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STICKNET – A NEW PORTABLE, RAPIDLY-DEPLOYABLE, SURFACE OBSERVING SYSTEM

Christopher C. Weiss* and John L. Schroeder
Texas Tech University, Lubbock, Texas

1. INTRODUCTION

In response to a growing need for high-resolution in-situ observations of meteorological phenomena, an array of portable, versatile, instrumented meteorological platforms, named StickNet, has been developed by atmospheric scientists and wind engineers at Texas Tech University. To date, 24 StickNet have been constructed and are available for use in the field. These platforms are designed for rapid deployment (~2 min each), and will provide high-resolution sampling of atmospheric phenomena in regions that are too dangerous for manned measurement systems.

2. STICKNET DESIGN, CONSTRUCTION, AND LOAD TESTING

The initial design for the StickNet platforms was developed as part of a summer 2005 design/field course within the Texas Tech Atmospheric Science and Wind Science and Engineering Research IGERT curricula (Schroeder and Weiss 2008). Faculty and students worked together to develop two prototype StickNet designs. The first design employs a RM Young Wind Monitor, while the second design uses a Vaisala "all-in-one" instrument capable of sensing accumulated precipitation and hailfall, in addition to the normal state parameters. Selected specifications of both platforms are listed (TABLE 1).

Each StickNet platform contains a GPS receiver/antenna to determine precise positioning and synchronize acquisition time, a flux compass to automatically calibrate wind measurements to magnetic north, and a bubble level to ensure wind measurements are parallel to the horizon. The internal lithium battery contained within the protected data acquisition (DAQ) enclosure provides power for ~ 18 continuous hours of operation. A supplemental external LGM battery can be attached to provide continuous operations for a period of up to seven days. On the RM Young prototype, signals may be sampled at either 1 or 10 Hz (a toggle switch on the box allows for easy selection); the Vaisala prototype samples at 1 Hz.

Three initial platforms were constructed and tested in severe thunderstorm environments during the spring of 2006. Construction continued through 2007 to arrive at the current total of 24 platforms, with plans to expand the amount to approximately 40 in 2008.

The StickNet stations are housed in two covered trailers, outfitted with the capability to store and recharge each platform in transit. An Ethernet hub allows one to download and manage collected data, also, while in transit. In field operations, the trailers are towed with diesel trucks to the area of interest.

The initial prototype StickNet platforms went through a series of load tests performed by students at the TTU Wind Science and Engineering Research Center. Their load calculations suggest that each platform, when properly secured to the ground with three 18" stakes, can withstand peak three-second gusts of 63 m/s (140 MPH), which is well suited for the vast majority of meteorological phenomena that are targeted. For hurricane deployments, an earth screw can also be used to add stability.

3. FIELD TESTING

The StickNet platforms have been deployed for a number of events in 2006 and 2007 since their development, including samples of dryline passages, mesoscale convective systems, and supercell thunderstorms.

In the spring of 2007, ~20 StickNet platforms were available for field operations. A summary of these operations is provided (TABLE 2). On 23 May 2007 a StickNet deployment was made in advance of a supercell thunderstorm near Canadian, TX, in coordination with the Shared Mobile Atmospheric Research and Training Radars (SMART-R) and the Doppler on Wheels (DOW). The event marked the second successful deployment of the full array.

SMART-R base reflectivity and radial velocity images show the positioning of the

* *Corresponding author address: Christopher C. Weiss, Texas Tech University, Atmospheric Science Group, Department of Geosciences, Lubbock, TX, 79409; e-mail: Chris.Weiss@ttu.edu*

StickNet platforms relative to the mesocyclone of the targeted updraft (FIG. 2).

Inspection of the trends of thermodynamic and kinematic state variables (FIG. 3) reveals considerable variability that is resolved on the storm-scale (inter-probe spacing was between 0.3 and 1.3 km across the array), which underscores the importance of the type of data these platforms can provide. Analysis of this case is currently underway, the results of which will be presented at a future conference.

4. FUTURE PLANS

The versatility of the StickNet platforms makes them eligible for many potential projects. These instruments are currently proposed for the upcoming VORTEX2 field project in 2009 and 2010. Similarly, StickNet has been proposed to document the characteristics of the hurricane wind fields at landfall. Further, future work is planned in the area of dryline study. In all these cases, the StickNet array can be adapted in scale and shape to address any number of science objectives.

5. ACKNOWLEDGEMENTS

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6. REFERENCES

Schroeder, J. L., and C. C. Weiss, 2008: Integrating research and education through measurement and analysis., *Bull. Amer. Meteor. Soc.* (accepted)

FIGURE 1 – Photographs of a StickNet station (top), transport trailers (lower left) and deployment (lower right) during the Spring 2007 field project.

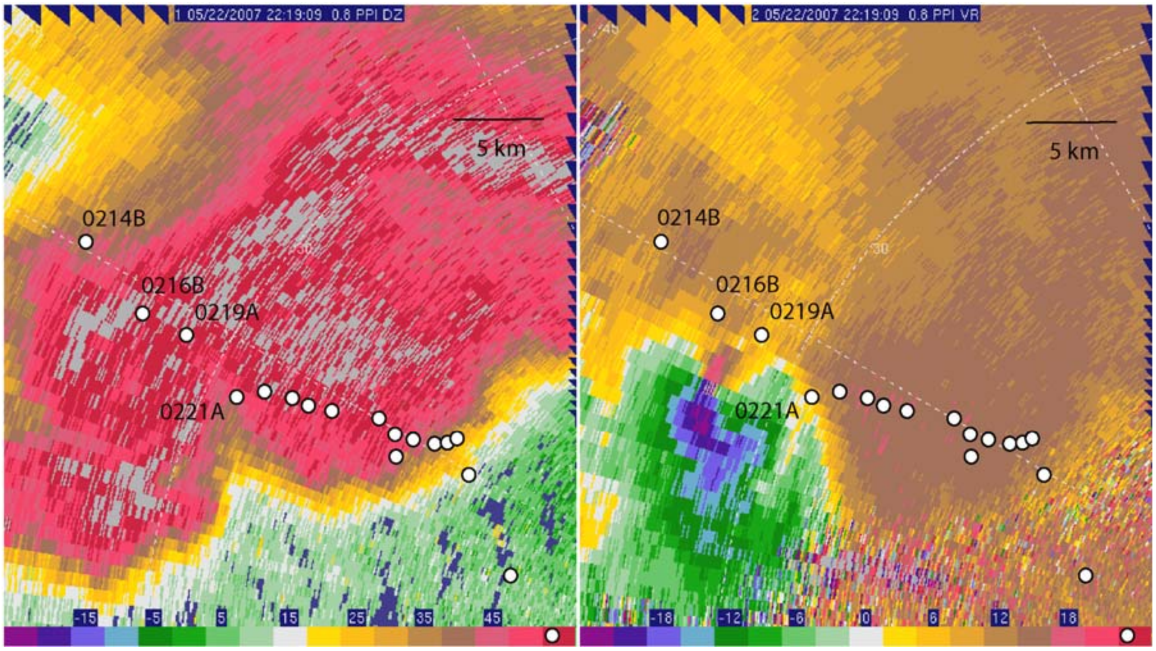

FIGURE 2 – SMART-Radar base reflectivity (left) and radial velocity (right) (0.8 deg) at 2240 UTC 23 May 2007. The fully-deployed array of StickNet instruments is indicated by each open circle. IDs of selected StickNet probes traced in FIG. 3 are shown. The SMART-Radar is located outside the lower right portion (southeast) of each panel. Distance scale is included in upper-right hand portion of panel. (SMART-Radar data provided by M. Biggerstaff and L. Wicker.)

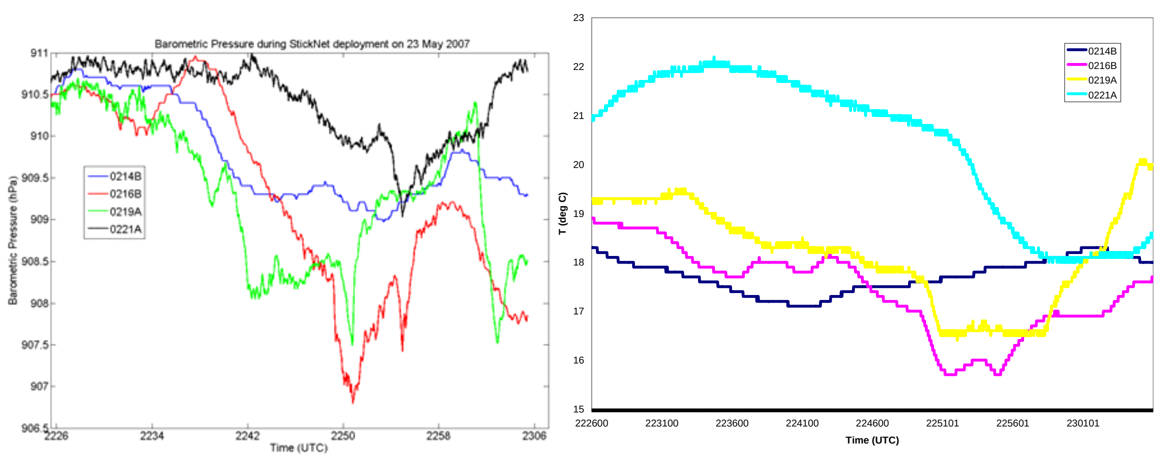

FIGURE 3 – Data from StickNet probes on 23 May 2007 (IDs located in FIG. 2). Included are barometric pressure (left, hPa) and temperature (right, ^{o}C) from four probes near the low-level mesocyclone. Other thermodynamic and kinematic data were collected but are not shown.

Component	Model	Platform	Output	Accuracy
GPS Receiver	SnyPaQ/E-M12 with SMA-35 Antenna	1,2	Time, lat, lon, altitude	
Compass	KVH C100	1,2	0-360 deg	+/- 0.5 deg
All-in-one Sensor	Vaisala WXT510	2	Temp: -52 to +60 ^{o}C RH: 0 to 100% BP: 600-1100 hPa WS: 0 to 60 m s^{-1} WD: 0 to 360 deg Accum Rainfall: mm Accum Hailfall: hits cm^{-2}	Temp: +/- 0.3 ^{o}C RH: +/- 3% BP: +/- 0.5 hPa WS: +/- 0.3 m s^{-1} WD: +/- 3 deg Accum Rainfall: +/- 5% / day
Temp/RH	RM Young 41382	1	Temp: -50 to +50 ^{o}C RH: 0 to 100%	Temp: +/- 0.3 ^{o}C RH: +/- 2%
Pressure	Vaisala PTB101B	1	600-1060 hPa	+/- 1.5 hPa
Wind	RM Young 05103V	1	WS: 0 to 100 m s^{-1} WD: 0 to 360 deg	WS: +/- 1% WD: +/- 3 deg

TABLE 1 – Key StickNet specifications for each of the two platform types.

Date	Location	Event Sampled
22 May 2007	Hill City, KS	Tornadic supercell
23 May 2007	Perryton, TX	Tornadic supercell
31 May 2007	Guymon, OK	Pre-tornadic supercell
6 June 2007	Kadoka, SD	Upscale transition / mini-bow echo
7 June 2007	Pittsburg, KS	Non-tornadic supercell

TABLE 2 – StickNet deployments during the MOBILE Project (Spring 2007)