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Radar-satellite retrieval of cell structure: impact of Tb-Z relationships

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The Meteorological Research Institute (IPMet)/ UNESP operates two weather radars (Bauru- BRU (22.3583 S, 49.0272 W) – Presidente Prudente – PPR (22.1178 S, 51.3836 W) covering an area of outstanding importance in the country. Logistic as well as economic factors restrict the number of radars deployed in the State of São Paulo, prompting development of efforts to extend as much as provide the useful range of the network radars. In this sense, studies are being carried out at IPMet to retrieve relevant possible information in the outer radar range rings. Since the inception of the radar program there was evidence that storms could be detected even in the outermost ranges. This condition was considerably strengthened after the old C-band Bauru radar was substituted for an S-band Doppler system. PPR entered operations about two years after the new BRU was installed. Previous work indicated the feasibility of retrieving the gross structure of the intense convective cells in the outer rings through the combination of the radar cell core with satellite radiometry, particularly in the microwave spectrum. A preliminary test, in which a cell far from PPR and at mid-distance from BRU, simultaneously observed by both radars, was run for that retrieving purpose.

The cell core detected on PPR was surrounded by satellite microwave image and the retrieved cell structure was compared with that reproduced with BRU observations.

For the test, Tb-Z relations were derived for a control cell near BRU. In the following, Tb-Z relationships were obtained for a number of days, in the search for a mean relation advantageous for the operational scenario.

In this paper, impacts of the (crucial) Tb-Z transformation on the retrieval is presented.

Three different relations are applied, i.e., one derived from a number of cells near BRU, in addition to the control cell previously utilized, another taken as representative of the period of the year within, which the preliminary test was performed, and a third one involving observations to the North inland from the Gulf of Mexico coast line for comparative purposes.

The retrieved cell structure (Z converted from satellite Tb) for the test relations shows a peak value compatible with the corresponding PPR measurement, corrected for distance. Distribution of reflectivies surrounding the peak is coherent with that of the cell as observed with the Bauru radar.

The mean relationship features a peak about 3 dBZ below the range corrected value (or the Z obtained with the test relationship), and a Z field following, in the average, gradient trends from the Bauru cell observations, but higher values of reflectivity.

The relation obtained with observations in the U.S. data shows the marked regional character of such measurements with a peak Z of more than 6 dBZ below the corrected value, a Z field with significantly higher reflectivities and even one gradient inversion.

Different storms observed by BRU in the test were checked for their vertical structure, characterizing the strong convection in the area with intense cores and high tops.