COMMENTS ON THE NWS RADIOSONDE REPLACEMENT SYSTEM (RRS)

Robert A. Maddox

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I have recently become very concerned about several aspects of the NWS sounding program, in particular the RRS - see: http://www.ua.nws.noaa.gov/rrs_overview.htm . I have learned of this program because the upper-air sounding system at Tucson has recently been replaced, and also physically relocated. Until this happened, I was not really aware that such a program has been underway since summer 2005 (see Fig. 1). Given the important character and potential impacts of the RRS implementation on both climate and weather research and prediction, I would have assumed that the program would be highly visible and that widespread communication between the NWS and its private sector, academic, and research customers would have preceded implementation decisions. This appears to be a bad assumption. The last formal, NOAA-wide data users meeting was apparently held in the late 1990s. I discuss two aspects of the RRS program below.

I. Relocation of the Tucson upper-air observing site (WMO 72274)

When the TUS NWS Office announced on their web site (http://www.wrh.noaa.gov/twc/) that the upper-air site had been relocated to the roof of the NWS/USGS building on campus, I (a long-term user of upper-air data) was quite surprised and shocked. This change in the site location occurred after upper-air observations had been taken at the Tucson airport for 51 years. (The Tucson upper-air site was relocated from Davis Monthan AFB to the Tucson airport on March 1st of 1956.) The RRS relocation of the site on June 4, 2007, shifts the upper-air observing site from an open, surface location, reasonably representative of the desert, to the roof of a three story building in an urban, artificial environment with tall buildings, trees, vegetation and irrigation (see Fig. 2). This relocation is not an NWS action that will preserve the long-term stability of the Tucson upper-air observations.

Unfortunately, even though the NWS Office is on the University of Arizona campus, there were no discussions during the planning process for this possible move with the many weather and climate researchers on campus. The NWS apparently did not share any information publicly until the move was imminent. This is certainly a dismal example of communication and interactions amongst the management of the local NWS office and their academic neighbors, who are customers/users of the local and national NWS observational data. However, the relocation announcements "followed NWS procedures." But, the NWS official procedures are so ineffective that none of the major organizations that process and archive upper-air data from the NWS (e.g., FSL, NCAR RAP, and Univ. of Wyoming) appear to have been aware that the move happened. Soundings processed with bad elevation, latitude, and longitude data have been going into the upper-air archives since the move. As of this morning (June 21,2007 at 1200 UTC) FSL still is processing the TUS sounding using the old station history data for the airport location, which is of course no longer operational!

Several of us from the Department of Atmospheric Science visited the NWS Office last week to learn more about the relocation and the new RSS system (many of the soundings taken from the new site have seemed quite bizarre). A look at the new system installation left me flabbergasted. The new site does not meet WMO guidelines for an upper-air site (see pages B-1-3 at http://www.ofcm.gov/fmh3/pdf/10-app-b.pdf). The roof launch site has significant nearby obstructions - larger buildings NW to E within 50 to 500 or 600 yards (i.e., the stadium to the east). A nine story building towers above the 3rd floor roof launch site only about 600 feet to the north (Fig. 3). Additionally, the white-painted, roof-top site, where the new, required surface observing instruments [information at (http://www.ua.nws.noaa.gov/rsoisphotos.htm], have also been installed, is cluttered with everything from large heating and cooling systems venting air in close proximity to the surface sensors, to a variety of additional obstructions and antennas and a satellite dish (Fig. 4). Based on viewing the RSS installations on the roof of the NWS/USGS building, I feel that there is probably not as badly a selected upper-air site location in the rest of the nation. Note that the green tub or bowl in the Fig. 3 photograph is where the sounding balloon is inflated, out in the open and whatever weather might be occurring, as the person taking the sounding prepares for release. The wooden "gizmo" has been locally fabricated to allow the balloonist to move the balloon around on the roof, before final release, to try to account for wind direction and the location of higher buildings and obstructions. Tucson is apparently the only upper-air site in the country that does not have an enclosed structure for balloon inflation.

II. Instrument problems associated with the new Sippican sondes.

During our visit we also learned that the unusual soundings (e.g., Figs. 5 and 6) that began after the move were not only due to the unrepresentative local campus environment, nearby tall buildings, and the cluttered roof-top environment, but were also due to a hygrister problem on the new sondes (yes, the NWS did a concurrent change in both observing site location and sonde instruments at Tucson). I have also learned that the thermistor on the Sippican
(http://www.sippican.com/stuff/contentmgr/files/6f597c276e01b5e1f76a5fed153a0117/sheet/gpsmark2.pdf)
sondes frequently produces unreliable data. It apparently is not coated with a hydrophobic agent, leaving it vulnerable to easy wetting and the subsequent effects of evaporation, freezing, and sublimation.

I am appalled that the installation process continues moving forward (refer back to Fig. 1), even though the data from the new sondes are not consistently reliable. Apparently the sensor inaccuracies are not systematic but are often related to the local conditions at the time of the flight (see Fig. 7 and all the sounding examples). Thus, it seems that significant, random noise is being introduced into the long-term, upper-air data archives. Examples of pathologically low dewpoint temperatures during the early minutes of flights are shown in the two TUS soundings above, and Figs. 8 and 9 show examples of soundings where the thermistor problems have created significant layers of meteorologically implausible data. The NWS has not informed users - be they private vendors, or university or government or private sector forecasters or researchers - of the Sippican sonde's instrument problems, and the new instabilities in both the real-time, upper-air data and their archives. The sensor problems and unrepresentative soundings going into the archives are not issues that the NWS should deal with essentially internally and seemingly in quasi-secrecy.

Figure 1 - Map showing the NWS upper-air stations in the conterminous U.S. Purple underlining identifies the sites currently using the new RRS sondes. Green underlining indicates sites to be converted between now and September. The new sondes were first used at KLWX (8-1-05) and KSLC (9-20-05). The most recent conversions were at KMFL (5-7-07) and KTUS (6-4-07).

Figure 2 - Photo of the RSS white tracking dome on the roof of the NWS/USGS building. The view is to the west-southwest toward the city center from the roof of a five storey U of A parking garage to the east of the NWS/USGS building.

Figure 3 - Photo of two large U of A buildings located just to the north of the NWS/USGS building. See text for explanations of the green tub and wooden "gizmo" in the bucket.

Figure 4 - Photo of the new surface observing system installed on the roof os the NWS/USGS building looking east toward the U of A football stadium.

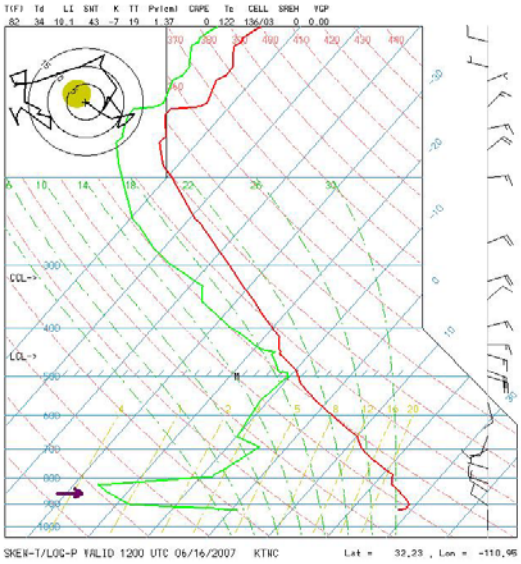

Figure 5 - Skew-T plot of TUS sounding for 1200 UTC June 16, 2007. Note that the very dry layer indicated by the purple arrow is due to hygrister problems of the Sippican sonde (sounding from UCAR RAP upper-air page).

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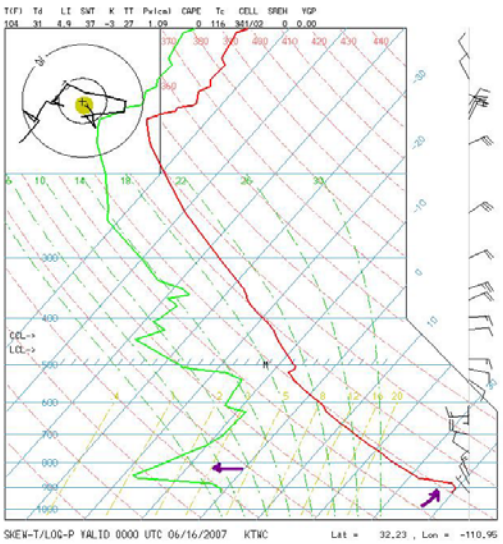

Figure 6 - Skew-T plot of TUS sounding for 0000 UTC June 16, 2007. A very dry layer is present again above the surface. The temperature structure on the roof top, and just above, seems very strange (sounding from UCAR RAP upper-air page).

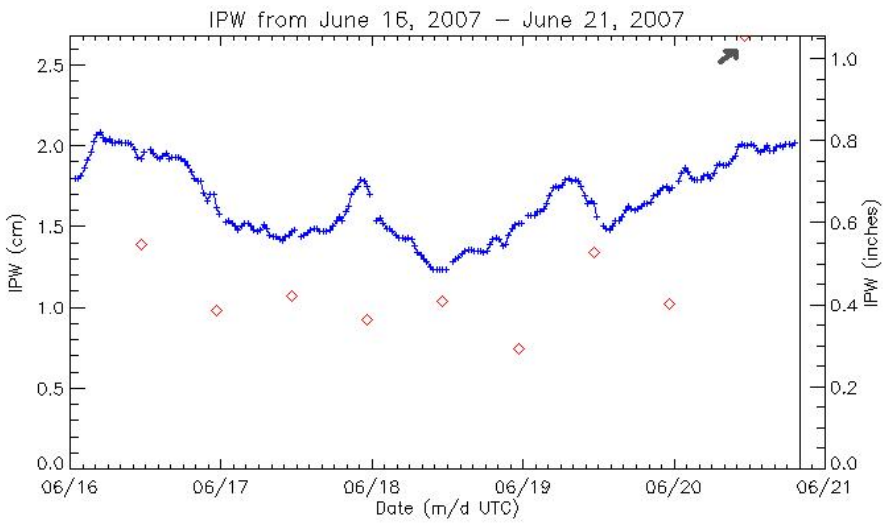

Figure 7 - Time series of integrated precipitable water (IPW) from GPS data (blue) for TUS from June 16 through June 21, 2007. The RRS sonde flights' IPW (red diamonds) for the same period are shown. For this period the RRS sonde data are consistently dry relative to the GPS IPW (both morning and evening flights) except that the morning flight on the 20th was strangely too moist (arrow indicates that diamond, which is almost off the figure - figure from NOAA FSL).

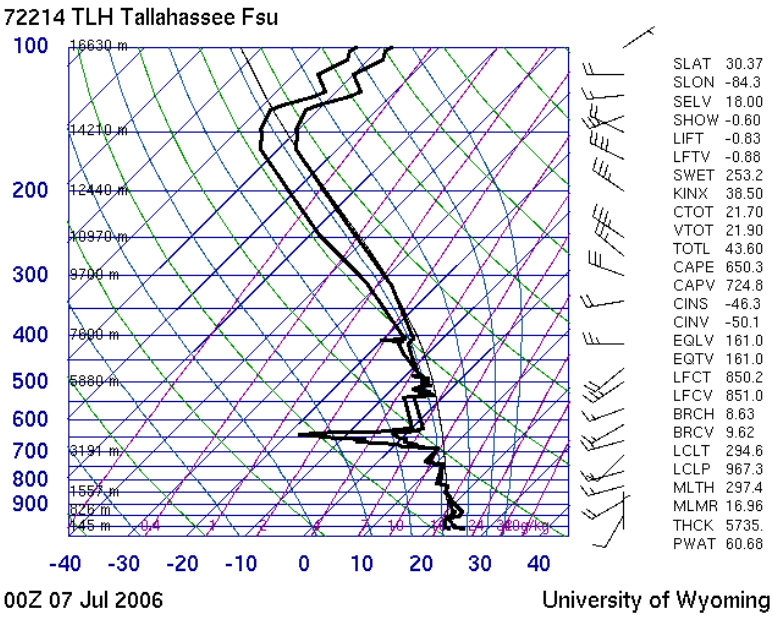

Figure 8 - An RSS sounding from Tallahassee, FL taken at 0000 UTC on July 7, 2006. There are many physically unrealistic layers present from the surface to 400 mb (sounding from the University of Wyoming upper-air web site).

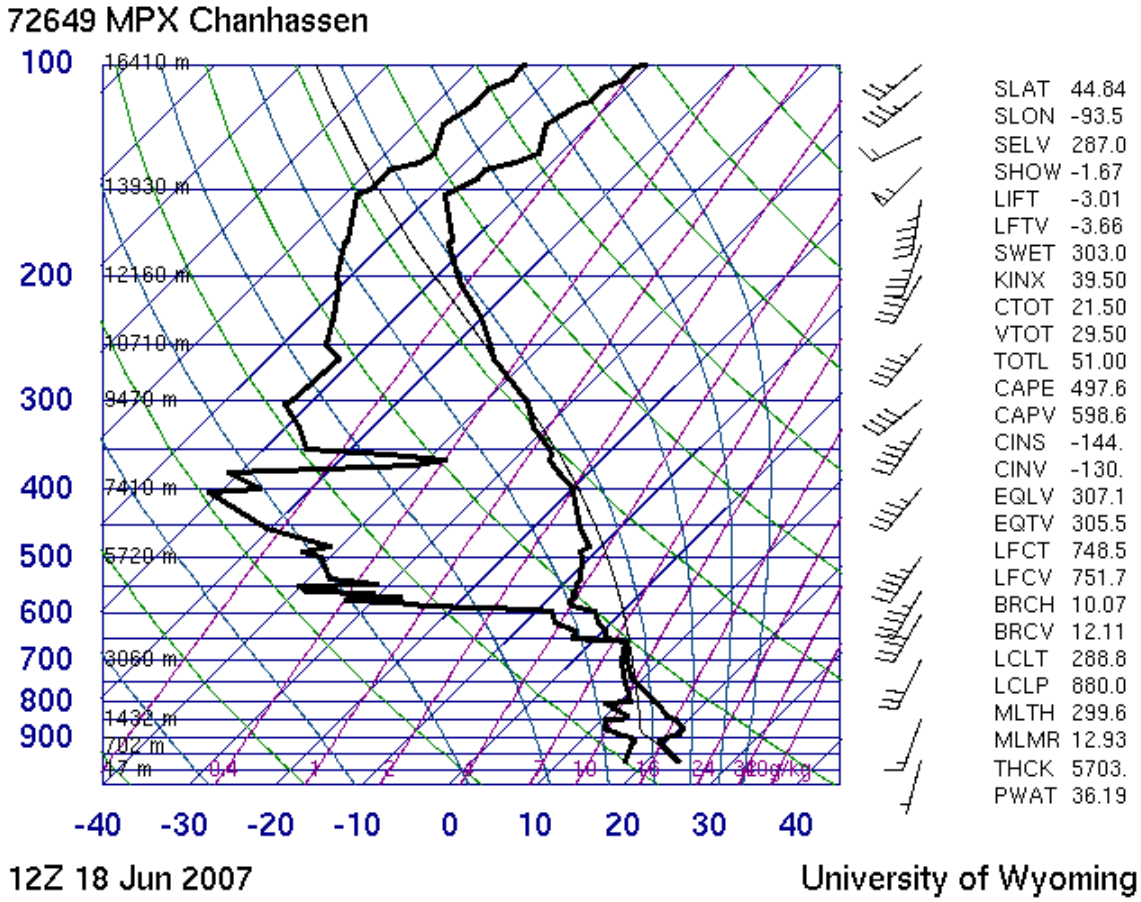

Figure 9 - An RSS sounding from Chanhassen, MN taken at 1200 UTC on June 18, 2007. The data appear physically unrealistic from 700 to 500 mb (sounding from the University of Wyoming upper-air web site).