Reconciliation of sensor height measurements

Steve Oncley and I are reviewing the measurement of sensor heights with the goal of perhaps reconciling ambiguities in the sensor heights.

Configuration 1 dimensions

The horizontal arrays sonic heights were measured relative to the mean of the heights agl of the reference marks for both the upwind (1.534 m) and downwind (1.53 m) arrays. The profile heights appear to have been measured relative to the height of the reference mark on the profile towere (1.52 m).

Configuration 2 dimensions

The reference mark height for all configuration 2 sensor heights was measured at the NE tower of the downwind horizontal array (goalposts) = 1.76 m. Sonic 1b at the NE end of the array was 1.91m+0.05m = 1.96 m above the reference mark and sonic 12b at the SW end of the array was 1.92m+0.05m = 1.97 m above the reference. Sonic spacing was 1.29 m.

The mean heights above the reference mark of the upwind sonics was 1.92m+0.05m = 1.97 m. The heights agl of the upwind reference marks or the profile reference marks do not appear to have been measured. Assuming a reference height of 1.76m for the horizontal arrays, gives array heights of 1.76 m+1.97m = 3.73m agl

Following are the new profile sensor heights.

nominal height	sonic*	+1.76+0.053m	+1.68+0.053**	SHT*	+1.76-0.37 m	+1.68-0.37 m**
3m	1.96m	3.77m	3.69m	2.36m	3.75m	3.67m
4m	2.90m	4.71m	4.63m	3.33m	4.72m	4.64m
5.5m	3.99m	5.80m	5.72m	4.43m	5.82m	5.74m

* heights above configuration 2 reference mark

**corrected reference mark height implied by continuity of 3m profile sensors through configurations 2-4 (see Discussion at end).

Configuration 3 dimensions

The reference mark height for configuration 3 was not measured agl, but was measured to be 15.2 cm below the reference mark for configuration 2 or 1.76 m-0.15m = 1.61 m. (BUT the height of the configuration 3 reference mark on the profile tower was later measured to be either 1.51m or 1.53m!) The heights of the downwind array sonic booms above the reference mark were measured to be

5b	6t(?)	6b	12b
3.254 m	3.252m (?)	3.250 m	3.275m

These heights were measured again on Aug 4 :

1b	5b	5t	7b	7t	11b	11t
3.263	3.262	4.260	3.261	4.264	3.262	4.264

for mean sonic heights of 3.262m+1.61m+0.053m = 4.93 m and 5.93 m agl. The heights of the upwind sonics appear to be 3.254m+0.053m+1.61m = 4.92 m agl.

The profile sonic (?) heights were measured on Aug 3 :

	8/3/08 boom hts*	+1.61m +0.05m	+1.51m +0.05m	+1.53m +0.05m
8m	6.468m	8.13m	8.03m	8.05m
7m	5.544m	7.20m	7.10m	7.12m
5.8m	4.256m	5.92m	5.82m	5.84m
4.8m	3.316m	4.98m	4.88m	4.90m
3.3m	2.110m	3.77m	3.66m	3.68m
1.5m	-0.026m	1.63m	1.53m	1.55m

Configuration 4 dimensions

There are several statements about the heights of the reference marks in this logbook entry. It is stated that the profile reference mark for configuration 3 = 1.505 m agl, but also that it is 0.027 m "above top of 1.55m sonic" (boom?), implying a height of 1.50m+0.027m = 1.53 m agl. Then it says the reference mark for configuration 4 is 0.040 m above the reference mark for configuration 3, which could be 1.65m, 1.55m or 1.57m agl.

The 1b sonic boom was measured to be 5.37m above the reference mark for configuration 4.

This logbook entry also measures the sonic and SHT heights wrt the 1.55m sonic boom. Note that these heights were not changed between configurations 3 and 4, and are consistent within 1cm of the last column of the preceding table.

nominal ht	sonic*	+1.55m	SHT*	+1.55m-0.42 m
8m	6.508m	8.06m	6.878	8.01
7m	5.582m	7.13m	5.886m	7.02m
5.5m	4.286m	5.84m	4.710m	5.84m
4m	3.352m	4.90m	3.749m	4.88m
3m	2.140m	3.69m	2.542m	3.67m
1.5m	0.0m	1.55m	0.376m	1.51m

- measured wrt the 1.5m sonic boom (at 1.50m agl)

Discussion

The 3m profile sensors were not moved through configurations 2-4, so that a discrepancy remains between the heights of the 3m profile sensors during configuration 2 (sonic:=3.77m and SHT=3.75m) and those for configurations 3 and 4 (sonic=3.69m and SHT=3.67m). This implies that the reference mark height for configuration 2, measured at the NE horizontal array tower to be 1.76m, did not apply at the profile tower, but should rather have been 1.68 m. (Note that simple transposing the last two digits of 1.76m gives 1.67m, which is within 1 cm of the implied value.) Kurt very carefully kept the baseplates of the 6 towers for the horizontal array at the same elevation using a 4' carpenters level and presumably did the same for the profile tower. It seems unlikely that there was an 8 cm difference between the elevations of the 7 AHATS Roan towers. Assuming 1.67m for the height of the reference mark for configuration 2 gives the following heights:

	Sonic 1	SHT 1		Sonic 2	SHT 2		Sonic 3	SHT 3		Sonic 4	SHT 4
reference ht	1.52m	1.52m		1.67m	1.67m		1.52m	1.52m		1.56m	1.56m
upwind	3.74/3.24	na		3.64	na			na		6.98	na
top	4.24	na		4.64	na		5.83	na		7.98	na
bottom	3.24	na		3.64	na		4.83	na		6.98	na
8m	8.05	8.01		unch	unch		8.04	8.01**		8.06	8.01
7m	7.08	7.01		unch	unch		7.12 *	7.02**		7.13	7.02
5.5m	5.53	5.47		5.71	5.73		5.83	5.84**		5.84	5.84
4m	4.24	4.23		4.62	4.63		4.89	4.88**		4.90	4.88
3m	3.30	3.26		3.68	3.66		3.68	3.67**		3.69	3.67
1.5m	1.55	1.51		unch	unch		1.55	1.51**		1.55	1.51

unch: Profile heights not measured for configuration 2, but same as configuration 1

Height changed for profile sensors at start of configuration

* 7m sonic moved up on Aug 3 at 09:41

** The configuration 3 SHT heights were not measured, but copied from configuration 4