

## **CURRICULUM VITAE: Rajesh Kumar**

### **Project Scientist II**

**Research Application Laboratory (RAL), National Center for Atmospheric Research (NCAR)**

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### **EDUCATION:**

- Jul 2001 - Jun 2004      **Bachelor of Science (B. Sc.)** (First Division – 79%)  
I. B. College, Panipat, India
- Jul 2004 - Jun 2006      **Master of Science (M. Sc.)** (First Division – 79%)  
Department of Physics, Kururkshetra University, India
- June 2012                **Ph. D. In Earth Sciences** (magna cum laude)  
University of Hamburg, Germany  
Thesis Title: “Weather Research and Forecasting Model with Chemistry (WRF-Chem) over South Asia”

### **PROFESSIONAL EXPERIENCE:**

- Feb 2018 – Present  
    **Project Scientist II, RAL, NCAR**
- Mar 2016 – Feb 2018  
    **Project Scientist I, RAL, NCAR**
- Oct 2015 – Feb 2016  
    **Post-doctoral Scientist, RAL, NCAR**
- Aug 2015 – Sep 2015  
    **Post-doctoral Scientist, RAL and ACOM, NCAR**
- Jan. 2015 – Aug. 2015  
    **Post-doctoral Scientist, ACOM, NCAR**
- Jan. 2013 – Dec 2014  
    **Post-doctoral fellow, Advanced Study Program (ASP), NCAR**
- Dec 2011 – Oct 2012  
    **Visiting Scientist, Max Planck Institute for Meteorology and Climate Service Center, Hamburg, Germany**
- Jul 2008 – Jun 2012  
    **Senior Research Fellow, Aryabhata Research Institute of Observational Sciences, Nainital, India**
- Jul 2006 – Jul 2008  
    **Junior Research Fellow, Aryabhata Research Institute of Observational Sciences, Nainital, India**

### **RESEARCH EXPERIENCE AND TOOLS**

#### **In situ measurements**

- In situ measurements of surface ozone, carbon monoxide, nitrogen oxides, sulphur dioxide, black carbon, aerosol optical depth, aerosol size distribution, particulate matter and meteorological parameters
- Air-sample collection and their analysis using gas chromatography (for CO and greenhouse gases)

- Balloon-borne measurements of ozone and meteorological parameters

#### **Satellite and Reanalysis Data Products**

- MODIS retrieved fire and aerosol products
- OMI retrieved tropospheric column NO<sub>2</sub>, ozone profiles and aerosol product
- MOPITT retrieved tropospheric CO products
- TES retrieved ozone and CO products
- AIRS retrieved temperature, tropopause pressure and water vapor products
- TRMM retrieved rainfall products
- CALIPSO retrieved aerosol profiles
- NCEP/NCAR reanalysis products

#### **Modeling**

- Weather Research and forecasting model coupled with Chemistry (WRF-Chem – regional chemistry transport model)
- Community Multi-scale Air Quality (CMAQ) Model
- Chemical data assimilation, WRF-CMAQ, WRF-Chem, and GSI
- Model for Prediction Across Scales (MPAS)
- NCAR Master Mechanism (box model)
- Air trajectory models (METEX and HYSPLIT)
- Optical properties of aerosols and clouds (OPAC – aerosol composition model)
- SBDART (A one dimensional model of radiative transfer)

#### **SCIENTIFIC/TECHNICAL ACCOMPLISHMENTS**

- Lead developer of chemistry component in MPAS
- Lead developer of the CMAQ-GSI chemical data assimilation system
- Chemical weather forecasting in support of FRAPPE field campaign.
- Studied the role of regional and distant sources in controlling surface ozone variations at Nainital
- Identified the impact of north Indian agricultural biomass burning on surface ozone, black carbon, AOD and radiation budget at Nainital
- Set-up the WRF-Chem model for the first time over the South Asian region and conducted detailed meteorological and chemistry evaluations
- Source contribution analysis of CO and BC in South Asia
- Studied the impact of a dust storm on regional scale aerosol optical properties, radiation budget and tropospheric chemistry in northern India
- Updated F-TUV photolysis scheme of the WRF-Chem model to include the effects of dust aerosols on photolysis rate calculation in WRF-Chem (**This update is available in official version of WRF-Chem since version 3.5.1**)
- Added heterogeneous chemistry occurring on the surface of dust particles in WRF-Chem
- Implementation of source, sector and region-specific BC and CO tracers in WRF-Chem
- Chemistry Climate simulations over South Asia

#### **AWARDS AND HONORS**

- FRAPPE field campaign special recognition award
- Advanced Study Program (ASP) Postdoctoral Fellowship
- ASP Graduate Student Visitor Program Fellowship
- 1<sup>st</sup> position in university in M. Sc. (**Jindal Jubilee Gold Model**).

## **PROFESSIONAL ACTIVITIES**

- Professional reviewer for peer-reviewed journals
  - Atmospheric Chemistry and Physics (ACP)
  - Geoscientific Model Development (GMD)
  - Journal of Geophysical Research (JGR)
  - Geophysical Research Letters (GRL)
  - Atmospheric Environment
  - Aeolian Research
  - Advances in Space Research
  - Atmospheric Pollution Research
  - Urban Climate
  - Environmental Science and Pollution Research
  - International Journal of Remote Sensing
  - Journal of Atmospheric Chemistry
  - Geohealth
  - Journal of Atmospheric and Oceanic Technology
  - Earth System Data Science
- Professional reviewer for funding agencies
  - NSF panel and single-proposal reviewer
  - NASA proposal reviewer
  - Pazi foundation proposal reviewer
- Internal reviewer for publications and proposals in NCAR.
- Member of UCAR innovation council.
- Member of ASP seminar committee at NCAR.
- Representative of various (computer, canteen and library) committees in ARIES.

## **COMPUTING EXPERIENCE**

- Programming Languages: IDL, NCL, FORTRAN, and C
- Operating Systems: Windows, Linux, Mac, and Unix
- File Handling: ASCII, NetCDF, HDF, HDF-EOS

### GRANTS AND RESEARCH AWARDS (External)

Period	My Role	Title	Agency	Amount (USD)
2019-2022	PI	A novel method for improving fine particulate matter air quality forecasts during wildfires	NOAA	\$509,714
2019-2022	PI	Quantification and Attribution of Past (2005-2018) Air Quality Trends over the Contiguous United States (CONUS) via Assimilation of NASA Atmospheric Composition	NASA	\$600,000
2018-2020	Co-PI	Enhancing Decision-Making Activity in the Area of Air Quality in Delhi	MOES	\$360,000
2019	PI	Crowd-Sourced Environment Sensing and Terrain Analysis using Mobile Devices	Creare	\$45,634
2019	PI	Quantify Inter-state Transport of Air Pollutants in India	WRI	\$25,000
2018-2021	Co-I	Multi-scale Chemical Forecasting and Analysis for FIREChem	NASA	\$605,617
2016-2019	PI (June 2018 – Dec 2019), Co-I (June 2016 -	A novel ensemble design for PM <sub>2.5</sub> Probabilistic predictions	NOAA	\$449,249
2016-2019	PI (Mar 2019- June 2020), Co-PI (Jan 2018 – Feb 2019)	Evaluation and Recommendation of State-of-the-Art Source Term Estimation Models for Methane Emission Applications	Exxon Mobil	\$300,000
2015-2017	PI (Jul 2018– Jan 2019), Co-I (Oct 2015 – Jun 2018)	Chemical data assimilation and analog-based uncertainty quantification to improve decision-making in public health and air quality	NASA	\$1,416,586
Total Funding				\$4,311,800.00

**STUDENT SUPERVISION (NCAR Graduate Student Visitor Program)**

<b>S. N.</b>	<b>Student Name</b>	<b>Student's Host Institute</b>
1.	Chandan Sarangi (2013)	Indian Institute of Technology, Kanpur, India
2.	Piyush Bhardwaj (2015)	Aryabhata Research Institute of Observational Sciences (ARIES), Nainital, India
3.	Aishwarya Raman (2016)	The University of Arizona, Tucson, USA
4.	Boris Mifka (2017)	University of Zagreb, Zagreb, Croatia
5.	Mauro Morichetti (2017)	University of Polytechnic of Marche, Ancona, Italy
6.	Abhishek Mishra (2018)	Indian Institute of Science Education and Research (IISER), Mohali, India
7.	Xiaokang Wu (2018)	Texas A&M University, Texas, USA
8.	Maryam Globazi (2019)	University of Delaware, Delaware, USA

**Sponsored and Hosted NCAR visiting scientists**

<b>S. N.</b>	<b>Student Name</b>	<b>Student's Host Institute</b>
1.	VijayKumar Nair (2014)	Space Physical Laboratory, Trivandrum, India
2.	Sachin D Ghude (2016)	Indian Institute for Tropical Meteorology (IITM), India
3.	Ashish Sharma (2017)	University of Notre Dame, Indiana, USA

## PUBLICATIONS

### THESIS

1. **R. Kumar**: Weather Research and Forecasting Model with Chemistry (WRF-Chem) over South Asia, 116, Reports on Earth System Science, ISSN 1614-1199, Max Planck Institute for Meteorology, Hamburg, Germany.

### PEER-REVIEWED PUBLICATIONS

1. **R. Kumar**, M. Naja, S. Venkataramani, and O. Wild (2010), Variations in surface ozone at Nainital: A high-altitude site in the central Himalayas, *J. Geophys. Res.*, 115, D16302, doi:[10.1029/2009JD013715](https://doi.org/10.1029/2009JD013715).
2. **R. Kumar**, M. Naja, S. K. Satheesh, N. Ojha, H. Joshi, T. Sarangi, P. Pant, U. C. Dumka, P. Hegde, and S. Venkataramani (2011), Influences of the springtime northern Indian biomass burning over the central Himalayas, *J. Geophys. Res.*, 116, D19302, doi:[10.1029/2010JD015509](https://doi.org/10.1029/2010JD015509).
3. **R. Kumar**, Naja, M., Pfister, G. G., Barth, M. C., and Brasseur, G. P.: Simulations over South Asia using the Weather Research and Forecasting model with Chemistry (WRF-Chem): set-up and meteorological evaluation (2012), *Geosci. Model Dev.*, 5, 321-343, doi:10.5194/gmd-5-321-2012.
4. **R. Kumar**, Naja, M., Pfister, G. G., Barth, M. C., Wiedinmyer, C., and Brasseur, G. P.: Simulations over South Asia using the Weather Research and Forecasting model with Chemistry (WRF-Chem): chemistry evaluation and initial results (2012), *Geosci. Model Dev.*, 5, 619-648, doi:10.5194/gmd-5-619-2012.
5. **R. Kumar**, M. Naja, G. G. Pfister, M. C. Barth, and G. P. Brasseur (2013), Source attribution of carbon monoxide in India and surrounding regions during wintertime, *J. Geophys. Res. Atmos.*, 118, 1981–1995, doi:[10.1002/jgrd.50134](https://doi.org/10.1002/jgrd.50134).
6. **R. Kumar**, Barth, M. C., Pfister, G. G., Naja, M., and Brasseur, G. P. (2014), WRF-Chem simulations of a typical pre-monsoon dust storm in northern India: influences on aerosol optical properties and radiation budget, *Atmos. Chem. Phys.*, 14, 2431-2446, doi:10.5194/acp-14-2431-2014.
7. **R. Kumar**, M. C. Barth, S. Madronich, M. Naja, G. R. Carmichael, G. G. Pfister, C. Knote, G. P. Brasseur, N. Ojha, and T. Sarangi (2014), Effects of dust aerosols on tropospheric chemistry during a typical pre-monsoon season dust storm in northern India, *Atmos. Chem. Phys.*, 14, 6813-6834, doi:10.5194/acp-14-6813-2014.
8. **R. Kumar**, M. C. Barth, V. S. Nair, G. G. Pfister, S. S. Babu, S. K. Satheesh, K. K. Moorthy, G. R. Carmichael, Z. Lu and D. G. Streets (2015), Sources of black carbon aerosols in South Asia and surrounding regions during the Integrated Campaign for Aerosols, Gases and Radiation Budget (ICARB), *Atmos. Chem. Phys.*, 15, 5415-5428, doi:10.5194/acp-15-5415-2015.
9. **R. Kumar**, M. C. Barth, G. G. Pfister, V. S. Nair, S. D. Ghude, N. Ojha (2015), What controls the seasonal cycle of black carbon aerosols in India? *J. Geophys. Res.*, 120, 7788-7812, doi: 10.1002/2015JD023298.
10. **R. Kumar**, M. C. Barth, G. G. Pfister, L. Delle Monache, J-F. Lamarque, S. Archer-Nicholls, S. Tilmes, S. D. Ghude, C. Wiedinmyer, M. Naja, and S. Walters (2018), How will air quality change in South Asia by 2050?, *JGR – Atmospheres*, doi: 10.1002/2017jd027357.
11. **R. Kumar**, V.-H. Peuch, J. H. Crawford, G. P. Brasseur (2018), Five steps to improve air quality forecasts, *Nature*, 561, 27-29, doi: 10.1038/d41586-018-06150-5.
12. **R. Kumar**, L. Delle Monache, J. Bresch, P. E. Saide, Y. Tang, Z. Liu, A. M. da Silva, S. Alessandrini, G. G. Pfister, D. Edwards, P. Lee, I. Djalalova (2018), Towards improving short-term predictions of fine particulate matter over the United States via assimilation of

- satellite aerosol optical depth retrievals, *J. Geophys. Res. – Atmos.*, 124 (5), 2753-2773, <https://doi.org/10.1029/2018JD029009>.
13. **R. Kumar**, J. A. Lee, L. Delle Monache, and S. Alessandrini, Effect of meteorological variability on fine particulate matter simulations over the contiguous United States, *J. Geophys. Res. – Atmos.*, 124 (10), 5669-5694, <https://doi.org/10.1029/2018JD029637>.
  14. U. C. Dumka, K. K. Moorthy, **R. Kumar**, P. Hegde, R. Sagar, P. Pant, N. Singh and S. S. Babu, “Characteristics of Aerosol Black Carbon Mass Concentration over a High Altitude location in the Central Himalayas from multi-year measurements”, *Atmospheric Research*, 96 (4), Pages 510-521, doi: 10.1016/j.atmosres.2009.12.010, 2010.
  15. N. Ojha, N., M. Naja, K. P. Singh, T. Sarangi, **R. Kumar**, S. Lal, M. G. Lawrence, T. M. Butler, and H. C. Chandola (2012), Variabilities in ozone at a semi-urban site in the Indo-Gangetic Plain region: Association with the meteorology and regional processes, *J. Geophys. Res.*, 117, D20301, doi:[10.1029/2012JD017716](https://doi.org/10.1029/2012JD017716).
  16. Ghude, S. D., G. G. Pfister, C. Jena, R.J. van der A, L. K. Emmons, and **R. Kumar**, (2012), Satellite constraints of nitrogen oxide (NO<sub>x</sub>) emissions from India based on OMI observations and WRF-Chem simulations, *Geophys. Res. Lett.* 40, doi: [10.1029/2012GL053926](https://doi.org/10.1029/2012GL053926).
  17. S. Dipu, T. V. Prabha, G. Pandithurai, J. Dudhia, G. Pfister, **R. Kumar**, B. N, Goswami, (2013), Impact of elevated aerosol layer on the cloud macrophysical properties prior to monsoon onset, *Atmos. Environ.*, 70, 454-467.
  18. T. Sarangi, M. Naja, N. Ojha, **R. Kumar**, S. Lal and H. C. Chandola, Variability in Meteorological Parameters and Trace Gases over the Central Himalayas: Observations and Model Simulations, *Vayumandal*, 38, 10-25.
  19. T. Sarangi, M. Naja, N. Ojha, **R. Kumar**, S. Lal, S. Venkataramani, A. Kumar, R. Sagar, H. Chandola, (2013), First simultaneous measurements of ozone, CO and NO<sub>y</sub> at a high altitude regional representative site in the central Himalayas, *J. Geophys. Res.*, 119, 1-17, doi: 10.1002/2013JD020631
  20. N. Ojha, M. Naja, T. Sarangi, **R. Kumar**, P. Bhardwaj, S. Lal, S. Venkataramani, R. Sagar, A. Kumar, H. C. Chandola (2014), On the Processes Influencing the Vertical distribution of ozone over the central Himalayas: Analysis of Yearlong ozonesonde observations, *Atmos. Environ.*, 88, 201-211.
  21. P. Mahapatra, Sipra Panda, P. P. Walvekar, **R. Kumar**, Trupti Das, B. R. Gurjar (2014), Seasonal trends, meteorological impacts and health risks associated with atmospheric concentrations of gaseous pollutants at an Indian coastal city, *Environ. Sci. Pollu. & Res.*, 19, 11418-32, doi: 10.1007/s11356-014-3078-2.
  22. S. D. Ghude, C. Jena, D. M. Chate, G. Beig, G. G. Pfister, R. Kumar and V. Ramanathan (2014), Reduction in India’s crop yield due to ozone, *Geophys. Res. Lett.*, 41, 5685-5691, doi: 10.1002/2014GL060930.
  23. C. Jena, S. D. Ghude, G. G. Pfister, D. M. Chate, **R. Kumar**, G. Beig, D. E. Sundran, S. Fadnavis, and D. M. Lal (2014), Influence of springtime biomass burning emissions in South Asia on regional ozone: A model based case study, *Atmos. Environ.*, 100, 37-47, DOI: 10.1016/j.atmosenv.2014.10.027.
  24. C. Jena, S. D. Ghude, G. Beig, D. M. Chate, **R. Kumar**, S. Fadnavis, G. G. Pfister, L. K. Emmons, R. J. van der A (2015), Inter-comparison of different NO<sub>x</sub> emission inventories and associated variation in simulated surface ozone in Indian region, *Atmos. Environ.*, 117, 61-73.
  25. H. Joshi, M. Naja, K. P. Singh, **R. Kumar**, P. Bhardwaj, S. S. Babu, S. K. Satheesh, K. K. Moorthy, H. C. Chandola (2016), Investigations of Aerosol Black Carbon from a Semi-urban Site in the Indo-Gangetic Plain Region, *Atmos. Environ.*, 125B, 346-359.

26. D. E. Surendran, S. D. Ghude, G. Beig, L. K. Emmons, C. Jena, **R. Kumar**, G. G. Pfister, D. M. Chate (2015), Simulations over South Asia using Hemispheric Transport of Air Pollution version-2 (HTAP-v2) emission inventory and Model for Ozone and Related chemical Tracers (MOZART-4): Initial Results, *Atmos. Environ.*, *122*, doi: 10.1016/j.atmosenv.2015.08.023.
27. T. Sarangi, M. Naja, S. Lal, S. Venkataramani, P. Bhardwaj, N. Ojha, **R. Kumar**, H. C. Chandola (2016), First observations of light non-methane hydrocarbons (C<sub>2</sub>–C<sub>5</sub>) over a high-altitude site in the central Himalayas, *Atmos. Environ.*, *125*, 450-460, doi: 10.1016/j.atmosenv.2015.10.024.
28. P. Bhardwaj, M. Naja, **R. Kumar**, H. C. Chandola (2016), Seasonal, interannual and longterm variabilities in biomass burning activity over South Asia, *Environ. Sci. Poll. Res.*, *23*, 5, 4397-4410, doi:10.1007/s11356-015-5629-6.
29. S. D. Ghude, D. M. Chate, C. Jena, G. Beig, **R. Kumar**, M. C. Barth, G. G. Pfister and P. Rao (2016), Premature mortality in India due to PM<sub>2.5</sub> and ozone exposure, *Geophys. Res. Lett.*, *43*, 4650–4658, doi:[10.1002/2016GL068949](https://doi.org/10.1002/2016GL068949).
30. S. Archer-Nicholls, E. M. Carter, **R. Kumar**, Q. Xiao, Y. Liu, J. J. Frostad, M. H. Forouzanfar, A. Cohen, M. Brauer, J. Baumgartner and C. Wideinmyer (2016), The Regional Impacts of Cooking and Heating Emissions on Ambient Air Quality and disease Burden in China, *Environ. Sci. & Tech.*, *50* (17), doi: 10.1021/acs.est.6b02533
31. S. D. Ghude, C. K. Jena, G. Beig, **R. Kumar**, S. H. Kulkarni and D. M. Chate (2016), Impact of emission mitigation on ozone-induced wheat and rice damage in India, *Current Science*, *110* (8), 1452-1458, doi: 10.18520/cs/v110/i8/1452-1458.
32. S. Tiwari, **R. Kumar**, P. Tunved, S. Singh, and A. S. Panicker (2016), Significant cooling effect on the surface due to soot particles over Brahmaputra River Valley region, India: An impact on regional climate, *Science of the Total Environment*, *15*, 562-504, doi: 10.1016/j.scitotenv.2016.03.157.
33. M. Naja, P. Bhardwaj, N. Singh, P. Kumar, **R. Kumar**, N. Ojha, R. Sagar, S. K. Satheesh, K. K. Moorthy, and V. R. Kotamarthi (2016), SPECIAL SECTION: RAWEX–GVAX: High-frequency vertical profiling of meteorological parameters using AMF1 facility during RAWEX–GVAX at ARIES, Nainital, *Current Science*, *111* (01), doi: 10.18520/cs/v111/i1/132-140.
34. S. Singh, S. Tiwari, U. C. Dumka, **R. Kumar**, and P. K. Singh (2017), Source Region and Sector Contributions of Atmospheric Soot Particle in a Coalfield Region of Dhanbad, Eastern part of India, *Atmos. Res.*, *197*, 415-424.
35. P. J. Young, V. Naik, A. M. Fiore, A. Gaudel, J. Guo, M. Y. Lin, J. Neu, D. D. Parrish, H. E. Rieder, J. L. Schnell, S. Tilmes, O. Wild, L. Zhang, J. Brandt, A. Delcloo, R. M. Doherty, C. Geels, M. I. Hegglin, L. Hu, U. Im, **R. Kumar**, A. Luhar, L. Murray, D. Plummer, J. Rodriguez, A. Saiz-Lopez, M. G. Schultz, M. Woodhouse, G. Zeng, and J. Ziemke (2017), Tropospheric Ozone Assessment Report: Assessment of global-scale model performance for global and regional ozone distributions, variability, and trends, *Elem Sci Anth* . 2018; 6 ( 1 ) :10 . DOI: <http://doi.org/10.1525/elementa.265>.
36. Tang, Y., M. Pagowski, T. Chai, L. Pan, P. Lee, B. Baker, **R. Kumar**, L. Delle Monache, D. Tong, and H.-C Kim (2017), A case study of aerosol data assimilation with the Community Multi-scale Air Quality Model over the contiguous United States using 3D-Var and optimal interpolation methods, *Geosci. Model Dev. Discuss.*, <https://doi.org/10.5194/gmd-2017-147>, *10*, 4743-4758, <https://doi.org/10.5194/gmd-10-4743-2017>.
37. Rama Krishna K., S. D. Ghude, **R. Kumar**, G. Beig, R. Kulkarni, S. Nivdange, and D. M. Chate (2019), Surface PM<sub>2.5</sub> Estimate Using Satellite-Derived Aerosol Optical Depth



over India, *Aerosols and Air Quality Research*, 19(1), 25-37, doi: 10.4209/aaqr.2017.12.0568.

38. S. Kedia, **R. Kumar**, S. Islam, Y. Sathe and A. Kagainalkar (2018), Radiative impact of a heavy dust storm over India and surrounding oceanic regions, *Atmos. Environ.*, 185, 109-120.
39. Alvarado, M. J., Winijkul, E., Adams-Selin, R., Hunt, E., Brodowski, C., Lonsdale, C. R., Shindell, D. T., Faluvegi, G., Kleiman, G., Moiser, T. M., and **R. Kumar** (2018), Sources of Black Carbon Deposition to the Himalayan Glaciers in Current and Future Climates, *J. Geophys. Res. - Atmos.*, 123 (14), 7482-7505, 2018.
40. Piyush Bhardwaj, Manish Naja, Maheswar Rupakheti, Arnico Panday, **R. Kumar**, Khadak Mahata, Shyam Lal, Harish Chandola, and Mark Lawrence (2018), Variations in surface ozone and carbon monoxide in the Kathmandu Valley and surrounding broader regions during SusKat-ABC field campaign: Role of local and regional sources, *Atmos. Chem. Phys.*, 18, 11949-11971, <https://doi.org/10.5194/acp-18-11949-2018>
41. P. Mahapatra, **R. Kumar**, C. Mallik, S. C. Sahu and T. Das (2018), Investigation of a regional ozone reduction event over eastern India by integrating in situ and satellite measurements with WRF-Chem simulations (2018), *Theor. Appl. Climatol.*, <https://doi.org/10.1007/s00704-018-2593-3>.
42. Dumka, U. C., D. G., Kaskaoutis, P. C. S. Devara, **R. Kumar**, S. Kumar, S. Tiwari, E. Gerasopoulos, N. Mihalopoulos (2019), Year-long variability of the fossil fuel and wood burning black carbon components at a rural site in southern Delhi outskirts, *Atmospheric Research*, 216, 11-25.
43. Lund, M. T., Myhre, G., Haslerud, A. S., Skeie, R. B., Griesfeller, J., Platt, S. M., **R. Kumar**, Myhre, C. L., and Schulz, M.: Concentrations and radiative forcing of anthropogenic aerosols from 1750–2014 simulated with the OsloCTM3 and CEDS emission inventory, *Geosci. Model Dev.*, 11, 4909-4931, <https://doi.org/10.5194/gmd-11-4909-2018>, 2018.
44. Archer-Nicholls, S., Lowe, D., Lacey, F., **R. Kumar**, Carter, E., Baumgartner, J., and Wiedinmyer, C.: Radiative Effects of Residential Sector Emissions in China: Sensitivity to Uncertainty in Black Carbon Emissions, *J. Geophys. Res. – Atmos.*, 124 (9), 5029-5044, <https://doi.org/10.1029/2018JD030120>.

#### PEER-REVIEWED PUBLICATIONS: Under Review

45. S. D. Ghude, A. Mahajan, R. Karumuri, U. Badimella, G. Pfister, **R. Kumar**, D. Lal, P. R. Pithani, R. Kulkarni, D. Chate (2018), What is driving the diurnal variation of tropospheric NO<sub>2</sub> columns over a cluster of high emitting thermal power plants in India?, under review, *J. Geophys. Res. – Atmos.*
46. T. Amnuaylojaroen, M. C. Barth, and **R. Kumar** (2018), Model analysis of processes contributing to high ozone over the Bay of Bengal during winter 2009, under review, *Atmos. Environ.*
47. Wu, X., Xu, Y., **R. Kumar**, M.C. Barth (2018), Understanding the meteorological drivers of future air quality over Indian megacities based on multi-year chemistry-climate simulations, under review, *J. Geophys. Res. - Atmos.*, submitted: May 2018.
48. Delle Monache, L., Alessandrini, S., Djalalova, I., Wilczak, J., Knierel, J. C., and **R. Kumar**: Air Quality Predictions with an Analog Ensemble, *Atmos. Chem. Phys. Discuss.*, <https://doi.org/10.5194/acp-2017-1214>, in review, 2018.
49. Xu, Y., X. Wu, **R. Kumar**, Barth, M. C., Meehl, G., Jones, B., Gao, M., and Lin, L. (2018), Substantial increase in the joint occurrence and human exposure of heat and haze hazards over South Asia in the mid-21<sup>st</sup> century, *Nature Climate Change*, under review, submitted: October 2018.

## CHAPTERS in BOOKS

1. **R. Kumar**, M. C. Barth, L. Delle Monache, S. D. Ghude, G. G. Pfister, M. Naja and G. P. Brasseur (2017), An Overview of Air Quality Modeling Activities in South Asia. In: Bouarar I., Wang X., Brasseur G. (eds) Air Pollution in Eastern Asia: An Integrated Perspective. ISSI Scientific Report Series, vol 16. Springer, Cham, doi: [https://doi.org/10.1007/978-3-319-59489-7\\_2](https://doi.org/10.1007/978-3-319-59489-7_2), ISBN: 978-3-319-59488-0.
2. T. Sarangi, M. Naja, K. P. Singh, Y. Kant, N. Ojha, **R. Kumar**, K. Pandey, S. Venkataramani, S. Lal and Ram Sagar, Observations of radiatively and chemically active trace gases in the central Himalaya and Indo-Gangetic Plain region, *Climate change in the Himalayas*, Editors- Vir Singh et al., ISBN 978-81-7387-228-0, pp. 61-74, 2011.

## MEDIA REPORTS BASED ON MY RESEARCH

1. Atmos News UCAR/NCAR. "Predicting Unhealthy Air", 30 Apr 2019, Available online at: <https://news.ucar.edu/132666/predicting-unhealthy-air>
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