A PROBABLE UNEXPLORED METEORITE FALL FOUND IN ARCHIVED WEATHER RADAR DATA.

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Introduction: The U.S. national weather radar network (commonly called NEXRAD) operated by the National Oceanic and Atmospheric Administration (NOAA) has shown to be a useful resource for identifying and charactering meteorite falls [1,2]. To date, numerous falls have been identified in NEXRAD radar imagery to include Park Forest IL, Portales Valley NM, Grimsby ONT, the "Ash Creek" fall outside West, TX, Lorton VA, and Mifflin WI. In all of these events, radar data is corroborated by meteorite recovery on the ground, but until now no probable meteorite falls have been found exclusively in radar imagery. We report here the probable discovery of an unexplored meteorite fall as seen in archived radar data. NEXRAD data is archived as far back as 1992 and the event detailed here advances the hypothesis that meteorite falls that would otherwise go undiscovered can be located by searching through archived radar data.

Description: A few minutes before 8pm CST on the evening of 04 February 2007 (≈0200 05 Feb 07 UTC), eyewitnesses across the Midwest reported a bright meteor traveling roughly NW to SE. This event was eye-catching to the point that 53 individual eyewitness reports were recorded by the American Meteor Society on their web page, but no meteorites have been reported to date. A Google Earth overlay showing the locations of the eyewitnesses seems to indicate that the fireball occurred in the vicinity of the corner shared by Iowa, Missouri and Illinois (Figure 1).

NEXRAD radar data show a significant fall event just north of the town of Jacksonville, IL. Reflectivity data indicate falling material (i.e. reflection signatures appearing initially at high altitude and proceeding to lower altitudes) and two apparent turbulence vortices are seen in Storm Relative Velocity (SRV) data products of the event. These apparent vortices are seen as contiguous, paired velocity values of high magnitude and opposite direction, indicating a localized "swirl" or atmospheric turbulence possibly caused by the passage of a "large" falling body. Both the falling nature of the reflectivity data and the presence of vortices are signatures of meteorite falls and have been seen in all major meteorite falls observed in radar data to date. In all, the Jacksonville event appears on seven separate NEXRAD radars (KDVN, KEAX, KILX, KLOT, KLSX, KIND, and KVWX sites) thus eliminating the possibility that the signature is simply "noise" observed on a single radar. The event occurs within

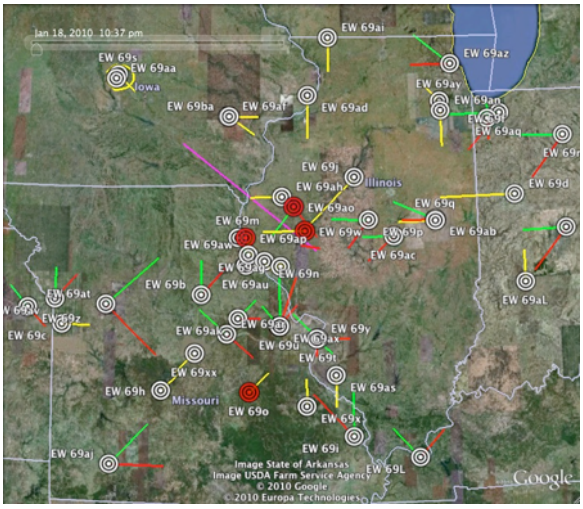

Figure 1: Eyewitnesses to the 05 Feb 07 meteor. Bullseye icons are eyewitness locations, with red bullseyes indicating that the eyewitness reported hearing the event. Green lines indicate the direction the eyewitness reports the fireball starting from, and red lines indicate the direction towards the terminus. Yellow lines indicate that the eyewitness reports only a general direction towards the fireball. The purple line is the approximate fireball path from eyewitness reports (without regard to correct length).

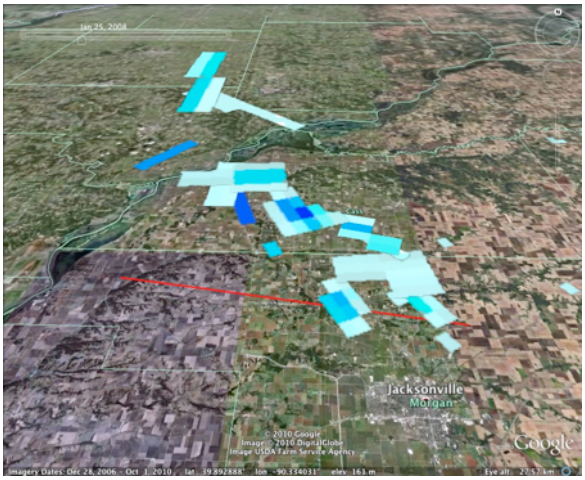

Figure 2: Perspective view of all radar reflectivity data from the Jacksonville, IL event shown at their correct altitudes. This image faces due north. The red line at ground level is the approximate centerline of the radar reflections. The general behavior is similar to that seen in the "Ash Creek", Mifflin, Grimsby, and other falls which appear in weather radar imagery. High winds out of the ~NW carry smaller, slower-falling particles further downrange, resulting in what appears to be an "inverted" strewn field with the largest masses closest to the fireball terminus.

minutes of the average time and in the location reported by eyewitnesses, indicating a causal relationship between the fireball and the radar signatures. We conclude that a significant meteorite fall occurred just north of Jacksonville, IL on 04 February 2007, and that meteorites reached the ground and await recovery.

The Jacksonville, IL event extends along a linear path approximately 20 km long along a compass heading of 98 degrees (Figure 2). The maximum altitude of all the radar signatures was at 17.2 km above ground level (AGL) and the lowest was at 1.1 km AGL. As the fall progresses, the altitude of radar signatures drops (Figure 3). The effects of atmosphere drag and gravity can be seen as smaller mass particles reach a lower terminal velocity and take longer to reach the ground while larger mass particles fall much faster, resulting in size sorting of the falling masses. This variance in the altitude versus time data starts out fairly narrow but it can be seen to widen as the falling particles descend at their varying downward velocities.

Winds aloft during the event were strong, peaking around 83 m/s at 11.6 km AGL and a originating direction of about 235° according to a NOAA radiosonde released from Lincoln, IL at 0023 UTC on 05 Feb 07. This data set represents winds approximately 85 km NE and two hours prior to the fireball event. The approximate centroid of the radar returns when projected directly onto the ground lies at 729460 m E, 4410800 m N in UTM grid 15 S. (or lat/long 39.816234°, -90.319197°), however deflection of falling meteorites due to wind must be incorporated into recovery efforts.

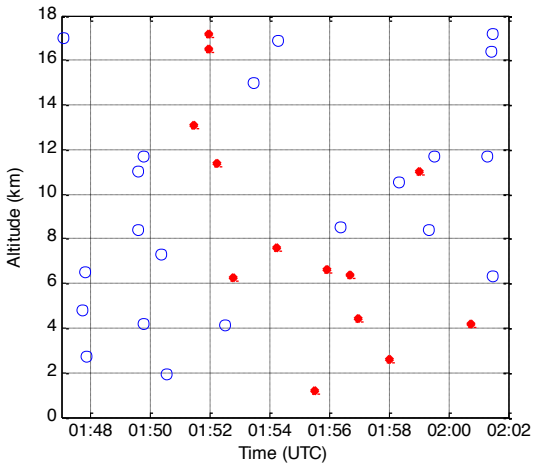

Figure 3: Altitude and time of radar sweeps over the Jacksonville, IL area for the 7 nearest radar sites. Red circles represent that a reflectivity radar signature was detected. Blue circles represent that the radar sweep at that altitude and time saw nothing.

References:

[1] Fries M. and Fries. J., 41st *LPSC*, Abstract #1179. [2] Fries M. and Fries J., *Meteoritics and Planetary Science* **45**, 9 (2010) 1476-1487.