Application of a detailed microphysical scheme in calculating optical properties of warm clouds

E. Lábó[a], I. Geresdi[b]

[a] OMSZ-Hungarian Meteorological Service, Address: H-1024 Budapest, Kitaibel P. u.1., Tel.: +36-1-346-4664, Fax: +36-1-346-4665, E-mail: labo.e@met.hu
[b] University of Pécs, Faculty of Sciences, Address: H-7624 Pécs, Ifjúság útja 6. Tel.: +36-72-503-600, Fax: +36-72-501-527, E-mail: geresdi@gamma.ttk.pte.hu

The clouds have important effect on the radiation budget of the atmosphere. For numerical weather prediction purposes, there is a need to describe this effect adequately. The radiative processes are included in numerical models through previously developed radiative transfer models. We have applied in our studies the RRTMG (Rapid Radiative Transfer Model) code developed by the Atmospheric and Environmental Research group and is being used in several numerical forecast models [1]. Radiative transfer models describe the interaction between radiation and cloud particles. The absorption, extinction and scattering parameters of the clouds are calculated by using simplifying methods [2].

One of these simplifications in radiative transfer models is the use of bulk microphysical schemes in the calculation of optical properties of clouds [3]. Detailed microphysical scheme is needed to take into account that the drop size distribution differs from the presumed idealized Gaussian size distribution. Thus, the collision processes between particles can be included in the microphysics.

In our research cloud optical properties (extinction coefficient of water droplets) are calculated by using a bin microphysical scheme [4]. Pre-calculated kernel functions have been defined for use to reduce the computational costs. The research focuses on the longwave radiation.

In our presentation, we will present the results of the newly developed parametrization scheme. The extinction coefficients obtained by using bin microphysics have been compared to the extinction coefficients of bulk microphysics in case of Gaussian size distribution. Also, the sensitivity of the extinction coefficient to the drop size distribution has been analysed.

[1] E. J. Mlawer, S. J. Taubman, P. D. Brown, M. J. Iacono, S. A. Clough: Radiative transfer for inhomogeneous atmospheres: RRTM, a validated correlated-k model for the longwave, *J. Geophys. Res.* **1997***, 102(D14)*, 16,663–16,682.

[2] M. Liu, J.E. Nachamkin, D. L. Westphal: On the Improvement of COAMPS Weather Forecasts Using an Advanced Radiative Transfer Model, *Weather and Forecasting* **2009**, *24*, 286.

[3] G. L. Stephens: The parameterization of radiation for numerical weather prediction and climate models, *Monthly Weather Review* **1984**, *112*, 826-867.

[4] J. Harrington, P. Q. Olsson: A method for the parameterization of cloud optical properties in bulk and bin microphysical models. Implications for arctic cloudy boundary layers, *Atmospheric Research* **2001**, *57*, 51-80.