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

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Abstract: Analysing magnetic field recordings from a quiet period in 2007 January we find that seismometers with a sensitivity to horizontal component of magnetic field larger than 0.2 m s-2 T-1 would not be able to resolve the New Low Noise Model (NLNM) between 0.3 and 3 mHz (i.e. in the low-frequency normal-mode band). In a previous study the sensitivity to magnetic field of stations in the German Regional Seismic Network (GRSN) was analysed. Only recently we became aware that this unwanted sensitivity can limit the resolution of some of these stations even during magnetically quiet periods. The situation will be even worse during less quiet periods and at other sites of the global network of broad-band seismometers since amplitudes of natural variations of Earth's magnetic field are likely to be larger at higher geomagnetic latitude. Vertical or oblique components of broad-band sensors which require a suspension spring can suffer from this since the springs are made from elinvar alloys. Elinvar alloys necessarily are ferromagnetic and magnetostrictive. It is thus crucial to use appropriate means (e.g. a permalloy shield) to ensure a low sensitivity to magnetic fields when designing and installing high-resolution broad-band seismometers for the observation of normal modes. Artificial sources of magnetic fields should be avoided in the vicinity of the seismometers. We demonstrate that even the small magnetic fields caused by supply currents in data acquisition systems can generate disturbances in seismic broad-band recordings. Although making use of invar and elinvar alloys too, the LaCoste Romberg earth tide gravimeter ET-19 and the invar wire strainmeters at BFO (Black Forest Observatory) are not limited due to magnetic field variations in their resolution for seismic normal modes.

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