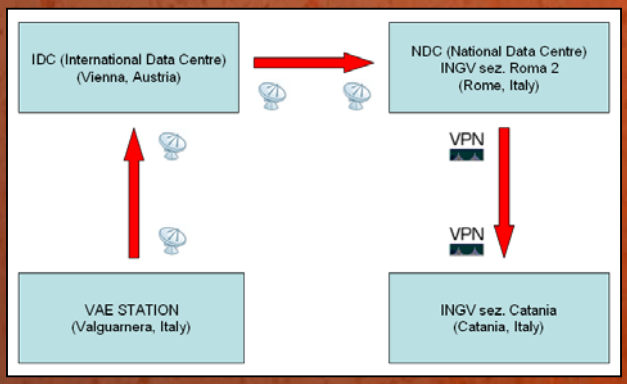
ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

Monitoring of Data Quality of the IMS Seismic Station AS050

H. Langer, A. Messina

Introduction

Continuous data acquisition, now frequent in many seismic networks, comes with the problem of accumulating huge data masses, in particular for waveform data (seismic, infrasound, hydro-acoustic). The problem is exacerbated by the complex transmission system necessary for a global network like IMS. In the context of the needs of CTBTO reliability and quality of data acquisition is a crucial issue. Severe malfunctions of the system (such as power failure, system hang-up, etc) can be easily detected, as these show up in large gaps of absent data or zeroes in the transmitted data packages. Other problems, not so evident but nonetheless seriously affecting data availability , arise when data transmission is disturbed to some degree, causing short term and intermittent disruptions which may easily escape the attention of the operators.

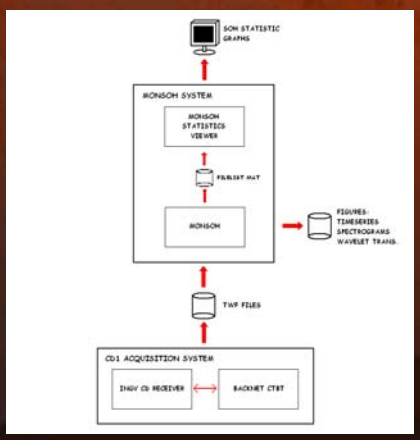


Data Transmission

Data transmission from the site to the observatory follows a chain via Vienna and the NDC in Rome. Unfortunately each step is subject to possible disturbance: VSAT transmission quality depends critically on meteo-conditions, other effects like vegetation at the site, dust or snow on the VSAT dish may affect the transmission, too.
The connection between NDC and CT uses a VPN, which is cost-effective but becomes sometimes instable for various reasons (general network conditions, load, etc.).
The complexity of the transmission chain means higher risk of data flow interruptions with varying duration. In particular, short breaks in the data flow easily escape the eye of the operators. On the other hand, many of these short disturbances may be cured by a suitable configuration of our CD receiver software - for instance, choosing a longer time window, in which the receiver requests the re-transmission of missing or corrupted data.

The MonSOH Software

The acronym MonSOH stands for **Mon**itoring **S**tate **O**f **H**ealth in near real-time. It exploits the TWF files created by the INGV CD1 Acquisition System.
MonSOH provides the following parameters:
a) Data Coverage, which stands for data (non-null or null) available in a time interval.
b) Non-Null Data that gives a rate of valid data distinguishing them from the null ones (packets containing only zeroes).
c) Missed Packets referred to the rate of packets transmitted by the VSAT instrumentation of the station but never arrived at the obervatory.

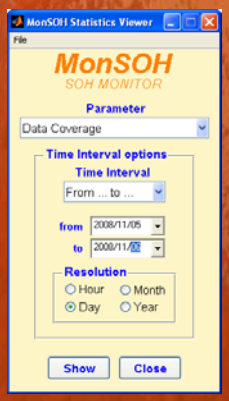


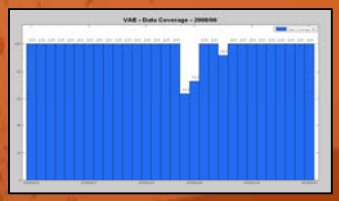
Besides this checks MonSOH provides a suite of images for visual inspection and validation of the quality of the recorded data. The production of the images is performed continously covering time sequences of 1 hour. The information produced by MonSOH can be accessed in two modes: (i) using the MonSOH Statistics Viewer, (ii) Inspectioning of the images (Waveform Inspection).

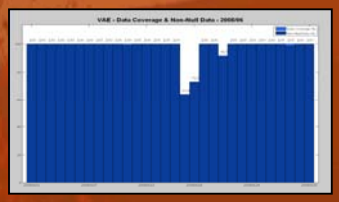
The MonSOH Statistics Viewer

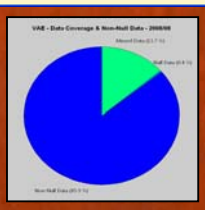
This tool offers a number of options, by a simple graphical user interface, for the creation of the statistical figures. The station operator can query the system specifying the parameter, the period of time and the time resolution of interest. Depending on the request the MonSOH Statistics Viewer creates bar plot or pie plots.

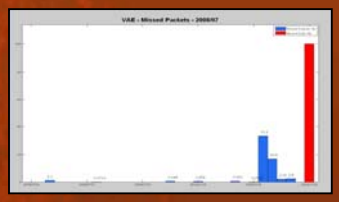
These figures concern (a) the data completeness for a specific period, (b) the occurrence of small intervals with no data (Null Data) (represented by some bars filled under 100% of data coverage), (c) the missed packets rate distinguishing it from periods of transmission down (represented by red bars).







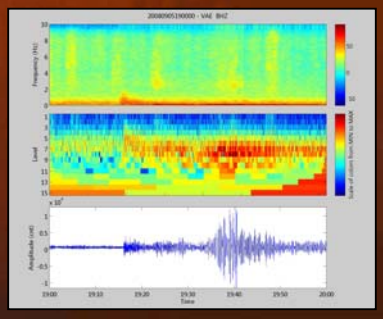




MonSOH Waveform Inspection

MonSOH creates continuously images of the signals of VAE. Besides showing the crude time series we have adopted two different techniques for the representation of the spectral content of the signals and its temporal evolution, i. e., the classical spectrogram technique applying short time Fourier Transform in a gliding window scheme, and the Discrete Wavelet Transform.

It is well known that band limited transients may not be visible in the crude time series, but can be easily recognized in the spectral images. The images allow an effcient over. view about the signals observed at the station. The operator can detect interesting signals as well as various disturbances of data acquisition.



Wavelet transform fixes the problem of the limited time resolution of the classical spectrogram method. The example shown below is affected by a data gap of 200 samples (red circle). This gap becomes clearly visible in the Wavelet tansform, whether it can hardly be recognized in the crude time series neither in the spectrogram.