

Kamal Kant CHANDRAKAR

Project Scientist (MMM, NCAR)

PERSONAL DATA

ADDRESS: Mesoscale & Microscale Meteorology Laboratory
National Center for Atmospheric Research
Boulder, CO-80301

PHONE: +1 906-370-6329

E-MAIL: kkchandr@ucar.edu

GOOGLE SCHOLAR: [Chandrakar Google Scholar](#)

RESEARCH INTEREST

Clouds are critical for both short-term weather patterns and long-term climate change since they affect radiative forcing and the hydrological cycle. Of particular importance, clouds and associated microphysical processes significantly impact climate sensitivity. My research interest lies in the interdisciplinary area of aerosol-cloud and cloud-turbulence interactions, focusing on microphysical interactions and their implications for macro-scale cloud properties and processes. Specifically, I am interested in theoretical, cutting edge numerical modeling and experimental/measurement studies of processes that determine climate sensitivity: aerosol-cloud-turbulence interactions, microphysics, precipitation formation, moist convection, and turbulence. My research interest also aims to improve the representation of clouds in models across scales.

EDUCATION

2019 | **PhD.** in *Atmospheric Sciences*,
Michigan Technological University, Houghton, MI
Major: Atmospheric Sciences
Thesis: *Aerosol-Cloud Interactions in Turbulent Clouds: A Combined Cloud Chamber and Theoretical Study.* | Advisor: Prof. Raymond A. Shaw

2013 | **Master of Engineering** in *Mechanical Engineering*,
Indian Institute of Science, Bangalore (INDIA)
First Class | Major: Fluid Dynamics
Thesis: *Unsteady Flow Through Flexible Opening.* | Advisor: Prof. Jaywant H. Arakeri

RESEARCH EXPERIENCE

Sep 2022 | **Project Scientist I** at MMM, National Center for Atmospheric Research, Boulder

- Sep 2019 - Sep 2022 | **ASP Postdoctoral Fellow at National Center for Atmospheric Research, Boulder**
Collaborators: Dr. Hugh Morrison, Dr. Wojciech W. Grabowski, and Dr. George Bryan
- Fall 2014 - Fall 2019 | **Graduate Research at Michigan Technological University**
II-Chamber Group | Advisor : Prof. Raymond A. Shaw
- Aug 2013 - Jul 2014 | **Research Assistant at Indian Institute of Science**
Fluid Mechanics Laboratory | Advisor : Prof. Jaywant H. Arakeri
- Jan 2012 - Jul 2013 | **Graduate Research at Indian Institute of Science**
Fluid Mechanics Laboratory | Advisor : Prof. Jaywant H. Arakeri

TEACHING EXPERIENCE

- Fall 2014 | **Teaching Assistant, Department of Physics at Michigan Technological University**
Physics by Inquiry I
- Fall 2015 | **Teaching Assistant, Department of Physics at Michigan Technological University**
Physics by Inquiry I

MENTORING EXPERIENCE

- 2020 | Served as a mentor for the ASP peer mentoring program at NCAR-ASP
- 2022 | Co-mentored a graduate student visitor at MMM (Yayun Qiao, The University of Oklahoma)

AWARDS & FELLOWSHIPS

- 2019-22 | NCAR Advance Study Program Postdoctoral Fellowship
- 2019 | Dean's Award for Outstanding Scholarship, MTU
- 2017-19 | NASA Earth and Space Science Fellowship
- 2017 | Best Graduate Poster Presentation Award, MTU (Physics)
- 2011-13 | Ministry of Human Resource Development Scholarship by the Government of India
to pursue Master's at IISc after qualifying Graduate Aptitude Test in Engineering (GATE)
with all India rank - 8

FUNDED RESEARCH GRANTS

- 2017 Aerosol indirect effects on optical properties of turbulent clouds. | Source of Support: NASA Earth and Space Science Fellowship Program
- 2019-2022 Research Proposal for the NCAR ASP Fellowship Program.
- 2021 Direct numerical simulations of a laboratory cloud chamber to investigate aerosol-cloud-turbulence interactions. | Source of Support: University Large Request CISL / NCAR (request for computational resources), PI: R A Shaw | Total Allocation: 2M CPU hours
- 2022 Benchmark simulations using a Lagrangian microphysics scheme to study cloud-turbulence interactions: from direct numerical simulations of a laboratory cloud chamber to high-resolution large-eddy simulations of clouds | Source of Support: Accelerated Scientific Discovery CISL / NCAR (computational resources in a new supercomputer – Derecho), PI: H Morrison, co-PI: **Kamal Kant Chandrakar** | Total Allocation: 50M CPU hours
- 2022 Surface, aerosol, and meteorological controls on Arctic boundary layer clouds: Observations and simulations of MOSAiC and COMBLE clouds. | Source of Support: DOE ASR, PI: A Dzambo, co-I: **Kamal Kant Chandrakar** | Total Amount- \$888,000
- 2022 Building a next-generation microphysics scheme for E3SM: a data-driven, physically constrained, single-category approach | Source of Support: DOE ESMD, PI: H Morrison, co-I: **Kamal Kant Chandrakar** | Total Amount- \$890,000

REVIEWER

AGU Books	Journal of the Atmospheric Sciences
Atmospheric Chemistry and Physics	Journal of Geophysical Research: Atmospheres
Boundary-Layer Meteorology	Physical Review E
Geophysical Research Letters	Quarterly Journal of the Royal Meteorological Society

SERVICES

- 2019 Poster Judge, ATOC ESSS Poster Conference, CU, Boulder
- 2019-2022 Thompson Lecture Series Committee, NCAR
- 2021-2022 ASP Research Review Committee, NCAR
- 2022-current AMS Committee on Cloud Physics
- 2022 Session co-Chair in AMS 16th Conference on Cloud Physics
- 2022 Judge for Student Presentations in AMS 16th Conference on Cloud Physics

SELECTED WORKSHOP AND TRAINING

- 2022 Early Career Leadership Program, NCAR, Boulder, CO
- 2021 GPU Workshop, CISL (NCAR), Boulder, CO
- 2019 Leadership Training, NCAR ASP, Boulder, CO
- 2019 Diversity, Equity, and Inclusion Training, Boulder, CO
- 2019 NCAR WRF Workshop, Boulder, CO
- 2014 Teaching Assistant Orientation and Training, Michigan Tech, Houghton, MI

MEDIA COVERAGE OF RESEARCH

[PHYS.ORG - Cloud in a box: Mixing aerosols and turbulence by Stefanie Sidortsova, MichiganTech](#)

LIST OF PUBLICATIONS

Publication Statistics:

Total Citations	h-index	i10-index
390	12	11

2016

1. **K. K. Chandrakar**, W. Cantrell, K. Chang, D. Ciochetto, D. Niedermeier, M. Ovchinnikov, R. A. Shaw, and F. Yang. Aerosol indirect effect from turbulence-induced broadening of cloud-droplet size distributions. **Proceedings of the National Academy of Sciences of the United States of America**, 113:14243–14248, 2016
2. K. Chang, J. Bench, M. Brege, W. Cantrell, **K. K. Chandrakar**, D. Ciochetto, C. Mazzoleni, L. R. Mazzoleni, D. Niedermeier, and R. A. Shaw. A laboratory facility to study gas-aerosol-cloud interactions in a turbulent environment: The π chamber. **Bulletin of the American Meteorological Society**, 97(12):2343–2358, 2016

2017

3. **K. K. Chandrakar**, W. Cantrell, D. Ciochetto, S. Karki, G. Kinney, and R. A. Shaw. Aerosol removal and cloud collapse accelerated by supersaturation fluctuations in turbulence. **Geophysical Research Letters**, 44(9):4359–4367, 2017

2018

4. N. Desai, **K. K. Chandrakar**, K. Chang, W. Cantrell, and R. A. Shaw. Influence of microphysical variability on stochastic condensation in a turbulent laboratory cloud. **Journal of the Atmospheric Sciences**, 75(1):189–201, 2018
5. D. Niedermeier, K. Chang, W. Cantrell, **K. K. Chandrakar**, D. Ciochetto, and R. A. Shaw. Observation of a link between energy dissipation rate and oscillation frequency of the large-scale circulation in dry and moist rayleigh-bénard turbulence. **Physical Review Fluids**, 3(8):083501, 2018

6. **K. K. Chandrakar**, W. Cantrell, and R. A. Shaw. Influence of turbulent fluctuations on cloud droplet size dispersion and aerosol indirect effects. **Journal of the Atmospheric Sciences**, 75(9):3191–3209, 2018
 7. **K. K. Chandrakar**, W. Cantrell, A. B. Kostinski, and R. A. Shaw. Dispersion aerosol indirect effect in turbulent clouds: Laboratory measurements of effective radius. **Geophysical Research Letters**, 45(19): 10–738, 2018
- 2019
8. N. Desai, **K. K. Chandrakar**, G. Kinney, W. Cantrell, and R. A. Shaw. Aerosol mediated glaciation of mixed phase clouds: Steady state laboratory measurements. **Geophysical Research Letters**, 46(15):9154–9162, 2019
 9. J. Bhandari, S. China, **K. K. Chandrakar**, G. Kinney, W. Cantrell, R. A. Shaw, L. R. Mazzoleni, G. Girotto, N. Sharma, K. Gorkowski, et al. Extensive soot compaction by cloud processing from laboratory and field observations. **Scientific reports**, 9(1):1–12, 2019
 10. **K. K. Chandrakar**. Aerosol-Cloud Interactions in Turbulent Clouds: A Combined Cloud Chamber and Theoretical Study. Open Access Dissertation, **Michigan Technological University**, 2019
- 2020
11. **K. K. Chandrakar**, I. Saito, F. Yang, W. Cantrell, T. Gotoh, and R. A. Shaw. Droplet size distributions in turbulent clouds: experimental evaluation of theoretical distributions. **Quarterly Journal of the Royal Meteorological Society**, 146(726): 483–504, 2020
 12. **K. K. Chandrakar**, W. Cantrell, S. Krueger, R. A. Shaw, and S. Wunsch. Supersaturation fluctuations in moist turbulent Rayleigh-Bénard convection: a two-scalar transport problem. **Journal of Fluid Mechanics**, 884, 2020
 13. **K. K. Chandrakar** and R. A. Shaw. Chapter-18: In-situ and laboratory measurements of cloud microphysical properties. Fast Physics in Large Scale Atmospheric Models: Parameterization, Evaluation, and Observation (**AGU BOOK**), 2020 (accepted)
- 2021
14. **K. K. Chandrakar**, W. Grabowski, H. Morrison, and G. H. Bryan. Entrainment-mixing and evolution of droplet size distribution in a cumulus cloud: an investigation using Lagrangian microphysics with a sub-grid-scale model. **Journal of the Atmospheric Sciences**, 78(9):2983–3005, 2021
 15. **K. K. Chandrakar**, H. Morrison, W. Grabowski, G. H. Bryan, and R. A. Shaw. Supersaturation variability from scalar mixing at unresolved scales: sub-grid model and its evaluation using direct numerical simulations of turbulent moist Rayleigh-Bénard convection. **Journal of the Atmospheric Sciences**, 79(4), 1191-1210, 2022

2022

16. H. Morrison, J. Peters, **K. K. Chandrakar**, and S. Sherwood. Influences of environmental relative humidity and horizontal scale of sub-cloud ascent on deep convective initiation. **Journal of the Atmospheric Sciences**, 79(2), 337–359, 2022
17. H. Morrison, P. Lawson, and **K. K. Chandrakar**. Observed and bin model simulated evolution of drop size distributions in high-based cumulus congestus over the United Arab Emirates. **Journal of Geophysical Research: Atmosphere**, 127, e2021JD035711, 2022
18. **K. K. Chandrakar**, H. Morrison, W. Grabowski, and G. H. Bryan. Comparison of Lagrangian super-droplet and Eulerian double-moment spectral microphysics schemes in large-eddy simulations of an isolated cumulus-congestus cloud. **Journal of the Atmospheric Sciences**, 79(7), 1887–1910, 2022
19. **K. K. Chandrakar**, H. Morrison, and M. Witte. Evolution of droplet size distributions during the transition of an ultraclean stratocumulus cloud system to open cell structure: an LES investigation using Lagrangian microphysics. **Geophysical Research Letters**, 2022

MANUSCRIPTS IN REVIEW / PREPARATION

20. **K. K. Chandrakar**, H. Morrison, and W. Grabowski. Impact of aerosol processing in stratocumulus cloud transition from closed to open cellular structure: Comparison of Lagrangian super-droplet and Eulerian double-moment bin microphysics schemes. **Monthly Weather Review** (in preparation), 2022
21. **K. K. Chandrakar**, H. Morrison, and R. A. Shaw. Lagrangian supersaturation statistics in turbulent cloudy Rayleigh–Bénard convection: Evaluation of assumptions in a stochastic sub-grid model using direct numerical simulations. **Journal of the Atmospheric Sciences** (in preparation), 2022

SELECTED PRESENTATIONS

- 2016 **Chandrakar et al.** Correlation of cloud droplet growth with the scalar fluctuations in a turbulent moist convection. In *APS Meeting Abstracts*, 2016
 - 2017 **Chandrakar et al.** Experimental investigation of cloud formation and growth in turbulent moist convection: turbulence induced droplet activation and growth. In *Summer school and Discussion Meeting on Buoyancy-driven flows*, ICTS, Bangalore, 2017
 - 2018 **Chandrakar et al.** Influence of turbulent fluctuations on cloud droplet size dispersion and aerosol indirect effects. In *AMS: 15th Conference on Cloud Physics*, 2018
- Chandrakar et al.** Aerosol removal and cloud collapse accelerated by supersaturation fluctuations with a positive feedback in a turbulent cloud: a cloud-chamber study. In *International Workshop on Cloud Dynamics, Microphysics, and Small-Scale Simulation*, IITM, Pune, 2018

- Chandrakar et al.** Supersaturation fluctuations from scalar transport in moist Rayleigh-Bénard convection: One-dimensional-turbulence simulation. In *AGU Fall Meeting*, 2018
- 2019 **Chandrakar et al.** Supersaturation fluctuations in moist turbulent Rayleigh-Bénard convection: a two-scalar transport problem. In *Pi chamber simulation workshop*, MichiganTech, Houghton, 2019
- 2020 **Chandrakar et al.** Droplet size distributions in turbulent clouds: experimental evaluation of theoretical distributions. In *3rd International Workshop on Cloud Turbulence (Nagoya Institute of Technology)*, 2020
- K. K. Chandrakar** Cloud turbulence interactions in a laboratory and cumulus clouds: theoretical, experimental, and modeling perspectives. In *Leibniz Institute for Tropospheric Research*, Leipzig (Germany), 2020
- 2021 **K. K. Chandrakar** Cloud turbulence interactions from a laboratory scale to cumulus entrainment: theoretical, experimental, and modeling perspectives. In *Brookhaven National Laboratory*, Upton (NY), 2021
- K. K. Chandrakar** Cloud-turbulence interactions from laboratory scale to cumulus entrainment and their impact on droplet size distributions. In *University of Wyoming*, Laramie (WY), 2021
- K. K. Chandrakar** Impact of Turbulence on Cloud Droplets in Laboratory and Cumulus Clouds and Comparison of Lagrangian and Eulerian Microphysics Schemes. In *University of Utah*, Salt Lake City (UT), 2021
- Chandrakar et al.** Droplet spectra in ice-free cumulus clouds: Lagrangian particle-based modeling and high-resolution observations. In *Joint ARM/ASR Meeting*, 2021
- Chandrakar et al.** Isolated cumulus congestus based on SCMS campaign: comparison between Eulerian bin and Lagrangian particle-based microphysics. In *The 10th International Cloud Modelling Workshop*, 2021
- Chandrakar et al.** Impact of entrainment-mixing and turbulent fluctuations on droplet size distributions in a cumulus cloud. In *AGU Fall Meeting*, 2021
- 2022 **Chandrakar et al.** Comparison of Lagrangian super-droplet and Eulerian double-moment spectral microphysics schemes in large-eddy simulations of an isolated cumulus-congestus. In *102nd AMS Annual Meeting (14th Symposium on Aerosol-Cloud-Climate Interactions)*, 2022
- Chandrakar et al.** Supersaturation variability from scalar mixing at unresolved scales: sub-grid model and its evaluation using direct numerical simulations of turbulent moist Rayleigh-Bénard convection. In *4th International Workshop on Cloud Turbulence (Nagoya Institute of Technology)*, 2022

K. K. Chandrakar Impact of aerosols and turbulence on clouds: process level investigations using experiments, theory, and modeling. In *Penn State MAS Colloquia*, University Park (PA), 2022

K. K. Chandrakar Impact of aerosols and turbulence on clouds: process level investigations using experiments, theory, and modeling. In *University of Houston EAS Seminar*, Houston (TX), 2022

K. K. Chandrakar Impact of aerosols and turbulence on clouds: process level investigations using experiments, theory, and modeling. In *UCLA AOS Seminar*, Los Angeles (CA), 2022

K. K. Chandrakar Impact of aerosols and turbulence on clouds: process level investigations using experiments, theory, and modeling. In *RAL seminar series*, NCAR, Boulder (CO), 2022

Chandrakar et al. Impact of aerosol processing in stratocumulus cloud transition from closed to open cellular structure: Comparison of Lagrangian super-droplet and Eulerian double-moment bin microphysics schemes. In *AMS Collective Madison Meeting (16th Conference on Cloud Physics)*, 2022

Chandrakar et al. Supersaturation variability from scalar mixing: evaluation of a new subgrid-scale model using direct numerical simulations of turbulent Rayleigh–Bénard convection. In *AMS Collective Madison Meeting (16th Conference on Cloud Physics)*, 2022

REFERENCES

1. Prof. Raymond A. Shaw
Professor, Dept. of Physics
Michigan Technological University,
1400 Townsend Dr, Houghton, MI 49931
E-Mail: rashaw@mtu.edu

2. Dr. Hugh Morrison
Senior Scientist
MMM, National Center for Atmospheric Research,
3450 Mitchell Ln, Boulder, CO 80301
E-Mail: morrison@ucar.edu

3. Dr. Wojciech Grabowski
Senior Scientist
MMM, National Center for Atmospheric Research,
3450 Mitchell Ln, Boulder, CO 80301
E-Mail: grabow@ucar.edu

4. Dr. George H. Bryan
Senior Scientist
MMM, National Center for Atmospheric Research,
3450 Mitchell Ln, Boulder, CO 80301
E-Mail: gbryan@ucar.edu

5. Prof. Will H. Cantrell
Professor, Dept. of Physics
Michigan Technological University,
1400 Townsend Dr, Houghton, MI 49931
E-Mail: cantrell@mtu.edu