

# Curriculum Vitae

**ROBERT A. WEST**

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## PERSONAL

Born: Valparaiso, Indiana, 14 June 1951

## EDUCATION

1973 B.S. with honors, Astronomy, California Institute of Technology, Pasadena, California

1977 Ph.D., Planetary Sciences, University of Arizona, Tucson, Arizona

## HONORS

Most Valued Reviewer for the *Journal of Quantitative Spectroscopy and Radiative Transfer*, 2013.

Applied Physics Lab, Johns Hopkins University 2012 Publication Award for an

Outstanding Research Paper in an Externally Refereed Journal Publication published in 2011, for E. Turtle et al., (2011) Rapid and Extensive Surface Changes near Titan's Equator: Evidence of April Showers, *Science* **331**, 1414-1417.

JQSRT 2010 Milestone Paper Award for a Seminal Contribution to the *Journal of Quantitative Spectroscopy and Radiative Transfer* for the paper by R. Goody, R. West,

L. Chen and D. Crisp (1989) "The correlated-k method for radiation calculations in nonhomogeneous atmospheres." *J. Quant. Spectr. and Radiat. Transfer* **42**, 539-550.

NASA Group Achievement Awards for Cassini UVIS and ISS teams.

NASA Group Achievement Award for Comet Shoemaker-Levy Jupiter Impact Observation Team (Hubble Space Telescope), 1996

NASA Group Achievement Award for the Galileo Gaspra Encounter Team, 1993

NASA Group Achievement Award for Galileo Orbiter Instrument Design, Development, and Test, 1991

NASA Group Achievement Award for Voyager Science Investigations at Neptune, 1990

NASA Group Achievement Award for Voyager Science Investigations at Uranus, 1986

NASA Group Achievement Award for SME Project Operations, 1983

NASA Group Achievement Award for Voyager Science Investigations at Saturn, 1982

NASA Group Achievement Award for Pioneer 10 Scientific Instrument Team (IPP), 1974

NASA Certificate of Recognition and monetary award for NASA Tech Brief, "The correlated-k method for radiation calculations in nonhomogeneous atmospheres", 1991

NASA Certificate of Recognition monetary award for NASA Tech Brief, "Mapping transformations for broadband atmospheric radiation calculations", 1991

NASA Certificate of Recognition and monetary award for NASA Tech Brief, "Remote sensing of the atmosphere of Mars using infrared pressure modulation and filter radiometry", 1988

## **POSITIONS HELD**

Present Senior Research Scientist, Jet Propulsion Laboratory  
1978–1984 Research Associate, Laboratory for Atmospheric and Space Physics, and Lecturer, Dept. of Astro-Geophysics, University of Colorado, Boulder

## **PROFESSIONAL AFFILIATIONS**

International Astronomical Union  
American Astronomical Society, Division for Planetary Sciences  
American Geophysical Union  
COSPAR

## **COMMITTEES AND SERVICE FUNCTIONS**

Co-Lead, WFIRST Solar System Working Group (FY 2017 - present)  
Co-Lead, JPL Exoplanet Science Initiative (FY 2015 - present)  
Chair, ESI Scientist II Search Committee, 2017, and ESI search committee 2015  
Member and Chair, JPL Senior Research Scientist Council (2013 - 2016; Chair in FY 2016, with continuing contribution in 2018)  
Conference Travel Tool Advisory Group, 2016.  
Post-Doc Mentor, JPL Post-Doc Mentors Program (2015-present)  
NPP Postdoc advisor (1993 - present)  
Mentor to numerous undergraduate and graduate students since 1985.  
NASA Peer Review Panels for: Planetary Atmospheres; Astrophysics Data Analysis; Microgravity and Containerless Materials; High Performance Computing; Planetary Astronomy  
JPL Science Advisory Group (SAG): Two years service as chair under the direction of Sam Gulkis, followed by three years as a member with Michael Warner as chair  
Member, Instrument Definition Science Team (NASA Facility Instrument Camera for Cassini mission), 1988 – 1989  
Member, Atmosphere Working Group of the U.S./German Planetary Telescope Mission  
Member, Steering Committee of the International Jupiter Watch Program (IJW)  
Member, 1983 DPS Program Committee  
Program Chairman, 1982, AAS, Division for Planetary Sciences meeting  
Member, Saturn and Titan Working Groups for Cassini  
Member, Atmosphere Working Group for Galileo  
Member, Atmosphere Working Group for Voyager 1978–1989

## **RELEVANT SCIENTIFIC EXPERIENCE**

- 2007–present PI, Cassini Data Analysis Program - Titan Retrievals (NASA Grant)  
2005–present PI, Outer Planets Research - Titan Chemistry (NASA Grant)  
1990–present Team member, Cassini Imaging Facility Instrument and  
**Deputy Team Leader** 9/25/2010–present and 8/10/92–7/31/93  
1990–2009 Co–Investigator, Descent Imager/Spectral Radiometer for the Titan Huygens Probe  
1990–present Co–Investigator, Cassini Ultraviolet Imaging Spectrometer  
1989–2000 General Observer, Hubble Space Telescope  
1987–2003 Co–Investigator, Galileo Ultraviolet Spectrometer Experiment  
1993–1994 Study Scientist for Jupiter and Saturn Low Cost Missions.  
1988–1991 Principal Investigator, Jovian Stratospheric Models (NASA Grant)  
1987–1991 Principal Investigator, An Investigation of the Bolometric Bond Albedo and Global Radiative Energy Balance of Uranus as Part of the Uranus Data Analysis Program (NASA grant)  
1984–1988 Principal Investigator, Analysis of Voyager Infrared and Imaging Data for the Jupiter and Saturn Atmospheres (NASA Grant)  
1981–1984 Principal Investigator, Analysis of Voyager Imaging Methane Band Photometry (NASA Grant)  
1980–1991 Co–Investigator, Voyager Photopolarimeter Experiment

## **MAJOR RESEARCH INTEREST**

Radiative transfer in planetary atmospheres, especially observation and interpretation of multiply-scattered light observed by spacecraft and ground-based instruments.

## **EDITORIAL CONTRIBUTIONS**

- Editorial Board, International Journal of Astronomy and Astrophysics (IJAA), 2010–present  
Editorial Committee, Saturn book, “Saturn from Cassini-Huygens”, 2007 (published by Springer, 2009, Eds. M. Dougherty, L. Esposito and S. Krimigis)  
“Time-Variable Phenomena in the Jovian System”, M. J. S. Belton, R. A. West, and J. H. Rahe, Eds., NASA Special Publication 494, (1989).  
Editorial Board, *Icarus* (1990–1992)

## **ENCYCLOPEDIA ARTICLES**

- Radiative Transfer in Planetary Atmospheres in Encyclopedia of Planetary Sciences. Chapman and Hall (1997).  
The Atmospheres of the Giant Planets, in Encyclopedia of the Solar System. Academic Press (1998) First, Second and Third Editions (2014).  
Clouds in Planetary Atmospheres, in Encyclopedia of Astronomy and Astrophysics. Institute of Physics Publishing and Grove Publishers Ltd. (2001).  
Saturn in McGraw-Hill Encyclopedia of Science & Technology (Authors are T. C. Owen and R. A. West), 2012.

## **BOOK CHAPTERS**

- Tomasko, M.G., R.A. West, G.S. Orton and V.G. Tejfel, "Clouds and Aerosols in Saturn's Atmosphere," in Saturn (T. Gehrels and M.S. Matthews, eds.), University of Arizona Press (1984).
- Beebe, R.F., G.S. Orton and R.A. West, "Time-Variable Nature of the Jovian Cloud Properties and Thermal Structure: An Observational Perspective." Review chapter in Time Variable Phenomena in the Jovian System, Belton, West and Rahe, eds. (NASA SP 494), (1989).
- West, R. A., K. H. Baines, and J. B. Pollack, "Clouds and Aerosols in the Uranian Atmosphere." in Uranus. J. T. Bergstralh and M.S. Matthews, Eds., Univ. of Arizona Press (1991).
- West, R. A., "Particles in Jupiter's Atmosphere from the Impacts of Comet P/Shoemaker-Levy 9," in The Collision of Comet Shoemaker-Levy 9 and Jupiter, K. Noll, P. Feldman and H. Weaver, Eds., Cambridge University Press, (1996).
- West, R.A., "Condensates in Jovian Atmospheres," in From Giant Planets to Cool Stars, C. Griffith and M. Marley, Eds., Astron. Soc. Pacific Conference Series (1999).
- West, R. A., K. H. Baines, A. J. Friedson, D. Banfield, B. Ragent, and F. Taylor, "Jovian Clouds and Haze", in Jupiter - The Planet, Satellites and Magnetosphere. F. Bagenal, T. Dowling and W. McKinnon, Eds., Cambridge University Press, 2004.
- Flasar, F. M., K. H. Baines, M. K. Bird, T. Tokano and R. A. West, "Atmospheric Dynamics and Meteorology", in Titan from Cassini/Huygens, R. Brown et al. Eds., Springer, 2009.
- Tomasko, M. G., and R. A. West, "Aerosols in Titan's Atmosphere", in Titan from Cassini/Huygens, R. Brown et al. Eds., Springer, 2009.
- West, R. A., K. H. Baines, E. Karkoschka and A. Sánchez-Lavega. "Clouds and Aerosols in Saturn's Atmosphere", in Saturn from Cassini/Huygens, M Dougherty et al. Eds., Springer, 2009.
- West, R. A., P. Lavvas, C. Anderson, and H. Imanaka. "Titan's Haze", in Titan: Surface, Atmosphere and Magnetosphere, I. Muller-Wodarg, C. Griffith, E. Lellouch and T. Cravens, Eds., Cambridge Univ. Press, 2014.
- West, R.A., P.A. Yanamandra-Fisher and V. Korokhin, "Polarization of the gas giant planets, Saturn's rings, and Titan: Observations and Interpretation", in Polarimetry of stars and planetary systems, L. Kolokolva, J. Hough and A.-Chantal Levasseur-Regourd Eds., Cambridge Univ. Press, 2015.
- Fletcher, L.N., T.K. Greathouse, S. Guerlet, J.I. Moses and R.A. West, "Saturn's Seasonally Changing Atmosphere: Thermal Structure, Composition and Aerosols", in Saturn in the 21st Century, K. Baines, Ed., Cambridge Univ. Press, in press, 2018.
- Sayanagi, K., , K.H. Baines, U.A. Dyudina, L.N. Fletcher, P.L. Read, A. Sánchez-Lavega, R.A. West, "Saturn's Polar Atmosphere", in Saturn in the 21st Century, K. Bines, Ed., Cambridge Univ. Press, in press, 2018.
- West, R. A., "Temperature, clouds and aerosols in giant and icy planets", in Handbook of Exoplanets, H. J. Deeg and J. A. Belmonte, Eds., Springer, in press, 2018

## **JOURNAL ARTICLES**

- Soderblom, L.A., D.C. Condit, R.A. West, B.M. Herman and T.J. Kreidler, "Martian Planet-Wide Crater Distributions: Implications for Geologic History and Surface Processes," *Icarus* **22**, 239–263 (1974).

- Tomasko, M.G., R.A. West and N.D. Castillo, "Photometry and Polarimetry of Jupiter at Large Phase Angles. I. Analysis of Imaging Data of a Prominent Belt and a Zone from Pioneer 10," *Icarus* **33**, 558–592 (1978).
- West, R.A., "Spatially Resolved Methane Band Photometry of Jupiter. I. Absolute Reflectivity and Center-to-Limb Variations in the 6190, 7250 and 8900 Å Bands," *Icarus* **38**, 12–33 (1979).
- West, R.A., "Spatially Resolved Methane Band Photometry of Jupiter. II. Analysis of the South Equatorial Belt and South Tropical Zone Reflectivity," *Icarus* **38**, 34–53 (1979).
- Pang, K., C.W. Hord, R.A. West, K.E. Simmons, D.L. Coffeen, J.T. Bergstralh and A.L. Lane, "Voyager I Photopolarimeter Experiment and the Phase Curve and Surface Microstructure of Ganymede," *Nature* **280**, 804–806 (1979).
- Hord, C.W., R.A. West, K.E. Simmons, D.L. Coffeen, M. Sato, A.L. Lane and J.T. Bergstralh, "Photometric Observations of Jupiter at 2400 Å," *Science* **806**, 956–958 (1979).
- West, R.A. and M.G. Tomasko, "Spatially Resolved Methane Band Photometry of Jupiter. III. Cloud Vertical Structures for Several Axisymmetric Bands and the Great Red Spot," *Icarus* **41**, 278–292 (1980).
- West, R.A., C.W. Hord, K.E. Simmons, D.L. Coffeen, M. Sato and A.L. Lane, "Near Ultraviolet Scattering Properties of Jupiter," *J. Geophys. Res.* **86**, 8783–8792 (1981).
- West, R.A., "Sunlight Absorption by Aerosols in Jupiter's Upper Atmosphere," *Geophys. Res. Lett.* **8**, 847–849 (1981).
- Lane, A.L., C.W. Hord, R.A. West, L.W. Esposito, D.L. Coffeen, M. Sato, K.E. Simmons, R.B. Pomphrey and R.B. Morris, "Photopolarimetry from Voyager 2. Preliminary Results on Saturn, Titan and the Rings," *Science* **215**, 537–543 (1982).
- West, R.A., M.G. Tomasko, B.A. Smith, M.P. Wijesinghe, L.R. Doose, H.J. Reitsema and S.M. Larson, "Spatially Resolved Methane Band Photometry of Saturn. I. Absolute Reflectivity and Center-to-Limb Variations in the 6190, 7250 and 8900 Å Bands," *Icarus* **51**, 51–64 (1982).
- West, R.A., C.W. Hord, K.E. Simmons, H. Hart, L.W. Esposito, A.L. Lane, R.B. Pomphrey, R.B. Morris, M. Sato and D. Coffeen, "Voyager Photopolarimeter Observations of Saturn and Titan," *Adv. Space Res.* **3**, 45–48 (1983).
- West, R.A., "Spatially Resolved Methane Band Photometry of Saturn: II. Cloud Structure Models at Four Latitudes," *Icarus* **53**, 301–309 (1983).
- Esposito, L.W., M. O'Callahan, K.E. Simmons, C.W. Hord, R.A. West, A.L. Lane, R.B. Pomphrey, D.L. Coffeen and M. Sato, "Voyager Photopolarimeter Stellar Occultation of Saturn's Rings," *J. Geophys. Res.* **88**, 8643–8649 (1983).
- Esposito, L.W., M. O'Callahan and R.A. West, "The Structure of Saturn's Rings: Implications from the Voyager Stellar Occultation," *Icarus* **56**, 439–452 (1983).
- West, R.A., A.L. Lane, H. Hart, K.E. Simmons, C.W. Hord, D.L. Coffeen, L.W. Esposito, M. Sato, R.B. Pomphrey, "Voyager 2 Photopolarimeter Observations of Titan," *J. Geophys. Res.* **88**, 8699–8708 (1983).
- West, R.A., M. Sato, H. Hart, A.L. Lane, C.W. Hord, K.E. Simmons, L.W. Esposito, D.L. Coffeen and R.B. Pomphrey, "Photometry and Polarimetry of Saturn at 2640 and 7500 Å," *J. Geophys. Res.* **88**, 8679–8697 (1983).
- Barth, C.A., R.W. Sanders, R.J. Thomas, G.E. Thomas, B.M. Jakosky and R.A. West, "Formation of the El Chichon Aerosol Cloud," *Geophys. Res. Lett.* **10**, 993–996 (1983).
- Thomas, G.E., B.M. Jakosky, R.A. West and R.W. Sanders, "Satellite Limb-Scanning Thermal Infrared Observations of the El Chichon Stratospheric Aerosol: First Re-

- sults,” *Geophys. Res. Lett.* **10**, 997–1000 (1983).
- West, R.A., “Remote Sounding of Jovian Cloud Properties from Voyager 1 IRIS 5  $\mu\text{m}$  spectra,” in *IRS '84: Current Problems in Atmospheric Radiation; Proceedings of the International Radiation Symposium*, Perugia, Italy, 21–28 August 1984 (G. Fiocco, ed.), A. Deepak Publishing, 369–372 (1984).
- West, R.A., P.N. Kupferman and H. Hart, “Voyager 1 Imaging and IRIS Observations of Jovian Methane Absorption and Thermal Emission: Implications for Cloud Structure,” *Icarus* **61**, 311–342 (1985).
- A’Hearn, M.F., D.G. Schleicher and R.A. West, “Emission by OD in Comets,” *Astrophys. J.* **297**, 826–836 (1985).
- West, R.A., D.F. Strobel and M.G. Tomasko, “Clouds, Aerosols and Photochemistry in the Jovian Atmosphere,” *Icarus* **65**, 161–217 (1986).
- Lane, A.L., C.W. Hord, R.A. West, L.W. Esposito, K.E. Simmons, R.M. Nelson, B.D. Wallis, B.J. Buratti, L.J. Horn, A.L. Graps and W.R. Pryor, “Photometry from Voyager 2: Initial Results from the Uranian Atmosphere, Satellites and Rings,” *Science* **233**, 65–70 (1986).
- McCleese, D.J., J.T. Schofield, R.W. Zurek, J.V. Martonchik, R.D. Haskins, D.A. Paige, R.A. West, D.J. Diner, J.R. Locke, M.P. Chrisp and W. Willis, “Remote Sensing of the Atmosphere of Mars Using Infrared Pressure Modulation and Filter Radiometry,” *Appl. Opt.* **25**, 4232–4245 (1986).
- West, R.A., A.L. Lane, C.W. Hord, L.W. Esposito, K.E. Simmons, R.M. Nelson and B.D. Wallis, “Temperature and Aerosol Structure of the Nightside Uranian Stratosphere from Voyager 2 Photopolarimeter Stellar Occultation Measurements,” *J. Geophys. Res.* **92**, 15030–15036 (1987).
- Nelson, R.M., B.J. Buratti, B.D. Wallis, A.L. Lane, R.A. West, K.E. Simmons, C.W. Hord and L.W. Esposito, “Voyager 2 Photopolarimeter Observations of the Uranian Satellites,” *J. Geophys. Res.* **92**, 14905–14910 (1987).
- West, R.A., “Voyager 2 Imaging Eclipse Observations of the Jovian High Altitude Haze,” *Icarus* **75**, 381–398 (1988).
- West, R.A., G.S. Orton, B.T. Draine, and E. A. Hubbell, “Infrared Absorption Features for Tetrahedral Ammonia Ice Crystals,” *Icarus* **80**, 220–223 (1989).
- Russell, C.T., J.J. Caldwell, I. de Pater, J. Goguen, M. J. Klein, B. L. Lutz, N. M. Schneider, W. M. Sinton and R. A. West, “International Jupiter Watch; a Program to Study the Time Variability of the Jovian System,” *Adv. Space Sci.*, **10**, 239–242 (1989).
- Lane, A. L., R. A. West, C. W. Hord, R. M. Nelson, K. E. Simmons, W. R. Pryor, L. W. Esposito, L. J. Horn, B. D. Wallis, B. J. Buratti, T. G. Brophy, P. Yanamandra-Fisher, J. E. Colwell, D. A. Bliss, M. J. Mayo and W. D. Smythe, “Photometry from Voyager 2: Initial results from the Neptunian atmosphere, satellites, and rings.” *Science*, **246**, 1450–1454 (1989).
- Goody, R., R. West, L. Chen and D. Crisp, “The correlated- $k$  method for radiation calculations in nonhomogeneous atmospheres.” *J. Quant. Spectr. and Radiat. Transfer* **42**, 539–550, (1989).
- Colwell, J.E., L. J. Horn, A. L. Lane, L. W. Esposito, P. A. Yanamandra-Fisher, S. H. Pilorz, K. E. Simmons, M. D. Morrison, C. W. Hord, R. M. Nelson, B. D. Wallis, R. A. West, and B. J. Buratti, “Voyager Photopolarimeter observations of uranian ring occultations.” *Icarus* **83**, 102–125, (1990).
- West, R., D. Crisp, and L. Chen, “Mapping Transformations for Broadband Atmospheric Radiation Calculations.” *J. Quant. Spectr. and Radiat. Transfer* **43**, 191–199, (1990).

- Orton, G.S., K. H. Baines, J. Caldwell, P. Romani, A. T. Tokunaga, and R. A. West, "Calibration of the 7- to 14- $\mu$ m brightness spectra of Uranus and Neptune," *Icarus* **85**, 257–265, (1990).
- Orton, G. S., A. J. Friedson, J. Caldwell, H. B. Hammel, K. H. Baines, J. T. Bergstralh, T. Z. Martin, M. E. Malcom, R. A. West, A. T. Tokunaga, J. Klavetter, R. Baron, D. Griep, W. Golisch, C. Kaminski and M. Shure, "Spatial Organization and Time Dependence of Jupiter's Stratospheric Temperatures: 1980–1990." *Science* **252**, 537–542, (1991).
- West, R. A., and P. H. Smith, "Evidence for Aggregate Particles in the Atmospheres of Titan and Jupiter." *Icarus* **90**, 330–333 (1991).
- Hord, C. W., C. A. Barth, L. W. Esposito, W. M. McClintock, W. R. Pryor, K. E. Simmons, A.I.F. Stewart, G. E. Thomas, J. M. Ajello, A. L. Lane, R. A. West, B. R. Sandel, A. L. Broadfoot, D. M. Hunten, and D. E. Shemansky, "Galileo Ultraviolet Spectrometer Experiment: Initial Venus and Interplanetary Cruise Results," *Science* **253**, 1548–1550, (1991).
- West, R. A., "Optical Properties of Aggregate Particles whose Outer Diameter is Comparable to the Wavelength." *Applied Optics* **30**, 5316–5324 (1991).
- Chassefière, E., J. E. Blamont, V. A. Krasnopolsky, O. I. Korablev, S. K. Atreya, and R. A. West, "Vertical Structure and Size Distributions of Martian Aerosols from Solar Occultation Measurements." *Icarus* **97**, 46–69 (1992).
- Hord, C. W., W. E. McClintock, A.I.F. Stewart, C. A. Barth, L. W. Esposito, G. E. Thomas, B. R. Sandel, D. M. Hunten, A. L. Broadfoot, and D. E. Shemansky, J. M. Ajello, A. L. Lane, and R. A. West, "Galileo Ultraviolet Spectrometer Experiment." *Space Science Reviews*, **60**, 503–530 (1992).
- Pryor, W. R., R. A. West, K. E. Simmons, and Mona Delitsky, "High Phase Angle Observations of Neptune at 2650 Å and 7500 Å: Haze Structure and Particle Properties." *Icarus* **99**, 302–317 (1992).
- West, R. A., A. J. Friedson, and J. F. Appleby, "Jovian Large-Scale Stratospheric Circulation." *Icarus* **100**, 245–259 (1992).
- Baines, K. H., R. A. West, L. P. Giver and Fernando Moreno, "Quasi-Random Narrow Band Model Fits to Near-Infrared Low-Temperature Laboratory Methane Spectra and Derived Exponential-Sum Absorption Coefficients," *JGR* **98**, 5517–5529 (1993).
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