Continued Assessment of WSR-88D Wind Data to Support ARM Single-Column Model IOPs

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Introduction

WSR-88D radar wind data from radars within the Atmospheric Radiation Measurement (ARM) Southern Great Plains (SGP) Cloud and Radiation Testbed (CART) site are used to provide vertical wind profiles of the horizontal wind and divergence. Assessment of the utility of this data is conducted as well as made available for use by the ARM scientific community.

WSR-88D Data Availability

Radar data from selected intensive observation periods (IOPs) are being acquired at the Cooperative Institute for Mesoscale Meteorological Studies (CIMMS). Processed radar data are available via *http://mana-tee.gcn.ou.edu/vad/VAD.html*. Two types of data are available at this site:

1. Velocity-Azimuth Display (VAD) vertical wind profiles—These files contain vertical profiles of the u- and v- wind components (m/s) at a frequency of about once every 6 minutes. The vertical levels reported [in feet mean sea level (MSL)] if available are: 1000., 2000., 3000., 4000., 5000., 6000., 7000., 8000., 9000., 10000., 11000., 12000., 13000., 14000., 15000., 16000., 17000., 18000., 19000., 20000., 22000., 24000., 25000., 26000., 28000., 30000., 35000., 40000., 45000., and 50000. Data do not frequently extend to the highest ranges. Data are available currently for the Summer 1995 IOP from Dodge City, Kansas; Wichita, Kansas; and Tulsa, Oklahoma.

2. VAD divergence profiles—These files contain vertical profiles of the divergence from a preselected radius of analysis. The vertical profiles are reported at the same time intervals as in the VAD wind profiles, but the heights are reported in meters above ground level (AGL). Due to constraints of the selected radius, these data are not reported with as great a vertical range and resolution. Data are also available from the three radars listed above for the single-column model (SCM) IOP.

Data from the Spring 1996 IOP is available but not yet processed. Also, data from the Summer 1997 IOP is expected to be available.

Comparison of SCM Summer 1995 IOP Data – Verification!

Verification of a High Amplitude Short Wave

Divergence data obtained from the WSR-88D radar at Wichita, Kansas, were used to provide quality assurance to SCM data (see *http://wetfly.llnl.gov/scm/9507.sonde_aq/*). A high amplitude and short wavelength feature was observed in the SCM-derived divergence and omega fields on July 20, 1995 (see Figure 1). Questions existed on whether this feature was real, or caused by observational error.

Vertical profiles of divergence from the Wichita, Kansas, WSR-88D (ICT) during this same period revealed strong convergence below 8 km and strong divergence above 8 km (see Figure 2). This transition from convergence to divergence at approximately 8 km corresponds well to the SCM divergence profile, which shows a similar transition near 300 mb. This couplet of convergence at low levels and divergence at upper levels is also consistent with positive vertical motions (or negative values of omega) in the SCM analyses.

Based on the radar-derived data, the decision was made to keep this period of data in the SCM data set for use by SCM modelers.

Evaluation of SCM Divergence at a Single Level for the Full Summer IOP

Divergence estimates were provided by John Yio (Lawrence Livermore National Laboratory) from the SCM analyses for a subset of the ARM CART site that corresponded to

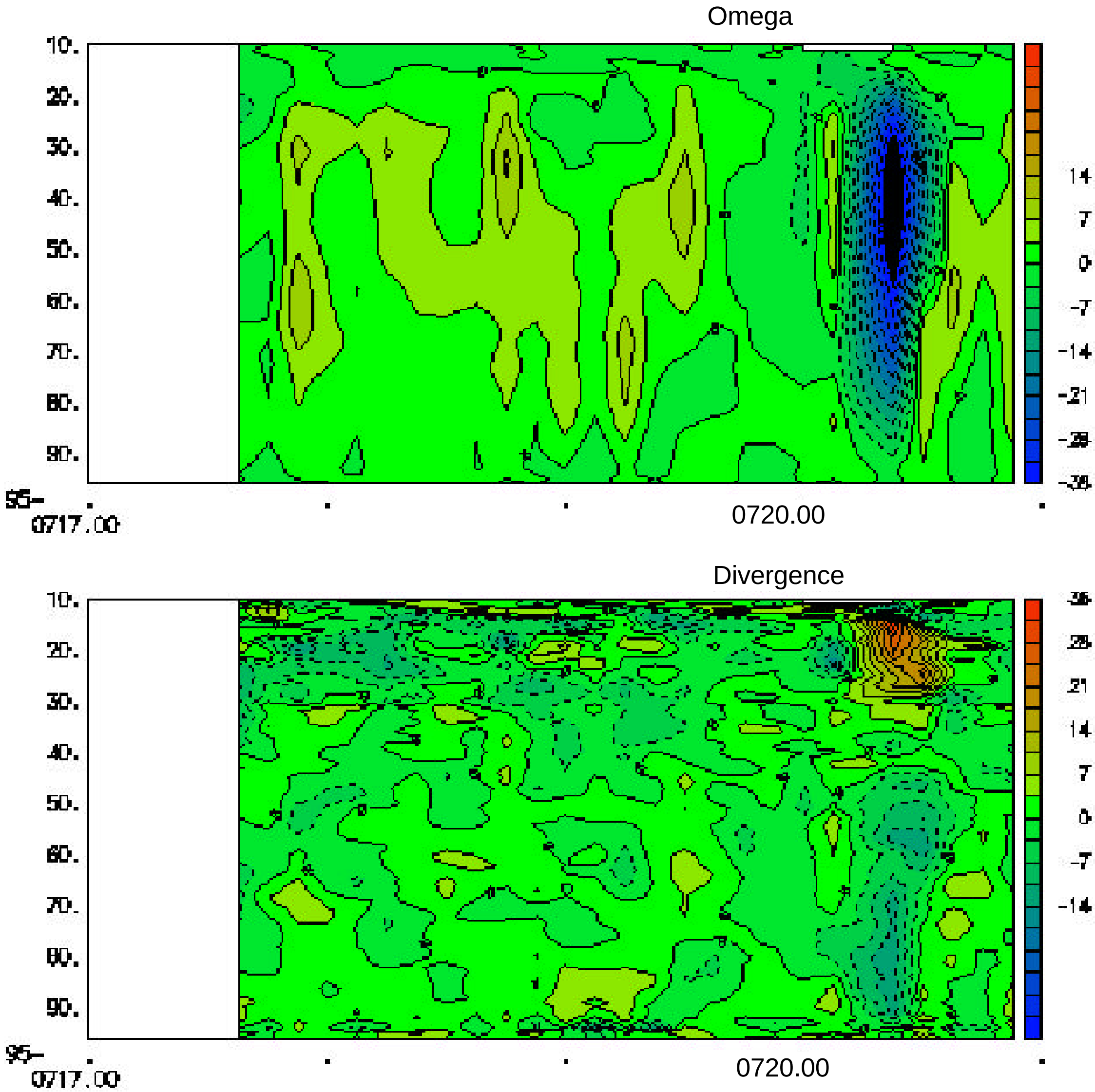

Figure 1. Vertical profiles of omega (top) and divergence (bottom) from the ARM SCM analyses reveal a high-amplitude short wavelength feature propagating through the CART site on July 20, 1995. (For a color version of this figure, please see *http://www.arm.gov/docs/documents/technical/conf_9803/splitt(2)-98.pdf*.)

a 90-km radius about the ICT radar site. These data were compared to divergence estimates obtained from the ICT WSR-88D for that same radius.

Comparison of the 90-km scale divergence from the WSR-88D radar and the SCM analyses at a level of 1240 m for the full IOP are shown in Figure 3. Balloon-Borne Sounding System (BBSS) (sonde) data were used to provide a transfer from pressure coordinates to height coordinates. A good comparison between the two divergence estimates is achieved for much of the IOP after the SCM divergence data is smoothed. This data may suggest that there is noise within the SCM analyses that is observable at the 90-km scale. (Note the SCM data used was based on the Barnes analysis, not via variational analysis.)

The WSR-88D is seen here to be a useful tool for verification of the SCM data. It may also be considered as a potential data source for inclusion into SCM analyses.

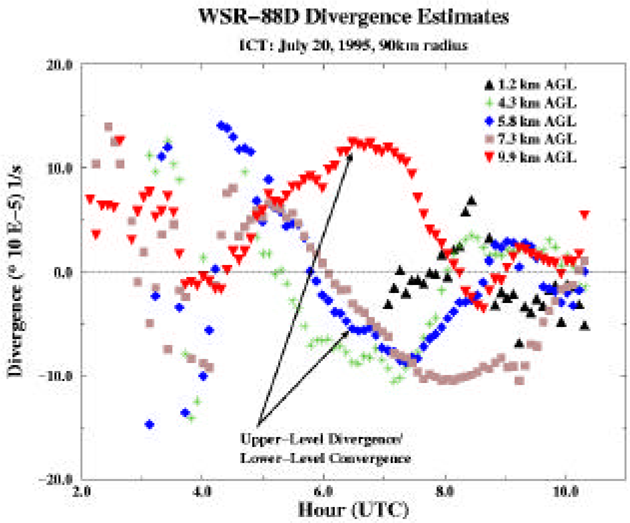

Figure 2. Vertical profiles of divergence from the Wichita, Kansas, WSR-88D on July 20, 1995, confirming the feature identified in the SCM analyses. (For a color version of this figure, please see *http://www.arm.gov/docs/documents/technical/conf_9803/splitt(2)-98.pdf*.)

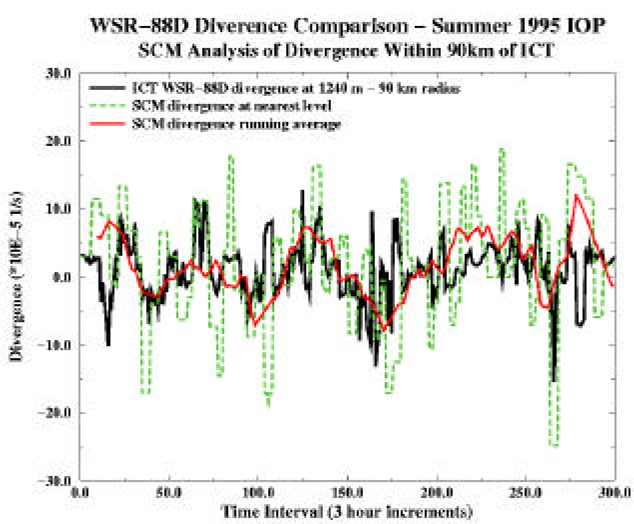

Figure 3. Comparison of 90-km scale divergence from WSR-88D and SCM analyses for the Summer 1995 SCM IOP. "Noise" is observable at the 90-km scale in the SCM analyses. (For a color version of this figure, please see *http://www.arm.gov/docs/documents/technical/conf_9803/splitt(2)-98.pdf*.)

Comparison of WSR-88D Divergence to ECMWF-Derived Divergence During the Fall of 1995

Divergence profile estimates from the VNX (Vance Air Force Base) WSR-88D were obtained from a 60-km radius (~11,000 km^2) from September 22, 1995, through September 26, 1995. Data gaps do exist within this period. At the 60-km radius (note that analyses at other radii can be done) divergence estimates were available at the following approximate levels: 750 m, 1800 m, 2800 m, 3800 m, 4800 m, and 6500 m. Data availability was highest at the lower levels.

The VNX radar is located (latitude/longitude of 37.74 and 261.88) within the European Centre for Medium-Range Weather Forecasts (ECMWF) region 29 (box defined by latitude/longitude of 263.0, 261.7, 37.0, 36.0), which is about 13,000 km^2. The 60-km radius for VNX was chosen to produce divergence estimates over the same approximate area (both in size and location).

Divergence estimates from the ECMWF model output were obtained by differentiating omega with respect to pressure; the divergence from this estimate was assigned a pressure level halfway between the pressure levels for which omega was specified. For this analysis a factor of 10 was used to "convert" omega to w, vertical velocity.

Figure 4 illustrates the comparison between the ECMWF and VNX WSR-88D divergence estimates near 780 mb. A 1-hour running average of the WSR-88D data was used to smooth the data, but note that the values of this curve near data gaps are suspect. The comparisons show some periods of correlation, which is encouraging, but differences between the two are not insignificant. The WSR-88D is shown here to be a tool that can potentially be used to assess the quality of model output data.

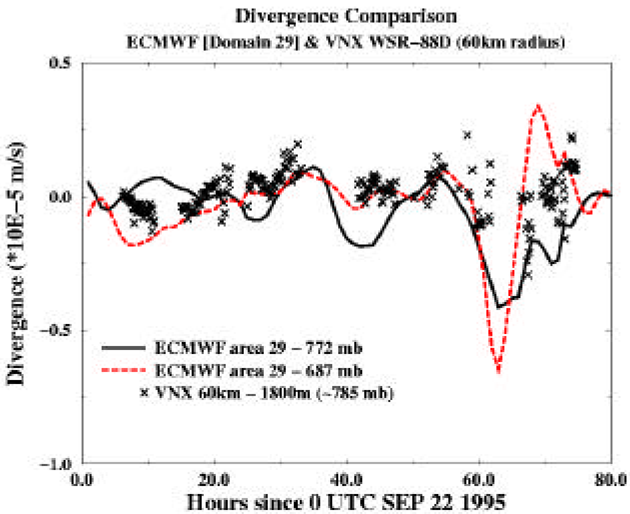

Figure 4. Comparison between ECMWF forecast divergence and WSR-88D divergence estimates. (For a color version of this figure, please see *http://www.arm.gov/docs/documents/technical/conf_9803/splitt(2)-98.pdf*.)