PhD position on Ice Cloud Optics in High-Resolution Atmospheric Models

The Lab for Multiscale Cloud Modeling and Experimentation at the University of Arizona is recruiting highly motivated PhD students to begin work in Fall 2022. The lab is broadly interested in how the effect of small-scale atmospheric processes propagates to larger-scale phenomena of social relevance (https://sylviasullivan.github.io/). As a specific instance of this general question, the current PhD position will be focused on how optical properties of ice crystals as a function of their complexity affect the radiative heating from ice clouds in the upper troposphere. This position will occur in collaboration with those performing remote-sensing and field measurements of these ice optical properties in the College of Optical Sciences here at the UA and in the Institute for Meteorology and Climate Research at the Karlsruhe Institute of Technology in Germany. The project will be primarily computational as described below. Interested applicants should send a letter of motivation, curriculum vitae, and contact information of three references to Sylvia Sullivan at sylvia@email.arizona.edu by 15th April 2022. The position begins from 15th August 2022.

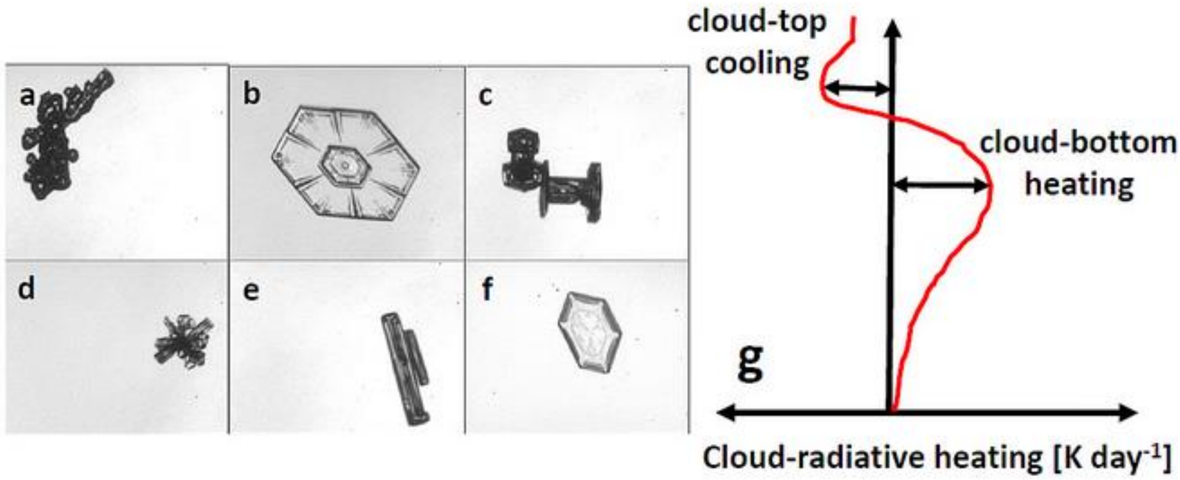

Figure 1 The small-scale complexity of ice crystals (panels a-f) translates to large differences in the absorption and reemission of infrared radiation by cirrus clouds that generates an in-cloud heating and above-cloud cooling dipole (panel g). Ice crystal images are shared from www.realicecrystals.de

Project Description

Ice clouds, or cirrus, heat the atmosphere locally through their absorption of infrared radiation but also cool the surface by reflecting incoming UV/visible radiation from the sun. The resulting in-cloud heating, above-cloud cooling dipole is often called cloud-radiative heating. Our recent work has illustrated the strong control of small-scale cloud ice processes (microphysics) on this cloud-radiative heating (see doi: s43247-021-00206-7). We now turn to how the optical properties of these ice crystals affect this heating. Tasks will include:

- Implement existing ice cloud optical schemes that account for crystal complexity into the ICON and GEOS-5 storm-resolving (high-resolution) models
- Synthesize measurements of ice crystal asymmetry parameter and polarization from various sources into a new ice cloud optical scheme

- Perform storm-resolving simulations over the Asian monsoon and North Atlantic regions during two field campaign periods to bound cloud-radiative heating changes

Qualifications

Applicants should have either a Bachelor's or Master's degree in chemical or environmental engineering, atmospheric sciences or meteorology, environmental sciences, or related disciplines and strong motivation to study climate-related problems. Programming experience, particularly in Python, MATLAB, or FORTRAN, is desired, and fluent English in written and oral form is required. A collaborative and communicative working style is preferred, and existing scientific publications are an asset.

About the University of Arizona

The University of Arizona is a Research I university, ranked in the top 20 among public universities and 35th among all universities in the US in research expenditures by the National Science Foundation. It is a proud member of the University Climate Change Coalition (UC3), consisting of 18 leading North American research institutions dedicated to finding practical solution to climate challenges.

Outstanding UA benefits include health, dental, vision, and life insurance; paid vacation, sick leave, and holidays; UA/ASU/NAU tuition reduction for the employee and qualified family members; and access to UA recreation and cultural activities. The University of Arizona has been recognized for innovative work-life programs.

At the University of Arizona, we value our inclusive climate because we know that diversity in experiences and perspectives is vital to advancing innovation, critical thinking, solving complex problems, and creating an inclusive academic community. As an Hispanic-serving institution, we translate these values into action by seeking individuals who have experience and expertise working with diverse students, colleagues, and constituencies. Because we seek a workforce with a wide range of perspectives and experiences, we provide equal employment opportunities to applicants and employees without regard to race, color, religion, sex, national origin, age, disability, veteran status, sexual orientation, gender identity, or genetic information.

About Tucson

The City of Tucson enjoys upwards of 350 sunny days each year and boasts a myriad of outdoor activities, from hiking, climbing, and cycling throughout the region to snowboarding and skiing on nearby Mount Lemmon in winter. The cost of living is below the national average and is well-below most comparable cities in the western states. More information on living in Tucson is available here: https://grad.arizona.edu/futurestudents/life-tucson

PhD position on Secondary Ice Production in Convective Storms

The Lab for Multiscale Cloud Modeling and Experimentation at the University of Arizona is recruiting highly motivated PhD students to begin work in Fall 2022. The lab is broadly interested in how the effect of small-scale atmospheric processes propagates to larger-scale phenomena of social relevance (https://sylviasullivan.github.io/). As a specific instance of this general question, the current PhD position will be focused on how secondary ice production (processes like crystal collisional breakup or after thermodynamic nucleation) within mesoscale convective storms affects their surface precipitation intensity. Interested applicants should send a letter of motivation, curriculum vitae, and contact information of three references to Sylvia Sullivan at sylvia@email.arizona.edu by 15th April 2022. The position begins from 15th August 2022.

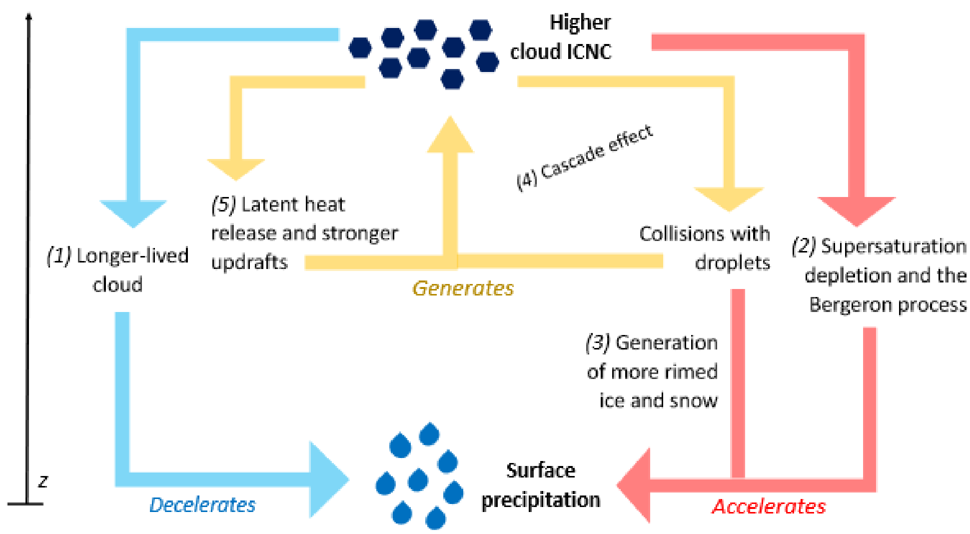

Figure 1 A variety of pathways link the ice crystal number concentration (ICNC) in clouds to surface precipitation, both via positive (red) and negative (blue) feedbacks. Taken from Sullivan et al. ACP 2018

Project Description

The partitioning of ice versus liquid within clouds is crucial in determining the intensity of surface precipitation. At warmer subzero temperatures, cloud ice generally forms via heterogeneous nucleation on the surface of an aerosol particle. But discrepancies between the number of such ice-nucleating aerosol and the number of cloud ice crystals have prompted increasing attention to a variety of secondary ice production processes over the past few years. We will look at how these secondary processes affect the precipitation intensity resulting from agglomerations of thunderstorms, or mesoscale convective systems, throughout the tropics. Tasks will include:

- Addition of aerosol data to an existing database of convective storms and associated rainfall intensity (see doi: 10.1029/2019JD031026) and construction of a second, higher-spatiotemporal resolution database of aerosol, convective storm, and rainfall data
- Comparison of aerosol and ice crystal number concentrations and collated surface rainfall in these datasets

- Similar aerosol-ice crystal-rainfall analyses for two sets of flight campaign data
- Assisting in benchtop experiments of fragmentation efficiency during ice crystal collision or sublimation

Qualifications

Applicants should have either a Bachelor's or Master's degree in chemical or environmental engineering, atmospheric sciences or meteorology, environmental sciences, or related disciplines and strong motivation to study climate-related problems. Programming experience, particularly in Python, MATLAB, or FORTRAN, is desired, and fluent English in written and oral form is mandatory. A collaborative and communicative working style is preferred, and existing scientific publications are an asset.

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