This file provides counts for Umkehr channels from all measurements during one day.

Excerpts from *"Brewer MKIV Spectrophotometer Operator's Manual OM-BA-C231 REV B"*, August 15, 1999 (page 76)

> ### Umkehr Files: UJJJJYY.nnn
>
> As part of the End-of-Day process the Umkehr data in the B file is transferred into a U file which contains both morning and evening data if it has been collected. This file is used as the input data for Umkehr processing (see Appendix E).

The file is not annotated. Numbers are coded as scaled logarithms.   The example of a file fragment (first 16 records) is given below:

Record #3 in file (odd)
2nd in 2nd Umkehr

Record #2 in file (even)
1st in 2nd Umkehr

```
300107 209 0 395032  40  147712  414768  462531  516236  556097  564735
300107 205 0 395095  40  160206  550796  568465  580385  586873  569115
300107 205 0 395159  40  160206  415137  465954  519615  560115  568728
300107 203 0 395222  40  177815  554941  572132  583211  589436  571155
300107 203 0 395286  40  147712  418441  469408  523591  564357  572254
300107 201 0 395349  40  160206  558903  575960  585981  591645  573276
300107 201 0 395412  40  147712  420222  473376  528133  568473  576356
300107 200 0 395475  40  147712  562957  579744  588714  594107  575711
300107 200 0 395538  40  200000  421827  476989  532701  572545  580232
300107 198 0 395601  40  177815  567175  583826  592083  597085  578699
300107 198 0 395663  40  184510  425959  482582  538268  577627  585095
300107 196 0 395726  40  147712  573069  589131  596699  601290  582377
300107 188 0 396658  40  147712  445834  512714  570325  606016  611776
300107 188 0 396719  40  169897  599912  614254  617003  620018  600402
300107 188 0 396781  40  160206  448087  515957  573588  608646  614133
300107 188 0 396841  40  169897  602204  616308  618439  621173  601603
300107 188 0 396902  40  130103  449762  519008  575940  610129  615217
```

Each Umkehr measurement consists of two records for two sets of wavelengths at two different grating positions. The even records 0,2,4,… and odd records 1,3,5,… in the file need to be processed differently.

The u-file can be parsed and processed by *prepro.c* program available from the WOUDC archive in Toronto, Canada http://www.woudc.org/data_e.html , (choose the LINK TO **DATA **ARCHIVE button, OK the data use agreement, and then follow the link Software/Analysis-QA/Umkehr/Brewer/newumk).

The gist of the *prepro.c* program has been distilled in the pseudo-code format by Paul Kouros and Irina Petropavlovskikh for NOAA. It is presented below:

```
Program that reads data in is "PREPRO" the subroutine is called "get_data"

DDMMYY vt nf AMIN   ic  C0 0    C0 1    C0 2    C0 3    C0 4    C0 5
060186 192 0 405507  40  147712  556533  616300  665459  689125  686753
DDMMYY vt nf AMIN   ic   C1 0    C1 1    C1 2    C1 3    C1 4    C1 5
060186 192 0 405558  40  147712  659995  677584  670394  679843  654764


DD day;
MM month;
YY year;
vt voltage;
nf 0/1 (am/pm)
AMIN are minutes to calculate time: GMT=10^(AMIN*1.0E-5 - 1)/60
(subroutine zenith()  calculates SZA)
ic time conversion
C0 0 is white noise for first set of measurements, dark count
C0 1 is counts for first wavelength (306 nm) in the first set of measurements
C0 2 is counts at 310
C0 3 is counts at 313
C0 4 is counts at 317
C0 5 is counts at 319
C1 0 is white noise for the second set of measurements
C1 1 is counts for first wavelength (317 nm) in the second set of measurements
C1 2 is counts at 319
C1 3 is counts at 323
C1 4 is counts at 326
C1 5 is counts at 329
```

Conversion of counts to intensities:

```
Time_conversion = 17.4368                              Note 1
rate=Time_conversion/double precision(ic)
tau=4.5E-8                                                      Note 3
scale=10e-4                           Note 2
double tc[ 11 ] = { 0.00, -2.04, -1.50, -1.16, -1.50,  -2.59,\
                    -1.45, -2.59, -5.40, -8.10, -12.50 } ;
                                                              Note 4

offset = 0
for (k in 0:1)
{
    i=0
    noise co = 10^(C[k,i]*1.E-5 - 1))*rate
    vtu = (0.16*vt[k]-30), where 16.0*0.01=0.16
    for (i in 1:5)
    {
        f = 10^(C[k,i]*1E-5-1)*rate-co

        if (f<2)
           f=2
        g=f
        //Dead time correction
        for (j 1:9)
        {
            g = f*exp(tau*g)                    Note 5
        }
        C[k,i]=log10(g)+scale*tc[i+offset]*vtu       Note 6
    }
    offset=5
}
```

Note 1: Time_conversion 17.4368=(4/0.2294), where 4 divisor of counts prior to being counted and 0.2294 [sec] is integration time of one cycle.

Note 2: tau is dead time that can be read from the B-file.

Note 3: These elements of *tc* array are applied to the 1st record , i.e., C0's (even records)

Note 4: These elements of *tc* array are applied to the 2nd record , i.e., C1's (odd records)

Note 5: This is a recursive dead time correction.

Note 6: The final C values are later multiplied by 100 as it is in traditional Dobson measurements.

In Figure 1 we present example of u-file processed data as a function of SZA. In the top panel C times 100 for 305, 313, 323, 326 and 329 nm channels is depicted. In the middle panel differences between 319 channels (odd-even) and 317nm channel (odd-even) are plotted. And in the bottom panel differences 329-313, 326-310 and 323-306 channels are plotted. The differences from the third panel are the ones that are utilized in the Umkehr algorithm.
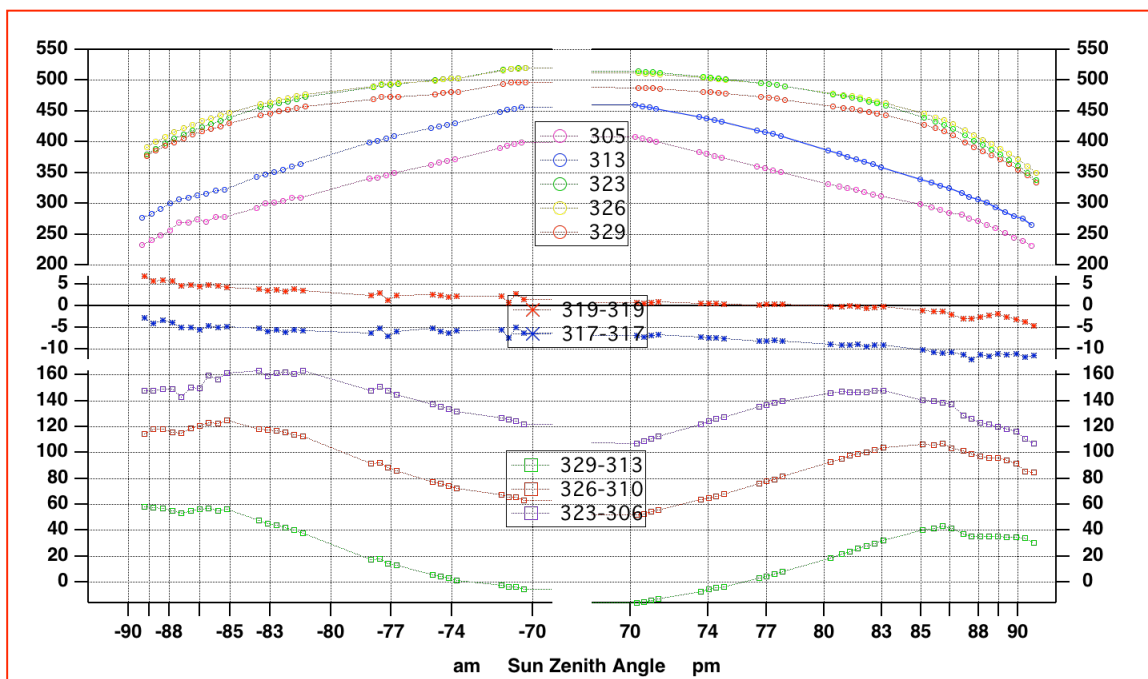

Figure 1. Example of processed u-file data.