

Table of contents

Chapter 1: Introduction	1
Chapter 2: Observations and model data	3
2.1 Ground-based observations.....	3
2.1.1 Measurement techniques	3
2.1.1.1 Ozonesonde	3
2.1.1.2 Lidar	4
2.1.1.3 Microwave radiometer.....	4
2.1.1.4 FTIR	5
2.1.1.5 Umkehr.....	6
2.1.2 Deseasonalised monthly mean time series.....	6
2.1.2.1 Procedure	6
2.1.2.2 Ozonesonde	7
2.1.2.3 Lidar and microwave radiometer.....	7
2.1.2.4 FTIR.....	8
2.1.2.5 Umkehr	8
2.1.2.6 Instrument and station measurement frequency.....	8
2.2 Satellite observations.....	10
2.2.1 General remarks	10
2.2.2 Nadir profile data records	10
2.2.2.1 SBUV MOD v8.6.....	12
2.2.2.2 SBUV COH v8.6	12
2.2.2.3 Limb profile data records in mixing ratio on pressure grid.....	12
2.2.3.1 GOZCARDS v2.20	12
2.2.3.2 SWOOSH v2.6	13
2.2.2.4 Limb profile data records in number density on altitude grid	13
2.2.4.1 SAGE-OSIRIS-OMPS	13
2.2.4.2 SAGE-CCI-OMPS	14
2.2.4.3 SAGE-MIPAS-OMPS v2	14
2.2.2.5 Satellite data in broad latitude bands.....	14
2.3 CCMI model data	15
2.3.1 Description of model data sets.....	15
2.3.2 Model data in broad latitude bands	15
2.4 Summary.....	15

Chapter 3: Challenges for trend studies	17
3.1 Consistency of ozone profile data records.....	17
3.1.1 Homogeneity of ground-based network data	17
3.1.2 Stability of limb data records relative to ground-based networks	23
3.1.3 Intercomparisons of limb satellite measurements.....	26
3.1.4 Stability of limb data records relative to ground-based networks	26
3.1.5 The BASIC composite and its use for intercomparisons of merged data records	28
3.2 Sampling bias and uncertainty correction characterisation.....	32
3.2.1 Sampling bias for occultation instruments estimated using simultaneous temporal and spatial (STS) analysis	33
3.2.2 Station means versus zonal means	34
3.3 Summary.....	36
Chapter 4: The LOTUS regression model.....	37
4.1 Regression methodology	37
4.2 Proxies	37
4.2.1 Non-trend proxies	38
4.2.2 Trend proxies	40
4.3 Sensitivity tests	41
4.3.1 Survey of existing regression models	41
4.3.2 Weighted versus unweighted regression.....	42
4.3.3 Non-trend proxy sensitivity	42
4.3.4 Trend proxy sensitivity	45
4.4 Alternative approaches.....	48
4.5 The “LOTUS regression” model.....	49
4.5.1 General description	49
4.5.2 Application to model simulations	49
4.6 Summary.....	50
Chapter 5: Time series and trend results	51
5.1 Satellite trends at native resolution	51
5.1.1 Trend results	51
5.1.2 Discussion of differences	52
5.2 Time series in broad latitude bands.....	56
5.3 Combined satellite trends in broad latitude bands	57
5.3.1 Selection and preparation of data sets.....	57
5.3.2 Approach to combine trends.....	57
5.3.3 Alternative methods.....	59
5.3.4 Discussion	60
5.4 Ground-based trends.....	61

5.5 Comparison between combined satellite and CCMI model trends.....	64
5.5.1 Pre-1997 period.....	64
5.5.2 Post-2000 period.....	65
5.6 Summary of observed profile trends.....	66
5.6.1 Pre-1997 period.....	66
5.6.2 Post-2000 period.....	66
5.6.3 Comparison of LOTUS trend results with previous assessments	67
5.7 Summary.....	69

References.....	71
------------------------	-----------

Supplementary Material(79) S-1

S.1 Chapter 1	S-1
S.2 Chapter 2.....	S-1
S.3 Chapter 3.....	S-2
S.4 Chapter 4.....	S-9
S.4.1 DLM estimated ozone changes from the BASIC composites.....	S-9
S.5 Chapter 5.....	S-12
S.5.1 Appendix A: Supplementary figures	S-12
S.5.2 Appendix B: Analysis of correlation between fit residuals.....	S-17
S.5.3 Appendix C: Table of LOTUS trend values.....	S-19

