Physics Colloquium

Michigan Technological University

Thursday, September 29, 2011 at 4:00 pm
Room 139 Fisher Hall

Clouds and Aerosol Nucleation from the Cloud-resolved to the Global Scale

Jan Kazil

Cooperative Institute for Research in Environmental Sciences (CIRES), Boulder, CO, USA
Chemical Sciences Division, NOAA Earth System Research Laboratory, Boulder, CO, USA

Abstract: Aerosol formation from the gas phase (nucleation) is a source of aerosol particles in the Earth's atmosphere, which constitute the substrate on which cloud droplets form. Aerosol nucleation can therefore modify cloud albedo and cloud amount via the Twomey and Albrecht effects, and act upon the albedo and the radiative forcing of the Earth. Nucleation is driven by molecules with a low saturation vapor pressure, such as sulfuric acid, ammonia, and amines, which form molecular clusters that can grow into aerosol particles. The process can also proceed via atmospheric ions, produced by (galactic) cosmic rays, onto which sulfuric acid and other polar molecules attach. Since the galactic cosmic ray flux and the resulting ionization of the atmosphere is modulated by solar activity, it has been proposed that this modulation could bring about a commensurate modulation in aerosol nucleation, aerosol concentrations, and consequently in Earth's cloud cover and albedo. This hypothesis has been invoked to explain a correlation of global cloud cover with the galactic cosmic ray flux over a solar cycle, retrieved from satellite observations. However, aerosol nucleation is an important source of aerosol particles with relevance for cloud properties beynd considerations on solar variability, and laboratory studies, field measurements, and atmospheric models have made great progress in our understanding of its behavior and role in the atmosphere. In this presentation, an introduction will be given on galactic cosmic rays in the atmosphere, aerosol nucleation from the gas phase, aerosol and cloud processes, and Earth's radiative forcing. Clouds and aerosol processes, with an emphasis on aerosol nucleation, will be illustrated with results from highly resolved simulations of the marine boundary layer, and the role of solar variability on Earth's radiative forcing via aerosol nucleation will be explored using results from climate simulations.

Bio: Jan Kazil received his MS degree (Theoretical Phycis) in 1998 and his PhD (Atmospheric Physics) in 2002 from the University of Bern, Switzerland. He was a Postdoctoral Fellow (2002 – 2004) at the National Center for Atmospheric Research, a CIRES (2006-2006) & a NRC (2006-2007) Research Associate for NOAA Chemical Sciences Division in Bolder, Co. He was a Research Scientist (2007-2008) in Hamburg, Germany for Max Planck Institute for Meteorology. He presently is in the Chemical Sciences Division at NOAA Earth System Research Laboratory and is a scientist II at the Univ. of Colorado at Bolder - CIRES.

MichiganTech