Polarization radar reflectivity calculations using the output of bin microphysics

Noémi Sarkadi[1], István Geresdi[1]

[1]*University of Pécs, Faculty of Science, Department of Geology and Meteorology*

Introduction

In WRF the radar reflectivity calculation for bulk microphysics is available, based on U. Blahak's work. Seliga – Bringi (1976) showed that radar reflectivity is an important variable in models to measure different precipitation types. Vivekanandan et al. (1999) showed that dual-polarization radar data describe well the microphysical properties of clouds.

The bin microphysical schemes are able to give a detailed description of microphysical processes. In this research a numerical method was developed to calculate dual-polarization radar reflectivity by using the output data of bin scheme.

Methods

Numerical method was developed to estimate radar reflectivity using bin microphysics (Geresdi, 1996). Both unpolarized and polarized radar reflectivity were calculated for three different hydrometeor types.

The unpolarized radar reflectivity simulation was based on Blahak (2012).

Polarization radar reflectivity calculation was based on Bringi – Chandrasekar (2001).

Input data for calculations were given by simulation of snow melting.

References

Blahak (2012), Bohren – Huffman (1983), Bringi – Chandrasekar (2001), Geresdi (1996), Seliga – Bringi (1976), *Vivekanandan et al. (1999)*

Results

Figure 1 shows the initial number concentrations of snowflakes and water drops.

Figure 2 shows the calculated axis ratio for water drops (a) and snowflakes (b).

Figure 3 a) and b) show the differential reflectivity for water drops and snowflakes respectively as a function of the size of the particles.

Figure 4 shows the differential reflectivity as a function of height.

The correct calculation of radar data in the melting layer is necessary for prediction of precipitation. The simulated ‚bright band' showed in Figure 5.

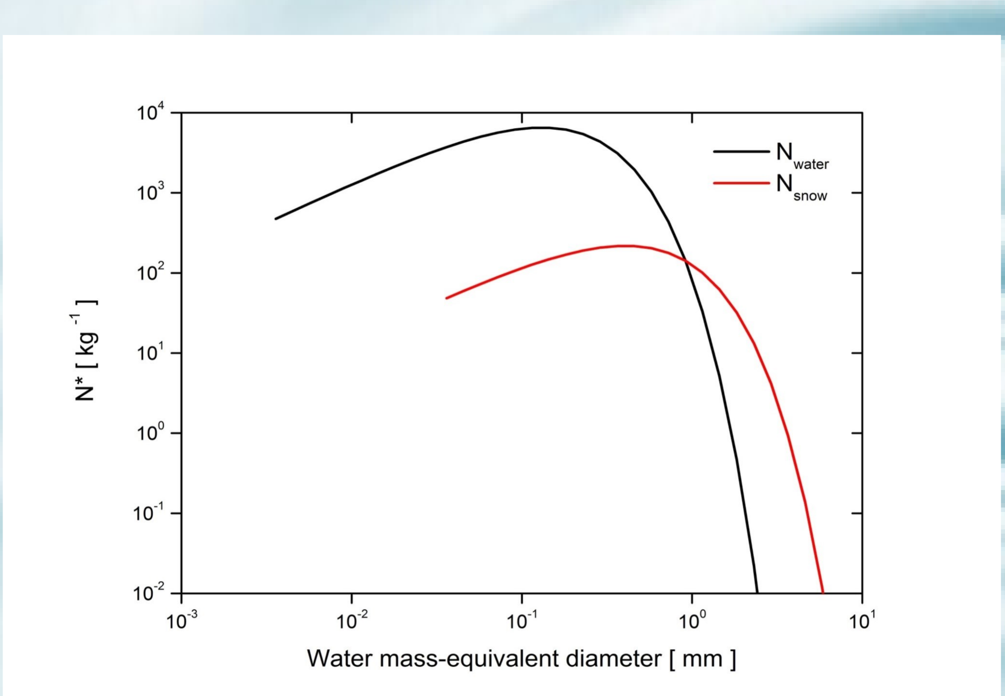

Figure 1.: Initial number concentration of water drops and snowflakes.

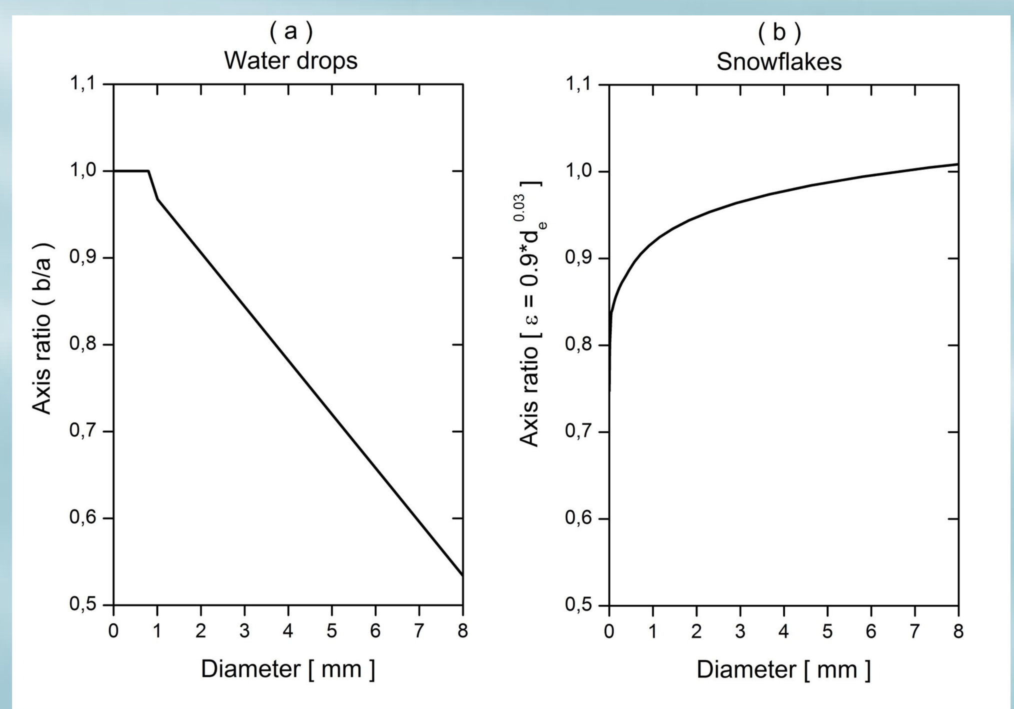

Figure 2.: Axis ratio of water drops and snowflakes as a function of the water mass-equivalent drop diameter.

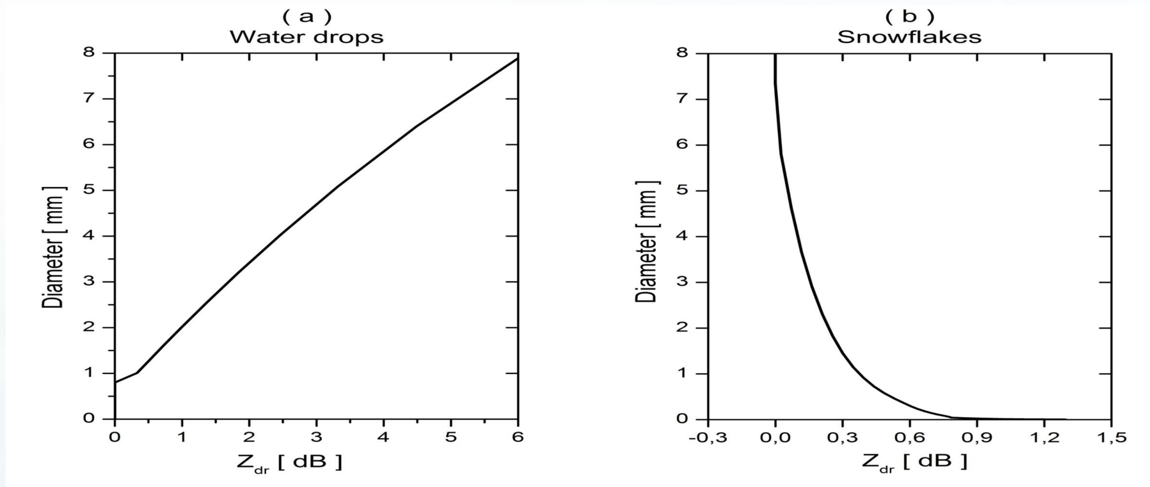

Figure 3.: Differential reflectivity for water drops (a) and snowflakes (b).

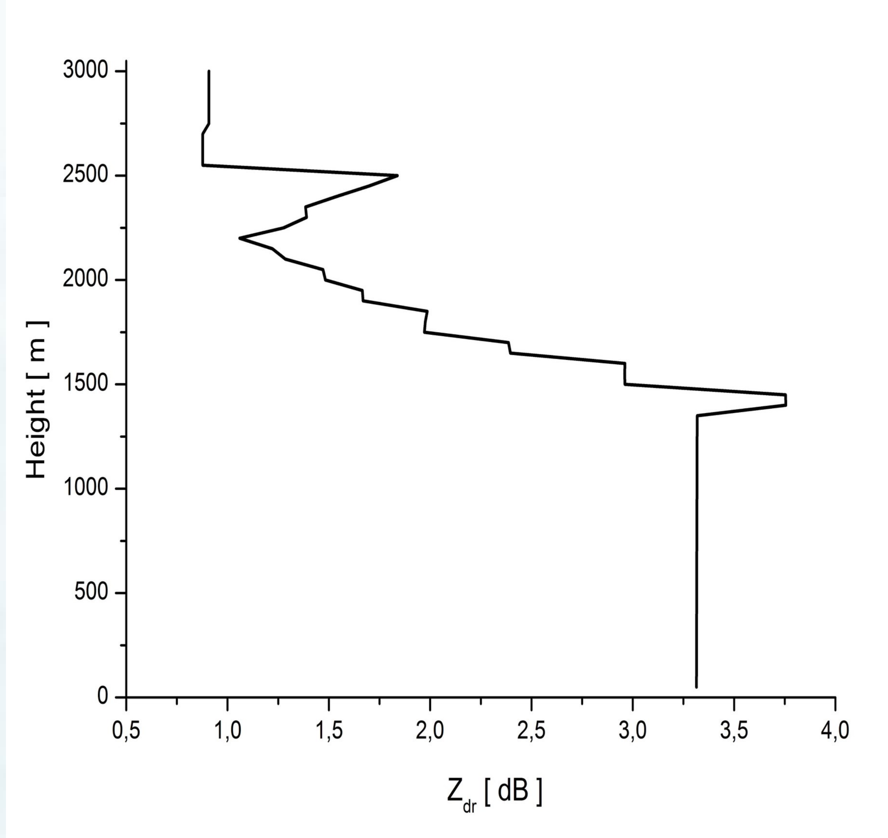

Figura 4.: Differential reflectivity for the simulation of the melting of snowflakes.

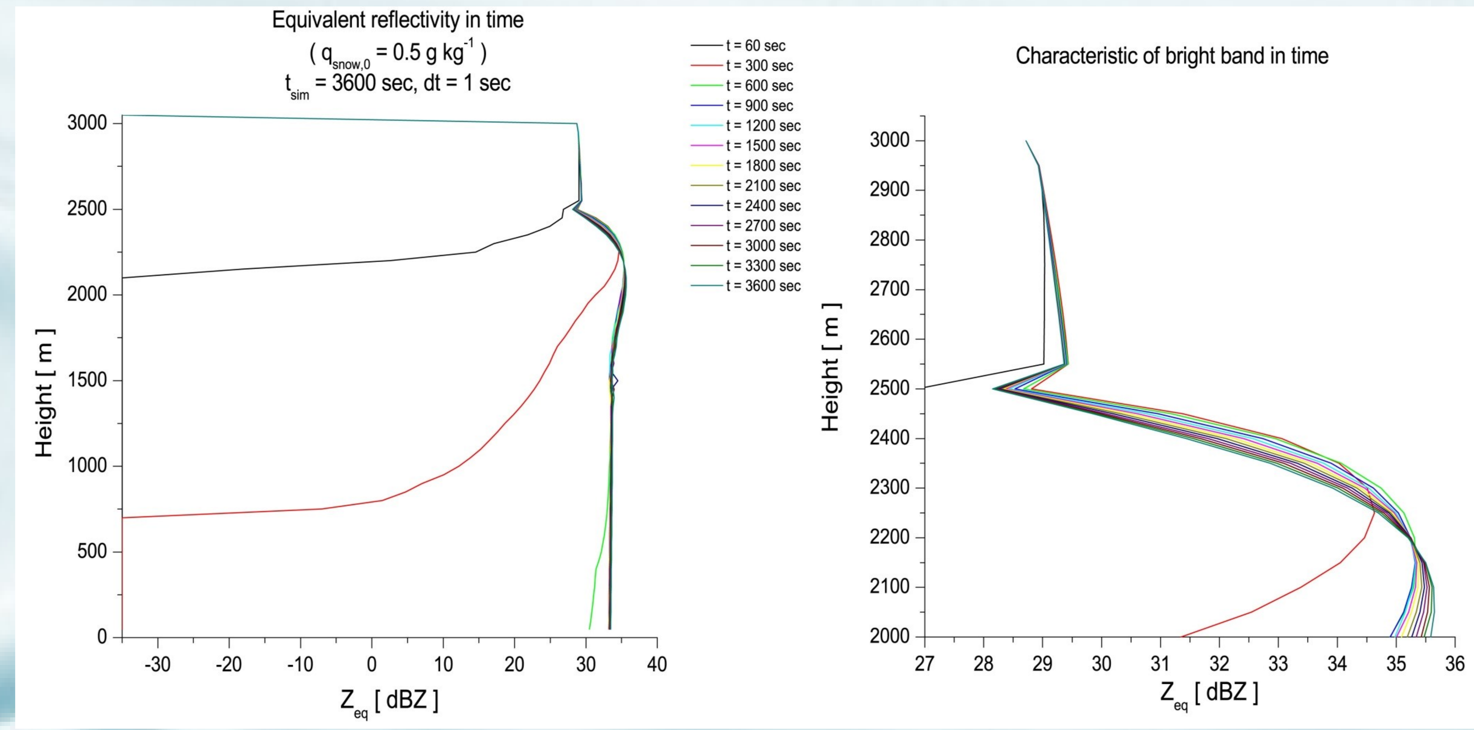

Figure 5.: Equivalent radar reflectivity values in time. Initial mixing ratio of snowflakes was given as 0.5 g kg-1. The simulation time was 1 hour and the time step was 1 sec.

Conclusions

The 1D simulations showed that reflectivity values are very sensitive on the density and on the axis ratio of the different hydrometeor type.

The main advantage of using bin microphysics for simulation of radar data is that several size dependent parameters are available in the output of the model (e.g.: melting fraction) or easy to calculate them. (e.g.: axis ratios).

Futher plans

In the future we would like to:

- run the reflectivity calculation code in WRF with detailed microphysics scheme,
- taken into consideration the attenuation,
- using T-matrix method to calculate the backscattering cross sections and scattering matrix elements for randomly oriented different shaped particles.

Contact information:

Noémi Sarkadi: sarkadin@gamma.ttk.pte.hu

István Geresdi: geresdi@gamma.ttk.pte.hu

Acknowledgements

This research was supported by the **European Union** and the **State of Hungary**, **co-financed by the European Social Fund** in the framework of TÁMOP 4.2.4. A/2-11-1-2012-0001 'National Excellence Program'.

15th Annual WRF Users' Workshop, June 23-27 2014, Boulder, Colorado, USA