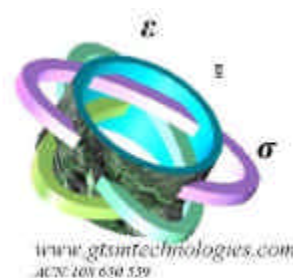


## WINXQP

*A plotting, data selection and processing tool for GTSM Technologies Borehole Strain Data*



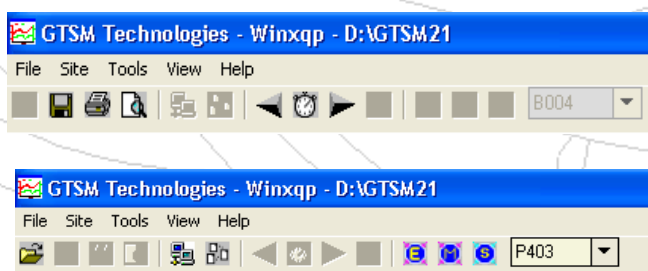
GTSM has an in house GUI based tool developed for front end presentation of field data and for performing typical processing tasks. It takes as input the raw field data structures and gives full access to raw and processed data. The tool incorporates the bottle structures of the raw field data and is suitable for accumulation of full or partial local data bases.

Main features of interest are:

- Direct presentation and comparison of up to four different GTSM data sets
  - raw sensor data at a site at any sampled frequencies,
  - intercomparison of sites across the array
  - station diagnostics,
  - derivation of strain using default calibrations or user defined sensor calibrations if available.
- Full time scale zoom and pan capabilities with all sensors displayed to the same timescale and to appropriate or user determined scales.
- Direct access to actual data values
- Removal of predetermined exponential borehole models so that residuals of interest can be directly compared over long or short time scales
- A Merge tool which allows concatenation of new raw data sets onto old data archives
- Print screen capabilities either direct or via jpg file outputs
- Export of screen selected data sets into csv files for independent analysis
- Filters including de-pressurisation filters designed to assist in analysis of strain data

We now provide this tool for more general use. For PBO users, data in the native field instrument format is available from an FTP site at <http://www.iris.edu/pbo/raw/bsm> and raw data is directly accessible through the tool with full time tagging of deformation data and diagnostics. PBO raw data can, however, be more readily be retrieved via the GTSM website <http://www.gtsmtechnologies.com>

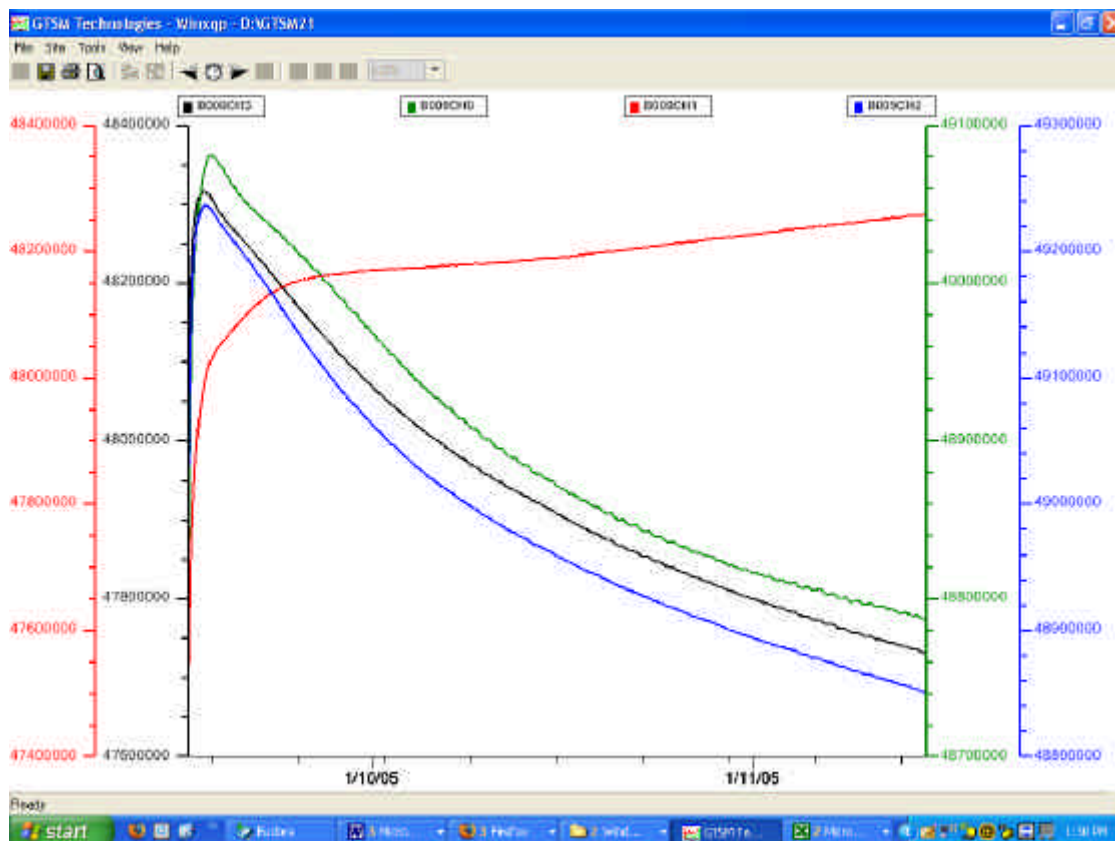
The major functions within the program can be seen from the normal view toolbar and are consistent with intuitive windows applications. The tool bar adjusts to the task in hand. Icons control file open functions, save, print (direct or to jpg) , merging, pan window time interval, derivation of models, production of residuals from predetermined exponential coefficients stored in an xml style control file, and production of strains for any time interval. Stations are selected from a drop down menu.



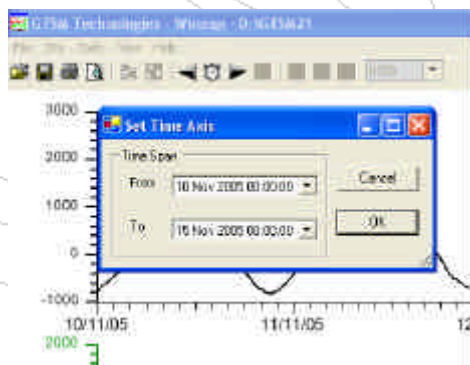
**Examples of Outputs.**

A typical point of entry to the data sets for a site is a full plot of the raw data files for each of the four raw sensors. The base screen is shown below. Each of the channels is automatically assigned a screen color and the file names and color codes of the data are presented in a live legend.

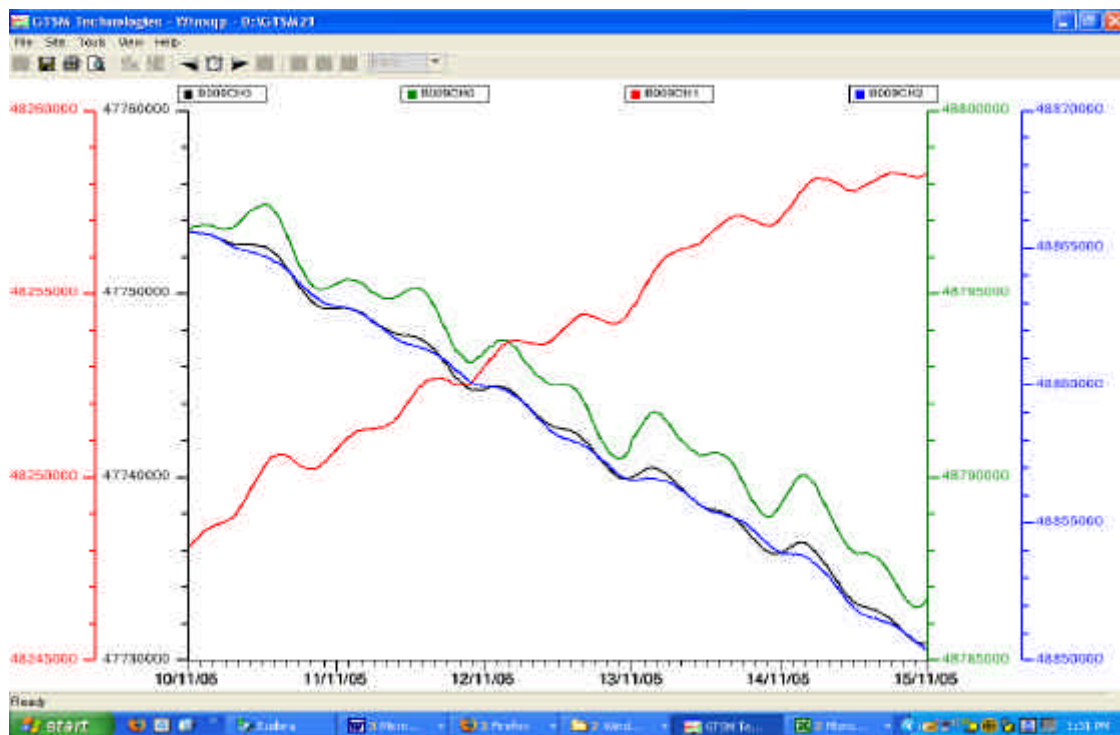
The y scales are initially optimized for visibility, but can be “normalized” to give equal scale ranges for all associated variables. This particular example shows a five month interval following installation with the grout cure and borehole recovery exponentials.



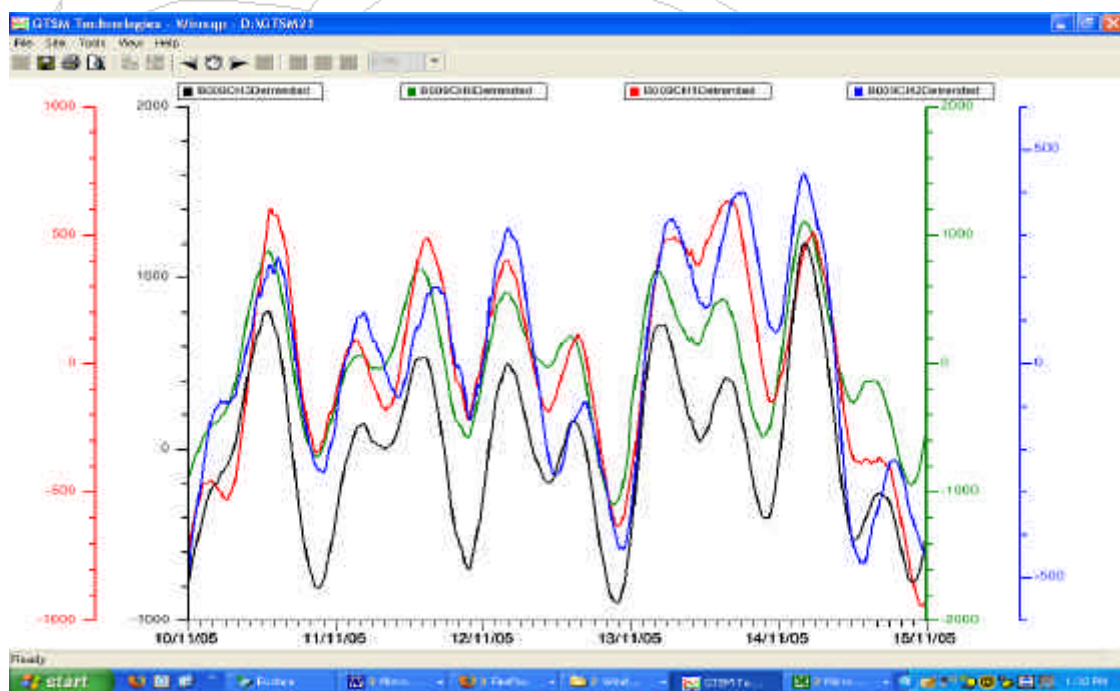
Raw data may be zoomed to any particular time interval to provide smaller time window views by direct selection or by use of a zoom tool.



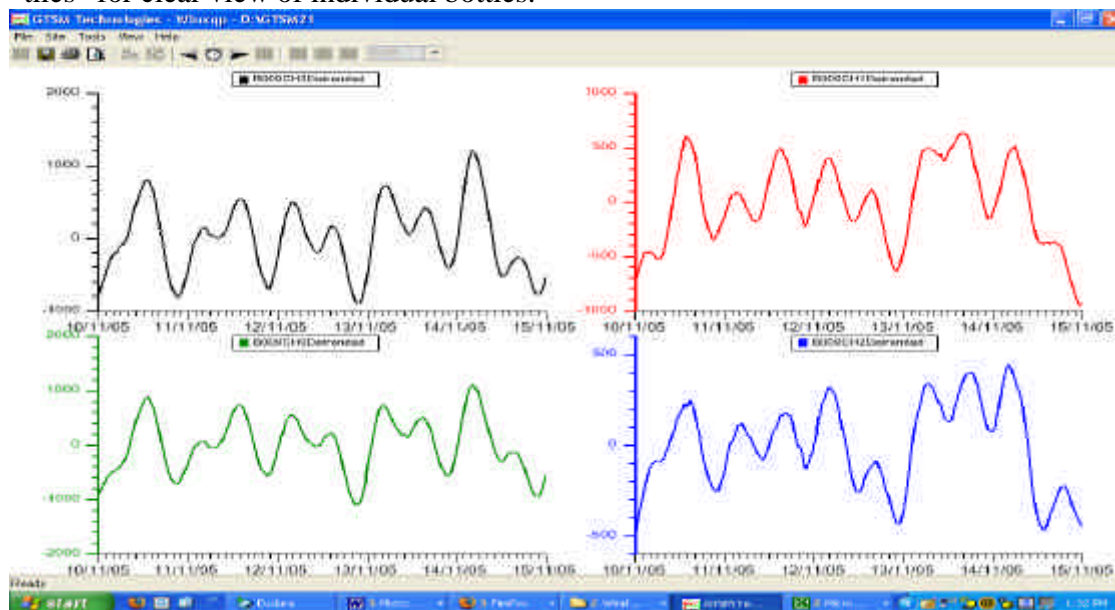
which can then be displayed.



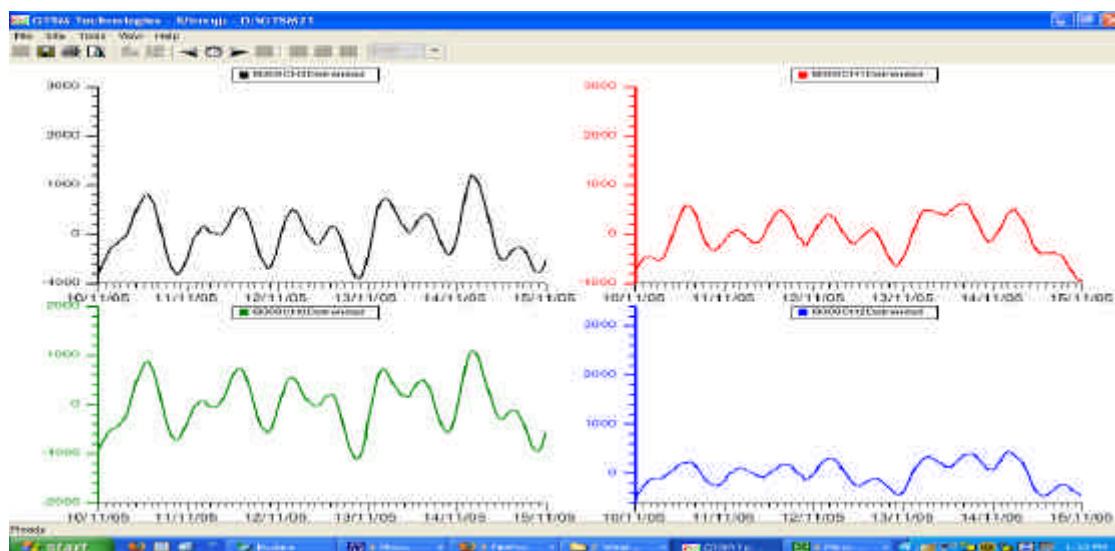
These raw data are contaminated by the borehole recovery effects, and the data can be better examined if the local linear trend is removed. The linear detrend tool allows removal of a linear trend across an arbitrary interval to produce images like the following. Full and proper removal of multiple long term exponential/linear trends is also supported.



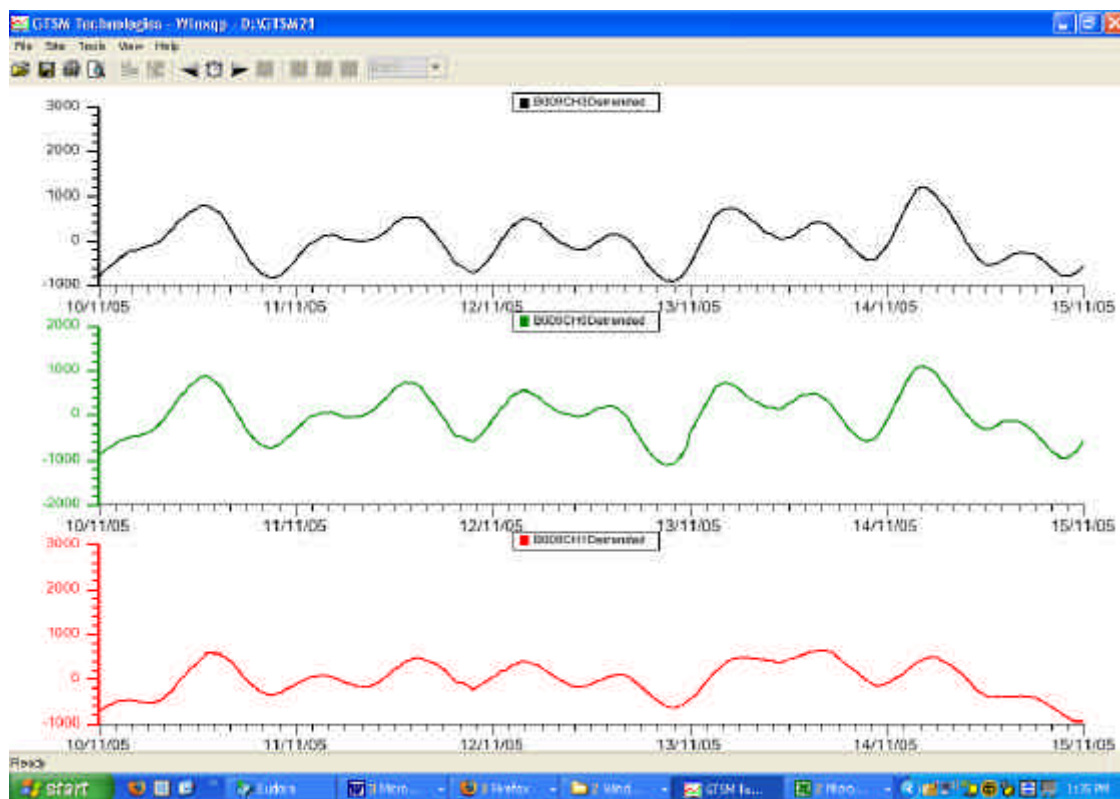
The data sets can be presented in two ways, as over-plotted for timing comparisons or as “tiles” for clear view of individual bottles.



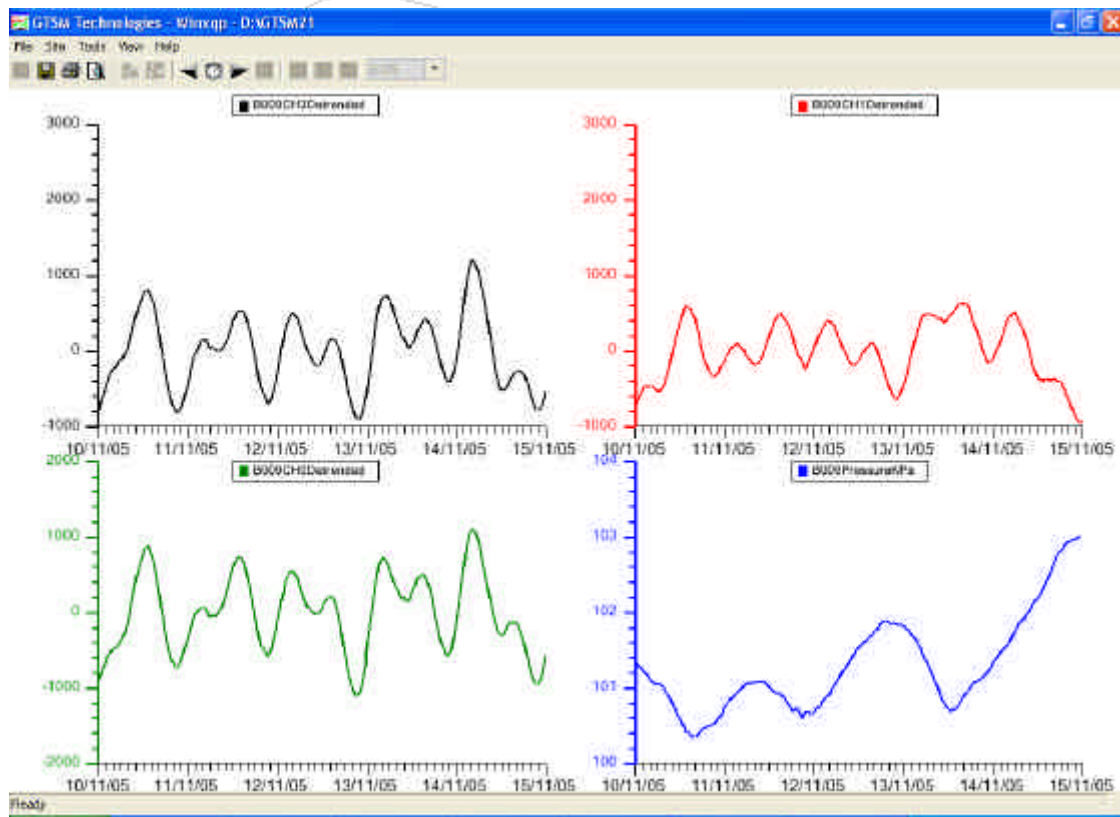
Data can be normalized to provide the same scale range on any plot view as shown below:



This normalized tiled view can be set to any number of traces less than four (three is often used to identify characteristics in the strain record as shown on the following image).

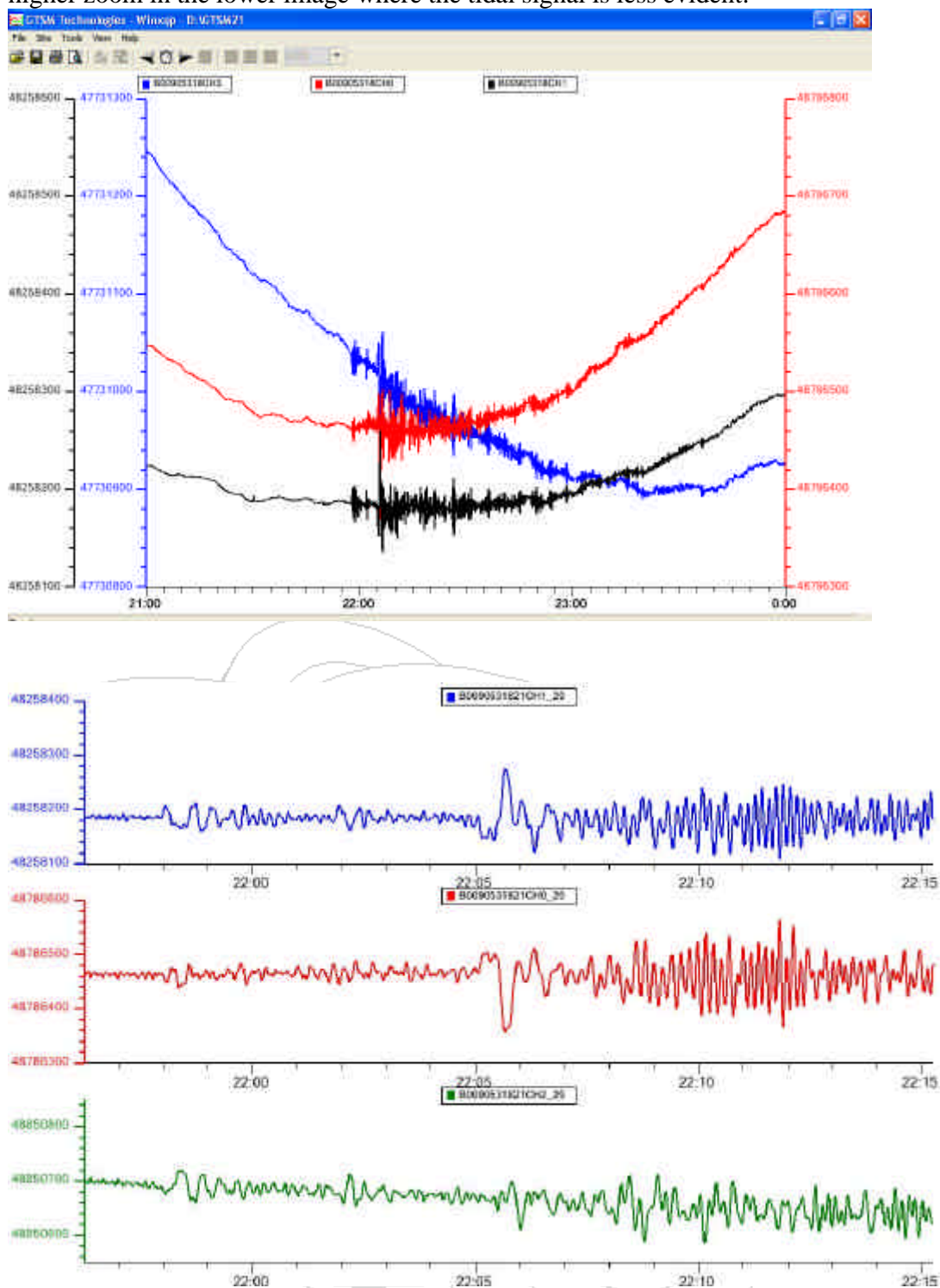


In any window, diagnostics or data from other sites can be incorporated in the correct time position. In the image below the atmospheric pressure has been added to the three normalized plots.



Any associated data set (no matter what the sampling rate) at any time scale can be displayed in these ways with currently up to four channels on screen.

An example of zoomed 20 Hz data taken during the Honshu earthquake is shown below. The earthquake data are shown raw and superimposed on the tidal signal in the top image, and at higher zoom in the lower image where the tidal signal is less evident.



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