Table of Contents

| 1 | Intro | Introduction | | | | |
|---|-------|--------------|--|----|--|--|
| | 1.1 | Ozone | in the Atmosphere | 2 | | |
| | | 1.1.1 | Early Observations of Atmospheric Ozone | 2 | | |
| | | 1.1.2 | The Chemistry of Stratospheric Ozone | 5 | | |
| | | 1.1.3 | The Distribution of Ozone in the Atmosphere | 9 | | |
| | 1.2 | Anthro | ppogenic Influence on the Ozone Layer | 12 | | |
| | 1.3 | | Stratospheric Ozone Loss | 16 | | |
| | | 1.3.1 | The Antarctic Ozone Hole | 16 | | |
| | | 1.3.2 | Arctic Ozone Loss | 18 | | |
| | | 1.3.3 | Chemical Mechanisms of Polar Ozone Destruction | 20 | | |
| | 1.4 | The Fu | nture of the Stratospheric Ozone Layer | 24 | | |
| | 1.5 | Aims o | of this Study | 27 | | |
| 2 | Trac | er-Trac | cer Relations in the Stratosphere | 29 | | |
| | 2.1 | Tracer- | -Tracer Relations as a Tool in Atmospheric Research | 29 | | |
| | | 2.1.1 | Climatology of Ozone–Tracer Relations in the Middle Atmosphere | 32 | | |
| | 2.2 | Impact | t of Cosmic-Ray-Induced Heterogeneous Chemistry on Polar Ozone . | 36 | | |
| | | 2.2.1 | Relation between Chlorofluorocarbons and Nitrous Oxide | 36 | | |
| | | 2.2.2 | Potential Importance of Cosmic Ray Initiated Heterogeneous Reac- | 20 | | |
| | | 2.2.2 | tions | 38 | | |
| | | 2.2.3 | Correlation between Polar Ozone Levels and Cosmic Ray Intensity | 41 | | |
| | | 2.2.4 | Conclusions on the Impact of Cosmic-Ray-Induced Chemistry on | 12 | | |
| | | | Stratospheric Chemistry | 43 | | |
| 3 | Qua | - | g Polar Ozone Loss from Ozone-Tracer Relations | 45 | | |
| | 3.1 | | bles of the Tracer-Tracer Correlation Technique | 45 | | |
| | 3.2 | | nce Ozone-Tracer Relations in the 'Early' Polar Vortex | 49 | | |
| | | 3.2.1 | Reference Relations Constructed from Mixing Lines | 49 | | |
| | | 3.2.2 | Representation of Ozone-Tracer Reference Relations in Models | 50 | | |
| | 3.3 | | t of Mixing on Ozone-Tracer Relations in the Polar Vortex | 55 | | |
| | | 3.3.1 | Impact of Cross Vortex Edge Mixing on Ozone-Tracer Relations in | | | |
| | | | the Vortex | 55 | | |
| | | 3.3.2 | Impact of Differential Descent in the Vortex on Tracer Relations | 57 | | |
| | | 3.3.3 | Can Mixing in the Arctic Vortex 'Mimic' Chemical Ozone Loss? . | 59 | | |
| | 3.4 | Impact | t of Mesospheric Intrusions on Ozone–Tracer Relations in the Strato- | | | |
| | | snherio | e Polar Vortex | 63 | | |

| | 3.5 | 3.4.1 Balloon-Borne Measurements in Arctic Winter 2002/2003 3.4.2 Chemical Change of Ozone in Descending Mesospheric Air Calculation of Chemical Ozone Loss in the Arctic in March 2003 Based on | 64 72 | | |
|-----|---------------------------|--|-----------------------|--|--|
| | | ILAS-II Measurements | 75 | | |
| 4 | Epil 6 4.1 4.2 | Summary | 81 81 84 | | |
| Α | Unit | s of Measurement Used in this Book | 86 | | |
| В | Calc | ulation of Column Ozone Loss | 88 | | |
| Sy | Symbols and Abbreviations | | | | |
| Lis | List of Figures | | | | |
| Lis | List of Tables | | | | |
| Re | References | | | | |