VALIDATION OF PR BRIGHT BAND DETECTION IN MIDDLE LATITUDES USING UHF WIND PROFILER

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1. Introduction

Retrieval algorithm for rain rate estimation using TRMM PR (Precipitation Radar) uses bright band information for choosing an appropriate Z-R relation in case of stratiform rain. Then, correct detection of the bright band is important for rain rate estimation from reflectivity of PR. However, in winter season in middle latitudes, the 0-degree's altitude becomes low and it is sometimes difficult to detect the bright band height from contamination of the ground clutter echo. If the bright band height is failed of detection, strong echo intensity at the bright band height causes overestimation of rain rate. In case of the GPM core satellite, which will observe up to 65 degree in latitude, detection of lower height bright band becomes more important.

For this study, we checked detection of the bright band close to the ground using an UHF wind profilers at Tokyo.

2. UHF wind profiler

Wind profiler is a Doppler radar for wind measurement using atmospheric echo, but wind profilers of higher frequency also have good sensitivity to precipitation particles. In this study, we use wind profiler as vertical-pointing Doppler radar for rain observation.

An UHF wind profiler has been operated continuously at Koganei, Tokyo since 1993. There were several breaks of observations by several malfunctions of the instrument, but it accumulates data over 11 years so far. Its frequency is 1357 MHz and its transmit peak power is 1 kW. Parabolic reflector of 4.2 meters diameter is used for the antenna. It observes a vertical direction every 5 minutes with height resolution of 75 meters. Unfortunately, since there is number limitation of echo sampling points in the data processor of our wind profiler, the maximum sampling height is 5 km in most cases.

3. Monthly mean bright band height

The wind profiler has better range resolution than the PR and there is less contamination of ground clutters to precipitation echoes. Moreover, it can also provide vertical Doppler velocity, which is useful for the bright band detection. The bright band heights are estimated using both vertical echo profile and Doppler velocity profile.

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Firstly, we compare the bright band height obtained by the PR and the wind profiler using monthly mean statistics. 3A25 data of the PR from 1998 to 2003 are used for this comparison. For the wind profiler, the bright band heights in each month are averaged using all available precipitation echo profiles obtained in that month. Figure 1 shows time sequences of the monthly mean bright band height of the two from 1998 to 2003. 3A25 data of 0.5 degrees fine grid including Koganei area are used as the PR data. Although observations of the PR data and the wind profiler data have different extent in space and time, generally, both time sequences agree well due to the monthly averaging. In winter season, the wind profiler shows lower bright band height than the PR, especially in 1998-99, 2001-02 and 2002-03. We infer that the difficulty of lower bright band detection with the PR may cause higher height in monthly average than that of the wind profiler. In such a case, stratiform rain echo profile may be mistaken as convective one and enhanced echo of the bright band may cause overestimation of its rain rate. Therefore we should check detection of low bright band height in winter carefully. Additionally, in summer season, the wind profiler data also shows lower bright band height than the PR, especially in 2000 and 2002. The bright band heights in those years are higher and close to 5km. A lot of higher bright bands seem to be missed in the wind profiler because of its maximum sampling height (5km).

In order to see biases of the individual bright band detection of the PR, its distributions in 5 degrees grid are checked using 3A25 data. Figure 2 shows the distribution at each month and monthly mean height around Tokyo. There are few counts of bright band detection under 1km in winter. Although counts of bright band in winter are less than those of summer, they are especially few in Jan 1998 and Feb 2000. Those months correspond to low bright band height seen in the wind profiler data in figure 1. A lot of lower bright band may be missed in those months because of the ground clutter contamination.

In presentation, we will investigate the detections of the bright band using simultaneous rain echo profiles of the PR and the wind profiler and discuss the rain rate estimation errors of the PR in winter middle latitude.

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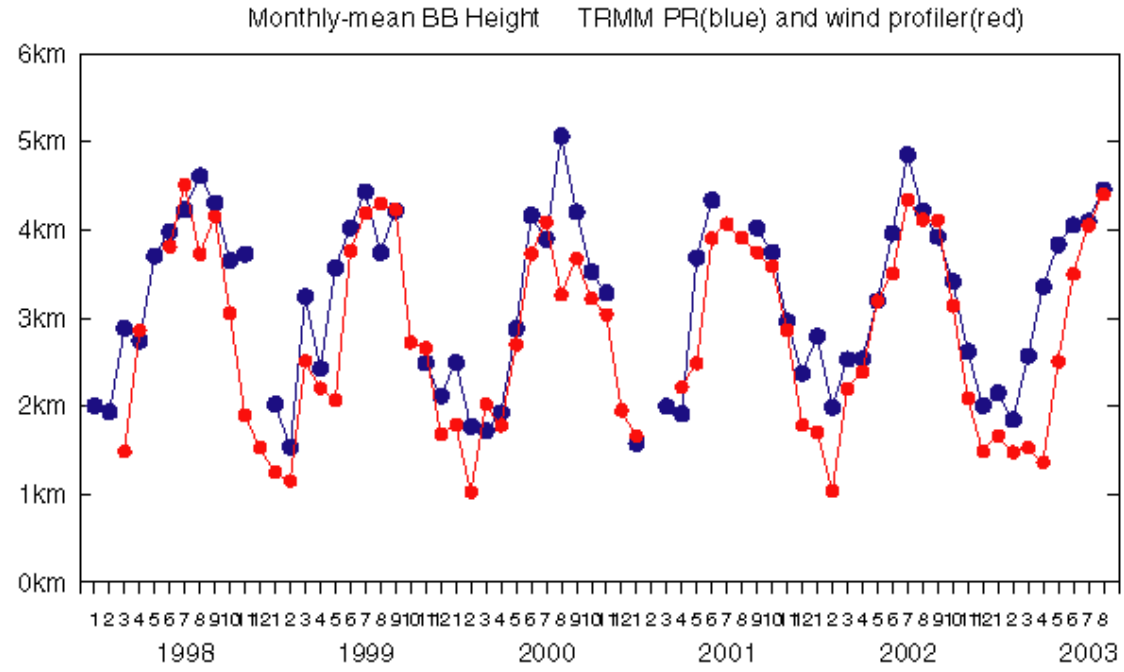

Figure 1: Time sequences of monthly mean bright band height from 1998 to 2003.
Blue line shows BB height of the PR picked out from 3A25 fine grid including Koganei area.
Red line shows BB height estimated from UHF wind profiler at Koganei.

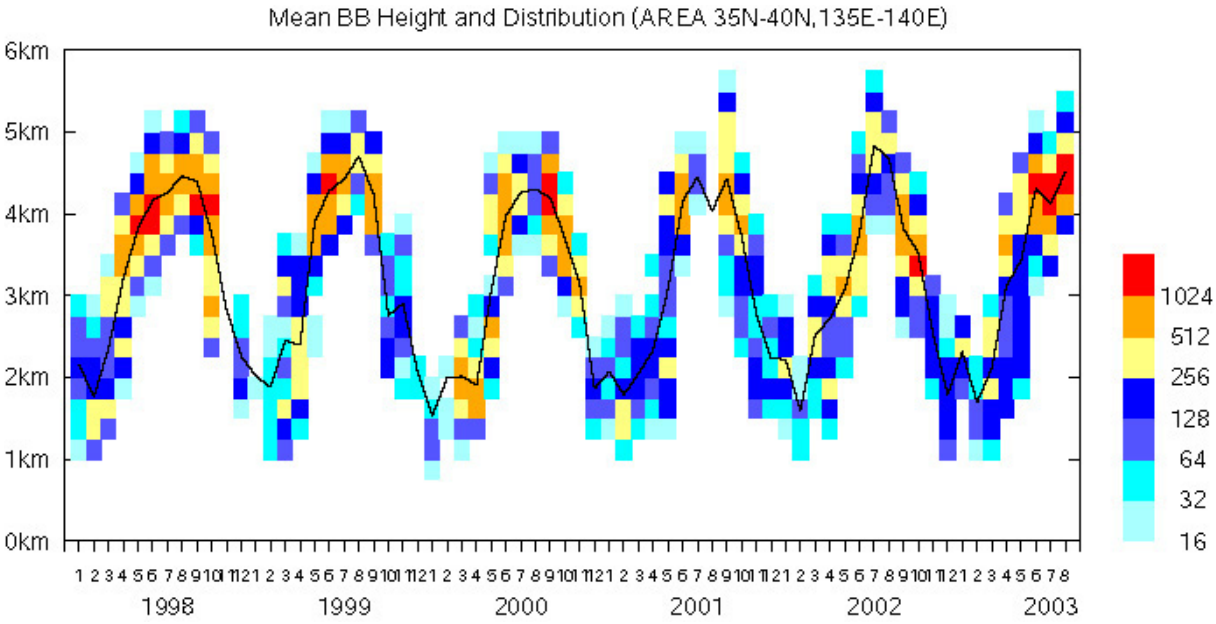

Figure 2: Number counts of bright band at each height and its mean over 5 degrees square including Koganei.