

Geophysical Monitoring System (GMS) interactive analysis updates

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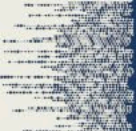
Sandia National Laboratories



INTRODUCTION AND MAIN RESULTS

Sandia National Laboratories is developing the Geophysical Monitoring System (GMS) for modernization of the United States National Data Center waveform processing system.

The GMS effort is developing interactive analysis capabilities, referred to as IAN, to replace the aging Analyst Review Station (ARS) used by IDC analysts to review events and create the IDC bulletins.



Introduction

The GMS effort is developing interactive analysis capabilities, referred to as IAN, to replace the aging Analyst Review Station (ARS) used by IDC analysts to review events and create the IDC bulletins.

GMS Interactive Analysis (IAN) now includes capabilities to filter, rotate, and beam station data, measure the azimuth and slowness of signal detections using frequency-wavenumber (FK) spectra, measure signal amplitude, create and locate events, and estimate event magnitude.

GMS is deployed using a cloud-ready Kubernetes containerized platform, hardened for cyber security accreditation.

The United States is providing the common architecture and processing components of GMS as a contribution-in-kind to accelerate progress on International Data Centre (IDC) Re-engineering.

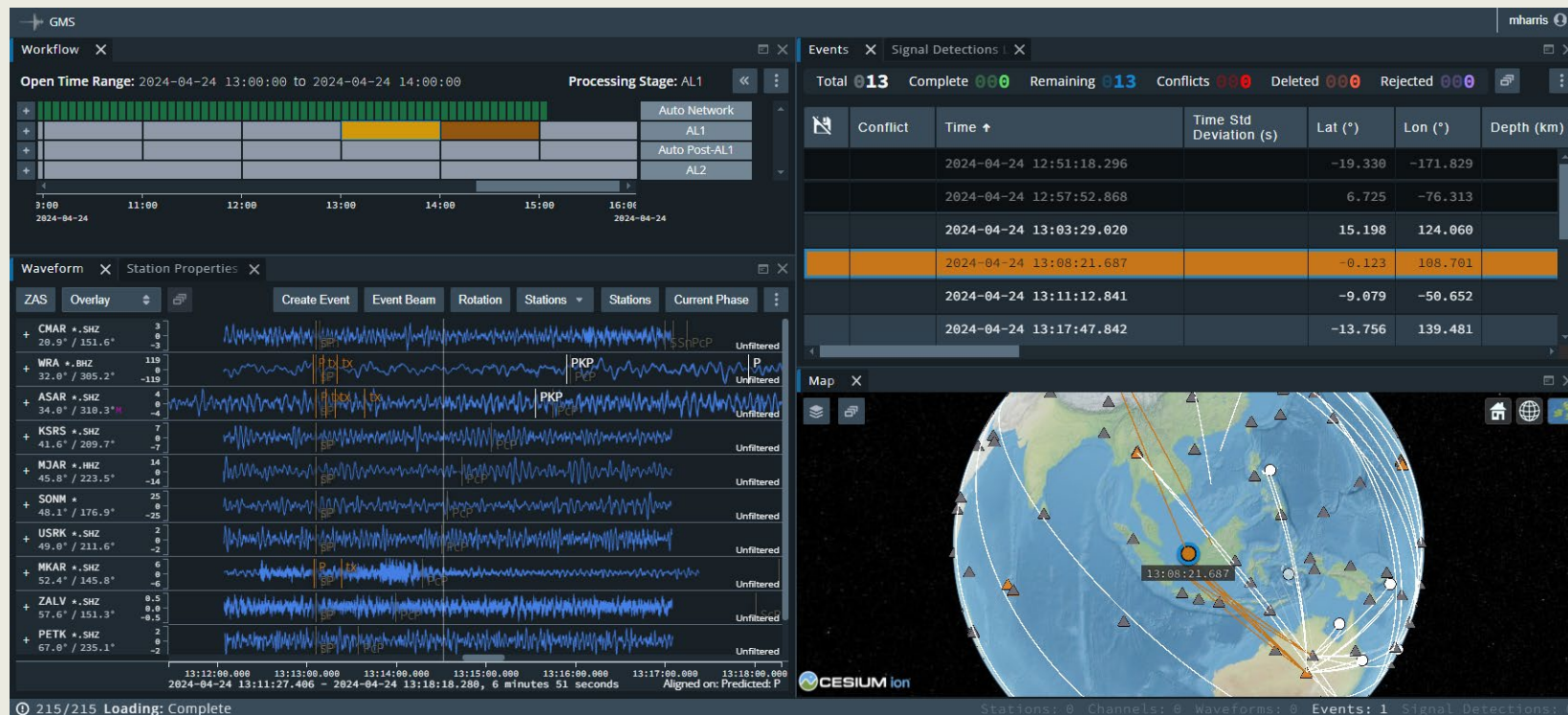
The current release is PI27, posted to GitHub in January 2025.

The next release will be PI31, in preparation, expected in September 2025.

Open source releases of GMS are available on GitHub:
<https://github.com/SNL-GMS>

Analysis Features

IAN can display the base data types needed for SHI analysis, and includes capabilities to filter, rotate, and beam station data, measure the azimuth and slowness of signal detections using frequency-wavenumber (FK) spectra, measure signal amplitude, create and locate events, and estimate event magnitude.



User Experience

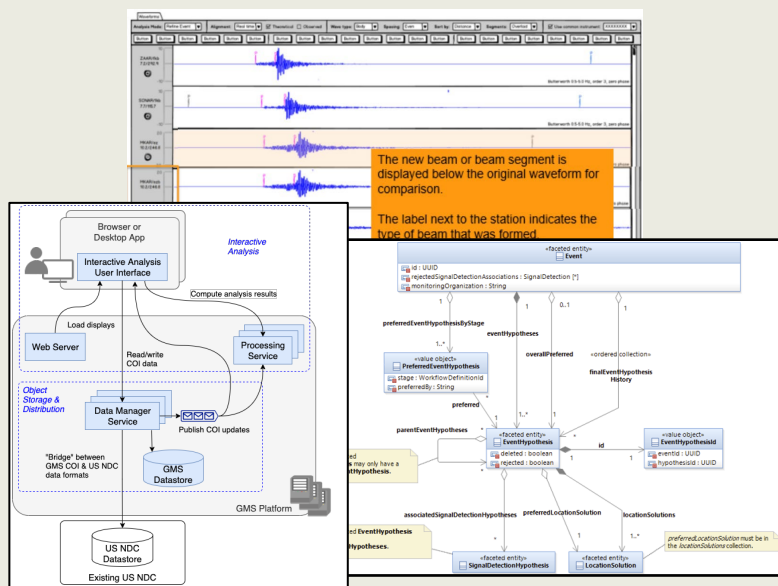
IAN uses modern web technology, accessed with a common web browser. Display are flexible and customizable. Data and user operations are fully synchronized across all displays, with consistent user experience design.

Product Design

GMS is a large software development project with several development teams, plus architecture, geoscience, platform, and test teams.

Product Management defines and prioritizes a capability roadmap, and along with user experience and architecture develops product guidance for developers in the form of descriptions, storyboards, and architecture designs.

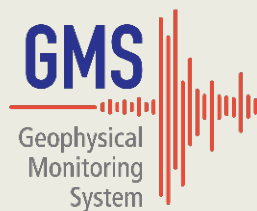
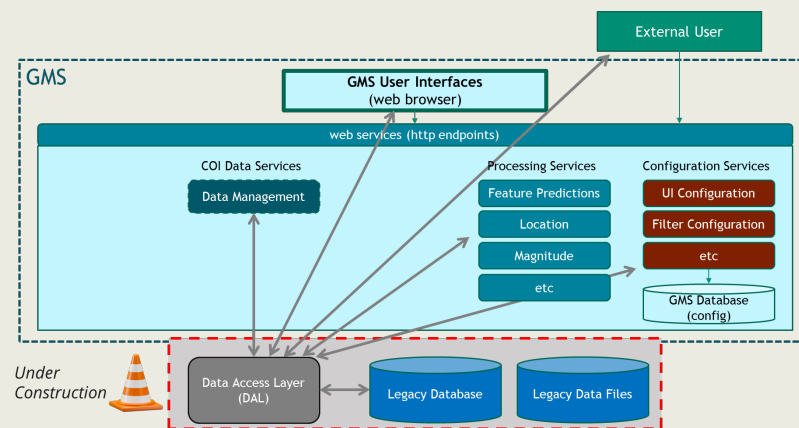
GMS regularly engages with SHI analysts and other users to improve IAN designs.



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Architecture

GMS is a service-oriented, distributed web application. Data services provide access to stored data (in this case from the legacy database) to GMS applications like IAN. Processing and configuration services also support analysis operations. External users can also access these services.

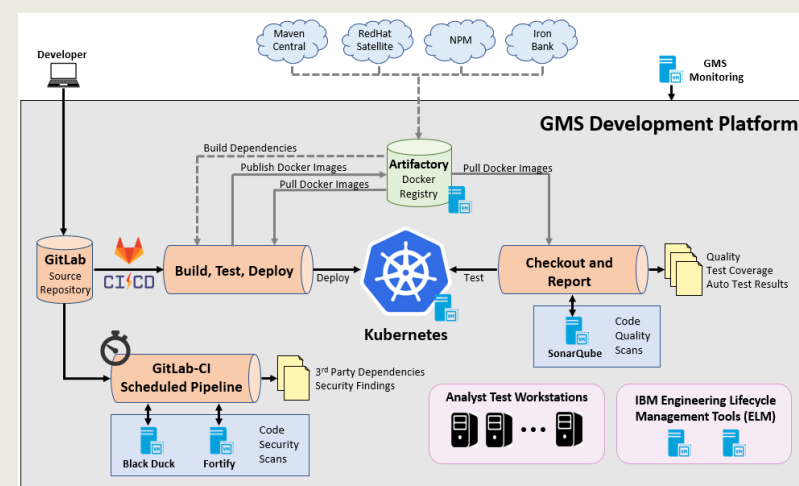


Development and Deployment

GMS uses agile development practices, working in two week iterations. GMS developers manage code and workflow in GitLab.

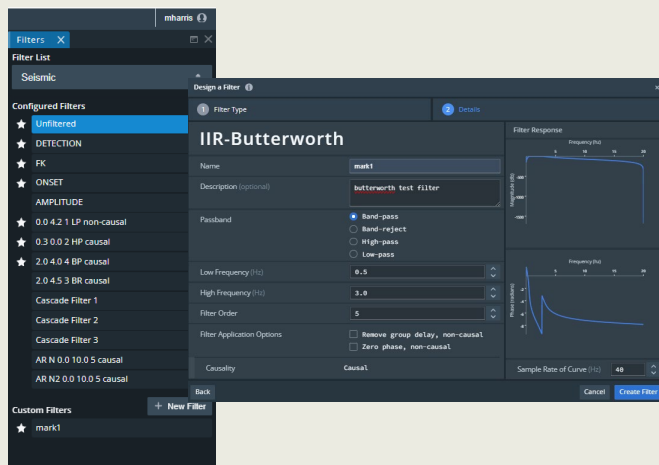
We use GitLab Continuous Integration / Continuous Deployment (CI/CD) to automate software build, test, and deployment pipelines.

GME is deployed using a cloud-ready Kubernetes containerized platform, hardened for cyber security accreditation.

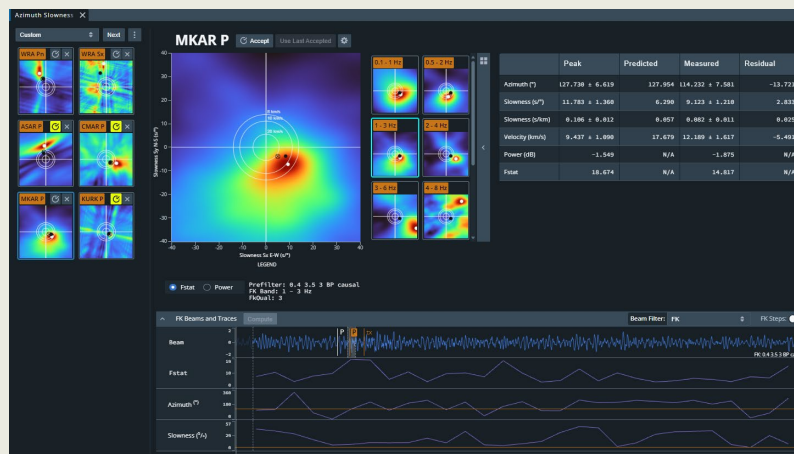


Example IAN Displays

Filtering



Frequency-Wavenumber (FK)

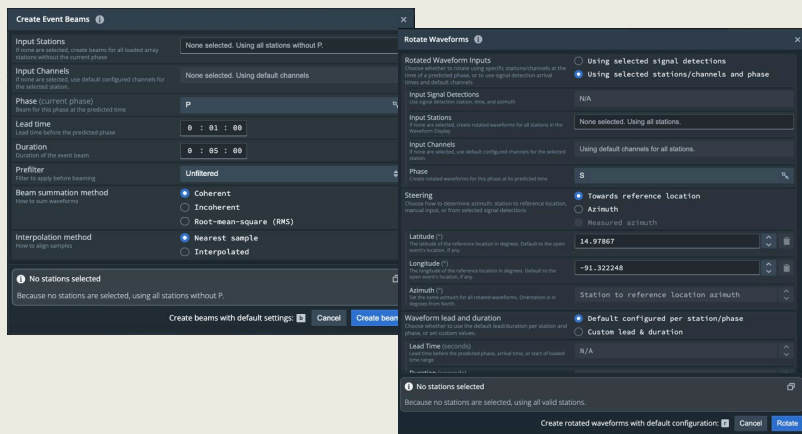


Location

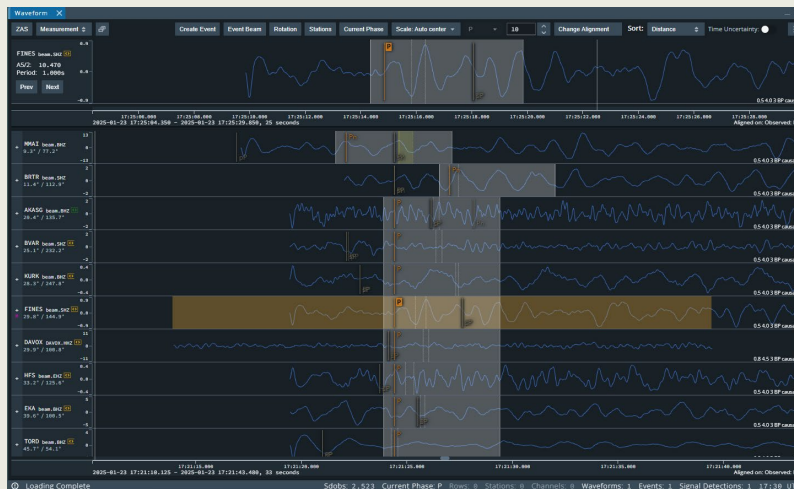
Preferred	Time	Lat (°)	Lon (°)	Depth (km)	Restraint	Sdobs	# Def	Region	Coverage Semi-major (km)	Coverage Semi-minor (km)	Coverage Semi-major trend
★	2010/05/07/21:02:31.600000	39.401	127.483	10.000	Unrestrained	0.435	12	Region A	127.483	127.483	127.483
●	2010/05/07/21:02:31.600000	35.457	128.131	10.000	Fixed at Depth	0.657	12	Region A	128.131	128.131	128.131
●	2010/05/07/21:02:31.600000	39.197	128.845	10.000	Fixed at Surface	1.345	12	Region A	128.845	128.845	128.845

GMS uses the LocOO3D location software.

Beamforming and Rotation



Amplitude



Magnitude

Station	Mag	Sd obs	# Defining	# Non-defining	# Detecting	# Non-detecting
Unrestrained	3.612	0.629	3	1	2	1