National Center for Atmospheric Research
Earth Observing Laboratory
P.O. Box 3000, Boulder, CO 80307

NCAR/EOL
Earth Observing
Laboratory

Status Report

Project Title: Development of Miniaturized In-situ Sounding Technology for THORPEX
For: ZoltanToth / NOAA THORPEX Program Manager
Author: Terry Hock / NCAR/EOL/RTF
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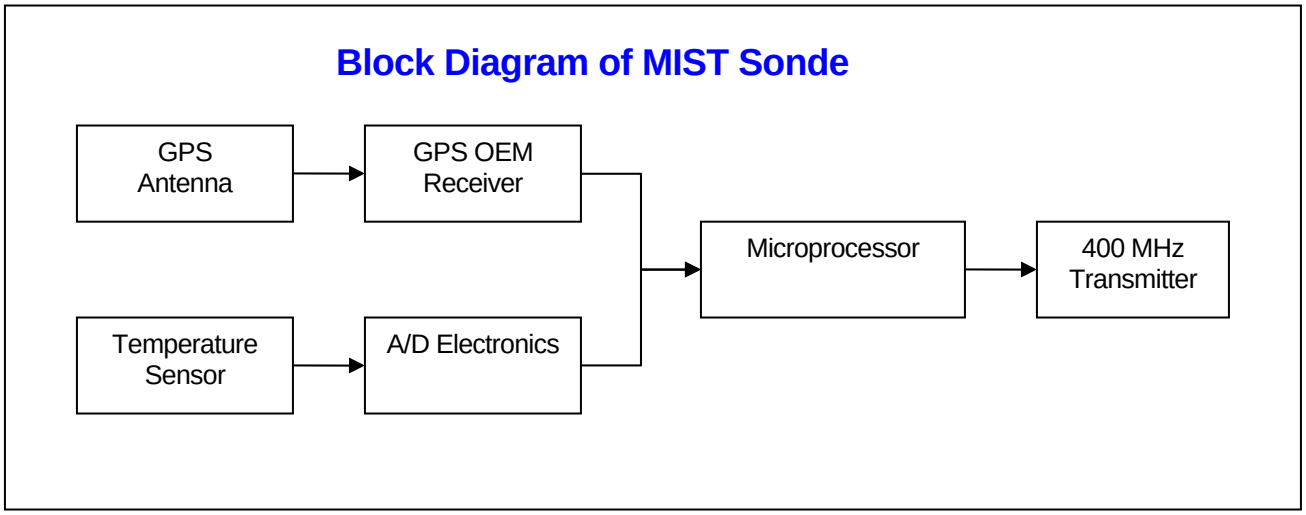
The development of the MIST sonde for Driftsonde has focused on the engineering design of the sonde. The engineering has been focused in three areas:

1. 400 MHz transmitter design
2. GPS receiver selection and evaluation (for Winds measurement)
3. Preliminary microprocessor development

Below is a simple block diagram of the MIST sonde.



The GPS Receiver is one of the most critical components in the MIST sonde as it will be used to derive the wind measurements. The first part of this year has been on research and evaluation of suitable GPS receiver technology for the MIST Sonde. The technical criteria for a GPS receiver are: 1) low cost, 2) compact size, 3) low power consumption, 4) good satellite tracking performance during significant vertical velocity motion. After a careful review of the available commercial OEM GPS receivers that would be suitable for a MIST sonde, the U-Blox TIM-LF module is the best choice. The u-Blox TIM-LF receiver is a 1) 16-channel GPS receiver, 2) light weights receiver at 4 grams and GPS antenna at 11 grams [total 15 grams], 3) size 25.4 mm x 25.4 mm x 3mm, 4) 153 mW power consumption.

There has been extensive testing of the u-Blox GPS receiver performance in static conditions and the GPS receiver has also been tested in the standard NCAR GPS dropsonde during this past year's 2004 hurricane season as this receiver will also replace the current Vaisala GPS receiver. The u-Blox GPS receiver performance in a dropsonde has shown excellent results. However, during evaluation of the u-Blox TIM-LF receiver undesirable characteristics of long satellite acquisition times occurred on a small percentage of the

drops with unacceptable results which are unique to the u-Blox GPS receiver when used only in a dropsonde. Working with the u-Blox technical staff on this problem and considerable data analysis by both NCAR staff and u-Blox engineers, u-Blox engineers developed a fix with a new release of firmware; subsequent testing demonstrated the long satellite lock up time to be solved during drop tests this past fall. Figure one shows a comparison of the standard NCAR GPS dropsonde and a modified dropsonde with u-Blox GPS receiver. Both dropsondes were released within 5 seconds of each other in the hurricane eye of Frances. The tracking performance of the u-Blox agrees very well with the standard GPS receiver and shows improved performance near the ocean surface.

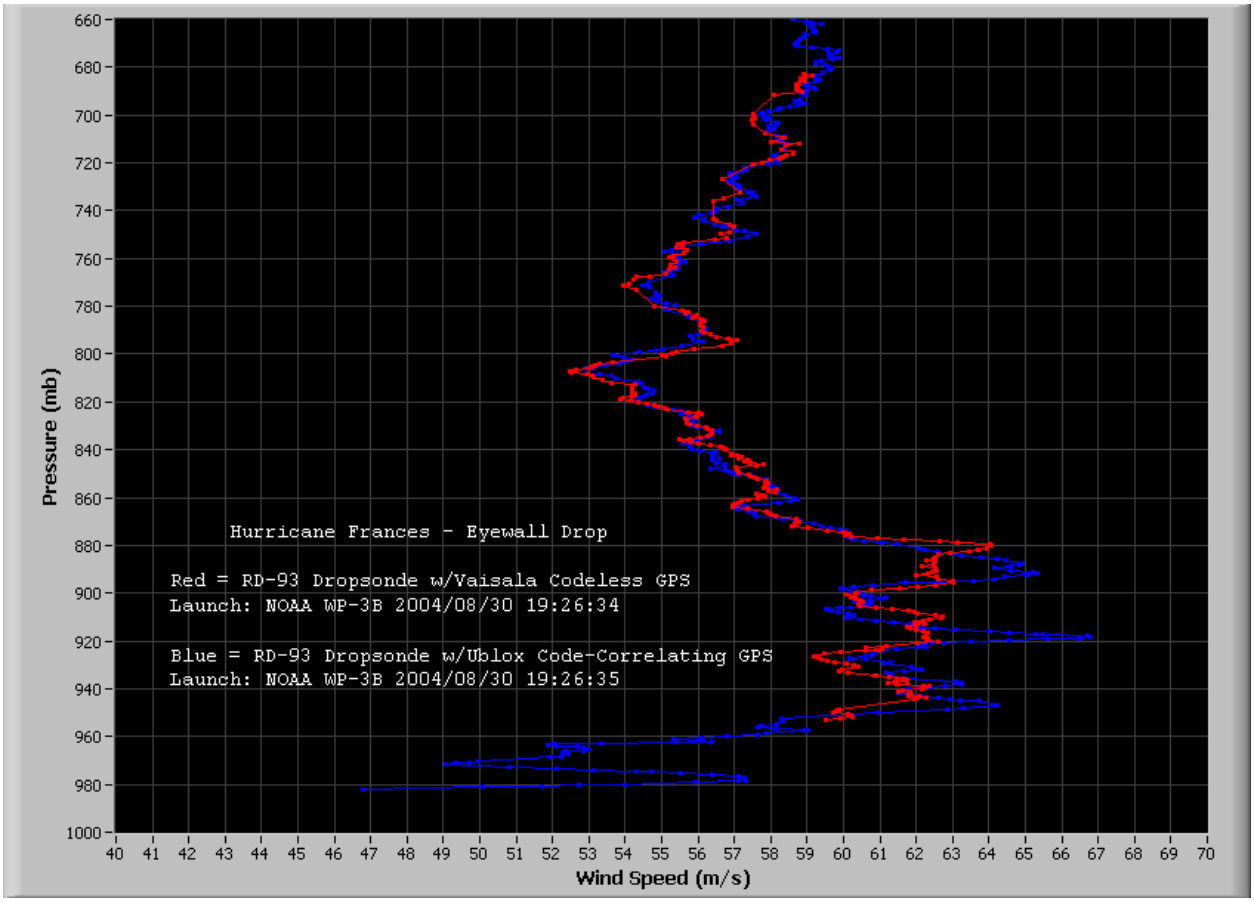


Figure 1 GPS receiver inter-comparison test, Vaisala codeless GPS receiver (RED) versus U-Blox GPS receiver (BLUE)

The current 400 MHz transmitter in the NCAR Dropsonde requires about 120 electronic components. The transmitter design is now currently ~ 8 years old. There has been a significant development in recent years of new Radio Frequency (RF) Application Specific Integrated Circuit (ASIC) technology for the commercial wireless market. The new RF ASIC technology allows for a significantly large reduction in the number of components required for a 400 MHz transmitter and thus a considerable reduction in the physical size of the electronic printed circuit board and manufacturing cost reduction. Two RF ASIC's are currently being evaluated for the MIST sonde transmitter 1) Chipcon CC1070 IC and 2) Numa Technologies NT2800 IC. Both IC's are FSK synthesized transmitters. The IC's are being evaluated for modulation characteristics, tuning range in the 400 MHz meteorological band, spurious signals, phase noise, power efficiency and overall implementation cost. An engineering developers kit for each RF ASIC was purchased. The RF tests are currently being performed on the IC's.

Parameter Description	Minimum	Maximum	Average	Deviation	Unit
Position Latitude	0.704618	40.038107	40.037699	0.103736	°
Position Longitude	-105.241387	-105.24119	-105.24126	0.000033	°
Position Altitude (above mean sea level)	1610.1	1646.1	1625.75	4.36	m
Velocity North	-0.62	5.36	0	0.08	m/s
Velocity East	-0.45	4.82	0	0.07	m/s
Velocity Down	-0.1	0.18	0.06	0.12	m/s

Table 1 20 hour GPS static test of u-Blox TIM-LF receiver

Engineering work has also begun on the development of microprocessor firmware for the MIST sonde. This has included the evaluation of the processing requirements needed for the sonde. The raw data format of the telemetry stream is being developed. The preliminary technical specifications are: 1) 2400 baud, 2) Manchester encoded,) sensor update rate 2 Hz. This format was chosen so as to be compatible with the receiving system hardware in the Driftsonde gondola. The type of microprocessor will be either in the Microchip PIC16F or PIC18F family.

The work that has been performed to date corresponds with the proposal for the first year with the emphasis on the development of a Miniature dropsonde for use in the Driftsonde gondola.