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Magnetic field background variations can limit the sensitivity of seismic broad-band sensors

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Most broad-band seismometers are sensitive to variations of the earth's magnetic field. This is due to ferromagnetic properties of the suspension spring of vertical or homogeneously triaxial sensors. A sensitivity of pure horizontal sensors without suspension spring is not observed. The magnitude of the sensitivity and the direction of the component of the magnetic field to which the sensor is sensitive apparently depends on the production process and differs for individual instruments. In previous studies sensitivities from 0.05 to 1.2 $\mathrm{m\,s^{-2}\,T^{-1}}$ where observed for STS-2 instruments in the GRSN when referring their signals to the field of a magnetic storm recorded at BFO. Magnetic field induced noise in seismic recordings can be reduced by appropriate shielding of the sensor or by recording the magnetic field separately and removing its contribution posteriorly.

Hitherto we assumed that interferences due to variations in the magnetic field are limited to significant magnetic storms or to stations that are exposed to strong man-made magnetic fields. However, during a huddle test of T240 seismometers (Trillium 240 s, produced by Nanometrics Inc.) and an STS-2 (produced by Streckeisen) at BFO (Black Forest Observatory) it became obvious that the normal magnetic background variations during a magnetically quiet period can already significantly limit the sensitivity of seismic broand-band sensors. Analysing magnetic field recordings from January 2007 we find that sensors with a sensitivity larger than 0.2 $\mathrm{m\,s^{-2}\,T^{-1}}$ would not be able to resolve the NLNM (New Low Noise Model, Peterson 1993) between 0.5 mHz and 3 mHz (i.e. in the normal-mode band).

For this reason it is crucial to find appropriate means to ensure a low sensitivity to magnetic fields when designing and installing high-sensitive broad-band seismometers for the observation of normal modes.