IRS2012-366-1
International Radiation Symposium 2012
Dahlem Cube, Berlin, Germany, 06 – 10 August 2012

Semi-Direct Effect — From Parameterization of Cloud Optical Property to Climate Impact

J. Li (1), E. Mlawer (2), and P. Chylek (3)

(1) Canadian Center for Climate Modeling and Analysis, Canada (Jiangnan.Li@ec.gc.ca), (2) Atmospheric and Environmental Research, Inc., USA (emlawer@aer.com), (3) Space and Remote Sensing, Los Alamos National Laboratory, USA (chylek@lanl.gov)

Black carbon (BC), a strong absorber of solar flux in the atmosphere, can have contributions to the direct and indirect radiative forcing. In addition, BC exerts the so-called semi-direct effect, i.e. the influence of aerosols on clouds by directly enhancing the shortwave heating rate. The consequence of this extra heating due to BC is thought to contribute to the loss of cloud cover as it exacerbates cloud evaporation. However, how to properly calculate the semi-direct effect in climate models is an unsolved problem. Therefore, a new parameterization of cloud optical properties with a mixture of BC is proposed. It is found that the changes in cloud optical properties due to mixture of BC can be treated as a perturbation to existing cloud optical property schemes. The advantage of the proposed method is that the current cloud optical property parameterizations used in climate models can be kept. The GCM simulations show that the BC semi-direct effect leads to increase in stability below and within clouds. Consequently, the global total cloud fraction is reduced and the energy balance in the atmosphere is affected.