

p' reconfiguration

We built a 26-liter volume out of 2 5' lengths of 4" ABS pipe, stuffed it with steel wool and buried it in the ground (after checking that there were no leaks). We disinterred the N2 cylinder. After the usual 2 hours, Pref has settled down. I <do> think the signal is better behaved than for any of the other volumes, however there still are fluctuations that are larger than the static pressure signal (by about an order of magnitude in the power spectra between 0.01 and 1.0 Hz).

I have attempted to despise the Pref signal (similar spikes don't occur on P for some reason) and "add" it back to get the "actual" pressure. This procedure undoubtedly alters the high-frequency information in the signal.

At Tom's suggestion, I also have computed a w/p' cospectrum with the resulting signal. This cospectrum looks <okay>, with a peak at 0.03 Hz for the last 30-min of data. There is some change of sign at high frequencies, indicative of a phase lag. I can mostly get rid of this by (arbitrarily) shifting the pressure data forward by 2 seconds. Again, my manipulation using Pref may be causing some of this, though there is a hint of a phase lag using the original p' signal as well.

The only explanation I can come up with is that much of the Pref fluctuations are still due to temperature changes of the 1/16" tubing. (I also am a bit concerned that the "curly" tubing on the "+" side of the ports could be filtering the real signal, but I've removed this from 6b and it agrees quite well with 7b.) Let's see: if 50 ml of tubing changes temperature by 5 degC connected to a 25 l reservoir at 300 K, the pressure change would be $(1000 \text{ mb}) * (5 \text{ K} / 300 \text{ K}) * (0.05 \text{ l} / 25 \text{ l}) = 0.03 \text{ mb}$. The standard deviation that I'm seeing is 0.015 mb now!

I can see 4 possible actions:

1. Keep the present configuration and hope that the tubing temperature fluctuations are not correlated with w (though other p' statistics might have errors). It would be best if we could get a better sensor (another 202BG) to monitor Pref, but our spare 202BG is now dead. (Should we sacrifice one of the 14?)
2. Treat the tubing so that the temperature changes are smaller. (This was the reason I chose clear tubing originally. Perhaps simply washing it would reduce temperature changes?) It isn't clear what else I could do (wrap it all in foil?).
3. Make an even bigger reservoir! (Home depot has lots of pipe!)
4. Rebuild the entire array with individual reservoirs. (How would they be made thermally stable? The reservoirs would have to be on the towers [and cause <more> flow distortion].)