IRS2012-574
International Radiation Symposium 2012
Dahlem Cube, Berlin, Germany, 06 – 10 August 2012
© Author(s) 2012

An Analytical Model for Efficient Computation of Radiative Forcing by Cirrus and Contrails

U. Schumann, B. Mayer, K. Graf, and H. Mannstein
DLR and LMU Munich, Germany

A new parameterized analytic model has been developed to compute the instantaneous radiative forcing (RF) at top of the atmosphere (TOA) produced by an additional thin contrail cirrus layer or “contrail”. The model calculates the RF using as input the outgoing longwave radiation and reflected solar radiation values at TOA for a contrail-free atmosphere, so that the model is applicable for both cloud-free and cloudy ambient atmospheres. Additional input includes the contrail temperature, contrail optical depth (at 550 nm), effective particle radius, particle habit, solar zenith angle, and the optical depth of cirrus above the contrail layer. The model parameters (five for longwave LW and ten for shortwave) are determined from least square fits to calculations from the radiative transfer model libRadtran over a wide range of atmospheric and surface conditions. The correlation coefficient between model and calculations is larger than 98∼\%. The analytic model is compared to published results, including a one-year simulation of global RF, and found to agree well with previous studies. The fast analytic model is part of a larger modeling system to simulate contrail lifecycles, and allows for the rapid simulation of contrail cirrus RF over a wide range of meteorological conditions and for a given size dependent habit mixture. This RF model is described in detail in a recent submitted paper Schumann, U., Mayer, B., Graf, K., and Mannstein, H.: A parametric radiative forcing model for contrail cirrus, J. Appl. Meteorol. Clim., accepted subject to minor revisions, 2012.

At the IRC Symposium, we plan to summarize the method, show applications, and discuss further improvements and extensions.