

PANKAJ KUMAR

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EDUCATION

PhD in Atmospheric Chemistry and Machine Learning **2017–2022**
IIT Kharagpur, Kharagpur, West Bengal, India

Master of Technology in Earth System Science and Technology **2015–2017**
IIT Kharagpur, Kharagpur, West Bengal, India

Bachelor of Engineering in Mechanical Engineering **2008–2012**
BIT Mesra, Ranchi, Jharkhand, India

SKILLS

Programming Languages: Python, Fortran, MATLAB, JavaScript

Data Science Skills

- **Artificial Intelligence:** Regression, Classification and Clustering, Time series analysis, Machine learning, Deep learning, and Causal Discovery / Inference.

Physical Modeling Skills

- **Trajectory Modeling:** HySPLIT
- **Atmospheric modeling:** WRF, GEOS-Chem, ICON-ART
- **Radiative Transfer Modeling:** RRTMG

Analytics Tools

- **Statistical Learning:** statsmodels, scikit-learn, Keras, PyTorch
- **Data visualization:** Matplotlib, ggplot, Leaflet, Folium, arviz, D3.js, Three.js
- **Mathematical optimization:** scipy
- **RADAR Data Analysis:** wradlib
- **Geospatial Data Analysis:** gdal, rasterio, xarray, geopandas, Google Earth Engine
- **Parallel Programming:** dask, joblib

Other Computer related skills

- Experience of version control with git/github and shell scripting in Linux
- Conversant with Markdown and LaTeX

OPEN SOURCE PYTHON PACKAGES DEVELOPED

- **[bias_correction](#):** Python library for performing bias correction of datasets using methods like quantile mapping, scaled distribution mapping (*>24k downloads*).
- **[HyTraj](#):** Implementation of HySPLIT based trajectory modeling and analysis in python (*>8k downloads*).

- [pyvortex](#): Python library for estimating Equivalent Latitude and polar vortex edge using Nash criteria (>7k downloads).
- [reprobus](#): Python library for post-processing of REPROBUS chemistry transport model using **fortran/python coupling**.

RESEARCH EXPERIENCE

Post-doctoral Researcher, IMK-TRO, KIT Germany

2022 – Present

- Developing ML based emulation and parameterization schemes for ICON-ART model.
- Developing mineral dust pre-processor for ICON modeling system.

Research Scholar, ATMOS Lab, IIT Kharagpur

2017 – 2022

- Developed open source python library ([bias_correction](#)) for bias-correction using various correction techniques like quantile mapping and scaled distribution mapping.
- Investigated long-term trend analysis of rainfall changes and Land Use Land Cover ([LULC](#)) change over North-East India using Random forest based classification.
- Developed Receptor models based on air mass trajectory generated with HySPLIT in python ([HyTraj](#)) for source detection studies and clustered them using Hierarchical agglomerative clustering and wavelet transform based K-Means clustering for transportation pathways analysis.
- Performed Self-organising map (SOM) based clustering and long-term analysis of tropospheric ozone using DLM and MLR.
- Conducted deep learning based Causal Effect Network (CEN) analysis for determination of robust predictors of tropospheric ozone variability in Antarctica.
- Developed a python library for polar vortex analysis ([pyvortex](#)).
- Carried out radiative transfer modeling using RRTMG for radiative forcing estimation.

Research Assistant, ATMOS Lab, IIT Kharagpur

2016 – 2017

- Estimated rainfall using preliminary data from Doppler Weather radar in Kolkata region using **wradlib** radar data analysis package in **python**.
- Investigated freezing of water droplet and subsequent transformation of its shape numerically using **python**.

Undergraduate project

2011 – 2012

- Carried out numerical investigation of natural convection in Bingham fluids within a square enclosure with differentially heated sidewalls using **Fluent**, a CFD package.
- Performed optimization of Wind Turbine Blades using **Fluent**.

PUBLICATIONS

1. R. Kashyap, J. Kuttippurath and **P. Kumar**: *Browning of vegetation in efficient carbon sink regions of India during the past two decades is driven by climate change and anthropogenic intrusions*, Journal of Environmental Management, 2023.
2. **Pankaj Kumar**, Jayanarayanan Kuttippurath, and Adway Mitra: *Causal discovery of drivers of surface ozone variability in Antarctica using a deep learning algorithm*, RSC Environmental Science: Processes & Impacts, 2022.
3. S. Murasingh, J. Kuttippurath, S. Sandeep Dash, R. Ramesan, S. Raj, Madan K. Jha, and **P. Kumar**: *Long-term trends and projections of hydrological fluxes under RCP climate change scenarios for a mountainous river basin of Northeast India*, Journal of Water and Climate Change, 2022.
4. R. Roy, J. Kuttippurath, F. Lefèvre, S. Raj, and **P. Kumar**: *The Sudden Stratospheric Warming and Chemical ozone loss in the Antarctic winter 2019: Comparison with the winters of 1988 and 2002*, Theoretical and Applied Climatology, 2022.
5. Divakaran Ardra, Jayanarayanan Kuttippurath, Raina Roy, **Pankaj Kumar**, Sarath Raj, Rolf Mueller, and Wuhu Feng: *The unprecedented ozone loss in the Arctic winter and spring of 2010/2011 and 2019/2020*, ACS Earth and Space Chemistry, 2022.
6. **Pankaj Kumar**, Jayanarayanan Kuttippurath, Peter von der Gathen, Irina Petropavlovskikh, Bryan Johnson, Audra McClure-Begley, Paolo Cristofanelli, Paolo Bonasoni, Maria Elena Barlasina, and Ricardo Sánchez: *The increasing surface and tropospheric ozone in Antarctica and their possible drivers*, ACS Environmental Science & Technology, 2021.
7. J. Kuttippurath, W. Feng, R. Müller, **P. Kumar**, S. Raj, G. S. Gopikrishnan and R. Roy: *Exceptional loss in ozone in the Arctic winter/spring 2020*, Atmospheric Chemistry and Physics, 2021.
8. J. Kuttippurath, F. Lefèvre, S. Raj, **P. Kumar**, and K. Abhishek: *The ozone hole measurements at the Indian station Maitri in Antarctica*, Polar Science, 2021.
9. J. Kuttippurath, S. Murasingh, P. A. Stott, B. Balan Sarojini, M. K. Jha, **P. Kumar**, P. J. Nair, H. Varikoden, S. Raj, P. A. Francis, and P. C. Pandey : *Observed rainfall changes in the past century (1901–2019) over northeast India and the wettest place on the Earth*, Environmental Research Letters, 2020.
10. J. Kuttippurath, **P. Kumar**, P. J. Nair, and P. C. Pandey: *Emergence of ozone recovery evidenced by reduction in the occurrence of Antarctic ozone loss saturation*, npj Climate and Atmospheric Science, 2018.
11. J. Kuttippurath, **P. Kumar**, P. J. Nair, and A. Chakraborty: *Accuracy of satellite total column ozone measurements in polar vortex conditions: Comparison with ground-based observations in 1979-2013*, Remote Sensing of Environment, 2018.