

Report of the 2nd Meeting of the WOUDC Umkehr Advisory Committee Kos, Greece, 03 June 2004

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List of Attendees

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Agenda:

1. Presentations
 - a. Introductory comments by C.T. McElroy
 - b. Introduction to the New Algorithm by P.K. Bhartia
 - c. Description of the New Algorithm by Irina Petropavlovskikh
2. Actions and Recommendations
3. Next meeting

Introductory Comments by C.T. McElroy

C.T. McElroy of the Meteorological Service of Canada welcomed the guests in attendance, outlined the agenda and then opened the meeting with an introduction of six elements that provided an evolution of the Umkehr development over the past several years, since the last Umkehr, meeting which was held in Toronto, Canada in November 1999¹.

1. It is quite likely that there would be some improvement to the Umkehr data set if a re-analysis were to be done based on the outcome of the REVUE project. This should be discussed at this meeting.
2. The work done under the REVUE project did not include any improvements to the actual Umkehr algorithm that I am aware of. I believe that there are actually still some errors in the code that cause systematic errors in the retrievals. This also needs some work and some discussion.
3. An Umkehr advisory committee has already been established to advise the WOUDC, which is the physical route by which the implementation of new processing procedures would be implemented. I chaired the first meeting of that committee in 1999 in Toronto. Many of the people here for this discussion are also members of that committee.
4. P.K. and Irina have been doing some significant work using a new algorithm that does not suffer from some of the shortcomings of the old algorithm, but is still not showing a significant improvement over the Mateer and Deluisi algorithm. They are concerned about the limits on the usefulness of the Dobson Umkehr data that the inherent stability and characterization of the instrument may be imposing. (This could conceivably lead to a recommendation to investigate the characterization requirements for Dobson instruments that make Umkehr measurements.)
5. The Brewer Umkehr analysis development is still in its infancy in spite of the existence now of up to 2 decades of data from some sites. The higher quality of the Brewer data (including the measurement of absolute sky radiance) should allow us to learn much more about the physics of the Umkehr measurement and should lead to a better understanding of the performance of the Dobson Umkehr, including understanding what the physical limits to its performance are.

¹ Report on the Meeting of the WOUDC Umkehr Sub-Committee, November 17-18, 1999, C.T. McElroy and E.W. Hare, Meteorological Service of Canada

6. I am concerned that the process adopting a 'new' Dobson algorithm might lead to the conclusion - at a 'political' level - that all development work on the Umkehr analysis is complete when, in fact, the analysis has not advanced significantly in 20 years. There is information in the Umkehr and this information should lead to the extraction of useful measurements of the trends in ozone in the upper levels of the stratosphere. Since there are only a few ways that that region of the atmosphere can be sounded from the ground, and there are many Brewer stations that can make the required measurements automatically around the world, the Umkehr should not be abandoned until the potential of that data set has been carefully assessed.

Introduction to the New Algorithm - P.K. Bhartia

P.K. Bhartia of NASA GSFC introduced the new Umkehr algorithm that he and I. Petropavlovskikh had developed. This version is a modification of the REVUE algorithm outlined by Bojkov et. al. (2000). One major change is the elimination of the *a priori* information that is viewed as affecting the trends. Also, the original code, written by C. Mateer in the early to mid 1990's is based on the assumption that computing power needed to be conserved. With modern, faster computing systems available, the new code has taken advantage of higher speed processing, which in turn provides a better level of numerical resolution. The two updates to the Mateer and Deluisi (1992) algorithm was the focus of much of the meeting.

Description of the New Algorithm - I. Petropavlovskikh

I. Petropavlovskikh of NOAA presented the evolution of the new algorithm. One update that she highlighted was a change from a single scattering Jacobian to a multiple scattering Jacobian. The entire presentation is available as a PDF document available at ftp://woudc:woudc*@ftp.tor.ec.gc.ca/publications/meeting_reports/umkehr_sub-committee

Following the presentations some discussion ensued. R. Evans from NOAA indicated that none of the Dobson instruments are "characterized" for the Umkehr measurements, meaning there is no specific optical arrangement or alignment. Some Dobson's are simply devoted to exclusively measuring the Umkehr effect. These systems are typically the automated Dobson variety.

Petropavlovskikh also mentioned that a web site is available that is dedicated to explaining the new forward model. The link is: <http://www.srrb.noaa.gov/research/umkehr>

Much discussion was centred around the definitions of what data needed to be examined, the Level 1, "N-values" versus the Level 2 (processed through the 1992 algorithm) profile data. The WOUDC presently uses the 1992 algorithm for a unified processing of all Umkehr Level 1 (N-values) data. There was further discussion about the inclusion of other Level 2 data sets. E. Hare of the Meteorological Service of Canada and the WOUDC commented that any Level 2 data sets are welcome and would be posted for the community to examine. McElroy added further, that this approach would be used provided that the originators of the data are known to the Umkehr community and considered a legitimate data source.

Actions and Recommendations

1. Add corrected ozone to the Dobson Umkehr data records
2. Recommend the correction of appropriate station total ozone and N values and suggest implementation to the contributing stations (REVUE)
3. Reprocess Dobson Umkehr data with 2004 Algorithm and make it available to the committee and the community to assess with the intention of implementing the new algorithm operationally
4. Recommend use of new algorithm for Brewer data analysis
5. Recommend further development of Umkehr analysis algorithm (aerosol improvements, model all data, ensemble retrievals)
6. Establish communications with both the Ozone SAG and the WOUDC for implementation and encourage and co-ordinate advanced algorithm development in the community

A sub task is to answer the question: if two products are required trends v. comparison / validation)?

Action Items:

1. ***An Umkehr statement about the state of the Brewer Umkehr data be included as a statement within the Brewer sub-committee meeting² minutes.***
2. ***A dynamic document be created and circulated within the Umkehr sub-group for updates on the state of algorithm developments.***
3. ***That the WOUDC communicate with REVUE committee to obtain corrected data resulting from the new Bhartia and Petropavlovskikh 2004 algorithm.***
4. ***A statement be prepared for presentation at the open IOC meeting to be held later in the QOS program. Note: A copy of this presentation is available from ftp://woudc:woudc*@ftp.tor.ec.gc.ca/publications/Meeting_Reports/Umkehr_sub-committee/Presentations_QOS2004***

Finally, McElroy expressed to the group that a follow-up meeting within a reasonable timeframe (6-12 months) would be useful and most productive. One suggestion was to re-visit the issues at the upcoming WMO SAG Ozone meeting in Boulder, USA in October 2004 with follow-up at the next Brewer workshop, scheduled for 2005 in Delft, Netherlands.

McElroy thanked everyone for attending and closed the meeting.

References

Bojkov, R.D., E. Kosmidis, V. Fioletov, J. DeLuisi, I. Petropavlovskikh, S. Godin, C. Zerefos, "Vertical ozone distribution characteristics deduced from 40,000 re-evaluated Umkehr profiles of 1957-1999 period", *Meteorology and Atmospheric Physics*, 79,127-158, 2002. (REVUE)

² WMO Brewer sub-committee meeting, Kos, Greece, June 2, 2004.

Mateer, C.L. and J.J. Deluisi, "A new Umkehr inversion algorithm". *The Götz Centennial issue of Journal of Atmospheric and Terrestrial Physics*, No. 35, 54:537-556, 1992.