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Broad-band seismometers in the extreme cold: what we learn from the observatory station CCD (Concordia, Antarctica)

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The seismological station CCD, located at Concordia (Dome C, East Antarctica) has been continuously operating since the year-round opening of the base in 2005. For the first two years, technical problems due to the extreme cold conditions (the seismic vault is at a constant temperature of -54°C) resulted in data whose quality was too poor to permit distribution. Since January 2007, after significant improvements, the data from CCD have been officially open to public distribution upon request to the operators. However, up to 2010, we have only been able to provide nominal seismometer responses along with the data, despite suspecting that the extreme cold could affect the characteristics of the instruments. Several attemps were made during the summer campaigns of 2008, 2009 and 2010 to perform an in situ calibration of the instruments, but were unsuccessful for various reasons, and finally, the first results came from the calibrations made in early 2011.

Two instruments were calibrated in 2011: an STS-2 running at -30°C (heated to come closer to the instrument specifications), and a T240 running at the ambient temperature of -54°C. We have found the response of the «warm» STS-2 to be near nominal, while that of the «cold T240» differs substantially from its nominal response. Furthermore, during the time period 2007-2009, the «warm» STS-2 was running alongside an identical but unheated STS-2, for which we attempted to make a relative calibration. Due to the much smaller excitation provided by natural signals, this relative calibration is by far less precise than a true active one, and does not provide reliable instrumental constants. However, no evidence was found for significant differences between the heated and non-heated STS2 seismometers.

In January 2012, a second set of in situ calibrations was performed, whose results will also be presented here.