Improving Cirrus Cloud Characterization with Raman Lidar Measurements at Southern Great Plains

Lori Borg, David Turner, Robert Holz, David Tobin, Bob Knuteson, Leslie Moy, Daniel DeSlover, Ed Eloranta, Hank Revercomb (PI)

Introduction:

Cirrus clouds play a significant role in the energy budget of the atmosphere and represent a major source of uncertainly in understanding climate and climate change. A large part of this uncertainty lies in the modeling of the cloud, which requires assumptions and simplifications of the cloud morphology. In this study uniform cirrus cloud events at the Atmospheric Radiation Measurement (ARM) Southern Great Plains (SGP) site are investigated using various data sources (radar, lidar) to derive cloud microphysical and optical properties. These properties are used to compute long wave heating rate profiles and top-of-atmosphere (TOA) fluxes using the rapid radiative transfer model (RRTM). Computed fluxes are compared with CERES and GOES observations and computed heating rates with the ARM Broadband Heating Rate Profile (BBHRP).

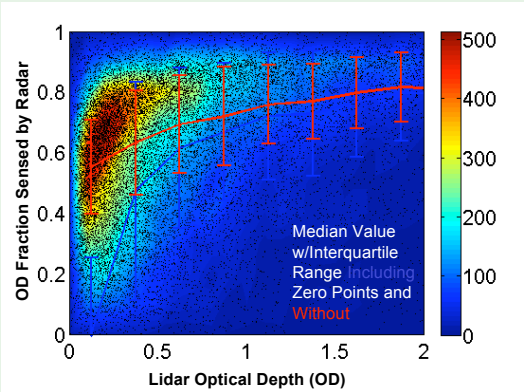
Highlights:

- Developed capability to derive cloud extinction from SGP Raman Lidar.
- Lidar extinctions combined with MMCR measurements for a 2+ year period.
- MMCR radar can miss significant upper level cirrus resulting in large errors in TOA fluxes and heating rates.
- Combined radar & lidar extinction measurements provide a better characterization of cirrus.

Lori Borg, lori.borg@ssec.wisc.edu

2+ Year Survey of Cirrus Clouds at SGP: 09/17/2004 - 12/31/2006

Number of Cases when Lidar NOT Attenuated in 2 Year Study



When lidar NOT attenuated …

- MMCR radar does not detect a significant amount of cloud OD for lidar OD<1.
- MMCR radar sees ~80% of cloud OD for lidar OD>1.

SGP Cirrus Case Study: 11/08/2005 18:00UTC - 11/11/2005 12:00 UTC