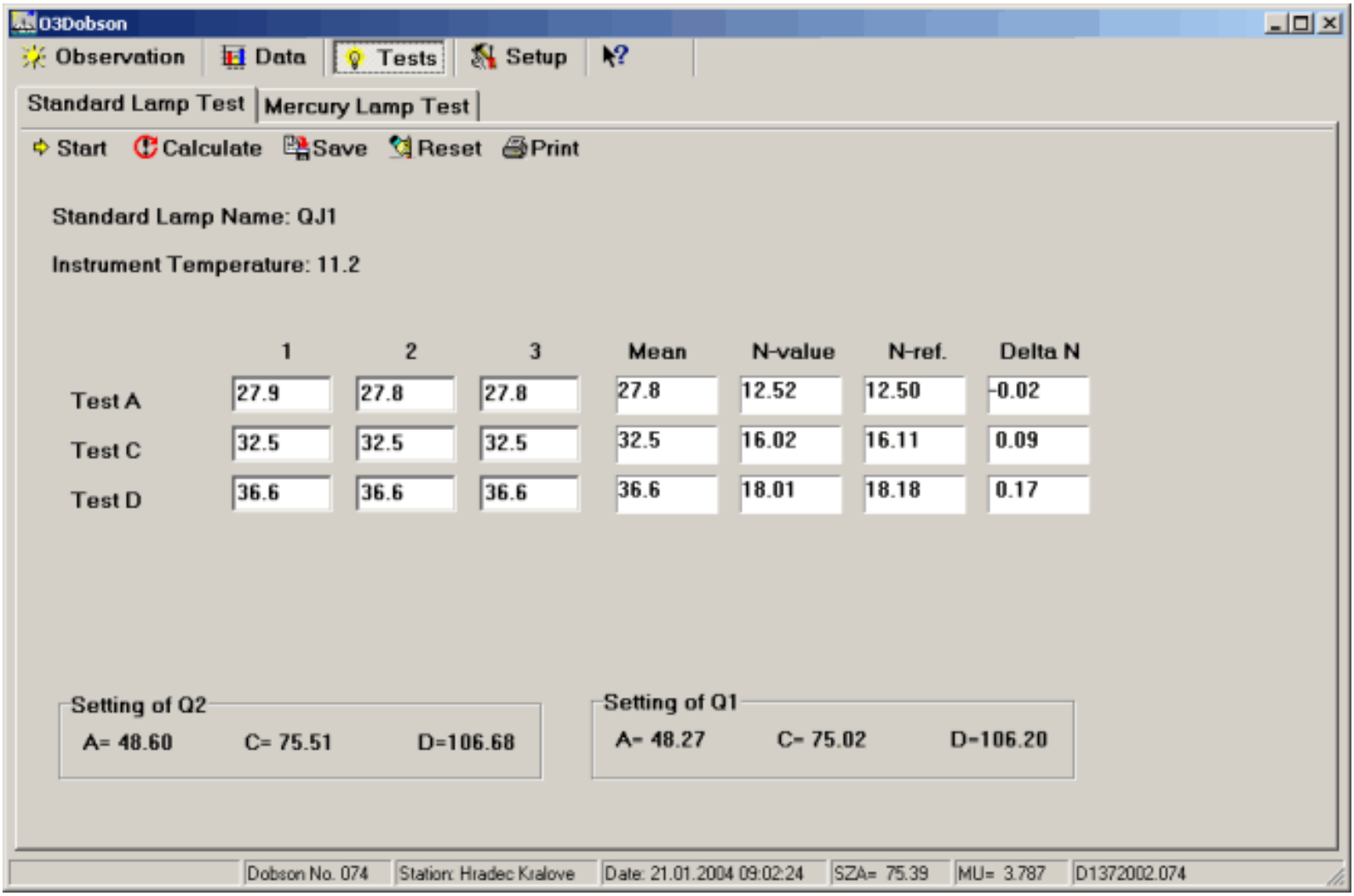
Data outputs are in ASCII code and it is possible to choose export to *.prn or *.csv file.



SL Test

Processing of results from the standard lamp test.
In the same directory must be at least one standard lamp file (lampxxx.slf, xxx .. name of SL) because lamp names are add to dialog window - see files of constants for *.slf structure.
New corrections of N tables are saved in O3Dobson.ini file for the future calculations.

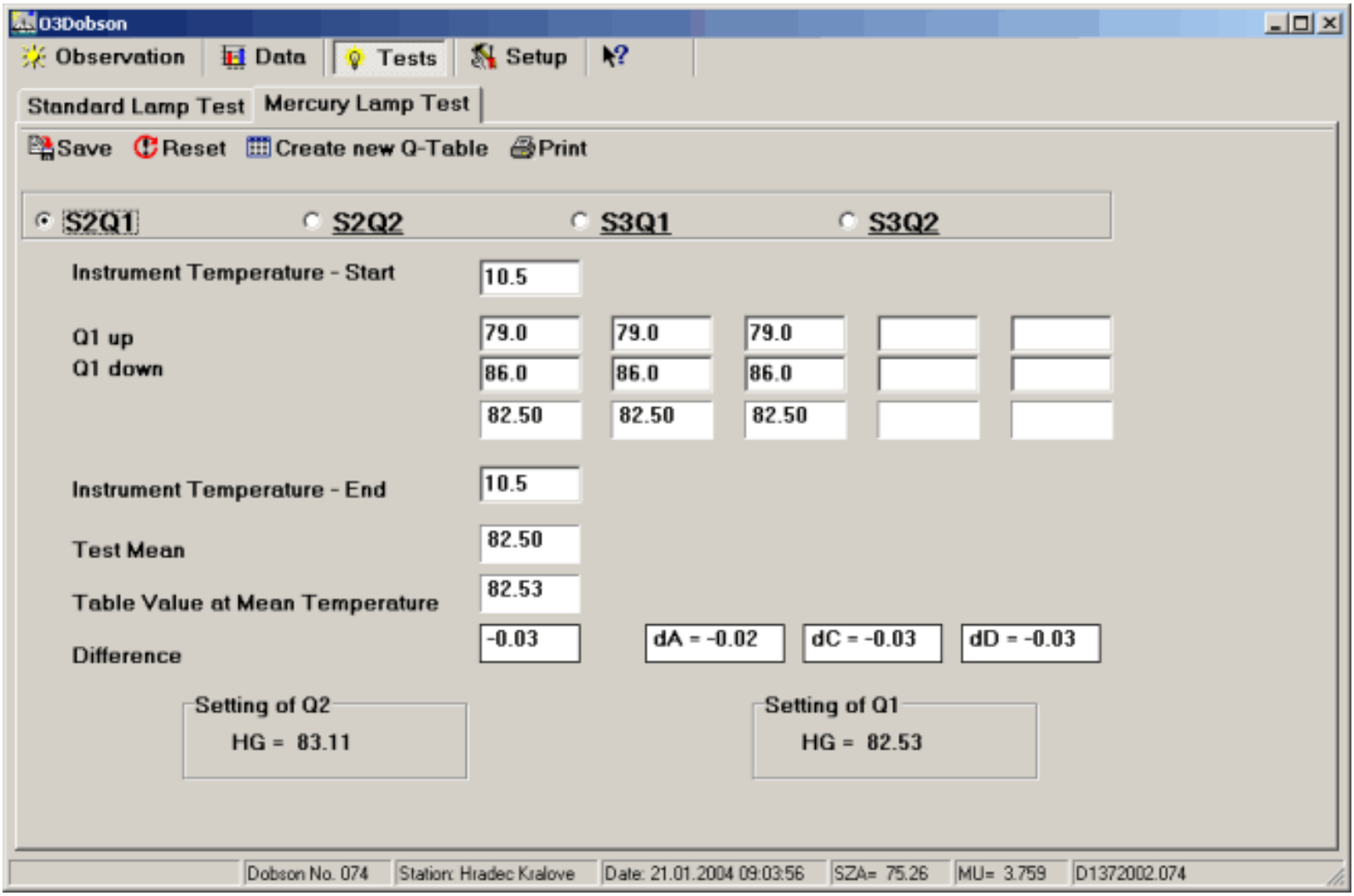
1. press 'Start' button to choose the lamp name and instrument temperature
2. fill in the form
3. use 'Calculate' button finally
4. 'Save' and 'Print' results



The correct setting of Q-levers is calculated based on the instrument temperature.

HG Test

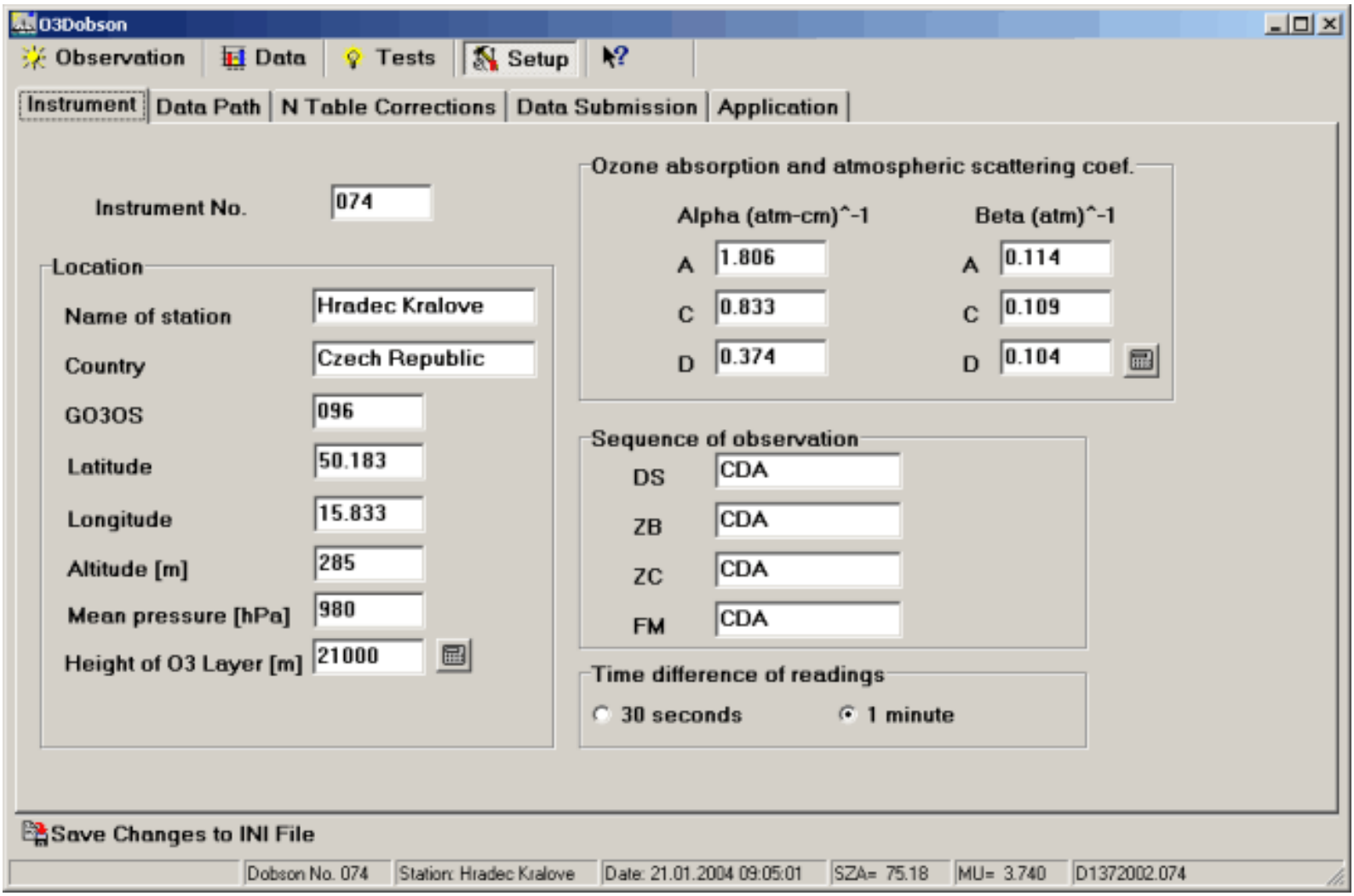
Processing of results from the mercury lamp test (symmetry test).
O3Dobson creates new table of settings of Q based on the test results.
If difference between test mean and table value is more than 0.3, the O3Dobson offers you creation of new Q-table.



New Q-table is saved in a file and must be printed separately. The button "Create new Q-Table" change constants in Q-Table file automatically.

Setup

Input of the reference parameters which are necessary for running the program.
notes:
It is possible to edit sequences of observation using "A", "C" or "D" (up to six) capital letters only and develop any kind of sequences for the automated mode of observation.



Appendix

Main differences between O3Dobson and old Dobson software

- 32 bit application for W95...XP
- data are in ASCII code in daily files and there is a header with all important constants at the beginning
- possibility of using random sequence of observation (up to 6 wavelengths)
- calculation and print new of Q table based on HG results
- calculation of R-N table corrections
- time of observation must be in GMT

Equations for Calculation of Total Ozone
Example, AD wavelength, B-P Scale

Direct Sun, Focused Moon

1. XAD = (NA / MU[A] - ND / MU[D]) / 1.432 – (0.0086*(M[A] + M[D])*P/(MU[A] + MU[D])/P0
2. XAD = XAD * 1000 + EcDSAD[1] + EcDSAD[2] * MU[AD] + EcDSAD[3] * MU[AD] ^2

where
MU[A] is MU in time of RA reading …
EcDSAD[1..3] … empirical correction function
P0 ... 1013.25
P ... mean pressure at the station

Zenith Blue

X = dN = NA-ND
Y = MU[AD]

1. XAD = ZBAD[0] + ZBAD[1]*Y + ZBAD[2]*X + ZBAD[3]*Y*Y + ZBAD[4]*X*X + ZBAD[5]*Y*X + ZBAD[6]*Y*Y*X + ZBAD[7]*Y*X*X + ZBAD[8]*Y*Y*Y + ZBAD[9]*X*X*X
2. XAD = XAD * EcZBAD

where
ZBAD[0..9] … coefficients of the zenith polynomial
EcZBAD … empirical correction

Zenith Cloud

X = dN = NA-ND
Y = MU[AD]

1. XAD = ZBAD[0] + ZBAD[1]*Y + ZBAD[2]*X + ZBAD[3]*Y*Y + ZBAD[4]*X*X + ZBAD[5]*Y*X + ZBAD[6]*Y*Y*X + ZBAD[7]*Y*X*X + ZBAD[8]*Y*Y*Y + ZBAD[9]*X*X*X
2. XAD = XAD - Cloud correction function

Cloud correction function (1) = ZCAD1[0] + ZCAD1[1] * XAD + ZCAD1[2] * MU[AD] + ZCAD1[3] * XAD * MU[AD]

ZCAD1[0...3] – uniform stratified layer of small opacity
ZCAD2[0...3] – uniform or moderately variable layer of medium opacity

ZCAD3[0...3] – uniform or moderately variable layer of large opacity
ZCAD4[0...3] – highly variable opacity, with or without precipitation
ZCAD5[0...3] – fog

Working with charts

Chart zoom and scroll

Scrolling and zooming a chart is simply setting its axis scales to the desired values. After zooming or scrolling a chart, all series will repaint their points in their new positions. Charts can be zoomed by user interaction with mouse dragging. Users can zoom drawing a rectangle around the chart area they want to see in detail. You should press the left mouse button to draw the zoomed area. Dragging should be done from top/left to bottom down. Dragging in the opposite direction resets axis scales [no zoom]. As soon as users release the mouse button, chart repaints to show the zoomed area. Scrolling is very similar to zoom. Axis scales are incremented or decrement and the whole chart component is repainted to show series points at their new positions. You should press the right mouse button and drag.

O3Dobson Data Files Structure - Header

Dobson2	Version of data file
7	Day
2	Month
2001	Year
Hradec Kralove	Location name
74	Instrument number
50.183	Latitude
15.833	Longitude
285	Altitude
980	Mean pressure [hPa]
21000	Height of O3 layer [m]
1.806	Ozone absorption coefficient - A wavelength
0.833	Ozone absorption coefficient - C wavelength
0.374	Ozone absorption coefficient - D wavelength
0.114	Atmospheric scattering coefficient - A wavelength
0.109	Atmospheric scattering coefficient - C wavelength
0.104	Atmospheric scattering coefficient - D wavelength
dN	
0.1	dNA - correction of RNA table
-0.1	dNC - correction of RNC table
-0.2	dND - correction of RND table
NTable	
-10.2, -1.8, 6.6, 14.8, 22.8, ...	RNA table, R=0,10,20,...,300
-10.2, -1.8, 6.6, 14.9, 23.0, ...	RNC table, R=0,10,20,...,300
-12.2, -3.8, 4.7, 13.0, 21.2, ...	RND table, R=0,10,20,...,300
Zpoly	
254.65762, -431.83249, 10.48619, ...	Coefficients of zenith polynomial - AD wavelength pair
319.82532, -420.20405, 24.51519, ...	Coefficients of zenith polynomial - CD wavelength pair
12.13830, -0.04950, -14.66870, 0.05870	Cloud correction function AD - uniform stratified layer of small opacity

12.13830, -0.04950, -14.66870, 0.05870	Cloud correction function AD - uniform or moderately variable layer of medium opacity
12.13830, -0.04950, -14.66870, 0.05870	Cloud correction function AD - uniform or moderately variable layer of large opacity
12.13830, -0.04950, -14.66870, 0.05870	Cloud correction function AD - highly variable opacity, with or without precipitation
12.13830, -0.04950, -14.66870, 0.05870	Cloud correction function AD - fog
12.13830, -0.04950, -14.66870, 0.05870	Cloud correction function CD - uniform stratified layer of small opacity
12.13830, -0.04950, -14.66870, 0.05870	Cloud correction function CD - uniform or moderately variable layer of medium opacity
12.13830, -0.04950, -14.66870, 0.05870	Cloud correction function CD - uniform or moderately variable layer of large opacity
12.13830, -0.04950, -14.66870, 0.05870	Cloud correction function CD - highly variable opacity, with or without precipitation
12.13830, -0.04950, -14.66870, 0.05870	Cloud correction function CD - fog
EmpCor	
0, 0, 0	Empirical correction DS - AD
0, 0, 0	Empirical correction DS - CD
1, 1	Empirical correction ZB - AD, ZB - CD
1, 1, 1, 1, 1	Empirical correction ZC - AD
1, 1, 1, 1, 1	Empirical correction ZC - CD

O3Dobson Data Files Structure

DS	Type of observation
000	Flag, L,S - Wavelengths used, kind of observation
CDA	Sequence of observation
XA	*XA block (sequence dependent)*
10:09:30	Averaged time of RA reading
212.4	AVG - RA
0.1	STD - RA
163.4	NA
301.6	Total ozone - A wavelength, XA
XC	*XC block (sequence dependent)*
10:08:30	Averaged time of RC reading
127	AVG - RC
0.0	STD - RC
90.1	NC
305.4	Total ozone - C wavelength, XC
XD	*XD block (sequence dependent)*
10:08:59	Averaged time of RD reading
84.5	AVG - RD
0.1	STD - RD
55.6	ND
324.1	Total ozone - D wavelength, XD
XAD	*XAD block*
10:09:14	Time - XAD
2.491	Mu - XAD
66.8	Solar zenith angle - XAD
295.7	Total ozone - AD wavelength, XAD
XCD	*XCD block*
10:08:44	Time - XCD
2.493	Mu - XCD
66.8	Solar zenith angle - XCD
290.1	Total ozone - CD wavelength, XCD

comment	*Comment block*
text	Text of comment

Flags used
0, 9

L - Wavelengths used
0 - AD
2 - CD

S - Kind of observation
0 - Direct Sun
1 - Focussed Moon
2 - Zenith Blue
3 - Zenith Cloud - uniform stratified layer of small opacity
4 - Zenith Cloud - uniform or moderately variable layer of medium opacity
5 - Zenith Cloud - uniform or moderately variable layer of large opacity
6 - Zenith Cloud - highly variable opacity, with or without precipitation
7 - Zenith Cloud - fog

O3Dobson files of constants

RN Tables - O3DRNT.nnn

1. column - NA values for R = 0 .. 300, step 10
2. column - NC values for R = 0 .. 300, step 10
3. column - ND values for R = 0 .. 300, step 10

R	NA	NC	ND
0	-10.2	-10.2	-12.2
10	-1.8	-1.8	-3.8
20	6.6	6.6	4.7
30	14.8	14.9	13
40	22.8	23	21.2
50	30.6	30.9	29.1
60	38.4	38.7	36.9
70	46	46.3	44.5
80	53.5	53.8	52.1
90	61.1	61.5	59.7
100	68.9	69.2	67.4
110	76.6	76.8	75
120	84.3	84.5	82.7
130	92.4	92.4	90.5
140	100.7	100.5	98.5
150	109.1	108.6	106.5
160	117.6	117	114.7
170	126.3	125.6	123.2
180	135.1	134.2	104.8
190	143.9	142.8	140.3
200	152.6	151.3	148.7
210	161.2	159.9	157.1
220	170.2	168.6	165.7
230	179.3	177.5	174.6

240	188.1	186.3	183.2
250	197.1	194.9	191.5
260	206.1	203.6	200
270	214.8	212.2	208.6
280	223.3	220.5	216.8
290	231.9	228.9	225
300	240.5	237.3	233.2

Zenith Polynomials - O3DPoly.nnn

1. row - coefficients of zenith polynomial - AD wavelength pair
2. row - coefficients of zenith polynomial - CD wavelength pair
3. - 7. row - coefficients of the cloud correction function (1 .. 5) - AD wavelength pair
8. - 12. row - coefficients of the cloud correction function (1 .. 5) - CD wavelength pair

cloud correction function (1) = uniform stratified layer of small opacity
cloud correction function (2) = uniform or moderately variable layer of medium opacity
cloud correction function (3) = uniform or moderately variable layer of large opacity
cloud correction function (4) = highly variable opacity, with or without precipitation
cloud correction function (5) = fog

2.55E+02	-4.32E+02	1.05E+01	1.95E+02	-1.73E-02	-3.92E+00	7.07E-01	-3.39E-03	-2.94E+01	1.01E-04
3.20E+02	-4.20E+02	2.45E+01	2.04E+02	1.47E-01	-1.38E+01	2.18E+00	-1.20E-02	-3.07E+01	-7.42E-04
12.1383	-0.0495	-14.6687	0.0587						
12.1383	-0.0495	-14.6687	0.0587						
12.1383	-0.0495	-14.6687	0.0587						
12.1383	-0.0495	-14.6687	0.0587						
12.1383	-0.0495	-14.6687	0.0587						
12.1383	-0.0495	-14.6687	0.0587						
12.1383	-0.0495	-14.6687	0.0587						
12.1383	-0.0495	-14.6687	0.0587						
12.1383	-0.0495	-14.6687	0.0587						
12.1383	-0.0495	-14.6687	0.0587						

Empirical Corrections - O3DECor.nnn

0	0	0			Correction function DS - AD
0	0	0			Correction function DS - CD
1	1				Empirical correction ZB - AD, ZB - CD
1	1	1	1	1	Empirical correction ZC - AD (1..5)
1	1	1	1	1	Empirical correction ZC - CD (1..5)

File of setting of Q for 15 deg C. - O3DQTab.nnn

0.129	Temperature coefficient of Q1
83.11	Standard wavelength setting of Q lever at 15 deg.C for HG-3129
48.60	Standard wavelength setting of Q lever at 15 deg.C for A
75.51	Standard wavelength setting of Q lever at 15 deg.C for C
106.68	Standard wavelength setting of Q lever at 15 deg.C for D

Standard Lamp File - LampName.slf

QJ1	Name of standard lamp
13.2	Reference reading of NA value
17.1	Reference reading of NC value
18.6	Reference reading of ND value