References

Brasseur, Guy and Solomon Susan, *Aeronomy of the Middle Atmosphere*, Dordrecht: D Reidel, ISBN: 9027717672, 1984.

Brown, J.M., J.E. Schubert, K.M. Evenson, and H.E. Radford, The far-infrared spectrum of the OH radical, *Astrophys J.* **258**, 899-903, 1982.

Chandasekhar, S., *Radiative Transfer*, Dover Publications, 1960. This is the classic radiative transfer book. Much mathematical detail on most or all aspects of radiative transfer encountered in the course.

Davidson, Norman, *Statistical Mechanics*, McGraw-Hill, 1962.

Gibson, Edward G., *The Quiet Sun*, NASA SP-303, 1973.

Goody, Richard M., *The transmission of radiation through an inhomogeneous atmosphere*, J. Atmos. Sci. **21**, 575-581, 1964.

Goody, Richard M., and Yuk L. Yung, *Atmospheric Radiation: Theoretical Basis* (2nd edition), Oxford University Press, ISBN: 0195051343, 1989.

Horowitz, P. and W. Hill, *The Art of Electronics*, Cambridge University Press, 1980. This evolved from Harvard Physics lab notes of yore. Their may well be a newer edition than this (my old one). For our purposes, the discussion of noise is valuable.

Houghton, John, *The Physics of Atmospheres* (3rd edition), Cambridge University Press, ISBN: 0521011221, 2002.

Liou, K.N., An Introduction to Atmospheric Radiation (2nd Edition), Academic Press, ISBN: 0124514510, 2002.

van de Hulst, H.C., Light scattering by small particles, Dover, NY 1981.

Voigt function

- Schreier, Franz, Voigt and complex error function: A comparison of computational methods, *J. Quant. Spectrosc. Radiat. Transfer* **48**, 743-762, 1992. (See http://www.op.dlr.de/ne-oe/ir/voigt.html.)
- Algorithm 363 of the Collected Algorithms from CACM.
- W. Gautschi, Efficient computation of the complex error function, *SIAM J. Numer. Anal*. **7**, 187-198, 1970.

Rayleigh scattering, Ring effect, and refractive index

- Chandasekhar, S., Radiative Transfer,

- K. Chance and R.J.D. Spurr, Ring effect studies: Rayleigh scattering, including molecular parameters for rotational Raman scattering, and the Fraunhofer spectrum, *Applied Optics* **36**, 5224-5230, 1997.
- B.A. Bodhaine, N.B. Wood, E.G. Dutton, and J.R. Slusser, On Rayleigh optical depth calculations, *J. Atmos. Ocean. Tech.* **16**, 1854-1861, 1999.
- S. Solomon, A.L. Schmeltekopf, and R.W. Sanders, On the interpretation of zenith sky absorption measurements, *J. Geophys. Res*. **92**, 8311-8319, 1987.
- G.W. Kattawar, A.T. Young, and T.J. Humphreys, Inelastic scattering in planetary atmospheres. I. The Ring effect, without aerosols, *Astrophys. J*. **243**, 1049-1057, 1981.
- Older references (especially Edlén) are cited in these two.

Ozone Profiling - the classic (invention of the BUV technique):

- S.F. Singer and R.C. Wentworth, A method for the determination of the vertical ozone distribution from a satellite, *J. Geophys. Res*. **62**, 299-308 (1957).

Aerosol models

- E.P. Shettle and R.W. Fenn, Models for the aerosols of the lower atmosphere and the effects of humidity variations on their optical properties, AFGL-TR-79-0214, 1979.

Radiative transfer modeling

References for LIDORT multiple scattering model:

- R.J.D. Spurr, LIDORT V2PLUS: A comprehensive radiative transfer package for UV/VIS/NIR nadir remote sensing; A general quasi analytic solution, *Proc. S.P.I.E*. **5235**, Remote Sensing of Clouds and the Atmosphere VIII, Barcelona, Spain, 2003.
- R.J.D. Spurr, T.P. Kurosu, and K. Chance, A linearized discrete ordinate radiative transfer model for atmospheric remote sensing retrieval, J. Quant. Spectrosc. Radiat. Transfer 68, 689-735, 2001.

LIDORT is a generic discrete ordinate radiative transfer (RT) tool that computes simultaneously backscatter intensities and a wide range of weighting functions (intensity derivatives with respect to atmospheric parameter variations) for a multiple-layer atmosphere with any number of scatterers and general surface boundary conditions. The model has a full multiple scatter treatment of the radiative transfer equation. The computation of weighting functions is based on an internal perturbation analysis of the discrete ordinate solution; the results are derived analytically without the need for finite difference approximations based on repeated calls to an intensity-only RT model. LIDORT is ideally suited for use as a general forward model for non-linear atmospheric retrieval algorithms, since a single call to the model will generate the complete field of intensities and weighting functions at any given stage of the retrieval.

DISORT (Discrete Ordinates Radiative Transfer Program for a Multi-Layered Plane-Parallel Medium):

- http://odin.phy.stevens.edu/remote_sensing/main.phtml

- K. Stamnes, S.C. Tsay, W. Wiscombe and K. Jayaweera, Numerically stable algorithm for discrete-ordinate-method radiative transfer in multiple scattering and emitting layered media, *Appl. Opt*. **27**(12), 2502–2509, 1988.

Fitting techniques

Optimal estimation and assorted diagnostics comes mainly from the work of Clive Rodgers:

- Retrieval of atmospheric temperature and composition from remote measurements of thermal radiation, *Rev. Geophys. Space Phys*. **14**, 609-624, 1976.
- Characterization and error analysis of profiles retrieved from remote sounding measurements, *J. Geophys. Res*. **95**, 5587-5595, 1990.
- Inverse Methods for Atmospheric Sounding: Theory and Practice, Series on Atmospheric, Oceanic and Planetary Physics, Vol. 2, World Scientific, 2000, ISBN 981-02-2740-X.
- For nonlinear least-squares, I relied on W.H. Press, B.P. Flannery, S.A. Teukolsky, and W.H. Vetterling *Numerical Recipes – The Art of Scientific Computing*, Cambridge University Press, 1986, ISBN 0-521-30811-9 (my very old version: there are later versions, including code in Pascal and FORTRAN 90); and P.R. Bevington and D.K. Robinson, *Data Reduction and Error Analysis for the Physical Sciences, 2nd Edition*, McGraw-Hill, 1992, ISBN 0-07-911243-9. The original Marquardt paper is D.W. Marquardt, An algorithm for least-squares estimation of nonlinear parameters, *J. Soc. Ind. Appl. Math*. **11**, 4310441, 1963.
- Numerical Recipes and on Bevington and Robinson.
- I like the discussion on retrieval in Goody and Yung, Chapter 6.5. It includes basic of Twomey-Tikhonov. More is available in Twomey's Book: Twomey, S., Introduction to the mathematics of inversion in remote sensing and indirect measurements, Elsevier Scientific Pub. Co, Amsterdam, New York, 1977.
- Global fitting is discussed by Massimo Carlotti: Global-fit approach to the analysis of limb-scanning atmospheric measurements, *Applied Optics* **27**, 3250-3254, 1988.
- For limb measurements, a classic is: J.C. Gille and F.B. House, On the inversion of limb radiance measurements I: Temperature and thickness, *J. Atmos. Sci*. **28**, 1427-1442, 1971.
- Here is an additional useful review volume: Inversion methods in atmospheric remote sounding, ed. Adarsh Deepak (Proceedings of the 1st International Interactive Workshop on Inversion Methods in Atmospheric Remote Sounding) Academic Press, New York, 1977.

LIDAR

- NASA Langley - look at http://asd-www.larc.nasa.gov/lidar/lidar.html where there is a primer (concept) page.
- W.B. Grant, Laser remote sensing techniques in "Laser Spectroscopy and its Applications," Chapter 8. A HOLLIS search shows that we have it here at the observatory: Laser spectroscopy and its applications, edited by Leon J. Radziemski, Richard W. Solarz, Jeffrey A. Paisner, New York, M. Dekker, 1987.