ATS/CIRA Colloquium

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Cosmic rays, aerosols, clouds and other adventures in aerosol microphysics

Hosted by Sonia Kreidenweis

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ATS room 101; Discussion will begin at 3:30pm
Refreshments will be served at 3:00pm in the coffee lounge

Cloud cover has been reported to correlate with the flux of Galactic Cosmic Rays (GCRs) to the troposphere. This potential GCR/cloud connection has been heralded by some as a driver for 20th temperature increases because GCR fluxes decreased in the first half of the 20th century. However, the reported correlations are still controversial, and we are just beginning to understand potential mechanisms for the effects of GCRs on clouds. The proposed mechanism that has received the most attention is the "ion-aerosol clear-sky hypothesis" where GCRs ionize tropospheric gases, which enhances aerosol nucleation rates and Cloud Condensation Nuclei (CCN) concentrations.

Recent results from the CLOUD experiment at CERN have addressed the GCR-ion-nucleation connection and have generated a lot of media attention and speculation about the role of GCRs on climate. However, the connection between aerosol nucleation, CCN and clouds has not yet been tested by CLOUD, and the scientists involved with the project have made no official claims to the importance of their findings to the cosmic-ray/cloud link.

How important are the results from CLOUD in terms of changes in CCN and clouds in the atmosphere? We can use aerosol microphysics theory to extend the CLOUD results from aerosol nucleation to CCN and clouds. I will show global aerosol predictions of the changes in CCN due to changes in GCRs. These predicted changes in CCN are likely far to small to cause significant changes in clouds. Furthermore, the predicted changes in 20th-century CCN due to human emissions are several orders-of-magnitude larger than the CCN changes due to cosmic rays over the same time period. Therefore, if there is a strong GCR/cloud connection, it seems unlikely that the ion-aerosol clear-sky hypothesis is the driving mechanism.

I will conclude by briefly presenting several other examples of where aerosol microphysics gives insightful results into difficult and intriguing problems.