Stability of temperature in Virgo Buildings

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Several times in the last two decades the effect of temperature stability on the interferometer and, specifically, on *superattenuators*, has been reported. In presentations at international workshops the side effects of temperature drifts have been reported in great detail, emphasizing the need of suppressing the downtime of HVAC system. In particular, achieving “good” accuracy in reducing temperature fluctuation is very relevant not to saturate suspension correction signals. Indeed, in some cases, major actions are required, readjusting sensor setpoints and overall mechanical position through motorized remote control. Such interventions imply interferometer duty cycle reduction, whose impact is small, but not negligible.

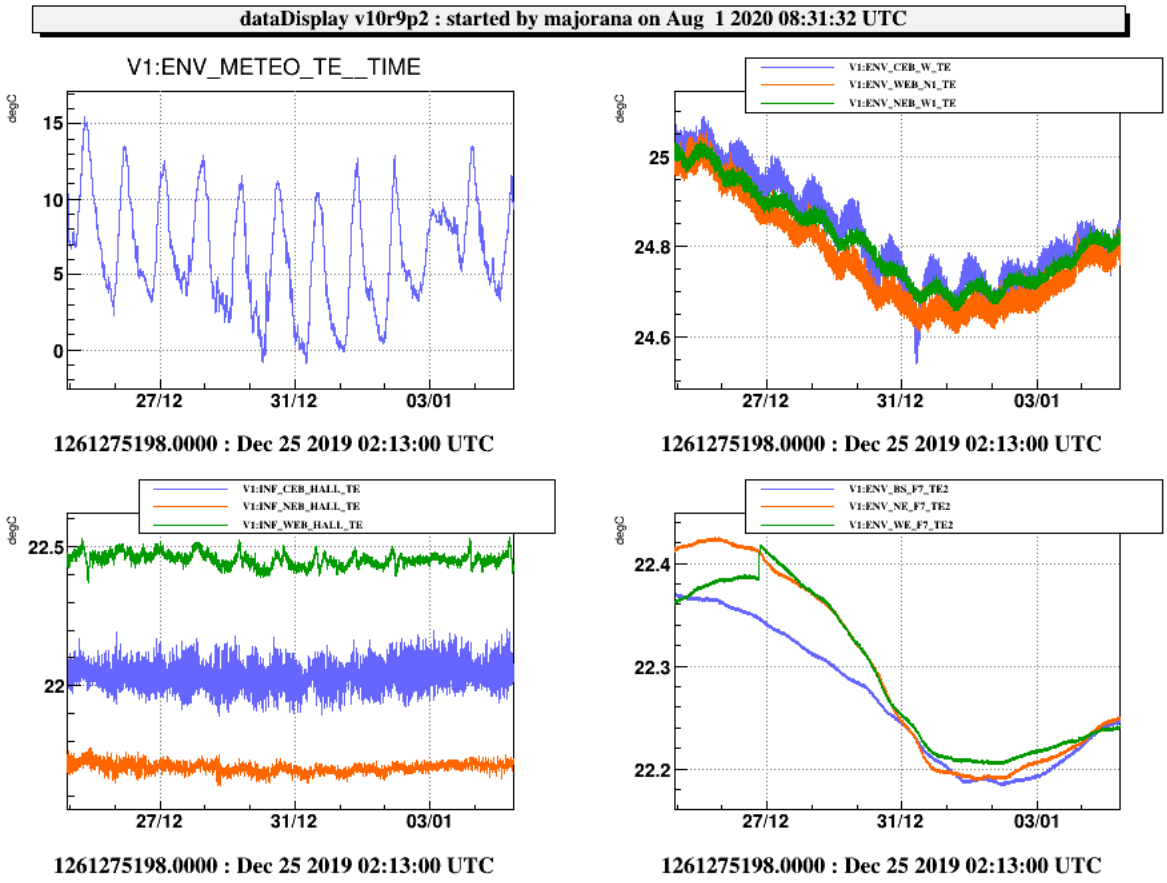

Fig.1: Up-Left, Meteo station on the roof of the central building (CEB). Up-Right, three sensors on the West wall of CEB, while WEW_N1 is one of the two sensor located at height 1 (~ 2m above the floor) on North wall of West End bld. Down-Left, one of sensors used by infrastructure monitoring. Down-Right, two temperature sensors per stage are distributed along the superattenuator chain; in the plot one of the sensor at the bottom of the filter chain is shown. There is a small absolute difference between buildings (~1. Cdeg), uninteresting for depicting the accuracy, in plot sets Up-Right and Down-Left the difference has been removed by normalizing to CEB values.

In Fig. 1 we see 10^6 s data chunk taken random-selected during O3. In Ref [1], the O3 overall environmental study is being reported, here we just focus on a time-series with the purpose of producing a reference figure. We observe a day/night fluctuation by 10 Cdeg that into the buildings is quite reduced (< 0.15 deg pp). Notice that a slow trend is present outside and sensed also by both environmental and suspension sensors with some delay. Its amplitude is larger, but still acceptable, given the time basis. Notice the accuracy inside the tower, on the suspension filters. In this case we see that day/night is negligible, while long-time-base fluctuation keeps laying in the 0.2 Cdeg pp.

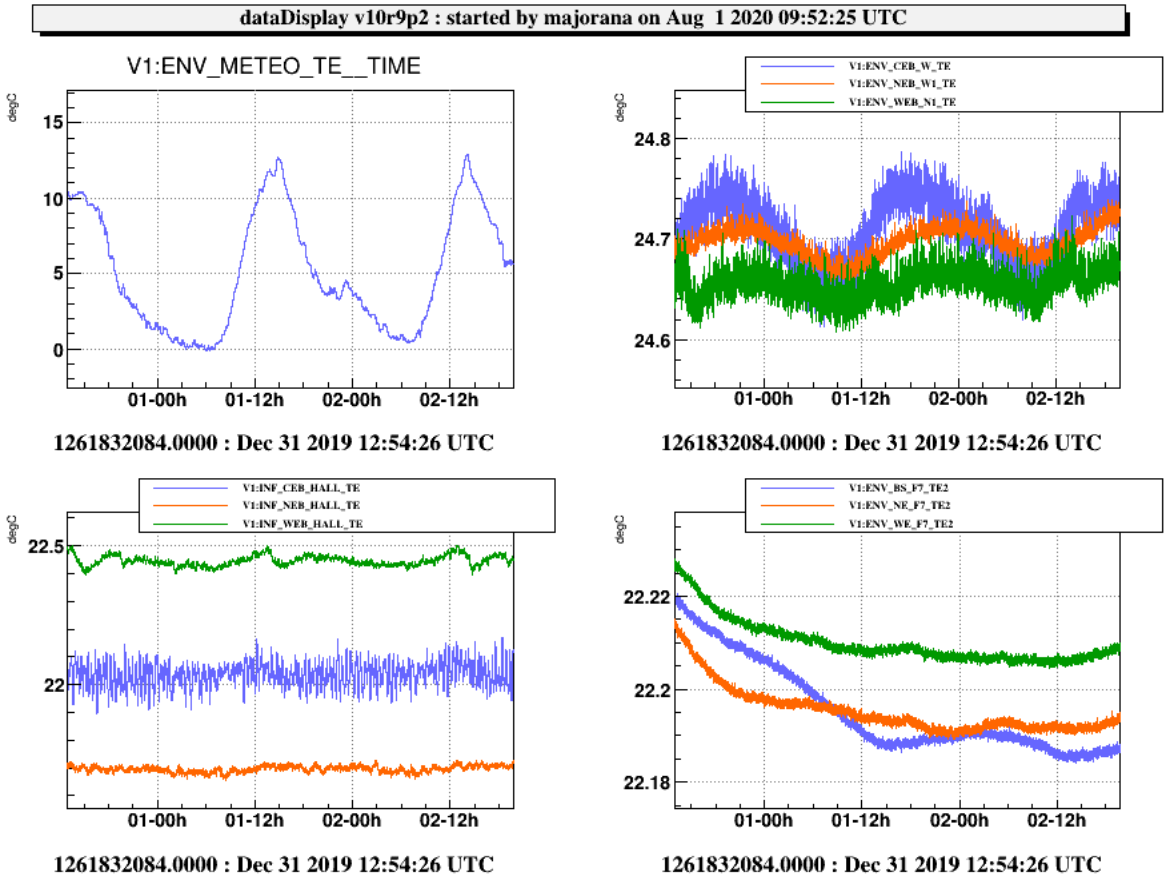

Fig. 2, the same as Fig.1, but zoomed on 2.5 days

[1] I. Fiori et al, 'Environmental noise studies for the Virgo O3 science run', VIR-0520A-20 (2020), https://tds.virgo-gw.eu/ql/?c=15645 , submitted for publication.