A New Scan Mode to Increase Clear-Air Data Coverage for Wind Analysis

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1. Introduction

By using long pulses with extended dwelling time, the radar measurement capability can be enhanced to detect weak echoes in the absence of precipitation and measure associated velocities from Bragg backscattering caused by temperature and moisture irregularities (sometime with insects and/or birds) in the atmospheric boundary layer (ABL). Such an enhanced capability may increase clear-air data coverage and provide useful information for detecting the ABL depth and lower-level wind convergence conducive for convective initiation (CI) in a pre-storm environment. To explore this potential capability and related benefits, a new scan mode with long pulses and low antenna rate is designed for the experimental (10.9 cm) S-band radar (named KOUN) at NSSL. This new scan mode is described below with its caused difficulty in velocity dealiasing and our solution.

2. New scan mode and velocity dealiaisng

The new mode completes each volume scan with three Doppler sweeps (at 0.5, 1.5 and 2.5 degrees) in 10.5 minutes. Using this scan mode, Doppler velocity data were collected from April 15 to 28 in 2016 storm season. During this period, the atmospheric condition changed from clear to cloudy and then following by CI along the east side of a prefrontal dry-line (to the west of KOUN). However, since the PRF was limited to 455 Hz and thus the Nyquist velocity was reduced to 12.4 m/s for this scan mode, the collected velocity data were severely aliased. To process and utilize these data, the dealiasing technique (Xu et al. 2013, *Advances in Meteorology*, Article ID 562386) developed for operational WSR-88D radars were modified adaptively by extending the continuity check in the second step beyond the radial range covered by the seed data produced by the reference check in the first step.

3. Results

The Doppler velocities scanned from the KOUN radar by using the new scan mode showed that the data coverage can be increased from 1 km to 2 km in vertical depth and from 100 km to 150 km in radial range under clear-air condition in comparison with the velocities scanned from the nearby operational test-bed KCRI radar. This increased clear-sky raw data coverage is shown by the area marked by the blue word "Clear" in Fig. 1a in comparison with that in Fig. 1c. The data coverage in cloudy areas were also increased significantly, as shown by the areas marked by the yellow words "Cloudy" in Fig. 1a in comparison with those in Fig. 1c. Since the Nyquist velocity was reduced to 12.4 m/s for this new scan mode, the collected velocity data were severely aliased, as marked by white letters "A" in Fig. 1a. The aliased data were mostly corrected by the adaptively modified dealiasing technique with much increased data coverage and almost no false dealiasing, as shown by the result in Fig. 1b in comparison with that in Fig. 1d.

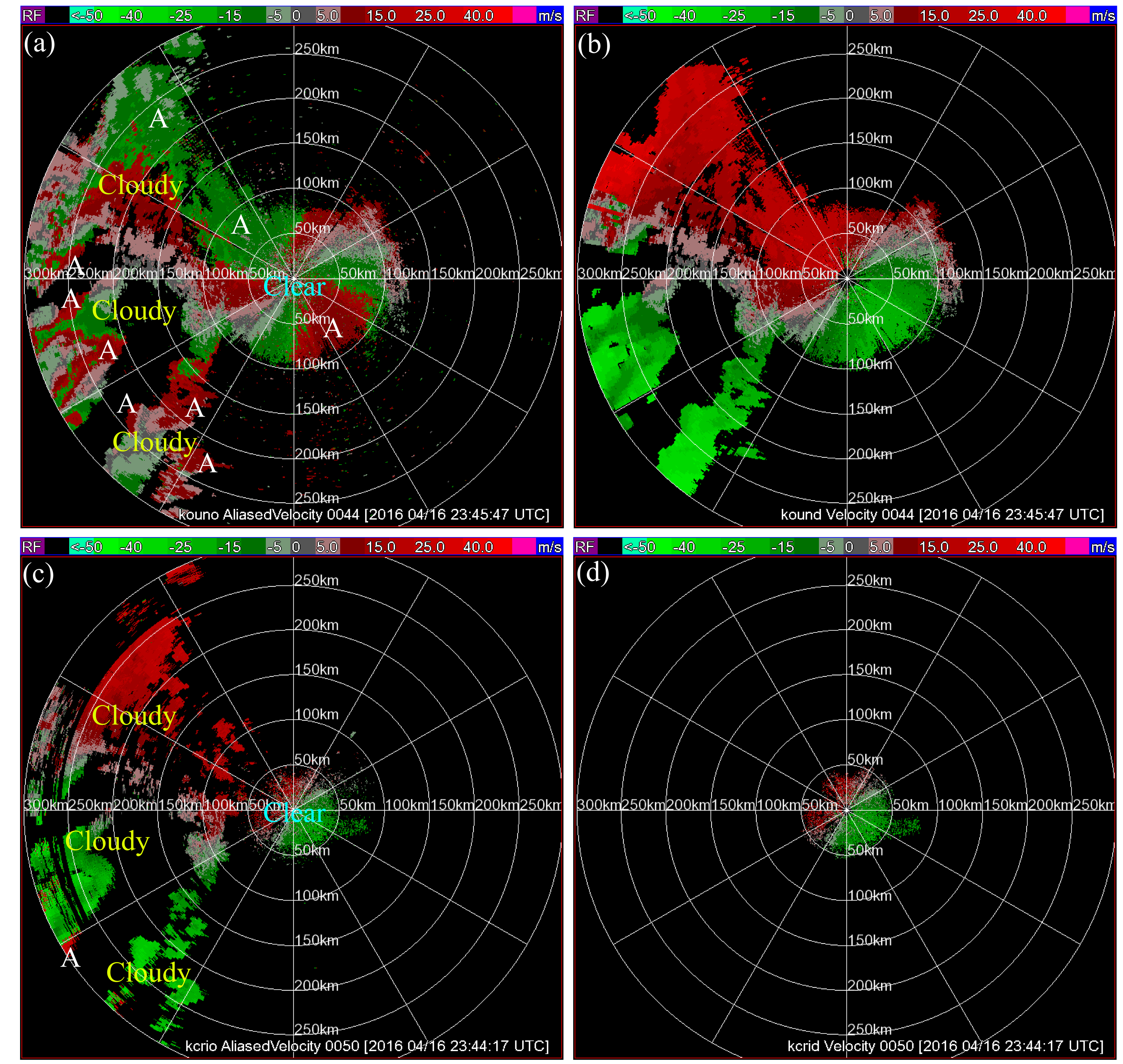

Fig. 1. (a) Image of raw radial velocity scanned from the KOUN radar using the new scan mode on 0.44° tilt at 2345 UTC on 16 April 2016. (b) As in (a) but for dealiased radial velocity produced by the adaptively modified dealiasing technique. (c) Image of raw radial velocity scanned from the KCRI radar on 0.5° tilt at 2344 UTC on 16 April 2016. (d) As in (c) but for dealiased radial velocity produced by the dealiasing technique developed for operational WSR-88D radars. In panels (a) and (c), the white letters "A" mark the aliased-velocity areas, the blue word "Clear" marks the area under clear-air condition, and the yellow words "Cloudy" mark the cloudy areas.