GeoWatch

December 2007, Issue 34

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Keynote: GeoSIG Celebrates 15th Year

We are proudly celebrating our 15th year.

Within these 15 years, starting from a vision, we have strongly grown to a large, well-known, worldwide family with all of our customers, representatives, affiliates, employees and suppliers. We believe that it is our family that brings the best out of us by encouraging, demanding, listening, questioning, teaching, learning, researching and most importantly responsibly valuing all that we are standing for. Many of our liaisons are more than just business links which enabled GeoSIG to deliver optimum products, solutions and services with the best value regarding any specific requirement.

With this opportunity we would most frankly like to thank to everyone that have contributed to the development and strength of this family and its continuing success towards many new endeavours.

We like to smile with you…

Earthquake Monitoring System Above 3'200 m Altitude, Lake Sarez, Tajikistan

A massive landslide triggered by a strong earthquake in 1911 became a large dam along the Murghob River in the Pamir mountains of Tajikistan, now called the Usoi Dam. Lake sarez is the resulting lake that is formed above surrounding drainages at an elevation greater than 3200m. The lake is about 56 km long, 3.5 km wide and 500 m deep, which holds an estimated 17 km^3 of water.

Over the years it is believed that the natural dam soil has become permeable and its stability has worsened. In addition the area experiences considerable seismic activity and scientists fear that part of the right bank may slide into the lake, creating a huge wave that will top over and possibly breach the natural dam. Impact projections suggest that the flood could affect roughly five million people living along the Bartang, Panj and Amu-Darya rivers, a path traversing Tajikistan, Afghanistan, Uzbekistan and Turkmenistan.

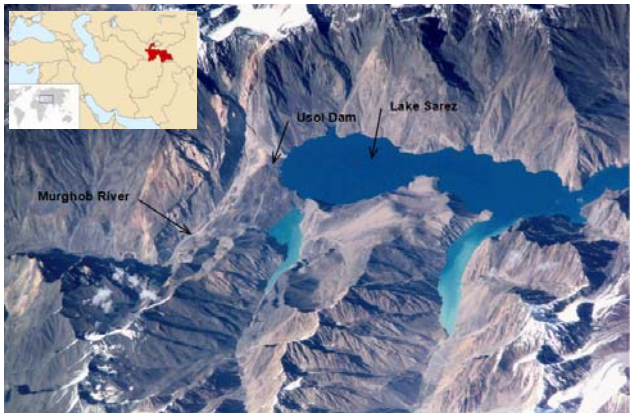


Figure 1. General view of the Usoi Dam and Lake Sarez

Over the years it is believed that the natural dam soil has become permeable and its stability has worsened. In addition the area experiences considerable seismic activity and scientists fear that part of the right bank may slide into the lake, creating a huge wave that will top over and possibly breach the natural dam. Impact projections suggest that the flood could affect roughly five million people living along the Bartang, Panj and Amu-Darya rivers, a path traversing Tajikistan, Afghanistan, Uzbekistan and Turkmenistan.

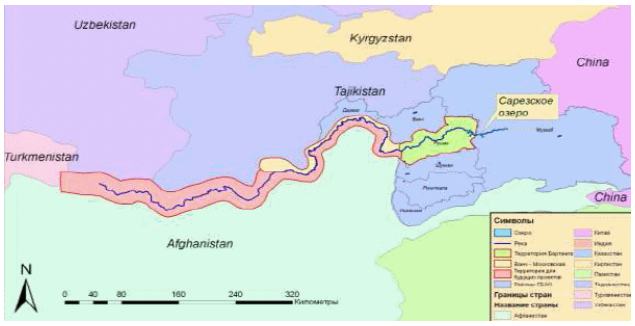


Figure 2. Vulnerable Regions Along the Bartang, Panj and Amu-Darya Rivers

Special equipment for monitoring the situation around Lake Sarez in eastern Tajikistan is now installed using funds granted by the Government of Switzerland, a step to ensure early warning for the vulnerable population in the region. The design of the system was established by STUCKY Ltd. The overall implementation of the instrumentation was taken over by the FELA Planungs AG, whereas GeoSIG has supplied the seismic instrumentation part.

The system is projected to:

- identify the beginning of an outburst flood or a substantial increase the danger,
- send a signal that will trigger alarms in the most vulnerable villages (approx. 15) below the dam, and
- provide long-term data needed to understand better the technical options for reducing the likelihood of a flood.

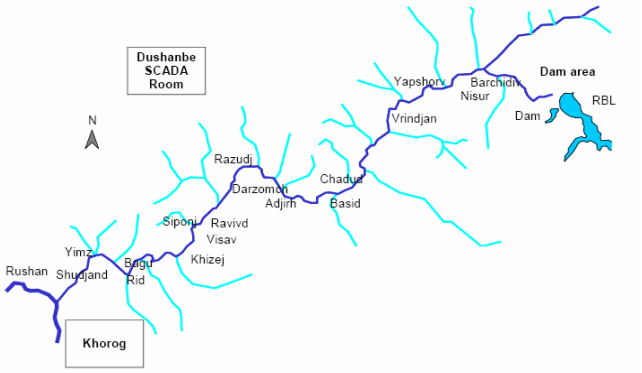


Figure 3. Vulnerable Villages Below the Dam and System Centres

Within the system GeoSIG has supplied three Strong Motion Accelerographs consisting of customised GSR-18 strong motion recorders with GPS receivers and AC-63 accelerometers.

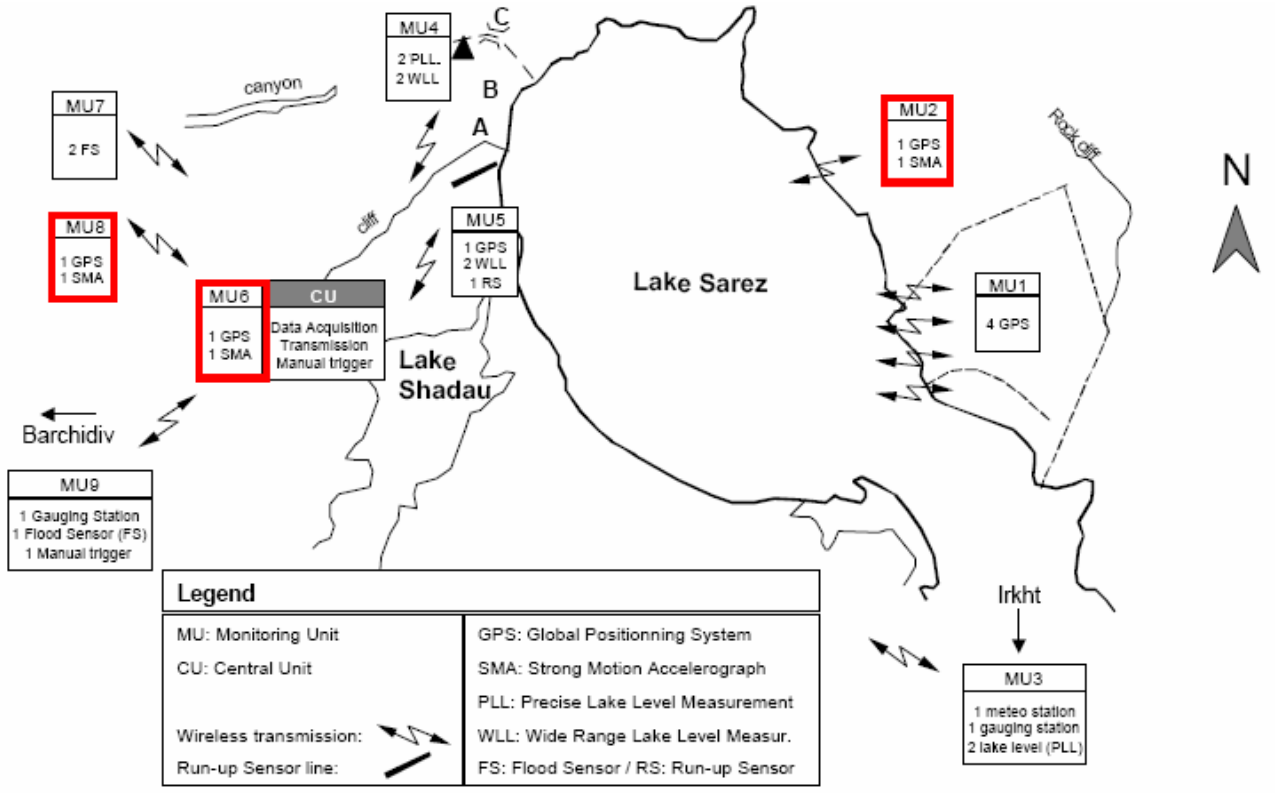


Figure 4. Overall System Topology

The Strong Motion Network is installed upon the dam and its vicinity for the time dependent recording of accelerations due to earthquakes in 3 orthogonal directions. One station is located in the Dam house, one is located on the right bank of lake Sarez and one is located on the left side of Usoi dam. The strong motion stations and their batteries at the MU2 and MU8 locations are installed in two thermo-sealed concrete housings their GPS being mounted outside and required power autonomy achieved by Solar Panel.

Figure 5. Strong Motion Station in Special Thermo-Insulated Housing

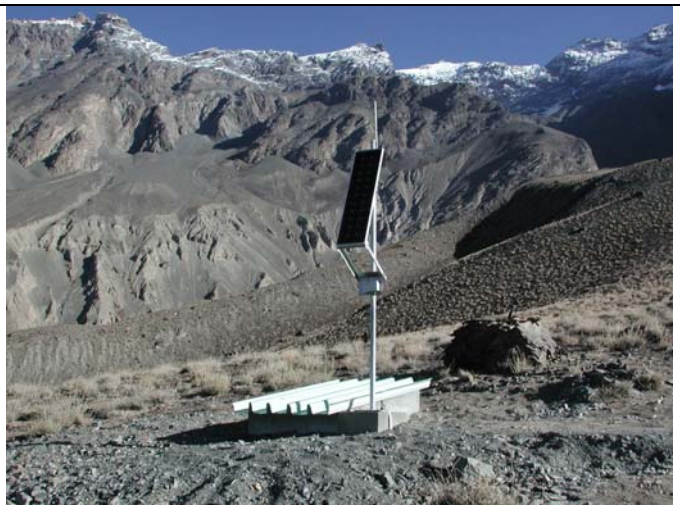
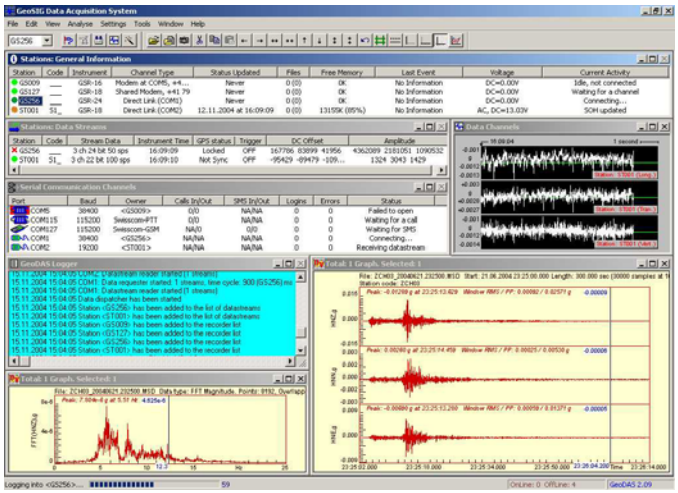


Figure 6. Finished view of MU2 station complete with Solar Panel

Latest Features and Improvements in GeoDAS

GeoDAS is the state-of-the-art graphical Microsoft Windows-based application running under Windows 9x/2000/NT4/XP.



Although it is a very well-known software for numerous industry professionals utilising GeoSIG equipment, a short overview would enable all to grasp the capabilities, multifunctional character and potential of this software.

Overview and Standard Features

GeoDAS is used for instrument configuration and for acquisition of data provided by any standard GeoSIG instrument. Data is delivered through serial communication channels. Two types of data delivery are supported. The first type is event downloading. In this case the instrument is configured as a seismic recorder, which detects events and keeps them locally in the instrument memory. These files are transferred to the PC via telephone line or direct link to GeoDAS. The second type is a continuous telemetry link or direct connection via cable providing near real-time data from the instrument, which is configured as digitiser in such case. If the serial channels to an instrument are bi-directional ones, GeoDAS can perform full configuration of the remote instrument and can monitor its state of health. GeoDAS is mainly intended for serving several instruments at the same time. The instruments may have different types and parameters and they are accessed through independent serial channels.

General Tasks of GeoDAS

- Setup of an instrument. One can change any parameters of an instrument with GeoDAS.
- State of health (SOH) monitoring. GeoDAS performs permanent or periodical monitoring of an instrument status.
- Downloading of the event files from an instrument working as a recorder
- Off-line event data view and simple data analysis
- Support for serial data streams (GSBU GeoSIG-Bergen and CWB or IASPEI formats)
- Logger features. GeoDAS keeps important messages in a log file.
- Real-time data viewer for an instrument, which provides serial data stream.

GeoDAS has been designed to meet all requirements with respect to almost every possible application. The program has an open architecture not only for multiple local recorders connected to the standard serial port, but also for networking of local recorders, supporting modem and network communications, including communication via Internet (TCP/IP protocol). These features provide flexible interfacing between GeoSIG recorders and users irrespective of how far they are located from each other.

In addition to the features above, GeoDAS allows all the Windows standard functionality to be used in an easy and intuitive way. It provides a perfect software interface between users (operators) and hardware based on GeoSIG product line.

With GeoDAS one can set any configuration of GeoSIG recorders, which is supported by current versions of hardware. Furthermore, the program keeps compatibility with the previous versions of GeoSys recorders based on GSR-12/16. GeoDAS supports data exchange between the recorders and the PC both in interactive and automatic modes of operation.

GeoDAS offers also special functionalities, which are required for particular applications and which can be activated in some special cases only.

Advanced Features

Data Analysis

The Data Analysis part of GeoDAS has been developed by GeoSIG especially for the strong motion, earthquake engineering and civil engineering data analysis and preliminary seismic analysis of recorded data. The following math operations are performed:

- Average values
- Frequency domain filtering
- Lowpass filtering
- Highpass filtering

- Baseline correction
- Integration of the signal to get the velocity and displacement
- Vector Sum
- Cumulative Absolute Velocity (CAV)
- Time domain filtering (Parzen, Hanning, Welch, Hamming)
- Effective Value (DIN 45 669)
- Damping and Eigenfrequency
- Power Spectrum calculation
- Fast Fourier Transformation (FFT)
- Terzband Spectrum calculation
- Response Spectrum for any damping in acceleration, velocity and displacement
- A sequence of operations

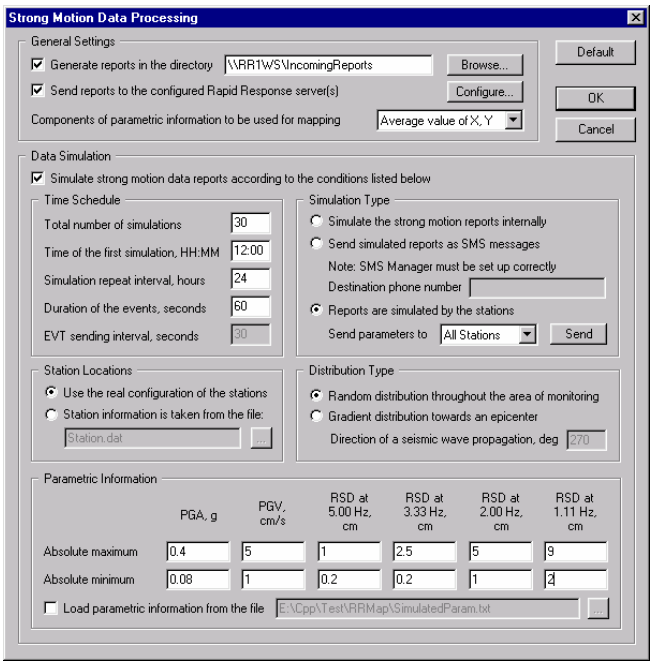
All the operations listed above are performed with the Off-line Data Viewer in a way that a user can see the result of every operation in the graphical format

Strong Motion Data Processing

Various GeoSIG instruments can provide parametric information containing the peak values (i.e. PGA peak ground acceleration, PGV peak ground velocity) and spectral characteristics (i.e. SD peak spectral displacements at different fixed frequencies) of the measured earthquake shaking.

This information can be used to estimate the intensity of the shake in those points where instruments are located and to create a distribution of these parameters throughout an area that is monitored by several instruments. The processing of the information is performed by another application provided by GeoSIG (i.e. Rapid Response Mapping application (RRmap); please contact GeoSIG Ltd. in case of any questions related to this application) or any other compatible software. Therefore GeoDAS is responsible to acquire the parametric information from all configured stations and to deliver this information to the processing application.

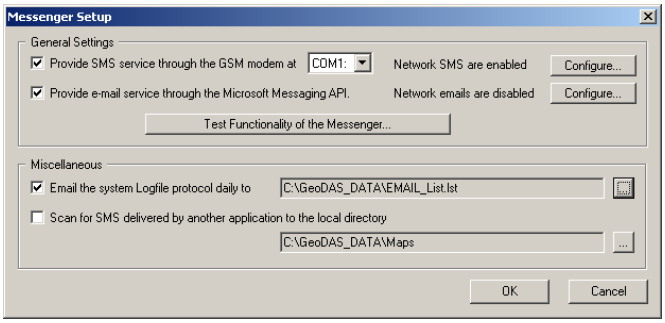
For a processing application, it is important to provide event simulation options for testing the system periodically. However testing data with useful parametric information can seldom be generated if not simulated; i.e. one can not wait for a real earthquake to happen.



GeoDAS lets the user to simulate the system functionality in a flexible and scheduled way which enables the user to create internal reports for testing the data processing algorithm, to send these reports out for testing the communication links and to send the simulation parameters to the field instruments which should perform the simulation at specified time for testing the functionality of the field instruments. The simulation options also include a selection of shaking distribution type and direction of seismic wave propagation, lower and the upper limits for parametric information. If it is necessary to provide some fixed customised parametric information for simulation, the user can also use a text file containing this information for all configured stations.

Messenger of GeoDAS

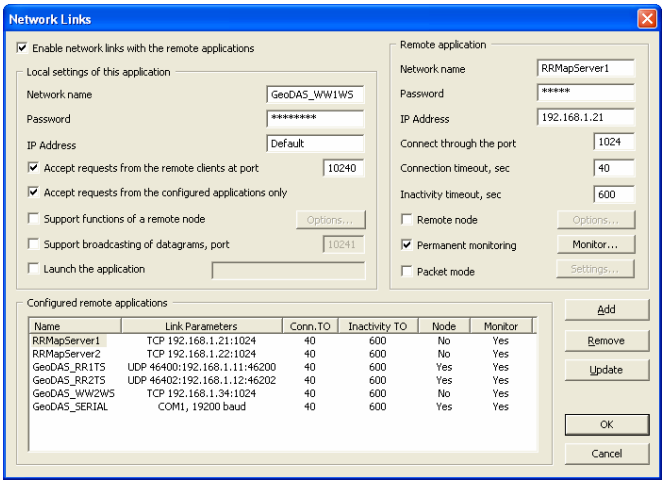
This is a tool, which is used to deliver different types of information from GeoDAS to the subscribers. Two ways of delivery are currently supported: email and SMS (short message service).



Messengers of the different instances of GeoDAS located in the different computers can exchange the data. Those messengers, which do not have the corresponding services enabled, still can send the emails and SMS by forwarding them to the "master" Messenger. Usually GeoDAS receives the SMS directly from GSM modems. But SMS can also be delivered in any other way, for instance, received by another application through the FTP or HTTP service and dumped into files from where GeoDAS picks them up. The functionality of the Messenger can be tested at any time.

Network Links of GeoDAS

GeoDAS can communicate to other instances of GeoDAS as well as to other applications developed by GeoSIG through Windows sockets.



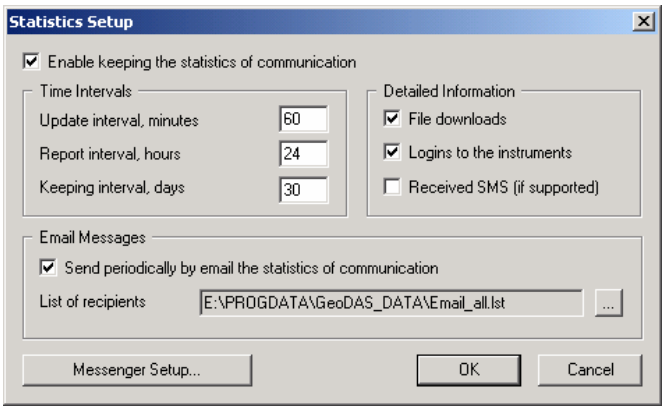
This features allows GeoDAS to,

- accept the requests from remote instances of GeoDAS and/or from other applications,
- support broadcasting of datagrams to forward the information provided by data streams to the remote applications,
- launch an external application that can be a communication utility or any other program required to be working when GeoDAS is active. GeoDAS monitors the status of this application and restarts it in case it is terminated due to some reason

- make the following different GeoDAS services available for the remote clients:
  - Monitoring State of Health (SOH) of the configured stations
  - Downloading events and ring buffer files
  - Requests for statistics of communication
  - Real time data streaming
  - Remote configuration
- activate the feature of permanent network monitor for the current application.
- utilize Packet Mode of communication over the network channel via UDP protocol rather than TCP.
- specify the details of network communications between several program modules that support networking features.

Statistics of Communications

GeoDAS can acquire some statistical information while communicating to the configured stations. This information can be used to optimise communication parameters for the purpose of debugging. The acquired information can be viewed, kept in a file and sent to email recipients.



Statistical information acquired consist of:

- The unique station name,
- Number of successful logins to the instrument,
- Total time spent logged in to the instrument,
- The number of downloaded files and their total size,
- The rate of data transfer from the instrument,
- Minimum/maximum/mean waiting time for a free communication channel to lock it and get an access to the current station,
- Minimum/maximum/mean waiting time for dialling out,
- Number of failed attempts to login to the instrument,
- Number of event detected (EVT) messages received,
- Number of event completed (FIL) messages received,
- Number of state of health (SOH) messages received

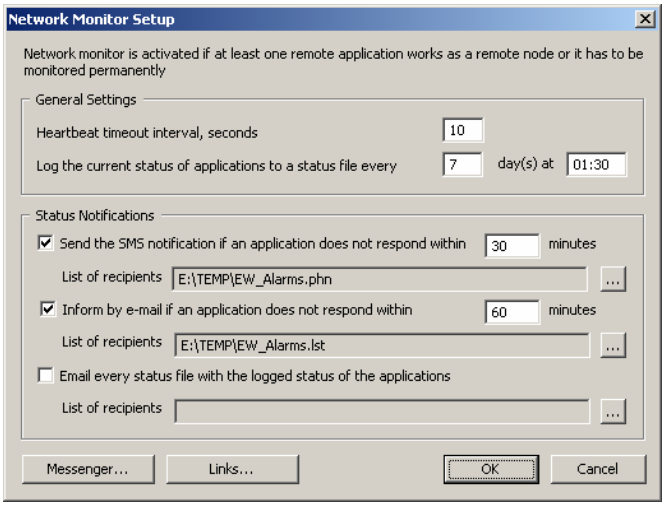
Network Monitor

The Network Monitor is used in multi-computer configurations only. A GeoDAS application installed as monitor can control remote GeoSIG applications and can provide general information about them to the subscribers by email and/or by SMS messages.

It is possible to restart a remote application or even reboot a remote computer using the Network Monitor.

The Network Monitor periodically checks the status of remote applications at selected time intervals. The status information is also logged to the status file. Enhanced information consisting of the following details are displayed, monitored and logged:

- The name and colour coded status of the remote application,
- Parameters identifying the link to remote application,
- Time of the last restart of the application,
- Time of the last response from the application,
- Number of the modules of the monitored application, which communicate over the network,
- Number of connections, which are currently active,
- The percentage of the free memory,
- The total amount of physical memory and the amount of free memory available,
- The total amount of virtual memory and the amount of the free virtual memory available,
- The total amount of HDD space and the amount of the free space available,
- Current rate for incoming and outgoing data over the link
- Current state of the system flags at the remote application, if supported
- Status of the monitored application: Online, Offline, Error.



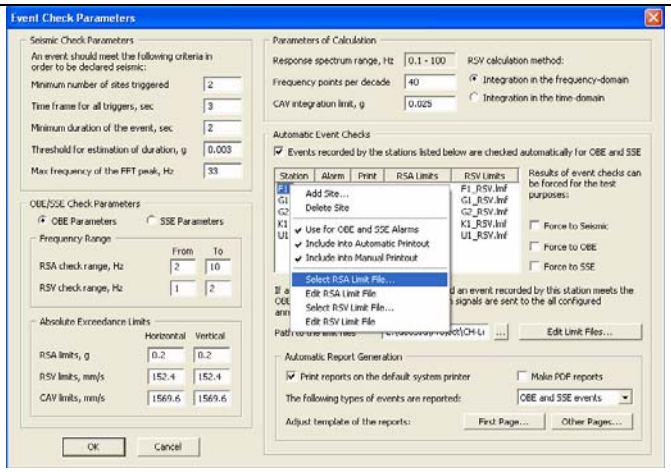
The Network Monitor can send information about monitored applications by email and/or by SMS if the corresponding services are supported and enabled. You can select to send an SMS notification message if any monitored application does not respond within the specified time interval. The same notification can be send by email also with more detailed information attached. The status of applications can be also send by email periodically.

Event Checks

The event files are analysed by GeoDAS in order to check whether they can be declared as seismic ones and whether they meet the Operating Basis Earthquake (OBE) and Safe Shutdown Earthquake (SSE) criteria. These checks are required for the applications of especially the Nuclear Power Plants (NPP) seismic instrumentation. The main role of such instrumentation is the prompt evaluation of seismic response of the safety-significant plant features after an earthquake. The analysis parameters are selected based on the following Standards and the Regulatory Guides:

- NRC Regulatory Guide 1.12, “Nuclear Power Plant Instrumentation For Earthquakes”, Revision 2, March 1997
- NRC Regulatory Guide 1.166, “Pre-earthquake Planning and Immediate Nuclear Power Plant Operator Postearthquake Actions”, March 1997
- EPRI TR-100082-T2, “Standardization of the Cumulative Absolute Velocity”, December 1991

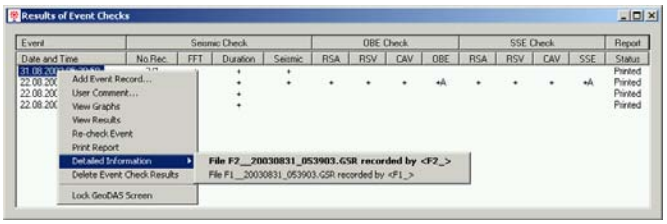
The parameters specified are used for both manual check of single even files and for automatic check of the group of event files provided by several stations and declared as the single seismic event. Very flexible configuration of these parameters allows to user to conveniently define seismic event checks (to determine whether an event is a seismic event) and to efficiently check any seismic event against OBE and SSE criteria.



Several important parameters used for calculation of the response spectrum acceleration (RSA), response spectrum velocity (RSV) and the cumulative absolute velocity (CAV) as these data used in the Boolean formula for calculation of OBE and SSE. Furthermore other check parameters specify two sets of frequency ranges and the absolute limits for OBE and SSE.

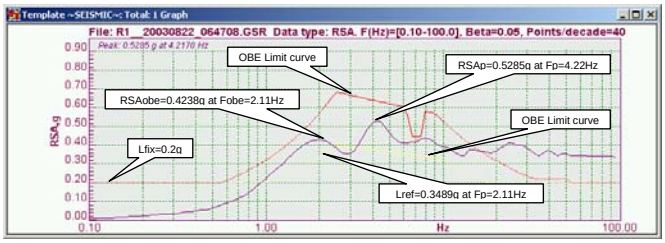
The event meets OBE or SSE criterion if at least one CAV component exceeds the specified limits and if at least one component of RSA or RSV exceeds their limits within the specified frequency range interval. The limits are set separately for horizontal and the vertical components.

The results of event checks can be forced to be positive for the testing of the system.



It is also possible to make PDF reports automatically if the appropriate third-party printer emulation software is installed. Several features of this printout, such as title and the logo can be modified and they can be different for the first and for next pages of the report.

Any event file can also be checked manually whether it meets the seismic and OBE/SSE criteria. The general information stored in the header of a selected data file will be displayed and the brief results of the checks are displayed. Optionally a graph window containing the RSA, RSV and CAV curves with the corresponding limits as well as the original waveforms is created.

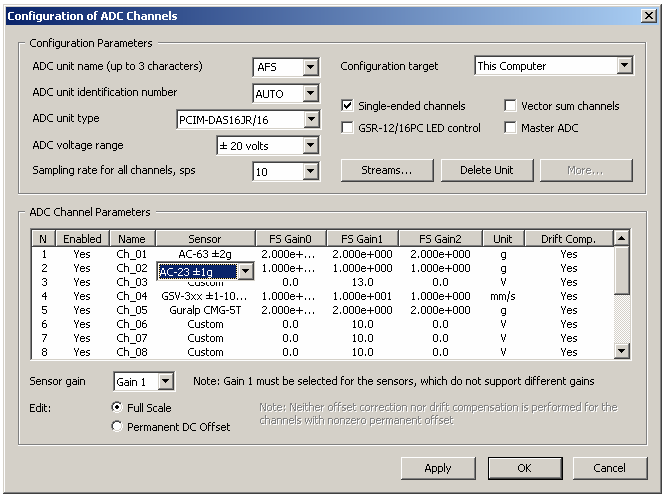


Station Map

If there are many stations configured, it might be useful to prepare the map showing the area where they are located. GeoDAS can display this map upon request. Such map is plotted on a general image format map (e.g. jpeg) by converting the graphical offsets in the image to the real latitude and longitude

Support for ADC boards

GeoDAS, if purchased accordingly, can acquire data directly from an industry standard A/D converter board. GeoSIG Ltd. has developed a computer-based seismic recorder named GSR-16PC, which utilises such types of A/D converter. For more information regarding GSR-16PC product please refer to the corresponding hardware manual or datasheet.



In most cases the configuration of ADC units and channels is edited locally, i.e. in the same computer where ADC units are installed. But there is also a possibility to configure ADC units in the remote instances of GeoDAS if they are configured as remote nodes allowing the remote configuration. This is achieved by the Network Links of GeoDAS.

If several boards of the same type are served simultaneously, the user can connect the clock output of the master board to the external clock input of the other board(s), which would ensure synchronisation between them with the precision of one sample.

Optionally it is possible to simulate an additional channel for every three-channel station, as the vector sum, which is a square root of the sum of the squares of the three channels.

For each channel it is possible to define the following parameters:

- Whether it provides data to the acquisition system or not,
- Channel name,
- Connected Sensor and its full scale,
- Full Scale or DC gain,
- Units,
- Drift Compensation

Furthermore, it is possible to adjust trigger settings and some other parameters for processing of data streams. Note that it is possible to edit both local and remote sets of parameters depending on the type of configuration currently selected. But there are exceptions: options of the data forwarding, messages and notifications and the target communication port for the Early Warning alarm messages cannot be adjusted remotely.

The acquisition and processing of the data provided by ADC channels is very similar to processing of the data streams delivered by the standard GeoSIG instruments, such as GSR-18/24 and GBV. Several little differences are listed below:

- Synchronisation with the GPS time is not currently supported,
- The data packets are never lost,
- Recording of the sensor test pulse files is only possible for some ADC units,
- Event files recorded form the data streams provided by ADC units do not contain some instrument-specific information, such as battery voltages, errors and warnings, location information, etc.

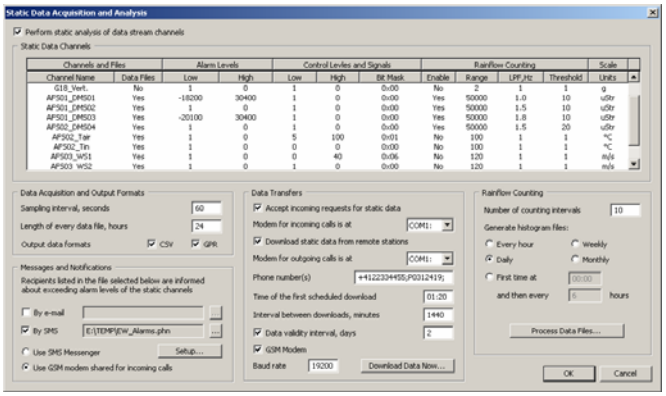
Similar to the data streams from standard instruments, both permanent and the event-based recording of data are possible for ADC channels. Also the filing system is compatible with the standard GSR event files; the enabled data channels of any

configured ADC unit are split into the groups of three channels, which appear in the Data Streams information window as 'stations' with the names consisting of three-character unit name and trailing numbers 01, 02, etc. Three first enabled channels are assigned to the station 01; three next enabled channels are assigned to the station 02, etc.

Static Measurements

If GeoDAS is configured to work with data stream channels, all or some of these channels can be configured for static measurements. The term 'static' does not mean that the signal decimated and delivered by such channel is constant. It changes but rather slowly, so it can be sampled with a time interval of several seconds, minutes or even hours. A typical example of static data is the air temperature. While dynamic data are very often high pass filtered to remove the DC offset, the main measured characteristics of the static channels is their offset, which is never removed or compensated.

Using the processing features of the static measurements it is possible to generate alarms and reports for these measurements. Enhanced analysis options such as rainflow counting is also implemented based on the original article "Simple rainflow counting algorithms" by S.D.Downing and D.F.Socie, INT.J.FATIGUE January 1982. The results of processing are converted automatically to the ASCII format of comma-separated values and are displayed with the default Windows viewer.



If alarm levels of the static channels are exceeded the SMS notification can be sent to recipients. To provide this service the computer running GeoDAS must have at least one GSM modem configured either for the static data transfers or for the use by GeoDAS Messenger. If the computer is connected to network, e-mails can be sent as well if the corresponding option is selected.

GeoDAS static data processing can send generated data files to another instance of GeoDAS over a dial-up link.

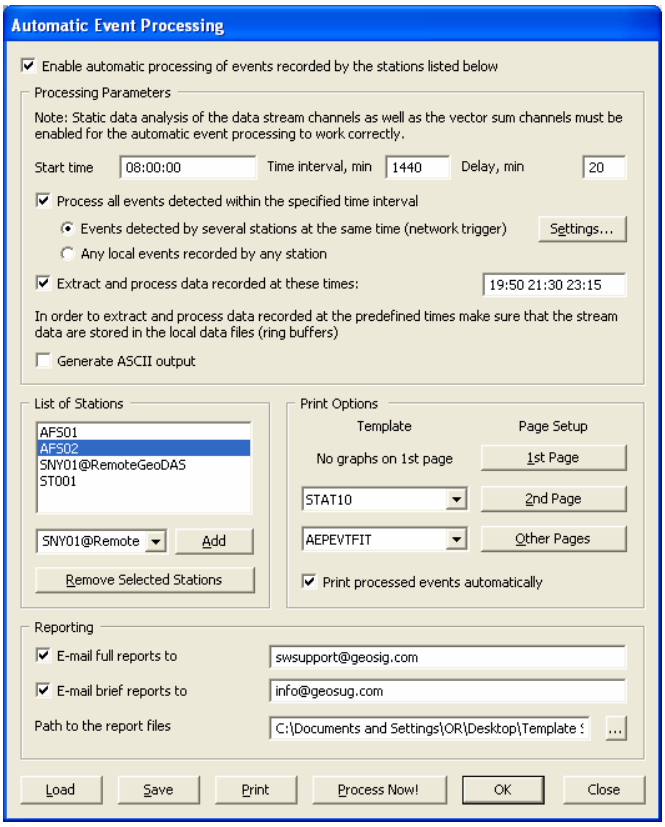
Automatic Event Processing

Automatic Event Processing is designed for automatic processing of event files recorded within a selected time interval, usually several hours or days.

The processing is done in the following steps:

- Making an overview of static data for the specified processing interval,
- Creating event files from the ring buffers extracting data recorded at specified times if the corresponding option of automatic data processing is enabled. It is assumed in this case that the data streams of the stations being processed are available and are saved to the DAT files.
- Processing all event files one by one by applying a template preliminary generated.

Results of processing are combined into a report that is forwarded for printing out at the default system printer. At the same time all processed data are stored together in a directory and can be printed later manually at any time.



EVACES'07 was held during 24-26 October 2007, Porto, Portugal

The International Conference on Experimental Vibration Analysis for Civil Engineering Structures (EVACES'07), was held at the Campus of FEUP from October 24-26, 2007.

GeoSIG Ltd. was one of the sponsors of the event and was present in the exhibition area in its booth.

Prof. Alvaro Cunha and his team did a brilliant job in organising the EVACES in Porto. Science, culture and friendship were in dynamic resonance in such a way that this conference has become more than a regular event.

It will remain as a real "trouvaille" in the busy 2008.

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We would like to take this opportunity to announce that our annual winter holiday will be from the 22nd of December 2007 until the 6th of January 2008,
And Wish You a Happy and Prosperous New Year