Name	**HU, Yongxiang**
Affiliation	Lidar Remote Sensing Branch, Science Directorate NASA Langley Research Center, Hampton, Virginia, USA (**retired**)
Contact	e-mail: yxhuva@gmail.com phone: 757 874 0475 (Cell)
Education	University of Alaska, Fairbanks, 1994 (PhD) Peking University, 1985 (B. Sc)
Employment History	• 1999–2025: Senior Research Scientist, NASA Langley Research Center • 1997–1999: Research Assistant Professor, Hampton University • 1995–1997: Post Doc, College of William & Mary
Research Experience	1. Developed Innovative Quantum Sensing Concepts: • spectrometer with ring resonators on photonic chips; • receiver system with quantum parametric mode sorting; • new lidar remote sensing concepts with multi-wave mixing, quantum coherence, and orbital angular momentum 2. Developed Quantum AI concept for lidar data analysis using photonic chip-based quantum computer / quantum annealing system, and onboard noise reduction through quantum annealing. 3. Inititated the early-stage development of the ASI/NASA joint satellite lidar mission, CALIGOLA/LUCE, which later become a central part of the Decadal Survey mission (AOS). 4. Theoretical radiative transfer studies: • developed one of the fastest fully polarized radiative transfer models for coupled ocean-atmospheric system • developed polarized radiative transfer models for lidar measurements of the atmosphere, ocean and snow 5. Innovative concepts for global cloud property retrievals using space lidar • discovered a simple relationship between water cloud depolarization ratio and multiple scattering factor of lidar measurements • developed the first cloud thermodynamics phase lidar data product • produced the first 16-year global microphysical property (cloud water content, drop number concentration, and particle size) lidar data product 6. Development of space-based lidar measurements of global oceans • developed the ocean lidar retrieval algorithm • produced the first 16-year global day/night ocean phytoplankton particulate backscatter and carbon biomass data product 7. Invented a new snow measurement technique using lidar measurement • Discovered a simple universal relationship between snow depth and the average traveling distance of multiple-scattering in snowpack • Derived snow density from Raman lidar backscatter signal • Developed/validated new global snow depth data product using ICESat-2 and microwave imager 8. Created innovative, value-added scientific data products using CALIPSO lidar measurements, such as high spatial resolution ocean surface wind speeds, and super-resolution land surface / vegetation canopy products. 9. Developed new high spectral resolution (10 pm) Oxygen A-band & carbon dioxide measurement instrument for future CubeSat measurements.

	10. Science PI of several NASA Earth Science Technology program's Advanced Component Technology and Incubator projects (IIPs) between 2008 and 2023
Awards and Honor	• INABA Prize, 2006: for the discovery of relationship between depolarization and multiple scattering of laser light propagation in cloudy atmosphere • NASA Exceptional Achievement Medal, 2008: for the development of super-resolution altimetry concept using profiling lidar measurements • NASA Exceptional Scientific Achievement Medal, 2022: for the lidar remote sensing of the Earth System • NASA Exceptional Scientific Achievement Medal, 2023: for the scientific leadership in developing innovative remote sensing concepts
Major Services	1. Co-lead, quantum sensing/computing committee of NASA ESTO (2024-present), and co-chaired the NASA ESTO Quantum Sensing Workshop for Earth observations in 2024 2. Lead, the NASA side in the designing / engineering studies of the multi-purpose cloud and aerosol lidar (CALIGOLA) (2020-2024), a potential joint Italian Space Agency (ASI) and NASA space lidar mission 3. Lead, the joint South Korea / US CubeSat project on multi-angle-multi-wavelength polarimeter measurements and developing synergistic active/passive remote sensing concepts (2016-2025) 4. Lead, an international coordination group on promoting ocean lidar measurements since 2008. The group includes oceanographers from Europe, Asia and North America. 5. Co-Chair, NASA's Energy and Water Cycles Studies in 2007 6. Panel member, satellite mission proposal reviews for NASA's Earth Venture Instruments (EV-I) in 2015 and Earth Venture Mission (EVM) competitions in 2021 7. Member, advisory committee for previous decadal survey missions, such as Aerosol/Clouds/Ecosystem (ACE) and Global 3D Winds Observation Systems (GWOS) in 2006 8. Associated Editor of *Frontiers of Remote Sensing* (on Satellite Missions) from 2020-present and Editorial Board Member of *Remote Sensing* from 2016-present 9. Member, institutional review board in the early 2010s for the Remote Sensing Earth System Institute of City University of New York, a Hispanic-Serving Institution. 10. Organizer and/or committee member, various international groups in the lidar and polarimeter measurement communities since 2008 (e.g., Committee for lidar, light scattering and remote sensing measurement coordination and international meetings in 2009, 2011, 2013, 2015, 2017 and 2019; Space-based polarimetric measurement coordination group and international meetings in 2017, 2019 and 2022). 11. Invited talks on space-based lidar measurements and retrievals at multiple government agencies & numerous universities in the U.S. & other countries 12. Mentored young scientists, engineers, and students in their scientific studies; many of them are minority and/or female; some later on became professors, civil servants, and leaders in their fields.

Selected list of Publications

Dr. Hu is the author of more than 250 peer-reviewed journal articles, one book on remote sensing of the aerosols and clouds, and 3 patents. His Google Scholar-based h-index is 69 and total citation of 20,885 (https://scholar.google.com/citations?user=YySlI2oAAAAJ&hl=en).

Patents:

Dr. Hu is the co-lead of NASA Langley Research Center's airborne Differential Absorption Radar for surface barometric pressure measurements. The measurement concept is patented (*U.S. Patent # 8855932*).

Dr. Hu led the theoretical analysis and design in the development of a lightweight photon sieve telescope that can be folded and rolled during rocket launch and deployed in space, fabricated with the laser lithography equipment in NASA Langley Research Center. The concept led to two US patents (*Patent #: 10393863* and *Patent #: 10775537*).

Selected Publications:

1. Yang, Y., Zhou, Y., Stachlewska, I.S., Hu, Y., Lu, X., Chen, W., Liu, J., Sun, W., Yang, S., Tao, Y. and Lin, L., 2024. Spaceborne high-spectral-resolution lidar ACDL/DQ-1 measurements of the particulate backscatter coefficient in the global ocean. Remote Sensing of Environment, 315, p.114444.
2. Hu, Y., Lu, X., Zeng, X., Gatebe, C., Fu, Q., Yang, P., Weimer, C., Stamnes, S., Baize, R., Omar, A. and Creary, G., 2023. Linking lidar multiple scattering profiles to snow depth and snow density: an analytical radiative transfer analysis and the implications for remote sensing of snow. Frontiers in Remote Sensing, 4, p.1202234.
3. Sun, W., Hu, Y., Stamnes, S.A., Trepte, C.R., Omar, A.H. and Baize, R.R., 2023. Effect of Partially Melting Droplets on Polarimetric and Bi-Spectral Retrieval of Water Cloud Particle Size. *Remote Sensing*, 15(6), p.1576.
4. Hu, Y., Lu, X., Zeng, X., Stamnes, S.A., Neuman, T.A., Kurtz, N.T., Zhai, P., Gao, M., Sun, W., Xu, K. and Liu, Z., 2022. Deriving snow depth from ICESat-2 LiDAR multiple scattering measurements. *Frontiers in Remote Sensing*, 3:855159. doi: 10.3389/frsen.2022.855159.
5. Lu, X., Hu, Y., Zeng, X., Stamnes, S.A., Neuman, T.A., Kurtz, N.T., Yang, Y., Zhai, P.W., Gao, M., Sun, W. and Xu, K., 2022. Deriving Snow Depth From ICESat-2 Lidar Multiple Scattering Measurements: Uncertainty Analyses. *Frontiers in Remote Sensing*, 3:891481.
6. Behrenfeld, M.J., Hu, Y., Bisson, K.M., Lu, X. and Westberry, T.K., 2022. Retrieval of ocean optical and plankton properties with the satellite Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) sensor: Background, data processing, and validation status. *Remote Sensing of Environment*, 281, p.113235..
7. Zhang J, Sua YM, Hu Y, Ramanathan J and Huang Y-P (2022) Oxygen A-band absorption spectroscopy with solar photon counting and lithium niobate nanophotonic circuits. *Frontiers in Remote Sensing.* 3:1064244. doi: 10.3389/frsen.2022.1064244
8. Lu, X., Hu, Y., Omar, A., Yang, Y., Vaughan, M., Rodier, S., Garnier, A., Ryan, R., Getzewich, B. and Trepte, C., 2022. Nearshore bathymetry and seafloor property studies from Space lidars: CALIPSO and ICESat-2. *Optics Express*, 30(20), pp.36509-36525.
9. Zhai, P.W. and Hu, Y., 2022. An improved pseudo spherical shell algorithm for vector radiative transfer. *Journal of Quantitative Spectroscopy and Radiative Transfer*, 282, p.108132.

10. Hu, Y., Lu, X., Zhai, P.W., Hostetler, C.A., Hair, J.W., Cairns, B., Sun, W., Stamnes, S., Omar, A., Baize, R. and Videen, G., (2021) Liquid Phase Cloud Microphysical Property Estimates From CALIPSO Measurements. *Front. Remote Sens.* 2:724615. doi: 10.3389/frsen.2021.724615.

11. Murphy A and Hu Y (2021) Retrieving Aerosol Optical Depth and High Spatial Resolution Ocean Surface Wind Speed From CALIPSO. *Front. Remote Sens.* 1:614029. doi: 10.3389/frsen.2020.614029

12. Zhu, S., Sua, Y.M., Hu, Y., Weimer, C., Ma, Z., Zheng, Z., Rehain, P., Stamnes, K., Zhou, Y., Lee, J.H. and Huang, Y.P., 2021. Quantum parametric mode sorting: a case study on small angle scattering. *JOSA B*, 38(10), pp.D15-D21..

13. Lu, X., Hu, Y., Yang, Y., Bontempi, P., Omar, A. and Baize, R., 2020. Antarctic spring ice-edge blooms observed from space by ICESat-2. *Remote Sensing of Environment*, 245, p.111827. https://doi.org/10.1016/j.rse.2020.111827

14. Xu, K.-M., Hu, Y., & Wong, T. (2019): Convective aggregation and indices examined from CERES cloud object data. *JGR Atmosphere*, 24, P 13604-13624. https://doi.org/10.1029/2019JD030816

15. He, M., Hu, Y., Chen, N., Wang, D., Huang, J. and Stamnes, K., 2019. High cloud coverage over melted areas dominates the impact of clouds on the albedo feedback in the Arctic., *Nature Scientific Reports*, 9, 9529, https://doi.org/https://doi.org/10.1038/s41598-019-44155-w

16. Tang, Q., Hu, Y., Li, W., Huang, J. and Stamnes, K., 2018. Cirrus Optical Depth over the Ocean obtained from Collocated CALIPSO and AMSR-E Observations, *Applied Optics*, 57. https://doi.org/10.1364/AO.57.007472

17. Sun, W., Hu, Y., MacDonnell, D.G., Kim, H.J., Weimer, C. and Baize, R.R., 2017: Fully transparent photon sieve, *Optics Express*, 25, 17356-17363.

18. Lu, Xiaomei, Yongxiang Hu, Zhaoyan Liu, Sharon Rodier, Mark Vaughan, Patricia Lucker, Charles Trepte, and Jacques Pelon, 2017: Observations of Arctic snow and sea ice cover from CALIOP lidar measurements, *REMOTE SENSING OF ENV*, 194, P 248-263. DOI: 10.1016/j.rse.2017.03.046

19. Zhai, P.W., Hu, Y., Winker, D.M., Franz, B.A., Werdell, J. and Boss, E., 2017. Vector radiative transfer model for coupled atmosphere and ocean systems including inelastic sources in ocean waters. *Optics express*, 25(8), pp.A223-A239.

20. Sun, W., Hu, Y., Weimer, C., Ayers, K., Baize, R.R. and Lee, T., 2017. A FDTD solution of scattering of laser beam with orbital angular momentum by dielectric particles: Far-field characteristics. *JQSRT*, 188, pp.200-213.

21. He, M., Hu, Y., Huang, J.P. and Stamnes, K., 2016: Aerosol optical depth under "clear" sky conditions derived from sea surface reflection of lidar signals, *Optical Express*, 24, pp. A1618-A1634, DOI: 10.1364/OE.24.0A1618.

22. Lu, X., Hu, Y., Trepte, C. and Liu, Z., 2013. A super-resolution laser altimetry concept. *IEEE Geoscience and Remote Sensing Letters,* 11, P 298-302. DOI: 10.1109/LGRS.2013.2256876.

23. Behrenfeld, M.J., Hu, Y., Hostetler, C.A., Dall'Olmo, G., Rodier, S.D., Hair, J.W. and Trepte, C.R., 2013. Space-based lidar measurements of global ocean carbon stocks. *Geophysical Research Letters*, 40, 4355–4360, doi:10.1002/grl.50816.

24. Hu, Y., Rodier, S., Xu, K.M., Sun, W., Huang, J., Lin, B., Zhai, P. and Josset, D., 2010. Occurrence, liquid water content, and fraction of supercooled water clouds from combined CALIOP/IIR/MODIS measurements. *J of Geophysical Research: Atmospheres*, 115, http://doi:10.1029/2009JD012384.

25. Stephens, G. L. and Y. Hu, 2010: Are climate-related changes to the character of global-mean precipitation predictable? *Environ, Res. Lett.*, 5, 025209, doi:10.1088/1748-9326/5/2/025209.

26. Hu, Y., Winker, D., Vaughan, M., Lin, B., Omar, A., Trepte, C., Flittner, D., Yang, P., Nasiri, S.L., Baum, B. and Holz, R., 2009: CALIPSO/CALIOP Cloud Phase Discrimination Algorithm*, J. Atmos. Oceanic Technol.* (2009) 26 (11): 2293–2309.

27. Zhai, P., Y. Hu et al., 2009: A vector radiative transfer model for coupled atmosphere and ocean systems based on successive order of scattering method, Optics Express, 17, 2057-2079.

28. Hu, Y., K. Stamnes, M. Vaughan, J. Pelon et al., 2008: "Sea surface wind speed estimation from space-based lidar measurements", *Atmos. Chem. Phys*., 8, 3593-3601.

29. Wu, D., Y. Hu et al., 2008: Deriving marine-boundary-layer lapse rate from collocated CALIPSO, MODIS, and AMSR-E data, *IEEE Geoscience and Remote Sensing Letters* 5 (4), 649-652.

30. Hu, Y., 2007: Depolarization ratio–effective lidar ratio relation: Theoretical basis for space lidar cloud phase discrimination, *Geophys. Res. Lett*., 34, L11812, doi:10.1029/ 2007GL029584.

31. Hu, Y. et al., 2007: The depolarization-attenuated backscatter relation: CALIPSO lidar measurements vs. theory, *Optics Express*, 15, 5327–5332.

32. Hu, Y, et al., 2007: Retrieving Optical Depths and Lidar Ratios for Transparent Layers Above Opaque Water Clouds From CALIPSO Lidar Measurements, *IEEE Geosc.&. Remote Sens. Letters*, 4, 523–526.

33. Fu., Q., Y. Hu, and Q. Yang, 2007: Identifying the top of the tropical tropopause layer from vertical mass flux analysis and CALIPSO lidar cloud observations. *GRL*, 34. DOI: 10.1029/2007GL030099.

34. Hu, Y., et al., 2007: Global statistics of liquid water content and effective number concentration of water clouds over ocean derived from combined CALIPSO and MODIS measurements, *Atmos. Chem. Phys.*, 7, 3353–3359.

35. Hu, Y., K. Powell, M. Vaughan, C. Tepte, C. Weimer, M. Beherenfeld et al., 2007: "Elevation information in tail (EIT) technique for lidar altimetry", *Optics Express*, 15, 14504–14515.

36. Hu, Y. et al., 2006: Simple relation between lidar multiple scattering and depolarization for water clouds, *Optics Letters*, 31, P. 1809-1811. DOI: 10.1364/OL.31.001809.

37. Hu, Y., Wielicki, B.A., et al., 2004. Application of deep convective cloud albedo observation to satellite-based study of the terrestrial atmosphere: Monitoring the stability of spaceborne measurements and assessing absorption anomaly. *IEEE Trans. on Geo. and Remote Sensing*, 42(11), pp.2594-2599.

38. Lin, B. and Y. Hu, 2004: Numerical simulations of radar surface air pressure measurements at O-2 bands, *IEEE Geosc. and Remote Sensing Letters*, 2, P 324-328. DOI: 10.1109/LGRS.2005.848515.

39. Hu, Y., et al, 2003: Discriminating between spherical and non-spherical scatterers with lidar using circular polarization: a theoretical study, *JQSRT*, 79, P 757-764. DOI: 10.1016/S0022-4073(02)00320-5.

40. Hu, Y. et al., 2001: Identification of cloud phase from PICASSO-CENA lidar depolarization: a multiple scattering sensitivity study, *JQSRT*, 70, 569-579. DOI: 10.1016/S0022-4073(01)00030-9.

41. Hu, Y. et al., 2000: delta-Fit: A fast and accurate treatment of particle scattering phase functions with weighted singular-value decomposition least-squares fitting, *JQSRT*, 65, DOI: 10.1016/S0022-4073(99)00147-8

42. Hu, Y.X. and Stamnes, K., 1993. An accurate parameterization of the radiative properties of water clouds suitable for use in climate models. *Journal of climate*, 6(4), pp.728-742.