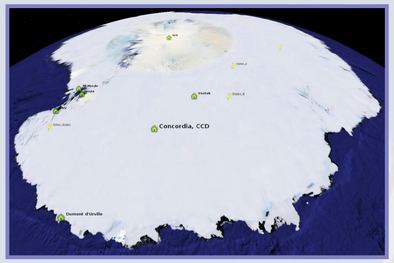
ConCorDia: a new, permanent seismological station in Antarctica

JJ. Lévêque(1), A. Maggi(1), A. Delladio(2), J. Burdin(1), JY. Thoré(1) & A. Morelli(3)

(1) Univ. Strasbourg & CNRS, France, (2) INGV Roma, (3) INGV Bologna, Italy

Concordia Permanent Station



Top : Concordia station in 2005.
Bottom: The two STS-2 seismometers at Concordia.

The Franco-Italian scientific base Concordia (Dome C, Antarctica) is also the site of an experimental permanent seismic observatory, which has been operational since 2005. The CCD station is located at 75.11°S, 123.30°E, and at altitude of 3240 m.

It is placed about 1 km away from the main buildings at Concordia base in order to reduce the impact of anthropic noise. The sensor, a Streckeisen STS2 seismometer, is installed in a vault, 12 m beneath the snow surface, where the temperature is stable over the year and close to –60 °C. The recording system, a Quanterra Q4128 data logger, is installed in a shelter on the surface, 50 m away from the sensors. The extreme temperatures present at the site have implied difficult operating conditions for the equipment in the past. During 2007, we experimented with moderately heating the seismometer niche up to –35°C, in order to get closer to the instrument specifications.

Some concerns we have ...

Since the very first tests at Concordia, low temperatures have been our main concern. At low temperatures, our seismometers often display unexpected signals of different kinds, of which "spikes" are the most common. These spikes look like the impulse response of a long-period seismometer. We report here how we retrieve information about the instruments from some of these spikes.

Fig. 1a displays a 3-component record of Jun 22 at CCD, and Fig 1b shows the same signal in terms of physical components U, V, W of the STS2 sensor. The spike-like perturbations seem to be caused by a single physical instrument, W.

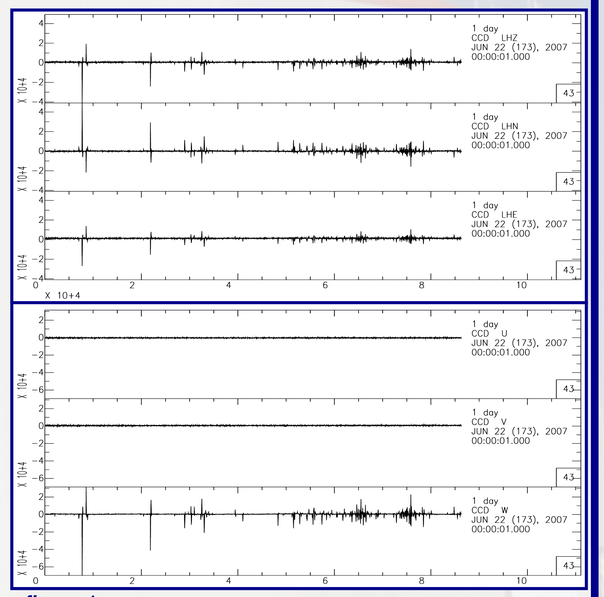


figure 1

Fig. 2 displays one of the spikes on the W component, and the fit obtained with an adapted impulse response. The values of eigenperiod and damping factor are significantly different from the standard ones for a STS2 (156s instead of 120s, and 0.647 instead of 0.707). Repeating the analysis for 12 spikes lead to periods ranging from 137s to 165s and damping factors from 0.599 to 0.667. No spike on instruments U and V means we have no information on their effective constants until we perform planned in situ calibrations.

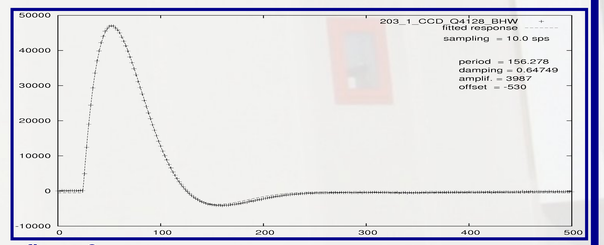
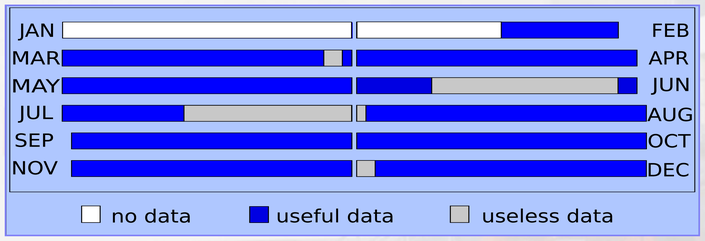
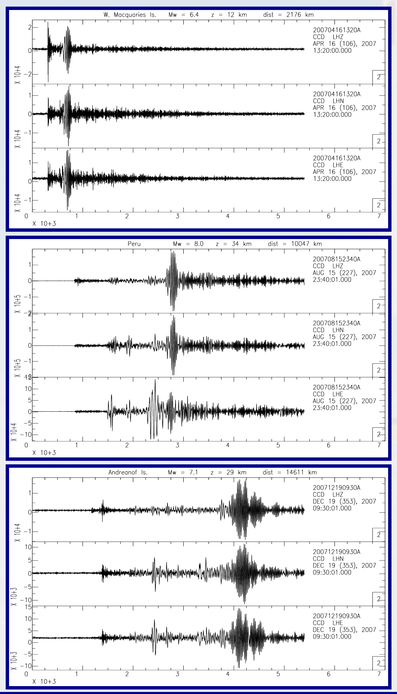


figure 2

Cold conditions and/or installation on snow seem to affect STS2 seismometers in at least two ways:
– occurrence of numerous spikes on certain physical instruments
– large changes in the eigenperiod and damping factor
Other kinds of perturbation exist too, but are not yet understood (by us).

Overview of year 2007 at CCD





The CCD station provided data for 318 days in 2007, of which 275 days contain useable signal. Lost days correspond to the beginning of the year, when sensors were reinstalled. Days of useless signal occurred mostly in June-July, in the depths of winter.

Thanks to this relatively good performance of the station, we have recorded 77 events that are directly visible on the LH data (1sps), corresponding to a detection threshold of approximately Mw = 6.3. As examples, we display events at three different epicentral distances.

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But ... things are not always as simple ...

A second STS2 sensor operated without heating (–60°C) suffered many fewer problems in 2007 than during previous years. In particular, in contrast with previous experiences, recentering operations posed no problem, and there are very few spikes in the data. However, the few spikes we have analysed from this sensor are clearly not caused by a single physical component. We look for other possible causes ...