

Satellite Observations of Atmospheric Halogen Oxides

Dissertation
von
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Heidelberg, Juli 1999

INAUGURAL - DISSERTATION
zur
Erlangung der Doktorwürde
der
der Naturwissenschaftlich - Mathematischen
Gesamtfakultät
der
Ruprecht - Karls - Universität
Heidelberg

vorgelegt von
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Tag der mündlichen Prüfung: 6. Juli 1999

Satellite Observations of Atmospheric Halogen Oxides

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Dissertation
submitted to the
Combined Faculties for the Natural Sciences and for Mathematics
of the Ruperta Calrola University of
Heidelberg, Germany
for the degree of
Doctor of Natural Sciences

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Zusammenfassung

Die große Bedeutung von Halogenverbindungen bezüglich der Zerstörung atmosphärischen Ozons wurde schlagartig offenbar, als Mitte der Achtziger Jahre ein dramatischer Ozonverlust über der Antarktis beobachtet wurde, seither bekannt als Ozonloch. Während der folgenden Jahre konnten reaktive Halogenverbindungen auch in der Troposphäre nachgewiesen werden. Seit der Entdeckung des Ozonlochs erweiterte sich das Wissen der atmosphärischen Halogenchemie deutlich; hierzu trugen unter anderem auch absorptionsspektroskopische Messungen von BrO und OCIO bei, die beide im ultravioletten Spektralbereich charakteristische Absorptionsstrukturen aufweisen. Diese Messungen wurden entweder vom Boden, Flugzeug oder Ballon aus durchgeführt und konnten damit noch kein umfassendes Bild der Atmosphäre erbringen. In dieser Arbeit wurden Algorithmen für die Auswertung atmosphärischen BrOs und OCIOs aus den Daten des GOME (Global Ozone Monitoring Experiment) Instruments an Bord des europäischen Forschungssatelliten ERS-2 entwickelt. Dadurch war es möglich, die zeitliche und räumliche Entwicklung des atmosphärischen BrOs und OCIOs global zu bestimmen. Insbesondere gelang es zum ersten Mal, erhöhte BrO-Konzentrationen in der planetaren Grenzschicht vom Satelliten aus zu messen. Außerdem konnten starke Indizien für die Existenz von BrO selbst in der freien Troposphäre gefunden werden. Die OCIO-Messungen des GOME Instrumentes erlaubten es, die Chlor-Aktivierung beider Polargebiete bezüglich der zeitlichen Entwicklung sowie ihrer Stärke zu untersuchen.

Abstract

The important role of halogen compounds in atmospheric ozone destruction became obvious after dramatic ozone loss was observed over Antarctica in the mid 1980s, usually referred to as 'ozone hole'. In the following years reactive halogen species were also discovered in the troposphere. Since the discovery of the ozone hole the understanding of the atmospheric halogen chemistry was largely extended, in particular by spectroscopic measurements of BrO and OCIO which both show characteristic absorption features in the UV spectral range. These measurements were performed from ground based and air borne instruments and thus could only provide 'snapshots' of the atmospheric conditions. In this PhD thesis algorithms for the analysis of atmospheric BrO and OCIO from the GOME (Global Ozone Monitoring Experiment) instrument aboard the European research satellite ERS-2 were developed. It was possible to monitor the spatial and temporal evolution of atmospheric BrO and OCIO on a global scale. In particular, enhanced BrO concentrations in the boundary layer were first detected from satellite. In addition, strong evidence for the presence of BrO in the free troposphere was found. From the GOME OCIO measurements it was possible to study stratospheric chlorine activation in both hemispheres with respect to their temporal evolution and strength.

Table of Contents

Chapter 1 Introduction	1
Chapter 2 The role of halogen species in atmospheric ozone chemistry	4
2.1 Atmospheric Ozone.....	4
2.1.1 Ozone in the stratosphere.....	4
2.1.2 Ozone in the troposphere.....	7
2.2 Sources and sinks of atmospheric halogen species.....	9
2.2.1 Stratospheric halogen compounds, the importance of CFCs and halons.....	10
2.2.2 Tropospheric halogen compounds.....	14
2.2.2.1 Emissions of partly halogenated halocarbons.....	14
2.2.2.2 Release of reactive bromine from sea salt during polar spring.....	15
2.3 Fundamental schemes of atmospheric halogen chemistry.....	16
2.4 Halogen chemistry of the stratosphere.....	17
2.4.1 Stratospheric halogen chemistry under ‘non-ozone hole’ conditions.....	19
2.4.2 Stratospheric halogen chemistry under ‘ozone hole’ conditions.....	21
2.4.3 Open questions of stratospheric halogen chemistry.....	24
2.4.3.1 Influence of dynamic processes on ozone destruction.....	25
2.4.3.2 PSC formation.....	27
2.4.3.3 Heterogeneous reactions.....	28
2.5 Halogen chemistry of the troposphere.....	28
2.5.1 Open questions of tropospheric halogen chemistry.....	30
Chapter 3 Global Ozone Monitoring Experiment (GOME)	32
3.1 The European research satellite ERS-2.....	32
3.2 The GOME instrument.....	33
3.3 Viewing geometry and coverage of the Earth’s surface.....	35
3.4 GOME products and data formats.....	36
Chapter 4 Absorption spectroscopy of atmospheric trace gases	37
4.1 Solar radiation.....	37
4.2 Interaction of radiation and matter in the UV/vis spectral region.....	39
4.2.1 The Beer-Lambert Law.....	41
4.3 Differential optical absorption spectroscopy (DOAS).....	41
4.3.1 Application of the DOAS method to the measurement of scattered radiation.....	43
4.3.2 The spectral fitting process.....	44
4.3.3 The influence of the spectral resolution of the instrument.....	46
4.3.4 The Ring effect.....	48
4.3.4.1 The Ring spectrum.....	49
4.3.4.2 Sensitivity studies for the correction of the Ring effect.....	51
4.3.4.3 An advanced concept for the correction of the Ring effect.....	51
4.3.5 The ‘solar I ₀ -effect’.....	53
4.3.6 Instrumental shortcomings and their consideration.....	54
4.3.6.1 Fabry Peron etalon structures.....	54
4.3.6.2 Undersampling of GOME spectra.....	54
4.3.6.3 Doppler shift.....	55
4.3.7 Development of the BrO analysis for GOME spectra.....	56
4.3.7.1 Wavelength range and reference spectra.....	56

4.3.7.2	Determination of the fitting error for the BrO evaluation.....	60
4.3.7.2.1	Determination of the statistical error of the fitting process.....	60
4.3.7.2.2	Impact of the undersampling problem of GOME on the BrO analysis.....	61
4.3.7.2.3	Errors caused by uncertainties of the wavelength calibration.....	62
4.3.7.2.4	Total error of the GOME BrO analysis.....	63
4.3.8	Development of the OCIO algorithm for GOME spectra	66
4.3.8.1	Wavelength range and reference spectra.....	66
4.3.8.2	Determination of the fitting error for the GOME OCIO analysis.....	70
4.3.9	Development of GOME DOAS algorithms O ₃ , NO ₂ , O ₂ and O ₄	72
4.3.9.1	O ₃ analysis.....	72
4.3.9.2	NO ₂ analysis.....	74
4.3.9.2	O ₂ and O ₄ analysis.....	76
Chapter 5	Modelling of the atmospheric radiative transport.....	77
5.1	Air mass factors for ground based and satellite observations.....	77
5.2	Calculation of air mass factors for GOME.....	79
5.2.1	Air mass factors for stratospheric BrO.....	80
5.2.1.1	Influence of the ground albedo.....	83
5.2.1.2	Influence of the atmospheric aerosol profile.....	85
5.2.1.3	Influence of the atmospheric temperature and pressure profile.....	88
5.2.1.4	Influence of the atmospheric ozone profile.....	89
5.2.1.5	The uncertainty of the air mass factor.....	90
5.2.2	Air mass factors for tropospheric BrO.....	90
5.2.3	Air mass factors for stratospheric OCIO.....	92
5.3	Influence of clouds on the air mass factor for ground based and satellite measurements... 93	
5.3.1	Influence on satellite air mass factors for stratospheric species.....	93
5.3.2	Influence on satellite air mass factors for tropospheric species.....	94
5.3.3	Broken cloudiness across one ground pixel, sensitivity of GOME measurements for tropospheric species.....	96
5.3.4	Conclusions	98
Chapter 6	Results of the BrO measurements.....	99
6.1	Latitudinal and seasonal variability of the BrO VCD measured by GOME.....	99
6.2	Stratospheric BrO.....	101
6.2.1	Summary of the GOME observations of stratospheric BrO.....	106
6.3	BrO in the boundary layer.....	106
6.3.1	Discovery.....	106
6.3.2	Quantitative determination of the BrO concentration in the boundary layer.....	109
6.3.3	Comparison to ground based observations of O ₃ and BrO.....	110
6.3.3.2	Comparison of GOME BrO to in-situ BrO observations at Spitsbergen.....	110
6.3.3.2	Comparison of GOME BrO to in-situ O ₃ observations at Spitsbergen.....	111
6.3.4	Examples of polar boundary layer BrO events observed in 1997.....	113
6.3.5	Time series for both hemispheres.....	118
6.3.5.1	Total area.....	118
6.3.5.2	Dependence on the latitude.....	119
6.3.5.3	Longitudinal distribution.....	122
6.3.5.4	Summary of the GOME observations of BrO in the boundary layer.....	123
6.4	BrO in the free troposphere.....	125
6.4.1	Comparison with balloon borne measurements.....	125
6.4.2	Comparison of the GOME BrO SCDs with GOME O ₄ measurements.....	129

6.4.3 Comparison with ground based BrO measurements.....	132
6.4.4 Summary of the GOME observations of BrO in the free troposphere.....	136
Chapter 7 Results of the OCIO measurements.....	137
7.1 OCIO in the Stratosphere.....	138
7.1.1 General features, SZA dependence.....	138
7.1.2 Comparison with ground based instruments.....	140
7.1.3 Time series of GOME OCIO observations in the northern hemisphere.....	144
7.1.4 Temperature dependence of chlorine activation in the Arctic.....	147
7.1.5 Comparison between both hemispheres.....	149
7.1.6 OCIO outside the polar vortices?.....	150
7.1.7 Time constant of chlorine activation, mixing inside the vortex.....	151
7.2 OCIO maps for THESEO.....	154
7.3 OCIO in the troposphere?.....	154
7.4 Summary of the GOME OCIO measurements.....	155
Summary and outlook.....	157
References.....	159
Appendix A.....	173
Appendix B.....	178