7B.3 THE SENSITIVITY OF THE MOVING FRAME SINGLE-DOPPLER WIND RETRIEVAL TECHNIQUE WITH RESPECT TO RADAR VIEWING ANGLE

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1. Introduction:

Over the past decade, the radar meteorology community has made considerable effort to develop the single Doppler velocity retrieval (SDVR) techniques whereby the unobserved transverse wind components can be estimated directly from single Doppler radar measurements. When only one radar is applied in real cases, would the SDVR results be affected by the radar viewing angle? In addition, if the retrieved winds turn out to be bad, due to the disadvantageous location of the radar, can this be immediately recognized from the SDVR information alone? These issues are the focuses of this study.

2. Experimental design:

The SDVR method used in this study is the so-called moving frame retrieval technique based on Gal-Chen (1982), Zhang and Gal-Chen (1996), and later modified by Liou (1999, hereafter L99). The data sets are collected by two 5-cm Doppler radars (NCAR CP-4 and TOGA) during 1987 Taiwan Area Mesoscale Experiment (TAMEX) IOP2, which represented a long-lasting subtropical squall line. Dual-Doppler syntheses were first performed to generate the "true" low-level wind field. Then, the Cartesian winds *u*, *v*, *w* are projected onto a specified site where a "virtual" Doppler radar is positioned. Through this process, the quality of the data sets collected by any "virtual" radar can be placed on an equal basis, and any comparisons become more meaningful. Figure 1 illustrates the relative positions of these 11 "virtual" radars with respect to the retrieval domain, superimposed by the storm-relative wind distributions.

3. Results:

Quantitative SDVR results using the L99 technique for the 11 virtual radars are listed in Table 1. The parameter *AOR* measures the relative importance of the azimuthal component with respect to the radial wind, and is defined by

$$AOR = \sqrt{\frac{\sum V_{azi}^2}{N}} \Big/ \sqrt{\frac{\sum V_{rad}^2}{N}} \qquad (1)$$

where *N* is the total number of grid points. Based on the *AORs*, the results are characterized into three groups, which represent the azimuthal wind is smaller than, approximately equal to, or larger than its radial counterpart. The discussion of Table 1 is given in the following:

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3.1 The underestimation of the wind speed:

From radars 1 to 11, the magnitudes of the retrieved radial winds are always smaller than, but comparable to their dual-Doppler counterparts, as shown in column 1. However, column 2 indicates that, the SDVR method is inclined to underestimate the azimuthal wind components. When the true azimuthal component gradually begins to dominate the radial wind, from the group I radars to the group III radars, the underestimation increases accordingly.

3.2 *The sequence of AOR:*

Although none of the SDVR retrieved *AOR*s is identical to their dual-Doppler counterparts, the statistics in column 3 do show that the L99 technique is capable of placing the retrieved *AOR* into the correct category. The most encouraging finding is that the sequence of the retrieved *AOR* is exactly the same as that obtained using the dual-Doppler *AOR*. This result implies that even lacking any *a priori* information about the true flow pattern (such as real cases), one can still determine the unknown portion of the total wind vectors would be smaller than, comparable to, or larger than the observable component. When the last situation occurs, it suggests that for this particular case, the radar happens to be at a disadvantageous location for executing the radar observations and SDVR calculations. Consequently, the users can be alerted that the radar data and the single Doppler retrieved products must be used cautiously.

References:

Gal-Chen, T., 1982: Errors in fixed and moving frame of reference: applications for conventional and Doppler radar analysis, *J. Atmos. Sci.*, **39**, 2279-2300.

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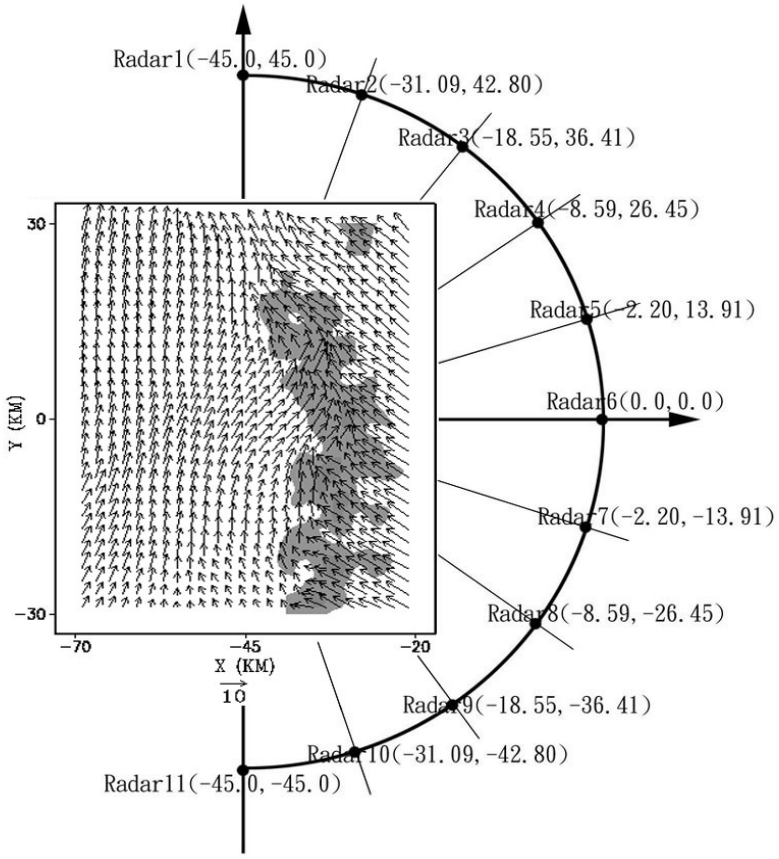

Figure 1: The positions of 11 “virtual” radars with respect to the retrieval domain, superimposed by the storm-relative wind distributions. The area with reflectivity greater than 30 dBZ is shaded.

Table1: The comparisons of 11 “virtual” radars’ SDVR results. rms(V) is the averaged magnitude of V. . “Dual” stands for dual-Doppler syntheses. “Single” means the SDVR results

		(1) *rms(Vrad) (m/s)*		(2) *rms(Vazi) (m/s)*		(3) *AOR*	
		Dual	Single	Dual	Single	Dual	Single
Group I	Radar 4	18.00	17.72	7.12	6.42	0.39	0.36
	Radar 3	17.95	17.71	7.23	6.31	0.40	0.36
AOR<0.7	Radar 5	16.87	16.54	9.51	7.76	0.56	0.47
	Radar 2	16.32	16.14	10.43	8.55	0.64	0.53
Group II	Radar 6	14.84	14.50	12.45	10.27	0.84	0.71
0.7<	Radar 1	13.35	13.26	14.04	11.79	1.05	0.89
AOR < 1.4	Radar 7	12.12	11.79	15.12	12.15	1.25	1.03
	Radar 11	11.27	11.27	15.77	13.34	1.40	1.18
Group III	Radar 8	9.17	8.90	17.07	13.54	1.86	1.52
AOR>1.4	Radar 10	8.43	8.40	17.45	14.48	2.07	1.72
	Radar 9	7.42	7.23	17.91	14.39	2.41	1.99