Radiative Transfer in Realistic Clouds: Past and Future Challenges

When Jim Weinman first took up the challenge, the theoretical treatment of radiative transfer in clouds was limited to one-dimensional clouds that were usually unrealistically defined in terms of their homogeneity and scattering properties. Chandrasekhar’s elegant mathematical solutions for radiative transfer worked well enough, but only for one-dimensional layers and simple scattering phase functions. By first revisiting the Eddington solution (and noting the Shettle-Weinman paradox), Jim discovered how to extend it to highly anisotropic scattering through the development of the delta-Eddington approximation — now the workhorse of many modeling groups. The move to progressively more realistic clouds continued with the development of three-dimensional solutions, both analytical and stochastic. Jim continued to play a highly influential role in this, exploring three-dimensional problems at solar, infrared and microwave frequencies.

I’ll review one of these problems in more depth: that of determining the albedo of a realistic cloud, with examples drawn from high-resolution satellite imagery. While the forward problem of radiative transfer in a well-specified cloud field is now essentially solved (at least for liquid clouds), significant challenges remain in the inversion of satellite measurements and the related modeling of dependencies between cloud albedo and cloud water content. And confidence in cloud albedo is a necessary prerequisite for equilibrium climate modeling.

Additional short presentations will follow from former students and colleagues in a timeline moving forward along Jim’s distinguished career in radiative transfer and remote sensing.

An optional dinner is being arranged at a nearby location after the colloquium. More details about the events and an electronic guestbook for leaving comments for Jim can be found at http://www.atmos.washington.edu/outreach/weinman.shtml

Out of Town Guests only please RSVP for the Seminar and/or Dinner:
burke@atmos.colostate.edu