Reply

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(Manuscript received 1 December 2006, in final form 18 December 2006)

Lorenz's comments (Lorenz 2007, hereafter L07) on the radiosonde compass measurements are most welcome, and we are pleased to discover applications of our work to the exploration of other planetary atmospheres. Because of the broader context beyond terrestrial atmospheric science, a common motion sensor package applicable to many measurement platforms seems a thoroughly excellent prospect.

In the Harrison and Hogan (2006, hereafter HH06) system, our reason for choosing a small semiconductor magnetic sensor was primarily a result of the limited space available within the radiosonde. Second, the use of an analog output device avoided substantial modifications to the space-constrained radiosonde data acquisition system (Harrison 2005a), which, although it has been used with a single-channel digital device (e.g., Harrison 2005b), had already been produced in quantity as a standard system. One final consideration was that the SS490 Hall sensor had been successfully tested at temperatures below −60°C, and some sensor samples had even shown negligible temperature coefficients. Micro-Electro-Mechanical Systems (MEMS) gyro devices and fluxgate magnetometers would, however, clearly produce good alternatives for a second-generation instrument.

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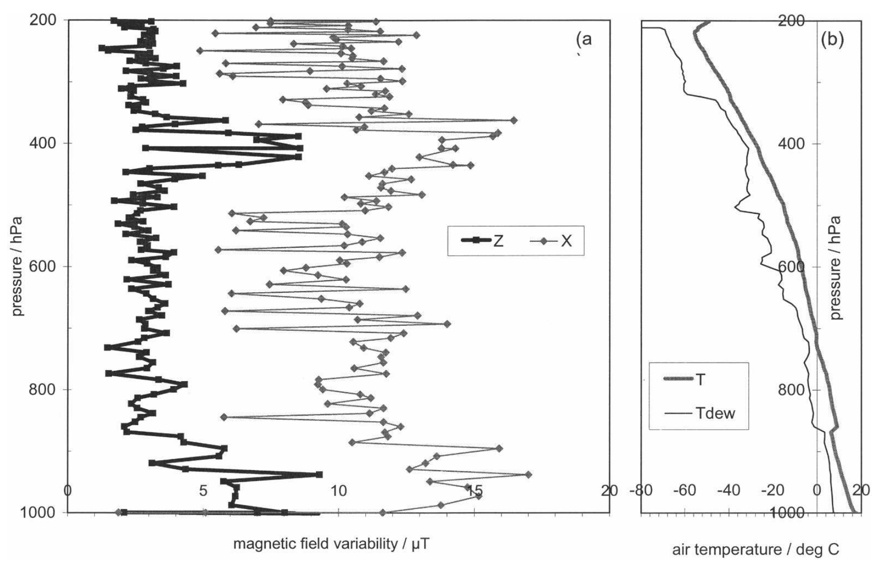

FIG. 1. Measurements obtained from a radiosonde carrying vertical (Z) and horizontal (X) geomagnetic sensors internally, with 1.7-m distance between balloon and radiosonde. The instrument was launched from Reading 0957 UTC 15 Aug 2006, when a layer of altocumulus cloud was observed from the surface. (a) Profile of standard deviation of Z and X direction magnetic measurements, using sequences of 32 measurements made at 0.3 Hz. (b) Air temperature (T) and dewpoint temperature (T_{dew}) as determined by the radiosonde's meteorological sensors during the same ascent.

DOI: 10.1175/JTECH2060.1

The simplicity in using the standard multiple channel analog data system has already permitted us to investigate the suggestion made in L07 for comparing vertically and horizontally aligned sensors. Figure 1 shows an ascent, which carried two Hall effect sensors using the same circuitry described in HH06: one aligned vertically (Z) and the other aligned horizontally (X). We calculated the standard deviation from a sequence of measurements and present a profile of variability in the X and Z data (Fig. 1a). It is clear from Fig. 1a that, as L07 argued, there is less residual variability in the Z data than the X data, because the X sensor is susceptible to spurious twisting. During this ascent, which lasted 1 h and 15 min, a layer of altocumulus cloud was observed from the surface. Turbulence associated with this cloud layer is thought to have generated the considerably increased X and Z variability measured around 400 hPa. (Fig. 1b shows that the air was relatively moist at this level.) While both X and Z sensors detected variability at this height, the Z sensor did so with less ambiguity. We doubt that the geographical variation in geomagnetism would have substantially reduced the ability to detect the enhanced variability, but there may be more marginal cases when this is less clear-cut.

In terms of calibrating the overall response to motion, while theoretical considerations and modeling are helpful, we agree with L07 that an empirical calibration is ultimately desirable. To this end we plan to launch further sensors within range of our cloud radar and compare the in situ and remotely sensed data directly.

Acknowledgments. This research was supported by the Paul Instrument Fund of the Royal Society. G. Rogers constructed the instrument sensors and S. D. Gill undertook the radiosonde launch.

REFERENCES

Harrison, R. G., 2005a: Inexpensive multichannel digital data acquisition system for a meteorological radiosonde. *Rev. Sci. Instrum.,* **76,** 026 103, doi:10.1063/1.1841971.

——, 2005b: Meteorological radiosonde interface for atmospheric ion production rate measurements. *Rev. Sci. Instrum.,* **76,** 126 111, doi:10.1063/1.2149005.

——, and R. J. Hogan, 2006: In situ atmospheric turbulence measurement using the terrestrial magnetic field—A compass for a radiosonde. *J. Atmos. Oceanic Technol.,* **23,** 517–523.

Lorenz, R. D., 2007: Comments on "In situ atmospheric turbulence measurement using the terrestrial magnetic field—A compass for a radiosonde." *J. Atmos. Oceanic Technol.,* **24,** 1519–1520.