HARSHVARDHAN
Professor Emeritus of Atmospheric Sciences 08/03/2022

EDUCATION:

1969	B.S.	Indian Institute of Technology, Kharagpur
1971	M.S.	Indian Institute of Science, Bangalore
1976	Ph.D.	State University of New York, Stony Brook

PROFESSIONAL EXPERIENCE:

2019-present	Professor Emeritus, Department of Earth, Atmospheric and Planetary Sciences, Purdue University
2009-2010	Associate Dean, Graduate Education and International Programs, College of Science, Purdue University
1996-2004	Head, Department of Earth and Atmospheric Sciences, Purdue University
1994-2018	Professor, Department of Earth, Atmospheric and Planetary Sciences, Purdue University
1988-1994	Associate Professor, Department of Earth and Atmospheric Sciences, Purdue University
1978-1988	University Research Associate, Laboratory for Atmospheres, NASA/Goddard Space Flight Center
1977-1978	Resident Research Associate, Laboratory for Atmospheric Sciences, NASA/Goddard Space Flight Center
1973-1976	Research Assistant, Department of Mechanics, S.U.N.Y.
1971-1973	Teaching Assistant, Department of Mechanics, S.U.N.Y.

HONORS AND AWARDS:

1977	National Research Council Resident Research Associate
1993	Henry G. Houghton Award, American Meteorological Society
1999	Fellow, American Meteorological Society

PROFESSIONAL ACTIVITIES:

Membership

1979-	Member, American Geophysical Union (AGU)
1980-	Member, American Meteorological Society (AMS)
1988-91	Member, Committee on Atmospheric Radiation, AMS
1998-2000	Member, AGU Heads & Chairs Executive Committee

Visiting Scientist

1981	National Center for Atmospheric Research, Boulder, CO
1994	Max Planck Institute for Meteorology, University of Hamburg, Germany
1994	National Centre for Medium Range Weather Forecasting, New Delhi, India
2002	Goddard Earth Sciences and Technology Center, Greenbelt, MD
2008	Program in Atmospheric and Oceanic Sciences, Princeton University, Princeton, NJ
2017	NASA Langley Research Center, Hampton, VA

Editorial Duties

1991-93	Associate Editor, Journal of Applied Meteorology
1992-94	Associate Editor, Journal of the Atmospheric Sciences
1996-2001	Editor, Journal of Applied Meteorology

Invited Participant (since 1990) * including invited lecturer

1990	*Workshop on Clouds, Radiation and Climate sponsored by the Department of Meteorology, University of Maryland, College Park, MD
	Planning meeting for the Atmospheric Radiation Measurement (ARM) program, Department of Energy, Argonne National Laboratory, Argonne, IL
	*Indo-U.S. Seminar on the Parameterization of Subgrid-Scale Processes in Dynamical Models of Medium-Range Prediction and Global Climate, Pune, India
	Contributor to the US Quandrennial Report to the XX General Assembly of the IUGG, Vienna, Austria
1991	*Meeting of the Committee on Meteorological Analysis, Prediction and Research of the Board on Atmospheric Science and Climate (National Research Council), Washington, D.C
	Workshop on critical areas in Heat Transfer, NSF Chemical and Thermal Systems Division, Chicago, IL

	*Workshop on water vapor, clouds, radiative processes and climate;p inferences from recent satellite observations, NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ
	*ECMWF/GEWEX Workshop on Hydrology and Surface Radiation in Atmospheric Models, European Centre for Medium Range Weather Forecasts, Reading, U.K.
1992	Foreign Applied Sciences Assessment Center Panel on Climate Research in the former Soviet Union, sponsored by Department of Energy, SAIC, McLean, VA
	*Third International Cloud Modeling Workshop, WMO Workshop on Cloud Microphysics and Applications to Global Change, Toronto, Canada
1994	Workshop on Ozone: Its Climate and Related Impacts, Argonne National Laboratory, Argonne, IL.
	Dahlem Conference on Aerosol Forcing of Climate, Berlin, Germany
	*Aspen Global Change Institute workshop on Radiation Feedbacks and the Credibility of Atmospheric Models, Aspen, CO
1995	Air Quality Criteria for Particulate Matter and Sulfur Oxides, U.S. EPA, Research Triangle Park, NC
1996	ARM/CHAMMP/PCMDI Workshop on Improving the Representation and Diagnosis of Solar Radiative Heating in Climate Models, U.S. DOE, Sequim, WA
	Panel Review, NASA Earth System Science Pathfinder Program, Washington, DC
	Panel Review, NASA AM-1 Platform Instrument Algorithm Theoretical Basis Documents, Columbia, MD
1997	Panel Review, NOAA/NASA Enhanced Data Sets for Analysis and Applications, Asheville, NC
	Panel Review, NASA, Satellite Remote Sensing Measurement Accuracy, Variability, and Validation Studies, Crystal City, VA
1998	*Gordon Research Conference, Solar Radiation and Climate, Plymouth, NH
	*Global Aerosol Climatology Project, Aerosol Radiative Forcing Science Team, NASA GISS, New York, NY
2000	Gordon Research Conference, Solar Radiation and Climate, New London, CT
	Workshop on Monitoring Global Aerosol Forcing of Climate, GFDL, Princeton, NJ
	*Third Global Aerosol Climatology Project Science Team Meeting, Lanham –Seabrook, MD
2005	IGAC specialty conference on the indirect effects of aerosols on climate, Manchester, UK
2006	*Aerosol Workshop on Climate Prediction Uncertainties, Santa Fe, NM
2008	Aviation-Climate Change Research Initiative, Virginia Beach, VA

Invited Lectures & Seminars (since 2002)

2002	Lawrence Livermore National Laboratory, Livermore, CA, May 10
	Naval Research Laboratory, Marine Meteorology Division, Monterey, CA, May 14
	NASA Ames Research Center, Moffett Field, CA, May 16
	Brookhaven National Laboratory, Upton, NY, August 27
	Goddard Space Flight Center, Greenbelt, MD, September 25
	NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ, September 26
	NCAR Climate and Global Dynamics Division, Boulder, CO, October 8
	Department of Atmospheric & Oceanic Sciences, U. of Wisconsin, Madison, WI, November 4
	Center for Ocean-Land-Atmosphere, Calverton, MD, November 13
	Department of Physics, Howard University, Washington, DC, November 20
	Naval Research Laboratory, Washington, DC, November 21
2005	ESSIC (Earth System Science Interdisciplinary Center), University of Maryland, College Park, MD, January 31
	Optical Society of America topical meeting on Hyperspectral Imaging and Sounding of the Environment, Alexandria, VA, February 1
	Department of Atmospheric Sciences, U. of Illinois, Urban-Champaign, IL, September 28
2006	Department of Environmental Sciences, Rutgers University, New Brunswick, NJ, June 5
	NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ, June 5
2008	NOAA Geophysical Fluid Dynamics Laboratory, Princeton, NJ, July 9, 23
	NASA Goddard Institute for Space Studies, New York, NY, August 13
	Department of Environmental Sciences, Rutgers University, New Brunswick, NJ, August 14
	Department of Atmospheric Science, Texas A&M University, College Station, TX, September 30
	NASA Goddard Space Flight Center, Climate & Radiation Branch, Greenbelt, MD, December 3
	National Centers for Environmental Prediction, Camp Springs, MD, December 4
2011	Lawrence Berkeley National Laboratory, Berkeley, CA, May 16
	Naval Research Laboratory, Marine Meteorology Division, Monterey, CA, May 18
	Centre for Atmospheric Sciences, Indian Institute of Technology, Delhi, India, November 28, 29
2013	Indian Institute of Tropical Meteorology, Pune, India, October 24, 25
2017	NASA Langley Research Center, Hampton VA, September 7
	Department of Atmospheric & Planetary Sciences, Hampton University, Hampton, VA, September 13

NASA Goddard Space Flight Center, Greenbelt, MD, September 19
Divecha Centre for Climate Change, Indian Institute of Science, Bangalore, India, November 13
National Centre for Medium Range Weather Forecasting, Noida, UP, India, November 20
Environmental Science Division, Argonne National Laboratory, Argonne, IL, December 7
2018 Qatar Computing Research Institute, Doha, Qatar, March 7
2019 NASA Goddard Space Flight Center, Greenbelt, MD, November 5

Journal Reviewer

Journal of Applied Meteorology
Journal of the Atmospheric Sciences
Journal of Climate
Journal of Quantitative Spectroscopy and Radiative Transfer
Bulletin of the American Meteorological Society
Journal of Geophysical Research (Atmospheres)
Journal of the Meteorological Society of Japan
Atmospheric Research
Theoretical and Applied Climatology
Climate Dynamics
Earth Science Reviews
Quarterly Journal of the Royal Meteorological Society
Geophysical Research Letters

Proposal and Program Reviewer

NASA Office of Space Science and Applications
NASA Mission to Planet Earth
NSF Division of Atmospheric Sciences
NSF Office of Science and Technology
Air Force Office of Scientific Research
Department of Energy Atmospheric Radiation Measurement Program
US Civilian Research & Development Foundation
Netherlands Organization for Scientific Research NOW
NASA Science Mission Directorate
Climate and Global Dynamics Division, National Center for Atmospheric Research
NSF Graduate Research Fellowship Program (geoscience panel), served for three years

REFEREED PUBLICATIONS:

Journals

Cess, R.D., and Harshvardhan, 1974. Shear-flow stability within the atmosphere of Venus. *J. Fluid Mech*., **66**, 267-272.

Harshvardhan, and Cess, R.D., 1976. Stratospheric aerosols: effect upon atmospheric temperature and global climate. *Tellus*, **28**, 1-10.

Harshvardhan, and Cess, R.D., 1978. Effect of tropospheric aerosols upon atmospheric infrared cooling rates. *J. Quant. Spectrosc. Radiat. Transfer*, **19**, 621-632.

Harshvardhan, 1979. Perturbation of the zonal radiation balance by a stratospheric aerosol layer. *J. Atmos. Sci*., **36**, 1274-1285.

Konyukh, L.A., Yurevich, F.B., Cess, R.D., and Harshvardhan, 1979. Tropospheric aerosols: effect upon the surface and surface-atmosphere radiation budgets. *J. Quant. Spectrosc. Radiat. Transfer*, **22**, 483-488.

Weinman, J.A., Harshvardhan, and Olson, W. S., 1981. Infrared radiation emerging from smoke produced by brush fires. *Appl. Opt*., **20**, 199-206.

Harshvardhan, Weinman, J.A., and Davies, R., 1981. Transport of infrared radiation in cuboidal clouds. *J. Atmos. Sci*., **38**, 2500-2513.

Harshvardhan, and Weinman J.A., 1982. Infrared radiative transfer through a regular array of cuboidal clouds. *J. Atmos. Sci*., **39**, 431-439.

Harshvardhan, 1982. The effect of brokenness on the cloud-climate sensitivity. *J. Atmos. Sci*., **39**, 1853-1861.

Weinman, J.A., and Harshvardhan, 1982. Solar reflection from a regular array of horizontally finite clouds. *Appl. Opt*., **21**, 2940-2944.

King, M.D., Harshvardhan, and Arking, A., 1984. A model of the radiative properties of the El Chichon stratospheric aerosol layer. *J. Climate Appl. Meteor*., **23**, 1121-1137.

Harshvardhan, and Thomas, R.W.L., 1984. Solar reflection from interacting and shadowing cloud elements. *J. Geophys. Res*., **89**, 7179-7185.

Harshvardhan, and Randall, D.A., 1985. Comments on 'The parameterization of radiation for numerical weather prediction and climate models'. *Mon. Wea. Rev*., **113**, 1832-1833.

King, M.D., and Harshvardhan, 1986. Comparative accuracy of selected multiple scattering approximations. *J. Atmos. Sci*., **43**, 784-801.

Harshvardhan, Davies, R., Randall, D.A., and Corsetti, T.G., 1987. A fast radiation parameterization for atmospheric circulations models. *J. Geophys. Res*., **92**, 1009-1016.

Betts, A.K., and Harshvardhan, 1987. Thermodynamic constraint on the cloud liquid water feedback in climate models. *J. Geophys. Res*., **92**, 8483-8485.

Platt, C.M.R., and Harshvardhan, 1988. The temperature dependence of cirrus extinction - implications for climate feedback. *J. Geophys. Res*., **93**, 11051-11058.

Harshvardhan, Randall, D.A., Corsetti, T.G., and Dazlich, D.A., 1989. Earth radiation budget and cloudiness simulations with a general circulation model. *J. Atmos. Sci*., **46**, 1922-1942.

Randall, D.A., Harshvardhan, Dazlich, D.A., and Corsetti, T.G., 1989. Interactions among radiation, convection, and large-scale dynamics in a general circulation model. *J. Atmos. Sci*., **46**, 1943-1970.

Harshvardhan, Randall, D.A., and Dazlich, D.A., 1990. Relationship between the longwave cloud radiative forcing at the surface and the top of the atmosphere. *J. Climate*, **3**, 1435-1443.

Randall, D.A., Harshvardhan, and Dazlich, D.A., 1991. Diurnal variability of the hydrologic cycle in a general circulation model. *J. Atmos. Sci*., **48**, 40-62.

Ridgway, W.L., Harshvardhan, and Arking, A., 1991. Computation of atmospheric infrared cooling rates by exact and approximate methods. *J. Geophys. Res*. **96**, 8969-8984.

Harshvardhan, 1991. Atmospheric radiation. *Rev. Geophys*., **29**, Supplements, 56-68.

Harshvardhan, and King, M.D., 1993. Comparative accuracy of diffuse radiative properties computed using selected multiple scattering approximations. *J. Atmos. Sci*., **50**, 247-259.

Zhi, H., and Harshvardhan, 1993. A hybrid technique for computing the monthly mean net longwave surface radiation over oceanic areas. *Theor. Appl. Climatol*., **47**, 65-79.

Harshvardhan, Wielicki, B.A., and Ginger, K.M., 1994. The interpretation of remotely sensed cloud properties from a model parameterization perspective. *J. Climat*., **7**, 1987-1998.

Cahalan, R.F., Ridgway, W., Wiscombe, W.J., Gollmer, S., and Harshvardhan, 1994. Independent pixel and Monte Carlo estimates of stratocumulus albedo. *J. Atmos. Sci*., **51**, 3776-3790.

Harshvardhan, and Espinoza, R.C., Jr., 1994. Simple parameterizations of the radiative properties of cloud layers: a review. *Atmos. Res*., **35**, 113-125.

Gollmer, S.M., Harshvardhan, Cahalan, R.F., and Snider, J.B., 1995. Windowed and wavelet analysis of marine stratocumulus cloud inhomogeneity. *J. Atmos. Sci*., **52**, 3013-3030.

Espinoza, R.C., Jr., and Harshvardhan, 1996. Parameterization of solar near-infrared radiative properties of cloud layers. *J. Atmos. Sci*., **53**, 1559-1568.

Cullather, R.I., Harshvardhan , and Campana, K.A., 1997. Climatology of cloud and radiation fields in a numerical weather prediction model. *Theor. Appl. Climatol*., **57**, 11-33.

Laird, J.L., and Harshvardhan, 1997. Analysis of cumulus solar irradiance reflectance (CSIR) events. *Atmos. Res.*, **44**, 317-332.

Harshvardhan, Ridgway, W., Ramaswamy, V., Freidenreich, S.M., and Batey, M., 1998. Spectral characteristics of solar near-infrared absorption in cloudy atmospheres. *J. Geophys. Res.*, **103**, 28, 793-28,799.

Batey, M., Harshvardhan, and Green, R., 2000: Geometrically effective cloud fraction for solar radiation. *Atmos. Res.*, **55**, 115-129.

Harshvardhan, Schwartz, S.E., Benkovitz, C.M, and Guo, G., 2002. Aerosol influence on cloud microphysics examined by satellite measurements and chemical transport modeling. *J. Atmos. Sci.*, **59**, 714-725.

Schwartz, S.E., Harshvardhan, and Benkovitz, C.M., 2002. Influence of anthropogenic aerosol on cloud optical depth and albedo shown by satellite measurements and chemical transport modeling. *Proc. Natl. Acad. Sci.*, **99**, 1784-1789.

Harshvardhan, Guo, G., Green, R.N., Qu, Z., and Nakajima, T.Y., 2004. Remotely sensed microphysical and thermodynamic properties of non-uniform water cloud fields. *J. Atmos. Sci.*, **61**, 2574-2587.

Bennartz, R. and Harshvardhan, 2007. Correction to 'Global assessment of marine boundary layer cloud droplet number concentration from satellite' by R. Bennartz. *J. Geophys. Res.,*. **112**, D16302, doi:10.1029/2007JD008841.

Harshvardhan, Zhao, G., Di Girolamo, L., and Green, R.N., 2009. Satellite-observed location of stratocumulus cloud-top heights in the presence of strong inversions. *IEEE Trans. Geosci. Remote Sensing*, **47**, doi: 10.1109/ TGRS. 2008.2005406, 1421-1428.

Wilcox, E.M, Harshvardhan, and Platnick, S., 2009. An estimate of the impact of absorbing aerosol over cloud on the MODIS retrievals of cloud optical thickness and effective radius using two independent retrievals of liquid water path. *J. Geophys. Res.,* **114,** D05210, doi:10.1029/2008JD010589.

Yang, P., Hong. G., Dessler, A.E., Ou, S.S.C., Liou, K.-N., Minnis, P., and Harshvardhan, 2010. Contrails and induced cirrus: Optics and radiation. *Bull. Amer. Meteor. Soc*., **91**, doi: 10.1175/2009BAMS2837.1, 473-478.

Petrenko, M., Kahn, R.A., Chin, M., Soja, A.J., Kucsera, T. and Harshvardhan, 2012. The use of satellite-measured aerosol optical depth to constrain biomass burning emissions source strength in the global model GOCART. *J. Geophys. Res*., **117**, D18, doi:10.1029/2012JD017870.

Horton, D.E., Harshvardhan, and Diffenbaugh, N.S., 2012. Response of air stagnation frequency to anthropogenically enhanced radiative forcing. *Environ. Res. Lett*., **7**, doi:10.1088/1748-9326/7/4/044034.

Das, S., Harshvardhan, H., Bian, H., Chin, M., Curci, G., Protonotariou, A.P., Mielonen, T., Zhang, K., Wang., H., and Liu, X., 2017. Biomass burning aerosol transport and vertical distribution over the South African-Atlantic region. *J. Geophys. Res*. *Atmos.*, **122**, doi:10.1002/2016JD026421.

Fountoukis, C., Harshvardhan, H., Gladich, I., Ackerman, L., and Ayoub, M.A, 2020. Anatomy of a severe dust storm in the Middle east: Impacts on aerosol optical properties and radiation budget. *Aerosol Air Qual.Res.*, **20**, 155-165, doi:10.4209/aaqr.2019.04.0165.

Das, S., Harshvardhan, H., and Colarco, P.R., 2020. The influence of elevated smoke layers on stratocumulus clouds over the SE Atlantic in the NASA Goddard Earth Observing System (GEOS) Model. *J. Geophys. Res*. *Atmos.* **125**, e2019JD031209. https://doi.org/10.1029/2019JD031209.

Harshvardhan, H., Ferrare, R., Burton, S., Hair, J., Hostetler, C., Harper, D., Cook, A., Fenn, M., Scarino, A. J., Chemyakin, E., and Müller, D., 2022. Vertical structure of biomass burning aerosol transported over the southeast Atlantic Ocean. *Atmos. Chem. Phys.,* **22**, 9859–9876, https://doi.org/10.5194/acp-22-9859-2022

Book Chapters

Harshvardhan, Arking, A., King, M.D., and Chou, M-D, 1984. Impact of the El Chichon stratospheric aerosol layer on northern hemisphere temperatures. *Aerosols and their Climatic Effects*, H. Gerber and A. Deepak (eds.), A. Deepak Publishing, 261-273.

Binenko, V.I, and Harshvardhan, 1991. Vliyanye aerozolya na perenos radiatsiyi. *Aerozola i Klimat*., K.Ya. Kondratyev (ed.), Leningrad Gidrometeoizdat, 427-487.

Harshvardhan, 1992. The computation of radiative fluxes and heating rates in high resolution atmospheric numerical models. *Physical Processes in Atmospheric Models*. D.R. Sikka and S.S. Singh (eds.), Wiley Eastern Limited, New Delhi, 261-279.

Binenko, V.I., and Harshvardhan, 1993. Aerosol effects in radiation transfer. *Aerosol Effects on Climate*, S.G. Jennings (ed.), University of Arizona Press, 190-232.

Harshvardhan, 1993. Aerosol-Climate Interactions. *Aerosol-Cloud-Climate Interactions*, P.V. Hobbs (ed.), Academic Press, 75-95.