

XL 294

Recent advances in the Lesser Antilles observatories – Part 2

WebObs - An integrated web-based system for monitoring and network management

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Abstract

Seismological and Volcanological observatories have common needs and often common practical problems for multi disciplinary data monitoring applications. In fact, access to integrated data in real-time and estimation of measurements uncertainties are keys for an efficient interpretation, but instruments variety, heterogeneity of data sampling and acquisition systems lead to difficulties that may hinder crisis management. In Guadeloupe observatory, we have developed in the last years an operational system that attempts to answer the questions in the context of a pluri-instrumental observatory. Based on a single computer server, open source

Monitoring = real-time observations

Adopted solutions

PGF

Web site

- Fixed architecture with mixed static/dynamic content - Data forms for manual data input and configuration files

Data bank

scripts (*Matlab, Perl, Bash, Nagios*) and a Web interface, the system proposes:

→ an extended database for networks management, stations and sensors (maps, station file with log history, technical characteristics, meta-data, photos and associated documents);

→ a web-form interfaces for manual data input/editing and export (like geochemical analysis, some of the deformation measurements, ...);

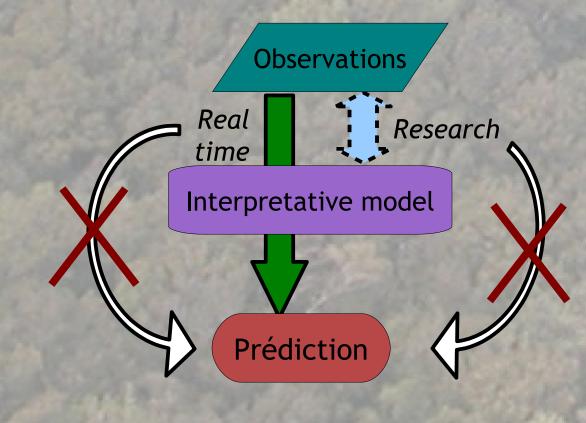
→ routine data processing with dedicated automatic scripts for each technique, production of validated data outputs, static graphs on preset moving time intervals, and possible e-mail alarms;

→ computers, acquisition processes, stations and individual sensors status automatic check with simple criteria (files update and signal quality), displayed as synthetic pages for technical control.

In the special case of seismology, WebObs includes a digital stripchart multichannel continuous seismogram associated with EarthWorm acquisition chain (see companion paper Part 1), event classification database, location scripts, automatic shakemaps and regional catalog with associated hypocenter maps accessed through a user request form.

This system leads to a real-time Internet access for integrated monitoring and becomes a strong support for scientists and technicians exchange, and is widely open to interdisciplinary real-time modeling. It has been set up at Martinique observatory and installation is planned this year at Montserrat Volcanological Observatory. It also in production at the geomagnetic observatory of Addis Abeba in Ethiopia

+ interpretative model



Research developments using observations of natural phenomena must lead to a gradual characterization of an interpretative model of physical and chemical processes. During a crisis management, operational scientific advisories (i.e., prediction) have to be based on the real-time observations *through* this interpretative model; there is no more time to spend in fundamental research. Thus, the main objective of tools in an observatory is to maintain up-to-date quantitative models linked to the real-time data.

Objectives

"Instant" access to monitoring data

 Real-time (or near real-time) - Different levels of data: original, validated, and through interpretative model (1st order) - Graphics available at preset timescales (moving windows) + possible manual request - Associated technical information (link to station and sensor) - Global and multidisciplinary overview: all networks

Technical networks maintenance

- Automatic control of acquisitions Log of technical information and interventions - Shared calendar for team organization

Help scientific and technical collaborations – Access to a unique level of information - Support for discussion and data exchanges (but not oriented

to public data distribution)

Common problems

- Diversity of networks (automated/manual, sampling from 100 Hz to 1 year, analog/digital, data formats, OS, ...) - Different levels of information (technical/scientific)

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Native format files in directories, centralized on a single computer (also necessary for archive purpose) - Simple text files for manual data inputs, networks characteristics and station interventions archives

Data processing: Matlab scripts

- Specific for each network \Rightarrow homogeneous matrices (t,d) - Preset usual moving time scales (day, month, year...) to anticipate the most common requests - Graphs per station (original data), per network (processed/validated data), per discipline (modelized data)

Routine schedule: every minute

- Test of acquisition computers (clock, disk, date and time of last data file) by *Linux* shell scripts and *Nagios* (for Ethernet-based stations) - Process of continuous seismic data (digital seismogram) - Process user graphic request (if any) - Update control screens on Web

Routine schedule: every 30 minutes

 Transfer of new data files from acquisitions to server (mirroring) - Launch the Matlab routines to make preset graphics (24 h, 30 days, 1 year, 10 years) for all networks

Routine schedule: every day

- Update some graphics (time scale "all data") and network maps - Full mirror of data on remote Paris server though Internet

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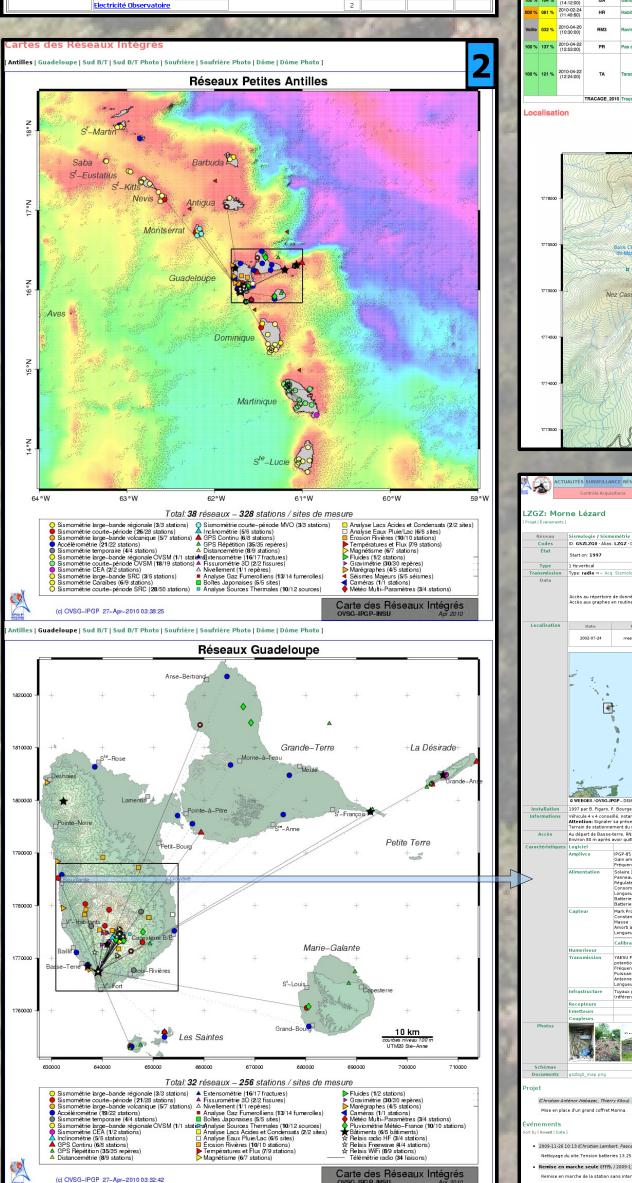
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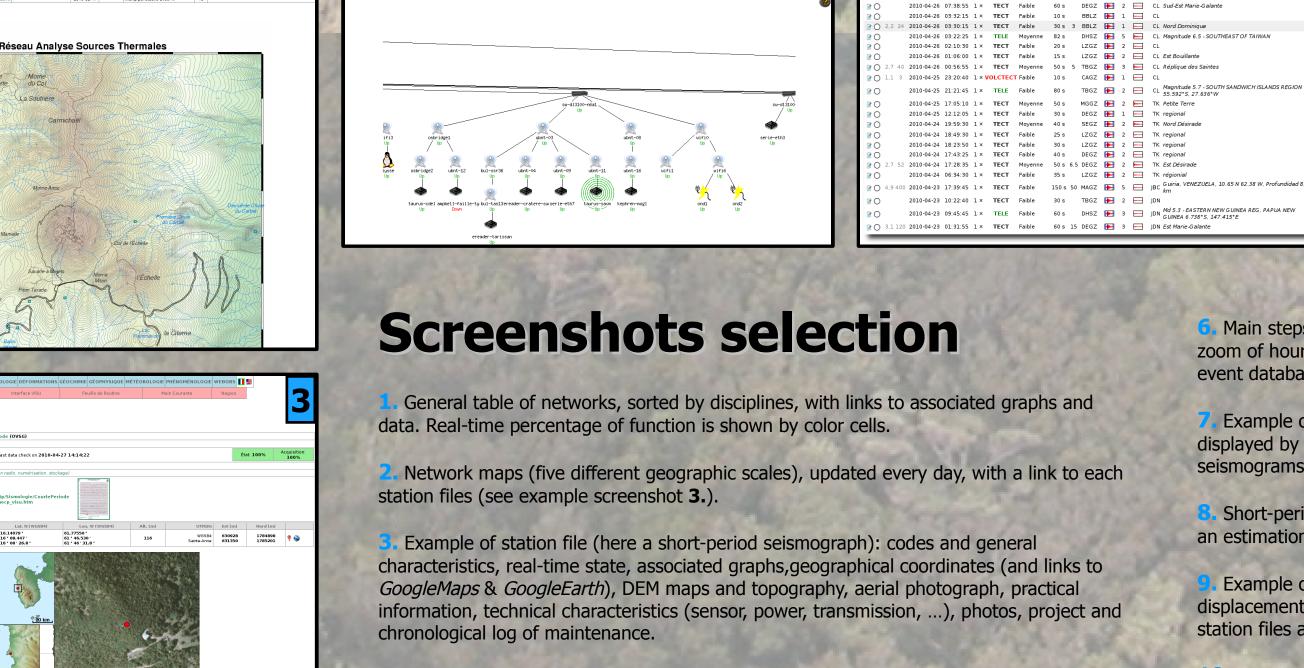
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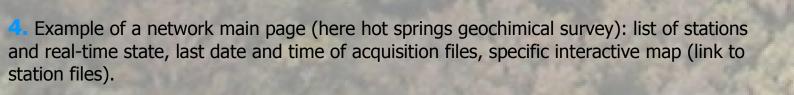
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Control of acquisitions is carried on by the *Nagios* system (www.nagios.org), an opensource package specifically dedicated to infrastructure monitoring. All computers, radio link, station and sensors using Ethernet protocol (wired or wireless) are monitored permanently, with specific state levels and possible alarms.

Main steps of real-time continuous seismic processing: (1) stripchart of selected stations, (2) zoom of hourly graph to select an event, (3) semi-automatic form of detected event, (4) seismic event database with detailed information for each event, including automatic shakemaps.

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Example of seismic hypocenter map (last year, regional and volcano scales): located events displayed by magnitude (size) and depth (color) with links to detailed information and seismograms. Known faults are also shown.

Short-period seismic helicorders (last 24 h), all stations, all components. The process includes an estimation of noise level and offset interval, in order to detect sensors problem.

Example of a synthetic graph (last 10 years) of the extensometer manual network: differential displacements sorted by active areas. Note also links to individual graphs of each monitored site, station files and data.

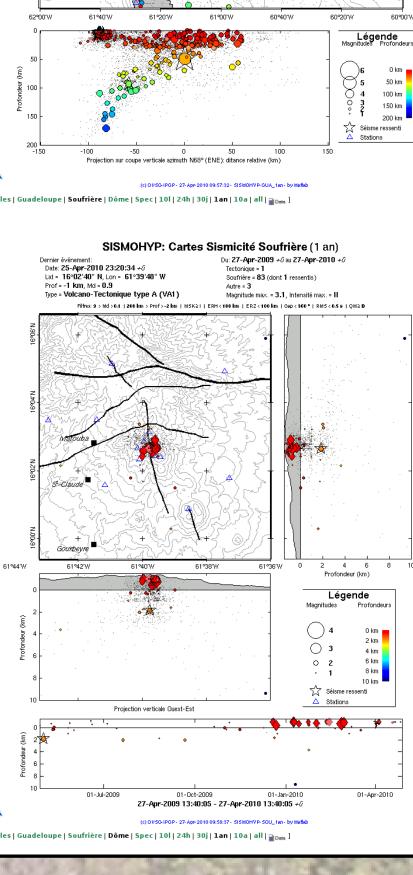
D. Example of synthetic graph (last 10 years) of the hot springs manual network: ternary plots and temporal variations of chemical parameters (ion chromatograph analyses).

11. Example of a real-time meteorological station (last 30 days). This particular process includes an alarm with rainfall threshold linked to a local landslide hazard (see red area).

12. Example of seismic bulletin statistics (last year): histogram of magnitudes, Gutenberg Richter B-value, number of events, energy.

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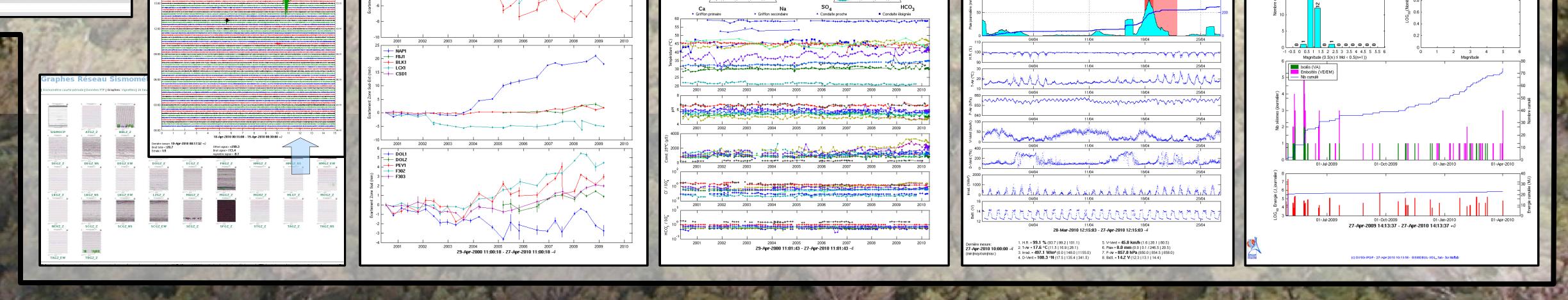
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Web structure

- **Home** Welcome page \rightarrow Daily information, volcano image, 24h seismicity and weather **Team coordinates** \rightarrow Phone emergency list Links to collaborators' web
- **Monitoring** Acquisitions control \rightarrow Real-time state of computer acquisitions **Routine daily form** \rightarrow Printable checklist for manual controls **Recent seismic events** \rightarrow Unprocessed bulletin and seismograms Cameras
- **Networks** Networks summary \rightarrow All networks sorted by discipline and techniques **Network maps** \rightarrow Interactive maps with links to station files (5 different scales) **Stations list** \rightarrow Table of all stations with current state and projects
- **Seismology Bulletins** \rightarrow Graphs of statistics (24 h, 30 d, 1 yr, 10 yr)
 - **Hypocenters** \rightarrow Maps of events with links to seismograms (24 h, 30 d, 1 yr, 10 yr) **RSAM** \rightarrow Graphs of amplitudes for selected stations (24 h, 30 d, 1 yr, 10 yr) **Stripchart paper** \rightarrow Continuous seismograms for selected stations (36 h) **Short-period** \rightarrow Helicorders per component (24 h) **Broad-band** \rightarrow Helicorders per component (24 h) Accelerometers \rightarrow Bulletin, maps and seismograms (per event)
- **Deformations GPS** \rightarrow Graphs of relative displacements (30 d, 1 yr, 10 yr) **Tiltmetry** \rightarrow Graphs of tilt signals (24 h, 30 d, 1 yr, 10 yr) **EDM** \rightarrow Graphs of relative displacements (24 h, 30 d, 1 yr, 10 yr) **Extensometry** \rightarrow Graphs of displacements (10 yr)
- **Geochimia** Fumarolles gaz \rightarrow Graphs of gas components and isotopes (10 yr) **Hot springs** \rightarrow Graphs of water components (10 yr) **Japanese boxes** \rightarrow Graphs of gas concentrations (10 yr)
- **Geophysics** Boreholes \rightarrow Graphs of temperature (24 h, 30 d, 1 yr, 10 yr) **Magnetic field** \rightarrow Graphs of absolute and differential values (24 h, 30 d, 1 yr, 10 yr) **Electric potential** \rightarrow Graphs of potentials (24 h, 30 d, 1 yr, 10 yr)
- **Meteorology** Weather \rightarrow Graphs of weather monitor (24 h, 30 d, 1 yr, 10 yr) **Rainmeters** \rightarrow Graphs of rain fall (1 yr, 10 yr)
 - **Data** User defined graphic form \rightarrow Allows time interval and network selection **Manual data input forms** \rightarrow Input field data for database update Access to data files \rightarrow Link to disks

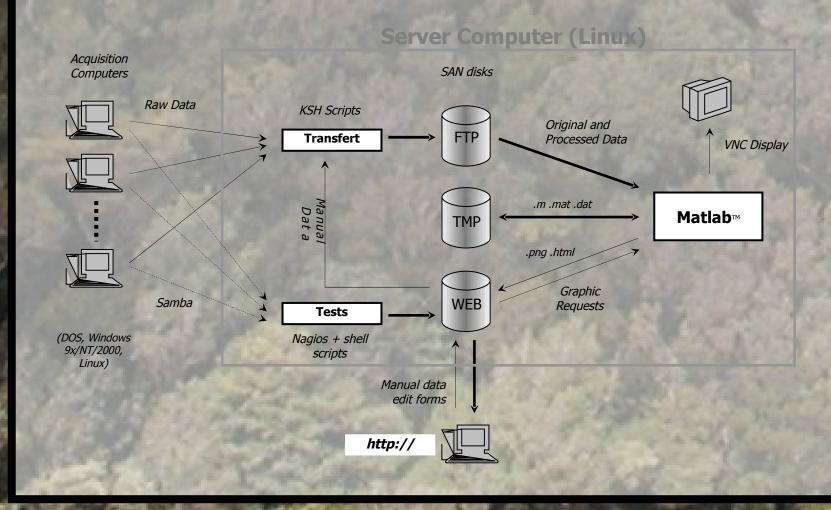


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Architecture

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All acquisition computers are Ethernet-connected (wired or wireless). A single server carries regular data transfers and machine controls for automatic acquisitions. Matlab scripts load the new data, process them and produce dedicated graphs for all networks. Manual measurements are updated through web data forms, then processed as other automatic acquisitions. User defined graphics can also be produced with the same scripts on request.

Simplified WEBOBS directories structure for configuration files (CONFIG), miscellaneous data files (DATA), network characteristics (STATIONS), temporary output files (OUTPUT) and scripts (TOOLS). All are in text file format and easily editable through any operating system.

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Conclusions

Simple and adapted tool

- Keep existing stations and acquisitions "as is" - Adapted scripts (process and display) for each specific network - Using of original data (no need for database layer) - Light hardware and software, allowing easy maintenance High adaptability to networks evolution

Sharing multidisciplinary data to users - Inside the observatory or from far Internet access - Access to all data, including technical information, to all involved community Not system-dependent or software-dependent (like GIS)

Real-time access for crisis management - All graphs (all disciplines, all time-scales) are instantaneously accessible for preset timescales - Very fast interface independent from the number of users