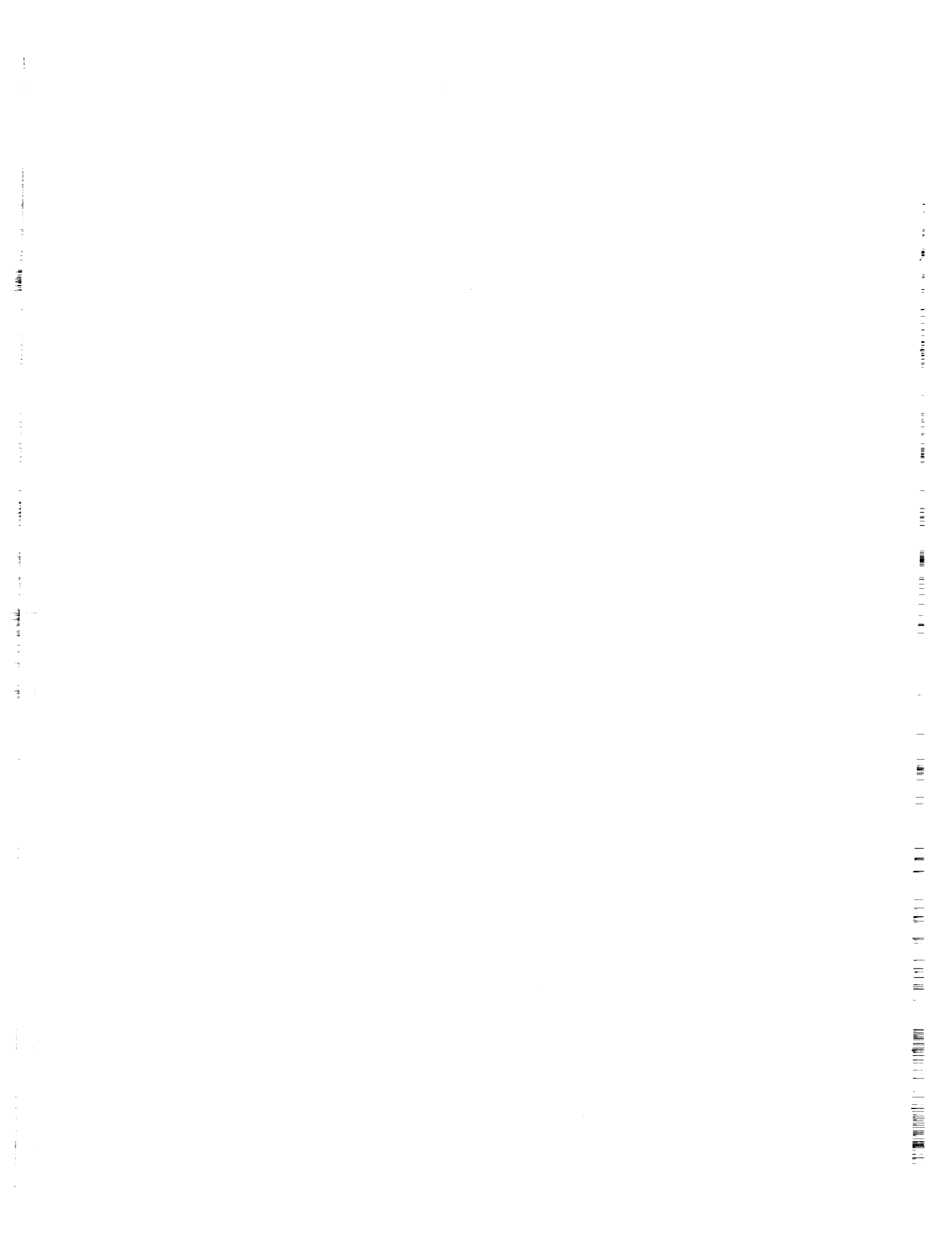


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# References



## Appendix: References

- Adriani, A., F. Congeduti, G. Fiocco, and G.P. Gobbi, One year lidar observations of the stratospheric aerosol at Frascati, March 1982–March 1983, *Geophys. Res. Lett.*, 10, 1005–1008, 1983.
- Aikin, A.C., and R.D. McPeters, Meteoric material and the behavior of upper stratospheric polar ozone, *Geophys. Res. Lett.*, 13, 1300–1303, 1986.
- Aikin, A.C., B. Woodgate, and H.J.P. Smith, Atmospheric ozone determination by solar occultation using the UV spectrometer on the Solar Maximum Mission, *Appl. Optics*, 21, 2412–2424, 1982.
- Aikin, A.C., B. Woodgate, and H.J.P. Smith, Equatorial ozone profiles from the Solar Maximum Mission—A comparison with theory, *Planet. Space Sci.*, 32, 503–513, 1984.
- Anderson, S., and K. Mauersberger, Calibration of a mass spectrometer experiment for ozone, *Rev. Sci. Instrum.*, 52, 1025–1028, 1981.
- Andreji, P.D., Evaluation of various factors affecting homogeneity of the total ozone time-series, in *Proc. Quadr. Ozone Symposium—1988*, Göttingen, edited by R.D. Bojkov and P. Fabian, Deepak Publ., USA, in press.
- Andrews, D.G., Some comparisons between the middle atmosphere dynamics of the Southern and Northern Hemispheres, *Pure Appl. Geophys.*, 130, 213–232, 1989.
- Andrews, D.G., and M.E. McIntyre, Planetary waves in horizontal and vertical shear: The generalized Eliassen–Palm relation and the mean zonal acceleration, *J. Atmos. Sci.*, 33, 2031–2048, 1976.
- Andrews, D.G., J.R. Holton, and C.B. Leovy, Extratropical zonal-mean circulation, in *Middle Atmospheric Dynamics*, pp. 295–312, Academic Press, Orlando, Florida, 1987.
- Angell, J.K., The close relation between Antarctic total-ozone depletion and cooling of the Antarctic low stratosphere, *Geophys. Res. Lett.*, 13, 1240–1243, 1986.
- Angell, J.K., Rocketsonde evidence for a stratospheric temperature decrease in the Western Hemisphere during 1973–85, *Mon. Weather Rev.*, 115, 2569–2577, 1987a.
- Angell, J.K., Seasonal differences in the trend of total ozone and contributions from tropospheric and stratospheric layers, *Mon. Weather Rev.*, 115, 753, 1987b.
- Angell, J.K., and J. Korshover, Global analysis of recent total ozone fluctuations, *Mon. Weather Rev.*, 104, 63–75, 1976.
- Angell, J.K., and J. Korshover, Global ozone variations: An update into 1976, *Mon. Weather Rev.*, 106, 725–737, 1978.
- Angell, J.K., and J. Korshover, Global temperature variations in the troposphere and stratosphere, *Mon. Weather Rev.*, 11, 901–921, 1983a.
- Angell, J.K., and J. Korshover, Global variation in total ozone and layer-mean ozone: An update through 1981, *J. Clim. and Appl. Meteor.*, 22, 1611–1627, 1983b.
- Angell, J.K., J. Korshover, and W.G. Planet, Ground-based and satellite evidence for a pronounced total-ozone minimum in early 1983 and responsible atmospheric layers, *Mon. Weather Rev.*, 113, 641–646, 1985.
- Atkinson, R.J., and J.R. Eason, Re-evaluation of the Australian total ozone record, in *Proc. Quadr. Ozone Symposium—1988*, Göttingen, edited by R.D. Bojkov and P. Fabian, Deepak Publ., USA, in press.
- Avaste, O.A., A.V. Fedynsky, G.M. Grechko, V.I. Sevastyanov, and Ch.I. Willmann, Advances in noctilucent cloud research in the space era, *PAGEOPH*, 118, 528–580, 1980.
- Bailey, P.L., and J.C. Gille, Inversion of limb radiance measurements: An operational algorithm, *J. Geophys. Res.*, 91, 2757–2774, 1986.

## REFERENCES

- Baldwin, A.C., and D.M. Golden, Heterogeneous atmospheric reactions—Sulphuric acid aerosols as tropospheric sinks, *Science*, 206, 562–563, 1979.
- Ball Aerospace Systems Division, *SBUV/2 Technical Description, Document Number B6802-10, Revision B*, Boulder, Colorado, 40 pp., November 16, 1981.
- Bandein, W.R., and R.S. Fraser, Radiative effects of the El Chichón volcanic eruption: Preliminary results concerning remote sensing, *NASA Tech. Memorandum 84959*, 1982.
- Barnes, R.A., Changes in SBUV ozone profiles near Natal, Brazil, from 1979 to 1985, *J. Geophys. Res.*, 93, 1704–1707, 1988.
- Barnes, R.A., and P.G. Simeth, Design of a rocket-borne radiometer for stratospheric ozone measurements, *Rev. Sci. Instrum.*, 57, 544–550, 1986.
- Barnes, R.A., A.R. Bandy, and A.L. Torres, Electrochemical concentration cell ozonesonde accuracy and precision, *J. Geophys. Res.*, 90, 7881–7887, 1985.
- Barnes, R.A., A.C. Holland, and H.S. Lee, An improved rocket ozonesonde (ROCOZ-A) 2. Preparation of stratospheric ozone profiles, *J. Geophys. Res.*, 91, 14521–14531, 1986.
- Barnes, R.A., A.C. Holland, and V.W.J.H. Kirchhoff, Equatorial ozone profiles from the ground to 52 km during the Southern Hemisphere autumn, *J. Geophys. Res.*, 92, 5573–5583, 1987.
- Barnett, J.J., and M.E. Corney, Middle atmosphere reference model derived from satellite data, edited by K. Labitzke, J.J. Barnett, and B. Edwards, *Handbook for MAP, Vol. 16*, pp. 47–85, SCOSTEP, Urbana, Illinois, 1985.
- Barnett, J.J., and M.E. Corney, Temperature comparisons between the Nimbus-7 SAMS, rocket/radiosondes and the NOAA-6 SSU, *J. Geophys. Res.*, 89, 5294–5302, 1984.
- Barnett, J.J., R.S. Harwood, J.T. Houghton, C.G. Morgan, C.D. Rodgers, and E.J. Williamson, *Atmospheric Physics Memorandum*, Clarendon Laboratory, University of Oxford, England, 1974.
- Barth, C.A., The ultraviolet spectroscopy of planets, in *The Middle Ultraviolet: Its Science and Technology*, edited by A.E.S. Green, pp. 177–218, John Wiley and Sons, New York, 1966.
- Barth, C.A., R.W. Sanders, R.J. Thomas, B.M. Jakosky, and R.A. West, Formation of the El Chichón aerosol cloud, *Geophys. Res. Lett.*, 10, 993–996, 1983.
- Basher, R.E., Review of the Dobson spectrophotometer and its accuracy, *WMO Ozone Report #13*, 1982.
- Bass, A.M., and R.J. Paur, The ultraviolet cross-sections of ozone: I. The measurements, in *Atmospheric Ozone, Proceedings of the Quadrennial Ozone Symposium*, Halkidiki, Greece, September 3–7, 1984, edited by C.S. Zerefos and A. Ghazi, pp. 606–610, D. Reidel, Dordrecht, The Netherlands, 1985.
- Bass, A.M., A.E. Ledford, Jr., and A.H. Laufer, Extinction coefficients of NO<sub>2</sub> and N<sub>2</sub>O<sub>4</sub>, *J. of Res. of the N.B.S.-A. Phys. and Chem.*, 80A, 143–166, 1976.
- Bates, D.R., Rayleigh scattering by air, *Planet. Space Sci.*, 32, 785–790, 1984.
- Bauer, E., A catalog of perturbing influences on stratospheric ozone, 1955–1975, *J. Geophys. Res.*, 84, 6929–6940, 1979.
- Benjamini, Y., Is the “t test” really conservative when the parent distribution is long-tailed? *J. Amer. Statist. Assoc.*, 78, 645–654, 1983.
- Bhartia, P.K., K.F. Klenk, V.G. Kaveeshwar, S. Ahmad, A.J. Fleig, R.D. McPeters, and C.L. Mateer, Algorithm for Vertical Ozone Profile Determination for the Nimbus-4 BUV Data Set, in *Proceedings of the 4th Conference on Atmospheric Radiation*, pp. 27–32, American Meteorological Society, Boston, MA, 1981.
- Bhartia, P.K., K.F. Klenk, C.K. Wong, D. Gordon, and A.J. Fleig, Intercomparison of the Nimbus 7 SBUV/TOMS total ozone data sets with Dobson and M83 results, *J. Geophys. Res.*, 89, 5239–5248, 1984.

## REFERENCES

- Bhartia, P.K., C.K. Wong, and A.J. Fleig, An evaluation of the performance of Umkehr stations by SBUV experiment, in *Atmospheric Ozone, Proceedings of the Quadrennial Ozone Symposium*, Halkidiki, Greece, September 3-7, 1984, edited by C.S. Zerefos and A. Ghazi, pp. 229-233, D. Reidel, Dordrecht, The Netherlands, 1985.
- Bhartia, P.K., S. Taylor, and A.J. Fleig, Estimation of errors in the long-term change in ozone reported by the SBUV/TOMS instruments—A new way of looking at the old data, *Proc. Quadr. Ozone Symposium—1988*, Göttingen, edited by R.D. Bojkov and P. Fabian, Deepak Publ., USA, in press.
- Birrer, W., *Homogenisierung und Diskussion der Totalozon-Missreihe von Arosa 1926-1971*, Laboratorium für Atmosphärenphysik, 1975.
- Bishop, L., and W.J. Hill, Analyzing total ozone for natural and man-made trend variability, *Geophys. Res. Lett.*, 9, 485-488, 1982.
- Blackmon, M.L., J.E. Geosler, and E.J. Pitcher, A general circulation model study of January climate anomaly patterns associated with interannual variation of equatorial Pacific sea surface temperatures, *J. Atmos. Sci.*, 40, 1410-1425, 1983.
- Blake, D.R., and F.S. Rowland, Continuing worldwide increase in tropospheric methane, 1978 to 1987, *Science*, 239, 1129-1131, 1988.
- Blake, D.R., and F.S. Rowland, World-wide increase in tropospheric methane, *J. Atmos. Chem.*, 4, 43-62, 1986.
- Bloomfield, P., M.L. Thompson, and S. Zeger, A statistical analysis of Umkehr measurements of 32-46 km. ozone, *J. Appl. Meteorol.*, 21, 1828-1837, 1982.
- Bloomfield, P., G. Oehlert, M.L. Thompson, and S. Zeger, A frequency domain analysis of trends in Dobson total ozone records, *J. Geophys. Res.*, 88, 8512-8522, 1983.
- Bojkov, R.D., Computing the vertical ozone distribution from its relationship with total ozone amount, *J. Appl. Meteor.*, 8, 284-292, 1969a.
- Bojkov, R.D., Differences in Dobson spectrophotometer and filter ozonometer measurements of total ozone, *J. Appl. Meteor.*, 8, 362-368, 1969b.
- Bojkov, R.D., Global total ozone distribution (1957-1965), NCAR manuscript presented at the Ozone Symposium, Monaco, 1968.
- Bojkov, R.D., The 1979-1985 ozone decline in Antarctica as reflected in ground based observations, *Geophys. Res. Lett.*, 13, 1236-1239, 1986a.
- Bojkov, R.D., The 1983 and 1985 anomalies in ozone distribution in perspective, *Mon. Weather Rev.*, 115, 2187-2201, 1987b.
- Bojkov, R.D., On the long-term changes of tropospheric ozone, in *Proc. Quadr. Ozone Symposium—1988*, Göttingen, edited by R.D. Bojkov and P. Fabian, Deepak Publ., USA, in press.
- Bojkov, R.D., Ozone changes at the surface and in the free troposphere, in *Tropospheric Ozone—Regional and Global Scale Interactions*, edited by I.S.A. Isaksen, pp. 83-96, D. Reidel, Norwell, Massachusetts, 1988b.
- Bojkov, R.D., Ozone changes at the surface and in the troposphere, in *Tropospheric Ozone: Proceedings of the NATO Workshop*, edited by I.S.A. Isaksen, pp. 83-96, D. Reidel, Boston, 1987a.
- Bojkov, R.D., Ozone variations in the Northern polar region, *Meteorol. Atmos. Phys.*, 38, 117-130, 1988a.
- Bojkov, R.D., Spring ozone change in the Antarctic and the role of the polar vortex, *Adv. Space Res.*, 136, 89-98, 1986b.
- Bojkov, R.D., Surface ozone during the second half of the nineteenth century, *J. Clim. Appl. Meteor.*, 25, 343-352, 1986c.

## REFERENCES

- Bojkov, R.D., and W. Attmannspacher, Ozone variability and trends from ozone soundings at Hohenpeissenberg, paper presented at the Quadrennial Ozone Symposium, Göttingen, August 8–17, 1988.
- Bojkov, R.D., and C.L. Mateer, On the relative quality and performance of the Global Ozone Observing System total ozone measurements, in *Atmospheric Ozone, Proceedings of the Quadrennial Ozone Symposium*, Halkidiki, Greece, September 3–7, 1984, edited by C.S. Zerefos and A. Ghazi, pp. 335–340, D. Reidel, Dordrecht, The Netherlands, 1985.
- Bojkov, R.D., and G.C. Reinsel, Trends in tropospheric ozone concentration, in *Atmospheric Ozone, Proceedings of the Quadrennial Ozone Symposium*, Halkidiki, Greece, September 3–7, 1984, edited by C.S. Zerefos and A. Ghazi, pp. 775–781, D. Reidel, Dordrecht, The Netherlands, 1985.
- Bojkov, R.D., C.L. Mateer, and A.L. Hansson, Comparison of ground-based and Total Ozone Mapping Spectrometer measurements used in assessing the performance of the Global Ozone Observing System, *J. Geophys. Res.*, 93, 9525–9533, 1988.
- Borucki, W.J., and W.L. Chameides, Lightning: Estimates of the rates of energy dissipation of nitrogen fixation, *Rev. Geophys.*, 22, 363–372, 1984.
- Bowman, K.P., and A.J. Krueger, A global climatology of total ozone from the Nimbus-7 Total Ozone Mapping Spectrometer (TOMS), *J. Geophys. Res.*, 90, 7967–7976, 1985.
- Box, G.E.P., and G.M. Jenkins, *Time Series Analysis, Forecasting and Control*, 575 pp., Holden-Day, San Francisco, 1976.
- Boyd, J.P., The noninteraction of waves with the zonally averaged flow on a spherical Earth and the interrelationships of eddy fluxes of energy, heat and momentum, *J. Atmos. Sci.*, 33, 2285–2291, 1976.
- Brasseur, G., and A. De Rudder, Theoretical prediction of perturbations in the middle atmosphere related to the increasing emission of greenhouse gases, *Adv. Space Res.*, 6, 51–54, 1986.
- Brasseur, G., and P.C. Simon, Stratospheric chemical and thermal response to long-term variability in solar UV irradiance, *J. Geophys. Res.*, 86, 7343–7362, 1981.
- Brasseur, G., and S. Solomon, *Aeronomy of the Middle Atmosphere*, D. Reidel, Boston, 441 pp., 1984.
- Brewer, A.W., A replacement for the Dobson spectrophotometer? *Pure and Applied Geophys.*, 106–108, 919–927, 1973.
- Brewer, A.W., and J.R. Milford, The Oxford-Kew ozonesonde, *Proc. Roy. Soc. London*, A256, 470–495, 1960.
- Brewer, A.W., and A.W. Wilson, The regions of formation of atmospheric ozone, *Quart. J. Roy. Meteorol. Soc.*, 94, 249–265, 1968.
- Bridges, J.M., and W.R. Ott, Vacuum ultraviolet radiometry. 3: The argon mini-arc as a new secondary standard of spectral radiance, *Appl. Opt.*, 16, 367–376, 1977.
- Brownscombe, J.L., J. Nash, G. Vaughan, and C.F. Rogers, Solar tides in the middle atmosphere. I: Description of satellite observations and comparison with theoretical calculations at equinox, *Quart. J. Roy. Meteorol. Soc.*, 111, 677–689, 1985.
- Bruhl, C., *Ein effizientes Model für global Klima- und Luftzusammensetzungänderungen durch menschliche Aktivitäten*, Doctorate Thesis, University of Mainz, Federal Republic of Germany, 1987.
- Bruhl, C., and P.J. Crutzen, Scenarios of possible changes in atmospheric temperatures and ozone concentrations due to man's activities, estimated with a one-dimensional coupled photochemical climate model, *Climate Dynamics*, 2, 173–203, 1988.
- Brune, W.H., and J.G. Anderson, In situ observations of midlatitude stratospheric ClO and BrO, *Geophys. Res. Lett.*, 13, 1391–1394, 1986.
- Brune, W.H., E.M. Weinstock, J.J. Schwab, R.M. Stimpfle, and J.G. Anderson, Stratospheric ClO: In situ detection with a new approach, *Geophys. Res. Lett.*, 12, 441–444, 1985.

## REFERENCES

- Brune, W.H., E.M. Weinstock, and J.G. Anderson, Midlatitude ClO below 22 km altitude: Measurements with a new aircraft-borne instrument, *Geophys. Res. Lett.*, 15, 144–147, 1988.
- Burnett, C.R., K.R. Minschwaner, and E.B. Burnett, Vertical column abundance measurements of atmospheric hydroxyl from 26°, 40°, and 65°N, *J. Geophys. Res.*, 93, 5241–5254, 1988.
- Cabannes, J., and J. Dufay, Les variations de la quantité d'ozone contenue dans l'atmosphère, *J. Phys. Rad., Ser. 6, 8*, 353–364, 1927.
- Cadle, R.D., C.S. Kiang, and J.F. Louis, The global scale dispersion of the eruption clouds from major volcanic eruptions, *J. Geophys. Res.*, 81, 3125–3132, 1976.
- Cadle, R.D., F.G. Fernald, and C.I. Frush, Combined use of lidar and numerical diffusion models to estimate the quantity and dispersion of volcanic eruption clouds in the stratosphere: Vulcán Fuego, 1974, and Augustine, 1976, *J. Geophys. Res.*, 82, 1783–1786, 1977.
- Callis, L.B., and M. Natarajan, The Antarctic ozone minimum: Relationship to odd nitrogen, odd chlorine, the final warming and the 11-year solar cycle, *J. Geophys. Res.*, 91, 10771–10796, 1986.
- Callis, L.B., J.C. Alpert, and M.A. Geller, An assessment of thermal, wind, and planetary wave changes in the middle atmosphere due to 11-year in flux variations, *J. Geophys. Res.*, 90, 2273–2282, 1985a.
- Callis, L.B., M. Natarajan, and J.M. Russell, III, Estimates of the stratospheric distribution of odd nitrogen from the LIMS data, *Geophys. Res. Lett.*, 12, 259–262, 1985b.
- Callis, L.B., M. Natarajan, R.E. Boughner, J.M. Russell III, and J.D. Lambeth, Stratospheric photochemical studies using Nimbus 7 data 2. Development of inferred trace specie distributions, *J. Geophys. Res.*, 91, 1167–1197, 1986.
- Cebula, R.P., H. Park, and D.F. Heath, Characterization of the Nimbus-7 SBUV radiometer for the long term monitoring of stratospheric ozone, *J. Atm. Oceanic Technology*, 5, 215–227, 1988.
- Chandra, S., Recent trends in stratospheric ozone inferred from Nimbus-7 SBUV spectrometer, National Workshop on Ozone, April 13–15, 1987, pp. 33–44, National Physical Laboratory, New Delhi, 1988.
- Chandra, S., Solar-induced oscillations in the stratosphere: A myth or reality?, *J. Geophys. Res.*, 90, 2331–2339, 1985.
- Chang, J.S., W.H. Duerwer, and D.J. Wuebbles, The atmospheric nuclear tests of the 1950's and 1960's: A possible test of ozone depletion theories, *J. Geophys. Res.*, 94, 1755–1765, 1979.
- Chemical Manufacturers Association (CMA), Production, sales and calculated release of CFC-11 and -12 through 1984, *Report of Fluorocarbon Program Panel*, Washington, D.C., 1985.
- Chemical Manufacturers Association (CMA), World production and release of chlorofluorocarbons 11 and 12 through 1981, *Report FPP 83-F*, Washington, D.C., 1982.
- Chu, W.P., Inversion of SAGE II Measurements, in *Abstracts of the 6th AMS Conference on Atmospheric Radiation*, pp. J49–J51, Williamsburg, Virginia, May 13–16, 1986.
- Chu, W.P., Inversion technique for SAGE II data, Workshop on Remote Sensing Retrieval Methods, Dec. 15–18, 1987, Williamsburg, Virginia, 1988.
- Chu, W.P., SAGE II inversion algorithm, *J. Geophys. Res.*, 94, 8339–8351, 1989.
- Chu, W.P., and M.P. McCormick, Inversion of stratospheric aerosol and gaseous constituents from spacecraft solar extinction data in the 0.38–1.0 $\mu$ m wavelength region, *Appl. Opt.*, 18, 1404–1413, 1979.
- Chu, W.P., and M.P. McCormick, SAGE observations of stratospheric nitrogen dioxide, *J. Geophys. Res.*, 91, 5465–5476, 1986.
- Chu, W.P., M.P. McCormick, J. Lenoble, C. Brogniez, and P. Pruvost, SAGE II inversion algorithm, *J. Geophys. Res.*, 94, 8339–8351, 1989.
- Chubachi, S., On the cooling of stratospheric temperatures at Syowa, Antarctica, *Geophys. Res. Lett.*, 13, 1221–1223, 1986.

## REFERENCES

- Chubachi, S., Preliminary results of ozone observations at Syowa Station from February 1982 to January 1983, *Mem. Natl. Inst. Polar Res., Spec. Issue No. 34, Proceedings of the Sixth Annual Symposium of Polar Meteorology and Glaciology*, National Institute of Polar Research, Tokyo, Japan, p. 13, 1984.
- Chubachi, S., and R. Kajawara, Total ozone variations at Syowa, Antarctica, *Geophys. Res. Lett.*, 13, 1197–1198, 1986.
- Cicerone, R.J., How has the atmospheric concentration of CO changed? in *The Changing Atmosphere*, edited by F.S. Rowland and I.S.A. Isaksen, Dahlem Konferenzen, Berlin, November 1–6, 1987, pp. 49–61, John Wiley and Sons, Ltd., Chichester, England, 1988.
- Cicerone, R.J., L.E. Heidt, and W.H. Pollock, Measurements of atmospheric methyl bromide ( $\text{CH}_3\text{Br}$ ) and bromoform ( $\text{CHBr}_3$ ), *J. Geophys. Res.*, 93, 3745–3749, 1988.
- Clancy, R.T., El Chichón and “mystery cloud” aerosols between 30 and 55 km: Global observations from the SME visible spectrometer, *Geophys. Res. Lett.*, 13, 937–940, 1986.
- Clavelin, J.L., and P. Mirabel, Determination des pressions partielles du melange eau-acide nitrique, *J. Chimie Phys.*, 76, 533–537, 1979.
- Clemesha, B.R., and D.M. Simonich, Lidar observations of the El Chichón dust cloud at 23°S, *Geophys. Res. Lett.*, 10, 321–324, 1983.
- Clyne, M.A.A., and R.T. Watson, Kinetic studies of diatomic free radicals using mass spectrometry, Part 4—The  $\text{BrO} + \text{ClO}$  and  $\text{BrO} + \text{ClO}$  reactions, *J. Chem. Soc., Faraday Trans. I.*, 73, 1169–1187, 1977.
- CMA: see Chemical Manufacturer’s Association
- Cochrane, D., and G.H. Orcutt, Applications of least-squares regression to relationships containing autocorrelated errors, *J. Amer. Statist. Assoc.*, 44, 32–61, 1949.
- Coffey, M., On the temporal change of stratospheric  $\text{NO}_2$ , *Geophys. Res. Lett.*, 15, 331–334, 1988.
- Connor, B.J., J.W. Barrett, A. Parish, P.M. Solomon, R.L. DeZafra, and M. Jaramillo, Ozone over McMurdo Station, Antarctica, austral spring 1986: Altitude profiles for the middle and upper stratosphere, *J. Geophys. Res.*, 92, 13221–13230, 1987.
- Conway, T.J., P. Tans, L.S. Waterman, K.W. Thoning, K.A. Masarie, and R.H. Gammon, Atmospheric carbon dioxide measurements in the remote global troposphere, 1981–1984, *Tellus*, 40B, 81–115, 1988.
- Cowley, J.R., and G.M. Lawrence, Earth limb altitude determination for the Solar Mesosphere Explorer, paper presented at 21st AIAA Aerospace Sciences Meeting, January 10–13, Reno, Nevada, 1983.
- Cox, R.A., and G.D. Hayman, Stability and photochemistry of  $\text{ClO}$  dimers formed at low temperature in the gas phase, Polar Ozone Workshop, *NASA Conf. Publ. 10014*, pp. 256–258, Snowmass, Colorado, 1988.
- Coy, L., An unusually large westerly amplitude of the quasi-biennial oscillation, *J. Atmos. Sci.*, 36, 174, 1979.
- Craig, H., and C.C. Chou, Methane: The record in polar ice cores, *Geophys. Res. Lett.*, 9, 1221–1224, 1982.
- Craig, R.A., *The Upper Atmosphere—Meteorology and Physics*, 209 pp., Academic Press, New York, 1965.
- Craig, R.A., J.J. DeLuisi, and I. Stuetzer, Comparison of chemiluminescent and Umkehr observations of ozone, *J. Geophys. Res.*, 72, 1667–1671, 1967.
- Crutzen, P.J., Tropospheric ozone: An overview, in *Tropospheric Ozone: Proceedings of the NATO Workshop*, edited by I.S.A. Isaksen, pp. 3–32, D. Reidel, Boston, 1987.
- Crutzen, P.J., and F. Arnold, Nitric acid cloud formation in the cold Antarctic stratosphere: A major cause for the springtime “ozone hole,” *Nature*, 324, 651–655, 1986.
- Crutzen, P.J., I.S.A. Isaksen, and G.C. Reid, Solar proton events: Stratospheric sources of nitric oxide, *Science*, 189, 457–459, 1975.



## REFERENCES

- Cunnold, D.M., R.G. Prinn, R.A. Rasmussen, P.G. Simmonds, F.N. Alyea, C.A. Cardelino, A.J. Crawford, P.J. Fraser, and R.D. Rosen, The Atmospheric Lifetime Experiment 3. Lifetime methodology and application to three years of  $\text{CCl}_3\text{F}$  data, *J. Geophys. Res.*, *88*, 8379–8400, 1983a.
- Cunnold, D.M., R.G. Prinn, R.A. Rasmussen, P.G. Simmonds, F.N. Alyea, C.A. Cardelino, and A.J. Crawford, The Atmospheric Lifetime Experiment 4. Result for  $\text{CCl}_2\text{F}_2$  based on three years of data, *J. Geophys. Res.*, *88*, 8401–8414, 1983b.
- Cunnold, D.M., M.C. Pitts, and C.R. Trepte, An intercomparison of SAGE and SBUV ozone observations for March and April 1979, *J. Geophys. Res.*, *89*, 5249–5262, 1984.
- Cunnold, D.M., R.G. Prinn, R.A. Rasmussen, P.G. Simmonds, F.N. Alyea, C.A. Cardelino, A.J. Crawford, P.J. Fraser, and R.D. Rosen, Atmospheric lifetime and annual release estimates for  $\text{CCl}_3\text{F}$  and  $\text{CCl}_2\text{F}_2$  from five years of ALE data, *J. Geophys. Res.*, *91*, 10797–10817, 1986.
- Cunnold, D.M., W.P. Chu, R.A. Barnes, M.P. McCormick, and R.E. Veiga, Validation of SAGE II ozone measurements, *J. Geophys. Res.*, *94*, 8447–8460, 1989.
- Danielsen, E.F., and H. Houben, Dynamics of the Antarctic stratosphere and implications for the ozone hole, unpublished manuscript.
- Dave, J.V., Effect of aerosol on estimation of total ozone in an atmospheric column from the measurement of its ultraviolet radiance, *J. Atmos. Sci.*, *35*, 899–911, 1978.
- Dave, J.V., Multiple scattering in a non-homogeneous, Rayleigh atmosphere, *J. Atmos. Sci.*, *22*, 273–279, 1964.
- Dave, J.V., and P.M. Furukawa, Scattered radiation in the ozone absorption bands at selected levels of a terrestrial, Rayleigh atmosphere, *Meteorol. Mon.*, *7* (29), 1966.
- Dave, J.V., and C.L. Mateer, A preliminary study on the possibility of estimating total atmospheric ozone from satellite measurements, *J. Atmos. Sci.*, *24*, 414–427, 1967.
- Dave, J.V., J.J. DeLuisi, and C.L. Mateer, Results of a comprehensive theoretical examination of the optical effects of aerosols on the Umkehr measurement, *Special Environmental Report 14*, pp. 15–22, World Meteorological Organization, Geneva, 1979.
- Dave, J.V., C.L. Mateer, and J.J. DeLuisi, An examination of the effect of haze on the Short Umkehr method for deducing the vertical distribution of ozone, in *Proc. Quadr. Ozone Symp.*, pp. 222–229, National Center for Atmospheric Research, Boulder, Colorado, 1980.
- Deirmendjian, D., On volcanic and other particulate turbidity anomalies, *Adv. Geophys.*, *16*, 267–296, 1973.
- DeLuisi, J.J., A study of the effect of haze upon Umkehr measurements, *Quart. J. Roy. Meteorol. Soc.*, *95*, 181–187, 1969.
- DeLuisi, J.J., Umkehr vertical ozone profile errors caused by the presence of stratospheric aerosols, *J. Geophys. Res.*, *84*, 1766–1770, 1979.
- DeLuisi, J.J., and C.L. Mateer, On the application of the optimum statistical inversion technique to the evaluation of Umkehr observations, *J. Appl. Meteor.*, *10*, 328–334, 1971.
- DeLuisi, J.J., and J. Nimira, Preliminary comparison of satellite BUV and surface-based Umkehr observations of the vertical distribution of ozone in the upper stratosphere, *J. Geophys. Res.*, *83*, 379–384, 1977.
- DeLuisi, J.J., C.L. Mateer, and D.F. Heath, Comparison of seasonal variations of upper stratospheric ozone concentrations revealed by Umkehr and Nimbus 4 BUV observations, *J. Geophys. Res.*, *84*, 3728–3732, 1979.
- DeLuisi, J.J., T. DeFoor, K. Coulson, F. Fernald, and K. Thorne, *Lidar Observations of Stratospheric Aerosol Over Mauna Loa Observatory: 1974–1981*, NOAA Data Report ERL ARL-4, 107 pp., NOAA Environmental Research Laboratories, Boulder, Colorado, 1982.
- DeLuisi, J.J., E.G. Dutton, K.L. Coulson, T.E. DeFoor, and B.G. Mendonca, On some radiative features of the El Chichón volcanic stratospheric dust cloud and a cloud of unknown origin observed at Mauna Loa, *J. Geophys. Res.*, *88*, 6769–6772, 1983.

## REFERENCES

- DeLuisi, J.J., C.L. Mateer, and P.K. Bhartia, On the correspondence between standard, short Umkehr, and solar backscattered ultraviolet vertical ozone profiles, *J. Geophys. Res.*, 90, 3845–3849, 1985.
- DeMore, W.B., and M. Patapoff, Comparison of ozone determinations by ultraviolet photometry and gas phase titration, *Environ. Sci. Technol.*, 10, 897–899, 1976.
- DeMore, W.B., J.J. Margitan, M.J. Molina, R.T. Watson, D.M. Golden, R.F. Hampson, M.J. Kurylo, C.J. Howard, and A.R. Ravishankara, Chemical kinetics and photochemical data for use in stratospheric modeling, evaluation number 7, *JPL Publication 85-37*, 226 pp., Jet Propulsion Laboratory, Pasadena, California, 1985.
- deZafra, R.L., A. Parrish, P.M. Solomon, and J.W. Barrett, Quantitative observations of stratospheric chlorine monoxide as a function of latitude and season during the period 1980–1983, in *Atmospheric Ozone, Proceedings of the Quadrennial Ozone Symposium*, Halkidiki, Greece, September 3–7, 1984, edited by C.S. Zerefos and A. Ghazi, pp. 206–209, D. Reidel, Dordrecht, The Netherlands, 1985.
- deZafra, R.L., M. Jaramillo, A. Parrish, P.M. Solomon, B. Connor, and J. Barrett, High concentrations of chlorine monoxide at low altitudes in the Antarctic spring stratosphere, I, Diurnal variation, *Nature*, 328, 408–411, 1987.
- Dianov-Klovov, V.I., and L.N. Yurganov, A spectroscopic study of the global spacetime distribution of atmospheric CO, *Tellus*, 33, 262–273, 1981.
- Dobson, G.M.B., Adjustment and calibration of ozone spectrophotometer, *Ann. IGY*, 5, 90–114, 1957b.
- Dobson, G.M.B., Annual variation of ozone in Antarctica, *Quart. J. Roy. Meteorol. Soc.*, 92, 549–552, 1966.
- Dobson, G.M.B., The development of instruments for measuring atmospheric ozone during the last fifty years, *J. Phys. E: Sci. Instrum.*, 6, 938–939, 1973.
- Dobson, G.M.B., Measurements of the amount of ozone in the Earth's atmosphere and its relation to other geophysical conditions, Part IV, *Proc. Roy. Soc. London, A* 129, 411–433, 1930.
- Dobson, G.M.B., Observers handbook for the ozone spectrophotometer, *Ann. IGY*, 5, 46–89, 1957a.
- Dobson, G.M.B., A photoelectric spectrophotometer for measuring the amount of atmospheric ozone, *Proc. Phys. Soc. London*, 43, 324–339, 1931.
- Dobson, G.M.B., and D.N. Harrison, Measurements of the amount of ozone in the Earth's atmosphere and its relation to other geophysical conditions, *Proc. Roy. Soc. London, A* 110, 660–693, 1926.
- Dobson, G.M.B., and C.W.B. Normand, Determination of the constants, etc., used in the calculation of the amount of ozone from spectrophotometer measurements and the accuracy of the results, *Ann. IGY*, 16, 161–191, 1962.
- Dobson, G.M.B., D.N. Harrison, and J. Lawrence, Measurements of the amount of ozone in the Earth's atmosphere and its relation to other geophysical conditions, Part II, *Proc. Roy. Soc. London, A* 114, 521–541, 1927.
- Dobson, G.M.B., D.N. Harrison, and J. Lawrence, Measurements of the amount of ozone in the Earth's atmosphere and its relation to other geophysical conditions, Part III, *Proc. Roy. Soc. London, A* 122, 456–486, 1929.
- Douglass, A.R., and R.S. Stolarski, The use of atmospheric measurements to constrain model predictions of ozone change from chlorine perturbations, *J. Geophys. Res.*, 92, 6662–6674, 1987.
- Douglass, A.R., R.B. Rood, and R.S. Stolarski, Interpretation of ozone temperature correlations 2. Analysis of SBUV ozone data, *J. Geophys. Res.*, 90, 10693–10708, 1985.

## REFERENCES

- Drayson, S.R., P.L. Bailey, H. Fischer, J.C. Gille, A. Girard, L.L. Gordley, J.E. Harries, W.G. Planet, E.E. Remsberg, and J.M. Russell, Spectroscopy and transmittances for the LIMS experiment, *J. Geophys. Res.*, *89*, 5141, 1984.
- Dreschhoff, G.A., E.J. Zeller, and B.C. Parker, Past solar activity variation reflected in nitrate concentrations in Antarctic ice, in *Weather and Climate Responses to Solar Variations*, edited by B.M. McCormac, pp. 225–236, Colorado University Press, Boulder, 1983.
- Dunkerton, T.J., Body force circulation and the Antarctic ozone minimum, *J. Atmos. Sci.*, *45*, 427–438, 1988.
- Dunkerton, T.J., On the mean meridional mass motions of the stratosphere and mesosphere, *J. Atmos. Sci.*, *35*, 2325–2333, 1978.
- Dütsch, H.U., The ozone distribution in the atmosphere, *Can. J. Chem.*, *52*, 1491–1504, 1974.
- Dütsch, H.U., Total ozone trend in the light of ozone soundings: The impact of El Chichón, in *Atmospheric Ozone, Proceedings of the Quadrennial Ozone Symposium*, Halkidiki, Greece, September 3–7, 1984, edited by C.S. Zerefos and A. Ghazi, pp. 263–268, D. Reidel, Dordrecht, The Netherlands, 1984a.
- Dütsch, H.U., An update of the Arosa ozone series to the present using a statistical instrument calibration, *Quart. J. Roy. Meteorol. Soc.*, *110*, 1079–1096, 1984b.
- Dutton, E.G., and J. DeLuisi, Spectral extinction of direct solar radiation by the El Chichón cloud during December, 1982, *Geophys. Res. Lett.*, *10*, 1013–1016, 1983.
- Dvoryashina, E.V., V.I. Dianov-Klokov, and L.N. Yurganov, Variations of the content of carbon monoxide in the atmosphere in the period from 1970 to 1982, *Journal of the Academy of Sciences USSR, Atmospheric and Oceanic Physics*, *20*, 27–33, 1984.
- Dziewulska-Losiowa, A., M. Degorska, and B. Rajewska-Wiech, The normalized total ozone data record, Belsk, 1963–1981, *Publ. Inst. Geophys., Ser. D, Pol. Acad. Sci.*, *18* (169), 23–73, 1983.
- Eck, T.F., P.K. Bhartia, P.H. Hwang, and L.L. Stowe, Reflectivity of the Earth's surface and clouds in ultraviolet from satellite observations, *J. Geophys. Res.*, *92*, 4287–4296, 1987.
- Eckerle, K.L., Modification of an NBS reference spectrophotometer, *Natl. Bur. Stand. (U.S.) Tech. Note 913*, 43 pp., 1976.
- Eckman, R.S., J.D. Haigh, and J.A. Pyle, An important uncertainty in coupled chlorine-carbon dioxide studies of atmospheric ozone modification, *Nature*, *329*, 616–619, 1987.
- Edmon, H.J., B.J. Hoskins, and M.E. McIntyre, Eliassen-Palm cross sections for the troposphere, *J. Atmos. Sci.*, *37*, 2600–2616, 1980. (See also *Corrigendum*, *38*, 1115, 1981, esp. the second-to-last item.)
- Ehhalt, D.H., R.J. Zander, and R.A. Lamontagne, On the temporal increase of tropospheric CH<sub>4</sub>, *J. Geophys. Res.*, *88*, 8442–8446, 1983.
- Elansky, N.R., A. Ya Arabov, A.S. Elokhov, and I.A. Senik, Spatial and temporal variability of the NO<sub>2</sub> total content based on annual observation data, in *Atmospheric Ozone, Proceedings of the Quadrennial Ozone Symposium*, Halkidiki, Greece, September 3–7, 1984, edited by C.S. Zerefos and A. Ghazi, pp. 157–162, D. Reidel, Dordrecht, The Netherlands, 1985.
- Etheridge, D.M., G.I. Pearman, and F. de Silva, Atmospheric trace gas variations as revealed by air trapped in an ice-core from Law Dome, Antarctica, *Annals of Glaciology*, *10*, 28–33, 1987.
- Evans, W.F.J., Depletion of the Arctic ozone hole by the notching mechanism during spring 1986, Paper A12-02, Spring AGU Meeting, *EOS*, *68*, 272, 1987.
- Evans, W.F.J., and J.B. Kerr, Estimates of the amount of sulphur dioxide injected into the stratosphere by the explosive volcanic eruptions: El Chichón, mystery volcano, Mt. St. Helens, *Geophys. Res. Lett.*, *10*, 1049–1051, 1983.
- Evans, W.F.J., I.A. Asbridge, J.B. Kerr, C.L. Mateer, and R.A. Olafson, The effects of SO<sub>2</sub> on Dobson and Brewer total ozone measurements, in *Proc. Quadrennial Ozone Symposium*, edited by J. London, pp. 48–56, International Ozone Commission, Boulder, Colorado, 1980.

## REFERENCES

- Fabian, P., R. Borchers, S.A. Penkett, and N.J.D. Prosser, Halocarbons in the stratosphere, *Nature*, 216, 135–136, 1981.
- Fabry, C., and M. Buisson, L'absorption de l'ultraviolet par l'ozone et la limite du spectre solaire, *J. Phys. Rad., Ser. 5*, 3, 196–226, 1913.
- Fabry, C., and M. Buisson, Etude de l'extrémité ultraviolette du spectre solaire, *J. Phys. Rad., Ser. 6*, 2, 197–226, 1921.
- Fahey, D.W., C.S. Eubank, G. Hubler, and F.C. Fehsenfeld, Evaluation of a catalytic reduction technique for the measurement of total reactive odd-nitrogen,  $\text{NO}_y$ , in the atmosphere, *J. Atmos. Chem.*, 3, 435–468, 1985.
- Fairchild, C.E., E.J. Stone, and G.M. Lawrence, Photofragment spectroscopy of ozone in the UV region 270–310 nm and at 600 nm, *J. Chem. Phys.*, 69, 3632, 1978.
- Farkas, E., *Proc. Quadr. Ozone Symposium—1988*, Göttingen, edited by R.J. Bojkov and P. Fabian, Deepak Publ., USA, in press.
- Farman, J.C., and B.G. Gardiner, Ozone depletion over Antarctica, *Nature*, 329, 574, 1987.
- Farman, J.C., B.G. Gardiner, and J.D. Shanklin, Large losses of ozone in Antarctica reveal seasonal  $\text{ClO}_x/\text{NO}_x$  interaction, *Nature*, 315, 207–210, 1985.
- Farmer, C.B., G.C. Toon, P.W. Schaper, J.F. Blavier, and L.L. Lowes, Stratospheric trace gases in the spring 1986 Antarctic atmosphere, *Nature*, 329, 126, 1987.
- Farrara, J.D., and C.R. Mechoso, An observational study of the final warming in the Southern Hemisphere stratosphere, *Geophys. Res. Lett.*, 13, 1232–1235, 1986.
- Federal Coordinator for Meteorological Services and Supporting Research, *The National Plan for Stratospheric Monitoring 1987–1997*, Department of Commerce, NOAA, Washington, D.C., 1988.
- Feister, U., and W. Warmbt, Long-term surface ozone increase at Arkona, in *Atmospheric Ozone, Proceedings of the Quadrennial Ozone Symposium*, Halkidiki, Greece, September 3–7, 1984, edited by C.S. Zerefos and A. Ghazi, pp. 782–787, D. Reidel, Dordrecht, The Netherlands, 1985.
- Fels, S.B., and M.D. Schwarzkopf, The simplified exchange approximation: A new method for radiative transfer calculations, *J. Atmos. Sci.*, 32, 1475–1488, 1975.
- Fels, S.B., J.D. Mahlman, M.D. Schwarzkopf, and R.W. Sinclair, Stratospheric sensitivity to perturbations in ozone and carbon dioxide: Radiative and dynamical response, *J. Atmos. Sci.*, 37, 2265–2297, 1980.
- Findlay, F.D., and D.R. Snelling, Collisional deactivation of  $\text{O}_2(^1\Delta_g)$ , *J. Chem. Phys.*, 55, 545–551, 1971.
- Finger, F.G., H.M. Woolf, and C.E. Anderson, A method for objective analysis of stratospheric constant-pressure charts, *Mon. Weather Rev.*, 93, 619–638, 1965.
- Finger, F.G., M.E. Gelman, F.J. Schmidlin, R. Leviton, and B.W. Kennedy, Compatibility of meteorological rocketsonde data as indicated by international comparison tests, *J. Atmos. Sci.*, 32, 1705–1714, 1975.
- Fiocco, G., and G. Grams, Observations of the aerosol layer at 20 km by optical radar, *J. Atmos. Sci.*, 21, 323–324, 1964.
- Fleig, A.J., K.F. Klenk, P.K. Bhartia, K.D. Lee, C.G. Wellemeyer, and V.G. Kaveeshwar, Vertical ozone profile results from Nimbus-4 data, in *Proc. Fourth Conference on Atmospheric Radiation*, pp. 20–26, AMS, Toronto, Ontario, June 16–18, 1981.
- Fleig, A.J., P.K. Bhartia, C.K. Wong, and C.L. Mateer, Comparison of Nimbus-7 TOMS and ground-station total ozone measurements, *Index 17, XV–XVII*, World Meteorol. Organ. World Ozone Data Cent., Toronto, Canada, 1982.
- Fleig, A.J., P.K. Bhartia, C.G. Wellemeyer, and D.S. Silberstein, Seven years of total ozone from the TOMS instrument—A report on data quality, *Geophys. Res. Lett.*, 13, 1355–1358, 1986a.

- Fleig, A.J., P.K. Bhartia, and D.S. Silberstein, An assessment of the long-term drift in SBUV total ozone data, based on comparison with the Dobson network, *Geophys. Res. Lett.*, 13, 1359–1362, 1986b.
- Fleig, A.J., D.S. Silberstein, C.G. Wellemeyer, R.P. Cebula, and P.K. Bhartia, An assessment of the long-term drift in TOMS total ozone data, based on comparison with the Dobson network, in *Proc. Quadr. Ozone Symposium—1988*, Göttingen, edited by R.D. Bojkov and P. Fabian, Deepak Publ., USA, in press.
- Fogle, B., and B. Haurwitz, Noctilucent clouds, *Space Sci. Rev.*, 6, 278–340, 1966.
- Folland, C.K., D.E. Parker, and F.E. Kates, Worldwide marine temperature fluctuations 1856–1981, *Nature*, 310, 670–673, 1984.
- Foot, J.S., Aircraft measurements of the humidity in the lower stratosphere from 1977 to 1980 between 45°N and 65°N, *Quart. J. Roy. Meteorol. Soc.*, 110, 303–319, 1984.
- Fowle, F.E., Atmospheric ozone: Its relation to some solar and terrestrial phenomena, *Smith's Misc. Coll.*, 81, No. 11, 1929.
- Fox, R.J., G.W. Grams, B.G. Schuster, and J.A. Weinman, Measurements of stratospheric aerosols by airborne laser radar, *J. Geophys. Res.*, 78, 7789–7801, 1973.
- Fraser, P.J., and N. Derek, Atmospheric halocarbons and nitrous oxide, 1982–1985, in *Baseline 85, Baseline Atmospheric Program (Australia) 1985*, edited by B.W. Forgan and P.J. Fraser, pp. 44–47, Bureau of Meteorology/CSIRO, 1987.
- Fraser, P.J., G.I. Pearman, and P. Hyson, The global distribution of atmospheric carbon dioxide 2. A review of provisional background observations, 1978–1980, *J. Geophys. Res.*, 88, 3591–3598, 1983.
- Fraser, P.J., P. Hyson, R.A. Rasmussen, A.J. Crawford, and M.A.K. Khalil, Methane, carbon monoxide and methylchloroform in the Southern Hemisphere, *J. Atmos. Chem.*, 4, 3–42, 1986a.
- Fraser, P.J., N. Derek, R. O'Brien, R. Shepherd, R.A. Rasmussen, and A.J. Crawford, Atmospheric halocarbons and nitrous oxide, 1976–1984, in *Baseline 83–84, Baseline Atmospheric Program (Australia) 1983–1984*, edited by R.J. Francey and B.W. Forgan, pp. 43–49, Bureau of Meteorology/CSIRO, 1986b.
- Fraser, P.J., P. Hyson, S. Coram, R.A. Rasmussen, A.J. Crawford, and M.A.K. Khalil, Carbon monoxide in the Southern Hemisphere, in *Proceedings of the 7th World Clean Air Congress*, 2, pp. 341–352, Sydney, Australia, August 1986, 1986c.
- Fraser, P.J., R.A. Rasmussen, and M.A.K. Khalil, Atmospheric observations of chlorocarbons, nitrous oxide, methane and carbon monoxide from the Oregon Graduate Center (OGC) flask sampling program, 1984–1985, in *Baseline 85, Baseline Atmospheric Program (Australia) 1985*, edited by B.W. Forgan and P.J. Fraser, pp. 57–55, Bureau of Meteorology/CSIRO, 1987a.
- Fraser, P.J., S. Coram, and N. Derek, Atmospheric methane, carbon monoxide and carbon dioxide by gas chromatography, 1978–1985, in *Baseline 85, Baseline Atmospheric Program (Australia) 1985*, edited by B.W. Forgan and P.J. Fraser, pp. 48–50, Bureau of Meteorology/CSIRO, 1987b.
- Frederick, J.E., G.N. Seraphino, and A.R. Douglass, An analysis of the annual cycle in upper stratospheric ozone, *J. Geophys. Res.*, 89, 9547–9555, 1984.
- Frederick, J.E., R.P. Cebula, and D.F. Heath, Instrument characterization for the detection of long-term changes in stratospheric ozone: An analysis of the SBUV/2 radiometer, *J. Atmos. Ocean. Tech.*, 3, 472, 1986.
- Friedl, R.R., and S.P. Sander, Kinetic and product studies of the reaction  $\text{ClO} + \text{BrO}$  using discharge flow-mass spectroscopy, Paper delivered at the Eighteenth International Symposium on Free Radicals, Oxford, England, 1987.
- Gandin, L.S., Objective analysis of meteorological fields, *GIMIZ Gidrometeorologicheskoe Izdatel'stvo*, Leningrad, 1963.

## REFERENCES

- Gandrud, B.W., M.A. Kritz, and A.L. Lazrus, Balloon and aircraft measurements of stratospheric sulfate mixing ratio following the El Chichón eruption, *Geophys. Res. Lett.*, 10, 1037–1040, 1983.
- Garcia, R., and S. Solomon, A possible relationship between interannual variability in Antarctic ozone and the quasi-biennial oscillation, *Geophys. Res. Lett.*, 14, 848–851, 1987.
- Garcia, R.R., S. Solomon, R.G. Roble, and D.W. Rusch, A numerical study of the response of the middle atmosphere to the 11 year solar cycle, *Planet. Space Sci.*, 32, 411–423, 1984.
- Gardiner, B.G., Comparative morphology of the vertical ozone profile in the Antarctic spring, *Geophys. Res. Lett.*, 8, 901–904, 1988.
- Geller, M.A., M.-F. Wu, M.E. Gelman, Troposphere–stratosphere (surface–55 km) monthly winter general circulation statistics for the Northern Hemisphere—Four year averages, *J. Atmos. Res.*, 40, 334–342, 1983.
- Gelman, M.E., and R.M. Nagatani, Objectives analyses of height and temperature at the 5, 2, and 0.4 mb levels using meteorological rocketsonde and satellite radiation data, *Space Research XVII*, 17, 122, 1977.
- Gelman, M.E., A.J. Miller, R.M. Nagatani, and H.D. Bowman II, Mean zonal wind and temperature structure during the PMP–1 winter periods, *Adv. Space Res.*, 2, 159–162, 1983.
- Gelman, M.E., A.J. Miller, K.W. Johnson, and R.M. Nagatani, Detection of long-term trends in global stratospheric temperature from NMC analyses derived from NOAA satellite data, *Adv. Space Res.*, 6, 17–25, 1986.
- Gernandt, H., The vertical ozone distribution above the GDR-research base, Antarctica in 1985, *Geophys. Res. Lett.*, 14, 84–86, 1987.
- Gille, J.C., and L.V. Lyjak, Radiative heating and cooling rates in the middle atmosphere, *J. Atmos. Sci.*, 43, 2215–2229, 1986.
- Gille, J.C., and J.M. Russell, III, The limb infrared monitor of the stratosphere: Experiment description, performance, and results, *J. Geophys. Res.*, 89, 5125–5140, 1984.
- Gille, J.C., P.L. Bailey, and J.M. Russell III, Temperature and composition measurements from the LRIR and LIMS experiments on Nimbus 6 and 7, *Phil. Trans. Roy. Soc. London Ser. A*, 296, 205–218, 1980.
- Gille, J.C., J.M. Russell, P.L. Bailey, L.L. Gordley, E.E. Remsberg, J.H. Lienesch, W.G. Planet, F.B. House, L.V. Lyjak, and S.A. Beck, Validation of temperature retrievals obtained by the Limb Infrared Monitoring of the Stratosphere (LIMS) experiment on Nimbus–7, *J. Geophys. Res.*, 89, 5147–5160, 1984a.
- Gille, J.C., J.M. Russell, III, P.L. Bailey, E.E. Remsberg, L.L. Gordley, W.F.J. Evans, H. Fischer, B.W. Gandrud, A. Girard, J.E. Harries, and S.A. Beck, Accuracy and precision of the nitric acid concentrations determined by the Limb Infrared Monitor of the Stratosphere experiment on Nimbus–7, *J. Geophys. Res.*, 89, 5179–5190, 1984b.
- Gille, J.C., C.M. Smythe, and D.F. Heath, Observed ozone response to variations in solar ultraviolet radiation, *Science*, 225, 315–317, 1984c.
- Gille, J.C., L. Lyjak, and A.K. Smith, The global residual mean circulation in the middle atmosphere for the northern winter period, *J. Atmos. Sci.*, 44, 1437, 1987.
- GMCC, 1986a, see Schnell, R.C.
- GMCC, 1986b, see Schnell, R.C., and R.M. Rosson.
- Goldman, A., F.J. Murcray, R.D. Blatherwick, and D.G. Murcray, Quantification of HCl from high-resolution, ground-based infrared solar spectra in the  $3000\text{ cm}^{-1}$  region, *J. Quant. Spec. Rad. Trans.* 30, 385–387, 1986.
- Gooding, J.L., D.S. Clanton, E.M. Gabel, and J.L. Warren, El Chichón volcanic ash in the stratosphere: Particle abundance and size distribution after the 1982 eruption, *Geophys. Res. Lett.*, 10, 1033–1036, 1983.

## REFERENCES

- Gordley, L.L., and J.M. Russell, Rapid inversion of limb radiance data using an emissivity growth approximation, *Appl. Opt.*, 20, 807, 1981.
- Götz, F.W.P., A.R. Meetham, and G.M.B. Dobson, The vertical distribution of ozone in the atmosphere, *Proc. Roy. Soc. London*, A145, 416-446, 1934.
- Graedel, T.E., and J.E. McRae, On the possible increase of the atmospheric methane and carbon monoxide concentrations during the last decade, *Geophys. Res. Letts.*, 7, 977-979, 1980.
- Grant, K.E., P.S. Connell, and D.J. Wuebbles, Monte Carlo uncertainty analysis of change in atmospheric ozone concentrations from large trace gas perturbations, *EOS*, 66, 838, 1985.
- Gray, L.J., and J.A. Pyle, A two dimensional model of the quasi-biennial oscillation of ozone, Polar Ozone Workshop, *NASA Conf. Publ. 10014*, 306 pp., Snowmass, Colorado, 1988.
- Grenander, U., On the estimation of regression coefficients in the case of an autocorrelated disturbance, *Ann. Math. Statist.*, 25, 252-272, 1954.
- Gustin, G.P., On the methodology of total ozone measurements in the global network, *Proc. Main Geophys. Obs. Leningrad*, 406, 63-75, 1978.
- Gustin, G.P., Universal ozonometer, *Proc. Main Geophys. Obs. Leningrad*, 141, 83-98, 1963.
- Gustin, G.P., S.A. Sokolenko, and V.A. Kovalyov, Total-ozone measuring instruments used at the USSR station network, in *Atmospheric Ozone, Proceedings of the Quadrennial Ozone Symposium*, Halkidiki, Greece, September 3-7, 1984, edited by C.S. Zerefos and A. Ghazi, pp. 543-546, D. Reidel, Dordrecht, The Netherlands, 1985.
- Haigh, J.D., Radiative heating in the lower stratosphere and the distribution of ozone in a two-dimensional model, *Quart. J. Roy. Meteorol. Soc.*, 110, 167-185, 1984.
- Hamill, P., The time dependent growth of H<sub>2</sub>O-H<sub>2</sub>SO<sub>4</sub> aerosols by heteromolecular condensation, *J. Aerosol Sci.*, 6, 475-482, 1975.
- Hamill, P., and L.R. McMaster (Eds.), *Polar Stratospheric Clouds: Their Role in Atmospheric Processes*, NASA CP-2318, 72 pp., Hampton, VA, 1984.
- Hamill, P., O.B. Toon, and R.P. Turco, Characteristics of polar stratospheric clouds during the formation of the Antarctic ozone hole, *Geophys. Res. Lett.*, 13, 1288-1291, 1986.
- Hamill, P., R.P. Turco, and O.B. Toon, Formation and properties of nitric acid polar stratospheric clouds, *J. Atmos Chem.*, 7, 287-315, 1988.
- Hamilton, K.P., *Stratospheric Circulation Statistics*, NCAR Tech. Note TN-191-STR, National Center for Atmospheric Research, Boulder, Colorado, 1982.
- Hansen, J.E., W.C. Wang, and A.A. Lacis, Mt. Agung provides best of a global climate perturbation, *Science*, 199, 1065-1068, 1978.
- Hanson, D., and K. Mauersberger, Precision ozone vapor pressure measurements, *J. Chem. Phys.*, 83, 326-328, 1985.
- Hanson, D., and K. Mauersberger, The vapor pressure of solid and liquid ozone, *J. Chem. Phys.*, 85, 4669-4672, 1986.
- Hao, W.M., S.C. Wofsy, M.B. McElroy, J.M. Beer, and M.A. Toqan, Sources of atmospheric nitrous oxide from combustion, *J. Geophys. Res.*, 92, 3098-3104, 1987.
- Harris, N.R.P., and F.S. Rowland, Trends in total ozone measurements at Arosa, *EOS*, 67, 875, 1986.
- Harris, N.R.P., and F.S. Rowland, *Trends in Total Ozone Measurements at Arosa*, American Geophys. Union, San Francisco, 1988.
- Harris, O.D., and G.W. Adams, Where does the O(<sup>1</sup>D) energy go? *J. Geophys. Res.*, 88, 4918-4928, 1983.
- Hartley, W.N., On the absorption of solar rays by atmospheric ozone, *J. Chem. Soc.*, 39, 111-128, 1881b.
- Hartley, W.N., On the absorption spectrum of ozone, *J. Chem. Soc.*, 39, 57-61, 1881a.

## REFERENCES

- Hartmann, D.L., The dynamical climatology of the stratosphere in the Southern Hemisphere during late winter 1973, *J. Atmos. Sci.*, 33, 1789–1802, 1976b.
- Hartmann, D.L., Some aspects of stratospheric dynamics, in *Advances in Geophysics*, 28A, edited by B. Saltzman, vol. ed. S. Manabe, pp. 219–247, Academic Press, Orlando, Florida, 1985.
- Hartmann, D.L., The structure of the stratosphere in the Southern Hemisphere during late winter 1973 as observed by satellite, *J. Atmos. Sci.*, 33, 1141–1154, 1976a.
- Hartmann, D.L., C.R. Mechoso, and K. Yamazaki, Observations of wave mean-flow interaction in the Southern Hemisphere, *J. Atmos. Sci.*, 41, 351–362, 1984.
- Harwood, R.S., The temperature structure of the Southern Hemisphere stratosphere August–October 1971, *Quart. J. Roy. Meteorol. Soc.*, 101, 75–91, 1975.
- Harwood, R.S., and J.A. Pyle, a two-dimensional mean circulation model for the atmosphere below 80 km, *Quart. J. Roy. Meteorol. Soc.*, 101, 723–747, 1975.
- Hasebe, F., The global structure of the total ozone fluctuations observed on the time scales of two to several years, in *Dynamics of the Middle Atmosphere*, edited by J.R. Holton and T. Matsuno, pp. 445–464, Terra Publishers, Tokyo, 1984.
- Hasebe, F., Interannual variations of global total ozone revealed from Nimbus IV BUUV and ground-based observations, *J. Geophys. Res.*, 88, 6819, 1983.
- Hayman, G.D., J.M. Davies, and R.A. Cox, Kinetics of the reaction  $\text{ClO} + \text{ClO} \rightarrow \text{products}$  and its potential relevance to Antarctic ozone, *Geophys. Res. Lett.*, 13, 1347, 1986.
- Hearn, A.G., The absorption of ozone in the ultra-violet and visible regions of the spectrum, *Proc. Phys. Soc. (London)*, 78, 932–940, 1961.
- Heath, D.F., Non-seasonal changes in total column ozone from satellite observations, 1970–1986, *Nature*, 332, 219–227, 1988.
- Heath, D.F., Testimony before the Subcommittee on Health and the Environment of the House Committee on Energy and Commerce, 1986.
- Heath, D.F., and B.M. Schlesinger, The Mg 280-nm doublet as a monitor of changes in solar ultraviolet irradiance, *J. Geophys. Res.*, 91, 8672–8682, 1986.
- Heath, D.F., and B.M. Schlesinger, Temporal variability of UV solar spectral irradiance from 160–400 nm over periods of the evolution and rotation regions from maximum to minimum phases of the sunspot cycle, in *IRS 84: Current Problems in Atmospheric Radiation, Proceedings of the International Radiation Symposium*, Perugia, Italy, edited by G. Fiocco, pp. 315–319, A. Deepak, Hampton, Virginia, 1984.
- Heath, D., A.J. Krueger, and C.L. Mateer, The Backscatter Ultraviolet (BUV) Spectrometer experiment, in *The Nimbus IV User's Guide*, edited by R.R. Sabatini, pp. 149–171, NASA, Greenbelt, Maryland, 1970.
- Heath, D.F., C.L. Mateer, and A.J. Krueger, The Nimbus-4 Backscatter Ultraviolet (BUV) atmospheric ozone experiment—Two years' operation, *PAGEOPH*, 106–108, 1238–1252, 1973.
- Heath, D.F., A.J. Krueger, H.A. Roeder, and B.D. Henderson, The Solar Backscatter Ultraviolet and Total Ozone Mapping Spectrometer (SBUV/TOMS) for Nimbus G, *Opt. Eng.*, 14, 323–331, 1975.
- Heath, D.F., A.J. Krueger, and H. Park, The Solar Backscatter Ultraviolet (SBUV) and Total Ozone Mapping Spectrometer (TOMS) experiment, in *The Nimbus-7 User's Guide*, edited by C.R. Madrid, NASA Goddard Space Flight Center, Greenbelt, MD., 175–211, 1978.
- Herron, M.M., Impurities sources of F, Cl,  $\text{NO}_3$ , and  $\text{SO}_4$  in Greenland and Antarctic precipitation, *J. Geophys. Res.*, 87, 3052–3060, 1982.
- Heymsfield, A.J., Ice particles observed in a cirriform cloud at  $-83^\circ\text{C}$  and implications for polar stratospheric clouds, *J. Atmos. Sci.*, 43, 851–855, 1986.
- Hill, W.J., P.N. Sheldon, and J.J. Tiede, Analyzing world-wide ozone for trends, *Geophys. Res. Lett.*, 4, 21–24, 1977.



## REFERENCES

- Hill, W.J., G.W. Oehlert, and G.C. Reinsel, Trend analysis sensitivity studies of Dobson total ozone data through 1984, *J. Geophys. Res.*, *91*, 14515–14520, 1986.
- Hilsenrath, E., and B.M. Schlesinger, Total ozone seasonal and interannual variations derived from the 7 year Nimbus-4 BUUV data set, *J. Geophys. Res.*, *86*, 12087–12096, 1981.
- Hilsenrath, E., P.J. Dunn, and C.L. Mateer, Standard ozone profiles from balloon and rocket data for satellite and theoretical model input, Presented at IAGA/IAMAP Joint Assembly, Seattle, 1977.
- Hilsenrath, E., W. Attmannspacher, A. Bass, W. Evans, R. Hagemeyer, R.A. Barnes, W. Komhyr, K. Mauersberger, J. Mentall, M. Proffitt, D. Robbins, S. Taylor, A. Torres, and E. Weinstock, Results from the balloon ozone inter-comparison campaign (BOIC), *J. Geophys. Res.*, *91*, 13137–13152, 1986.
- Hofmann, D.J., Perturbations to the global atmosphere associated with El Chichón volcanic eruption of 1982, *Rev. Geophys.*, *25*, 743–759, 1987.
- Hofmann, D.J., and J.M. Rosen, Antarctic observations of stratospheric aerosol and high altitude condensation nuclei following the El Chichón eruption, *Geophys. Res. Lett.*, *12*, 13–16, 1985.
- Hofmann, D.J., and J.M. Rosen, On the temporal variation of stratospheric aerosol size and mass during the first 18 months following the 1982 eruption of El Chichón, *J. Geophys. Res.*, *89*, 4883–4890, 1984.
- Hofmann, D.J., and J.M. Rosen, Stratospheric sulfuric acid fraction and mass estimate for the 1982 volcanic eruption of El Chichón, *Geophys. Res. Lett.*, *10*, 313–316, 1983b.
- Hofmann, D.J., and J.M. Rosen, Sulfuric acid droplet formation and growth in the stratosphere after the 1982 eruption of El Chichón, *Science*, *222*, 325–327, 1983, 1983a.
- Hofmann, D.J., J.M. Rosen, T.J. Pepin, and R.G. Pinnick, Stratospheric aerosol measurements I: Time variations at northern mid-latitudes, *J. Atmos. Sci.*, *32*, 1446–1456, 1975.
- Hofmann, D.J., J.M. Rosen, J.W. Harder, and S.R. Rolf, Ozone and aerosol measurements in the springtime Antarctic stratosphere in 1985, *Geophys. Res. Lett.*, *13*, 1252–1255, 1986.
- Hofmann, D.J., J.W. Harder, S.R. Rolf, and J.M. Rosen, Balloon-borne observations of the development and vertical structure of the Antarctic ozone hole in 1986, *Nature*, *326*, 59–62, 1987a.
- Hofmann, D.J., J.M. Rosen, J.W. Harder, and S.R. Rolf, Observations of the decay of the El Chichón stratospheric aerosol cloud in Antarctica, *Geophys. Res. Lett.*, *14*, 614–617, 1987b.
- Hofmann, D.J., J.M. Rosen, and J.W. Harder, Aerosol measurements in the winter/spring Antarctic stratosphere: I. Correlative measurements with ozone, *J. Geophys. Res.*, *93*, 665–676, 1988.
- Hofmann, D.J., J.W. Harder, J.M. Rosen, J.V. Hereford, and J.R. Carpenter, Ozone profile measurements at McMurdo Station, Antarctica, during spring 1987, *J. Geophys. Res.*, 1989, in press.
- Holland, A.C., R.A. Barnes, and H.S. Lee, Improved rocket ozonesonde (ROCOZ-A) 1. Demonstration of precision, *Appl. Opt.*, *24*, 3286–3295, 1985.
- Holton, J.R., and W.M. Wehrbein, A numerical model of the zonal mean circulation of the middle atmosphere, *Pure Appl. Geophys.*, *118*, 284–306, 1980b.
- Holton, J.R., and W.M. Wehrbein, The role of forced planetary waves in the annual cycle of the zonal mean circulation of the middle atmosphere, *J. Atm. Sci.*, *37*, 1968–1983, 1980a.
- Hood, L.L., The temporal behavior of upper stratospheric ozone at low latitudes: Evidence from Nimbus 4 BUUV data for short-term responses to solar ultraviolet variability, *J. Geophys. Res.*, *89*, 9557–9568, 1984.
- Hoskins, B.J., M.E. McIntyre, and A.W. Robertson, On the use and significance of isentropic potential vorticity maps, *Quart. J. Roy. Meteorol. Soc.*, *111*, 877–946, 1985.

## REFERENCES

- Houghton, J.T., Absorption and emission by carbon dioxide in the mesosphere, *Quart. J. Roy. Meteorol. Soc.*, 95, 1–20, 1969.
- Howard, C.J., and K.M. Evenson, Kinetics of the reaction of HO<sub>2</sub> with NO, *Geophys. Res. Lett.*, 4, 437–441, 1977.
- Hunter, W.R., Optical contamination: Its prevention in the XUV spectrographs flown by the Naval Research Observatory in the Apollo telescope mount, *Appl. Opt.*, 16, 909–916, 1977.
- Hyson, P., Stratospheric water vapour over Australia, *Quart. J. R. Meteorol. Soc.*, 109, 285–294, 1983.
- Isaksen, I.S.A., and O. Hov, Calculations of trends in the tropospheric ozone concentrations of O<sub>3</sub>, OH, CO, CH<sub>4</sub> and NO<sub>x</sub>. *Tellus*, 39B, 271–283, 1987.
- Isaksen, I.S.A., and F. Stordal, Antarctic ozone depletion: 2-D model studies, *Geophys. Res. Lett.*, 13, 1327–1330, 1986a.
- Isaksen, I.S.A., and F. Stordal, Ozone perturbations by enhanced levels of CFCs, N<sub>2</sub>O and CH<sub>4</sub>: A two-dimensional model study including uncertainty estimates, *J. Geophys. Res.*, 91, 5249–5263, 1986b.
- Iwasaka, Y., Non-spherical particles in the Antarctic polar stratosphere—Increase in particulate content and stratospheric water vapor budget, *Tellus*, 38B, 364–374, 1986.
- Iwasaka, Y., and K. Kondoh, Depletion of Antarctic ozone: Height of ozone loss and its temporal changes, *Geophys. Res. Lett.*, 14, 87–90, 1987.
- Iwasaka, Y., T. Ono, and A. Nonura, Changes in aerosol content and temperature in the Antarctic spring stratosphere: Lidar measurement at Syowa station (69° 00' S, 30° 35' E) in 1883, 1984, and 1985, *Geophys. Res. Lett.*, 13, 1407–1410, 1985a.
- Iwasaka, Y., A. Ono, and A. Saitoh, Measurements of water vapor content in the polar stratosphere: Syowa Station, Spring 1983, *Mem. Nat. Inst. Polar Research, Tokyo, Spec. Issue No. 39*, 51–55, 1985b.
- Iwasaka, Y., T. Hirasawa, and H. Fukunishi, Lidar measurement on the Antarctic stratospheric aerosol layer (II) The changes of layer, height, and thickness in winter, *J. Geomag. Geoelectr.*, 38, 99–109, 1986.
- Iwasaka, Y., T. Ono, and A. Nonura, Lidar measurements of Antarctic stratospheric aerosols during 1983, 1984, and 1985: Effect of volcanic eruption of El Chichón, *Mem. Natl. Inst. Polar Res., Spec. Issue No. 47*, 56–61, 1987.
- Jackman, C.H., J.E. Frederick, and R.S. Stolarski, Production of odd nitrogen in the stratosphere and mesosphere: An intercomparison of source strengths, *J. Geophys. Res.*, 85, 7495–7505, 1980.
- Jackman, C.H., R.S. Stolarski, and J.A. Kaye, Two-dimensional monthly average ozone balance from Limb Infrared Monitor of the stratosphere and stratospheric and mesospheric sounder data, *J. Geophys. Res.*, 91, 1103–1116, 1986.
- Jager, H., R. Reiter, W. Carnuth, and S. Jian, Stratospheric aerosol layers during 1982 and 1983 as observed by lidar at Garmisch-Partenkirchen, 12th International Laser Radar Conference, Aix-en-Provence, France, August 13–17, 1984, *Abstracts*, pp. 207–210, 1984.
- Jakosky, B.M., G.E. Thomas, D.W. Rusch, C.A. Barth, G.M. Lawrence, J.J. Olivero, R.T. Clancy, R.W. Sanders, and B.G. Knapp, Solar Mesosphere Explorer observations of stratospheric and mesospheric water vapor, *MECA Workshop on Atmospheric H-b<sub>2</sub>-sO Observations of Earth and Mars: Physical Processes, Measurements, and Interpretations*, Houston, Texas, edited by S.M. Clifford and R.M. Haberle, Lunar and Planetary Inst., Houston, Texas, 1988.
- Johnson, K.W., and M.E. Gelman, Trends in the upper stratospheric temperatures as observed by rocketsondes (1965–1983), in *Handbook for MAP*, edited by S. Kato, SCOSTEP, Urbana, Illinois, 18, 24–27, 1985.
- Johnston, P.V., and R.L. McKenzie, NO<sub>2</sub> observations at 45° during the decreasing phase of solar cycle 21, from 1980 to 1987, *J. Geophys. Res.*, 94, 3473–3486, 1989.

## REFERENCES

- Juckes, M.N., and M.E. McIntyre, A high-resolution one-layer model of breaking planetary waves in the stratosphere, *Nature*, 328, 590–596, 1987.
- Junge, C.E., C.W. Chagnon, and J.E. Mason, Stratospheric aerosols, *J. Meteorol.*, 18, 81–108, 1961.
- Keating, G.M., The response of ozone to solar activity variations. A review, *Solar Physics*, 74, 321–347, 1981.
- Keating, G.M., G.P. Brasseur, J.Y. Nicholson III, and A. De Rudder, Detection of the response of ozone in the middle atmosphere to short-term solar ultraviolet variations, *Geophys. Res. Lett.*, 12, 449–452, 1985.
- Kent, G.S., Dispersion characteristics of volcanically injected aerosol as seen by SAGE I, SAM II and SAGE II, Conference on Atmospheric Radiation, Williamsburg, Virginia, May 13–16, 1986, *Abstracts*, pp. 54–55, 1986.
- Kent, G.S., and M.P. McCormick, SAGE and SAM II measurements of global stratospheric aerosol optical depth and mass loading, *J. Geophys. Res.*, 89, 5303–5314, 1984.
- Kent, G.S., C.R. Trepte, U.O. Farrukh, and M.P. McCormick, Variation in the stratospheric aerosol associated with the north cyclonic polar vortex as measured by the SAM II satellite sensor, *J. Atmos. Sci.*, 42, 1536–1551, 1985a.
- Kent, G.S., P.H. Wang, U.O. Farrukh, A. Deepak, and E.M. Patterson, Development of a global model for atmospheric backscatter at CO<sub>2</sub> wavelengths, *NASA Final Report*, Contract NAS8–35594, 1985b.
- Kent, G.S., L.R. Poole, and M.P. McCormick, Characteristics of Arctic polar stratospheric clouds as measured by airborne lidar, *J. Atmos. Sci.*, 43, 2149–2161, 1986.
- Kerr, J.B., I.A. Asbridge, and W.F.J. Evans, Intercomparison of total ozone measured by the Brewer and Dobson spectrophotometers at Toronto, *J. Geophys. Res.*, 93, 11129–11140, 1988a.
- Kerr, J.B., I.A. Asbridge, and W.F.J. Evans, Long-term intercomparison between the Brewer and Dobson spectrophotometers at Canadian network stations, in *Proc. Quadr. Ozone Symposium—1988*, Göttingen, edited by R.D. Bojkov and P. Fabian, Deepak Publ., USA, in press.
- Khalil, M.A.K., and R.A. Rasmussen, The atmospheric lifetime of methylchloroform (CH<sub>3</sub>CCl<sub>3</sub>), *Tellus*, 36B, 317–332, 1984a.
- Khalil, M.A.K., and R.A. Rasmussen, Atmospheric methane: Trends over the last 10,000 years, *Atmos. Environ.*, 21, 2445–2452, 1987c.
- Khalil, M.A.K., and R.A. Rasmussen, Carbon monoxide in the Earth's atmosphere: Increasing trend, *Science*, 224, 54–56, 1984b.
- Khalil, M.A.K., and R.A. Rasmussen, Carbon monoxide in the Earth's atmosphere: Indications of a global increase, *Nature*, 332, 242–245, 1988.
- Khalil, M.A.K., and R.A. Rasmussen, Chlorocarbons in the Southern Hemisphere: Concentrations and temporal trends, in *Baseline 85, Baseline Atmospheric Program (Australia) 1985*, edited by B.W. Forgan and P.J. Fraser, pp. 26–29, Bureau of Meteorology/CSIRO, 1987a.
- Khalil, M.A.K., and R.A. Rasmussen, Increase and seasonal cycles of nitrous oxide in the Earth's atmosphere, *Tellus*, 35B, 161–169, 1983a.
- Khalil, M.A.K., and R.A. Rasmussen, Increase of CHClF<sub>2</sub> in the Earth's atmosphere, *Nature*, 292, 823–824, 1981.
- Khalil, M.A.K., and R.A. Rasmussen, Interannual variability of atmospheric methane: Possible effects of the El Niño–Southern Oscillation, *Science*, 232, 56–58, 1986.
- Khalil, M.A.K., and R.A. Rasmussen, Nitrous oxide: Trends and global mass balance over the last 3,000 years, *Annals of Glaciology*, 10, 73–79, 1987b.
- Khalil, M.A.K., and R.A. Rasmussen, Secular trends of atmospheric methane, *Chemosphere*, 11, 877–883, 1982.

## REFERENCES

- Khalil, M.A.K., and R.A. Rasmussen, Sources, sinks and seasonal cycles of atmospheric methane, *J. Geophys. Res.*, 88, 5131–5144, 1983b.
- Khalil, M.A.K., and R.A. Rasmussen, The trend of bromochlorodifluoromethane (CB<sub>1</sub>ClF<sub>2</sub>) and the concentrations of other bromine containing gases at the South Pole, *Antarctic Journal of the United States: 1985 Review*, pp. 206–207, 1985.
- Khalil, M.A.K., R.A. Rasmussen, and R. Gunawardena, Atmospheric bromine in the polar regions, in *Geophysical Monitoring for Climatic Change No. 15 Summary Report 1986*, edited by R. Schnell, pp. 123–125, NOAA, Boulder, Colorado, 1986.
- Kiang, C.S., and P. Hamill, H<sub>2</sub>SO<sub>4</sub>–HNO<sub>3</sub>–H<sub>2</sub>O ternary system in the stratosphere, *Nature*, 250, 401–402, 1974.
- Kiehl, J.T., and B.A. Boville, The radiative–dynamical response of a stratospheric–tropospheric general circulation model to changes in ozone, *J. Atmos. Sci.*, 45, 1798–1817, 1988.
- Kiehl, J.T., B.A. Boville, and B.P. Briegleb, Response of a general circulation model to a prescribed Antarctic ozone hole, *Nature*, 332, 522–525, 1988.
- Klenk, K.F., Absorption coefficients of ozone for the backscatter U.V. experiment, *Appl. Opt.*, 19, 236–242, 1980.
- Klenk, K.F., P.K. Bhartia, A.J. Fleig, V.G. Kaveeshwar, R.D. McPeters, and P.M. Smith, Total ozone determination from the Backscatter UV Experiment (BUV), *J. Appl. Meteorol.*, 21, 1672–1684, 1982.
- Kley, D., A. Volz, and F. Mülheims, Ozone measurements in historic perspective: Tropospheric ozone, regional and global scale interactions, edited by I.S.A. Isaksen, *NATO ASI Series C*, Vol. 227, pp. 63–72, D. Reidel, Dordrecht, The Netherlands, 1988.
- Knollenberg, R.G., and D. Huffman, Measurements of the aerosol size distributions in the El Chichón cloud, *Geophys. Res. Lett.*, 10, 1025–1028, 1983.
- Ko, M.K.W., K.K. Tung, D.K. Weinstein, and N.D. Sze, A zonal-mean model of stratospheric tracer transport in isentropic coordinates: Numerical solutions for nitrous oxide and nitric acid, *J. Geophys. Res.*, 90, 2313–2329, 1985.
- Ko, M.K.W., M.B. McElroy, D.K. Weisenstein, and N.D. Sze, Lightning: A possible source of stratospheric odd nitrogen, *J. Geophys. Res.*, 91, 5395–5404, 1986.
- Kobayashi, J., and Y. Toyama, On various methods of measuring the vertical distribution of atmospheric ozone 2, *Papers in Meteor. and Geoph.*, 17, 97–112, 1966.
- Köhler, U., and W. Attmannspacher, Long time intercomparison between Brewer and Dobson spectrophotometer at the Hohenpeissenberg, *Beitr. Phys. Atmosph.*, 59, 85–96, 1986.
- Komhyr, W.D., A carbon–iodine sensor for atmospheric soundings, *Proc. Ozone Symp.*, Albuquerque, New Mexico, pp. 26–30, 1965.
- Komhyr, W.D., Electrochemical concentration cells for gas analysis, *Ann. Geophys.*, 25, 203–210, 1969.
- Komhyr, W.D., Operations handbook: Ozone observations with the Dobson spectrophotometer, *WMO Ozone Report #6*, 125 pp., 1980.
- Komhyr, W.D., and R.D. Evans, Dobson spectrophotometer total ozone measurement errors caused by interfering absorbing species such as SO<sub>2</sub>, NO<sub>2</sub>, and photochemically produced O<sub>3</sub> in polluted air, *Geophys. Res. Lett.* 7, 157–160, 1980.
- Komhyr, W.D., and T.B. Harris, Development of an ECC ozonesonde, *NOAA Tech. Rep. ERL 200–APCL 18*, 54 pp., Natl. Oceanic and Atmos. Admin., Boulder, Colorado, 1971.
- Komhyr, W.D., S.J. Oltmans, A.N. Chopra, R.K. Leonard, T.E. Garcia, and C. McFee, Results of Umkehr, ozonesonde, total ozone, and sulfur dioxide observations in Hawaii following the eruption of El Chichón volcano in 1982, in *Atmospheric Ozone, Proceedings of the Quadrennial Ozone Symposium*, Halkidiki, Greece, September 3–7, 1984, edited by C.S. Zerefos and A. Ghazi, pp. 305–310, D. Reidel, Dordrecht, The Netherlands, 1985.

## REFERENCES

- Komhyr, W.D., R.D. Grass, and R.K. Leonard, Total ozone decrease at South Pole, Antarctica, 1964–1985, *Geophys. Res. Lett.*, 13, 1248–1251, 1986.
- Komhyr, W.D., R.D. Grass, and R.K. Leonard, Dobson spectrophotometer No. 83: A standard for total ozone measurements, manuscript of the NOAA Air Resources Laboratory, Boulder, Colorado, 36 pp., 1987.
- Komhyr, W.D., R.D. Grass, and R.K. Leonard, Calibration history of world standard Dobson spectrophotometer 83 and total ozone trends at Mauna Loa Observatory, Hawaii, and at American Samoa, South Pacific, *Proc. Quadr. Ozone Symposium—1988*, Göttingen, edited by R.D.Bojkov and P. Fabian, A. Deepak, USA, in press.
- Komhyr, W.D., P.R. Franchois, S.E. Kuester, P.J. Reitelbach, and M.L. Fanning, ECC ozone-sonde observations at South Pole, Antarctica, during 1987, *NOAA Data Report ERL ARL-15*, Boulder, CO, 319 pp., 1988a.
- Komhyr, W.D., S.J. Oltmans, and R.D. Grass, Atmospheric ozone at South Pole, Antarctica, in 1986, *J. Geophys. Res.*, 93, 5167–5184, 1988b.
- Komhyr, W.D., R.D. Grass, and R.K. Leonard, Total ozone, ozone vertical distribution, and stratospheric temperatures at South Pole, Antarctica, in 1986 and 1987, *J. Geophys. Res.*, 94, 11429–11436, 1989.
- Krueger, A.J., Sighting of El Chichón sulfur dioxide clouds with the Nimbus 7 total ozone mapping spectrometer, *Science*, 220, 1377–1379, 1983.
- Krueger, A.J., and R.A. Minzner, A mid-latitude ozone model for the 1976 U.S. Standard Atmosphere, *J. Geophys. Res.*, 81, 4477, 1976.
- Krueger, A.J., and M.R. Schoeberl, TOMS observations of total ozone in the 1986 Arctic spring, *Geophys. Res. Lett.*, 14, 527–530, 1987.
- Krueger, A.J., P.E. Ardanuy, F.S. Sechrist, L.M. Penn, D.E. Larko, S.D. Doiron, and R.N. Galimore, The 1987 airborne Antarctic ozone experiment, *NASA Ref. Pub. 1201*, 252 pp., NASA/Goddard Space Flight Center, Greenbelt, MD, 1988.
- Krumins, M.V., and W.C. Lyons, Corrections for the upper atmosphere temperatures using a thin film loop mount, *NOLTR 72-152*, Naval Ordnance Laboratory, White Oak, Silver Spring, Maryland, 1972.
- Labitzke, K., Sunspots, the QBO, and the stratospheric temperature in the north polar region, *Geophys. Res. Lett.*, 14, 535–537, 1987.
- Labitzke, K., and H. van Loon, Associations between the 11-year solar cycle, the QBO and the atmosphere. Part I: The troposphere and stratosphere in the Northern Hemisphere in winter, *J. Atm. Terr. Phys.*, 50, 3, 197–206, 1988.
- Labitzke, K., J.J. Barnett, and B. Edwards, Atmospheric structure and its variation in the region 20 to 120 km, Draft of a new reference middle atmosphere, *Handbook for MAP, Vol. 16*, 318 pp., SCOSTEP, Urbana, Illinois, 1985.
- Labitzke, K., G. Brasseur, B. Naujokat, and A. De Rudder, Long-term temperature trends in the stratosphere: Possible influence of anthropogenic gases, *Geophys. Res. Lett.*, 12, 52–55, 1986a.
- Labitzke, K., B. Naujokat, and J.K. Angell, Long-term temperature trends in the middle stratosphere of the Northern Hemisphere, *Adv. Space Res.*, 6, 7–16, 1986b.
- Labs, D., and H. Neckel, The radiation of the solar photosphere from 2000Å to 100 microns, *Z. Astrophys.*, 69, 1–73, 1968.
- Lacis, A.A., and J.E. Hansen, A parameterization for the absorption of solar radiation in the Earth's atmosphere, *J. Atmos. Sci.*, 31, 118–133, 1974.
- Laird, C.M., Solar particle flux and nitrate in South Pole snow, in *Weather and Climate Responses to Solar Variations*, edited by B.M. McCormac, pp. 237–242, Colorado, Assoc. Univ. Press, Boulder, 1983.
- Lait, L.R., M.R. Schoeberl, and P.A. Newman, Quasi-biennial modulation of the Antarctic ozone depletion, *J. Geophys. Res.*, 94, 11559–11571, 1989.

## REFERENCES

- Lal, S., R. Borchers, P. Fabian, and B.C. Kruger, Increasing abundance of CBrClF<sub>2</sub> in the atmosphere, *Nature*, 216, 135–136, 1985.
- Larsen, J.C., M.P. McCormick, L.R. McMaster, and W.P. Chu, Observations of atmospheric water vapor with the SAGE II instrument, MECA Workshop on Atmospheric H<sub>2</sub>O Observations of Earth and Mars, Houston, Texas, July 1986.
- Lau, N.-C., Circulation statistics based on FGGE level III-B analyses produced by GFDL, *NOAA Data Report, ERL GFDL-5*, 427 pp., NOAA Fluid Dynamics Laboratory, Princeton, NJ, 1984.
- Lazrus, A.L., R.D. Cadle, B.W. Gandrud, J.P. Greenberg, B.J. Huebert, and W.I. Rose, Jr., Sulfur and halogen chemistry of the stratosphere and of volcanic eruption plumes, *J. Geophys. Res.*, 84, 7869–7875, 1979.
- Lean, J., Solar ultraviolet irradiance variations: A review, *J. Geophys. Res.*, 92, 839–868, 1987.
- Legrand, M.R., and R.J. Delmas, The ionic balance of Antarctic snow: A 10-year detailed record, *Atmos. Environ.*, 18, 1867–1874, 1984.
- Legrand, M.R., and R.J. Delmas, Relative contributions of tropospheric and stratospheric sources to nitrate in Antarctic snow, *Tellus*, 38, 236–249, 1986.
- Leovy, C.B., and P.J. Webster, Stratospheric long waves: Comparison of thermal structure in the Northern and Southern Hemispheres, *J. Atmos. Sci.*, 33, 1624–1638, 1976.
- List, R.J., *Smithsonian Meteorological Tables, 6th Edition*, 527 pp., Smithsonian Institution Press, Washington, D.C., 1951.
- Lockwood, G.W., N.M. White, D.T. Thompson, and H. Tug, Spectrally resolved measurements of the El Chichón cloud, May 1982–August 1983, *Geof. Int.*, 23–3, 351–362, 1984.
- Logan, J.A., Tropospheric ozone—Seasonal behaviour, trends and anthropogenic influence, *J. Geophys. Res.*, 90, 10463–10482, 1985.
- London, J., Radiative energy sources and sinks in the stratosphere and mesosphere, in *Proceedings of the NATO Advanced Study Institute on Atmospheric Ozone: Its Variations and Human Influence*, edited by Nicolet and Aiken, pp. 703–721, U.S. Department of Transportation, Washington, D.C., 1980.
- London, J., R.D. Bojkov, S. Oltmans, and J.I. Kelley, Atlas of the global distribution of total ozone, July 1957–June 1967, *NCAR Technical Note NCAR/TN/113 STR*, National Center for Atmospheric Research, Boulder, Colorado, 1976.
- Lovelock, J.E., Methylchloroform in the troposphere as an indicator of OH radical abundance, *Nature*, 267, 32, 1977.
- Luther, F.M., Monthly values of eddy diffusion coefficients in the lower stratosphere, *UCRL Report No. 74616, AIAA Paper No. 73-498*, presented to the AIAA/AMS Conference on the Environmental Impact of Aerospace Operations in the High Atmosphere, Denver, 1973.
- Madden, R.P., Reflecting films for the vacuum ultraviolet, in *Physics of Thin Films*, Vol. 1, edited by G. Hass, pp. 123–186, Academic Press, New York, 1963.
- Mahlman, J.D., and S.B. Fels, Antarctic ozone decreases: A dynamical cause?, *Geophys. Res. Lett.*, 13, 1316–1319, 1986.
- Mahlman, J.D., and L.J. Umscheid, Comprehensive modeling of the middle atmosphere: The influence of horizontal resolution, *Trans. Processes in Middle Atmos.*, edited by G. Visconti and Rolando Garcia, pp. 251–266, 1987.
- Mahlman, J.D., and L.J. Umscheid, Dynamics of the middle atmosphere: Successes and problems of the GFDL “SKYHI” general circulation model, in *Dynamics of the Middle Atmosphere*, edited by J.R. Holton and T. Matsuno, pp. 501–525, Terra Sci. Publ. Co., Tokyo, 1984.
- Mahlman, J.D., H.B. Levy II, and W.J. Moxim, Three-dimensional tracer structure and behavior as simulated in two ozone precursor experiments, *J. Atmos. Sci.*, 37, 655–685, 1980.
- Mahlman, J.D., D.G. Andrews, H.U. Dütsch, D.L. Hartmann, T. Matsuno, R.J. Murgatroyd, and J.F. Noxon, Transport of trace constituents in the stratosphere, *Handbook for MAP, Vol. 3*, edited by C.F. Sechrist, J., 14–43, SCOSTEP, Urbana, Illinois, 1981.

- Mahlman, J.D., D.G. Andrews, D.L. Hartmann, T. Matsuno, and R.G. Murgatroyd, Transport of trace constituents in the stratosphere, in *Dynamics of the Middle Atmosphere*, edited by J.R. Holton and T. Matsuno, pp. 387-416, Terrapub, Tokyo, 1984.
- Makide, Y., and F.S. Rowland, Tropospheric concentrations of methylchloroform,  $\text{CH}_3\text{CCl}_3$ , in January 1978 and estimates of atmospheric residence times for hydrocarbons, *Proc. Nat. Acad. Sci., USA*, 78, 5933-5937, 1981.
- Makide, Y., A. Yokohata, Y. Kubo, and T. Tominaga, Atmospheric concentrations of halocarbons in Japan in 1979-1986, *Bull. Chem. Soc. Japan*, 60, 571-524, 1987a.
- Makide, Y., Y. Kubo, Y. Tojima, and T. Tominaga, The increase of the atmospheric concentration of CFC-113 ( $\text{CCl}_2\text{FCClF}_2$ ), 54th Annual Meeting, Chemical Society of Japan, Tokyo, 1-4 April 1987, *Abstracts*, 1, R8, 1987b.
- Manabe, S., and R.W. Weatherald, Thermal equilibrium of the atmosphere with a given distribution of relative humidity, *J. Atmos. Sci.*, 24, 241-259, 1967.
- Mankin, W.G., and M.T. Coffey, Increased stratospheric hydrogen chloride in the El Chichón cloud, *Science*, 226, 170-172, 1984.
- Mankin, W.G., and M.T. Coffey, Latitudinal distributions and temporal changes of stratospheric HCl and HF, *J. Geophys. Res.*, 88, 10776-10784, 1983.
- Marche, P., and C. Meunier, Atmospheric trace species measured above Haute-Provence observatory, *Planet. Space Sci.*, 31, 731-733, 1983.
- Marche, P., A. Barbe, C. Secroun, J. Corr, and P. Jouve, Ground-based spectroscopic measurement of HCl, *Geophys. Res. Lett.*, 7, 869-872, 1980.
- Martin, L.R., H.S. Judeikis, and M. Wu, Heterogeneous reactions of Cl and ClO in the stratosphere, *J. Geophys. Res.*, 85, 5511-5518, 1980.
- Massie, S.T., J.A. Davidson, C.A. Cantrell, A.H. McDaniel, J.C. Gille, V.G. Kunde, J.C. Brasunas, W.C. Maguire, A. Goldman, and M.M. Abbas, Atmospheric infrared emission of  $\text{ClONO}_2$  observed by a balloon-borne Fourier spectrometer, *J. Geophys. Res.*, 92, 14806-14814, 1987.
- Mastenbrook, H.J., and S.J. Oltmans, Stratospheric water vapor variability for Washington, DC/Boulder, Colorado: 1964-82, *J. Atmos. Sci.*, 40, 2157-2165, 1983.
- Mateer, C.L., On the information content of Umkehr observations, *J. Atmos. Sci.*, 21, 370-381, 1964.
- Mateer, C.L., A review of some aspects of inferring the ozone profile from inversion of ultraviolet radiance measurements, in *Mathematics of Profile Inversion*, edited by L. Colin, pp. 1-2 to 1-25, *NASA Tech. Memo. TM X-62*, 150 pp., Greenbelt, Maryland, 1972.
- Mateer, C.L., and H.U. Dütsch, *Uniform Evaluation of Umkehr Observations From the World Ozone Network, Part I. Proposed Standard Umkehr Evaluation Technique*, 105 pp., National Center for Atmospheric Research, Boulder, Colorado, 1964.
- Mateer, C.L., J.J. DeLuisi, and C.C. Porco, The short Umkehr method, part I: Standard ozone profiles for use in the estimation of ozone profiles by the inversion of short Umkehr observations, *NOAA Tech. Memo. ERL ARL-86*, 20 pp., NOAA Air Resources Laboratories, Silver Spring, MD, 1980.
- Mateer, C.L., D.F. Heath, and A.J. Krueger, Estimation of total ozone from satellite measurements of backscattered ultraviolet Earth radiances, *J. Atmos. Sci.*, 28, 1307-1311, 1971.
- Mauersberger, K., D. Hanson, J. Barnes, and J. Morton, Ozone vapor pressure and absorption cross section measurements: Introduction of an ozone standard, *J. Geophys. Res.*, 92, 8480-8482, 1987.
- Mauldin, L.E., III, and W.P. Chu, Optical degradation due to contamination on the SAGE/SAGE II spaceflight instruments, in *Proc. Society of Photo-optical Instrumentation Engineers*, Arlington, Virginia, May 4-6, 1982.

## REFERENCES

- Mauldin, L.E., III, N.H. Zaun, M.P. McCormick, J.H. Guy, and W.R. Vaughn, Stratospheric Aerosol and Gas Experiment II instrument: A functional description, *Opt. Eng.*, 24, 307–321, 1985a.
- Mauldin, L.E., III, M.P. McCormick, L.R. McMaster, and W.R. Vaughn, The Stratospheric Aerosol and Gas Experiment II (SAGE II) design and in-orbit performance, in *Proc. Society of Photo-optical Instrumentation Engineers, Arlington, Virginia, Vol. 589, Instrumentation for Remote Sensing From Space*, pp. 104–111, 1985b.
- McClatchey, R.A., R.W. Fenn, J.E.A. Selby, F.E. Volz, and J.S. Garind, Optical properties of the atmosphere, *Environ. Res. Papers, AFCRL-71-0279*, Air Force Cambridge Research Laboratories, Bedford, Massachusetts, 1971.
- McCormick, M.P., El Chichón: Lidar and satellite measurements versus time and latitude, Topical Meeting on Optical Remote Sensing of the Atmosphere, January 15–18, 1985, Incline Village, Nevada, *Technical Digest*, pp. TuA2-1 to TuA2-5, 1985.
- McCormick, M.P., Lidar measurements of the El Chichón stratospheric aerosol climatology, 12th International Laser Radar Conference, Aix-en-Provence, France, August 13–17, 1984, *Abstracts*, pp. 207–210, 1984.
- McCormick, M.P., and J.C. Larsen, Antarctic springtime measurements of ozone, nitrogen dioxide, and aerosol extinction by SAM II, SAGE, and SAGE II, *Geophys. Res. Lett.*, 13, 1280–1283, 1986.
- McCormick, M.P., and T.J. Swissler, Stratospheric aerosol mass and latitudinal distribution of the El Chichón eruption cloud for October, 1982, *Geophys. Res. Lett.*, 10, 877–880, 1983.
- McCormick, M.P., and C.R. Trepte, Polar stratospheric optical depth observed between 1978 and 1985, *J. Geophys. Res.*, 92, 4297–4307, 1987.
- McCormick, M.P., and C.R. Trepte, SAM II measurements of Antarctic PSC's and aerosols, *Geophys. Res. Lett.*, 13, 1276–1279, 1986.
- McCormick, M.P., P. Hamill, T.J. Pepin, W.P. Chu, T.J. Swissler, and L.R. McMaster, Satellite studies of the stratospheric aerosol, *Bull. Amer. Meteorol. Soc.*, 60, 1038–1046, 1979.
- McCormick, M.P., G.S. Kent, G.K. Yue, and D.M. Cunnold, SAGE measurements of the stratospheric aerosol dispersion and loading from the Soufriere volcano, *NASA Tech. Paper 1922*, 23 pp., NASA/Langley Research Center, Hampton, VA, 1981.
- McCormick, M.P., H.M. Steele, P. Hamill, W.P. Chu, and T.J. Swissler, Polar stratospheric cloud sightings by SAM II, *J. Atmos. Sci.*, 39, 1387–1397, 1982.
- McCormick, M.P., C.R. Trepte, and G.S. Kent, Spatial changes in the stratospheric aerosol associated with the north polar vortex, *Geophys. Res. Lett.*, 10, 941–944, 1983.
- McCormick, M.P., T.J. Swissler, E. Hilsenrath, A.J. Krueger, and M.T. Osborn, Satellite and correlative measurements of stratospheric ozone: Comparison of measurements made by SAGE, ECC balloons, chemiluminescent, and optical rocketsondes, *J. Geophys. Res.*, 89, 5315–5320, 1984a.
- McCormick, M.P., T.J. Swissler, W.H. Fuller, W.H. Hunt, and M.T. Osborn, Airborne and ground-based lidar measurements of the El Chichón stratospheric aerosol from 90°N to 56°S, *Geof. Int.*, 23-2, 187–221, 1984b.
- McElroy, M.B., R.J. Salawitch, and S.C. Wofsy, Antarctic ozone: Chemical mechanisms for the spring decrease, *Geophys. Res. Lett.*, 13, 1296–1299, 1986a.
- McElroy, M.B., R.J. Salawitch, S.C. Wofsy, and J.A. Logan, Reductions of Antarctic ozone due to synergistic interactions of chlorine and bromine, *Nature*, 321, 759–762, 1986b.
- McIntyre, M.E., and T.N. Palmer, Breaking planetary waves in the stratosphere, *Nature*, 305, 593–600, 1983.
- McIntyre, M.E., and T.N. Palmer, A note on the concept of wave breaking for Rossby and gravity waves, *PAGEOPH*, 123, 964–975, 1985.



## REFERENCES

- McIntyre, M.E., and T.N. Palmer, The "surf-zone" in the stratosphere, *J. Atmos. Terr. Phys.*, **46**, 825–850, 1984.
- McKenzie, R.L., and P.V. Johnston, Springtime stratospheric NO<sub>2</sub> in Antarctica, *Geophys. Res. Lett.*, **11**, 73–75, 1984.
- McMaster, L.R., Stratospheric Aerosol and Gas Experiment (SAGE II), in *Abstracts of the 6th AMS Conference on Atmospheric Radiation*, pp. J46–J48, Williamsburg, Virginia, 1986.
- McPeters, R.D., The climatology of nitric oxide in the upper stratosphere and mesosphere as measured by SBUV, in *Abstracts of the 19th General Assembly of the IUGG*, pp. 7–13, Vancouver, Canada, 1987.
- McPeters, R.D., The climatology of nitric oxide in the upper stratosphere, mesosphere, and thermosphere from 1979 through 1986, *J. Geophys. Res.*, **94**, 3461–3472, 1989.
- McPeters, R.D., A nitric oxide increase observed following the July 1982 solar proton event, *Geophys. Res. Lett.*, **13**, 667–670, 1986.
- McPeters, R.D., and A. Bass, Anomalous atmospheric spectral features between 300 and 310 nm interpreted in light of new ozone absorption coefficients measurements, *Geophys. Res. Lett.*, **9**, 227–230, 1982.
- McPeters, R.D., and W.D. Komhyr, Long-term changes in SBUV/TOMS relative to the world primary standard Dobson instrument, *Proc. Quadr. Ozone Symposium—1988*, Göttingen, edited by R.D. Bojkov and P. Fabian, A. Deepak, USA, in press.
- McPeters, R.D., D.F. Heath, and P.K. Bhartia, Average ozone profiles for 1979 from Nimbus 7 SBUV instrument, *J. Geophys. Res.*, **89**, 5199–5214, 1984.
- McPeters, R.D., R.D. Hudson, P.K. Bhartia, and S.L. Taylor, The vertical ozone distribution in the Antarctic ozone minimum measured by SBUV, *Geophys. Res. Lett.*, **13**, 1213–1216, 1986.
- Mechoso, C.R., D.L. Hartmann, and J.D. Farrara, Climatology and interannual variability of wave, mean-flow interaction in the Southern Hemisphere, *J. Atmos. Sci.*, **42**, 2189–2206, 1985.
- Mechoso, C.R., A. O'Neill, V.D. Pope, and J.D. Farrara, A study of the stratospheric final warming of 1982 in the Southern Hemisphere, *Quart. J. Roy. Meteorol. Soc.*, **114**, 1365–1384, 1988.
- Meeks, M.L., and A.E. Lilley, The microwave spectrum of oxygen in the Earth's atmosphere, *J. Geophys. Res.*, **68**, 1683–1703, 1963.
- Meetham, A.R., Correlation of atmospheric ozone with other geophysical phenomena, *Quart. J. Roy. Meteorol. Soc., Suppl. to 62*, 59–66, 1936.
- Meetham, A.R., The correlation of the amount of ozone with other characteristics of the atmosphere, *Quart. J. Roy. Meteorol. Soc.*, **63**, 289–307, 1937.
- Megie, G., G. Aucellar, and J. Pelon, Lidar measurements of ozone vertical profiles, *Appl. Opt.*, **24**, 3453–3463, 1985.
- Menzies, T., A re-evaluation of laser heterodyne radiometer ClO measurements, *Geophys. Res. Lett.*, **10**, 729–732, 1983.
- Mielenz, K.D., K.L. Eckerle, R.P. Madden, and J. Reader, New reference spectrophotometer, *Appl. Opt.*, **12**, 1630–1641, 1973.
- Miller, A.J., and F.J. Schmidlin, Rocketsonde repeatability and stratospheric variability, *J. Appl. Meteor.*, **10**, 320–327, 1971.
- Molina, L.T., and M.J. Molina, Absolute absorption cross sections of ozone in the 185- to 350-nm wavelength range, *J. Geophys. Res.*, **91**, 14501–14508, 1986.
- Molina, L.T., and M.J. Molina, Production of Cl<sub>2</sub>O<sub>2</sub> from the self-reaction of the ClO radical, *J. Phys. Chem.*, **91**, 433–436, 1987.
- Molina, M.J., T.-L. Tso, L.T. Molina, and F.C.-Y. Wang, Antarctic stratospheric chemistry of chlorine nitrate, hydrogen chloride, and ice: Release of active chlorine, *Science*, **238**, 1253–1257, 1987.

## REFERENCES

- Mount, G.H., *The SME Ultraviolet Ozone Spectrometer—A Users Guide*, Laboratory for Atmospheric and Space Physics Internal Report, University of Colorado, Boulder, 50 pp., 1982.
- Mount, G.H., D.W. Rusch, J.F. Noxon, J.M. Zandony, and C.A. Barth, Measurements of stratospheric NO<sub>2</sub> from the Solar Mesosphere Explorer satellite, 1. An overview of the results, *J. Geophys. Res.*, 89, 1327–1340, 1984.
- Mount, G., R. Sanders, A. Schmeltekopf, and S. Solomon, Visible spectroscopy at McMurdo Station, Antarctica: 1. Overview and daily variations of NO<sub>2</sub> and O<sub>3</sub>, austral spring, 1986, *J. Geophys. Res.*, 92, 8320–8328, 1987.
- Mroz, E.J., A.S. Mason, and W.A. Sedlacek, Stratospheric sulfate from El Chichón and the mystery volcano, *Geophys. Res. Lett.*, 10, 873–876, 1983.
- Murcray, F.J., F.H. Murcray, A. Goldman, D.G. Murcray, and C.P. Rinsland, Infrared measurements of several nitrogen species above the South Pole in December 1980 and November–December 1986, *J. Geophys. Res.*, 92, 13373–13376, 1987.
- Murgatroyd, R.J., and F. Singleton, Possible meridional circulations in the stratosphere and mesosphere, *Quart. J. Roy. Meteorol. Soc.*, 84, 225–234, 1958.
- Muzio, L.J., and J.C. Kramuch, An artifact in the measurement of N<sub>2</sub>O from combustion sources, *Geophys. Res. Lett.*, 15, 1369–1372, 1988.
- Nagatani, R.M., and A.J. Miller, The influence of lower stratospheric forcing on the October Antarctic ozone decrease, *Geophys. Res. Lett.*, 14, 202–205, 1987.
- Nash, J., Extension of explicit radiance observations by the stratospheric sounding unit into the lower stratosphere and lower mesosphere, *Quart. J. Roy. Meteorol. Soc.*, 114, 1153–1171, 1988.
- Nash, J., and J.L. Brownscombe, Validation of the stratospheric sounding unit, *Adv. Space Res.*, 2, 6, 59–62, 1983.
- Nash, J., and G.F. Forrester, Long-term monitoring of stratospheric temperature trends using radiance measurements obtained by the TIROS-N series of NOAA spacecraft, *Adv. Space Res.*, 6, 37–43, 1986.
- Nash, J., and F.J. Schmidlin, *Final Report of the WMO International Radiosonde Intercomparison, Report 30*, WMO, 120 pp., 1987.
- Nastrom, G.D., and A.D. Belmont, Periodic variations in stratospheric–mesospheric temperatures from 20–65 km at 80° N to 30° S, *J. Atmos. Sci.*, 32, 1715–1722, 1975.
- Natarajan, M., L.B. Callis, and J.E. Nealy, Solar UV variability: Effects on stratospheric ozone, trace constituents and thermal structure, *Pure Appl. Geophys.*, 119, 750–779, 1980/81.
- National Research Council (NRC), *The Effects on the Atmosphere of a Major Nuclear Exchange*, 193 pp., National Academy Press, Washington, D.C., 1985.
- Naujokat, B., Long-term variations in the stratosphere of the Northern Hemisphere during the last two sunspot cycles, *J. Geophys. Res.*, 86, 9811–9816, 1981.
- Naujokat, B., An update of the observed quasi-biennial oscillation of the stratospheric winds over the tropics, *J. Atmos. Sci.*, 43, 1873, 1986.
- Naylor, J.A., Error evaluation of a rocket meteorological temperature sounding system, *Contractor Report*, University of Utah to NASA/Wallops Flight Center, Virginia, 1976.
- Neftel, A., J. Beer, H. Oeschger, F. Zurcher, and R.C. Finkel, Sulphate and nitrate concentrations in snow from South Greenland 1895–1978, *Nature*, 314, 611–614, 1985.
- Newman, P.A., The final warming and polar vortex disappearance during the Southern Hemisphere spring, *Geophys. Res. Lett.*, 13, 1228–1231, 1986.
- Newman, P.A., and W.J. Randel, Coherent ozone-dynamical changes during the Southern Hemisphere spring, 1979–1986, *J. Geophys. Res.*, 93, 12585–12606, 1988.
- Newman, P.A., and M.R. Schoeberl, October Antarctic temperature and total ozone trends from 1979–1985, *Geophys. Res. Lett.*, 13, 1206–1209, 1986.
- Noxon, J.F., E.C. Whipple, Jr., and R.S. Hyde, Stratospheric NO<sub>2</sub>, 1. Observational method and behavior at mid-latitude, *J. Geophys. Res.*, 84, 5047–5065, 1979.

## REFERENCES

- NRC: See National Research Council
- Ny, T.-Z., and Choong S.P., L'absorption de la lumiere par l'ozone entre 3050 et 2150 Å, *C.R. Acad. Sci. Paris*, 196, 916-918, 1933.
- Ny, T.-Z., and Choong S.P., L'absorption de la lumiere par l'ozone entre 3050 et 3400 Å (region des bandes de Huggins), *C.R. Acad. Sci. Paris*, 195, 309-311, 1932.
- Oberbeck, V.R., E.F. Danielsen, K.G. Snetsinger, G.V. Ferry, W. Fong, and D.M. Hayes, Effect of the eruption of El Chichón on stratospheric aerosol size and composition, *Geophys. Res. Lett.*, 10, 1021-1024, 1983.
- Oehlert, G., Trends in Dobson total ozone: An update through 1983, *J. Geophys. Res.*, 91, D2, 2675-2679, 1986.
- Ohring, G., K. Gallo, A. Gruber, W. Planet, L. Stowe, and J.D. Tarpley, Climate and Global Change: Chapter 6 of NOAA Satellite Data, *EOS*, 70, 41, p. 889, 1989.
- Olsen, R.O., F.J. Schmidlin, D.U. Wright, and J.K. Luers, Comparison of atmospheric temperatures derived from falling sphere and grenade experiments conducted at Wallops Island in 1975, in *COSPAR Space Research*, XIX, 111-114, 1979.
- Oltmans, S.J., Water vapor profiles for Washington, DC; Boulder, CO; Palestine, TX; Laramie, WY; and Fairbanks, AK; during the period 1974 to 1985, *NOAA Data Report ERL ARL-7*, NOAA, Silver Spring, Maryland, 1986.
- Osantowski, J.F., Contamination sensitivity of typical mirror coatings—A parametric study, *Proc. SPIE* 338, 80-86, 1983.
- Oslik, N., *Solar Backscattered Ultraviolet Radiometer Version 2 User's Guide*, SASC Document No. SASC-T-5-5085-017-84, ST Systems Corp., Lanham, Maryland, 1984.
- Owens, A.J., C.H. Hales, D.L. Filkin, C. Miller, and M. McFarland, Multiple scenario ozone change calculations: The subtractive perturbation approach, in *Atmospheric Ozone, Proceedings of the Quadrennial Ozone Symposium*, Halkidiki, Greece, September 3-7, 1984, edited by C.S. Zerefos and A. Ghazi, pp. 82-86, D. Reidel, Dordrecht, The Netherlands, 1985.
- Ozone Data for the World*, Atmospheric Environment Service, Department of the Environment in cooperation with the World Meteorological Organization, Downsview, Ontario.
- Palmer, K.F., and D. Williams, Optical constants of sulfuric acid; application to the clouds of Venus?, *Appl. Opt.*, 14, 208-219, 1975.
- Park, H., and D.F. Heath, Nimbus 7 SBUV/TOMS calibration for the ozone measurement, in *Atmospheric Ozone, Proceedings of the Quadrennial Ozone Symposium*, Halkidiki, Greece, September 3-7, 1984, edited by C.S. Zerefos and A. Ghazi, pp. 412-416, D. Reidel, Dordrecht, The Netherlands, 1985.
- Parrish, A., P. Solomon, L. deZafra, M. Jaramillo, B. Connor, and J. Barrett, Extremely low N<sub>2</sub>O concentration in the springtime stratosphere at McMurdo Station, Antarctica, 1988, *Nature*, 332, 53, 1988.
- Parsons, C.L., J.C. Gerlach, and M.E. Williams, An intercomparison of ground-based total ozone instruments, *J. Appl. Meteorol.*, 21, 708-724, 1982.
- Paur, R.J., and A.M. Bass, The ultraviolet cross-sections of ozone: II. Results and temperature dependence, in *Atmospheric Ozone, Proceedings of the Quadrennial Ozone Symposium*, Halkidiki, Greece, September 3-7, 1984, edited by C.S. Zerefos and A. Ghazi, pp. 611-616, D. Reidel, Dordrecht, The Netherlands, 1985.
- Pearman, G.I., D. Etheridge, F. de Silva, and P.J. Fraser, Evidence of changing concentrations of atmospheric CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub> from air bubbles in Antarctic ice, *Nature*, 320, 248-250, 1986.
- Penndorf, R.B., Tables of the refractive index for standard air and the Rayleigh scattering coefficient for the spectral region between 0.2μ and 20.0μ and their application to atmospheric optics, *J. Opt. Soc. Am.*, 47, 176, 1957.
- Penney, C.M., Study of temperature dependence of the Chappuis band absorption of ozone, *NASA CR 158977*, 1979.

## REFERENCES

- Perry, R.A., Kinetics of the reactions of the NCO radicals with H<sub>2</sub> and NO using photolysis-laser induced fluorescence, *J. Chem. Phys.*, *82*, 5485–5488, 1985.
- Peterson, K.R., An empirical model for estimating world-wide deposition from atmospheric nuclear detonations, *Health Physics*, *18*, 357–378, 1970.
- Pick, D.R., and J.L. Brownscombe, Early results based on the stratospheric channels of TOVS on the TIROS-N series of operational satellites, *Adv. Space Res.*, *1*, 247–260, 1981.
- Pickering, S.U., Isolation of two predicted hydrates of nitric acid, *J. Chem. Soc.*, *63*, 436–443, 1893.
- Pinnick, R.G., and D.J. Hofmann, Efficiency of light-scattering aerosol particle counters, *Appl. Optics*, *12*, 2593–2597, 1973.
- Pinnick, R.G., J.M. Rosen, and D.J. Hofmann, Measured light scattering properties of individual aerosol particles compared to Mie scattering theory, *Appl. Optics*, *12*, 37–41, 1973.
- Pitari, G., and G. Visconti, Two-dimensional tracer transport: Derivation of residual mean circulation and eddy transport tensor from a 3-D model data set, *J. Geophys. Res.*, *90*, 8019–8032, 1985.
- Pitari, G., M. Verdecchia, and G. Visconti, A transformed Eulerian model to study possible effects of the El Chichón eruption on the stratospheric circulation, *J. Geophys. Res.*, *92*, 10961–10975, 1987.
- Plumb, R.A., and J.D. Mahlman, The zonally averaged transport characteristics of the GFDL general circulation/transport model, *J. Atmos. Sci.*, *44*, 298–327, 1987.
- Pollack, J.B., and T.P. Ackerman, Possible effects of the El Chichón cloud on the radiation budget of the northern tropics, *Geophys. Res. Lett.*, *10*, 1057–1060, 1983.
- Pollack, J.B., and C.P. McKay, The impact of polar stratospheric clouds on the heating rates of the polar winter stratosphere, *J. Atmos. Sci.*, *42*, 245–262, 1985.
- Pollack, J.B., O.B. Toon, C. Sagan, A. Summers, B. Baldwin, and W. VanCamp, Volcanic explosions and climate change: A theoretical assessment, *J. Geophys. Res.*, *81*, 1071–1083, 1976.
- Poole, L.R., *Airborne Lidar Studies of Arctic Polar Stratospheric Clouds*, Ph.D. Dissertation, University of Arizona, Tucson, 1987.
- Poole, L.R., and M.P. McCormick, Airborne lidar observations of Arctic polar stratospheric clouds: Indications of two distinct growth modes, *Geophys. Res. Lett.*, *15*, 21–23, 1988.
- Post, M.J., Atmospheric infrared backscattering profiles: Interpretation of statistical and temporal properties, *NOAA Tech. Memorandum ERL WPL-122*, 113 pp., NOAA, Boulder, CO, 1985.
- Prather, M.J., Continental sources of halocarbons and nitrous oxide, *Nature*, *317*, 221–225, 1985.
- Prather, M.J., European sources of halocarbons and nitrous oxide: Update 1986, *J. Atmos. Chem.*, *6*, 375–406, 1988.
- Prather, M.J., M.B. McElroy, and S.C. Wofsy, Reductions in ozone at high concentrations of stratospheric halogens, *Nature*, *312*, 227–231, 1984.
- Prinn, R.G., P.G. Simmonds, R.A. Rasmussen, R.D. Rosen, F.N. Alyea, C.A. Cardelino, A.J. Crawford, D.M. Cunnold, P.J. Fraser, and J.E. Lovelock, The Atmospheric Lifetime Experiment 1. Introduction, instrumentation and overview, *J. Geophys. Res.*, *88*, 8353–8367, 1983a.
- Prinn, R.G., R.A. Rasmussen, P.G. Simmonds, F.N. Alyea, D.M. Cunnold, B.C. Lane, C.A. Cardelino, and A.J. Crawford, The Atmospheric Lifetime Experiment 5. Results for CH<sub>3</sub>CCl<sub>3</sub> based on three years of data, *J. Geophys. Research*, *88*, 8415–8426, 1983b.
- Prinn, R.G., D. Cunnold, R. Rasmussen, P. Simmonds, F. Alyea, A. Crawford, P. Fraser, and R. Rosen, Atmospheric trends in methylchloroform during 1978–1985 and the global-average OH concentration, *Science*, *238*, 945–950, 1987.
- Prinn, R.G., D. Cunnold, R. Rasmussen, P. Simmonds, F. Alyea, A. Crawford, P. Fraser, and R. Rosen, Atmospheric trends and emissions of nitrous oxide deduced from nine years of ALE-GAGE data, 1988, in preparation.

## REFERENCES

- Pruppacher, H.R., and J.D. Klett, *Microphysics of Clouds and Precipitation*, D. Reidel, Dordrecht, The Netherlands, 1978.
- Pyle, J.A., A calculation of the possible depletion of ozone by chlorofluorocarbons using a two-dimensional model, *PAGEOPH*, 118, 355–377, 1980.
- Ramaswamy, V., and J.T. Kiehl, Sensitivities of the radiative forcing due to large loadings of smoke and dust aerosols, *J. Geophys. Res.*, 90, 5597–5613, 1985.
- Ramaswamy, V., and V. Ramanathan, Solar absorption by cirrus clouds and the maintenance of the upper troposphere thermal structure, *J. Atmos. Sci.*, 46, 2293–2310, 1989.
- Raper, O.F., C.B. Farmer, R. Zander, and J.H. Park, Infrared spectroscopic measurements of halogenated sink and reservoir gases in the stratosphere with the ATMOS instrument, *J. Geophys. Res.*, 92, 9851–9858, 1987.
- Rasmussen, R.A., and M.A.K. Khalil, Atmospheric methane (CH<sub>4</sub>): Trends and seasonal cycles, *J. Geophys. Res.*, 86, 9826–9832, 1981.
- Rasmussen, R.A., and M.A.K. Khalil, Atmospheric methane in recent and ancient atmospheres: Concentrations, trends and interhemispheric gradients, *J. Geophys. Res.*, 89, 11599–11605, 1984.
- Rasmussen, R.A., and M.A.K. Khalil, Atmospheric trace gases: Trends and distributions over the last decade, *Science*, 232, 1623–1624, 1986.
- Rasmussen, R.A., and J.E. Lovelock, The Atmospheric Lifetime Experiment 2. Calibration, *J. Geophys. Res.*, 88, 8369–8378, 1983.
- Reed, R.J., The role of vertical motions in ozone-weather relationships, *J. Meteorology*, 1, 263–267, 1950.
- Reed, R.J., The structure and dynamics of the 26-month oscillation, Paper presented at the 40th anniversary meeting of the Amer. Met. Soc., Boston, 1960.
- Reed, R.J., W.J. Campbell, L.A. Rasmussen, and D.G. Rogers, Evidence of downward-propagating annual wind reversal in the equatorial stratosphere, *J. Geophys. Res.*, 66, 813–818, 1961.
- Reinsel, G.C., Analysis of total ozone data for the detection of recent trends and the effects of nuclear testing during the 1960's, *Geophys. Res. Lett.*, 8, 1227–1230, 1981.
- Reinsel, G.C., and G.C. Tiao, Impact of chlorofluoromethanes on stratospheric ozone: A statistical analysis of ozone data for trends, *J. Am. Stat. Assoc.*, 82, 20–30, 1987.
- Reinsel, G.C., G.C. Tiao, M.N. Wang, R. Lewis, and D. Nychka, Statistical analysis of stratospheric ozone data for the detection trend, *Atmos. Environ.*, 15, 1569–1577, 1981.
- Reinsel, G.C., G.C. Tiao, J.J. DeLuisi, C.L. Mateer, A.J. Miller, and J.E. Frederick, An analysis of upper stratospheric Umkehr ozone profile data for trends and the effects of stratospheric aerosols, *J. Geophys. Res.*, 89, 4833–4840, 1984.
- Reinsel, G.C., G.C. Tiao, A.J. Miller, D.J. Wuebbles, P.S. Connell, C.L. Mateer, and J. Deluisi, Statistical analysis of total ozone and stratospheric Umkehr data for trends and solar cycle relationship, *J. Geophys. Res.*, 92, 2201–2209, 1987.
- Reinsel, G.C., G.C. Tiao, S.K. Ahn, M. Pugh, S. Basu, J.J. Deluisi, C.L. Mateer, A.J. Miller, P.S. Connell, and D.J. Wuebbles, An analysis of the 7 year record of SBUV satellite ozone data: Global profile features and trends in total ozone, *J. Geophys. Res.*, 93, 1689–1703, 1988.
- Reiter, R., H. Jager, W. Carnuth, and W. Funk, The El Chichón cloud over central Europe, observed by lidar at Garmisch-Partenkirchen during 1982, *Geophys. Res. Lett.*, 10, 1001–1004, 1983.
- Remsberg, E.E., J.M. Russell III, L.L. Gordley, P.L. Bailey, W.G. Planet, and J.E. Harries, The validation of Nimbus 7 LIMS measurements of ozone, *J. Geophys. Res.*, 89, 5161–5178, 1984.
- Rinsland, C.P., and J.S. Levine, Free tropospheric carbon monoxide concentrations in 1950 and 1951 deduced from infrared total column amount measurements, *Nature*, 318, 250–254, 1985.

## REFERENCES

- Rinsland, C.P., J.S. Levine, and T. Miles, Concentration of methane in the troposphere deduced from 1951 infrared solar spectra, *Nature*, 318, 245–249, 1985.
- Robbins, R.C., L.A. Cavanagh, L.J. Salas, and E. Robinson, Analysis of ancient atmospheres, *J. Geophys. Res.*, 78, 5341–5344, 1973.
- Robock, A., and M. Matson, Circumglobal transport of the El Chichón volcanic dust cloud, *Science*, 221, 195–197, 1983.
- Rodgers, C.D., A General Error Analysis for Profile Retrieval, 1988, in preparation.
- Rodgers, C.D., Retrieval of atmospheric temperature and composition from remote measurements of thermal radiation, *Rev. Geophys. and Space Phys.* 14, 609–624, 1976.
- Rodriguez, J.M., M.K.W. Ko, and N.D. Sze, Chlorine chemistry in the Antarctic stratosphere: Impact of OClO and Cl<sub>2</sub>O<sub>2</sub> and implications for observations, *Geophys. Res. Lett.*, 13, 1292–1295, 1986.
- Rodriguez, J.M., M.K.W. Ko, and N.D. Sze, Antarctic chlorine chemistry: Possible global implications, *Geophys. Res. Lett.*, 15, 257–260, 1988.
- Roewe, D.A., J.C. Gille, and P.L. Bailey, Infrared limb scanning in the presence of horizontal temperature gradients: An operational approach, *Appl. Opt.*, 21, 3775–3783, 1982.
- Rood, R.B., and A.R. Douglass, Interpretation of ozone temperature correlations—Theory, *J. Geophys. Res.*, 90, 5733–5743, 1985.
- Rosen, J.M., Correlation of dust and ozone in the stratosphere, *Nature*, 209, 1342, 1966.
- Rosen, J.M., The vertical distribution of dust to 30 kilometers, *J. Geophys. Res.*, 69, 4673–4676, 1964.
- Rosen, J.M., The boiling point of stratospheric aerosols, *J. Appl. Meteorol.*, 10, 1044–1046, 1971.
- Rosen, J.M., Simultaneous dust and ozone soundings over North and Central America, *J. Geophys. Res.*, 73, 479–486, 1968.
- Rosen, J.M., and D.J. Hofmann, Balloon-borne measurements of condensation nuclei, *J. Appl. Meteorol.*, 16, 56–62, 1977.
- Rosen, J.M., and D.J. Hofmann, Optical model of stratospheric aerosol: Present status, *Appl. Optics*, 25, 410–419, 1986.
- Rosen, J.M., and D.J. Hofmann, Unusual behavior in the condensation nuclei concentration at 30 km, *J. Geophys. Res.*, 88, 3725–3731, 1983.
- Rosen, J.M., D.J. Hofmann, and J.W. Harder, Aerosol measurements in the winter/spring Antarctic stratosphere 2: Impact on polar stratospheric cloud theories, *J. Geophys. Res.*, 93, 677–686, 1988.
- Rosenfield, J.E., and M.R. Schoeberl, A computation of stratospheric heating rates and diabatic circulation for the Antarctic spring, *Geophys. Res. Lett.*, 13, 1339–1342, 1986.
- Rosenfield, J.E., M.R. Schoeberl, and P.A. Newman, Antarctic springtime ozone depletion computed from temperature observations, *J. Geophys. Res.*, 93, 3833–3849, 1988.
- Rossi, M.J., R. Malhotra, and D.M. Golden, Heterogeneous chemical reaction of chlorine nitrate and water on sulfuric-acid surfaces at room temperature, *Geophys. Res. Lett.*, 14, 127–130, 1987.
- Rottman G.J., C.A. Barth, R.J. Thomas, G.H. Mount, G.M. Lawrence, D.W. Rusch, R.W. Sanders, G.E. Thomas, and J. London, Solar spectral irradiance 120 to 190 nm, October 13, 1981–January 3, 1982, *Geophys. Res. Lett.* 9, 587–590, 1982.
- Rowland, F.S., Some aspects of chemistry in the springtime Antarctic stratosphere, edited by F.S. Rowland and I.S.A. Isaksen, in *The Changing Atmosphere*, Dahlem Konferenzen, November 1–6, 1987, pp. 121–140, John Wiley and Sons, Ltd., Chichester, England, 1988.
- Rowland, F.S., N.R.P. Harris, R.D. Bojkov, and P. Bloomfield, Statistical error analysis of ozone trends Winter depletion in the Northern Hemisphere, in *Proc. Quadr. Ozone Symposium—1988*, Göttingen, edited by R.D. Bojkov and P. Fabian, A. Deepak, USA, in press.

## REFERENCES

- Rusch, D.W., and R.T. Clancy, A comparison of ozone trends from SME and SBUV satellite observations and model calculations, *Geophys. Res. Lett.*, 15, 776–779, 1988.
- Rusch, D.W., G.H. Mount, C.A. Barth, R.J. Thomas, and M.T. Callan, Solar Mesosphere Explorer Ultraviolet Spectrometer: Measurements of ozone in the 1.0–0.1 mbar region, *J. Geophys. Res.*, 89, 11677–11687, 1984.
- Russell, J.M., and S.R. Drayson, The inference of atmospheric ozone using satellite observations in the  $1042\text{ cm}^{-1}$  band, *J. Atmos. Sci.*, 29, 376–390, 1972.
- Russell, J.M., III, and J.C. Gille, The Limb Infrared Monitor of the Stratosphere (LIMS) experiment, in *The Nimbus 7 Users' Guide*, edited by C.R. Madrid, pp. 71–103, NASA/Goddard Space Flight Center, Greenbelt, MD, 1978.
- Russell, P.B., M.P. McCormick, T.J. Swissler, W.P. Chu, J.M. Livingston, W.H. Fuller, J.M. Rosen, D.J. Hofmann, L.R. McMaster, D.C. Woods, and T.J. Pepin, Satellite and correlative measurements of the stratospheric aerosol. II: Comparison of measurements made by SAM II, dustsondes and airborne lidar, *J. Atmos. Sci.*, 38, 1295–1312, 1981.
- Russell, J.M., III, C.B. Farmer, C.P. Rinsland, R. Zander, L. Froidevaux, G.C. Toon, B. Gao, J. Shaw, and M. Gunson, Measurements of odd nitrogen compounds in the stratosphere by the ATMOS experiment on Spacelab 3, *J. Geophys. Res.*, 93, 1718–1736, 1988.
- Salawitch, R.J., S.C. Wofsy, and M.B. McElroy, Chemistry of OClO in the Antarctic stratosphere: Implications for bromine, *Planet. Space Sci.*, 36, 213–224, 1988a.
- Salawitch, R.J., S.C. Wofsy, and M.B. McElroy, Influence of polar stratospheric clouds on the depletion of ozone over Antarctica, *Geophys. Res. Lett.*, 15, 871–874, 1988b.
- Sander, S.P., and R.R. Friedl, Kinetics and product studies of the  $\text{BrO} + \text{ClO}$  reaction: Implications for Antarctic chemistry, *Geophys. Res. Lett.*, 15, 887–890, 1988.
- Sander, S.P., and R.R. Friedl, Kinetic studies of the reaction  $\text{BrO} + \text{ClO}$ : Products by flash photolysis, Paper delivered at the Eighteenth International Symposium of Free Radicals, Oxford, England, 1987.
- Sanford, J.L., On the nature of persistent stratospheric clouds in the Antarctic, *Tellus*, 29, 530–534, 1977.
- Sargan, J.D., Wages and prices in the United Kingdom: A study in econometric methodology, in *Econometric Analysis for National Economic Planning*, edited by P.E. Hart, G. Mills, and J.K. Whittaker, pp. 25–54, Butterworth, London, 1964.
- Schlesinger, M.E., and J.F.B. Mitchell, Climate model simulations of the equilibrium response to increased carbon dioxide, *Rev. Geophys.*, 25, 760–798, 1987.
- Schmidlin, F.J., Intercomparison of temperature, density, and wind measurements from in situ and satellite techniques, *Adv. Space Res.*, 4, 101–110, 1984.
- Schmidlin, F.J., Repeatability and measurement uncertainty of the United States meteorological rocketsonde, *J. Geophys. Res.*, 86, 9599–9603, 1981.
- Schnell, R.C. (Ed.), *Geophysical Monitoring for Climatic Change, No. 14, Summary Report 1985*, NOAA, Air Resources Laboratory, Boulder, CO, pp. 57–60, 1986a.
- Schnell, R.C. (Ed.), *Geophysical Monitoring for Climatic Change, No. 14, Summary Report 1985*, NOAA, Air Resources Laboratory, Boulder, CO, pp. 37–42, 1986b.
- Schoeberl, M.R., and R.S. Stolarski, Reply to Elliott and Rowland, *Geophys. Res. Lett.*, 15, 198–199, 1988.
- Schoeberl, M.R., and D.F. Strobel, The response of the zonally averaged circulation to stratospheric ozone reductions, *J. Atmos. Sci.*, 35, 1751–1757, 1978.
- Schoeberl, M.R., A.J. Krueger, and P.A. Newman, The morphology of Antarctica total ozone as seen by TOMS, *Geophys. Res. Lett.*, 13, 1217–1220, 1986.
- Schuster, G., R. Rood, and M. Schoeberl, Quasi-biennial and inter-annual variability in high resolution Total Ozone Data (TOMS), in *Proc. Quadr. Ozone Symposium—1988*, Göttingen, edited by R.D. Bojkov and P. Fabian, Deepak Publ., USA, in press.

## REFERENCES

- Schwarzkopf, M.D., and S.B. Fels, Improvements to the algorithm for computing CO<sub>2</sub> transmissivities and cooling rates, *J. Geophys. Res.*, 90, 10541–10550, 1985.
- Seiler, W., H. Giehl, E.G. Brunke, and E. Halliday, The seasonality of CO abundance in the Southern Hemisphere, *Tellus*, 36B, 250–254, 1984.
- Sekiguchi, Y., Antarctic ozone change correlated to the stratospheric temperature field, *Geophys. Res. Lett.*, 13, 1202–1205, 1986.
- Self, S., M.R. Rampino, and J.J. Barbera, The possible effects of large 19th and 20th century volcanic eruptions on zonal and hemispheric surface temperatures, *J. Volcan. Geotherm. Res.*, 11, 41–60, 1981.
- Shah, G.M., and W.F.J. Evans, Latitude survey of aerosol optical thickness of the El Chichón eruption cloud in May 1983, *Geophys. Res. Lett.*, 12, 255–258, 1985.
- Shapiro, M.A., R.C. Schnell, F.P. Parungo, S.J. Oltmans, and B.A. Bodhaine, El Chichón volcanic debris in an Arctic tropopause fold, *Geophys. Res. Lett.*, 11, 421–424, 1984.
- Shettle, E.P., and R.W. Fenn, Models for the aerosols of the lower atmosphere and the effects of humidity variations on their optical properties, *Rep. AFGL-TR-79-0214*, 94 pp., 1979.
- Shi, G.Y., W.C. Wang, M.K.W. Ko, and M. Tanaka, Radiative heating due to stratospheric aerosols over Antarctica, *Geophys. Res. Lett.*, 13, 1335–1338, 1986.
- Shibasaki, K., N. Iwagami, and T. Ogawa, Stratospheric nitrogen dioxide observed by ground-based and balloonborne techniques at Syowa Station (69.0°S, 39.6°E), *Geophys. Res. Lett.*, 13, 1268–1271, 1986.
- Shibata, T., M. Fujiwara, and M. Hirono, The El Chichón volcanic cloud in the stratosphere: Lidar observations at Fukuoka and numerical simulation, *J. Atmos. Terr. Phys.*, 46, 1121–1146, 1984.
- Shine, K.P., The middle atmosphere in the absence of dynamical heat fluxes, *Quart. J. Roy. Meteorol. Soc.*, 113, 603–633, 1987.
- Shine, K.P., On the modelled thermal response of the Antarctic stratosphere to a depletion of ozone, *Geophys. Res. Lett.*, 13, 1331–1334, 1986.
- Shiotani, M., and J.C. Gille, Dynamical factors affecting ozone mixing ratios in the Antarctic lower stratosphere, *J. Geophys. Res.*, 92, 9811–9824, 1987.
- Shumway, R.H., *Applied Statistical Time Series Analysis*, Prentice-Hall, Englewood Cliffs, New Jersey, 1988.
- Simkin, T., L. Siebert, L. McClelland, D. Bridge, C. Newhall, and J.H. Latter, *Volcanoes of the World*, 232 pp., Smithsonian Institution, Washington, D.C., 1981.
- Simmonds, P.G., F.N. Alyea, C.A. Cardelino, A.J. Crawford, D.M. Cunnold, B.C. Lane, J.E. Lovelock, R.G. Prinn, and R.A. Rasmussen, The Atmospheric Lifetime Experiment 6. Results for carbon tetrachloride based on three years of data, *J. Geophys. Res.*, 88, 8427–8441, 1983.
- Simmonds, P.G., D.M. Cunnold, F.N. Alyea, C.A. Cardelino, A.J. Crawford, R.G. Prinn, P.J. Fraser, R.A. Rasmussen, and R.D. Rosen, Carbon tetrachloride lifetimes and emissions determined from daily global measurements during 1978–1985, *J. Atmos. Chem.*, 7, 35–58, 1988.
- Singer, S.F., and R.C. Wentworth, A method for the determination of the vertical ozone distribution from a satellite, *J. Geophys. Res.*, 62, 299–308, 1957.
- Singh, H.B., Preliminary estimates of average tropospheric OH concentrations in the Northern and Southern Hemispheres, *Geophys. Res. Lett.*, 4, 453–456, 1977.
- Smith, D.Y., E. Shiles, and M. Inokuti, The optical properties of metallic aluminum, in *Handbook of Optical Constants of Solids*, edited by E.D. Palik, pp. 369–406, Academic Press, Orlando, Florida, 1985.
- Smith, W.L., H.M. Woolf, C. Hayden, D.Q. Wark, and L.M. McMillan, TIROS-N operational vertical sounder, *Bull. Amer. Meteor. Soc.*, 60, 1177–1197, 1979.



## REFERENCES

- Solomon, S., The mystery of the Antarctic ozone hole, *Rev. Geophysics*, 26, 131–148, 1988.
- Solomon, S., and R.R. Garcia, On the distributions of long-lived tracers and chlorine species in the middle atmosphere, *J. Geophys. Res.*, 89, 11633–11644, 1984a.
- Solomon, S., and R.R. Garcia, Transport of thermospheric NO to the upper stratosphere?, *Planet. Space Sci.*, 32, 399–409, 1984b.
- Solomon, S., R.R. Garcia, F.S. Rowland, and D.J. Wuebbles, On the depletion of Antarctic ozone, *Nature*, 321, 755–758, 1986a.
- Solomon, S., J.T. Keihl, B.J. Kerridge, E.E. Remsberg, and J.M. Russell III, Evidence for nonlocal thermodynamic equilibrium in the  $v_3$  mode of mesospheric ozone, *J. Geophys. Res.*, 91, 9865–9876, 1986b.
- Solomon, P.M., B. Connor, R. deZafra, A. Parrish, J. Barrett, and M. Jaramillo, Observations of high concentrations of chlorine monoxide in the lower stratosphere during the Antarctic spring, II, Secular variation, *Nature*, 328, 411–413, 1987.
- Solomon, S., G.H. Mount, R.W. Sanders, and A.L. Schmeltekopf, Visible spectroscopy at McMurdo Station, Antarctica: 2 Observations of OClO, *J. Geophys. Res.*, 92, 8329–8338, 1987.
- Spinhirne, J.D., El Chichón eruption cloud: Latitudinal variation of the spectral optical thickness for October 1982, *Geophys. Res. Lett.*, 10, 881–884, 1983.
- St. John, D.S., S.P. Bailey, W.H. Fellner, J.M. Minor, and R.D. Snee, Time series search for trend in total ozone measurements, *J. Geophys. Res.*, 86, 7299–7311, 1981.
- St. John, D.S., S.P. Bailey, W.H. Fellner, J.M. Minor, and R.D. Snee, Time series analysis of stratospheric ozone, *Commun. Statist. Theory Methods*, 11, 1293–1333, 1982.
- Stauffer, B., G. Fischer, A. Neftel, and H. Oeschger, Increase of atmospheric methane recorded in Antarctic ice, *Science*, 229, 1386–1388, 1985.
- Steele, H.M., and P. Hamill, Effects of temperature and humidity on the growth and optical properties of sulphuric acid water droplets in the stratosphere, *J. Aerosol Sci.*, 12, 515–527, 1981.
- Steele, H.M., P. Hamill, M.P. McCormick, and T.J. Swissler, The formation of polar stratospheric clouds, *J. Atmos. Sci.*, 40, 2055–2067, 1983.
- Steele, L.P., P.J. Fraser, R.A. Rasmussen, M.A.K. Khalil, T.J. Conway, A.J. Crawford, R.H. Gammon, K.A. Masarie, and K.W. Thoning, The global distribution of methane in the troposphere, *J. Atmos. Chem.*, 5, 125–171, 1987.
- Stolarski, R.S., The Antarctic ozone hole, *Sci. Am.*, 258, 20–26, 1988.
- Stolarski, R.S., Changes in ozone over the Antarctic, in *The Changing Atmosphere*, Dahlem Konferenzen, edited by F.S. Rowland and I.S.A. Isaksen, pp. 105–120, John Wiley and Sons Ltd., Chichester, England, 1988.
- Stolarski, R.S., and A.R. Douglass, Sensitivity of an atmospheric photochemistry model to chlorine perturbations including consideration of uncertainty propagation, *J. Geophys. Res.*, 91, 7853–7864, 1986.
- Stolarski, R.S., and M.R. Schoeberl, Further interpretation of satellite measurements of Antarctic total ozone, *Geophys. Res. Lett.* 13, 1210–1212, 1986.
- Stolarski, R.S., A.J. Krueger, M.R. Schoeberl, R.D. Peters, P.A. Newman, and J.C. Alpert, Nimbus 7 SBUV/TOMS measurements of the springtime Antarctic ozone decrease, *Nature*, 322, 808–811, 1986.
- Stolarski, R.S., A.J. Krueger, and M.R. Schoeberl, Total ozone trends from TOMS data, in *Proc. Quadr. Ozone Symp.—88*, Göttingen, Deepak Publ., USA, in press.
- Stordal, F., Isaksen, I.S.A., and Hornveth, K., 1985, A diabatic circulation two-dimensional model with photochemistry simulations of ozone and long-lived tracers with surface sources, *J. Geophys. Res.*, 90, 5757–5776, 1985.
- Strand, O.N., and E.R. Westwater, Statistical estimation of the numerical solution of a Fredholm integral equation of the first kind, *J. Assoc. Comp. Mach.*, 15, 100–114, 1968.

## REFERENCES

- Streit, G.E., C.J. Howard, A.L. Schmeltekopf, J.A. Davidson, and H.I. Schiff, Temperature dependence of the  $O(^1D)$  rate constants for reactions with  $O_2$ ,  $N_2$ ,  $CO_2$ ,  $O_3$  and  $H_2O$ , *J. Chem. Phys.*, 65, 4761–4764, 1976.
- Strong, A.E., Monitoring El Chichón aerosol distribution using NOAA-7 satellite AVHRR sea surface temperature, *Geof. Int.*, 23-2, 129–142, 1984.
- Swissler, T.J., M.P. McCormick, and J.D. Spinhirne, El Chichón eruption cloud, comparison of lidar and optical thickness measurements for October 1982, *Geophys. Res. Lett.*, 10, 885–888, 1983.
- Sze, N.D., Anthropogenic CO emissions: Implications for the atmospheric CO–OH–CH<sub>4</sub> cycle, *Science*, 195, 673–675, 1977.
- Taylor, S.L., P.K. Bhartia, V.G. Kaveeshwar, K.F. Klenk, A.J. Fleig, and C.L. Mateer, Role of multiple scattering in ozone profile retrieval from satellite measurements in the ultraviolet, in *Remote Sensing of Atmospheres and Oceans*, edited by A. Deepak, pp. 219–231, Academic Press, New York, 1980.
- Thomas, G.E., Solar Mesosphere Explorer measurements of polar mesospheric clouds (noctilucent clouds), *J. Atmos. Terr. Phys.*, 46, 819–824, 1984.
- Thomas, G.E., B.M. Jakosky, R.A. West, and R.W. Sanders, Satellite limb-scanning thermal infrared observations of the El Chichón stratospheric aerosols: First results, *Geophys. Res. Lett.*, 10, 997–1000, 1983.
- Thomas, R.J., C.A. Barth, D.W. Rusch, and R.W. Sanders, Solar Mesosphere Explorer Near-Infrared Spectrometer: Measurements of  $1.27\mu$  radiances and the inference of mesospheric ozone, *J. Geophys. Res.*, 89, 9569–9580, 1984.
- Thomas, R.W.L., and A.C. Holland, Simple relationship between UV radiation backscattered by the Earth's atmosphere and the vertical ozone profile, *Appl. Opt.* 16, 2581–2583, 1977.
- Thompson, A.M., and R.J. Cicerone, Possible perturbations to atmospheric CO, CH<sub>4</sub> and OH, *J. Geophys. Res.*, 91, 10853–10864, 1986.
- Tiao, G.C., G.C. Reinsel, J.H. Frederick, G.M. Allenby, C.L. Mateer, A.J. Miller, and J.J. DeLuisi, A statistical trend analysis of ozonesonde data, *J. Geophys. Res.*, 91, 13121–13136, 1986.
- Tolbert, M.A., M.J. Rossi, R. Malhotra, and D.M. Golden, Reaction of chlorine nitrate with hydrogen chloride and water at Antarctic stratospheric temperatures, *Science*, 238, 1258–1260, 1987.
- Tolson, R.H., Spatial and temporal variations of monthly mean total columnar ozone derived from 7 years of BUV data, *J. Geophys. Res.*, 86, 4788–4796, 1981.
- Toohey, D.W., and J.G. Anderson, Formation of BrCl ( $3\pi\sigma^+$ ) in the reaction of BrO with ClO, *J. Phys. Chem.*, 92, 1705, 1988.
- Toon, O.B., and J.B. Pollack, A global average model of atmospheric aerosols for radiative transfer calculations, *J. Appl. Meteor.*, 15, 225–246, 1976.
- Toon, O.B., P. Hamill, R.P. Turco, and J. Pinto, Condensation of HNO<sub>3</sub> and HCl in the winter polar stratosphere, *Geophys. Res. Lett.*, 13, 1284–1287, 1986.
- Torres, A.L., and A.R. Bandy, Performance characteristics of the electrochemical concentration cell ozonesonde, *J. Geophys. Res.*, 83, 5501–5504, 1978.
- Torres, A.L., and G. Brothers, Ozone measurements above Palmer Station, Antarctica, Polar Ozone Workshop, *NASA Conf. Publ. 10014*, pp. 42–44, Snowmass, Colorado, 1988.
- Tung, K.K., On the relationship between the thermal structure of the stratosphere and the seasonal distribution of ozone, *Geophys. Res. Lett.*, 13, 1308–1311, 1986.
- Tung, K.K., and H. Yang, Dynamic variability of column ozone, *J. Geophys. Res.*, 93, 11123–11128, 1988.
- Tung, K.K., and H. Yang, Dynamical component of seasonal and year-to-year changes in Antarctic and global ozone, *J. Geophys. Res.*, 93, 12537–12559, 1989.

## REFERENCES

- Tung, K.K., M.K.W. Ko, J.M. Rodriguez, and N.D. Sze, Are Antarctic ozone variations a manifestation of dynamics or chemistry?, *Nature*, 322, 811–814, 1986.
- Turco, R.P., R.C. Whitten, and O.B. Toon, Stratospheric aerosols: Observation and theory, *Rev. Geophys. Space Phys.*, 20, 233–279, 1982.
- Turco, R.P., O.B. Toon, and P. Hamill, Heterogeneous physicochemistry of the polar ozone hole, *J. Geophys. Res., Special Issue*, 1989, in press.
- Twomey, S., *Atmospheric Aerosols*, 302 pp., Elsevier, Amsterdam, The Netherlands, 1977.
- Twomey, S., On the numerical solution of Fredholm integral equations of the first kind by the inversion of the linear systems produced by quadrature, *J. Assoc. Comp. Mach.*, 10, 97–101, 1963.
- Twomey, S., B. Herman, and R. Rabinoff, An extension to the Chahine method of inverting the radiative transfer equation, *J. Atmos. Sci.*, 34, 1085–1096, 1977.
- Uchino, O., On dispersion processes of the El Chichón dust particles in the lower stratosphere, *J. Meteor. Soc. Japan*, 63, 288–293, 1985.
- Valentini, J.J., D.P. Gerrity, D.L. Phillips, J.C. Neih, and K.D. Tabor, CARS spectroscopy of  $O_2(^1\Delta/g)$  from the Hartley band photodissociation of  $O_3$ : Dynamics of the dissociation, *J. Chem. Phys.*, 86, 6745–6756, 1987.
- van Loon, H., and K. Labitzke, The Southern Oscillation, Part V: The anomalies in the lower stratosphere of the Northern Hemisphere in winter and a comparison with the Quasi-Biennial Oscillation, *Mon. Weather Rev.*, 115, 357–369, 1987.
- Vassey, A., and E. Vassey, Effect of temperature on the absorption spectrum of ozone: Chappuis bands, *J. Chem. Phys.*, 16, 1163–1164, 1948.
- Vedder, J.F., E.P. Condon, E.C.Y. Inn, K.D. Tabor, and M.A. Kritz, Measurements of stratospheric  $SO_2$  after the El Chichón eruptions, *Geophys. Res. Lett.*, 10, 1045–1048, 1983.
- Veryard, R.G., and Ebdon, R.A., Fluctuations in tropical stratospheric winds, *Meteor. Mag.*, 90, 125–143, 1961.
- Vierkorn-Rudolph, B., K. Bachmann, B. Schwarz, and F.X. Meixner, Vertical profiles of hydrogen chloride in the troposphere, *J. Atmos. Chem.*, 2, 47–63, 1984.
- Vigroux, E., Contribution a l'étude expérimentale de l'absorption de l'ozone, *Ann. Phys.*, 8, 709–762, 1953.
- Vigroux, E., Détermination des coefficients moyens d'absorption de l'ozone en vue des observations concernant l'ozone atmosphérique a l'aide du spectromètre Dobson, *Ann. Phys.*, 2, 209–215, 1967.
- Vupputuri, R.K.R., Potential effects of anthropogenic trace gas emissions on atmospheric ozone, temperature structure and surface climate, in *Measuring the Greenhouse Effect, Report ARD87-2*, edited by W.F.J. Evans, A.J. Forester, and D.I. Wardle, pp. 147–156, Atmospheric Environment Service, Canada, 1987.
- Wagner, N.K., Theoretical accuracy of a meteorological thermistor, *J. Appl. Meteor.*, 3, 461–469, 1964.
- Wallace, J.M., General circulation of the tropical lower stratosphere, *Rev. Geophys. Space Phys.*, 11, 191–222, 1973.
- Wang, W.-C., D.J. Wuebbles, W.M. Washington, R.G. Isaacs, and G. Molnar, Trace gases and other potential perturbations to global climate, *Rev. Geophys.*, 24, 110–140, 1986.
- Wardle, D.J., C.D. Walshaw, and T.W. Wormell, A new instrument for atmospheric ozone, *Nature*, 199, 1177–1178, 1983.
- Waters, J.W., J.C. Hardy, R.F. Jarnot, and H.M. Pickett, Chlorine monoxide radical, ozone, and hydrogen peroxide: Stratospheric measurements by microwave limb sounding, *Science*, 214, 61–64, 1981.

- Watson, R.T., M.A. Geller, R.S. Stolarski, and R.F. Hampson, Present state of knowledge of the upper atmosphere: An assessment, *NASA Reference Publication RP 1162*, NASA/Goddard Space Flight Center, Greenbelt, MD, 1986.
- Wayne, R.P., Reactions of singlet molecular oxygen in the gas phase, in *Singlet O<sub>2</sub>, Vol 1, Physical-Chemical Aspects*, edited by A.A. Frimer, pp. 81–175, CRC Press, Boca Raton, Florida, 1985.
- Weinstock, E.M., M.J. Phillips, and J.G. Anderson, In situ observation of ClO in the stratosphere: A review of recent results, *J. Geophys. Res.*, *86*, 7273–7278, 1981.
- Weiss, R.F., The temporal and spatial distribution of tropospheric nitrous oxide, *J. Geophys. Res.*, *86*, 7185–7195, 1981.
- Wellemeyer, C.G., A.J. Fleig, and P.K. Bhartia, Internal comparisons at SBUV and TOMS total ozone measurements, *Proc. Quadr. Ozone Symposium—1988*, Göttingen, edited by R.D. Bojkov and P. Fabian, Deepak Publ., USA, in press.
- Witteborn, F.C., K. O'Brien, H.W. Crean, J.B. Pollack, and K.H. Bilski, Spectroscopic measurements of the 8- to 13-micrometer transmission of the upper atmosphere following the El Chichón eruptions, *Geophys. Res. Lett.*, *10*, 1009–1012, 1983.
- WMO, Report of the meeting of experts on the assessment of performance characteristics of various ozone observing systems, World Meteorological Organization Ozone Project, *Report No. 9*, WMO, Boulder, Colorado, 1980.
- WMO, Report of the meeting of experts on sources of errors in detection of ozone trends, World Meteorological Organization Ozone Project, *Report No. 12*, WMO, Toronto, 48 pp., 1982.
- WMO, *Atmospheric Ozone, Assessment of Our Understanding of the Processes Controlling its Present Distribution and Change*, *Report No. 16*, World Meteorological Organization Global Ozone Research and Monitoring Project, in three volumes, Washington D.C., 1986.
- Wofsy, S.C., M. Molina, R.J. Salawitch, L.E. Fox, and M.B. McElroy, Interactions between HCl, NO<sub>x</sub>, and H<sub>2</sub>O ice in the Antarctic stratosphere: Implications for ozone, *J. Geophys. Res.*, *93*, 2442–2450, 1988.
- Woodgate, B.R., E.A. Tandberg-Hanssen, E.C. Bruner, J.M. Beckers, J.C. Brandt, W. Henze, C.L. Hyder, M.W. Kalet, P.J. Kenny, E.D. Knox, A.G. Michalitsianos, R. Rehse, R.A. Shine, and H.D. Tinsley, The ultraviolet spectrometer and polarimeter on the Solar Maximum Mission, *Sol. Phys.*, *65*, 73–90, 1980.
- Woods, D.C., and R.L. Chuan, Size-specific composition of aerosols in the El Chichón volcanic cloud, *Geophys. Res. Lett.*, *10*, 1041–1044, 1983.
- Worsnop, D.R., M.S. Zahniser, P. Davidovits, C.C. Kolb, Heterogeneous reaction kinetics of importance to stratospheric chemistry, *Report No. ARIRR #613*, 1987.
- Wuebbles, D.J., A theoretical analysis of the past variations in global atmospheric composition and temperature structure, *UCRL-53423*, Lawrence Livermore National Laboratory, Livermore, CA, 1983a.
- Wuebbles, D.J., *A Theoretical Analysis of the Past Variations in Global Atmospheric Composition and Temperature Structure*, Ph.D. Thesis, University of California, Livermore, 1983b.
- Wuebbles, D.J., Trends in ozone and temperature structure: Comparison of theory and measurement, in *Atmospheric Ozone, Proc. Quadrennial Ozone Symposium*, Halkidiki, Greece, September 3–7, 1984, edited by C.S. Zerefos and A. Ghazi, pp. 87–91, D. Reidel, Dordrecht, The Netherlands, 1985.
- Wuebbles, D.J., M.C. MacCracken, and F.M. Luther, A proposed reference set of scenarios for radiatively active atmospheric constituents, U.S. Department of Energy, Carbon Dioxide Research Division, *Technical Report 015*, 54 pp., Washington, DC, 1984.
- Wuebbles, D.J., P.S. Cornell, K.E. Grant, R. Tarp, and K.E. Taylor, Initial results with the LLNL 2-D chemical-radiative-transport model of the troposphere and stratosphere, Lawrence Livermore National Laboratory Report, *CID-21145*, 14 pp., Livermore, California, 1987.



- Yue, G.K., M.P. McCormick, and W.P. Chu, A comparative study of aerosol extinction measurements made by the SAM II and SAGE satellite experiments, *J. Geophys. Res.*, 89, 5321-5327, 1984.
- Yue, G.K., M.P. McCormick, W.P. Chu, P. Wang, and M.T. Osborn, Comparative studies of aerosol extinction measurements made by the SAM II and SAGE II satellite experiments, *J. Geophys. Res.*, 94, 8412-8424, 1989.
- Zander, R., and Ph. de Moulin, Spectroscopic evidence for the presence of the  $v_4$ -Q branch of chlorine nitrate (ClONO<sub>2</sub>) in ground-based infrared solar spectra, *J. Atmos. Chem.*, 6, 191-200, 1988.
- Zander, R., G. Roland, L. Delbouille, A. Sauval, C.B. Farmer, and R.H. Norton, Column abundance and long-term trend of hydrogen chloride (HCl) above the Jungfraujoch station, *J. Atmos. Chem.*, 5, 395-404, 1987a.
- Zander, R., G. Roland, L. Delbouille, A. Sauval, C.B. Farmer, and R.H. Norton, Monitoring of the integrated column of hydrogen fluoride above the Jungfraujoch station since 1977—The HF/HCl column ratio, *J. Atmos. Chem.*, 5, 385-394, 1987b.
- Zander, R., G. Roland, L. Delbouille, A.J. Sauval, P. Marche, F. Karcher, M. Amoudei, and B. Dufour, Concentrations of hydrogen chloride and hydrogen fluoride during the MAP/GLOBUS comparison of September 1983, *Planet. Space Sci.*, 35, 665-672, 1987c.
- Zander, R., Ph. de Moulin, D.H. Ehhalt, and U. Schmidt, Secular increase of the column abundance of methane above the Jungfraujoch station, 1989, in preparation.